03

NOTICE — When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

APPLICATION		PART No.	M F
NEXT ASSY	USED ON		

REVISIONS

SYM	DESCRIPTION	DATE	APPROVAL
A	Sheets:1,7,13,29,48,146, 165,204,210,214,. ,230, 243,248,255,258,260,282, 298,308,310-313,324,341, 347,350,351,354,357,359, 367,374,388,391,393,397, 398,399,411,414,441,442, 444,445,498,539,550,558, 563,564	5/30/78	L. Manfredi
B	*SHEETS:1,3,13,51,107,109, 110,164,164A,179,180, 180A,180B,199,335,342, 355,372,399,415,417,418, 419,420,452,453,513,528, 538,539,540,548,552,554, 569,570,180C, 456,4.* Added 164A, 180A, 180B, 180C	10-6-78	
C	*SHEETS:1,2,5,6,108,109, 475,480,496,528*	1-29-79	
D	*SHEETS:1,4,350,351,353*	7-10-79	
E	*SHEETS: 1,3,240,305*	9-28-79	
F	*SHEETS: 1,3,5,176,511, 512, 255*	4-16-80	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS DECIMALS ANGLES	ORIGINAL DATE OF DRAWING 11-28-77	MODIFICATIONS TO LAUNCH PAD 39B FOR SPACE SHUTTLE TASK I SPECIFICATION FOR	JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER FLORIDA
MATERIAL	DRAFTSMAN / CHECKER		
HEAT TREATMENT	TRACER / CHECKER		
FINAL PROTECTIVE FINISH	ENGINEER / ENGINEER		
	SUBMITTED HOYT E. BROWARD		
	APPROVED 3/8/8	SCALE / UNIT WT	DWG SIZE A — 79K11306 — SHEET 1 OF 18

KSC FORM 21-2 (REV. 9/65) NASA-KSC NO

INDEX

TECHNICAL SPECIFICATIONS 79K11306

FOR

MODIFICATIONS TO LAUNCH PAD 39B FOR SPACE SHUTTLE - TASK I

SECTION 1A

SCOPE AND DESCRIPTION

---SCOPE---

THE WORK TO BE PERFORMED UNDER THESE SPECIFICATIONS CONSISTS OF TASK I MODIFICATIONS TO LAUNCH PAD 39B WHICH WILL SERVE TO LAUNCH SPACE SHUTTLE FLIGHTS FROM KENNEDY SPACE CENTER (KSC) OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA). ALL WORK SHALL BE ACCOMPLISHED AS SHOWN ON THE DRAWINGS AND AS DESCRIBED IN THESE SPECIFICATIONS.

THE PROJECT INCLUDES TRANSPORT FROM STORAGE SEGMENTS OF AN EXISTING TOWER, MODIFICATIONS TO THE SEGMENTS, AND ERECTION OF SPECIFIED SEGMENTS OF THE TOWER AT LAUNCH PAD 39B ON NEW FOUNDATIONS. THE NEW TOWER STRUCTURE WILL BE IDENTIFIED AS THE SHUTTLE SERVICE AND ACCESS TOWER (SSAT). EXISTING TWIN ELECTRIC ELEVATORS AND EXISTING HAMMERHEAD CRANE WITH NEW LIGHTNING MAST SHALL BE PROVIDED AND ERECTED ON THE SSAT.

THE CONTRACTOR SHALL FURNISH ALL PLANT, EQUIPMENT, TOOLS, MATERIALS, LABOR AND SERVICES NECESSARY AND INCIDENTAL FOR ACCOMPLISHING ALL WORK AND FOR PROVIDING A COMPLETE AND FINISHED MODIFIED LAUNCH PAD IN ACCORDANCE WITH THESE SPECIFICATIONS AND THE HEREIN REFERENCED CONTRACT DRAWINGS. THE GOVERNMENT WILL FURNISH SELECTED EQUIPMENT (GFE) AS INDICATED BY THESE SPECIFICATIONS, DRAWINGS AND CONTRACT SCHEDULE.

---PROJECT SITE---

THE SITE OF THIS PROJECT IS KSC LAUNCH COMPLEX 39, THE DESIGNATED STORAGE, WORK, BORROW AND STORAGE/SHAKE-OUT AREAS THEREON, AND THE SPECIFIED SALVAGE AND DISPOSAL AREAS AND ROADS CONNECTING SAME TO LAUNCH COMPLEX 39. MORE SPECIFICALLY, THE MAJOR WORK/STORAGE/SHAKE-OUT AREAS ARE:

LAUNCH PAD 39B AND ADJACENT STORAGE/SHAKE-OUT AREAS.

MLP PARK SITE NO. 2 LOCATED NORTH OF THE VAB AND ADJACENT STORAGE/SHAKE-OUT AREAS. REFER TO SECTION 1E OF THE SPECIFICATIONS.

THE BORROW SITE FOR FILL *WILL BE DETERMINED BY THE CONTRACTING OFFICER AND WILL BE LOCATED WITHIN 10 MILES OF LAUNCH PAD 39B".* EXCESS FILL REMOVED BY CONTRACTOR'S EXCAVATION FOR 84 INCH PIPING AT NORTH END OF PAD 39B MAY BE UTILIZED AS WELL AS SUITABLE SOIL REMOVED BY EXCAVATION FOR THE ELEVATED WATER TANK. (A)

THE SALVAGE AND DISPOSAL AREAS ARE LOCATED SOUTH OF LAUNCH COMPLEX 39, WEST AND EAST OF KENNEDY PARKWAY, RESPECTIVELY, AS SHOWN ON THE DRAWINGS. TO THESE SITES THE CONTRACTOR SHALL TRANSPORT AND UNLOAD MATERIALS AND DISPOSABLES THAT RESULT FROM HIS OPERATIONS.

---CONTRACT DRAWING NO. 79K10338 DATED 11-22-77, SHEETS 1 THROUGH 378 ENTITLED: "MODIFICATIONS TO LAUNCH PAD 39B FOR SPACE SHUTTLE - TASK I."---

THE CONTRACT DRAWINGS ACCOMPANY THESE SPECIFICATIONS AND ARE A PART THEREOF. DRAWINGS ARE THE PROPERTY OF THE GOVERNMENT AND SHALL NOT BE USED FOR ANY PURPOSE OTHER THAN AS REQUIRED UNDER THESE SPECIFICATIONS. IF ANY CONFLICTS OCCUR NECESSITATING DEPARTURES FROM THE CONTRACT DRAWINGS, DETAILS OF DEPARTURES AND REASONS THEREFORE SHALL BE SUBMITTED IN WRITING, AS SOON AS PRACTICABLE, FOR APPROVAL OF THE CONTRACTING OFFICER. THE CONTRACTOR SHALL MAKE NO FIELD CHANGES TO THE DRAWING WITHOUT THE CONTRACTING OFFICER'S AUTHORIZATION. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO BRING TO THE ATTENTION OF THE GOVERNMENT, BEFORE STARTING CONSTRUCTION, ANY DISCREPANCY, CODE VIOLATION OR ABNORMAL REQUIREMENT FOUND ON THE CONTRACT DRAWINGS.

ANY ITEM CALLED FOR ON THE DRAWINGS, BUT OMITTED IN THESE SPECIFICATIONS; OR, CALLED FOR IN THESE SPECIFICATIONS, BUT OMITTED FROM THE DRAWINGS; SHALL BE FURNISHED AND INSTALLED AS THOUGH INCLUDED IN BOTH.

---PROJECT DESCRIPTION---

---STRUCTURAL/ARCHITECTURAL WORK

IN GENERAL, THE MAJOR CIVIL/STRUCTURAL/ARCHITECTURAL WORK TO BE ACCOMPLISHED INCLUDES:

MODIFICATIONS TO SEGMENTS OF EXISTING DISASSEMBLED STEEL TOWER.

FOUNDATIONS FOR MODIFIED TOWER (SSAT) AND FOR FUTURE HINGE COLUMN FOR FUTURE ROTARY BRIDGE AT LAUNCH PAD 39B.

TRANSPORT OF SEGMENTS AND ERECTION OF MODIFIED 247 FT. HIGH NEW SHUTTLE SERVICE AND ACCESS TOWER (SSAT) AT LAUNCH PAD 39B, INCLUDING HOISTWAY FOR TWIN ELEVATORS.

TRANSPORT AND INSTALLATION OF EXISTING TWIN ELEVATORS IN NEW SHUTTLE SERVICE AND ACCESS TOWER (SSAT) WITH 27 FT. HIGH NEW CONCRETE HOISTWAY, AND TRANSPORT AND INSTALLATION OF EXISTING PARTIALLY DISASSEMBLED HAMMERHEAD CRANE, INCLUDING NEW LIGHTNING MAST, ATOP THE SSAT.

CLEAN AND PAINT INTERIOR OF BLDG. #J7-385.

RESTORATION OF ROOFING ON EIGHT EXISTING BUILDINGS.

PLATFORM FOR ECS FILTER CHAMBER AND SUPPORTS FOR DEWARS ON SSAT. SLIDEWIRE EMERGENCY EGRESS SYSTEM - SSAT TO GROUND. ANTENNA ACCESS PLATFORM ON SSAT. IAA SUPPORT STRUCTURE ON SSAT.

PROVIDE 160 FT. RADIUS BEAM/BRIDGE/RAIL SYSTEM FOR FUTURE ROTARY BRIDGE AND MODIFICATIONS TO CONCRETE PAD STRUCTURE INCIDENTAL THERETO.

PROVIDE TWO MOBILE SIDE FLAME DEFLECTORS WITH PNEUMATIC-HYDRAULIC JACKING SYSTEMS AND RAIL SYSTEMS ON EACH SIDE OF FLAME TRENCH.

EXTEND TUNNEL FOR CABLING TO PAD AREA BELOW SSAT.

FOUNDATIONS, SUPPORTS, RETAINING WALLS AND MODIFICATIONS TO CONCRETE STRUCTURES FOR SOUND SUPPRESSION WATER PIPING.

PROVIDE ELEVATED STEEL WATER TANK AND FOUNDATIONS.

MODIFY EXISTING LOX AND LH_2 STEEL TOWERS.

DEMOLITION OF EXISTING CONCRETE PAVING OF LAUNCH PAD AS REQUIRED FOR NEW CONSTRUCTION, DEMOLITION OF CONCRETE MACHINERY ROOMS FOR EAST AND WEST PAD HYDRAULIC ELEVATORS AND CONSTRUCTION OF A NEW CONCRETE MACHINERY ROOM FOR THE WEST PAD ELEVATOR. REMOVAL AND REPLACEMENT OF EXISTING EQUIPMENT IN THE NEW WEST PAD ELEVATOR ROOM.

REMOVAL OF THE STAIR/ELEVATOR TOWER ON THE EAST SIDE OF THE PAD, AND RELOCATION OF THE MODIFIED STAIR PORTION OF THE TOWER ON NEW FOUNDATIONS NORTH OF THE EXISTING LOCATION.

DEMOLITION/FILLING/PAVING/CURBING/CLOSURES OF CERTAIN PITS, TRENCHES AND OPENINGS FORMERLY SERVING SUPPORTS, TOWER AND PIPING PREVIOUSLY REMOVED BY OTHERS.

NEW TRENCHES IN EXISTING CONCRETE PAD SURFACE FOR FUTURE HYPERGOLIC AND PNEUMATIC PIPING.

A STEEL BRIDGE (APPROXIMATELY 6 FT. WIDE X 132 FT. LONG X 40 FT. HIGH) ACROSS THE EXISTING FLAME TRENCH, AND IDENTIFIED AS THE "NORTH BRIDGE" ON THE DRAWINGS.

HINGED BRIDGES ON SSAT AND ON RELOCATED NORTH STAIR TOWER TO SPAN TO MOBILE LAUNCHER PLATFORM.

MISCELLANEOUS NEW AND RELOCATED STEEL WORK FOR THE SUPPORT OF NEW AND FUTURE DUCTWORK AND PIPING.

REMOVAL/MODIFICATION/RELOCATION OF HANDRAILS ALONG EACH SIDE OF FLAME TRENCH.

CONSTRUCTION OF FLAME DEFLECTORS FOR SOLID ROCKET BOOSTER (SRB) AND FOR ORBITER USING NEW STEEL AND STEEL AND COMPONENTS FROM ONE EXISTING FLAME DEFLECTOR FOR SATURN V ROCKET, AND MODIFICATIONS TO FLOOR OF EXISTING FLAME TRENCH TO ACCOMMODATE THE TWO NEW DEFLECTORS.

BLAST PROTECTION FOR TWIN ELEVATOR SHAFT BETWEEN ELEVATIONS 53'-0"/80'-0" AND 100'-0"/120'-0" OF SSAT.

CONSTRUCT SEPARATE HYPERGOLIC FUEL AND HYPERGOLIC OXIDIZER BUILDINGS AND ADJACENT ELECTRICAL BUILDINGS, INCLUDING CONCRETE APRONS, BITUMINOUS PAVING, AND CROSS-COUNTRY SUPPORTS AND CABLE TRAY FOR FUTURE HYPERGOLIC PIPING AND ELECTRICAL/COMMUNICATION CABLES.

REFRACTORY COATINGS FOR SRB, ORBITER AND SIDE FLAME DEFLECTORS, PORTIONS OF FLAME TRENCH WALLS, AND BRIDGE PIER.

ACCOMPLISH BONDING AND GROUNDING OF METALS AS SPECIFIED.

MISCELLANEOUS OTHER ITEMS OF CIVIL/STRUCTURAL/ARCHITECTURAL WORK AS SHOWN ON THE DRAWINGS OR SPECIFIED.

---MECHANICAL WORK

GENERALLY, MECHANICAL WORK INCLUDES THE PROVIDING OF:

WIND ANCHORAGE, OR TIE-DOWN, SYSTEM FOR FUTURE TRUCKS OF FUTURE ROTARY BRIDGE AT EACH TERMINAL OF TRAVEL ARC.

DUCT SYSTEM FOR CHILLED AIR (ECS), AND AN AMBIENT AIR PRESSURIZATION DUCT SYSTEM (FOR FUTURE HOIST ROOM ATOP PCR) AND FOR RELOCATED ELEVATOR MACHINERY ROOM ON SSAT. INCLUDED ARE EXTENSIONS OF EXISTING DUCT SYSTEMS TO SERVE THE ABOVE AREAS.

PACKAGE WINDOW-TYPE AIR CONDITIONING UNIT FOR EACH ELECTRICAL BUILDING ADJACENT TO EACH HYPER-GOLIC FACILITY.

FIREX WATER FOGGING AND FIRE HOSE SYSTEMS, POTABLE WATER AND SAFEWASTE SYSTEMS, AND TOILETS FOR THE SHUTTLE SERVICE AND ACCESS TOWER (SSAT).

FIRE HYDRANTS AT THREE CORNERS OF THE ELEVATED LAUNCH PAD AND AUTOMATIC/MANUAL WATER DELUGE SYSTEM FOR TWO HIGH PRESSURE GO_2 CYLINDERS IN THE HIGH PRESSURE GAS STORAGE AREA AND CONNECTING WATER PIPING FOR ABOVE.

AUTOMATIC/MANUAL DELUGE SPRINKLER SYSTEM, FIRE HOSE STATIONS, AND POTABLE WATER SYSTEM FOR EACH HYPERGOLIC FACILITY.

EMERGENCY SHOWER/EYE WASH/DRINKING FOUNTAIN STATIONS AT SPECIFIED LEVELS OF THE SSAT, AND AT THE HYPERGOLIC FUEL AND OXIDIZER BUILDINGS.

MODIFICATIONS TO TANKS AND WATER AND NITROGEN GAS PIPING IN EXISTING VALVE PIT AREA AT PAD 39B.

MODIFICATIONS TO WATER PIPING AT EXISTING GROUND STORAGE TANK - PUMP HOUSE AREA.

SOUND SUPPRESSION WATER SYSTEM, INCLUDING NITROGEN GAS SUPPLY SYSTEM FOR 48 INCH VALVES, PIPE SUPPORTS AND MISCELLANEOUS COMPONENTS AND TIE-INS TO EXISTING FIREX WATER SYSTEM.

COMPRESSED AIR SUPPLY TO TANK T3B AND MODIFICATIONS TO TANK, PIPING, AND COMPONENTS.

PNEUMATIC-HYDRAULIC JACKING SYSTEM AND WHEEL TRUCK SYSTEM FOR EACH OF TWO SIDE FLAME DEFLECTORS.

SLIDEWIRE EMERGENCY EGRESS SYSTEM - SSAT TO GROUND.

MISCELLANEOUS MODIFICATIONS TO WATER PIPING SYSTEMS IN THE CATACOMBS AND VALVE PIT OF PAD 39B.

MODIFICATIONS TO PIPING SYSTEMS AS REQUIRED BY FOUNDATION WORK FOR STRUCTURES ERECTED FOR THIS PROJECT.

MISCELLANEOUS OTHER MECHANICAL WORK AS SHOWN ON THE DRAWINGS OR SPECIFIED.

ACCOMPLISH BONDING AND GROUNDING OF METALS AS SPECIFIED.

---ELECTRICAL WORK

MAJOR ELECTRICAL WORK TO BE ACCOMPLISHED:

PROVIDE SSAT SUBSTATION IN SWITCHING STATION 1002 (UNDER PAD).

PROVIDE ELECTRICAL POWER AND LIGHTING FOR SSAT.

PROVIDE EMERGENCY SWTICHGEAR IN PTCR (UNDER PAD).

PROVIDE EMERGENCY FEEDERS FROM EMERGENCY SWITCHGEAR IN PTCR TO LH_2 FACILITY, NEW MLP INTERFACE AND SSAT. MODIFY SMOKE DETECTOR SYSTEM IN CABLE TUNNEL TO SSAT AND MLP.

PROVIDE FIRE ALARM SYSTEM FOR SSAT.

PROVIDE CABLE TRAY SYSTEMS ON SSAT AND ANTENNA ACCESS PLATFORM.

PROVIDE ELECTRICAL FEEDERS FROM EXISTING PAD 39B MAIN GATE SUBSTATION TO HYPERGOLIC FUEL FACILITY.

PROVIDE HYPERGOLIC OXIDIZER SUBSTATION.

PROVIDE ELECTRICAL POWER AND LIGHTING FOR HYPERGOLIC FUEL AND OXIDIZER FACILITIES AND ELEVATED STEEL WATER TANK.

PROVIDE FIRE ALARM SYSTEMS FOR HYPERGOLIC FUEL AND OXIDIZER FACILITIES.

PROVIDE INSTRUMENTATION CABLE TRAY SYSTEMS TO HYPERGOLIC FUEL AND OXIDIZER FACILITIES.

REWORK EXISTING 15KV FEEDER TO MLP INTERFACE CONNECTION.

REMOVE EXISTING 15KV FEEDER TO MSS INTERFACE CONNECTION.

REMOVE SELECTED ELECTRICAL POWER AND INSTRUMENTATION FEEDERS AND CABLE TRAYS TO THE EXISTING MSS INTERFACE.

MODIFY EXISTING OIL SWITCHES TO SUPPLY MLP INTERFACE.

PROVIDE SENSORS AND TRANSDUCERS FOR UTILITY CONTROL SYSTEM (UCS).

PROVIDE POWER FEEDERS TO HAMMERHEAD CRANE ATOP SSAT.

PROVIDE LIGHTNING PROTECTION FOR HAMMERHEAD CRANE ATOP SSAT AND FOR NEW ELEVATED WATER TANK.

PROVIDE POWER FEEDERS FOR RELOCATED SSAT ELEVATORS.

REMOVE AND REINSTALL WEST PAD ELEVATOR MACHINE ROOM ELECTRICAL DEVICES.

REWORK MISCELLANEOUS CONDUITS, CONDUCTORS AND ELECTRICAL DEVICES AS REQUIRED IN AREAS TO BE EXCAVATED FOR NEW CONSTRUCTION.

ACCOMPLISH BONDING AND GROUNDING AS SPECIFIED.

PERFORM ANY OTHER ELECTRICAL WORK FOR THE COMPLETION OF THE OVERALL PROJECT AS SHOWN ON THE DRAWINGS OR SPECIFIED.

PROVIDE CATHODIC PROTECTION SYSTEM FOR FOUNDATION PILING ON THE DRAWINGS AND SPECIFIED. AS SHOWN (B)

ACCOMPLISH ELECTRICAL WORK ASSOCIATED WITH MODIFICATIONS TO TANK T-3B.

---TESTING

ACCOMPLISH TESTING OF WORK AND SYSTEMS AS SPECIFIED IN THE VARIOUS SECTIONS AND SECTION 18A OF THE SPECIFICATIONS.

---PAINTING AND FINISHING AND PIPING IDENTIFICATION

ALL NEW NON-GALVANIZED STRUCTURAL AND MISCELLANEOUS STEEL SHALL BE ABRASIVE BLASTED AND SHOP COATED WITH ZINC-RICH COATING AS SPECIFIED IN SECTIONS 9A AND 9L OF THE SPECIFICATIONS. ACCOMPLISH OTHER PAINTING AS SPECIFIED IN SECTION 9A AND RESPECTIVE SECTIONS OF SPECIFICATIONS. PIPING IDENTIFICATION SHALL BE AS SPECIFIED IN SECTION 13L. SOUND SUPPRESSION PIPING, CHILLED WATER PIPING AT SSAT, AND ELEVATED STEEL WATER TANK SHALL HAVE EPOXY COAL-TAR COATINGS AND SPECIAL LINING AS SPECIFIED.

---*GALVANIZED STEEL* (A)

ALL ITEMS FABRICATED FROM STEEL SHAPES, ROD, PLATE AND SHEET, AND ALL STEEL HARDWARE, BOLTS, SCREWS, NUTS AND WASHERS PROVIDED FOR THE INSTALLATION OF PIPING AND CONDUIT AND THE MOUNTING OF COMPONENTS OF PIPING AND ELECTRICAL SYSTEMS SHALL BE GALVANIZED UNLESS OTHERWISE TO THE CONTRARY SPECIFIED OR NOTED."

SECTION 1E

TRANSPORT AND ERECTION OF TOWER SEGMENTS, CRANE AND ELEVATORS

---GENERAL REQUIREMENTS---

---HEIGHT

PRIOR TO DISASSEMBLY BY OTHERS, THE EXISTING TOWER ROSE 380 FEET ABOVE DECK "0" OF MOBILE LAUNCER NO. 2 (ML NO. 2). THE TOWER WAS DISASSEMBLED IN SEGMENTS AND STORED NORTH OF THE VAB AS SHOWN ON THE DRAWINGS.

---WEIGHT

THE WEIGHTS OF THE TOWER SEGMENTS ARE TABULATED ON THE DRAWINGS.

---DESCRIPTION

THE TOWER CONSISTS OF A STEEL STRUCTURAL FRAME HAVING HEAVY CORNER COLUMNS CONNECTED WITH PERIMETER GIRDERS AND A CENTRAL HOISTWAY FOR TWIN ELEVATORS, WITH ADJACENT STAIRWAY. THE ELEVATOR HOISTWAY IS ENCLOSED WITH FRAMES OF WOVEN WIRE MESH, EXCEPT THAT CERAMIC SIDING ENCLOSES THE FIRST SEVEN FEET ABOVE EACH LEVEL. AT EACH LEVEL (EXCEPT THE TOP LEVEL) FLOOR BEAMS SUPPORT GALVANIZED STEEL GRATING HAVING HANDRAILS WITH KICKPLATE.

THE TOP TOWER LEVEL CONSISTS OF DEEP GIRDERS POSITIONED TO SUPPORT A CIRCULAR RAIL FOR A HAMMERHEAD CRANE (PREVIOUSLY REMOVED BY OTHERS) TO BE INSTALLED UNDER THIS CONTRACT FOLLOWING TRANSPORT, MODIFICATION AND ERECTION OF THE TOWER SEGMENTS AT LAUNCH PAD 39B.

IMMEDIATELY BELOW TOWER TOP LEVEL IS LOCATED THE ELEVATOR MACHINERY ROOM.

RISING THROUGH THE GRATING OF EACH LEVEL ARE VERTICAL HEAVY ALUMINUM CABLE TRAYS (NO CABLE). CABLE TRAYS, LIGHTING FIXTURES AND CONDUIT ARE ALSO HUNG FROM THE UNDERSIDE OF THE FLOOR BEAM SYSTEM AT MOST TOWER LEVELS. ALSO VERTICAL CONDUIT AND WIRING EXISTS AT CORNER COLUMNS AND AT THE SIDES OF THE ELEVATOR HOISTWAY.

ON THE EXTERIOR SIDES OF THE TOWER EXISTS VERTICAL STEEL FORMERLY UTILIZED FOR SUPPORT OF UMBILICAL ARMS. ON SIDE 2 EXISTS VERTICAL/HORIZONTAL STEEL FORMERLY USED FOR DUCT SUPPORTS, AND THIS STEEL SHALL BE REMOVED AND PORTIONS INSTALLED ON THE NEW TOWER (SSAT) AFTER ERECTION AT PAD 39B.

---DRAWINGS

THE DRAWINGS INCLUDE IDENTIFICATION OF THE TOWER SEGMENTS AND THE SEQUENCE FOR ERECTION AT PAD 39B. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PLAN THE ERECTION IN ACCORDANCE WITH PRUDENT CONSTRUCTION PRACTICES. ALL COSTS IN CONNECTION WITH THE RE-USE OF MATERIAL IN ERECTION OF THE SSAT IS TO BE INCLUDED IN THE CONTRACTOR'S BID PRICE AND NO ADDITIONAL COST WILL BE CONSIDERED FOR PROCEDURES ELECTED BY THE CONTRACTOR DURING ERECTION OPERATIONS THAT RESULT IN INCREASED CONTRACT COST. THE CONTRACTOR'S ERECTION PLAN SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL AS SPECIFIED.

---STORAGE AND ERECTION SITES---

---ML PARK SITE NO. 2 STORAGE AREA

THIS SITE IS LOCATED NORTH OF THE VEHICLE ASSEMBLY BUILDING (VAB) AND IS THE CENTER SITE OF THE THREE PARK SITES AS SHOWN ON THE DRAWINGS. STORAGE AREAS FOR THE TOWER SEGMENTS, CRANE AND ELEVATORS ARE SHOWN ON THE DRAWINGS.

---PAD 39B ERECTION AREA

AT THIS LOCATION THE TOP OF THE TOWER (ELEV. 300'-0") WHEN ERECTED WILL BE APPROXIMATELY 247 FEET ABOVE THE PAD SURFACE AND 289 FEET ABOVE THE BOTTOM OF THE FLAME TRENCH AND GRADE AT THE TOE OF THE PAD EMBANKMENT. IF STEEL IS PLACED ON THE CONCRETE PAVING FORMING THE TOP OF THE PAD (EL 53'-0" $\pm$), DUNNAGE MUST BE UTILIZED IN AREAS OTHER THAN THE CRAWLERWAY TO DISTRIBUTE THE LOAD; HOWEVER, SUCH PLACEMENT MAY INTERFERE WITH OTHER CONSTRUCTION OPERATIONS OF THE CONTRACTOR. IN ANY EVENT, ALL PAVING THAT IS NOT SCHEDULED FOR REMOVAL/REPLACEMENT SHALL BE PROTECTED FROM DAMAGE. OTHER STORAGE AREAS ARE LOCATED AS SHOWN ON THE DRAWINGS.

---ERECTION PROCEDURE---

---RESPONSIBILITIES

MODIFICATION AND ERECTION OF THE SSAT TOWER AT PAD 39B SHALL BE PERFORMED BY ONE CONTRACTOR.

REMOVED PARTS SHALL BE TRANSPORTED BY THE CONTRACTOR TO RESPECTIVE SALVAGE STORAGE AREAS.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR MOBILIZING, ERECTING AND RIGGING OF CRANE EQUIPMENT.

---SEQUENCE OF OPERATIONS

NOT LATER THAN 30 DAYS AFTER THE DATE OF CONTRACT AWARD, THE CONTRACTOR SHALL SUBMIT FOR APPROVAL, THE SEQUENCE OF OPERATIONS AND PROCEDURES FOR THE ERECTION OF THE SSAT, INCLUDING ELEVATORS AND CRANE WITH NEW LIGHTNING MAST. DETAILED INFORMATION ON SCHEDULING THE WORK SHALL BE INCLUDED IN THE CONTRACTOR'S CPM. THE CONTRACTOR'S PLAN SHALL BE APPROVED PRIOR TO THE START OF TOWER ERECTION. A SUGGESTED ERECTION PLAN IS AS FOLLOWS:

TRANSPORT TOWER SEGMENTS SCHEDULED FOR ERECTION AT PAD 39B TO TEMPORARY STORAGE AREA AT PAD 39B. PERFORM MODIFICATIONS TO TOWER SEGMENTS AS SHOWN ON THE DRAWINGS, INCLUDING TOP LEVEL CRANE DECK, ETC. AS SHOWN ON THE DRAWINGS.

ERECT TOWER STEEL, CABLE TRAYS, AND ELEVATOR SYSTEM INSOFAR AS POSSIBLE IN COMPLETE SEGMENTS. THE LOWER SEGMENT SHALL BE MODIFIED AS SHOWN ON THE DRAWINGS.

TRANSPORT FROM STORAGE THE GOVERNMENT FURNISHED HAMMERHEAD CRANE, MODIFY FOR LIGHTNING MAST AS SHOWN ON THE DRAWINGS, AND REASSEMBLE ATOP NEW TOWER. SEE THE DRAWINGS FOR WEIGHTS.

SEQUENCE OF PAINTING TOWER STEEL SHALL BE SUCH THAT TOP FLANGES OF FLOOR BEAMS ARE CLEANED AND PAINTED PRIOR TO FINAL PLACING OF FLOOR GRATINGS ON FLOOR BEAMS.

---RESTRICTIONS ON ROAD LOADINGS---

THE FOLLOWING ROADS HAVE LIMITATIONS OF 8,000 POUNDS PER WHEEL AND 32,000 POUNDS PER AXLE:

KENNEDY PARKWAY (4 LANE, 88 FT. O.A. PAVED WIDTH)

KENNEDY PARKWAY (2 LANE, 24 FT. O.A. PAVED WIDTH)

RANSOM ROAD

SWARTZ ROAD

ML PARK SITE NO. 2 TO KENNEDY PARKWAY

KENNEDY PARKWAY TO PAD 39B

PAD 39B PERIMETER ROAD

NASA CAUSEWAY (4 LANE, 88 FT. O.A. PAVED WIDTH)

REFER TO THE INFORMATION SHEET IN DRAWINGS. THE 16'-4" VERTICAL CLEARANCE UNDER THE NASA CAUSEWAY OVERPASS OF KENNEDY PARKWAY CAN BE AVOIDED WHEN TRAVELING SOUTH BY DETOURING WEST ON NASA CAUSEWAY ABOUT ONE-HALF MILE TO THE MEDIAN CROSSOVER U-TURN AND THEN RETURNING EAST TO KENNEDY PARKWAY AND THENCE TO RANSOM ROAD. HORIZONTAL CLEARANCE THROUGH THE OVERPASS SUPPORTING PIERS IS 38 FEET.

SECTION 2A

DEMOLITION WORK

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS ALL DEMOLITION WORK ASSOCIATED WITH THIS PROJECT.

---REFERENCE STANDARDS, ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AGCA	ASSOCIATED GENERAL CONTRACTORS OF AMERICA
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE

---CONDITION OF STRUCTURES TO BE DEMOLISHED

THE CONTRACTOR SHALL VERIFY IN THE FIELD THE CONDITION OF STRUCTURES TO BE DEMOLISHED.

---OCCUPANCY OF STRUCTURES TO BE DEMOLISHED

BUILDINGS AND OTHER STRUCTURES TO BE DEMOLISHED WILL BE VACATED AND DISCONTINUED IN USE PRIOR TO THE START OF THE WORK UNDER THIS CONTRACT.

---EXISTING UTILITIES INDICATED TO REMAIN

EXISTING UTILITIES INDICATED TO REMAIN SHALL BE MAINTAINED IN SERVICE UNLESS OTHERWISE SPECIFIED AND SHALL BE PROTECTED AGAINST DAMAGE.

---USE OF EXPLOSIVES

THE USE OF EXPLOSIVES WILL NOT BE PERMITTED.

---PROTECTION OF PERSONS AND PROPERTY

DEMOLITION OPERATIONS SHALL BE CONDUCTED TO INSURE THE SAFE PASSAGE OF PERSONS TO AND FROM FACILITIES OCCUPIED AND USED BY THE GOVERNMENT AND TO PREVENT DAMAGE BY FALLING DEBRIS OR OTHER CAUSE TO ADJACENT BUILDINGS, STRUCTURES, AND OTHER FACILITIES.

THE SEQUENCE OF OPERATIONS SHALL BE SUCH THAT MAXIMUM PRACTICABLE PROTECTION FROM INCLEMENT WEATHER SHALL BE PROVIDED FOR MATERIALS AND EQUIPMENT LOCATED WITHIN PARTIALLY DISMANTLED STRUCTURES AND ENCLOSURES WHICH, PRIOR TO THE CONTRACTOR'S OPERATIONS, PROTECTED THE EQUIPMENT FROM THE WEATHER.

---MAINTAINING TRAFFIC

DEMOLITION OPERATIONS AND THE REMOVAL OF DEBRIS TO DISPOSAL AREAS SHALL BE CONDUCTED TO INSURE MINIMUM INTERFERENCE WITH TRAFFIC ON ROADS, STREETS, WALKS, AND THE FUNCTIONS OF OTHER FACILITIES OCCUPIED AND USED BY THE GOVERNMENT.

STREETS, WALKS, AND OTHER FACILITIES OCCUPIED AND USED BY THE GOVERNMENT SHALL NOT BE CLOSED OR OBSTRUCTED WITHOUT WRITTEN PERMISSION.

---SAFETY REQUIREMENTS

DEMOLITION OPERATIONS SHALL BE CONDUCTED TO INSURE THE SAFETY OF PERSONS IN ACCORDANCE WITH ANSI A10.6-1969 "SAFETY REQUIREMENTS FOR DEMOLITION".

THE MECHANICAL METHOD OF DEMOLITION, (WHEREBY DEMOLITION OF A STRUCTURE IS ACCOMPLISHED BY MEANS OF A WEIGHT BALL, POWER SHOVEL, OR OTHER MECHANICAL DEVICE) SHALL BE CONDUCTED IN ACCORDANCE WITH AGCA "MANUAL OF ACCIDENT PREVENTION IN CONSTRUCTION", SECTION 3.10, AND AS APPROVED BY THE CONTRACTING OFFICER. ALL INTERIOR EQUIPMENT SHALL BE REMOVED PRIOR TO COMMENCING SUCH OPERATIONS.

ALL THERMIC AND OTHER FLAME CUTTING OPERATIONS SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE "CONTRACT SCHEDULE" RELATIVE TO PROTECTION AGAINST HAZARDS, ETC.

---REQUIREMENTS BEFORE DEMOLITION---

---DISCONNECTING UTILITIES SERVING STRUCTURES TO BE DEMOLISHED

THE GOVERNMENT WILL DISCONNECT AND SEAL THE UTILITIES SERVING EACH STRUCTURE TO BE DEMOLISHED PRIOR TO THE START OF DEMOLITION.

---PRECAUTIONS AGAINST MOVEMENT

THE CONDITION OF STRUCTURES AND OTHER FACILITIES ADJACENT TO ANY STRUCTURE TO BE DEMOLISHED SHALL BE RECORDED BY PHOTOGRAPHS AND OTHERWISE AS SPECIFIED PRIOR TO THE START OF DEMOLITION. SUCH RECORD SHALL CONTAIN THE ELEVATION OF THE TOP OF FOUNDATION WALLS, THE LOCATION AND EXTENT OF CRACKS AND OTHER EXISTING DAMAGE, AND DESCRIPTIONS OF ANY OTHER CONDITION THAT COULD BE DUE TO MOVEMENT CAUSED BY DEMOLITION WORK. SUBMIT TWO COPIES OF THE RECORD OF THE CONDITION OF ADJACENT FACILITIES TO THE CONTRACTING OFFICER NOT LATER THAN ONE WORKING DAY BEFORE STARTING DEMOLITION.

SHORING AND BRACING OR OTHER SUPPORT SHALL BE PROVIDED AS NECESSARY TO PREVENT MOVEMENT OR SETTLEMENT OR COLLAPSE OF FACILITIES TO REMAIN THAT ARE ADJACENT TO A STRUCTURE TO BE DEMOLISHED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY AND ADEQUACY OF THE PRECAUTIONS AGAINST MOVEMENT.

---REPAIR OF DAMAGE

ANY DAMAGE CAUSED BY DEMOLITION OPERATIONS TO ADJACENT FACILITIES WHICH ARE TO REMAIN, AS EVIDENCED BY THE RECORD OF THE CONDITION OF SUCH FACILITIES SPECIFIED HEREINBEFORE, SHALL BE PROMPTLY REPAIRED AS DIRECTED BY THE CONTRACTING OFFICER, AND AT NO ADDITIONAL COST TO THE GOVERNMENT. CONTRACTOR TO PAINT (TOUCH UP) ALL REUSED MATERIALS TO MATCH EXISTING.

---CONCURRENT EARTH MOVING OPERATIONS

EXCAVATION, FILLING, AND OTHER EARTH MOVING OPERATIONS THAT ARE CONCURRENT WITH DEMOLITION WORK SHALL NOT BE STARTED IN AREAS OCCUPIED BY STRUCTURES TO BE DEMOLISHED UNTIL ALL DEMOLITION IN THE AREA HAS BEEN COMPLETED AND DEBRIS HAS BEEN REMOVED.

---DUST ABATEMENT

DUST AND DIRT RISING DURING DEMOLITION OPERATIONS SHALL BE EFFECTIVELY CONTROLLED BY WATER SPRINKLING OR OTHER APPROVED METHODS.

---STRUCTURES

DEMOLITION SHALL PROCEED IN A SYSTEMATIC MANNER FROM THE TOP OF THE STRUCTURE TO THE GROUND. ALL DEMOLITION WORK ABOVE EACH TIER OR FLOOR SHALL BE COMPLETED BEFORE ANY OF THE SUPPORTING MEMBERS ON THE LOWER LEVELS ARE DISTURBED. CONCRETE AND MASONRY WALLS SHALL BE DEMOLISHED IN SMALL SECTIONS. STRUCTURAL FRAMING MEMBERS SHALL BE REMOVED AND LOWERED BY MEANS OF DERRICKS, PLATFORM HOISTS, OR OTHER APPROVED METHOD.

CONCRETE SLABS ON GROUND SHALL BE BROKEN UP AND REMOVED WHERE NOTED FOR REMOVAL ON THE DRAWINGS.

---EXTENT OF DEMOLITION OF STRUCTURES

STRUCTURES ABOVE AND BELOW GRADE NOTED ON THE DRAWINGS TO BE REMOVED SHALL BE REMOVED COMPLETE UNLESS OTHERWISE NOTED.

---FILLING VOIDS

VOIDS RESULTING FROM THE DEMOLITION OF STRUCTURES SHALL BE COMPLETELY FILLED WITH FILL MATERIAL AND GRADED. FOR BACKFILLING REFER TO SECTION 2D OF THE SPECIFICATIONS.

---PARTIAL DEMOLITION FOR RECEIVING NEW WORK

PORTIONS OF STRUCTURES SHALL BE DEMOLISHED TO RECEIVE NEW WORK AS SHOWN AND NOTED ON THE DRAWINGS. SPECIAL CARE SHALL BE TAKEN TO AVOID DAMAGE TO THE PORTION OF STRUCTURES THAT ARE TO REMAIN.

---ITEMS SCHEDULED FOR RELOCATION, ETC.---

---ELEVATOR ON WEST SIDE OF PAD

THE MACHINERY ROOM FALLS WITHIN THE AREA TO BE EXCAVATED FOR THE FOUNDATIONS OF THE SHUTTLE SERVICE AND ACCESS TOWER (SSAT). EQUIPMENT SHALL BE REMOVED FROM THE MACHINERY ROOM AND THE ROOM DEMOLISHED. FOLLOWING CONSTRUCTION OF UNDERGROUND WORK AND PAVING, A NEW MACHINERY ROOM SHALL BE CONSTRUCTED, THE REMOVED MACHINERY REINSTALLED, AS SHOWN ON THE DRAWINGS.

---ELEVATOR/STAIR TOWER ON EAST SIDE OF PAD

THE STAIR TOWER AND PORTIONS OF THE ELEVATOR TOWER SHALL BE DISASSEMBLED AND RELOCATED AS NOTED ON THE DRAWINGS AND SPECIFIED HEREIN. EAST SIDE ELEVATOR REMOVED "BY OTHERS".

---DISPOSAL OF REMOVED MATERIALS---

---GENERAL

REMOVE ALL DEBRIS, RUBBISH, AND OTHER MATERIALS RESULTING FROM DEMOLITION OPERATIONS. REMOVED MATERIALS THAT ARE NOT TO BE REUSED IN THE PROJECT SHALL NOT BE STORED ON THE PROJECT SITE. REMOVED MATERIALS

SHALL BE TRANSPORTED TO THE APPROPRIATE DISPOSAL OR STORAGE SITES NOTED ON THE DRAWINGS AND AS SPECIFIED IN THE "CONTRACT SCHEDULE". REUSABLE MATERIAL CAN BE STORED AT THE PROJECT SITE WITH THE CONCURRENCE OF THE CONTRACTING OFFICER OR AS SPECIFIED IN THE "CONTRACT SCHEDULE".

---BURNING ON GOVERNMENT PROPERTY

COMBUSTIBLE MATERIALS REMOVED FROM DEMOLISHED STRUCTURES SHALL BE TRANSPORTED TO THE AREAS DESIGNATED BY THE CONTRACTING OFFICER FOR BURNING BY OTHERS.

---REMOVAL OF MATERIALS FROM PROJECT SITE

ALL MATERIALS REMOVED FROM DEMOLISHED STRUCTURES SHALL BE TRANSPORTED BY THE CONTRACTOR FROM THE PROJECT SITE TO SPECIFIC SALVAGE OR DISPOSAL AREAS AND THERE UNLOADED BY THE CONTRACTOR IN AREAS DESIGNATED BY THE CONTRACTING OFFICER, OR HIS ASSIGNED REPRESENTATIVE. FOR ROAD LIMITS AND CLEARANCES REFER TO THE DRAWINGS AND SECTION 1E OF THIS SPECIFICATION. MAXIMUM ONE-WAY HAUL DISTANCE IS 25 MILES.

SECTION 2B

CLEARING AND GRUBBING

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS, ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AASHTO AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

---DEFINITIONS

SATISFACTORY SOIL MATERIALS-----SHALL MEAN AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-1, A-2-4, A-2-5, AND A-3.

UNSATISFACTORY SOIL MATERIALS-----SHALL MEAN AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-2-6, A-2-7, A-4, A-5, A-6 AND A-7, PEAT AND OTHER HIGHLY ORGANIC SOILS, AND SOIL MATERIALS OF ANY CLASSIFICATION THAT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION BEYOND THE RANGE OF ONE PERCENTAGE POINT BELOW AND THREE PERCENTAGE POINTS ABOVE THE OPTIMUM MOISTURE CONTENT OF THE SOIL MATERIAL AS DETERMINED BY MOISTURE DENSITY RELATIONS TEST.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE"SUPPLEMENTARY GENERAL PROVISIONS" AND AS FOLLOWS:

LABORATORY TEST REPORTS FOR FILL MATERIAL, BOTH NEW AND REUSED.

---USE OF EXPLOSIVES

THE USE OF EXPLOSIVES WILL NOT BE PERMITTED.

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---PROTECTION OF PERSONS AND PROPERTY

CLEARING AND GRUBBING OPERATIONS SHALL BE CONDUCTED TO INSURE SAFETY OF PERSONS AND TO PREVENT DAMAGE TO EXISTING STRUCTURES AND UTILITIES, CONSTRUCTION IN PROGRESS, TREES AND OTHER VEGETATION TO REMAIN STANDING, AND OTHER PROPERTY.

---CLEARING AND GRUBBING---

---CLEARING OPERATIONS

THE PROJECT SITE SHALL BE CLEARED OF TREES, SHRUBS AND OTHER VEGETATION.

---GRUBBING OPERATIONS

COMPLETELY REMOVE STUMPS, ROOTS INCLUDING MATTED ROOTS, AND ORGANIC OR METALLIC DEBRIS PROTRUDING THROUGH THE GROUND SURFACE. THIS MATERIAL SHALL BE EXCAVATED AND REMOVED TO A DEPTH OF NOT LESS THAN 8 INCHES BELOW THE SURFACE LEVEL OF THE ORIGINAL GROUND.

---DISPOSAL OF CLEARED AND GRUBBED MATERIALS---

---BURNING ON GOVERNMENT PROPERTY

COMBUSTIBLE CLEARED AND GRUBBED MATERIALS SHALL BE TRANSPORTED TO THE AREAS DESIGNATED BY THE CONTRACTING OFFICER FOR BURNING BY OTHERS.

NO BURNING OF CLEARED AND GRUBBED MATERIALS BY THE CONTRACTOR WILL BE PERMITTED.

---REMOVAL OF NONCOMBUSTIBLE PROPERTY

ALL NONCOMBUSTIBLE CLEARED AND GRUBBED MATERIALS SHALL BE REMOVED TO THE DESIGNATED GOVERNMENT AREA AT NO ADDITIONAL COST TO THE GOVERNMENT.

SECTION 2C

TOPSOIL REMOVAL

---GENERAL REQUIREMENTS---

---DEFINITIONS

SUITABLE TOPSOIL-----SHALL MEAN FRIABLE CLAY LOAM SURFACE SOIL SUITABLE FOR USE IN GRASS PLANTING. IT SHALL OCCUR IN DEPTH OF NOT LESS THAN 4 INCHES ON NATURALLY WELL DRAINED LAND COVERED WITH A HEAVY GROWTH OF GRASS OR WHICH HAS BEEN COVERED WITH A HEAVY GROWTH OF GRASS DURING THE LATEST GROWING PERIOD BEFORE START OF CONSTRUCTION. IN ADDITION, THE TOPSOIL SHALL BE REASONABLY FREE FROM SUBSOIL, CLAY LUMPS, BRUSH, OBJECTIONABLE WEEDS, AND OTHER LITTER, AND SHALL BE FREE FROM STONES, STUMPS, AND OTHER OBJECTS LARGER THAN 2 INCHES IN ANY DIMENSION, ROOTS, AND OTHER OBJECTIONABLE MATERIAL.

UNSUITABLE TOPSOIL-----SHALL MEAN SOIL MATERIAL THAT DOES NOT MEET THE REQUIREMENTS SPECIFIED ABOVE FOR SUITABLE TOPSOIL.

---PROTECTION OF PERSONS AND PROPERTY

TOPSOIL REMOVAL OPERATIONS SHALL BE CONDUCTED TO INSURE SAFETY OF PERSONS AND TO PREVENT DAMAGE TO EXISTING STRUCTURES AND UTILITIES, CONSTRUCTION IN PROGRESS, TREES AND OTHER VEGETATION WHICH IS TO REMAIN STANDING, AND OTHER PROPERTY.

---STRIPPING TOPSOIL---

---AREAS TO BE STRIPPED

TOPSOIL, BOTH SUITABLE AND UNSUITABLE, SHALL BE STRIPPED FROM THE SURFACE OF AREAS INDICATED TO RECEIVE FILLS OR EMBANKMENTS.

---SURFACE PREPARATION

HEAVY GROWTHS AND OTHER VEGETATION, ROOTS, DEBRIS, STONES AND OTHER OBJECTS LARGER THAN TWO INCHES IN ANY DIMENSION, AND OTHER UNSUITABLE MATERIALS SHALL BE REMOVED FROM THE SURFACE OF AREAS TO BE STRIPPED BY MOWING, GRUBBING, RAKING OR OTHER SUITABLE METHODS, AS REQUIRED.

---STRIPPING

SUITABLE TOPSOIL SHALL BE STRIPPED TO WHATEVER DEPTHS ENCOUNTERED, AND IN SUCH MANNER AS TO PREVENT INTERMINGLING WITH THE UNDERLYING SUBSOIL AND OTHER OBJECTIONABLE MATERIALS HEREINBEFORE SPECIFIED FOR SUITABLE TOPSOIL IN THE ARTICLE ENTITLED "SUITABLE TOPSOIL", "DEFINITIONS."

UNSUITABLE TOPSOIL SHALL BE STRIPPED TO THE DEPTH REQUIRED TO REMOVE ALL VEGETATION, DEBRIS, AND OTHER OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH THE CONSTRUCTION OF FILLS OR EMBANKMENTS OR OTHER SUPERIMPOSED CONSTRUCTIONS.

---STOCKPILING SUITABLE TOPSOIL---

---STORAGE AREAS

SUITABLE TOPSOIL SHALL BE TRANSPORTED TO, AND STOCKPILED IN, DESIGNATED TOPSOIL STORAGE AREAS ON GOVERNMENT PROPERTY.

---STORAGE PILES

STORAGE PILES OF SUITABLE TOPSOIL SHALL BE LOCATED AWAY FROM OTHER SOIL MATERIAL STORAGE PILES SO AS TO PREVENT THE INTERMINGLING OF MATERIALS. CONSTRUCT STORAGE PILES SO THAT SURFACE WATER WILL DRAIN FREELY. WIND BLOWN DUST FROM THE STORAGE PILES SHALL BE PREVENTED BY COVERING THE SURFACE WITH BURLAP, OR BY OTHER METHODS AS APPROVED BY THE CONTRACTING OFFICER.

---DISPOSAL OF WASTE MATERIALS AND UNSUITABLE TOPSOIL---

---BURNING ON GOVERNMENT PROPERTY

COMBUSTIBLE WASTE MATERIALS RESULTING FROM STRIPPING OPERATIONS SHALL BE TRANSPORTED TO THE AREAS DESIGNATED BY THE CONTRACTING OFFICER FOR BURNING BY OTHERS.

NO BURNING OF WASTE MATERIALS BY THE CONTRACTOR WILL BE PERMITTED ON GOVERNMENT PROPERTY.

---REMOVAL OF WASTE MATERIAL

ALL WASTE MATERIALS AND UNSUITABLE TOPSOIL RESULTING FROM STRIPPING OPERATIONS SHALL BE REMOVED TO THE DESIGNATED GOVERNMENT AREA AT NO ADDITIONAL COST TO THE GOVERNMENT.

SECTION 2D

EXCAVATION, FILL AND BACKFILL FOR STRUCTURES AND UTILITIES

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS, ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS.

AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
MIL-STD	MILITARY STANDARDS

---DEFINITIONS

SATISFACTORY SOIL MATERIALS-----SHALL MEAN AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-1, A-2-4, A-2-5, A-3.

UNSATISFACTORY SOIL MATERIALS-----SHALL MEAN ASSHTO M145-73 SOIL CLASSIFICATION GROUPS A-2-6, A-2-7, A-4, A-5 AND A-7, PEAT AND OTHER HIGHLY ORGANIC SOILS, AND SOIL MATERIALS OF ANY CLASSIFICATION THAT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION BEYOND THE RANGE OF ONE PERCENTAGE POINT BELOW AND THREE PERCENTAGE POINTS ABOVE THE OPTIMUM MOISTURE CONTENT OF THE SOIL MATERIALS AS DETERMINED BY MOISTURE DENSITY RELATIONS TEST.

COHESIONLESS SOIL MATERIALS-----INCLUDE GRAVELS, GRAVEL-SAND MIXTURES, SANDS AND GRAVELLY SAND. MOISTURE DENSITY RELATIONS OF COMPACTED COHESIONLESS SOILS, WHEN PLOTTED ON GRAPHS WILL SHOW STRAIGHT LINES OR REVERSE SHAPED MOISTURE DENSITY CURVES.

COHESIVE SOIL MATERIALS-----INCLUDE CLAYEY AND SILTY GRAVELS, SAND-CLAY MIXTURES, GRAVEL-SILT MIXTURES, CLAYEY AND SILTY SANDS, SAND-SILT MIXTURES, CLAYS, SILTS, AND VERY FINE SANDS. MIXTURE DENSITY RELATIONS OF COMPACTED COHESIVE SOILS, WHEN PLOTTED ON GRAPHS, WILL SHOW NORMAL MOISTURE DENSITY CURVES.

SUBGRADE-----SHALL MEAN THE TOP SURFACE OF A BACKFILL OR FILL, OR THE UPPERMOST SURFACE OF AN EXCAVATION, GRADED TO CONFORM TO THE REQUIRED SUBGRADE ELEVATION AND COMPACTED TO SUPPORT A STRUCTURE, OR TOPSOIL IN GRASSED AREAS, OR A PAVEMENT SYSTEM.

---SITE INFORMATION

ORIGINAL BACKFILL UNDER ELEVATED PAD AREA IS HYDRAULICALLY DREDGED RIVER BOTTOM SAND AND SHELL FILL.

THE DATA ON SUBSURFACE SOIL CONDITIONS INDICATED ARE NOT INTENDED AS REPRESENTATIONS OR WARRANTIES OF THE CONTINUITY OF SUCH CONDITIONS BETWEEN SOIL BORINGS. IT IS EXPRESSLY UNDERSTOOD THAT THE GOVERNMENT WILL NOT BE RESPONSIBLE FOR ANY INTERPRETATION OR CONCLUSION DRAWN THEREFROM BY THE CONTRACTOR. THE DATA ARE MADE AVAILABLE FOR THE CONVENIENCE OF THE CONTRACTOR.

ADDITIONAL SOIL BORINGS AND OTHER EXPLORATORY OPERATIONS MAY BE MADE BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT, PROVIDED SUCH OPERATIONS ARE APPROVED BY THE CONTRACTING OFFICER.

---QUALIFICATIONS FOR SOIL TESTING SERVICE

SOIL TESTING SHALL BE PERFORMED BY A LABORATORY AND INSPECTION SERVICE THOROUGHLY EXPERIENCED IN SAMPLING AND TESTING SOILS AND AGGREGATES.

SUBMIT A WRITTEN DESCRIPTION OF PROPOSED SOIL TESTING SERVICE GIVING QUALIFICATIONS OF PERSONNEL, LABORATORY EQUIPMENT AND FACILITIES, LIST OF PROJECTS SIMILAR IN SCOPE TO SPECIFIED WORK, AND OTHER INFORMATION AS MAY BE REQUIRED BY THE CONTRACTING OFFICER.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

LABORATORY TEST REPORTS FOR PROPOSED SOIL MATERIALS.

LABORATORY TEST REPORTS FOR SOIL COMPACTION TESTS.

---EXISTING UTILITIES

BEFORE STARTING MECHANICAL EARTHWORK OPERATIONS, CAREFUL HAND METHODS SHALL BE USED TO VERIFY THE LOCATION OF UNDERGROUND UTILITIES. IF UTILITIES ARE LEFT IN PLACE, PROTECTION AGAINST DAMAGE SHALL BE PROVIDED INCLUDING SHEETING WHERE NECESSARY.

EXISTING UTILITIES SERVING FACILITIES OCCUPIED AND USED BY THE GOVERNMENT SHALL NOT BE INTERRUPTED EXCEPT WHEN APPROVED IN WRITING BY THE CONTRACTING OFFICER. (A)

MECHANICAL EXCAVATION SHALL NOT BE USED WITHIN FOUR FEET OF EXISTING UTILITIES. HAND DIGGING SHALL BE REQUIRED WITHIN FOUR FEET OF EXISTING UTILITIES.

---USE OF EXPLOSIVES

THE USE OF EXPLOSIVES WILL NOT BE PERMITTED.

---PROTECTION OF PERSONS AND PROPERTY

ALL EXCAVATIONS SHALL BE BARRICADED AND POSTED WITH WARNING SIGNS FOR THE SAFETY OF PERSONS. WARNING LIGHTS SHALL BE PROVIDED DURING HOURS OF DARKNESS.

STRUCTURES, UTILITIES, SIDEWALKS, PAVEMENTS AND OTHER FACILITIES IMMEDIATELY ADJACENT TO EXCAVATIONS SHALL BE PROTECTED AGAINST DAMAGE INCLUDING SETTLEMENT, LATERAL MOVEMENT, UNDERMINING AND WASHOUT. ALL CORRECTIVE OR REMEDIAL WORK WILL BE APPROVED BY THE CONTRACTING OFFICER AND SHALL BE PERFORMED AT NO COST TO THE GOVERNMENT.

---SAMPLING AND TESTING---

---SOIL TESTING SERVICE

SOIL TESTING SERVICE SHALL BE PROVIDED BY THE CONTRACTOR.

TESTING SERVICE SHALL BE APPROVED BY THE CONTRACTING OFFICER, AND SHALL INCLUDE SOIL SURVEY FOR SATISFACTORY SOIL MATERIALS, SAMPLING AND TESTING SOIL MATERIALS PROPOSED FOR USE IN THE WORK, AND FIELD TESTING FACILITIES FOR QUALITY CONTROL TESTING DURING CONSTRUCTION PERIOD.

---TESTS FOR PROPOSED SOIL MATERIALS

SOIL MATERIALS PROPOSED FOR USE IN THE WORK SHALL BE SAMPLED AND TESTED AS FOLLOWS:

MATERIAL	REQUIREMENT	AASHTO TEST METHOD	NUMBER OF TESTS
SATISFAC-TORY SOIL MATERIALS	SAMPLING	AASHTO T2-74	ONE FROM EACH SOURCE OF SOIL MATERIAL AND IF THERE IS ANY APPARENT CHANGE
	PREPARATION OF SAMPLES	AASHTO T87-72	
	SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES	AASHTO T27-74	
	MECHANICAL ANALYSIS OF SOILS	AASHTO T88-72	
	LIQUID LIMIT OF SOILS	AASHTO T89-68	
	PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS	AASHTO T90-70	
	MOISTURE DENSITY RELATIONS OF SOIL	AASHTO T180-74 METHOD D	AS REQUIRED TO DETERMINE MOISTURE DENSITY REQUIREMENT OF MATERIAL FROM EACH SOURCE

---QUALITY CONTROL TESTING DURING CONSTRUCTION

SOIL MATERIALS PRIOR TO COMPACTION AND EACH LAYER OF SOIL MATERIAL-IN-PLACE AFTER COMPACTION SHALL BE SAMPLED AND TESTED FOR QUALITY CONTROL DURING CONSTRUCTION AS FOLLOWS (UNDISTURBED BOTTOMS OF EXCAVATIONS FOR FOOTINGS, FOUNDATIONS AND PIPES DO NOT REQUIRE SAMPLING AND TESTING):

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
SOIL MATERIALS PRIOR TO COMPACTION	MOISTURE DENSITY RELATIONS OF SOIL PRIOR TO COMPACTION	AASHTO T180-74 METHOD D	ONE FOR EACH BACKFILL AND FILL MATERIAL FROM EACH SOURCE
SOIL MATERIAL-IN-PLACE AFTER COMPACTION	DENSITY OF SOIL-IN-PLACE	ASTM D1556-64 SAND CONE METHOD OR ASTM D2167-66 RUBBER BALLOON METHOD	ALONG AND PARALLEL TO BURIED SECTION OF 84 INCH PIPE: AT INTERVALS OF NOT MORE THAN 20 FEET, AND STAGGERED WITHIN 6 FEET EACH SIDE OF CENTERLINE OF PIPES, FOR EACH LAYER OF COMPACTED FILL OR BACKFILL MATERIALS

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
SOIL MATERIAL-IN PLACE AFTER COMPACTION	DENSITY OF SOIL-IN-PLACE	ASTM D1556-64(1974) SAND CODE METHOD OR ASTM D2167-66(1972) RUBBER BALLOON METHOD	AT OTHER LOCATIONS WHERE COMPACTION IS SPECIFIED: AT LEAST 3 DAILY FOR EACH LAYER OF BACKFILL OR FILL MATERIALS; ADDITIONAL TEST IS REQUIRED WHENEVER THERE IS ANY CHANGE IN MOISTURE CONDITIONS.

---REPORTS

THE SOIL TESTING SERVICE SHALL REPORT IN WRITING ALL TEST RESULTS TO THE CONTRACTOR AND THE CONTRACTING OFFICER ON THE SAME DAY THAT TESTS ARE MADE.

---EVALUATION OF TEST RESULTS

SOIL MATERIALS OF ANY CLASSIFICATION SHALL NOT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION OUTSIDE THE LIMITS HEREINBEFORE SPECIFIED FOR UNSATISFACTORY SOIL MATERIALS IN THE ARTICLE ENTITLED "---DEFINITIONS".

THE RESULTS OF DENSITY OF SOIL-IN-PLACE TESTS SHALL BE CONSIDERED SATISFACTORY IF THE AVERAGE OF ANY GROUP OF FOUR CONSECUTIVE DENSITY TESTS WHICH MAY BE SELECTED ARE IN EACH INSTANCE EQUAL TO OR GREATER THAN THE SPECIFIED DENSITY, AND IF NOT MORE THAN ONE DENSITY TEST IN FIVE HAS A VALUE MORE THAN TWO PERCENTAGE POINTS BELOW THE SPECIFIED DENSITY.

---SUBGRADE ELEVATIONS---

---GENERAL

PERFORM ALL EXCAVATING, FILLING AND GRADING TO BRING THE AREA TO THE SUBGRADE ELEVATIONS AS INDICATED.

---EXCAVATION---

---GENERAL

EXCAVATION SHALL CONSIST OF THE REMOVAL AND DISPOSAL OF ALL MATERIALS ENCOUNTERED TO OBTAIN THE SPECIFIED SUBGRADE ELEVATIONS.

---UNAUTHORIZED EXCAVATION

UNAUTHORIZED EXCAVATION SHALL CONSIST OF REMOVAL OF MATERIALS BEYOND INDICATED SUBGRADE ELEVATIONS OR SIDE DIMENSIONS SPECIFIED WITHOUT THE SPECIFIC DIRECTION OF THE CONTRACTING OFFICER AND SHALL BE REPLACED AS HEREINAFTER SPECIFIED AT NO ADDITIONAL COST TO THE GOVERNMENT.

UNAUTHORIZED EXCAVATION UNDER THE FOOTING OR BASE OF FOUNDATION OR RETAINING WALL SHALL BE FILLED BY LOWERING THE BOTTOM ELEVATION OF THE FOOTING OR BASE TO THE EXCAVATION BOTTOM, WITHOUT ALTERING THE APPROVED TOP ELEVATION.

ELSEWHERE UNAUTHORIZED EXCAVATIONS SHALL BE BACKFILLED AND COMPACTED AS SPECIFIED FOR AUTHORIZED EXCAVATIONS OF THE SAME CLASSIFICATION.

---STABILITY OF SIDES

SIDES OF EXCAVATIONS OVER FIVE FEET IN DEPTH SHALL BE SLOPED TO THE ANGLE OF REPOSE OF THE MATERIAL EXCAVATED, OR SHALL BE SHORED AND BRACED WHEN INDICATED ON DRAWINGS AND WHERE SLOPING IS NOT POSSIBLE EITHER BECAUSE OF SPACE RESTRICTIONS OR STABILITY OF MATERIAL EXCAVATED.

SIDES AND SLOPES OF EXCAVATIONS SHALL BE MAINTAINED UNTIL COMPLETION OF BACKFILL PLACEMENT IN A SAFE CONDITION BY SCALING, BENCHING, SHELVING, OR BRACING.

PRECAUTIONS SHALL BE TAKEN TO PREVENT SLIDES OR CAVE-INS WHEN EXCAVATIONS ARE MADE IN LOCATIONS ADJACENT TO BACKFILLED EXCAVATIONS AND WHEN SIDES OF EXCAVATIONS ARE SUBJECTED TO VIBRATIONS FROM VEHICULAR TRAFFIC OR THE OPERATION OF MACHINERY OR ANY OTHER SOURCE.

---SHORING AND BRACING

MATERIALS USED FOR SHORING AND BRACING, SUCH AS SHEET PILING, UPRIGHTS, STRINGERS AND CROSSBRACES, SHALL BE IN GOOD SERVICEABLE CONDITION. ANY TIMBER USED SHALL BE SOUND AND FREE FROM LARGE OR LOOSE KNOTS.

SHORING AND BRACING IN EXCAVATIONS SHALL BE MAINTAINED REGARDLESS OF THE LENGTH OF TIME EXCAVATIONS WILL BE OPEN. ALL SHORING AND BRACING SHALL BE CARRIED DOWN WITH THE EXCAVATION.

SHEET PILING SHALL BE REMOVED AFTER COMPLETION OF CONSTRUCTION.

COMPLY WITH OSHA CONSTRUCTION REGULATION, SUBPART "P", SECTIONS 1926.650 THROUGH 1926.653, AS APPLICABLE.

---WATER REMOVAL

EXCAVATION SHALL BE PERFORMED IN A MANNER TO PREVENT SURFACE WATER AND SUBSURFACE OR GROUND WATER FROM FLOWING INTO THE EXCAVATIONS AND TO PREVENT WATER FROM FLOODING THE PROJECT SITE AND SURROUNDING AREA.

WATER SHALL NOT BE PERMITTED TO ACCUMULATE IN EXCAVATIONS. ALL WATER SHALL BE REMOVED FROM EXCAVATIONS BY APPROVED DEWATERING METHODS SO THAT SOFTENING OF FOUNDATION BOTTOM, UNDERCUTTING FOOTINGS, AND SOIL CHANGES DETRIMENTAL TO THE STABILITY OF SUBGRADES AND FOUNDATION WILL NOT OCCUR. PROVIDE AND MAINTAIN PUMPS, SUMPS, SUCTION AND DISCHARGE LINES, AND OTHER DEWATERING SYSTEM COMPONENTS NECESSARY TO CONVEY THE WATER AWAY FROM THE EXCAVATIONS.

DEWATERING OPERATIONS SHALL BE CONTINUED UNTIL THE COMPLETION OF BACKFILL PLACEMENT AND UNTIL CONSTRUCTION SUBJECT TO WATER PRESSURE HAS OBTAINED THE FULL SPECIFIED STRENGTH. IN ALL INSTANCES, DEWATERING OPERATIONS SHALL CONTINUE AS LONG AS WATER CAN ENTER OR ACCUMULATE IN THE EXCAVATIONS.

WATER REMOVED FROM EXCAVATIONS AND RAIN WATER SHALL BE CONVEYED TO COLLECTING OR RUNOFF AREAS, AS APPROVED BY THE CONTRACTING OFFICER. PROVIDE AND MAINTAIN TEMPORARY DRAINAGE DITCHES AND OTHER DIVERSIONS OUTSIDE THE EXCAVATION LIMITS FOR EACH STRUCTURE. THE USE OF TRENCH EXCAVATIONS FOR SITE UTILITIES AS TEMPORARY DRAINAGE DITCHES WILL NOT BE PERMITTED.

---MATERIAL STORAGE

EXCAVATED MATERIALS CLASSIFIED AS SATISFACTORY SOIL MATERIAL SHALL BE STOCKPILED, WHERE DIRECTED, UNTIL REQUIRED FOR BACKFILL OR FILL. STOCKPILES SHALL BE PLACED, GRADED, AND SHAPED FOR PROPER DRAINAGE.

MATERIALS REQUIRED IN THE WORK SHALL BE LOCATED AND RETAINED A SUFFICIENT DISTANCE FROM THE EDGE OF EXCAVATIONS TO PREVENT SUCH MATERIAL FALLING OR SLIDING BACK INTO THE EXCAVATIONS, AND TO PREVENT CAVE-INS.

WASTE MATERIALS, SUCH AS EXCAVATED MATERIAL CLASSIFIED AS UNSATISFACTORY SOIL MATERIAL, TRASH, DEBRIS, AND EXCESS SATISFACTORY SOIL MATERIAL, SHALL BE DISPOSED OF AS SPECIFIED HEREINAFTER.

---EXCAVATION FOR STRUCTURES

EXCAVATION FOR STRUCTURES SHALL CONFORM TO THE DIMENSIONS AND ELEVATIONS INDICATED WITHIN A TOLERANCE OF PLUS OR MINUS 0.05 FOOT, AND SHALL EXTEND A SUFFICIENT DISTANCE FROM FOOTINGS AND FOUNDATIONS TO PERMIT PLACING AND REMOVAL OF CONCRETE FORMWORK, INSTALLATION OF SERVICES AND OTHER CONSTRUCTION INDICATED, AND FOR INSPECTION.

IN EXCAVATION FOR FOOTINGS AND FOUNDATIONS, TAKE CARE NOT TO DISTURB THE BOTTOM OF THE EXCAVATION. EXCAVATE TO FINAL GRADE JUST BEFORE CONCRETE IS PLACED. TRIM BOTTOMS TO THE REQUIRED LINES AND GRADES TO LEAVE A SOLID BED TO RECEIVE CONCRETE.

FOR PILE FOUNDATIONS, EXCAVATION SHALL STOP AT AN ELEVATION OF FROM 6 TO 12 INCHES ABOVE THE BOTTOM OF THE FOOTING BEFORE PILES ARE DRIVEN. AFTER PILE DRIVING HAS BEEN COMPLETED, REMOVE LOOSE AND DISPLACED MATERIAL, AND EXCAVATE TO FINAL GRADE, LEAVING A SOLID BED TO RECEIVE CONCRETE.

---TRENCH EXCAVATIONS

OPEN CUT TRENCH EXCAVATIONS SHALL BE RESTRICTED IN SIZE TO THAT WHICH WILL PROVIDE SUFFICIENT WIDTH AT THE TRENCH BOTTOM AND ALLOW ADEQUATE WORKING SPACE FOR THE PROPER INSTALLATION OF CONDUIT BEDDING AND CONDUIT, OR OTHER UNDERGROUND UTILITY SYSTEM, AS SPECIFIED HEREINAFTER. THE SIDE OF TRENCH EXCAVATIONS SHALL BE VERTICAL FOR A DEPTH ABOVE BOTTOM OF THE TRENCH EXCAVATION EQUAL TO THE OUTSIDE DIAMETER OF UNDERGROUND PIPING PLUS NOT LESS THAN 12 INCHES. WHERE PIPING WILL BE INSTALLED IN BEDDING MATERIAL, THE CLEAR HORIZONTAL DISTANCE BETWEEN PIPE O.D. AND TRENCH EXCAVATION WALL SHALL BE NOT LESS THAN EIGHT INCHES OR MORE THAN TEN INCHES. TRENCHES SHALL BE OVER EXCAVATED TO PROVIDE DEPTH OF BEDDING SPECIFIED, UNLESS OTHERWISE INDICATED. COMPLY WITH OSHA CONSTRUCTION REGULATION, SUBPART "P", SECTIONS 1926.650 THROUGH 1926.653, AS APPLICABLE.

---REMOVAL OF UNSATISFACTORY SOIL MATERIALS

UNSATISFACTORY SOIL MATERIALS ENCOUNTERED THAT EXTEND BELOW THE REQUIRED ELEVATIONS SHALL BE EXCAVATED TO THE DEPTH DIRECTED BY THE CONTRACTING OFFICER.

SUCH ADDITIONAL WORK, PROVIDED IT IS NOT DUE TO THE FAULT OR NEGLECT OF THE CONTRACTOR, SHALL BE MEASURED AS DIRECTED BY THE CONTRACTING OFFICER.

WHERE THE REMOVAL OF UNSATISFACTORY SOIL MATERIALS IS DUE TO THE FAULT OR NEGLECT OF THE CONTRACTOR IN HIS PERFORMANCE OF SHORING AND BRACING, WATER REMOVAL, MATERIAL STORAGE, OR OTHER SPECIFIED REQUIREMENT, THE RESULTING UNSATISFACTORY SOIL MATERIAL SHALL BE EXCAVATED AND REPLACED WITH SATISFACTORY SOIL MATERIAL AS HEREINAFTER SPECIFIED AT NO ADDITIONAL COST TO THE GOVERNMENT.

---REMOVAL OF EXISTING UNDERGROUND UTILITIES

EXISTING UNDERGROUND UTILITIES INDICATED TO BE REMOVED SHALL BE DEMOLISHED AND COMPLETELY REMOVED FROM THE EXCAVATION.

---CLOSING OPEN ENDS OR ABANDONED UNDERGROUND UTILITIES

CLOSE OPEN ENDS OF METALLIC CONDUIT AND PIPE WITH THREADED GALVANIZED METAL CAPS OR PLASTIC PLUGS OR OTHER APPROVED METHOD SUITABLE FOR THE TYPE OF MATERIAL AND SIZE OF PIPE. WOOD PLUGS WILL NOT BE PERMITTED.

---COMPACTION---

---GENERAL

THE COMPACTION OF SOIL MATERIALS FOR BACKFILLS AND FILLS SHALL BE PERFORMED BY USE OF THE SPECIFIED COMPACTION EQUIPMENT THAT IS SUITABLE FOR THE SOIL MATERIAL BEING COMPACTED AND FOR USE IN THE LOCATION OF THE WORK AREA.

SOIL COMPACTION SHALL BE CONTROLLED DURING CONSTRUCTION FOR COMPLIANCE WITH THE PERCENTAGE OF MAXIMUM DENSITY SPECIFIED FOR EACH AREA CLASSIFICATION AS SPECIFIED HEREINBEFORE IN THE ARTICLE ENTITLED "SAMPLING AND TESTING".

---COMPACTION EQUIPMENT

ALL COMPACTION EQUIPMENT SHALL BE OF SUITABLE SIZE AND NUMBER, AND IN SATISFACTORY WORKING CONDITION TO COMPLETE THE WORK ON SCHEDULE.

COMPACTION EQUIPMENT SHALL CONSIST OF SHEEPSFOOT ROLLERS, PNEUMATIC TIRED ROLLERS, TAMPER ROLLERS, VIBRATING TAMPERS, OR OTHER COMPACTION EQUIPMENT SUITABLE FOR THE SOIL MATERIAL BEING COMPACTED AND CAPABLE OF OBTAINING THE REQUIRED DENSITY THROUGHOUT THE ENTIRE LAYER BEING COMPACTED.

---PERCENTAGE OF MAXIMUM DENSITY REQUIREMENTS

THE ACTUAL DENSITY OF EACH LAYER OF SOIL MATERIAL-IN-PLACE SHALL BE NOT LESS THAN THE FOLLOWING PERDENTAGES OF THE MAXIMUM DENSITY OF THE SAME SOIL MATERIAL DETERMINED BY THE MOISTURE DENSITY TEST HEREINBEFORE SPECIFIED IN THE ARTICLE ENTITLED "SAMPLING AND TESTING".

AREA CLASSIFICATION	PERCENT MAXIMUM COHESIONLESS SOIL MATERIAL
14" PAD SLAB, SLABS ON SLOPE, STRUCTURES, AND 84 INCH PIPES:	
EACH LAYER OF BACKFILL MATERIAL	100
OTHER BUILDING SLABS AND PAVEMENTS:	
TOP 12 INCHES OF SUBGRADE AND EACH LAYER OF BACKFILL OR FILL MATERIAL	100
GRASSED AREAS:	
EACH LAYER OF BACKFILL MATERIAL	95

---MOISTURE CONTROL

PROVIDE EQUIPMENT CAPABLE OF ADDING MEASURED AMOUNTS OF MOISTURE TO THE SOIL MATERIAL AS DETERMINED BY MOISTURE DENSITY RELATION TESTS. THE MOISTURE CONTENT IN THE SOIL MATERIAL AT THE TIME OF COMPACTION SHALL BE WITHIN THE LIMITS HEREINBEFORE SPECIFIED.

FOR UNSATISFACTORY SOIL MATERIALS IN ARTICLE ENTITLED "DEFINITIONS", WHERE THE SUBGRADE OR LAYER OF SOIL MATERIAL MUST BE MOISTURE CONDITIONED BEFORE COMPACTION, THE REQUIRED AMOUNT OF WATER SHALL BE UNIFORMLY APPLIED TO THE SURFACE OF SUBGRADE OR LAYER OF SOIL MATERIAL IN SUCH MANNER AS TO PREVENT FREE WATER APPEARING ON THE SURFACE DURING OR SUBSEQUENT TO COMPACTION OPERATIONS.

ANY SOIL MATERIAL THAT IS TOO WET TO PERMIT COMPACTION TO SPECIFIED PERCENTAGE OF MAXIMUM DENSITY SHALL BE REMOVED AND REPLACED WITH SATISFACTORY SOIL MATERIAL.

SOIL MATERIAL THAT HAS BEEN REMOVED BECAUSE IT IS TOO WET TO PERMIT COMPACTION MAY BE STOCKPILED OR SPREAD ON THE SURFACE WHERE DIRECTED BY THE CONTRACTING OFFICER AND PERMITTED TO DRY, ASSISTED BY DISCING, HARROWING OR PULVERIZING, UNTIL THE MOISTURE CONTENT IS REDUCED TO A SATISFACTORY VALUE AS DETERMINED BY MOISTURE DENSITY RELATION TESTS, AFTER WHICH THE SOIL MATERIAL MAY BE USED IN COMPACTED BACKFILL OR FILL.

---GENERAL

BACKFILL SHALL CONSIST OF THE PLACEMENT OF SPECIFIED BACKFILL MATERIAL, IN LAYERS, IN THE EXCAVATIONS TO THE INDICATED SUBGRADE ELEVATIONS, FOR EACH AREA CLASSIFICATION LISTED BELOW.

FILL SHALL CONSIST OF THE PLACEMENT OF SPECIFIED FILL MATERIALS, IN LAYERS, OVER THE GROUND SURFACE TO THE INDICATED ELEVATIONS, FOR EACH AREA CLASSIFICATION LISTED BELOW.

---BACKFILL AND FILL MATERIALS

SOIL MATERIAL FOR BACKFILL AND FILL SHALL BE FREE OF CLAY CLODS, ROCK OR GRAVEL LARGER THAN TWO INCHES IN ANY DIMENSION, DEBRIS, WASTE, AND OTHER DELETERIOUS MATTER, AND SHALL BE SATISFACTORY SOIL MATERIALS AS FOLLOWS:

AREA CLASSIFICATION	BACKFILL OR FILL MATERIAL
IN ALL EXCAVATIONS.	EXCAVATED OR BORROW MATERIAL THAT HAS BEEN SAMPLED, TESTED AND APPROVED AS "SATISFACTORY SOIL MATERIAL".

---PREPARATIONS PRIOR TO BACKFILL PLACEMENT

EXCAVATIONS SHALL BE BACKFILLED AS PROMPTLY AS THE WORK PERMITS, BUT NOT UNTIL COMPLETION OF THE FOLLOWING:

APPROVAL OF CONSTRUCTION BELOW FINISH GRADE.

INSPECTION, TESTING, APPROVAL, AND RECORDING LOCATION OF UNDERGROUND UTILITIES.

REMOVAL OF CONCRETE FORMWORK.

REMOVAL OF SHORING AND BRACING, AND BACKFILLING OF VOIDS WITH SATISFACTORY SOIL MATERIAL; TEMPORARY SHEET PILING DRIVEN BELOW BOTTOM OF STRUCTURES AND UTILITIES SHALL BE CUT OFF AND REMOVED IN MANNER TO PREVENT SETTLEMENT OF THE STRUCTURE OF UTILITIES.

REMOVAL OF TRASH AND DEBRIS.

---PREPARATION OF GROUND SURFACE TO RECEIVE FILL

VEGETATION, DEBRIS, UNSATISFACTORY SOIL MATERIALS, OBSTRUCTIONS, AND DELETERIOUS MATERIALS SHALL BE REMOVED FROM GROUND SURFACE PRIOR TO THE PLACEMENT OF FILLS. SLOPED SURFACES STEEPER THAN ONE VERTICAL TO FOUR HORIZONTAL SHALL BE PLOWED, STRIPPED, OR BROKEN UP IN SUCH A MANNER THAT FILL MATERIAL WILL BOND TO EXISTING IN-PLACE SOILS.

WHEN THE GROUND SURFACE HAS A DENSITY LESS THAN THAT SPECIFIED FOR THE PARTICULAR AREA CLASSIFICATION IN ARTICLE ENTITLED "COMPACTION" THE GROUND SURFACE SHALL BE BROKEN UP, PULVERIZED, MOISTURE CONDITIONED TO NEAR OPTIMUM MOISTURE CONTENT OF THE SOIL MATERIAL AND COMPACTED TO THE REQUIRED DEPTH AND PERCENTAGE OF MAXIMUM DENSITY.

---PLACEMENT AND COMPACTION

BACKFILL AND FILL MATERIALS SHALL BE PLACED IN LAYERS NOT MORE THAN SIX INCHES IN LOOSE DEPTH. BEFORE COMPACTION, EACH LAYER OF BACKFILL OR FILL MATERIAL SHALL BE MOISTENED OR AERATED AS NECESSARY TO PROVIDE THE OPTIMUM MOISTURE CONTENT OF THE SOIL MATERIAL, AND SHALL THEN BE COMPACTED TO THE PERCENTAGE OF MAXIMUM DENSITY FOR EACH AREA CLASSIFICATION AS SPECIFIED IN ARTICLE ENTITLED "COMPACTION". NO BACKFILL OR FILL MATERIAL SHALL BE PLACED ON SURFACES THAT ARE MUDDY.

BACKFILL AND FILL MATERIALS ADJACENT TO STRUCTURES SHALL BE BROUGHT UP EVENLY AROUND THE STRUCTURES, AND SHALL BE CARRIED UP TO THE INDICATED ELEVATIONS. THIS ALSO APPLIES TO 84 INCH PIPES.

COMPACTION ADJACENT TO STRUCTURES, WITHIN A HORIZONTAL DISTANCE FROM THE FACE OF THE STRUCTURE EQUAL TO THE DEPTH OF BACKFILL OR FILL MATERIAL (MEASURED FROM THE BOTTOM OF FOOTING OR BOTTOM OF FOUNDATION OR RETAINING WALL) TO FINAL GRADE, SHALL BE DONE WITH POWER DRIVEN HAND TAMPERS. THE ABOVE WORD "STRUCTURES" SHALL ALSO INCLUDE 84 INCH PIPES.

---GRADING---

---GENERAL

ALL AREAS WITHIN THE LIMITS OF GRADING UNDER THIS SECTION, INCLUDING ADJACENT TRANSITION AREAS, SHALL BE UNIFORMLY GRADED. THE FINISHED SURFACE SHALL BE SMOOTH WITHIN THE SPECIFIED TOLERANCES, COMPACTED, AND WITH UNIFORM LEVELS OR SLOPES BETWEEN POINTS WHERE ELEVATIONS ARE INDICATED, OR BETWEEN SUCH POINTS AND EXISTING GRADES.

---GRADING OUTSIDE BUILDING LINES

THE AREAS OUTSIDE THE BUILDING LINES FOR EACH STRUCTURE SHALL BE HAND GRADED TO DRAIN AWAY FROM THE STRUCTURE AND TO PREVENT PONDING OF WATER AFTER RAINS. THE FINISHED SURFACE SHALL BE WITHIN THE TOLERANCE SPECIFIED BELOW FOR EACH AREA CLASSIFICATION, COMPACTED AS SPECIFIED, AND FREE FROM IRREGULAR SURFACE CHANGES.

GRASSED AREAS

THE FINISHED SURFACE OF AREAS TO RECEIVE TOPSOIL SHALL BE NOT MORE THAN 0.10 FOOT ABOVE OR BELOW THE INDICATED SUBGRADE ELEVATIONS.

---PAVEMENTS

THE SURFACE OF AREAS UNDER PAVEMENTS SHALL BE SHAPED TO LINE GRADE AND CROSS SECTION, AND THE FINISHED SURFACE SHALL BE NOT MORE THAN 1/2 INCH ABOVE OR BELOW THE INDICATED SUBGRADE ELEVATION, WHEN TESTED WITH A 10-FOOT STRAIGHTEDGE APPLIED BOTH PARALLEL WITH AND AT RIGHT ANGLES TO THE CENTERLINE OF THE AREA.

---GRADING SURFACE OF FILL UNDER BUILDING SLABS

THE SURFACE OF FILL UNDER BUILDING SLABS SHALL BE SMOOTH AND EVEN, FREE OF VOIDS, COMPACTED AS SPECIFIED, AND TO INDICATED GRADE WITHIN THE SPECIFIED TOLERANCES. WHEN TESTED WITH A 10-FOOT STRAIGHTEDGE, PARALLEL WITH AND AT RIGHT ANGLES TO THE BUILDING LINES, THE FINISH SURFACE SHALL NOT SHOW ANY DEVIATION IN EXCESS OF 1/4 INCH.

---COMPACTION

AFTER GRADING, SUBGRADE SURFACES SHALL BE COMPACTED TO THE DEPTH AND PERCENTAGE OF MAXIMUM DENSITY FOR EACH AREA CLASSIFICATION AS SPECIFIED IN THE ARTICLE ENTITLED "---COMPACTION---" HEREINBEFORE.

---MAINTENANCE---

---PROTECTION OF GRADED AREAS

NEWLY GRADED AREAS SHALL BE PROTECTED FROM TRAFFIC AND EROSION, AND SHALL BE MAINTAINED FREE OF TRASH OR DEBRIS.

THE CONTRACTOR SHALL REPAIR AND RE-ESTABLISH GRADES IN SETTLED, ERODED AND RUTTED AREAS AND MAINTAIN THE SURFACE, AT NO ADDITIONAL COST TO THE GOVERNMENT, FOR A PERIOD OF NOT LESS THAN 3 MONTHS AFTER DATE OF ACCEPTANCE OF THE WORK BY THE CONTRACTING OFFICER.

---RECONDITIONING COMPACTED AREAS

WHERE APPROVED COMPACTED AREAS ARE DISTURBED BY SUBSEQUENT CONSTRUCTION OPERATIONS OR ADVERSE WEATHER, THE SURFACE SHALL BE SCARIFIED, RESHAPED, AND COMPACTED AS SPECIFIED HEREINBEFORE TO THE REQUIRED DENSITY PRIOR TO FURTHER CONSTRUCTION THEREON. RECOMPACTION OVER UNDERGROUND UTILITIES AND FOUNDATION SUBDRAINS SHALL BE BY HAND TAMPING.

---DISPOSAL OF EXCESS AND WASTE MATERIALS---

---REMOVAL TO DESIGNATED AREAS ON GOVERNMENT PROPERTY

EXCESS EXCAVATED MATERIAL CLASSIFIED AS SATISFACTORY SOIL MATERIAL SHALL BE TRANSPORTED TO, AND DISPOSED OF IN, DESIGNATED SOIL STORAGE AREAS ON GOVERNMENT PROPERTY.

---REMOVAL OF WASTE MATERIAL

WASTE MATERIALS, INCLUDING EXCAVATED MATERIAL CLASSIFIED AS UNSATISFACTORY SOIL MATERIAL, TRASH AND DEBRIS, SHALL BE REMOVED TO THE DESIGNATED GOVERNMENT AREA AT NO ADDITIONAL COST TO THE GOVERNMENT.

SECTION 2E

EARTHWORK FOR SITE GRADING

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS, ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AASHTO — AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

---DEFINITIONS

BACKFILL-----EARTH MATERIALS PLACED TO RAISE EXISTING OR EXCAVATED GRADES. BACKFILL MATERIALS MAY BE SELECTED TYPE GRANULAR MATERIAL OR APPROVED SOIL MATERIAL FROM THE IMMEDIATE EXCAVATIONS, THE PROJECT SITE, OR BORROW.

BORROW MATERIALS-----EARTH SECURED FROM APPROVED SOURCES.

SOIL MATERIALS-----EARTH MATERIAL NATIVE TO THE PROJECT SITE OR EARTH MATERIAL SECURED FROM PRIVATE SOURCES.

SATISFACTORY SOIL MATERIALS-----AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-2-4, A-2-5 AND A-3.

UNSATISFACTORY SOIL MATERIALS-----AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-2-6, A-2-7, A-4, A-5, A-6 AND A-7, PEAT AND OTHER HIGHLY ORGANIC SOILS AND SOIL MATERIALS OF ANY CLASSIFICATION THAT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION BEYOND THE RANGE OF ONE PERCENTAGE POINT BELOW AND 3 PERCENTAGE POINTS ABOVE THE OPTIMUM MOISTURE CONTENT OF THE SOIL MATERIAL AS DETERMINED BY MOISTURE DENSITY RELATIONS TEST.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR PROPOSED SOIL MATERIALS INCLUDING SIEVE ANALYSIS CURVES.

---EXISTING UTILITIES

BEFORE STARTING MECHANICAL EARTHWORK OPERATIONS, CAREFUL HAND METHODS SHALL BE USED TO VERIFY THE LOCATION OF UNDERGROUND UTILITIES. IF UTILITIES ARE TO BE LEFT IN PLACE, PROTECTION AGAINST DAMAGE SHALL BE PROVIDED.

---USE OF EXPLOSIVES

THE USE OF EXPLOSIVES WILL NOT BE PERMITTED.

---SOIL TESTING AND INSPECTION SERVICE

SOIL TESTING AND INSPECTION SERVICE SHALL BE PROVIDED BY THE CONTRACTOR AND THE COST THEREOF SHALL BE INCLUDED IN THE CONTRACT PRICE. TESTING SERVICE SHALL BE APPROVED BY THE CONTRACTING OFFICER, AND SHALL INCLUDE SOIL SURVEY FOR SATISFACTORY SOIL MATERIALS, SAMPLING AND TESTING SOIL MATERIALS PROPOSED FOR USE IN THE WORK, AND FIELD TESTING FACILITIES FOR QUALITY CONTROL TESTING DURING CONSTRUCTION.

---EXCAVATION---

---GENERAL

EXCAVATIONS SHALL BE SHAPED IN SUCH MANNER AND ARRANGEMENT THAT EARTH MOVEMENT WILL NOT UNDERMINE ADJACENT STRUCTURES.

ALL EXCAVATION METHODS SHALL BE APPROVED BY THE CONTRACTING OFFICER IN ADVANCE OF THE WORK.

ALL DRAINAGE ROUTES SHALL BE MAINTAINED TO SAME CROSS SECTION WHICH EXISTS EACH SIDE OF WORK AREA. DEPTH OF CUT SHALL NOT EXCEED AMOUNT NECESSARY TO MAINTAIN EXISTING DRAINAGE FLOW.

---STABILITY OF EXCAVATIONS

SIDES AND SLOPES OF EXCAVATIONS SHALL BE MAINTAINED UNTIL COMPLETION OF ADJACENT BACKFILLING IN A SAFE CONDITION BY SCALING, BENCHING, SHELVING, OR BRACING.

PRECAUTIONS SHALL BE TAKEN TO PREVENT SLIDES OR CAVE-INS WHEN EXCAVATIONS ARE MADE IN LOCATIONS ADJACENT TO BACKFILLED EXCAVATIONS, AND WHEN SIDES OF EXCAVATIONS ARE SUBJECTED TO VIBRATIONS FROM VEHICULAR TRAFFIC OR THE OPERATION OF MACHINERY OR ANY OTHER SOURCE.

---FILLING---

---GENERAL

FILL SHALL CONSIST OF CLEAN FREE DRAINING SAND MATERIAL FREE OF CLUMPS OF CLAY OR ORGANIC PARTICLES CONFORMING TO "SATISFACTORY SOIL MATERIALS" DEFINED HEREINBEFORE.

---PLACEMENT

FILL SHALL BE PLACED IN NOT MORE THAN 6 INCH LAYERS LOOSE MEASURE, SPREAD EVENLY AND COMPACTED TO DENSITY OF ADJACENT SOIL SURFACES. PLACE FILL TO PROVIDE GRADES, SLOPES AND ELEVATIONS REQUIRED. COMPACTION ADJACENT TO STRUCTURES SHALL BE DONE BY POWER DRIVEN HAND TAMPERS.

---GRADING---

---GENERAL

ALL AREAS WITHIN THE LIMITS OF EARTHWORK UNDER THIS SECTION, INCLUDING ADJACENT TRANSITION AREAS, SHALL BE UNIFORMLY GRADED. THE FINISHED SURFACE SHALL BE SMOOTH WITHIN THE SPECIFIED TOLERANCES, COMPACTED, AND WITH UNIFORM LEVELS OR SLOPES BETWEEN POINTS WHERE ELEVATIONS ARE INDICATED, OR BETWEEN SUCH POINTS AND EXISTING GRADES.

---GRASSED AREAS

THE FINISHED SURFACE OF AREAS TO RECEIVE TOPSOIL SHALL BE NOT MORE THAN 0.10 FOOT ABOVE OR BELOW THE INDICATED ELEVATIONS.

---MAINTENANCE---

---GENERAL

THE CONTRACTOR SHALL REPAIR AND RE-ESTABLISH GRADES IN SETTLED, ERODED AND RUTTED AREAS AND MAINTAIN THE SURFACE, AT NO ADDITIONAL COST TO THE GOVERNMENT, FOR A PERIOD OF NOT LESS THAN 3 MONTHS AFTER DATE OF ACCEPTANCE OF THE WORK BY THE CONTRACTING OFFICER.

---QUALITY CONTROL SOIL TESTING DURING CONSTRUCTION

SOIL MATERIALS SPECIFIED HEREIN AND DELIVERED TO THE PROJECT SITE, SOIL MATERIALS PRIOR TO COMPACTION UNDER PAVEMENTS AND SOIL MATERIAL-IN-PLACE AFTER COMPACTION WILL BE TESTED AND SAMPLES OF EACH SOIL MATERIAL SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR QUALITY CONTROL DURING CONSTRUCTION.

---CERTIFICATES OF CONFORMANCE

PRIOR TO THE PLACING OF ANY SOIL MATERIALS, CERTIFICATES OF CONFORMANCE SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR REVIEW.

SOIL ANALYSIS CURVES FOR CERTIFICATES OF CONFORMANCE SHALL BE PLOTTED AND RECORDED IN ACCORDANCE WITH AASHTO T88-72 WITH PERCENT FINER BY WEIGHT AS ORDINATE AND SIEVE SIZES OF 2, 1-1/2, 1, 3/4, 1/2, 3/8 INCHES AND ALTERNATE TYLER SIEVE SIZES STARTING WITH NO. 4 AND EQUIVALENT GRAIN SIZE IN MILLIMETERS AS ABSCISSA, ALL ON SEMI-LOG PAPER.

---EVALUATION OF TEST RESULTS

SOIL MATERIALS DELIVERED TO THE PROJECT SITE HAVING CHARACTERISTICS WHICH DO NOT CONFORM TO THE REQUIREMENTS SPECIFIED SHALL NOT BE USED, AND SHALL BE PROMPTLY REMOVED FROM THE PROJECT SITE.

SOIL MATERIALS OF ANY CLASSIFICATION SHALL NOT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION OUTSIDE THE LIMITS SPECIFIED IN THE DEFINITION OF "UNSATISFACTORY SOIL MATERIALS" HEREINBEFORE.

---EARTHWORK ACTIVITIES---

---GENERAL

ALL EXCAVATION, TESTING, BACKFILLING, AND GRADING SHALL BE DONE IN THE PRESENCE OF THE CONTRACTING OFFICER WHO SHALL BE NOTIFIED BY THE CONTRACTOR 48 HOURS IN ADVANCE OF THE WORK.

THE METHODS OF EXCAVATION, BACKFILLING AND GRADING SHALL BE CONDUCTED WITH PRIMARY CONSIDERATION FOR THE SAFETY OF THE MEN AND THE WORK, AND PREVENTION OF DAMAGE TO ADJACENT PAVEMENT, UTILITIES, STRUCTURES AND OTHER FACILITIES, DUE TO SETTLEMENT, LATERIAL MOVEMENT, UNDERMINING AND WASHOUT.

SECTION 2K

PRECAST PRESTRESSED CONCRETE PILING

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
ACI	AMERICAN CONCRETE INSTITUTE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS

---SITE INFORMATION

THE DATA ON SOIL SUBSURFACE CONDITIONS INDICATED ARE NOT INTENDED AS REPRESENTATIONS OR WARRANTIES OF THE CONTINUITY OF SUCH CONDITIONS BETWEEN SOIL BORINGS. IT IS EXPRESSLY UNDERSTOOD THAT THE GOVERNMENT WILL NOT BE RESPONSIBLE FOR ANY INTERPRETATION OR CONCLUSION DRAWN THEREFROM BY THE CONTRACTOR. THE DATA ARE MADE AVAILABLE FOR THE CONVENIENCE OF THE CONTRACTOR. REFER TO SECTION 18B AND THE DRAWINGS.

ADDITIONAL SOIL BORINGS AND OTHER EXPLORATORY OPERATIONS MAY BE MADE BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT, PROVIDED SUCH OPERATIONS ARE APPROVED BY THE CONTRACTING OFFICER.

---QUALIFICATIONS FOR PILING WORK

PILING INSTALLATION SHALL BE PERFORMED BY A CONTRACTING ORGANIZATION THOROUGHLY EXPERIENCED IN PILING WORK.

SUBMIT A WRITTEN DESCRIPTION OF PROPOSED PILING CONTRACTING ORGANIZATION GIVING QUALIFICATIONS OF PERSONNEL, LIST OF PROJECTS SIMILAR IN SCOPE TO SPECIFIED WORK, AND OTHER INFORMATION AS MAY BE REQUESTED BY THE CONTRACTING OFFICER.

---QUALIFICATIONS FOR PRESTRESSED CONCRETE MANUFACTURER

PRECAST PRESTRESSED CONCRETE PILES SHALL BE MANUFACTURED AND DELIVERED TO THE PROJECT SITE BY A CONCRETE MANUFACTURER THOROUGHLY EXPERIENCED IN PRESTRESSED CONCRETE.

SUBMIT A WRITTEN DESCRIPTION OF PROPOSED PRESTRESSED CONCRETE MANUFACTURER GIVING QUALIFICATIONS OF PERSONNEL, LOCATION OF PLANT, CONCRETE BATCHING FACILITIES, LIST OF PROJECTS SIMILAR IN SCOPE TO THE SPECIFIED WORK, AND OTHER INFORMATION AS MAY BE REQUESTED BY THE CONTRACTING OFFICER.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR MATERIALS.

LABORATORY TEST REPORTS AS SPECIFIED IN ARTICLE ENTITLED "CONCRETE SAMPLING AND TESTING".

DRIVING LOG FOR EACH PILE. SUBMIT FIVE COPIES OF EACH DRIVING LOG WITHIN TWO WORKING DAYS AFTER COMPLETION OF DRIVING.

---SHOP DRAWINGS AND DESCRIPTIVE DATA

SUBMIT SHOP DRAWINGS AND DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

DESCRIPTIVE DATA AS THE CONTRACTING OFFICER MAY REQUIRE TO DEMONSTRATE COMPLIANCE OF PILE DRIVING EQUIPMENT WITH THE CONTRACT DOCUMENTS.

SHOP DRAWINGS INDICATING THE DIMENSIONS OF PRECAST CONCRETE PILES, REINFORCEMENT, LOCATION OF PILE PICK UP POINTS, AND OTHER DETAILS OF THE PILING.

---DRIVING RECORDS (LOGS)

SUBMIT TWO COPIES OF THE DRIVING RECORDS OF EACH PILE TO THE CONTRACTING OFFICER NOT LATER THAN TWO WORKING DAYS AFTER DRIVING. SUCH RECORDS SHALL CONTAIN THE PROJECT NAME AND NUMBER, DATE, NAME OF CONTRACTOR, THE PILE LOCATION AND NUMBER, COMPUTED PILE CAPACITY. THE TYPE AND SIZE OF HAMMER USED, THE TYPE OF DRIVING CAP USED, RATE OF OPERATION OF PILE DRIVING EQUIPMENT, TYPE OF PILE, ALL PILE DIMENSIONS, ELEVATION OF POINT, ELEVATION OF PILE TOP BEFORE AND AFTER CUT OFF, GROUND ELEVATION, CONTINUOUS RECORD OF NUMBER OF BLOWS FOR EACH FOOT OF PENETRATION, PILE DEVIATION, AND ANY UNUSUAL OCCURRENCE DURING THE DRIVING OF THE PILE.

---DELIVERY AND STORAGE

MATERIALS SHALL BE DELIVERED TO THE PROJECT SITE IN SUCH QUANTITIES AND AT SUCH TIMES AS WILL ASSURE THE CONTINUITY OF PILE DRIVING OPERATIONS AND MAINTENANCE OF THE PROGRESS SCHEDULE.

PILES SHALL BE STORED ON LEVEL BLOCKING PLACED AT THE PILE PICK UP POINTS SO THAT THE AXIS OF EACH PILE IS MAINTAINED IN A STRAIGHT LINE AND TO PREVENT CRACKING OF THE PILES. PILES EXHIBITING VARIATIONS BEYOND THE LIMITS OF THE TOLERANCES SPECIFIED HEREINAFTER SHALL BE CONSIDERED DISTORTED. PILES THAT ARE DISTORTED OR CRACKED OR OTHERWISE DAMAGED SHALL BE REMOVED FROM GOVERNMENT PROPERTY.

---PROTECTION OF PERSONS AND PROPERTY

PILE DRIVING OPERATIONS SHALL BE CONDUCTED TO INSURE SAFETY OF PERSONS AND PROPERTY.

STRUCTURES, UNDERGROUND UTILITIES, AND OTHER CONSTRUCTION SHALL BE PROTECTED FROM DAMAGE CAUSED BY PILE DRIVING OPERATIONS.

IN THE CASE OF ADJACENT STRUCTURES PROVIDE BENCH MARKS ON SUCH STRUCTURES AT THE LOCATIONS DESIGNATED BY THE CONTRACTING OFFICER BEFORE PILE DRIVING IS BEGUN.

RECORD AND REPORT THE ELEVATION OF EACH BENCH MARK BEFORE AND AFTER DRIVING EACH PILE AND AT LEAST TWICE A DAY WHILE PILE DRIVING IS IN PROGRESS.

IN THE EVENT THAT BENCH MARK READINGS INDICATE ANY DISPLACEMENT OF ADJACENT STRUCTURES, IMMEDIATELY STOP DRIVING OPERATIONS AND NOTIFY THE CONTRACTING OFFICER.

PILE DRIVING SHALL BE RESUMED ONLY WHEN CORRECTIVE ACTION AS APPROVED BY THE CONTRACTING OFFICER HAS BEEN PROVIDED. SUCH ADDITIONAL WORK SHALL BE MEASURED AND PAID FOR BY THE GOVERNMENT IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" RELATIVE TO CHANGES IN THE WORK.

---MATERIALS---

---CONCRETE MATERIALS

THE MATERIALS USED IN THE MANUFACTURE OF CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF SECTION 3A, "CAST IN PLACE CONCRETE".

---PRESTRESSING STRANDS

THE PRESTRESSING CABLES SHALL BE HIGH TENSILE STRENGTH, SEVEN WIRE STRAND CONFORMING TO THE REQUIREMENTS OF AASHTO M203-70.

---STEEL WIRE

STEEL WIRE SHALL BE COLD DRAWN, NONDEFORMED STEEL WIRE CONFORMING TO ASTM A82-76.

---CLASS OF CONCRETE

CONCRETE SHALL HAVE A MINIMUM DESIGN COMPRESSIVE STRENGTH AT 28 DAYS OF 5,000 POUNDS PER SQUARE INCH. THE REQUIRED CYLINDER STRENGTH OF CONCRETE AT TRANSFER OF THE TENSIONING LOAD SHALL NOT BE LESS THAN 4,000 POUNDS PER SQUARE INCH.

---PILE FABRICATION---

---GENERAL

PRECAST PRESTRESSED CONCRETE PILES SHALL BE FABRICATED BY AN APPROVED PRESTRESSED CONCRETE MANUFACTURER AND THE COMPLETED AND CURED PILES SHALL BE DELIVERED TO THE PROJECT SITE.

---PILE DESCRIPTION

CONCRETE PILES SHALL BE SQUARE IN CROSS-SECTION, AND LENGTH SHALL BE AS REQUIRED TO ACHIEVE THE REQUIREMENTS SPECIFIED IN THE PARAGRAPH ENTITLED: --- CAPACITY AND PENETRATION OF PILES --- ON PAGE 2K-6." (A)

---FABRICATION TOLERANCES

PILES SHALL BE FABRICATED IN A MANNER NOT TO EXCEED THE FOLLOWING LIMITS OF TOLERANCE.

CROSS SECTION SIDE:	PLUS OR MINUS 1/4 INCH.
LENGTH:	PLUS OR MINUS 1-1/2 INCHES.
DEVIATION FROM A STRAIGHT LINE PARALLEL TO THE CENTERLINE OF THE PILE:	MAXIMUM 3/8 INCH PER 20 FEET OF LENGTH.
CONCRETE COVER OVER REINFORCEMENT:	MINUS 0 INCH TO PLUS 1/4 INCH.
SPIRAL SPACING:	PLUS OR MINUS ONE INCH FOR ANY ONE SPIRAL. PLUS OR MINUS ONE INCH FOR OVERALL GROUP OF SPIRALS.
POSITION OF PICK UP DEVICES:	PLUS OR MINUS 6 INCHES.

---CONCRETE WORK

FORMS, PLACING OF CONCRETE, CURING AND TESTING SHALL CONFORM TO THE REQUIREMENTS OF SECTION 3A, "CAST IN PLACE CONCRETE".

---PILE PICK UP POINTS AND DATE OF CASTING

PILES SHALL BE CAST SO THAT THE PICK UP POINTS, AS INDICATED ON THE APPROVED SHOP DRAWINGS, ARE ACCESSIBLE FOR MOVING THE PILE INTO POSITION FOR THE COMPLETION OF SEASONING AS REQUIRED.

EACH PILE SHALL HAVE THE DATE OF CASTING PLAINLY INDENTED IN THE CONCRETE.

---FORM REMOVAL AND REPAIR OF SURFACE DEFECTS

PILE FORMS SHALL REMAIN IN PLACE FOR AT LEAST 48 HOURS AFTER THE CONCRETE IS PLACED.

AS SOON AS THE FORMS ARE REMOVED, DEFECTS IN THE SURFACE OF THE CONCRETE PILES SHALL BE CAREFULLY POINTED WITH MORTAR CONSISTING OF ONE PART PORTLAND CEMENT, 2-1/2 PARTS FINE AGGREGATE, AND MIXING WATER AS NECESSARY FOR THE STIFFEST CONSISTENCY THAT WILL PERMIT PLACING.

---PILE DRIVING EQUIPMENT---

---GENERAL

PILE DRIVING EQUIPMENT SHALL BE AN APPROVED TYPE, ACTUATED BY STEAM OR COMPRESSED AIR, SINGLE ACTING HAMMER, AND SHALL BE IN SATISFACTORY WORKING CONDITION TO COMPLETE THE WORK ON SCHEDULE.

---HAMMER

THE HAMMER SHALL BE STEAM, AIR OR COMBUSTION TYPE AND SHALL HAVE A RATED DRIVING ENERGY OF NOT LESS THAN 15,000 NOR MORE THAN 20,000 FOOT-POUNDS PER BLOW. HAMMER SHALL BE OPERATED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS TO DEVELOP THE RATED ENERGY PER BLOW.

---DRIVING CAP

THE HAMMER SHALL BE EQUIPPED WITH A DRIVING CAP CAPABLE OF PROTECTING THE PILE HEAD AND PROVIDING UNIFORM DISTRIBUTION OF HAMMER ENERGY TO THE PILE HEAD. CUSHION MATERIAL SHALL BE SOLID HARDWOOD BLOCK WITH THE GRAIN PARALLEL TO THE PILE AXIS, OR APPROVED LAMINATED BLOCK. NO MATERIAL WILL BE PERMITTED THAT WILL EXCESSIVELY REDUCE THE APPLIED HAMMER ENERGY OR HAMMER BLOW COUNT.

---LEADS

PILE DRIVER LEADS SHALL BE OF THE FIXED OR RIGID TYPE THAT WILL HOLD THE PILE FIRMLY IN POSITION AND ALIGNMENT, AND IN AXIAL ALIGNMENT WITH THE HAMMER.

---CAPACITY AND PENETRATION OF PILES---

---PILE CAPACITY

PILES SHALL BE DRIVEN TO A SAFE BEARING CAPACITY OF 15 TONS PER PILE.

---PILE PENETRATION

MINIMUM PENETRATION OF ALL PILES SHALL BE TO ELEVATION -10 FEET AND TO THE BLOWS PER FOOT ESTABLISHED FROM THE FOLLOWING FORMULAS:

$$R = \frac{2E}{S + 0.1 + 0.01P}$$ FOR POWER HAMMERS; AND: $$S = \frac{2E}{R} - 0.1 - 0.01P$$; AND: BLOWS PER FOOT = $$\frac{12}{S}$$

WHERE: R = SAFE BEARING CAPACITY, IN TONS.
S = THE AVERAGE PENETRATION PER BLOW, IN INCHES.
P = WEIGHT OF PILE AS DRIVEN, IN TONS.
H = HEIGHT OF HAMMER FALL, IN FEET.
W = WEIGHT OF STRIKING PART OF HAMMER, IN TONS.
E = ENERGY PER BLOW OF HAMMER, IN FOOT-TONS; (WHICH SHALL BE THE PRODUCT WH, FOR SINGLE ACTING HAMMERS, AND THE MANUFACTURER'S RATED CAPACITY FOR THE SPEED USED IN DRIVING, FOR DOUBLE ACTING HAMMERS. THE ENERGY PER BLOW FOR COMBUSTION HAMMERS SHALL BE DETERMINED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS).

THE TOTAL BLOWS FOR THE LAST 12 INCHES OR LESS OF PENETRATION SHALL NOT BE LESS THAN THE BLOWS PER FOOT OF PENETRATION AS DETERMINED BY THE ABOVE FORMULAS.

IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE PILE LENGTHS TO BE ORDERED TO ACHIEVE THE ABOVE STATED REQUIREMENTS. WHEN DETERMINING LENGTHS OF PILE TO BE ORDERED THE CONTRACTOR SHALL MAKE ALLOWANCE FOR VARYING SUBSOIL CONDITIONS.

~~---BASIS OF BIDS AND PAYMENT---~~

~~---BASIS OF BIDS~~

~~BIDS SHALL BE BASED ON A TOTAL NET PILE FOOTAGE OF 2,000 LINEAR FEET, MEASURED FROM POINT TO CUT-OFF. BIDS SHALL INCLUDE THE COST OF ALL MATERIALS, PILE WASTES, SPLICING, CUTTING OFF, LABOR AND EQUIPMENT NECESSARY TO ACCOMPLISH THE WORK IN EVERY RESPECT.~~

~~---BASIS OF PAYMENT~~

~~THE QUANTITY TO BE PAID FOR UNDER THIS~~ *THESE PARAGRAPHS DELETED BY AMENDMENT #1 DURING BIDDING PERIOD.* ~~OF LINEAR FEET OF PILES ACCEPTED AND RE-MAINING UNDER THE COMPLETED STRUC~~ ~~-OFF. THE TOTAL ESTIMATED FOOTAGE SPECIFIED IN "BASIS OF BID" IS AN~~ ~~OUNT OF PILE REQUIRED. SHOULD THE ACTUAL AMOUNT OF PILE FOOTAGE INSTALLED~~ ~~PROXIMATED AMOUNT, THE COST OF SUCH DIFFERENCE SHALL BE DETERMINED IN ACCORDANCE~~ ~~SINGLE UNIT PRICE PER LINEAR FOOT OF PILE, WHICH SHALL BE INDICATED ON HIS PROPOSAL~~ ~~SHALL BE ADDED TO OR DEDUCTED FROM THE TOTAL CONTRACT PRICE AS APPLICABLE. THE GOVERNMEN~~ ~~SERVES THE RIGHT TO VARY THE ACTUAL FOOTAGE FROM THE APPROXIMATE FOOTAGE MENTIONED HEREINBEFORE BY AN AMOUNT UP TO 30% MORE OR LESS THAN THE APPROXIMATED AMOUNT AT THE SAME UNIT PRICE. THIS CONDITION MAY BE CAUSED BY VARYING EITHER THE TOTAL NUMBER OF PILES OR LENGTH OF PILES. SUCH PRICE AND PAYMENT SHALL BE FULL COMPENSATION FOR ALL WORK SPECIFIED IN THIS OR OTHER SECTIONS OF THESE SPECIFICATIONS AND AS SHOWN ON THE DRAWINGS AND SHALL INCLUDE THE PILES, PILE DRIVING, RE-DRIVING, CUTTING OFF, SPLICING, EXCAVATION, ALL OTHER MATERIALS, EQUIPMENT, TOOLS, LABOR AND INCIDENTALS NECESSARY TO COM-PLETE THE WORK.~~ B

---PREPARATIONS BEFORE DRIVING---

---CONDITIONS BEFORE DRIVING

PILES SHALL NOT BE DRIVEN UNTIL THE EARTHWORK IN THE AREA WHICH PILES ARE TO OCCUPY HAS BEEN COMPLETED AS FOLLOWS:

IN THE CASE OF EXCAVATIONS, EARTH EXCAVATION WILL STOP AT AN ELEVATION OF 6 TO 12 INCHES ABOVE THE BOTTOM OF THE FOOTING BEFORE PILES ARE DRIVEN. FINAL EXCAVATIONS TO THE REQUIRED ELEVATION OF FOOTING BOTTOMS WILL BE DONE AS PART OF EARTHWORK FOR STRUCTURES AFTER THE PILES HAVE BEEN INSTALLED AND TESTED.

IN THE CASE OF FILLS, SUCH FILLS WILL BE CONSTRUCTED AND COMPACTED TO THE ELEVATION OF THE GRADE INDICATED.

PILES SHALL NOT BE DRIVEN WITHIN 20 FEET OF ANY CONCRETE OR MASONRY STRUCTURE WHICH HAS NOT ATTAINED ITS FULL DESIGN STRENGTH.

---PILE LENGTH MARKING

BEFORE DRIVING IS BEGUN, PILE LENGTH SHALL BE MARKED ON EACH PILE BY PAINTING A BAR AND THE NUMBER OF FEET DISTANT FROM THE PILE POINT AT INTERVALS OF ONE FOOT.

---CONCRETE STRENGTH BEFORE DRIVING PILES

PILES SHALL NOT BE DRIVEN UNTIL THE CONCRETE HAS ATTAINED A COMPRESSIVE STRENGTH OF 5,000 POUNDS PER SQUARE INCH.

PILES SHALL NOT BE DRIVEN BEFORE 28 DAYS FROM THE DATE OF CASTING UNLESS PERMISSION HAS BEEN RECEIVED FROM THE CONTRACTING OFFICER TO MAKE ONE COMPRESSIVE STRENGTH TEST (ASTM C39-72) AND ONE FLEXURAL STRENGTH TEST USING SIMPLE BEAM WITH THIRD POINT LOADING (ASTM C78-75) ON FIELD CURED CONCRETE TEST SPECIMENS (ASTM C31-69) FOR EACH INDIVIDUAL PILE TO DETERMINE THE STRENGTH OF THE CONCRETE. THESE TESTS SHALL BE PERFORMED AT NO ADDITIONAL COST TO THE GOVERNMENT.

---HANDLING PILES

PILES SHALL BE HANDLED IN SUCH MANNER AS TO AVOID EXCESSIVE BENDING STRESSES, CRACKING, SPALLING, OR OTHER INJURIOUS RESULTS.

---PILE DRIVING---

---GENERAL

EACH PILE SHALL BE DRIVEN AT THE LOCATION INDICATED TO THE REQUIRED POINT ELEVATION AND DRIVING RESISTANCE ESTABLISHED, SPECIFIED IN THE ARTICLE ENTITLED "PILE LENGTH" HEREINBEFORE.

---DRIVING TOLERANCES

PILES SHALL BE DRIVEN WITHIN THE MAXIMUM TOLERANCES AS FOLLOWS:

LOCATION-----THREE INCHES FROM THE LOCATION INDICATED.

PLUMBNESS-----1/4 INCH PER FOOT OF PILE LENGTH FROM THE VERTICAL.

---SURVEY

AFTER THE PILES IN ANY ONE GROUP OR AREA HAVE BEEN DRIVEN, THE CONTRACTOR SHALL PROMPTLY PROVIDE THE CONTRACTING OFFICER WITH A SURVEY SHOWING ACTUAL LOCATIONS OF PILES AS DRIVEN. THE CONTRACTOR SHALL NOT PROCEED WITH CONSTRUCTION OF PILE CAPS OR OTHER CONSTRUCTION RELATED TO THE PILES UNTIL THE CONTRACTING OFFICER HAS RECEIVED AND REVIEWED THE SURVEY AND VERIFIED THE SAFE LOADS FOR THE PILES AS DRIVEN.

---PREAUGERED HOLES

ALL PILES SHALL BE DRIVEN IN PREAUGERED HOLES DRILLED TO AN ELEVATION OF -9 FEET. THE DIAMETER OF EACH PREAUGERED HOLE SHALL BE FROM TWO INCHES MORE TO TWO INCHES LESS THAN THE NOMINAL SIDE OF THE PILE.

---JETTING

JETTING FOR INSTALLATION OF THE PILES WILL NOT BE PERMITTED.

---REDRIVING OF HEAVED PILES

INSTRUMENT OBSERVATIONS SHALL BE MADE DURING PILE DRIVING TO DETERMINE WHETHER A DRIVEN PILE HAS LIFTED FROM ITS ORIGINAL SEAL DURING THE DRIVING OF ADJACENT PILES. IF UPLIFT OCCURS, PILES SO AFFECTED SHALL BE REDRIVEN TO A POINT ELEVATION AT LEAST AS DEEP AS THE ORIGINAL POINT ELEVATION AND A DRIVING RESISTANCE AT LEAST AS GREAT AS THE ORIGINAL DRIVING RESISTANCE, AS DIRECTED BY THE CONTRACTING OFFICER, AT NO ADDITIONAL COST TO THE GOVERNMENT.

---DAMAGED AND MISDRIVEN PILES

DAMAGED PILES, AND PILES DRIVEN OUTSIDE THE SPECIFIED DRIVING TOLERANCES WILL NOT BE ACCEPTED.

PILES REJECTED AFTER DRIVING SHALL BE WITHDRAWN AND REPLACED BY NEW PILES, AT NO ADDITIONAL COST TO THE GOVERNMENT.

WHEN THE SPACE LEFT BY A WITHDRAWN PILE WILL NOT BE FILLED BY THE PILE DRIVEN TO REPLACE THE REJECTED PILE SUCH SPACE SHALL BE BACKFILLED SOLID WITH COHESIONLESS SOIL MATERIAL. BACKFILL MATERIAL, PLACEMENT, AND COMPACTION SHALL BE ACHIEVED BY PLACING THE BACKFILL MATERIAL WITH WATER.

WHEN DIRECTED BY THE CONTRACTING OFFICER, PILES REJECTED AFTER DRIVING MAY BE ABANDONED AND CUT OFF, AND ADDITIONAL PILES DRIVEN TO REPLACE THE REJECTED PILES AT THE NEWLY DESIGNATED LOCATIONS, AT NO ADDITIONAL COST TO THE GOVERNMENT.

---CUTTING OFF PILES

THE TOPS OF DRIVEN PILES SHALL BE CUT OFF SQUARE WITH THE PILE AXIS AT THE CUT OFF ELEVATION INDICATED. CUTTING SHALL BE DONE WITH POWER SAWS, PNEUMATIC TOOLS, OR OTHER APPROVED MEANS.

---DISPOSAL OF WASTE MATERIALS---

---REMOVAL TO SPOIL AREAS ON GOVERNMENT PROPERTY

ALL WASTE MATERIALS SHALL BE TRANSPORTED TO, AND DISPOSED OF IN, DESIGNATED SPOIL AREAS ON GOVERNMENT PROPERTY.

---SPLICES AND BUILD-UPS

SPLICES AND BUILD-UPS, WHEN REQUIRED, SHALL BE CONSTRUCTED IN ACCORDANCE WITH DETAILS SHOWN ON THE DRAWINGS. ONLY ONE SPLICE OR BUILD-UP PER PILE WILL BE PERMITTED.

SECTION 2P

BITUMINOUS CONCRETE PAVING

---GENERAL REQUIREMENTS---

---DEFINITION OF SATISFACTORY SOIL MATERIALS

SATISFACTORY SOIL MATERIALS SHALL MEAN AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) M145-73 SOIL CLASSIFICATION GROUPS A-1, A-2-4, A-2-5, AND A-3.

---DEFINITION OF UNSATISFACTORY SOIL MATERIALS

UNSATISFACTORY SOIL MATERIALS SHALL MEAN AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-2-6, A-2-7, A-4, A-5, A-6 AND A-7, PEAT AND OTHER HIGHLY ORGANIC SOILS, AND SOIL MATERIALS OF ANY CLASSIFICATION THAT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION BEYOND THE RANGE OF ONE PERCENTAGE POINT BELOW AND THREE PERCENTAGE POINTS ABOVE THE OPTIMUM MOISTURE CONTENT OF THE SOIL MATERIAL AS DETERMINED BY MOISTURE DENSITY RELATIONS TEST.

---DEFINITIONS OF COHESIONLESS AND COHESIVE SOIL MATERIALS

COHESIONLESS SOIL MATERIALS INCLUDE GRAVELS, GRAVEL-SAND MIXTURES, SANDS AND GRAVELLY-SANDS. MOISTURE DENSITY RELATIONS OF COMPACTED COHENSIONLESS SOILS, WHEN PLOTTED ON GRAPHS, WILL SHOW STRAIGHT LINES OR REVERSE SHAPED MOISTURE DENSITY CURVES.

COHESIVE SOIL MATERIALS INCLUDE CLAYEY AND SILTY GRAVELS, SAND-CLAY MIXTURES, GRAVEL-SILT MIXTURES, CLAYEY AND SILTY SANDS, SAND-SILT MIXTURES, CLAYS, SILTS AND VERY FINE SANDS. MOISTURE DENSITY RELATIONS OF COMPACTED COHESIVE SOILS, WHEN PLOTTED ON GRAPHS, WILL SHOW NORMAL MOISTURE DENSITY CURVES.

---DEFINITION OF STANDARD SPECIFICATIONS

STANDARD SPECIFICATIONS SHALL MEAN FLORIDA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 1977 EDITION.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR BITUMINOUS PRIME COAT AND BITUMINOUS TACK COAT MATERIALS.

LABORATORY TEST REPORTS FOR PROPOSED SOIL MATERIALS AND FOR LIMEROCK BASE COURSE QUALITY CONTROL TEST DURING CONSTRUCTION.

LABORATORY TEST REPORTS FOR PROPOSED BITUMINOUS CONCRETE MATERIALS, BITUMINOUS CONCRETE MIXTURES, AND FOR BITUMINOUS CONCRETE QUALITY CONTROL TEST DURING CONSTRUCTION.

---DESCRIPTIVE DATA

SUBMIT DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AS FOLLOWS:

WRITTEN DESCRIPTION OF THE PROPOSED SOIL MATERIALS AND BITUMINOUS CONCRETE SAMPLING AND TESTING SERVICES GIVING THE QUALIFICATIONS OF PERSONNEL, LABORATORY EQUIPMENT AND FACILITIES, LIST OF PROJECTS SIMILAR IN SCOPE TO SPECIFIED WORK, AND OTHER INFORMATION AS MAY BE REQUIRED BY THE CONTRACTING OFFICER.

---WEATHER LIMITATIONS

LIMEROCK BASE COURSE SHALL BE CONSTRUCTED ONLY WHEN THE AMBIENT TEMPERATURE IS ABOVE 35 DEGREES FAHRENHEIT, AND WHEN THE SUBGRADE DOES NOT CONTAIN FROZEN OR WET MATERIAL.

ANY AREAS OF IN-PLACE LIMEROCK BASE COURSE THAT ARE DAMAGED BY FREEZING, RAINFALL, OR OTHER WEATHER CONDITIONS SHALL BE BROUGHT TO A SATISFACTORY CONDITION IN CONFORMANCE WITH THE REQUIREMENTS OF THIS SECTION WITHOUT ADDITIONAL COST TO THE GOVERNMENT.

BITUMINOUS PRIME COAT AND BITUMINOUS TACK COAT SHALL BE APPLIED ONLY WHEN THE AMBIENT TEMPERATURE IN THE SHADE IS ABOVE 50 DEGREES FAHRENHEIT AND WHEN THE TEMPERATURE HAS NOT BEEN BELOW 35 DEGREES FAHRENHEIT FOR 12 HOURS IMMEDIATELY PRIOR TO APPLICATION, AND WHEN THE AGGREGATE BASE COURSE OR OTHER SURFACE IS DRY OR CONTAINS MOISTURE NOT IN EXCESS OF THE AMOUNT THAT WILL PERMIT DISTRIBUTION AND THE REQUIRED PENETRATION.

BITUMINOUS CONCRETE COURSES SHALL BE CONSTRUCTED ONLY WHEN ATMOSPHERIC TEMPERATURE IS ABOVE 40 DEGREES FAHRENHEIT, WHEN THE UNDERLYING BASE COURSE IS DRY, AND WHEN THE WEATHER IS NOT RAINY.

---GRADE CONTROL

DURING CONSTRUCTION, THE LINES AND GRADES INCLUDING CROWN AND CROSS-SLOPE INDICATED FOR EACH PAVEMENT COURSE SHALL BE ESTABLISHED AND MAINTAINED BY MEANS OF THE LINE AND GRADE STAKES PLACED BY THE CONTRACTOR IN ACCORDANCE WITH THE "CONTRACT SCHEDULE."

---PROTECTION OF PERSONS AND PROPERTY

PAVING OPERATIONS SHALL BE CONDUCTED TO INSURE SAFETY OF PERSONS AND TO PREVENT DAMAGE TO EXISTING STRUCTURES AND UTILITIES, CONSTRUCTION IN PROGRESS, AND OTHER PROPERTY.

---MAINTAINING TRAFFIC

VEHICULAR AND PEDESTRIAN TRAFFIC SHALL BE MAINTAINED DURING THE CONSTRUCTION OF THE SPECIFIED WORK BY KEEPING OPEN VEHICULAR TRAFFIC LANES OR BY PROVIDING DETOUR ROUTES, AS APPROVED BY THE CONTRACTING OFFICER.

SUCH TRAFFIC LANES AND DETOUR ROUTES SHALL BE BARRICADED AND POSTED WITH WARNING SIGNS FOR THE SAFETY AND DIRECTING OF TRAFFIC. WARNING LIGHTS SHALL BE PROVIDED DURING HOURS OF DARKNESS.

WHEN REQUIRED BY THE CONTRACTING OFFICER COMPETENT AND COURTEOUS FLAGMEN SHALL BE PROVIDED AND SHALL BE AVAILABLE AT ALL TIMES DURING WORKING HOURS.

---SOIL MATERIALS SAMPLING AND TESTING---

---SOIL TESTING AND INSPECTION SERVICE

SAMPLES OF SOIL MATERIALS SHALL BE FURNISHED BY THE CONTRACTOR AS SPECIFIED HEREINAFTER.

SOIL TESTING AND INSPECTION SERVICE SHALL BE PROVIDED BY THE CONTRACTOR AND THE COST THEREOF SHALL BE INCLUDED IN THE CONTRACT PRICE. TESTING SERVICE SHALL BE APPROVED BY THE CONTRACTING OFFICER, AND SHALL INCLUDE SAMPLING AND TESTING SOIL MATERIALS PROPOSED FOR USE IN THE WORK, AND FIELD TESTING FACILITIES FOR QUALITY CONTROL DURING CONSTRUCTION OF THE LIMEROCK BASE COURSE.

---TESTS FOR PROPOSED SOIL MATERIALS

LIMEROCK BASE COURSE MATERIAL AND SATISFACTORY SOIL MATERIALS PROPOSED FOR USE IN THE WORK SHALL BE SAMPLED AND TESTED AS FOLLOWS:

MATERIAL	REQUIREMENT	AASHTO TEST METHOD	NUMBER OF TESTS
LIMEROCK BASE COURSE MATERIAL	SAMPLING	AASHTO T2-74	ONE FOR EACH SOURCE OF MATERIAL TO DETERMINE CONFORMANCE TO STANDARD SPECIFICATION SECTION SPECIFIED IN "MATERIALS"
	PREPARATION OF SAMPLES	AASHTO T87-72	
	SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES	AASHTO T27-74	

MATERIAL	REQUIREMENT	AASHTO TEST METHOD	NUMBER OF TESTS
	LIQUID LIMIT OF SOILS	AASHTO T89-68	
	PLASTIC LIMIT OF SOILS	AASHTO T90-70	
SATISFACTORY SOIL MATERIALS	SAMPLING	AASHTO T2-74	ONE FOR EACH SOURCE OF MATERIALS TO DETERMINE CONFORMANCE TO DEFINITION OF SATISFACTORY SOIL MATERIALS; ADDITIONAL TESTS WHENEVER THERE IS ANY APPARENT CHANGE
	PREPARATION OF SAMPLES	AASHTO T87-72	
	SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE	AASHTO T27-74	
	MECHANICAL ANALYSIS OF SOILS	AASHTO T88-72	
	LIQUID LIMIT OF SOILS	AASHTO T89-68	
	PLASTIC LIMIT AND PLASTICITY OF SOILS	AASHTO T90-70	
	MOISTURE DENSITY RELATIONS OF SOIL	AASHTO T180-74 METHOD D	

---QUALITY CONTROL TESTING DURING CONSTRUCTION

FOR QUALITY CONTROL DURING CONSTRUCTION OF THE LIMEROCK BASE COURSE THE FOLLOWING APPLIES:

LIMEROCK BASE COURSE MATERIAL DELIVERED TO THE PROJECT SITE, SOIL MATERIALS PRIOR TO COMPACTION, AND EACH LAYER OF SOIL MATERIAL-IN-PLACE AFTER COMPACTION SHALL BE SAMPLED AND TESTED FOR QUALITY CONTROL DURING CONSTRUCTION OF THE LIMEROCK BASE COURSE AS FOLLOWS:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
SOILS MATERIALS PRIOR TO COMPACTION	SIEVE ANALYSIS		
	MOISTURE CONTENT	ASTM D2216-71	AT LEAST 3 DAILY AT PLACE OF MIXING.
	MOISTURE/DENSITY RELATIONS	AASHTO T180-74	ONE FOR EACH TYPE OF MATERIAL

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
SOIL MATERIAL IN PLACE AFTER COMPACTION	DENSITY OF SOIL IN-PLACE	ASTM D1556-64(1974) SAND CONE METHOD OR ASTM D2167-66(1972) RUBBER BALLOON METHOD	AT LEAST 3 DAILY FOR EACH SUBGRADE SOIL MATERIAL AND FOR EACH 6 INCH THICK LAYER OF LIMEROCK BASE COURSE MATERIAL: ADDITIONAL TEST WHENEVER THERE IS ANY CHANGE IN MOISTURE CONDITION.
	MOISTURE/DENSITY RELATIONS OF SOIL-IN-PLACE	AASHTO T180-74 METHOD D	ONE FOR EACH DENSITY OF SOIL-IN-PLACE TEST.

THE SOIL TESTING SERVICE SHALL REPORT IN WRITING ALL TEST RESULTS TO THE CONTRACTOR AND THE CONTRACTING OFFICER ON THE SAME DAY THAT TESTS ARE MADE.

SOIL MATERIALS OF ANY CLASSIFICATION SHALL NOT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION OUTSIDE THE LIMITS SPECIFIED IN THE ARTICLE ENTITLED "DEFINITION OF UNSATISFACTORY SOIL MATERIALS" UNLESS OTHERWISE SPECIFIED.

THE RESULTS OF DENSITY OF SOIL-IN-PLACE TESTS SHALL BE CONSIDERED SATISFACTORY IF THE AVERAGE OF ANY FOUR CONSECUTIVE DENSITY TESTS WHICH MAY BE SELECTED ARE IN EACH INSTANCE EQUAL TO OR GREATER THAN THE SPECIFIED DENSITY, AND IF NOT MORE THAN ONE DENSITY TEST IN FIVE HAS A VALUE MORE THAN TWO PERCENTAGE POINTS BELOW THE SPECIFIED DENSITY.

---BITUMINOUS CONCRETE SAMPLING AND TESTING---

---BITUMINOUS CONCRETE TESTING AND INSPECTION SERVICE

BITUMINOUS CONCRETE TESTING AND INSPECTION SERVICE SHALL BE PROVIDED BY THE CONTRACTOR AND THE COST THEREOF SHALL BE INCLUDED IN THE CONTRACT PRICE. TESTING SERVICE SHALL BE APPROVED BY THE CONTRACTING OFFICER AND SHALL INCLUDE SAMPLING AND TESTING FOR BITUMINOUS CONCRETE MATERIALS PROPOSED FOR USE IN THE WORK, TESTS AND CALCULATIONS FOR BITUMINOUS CONCRETE MIXTURES, AND FIELD TESTING FACILITIES FOR QUALITY CONTROL DURING CONSTRUCTION OF BITUMINOUS CONCRETE COURSES.

---TESTS FOR PROPOSED BITUMINOUS CONCRETE MATERIALS

BITUMINOUS CONCRETE MATERIAL PROPOSED FOR USE IN THE WORK SHALL BE SAMPLED AND TESTED AS FOLLOWS:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
COARSE AND FINE AGGREGATES	SAMPLING	AASHTO T2-74	ONE FOR EACH MATERIAL TO DETERMINE CONFORMANCE TO STANDARD SPECIFICATION SECTIONS SPECIFIED IN "MATERIALS".
	SIEVE ANALYSIS	AASHTO T27-74	
	UNIT WEIGHT OF SLAG	AASHTO T19-74	
	MAGNESIUM SULPHATE SOUNDNESS TEST	AASHTO T104-74	
	SAND EQUIVALENT TEST OF FINE AGGREGATE	AASHTO T176-73	
	LOS ANGELES ABRASION OF COARSE AGGREGATE	AASHTO T96-74	
MINERAL	SIEVE ANALYSIS	AASHTO T37-70	ONE FOR EACH SOURCE OF MATERIAL TO DETERMINE CONFORMANCE STANDARD SPECIFICATION.
ASPHALT CEMENT	PENETRATION	ASTM D5-73	ONE FOR EACH SPECIFIED PENETRATION GRADE TO DETERMINE CONFORMANCE TO THE REQUIREMENTS SPECIFIED IN "MATERIALS".
	FLASH POINT	ASTM D2170-76	
	DUCTILITY	ASTM D113-76	
	LOSS ON HEATING	ASTM D1754-76	
	SOLUBILITY	ASTM D4-70 METHOD NO. 1	
	ASH	ASTM D271-70	

---TESTS AND CALCULATIONS FOR BITUMINOUS CONCRETE MIXTURES

THE JOB-MIX FORMULA FOR EACH BITUMINOUS CONCRETE MIXTURE PROPOSED FOR USE IN THE WORK SHALL BE TESTED AS FOLLOWS:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
COMPACTED BITUMINOUS CONCRETE MIX	BULK DENSITY	AASHTO T166-74	4 FOR EACH BITUMINOUS CONCRETE MIXTURE
	MARSHALL STABILITY AND FLOW TEST	ASTM D1559-76	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
AGGREGATE AND ASPHALT CEMENT	BULK SPECIFIC GRAVITY OF COARSE AGGREGATE	AASHTO T84-74	ONE FOR EACH MATERIAL
	BULK SPECIFIC GRAVITY OF FINE AGGREGATE	AASHTO T85-74	
	APPARENT SPECIFIC GRAVITY OF MINERAL FILLER	AASHTO T100-74	
	APPARENT SPECIFIC GRAVITY OF ASPHALT CEMENT	AASHTO T228-68	
UNCOMPACTED BITUMINOUS CONCRETE MIX	MAXIMUM THEORETICAL SPECIFIC GRAVITY	ASTM D2041-71(1976)	2 FOR EACH BITUMINOUS CONCRETE MIXTURE.

A DENSITY AND VOIDS ANALYSIS SHALL BE CALCULATED FOR EACH SERIES OF BITUMINOUS CONCRETE MIXTURE TEST SPECIMENS IN CONFORMANCE WITH THE ASPHALT INSTITUTE'S "MIX DESIGN METHODS FOR ASPHALT CONCRETE" MANUAL SERIES NO. 2, SECOND EDITION (1962), FOR THE MARSHALL METHOD OF MIX DESIGN. ANALYSIS SHALL INCLUDE THE QUANTITY OF ABSORBED ASPHALT CEMENT IN POUNDS OF DRY AGGREGATE, PERCENT AIR VOIDS, AND PERCENT VOIDS IN MINERAL AGGREGATE.

THE REPORT OF EACH JOB-MIX FORMULA SHALL BE SUBMITTED TO THE CONTRACTING OFFICER IN THE FORM ENTITLED "HOT MIX DESIGN DATA BY THE MARSHALL METHOD" AS SHOWN IN THE ASPHALT INSTITUTES MANUAL SERIES NO. 2.

---QUALITY CONTROL TESTING DURING CONSTRUCTION

BITUMINOUS CONCRETE MIXTURES SHALL BE SAMPLED AND TESTED FOR QUALITY CONSTRUCTION.

BITUMINOUS CONCRETE MIXTURES SHALL BE SAMPLED AND TESTED FOR QUALITY CONTROL DURING CONSTRUCTION OF THE BITUMINOUS CONCRETE COURSES AS FOLLOWS:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
UNCOMPACTED BITUMINOUS CONCRETE MIX	SAMPLING	AASHTO T168-55	ONE FOR EACH 400 TONS, OR FRACTION THEREOF, OF EACH MIXTURE TAKEN AT MIXING PLANT.
	ASPHALT CEMENT CONTENT	AASHTO T164-74	
	MECHANICAL ANALYSIS EXTRACTED AGGREGATES	AASHTO T30-74	
	RECOVERY OF ASPHALT CEMENT BY ABSON METHOD	AASHTO T170-73	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
	PENETRATION OF RECOVERED ASPHALT CEMENT	AASHTO T49-68	
	DUCTIBILITY OF RECOVERED ASPHALT CEMENT	AASHTO T51-74	
COMPACTED BITUMINOUS CONCRETE	BULK DENSITY	AASHTO T166-74	SAME AS SPECIFIED FOR UNCOMPACTED MIX.
	MARSHALL STABILITY AND FLOW TESTS	ASTM D1559-76	
IN-PLACE PAVEMENT	DENSITY AND THICKNESS	AS SPECIFIED IN "ACCEPTANCE PROVISIONS"	ONE SPECIMEN FOR EACH 500 SQUARE YARDS OF COMPLETED BITUMINOUS CONCRETE COURSE.

TEST RESULTS SHALL BE REPORTED IN WRITING TO THE CONTRACTING OFFICER ON THE SAME DAY THAT TESTS ARE MADE.

ANY BITUMINOUS CONCRETE MIXTURE THAT DOES NOT MEET THE REQUIREMENTS SPECIFIED IN ARTICLE ENTITLED "COMPOSITION OF BITUMINOUS CONCRETE MIXTURES" SHALL NOT BE USED IN THE SPECIFIED WORK.

---FIELD TESTING FACILITIES AT BITUMINOUS MIXING PLANT

FIELD TESTING FACILITIES FOR THE PURPOSE OF TESTING BITUMINOUS CONCRETE MATERIALS AND MIXES AT THE BITUMINOUS MIXING PLANT SHALL BE PROVIDED BY THE TESTING SERVICE.

---MATERIALS---

---LIMEROCK BASE COURSE MATERIAL

LIMEROCK BASE COURSE MATERIAL SHALL CONFORM TO THE REQUIREMENTS OF SECTION 911 OF THE STANDARD SPECIFICATIONS.

---COARSE AGGREGATE FOR BITUMINOUS CONCRETE

COARSE AGGREGATE BITUMINOUS CONCRETE SHALL BE CRUSHED STONE, CRUSHED SLAG, OR CRUSHED GRAVEL, AND SHALL MEET THE REQUIREMENTS OF SECTION 901 OF THE STANDARD SPECIFICATIONS, GRADE 16S.

---FINE AGGREGATE FOR BITUMINOUS CONCRETE

FINE AGGREGATE FOR BITUMINOUS CONCRETE SHALL BE NATURAL SAND, STONE SCREENING, SLAG SCREENINGS, OR A COMBINATION THEREOF, AND SHALL MEET THE REQUIREMENTS OF SECTION 902-3 OF THE STANDARD SPECIFICATIONS.

---MINERAL FILLER

MINERAL FILLER SHALL MEET THE REQUIREMENTS OF SECTIONS 917-1 AND 917-2 OF THE STANDARD SPECIFICATIONS.

---ASPHALT CEMENT

ASPHALT CEMENT SHALL MEET THE REQUIREMENTS OF SECTION 916-1 OF THE STANDARD SPECIFICATIONS, GRADE AC20.

---BITUMINOUS PRIME COAT

BITUMINOUS PRIME COAT SHALL BE CUT BACK ASPHALT, AND SHALL MEET THE REQUIREMENTS OF SECTION 916-3 OF THE STANDARD SPECIFICATIONS.

---BITUMINOUS TACK COAT

BITUMINOUS TACK COAT SHALL BE CUT-BACK ASPHALT, AND SHALL MEET THE REQUIREMENTS OF SECTION 916-2 OF THE STANDARD SPECIFICATIONS.

---COMPOSITION OF BITUMINOUS CONCRETE MIXTURES---

---ASPHALTIC CONCRETE

ASPHALTIC CONCRETE SHALL CONFORM TO THE PERFORMANCE REQUIREMENTS SPECIFIED HEREINAFTER, AND SHALL MEET THE REQUIREMENTS OF SECTION 331-4 OF THE STANDARD SPECIFICATIONS.

---JOB-MIX FORMULAS

A JOB-MIX FORMULA FOR THE ASPHALTIC CONCRETE MIXTURE PROPOSED FOR USE IN THE WORK SHALL BE SUBMITTED FOR THE APPROVAL OF THE CONTRACTING OFFICER PRIOR TO THE START OF THE SPECIFIED WORK.

THE JOB-MIX FORMULA SHALL BE WITHIN THE LIMITS SPECIFIED IN SECTION 331 OF THE STANDARD SPECIFICATION FOR TYPE S-1 ASPHALTIC CONCRETE. THE JOB-MIX FORMULA SHALL ESTABLISH A SINGLE PERCENTAGE OF AGGREGATE PASSING EACH REQUIRED SIEVE, A SINGLE PERCENTAGE OF ASPHALT CEMENT TO BE ADDED TO THE AGGREGATE, AND A SINGLE TEMPERATURE AT WHICH THE BITUMINOUS CONCRETE MIXTURE IS TO BE PRODUCED.

THE MAXIMUM PERMITTED VARIATION FROM THE JOB-MIX FORMULA, WITHIN THE LIMITS SPECIFIED, SHALL BE AS FOLLOWS:

AGGREGATE PASSING NO. 4 SIEVE OR LARGER	7 PERCENT (PLUS OR MINUS)
AGGREGATE PASSING NO. 8, 30, 50 AND 100 SIEVES	4 PERCENT (PLUS OR MINUS)
AGGREGATE PASSING NO. 200 SIEVES	2 PERCENT (PLUS OR MINUS)
ASPHALT CEMENT	0.4 PERCENT (PLUS OR MINUS)
TEMPERATURE OF MIXING	20 DEGREES FAHRENHEIT (PLUS OR MINUS)

---PERFORMANCE REQUIREMENTS

BITUMINOUS CONCRETE MIXTURES SHALL MEET THE PERFORMANCE REQUIREMENTS HEREINAFTER DESCRIBED WHEN SAMPLED, TESTED, AND CALCULATIONS MADE FOR DENSITY AND VOIDS ANALYSIS AS SPECIFIED HEREINBEFORE IN ARTICLE ENTITLED "BITUMINOUS CONCRETE SAMPLING AND TESTING".

TEST PROPERTY	PERFORMANCE REQUIREMENTS SURFACE COURSE
MARSHALL STABILITY, POUNDS	1500 MINIMUM
MARSHALL FLOW, 1/100 INCH UNITS	8 MINIMUM 18 MAXIMUM
PERCENT AIR VOID	2 MINIMUM 5 MAXIMUM

THE ASPHALT CEMENT USED IN THE ASPHALTIC CONCRETE MIXTURE, WHEN EXTRACTED AND RECOVERED AS SPECIFIED HEREINBEFORE, SHALL HAVE THE FOLLOWING TEST PROPERTIES:

PENETRATION SHALL BE NOT LESS THAN 60.

DUCTIBILITY AT 77 DEGREES FAHRENHEIT SHALL BE NOT LESS THAN 80 CENTIMETERS.

---STABILIZED SUBGRADE EQUIPMENT---

---GENERAL

ALL EQUIPMENT USED FOR CONSTRUCTION OF THE STABILIZED SUBGRADE AND SHOULDERS SHALL BE AS HEREINAFTER SPECIFIED UNDER THE HEADING "---LIMEROCK BASE COURSE EQUIPMENT---". IN ADDITION, MIXING EQUIPMENT OF THE ROTARY TILLER TYPE (OR OTHER EQUIVALENT EQUIPMENT MEETING THE APPROVAL OF THE CONTRACTING OFFICER) SHALL BE USED.

---STABILIZED SUBGRADE AND SHOULDERS CONSTRUCTION METHODS---

---GENERAL

PRIOR TO THE BEGINNING OF STABILIZING OPERATIONS, THE AREA TO BE STABILIZED SHALL HAVE BEEN CONSTRUCTED TO AN ELEVATION SUCH THAT UPON COMPLETION OF STABILIZING OPERATIONS THE COMPLETED STABILIZED SUBGRADE WILL CONFORM TO THE LINES, GRADES AND CROSS SECTION SHOWN IN THE PLANS. PRIOR TO THE SPREADING OF ANY ADDITIVE STABILIZING MATERIAL, THE SURFACE OF THE ROADBED SHALL BE BROUGHT TO A PLANE APPROXIMATELY PARALLEL TO THE PLANE OF THE PROPOSED FINISHED SURFACE.

---APPLICATION OF STABILIZING MATERIAL

THREE INCHES LOOSE MEASURE OF STABILIZING MATERIAL SHALL BE SPREAD OVER THE AREA TO BE STABILIZED. THE STABILIZING MATERIAL SHALL BE EITHER LIMEROCK OR LOCAL MARL. THE STABILIZING MATERIAL SHALL BE SPREAD BY THE USE OF MECHANICAL MATERIAL SPREADERS EXCEPT THAT WHERE USE OF SUCH EQUIPMENT IS NOT PRACTICABLE OTHER MEANS OF SPREADING MAY BE USED, BUT ONLY UPON WRITTEN APPROVAL OF THE CONTRACTING OFFICER FOR THE PROPOSED ALTERNATE METHOD.

---MIXING

THE MIXING SHALL BE DONE WITH ROTARY TILLERS, OR OTHER EQUIPMENT MEETING THE APPROVAL OF THE CONTRACTING OFFICER. AT THE CONTRACTOR'S ELECTION, THE MIXING OF THE MATERIALS MAY BE ACCOMPLISHED IN A PLANT OF AN APPROVED TYPE, SUITABLE FOR THIS WORK. THE AREA TO BE STABILIZED SHALL BE THOROUGHLY MIXED THROUGHOUT THE ENTIRE DEPTH AND WIDTH OF THE STABILIZING LIMITS AS SHOWN ON THE DRAWINGS.

---COMPACTION

THE AREA SHALL BE COMPACTED TO THE SPECIFIED DENSITY. IF THE MOISTURE CONTENT OF THE MATERIAL IS IMPROPER FOR ATTAINING THE SPECIFIED DENSITY, EITHER WATER SHALL BE ADDED OR THE MATERIAL SHALL BE PERMITTED TO DRY UNTIL THE PROPER MOISTURE CONTENT IS OBTAINED.

---DENSITY REQUIREMENTS

WITHIN THE ENTIRE LIMITS OF THE WIDTH AND DEPTH OF THE AREAS TO BE STABILIZED, THE MINIMUM DENSITY ACCEPTABLE AT ANY LOCATION WILL BE 98 PERCENT OF THE MAXIMUM DENSITY AS DETERMINED BY AASHTO T-180.

---LIMEROCK BASE COURSE EQUIPMENT---

---GENERAL

ALL EQUIPMENT USED IN THE CONSTRUCTION OF LIMEROCK BASE COURSE SHALL BE OF SUFFICIENT SIZE AND QUANTITY, AND IN SATISFACTORY WORKING CONDITION TO COMPLETE THE WORK ON SCHEDULE.

---BLADE GRADERS

BLADE GRADERS SHALL BE SELF PROPELLED, AND SHALL HAVE A WHEEL BASE OF NOT LESS THAN 15 FEET, AND A BLADE LENGTH OF NOT LESS THAN 10 FEET.

---COMPACTION EQUIPMENT

COMPACTION EQUIPMENT SHALL CONSIST OF PNEUMATIC TIRED ROLLERS, THREE-WHEELED STEEL ROLLERS, TAMPERS, AND OTHER COMPACTION EQUIPMENT SUITABLE FOR THE MATERIAL BEING COMPACTED AND CAPABLE OF OBTAINING THE REQUIRED DENSITY THROUGHOUT THE ENTIRE LIFT OR LAYER BEING COMPACTED.

ROLLERS SHALL WEIGH NOT LESS THAN 10 TONS AND HAVE A MINIMUM WEIGHT OF 300 POUNDS PER INCH WIDTH OF ROLLER.

TAMPERS SHALL BE AN APPROVED MECHANICAL TYPE, OPERATED BY EITHER PNEUMATIC PRESSURE OR INTERNAL COMBUSTION.

---PLACING EQUIPMENT

PLACING EQUIPMENT SHALL BE MECHANICAL SPREADER, EITHER SELF PROPELLED OR ATTACHED TO A PROPELLING UNIT CAPABLE OF MOVING THE SPREADER AND MATERIAL TRUCK. THE SPREADER AND PROPELLING UNIT SHALL BE CARRIED ON TRACKS, RUBBER TIRES, OR DRUM-TYPE STEEL ROLLERS THAT WILL NOT CAUSE DISTURBANCE OF THE SUBGRADE. PLACING EQUIPMENT SHALL BE CAPABLE OF LAYING THE BASE COURSE MATERIAL ACROSS THE FULL WIDTH OF THE LANE TO A UNIFORM THICKNESS AND TO A UNIFORM LOOSE DENSITY THAT WHEN COMPACTED THE LAYER WILL CONFORM TO THE THICKNESS AND GRADE REQUIREMENTS INDICATED.

---SPRINKLER EQUIPMENT

SPRINKLER EQUIPMENT SHALL CONSIST OF TANK TRUCKS, PRESSURE DISTRIBUTORS, AND OTHER EQUIPMENT DESIGNED TO APPLY WATER UNIFORMLY AND AT CONTROLLED QUANTITIES TO VARIABLE WIDTHS OF SURFACE.

---MISCELLANEOUS EQUIPMENT

TRACTORS, HAULING EQUIPMENT, AND OTHER EQUIPMENT SHALL BE OF TYPES SUITABLE FOR CONSTRUCTING LIMEROCK BASE COURSES.

---LIMEROCK BASE COURSE CONSTRUCTION METHODS---

---SUBGRADE PREPARATION

BEFORE PLACING THE LIMEROCK BASE COURSE MATERIAL, THE PREVIOUSLY CONSTRUCTED SUBGRADE SHALL BE CLEANED OF ALL FOREIGN SUBSTANCES AND SHALL BE INSPECTED BY THE CONTRACTOR IN THE PRESENCE OF THE CONTRACTING OFFICER FOR SPECIFIED COMPACTION AND SURFACE TOLERANCES. THE FINISHED SUBGRADE ELEVATION SHALL BE WITHIN PLUS OR MINUS 1/2 INCH OF THE ELEVATION INDICATED, AND GRADED TO PREVENT PONDING OF WATER AFTER RAINS.

RUTS OR SOFT YIELDING SPOTS THAT MAY APPEAR IN THE SUBGRADE, AREAS HAVING INADEQUATE COMPACTION, AND DEVIATIONS IN THE SURFACE BEYOND THE SPECIFIED SURFACE TOLERANCES SHALL BE CORRECTED TO LINE AND GRADE AND TO ALL SPECIFICATION REQUIREMENTS.

THE FINISHED SUBGRADE SHALL NOT BE DISTURBED BY TRAFFIC OR OTHER OPERATIONS AND SHALL BE MAINTAINED IN A SATISFACTORY CONDITION UNTIL THE AGGREGATE BASE COURSE IS PLACED.

---PLACING

THE LIMEROCK BASE COURSE MATERIAL SHALL BE PLACED ON THE PREPARED SUBGRADE IN A LAYER OF UNIFORM THICKNESS BY MEANS OF THE SPECIFIED PLACING EQUIPMENT. THE LAYER SHALL BE SO PLACED THAT WHEN COMPACTED IT WILL CONFORM TO THE INDICATED CROSS-SECTION AND THICKNESS.

THE MOISTURE CONTENT OF THE LIMEROCK BASE COURSE MATERIAL SHALL BE MAINTAINED DURING THE PLACING PERIOD AT THE OPTIMUM MOISTURE CONTENT FOR COMPACTING WITHIN A TOLERANCE OF PLUS OR MINUS TWO PERCENTAGE POINTS.

SUCH ADJUSTMENTS IN PLACING PROCEDURES OR EQUIPMENT SHALL BE MADE BY THE CONTRACTOR AS MAY BE REQUIRED TO OBTAIN TRUE GRADES, TO REDUCE OR ACCELERATE THE LOSS OR GAIN OF WATER, AND TO INSURE A SATISFACTORY LIME-ROCK BASE COURSE.

---COMPACTION

AFTER PLACING AND SHAPING THE LIMEROCK BASE COURSE SHALL BE COMPACTED WITH THE SPECIFIED COMPACTION EQUIPMENT UNTIL THE LAYER IS COMPACTED THROUGH THE FULL DEPTH TO AT LEAST 98 PERCENT OF THE MAXIMUM DENSITY AT OPTIMUM MOISTURE CONTENT.

---FINISHING

THE LIMEROCK BASE SHALL BE FINISHED IN ACCORDANCE WITH SECTION 200-7 OF THE STANDARD SPECIFICATIONS.

---SMOOTHNESS TEST

THE SURFACE OF THE FINISHED AND COMPLETED LIMEROCK BASE COURSE SHALL BE SMOOTH AND EVEN, FREE OF VOIDS, AND TO INDICATED LINES, GRADES AND CROSS-SECTION WITHIN THE SPECIFIED TOLERANCES. WHEN TESTED WITH A TEN FOOT STRAIGHTEDGE, PARALLEL WITH AND AT RIGHT ANGLES TO THE CENTERLINE OF THE PAVED AREA, THE FINISHED SURFACE SHALL NOT SHOW ANY DEVIATIONS IN EXCESS OF 1/4 INCH. ANY DEVIATION IN EXCESS OF THIS AMOUNT SHALL BE CORRECTED BY THE CONTRACTOR, AS SPECIFIED IN PARAGRAPH 200-8 OF THE STANDARD SPECIFICATIONS.

---ASPHALTIC CONCRETE EQUIPMENT---

---GENERAL

ALL EQUIPMENT USED IN THE CONSTRUCTION OF ASPHALTIC CONCRETE COURSES SHALL BE OF SUFFICIENT SIZE AND QUANTITY, AND IN SATISFACTORY WORKING CONDITION, TO COMPLETE THE WORK ON SCHEDULE.

---ASPHALTIC CONCRETE MIXING PLANT

ASPHALTIC CONCRETE MIXING PLANT SHALL BE DESIGNED, COORDINATED, AND OPERATED TO PRODUCE MIXTURES WITHIN THE JOB-MIX FORMULA TOLERANCES SPECIFIED IN THE ARTICLE ENTITLED "COMPOSITION OF ASPHALTIC CONCRETE MIXTURES". THE PLANT MAY BE EITHER BATCH MIXING TYPE OR CONTINUOUS MIXING TYPE PROVIDED THE EQUIPMENT HAS DEMONSTRATED SUITABILITY FOR PRODUCING MIXTURES CONFORMING TO THE REQUIREMENTS SPECIFIED HEREIN. ASPHALTIC CONCRETE MIXING PLANT SHALL MEET THE REQUIREMENTS OF SECTION 320-2 AND 320-3 OF THE STANDARD SPECIFICATIONS.

---BROOMS AND BLOWERS

BROOMS AND BLOWERS SHALL BE OF THE POWER TYPE AND SHALL BE SUITABLE FOR CLEANING THE SURFACE TO BE COATED WITH BITUMINOUS MATERIAL OR TO BE PAVED WITH ASPHALTIC CONCRETE, AS APPLICABLE.

---BITUMINOUS DISTRIBUTORS

BITUMINOUS DISTRIBUTORS SHALL BE DESIGNED AND EQUIPPED TO DISTRIBUTE THE REQUIRED AMOUNT OF BITUMINOUS COATING MATERIAL AT THE SPECIFIED TEMPERATURE AND IN A UNIFORM SPRAY, WITHOUT ATOMIZATION. EACH DISTRIBUTOR SHALL BE EQUIPPED WITH PNEUMATIC TIRES OF SUCH WIDTH AND NUMBER THAT THE SURFACE BEING SPRAYED WILL NOT BE RUTTED OR OTHERWISE DISTURBED. DISTRIBUTOR EQUIPMENT SHALL INCLUDE A SEPARATE POWER UNIT FOR THE BITUMEN PUMP, FULL CIRCULATION SPRAY BARS, TACHOMETER, PRESSURE AND VOLUME MEASURING DEVICES, ADEQUATE HEATERS FOR HEATING MATERIALS TO THE APPLICATION TEMPERATURE, A THERMOMETER TO INDICATE THE TEMPERATURE OF TANK CONTENTS, AND HOSE ATTACHMENT SUITABLE FOR APPLYING THE BITUMINOUS COATING MATERIAL TO AREAS MISSED BY THE DISTRIBUTOR. EACH DISTRIBUTOR SHALL BE EQUIPPED AND OPERATED SO THAT THE BITUMINOUS COATING MATERIAL SHALL BE CIRCULATED OR AGITATED THROUGHOUT THE ENTIRE HEATING PROCESS.

THE HEATING EQUIPMENT FOR BITUMINOUS COATING MATERIAL STORAGE TANKS SHALL CONSIST OF STEAM COILS AND EQUIPMENT FOR PRODUCING STEAM, SO DESIGNED THAT STEAM CANNOT GET INTO THE BITUMINOUS MATERIAL. AN ARMORED THERMOMETER WITH A RANGE FROM 40 TO 200 DEGREES FAHRENHEIT SHALL BE FIXED TO THE TANK SO THAT THE TEMPERATURE OF THE BITUMINOUS COATING MATERIAL MAY BE READ AT ALL TIMES.

---BITUMINOUS PAVERS

BITUMINOUS PAVERS SHALL BE SELF PROPELLED TYPE EQUIPPED WITH HOPPERS, TAMPING OR VIBRATING DEVICES, DISTRIBUTION SCREWS, ADJUSTABLE SCREEDS, EQUIPMENT FOR HEATING SCREEDS, AND EQUALIZING DEVICES.

PAVERS SHALL BE CAPABLE OF SPREADING HOT BITUMINOUS CONCRETE MIXTURES WITHOUT TEARING, SHOVING OR GOUGING, AND SHALL BE CAPABLE OF PRODUCING A FINISHED SURFACE CONFORMING TO THE SMOOTHNESS REQUIREMENTS SPECIFIED HEREINAFTER.

PAVERS SHALL BE CAPABLE OF CONFINING THE EDGES OF THE BITUMINOUS CONCRETE STRIPS TO TRUE LINES WITHOUT THE USE OF STATIONARY FORMS, AND SHALL BE CAPABLE OF PLACING EACH BITUMINOUS CONCRETE COURSE TO THE REQUIRED THICKNESS.

PAVERS SHALL BE DESIGNED TO OPERATE FORWARD AT VARIABLE SPEEDS AND IN REVERSE AT TRAVELING SPEEDS OF NOT LESS THAN 100 FEET PER MINUTE.

THE USE OF A PAVER THAT LEAVES INDENTED AREAS OR OTHER OBJECTIONABLE IRREGULARITIES IN THE FRESH-LAID BITUMINOUS CONCRETE MIXTURE DURING OPERATION WILL NOT BE PERMITTED.

---ROLLING EQUIPMENT

ROLLING EQUIPMENT SHALL CONSIST OF STEEL-WHEELED ROLLERS AND PNEUMATIC-TIRED ROLLERS, ROLLERS SHALL BE IN GOOD OPERATING CONDITION AND SHALL BE CAPABLE OF REVERSING WITHOUT BACKLASH.

ROLLERS SHALL MEET THE REQUIREMENTS OF PARAGRAPH 320-5.3 OF THE STANDARD SPECIFICATIONS.

---SMALL TOOLS

SMALL TOOLS SHALL CONSIST OF RAKES, LUTES, SHOVELS, TAMPERS, SMOOTHING IRONS, PAVEMENT CUTTERS, PORTABLE HEATER FOR HEATING SMALL TOOLS, AND OTHER TOOLS AS REQUIRED TO COMPLETE THE SPECIFIED WORK. A SUFFICIENT NUMBER OF SMALL TOOLS SHALL BE AVAILABLE AT ALL TIMES FOR USE IN THE SPECIFIED WORK.

HAND TAMPERS SHALL WEIGH NOT LESS THAN 25 POUNDS AND SHALL HAVE A TAMPING FACE NOT EXCEEDING 50 SQUARE INCHES.

---ASPHALTIC CONCRETE MIXING PLANT OPERATION---

---GENERAL

THE ASPHALTIC CONCRETE MIXTURES SHALL BE PRODUCED IN A BITUMINOUS CONCRETE MIXING PLANT AS SPECIFIED HEREINBEFORE.

---AGGREGATE STORAGE

EACH COMPONENT OF THE VARIOUS SIZED AGGREGATES WHICH ARE TO BE BLENDED IN THE PREPARATION OF EACH ASPHALTIC CONCRETE MIXTURE SHALL BE PLACED IN SEPARATE STOCKPILES IN SUCH MANNER THAT THE SEPARATE AGGREGATE SIZES WILL NOT BE INTERMIXED AND TO PREVENT SEGREGATION OF THE SEPARATE STOCKPILES.

---PREPARATION OF ASPHALT CEMENT

THE ASPHALT CEMENT SHALL BE HEATED AT THE MIXING PLANT TO A VISCOSITY AT WHICH IT CAN BE PROPERLY HANDLED THROUGH THE PUMPING SYSTEM AND UNIFORMLY DISTRIBUTED THROUGHOUT THE BITUMINOUS CONCRETE MIXTURE.

---PREPARATION OF AGGREGATES

EACH SIZE AGGREGATE SHALL BE SEPARATELY FED BY FEEDERS TO THE COLD ELEVATOR OR ELEVATORS IN A MANNER THAT WILL PRODUCE AN AGGREGATE GRADED WITHIN THE REQUIREMENTS OF THE JOB-MIX FORMULA AND AT A RATE TO PERMIT CORRECT AND UNIFORM TEMPERATURE CONTROL OF THE HEATING AND DRYING OPERATION.

THE AGGREGATES SHALL BE DRIED AND DELIVERED TO THE MIXER AT A TEMPERATURE BETWEEN 250 AND 325 DEGREES FAHRENHEIT. THE TEMPERATURE BETWEEN THESE LIMITS SHALL BE REGULATED ACCORDING TO THE PENETRATION GRADE AND VISCOSITY CHARACTERISTICS OF THE ASPHALT CEMENT, THE TEMPERATURE OF THE ATMOSPHERE, AND THE WORKABILITY OF THE ASPHALTIC CONCRETE MIXTURE.

AGGREGATES IN THE HOT BINS SHALL NOT CONTAIN MOISTURE TO SUCH AN EXTENT AS TO CAUSE THE ASPHALTIC CONCRETE MIXTURE TO FOAM, SLUMP, OR SEGREGATE DURING HAULING AND PLACING OPERATIONS.

IF THE DRIED AGGREGATES ARE SEPARATED INTO MORE THAN ONE BIN, THEY SHALL BE SCREENED INTO SIZES THAT MAY BE RECOMBINED INTO A GRADATION MEETING THE REQUIREMENTS OF THE JOB-MIX FORMULA.

ADEQUATE DRY STORAGE SHALL BE PROVIDED FOR MINERAL FILLER.

---PREPARATION OF ASPHALTIC CONCRETE MIXTURES

THE DRIED AGGREGATES SHALL BE ACCURATELY WEIGHED OR MEASURED AND CONVEYED TO THE MIXER IN THE PROPORTIONATE AMOUNTS OF EACH AGGREGATE SIZE REQUIRED TO CONFORM TO THE JOB-MIX FORMULA. THE ASPHALT CEMENT SHALL BE WEIGHED OR METERED AND INTRODUCED INTO THE MIXER IN THE AMOUNT REQUIRED BY THE JOB-MIX FORMULA.

THE ASPHALT CEMENT AND AGGREGATE SHALL BE INTRODUCED INTO THE MIXER WITHIN 35 DEGREES FAHRENHEIT OF EACH OTHER AND AT A TEMPERATURE THAT WILL PRODUCE A BITUMINOUS CONCRETE MIXTURE WITHIN THE REQUIREMENTS OF THE JOB-MIX FORMULA. HOWEVER, IN NO CASE SHALL THE TEMPERATURE OF THE ASPHALT CEMENT EXCEED 300 DEGREES FAHRENHEIT AT THE TIME OF INTRODUCTION INTO THE MIXER.

IN BATCH MIXING PLANTS THE AGGREGATES SHALL BE MIXED DRY FOR A PERIOD OF NOT LESS THAN 10 SECONDS. THE ASPHALT CEMENT SHALL BE ADDED IN AN EVENLY SPREAD SHEET OVER THE FULL LENGTH OF THE MIXER BOX, EXCEPT THAT IN CONTINUOUS MIXING PLANTS THE ASPHALT CEMENT SHALL BE SPREAD EVENLY ACROSS THE MIXER BOX. AFTER THE ASPHALT CEMENT HAS BEEN INTRODUCED TO THE AGGREGATES, THE MIXING SHALL BE CONTINUED FOR A PERIOD OF NOT LESS THAN 30 SECONDS NOR MORE THAN 75 SECONDS. THE LENGTH OF THE DRY MIXING AND WET MIXING PERIOD MAY VARY, BUT UNDER NO CIRCUMSTANCES SHALL THE TOTAL MIXING TIME OR INTERVAL OF TIME BETWEEN THE OPENING OF THE WEIGHT BOX GATE AND THE OPENING OF THE MIXER GATE BE LESS THAN 45 SECONDS.

---TRANSPORTATION OF ASPHALTIC CONCRETE MIXTURES

THE ASPHALTIC CONCRETE MIXTURES SHALL BE TRANSPORTED FROM THE MIXING PLANT TO THE PROJECT SITE IN TRUCKS MEETING THE REQUIREMENTS OF PARAGRAPH 320-5.4 AND 330-7 OF THE STANDARD SPECIFICATIONS AND THE FOLLOWING:

EACH LOAD OF BITUMINOUS CONCRETE MIXTURE SHALL BE COVERED WITH CANVAS, OR OTHER SUITABLE MATERIAL, OF SUFFICIENT SIZE AND WEIGHT TO PROTECT THE BITUMINOUS CONCRETE MIXTURE FROM THE WEATHER AND TO PREVENT LOSS OF HEAT.

DELIVERIES OF THE BITUMINOUS CONCRETE MIXTURE SHALL BE SO SCHEDULED THAT THE PLACING AND COMPACTION OF ALL THE BITUMINOUS CONCRETE MIXTURE PREPARED FOR THE WORK OF ONE DAY CAN BE COMPLETED DURING DAYLIGHT, UNLESS SATISFACTORY ARTIFICIAL LIGHT IS PROVIDED.

THE BITUMINOUS CONCRETE MIXTURE SHALL BE DELIVERED TO THE LOCATION OF THE WORK IN SUCH MANNER THAT THE TEMPERATURE OF THE MIXTURE AT THE TIME OF DUMPING INTO THE BITUMINOUS PAVER WILL NOT BE LESS THAN 270 DEGREES FAHRENHEIT.

TRUCKS SHALL NOT TRAVEL ON THE ASPHALTIC CONCRETE MIXTURE UNTIL COMPACTION HAS BEEN COMPLETED AND THE BITUMINOUS CONCRETE PAVEMENT SURFACE WILL SUPPORT TRAFFIC WITHOUT MEASURABLE DEFORMATION.

---PREPARATION OF AREA TO BE PAVED---

---SURFACE PREPARATION

IMMEDIATELY BEFORE APPLYING BITUMINOUS PRIME COAT TO THE LIMEROCK BASE COURSE SURFACE OR OTHER CONTACT SURFACE, ALL LOOSE MATERIAL, DIRT, CLAY, OR OTHER OBJECTIONABLE SUBSTANCE SHALL BE REMOVED BY MEANS OF A POWER BROOM OR BLOWER, SUPPLEMENTED WITH HAND BROOMS.

---PRIMING AGGREGATE BASE COURSE SURFACE

BITUMINOUS PRIME COAT SHALL BE UNIFORMLY APPLIED TO THE PREPARED BASE COURSE SURFACE BY MEANS OF A BITUMINOUS DISTRIBUTOR. THE RATE OF APPLICATION SHALL BE WITHIN THE RANGE OF 0.10 TO 0.15 GALLONS PER SQUARE YARD OF SURFACE. THE TEMPERATURE OF THE BITUMINOUS MATERIAL AT THE TIME OF APPLICATION SHALL BE WITHIN THE RANGE OF 100 TO 150 DEGREES FAHRENHEIT.

CARE SHALL BE TAKEN THAT THE AMOUNT OF BITUMINOUS PRIME COAT AT THE JUNCTION OF PREVIOUS AND SUBSEQUENT APPLICATIONS IS NOT IN EXCESS OF THAT SPECIFIED IN THE RATE OF APPLICATION. EXCESS BITUMINOUS PRIME COAT MATERIAL SHALL BE SQUEEGEED FROM THE SURFACE. ALL AREAS MISSED BY THE BITUMINOUS DISTRIBUTOR SHALL BE TREATED WITH BITUMINOUS PRIME COAT MATERIAL BY MEANS OF HAND SPRAYERS.

FOLLOWING THE APPLICATION OF BITUMINOUS PRIME COAT MATERIAL THE SURFACE SHALL BE SANDED AS SPECIFIED IN PARAGRAPH 300-6.5 OF THE STANDARD SPECIFICATIONS.

---PRIMING OTHER CONTACT SURFACES

BITUMINOUS TACK COAT SHALL BE UNIFORMLY APPLIED TO THE CONTACT SURFACES OF PREVIOUSLY CONSTRUCTED BITUMINOUS CONCRETE OR PORTLAND CEMENT CONCRETE PAVEMENT AND OTHER SIMILAR SURFACES BY MEANS OF A BITUMINOUS DISTRIBUTOR. THE RATE OF APPLICATION SHALL BE WITHIN THE RANGE OF 0.02 TO 0.08 GALLONS PER SQUARE YARD OF SURFACE. THE TEMPERATURE OF THE BITUMINOUS MATERIAL AT THE TIME OF APPLICATION SHALL BE WITHIN 105 TO 180 DEGREES FAHRENHEIT.

THE CONTACT SURFACES OF CURBS, GUTTERS, MANHOLES, AND OTHER STRUCTURES PROJECTING INTO OR BUTTING THE BITUMINOUS CONCRETE PAVEMENT SHALL BE PAINTED WITH A THIN, UNIFORM COATING OF BITUMINOUS TACK COAT MATERIAL PRIOR TO THE BITUMINOUS CONCRETE MIXTURE BEING PLACED AGAINST SUCH STRUCTURES.

FOLLOWING THE APPLICATION OF BITUMINOUS TACK COAT MATERIAL, THE SURFACE SHALL BE ALLOWED TO DRY UNTIL IT IS IN A PROPER CONDITION OF TACKINESS TO RECEIVE THE BITUMINOUS CONCRETE MIXTURE. EXCESS BITUMINOUS TACK COAT MATERIAL SHALL BE COVERED WITH A SUFFICIENT QUANTITY OF CLEAN, DRY SAND AS REQUIRED TO BLOT UP AND CURE THE EXCESS BITUMINOUS MATERIAL.

---PLACING ASPHALTIC CONCRETE COURSES---

---GENERAL

THE ASPHALTIC CONCRETE MIXTURE SHALL BE PLACED ON THE PREPARED SURFACE, SPREAD AND STRUCK-OFF BY MEANS OF THE SPECIFIED PAVER, EXCEPT IN AREAS THAT ARE INACCESSIBLE OR TOO SMALL FOR THE USE OF MECHANICAL PLACING. ASPHALTIC CONCRETE SHALL BE PLACED IN ONE LAYER. THE COURSE SHALL BE SO PLACED THAT WHEN COMPACTED IT WILL CONFORM TO THE INDICATED GRADE, CROSS-SECTION, AND THICKNESS.

---PAVER PLACING

EACH PAVER SHALL BE ADJUSTED AND THE SPEED REGULATED SO THAT THE SURFACE OF THE ASPHALTIC CONCRETE MIXTURE WILL BE SMOOTH, AND WHEN COMPACTED WILL CONFORM TO THE DEPTH, CROSS-SECTIONS, GRADES AND CONTOURS INDICATED.

UNLESS OTHERWISE DIRECTED, THE PLACING SHALL BEGIN ALONG THE CENTERLINE OF AREAS TO BE PAVED ON A CROWNED SECTION AND AT THE HIGH SIDE OF A SECTION WITH A ONE WAY SLOPE,AND SHALL BE IN THE DIRECTION OF THE TRAFFIC FLOW. THE ASPHALTIC CONCRETE MIXTURE SHALL BE PLACED IN STRIPS NOT LESS THAN 10 FEET WIDE. AFTER THE FIRST STRIP HAS BEEN PLACED AND ROLLED, THE SECOND STRIP AND SUCCEEDING STRIPS SHALL BE PLACED AND ROLLING SHALL BE EXTENDED TO OVERLAP THE FIRST STRIP. PLACING OF THE BITUMINOUS CONCRETE MIXTURE SHALL BE AS CONTINUOUS AS POSSIBLE.

A SUFFICIENT NUMBER OF EXPERIENCED SHOVELERS AND RAKERS SHALL FOLLOW EACH PAVER, ADDING HOT MIXTURE AND RAKING THE MIXTURE AS REQUIRED TO PRODUCE A COURSE THAT, WHEN COMPLETED, WILL CONFORM TO ALL REQUIREMENTS SPECIFIED HEREIN.

---HAND PLACING

IN AREAS WHERE THE USE OF MACHINE SPREADING IS NOT PRACTICAL, THE MIXTURE SHALL BE SPREAD AND FINISHED BY THE USE OF HAND TOOLS.

THE MIXTURE SHALL BE DUMPED ON APPROVED DUMP BOARDS AND SHALL BE DISTRIBUTED INTO PLACE FROM THE DUMP BOARDS BY MEANS OF HOT SHOVELS AND SPREAD WITH HOT RAKES IN A UNIFORMLY LOOSE LAYER OF SUCH THICKNESS THAT, WHEN COMPACTED, IT WILL CONFORM TO THE REQUIRED GRADE AND THICKNESS.

THE MIXTURE SHALL NOT BE DUMPED ANY FASTER THAN CAN BE HANDLED PROPERLY BY THE SHOVELERS AND RAKERS. RAKERS WITHOUT STILT SANDALS SHALL NOT BE PERMITTED TO STAND IN THE HOT BITUMINOUS CONCRETE MIXTURE WHILE RAKING THE COURSE.

---JOINTS

JOINTS SHALL HAVE THE SAME TEXTURE, DENSITY, AND SMOOTHNESS AS OTHER SECTIONS OF THE BITUMINOUS CONCRETE COURSE. THE JOINTS BETWEEN OLD AND NEW PAVEMENTS, OR BETWEEN SUCCESSIVE DAYS' WORK, SHALL BE CAREFULLY MADE TO INSURE A CONTINUOUS BOND BETWEEN THE OLD AND NEW SECTIONS OF THE PAVEMENT. CONTACT SURFACES OF PREVIOUSLY CONSTRUCTED PAVEMENTS THAT HAVE BECOME COATED WITH SAND, DUST, OR OTHER OBJECTIONABLE MATERIAL SHALL BE CLEANED BY BRUSHING OR OTHER APPROVED MEANS, AND UNIFORMLY COATED WITH BITUMINOUS TACK COAT MATERIAL AS SPECIFIED HEREINBEFORE.

---COMPACTION OF ASPHALTIC CONCRETE MIXTURES---

---GENERAL

COMPACTION OF THE ASPHALTIC CONCRETE MIXTURE SHALL BE ACCOMPLISHED BY THE SPECIFIED ROLLING EQUIPMENT. AT LEAST TWO ROLLERS SHALL BE PROVIDED FOR EACH PAVER OPERATING ON THE SPECIFIED WORK. ADDITIONAL 10-TON ROLLERS SHALL BE PROVIDED IF THE SPECIFIED PAVEMENT DENSITY IS NOT OBTAINED BY THE OPERATION OF THE MINIMUM NUMBER OF ROLLERS.

ROLLING SHALL BEGIN AS SOON AFTER PLACING AS THE ASPHALTIC CONCRETE MIXTURE WILL BEAR THE WEIGHT OF THE ROLLER WITHOUT UNDUE DISPLACEMENT.

DELAYS IN ROLLING THE FRESHLY SPREAD ASPHALTIC CONCRETE MIXTURE WILL NOT BE PERMITTED.

DURING ROLLING, THE ROLLER WHEELS SHALL BE KEPT MOIST WITH THE MINIMUM AMOUNT OF WATER NECESSARY TO AVOID PICKING UP THE ASPHALTIC CONCRETE MIXTURE.

IN ALL PLACES NOT ACCESSIBLE TO THE ROLLERS, THE ASPHALTIC CONCRETE MIXTURE SHALL BE COMPACTED THOROUGHLY WITH HOT HAND TAMPERS.

---ROLLING PROCEDURE

ROLLING SHALL START LONGITUDINALLY AT THE EXTREME SIDES OF LANES AND SHALL PROCEED TOWARD THE CENTER OF THE PAVEMENT, EXCEPT ON SUPER-ELEVATED CURVES. ROLLING ON SUPER-ELEVATED CURVES SHALL BEGIN ON THE LOW SIDE AND PROGRESS TO THE HIGH SIDE, OVERLAPPING ON SUCCESSIVE TRIPS BY AT LEAST ONE-HALF THE WIDTH OF THE REAR WHEEL OF THE ROLLER.

ALTERNATE TRIPS OF THE ROLLER SHALL BE OF SLIGHTLY DIFFERENT LENGTHS.

THE ROLLERS SHALL MOVE AT A SLOW BUT UNIFORM SPEED WITH THE DRIVE ROLL OR WHEEL NEAREST THE BITUMINOUS PAVER. THE SPEED OF THE ROLLERS SHALL NOT EXEED 3 MILES PER HOUR FOR STEEL WHEELED ROLLERS OR 5 MILES PER HOUR FOR PNEUMATIC TIRED ROLLERS.

---INITIAL ROLLING

THE INTIIAL ROLLING SHALL BE ACCOMPLISHED BY USE OF 3-WHEEL STEEL ROLLER, AND SHALL IMMEDIATELY FOLLOW THE ROLLING OF THE LONGITUDINAL JOINT AND EDGES. THE ROLLERS SHALL BE OPERATED AS CLOSE TO THE BITUMINOUS PAVER AS POSSIBLE WITHOUT CAUSING UNDUE DISPLACEMENT.

PRELIMINARY TEST OF CROWN, GRADE, AND SMOOTHNESS SHALL BE MADE IMMEDIATELY AFTER THE INITIAL ROLLING.

BEFORE THE ROLLING IS CONTINUED, DEFICIENCIES SHALL BE CORRECTED BY ADDING OR REMOVING MATERIALS SO THAT THE FINISHED COURSE WILL CONFORM TO THE REQUIREMENTS FOR GRADE AND SMOOTHNESS SPECIFIED HEREINAFTER IN "SURFACE REQUIREMENTS".

---SECOND ROLLING

THE SECOND ROLLING SHALL BE ACCOMPLISHED BY THE USE OF PNEUMATIC TIRED ROLLERS. THE SECOND ROLLING SHALL FOLLOW THE INITIAL ROLLING AS CLOSELY AS POSSIBLE AND WHILE THE ASPHALTIC CONCRETE MIXTURE IS HOT AND IN CONDITION SUITABLE FOR PROPER COMPACTION.

PNEUMATIC TIRED ROLLING SHALL BE CONTINUOUS (AT LEAST 3 COMPLETE COVERAGES) AFTER THE INITIAL ROLLING UNTIL ALL OF THE MIXTURE PLACED HAS BEEN THOROUGHLY COMPACTED.

TURNING OF PNEUMATIC TIRED ROLLERS ON THE HOT MIXTURE WHICH CAUSES UNDUE DISPLACEMENT WILL NOT BE PERMITTED.

---FINISH ROLLING

FINISH ROLLING SHALL BE ACCOMPLISHED BY THE USE OF STEEL WHEELED OR PNEUMATIC TIRED ROLLERS. THE FINISH ROLLING SHALL BE DONE WHILE THE MIXTURE IS STILL WARM ENOUGH FOR THE REMOVAL OF ROLLER MARKS. THE ROLLING SHALL CONTINUE UNTIL ALL ROLLER MARKS ARE ELIMINATED AND THE ASPHALTIC CONCRETE COURSE HAS THE DENSITY SPECIFIED HEREINAFTER IN "DENSITY AND THICKNESS REQUIREMENTS".

---PATCHING DEFICIENT AREAS

ASPHALTIC CONCRETE MIXTURES THAT BECOME MIXED WITH FOREIGN MATERIAL OR THAT ARE DEFECTIVE, SUCH AS LOW AREAS OR "BIRD-BATHS", SHALL BE REMOVED AND REPLACED WITH FRESH ASPHALTIC CONCRETE TO OBTAIN THE GRADE AND SMOOTHNESS REQUIRED FOR THE FINISHED SURFACE AND COMPACTED TO THE DENSITY SPECIFIED HEREIN.

THE PAVEMENT IN DEFICIENT AREAS SHALL BE REMOVED THE FULL THICKNESS OF THE COURSE AND SHALL BE SO CUT THAT THE SIDES ARE PERPENDICULAR AND PARALLEL TO THE DIRECTION OF TRAFFIC AND THE EDGES ARE VERTICAL. EDGES SHALL BE SPRAYED WITH BITUMINOUS TACK COAT MATERIAL AS SPECIFIED HEREINBEFORE IN "PRIMING OTHER CONTACT SURFACES".

SKIN PATCHING OF AN AREA THAT HAS BEEN ROLLED WILL NOT BE PERMITTED.

---PROTECTION OF PAVEMENT

AFTER FINAL ROLLING, VEHICULAR TRAFFIC OF ANY KIND SHALL NOT BE PERMITTED ON THE BITUMINOUS CONCRETE PAVEMENT UNTIL IT HAS COOLED AND HARDENED, AND IN NO CASE LESS THAN SIX HOURS.

---ACCEPTANCE PROVISIONS---

---GENERAL

THE COMPLETED ASPHALTIC CONCRETE BASE COURSE SHALL BE TESTED FOR DENSITY, SURFACE SMOOTHNESS, AND THICKNESS DURING CONSTRUCTION FOR COMPLIANCE TO THE REQUIREMENTS SPECIFIED HEREINAFTER.

---DENSITY AND THICKNESS REQUIREMENTS

PAVEMENT SPECIMENS OF THE COMPLETED COURSE SHALL BE TAKEN ON THE BASIS SPECIFIED HEREINBEFORE IN THE ARTICLE ENTITLED "BITUMINOUS CONCRETE SAMPLING AND TESTING". THE DIAMETER OF PAVEMENT SPECIMENS SHALL BE NOT LESS THAN THREE INCHES. THE LOCATIONS FOR THE REMOVAL OF PAVEMENT SPECIMENS SHALL BE AS DIRECTED BY THE CONTRACTING OFFICER. THE TEST HOLES SHALL BE REPAIRED AS SPECIFIED HEREINBEFORE IN "PATCHING DEFICIENT AREAS".

THE DENSITY OF THE COMPLETED COURSE SHALL BE NOT LESS THAN 95 PERCENT OF THE DENSITY OBTAINED IN A LABORATORY SPECIMEN OF THE SAME BITUMINOUS CONCRETE MIXTURE WHEN SUBJECTED TO 50 BLOWS OF THE STANDARD MARSHALL HAMMER ON EACH SIDE OF THE SPECIMEN.

THE THICKNESS SHALL NOT VARY FROM THE INDICATED THICKNESS BY MORE THAN 1/4 INCH FOR THE SURFACE COURSE.

---SURFACE REQUIREMENTS

THE FINISHED SURFACE SHALL BE TESTED FOR SMOOTHNESS IN THE PRESENCE OF THE CONTRACTING OFFICER WITH A TEN FOOT STRAIGHTEDGE APPLIED PARALLEL WITH AND AT RIGHT ANGLES TO THE CENTERLINE OF THE PAVED AREA. THE ENTIRE PAVED AREA SHALL BE CHECKED FROM ONE SIDE TO THE OTHER. ADVANCE ALONG THE PAVEMENT SHALL BE IN SUCCESSIVE STAGES OF NOT MORE THAN HALF THE LENGTH OF THE STRAIGHTEDGE.

BASE COURSE SURFACE SHALL VARY NOT MORE THAN 1/4 INCH FROM THE STRAIGHTEDGE.

SURFACE COURSE SURFACE SHALL VARY NOT MORE THAN 1/8 INCH FROM THE STRAIGHTEDGE.

THE FINAL SURFACE SHALL BE OF UNIFORM TEXTURE AND SHALL CONFORM TO THE REQUIRED GRADE AND CROSS SECTION. LOW OR DEFECTIVE AREAS SHALL BE IMMEDIATELY CORRECTED BY CUTTING OUT THE FAULTY AREAS AND REPLACING AS SPECIFIED HEREINBEFORE IN "PATCHING DEFICIENT AREAS".

SECTION 2T

TOPSOILING AND SEEDING

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS, ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
FS	FEDERAL SPECIFICATIONS

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR REFERENCE SPECIFICATION MATERIALS.

LABORATORY TEST REPORTS FOR PROPOSED MATERIALS.

---WEATHER LIMITATIONS

TOPSOIL SHALL NOT BE PLACED WHEN THE SUBGRADE IS FROZEN, EXCESSIVELY WET, EXTREMELY DRY, OR IN ANY OTHER CONDITION DETRIMENTAL TO GRASS SEED PLANTING OR FINISH GRADING.

SEEDING SHALL BE DONE BETWEEN MARCH 15 AND MAY 1 OR SEPTEMBER 1 AND OCTOBER 15, UNLESS OTHERWISE PERMITTED IN WRITING BY THE CONTRACTING OFFICER.

WHEN DELAYS IN OPERATIONS CARRY THE SPECIFIED WORK BEYOND THE MOST FAVORABLE GRASS SEED PLANTING SEASON, OR WHEN CONDITIONS ARE SUCH, BY REASON OF DROUGHT, WINDS EXCEEDING 5 MILES PER HOUR, EXCESSIVE MOISTURE OR OTHER FACTORS, THAT SATISFACTORY RESULTS ARE NOT LIKELY TO BE OBTAINED, THE SPECIFIED WORK SHALL BE STOPPED AND RESUMED ONLY WHEN CONDITIONS ARE FAVORABLE FOR SEEDING OPERATIONS.

---DELIVERY AND STORAGE

GRASS SEED AND FERTILIZER SHALL BE DELIVERED TO THE PROJECT SITE IN SEALED CONTAINERS OR BAGS, EACH FULLY LABELED IN ACCORDANCE WITH THE APPLICABLE FEDERAL AND STATE REGULATIONS, AND BEARING THE NAME, TRADE NAME OR TRADE MARK, AND CERTIFICATION OF THE PRODUCER.

PACKAGED MATERIALS SHALL BE STORED OFF THE GROUND AND UNDER WATERTIGHT COVERS, AWAY FROM SWEATING WALLS AND OTHER DAMP SURFACES, UNTIL READY FOR USE.

---PROTECTION

THE SEEDED AREAS SHALL BE PROTECTED AGAINST TRAFFIC OR OTHER USE BY ERECTING BARRICADES AROUND EACH AREA IMMEDIATELY AFTER SEEDING IS COMPLETED AND BY PLACING WARNING SIGNS OF AN APPROVED TYPE ON EACH SEEDED AREA.

---AREA

THE AREA TO BE GRASSED SHALL BE THE AREA CLEARED AND GRUBBED, EXCLUSIVE OF PAVED AREAS, AND OTHER GRASSED AREAS DISTURBED BY THE CONTRACTOR'S OPERATIONS.

---SAMPLING AND TESTING---

---TESTING SERVICE

SAMPLES OF THE MATERIALS TO BE TESTED SHALL BE FURNISHED BY THE CONTRACTOR AS SPECIFIED HEREINAFTER.

TESTING SERVICE SHALL BE PROVIDED BY THE CONTRACTOR.

THE FOLLOWING MATERIALS PROPOSED FOR USE IN THE WORK SHALL BE SAMPLED AND TESTED TO DETERMINE CONFORMANCE TO THE REQUIREMENTS SPECIFIED IN THE ARTICLE ENTITLED "MATERIALS", AS FOLLOWS:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
TOPSOIL	CHEMICAL AND MECHANICAL ANALYSIS	CURRENT METHOD OF THE ASSOCIATION OF AGRICULTURAL CHEMISTS	ONE FOR EACH SOURCE OF TOPSOIL
GRASS SEED	SAMPLING PERCENT PURE GRASS SEED PERCENT GERMINATION AND HARD SEED PERCENT WEED SEED	FS JJJ-S-181B SECTION 4, UNLESS OTHERWISE SPECIFIED HEREIN	ONE FOR EACH GRASS SEED LOT

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
FERTILIZER	CHEMICAL ANALYSIS NONACID FORMING PROPERTIES SIEVE ANALYSIS	FS O-F-241D SECTION 4	ONE FOR EACH FERTILIZER LOT

---TOPSOIL

THE TOPSOIL PREVIOUSLY REMOVED AND STOCKPILED IN THE DESIGNATED TOPSOIL STORAGE AREAS ON GOVERNMENT PROPERTY SHALL BE USED IN THE WORK. THE TOPSOIL SHALL BE REASONABLY FREE FROM SUBSOIL, CLAY LUMPS, BRUSH, OBJECTIONABLE WEEDS, AND OTHER LITTER, AND SHALL BE FREE FROM STONES, STUMPS, AND OTHER OBJECTS LARGER THAN TWO INCHES IN ANY DIMENSION, ROOTS, AND OTHER OBJECTIONABLE MATERIAL.

---GRASS SEED

GRASS SEED FOR LAWN AREAS SHALL BE AS FOLLOWS:

KIND OF GRASS SEED	GRASS SEED IN MIXTURE BY WEIGHT PERCENTAGE	MINIMUM GRASS SEED PURITY PERCENTAGE	MINIMUM GRASS SEED GERMINATION PERCENTAGE
COMMON BERMUDA	20	92.5	85
HULLED PENSACOLA BAHIA	80	85	85

GRASS SEED SHALL MEET THE REQUIREMENTS OF FS JJJ-S-181B WITH THE MODIFICATION IN THE REFERENCED FS SECTION AS FOLLOWS:

FS SECTION 5 "PREPARATION AND DELIVERY". DELETE FS SECTION AND SUBSTITUTE,"GRASS SEED SHALL BE PACKAGED AND LABELED AS SPECIFIED IN THE PROJECT SPECIFICATIONS".

GRASS SEED WHICH HAS BECOME WET, MOLDY, OR OTHERWISE DAMAGED IN TRANSIT OR STORAGE WILL NOT BE ACCEPTABLE.

LIME SHALL BE AGRICULTURAL GROUND LIMESTONE HAVING A CALCIUM CARBONATE EQUIVALENT OF NOT LESS THAN 85 PERCENT, GROUND TO SUCH FINENESS THAT AT LEAST 99 PERCENT WILL PASS THROUGH A NO. 8 SIEVE AND AT LEAST 75 PERCENT WILL PASS THROUGH A NO. 60 SIEVE, AND SHALL MEET THE REQUIREMENTS OF ASTM C602-69(1975) AGRICULTURAL LIMESTONE CLASS DESIGNATION T.

---FERTILIZER

FERTILIZER SHALL BE COMMERCIAL MIXED FERTILIZER, THE TYPE SUITABLE FOR APPLICATION WITH APPROVED EQUIPMENT, GRADE 12-8-8, AND PHYSIOLOGICALLY NEUTRAL, AND SHALL MEET THE REQUIREMENTS OF FS O-F-241D, TYPE I OR TYPE II.

---MULCH

MULCH SHALL BE STRAW OF WHEAT, RYE OR OATS, OR PANGOLA, PEANUT, BERMUDA OR BAHIA GRASS HAY.

MULCH THAT IS FRESH AND EXCESSIVELY BRITTLE, OR THAT IS IN SUCH AN ADVANCED STAGE OF DECOMPOSITION AS TO SMOTHER OR RETARD THE GROWTH OF GRASS WILL NOT BE ACCEPTABLE.

---TOPSOILING---

---SUBGRADE PREPARATION

BEFORE PLACING THE TOPSOIL, THE SUBGRADE SURFACE SHALL BE CLEARED OF ALL MATERIALS THAT MIGHT HINDER THE PERFORMANCE OF THE SPECIFIED WORK OR SUBSEQUENT MAINTENANCE OPERATIONS.

---GRADING

GRADES ON THE AREAS THAT HAVE BEEN PREVIOUSLY ESTABLISHED, AS INDICATED, SHALL BE MAINTAINED IN A TRUE AND EVEN CONDITION.

WHERE THE GRADES HAVE NOT BEEN ESTABLISHED, AND WHERE IMPROPERLY GRADED, THE AREAS SHALL BE UNIFORMLY GRADED. THE FINISHED SURFACE SHALL BE SMOOTH WITHIN A TOLERANCE OF 0.1 FOOT ABOVE OR BELOW THE INDICATED SUBGRADE ELEVATIONS, AND WITH UNIFORM LEVELS OR SLOPES BETWEEN THE POINTS WHERE ELEVATIONS ARE INDICATED,

OR BETWEEN SUCH POINTS AND EXISTING GRADES, AND FREE FROM IRREGULAR SURFACE CHANGES TO PREVENT THE FORMATION OF DEPRESSIONS WHERE WATER WILL STAND.

---TILLAGE

IMMEDIATELY PRIOR TO PLACING THE TOPSOIL, THE SUBGRADE WHEREVER EXCESSIVELY COMPACTED BY TRAFFIC OR OTHER CAUSE SHALL BE LOOSENED TO A DEPTH OF AT LEAST 3 INCHES BY PLOWING, DISCING, HARROWING, OR OTHER APPROVED MEANS.

---PLACING TOPSOIL

THE TOPSOIL SHALL BE UNIFORMLY DISTRIBUTED ON THE SUBGRADE SURFACE AND EVENLY SPREAD TO AN AVERAGE THICKNESS OF 4 INCHES, PLUS OR MINUS 1/2 INCH.

TOPSOIL SPREADING SHALL BE PERFORMED IN SUCH MANNER THAT GRASS SEED PLANTING CAN PROCEED WITH LITTLE ADDITIONAL SOIL PREPARATION OR TILLAGE. IRREGULARITIES IN THE SURFACE RESULTING FROM TOPSOILING OR OTHER OPERATIONS SHALL BE CORRECTED SO AS TO PREVENT THE FORMATION OF DEPRESSIONS WHERE WATER WILL STAND.

---APPLICATION OF FERTILIZER

FERTILIZER SHALL BE UNIFORMLY DISTRIBUTED OVER THE TOPSOIL SURFACE AT A RATE OF 25 POUNDS PER 1000 SQUARE FEET, AND SHALL BE INCORPORATED INTO THE TOPSOIL TO A DEPTH OF AT LEAST ONE INCH BY DISCING, HARROWING OR OTHER APPROVED MEANS.

INSTEAD OF THE ABOVE, FERTILIZER MAY BE APPLIED MIXED WITH SEED AND WATER AS SPECIFIED IN THE ARTICLE ENTITLED "SEEDING".

---SMOOTH GRADING

UNDULATIONS OR IRREGULARITIES IN THE TOPSOIL SURFACE RESULTING FROM ANY OPERATION SPECIFIED HEREINBEFORE SHALL BE LEVELED.

MEMBRANE CURING COMPOUNDS SHALL NOT BE USED ON SURFACES THAT ARE TO BE COVERED WITH A COATING MATERIAL APPLIED DIRECTLY TO THE CONCRETE OR WITH A COVERING MATERIAL BONDED TO THE CONCRETE, SUCH AS OTHER CONCRETE, LIQUID FLOOR HARDENER, WATERPROOFING, DAMPPROOFING, MEMBRANE ROOFING, FLOORING, PAINTING, AND OTHER COATINGS AND FINISH MATERIALS.

---CURING FORMED SURFACES

THE CURING OF FORMED SURFACES, INCLUDING THE UNDERSURFACES OF GIRDERS, BEAMS, SUPPORTED SLABS AND OTHER SIMILAR SURFACE, SHALL BE ACCOMPLISHED BY MOIST CURING WITH THE FORMS IN PLACE FOR THE FULL CURING PERIOD OR UNTIL THE FORMS ARE REMOVED. IF THE FORMS ARE REMOVED BEFORE THE END OF THE CURING PERIOD, FINAL CURING OF THE FORMED SURFACES SHALL BE ACCOMPLISHED BY ANY OF THE CURING METHODS SPECIFIED ABOVE, AS APPLICABLE.

---CURING UNFORMED SURFACES

INITIAL CURING OF UNFORMED SURFACES, SUCH AS MONOLITHIC SLABS AND OTHER FLAT SURFACES, SHALL BE ACCOMPLISHED BY MEMBRANE CURING.

FINAL CURING OF UNFORMED SURFACES, UNLESS OTHERWISE SPECIFIED HEREINAFTER, SHALL BE ACCOMPLISHED BY ANY OF THE CURING METHODS SPECIFIED ABOVE, AS APPLICABLE.

FINAL CURING OF CONCRETE SURFACES TO RECEIVE LIQUID FLOOR HARDENER OR FINISH FLOORING SHALL BE ACCOMPLISHED BY MOISTURE RETAINING COVER CURING.

---PROTECTION FROM MECHANICAL INJURY

DURING THE CURING PERIOD, THE CONCRETE SHALL BE PROTECTED FROM DAMAGING MECHANICAL DISTURBANCES PARTICULARLY LOAD STRESSES, HEAVY SHOCK, AND EXCESSIVE VIBRATION AND FROM DAMAGE CAUSED BY RAIN OR RUNNING WATER.

---PROTECTION AFTER CURING

ALL FINISHED CONCRETE SURFACES SHALL BE PROTECTED FROM DAMAGE BY CONSTRUCTION OPERATIONS.

---INSPECTION AND ACCEPTANCE PROVISIONS---

---EVALUATION OF CONCRETE QUALITY CONTROL TEST RESULTS

THE CONCRETE QUALITY CONTROL TESTS SPECIFIED HEREINBEFORE IN THE ARTICLE ENTITLED "QUALITY CONTROL TESTING DURING CONSTRUCTION" WILL BE EVALUATED AS SPECIFIED HEREINAFTER.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AS FOLLOWS:

PROVIDE CERTIFICATION FOR ALL COATING MATERIALS PROPOSED FOR USE IN THE PROJECT, CERTIFYING THAT PROPOSED COATING MATERIALS MEET THE PROJECT SPECIFICATIONS AND THE LISTED REFERENCE SPECIFICATIONS.

---DESCRIPTIVE DATA

SUBMIT DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

COATING MANUFACTURER'S NAME AND IDENTIFICATION OF EACH COATING MATERIAL.

DETAILED ANALYSIS OF EACH COATING MATERIAL REQUIRED FOR THE PROJECT, WITH ALL THE COATING CONSTITUENTS MEASURED AS PERCENTAGES OF THE TOTAL WEIGHT OF THE COATING.

COATING MANUFACTURER'S DATA CONCERNING APPLICATION, THINNING, AVERAGE COVERAGE PER GALLON AND OTHER SIMILAR ITEMS.

---SAMPLES

PROVIDE SAMPLES IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" AS FOLLOWS:

PROVIDE THREE COLOR CHIPS OF EACH FINISH COLOR AND GLOSS AS SCHEDULED. CHIPS SHALL BE 4 INCHES BY 8 INCHES.

PROVIDE THREE SAMPLES OF EACH NATURAL AND STAINED WOOD FINISH AS REQUIRED.

FINISH SAMPLES SHALL BE FURNISHED ON 4 INCH BY 8 INCH BOARDS OF THE SAME MATERIAL SPECIFIED FOR THE PROJECT.

---TESTS FOR COATING THICKNESS

FILM THICKNESS OF ZINC-RICH COATINGS SHALL BE AS SPECIFIED IN SECTION 9L. TOTAL TOP COATING FOR NON-ZINC-RICH SYSTEMS SHALL HAVE A DRY FILM THICKNESS OF NOT LESS THAN 3 MILS. CONTRACTOR SHALL APPLY ADDITIONAL COATS TO SURFACES WHERE THERE IS LESS THAN HEREIN SPECIFIED MINIMUM DRY FILM THICKNESS.

MATERIALS AND EQUIPMENT SHALL BE AS SPECIFIED HEREIN AND AS SHOWN ON THE DRAWINGS AND SHALL BE THE PRODUCT OF MANUFACTURERS REGULARLY ENGAGED IN THE MANUFACTURE OF EACH PRODUCT. WHERE TWO OR MORE UNITS OF THE SAME CLASS OF EQUIPMENT ARE REQUIRED, THESE UNITS SHALL BE OF THE SAME MANUFACTURER AND SHALL BE DIRECTLY INTERCHANGEABLE WHEN OF THE SAME RATING.

ALL MATERIALS THAT ARE SHOWN ON THE DRAWINGS AND LISTED IN THE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED OR INDICATED, SHALL BE FURNISHED AS A PART OF THE CONTRACT.

ANY ITEM CALLED FOR ON THE DRAWINGS, BUT OMITTED IN THESE SPECIFICATIONS, OR CALLED FOR IN THESE SPECIFICATIONS, BUT OMITTED FROM THE DRAWINGS, SHALL BE FURNISHED AND INSTALLED AS THOUGH INCLUDED IN BOTH.

---APPLICABLE PUBLICATIONS

THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO:

ANSI A 17.1-1971 ANSI A 17.1B-1973	AMERICAN NATIONAL STANDARD SAFETY CODE FOR ELEVATORS, DUMBWAITERS, ESCALATORS AND MOVING WALKS (HEREINAFTER REFERRED TO AS ASE CODE).
ANSI A 17.2-1972	AMERICAN STANDARD PRACTICE FOR THE INSPECTION OF ELEVATORS - INSPECTORS MANUAL.
NEC-1975	NATIONAL ELECTRICAL CODE 1975 (NFPA NO. 70-1975)

---GENERAL ARRANGEMENT

THIS SHALL BE IN ACCORDANCE WITH THE CONTRACT DRAWINGS AND THESE SPECIFICATIONS. SUBSEQUENT TO THE CONTRACTING OFFICER'S APPROVAL OF THE SHOP DRAWINGS SUBMITTED BY THE CONTRACTOR COVERING THE REVISED ELEVATOR SYSTEM, THE STRUCTURES, SPACE REQUIREMENTS AND OTHER WORK FOR ACCOMMODATING THE ELEVATOR SYSTEM SHALL BE INCORPORATED IN THE SHOP DRAWINGS. FOR ALL OTHER WORK OF THE CONTRACTOR COVERED BY THE RESPECTIVE SECTIONS OF THESE SPECIFICATIONS AND MODIFICATIONS THERETO, IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CHECK THE FINAL SHOP DRAWINGS FOR THE STRUCTURAL STEEL AND OTHER WORK AND TO DETERMINE THAT REQUIREMENTS ARE MET FOR OVERHEAD CLEARANCES, PIT CLEARANCES, OVERALL SPACE REQUIREMENTS, SIZES AND WEIGHTS OF ASSEMBLIES WITH RESPECT TO ERECTION TECHNIQUES AND CONSTRUCTION CONDITIONS. THE CONTRACTOR WILL BE REQUIRED TO PAY ALL COSTS OCCASIONED BY ANY ADDITIONAL SPACE REQUIREMENTS OR CONSTRUCTION CHANGES THAT THE CONTRACTOR MAY REQUIRE OR DESIRE TO PROPERLY INSTALL HIS WORK AND SUCH CHANGES AND ANY COSTS THEREFOR SHALL BE PERFORMED BY THE CONTRACTOR WITHOUT COST TO THE GOVERNMENT. ALL RECESSES, CUTOUTS, SLOTS, HOLES, PATCHING, ETC., TO ACCOMMODATE THE INSTALLATION OF SIGNAL FIXTURES, LANDING STATIONS, ROPES, CABLES, ETC., SHALL BE PROVIDED BY THE CONTRACTOR WITHOUT ADDITIONAL COST TO THE GOVERNMENT. OTHER THAN HEREIN SPECIFIED, THE GENERAL ARRANGEMENT SHALL BE EQUIVALENT TO THAT EXISTING ON ML NO. 1, EXCEPT THAT THE LOWER PORTION SHALL HAVE BLAST PROTECTION AS SPECIFIED, THE PIT DEPTH IS REDUCED, THE NUMBER OF STOPS ARE FEWER, AND THE EGRESS CONTROLLER/DISTRIBUTOR AND SPECIFIED INTERCONNECTING WIRING SHALL BE REMOVED.

---ELECTRICAL WORK

ALL ELECTRICAL WORK SHALL COMPLY WITH THE APPROPRIATE PARTS OF DIVISION 16 OF THE SPECIFICATIONS, AND ARTICLE 620 OF THE NEC. HAZARD-PROOFING SHALL COMPLY WITH SECTION 16V (PART 2) OF THE SPECIFICATIONS.

---BONDING AND GROUNDING

ALL METALS SHALL BE BONDED AND GROUNDED AS OUTLINED IN SECTION 16X (PART 51) OF THE SPECIFICATIONS

---MATERIALS

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL MATERIALS, SURFACES AND FINISHES FROM ANY CAUSE PRIOR TO FINAL ACCEPTANCE OF THE TOTAL WORK COVERED BY THESE SPECIFICATIONS. ALL DAMAGES SHALL BE REPAIRED AND/OR REFINISHED TO THE FULL SATISFACTION OF THE CONTRACTING OFFICER. THE CONTRACTOR SHALL PROTECT ALL UNPAINTED, MACHINED SURFACES FROM CORROSION FROM ANY CAUSE DURING SHIPMENT, STORAGE AT THE SITE AND CONSTRUCTION OPERATIONS SUCH THAT THESE SURFACES ARE IN NEW CONDITION, FREE FROM RUST AND CORROSION DAMAGE, AT THE TIME OF FINAL ACCEPTANCE. TEMPORARY PROTECTION SHALL BE GENERALLY A WAX OR GREASE TYPE MATERIAL SPECIFICALLY FORMULATED AS A TEMPORARY PROTECTIVE COATING FOR MACHINED SURFACES. THE TEMPORARY COATING SHALL BE COMPLETELY REMOVED AND THE SURFACES PROPERLY LUBRICATED PRIOR TO FINAL ACCEPTANCE. THE TEMPORARY COATING AND THE OPERATIONS OF APPLICATIONS AND REMOVAL SHALL NOT DAMAGE OR DETRACT FROM THE ULTIMATE PROPERTIES OF PERMANENT COATINGS. LOST OR PILFERED ITEMS SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.

---HOISTWAY ENCLOSURE

THE CONTRACTOR SHALL PROVIDE NEW HOISTWAY ENCLOSURE FOR BLAST PROTECTION AS SHOWN ON DRAWINGS. FROM THE NEW PIT TO LANDING 27, ENCLOSURE SHALL BE REINFORCED CONCRETE. FROM LANDING MLP TO LANDING 67, ENCLOSURE SHALL BE NEW STEEL FRAMING WITH 1/4 INCH THICK COVER PLATE. THE HOISTWAY AT LANDINGS 27, 67 AND ABOVE SHALL EACH BE PROVIDED WITH NEW METAL SIDING WAINSCOAT (REMOVE EXISTING CERAMIC-COATED SIDING) ABOVE WHICH SHALL BE INSTALLED EXISTING FRAMED WOVEN WIRE MESH PANELS.

---PAINTING AND FINISHING

PAINTING AND FINISHING SHALL CONFORM TO THE REQUIREMENTS OF SECTION 9A OF THE SPECIFICATIONS. COLORS SHALL CONFORM TO SECTION 13L.

ALL DAMAGED FINISHES AND ALL CORRODED FERROUS METALS SHALL BE CLEANED AND TOUCHED-UP WITH SPECIFIED METAL PRIMER COMPATIBLE WITH EXISTING FINISH AND SUBSEQUENT COATS TO BE APPLIED. WHERE NEW STRUCTURAL STEEL IS PROVIDED (BLAST PROTECTION, BUFFER SUPPORTS, PIT STEEL, RAIL BRACKETS, ETC.), IT SHALL RECEIVE A SHOP COAT OF INORGANIC ZINC-RICH COATING. OTHER NEW FERROUS METALS SHALL BE PRIMED AND FINISHED TO THE MANUFACTURER'S STANDARDS

FOLLOWING TOUCH-UP AND PREPARATION OF SURFACES AS SPECIFIED, TWO COATS OF PAINT SHALL BE APPLIED TO THE FOLLOWING FERROUS METAL SURFACES: INTERIOR AND EXTERIOR OF ELEVATOR MACHINE AND AUXILIARY EQUIPMENT

ROOMS; INTERIOR AND EXTERIOR OF ELEVATOR HOISTWAY (EXCEPT FACTORY-COATED SIDING); AND LANDING DOORS AND FRAMES; AND TWO ELEVATOR CARS.

---STORAGE

AN AREA FOR STORAGE OF MATERIAL AND EQUIPMENT WILL BE PROVIDED BY THE GOVERNMENT. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO TRANSPORT, HANDLE, AND PLACE ALL MATERIAL AND EQUIPMENT, AS REQUIRED. THE CONTRACTOR SHALL TAKE NECESSARY STEPS AS REQUIRED TO PROTECT ALL EQUIPMENT. REFER TO THE "CONTRACT SCHEDULE" FOR FURTHER DETAILS.

---SUBMITTALS OF SHOP DRAWINGS AND DESCRIPTIVE DATA FOR NEW MATERIALS AND EQUIPMENT

ALL SUBMITTALS SHALL CONFORM TO THE REQUIREMENTS OF THE ARTICLE "SHOP DRAWINGS" OF THE "CONTRACT SCHEDULE".

PRIOR TO SUBMITTAL OF SHOP DRAWINGS THE CONTRACTOR SHALL SUBMIT TO THE GOVERNMENT FOR APPROVAL A COMPLETE LIST OF MATERIALS AND EQUIPMENT PROPOSED FOR INSTALLATION. THIS LIST SHALL INCLUDE MANUFACTURERS' NAMES AND MATERIAL OR EQUIPMENT IDENTIFICATION SUCH AS STYLES, TYPES, OR CATALOG NUMBERS, TO PERMIT IDENTIFICATION.

SUBMIT PROPOSED METHOD FOR TRANSPORT/ERECTION OF MACHINE ROOM WHICH HAS EQUIPMENT IN-PLACE.

IN ADDITION TO THE ABOVE AND BEFORE STARTING INSTALLATION OF ANY MATERIALS OR EQUIPMENT, THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS FOR APPROVAL. THE SHOP DRAWINGS SHALL INCLUDE CATALOG CUTS OR DRAWINGS OF THE ITEMS BEING SUBMITTED, AS WELL AS COMPLETE DETAILED WIRING DIAGRAMS. THE FOLLOWING TYPES OF NEW EQUIPMENT REQUIRE SUBMITTALS:

BOXES AND ENCLOSURES
SPECIAL RECEPTACLES
SAFETY SWITCHES
PANELBOARDS
CIRCUIT BREAKERS
LIGHTING FIXTURES
GUARDS FOR CONNECTING RODS
MOUNTINGS FOR BUFFERS
LANDING ENTRANCE AND DOORS
INDUCTORS
WIRE ROPING
CABLE TROUGHS
SUMP PUMP, MOTOR, CONTROLS
WIRE ROPING
CABLING
FACEPLATE - CAR CONTROL
FACEPLATE - CAR POSITION (CAR)
FACEPLATE - LANDING BUTTONS
FACEPLATE - CAR POSITION (LANDING)
LOCKS/LATCHES FOR EMERGENCY EXITS

---PROOFS OF COMPLIANCE

APPROVAL OF MATERIALS AND EQUIPMENT WILL BE BASED ON THE FOLLOWING:

MANUFACTURER'S PUBLISHED CATALOG DATA.

MANUFACTURER'S STATEMENT THAT THE MATERIAL OR EQUIPMENT COMPLIES WITH THE APPLICABLE FEDERAL, MILITARY, AND INDUSTRIAL SPECIFICATIONS. PROVISIONS FOR HAZARD PROOFING WITH NITROGEN GAS.

UL STAMP, LABEL, OR LISTING. IN LIEU OF SUCH STAMP, LABEL, OR LISTING, THE CONTRACTOR MAY SUBMIT A WRITTEN CERTIFICATE FROM ANY APPROVED AND NATIONALLY RECOGNIZED TESTING AGENCY ADEQUATELY EQUIPPED AND COMPETENT TO PERFORM SUCH SERVICES, STATING THAT THE MATERIALS HAVE BEEN TESTED AND THAT THE ITEMS CONFORM WITH OR EXCEED THE REQUIREMENTS OF THE UL, INCLUDING THE METHODS OF TESTING.

SUBMITTAL SHALL COMPLY WITH THE REQUIREMENTS OF THE ARTICLE ENTITLED "CERTIFICATES OF COMPLIANCE" OF THE CONTRACT SCHEDULE.

---SERVICE INTERRUPTIONS

SERVICE INTERRUPTIONS WILL BE GRANTED AT THE CONVENIENCE OF THE GOVERNMENT ONLY AND AS OUTLINED IN THE CONTRACT SCHEDULE.

---WORKMANSHIP

NEW WORK SHALL BE CAREFULLY LAID OUT IN ADVANCE. WHERE CUTTING, CHANNELING, CHASING, OR DRILLING OF FLOORS, WALLS, PARTITIONS, CONCRETE OR OTHER SURFACES IS NECESSARY FOR THE PROPER INSTALLATION OF EQUIPMENT, THE WORK SHALL BE CAREFULLY PERFORMED. ANY DAMAGE TO STRUCTURES, PIPING, OR EQUIPMENT SHALL BE REPAIRED AND REFINISHED BY SKILLED MECHANICS OF THE TRADES INVOLVED, AT NO EXTRA COST TO THE GOVERNMENT.

MATERIALS AND EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE APPROVED RECOMMENDATIONS OF THE MANUFACTURER, AS SPECIFIED BY THIS DOCUMENT, OR AS SHOWN ON THE CONTRACT DRAWINGS. THE INSTALLATION SHALL BE ACCOMPLISHED BY WORKMEN SKILLED IN THEIR OWN PARTICULAR CRAFTS, AND ALL WORK SHALL BE CONDUCTED AND FINALIZED IN A MANNER CONSISTENT WITH ACCEPTED INDUSTRY PRACTICES.

---INSPECTION, TEST AND CHECKOUT

THE CONTRACTOR SHALL CONDUCT ALL TESTS AND CHECKOUTS AS SPECIFIED. THE CONTRACTOR SHALL DEMONSTRATE AND OPERATE INSTALLED EQUIPMENT ACCORDING TO THE ASE CODE RECOMMENDATIONS AND THESE SPECIFICATIONS. THE TESTS SHALL BE PERFORMED IN THE PRESENCE OF THE CONTRACTING OFFICER. THE CONTRACTOR SHALL FURNISH ALL INSTRUMENTS AND PERSONNEL REQUIRED FOR THE TESTS AND SUBMIT WRITTEN TEST RESULTS OR REPORTS TO THE GOVERNMENT FOR APPROVAL.

THE GOVERNMENT RESERVES THE RIGHT TO PERFORM FULL-TIME OR SPOT INSPECTIONS ON ALL ASSEMBLIES, INSTALLATIONS, OR FACILITIES THROUGHOUT THE TERM OF THE CONTRACT. SUCH INSPECTIONS WILL BE ACCOMPLISHED WITH MINIMUM INTERFERENCE WITH THE CONTRACTOR'S WORK.

---HOISTWAY EQUIPMENT

THE CONTRACTOR SHALL FURNISH AND INSTALL NEW TROUGHS FOR THE TRAVELING CABLE, NEW NITROGEN PURGE HOSE AND NEW GOVERNOR ROPE. THE CONTRACTOR SHALL PROVIDE NEW HOISTWAY WIRING. THE CONTRACTOR SHALL INSTALL THE CAR AND COUNTERWEIGHT RAILS AND CAR AND COUNTERWEIGHT RAIL BRACKETS. THE CONTRACTOR SHALL INSTALL THE GOVERNOR TENSION SHEAVE, ALL LIMIT SWITCHES AND INDUCTOR SWITCHES.

DOOR OPENINGS WHICH CONSIST OF THE ENTRANCES, HANGERS AND DOOR LOCKS SHALL BE RE-USED. THE CONTRACTOR SHALL PROVIDE ELECTRICAL WIRING TO THE DOOR LOCKS.

THE CONTRACTOR SHALL ERECT THE ELEVATOR CARS, CARFRAMES AND PLATFORMS WITH APPENDAGES IN THE ELEVATOR SHAFTS, AND INSTALL THE COUNTERWEIGHTS, AND BUFFERS IN THE ELEVATOR PITS SHALL BE INSTALLED.

---REMOVED MATERIAL

TRANSPORT ALL RESIDUE TO THE SALVAGE AREA AND TURN IN TO THE CONTRACTING OFFICER.

---INSTALLATION---

---GENERAL

THE NEW SSAT ELEVATOR SYSTEM TOWER CONFIGURATION SHALL BE AS ORIGINALLY DESIGNED AND INSTALLED BUT ARRANGED TO SUIT THE NEW TRAVEL AND LANDINGS OF THE ELEVATORS.

---OPERATION

THE OPERATION OF THE ELEVATOR SYSTEM SHALL NOT BE CHANGED. THE HALL CALL AND CAR CALL OPERATION SHALL BE ALTERED AS NECESSARY AND REQUIRED FOR THE NEW TRAVEL AND LANDINGS SERVED.

---CAPACITY

THE SYSTEM SHALL RETAIN ITS PRESENT CAPACITY OF A LIVE LOAD OF 2500 LBS PER CAR.

---SPEED

THE SYSTEM SHALL RETAIN ITS PRESENT NOMINAL SPEED OF 600 FPM.

---TRAVEL

THE SYSTEM SHALL BE ARRANGED TO SERVE A RISE OF 207'.

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---LANDINGS

THE SYSTEM SHALL BE ARRANGED SO THAT EACH ELEVATOR CAR SERVES 11 LANDINGS ALL LOCATED ON THE FRONT OF THE HOISTWAY ON THE SOUTH SIDE OF THE SSAT, WHICH IS THE SAME ORIENTATION WITH RESPECT TO THE EXISTING TOWER SEGMENTS.

---POWER SUPPLY

THE ELEVATOR SHALL BE ARRANGED TO OPERATE FROM A POWER SUPPLY OF 480 VOLTS, 3 PHASE, 60 CYCLES (AS IS THE PRESENT POWER SUPPLY). PANEL P3 AND ELECTRICAL FEEDERS TO PANEL P3 ARE COVERED UNDER DIVISION 16 OF THE SPECIFICATIONS. ALL WIRING BEYOND PANEL P3 SHALL BE THE WORK OF THIS ELEVATOR SECTION OF THE SPECIFICATIONS.

---MACHINES

THE EXISTING ELEVATOR MACHINES COMPLETE WITH MOTOR AND BRAKE SHALL BE RETAINED AND REUSED.

---HOIST ROPES

NEW ELEVATOR HOIST ROPES FOR EACH CAR AND COUNTERWEIGHT SYSTEM SHALL BE PROVIDED. CAR AND COUNTERWEIGHT SHALL BE SUPPORTED BY FIVE (5) CONTINUOUS 5/8 INCH DIAMETER 6 x 19 DRAWN ZINC-COATED PREFORMED TRACTION STEEL ROPES WITH INDEPENDENT WIRE ROPE CORE, EACH HOIST ROPE HAVING A BREAKING STRENGTH OF NOT LESS THAN 24,700 POUNDS. ROPES SHALL BE DRY." (A)

---GOVERNOR ROPES

"NEW GOVERNOR ROPES SHALL BE PROVIDED AND INSTALLED IN NEW GOVERNOR ROPE TROUGHS. ELEVATOR GOVERNOR ROPES SHALL BE CONTINUOUS 1/2 INCH DIAMETER 6 X 19 DRAWN ZINC-COATED NON-PREFORMED IRON ROPES WITH FIBER CORE, EACH GOVERNOR ROPE HAVING A BREAKING STRENGTH OF NOT LESS THAN 7,500 POUNDS. ROPES SHALL BE DRY." (A)

---RAILS

THE EXISTING CAR AND COUNTERWEIGHT GUIDE RAILS SHALL BE REUSED AND INSTALLED IN A MANNER AS ORIGINALLY INSTALLED IN THE TOWER. NEW RAIL BRACKETS, FASTENINGS AND HARDWARE AS REQUIRED FOR THE INSTALLATION OF THE RAILS SHALL BE PROVIDED FOR THE CONCRETE ENCLOSED PORTION OF THE HOISTWAY. EXISTING THREADED FASTENERS SHALL NOT BE REUSED. NEW THREADED FASTENERS SHALL BE GALVANIZED AND PROVIDED BY THE CONTRACTOR.

---CAR ENCLOSURES

SHIELDS SHALL BE PROVIDED OVER THE CAR TOP CONNECTING RODS TO PREVENT BENDING AND DAMAGE BY MAINTENANCE PERSONNEL. SHIELDS, OR GUARDS, SHALL BE OF ADEQUATE STRENGTH TO SUPPORT THE WEIGHT OF A 200 POUND MAN WHEN APPLIED ON A SINGLE FOOT, AND SHALL BE CONSTRUCTED OF STEEL CONFORMING TO ASTM A36.

MACHINE ROOM EQUIPMENT FOR EACH ELEVATOR

THE MACHINE ROOM EQUIPMENT CONSISTING OF THE MACHINE, BRAKE, MOTOR, MOTOR GENERATOR SET, CONTROLLER, SELECTOR, RELAY PANEL AND GOVERNOR ALL OF WHICH ARE LOCATED ON A MACHINE ROOM DECK, SHALL BE PLACED IN POSITION ON THE TOWER ABOVE THE ELEVATOR HOISTWAY. THE CONTRACTOR SHALL PROVIDE ADEQUATE TECHNICAL SUPERVISION IN LOCATING THE MACHINE ROOM EQUIPMENT SO THAT PROPER ALIGNMENT OF THE MACHINE ROOM EQUIPMENT WITH THE HOISTWAY EQUIPMENT SHALL BE INSURED. THE CONTRACTOR SHALL SEAL AND PROVIDE CLOSURES FOR THE MACHINE ROOM AS REQUIRED TO MAINTAIN A POSITIVE INTERNAL AIR PRESSURE OF THREE INCHES OF WATER FOR WHICH THE ROOM WAS ORIGINALLY DESIGNED. PROVIDE ALTERATIONS TO THE MACHINE ROOM PRESSURIZATION AND VENTILATION SYSTEM AS SHOWN.

---INDUCTOR SWITCHES

THE EXISTING OTIS INDUCTOR SWITCHES SHALL BE REPLACED WITH NEW MV4 INDUCTORS

---LIMIT SWITCHES

THE EXISTING LIMIT SWITCHES SHALL BE RETAINED AND REUSED. THE LIMIT SWITCHES SHALL BE INSTALLED IN THEIR PROPER LOCATION TO FUNCTION AS ORIGINALLY DESIGNED FOR THIS EQUIPMENT.

---BUFFERS FOR EACH ELEVATOR

THE EXISTING OIL BUFFERS SHALL BE RETAINED AND REINSTALLED. THE BUFFERS SHALL ACT AS A MEANS OF BRINGING THE CAR AND COUNTERWEIGHTS TO A POSITIVE STOP AT THE EXTREME LOWER LIMITS OF TRAVEL. NEW BUFFER BLOCKING AND SUPPORTS SHALL BE PROVIDED AS REQUIRED FOR EACH CAR AND COUNTERWEIGHTS TO ACCOMMODATE THE REDUCED PIT DEPTH.

---TOP OF CAR INSPECTION AND PIT SWITCH

THE EXISTING TOP OF CAR INSPECTION DEVICES AND PIT SWITCH SHALL BE RETAINED AND REINSTALLED. THESE DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF ANSI A17.1, AMERICAN STANDARD SAFETY CODE FOR ELEVATORS, DUMBWAITERS, ESCALATORS AND MOVING WALKS. THE ABOVE IS TYPICAL FOR EACH ELEVATOR.

---CAR OPERATING PANEL FOR EACH CAR

THE EXISTING CAR OPERATING PANEL SHALL BE RETAINED AND REINSTALLED. THE CAR OPERATING PANEL SHALL BE ALTERED AND MODIFIED TO SUIT THE NEW LANDINGS TO BE SERVED. A NEW CAR OPERATING PANEL FACEPLATE SHALL BE PROVIDED AS SHOWN ON THE DRAWING.

---HALL BUTTONS

THE EXISTING HALL BUTTONS SHALL BE RETAINED AND REINSTALLED. NEW FACEPLATES INDICATING THE NEW LANDINGS (PAD, 27, MLP, 67, 87, 107, 127, 147, 168, 187 AND 207) SHALL BE PROVIDED AS SHOWN ON THE DRAWINGS.

---CAR SIGNALS

THE EXISTING CAR POSITION INDICATOR SHALL BE RETAINED AND REINSTALLED. THE POSITION INDICATOR SHALL BE MODIFIED AS REQUIRED TO SUIT THE NEW LANDINGS TO BE SERVED BY EACH ELEVATOR. A NEW CAR POSITION INDICATOR FACEPLATE SHALL BE PROVIDED FOR EACH CAR AS SHOWN ON THE DRAWINGS.

---LANDING POSITION INDICATORS FOR CAR

THE EXISTING LANDING POSITION INDICATOR SHALL BE RETAINED AND REINSTALLED (PAD LEVEL ONLY). THE LANDING POSITION INDICATOR SHALL BE MODIFIED AS REQUIRED TO SUIT THE NEW LANDINGS SERVED BY EACH ELEVATOR. A NEW LANDING POSITION INDICATOR FACEPLATE SHALL BE PROVIDED AS DETAILED.

---CAR DIRECTION INDICATORS

THE EXISTING CAR DIRECTION INDICATOR SHALL BE RETAINED AND REUSED. THE CAR DIRECTION INDICATOR WILL FUNCTION AS ORIGINALLY DESIGNED FOR EACH CAR.

---SUMP PUMP

A SUMP PUMP AND REQUIRED CONTROLS SHALL BE PROVIDED AND INSTALLED IN THE SSAT ELEVATOR PIT. THE SUMP PUMP SHALL BE A CENTRIFUGAL PUMP DRIVEN BY A DIRECT COUPLED 1/2 HP, 3 PHASE, 60 CYCLE, 480V MOTOR. SUMP WATER LEVEL CONTROL SHALL BE BY FLOAT OPERATED SWITCH. FLOAT AND ASSOCIATED MOVING PARTS SHALL BE OF STAINLESS STEEL. MOTOR AND LEVEL CONTROL SWITCH SHALL BE EXPLOSION-PROOF AND EACH SHALL BE EQUIPPED WITH FITTINGS AS REQUIRED BY SECTION 16V (PART 2) OF THE SPECIFICATIONS FOR HAZARDOUS INSTALLATIONS IN HIGH OXYGEN AND HYDROGEN ATMOSPHERES.

---COMMUNICATIONS FOR EACH CAR

THE EXISTING TELEPHONE CABINET AND TELEPHONE INSTRUMENT SHALL BE RETAINED AND REUSED. THE CONTRACTOR WILL PROVIDE A NEW TRAVELING CABLE TO THE HOISTWAY JUNCTION BOX AND OTHERS SHALL PROVIDE WIRING FROM THAT POINT.

---ELECTRIC DOOR OPERATORS

THE PRESENT DOOR OPERATOR SHALL BE RETAINED AND REUSED FOR EACH CAR.

---DOOR PROTECTION DEVICES

THE EXISTING DOOR PROTECTION DEVICE SHALL BE RETAINED AND REUSED FOR EACH CAR.

---ENTRANCES AT LANDINGS

THE PRESENT ENTRANCE FRAMES, SILLS, STRUTS, HEADERS, HANGER COVER PLATES, FASCIAS, DUST COVERS, TOE

ALL ELECTRICAL CONDUCTORS BETWEEN ELEVATOR CARS AND FIXED JUNCTION BOXES SHALL BE OF THE HIGHEST GRADE, FLEXIBLE, NON-KINKING, TRAVELING TYPE CABLES, PROPERLY INSULATED WITH FLAME RESISTANT AND MOISTURE RESISTANT CONDUCTIVE OUTER COVER SUITABLE FOR OUTDOOR EXPOSURE IN THE SPECIFIED ENVIRONMENT. ALL CABLES SHALL BE THE PRODUCT OF A CABLE MANUFACTURER WHO HAS FOR NOT LESS THAN THE PAST FIVE YEARS PRODUCED FLEXIBLE CABLE EXPRESSLY FOR USE AS TRAVELING CABLE FOR HIGH SPEED ELEVATOR SYSTEMS OF THE TYPE HEREIN SPECIFIED. ALL INSTALLATION WORK SHALL CONFORM TO THE REQUIREMENTS OF THESE SPECIFICATIONS, WITH PARTICULAR ATTENTION TO HAZARD PROOFING REQUIREMENTS. TEN PERCENT UNUSED SPARE WIRES SHALL BE PROVIDED IN EACH MULTIPLE CABLE. EACH END OF THE FLEXIBLE CABLE WIRES SHALL BE FASTENED TO A TERMINAL BLOCK HAVING PERMANENT IDENTIFYING NUMBERS. ALL CONDUCTORS SHALL BE IDENTIFIED WITH PERMANENT MARKING CORRESPONDING TO THE NUMBERS ON TERMINAL BLOCK STUDS. EACH CABLE END SHALL BE SO ANCHORED THAT THERE WILL BE NO STRAIN ON THE ELECTRICAL CONNECTIONS TO THE TERMINALS. NEW CABLES SHALL BE PROVIDED FOR THE FOLLOWING:

CONTROL CIRCUITS
CAR LIGHTING, BLOWER, WORK LIGHTS AND RECEPTACLES
COMMUNICATIONS (SHIELDED)
SAFETY SWITCHES
EMERGENCY STOP SWITCHES
ANY OTHER EXISTING OR ADDITIONAL EQUIPMENT INSTALLED

ALL STATIONARY CONDUCTORS, EXCEPT SWITCHBOARD WIRING, SHALL BE MINERAL INSULATED CABLE (TYPE MI), EMPLOYING FITTINGS SUITABLE FOR THE SPECIFIED HAZARDOUS ENVIRONMENT. ALL CONNECTIONS OF RIGID CONDUIT TO ROTATING MACHINERY AND/OR EQUIPMENT HAVING VIBRATION MOUNTS SHALL BE BY MEANS OF FLEXIBLE METAL CONDUIT WITH POLY-VINYLCHLORIDE OUTER JACKET. SIGNAL WIRING SHALL MEET THE REQUIREMENTS OF THE SPECIFIED EDITION OF THE NATIONAL ELECTRIC CODE. CONTROLLER PANEL WIRING SHALL MEET THE REQUIREMENTS OF THE SPECIFIED EDITION OF THE NATIONAL ELECTRICAL CODE FOR ELEVATOR SWITCHBOARDS. ALL CONDUCTORS, NO. 8 AMERICAN WIRE GAGE AND LARGER, INSTALLED IN THE FIELD SHALL BE STRANDED AND CONNECTIONS SHALL BE MADE WITH APPROVED COMPRESSION TYPE TERMINAL LUGS. NO JOINTS OR SPLICES WILL BE PERMITTED IN FEEDERS EXCEPT AT OUTLET BOXES. WHERE SIZE OF CONDUCTORS IS NOT GIVEN, THE CAPACITY SHALL BE SUCH THAT THE MAXIMUM CURRENT WILL NOT EXCEED THE LIMITS PRESCRIBED BY THE NATIONAL ELECTRIC CODE. ALL WIRING SHALL TEST FREE FROM SHORT CIRCUITS AND GROUNDS, AND THE INSULATION RESISTANCE BETWEEN CONDUCTORS, AND BETWEEN CONDUCTORS AND GROUND, SHALL BE NOT LESS THAN ONE MEGOHM.

---PROVISIONS FOR NITROGEN GAS PURGING

THE EXISTING PURGE HOSE SHALL BE REPLACED WITH NEW HOSE. FOR THOSE ELECTRICAL ITEMS LOCATED ELSEWHERE THAN WITHIN THE CONFINES OF THE MACHINE ROOM, SUCH ITEMS SHALL COMPLY WITH THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE FOR THE SPECIFIED HAZARDOUS ENVIRONMENT, OR SHALL BE EQUIPPED WITH SPECIAL ENCLOSURES AND SPECIAL FITTINGS FOR DRY NITROGEN PURGE AS SPECIFIED BY SECTION 16V (PART 2) OF THE SPECIFICATIONS.

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SECTION 14M

RAIL SYSTEM FOR PCR ROTARY BRIDGE

---GENERAL REQUIREMENTS---

---GENERAL

THIS SECTION COVERS COMPLETE RAIL SYSTEM FOR PCR ROTARY BRIDGE INCLUDING HURRICANE TIE DOWN ANCHOR BOLTS, HINGE COLUMN ANCHOR BOLTS, RAIL CLIPS, RAIL ANCHOR BOLTS, RAIL SHIMS, RAIL STOPS, GROUTING AND ALL PLANT LABOR AND EQUIPMENT NECESSARY FOR A COMPLETE INSTALLATION AS SPECIFIED HEREINAFTER AND SHOWN IN THE CONTRACT DRAWINGS.

UNLESS OTHERWISE INDICATED, THE SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL BUILDINGS OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION SHALL GOVERN THE WORK. ALL CONCRETE WORK SHALL BE IN ACCORDANCE WITH SECTION 3A. STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH SECTION 5J. WELDING SHALL BE IN ACCORDANCE WITH SECTION 17K OF THESE SPECIFICATIONS. HIGH STRENGTH BOLTING SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR ASTM A490, AS MODIFIED BY THE BONDING AND GROUNDING REQUIREMENTS LISTED UNDER SECTION 16X (PART 51). THE CONTRACTOR SHALL PROVIDE ALL BOLTING.

RAILS SHALL BE FULLY HEAT TREATED CARBON STEEL, CAREFULLY SELECTED FROM HEATS WHICH HAVE MET ALL REQUIREMENTS AND SHALL BE NO. 1 CRANE RAIL QUALITY, AND SHALL BE AS HEREINAFTER SPECIFIED.

SUBSTITUTIONS OF SECTIONS OR MODIFICATIONS OF DETAILS, OR BOTH, AND THE REASONS THEREFOR SHALL BE SUBMITTED IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" UNDER THE HEADING "DEVIATIONS AND WAIVERS."

THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ERRORS OF DETAILING, FABRICATION, AND FOR THE CORRECT INSTALLATION OF THE RAILS AND ALL ASSOCIATED ACCESSORIES.

---REFERENCE SPECIFICATIONS

THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO. IN THE EVENT OF DIFFERENCE BETWEEN THIS SPECIFICATION OR ITS ACCOMPANYING DRAWINGS AND THE REFERENCED SPECIFICATION, THIS SPECIFICATION AND ITS ACCOMPANYING DRAWINGS SHALL GOVERN TO THE EXTENT OF SUCH DIFFERENCE.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION PUBLICATIONS (AISC):

CODE OF STANDARD PRACTICE FOR STRUCTURAL STEEL BUILDINGS

MANUAL OF STEEL CONSTRUCTION

SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR ASTM A490 BOLTS

SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, WITH COMMENTARY.

AMERICAN WELDING SOCIETY (AWS):

AWS A2.4-76	STANDARD WELDING SYMBOLS
AWS D1.1-REV 2-74	STRUCTURAL WELDING CODE

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS (ASTM):

A1-76	CARBON-STEEL TEE RAILS
A325-76C	HIGH STRENGTH BOLTS FOR STRUCTURAL STEEL JOINTS, INCLUDING SUITABLE NUTS AND PLAIN HARDENED WASHERS
A354-76B	QUENCHED AND TEMPERED ALLOY STEEL BOLTS AND STUDS WITH SUITABLE NUTS
A370-76	METHODS AND DEFINITIONS FOR MECHANICAL TESTING OF STEEL PRODUCTS
A490	QUENCHED AND TEMPERED ALLOY STEEL BOLTS FOR STRUCTURAL STEEL JOINTS.

---SHOP DRAWINGS

SHOP DRAWINGS SHALL BE SUBMITTED FOR APPROVAL IN ACCORDANCE WITH THE "CONTRACT SCHEDULE." RESTRICTIONS ON FABRICATION AND DELIVERY OF MATERIAL TO THE SITE PRIOR TO APPROVAL OF SHOP DRAWINGS SHALL BE AS STATED IN THE "CONTRACT SCHEDULE." DRAWINGS SHALL INCLUDE ALL SHOP AND ERECTION DETAILS, INCLUDING CUTS, COPES, RAIL ANCHORS, CONNECTIONS, HOLES, TOLERANCES, BOLTS AND WELDS IN STRUCTURAL STEEL. ALL WELDS, BOTH SHOP AND FIELD, SHALL BE INDICATED BY STANDARD WELDING SYMBOLS IN AWS A2.4. DRAWINGS SHALL SHOW THE SIZE, LENGTH AND TYPE OF EACH WELD. ALONG WITH THE SHOP DRAWINGS, THE CONTRACTOR SHALL FURNISH FOR APPROVAL A DETAILED ERECTION PROCEDURE, INCLUDING SEQUENCE OF ERECTION AND TOLERANCES. THE CONTRACTOR SHALL INDICATE TOLERANCES ON SHOP DRAWINGS, WHERE APPLICABLE.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE IN TWO CERTIFIED COPIES AS SPECIFIED IN THE "CONTRACT SCHEDULE" FOR THE FOLLOWING ITEMS:

REPORTS OF LADLE ANALYSIS OF ALL RAIL STEEL

REPORTS OF TENSILE PROPERTIES AND BEND TESTS, AS SPECIFIED IN THE PARTICULAR REFERENCED SPECIFICATION FOR THE MATERIAL AND ASTM A370 FOR ROLLED STEEL PLATES, SHAPES AND BARS

REPORT OF CONTROLLED COOLING FOR RAILS

REPORT OF BRINELL HARDNESS FOR RAILS

REPORT OF TENSILE PROPERTIES, AS SPECIFIED IN THE PARTICULAR REFERENCE SPECIFICATION FOR THE MATERIALS AND ASTM A370 FOR STEEL CASTINGS AND STEEL FORGINGS

REPORT OF MECHANICAL TESTS, AS SPECIFIED IN THE REFERENCED SPECIFICATION FOR THE MATERIAL AND ASTM A370 FOR HIGH STRENGTH BOLTS

REPORTS OF CHEMICAL COMPOSITION, AND MECHANICAL USABILITY AND SOUNDNESS TESTS, AS SPECIFIED IN THE PARTICULAR REFERENCED SPECIFICATION FOR THE MATERIAL

CERTIFICATE OF CONFORMANCE FOR PAINT

CERTIFICATE OF CONFORMANCE FOR INSTALLATION TOLERANCE AND DIMENSIONS INCLUDING DETAILS OF SURVEY AND INSTRUMENTATION UTILIZED.

---STORAGE OF MATERIALS

RAILS AND STRUCTURAL STEEL MEMBERS WHICH ARE STORED AT THE PROJECT SITE SHALL BE STORED ABOVE GROUND AND NOT IN CONTACT WITH THE GROUND. MATERIALS SHALL BE KEPT FREE FROM DIRT, GREASE, AND OTHER FOREIGN MATTER AND SHALL BE PROTECTED FROM CORROSION.

PACKAGED MATERIALS SHALL BE STORED IN THEIR ORIGINAL, UNBROKEN PACKAGE OR CONTAINER IN A WEATHERTIGHT AND DRY PLACE UNTIL READY FOR INSTALLATION.

---PAINTING

ALL PAINTING SHALL BE IN ACCORDANCE WITH SECTION 9L "PROTECTIVE COATING OF CARBON STEEL" OF THESE SPECIFICATIONS. THIS PAINTING APPLIES TO RAIL SURFACES EXCEPT TOP OF RAIL AND SURFACES EMBEDDED IN CONCRETE.

---BONDING AND GROUNDING

BONDING OF ALL JOINTS AND CONNECTIONS SHALL BE ACCOMPLISHED AS OUTLINED IN SECTION ENTITLED "BONDING AND GROUNDING REQUIREMENTS" SECTION 16X (PART 51).

---IDENTIFICATION

ALL HEAT TREATED RAILS SHALL BE MARKED WITH THE LETTER "T"

AT THE OPTION OF THE MANUFACTURER:

THE LETTERS "CT" MAY BE HOT STAMPED INTO THE WEB OF RAILS TO BE HEAT TREATED, AND LETTER "T" TO BE PROPERLY GROUND OFF THE WEB OF ANY RAIL WHICH IS NOT SUBSEQUENTLY HEAT TREATED; OR THE LETTER "T" MAY BE COLD STAMPED ON EACH OF THE TWO END FACES OF EACH HEAT TREATED RAIL.

ALL HEAT TREATED RAILS SHALL BE PAINT MARKED ORANGE ON THE HEAD AND IN THE WEB AT OR NEAR EACH END OF EACH RAIL.

---SAFETY

SEE SECTIONS ENTITLED "CONTRACT SCHEDULE" AND "DEMOLITION WORK."

---CRANE RAILS - CURVED

PCR TRUCK DRIVE RAILS SHALL BE 175 LBS/YD FULLY HEAT TREATED TO A BRINELL HARDNESS NUMBER OF 321 TO 388. RAILS SHALL BE NO. 1 CRANE QUALITY, CARBON STEEL CRANE RAILS MANUFACTURED BY OPEN HEARTH, BASIC OXYGEN OR ELECTRIC FURNACE PROCESS AND CONTROL COOLED IN ACCORDANCE WITH ASTM A1. CHEMICAL REQUIREMENTS OF RAILS SHALL BE IN ACCORDANCE WITH ASTM A1. RAILS SHALL BE PROVIDED WITH TIGHT END JOINTS EXCEPT AS SHOWN OR NOTED ON THE DRAWINGS, SUITABLE FOR CONCRETE EMBEDDED SERVICE, EXPANSION JOINTS WHERE SHOWN, JOINT BARS MATCHING THE RAIL SECTION, JOINT BAR BOLTS AND NUTS CONFORMING TO ASTM A325, AREA ALLOY STEEL SPRING WASHERS AND TIGHT TYPE FORGED STEEL RAIL CLAMPS, AS INDICATED ON THE DRAWINGS. MANUFACTURING TOLERANCES SHALL BE COORDINATED WITH TOLERANCES FOR THE RAIL INSTALLATION TO ASSURE THAT THE FINAL INSTALLATION COMPLIES WITH SPECIFIED INSTALLATION TOLERANCES. RAILS SHALL BE EQUAL TO U.S. STEEL OR BETHLEHEM 175 POUND CRANE RAIL CROSS-SECTION HAVING DIMENSIONS AS FOLLOWS: WIDTH OF BASE = 6"; WIDTH OF HEAT AT TOP = 4 1/32"; OVERALL HEIGHT = 6"; STEM THICKNESS = 1 1/2".

---TOLERANCES

TOLERANCES IN FABRICATION AND ERECTION SHALL BE AS INDICATED ON THE DRAWINGS AND AS HEREINAFTER LISTED. SPECIAL ATTENTION IS DIRECTED TO THE RELATIONSHIP BETWEEN THE CURVED RAILS, HINGE COLUMN CENTERLINE, AND TRUCK TIE DOWN ANCHOR BOLTS. THE CONTRACTOR SHALL COORDINATE THE COMPLETE MANUFACTURING AND INSTALLATION PROCESS TO ASSURE THAT THE FINAL INSTALLATION COMPLIES WITH THE SPECIFIED TOLERANCES.

---TOLERANCES FOR RAIL INSTALLATION

HINGE COLUMN CENTERLINE	± 0.0625"
RAIL RADIUS	± 0.0625"
RAIL GAUGE	± 0.0625"
ELEVATION TOP SURFACE OF RAILS	± 0.0625"
TRUCK TIE DOWN ANCHOR BOLTS	± 0.0625"

THE RAIL GAUGE SHALL BE CHECKED USING A 3-POINT RAILROAD TYPE TRACK GAUGE CONSTRUCTED ESPECIALLY FOR THE PURPOSE OF PERMITTING AN ACCURATE DETERMINATION OF THE TRUE GAUGE OF THE RAILS. THE TRACK GAUGE SHALL BE DESIGNED TO PERMIT SETTING THE RAILS TO A GAUGE OF THREE FEET ZERO INCHES WITH A TOLERANCE OF PLUS OR MINUS 0.0625 INCHES (1/16 INCH).

JOINTS SHALL BE SMOOTH, LEVEL AND IN TRUE ALIGNMENT, OFFERING NO OBSTRUCTION TO TRUCK MOVEMENT, WELDED JOINTS SHALL BE GROUND SMOOTH. JOINTS SHALL BE CUT AT A HORIZONTAL ANGLE OF 45 DEGREES UNLESS OTHERWISE NOTED ON THE DRAWINGS.

THE CONTRACTOR SHALL SUBMIT A COMPLETE AND DETAILED FABRICATION AND INSTALLATION PLAN SHOWING PROCEDURES TO BE USED FOR RAIL INSTALLATION. AFTER INSTALLATION OF THE RAILS AND PRIOR TO FINAL GROUTING THE CONTRACTOR SHALL EMPLOY AN INDEPENDENT SURVEYING AGENCY TO VERIFY ACTUAL RAIL INSTALLATION DIMENSIONS AND RESULTING TOLERANCES. COMPLETE DETAILS OF THIS SURVEY SHALL BE SUBMITTED TO THE CONTRACTING OFFICER ACCOMPANIED BY A CERTIFICATION THAT THE RAILS HAVE BEEN INSTALLED IN COMPLETE COMPLIANCE WITH THE CONTRACT DOCUMENTS.

---CONNECTIONS

RAIL ANCHOR CLIPS SHALL BE FORGED STEEL DOUBLE BOLT CLIP AND HOLDER TYPE EQUAL TO BETHLEHEM NO. 202, UNLESS OTHERWISE NOTED ON THE DRAWINGS.

RAIL CLIP ANCHOR BOLTS SHALL BE QUENCHED AND TEMPERED MEDIUM CARBON STEEL BOLTS FOR STRUCTURAL JOINTS, INCLUDING SUITABLE NUTS AND HARDENED WASHERS, CONFORMING TO ASTM A325. ALL COMPONENTS SHALL BE GALVANIZED, CONFORMING TO ASTM A153.

ANCHOR BOLTS FOR TRUCK TIE DOWNS SHALL BE QUENCHED AND TEMPERED ALLOY STEEL BOLTS WITH SUITABLE NUTS, CONFORMING TO ASTM A354, GRADE BC.

BOLT TENSION SHALL BE PROVIDED USING THE TURN-OF-THE-NUT TIGHTENING METHOD.

HOLES SHALL BE CUT, DRILLED, OR PUNCHED AT RIGHT ANGLES TO THE SURFACE OF THE METAL AND SHALL NOT BE MADE OR ENLARGED BY BURNING. HOLES IN BASE OR BEARING PLATES SHALL BE DRILLED. HOLES SHALL BE CLEAN CUT WITHOUT TORN OR RAGGED EDGES. OUTSIDE BURRS RESULTING FROM DRILLING OR REAMING OPERATIONS SHALL BE REMOVED WITH A TOOL MAKING A 1/16 INCH BEVEL.

BOLTS SHALL BE INSERTED ACCURATELY INTO THE HOLES WITHOUT DAMAGING THE THREAD. BOLT HEADS SHALL BE PROTECTED FROM DAMAGE DURING DRIVING. BOLT HEADS AND NUTS SHALL REST SQUARELY AGAINST THE METAL. WHERE BOLTS ARE TO BE USED ON BEVELED SURFACES HAVING SLOPES GREATER THAN 1 IN 20 WITH A PLANE NORMAL TO THE BOLT AXIS, BEVELED WASHERS SHALL BE PROVIDED TO GIVE FULL BEARING TO THE HEAD OR NUT.

EACH TERMINAL END OF RAIL TRACK SYSTEM SHALL BE PROVIDED WITH THREE 1-3/16 INCH DIAMETER DRILLED HOLES FOR MOUNTING RAIL STOPS.

---SHOP PAINTING

ZINC-RICH COAT ALL STEEL WORK, EXCEPT SURFACES OF STEEL TO BE ENCASED IN CONCRETE, SURFACES TO BE WELDED, TOP SURFACES OF RAILS AND AS REQUIRED FOR BONDING AND GROUNDING. CONTACT SURFACES WITH FRICTION-TYPE JOINTS SHALL BE FREE OF OIL, PAINT, LACQUER OR GALVANIZING. SHOP COAT SHALL CONFORM TO SECTION 9L.

---ERECTION---

---GENERAL

THE ERECTION OF RAILS SHALL BE IN ACCORDANCE WITH THIS SPECIFICATION AND THE CONTRACT DRAWINGS.

WELDING WILL BE PERMITTED ONLY WHERE INDICATED OR APPROVED ON THE SHOP DRAWINGS. FASTENERS SHALL BE INSTALLED AS SPECIFIED ABOVE UNDER "---CONNECTIONS." ERECTING EQUIPMENT SHALL BE SUITABLE AND SAFE FOR THE WORKMEN. ERRORS IN SHOP FABRICATION OR DEFORMATION RESULTING FROM HANDLING AND TRANSPORTATION WHICH PREVENT THE PROPER ASSEMBLY AND FITTINGS OF PARTS SHALL BE CORRECTED PROMPTLY BY THE CONTRACTOR.

AFTER ASSEMBLY, THE VARIOUS MEMBERS FORMING PARTS OF THE COMPLETE RAIL SYSTEM SHALL BE ALIGNED AND ADJUSTED ACCURATELY BEFORE BEING FASTENED.

THE USE OF A GAS CUTTING TORCH IN THE FIELD FOR CORRECTING FABRICATION ERRORS WILL NOT BE PERMITTED. SHIMS SHALL BE ASTM A36 OR A441 MATERIAL MACHINED TO ACHIEVE THE REQUIRED INSTALLATION TOLERANCES. SHIMS SHALL BE WELDED TO THE STEEL RAIL BEAM TOP PLATE AS SHOWN ON THE CONTRACT DRAWINGS. GROUT SHALL BE EMBECO NO. 636 MIXED AND PLACED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

---ANCHOR BOLTS INSTALLATION

ANCHOR BOLTS AND ANCHORS SHALL BE CORRECTLY LOCATED AND BUILT INTO CONNECTING WORK. BOLTS AND ANCHORS SHALL BE PRESET BY THE USE OF TEMPLATES OR OTHER PRECISE METHODS AS MAY BE REQUIRED TO LOCATE THE ANCHOR BOLTS AND OTHER CONNECTIONS ACCURATELY TO THE TOLERANCES SPECIFIED.

---INSPECTION AND TESTS---

---GENERAL

ALL MATERIAL AND WORKMANSHIP FURNISHED UNDER THIS CONTRACT SHALL BE INSPECTED BY THE CONTRACTOR'S QUALITY CONTROL ORGANIZATION, MEETING THE REQUIREMENTS SET FORTH IN THE "CONTRACT SCHEDULE" SECTION OF THE CONTRACT. MATERIAL AND WORKMANSHIP SHALL BE SUBJECT TO INSPECTION AND TESTS IN THE MILL, SHOP AND FIELD BY GOVERNMENT INSPECTORS. WHEN MATERIALS AND WORKMANSHIP DO NOT CONFORM TO THE SPECIFICATION REQUIREMENTS, THE CONTRACTING OFFICER RESERVES THE RIGHT TO REJECT MATERIAL OR WORKMANSHIP, OR BOTH,AT ANY TIME BEFORE FINAL ACCEPTANCE OF THE STRUCTURE. IN CASE OF DOUBT, THE CONTRACTING OFFICER MAY REQUIRE COUPONS TO BE CUT FROM BASE AND/OR WELD MATERIAL FOR DESTRUCTIVE TESTS. IF THE MATERIAL OR WELD DOES NOT MEET THE APPLICABLE SPECIFICATIONS FOR STRENGTH AND SOUNDNESS, THE CONTRACTOR SHALL BE LIABLE FOR THE COST OF THE INVESTIGATION OF THE DEFECTIVE AREA. WHEN COUPONS ARE REMOVED FROM ANY PART OF THE STRUCTURE, THE MEMBERS SHALL BE REPAIRED IN A NEAT AND WORKMANLIKE MANNER, WITH JOINTS OF PROPER TYPE TO DEVELOP THE FULL STRENGTH OF THE MEMBERS AND JOINTS CUT, AND WITH PEENING AS NECESSARY OR AS DIRECTED TO RELIEVE RESIDUAL STRESS.

INSPECTION BY THE CONTRACTING OFFICER WILL INCLUDE PROPER PREPARATION, SIZE, GAGING LOCATION, AND DEFECTS OF WELDS; IDENTIFICATION MARKING; OPERATION AND CURRENT CHARACTERISTICS OF WELDING SETS IN USE; AND CALIBRATION OF WRENCHES FOR HIGH STRENGTH BOLTS. INSTALLATION DIMENSIONS AND TOLERANCES WILL BE INSPECTED.

INSPECTION OF WELDING WILL BE PERFORMED IN ACCORDANCE WITH SECTION 17K OF THESE SPECIFICATIONS.

---INSPECTION OF HIGH STRENGTH BOLT CONNECTIONS

INSPECTION OF HIGH STRENGTH BOLT CONNECTIONS WILL BE PERFORMED IN ACCORDANCE WITH AISC SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS, SECTION 6 "INSPECTION".

SECTION 14N

LIGHTNING MAST

---GENERAL REQUIREMENTS---

---GENERAL

PROVIDE A FIBERGLASS REINFORCED POLYESTER LIGHTNING MAST, COMPLETE WITH TOP SWIVEL ASSEMBLY, BOTTOM STEEL BASE, INTERIOR PLASTIC LADDER, WIND SPOILERS, ET CETERA, AS SHOWN ON THE DRAWINGS.

LIGHTNING MAST COMPONENTS SHALL BE DESIGNED TO SUSTAIN THE LOADINGS HEREINAFTER SPECIFIED. SAFETY FACTORS SHALL BE AS SPECIFIED.

UNLESS OTHERWISE INDICATED, THE PLASTICS TERMINOLOGY USED IN THIS SPECIFICATION SHALL BE IN ACCORDANCE WITH THE DEFINITIONS GIVEN IN ASTM D883-76.

---QUALIFICATIONS

THE LIGHTNING MAST SHALL BE THE DESIGN AND PRODUCT OF A MANUFACTURER WHO HAS BEEN ENGAGED IN THE LAST THREE YEARS IN THE FABRICATION OF FILAMENT WOUND FIBERGLASS REINFORCED POLYESTER PIPES, DUCTS OR TANKS.

SUBMIT A WRITTEN DESCRIPTION OF PROPOSED FIBERGLASS REINFORCED POLYESTER FABRICATOR GIVING QUALIFICATIONS OF PERSONNEL, LOCATION OF PLANT, FILAMENT WINDING FACILITIES AND OTHER INFORMATION AS MAY BE REQUIRED BY THE CONTRACTING OFFICER.

THREE SUGGESTED FABRICATORS FOR THE LIGHTNING MAST ASSEMBLY ARE LISTED BELOW:

JONES AND HUNT, INC.
ORWIGSBURG, PENNSYLVANIA

CORBAN INDUSTRIES
TAMPA, FLORIDA

WOLF RIDGE PLASTICS
MOBILE, ALABAMA

---SHOP DRAWINGS AND DESCRIPTIVE DATA

SUBMIT SHOP DRAWINGS AND DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

SHOP DRAWINGS INDICATING THE DIMENSIONS AND THICKNESSES OF ALL LIGHTNING MAST COMPONENTS. DRAWINGS SHALL INCLUDE ALL SHOP AND ERECTION DETAILS. ALONG WITH THE SHOP DRAWINGS, THE CONTRACTOR SHALL FURNISH A DETAILED ERECTION PROCEDURE FOR APPROVAL.

COMPLETE DESIGN CALCULATION OF ALL COMPONENTS OF THE LIGHTNING MAST SHOWING ALL LOADS USED IN THE DESIGN, MAXIMUM STRESSES AND DEFLECTIONS AND THE ESTIMATED MAST WEIGHT.

A TWO FEET SQUARE PREPRODUCTION SAMPLE OF THE LAMINATE CONSTRUCTION PROPOSED.

---DELIVERY AND STORAGE

MAST SHALL BE SHIPPED AND STORED MOUNTED ON CRADLES PROPERLY PADDED AND SECURED. MAST SHALL NOT BE DROPPED, ROLLED OR SLID; IT SHALL BE HOISTED WITH NYLON STRAPS FOLLOWING PROPER RIGGING PRACTICES. UNDER NO CONDITIONS SHALL CHAINS OR CABLES BE PUT AROUND THE MAST.

---MATERIALS---

---FIBERGLASS REINFORCED POLYESTER

RESIN SHALL BE ATLAC 382, AS MANUFACTURED BY ICI UNITED STATES, *INC, OR APPROVED EQUAL*. THE RESIN SHALL NOT CONTAIN FILLERS EXCEPT THAT UP TO FIVE PERCENT BY WEIGHT OF A THIXOTROPIC AGENT, WHICH WILL NOT INTERFERE WITH VISUAL INSPECTION, MAY BE ADDED FOR VISCOSITY CONTROL. AN ULTRAVIOLET ABSORBER SHALL BE ADDED TO THE RESIN TO IMPROVE THE WEATHER RESISTANCE OF THE PLASTIC. (A)

GLASS FIBER SHALL BE COMMERCIAL GRADE "C" OR "E" HAVING A COUPLING AGENT COMPATIBLE WITH THE RESIN USED, AND SUITABLE FOR THE PARTICULAR FABRICATION TECHNIQUE. GLASS FIBER SHALL CONFORM TO MIL-Y-1140H.

---STEEL

STEEL SHALL CONFORM TO ASTM A36-75 AND THE REQUIREMENTS OF SECTION 5J.

---FASTENERS

ALL BOLTS SHALL CONFORM TO ASTM A325-76C AND SHALL BE GALVANIZED.

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---GENERAL---

THE MAST SHALL BE DESIGNED TO SUSTAIN THE WIND LOADING AND WIRE TENSION SHOWN ON THE DRAWINGS. WEIGHT OF MAST, TOP SWIVEL ASSEMBLY AND STEEL BOTTOM SUPPORT SHALL BE CONSIDERED ALSO IN THE DESIGN. THE DESIGN OF THE MAST SHALL BE BASED ON THE MECHANICAL PROPERTIES HEREINAFTER SPECIFIED WITH A SAFETY FACTOR OF 7.

---MECHANICAL PROPERTIES OF LAMINATES

THE DESIGN OF THE MAST SHALL BE BASED ON THE FOLLOWING MECHANICAL PROPERTIES OF THE LAMINATE AT 73 DEGREES FAHRENHEIT.

ULTIMATE TENSILE STRENGTH	20,000 PSI
ULTIMATE FLEXURAL STRENGTH	30,000 PSI
FLEXURAL MODULUS OF ELASTICITY (TANGENT)	
LONGITUDINAL	2.0×10^6 PSI
CIRCUMFERENTIAL	3.0×10^6 PSI
ULTIMATE COMPRESSIVE STRENGTH	20,000 PSI
ULTIMATE BEARING STRENGTH	30,000 PSI
ULTIMATE SHEAR STRENGTH	1,000 PSI

LAMINATES WHICH DO NOT MEET THE MINIMUM VALUES SPECIFIED ABOVE WILL BE ACCEPTABLE PROVIDED THE DESIGN IS BASED ON THE ACTUAL MECHANICAL PROPERTIES OF THE LAMINATE VERIFIED BY THE TESTS SPECIFIED IN PARAGRAPH ENTITLED "TESTING".

---STEEL DESIGN, FABRICATION AND PAINTING

ALL STEEL DESIGN SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS OR THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION. FABRICATION, SHOP BLASTING AND COATING, AND FIELD PAINTING SHALL BE IN ACCORDANCE WITH SECTION 5J OF THESE SPECIFICATIONS.

---MAST

THE MAST SHALL BE A FILAMENT WOUND CYLINDRICAL SHELL WITH AN INSIDE DIAMETER OF FIVE FEET. THE THICKNESS OF THE SHELL MAY BE VARIED WITH THE MAST HEIGHT AND SHALL CONFORM AT ANY HEIGHT LEVEL WITH THE STRENGTH REQUIREMENTS OF THE PARAGRAPH ENTITLED "DESIGN". MINIMUM THICKNESS OF THE MAST SHELL SHALL BE AS SHOWN ON THE DRAWINGS.

MAST MAY BE FABRICATED IN NO MORE THAN FOUR SECTIONS PROVIDED THE SPLICES ARE DESIGNED TO FULLY DEVELOP (100 PERCENT) THE STRENGTH OF THE MAST.

THE LAMINATE CONSTRUCTION FOR THE MAST SHALL CONSIST OF AN INTERIOR LAYER AND AN EXTERIOR LAYER. THE INTERIOR LAYER SHALL BE APPROXIMATELY 0.10 INCH THICK AND SHALL CONTAIN 20 TO 30 PERCENT BY WEIGHT OF NONCONTINUOUS GLASS STRAND. BEFORE FILAMENT IS APPLIED THE INTERIOR LAYER SHALL BE ALLOWED TO GEL COMPLETELY SO THE INTERIOR LAYER WILL NOT BE SQUEEZED DOWN TO A THIN LAYER OR GLASS CONTENT OVER 30 PERCENT; THE EXTERIOR LAYER (FILAMENT WOUND) SHALL CONTAIN 50 TO 80 PERCENT BY WEIGHT OF CONTINUOUS STRAND ROVING WOUND IN A PATTERN AND AT A HELIX ANGLE WITH RESPECT TO THE LONGITUDINAL AXIS OF NO MORE THAN 60 DEGREES. OTHER FORMS OF REINFORCEMENT MAY BE EMPLOYED TO PROVIDE ADDITIONAL LONGITUDINAL STRENGTH.

HAND LAY-UP LAMINATES SHALL CONFORM TO PRODUCT STANDARD PS 15-69, A DEPARTMENT OF COMMERCE PUBLICATION.

THE SURFACE OF THE LAMINATE SHALL HAVE A BARCOL HARDNESS OF AT LEAST 90 PERCENT OF THE RESIN MANUFACTURER'S MINIMUM SPECIFIED HARDNESS FOR THE CURED RESIN.

---OPTIONAL SPLICE

THE JOINT BETWEEN SECTIONS OF THE MAST SHALL BE OVERWOUND OR OVERLAID. CREVICES BETWEEN JOINED PIECES SHALL BE FILLED WITH RESIN OR THIXOTROPIC RESIN PASTE. THE INTERIOR OF THE JOINT SHALL BE SEALED WITH LAMINATE SIMILAR TO INTERIOR LAYER OF MAST.

---DIAPHRAGMS

FIBERGLASS REINFORCED POLYESTER DIAPHRAGMS SHALL BE PROVIDED WHERE SHOWN ON THE DRAWINGS. DIAPHRAGMS SHALL BE HAND LAY-UP LAMINATE WITH A MINIMUM THICKNESS OF 1/2 INCH. DIAPHRAGMS SHALL BE CONNECTED TO MAST SHELL WITH OVERLAYS.

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---TOP CONNECTION

THE WALL THICKNESS OF THE MAST IN THE AREA OF THE TOP CONNECTION SHALL BE ONE INCH. THE STEEL REINFORCING BANDS SHALL BE CLEANED AND PREPARED TO ASSURE A COMPLETE BOND WITH LAMINATE.

---TOP SWIVEL ASSEMBLY

THE TOP SWIVEL ASSEMBLY SHALL BE AS SHOWN ON THE DRAWINGS.

---BOTTOM STEEL BASE

THE BOTTOM STEEL BASE SHALL BE AS SHOWN ON THE DRAWINGS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DESIGN THE BOTTOM STEEL BASE TO SUSTAIN THE LOADINGS SPECIFIED IN THE PARAGRAPH ENTITLED "DESIGN". SIZE OF STEEL MEMBERS SHOWN ON THE DRAWINGS ARE MINIMUM SIZES. SEE SECTION 5J OF THESE SPECIFICATIONS.

THE BOTTOM SURFACE OF THE STEEL BASE SHALL MATCH THE MATING SURFACE OF THE MAST SUPPORT FRAMING. THE CONTRACTOR SHALL PROVIDE A TEMPLATE FOR DRILLING THE BOLT HOLES IN THE BOTTOM STEEL BASE, AND THIS SAME TEMPLATE SHALL BE USED TO DRILL THE BOLT HOLES IN THE MAST SUPPORT FRAMING.

---MAST LADDER

ALL COMPONENTS OF THE MAST LADDER SHALL BE FIBERGLASS REINFORCED POLYESTER. LADDER AND CONNECTIONS SHALL BE DESIGNED TO SUPPORT TWO 250 POUND MEN.

---WIND SPOILERS

THE MAST SHALL BE PROVIDED WITH FIBERGLASS REINFORCED POLYESTER WIND SPOILERS AS SHOWN ON THE DRAWINGS.

---GEL COAT

THE GEL COAT SHALL BE A WHITE THERMOSETTING RESIN THAT WILL PRODUCE A DRY AND TACK FREE SURFACE AND WILL NOT PEEL, DELAMINATE OR CRAZE. THE GEL COAT SHALL NOT BE APPLIED UNTIL ALL FINAL VISUAL INSPECTIONS HAVE BEEN COMPLETED. THE GEL COAT SHALL BE BRUSHED OR SPRAYED TO A THICKNESS OF 0.010 TO 0.015 INCH.

---WELDING

WELDING SHALL CONFORM TO SECTION 17K ENTITLED "WELDING OF CARBON STEEL" OF THESE SPECIFICATIONS.

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---GENERAL

THE CONTRACTOR IS RESPONSIBLE FOR THE PERFORMANCE OF ALL TESTING REQUIREMENTS AS SPECIFIED HEREIN. THE CONTRACTOR SHALL EMPLOY AN INDEPENDENT TESTING LABORATORY, ACCEPTABLE TO THE GOVERNMENT, TO PERFORM ALL TESTING. THE GOVERNMENT RESERVES THE RIGHT TO PERFORM (AT GOVERNMENT EXPENSE AND WITHOUT ANY INCREASE IN CONTRACT PRICE) ANY OR ALL OF THE TESTS SPECIFIED TO ASSURE THAT THE END ITEM CONFORMS TO THE PRESCRIBED REQUIREMENTS.

THE MECHANICAL PROPERTIES OF EACH LAMINATE CONSTRUCTION (FILAMENT WOUND AND HAND LAY-UP) SHALL BE DETERMINED BY TESTS. THE AVERAGE OF FIVE TEST SPECIMENS SHALL BE CONSIDERED THE ACTUAL VALUE OF THE MECHANICAL PROPERTY TESTED FOR THE PARTICULAR LAMINATE CONSTRUCTION REPRESENTED BY THE SPECIMENS.

TEST RESULTS SHALL BE REPORTED IN WRITING TO THE CONTRACTING OFFICER WITHIN TWO WEEKS FROM THE DAY THE TEST IS COMPLETED.

---SPECIMENS

TESTS SHALL BE MADE ON SPECIMENS CUT FROM WASTE AREAS WHEN POSSIBLE; OTHERWISE THE SPECIMENS SHALL BE CUT FROM LAMINATES PREPARED IN THE SAME CONSTRUCTION AND BY THE SAME TECHNIQUES AS THE LAMINATE THAT THE SPECIMEN REPRESENTS. THE TEST SPECIMENS SHALL BE CONDITIONED IN ACCORDANCE WITH PROCEDURE "A" OF ASTM D618-61. SPECIMENS SHALL NOT BE MACHINED ON THE SURFACE.

---GLASS CONTENT

THE GLASS CONTENT SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D2584-68, EXCEPT THAT THE SPECIMENS TESTED SHALL BE APPROXIMATELY ONE INCH SQUARE IN AREA. LOW TEMPERATURE PREIGNITION PRIOR TO REPLACEMENT IN MUFFLE FURNACE IS RECOMMENDED.

---TENSILE STRENGTH

THE TENSILE STRENGTH SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D638-76, EXCEPT THAT THE SPECIMENS SHALL BE THE ACTUAL THICKNESS OF THE LAMINATE THAT THE SPECIMEN REPRESENTS, AND THE WIDTH OF THE REDUCED SECTION SHALL BE ONE INCH. OTHER DIMENSIONS OF THE SPECIMENS SHALL BE AS DESIGNATED FOR TYPE I SPECIMENS. TEST LOAD SHALL BE APPLIED AT A SPEED OF 0.20 INCH PER MINUTE.

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---FLEXURAL STRENGTH

THE FLEXURAL STRENGTH SHALL BE DETERMINED IN ACCORDANCE WITH PROCEDURE "A" AND TABLE I OF ASTM D790-71, EXCEPT THAT THE SPECIMENS SHALL BE THE ACTUAL THICKNESS OF THE LAMINATE THAT THE SPECIMEN REPRESENTS, AND THE WIDTH OF THE REDUCED SECTION SHALL BE ONE INCH. TESTS SHALL BE MADE WITH THE RESIN RICH SIDE IN COMPRESSION.

---FLEXURAL MODULUS

THE TANGENT MODULUS OF ELASTICITY IN FLEXURE SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D790-71.

---COMPRESSIVE STRENGTH

THE COMPRESSIVE STRENGTH SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D695-69.

---BEARING STRENGTH

THE BEARING STRENGTH SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D953-75.

---HARDNESS

THE HARDNESS SHALL BE DETERMINED IN ACCORDANCE WITH ASTM D2583-75. TEN READINGS SHALL BE MADE ON THE CLEAN RESIN RICH SURFACE OF THE MAST LAMINATE. AFTER ELIMINATING THE TWO HIGH AND TWO LOW READINGS, THE AVERAGE OF THE REMAINDER SHALL BE CONSIDERED THE HARDNESS VALUE OF THE LAMINATE.

---OPERATION, MAINTENANCE, PARTS AND TESTING MANUALS

CONTRACTOR SHALL PROVIDE MANUALS, BOUND UNDER ONE COVER, FOR OPERATION, MAINTENANCE, PARTS LISTING AND TESTING OF ALL EQUIPMENT FURNISHED AS OUTLINED IN THE "CONTRACT SCHEDULE."

SECTION 14Q

SSAT SLIDEWIRE EMERGENCY EGRESS SYSTEM

---GENERAL REQUIREMENTS---

---GENERAL

THE SSAT SLIDEWIRE EMERGENCY EGRESS SYSTEM SHALL BE PROVIDED IN ACCORDANCE WITH THE DRAWINGS. CONSTRUCTION SHALL CONFORM TO THE GENERAL NOTES, COMMENTS AND SPECIFICATIONS ON THE REFERENCED DRAWINGS AND THE APPLICABLE SECTIONS OF THE SPECIFICATIONS.

---EARTHWORK

ALL CLEARING, GRADING, EXCAVATION, FILLING AND SEEDING SHALL BE ACCOMPLISHED IN ACCORDANCE WITH THE CONTOURS AND PROFILES SHOWN AND SUBJECT TO THE APPROVAL OF THE CONTRACTING OFFICER. CONTRACTOR SHALL VERIFY EXISTING GRADES AND UTILITY LOCATIONS PRIOR TO WORK COMMENCEMENT. ANY UTILITIES OR SURFACES DAMAGED AS A RESULT OF THE SITEWORK OPERATIONS SHALL BE REPAIRED IN A MANNER APPROVED BY THE CONTRACTING OFFICER. CONTRACTOR SHALL VERIFY LOCATION OF DIRECT BURIAL ELECTRIC CABLES AND AVOID ANY DAMAGE TO SAME DURING CONSTRUCTION OF THIS WORK. FOR EARTHWORK, SEE SECTION 2E.

---STRUCTURAL WORK

CONCRETE WORK SHALL COMPLY WITH THE APPLICABLE PORTIONS OF SECTION 3A, "CAST-IN-PLACE CONCRETE", AND TO THE DETAILS SHOWN ON THE DRAWINGS.

STRUCTURAL STEEL WORK SHALL COMPLY WITH THE APPLICABLE PORTIONS OF SECTION 5J, "STRUCTURAL STEEL"; SECTION 5K, "MISCELLANEOUS METALS"; SECTION 9L, "PROTECTIVE COATING OF CARBON STEEL" AND SECTION 17K, "WELDING OF CARBON STEEL".

TIMBER POLES AND CABLES SHALL BE PROVIDED IN ACCORDANCE WITH THE NOTES AND SPECIFICATIONS SHOWN ON THE DRAWINGS.

---PAINTING

ALL FERROUS METAL SURFACES SHALL BE PAINTED IN ACCORDANCE WITH SECTION 9A, "PAINTING AND FINISHING"; SECTION 9L, "PROTECTIVE COATING OF CARBON STEEL" AND SECTION 13L, "COLOR FINISH SCHEDULE AND PIPING IDENTIFICATION".

---ELECTRICAL WORK

ALL ELECTRICAL WORK SHALL BE PROVIDED IN ACCORDANCE WITH THE APPLICABLE PORTIONS OF SECTION 16V AND 16X OF THE SPECIFICATIONS AND WITH THE NOTES ON THE DRAWINGS. BONDING AND GROUNDING AND TESTING OF GROUNDING SHALL BE IN ACCORDANCE WITH SECTION 16X (PART 51).

---GOVERNMENT FURNISHED EQUIPMENT

GOVERNMENT FURNISHED EQUIPMENT (GFE), (LOAD CELLS AND BASKETS) WILL BE PROVIDED AT GROUND ELEVATION TO THE CONTRACTOR AT A REASONABLE TIME AFTER REQUEST FOR SAME. LIFTING AND ERECTION OF INDIVIDUAL COMPONENTS WILL BE PERFORMED BY THE CONTRACTOR.

---OPERATIONAL TESTING

EACH SLIDEWIRE SYSTEM SHALL BE PROOF-TESTED USING SAND BAGS TO SIMULATE PERSONNEL LOADS. TESTS SHALL BE CONDUCTED ONLY AFTER THE SPECIFIED CABLE TENSIONS HAVE BEEN DEVELOPED AND APPROVED BY THE CONTRACTING OFFICER, OR HIS DESIGNATED REPRESENTATIVE.

TESTING PROCEDURES SHALL BE PERFORMED BY THE CONTRACTOR AS FOLLOWS:

A. ALL TESTS SHALL BE PERFORMED IN THE PRESENCE OF THE CONTRACTING OFFICER, OR HIS DESIGNATED REPRESENTATIVE.

B. ALL CONDITIONS SHALL BE AS NEAR ACTUAL CONDITIONS AS SIMULATION WILL PERMIT.

C. EACH BASKET SHALL BE LOADED TO 400 LBS. NET LOAD. BASKETS FURNISHED BY THE GOVERNMENT AND INSTALLED BY THE CONTRACTOR.

D. EACH SLIDEWIRE SHALL BE FITTED WITH *ONE* BASKET TESTED TO SIMULATE ACTUAL USE. (E)

E. ALL SAFETY AND ARRESTING NETS SHALL BE COMPLETELY INSTALLED AND READY FOR USE.

F. BASKETS SHALL BE RETURNED BY THE CONTRACTOR TO THE SSAT STARTING POSITION AFTER EACH TEST.

G. ANY DEFICIENCIES NOTED DURING THE TESTING ACTIVITIES SHALL BE CORRECTED AS DIRECTED BY THE CONTRACTING OFFICER, OR HIS DESIGNATED REPRESENTATIVE.

H. EACH BASKET SHALL BE INDIVIDUALLY TESTED FIVE TIMES.

I. ALL BASKETS ON ALL FIVE SLIDEWIRES SHALL BE SIMULTANEOUSLY TESTED FIVE TIMES.

J. ALL BASKETS SHALL TRAVERSE THE SLIDEWIRES FROM THE SSAT TO THE LANDING ZONE AS SHOWN ON THE DRAWINGS.

---OPERATION, MAINTENANCE, PARTS AND TESTING MANUALS

CONTRACTOR SHALL PREPARE AND FURNISH COMPOSITE MANUALS, BOUND UNDER ONE COVER, FOR OPERATION, MAINTENANCE, PARTS AND TESTING INCLUDING INSTALLATION AND ERECTION TESTING SPECIFIED ON THE DRAWINGS, AND OPERATIONAL TESTING SPECIFIED HEREINBEFORE, AND FOR ALL EQUIPMENT COMPRISING THE SLIDEWIRE SYSTEM, ALL TO BE SUBMITTED AS OUTLINED IN THE "CONTRACT SCHEDULE."

---SHOP DRAWINGS

SHOP DRAWINGS FOR ALL MATERIALS AND EQUIPMENT SHALL BE SUBMITTED FOR APPROVAL IN ACCORDANCE WITH THE PROCEDURES OUTLINED IN THE "CONTRACT SCHEDULE".

SECTION 14R

SIDE FLAME DEFLECTORS FOR SRB

---GENERAL REQUIREMENTS---

--GENERAL

INCLUDED IS THE FURNISHING OF ALL MATERIAL, LABOR AND PLANT FOR THE COMPLETE FABRICATION, ERECTION, CHECK-OUT AND TESTING OF TWO MOBILE SIDE FLAME DEFLECTORS FOR SOLID ROCKET BOOSTERS (SRB) AND OTHER WORK AT EXISTING LAUNCH PAD 39B, KENNEDY SPACE CENTER, FLORIDA, AS SHOWN ON THE DRAWINGS, AND AS SPECIFIED HEREIN:

A. INCLUDED FOR EACH FLAME DEFLECTOR SHALL BE: RAIL SYSTEM AND FOUR WHEEL TRUCK ASSEMBLIES FOR MOVEMENT OF DEFLECTOR FROM THE "LAUNCH" TO "PARK" POSITION; FOUR HYDRAULIC JACKING CYLINDERS (TOGETHER WITH HYDRAULIC-PNEUMATIC SYSTEM AND COMPONENTS) FOR TRANSFER OF DEFLECTOR WEIGHT FROM WHEELS TO JACKS TO DEFLECTOR ANCHORAGE SYSTEM, AND VICE-VERSA; BEARING PADS, JACKING PADS AND ANCHORAGE SYSTEM AT "LAUNCH" AND "PARK" POSITIONS OF THE DEFLECTOR. MOTORIZED TUG FOR DEFLECTOR TRAVERSE BETWEEN THE TWO ANCHORAGE POSITIONS WILL BE GOVERNMENT FURNISHED, AS WILL BE THE SOURCE OF PNEUMATIC NITROGEN GAS.

B. OTHER WORK SHALL BE AS SHOWN ON THE DRAWING AND AS SPECIFIED HEREIN. MAJOR ITEMS INCLUDE:

PROVIDING REFRACTORY SURFACING FOR THE SIDE FLAME DEFLECTORS AS INDICATED ON THE DRAWINGS AND OF MATERIALS AS SPECIFIED IN SECTION 3R.

C. SHOP DRAWINGS SHALL BE SUBMITTED FOR APPROVAL ON ALL WORK IN ACCORDANCE WITH THE "CONTRACT SCHEDULE".

D. MODIFICATIONS TO HANDRAILS ALONG FLAME TRENCH.

E. REMOVAL OF EXISTING CONCRETE CURBS AT NORTH END OF PAD SURFACE ON WEST SIDE OF FLAME TRENCH.

F. MODIFICATIONS TO ELECTRICAL AND FIRE ALARM SYSTEMS AT NORTH END OF PAD ON EACH SIDE OF FLAME TRENCH.

G. BONDING AND GROUNDING IN ACCORDANCE WITH SECTION 16X (PART 51) OF THE SPECIFICATIONS.

H. TESTING OF WORK AS SPECIFIED HEREIN AND RELATED SECTIONS.

I. PAINTING AND FINISHING AS SPECIFIED IN SECTIONS 9A AND 9L.

J. OTHER WORK AS SHOWN ON THE DRAWINGS AND AS SPECIFIED.

---STRUCTURAL STEEL

ALL STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH SECTION 5J OF THE SPECIFICATIONS. SHAPES AND PLATES SHALL BE ASTM-A36, EXCEPT AS OTHERWISE NOTED ON THE DRAWING OR SPECIFIED HEREIN.

---RAILS

RAILS SHALL BE AS SHOWN ON THE DRAWINGS AND AS SPECIFIED IN SECTION 5K OF THE SPECIFICATIONS, PAGE 5K-14.

---SCHEDULING OF WORK

SCHEDULING OF SIDE FLAME DEFLECTOR CONSTRUCTION AND INSTALLATION OF NEW REFRACTORY ON FLAME TRENCH WALLS SHALL BE COORDINATED WITH INSTALLATION OF SOUND SUPPRESSION PIPING IN THE SRB/ORBITER FLAME DEFLECTOR AS OUTLINED IN SECTION 15E AND SHOWN ON THE DRAWINGS. SUBMIT SCHEDULING TO CONTRACTING OFFICER FOR APPROVAL PRIOR TO COMMENCING ON-SITE WORK.

---WHEEL TRUCK SYSTEM---

---WHEELS

MAXIMUM LOADS (DEADLOAD; AND DEAD LOAD PLUS WIND LOAD) ARE SHOWN ON THE DRAWING.

WHEELS ON RAILS NEAR FLAME TRENCH SHALL BE DOUBLE FLANGED, WITH TAPER TREAD MEASURING 3.25 INCHES AS DETAILED ON THE DRAWING. OTHER WHEELS SHALL BE SINGLE-FLANGE. GREATER TREAD DIAMETER SHALL BE AT OUTBOARD EDGE OF RAIL." (A)

WHEELS SHALL BE ROLLED STEEL, WITH RIM-TOUGHENED TREADS AND PRESS FIT ON THE AXLES (5" $\pm$ O.D. MAX.) OF AISI 4340 STEEL HEAT TREATED TO A YIELD STRENGTH OF NOT LESS THAN 110,000 PSI AND FINISHED TO FIT THE PILLOW BLOCK BEARINGS, SEALS AND WHEEL BORE. WHEELS SHALL BE A PRESS FIT ON AXLES IN ACCORDANCE WITH AMERICAN ASSOCIATION OF RAILROADS "WHEEL AND AXLE MANUAL", AAR (DIV. V).

---PILLOW BLOCKS AND BEARINGS

THESE SHALL BE OF THE SPHERICAL ROLLER BEARING, SELF-ALIGNING TYPE EQUAL TO SKF INDUSTRIES, INC. PILLOW BLOCK ASSEMBLY NO. 22322 WITH OUTBOARD END PLUGS AND STABILIZING RINGS FOR THE "HELD" BEARINGS. "HELD" BEARINGS SHALL BE THE INBOARD BEARING OF THE INBOARD PILLOW BLOCK ON ALL WHEEL AXLES OF ALL TRUCKS (8 TOTAL). AXLES SHALL BE TURNED TO THE REQUIRED DIAMETERS AND TOLERANCES REQUIRED FOR AXIAL RETENTION OF THE BEARING INNER RACE AND AXLE SEALS, AND THREADED AND KEYWAYED TO ACCOMMODATE THE LOCKNUT AND LOCKWASHER. THE BOTTOM OF THE PLATES ON THE SUPPORT BEAMS FOR THE PILLOW BLOCKS SHALL BE MACHINED TO A FLAT SURFACE HAVING A ROUGHNESS NOT GREATER THAN 125 MICROINCHES. PILLOW BLOCKS SHALL BE EQUIPPED WITH BUTTON-HEAD TYPE PRESSURE GREASE FITTINGS WITH BALL CHECK VALVE AND PLUGGED PORTS FOR MONITORING DURING LUBRICATION TO PREVENT OVER-PRESSURIZATION. PILLOW BLOCK ASSEMBLY SHALL BE RATED AT NOT LESS THAN 138,000 POUNDS RADIAL LOAD AND NOT LESS THAN 48,000 POUNDS THRUST IN EACH AXIAL DIRECTION.

---GUIDE COLUMNS FOR TRUCKS

THESE SHALL BE OF HEAVY WALL PIPE FINISHED AND PLATED AS SHOWN ON THE DRAWING. PAIRS OF COLUMNS SHALL BE INSTALLED STRAIGHT, TRUE, ALIGNED AND PARALLEL EACH WITH THE OTHER TO ASSURE SMOOTH, NON-BINDING SLIDING THROUGH THE BRONZE SLEEVE BEARINGS. HOLE FOR SHEAR PIN SHALL BE SQUARE WITH AXIS OF PIPE.

---SLEEVE BEARINGS AND HOUSINGS

THESE SHALL BE AS DETAILED ON THE DRAWING. (AS AN ALTERNATE, AT NO ADDITIONAL COST TO THE GOVERNMENT, HOUSINGS MAY BE MACHINED STEEL CASTINGS WITH ALL PARTS (EXCEPT LOOSE FILLER) BEING 1.5 X NOTED PLATE THICKNESSES AND CONFORMING TO ASTM A27-71, GRADE U-60-30 HEAT TREATED, STRESS RELIEVED AND MAGNETIC PARTICLE INSPECTED TO ASTM. E109, AND FLAW-FREE).

---BOLTING

UNLESS OTHERWISE NOTED AS CORROSION-RESISTANT STEEL, ALL BOLTING OF STRUCTURAL PARTS INCLUDING SOLE PLATES, SLEEVE BEARING HOUSINGS, AND JACK MOUNTING PLATES, SHALL BE HIGH STRENGTH FASTENERS COMPLYING WITH ASTM A325-71, GALVANIZED. ALL NUTS AND BOLTS IN TAPPED HOLES SHALL HAVE GALVANIZED LOCK WASHERS. ALL NOTED CORROSION-RESISTANT STEEL SHALL BE TYPE 316 OR 304 STAINLESS STEEL

---BONDING AND GROUNDING

ALTHOUGH NOT SHOWN ON THE DRAWINGS, ONE W10 OF EACH TRUCK ASSEMBLY SHALL BE BONDED TO THE WHEEL TRUCK BOX GIRDER ABOVE WITH A 1" X 1/8" FLAT FLEXIBLE COPPER JUMPER STRAP OF TINNED WOVEN WIRE BRAID WITH ENDS BRAZED TO THE RESPECTIVE PARTS, ALL AS OUTLINED IN SECTION 16X (PART 51) OF THE SPECIFICATIONS.

---TRUCK BEAMS AND SHEAR PINS

THESE SHALL BE OF HIGH STRENGTH STEEL AS NOTED ON THE DRAWINGS.

---BEARING PADS AND JACKING PADS---

---GENERAL

THE TOP SURFACE OF ALL BEARING AND JACKING PADS SHALL BE MACHINED FLAT TO A SURFACE ROUGHNESS NOT GREATER THAN 250 MICROINCHES PRIOR TO WELDING ON THE LOCKING PLATES AND HOT-DIP GALVANIZING AFTER ALL FABRICATION.

---ALTERNATE BEARING PADS

AS AN ALTERNATE TO THE WELDMENT DESIGN SHOWN ON THE DRAWING FOR THE BEARING PADS, AND AT NO ADDITIONAL COST TO THE GOVERNMENT, BEARING PADS MAY BE OF MACHINED, FLAW-FREE STEEL CASTINGS CONFORMING TO ASTM A27-71, GRADE 70-36, HEAT TREATED, STRESS RELIEVED, AND INSPECTED BY ASTM DRY MAGNETIC PARTICLE METHOD E109 AND OTHERWISE MEETING ALL THE REQUIREMENTS SHOWN ON THE DRAWING FOR WELDED CONSTRUCTION.

---GENERAL

JACKING SYSTEM FOR EACH FLAME DEFLECTOR SHALL BE OF THE CLOSED HYDRAULIC TYPE EMPLOYING 1500 PSIG GASEOUS NITROGEN AS A PRESSURE SOURCE AS SHOWN ON THE DRAWING. HYDRAULIC FLUID SHALL BE PROVIDED *BY THE GOVERNMENT AND SHALL CONFORM TO MIL-H-6083D.* (A)

---PERFORMANCE

EACH JACKING SYSTEM SHALL SO PERFORM TO LIFT (AND LOWER) THE TOTAL DEAD WEIGHT (APPROXIMATELY 250,000 POUNDS) OF EACH SIDE FLAME DEFLECTOR THROUGHOUT THE TOTAL TRAVEL RANGE (10 INCH STROKE) EVENLY AND IN A LEVEL PLANE SUCH THAT ANY ONE OF THE FOUR JACK INTERFACES ON THE FLAME DEFLECTOR IS WITHIN 0.250 INCHES OF THE OTHER THREE AS MEASURED FROM A LEVEL REFERENCE PLANE AFTER MAKING ADJUSTMENTS FOR THE ORIGINAL PRE-LIFT (AND PRE-LOWER) ELEVATIONS OF THE RESPECTIVE JACK INTERFACES EACH TO THE OTHER. LIFTING (AND LOWERING) SPEED SHALL BE APPROXIMATELY FOUR (4) INCHES PER MINUTE. PRIOR TO LIFTING FLAME DEFLECTORS, ABOVE SYNCHRONIZATION OF JACKS AND SPEED SHALL BE SET AND FINAL SETTING OPERATION REPEATED SATISFACTORILY THREE TIMES.

---SYSTEM COMPONENTS

SYSTEM COMPONENTS SHALL BE AS SPECIFIED HEREIN AND NOTED ON THE DRAWING. THESE INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING, ALL OF WHICH SHALL HAVE OPERATING PRESSURE RATINGS OF NOT LESS THAN 1500 PSIG:

A. HYDRAULIC CYLINDERS (JACKS) SHALL BE AS NOTED ON THE DRAWING. CYLINDERS SHALL HAVE A MODERATE SERVICE RATING OF NOT LESS THAN 5,000 PSIG. SMALLER CYLINDERS SHALL HAVE OVERSIZE RODS. ALL CYLINDERS SHALL HAVE CHROME PLATED HEAT TREATED STEEL RODS, SQUARE END MOUNTING FLANGE, PISTONS WITH SPRING-LOADED TEFLON CUPS, AND SPHERICAL BEARING PADS NOT LESS THAN 8 INCHES NOR MORE THAN 12 INCHES IN DIAMETER. EACH CYLINDER SHALL BE EQUIPPED WITH BLEED VALVES FOR BOTH SIDES OF THE PISTON. AT 1500 PSIG CYLINDERS SHALL DEVELOP PUSH AND PULL STROKE FORCES NOT LESS THAN: FOR 10" DIA. CYLINDERS 115,000 LBS. PUSH AND 90,000 LBS PULL; FOR 6" DIA. CYLINDERS 41,560 LBS PUSH AND 30,000 LBS PULL.

B. HYDRAULIC ACCUMULATORS SHALL BE BLADDER TYPE FOR SPECIFIED HYDRAULIC FLUID AND DRY NITROGEN GAS SERVICE. EACH UNIT SHALL BE FURNISHED WITH BRACKETS WITH SADDLES FOR VERTICAL MOUNTING AS SHOWN ON THE DRAWING. EACH PRESSURE VESSEL SHALL BE RATED FOR A WORKING PRESSURE OF NOT LESS THAN 1800 PSIG AND BEAR ASME CODE STAMP SHOWING TEST PRESSURE AND MAXIMUM ALLOWABLE WORKING PRESSURE. EACH VESSEL SHALL HAVE A FACTORY INSTALLED METAL TAB FOR JUMPER BONDING THE VESSEL TO THE STRUCTURE OF THE FLAME DEFLECTOR AND SHALL BE SO BONDED IN ACCORDANCE WITH SECTION 16X (PART 51) OF THE SPECIFICATIONS. SUITABLE CONNECTIONS FOR NITROGEN AND HYDRAULIC TUBING CONNECTIONS SHALL BE PROVIDED. *"THE NITROGEN CONNECTION SHALL BE FACTORY-MODIFIED TO ACCOMMODATE REMOTE CONTROL OF CHARGING AND VENTING OF THE BLADDER AS INDICATED BY THE SCHEMATIC JACKING DIAGRAM AND AS OUTLINED ELSEWHERE HEREIN."* (A)

C. FILL AND RETURN TANK - THIS UNIT SHALL BE A PRESSURE VESSEL RATED AT NOT LESS THAN 200 PSIG WORKING PRESSURE AND SHALL HAVE RELIEF VALVE MOUNTED AT TOP END AND SET AT MAXIMUM ALLOWABLE WORKING PRESSURE. TANK SHALL HAVE VENT VALVE ON TOP SIDE. VESSEL SHALL HAVE ASME CODE STAMP SHOWING TEST PRESSURE AND MAXIMUM ALLOWABLE WORKING PRESSURE. UNIT SHALL BE VERTICALLY MOUNTED AND BE EQUIPPED WITH SIGHT-GLASSES AND FILL PORT WITH CLOSURE FOR PRESSURIZED SERVICE. TUBING CONNECTION SHALL BE PROVIDED AT TOP FOR NITROGEN GAS. TANK SHALL BE FITTED WITH 20 MICRON FILTER AND TUBE CONNECTED AT BOTTOM HYDRAULIC FLUID CONNECTION. FILTER SHALL BE OF STAINLESS STEEL CONSTRUCTION.

D. FLEXIBLE PNEUMATIC HOSES AND FITTINGS - TWO HOSES SHALL EACH BE 0.25 I.D., 150 FEET *CONT. LENGTH, 2-WIRE BRAID* REINFORCED, TEXTILE BRAID AND PERFORATED SYNTHETIC RUBBER COVER, 5,000 PSIG WORKING PRESSURE, 20,000 PSIG MINIMUM BURST PRESSURE, 4 INCH MINIMUM BEND RADIUS AND WEIGHING NOT MORE THAN 0.33 POUNDS PER FOOT AND OTHERWISE EQUAL TO AEROQUIP PART NO. 1529 AND COMPLETE WITH FACTORY INSTALLED END FITTINGS WITH SWIVEL UNION NUTS OF STAINLESS STEEL FOR 1/4 INCH FLARE TUBE CONNECTORS. A

FURTHER, A QUICK-DISCONNECT TUBING ASSEMBLY SHALL BE PROVIDED AS SHOWN ON THE DRAWING COMPLETE WITH 3-WAY VALVE FOR VENTING OF HOSE PRIOR TO DISCONNECT. ALL PARTS SHALL BE RATED FOR NOT LESS THAN 5,000 PSIG WORKING PRESSURE, AND SHALL BE OF TYPE 316 STAINLESS STEEL, OR SIMILAR TYPE, AND STAINLESS STEEL CHAIN TETHERED DUST CAPS SHALL BE PROVIDED AT EACH END OF THE HOSE AND QUICK-DISCONNECT ASSEMBLY. MATERIALS SHALL BE EQUAL TO THOSE NOTED ON THE DRAWING.

E. *ALL STAINLESS STEEL TUBE FITTINGS WILL BE "KC STANDARD" TYPE. ALL STAINLESS STEEL TUBING AND "KC STANDARD" TUBE FITTINGS WILL BE MADE AVAILABLE TO THE CONTRACTOR UPON HIS SUBMITTAL TO THE GOVERNMENT OF TUBE AND TUBE FITTING REQUIREMENTS LISTINGS."* A

F. PRESSURE REGULATORS SHALL BE STAINLESS STEEL BODY RATED FOR SERVICE PRESSURE AND CONTACT WITH DRY GASEOUS NITROGEN.

PRESSURE REGULATORS SHALL BE RELIEVING TYPE TO AUTOMATICALLY PREVENT EXCESS PRESSURE BUILD-UP AT LOW FLOWS AND DEAD-END SERVICE, AND SHALL PRODUCE AN ESSENTIALLY FLAT REDUCED PRESSURE CURVE. SHOP DRAWINGS SHALL BE ACCOMPANIED BY CURVES INDICATING CONFORMANCE TO THIS REQUIREMENT.

G. PRESSURE RELIEF VALVES SHALL BE SET AT NOT MORE THAN SHOWN ON DRAWING OR NOT MORE THAN 10% ABOVE NOTED LINE PRESSURE. PRESSURE RELIEF VALVES SHALL BE OF STAINLESS STEEL CONSTRUCTION.

H. PRESSURE GAUGES SHALL BE 2" DIAMETER, PANEL MOUNTING WITH BLOW-OUT BACK AND SHALL BE PROTECTED BY GAUGE PROTECTORS.

I. DIRECTIONAL VALVES SHALL BE FOR RATED SERVICE PRESSURE WITH DRY GASEOUS NITROGEN (GN_2).

THE THREE POSITION-FOUR WAY VALVE SHALL BE A MANUAL VALVE, SPRING-LOADED TO RETURN TO CENTER POSITION TO VENT GN_2 FROM BOTH ACCUMULATOR BLADDERS.

J. FLOW CONTROL VALVES SHALL BE FOR RATED SERVICE HYDRAULIC PRESSURE, AND SHALL BE PRESSURE & TEMPERATURE COMPENSATED.

K. NEEDLE VALVES SHALL BE FOR RATED SERVICE PRESSURE WITH DRY GASEOUS NITROGEN, OR HYDRAULIC FLUID, AS SHOWN ON THE DRAWINGS. NEEDLE VALVES SHALL BE OF STAINLESS STEEL CONSTRUCTION.

L. *EACH PNEUMATIC CONTROL PANEL SHALL BE FURNISHED COMPLETE WITH A NEMA TYPE 4 ENCLOSURE WITH FULL WIDTH FRONT AND REAR ACCESS DOORS.* (A)

M. MISCELLANEOUS SHUT-OFF VALVES - ALL SHUTOFF VALVES AND ISOLATION VALVES SHALL BE FOR RATED SERVICE PRESSURE AND FOR GAS, OR FLUID, IN CONTACT WITH VALVE AND SEALS, AND OF STAINLESS STEEL CONSTRUCTION.

FITTINGS WITH ISOLATION VALVES AS NOTED ON DRAWING SHALL BE PROVIDED IN THE TUBING TO MAJOR EQUIPMENT ITEMS AS FOLLOWS:

HYDRAULIC TUBES TO EACH JACKING CYLINDER.
HYDRAULIC TUBE AT EACH ACCUMULATOR.
HYDRAULIC AND NITROGEN TUBES AT FILL TANK.

---MISCELLANEOUS COMPONENTS

ALL ADDITIONAL COMPONENTS REQUIRED, (BLEED VALVES, CHECK VALVES, ETC.,) SHALL BE PROVIDED TO ACHIEVE AN OPERATIONAL SYSTEM THAT SHALL MEET THE PERFORMANCE REQUIREMENTS. MATERIALS SHALL BE STAINLESS STEEL.

THE HYDRAULIC SYSTEM SHALL BE A CLOSED SYSTEM TO AVOID HYDRAULIC FLUID LEAKAGE. BLEED VALVES SHALL BE PROVIDED, TUBED TO A VENTED RECEIVER (WITH ISOLATION VALVES) AND THENCE TO THE FILL AND RETURN TANK TO PERMIT A PRESSURE DIFFERENTIAL FOR BLEEDING.

---SYSTEM SCHEMATIC, IDENTIFICATION, ETC.---

THE CONTRACTOR SHALL PROVIDE A COORDINATED SYSTEM OF SYSTEM IDENTIFICATION INCLUDING:

A. BLACK-AND-WHITE ENGRAVED LAMINATED PLASTIC SCHEMATIC DIAGRAM OF COMPONENTS AND TUBING MOUNTED ON JACKING CONTROL PANEL WITH MAJOR COMPONENTS AND OPERATING VALVES IDENTIFIED. MOUNTING SHALL BE AS NOTED ON THE DRAWINGS *AND TWO 3000/1500 PSIG GN_2 SUPPLY PANELS FOR IDENTIFICATION PLATES.* (A)

B. IDENTIFICATION PLATES FOR ALL COMPONENTS MOUNTED ON THE JACKING CONTROL PANEL *AND TWO 3000/1500 PSIG GN_2 SUPPLY PANELS.* (A)

C. METAL TAG IDENTIFICATION ATTACHED TO ALL COMPONENTS (WHICH HAVE SUFFICIENT DATA FOR REPLACEMENT ORDERING).

D. COLOR-CODING AND METAL TAGS FOR TUBING. COLORS AND METAL TAGS SHALL CONFORM TO SECTIONS 13L OF THE SPECIFICATIONS.

E. METAL TAGGING OF TUBING AND COMPONENTS SHALL COMPLY WITH KSC-STD-E-0015 AND C75M04185.

---CLEANING OF SYSTEM---

---GENERAL

SPECIFICATION KSC-C-123E ENTITLED "SURFACE CLEANLINESS OF FLUID SYSTEMS" SHALL GOVERN. FACTORY COMPONENTS SHALL MEET THE REQUIREMENTS OF METHOD"A", LEVELS 50 AND "A". FIELD CLEANING OF HYDRAULIC AND PNEUMATIC SYSTEMS SHALL MEET THE REQUIREMENTS OF METHOD "B", LEVELS 250 AND "B". *"COMPONENTS FACTORY CLEANED TO THE ABOVE REQUIREMENTS SHALL BE INSTALLED IN THE FIELD AS RECEIVED WITHOUT FURTHER CLEANING."* (A)

---ACCEPTANCE TESTING---

---GENERAL

COMPLY WITH ALL PRE-TEST AND OTHER REQUIREMENTS OF SECTION 18A OF THE SPECIFICATIONS.

---JACKING SYSTEM FOR EACH SIDE FLAME DEFLECTOR

A. EACH COMPLETED SYSTEM SHALL BE CONNECTED BY FLEXIBLE HOSE TO A SOURCE OF PRESSURIZED CLEAN, DRY NITROGEN BY MEANS OF THE FLEXIBLE HOSE ASSEMBLY PROVIDED. CONTRACTOR SHALL FURNISH PRESSURIZED SOURCE OF COMMERCIALLY CLEAN DRY NITROGEN AND REGULATOR SYSTEM FOR TESTING. HYDRAULIC SYSTEM SHALL BE CHARGED WITH FLUID, PRESSURIZED AND BLED TO REMOVE ALL AIR FROM THE HYDRAULIC FLUID LINES.

B. PRIOR TO LIFTING THE FLAME DEFLECTOR, THE SYSTEM SHALL THEN BE ADJUSTED, JACKS SYNCHRONIZED AND TIMED AS OUTLINED HEREIN ABOVE UNDER "---PERFORMANCE" WITHOUT LIFTING OF THE DEFLECTOR.

C. EACH FLAME DEFLECTOR SHALL THEN BE JACKED, AND DURING THE LIFTING OPERATION, SYNCHRONIZATION AND SPEED OF JACKS SHALL BE DEMONSTRATED FOR COMPLIANCE WITH REQUIREMENTS HEREIN ABOVE OUTLINED UNDER "---PERFORMANCE." REPEAT ABOVE FOR LOWERING OPERATION, CHECKING ALIGNMENT OF THE FLAME DEFLECTOR-TO-PAD ANCHORAGE SYSTEM. DEMONSTRATE ABOVE LIFTING AND LOWERING CYCLE THREE TIMES, EXCEPT END IN THE "UP" POSITION.

D. LUBRICATE PILLOW BLOCK BEARINGS WITH GREASE AS RECOMMENDED BY BEARING MANUFACTURER AND APPROVED BY CONTRACTING OFFICER. (LUBRICATION SHALL BE ACCOMPLISHED PRIOR TO LIFTING).

E. INSTALL SHEAR PINS IN TWO GUIDE COLUMNS OF EACH WHEEL-TRUCK ASSEMBLY AND LOWER WITH JACKS TO TRANSFER DEFLECTOR LOAD TO WHEELS. CHECK WHEEL TRUCKS AND SHEAR PINS FOR ANY DEFICIENCIES AND CORRECT AS REQUIRED.

F. CONNECT GOVERNMENT FURNISHED AND OPERATED TUG TO DEFLECTOR AND TRAVERSE DEFLECTOR TO OPPOSITE ANCHORAGE TERMINAL ON THE PAD. TRAVERSE OF WHEELS ON RAILS SHALL BE CHECKED FOR ALIGNMENT, FLANGE BINDING, ETC. ALIGN DEFLECTOR WITH BEARING PAD ANCHORAGE SOCKETS. DISCONNECT TUG. USE JACKS TO RAISE DEFLECTOR, REMOVE AND STOW SHEAR PINS AT GUIDE COLUMNS, LOWER DEFLECTOR INTO ANCHORAGE SOCKETS, AND DETERMINE THAT UPLIFT RETAINER WEDGES FIT IN ALL LOCKING PLATES. REMOVE WEDGES AND STOW. JACK FLAME DEFLECTOR TO "UP" POSITION AND REPEAT STEP "E". *"WHEEL AXLES SHALL BE ALIGNED WITH RAILS (BY ADJUSTING THE PILLOW BLOCKS) TO OBTAIN TRUE TRACKING OF THE WHEELS ON THE RAILS AND WITH A MINIMUM OF WHEEL FLANGE CONTACT WITH RAIL HEAD DURING TRAVERSE OF THE DEFLECTOR FROM LAUNCH POSITION TO PARK POSITION , AND VICE VERSA."* (A)

G. RECONNECT TUG, AND REPEAT ABOVE STEP "F", FOR TRAVERSE TO THE OPPOSITE DEFLECTOR ANCHORAGE TERMINAL.

H. DEMONSTRATE ABOVE STEPS "F" AND "G" A TOTAL OF THREE TIMES, ENDING WITH THE DEFLECTOR IN THE "LAUNCH" ANCHORAGE POSITION WITH ALL WEDGES IN LOCKING PLATES.

I. SHOULD DEFECTS AND/OR DEFICIENCIES BE ENCOUNTERED DURING ANY OF THE ABOVE TESTS, SUCH SHALL BE CORRECTED AND THE TESTS REPEATED, ALL CORRECTIONS AND TESTS BEING TO THE SATISFACTION OF THE CONTRACTING OFFICER, OR HIS DESIGNATED REPRESENTATIVE, WHO WILL WITNESS ALL ACCEPTANCE TESTING; HOWEVER, THIS SHALL NOT PRECLUDE THE CONTRACTOR FROM ACCOMPLISHING PRE-ACCEPTANCE TESTING.

---OPERATION, MAINTENANCE, INSTRUCTIONS, PARTS AND TESTING---

---GENERAL

THE CONTRACTOR SHALL PROVIDE OPERATION, MAINTENANCE AND TESTING INSTRUCTION MANUALS CONTAINING PARTS LISTS OF ALL EQUIPMENT FURNISHED AS OUTLINED IN THE "CONTRACT SCHEDULE".

---COATING OF STAINLESS STEEL TUBING---

---GENERAL

STAINLESS STEEL TUBING ASSEMBLIES, AND TUBE CLAMPS SHALL BE PROTECTED FROM CORROSION BY APPLYING 3 MIL MINIMUM THICKNESS OF NAPKO 2Z, NAPKO CORPORATION; OR, SUBOX GALVANOX, TYPE I, WYANDOTTE CHEMICALS CORPORATION. COATING SHALL BE APPLIED CONTINUOUSLY AND EXTENSIVELY TO EXTERIOR SURFACES AND CREVICES TO PRECLUDE MOISTURE ENTRY. TO MINIMIZE CONTAMINATION OF INTERIOR SURFACES, TUBE FITTINGS SHALL NOT BE COATED UNTIL AFTER ASSEMBLY. PRIOR TO COATING, SURFACES SHALL BE DEGREASED BY SOLVENT CLEANING.

---EQUIPMENT AND SITE CLEANUP---

---GENERAL

CLEANING OPERATIONS DURING CONSTRUCTION AND UPON COMPLETION OF THE WORK OF THIS CONTRACT SHALL BE PERFORMED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF THE "CONTRACT SCHEDULE," AND THIS SECTION OF THE SPECIFICATIONS. SPECIFIC OPERATIONS SHALL INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING:

REMOVAL OF RUST AND ALL DIRT AND DELETERIOUS SUBSTANCES FROM EXTERIOR SURFACES OF ALL TUBING, EQUIPMENT AND SUPPORTS.

TOUCH-UP OR REPAINTING OF EQUIPMENT IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THIS SPECIFICATION.

UPON COMPLETION OF THE WORK, IMMEDIATELY PRIOR TO FINAL ACCEPTANCE, ALL EQUIPMENT PROVIDED UNDER THIS CONTRACT SHALL BE CLEANED TO REMOVE ALL FOREIGN MATERIALS.

SECTION 14S

SRB/ORBITER FLAME DEFLECTOR

---GENERAL REQUIREMENTS---

---GENERAL

INCLUDED IS THE FURNISHING OF ALL MATERIAL, LABOR AND PLANT FOR THE COMPLETE FABRICATION, ERECTION, CHECK-OUT AND TESTING OF A MAIN FLAME DEFLECTOR FOR THE SRB AND ORBITER ENGINE EXHAUSTS AND ALL OTHER WORK INCIDENTAL THERETO AT EXISTING LAUNCH PAD 39B, KENNEDY SPACE CENTER, FLORIDA, AS SHOWN ON THE DRAWINGS AND AS SPECIFIED HEREIN.

---SHOP DRAWINGS, PROOFS OF COMPLIANCE, SAMPLES AND DESCRIPTIVE DATA

THE CONTRACTOR SHALL SUBMIT EACH OF THESE ITEMS FOR APPROVAL IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION 3R - REFRACTORY COATING, SECTION 5J - STRUCTURAL STEEL, AND SECTION 5K - MISCELLANEOUS METALS, OF THESE SPECIFICATIONS. SUBMITTAL SHALL COMPLY WITH "CONTRACT SCHEDULE".

---SRB/ORBITER FLAME DEFLECTOR---

---SRB FLAME DEFLECTOR

INCLUDED FOR THE SRB PART OF THE FLAME DEFLECTOR SHALL BE:

1. THE MODIFICATION OF THE EXISTING SATURN V FLAME DEFLECTOR WHICH INCLUDES THE CUTTING AND RELOCATION OF EXISTING TRUSSES, THE RELOCATION OF FOUR EXISTING WHEEL AND TRUCK AND HYDRAULIC CYLINDER ASSEMBLIES, AND THE REMOVAL OF THE EXISTING CREST SECTION.

2. THE ACCOMMODATION OF SOUND SUPPRESSION PIPING TOGETHER WITH PIPE HANGERS, PIPE THRUST ANCHOR, NOZZLES AND OTHER ITEMS AS SHOWN AND SPECIFIED, INCLUDING COORDINATION OF TRADES AS REQUIRED.

---ORBITER FLAME DEFLECTOR

INCLUDED FOR THE ORBITER PART OF THE FLAME DEFLECTOR SHALL BE THE ECONOMICAL RE-USE OF STRUCTURALLY SOUND MATERIAL FROM THE EXISTING SATURN V FLAME DEFLECTOR WHICH IS NOT REQUIRED FOR THE SRB PART AND AS SHOWN ON THE DRAWINGS. THE REMAINING PARTS OF THE SATURN V FLAME DEFLECTOR SHALL BE TURNED OVER TO THE GOVERNMENT AT THE KSC DESIGNATED SALVAGE AREA.

---SRB/ORBITER FLAME DEFLECTOR

INCLUDED FOR BOTH THE SRB AND ORBITER PARTS OF THE FLAME DEFLECTOR SHALL BE:

1. THE FABRICATION AND ERECTION OF NEW STEEL INCLUDING TRUSSES, BEAMS, FLAME FENCE, BEARING PLATES, SURFACE PLATE AND INCIDENTAL STEEL SUCH AS GUSSETS, REINFORCING PLATES AND OTHER ITEMS AS SHOWN ON THE DRAWINGS AND IN ACCORDANCE WITH SECTION 5J - STRUCTURAL STEEL, OF THESE SPECIFICATIONS.

2. PAINTING AND FINISHING AS SPECIFIED IN SECTIONS 9A - PAINTING AND FINISHING AND 9L - PROTECTIVE COATING OF CARBON STEEL, OF THESE SPECIFICATIONS.

3. INSTALLATION OF REFRACTORY COATING ON DEFLECTOR SURFACES AS SHOWN ON THE DRAWINGS AND AS SPECIFIED IN SECTION 3R - REFRACTORY COATING, OF THESE SPECIFICATIONS.

4. MATING THE TWO PARTS OF THE FLAME DEFLECTOR TOGETHER INCLUDING COORDINATION WITH INSTALLATION OF SOUND SUPPRESSION PIPING, SIDE FLAME DEFLECTORS, AND FLAME TRENCH WALL REFRACTORY IN ORDER TO AVOID INTERFERENCES.

---WELDING

ALL WELDING SHALL COMPLY WITH THE REQUIREMENTS OF SECTION 17K OF THESE SPECIFICATIONS ENTITLED "WELDING OF CARBON STEEL".

SECTION 15A

ECS AND AMBIENT AIR DUCTS

---GENERAL REQUIREMENTS---

---GENERAL

ALL DUCTS WILL BE EXPOSED TO THE NATURAL ENVIRONMENT. PORTIONS OF THE SYSTEM WILL BE IN THE PROXIMITY OF ROCKET ENGINE EXHAUST GASES.

CONNECTIONS SHALL BE MADE TO EXISTING 18 INCH O.D. X 14 INCH I.D. INNER DUCT ENVIRONMENTAL CONTROL SYSTEM (ECS) INSULATED DUCT AND EXISTING 8 INCH O.D. AMBIENT AIR DUCT LOCATED AT THE EXISTING DUCT TOWER NORTH OF THE SHUTTLE SERVICE AND ACCESS TOWER (SSAT).

THE CONTRACTOR SHALL REMOVE AND BLANK-OFF ECS DUCTS AS DETAILED ON SHEET M17.

FROM THE NEW CONNECTIONS, NEW DUCTS SHALL BE EXTENDED SOUTHWARD TO THE SSAT, SHALL RISE ON SAME, AND SHALL BE ROUTED TO SERVE THE FOLLOWING (SEE SHEETS M15 THRU M17):

8" AMBIENT AIR:	MACHINE ROOM FOR SSAT ELEVATORS AND HOIST ROOM ON THE FUTURE PAYLOAD CHANGEOUT ROOM (PCR). TERMINATE AT SIDE 2 OF SSAT.
18" O.D. X 14" I.D. INSULATED:	TWO FAN ROOMS ON THE FUTURE PCR. TERMINATE AT SIDE 2 OF SSAT.

TO WITHSTAND THE ROCKET BLAST ENVIRONMENT AT THE LOWER ELEVATIONS, THE DUCTS SHALL HAVE BLAST PROTECTION FROM THE PROXIMITY OF EXISTING DUCTS TO THE SSAT ELEVATIONS NOTED ON THE DRAWINGS. BLAST PROTECTION SHALL BE EFFECTED BY INCREASING THE THICKNESS OF THE EXTERIOR DUCT TUBES AS SPECIFIED.

ALL DUCTS SHALL BE SUPPORTED AND ANCHORED AS DETAILED. ON THE NORTH FACE OF THE SSAT RELOCATED STEEL-WORK SHALL BE UTILIZED AS SHOWN ON THE DRAWINGS FOR SUPPORT OF THE NEW DUCTS.

EXPANSION JOINTS SHALL BE PROVIDED FOR EACH DUCT SYSTEM WHERE NOTED ON THE DRAWINGS AND AS HEREIN SPECIFIED.

ALL DUCTS SHALL BE CLEANED AND PAINTED, AND THE SERVICE IDENTIFIED, AS OUTLINED.

---REFERENCE SPECIFICATIONS

ASTM A120-73	BLACK OR HOT DIPPED ZINC-COATED (GALVANIZED) WELDED OR SEAMLESS STEEL PIPE
A53-73	WELDED AND SEAMLESS STEEL PIPE
A527-71	STEEL, SHEET, ZINC-COATED (GALVANIZED) BY THE HOT DIP PROCESS
B241-72	ALUMINUM PIPE
HH-1-00530	INSULATION, POLYURETHANE
MIL-STD-171	FINISHES, SURFACE
FED-STD-595	PAINTING AND MARKING COLOR CODING

---ABBREVIATIONS

O.D.	OUTSIDE DIAMETER
I.D.	INSIDE DIAMETER
PSIG	POUNDS PER SQUARE INCH GAUGE PRESSURE
W.G.	WATER GAUGE PRESSURE
PCR	PAYLOAD CHANGEOUT ROOM
SSAT	SHUTTLE SERVICE AND ACCESS TOWER
GAGE	U.S. STANDARD WIRE GAGE
AL	ALUMINUM
X"	DIMENSION (X) IN INCHES
FDB	FAHRENHEIT DRY BULB

---18" O.D./13" I.D. ECS DOUBLEWALL DUCT SYSTEM---

---14 INCH O.D. INNER DUCT

MATERIAL: 14 INCH O.D. ALCLAD ALLOY 3004H-24, OR ALCLAD ALLOY 5052H-32, WITH WALL THICKNESS NOT LESS THAN 0.064 INCHES. JOINTS SHALL BE WELDED WITH SMOOTH INTERIOR AND EXTERIOR SURFACES.

FLANGES: ANGLE RING FLANGES WELDED TO ENDS OF DUCT SECTIONS SHALL BE 1 1/2" X 1 1/2" X 3/16" ALUMINUM ALLOY 6063T OR 6061T; OR, FLAT FACE FLANGES, 1/4 INCH THICK, OF ALUMINUM ALLOY 5052H-32. EACH FLANGE SHALL HAVE 12 EQUALLY SPACE BOLT HOLES ON IDENTICAL 16 INCH BOLT CIRCLES, WITH 7/16 DIA. DRILLED HOLES.

BOLTING: BOLTING SHALL BE OF HARD (ALLOY 2024-T4 OR EQUAL) ALUMINUM ALLOY HEXAGON HEAD BOLTS, SELF LOCKING NUTS AND WASHERS, 3/8 INCH IN DIAMETER; OR, MATERIAL MAY BE STAINLESS STEEL.

DESIGN PRESSURE AND TEMPERATURE: DESIGN WORKING PRESSURE SHALL BE NOT LESS THAN 5.0 PSIG INTERNAL AND COLLAPSING PRESSURE SHALL BE NOT LESS THAN 2 PSIG EXTERNALLY APPLIED. TEMPERATURE RANGE SHALL BE BETWEEN 45 TO 225 DEGREES F. FLOW RATE IS 9,300 SCFM.

000318

--18 INCH O.D. OUTER DUCT ABOVE ELEVATION 114'-7"

MATERIAL SHALL BE 16 U.S. STANDARD GAGE GALVANIZED SHEET STEEL EQUAL TO ASTM A 527-71, SPIRAL SEALED LOCK SEAM CONSTRUCTION EQUAL TO UNITED MCGILL CORPORATION "UNI-SEAL" DUCT, AND SHALL BE SUITABLE FOR THE PRESSURES AND TEMPERATURES HEREINABOVE SPECIFIED FOR THE 14 INCH I.D. INNER DUCT.

DUCT SECTIONS SHALL BE EQUIPPED WITH GALVANIZED STEEL 1-1/2" X 1-1/2" X 3/16" ANGLE FLANGES CONNECTED TO THE DUCT IN SUCH A MANNER AS TO PERMIT BOLTING OF THE INNER DUCT FLANGES, SUBSEQUENT MATING AND BOLTING OF THE OUTER DUCT FLANGES, AND THE COMPLETED OUTER DUCT JOINT SYSTEM FORMING A WEATHER-TIGHT AND AIR PRESSURE TIGHT CONNECTION INCORPORATING MECHANICAL MEANS OTHER THAN FRICTION TO PREVENT AXIAL SEPARATION OF THE JOINT. IN LIEU OF FLANGES, SMOOTH O.D. SPOOL DUCT ENDS MAY BE PROVIDED FOR DRESSER-TYPE COUPLINGS AS ABOVE SPECIFIED. WHERE CONNECTIONS ARE MADE TO THE CROSSOVER BULKHEAD PLATES, FLANGES TO MATCH THE DRILLING OF THE BULKHEAD PLATES AND THE FLEXIBLE DUCT SHALL BE PROVIDED.

---FITTINGS

MATERIALS: MATERIALS SHALL MATCH THAT OF THE HEREINBEFORE SPECIFIED 14 INCH I.D. INNER DUCT AND FOR THE TWO TYPES OF 18 INCH OUTER DUCTS, RESPECTIVELY.

PRESSURE AND TEMPERATURE CRITERIA SHALL BE AS HEREINBEFORE SPECIFIED FOR THE DUCTS.

CONSTRUCTION: ELBOWS SHALL BE OF THE LONG RADIUS TYPE WITH CENTER-TO-END DIMENSIONS NOT LESS THAN 1-1/2 TIMES THE DUCT DIAMETER. ELBOWS FOR THE 1/4 INCH THICK OUTER DUCT MAY BE OF THE 5-PIECE WELDED MITER TYPE, GALVANIZED AFTER FABRICATION. FITTINGS FOR LIGHT WALL GALVANIZED STEEL (16 GAGE) OUTER DUCT MAY BE FABRICATED OF NOT LESS THAN 20 GAGE U.S. STANDARD GALVANIZED STEEL. ALL INNER DUCT FITTINGS SHALL HAVE SMOOTH INTERIOR SURFACES TO RESIST TO MINIMUM FRICTIONAL LOSSES. ALL WELDS SHALL BE CLEANED AND COATED.

---INSULTATION

THE ANNULAR SPACE OF DOUBLE WALL FITTINGS AND DOUBLE WALL DUCTS SHALL BE FILLED WITH POLYURETHANE FOAMED-IN-PLACE INSULATION. FOR DOUBLE WALL FITTINGS, AND DOUBLE WALL DUCTS, INSULATION SHALL BE FACTORY INSTALLED AND CONTINUOUS. WHERE FACTORY-INSTALLED INSULATION HAS NOT BEEN APPLIED AT JOINTS, CONTRACTOR SHALL PROVIDE SUITABLE FIELD-INSTALLED INSULATION WITH THERMAL INSULATING PROPERTIES EQUAL TO THE FACTORY-INSTALLED INSULATION. ON FITTINGS THAT HAVE FLAT TYPE FLANGES, POLYURETHANE (FOAMED-IN-PLACE) INSULATION SHALL BE POURED THROUGH 1-1/2" HOLE DRILLED IN THE FACE OF THE FLANGE. AFTER FITTING HAS BEEN POURED (INSULATED) AND CURED, REMOVE EXCESS INSULATION SO IT WILL BE LEVEL WITH FACE OF FLANGE. THE POLYURE-THANE INSULATION SHALL HAVE A DENSITY OF 2 POUNDS PER CUBIC FOOT AND CONFORM TO HH-1-00530 TYPE III, CLASS 2 (NON-BURNING). THERMAL CONDUCTIVITY (K) OF INSULATION SHALL BE NOT MORE THAN 0.15 BTU/HR/°F/SQ. FT./INCH OF THICKNESS AT A MEAN TEMPERATURE OF 75°F. DOUBLE WALL DUCT INSULATION SHALL BE CONTINUOUS. WHERE FACTORY-INSTALLED INSULATION HAS NOT BEEN APPLIED AT JOINTS, ETC., CONTRACTOR SHALL PROVIDE FIELD-INSTALLED INSULATION, THE THERMAL INSULATING PROPERTIES OF WHICH SHALL BE EQUAL TO THE FACTORY-INSTALLED INSULATION.

---8" DUCT BELOW SSAT ELEVATION 125'-0"

BETWEEN THE CONNECTION TO THE EXISTING 8 INCH DUCT AND THE ABOVE ELEVATION DUCT SHALL BE CONSTRUCTED OF SCHEDULE 40 ALUMINUM PIPE, LONG RADIUS WELDING ELBOWS OF SAME WALL THICKNESS AND ALUMINUM FLANGES. PIPE AND FITTINGS SHALL CONFORM TO ALLOY NO. 6061-T6 OR 6063-T6 AND ASTM B 241.

FLANGES SHALL BE OF SAME MATERIAL, NOT LESS THAN 1/2 INCH THICK, FLAT FACE, SLIP-ON WELD TYPE, DRILLED TO 150 LB. ANSI STANDARD. BUTT JOINTS SHALL BE MADE BY WELDING, FLANGES OR ALUMINUM GROOVE-TYPE COUPLINGS WITH ALUMINUM BOLTS AND GASKETS.

STEEL PIPE CLAMPS SHALL BE NEOPRENE COATED.

---8" DUCT ABOVE SSAT ELEVATION 125'-0"

THIS PORTION OF THE DUCT SHALL BE OF 16 U.S. STANDARD GAGE ALUMINUM, SPIRAL SEALED LOCK-SEAM TYPE EQUAL TO UNITED MCGILL CORPORATION "UNI-SEAL" DUCT.

JOINTS SHALL BE FLANGED AND DRILLED TO 150 LB. ANSI STANDARD, NOT LESS THAN 1/4" THICK, WELDED.

FITTINGS SHALL BE MACHINE FORMED OF ALUMINUM WITH FLANGES DRILLED TO MATE WITH DUCT FLANGES, EXPANSION JOINT FLANGES, FLEXIBLE DUCT FLANGES, EXISTING FLANGE AT THE ELEVATOR MACHINE ROOM, AND FLANGE AT THE HOIST ROOM ATOP THE PCR.

EXPANSION JOINTS IN LIGHT GAGE 8 INCH DUCT SHALL BE HEAVY FLEXIBLE RUBBER OF THE TYPE NOTED ON THE DRAWINGS.

---FLANGED JOINTS - BOLTING

BOLTING IN STEEL FLANGES SHALL BE GALVANIZED STEEL HEXAGON HEAD BOLTS, WASHERS AND SELF-LOCKING NUTS, OR SPLIT LOCKWASHERS. BOLTS CONTACTING ALUMINUM SHALL BE COATED.

BOLTING IN ALUMINUM FLANGES SHALL BE TYPE 2024-T4 ALUMINUM ALLOY AND NUTS OF THE SELF-LOCKING TYPE, WITH ALUMINUM WASHERS. NUTS AND BOLTS SHALL HAVE HEXAGON HEADS.

---FLANGED JOINTS - GASKETS

NEOPRENE, NOT EXCEEDING 1/8 INCH IN THICKNESS.

000321

---STEEL PIPE

WELDING SHALL CONFORM TO THE REQUIREMENTS OF SECTION 17B OF THE SPECIFICATIONS.

---STEEL, STRUCTURAL AND SUPPORTS

WELDING SHALL CONFORM TO THE REQUIREMENTS OF SECTION 17K OF THE SPECIFICATIONS.

---ALUMINUM

WELDING SHALL BE BY THE INERT-GAS-METAL-ARC (TUNGSTEN) METHOD USING APPROPRIATE FILLER WIRE FOR THE BASE METAL JOINED. ALLOY 4043, OR EQUAL, SHALL BE USED FOR WELDING OF 6061 AND 6063 ALUMINUM.

---GENERAL

SUBMIT SHOP DRAWINGS AS OUTLINED IN THE "CONTRACT SCHEDULE" FOR THE FOLLOWING:

8" AMBIENT AIR SYSTEM
18" X 14" ECS AIR SYSTEM
DUCT SUPPORTS AND ANCHORS
EXPANSION JOINTS

---SOURCES ARE NOT LIMITED TO THE FOLLOWING:

CARRIER AIR CONDITIONING CO., MILITARY EQUIPMENT DEPARTMENT, SYRACUSE, NEW YORK 13211; GENERAL CONNECTORS CORPORATION, P. O. BOX 4008, 3223 BURTON AVENUE, BURBANK, CALIFORNIA 91503; GOLDMAN AND GIBSON, 675 CYPRESS, MERRITT ISLAND, FLORIDA 32952; STRAZA INDUSTRIES, 790 GREENFIELD DRIVE, EL CAJON, CALIFORNIA 92021; AVICA CORP., P. O. BOX 180, NEWPORT, R.I. 02840; UNITED SHEET METAL DIVISION, UNITED MCGILL CORPORATION, 1122 MILFORD, ROCKFORD, ILLINOIS 61109.

---SHOP TESTING

ALL FABRICATED DUCT (EXCEPT DUCT MADE OF PIPES) SHALL BE FACTORY TESTED FOR AIR TIGHTNESS AT NOT LESS THAN 1 1/2 TIMES THE SPECIFIED WORKING PRESSURE. PRESSURE DROP SHALL NOT EXCEED 0.10 PSIG OVER A TWO HOUR PERIOD COMMENCING 10 MINUTES AFTER PRESSURIZATION WITH APPROXIMATELY CONSTANT AMBIENT TEMPERATURE.

---FIELD TESTING

THE INSTALLED DUCT SYSTEMS SHALL BE ISOLATED AND TESTED AT THE DESIGN WORKING PRESSURES.

THE AIR LEAKAGE AT THE TEST PRESSURE SHALL BE MEASURED BY A CALIBRATED ORIFICE FLOW METER. TOTAL ALLOWABLE LEAKAGE OF THE SYSTEM SHALL NOT EXCEED 1/2 OF 1% OF THE AIR HANDLING CAPACITY (9,300 CFM FOR THE 14 INCH DUCT AND 1600 CFM FOR THE 8 INCH DUCT). CONTRACTOR SHALL PROVIDE A SOURCE OF FILTERED, CLEAN, OIL-FREE COMPRESSED AIR.
IF THE SYSTEM IS TESTED IN SECTIONS, THE LEAKAGE RATES SHALL BE ADDED TO GIVE THE PERFORMANCE OF THE WHOLE SYSTEM.

LEAKAGE CONCENTRATED AT ONE POINT MAY RESULT IN OBJECTIONABLE NOISE EVEN IF THE SYSTEM PASSES THE LEAKAGE RATE CRITERIA. ALL NOISE SOURCES SHALL BE CORRECTED TO THE SATISFACTION OF THE CONTRACTING OFFICER.

THE ORIFICE FLOW MEASUREMENT DEVICE SHALL HAVE BEEN INDIVIDUALLY CALIBRATED AGAINST A PRIMARY STANDARD, AND THIS CALIBRATED CURVE PERMANENTLY ATTACHED TO THE ORIFICE TUBE ASSEMBLY.

TESTING MUST BE IN ACCORDANCE WITH A PROCEDURE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL.

TESTING SHALL BE WITNESSED BY THE CONTRACTING OFFICER.

---PAINTING AND FINISHING---

---FINISH FOR DUCTS

ALL SURFACES SHALL BE FINISHED PER MIL-STD-171. ALL STEEL SURFACES SHALL BE CLEANED PER FINISH NO. 4.3, TREATED PER FINISH NO. 5.1.1 AND 5.2. ALL ALUMINUM SURFACES SHALL BE TREATED PER FINISH NO. 7.3.

---PAINTING FOR DUCTS

ALL EXTERNAL SURFACES SHALL BE PAINTED PER MIL-STD-171, FINISH NO. 21.9, COLOR WHITE, NO. 27875 OF FED-STD-595.

000323

---MARKING

ALL MARKING ON DUCTS SHALL BE BLUE, COLOR NO. 25102 OF FED-STD-595, SEMI-GLOSS SYNTHETIC ENAMEL IN ACCORDANCE WITH TT-E-529.

MARKINGS ON EXTERIOR OF DUCTS SHALL BE AS FOLLOWS IN NEATLY STENCILED LETTERS 1 1/2 INCHES HIGH WITH MARKING SPACED 10 FEET ON CENTERS AXIALLY AND AT 120 DEGREES AROUND THE CIRCUMFERENCE OF THE DUCT AND WITH MARKING SPACED AXIALLY ALONG THE DUCT:

DUCT	MARKING	*COLOR BAND*
18" O.D.	ECS AIR TO PCR *(Breathing 20/25% O_2)*	*Green #14260*
8" (BELOW TEE TO PCR)	AMB. PRESS. AIR *(Breathing 20/25% O_2)*	*Green #14260*
8" (ABOVE TEE ON SIDE 4)	AMB. PRESS. AIR-ELEVATOR MACH. RM. *(Breathing 20/25% O_2)*	*Green #14260*
8" (TO PCR)	AMB. PRESS. AIR-PCR HOIST RM. *(Breathing 20/25% O_2)*	*Green #14260*

A

---OTHER METALS

PAINTING OF FERROUS METALS OTHER THAN DUCTS SHALL CONFORM TO SECTION 9L OF THE SPECIFICATIONS FOR ZINC-RICH COATINGS FOR NON-GALVANIZED STEEL, AND TO SECTION 9A FOR GALVANIZED STEEL.

---CLEANING OF DUCT SYSTEMS---

---GENERAL

ALL DUCT LENGTHS SHALL BE SHOP CLEANED AND DELIVERED TO THE SITE WITH END CLOSURES WHICH SHALL REMAIN INTACT UNTIL INSTALLATION.

---FINAL CLEANING OF DUCT SYSTEMS

ASSEMBLED DUCTING SHALL BE CLEANED BY SUBJECTING ALL INTERIOR SURFACES TO AIR STREAMS AT VELOCITIES TWO TIMES SPECIFIED WORKING VELOCITIES, AND AT STATIC PRESSURES WITHIN MAXIMUM DUCT RATINGS. THIS MAY BE ACCOMPLISHED BY: FILTER EQUIPPED PORTABLE BLOWERS WHICH REMAIN THE CONTRACTOR'S PROPERTY; WHEEL MOUNTED, COMPRESSED AIR OPERATED, PERIMETER LANCES WHICH DIRECT THE COMPRESSED AIR AND WHICH ARE PULLED IN THE DIRECTION OF NORMAL AIR FLOW; OTHER MEANS APPROVED BY THE CONTRACTING OFFICER. COMPRESSED AIR USED FOR CLEANING DUCTING SHALL BE WATER AND OIL FREE. AFTER CONSTRUCTION IS COMPLETE, AND PRIOR TO ACCEPTANCE, ALL CONSTRUCTION DUST AND DEBRIS SHALL BE REMOVED FROM EXTERIOR SURFACES.

SECTION 15E

PIPING - SOUND SUPPRESSION WATER SYSTEM

---GENERAL REQUIREMENTS---

---GENERAL

INCLUDED IS THE FURNISHING OF ALL MATERIAL, LABOR AND PLANT FOR THE COMPLETE FABRICATION, ERECTION, CHECKOUT, HYDROSTATIC PRESSURE TESTING OF PIPING SYSTEMS, SUPPORTS, ANCHORS AND ACCESSORIES AS SPECIFIED AND SHOWN ON DRAWING 79K10338 AND WITHIN THE FOLLOWING GENERAL LIMITS:

A. AFTER HYDROSTATIC TEST OF NEW ELEVATED TANK, CONNECT TO TWO RISERS OF NEW ELEVATED WATER TANK AND PROVIDE ALL PIPING WORK DOWNSTREAM OF SAME, INCLUDING CONNECTIONS TO: THREE INTERFACES FOR MOBILE LAUNCHER PLATFORM, SRB/ORBITER FLAME DEFLECTOR CREST SPRAY, SIDE PIPES IN FLAME TRENCH, AND CONNECTION TO REROUTED UNDERGROUND FIREX WATER SYSTEM.

B. DEMOLISH, RECONSTRUCT AND PROVIDE NEW REINFORCED CONCRETE STRUCTURES, EXCAVATE, FILL AND BACKFILL, AND PROVIDE PENETRATIONS AND SLEEVES IN NEW AND EXISTING REINFORCED CONCRETE STRUCTURES FOR NEW PIPING.

C. PROVIDE PILE FOUNDATIONS AND STEEL SUPPORTS FOR NEW PIPING, PROVIDE NEW RETAINING WALL, NEW SLABS, ELECTRICAL WORK AND OTHER MISCELLANEOUS WORK AS SHOWN ON THE DRAWING OR SPECIFIED.

D. PROVIDE HIGH PRESSURE NITROGEN GAS SYSTEMS FOR OPERATION OF SIX (6) 48" VALVES AS SPECIFIED IN SECTIONS 13F AND 15F, RESPECTIVELY, OF THE SPECIFICATIONS.

E. HYDROSTATICALLY TEST PIPE, FITTINGS AND COMPLETED PIPING SYSTEMS AS NOTED AND SPECIFIED.

---RELATED WORK

THE FOLLOWING RELATED WORK SHALL BE ACCOMPLISHED AS SHOWN ON THE DRAWING AND AS SPECIFIED:

A. REROUTING OF UNDERGROUND POTABLE AND FIREX WATER LINES AT NEW TANK AND NEW MAIN VALVE STATION AREAS TO CLEAR NEW CONSTRUCTION AS OUTLINED IN SECTION 15H - MISCELLANEOUS PIPING. RELOCATE LIGHTING AND COMMUNICATION POLE AND FOUNDATION, AND REMOVE, OR RELOCATE, AS SPECIFIED CONDUIT AND ELECTRICAL WORK IN AREAS SCHEDULED FOR EXCAVATION AS SHOWN ON THE DRAWING.

B. PROVIDE NEW UNDERGROUND DRAIN PIPING AND CURB CATCH BASIN DRAIN, AS OUTLINED IN SECTION 15H - MISCELLANEOUS PIPING.

---VALVES AND CONTROLS

UNLESS OTHERWISE NOTED, ALL VALVES WITH OTHER THAN MANUAL OPERATORS SHALL BE AS SPECIFIED IN SECTION 15F OF THE SPECIFICATIONS. VALVES WITH ONLY MANUAL OPERATORS SHALL BE AS SPECIFIED HEREIN OR AS NOTED ON THE DRAWINGS.

---REFERENCE STANDARDS AND ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
AWWA	AMERICAN WATER WORKS ASSOCIATION
FS	FEDERAL SPECIFICATIONS
MIL	MILITARY SPECIFICATIONS
MSS	MANUFACTURER'S STANDARDIZATION SOCIETY
QPL	QUALIFIED PRODUCTS LIST (NAVAL SHIP ENGINEERING CENTER)

COMMONLY USED TERMS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

I.D.	INSIDE DIAMETER	WOG	WATER, OIL, GAS (PRESSURE RATING)
IPS	IRON PIPE SIZE	WSP	WORKING STEAM PRESSURE
O.D.	OUTSIDE DIAMETER	MLP	MOBILE LAUNCHER PLATFORM
PSI	POUNDS PER SQUARE INCH	SSAT	SHUTTLE SERVICE & ACCESS TOWER
PSIG	POUNDS PER SQUARE INCH GAGE	ESPT	ENGINE SERVICE PLATFORM TRANSPORTER
USS	UNITED STATES STANDARD		

---MATERIALS AND WORK

ALL MATERIALS SHALL BE NEW. ALL WORK SHALL BE ACCOMPLISHED IN STRICT ACCORDANCE WITH THE REQUIREMENTS OF THE SPECIFICATIONS AND DRAWINGS. WHERE FEASIBLE, PIPING SHALL BE PREFABRICATED AT THE CONTRACTOR'S SHOP, SHIPPED TO THE SITE AND ERECTED. THE CONTRACTOR SHALL FURNISH ALL NECESSARY LABOR, MATERIALS, PLANT, TOOLS AND EQUIPMENT FOR A COMPLETE JOB, CLEANING OF ALL FOREIGN MATTER FROM THE INTERIOR AND EXTERIOR OF THE PIPING SYSTEMS AS SPECIFIED, PRESSURE AND OPERATIONAL FLOW TESTING, PAINTING AND IDENTIFICATION OF PIPING SYSTEMS AS SPECIFIED, AND CLEAN-UP PRIOR TO FINAL ACCEPTANCE.

---EXCEPTIONS

IF THE PROPOSED EQUIPMENT AND WORK DIFFER IN ANY MANNER FROM THAT SPECIFIED, THE CONTRACTOR SHALL STATE WHEREIN THE DIFFERENCE OCCURS, AND FAILURE TO STATE SHALL NOT RELIEVE THE CONTRACTOR FROM FURNISHING AND INSTALLING ALL WORK IN STRICT ACCORDANCE WITH THESE SPECIFICATIONS.

---ITEMS OF WORK INCLUDED

ITEMS OF WORK TO BE PROVIDED BY THE CONTRACTOR INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING:

ALL PIPING, FLANGES AND BOLTS; FITTINGS, PIPE HANGERS, PIPE SUPPORTS, PIPE ANCHORS, SWAY BRACES; ALL CONNECTIONS, NOZZLES, ORIFICES AND THREE PAD-TO-MLP INTERFACES (GFE).

ALL SUPPLEMENTAL STRUCTURAL STEEL INDICATED FOR PIPE HANGERS, PIPE SUPPORTS, PIPE SWAY BRACES, AND ANCHORS FOR THE PROPER INSTALLATION AND ERECTION OF THE PIPING SYSTEMS.

ALL MATERIALS AND LABOR FOR WELDING AND CUTTING OPERATIONS. WELDING SHALL BE IN ACCORDANCE WITH SECTION 17B OF THE SPECIFICATIONS ENTITLED, "WELDING FOR LOW PRESSURE PIPING SYSTEMS."

CLEANING OF MILL SCALE, SAND, RUST AND OTHER FOREIGN MATTER FROM THE INTERIOR OF PIPING PRIOR TO ERECTION.

ASSISTANCE IN THE MAKING OF RADIOGRAPHS OF WELDS IN SPECIFIED PIPING SYSTEMS TO THE EXTENT HEREINAFTER SPECIFIED, AND AS OUTLINED IN SECTION 17B OF THE SPECIFICATIONS.

ALL TESTS AND TEST REPORTS OF MATERIALS AND WORKMANSHIP AS SPECIFIED. SUBMITTAL OF ISOMETRIC, OR LAYOUT DRAWINGS, OF EACH PIPING SYSTEM, TOGETHER WITH SKETCHES CROSS-REFERENCED BY PIECE MARK NUMBERS, FOR APPROVAL PRIOR TO FABRICATION AND/OR ERECTION AND INCLUDING HANGER, SUPPORT AND ANCHOR DETAILS. FINAL ADJUSTMENTS OF ALL HANGERS AND SUPPORTS.

PRESSURE TESTING OF ALL PIPING SYSTEMS INSTALLED BY THE CONTRACTOR, SAID TESTS TO BE WITNESSED BY THE CONTRACTING OFFICER WHO SHALL BE GIVEN NOT LESS THAN 3 DAYS NOTICE OF SUCH TESTS.

REPRESENTATIVE OF THE CONTRACTOR SHALL BE ON THE SITE TO OBSERVE OPERATIONAL FLOW TESTS THAT WILL BE CONDUCTED BY THE GOVERNMENT.

CLEANING OF EXTERIOR AND FLUSHING OF THE INTERIOR OF COMPLETED PIPING SYSTEMS TO THE EXTENT THAT THE SYSTEMS ARE CLEAN OF ALL FOREIGN MATTER TO THE SATISFACTION OF THE CONTRACTING OFFICER. PROVIDING OF TEMPORARY BLOW-OFF, VENT AND DRAIN LINES, AND TEST CONNECTIONS.

CUTTING OF HOLES IN GRATING, PLATE, WALLS, STRUCTURES, ETC., IN ONLY THOSE CASES WHERE REQUIRED FOR THE PASSAGE OF ONLY THAT PIPING SHOWN ON THE DRAWINGS AND ONLY THEN WITH PRIOR APPROVAL OF THE CONTRACTING OFFICER UNLESS HOLES ARE DETAILED ON THE DRAWINGS.

ABRASIVE BLASTING, COATING AND LINING OF SPECIFIED PIPING. ABRASIVE BLASTING AND ZINC-RICH COATING OF ALL OTHER FERROUS, NON-GALVANIZED METALS IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THE SPECIFICATIONS. COLOR CODING AND IDENTIFICATION OF PIPING SYSTEMS IN ACCORDANCE WITH SECTION 13L OF THE SPECIFICATIONS.

---WITNESS OF TESTS IN THE FIELD

TESTS CONDUCTED WITHOUT PRESENCE OF CONTRACTING OFFICER, OR HIS DULY AUTHORIZED REPRESENTATIVE, WILL NOT

SERVE AS ACCEPTANCE TESTS; HOWEVER, THIS SHALL NOT BE CONSTRUED TO LIMIT THE CONTRACTOR INSOFAR AS TESTS PRELIMINARY TO ACCEPTANCE ARE CONCERNED. THE TIME SELECTED FOR ACCEPTANCE TESTS SHALL BE MUTUALLY AGREEABLE TO ALL PARTIES CONCERNED AND AT A TIME AGREEABLE TO THE CONTRACTING OFFICER. SUBMIT PROPOSED TEST SCHEDULES AND FIELD TEST PROCEDURES FOR APPROVAL BY THE CONTRACTING OFFICER. ALSO, REFER TO SECTION 18A.

---RADIOGRAPHS OF WELDS

THE GOVERNMENT MAY ELECT TO HAVE AN INDEPENDENT TESTING LABORATORY MAKE RADIOGRAPHS OF SELECTED FIELD WELDS, THE COST OF WHICH WILL BE PAID BY THE GOVERNMENT. THE CONTRACTOR, AT NO ADDITIONAL COST TO THE GOVERNMENT, SHALL PREPARE THE WELDS FOR RADIOGRAPHING AND SHALL ASSIST IN ONLY THAT WORK PECULIAR TO HIS TRADE AND SHALL CLEAR THE RESTRICTED AREA OF PERSONNEL DURING THOSE TIMES CONSIDERED TO BE HAZARDOUS. FILMS THAT REVEAL QUESTIONABLE WELDS, AS DETERMINED BY THE CONTRACTING OFFICER, WILL BE FORWARDED TO THE LABORATORY FOR THEIR REVIEW AND APPROVAL. COST OF ANY SERVICES FOR CORRECTION OF FAULTY WELDS SHALL BE INCLUDED AS WORK OF THIS SECTION AT NO ADDITIONAL COST TO THE GOVERNMENT. THE STANDARDS FOR ACCEPTANCE FOR WELDS EXAMINED BY RADIOGRAPHS SHALL BE AS OUTLINED IN "TECHNIQUE FOR RADIOGRAPHIC EXAMINATION OF WELDED JOINTS," SECTION VIII OF THE ASME BOILER AND PRESSURE VESSEL CODE, 1974 EDITION AND ADDENDA. REFER TO SECTION 17B OF THE SPECIFICATIONS. SEE "---MATERIALS---" FOR OTHER RADIOGRAPHY.

---FABRICATION

ALL PIPING SHALL BE FABRICATED IN ACCORDANCE WITH THE METHODS DESCRIBED HEREIN AND IN ACCORDANCE WITH APPLICABLE CODES. IN CERTAIN INSTANCES CONSIDERATION WILL BE GIVEN TO OTHER PROCEDURES NOT OUTLINED HEREIN; HOWEVER, NO OTHER SUCH PROCEDURES SHALL BE USED WITHOUT PRIOR APPROVAL IN WRITING FROM THE CONTRACTING OFFICER. CODE FOR POWER PIPING, ANSI B31.1-1973, IS APPLICABLE TO THIS PROJECT.

ALL STRAIGHT RUNS OF PIPING MEASURING LESS THAN 8 FEET IN LENGTH SHALL BE CONTINUOUS WITHOUT TRANSVERSE BUTT WELDS, UNLESS OTHERWISE DETAILED.

---SHOP CLEANING OF MILL SCALE

ALL FABRICATED PIPING SHALL BE THOROUGHLY CLEANED OF ALL MILL SCALE AND FOREIGN MATERIAL AT THE SHOP. ALL PIPE ENDS SHALL BE PROVIDED WITH SUITABLE PROTECTION FOR SHIPPING. PIPE SIZES 36" AND SMALLER SHALL BE PROVIDED WITH END CLOSURES PRIOR TO SHIPMENT. ALL CLOSURES WHICH BECOME DAMAGED PRIOR TO INSTALLATION OF THE PIPING SHALL BE CAUSE FOR RECLEANING OF THE PIPING TO THE FULL SATISFACTION OF THE CONTRACTING OFFICER AT NO ADDITIONAL COST TO THE GOVERNMENT.

---WELDING

ALL WELDING SHALL CONFORM TO THE REQUIREMENTS OF SECTION 17B ENTITLED, "WELDING FOR LOW PRESSURE WATER PIPING SYSTEMS," AND ANY ADDITIONAL REQUIREMENTS OF THIS SECTION (15E) OF THE SPECIFICATIONS. IF BACKING RINGS ARE USED, THEY SHALL BE REMOVED ON SHOP AND FIELD TRANSVERSE BUTT WELDS ON PIPE SIZES 24 INCH AND LARGER, BACK-WELDED AND GROUND FLUSH WITH THE INSIDE OF THE PIPE WALL. POST WELD HEAT TREATMENT OR STRESS-RELIEVING, WILL NOT BE REQUIRED.

SECTION 15AD

FLEXIBLE HOSES FOR WATER

---GENERAL REQUIREMENTS---

---GENERAL

PROVIDE FLEXIBLE RUBBER HOSES FOR CROSSOVER NO. 2 AT THE HINGE COLUMN TO CONNECT BETWEEN PIPING FROM THE SHUTTLE SERVICE AND ACCESS TOWER (SSAT) AND THE PAYLOAD CHANGEOUT ROOM (PCR) AS SHOWN ON THE DRAWINGS.

FLANGE-TO-FLANGE HOSE LENGTHS SHALL BE AS TABULATED ON THE DRAWINGS.

HOSES SHALL BE PROVIDED WITH SWAGED ON FLANGES, ONE OF WHICH SHALL BE OF THE LAP-JOINT, OR VAN STONE, TYPE. FLANGES SHALL MATE WITH CONNECTING PIPE FLANGES AT THE BULKHEAD PLATES, AND SHALL BE OF THE SIZE AND ANSI PRESSURE STANDARD NOTED ON THE DRAWINGS.

---SHOP DRAWINGS

SHOP DRAWINGS OF HOSE ASSEMBLIES SHALL BE SUBMITTED IN THE MANNER OUTLINED IN THE "CONTRACT SCHEDULE."

---RUB STRIPS

THE OUTSIDE DIAMETER OF EACH HOSE SHALL BE PROVIDED WITH A TEFLON RUB STRIP AS SHOWN ON THE DRAWINGS.

---HOSE CONSTRUCTION---

HOSE SHALL HAVE A RATED WORKING PRESSURE OF 400 PSIG (WATER), SHALL WITHSTAND WITHOUT COLLAPSING A FULL VACUUM. HOSE SHALL HAVE NEOPRENE COVER AND PETROLEUM RESISTANT SMOOTHBORE INNER TUBE.

HOSE BURST PRESSURE SHALL BE NOT LESS THAN 1600 PSIG.

HOSE SHALL BE SUITABLE FOR CONVEYING WATER AT TEMPERATURES BETWEEN 35 AND 150°F AT HIGH VELOCITY.

HOSE REINFORCEMENT SHALL BE OF SPIRALED STEEL WIRE PLIES TO RESIST CRUSHING AND KINKING. STEEL REINFORCEMENT SHALL BE BONDED TO THE FLANGES TO DISSIPATE STATIC ELECTRICITY.

HOSES FOUR INCHES AND LARGER SHALL BE EQUAL TO GOODYEAR "FLEXSTEEL" DOCK HOSE FOR SUCTION AND DISCHARGE SERVICE.

HOSES SMALLER THAN FOUR INCHES SHALL BE EQUAL TO SALEM REPUBLIC H611-400.

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---DUCTS

CARRIER AIR CONDITIONING CO.
MILITARY EQUIPMENT DEPARTMENT
SYRACUSE, NEW YORK 13211

GENERAL CONNECTORS CORPORATION
P.O. BOX 4008
3223 BURTON AVENUE
BURBANK, CALIFORNIA 91503

GOLDMAN AND GIBSON
675 CYPRESS
MERRITT ISLAND, FLORIDA 32952

STRAZA INDUSTRIES
790 GREENFIELD DRIVE
EL CAJON, CALIFORNIA 92021

AVICA CORP.
P.O. BOX 180
NEWPORT, R.I. 02840

---EXPANSION JOINTS AND FLEXIBLE AIR DUCT

THE GARRETT CORPORATION
AIR CRUISERS DIVISION
BELMAR, NEW JERSEY

FLEXIBLE TUBING CORPORATION
GULIFORD, CONNECTICUT 06437

AICO RUBBER PRODUCTS
GRAND HAVEN, MICHIGAN

KIRKHILL RUBBER COMPANY
BREA, CALIFORNIA

---18 INCH O.D. OUTER DUCT ABOVE ELEVATION 109'-7"

MATERIAL SHALL BE 16 U.S. STANDARD GAGE GALVANIZED SHEET STEEL EQUAL TO ASTM A 527-71, SPIRAL SEALED LOCK SEAM CONSTRUCTION EQUAL TO UNITED MCGILL CORPORATION "UNI-SEAL" DUCT, AND SHALL BE SUITABLE FOR THE PRESSURES AND TEMPERATURES HEREINABOVE SPECIFIED FOR THE 14 INCH O.D. INNER DUCT.

DUCT SECTIONS SHALL BE EQUIPPED WITH GALVANIZED STEEL 1 1/2" X 1 1/2" X 3/16" ANGLE FLANGES CONNECTED TO THE DUCT IN SUCH A MANNER AS TO PERMIT BOLTING OF THE INNER DUCT FLANGES, SUBSEQUENT MATING AND BOLTING OF THE OUTER DUCT FLANGES, AND THE COMPLETED OUTER DUCT JOINT SYSTEM FORMING A WEATHER-TIGHT AND AIR PRESSURE TIGHT CONNECTION INCORPORATING MECHANICAL MEANS OTHER THAN FRICTION TO PREVENT AXIAL SEPARATION OF THE JOINT.

WHERE CONNECTIONS ARE MADE TO THE CROSSOVER BULKHEAD PLATES, FLANGES TO MATCH THE DRILLING OF THE BULKHEAD PLATES AND THE FLEXIBLE DUCT SHALL BE PROVIDED.

---FITTINGS

MATERIALS: MATERIALS SHALL MATCH THAT OF THE HEREINBEFORE SPECIFIED 14 INCH O.D. INNER DUCT AND FOR THE TWO TYPES OF 18 INCH OUTER DUCTS, RESPECTIVELY.

PRESSURE AND TEMPERATURE CRITERIA SHALL BE AS HEREINBEFORE SPECIFIED.

CONSTRUCTION: ELBOWS SHALL BE OF THE LONG RADIUS TYPE WITH CENTER-TO-END DIMENSIONS NOT LESS THAT 1 1/2 TIMES THE DUCT DIAMETER. ELBOWS FOR THE 1/4 INCH THICK OUTER DUCT MAY BE OF THE 5-PIECE WELDED MITER TYPE, GALVANIZED AFTER FABRICATION. FITTINGS FOR LIGHT WALL GALVANIZED STEEL (16 GAGE) OUTER DUCT MAY BE FABRICATED OF NOT LESS THAN 20 GAGE U.S. STANDARD GALVANIZED STEEL. ALL INNER DUCT FITTINGS SHALL HAVE SMOOTH INTERIOR SURFACES TO RESIST TO MINIMUM FRICTIONAL LOSSES.

---INSULATION

THE ANNULAR SPACE OF DOUBLE WALL FITTINGS AND DOUBLE WALL DUCTS SHALL BE FILLED WITH POLYURETHANE FOAMED-IN-PLACE INSULATION. FOR DOUBLE WALL FITTINGS AND DOUBLE WALL DUCTS, INSULATION SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

ON FITTINGS THAT HAVE FLAT TYPE FLANGES, POLYURETHANE (FOAMED-IN-PLACE) INSULATION SHALL BE POURED THROUGH 1 1/2" HOLE DRILLED IN THE FACE OF THE FLANGE. AFTER FITTING HAS BEEN POURED (INSULATED) AND CURED, REMOVE EXCESS INSULATION SO IT WILL BE LEVEL WITH FACE OF FLANGE. THE POLYURETHANE INSULATION SHALL HAVE A DENSITY OF 2 POUNDS PER CUBIC FOOT AND CONFORM TO HH-1-00530 TYPE III, CLASS 2 (NON-BURNING). THERMAL CONDUCTIVITY (K) OF INSULATION SHALL BE NOT LESS THAN 0.15 BTU/HR/OF/FT 2/INCH OF THICKNESS AT A MEAN TEMPERATURE OF 75° F.

PROVISIONS SHALL BE PROVIDED TO ACCOMODATE WITHOUT AIR LEAKAGE THE DIFFERENTIAL EXPANSION BETWEEN THE INNER AND OUTER DUCT.

INNER DUCT EXPANSION JOINTS: THESE SHALL BE OF THE HELIX WIRE REINFORCED IMPREGNATED FABRIC TYPE SUITABLE FOR THE OPERATING PRESSURES AND TEMPERATURES HEREIN SPECIFIED. INNER PLY AND OUTER PLY AND CORD SHALL BE OF SILICONE COATED IMPREGNATED GLASS FIBER. THE WIRE HELIX SHALL BE OF GALVANIZED SPRING STEEL.

CONFIGURATION SHALL BE CYLINDRICAL, FLEXIBLE TUBES, WITH END FLANGES, ONE OF WHICH SHALL BE A LOOSE FLANGE OF THE LAP-JOINT OR THE VAN STONE TYPE TO EFFECT HOLE ALIGNMENT BETWEEN THE DUCT SECTIONS CONNECTED THERETO.

FLANGES SHALL MATE WITH DUCT FLANGES HEREINABOVE SPECIFIED, SHALL BE OF ALUMINUM COVERED WITH SILICONE COATED AND IMPREGNATED GLASS FIBER.

CRUSH RESISTANCE: 300 POUNDS PER FOOT.

AXIAL TENSILE STRENGTH: 1400 POUNDS

PRESSURE DROP: WITH THE JOINT IN A STRAIGHT POSITION THE AIR FRICTION DROP SHALL NOT EXCEED 5 INCHES OF WATER PER 100 FEET OF LENGTH AT A FLOW RATE OF 6500 SCFM.

FLEXIBILITY AND PRESSURES: WHEN FULLY EXTENDED, WHEN COMPRESSED TO 45 PERCENT OF FULLY EXTENDED LENGTH, OR WHEN BENT TO AN INSIDE BEND RADIUS OF 1 1/2 THE INSIDE DIAMETER OF THE TUBE, THE EXPANSION JOINTS SHALL WITHSTAND THE FOLLOWING WORKING PRESSURES:

5 PSIG POSITIVE INTERNAL
4 PSIG NEGATIVE INTERNAL

LEAKAGE SHALL NOT EXCEED 0.10 SCFM.
BURST PRESSURE SHALL BE NOT LESS THAN 15 PSIG INTERNAL.

OPERATING RANGE: PLUS OR MINUS 1 1/2 INCHES EXTENSION AND COMPRESSION, RESPECTIVELY, FROM THE INSTALLED LENGTH. JOINTS SHALL BE FURNISHED AND INSTALLED IN THE DUCT SYSTEM 50 PERCENT COMPRESSED.

---18 INCH O.D. OUTER DUCT BELOW ELEVATION 114'-7"

18 INCH O.D. SCHEDULE 10 (0.250 INCH WALL) GALVANIZED STEEL PIPE CONFORMING TO ASTM A120 OR A53 GRADE A. PIPE SHALL BE PLAIN END WITH SUFFICIENT GAP BETWEEN SECTIONS TO PERFORM THE BOLTING OPERATIONS FOR THE INNER DUCT FLANGES AND FITTING FLANGES. GAP BETWEEN OUTER DUCT PIPE ENDS SHALL BE CLOSED WITH A DRESSER-TYPE COUPLING HAVING ALL FERROUS COMPONENTS GALVANIZED, AND WITH NEOPRENE GASKETS.

000319

ALL NEW ELEVATOR ITEMS THAT REQUIRE GAS PURGING SHALL BE EQUIPPED WITH FITTINGS BY THE CONTRACTOR FOR CONNECTION (BY OTHERS) TO THE NITROGEN SYSTEM. FITTINGS ON EXISTING EQUIPMENT SHALL BE RETAINED.

NITROGEN GAS SUPPLY CONTROL VALVES, HARDWARE AND TESTING OF THE PURGING SYSTEM SHALL BE AS REQUIRED BY SECTION 16V (PART 2) OF THE SPECIFICATIONS. CONTRACTOR SHALL FURNISH NEW NITROGEN HOSE, BETWEEN EACH CAR AND ITS FIXED HOISTWAY CONNECTION, AND NEW HOSE TROUGHS.

---WELDING

ALL WELDING SHALL COMPLY WITH SECTION 17K OF THE SPECIFICATIONS.

---FIELD TESTS---

---GENERAL

AFTER THE CONTRACTOR HAS ERECTED, ADJUSTED, LUBRICATED AND OTHERWISE PREPARED THE ELEVATOR SYSTEM FOR NORMAL OPERATION, IT SHALL BE TESTED IN THE PRESENCE OF THE CONTRACTING OFFICER AS SPECIFIED HEREINBELOW. THROUGHOUT THE CONDUCT OF TEST, ALL COMPONENTS SHALL BE CAREFULLY INSPECTED TO INSURE THAT ALL COMPONENTS OPERATE SMOOTHLY AND PROPERLY IN ACCORDANCE WITH THE SPECIFICATION REQUIREMENTS; THAT THERE IS NO EVIDENCE OF MALFUNCTIONING; THAT NONE OF THE COMPONENTS OVERHEAT TO THE EXTENT THAT THERMAL RATINGS ARE EXCEEDED; AND THAT THERE ARE NO INTERRUPTIONS DUE TO OPERATION OF THERMAL OR OVERCURRENT PROTECTION DEVICES. ALL TEST DATA AND THE CHARACTERISTIC VALUES OF VOLTAGE AND CURRENT FOR THE VARIOUS CONTROL COMPONENTS UNDER BOTH FULL LOAD CONDITIONS AND NO-LOAD CONDITIONS SHALL BE MEASURED AND RECORDED IN EACH COPY OF THE SERVICE MANUAL HEREINBEFORE SPECIFIED. THE GOVERNMENT WILL MAKE AVAILABLE, FOR TRANSPORT BY THE CONTRACTOR, THE NECESSARY TEST LOADS. THE CONTRACTOR SHALL PROVIDE ALL OTHER NECESSARY EQUIPMENT, INSTRUMENTATION AND ALL PERSONNEL REQUIRED FOR THE CONDUCT OF THE TESTS.

---ACCEPTANCE TESTS

ACCEPTANCE TESTS SHALL INCLUDE, BUT NOT BE LIMITED TO, ALL TESTS SPECIFIED IN ANSI A17.1 THRU 1973 REVISIONS.

ACCEPTANCE TESTS SHALL BEAR SIGNATURES OF DESIGNATED REPRESENTATIVES OF THE CONTRACTOR AND CONTRACTING OFFICER IN EVIDENCE OF WITNESSING THE TESTS.

GUARDS AND DOOR PANELS SHALL BE RETAINED AND REUSED. THESE ENTRANCES SHALL BE INSTALLED AT LANDINGS 27 THROUGH 207. THE EXISTING HANGERS AND DOOR LOCKS FOR THESE ENTRANCES SHALL BE RETAINED AND REUSED.

THE PAD ENTRANCES SHALL BE SET IN CONCRETE. NEW ENTRANCE FRAMES AND ACCESSORIES SUITABLE FOR MOUNTING IN CONCRETE SHALL BE PROVIDED FOR THE PAD ELEVATION ENTRANCES COMPLETE WITH NEW DOORS OF WEATHER-PROOF CONSTRUCTION AND STAINLESS STEEL COVERING.

---PITS

AT THE BOTTOM OF THE TWO HOISTWAYS A PIT SHALL BE PROVIDED TO RECEIVE THE UNDERPARTS OF THE ELEVATOR CARS. WITHIN THE PIT SHALL BE PROVIDED OIL BUFFERS, PIT LIGHTS AND A STEEL ACCESS LADDER FROM THE LOWER HOISTWAY LANDING OF EACH ELEVATOR. THE CONTRACTOR SHALL PROVIDE ALL PIT EQUIPMENT REQUIRED FOR THE PROPER OPERATION OF THE ELEVATOR SYSTEM AND COMPLIANCE WITH THE ASE CODE. A BARRIER SHALL BE PROVIDED ACROSS THE PIT TO ISOLATE THE AREAS SERVING THE RESPECTIVE CARS.

---TRAVELING CABLES AND WIRING AND PURGE HOSE AND TROUGHS

NEW TRAVELING CABLES AND WIRING SHALL BE INSTALLED WITH SUFFICIENT NUMBER OF SPARES IN THE TRAVELING CABLES TO MAINTAIN THE 10% RATIO OF SPARES TO USED CONDUCTORS. THE CONTRACTOR SHALL PROVIDE AND INSTALL A NEW TRAVELING CABLE AND NEW CABLE TROUGH SYSTEM THAT SHALL COMPLY WITH THE PRESENT TROUGH DESIGN. ALL HINGES SHALL BE OF STAINLESS STEEL.

ALL TROUGHS AND CABLES SHALL BE SUITABLE FOR OUTDOOR EXPOSURE IN THE SPECIFIED ENVIRONMENT OF WIND LOAD, TRANSIENT HIGH TEMPERATURE, SALT WATER SPRAY, TRANSIENT HIGH SOUND-PRESSURE-LEVEL, EXPOSURE TO HYDROGEN AND OXYGEN, ETC.

EXISTING CAR ENCLOSURES CONSISTING OF THE CAR FRAME, SAFETY, PLATFORM AND CAR GUIDE, SHALL BE REINSTALLED. THIS EQUIPMENT SHALL BE INSTALLED IN A SINGLE UNIT. A SUITABLE HOIST TO LIFT AND PLACE THIS EQUIPMENT INTO THE HOISTWAY SHALL BE PROVIDED. THE CONTRACTOR SHALL PROVIDE SUPERVISION AS REQUIRED TO INSURE THAT THIS EQUIPMENT IS PLACED IN THE HOISTWAY IN THE PROPER MANNER. THE EMERGENCY EXIT HATCH LOCKS ON CARS SHALL BE REPLACED WITH NEW LOCKS. A NIGHT LATCH SHALL BE PROVIDED ON THE OUTSIDE.

---COUNTERWEIGHTS

ELEVATOR COUNTERWEIGHTS CONSISTING OF THE COUNTERWEIGHT FRAME AND COUNTERWEIGHT SHALL BE RETAINED AND REUSED. ELEVATOR COUNTERWEIGHTS SHALL BE HOISTED AND PLACED INTO THE ELEVATOR HOISTWAY. THE CONTRACTOR SHALL PROVIDE ADEQUATE TECHNICAL SUPERVISION TO INSURE THAT THE ELEVATOR COUNTERWEIGHTS ARE LOCATED IN THE HOISTWAY IN THE PROPER MANNER.

---MOTOR GENERATOR SETS

THE EXISTING MOTOR GENERATOR SETS SHALL BE RETAINED AND REUSED IN THE RELOCATED MACHINE ROOM.

---CONTROLLERS

THE EXISTING ELEVATOR CONTROLLERS SHALL BE RETAINED AND REUSED. CONTROLLERS SHALL BE ALTERED AS REQUIRED FOR THE NEW RISE AND NUMBER OF STOPS SERVED.

---SELECTORS

THE EXISTING ELEVATOR SELECTORS SHALL BE RETAINED AND REUSED. THE SELECTORS SHALL BE ALTERED AS REQUIRED FOR THE NEW RISE AND NUMBER OF STOPS SERVED.

---RELAY PANELS

THE EXISTING ELEVATOR RELAY PANELS SHALL BE RETAINED AND REUSED. RELAY PANELS SHALL BE ALTERED AS REQUIRED FOR THE NEW RISE AND NUMBER OF STOPS SERVED.

---EGRESS CONTROLLER

THE EXISTING EGRESS CONTROLLER, DISTRIBUTOR AND INTERCONNECTING WIRING SHALL BE DISCONNECTED AND TRANSPORTED TO THE DESIGNATED GOVERNMENT SALVAGE AREA.

---GOVERNORS

THE EXISTING GOVERNORS SHALL BE RETAINED AND REUSED.

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---HOISTWAY EQUIPMENT

THE CONTRACTOR SHALL DISCONNECT AND REMOVE ALL EXISTING TROUGHS FOR THE TRAVELING CABLE, NITROGEN PURGE HOSES AND THE GOVERNOR ROPE. THE CONTRACTOR SHALL REMOVE ALL HOISTWAY WIRING. THE CONTRACTOR SHALL REMOVE THE CAR AND COUNTERWEIGHT RAILS AND CAR AND COUNTERWEIGHT RAIL BRACKETS. THE CONTRACTOR SHALL REMOVE THE GOVERNOR TENSION SHEAVE, ALL LIMIT SWITCHES AND INDUCTOR SWITCHES.

DOOR OPENINGS WHICH CONSIST OF THE ENTRANCES, HANGERS AND DOOR LOCKS MAY REMAIN IN PLACE. THE CONTRACTOR SHALL DISCONNECT ELECTRICAL WIRING TO THE DOOR LOCKS.

THE CONTRACTOR SHALL LIFT THE ELEVATOR CARS, CARFRAMES AND PLATFORMS WITH APPENDAGES FROM THE ELEVATOR SHAFT; THEN REMOVE THE COUNTERWEIGHTS AND BUFFERS FROM THE ELEVATOR PITS.

---REMOVED MATERIAL

TRANSPORT ALL REMOVED ELEVATOR EQUIPMENT TO BE REUSED TO AND FROM THE DESIGNATED STORAGE PLACE.

TRANSPORT ALL RESIDUE TO THE SALVAGE AREA AND TURN IN TO THE CONTRACTING OFFICER.

---INSTALLATION---

---GENERAL

THE NEW SSAT ELEVATOR SYSTEM TOWER CONFIGURATION SHALL BE AS ORIGINALLY DESIGNED AND INSTALLED BUT ARRANGED TO SUIT THE NEW TRAVEL AND LANDINGS OF THE ELEVATORS.

---OPERATION

THE OPERATION OF THE ELEVATOR SYSTEM SHALL NOT BE CHANGED. THE HALL CALL AND CAR CALL OPERATION SHALL BE ALTERED AS NECESSARY AND REQUIRED FOR THE NEW TRAVEL AND LANDINGS SERVED. THE EGRESS SYSTEM SHALL REMAIN AS A FEATURE OF THE OPERATION. IT SHALL BE ALTERED AS NECESSARY AND REQUIRED FOR THE NEW TRAVEL AND LANDINGS SERVED, BUT ALL WIRING SHALL TERMINATE IN THE MACHINE ROOM.

---CAPACITY

THE SYSTEM SHALL RETAIN ITS PRESENT CAPACITY OF A LIVE LOAD OF 2500 LBS PER CAR.

---SPEED

THE SYSTEM SHALL RETAIN ITS PRESENT NOMINAL SPEED OF 600 FPM.

---TRAVEL

THE SYSTEM SHALL BE ARRANGED TO SERVE A RISE OF 207'.

---SERVICE AND PART MANUALS AND DATA

THE CONTRACTOR SHALL PREPARE AND DELIVER TO THE CONTRACTING OFFICER SIX COPIES OF SERVICE AND PART MANUALS AND DATA, CORRECTED BY THE "AS-REBUILT" CONFIGURATION AND INCLUDING COPIES OF THE ACCEPTANCE TEST RECORDS FOR ALL NEW COMPONENTS FURNISHED.

---WIRING DIAGRAM FOR MOUNTING

COMPLETE SCHEMATIC WIRING DIAGRAMS AND STRAIGHT DIAGRAMS SHOWING THE "AS-REBUILT" ELECTRICAL CONNECTIONS SHALL BE FURNISHED BY THE CONTRACTOR SUITABLY FRAMED UNDER CLEAR PLASTIC WITH NON-FERROUS METAL FRAME AND MOUNTED IN THE MACHINE ROOM WHERE DIRECTED BY THE CONTRACTING OFFICER.

---INSPECTION AND ERECTION OF EXISTING EQUIPMENT---

---GENERAL

THE ELEVATOR SYSTEM SHALL BE THOROUGHLY INSPECTED BY THE CONTRACTOR PRIOR TO ERECTION. A WRITTEN REPORT SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL DESCRIBING ALL DAMAGE, DETERIORATION AND ANY OTHER CONDITIONS THAT NEED REPAIR AND/OR CORRECTION. THE REPORT SHALL INCLUDE ESTIMATED COST TO REPAIR AND/OR REPLACE EACH ITEM NOT COVERED BY CONTRACT.

THE CONTRACTOR SHALL ERECT THE EXISTING ELEVATOR EQUIPMENT ON THE NEW SSAT. THE CONTRACTOR SHALL PROVIDE A WORK FORCE OF THE CALIBER HEREINBEFORE SPECIFIED CONSISTING OF SUPERVISION AND MANPOWER HAVING SUFFICIENT EXPERIENCE AND SKILLS TO ERECT THIS EQUIPMENT IN SUCH A MANNER THAT IT CAN BE OPERATED AND PROPERLY FUNCTION.

---EGRESS CONTROLLER, DISTRIBUTOR AND INTERCONNECTING WIRING

THE CONTRACTOR SHALL DISCONNECT THE EGRESS CONTROLLER AND DISTRIBUTOR AND TRANSPORT TO DESIGNATED GOVERNMENT SALVAGE AREA. CONTRACTOR SHALL REMOVE INTERCONNECTING WIRING BETWEEN ABOVE ITEMS AND TRANSPORT TO SALVAGE AREA. CONTRACTOR SHALL MODIFY REMAINING WIRING AS REQUIRED TO EFFECT PROPER OPERATION OF ELEVATOR SYSTEMS.

---MACHINE ROOM

THE ELEVATOR MACHINE ROOM SHALL BE ERECTED WITH THE EXISTING MACHINERY REMAINING IN PLACE. (WHEN ORIGINALLY INSTALLED, EQUIPMENT WAS MOUNTED IN EACH HALF OF THE MACHINE ROOM PRIOR TO HOISTING THE HALVES TO THE TOP OF THE ML NO. 2 TOWER). TWO 7 TON PACKAGE AIR CONDITIONING UNITS (MODEL SUA-754B, TYPE 167-26E, 440/480 V - 3 PH-60 CY, 20 AMPS AT FULL LOAD PLUS A 1 HP, 1.8 FLA MOTOR DRIVE) SHALL BE RELOCATED TO FUNCTION AS EXISTING WITHIN THE ROOM. THE OUTSIDE CONDENSER UNIT (TRANE MODEL DA-6, TYPE 269-118, WITH THREE 1/3 HP, SINGLE PHASE - 60 CY. - 440/480 VOLT, 2.3 FLA MOTOR POWERED FANS SHALL ALSO BE RELOCATED TO FUNCTION AS EXISTING. ALL WIRING AND CONTROLS SHALL BE INSTALLED TO DUPLICATE EXISTING.

000280

---ELECTRICAL WORK

ALL ELECTRICAL WORK SHALL COMPLY WITH THE APPROPRIATE PARTS OF DIVISION 16 OF THE SPECIFICATIONS, AND ARTICLE 620 OF THE NEC. HAZARD-PROOFING SHALL COMPLY WITH SECTION 16

---BONDING AND GROUNDING

ALL METALS SHALL BE BONDED AND GROUNDED AS OUTLINED IN SECTION 16X (PART 51) OF THE SPECIFICATIONS.

---MATERIALS

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL MATERIALS, SURFACES AND FINISHES FROM ANY CAUSE PRIOR TO FINAL ACCEPTANCE OF THE TOTAL WORK COVERED BY THESE SPECIFICATIONS. ALL DAMAGES SHALL BE REPAIRED AND/OR REFINISHED TO THE FULL SATISFACTION OF THE CONTRACTING OFFICER. THE CONTRACTOR SHALL PROTECT ALL UNPAINTED, MACHINED SURFACES FROM CORROSION FROM ANY CAUSE DURING SHIPMENT, STORAGE AT THE SITE AND CONSTRUCTION OPERATIONS SUCH THAT THESE SURFACES ARE IN NEW CONDITION, FREE FROM RUST AND CORROSION DAMAGE, AT THE TIME OF FINAL ACCEPTANCE. TEMPORARY PROTECTION SHALL BE GENERALLY A WAX OR GREASE TYPE MATERIAL SPECIFICALLY FORMULATED AS A TEMPORARY PROTECTIVE COATING FOR MACHINED SURFACES. THE TEMPORARY COATING SHALL BE COMPLETELY REMOVED AND THE SURFACES PROPERLY LUBRICATED PRIOR TO FINAL ACCEPTANCE. THE TEMPORARY COATING AND THE OPERATIONS OF APPLICATIONS AND REMOVAL SHALL NOT DAMAGE OR DETRACT FROM THE ULTIMATE PROPERTIES OF PERMANENT COATINGS. LOST OR PILFERED ITEMS SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.

---HOISTWAY ENCLOSURE

THE CONTRACTOR SHALL PROVIDE NEW HOISTWAY ENCLOSURE FOR BLAST PROTECTION AS SHOWN ON DRAWINGS. FROM THE NEW PIT TO LANDING 27, ENCLOSURE SHALL BE REINFORCED CONCRETE. FROM LANDING MLP TO LANDING 67, ENCLOSURE SHALL BE NEW STEEL FRAMING WITH 1/4 INCH THICK COVER PLATE. THE HOISTWAY AT LANDINGS 27, 67 AND ABOVE SHALL EACH BE PROVIDED WITH NEW METAL SIDING WAINSCOAT ABOVE WHICH SHALL BE INSTALLED ON EXISTING FRAMED WOVEN WIRE MESH PANELS.

---ENVIRONMENT

NEW EQUIPMENT AND WORK SHALL BE SUITABLE FOR SATISFACTORY OPERATION EXPOSED TO THE ELEMENTS (WIRE MESH ENCLOSED SHAFT) ON THE COAST OF THE ATLANTIC OCEAN AT KENNEDY SPACE CENTER, AND SUBJECT TO INTERMITTENT SALT WATER SPRAY. ELEVATOR MACHINERY SHALL BE ENCLOSED WITHIN A ROOM AS SHOWN ON THE CONTRACT DRAWINGS. IN ADDITION TO THE ABOVE, NEW ELEVATOR DEVICES SHALL BE DESIGNED FOR, AND CAPABLE OF, SATISFACTORILY OPERATING UNDER THE FOLLOWING ENVIRONMENTAL CONDITIONS AND SHALL WITHSTAND WITHOUT DAMAGE THE SPECIFIED ENVIRONMENTS WHERE NOTED AS "NON-OPERATING", ALL AS SPECIFIED FOR THE EXISTING SYSTEM:

1. WIND VELOCITY OF 67.6 KNOTS RESULTING IN A PRESSURE OF TWENTY (20) POUNDS PER SQUARE FOOT. (CAR, CABLES, ROPES, CABLE TROUGH SYSTEM, CAR GUIDE AND SAFETY SYSTEM, COUNTERWEIGHT AND SAFETY SYSTEM SHALL ALSO BE CAPABLE OF WITHSTANDING WITHOUT DAMAGE A "NON-OPERATING" HURRICANE WIND LOAD OF 181 MILES PER HOUR EQUIVALENT TO A PRESSURE OF ONE HUNDRED TEN (110) POUNDS PER SQUARE FOOT ON A FLAT SURFACE INCLUDING WIND GUST FACTOR).

2. INTERMITTENT GASEOUS HYDROGEN ATMOSPHERE.

3. INTERMITTENT GASEOUS OXYGEN ATMOSPHERE.

4. INTERMITTENT "NON-OPERATING" MAXIMUM SOUND PRESSURE LEVELS IN DECIBELS REFERENCED TO 0.0002 MICROBARS AS FOLLOWS: 167 DB OVERALL; AND AT ONE-THIRD OCTAVE CENTERBAND FREQUENCIES IN CYCLES PER SECOND AS FOLLOWS: 147 DB AT 10 CPS; 156 DB AT 100 CPS; AND 147 DB AT 3000 CPS.

5. NORMAL AMBIENT AIR BETWEEN 25 AND 110°F AT 50% R.H.

6. INTERMITTENT TRANSIENT (20 SECONDS) "NON-OPERATING" AMBIENT AIR TEMPERATURES OF UP TO 700°F AT INTERVALS NOT MORE FREQUENT THAN ONCE EACH WEEK.

EXCEPTIONS: IF NEW PROPOSED EQUIPMENT DIFFERS IN ANY MANNER FROM THAT SPECIFIED, THE BIDDER SHALL STATE WHEREIN THE DIFFERENCE OCCURS, AND FAILURE TO SO STATE WILL NOT RELIEVE THE CONTRACTOR FROM FURNISHING AND INSTALLING ALL WORK IN STRICT ACCORDANCE WITH THESE SPECIFICATIONS.

---PERSONNEL QUALIFICATIONS

THE CONTRACTOR SHALL PROVIDE THE SERVICES OF TECHNICIANS IN THE EMPLOY OF AN ESTABLISHED COMPANY REGULARLY ENGAGED IN THE BUSINESS OF INSTALLING AND SERVICING ELEVATORS OF THE TYPE AND CHARACTER OUTLINED IN THIS SPECIFICATION.

ALL ITEMS HANDLED BY THE CONTRACTOR SHALL BE ERECTED, INSTALLED, ADJUSTED, CHECKED OUT AND PLACED IN OPERATION BY COMPETENT PERSONNEL UNDER THE SUPERVISION AND IN THE DIRECT EMPLOY OF THE AFORESAID ESTABLISHED ELEVATOR INSTALLATION AND SERVICING COMPANY.

---INTERFERENCES

THE CONTRACTOR SHALL COORDINATE THE WORK OF THE DIFFERENT TRADES SO THAT INTERFERENCE BETWEEN PIPING, EQUIPMENT, ARCHITECTURAL AND STRUCTURAL WORK SHALL BE AVOIDED. ALL NECESSARY OFFSETS IN PIPING AND ALL FITTINGS, ETC., REQUIRED TO PROPERLY INSTALL THE WORK SHALL BE FURNISHED COMPLETE IN PLACE WITHOUT ADDITIONAL COST TO THE GOVERNMENT. IN CASE INTERFERENCE DEVELOPS, THE CONTRACTING OFFICER WILL DECIDE WHICH EQUIPMENT SHALL BE RELOCATED, REGARDLESS OF WHICH APPARATUS WAS FIRST INSTALLED.

---SINGULAR NUMBER

WHERE ANY DEVICE OR PART OF EQUIPMENT IS HEREIN REFERRED TO IN THE SINGULAR NUMBER, SUCH REFERENCE SHALL BE DEEMED TO APPLY TO AS MANY SUCH DEVICES AS ARE REQUIRED TO COMPLETE THE INSTALLATION.

---CROSS-CONNECTIONS AND INTERCONNECTIONS

NO PLUMBING FIXTURE, DEVICE, OR PIPING SHALL BE INSTALLED WHICH WILL PROVIDE A CROSS CONNECTION OR INTERCONNECTION BETWEEN A POTABLE WATER SUPPLY FOR DRINKING PURPOSES AND A POLLUTED SUPPLY SUCH AS A DRAINAGE SYSTEM, WHICH WOULD MAKE POSSIBLE THE BACKFLOW OF POLLUTED WATER INTO THE POTABLE WATER SUPPLY SYSTEM.

---REFERENCED DOCUMENTS

WHERE SPECIFIC REQUIREMENTS ARE SET FORTH IN THIS SECTION OF THE SPECIFICATIONS, AND WHERE SUCH SPECIFIC REQUIREMENTS DEPART FROM REQUIREMENTS OR ALTERNATIVES CONTAINED IN ANY DOCUMENTS REFERENCED HEREIN, THE SPECIFIC REQUIREMENTS CONTAINED IN THIS SECTION OF THE SPECIFICATIONS SHALL GOVERN AND TAKE PRECEDENCE.

---SPECIFICATIONS

MATERIALS SHALL BE OF THE SPECIFIED CLASS, GRADE, AND TYPE. SHOP TESTS OF PIPE, VALVES, AND FITTINGS, REQUIRED BY THE FEDERAL SPECIFICATIONS SHALL BE CONDUCTED; HOWEVER, THE PRESENCE OF A GOVERNMENT INSPECTOR IS WAIVED; HOWEVER, CERTIFICATIONS OF ALL SUCH TESTS SHALL BE SUBMITTED AS OUTLINED UNDER THE HEADING "---PROOFS OF COMPLIANCE" ON PAGE 15E-7.

---DRAWINGS

BECAUSE OF THE SMALL SCALE OF THE DRAWINGS, IT IS NOT POSSIBLE TO INDICATE ALL OFFSETS, FITTINGS, AND ACCESSORIES WHICH MAY BE REQUIRED FOR SMALL PIPES (SIZES 4" AND SMALLER). THE CONTRACTOR SHALL CAREFULLY INVESTIGATE THE STRUCTURAL AND FINISH CONDITIONS AFFECTING ALL HIS WORK AND SHALL ARRANGE HIS WORK ACCORDINGLY, FURNISHING SUCH FITTINGS AND ACCESSORIES AS REQUIRED TO MEET SUCH CONDITIONS.

---CLEANING

CLEANING OPERATIONS DURING CONSTRUCTION AND UPON COMPLETION OF THE WORK OF THIS CONTRACT SHALL BE PERFORMED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF THE "CONTRACT SCHEDULE," AND THIS SECTION OF THE SPECIFICATIONS. SPECIFIC OPERATIONS SHALL INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING:

REMOVAL OF RUST AND ALL DIRT AND DELETERIOUS SUBSTANCES FROM THE BORE AND EXTERIOR SURFACES OF ALL PIPING AND EQUIPMENT.

UPON COMPLETION OF THE WORK, IMMEDIATELY PRIOR TO FINAL ACCEPTANCE, ALL EQUIPMENT PROVIDED UNDER THIS CONTRACT SHALL BE CLEANED.

---DISPOSAL OF EXCESS AND WASTE MATERIALS

WASTE MATERIALS, TRASH AND DEBRIS, SHALL BE REMOVED FROM THE SITE AND DISPOSED OF AT NO ADDITIONAL COST TO THE GOVERNMENT AS SPECIFIED IN THE "CONTRACT SCHEDULE."

---PAINTING AND FINISHING

GENERAL

PIPE HANGERS, SUPPORTS, AND OTHER IRON WORK NOT OTHERWISE SPECIFIED SHALL BE THOROUGHLY BLAST CLEANED AND SHOP COATED WITH INORGANIC ZINC-RICH COATING IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THE SPECIFICATIONS.

---COLOR CODING SYSTEM AND LABELS

COLOR CODING AND LABELLING

ALL PIPING, INCLUDING THAT CONCEALED (INACCESSIBLE SPACES) SHALL BE COLOR CODED AND LABELLED WITH STENCILED LETTERS AND ARROWS TO DESIGNATE THE PARTICULAR SERVICE AND FLOW DIRECTION AS SPECIFIED IN SECTION 13L - "COLOR FINISH SCHEDULE AND PIPING IDENTIFICATION."

---SHOP DRAWINGS

SHOP DRAWINGS, WHICH INCLUDE CALCULATIONS, DRAWINGS OR SKETCHES AND OTHER DATA NECESSARY TO COMPLETELY IDENTIFY EACH OF THE FOLLOWING ITEMS, SHALL BE FURNISHED TO THE CONTRACTING OFFICER IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" ARTICLE ENTITLED "SHOP DRAWINGS." SHOP DRAWINGS ARE REQUIRED FOR ALL DEVIATIONS FROM SPECIFICATIONS AND DRAWINGS.

PIPING SYSTEMS
FABRICATED FITTINGS
PIPING SPECIALTIES (NOZZLES, ORIFICES, GAGES, VALVES, VENTS, ETC.)

PIPE SUPPORT ELEMENTS AND HANGERS
TESTING EQUIPMENT, PROCEDURES AND SCHEDULES OF TESTING
CALCULATIONS FOR FABRICATED LATERALS AND WYE FITTINGS FOR COMPLIANCE WITH ANSI B31.1-73, PARAGRAPHS 104.3 AND 104.4 WHERE NOT DETAILED ON THE DRAWINGS
REPORTS OF SHOP TESTING OF FABRICATED PIPING AND FABRICATED FITTINGS
ENAMEL COATINGS AND LINING MATERIALS FOR PIPE AND FITTINGS.

NONE OF THE PRECEDING ITEMS SHALL BE FABRICATED, DELIVERED TO THE SITE, OR INSTALLED UNTIL APPROVAL HAS BEEN OBTAINED.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR PROPOSED PIPING MATERIALS, AND AFFIDAVIT FOR COATINGS/LININGS.

NONE OF THE PRECEDING MATERIALS SHALL BE FABRICATED, DELIVERED TO THE SITE, OR INSTALLED UNTIL APPROVAL HAS BEEN OBTAINED.

---BONDING AND GROUNDING

BONDING OF METALS TO GROUND SHALL COMPLY WITH SECTION 16X (PART 51) OF THE SPECIFICATIONS.

---CUTTING

CUTTING OF CONSTRUCTION OTHER THAN DETAILED SHALL BE DONE ONLY WITH THE WRITTEN PERMISSION OF THE CONTRACTING OFFICER. ANY DAMAGE TO THE STRUCTURE, PIPING, WIRING OR EQUIPMENT AS A RESULT OF CUTTING FOR INSTALLATION SHALL BE REPAIRED BY SKILLED MECHANICS OF THE TRADE INVOLVED, AT NO ADDITIONAL EXPENSE TO THE GOVERNMENT.

---MATERIALS---

---DRAIN PIPING

AS SPECIFIED IN SECTION 15H - MISCELLANEOUS PIPING.

---PIPE: 26 INCH AND SMALLER

ASTM A53-76, GRADE "B", TYPE "E" OR "S", (OR API-5L-1957, GRADE "B") OF THE FOLLOWING WALL THICKNESSES, UNLESS OTHERWISE DETAILED. ENDS SHALL BE BEVELED FOR WELDING EXCEPT AS NOTED:

1/4" THRU 4": SCHEDULE 80 (SIZES 1/4" THRU 2" SHALL HAVE THREADED ENDS) - GALVANIZED*
5" THRU 10": SCHEDULE 40 - GALVANIZED* (6" AT SIDE WALL HEADERS, SCHEDULE 160)
12" THRU 26": 0.375 INCH WALL - GALVANIZED*

*PIPE TO BE PLACED UNDERGROUND SHALL NOT BE GALVANIZED, BUT SHALL HAVE ENAMEL COATING AND LINING AS HEREINAFTER SPECIFIED.

---PIPE: 30 INCH THRU 114 INCH

ELECTRIC FUSION (ARC) WELDED STEEL PLATE PIPE SHALL BE SHOP FABRICATED IN ACCORDANCE WITH ASTM A134-73 OF ASTM A36-75 PLATE (36,000 PSI MINIMUM YIELD STRENGTH). ELECTRODES SHALL MEET THE REQUIREMENTS OF AWS D1.1 AND AWS A5.1, COATED E70 SERIES LOW-HYDROGEN FOR MANUAL WELDING, AND AWS D1.1 AND AWS A5.17 BARE ELECTRODES AND FLUX F70 SERIES FOR SUBMERGED ARC WELDING. ALL PIPE THROUGH SIZE 84 INCH SHALL BE SHOP HYDROTESTED AND PROVED TIGHT AT NOT LESS THAN 300 PSIG. PIPE SIZES LARGER THAN 84 INCH SHALL HAVE ALL WELDS INSPECTED BY RADIOGRAPH OR THE DRY MAGNETIC PARTICLE METHOD CONFORMING TO ASTM E-109. SIZES AND WALL THICKNESSES SHALL BE AS FOLLOWS AND ENDS PREPARED FOR INTERIOR OR EXTERIOR FIELD WELDING AS DIRECTED BY CONTRACTOR WHO SHALL SELECT LOCATION OF SUCH WELDS TO FACILITATE FIELD ERECTION AS HEREINAFTER OUTLINED:

+30" O.D. THRU 36" O.D.:	0.500 INCH WALL (EXCEPTION:	36" RISER TO MLP SHALL BE 1.000" WALL.)
+42" I.D. THRU 66" I.D.:	0.500 INCH WALL (EXCEPTION:	54" RISERS TO MLP SHALL BE 1.000" WALL.)
72" I.D. THRU 78" I.D.:	0.625 INCH WALL	
84" I.D.:	0.750 INCH WALL (EXCEPTION:	BURIED PIPE SHALL BE 1.000" WALL.)
114" I.D.:	1.000 INCH WALL	

EXTERIOR OF ABOVE GROUND (NON-BURIED) PIPE AND ALL ATTACHMENTS THERETO SHALL BE ABRASIVE BLASTED AND SHOP COATED WITH INORGANIC ZINC-RICH COATING WITH FIELD TOUCH-UP ALL IN ACCORDANCE WITH SECTION 9L OF THE SPECIFICATIONS. INTERIOR OF PIPE SHALL BE ABRASIVE BLASTED AND SHOP LINED WITH ENAMEL WITH FIELD TOUCH-UP AS HEREINAFTER OUTLINED. ENTIRE EXTERIOR OF PIPE TO BE PLACED UNDERGROUND (BURIED) SHALL BE ENAMEL COATED AS HEREINAFTER SPECIFIED. (+NOTE: 36" SIDE WALL SPRAY HEADERS AND 42" CREST SPRAY HEADER NOT COAL-TAR LINED, BUT GALVANIZED.)

---FORGED FITTINGS: FOR PIPE SIZES 2-1/2 INCH THRU 36 INCH

FITTINGS SHALL BE CARBON STEEL, BUTT-WELDING, LONG RADIUS ELBOWS (UNLESS NOTED S.R.) AND SHALL CONFORM TO ANSI B16.9-71 AND TO ASTM A234-71 FOR CARBON STEEL. ELBOW AT 36" RISER TO MLP SHALL HAVE 1.000 INCH WALL. FORGED TEES SHALL BE USED FOR 90° LATERALS. OTHER LATERALS SHALL BE REINFORCED AS DETAILED ON THE DRAWINGS, AND WHERE NOT DETAILED REINFORCING SHALL CONFORM TO THE REQUIREMENTS OF THE ANSI CODE FOR POWER PIPING B31.1-1973, PARAGRAPHS 104.1 AND 104.7 AS EVIDENCED BY CALCULATIONS WHICH SHALL BE SUBMITTED (SEE "---SHOP DRAWINGS"). FITTINGS IN THIS SIZE RANGE SHALL MATCH WALL THICKNESS OF LARGER PIPE CONNECTED. HEADERS WITH MULTIPLE OUTLETS MAY BE EXTRUDED TYPE AT CONTRACTOR'S OPTION WITHOUT ADDITIONAL COST TO THE GOVERNMENT. FITTINGS USED IN GALVANIZED PIPE SYSTEMS SHALL BE GALVANIZED.

---FABRICATED FITTINGS: PIPE SIZES LARGER THAN 36 INCH, SHOP WELDED

FITTINGS SHALL BE FABRICATED OF ASTM A36-75 PLATE OF NOT LESS THAN THE WALL THICKNESSES HEREINABOVE SPECIFIED FOR SHOP FABRICATED STEEL PLATE PIPE 42 INCH THROUGH 114 INCH INSIDE DIAMETER AS DETAILED. FITTINGS SHALL BE SHOP TESTED AS ABOVE SPECIFIED FOR 30 THROUGH 114 INCH PIPE.

WALL THICKNESS OF REDUCERS SHALL BE BASED ON DIAMETER OF LARGER END OF REDUCERS.

REINFORCEMENT OF FITTINGS SHALL BE AS DETAILED ON THE DRAWINGS. IF NOT DETAILED, REINFORCEMENT SHALL COMPLY WITH *ANSI* A31.1-1973, PARAGRAPHS 104.1 AND 104.7 AS EVIDENCED BY CALCULATIONS WHICH SHALL BE SUBMITTED (SEE "---SHOP DRAWINGS"). ELBOWS AT MLP RISERS SHALL HAVE 1.000" WALL.

---SCREWED FITTINGS: PIPE SIZES 2" AND SMALLER

300 LB. ANSI STANDARD, SCREWED, GALVANIZED MALLEABLE IRON. UNIONS SHALL BE 300 LB. WSP FORGED STEEL WITH BRONZE SEAT RING, SCREWED, GALVANIZED.

---ORIFICES AND ORIFICE FLANGES

ORIFICE FLANGES AND ORIFICES SHALL BE PROVIDED WHERE INDICATED ON THE DRAWINGS AND AS DETAILED. PROVIDE ONE-HALF INCH DRILLED AND TAPPED PORTS FROM FLANGE O.D. TO I.D. OF PIPE. ORIFICE PLATE HANDLES SHALL BE LOCATED AT TOP OF FLANGES.

---AUTOMATIC AIR VENT VALVES

CHAMBER AND INTERNALS SHALL BE FACTORY HYDRO-TESTED AT NOT LESS THAN 700 PSIG, SHALL HAVE STAINLESS STEEL FLOAT, STAINLESS STEEL VALVE AND STAINLESS STEEL LEVER PINS. OTHER INTERNAL PARTS SHALL BE OF BRONZE EXCEPT SEAT WHICH SHALL BE SYNTHETIC RUBBER. BODY AND COVER SHALL BE OF HIGH-GRADE MALLEABLE IRON, OR STEEL. INLET SHALL BE NOT LESS THAN 2 INCHES AND OUTLET NOT LESS THAN 1 INCH. VENTING CAPACITY SHALL BE NOT LESS THAN 170 SCFM AT 400 PSIG. EQUIPMENT SHALL BE SIMILAR AND EQUAL TO NUMBER S-205 AIR RELEASE VALVE AS MANUFACTURED BY VALVE AND PRIMER CORP. OF CHICAGO, ILLINOIS. PIPE CONNECTING ABOVE TO TOP OF RISER SHALL BE 2" SCHEDULE 80, GALVANIZED, THREADED, WITH 300 LB. WSP GALVANIZED STEEL UNION; AND 200 LB. WSP BRONZE, RISING STEM GATE AND GLOBE VALVES LOCATED AS DETAILED.

---PRESSURE GAGES FOR WATER

THESE SHALL BE PROVIDED WHERE INDICATED ON THE DRAWINGS, AND SHALL HAVE 6 INCH DIA. DIAL WITH BLACK NUMERALS, AL-EPOXY CASE, TYPE 316 S.S. TUBE, BOTTOM CONNECTED. GAGES SHALL BE SOLID FRONT TYPE DESIGNED FOR BACK BLOW OUT. GAGES SHALL BE EQUAL TO DRESSER/ASHCROFT "NO. 1379" WITH ACCURACY OF 1/2 PERCENT OF FULL SCALE. RANGE SHALL BE AS NOTED ON THE DRAWINGS. GAUGES SHALL BE CONNECTED WITH 1/2 INCH NEEDLE VALVE, BRASS, RATED 400 PSIG WOG AND EQUAL TO CRANE FIG. 88, OR 89. ALL GAGES SHALL BE CONNECTED TO PIPING WITH 1/2" SCHEDULE 80 PIPE AND 300 LB. STD. MALLEABLE IRON SCREWED FITTINGS, ALL MATERIAL GALVANIZED.

---NEOPRENE PIPE CLOSURES

THESE SHALL BE PROVIDED WHERE NOTED ON THE DRAWINGS FOR THE CLOSURE OF ABANDONED PIPING REMAINING AFTER NEW INTERCONNECTIONS. CLOSURES SHALL BE OF PLIABLE SHEET NEOPRENE NOT LESS THAN 1/8 INCH THICK ATTACHED TO THE CIRCUMFERENCE OF THE PIPE END WITH 1/2 INCH WIDE STAINLESS STEEL STRAP TENSIONED BY A TOOL EQUAL TO BAND-IT, OR EQUAL ADJUSTABLE HOSE CLAMP WITH SCREW TENSIONING DEVICE. EXCESS NEOPRENE SHALL BE TRIMMED FOLLOWING BANDING; OR, CLOSURES MAY BE NEOPRENE CAPS AVAILABLE (UNDER THE TRADE NAME "JIM-CAP" AS MANUFACTURED BY THE JIM-CAP COMPANY) FOR SMALLER SIZE PIPES.

---PIPE FLANGES

FOR PIPE SIZES THROUGH 24 INCH O.D., FLANGES SHALL BE FORGED STEEL WITH BORE TO MATCH PIPE INSIDE DIAMETER, CARBON STEEL CONFORMING TO ANSI B16.5 AND ASTM A181-GRADE 1, WELD NECK PATTERN WITH SERRATED FACE UNLESS OTHERWISE NOTED ON THE DRAWINGS, ANSI 150 POUND CLASS EXCEPT AS NOTED FOR HIGHER PRESSURE RATING ON THE DRAWINGS. FLANGES USED IN GALVANIZED PIPE SYSTEM SHALL BE GALVANIZED.

FOR PIPE SIZES LARGER THAN 24" O.D., FLANGES SHALL BE FORGED STEEL, AWWA STD. C207, CLASS "E," WELD NECK OR SLIP-ON, PATTERN. FLANGES FOR 48 INCH PIPING SHALL MATE WITH THE 48 INCH CONTROL VALVES.

---EPOXY COAL-TAR ENAMEL COATING AND LINING FOR PIPING SYSTEMS---

---GENERAL

ALL SURFACES SPECIFIED TO RECEIVE COATING AND LINING SHALL BE FACTORY CLEANED TO BASE METAL BY DRY BLAST CLEANING IN ACCORDANCE WITH STEEL STRUCTURES PAINTING COUNCIL SPECIFICATIONS SP-5-63 TO WHITE METAL AND THEN COATED WITH COAL-TAR EPOXY CONFORMING TO "PAINT COATING SYSTEMS, STEEL SHIP TANK, FUEL AND SALT WATER BALLAST," SPECIFICATION MIL-P-23236 (SHIPS) AMEND 4, TYPE I, CLASS 2, APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS PRINTED INSTRUCTIONS TO A THICKNESS OF NOT LESS THAN 16 MILS. COATING PRODUCT SHALL BE QUALIFIED PER QPL-23236-38 DATED 14 NOVEMBER 1975.

ALL FACTORY APPLIED COATING AND LINING AND FIELD-TOUCH-UP SHALL BE ACCOMPLISHED BY, OR UNDER DIRECT SUPERVISION OF, AN ESTABLISHED ORGANIZATION NORMALLY AND REGULARLY OPERATING FOR A PERIOD OF NOT LESS THAN FIVE YEARS IN THE COATING AND LINING OF LARGE DIAMETER PIPING, FITTINGS AND SPECIALS.

(NOTE: IN LIEU OF FACTORY APPLICATION OF THE EPOXY COAL-TAR ENAMEL, THE METAL SHALL BE DRY BLAST CLEANED AT THE SHOP FOLLOWED BY SHOP APPLICATION OF A 2 MIL THICK PRIMER COMPATIBLE WITH THE EPOXY COAL-TAR ENAMEL TO BE FIELD-APPLIED IN TWO CROSS-PASS COATS EACH OF NOT LESS THAN 8 MILS DRY FILM THICKNESS.)

---PIPING SYSTEMS TO RECEIVE EXTERIOR COATING (PIPE, FITTINGS AND SPECIALS)

ALL NEW STEEL PIPING SHOWN ON THE DRAWINGS AS UNDERGROUND (BURIED) SHALL BE COATED TO NOT LESS THAN ONE FOOT BEYOND THE GROUND LINE OR RETAINING WALL THROUGH WHICH THE PIPE PENETRATES. PIPING TO RECEIVE EXTERIOR COATING INCLUDE THE FOLLOWING SYSTEMS:

A. TWO NEW 84 INCH PIPES (HEADERS "A" AND "B") SHOWN BETWEEN THE NORTH WALL OF THE EXISTING EAST CATACOMBS AND THE NEW RETAINING WALL LOCATED NORTH OF THE EAST CATACOMBS.

B. REINFORCING PLATES OF FITTINGS AT VALVE STATION THAT EXTEND BELOW BOTTOM OF PIPES.

C. NEW 16 INCH STEEL 'TANK FILL LINE AND ALL NEW UNDERGROUND STEEL PIPE SYSTEMS IN THE AREA OF THE NEW MAIN VALVE STATION ADJACENT TO THE NEW ELEVATED WATER TANK. (B)

---PIPING SYSTEMS (PIPE, FITTINGS AND SPECIALS) TO RECEIVE INTERIOR LINING

COMMENCING AT THE 114 INCH ELBOW OUTLET WELD AT THE BASE OF THE NEW ELEVATED WATER TANK, AND CONTINUING THROUGH THE NEW MAIN VALVE STATION, AND CONTINUING HEADERS "A" AND "B" ABOVEGROUND AND UNDERGROUND, AND WITHIN THE CATACOMBS, AND ALL NON-GALVANIZED PIPING SYSTEMS WITHIN THE CATACOMBS AND FLAME TRENCH AND CONTINUING UP TO THE THREE INTERFACE CONNECTIONS TO MOBILE LAUNCHER PLATFORM, AND THROUGH THE 36" FLANGES FOR THE SIDE WALL SPRAY HEADER IN THE EAST AND WEST CATACOMBS.

---AFFIDAVIT OF COMPLIANCE

FURNISH AFFIDAVIT (SEE ---SHOP DRAWINGS IN CONTRACT SCHEDULE FOR SUBMITTAL PROCEDURE, ETC.) THAT ALL MATERIALS AND WORK TO BE PROVIDED HAVE COMPLIED WITH HEREIN SPECIFIED REQUIREMENTS FOR COATINGS AND LININGS. SUBMIT PROPOSED PLAN FOR APPLICATION OF COATINGS AND LININGS.

---SAMPLES

SUBMIT SAMPLES OF COATING APPLIED TO METAL PLATE (2" X 6") IN ACCORDANCE WITH THE "CONTRACT SCHEDULE."

---OMISSION OF FACTORY COATING AND LINING AT ENDS OF PIPE, FITTINGS AND SPECIALS TO BE FIELD WELDED

THE FACTORY-APPLIED INTERIOR LINING AND EXTERIOR COATING SHALL BE NEATLY TERMINATED 6 INCHES FROM EACH END OF EACH PIECE OF PIPE, FITTING AND SPECIAL SCHEDULED FOR FIELD WELDING. UNCOATED AND UNLINED ENDS SHALL HAVE ONLY A PRIMER APPLIED OVER ABRASIVE BLASTED SURFACE OF PIPE TO RESIST CORROSION. PRIMER SHALL BE COMPATIBLE WITH EPOXY COAL-TAR ENAMEL SELECTED.

---FIELD COATING, FIELD LINING AND TOUCH-UP

ALL FIELD COATING AND TOUCH-UP SHALL BE ACCOMPLISHED FOLLOWING ALL HYDROSTATIC TESTING, REPAIR, AND RETESTING. ALL AREAS SHALL BE THOROUGHLY BLAST CLEANED AND DRIED BEFORE APPLYING EPOXY COAL-TAR ENAMEL.

ALL WORK SHALL BE ACCOMPLISHED BY, OR UNDER THE DIRECT SUPERVISION OF, THE MANUFACTURER OF THE COATING AND LINING MATERIAL. THE CONTRACTOR SHALL HAVE THE COATING MANUFACTURER FURNISH EXPERIENCED PERSONNEL SKILLED IN THE APPLICATION OF THE EPOXY COAL-TAR ENAMEL AND THE EQUIPMENT REQUIRED TO PERFORM THE FIELD COATING AND LINING INSPECTION, TOUCH-UP, AND BLAST CLEANING, COATING AND LINING OF FIELD WELDED JOINTS. SUBMIT NAME OF COATING AND LINING MANUFACTURER.

---INSPECTION AND TESTING OF MATERIALS AND PROCEDURES

THE GOVERNMENT RESERVES THE RIGHT TO INSPECT COATING AND LINING MATERIALS AND PROCEDURES IN THE FACTORY AND IN THE FIELD.

---DATA FOR OPERATION AND MAINTENANCE MANUALS---

---GENERAL

THE CONTRACTOR SHALL PROVIDE DATA FOR OPERATIONS, MAINTENANCE AND SPARE PARTS MANUALS AS OUTLINED IN THE "CONTRACT SCHEDULE" FOR ALL ITEMS FURNISHED (OTHER THAN PIPING, FLANGES, FITTINGS, GASKETS, BOLTING, AND HANGERS, SUPPORTS AND ANCHORS).

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---GENERAL

ALL PIPING SHALL BE INSTALLED AS SHOWN ON THE DRAWINGS. WHERE DETAILED DIMENSIONS ARE NOT GIVEN FOR SMALL PIPING, THE CONTRACTOR SHALL "FIELD RUN" THE PIPING IN A NEAT AND SUBSTANTIAL MANNER. ANY FIELD RUN PIPE CONTACTING INSULATION ON OTHER PIPING OR DUCTWORK, PIPE, EQUIPMENT, STEEL WORK, ETC., SHALL BE CAUSE FOR THE CONTRACTOR TO REMOVE AND REROUTE SAID FIELD RUN PIPE(S) AT NO ADDITIONAL COST TO THE GOVERNMENT. NO PIPING SHALL BE RUN IN SUCH A MANNER AS TO BLOCK ACCESS. WHERE NEW PIPE CONFLICTS WITH OTHER WORK, RESOLUTION SHALL BE MADE BY THE CONTRACTING OFFICER PRIOR TO ROUTING OF PIPE(S).

PIPING SYSTEMS SHALL BE FABRICATED AND INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF FOLLOWING CODES AND STANDARDS EXCEPT AS SUPPLEMENTED AND MODIFIED BY THESE SPECIFICATIONS.

ANSI B31.1 - 1973 CODE FOR POWER PIPING.

SECTION 17B- "WELDING FOR LOW PRESSURE PIPING SYSTEMS" OF THE SPECIFICATIONS.

THE PROVISIONS OF REFERENCED CODES AND STANDARDS SHALL CONSTITUTE MINIMUM REQUIREMENTS FOR SYSTEM MATERIALS, INSTALLATION AND WORKMANSHIP. WHERE THE DRAWINGS AND SPECIFICATION REQUIRE BETTER MATERIALS AND METHODS OF INSTALLATION THAN THE MINIMUM REQUIREMENTS SET FORTH IN THE CODE OR STANDARD, THE DRAWINGS AND SPECIFICATIONS SHALL SUPERSEDE CODE AND STANDARDS REQUIREMENTS. WHERE CONTRACTOR PROPOSES TO DEVIATE FROM SPECIFIED INSTRUCTIONS, THE PROPOSED DEVIATION SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL IN WRITING TOGETHER WITH CREDIT TO GOVERNMENT FOR SUCH DEVIATION.

PIPE SHALL BE CAREFULLY WORKED INTO PLACE WITHOUT SPRINGING OR FORCING. ADEQUATE PROVISION SHALL BE MADE FOR ABSORBING ALL EXPANSION AND CONTRACTION WITHOUT UNDUE STRESS IN ANY PART OF THE SYSTEM.

ALL PIPE, FITTINGS, VALVES, EQUIPMENT AND ACCESSORIES SHALL BE CLEAN AND FREE OF ALL EXTRANEOUS FOREIGN MATERIAL BEFORE BEING INSTALLED INTO THEIR RESPECTIVE SYSTEMS. PIPE SHALL BE CLEANED BY HAMMERING, SHAKING, SWABBING, AND FLUSHING. IMMEDIATELY PRIOR TO ERECTION ALL PIPING SHALL BE CHECKED FOR CLEANLINESS AND, IF FOUND OTHERWISE, SHALL BE THOROUGHLY CLEANED BY POUNDING AND THE PASSING OF HIGH VELOCITY AIR OR VACUUMING. AFTER PRESSURE TESTING AND COATING, ALL PIPING SHALL HAVE INTERIOR HOSED DOWN AND DISCHARGED TO WASTE. THE CONTRACTOR SHALL PROVIDE ALL MATERIAL AND LABOR FOR THE ABOVE AND FOR THE BREAKING AND REBOLTING OF FLANGES, AND SHALL PROVIDE ANY TEMPORARY WASTE PIPING REQUIRED FOR SAID CLEANING OPERATIONS. ALL FINAL CLEANING SHALL BE WITNESSED BY THE CONTRACTING OFFICER. DURING THE PROGRESS OF CONSTRUCTION, OPEN ENDS OF PIPE, FITTINGS, AND VALVES SHALL BE PROPERLY PROTECTED AT ALL TIMES BY PLUGS, OR CLOSURES TO PREVENT FOREIGN SUBSTANCES OR ANIMAL LIFE FROM ENTERING PIPES.

---MAN WAYS

HINGED AND BOLTED MAN WAYS SHALL BE PROVIDED IN LARGE DIAMETER PIPING AS DETAILED AND AT THE LOCATIONS NOTED ON THE DRAWINGS.

---JOINTS

REAM ALL PIPE ENDS BEFORE JOINT CONNECTIONS ARE MADE IN THREADED PIPING SYSTEMS.

SCREWED JOINTS SHALL BE MADE UP WITH TEFLON TAPE, OR 100% TEFLON COMPOUND.

JOINT COMPOUNDS SHALL BE APPLIED TO THE MALE THREAD ONLY, AND CARE SHALL BE EXERCISED TO PREVENT TAPE FROM REACHING THE INTERIOR OF THE PIPE.

SCREWED UNIONS, WELDED UNIONS OR BOLTED FLANGES SHALL BE PROVIDED WHEREVER REQUIRED TO PERMIT CONVENIENT, MAINTENANCE-WISE REMOVAL OF EQUIPMENT, VALVES AND PIPING ACCESSORIES FROM THE PIPING SYSTEM.

WELDED JOINTS SHALL CONFORM TO SECTION 17B "WELDING FOR LOW PRESSURE WATER PIPING SYSTEMS."

FLANGED JOINTS SHALL BE ASSEMBLED WITH APPROPRIATE FLANGES, GASKETS, AND BOLTING. THE CLEARANCE BETWEEN FLANGE FACES SHALL BE SUCH THAT THE CONNECTIONS CAN BE GASKETED AND BOLTED TIGHT WITHOUT IMPOSING UNDUE STRAIN ON THE PIPING SYSTEM. FLANGE FACES SHALL BE PARALLEL AND THE BORES CONCENTRIC; GASKETS SHALL BE CENTERED ON THE FLANGE FACES WITHOUT PROJECTING INTO THE BORE. BOLTING SHALL BE LUBRICATED WITH OIL AND GRAPHITE BEFORE ASSEMBLY TO INSURE UNIFORM BOLT STRESSING. THE FLANGE BOLTS SHALL BE DRAWN UP AND TIGHTENED IN STAGGERED SEQUENCE IN ORDER TO PREVENT UNEQUAL GASKET COMPRESSION AND DEFORMATION OF THE FLANGES. WHEREVER A FLANGE WITH A RAISED FACE IS JOINED TO A COMPANION FLANGE WITH A FLAT FACE, THE RAISED FACE SHALL BE MACHINED DOWN TO A FLAT SERRATED SURFACE AND A FULL FACE GASKET SHALL BE USED. ONLY HEX HEAD NUTS AND BOLTS SHALL BE ACCEPTABLE. GASKET MATERIAL SHALL BE FRESH STOCK, SHALL NOT EXCEED 1/8 INCH THICKNESS, AND SHALL BE OF CLOTH REINFORCED RUBBER EQUAL TO CRANE COMPANY TYPE "CC." ALL CAST IRON FLANGES SHALL HAVE FULL-FACE GASKETS. GASKETS FOR 48 INCH VALVES SHALL BE BY MANUFACTURER.

FLANGE BOLTING SHALL CONFORM TO ANSI B16.5 AND ASTM A307, GRADE B, HEAVY HEXAGON HEADS WITH HEAVY NUTS AND STEEL WASHERS.

---SUPPORTING ELEMENTS INSTALLATION

SUPPORTING ELEMENTS SHALL BE PROVIDED IN ACCORDANCE WITH THE REFERENCED CODES, STANDARDS AND REQUIREMENTS SPECIFIED HEREIN, AND SHOWN ON THE DRAWINGS.

NO PIPING SHALL BE HUNG FROM OTHER PIPE, UNLESS DETAILED ON THE DRAWINGS.

PIPING HANGERS, SUPPORTS, ANCHORS AND GUIDES SHALL BE PROVIDED BY THE CONTRACTOR. WHERE DETAILED ON THE DRAWINGS THESE ITEMS SHALL BE PROVIDED BY THE CONTRACTOR AS DETAILED.

ALL SUPPORTS AND PARTS SHALL CONFORM TO THE REQUIREMENTS OF ANSI CODE FOR POWER PIPING B31.1-1973, EXCEPT AS MODIFIED AND SUPPLEMENTED BY THE REQUIREMENTS SET FORTH IN THIS SPECIFICATION AND RELATED DRAWINGS, AND SHALL BE SUBJECT TO APPROVAL BY THE CONTRACTING OFFICER.

---SUGGESTED INSTALLATION PROCEDURE

PIPING INSTALLATION IN THE EAST CATACOMBS AND FLAME TRENCH/DEFLECTOR AREA APPEARS TO BE THE MOST DIFFICULT. THE INSTALLATION PROCEDURE SHALL BE AS DEVISED BY THE CONTRACTOR. THE FOLLOWING IS A SUGGESTED PROCEDURE. THE LOCATION OF ALL FIELD WELDS SHALL BE AS SELECTED BY THE CONTRACTOR TO FACILITATE HIS SELECTED INSTALLATION PROCEDURE:

A. EAST CATACOMBS AND EXCAVATED AREA:

1. REMOVE CONCRETE PAD SURFACE AND EMBANKMENT CONCRETE.

2. INSTALL SHEET PILE AND EXCAVATE. CUT HOLES IN INTERIOR PARTITIONS OF EAST CATACOMBS.

3. CUT-OUT HOLE(S) IN NORTH WALL OF EAST CATACOMBS AS SHOWN ON THE DRAWINGS.

4. TRANSPORT VIA UTILITY TUNNEL THRU 10' X 10' OPENINGS IN EAST CATACOMB PARTITION WALLS THE FITTINGS FOR 84 INCH HEADERS "A" AND "B", ETC., AND ELEVATE SAME TO CLEAR CONNECTING PIPING WHEN IN PLACE.

5. THROUGH HOLE(S) (SEE 3) IN NORTH WALL OF EAST CATACOMBS, INSERT VIA EXCAVATED AREA ALL STRAIGHT SECTIONS OF SMALLER PIPE, FOLLOWED BY LARGER PIPE.

6. INSTALL NEW CONCRETE RETAINING WALLS, SLABS AND ANCHORS IN EXCAVATED AREA NORTH OF EAST CATACOMBS AND PARTIALLY COMPLETE CLOSURE OF HOLE(S) IN NORTH WALL.

7. BACKFILL AND COMPACT FILL AS SPECIFIED UP TO BOTTOM OF NEW HEADER "B" IN EXCAVATED AREA NORTH OF EAST CATACOMBS. REFER TO SECTION 2D FOR SOIL COMPACTION.

8. INSTALL HEADER "B" ON SPECIFIED COMPACTED BACKFILL AND EXTEND THRU TWO WALL PENETRATIONS. COMPLETE ALL PERMANENT WELDING OPERATIONS. PERFORM RADIOGRAPHS AS MAY BE REQUIRED BY THE GOVERNMENT AS SPECIFIED ON PAGE 15E-4.

9. BLANK-OFF ENDS OF HEADER "B" WITH TEMPORARY DISHED HEADS (HAVING VALVED VENT AND DRAIN CONNECTIONS), FILL HEADER WITH WATER AND HYDROTEST UNTIL ACCEPTED BY INSPECTORS. REMOVE DISHED HEADS.

10. CLEAN ALL WELDS, DRY PIPE AT ALL AREAS NOT HAVING PRIMER AND EPOXY COAL-TAR ENAMEL AND/OR REQUIRING TOUCH-UP PER INSPECTION AND COMPLETE ALL COATING AND LINING OPERATIONS. INSTALL WALL PENETRATION SEALS.

11. BACKFILL AND COMPACT AS SPECIFIED AROUND AND ABOVE HEADER "B" UP TO PLACEMENT FOR HEADER "A".

12. FOR HEADER "A" REPEAT ABOVE STEPS 8 THRU 10 (AS OUTLINED FOR HEADER "B".)

13. CONTINUE BACKFILLING OPERATIONS AND PLACEMENT OF CONCRETE AS PER STRUCTURAL DRAWINGS AND APPLICABLE SECTIONS OF THE SPECIFICATIONS.

14. COMPLETE PIPING SYSTEMS IN THE EAST CATACOMBS.

B. FLAME DEFLECTOR/FLAME TRENCH

1. AT THE CONTRACTOR'S OPTION THE FLAME DEFLECTOR PIPING (SEE SHEETS S110, ETC.) MAY BE INSTALLED WITH THE SRB FLAME DEFLECTOR IN PLACE (OR, WITH THE SRB FLAME DEFLECTOR IN THE "PARK POSITION" BEYOND THE NORTH END OF THE FLAME TRENCH. IN THE LATTER CASE, THE SRB FLAME DEFLECTOR SHALL BE MOVED FROM THE LAUNCH POSITION SHOWN ON THE ABOVE REFERENCED DRAWINGS TO THE "PARK POSITION". AFTER INSTALLATION OF SELECTED PIPING AND SELECTED PORTIONS OF THE NEW WORK TO THE SRB FLAME DEFLECTOR BY THE CONTRACTOR, IT SHALL THEN BE MOVED SOUTH TO ABUT THE ORBITER FLAME DEFLECTOR, LOWERED INTO POSITION, AND THE REMAINDER OF THE PIPING AND FLAME DEFLECTOR MODIFICATIONS SHALL THEN BE ACCOMPLISHED IN THE FINAL POSITION, INCLUDING CONNECTIONS TO THE NEW PIPING PENETRATING THE TWO WALLS OF THE FLAME TRENCH). MODIFICATIONS TO THE FLAME DEFLECTORS AND INSTALLATION OF PIPING THEREIN MUST BE TIME SEQUENCED WITH THE CONSTRUCTION OF SIDE SPRAY PIPES, FLAME TRENCH WALL REFRACTORY, AND SRB SIDE FLAME DEFLECTOR CONSTRUCTION, ALL OF WHICH INFRINGE ON THE CLEARANCES REQUIRED FOR MOVEMENT OF THE SRB FLAME DEFLECTOR IN THE FLAME TRENCH.

2. FOLLOWING ALL OF THE ABOVE AND HYDROSTATIC TESTING OF THE NEW PIPING, REFRACTORY SURFACING SHALL BE APPLIED TO THE FLAME DEFLECTOR AS SPECIFIED IN SECTION 3R OF THESE SPECIFICATIONS.

C. WEST CATACOMBS

1. ENTRANCE FOR PIPING AND SPECIALTIES IS AVAILABLE VIA THE UTILITY TUNNEL AND THE 10' X 10' OPENINGS IN THE PARTITION WALLS OF THE WEST CATACOMBS.

D. WELDS FOR FINAL CLOSURE JOINTS

1. THESE SHALL BE AS LOCATED IN THE VICINITY OF PIPE SUPPORTS 7A & 7B AND 8A & 8B. PRIOR TO WELDING, PIPES AT SUPPORTS 5A & 5B SHALL BE CENTERED ON SUPPORTS.

2. *"FINAL CLOSURE WELDS SHALL BE MADE FOLLOWING EXPOSURE OF THE PIPELINE TO A PERIOD OF STABILIZED TEMPERATURE OF 60 ± 5°F. AT FINAL WELDING THE BASE PLATES AT THE PIPE SUPPORTS SHALL BE CENTERED ON THE SOLE PLATES AND THE KEEPER BARS CENTERED ON THE BASE PLATES AND WELDED TO THE SOLE PLATES. SEE SHEET M-57."* (A)

3. FINAL CLOSURE JOINTS SHALL BE MADE BY BUTT-WELDING INTO THE CLOSURE GAP A MEASURED SPOOL PIECE; (OR, AS AN ALTERNATE, AN EXTERIOR CIRCUMFERENTIAL STRAP NOT LESS THAN 6 INCHES WIDE AND 1/4 INCH THICKER THAN THE PIPE WALL. WIDTH SHALL BE SUFFICIENT TO LAP OVER ENDS OF JOINED PIPE NOT LESS THAN 2 INCHES WHEN PIPE IS AT COLDEST TEMPERATURE (MAXIMUM GAP). WELD STRAP ON PIPE I.D. AND O.D. WITH CONTINUOUS 3/4" FILLET WELDS WITH 1/8" DRILLED VENT HOLE IN STRAP BETWEEN I.D. AND O.D. WELDS.

4. ALL OTHER PIPE WELDS SHALL BE OF THE BUTT TYPE, SINGLE, OR DOUBLE, FULL PENETRATION WELDS, AND IN ACCORDANCE WITH THIS SECTION OF THE SPECIFICATIONS AND SECTION 17B OF THESE SPECIFICATIONS.

---TESTING OF PIPING SYSTEMS---

---GENERAL

PRIOR TO ACCEPTANCE OF THE WORK, TEST ALL COMPLETED SYSTEMS IN THE PRESENCE OF THE CONTRACTING OFFICER. ALL PRESSURE TESTS SPECIFIED HEREIN SHALL BE MADE PRIOR TO CONCEALMENT OF PIPING. THE TIME AND DATE OF TEST SHALL BE APPROVED BY THE CONTRACTING OFFICER. TESTS SHALL BE MADE IN THE PRESENCE OF THE CONTRACTING OFFICER, OR HIS DULY AUTHORIZED TECHNICAL REPRESENTATIVE. A PROPOSED TEST SCHEDULE AND ACTUAL FIELD TEST PROCEDURE SHALL BE SUBMITTED FOR APPROVAL PRIOR TO THE ACTUAL TEST. ALL TEST PROCEDURES SHALL BE ESSENTIALLY AS SPECIFIED HEREIN UNLESS JOB CONDITIONS REQUIRE A MODIFICATION TO THE METHOD OF PERFORMING THE TEST; HOWEVER, ANY CHANGES SHALL HAVE PRIOR APPROVAL OF THE CONTRACTING OFFICER. IN NO CASE WILL REDUCTIONS OF THE TEST PRESSURES BE PERMITTED. ONLY EXPERIENCED PERSONNEL OF THE CONTRACTOR SHALL CONDUCT THE TESTS. ALL HYDRAULIC PRESSURE TESTS SHALL BE MADE WITH CLEAN WATER. ALL MATERIAL, LABOR, TEST CONNECTIONS, GAGES AND TEST EQUIPMENT SHALL BE FURNISHED BY THE CONTRACTOR WITHOUT ADDITIONAL COST TO THE GOVERNMENT. UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER, ALL TEMPORARY TEST CONNECTIONS, MATERIALS OR EQUIPMENT SHALL BE REMOVED FROM THE PERMANENT SYSTEM FOLLOWING FINAL TESTING.

---TEST LIMITS AND PRESSURES

TEST PRESSURES SHALL BE AS FOLLOWS:

1. PROVIDE TEMPORARY CLOSURES WITH VENTS AND HYDROTEST 34 INCH HEADERS "A" AND "B" PRIOR TO BACK-FILLING (SEE PAGE 15E-16, PARA. 9) @ 175 PSIG.

2. LARGE PIPING FROM 114 INCH ELBOW AT BOTTOM OF TANK RISER TO TOP OF THREE RISERS TO MLP, TO FLANGES AT SIDE SPRAY HEADERS, AND TO 16 NOZZLES ON CREST SPRAY HEADER: PROVIDE TEMPORARY CLOSURES WITH VENTS AT EACH OF ABOVE TERMINALS AND TEST AT 130 PSIG AT TOP OF MLP RISERS WITH 48 INCH VALVES IN OPEN POSITION. (B)

3. WITH 48 INCH VALVES CLOSED, AND VALVE AT 16" TEE SIDE INLET CLOSED, AND ELEVATED TANK AT OVERFLOW LEVEL, GRAVITY PRESSURE TEST BETWEEN 114 INCH ELBOW AT BOTTOM OF TANK RISER AND SIX CLOSED 48 INCH VALVES AND DETERMINE VALVE LEAKAGE RATE, AND CHECK FINAL WELDS AT 114 INCH AND 16 INCH CONNECTIONS. (B)

---TEST DURATION

THE DURATION OF A TEST WILL BE DETERMINED BY THE CONTRACTING OFFICER.

A PRESSURE TEST SHALL BE HELD FOR A MINIMUM OF ONE (1) HOUR.

AN OPERATIONAL FLOW TEST (BY THE GOVERNMENT) SHALL BE FOR A MAXIMUM OF 8 HOURS FOR TWO 8 HOUR TESTS ON SEPARATE DAYS WITHIN 3 WEEKS.
THE TEST MAY BE TERMINATED BY DIRECTION OF CONTRACTING OFFICER AT ANY POINT AFTER IT HAS BEEN DETERMINED THAT THE SYSTEM COMPLIES WITH SPECIFIED REQUIREMENTS.

---TEST GAGES

CONTRACTOR'S TEST GAGES SHALL CONFORM TO ANSI B40.1-1968 AND SHALL HAVE A DIAL SIZE 6 INCHES OR LARGER. MAXIMUM PERMISSIBLE SCALE RANGE FOR A GIVEN TEST SHALL BE SUCH THAT THE POINTER DURING A TEST SHALL HAVE A STARTING POSITION AT MID-POINT OF THE DIAL OR WITHIN THE MIDDLE THIRD OF THE SCALE RANGE. CERTIFICATION OF ACCURACY AND CORRECTION TABLE SHALL BEAR A DATE WITHIN 90 DAYS OF THE TEST USE, TEST GAGE NUMBER, AND THE PROJECT NUMBER, UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

----ACCEPTANCE PRESSURE TESTING

TESTING SHALL TAKE PLACE DURING STEADY STATE AMBIENT TEMPERATURE CONDITIONS APPROXIMATELY, AND PRIOR TO FIELD TOUCH-UP OF COATING AND LINING AT WELDS.

TEST PRESSURES SHALL BE AS HEREINABOVE SPECIFIED FOR THE PARTICULAR SYSTEMS. PORTIONS OF THE SYSTEM MAY BE TESTED IN SECTIONS WHERE REQUIRED TO ALLOW OTHER PHASES OF THE WORK TO PROCEED. THE FULL TEST PRESSURE SHALL BE PLACED ON THE SYSTEM AT LEAST 15 MINUTES PRIOR TO THE TEST. VENTS, PLUGS OR VALVES SHALL BE PROVIDED AT HIGH POINTS TO BLEED TRAPPED AIR AND INSURE AN AIR-FREE, SOLID HYDROSTATIC TEST. DURING THE TEST PERIOD ALL JOINTS AND CONNECTIONS SHALL BE INSPECTED FOR LEAKS. FOLLOWING THE REPAIR OF ALL LEAKS, THE PRESSURE TEST PERIOD SHALL AGAIN COMMENCE.

HYDROSTATIC TESTS OF SYSTEMS SHALL BE MADE WITH WATER AVAILABLE TO THE CONTRACTOR FROM THE GOVERNMENT.

SYSTEMS SHALL BE TESTED AT THE HEREIN SPECIFICED PRESSURES AND THE APPLIED PRESSURE SHALL BE MAINTAINED WITHOUT FURTHER ADDITION OF TEST MEDIA FOR NOT LESS THAN 1 HOUR. THE MAXIMUM ALLOWABLE PRESSURE DROP SHALL BE 5 PSI, OR AS APPROVED BY THE CONTRACTING OFFICER, WITHOUT LEAKS AT JOINTS.

THE CONTRACTOR MAY CONDUCT TESTS FOR HIS OWN PURPOSES, BUT THE ACCEPTANCE TEST SHALL BE CONDUCTED AS SPECIFIED HEREIN.

IN THE EVENT THAT TESTING DEMONSTRATES LEAKAGE OCCURS (VISUAL OR PRESSURE), DETERMINE THE SOURCE(S) OF LEAKAGE, REPAIR OR REPLACE DEFECTIVE MATERIALS AND WORKMANSHIP, AND RETEST THE INSTALLATION UNTIL SPECIFIED REQUIREMENTS ARE COMPLIED WITH. LEAKING GASKET JOINTS SHALL BE REMADE WITH NEW GASKETS, NEW FLANGE BOLTING, AND OLD BOLTING SHALL BE DESTROYED.

OTHER THAN DISHED HEADS, FLANGES, PLUGS, CAPS AND VALVES, ONLY COMMERCIALLY MANUFACTURED EXPANDABLE ELASTOMER PLUGS SHALL BE USED FOR SEALING OFF PIPING FOR TEST PURPOSES. THE SAFE TEST PRESSURE RATING OF ANY PLUG USED SHALL BE NOT LESS THAN TWO TIMES THE ACTUAL TEST PRESSURE BEING APPLIED.

TAKE ALL NECESSARY PRECAUTIONS TO VENT THE EXPANSIVE FORCE OF COMPRESSED AIR TRAPPED DURING HIGH PRESSURE HYDROSTATIC TESTING TO PRECLUDE INJURY AND DAMAGE. THE CONTRACTING OFFICER MAY REQUIRE THE REMOVAL OF ANY SYSTEM COMPONENT SUCH AS PLUGS AND CAPS TO ASCERTAIN WHETHER OR NOT THE WATER HAS REACHED ALL PARTS OF THE SYSTEM IF ADEQUATE PURGING OR VENT VALVES ARE NOT PROVIDED TO ASSURE REMOVAL OF COMPRESSED AIR CUSHION.

COMPONENTS SHALL BE REMOVED FROM PIPING SYSTEMS DURING HYDROSTATIC TESTING WHENEVER THE COMPONENT MAY SUSTAIN DAMAGE DUE TO SHOCK OR TEST PRESSURE.

PIPING SYSTEM COMPONENTS SUCH AS VALVES SHALL BE CHECKED FOR FUNCTIONAL OPERATION UNDER SYSTEM TEST PRESSURE, WHERE PRACTICABLE.

CONTRACTOR SHALL PROVIDE ALL PIPING AND EQUIPMENT FOR HYDROSTATIC TESTING.

PIPING SHALL BE SUBJECTED TO SHOCK DEVELOPED BY A VIGOROUSLY APPLIED 2-POUND HAMMER AT 18" O.C. ALONG ALL FIELD WELDS AND AT OTHER LOCATIONS AS DIRECTED BY THE CONTRACTING OFFICER.

TEMPERATURE OF WATER USED FOR TESTING SHALL NOT CAUSE CONDENSATION OF ATMOSPHERIC MOISTURE ON SYSTEM SURFACES; OR IF SUCH OCCURS, TEST SHALL COMMENCE AFTER EVAPORATION.

AT THE COMPLETION OF THE PRESSURE TESTS, ALL PARTS OF THE INSTALLATION SHALL BE THOROUGHLY CLEANED, INTERNALLY AND EXTERNALLY. ALL EQUIPMENT, PIPE, VALVES, AND FITTINGS SHALL BE CLEANED FREE OF GREASE, METAL CUTTINGS, AND SLUDGE BY FILLING AND FLUSHING THE SYSTEMS UNTIL CLEAN IN THE PRESENCE OF THE CONTRACTING OFFICER. FOLLOWING CLEANING THE PIPING SHALL BE THOROUGHLY DRIED PRIOR TO TOUCH UP OF PIPE COATING AND LINING AT WELDS AND OTHER AREAS.

---OPERATIONAL FLOW TESTING

SOME TESTS WILL BE MADE AFTER THE MLP IS TRANSPORTED, BY OTHERS, TO LAUNCH PAD 39B AND CONNECTED TO THE MLP INTERFACES. THE GOVERNMENT WILL PERFORM THESE TESTS. THE CONTRACTOR SHALL, 2 WEEKS FOLLOWING NOTICE, FURNISH AN ON-SITE REPRESENTATIVE TO OBSERVE THESE TESTS.

---TEST RECORDS

PREPARE AND MAINTAIN TEST RECORDS OF ALL SYSTEMS TESTS. RECORDS SHALL SHOW GOVERNMENTAL AND CONTRACTOR TEST PERSONNEL RESPONSIBILITIES, DATES, TEST GAGE IDENTIFICATION NUMBERS, PRESSURE RANGES, RATES OF PRESSURE DROP, LEAKAGE RATES, AND OTHER SYSTEM CHARACTERISTICS. TEST RECORD SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL.

---BACKFILL AND COMPACTION---

---GENERAL

EXCAVATION, FILL, BACKFILL AND COMPACTION OF FILL SHALL BE AS SPECIFIED IN SECTION 2D OF THESE SPECIFICATIONS.

---WATER SYSTEM VALVES-MANUALLY OPERATED---

---GENERAL

CONTROL VALVES FOR THE WATER SYSTEM WITH POWER OPERATORS AND OTHER FEATURES SHALL BE AS SPECIFIED IN SECTION 15F OF THESE SPECIFICATIONS.

VALVES IN SIZES 2 INCH AND SMALLER ARE NOTED ON THE DRAWINGS AND SPECIFIED HEREIN.

VALVES IN SIZES ABOVE 2 INCH SHALL BE AS HEREIN BELOW SPECIFIED FOR THE SIZES AND TYPES NOTED ON THE DRAWING, AND SHALL BE FOR MATING WITH 150 LB. STANDARD ANSI FLANGES. PIPE FLANGES MATING WITH FLAT-FACE VALVE FLANGES SHALL HAVE FLAT-FACES WITH SERRATED FINISH.

---GATE VALVES (SIZES LARGER THAN 2 INCH)

OUTSIDE SCREW AND YOKE (OS&Y) TYPE, SOLID DISC WEDGE TYPE, BRONZE STEM AND DISC SEATS, 125 PSIG STEAM WORKING PRESSURE (100 PSIG WOG), 350 PSIG SHELL TEST, 125 LB. STD. ANSI FLANGED AND EQUAL TO CRANE NO. 465 1/2.

WHERE CHAIN WHEEL/CHAIN OPERATORS ARE NOTED ON THE DRAWINGS, THESE SHALL BE EQUAL TO CRANE HAMMERBLOW TYPE WITH CHAIN GUIDE AND BRASS CHAIN FOR LENGTH SHOWN ON THE DRAWINGS.

SEE THE DRAWING FOR OTHER VALVES.

---BALL VALVES

EQUAL TO JAMESBURY BULLETIN 221, DOUBLE SEAL, ANSI CLASS 150 FLANGED, STYLES A150F21MT AND D150F21MT, WITH MANUAL LEVER OPERATOR, AND WITH GLASS-FILLED TEFLON SEATS AND TEFLON SEALS FOR SIZES LARGER THAN 2 INCH. SMALLER SIZES SHALL BE SCREWED EQUAL TO CAT. NO. A11TT.

---CHECK VALVES

EQUAL TO TRW MISSION STYLE "K" DUO-CHECK SERIES 150 WITH SERRATED FLANGES, FIG. NO. K155SNF.

---BUTTERFLY VALVES - *SIZES 24 INCH AND SMALLER* (A)

WHERE BUTTERFLY VALVES ARE NOTED ON THE DRAWINGS, THEY SHALL BE ANSI CLASS 150 WAFER PATTERN WITH ENCLOSED GEARED OPERATORS WITH MANUAL HANDWHEEL. VALVE AND OPERATOR SHALL BE CAPABLE OF SHUT-OFF AGAINST 150 PSIG UPSTREAM WATER PRESSURE WHEN DISCHARGING TO PIPE LINE. SEATS SHALL BE GLASS FILLED TEFLON, BODY SHALL BE CARBON STEEL, DISC SHALL BE STAINLESS STEEL (OR SHALL BE OF CARBON STEEL WITH STAINLESS STEEL SEATING SURFACES), SHAFT AND KEYS SHALL BE 17-4 PH STAINLESS STEEL OR EQUAL. OPERATOR SHAFTING SHALL BE STAINLESS STEEL AND GEARS SHALL BE OF HIGH STRENGTH BRONZE OR STAINLESS STEEL. OPERATOR SHALL HAVE POSITION INDICATOR. ENCLOSED GEAR CASE SHALL BE LUBRICATED TYPE. VALVES SHALL BE EQUAL TO JAMESBURY FIG. 8026M, OR FIG. 8226M, WITH TYPE MA MANUAL GEAR ACTUATOR FOR THE REQUIRED TORQUE FOR OPENING AND CLOSING AGAINST SPECIFIED PRESSURE.

---PAINTING AND FINISHING---

---GENERAL

ALL WORK SHALL COMPLY WITH THE REQUIREMENTS OF SECTION 9A OF THE SPECIFICATIONS ENTITLED, "PAINTING AND FINISHING." FINAL PAINTING SHALL BE ACCOMPLISHED ONLY AFTER COMPLETION OF THE HYDROSTATIC TEST. SYSTEMS SHALL BE PAINTED COMPLETE INCLUDING ALL VALVES, TRAPS, PIPE, STEEL WORK, ANCHORS, HANGERS, SUPPORTS, AND MISCELLANEOUS STEEL. ALL ABOVEGROUND, NON-GALVANIZED PIPE AND STEEL SHALL BE SHOP BLASTED AND HAVE INORGANIC ZINC-RICH COATING SHOP-APPLIED WITH FIELD TOUCH-UP IN ACCORD WITH SECTION 9L OF THE SPECIFICATIONS. FACTORY AND SHOP FINISHES SHALL BE TOUCHED-UP IN THE FIELD. ALL DAMAGED GALVANIZED SURFACES SHALL BE CLEANED AND TOUCHED-UP WITH ORGANIC ZINC-RICH COATING IN ACCORDANCE WITH SECTION 9L.

---CLEANING OF CUT THREADS AND WELDS AND ZINC-RICH COATING

THREADS SHALL BE CLEANED AND WELDS POWER TOOL CLEANED AND COATED WITH ORGANIC ZINC-RICH COATING, ALL AS SPECIFIED IN SECTION 9L - "PROTECTIVE COATING OF CARBON STEEL." THREADS OF UNDERGROUND PIPING SHALL BE CLEANED AND COATED WITH COAL-TAR EQUAL TO KOPPERS BITUMASTIC NO. 50.

---PIPING IDENTIFICATION

ALL NON-BURIED PIPING SHALL BE IDENTIFIED BY LABELING IN ACCORDANCE WITH SECTION 13L OF THE SPECIFICATIONS.

---PLATFORMS, STAIRS, ETC.---

---AT MAIN VALVE STATION

STEEL PLATFORM WITH GALVANIZED GRATING, HANDRAILS, AND STAIRS SHALL BE AS SHOWN ON SHEETS S179 AND M55 AND AS SPECIFIED IN SECTIONS 5J AND 5K OF THE SPECIFICATIONS.

---AT PAD-TO-MLP INTERFACES

STEEL PLATFORMS WITH GALVANIZED GRATING, HATCHES, HANDRAILS AND LADDERS SHALL BE AS SHOWN ON SHEETS S177 AND S178 AND IN ACCORD WITH SECTIONS 5J AND 5K OF THE SPECIFICATIONS.

---CONCRETE WORK---

---GENERAL

NEW CONCRETE WORK, PILING, FOUNDATIONS, ETC., AND MODIFICATIONS TO EXISTING CONCRETE WORK SHALL BE AS SHOWN ON THE DRAWINGS AND AS SPECIFIED IN SECTIONS 2K AND 3A OF THE SPECIFICATIONS.

---FLAME DEFLECTORS---

---GENERAL

FLAME DEFLECTORS SHALL BE AS SHOWN ON THE DRAWINGS AND AS SPECIFIED IN SECTIONS 14R AND 14S OF THE SPECIFICATIONS. SCHEDULING OF THIS WORK WITH RESPECT TO INSTALLATION OF NEW PIPING SHALL BE AS HEREINABOVE OUTLINED AND NOTED ON THE DRAWINGS. ALSO, REFER TO SECTION 3R - REFRACTORY COATING.

---WALL SLEEVES---

---GENERAL

WALL SLEEVES THROUGH EXISTING AND NEW CONCRETE WALLS SHALL BE PROVIDED AS SHOWN ON THE DRAWINGS.

---THRUST BLOCKS AND ANCHORS---

---GENERAL

THRUST BLOCKS AND ANCHORS FOR PIPING SHALL BE AS DETAILED.

---ELECTRICAL WORK---

---GENERAL

THE EXISTING FLOODLIGHT AND COMMUNICATIONS POLE SHALL BE RELOCATED AS SHOWN ON SHEET E31. ELECTRICAL ITEMS, CONDUIT AND WIRING SHALL BE REMOVED AND/OR RELOCATED AT PAD ELEVATION 53'-0" AS DETAILED ON SHEET E20 WITHIN THE AREA SCHEDULED FOR EXCAVATION AND RECONSTRUCTION. REROUTING OF UNDERGROUND ELECTRICAL WORK AT THE NEW ELEVATED TANK AND NEW MAIN VALVE STATION SHALL BE ACCOMPLISHED AS SHOWN ON SHEET E31. ALL WORK SHALL COMPLY WITH DIVISION 16 OF THE SPECIFICATIONS.

---BONDING OF METALS TO GROUND---

---GENERAL

THIS WORK SHALL BE IN ACCORDANCE WITH SECTION 16X (PART 51) OF THE SPECIFICATIONS AND AS NOTED AND DETAILED ON THE DRAWINGS.

---GASKETED PIPE FLANGES

THESE SHALL BE CONNECTED BY JUMPER WITH ONE FIXED END AND ONE REMOVABLE END AS DETAILED ON THE DRAWINGS.

---SUPPORTS FOR LARGE PIPING

ANCHOR BOLTS FOR SOLE PLATES SHALL BE BONDED TO REINFORCING STEEL; ANCHOR BOLT NUTS BONDED TO SOLE PLATES THROUGH SPLIT LOCKWASHERS; AND SOLE PLATES JUMPERED ACROSS LUBE PLATES TO BASE PLATES; AND BASE PLATES BONDED TO PIPE SUPPORTS BY WELDING. DETAILS SHALL BE AS SHOWN AND NOTED ON THE DRAWINGS.

---MISCELLANEOUS WORK---

---GENERAL

ACCOMPLISH ALL OTHER WORK WHERE NOTED ON THE DRAWINGS.

---TIE-INS TO EXISTING PIPING---

---GENERAL

ALL OUTAGES OF EXISTING PIPING SYSTEMS SHALL BE SCHEDULED AND SUBMITTED TO CONTRACTING OFFICER FOR PRIOR APPROVAL AS OUTLINED IN THE "CONTRACT SCHEDULE."

SECTION 15F

LARGE CONTROL VALVES WITH OPERATORS-SOUND SUPPRESSION WATER SYSTEM

---48 INCH CONTROL VALVES - GENERAL DESCRIPTION---

---GENERAL

VALVES SHALL BE OF THE BUTTERFLY WAFER PATTERN WITH PNEUMATIC MAIN OPERATORS AND MANUAL OPERATORS EMPLOYING A SELF-CONTAINED HYDRAULIC MOTIVE POWER UNIT, AND MANUAL LOCKING DEVICE.

VALVE DISC SHALL BE CAPABLE OF REPETITIVE CONTINUOUS FULL-CIRCLE, POSITIVE, LEAKTIGHT SEAL WITH BODY SEATS AGAINST THE SPECIFIED FRESH WATER (70°F - 100°F) PRESSURE. CENTERLINE OF DISC SHAFT SHALL BE OFF-SET FROM CENTERLINE OF VALVE, AND OFF-SET FROM CENTERLINE OF THE DISC SEATING SURFACE. THE SEATING SURFACE SHALL BE THE SEGMENT OF A SPHERE.

VALVE BODY SHALL BE WAFER TYPE OF CARBON STEEL WITH GASKET SURFACES SERRATED. DISC SHALL BE TYPE 316 STAINLESS STEEL, OR CARBON STEEL WITH TYPE 316 STAINLESS STEEL MACHINED AND GROUND SEATING SURFACE. SHAFT SHALL BE 17-4-PH STAINLESS STEEL. SEATS SHALL BE GLASS-FILLED TEFLON. BODY TO PIPE FLANGES BOLTING AND GASKETS SHALL BE PROVIDED WITH EACH VALVE.

VALVES SHALL BE OF JAMESBURY CORPORATION MANUFACTURE, SERIES 8226M AND SHALL INCORPORATE FEATURES HEREIN SPECIFIED. (A)

MAIN VALVE OPERATOR SHALL BE OF THE PNEUMATIC, DOUBLE-ACTING (PRESSURE TO "OPEN" AND PRESSURE TO "CLOSE" MAIN VALVE) TYPE FOR OPERATION WITH CLEAN DRY NITROGEN GAS AT TEMPERATURES BETWEEN 30°F TO 125°F. OPERATOR AND/OR MAIN VALVE DESIGN SHALL BE SUCH THAT UPON LOSS OF OPERATING MEDIUM (NITROGEN) PRESSURE, VALVE DISC SHALL NOT MOVE FROM "OPEN", OR "PARTIALLY OPEN", POSITION TO "CLOSED" POSITION DURING ANY SPECIFIED WATER FLOW RATE. VALVE OPERATOR SHALL BE CAPABLE OF OPENING AND TIGHT CLOSING OF VALVE WITHIN THE SPECIFIED WATER PRESSURES AND FOR THE SPECIFIED WATER FLOW RATES. ALL INTERCONNECTING TUBING SHALL BE FURNISHED AND FACTORY INSTALLED BETWEEN THE BELOW LISTED VALVE-MOUNTED ITEMS. (A)

VALVE OPERATOR SHALL HAVE A HISTORY OF SATISFACTORY SERVICE IN INDUSTRY OF A MINIMUM OF FIVE (5) YEARS. (D) A DEVICE SHALL BE PROVIDED FOR MANUALLY LOCKING THE MAIN VALVE TO PREVENT MOVEMENT OF DISC UNDER ANY CONDITION.

(A) *5-30-78* (D) *7-10-79*

ALL PNEUMATIC AND HYDRAULIC TUBING AND ALL TUBING FITTINGS ON THE VALVE AND VALVE COMPONENTS SHALL BE STAINLESS STEEL, FLARE TYPE, *AND SHALL BE GOVERNMENT FURNISHED (GFE) FITTINGS AND GFE TUBING. ASSEMBLED COMPONENTS, INCLUDING THE GFE FITTINGS AND GFE TUBING SHALL BE* FACTORY TESTED AND PROVED TIGHT AT NOT LESS THAN 150% OF WORKING PRESSURE. (D)

MANUAL VALVE OPERATOR SHALL BE OF THE SELF-CONTAINED HYDRAULIC TYPE, HAND PRESSURIZED, COMPLETE WITH INTERCONNECTING TUBING AND FITTINGS, RESERVOIR, VALVE ACTUATING HYDRAULIC CYLINDER, AND SUITABLE INTERLOCK WITH MAIN PNEUMATIC OPERATING CYLINDER SUCH THAT THE MANUAL SYSTEM SHALL NOT EFFECT THE PROPER FUNCTIONING AND TIMING OF THE VALVE OPENING AND CLOSING CYCLES. CAPABILITY SHALL BE AS SPECIFIED FOR MAIN VALVE OPERATOR. PROVISIONS SHALL BE INCORPORATED FOR LOCKING OPERATOR IN NON-OPERATING POSITION. HYDRAULIC RESERVOIR SHALL BE MOUNTED VERTICALLY, AND ALL COMPONENTS SHALL BE WITHIN THE HORIZONTAL LIMITS NOTED ON THE DRAWINGS FOR THE MAIN VALVE OPERATOR SO THAT PERSONNEL PASSAGEWAY IS MAINTAINED BETWEEN ADJACENT VALVES. *"CONTROL PANEL, MOUNTING BRACKETS AND SUPPORTS SHALL BE STAINLESS STEEL: OR, ZINC-COATED STEEL HOT-DIPPED AFTER FABRICATION."* (A)

ALL EQUIPMENT AND FACTORY FINISHES SHALL BE SUITABLE FOR WITHSTANDING EXTERIOR EXPOSURE TO SEACOAST ENVIRONMENT. ALL VALVE OPENING AND CLOSING TIME CYCLES SHALL BE FACTORY SET.

---POSITION INDICATING SWITCHES

EACH VALVE SHALL BE PROVIDED WITH A FACTORY-MOUNTED POSITION INDICATING SWITCH EQUAL TO BETTIS MODEL 5R-344-ABC. SWITCH CONTACTS SHALL SIGNAL "OPEN" AND "CLOSED" DISC POSITIONS. SWITCH HOUSINGS SHALL HAVE CAST METAL BODIES WITH THREADED CONDUIT FITTINGS AND SCREWED AND GASKETED CAPS. SWITCHES SHALL BE MOUNTED AND SET AT FACTORY, AND ALUMINUM-TO-FERROUS CONTACT SURFACES SHALL BE SEPARATED BY SUITABLE NYLON MEMBRANES TO PREVENT GALVANIC CORROSION." (A)

---FACTORY TESTING

EACH COMPLETED VALVE ASSEMBLY SHALL BE FACTORY TESTED AS FOLLOWS: (1) STRUCTURAL HYDROSTATIC TEST OF BODY, SEAT AND DISC AT 275 PSIG DIFFERENTIAL FROM EACH END, RESPECTIVELY; (2) LEAKAGE TEST AT 150 PSIG DIFFERENTIAL ACROSS DISC FROM EACH END, RESPECTIVELY; (3) PRESSURE TEST OF PNEUMATIC/HYDRAULIC SYSTEM AT 1125 PSIG; AND (4) DISC OPENING AND CLOSING TIME CYCLES USING 600 PSIG GN_2 INCLUDING INDICATOR SWITCH DISC POSITION SIGNALS. SUBMIT CERTIFICATIONS OF ABOVE TESTS.

---FACTORY FIELD SUPERVISION

CONTRACTOR SHALL FURNISH THE FIELD SERVICES OF A FACTORY REPRESENTATIVE OF THE VALVE MANUFACTURER FOR CHECKING AND SETTING OF VALVES PRIOR TO AND DURING THE "DRY SYSTEM" TEST AND FUTURE "WET SYSTEM" OPERATIONAL FLOW TEST OF THE VALVES.

---48 INCH CONTROL VALVES FOR MAIN VALVE STATION---

---GENERAL

QUANTITY REQUIRED: SIX (6).

MAXIMUM STATIC HYDRAULIC DIFFERENTIAL PRESSURE ACROSS VALVE DISC: 170 PSIG; 115 PSIG NORMAL.

NORMAL HYDRAULIC DIFFERENTIAL: 218 FT. OF WATER (94 PSIG) AFTER FILLING DOWNSTREAM PIPING.

EACH VALVE WILL HAVE BY-PASS TO PRE-FILL DOWNSTREAM PIPELINE TO HEAD OF APPROXIMATELY 100 FEET OF WATER HEAD. BY-PASS SHALL BE EXTERNAL TO VALVE AS SHOWN ON THE DRAWINGS.

ESTIMATED MAXIMUM FLOW: 250,000 GALLONS PER MINUTE.

ESTIMATED NORMAL FLOW: 140,000 TO 170,000 GALLONS PER MINUTE.

BODY, SEAT AND DISC DIFFERENTIAL PRESSURE RATING: NOT LESS THAN 275 PSI IN EACH DIRECTION.

VALVE SEAT LEAKAGE RATING: AT 150 PSIG IN EACH DIRECTION, RESPECTIVELY, LEAKAGE NOT TO EXCEED 16 FLUID OUNCES PER MINUTE.

---TIME CYCLE

TIME FOR VALVE DISC TO MOVE FROM "CLOSED" TO "OPEN" POSITION STARTING WITH MAXIMUM STATIC HYDRAULIC DIFFERENTIAL PRESSURE: 4 SECONDS.

TIME FOR VALVE DISC TO MOVE FROM "OPEN" TO "CLOSED" POSITION WHEN PASSING ESTIMATED MAXIMUM FLOW: 15 SECONDS. (NOTE: THIS IS STRUCTURAL DESIGN REQUIREMENT. IN OPERATION, VALVE WILL NOT CLOSE WHEN WATER IS FLOWING.)

---OPERATING MEDIUM

NITROGEN PRESSURE AT OPERATOR CONNECTION INLETS: FOR VALVE OPERATION = 600 PSIG (CYLINDER RATING = 1,000 PSIG MINIMUM). NITROGEN PRESSURE UPSTREAM OF NITROGEN SOLENOID VALVES WILL BE 750 PSIG.

---SHOP DRAWINGS

CONTRACTOR SHALL PROVIDE SHOP DRAWINGS OF ALL EQUIPMENT AND SYSTEMS FURNISHED AS OUTLINED IN THE "CONTRACT SCHEDULE." *SHOP DRAWINGS MUST INCLUDE ALL CALCULATIONS AND ENGINEERING DATA TO PROVE THE VALVE AND VALVE OPERATOR WILL PERFORM AS SPECIFIED WHEN OPERATED UNDER DYNAMIC CONDITIONS.* (D)

---MOUNTING IN PIPELINE---

VALVES AND OPERATORS SHALL BE ORIENTED AND MOUNTED IN THE RESPECTIVE PIPELINES AS SHOWN ON THE DRAWINGS; THAT IS, VALVE SHAFTS SHALL BE HORIZONTAL AS SHOWN; AND OPERATORS SHALL BE ON THE SIDE OF PIPE AS SHOWN. PNEUMATIC OPERATOR SHALL BE ON *DOWNSTREAM* END, AND DISC SHAFT ON DOWNSTREAM END, OF MAIN VALVE. (D)

---BONDING AND GROUNDING---

---GENERAL

BONDING OF METALS TO GROUND SHALL COMPLY WITH SECTION 16X (PART 51) OF THE SPECIFICATIONS AND AS OUTLINED IN SECTION 15E FOR FLANGES, ETC.

---VALVE OPERATION FIELD TEST (DRY SYSTEM)

USING A SOURCE OF CONTRACTOR-FURNISHED 750 PSIG DRY NITROGEN, AND A TEMPORARY D.C. ELECTRIC POWER SUPPLY AND MONITORING APPARATUS, THE INSTALLED VALVES AND THEIR PNEUMATIC OPERATING SYSTEMS SHALL BE TESTED TO DEMONSTRATE TO A REPRESENTATIVE OF THE CONTRACTING OFFICER THAT THE SYSTEM FUNCTIONS AS INTENDED, SPECIFIED, AND AS FOLLOWS, EACH FUNCTION TO BE REPEATED 3 TIMES, THE CONTROL BEING FROM AN APPROVED TEMPORARY PANEL FURNISHED BY THE CONTRACTOR: VALVE OPENING AND CLOSING TIME CYCLES; POSITION INDICATOR SWITCHES FUNCTION PROPERLY; AND MANUAL LOCKING DEVICE PREVENTS OPENING OF MAIN VALVE DISC UNDER ALL CONDITIONS. THE OPERATION OF THE MANUAL OPERATOR SHALL ALSO BE DEMONSTRATED 3 TIMES.

PRIOR TO AND DURING THESE TESTS A FACTORY REPRESENTATIVE OF THE VALVE MANUFACTURER SHALL BE ON-SITE.

---VALVE OPERATION FIELD TEST (WET SYSTEM)

THIS SHALL BE AS ABOVE SPECIFIED FOR THE "DRY SYSTEM" TEST EXCEPT THAT WATER SHALL BE SUPPLIED TO THE VALVES FROM THE NEW ELEVATED WATER TANK. A REPRESENTATIVE OF THE CONTRACTOR SHALL OBSERVE THE WATER FLOW

TESTS (WHICH WILL BE CONDUCTED BY GOVERNMENT PERSONNEL) AND SHALL MAKE ADJUSTMENTS TO HIS WORK AS REQUIRED FOR PROPER FUNCTIONING AND VALVE TIMING. FOR THESE TESTS, A FACTORY REPRESENTATIVE OF THE VALVE MANUFACTURER SHALL BE ON-SITE. THE TESTING PERIOD SHALL BE CONCURRENT WITH WATER FLOW TEST OF THE PIPING SYSTEM AS STATED IN SECTION 15E OF THE SPECIFICATIONS, AND THE 48 INCH VALVES SHALL BE USED AS CLOSURES FOR THE HYDROSTATIC TEST OF THE PIPING SYSTEM AS THEREIN DEFINED FOR PIPING PRESSURE TESTS.

IT IS NOT INTENDED THAT 48 INCH VALVES BE CLOSED DURING THE PERIOD OF WATER FLOW. TO DO SO WOULD PRODUCE "HAMMER" IN THE PIPING SYSTEM.

---HYDRAULICALLY OPERATED, ELECTRICALLY CONTROLLED VALVES---

---GENERAL

EACH MAIN VALVE SHALL BE OF THE HYDRAULICALLY-OPERATED, PILOT-CONTROLLED, DIAPHRAGM TYPE, AND SHALL HAVE A SINGLE REMOVABLE SEAT AND RESILIENT DISC. NO EXTERNAL PACKING GLANDS SHALL BE PERMITTED, AND THE DIAPHRAGM SHALL NOT BE USED AS A SEATING SURFACE. THE PILOT CONTROL SHALL BE A DIRECT-ACTING, ADJUSTABLE, SPRING-LOADED, DIAPHRAGM VALVE. MAIN VALVE BODY SHALL BE RATED 300 PSI WITH 250 ANSI B16.1 FLANGES, GLOBE TYPE. MAIN VALVE BODY SHALL HAVE DIRECTIONAL FLOW ARROW. EACH VALVE SHALL BE EQUIPPED AND PIPED WITH ELECTRICALLY OPERATED SOLENOID VALVES TO ACCOMPLISH THE REMOTE COMMAND FUNCTIONS HEREINAFTER SPECIFIED. EACH VALVE SHALL BE EQUIPPED WITH TWO SEPARATE POSITION INDICATOR SWITCH ASSEMBLIES: ONE ASSEMBLY TO INDICATE REMOTELY THE "OPEN" (OR, "REGULATING") POSITION, AND ONE THE "CLOSED" POSITION, OF THE VALVE.

EACH VALVE SHALL BE FACTORY TUBED WITH ALL THE HEREINABOVE COMPONENTS MOUNTED ON THE MAIN VALVE, AND INCLUDING PILOT CONTROL VALVE, STRAINERS AND NEEDLE VALVE ASSEMBLIES, SHUT-OFF COCKS, FLOW (SPEED) CONTROL VALVES, AND TEST COCKS FOR MANUALLY CHECKING OPERATION OF MAIN VALVE.

VALVES WILL HANDLE FRESH NON-POTABLE WATER AT 35° TO 110°F.

ALL EQUIPMENT SHALL BE CLAYTON 100 HYTROL VALVE TYPES WITH CLAYTON MODULATING CONTROLS AS MANUFACTURED BY THE CLA-VAL COMPANY, NEWPORT BEACH, CALIFORNIA, AND ARRANGED WITH CONTROL TUBING AND SPECIFIED CONTROL COMPONENTS TO ACCOMPLISH THE FUNCTIONS HEREINAFTER SPECIFIED. A

---MATERIALS

MAIN VALVE BODY AND COVER:	ASTM A48 CAST IRON
TRIM FOR MAIN VALVE:	ASTM B61 BRONZE
DIAPHRAGM FOR MAIN VALVE:	NYLON FABRIC REINFORCED BUNA N SYNTHETIC RUBBER

SEAT FOR MAIN VALVE:	BUNA N SYNTHETIC RUBBER
PILOT CONTROL:	ASTM B62 BRONZE WITH TYPE 303 STAINLESS STEEL TRIM
STRAINER AND NEEDLE VALVE ASSEMBLY:	BRONZE BODY, STAINLESS STEEL TRIM, MONEL SCREEN
FLOW (SPEED) CONTROL:	BRONZE BODY WITH STAINLESS STEEL TRIM
SHUT-OFF AND TEST COCKS:	BRONZE
TUBING AND FITTINGS:	STAINLESS STEEL
POSITION INDICATOR SWITCHES:	NEMA 4 ENCLOSURES, SP-DT, WITH THREADED CONDUIT CONNS. RATED 2 AMP - 28 VOLTS DC
SOLENOID VALVES:	CONTINUOUS DUTY MOLDED COILS IN NEMA 4 ENCLOSURES WITH THREADED CONDUIT CONNS. RATED FOR 28 VOLTS D.C. VALVE BODY BRASS OR BRONZE WITH STAINLESS STEEL TRIM
OTHER COMPONENTS:	AS REQUIRED TO ACHIEVE THE HEREIN SPECIFIED VALVE FUNCTIONS

---VALVE SIZES AND FUNCTIONS

VALVE #V24 - SIZE 16 INCH: (TO 114" TANK RISER)	VALVE NORMALL "CLOSED". WHEN SOLENOID IS ENERGIZED, VALVE SHALL REGULATE TO MAINTAIN UPSTREAM (FIREX LOOP) PRESSURE AT NOT LESS THAN 90 PSIG. SET PRESSURE SHALL BE ADJUSTABLE. WHEN SOLENOID IS DE-EMERGIZED, VALVE SHALL MOVE TO NORMALLY "CLOSED" POSITION.
VALVE #V22 - SIZE 10 INCH: (PUMP CONNECTION TO LOOP)	SHALL NORMALLY REGULATE TO MAINTAIN DOWNSTREAM (LOOP) PRESSURE AT 90 PSIG. SET PRESSURE SHALL BE ADJUSTABLE. WHEN SOLENOID IS ENERGIZED, VALVE SHALL MOVE TO "CLOSED" POSITION. WHEN SOLENOID IS DE-ENERGIZED, VALVE SHALL REGULATE DOWNSTREAM PRESSURE AS SPECIFIED.
VALVE #V9 - SIZE 16 INCH: (TO PAD/TRENCH FLUSH)	VALVE NORMALLY "CLOSED". WHEN SOLENOID IS ENERGIZED, VALVE SHALL REGULATE UPSTREAM (PUMP SIDE) PRESSURE AT 180 PSIG. SET PRESSURE SHALL BE ADJUSTABLE. WHEN SOLENOID IS DE-ENERGIZED, VALVE SHALL MOVE TO "CLOSED" POSITION.

---FACTORY ASSEMBLY AND TESTING

MAIN VALVES SHALL BE FACTORY ASSEMBLED COMPLETE WITH ALL COMPONENTS MOUNTED AND TUBED. EACH VALVE SHALL HAVE APPLIED A HYDROSTATIC TEST AT NOT LESS THAN 150% OF RATED DESIGN PRESSURE OF 300 PSIG, AND SHALL RECEIVE AN OPERATIONAL FLOW TEST TO DEMONSTRATE FUNCTION AS HEREINABOVE SPECIFIED. ALL VALVES SHALL BE DROP TIGHT IN THE CLOSED POSITION AT MAXIMUM RATED PRESSURE. FACTORY TEST RECORDS SHALL BE SUBMITTED FOR APPROVAL.

---PROTECTION DURING SHIPMENT

ALL VALVE ASSEMBLIES SHALL BE SUITABLY PROTECTED AGAINST DAMAGE DURING SHIPMENT. ALL FLANGES AND PORTS SHALL HAVE CLOSURES. CONTROL COMPONENTS AND TUBING SHALL BE PROTECTED AGAINST DAMAGE.

---INSTALLATION AND TESTING

CONTRACTOR SHALL COMPLETELY INSTALL ALL VALVES AND COMPONENTS, AND SHALL PERFORM OPERATIONAL FLOW TEST ON VALVES NO. V9 AND NO. V22, LOCATED IN THE PAD VALVE PIT.

POSITION INDICATOR SWITCHES SHALL BE CHECKED FOR ACCURATE INDICATION OF VALVE POSITION ON ALL VALVES, AND SOLENOID VALVES SHALL BE DEMONSTRATED FOR PROPER OPERATION AND PORTING WHEN ENERGIZED.

CONTRACTOR SHALL FURNISH TEMPORARY D.C. POWER SUPPLY FOR ABOVE TESTS, AND SHALL PROVIDE SUITABLE TEMPORARY SWITCH PANEL.

---DATA FOR OPERATIONS AND MAINTENANCE MANUALS---

---GENERAL

THE CONTRACTOR SHALL FURNISH DATA FOR OPERATIONS AND MAINTENANCE MANUALS AND SPARE PARTS AND TEST PROCEDURES FOR ALL EQUIPMENT FURNISHED IN ACCORDANCE WITH THE "CONTRACT SCHEDULE."

SECTION 15H

MISCELLANEOUS PIPING SYSTEMS

---GENERAL REQUIREMENTS---

---GENERAL

THIS SECTION INCLUDES THE FURNISHING OF ALL MATERIAL, LABOR AND PLANT FOR THE COMPLETE FABRICATION, ERECTION, CHECKOUT AND TESTING OF THE HEREINBELOW LISTED PIPING SYSTEMS. WORK FOR OTHER PIPING SYSTEMS SHALL BE AS DEFINED IN OTHER SECTIONS LISTED IN THE INDEX TO THE SPECIFICATIONS.

---PAD CONNECTIONS

PROVIDE ALL PIPING WORK ABOVE THE ELEVATION OF THE EXISTING MLP PAD CONNECTION FLANGES LOCATED 12± INCHES ABOVE THE WEST PAD SURFACE, AND EXTENSIONS THEREFROM TO SERVE THE SSAT FIREX AND POTABLE WATER (AND FUTURE PCR WITH FIREX WATER, CHILLED WATER SUPPLY, CHILLED WATER RETURN, AND POTABLE WATER). ALL HANGERS, SUPPORTS, ANCHORS, SLEEVES, AND OTHER SPECIALITIES AS SPECIFIED AND/OR SHOWN ON THE DRAWINGS SHALL BE PROVIDED. MODIFY MLP-TO-PAD FLEXIBLE CONNECTIONS AS DETAILED. SEE SHEETS M5 AND M8 THRU M14.

---REROUTING OF PIPING FOR FOUNDATIONS

ALL PIPING LOCATED BELOW THE PAD SURFACE SHALL BE REROUTED AS SHOWN ON THE DRAWINGS TO CLEAR THE PILING AND FOUNDATIONS OF THE NEW SHUTTLE SERVICE AND ACCESS TOWER (SSAT). SEE SHEET *M1, M2 and M3.* ⚠A

PIPING LOCATED IN THE VICINITY OF THE NEW ELEVATED WATER TANK AND THE NEW MAIN VALVE STATION SHALL BE REROUTED AS SHOWN ON THE DRAWINGS TO CLEAR PILING AND FOUNDATIONS OF THE NEW SOUND SUPPRESSION WATER SYSTEM. SEE SHEET M62.

MODIFY DRAIN PIPING FROM PIT AT MOUNT MECHANISM NO. 3 AS SHOWN ON SHEET *M2.* ⚠A

---WORK IN PAD WATER PIT AND INDUSTRIAL WATER SUPPLY (REFER TO SHEETS M5, M6, M8, M63, M64, M65 AND M70)

PROVIDE ALL NEW PIPING MODIFICATIONS FOR PUMPS P-1B AND P-2B SYSTEMS.

PROVIDE MODIFICATIONS FOR TANK T-3B SYSTEM AND TANK T-4B SYSTEM AS SHOWN ON THE DRAWINGS, AND TEST MODIFIED SYSTEMS AS OUTLINED IN SECTION 18A.

⚠A *5-30-78*

PROVIDE MISCELLANEOUS REMOVAL, RELOCATION, CLOSURE AND BLIND FLANGE WORK ASSOCIATED WITH EXISTING PAD WATER PIT TANKS, VALVES, PIPING, HIGH PRESSURE GAS SYSTEMS AND RELATED ELECTRICAL AND INSTRUMENTATION HARDWARE AS SHOWN ON THE DRAWINGS. SEE SHEETS M63, M64, M65 AND M70.

---SUMP PUMPING UNITS

PROVIDE NEW ELEVATOR PIT SUMP PUMPING UNIT AND RELATED PIPING DESCRIBED ON THE DRAWINGS AND IN SECTION 14D OF THESE SPECIFICATIONS. SEE SHEET M2.

REMOVE EAST CATACOMB SUMP PUMPING UNIT AND RELATED PIPING DESCRIBED ON DRAWING SHEET M3.

---PIPING AT COMPRESSED AIR BUILDING

PROVIDE CONNECTION TO UNDERGROUND POTABLE WATER LINE AND PROVIDE NEW POTABLE WATER SERVICE LINE TO EXISTING COMPRESSED AIR BUILDING, AND ACCOMPLISH PIPING WORK WITHIN BUILDING AS NOTED. SEE SHEET M19.

PROVIDE NEW COMPRESSED AIR SERVICE LINE FROM THE EXISTING COMPRESSED AIR BUILDING TO THE PAD WATER PIT AS DESCRIBED ON THE DRAWINGS. SEE SHEETS M61, M63, AND M65.

---DRAIN LINES

PROVIDE NEW DRAIN PIPING FROM THE NEW SOUND SUPPRESSION SYSTEM MAIN VALVE STATION TRENCH TO EXISTING EAST HOLDING POND. SEE SHEET M62.

PROVIDE NEW DRAIN PIPING FOR NEW SOUND SUPPRESSION SYSTEM WATER LINES AT ELEVATED TANK AREA. SEE SHEET M62.

PROVIDE CATCH BASIN AND CURB DRAIN PIPING AT NEW PAD RETAINING WALL AREA. SEE SHEET M62.

PROVIDE DRAIN LINES FOR NEW HYPERGOLIC BUILDINGS AND PARKING APRONS. SEE SHEET S100.

---POTABLE WATER TO HYPERGOLIC FACILITIES

UNDERGROUND VALVED CONNECTIONS TO EXISTING POTABLE WATER LINES AT THE SOUTHEAST AND SOUTHWEST CORNERS OF PAD 39B, AND EXTENSIONS THEREFROM TO SERVE THE NEW HYPERGOLIC FUEL AND HYPERGOLIC OXIDIZER FACILITIES, RESPECTIVELY. SEE SHEETS M71 THRU M75.

---SAFE WASTE FOR SSAT (REFER TO SHEETS M2 AND M9 THRU M13)

SANITARY SEWER (SAFEWASTE) FOR SSAT AND CONNECTION TO EXISTING SANITARY SEWER BELOW THE PAD SURFACE.

---PAD FLUSH NOZZLES AND FLAME TRENCH PIPING

REMOVE NOZZLES AT PAD SURFACE (THAT CONFLICT WITH CONSTRUCTION OF NEW SSAT AND NEW RAIL BEAM FOR ROTARY BRIDGE) AND CONNECTING PIPING TO SAME. *"REINSTALL PAD FLUSH NOZZLES WITH NEW SCHEDULE 40 ASTM A53, GRADE B, FACTORY COAL-TAR COATED AND WRAPPED STEEL PIPING AND SCHEDULE 40 STEEL WELD FITTINGS, THE LATTER TO BE POWER TOOL CLEANED AND COAL-TAR COATED IN THE FIELD."* SEE SHEET M18. MODIFY PIPING AT FLAME TRENCH WALLS PER SHEET M23. (A)

---MISCELLANEOUS

ACCOMPLISH OTHER PIPING WORK AS SHOWN ON THE DRAWINGS OR SPECIFIED HEREIN.

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
WOG	WATER, OIL, GAS (PRESSURE RATING)
FS	FEDERAL SPECIFICATIONS
MIL	MILITARY SPECIFICATIONS
MSS	MANUFACTURER'S STANDARDIZATION SOCIETY
PFI	PIPE FABRICATION INSTITUTE
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE

COMMONLY USED TERMS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

I.D.	INSIDE DIAMETER
IPS	IRON PIPE SIZE
O.D.	OUTSIDE DIAMETER
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH GAGE
USS	UNITED STATES STANDARD
WSP	WORKING STEAM PRESSURE

---MATERIALS AND WORK

ALL MATERIALS SHALL BE NEW. ALL WORK SHALL BE ACCOMPLISHED IN STRICT ACCORDANCE WITH THE REQUIREMENTS OF THE SPECIFICATIONS AND DRAWINGS. WHERE FEASIBLE, PIPING SHALL BE PREFABRICATED AT THE CONTRACTOR'S SHOP, SHIPPED TO THE SITE AND ERECTED. THE CONTRACTOR SHALL FURNISH ALL NECESSARY LABOR, MATERIALS, PLANT, TOOLS AND EQUIPMENT FOR A COMPLETE JOB, CLEANING OF ALL FOREIGN MATTER FROM THE INTERIOR AND EXTERIOR OF THE PIPING SYSTEMS AS SPECIFIED, PRESSURE AND OPERATIONAL TESTING, STERILIZATION OF THE POTABLE WATER SYSTEM, PAINTING AND IDENTIFICATION OF PIPING SYSTEMS AS SPECIFIED, AND CLEAN-UP PRIOR TO FINAL ACCEPTANCE.

---ENVIRONMENT

SYSTEMS WILL BE LOCATED ON THE PAD FROM WHICH THE SPACE SHUTTLE WILL BE LAUNCHED, THE ENGINES OF WHICH WILL CREATE EXTREME MECHANICAL VIBRATION. IN VIEW OF THE ABOVE, ALL PIPING SHALL BE ADEQUATELY SUPPORTED AND ANCHORED AS DETAILED ON THE DRAWINGS; OTHERS SHALL BE PROVIDED AS REQUIRED TO COMPLY WITH ANSI CODE B31.1-1973, CODE FOR POWER PIPING.

---EXCEPTIONS

IF THE PROPOSED EQUIPMENT AND WORK DIFFER IN ANY MANNER FROM THAT SPECIFIED, THE CONTRACTOR SHALL STATE WHEREIN THE DIFFERENCE OCCURS, AND FAILURE TO STATE SHALL NOT RELIEVE THE CONTRACTOR FROM FURNISHING AND INSTALLING ALL WORK IN STRICT ACCORDANCE WITH THESE SPECIFICATIONS.

---ITEMS OF WORK INCLUDED

ITEMS OF WORK TO BE PROVIDED BY THE CONTRACTOR INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING:

ALL PIPING, FLANGES AND BOLTS, FITTINGS, PIPE HANGERS, PIPE SUPPORTS, PIPE ANCHORS, SWAY BRACES, AND ALL CONNECTIONS, NOZZLES, ORIFICES.

ALL SUPPLEMENTAL STRUCTURAL STEEL INDICATED FOR PIPE HANGERS, PIPE SUPPORTS, PIPE SWAY BRACES, AND ANCHORS FOR THE PROPER INSTALLATION AND ERECTION OF THE PIPING SYSTEMS.

ALL MATERIALS AND LABOR FOR WELDING AND CUTTING OPERATIONS. WELDING SHALL BE IN ACCORDANCE WITH SECTION 17B OF THE SPECIFICATIONS ENTITLED, "WELDING FOR LOW PRESSURE WATER PIPING SYSTEMS."

CLEANING OF MILL SCALE, SAND, RUST AND OTHER UNDESIRABLE MATTER FROM THE INTERIOR OF PIPING PRIOR TO ERECTION.

WELDING OF SUPPLEMENTAL STRUCTURAL STEEL SHALL COMPLY WITH SECTION 17K.

ASSISTANCE IN THE MAKING OF RADIOGRAPHS OF WELDS IN SPECIFIED PIPING SYSTEMS TO THE EXTENT HEREINAFTER SPECIFIED, AND AS OUTLINED IN SECTION 17B OF THE SPECIFICATIONS.

ALL TESTS AND TEST REPORTS OF MATERIALS AND WORKMANSHIP AS SPECIFIED. SUBMITTAL OF ISOMETRIC, OR LAYOUT DRAWINGS, OF EACH PIPING SYSTEM, TOGETHER WITH SKETCHES CROSS-REFERENCED BY PIECE MARK NUMBERS, FOR APPROVAL PRIOR TO FABRICATION AND/OR ERECTION AND INCLUDING HANGER, SUPPORT AND ANCHOR DETAILS. FINAL ADJUSTMENT OF ALL HANGERS AND SUPPORTS.

PRESSURE TESTING OF ALL PIPING SYSTEMS INSTALLED BY THE CONTRACTOR, SAID TESTS TO BE WITNESSED BY THE CONTRACTING OFFICER WHO SHALL BE GIVEN NOT LESS THAN 3 DAYS' NOTICE OF SUCH TESTS.

OPERATIONAL TESTS OF EACH SYSTEM. ASSISTANCE IN PLACING SYSTEMS IN SERVICE TO THE EXTENT THAT ANY LEAKS THAT DEVELOP ARE REPAIRED IMMEDIATELY AND THEREBY PERMIT OPERATION TO CONTINUE WITHOUT DELAY.

CLEANING OF EXTERIOR AND FLUSHING OF THE INTERIOR OF COMPLETED PIPING SYSTEMS TO THE EXTENT THAT THE SYSTEMS ARE CLEAN OF ALL FOREIGN MATTER TO THE SATISFACTION OF THE CONTRACTING OFFICER. PROVIDING OF TEMPORARY BLOW-OFF, VENT AND DRAIN LINES, AND TEST CONNECTIONS.

CUTTING OF HOLES IN GRATING, PLATE, WALLS, STRUCTURES, ETC., IN ONLY THOSE CASES WHERE REQUIRED FOR THE PASSAGE OF ONLY THAT PIPING SHOWN ON THE DRAWINGS AND ONLY THEN WITH PRIOR APPROVAL OF THE CONTRACTING OFFICER UNLESS HOLES ARE DETAILED ON THE DRAWINGS.

ABRASIVE BLASTING, COATING AND LINING OF SPECIFIED PIPING. ABRASIVE BLASTING AND ZINC-RICH COATING OF ALL OTHER FERROUS, NON-GALVANIZED METALS IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THE SPECIFICATIONS. COLOR CODING AND IDENTIFICATION OF PIPING SYSTEMS IN ACCORDANCE WITH SECTION 13L OF THE SPECIFICATIONS. ALL UNDERGROUND FERROUS MATERIALS SHALL BE COAL-TAR COATED.

---WITNESS OF TESTS IN THE FIELD

TESTS CONDUCTED WITHOUT PRESENCE OF CONTRACTING OFFICER, OR HIS DULY AUTHORIZED REPRESENTATIVE, WILL NOT SERVE AS ACCEPTANCE TESTS; HOWEVER, THIS SHALL NOT BE CONSTRUED TO LIMIT THE CONTRACTOR INSOFAR AS TESTS PRELIMINARY TO ACCEPTANCE ARE CONCERNED. THE TIME SELECTED FOR ACCEPTANCE TESTS SHALL BE MUTUALLY AGREEABLE TO ALL PARTIES CONCERNED AND AT A TIME AGREEABLE TO THE CONTRACTING OFFICER. ALSO, REFER TO SECTION 18A, "SUMMARY OF TESTING."

---RADIOGRAPHS OF WELDS

THE GOVERNMENT MAY ELECT TO HAVE AN INDEPENDENT TESTING LABORATORY MAKE RADIOGRAPHS OF SELECTED WELDS, THE COST OF WHICH WILL BE PAID BY THE GOVERNMENT. THE CONTRACTOR, AT NO ADDITIONAL COST TO THE

GOVERNMENT, SHALL PREPARE THE WELDS FOR RADIOGRAPHING AND SHALL ASSIST IN ONLY THAT WORK PECULIAR TO HIS TRADE AND SHALL CLEAR THE RESTRICTED AREA OF PERSONNEL DURING THOSE TIMES CONSIDERED TO BE HAZARDOUS. FILMS THAT REVEAL QUESTIONABLE WELDS, AS DETERMINED BY THE CONTRACTING OFFICER, WILL BE FORWARDED TO THE LABORATORY FOR THEIR REVIEW AND APPROVAL. COST OF ANY SERVICES FOR CORRECTION OF FAULTY WELDS SHALL BE INCLUDED AS WORK OF THIS SECTION AT NO ADDITIONAL COST TO THE GOVERNMENT. THE STANDARDS FOR ACCEPTANCE FOR WELDS EXAMINED BY RADIOGRAPHS SHALL BE AS OUTLINED IN "TECHNIQUE FOR RADIOGRAPHIC EXAMINATION OF WELDED JOINTS", SECTION VIII OF THE ASME BOILER AND PRESSURE VESSEL CODE, 1974 EDITION AND ADDENDA. REFER TO SECTION 17B OF THE SPECIFICATIONS.

---FABRICATION

ALL PIPING SHALL BE FABRICATED IN ACCORDANCE WITH THE METHODS DESCRIBED HEREIN AND IN ACCORDANCE WITH APPLICABLE CODES. IN CERTAIN INSTANCES CONSIDERATION WILL BE GIVEN TO OTHER PROCEDURES NOT OUTLINED HEREIN; HOWEVER, NO OTHER SUCH PROCEDURES SHALL BE USED WITHOUT PRIOR APPROVAL IN WRITING FROM THE CONTRACTING OFFICER. CODE FOR POWER PIPING, ANSI B31.1-1973, APPLIES TO THIS PROJECT.

ALL STRAIGHT RUNS OF PIPING MEASURING LESS THAN 10 FEET IN LENGTH SHALL BE CONTINUOUS WITHOUT TRANSVERSE BUTT WELDS, UNLESS OTHERWISE DETAILED.

---SHOP CLEANING OF MILL SCALE

ALL FABRICATED PIPING SHALL BE THOROUGHLY CLEANED OF ALL MILL SCALE AND FOREIGN MATERIAL AT THE SHOP. ALL PIPE ENDS SHALL BE PROVIDED WITH SUITABLE CLOSURES FOR SHIPPING AND STORAGE. ALL CLOSURES WHICH BECOME DAMAGED PRIOR TO INSTALLATION OF THE PIPING SHALL BE CAUSE FOR RECLEANING OF THE PIPING TO THE FULL SATISFACTION OF THE CONTRACTING OFFICER AT NO ADDITIONAL COST TO THE GOVERNMENT.

---WELDING

ALL WELDING SHALL CONFORM TO THE REQUIREMENTS OF SECTION 17B ENTITLED, "WELDING FOR LOW PRESSURE WATER PIPING SYSTEMS," AND ANY ADDITIONAL REQUIREMENTS OF THIS SECTION (15H) OF THE SPECIFICATIONS. POST WELD HEAT TREATMENT, OR STRESS-RELIEVING, WILL NOT BE REQUIRED.

---INTERFERENCES

THE CONTRACTOR SHALL COORDINATE THE WORK OF THE DIFFERENT TRADES SO THAT INTERFERENCE BETWEEN PIPING, EQUIPMENT, ARCHITECTURAL AND STRUCTURAL WORK WILL BE AVOIDED. ALL NECESSARY OFFSETS IN PIPING AND ALL

FITTINGS, ETC., REQUIRED TO PROPERLY INSTALL THE WORK SHALL BE FURNISHED COMPLETE IN PLACE WITHOUT ADDITIONAL COST TO THE GOVERNMENT. IN CASE INTERFERENCE DEVELOPS, THE CONTRACTING OFFICER WILL DECIDE WHICH EQUIPMENT SHALL BE RELOCATED, REGARDLESS OF WHICH APPARATUS WAS FIRST INSTALLED.

---SINGULAR NUMBER

WHERE ANY DEVICE OR PART OF EQUIPMENT IS HEREIN REFERRED TO IN THE SINGULAR NUMBER, SUCH REFERENCE SHALL BE DEEMED TO APPLY TO AS MANY SUCH DEVICES AS ARE REQUIRED TO COMPLETE THE INSTALLATION.

---CROSS CONNECTIONS AND INTERCONNECTIONS

NO PLUMBING FIXTURE, DEVICE, OR PIPING SHALL BE INSTALLED WHICH WILL PROVIDE A CROSS CONNECTION OR INTER-CONNECTION BETWEEN A POTABLE WATER SUPPLY FOR DRINKING PURPOSES AND A POLLUTED SUPPLY SUCH AS A DRAINAGE SYSTEM, WHICH WOULD MAKE POSSIBLE THE BACKFLOW OF POLLUTED WATER INTO THE POTABLE WATER SUPPLY SYSTEM.

---REFERENCED DOCUMENTS

WHERE SPECIFIC REQUIREMENTS ARE SET FORTH IN THIS SECTION OF THE SPECIFICATIONS, AND WHERE SUCH SPECIFIC REQUIREMENTS DEPART FROM REQUIREMENTS OR ALTERNATIVES CONTAINED IN ANY DOCUMENTS REFERENCED HEREIN, THE SPECIFIC REQUIREMENTS CONTAINED IN THIS SECTION OF THE SPECIFICATIONS SHALL GOVERN AND TAKE PRECEDENCE.

---SPECIFICATIONS

MATERIALS SHALL BE OF THE SPECIFIED CLASS, GRADE, AND TYPE. SHOP TESTS OF PIPE, VALVES, AND FITTINGS, REQUIRED BY THE FEDERAL SPECIFICATIONS TO BE CONDUCTED IN THE PRESENCE OF A GOVERNMENT INSPECTOR ARE WAIVED; HOWEVER, CERTIFICATIONS OF ALL SUCH TESTS SHALL BE SUBMITTED AS OUTLINED UNDER THE HEADING "----PROOFS OF COMPLIANCE".

---DRAWINGS

BECAUSE OF THE SMALL SCALE OF THE DRAWINGS, IT IS NOT POSSIBLE TO INDICATE ALL OFFSETS, FITTINGS, AND ACCESSORIES WHICH MAY BE REQUIRED. THE CONTRACTOR SHALL CAREFULLY INVESTIGATE THE STRUCTURAL AND FINISH CONDITIONS AFFECTING ALL HIS WORK AND SHALL ARRANGE HIS WORK ACCORDINGLY, FURNISHING SUCH FITTINGS AND ACCESSORIES AS MAY BE REQUIRED TO MEET SUCH CONDITIONS.

---OPERATION, MAINTENANCE, PARTS AND TESTING MANUALS

CONTRACTOR SHALL PROVIDE MANUALS FOR OPERATION, MAINTENANCE, PARTS LISTING AND TESTING OF ALL EQUIPMENT FURNISHED AS OUTLINED IN THE "CONTRACT SCHEDULE."

---CLEANING

CLEANING OPERATIONS DURING CONSTRUCTION AND UPON COMPLETION OF THE WORK OF THIS CONTRACT SHALL BE PERFORMED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF THE "CONTRACT SCHEDULE," AND THIS SECTION OF THE SPECIFICATIONS.

SPECIFIC OPERATIONS SHALL INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING:

REMOVAL OF RUST AND ALL DIRT AND DELETERIOUS SUBSTANCES FROM THE BORE AND EXTERIOR SURFACES OF ALL PIPING AND EQUIPMENT AS SPECIFIED.

UPON COMPLETION OF THE WORK, IMMEDIATELY PRIOR TO FINAL ACCEPTANCE, ALL EQUIPMENT PROVIDED UNDER THIS CONTRACT SHALL BE CLEANED.

---DISPOSAL OF EXCESS AND WASTE MATERIALS

WASTE MATERIALS, TRASH AND DEBRIS, SHALL BE REMOVED FROM THE SITE AND DISPOSED OF AT NO ADDITIONAL COST TO THE GOVERNMENT AS SPECIFIED IN THE "CONTRACT SCHEDULE."

---PAINTING AND FINISHING

GENERAL

PIPE HANGERS, SUPPORTS, AND OTHER IRON WORK NOT OTHERWISE SPECIFIED SHALL BE THOROUGHLY BLAST CLEANED AND SHOP COATED WITH INORGANIC ZINC-RICH COATING IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THE SPECIFICATIONS.

FINISH PAINTING OF SURFACES SHALL CONFORM TO REQUIREMENTS OF SECTIONS 9A, "PAINTING AND FINISHING," EXCEPT AS OTHERWISE SPECIFIED HEREIN.

---COLOR CODING SYSTEM AND LABELS

COLOR CODING AND LABELLING

ALL PIPING, INCLUDING THAT CONCEALED (INACCESSIBLE SPACES), SHALL BE COLOR CODED AND LABELLED WITH STENCILED LETTERS AND ARROWS TO DESIGNATE THE PARTICULAR SERVICE AND FLOW DIRECTION AS SPECIFIED IN SECTION 13L - "COLOR FINISH SCHEDULE AND PIPING IDENTIFICATION."

---SHOP DRAWINGS

SHOP DRAWINGS, WHICH INCLUDE CALCULATIONS, DRAWINGS OR SKETCHES AND OTHER DATA NECESSARY TO COMPLETELY IDENTIFY EACH OF THE FOLLOWING ITEMS, SHALL BE SUBMITTED TO THE CONTRACTING OFFICER IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" ARTICLE ENTITLED "SHOP DRAWINGS". SHOP DRAWINGS, SUBMITTED WITH DEVIATION WAIVERS, ARE REQUIRED FOR ALL DEVIATIONS FROM SPECIFICATIONS AND DRAWINGS AS OUTLINED IN THE "CONTRACT SCHEDULE".

PUMPING UNITS
EMERGENCY SHOWERS, EYE WASH, AND DRINKING FOUNTAINS
PIPING SPECIALTIES (NOZZLES, ORIFICES, VENTS, GAUGES AND VALVES)
PIPE SUPPORT ELEMENTS AND HANGERS
PIPING SYSTEMS
TESTING EQUIPMENT, PROCEDURES AND SCHEDULES OF TESTING

NONE OF THE PRECEDING ITEMS SHALL BE PURCHASED, DELIVERED TO THE SITE, OR INSTALLED UNTIL APPROVAL HAS BEEN OBTAINED.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR PROPOSED PIPING MATERIALS, AND AFFIDAVIT FOR COATINGS/LININGS.

NONE OF THE PRECEDING MATERIALS SHALL BE PURCHASED, DELIVERED TO THE SITE, OR INSTALLED UNTIL APPROVAL HAS BEEN OBTAINED.

---BONDING AND GROUNDING

BONDING OF METALS TO GROUND SHALL COMPLY WITH SECTION 16X (PART 51) OF THE SPECIFICATIONS.

---HAZARDOUS ENVIRONMENT

ELECTRICAL WORK IN THE AREAS COVERED BY THIS SECTION OF THE SPECIFICATIONS SHALL COMPLY WITH THE REQUIREMENTS OF SECTION 16V (PART 2) OF THE SPECIFICATIONS FOR HAZARDOUS LOCATIONS (OXYGEN AND HYDROGEN GASES, ETC.). MOTOR FOR SUMP PUMP SHALL COMPLY WITH THE REQUIREMENTS OF THE ABOVE REFERENCED SECTION AS SPECIFIED IN SECTION 14D FOR THE SSAT ELEVATOR PIT.

---UNDERGROUND VALVES

EACH VALVE LOCATED UNDERGROUND SHALL HAVE VALVE BOX AND WRENCH.

---CUTTING

CUTTING OF CONSTRUCTION AND/OR WORK DONE BY OTHERS SHALL BE DONE ONLY WITH THE WRITTEN PERMISSION OF THE CONTRACTING OFFICER. ANY DAMAGE TO THE STRUCTURE, PIPING, WIRING OR EQUIPMENT AS A RESULT OF CUTTING FOR INSTALLATION SHALL BE REPAIRED BY SKILLED MECHANICS OF THE TRADE INVOLVED, AT NO ADDITIONAL EXPENSE TO THE GOVERNMENT.

---POTABLE WATER SYSTEMS--

---GENERAL

SYSTEM COMMENCES WITH REWORK OF 3 INCH PAD CONNECTION; REWORK OF ARTICULATED MLP CONNECTION; PROVIDING NEW 3 INCH SUPPLY RISER UP SIDE 2 OF THE SSAT, AND A 2 INCH VALVED CONNECTION FROM NEW 3 INCH RISER TO THE FUTURE PCR; AND PROVIDING EMERGENCY SHOWERS, EYE WASHES, AND DRINKING FOUNTAINS ON THE SSAT AT VARIOUS LOCATIONS SHOWN ON THE DRAWING.

WORK SHALL INCLUDE MODIFICATIONS TO THE POTABLE WATER SYSTEM IN THE PAD WATER PIT AREA, INSTALLATION OF A NEW SERVICE LINE TO THE COMPRESSED AIR BUILDING, AND NEW POTABLE WATER SYSTEMS FOR THE NEW HYPERGOLIC FACILITIES.

NEW POTABLE WATER RISER ON THE SSAT SHALL SERVE NEW EMERGENCY SHOWERS, EYE WASHES, DRINKING FOUNTAINS, AND TWO TOILET FACILITIES. DISINFECTING OF ALL NEW AND REROUTED POTABLE WATER MAINS SHALL BE ACCOMPLISHED AS REQUIRED TO COMPLY WITH AWWA C601-68, STANDARD CODE FOR DISINFECTING WATER MAINS, AND AS HEREIN SPECIFIED.

ALL UNDERGROUND STEEL OR GALVANIZED STEEL PIPING, INCLUDING EXPOSED THREADS SHALL HAVE A 20 MIL THICK COAL-TAR ENAMEL COATING.

ALL UNDERGROUND VALVES SHALL BE INSTALLED WITH AN ACCOMPANYING VALVE BOX AS SPECIFIED HEREIN.

---PIPE

ASTM A53, TYPE S, GRADE A, SCHEDULE 80, GALVANIZED, WITH THREADED, OR WELDED, JOINTS AS INDICATED ON THE DRAWINGS.

---FITTINGS & FLANGES

300 PSIG ANSI STANDARD MALLEABLE IRON, GALVANIZED, SCREWED FITTINGS, WHERE THREAD FITTINGS ARE SHOWN ON THE DRAWINGS. WHERE WELDING FITTINGS ARE SHOWN, THEY SHALL BE EXTRA-STRONG, GALVANIZED CARBON STEEL, LONG RADIUS, BUTT-WELD TYPE. FLANGES SHALL BE CARBON STEEL, GALVANIZED, AND OF THE TYPES AND PRESSURE CLASS NOTED.

---VALVES, BALL - 90° TURN, LEVER OPERATED - MANUAL

THESE SHALL BE OF SIZE AND TYPE AS NOTED ON THE DRAWINGS.

---VALVES, GATE AND GLOBE

300 PSIG WSP, UNION BONNET, RISING STEM, BRONZE BODY AND STEM, GATE OR GLOBE OR AS INDICATED ON THE DRAWINGS.

---VALVES, PRESSURE REGULATOR

1-1/2" SIZE REGULATOR AS NOTED ON THE DRAWINGS.

---HOSE BIBBS

250 PSIG WATER PRESSURE ANGLE HOSE VALVE, 3/4 INCH HOSE CONNECTION OUTLET, 3/4 INCH NPT INLET, BRONZE BODY, RISING STEM, EQUAL TO CRANE FIGURE 117 SHALL BE USED.

---EMERGENCY SHOWER, EYE WASH AND DRINKING FOUNTAIN

EMERGENCY SHOWERS AND EYE-FACE WASH FOUNTAINS SHALL BE PROVIDED WHERE INDICATED. *"THE EMERGENCY SHOWER SHALL CONSIST OF A 1 1/2 INCH SUPPLY CONNECTION, 12 CHROME-PLATED BRASS SELF-CLEANING SPRAY NOZZLES PLUS 2 WEEP SPRAYS AND A 1 1/2 INCH CHROME-PLATED QUICK-OPENING BALL VALVE OPERATED BY A 4 INCH X8 INCH PANIC BAR."* (A)

ALL FUNCTIONAL PARTS SHALL BE OF NOT LESS THAN 1 INCH SCHEDULE 40 PIPE. FREE STANDING SHOWERS SHALL BE WALK-THROUGH TYPE EQUAL TO HAWS NO. 8560 LESS SIDE PANELS AND WITH MODEL 7760 EYE-FACE WASH MOUNTED TO FRAME. HANDRAIL MOUNTED UNITS SHALL BE EQUAL TO HAWS NO. 8590 AS MODIFIED BY THE DRAWINGS. PRESSURE REDUCING VALVES SHALL BE EQUAL TO FISHER 95H-ONE INCH.

EYE-FACE FIXTURE SHALL CONSIST OF A STAINLESS STEEL RECEPTOR SUPPLIED WITH TWIN, AERATED JETS OF WATER, CONTROLLED BY A BRASS, SELF-CLOSING, LEVER OPERATED VALVE WITH STRAINER. PROVIDE VOLUME CONTROL STOPS ON EACH INDIVIDUAL EYE-WASH JET; PROVIDE DRAIN CONNECTION FOR FOUNTAIN AS DETAILED, AND AS MANUFACTURED BY THE HAWS DRINKING FAUCET CO., BERKELY, CALIFORNIA. ALL PIPING SHALL BE CORROSION-RESISTANT RED BRASS WITH WHITE ENAMEL FINISH.

DRINKING FOUNTAIN SHALL BE SUITABLE FOR OUTDOOR, SALT SPRAY ENVIRONMENT, SHALL BE OF STAINLESS STEEL FURNISHED WITH CHROME-PLATED BRASS STREAM CONTROLLED BUBBLER WITH INTEGRAL STRAINER, ADJUSTABLE AUTO-FLO REGULATOR FOR STREAM CONTROL, LEVER TYPE BUBBLER VALVE, AND MOUNTED ON THE FRAME AS DETAILED ADJACENT TO, OR ON, THE EMERGENCY SHOWERS. DRINKING FOUNTAIN SHALL BE EQUAL TO HAWS MODEL *1120.* (A)

(A) *5-30-78*

---UNDERGROUND VALVES AND BOXES

VALVES SHALL BE 200 LB. W.O.G. SCREWED IRON BODY, DOUBLE DISC, NON-RISING STEM GATE VALVE WITH BRONZE STEM, TRIM AND STEM NUT FOR UNDERGROUND SERVICE EQUAL TO CRANE NO. 480. UNDERGROUND VALVE BOXES SHALL BE EQUAL TO CLOW NO. F-2450 WITH F-2494 STAY-PUT COVER MARKED "WATER" AND WITH EXTENSION SECTION AS REQUIRED.

---HOSE REELS FOR WASH DOWN

THESE SHALL HAVE SWIVEL-JOINT, (STRAIGHT OR 90° AS INDICATED) DESIGNED FOR 290 PSIG, 100 FEET OF 1" X 1-9/16" HOSE AND EQUAL TO HANNAY SERIES 7500, WITH GEARED HAND CRANK, HOT DIPPED GALVANIZED, GREEN FINISH. FURNISH HOSES AND NOZZLES OF THE TYPE SPECIFIED IN SECTION 15P.

---STRAINERS

IN-LINE, "Y" TYPE, 250 PSIG-W.O.G., CONFORMING TO MILITARY SPECIFICATION MIL-S-16293F, BRONZE SCREEN WITH 3/64 INCH PERFORATIONS.

---COMPRESSED AIR BUILDING PIPING

CONNECTION OF POTABLE WATER SOURCE TO COMPRESSED AIR BUILDING SHALL BE ACCOMPLISHED AS SHOWN ON THE DRAWING. SEE SHEET M19.

---TOILET FACILITIES---

---GENERAL

TYPES OF FIXTURES AND FIXTURE TRIMMINGS SPECIFIED HEREIN SHALL BE FURNISHED AND INSTALLED COMPLETE WITH ALL TRIMMINGS AND FITTINGS. ALL FIXTURES, EXCEPT WATER CLOSETS AND URINALS, SHALL HAVE THE WATER SUPPLY ABOVE THE RIM. FIXTURES WITH THE SUPPLY DISCHARGE BELOW THE RIM SHALL BE EQUIPPED WITH BACKFLOW PREVENTORS. ANGLE STOPS, STRAIGHT STOPS, STOPS INTEGRAL WITH THE FAUCETS, OR CONCEALED TYPE OF LOCK-SHIELD LOOSE-KEY PATTERN STOPS FOR CONCEALED SUPPLIES SHALL BE FURNISHED AND INSTALLED. EXPOSED TRAPS AND SUPPLY PIPES FOR ALL FIXTURES AND EQUIPMENT SHALL BE CONNECTED TO THE ROUGH PIPING SYSTEM AT THE WALL UNLESS OTHERWISE SPECIFIED UNDER THE ITEM AND/OR OTHERWISE SHOWN ON THE DRAWINGS.

---CROSS CONNECTIONS

FIXTURES AND TRIMMINGS SHALL BE DESIGNED TO PREVENT THE BACKFLOW OF POLLUTED WATER OR WASTE INTO THE POTABLE WATER SUPPLY SYSTEM.

---FIXTURE CONNECTIONS

CONNECTION BETWEEN ANY FIXTURE AND WASTE PIPE SHALL BE MADE ABSOLUTELY GASTIGHT AND WATERTIGHT WITH PLUMBING FIXTURE SETTING GASKETS. RUBBER GASKETS OR PUTTY WILL NOT BE PERMITTED FOR THIS CONNECTION. FIXTURE WITH OUTLET FLANGES SHALL BE SET THE PROPER DISTANCE FROM THE FLOOR OR WALL TO MAKE A FIRST-CLASS JOINT WITH THE COMPOUND OR GASKET AND FIXTURE USED. NO FIXTURE SHALL BE SET IN PLACE UNTIL THE CONTRACTING OFFICER HAS EXAMINED AND APPROVED SUCH FLANGE CONNECTION.

---WATER CLOSET

THE WATER CLOSET SHALL BE SIMILAR AND EQUAL TO "SUPER SECURE WARE," MODEL A-300 CAST ALUMINUM (AS MANUFACTURED BY THE ALUMINUM PLUMBING FIXTURE CORPORATION, BURLINGAME, CALIFORNIA) WALL HUNG, LESS CHAIR CARRIER, INTEGRAL SEAT; FLUSH VALVE, TYPE LC, EXPOSED ON BACK SIDE OF PARTITION.

---URINALS

URINALS SHALL BE SIMILAR AND EQUAL TO "SUPER SECURE WARE," MODEL A-600 CAST ALUMINUM, WALL HUNG, LESS CHAIR CARRIER, TYPE LC FLUSH VALVE; FLUSH VALVE TO BE EXPOSED ON BACK SIDE OF PARTITION.

---LAVATORY

LAVATORY SHALL BE SIMILAR AND EQUAL TO "SUPER SECURE WARE," MODEL A-75 CAST ALUMINUM, WALL HUNG WITH TYPE 10 FAUCET FOR C.W. ONLY, TYPE 75 DRAIN, CHROME-PLATED HOLE BLANK FOR H.W. DRILLING; TYPE 114 TRAP.

---SAFE WASTE AND VENT PIPING---

---INSTALLATION

SAFE WASTE PIPING FOR THE TOILETS SHALL BE COPPER FROM FIXTURES TO THE TRANSITION POINTS INDICATED ON THE DRAWINGS AND SCHEDULE 80 GALVANIZED STEEL WITH EXTRA STRONG GALVANIZED WELDING FITTINGS FROM THE TRANSITION POINTS TO THE MAIN SAFE WASTE AND VENT RISER, WHICH SHALL BE SCHEDULE 80, GALVANIZED, WELDED. SUITABLE BRASS OR BRONZE CONNECTORS SHALL BE USED AT THESE TRANSITION POINTS.

HORIZONTAL PIPES SHALL BE PITCHED TO DRAIN AT 1/8" PER FOOT.

CLEANOUTS SHALL BE AS DETAILED ON THE DRAWINGS.

CHANGES IN PIPE SIZE ON HORIZONTAL SAFE WASTE AND DRAIN LINES SHALL BE MADE WITH ECCENTRIC REDUCERS WITH FLAT SIDE AT BOTTOM OF PIPE. ALL CHANGES IN DIRECTION SHALL BE MADE BY THE APPROPRIATE USE OF WELDED 45° LATERALS, LONG RADIUS 45° AND 90° ELBOWS, AND DOUBLE LONG TURN TEE-WYES. MATERIALS SHALL BE AS OUTLINED HEREINBELOW AND SHALL BE COMPATIBLE WITH THE PIPING TO WHICH CONNECTED. SCREWED UNION CONNECTIONS SHALL BE AS HEREINAFTER SPECIFIED.

---JOINTS

WELDING: FOR STEEL PIPE SIZES LARGER THAN 1-1/2 INCHES, JOINTS BETWEEN SECTIONS OF PIPE AND BETWEEN PIPE AND FITTINGS SHALL BE FUSION WELDED IN ACCORDANCE WITH SECTION 17B. ALL CHANGES IN DIRECTION AND INTERSECTIONS OF LINES SHALL BE MADE WITH EXTRA STRONG FORGED STEEL, GALVANIZED WELDING FITTINGS. WELDING TYPE, SCHEDULE 80 STEEL SHAPED NIPPLES TO MAKE 45 DEGREE LATERALS WILL BE PERMITTED; HOWEVER, THESE SHALL BE PREFABRICATED AND ALL INTERNAL WELDING SLAG, PROJECTIONS AND RAW EDGES REMOVED PRIOR TO BUTT-WELDING THE FITTING INTO THE LINE.

THREADED JOINTS: STEEL PIPE IN SIZES 1-1/2 INCHES AND SMALLER SHALL HAVE THREADED JOINTS. AFTER CUTTING AND BEFORE THREADING, PIPE SHALL HAVE BURRS REMOVED BY REAMING. SCREW JOINTS SHALL BE MADE WITH GRAPHITE OR INERT FILLER AND OIL OR WITH A THREADED LUBRICANT COMPOUND APPLIED TO MALE THREADS ONLY. CAULKING OF THREADED JOINTS TO STOP OR PREVENT LEAKS WILL NOT BE PERMITTED.

SILVER SOLDERED JOINTS: JOINTS IN COPPER TUBING AND TO TUBING FITTINGS SHALL BE SILVER SOLDERED. SILVER SOLDERED JOINTS SHALL BE MADE WITH THE HIGH MELTING POINT SILVER SOLDER IN ACCORDANCE WITH SECTION 17J OF THE SPECIFICATIONS.

---MATERIALS

STEEL PIPE: ASTM A53, TYPE S, GRADE A, SCHEDULE 80, GALVANIZED.

COPPER TUBING: FEDERAL SPECIFICATION WW-T-799, TYPE K, HARD DRAWN, STRAIGHT LENGTHS.

FITTINGS AND FLANGES:

FOR STEEL PIPE 4" THROUGH 2" NOMINAL SIZE: BUTT WELD TYPE, SCHEDULE 80, CONFORMING TO ASTM A234, GALVANIZED. ELBOW SHALL BE LONG RADIUS.

FOR STEEL PIPE 1-1/2" NOMINAL SIZE AND SMALLER; 300 POUND SCREWED ANSI STANDARD MALLEABLE IRON, GALVANIZED.

FITTINGS FOR COPPER TUBING: ASTM B-62 CAST BRONZE, DRAINAGE PATTERN, SILVER SOLDER TYPE.

FLANGES FOR STEEL PIPE: 150 LB. ANSI STD. GALVANIZED CARBON STEEL, SERRATED FACE.

UNIONS: FEDERAL SPECIFICATION WW-U-536, 300 POUND MALLEABLE IRON, TYPE XB.

D.I. PIPE: MECHANICAL JOINT DUCTILE IRON PIPE AND FITTINGS CONFORMING TO FS XXW-P-421C, TYPE III, CLASS 6, AND ANSI STD. 421.11, COAL-TAR COATED AND LINED.

---CHILLED WATER PIPING (ABOVE GROUND)---

---GENERAL

SYSTEM SHALL COMMENCE AT THE EXISTING 6" MLP PAD CONNECTIONS, THE FLANGES OF WHICH SHALL BE LOWERED TO ACCOMMODATE THE NEW CONNECTIONS AS SHOWN ON THE DRAWINGS. VALVES SHALL BE PROVIDED AS NOTED ON THE DRAWINGS. ROTATE EXISTING ARTICULATED BALL-JOINT CONNECTIONS AS NOTED.

PIPING SHALL BE ROUTED FROM THE VALVES TO SIDE 2 OF THE SSAT AND FLANGED. VENT VALVES SHALL BE PROVIDED AT HIGH POINTS. ALL PIPING SHALL BE INSULATED AS SPECIFIED, INCLUDING VALVES AND SPECIALTIES.

---PIPE

ASTM A53, GRADE A OR B, SEAMLESS, BLACK, ABRASIVE BLASTED WITH EXTERIOR COAL-TAR COATING, EXCEPT WHERE OTHERWISE NOTED ON THE DRAWINGS AT THE NEW PAD CONNECTION. SCREWED PIPE SHALL BE SCHEDULE 80. PIPE SIZES 2-1/2 INCH AND LARGER SHALL BE SCHEDULE 40, WELDED. COATING SHALL COMPLY WITH AWWA STD. C-203-73, FACTORY APPLIED; OR, AMERCOAT NO. 78 OR 325 TO DRY COAT THICKNESS OF 16 MILS.

---FITTINGS AND FLANGES

SIZES 2-1/2 INCH AND LARGER SHALL BE WELDING TYPE, BLACK STEEL, ELBOWS SHALL BE LONG RADIUS PATTERN, STD. WT. FLANGES SHALL BE CARBON STEEL, WELD NECK, SERRATED FACE, RATED AS NOTED.

SIZES 2 INCH AND SMALLER SHALL BE 300 LB. ANSI STANDARD MALLEABLE IRON, BLACK, SCREWED.

---TOUCH-UP OF TAR COATING AND COATING OF FITTINGS

ALL WELD AREAS SHALL BE CHIPPED AND POWER TOOL CLEANED. ALL EXPOSED THREADS SHALL BE CLEANED OF OIL AND JOINT COMPOUND AND OTHER FOREIGN MATTER. AFTER CLEANING, TOUCH-UP ALL CLEANED METAL WITH HAND APPLIED COAL-TAR COATING TO MATCH SURROUNDING TAR COATED PIPING. COAT ALL FITTINGS WITH TAR COATING.

---INSULATION FOR CHILLED WATER PIPING (ABOVE GROUND)

CELLULAR PRE-MOLDED GLASS TYPE, 2-1/2 INCHES THICK, WITH GLASS FABRIC REINFORCED MASTIC JACKET, CONFORMING TO FS HH-I-551*E*, TYPE II, CLASS 3, AND WITH 20 U.S. GAUGE ALUMINUM JACKET FASTENED WITH ALUMINUM OR STAINLESS STEEL SHEET METAL SCREWS WITH RESILIENT WASHERS ON NOT MORE THAN 6 INCH CENTERS AT ALL LAPS. LONGITUDINAL LAPS OF JACKET SHALL BE ON THE SIDE OF THE PIPE AND LAPPED TO SHED WATER. (B)

INSULATION AND ALUMINUM JACKET SHALL COMMENCE AT THE VALVED PAD CONNECTIONS AND CONTINUE TO THE END OF THE SYSTEMS. ALL VALVES, SPECIALTIES, PIPING AND FITTINGS SHALL HAVE SPECIFIED INSULATION WITH ALUMINUM JACKET. PIPE HANGER CLAMPS SHALL BE NEOPRENE COATED.

CELLULAR GLASS INSULATION SHALL BE HELD TO THE OUTSIDE DIAMETER OF THE PIPE BY ALUMINUM BANDING ON NOT MORE THAN 18 INCH CENTERS AND OTHERWISE IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS.

---UNDERGROUND PIPING AT SSAT FOUNDATION---

---GENERAL

LAYOUT REROUTED EXISTING PIPING AND DUCT TO CLEAR NEW FOUNDATIONS AND PILES. CONTRACTOR SHALL VERIFY LOCATIONS OF EXISTING PIPING AND DUCT AND ADJUST LAYOUT OF NEW PIPING ACCORDINGLY. SHEET PILING AND FOUNDATION PILE DRIVING SHALL BE COORDINATED WITH THE LOCATIONS OF NEW AND EXISTING PIPING. PRESSURE TEST BEFORE BACKFILLING.

---PIPE AND FITTINGS

PIPE, FITTINGS, AND TAR COATINGS SHALL BE AS NOTED ON THE DRAWINGS, SHEET M2.

---INSULATION AND COAL-TAR COATING

INSULATION SHALL COMPLY WITH FS HH-I-551D, TYPE II, CLASS 3, PRE-MOLDED CELLULAR GLASS WITH GLASS-FIBER WRAP FACTORY APPLIED WITH HOT ASPHALT. NOMINAL THICKNESS SHALL BE 1-1/2 INCHES.

INSULATION SHALL BE APPLIED AND ATTACHED TO THE 6 INCH CHILLED WATER PIPING AND 26 INCH O.D. DEHUMIDIFIED AIR DUCT IN STRICT ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS FOR UNDERGROUND INSTALLATION. ALL JOINTS SHALL BE BUTTERED WITH MANUFACTURER'S APPROVED JOINT SEALER COMPOUND. BANDING SHALL BE ON NOT MORE THAN 9 INCH CENTERS FOR 18 INCH LENGTHS OF INSULATION AND NOT MORE THAN 12 INCH CENTERS FOR 24 INCH LENGTHS.

FOLLOWING SEALING AND BANDING, THE GLASS-FABRIC JACKET SHALL BE GIVEN TWO COMPLETE COATINGS OF FAST-DRYING, SELF-PRIMING HEAVY DUTY COAL-TAR BASE SEALER EQUAL TO KOPPERS BITUMASTIC NO. 50 APPLIED BY HAND BRUSH. TOTAL COATING THICKNESS SHALL BE NOT LESS THAN 1/8 INCH.

---DRAIN PIPING---

---GENERAL

DRAIN PIPING AT THE MAIN VALVE STATION SHALL BE M.J. DUCTILE IRON OF THE TYPES NOTED ON THE DRAWINGS. DRAIN PIPING FROM CURB CATCH BASIN SHALL BE PVC AND DUCTILE IRON OF TYPES NOTED. VALVES SHALL BE AS NOTED ON THE DRAWINGS, OR EQUAL. HYDROSTATICALLY PRESSURE TEST BEFORE BACKFILLING AT JOINTS AS HEREINAFTER SPECIFIED.

---MODIFICATION TO PIPING AT INDUSTRIAL WATER STATION---

---GENERAL

ACCOMPLISH ALL WORK AS DESCRIBED AND AS NOTED ON THE DRAWING. SEE SHEET M70. HYDROSTATICALLY PRESSURE TEST AFTER COMPLETION OF NEW WORK AS NOTED ON THE DRAWING AND AS HEREIN SPECIFIED.

---PIPING IN PAD WATER PIT---

---GENERAL

THESE SYSTEMS ARE SHOWN ON DRAWING SHEETS M63 AND M64, EXCEPT THAT POTABLE WATER PIPING SHALL BE AS HEREINABOVE SPECIFIED.

---PIPE: 26 INCH AND SMALLER

ASTM A53-76, GRADE "B", TYPE "E" OR "S", (OR API-5L-1957, GRADE "B") OF THE FOLLOWING WALL THICKNESSES, UNLESS OTHERWISE DETAILED. ENDS SHALL BE BEVELED FOR WELDING EXCEPT AS NOTED:

1/4" THRU 4":	SCHEDULE 80 (SIZES 1/4" THRU 2" SHALL HAVE THREADED ENDS) - GALVANIZED
5" THRU 10":	SCHEDULE 40 - GALVANIZED
12" THRU 26":	0.375 INCH WALL - GALVANIZED

NOTE: PIPE TO BE PLACED UNDERGROUND SHALL ALSO BE BRUSH-COATED WITH KOPPERS BITUMASTIC NO. 50, OR EQUAL.

---PIPE: 30 INCH

ELECTRIC FUSION (ARC) WELDED STEEL PLATE PIPE SHALL BE SHOP FABRICATED IN ACCORDANCE WITH ASTM A134-73 OF ASTM A36-75 PLATE. ALL PIPE SHALL BE SHOP HYDROTESTED AND PROVED TIGHT AT NOT LESS THAN 300 PSIG. WALL THICKNESS SHALL BE 0.500 INCH. EXTERIOR OF PIPE AND ALL ATTACHMENTS THERETO SHALL BE ABRASIVE BLASTED AND SHOP COATED WITH INORGANIC ZINC-RICH COATING WITH ORGANIC ZINC FIELD TOUCH-UP ALL IN ACCORDANCE WITH SECTION 9L OF THE SPECIFICATIONS.

---FORGED FITTINGS: FOR PIPE SIZES 2-1/2 INCH THRU 36 INCH

FITTINGS SHALL BE CARBON STEEL, BUTT-WELDING, LONG RADIUS ELBOWS (UNLESS NOTED S.R.) AND SHALL CONFORM TO ANSI B16.9-71 AND TO ASTM A234-71 FOR CARBON STEEL. FORGED TEES SHALL BE USED FOR 90° LATERALS. OTHER LATERALS SHALL BE REINFORCED AS DETAILED ON THE DRAWINGS. REDUCERS IN THIS SIZE RANGE SHALL MATCH WALL THICKNESS OF LARGER PIPE CONNECTED. FITTINGS USED IN GALVANIZED PIPE SYSTEMS SHALL BE GALVANIZED.

---SCREWED FITTINGS: PIPE SIZES 2" AND SMALLER

300 LB. ANSI STANDARD, SCREWED, GALVANIZED, MALLEABLE IRON. UNIONS SHALL BE 300 LB. MALLEABLE IRON WITH BRASS/BRASS SEATS, SCREWED, GALVANIZED.

---MISCELLANEOUS MATERIALS---

---BOLTING

FLANGE BOLTING SHALL BE HEX HEAD AND SHALL CONFORM TO ASTM A307-74. HEAVY HEX NUTS SHALL CONFORM TO ANSI B18.2.2-1972. SQUARE HEAD BOLTS AND NUTS ARE NOT ACCEPTABLE.

---*BUTTERFLY VALVES - 24 INCH AND SMALLER* Ⓐ

THESE VALVES SHALL BE AS SPECIFIED IN SECTION 15E, PAGE 15E-23."

---PIPE THREAD COMPOUNDS

TETRAFLUOROETHYLENE TAPE NOT LESS THAN 2 TO 3 MILS THICK, OR 100% TETRAFLUOROETHYLENE DISPERSIONS, SHALL BE USED IN WATER SYSTEMS FOR PIPE THREADS. NO LEAD CONTAINING COMPOUNDS SHALL BE USED IN POTABLE WATER SYSTEMS.

---CLOSURE PLATES

CLOSURE PLATES SHALL BE PROVIDED AT LOCATIONS WHERE RISERS PENETRATE FLOORS. PROVIDE THE CLOSURE PLATES DETAILED ON THE DRAWINGS.

---GASKETS

RUBBER GASKETS NOT EXCEEDING 1/8-INCH IN THICKNESS AND EQUAL TO GARLOCK WIRE INSERTED RED RUBBER SHEET NO. 24. FABRIC-REINFORCED RED RUBBER GASKETS MAY ALSO BE USED.

---ORIFICES AND ORIFICE FLANGES

ORIFICE FLANGES AND ORIFICES SHALL BE PROVIDED WHERE INDICATED ON THE DRAWINGS. PROVIDE TAPPED PORTS THROUGH FLANGES DETAILED. ORIFICE PLATE HANDLES SHALL BE LOCATED AT TOP OF FLANGES.

---AUTOMATIC AIR VENT VALVES

CHAMBER AND INTERNALS SHALL BE FACTORY HYDRO-TESTED AT NOT LESS THAN 700 PSIG, SHALL HAVE STAINLESS STEEL FLOAT, STAINLESS STEEL VALVE AND STAINLESS STEEL LEVER PINS. OTHER INTERNAL PARTS SHALL BE OF BRONZE EXCEPT SEAT WHICH SHALL BE SYNTHETIC RUBBER. BODY AND COVER SHALL BE OF HIGH-GRADE MALLEABLE IRON, OR STEEL. INLET SHALL BE NOT LESS THAN 2 INCHES AND OUTLET NOT LESS THAN 1 INCH. VENTING CAPACITY SHALL BE NOT LESS THAN 170 SCFM AT 400 PSIG. EQUIPMENT SHALL BE SIMILAR AND EQUAL TO NO. 205 AIR RELEASE VALVE AS MANUFACTURED BY VALVE AND PRIMER CORP. OF CHICAGO, ILLINOIS. PIPE CONNECTING ABOVE TO TOP OF RISER SHALL BE 2" SCHEDULE 80, GALVANIZED, THREADED, WITH 300 LB. SWP FORGED STEEL UNION AND 200 LB. SWP BRONZE, RISING STEM GATE AND GLOBE VALVES LOCATED AS DETAILED.

---PRESSURE GAUGES

THESE SHALL BE PROVIDED WHERE INDICATED ON THE DRAWINGS, AND SHALL HAVE 6 INCH DIA. DIAL WITH BLACK NUMERALS, PHENOLIC CASE, TYPE 316 S.S. TUBE, BOTTOM CONNECTED. GAUGES SHALL BE SOLID FRONT TYPE DESIGNED FOR BACK BLOW OUT. GAUGES SHALL BE EQUAL TO DRESSER/ASHCROFT NO. 1379 WITH ACCURACY OF 1/2 PERCENT OF FULL SCALE. RANGE SHALL BE AS NOTED ON THE DRAWINGS. GAUGES SHALL BE CONNECTED WITH 1/2 INCH NEEDLE VALVE, BRASS, RATED 400 PSIG WOG AND EQUAL TO CRANE FIG. 88, OR 89. ALL GAUGES SHALL BE CONNECTED TO PIPING WITH 1/2" SCHEDULE 80 PIPE AND 300 LB. STD. MALLEABLE IRON SCREWED FITTINGS.

---NEOPRENE PIPE CLOSURES

THESE SHALL BE PROVIDED WHERE NOTED ON THE DRAWINGS FOR THE CLOSURE OF ABANDONED PIPING REMAINING AFTER NEW INTERCONNECTIONS. CLOSURES SHALL BE OF PLIABLE SHEET NEOPRENE NOT LESS THAN 1/8 INCH THICK ATTACHED TO THE CIRCUMFERENCE OF THE PIPE END WITH 1/2 INCH WIDE STAINLESS STEEL STRAP TENSIONED BY TOOL EQUAL TO BAND-IT, OR EQUAL ADJUSTABLE HOSE CLAMP WITH SCREW TENSIONING DEVICE. EXCESS NEOPRENE SHALL BE TRIMMED FOLLOWING BANDING; OR, CLOSURES MAY BE NEOPRENE CAPS (AVAILABLE UNDER THE TRADE NAME "JIM-CAP" AS MANUFACTURED BY THE JIM-CAP COMPANY) FOR SMALLER SIZE PIPES.

---PIPE FLANGES

FOR PIPE SIZES THROUGH 24 INCH O.D., FLANGES SHALL BE FORGED STEEL WITH BORE TO MATCH PIPE INSIDE DIAMETER, CARBON STEEL CONFORMING TO ANSI B16.5 AND ASTM A181-GRADE 1, WELD NECK PATTERN WITH SERRATED FACE UNLESS OTHERWISE NOTED ON THE DRAWINGS, ANSI 150 POUND CLASS EXCEPT AS NOTED FOR HIGHER PRESSURE RATING ON THE DRAWINGS. FLANGES USED IN GALVANIZED PIPE SYSTEM SHALL BE GALVANIZED. LARGER FLANGES SHALL BE TO MSS-SP44 STANDARD, PRESSURE CLASS AS NOTED.

---PIPING INSTALLATION---

---GENERAL

ALL PIPING SHALL BE INSTALLED AS SHOWN ON THE DRAWINGS. WHERE DETAILED DIMENSIONS ARE NOT GIVEN, THE CONTRACTOR SHALL "FIELD RUN" THE PIPING IN A NEAT AND SUBSTANTIAL MANNER. ANY FIELD RUN PIPE CONTACTING INSULATION ON OTHER PIPING OR DUCTWORK, PIPE, EQUIPMENT, STEEL WORK, ETC., SHALL BE CAUSE FOR THE CONTRACTOR TO REMOVE AND REROUTE SAID FIELD RUN PIPE(S) AT NO ADDITIONAL COST TO THE GOVERNMENT. NO PIPING SHALL BE RUN IN SUCH A MANNER AS TO BLOCK ACCESS. WHERE ANY PIPE CONFLICTS WITH OTHER WORK, RESOLUTION SHALL BE MADE BY THE CONTRACTING OFFICER PRIOR TO ROUTING OF PIPE(S).

THRUST BLOCKS SHALL BE PROVIDED AS DETAILED TO ABSORB HYDRAULIC THRUST AT CAPS, VALVES, AND AT CHANGE OF DIRECTION FITTINGS, FOR ALL NEW AND REWORKED UNDERGROUND PIPING.

THRUST BLOCKS SHALL BE 3000 PSI CONCRETE PLACED AGAINST UNDISTURBED SOIL WITH AN AREA SUFFICIENT TO PROVIDE LOAD TRANSMITTAL AS SHOWN ON THE DRAWINGS.

HYDROSTATIC TESTING SHALL NOT TAKE PLACE UNTIL CONCRETE HAS CURED AT LEAST 7 DAYS.

PIPING SYSTEMS SHALL BE FABRICATED AND INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE FOLLOWING CODES AND STANDARDS EXCEPT AS SUPPLEMENTED AND MODIFIED BY THESE SPECIFICATIONS.

ANSI B31.1 - 1973 CODE FOR POWER PIPING.

SECTION 17B - WELDING FOR LOW PRESSURE WATER PIPING SYSTEMS OF THE SPECIFICATIONS.

THE PROVISIONS OF REFERENCED CODES AND STANDARDS SHALL CONSTITUTE MINIMUM REQUIREMENTS FOR SYSTEM MATERIALS, INSTALLATION AND WORKMANSHIP. WHERE THE DRAWINGS AND SPECIFICATION REQUIRE BETTER MATERIALS AND METHODS OF INSTALLATION THAN THE MINIMUM REQUIREMENTS SET FORTH IN THE CODE OR STANDARD, THE DRAWINGS AND SPECIFICATIONS SHALL SUPERSEDE CODE AND STANDARDS REQUIREMENTS. WHERE CONTRACTOR PROPOSES TO DEVIATE FROM SPECIFIED INSTRUCTIONS, THE PROPOSED DEVIATION SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL IN WRITING TOGETHER WITH CREDIT TO GOVERNMENT FOR SUCH DEVIATION.

PIPE SHALL BE CAREFULLY WORKED INTO PLACE WITHOUT SPRINGING OR FORCING. ADEQUATE PROVISION SHALL BE MADE FOR ABSORBING ALL EXPANSION AND CONTRACTION WITHOUT UNDUE STRESS IN ANY PART OF THE SYSTEM.

ALL PIPE, FITTINGS, VALVES, EQUIPMENT AND ACCESSORIES SHALL BE CLEAN AND FREE OF ALL EXTRANEOUS FOREIGN MATERIAL BEFORE BEING INSTALLED INTO THEIR RESPECTIVE SYSTEMS. PIPE SHALL BE CLEANED BY HAMMERING, SHAKING, SWABBING, AND FLUSHING. IMMEDIATELY PRIOR TO ERECTION ALL PIPING SHALL BE CHECKED FOR CLEANLINESS AND, IF FOUND OTHERWISE, SHALL BE THOROUGHLY CLEANED BY POUNDING AND THE PASSING OF HIGH VELOCITY AIR OR VACUUMING. AFTER PRESSURE TESTING AND COATING, ALL PIPING SHALL HAVE INTERIOR HOSED DOWN AND DISCHARGED TO WASTE. THE CONTRACTOR SHALL PROVIDE ALL MATERIAL AND LABOR FOR THE ABOVE AND FOR THE BREAKING AND REBOLTING OF FLANGES, AND SHALL PROVIDE ANY TEMPORARY WASTE PIPING REQUIRED FOR SAID CLEANING OPERATIONS. ALL FINAL CLEANING SHALL BE WITNESSED BY THE CONTRACTING OFFICER. DURING THE PROGRESS OF CONSTRUCTION, OPEN ENDS OF PIPE, FITTINGS, AND VALVES SHALL BE PROPERLY PROTECTED AT ALL TIMES BY PLUGS, OR CLOSURES TO PREVENT FOREIGN SUBSTANCES OR ANIMAL LIFE FROM ENTERING PIPES.

PIPING SHALL BE INSTALLED STRAIGHT AND TRUE WITH APPROVED OFFSETS AROUND OBSTRUCTIONS AS MAY BE NECESSARY TO INCREASE HEADROOM OR TO AVOID INTERFERENCE WITH CONSTRUCTION, ELECTRIC CONDUIT OR EQUIPMENT, AND AS APPROVED BY THE CONTRACTING OFFICER.

UNLESS OTHERWISE NOTED, STANDARD LONG SWEEP PIPE FITTINGS SHALL BE USED FOR CHANGES IN DIRECTION. NO MITERED JOINTS OR UNAPPROVED PIPE BENDS WILL BE PERMITTED, UNLESS INDICATED ON THE DRAWINGS.

TEE CONNECTIONS SHALL BE MADE WITH TEE FITTINGS, OR WHERE PIPE IS BEING WELDED, BRANCH CONNECTIONS MAY BE MADE WITH BRANCH OUTLET FITTINGS IF NOTED ON DRAWINGS. BRANCH OUTLET FITTINGS, WHERE USED, SHALL BE REINFORCED AGAINST EXTERNAL STRAINS AND DESIGNED TO WITHSTAND FULL PIPE-BURSTING STRENGTH REQUIREMENTS IN ACCORDANCE WITH ANSI B31.1, OR OTHERWISE IF SO DETAILED.

---JOINTS

REAM ALL PIPE ENDS BEFORE JOINT CONNECTIONS ARE MADE IN THREADED PIPING SYSTEMS.

SCREWED JOINTS SHALL BE MADE UP WITH TEFLON TAPE OR 100% TEFLON DISPERSION COMPOUND.

JOINT COMPOUNDS SHALL BE APPLIED TO THE MALE THREAD ONLY, AND CARE SHALL BE EXERCISED TO PREVENT IT FROM REACHING THE INTERIOR OF THE PIPE.

SCREWED UNIONS, WELDED UNIONS OR BOLTED FLANGES SHALL BE PROVIDED WHEREVER REQUIRED TO PERMIT CONVENIENT, MAINTENANCE-WISE REMOVAL OF EQUIPMENT, VALVES AND PIPING ACCESSORIES FROM THE PIPING SYSTEM.

WELDED JOINTS SHALL CONFORM TO SECTION 17B "WELDING FOR LOW PRESSURE WATER PIPING SYSTEMS".

FLANGED JOINTS SHALL BE ASSEMBLED WITH APPROPRIATE FLANGES, GASKETS, AND BOLTING. THE CLEARANCE BETWEEN FLANGE FACES SHALL BE SUCH THAT THE CONNECTIONS CAN BE GASKETED AND BOLTED TIGHT WITHOUT IMPOSING UNDUE STRAIN ON THE PIPING SYSTEM. FLANGE FACES SHALL BE PARALLEL AND THE BORES CONCENTRIC; GASKETS SHALL BE CENTERED ON THE FLANGE FACES WITHOUT PROJECTING INTO THE BORE. BOLTING SHALL BE LUBRICATED WITH OIL AND GRAPHITE BEFORE ASSEMBLY TO INSURE UNIFORM BOLT STRESSING. THE FLANGE BOLTS SHALL BE DRAWN UP AND TIGHTENED IN STAGGERED SEQUENCE IN ORDER TO PREVENT UNEQUAL GASKET COMPRESSION AND DEFORMATION OF THE FLANGES. WHEREVER A FLANGE WITH A RAISED FACE IS JOINED TO A COMPANION FLANGE WITH A FLAT FACE, THE RAISED FACE SHALL BE MACHINED DOWN TO A FLAT SERRATED SURFACE AND A FULL FACE GASKET SHALL BE USED. ONLY HEX HEAD NUTS AND BOLTS SHALL BE ACCEPTABLE. ALL CAST IRON FLANGES SHALL HAVE FULL-FACE GASKETS. COMPLY WITH SECTION 16X (PART 51) REGARDING BONDING AND GROUNDING ACROSS FLANGED JOINTS.

---SUPPORTING ELEMENTS INSTALLATION

SUPPORTING ELEMENTS SHALL BE PROVIDED IN ACCORDANCE WITH THE REFERENCED CODES, STANDARDS AND REQUIREMENTS SPECIFIED HEREIN, AND SHOWN ON THE DRAWINGS.

PIPING SHALL BE HUNG FROM THE STRUCTURE. NO PIPING SHALL BE HUNG FROM OTHER PIPE.

PIPING HANGERS, SUPPORTS, ANCHORS AND GUIDES SHALL BE PROVIDED BY THE CONTRACTOR. WHERE DETAILED ON THE DRAWINGS THESE ITEMS SHALL BE PROVIDED BY THE CONTRACTOR AS DETAILED.

ALL SUPPORTS AND PARTS SHALL CONFORM TO THE REQUIREMENTS OF ANSI CODE FOR POWER PIPING B31.1-1973, EXCEPT AS MODIFIED AND SUPPLEMENTED BY THE REQUIREMENTS SET FORTH IN THIS SPECIFICATION AND RELATED DRAWINGS, AND SHALL BE SUBJECT TO APPROVAL BY THE CONTRACTING OFFICER.

CONVENTIONAL STANDARD STOCK OR PRODUCTION PARTS, SHALL BE UTILIZED WHEREVER POSSIBLE.

RIGID HANGERS SHALL BE DESIGNED IN ACCORDANCE WITH THIS SECTION AND SHALL PROVIDE A MEANS OF VERTICAL ADJUSTMENT AFTER ERECTION. ALL PIPE SUPPORTS SHALL BE DESIGNED TO AVOID INTERFERENCES WITH INSULATION, OTHER PIPING, HANGERS, ELECTRICAL CONDUITS AND SUPPORTS, STRUCTURES AND EQUIPMENT. ALL NUTS ON RODS AND CLAMPS SHALL BE OF THE SELF-LOCKING TYPE, OR SHALL HAVE LOCK-WASHERS, OR SHALL HAVE JAM NUTS AND SHALL BE TORQUED TIGHT. HANGER RODS SHALL NOT AT ANY TIME BE SUBJECTED TO BENDING OR STRESSES OTHER THAN TENSION. HANGERS AT LOCATIONS WHERE LATERAL OR AXIAL MOVEMENT IS ANTICIPATED SHALL BE PROVIDED WITH SUITABLE LINKAGE TO PERMIT SWING. HANGERS SHALL BE DESIGNED FABRICATED AND ASSEMBLED IN SUCH MANNER SO THAT THEY CANNOT BECOME DISENGAGED BY ANY MOVEMENT OF THE SUPPORTED PIPE. HANGERS SHALL BE SPACED AS FAR APART AS ECONOMICALLY POSSIBLE, WITH DUE CONSIDERATION TO INSURE THAT THE SAG OF THE LINE BETWEEN SUPPORTS IS WITHIN LIMITS THAT WILL PERMIT DRAINAGE AND ALSO AVOID EXCESSIVE BENDING STRESSES FROM CONCENTRATED LOADS. IN NO INSTANCE SHALL THE DEFLECTION OF THE PIPE BETWEEN SUPPORTS EXCEED 0.10 INCH. SHIELDS SHALL BE PROVIDED TO PROTECT INSULATION.

ALL PIPING SHALL RUN PARALLEL TO STRUCTURAL STEEL. UNLESS OTHERWISE INDICATED, PIPING AND COMPONENTS SHALL BE SPACED AND INSTALLED SO THAT A THREADED PIPE FITTING MAY BE REMOVED BETWEEN ADJACENT PIPES AND SO THAT THERE WILL BE NOT LESS THAN 1/2 INCH OF CLEAR SPACE BETWEEN THE FINISHED SURFACE AND OTHER WORK AND BETWEEN THE FINISHED SURFACE OF PARALLEL ADJACENT PIPING. HANGERS ON DIFFERENT ADJACENT SERVICE LINES RUNNING PARALLEL WITH EACH OTHER SHALL BE ARRANGED TO BE IN LINE WITH EACH OTHER AND PARALLEL TO THE LINES OF THE STRUCTURAL STEEL.

PIPE HANGERS LOCATED AT POINTS SUBJECT TO VERTICAL MOVEMENT SHALL BE OF VARIABLE SPRING DESIGN. PIPE ANCHORS SHALL BE INCORPORATED INTO PIPING SYSTEMS TO MAINTAIN NECESSARY PERMANENT PIPE POSITIONS.

---TESTING OF PIPING SYSTEMS---

---GENERAL

PRIOR TO ACCEPTANCE OF THE WORK, TEST ALL COMPLETED SYSTEMS IN THE PRESENCE OF THE CONTRACTING OFFICER.

ALL PRESSURE TESTS SPECIFIED HEREIN SHALL BE MADE PRIOR TO CONCEALMENT OF PIPING. THE TIME AND DATE OF TEST SHALL BE APPROVED BY THE CONTRACTING OFFICER. TESTS SHALL BE MADE IN THE PRESENCE OF THE CONTRACTING OFFICER, OR HIS DULY AUTHORIZED TECHNICAL REPRESENTATIVE. A PROPOSED TEST SCHEDULE AND ACTUAL FIELD TEST PROCEDURE SHALL BE SUBMITTED FOR APPROVAL PRIOR TO THE ACTUAL TEST. ALL TEST PROCEDURES SHALL BE ESSENTIALLY AS SPECIFIED HEREIN UNLESS JOB CONDITIONS REQUIRE A MODIFICATION TO THE METHOD OF PERFORMING THE TEST; HOWEVER, ANY CHANGES SHALL HAVE PRIOR APPROVAL OF THE CONTRACTING OFFICER. IN NO CASE WILL REDUCTIONS OF THE TEST PRESSURES BE PERMITTED.

TEST PRESSURES SHALL BE AS HEREINAFTER SPECIFIED FOR THE RESPECTIVE PIPING SYSTEMS.

ONLY EXPERIENCED PERSONNEL OF THE CONTRACTOR SHALL CONDUCT THE TESTS. ALL HYDRAULIC PRESSURE TESTS SHALL BE MADE WITH CLEAN WATER. ALL MATERIAL, LABOR, TEST CONNECTIONS, GAUGES AND TEST EQUIPMENT SHALL BE FURNISHED BY THE CONTRACTOR WITHOUT ADDITIONAL COST TO THE GOVERNMENT. UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER, ALL TEMPORARY TEST CONNECTIONS, MATERIALS OR EQUIPMENT SHALL BE REMOVED FROM THE PERMANENT SYSTEM FOLLOWING FINAL TESTING.

---TEST DURATION

THE DURATION OF A TEST WILL BE DETERMINED BY THE CONTRACTING OFFICER.

A PRESSURE TEST SHALL BE HELD FOR A MINIMUM OF ONE (1) HOUR.

AN OPERATIONAL FLOW TEST SHALL BE ACCOMPLISHED AS HEREINAFTER OUTLINED.

THE TEST MAY BE TERMINATED BY DIRECTION OF CONTRACTING OFFICER AT ANY POINT AFTER IT HAS BEEN DETERMINED THAT THE SYSTEM COMPLIES WITH SPECIFIED REQUIREMENTS.

---TEST GAUGES

CONTRACTOR'S TEST GAUGES SHALL CONFORM TO ANSI B40.1-1974 AND SHALL HAVE A DIAL SIZE 6 INCHES OR LARGER. MAXIMUM PERMISSIBLE SCALE RANGE FOR A GIVEN TEST SHALL BE SUCH THAT THE POINTER DURING A TEST SHALL HAVE A STARTING POSITION AT MID-POINT OF THE DIAL OR WITHIN THE MIDDLE THIRD OF THE SCALE RANGE. CERTIFICATION OF ACCURACY AND CORRECTION TABLE SHALL BEAR A DATE WITHIN 90 DAYS OF THE TEST USE, TEST GAUGE NUMBER, AND THE PROJECT NUMBER, UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

---ACCEPTANCE PRESSURE TESTING

TESTING SHALL TAKE PLACE DURING STEADY STATE AMBIENT TEMPERATURE CONDITIONS APPROXIMATELY, AND PRIOR TO FIELD TOUCH-UP OF COATING AND LINING AT WELDS.

TESTS SHALL BE HYDROSTATIC (UNLESS OTHERWISE NOTED FOR AIR DUCTS).

TEST PRESSURES SHALL BE AS HEREINAFTER SPECIFIED FOR THE PARTICULAR SYSTEMS. PORTIONS OF THE SYSTEM MAY BE TESTED IN SECTIONS WHERE REQUIRED TO ALLOW OTHER PHASES OF THE WORK TO PROCEED. THE FULL TEST PRESSURE SHALL BE PLACED ON THE SYSTEM AT LEAST 15 MINUTES PRIOR TO THE TEST. VENTS, PLUGS OR VALVES SHALL BE PROVIDED AT HIGH POINTS TO BLEED TRAPPED AIR AND INSURE AN AIR-FREE, SOLID HYDROSTATIC TEST. DURING THE TEST PERIOD ALL JOINTS AND CONNECTIONS SHALL BE INSPECTED FOR LEAKS. FOLLOWING THE REPAIR OF ALL LEAKS, THE PRESSURE TEST PERIOD SHALL AGAIN COMMENCE.

HYDROSTATIC TESTS OF SYSTEMS (NEW PLUS PORTION OF EXISTING TO WHICH NEW CONNECTIONS HAVE BEEN MADE) SHALL BE MADE WITH WATER AVAILABLE FROM THE GOVERNMENT. CONTRACTOR SHALL PROVIDE ALL PIPING AND EQUIPMENT FOR HYDROSTATIC TESTING.
SYSTEMS SHALL BE TESTED AT THE HEREIN SPECIFIED PRESSURES AND THE APPLIED PRESSURE SHALL BE MAINTAINED WITHOUT FURTHER ADDITION OF TEST MEDIA FOR NOT LESS THAN 1 HOUR. THE MAXIMUM ALLOWABLE PRESSURE DROP SHALL BE 5 PSI, OR AS APPROVED BY THE CONTRACTING OFFICER, WITHOUT LEAKS AT JOINTS.

THE CONTRACTOR MAY CONDUCT TESTS FOR HIS OWN PURPOSES, BUT THE ACCEPTANCE TEST SHALL BE CONDUCTED AS SPECIFIED HEREIN.

IN THE EVENT THAT TESTING DEMONSTRATES THAT LEAKAGE RATE EXCEEDS SPECIFIED LIMITS, DETERMINE THE SOURCE(S) OF LEAKAGE, REPAIR OR REPLACE DEFECTIVE MATERIALS AND WORKMANSHIP, AND RETEST THE INSTALLATION UNTIL SPECIFIED REQUIREMENTS ARE COMPLIED WITH. LEAKING GASKET JOINTS SHALL BE REMADE WITH NEW GASKETS, NEW FLANGE BOLTING, AND OLD BOLTING SHALL BE DESTROYED.

OTHER THAN STANDARD PIPING FLANGES, PLUGS, CAPS AND VALVES, ONLY COMMERCIALLY MANUFACTURED EXPANDABLE ELASTOMER PLUGS SHALL BE USED FOR SEALING OFF PIPING FOR TEST PURPOSES. THE SAFE TEST PRESSURE RATING OF ANY PLUG USED SHALL BE NOT LESS THAN TWO TIMES THE ACTUAL TEST PRESSURE BEING APPLIED.

TAKE ALL NECESSARY PRECAUTIONS TO VENT THE EXPANSIVE FORCE OF COMPRESSED AIR TRAPPED DURING HIGH PRESSURE HYDROSTATIC TESTING TO PRECLUDE INJURY AND DAMAGE. THE CONTRACTING OFFICER MAY REQUIRE THE REMOVAL OF ANY SYSTEM COMPONENT SUCH AS PLUGS AND CAPS TO ASCERTAIN WHETHER OR NOT THE WATER HAS REACHED ALL PARTS OF THE SYSTEM IF ADEQUATE PURGING OR VENT VALVES ARE NOT PROVIDED TO ASSURE REMOVAL OF COMPRESSED AIR CUSHION.

COMPONENTS SHALL BE REMOVED FROM PIPING SYSTEMS DURING HYDROSTATIC TESTING WHENEVER THE COMPONENT MAY SUSTAIN DAMAGE DUE TO SHOCK OR TEST PRESSURE.

PIPING SYSTEM COMPONENTS SUCH AS VALVES SHALL BE CHECKED FOR FUNCTIONAL OPERATION UNDER SYSTEM TEST PRESSURE, WHERE PRACTICABLE.

PIPING SHALL BE SUBJECTED TO SHOCK DEVELOPED BY A VIGOROUSLY APPLIED 2-POUND HAMMER AT 18" O.C. ALONG ALL FIELD WELDS AND AT OTHER LOCATIONS AS DIRECTED BY THE CONTRACTING OFFICER.

TEMPERATURE OF WATER USED FOR TESTING SHALL NOT CAUSE CONDENSATION OF ATMOSPHERIC MOISTURE ON SYSTEM SURFACES; OR IF SUCH OCCURS, TEST SHALL COMMENCE AFTER EVAPORATION.

AT THE COMPLETION OF THE PRESSURE TESTS, ALL PARTS OF THE INSTALLATION SHALL BE THOROUGHLY CLEANED, INTERNALLY AND EXTERNALLY. ALL EQUIPMENT, PIPE, VALVES, AND FITTINGS SHALL BE CLEANED FREE OF GREASE, METAL CUTTINGS, AND SLUDGE BY FILLING AND FLUSHING THE SYSTEMS UNTIL CLEAN IN THE PRESENCE OF THE CONTRACTING OFFICER. ANY STOPPAGE OR DISCOLORATION OR DAMAGE TO PARTS OF THE STRUCTURE, ITS FINISH OR FURNISHINGS, DUE TO THE CONTRACTOR'S FAILURE TO PROPERLY PERFORM HIS CLEANING OPERATIONS SHALL BE REPAIRED BY THE CONTRACTOR WITHOUT ADDITIONAL COST TO THE GOVERNMENT.

---COMPRESSED AIR PIPING TEST

COMPRESSED AIR OR NITROGEN SHALL BE USED TO PROVIDE TEST PRESSURE AS HEREIN SPECIFIED. TEST PRESSURE SHALL BE MAINTAINED FOR A MINIMUM OF ONE HOUR WITH A MINIMUM VARIATION OF 5 PSI. SOAP ALL JOINTS AND CHECK FOR LEAKS.

---OPERATIONAL FLOW TESTING

THE GOVERNMENT WILL PROVIDE PRESSURIZED WATER FOR THE TESTING OF ALL SYSTEMS. CONTRACTOR'S RESPONSIBILITY SHALL BE TO MAKE-UP ALL CONNECTIONS NECESSARY FOR ALL TESTS, PROVE THAT ALL EQUIPMENT AND WORK FURNISHED BY HIM FUNCTIONS AS SPECIFIED, AND IN GENERAL TO FURNISH ALL LABOR AND MATERIAL NECESSARY FOR THE ABOVE AND FOR ANY REWORK, OR REPLACEMENT, OF DEFECTIVE WORK. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR CLEAN-UP AND ANY PIPING DISCONNECTIONS REQUIRED FOLLOWING THE OPERATIONAL TESTS. SEE SECTION 18A.

---TEST RECORDS

PREPARE AND MAINTAIN TEST RECORDS OF ALL SYSTEMS TESTS. RECORDS SHALL SHOW GOVERNMENTAL AND CONTRACTOR TEST PERSONNEL RESPONSIBILITIES, DATES, TEST GAUGE IDENTIFICATION NUMBERS, PRESSURE RANGES, RATES OF PRESSURE DROP, ANY LEAKAGE, AND OTHER SYSTEM CHARACTERISTICS. TEST RECORD SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL.

---TEST PRESSURES

ALL SYSTEMS, UNLESS OTHERWISE NOTED, SHALL BE PRESSURE TESTED WITH CLEAN, POTABLE WATER:

FLUID SYSTEM	PRESSURE (PSIG UNLESS NOTED) OPERATING	TESTING
PUMP P-1 & P-2, 8" FIREX BELOW PAD, FIREX ON SSAT, FIREX IN VALVE PIT	300	450
PAD FIRE HYDRANTS	140	200
COMPRESSED AIR	250	375
POTABLE WATER SYSTEMS (PAD-TO-SSAT)	300	450
POTABLE WATER SYSTEM TO HYPERGOLIC FACILITIES AND COMPRESSED AIR BLDG.	60	100
UNDERGROUND PIPING AT SSAT FOUNDATIONS:		
6" CHILLED WATER	60	150
26" DEHUMIDIFIED AIR	8" W.G.	5 PSIG AIR (OR MAX. BLOWER W/SMOKE)
2" SUMP PUMP DISCHARGE	FULL PIPE	FULL PIPE
6" C.I. DRAIN	FULL PIPE	FULL PIPE
6" C.I. SANITARY SEWER	FULL PIPE	FULL PIPE
PAD FLUSH NOZZLES	115	200
SAFEWASTE ON SSAT	FULL PIPE	FULL PIPE
CHILLED WATER	60	150
OTHER NEW PIPING SYSTEMS	PSIG	1.5 X PSIG

---STERILIZATION

THE COMPLETE NEW POTABLE WATER SYSTEMS, INCLUDING PORTIONS OF EXISTING SYSTEMS TO WHICH NEW CONNECTIONS HAVE BEEN MADE, SHALL BE STERILIZED WITH CHLORINE SOLUTION PRIOR TO SYSTEM ACCEPTANCE.

THE CONTRACTOR SHALL PROVIDE ALL NECESSARY CHLORINE AND ALL MATERIALS AND LABOR TO CHLORINATE THE SYSTEM AND TO SET-UP AND PERFORM THE TESTS.

CHLORINE SOLUTION SHALL CONTAIN NOT LESS THAN 50 PARTS PER MILLION (PPM) OF AVAILABLE CHLORINE.

CHLORINATING MATERIAL SHALL BE COMMERCIAL LAUNDRY BLEACH WITH MINIMUM 5.25 PERCENT AVAILABLE CHLORINE. BLEACH SHALL BE ADDED IN THE RATIO OF 1/8-OUNCE OF BLEACH PER GALLON OF WATER IN SYSTEM TO OBTAIN REQUIRED 50 PPM AT TIME OF FILLING.

THE FOLLOWING PROCEDURE SHALL BE FOLLOWED IN APPLYING BLEACH TO THE PIPING:

THE PROPER AMOUNT OF BLEACH SHALL BE ADDED SIMULTANEOUSLY TO EACH SECTION OF LINE AS IT IS BEING FILLED WITH WATER FROM A POTABLE SOURCE.

SYSTEM STERILIZED SHALL STAND FOR A MINIMUM OF 24-HOURS DURING WHICH TIME CARE SHALL BE EXERCISED TO PRECLUDE DUMPING OR DILUTION OF CONTENTS.

STERILIZING SOLUTION SHALL PRODUCE NO LESS THAN 10 PPM CHLORINE RESIDUAL AT EXTREME END OF LINE AT THE END OF THE RETENTION PERIOD.

AFTER 24-HOURS, THE STERILIZING SOLUTION SHALL BE FLUSHED OUT UNTIL THE CHLORINE CONTENT IS LESS THAN 1 PPM.

THE LINE SHALL BE ALLOWED TO STAND AN ADDITIONAL 24 HOURS; IF THERE IS A CHLORINE RESIDUAL, A BACTERIOLOGICAL COUNT WILL BE MADE BY THE CONTRACTOR AND IF THE COUNT IS WITHIN UNITED STATES PUBLIC HEALTH SERVICE RECOMMENDATIONS, PIPING MAY BE PUT INTO SERVICE.

THE CONTRACTOR SHALL PROVIDE AT LEAST THREE SAMPLES FOR BACTERIOLOGICAL TESTING BY THE GOVERNMENT AT THE END OF 7 DAYS AND AT THE END OF 21 DAYS AFTER THE DISTRIBUTION SYSTEM HAS BEEN PUT INTO SERVICE.

THE STERILIZATION PROCESS SHALL BE REPEATED UNTIL SPECIFIED RESULTS ARE OBTAINED.

ALL PIPES, TANKS, VALVES, COCKS, FITTINGS, HOSES, CONTAINERS AND MISCELLANEOUS ITEMS USED FOR CONNECTION OF NEW PIPING TO THE EXISTING PIPING SYSTEM SHALL BE STERILIZED.

AFTER COMPLETION OF STERILIZATION AND APPROVAL OF TESTS, PIPING SHALL BE FILLED WITH CLEAN POTABLE WATER AS SPECIFIED IN SECTION 18A.

---PAINTING AND FINISHING---

---GENERAL

ALL WORK SHALL COMPLY WITH THE REQUIREMENTS OF SECTION 9A OF THE SPECIFICATIONS ENTITLED, "PAINTING AND FINISHING." FINAL PAINTING SHALL BE ACCOMPLISHED ONLY AFTER COMPLETION OF THE HYDROSTATIC TEST. UNDERGROUND PIPING, BOLTING AND SPECIALTIES SHALL HAVE A COAL-TAR COATING AS SPECIFIED. THE SYSTEMS SHALL RECEIVE A TOTAL OF AT LEAST 1 COAT OF PAINT, INCLUDING THE SHOP COAT AND/OR GALVANIZING, WHICH SHALL BE TOUCHED-UP AT ALL WELDS AND OTHER AREAS WHERE THE COATING HAS BEEN DAMAGED. GALVANIZED PIPING AND EQUIPMENT SHALL HAVE AN INITIAL PRIMER AS SPECIFIED TO IMPROVE ADHESION. SYSTEMS SHALL BE PAINTED COMPLETE INCLUDING ALL VALVES, TRAPS, STRAINERS, AND SPECIALTIES. INORGANIC ZINC-RICH SHALL BE SINGLE COAT WITH TOUCH-UP AS HEREINAFTER SPECIFIED.

---FINAL COLOR COAT

FINAL COLOR COAT SHALL BE AS SPECIFIED IN SECTION 13L - "COLOR FINISH SCHEDULE AND PIPING IDENTIFICATION."

---TOUCH-UP OF CUT THREADS AND WELDS PRIOR TO PAINTING

THREADS SHALL BE CLEANED AND WELDS POWER TOOL CLEANED AND COATED WITH ORGANIC ZINC-RICH COATING, ALL AS SPECIFIED IN SECTION 9L - "PROTECTIVE COATING OF CARBON STEEL." THREADS OF UNDERGROUND PIPING SHALL BE CLEANED AND COATED WITH SPECIFIED COAL-TAR AS SHALL BE THE PIPING.

---HANGERS, SUPPORTS, ANCHORS AND SUPPLEMENTARY STEEL

THESE ITEMS SHALL ALL BE PAINTED AS SPECIFIED IN SECTION 9A - "PAINTING AND FINISHING." CLAMPS CONTACTING ALUMINUM SHALL BE NEOPRENE COATED.

---CHILLED WATER PIPING SYSTEMS

CHILLED WATER SUPPLY AND RETURN PIPING SHALL BE COAL-TAR COATED AS SPECIFIED HREINABOVE.

---TIE-INS TO EXISTING PIPING---

---GENERAL

ALL OUTAGES OF EXISTING PIPING SYSTEMS SHALL BE SCHEDULED AND SUBMITTED TO CONTRACTING OFFICER FOR PRIOR APPROVAL AS OUTLINED IN THE "CONTRACT SCHEDULE."

---POTABLE WATER SYSTEMS

TIE-INS AND REROUTING IN THE AREA OF THE NEW ELEVATED WATER TANK AND MAIN VALVE STATION AREAS SHALL BE SCHEDULED FOR MINIMUM OUTAGE OF THE EXISTING SYSTEM. OUTAGE SHALL BE ON A DIFFERENT DAY THAN OUTAGE FOR WORK IN THE PAD WATER PIT AREA. OUTAGE TIME AT NEW TANK AREA SHALL NOT EXCEED TWO CONSECUTIVE WORKING DAYS, AND OUTAGE TIME AT PAD WATER PIT SHALL NOT EXCEED ONE WORKING DAY. STERILIZE ALL NEW WORK AS HEREINABOVE SPECIFIED.

---VERIFICATION OF EXISTING WORK---

---GENERAL

PRIOR TO CONSTRUCTION AND SUBMITTAL OF SHOP DRAWINGS, CONTRACTOR SHALL VERIFY ALL PIPE, MATERIALS, AND FLANGE SIZES AND RATINGS TO AVOID COSTLY TIME DELAYS AND RESCHEDULING OF OUTAGES FOR REWORK AND TIE-INS TO EXISTING SYSTEMS.

SECTION 15P

FIRE PROTECTION SYSTEMS

---GENERAL REQUIREMENTS---

---GENERAL

THIS SECTION COVERS WORK FOR THE TWO HYPERGOLIC FACILITIES. THIS SECTION ALSO COVERS THE AUTOMATIC FOGGING SYSTEM FOR THE GO_2 STORAGE TANKS; FIRE HYDRANTS AND PIPING FOR LAUNCH PAD 39B; AND HOSE STATIONS AND FOGGING SYSTEMS ON THE SSAT. ALL WORK SHALL BE ACCOMPLISHED AS SHOWN ON THE DRAWINGS AND AS SPECIFIED HEREIN.

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWWA	AMERICAN WATER WORKS ASSOCIATION
AWS	AMERICAN WELDING SOCIETY
USDC	UNITED STATES DEPARTMENT OF COMMERCE (COMMERCIAL STANDARDS)
FM	FACTORY MUTUAL
FS	FEDERAL SPECIFICATIONS
MSS	MANUFACTURERS STANDARDIZATION SOCIETY
NEC	NATIONAL ELECTRICAL CODE
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
SSPC	STEEL STRUCTURES PAINTING COUNCIL
UL	UNDERWRITERS' LABORATORIES, INC.
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
MIL	MILITARY SPECIFICATIONS

COMMONLY USED TERMS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AWG	AMERICAN WIRE GAGE
BPM	BLOWS PER MINUTE
I.D.	INSIDE DIAMETER
IPS	IRON PIPE SIZE
O.D.	OUTSIDE DIAMETER

PIV	POST INDICATOR VALVE
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH GAGE
USS	UNITED STATES STANDARD
WSP	WORKING STEAM PRESSURE

---EXCAVATION, FILL, BACKFILL AND COMPACTION

EARTHWORK SHALL BE IN ACCORDANCE WITH SECTIONS 2D AND 2E OF THESE SPECIFICATIONS. PIPE BEDDING IN TRENCHES SHALL BE AS HEREINAFTER SPECIFIED.

---CONCRETE

CONCRETE SHALL COMPLY WITH SECTION 3A OF THESE SPECIFICATIONS.

---WELDING

PIPE WELDING SHALL COMPLY WITH SECTION 17B. WELD OF OTHER STEEL SHALL COMPLY WITH SECTION 17K.

---EXISTING UTILITIES

BEFORE STARTING MECHANICAL EARTHWORK OPERATIONS, CAREFUL HAND METHODS SHALL BE USED TO VERIFY THE LOCATION OF UNDERGROUND UTILITIES UNDER THE DIRECTION OF THE CONTRACTING OFFICER. UTILITIES TO BE LEFT IN PLACE SHALL BE PROTECTED AGAINST DAMAGE TO THE SATISFACTION OF THE CONTRACTING OFFICER.

---CONSTRUCTION MATERIALS AND EQUIPMENT APPROVAL

GENERAL

FIRE PROTECTION SYSTEM MATERIALS AND EQUIPMENT PROVIDED UNDER THIS SECTION SHALL CONFORM TO THE REQUIREMENTS OF UNDERWRITERS' LABORATORIES INC. (UL) OR THE FACTORY MUTUAL (FM) LABORATORIES.

PRODUCTS WITH UL LABEL OR SEAL, OR LISTING IN THE JANUARY *1978* UL "FIRE PROTECTION EQUIPMENT *DIRECTORY* AND SUPPLEMENT CURRENT AT THE END OF THE BIDDING PERIOD, AND PRODUCTS WITH FM LABEL OR LISTING IN THE "FACTORY MUTUAL APPROVAL GUIDE *1977* ARE ACCEPTABLE FIRE PROTECTION SYSTEM MATERIALS AND EQUIPMENT. MATERIALS AND EQUIPMENT FURNISHED SHALL BE COMPATIBLE WITH EXISTING SYSTEM. (A)

ALL OTHER CONSTRUCTION MATERIALS SUBMITTED FOR APPROVAL SHALL BE EXHIBITED IN THE MANUFACTURER'S CATALOGUE AND LITERATURE CURRENT AT THE END OF THE BIDDING PERIOD.

MATERIALS AND EQUIPMENT NOT HEREIN SPECIFIED OR INDICATED AS TO THE MANUFACTURER BUT NECESSARY FOR COMPLETE FUNCTIONING SYSTEMS, SHALL BE PROVIDED FROM SOURCES OPTIONAL TO THE CONTRACTOR AND CONFORMING TO THE QUALITY LEVELS AND FUNCTIONAL REQUIREMENTS FOR CORRESPONDING EQUIPMENT SET FORTH HEREIN. THESE ITEMS WILL BE EXCLUDED FROM THE REQUIREMENTS OF THE PARAGRAPH "PROPOSED MATERIALS LIST AND SHOP DRAWINGS" UNLESS OTHERWISE SPECIFIED.

PROPOSED MATERIALS LIST AND SHOP DRAWINGS

AS SPECIFIED UNDER "CONTRACT SCHEDULE" SECTION, SUBMIT TO THE CONTRACTING OFFICER FOR APPROVAL A COMPLETE LIST OF ITEMS PROPOSED,FOR USE IN THE PROJECT. THE LIST SHALL ENUMERATE THE MANUFACTURING SOURCE, CATALOGUED MODEL NUMBER, TRADE NAME, UL OR FM LISTING CATALOGUE PUBLICATION NUMBER.

THE LIST SHALL BE ITEM NUMBERED AND KEYED TO INDICATE ITEMS TO BE FURTHER IDENTIFIED BY EITHER: CATALOGUE CUTS ONLY, SHOP DRAWINGS, PROOFS OF COMPLIANCE ONLY.

SHOP DRAWINGS, WHICH INCLUDE CALCULATIONS, DRAWINGS OR SKETCHES, CATALOGUE DATA DESCRIPTIVE LITERATURE AND OTHER DATA NECESSARY TO COMPLETELY IDENTIFY EACH OF THE REQUIRED ITEMS, SHALL BE FURNISHED TO THE CONTRACTING OFFICER IN ACCORDANCE WITH THE SECTION ENTITLED "CONTRACT SCHEDULE" AND PROVISIONS OF APPLICABLE REFERENCED NFPA STANDARD. AT THE TIME OF APPROVAL OF THE PROPOSED MATERIALS LIST, THE CONTRACTING OFFICER MAY REQUEST SHOP DRAWINGS FOR SPECIFIC ADDITIONAL ITEMS. SHOP DRAWINGS ARE REQUIRED FOR ALL DEVIATIONS FROM SPECIFICATIONS AND DRAWINGS AND SPECIFIED CONTRACTOR OPTIONS.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR PROPOSED UNDERGROUND SYSTEM MATERIALS.

CERTIFICATES OF CONFORMANCE FOR PROPOSED ABOVEGROUND PIPING MATERIALS.

CERTIFICATES OF CONFORMANCE FOR PROPOSED FIRE PROTECTION SYSTEM COMPONENTS.

NONE OF THE PRECEDING MATERIALS SHALL BE PURCHASED, DELIVERED TO THE SITE, OR INSTALLED UNTIL APPROVAL HAS BEEN OBTAINED.

---CUTTING AND MAINTENANCE

TO AVOID UNNECESSARY CUTTING OF MASONRY OR CONCRETE SECTIONS: ALL INSERTS, ANCHORS, CHASES, OPENINGS, SET IN MASONRY OR CONCRETE, SHALL BE PROVIDED DURING CONSTRUCTION IN COOPERATION WITH ALL TRADES INVOLVED.

ALL HOLES FOR ANCHOR DEVICES SHALL BE DRILLED AS SPECIFIED UNDER, "SUPPORT ELEMENTS INSTALLATION".

NO CUTTING OR BURNING OF STRUCTURAL MEMBERS SHALL BE UNDERTAKEN WITHOUT THE WRITTEN AUTHORITY OF THE CONTRACTING OFFICER.

---CLEANING

CLEANING OPERATIONS DURING CONSTRUCTION AND UPON COMPLETION OF THE WORK OF THIS CONTRACT SHALL BE PERFORMED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF THE REFERENCED NFPA STANDARD AND THIS SECTION.

SPECIFIC OPERATIONS SHALL INCLUDE BUT NOT LIMITED TO THE FOLLOWING.

REMOVAL OF RUST AND ALL DIRT FROM THE BORE AND EXTERIOR SURFACE OF ALL PIPING AND EQUIPMENT.

CLEANING OF ALL PIPELINE STRAINERS, TEMPORARY AND PERMANENT, DURING FLUSHING OPERATIONS, AFTER START-UP AND IMMEDIATELY PRIOR TO FINAL ACCEPTANCE BY THE GOVERNMENT.

NAMEPLATES SHALL BE PROTECTED AND KEPT CLEAN. DAMAGED AND ILLEGIBLE NAMEPLATES SHALL BE REPLACED.

UPON COMPLETION OF THE WORK, IMMEDIATELY PRIOR TO FINAL ACCEPTANCE, ALL EQUIPMENT PROVIDED UNDER THIS CONTRACT SHALL BE CLEANED TO THE SATISFACTION OF THE CONTRACTING OFFICER.

---DISPOSAL OF EXCESS AND WASTE MATERIALS

EXCESS AND WASTE MATERIALS, INCLUDING EXCAVATED MATERIAL CLASSIFIED AS UNSATISFACTORY SOIL MATERIAL, TRASH AND DEBRIS, SHALL BE REMOVED TO THE DESIGNATED GOVERNMENT DISPOSAL AREA AT NO ADDITIONAL COST TO THE GOVERNMENT. ALL PERMITS AND FEES FOR DISPOSAL SHALL BE PAID FOR BY THE CONTRACTOR.

---OPERATION, MAINTENANCE, PARTS AND TESTING MANUALS

CONTRACTOR SHALL PROVIDE MANUALS FOR OPERATION, MAINTENANCE, PARTS LISTING AND TESTING OF ALL EQUIPMENT FURNISHED AS OUTLINED IN THE "CONTRACT SCHEDULE."

---PAINTING---

---GENERAL

WHERE EQUIPMENT IS THE MANUFACTURER'S STANDARD PRODUCT IT SHALL BE FURNISHED WITH THE MANUFACTURER'S STANDARD FINISH PAINT COAT CONFORMING TO NFPA REQUIREMENTS, UNLESS OTHERWISE SPECIFIED.

ALL OTHER FERROUS STEEL SHALL BE SHOP BLASTED AND ZINC-RICH COATED IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THESE SPECIFICATIONS.

ALL MANUFACTURER'S STANDARD FINISHED EQUIPMENT SURFACES DAMAGED DURING CONSTRUCTION SHALL BE BROUGHT TO "AS NEW" CONDITION BY TOUCH UP, OR REPAINTING, TO THE SATISFACTION OF THE CONTRACTING OFFICER.

FINISH PAINTING OF EXPOSED TO VIEW SURFACES SHALL CONFORM TO RECOMMENDATIONS OR APPLICABLE NFPA STANDARDS AND TO REQUIREMENTS OF SECTION 9A, "PAINTING AND FINISHING", UNLESS OTHERWISE SPECIFIED.

---FIRE PROTECTION SYSTEMS IDENTIFICATION---

---GENERAL

PROVIDE A COORDINATED, NFPA RECOMMENDED SYSTEM OF PIPING AND EQUIPMENT IDENTIFICATION, FOR EACH OF THE FOUR INSTALLATIONS, TO INCLUDE:

FRAMED AND PLASTIC PROTECTED DIAGRAMMATIC LAYOUT OF ALL PIPING SYSTEMS, IDENTIFYING AND SHOWING PIPING, EQUIPMENT AND VALVE LOCATION.

METAL TAG IDENTIFIED MAJOR VALVES, PIPING SYSTEMS COMPONENTS, AND EQUIPMENT.

COLOR CODED AND SERVICE LABELLED PIPING. *PIPING SHALL BE COLOR CODED TO DESIGNATE PARTICULAR SERVICE AND IDENTIFIED WITH STENCILED LETTERS AND FLOW DIRECTION ARROWS IN ACCORDANCE WITH* SECTION 13L OF THESE SPECIFICATIONS. NUMBERING OF PIV, AND OTHER COMPONENTS, SHALL BE AN EXTENSION OF EXISTING SYSTEM. THE CONTRACTOR SHALL SUBMIT THE ENTIRE IDENTIFICATION SYSTEMS, INCLUDING COLOR CODES, LEGENDS AND STENCILS, FOR APPROVAL PRIOR TO PROCEEDING WITH THE WORK. Ⓐ

---DIAGRAMS

CHART LISTING OF EQUIPMENT SHALL BE BY DESIGNATION NUMBER, AND SHOWING PERTINENT DATA.

DIAGRAMS SHALL BE NEAT MECHANICAL DRAWINGS MOUNTED IN EXTRUDED ALUMINUM FRAMES WITH 1/8 INCH THICK ACRYLIC PLASTIC PROTECTION. LOCATION SHALL BE AS DIRECTED BY THE CONTRACTING OFFICER. THE NUMBER OF CHARTS AND DIAGRAMS SHALL BE EQUAL TO OR GREATER THAN THE NUMBER OF FIRE PROTECTION SYSTEMS.

---METAL TAGS

IDENTIFICATION TAGS MADE OF BRASS OR ALUMINUM INDICATING FUNCTION OF A VALVE OR SIMILAR COMPONENT SHALL BE INSTALLED ON ALL SUCH SYSTEM DEVICES. TAGS SHALL BE 1-3/8 INCHES IN DIAMETER, AND MARKING SHALL BE STAMPED.

ALL EQUIPMENT SHALL BE PROVIDED WITH METAL IDENTIFICATION TAGS GIVING EQUIPMENT DESIGNATION NUMBER, MATCHING DRAWING OR DIAGRAM DESIGNATIONS.

TAGS SHALL BE WIRED TO VALVE OR EQUIPMENT ITEMS WITH STAINLESS STEEL WIRE PER MS-20995C32.

---UNDERGROUND PIPING MATERIALS---

---PIPING TYPES

GENERAL

ELLS, TEES, REDUCING TEES, WYES, COUPLINGS, INCREASERS, CROSSES, TRANSITIONS AND ADAPTERS AND END CAPS SHALL BE OF THE SAME TYPE AND CLASS OF MATERIAL AS THE PIPE, OR OF MATERIAL HAVING EQUAL OR SUPERIOR PHYSICAL AND CHEMICAL PROPERTIES. METAL PIPE AND FITTINGS SHALL BE DUCTILE IRON, MECHANICAL JOINT TYPE, COAL-TAR COATED AND LINED, CONFORMING TO WW-P-421C, TYPE III, GRADE 6, PRESSURE CLASS 250 PSI, AND SEALING GASKETS, LUBRICANT, BOLTS AND NUTS SHALL CONFORM TO ANSI STD. 421.11.

TYPE ACPP-----ASBESTOS CEMENT PRESSURE PIPE SHALL CONFORM TO AWWA STANDARD C400, CLASS 200. ALL FITTINGS, COUPLINGS, ADAPTERS, AND VALVES SHALL BE INSTALLED IN COMPLIANCE WITH "AWWA STANDARD FOR INSTALLATION OF ASBESTOS CEMENT WATER PIPE" AWWA C 603. USE ABOVE FOR SERVICE TO HYPERGOLIC FACILITIES, FOR ALL SIZES 6 INCHES AND LARGER.
ALL METAL UNDERGROUND PIPING COMPONENTS SHALL BE COATED WITH A BITUMINOUS SEALER IN ACCORDANCE WITH ANSI A21.4-1971.

RESTRAINING OF JOINTS AGAINST END-WISE SEPARATION DUE TO INTERNAL PRESSURE SHALL BE ACCOMPLISHED BY USE OF PROPERLY INSTALLED THRUST BLOCKS. ALL VALVES SHALL BE STRAPPED AND ANCHORED WITH THRUST BLOCKS ACCORDING TO THE ASBESTOS CEMENT PIPE MANUFACTURER'S RECOMMENDED INSTRUCTIONS AND AS DETAILED ON THE DRAWINGS.

GALV. STEEL-----AS SPECIFIED HEREINBELOW, BUT WITH 20 MIL THICK COAL-TAR COATING.

---ABOVEGROUND PIPING SYSTEM MATERIALS---

---FIRE PROTECTION PIPING

PIPE (1/2 THROUGH 10 INCHES AND WHERE INDICATED)	GALVANIZED FOR ALL SYSTEMS (EXCEPT LAUNCH PAD HYDRANTS), SCHEDULE 40 (EXCEPT SCH. 80 IN SIZES 3 INCH AND LESS), SEAMLESS OR ELECTRIC RESISTANCE WELDED STEEL CONFORMING TO ASTM A53-72A, GRADE B, TYPE E OR S. TYPE F IS ACCEPTABLE FOR SIZES LESS THAN 2 INCHES.

FITTINGS (2 INCHES AND UNDER)	300 PSIG WSP BANDED GALVANIZED MALLEABLE IRON, SCREWED, CONFORMING TO ASTM A197-47(1971) AND ANSI B16.3-1971.
FITTINGS (AT HYPERGOLIC FACILITIES) (2-1/2 INCHES AND OVER)	250 PSIG WSP CAST IRON FLANGES AND FLANGED FITTINGS CONFORMING TO ASTM A126-66, CLASS A AND TO ANSI B16.1-1967.
UNIONS (2 INCHES AND UNDER)	300 PSIG WSP FEMALE, SCREWED, GALVANIZED MALLEABLE IRON WITH BRASS TO IRON SEAT AND GROUND JOINT.
FITTINGS (OTHER THAN HYPERGOLIC FACILITIES)	GALVANIZED FOR SSAT FOGGING SYSTEMS. BUTT-WELDING TYPE CARBON STEEL, LONG RADIUS ELBOWS, SCHEDULE TO MATCH WALL THICKNESS OF HEAVIER PIPE CONNECTED, ANSI B16.9-71 AND ASTM A234-71. WELD NECK STEEL FLANGES, SERRATED FACE (FLAT-FACE AT VALVES), ANSI B16.5 AND ASTM A181- GRADE 1, 150 OR 300 LB. STD. AS NOTED.

---SUPPORTING ELEMENTS---

---GENERAL

PROVIDE ALL NECESSARY PIPING SYSTEMS COMPONENTS AND MISCELLANEOUS REQUIREMENT SUPPORTING ELEMENTS, INCLUDING BUT NOT LIMITED TO: BUILDING STRUCTURE ATTACHMENTS; SUPPLEMENTARY STEEL; HANGER RODS; STANCHIONS AND FIXTURES; VERTICAL PIPE ATTACHMENTS; HORIZONTAL PIPE ATTACHMENTS; RESTRAINING ANCHORS AND GUIDES. ALL SUPPORTING ELEMENTS SHALL BE SUITABLE FOR STRESSES IMPOSED BY: SYSTEMS PRESSURES AND TERMPERATURES, DYNAMIC AND GRAVITY FORCES.

SUPPORTING ELEMENTS SHALL BE FM OR UL APPROVED OR LISTED, SHALL CONFORM TO ANSI B31.1.0-1967, MSS SP-69-66, EXCEPT AS SUPPLEMENTED AND MODIFIED BY THESE SPECIFICATIONS.

"TYPE" DEVICES SPECIFIED HEREINAFTER ARE DEFINED IN MSS STANDARDS, UNLESS OTHERWISE INDICATED.

"ALL BUILDING STRUCTURE ATTACHMENTS, SUPPLEMENTARY STEEL, HANGAR RODS, STANCHIONS AND FIXTURES, PIPE ATTACHMENTS AND CLAMPS, ANCHORS, GUIDES, NUTS, BOLTS AND WASHERS, SHALL BE GALVANIZED." (A)

---BUILDING STRUCTURE ATTACHMENTS

BEAM CLAMPS

BEAM CLAMPS SHALL BE CENTER LOADING TYPE 21, 28, 29 AND 30, UL LISTED, CATALOGUED AND LOAD-RATED, COMMERCIALLY MANUFACTURED PRODUCTS, EXCEPT AS OTHERWISE SPECIFIED OR INDICATED.

TYPE 20 BEAM CLAMPS MAY BE USED FOR PIPE 2 INCHES AND UNDER.

TYPE 25 BEAM CLAMPS MAY BE USED PROVIDED TWO SUCH CLAMPS ARE USED PER POINT OF PIPE SUPPORT.

"C" CLAMPS

"C" CLAMPS SHALL NOT BE USED.

---HORIZONTAL PIPE ATTACHMENTS

SINGLE PIPES

PIPING IN SIZES TO AND INCLUDING 2-INCH IPS SHALL BE SUPPORTED BY TYPE 1,5,6,7,9,10,11 OR 12 SPLIT RING TYPE, GALVANIZED.

PIPING IN SIZES 2-1/2 INCHES AND LARGER SHALL BE SUPPORTED BY THE 1,2,3 OR 4 ATTACHMENTS, GALVANIZED.

PARALLEL FIRE PROTECTION PIPES

TRAPEZE HANGERS FABRICATED FROM APPROVED STRUCTURAL STEEL SHAPES, WITH U-BOLTS, MAY BE USED. STRUCTURAL STEEL SHAPES SHALL CONFORM TO SUPPLEMENTARY STEEL REQUIREMENTS, OR THE SUPPORT MAY BE OF COMMERCIALLY AVAILABLE, PROPRIETARY DESIGN, ROLLED STEEL. ALL COMPONENTS GALVANIZED.

---VERTICAL PIPE ATTACHMENTS

SINGLE PIPE

VERTICAL PIPE ATTACHMENTS SHALL BE TYPE B, UNLESS OTHERWISE SPECIFIED OR INDICATED, GALVANIZED.

---HANGER RODS AND FIXTURES

ONLY CIRCULAR CROSS-SECTION ROD HANGERS MAY BE USED TO CONNECT BUILDING STRUCTURE ATTACHMENTS TO PIPE SUPPORT DEVICES. RODS AND FIXTURES SHALL BE GALVANIZED. SUPPORTS SHALL BE AS HEREINAFTER SPECIFIED.

TURNBUCKLES, SWING EYES AND CLEVISES SHALL BE PROVIDED AS REQUIRED BY SUPPORT SYSTEM TO ACCOMMODATE TEMPERATURE CHANGES, PIPE ACCESSIBILITY, AND ADJUSTMENT FOR LOAD AND PITCH. THE ABOVE ITEMS SHALL BE GALVANIZED.

---SUPPLEMENTARY STEEL

WHERE IT IS NECESSARY TO FRAME STRUCTURAL MEMBERS BETWEEN EXISTING MEMBERS OR WHERE STRUCTURAL MEMBERS ARE USED IN LIEU OF COMMERCIALLY RATED SUPPORTS, SUCH SUPPLEMENTARY STEEL SHALL BE DESIGNED AND FABRICATED IN ACCORDANCE WITH THE AISC "SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDING," AND SHOP BLASTED AND COATED IN ACCORDANCE WITH SECTION 9L.

---FIRE DEPARTMENT CONNECTIONS---

---GENERAL

ALL HOSE CONNECTIONS SHALL HAVE NATIONAL FIRE HOSE STANDARD THREAD FORM AND ROCKER LUGS.

---SIDEWALK SIAMESE

UNIT SHALL BE OF CAST BRASS OR BRONZE, WITH TWO 2-1/2 INCH FIRE DEPARTMENT INLETS, DOUBLE CLAPPER VALVES, ROCKER LUG CAPS AND CHAINS.

UNIT SHALL BE MOUNTED ON A SCHEDULE 40 ASTM A53-72A GALVANIZED CARBON STEEL PIPE WITH RED ENAMELED FINISH ON PRIME COATED SURFACE.

---FIRE HYDRANTS FOR LAUNCH PAD

EQUAL TO ELKHART BRASS MFG. CO. NO. 158 THREE OUTLET HORIZONTAL ROOF MANIFOLD, SIZE 2-1/2" X 2-1/2" X 2-1/2" X 6".

---RISER ALARM EQUIPMENT---

---DELUGE VALVE ALARM DEVICE FOR EACH HYPERGOLIC FACILITY

DELUGE VALVE ALARM DEVICE SHALL BE COMPLETE WITH STANDARD ACCESSORIES AND TRIM NECESSARY TO GIVE AN ALARM EITHER BY DELUGE VALVE MANUAL ACTIVATION, BOTH LOCAL AND REMOTE, OR BY HEAT ACTUATED DEVICES. THE ALARM DEVICE SHALL BE ELECTRICALLY INTERCONNECTED TO THE DELUGE VALVE, HEAT ACTUATED DEVICES, AND THE MANUAL ACTIVATION LOCATION.

---HOSE STATIONS---

---HOSE REELS, HOSE AND NOZZLES

HOSE REELS SHALL BE GALVANIZED AND SHALL BE SUITABLE FOR SPECIFIED HOSE LENGTHS. ALL HOSE REELS AND ACCESSORIES SHALL HAVE SUITABLE PRIMER(S) AND SHALL BE RED-ENAMELED, AND DESIGNED FOR STAND MOUNTING AT AN ELEVATION HIGH ENOUGH FOR EASY ACCESS. PROVIDE SUITABLE CLIPS OR SPRING LOADED RETAINERS TO PREVENT HOSE FROM UNWINDING, AND HOSE REELS AND NOZZLES FROM SWINGING FROM THEIR MOUNTED POSITION UNTIL PLACED INTO SERVICE. REELS SHALL HAVE 200 PSIG FLEXIBLE HOSE CONNECTORS. REELS ON SSAT SHALL BE PROVIDED WITH ENCLOSURES AS DETAILED. REEL VALVE SHALL BE POLISHED BRASS, 175 PSI RATED, FITTED WITH AUTOMATIC DRAIN-VENT DEVICE. REELS EQUAL TO HANNAY 7528-22-23, GALVANIZED AND PAINTED.

HOSES SHALL BE MULTIPURPOSE NEOPRENE HOSE 1" I.D., 1 9/16" O.D., WORKING PRESSURE 300 PSI; 3 BRAID HEAVY DUTY SYNTHETIC COVER, RESISTANT TO ALL PETROLEUM PRODUCTS AND MOST DILUTE ACIDS, CHEMICALS, ORGANIC SOLVENTS AND HOT WATER TO 180°F; ABRASION RESISTANT, RED COVER, FULL FLOW, FLEXIBLE TO ROLL ON REELS WITHOUT KINKING, 3 RAYON BRAIDS MOLDED INSIDE HOSE; DESIGNED FOR HIGH PRESSURE UNIVERSAL SERVICE; AND WEIGHT NOT OVER 75 POUNDS/100 FT. OF LENGTH. HOSE AVAILABLE FROM ACME HAMILTON MANUFACTURING CORPORATION OF TRENTON, N.J., OR HALPRIN SUPPLY COMPANY OF LOS ANGELES, CALIFORNIA. HOSE LENGTH = 100 FT/REEL.

NOZZLES SHALL BE AKRON BRASS CORPORATION "AKR-O-JET", DOUBLE SHUT-OFF, ALL-PRESSURE FOG NOZZLE STYLE 1201 - 1 INCH INSIDE DIAMETER, BRASS, TYPE 2, CLASS "A", 27 GPM, AVAILABLE FROM HALPRIN SUPPLY COMPANY OF LOS ANGELES, CALIFORNIA, OR FLORIDA SAFETY EQUIPMENT COMPANY, ORLANDO, FLORIDA.

---DELUGE HEADS FOR HYPERGOLIC FACILITIES---

---DELUGE HEAD TYPES

STANDARD OPEN DELUGE HEADS SHALL BE USED. PROVIDE TEMPORARY CLOSURES FOR HYDROTESTING OF PIPING SYSTEM. PROVIDE TETHERED RUBBER BLOW-OUT PLUGS FOR HEAD OPENINGS.

---DELUGE HEAD PROTECTION

HEADS SHALL BE PROTECTED DURING PAINTING OPERATIONS WITH PAPER OR PLASTIC BAGS SECURED OVER HEADS. PROTECTION SHALL BE REMOVED IMMEDIATELY UPON THE FINISHING OF PAINTING OPERATIONS.

---UNDERGROUND VALVES

POST INDICATOR VALVE ASSEMBLY (PIV):

ASSEMBLY SHALL CONSIST OF A FM APPROVED, 175 PSIG RATED, GATE VALVE AND LOCKABLE ABOVE GRADE POST INDICATOR-OPERATOR. DIRECTION TO OPEN SHALL BE COUNTER CLOCKWISE.

ALL SURFACES BELOW GRADE SHALL RECEIVE A COATING OF BITUMEN NOT LESS THAN 12 MILS THICK. ALL ABOVE GRADE SURFACES SHALL BE FILLED, PRIMED AND FINISHED WITH A MULTIPLE COAT OF HIGH-GLOSS WEATHER-RESISTANT, RED ENAMEL, NOT LESS THAN 5 MILS THICKNESS.

VALVE BOXES:

VALVE BOXES SHALL BE OF NOT LESS THAN 3/16 INCH THICK CAST IRON CONSTRUCTION WITH LOCKING COVER WHICH HAS CAST INTO IT AN APPROPRIATE IDENTIFICATION LEGEND. BOXES SHALL BE ADJUSTABLE EXTENSION TYPE WITH SCREW-OR SLIDE-TYPE ADJUSTMENT. VALVES 4 INCHES AND LARGER SHALL BE FITTED WITH 5-1/4 INCH SHAFT. BASE FLANGE SHALL BE FITTED TO THE VALVE FLANGE. BOX FULL EXTENDED LENGTH SHALL BE GREATER THAN REQUIRED BY DEPTH OF COVER BY NOT LESS THAN 4 INCHES. ONE VALVE OPERATING WRENCH SHALL BE SUPPLIED FOR EACH SIZE OF VALVE WRENCH NUT. PROVIDE GUIDE RINGS WHERE OPERATING RODS ARE LONGER THAN 6 FEET.

---ABOVEGROUND VALVES

"ABOVEGROUND VALVES SHALL BE OF THE TYPES, RATINGS, MATERIALS, ETC. AS NOTED ON THE DRAWINGS. CHAIN WHEEL OPERATORS SHALL BE PROVIDED WHERE NOTED. UNLESS OTHERWISE NOTED OR SPECIFIED TO THE CONTRARY, VALVES SHALL BE RATED AT NOT LESS THAN 175 PSIG WOG WORKING PRESSURE (250 PSIG FOR CHECK VALVES AT SSAT - SHEET 14 AND 300 PSIG WSP FOR 6" GATE VALVE - SHEET M11); GATE VALVES SHALL BE OS&Y PATTERN: AND SHALL BE UL OR FM LISTED." A

---DELUGE VALVES - ELECTRICALLY OPERATED

DELUGE VALVES FOR THE HYPERGOLIC FACILITIES SHALL BE SIZE 6 INCH EQUAL TO AUTOMATIC SPRINKLER COMPANY MODEL "C", 98-6000, ELECTRICALLY OPERATED TYPE, WITH SEALED DRAIN, ARRANGED TO RELEASE BY ENERGIZED SOLENOID FOR 120V - 60 HZ POWER SUPPLY, AND WITH ALL ELECTRICAL DEVICES IN NEMA 4 ENCLOSURES. VALVE SHALL BE SUITABLE FOR NOT LESS THAN 175 PSIG WORKING PRESSURE. *"ALL COMPONENTS FABRICATED FROM FERROUS ROD, SHAPES, SHEET, OR PLATE SHALL BE HOT-DIPPED GALVANIZED AFTER FABRICATION. ALL FASTENERS SHALL BE STAINLESS STEEL, OR GALVANIZED STEEL."* A

---GENERAL

SYSTEM SHALL BE EQUAL TO AUTOMATIC SPRINKLER CO. "SUPROTEX-DELUGE SYSTEM" WITH FEATURES HEREIN SPECIFIED. ALL EQUIPMENT SHALL BE SUITABLE FOR OUTSIDE EXPOSURE TO SEACOAST ENVIRONMENT.

---DELUGE VALVE

DELUGE VALVE SHALL BE SUITABLE FOR NOT LESS THAN 175 PSIG WORKING PRESSURE, AND SHALL OPERATE IN RESPONSE TO AN ABNORMAL TEMPERATURE RATE-OF-RISE DETECTED BY PNEUMATIC HEAT ACTUATED DEVICES. WATER SHALL BE DISCHARGED THROUGH THE VALVE TO THE SPRINKLER HEADS AS SOON AS THE PRESSURE IMPULSE IS RECEIVED BY THE DIAPHRAGM IN THE RELEASE ENCLOSING BOX. THE VALVE SHALL BE CAPABLE OF MANUAL ACTUATION REMOTELY AND LOCALLY. VALVE SHALL HAVE EXPLOSION-PROOF, OR NEMA 4, SWITCH FOR FIRE ALARM CONNECTION. VALVE SHALL BE EQUAL TO AUTOMATIC SPRINKLER CO. MODEL "C", 2-1/2 INCH, WITH SEALED DRAIN. *"ALL COMPONENTS FABRICATED FROM FERROUS ROD, SHAPES, SHEET, OR PLATE SHALL BE HOT-DIPPED GALVANIZED AFTER FABRICATION. ALL FASTENERS SHALL BE STAINLESS STEEL OR GALVANIZED STEEL."* (A)

---DELUGE VALVE ALARM DEVICE

ACTUATION OF THE DELUGE VALVE SHALL GENERATE A SIGNAL TO THE CENTRAL FIRE ALARM SYSTEM. DUE TO THE HAZARD INVOLVED, THE ELECTRICAL CONNECTION SHALL BE ACCOMPLISHED IN AN EXPLOSION-PROOF BOX. SEE SECTION 16V (PART 1) OF THE SPECIFICATIONS.

---HEAT ACTUATED DEVICES

HEAT ACTUATED DEVICES (H.A.D.'S) SHALL BE LOCATED IN THE PROXIMITY OF THE EQUIPMENT TO BE PROTECTED. NOT MORE THAN SIX (6) H.A.D.'S SHALL BE INTERCONNECTED TO ONE 1/8" COPPER TUBING BRANCH. THE COPPER TUBING SHALL BE RUN IN PROTECTIVE STEEL TUBING AND SHALL BE CONNECTED TO THE HEADER BAR IN THE HEADER BAR CABINET ON THE DELUGE VALVE.

---BREAK GLASS STATION

BREAK-GLASS STATION FOR REMOTE OPERATION OF THE DELUGE VALVE SHALL BE LOCATED FIFTY (50) FEET OR MORE FROM THE HAZARD AREA AS SHOWN ON THE DRAWINGS. IT SHALL BE CONNECTED TO THE DELUGE VALVE BY PROTECTED COPPER TUBING FOR PNEUMATIC ACTUATION OF THE DELUGE VALVE.

---NITROGEN GAS SUPERVISORY SYSTEM

NITROGEN CYLINDER SHALL CONTAIN NITROGEN GAS AT A MAXIMUM STORED PRESSURE OF 2200 PSIG. HIGH PRESSURE REGULATORS SHALL REDUCE THE PRESSURE TO 100 PSIG. A LOW PRESSURE REGULATOR SHALL REDUCE THE PRESSURE

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TO ONE AND ONE-HALF (1-1/2) PSIG PRIOR TO ENTRY INTO THE RELEASE ENCLOSING BOX. A RELIEF VALVE SHALL BE BUILT INTO THE LOW PRESSURE REGULATOR WHICH SHALL OPEN AT THREE (3) PSIG. NITROGEN GAS IS THE ONLY ACCEPTABLE MEDIA AND SHALL BE CONTAINED IN AN I.C.C. APPROVED CYLINDER.

---FOGGING SYSTEM VALVES FOR SSAT--- (A)

---CONTROL VALVES FOR SSAT

PROVIDE *SIX* (6), SIZE 4 INCH, PNEUMATICALLY-OPERATED, CONTROL VALVES FOR SSAT FOGGING SYSTEMS EQUAL TO BULLETIN 241 JAMESBURY NO. 8126 MT, EACH WITH BULLETIN 251 ST 200 PNEUMATIC ACTUATOR AND TYPE 3R BETTIS-WITCH *(2-DP/DT)*, TO INDICATE VALVE "CLOSED" AND "OPEN" POSITIONS. INSTALL VALVE WITH SHAFT UPSTREAM. OPERATING FLUID WILL BE COMPRESSED AIR AND SEALS FOR ACTUATOR SHALL BE COMPATIBLE. VALVE WILL HANDLE FRESH WATER AT 125°F MAXIMUM TEMPERATURE. WITH 100 PSIG AIR SUPPLY TO THE ACTUATOR, THE ACTUATOR SHALL "OPEN", AND "CLOSE", THE VALVE AGAINST A DIFFERENTIAL WATER PRESSURE OF 160 PSIG. ACTUATOR SHALL BE SUITABLE FOR MAXIMUM AIR PRESSURE OF 150 PSIG AND VALVE SHALL BE RATED DROP-TIGHT FOR 285 PSIG, MAXIMUM AND LOWER, DIFFERENTIAL WATER PRESSURE. *EACH VALVE SHALL BE PROVIDED WITH ADJUSTABLE CONTROLS FOR SPEED OPENING, AND FOR SPEED OF CLOSING." "EACH ACTUATOR SHALL HAVE A SPEED CONTROL VALVE AT EACH CYLINDER PORT. SPEED CONTROL SHALL BE EQUAL TO DELTROL FLUID PRODUCTS CO. (BELLWOOD, ILL) "PNEU-TROL" PART NO. FMF-20SS."* (B) (A)

---MISCELLANEOUS MATERIALS ---

---BITUMINOUS COATING FOR UNDERGROUND FERROUS METALS

BITUMINOUS COATING SHALL BE A SOLVENT-CUT-BACK, HEAVY BODIED MATERIAL TO PRODUCE NOT LESS THAN A 12 MIL DRY FILM IN ONE COAT, AND SHALL BE RECOMMENDED BY THE PIPING MANUFACTURER AS COMPATIBLE WITH FACTORY COATING AND RUBBER JOINTS.

FOR PREVIOUSLY COAL-TAR COATED AND FOR UNCOATED FERROUS SURFACES UNDERGROUND, BITUMINOUS COATING SHALL BE SOLVENT-CUT-BACK COAL-TAR TYPE CONFORMING TO MIL-C-18480A(1).

---BOLTING

FLANGE AND GENERAL PURPOSE BOLTING SHALL BE HEX HEAD AND SHALL CONFORM TO ASTM A307-74 GRADE B. HEAVY HEX NUTS SHALL CONFORM TO ANSI B18.2.2-1972. SQUARE HEAD BOLTS AND NUTS ARE NOT ACCEPTABLE.

---PRESSURE SWITCHES *(DUAL TYPE)* FOR HYPERGOLIC AND GO_2 FACILITIES (B)

PRESSURE SWITCH (SET @ 30 PSIG) SHALL BE CONNECTED TO RISER WITH WELDED AND THREADED BOSS, 1/2" - SCHEDULE 80 GALVANIZED NIPPLES, 1/2" - 300 LB. R.S. BRONZE GATE VALVE, 300 LB. M.I. ELBOW AND BUSHING. PRESSURE SWITCH EQUAL TO UNITED ELECTRIC CONTROLS CO. TYPE *J110A* CAT. MODEL NO. 555, FOR PROOF-PRESSURE OF 225 PSIG., TEFLON DIAPHRAGM AND STAINLESS STEEL WETTED PARTS, NEC CLASS 1, DIV. 1 - GROUPS B, C AND D. FOR WIRING SEE ELECTRICAL DRAWINGS. *SOURCE ADDRESS: WATERTOWN, MASS. 02172.* (B)

---STRAINER FOR SSAT FOGGING SYSTEMS - SIZE 6 INCH (3 REQUIRED)

250 LB. ANSI STD. FLANGED (400 LB. WOG), EQUAL TO MUESSCO CAT. NO. 752 WITH 3/64" DIAMETER PERFORATED BRASS BASKET.

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---FOGGING NOZZLES FOR SSAT (12 REQUIRED)

1-1/2 INCH FEMALE INLET, 125 GPM AT 50 PSIG SUPPLY PRESSURE, 90° SPRAY PATTERN, EQUAL TO ELKHART NO. NT-C FACTORY PRE-SET.

---FLANGE GASKETS

COMPRESSED ASBESTOS SHEET CONFORMING TO ASTM F104-71 TYPE 1 - P1161A, COATED ON BOTH SIDES WITH GRAPHITE OR SIMILAR LUBRICANT, CONTAINING NOT LESS THAN 75 PERCENT CHRYSOTILE ASBESTOS.

---PIPE THREAD COMPOUNDS

TETRAFLUOROETHYLENE (100% VIRGIN) DISPERSIONS (OTHER SUITABLE COMPOUNDS MAY BE USED UPON APPROVAL OF THE CONTRACTING OFFICER).

---PRESSURE GAUGES

THESE SHALL BE PROVIDED WHERE INDICATED ON THE DRAWINGS, AND SHALL HAVE 6 INCH DIA. DIAL WITH BLACK NUMERALS, PHENOLIC CASE, TYPE 316 S.S. TUBE, BOTTOM CONNECTED. GAUGES SHALL BE SOLID FRONT TYPE DESIGNED FOR BACK BLOW OUT. GAUGES SHALL BE EQUAL TO DRESSER/ASHCROFT NO. 1379 WITH ACCURACY OF 1/2 PERCENT OF FULL SCALE. RANGE SHALL BE AS NOTED ON THE DRAWINGS. GAUGES SHALL BE CONNECTED WITH 1/2 INCH NEEDLE VALVE, BRASS, RATED 400 PSIG WOG AND EQUAL TO CRANE FIG. 88, OR 89. ALL GAUGES SHALL BE CONNECTED TO PIPING WITH 1/2" SCHEDULE 80 PIPE AND 300 LB. STD. MALLEABLE IRON SCREWED FITTINGS.

---EARTHWORK---

---GENERAL

UNLESS OTHERWISE SPECIFIED HEREIN, ALL EARTHWORK SHALL COMPLY WITH SECTION 2D OF THESE SPECIFICATIONS.

---PAVEMENT CUTTING---

---GENERAL

PAVEMENT CUTTING SHALL BE LIMITED TO THE MINIMUM AREA NECESSARY TO PERFORM THE REQUIRED UNDERGROUND WORK. CUTTING SHALL BE DONE ONLY BY METHODS APPROVED BY THE CONTRACTING OFFICER AND IN CONFORMANCE WITH THE FOLLOWING REQUIREMENTS:

WHERE AN UNDERGROUND UTILITY WILL CROSS UNDER AN EXISTING CONCRETE SLAB, THE SLAB SHALL BE REMOVED BY SAW-CUTTING WITH A CONCRETE SAW.

SAWED JOINTS SHALL BE STRAIGHT, VERTICAL, A MINIMUM OF 2 INCHES DEEP, AND SHALL HAVE AT LEAST 1 FOOT OF UNDISTURBED SOIL ADJACENT TO THE CUT.

SUBSEQUENT REMOVAL OF SLAB SHALL BE DONE IN SUCH A MANNER AS NOT TO CHIP OR DAMAGE THE FACE OF THE SAW CUT ON THE REMAINING SLAB.

EXISTING MESH OR OTHER REINFORCEMENT SHALL BE LEFT EXTENDING FROM REMAINING SLAB FOR REUSE IN REPLACED SLAB, WHERE PRACTICABLE. OTHERWISE, SUCH REINFORCEMENT SHALL BE LEFT FOR MINIMUM LAP DISTANCE AND ADDITIONAL REINFORCEMENT MATCHING EXISTING REINFORCEMENT SHALL BE PROVIDED.

SAWED JOINTS SHALL BE MADE PERPENDICULAR TO ROAD CENTERLINES. IN CASES WHERE A CONDUIT IS SKEWED WITH RESPECT TO AN EXISTING ROAD CENTERLINE, THE SAW CUT SHALL BE STEPPED BACK AT EXISTING LONGITUDINAL JOINTS TO PROVIDE THE MINIMUM WIDTH OF SLAB REMOVAL AS INDICATED.

NO SAWED JOINT SHALL BE MADE WITHIN 2 FEET OF AN EXISTING JOINT. IN LIEU THEREOF, THE EXISTING SLAB SHALL BE REMOVED TO THE EXISTING JOINT.

WIDTH BETWEEN SAW CUTS SHALL BE SUCH THAT A MINIMUM 12 INCHES OF UNDISTURBED SOIL WILL REMAIN ON BOTH SIDES OF THE TRENCH AFTER REMOVAL OF CONCRETE.

---BEDDING OF PIPING IN TRENCHES---

---MATERIALS

BEDDING MATERIALS SHALL BE GRANULAR, OF TYPES INDICATED AND SPECIFIED HEREIN.

TYPE CA: COARSE AGGREGATE SHALL BE AN ANGULAR, WASHED, UNIFORMLY GRADED MIXTURE OF CRUSHED GRAVEL OR CRUSHED STONE. GRADATION SHALL CONFORM TO ASSHO M43-54, TABLE 1, SIZE NO. 67, WITH 100 PERCENT BY WEIGHT PASSING 1-INCH SIEVE AND NOT MORE THAN 5 PERCENT PASSING NO. 8 SIEVE.

---BEDDING CLASSIFICATION

BEDDING SHALL BE AS INDICATED AND SPECIFIED HEREIN.

CLASS B-2: TRENCH BEDDING IS THAT METHOD IN WHICH PIPING IS BEDDED IN A COMPACTED GRANULAR MATERIAL PLACED ON AN OVER-EXCAVATED, FLAT, GRADED, TRENCH BOTTOM.

GRANULAR BEDDING MATERIAL SHALL BE TYPE CA.

BEDDING SHALL HAVE A MINIMUM COMPACTED THICKNESS BELOW THE BOTTOM OF THE EXTERIOR OF THE PIPING OF ONE-FOURTH OF THE OUTSIDE DIAMETER, BUT IN NO CASE LESS THAN 4 INCHES NOR MORE THAN 12 INCHES.

BEDDING SHALL BE CAREFULLY PLACED AND COMPACTED IN LAYERS NOT MORE THAN 6 INCHES, LOOSE MEASURE, TO AN ELEVATION NOT LESS THAN 12 INCHES ABOVE THE TOP OF THE PIPING.

---INSTALLATION OF MATERIALS AND EQUIPMENT---

---GENERAL

INSTALLATION OF SYSTEM MATERIALS AND EQUIPMENT SHALL BE IN ACCORDANCE WITH THE RECOMMENDATIONS AND PROVISIONS OF NFPA "STANDARD NO. 13 - 1972, FOR THE INSTALLATION OF SPRINKLER SYSTEMS", NFPA STANDARD NO. 13B "FIRE DEPARTMENT OPERATIONS IN PROPERTIES PROTECTED BY SPRINKLER AND STANDPIPE SYSTEMS" AND NFPA STANDARD NO. 24 "OUTSIDE PROTECTION". ALL WORK SHALL BE DONE IN THE PRESENCE OF THE CONTRACTING OFFICER WHO SHALL BE NOTIFIED BY THE CONTRACTOR 48 HOURS IN ADVANCE OF THE WORK.

THE PROVISIONS AND RECOMMENDATIONS OF THE NFPA CONSTITUTE MANDATORY MINIMUM REQUIREMENTS FOR WORK SPECIFIED HEREIN. STRICT COMPLIANCE THEREWITH WILL BE REQUIRED FOR ALL WORK EXCEPT WHERE THE DRAWINGS AND SPECIFICATIONS REQUIRE BETTER MATERIALS, EQUIPMENT AND INSTALLATION THAN THE NFPA STANDARDS IN WHICH CASE THE DRAWINGS AND SPECIFICATIONS SHALL SUPERSEDE NFPA REQUIREMENTS.

PROVIDE CERTIFICATE COVERING TESTS FOR SIGNATURE BY THE CONTRACTING OFFICER PRIOR TO ACCEPTANCE OF WORK.

EXERCISE ALL NECESSARY CARE TO MAINTAIN CONTINUITY OF SERVICE OF EXISTING SYSTEMS. SHUT-DOWNS AND TIE-INS SHALL BE DONE ONLY UPON ADVANCE APPROVAL OF SCHEDULE WHICH MUST BE SUBMITTED NOT LESS THAN 5 WORKING DAYS PRECEDING REQUEST DATA. A TENTATIVE PROJECT SCHEDULE OF SHUT-DOWNS AND TIE-INS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR PRELIMINARY APPROVAL IMMEDIATELY UPON AWARD OF CONTRACT. PROVIDE APPROVED TEMPORARY MEANS NECESSARY TO MAINTAIN FIRE PROTECTION OF FACILITIES AFFECTED.

---EXPERIENCED WORKMEN

FIRE PROTECTION SYSTEM WORK SHALL BE SUPERVISED AND PERFORMED BY PERSONNEL REGULARLY ENGAGED IN THE INSTALLATION OF FIRE PROTECTION SYSTEMS CONFORMING TO UNDERWRITERS' AND NFPA STANDARDS AND CLOSELY SIMILAR TO THE WORK AS SPECIFIED AND INDICATED. SUBMIT EVIDENCE OF QUALIFICATION OF ANY PROPOSED SUPERVISOR OR INSTALLER. THE CONTRACTING OFFICER MAY REJECT THOSE WHO CANNOT SHOW EVIDENCE OF SUCH QUALIFICATIONS.

---GENERAL

INSTALLATION OF WATER SUPPLY SYSTEMS SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS SPECIFIED HEREIN UNDER "INSTALLATION OF MATERIALS AND EQUIPMENT" AND IN THE PRESENCE OF THE CONTRACTING OFFICER WHO SHALL BE NOTIFIED BY THE CONTRACTOR 48 HOURS IN ADVANCE OF THE WORK.

INSTALLATION OF CONDUIT MATERIALS SHALL CONFORM TO THE WRITTEN OR PUBLISHED INSTRUCTIONS OF THE MANUFACTURER, EXCEPT AS OTHERWISE SPECIFIED HEREIN. WHERE THE CONTRACTOR PROPOSES TO DEVIATE FROM SPECIFIED INSTRUCTIONS, THE PROPOSED DEVIATIONS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL.

PRIOR TO BEING LOWERED INTO A TRENCH, ALL PIPING SHALL BE CLEANED AND VISUALLY INSPECTED FOR APPARENT DEFECTS.

DEFECTIVE MATERIALS FOUND SHALL BE DISTINCTLY MARKED USING A ROAD TRAFFIC QUALITY YELLOW PAINT, AND SAID MATERIAL SHALL BE PROMPTLY REMOVED FROM THE SITE.

AFTER PIPING HAS BEEN INSPECTED AND NOT LESS THAN 48 HOURS PRIOR TO BEING LOWERED INTO A TRENCH, ALL EXTERNAL SURFACES OF ALL FERROUS METAL COMPONENTS AND ANCHOR RODS SHALL BE COATED WITH A COMPATIBLE BITUMINOUS COATING FOR PROTECTION AGAINST BRACKISH GROUND WATER. APPLICATION SHALL BE SINGLE COAT, IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS, TO RESULT IN A DRY FILM THICKNESS OF NOT LESS THAN 12 MILS.

ALL EXCAVATIONS SHALL BE DRY AND CLEAR OF EXTRANEOUS MATERIALS WHEN PIPE IS BEING LAID.

ALL CUTTING OF PIPING SHALL BE BY WHEEL-CUTTERS OR OTHER MACHINES DESIGNED SPECIFICALLY FOR THAT PURPOSE.

PIPING SHALL BE LAID BEGINNING AT THE LOW POINT OF A SYSTEM AND WHEN IN FINAL ACCEPTANCE POSITION, PIPING SHALL BE TRUE TO THE GRADES AND ALIGNMENT INDICATED, WITH UNBROKEN CONTINUITY OF INVERT. BLOCKING AND WEDGING WILL NOT BE PERMITTED.

BELL ENDS OF PIPING SHALL POINT UPSTREAM, UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

ALL CHANGES IN DIRECTION SHALL BE MADE WITH LONG SWEEP FITTINGS, UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

PROVIDE ALL NECESSARY SOCKET CLAMPING, PIERS, BASES, ANCHORS, AND THRUST-BLOCKING. RODS, CLAMPS AND BOLTING SHALL BE PROTECTED WITH A COATING OF BITUMEN.

PIPES PASSING THROUGH CONCRETE SLAB, SHALL PASS THROUGH PIPE SLEEVES AND SHALL BE CAULKED WATERTIGHT WITH DOW-CORNING SEALANT NO. 790, OR GENERAL ELECTRIC "SILPRUF," OR EQUAL SEALANT COMPLYING WITH FEDERAL SPECIFICATION TT-S-001543.

ON EXCAVATIONS WHICH OCCUR NEAR AND BELOW BUILDING FOOTINGS, THE BACKFILLING MATERIAL SHALL CONSIST OF CONCRETE POURED OR PRESSURE GROUTED UP TO THE LEVEL OF THE FOOTING.

ALL WATER RISERS SHALL BE PROPERLY SUPPORTED ON APPROVED PIERS AT THEIR BASE AND PROVIDED WITH APPROVED STRUCTURAL SUPPORTS ATTACHED TO BUILDING CONSTRUCTION. SEE DRAWING DETAILS.

---JOINTS

JOINTS SHALL BE MADE IN ACCORDANCE WITH REFERENCED CODES, STANDARDS, OR THE MANUFACTURER'S INSTRUCTIONS, UNLESS OTHERWISE SPECIFIED HEREIN.

INSTALLATION OF ELASTOMER GASKETS SHALL BE IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE GASKET MANUFACTURER IN REGARD TO THE USE OF LUBRICANTS AND CEMENTS AND OTHER SPECIAL INSTALLATION REQUIREMENTS.

ELASTOMER GASKETS THAT ARE NOT TO BE INSTALLED IMMEDIATELY SHALL BE STORED IN A COOL DARK PLACE.

AFTER PIPING JOINT IS MADE; THE POSITION OF THE GASKET SHALL BE CHECKED WITH A FEELER GAGE IN ACCORDANCE WITH THE PIPE MANUFACTURER'S RECOMMENDATIONS.

BONDED JOINTS AND INSULATING JOINTS SHALL BE INSTALLED WHERE INDICATED ON THE DRAWINGS.

---CONSTRUCTION TOLERANCES FOR TYPE ACPP PIPING

THE MAXIMUM DEVIATION FROM DESIGN ELEVATION AT ANY POINT ALONG PIPING SHALL NOT EXCEED 0.2 FOOT FOR ALL SIZES OF CONDUIT.

THE MAXIMUM DEVIATION FROM LINE AT THE END OF AN 18-FOOT LENGTH OF PIPING SHALL BE 0.2 FOOT AND CUMULATIVELY SHALL NOT EXCEED 0.5 FOOT. CORRECTIONS FROM LINE WITHIN PRECEDING TOLERANCES SHALL BE MADE AT A RATE NOT TO EXCEED 0.2 FOOT FOR ANY ONE LENGTH OF PIPING.

THE FOLLOWING TABLE SHOWS MAXIMUM DEFLECTION FOR CURVES FOR 18-FOOT LENGTHS OF ASBESTOS CEMENT PIPE. FOR OTHER LENGTHS THE DEFLECTION WILL VARY PROPORTIONATELY.

PIPE SIZE, INCHES	DEFLECTION DEGREES	ANGLE MINUTES	DEFLECTION INCHES
2 1/2	5	0	19
3	5	0	19
4	5	0	19
6	4	45	18

IF THE ALIGNMENT REQUIRES DEFLECTIONS IN EXCESS OF THE ABOVE LIMITATIONS, SPECIAL BENDS OR A SUFFICIENT NUMBER OF SHORTER LENGTHS OF PIPE SHALL BE FURNISHED TO PROVIDE ANGULAR DEFLECTIONS WITHIN THE LIMIT SET FORTH, AS APPROVED.

---VALVE BOXES

VALVES AND VALVE BOXES SHALL BE INSTALLED WHERE INDICATED, AND SHALL BE SET PLUMB. VALVE BOXES SHALL BE CENTERED ON THE VALVES. WHERE FEASIBLE, VALVES SHALL BE LOCATED OUTSIDE TRAFFIC AREAS. SOIL SHALL BE CAREFULLY TAMPED AROUND EACH VALVE BOX TO A DISTANCE OF 4 FEET ON ALL SIDES OF THE BOX, OR TO THE UNDISTRUBED TRENCH FACE IF LESS THAN 4 FEET.

PROVIDE 2 FOOT SQUARE, 4 INCHES THICK, CLASS 3000A CONCRETE SLABS TO PROTECT VALVE BOXES, UNLESS OTHER PROTECTION IS INDICATED. CONCRETE SHALL HAVE 6 X 6 - 6/6 WELDED WIRE MESH REINFORCING.

---THRUST BLOCKS

THRUST BLOCKS SHALL BE PROVIDED AS DETAILED TO ABSORB HYDRAULIC THRUST AT CAPS, VALVES, AND AT SYSTEM CHANGE OF DIRECTION FITTINGS.

THRUST BLOCKS SHALL BE 3000 PSI CONCRETE IN ACCORDANCE WITH SECTION 3A, PLACED AGAINST UNDISTURBED SOIL WITH AN AREA SUFFICIENT TO PROVIDE LOAD TRANSMITTAL AS SHOWN ON THE DRAWINGS.

HYDROSTATIC TESTING SHALL NOT TAKE PLACE UNTIL CONCRETE HAS CURED AT LEAST 7 DAYS.

---GENERAL

INSTALLATION OF ABOVEGROUND SYSTEM PIPING SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS SPECIFIED HEREIN UNDER "INSTALLATION OF MATERIALS AND EQUIPMENT" AND IN THE PRESENCE OF THE CONTRACTING OFFICER WHO SHALL BE NOTIFIED 48 HOURS IN ADVANCE OF THE WORK.

WHERE THE CONTRACTOR PROPOSES TO DEVIATE FROM SPECIFIED INSTRUCTIONS, THE PROPOSED DEVIATION SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL.

ALL PIPE, FITTINGS, VALVES, EQUIPMENT AND ACCESSORIES SHALL BE CLEAN AND FREE OF ALL DELETERIOUS MATERIAL BEFORE BEING INSTALLED IN THEIR RESPECTIVE SYSTEMS. PIPE SHALL BE CLEANED BY SHAKING, SWABBING AND FLUSHING OR BY A COMBINATION OF METHODS. DURING THE PROGRESS OF CONSTRUCTION, OPEN ENDS OF PIPE, FITTINGS, AND VALVES SHALL BE PROPERLY PROTECTED AT ALL TIMES TO PREVENT THE ADMISSION OF FOREIGN MATTER.

---JOINTS

REAM ALL PIPE ENDS BEFORE JOINT CONNECTIONS ARE MADE.

SCREWED JOINTS SHALL BE MADE UP WITH JOINT COMPOUND.

JOINT COMPOUNDS SHALL BE APPLIED TO THE MALE THREAD ONLY, AND CARE SHALL BE EXERCISED TO PREVENT COMPOUND FROM REACHING THE INTERIOR OF THE PIPE.

SCREWED UNIONS, OR BOLTED FLANGES SHALL BE PROVIDED WHEREVER REQUIRED TO PERMIT CONVENIENT REMOVAL OF EQUIPMENT, VALVES AND PIPING ACCESSORIES FROM THE PIPING SYSTEM.

FLANGED JOINTS SHALL BE ASSEMBLED WITH APPROPRIATE FLANGES, GASKETS, AND BOLTING. THE CLEARANCE BETWEEN FLANGE FACES SHALL BE SUCH THAT THE CONNECTIONS CAN BE GASKETED AND BOLTED TIGHT WITHOUT IMPOSING UNDUE STRAIN ON THE PIPING SYSTEM. FLANGE FACES SHALL BE PARALLEL AND THE BORES CONCENTRIC; GASKETS SHALL BE CENTERED ON THE FLANGE FACES WITHOUT PROJECTING INTO THE BORE. BOLTING SHALL BE LUBRICATED WITH OIL AND GRAPHITE BEFORE ASSEMBLY TO INSURE UNIFORM BOLT STRESSING.

THE FLANGE BOLTS SHALL BE DRAWN UP AND TIGHTENED IN STAGGERED SEQUENCE IN ORDER TO PREVENT UNEQUAL GASKET COMPRESSION AND DEFORMATION OF THE FLANGES. WHEREVER A FLANGE WITH A RAISED FACE IS JOINED TO A COMPANION FLANGE WITH A FLAT FACE, THE RAISED FACE SHALL BE MACHINED DOWN TO A SMOOTH MATCHING SURFACE AND A FULL FACE GASKET SHALL BE USED. AFTER THE PIPING SYSTEM HAS BEEN TESTED AND IS IN SERVICE AT THE MAXIMUM TEMPERATURE, RE-TORQUE ALL BOLTING. ONLY HEX HEAD NUTS AND BOLTS SHALL BE USED. GASKET MATERIAL SHALL BE FRESH STOCK, 1/16 INCH THICK, EQUAL TO GARLOCK NO. 24.

---SUPPORTING ELEMENTS INSTALLATION

SUPPORTING ELEMENTS SHALL BE PROVIDED IN ACCORDANCE WITH THE REQUIREMENTS OF ANSI B31.1.0-1967; MSS SP-58-1967; MSS SP-69-1966; REQUIREMENTS SPECIFIED HEREIN. PIPING SHALL BE HUNG FROM BUILDING CONSTRUCTION. NO PIPING SHALL BE HUNG FROM ROOF DECK, OR FROM OTHER PIPE.

ATTACHMENT TO BUILDING CONSTRUCTION CONCRETE SHALL BE BY APPROVED CAST-IN CONCRETE INSERTS OR BY BUILT-IN ANCHORS.

INSERTS AND ANCHORS SHALL BE SIZED FOR THE TOTAL STRESS TO BE APPLIED WITH A SAFETY FACTOR AS REQUIRED BY APPLICABLE CODES BUT IN NO CASE LESS THAN 4. COMPLETE SHOP DRAWINGS SHALL BE SUBMITTED.

ANCHOR DEVICES SHALL BE INSERTED INTO CONCRETE SECTIONS NOT LESS THAN 2 TIMES OVERALL LENGTH OF THE DEVICE AND SHALL BE LOCATED NOT LESS THAN 3 INCHES FROM ANY SIDE OR END EDGE OF CONCRETE.

ALL PIPING SHALL RUN PARALLEL WITH THE LINES OF THE BUILDING UNLESS OTHERWISE INDICATED. PIPING AND COMPONENTS SHALL BE SPACED AND INSTALLED SO THAT A THREADED PIPE FITTING MAY BE REMOVED BETWEEN ADJACENT PIPES AND SO THAT THERE WILL BE NOT LESS THAN 1/2 INCH OF CLEAR SPACE BETWEEN THE FINISHED SURFACE AND OTHER WORK AND BETWEEN THE FINISHED SURFACE OF PARALLEL ADJACENT PIPING. HANGERS ON DIFFERENT ADJACENT SERVICE LINES RUNNING PARALLEL WITH EACH OTHER SHALL BE ARRANGED TO BE IN LINE WITH EACH OTHER AND PARALLEL TO THE LINES OF THE BUILDING.

ALL ANCHORS INCORPORATED IN PIPING SYSTEMS FOR THE PURPOSE OF MAINTAINING PERMANENT PIPE POSITIONS SHALL BE WELDED TO THE PIPING AND ATTACHED TO THE BUILDING STRUCTURE IN A MANNER APPROVED BY THE CONTRACTING OFFICER.

PIPING SHALL BE FIRMLY BRACED AGAINST SWAY, VIBRATION AND REACTION. BRACING SHALL CONSIST OF BRACKETS, ANCHOR CHAIRS, RODS, PRELOADED SPRINGS, AND STRUCTURAL STEEL.

FIRE PROTECTION LINES, WHEN SUPPORTED FROM ROOF PURLINS, SHALL NOT BE LOCATED GREATER THAN ONE-SIXTH OF THE PURLIN SPAN FROM THE ROOF TRUSS. LOADS PER HANGER SHALL NOT EXCEED 400 POUNDS, WHEN SUPPORT IS FROM A SINGLE PURLIN OR 800 POUNDS WHEN HANGER LOAD IS APPLIED TO PURLINS HALFWAY BETWEEN PURLINS BY MEANS OF AUXILIARY SUPPORT STEEL BY THIS CONTRACTOR. WHEN SUPPORT IS NOT HALFWAY BETWEEN PURLINS THE ALLOWABLE HANGER LOAD SHALL BE THE PRODUCT OF 400 TIMES THE INVERSE RATIO OF THE LONGEST DISTANCE TO PURLIN TO PURLIN SPACING.

WHEN THE HANGER LOAD EXCEEDS THE ABOVE LIMITS THE REINFORCING OF THE ROOF PURLIN(S) OR ADDITIONAL SUPPORT BEAM(S) SHALL BE PROVIDED. WHEN AN ADDITIONAL BEAM IS USED THE BEAM SHALL BEAR ON THE TOP CHORD OF THE ROOF TRUSSES AND BEARING SHALL BE OVER GUSSET PLATES OF TOP CHORD. STABILIZE BEAM BY CONNECTION TO ROOF PURLIN ALONG BOTTOM FLANGE WITH 2" X 2" X 1/4" ANGLE WELDED BOTH ENDS.

ALL PURLINS USED FOR SUPPORTING FIRE PROTECTION SPRINKLER LINES, ELECTRICAL LIGHTING FIXTURES, AND ELECTRICAL POWER DUCT OR CABLE TRAY, SHALL BE CONSIDERED FULLY LOADED.

HANGERS AND SUPPORTS SHALL BE INSTALLED AT INTERVALS SPECIFIED HEREINAFTER AT LOCATIONS NOT MORE THAN 3 FEET FROM THE ENDS OF EACH RUNOUT, AND NOT OVER 25 PERCENT OF SPECIFIED INTERVAL FROM EACH CHANGE IN DIRECTION OF THE PIPE.

THE LOAD RATING FOR ALL PIPE HANGER SUPPORTS SHALL BE BASED ON ALL PIPES FILLED WITH WATER, THE DEFLECTION PER SPAN SHALL NOT EXCEED SLOPE GRADIENT OF PIPE. SCHEDULE 40 AND HEAVIER FERROUS PIPE SUPPORTS SHALL BE IN ACCORDANCE WITH THE FOLLOWING MINIMUM ROD SIZE AND MAXIMUM ALLOWABLE HANGER SPACING. FOR CONCENTRATED LOADS SUCH AS VALVES, REDUCE ALLOWABLE SPAN PROPORTIONATELY.

PIPE SIZE (INCHES)	ROD SIZE (INCHES)	STEEL PIPE SPAN (FEET)
1/2 AND SMALLER	3/8	8
3/4 - 1	3/8	8
1-1/4 - 1-1/2	3/8	10
2	3/8	12
2-1/2 - 3-1/2	1/2	12
4 - 5	5/8	16
6	3/4	16
8	7/8	20

VERTICAL RISERS SHALL BE SUPPORTED AT THE BASE WHERE POSSIBLE AND AT INTERVALS SPECIFIED. PIPING SHALL BE GUIDED FOR LATERAL STABILITY AS SPECIFIED. CLAMPS SHALL BE PLACED UNDER FITTINGS WHEREVER POSSIBLE. CARBON STEEL PIPE SHALL BE SUPPORTED AT EACH FLOOR, AT NOT MORE THAN 15-FOOT INTERVALS FOR PIPE 2 INCHES AND SMALLER, AND AT NOT MORE THAN 20-FOOT INTERVALS FOR PIPE 2-1/2 INCHES AND LARGER.

AFTER THE PIPING SYSTEMS HAVE BEEN INSTALLED, TESTED AND PLACED IN SATISFACTORY OPERATION, FIRMLY TIGHTEN HANGER ROD NUT AND JAM NUT TO PREVENT ANY MOVEMENT OF NUTS.

---SLEEVES

SLEEVES ARE REQUIRED WHERE PIPING PASSES THROUGH THE VALVE STATION CONCRETE SLAB AND THE FIRE HOSE REEL SUPPORT CONCRETE. SLEEVES SHALL BE GALVANIZED SCHEDULE 40 STEEL PIPE.

LAY OUT SLEEVE WORK IN ADVANCE OF PLACING OF SLABS, AND FURNISH AND SET ALL SLEEVES NECESSARY TO COMPLETE THE WORK.

THE SPACE BETWEEN A PIPE AND THE INSIDE OF A PIPE SLEEVE SHALL BE PACKED SOLID WITH DOW-CORNING NO. 790, OR GENERAL ELECTRIC "SILPRUF," OR EQUAL SEALANT COMPLYING WITH FS TTS-001543.

---SYSTEM TESTING---

---GENERAL

SYSTEMS PRESSURE AND LEAK TESTS SHALL BE CONDUCTED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED UNDER "INSTALLATION OF MATERIALS AND EQUIPMENT" AND REQUIREMENTS SPECIFIED HEREIN. PRESSURE TEST SHALL INCLUDE NEW WORK PLUS PORTIONS OF EXISTING SYSTEMS TO WHICH NEW WORK CONNECTS.
PRIOR TO ACCEPTANCE OF THE WORK, TEST ALL COMPLETED SYSTEMS IN THE PRESENCE OF THE CONTRACTING OFFICER AND THEN UPON APPROVAL, PROVIDE CERTIFICATES OF TESTING.

TESTS SHALL BE HYDROSTATIC, UNLESS OTHERWISE SPECIFIED. ONLY POTABLE WATER SHALL BE USED FOR TESTING.

THE GOVERNMENT WILL SUPPLY TESTING WATER AT A LOCATION DETERMINED BY THE CONTRACTING OFFICER.

THE CONTRACTOR MAY CONDUCT TESTS FOR HIS OWN PURPOSES BUT THE ACCEPTANCE TEST SHALL BE CONDUCTED AS SPECIFIED HEREIN.

IN THE EVENT THAT THE TEST DEMONSTRATES THAT LEAKAGE RATE EXCEEDS SPECIFIED LIMITS, THE CONTRACTOR SHALL DETERMINE THE SOURCE(S) OF LEAKAGE, REPAIR OR REPLACE DEFECTIVE MATERIALS AND WORKMANSHIP, AND RETEST THE INSTALLATION UNTIL SPECIFIED REQUIREMENTS ARE COMPLIED WITH.

IRRESPECTIVE OF THE AMOUNT OF MEASURED LEAKAGE, ALL VISIBLE LEAKS OR DEFECTS IN THE PIPELINE SHALL BE IMMEDIATELY REPAIRED BY THE CONTRACTOR.

OTHER THAN STANDARD PIPING FLANGES, PLUGS, CAPS AND VALVES, ONLY COMMERCIALLY MANUFACTURED EXPANDABLE ELASTOMER PLUGS SHALL BE USED FOR SEALING OFF PIPING FOR TEST PURPOSES. THE SAFE TEST PRESSURE RATING OF ANY PLUG USED, SHALL BE NOT LESS THAN TWO TIMES THE ACTUAL TEST PRESSURE BEING APPLIED.

TAKE ALL NECESSARY PRECAUTIONS TO VENT THE EXPANSIVE FORCE OF COMPRESSED AIR TRAPPED DURING HIGH PRESSURE HYDROSTATIC TESTING AND PRECLUDE INJURY AND DAMAGE. THE CONTRACTING OFFICER MAY REQUIRE THE REMOVAL OF ANY SYSTEM COMPONENT SUCH AS PLUGS, CAPS, ETC., TO ASCERTAIN WHETHER OR NOT THE WATER HAS REACHED ALL PARTS OF THE SYSTEM IF PURGING OR VENT VALVES ARE NOT PROVIDED BY THE CONTRACTOR.

COMPONENTS SHALL BE REMOVED FROM PIPING SYSTEMS DURING HYDROSTATIC TESTING WHENEVER THE COMPONENT MAY SUSTAIN DAMAGE DUE TO TEST PRESSURE.

LEAKING GASKET JOINTS SHALL BE REMADE WITH NEW GASKETS.

PIPING SYSTEM COMPONENTS SUCH AS VALVES SHALL BE CHECKED FOR PROPER OPERATION UNDER SYSTEM TEST PRESSURES.

TEMPERATURE OF WATER USED FOR TESTING SHALL BE HIGH ENOUGH TO PRECLUDE CONDENSATION OF ATMOSPHERIC MOISTURE ON SYSTEM SURFACES.

NO TEST MEDIA MAY BE ADDED TO A SYSTEM DURING A TEST FOR A PERIOD AS SPECIFIED OR TO BE DETERMINED BY THE CONTRACTING OFFICER.

THE DURATION OF A TEST WILL BE DETERMINED BY THE CONTRACTING OFFICER AND SHALL BE AS HEREINAFTER SPECIFIED WITH A MAXIMUM OF 24 HOURS, UNLESS OTHERWISE SPECIFIED. THE TEST MAY BE TERMINATED BY DIRECTION OF THE CONTRACTING OFFICER AT ANY POINT DURING THIS PERIOD AFTER IT HAS BEEN DETERMINED THAT THE PERMISSIBLE LEAKAGE RATE HAS NOT BEEN EXCEEDED.

PREPARE AND MAINTAIN TEST RECORDS OF ALL PIPING SYSTEM TESTS. RECORDS SHALL SHOW GOVERNMENTAL AND CONTRACTOR TEST PERSONNEL RESPONSIBILITIES, DATES, TEST GAGE IDENTIFICATION NUMBER, AMBIENT AND TEST WATER TEMPERATURES, PRESSURE RANGES, RATES OF PRESSURE DROPS, AND LEAKAGE RATES. EACH TEST ACCEPTANCE SHALL BE SIGNED BY THE CONTRACTING OFFICER.

---TEST GAGES

TEST GAGES, TO BE ACCEPTABLE, SHALL HAVE DIAL SIZE 4-1/2 INCHES OR LARGER WITH ACCURACY OF PLUS OR MINUS ONE-HALF OF ONE PERCENT OF FULL SCALE RANGE AND DIAL GRADUATIONS AND POINTER WIDTH COMPATIBLE WITH READABILITY ONE-HALF THE ACCURACY EXTREMES. MAXIMUM PERMISSIBLE SCALE RANGE FOR A GIVEN TEST SHALL BE SUCH THAT THE POINTER DURING A TEST SHALL HAVE A STARTING POSITION AT MID-POINT OF THE DIAL OR WITHIN THE MIDDLE THIRD OF THE SCALE RANGE. CERTIFICATION OF ACCURACY AND CORRECTION TABLE SHALL BEAR A DATE WITHIN 90 DAYS OF THE TEST USE, TEST GAGE NUMBER, AND THE PROJECT NUMBER, UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

---PRESSURE TEST AND ACCEPTABLE CRITERIA

ABOVEGROUND SYSTEMS SHALL BE TESTED AT 200 PSIG AND THE APPLIED PRESSURE SHALL BE MAINTAINED WITHOUT FURTHER ADDITION OF TEST MEDIA FOR NOT LESS THAN *2 hours*.THE MAXIMUM ALLOWABLE PRESSURE DROP SHALL BE 2 PSI, OR AS APPROVED BY THE CONTRACTING OFFICER. A

UNDERGROUND RUBBER JOINTED FERROUS PIPE WATER SYSTEMS SHALL BE TESTED AT 200 PSIG AND THE APPLIED TEST PRESSURE SHALL BE MAINTAINED FOR NOT LESS THAN TWO HOURS. AFTER SATISFACTORY HYDROSTATIC TESTING, PIPING SHALL BE TESTED FOR LEAKAGE AS FOLLOWS:

THE DURATION OF EACH LEAKAGE TEST SHALL BE NOT LESS THAN 2 HOURS, AND DURING THE TEST THE MAIN SHALL BE SUBJECTED TO 200 POUNDS PER SQUARE INCH PRESSURE BASED ON THE ELEVATION OF THE LOWEST SECTION UNDER TEST AND CORRECTED TO THE ELEVATION OF THE TEST GAGE.

LEAKAGE IS DEFINED AS THE QUANTITY OF WATER TO BE SUPPLIED INTO THE LAID PIPE, OR ANY VALVED SECTION THEREOF, NECESSARY TO MAINTAIN THE SPECIFIED LEAKAGE TEST PRESSURE AFTER THE PIPE HAS BEEN FILLED WITH WATER AND THE AIR EXPELLED.

NO PIPING INSTALLATION WILL BE ACCEPTED IF THE LEAKAGE IN GALLONS PER HOUR EXCEEDS 0.00054 TIMES THE NUMBER OF JOINTS IN THE LENGTH OF THE PIPE LINE TESTED, TIMES THE NOMINAL DIAMETER OF THE PIPE IN INCHES, TIMES THE SQUARE ROOT OF THE AVERAGE TEST PRESSURE EXPRESSED AS PSIG. THE ALLOWABLE LEAKAGE IN GALLONS PER HOUR, PER JOINT, AT 200 POUNDS PER SQUARE INCH AVERAGE TEST PRESSURE SHALL BE AS FOLLOWS:

PIPE DIAMETER (INCHES)	GALLONS PER HOUR
4	0.0306
6	0.0458

HYDROSTATIC TESTS SHALL BE APPLIED TO PIPING WITH CONCRETE THRUST BLOCKING NOT LESS THAN SEVEN (7) DAYS AFTER CONCRETE PLACEMENT.

---WATER FLOW TEST

EACH COMPLETED SYSTEM SHALL BE GIVEN AN OPERATIONAL FLOW TEST FOR WHICH PRESSURIZED WATER WILL BE PROVIDED BY THE GOVERNMENT. ALL AUTOMATIC AND MANUAL ACTIVATION DEVICES, AND RELATED ELECTRIC SWITCH DEVICES FOR

FIRE ALARM SIGNALS, SHALL BE DEMONSTRATED TO FUNCTION PROPERLY. SYSTEMS WITH HEAT ACTIVATED DEVICES (HAD) SHALL BE TRIGGERED BY THE APPLICATION OF HEAT TO THE PARTICULAR DEVICE AS SELECTED BY THE CONTRACING OFFICER. THE SSAT TOWER FOGGING SYSTEMS SHALL BE OPERATED BY APPLYING CONTRACTOR-FURNISHED COMMERCIALLY CLEAN COMPRESSED NITROGEN TO THE RESPECTIVE CONTROL VALVE OPERATORS LOCATED AT THE THREE TOWER LEVELS.

---STERILIZATION WORK---

---GENERAL

SYSTEMS SHALL BE STERILIZED WITH AN APPROVED CHLORINE SOLUTION PRIOR TO SYSTEM ACCEPTANCE, INCLUDING NEW WORK PLUS PORTIONS OF EXISTING SYSTEMS TO WHICH NEW WORK CONNECTS.
THE CONTRACTOR SHALL PROVIDE ALL NECESSARY CHLORINE AND ALL OTHER MATERIALS AND LABOR TO CHLORINATE THE PIPING SYSTEMS AND TO SET-UP AND PERFORM THE TESTS.

APPLICATION OF CHLORINATED SOLUTION SHALL BE AT THE POINT OF LINE ORIGIN NEAREST TO EXISTING CHLORINATED SUPPLY.

---MATERIALS

CHLORINE SOLUTION SHALL BE CALCIUM HYPOCHLORITE, AND FOR SMALL LINE SIZES, COMMERCIAL, LAUNDRY BLEACH WITH MINIMUM 5.25 PERCENT AVAILABLE CHLORINE. BLEACH SHALL BE ADDED IN THE RATIO OF 1/8-OUNCE OF BLEACH PER GALLON OF WATER IN SYSTEM TO OBTAIN REQUIRED 50 PPM AT TIME OF FILLING. THE FOLLOWING TABLE SHOWS THE AMOUNT OF CALCIUM HYPOCHLORITE, IN OUNCES, TO THE NEAREST 1/2-OUNCE TO BE PLACED FOR EACH DIAMETER AND INDICATED LENGTH OF PIPE:

DIAMETER OF PIPE, INCHES	PIPE LENGTHS, FEET 12	16	40	50
6 AND SMALLER	0.5	0.5	0.5	0.5

---PROCEDURES

THE FOLLOWING PROCEDURE SHALL BE FOLLOWED IN APPLYING CALCIUM HYPOCHLORITE TO THE PIPING:

THE CALCIUM HYPOCHLORITE SHALL BE MADE UP AS A SLURRY IN A CONVENIENT CONTAINER.

THE PROPER AMOUNT OF CALCIUM HYPOCHLORITE IN SLURRY FORM SHALL BE ADDED SIMULTANEOUSLY TO EACH SECTION OF LINE AS IT IS BEING FILLED WITH WATER FROM POTABLE SOURCE.

LINE BEING STERILIZED SHALL STAND FOR A MINIMUM OF 24-HOURS DURING WHICH TIME CARE SHALL BE EXERCISED TO PRECLUDE DUMPING OR DILUTION OF CONTENTS.

STERILIZING SOLUTION SHALL PRODUCE NO LESS THAN 10 PPM CHLORINE RESIDUAL AT EXTREME END OF LINE AT THE END OF THE RETENTION PERIOD.

AFTER 24-HOURS, THE STERILIZING SOLUTION SHALL BE FLUSHED OUT UNTIL THE CHLORINE CONTENT IS LESS THAN 1 PPM.

THE LINE SHALL BE ALLOWED TO STAND AN ADDITIONAL 24 HOURS; IF THERE IS A CHLORINE RESIDUAL, A BACTERIOLOGICAL COUNT WILL BE MADE BY THE GOVERNMENT AND IF THE COUNT IS WITHIN UNITED STATES PUBLIC HEALTH SERVICE RECOMMENDATIONS, PIPING MAY BE PUT INTO SERVICE.

THE CONTRACTOR SHALL PROVIDE AT LEAST THREE SAMPLES FOR BACTERIOLOGICAL TESTING BY THE GOVERNMENT AT THE END OF 7 DAYS AND AT THE END OF 21 DAYS AFTER THE DISTRIBUTION SYSTEM HAS BEEN PUT INTO SERVICE.

THE STERILIZATION PROCESS SHALL BE REPEATED UNTIL SPECIFIED RESULTS ARE OBTAINED.

ALL PIPES, VALVES, COCKS, FITTINGS, HOSES, CONTAINERS AND MISCELLAENOUS ITEMS USED FOR CONNECTION OF NEW PIPING TO AN EXISTING FACILITY SHALL BE THOROUGHLY STERILIZED IMMEDIATELY PRIOR TO INSTALLATION. ALL MATERIALS INVOLVED SHALL BE CLEANED AND STERILIZED WITH A SOLUTION CONTAINING NOT LESS THAN 2000 PPM AVAILABLE CHLORINE AND FLUSHED WITH POTABLE WATER. CARE SHALL BE EXERCISED TO PRECLUDE CONTAMINATION OF STERILIZED MATERIALS PRIOR TO INSTALLATION.

FOLLOWING STERILIZATION AND APPROVAL OF TESTS, PIPING SYSTEM SHALL BE PURGED BY FLUSHING AND FILLED WITH NON-CHLORINATED FRESH WATER.

---ELECTRICAL WORK---

---ELECTRICAL SERVICE

ELECTRICAL SERVICE AVAILABLE FOR POWER IS 480 VAC, 3 PHASE, 60 HERTZ (HZ) AND 120/240 VAC SINGLE PHASE 60 HZ. EQUIPMENT FURNISHED WITH VOLTAGE REQUIREMENTS OTHER THAN THAT SPECIFIED SHALL INCLUDE ALL NECESSARY TRANSFORMER EQUIPMENT SELECTED TO PROVIDE VOLTAGE LIMITS WHICH WILL PROVIDE MAXIMUM EFFICIENCY OPERATION. THE CONTRACTOR SHALL REFER TO THE ELECTRICAL DRAWINGS AND DIVISION 16 ELECTRICAL WORK SPECIFICATIONS FOR SPECIFIC INFORMATION AS TO PROVISIONS FOR AND ARRANGEMENT OF THE ELECTRIC SERVICE CIRCUITS AND THEIR EFFECT ON THE EQUIPMENT AND WORK SPECIFIED HEREIN.

SECTION 15T

ELEVATED STEEL WATER TANK

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
AWS	AMERICAN WELDING SOCIETY
AWWA	AMERICAN WATER WORKS ASSOCIATION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
MIL	MILITARY SPECIFICATIONS
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION

---GENERAL

THE WORK COVERED BY THIS SECTION OF THE SPECIFICATIONS CONSISTS OF FURNISHING ALL PLANT, LABOR, EQUIPMENT, ACCESSORIES, AND MATERIALS, AND IN PERFORMING ALL OPERATIONS IN CONNECTION WITH THE DESIGN, FABRICATION AND ERECTION OF AN ELEVATED STEEL WATER TANK, INCLUDING CONCRETE FOUNDATIONS FOR TANK COLUMNS AND RISERS, FITTINGS, AND PIPING, COMPLETE AS SHOWN ON DRAWING 79K10338 AND AS SPECIFIED HEREIN.

---SHOP AND ERECTION DRAWINGS, AND OPERATION, MAINTENANCE, PARTS AND TESTING MANUALS

SHOP AND ERECTION DRAWINGS SHALL BE SUBMITTED FOR APPROVAL. THE DRAWINGS SHALL BE COMPLETE WITH DETAILS OF ALL STEEL WORK, PIPE WORK, ELECTRICAL WORK, AND CONCRETE WORK AND WITH DETAILS OF THE ASSEMBLING OF ALL ITEMS REQUIRED FOR THE COMPLETE INSTALLATION. THE GENERAL ARRANGEMENT OF ACCESSORIES SHALL BE AS SHOWN ON THE DRAWINGS. SUBMIT SHOP DRAWINGS IN ACCORDANCE WITH THE "CONTRACT SCHEDULE."

THE SHOP DRAWINGS SHALL INCLUDE MANUFACTURER'S DRAWINGS SHOWING THE DIMENSIONS OF THE TANK AND TOWER, INDICATING THE HEIGHT TO LOWER AND UPPER CAPACITY LEVELS, THICKNESSES OF ALL IMPORTANT PLATES, THE SECTIONS OF THE COLUMNS, STRUTS, SWAY RODS, AND ALL PRINCIPAL MEMBERS, ACCOMPANIED BY DATA AND STRESS SHEETS, TOGETHER WITH WELDING DATA FOR EACH TYPE OF WELDED JOINT, WITH COMPUTATIONS IN SUFFICIENT DETAIL TO ENABLE THE STRESSES AND FOUNDATION LOADINGS TO BE READILY CHECKED. WITHIN TWO WEEKS AFTER AWARD OF CONTRACT AND PRIOR TO FOUNDATION CONSTRUCTION, CONTRACTOR SHALL SUBMIT FOUNDATION LOADING DATA. Δ A

CONTRACTOR SHALL PROVIDE MANUALS FOR OPERATION, MAINTENANCE, PARTS LISTING AND TESTING OF ALL EQUIPMENT FURNISHED AS OUTLINED IN THE "CONTRACT SCHEDULE".

GENERAL

ELEVATION OF TANK, BOTTOM ELEVATION OF COLUMNS, AND EXISTING GRADE ELEVATION AT TANK SITE SHALL BE AS SHOWN ON THE DRAWINGS. TOTAL TANK CAPACITY SHALL BE NOT LESS THAN 300,000 U.S. GALLONS FRESH, NON-POTABLE WATER.

THE TANK SHALL HAVE AN ELLIPSOIDAL BOTTOM WITH VERTICAL SIDE SHEETS OR SHALL BE OF AN ELLIPTICAL OR OVAL DESIGN COMPLYING WITH AWWA D100-73. THE LOWER SECTION OF THE ROOF MAY BE USED FOR WATER STORAGE. THE TOWER SUPPORTING THE TANK SHALL BE CONSTRUCTED OF STRUCTURAL TUBULAR SECTIONS, SEAL WELDED AIR-TIGHT. THE TOWER SHALL BE THROUGHLY BRACED WITH HORIZONTAL STRUTS AND DIAGONAL TIES. THE TOWER COLUMNS MAY BE VERTICAL OR INCLINED AS THE DESIGN MAY REQUIRE. MAIN COLUMN SPLICES SHALL BE AS FEW AS POSSIBLE AND SHALL BE LOCATED AS NEAR AS PRACTICABLE TO THE INTERSECTION OF THE CENTERLINE OF THE STRUTS. SPLICE PLATES SHALL BE PROPERLY WELDED SO AS TO HOLD THE MEMBERS IN LINE AND TRANSMIT ANY TENSION OR SHEARING STRESSES TO WHICH THE MEMBERS MAY BE SUBJECTED. THE CONNECTIONS OF THE TANK WITH THE COLUMNS SHALL BE MADE SO AS TO DISTRIBUTE THE LOAD PROPERLY OVER THE COLUMN SECTIONS AND OVER THE SHELL OF THE TANK. ALTERNATE DESIGNS SHOWING DIFFERENT TYPES OF CONSTRUCTION MAY BE SUBMITTED AND USED ONLY WITH PRIOR APPROVAL OF THE CONTRACTING OFFICER AND AT NO ADDITIONAL COST TO THE GOVERNMENT.

---DESIGN REQUIREMENTS

THE DESIGN, FABRICATION, AND ERECTION OF THE ELEVATED TANK SHALL BE IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AWWA D100-73 AND AWS D5.2-73. THE APPLICABLE REQUIREMENTS SET FORTH IN THE FOLLOWING DESIGNATED SECTIONS THEREOF SHALL GOVERN UNLESS OTHERWISE SPECIFIED. CORROSION ALLOWANCE = .0625 FOR ALL PARTS. FOR TANK, VENT CUPOLA, TOWER, RISERS AND PIPING, THE DESIGN WIND LOAD SHALL BE 138 MPH AT A REFERENCE ELEVATION OF 60 FEET ABOVE GRADE ELEVATION AND AS NOTED ON THE DRAWINGS FOR HIGHER ELEVATIONS AND SHAPE FACTORS.

---ACCESSORIES---

ALL LADDERS AND ROOF VENT CUPOLA STEEL SHALL BE GALVANIZED.

ALL TOWER AND TANK LADDERS SHALL BE EQUIPPED WITH O.S.H.A. APPROVED SAFETY DEVICES.

ROOF VENT: SIZED TO DISCHARGE 1,200,000 GALLONS PER MINUTE FROM MAIN RISER WITHOUT COLLAPSING TANK.

TANK SHALL HAVE *ONE* RISER. THE SUPPLY SHALL BE 114 INCH I.D. PIPE AND BE LOCATED IN THE CENTER OF THE TANK. *THE TANK LOW POINT SHALL BE DRAINED INTO THE 114 INCH RISER BY A FOUR (4) INCH INTERCONNECTING LINE AS SHOWN ON THE DRAWINGS, AND SHALL BE DESIGNED WITH SUFFICIENT FLEXIBILITY TO AVOID A FLEXIBLE COUPLING.* TANK OVERFLOW TO BE STUB TYPE, AND SIZED FOR 7500 GPM FILL RATE PER AWWA D100-73, BUT NOT LESS THAN SIZE SHOWN ON THE DRAWING. (B)

PROVIDE ELECTRICAL WORK AS HEREINAFTER SPECIFIED. (B)

FURNISH AND INSTALL A LIQUID LEVEL TRANSMITTER AND INDICATOR AND OVERFLOW SWITCH FOR THE TANK AS NOTED ON THE DRAWINGS AND AS HEREINAFTER SPECIFIED.

---FABRICATION AND ERECTION---

---GENERAL

WELDING SHALL CONFORM TO AWWA D100-73, SECTION 8. TANK, TOWER AND 114 INCH RISER SHALL BE ASTM A36, OR EQUAL.
SHOP FABRICATION SHALL CONFORM TO AWWA D100-73, SECTION 9.
ERECTION SHALL CONFORM TO AWWA D100-73, SECTION 10.
CONTRACTOR SHALL FURNISH ALL UTILITIES FOR CONSTRUCTION. FOR SITE ACCESS SEE DRAWING 79K10338, SHEETS V8,V9.

---GENERAL

INSPECTION SHALL CONFORM TO AWWA D100-73, SECTION 11.
TESTING SHALL CONFORM TO AWWA D100-73, SECTION 12.1, EXCEPT AS HEREIN MODIFIED.

---TESTING

AFTER THE TANK HAS BEEN ERECTED AND PIPING INSTALLED, AND BEFORE FIELD PAINTING IS BEGUN, THE TANK AND PIPING SHALL BE SUBJECTED FOR ONE HOUR TO A HYDROSTATIC PRESSURE TEST. ANY DEFECTIVE MATERIAL DISCLOSED BY THE PRESSURE TEST SHALL BE REPLACED BY THE CONTRACTOR WITH SOUND MATERIAL, AND THE TEST SHALL BE REPEATED UNTIL THE TEST RESULTS ARE SATISFACTORY TO THE CONTRACTING OFFICER. CONTRACTOR SHALL BE RESPONSIBLE FOR CLOSING OFF TANK FOR TESTING AND REMOVING SAME AFTER TEST IS COMPLETED, AND SHALL PROVIDE ANY TEMPORARY PIPING FOR CONNECTION TO FIREX WATER SUPPLY AND FOR DRAINAGE TO EXISTING FLUME. OTHER THAN ABOVE, COMPLY WITH SECTION 12.1 OF AWWA D100-73.

---LOCATION AND ELEVATION---

---GENERAL

PRIOR TO SITE CONSTRUCTION, THE CONTRACTOR SHALL LOCATE THE CENTERLINES OF THE STRUCTURE BY ESTABLISHING MARKERS OUTSIDE THE EXCAVATION AREA TO LOCATE THE AXES OF THE TANK WITH RESPECT TO THE PROJECT BASE LINES SHOWN ON THE DRAWINGS. CENTERLINE OF TANK AND OUTLET OF 114 INCH ELBOW ARE CRITICAL FOR CONNECTING PIPING. SEE SHEET C2, "PAD 39B - DIMENSION CONTROL AND BENCH MARK."

---FOUNDATIONS

FOUNDATIONS FOR THE TANK COLUMNS AND RISERS SHALL BE CONSTRUCTED AS DETAILED ON THE DRAWINGS, MODIFIED AS REQUIRED TO SUIT THE PARTICULAR TANK DIMENSIONS AND LOADINGS FOR THE PROPOSED TANK AT NO ADDITIONAL COST TO THE GOVERNMENT UNLESS ADDITIONAL PILES ARE REQUIRED. SEE "---SHOP DRAWINGS" FOR SUBMITTAL OF FOUNDATION LOAD DATA FOR ANALYSIS AND APPROVAL.

---PIPES---

---STEEL PIPE RISER

(B)

THE LOWER PORTION OF THE 114 INCH I.D. RISER AND MITERED ELBOW SHALL HAVE A WALL THICKNESS OF NOT LESS THAN 0.750 INCHES AND SHALL OTHERWISE COMPLY WITH THE REQUIREMENTS OF SECTION 5.12 OF AWWA D100-73 AND ABOVE SPECIFIED WINDLOAD, WITH BOTTOM ANCHORED FOR ALL TANK LOADS AND THRUST LOAD OF CONNECTING PIPE.

(B)

---PAINTING---

---GENERAL

PAINTING SHALL COMMENCE AFTER TESTING. ALL COATS SHALL BE APPLIED IN SUCH MANNER AS TO PRODUCE AN EVEN FILM OF UNIFORM THICKNESS. EDGES, CORNERS, CREVICES, AND JOINTS SHALL RECEIVE SPECIAL ATTENTION TO INSURE THAT THEY ARE THROUGHLY CLEANED AND RECEIVE AN ADEQUATE THICKNESS OF PAINT. PAINT SHALL BE DELIVERED IN UNBROKEN CONTAINERS WHICH SHALL SHOW THE DESIGNATED NAME, SPECIFICATION NUMBER, COLOR, DIRECTIONS FOR USE, MANUFACTURER, AND DATE OF MANUFACTURER, ALL OF WHICH SHALL BE PLAINLY LEGIBLE AT THE TIME OF USE. DIRECTIONS FOR USE SHALL BE CAREFULLY FOLLOWED IN THE MIXING AND APPLICATION OF THE PAINT. PAINT SHALL BE APPLIED UNDER DRY AND DUST FREE CONDITIONS, AND UNLESS OTHERWISE APPROVED, SHALL NOT BE APPLIED WHEN THE TEMPERATURE IS BELOW 50 DEGREES FAHRENHEIT OR ABOVE 90 DEGREES FAHRENHEIT. SUFFICIENT TIME SHALL ELAPSE BETWEEN COATS TO PERMIT SATISFACTORY RECOATING, BUT ONCE COMMENCED, THE COMPLETE PAINTING OPERATION SHALL BE COMPLETED WITHOUT UNDUE DELAY.

---SHOP PAINTING OF ALL FERROUS STEEL

AS SOON AFTER FABRICATION AS PRACTICABLE, ALL STEEL SURFACES (EXCEPT INTERIOR, AND SEAM SURFACES OF TANK PLATES) SHALL BE ABRASIVE BLASTED AND SHOP-COATED WITH INORGANIC ZINC-RICH COATING IN STRICT ACCORDANCE WITH SECTION 9L OF THESE SPECIFICATIONS. THE SHOP COAT SHALL BE TOUCHED-UP AS NECESSARY TO MAINTAIN IT IN GOOD CONDITION IN THE FIELD AS SPECIFIED IN SECTION 9L, EXCEPT THAT TOUCH-UP SHALL BE WITH SAME MATERIAL AS SHOP-COAT AND APPLIED IN SAME MANNER AS SHOP-COAT.

---FIELD PAINTING

AFTER THE TANK HAS BEEN ERECTED AND TESTED FOR LEAKAGE, THE ENTIRE STRUCTURE SHALL BE PAINTED AS FOLLOWS:

INTERIOR TANK SURFACES (INCLUDING BELL MOUTH AND 114 INCH RISER AND ELBOW AT BASE) SHALL BE CLEANED TO BASE METAL BY DRY BLAST CLEANING IN ACCORDANCE WITH STEEL STRUCTURES PAINTING COUNCIL SPECIFICATIONS SP-5-63 TO WHITE METAL AND THEN COATED WITH COAL-TAR EPOXY CONFORMING TO "PAINT COATING SYSTEMS, STEEL SHIP TANK, FUEL AND SALT WATER BALLAST," SPECIFICATION MIL-P-23236 (SHIPS) AMEND 4, TYPE I, CLASS 2, APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS PRINTED INSTRUCTIONS TO A THICKNESS OF NOT LESS THAN 16 MILS. COATING PRODUCT SHALL BE QUALIFIED PER QPL-23236-38 DATED 14 NOVEMBER 1975.

EXTERIOR SURFACES NOT COVERED BY THE SHOP COAT, AND ALL ABRADED SURFACES IN THE SHOP COAT SHALL BE THOROUGHLY ABRASIVE BLASTED AND INORGANIC ZINC-RICH COATING APPLIED AS OUTLINED IN SECTION 9L OF THE SPECIFICATIONS.

---ELECTRICAL WORK---

---GENERAL

REROUTE UNDERGROUND WIRING AND CONDUIT TO CLEAR NEW CONSTRUCTION AS NOTED ON THE DRAWINGS.

AN OBSTRUCTION LIGHTING SYSTEM SHALL BE PROVIDED ON THE WATER TANK AS INDICATED. CONDUIT AND WIRE SHALL BE OF THE SIZE INDICATED ON THE DRAWINGS. OBSTRUCTION LIGHTING FIXTURES AND LAMPS OF THE TYPE INDICATED ON THE DRAWINGS SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR. THE OBSTRUCTION LIGHTING SYSTEM SHALL BE CONTROLLED BY MEANS OF A WEATHER PROOF PHOTO-ELECTRIC EYE AND RELAY MOUNTED ON A TOWER SUPPORT COLUMN. THE BEACON SHALL BE SUPPLIED FROM THE RELAY THROUGH A FLASHER UNIT MOUNTED IN A WEATHER-PROOF HOUSING ADJACENT TO THE PHOTO-CELL MOUNTING. POWER SUPPLY AND OTHER LIGHTING SHALL BE PROVIDED AS INDICATED ON THE DRAWINGS.

THE INSTALLATION AND RELOCATION OF CONDUIT, WIRE, TRANSFORMERS, RECEPTACLES, PHOTO-CELLS, RELAYS, FLASHER, OBSTRUCTION LIGHTING, LAMPS, ETC. SHALL BE AS INDICATED ON THE DRAWINGS AND AS SPECIFIED IN DIVISION 16 "ELECTRICAL".

---GROUNDING, BONDING AND LIGHTNING PROTECTION

GROUNDING, BONDING AND LIGHTNING PROTECTION SHALL BE INSTALLED AS INDICATED ON THE DRAWINGS AND AS SPECIFIED IN SECTION 16X (PART 51) "GROUNDING AND LIGHTNING PROTECTION".

(B)

AUTOMATIC CONTROLLER----THE CONTROLLER SHALL BE EITHER HOUSED INTEGRALLY WITH THE RECTIFIER UNIT OR IN A SEPARATE WEATHER-PROOF CABINET WITH PROVISIONS FOR LOCKING. THE AUTOMATIC CONTROLLER SHALL BE COMPLETELY SOLID STATE DESIGN HAVING NO MOVING PARTS AND SHALL BE CAPABLE OF AUTOMATICALLY MAINTAINING THE TANK-TO-WATER POTENTIAL AT (-)900 MILLIVOLTS WITH RESPECT TO A COPPER-COPPER SULPHATE REFERENCE ELECTRODE WITHIN AN ACCURACY OF 25 MILLIVOLTS. THE TANK-TO-WATER POTENTIAL MEASURED AND MAINTAINED BY THE CONTROLLER SHALL BE FREE OF "IR" DROP ERROR. THE CONTROLLER SHALL BE EQUIPPED WITH A CALIBRATED VOLTMETER HAVING AN INTERNAL IMPEDANCE EXCEEDING 1000 MEGOHMS WHICH SHALL BE SO CONNECTED TO READ FROM THE SYSTEM REFERENCE CELL, THE TANK-TO-WATER POTENTIAL BEING MAINTAINED BY THE CATHODIC PROTECTION SYSTEM. THIS VOLTAGE READING SHALL BE FREE OF "IR" DROP ERROR.

ELECTRODES----ELECTRODES SHALL BE 14.5 PERCENT SILICON ALLOY CAST IRON OF AT LEAST 1 INCH DIAMETER AND OF SUFFICIENT SIZE AND LENGTH TO PROVIDE A MINIMUM DESIGN LIFE OF EIGHT YEARS. A SUFFICIENT NUMBER SHALL BE INSTALLED TO OBTAIN REQUIRED CURRENT TO SUBMERGED SURFACES OF THE TANK. ANODES SHALL BE POSITIONED TO PROVIDE FULL DISTRIBUTION TO THE SUBMERGED SURFACE AREA. ELECTRODES SHALL BE SUSPENDED FROM A WIRE CONNECTION DEVICE ATTACHED TO THE TANK. SUSPENSION DEVICE SHALL BE A CLEVIS EQUIPPED WITH INSULATOR. ELECTRODES SHALL BE EASILY REMOVABLE FOR REPLACEMENT. HANDHOLES OF ADEQUATE SIZE. HANDHOLES SHALL BE PROVIDED WITH GASKETS AND BOLTED IN PLACE. THE CONNECTION OF THE COPPER WIRE TO THE ELECTRODE SHALL BE SEALED WITH INSULATING MATERIAL TO PREVENT ELECTROLYTIC ACTION. △B

NOTE
THIS ENTIRE SHEET IS DELETED BY △B.

REFERENCE ELECTRODE----THE SYSTEM SHALL BE EQUIPPED WITH EITHER A COPPER-COPPER SULPHATE OR SILVER-SILVER CHLORIDE REFERENCE ELECTRODE DESIGNED FOR A MINIMUM FIVE YEAR LIFE.

INSTALLATION----THE SYSTEM SHALL BE INSTALLED BY PERSONNEL WHO ARE SPECIFICALLY TRAINED IN THIS WORK BY THE MANUFACTURER AND WHO ARE ENGAGED FULL TIME IN THE INSTALLATION AND SERVICING OF CATHODIC PROTECTION EQUIPMENT.

ELECTRICAL SERVICE----FOR THE UNIT SHALL BE OBTAINED FROM THE 480/277 VOLT, 3 PHASE, PANEL TO BE INSTALLED ON A TOWER SUPPORT COLUMN AS INDICATED ON THE PLANS. THE CONTRACTOR SHALL FURNISH ALL INTERFACE EQUIPMENT FOR THE TANK CATHODIC PROTECTION SYSTEM, INCLUDING TRANSFORMERS, CIRCUIT BREAKERS, SWITCHES AND OTHER ITEMS NECESSARY FOR THE PROPER OPERATION OF CATHODIC PROTECTION SYSTEM.

ENERGIZING AND TESTING----AFTER THE INSTALLATION IS COMPLETED, THE SYSTEM SHALL BE ENERGIZED AND ADJUSTED FOR OPTIMUM OPERATION BY A TRAINED EMPLOYEE OF THE MANUFACTURER. AFTER THE UNIT IS ADJUSTED, MEASUREMENTS OF TANK-TO-WATER POTENTIAL SHALL BE TAKEN USING A COPPER-COPPER SULPHATE HALF CELL AS A REFERENCE ELECTRODE. A REPORT SHALL BE SUBMITTED WHICH INCLUDES ALL OF THE TEST RESULTS OBTAINED.

CRITERIA FOR PROTECTION----THE TANK-TO-WATER POTENTIAL WHEN THE CATHODIC PROTECTION SYSTEM IS SET TO OPERATE SHALL BE IN ACCORDANCE WITH THE PROTECTION OF STEEL AS ESTABLISHED BY THE NATIONAL ASSOCIATION OF CORROSION

NOTE

THESE FOUR PARAGRAPHS DELETED BY (B)

INSTRUCTIONS----BEFORE FINAL ACCEPTANCE, OPERATING AND MAINTENANCE INSTRUCTIONS SHALL BE FURNISHED, TOGETHER WITH TESTING DATA. SEE THE "CONTRASTING SCHEDULE." (B)

GUARANTEE----ALL WORKMANSHIP, MATERIALS AND EQUIPMENT SHALL BE GUARANTEED FOR A PERIOD OF ONE YEAR FROM DATE OF FINAL ACCEPTANCE OF THE SYSTEM BY THE GOVERNMENT. THE CONTRACTOR SHALL GUARANTEE THAT THE CATHODIC PROTECTION SYSTEM WILL PROVIDE PROTECTION AGAINST CORROSION OF THE SUBMERGED SURFACES INSIDE THE TANK. IN THE EVENT CORROSION IS NOT PREVENTED, THE CONTRACTOR SHALL, AT NO EXPENSE TO THE GOVERNMENT, MAKE WHATEVER CHANGES ARE NECESSARY IN THE CATHODIC PROTECTION SYSTEM TO PREVENT CORROSION.

---LIQUID LEVEL TRANSMITTER AND INDICATOR---

---GENERAL

EQUIPMENT SHALL BE AS NOTED ON THE DRAWING. EQUIPMENT SHALL BE MOUNTED ON STAND NEAR 16 INCH CLAYTON FILL VALVE AS SHOWN ON DRAWING 79K07861, SHEET M5. SUBMIT SHOP DRAWINGS FOR APPROVAL.

---OPERATION, MAINTENANCE, INSTRUCTIONS, PARTS AND TESTING

CONTRACTOR SHALL SUBMIT MANUAL FOR OPERATION, MAINTENANCE, INSTRUCTIONS, PARTS LIST AND TESTING AS OUTLINED IN THE "CONTRACT SCHEDULE."

---FIELD TESTING

CONTRACTOR SHALL DEMONSTRATE THAT EQUIPMENT MONITORS, INDICATES, AND TRANSMITS THE TRUE WATER LEVEL IN THE TANK AND *114* INCH RISER BETWEEN *TANK* OVERFLOW LEVEL AND *THE* BOTTOM OF *THE* 114 INCH ELBOW. (B)

---TANK OVERFLOW SWITCH---

---GENERAL

SWITCH SHALL HAVE STAINLESS STEEL FLOAT AND LINKAGE, VAPOR-PROOF ENCLOSURE, SHALL CLOSE ON RISING WATER LEVEL, UL LISTED AND EQUAL TO McDONNELL PRODUCT NO. 165. MOUNT ON TANK AND PROVIDE WIRING IN CONDUIT TO JUNCTION BOX (SEE DWG. 79K07865) AT BASE OF TANK LEG. DEMONSTRATE OPERATION.

SECTION 16V (PART 1)

GENERAL

---GENERAL REQUIREMENTS---

---SCOPE

THESE SPECIFICATIONS COVER ELECTRICAL WORK, COMPLETE.

---GENERAL

THE INSTALLATION SHALL CONFORM TO THE APPLICABLE MANDATORY RULES (THOSE CHARACTERIZED BY THE WORD "SHALL") OF NFPA NO. 70-1975, "NATIONAL ELECTRICAL CODE" (HEREINAFTER REFERRED TO AS THE NEC), EXCEPT WHERE THE SPECIFICATIONS OR DRAWINGS SPECIFICALLY EXCEED THE REQUIREMENTS OF THE NEC. IN ADDITION, ALL REQUIREMENTS OF THE OSHA STANDARDS SHALL BE MANDATORY FOR ALL CONSTRUCTION, INSTALLATION, AND EQUIPMENT COVERED BY THESE SPECIFICATIONS.

MATERIALS SHALL BE NEW, UNUSED, AND OF RECENT MANUFACTURE, EXCEPT WHERE REUSE OF EXISTING EQUIPMENT AND MATERIALS IS SHOWN ON THE DRAWINGS OR IDENTIFIED IN THE SPECIFICATIONS.

MATERIALS AND EQUIPMENT SHALL BE AS SPECIFIED HEREIN AND AS SHOWN ON THE DRAWINGS AND SHALL BE THE PRODUCT OF MANUFACTURERS REGULARLY ENGAGED IN THE MANUFACTURE OF EACH PRODUCT. WHERE TWO OR MORE UNITS OF THE SAME CLASS OF EQUIPMENT ARE REQUIRED, THESE UNITS SHALL BE OF THE SAME MANUFACTURER AND SHALL BE DIRECTLY INTERCHANGEABLE WHEN OF THE SAME RATING.

ALL MATERIALS THAT ARE SHOWN ON THE DRAWINGS AND LISTED IN THE SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED OR INDICATED, SHALL BE FURNISHED AS A PART OF THE CONTRACT.

ANY ITEM CALLED FOR ON THE DRAWINGS, BUT OMITTED IN THESE SPECIFICATIONS, OR CALLED FOR IN THESE SPECIFICATIONS, BUT OMITTED FROM THE DRAWINGS, SHALL BE FURNISHED AND INSTALLED AS THOUGH INCLUDED IN BOTH.

THE CONTRACT DRAWINGS INDICATE THE EXTENT AND GENERAL ARRANGEMENT OF THE CONDUIT, EQUIPMENT AND DISTRIBUTION SYSTEMS. WHERE DIMENSIONS ARE NOT INDICATED ON THE DRAWINGS, THE LOCATION OR MEASUREMENT SHALL BE DETERMINED ON THE JOB BY THE CONTRACTOR. THE DRAWINGS SHALL NOT BE SCALED TO DETERMINE CABLE LENGTHS. THE CONTRACTOR SHALL VERIFY THE EXACT DISTANCES BETWEEN CABLE TERMINATION POINTS BEFORE GIVING THE CUTTING LENGTHS OF CABLES TO THE MANUFACTURER AND BEFORE INSTALLING CABLES.

---STORAGE

AN AREA FOR STORAGE OF MATERIAL AND EQUIPMENT WILL BE PROVIDED BY THE GOVERNMENT. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO TRANSPORT, HANDLE AND PLACE ALL MATERIAL AND EQUIPMENT, AS REQUIRED. THE CONTRACTOR SHALL TAKE NECESSARY STEPS, AS REQUIRED, TO PROTECT ANY EQUIPMENT. REFER TO THE CONTRACT SCHEDULE FOR FURTHER DETAILS.

---SUBMITTALS OF SHOP DRAWINGS AND DESCRIPTIVE DATA

ALL SUBMITTALS SHALL CONFORM TO THE REQUIREMENTS OF THE ARTICLE "SHOP DRAWINGS" OF THE CONTRACT SCHEDULE.

PRIOR TO SUBMITTAL OF SHOP DRAWINGS, THE CONTRACTOR SHALL SUBMIT, IN TRIPLICATE, TO THE GOVERNMENT FOR APPROVAL, A COMPLETE LIST OF MATERIALS AND EQUIPMENT PROPOSED FOR INSTALLATION. THIS LIST SHALL INCLUDE MANUFACTURER'S NAMES WITH MATERIAL OR EQUIPMENT IDENTIFICATION SUCH AS STYLES, TYPES, CATALOG NUMBERS AND A UNIT PRICE TO PERMIT READY AND COMPLETE IDENTIFICATION.

IN ADDITION TO THE ABOVE AND BEFORE STARTING INSTALLATION OF ANY MATERIALS OR EQUIPMENT, THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS FOR APPROVAL. THE SHOP DRAWINGS SHALL INCLUDE CATALOG CUTS OR DRAWINGS OF THE ITEMS BEING SUBMITTED, AS WELL AS COMPLETE DETAILED WIRING DIAGRAMS. THE FOLLOWING TYPES OF NEW EQUIPMENT REQUIRE SUBMITTALS:

FIRE ALARM DEVICES	CABLES	*CABLE TRAY (NEW)
BOXES AND ENCLOSURES	SPECIAL RECEPTACLES	*CABLE TRAY SUPPORTS (NEW)
SAFETY SWITCHES	PANELBOARDS	*CABLE TRAY (EXISTING)
CIRCUIT BREAKERS	LIGHTING FIXTURES	*CABLE TRAY SUPPORTS (EXISTING)
TRANSFORMERS	RELAYS	
SENSORS	POWER SUPPLIES	
TERMINAL CABINETS	DISTRIBUTORS	* = INCLUDE LAYOUT SHOWING LOCATIONS OF SUPPORTS AND SPLICES.
BULKHEAD PLATES FOR MULTI-CONDUCTOR INSTRUMENTATION CABLES		

SUPPORT ASSEMBLIES INCLUDING COMPONENT PARTS LIST
EQUIPMENT IDENTIFICATION NAME PLATES WITH PLATE TEXT
ANY DEVICE OR MATERIAL RATED AT 5KV AND HIGHER
OTHER SIMILAR ELECTRICAL ASSEMBLIES

THIRTY DAYS PRIOR TO ANY CABLE TESTING, THE CONTRACTOR MUST SUBMIT FOR APPROVAL A TEST PLAN LISTING THE TYPES OF INSTRUMENTS THAT WILL BE USED, WITH CALIBRATION DETAILS FOR EACH INSTRUMENT AND THE PROCEDURE TO BE USED TO ACCOMPLISH THE REQUIRED CABLE TESTS.

APPROVAL OF THE MATERIALS AND SHOP DRAWINGS SHALL NOT BE CONSTRUED AS AUTHORIZING ANY DEVIATIONS FROM THE SPECIFICATIONS, UNLESS ATTENTION HAS BEEN DIRECTED TO THESE DEVIATIONS. MATERIALS DIFFERING FROM THOSE SPECIFIED MAY BE PROPOSED, PROVIDED THE CONTRACTOR CLEARLY STATES SUCH AND PROVIDED ALL ESSENTIAL REQUIREMENTS OF THE SPECIFICATIONS ARE MET. IF THE MATERIALS OFFERED UNDER THIS PROVISION ARE EQUAL TO OR BETTER THAN THOSE SPECIFIED, THEY WILL BE GIVEN CONSIDERATION. ANY ADDITIONAL EXPENSE INCURRED BY THE CONTRACTOR BY DEVIATION FROM THE SPECIFICATIONS AND DRAWINGS SHALL ENTAIL NO ADDITIONAL COST TO THE GOVERNMENT.

---PROOFS OF COMPLIANCE

APPROVAL OF MATERIALS AND EQUIPMENT WILL BE BASED ON THE FOLLOWING:

MANUFACTURER'S PUBLISHED CATALOG DATA.

MANUFACTURER'S STATEMENT THAT THE MATERIAL OR EQUIPMENT COMPLIES WITH THE APPLICABLE FEDERAL, MILITARY, AND INDUSTRIAL SPECIFICATIONS.

UL STAMP, LABEL, OR LISTING. IN LIEU OF SUCH STAMP, LABEL, OR LISTING, THE CONTRACTOR MAY SUBMIT A WRITTEN CERTIFICATE FROM ANY APPROVED AND NATIONALLY RECOGNIZED TESTING AGENCY ADEQUATELY EQUIPPED AND COMPETENT TO PERFORM SUCH SERVICES, STATING THAT THE MATERIALS HAVE BEEN TESTED AND THAT THE ITEMS CONFORM WITH OR EXCEED THE REQUIREMENTS OF THE UL, INCLUDING THE METHODS OF TESTING.

SUBMITTAL SHALL COMPLY WITH THE REQUIREMENTS OF THE ARTICLE ENTITLED "CERTIFICATES OF COMPLIANCE" OF THE CONTRACT SCHEDULE.

---EQUIPMENT IDENTIFICATION

EACH GFE OR CONTRACTOR FURNISHED ITEM OF ELECTRICAL EQUIPMENT SHALL BE CLEARLY AND PERMANENTLY LABELED WITH A SECURELY FASTENED NAMEPLATE. EXCEPT WHERE SPECIFIED OTHERWISE ALL NAMEPLATES SHALL BE 1/16 INCH THICK ENGRAVED LAMINATED PLASTIC MEETING THE REQUIREMENTS OF FS L-P-387A, "PLASTIC SHEET, LAMINATED, THERMO-SETTING (FOR DESIGNATION PLATES)" TYPE "NEP", AND SHALL HAVE 1/4-INCH HIGH WHITE LETTERS ON A

BLACK BACKGROUND. INFORMATION ON EACH NAMEPLATE SHALL INCLUDE VOLTAGE AND CURRENT RATING, NUMBER OF PHASES, PANEL, CIRCUIT NUMBER FROM WHICH THE EQUIPMENT IS FED, THE IDENTIFYING MARK INDICATED ON THE CONTRACT DRAWINGS AND ITEM OF EQUIPMENT CONTROLLED. FOR RECEPTACLES, ALUMINUM TAPE MAY BE SUBSTITUTED FOR LAMINATED PLASTIC WHERE SPACE LIMITATIONS OR MOUNTING DIFFICULTIES ARE ENCOUNTERED.

WIRES SHALL BE PERMANENTLY MARKED ON 2-FOOT OR CLOSER CENTERS WITH MAXIMUM WORKING VOLTAGE, NEC TYPE, MANUFACTURER'S NAME, AND AWG SIZE.

CONTROL CIRCUIT TERMINALS OF EQUIPMENT SHALL BE PROPERLY IDENTIFIED BY COLOR-CODED INSULATED CONDUCTORS, NUMBER-CODED PLASTIC SELF-STICKING PRINTED MARKERS, OR PERMANENTLY ATTACHED STAMPED METAL-FOIL MARKERS.

CABLE IDENTIFICATION PLATES AND TAGS SHALL BE AS SPECIFIED ON THE CONTRACT DRAWINGS. CABLE AND CONDUCTOR IDENTIFICATION SHALL BE PROVIDED WITHIN EACH ENCLOSURE WHERE A TAP, SPLICE OR TERMINATION IS MADE AND AT THE EQUIPMENT TERMINAL OF EACH CONDUCTOR. CABLE, TERMINAL AND CONDUCTOR IDENTIFICATION SHALL MATCH THAT SHOWN ON APPROVED SHOP DRAWINGS. IN DISTRIBUTORS ALL CABLE IDENTIFICATION SHALL BE IMMEDIATELY BELOW THEIR RESPECTIVE TERMINAL BLOCKS OR IMMEDIATELY BESIDE ALL CABLE CONNECTORS.

CONDUCTORS SHALL BE COLOR-CODED; 3-PHASE CONDUCTORS CONNECTED TO A PARTICULAR PHASE SHALL BE OF THE SAME COLOR (PHASE A, BLACK; PHASE B, RED; PHASE C, BLUE; NEUTRAL, WHITE OR GRAY). INSULATED GROUND WIRES SHALL BE GREEN.

WIRING DIAGRAMS INDICATE WIRE AND CONDUIT SIZES FOR TYPICAL EQUIPMENT. IF SIZES SHOWN ON THE DRAWINGS ARE NOT APPROPRIATE FOR THE EQUIPMENT CHOSEN BY THE CONTRACTOR, WIRES AND CONDUIT SHALL BE SIZED FOR THE PROPER CURRENT CARRYING CAPACITY IN ACCORDANCE WITH THE NEC, AT NO EXTRA COST TO THE GOVERNMENT.

---SERVICE INTERRUPTIONS

SERVICE INTERRUPTIONS WILL BE GRANTED AT THE CONVENIENCE OF THE GOVERNMENT ONLY AND AS OUTLINED IN THE CONTRACT SCHEDULE.

---GOVERNMENT FURNISHED EQUIPMENT (GFE)

ALL EQUIPMENT SHOWN ON THE DRAWINGS AS GFE WILL BE FURNISHED BY THE CONTRACTING OFFICER. SUCH PROPERTY WILL BE FURNISHED BY THE GOVERNMENT AT A STORAGE AREA LOCATED ON KENNEDY SPACE CENTER. THE CONTRACTOR SHALL BE REQUIRED TO ACCEPT DELIVERY AND LOAD, TRANSPORT AND UNLOAD AT HIS OWN EXPENSE. THE CONTRACTOR SHALL PERFORM ALL OPERATIONS NECESSARY FOR INSTALLING OR INCORPORATING THE PROPERTY IN THE WORK. THE CONTRACTOR SHALL MAKE ALL CONNECTIONS AND FURNISH AND INSTALL ALL ADDITIONAL PARTS, ACCESSORIES, AND MATERIALS NECESSARY TO MAKE A COMPLETE AND OPERABLE UNIT OR SYSTEM WITHIN THE INTENT OF THE SPECIFICATIONS AND DRAWINGS. ALL GFE SHALL BE CONTRACTOR INSTALLED.

IF GOVERNMENT FURNISHED CABLE IS TO BE INSTALLED, THE CONTRACTOR SHALL VERIFY ALL LENGTHS BEFORE CABLE REPLACEMENT TO ENSURE THAT THE CABLE LENGTH IS ADEQUATE. CABLE LENGTH DISCREPANCIES ON CONTRACT DRAWINGS SHALL BE CORRECTED ON CONTRACTOR AS-BUILT DRAWINGS. ALL GFE CABLES ARE TO BE TESTED UPON RECEIPT BY THE CONTRACTOR AS DESCRIBED IN SECTION 16Y, PART 3.

CABLES WHICH ARE FOUND DEFECTIVE FOR ANY REASON SHALL BE TAGGED AS NOT ACCEPTABLE AND FAULT CONDITIONS SHALL BE RECORDED ON A SUITABLE FORM (APPROVED BY THE CONTRACTING OFFICER) AND COPIES SHALL BE SENT TO THE CONTRACTING OFFICER FOR DISPOSITION. THE CONTRACTING OFFICER WILL DIRECT WHAT ACTION SHALL BE TAKEN WITH REGARD TO EACH DEFECTIVE CABLE.

---AS-BUILT DRAWINGS

THE CONTRACTOR SHALL MAINTAIN A COMPLETE SET OF CONTRACT DRAWINGS WHICH SHALL BE CORRECTED DAILY AND IN SUFFICIENT DETAIL TO CLEARLY SHOW THE AS-BUILT CONFIGURATION OF THE WORK DONE. UPON COMPLETION OF ALL CONTRACT WORK, THE CONTRACTOR SHALL FURNISH THE CONTRACTING OFFICER TWO COMPLETE SETS OF DRAWINGS SHOWING THE AS-BUILT CONFIGURATION. THE AS-BUILT DRAWINGS MAY BE MARKED-UP CONTRACT DRAWINGS WITH SUPPLEMENTAL DRAWINGS, IF NEEDED, AND SHALL CONTAIN THE FOLLOWING AS A MINIMUM (ALL MEASUREMENTS SHALL BE SHOWN TO THE NEAREST FOOT):

ANY DEVIATIONS FROM CONTRACT DRAWING DETAILS OR DIMENSIONS

INSTALLED CABLE LENGTHS FOR CABLES INSTALLED

---WORKMANSHIP

WORK SHALL BE CAREFULLY LAID OUT IN ADVANCE. WHERE CUTTING, CHANNELING, CHASING, OR DRILLING OF FLOORS, WALLS, PARTITIONS, CEILINGS, OR OTHER SURFACES IS NECESSARY FOR THE PROPER INSTALLATION OF MATERIALS AND EQUIPMENT, THE WORK SHALL BE CAREFULLY PERFORMED. ANY DAMAGE TO BUILDINGS, PIPING, OR EQUIPMENT SHALL BE REPAIRED AND REFINISHED BY SKILLED CRAFTSMEN AT NO EXTRA COST TO THE GOVERNMENT. MATERIALS AND EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE APPROVED RECOMMENDATIONS OF THE MANUFACTURER, AS SPECIFIED BY THIS DOCUMENT, OR AS SHOWN ON THE CONTRACT DRAWINGS. WORK SHALL BE ACCOMPLISHED BY SKILLED CRAFTSMEN AND SHALL BE CONDUCTED AND COMPLETED IN A MANNER CONSISTENT WITH ACCEPTED INDUSTRY PRACTICES.

THE FINISHED CABLE INSTALLATIONS SHALL CONFORM IN ALL RESPECTS TO THIS SPECIFICATION AND THE CONTRACT DRAWINGS. ANY EVIDENCE OF NONCONFORMANCE WILL RESULT IN THE REJECTION OF PART OR ALL OF THE INSTALLATION BY THE CONTRACTING OFFICER. SPECIFICALLY, KINKS, ACUTE BENDS, RIPPLES, CUTS, ABRASIONS, OR OTHER DAMAGE TO CABLES OR EQUIPMENT WILL BE CAUSE FOR REJECTION. THE CONTRACTING OFFICER WILL HAVE THE OPTION OF DETERMINING WHETHER REJECTED WORK IS TO BE REPAIRED OR REPLACED. CORRECTIVE ACTION DIRECTED BY THE CONTRACTING OFFICER SHALL BE PERFORMED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT.

ALL CABLES SHALL BE INSTALLED IN A WORKMANLIKE MANNER, FULLY IN ACCORDANCE WITH THE APPLICABLE DRAWINGS, THE MANUFACTURER'S RECOMMENDATIONS, AND THE HIGHEST PROFESSIONAL STANDARDS. IN ALL CASES OF CONFLICT BETWEEN THE REQUIREMENTS OF THE APPLICABLE DRAWINGS AND THE MANUFACTURER'S RECOMMENDATIONS, THE CONTRACTOR SHALL SUBMIT THE MANUFACTURER'S RECOMMENDATIONS AS A DEVIATION FOR APPROVAL BY THE CONTRACTING OFFICER. THE DEVIATION SHALL INVOLVE NO INCREASE IN COST TO THE GOVERNMENT.

ALL CABLE INSTALLATIONS SHALL BE PERFORMED BY SKILLED PERSONNEL WHO ARE FULLY QUALIFIED IN ACCORDANCE WITH THE REQUIREMENTS OF THIS SPECIFICATION.

UPON COMPLETION OF THE INSTALLATION, THE CONTRACTOR SHALL ENSURE THAT ALL DEBRIS AND EXCESSIVE MATERIALS HAVE BEEN REMOVED AND THAT ALL WORK AND STORAGE AREAS ARE LEFT NEAT AND ORDERLY TO THE SATISFACTION OF THE CONTRACTING OFFICER.

---INSPECTION, TEST AND CHECKOUT

THE CONTRACTOR SHALL CONDUCT ALL TESTS AND CHECKOUTS AS SPECIFIED. AS SPECIFIED UNDER "SUBMITTALS OF SHOP DRAWINGS AND DESCRIPTIVE DATA", THE CONTRACTOR SHALL SUBMIT A CABLE TEST PLAN 30 DAYS PRIOR TO ANY CABLE TESTING. THE CONTRACTOR SHALL ALSO SUBMIT A SCHEDULE OF THE TESTS TO BE CONDUCTED AS WELL AS THE CORRECT RESULTS OF THAT TEST TO THE CONTRACTING OFFICER FOR HIS APPROVAL. THE CONTRACTOR SHALL DEMONSTRATE AND OPERATE ALL INSTALLED EQUIPMENT, ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS AND THESE SPECIFICATIONS, IN THE PRESENCE OF THE CONTRACTING OFFICER OR THE CONTRACTING OFFICER'S REPRESENTATIVE. THE CONTRACTOR SHALL FURNISH ALL INSTRUMENTS AND PERSONNEL REQUIRED FOR THESE TESTS. AFTER TESTING THE CONTRACTOR SHALL SUBMIT WRITTEN TEST RESULTS OR REPORTS TO THE GOVERNMENT FOR APPROVAL.

THE CONTRACTOR SHALL TEST SYSTEMS OR EQUIPMENT, SUCH AS VALVES WITH THEIR ASSOCIATED LIMIT SWITCHES, AS A UNIT. THE CONTRACTOR SHALL PROVIDE AND INSTALL A TEMPORARY TEST PANEL IN ROOM 210 OF THE PTCR TO TEST AND CHECK OUT ALL VALVES, LIMIT SWITCHES, ETC. IN THE PAD 39B WATER SYSTEM, MODIFIED OR INSTALLED BY DRAWING 79K10338. THIS TEST PANEL SHALL BE COMPOSED OF SWITCHES TO SIMULATE THE REQUIRED COMMANDS AND LIGHTS TO INDICATE THE CORRECT OPERATION OF THE SYSTEM COMPONENTS. DURING TESTING AND CHECKOUT OF THE WATER SYSTEM CONTROLS THE CONTRACTOR SHALL USE A SYSTEM OF TWO-WAY COMMUNICATIONS TO FIELD VERIFY THAT THE ITEMS SELECTED FOR OPERATION ACTUALLY OPERATE AS REQUIRED. EACH SYSTEM THAT IS A PART OF THE WATER CONTROL SYSTEM SHALL BE OPERATED THROUGH A COMPLETE CYCLE NO LESS THAN FIVE TIMES TO VERIFY CORRECT OPERATION. ALL TESTS SHALL BE PERFORMED IN THE PRESENCE OF THE CONTRACTING OFFICER OR THE CONTRACTING OFFICER'S REPRESENTATIVE.

TESTS SHALL BE PERFORMED ON, BUT NOT LIMITED TO, THE FOLLOWING SYSTEMS:

A. ALL EQUIPMENT AND DEVICES IN THE PAD 39B WATER PIT

B. ALL EQUIPMENT AND DEVICES INSTALLED IN, OR CONNECTED TO, THE HYPERGOLIC FUEL AND OXIDIZER AREAS

C. THE SSAT SUBSTATION FOR PAD 39B

D. THE EMERGENCY POWER PANELBOARD FOR PAD 39B

E. THE ITEMS OF THE UTILITIES CONTROL SYSTEM MODIFIED OR ADDED BY DRAWING 79K10338 TO PAD 39B

F. ALL ELECTRICAL EQUIPMENT FILLED WITH INSULATION OIL, TRANSFORMERS, ETC. SHALL HAVE THE OIL DIELECTRICALLY TESTED BY THE CONTRACTOR BEFORE BEING ENERGIZED. THE OIL SHALL WITHSTAND A POTENTIAL OF 25,000 V IMPRESSED ACROSS TWO ONE-INCH DIAMETER DISCS 0.10 INCHES APART.

G. ALL EQUIPMENT RATED AT 5 KV AND HIGHER.

THE GOVERNMENT RESERVES THE RIGHT TO PERFORM FULL-TIME OR SPOT INSPECTIONS AND TESTS ON ALL ASSEMBLIES, INSTALLATIONS OR FACILTIIES THROUGHOUT THE TERM OF THE CONTRACT. SUCH INSPECTIONS AND TESTS WILL BE ACCOMPLISHED WITH MINIMUM INTERFERENCE WITH THE CONTRACTOR'S WORK.

---DEFINITIONS

WORK DEFINITIONS ARE THOSE IN THE NEC, ANSI C42-100-1975, "DEFINITIONS OF ELECTRICAL TERMS" AND AS GIVEN BELOW. WHERE THESE DIFFER, THE NEC DEFINITION SHALL APPLY.

CONTRACTING OFFICER: AS DEFINED IN THE CONTRACT SCHEDULE.

RAINTIGHT: SO CONSTRUCTED OR PROTECTED THAT EXPOSURE TO A BEATING RAIN WILL NOT RESULT IN THE ENTRANCE OF WATER.

WATERTIGHT: SO CONSTRUCTED THAT THERE SHALL BE NO LEAKAGE OF WATER INTO THE ENCLOSURE WHEN SUBJECTED TO A STREAM FROM A HOSE WITH A ONE-INCH NOZZLE AND DELIVERING AT LEAST 65 GALLONS PER MINUTE, WITH THE WATER DIRECTED AT THE ENCLOSURE FROM A DISTANCE OF NOT LESS THAN TEN FEET FOR A PERIOD OF FIVE MINUTES. DURING THIS PERIOD THE WATER MAY BE DIRECTED IN ONE OR MORE DIRECTIONS AS REQUIRED.

WEATHERPROOF: SO CONSTRUCTED OR PROTECTED THAT EXPOSURE TO WEATHER HAZARDS SUCH AS RAIN, SNOW, OR SLEET WILL NOT INTERFERE WITH SUCCESSFUL OPERATION.

---ABBREVIATIONS AND UNIT SYMBOLS

A	AMPERE
AC	ALTERNATING CURRENT
AEIC	ASSOCIATION OF EDISON ILLUMINATING COMPANIES
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWG	AMERICAN WIRE GAGE (BROWN AND SHARPE)
AWPA	AMERICAN WOOD PRESERVERS ASSOCIATION
C	CELSIUS
CLPPVCJ	CROSS-LINKED POLYETHYLENE POLYVINYLCHLORIDE-JACKETED
DB	DECIBEL
DC	DIRECT CURRENT
EEI	EDISON ELECTRIC INSTITUTE
EMT	ELECTRICAL METALLIC TUBING
ETL-CBM	ELECTRICAL TESTING LABORATORIES -- CERTIFIED BALLAST MANUFACTURERS
F	FAHRENHEIT
FM	FACTORY MUTUAL LABORATORIES, INC.
FS	FEDERAL SPECIFICATIONS
HAD	HEAT ACTIVATED DETECTOR

HP	HORSEPOWER
HZ	HERTZ
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
IES	ILLUMINATION ENGINEERS SOCIETY
IPCEA	INSULATED POWER CABLE ENGINEERS ASSOCIATION
KSC	KENNEDY SPACE CENTER
KV	KILOVOLT
KVA	KILOVOLT-AMPERE
LB	POUND
MI	MINERAL INSULATED
MIL	MILITARY SPECIFICATION
ML	MOBILE LAUNCHER
MLP	MOBILE LAUNCHER PLATFORM
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NESC	NATIONAL ELECTRICAL SAFETY CODE
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
OSHA	OCCUPATIONAL SAFETY AND HEALTH ACT
PCR	PAYLOAD CHANGEOUT ROOM
PILCPJ	PAPER-INSULATED LEAD-COVERED POLYETHYLENE-JACKETED
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH GAGE
PVC	POLYVINYLCHLORIDE
RFI	RADIO FREQUENCY INTERFERENCE
RMS	ROOT MEAN SQUARE
SSAT	SHUTTLE SERVICE AND ACCESS TOWER
STD	STANDARD
UL	UNDERWRITERS' LABORATORIES, INC.
V	VOLT
W	WATT

---PROTECTION OF EXISTING EQUIPMENT AND REUSE

FIXTURES, RECEPTACLES, MI CABLES AND OTHER ELECTRICAL DEVICES PRESENTLY ON THE ML TOWER SECTIONS BUT SCHEDULED TO BE REUSED ON THE SSAT, MAY BE REMOVED AND LATER REINSTALLED, OR MAY BE LEFT IN PLACE FOR REINSTALLATION WITH THE TOWER SECTION AT THE OPTION OF THE CONTRACTOR. HOWEVER, THE REPAIR AND/OR REPLACEMENT OF ANY DAMAGED FIXTURES, RECEPTACLES, CABLES OR ELECTRICAL DEVICES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. LIKEWISE, MI FEEDER CABLES TO LIGHT OR POWER PANELS PRESENTLY EXISTING ON THE ML TOWER SECTIONS MAY BE REUSED IF CARE IS TAKEN IN THEIR REMOVAL AND REINSTALLATION; HOWEVER, DAMAGED CABLE OR SHORT LENGTHS OF CABLE MAY NOT BE SPLICED AND REUSED.

---SAFETY

ADEQUATE BARRIERS AND WARNING DEVICES SHALL BE PLACED AROUND WORK AREAS WHICH CONSTITUTE A POTENTIAL HAZARD TO PERSONNEL.

THE CONTRACTOR SHALL OBTAIN A BURN PERMIT FROM PROPER AUTHORITIES BEFORE LIGHTING AN OPEN FLAME IN AN INTERIOR LOCATION OR FUEL STORAGE AREA.

THE CONTRACTOR SHALL ENSURE THAT EXISTING FACILITIES, EQUIPMENT, AND CABLE, POWER, WATER, SEWER AND DUCT SYSTEMS ARE PROTECTED FROM DAMAGE.

ALL MANHOLES SHALL BE VENTILATED WITH FORCED AIR BEFORE ENTRY. FORCED AIR VENTILATION SHALL BE CONTINUOUS WHEN WORK IS BEING PERFORMED OR PERSONNEL ARE PRESENT IN A MANHOLE.

SECTION 16V (PART 2)

HAZARDOUS INSTALLATIONS

---GENERAL REQUIREMENTS---

---CLASSIFICATION

ELECTRICAL WORK WITHIN ANY HAZARDOUS LOCATION SHALL MEET THE APPLICABLE REQUIREMENTS OF NEC, CHAPTER 5, ARTICLES 500 THROUGH 517. THE FOLLOWING DEFINITIONS APPLY:

EXPLOSIONPROOF: A RECEPTACLE OR ENCLOSURE THAT IS DESIGNED TO WITHSTAND AN EXPLOSION OF A SPECIFIED LIQUID, GAS, VAPOR, OR DUST WITHIN THE RECEPTACLE OR ENCLOSURE AND TO PREVENT THE IGNITION OF A SPECIFIED GAS, VAPOR, OR DUST SURROUNDING THE RECEPTACLE OR ENCLOSURE BY SPARKS, FLASHES, OR EXPLOSIONS OF THE SPECIFIED LIQUID, GAS, VAPOR, OR DUST THAT MAY OCCUR WITHIN THE ENCLOSURE. THE RECEPTACLE OR ENCLOSURE MUST BE CAPABLE OF OPERATING AT SUCH AN EXTERNAL TEMPERATURE THAT A SURROUNDING FLAMMABLE ATMOSPHERE WILL NOT BE IGNITED THEREBY.

HAZARDOUS LOCATION: AN AREA WHERE IGNITIBLE VAPORS OR DUST MAY CAUSE A FIRE OR EXPLOSION CREATED BY ENERGY EMITTED FROM LIGHTING OR OTHER ELECTRICAL EQUIPMENT OR BY ELECTROSTATIC GENERATION.

HAZARDOUS AREA, CLASS I, DIVISION 1: LOCATIONS IN WHICH HAZARDOUS CONCENTRATIONS OF FLAMMABLE GASES OR VAPORS EXIST CONTINUOUSLY, INTERMITTENTLY, OR PERIODICALLY UNDER NORMAL OPERATING CONDITIONS; LOCATIONS IN WHICH HAZARDOUS CONCENTRATIONS OF SUCH GASES OR VAPORS MAY EXIST FREQUENTLY BECAUSE OF REPAIR OR MAINTENANCE OPERATIONS OR BECAUSE OF LEAKAGE; OR LOCATIONS IN WHICH BREAKDOWN OR FAULTY OPERATION OF EQUIPMENT OR PROCESSES, WHICH MIGHT RELEASE HAZARDOUS CONCENTRATIONS OF FLAMMABLE GASES OR VAPORS, MIGHT ALSO CAUSE SIMULTANEOUS FAILURE OF ELECTRICAL EQUIPMENT.

HAZARDOUS AREA, CLASS I, DIVISION 2: LOCATIONS IN WHICH VOLATILE FLAMMABLE LIQUIDS OR FLAMMABLE GASES ARE HANDLED, PROCESSED, OR USED, BUT IN WHICH THE HAZARDOUS LIQUIDS, VAPORS, OR GASES WILL NORMALLY BE CONFINED WITHIN CLOSED CONTAINERS OR CLOSED SYSTEMS FROM WHICH THEY CAN ESCAPE ONLY IN CASE OF ACCIDENTAL RUPTURE OR BREAKDOWN OF SUCH CONTAINERS OR SYSTEMS, OR IN CASE OF ABNORMAL OPERATION OF EQUIPMENT; LOCATIONS IN WHICH HAZARDOUS CONCENTRATIONS OF GASES OR VAPORS ARE NORMALLY PREVENTED BY POSITIVE MECHANICAL VENTILATION, BUT WHICH MIGHT BECOME HAZARDOUS THROUGH FAILURE OR ABNORMAL OPERATION OF THE VENTILATING EQUIPMENT; OR LOCATIONS THAT ARE ADJACENT TO CLASS I, DIVISION 1 LOCATIONS, AND TO WHICH HAZARDOUS CONCENTRATIONS OF GASES OR VAPORS MIGHT OCCASIONALLY BE COMMUNICATED UNLESS SUCH COMMUNICATION IS PREVENTED BY ADEQUATE POSITIVE-PRESSURE VENTILATION FROM A SOURCE OF CLEAN AIR, AND EFFECTIVE SAFEGUARDS AGAINST VENTILATION FAILURE ARE PROVIDED.

TABLE 500-2 LISTS CHEMICAL ATMOSPHERES BY GROUPS A, B, C, AND D. IN ADDITION, ALTHOUGH NOT DEFINED AS A HAZARDOUS MATERIAL BY THE NEC, IT IS CONSIDERED THAT OXYGEN CONCENTRATIONS (LIQUID AND GASEOUS) PROVIDE A HAZARD BECAUSE OF THE INCREASED FLAMMABILITY OF MATERIALS EXPOSED TO OXYGEN. THEREFORE, OXYGEN CONCENTRATIONS ARE CLASSIFIED UNDER GROUP D AT KENNEDY SPACE CENTER.

---HAZARDOUS AREAS FOR PROJECT

THOSE GENERAL AREAS OF LAUNCH PAD 39B DESIGNATED AS HAZARDOUS AREAS FOR ELECTRICAL WIRING AND REQUIRING EXPLOSION PROOF WIRING DEVICES ARE:

ALL AREAS WITHIN 25 FEET OF PROPELLANT TRANSFER LINES OR WITHIN 50 FEET OF PROPELLANT STORAGE TANKS. HAZARDOUS CLASSIFICATION TO BE DEPENDANT ON CONTENTS OF TRANSFER LINES OR STORAGE TANKS.

THE ENTIRE SHUTTLE SERVICE AND ACCESS TOWER (SSAT) ABOVE PAD LEVEL AND INCLUDING SSAT ELEVATOR PITS (BUT EXCLUDING THE PRESSURIZED ELEVATOR MACHINE ROOM), SHALL BE CLASS I, DIVISION 1, GROUP B (HYDROGEN).

THE HYPERGOLIC FUEL STORAGE FACILITY BUILDING, (BUT NOT INCLUDING THE REMOTE ELECTRICAL BUILDING), SHALL BE CLASS I, DIVISION 1, GROUP C (HYDRAZINE).

THE HYPERGOLIC OXIDIZER STORAGE FACILITY BUILDING, (BUT NOT INCLUDING THE REMOTE ELECTRICAL BUILDING), SHALL BE CLASS I, DIVISION 1, GROUP D (OXYGEN).

---DEFINITION OF HAZARDOUS AREA

A HAZARDOUS AREA AS REFERRED TO UNDER THIS SPECIFICATION IS AN AREA WHICH, UNDER THE NATIONAL ELECTRICAL CODE, IS DEFINED AS CLASS I (HAZARDOUS GASES), DIVISION 1, GROUP B, C, OR D.

---LISTINGS, CERTIFICATIONS AND APPROVALS

THE CONTRACTOR SHALL PROVIDE A COMPLETE LIST OF ALL ELECTRICAL DEVICES REQUIRING PURGING FITTINGS FOR HAZARD PROOFING. EACH ITEM SHALL BE IDENTIFIED AND LIST SHALL INDICATE LOCATION OF EACH ITEM. THIS LIST SHALL BE SUBMITTED WITHIN 180 DAYS AFTER NOTICE TO PROCEED. THIS LIST SHALL INDICATE THE LOCATION OF THE FLOW RESTRICTING ORIFICE ON THE EQUIPMENT TO BE PURGED.

CERTIFIED TEST RESULTS OF THE PRESSURE-HOLDING QUALITIES OF ALL CABINETS, ENCLOSURES AND DEVICES TO BE PRESSURIZED SHALL BE SUBMITTED PRIOR TO INSTALLATION.

MATERIALS REQUIRING APPROVAL PRIOR TO INSTALLATION INCLUDE THE FOLLOWING: POTTING COMPOUNDS, SEALING FITTINGS, JUNCTION BOXES AND ALL EQUIPMENT RATED FOR GROUP B, C, OR D HAZARDOUS LOCATIONS.

---REQUIREMENTS FOR HAZARDOUS AREAS

ALL WORK SHALL BE DONE BY PERSONS FULLY EXPERIENCED IN ELECTRICAL EXPLOSION-PROOF INSTALLATIONS.

INSOFAR AS POSSIBLE, ALL AREAS SHALL BE LEFT OPEN TO PERMIT FREE AIR FLOW AND RAPID DIFFUSION OF HAZARDOUS GASES.

PURGING SHALL BE PROVIDED FOR ALL ELECTRICAL EQUIPMENT ENCLOSURES WHICH DO NOT OTHERWISE SATISFY REQUIREMENTS FOR RESPECTIVE GROUP CLASSIFICATION.

ALL CIRCUIT SWITCHING DEVICES NOT RATED FOR CORRECT GROUP CLASSIFICATION SHALL BE EITHER HERMETICALLY SEALED OR PURGED (EXCEPT IN THOSE CASES WHERE COMPATIBLE POTTING MATERIAL IS PERMITTED).

INSTALLATION IN THE FIELD OF DEVICES ON PRESSURIZED COMPARTMENTS SHALL NOT INTRODUCE CRACKS OR HOLES.

NONCIRCUIT SWITCHING DEVICES (SOLENOIDS, TRANSDUCERS, ETC.) SHALL BE HERMETICALLY SEALED, PURGED, OR ENCAPSULATED WITH COMPATIBLE MATERIAL. IF THE DEVICE HAS MOVING PARTS, SUCH AS A SQUIRREL CAGE INDUCTION MOTOR, ASSURANCE SHALL BE MADE THAT METAL-TO-METAL SPARKING CANNOT OCCUR, UNLESS PURGING IS PROVIDED.

---METHODS OF HAZARD PROOFING

HAZARD PROOFING OF THE ELECTRICAL EQUIPMENT AND DEVICES SHALL BE OBTAINED BY THE FOLLOWING METHODS:

ELECTRICAL EQUIPMENT AND DEVICES THAT ARE APPROVED BY UNDERWRITERS' LABORATORIES, INC., FOR USE IN GROUPS B, C, AND D, HAZARDOUS GASES AS DEFINED BY THE NATIONAL ELECTRICAL CODE SHALL BE USED IF AVAILABLE. SUBSTITUTION OF A PURGED DEVICE FOR AVAILABLE GROUP B, C, OR D RATED DEVICES SHALL NOT BE MADE WITHOUT WRITTEN APPROVAL OF THE CONTRACTING OFFICER.

ELECTRICAL INSTALLATIONS IN SPACES MAINTAINED AT A POSITIVE PRESSURE ABOVE EXTERNAL ATMOSPHERIC PRESSURE WILL BE CONSIDERED "HAZARD PROOFED" BY VIRTUE OF THIS PRESSURIZATION. THE SPACES TO BE PRESSURIZED IN THIS MANNER ARE THOSE DEFINED HEREINABOVE UNDER THE HEADING "HAZARDOUS AREAS FOR PROJECT". ALL CONDUITS AND CABLES LEAVING THESE SPACES SHALL BE SEALED BY USE OF O-Z ELECTRIC COMPANY'S TYPE KR CABLE SEALS, OR EQUAL.

ELECTRICAL DEVICES FOR WHICH EXPLOSION PROOF RATINGS IN GROUP B, C, OR D CANNOT BE OBTAINED SHALL BE HAZARD PROOFED BY MAKING PROVISIONS FOR PURGING WITH CLEAN DRY AIR (OR NITROGEN) AS DESCRIBED BELOW. ALL ELECTRICAL ITEMS TO BE PRESSURIZED OR PURGED SHALL INCLUDE, BUT NOT BE LIMITED TO, MOTORS, PANELBOARDS, TERMINAL DISTRIBUTORS, AND CONTROL EXCLOSURES.

PURGED ENCLOSURES SHALL BE CONSTRUCTED SO AS TO BE CAPABLE OF A MAXIMUM MAINTAINED INTERNAL PRESSURE OF FIVE-INCH WATER GAGE PRESSURE ABOVE EXTERNAL ATMOSPHERE. PRESSURIZED ENCLOSURES SHALL BE SUFFICIENTLY TIGHT TO PASS THE FOLLOWING TEST: WITH A PRESSURE OF FIVE-INCH WATER GAGE ABOVE ATMOSPHERIC PRESSURE APPLIED WITHIN THE ENCLOSURE AND THE SUPPLY DISCONNECTED, AFTER A ONE HOUR PERIOD THE PRESSURE SHALL BE NOT LESS THAN TWO-INCH WATER GAGE ABOVE ATMOSPHERIC PRESSURE WITH PURGE FITTINGS AND HUBS CAPPED. AT THE END OF TWO HOURS THE PRESSURE SHALL BE NOT LESS THAN 1-3/4 INCH WATER GAGE.

PRESSURIZING FITTINGS SHALL BE PROVIDED WITH ALL DEVICES TO BE PURGED. THESE FITTINGS SHALL BE INSTALLED IN A MANNER PROPERLY SUITING THE TYPE OF CONSTRUCTION OF EACH DEVICE TO BE PRESSURIZED. EACH ENCLOSURE SHALL BE EQUIPPED WITH A FITTING CONTAINING A FIXED 0.031 INCH DIAMETER ORIFICE (FIG. 2) AND A CALIBRATED BLEED DEVICE (FIG. 3). FITTINGS SHALL CONFORM TO ATTACHED DRAWINGS.

IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT THE ABOVE PRESSURIZING DEVICES IN SUCH A WAY THAT THEY DO NOT BECOME CONTAMINATED PRIOR TO CONNECTION TO THE PURGING SYSTEM.

---TESTING OF PURGED EQUIPMENT AND SYSTEMS

FINAL TESTING OF INSTALLATIONS OF PURGED EQUIPMENT SHALL BE DONE AFTER EACH SYSTEM IS COMPLETE WITH ALL SEALS, GASKETS, PURGE FITTINGS AND CONNECTING CONDUIT SYSTEMS AT SUCH A TIME AS DESIGNATED BY THE CONTRACTING OFFICER. THE CONTRACTOR SHALL FURNISH A SOURCE OF COMPRESSED AIR OR GASEOUS NITROGEN WITH ALL NECESSARY FITTINGS AND ACCESSORIES TO APPLY 50 PSI PRESSURE TO THE FLOW RESTRICTING ORIFICE OF EACH PURGED SYSTEM. THIS PRESSURE SHALL BE MAINTAINED UNTIL THE INTERNAL PRESSURE STABILIZES AT ONE-INCH WATER COLUMN OR MORE.

A MANOMETER TYPE GAGE SHALL BE PROVIDED AND TEMPORARILY INSTALLED BY THE CONTRACTOR TO MEASURE INTERNAL PURGING PRESSURE OF EACH SYSTEM.

PURGED SYSTEMS FAILING TO MEET THE ABOVE REQUIREMENTS SHALL BE CORRECTED AND RETESTED UNTIL A STABILIZED INTERNAL PRESSURE OF ONE-INCH WATER COLUMN OR MORE CAN BE MAINTAINED WITHOUT THE USE OF ANY SUPPLEMENTARY AIDS SUCH AS MASKING TAPE, DUCT SEAL OR ANY OTHER MATERIALS OTHER THAN SPECIFIED OR SPECIFICALLY APPROVED BY THE CONTRACTING OFFICER.

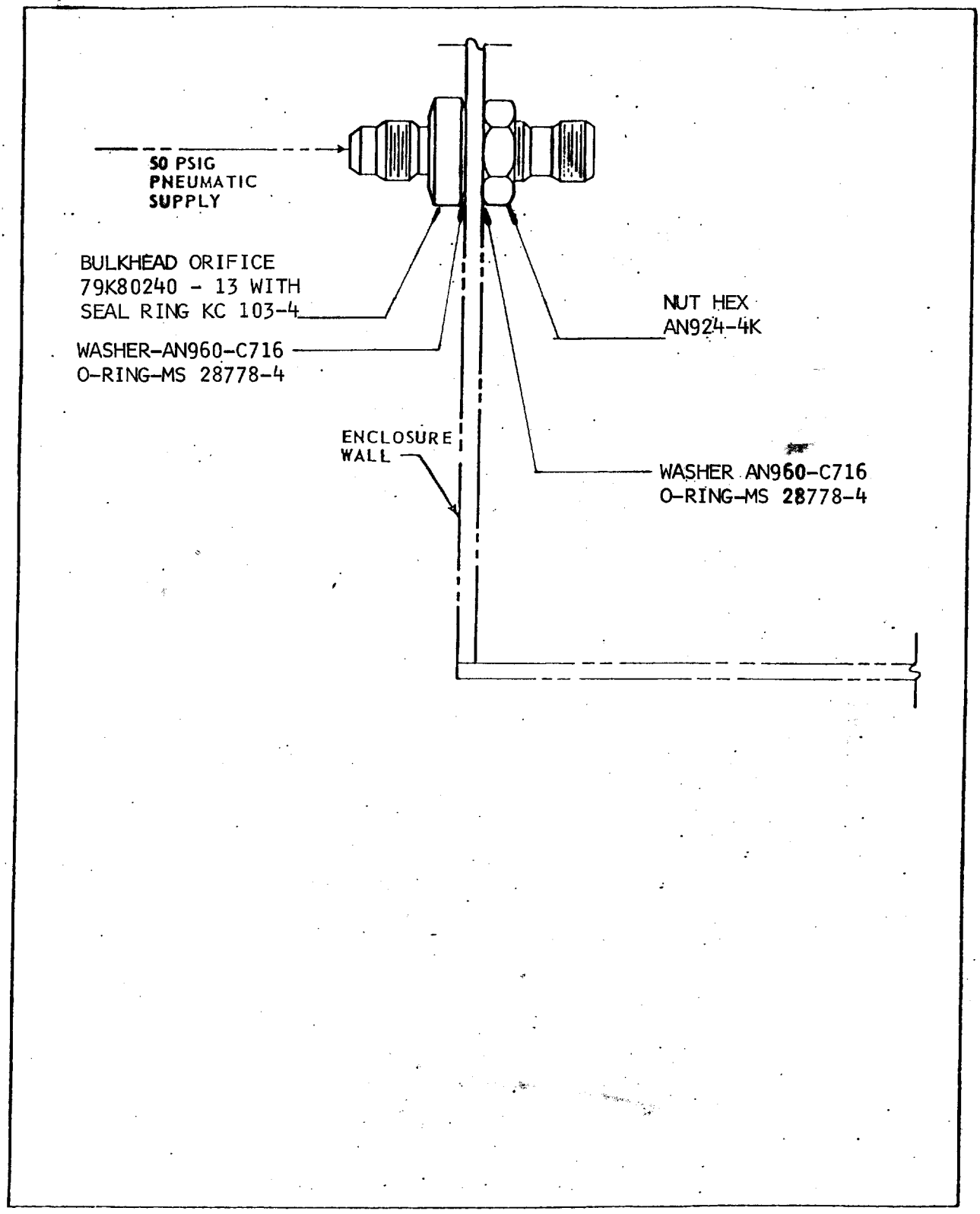
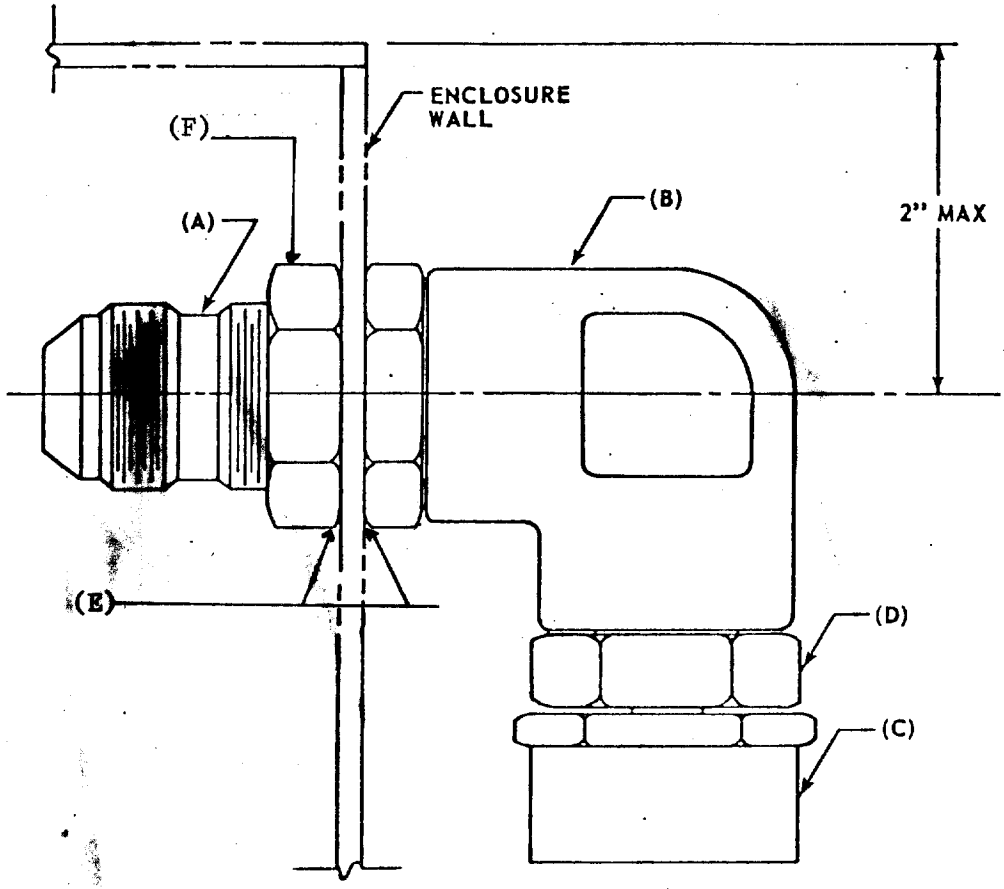


Figure 2. Purge Supply Assembly



(A) BULKHEAD UNION, AN-832-12K

(B) ELBOW, AN939K12., O-RING MS28778-12 (2 REQ)

(C) CALIBRATED BLEED FITTING, 75M02048
PART NO. 10026 (HEAT TREATED) OR PART NO. 259 OR EQUAL.
DEL MANUFACTURING
5711 SHEILA STREET
LOS ANGELES, CALIFORNIA
STRATOTECH COMPANY
P. O. BOX 125
EL SEGUNDO, CALIFORNIA

(D) REDUCER BUSHING, AN893-13K, O-RING MS28778-8

(E) WASHER, AN960-C1716; O-RING MS28778-8

(F) NUT, HEX AN924-12K

Figure 3. Purge Outlet Assembly No. 1

SECTION 16V (PART 3)

LOW VOLTAGE WIRING

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE MATERIALS AND PROCEDURES USED IN INSTALLING LOW VOLTAGE WIRING.

---MATERIALS---

---INSULATED AND GROUND WIRES

INSULATED LOW VOLTAGE CURRENT CARRYING WIRES SHALL BE COPPER AND SHALL CONFORM TO NFPA 70-1975, TYPE THWN/THHN, XHHW, MI OR INTERLOCKED ARMORED CABLE.

---CONDUCTORS

BRANCH CIRCUIT CONDUCTORS SHALL NOT BE SMALLER THAN NO. 12 AWG. CONTROL WIRING CONDUCTORS MAY BE NO. 14 OR LARGER AND SHALL BE STRANDED, EXCEPT WHERE MI CABLE IS USED FOR CONTROL WIRING AS MI CABLE IS ONLY MANUFACTURED WITH SOLID CONDUCTORS.

---FITTINGS

FITTINGS FOR CABLE SHALL CONFORM TO FS W-F-406B, AND INT. AMD. 1.

---INSULATING TAPE

VINYL-PLASTIC ELECTRICAL INSULATING TAPE FOR OUTDOOR LOCATIONS SHALL MEET THE REQUIREMENTS OF FS HH-I-5958(1) AND FOR INDOOR LOCATION SHALL MEET THE REQUIREMENTS OF MIL-I-24391A.

---INSTALLATION---

---APPLICABLE STANDARDS

INSULATION OF CURRENT CARRYING WIRES AND GROUND WIRES SHALL MEET THE REQUIREMENTS OF FS J-C-30A.

---WIRING INSTALLATION

WIRING SHALL NOT BE INSTALLED UNTIL THE INSTALLATION OF THE CONDUIT SYSTEM IS COMPLETE NOR UNTIL ALL MECHANICAL WORK LIKELY TO INJURE THE CONDUCTORS HAS BEEN COMPLETED. CONDUCTORS SHALL BE INSTALLED IN CONDUIT EXCEPT WHERE OTHERWISE INDICATED. EXPOSED CONDUCTORS SHALL BE INSTALLED PARALLEL OR AT RIGHT ANGLES TO WALLS OR STRUCTURAL MEMBERS. IN AREAS NOT PROVIDED WITH CEILING OR WALL FINISH, CONDUCTORS AND OUTLETS SHALL BE SO INSTALLED THAT A ROOM FINISH MAY BE APPLIED IN THE FUTURE WITHOUT DISTURBING THE CONDUCTORS OR RESETTING THE BOX.

---SPLICES AND TERMINATIONS

IN LOCATIONS WHERE SPLICES MAY BE REQUIRED, THEY SHALL CONFORM TO FS W-S-610 AND SHALL BE MADE IN APPROVED ENCLOSURES USING SOLDERLESS PRESSURE CONNECTORS ADEQUATELY INSULATED WITH VINYL-PLASTIC ELECTRICAL INSULATING TAPE. ALL CONDUCTORS AND MATERIALS USED IN A SPLICE, TAP, OR CONNECTION SHALL BE THOROUGHLY CLEANED PRIOR TO MAKEUP TO ENSURE GOOD ELECTRICAL AND MECHANICAL CONNECTIONS. CONDUCTOR IDENTIFICATION SHALL BE PROVIDED WITHIN EACH ENCLOSURE WHERE A TAP, SPLICE, OR TERMINATION IS MADE AND AT THE EQUIPMENT TERMINAL OF EACH CONDUCTOR. TERMINAL AND CONDUCTOR IDENTIFICATION SHALL MATCH THAT SHOWN ON APPROVED SHOP DRAWINGS. HAND LETTERING OR MARKING WILL NOT BE ACCEPTED. CONTROL CIRCUIT TERMINALS OF EQUIPMENT SHALL BE PROPERLY IDENTIFIED BY COLOR CODED INSULATED CONDUCTORS, NUMBER CODED PLASTIC SELF-STICKING PRINTED MARKERS, OR PERMANENTLY ATTACHED METAL-FOIL MARKERS. ALL WIRES LARGER THAN #18 AWG SHALL HAVE TERMINAL LUGS TO ENSURE GOOD ELECTRICAL AND MECHANICAL CONNECTIONS.

---IDENTIFICATION

WHERE SEVERAL FEEDERS PASS THROUGH A COMMON PULLBOX, THE FEEDERS SHALL BE TAGGED TO CLEARLY INDICATE THE ELECTRICAL CHARACTERISTICS, CIRCUIT NUMBER AND PANEL DESIGNATION.

---COLOR CODING

POWER CONDUCTORS SHALL BE COLOR CODED IN ACCORDANCE WITH THE FOLLOWING: THREE-PHASE CONDUCTORS CONNECTED TO A PARTICULAR PHASE SHALL BE THE SAME COLOR (PHASE A, BLACK; PHASE B, RED; PHASE C, BLUE; NEUTRAL, WHITE OR GRAY). INSULATED GROUND WIRES SHALL BE GREEN.

---SPECIAL CONDITIONS

THE WIRING ON THE SSAT SHALL BE MI CABLE EXCEPT WHERE SPECIFICALLY CALLED OUT OTHERWISE ON THE DRAWINGS OR IN THE SPECIFICATIONS.

---ACCEPTANCE---

---INSPECTION AND TESTS

CONTINUITY TESTS AND INSULATION RESISTANCE TESTS SHALL BE PERFORMED TO ASSURE THERE ARE NO SHORTS OR UNINTENTIONAL GROUNDS. THE INSULATION RESISTANCE SHALL BE MEASURED WITH A 500V DC MEGGER (CONDUCTOR TO CONDUCTOR AND CONDUCTOR TO GROUND) AND SHOULD READ GREATER THAN 75 PERCENT OF THE VALUE OBTAINED BY THE FOLLOWING CALCULATION:

$$R = K \underset{\text{LOG } 10}{} \frac{D}{d}$$

WHERE R = INSULATION RESISTANCE IN MEG OHMS - 1000 FT.
K = INSULATION CONSTANT (OBTAINED FROM CABLE MANUFACTURER)
D = DIAMETER OVER INSULATION ON EACH CONDUCTOR
d = DIAMETER OVER CONDUCTOR

TYPICAL PUBLISHED K VALUES FOR GENERAL ELECTRIC CABLE TYPES:

POLYETHYLENE 50,000 VULKENE 10,000 FLAMENOL THW 2,000

TEST READINGS SHALL BE RECORDED AND A CERTIFIED COPY GIVEN TO THE CONTRACTING OFFICER.

SECTION 16V (PART 4)

MINERAL INSULATED CABLE

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS MATERIAL AND PROCEDURES USED IN INSTALLING MINERAL INSULATED CABLE.

---MATERIALS---

---MINERAL INSULATED (MI CABLE)

CABLE SHALL CONSIST OF SOFT ANNEALED UNCOATED COPPER CONDUCTORS INSULATED WITH A HIGHLY COMPRESSED REFRACTORY MINERAL INSULATION.

---SEALING COMPOUND

SEALING COMPOUND SHALL BE IN ACCORDANCE WITH PROCEDURE 79K06110 ONLY. TERMINATIONS PER PROCEDURE 79K06110 SHALL BE USED IN CLASS I, DIVISION 1 AND DIVISION 2, HAZARDOUS AREAS.

---INSTALLATION---

---GENERAL

THE LENGTH OF CABLE NEEDED FOR A PARTICULAR RUN SHALL BE MEASURED AND AN ALLOWANCE MADE FOR THE LENGTH OF CONDUCTOR NEEDED AT EACH END TO PROPERLY MAKE THE DESIRED TERMINATIONS. THE CABLE SHALL BE CUT TO THE NECESSARY LENGTH WITH A HACKSAW. CABLE CUTTERS AND OTHER CUTTING TOOLS THAT EXERT EXCESSIVE PRESSURE ON THE METALLIC SHEATH SHALL NOT BE USED. IMMEDIATELY FOLLOWING CUTTING, THE END OF THE UNUSED PORTION OF CABLE ON THE REEL SHALL BE SEALED WITH TAPE OR, DOW-CORNING 3140 SILICON COMPOUND OR APPROVED, EQUAL, TO PREVENT MOISTURE PENETRATION OF THE INSULATION. CUTTING SHALL BE DONE IMMEDIATELY PRECEDING INSTALLATION.

THE CABLE SHALL BE TRAINED INTO PLACE BY HAND WHEREVER POSSIBLE. ON STRAIGHT RUNS, IT MAY BE STRAIGHTENED INTO ITS FINAL POSITION BY BEING TAPPED WITH A WOODEN MALLET, BLOCK OR PLANK.

SHARP BENDS AND KINKS SHALL BE AVOIDED DURING PRELIMINARY HANDLING AND TRAINING IN ORDER TO AVOID WORK-HARDENING OF THE SHEATH.

THE CABLE SHALL BE SUPPORTED AT LEAST EVERY SIX FEET DURING HANDLING AND TRAINING.

BENDS SHALL BE MADE BY APPROVED TEMPLATE OR HAND HICKEY. MINIMUM BENDING RADIUS OF THE INSIDE EDGE OF ANY BEND SHALL BE FIVE TIMES THE DIAMETER OF THE CABLE.

A LOOP OR AN OFFSET SHALL BE FORMED IN THE CABLE WITHIN FOUR FEET OF CABLE TERMINATIONS IN ALL RUNS WHICH EXCEED 30 FEET. THE LOOP OR OFFSET SHALL BE OF SUCH A SIZE AS TO PROVIDE A MINIMUM OF 12 INCHES OF EXCESS CABLE TO ALLOW FOR RETERMINATION WITHOUT REPLACING THE CABLE RUN.

SHEATH MATERIAL SHALL BE STRIPPED BACK AS NECESSARY TO LEAVE SUFFICIENT CONDUCTOR LENGTH TO MAKE A TERMINATION. SHEATH STRIPPING SHALL BE ACCOMPLISHED ONLY WITH DIAGONAL CUTTERS, STRIPPING RODS, AND COPPER TUBE CUTTERS, OR WITH ROTARY STRIPPING TOOL AND GLAND, IN ACCORDANCE WITH PROCEDURE 79K06110, "PROCEDURE FOR MI CABLE TERMINATION". ALL INSULATION SHALL BE REMOVED FROM THE CONDUCTORS BACK TO A DISTANCE OF APPROXIMATELY 1/32 INCH INSIDE THE REMAINING SHEATH.

ALL THREADED GLAND PARTS, POTS, INSULATING CAPS, AND INSULATED SPAGHETTI SLEEVING SHALL BE INSTALLED ON CABLES IN STRICT ACCORDANCE WITH PROCEDURE 79K06110.

THE COMPLETED TERMINATION SHALL BE INSTALLED IN A JUNCTION BOX WITH A STANDARD "MYERS" THREADED HUB, BUT ONLY AFTER A PERIOD OF 12 HOURS OR UNTIL THE SEALING COMPOUND HAS CURED. CABLE TERMINATIONS SHALL NOT BE LEFT IN A HORIZONTAL OR INVERTED POSITION UNTIL THE SEALING COMPOUND HAS CURED.

MI CABLES SHALL BE SUPPORTED AS SHOWN ON THE DRAWINGS. INTERVALS BETWEEN SUPPORTS SHALL NOT BE MORE THAN SIX FEET ON BOTH HORIZONTAL AND VERTICAL RUNS. CABLE SHALL BE SUPPORTED A MAXIMUM OF 18 INCHES FROM ANY TERMINATION. MI CABLE INSTALLED IN DUCTS, RACEWAYS, CONDUITS, AND CABLE TRAYS, AND DIRECT-BURIED CABLES SHALL BE DEEMED ADEQUATELY SUPPORTED ALONG HORIZONTAL RUNS. THE CABLE SHALL BE WRAPPED WITH AN ADHESIVE HEAT RESISTANT GLASS TAPE AT EACH SUPPORT POINT TO MINIMIZE ELECTROLYSIS BETWEEN THE CABLE SHEATH AND THE SUPPORTS. THE WRAP SHALL BE A MINIMUM THICKNESS OF 14 MILS (TWO COMPLETE WRAPS OF 7-MIL TAPE) AND SHALL EXTEND PAST THE SUPPORT DEVICE A MINIMUM OF 1/4 INCH ON EACH SIDE. *"ALL SUPPORT HARDWARE FOR MI CABLE SHALL BE OF MATERIALS AS NOTED ON THE DRAWINGS: AND, WHERE NOT NOTED, THE YOKE CLAMPS WHICH GRIP THE MI SHALL BE STAINLESS STEEL AND ALL OTHER PARTS OF THE SUPPORTS SHALL BE OF STAINLESS STEEL, OR ZINC-COATED."* (A)

---ACCEPTANCE---

---TESTS

ALL MI CABLE SHALL BE TESTED IN ACCORDANCE WITH PROCEDURE 79K06110.

(A)- *5-30-78*

SECTION 16V (PART 5)

RIGID CONDUIT

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS MATERIALS AND PROCEDURES USED IN INSTALLING RIGID STEEL CONDUIT.

---MATERIALS---

---CONDUIT

RIGID STEEL CONDUIT SHALL BE USED IN ALL CONDUIT SYSTEMS EXCEPT WHERE EMT, MI CABLE, IAC OR FLEXIBLE CONDUIT IS SPECIFIED OR SHOWN ON THE DRAWINGS. RIGID STEEL CONDUIT SHALL CONFORM TO THE REQUIREMENTS OF FS WW-C-581D(3).

---FITTINGS

FITTINGS FOR RIGID STEEL CONDUIT SHALL BE THREADED AND SHALL CONFORM TO FS W-C-586B AND FS W-F-408C(1).

GASKETS SHALL BE SOLID FOR FITTINGS SIZED 1-1/2 INCHES AND LESS. ALL CONDUIT FITTINGS WITH BLANK COVERS SHALL HAVE GASKETS EXCEPT IN CLEAN, DRY AREAS OR AT THE LOWEST POINT OF A CONDUIT RUN WHERE DRAINAGE IS REQUIRED.

---*SUPPORTS AND HARDWARE*

ALL SUPPORTS AND SUPPORT HARDWARE PROVIDED FOR THE INSTALLATION OF CONDUIT SHALL BE GALVANIZED, INCLUDING STRUCTURAL STEEL, CHANNELS, BOLTING, SCREWS, WASHERS, NUTS, CLAMPS, STRAPS, BRACKETS, ETC." Ⓐ

---INSTALLATION---

---COVERS

FITTINGS SHALL BE INSTALLED WITH COVERS HAVING CAPTIVE SCREWS AND SHALL BE ACCESSIBLE AFTER THE WORK IS COMPLETED.

---BENDS AND ELBOWS

EACH RUN OF CONDUIT BETWEEN OUTLET AND OUTLET, BETWEEN FITTING AND FITTING, AND BETWEEN OUTLET AND FITTING SHALL CONTAIN THE EQUIVALENT OF NOT MORE THAN THREE 90 DEGREE BENDS. ALL 90 DEGREE BENDS LARGER THAN ONE INCH SHALL BE MADE WITH FACTORY MADE ELBOWS. CONDUIT ELBOWS LARGER THAN 2-1/2 INCHES SHALL BE LONG RADIUS. FIELD MADE BENDS AND OFFSETS SHALL BE MADE WTIH AN APPROVED HICKEY OR CONDUIT BENDING MACHINE IN A MANNER SUCH THAT CONDUIT WILL NOT BE DAMAGED AND THE INTERNAL DIAMETER WILL NOT BE EFFECTIVELY REDUCED. CHANGES IN DIRECTIONS OF RUNS SHALL BE MADE WITH SYMMETRICAL BENDS OR CAST-METAL FITTINGS.

---GROUNDING CONDUIT

CONDUIT SHALL BE SECURELY FASTENED TO ALL SHEETMETAL OUTLET, JUNCTION, AND PULL BOXES WITH GALVANIZED LOCK-NUTS AND BUSHINGS. A SUFFICIENT NUMBER OF THREADS SHALL PROJECT THROUGH TO PERMIT THE BUSHING TO BE DRAWN TIGHT AGAINST THE END OF THE CONDUIT, AFTER WHICH THE LOCKNUT SHALL BE PULLED UP SUFFICIENTLY TIGHT TO DRAW THE BUSHING INTO FIRM ELECTRICAL CONTACT WITH THE BOX. WHERE INSULATING BUSHINGS ARE USED, WHERE END BUSHINGS CANNOT BE BROUGHT INTO FIRM CONTACT WITH THE BOX, WHERE SHOWN ON THE DRAWINGS AND WHERE REQUIRED BY THE NEC, CONDUITS SHALL BE FASTENED TO ALL SHEETMETAL BOXES AND CABINETS WITH TWO LOCKNUTS. BUSHINGS SHALL BE INSTALLED ON ALL CONDUIT ENDS AND SHALL BE OF THE INSULATING TYPE WHERE REQUIRED BY NFPA 70-1975. IN HAZARDOUS AREAS USE "MYERS" HUBS.

---JOINTS

CONDUIT JOINTS SHALL BE MADE WITH TAPERED THREADS AND SET FIRMLY. EACH LENGTH OF CONDUIT CUT IN THE FIELD SHALL BE REAMED BEFORE INSTALLATION. WHERE CONDUIT IS THREADED IN THE FIELD, EACH THREADED END SHALL CON-SIST OF AT LEAST FIVE FULL THREADS. CORROSION INHIBITING CONDUCTIVE COMPOUND SHALL BE USED ON THE CONDUIT THREADS.

---CONDUIT THROUGH FLOORS

CONDUIT STUBBED UP THROUGH CONCRETE FLOORS FOR CONNECTIONS TO FREE STANDING EQUIPMENT (EXCEPT FOR MOTOR CONTROL CENTERS, CUBICLES, ETC.) SHALL BE PROVIDED WITH A FLUSH COUPLING IF THE FLOOR SLAB IS OF SUFFICIENT THICKNESS; IF NOT, A FLOOR BOX SHALL BE PROVIDED AND SET FLUSH WITH THE FINISHED FLOOR. CONDUITS INSTALLED FOR FUTURE USE SHALL BE TERMINATED WITH A COUPLING AND PLUG SET FLUSH WITH THE FLOOR UNLESS OTHERWISE INDICATED. JOINTS IN CONDUIT INSTALLED IN CONCRETE SHALL BE PAINTED WITH ACID RESISTING TAR BASE PAINT AFTER THE JOINT HAS BEEN MADE TO ENSURE A WATERTIGHT SEAL.

---CLEANLINESS

CARE SHALL BE TAKEN TO PREVENT THE LODGEMENT OF PLASTER, DIRT, OR TRASH IN CONDUIT, BOXES, FITTINGS OR EQUIPMENT DURING CONSTRUCTION. CLOGGED CONDUIT SHALL BE ENTIRELY FREED OF OBSTRUCTION OR SHALL BE REPLACED.

---EXPANSION

CONDUIT CROSSING EXPANSION JOINTS IN CONCRETE SLAB SHALL BE PROVIDED WITH SUITABLE EXPANSION FITTINGS, OR OTHER SUITABLE MEANS SHALL BE PROVIDED TO COMPENSATE FOR THE BUILDING EXPANSION AND CONTRACTION.

---PULL WIRE

A TW INSULATED PULL WIRE NOT LESS THAN 14 GAGE SHALL BE INSTALLED IN ALL EMPTY CONDUIT LONGER THAN 20 FEET.

---LOCATION

CONDUIT SHALL BE CONCEALED WITHIN FINISHED WALLS, CEILINGS, AND FLOORS WHERE POSSIBLE AND SHALL BE KEPT SIX INCHES AWAY FROM PARALLEL RUNS OF FLUES, STEAM OR HOT WATER PIPES, AND OTHER MECHANICAL PIPING.

---EXPOSED CONDUIT

EXPOSED CONDUIT SHALL HAVE RUNS INSTALLED PARALLEL OR PERPENDICULAR TO WALLS, STRUCTURAL MEMBERS, OR INTERSECTIONS OF VERTICAL PLANES AND CEILINGS. IN ROOMS OR AREAS NOT PROVIDED WITH A CEILING OR WALL FINISH, CONDUIT AND OUTLETS SHALL BE SO INSTALLED THAT A ROOM FINISH MAY BE APPLIED IN THE FUTURE WITHOUT DISTURBING THE CONDUIT OR RESETTING THE BOXES.

---STRAPS AND CLAMPS

WHERE EXPOSED CONDUIT REQUIRES CLAMPING TO FLAT SURFACES, CLAMPS SHALL CONSIST OF GALVANIZED MALLEABLE IRON PIPE STRAPS FOR CONDUIT UP TO AND INCLUDING 1-1/2 INCHES. STRAPS FOR CONDUITS LARGER THAN 1-1/2 INCHES SHALL BE TWO HOLE EXTRA HEAVY STEEL. STEEL BOLTS OF AN APPROPRIATE SIZE TO FILL HOLES OF THE STRAPS SHALL BE USED. BEAM CLAMPS ARE ACCEPTABLE. CLAMP BACKS SHALL BE USED TO ALLOW SPACE BETWEEN CONDUIT AND SUPPORTING SURFACE IN WET OR CORROSIVE AREAS. *"ALL STRAPS, CLAMPS, BOLTS, NUTS, WASHERS, BEAM CLAMPS, AND ALL OTHER HARDWARE AND COMPONENTS FOR INSTALLING CONDUIT, SHALL BE GALVANIZED."* (A)

---SUPPORTING AND FASTENING

WOODEN PLUGS INSERTED IN CONCRETE OR MASONRY SHALL NOT BE ACCEPTABLE AS A BASE FOR CONDUIT FASTENINGS, NOR SHALL CONDUIT OR PIPE STRAPS BE WELDED TO STEEL STRUCTURES. CONDUIT SHALL BE SECURED BY PIPE STRAPS OR SHALL BE SUPPORTED BY WALL BRACKETS, STRAP HANGERS, OR CEILING TRAPEZES, FASTENED BY WOOD SCREWS ON WOOD,

TOGGLE BOLTS ON HOLLOW MASONRY UNITS, EXPANSION BOLTS ON CONCRETE OR BRICK, AND MACHINE SCREWS OR WELDED THREADED STUDS ON STEEL WORK. IN ADDITION THREADED STUDS, DRIVEN IN BY POWDER CHARGE AND PROVIDED WITH LOCKWASHERS AND NUTS, ARE ACCEPTABLE IN LIEU OF EXPANSION BOLTS OR MACHINE OR WOOD SCREWS. *ALL OF THE ABOVE COMPONENTS, IF OF FERROUS MATERIAL, SHALL BE GALVANIZED.* (A)

---SUPPORTS

CONDUIT SHALL BE SUPPORTED AND SECURED AT INTERVALS OF NOT MORE THAN EIGHT FEET IN HORIZONTAL RUNS AND TEN FEET IN VERTICAL RUNS(WITHIN 18 INCHES OF EACH OUTLET BOX, JUNCTION BOX, CABINET, ENCLOSURE, OR FITTINGS´(AND WITHIN 12 INCHES OF EACH CHANGE OF DIRECTION. SUPPORTS SHALL BE OF STEEL BAR, ANGLE, OR CHANNEL OF A SIZE TO PROVIDE A FIRM, RIGID SUPPORT. ROD HANGERS MAY BE USED WHEN LATERALLY BRACED.

STRUCTURAL STEEL SHALL NOT BE DRILLED FOR CLAMPING BANKS OF CONDUIT. THE BOTTOM FLANGES OF I-BEAMS OR CHANNELS SHALL NOT BE DRILLED. PREFABRICATED CHANNEL SECTIONS MAY BE USED ON APPROVAL. SUPPORTS SHALL NOT FORM CLOSED POCKETS WHICH COULD HOLD LIQUID SPILLS. PIPING OR INSULATED EQUIPMENT SHALL NOT BE USED TO ANCHOR SUPPORTS .

"ALL FERROUS ITEMS AND FERROUS FASTENERS USED FOR THE SUPPORT OF CONDUIT SHALL BE GALVANIZED." (A)

---UNDERGROUND CONDUIT COATING

AT THE OPTION OF THE CONTRACTOR, UNDERGROUND PORTIONS OF CONDUIT RUNS SHALL BE BITUMASTIC PAINTED OR SHALL BE PROVIDED WITH A FACTORY APPLIED COATING OF PVC NOT LESS THAN 0.020 INCHES THICK. IF THE FACTORY APPLIED COATING IS CHOSEN BY THE CONTRACTOR, ALL NICKS, CUTS, OR OTHER ABRASIONS SHALL BE WRAPPED WITH A SINGLE LAYER OF 0.010 INCH THICK PRESSURE SENSITIVE PVC TAPE, HALF LAPPED TO OBTAIN A MINIMUM THICKNESS OF 0.020 INCHES. WHERE PRESSURE SENSITIVE TAPE IS USED, THE SURFACE SHALL BE CLEANED SO THAT IT IS FREE OF DUST, SAND, OR OTHER FOREIGN MATERIAL AND A PRIMER RECOMMENDED BY THE TAPE MANUFACTURER APPLIED PRIOR TO TAPING. COUPLINGS SHALL BE WRAPPED WITH PRESSURE SENSITIVE TAPE, AS DESCRIBED ABOVE, OVER THE COUPLING AND FOR TWO INCHES ON EACH SIDE OF THE COUPLING. IF PRECOATED COUPLINGS DESIGNED FOR THE PURPOSE ARE USED, TAPING MAY BE OMITTED PROVIDED THE MANUFACTURER'S ADHESIVE IS USED BETWEEN THE COATING ON THE COUPLING AND THE COATING ON THE CONDUIT. FIELD BENDS SHALL BE MADE IN ACCORDANCE WITH THE MANUFACTURER' RECOMMENDATIONS WHICH NORMALLY REQUIRE USE OF A ONE SIZE LARGER BENDER THAN WOULD BE REQUIRED FOR UNCOATED CONDUIT. DEPTH OF BURIED CONDUIT SHALL BE AS INDICATED ON THE DRAWINGS OR AS SPECIFIED IN SECTION 16W (PART 40), "TRENCHING AND BACKFILL".

SECTION 16V (PART 6)

ELECTRICAL METALLIC TUBING

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE MATERIAL AND INSTALLATION PROCEDURES FOR ELECTRICAL METALLIC TUBING (EMT).

---EMT

ELECTRICAL METALLIC TUBING (EMT) SHALL BE GALVANIZED STEEL MEETING THE REQUIREMENTS OF FS WW-C-563.

---FITTINGS

COUPLINGS AND CONNECTORS SHALL BE HEXNUT, EXPANSION GLAND TYPE, ZINC OR CADMIUM PLATED. CRIMP, SPRING, OR SET SCREW TYPE FITTINGS ARE NOT ACCEPTABLE. WHERE EMT ENTERS OUTLET BOXES, CABINETS, OR OTHER ENCLOSURES, CONNECTORS SHALL BE THE INSULATED THROAT TYPE WITH A LOCKNUT. FITTINGS SHALL MEET THE REQUIREMENTS OF FS W-F-408C(1).

---INSTALLATION---

---DETAILS OF INSTALLATION

EMT SHALL BE SECURELY FASTENED TO THE SUPPORTING SURFACES WITH CORROSION RESISTANT METAL CLAMPS OR FASTENERS, UTILIZING SCREWS, TOGGLE BOLTS, OR EXPANSION SHIELDS WHERE APPROPRIATE. MAXIMUM SPACING OF CONDUIT SUPPORTS SHALL BE EIGHT FEET.

EMT SHALL BE CUT SQUARE WITH A HACKSAW OR THREE-WHEEL PIPE CUTTER AND THOROUGHLY REAMED TO REMOVE ALL BURRS OR ROUGH SURFACES.

FIELD MADE BENDS AND OFFSETS SHALL BE AVOIDED WHERE POSSIBLE, BUT WHERE NECESSARY SHALL BE MADE WITH AN APPROVED HICKEY OR CONDUIT BENDING MACHINE. CHANGES IN DIRECTION OF RUNS SHALL BE MADE WITH SYMMETRICAL BENDS OR APPROVED METAL FITTINGS. CRUSHED OR DEFORMED EMT SHALL NOT BE INSTALLED. TRAPPED CONDUIT RUNS SHALL BE AVOIDED WHERE POSSIBLE. CARE SHALL BE TAKEN TO PREVENT THE LODGMENT OF PLASTER, DIRT, OR TRASH IN THE CONDUIT, BOXES, FITTINGS, AND EQUIPMENT DURING THE COURSE OF CONSTRUCTION. CLOGGED CONDUIT SHALL BE ENTIRELY FREED OF OBSTRUCTIONS OR SHALL BE REPLACED.

EXPOSED CONDUIT SHALL BE RUN PARALLEL OR PERPENDICULAR TO WALLS AND THE INTERSECTIONS OF VERTICAL PLANES. CORNERS SHALL BE TURNED WITH APPROVED METAL FITTINGS OR FIELD BENDS ARRANGED SO MULTIPLE RUNS WILL BE PARALLEL.

EMT MAY BE USED IN NONHAZARDOUS AREAS WHERE IT IS PRESENTLY USED, SUCH AS WITHIN THE PRESSURIZED ELEVATOR ROOM AND IN PTCR UNDER THE PAD, UNLESS SPECIFICALLY CALLED OUT OTHERWISE. ALSO, IT MAY BE USED INSIDE THE TWO NEW ELECTRICAL BUILDINGS (ONE AT THE HYPERGOLIC FUEL STORAGE SITE AND ONE AT THE HYPERGOLIC OXIDIZER STORAGE SITE).

SECTION 16V (PART 8)

FLEXIBLE METALLIC CONDUIT

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF FLEXIBLE METALLIC CONDUIT.

---MATERIALS---

---CONDUIT

FLEXIBLE METALLIC CONDUIT SHALL MEET THE REQUIREMENTS OF FS WW-C-566B, AND UL 1-1972, AND SHALL BE USED FOR ALL ELECTRICAL CONNECTIONS TO VIBRATING EQUIPMENT AND TO CONNECT RECESSED FIXTURES TO OUTLET BOXES.

SECTIONS OF FLEXIBLE METALLIC CONDUIT SHALL BE NOT MORE THAN SIX FEET LONG.

---FITTINGS

FITTINGS FOR FLEXIBLE METALLIC CONDUIT SHALL MEET THE REQUIREMENTS OF FS W-F-406B AND INT. AMD. 1, TYPE I, III, OR IV, CLASS AND STYLE AS REQUIRED.

FITTINGS FOR LIQUID TIGHT FLEXIBLE CONDUIT SHALL MEET THE REQUIREMENTS OF FS W-F-406B AND INT. AMD. 1, TYPE I, CLASS 3, STYLE AS REQUIRED.

---INSTALLATION---

---GENERAL

CONDUIT SHALL BE INSTALLED ONLY IN EXPOSED OR ACCESSIBLE LOCATIONS, IN ACCORDANCE WITH NFPA 70-1975, ARTICLE 350.

FLEXIBLE METALLIC CONDUIT INSTALLED IN OUTDOOR, WET, OR DAMP LOCATIONS SHALL HAVE AN OUTER LIQUID TIGHT, NONMETALLIC, SUNLIGHT RESISTANT JACKET. INSTALLATION SHALL BE IN ACCORDANCE WITH NFPA 70-1975, ARTICLE 351,

EXCEPT THAT A GREEN INSULATED GROUND WIRE SHALL BE RUN BETWEEN THE CONDUIT FITTINGS IN ALL SIZES OF LIQUID TIGHT FLEXIBLE CONDUIT WHERE THE CONDUIT AND FITTINGS ARE NOT APPROVED FOR THE PURPOSE OF GROUNDING.

SECTION 16V (PART 9)

CABLE TRAYS

---GENERAL REQUIREMENTS---

---SCOPE

THIS PART COVERS MATERIAL AND PROCEDURES USED IN INSTALLING CABLE TRAYS.

---MATERIALS---

---CABLE TRAYS

THE WORK INCLUDES NEW AND GFE CABLE TRAYS.

NEW CABLE TRAYS SHALL COMPLY WITH NEMA STANDARD VE1-1976 AND WITH THE REQUIREMENTS LISTED HEREINAFTER. ALL CABLE TRAY SECTIONS, FITTINGS, HARDWARE AND ASSEMBLIES SHALL BE THE PRODUCT OF A SINGLE MANUFACTURER.

NEW LADDER TYPE CABLE TRAYS (MANUFACTURER'S CATALOG ITEM).

USE: USE IN ALL LOCATIONS NOTED ON DRAWINGS AND INSTALL WITHOUT COVER EXCEPT WHERE SPECIFICALLY INDICATED OTHERWISE.

DEPTH: 4" NOMINAL

INSIDE WIDTH: 6", 12", 18", 24" OR 36" AS INDICATED.

RUNG SPACING: 6"

MATERIAL: ALUMINUM (ALLOY 6063-T6 FOR STRAIGHT SECTIONS AND ALL RUNGS AND RUNG SUPPORT BARS)

COVER: NONE

BEND RADIUS: 24" MINIMUM

QUALITY AND TYPE REFERENCE: CHALFANT ALUMINUM CABLE BEAM TYPE 655A OR APPROVED EQUAL.

CABLE TRAYS, FITTINGS, HARDWARE AND ACCESSORIES SHALL BE NEW AND CONTRACTOR FURNISHED AND INSTALLED.

ENCLOSED LADDER CABLE TRAYS (CLOSED BOTTOM, ALUMINUM COVER, EXTERIOR INSTALLATION, BLAST RESISTANT).

USE: ON SSAT AND FROM SSAT TO PAD SURFACE, UNLESS OTHERWISE INDICATED.

NOTE: THE CONTRACTOR SHALL INVENTORY THE TRAY EXISTING ON THE ML #2 TOWER SECTIONS AS THIS TRAY WILL BE INSTALLED ON THE SSAT (THE SSAT IS THE ML #2 TOWER RECONFIGURED). ANY DEFICIENCIES IN TRAY FITTINGS OR SECTIONS SHALL BE SUPPLIED BY THE CONTRACTOR AS PART OF THIS CONTRACT. ANY NEW TRAY FITTINGS OR SECTIONS REQUIRED SHALL MATCH IN MATERIAL, STRENGTH AND CONFIGURATION THE EXISTING TRAY AND COVERS NOW ON THE ML #2 TOWER SECTIONS. VERTICAL SECTIONS OF TRAY SHALL BE REWORKED FOR USE AS HORIZONTAL TRAY BY REMOVING THE CABLE SUPPORT SECTION, INSTALLING A CLOSURE PLATE AND LADDER RUNGS.

TRAY CONSTRUCTION: MATERIAL SHALL BE 6063-T6 ALUMINUM ALLOY, LADDER TYPE TRAY WITH 9" RUNG SPACING, 1/8" WELDED IN PLACE BOTTOM CLOSURE PLATE, WIDTHS OF 12", 18" OR 24", FITTING MINIMUM RADIUS OF 24", TRAY INSIDE CLEAR DEPTH OF 5 1/2", 1/8" ALUMINUM COVER WITH STAINLESS STEEL LATCHES EQUAL TO SIMMONS LINK LOCK FASTENER NO. 3 REFER TO DETAIL "F", SHEET 355 (E77).

QUALITY AND REFERENCE: EXISTING TRAY ON ML #2 TOWER.

---INSTALLATION---

---CABLE TRAYS

ALL CABLE TRAYS SHALL BE INSTALLED BY THE CONTRACTOR AS A COMPLETE WIREWAY SYSTEM. TRAYS SHALL INCLUDE SPLICE AND END PLATES, DROPOUTS, AND MISCELLANEOUS HARDWARE. PRIOR TO ASSEMBLY, ALL CONTACT SURFACES OF TRAYS SHALL BE COATED WITH AN ANTIOXIDENT COMPOUND. ALL EDGES, FITTINGS, AND HARDWARE SHALL BE FINISHED FREE FROM BURRS AND SHARP EDGES. ALL CABLE TRAY SECTIONS AND FITTINGS SHALL BE CONNECTED BY MEANS OF SPLICE PLATES AND HIGH STRENGTH BOLTS TO BE ELECTRICALLY CONTINUOUS.

---SUPPORTS

ALL TYPES OF SUPPORTS AND HANGERS SHALL PERMIT VERTICAL ADJUSTMENT, ALONG WITH HORIZONTAL ADJUSTMENT, WHERE POSSIBLE. THIS SHALL BE ACCOMPLISHED BY THE USE OF CHANNEL FRAMING, BEAM CLAMPS, AND THREADED HANGER RODS. HORIZONTAL AND VERTICAL TRAY SUPPORTS SHALL PROVIDE AN ADEQUATE BEARING SURFACE FOR THE TRAY AND SHALL HAVE PROVISIONS FOR HOLD-DOWN CLAMPS OR FASTENERS. VERTICAL TRAY SUPPORTS SHALL PROVIDE

SECURE MEANS, OTHER THAN FRICTION, FOR FASTENING CABLE TRAYS TO SUPPORTS. WHERE POSSIBLE, SUPPORTS SHALL BE LOCATED SO THAT CONNECTORS BETWEEN HORIZONTAL STRAIGHT SECTIONS OF CABLE TRAY RUNS FALL BETWEEN THE SUPPORT POINT AND THE QUARTER POINT OF THE SPAN. UNSPLICED STRAIGHT SECTIONS SHALL BE USED ON ALL SINGLE SPANS AND ON END SPANS OF CONTINUOUS SPAN ARRANGEMENTS. WHERE DETAILED, SUPPORTS SHALL BE AS SHOWN, OTHER SUPPORTS SHALL MEET ALL FOLLOWING REQUIREMENTS: DEFLECTION NOT GREATER THAN SPAN DIVIDED BY 180; NON-OBSTRUCTION OF WALKWAYS; AND METAL THICKNESS NOT LESS THAN 0.109 INCHES. ALL SUPPORTS SHALL BE OF HOT-DIPPED GALVANIZED STEEL. SUBMIT SHOP DRAWINGS OF ALL CABLE TRAY SUPPORTS PER THE "CONTRACT SCHEDULE" AND IN ACCORDANCE WITH SECTION 16V (PART 1), PAGE 16V-2.

CABLE TRAYS SHALL BE SUPPORTED WITH SUPPORT SPACING NOT GREATER THAN SIX FEET AND ELSEWHERE AS INDICATED ON THE DRAWINGS. WHEN SO SUPPORTED, STANDARD TRAYS SHALL BE CAPABLE OF CARRYING NOT LESS THAN 900 POUNDS PER LINEAR FOOT. TRAY FITTINGS SHALL HAVE NOT LESS THAN THE LOAD CARRYING ABILITY OF STRAIGHT TRAY SECTIONS AND SHALL HAVE 24" MINIMUM RADIUS, UNLESS OTHERWISE INDICATED ON THE DESIGN DRAWINGS.

SUPPORTS FOR HORIZONTAL ELBOW TRAY FITTINGS SHALL BE PLACED WITHIN TWO FEET OF EACH FITTING EXTREMITY AND AS FOLLOWS:

90 DEGREE SUPPORTS - AT THE 45 DEGREE POINT OF ARC
60 DEGREE SUPPORTS - AT THE 30 DEGREE POINT OF ARC
45 DEGREE SUPPORTS - AT THE 22-1/2 DEGREE POINT OF ARC
30 DEGREE SUPPORTS - AT THE 15 DEGREE POINT OF ARC

AT LEAST ONE SUPPORT FOR A HORIZONTAL TEE SHALL BE PLACED UNDER EACH SIDE RAIL OF THE HORIZONTAL CROSS. THERE SHALL NOT BE MORE THAN ONE SPLICE BETWEEN SUPPORTS OF HORIZONTAL TRAYS. VERTICAL CABLE TRAY ELBOWS AT THE TOP OF RUNS SHALL BE SUPPORTED AT EACH END. VERTICAL CABLE TRAY ELBOWS AT THE BOTTOM OF RUNS SHALL BE SUPPORTED AT THE TOP OF THE ELBOW AND WITHIN TWO FEET OF THE LOWER EXTREMITY OF THE ELBOW. VERTICAL STRAIGHT LENGTHS SHALL BE SUPPORTED AT INTERVALS NOT GREATER THAN THOSE FOR HORIZONTAL TRAYS OF THE SAME DESIGN FOR THE SAME INSTALLATION.

---DRAINAGE FOR SOLID BOTTOM HORIZONTAL TRAYS (B)

SOLID BOTTOM HORIZONTAL TRAYS SHALL BE PROVIDED WITH ONE-HALF INCH DRILLED WEEP HOLES IN THE BOTTOM ON 24 INCH CENTERS ALONG THE RUN OF TRAY AND ONE INCH INBOARD FROM EACH SIDE CHANNEL. HOLES ALONG ONE SIDE CHANNEL SHALL BE STAGGERED 12 INCHES WITH RESPECT TO HOLES ALONG CHANNEL ON OPPOSITE SIDE.

---CABLES

CABLES SHALL BE ARRANGED IN CABLE TRAYS TO GIVE A MINIMUM OF CABLE CROSSOVERS AND IN NO CASE SHALL SPLICES BE MADE WITHIN A CABLE TRAY.

CABLE INSTALLED IN VERTICAL RUNS SHALL BE SUPPORTED IN SUCH MANNER THAT NO RUNS OF CABLE TRAYS SHALL BE DEFORMED BY THE WEIGHT OF THE VERTICAL SECTIONS OF CABLES. CABLES ENTERING OR LEAVING CABLE TRAYS SHALL BE SUITABLY SUPPORTED SO AS TO ELIMINATE ANY STRAIN AT THE CABLE TERMINATION POINTS.

---GROUNDING

ALL CABLE TRAYS SHALL BE PROPERLY GROUNDED BY MEANS OF A LOW RESISTANCE CONDUCTOR OF SUFFICIENT CAPACITY (BUT IN NO CASE SMALLER THAN NO. 2 AWG COPPER FOR STEEL TRAYS OR NO. 1/0 AWG ALUMINUM FOR ALUMINUM TRAYS) TO IMMEDIATELY CARRY OFF ALL CURRENTS TO EARTH, WITH A MINIMUM DANGER OF FIRE AND SHOCK. THE GROUNDING CONDUCTOR SHALL BE BONDED TO CABLE TRAY SECTIONS AND FITTINGS BY COMPATIBLE BOLTED CONNECTIONS. THE EFFECTIVE GROUNDING SHALL BE PERMANENT AND CONTINUOUS, WITH AN IMPEDANCE SUFFICIENTLY LOW TO LIMIT THE POTENTIAL ABOVE GROUND AND TO FACILITATE OPERATION OF OVER CURRENT DEVICES IN THE CIRCUIT. GROUNDING AND BONDING OF ALL CABLE TRAYS SHALL BE IN ACCORDANCE WITH THE DRAWINGS, NFPA 70-1975, ARTICLE 250, AND THOSE REQUIREMENTS SET FORTH IN SECTION 16X (PART 51) OF THESE SPECIFICATIONS. ALUMINUM CABLE TRAY GROUNDING CONDUCTOR, IF OVER 24 INCHES, SHALL BE INSULATED TO AVOID CATHODIC PROBLEMS.

---CLEANING OF TRAYS 

FOLLOWING INSTALLATION OF TRAYS AND CABLING, ALL FOREIGN MATTER AND DEBRIS SHALL BE REMOVED FROM THE INTERIORS OF THE TRAYS.

SECTION 16V (PART 10)

BOXES AND ENCLOSURES

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE MATERIAL AND PROCEDURES FOR INSTALLING BOXES AND ENCLOSURES.

---EQUIPMENT---

---BOXES

BOXES SHALL HAVE SUFFICIENT VOLUME TO ACCOMMODATE THE NUMBER OF CONDUCTORS ENTERING THE BOX IN ACCORDANCE WITH THE REQUIREMENTS OF NFPA 70-1975, ARTICLE 370. BOXES THAT ARE LOCATED IN HAZARDOUS AREAS SHALL BE APPROVED FOR SUCH DUTY. BOXES THAT ARE EXPOSED TO THE WEATHER OR THAT ARE IN NORMALLY WET LOCATIONS SHALL BE OF THE CAST METAL TYPE HAVING THREADED HUBS. BOXES IN OTHER AREAS SHALL BE CADMIUM PLATED OR ZINC COATED SHEET METAL CONFORMING TO FS W-J-800C(3).

PULL AND JUNCTION BOXES SHALL BE FURNISHED WITH SCREW FASTENED COVERS. OUTLET BOXES FOR DUPLEX RECEPTACLES SHALL BE MOUNTED 18 INCHES ABOVE THE FINISHED FLOOR. OUTLET BOXES FOR USE WITH CONDUIT SYSTEMS SHALL BE NOT LESS THAN 1-1/2 INCHES DEEP.

---INSTALLATION---

---GENERAL

JUNCTION, PULL, AND OUTLET BOXES SHALL BE INSTALLED WHERE REQUIRED OR WHERE INDICATED ON THE DRAWINGS.

PULL BOXES SHALL BE FURNISHED AND INSTALLED WHERE NECESSARY IN THE CONDUIT SYSTEM TO FACILITATE CONDUCTOR INSTALLATION. CONDUIT RUNS LONGER THAN 100 FEET, OR WITH MORE THAN THREE RIGHT ANGLE BENDS, SHALL HAVE A PULL BOX INSTALLED AT A CONVENIENT INTERMEDIATE LOCATION.

BOXES AND ENCLOSURES SHALL BE SECURELY MOUNTED TO THE BUILDING STRUCTURE WITH SUPPORTING FACILITIES INDEPENDENT OF THE CONDUITS ENTERING OR LEAVING THE BOXES.

---IDENTIFICATION AND MARKING

WHERE SEVERAL FEEDERS PASS THROUGH A COMMON PULL BOX, THE FEEDERS SHALL BE TAGGED TO CLEARLY INDICATE THE ELECTRICAL CHARACTERISTICS, CIRCUIT NUMBER, AND PANEL DESIGNATION.

SECTION 16V (PART 11)

RECEPTACLES

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF RECEPTACLES.

---RECEPTACLES---

---SPECIFIC PURPOSE TYPE

LOCKING TYPE RECEPTACLES SHALL BE SIZED AS SHOWN ON THE DRAWINGS AND SHALL CONFORM TO NEMA WD-5-1972. ONE PLUG SHALL BE FURNISHED WITH EACH NEW LOCKING RECEPTACLE. RECEPTACLES IN HAZARDOUS CLASSIFICATION AREAS SHALL BE APPROVED FOR THIS CLASS LOCATION.

---CONSTRUCTION

POWER OUTLETS RATED 100 AMPERES OR LESS SUITABLE FOR CONNECTION TO 208 VOLT OR 480 VOLT, THREE PHASE OR SINGLE PHASE, ALTERNATING CURRENT OR DIRECT CURRENT CIRCUITS SHALL CONSIST OF SINGLE RECEPTACLES IN INDUSTRIAL TYPE CAST METAL ENCLOSURES WITH CAST ALUMINUM BODY, ANGLE ADAPTER AND RECEPTACLE HOUSING WITH SCREW TYPE CAPTIVE COVER EXCEPT WHERE SPECIFICALLY INDICATED OTHERWISE. SCREWS SHALL BE CHROMIUM, CADMIUM PLATED BRASS OR STAINLESS STEEL. RECEPTACLES INDICATED OR SPECIFIED FOR USE IN AREAS CLASSIFIED HAZARDOUS SHALL BE UL LISTED FOR USE IN CLASS I, DIVISION 1, GROUP B ATMOSPHERE AND SHALL BE OF THE AMPERAGE INDICATED ON THE DRAWINGS. *ALL RECEPTACLES SHALL COMPLY WITH KSC STANDARD KSC-STD-E-0011-D.* (B)

---GENERAL PURPOSE TYPE

RECEPTACLES SHALL BE 15A, 125V AC, 2-POLE, 3-WIRE, DUPLEX GROUNDED TYPE, CONFORMING TO FS W-C-596A(2) AND INT. AMD. 3, AND TO THE 5-15R CONFIGURATION IN NEMA WD 1-1971, EXCEPT WHERE SPECIFIC PURPOSE, LOCKING OR HIGHER RATED RECEPTACLES ARE SHOWN ON THE DRAWINGS.

---CONSTRUCTION

BODIES OF 15A RECEPTACLES SHALL BE OF PHENOLIC COMPOUND SUPPORTED BY A MOUNTING YOKE HAVING PLASTER EARS. CONTACT ARRANGEMENT SHALL BE SUCH THAT CONTACT IS MADE ON TWO SIDES OF AN INSERTED BLADE. EACH RECEPTACLE SHALL BE SIDE OR BACK WIRED WITH TWO SCREWS PER TERMINAL, SHALL BE PROVIDED WITH A THIRD GROUNDED POLE, AND SHALL BE CAPABLE OF RECEIVING 2-WIRE, 3-POLE PARALLEL BLADE CAPS. THE THIRD GROUNDING POLE SHALL BE CONNECTED TO A METAL MOUNTING YOKE AND SHALL BE PROVIDED WITH A GREEN COLORED SCREW FOR GROUNDING.

---INSTALLATION---

---MOUNTING

MOUNTING HEIGHTS AND LOCATIONS SHALL BE AS INDICATED ON THE DRAWINGS. RECEPTACLES SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND PROVISIONS OF NFPA 70-1975.

---TESTING

ALL RECEPTACLES SHALL BE TESTED FOR PHASING PER KSC STANDARD KSC-STD-E-0011-D.

SECTION 16V (PART 13)

TOGGLE SWITCHES

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS ENCLOSED, TUMBLER TYPE, WALL SWITCHES.

---MATERIALS---

---TOGGLE SWITCHES

WALL SWITCHES SHALL BE OF THE TOTALLY ENCLOSED TUMBLER TYPE WITH BODIES OF PHENOLIC COMPOUND. NOT MORE THAN ONE SWITCH SHALL BE INSTALLED IN A SINGLE GANG POSITION. SWITCHES SHALL BE "T" RATED FOR NOT LESS THAN 15A AT 120V. THE AMPERE RATING OF THE SWITCH SHALL EXCEED THE AMPERE LOAD OF THE CIRCUIT BEING SWITCHED. SWITCHES SHALL CONFORM TO FS W-S-893C AND INT. AMD. 1.

---SPECIAL TOGGLE SWITCHES

IN SOME HAZARDOUS AREAS SOME OF THE EXPLOSION PROOF TOGGLE SWITCHES CALLED OUT ON THE DRAWINGS ARE DOUBLE POLE (SINGLE THROW) SWITCHES WHICH CONTROL TWO CIRCUITS OF LIGHTS IN A GIVEN AREA.

---INSTALLATION---

---GENERAL

THE TOGGLE SWITCHES SHALL BE INSTALLED ACCORDING TO MANUFACTURER'S INSTRUCTION AND WHERE SHOWN ON THE DRAWINGS.

SECTION 16V (PART 14)

SAFETY SWITCHES

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF SAFETY SWITCHES.

---MATERIALS---

---SAFETY SWITCHES

SWITCHES SHALL COMPLY WITH FS W-S-865C(1) AND INT. AMD. 2.

SAFETY SWITCHES SHALL BE OF THE HEAVY DUTY TYPE WITH VOLTAGE, CURRENT RATING, NUMBER OF POLES, AND FUSING AS SHOWN ON THE DRAWINGS. SWITCH CONSTRUCTION SHALL BE SUCH THAT, WITH THE SWITCH HANDLE IN THE "ON" POSITION, THE COVER OR DOOR CANNOT BE OPENED. THE COVER RELEASE DEVICE SHALL BE COINPROOF AND SHALL BE SO CONSTRUCTED THAT AN EXTERNAL TOOL (SCREWDRIVER) MUST BE USED TO OPEN THE COVER. PROVISIONS SHALL BE MADE TO LOCK THE HANDLE IN THE "OFF" POSITION, BUT THE SWITCH SHALL NOT BE CAPABLE OF BEING LOCKED IN THE "ON" POSITION.

SWITCHES SHALL HAVE VISIBLE BLADES THAT SHALL BE OF THE QUICK-MAKE, QUICK-BREAK TYPE. TERMINAL LUGS SHALL BE APPROVED FOR USE WITH COPPER CONDUCTORS.

---INSTALLATION---

---GENERAL

SWITCHES SHALL BE SECURELY FASTENED TO THE SUPPORTING STRUCTURE OR WALL UTILIZING FOUR 1/4-INCH BOLTS (MINIMUM). THE USE OF SHEET METAL SCREWS OR SMALL MACHINE SCREWS FOR MOUNTING IS NOT ALLOWED. SWITCHES SHALL NOT BE MOUNTED IN AN INACCESSIBLE LOCATION OR WHERE PASSAGEWAY TO THE SWITCH MAY BECOME OBSTRUCTED. MOUNTING HEIGHT SHALL BE APPROXIMATELY FIVE FEET ABOVE FLOOR LEVEL WHEN POSSIBLE TO ALLOW FOR EASE OF OPERATION.

SECTION 16V (PART 15)

FUSES

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF FUSES AND FUSE HOLDERS.

---MATERIAL---

---FUSES

THE CONTRACTOR SHALL FURNISH A COMPLETE SET OF FUSES FOR ALL SWITCHES AND SWITCHGEAR, AS REQUIRED. FUSES SHALL HAVE A VOLTAGE RATING NOT LESS THAN THE CIRCUIT VOLTAGE.

FUSES RATED 30A, 125V OR LESS SHALL BE OF THE NONRENEWABLE CARTRIDGE TYPE. FUSES RATED ABOVE 30A AND UNDER 600V SHALL BE THE RENEWABLE CARTRIDGE TYPE WITH TIME DELAY DUAL ELEMENTS UNLESS SHOWN OTHERWISE ON THE DESIGN DRAWINGS. FUSES SHALL CONFORM TO FS W-F-1726 AND SUPP. 1.

SPECIAL FUSES SUCH AS EXTRA HIGH INTERRUPTING CAPACITY FUSES, FUSES FOR WELDING MACHINES, AND CAPACITOR FUSES SHALL BE INSTALLED WHERE CALLED FOR ON THE DRAWINGS. PLUG FUSES ARE NOT PERMITTED.

POWER FUSES ON AC SYSTEMS ABOVE 600V SHALL BE AS DENOTED ON THE DESIGN DRAWINGS. NO CHANGE IN CONTINUOUS CURRENT RATING, INTERRUPTING RATING, AND CLEARING OR MELTING TIME OF FUSES SHALL BE MADE BY THE CONTRACTOR UNLESS WRITTEN PERMISSION HAS FIRST BEEN SECURED FROM THE CONTRACTING OFFICER.

---INSTALLATION---

---GENERAL

THE FIELD INSTALLATION OF FUSE HOLDERS SHALL CONFORM TO DRAWINGS AND MANUFACTURER'S RECOMMENDATIONS. FUSES SHALL BE INSTALLED WHERE DESIGNATED ON DRAWINGS. ALL FUSES SHALL BE EASILY AND SAFELY ACCESSIBLE.

SECTION 16V (PART 16)

PANELBOARDS

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS MATERIALS AND PROCEDURES USED IN CONSTRUCTING AND INSTALLING PANELBOARDS.

---GENERAL

SOME PANELBOARDS PRESENTLY EXISTING ON THE ML#2 TOWER SECTIONS WILL BE REUSED AS INDICATED ON THE DRAWINGS.

PANELS TO BE LOCATED IN HAZARDOUS AREAS SHALL BE HAZARD PROOFED IN ACCORDANCE WITH THE PROVISIONS OF SECTION 16V (PART 2), "HAZARDOUS INSTALLATION" AND SIMILAR TO EXISTING HAZARD PROOFED PANELS ON ML#2 TOWER SECTIONS. OUTER CABINETS OF NEW PANELBOARDS LOCATED IN HAZARDOUS AREAS SHALL BE HOT DIPPED ZINC COATED BEFORE PAINTING. ALL OUTER CABINET HARDWARE OF NEW PANELS IN HAZARDOUS AREAS SHALL BE #316 STAINLESS STEEL AND SHALL BE SIMILAR AND EQUAL TO CABINET HARDWARE PRESENTLY ON HAZARD PROOFED PANELS ON ML#2 TOWER SECTIONS.

GUTTER SPACE IN THE NEW LIGHTING AND POWER PANELBOARDS SHALL BE PROVIDED AS FOLLOWS:

LIGHTING PANELBOARDS (120/208V); SIDE GUTTERS - MANUFACTURER'S STANDARD; TOP AND BOTTOM GUTTERS - 6" MINIMUM.

POWER PANELBOARDS (277/480V); SIDE GUTTERS - 4" MINIMUM; TOP AND BOTTOM GUTTERS - 10" MINIMUM.

---MATERIALS---

---PANELBOARDS

NEW PANELBOARDS SHALL BE OF THE DEAD FRONT SAFETY TYPE WITH RATING AND TYPE OF CIRCUIT BREAKERS (BOLT-IN) AS INDICATED ON DRAWINGS. PANELBOARDS SHALL NOT BE USED AS PULL BOXES FOR FEEDTHROUGH CIRCUITS. ALL NEW PANELBOARDS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF FS W-P-115A(2) AND UL 67-1972.

---CIRCUIT BREAKERS

PANELBOARDS SHALL BE PROVIDED WITH THE SIZE AND NUMBER OF SINGLE, DOUBLE OR TRIPLE POLE BREAKERS AS INDICATED ON THE DRAWINGS. TWO OR THREE SINGLE POLE CIRCUIT BREAKERS WITH HANDLE TIE OR BAIL SHALL NOT BE SUBSTITUTED FOR MULTI-POLE BREAKERS IN ANY NEW PANELBOARDS. EXISTING CIRCUIT BREAKERS WITH TIE HANDLES MAY BE REUSED AS INDICATED.

---NUMBERING

NUMBERING ON PANELBOARD CIRCUITS SHALL BE BY SPACES AND NOT BY BREAKER UNITS. PANELBOARDS WITH SPACES IN TWO COLUMNS SHALL HAVE ODD NUMBERED SPACES ON THE LEFT AND EVEN NUMBERED SPACES ON THE RIGHT; NUMBERING SHALL BE FROM TOP TO BOTTOM. SINGLE POLE BREAKERS SHALL BE DESIGNATED BY THE NUMBER OF THE SPACE; 2-POLE BREAKERS SHALL BE DESIGNATED BY THE LOWER NUMBER OF THE TWO SPACES (I.E., A 2-POLE BREAKER IN SPACES 4 AND 6 SHALL BE DESIGNATED CIRCUIT BREAKER NO. 4); 3-POLE BREAKERS SHALL TAKE THE CENTER NUMBER OF THE THREE SPACES. COLUMN PANELBOARDS WITH SPACES IN A SINGLE COLUMN SHALL BE NUMBERED CONSECUTIVELY FROM TOP TO BOTTOM.

---DETAILS OF PANELBOARD CONSTRUCTION

PANELBOARD CONSTRUCTION MAY BE MAIN LUGS ONLY OR CIRCUIT BREAKER MAINS, AS DESIGNATED. IF NO DESIGNATION IS CALLED FOR ON THE DRAWINGS, PANELBOARDS SHALL BE MAIN LUGS ONLY. CONSTRUCTION SHALL BE CODE GAGE GALVANIZED STEEL WITH BAKED ON ENAMEL FINISH. NONHAZARDOUS PANELBOARD CABINETS SHALL HAVE FLAT FRONTS WITH CONCEALED TRIM CLAMPS OR SCREW ON COVERS AND DOORS SHALL HAVE HINGES AND A COMBINATION LATCH AND LOCK. TRIM SHALL BE SUITABLE FOR FLUSH OR SURFACE MOUNTING AS REQUIRED BY LOCATION OR INSTALLATION. A DIRECTORY CARD HOLDER AND CARD SHALL BE PROVIDED FOR EASY BRANCH CIRCUIT IDENTIFICATION.

---SIZE

PANELBOARDS SHALL NOT EXCEED 78 INCHES IN LENGTH AND SHALL BE SO MOUNTED THAT THE HEIGHT FROM THE FLOOR TO THE TOP OPERATING HANDLE WILL NOT BE GREATER THAN SIX FEET.

---MAXIMUM CAPACITY

NO PANEL SHALL BE INSTALLED THAT HAS A CAPACITY TO RECEIVE MORE THAN 42 OVERCURRENT DEVICES. IF DESIGN OR CONDITIONS DICTATE THE USE OF MORE THAN 42 OVERCURRENT DEVICES, TWO OR MORE PANELBOARDS SHALL BE INSTALLED. A 2-POLE CIRCUIT BREAKER SHALL BE CONSIDERED AS TWO OVERCURRENT DEVICES. A 3-POLE CIRCUIT BREAKER SHALL BE CONSIDERED AS THREE OVERCURRENT DEVICES.

---KEYS

LOCKS SHALL BE PROVIDED WITH KEYS. THE KEYS SHALL BE SHOWN TO OPERATE THE LOCKS IN THE PRESENCE OF THE CONTRACTING OFFICER AND SHALL THEN BE PROPERLY TAGGED AND DELIVERED TO THE CONTRACTING OFFICER.

SECTION 16V (PART 17)

CIRCUIT BREAKERS

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS MOLDED CASE TYPE CIRCUIT BREAKERS.

---MATERIALS---

---CIRCUIT BREAKERS

UNLESS OTHERWISE INDICATED, CIRCUIT BREAKERS SHALL BE OF THE MOLDED CASE TYPE, MANUALLY OPERATED, TRIP FREE, WITH INVERSE TIME, THERMAL OVERLOAD PROTECTION, AND INSTANTANEOUS, MAGNETIC, SHORT CIRCUIT PROTECTION AS REQUIRED.

THE BREAKER SIZE SHALL BE AS REQUIRED FOR THE CONTINUOUS CURRENT RATING OF THE CIRCUIT.

THE INTERRUPTING CAPACITY OF THE BREAKERS SHALL BE SUFFICIENT TO SUCCESSFULLY INTERRUPT THE MAXIMUM SHORT CIRCUIT CURRENT IMPOSED ON THE CIRCUIT AT THE BREAKER TERMINALS. NEW CIRCUIT BREAKERS INTERRUPTING CAPACITIES SHALL BE A MINIMUM OF 10,000A AND SHALL CONFORM TO GENERAL REQUIREMENTS OF FS W-C-375A(3), UNLESS OTHERWISE SPECIFIED.

ANY NEW MULTI-POLE CIRCUIT BREAKERS SHALL BE OF THE COMMON TRIP TYPE HAVING A SINGLE OPERATING HANDLE. BREAKERS SHALL BE AMBIENT COMPENSATED AND SHALL HAVE 2-POSITION ON/OFF INDICATION. THE BREAKER BODY SHALL BE OF PHENOLIC COMPOSITION. BREAKERS SHALL BE CAPABLE OF HAVING ATTACHED SUCH ACCESSORIES AS HANDLE EXTENSION, HANDLE LOCKING, AND PADLOCKING DEVICES, WHERE REQUIRED ON THE DRAWINGS.

CIRCUIT BREAKERS USED FOR MOTOR CIRCUIT DISCONNECTS SHALL MEET THE REQUIREMENTS OF NFPA 70-1975, ARTICLE 422-26, AND PART H OF ARTICLE 430.

CIRCUIT BREAKERS USED AS A SERVICE DISCONNECTING MEANS SHALL BE OF THE ENCLOSED CIRCUIT BREAKER TYPE WITH EXTERNAL HANDLE FOR MANUAL OPERATION. ENCLOSURES SHALL BE SHEET METAL WITH A HINGED COVER AND SUITABLE FOR SURFACE MOUNTING UNLESS OTHERWISE INDICATED.

---GENERAL

CIRCUIT BREAKERS SHALL BE INSTALLED ACCORDING TO MANUFACTURER'S INSTRUCTIONS AND AS SHOWN ON DRAWINGS.

SECTION 16V (PART 18)

INCANDESCENT LIGHTING

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF INCANDESCENT LIGHTING.

---DELIVERY AND STORAGE

FIXTURES AND LAMPS SHALL BE DELIVERED TO THE PROJECT SITE IN THEIR ORIGINAL CARTONS.

---MATERIALS---

---LIGHTING

LAMPS OF THE PROPER TYPE, WATTAGE, AND VOLTAGE RATING SHALL BE FURNISHED FOR AND INSTALLED IN EACH FIXTURE.

ANY NEW LIGHTING FIXTURES SHALL BE FURNISHED AND INSTALLED IN ACCORDANCE WITH THE DRAWINGS AND AS SPECIFIED IN THIS SECTION. (SOME LIGHTING FIXTURES SUCH AS ON THE SSAT AND IN THE WEST ELEVATOR ROOM WILL BE REUSED IF NOT DAMAGED.) ACCESSORIES SUCH AS STRAPS, MOUNTING PLATES, NIPPLES AND BRACKETS SHALL BE PROVIDED AND PROPERLY INSTALLED. ALL INCANDESCENT FIXTURES EQUIPPED WITH 300 WATT OR LARGER LAMPS SHALL BE PROVIDED WITH A MOGUL BASE.

IT SHALL BE A PART OF THIS CONTRACT TO REINSTALL, MAINTAIN AND OPERATE A SYSTEM OF AVIATION OBSTRUCTION LIGHTS FOR THE DURATION OF THIS CONTRACT. THESE LIGHTS ARE PRESENTLY LOCATED ON ML#2 TOWER SECTIONS BUT SHALL BE RELOCATED AS A PART OF THIS CONTRACT AS INDICATED ON THE DRAWINGS. FURTHER, THE FLASHING BEACON LIGHT MUST BE MAINTAINED IN OPERATION ON THE UPPER MOST LEVEL AS THE SSAT IS BUILT.

A FLASHING BEACON AND OBSTRUCTION LIGHTS SHALL BE INSTALLED ON THE ELEVATED WATER TANK.

---GENERAL

LIGHTING SHALL BE INSTALLED AS SHOWN ON DRAWINGS AND IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

REFLECTORS AND SOCKETS SHALL BE EASILY DETACHED AS A UNIT WITHOUT THE USE OF TOOLS, BUT SHALL BE SO ARRANGED THAT THEY CANNOT COME LOOSE.

NEW LAMPS SHALL BE INSTALLED IN THE FIXTURES JUST PRIOR TO COMPLETION OF THE PROJECT.

ALL FIXTURES AND SUPPORTS SHALL BE CAREFULLY LAID OUT IN ACCORDANCE WITH THE LOCATIONS SHOWN ON THE DRAWINGS. ALL FIXTURES AND FIXTURE SUPPORTS SHALL BE INSTALLED WITH SUITABLE SWIVEL HANGARS, CANOPIES AND OTHER AUXILIARIES TO ASSURE THAT THE FIXTURES ARE:

PLUMB WITHOUT BENDING OR OFFSETTING THE FIXTURE STEMS, RODS OR SUPPORTS;

PROPERLY ALIGNED, BOTH LENGTHWISE AND CROSSWISE, EXCEPT THAT WHERE OBSTRUCTIONS OR CONFLICTS ARE ENCOUNTERED, THE FIXTURE, OR FIXTURES, SHALL BE RELOCATED AS DIRECTED BY THE CONTRACTING OFFICER;

INSTALLED IN SUCH A MANNER AS TO PROVIDE A FINISHED, NEAT AND WORKMANLIKE INSTALLATION.

---RELOCATION OF FLOODLIGHT STANDARDS

FLOODLIGHT STANDARD NO. 15 PRESENTLY LOCATED ON THE SOUTHWEST SECTION OF THE PAD SHALL BE MOVED APPROXIMATELY FIFTEEN FEET DUE SOUTH OF THE PRESENT LOCATION AND FLOODLIGHT STANDARD NO. 19 ON THE NORTHEAST CORNER OF THE PAD APRON SHALL BE RELOCATED APPROXIMATELY 45 FEET EAST AS INDICATED ON DRAWING E77. ALL EXISTING FIRE ALARM STATIONS, FIRE BELLS AND COMMUNICATIONS SPEAKERS ARE TO BE RELOCATED WITH THE STANDARDS. FOR THE FLOODLIGHTS AND FIRE ALARM DEVICES, THE CONTRACTOR SHALL REMOVE THE PRESENT CONDUCTORS, CUT THE CONCRETE, EXTEND THE CONDUITS TO THE NEW LOCATIONS AND PULL IN NEW CONDUCTORS TO THE RELOCATED DEVICES. FOR THE SPEAKER FEEDERS, NASA WILL REMOVE THE CONDUCTORS, THE CONTRACTOR SHALL EXTEND THE CONDUIT AND NASA WILL PULL IN NEW CONDUCTORS. THE CONTRACTOR SHALL PROVIDE THE CONCRETE FLOODLIGHT STANDARD FOUNDATIONS AS CALLED FOR ON THE DRAWINGS. THE CROSS ARM OF THE FLOODLIGHT STANDARD SHALL BE ORIENTED AS AT PRESENT AND THE CONTRACTOR SHALL REDIRECT THE FLOODLIGHTS INDIVIDUALLY AS DIRECTED BY THE CONTRACTING OFFICER.

SECTION 16W (PART 24)

MOTORS

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF MOTORS.

---MOTORS

MOTORS FURNISHED UNDER THIS AND OTHER SECTIONS OF THE SPECIFICATIONS SHALL BE OF SUFFICIENT SIZE FOR THE DUTY TO BE PERFORMED AND THE MOTOR'S RATED FULL LOAD CURRENT SHALL NOT BE EXCEEDED WHEN THE DRIVEN EQUIPMENT IS OPERATING AT SPECIFIED CAPACITY.

THE HORSEPOWER RATINGS INDICATED ON THE DRAWINGS ARE ESTIMATED ONLY AND DO NOT LIMIT EQUIPMENT SIZE.

UNLESS OTHERWISE SPECIFIED, ALL MOTORS SHALL HAVE OPEN FRAMES, SHALL BE DRIP-PROOF, AND SHALL HAVE CONTINUOUS DUTY CLASSIFICATION BASED ON 40 DEGREES CELSIUS AMBIENT TEMPERATURE OF REFERENCE. MOTORS LOCATED IN HAZARDOUS AREAS MUST CONFORM TO THE REQUIREMENTS IN SECTION 16V, PART 2, "HAZARDOUS INSTALLATIONS".

POLYPHASE MOTORS SHALL BE TYPE II, DESIGN B, SQUIRREL CAGE TYPE, HAVING NORMAL STARTING TORQUE AND LOW STARTING CURRENT CHARACTERISTICS, UNLESS OTHER CHARACTERISTICS ARE SPECIFIED ELSEWHERE. WHEN ELECTRICALLY DRIVEN EQUIPMENT FURNISHED UNDER OTHER SECTIONS OF THE SPECIFICATIONS MATERIALLY DIFFERS FROM THE CONTEMPLATED DESIGN, THE CONTRACTOR SHALL MAKE THE NECESSARY ADJUSTMENTS TO THE WIRING, DISCONNECT DEVICES, BRANCH CIRCUIT PROTECTION, AND MOTOR CONTROLS TO ACCOMMODATE THE EQUIPMENT ACTUALLY INSTALLED. FRACTIONAL HORSEPOWER MOTORS SHALL CONFORM TO FS CC-M-636C, AND INTEGRAL HORSEPOWER MOTORS SHALL CONFORM TO FS-CC-M-641D. MOTORS 1/2 HORSEPOWER AND LARGER SHALL BE 3-PHASE UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS.

EACH MOTOR OF 1/8 HORSEPOWER OR LARGER SHALL BE PROVIDED WITH THERMAL OVERLOAD PROTECTION. THE OVERLOAD PROTECTION DEVICE SHALL BE PROVIDED EITHER INTEGRAL WITH THE MOTOR OR CONTROLLER OR MOUNTED IN A SEPARATE ENCLOSURE. UNLESS OTHERWISE SPECIFIED, THE PROTECTIVE DEVICE SHALL BE OF THE MANUAL RESET TYPE. ALL 3-PHASE MOTOR CONTROLLERS SHALL PROVIDE OVERLOAD PROTECTION AND A SET OF CONTACTS IN EACH PHASE. THE OVERLOAD RELAY HEATER ELEMENTS SHALL BE THE SIZE RECOMMENDED BY THE MANUFACTURER FOR THE FULL LOAD RATED CURRENT OF THE MOTOR.

---STARTERS

REDUCED VOLTAGE STARTERS SHALL BE USED FOR MOTORS WHERE SHOWN ON THE DESIGN DRAWINGS. STARTERS SHALL BE OF THE AUTO-TRANSFORMER, SINGLE STEP, CLOSED TRANSITION TYPE HAVING AN ADJUSTABLE TIME INTERVAL BETWEEN APPLICATION OF REDUCED AND FULL VOLTAGES TO THE MOTORS. IF DELTA-STAR TYPE STARTERS (CLOSED TRANSITION TYPE) ARE FURNISHED OR RECOMMENDED BY MANFUACTURERS OF COMPRESSOR TYPE EQUIPMENT, THEY ARE ACCEPTABLE FOR THIS USE. SOLID STATE TYPES SHALL BE USED ONLY WHERE SHOWN ON THE DESIGN DRAWINGS.

---DISCONNECT

EACH MOTOR SHALL BE PROVIDED WITH A DISCONNECTING MEANS MEETING THE REQUIREMENTS OF NFPA 70-1975, ARTICLE 430, PART H. FOR SINGLE PHASE FRACTIONAL HORSEPOWER MOTORS, A SINGLE OR DOUBLE POLE TOGGLE SWITCH, RATED FOR ALTERNATING CURRENT, WILL BE ACCEPTABLE PROVIDED THE AMPERE RATING OF THE SWITCH IS AT LEAST 125 PERCENT OF THE MOTOR RATING. ENCLOSED SAFETY SWITCHES SHALL BE HORSEPOWER RATED IN CONFORMANCE WITH TABLE III OF FS W-S-865C(1) AND INT. AMD. 1 (GL). SWITCHES SHALL BE THE QUICK-MAKE, QUICK-BREAK TYPE, AND SHALL DISCONNECT ALL UNGROUNDED CONDUCTORS.

---INSTALLATION---

---MOTOR BASE

MOTORS SHALL BE INSTALLED ON A COMMON BASE WITH THE DRIVEN EQUIPMENT IN ACCORDANCE WITH THE REQUIREMENTS OF THE SECTIONS IN WHICH THE DRIVEN EQUIPMENT IS SPECIFIED, IN ACCORDANCE WITH THE DRIVEN EQUIPMENT MANUFACTURER'S INSTRUCTION, AND AS SHOWN ON DRAWINGS.

---INSTALLATION

EXCEPT WHERE OTHERWISE INDICATED HEREIN, ALL MOTORS SHALL BE FURNISHED AND INSTALLED AS WORK OF OTHER SECTIONS OF THESE SPECIFICATIONS.

---HAMMERHEAD CRANE

THE REINSTALLATION OF THE HAMMERHEAD CRANE IS COVERED UNDER ANOTHER SECTION OF THESE SPECIFICATIONS, HOWEVER, POWER WIRING TO PANEL P2 IS A PART OF THIS ELECTRICAL SPECIFICATION. ALL POWER WIRING BEYOND PANEL P2 AND ALL HAMMERHEAD CRANE CONTROL WIRING SHALL BE INCLUDED IN THE HAMMERHEAD CRANE SECTION. FURTHER, THE REINSTALLATION OF LIGHTNING AIR TERMINALS AND RELATED CABLING, FLOODLIGHTS, AND OBSTRUCTION LIGHTS SHALL BE INCLUDED AS A PART OF THIS ELECTRICAL SECTION.

---SSAT ELEVATORS

THE RELOCATING AND REPAIRING OF THE SSAT ELEVATORS ARE INCLUDED UNDER ANOTHER SECTION OF THESE SPECIFICATIONS; HOWEVER, THE INSTALLATION OF THE ELECTRICAL FEEDERS TO PANEL P3 ARE A PART OF THIS CONTRACT. PANEL P3 WILL BE MOVED AND REINSTALLED AS A PART OF THE ELEVATOR WORK. ALSO, ALL ELEVATOR WIRING (POWER AND CONTROLS) BEYOND PANEL P3 SHALL BE INCLUDED IN THE ELEVATOR RELOCATION WORK.

---THE WEST ELEVATOR

THE WEST ELEVATOR MACHINERY ROOM AND RELATED ELECTRICAL DEVICES (SEE DRAWING E-71) ARE EXISTING, BUT MUST BE REMOVED DURING INSTALLATION OF FOOTINGS FOR SSAT. THE REMOVAL, LATER REINSTALLATION AND TESTING OF ALL ELECTRICAL DEVICES, INCLUDING ANY TESTING AND READJUSTING OF THE WEST ELEVATOR, ARE TO BE PERFORMED UNDER THE SCOPE OF WORK OF THE ELEVATOR SECTION (SECTION 14B) OF THESE SPECIFICATIONS.

SECTION 16W (PART 25)

MOTOR CONTROLS

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF MOTOR CONTROLLERS, INCLUDING AUTOMATIC, MANUAL, AND MANUAL AND AUTOMATIC CONTROL DEVICES.

---MOTOR CONTROLS---

---GENERAL

EACH MOTOR SHALL BE PROVIDED WITH A SUITABLE CONTROLLER AND DEVICES THAT WILL PERFORM THE FUNCTIONS AS REQUIRED FOR THE RESPECTIVE MOTORS.

ALL CONTROLLERS SHALL CONFORM TO THE ADOPTED STANDARDS AND RECOMMENDED PRACTICES OF UL 508-1972, AND NEMA ICS-1970.

ALL MOTOR CONTROL CIRCUITS SHALL OPERATE AT 120V. CONTROL CIRCUITRY POWER SHALL BE OBTAINED FROM THE LOAD SIDE OF THE MOTOR DISCONNECT MEANS, FROM A 2-WIRE, 120V GROUNDED CIRCUIT OBTAINING ITS SOURCE FROM THE SAME CIRCUIT FEEDING THE MOTOR. IF THE MOTOR CIRCUIT IS MORE THAN 120V TO GROUND, THE CONTROL CIRCUIT SHALL BE ENERGIZED FROM A 2-WINDING TRANSFORMER HAVING ITS 120V SECONDARY WINDING GROUNDED. OVERCURRENT PROTECTION SHALL BE PROVIDED IN THE UNGROUNDED SECONDARY CONDUCTOR ONLY AND SHALL BE PROPERLY SIZED FOR THE LOAD. SEVERAL INTERRELATED MOTORS MAY BE SUPPLIED FROM ONE CONTROL CIRCUIT TRANSFORMER.

---INTRINSICALLY SAFE RELAYS

INTRINSICALLY SAFE RELAYS ARE DESIGNED SO THAT WHEN PROPERLY INSTALLED, ANY SPARKING THAT MAY OCCUR IN THE PILOT DEVICE OR ITS CIRCUIT, IS INCAPABLE OF CAUSING AN EXPLOSION IN A HAZARDOUS LOCATION. THE RELAY HAS AN EPOXY ENCAPSULATED MODULE CONTAINING A SOLID STATE CIRCUIT WHICH LIMITS CURRENT AND VOLTAGE IN THE PILOT CIRCUIT TO A SAFE LEVEL. THE CONCEPT OF INTRINSIC SAFETY IS RECOGNIZED BY THE NATIONAL ELECTRICAL CODE AND RELAYS ARE LISTED BY UNDERWRITERS' LABORATORY FOR ACTUATION BY INTRINSICALLY SAFE (LOW ENERGY) PILOT CIRCUITS EXTENDING INTO CLASS 1, GROUP A, B, C, OR D HAZARDOUS LOCATIONS. THUS, INTRINSICALLY SAFE RELAYS MAY BE USED ON THIS CONTRACT AS AN APPROVED METHOD OF WIRING IN HAZARDOUS AREAS WHERE APPLICABLE.

THE INTRINSICALLY SAFE RELAY SHALL BE MOUNTED IN A NONHAZARDOUS LOCATION. ITS INTRINSICALLY SAFE LOW ENERGY PILOT CIRCUIT CAN THEN BE ROUTED TO THE HAZARDOUS AREA.

CAUTION: WHEN USING INTRINSICALLY SAFE RELAY CIRCUITS, EXTRA CARE MUST BE EXERCISED IN SPACING AND ROUTING OF THE LOW ENERGY PILOT CIRCUITS TO PREVENT THE INTRODUCTION OF UNWANTED ELECTRICAL SIGNALS DUE TO ELECTRICAL FIELDS SURROUNDING ELECTRICAL POWER CONDUCTORS.

---AUTOMATIC CONTROLLERS

AUTOMATIC CONTROL DEVICES SUCH AS THERMOSTATS OR FLOAT OR PRESSURE SWITCHES MAY DIRECTLY CONTROL THE STARTING AND STOPPING OF MOTORS UP TO 1/4 HORSEPOWER, PROVIDED THE DEVICES USED ARE DESIGNED FOR THE PURPOSE AND HAVE AN ADEQUATE HORSEPOWER RATING. WHEN THE AUTOMATIC CONTROL DEVICE DOES NOT HAVE SUCH A RATING, A MAGNETIC STARTER SHALL BE USED WITH THE AUTOMATIC CONTROL DEVICE ACTUATING THE PILOT CONTROL CURCUIT.

---MANUAL CONTROLLERS

MANUAL CONTROLLERS FOR MOTORS LARGER THAN 1/4 HORSEPOWER SHALL BE SPECIFICALLY DESIGNED FOR THE PURPOSE AND SHALL HAVE A HORSEPOWER RATING EQUAL TO THE MOTOR INVOLVED.

---MANUAL AND AUTOMATIC CONTROLLERS

WHEN COMBINATION MANUAL AND AUTOMATIC CONTROL IS SPECIFIED, AND THE AUTOMATIC CONTROL DEVICE OPERATES THE MOTOR DIRECTLY, A DOUBLE THROW, 3-POSITION TUMBLER OR ROTARY SWITCH SHALL BE PROVIDED FOR THE MANUAL CONTROL; WHEN THE AUTOMATIC CONTROL DEVICE ACTUATES THE PILOT CONTROL CIRCUIT OF A MAGNETIC STARTER, THE LATTER SHALL BE PROVIDED WITH A 3-POSITION SELECTOR SWITCH MARKED "MANUAL-OFF-AUTOMATIC". CONNECTIONS TO THE SELECTOR SWITCH SHALL BE SUCH THAT ONLY THE NORMAL AUTOMATIC REGULATORY CONTROL DEVICES WILL BE BY-PASSED WHEN THE SWITCH IS IN THE MANUAL POSITION; ALL SAFETY CONTROL DEVICES SUCH AS A LOW OR HIGH PRESSURE CUTOUT, HIGH TEMPERATURE CUTOUT, AND MOTOR OVERLOAD PROTECTIVE DEVICES SHALL BE CONNECTED IN THE MOTOR CONTROL CIRCUIT IN BOTH THE MANUAL AND THE AUTOMATIC POSITIONS OF THE SELECTOR SWITCH.

TO DETERMINE SOURCE OF SUPPLY OF VARIOUS MOTOR STARTERS AND CONTROLLERS, REFER TO OTHER SECTIONS OF THESE SPECIFICATIONS.

SECTION 16W (PART 26)

CONTACTORS

---GENERAL REQUIREMENTS---

---SCOPE

THIS PART COVERS THE FURNISHING AND INSTALLATION OF CONTACTORS WHICH SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND AS SHOWN ON DRAWINGS.

---CONTACTORS---

---NONMOTOR LOADS

AC CONTACTORS SHALL BE USED FOR THE FOLLOWING PURPOSES:

MAGNETIC CONTACTORS FOR THE CONTROL OF LOW VOLTAGE, DIRECT CURRENT OR ALTERNATING CURRENT RECEPTACLE OR LIGHTING LOADS, SHALL BE IN ACCORDANCE WITH SECTION 11, PART 11 OF NEMA PUBLICATION NO. ICS-1970 AS INDICATED AND HEREIN SPECIFIED.

CONTACTORS SHALL BE OF THE VERTICAL LIFT DESIGN AND SHALL INCLUDE A STATIONARY ELECTROMAGNETIC CORE AND COIL ASSEMBLY, MOVABLE ARMATURE, YOKE WITH MOVABLE CONTACTS, STATIONARY CONTACTS, AUXILIARY CONTACTS, AND LINE AND LOAD TERMINAL CONNECTORS. THE ACTION OF THE ARMATURE AS A RESULT OF THE MAGNETIC FIELD ESTABLISHED IN THE CORE BY THE COIL CURRENT SHALL CLOSE THE MAIN CONTACTS COMPLETING THE CIRCUIT TO THE MOTOR. THE COLLAPSE OF THE MAGNETIC FIELD WITH LOSS OF COIL CURRENT SHALL DROP THE ARMATURE TO ITS DE-ENERGIZED POSITION AND OPEN THE MAIN CONTACTS OF THE CONTACTOR.

THE CORE ARMATURE OF THE ELECTROMAGNET SHALL BE BUILT UP WITH LAMINATED, NONAGING, HIGH PERMEABILITY, GRAIN ORIENTED, COLD ROLLED SILICON SHEET STEEL. LAMINATIONS SHALL BE COATED WITH AN INSULATING FILM OR FINISH TO MINIMIZE EDDY CURRENT LOSSES. SHEET STEEL SHALL CONFORM TO ASTM A345-55(1970) TABLE IV, "SPECIFICATION FOR FLAT ROLLED ELECTRICAL STEEL". SHADING COILS SHALL BE PLACED IN THE POLE FACES TO SEAL THE GAP AND PREVENT CHATTERING. THE COIL SECTION CONSISTS OF INSULATED COPPER CONDUCTORS CONCENTRICALLY WOUND AROUND THE CORE OPENING.

COIL SECTIONS SHALL BE REMOVABLE FROM THE CORE AND IMPREGNATED WITH A HIGH TEMPERATURE, MOISTURE RESISTANT, THERMOSETTING VARNISH AND BAKED. THE COPPER CONDUCTORS IN THE COIL SECTION SHALL CONFORM TO ASTM 83-63(1969) "SPECIFICATION FOR SOFT OR ANNEALED COPPER WIRE".

THE TEMPERATURE RISE OF COILS ABOVE THE AMBIENT TEMPERATURE SHALL NOT EXCEED 65 DEGREES CELSIUS.

THE CORE AND COIL ASSEMBLY SHALL OPERATE SATISFACTORILY WITH COIL VOLTAGE BETWEEN 85 PERCENT AND 110 PERCENT OF ITS VOLTAGE RATING.

THE STATIONARY AND MOVABLE MAIN CONTACTS SHALL BE OF SILVER ALLOY WHICH IS NONWELDING AND NONCORRODING UNDER ALL CONDITIONS OF SERVICE WITHIN THE RATING OF THE CONTACTOR. THE TEMPERATURE RISE OF CONTACTS ABOVE THE AMBIENT TEMPERATURE SHALL NOT EXCEED 65 DEGREES CELSIUS.

THE CONTACTOR SHALL BE DESIGNED WITH A NORMALLY OPEN HOLDING CIRCUIT AUXILIARY CONTACT FOR CONTROL CIRCUITS. THE RATING OF THE AUXILIARY CONTACT SHALL BE IN ACCORDANCE WITH PART ICS-2-125 OF NEMA PUBLICATION NO. ICS-1970.

SOLDERLESS, PRESSURE WIRE, TERMINAL CONNECTORS SHALL BE FURNISHED OR MADE AVAILABLE FOR LINE AND LOAD CONNECTIONS TO CONTACTORS IN ACCORDANCE WITH ARTICLE 2-110.02 OF NEMA PUBLICATION NO. ICS-1970.

THE ELECTRICAL INSULATING SUPPORTS AND ENCLOSURES FOR THE CURRENT CARRYING METAL PARTS OF CONTACTORS INCLUDING BASE, BARRIERS, YOKE AND COVERS SHALL BE MOLDED FROM PHENOLIC OR UREA BASED COMPOUNDS OR OTHER MATERIALS RECOGNIZED AS SUITABLE FOR THIS APPLICATION.

---MOTOR LOADS

CONTACTORS SHALL BE CAPABLE OF PROVIDING CONTINUOUS SERVICE FOR AUTOMATICALLY OPENING AND CLOSING MOTOR CIRCUITS.

MINIMUM RATING FOR CONTACTORS SHALL BE NEMA SIZE 0.

NEMA SIZE, CONTINUOUS AMPERE RATING, MOTOR VOLTAGE, COIL VOLTAGE, LINE FREQUENCY, NUMBER OF PHASES, HORSEPOWER RATING, NUMBER OF POLES, AND TYPE OF ENCLOSURE SHALL BE AS SHOWN ON THE DRAWINGS.

EACH CONTACTOR SHALL BE PROVIDED WITH A NORMALLY OPEN AUXILIARY CONTACT FOR USE AS A HOLD-IN CONTACT FOR 3-WIRE PUSHBUTTON CONTROL. ADDITIONAL AUXILIARY CONTACTS SHALL BE PROVIDED FOR UTILITY CONTROL SYSTEM (UCS) AS REQUIRED.

---ENCLOSURE

CONTACTOR SHALL BE HOUSED IN A NEMA 4 ENCLOSURE.

METAL FINISHES SHALL BE IN ACCORDANCE WITH SECTION 9 OF THE SPECIFICATIONS.

SECTION 16W (PART 27)

TRANSFORMERS

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF POWER TRANSFORMERS OF 600 VOLTS PRIMARY OR LESS.

---MATERIALS---

---TRANSFORMERS

NEW DRY TYPE, 480 VOLT PRIMARY TRANSFORMERS TO BE FURNISHED AND INSTALLED UNDER THIS SECTION ARE:

TRANSFORMER	SIZE	LOCATED
T-20	45 KVA	IN PTCR
T-23	45 KVA	IN PTCR
T-25	30 KVA	HYPERGOLIC FUEL ELECT. BLDG (LTS)
T-26	1 KVA	HYPERGOLIC FUEL ELECT. BLDG (FIRE ALARM)
T-27	30 KVA	HYPERGOLIC OXIDIZER ELECT. BLDG (LTS)
T-28	1 KVA	HYPERGOLIC OXIDIZER ELECT. BLDG (FIRE ALARM)
T-33	112.5 KVA	PAD POWER
T-EP	*150* KVA	PTCR

(C)

ALL TRANSFORMERS 5 KVA OR OVER SHALL BE THREE PHASE.

THE TRANSFORMERS SHALL COMPLY WITH ANSI C57.12.00-1968, AND ANSI C57.12.90-1973.

TRANSFORMERS SHALL BE THE GENERAL PURPOSE DRY TYPE IN AN INDOOR ENCLOSURE, AS REQUIRED BY THE LOCATION. THE FINISH SHALL BE THE MANUFACTURER'S STANDARD FOR SUITABLE PROTECTION AGAINST RUST, CORROSION, AND SALT AIR FOR INDOOR USAGE.

TRANSFORMERS SHALL BE SUITABLE FOR FLOOR, WALL, OR CEILING MOUNTING, AS SHOWN ON THE DRAWINGS.

FULL CAPACITY NEMA STANDARD TAPS SHALL BE PROVIDED IN THE HIGHVOLTAGE WINDING IN ACCORDANCE WITH NEMA ST1-1972.

TRANSFORMERS SHALL BE THE QUIET TYPE WITH AN AVERAGE SOUND LEVEL NOT EXCEEDING THE FOLLOWING:

TRANSFORMER RATING (KVA)	AVERAGE SOUND LEVEL (DB)
0-9	40
10-50	45
51-150	50

WINDING CONNECTIONS SHALL BE DELTA PRIMARY WITH A GROUNDED WYE SECONDARY UNLESS SHOWN OTHERWISE ON THE DRAWINGS.

TRANSFORMERS INSTALLED INDOORS SHALL BE THE DRY TYPE UNLESS OTHERWISE INDICATED ON THE DRAWINGS.

---INSTALLATION---

---MOUNTING

TRANSFORMERS SHALL BE INSTALLED AS SHOWN ON DRAWINGS.

TRANSFORMERS WITH SOUND LEVELS GREATER THAN 45 DB SHALL BE INSTALLED ON RESILIENT, VIBRATION ISOLATING MOUNTINGS TO PREVENT AMPLIFICATION OF SOUND.

---IDENTIFICATION

EACH TRANSFORMER SHALL HAVE ITS COMPLETE STANDARD NAMEPLATE. NAMEPLATES SHALL BE 1/16-INCH THICK ENGRAVED LAMINATED PLASTIC MEETING THE REQUIREMENTS OF FS L-P-387A(1) AND INT. AMD. 2, TYPE "NEP" AND SHALL HAVE 1/4-INCH HIGH WHITE LETTERS ON A BLACK BACKGROUND. INFORMATION ON EACH NAMEPLATE SHALL INCLUDE VOLTAGE AND CURRENT RATING, NUMBER OF PHASES, PANEL AND CIRCUIT NUMBER FROM WHICH THE EQUIPMENT IS FED, AND ITEM OF EQUIPMENT CONTROLLED.

---ACCEPTANCE---

---TESTS

AUDIBLE SOUND LEVEL TESTS SHALL BE MADE IN ACCORDANCE WITH NEMA ST1-1972.

SECTION 16W (PART 34)

HIGH VOLTAGE WIRING

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS MATERIALS AND PROCEDURES USED IN INSTALLING HIGH VOLTAGE WIRING. A HIGH VOLTAGE PRIMARY DISTRIBUTION SHALL BE USED ON A 60-HZ SYSTEM OPERATING AT A NOMINAL VOLTAGE ABOVE 600V AND BELOW 15KV.

---PERSONNEL QUALIFICATIONS

THE PERSONNEL INVOLVED IN SPLICING SHALL BE WELL QUALIFIED AND QUALIFICATIONS OF CABLE SPLICERS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL. ONCE A TERMINATION OR SPLICE HAS BEEN STARTED BY A WORKER, THE SAME MAN SHALL COMPLETE THAT PARTICULAR SPLICE. EACH TERMINATION AND SPLICE SHALL BE COMPLETED IN ONE CONTINUOUS WORK PERIOD. PERSONNEL WHOSE WORKMANSHIP IS FOUND TO BE UNSATISFACTORY SHALL BE REMOVED FROM THE PROJECT AND REPLACED WITH A QUALIFIED SPLICER AT NO ADDITIONAL COST TO THE GOVERNMENT.

---MATERIALS---

---CABLE

ALL CONDUCTORS INSTALLED IN A PRIMARY DISTRIBUTION SYSTEM SHALL BE OF CROSS LINK POLYETHYLENE POLYVINYL CHLORIDE JACKETED (CLPPVCJ) CABLE.

CLPPVCJ PRIMARY CABLE SHALL CONSIST OF CONDUCTORS SUITABLE FOR INSTALLATION IN CONDUIT. DRAWINGS SHOW CONDUCTORS SIZED FOR COPPER. ALUMINUM OF LIKE AMPACITY WILL BE ACCEPTABLE ON 13.8KV CIRCUITS. WHEN ALUMINUM CONDUCTORS ARE USED ANY REQUIRED INCREASE IN THE SIZE OF CONDUIT, TERMINATION DEVICES AND CABLE LUGS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL INVOLVE NO INCREASE IN COST TO THE GOVERNMENT. ALL CHANGES REQUIRED SHALL BE SUBMITTED AS DEVIATIONS FOR APPROVAL BY THE CONTRACTING OFFICER.

---JOB CONDITIONS

BLOWERS SHALL BE PROVIDED TO FORCE FRESH AIR INTO ALL MANHOLES OR CONFINED AREAS WHERE FREE MOVEMENT OR CIRCULATION OF AIR IS OBSTRUCTED. WATERPROOF PROTECTIVE COVERINGS SUCH AS A TENT, CANVAS, OR TARPAULIN SHALL BE ON THE WORK SITE TO PROVIDE FOR PROTECTION AGAINST RAIN, MIST, OR SPRAY WHILE A SPLICE IS BEING MADE. PUMPS SHALL BE USED TO KEEP MANHOLES DRY DURING SPLICING OPERATIONS. UNDER NO CONDITIONS SHALL A SPLICE OR TERMINATION BE MADE WITH THE INTERIOR OF A CABLE EXPOSED TO MOISTURE.

---BENDS

IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT RADII OF BENDS, POTHEADS, FITTINGS, CABLE RISERS, ETC., ARE SUITABLE FOR THE CABLE, CONFORMING FULLY WITH THE RECOMMENDATIONS OF THE CABLE MANUFACTURER. ANY CHANGES OR MODIFICATIONS TO THESE ITEMS REQUIRED BY THE MANUFACTURER'S RECOMMENDATIONS FOR THE CONTRACTOR SUPPLIED CABLE SHALL BE SUBMITTED AS DEVIATIONS FOR APPROVAL BY THE CONTRACTING OFFICER AND SHALL INVOLVE NO INCREASE IN COST TO THE GOVERNMENT.

---PULLING

THE CABLE MAY BE PULLED IN EITHER DIRECTION BETWEEN TERMINALS. HOWEVER, DUE CONSIDERATION SHALL BE GIVEN TO SUCH FACTORS AS RELATIVE ELEVATIONS OF THE TERMINALS AND BENDS IN THE CONDUITS.

---LUBRICATING

THE CABLE SHEATH OR JACKET SHALL BE LUBRICATED IN ACCORDANCE WITH THE CABLE MANUFACTURER'S INSTRUCTIONS IMMEDIATELY PRIOR TO ITS ENTERING THE DUCT DURING THE PULLING OPERATION. THE LUBRICANT SHALL BE AN APPROVED TYPE FOR THE LUBRICATION OF METAL OR PLASTIC SHEATHED CABLE. THE USE OF SOAP, DETERGENT, AND GREASE-TYPE LUBRICANTS FOR THIS PURPOSE IS PROHIBITED.

---CUTTING

FOLLOWING THE PULLING OPERATION THE CABLE SHALL BE CUT TO THE NECESSARY LENGTH AND UNLESS SPLICING IS TO BE DONE IMMEDIATELY THE CUT END SHALL BE SEALED IN AN APPROVED MANNER WITH THE CUT END BEING HELD POINTING UPWARD DURING THE APPLICATION OF THE SEAL.

---SPLICING

SPLICES SHALL BE MADE WHERE CABLE TERMINATIONS ARE SPECIFICALLY SHOWN ON THE DRAWINGS.

THE CONTRACTOR SHALL EXERCISE THE UTMOST CARE AND CAUTION WHEN MAKING TERMINATIONS AND SPLICES. ALL SPLICES SHALL BE MADE IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. ONLY THOSE TAPES, VARNISHES, COMPOUNDS, ETC., RECOMMENDED BY THE CABLE MANUFACTURER SHALL BE USED. ONLY CLEAN OR NEW BRUSHES AND VESSELS SHALL BE USED IN APPLYING VARNISHES AND COMPOUNDS. ANY BRUSH OR VESSEL PREVIOUSLY USED WITH LIQUIDS OR COMPOUNDS OTHER THAN ASSOCIATED WITH THE CABLE SPLICE SHALL NOT BE USED.

---INSTALLATION OF STRESS CONES

SHIELDED CABLES SHALL HAVE STRESS CONES INSTALLED AT TERMINATIONS WITH A GROUND CONNECTION MADE TO THE SHIELDING TAPE TO ENSURE KEEPING THE SHIELD AT GROUND POTENTIAL. IF SPACE IS LIMITED WHERE A STRESS CONE, TERMINATION, OR SPLICE IS TO BE MADE, MODIFICATION SHALL BE MADE TO THE ENCLOSURE. NO SACRIFICE OF NUMBER OF WRAPS, THICKNESS OF INSULATION. OUTER JACKET. ETC.. SHALL BE MADE TO THE CABLE.

---WORK STATEMENT

THE 15KV CONDUITS PRESENTLY FEEDING THE ML AND MSS INTERFACES SHALL BE REWORKED. THE CONDUITS SHALL BE REMOVED BACK TO THE EDGE OF THE EXCAVATION FOR THE NEW SSAT FOUNDATIONS. AT THIS POINT (SEE DRAWING E21) TWO OF THE CONDUITS SHALL BE RETHREADED AND EXTENDED TO FEED THE NEW MLP INTERFACE. THE OTHER CONDUITS SHALL BE CAPPED AND ABANDONED. THE 15KV CONDUCTORS TO BE PULLED IN SHALL BE NEW.

THE 15KV CABLES AND CONDUITS FEEDING THE SSAT SUBSTATION (1040-1 & -2) AND THE HYPERGOLIC OXIDIZER SUBSTATION (1041-1 & -2) SHALL BE FURNISHED AND INSTALLED NEW AS A PART OF THIS SECTION OF THE SPECIFICATIONS.

---SPECIAL 15KV PLUGS

TWO SPECIAL 15KV TERMINAL PLUGS SHALL BE INSTALLED AT THE 15KV PAD/MLP INTERFACE TO SUPPLY 15KV POWER TO THE MLP. THE TERMINAL PLUGS SHALL BE 15KV, 3-CONDUCTOR, FOR #1 CABLE WITH COLDPOUR COMPOUND AND SHALL BE CATALOG #PF6154C WITH #CP-1 COMPOUND AND CATALOG #PF6154C (SPECIALLY POLARIZED) WITH #CP-1 COMPOUND AS

MANUFACTURED BY PLM PRODUCTS OF CLEVELAND, OHIO, OR APPROVED EQUAL. FURTHER, THE PLUGS MUST MATE WITH EXISTING 15KV RECEPTACLES INSTALLED ON THE MLP BY OTHERS. THESE EXISTING RECEPTACLES ARE 15KV, 3-CONDUCTOR, #1 CABLE SIZE, CATALOG # SMG6015C WITH KIRK TYPE INTERLOCK AND CATALOG #SMG6015C (SPECIALLY POLARIZED) WITH KIRK TYPE INTERLOCK AS MANUFACTURED BY PLM PRODUCTS. THE KIRK KEY NUMBERS ARE 11660 AND 11669. THE CONTRACTOR SHALL PURCHASE *TWO* PLUGS (*ONE* OF EACH TYPE): *THEY SHALL BE INSTALLED AT PAD "B".* (A) (C)

TWO KIRK INTERLOCKS, OR APPROVED EQUAL, SHALL BE PURCHASED BY THE CONTRACTOR AND INSTALLED ON THE RESPECTIVE OIL SWITCHES OF SWITCHING STATION # 1002 IN SUCH MANNER THAT THE PAD/MLP 15KV PLUGS AND RECEPTACLES CANNOT BE DEMATED UNTIL THE RESPECTIVE OIL SWITCH FEEDING THE PLUG AND RECEPTACLE IS IN THE "OPEN" POSITION. THESE INTERLOCKS SHALL HAVE LOCKS OPERATED BY KEY NUMBERS 11660 AND 11669. (A)

---ACCEPTANCE---

---INSPECTION AND TESTS

AFTER ALL SPLICES HAVE BEEN MADE AND POTHEAD TERMINATIONS COMPLETED, WITH MAIN SWITCHES TO TERMINATING POINTS OPEN, A 15 MINUTE DC HIGH POTENTIAL TEST SHALL BE APPLIED TO THE NEW CABLE. THE HIGH POTENTIAL TEST VOLTAGE SHALL BE DETERMINED BY AEIC NO. 1+68 FOR PILC AND BY IPCEA S-66-524(1971). THE NEGATIVE LEAD SHALL BE TIES TO THE CONDUCTOR. THE TEST VOLTAGE SHALL BE APPLIED BETWEEN EACH CONDUCTOR AND GROUND WITH THE OTHER CONDUCTORS TIED TOGETHER AND TO THE SAME GROUND. TEST RESULTS SHALL BE ENTERED ON EXHIBIT 1, "PRIMARY CABLE - DC PROOF TEST."

FINAL ACCEPTANCE TESTS OF THE PRIMARY POWER FEEDERS, INCLUDING EXISTING CABLE, WILL BE PERFORMED BY THE GOVERNMENT WITH THE CONTRACTOR WITNESSING THE TESTS. FAILURES DUE TO WORK INSTALLED BY THE CONTRACTOR SHALL BE CORRECTED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT. THE CONTRACTOR WILL FURNISH THE NECESSARY TEST EQUIPMENT AND PERSONNEL FOR THE ACCEPTANCE TESTS.

EXHIBIT 1

PRIMARY CABLE - DC PROOF TEST

LOCATION:
DESCRIPTION OF CABLE:
RATED VOLTAGE:

TEST DATA

SET LEAKAGE @ TEST VOLTAGE MA VARIAC PRI. VOLTAGE
SPHERE GAP INCHES
DUCT TEMP. AMBIENT TEMP. WEATHER
CABLE STATUS 1 HOUR PRIOR TO TEST

PHASE OR CONDUCTOR	A	B	C	REMARKS
STARTING TIME:				
	MA	MA	MA	
0				
15 SEC.				
30 SEC.				
45 SEC.				
1 MIN.				
2 MIN.				
3 MIN.				
4 MIN.				
5 MIN.				
6 MIN.				
7 MIN.				
8 MIN.				
9 MIN.				
10 MIN.				
11 MIN.				
12 MIN.				
13 MIN.				
14 MIN.				
15 MIN.				

FINAL TEST VOLTAGE
TIME FINISH:
KV DC AFTER 1 MIN.
TEST PROCEDURE NO. OF TERMINALS JOINTS
WITNESSED BY PERFORMED BY

SECTION 16W (PART 36)

POTHEADS

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF POTHEADS. POTHEADS SHALL BE USED FOR TERMINATION OF ALL CABLES AS INDICATED ON THE DRAWINGS.

---MATERIALS---

---POTHEADS

POTHEADS SHALL BE MULTIPLE OR SINGLE CONDUCTOR, CAPNUT TYPE, EXCEPT WHERE OTHER TYPES OF POTHEADS ARE REGULARLY FURNISHED AS AN INTEGRAL PART OF EQUIPMENT, AND SHALL BE SUITABLE FOR CONDUCTORS OF THE GAGE AND TYPE USED. POTHEADS SHALL HAVE CAST IRON BELLS AND BE PROVIDED WITH GROUNDING TERMINALS. POTHEADS SHALL BE USED FOR TERMINATION OF ALL CABLES AS INDICATED.

---INSULATORS

INSULATORS SHALL BE MADE OF HIGH GLAZED PORCELAIN OF THE OUTDOOR TYPE.

---INSULATING COMPOUND

COMPOUND USED SHALL BE A TYPE RECOMMENDED BY THE POTHEAD MANUFACTURER AND ACCEPTABLE TO THE CABLE MANUFACTURER.

---INSTALLATION---

---GENERAL

WHERE MADE NECESSARY BY A PARTICULAR INSTALLATION TO OBTAIN PROPER CLEARANCES OR TRAINING OF CABLE, SPECIAL BODY SHAPES SHALL BE PROVIDED.

POTHEADS PROVIDED FOR SWITCHES, AND OTHER PLACES WHERE THEY ARE REQUIRED FOR A PROPER INSTALLATION, SHALL BE PROVIDED WITH SPECIAL FITTINGS, INCLUDING INVERTED WIPING SLEEVES AND SPLIT CONDUIT CONNECTORS.

POTHEADS SHALL BE COMPLETELY FILLED WITH INSULATING COMPOUND OF SUCH NATURE THAT WHEN HEATED IT WILL FLOW INTO EVERY PART OF THE TERMINAL AND COMPLETELY FILL IT LEAVING NO GAPS OR AIR SPACES. THE POTHEAD MANUFACTURER'S INSTRUCTIONS FOR FILLING THE POTHEAD SHALL BE FOLLOWED.

IN HEATING THE COMPOUND, A THERMOMETER SHALL BE INSERTED TO PREVENT OVER HEATING.

NONCURRENT CARRYING METAL PARTS OF POTHEADS SHALL BE GROUNDED.

---ACCEPTANCE---

---TESTS

THE VOLTAGE RATING OF POTHEADS SHALL BE 15KV UNLESS OTHERWISE DETAILED. THE WET WITHSTAND VOLTAGE OF 15KV POTHEADS SHALL BE NOT LESS THAN 60,000V. POTHEADS SHALL BE TESTED IN ACCORDANCE WITH IEEE 48-1962 "POTHEADS". POTHEADS TO BE TESTED SHALL BE CLEAN AND DRY. THE HIGH VOLTAGE TEST CONNECTION SHALL LEAVE THE POTHEAD TERMINAL IN A DIRECTION APPROXIMATELY PARALLEL TO THE AXIS OF THE POTHEAD FOR A DISTANCE OF NOT LESS THAN THE DRY ARCING DISTANCE OVER THE INSULATOR. NO OTHER OBJECT EXCEPT THE SUPPORTING STRUCTURE SHALL BE CLOSE ENOUGH TO THE POTHEAD TO APPRECIABLY AFFECT THE TEST RESULTS. IN ADDITION, A RADIOGRAPHIC EXAMINATION SHALL BE PERFORMED AND EVALUATED BY THE CONTRACTOR TO DETERMINE IF VOIDS OR FOREIGN OBJECTS EXIST INSIDE THE POTHEAD. THE RADIOGRAPHIC RECORDS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL AND RETENTION. UNACCEPTABLE TERMINATIONS SHALL BE REWORKED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT.

SECTION 16W (PART 37)

DUCT WORK

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE PROCEDURES USED IN INSTALLING NEW CONDUCTORS IN A DUCT SYSTEM.

---GENERAL

A PART OF THIS CONTRACT INCLUDES PULLING NEW CONDUCTORS FROM THE NEW EMERGENCY POWER PANEL IN THE PTCR TO LH_2/RP1 FACILITY THROUGH AN EXISTING DUCT SYSTEM, NEW CONDUIT AS INDICATED ON THE DRAWINGS, AND NEW CONDUCTORS TO HYPERGOLIC OXIDIZER FACILITY.

THE DUCTS SHALL BE THOROUGHLY CLEANED BEFORE USING. SHOULD THE DESIGNATED DUCTS BE FOUND CLOSED OR UNUSABLE FOR ANY REASON, THE WORK REQUIRED TO OPEN THE DUCT OR TO INSTALL NEW DUCT BETWEEN MANHOLES, SHALL BE CONSIDERED OUTSIDE THE SCOPE OF THIS CONTRACT AND SHALL BE DONE AT GOVERNMENT EXPENSE.

AFTER THE CABLE IS PULLED INTO THE DUCT SYSTEM ALL NEW CABLES SHALL HAVE A LEAD TAG ATTACHED WHERE THE CABLE ENTERS AND LEAVES THE MANHOLE. THIS TAG SHALL SHOW CABLE NUMBER OR IDENTIFICATION AND THE NUMBER OF THE MANHOLE FED FROM AND THE MANHOLE FEEDING TO. THE TAG SHALL BE ATTACHED WITH LEAD WIRE.

SECTION 16W (PART 40)

TRENCHING AND BACKFILL

---GENERAL REQUIREMENTS---

---SCOPE

REFER TO SECTION 2D FOR GENERAL SPECIFICATIONS FOR TRENCHING AND BACKFILL.

NOTE: AS THE EXACT LOCATION OF THE BURIED COMMUNICATIONS CABLE IS UNKNOWN, THE CONTRACTOR SHALL HAND DIG ANY EXCAVATION WITHIN 25 FEET OF THE INDICATED LOCATIONS UNTIL THE CONTRACTOR HAS CONFIRMED THE EXACT LOCATION OF THE BURIED CABLE.

---SPECIAL INSTRUCTIONS FOR ELECTRICAL INSTALLATIONS

THE MINIMUM DEPTH OF CABLE RATED ABOVE 600V, WHEN INSTALLED UNDERGROUND IN CONDUIT OR DUCTS, IS 30 INCHES.

THE MINIMUM DEPTH OF CABLE RATED 600V AND BELOW, WHEN INSTALLED UNDERGROUND IN CONDUIT OR DUCTS IS 18 INCHES.

CONDUIT SHALL BE PLACED IN THE TRENCH ON TOP OF A THREE TO FOUR INCH LAYER OF SCREENED SAND OR FILL MATERIAL.

A LAYER OF SCREENED SAND OR FILL MATERIAL SIX TO EIGHT INCHES THICK SHALL BE LAID ON TOP OF THE CONDUIT AND TAMPED TIGHTLY.

A BRIGHT YELLOW PVC RIBBON, MINIMUM TWO INCHES WIDE CONTINUOUSLY MARKED "CAUTION - ELECTRICAL SERVICE BELOW" SHALL BE PLACED IN THE TRENCH APPROXIMATELY EIGHT INCHES BELOW GROUND LEVEL AND RUN CONTINUOUSLY PARALLEL WITH AND ABOVE THE CONDUIT.

SECTION 16X (PART 42)

AIR CIRCUIT BREAKERS

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF LOW VOLTAGE AIR CIRCUIT BREAKERS.

---MATERIALS---

---CIRCUIT BREAKERS

POWER CIRCUIT BREAKERS RATED BELOW 600V SHALL BE OF THE AIRBREAK TYPE ENCLOSED IN VENTILATED HOUSINGS. INTERRUPTING, CURRENT, AND VOLTAGE RATINGS SHALL BE AS INDICATED ON THE DRAWINGS.

ALL AIR CIRCUIT BREAKERS SHALL COMPLY WITH NEMA SG3-1971.

WHERE INDICATED ON THE DRAWINGS BREAKERS INSTALLED IN METAL HOUSING SUCH AS UNIT SUBSTATIONS, SHALL BE OF THE DRAWOUT TYPE. IF A BREAKER IS NOT CALLED OUT ON THE DRAWINGS AS DRAWOUT TYPE (BY SYMBOLS), IT MAY BE SWITCHBOARD OR MOLDED CASE BREAKER.

METAL-ENCLOSED, LOW VOLTAGE, DRAW-OUT TYPE POWER CIRCUIT BREAKERS SHALL BE REMOVABLE WITH PRIMARY AND SECONDARY DISCONNECTING DEVICES AND MECHANICAL INTERLOCKS TO PREVENT THE REMOVABLE ELEMENT FROM BEING INSERTED OR WITHDRAWN WHEN THE BREAKER IS CLOSED.

POWER CIRCUIT BREAKERS SHALL BE THREE POLE, SINGLE THROW, ELECTRICALLY OPERATED AS INDICATED WITH AN ADJUSTABLE OVER-CURRENT TRIPPING DEVICE FOR OVERLOAD, SHORT-CIRCUIT AND GROUND FAULT PROTECTION. THE VOLTAGE RATING, AMPERE FRAME SIZE AND SHORT-CIRCUIT INTERRUPTING CAPABILITY SHALL CONFORM TO NEMA STANDARDS PUBLICATION NO. 211-5.02, DATED 1957, "OUTGOING SECTION."

OVERCURRENT TRIPPING DEVICES SHALL INCLUDE A SOLID-STATE UNIT WITH SOLID-STATE COMPONENTS AND CIRCUITRY, CURRENT SENSING TRANSFORMERS, A SEPARATE POWER SUPPLY TRANSFORMER AND TRIPPING SOLENOID. THE SOLID-STATE UNIT SHALL CONSIST OF FOUR SEPARATE TIME-ENERGY INTEGRATING CIRCUITS WHICH WILL SENSE THE CURRENT MAGNITUDE, PICKUP AND FUNCTION AT LONG-TIME-DELAY, SHORT-TIME-DELAY, INSTANTANEOUS AND GROUND FAULT SETTINGS. A TRIPPING PULSE FROM ANY OF THE INTEGRATING CIRCUITS SHALL TRIGGER A THRYISTOR IN THE TRIP CIRCUIT TO DISCHARGE A CAPACITOR ACROSS THE TRIP SOLENOID.

SHORT-TIME-DELAY TRIP CIRCUITS SHALL BE PROVIDED WITH SELECTIVE MINIMUM, INTERMEDIATE AND MAXIMUM TIME-DELAY BAND SETTINGS OF 4.8, 12 AND 24 CYCLES RESPECTIVELY. THE LONG-TIME-DELAY TRIP CIRCUIT SHALL BE PROVIDED WITH SELECTIVE MINIMUM, INTERMEDIATE AND MAXIMUM TIME-DELAY BAND SETTINGS OF 5.15 AND 30 SECONDS RESPECTIVELY. THE GROUND FAULT TRIP CIRCUIT SHALL BE PROVIDED WITH SELECTIVE TIME-DELAY SETTINGS OF .06, .12, .18, .24 AND .30 SECONDS. LONG-TIME-DELAY TRIP CIRCUITS SHALL HAVE SELECTIVE OVER-CURRENT PICKUP POINTS OF 80, 90, 110, 120 AND 130 PERCENT OF TAP SETTINGS. SHORT-TIME-DELAY TRIP CIRCUITS SHALL HAVE SELECTIVE OVER-CURRENT PICKUP POINTS OF 400, 500, 600, 700, 800 AND 1000 PERCENT OF TAP SETTINGS. INSTANTANEOUS TRIP CIRCUITS SHALL HAVE SELECTIVE OVER-CURRENT PICKUP POINTS OF 400, 500, 600, 800, 1000 AND 1200 PERCENT OF TAP SETTINGS.

GROUND FAULT TRIP CIRCUITS FOR 225 AMPERE FRAME SIZE BREAKERS SHALL HAVE SELECTIVE PICKUP POINTS AT 100, 200, 300 AND 400 AMPERES. GROUND FAULT TRIP CIRCUITS FOR 600 AND 1600 AMPERE FRAME SIZE BREAKERS SHALL HAVE SELECTIVE PICKUP POINTS AT 300, 500, 900 AND 1200 AMPERES. GROUND FAULT TRIP CIRCUITS FOR 3000 AMPERE FRAME SIZE BREAKERS SHALL HAVE SELECTIVE PICKUP POINTS AT 750, 1500, 2250 AND 3000 AMPERES.

A CALIBRATED FACE PLATE WITH ADJUSTABLE CAPTIVE THUMB SCREWS SHALL BE PROVIDED FOR PICKUP CURRENT SETTINGS, TIME-DELAY BAND SETTINGS AND GROUND FAULT CURRENT AND TIME SETTINGS. A SINGLE THUMB SCREW SHALL ADJUST ALL THREE PHASES OF THE TRIPPING CIRCUIT FOR ANY PARTICULAR TIME-CURRENT CHARACTERISTIC. EACH TRIPPING CIRCUIT SHALL BE INDEPENDENT OF EACH OTHER IN ACTION AND ADJUSTMENT.

ALARMS, AUXILIARY SWITCHES, INTERLOCKS, ETC., SHALL BE SUPPLIED AS DESIGNATED ON THE DRAWINGS.

ALL DRAWOUT AIR CIRCUIT BREAKERS SHALL HAVE A REMOVABLE OPERATING HANDLE,PROVISIONS FOR PAD LOCKING, AND POSITION INDICATION.

SECTION 16X (PART 49)

SWITCHGEAR ASSEMBLIES

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS MULTIPLE UNIT CONSTRUCTION TYPE SWITCHGEAR ASSEMBLIES.

---SWITCHGEAR ASSEMBLIES GENERAL---

---SWITCHGEAR ASSEMBLIES

SWITCHGEAR ASSEMBLIES SHALL BE OF THE MULTIPLE UNIT CONSTRUCTION TYPE COMPRISED OF INDIVIDUAL STANDARDIZED ENCLOSED UNITS TO FORM A SINGLE, COMPACT ASSEMBLY. EACH UNIT MAY HOUSE ONE OR MORE PIECES OF ELECTRICAL GEAR (BREAKERS, SWITCHES, ETC.) AS DETERMINED BY STANDARD ENGINEERING PRACTICES FOR THE PRESCRIBED ASSEMBLY BEING INSTALLED. THE ASSEMBLIES SHALL BE TOTALLY METAL ENCLOSED, INCLUDING TOP, REAR, AND SIDES. THE ASSEMBLIES SHALL INCLUDE COMPLETE INTERLOCKING FEATURES AS REQUIRED. ALL UNITS SHALL HAVE HINGED FRONT DOORS WITH PROVISIONS FOR PADLOCKING.

---GENERAL FREESTANDING SWITCHGEAR

FREE STANDING SWITCHGEAR SHALL BE OF SELF-SUPPORTING DESIGN USING THE SPECIFIED NUMBER OF WELDED FRAMES EACH OF WHICH SHALL BE BOLTED TOGETHER TO FORM THE COMPLETE ASSEMBLY WHICH CAN EASILY BE DISMANTLED AND REARRANGED.

A MAIN BUS WILL EXTEND THROUGHOUT THE SWITCHGEAR. BUSES INTERCONNECTED WITH THE MAIN BUS SHALL HAVE SILVER PLATED BOLTED CONNECTIONS. THE BUS WORK SHALL BE DESIGNED TO CARRY ITS REQUIRED CURRENT, WITH PROVISIONS FOR EXPANSION AND CONTRACTION, AND BRACED TO WITHSTAND THE ELECTRICAL AND MECHANICAL STRESSES OF A SHORT CIRCUIT ON THE BUSES. THE INSULATING SUPPORTS AND BUS BRACING SHALL BE ARRANGED TO PROVIDE AMPLE ELECTRICAL CLEARANCES.

PROVISIONS SHALL BE MADE IN THE BUS SECTION FOR BRINGING THE INCOMING CABLES IN FROM EITHER THE TOP OR THE BOTTOM AS NOTED ON THE DRAWINGS AND TERMINALS SHALL BE PROVIDED FOR MAKING THE TERMINATIONS.

ALL TERMINALS WILL BE CLEARLY NUMBERED FOR EASE OF IDENTIFICATION OF CIRCUITS. NUMBERING SYSTEM SHALL COINCIDE WITH NUMERICAL DESIGNATIONS ON SHOP DRAWINGS. MARKERS SHALL BE PRESSURE SENSITIVE, PLASTIC CLOTH WIRE MARKERS.

ALL SWITCHBOARDS SHALL BE EQUIPPED WITH A NEUTRAL BUS RATED 70 PERCENT OR MORE OF THE CURRENT CARRYING CAPACITY OF THE PHASE CONDUCTORS. SWITCHBOARDS SHALL BE PROVIDED WITH A SEPARATE GROUND BUS IN EACH SECTION CONNECTED TO THE SYSTEM GROUND IN ACCORDANCE WITH ALL REQUIREMENTS OF THIS SPECIFICATION. ANY CONDUITS, BUS DUCTS, METALLIC SHEATHS LEAVING THE SWITCHBOARD ENCLOSURE SHALL BE BONDED TO THE SWITCH-BOARD FRAME OR GROUND BUS IN ACCORDANCE WITH ALL REQUIREMENTS OF THE NEC.

THE SWITCHBOARD SHALL BE COMPLETE WITH NAMEPLATES WHICH WILL PROPERLY IDENTIFY EACH MAIN AND EACH FEEDER CIRCUIT BREAKER AND ANY OTHER APPARATUS WHICH MAY BE INSTALLED IN THE SWITCHBOARD. NAMEPLATE SCHEDULES SHALL BE SUBMITTED FOR APPROVAL PRIOR TO FABRICATION.

THE MINIMUM INTERRUPTING RATING OF ANY CIRCUIT BREAKER IN NEW FREESTANDING SWITCHGEAR SHALL BE 20,000 AMPERES (SYM. RMS AMPERES) AT 480 VOLTS.

---SWITCHGEAR ASSEMBLIES

THE FOLLOWING FREESTANDING SWITCHGEAR ASSEMBLIES SHALL BE FURNISHED AND INSTALLED AS A PART OF THIS CONTRACT.

1. SSAT INDUSTRIAL POWER SUBSTATION #1040-1 AND #1040-2 IN SWITCHING STATION #1002
2. EMERGENCY POWER SWITCHGEAR IN PTCR
3. HYPERGOLIC OXIDIZER SWITCHGEAR IN HYPERGOLIC OXIDIZER ELECTRICAL BUILDING
4. HYPERGOLIC FUEL SWITCHGEAR IN HYPERGOLIC FUEL ELECTRICAL BUILDING
5. MOTOR CONTROL CENTER IN PTCR

FURTHER MISCELLANEOUS FREESTANDING SWITCHGEAR FOR MOTOR CONTROLLERS, ETC., ARE SUPPLIED UNDER OTHER SECTIONS OF THESE SPECIFICATIONS.

---TRANSFORMER POWER CENTERS---

---INTEGRAL TRANSFORMER POWER CENTERS

INTEGRAL TRANSFORMER POWER CENTERS SHALL BE THE OUTDOOR TYPE AND OF THE RATINGS AND ARRANGEMENTS INDICATED ON THE DRAWINGS. EACH FACTORY ASSEMBLED, METAL ENCLOSED CENTER SHALL CONSIST OF A PRIMARY INCOMING SECTION, A TRANSFORMER SECTION, AND AN OUTGOING SECONDARY CABLE TERMINATION COMPARTMENT SECTION, MOUNTED

INTEGRALLY ON THE TRANSFORMER, AND SHALL BE THE PRODUCT OF ONE MANUFACTURER. POWER CENTERS SHALL BE OF WEATHERPROOF CONSTRUCTION AND SHALL MEET THE OUTDOOR SWITCHGEAR WEATHERPROOF TESTS IN ACCORDANCE WITH NEMA SG5-1971 AND ANSI C37.20-1965 "SWITCHGEAR ASSEMBLIES INCLUDING METAL ENCLOSED BUS".

THE FOLLOWING INTEGRAL TRANSFORMER POWER CENTERS SHALL BE FURNISHED AND INSTALLED AS A PART OF THIS CONTRACT.

1. SSAT SUBSTATIONS #1040-1 AND #1040-2
2. HYPERGOLIC OXIDIZER SUBSTATIONS #1041-1 AND #1041-2

---INCOMING SECTION

THE INCOMING SECTION SHALL CONSIST OF A FLOOR MOUNTED, FORMED METAL ENCLOSURE, CLOSE COUPLED TO THE TRANSFORMER SECTION THROUGH A TRANSITION SECTION. THE INCOMING SECTION SHALL HOUSE A FUSED OR NONFUSED 3-POLE, GANG OPERATED, TWO POSITION, EXTERNALLY OPERATED LOAD-BREAK SWITCH HAVING PROVISIONS FOR LOCKING. WHERE INDICATED ON THE DRAWINGS THERE SHALL BE THREE I.T.E. CIRCUIT BREAKER COMPANY, OR EQUAL, POWER FUSES, WITH THE CURRENT RATING INDICATED ON THE DRAWINGS, INSTALLED BETWEEN THE SWITCH AND TRANSFORMER. THE LINE SIDE OF THE SSAT SUBSTATION INCOMING SECTIONS SHALL HAVE CONNECTORS PROVIDED FOR THE FUTURE CONNECTION OF AN ADDITIONAL 15KV FEEDER CABLE. THE INCOMING SECTION DOOR SHALL BE KEY INTERLOCKED WITH THE PRIMARY DISCONNECT SWITCH OPERATING HANDLE AND THE SECONDARY MAIN BREAKERS. ONE COMPLETE SET OF SPARE FUSES SHALL BE MOUNTED ON A RACK INSIDE EACH FUSED SWITCH ENCLOSURE.

---TRANSFORMER SECTION

THE TRANSFORMER SECTIONS OF THE SSAT SUBSTATION #1040-1 AND #1040-2 AND THE TRANSFORMER SECTIONS OF THE HYPERGOLIC OXIDIZER SUBSTATION #1041-1 AND #1041-2 SHALL BE SEALED TANK, OIL IMMERSED TYPE. BOTH SHALL BE SELF-COOLED, 3-PHASE, 60 HZ TYPE, WITH DELTA PRIMARY AND NEMA STANDARD PRIMARY TAPS, WITH MANUAL TAP CHANGER ARRANGED FOR CHANGING TAPS ONLY WHEN THE TRANSFORMER IS DE-ENERGIZED. THE TRANSFORMER SECTION SHALL BE COMPLETE WITH ALL STANDARD ACCESSORIES AND MAINTENANCE DEVICES. POWER DISTRIBUTION TRANSFORMERS SHALL MEET THE REQUIREMENTS OF FS W-T-631C(2).

FULL CAPACITY NEMA STANDARD TAPS SHALL BE PROVIDED IN THE HIGH VOLTAGE WINDING IN ACCORDANCE WITH NEMA ST1-1972.

TRANSFORMERS SHALL BE THE QUIET TYPE WITH AN AVERAGE SOUND LEVEL NOT EXCEEDING THE FOLLOWING:

TRANSFORMER RATING (KVA)	AVERAGE SOUND LEVEL (DB)
0-9	40
10-50	45
51-150	50
151-300	55
301-500	60
501-2000	67

WINDING CONNECTIONS SHALL BE DELTA PRIMARY WITH A GROUNDED WYE SECONDARY UNLESS SHOWN OTHERWISE ON THE DRAWINGS.

LIQUID FILLED POWER TRANSFORMERS OF THE SUBSTATION CLASS SHALL HAVE THE FOLLOWING FEATURES PROVIDED, PLUS OTHERS THAT MAY BE DESIGNATED ON THE DRAWINGS.

COVER MOUNTED BUSHINGS
THERMOMETER WITH MAXIMUM AND MINIMUM HANDS AND ALARM CONTACTS
LIFTING LUGS CAPABLE OF LIFTING THE COMPLETE TRANSFORMER
SUITABLE TRANSFORMER BASE, SUCH AS A PARALLEL I-BEAM FRAME
TANK-GROUNDING PADS WELDED TO THE TANK
WELDED-ON MAIN TANK COVER
STAINLESS STEEL NAMEPLATE
PRESSURE RELIEF DEVICE
LIQUID-LEVEL GAGE
DRAIN VALVE
UPPER FILLER VALVE
PRESSURE VACUUM GAGE
PHENOLIC NAMEPLATE, AS NOTED IN 16V (PART 1) "EQUIPMENT IDENTIFICATION"

A MANUAL TAP CHANGER SHALL BE LOCATED ON THE OUTSIDE OF THE TANK FOR DE-ENERGIZED OPERATION. THE NEUTRAL WINDING CONNECTION SHALL BE TERMINATED ON A BUSHING.

---OUTGOING SECTION

THE OUTGOING SECONDARY SECTION SHALL CONSIST OF A CABLE TERMINATION COMPARTMENT MOUNTED INTEGRALLY WITH TRANSFORMER UNLESS SHOWN OTHERWISE ON THE DRAWINGS.

---SWITCHGEAR BRACING

MAIN BUSES SHALL BE PROVIDED WITH BRACING THAT IS SUFFICIENT TO WITHSTAND THE MAXIMUM SHORT CIRCUIT CURRENT AVAILABLE ON THE SYSTEM WHERE THE SWITCHGEAR IS BEING INSTALLED. MINIMUM BRACING FOR ANY PIECE OF SWITCHGEAR SHALL BE FOR 50,000A.

---SSAT SUBSTATION

SWITCHGEAR SHALL BE OF UNITIZED, SELF-SUPPORTING DESIGN USING THE SPECIFIED NUMBER OF WELDED FRAMES, EACH OF WHICH SHALL BE BOLTED TOGETHER TO FORM THE COMPLETE ASSEMBLY WHICH CAN EASILY BE DISMANTLED AND REARRANGED. EACH FRAME SHALL BE DIVIDED VERTICALLY BY BARRIERS INTO A REAR BUS SECTION AND A FRONT BREAKER SECTION. THE FULL HEIGHT BUS SECTION SHALL HOUSE PRIMARY AND SECONDARY BUS CONNECTIONS, BARE MAIN BUS, BUS INTERCONNECTIONS, CURRENT TRANSFORMERS AND OUTGOING CABLES. THE FRONT OF THE CIRCUIT BREAKER SECTION SHALL BE FURTHER DIVIDED INTO HORIZONTAL ISOLATED CELLS TO HOUSE CIRCUIT BREAKERS, INSTRUMENTS, POTENTIAL TRANSFORMERS, AND STATION SERVICE TRANSFORMER. FULL LENGTH REMOVAL COVERS TO FACILITATE THE INSTALLATION OF INCOMING AND OUTGOING CABLES SHALL BE BOLTED OVER THE BUS SECTION FOR EASY REMOVAL.

FORMED SHEET STEEL FRONT DOORS SHALL BE EQUIPPED WITH ADJUSTABLE CONCEALED HINGES AND REMOVABLE PINS AND HELD CLOSED BY KNURLED AND SLOT HEADED SCREWS WITH NO-LOSS RETAINERS THAT BOLT INTO ADJUSTABLE NUTS ON THE FRAME. THE ENTIRE UNIT SHALL BE MADE SUITABLE FOR OUTDOOR OPERATION BY INSTALLING THE COMPONENTS IN AN OUTDOOR WEATHERPROOF ENCLOSURE.

EACH CIRCUIT BREAKER AND ITS DRAWOUT MECHANISM SHALL BE COMPLETELY ENCLOSED TO PREVENT IONIZED GASES FROM PASSING INTO ADJACENT COMPARTMENTS. EACH COMPARTMENT WILL BE ENCLOSED ON THE TOP, SIDES, BOTTOM AND BACK BY SHEET STEEL. THE REAR BARRIER WILL BE FORMED BY REAR STEEL SHEETS ON THE FRAME AND BY THE REAR STATIONARY TERMINAL SUPPORTS. EACH CIRCUIT BREAKER COMPARTMENT DOOR WILL BE ADEQUATELY VENTED BY GRILLE TYPE LOUVERS TO ALLOW FOR VENTING OF IONIZED GASES AND FOR COOLING.

IN THE BUS SECTION A MAIN BUS WILL EXTEND THROUGHOUT THE SWITCHGEAR. BUSES INTERCONNECTED WITH THE MAIN BUS SHALL HAVE SILVER PLATED BOLTED CONNECTIONS. THE BUS WORK SHALL BE DESIGNED TO CARRY ITS REQUIRED CURRENT, WITH PROVISIONS FOR EXPANSION AND CONTRACTION, AND BRACED TO WITHSTAND THE ELECTRICAL AND MECHANICAL STRESSES OF A SHORT CIRCUIT ON THE BUSES. THE INSULATING SUPPORTS AND BUS BRACING SHALL BE ARRANGED TO PROVIDE AMPLE ELECTRICAL CLEARANCES. A 3,000A, 3-PHASE, 600V, TIE BUS DUCT, WEATHERPROOFED FOR OUTDOOR INSTALLATION SHALL BE INSTALLED BETWEEN THE TIE BREAKER IN SECTION 1040-1 AND THE 480V BUS IN SECTION 1040-2. THE TIE BUS DUCT SHALL CARRY A NEUTRAL BUS RATED 70 PERCENT OR MORE OF THE PHASE CONDUCTOR RATING. THE BUS DUCT SHALL BE ROUTED AS INDICATED ON DRAWING E17.

ALL SECONDARY AIR CIRCUIT BREAKERS SHALL HAVE A MINIMUM INTERRUPTING CAPACITY OF 30,000 SYMMETRICAL RMS AMPERES.

PROVISIONS SHALL BE MADE IN THE BUS SECTION FOR BRINGING THE INCOMING CABLES IN FROM EITHER THE TOP OR THE BOTTOM AS NOTED ON THE DRAWINGS AND CLAMP TYPE TERMINALS SHALL BE PROVIDED FOR MAKING THE CABLE TERMINATIONS.

MOLDED TERMINAL BLOCKS FOR CONTROL CIRCUITS SHALL BE MOUNTED VERTICALLY ON THE REAR OF THE BUS COMPARTMENT SIDE SHEET. ALL TERMINALS WILL BE CLEARLY NUMBERED FOR EASE OF IDENTIFICATION OF CIRCUITS. NUMBERING SYSTEM SHALL COINCIDE WITH NUMERICAL DESIGNATIONS ON SHOP DRAWINGS. MARKERS SHALL BE PRESSURE SENSITIVE, PLASTIC CLOTH WIRE MARKERS.

THE AIR CIRCUIT BREAKERS SHALL BE EQUIPPED WITH A DRAWOUT MECHANISM FOR RACKING THE BREAKER. THE MECHANISM MUST BE PROVIDED WITH MECHANICAL INTERLOCKS TO PREVENT MOVING THE CIRCUIT BREAKER TO OR FROM THE OPERATING,TEST OR DISCONNECT POSITION WITH THE CIRCUIT BREAKER IN THE CLOSED POSITION AND SHALL PREVENT CLOSING THE BREAKER UNLESS THE PRIMARY CONTACTS ARE SAFELY SEPARATED OR FULLY CONNECTED. THE MECHANISM SHALL BE CLEARLY MARKED TO SHOW THAT THE BREAKER IS IN THE OPERATING, TEST, OR FULLY DISCONNECTED POSITION. THE DESIGN SHALL PERMIT THE COMPARTMENT DOOR TO BE CLOSED IN ALL BUT THE FULLY WITHDRAWN POSITION OF THE BREAKER.

ALL OF THE CIRCUIT BREAKERS SHALL BE THREE-POLE, ELECTRICALLY OPERATED AND EQUIPPED WITH ADJUSTABLE OVER CURRENT TRIP DEVICES AS SHOWN ON THE DRAWINGS. CIRCUIT BREAKER CLOSING SHALL BE ACCOMPLISHED BY A MOTOR WHICH WILL RECEIVE ITS POWER AT 120 VOLTS AC FROM THE STATION SERVICE TRANSFORMER WITHIN THE SWITCHGEAR.

THE BREAKERS SHALL BE ELECTRICALLY CLOSED BY EITHER A "CLOSE" PUSHBUTTON OR AN OPERATING HANDLE ON THE CIRCUIT BREAKER OR BY A REMOTE CONTACT. AN EMERGENCY CLOSE LEVER SHALL BE PROVIDED AS A MEANS OF CLOSING WHEN CONTROL POWER IS NOT AVAILABLE. THE BREAKER SHALL BE CAPABLE OF BEING TRIPPED BY A PUSHBUTTON OR CONTROL HANDLE ON THE BREAKER OR BY A SHUNT TRIP COIL CONTROLLED FROM A REMOTE POINT.

PROVISION SHALL BE MADE FOR PADLOCKING THE CIRCUIT BREAKERS OPEN IN THE OPERATING, TEST, OR FULL DISCONNECTED POSITION.

A MECHANICAL POSITION INDICATOR WILL BE FURNISHED TO SHOW THE OPEN AND CLOSED POSITIONS. IN ADDITION TO THE MECHANICAL POSITION INDICATORS, EACH BREAKER SHALL BE EQUIPPED WITH RED AND GREEN INDICATING LIGHTS. THE RED INDICATING LIGHT SHALL INDICATE BREAKER CLOSED POSITION AND THE GREEN INDICATING LIGHT SHALL INDICATE BREAKER OPEN POSITION.

SEPARABLE CONTACTS SHALL BE PROVIDED. STATIONARY CONTACTS SHALL BE MOUNTED ON AN INSULATING BARRIER IN THE REAR OF THE BREAKER COMPARTMENT. THE PRIMARY MOVING CONTACTS SHALL CONSIST OF A SET OF FINGERS

SUITABLY SPACED ON THE BREAKER STUDS. HIGH UNIFORM PRESSURE ON EACH FINGER SHALL BE MAINTAINED BY INDIVIDUAL SPRINGS. THE SECONDARY DISCONNECTING DEVICES SHALL CONSIST OF FLOATING FINGERS MOUNTED ON THE REMOVABLE UNIT WHICH ENGAGE FLAT CONTACT SEGMENTS LOCATED AT THE REAR OF EACH COMPARTMENT.

A HEAVY DUTY, FINGER TYPE, GROUND CONTACT SHALL BE PROVIDED AND MOUNTED ON THE FRAME OF THE REMOVABLE UNIT AND A STATIONARY GROUND CONTACT OF AMPLE CAPACITY SHALL BE BOLTED TO THE GROUND BUS. CONTACT ENGAGEMENT SHALL BE MAINTAINED IN THE CONNECTED AND TEST POSITIONS.

THE SWITCHGEAR SHALL INCLUDE METERING AS INDICATED ON DRAWINGS AND SHALL INCLUDE:

3-PHASE AMMETERS (PHASE TO PHASE SELECTIVE)
3-PHASE VOLTMETERS (PHASE TO PHASE SELECTIVE)
WATT HOUR METERS

THE SWITCHBOARD SHALL BE COMPLETE WITH NAMEPLATES WHICH WILL PROPERLY IDENTIFY EACH MAIN AND EACH FEEDER CIRCUIT BREAKER AND ANY OTHER APPARATUS WHICH MAY BE INSTALLED IN THE SWITCHBOARD. NAMEPLATE SCHEDULES SHALL BE SUBMITTED FOR APPROVAL PRIOR TO FABRICATION.

METERS SHALL BE RECTANGULAR CASE TYPE WITH BLACK METAL CASES, WHITE DIALS, AND BLACK MARKINGS AND POINTERS. METERS SHALL BE EQUIPPED WITH AN EXTERNAL ZERO ADJUSTMENT. DIALS SHALL BE AT LEAST FOUR INCHES WIDE. ACCURACY SHALL BE WITHIN ONE PERCENT OF FULL SCALE.

INSTRUMENT TRANSFER SWITCHES SHALL BE OF THE HEAVY DUTY TYPE AND SHALL BE EQUIPPED WITH POSITION INDICATORS AND ROUND KNURLED HANDLES.

EACH SWITCHGEAR FRAME OF SSAT SUBSTATION SHALL BE EQUIPPED WITH HEATERS RATED 120 VOLTS AC AND SUPPLIED BY THE STATION SERVICE TRANSFORMER.

THE MAIN AIR CIRCUIT BREAKERS AND THE TIE AIR CIRCUIT BREAKER IN THE TWO UNIT SUBSTATIONS SHALL BE ELECTRICALLY INTERLOCKED IN SUCH A MANNER THAT THE FOLLOWING OPERATIONS MAY BE SET UP BUT IN NO CASE SHALL IT BE POSSIBLE FOR BOTH MAIN BREAKERS AND THE TIE BREAKER TO BE CLOSED AT THE SAME TIME, PUTTING THE TRANSFORMERS IN PARALLEL:

1. BOTH MAIN BREAKERS CLOSED BUT TIE BREAKER OPEN
2. EITHER MAIN BREAKER CLOSED, THE OTHER MAIN BREAKER OPEN AND TIE CIRCUIT CLOSED.

THE MAIN BREAKER IN EACH OF THE UNIT SUBSTATIONS SHALL BE PROVIDED WITH TIME DELAY UNDERVOLTAGE TRIP UNIT TO OPEN THE BREAKER IN THE EVENT THE SOURCE VOLTAGE FALLS BELOW 70 PERCENT OF RATED VOLTAGE. AFTER RESTORATION OF VOLTAGE THE CIRCUIT BREAKER MUST BE RECLOSED MANUALLY.

THE STATION SERVICE TRANSFORMER SHALL BE SIZED TO SUPPLY ALL LIGHTS, HEATERS, RECEPTACLES, CONTROLS AND AIR CIRCUIT BREAKER CONTROLS ASSUMING THAT ALL BREAKERS MAY BE CLOSED SIMULTANEOUSLY.

INSTRUMENT TRANSFORMERS SHALL COMPLY WITH THE APPLICABLE REQUIREMENTS OF AMERICAN STANDARD C57.13 AND SHALL BE OF THE STANDARD ACCURACY TYPE. POTENTIAL TRANSFORMERS SHALL BE OF THE FIXED TYPE COMPLETE WITH CURRENT LIMITING FUSES. CURRENT AND POTENTIAL TRANSFORMERS SHALL BE AS SHOWN ON THE DRAWINGS.

THE MAIN CIRCUITS SHALL BE GIVEN A DIELECTRIC TEST OF 2200 VOLTS FOR ONE MINUTE BETWEEN LIVE PARTS AND GROUND AS WELL AS PHASE TO PHASE. WIRING AND CONTROL CIRCUITS SHALL BE GIVEN A DIELECTRIC TEST OF 1500 VOLTS FOR ONE MINUTE BETWEEN LIVE PARTS AND GROUND. THE ABOVE TESTS SHALL BE MADE AT THE FACTORY AFTER ASSEMBLY. THE COMPLETE SWITCHGEAR SHALL BE TESTED UNDER SIMULATED SERVICE CONDITIONS TO INSURE ACCURACY OF WIRING AND FUNCTIONING OF EQUIPMENT. RESULTS OF THESE TESTS MUST BE SUBMITTED BEFORE SHIPMENT OF THE EQUIPMENT FROM THE FACTORY.

---EMERGENCY SWITCHBOARD

THE EMERGENCY SWITCHBOARD LOCATED IN THE PTCR SHALL HAVE BREAKERS ON ALL CIRCUITS FEEDING FROM THE 480V BUSES AND THESE BREAKERS SHALL HAVE AN INTERRUPTING CAPACITY (NEMA) OF 20,000 SYMMETRICAL RMS AMPERES AT 480 VOLTS.

THIS CONTRACTOR SHALL FURNISH AND INSTALL THE EMERGENCY SWITCHBOARD AND ALL EMERGENCY CIRCUITS FEEDING FROM IT. HOWEVER, THE CONDUITS AND CONDUCTORS SUPPLYING THE EMERGENCY SWITCHBOARD SHALL NOT BE INCLUDED IN THE CONTRACT.

---HIGH PRESSURE GAS SUBSTATION

IT SHALL BE NECESSARY TO INSTALL ONE NEW AIR CIRCUIT BREAKER OF THE ELECTRICALLY OPERATED, DRAWOUT TYPE IN THE EXISTING HIGH PRESSURE GAS SUBSTATION TO PROTECT THE FEEDER TO THE ELEVATED STORAGE TANK. THE A.C.B. SHALL BE SIMILAR AND EQUAL TO THE A.C.B. PRESENTLY INSTALLED IN THE HIGH PRESSURE GAS SUBSTATION AND SHALL BE COMPLETE WITH ALL MOUNTING HARDWARE.

---HYPERGOLIC OXIDIZER SWITCHGEAR AND HYPERGOLIC FUEL SWITCHGEAR

THE FREESTANDING SWITCHGEAR IN THE ELECTRICAL BUILDINGS AT EACH OF THE TWO HYPERGOLIC FACILITIES SHALL BE PROVIDED AND INSTALLED AS CALLED OUT ON THE DRAWINGS. IT IS PLANNED THAT AT A LATER DATE ADDITIONAL SECTIONS OF SWITCHGEAR WILL BE INSTALLED TO INCLUDE ADDITIONAL FEEDER CIRCUIT BREAKERS, MOTOR STARTERS AND TIE BREAKER, BUT THIS WILL BE ACCOMPLISHED BY OTHERS AND IS NOT INCLUDED IN THIS CONTRACT.

---MAIN GATE SUBSTATION

IT SHALL BE NECESSARY TO INSTALL ONE *GFE* AIR CIRCUIT BREAKER OF THE ELECTRICALLY OPERATED, DRAWOUT TYPE IN THE EXISTING MAIN GATE SUBSTATION TO PROTECT A FEEDER TO THE HYPERGOLIC FUEL FACTILITY. *THE CONTRACTOR SHALL PROVIDE AND INSTALL ALL REQUIRED BREAKER MOUNTING HARDWARE.* THE OTHER FEEDER SHALL BE PROTECTED BY AN EXISTING, SPARE A.C.B. IN WHICH A NEW TRIP UNIT SHALL BE INSTALLED. ⚠C

---MOTOR CONTROL CENTER (MCC)

THE MOTOR CONTROL CENTER IN THE PTCR ROOM 103 SHALL BE FURNISHED AND INSTALLED AS A FREESTANDING SECTION OF SWITCHGEAR, COMPLETE WITH BUSES, CABLE TERMINALS, COMBINATION MOTOR STARTERS AND ANY RELATED ITEMS AS CALLED OUT ON THE DRAWINGS.

---GENERAL---

---INSTALLATION

THE UNIT SUBSTATIONS SHALL BE INSTALLED AT THE LOCATIONS AND IN THE MANNER INDICATED AND IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION MANUALS AND DRAWINGS. THE CONTRACTOR SHALL VERIFY ALL CONDUIT LOCATIONS AND ANCHOR BOLTS FROM APPROVED SHOP DRAWINGS ON THE EQUIPMENT.

---FIELD ENGINEER

THE SERVICES OF THE SUPERVISOR OR FIELD ENGINEER REPRESENTING THE MANUFACTURER OF THE SWITCHGEAR AND UNIT SUBSTATIONS SHALL BE REQUIRED TO CHECK THE EQUIPMENT AFTER INSTALLATION AND ASSIST IN PUTTING THE EQUIPMENT IN SERVICE. THE FIELD ENGINEER SHALL BE WELL QUALIFIED BY LONG TRAINING AND EXPERIENCE IN THE INSTALLATION AND OPERATION OF EQUIPMENT OF THE CHARACTER COVERED BY THIS SPECIFICATION.

SECTION 16X (PART 51)

GROUNDING AND LIGHTNING PROTECTION

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE MATERIALS AND INSTALLATION FOR GROUND AND LIGHTNING PROTECTION.

GROUNDING AND LIGHTNING PROTECTION FOR THIS CONTRACT SHALL INCLUDE BUT NOT BE LIMITED TO:

1. INSTALLING AIR TERMINALS, GROUNDING SHOE ASSEMBLIES AND RING (UNDER HAMMERHEAD CRANE), GROUNDING CABLES AND EXOTHERMIC WELDS FOR THE HAMMERHEAD CRANE AND SSAT.
2. EXTENDING EXISTING FACILITY GROUNDING SYSTEM ON THE PAD AS INDICATED.
3. GROUNDING ALL UNIT SUBSTATION POWER TRANSFORMERS.
4. GROUNDING ALL EXPOSED CABLE TRAY RUNS.
5. GROUNDING OF STRUCTURAL STEEL OF ALL METAL BUILDINGS.
6. GROUNDING OF ALL ELECTRICAL EQUIPMENT AND THE NEUTRAL CONDUCTOR OF THE WIRING SYSTEMS.
7. INSTALLING A SPECIAL SINGLE POINT GROUNDING BUS ON THE SSAT.
8. INSTALLING LIGHTNING MAST AND GROUNDING PADS FOR SSAT.
9. INSTALLING SLIDEWIRE LIGHTNING SHIELD WIRE.
10. GROUNDING ELEVATED WATER TANK AND WATER PIPELINE TO PAD.
11. BONDING ACROSS GASKETED PIPE FLANGES AND ACROSS SELF LUBRICATED PLATE TYPE PIPE SUPPORTS.

---PROOFS OF COMPLIANCE

THE CONTRACTOR SHALL SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

A WRITTEN REPORT INDICATING THE READINGS OBTAINED ON THE RESISTANCE OF GROUND SYSTEM.

---MATERIALS---

---GENERAL

GROUNDING SHALL CONFORM TO NFPA 70-1975, ARTICLE 250. LIGHTNING PROTECTION SYSTEMS SHALL CONFORM TO NFPA 70-1975, ARTICLE 250 AND NFPA NO. 78 (1968).

ELECTRICAL EQUIPMENT AND THE NEUTRAL CONDUCTOR OF THE WIRING SYSTEMS SHALL BE GROUNDED. THE GROUND CONNECTIONS OF THE 480/277 VOLT ELECTRICAL SYSTEMS NEUTRALS AND CONDUIT SYSTEMS SHALL BE MADE IN THE RESPECTIVE UNIT SUBSTATIONS. BARE COPPER GROUND CONDUCTORS SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE SHALL BE EXTENDED TO THE ELECTRICAL GROUNDING SYSTEM.

GROUNDING CONDUCTORS FOR TRANSFORMERS SECONDARY NEUTRALS SHALL HAVE A CURRENT CARRYING CAPACITY OF NOT LESS THAN 1/5 OF THE AGGREGATE BANK FULL LOAD CURRENT, BUT SHALL NOT BE LESS THAN #6 AWG. THIS APPLIES TO ALL POWER TRANSFORMERS THROUGHOUT THE PAD.

ALL GROUNDING CONDUCTORS SHALL BE SUITABLY PROTECTED AGAINST MECHANICAL INJURY.

ALL ELECTRICAL OUTLETS AND EQUIPMENT SHALL BE GROUNDED. ALL ELECTRICAL PANELBOARDS, CABINETS, WIRING GUTTERS, CONDUITS AND CABLE TRAYS PLUS ALL NONCURRENT CARRYING METALLIC PARTS OF ELECTRICAL EQUIPMENT FURNISHED OR INSTALLED UNDER THIS CONTRACT SHALL BE BONDED TO GROUND IN STRICT ACCORDANCE WITH THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE, ARTICLE 250 AND AS FOLLOWS IN THIS SECTION.

---GROUND RODS

GROUND RODS SHALL BE 3/4 INCH DIAMETER BY 40 FEET LONG, UNLESS RODS OF OTHER LENGTHS ARE SPECIFIED ELSEWHERE. RODS SHALL BE COPPERCLAD STEEL CONFORMING TO MIL R-11461C AND INT. AMD. 2(MO), TYPE II, STYLE 2. TEN FOOT EXOTHERMIC FUSION WELDED SECTIONAL RODS SHALL BE UTILIZED TO MAKE UP THE LENGTH OF ROD REQUIRED. REINFORCING STEEL IN PILES AND PILE CAPS SHALL SERVE AS GROUND ELECTRODES FOR SOUND SUPPRESSION WATER PIPING GROUNDING.

---AIR TERMINALS

AIR TERMINALS SHALL BE 1/2 INCH DIAMETER NICKEL TIPPED SOLID COPPER, WITH LENGTH AND LOCATION AS INDICATED ON THE DRAWINGS. THE GROUND WIRE SHALL BE FASTENED BY THREADED BOLTS TO A BRONZE CONNECTOR WITH A MALE THREADED STUD ON WHICH THE FEMALE THREADED AIR TERMINAL SHAFT SHALL BE MOUNTED.

---CONNECTORS

ALL CONNECTORS SHALL BE SPECIFICALLY DESIGNED FOR GROUNDING WITH ADEQUATE PROTECTION AGAINST CORROSION AND WHERE CONNECTION IS MADE TO DISSIMILAR METALS, SHALL PROTECT THE JOINED MEMBERS AS WELL AS THE CONNECTOR AGAINST ELECTROLYSIS.

---GROUND WIRES

GROUND WIRES SHALL BE SOFT DRAWN STRANDED COPPER SIZED AS SHOWN ON THE DRAWINGS.

---INSULATORS

INSULATORS AND SUSPENSION HARDWARE SHALL BE AS INDICATED ON THE DRAWINGS.

---INSTALLATION---

---GENERAL

THE DIFFERENT TYPES OF FACILITIES AT KSC REQUIRE VARYING DEGREES OF BONDING AND GROUNDING, DEPENDING ON LOCATION AND FUNCTION. THIS SPECIFICATION ESTABLISHES THE BONDING AND GROUNDING REQUIRED FOR THIS CONTRACT.

---ZONES

REQUIREMENTS FOR BONDING AND GROUNDING OF FACILITIES AND EQUIPMENT VARY DEPENDING UPON THEIR FUNCTION AND THE ENVIRONMENT IN WHICH THEY ARE LOCATED.

---BONDING AND GROUNDING REQUIREMENTS---

---REQUIREMENTS APPLICABLE TO ALL AREAS

THE FOLLOWING BONDING AND GROUNDING REQUIREMENTS APPLY TO ALL AREAS. BONDING AND GROUNDING REQUIREMENTS AS A MINIMUM SHALL BE THOSE SPECIFIED BY NFPA NO. 70, NATIONAL ELECTRICAL CODE AND THE FOLLOWING REQUIREMENTS AND IN CASE OF CONFLICT BETWEEN THE REQUIREMENTS SPECIFIED HEREIN AND THE NEC, THE REQUIREMENTS OF THIS SPECIFICATION SHALL GOVERN.

---ELECTRICAL POWER SYSTEMS

WHERE THE VOLTAGE TRANSFORMER IS LOCATED WITHIN THE BUILDING OR FACILITY, AC POWER DISTRIBUTION SYSTEMS SHALL BE GROUNDED TO THE COUNTERPOISE AT ONE POINT ONLY. IN THE EVENT THE VOLTAGE TRANSFORMATION POINT IS EXTERNAL TO THE BUILDING OR FACILITY, A GROUND CONNECTION SHALL BE MADE TO THE CIRCUIT GROUND ON THE SECONDARY SIDE OF THE SUPPLY TRANSFORMERS AND AN ADDITIONAL GROUND SHALL BE MADE ON THE SUPPLY SIDE OF THE SERVICE ENTRANCE EQUIPMENT. THE CONNECTION SHALL BE MADE BY MEANS OF A CURRENT CARRYING CONDUCTOR NOT LESS THAN THAT GIVEN ON TABLE 250-94, NATIONAL ELECTRICAL CODE. ALL DISTRIBUTION CIRCUITRY DOWNSTREAM OF THIS GROUND CONNECTION SHALL BE ISOLATED FROM GROUND SO THAT NO CURRENT NORMALLY FLOWS THROUGH THE GROUND NETWORK WITHIN THE FACILITY. TRANSFORMER NEUTRAL CONDUCTORS SHALL BE GROUNDED AS SHOWN ON THE DESIGN DRAWINGS. THE POWER GROUND CONNECTION SHALL BE MADE TO THE NEAREST ACCESSIBLE POINT ON THE GROUNDING COUNTERPOISE. THE GROUNDED CONDUCTOR SHALL NOT BE SWITCHED DOWNSTREAM OF THE GROUND CONNECTION.

---WIRING SYSTEM ENCLOSURES AND ELECTRICAL EQUIPMENT GROUNDING

ALL METALLIC WIRING SYSTEM ENCLOSURES AND ELECTRICAL EQUIPMENT FRAMES SHALL BE BONDED TO GROUND. ANY TYPE OF METALLIC ELECTRICAL ENCLOSURE COMPONENT WHICH MAY COME IN CONTACT WITH A CONDUCTOR SHALL BE GROUNDED, OR SHALL BE BONDED TO OTHER COMPONENT PARTS WHICH ARE GROUNDED.

CIRCUITS RATED 600 VOLTS AND BELOW -- AT LEAST ONE COPPER CONNECTION SHALL BE MADE FROM THE COUNTERPOISE AND CONNECTED TO ONE OR MORE ENCLOSURES IN THE POWER TRANSFORMER AREAS SUCH THAT ALL ELECTRICAL EQUIPMENT AND CONDUCTOR ENCLOSURES WITHIN THE FACILITY SERVED BY THESE POWER SOURCES WHEN PROPERLY BONDED TOGETHER ARE PROVIDED WITH A LOW IMPEDANCE PATH FROM ANY POSSIBLE FAULT LOCATION TO THE POWER SOURCE GROUND.

CIRCUITS RATED ABOVE 600 VOLTS -- IN ADDITION TO THE ABOVE, A SEPARATE EQUIPMENT GROUND CONDUCTOR SIZED IN ACCORDANCE WITH TABLE 250-95, NEC, SHALL BE CONNECTED BETWEEN THE EQUIPMENT ENCLOSURE AND THE FACILITY GROUND NETWORK.

---BONDING AND GROUNDING OF CABLE TRAYS

CABLE TRAY SECTIONS, WHETHER IN SINGLE RUNS OR IN SYSTEM ARRANGEMENT, SHALL BE BONDED TOGETHER AND GROUNDED. CABLE TRAY SECTIONS, IN TANDEM ASSEMBLY, SHALL BE CONSIDERED AS HAVING ELECTRICAL CONTINUITY WHEN THE SECTIONS ARE BONDED WITH APPROPRIATE HIGH STRENGTH BOLTS. WHENEVER EXPANSION JOINTS ARE REQUIRED A JUMPER CONSISTING OF A BOND STRAP SHALL BE INSTALLED (SEE BONDING STRAPS AND JUMPERS, THIS SECTION).

ALL CABLE TRAYS SHALL BE PROPERLY GROUNDED BY MEANS OF A LOW RESISTANCE CONDUCTOR OF SUFFICIENT CAPACITY (BUT IN NO CASE SMALLER THAN NO. 1/0 AWG ALUMINUM FOR ALUMINUM TRAYS) TO IMMEDIATELY CARRY OFF ALL CURRENTS TO EARTH WITH A MINIMUM DANGER OF FIRE OR SHOCK. THE GROUNDING CONDUCTOR SHALL BE BONDED TO CABLE TRAY SECTIONS AND FITTINGS BY COMPATIBLE BOLTED CONNECTIONS. THE EFFECTIVE GROUNDING SHALL BE PERMANENT AND CONTINUOUS, WITH AN IMPEDANCE SUFFICIENTLY LOW TO LIMIT THE POTENTIAL ABOVE GROUND AND TO FACILITATE OPERATION OF OVER CURRENT DEVICES IN THE CIRCUIT. GROUNDING AND BONDING SHALL BE IN ACCORDANCE WITH THE DESIGN DRAWINGS. ALUMINUM CABLE TRAY GROUNDING CONDUCTOR SHALL BE INSULATED TO AVOID CATHODIC PROBLEMS.

---CONDUIT AND RACEWAY SYSTEMS

METAL CONDUIT, FITTINGS, JUNCTION BOXES, OUTLET BOXES, ARMORED AND METAL SHEATHED CABLE, AND OTHER RACEWAYS SHALL BE BONDED AS LISTED BELOW TO SERVE AS THE GROUNDING CONDUCTOR.

RIGID METAL CONDUIT AND TERMINATIONS -- ALL THREADED CONNECTIONS MUST BE WRENCH TIGHT AND THE UNEXPOSED INTERNAL AND EXTERNAL THREADS SHALL BE TREATED WITH A CORROSION INHIBITING COMPOUND. ALL EXPOSED

THREADS SHALL BE PAINTED. CONDUITS ENTERING BOXES AND ENCLOSURES SHALL BE BONDED TO THE BOX WITH BONDING TYPE LOCKNUTS (ONE OUTSIDE AND ONE INSIDE) OR LOCKNUT AND GROUNDING TYPE BUSHING. LOCKNUTS THAT GOUGE INTO THE METAL BOX WHEN TIGHTENED ARE ACCEPTABLE.

ELECTRICAL METALLIC TUBING AND FLEXIBLE CONDUIT NOT RATED AS A GROUNDING CONDUCTOR ARE NOT CONSIDERED ADEQUATE FOR FAULT CURRENT RETURN; THEREFORE, A GROUND WIRE SHALL ALWAYS BE INSTALLED INSIDE THE CONDUIT.

THE METAL SHEATH OF MI CABLE AND ARMOR OF TYPE 1AC CABLE SHALL BE INSTALLED WITH APPROVED FITTINGS.

CARE SHALL BE TAKEN ON ANY RACEWAY SYSTEM, WHEN SPECIFICALLY APPROVED FOR GROUNDING PURPOSES, TO INSURE ADEQUATE ELECTRICAL CONTACT AT THE JOINTS AND TERMINATIONS.

SHORT SECTIONS OF FLEXIBLE CONDUIT SUCH AS THOSE USED TO TERMINATE CONDUIT ON MOTORS, ETC., SHALL BE JUMPERED OUT WITH A COPPER JUMPER UNLESS THE FLEXIBLE CONNECTION HAS A BUILT-IN GROUNDING CONDUCTOR.

REMOVABLE COVERS -- FOR INTERNAL LOCATIONS, REMOVALBE COVERS ON BOXES OR CABINETS MADE OF SHEET METAL LESS THAN 1/8 INCH THICK SHALL BE CONSIDERED BONDED WHEN ATTACHED BY SHEET METAL OR SELF TAPPING SCREWS, OR MACHINE BOLTS AND NUTS. WHERE THE THICKNESSES ARE GREATER, OR FOR EXTERNAL LOCATIONS, MACHINE BOLTS AND NUTS SHALL BE USED.

---POWER RECEPTACLES

POWER RECEPTACLES SHALL BE INSTALLED IN ACCORDANCE WITH THE DRAWINGS. IN SOME OF THESE RECEPTACLES THE GROUND TERMINALS ARE GROUNDED THROUGH THE CONNECTOR SHELL FOR SOME THREE PHASE 120/208 VOLT APPLICATIONS AND IN SUCH CASES THE INSTALLATION MUST INSURE A GOOD GROUND CONNECTION TO THE CONNECTOR SHELL. PRECAUTION SHALL BE TAKEN IN GROUNDING THE GROUND TERMINAL OF ANY POWER CONNECTOR.

---MOBILE AND PORTABLE EQUIPMENT

PORTABLE ELECTRICAL EQUIPMENT, SUCH AS OFFICE EQUIPMENT, POWER TOOLS, ELECTRICAL TEST EQUIPMENT, ETC., SHALL BE CONSIDERED ADEQUATELY GROUNDED THROUGH THE POWER CORD GROUND CONDUCTOR, PROVIDED A SOLID CONNECTION IS MADE THEREBY BETWEEN THE EQUIPMENT CASE AND THE GROUND TERMINAL OF THE POWER RECEPTACLE. DOUBLE INSULATED PORTABLE ELECTRICAL TOOLS ARE CONSIDERED SAFE WITHOUT AN EQUIPMENT GROUND AND SHALL BE CONSIDERED AN EXCEPTION TO THE FOREGOING REQUIREMENTS. ALL WIRING ENCLOSURES AND FRAMES OF ELECTRICAL EQUIPMENT IN MOBILE EQUIPMENT SUCH AS ELEVATORS, CRANES, TRAILERS, CRAWLER TRANSPORTERS, FUEL AND OXIDIZER HANDLING EQUIPMENT, ETC., SHALL BE GROUNDED TO THE MOBILE EQUIPMENT MAIN METAL FRAME IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF THIS STANDARD. THE MOBILE EQUIPMENT SHALL BE GROUNDED AS FOLLOWS:

ELEVATORS -- ALL ELEVATORS SHALL BE GROUNDED IN ACCORDANCE WITH THE REQUIREMENTS OF APPLICABLE ELEVATOR CODES AND THE NATIONAL ELECTRICAL CODE.

CRANES -- ALL BRIDGE AND TROLLEY CRANES SHALL BE GROUNDED THROUGH THE GROUND RAILS WITH COPPER SHOES. THE SECTIONS OF CRANE RAILS SHALL BE BONDED TOGETHER USING 2/0 COPPER WIRE EXOTHERMICALLY WELDED.

---BUILDINGS AND STRUCTURES

ALL STRUCTURAL MEMBERS OF STEEL FRAME BUILDINGS SHALL BE BONDED TOGETHER AND GROUNDED IN ACCORDANCE WITH THIS SPECIFICATION.

---METAL SIDING, ROOFING, AND CANOPIES

THESE ITEMS SHALL BE BONDED TO GROUND. THE PREFERRED METHOD FOR BONDING THESE ITEMS SHALL BE PERMANENTLY INSTALLED BONDING JUMPERS. ALTERNATE METHODS INCLUDE SPOT WELDS TO OTHER STRUCTURAL MEMBERS OR THROUGH BOLTS WITH TOOTHED LOCKWASHERS BETWEEN BOLT AND SHEET METAL. SHEET METAL SCREWS ARE NOT ACCEPTABLE.

---MISCELLANEOUS BUILDING COMPONENTS

UNLESS OTHERWISE PROTECTED FROM LIGHTNING HAZARDS, FIXED EXTERIOR METAL RAILINGS, ROLL-UP DOOR HOUSING, JOINTS OF FOLDING BRIDGES, METAL EQUIPMENT ON ROOFS (SUCH AS DOOR FRAMES) METAL COPING, VENTILATORS, PENTHOUSE STRUCTURES, RAIN GUTTERS, FIXED EXTERIOR LADDERS, ETC., SHALL ALL BE BONDED TO GROUND.

---RAISED FLOORS

RAISED FLOOR PEDESTALS, STRINGERS, SPACE ASSEMBLY BLOCKS, SPRING AND SPRING ISOLATION ASSEMBLIES SHALL BE GROUNDED TO THE FACILITY GROUND NETWORK. RAISED FLOOR PEDESTALS SHALL EACH BE INTERCONNECTED WITH #6 AWG COPPER CONDUCTORS SUCH THAT EACH PEDESTAL IS CONNECTED WITH AT LEAST TWO PATHS TO GROUND. THE INTER-CONNECTED PEDESTALS SHALL BE CONNECTED TO THE FACILITY GROUND NETWORK AT INTERVALS NOT EXCEEDING 20 FEET. EACH FLOOR PLATE SHALL BE BONDED TO THE SUPPORT JACKS THROUGH EITHER METAL-TO-METAL CONTACT OR FLEXIBLE BONDING JUMPERS.

---BOXES AND ENCLOSURES

ALL BOXES AND ENCLOSURES SHALL BE GROUNDED. A #6 AWG STRANDED WIRE WITH TINNED COPPER LUGS SHALL BE USED TO PROVIDE THE GROUNDING CONNECTION. USE INTERNAL TOOTH TYPE LOCKWASHERS WITH STAINLESS STEEL SCREWS AT THE GROUND CONNECTION AND BRAZE OR WELD THE OTHER END OF THE WIRE TO THE BOX OR ENCLOSURE. THE GROUND CONNECTION MUST NOT ENTER THE BOX OR ENCLOSURE. AFTER BRAZING OR WELDING, ALL TOUCHUP PAINTING SHALL BE AS REQUIRED BY SPECIFICATION SECTION 9 "PAINTING AND FINISHING".

---COUNTERPOISE DESIGN

THE FOLLOWING GUIDELINES SHALL BE USED AS A MINIMUM.

EXCEPT FOR STRAIGHT LINE COUNTERPOISE FOR DUCT BANKS, CABLE TRAYS, ETC., THERE SHALL BE AT LEAST TWO COPPER PATHS, WITHIN THE COUNTERPOSIE, BETWEEN ANY TWO POINTS IN THE COUNTERPOISE

GROUND RODS SHALL BE INSTALLED SO THAT ANY POINT ON THE COUNTERPOISE IS WITHIN 50 FEET OF A GROUND ROD. SPACING BETWEEN GROUND RODS SHALL BE AS UNIFORM AS PRACTICABLE THROUGHOUT THE COUNTERPOISE.

WIRES USED FOR INTERCONNECTING GROUND RODS SHALL BE BARE STRANDED COPPER CONDUCTORS NOT LESS THAN NO.4/0 AWG IN SIZE.

GROUND RODS SHALL BE DRIVEN AS CLOSE TO STRUCTURE FOUNDATIONS AS PRACTICAL, AND TO A DEPTH SO THAT THE TOPS OF THE RODS ARE NOT LESS THAN 12 INCHES BELOW GRADE LEVEL. INTERCONNECTING WIRES SHALL BE BURIED NOT LESS THAN 18 INCHES BELOW GRADE LEVEL.

WIRE CONNECTIONS TO GROUND RODS, AND RISER CONNECTIONS TO COUNTERPOISE WIRES, SHALL BE MADE BY EXOTHERMIC WELDING ONLY. THE WIRES, OR WIRE AND ROD, SHALL BE PLACED IN PARALLEL CONTACT AND CONTINUOUSLY WELDED FOR A DISTANCE OF AT LEAST TWO INCHES.

INTERCONNECTING WIRE FOR A BUILDING COUNTERPOISE SHALL CONSIST OF A COMPLETE LOOP AROUND THE BUILDING, INSTALLED IN THE EXCAVATION FOR CURTAIN WALL AND COLUMN FOOTINGS, AND BE NOT LESS THAN 12 INCHES FROM THE BUILDING WALLS.

---TYPES OF BONDS

UNLESS OTHERWISE SPECIFIED HEREIN, BONDING OF METAL SURFACES SHALL BE ACCOMPLISHED BY: (1) BRAZING, (2) WELDING, (3) CLAMPING, OR (4) STRUCTURAL JOINING METHODS, OR A COMBINATION THEREOF.

BRAZING SOLDER SHALL CONFORM TO KSC-SPEC-Z-0005.

WELDING SHALL BE BY EXOTHERMIC PROCESS IN WHICH THE CONDUCTORS ARE JOINED BY MOLTEN SUPERHEATED COPPER PRODUCED BY REDUCTION OF COPPER OXIDE BY ALUMINUM. THE WELDING PROCEDURE SHALL INCLUDE THE PROPER MOLD AND POWDER CHARGE AND SHALL CONFORM TO THE MANUFACTURER'S RECOMMENDATIONS.

IN EXTERNAL LOCATIONS, CLAMPING SHALL BE USED ONLY WHERE A DISCONNECT TYPE OF CONNECTION IS REQUIRED, OR AS PERMITTED BY OTHER PARAGRAPHS OF THIS SPECIFICATION. THE CONNECTION DEVICE MAY UTILIZE EITHER SPRING LOADED JAWS OR THREADED FASTENERS. THE DEVICE SHALL BE SO CONSTRUCTED THAT POSITIVE CONTACT PRESSURE IS MAINTAINED AT ALL TIMES. THIS METHOD INCLUDES USE OF MACHINE BOLTS WITH TOOTH OR SPRING TYPE LOCK WASHERS.

---STRUCTURAL JOINING METHODS

JOINTS MADE WITH HIGH STRENGTH STRUCTURAL BOLTS, AND CLEAN UNPAINTED FAYING SURFACES SHALL BE CONSIDERED AS SUFFICIENTLY BONDED TO MEET THE ELECTRICAL REQUIREMENTS OF THIS SPECIFICATION. THE TERM "CLEAN" AS USED HEREIN SHALL MEAN THAT FAYING SURFACES ON NEW STEEL SHALL HAVE BEEN BLASTED TO BARE METAL. WHERE THIS CONDITION DOES NOT EXIST, THIS SPECIFICATION WOULD CONSIDER SUFFICIENT A JUMPER IN THE FORM OF A #4 AWG BARE COPPER WIRE EXOTHERMALLY WELDED AT EACH END OT THE SURFACES INVOLVED SPANNING THE CONNECTION; OR A BOND WELD DEFINED AS A 1/4 INCH OR LARGER FILLET WELD WITH A 2 INCH MINIMUM LENGTH ACROSS THE CONNECTION; WIRE JUMPERS SHALL BE USED ACROSS JOINTS EMPLOYING MISCELLANEOUS MACHINE BOLTS SUCH AS THOSE USED IN STAIRWAY CONSTRUCTION.

---CLEANING OF BONDING SURFACES

ALL SURFACES WHICH COMPRISE THE BOND SHALL BE THOROUGHLY CLEANED BEFORE JOINING TO REMOVE PAINT, OXIDES, AND OTHER RESISTANCE FILMS FROM THE MATING SURFACES. GENTLE AND UNIFORM PRESSURE ALONG WITH AN APPROPRIATE ABRASIVE SHALL BE USED TO INSURE A SMOOTH, UNIFORM SURFACE WITHOUT "POINT CONTACTS". EXCESSIVE METAL SHALL NOT BE REMOVED FROM THE SURFACE. CLAD METALS SHALL BE CLEANED WITH A FINE STEEL WOOL OR GRIT IN SUCH A MANNER THAT THE CLADDING MATERIAL IS NOT PENETRATED BY THE CLEANING PROCESS. BARE METAL SHALL THEN BE CLEANED WITH A SOLVENT MOISTENED CHEESECLOTH. GREASE, OIL, DIRT, CORROSIVE PREVENTIVES, AND OTHER CONTAMINANTS SHALL ALSO BE REMOVED USING THIS SAME METHOD. THIS CLEANED AREA SHALL BE ALLOWED TO AIR DRY BEFORE CONNECTION OF BOND. THE BOND SHALL BE ATTACHED WITHIN ONE HOUR AFTER CLEANING. THE JOINT SHALL BE SEALED AND THE EXPOSED SURFACES REFINISHED WITHIN TWO HOURS TO PREVENT OXIDATION. IF ADDITIONAL TIME IS REQUIRED, A CORROSION PREVENTIVE SHALL BE APPLIED UNTIL THE AREA CAN BE REFINISHED.

---DISSIMILAR METALS

ALL MATING SURFACES WHICH COMPRISE A BOND SHALL BE IDENTICAL WHERE POSSIBLE.

WHEN SUCH JOINTS ARE NECESSARY, DISSIMILAR METALLIC JOINTS SHALL NOT FORM COUPLES WITH A VALUE GREATER THAN 1 AS TAKEN FROM ATTACHED FIGURE 1. WHEN BASE METALS INTENDED FOR INTERMETALLIC CONTACT FORM COUPLES THAT EXCEED 1, THE METALS SHALL BE PLATED AS SPECIFIED IN MIL-F-14072 TO REDUCE THE POTENTIAL DIFFERENCE TO 1 OR LESS.

---PROTECTION OF FINISHED BONDS

FINISHED BONDS SHALL BE PROTECTED BY PAINTING TO MATCH THE ORIGINAL FINISH AFTER BOND IS MADE.

ANODE-CORRODED END (LESS NOBLE)

CATHODE-PROTECTED END (NOBLE)

CATEGORY	METAL OR ALLOY	1 MAGNESIUM	1 MAGNESIUM ALLOY	2 ZINC	3 CLAD 70 AL	3 CLAD 7075 AL	3 CLAD 6061 AL	3 CLAD 2024 AL	4 3003 AL	5 6061-T6 AL	5 CADMIUM	6 2024-T4 AL	7 STEEL OR IRON	8 CAST IRON	8 CHROMIUM IRON (ACTIVE)	9 304 S/S (ACTIVE)	10 316 S/S (ACTIVE)	10 LEAD-TIN SOLDERS	11 LEAD	11 TIN	11 NICKEL (ACTIVE)	12 HASTELLOY C (ACTIVE)	13 HASTELLOY A (ACTIVE)	14 BRASSES	15 COPPER	15 BRONZES	15 SILVER SOLDER	16 NICKEL (PASSIVE)	17 304 S/S (PASSIVE)	18 316 S/S (PASSIVE)	18 SILVER	19 GRAPHITE	20 PLATINUM	20
1	MAGNESIUM	0	0	1	2	2	2	3	4	4	5	6	7	7	8	9	9	10	10	10	11	12	13	14	14	14	15	16	17	17	18	19	19	
1	MAGNESIUM ALLOY		0	1	2	2	2	3	4	4	5	6	7	7	8	9	9	10	10	10	11	12	13	14	14	14	15	16	17	17	18	19	19	
2	ZINC			0	1	1	1	2	3	3	4	5	6	6	7	8	8	9	9	9	10	11	12	13	13	13	14	15	16	16	17	18	18	
3	CLAD 70 AL				0	0	0	1	2	2	3	4	5	5	6	7	7	8	8	8	9	10	11	12	12	12	13	14	15	15	16	17	17	
3	CLAD 7075 AL					0	0	1	2	2	3	4	5	5	6	7	7	8	8	8	9	10	11	12	12	12	13	14	15	15	16	17	17	
3	CLAD 6061 AL						0	1	2	2	3	4	5	5	6	7	7	8	8	8	9	10	11	12	12	12	13	14	15	15	16	17	17	
4	CLAD 2024 AL							0	1	1	2	3	4	4	5	6	6	7	7	7	8	9	10	11	11	11	12	13	14	14	15	16	16	
5	3003 AL								0	0	1	2	3	3	4	5	5	6	6	6	7	8	9	10	10	10	11	12	13	13	14	15	15	
5	6061-T6 AL									0	1	2	3	3	4	5	5	6	6	6	7	8	9	10	10	10	11	12	13	13	14	15	15	
6	CADMIUM										0	1	2	2	3	4	4	5	5	5	6	7	8	9	9	9	10	11	12	12	13	14	14	
7	2024-T4 AL											0	1	1	2	3	3	4	4	4	5	6	7	8	8	8	9	10	11	11	12	13	13	
8	STEEL OR IRON												0	0	1	2	2	3	3	3	4	5	6	7	7	7	8	9	10	10	11	12	12	
8	CAST IRON													0	1	2	2	3	3	3	4	5	6	7	7	7	8	9	10	10	11	12	12	
9	CHROMIUM IRON (ACTIVE)														0	1	1	2	2	2	3	4	5	6	6	6	7	8	9	9	10	11	11	
10	304 S/S (ACTIVE)															0	0	1	1	1	2	3	4	5	5	5	6	7	8	8	9	10	10	
10	316 S/S (ACTIVE)																0	1	1	1	2	3	4	5	5	5	6	7	8	8	9	10	10	
11	LEAD-TIN SOLDERS																	0	0	0	1	2	3	4	4	4	5	6	7	7	8	9	9	
11	LEAD																		0	0	1	2	3	4	4	4	5	6	7	7	8	9	9	
11	TIN																			0	1	2	3	4	4	4	5	6	7	7	8	9	9	
12	NICKEL (ACTIVE)																				0	1	2	3	3	3	4	5	6	6	7	8	8	
13	HASTELLOY C (ACTIVE)																					0	1	2	2	2	3	4	5	5	6	7	7	
14	HASTELLOY A (ACTIVE)																						0	1	1	1	2	3	4	4	5	6	6	
15	BRASSES																							0	0	0	1	2	3	3	4	5	5	
15	COPPER																								0	0	1	2	3	3	4	5	5	
15	BRONZES																									0	1	2	3	3	4	5	5	
16	SILVER SOLDER																										0	1	2	2	3	4	4	
17	NICKEL (PASSIVE)																											0	1	1	2	3	3	
18	304 S/S (PASSIVE)																												0	0	1	2	2	
18	316 S/S (PASSIVE)																													0	1	2	2	
19	SILVER																														0	1	1	
20	GRAPHITE																															0	0	
20	PLATINUM																																0	

CATHODE-PROTECTED END (NOBLE)

NUMBERS ARE QUALITATIVE ONLY
THE LARGER THE NUMBER - THE GREATER
THE TENDENCY FOR GALVANIC CORROSION

FIGURE 1. TABLE OF POTENTIAL TENDENCY FOR GALVANIC CORROSION

EXHIBIT 1

PRIMARY CABLE - DC PROOF TEST

LOCATION:
DESCRIPTION OF CABLE:
RATED VOLTAGE:

TEST DATA

SET LEAKAGE @ TEST VOLTAGE MA VARIAC PRI. VOLTAGE
SPHERE GAP INCHES
DUCT TEMP. AMBIENT TEMP. WEATHER
CABLE STATUS 1 HOUR PRIOR TO TEST

PHASE OR CONDUCTOR	A	B	C	REMARKS
STARTING TIME:				
	MA	MA	MA	
0				
15 SEC.				
30 SEC.				
45 SEC.				
1 MIN.				
2 MIN.				
3 MIN.				
4 MIN.				
5 MIN.				
6 MIN.				
7 MIN.				
8 MIN.				
9 MIN.				
10 MIN.				
11 MIN.				
12 MIN.				
13 MIN.				
14 MIN.				
15 MIN.				

FINAL TEST VOLTAGE
TIME FINISH:
KV DC AFTER 1 MIN.
TEST PROCEDURE NO. OF TERMINALS JOINTS
WITNESSED BY PERFORMED BY

---BONDING STRAPS AND JUMPERS

UNLESS OTHERWISE SPECIFIED, BONDING STRAPS AND JUMPERS SHALL BE COPPER AND SHALL HAVE A CROSS SECTIONAL AREA OF NOT LESS THAN THAT OF #6 AWG COPPER WIRE. BONDING STRAPS AND JUMPERS FOR SHOCK MOUNTED DEVICES, PIVOT, HINGED, OR SWIVEL JOINTS SHALL BE MADE OF FLAT TINNED COPPER WOVEN WIRE BRAID OR FLEXIBLE STRANDED WIRE. VIBRATION OF THE STRAP OF JUMPER BY THE SHOCK MOUNTED DEVICE SHALL NOT CHANGE ITS ELECTRICAL CHARACTERISTICS. BONDING JUMPERS INSTALLATION SHALL CONFORM TO THE FOLLOWING:

BONDS SHALL BE ACCOMPLISHED BY BRAZING OR WELDING IN OUTDOOR LOCATIONS UNLESS A DISCONNECT TYPE CONNECTION IS REQUIRED.

THE STRAPS SHALL BE BONDED DIRECTLY TO THE BASIC STRUCTURE RATHER THAN THROUGH ANY ADJACENT PARTS.

WHEN INSTALLED, THE STRAPS SHALL BE UNAFFECTED ELECTRICALLY BY MOTION OR VIBRATION.

THE STRAPS SHALL BE INSTALLED IN AN AREA THAT IS ACCESSIBLE FOR MAINTENANCE.

SINGLE STRAPS SHALL BE USED. TWO OR MORE STRAPS SHALL NOT BE CONNECTED IN SERIES.

STRAPS SHALL BE INSTALLED SO THAT THEY WILL NOT RESTRICT MOVEMENT OF STRUCTURE MEMBERS.

STRAPS SHALL BE INSTALLED SO THAT THEY WILL NOT WEAKEN STRUCTURE MEMBERS TO WHICH THEY ARE ATTACHED.

---GROUND CONNECTIONS (GENERAL)

ALL GROUND CONNECTIONS SHALL BE BONDED CONNECTIONS. IF NOT OTHERWISE SPECIFIED, GROUNDING CONDUCTORS SHALL BE CLASS B STRANDED COPPER OF A SIZE SUFFICIENT TO MEET THE GROUNDING RESISTANCE REQUIREMENTS SPECIFIED HEREIN. WELDING OR BRAZING ARE THE PREFERRED METHODS OF ATTACHING GROUNDING CONDUCTORS AND THESE METHODS SHALL BE EMPLOYED WHEREVER POSSIBLE. WHEN WELDING OR BRAZING IS UNSAFE, BOLTED OR CLAMPED CONNECTIONS MAY BE USED. WHEN CONNECTORS ARE REQUIRED ON GROUND WIRES OR STRAPS THE CONNECTORS SHALL BE ATTACHED BY WELDING, BRAZING OR COMPRESSION METHODS. SOLDER TYPE CONNECTORS SHALL NOT BE USED FOR MAKING GROUND CONNECTIONS.

---CONTROL TRANSFORMERS

THE SECONDARY CIRCUIT ON CONTROL TRANSFORMERS SHALL BE GROUNDED WHERE THE CONTROL CIRCUIT EXCEEDS 50 VOLTS, WHERE THE TRANSFORMER SUPPLY SYSTEM EXCEEDS 150 VOLTS TO GROUND, OR WHERE THE TRANSFORMER SUPPLY IS UNGROUNDED.

---METALLIC FENCES FOR ELECTRICAL SUBSTATIONS

SUBSTATION FENCES SHALL BE BONDED TO THE STATION COUNTERPOISE AT INTERVALS NOT EXCEEDING 100 FEET. EACH FENCE SIDE MUST HAVE AT LEAST ONE BONDED CONNECTION TO THE COUNTERPOISE REGARDLESS OF LENGTH, (A MINIMUM OF FOUR BONDED CONNECTIONS FOR A SQUARE OR RECTANGULAR FENCE). EACH GATE POST MUST BE BONDED TO THE COUNTERPOISE. GROUND TOP RAIL AND POSTS WITH #2/0 AWG STRANDED COPPER WIRE AND CONNECT TO SUBSTATION GROUNDING GRID.

---ADDITIONAL REQUIREMENTS FOR HAZARDOUS AREAS - (SEE SECTION 16, PART 2)

ALL EXPOSED METAL OBJECTS EXCEEDING 48 INCHES IN ANY DIMENSION SHALL BE BONDED TO GROUND. UNEXPOSED METALS SUCH AS REINFORCING STEEL COMPLETELY ENCASED IN CONCRETE OR OBJECTS COMPLETELY BURIED, DO NOT REQUIRE BONDING OR GROUNDING. FUEL AND OXIDIZER HANDLING EQUIPMENT SHALL BE BONDED TO GROUND.

HEATING, VENTILATING AND AIR CONDITIONING DUCTS SHALL BE BONDED TOGETHER AND GROUNDED ON EACH END AS A MINIMUM. JUMPERS SHALL BE USED ACROSS FLEXIBLE CONNECTIONS AND SHALL BE BONDED TO THE FLANGES BY BRAZING OR WELDING. REGULAR SLIP JOINTS BETWEEN DUCT SECTIONS CONSISTING OF LOCKING DEVICES OR SHEET METAL SCREWS ARE CONSIDERED ADEQUATELY BONDED AND REQUIRE NO ADDITIONAL BOND STRAPS.

PIPE SHALL BE BONDED TO GROUND AT THE END TERMINATIONS AND AT INTERVALS OF NOT MORE THAN 100 FEET. FOR INTERNAL LOCATIONS BONDING MAY BE BY CLAMPING METHODS IF CONTINUOUS PRESSURE FOLLOW-UP IS PROVIDED WITH SERRATED OR SPRING WASHERS. EXTERNAL LOCATIONS SHALL HAVE BRAZED OR WELDED BONDS - EXCEPT THAT STAINLESS STEEL CLAMPS MAY BE USED TO BOND STAINLESS STEEL PIPE TO GROUND IF THE RESTRICTIONS OF DISSIMILAR METALS AS PRESENTED IN THIS SPECIFICATION ARE CONSIDERED. THREADED JOINTS WHICH HAVE A TAPERED THREAD ARE ACCEPTABLE IF DRAWN UP TIGHTLY WITH A CORROSION INHIBITING COMPOUND APPLIED ON BOTH THE INTERNAL AND EXTERNAL THREADS TO ASSURE AN ADEQUATE BOND ACROSS THE JOINT. FLANGED JOINTS ARE ACCEPTABLE IF THE FLANGES ARE STAINLESS STEEL OR THE FLANGED AREAS IN CONTACT WITH THE BOLT HEADS AND WASHERS ARE CLEAN AND BRIGHT. IN ADDITION, THE BOLTS AND NUTS MUST BE EQUIPPED WITH SERRATED OR SPRING WASHERS TO MAINTAIN TIGHTNESS. TUBING WITH SEATED FITTINGS ARE CONSIDERED ADEQUATELY BONDED.

BIMETALLIC AND VACUUM JACKETED PIPING SHALL BE BONDED BY CLAMPS OR BY PREVIOUSLY ATTACHED GROUNDING LUGS AND PIGTAILS OF COMPATIBLE MATERIALS.

---RESISTANCE VALUES

THE FOLLOWING RESISTANCE VALUES ARE THE MAXIMUM DESIRED TO ACHIEVE THE INTENDED BONDING AND GROUNDING OBJECTIVES. ANY BONDS THAT EXCEED THE MAXIMUM ALLOWABLE RESISTANCE INDICATED BY WORDS "SHALL NOT EXCEED" SHALL BE REWORKED BY THE CONTRACTOR TO CONFORM TO THE REQUIREMENTS OF THIS SPECIFICATION AT NO ADDITIONAL COST TO THE GOVERNMENT.

FACILITY GROUND NETWORKS: THE TOTAL RESISTANCE FROM ANY POINT ON THE FACILITY GROUND NETWORK TO THE COUNTERPOISE SHOULD NOT EXCEED 50 MILLIOHMS. *

POWER GROUNDS: THE TOTAL RESISTANCE FROM THE NEUTRAL OF THE POWER SOURCE THROUGH THE CONNECTION TO THE COUNTERPOISE GROUND SHOULD NOT EXCEED 20 MILLIOHMS. *

WIRING SYSTEM ENCLOSURES: THE TOTAL RESISTANCE FROM EACH WIRING SYSTEM ENCLOSURE TO THE FACILITY GROUND NETWORK SHOULD NOT EXCEED 50 MILLIOHMS. *

LIGHTNING PROTECTION: THE TOTAL RESISTANCE BETWEEN THE GROUND CONNECTION OF ANY LIGHTNING ARRESTOR OR AIR TERMINAL AND THE COUNTERPOISE SHALL NOT EXCEED 10 MILLIOHMS.

GROUND RODS: THE RESISTANCE OF INDIVIDUAL GROUND RODS TO EARTH SHALL BE MEASURED PRIOR TO INTERCONNECTION WITH THE COUNTERPOISE. MAXIMUM RESISTANCE VALUES SHALL NOT EXCEED 5 OHMS FOR 20 FEET RODS AND ONE OHM FOR 40 FEET RODS. SEE PARAGRAPH OF TESTING PROCEDURES. REINFORCING STEEL IN CONCRETE (WHERE USED AS GROUNDING ELECTRODE) SHALL ALSO BE TESTED.

* ESTABLISHED AS A GENERAL GUIDE

COUNTERPOISE: RESISTANCE FROM ANY POINT ON THE COUNTERPOISE TO EARTH SHALL BE NO GREATER THAN 0.5 OHM FOR AREAS REQUIRING 40 FOOT GROUND RODS AND 2.5 OHMS FOR AREAS REQUIRING 20 FOOT GROUND RODS.

BOND RESISTANCE: THE RESISTANCE OF ANY BOND CONNECTION SHALL NOT EXCEED 0.5 MILLIOHM.

---ACCEPTANCE TESTS

THE FOLLOWING TESTS SHALL BE PERFORMED BY THE CONTRACTOR FOR ALL NEW INSTALLATIONS AND MODIFICATIONS TO EXISTING INSTALLATIONS. THE GOVERNMENT RESERVES THE RIGHT TO WITNESS THE TESTS PERFORMED BY THE CONTRACTOR AND TO PERFORM THESE TESTS AND ANY ADDITIONAL TESTS DEEMED APPROPRIATE.

GROUND ROD RESISTANCE: ALL NEWLY INSTALLED GROUND RODS SHALL BE INDIVIDUALLY TESTED PRIOR TO INTERCONNECTION WITH OTHER GROUND RODS AND THE ROD-TO-EARTH RESISTANCE FOR EACH ROD SHALL BE RECORDED. INSTALLATION CONTRACTORS SHALL FURNISH THESE DATA TO THE CONTRACTING OFFICER.

CONTINUITY TESTS SHALL BE PERFORMED ON ALL POWER RECEPTACLES TO INSURE THAT THE GROUND TERMINALS ARE PROPERLY GROUNDED TO THE FACILITY GROUND NETWORK.

---TESTING PROCEDURES

THE RESISTANCE BETWEEN A GROUND ROD AND EARTH SHALL BE DETERMINED BY THE FALL OF POTENTIAL TEST METHOD DESCRIBED BELOW. THIS METHOD UTILIZES A GROUND OHMMETER THAT PRODUCES AN ALTERNATING CURRENT THAT IS CLOSE TO, BUT NOT, 60 HERTZ (A 60 HERTZ SOURCE MAY BE INFLUENCED BY OUTSIDE FIELDS AND CURRENTS), AND THREE TEST ELECTRODES FOR THIS DISCUSSION IDENTIFIED AS (EE) EARTH ELECTRODE; (DR) DRIVEN REFERENCE ELECTRODE; AND (PR) POTENTIAL REFERENCE ELECTRODE. THE (DR) ROD IS PLACED NOT LESS THAN 100 FEET FROM THE EARTH ELECTRODE (EE) UNDER TEST. THE (PR) IS DRIVEN APPROXIMATELY MIDWAY BETWEEN THE (EE) AND (DR) RODS AND A READING IS MADE OF THE RESISTANCE. AFTER RECORDING THIS RESISTANCE MEASUREMENT OTHER READINGS ARE TAKEN WITH THE (PR) RELOCATED TO POSITIONS ON EITHER SIDE OF ITS INITIAL LOCATION, ABOUT 10 FEET APART. IF ALL THREE MEASUREMENTS ARE FOUND TO BE WITHIN TEN PERCENT OF EACH OTHER, THE MEAN VALUE OF ALL THE READINGS IS USED AS THE EARTH RESISTANCE. SHOULD THE READINGS BE OUTSIDE THE TEN PERCENT RANGE, THE (DR) IS PLACED FURTHER AWAY AND THE TEST PROCEDURE REPEATED.

THE RESISTANCE BETWEEN A COUNTERPOISE AND EARTH SHALL BE DETERMINED BY THE FALL OF POTENTIAL METHOD EXCEPT THE DISTANCE FROM THE GROUND UNDER TEST (EE) TO THE DRIVEN REFERENCE ELECTRODE (DR) IS DETERMINED BY THE SIZE OF THE COUNTERPOISE, THAT IS, THE GREATER THE SIZE OF THE COUNTERPOISE THE GREATER THE DISTANCE REQUIRED BETWEEN ELECTRODES. THE POTENTIAL ELECTRODE (PR) IS PLACED AT VARIOUS POINTS BETWEEN THE CURRENT ELECTRODES AND RESISTANCE READINGS ARE TAKEN AT THESE VARIOUS POINTS. THESE READINGS ARE THEN PLOTTED AND THE TRUE RESISTANCE VALUE IS OBTAINED WHEN THE POTENTIAL ELECTRODE (PR) IS OUTSIDE THE INFLUENCE OF EITHER THE GROUND UNDER TEST (EE) OR THE REFERENCE ELECTRODE (DR) AND IS CONSIDERED TO BE IN THE HORIZONTAL PORTION OF THE CURVE.

CARE SHOULD BE TAKEN THAT TESTS ARE NOT MADE DURING PERIODS OF WET WEATHER OR IMMEDIATELY SUBSEQUENT TO HEAVY RAINS.

---BITUMASTIC PAINT

ALL GROUND CONNECTIONS BELOW GRADE SHALL BE PAINTED WITH A HEAVY COAT OF BITUMASTIC PAINT BEFORE BACKFILL.

---ACCEPTANCE---

---INSPECTION

ALL GROUND CONNECTIONS SHALL BE INSPECTED AND APPROVED BY THE CONTRACTING OFFICER BEFORE BACKFILL.

SECTION 16X (PART 52)

FIRE ALARM SYSTEM

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF FIRE ALARM SYSTEMS.

---DESCRIPTION OF SYSTEM

THE SYSTEM WITHIN A SINGLE FACILITY SHALL BE OF THE NONCODED TYPE AND SHALL CONFORM TO FS W-F-398C(1). THE SYSTEM SHALL BE ELECTRICALLY SUPERVISED IN CONFORMANCE WITH ARTICLE 240 OF NFPA 72A-1972.

THE NORMAL POWER FOR THE LOCAL SYSTEMS FOR ALL PURPOSES SHALL BE FROM 120/208V AC 60HZ POWER SUPPLY, AHEAD OF THE MAIN SWITCH, TO THE BUILDING BEING SERVED OR AS CALLED OUT ON THE DRAWINGS. THE SYSTEM SHALL OPERATE SATISFACTORILY ON 85 TO 110 PERCENT OF NORMAL VOLTAGE.

THE FIRE ALARM INITIATING CIRCUIT SHALL BE NORMAL DOUBLE LOOP SYSTEM UNDER NORMAL OPERATING CONDITIONS AND SHALL HAVE A FLOW OF CURRENT SUPERVISING THE INTEGRITY OF THE CIRCUIT. LOSS OF THIS SUPERVISORY CURRENT SHALL BE AN INDICATION OF "TROUBLE" IN THE ALARM INITIATING CIRCUIT THAT SHALL TRANSMIT A "TROUBLE" SIGNAL TO THE CENTRAL FIRE STATION.

TRANSMISSION OF A TROUBLE SIGNAL SHALL AUTOMATICALLY RESULT FROM A BREAK IN A FIRE DETECTING CIRCUIT OR INTERIOR MANUAL FIRE ALARM BOX CIRCUIT OR FROM FAILURE OF THE MAIN POWER SUPPLY FOR ALARM BELL OPERATION.

THE LOCAL FIRE ALARM SYSTEMS SHALL HAVE PROVISIONS FOR MANUAL RESET FROM AN "ALARM" CONDITION AT THE CONTROL UNIT WHEN THE CAUSE OF THE "ALARM" CONDITION IS CLEARED.

A SWITCH SHALL BE PROVIDED IN THE CONTROL PANEL WHICH, WHEN MANUALLY OPERATED, SHALL SILENCE THE "TROUBLE" BELL AND LIGHT AN INDICATOR LAMP. WHEN THE "TROUBLE" FAULT HAS BEEN CLEARED THE MANUAL OPERATION OF THE SWITCH SHALL TURN OFF THE INDICATOR LAMP AND REACTIVATE THE "TROUBLE" BELL.

---PAD

THERE IS PRESENTLY AT PAD 39B A FIRE ALARM SYSTEM WITH THE CENTRAL PAD CONTROL PANEL LOCATED IN THE PTCR ENTRANCE TUNNEL UNDER THE PAD.

THE ML-2 TOWER SECTIONS PRESENTLY HAVE HEAT ACTUATED DETECTORS (HAD), MANUAL STATIONS AND BELLS WHICH WERE CONNECTED INTO A FIRE ALARM PANEL ON BOARD THE ML. THESE FIRE ALARM DEVICES ON THE TOWER SECTIONS (BUT NOT THE CONTROL PANELS) SHALL BE REUSED TO PROTECT THE NEW SSAT. THE ALARM INITIATING DEVICES (HAD'S AND MANUAL STATIONS) ON THE SSAT SHALL BE GROUPED INTO TWO ZONES. THE DEVICES FROM SSAT ELEVATION 220' AND LOWER SHALL BE CONNECTED AS ONE ZONE, AND THE DEVICES ABOVE ELEVATION 230' SHALL BE CONNECTED AS A SECOND ZONE.

THE NEW SSAT FIRE ALARM PANEL SHALL BE LOCATED IN THE ENTRANCE TUNNEL TO THE PTCR UNDER THE PAD NEAR THE PRESENT FIRE ALARM EQUIPMENT AND NEAR THE EXISTING TELEPHONE TERMINAL CABINET (TTC) AS SHOWN ON THE DRAWINGS. IF ANY ONE OF THE ALARM INITIATING DEVICES IS TRIPPED, IT WILL:

1. INITIATE A ZONED FIRE ALARM SIGNAL TO BE REPORTED TO LCC ROOM 1P10 VIA TELEPHONE CIRCUITS (BY OTHERS).
2. RING FIRE BELLS THROUGHOUT THE AREA.
3. LIGHT A PILOT LIGHT ON THE LOCAL PANEL INDICATING THE ZONE.

---HYPERGOLIC FACILITIES

EACH OF THE TWO NEW HYPERGOLIC FACILITIES (BOTH FUEL AND OXIDIZER) SHALL HAVE A SEPARATE FIRE ALARM SYSTEM, COMPLETE IN ITSELF. THEY SHALL BOTH BE SIMILAR AND SHALL OPERATE AS FOLLOWS:

EACH FACILITY SHALL HAVE THE ALARM INITIATING DEVICES CONNECTED INTO THREE ZONES. ONE ZONE, THE ELECTRICAL BUILDING SHALL HAVE A MANUAL STATION AND A HAD. IF EITHER DEVICE TRIPS, IT WILL:

1. INITIATE A FIRE ALARM SIGNAL TO BE REPORTED TO LCC ROOM 1P10 VIA TELEPHONE CIRCUITS (BY OTHERS).
2. RING FIRE BELLS THROUGHOUT THE AREA.
3. LIGHT A PILOT LIGHT ON THE LOCAL PANEL INDICATING THE ZONE.

THE FACILITY STORAGE BUILDING SHALL HAVE TWO ZONES. THE FIRST ZONE SHALL HAVE TWO MANUAL STATIONS AND A DELUGE VALVE. IF ANY DEVICE IS TRIPPED, IT WILL:

1. INITIATE A FIRE ALARM SIGNAL TO BE REPORTED TO LCC ROOM 1P10 VIA TELEPHONE CIRCUITS (BY OTHERS).
2. RING FIRE BELLS THROUGHOUT THE AREA.
3. LIGHT A PILOT LIGHT ON THE LOCAL PANEL INDICATING THE ZONE.
4. ACTUATE A SOLENOID VALVE WHICH WILL OPEN THE FIREX WATER VALVE.

THE SECOND ZONE AT THE FACILITY STORAGE BUILDING SHALL HAVE THREE "HADS" AND A KEY OPERATED AUTOMATIC/OFF SWITCH ON THE LOCAL PANEL TO PREVENT ELECTRICAL OPERATION OF THE DELUGE VALVE.

IF ANY "HAD" IS TRIPPED WHILE THE KEY OPERATED SWITCH IS IN THE "AUTO" POSITION IT WILL:

1. INITIATE A FIRE ALARM SIGNAL TO BE REPORTED TO LCC ROOM 1P10 VIA TELEPHONE CIRCUITS (BY OTHERS).
2. RING FIRE BELLS THROUGHOUT THE AREA.
3. LIGHT A PILOT LIGHT ON THE LOCAL PANEL INDICATING THE ZONE.
4. ACTUATE A SOLENOID VALVE WHICH WILL OPEN THE FIREX WATER VALVE.

IF ANY "HAD" IS TRIPPED WHILE THE KEY OPERATED SWITCH IS IN THE "OFF" POSITION IT WILL:

1. INITIATE A FIRE ALARM SIGNAL TO BE REPORTED TO LCC ROOM 1P10 VIA TELEPHONE CIRCUITS (BY OTHERS).
2. RING FIRE BELLS THROUGHOUT THE AREA.
3. LIGHT A PILOT LIGHT ON THE LOCAL PANEL INDICATING THE ZONE.

THE FIREX WATER SWITCHES AND FIREX WATER VALVES SHALL BE FURNISHED AND INSTALLED AS SPECIFIED UNDER ANOTHER SECTION OF THESE SPECIFICATIONS, BUT ALL ELECTRICAL CONNECTIONS SHALL BE BY THIS CONTRACTOR.

---HIGH PRESSURE GAS STORAGE FACILITY

AT THE HIGH PRESSURE GAS STORAGE FACILITY ON THE EAST SIDE OF PAD B, THE CONTRACTOR SHALL INSTALL FOUR CONDUCTORS OF #14 AWG FROM THE NEW FIREX DELUGE VALVE AUXILIARY CONTACT SWITCH TO THE EXISTING FIRE ALARM PANEL INSIDE NORTH BAY OF HIGH PRESSURE GAS FACILITY. THE NEW DELUGE VALVE AND AUXILIARY SWITCH ARE TO BE FURNISHED AND INSTALLED BY OTHERS. CONNECT THE NEW AUXILIARY SWITCH IN PARALLEL WITH THE EXISTING FIRE ALARM DEVICE (HEAT ACTUATED DETECTOR) SO THAT WHEN THE WATER VALVE IS TRIPPED IT WILL SEND A SIGNAL TO THE MAIN FIRE ALARM CONTROL BOX. ALSO, THE CIRCUIT EXTENSION TO THE NEW AUXILIARY SWITCH MUST BE A SUPERVISED CIRCUIT; THEREFORE, FOUR CONDUCTORS ARE REQUIRED. THIS NEW WIRING (AT THE HIGH PRESSURE GAS STORAGE FACILITY) SHALL BE IN RIGID CONDUIT RUN EXPOSED ON THE SURFACE OF THE WALLS AND CEILING, AS REQUIRED.

---FIRE ALARM STATIONS ON PAD B SURFACE

ON THE SURFACE OF THE PAD, LIGHTING POLES AND FIRE ALARM STATIONS MUST BE RELOCATED. THE EXISTING FIRE ALARM STATIONS AND FIRE BELLS ARE TO BE RELOCATED WITH THE PRESENT SUPPORTS. THE CONTRACTOR SHALL REMOVE THE PRESENT DEVICES, REMOVE THE CONDUCTORS, EXTEND THE CONDUITS, PULL IN NEW CONDUCTORS AND REINSTALL THE EXISTING DEVICES.

---SHOP DRAWINGS AND DESCRIPTIVE DATA

THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS (INCLUDING SCHEMATICS AND WIRING DIAGRAMS OF THE ADDITIONS TO THE FIRE ALARM SYSTEM) AND DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" FOR ALL NEW EQUIPMENT FURNISHED. THE FOLLOWING TYPES OF EQUIPMENT REQUIRE SUBMITTALS:

MANUAL STATIONS
FIRE ALARM BELLS
HEAT ACTUATED DETECTORS
CONTROL PANELS

---MATERIALS---

---GENERAL REQUIREMENTS

ALL EQUIPMENT FOR THE FIRE ALARM SYSTEM SHALL MEET THE REQUIREMENTS OF NFPA 72A-1972.
ALL MOUNTING HARDWARE SHALL BE GALVANIZED.
ALL NEW MATERIALS AND EQUIPMENT SHALL BE FIRST GRADE, STANDARD, CURRENT PRODUCTS OF THE MANUFACTURER AND SHALL BE SUITABLE FOR THE PERFORMANCE OF THEIR SEPARATE DESIGNED FUNCTIONS. WHERE TWO OR MORE PIECES OF EQUIPMENT PERFORM THE SAME FUNCTION, THEY SHALL BE EXACT DUPLICATES. △B

---WIRING

DETECTOR CIRCUITS SHALL BE WIRED WITH #14 AWG MINIMUM. POWER WIRING SHALL BE #12 AWG MINIMUM. ALL WIRES SHALL BE COPPER. WIRING INSULATION SHALL CONFORM TO NFPA 70-1975, TYPE THWN/THHN OR MI. THE NUMBER OF CONDUCTORS SHALL BE AS SHOWN ON THE DRAWINGS.

ANY NEW FIRE ALARM DEVICES SHALL MEET THE FOLLOWING REQUIREMENTS EXCEPT THAT DEVICES IN HAZARDOUS AREAS SHALL BE SIMILAR AND EQUAL TO THOSE DEVICES PRESENTLY LOCATED IN HAZARDOUS AREAS ON THE ML AND SHALL MEET THE REQUIREMENTS AS SET FORTH IN THE "HAZARDOUS INSTALLATIONS" SECTION OF THIS SPECIFICATION.

---CONTROL UNITS

CONTROL UNIT ENCLOSURES SHALL BE DUST PROOF, HAVE A HINGED COVER, AND BE PROVIDED WITH AN INTEGRAL KEY LOCK THAT WILL ACCEPT THE SPECIFIED KSC LOCK CYLINDER.

TEST SWITCHES, ALARM SILENCING SWITCHES, AND OTHER LOCAL FIRE ALARM SYSTEM CONTROL DEVICES SHALL BE LOCATED WITHIN THE CONTROL UNIT AND SHALL BE ACCESSIBLE ONLY BY UNLOCKING AND OPENING THE UNIT.

EACH UNIT SHALL BE EQUIPPED WITH A SUPERVISING CURRENT METER, LOCATED TO BE VISIBLE WITHOUT OPENING THE UNIT.

THE CONTROL UNIT SHALL CONTAIN, AS NECESSARY, THE COMPONENTS AND CIRCUITRY REQUIRED FOR THE OPERATION OF AN ANNUNCIATOR FOR MONITORING AND SUPERVISING AUXILIARY FIRE DETECTION SYSTEMS; OR, SHALL ITSELF BE CAPABLE OF PERFORMING THE ANNUNCIATION FUNCTION.

---MANUAL STATIONS

MANUAL FIRE ALARM STATIONS SHALL BE THE NONCODED, BREAK GLASS, PULL LEVER TYPE CONFORMING TO FS W-F-398C(1) CLASS 1. MANUAL STATIONS IN HAZARDOUS AREAS SHALL MATCH THE EXISTING.

STATIONS IN GENERAL SHALL NOT BE RESETTABLE WITHOUT THE USE OF A KEY OR WRENCH. THE OPERATION OF ANY STATION SHALL SOUND ALL GENERAL ALARM DEVICES CONTINUOUSLY UNTIL THE STATION HAS BEEN RESTORED TO ITS NORMAL OPERATING POSITION.

SURFACE MOUNTED MANUAL STATIONS SHALL BE FURNISHED WITH MATCHING CAST IRON OR CAST ALUMINUM BACK BOXES WITH TOP AND BOTTOM THREADED CONDUIT CONNECTIONS.

---DETECTORS

HEAT ACTIVATED DETECTORS (HAD) SHALL BE RATED 136 DEGREES FAHRENHEIT (190 DEGREES FAHRENHEIT WHERE INDICATED ON THE DRAWINGS) FIXED TEMPERATURE (NONRESTORABLE) AND 15 DEGREES FAHRENHEIT PER MINUTE RATE-OF-RISE, AND SHALL HAVE A SET OF NORMALLY OPEN CONTACTS THAT CLOSE TO INITIATE AN ALARM. DETECTORS SHALL BE RUST AND CORROSION RESISTANT, SHALL BE UL LISTED OR HAVE FM APPROVAL, AND SHALL CONFORM TO FS W-F-398C(1), TYPE VIII. DETECTORS IN HAZARDOUS AREAS SHALL BE SO APPROVED.

---FIRE ALARM BELLS

ALARM BELLS SHALL BE ELECTRIC, SOLENOID OPERATED, PLUNGER TYPE, VIBRATING, NO CONTACT, UNDER DOME ALARM INDICATING DEVICES NOT LESS THAN 10 INCHES IN DIAMETER, MEETING THE REQUIREMENTS OF FS W-F-398C(1).

THE BELLS SHALL PRODUCE SIGNALS DISTINCTIVE FROM OTHER SIMILAR APPLIANCES USED IN THE SAME AREA FOR OTHER PURPOSES.

BELLS IN EXTERIOR LOCATIONS SHALL BE THE CORROSION RESISTANT WEATHERPROOF TYPE WITH A NEOPRENE GASKET EXCEPT IN HAZARDOUS AREAS BELLS SHALL BE APPROVED FOR THIS CLASSIFICATION.

---INSTALLATION---

---REQUIREMENTS

THE SYSTEM SHALL BE COMPLETELY INSTALLED, PROPERLY INTERCONNECTED, AND PLACED IN WORKING ORDER.

EACH FIRE ALARM CIRCUIT WIRE TERMINATION SHALL BE MADE WITH A SOLDERLESS TYPE TOOL CRIMPED RING OR SPADE TONGUE UL LISTED TERMINAL.

MANUAL FIRE ALARM STATIONS SHALL BE LOCATED NEAR EXITS APPROXIMATELY WHERE SHOWN ON THE DRAWINGS AND MOUNTED 54 INCHES ABOVE THE FLOOR.

DETECTORS SHALL BE CEILING MOUNTED. LOCATION, NUMBER, AND GENERAL ARRANGEMENT SHALL BE AS RECOMMENDED BY NFPA 72A-1972 FOR COMPLETE PROTECTION OF THOSE AREAS SHOWN ON THE DRAWINGS. THE DETECTOR SPACING ON SMOOTH SURFACES SHALL NOT EXCEED THE DISTANCE RECOMMENDED. IN AREAS WHERE IRREGULARITIES EXCEED THOSE DESCRIBED, THE DETECTOR SPACING SHALL BE REDUCED TO THAT REQUIRED TO PROVIDE DETECTION COVERAGE TO EACH SUBDIVISION RESULTING FROM SUCH IRREGULARITIES.

FIRE ALARM BELLS SHALL BE MOUNTED SEVEN FEET ABOVE THE FLOOR UNLESS SHOWN OTHERWISE ON THE DRAWINGS AND BELOW THE BOTTOM SURFACE OF THE CEILING CONSTRUCTION IN THE APPROXIMATE LOCATION SHOWN ON THE DRAWINGS.

THE FIRE ALARM LOOP WILL BE TERMINATED IN THE MAIN TELEPHONE CABINET BY OTHERS. CONNECTION TO THE LOOP SHALL BE MADE BY THE CONTRACTOR.

---SPLICING

WIRE-TO-WIRE SPLICES SHALL BE MADE WITH SOLDERLESS, WIRE NUTS, UL LISTED WIRE SPLICING DEVICES OR CONNECTORS. INSULATION SHALL BE INTEGRAL WITH THE DEVICE OR CONNECTOR OR SHALL BE AN INSULATOR SPECIFICALLY DESIGNED FOR THE DEVICE OR CONNECTOR. TAPE INSULATION SHALL NOT BE USED. SPLIT BOLT TYPE OF SPLICES ARE PROHIBITED. WIRE-TO-WIRE SPLICES SHALL NOT BE MADE IN THE FIRE ALARM CONTROL PANEL CABINETS. IF WIRES FROM A SINGLE ALARM SOUNDING OR SIGNAL INITIATING CIRCUIT LEAVE THE CABINET IN MORE THAN ONE CONDUIT, UL LISTED BARRIER TYPE TERMINAL BLOCKS SHALL BE INSTALLED ON THE SIDES OF THE GUTTERS OF THE CABINET. WIRES OF CIRCUITS REQUIRING INTERCONNECTIONS SHALL BE TERMINATED ON THESE BLOCKS. JUMPERS NECESSARY TO PRODUCE THE LOOP CIRCUITS REQUIRED SHALL BE INSTALLED ON THE BLOCKS AND TO THE CORRECT PANEL TERMINALS. THERE SHALL BE NO SPLICES IN WIRING RUNS BETWEEN DETECTOR UNITS OR BETWEEN BELLS EXCEPT AS INDICATED ON DRAWINGS.

---GROUNDING

NEW CONDUIT, CABLE, ELECTRICAL EQUIPMENT, AND EQUIPMENT ENCLOSURES SHALL BE BONDED TO THE EXISTING BUILDING GROUND NET.

---MARKING AND EQUIPMENT IDENTIFICATION---

---GENERAL

THE MANUFACTURER'S NAME AND SERIAL NUMBER SHALL APPEAR ON ALL MAJOR NEW COMPONENTS.

DISCONNECT SWITCHES SHALL BE RED WITH A BAKED ENAMEL FACTORY FINISH OR SHALL BE PAINTED BY THE CONTRACTOR WITH A BRIGHT RED ENAMEL. IN ADDITION, SWITCHES SHALL BE MARKED "FIRE ALARM DISCONNECT" USING 1/2-INCH HIGH LETTERS IN WHITE PAINT OR ENGRAVED PHENOLIC NAMEPLATES FASTENED WITH SHEET METAL SCREWS.

THE SIGNAL INITIATING CIRCUIT SHALL HAVE ONE LOOP COLORED BLACK AND ONE LOOP COLORED BLUE. EACH ALARM SIGNAL SOUNDING CIRCUIT SHALL HAVE BOTH WIRES COLORED RED. EACH CIRCUIT SHALL MAINTAIN THE SAME COLOR CODE THROUGHOUT ITS LENGTH.

POWER CONDUCTORS SHALL BE COLOR CODED. CONDUCTORS CONNECTED TO A PARTICULAR PHASE SHALL BE OF THE SAME COLOR (PHASE A, BLACK; PHASE B, RED; PHASE C, BLUE; NEUTRAL, WHITE OR GRAY). INSULATED GROUND WIRES SHALL BE GREEN.

ALL EXPOSED METAL SURFACES ON MANUAL STATION ENCLOSURES SHALL BE PAINTED WITH A PRIME COAT AND ONE OR MORE FINISH COATS OF RED ENAMEL TO PRODUCE A SMOOTH HARD DURABLE FINISH. IDENTIFICATION AND DIRECTIONS FOR OPERATION OF THE FIRE ALARM STATION SHALL BE PROVIDED ON THE COVER IN RAISED OR DEPRESSED WHITE ENAMELED LETTERS.

---TESTS---

---GENERAL

THE CONTRACTOR SHALL RENDER A REPORT COVERING INSTALLATION AND TESTS OF SYSTEM COMPONENTS. THE CONTRACTOR, IN THE PRESENCE OF THE FIRE ALARM INSPECTOR, SHALL ACCOMPLISH THE FOLLOWING:

ACTIVATE EACH MANUAL STATION IN EACH BUILDING TO ASCERTAIN THAT ALL FIRE ALARM BELLS IN EACH BUILDING WILL OPERATE SATISFACTORILY.

OPEN CIRCUIT EACH DEVICE TO VERIFY TROUBLE OPERATION OF BOTH THE BOX CIRCIUT AND BELL CIRCUIT.

SHORT CIRCIUT THE TERMINALS OF EACH HAD TO SIMULATE ACTIVATION OF THE DETECTOR FOR "ALARM" CONDITION.

DEMONSTRATE THAT EACH ALARM INITIATING CIRCUIT OPERATES.

---FIRE ALARM OUTAGES

THE CONTRACTOR SHALL OBTAIN PERMISSION FOR FIRE ALARM OUTAGES PRIOR TO REMOVING ANY FIRE ALARM EQUIPMENT FROM SERVICE AND SHALL RETURN THE SYSTEM TO OPERATION IN A REASONABLE TIME PERIOD.

SECTION 16X (PART 53)

COMMUNICATIONS

---GENERAL REQUIREMENTS---

---SCOPE

THIS CONTRACT SHALL NOT INCLUDE THE FURNISHING NOR INSTALLING OF CABLE, CONDUCTORS, RACEWAYS (OTHER THAN CABLE TRAYS OR CONDUITS CALLED OUT ELSEWHERE), TERMINAL CABINETS OR DISTRIBUTORS, TERMINAL INSTRUMENTS OR DEVICES FOR THE FOLLOWING FACILITIES:

1. OPERATIONAL INTERCON SYSTEM FACILITIES.
2. BASE PAGING SYSTEM.
3. COUNTDOWN AND CONTROL FACILITIES.
4. OPERATIONAL TELEVISION CAMERAS AND CAMERA CONTROLS. (OTV POWER RECEPTACLES ARE INCLUDED AS SHOWN ON THE DRAWINGS).
5. SOUND POWERED TELEPHONES.
6. INTERIM TELEPHONE SYSTEM.
7. BASE COMMUNICATIONS FACILITIES.
8. PAD MEASURING COAXIAL CABLE FACILITIES.
9. PAD MEASURING ACQUISITION CABLE FACILITIES.
10. COMMUNICATION ANTENNA SYSTEMS.

SECTION 16X (PART 55)

UTILITIES CONTROL SYSTEMS (UCS)

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE MATERIALS AND PROCEDURES FOR INSTALLING THE UTILITIES CONTROL SYSTEMS.

---GENERAL

THE WORK INCLUDED IN THIS CONTRACT SHALL CONSIST OF FURNISHING AND INSTALLING THE NECESSARY AUXILIARY CONTACTS, SENSORS AND TRANSDUCERS AT THE ITEMS TO BE MONITORED AND CONTROLLED AND TO EXTEND THESE SIGNALS TO TERMINAL STRIPS IN TELEPHONE TERMINAL CABINETS (TTC) OR UCS TERMINAL CABINETS SHOWN ON THE DRAWINGS. THE TRANSMISSION AND UTILIZATION OF THIS DATA BEYOND THESE CABINETS IS BY OTHERS AND IS NOT INCLUDED IN THIS CONTRACT.

---INTERFACE CHARACTERISTICS---

---GENERAL

THE FOLLOWING INTERFACE CHARACTERISTICS ARE PROVIDED TO ASSIST IN THE SELECTION OF SENSORS AND CONTROLS.

---ANALOG MEASUREMENTS

CURRENT MEASUREMENT

CURRENT TRANSFORMERS FOR METERING THE PANELBOARD FEEDERS SHALL MEET THE AEIC-EEI-NEMA STANDARDS (NEMA PUB. NO. EL 21-1973).

CURRENT TRANSDUCERS SHALL BE SIMILAR AND EQUAL TO SCIENTIFIC COLUMBUS "HALLTIPLIER" CATALOG NO. CT-510 A3 WITH THE FOLLOWING CHARACTERISTICS:

5 AMP FULL SCALE CURRENT
.05 VA BURDEN
50 - 500 HZ FREQUENCY RANGE

-20^0 C TO $+60^0$ C TEMPERATURE RANGE
$\pm$ 1 PERCENT OF FULL SCALE TEMPERATURE EFFECTS ON ACCURACY
3 MA DC OUTPUT AT FULL SCALE
0-10 OHM OUTPUT LOAD REQUIRED
$\leqslant$ 0.25 PERCENT PEAK RIPPLE
400 MS RESPONSE TIME
1500 RMS DIELECTRIC TEST

---VOLTAGE MONITOR (DISCRETE)

A. THE VOLTAGE MONITOR SHALL HAVE THE FOLLOWING CHARACTERISTICS:

NOMINAL INPUT VOLTAGE	480 VAC, 3 Ø
ADJUSTMENT RANGE	340-480 VAC
POWER CONSUMPTION	1.5 WATTS PER PHASE
REPEAT ACCURACY	0.1%
CONTACT RATING	3 AMPS @ 115 VAC
DROP OUT TIME	.05 SEC. MAX.
DEADBAND BETWEEN PULL IN AND DROP OUT	2%
MOUNTING	OCTAL TYPE PLUG
TRANSIENT PROTECTION	2500 VOLTS FOR 10 MS

THE VOLTAGE MONITOR SHALL BE TIME MARK MODEL A258B OR AN APPROVED EQUAL.

B. THE VOLTAGE MONITOR SHALL HAVE THE FOLLOWING CHARACTERISTICS:

NOMINAL INPUT VOLTAGE	120 VAC, 3 Ø
ADJUSTMENT RANGE	85 - 125 VAC
POWER CONSUMPTION	1/4 WATT PER PHASE
REPEAT ACCURACY	0.1%
CONTACT RATING	3 AMPS @ 115 VAC
DROP OUT TIME	.05 SEC. MAX.
DEADBAND BETWEEN PULL IN AND DROPOUT	2%
MOUNTING	OCTAL TYPE PLUG
TRANSIENT PROTECTION	2500 VOLTS FOR 10 MS

THE VOLTAGE MONITOR SHALL BE TIME MARK MODEL B258B OR AN APPROVED EQUAL.

---INTERPOSING RELAYS

INTERPOSING RELAYS SHALL BE DOUBLE POLE DOUBLE THROW WITH TWO FORM C CONTACTS HAVING A MINIMUM RATING OF TEN AMPS INDUCTIVE AT 230 VOLTS AC. THE RELAY COIL SHALL BE RATED 28V DC WITH A MAXIMUM BURDEN OF THREE WATTS. THE CONTACTS SHALL HAVE A VOLTAGE RATING SUITABLE FOR THE INTENDED SERVICE. THE RELAY SHALL BE INSTALLED IN THE LOCATIONS INDICATED ON THE DRAWINGS.

---DIGITAL COMMAND RELAY INFORMATION

THIS INFORMATION IS INCLUDED TO INDICATE THE INTERFACE CHARACTERISTICS BETWEEN THE INTERPOSING RELAYS AND THE COMMAND MODULE.

A. OUTPUT OPTIONS

RELAY OPTION - 2 AMPS @ 28VDC RESISTIVE

SOLID STATE LOW CURRENT DC OUTPUT - 50MA @ 28VDC RESISTIVE WITH CIRCUIT PROTECTION TO WITHSTAND TRANSIENTS.

SOLID STATE HIGH CURRENT DC OUTPUT - 1 AMP @ 28VDC RESISTIVE MAXIMUM OF 8MA DRAWN THROUGH LOAD IN OFF STATE WITH CIRCUIT PROTECTION TO WITHSTAND TRANSIENTS.

SOLID STATE LOW CURRENT AC OUTPUT - 200MA @ 120 VAC RESISTIVE.

B. MAXIMUM COMMAND RATE

CAPABLE OF BEING COMMANDED UP TO 76K COMMANDS PER SECOND.

---DESCRIPTIVE DATA AND SHOP DRAWINGS

THE CONTRACTOR SHALL SUBMIT SPECIFICATION SHEETS FOR GOVERNMENTAL APPROVAL OF THE PROPOSED INSTRUMENTS (SENSORS, TRANSDUCERS, SWITCHES, RELAYS, TRANSMITTERS, MOUNTING DETAILS, WIRING DIAGRAMS AND INDICATORS) TO BE INSTALLED IN THE FACILITY SYSTEMS.

---TERMINAL BOX

THE CONTRACTOR SHALL TERMINATE THE CONDUCTORS ON A TERMINAL STRIP IN A TELEPHONE TERMINAL CABINET OR UCS TERMINAL CABINET FOR EXTENSION, BY OTHERS, BEYOND THESE CABINETS. THE TERMINAL STRIP SHALL BE 600 VOLT HEAVY DUTY SECTIONAL TERMINAL BLOCKS FOR FLAT BASE BLOCKS AND STRAP CLAMPS. EACH TERMINAL STRIP SHALL HAVE THE REQUIRED TERMINALS PLUS AN EQUAL NUMBER OF SPARE TERMINALS.

---CONTINUITY AND INSULATION TESTS OF CONDUCTORS AFTER PLACEMENT

ALL INSULATED CONDUCTORS SHALL BE TESTED FOR END TO END CONTINUITY. CONTINUITY TESTS SHALL INCLUDE ALL TESTS NECESSARY TO CONFIRM THAT EACH CONDUCTOR IS CONTINUOUS THROUGHOUT ITS ENTIRE LENGTH.

RESISTANCE FROM GROUND PROVIDED BY THE INSULATION ON ALL FIELD INSTALLED INSULATED CONDUCTORS SHALL BE MEASURED. MEASUREMENT SHALL BE ACCOMPLISHED AS DESCRIBED IN THE PARAGRAPHS WHICH FOLLOW.

ALL INSULATED CONDUCTORS, NO. 14 OR LARGER, SHALL BE TESTED WITH A 1000 VOLT MEGGER OR AN EQUIVALENT TESTING DEVICE. MEASURED INSULATION RESISTANCE SHALL BE GREATER THAN 200,000 OHMS BETWEEN EACH CONDUCTOR AND GROUND.

ALL INSULATED CONDUCTORS, SMALLER THAN NO. 14 AWG, SHALL BE TESTED WITH A MULTI-METER. MEASURED INSULATION RESISTANCE SHALL BE GREATER THAN 10,000 OHMS BETWEEN EACH CONDUCTOR AND GROUND.

CONTINUITY AND INSULATION TESTS ON CONDUCTORS SHALL BE MADE ONLY PRIOR TO TERMINATIONS.

SECTION 16X (PART 56)

CATHODIC PROTECTION

---GENERAL REQUIREMENTS---

---SCOPE

THIS SECTION COVERS THE FURNISHING AND INSTALLATION OF CATHODIC PROTECTION CONDUCTORS FOR THE NEW STEEL PILES AT PAD 39B.

---MATERIALS AND INSTALLATION

CATHODIC PROTECTION ANODES SHALL BE 4.5 INCH DIAMETER, 60 INCHES LONG, 220 POUNDS, SUITABLE FOR USE IN SEA WATER, WITH HIGH CURRENT DISCHARGE PER ANODE. COMPLETE WITH AN INTEGRAL CABLE CONNECTION WITH A 45 FOOT LEAD ON EACH END. ANODES SHALL HAVE THE FOLLOWING CHEMICAL MAKE-UP:

CHEMICAL	PERCENT
SILICON	14.50
MANGANESE	0.75
CARBON	0.95
CHROMIUM	4.50
IRON	BALANCE

THE CATHODIC PROTECTION ANODES SHALL BE JETTED INTO PLACE TO A DEPTH OF 35 TO 40 FEET BELOW THE CONCRETE PILE CAP. THE ANODE LEADS SHALL BE CONTINUOUS AND SHALL BE BROUGHT UP AND SPLICED TO THE #1/0 COLLECTOR CABLE. THE COLLECTOR CABLE SHALL NOT BE CUT; INSULATION SHALL BE REMOVED AND THE ANODE LEAD TAPPED INTO THE SPLICE. THE SPLICE SHALL THEN BE ENCAPSULATED USING AN EPOXY SPLICE KIT AND FOLLOWING THE MANUFACTURER'S DIRECTIONS. THE SPLICES WILL BE INSPECTED BY THE CONTRACTING OFFICER OR HIS AUTHORIZED REPRESENTATIVE AND IF AIR BUBBLES ARE PRESENT, THE CONTRACTOR SHALL REMOVE THE EPOXY AND RE-ENCAPSULATE THE SPLICE AT NO ADDITIONAL COST TO THE GOVERNMENT. ANODES SHALL BE INSTALLED AT THE RATE OF ONE ANODE PER THREE PILES OR FRACTION THEREOF. ANODES MUST NOT TOUCH THE PILES.

THE CATHODIC PROTECTION TEST ANODES SHALL BE PERMANENT SILVER/SILVER CHLORIDE REFERENCE ELECTRODES WITH #14 HMW CABLE LEADS SUITABLE FOR USE IN SALT WATER. THE PERMANENT REFERENCE ELECTRODE SHALL HAVE AN ION TRAP TO PREVENT CHLORIDE CONTAMINATION AND MUST BE THOROUGHLY SOAKED WITH WATER DURING INSTALLATION. THE TEST ANODES SHALL BE JETTED INTO PLACE SIMILARLY TO THE ANODES AND SHALL BE SPLICED TO A #1/0 COLLECTOR

CABLE FOR EACH ANODE. THE COLLECTOR CABLE INSULATION SHALL BE REMOVED AND TEST ANODE LEAD SPLICED TO THE END OF THE COLLECTOR CABLE WITH EPOXY KIT AS FOR ANODE LEADS.

A #1/0 COLLECTOR CONDUCTOR IS TO BE BONDED (CADWELDED) TO ONE PILE IN EACH PILE GROUP (1 GROUP FOR EACH TOWER LEG AND 1 FOR THE THRUST BLOCK). THE PILES IN EACH GROUP ARE THEMSELVES TO BE TIED TOGETHER BY USE OF A #6 CONDUCTOR BONDED TO EACH PILE.

THE CONTRACTOR SHALL BRING THE #1/0 ANODE CABLES AND THE #1/0 PILE COLLECTOR CABLES TO A TERMINAL BOX LOCATED WHERE INDICATED ON THE DRAWINGS. A SECOND TERMINAL BOX SHALL BE LOCATED CLOSE BY AND THE #1/0 COLLECTOR CONDUCTORS FROM THE TEST ANODES WILL BE TERMINATED THEREIN.

THE COLLECTOR CABLES, THE ANODE CONDUCTORS, THE TEST ANODE CONDUCTORS AND THE PILE BONDING CONDUCTORS SHALL ALL BE INSTALLED DIRECT BURIAL IN THE CONCRETE SLAB (OR SURROUNDING SOIL) EXCEPT THAT CONDUIT SHALL BE INSTALLED OVER THE CONDUCTORS WHERE EXPOSED APPROACHING THE TERMINAL BOXES. SUITABLE SEALS SHALL BE USED TO PREVENT WATER FOLLOWING THE CONDUCTORS INTO THE BOXES OR INTERIOR SPACES.

GROUND WIRES AND COLLECTOR CABLES SHALL BE COPPER. INSULATION ON THE COLLECTOR CABLES AND ON THE ANODE ELECTRODE LEADS SHALL BE TYPE CP, LOW DENSITY HMW POLYETHYLENE, UNIT CONSTRUCTION, MEETING ASTM D1248, TYPE 1, CLASS C, CATEGORY 5, REQUIREMENTS. THE COLLECTOR CABLE SHALL BE #1/0 AWG; 0.125 INCH THICK; ANODE ELECTRODE LEADS SHALL BE #8 AWG; TEST ANODE LEAD SHALL BE #14 AWG. COLLECTOR CABLE WIRES SHALL BE 19 STRAND, ANNEALED UNCOATED COPPER, CONCENTRIC STRANDED, MEETING IPCEA S-61-402, CLASS B REQUIREMENTS.

TERMINAL BOXES SHALL BE INSTALLED AS SHOWN ON THE DRAWINGS AND AS CALLED OUT IN THESE SPECIFICATIONS. THE BOXES SHALL BE NEMA 4 CAST IRON AND SHALL BE PROVIDED WITH A TEN POSITION TERMINAL STRIP, RATED 600V AC, 125 AMP, FURNISHED WITH BOX LUGS SUITABLE FOR #2/0 AWG COPPER WIRE. CONDUCTORS TERMINATED IN THE TERMINAL BOXES SHALL BE IDENTIFIED (LABELED) AT OR ON THE TERMINAL STRIPS IN THE BOXES.

---TESTING

THE CATHODIC PROTECTION SYSTEM TESTS WILL BE PERFORMED BY THE GOVERNMENT. THE CONTRACTOR SHALL PERFORM CONTINUITY AND INSULATION - RESISTANCE TESTS IN THE PRESENCE OF THE CONTRACTING OFFICER WITH THE CONTRACTOR FURNISHING ALL INSTRUMENTS AND PERSONNEL REQUIRED AND THE GOVERNMENT FURNISHING THE NECESSARY ELECTRICAL POWER. ALL SAFEGUARDS NECESSARY TO PROTECT PERSONNEL AND SYSTEM COMPONENTS SHALL BE EMPLOYED. THE CONTRACTING OFFICER SHALL BE NOTIFIED THREE WORKING DAYS PRIOR TO EACH TEST. ALL WIRING SHALL BE CHECKED FOR CONTINUITY AND IDENTIFICATION AND SHALL BE SUBJECTED TO A MEGGER TEST. TESTS FOR CONTINUITY AND IDENTIFICATION OF EACH CONDUCTOR SHALL BE MADE BY MEANS OF A DIRECT CURRENT DEVICE USING A BELL OR BUZZER TO RING OUT THE WIRES. EACH CONDUCTOR SHALL BE MEGGERED WITH A 500V MEGGER. READINGS SHALL BE NOT LESS THAN 75 PERCENT OF THE VALUE OBTAINED BY THE FOLLOWING CALCULATION:

$$R = K \Big/ \text{LOG } 10 \frac{D}{d}$$

WHERE R = INSULATION RESISTANCE IN MEGOHMS - 1000 FT.
K = INSULATION CONSTANT (OBTAINED FROM CABLE MANUFACTURER)
D = DIAMETER OVER INSULATION ON EACH CONDUCTOR
d = DIAMETER OVER CONDUCTOR

TYPICAL PUBLISHED K VALUES FOR GENERAL ELECTRIC CABLE TYPES:

VULKENE	10,000	FLAMENOL THW	2,000	POLYETHYLENE	50,000

IF ANY MEGGER READINGS ON ANY CONDUCTOR SHOW LESS THAN ONE MEGOHM, INDICATING DAMAGED INSULATION, THE CONDUCTOR SHALL BE REPLACED. TESTS ON THE CP CABLE SHALL BE PERFORMED AFTER THE CABLE HAS BEEN LAID, BUT PRIOR TO SPLICING ON ANODE LEADS.

SECTION 16Y (PART 8)

CABINETS AND TERMINAL DISTRIBUTORS

---GENERAL REQUIREMENTS---

---SCOPE

THIS PART COVERS THE MATERIAL AND PROCEDURES FOR INSTALLING CABINETS AND TERMINAL DISTRIBUTORS.

---GENERAL

SHOP DRAWINGS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL BEFORE ANY BOX OR ENCLOSURE FABRICATION IS STARTED. ALL OF THE CABINET AND DISTRIBUTOR DESIGNS SHALL BE AS REQUIRED BY THE DRAWINGS.

TERMINAL DISTRIBUTORS AND CABINETS SHALL BE SIZED AS SHOWN ON THE DRAWINGS. CABINET BOXES SHALL BE CONSTRUCTED AS SHOWN ON THE DRAWINGS.

CABINETS AND DISTRIBUTORS SHALL BE SECURELY MOUNTED TO THE BUILDING STRUCTURE OR SUPPORT ASSEMBLY AS INDICATED, INDEPENDENT OF THE CONDUITS OR CABLING ENTERING OR LEAVING THE BOXES.

DISTRIBUTORS SHALL INCLUDE ALL NECESSARY CABLE TERMINATING EQUIPMENT AND SUPPORTS. OPENINGS NECESSARY FOR PROPER ATTACHMENT OF THE CONDUIT AND CABLE TRAY AND CABLE ENTRANCES SHALL BE PROVIDED AS REQUIRED. FITTINGS FOR PURGING SHALL BE PROVIDED WHERE INDICATED.

CABLES SHALL BE PROPERLY SUPPORTED, FORMED, TERMINATED, AND DESIGNATED IN THE ASSIGNED TERMINAL DISTRIBUTORS AS INDICATED ON THE DRAWINGS AND THESE SPECIFICATIONS.

HOLES DRILLED IN THE TERMINAL BLOCK ASSEMBLY MOUNTING CHANNELS FOR MOUNTING ALL TERMINAL BLOCK ASSEMBLIES SHALL BE SLOTTED 1/8 INCH EACH WAY FROM CENTER IN THE HORIZONTAL PLATE. THESE SLOTS SHALL BE SO LOCATED AS TO RELIEVE ANY STRESS OR DISTORTION TO THE TERMINAL BLOCK ASSEMBLIES DUE TO EXPANSION OR CONTRACTION AS WELL AS MISALIGNING MOUNTING SCREWS DURING INSTALLATION.

ALL PARTS AND MATERIAL USED IN THE FABRICATION OF BOXES AND ENCLOSURES SHALL BE AS SPECIFIED ON THE DRAWINGS.

COPPER STRIPS SHALL CONFORM TO MIL-T-55164.

STEEL SCREWS, WASHERS, AND NUTS SHALL BE CORROSION RESISTANT STEEL PER QQ-S-763, CLASS 305. TOOTHED LOCK WASHERS SHALL BE PER FF-W-100.

ALUMINUM SCREWS AND WASHERS SHALL BE ASCE 2024-T4 AND 6061-T6, RESPECTIVELY.

GALVANIZED PIPE NIPPLES SHALL CONFORM TO ASTM A 53.

MOUNTINGS WILL BE UNISTRUT P-1000 OR EQUAL AND AS REQUIRED.

COMPONENTS SUCH AS INSULATING MATERIALS, NEOPRENE OR TEFLON GASKETS, AND FIBERGLASS SHALL BE UTILIZED WITHIN THE LIMITS OF THE COMPONENT MANUFACTURER'S RECOMMENDATIONS.

---BONDING AND GROUNDING

ALL ENCLOSURES SHALL BE GROUNDED AS SPECIFIED IN 16X (PART 51) ENTITLED "GROUNDING AND LIGHTNING PROTECTION".

SECTION 17B

WELDING FOR LOW PRESSURE WATER PIPING SYSTEMS

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS AND DEFINITIONS

THIS SECTION IS NOT TO BE USED IN ISOLATION. IT DEFINES WELDING PROCEDURES AND WELDING QUALITY PROCEDURES FOR PIPING SYSTEMS SPECIFIED ELSEWHERE. FREQUENT REFERENCE IS MADE TO OTHER SECTIONS OF DIVISION 17 AND TO SECTIONS OF OTHER DIVISIONS. THE CONTRACTOR SHALL REQUIRE THAT THOSE WHO DO WORK UNDER THIS SECTION FULLY ACQUAINT THEMSELVES WITH THE REQUIREMENTS OF THE REFERENCED SECTIONS.

RECOGNIZED CODES AND STANDARDS ARE INCORPORATED INTO THE SPECIFICATIONS BY REFERENCE. THE REFERENCED PORTIONS OF THESE CODES AND STANDARDS, AS SPECIFICALLY MODIFIED BY THE SPECIFICATIONS, SHALL CONSTITUTE A PART OF THE SPECIFICATIONS.

WHEREVER THE WORDS "THE SPECIFICATIONS" ARE USED IN THIS SECTION, SHALL BE UNDERSTOOD TO MEAN THIS SECTION OF THE SPECIFICATIONS. WHERE THE WORD "SPECIFICATIONS" IS USED WITHOUT MODIFIER, OR WITH MODIFIER OTHER THAN "THE" OR "THESE", IT IS NOT TO BE REGARDED AS REFERRING TO THE CONTRACT SPECIFICATIONS.

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASME CODE	ASME BOILER AND PRESSURE VESSEL CODE-1974 EDITION & 1974 & 1975 ADDENDA PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
ANSI POWER PIPING CODE	ANSI B31-1.0-1973 - "POWER PIPING" PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

COMMONLY USED TERMS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

I.D.	INSIDE DIAMETER
IPS	IRON PIPE SIZE
O.D.	OUTSIDE DIAMETER
PSI	POUNDS PER SQUARE INCH
P-NUMBERS	THE CLASSIFICATION GROUPS OF BASE METALS AS SHOWN IN TABLE QW-422 OF SECTION IX OF THE ASME CODE.

---QUALIFICATION OF CODE LANGUAGE

WHEREVER, IN ANY OF THE CODES OR STANDARDS REFERENCED IN THIS SECTION, A REQUIREMENT FOR APPROVAL IS REQUIRED, IT SHALL BE UNDERSTOOD TO MEAN "APPROVAL OF THE CONTRACTING OFFICER". THIS APPLIES TO ALL APPROVALS THEREIN REQUIRED OR RECOMMENDED.

WHEREVER THE WORDS "SHOULD", "IT IS RECOMMENDED", OR OTHER WORDS INDICATING PREFERRED OR RECOMMENDED PROCEDURES ARE USED, THEY SHALL BE REGARDED AS IMPERATIVE CODE DIRECTIVES.

---WELDING PROCESSES

ALL WELDING PERFORMED UNDER THESE SPECIFICATIONS SHALL BE BY ANY TYPE OF MANUAL OR MACHINE WELDING PROCESS PERMITTED BY THE ASME BOILER AND PRESSURE VESSEL CODE UPON WRITTEN APPROVAL OF THE CONTRACTING OFFICER OR HIS DESIGNATED REPRESENTATIVE. SHOP AND FIELD TRANSVERSE BUTT WELDS ON PIPE SIZES 24 INCH AND LARGER SHALL BE GROUND FLUSH WITH THE INSIDE OF THE PIPE WALL. BACKING RINGS SHALL NOT BE USED IN SOUND SUPPRESSION WATER PIPING. BACKING RINGS SHALL BE USED IN ALL OTHER WATER PIPING SYSTEMS. FOR ALL WELDS, THE FIT-UP PRIOR TO WELDING SHALL BE INSPECTED TO DETERMINE THAT PROPER ROOT OPENING IS MAINTAINED. *TEN (10) PERCENT OF ALL ROOT PASSES SHALL BE INSPECTED BY THE CONTRACTOR. THE CONTRACTOR SHALL OBTAIN THE CONTRACTING OFFICER'S APPROVAL OF THE RESULTS OF THE INSPECTIONS.* (C)(B)
IT SHALL BE UNDERSTOOD THAT ANY APPROVAL OF WELDING PROCESSES SHALL BE PREDICATED UPON APPROVED PROCEDURE QUALIFICATION OF EVERY TYPE OF WELD AND EVERY TYPE OF BASE METAL TO BE SO WELDED. THE CONTRACTING OFFICER, IN GRANTING APPROVAL FOR WELDING PROCESSES, RESERVES THE RIGHT TO REQUIRE REVERSION TO THESE PROCESSES IF HE REGARDS THE QUALITY OF THE WELDS, AS PRODUCED, TO BE UNACCEPTABLE.

PROCEDURE QUALIFICATION FOR PROCESSES SPECIFIED SHALL BE BASED UPON APPROVED WELDING PROCEDURE SPECIFICATIONS COVERING ALL OF THE ESSENTIAL VARIABLES OF THE PRODUCTION OF THE SPECIFIC WELD TYPES IN THE REQUIRED THICKNESS RANGES OF THE SPECIFIED BASE METALS AND FILLER METALS, AND WITH JOINT GEOMETRY AND ORIENTATION CORRESPONDING TO THOSE OF THE WELDS TO BE MADE BY THE PROPOSED METHODS.

NO APPROVAL SHALL BE APPLIED UNLESS THE WELDING PROCEDURE SPECIFICATIONS FOR THE RESPECTIVE WELDS INVOLVED HAVE BEEN APPROVED AND PROCEDURE QUALIFICATION TESTS HAVE BEEN ACCEPTABLY COMPLETED.

---COORDINATION WITH DRAWINGS

WHEREVER THE CONTRACT DRAWINGS OR THE APPROVED SHOP DRAWINGS INCLUDE SPECIFIC REQUIREMENTS FOR PIPING ASSEMBLY METHODS, THESE SHALL BE REGARDED AS SUPERSEDING THE REQUIREMENTS OF THESE SPECIFICATIONS OR THE CODES OR STANDARDS WHICH HAVE BEEN INCORPORATED INTO THEM BY REFERENCE; UNLESS THE REQUIREMENTS OF THESE SPECIFICATIONS, OR THE CODES OR STANDARDS INCORPORATED THEREINTO BY REFERENCE, ARE MORE EXACTING OR MORE STRINGENT THAN THOSE SHOWN ON THE DRAWINGS. THE SAME SHALL BE TRUE OF FIELD WELDING SHOWN ON APPROVED MANUFACTURERS' DRAWINGS.

A CODING SYSTEM SHALL BE DEVISED TO IDENTIFY ALL WELDS AND TO COORDINATE THEM WITH WELDING PROCEDURE SPECIFICATIONS, AND DRAWING LOCATION, AS-BUILT DRAWINGS SHALL BE MAINTAINED BY THE CONTRACTOR, ON WHICH EACH WELD IS IDENTIFIED IN TERMS OF THIS CODE. WELDS IN THE SAME SYSTEM, EMPLOYING THE SAME MATERIALS AND WELD TYPE IN CONFORMITY WITH A SINGLE WELDING PROCEDURE, MAY BE GIVEN THE SAME CODE IDENTIFICATION.

---WELDING PROCEDURE SPECIFICATIONS

THE CONTRACTOR SHALL PREPARE WELDING PROCEDURE SPECIFICATIONS FOR ALL WELDS. WHERE THERE ARE MULTIPLE IDENTICAL WELDS USING SUBSTANTIALLY IDENTICAL MATERIAL AND ORIENTATIONS AND POSITIONS, A SINGLE WELDING PROCEDURE SPECIFICATION COVERING SUCH WELDS WILL BE ACCEPTABLE. WELDING PROCEDURE SPECIFICATIONS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER WITH DRAWINGS SHOWING ALL WELDS EXCEPT IDENTICAL WELDS IN UNBROKEN PIPE RUNS, AND IDENTIFYING ALL WELDS BY CODED NUMBERS ASSIGNED TO THE CORRESPONDING PROCEDURE SPECIFICATION.

EACH WELDING PROCEDURE SPECIFICATION SHALL INCLUDE ALL OF THE FOLLOWING INFORMATION RELATIVE TO THE WELD:

IDENTIFICATION OF THE WELD BY ASSIGNED CODE NUMBER.

TYPE OF WELD: GROOVE, BUTT, FILLET, PLUG, ETC.

COMPONENTS JOINED

BASE METALS JOINED

ORIENTATION

THICKNESS RANGE

PIPE SIZE RANGE

WELDING PROCESS (AC OR DC CURRENT, POLARITY, AMPERAGE AND VOLTAGE)

WELDING EQUIPMENT - FULL PARTICULARS OF MANUFACTURE, MODEL, RATING, AUXILIARY EQUIPMENT, ETC.

FILLER METAL IDENTIFICATION

ELECTRODE SIZE AND IDENTIFICATION

MAXIMUM AND MINIMUM THICKNESSES OF WELD METAL PER PASS

DESCRIBE PROCEDURE FOR MAINTAINING REQUIRED ALIGNMENT

TYPE OF BACK-UP RINGS *OR CONSUMABLE INSERTS, IF EITHER IS USED.*

PREPARATION OF PIPE ENDS FOR WELDING TOLERANCES

METHOD OF PREHEATING WHEN AMBIENT AIR TEMPERATURE IS BELOW 40 DEGREES FAHRENHEIT

EXTENT, RATE AND METHOD OF PREHEAT AND POSTHEAT WHEREVER THE COMPOSITION OF THE BASE METALS REQUIRES SUCH HEATING. PRE-HEAT AND POST-HEAT TEMPERATURES.

PROCEDURE FOR PREVENTION OF OXIDATION OF PIPE INSIDE DURING WELDING; PROCEDURE FOR USING INERT GASES.

PREWELD CLEANING PROCEDURE

INTERPASS CLEANING PROCEDURE

FLUX IDENTIFICATION

WELDING INSPECTION REQUIREMENTS. PROCEDURE QUALIFICATION REQUIRES X-RAY.

POSTWELD CLEANING OF WELDS

A SKETCH SHOWING ORIENTATION, TOLERANCES, THICKNESS RANGE, PASS PATTERN.

THE WELDING PROCEDURE SPECIFICATIONS SHALL CONFORM TO ALL OF THE REQUIREMENTS OF THE SPECIFICATIONS, THE CONTRACT DRAWINGS AND THE APPROVED SHOP DRAWINGS, AS WELL AS TO THE SPECIFIC REQUIREMENTS OF THE REFERENCED CODES AND STANDARDS AS REFERENCED.

THE WELDING PROCEDURE SPECIFICATIONS, AS APPROVED BY THE CONTRACTING OFFICER, SHALL GOVERN THE WELDING OF THE IDENTIFIED JOINTS FOR ALL REQUIRED WELDING PROCEDURE QUALIFICATION AND FOR JOB WELDING. THERE SHALL BE NO DEVIATION FROM THE APPROVED WELDING PROCEDURE SPECIFICATIONS WITHOUT WRITTEN APPROVAL OF THE CONTRACTING OFFICER. WHEN A CHANGE IN THE APPROVED PROCEDURE IS PROPOSED, THE CONTRACTOR SHALL SUBMIT A REVISED WELDING PROCEDURE SPECIFICATION INCORPORATING THE PROPOSED CHANGE, IDENTIFYING THE CHANGE, AND FULLY EXPLAINING THE REASON FOR THE PROPOSED CHANGE.

IF ANY OF THE VARIABLES TO BE CHANGED ARE AMONG THE FOLLOWING, THE CONTRACTING OFFICER SHALL HAVE THE RIGHT TO INSTITUTE THE FULL RANGE OF QUALIFICATION TESTING HEREINAFTER SPECIFIED:

A CHANGE IN FILLER METAL FROM ONE A-NUMBER TO ANOTHER A-NUMBER, OR FROM ONE F-NUMBER TO ANOTHER F-NUMBER AS SHOWN IN TABLES QW-442 AND QW-432 OF SECTION IX OF THE ASME CODE

A CHANGE IN ELECTRODE SIZE OR TYPE. CHANGE VERTICAL WELDING PROGRESSION

A CHANGE IN WELDING POSITION; A CHANGE IN BASE METAL "P" NUMBER

A CHANGE IN THE KIND OF BACKING RING, *IF USED, OR THE OMISSION OF BACKING RING*

ANY CHANGE IN SHIELDING GAS COMPOSITION FOR INERT-GAS TUNGSTEN-ARC WELDING AND GAS METAL ARC WELDING

ANY CHANGE IN WELDING PROCESS, CURRENT, POLARITY, AMPERAGE AND VOLTAGE

ANY CHANGE IN INERT GAS BACKING, PRE-HEAT AND POST HEAT TEMPERATURE

APPROVAL OF WELDING PROCEDURE SPECIFICATIONS BY THE CONTRACTING OFFICER SHALL IN NO WAY RELIEVE THE CONTRACTOR OF FULL RESPONSIBILITY FOR THE PRODUCTION OF FUNCTIONALLY ACCEPTABLE WELDS. IN THE EVENT THAT A WELDING PROCEDURE WHICH HAS BEEN DEFINED BY AN APPROVED WELDING PROCEDURE SPECIFICATION DOES NOT PRODUCE WELDS WHICH MEET QUALIFICATION OR JOB WELDING REQUIREMENTS, THE CONTRACTOR IN COOPERATION WITH THE APPROVED TESTING LABORATORY SHALL REVISE THE PROCEDURE; A REVISED WELDING PROCEDURE SPECIFICATION SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL BEFORE THE REVISED PROCEDURE IS FOLLOWED.

---PROCEDURE QUALIFICATION WELDS

THE SPECIMEN WELDS FOR PROCEDURE QUALIFICATION SHALL BE THOSE HEREINAFTER REQUIRED FOR WELDER PERFORMANCE QUALIFICATION. IF THE SPECIMENS PREPARED FOR WELDER QUALIFICATION ARE SHOWN TO BE ACCEPTABLE BY DESTRUCTIVE TESTING, THE PROCEDURES WHICH WERE FOLLOWED IN THEIR PREPARATION WILL BE DEEMED TO HAVE BEEN DULY QUALIFIED. IT SHALL BE UNDERSTOOD THAT IN THE PREPARATION OF THE SPECIMENS, THE WELDER SHALL FOLLOW THE APPROPRIATE APPROVED WELDING PROCEDURE SPECIFICATION.

PROCEDURE QUALIFICATION WELDS ARE REQUIRED FOR ALL WELDING PROCEDURE SPECIFICATIONS. THESE WELDS SHALL BE MADE WITH WELDING EQUIPMENT WHICH IS IDENTICAL TO THAT TO BE USED IN MAKING JOB WELDS. SPECIMEN WELDS ARE REQUIRED FOR EACH COMBINATION OF:

WELDING PROCESS

BASE METAL P-NUMBER

FILLER METAL A-NUMBER, FOR BOTH SHIELDED METAL-ARC AND INERT-GAS TUNGSTEN-ARC WELDING

ELECTRODE F-NUMBER, FOR SHIELDED METAL-ARC WELDING

POSITION, AS DEFINED IN ARTICLES QW-121, QW-122, QW-130 AND QW-131 OF SECTION IX OF THE ASME CODE

THICKNESS RANGED AS DEFINED IN TABLE QW-451.1 OF SECTION IX OF THE ASME CODE

WELD TYPE:-GROOVE FILLET, BRANCH CONNECTIONS IF USED, SOCKET WELD IF USED, ETC.

WELDING RING *OR CONSUMABLE INSERT, IF EITHER IS USED*

GAS COMPOSITION FOR SHIELDING

METHOD OF PREHEAT

METHOD OF POSTWELD HEATING

THE DIMENSIONS OF THE TEST MATERIAL AND THE LENGTH OF THE WELD SHALL BE SUFFICIENT TO PROVIDE THE REQUIRED TEST SPECIMENS. THE TYPE AND NUMBER OF TEST SPECIMENS TO BE MADE FROM EACH OF THE WELD SPECIMENS SHALL CONFORM TO THE REQUIREMENTS OF (SEE BELOW) ARTICLES QW-211, QW-212, QW-213 AND TABLES QW-451.1 AND QW-451.2 OF SECTION IX OF THE ASME CODE. PLATE OR PIPE MAY BE USED, DEPENDING UPON THE PREPONDERANCE OF WELDING WHICH IS TO BE DONE ON THE RESPECTIVE TYPES; WHERE THE SPECIFIC WELDS WILL BE USED FOR BOTH PLATE AND PIPE, THE USE OF PIPE FOR THE WELD SPECIMENS IS REQUIRED. PREPARATION OF TEST JOINT SHALL CONFORM TO ARTICLE QW-212 OF SECTION IX OF THE ASME CODE. (ALSO, TABLE QW-452.3.)

---PROCEDURE QUALIFICATION TEST SPECIMENS

ALL PROCEDURE QUALIFICATION COUPONS SHALL BE X-RAYED.
TEST SPECIMENS SHALL BE PREPARED IN CONFORMITY WITH QW-151 AND QW-161 OF THE SECTION IX OF THE ASME CODE TOGETHER WITH THEIR REFERENCED FIGURES, FOR THE FOLLOWING:

GROOVE WELDS FOR ALL OF THE MATERIALS AND POSITIONS FOR WHICH PROCEDURE QUALIFICATION IS HEREINBEFORE REQUIRED; INCLUDING ALL THOSE EMPLOYING NONREMOVALBE BACKING RINGS OR CONSUMABLE INSERTS, *IF USED*.

WHERE FILLET WELDS INVOLVE BASE MATERIALS WITH P-NUMBERS OTHER THAN THOSE QUALIFIED FOR GROOVE WELDS, OR WHERE FILLET WELDS INVOLVE POSITIONS OTHER THAN THOSE QUALIFIED FOR GROOVE WELDS, PROCEDURE QUALIFICATION TEST SPECIMENS SHALL BE PREPARED IN CONFORMITY WITH QW-181.1 OF SECTION IX OF THE ASME CODE, TOGETHER WITH THE THEREIN REFERENCED FIGURES.

THE CONTRACTING OFFICER SHALL BE KEPT FULLY ADVISED AS TO THE TIME AND PLACE OF THE PRODUCTION OF THESE TEST SPECIMENS, AND SHALL HAVE FREE ACCESS TO THE LOCATION.

---REQUALIFICATION

IN THE EVENT THAT A PROCEDURE FAILS TO QUALIFY, A REVISED WELDING PROCEDURE SPECIFICATION SHALL BE PREPARED AND SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL. AS ULTIMATELY APPROVED BY THE CONTRACTING OFFICER, IT SHALL BECOME THE BASIS FOR NEW PROCEDURE QUALIFICATION TESTING. THE SAME PROCEDURES FOR SPECIMEN PREPARATION, ARE REQUIRED FOR THE REVISED PROCEDURE AS HAVE BEEN HEREINBEFORE SPECIFIED FOR PROCEDURE QUALIFICATION, ALL AT NO COST TO THE GOVERNMENT.

IN THE EVENT THAT THE CONTRACTOR WISHES TO MAKE A CHANGE IN ANY OF THE ESSENTIAL VARIABLES OF ANY APPROVED AND QUALIFIED PROCEDURE, HE SHALL PREPARE A REVISED WELDING PROCEDURE SPECIFICATION FOR APPROVAL; AFTER APPROVAL BY THE CONTRACTING OFFICER THE REVISED PROCEDURE SHALL BE SUBJECTED TO THE SAME PROCEDURE QUALIFICATION TESTING, IF ANY, WHICH WAS REQUIRED FOR THE ORIGINAL PROCEDURE FOR QUALIFICATION. ALL SPECIFICATION PREPARATION AND SPECIMEN PREPARATION SHALL BE DONE BY THE APPROVED TESTING LABORATORY WITHOUT COST TO THE GOVERNMENT.

---GENERAL

EACH WELDER SHALL SATISFY THE PERFORMANCE WELDING QUALIFICATION REQUIREMENTS FOR THE FULL RANGE OF THE BASE METAL P-NUMBERS, THE ORIENTATIONAL WELD POSITIONS AND THE WELD TYPES TO WHICH HE WILL BE ASSIGNED. QUALIFICATION FOR USE OF ELECTRODES AND WELDING ROD FOR ALL OF THE BASE METAL P-NUMBERS SHALL CONFORM TO TABLE QW-422, SECTION IX OF THE ASME CODE, TOGETHER WITH THE TABLE FOOTNOTES.

ALL PERFORMANCE QUALIFICATION WELDING SHALL BE DONE UNDER DIRECT OBSERVATION OF THE GOVERNMENT INSPECTOR. ALL TESTING OF THE QUALIFICATION WELD SPECIMENS WILL BE DONE BY AN APPROVED INDEPENDENT TESTING LABORATORY. CERTIFICATIONS SHALL HAVE GOVERNMENT INSPECTOR'S STAMP AFFIXED.

WELDERS WHO PRODUCED ACCEPTED PROCEDURE QUALIFICATION WELD SPECIMENS SHALL BE CONSIDERED TO HAVE MET THE PERFORMANCE QUALIFICATION REQUIREMENTS FOR WELDS WITH SAME COMBINATIONS OF BASE METAL P-NUMBERS, POSITIONS, ELECTRODES OR WELDING RODS, AND WELD TYPES.

QUALIFICATION REQUIREMENTS FOR SPECIFIC COMBINATIONS OF THE ESSENTIAL VARIABLES HEREINAFTER SPECIFIED SHALL BE CONSIDERED TO HAVE BEEN SATISFIED IF THE CONTRACTOR PRODUCES EVIDENCE, CERTIFIED BY A QUALIFIED TESTING LABORATORY, THAT THE WELDER WAS QUALIFIED FOR SUCH WELDS UNDER THE REQUIREMENTS OF THESE SPECIFICATIONS FOR PERFORMANCE QUALIFICATION WITHIN THE PRECEDING THREE MONTH PERIOD. SATISFACTORY EXPERIENCE IN THE PRODUCTION OF SUCH WELDS AT KSC WITHIN THE PRECEDING THREE MONTHS SHALL BE DEEMED TO SATISFY THE REQUIREMENTS FOR PERFORMANCE QUALIFICATION.

---ESSENTIAL VARIABLES

ESSENTIAL VARIABLES FOR PERFORMANCE QUALIFICATION SHALL INCLUDE THE FOLLOWING:

WELDING PROCESS AND EQUIPMENT. WELDING QUALIFICATION IS LIMITED TO THE PROCESS AND THE EQUIPMENT WITH WHICH THE WELDS FOR PERFORMANCE QUALIFICATION WERE PRODUCED.

PROGRESSION SPECIFIED FOR ANY PASS OF A VERTICAL WELD.
TYPE OF CURRENT AND POLARITY UTILIZED.
P-NUMBER OR P-NUMBERS OF THE BASE METAL
F-NUMBER OF THE ELECTRODE OR WELDING ROD USED.

WELDING POSITION AS SHOWN FOR PIPE WELDS IN FIGURE QW-461.3 OF SECTION IX OF THE ASME CODE; SUBJECT TO THE CONDITION THAT QUALIFICATION IN POSITION 2G OR 5G AS THERE SHOWN QUALIFIES THE WELDER FOR POSITION 1G AS WELL, AND THAT QUALIFICATION IN BOTH POSITIONS 2G AND 5G QUALIFIES THE WELDER FOR ANY POSITION OR ORIENTATION OF PIPE OR WELD.

WELD TYPE; WITH THE CONDITION THAT QUALIFICATION FOR GROOVE WELDS QUALIFIES THE WELDER FOR FILLET WELDS WHERE THE ORIENTATION OF THE FILLER METAL, IN PLACE, IS THE SAME AS THAT OF THE GROOVE WELD POSITION FOR WHICH THE WELDER WAS QUALIFIED.

BACKING RINGS. TO QUALIFY FOR PIPE WELDS USING RINGS, OR INSERTS, SPECIMEN WELDS SHALL EMPLOY IDENTICAL ITEMS, IF SUCH ITEMS ARE TO BE USED IN PRODUCTION WELDS.

INERT GAS BACKING. WHERE INERT GAS BACKING IS REQUIRED BY THE SPECIFICATIONS, THE CONTRACT DRAWINGS OR THE APPROVED SHOP DRAWINGS, THE REQUIRED GAS SHALL BE EMPLOYED IN THE PREPARATION OF TEST SPECIMENS.

---PREPARATION OF THE TEST JOINTS

THE QUALIFICATION WELDS SHALL CONFORM TO THE REQUIREMENTS OF ARTICLE QW-310 OF SECTION IX OF THE ASME CODE. PIPE SHALL BE USED FOR THE PREPARATION OF ALL SPECIMENS.

---TYPE AND NUMBER OF TEST SPECIMENS

TYPE AND NUMBER OF TEST SPECIMENS SHALL BE IN CONFORMITY WITH THE REQUIREMENTS OF ARTICLE QW-302 OF SECTION IX OF THE ASME CODE.

SPECIMENS SHALL BE PREPARED FOR EACH OF THE WELDED CONNECTIONS WHICH ARE TO BE QUALIFIED. ALL PERFORMANCE TEST SPECIMENS SHALL BE X-RAYED.

SPECIMENS FOR TENSION TESTS SHALL BE PREPARED IN CONFORMITY WITH ARTICLE QW-150 OF SECTION IX OF THE ASME CODE.

SPECIMENS FOR GUIDED BEND TESTS SHALL BE PREPARED IN CONFORMITY WITH ARTICLE QW-160 OF SECTION IX OF THE ASME CODE. SPECIMENS FOR FILLET-WELD TESTS SHALL BE PREPARED IN CONFORMITY WITH ARTICLE QW-180 OF SECTION IX OF THE ASME CODE.

---TESTS

PERFORMANCE QUALIFICATION TEST SPECIMENS SHALL CONFORM TO THE REQUIREMENTS OF TABLE NO. QW-452 OF SECTION IX OF THE ASME CODE. IF THE JOINING OF TWO BASE METALS OF SUBSTANTIALLY DIFFERENT BENDING PROPERTIES NECESSITATES THE USE OF LONGITUDINAL BEND TESTS IN LIEU OF TRANSVERSE BEND TESTS, THE TEST SPECIMENS SHALL MEET THE REQUIREMENTS OF QW-452.2 OF SECTION IX OF THE ASME CODE.

---REQUALIFICATION

REQUIREMENTS FOR REQUALIFICATION SHALL CONFORM TO ARTICLE QW-251.2 OF SECTION IX OF THE ASME CODE.

---GENERAL

WELDING SHALL NOT BE DONE AT AMBIENT TEMPERATURES BELOW ZERO DEGREES FAHRENHEIT, OR WHEN THE SURFACES ARE WET OR ARE EXPOSED TO RAIN. THE GENERAL TEMPERATURE OF THE METALS IN THE AREA WHERE WELDING IS BEING DONE SHALL NOT BE BELOW 70 DEGREES FAHRENHEIT; WHEN THE AMBIENT CONDITIONS ARE SUCH THAT THE NORMAL TEMPERATURE OF THE BASE METAL IS BELOW 70 DEGREES FAHRENHEIT, THE AREA SURROUNDING THE JOINT SHALL BE PREHEATED SO AS TO PROVIDE A MINIMUM BASE METAL TEMPERATURE OF 70 DEGREES FAHRENHEIT FOR A DISTANCE OF AT LEAST 3 INCHES IN ALL DIRECTIONS FROM THE TO-BE-WELDED JOINT.

PROCEDURES SHALL CONFORM TO ALL DRAWING NOTES AND DETAILS RELATING TO WELDING PROCEDURES AND REQUIREMENTS.

---JOINT PREPARATION

THE BASE METAL SURFACES WHICH ARE TO RECEIVE WELD METAL SHALL BE CLEAN AND FREE OF SURFACE DEFECTS WHICH DISTURB THE HOMOGENEITY OF SURFACE STRUCTURE. THERE SHALL BE NO CRACKS, FINS, TEARS, INCLUSIONS, OR OTHER DEFECTS WHICH AFFECT THE CONTINUOUS HOMOGENEITY OF THE SURFACES WHICH ARE TO RECEIVE WELD METALS; SURFACES TO RECEIVE WELD METAL SHALL BE FREE OF SCALE, RUST, GREASE OR OTHER FOREIGN MATERIAL. COATINGS ON METAL SHALL BE REMOVED.

SURFACES ADJACENT TO ANY WELD SHALL BE FREE OF PAINT AND ANY MATERIAL WHICH MIGHT CONTAMINATE THE TO-BE-WELDED SURFACES OR THE FILLER METAL, OR WHOSE FUMES MIGHT COMPROMISE THE SUCCESS OF THE WELDING PROCEDURE OR THE WELL-BEING OF PERSONNEL. THE DISTANCE TO BE KEPT CLEAR OF SUCH MATERIALS SHALL BE DETERMINED BY THE NATURE OF THE MATERIAL, AND THE NATURE OF THE PRODUCTS RESULTING FROM THERMAL DECOMPOSITION, EXPECIALLY THEIR TOXICITY AND THEIR REACTIVITY WITH THE MATERIALS INVOLVED IN THE WELDING PROCEDURE.

CUTTING OF THE BASE METAL TO PREPARE EDGES FOR WELDING SHALL BE DONE BY A METHOD WHICH PRODUCES FULLY ACCEPTABLE SURFACE FOR THE RECEPTION OF THE FILLER METAL. CUTTING SHALL BE DONE BY EITHER MECHANICAL MEANS OR BY MACHINE OXYGEN CUTTING. WHEN OXYGEN CUTTING IS EMPLOYED, THE TO-BE-WELDED SURFACES SHALL BE FINISHED TO THE CONDITION HEREINBEFORE SPECIFIED. OXYGEN CUTTING PROHIBITED FOR ALUMINUM AND STAINLESS STEEL.

---ASSEMBLY

ALIGNMENT OF PIPING COMPONENTS TO BE JOINED BY GROOVE WELDING SHALL CONFORM TO PARAGRAPH 127.3.1(C) OF THE ANSI B31.1 - 1973. THE LIMITS AND TOLERANCES SHOWN ON THE APPROVED WELDING PROCEDURE SPECIFICATION.

PARTS TO BE JOINED BY FILLET WELDS SHALL BE BROUGHT INTO THE CLOSEST PRACTICABLE CONTACT - IN NO EVENT SEPARATED BY MORE THAN 3/16 INCH UNLESS SO SHOWN ON THE APPROVED WELDING PROCEDURE SPECIFICATIONS. IF THE SEPARATION IS 1/16 INCH OR GREATER, THE LEG OF THE FILLET WELD SHALL BE INCREASED BY THE AMOUNT OF THE SEPARATION.

IF TEMPORARY OR TACK WELDS ARE EMPLOYED, THESE SHALL BE PERFORMED BY WELDERS QUALIFIED TO MAKE THE FINAL WELDS. WELD METAL COMPOSITION SHALL BE THE SAME AS FOR THE FINAL WELD. THE CONTRACTING OFFICER MAY REQUIRE THE REMOVAL OF ANY OR ALL TEMPORARY OR TACK WELDS BEFORE THE WELDING OPERATION APPROACHES THE POINT WHERE IT WOULD INCORPORATE THEM INTO THE FINAL WELD. TACK WELDS WHICH ARE NOT REMOVED SHALL BE GROUND TO CONTOURS TO IMPLEMENT THEIR HOMOGENEOUS ABSORPTION INTO THE FINAL WELD.

DISTORTION OF RESIDUAL STRESS SHALL BE MINIMIZED BY PROPER WELDING PROCEDURES. WHERE THE CONFIGURATION OF A PIPING SYSTEM IMPOSES THE LIKELIHOOD OF DISTORTION OR RESIDUAL STRESS WHICH COULD COMPROMISE THE SECURITY OF THE SYSTEM, THE CONTRACTOR SHALL SUBMIT TO THE CONTRACTING OFFICER A PROGRAM FOR WELDING SEQUENCE TO MINIMIZE SUCH DISTORTION AND STRESSES.

---WELD DETAILS

GROOVE WELDS SHALL CONFORM TO THE RESPECTIVE APPROVED WELDING PROCEDURE SPECIFICATIONS. THE FINISHED SURFACE OF THE WELD SHALL MERGE SMOOTHLY INTO THE COMPONENT SURFACE OF THE WELD TOE. THE THICKNESS OF THE WELD REINFORCEMENT SHALL CONFORM TO THE LIMITS OF PARAGRAPH 127.4.2(D) OF THE ANSI PIPING CODE, B31.1 - 1973.

WHEN COMPONENTS OF DIFFERENT OUTSIDE DIAMETERS ARE WELDED TOGETHER, THERE SHALL BE A GRADUAL TRANSITION IN THE WELD BETWEEN THE TWO SURFACES. IF THE DIFFERENCE IN SURFACE EXCEEDS 1/4 INCH, THE OUTSIDE OF THE LARGER COMPONENT SHALL BE TAPERED AT AN ANGLE NOT TO EXCEED 30 DEGREES WITH THE PIPE AXIS; THIS SHALL BE DONE IN SUCH A WAY AS TO MAINTAIN DESIGN STRENGTH IN THE CONNECTION.

FILLET WELDS MAY HAVE FLAT, SLIGHTLY CONCAVE OR SLIGHTLY CONVEX FACES. EXCEPT AT OUTSIDE CORNERS OF PLATE ASSEMBLIES, THE CONVEXITY SHALL NOT EXCEED 0.03 INCH MORE THAN ONE-TENTH OF THE LEG OF THE WELD.

---PROCEDURES

THE PROCEDURES FOR EACH WELD SHALL CONFORM TO THE CORRESPONDING APPROVED WELDING PROCEDURE SPECIFICATION. PREHEATING, INTERPASS TEMPERATURE AND POSTWELD HEATING REQUIREMENTS SHALL BE RIGIDLY FOLLOWED. NO WELDING SHALL BE DONE ON METALS REQUIRING NO PREHEATING, WHEN THE TEMPERATURE OF THE METAL IN THE AREA IN WHICH WELDING IS BEING DONE IS BELOW 70 DEGREES FAHRENHEIT.

BRANCH CONNECTIONS SHALL CONFORM TO 127.4.8 OF THE ANSI POWER PIPING CODE, MODIFIED AS REQUIRED BY THE APPROVED WELDING PROCEDURE SPECIFICATIONS, THE CONTRACT DRAWINGS, OR THE APPROVED SHOP DRAWINGS.

WHERE SEAL WELDING IS REQUIRED BY THE SPECIFICATIONS, THE APPROVED WELDING PROCEDURE SPECIFICATIONS, THE CONTRACT DRAWINGS, OR THE APPROVED SHOP DRAWINGS, THREADS SHALL BE ENTIRELY COVERED BY THE SEAL WELD. SEAL WELDING SHALL BE PERFORMED BY QUALIFIED WELDERS.

ALL EQUIPMENT SHALL BE MAINTAINED IN GOOD WORKING CONDITION. ALL ELECTRICAL COMPONENTS SHALL BE MAINTAINED DIRT-DUST-FREE. ELECTRODES AND CURRENT-CARRYING LEADS SHALL BE KEPT IN GOOD CONDITION. THE GAS SYSTEM IN INERT-GAS SYSTEMS SHALL BE MAINTAINED IN A LEAK-PROOF CONDITION. HOSES MUST BE INTACT, WITHOUT WORN AREAS, KINKS, ABRASIONS OR OTHER DAMAGE; HOSE MATERIALS SHALL BE LOW-PERMEANCE SYNTHETIC ELASTOMERS. WELDER'S FACE SHIELD SHALL BE CLEAN, UNCLOUDED AND CRACK-FREE.

IN THE WELDING OF STAINLESS STEEL PIPING, WHEN THE REVERSE SIDE OF THE WELD IS NOT ACCESSIBLE FOR BACK-WELDING, THE AREA BEING WELDED SHALL BE INTERNALLY PURGED WITH INERT GAS BEFORE WELDING; AND A MINIMUM FLOW OF 3 TO 5 CUBIC FEET OF THE GAS PER HOUR SHALL BE MAINTAINED DURING THE WELDING. THE PREWELD PURGE SHALL BE A MINIMUM OF SIX VOLUMES OF THE PIPING INTERIOR AT STANDARD CONDITIONS. THE SECTION PURGED SHALL BE EFFECTIVELY ISOLATED DURING PURGING TO PREVENT INTERFUSION OF ATMOSPHERIC GASES. ARGON, AS HEREINBEFORE SPECIFIED, SHALL BE USED.

---PREHEATING AND POSTWELD HEATING

ANY PREHEATING HEREINBEFORE REQUIRED, OR REQUIRED UNDER THE APPROVED WELDING PROCEDURE SPECIFICATIONS, SHALL BE PERFORMED IN SUCH A WAY AS TO PREVENT OVERHEATING ANY PART OF THE METAL AND TO PREVENT THE PRODUCTION OF RESIDUAL STRESSES OR DISTORTION.

PREHEATING SHALL EXTEND AT LEAST 3 INCHES ON EACH SIDE OF THE WELD. INDUCTION HEATING OF CIRCUMFERENTIAL WELDS IS PREFERRED FOR FIELD WELDS. WHERE GAS IS USED FOR PREHEATING, ONLY SULFURFREE GASES AND RING BURNERS MAY BE EMPLOYED FOR CIRCUMFERENTIAL JOINTS. ELECTRICAL STRIP HEATING IS PERMISSIBLE.

TEMPERATURE-SENSITIVE CRAYONS MAY BE USED TO MAINTAIN TEMPERATURE CONTROL. THE COLOR CHANGE OF CRAYONS UPON HEATING TO THE PREDETERMINED TEMPERATURE SHALL BE PERMANENT. WHERE SPECIFIED REHEAT MINIMUM TEMPERATURES EXCEED 300 DEGREES FAHRENHEIT, CRAYON MARKS SHALL BE USED IN PAIRS: ONE MARK WHICH CHANGES COLOR AT THE DESIGNATED MINIMUM TEMPERATURE; ANOTHER, ADJACENT THERETO AT 100 FAHRENHEIT DEGREES, PLUS OR MINUS 50 DEGREES, ABOVE THIS MINIMUM. ANY OTHER APPROVED MEANS FOR RECORDING PREHEAT TEMPERATURE MAY BE USED. WELDING PROCEDURE SPECIFICATIONS SHALL DEFINE THE NATURE AND EXACT LIMITS OF POSTWELD HEAT TREATMENT FOR ALL WELD TYPES TO BE QUALIFIED, WHETHER FOR STRESS RELIEF OR TO METALLURGICALLY RESTORE THE BASE METALS TO THEIR PREWELD CONDITION.

DURING POSTWELD HEATING AND COOLING OR CARBON AND LOW ALLOY STEELS, THE TEMPERATURE SHALL BE MAINTAINED UNIFORMLY SO THAT THE TEMPERATURE GRADIENT THROUGHOUT THE ASSEMBLY DOES NOT EXCEED 100 FAHRENHEIT DEGREES PER LINEAL FOOT IN ANY AFFECTED AREA. AFTER THE REQUIRED MEAN TEMPERATURE IS REACHED, THE TEMPERATURE OF THE ASSEMBLY SHALL BE HELD WITHIN PLUS-OR-MINUS 50 FAHRENHEIT DEGREES OF THIS MEAN FOR ONE HOUR PER INCH OF THICKNESS OF THE THICKEST PART. COOLING RATE SHALL BE LIMITED TO 400 FAHRENHEIT DEGREES PER HOUR DIVIDED BY THE THICKNESS IN INCHES OF THE THICKEST PART. WHEN THE TEMPERATURE REACHES 600 DEGREES FAHRENHEIT, THE ASSEMBLY MAY BE AIR COOLED IN STILL AIR. THERE SHALL BE CONTINUOUS RECORDING MONITORING OF THE WELDMENT TEMPERATURES DURING THE ENTIRE PROCESS. ALL POST WELD HEAT TREATMENT SHALL BE UNDER THE INSPECTIONAL SUPERVISION OF QUALIFIED PERSONNEL OF THE TESTING LABORATORY, WHO SHALL GIVE A FULL REPORT ON THE OPERATION, INCLUDING ALL EQUIPMENT AND ITS EXACT USE, AND ALL DATA ON TEMPERATURES DURING HEATING, SOAKING AND COOLING.

LOCALIZED POSTWELD HEAT TREATMENT OF IN-PLACE WELDS MAY BE DONE BY INDUCTION HEATING OF THE PIPE AFTER SUBSTANTIALLY INSULATING IT WITH ASBESTOS PAPER. THERMOCOUPLES AND TEMPERATURE RECORDERS SHALL BE USED IN SUCH QUANTITY AS TO EFFECTIVELY MONITOR THE OPERATION WITHIN THE CONTROL RANGES SPECIFIED IN THE PRECEDING PARAGRAPH. VOLTAGE CONTROL ON THE INDUCTION EQUIPMENT SHALL BE SUCH AS TO PROVIDE COMPLETE CONTROL OF THE INDUCTION HEATING.

IF PRESCRIBED HEATING RATES, TEMPERATURE RANGES, HOLDING TEMPERATURES OR COOLING RATES ARE EXCEEDED, THE HEAT TREATMENT SHALL BE REPEATED. IF THE PRESCRIBED MAXIMUM TEMPERATURE IS EXCEEDED BY 50 FAHRENHEIT DEGREES OR MORE, THE CONTRACTING OFFICER MAY REQUIRE THE REMOVAL AND METALLOGRAPHIC EXAMINATION OF ONE OR MORE PLUGS FROM THE WELD. REMOVAL OF THE PLUG, THEIR EXAMINATION, AND THE REPAIR OF THE WELDMENT SHALL BE DONE AT NO COST TO THE GOVERNMENT.

---INSPECTION AND TESTING---

THE CONTRACTOR WILL BE RESPONSIBLE FOR ALL TESTING FOR PROCEDURE QUALIFICATION AND WELDER PERFORMANCE QUALIFICATION BY AN APPROVED TESTING LABORATORY. THE TESTING LABORATORY *SHALL* ALSO CONDUCT FIELD INSPECTION OF WELDS AND CONDUCT SUCH TESTS AS THE CONTRACTING OFFICER DEEMS NECESSARY. (B)

PRODUCTION WELDS SHALL MEET THE SAME TEST REQUIREMENTS AS THE SPECIMENS PREPARED FOR THE QUALIFICATION OF THE RESPECTIVE WELDS AND THOSE WHICH QUALIFIED THE PERFORMANCE OF THE WELDER.

THE CONTRACTOR SHALL PROVIDE ALL NECESSARY ASSISTANCE IN FACILITATING AND EXPEDITING INSPECTION. THE CONTRACTOR SHALL PROVIDE LADDERS, PLATFORMS, LIGHTING, POWER AND ASSISTANCE LABOR AS REQUESTED BY THE CONTRACTING OFFICER. SUCH ASSISTANCE AND ACCESSORY FACILITIES SHALL BE PROVIDED WITHOUT COST TO THE GOVERNMENT.

THE CONTRACTOR SHALL KEEP THE CONTRACTING OFFICER ADVISED AS TO THE WELDING SCHEDULE. THIS SHALL INCLUDE TIMETABLE LOCATIONS AND WELDING PERSONNEL FOR THE WELDING OF THE RESPECTIVE PIPING SYSTEMS.

SHOULD THE CONTRACTING OFFICER REGARD THE QUALITY OF A WELD OR WELDS AS QUESTIONABLE IN TERMS OF THE PROCEDURES AND WORKMANSHIP UNDER WHICH IT WAS QUALIFIED, HE MAY REQUIRE DESTRUCTIVE TESTING OF COUPONS OR SPECIMENS TAKEN FROM THE RESPECTIVE WELDS IN QUESTION. THE CONTRACTOR SHALL REMOVE SUCH COUPONS AS DIRECTED BY THE CONTRACTING OFFICER AND SUBMIT THEM TO A PRIVATE LABORATORY. FOR TESTING, THIS REMOVAL MAY BE MADE IN THE PRESENCE OF THE CONTRACTING OFFICER OR HIS DESIGNATED REPRESENTATIVE.

IF THE TEST RESULTS VERIFY COMPLIANCE OF THE WELDS WITH THE PROCEDURE AND PERFORMANCE QUALIFICATION ON WHICH THEY WERE BASED THE GOVERNMENT WILL REIMBURSE THE CONTRACTOR FOR THE EXPENSE OF COUPON REMOVAL AND THE PROPER REPAIR OF THE WELD FROM WHICH THE COUPON WAS REMOVED.

IF THE TEST RESULTS SHOW THAT THE WELDS IN QUESTION DO NOT MEET THE RESPECTIVE PROCEDURE AND PERFORMANCE QUALIFICATION UPON WHICH THEY WERE BASED, THE CONTRACTOR SHALL REPAIR OR REPLACE THE WELD AS DIRECTED BY THE CONTRACTING OFFICER AT NO COST TO THE GOVERNMENT.

---INSPECTION

IN-PROCESS INSPECTION SHALL BE PERFORMED. THE INSPECTOR SHALL DETERMINE THAT ACCURATE FIT-UP OF THE JOINT IS ATTAINED TO ASSURE COMPLETE AND SOUND PENETRATION OF THE ROOT PASS. THE INSPECTOR SHALL ALSO INSPECT EACH ROOT PASS TO ASSURE COMPLETE PENETRATION AND SOUNDNESS. *WELDS SHALL BE 100% VISUALLY INSPECTED.* (B)

---*CERTIFICATION OF WELDING INSPECTORS* (A)

WELDING INSPECTORS SHALL BE CERTIFIED TO MEET THE REQUIREMENTS OF MIL-STD-410D. THE EMPLOYER (CONTRACTOR OR SUBCONTRACTOR) MAY HAVE AN IN-HOUSE LEVEL III CERTIFIED INSPECTOR (AS A DESIGNATED REPRESENTATIVE OF THE EMPLOYER) TO CERTIFY OTHER INSPECTORS AT LEVELS I AND II. AS AN OPTION, HE MAY USE THE SERVICES OF A PRIVATE LABORATORY, APPROVED BY THE CONTRACTING OFFICER, TO PROVIDE A CERTIFIED LEVEL III INSPECTOR TO PROVIDE QUALIFICATION TRAINING AND EXAMINATION SERVICES OF THE EMPLOYER'S (CONTRACTOR/SUBCONTRACTOR) PERSONNEL AT LEVEL II. IN SUCH INSTANCES, THE RESPONSIBILITY OF CERTIFICATION MUST BE RETAINED BY THE EMPLOYER.

IF A PRIVATE LABORATORY IS USED TO PROVIDE QUALIFICATION TRAINING AND EXAMINATION OF THE EMPLOYER'S INSPECTORS, THE EMPLOYER IS REQUIRED TO HAVE AT LEAST LEVEL II NONDESTRUCTIVE TESTING (NDT) INSPECTORS OF THE APPLICABLE TESTING METHOD ON HIS STAFF FOR PERFORMANCE OF THE REQUIRED INSPECTIONS. THESE INSPECTORS ARE TO BE CERTIFIED TO PERFORM INSPECTIONS OF THE TYPE REQUIRED BY THE SPECIFICATIONS, I.E., RADIOGRAPH, ULTRASONIC, MAGNETIC PARTICLE AND LIQUID PENETRANT METHOD OR METHODS AS REQUIRED.

THE CONTRACTOR/SUBCONTRACTOR MAY CERTIFY A LEVEL II INSPECTOR IN MAGNETIC PARTICLE OR LIQUID PENETRANT AND WAIVE THE REQUIRED TRAINEE OR LEVEL I DOCUMENTED WORK EXPERIENCE TIME IF THE EMPLOYER SPECIFICALLY ASCERTAINS THE EMPLOYEE IS QUALIFIED TO PROPERLY PERFORM THE REQUIRED INSPECTION AND SO STATES IN HIS CERTIFICATION TO THE CONTRACTING OFFICER. ONCE AN INSPECTOR IS CERTIFIED, NO FURTHER TRAINING IS REQUIRED FOR THE LIFE OF THE CONTRACT.

THE CONTRACTOR ALSO HAS THE OPTION OF USING THE SERVICES OF A PRIVATE LABORATORY, APPROVED BY THE CONTRACTING OFFICER, TO PROVIDE THE REQUIRED NDT INSPECTIONS.

~~SHOULD THE CONTRACTING OFFICER REGARD THE QUALITY OF A WELD OR WELDS AS QUESTIONABLE IN TERMS OF THE~~ PROCEDURES AND WORKMANSHIP UNDER WHICH IT WAS QUALIFIED, HE MAY REQUIRE DESTRUCTIVE TESTING OF COUPONS OR SPECIMENS TAKEN FROM THE RESPECTIVE WELDS IN QUESTION. THE CONTRACTOR SHALL REMOVE SUCH COUPONS AS DIRECTED BY THE CONTRACTING OFFICER AND SUBMIT THEM TO THE C.O. FOR TESTING; THIS REMOVAL MAY BE MADE IN THE PRESENCE OF THE CONTRACTING OFFICER OR HIS DESIGNATED REPRESENTATIVE.

THE CONTRACTOR SHALL HAVE THE RIGHT TO BE REPRESENTED BY AN OBSERVER WHEN THE COUPONS OR SPECIMENS ARE TESTED.

THE CONTRACTING OFFICER WILL SUBMIT TO THE CONTRACTOR A REPORT OF THE RESULTS OF THE TESTING.

IF THE TEST RESULTS VERIFY COMPLIANCE OF THE WELDS WITH THE PROCEDURE AND PERFORMANCE QUALIFICATION ON WHICH THEY WERE BASED THE GOVERNMENT WILL REIMBURSE THE CONTRACTOR FOR THE EXPENSE OF COUPON REMOVAL AND THE PROPER REPAIR OF THE WELD FORM WHICH THE COUPON WAS REMOVED.

IF THE TEST RESULTS SHOW THAT THE WELDS IN QUESTION DO NOT MEET THE RESPECTIVE PROCEDURE AND PERFORMANCE QUALIFICATION UPON WHICH THEY WERE BASED, THE CONTRACTOR SHALL REPAIR OR REPLACE THE WELD AS DIRECTED ~~BY THE CONTRACTING OFFICER AT NO COST TO THE GOVERNMENT.~~

(B)

(NOTE: THIS ENTIRE SHEET IS DELTED BY (B))

SECTION 17J

BRAZING AND SOLDERING

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS

RECOGNIZED CODES AND STANDARDS ARE INCORPORATED INTO THE SPECIFICATIONS BY REFERENCE. THE REFERENCED PORTIONS OF THESE CODES AND STANDARDS, AS SPECIFICALLY MODIFIED HEREIN, SHALL CONSTITUTE A PART OF THE SPECIFICATIONS.

WHEREVER THE WORDS "THE SPECIFICATIONS", ARE USED IN THIS SECTION, THEY SHALL BE UNDERSTOOD TO MEAN THIS SECTION OF THE CONTRACT SPECIFICATIONS TOGETHER WITH ALL OTHER SECTIONS OF THE CONTRACT SPECIFICATIONS ISSUED THEREWITH, INCLUDING ALL CODES AND STANDARDS INCORPORATED THEREINTO BY REFERENCE. THE WORDS "THESE SPECIFICATIONS" SHALL BE UNDERSTOOD TO MEAN THIS SECTION OF THE SPECIFICATIONS. THE WORD "SPECIFICATIONS" USED WITHOUT MODIFIER OR WITH MODIFIERS OTHER THAN "THE", "THESE" OR "CONTRACT" IS NOT TO BE REGARDED AS REFERRING TO THE CONTRACT SPECIFICATIONS.

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASME CODE	"ASME BOILER AND PRESSURE VESSEL CODE" - 1974 EDITION AND 1974 AND 1975 ADDENDA. PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

---QUALIFICATION OF CODE LANGUAGE

WHEREVER, IN THE CODES OR STANDARDS INCORPORATED BY DIRECT REFERENCE INTO THESE SPECIFICATIONS, A REQUIREMENT FOR APPROVAL IS SPECIFIED, IT SHALL BE UNDERSTOOD TO MEAN "APPROVAL BY THE CONTRACTING OFFICER". THIS APPLIES TO ALL APPROVALS. SIMILARLY, THE WORD "APPROVED" SHALL BE UNDERSTOOD TO MEAN "APPROVED BY THE CONTRACTING OFFICER."

WHEREVER, IN THE REFERENCED CODES OR STANDARDS, WORDS SUCH AS "IT IS PREFERRED", "IT IS RECOMMENDED", "SHOULD" AND THE LIKE, INDICATE RECOMMENDED OR PREFERRED PRACTICE OR PROCEDURE, IS TO BE REGARDED AS MANDATORY.

---DEFINITIONS

THE WORD "BRAZING" AS HEREIN USED, REFERS TO ANY PROCESS WHICH PRODUCES COALESCENCE BY HEATING THE BASE METALS TO SUITABLE TEMPERATURES ABOVE 800 DEGREES FAHRENHEIT, AND BY USING A NONFERROUS FILLER METAL WHOSE MELTING POINT IS BELOW THAT OF THE BASE METAL AND DISTRIBUTING IT BETWEEN THE CLOSELY FITTED SURFACES OF THE JOINT BY CAPILLARY ACTION.

THE WORD "SOLDERING" INCLUDES ANY PROCESS WHICH PRODUCES COALESCENCE BY HEATING THE BASE METAL TO A TEMPERATURE ABOVE THE MELTING POINT OF THE TIN-LEAD ALLOY FILLER METAL BUT BELOW 800 DEGREES FAHRENHEIT, AND IN WHICH THE FILLER METAL IS DISTRIBUTED BETWEEN THE CLOSELY-FITTED SURFACES OF THE JOINT BY CAPILLARY ACTION.

---BRAZING---

---GENERAL

BRAZING IN THE FIELD MAY BE DONE BY EITHER INDUCTION OR FLAME HEATING. IN EITHER CASE, THE CONTRACTOR SHALL SUBMIT TO THE CONTRACTING OFFICER, FOR APPROVAL, A COMPLETE COMPILATION OF DESCRIPTIVE DATA RELATIVE TO THE SPECIFIC EQUIPMENT AND ACCESSORIES HE PROPOSES FOR USE IN FIELD BRAZING.

---JOINT DESIGN

UNLESS OTHERWISE REQUIRED BY THE SPECIFICATIONS OR SHOWN ON THE CONTRACT DRAWINGS OR APPROVED SHOP DRAWINGS, ALL JOINTS SHALL BE LAP, SOCKET, SLEEVE OR BUTT-LAP; BUTT JOINTS NOT TO BE USED UNLESS THEY ARE UPSET OR OTHERWISE MODIFIED TO PRODUCE A JOINT DEPTH OR AT LEAST THREE TIMES THE THICKNESS OF THE PIECES TO BE JOINED.

FAYING SURFACES SHALL BE PREPARED IN SUCH A WAY AS TO LIMIT THE DISTANCE BETWEEN THEM AT ANY POINT OR POINTS TO A MINIMUM OF 0.001 INCH AND A MAXIMUM OF 0.004 INCH. PIPING SOCKET CONNECTIONS SHALL BE SO MATED AS TO PROVIDE LIGHT FRICTION FIT BEFORE HEATING EXCEPT WHERE DIFFERENT COEFFICIENTS OF LINEAR EXPANSION OF THE BASE METALS REQUIRE OTHERWISE.

---FILLER METALS

FILLER METALS SHALL BE SELECTED FROM THE "BAG" GROUP AS DEFINED BY QB-432 UNLESS OTHERWISE REQUIRED BY THE SPECIFICATIONS OR THE CONTRACT DRAWINGS, OR REQUIRED BY THE SPECIFIC REQUIREMENTS OF THE APPLICATIONS OR BY THE NATURE OF THE BASE METALS INVOLVED, THE FILLER METAL SHALL HAVE A SOLIDUS TEMPERATURE NOT IN EXCESS OF 1300 DEGREES FAHRENHEIT AND A LIQUIDUS TEMPERATURE NOT IN EXCESS OF 1550 DEGREES FAHRENHEIT; THE TEMPERATURE DIFFERENCE BETWEEN SOLIDUS AND LIQUIDUS SHALL NOT EXCEED 180 FAHRENHEIT DEGREES. COMPOSITION SHALL INCLUDE, PRIMARILY, SILVER, COPPER AND ZINC WITH PERMISSIBLE ADDITIONS OF NICKEL OR TIN IN AMOUNTS NOT IN EXCESS OF 3 PERCENT AND 5 PERCENT, RESPECTIVELY. CADMIUM-CONTAINING ALLOYS SHALL NOT BE USED UNLESS THE CONTRACTING OFFICER HAS APPROVED ITS USE AND THE MEASURES TO BE TAKEN TO PROTECT PERSONNEL FROM THE TOXIC FUMES THEY PRODUCE IN THE BRAZING PROCESS.

FILLER METALS MAY BE SILVER-CONTAINING ALLOYS IN THE "B CUP 4" OR "B CUP 5" GROUPS AS DEFINED BY QB-432.

---FLUXES

THE FLUX TO BE USED FOR EACH COMBINATION OF BASE METALS AND FILLER METALS SHALL BE EXACTLY IDENTIFIED BY COMPOSITION IN THE RESPECTIVE BRAZING PROCEDURE SPECIFICATIONS. THESE FLUXES SHALL BE SELECTED WITH DUE CONSIDERATION FOR THE PROTECTION OF THE METALS AND THE SAFETY OF PERSONNEL. FLUXES WHICH ARE CORROSIVE TO THE METALS SHALL NOT BE USED UNLESS ACCEPTABLE PROCEDURES FOR THE PROTECTION OF THESE METALS ARE DETAILED IN THE APPROVED BRAZING PROCEDURE SPECIFICATIONS. FLUXES BASED UPON FLUORIDES OR FLUROBORATES SHALL NOT BE USED USED UNLESS PRECAUTIONARY MEASURES FOR THE PROTECTION OF PERSONNEL ARE DETAILED IN THE APPROVED BRAZING PROCEDURE SPECIFICATIONS.

THE EXACT PROCEDURES FOR THE USE OF FLUXES SHALL BE DETAILED IN THE BRAZING PROCEDURE SPECIFICATIONS.

---BRAZING PROCEDURE SPECIFICATIONS

THE CONTRACTOR, SHALL PREPARE, AND SUBMIT TO THE CONTRACTING OFFICER FOR APPROVAL, COMPLETE BRAZING PROCEDURE SPECIFICATIONS FOR EACH TYPE OF BRAZED JOINT, FOR EACH COMBINATION OF MATERIALS USED. THESES SPECIFICATIONS SHALL BE ASSIGNED CODE NUMBERS TO FACILITATE IDENTIFICATION AND COORDINATION WITH DRAWING LOCATIONS, PROCEDURE QUALIFICATION TESTS AND REPORTS, PERFORMANCE QUALIFICATION REPORTS, REPORTS OF FIELD BRAZING, AND REPORTS OF BRAZING DEFECTS AND THEIR CORRECTION.

THE BRAZING PROCEDURE SPECIFICATIONS SHALL INCLUDE THE FOLLOWING.

TYPE OF JOINT: LAP, BUTT, SCARF, RABBET, SPECIAL.

POSITION OF JOINT: FLAT-FLOW, VERTICAL-DOWN-FLOW, VERTICAL-UP-FLOW, HORIZONTAL-FLOW, SPECIAL.

SKETCH OF JOINT, SHOWING MAXIMUM TOLERANCES, DIMENSIONAL RANGES, THICKNESS/AREA RATIOS, ETC.

BASE METAL OR METALS - INCLUDING P-NUMBER.

FILLER METAL IDENTIFICATION: MANUFACTURE, ASTM OR AWS SPECIFICATION AND CLASSIFICATION TO WHICH IT CONFORMS, COMPOSITION, ASME CODE F-NUMBER.

FLUX - MANUFACTURE, MANUFACTURER'S IDENTIFYING NUMBER, AWS NUMBER.

METHOD OF HEATING: DESCRIBE THE EQUIPMENT IN DETAIL.

RATE OF HEATING.

TEMPERATURE TO WHICH BASE METAL WILL BE HEATED; HOW IT WILL TEMPERATURE BE MONITORED.

HOW WILL FILLER METAL ENTER THE JOINT IF PREPLACED, IN WHAT FORM, AND HOW MEASURED TO MATCH JOINT VOLUME.

WILL FLUXING BE A SEPARATE OPERATION. HOW WILL FLUX BE APPLIED.

CLEANING OF TO-BE-JOINED-SURFACES. DESCRIBE CLEANING PROCEDURE.

REMOVAL OF FLUX AND BRAZING BY-PRODUCTS AFTER WELDING.

FOR PIPING ASSEMBLY, WHAT ANNULAR TOLERANCES WILL BE OBSERVED.

---BRAZING PROCEDURE QUALIFICATION

THE CONTRACTOR, EMPLOYING EXPERIENCED PERSONNEL, SHALL PRODUCE BRAZE SPECIMENS FOR EACH OF THE JOINTS DESCRIBED BY THE APPROVED BRAZING PROCEDURE SPECIFICATIONS. THESE SPECIMENS SHALL BE OF SIZE TO PROVIDE FOR THE HEREINAFTER-REQUIRED TEST SPECIMENS. THE CONTRACTOR SHALL SUBMIT TO THE CONTRACTING OFFICER IN ADVANCE A SCHEDULE SHOWING THE TIME AND PLACE OF PREPARATION OF BRAZE SPECIMENS. BRAZE SPECIMENS SHALL BE PRODUCED IN THE PRESENCE OF THE GOVERNMENT INSPECTOR.

THE INSPECTOR WILL INSPECT EACH BRAZE SPECIMEN TO DETERMINE THE DEGREE OF PENETRATION OF FILLER METAL, THE POSSIBLE PRESENCE OF CRACKS IN EITHER THE BASE METALS OR FILLER METAL, THE PRESENCE OF PINHOLES, EVIDENCE OF UNDERHEATING OR OVERHEATING, CORROSIVE ATTACK OF THE METALS BY THE FLUX, OR OTHER IMPERFECTIONS.

THE CONTRACTOR SHALL PREPARE TEST SPECIMENS FROM THREE PROCEDURE QUALIFICATION BRAZE SPECIMENS.

IF A PIPE JOINT, SPECIMEN WHOSE ID IS 2 INCHES OR LESS, IS AMONG THOSE SELECTED IT SHALL BE TENSION TESTED IN CONFORMITY WITH FIGURE QB-463.4 OF SECTION IX OF THE ASME CODE; FAILURE IN THE BASE METAL SHALL BE THE TENSILE REQUIREMENT FOR QUALIFICATION; AFTER SATISFACTORY COMPLETION OF THE TENSILE TEST, THE PIPE JOINT SHALL BE QUARTERED BY SAWCUTS PARALLEL TO THE PIPE AXIS AND SUBMITTED TO THE CONTRACTING OFFICER FOR EXAMINATION FOR PENETRATION AND FULL DISTRIBUTION OF FILLER METAL.

FROM ALL OTHER SPECIMENS SELECTED BY THE CONTRACTING OFFICER FOR QUALIFICATION TESTING, TEST SPECIMENS SHALL BE PREPARED IN CONFORMITY WITH TABLE QB-453.1, AND PARAGRAPH QB-150, QB-160 AND QB-170 OF SECTION IX OF THE ASME CODE. TESTING AND EVALUATION OF TEST RESULTS SHALL CONFORM TO PARAGRAPHS QB-153, QB-164 AND QB-172 OF THE ASME CODE.

THE CONTRACTOR SHALL PREPARE TEST SPECIMENS FROM ALL BRAZING SPECIMENS WHICH WERE PREPARED AS A REQUIREMENT FOR PROCEDURE QUALIFICATION. THE TYPE AND NUMBER OF TEST SPECIMENS SHALL CONFORM TO PARAGRAPH QB-202 OF SECTION IX OF THE ASME CODE. PREPARATION OF THE TEST SPECIMENS SHALL CONFORM TO THE REQUIREMENTS OF PARAGRAPH QB-210 OF THE ASME CODE.

THE CONTRACTOR WILL CONDUCT TESTS UPON THE TEST SPECIMENS PREPARED AS SPECIFIED IN THE FOREGOING PARAGRAPH, IN CONFORMITY WITH THE REQUIREMENTS OF PARAGRAPH QB-210 OF SECTION IX OF THE ASME CODE. STANDARDS FOR THE EVALUATION OF TEST RESULTS SHALL CONFORM TO PARAGRAPHS QB-153, QB-164 AND QB-172 OF THE ASME CODE.

NO BRAZING WHICH IS CONTINGENT UPON THE ACCEPTABILITY OF THE PROCEDURE QUALIFICATION RESULTS SHALL BE BEGUN UNTIL THE BRAZE SPECIMENS HAVE BEEN APPROVED BY THE CONTRACTING OFFICER ON THE BASIS OF THE TESTS.

---REQUALIFICATION

REQUALIFICATION OF BRAZING PROCEDURES IS REQUIRED IF THERE IS A CHANGE OF ANY OF THE ESSENTIAL VARIABLES AS LISTED IN PARAGRAPH QB-250 OF SECTION IX OF THE ASME CODE. REQUALIFICATION SHALL BE CONDITIONED UPON PREPARATION AND SUBMITTAL OF A REVISED BRAZING PROCEDURE SPECIFICATION, AND THE PREPARATION AND TESTING OF THE SAME BRAZE AND TEST SPECIMENS WHICH ARE REQUIRED FOR THE INITIAL QUALIFICATION OF A BRAZING PROCEDURE.

---PERFORMANCE QUALIFICATION

THE BRAZER WHO SATISFACTORILY PREPARES SPECIMENS FOR PROCEDURE QUALIFICATION SHALL BE DEEMED TO HAVE SATISFIED THE PERFORMANCE QUALIFICATION REQUIREMENTS FOR THE PROCEDURE-QUALIFIED JOINTS HE PRODUCED. PERFORMANCE QUALIFICATION SHALL BE LIMITED TO BRAZING OF THE TYPES, IN THE METALS COMBINATIONS, IN THE THICKNESS RANGES AND IN THE POSITIONS OF THOSE PRODUCED BY THE BRAZER FOR PROCEDURE QUALIFICATION.

FOR ALL OTHER TYPES OF BRAZED CONNECTIONS, METAL COMBINATION, THICKNESS RANGES AND BRAZING POSITIONS, THE BRAZER SHALL SATISFY THE PERFORMANCE QUALIFICATION REQUIREMENTS OF ARTICLE XIII OF SECTION IX OF THE ASME CODE. THE CONTRACTOR SHALL PREPARE THE PERFORMANCE QUALIFICATION SPECIFICATIONS, PRODUCE THE QUALIFYING BRAZE SPECIMENS AND PREPARE THE PRESCRIBED TEST SPECIMENS FROM THE BRAZE SPECIMENS.

THE GOVERNMENT INSPECTOR WILL INSPECT THE BRAZE SPECIMENS BEFORE PREPARATION OF THE TEST SPECIMENS. THE CONTRACTOR WILL CONDUCT THE NECESSARY TESTING.

NO BRAZING SHALL BE DONE UNTIL THE BRAZER HAS BEEN DULY APPROVED AS QUALIFIED FOR THE SPECIFIC BRAZING OPERATIONS INVOLVED.

BRAZERS WHO FAIL TO MEET THE REQUIREMENTS OF ONE OR MORE OF THE PERFORMANCE QUALIFICATION TESTS MAY BE RETESTED IN CONFORMITY WITH PARAGRAPH QB-328 OF THE ASME CODE.

CONDITIONS UNDER WHICH REQUALIFICATION IS MANDATORY, AND THE REQUIREMENTS FOR REQUALIFICATION SHALL CONFORM TO PARAGRAPH QB-329 OF SECTION IX OF THE ASME CODE.

---TECHNIQUE AND WORKMANSHIP

GENERAL - - IN THE EVENT THAT A BRAZER DEVIATES FROM THE CONTROLLING APPROVED PROCEDURE SPECIFICATION, FROM THESE SPECIFICATIONS, OR FROM WORKMANSHIP LEVELS WHICH INSURE COMPLETE JOINT SECURITY, IT WILL BE CALLED TO THE ATTENTION OF THE BRAZER AND THE CONTRACTOR'S SUPERINTENDENT. SHOULD THE DEVIATIONAL PRACTICE CONTINUE OR BE REPEATED, THE INSPECTOR SHALL NOTIFY THE CONTRACTOR'S SUPERINTENDENT. THE CONTRACTOR'S SUPERINTENDENT SHALL IMMEDIATELY SUSPEND BRAZING BY THE BRAZER INVOLVED UNTIL THE CONTRACTING OFFICER HAS EVALUATED THE DEVIATION AND HAS CONSENTED TO THE CONTINUED USE OF THE BRAZER.

THE CONTRACTOR SHALL SUBMIT TO THE CONTRACTING OFFICER DAILY REPORTS BY THE INSPECTORS OF THE EXTENT OF BRAZING PERFORMED.

SURFACE PREPARATION - - THE SURFACES TO BE BRAZED SHALL BE CLEAN AND FREE FROM GREASE, SCALE, HEAVY OXIDES, PAINT, COATINGS AND DIRT OF ANY KIND. IF SOLVENTS ARE USED, THEY MUST BE FREELY USED, TO PREVENT THIN FILM RESIDUES WHICH CAN INTERFERE WITH GOOD FILLER METAL FLOW. SPECIAL ATTENTION SHALL BE GIVEN TO PROTECT PERSONNEL FROM TOXIC EFFECTS OF CONTACT WITH THE SOLVENTS, AND TO PREVENT THE CREATION OF FIRE HAZARDS THROUGH THE USE OF FLAMMABLE SOLVENTS IN THE PRESENCE OF BRAZING FLAMES. DIPPING INTO SOLVENT IS TO BE PREFERRED TO WIPING, PROVIDED THAT THE SOLVENT IS FREQUENTLY CHANGED, AND THAT IT IS SUFFICIENTLY VOLATILE TO QUICKLY EVAPORATE FROM THE SURFACE UPON REMOVAL.

CLEANERS WHICH HAVE A CORROSIVE EFFECT UPON THE METALS INVOLVED SHALL BE EFFECTIVELY REMOVED BEFORE THE BRAZING OPERATION IS COMMENCED.

FLUXING SHALL BE DONE IN SUCH A WAY AS TO INSURE COMPLETE COVERING OF ALL SURFACES WITH WHICH THE FILLER METAL WILL COME INTO CONTACT. THE VISCOSITY OF THE FLUX SHALL BE SUCH AS TO KEEP IT IN PLACE UNTIL THE TEMPERATURE APPROACHES THAT AT WHICH THE FILLER METAL STARTS TO MELT; IT SHALL THEN ACQUIRE A VISCOSITY WHICH PRODUCES AND MAINTAINS A THIN FLUID FILM, EASILY DISPLACEABLE BY THE MOLTEN FILLER METAL.

INERT GAS BACKING - - SHALL BE PROVIDED AS REQUIRED BY THE SPECIFICATIONS OR THE CONTRACT DRAWINGS. WHERE THIS IS REQUIRED, A PORTION OF THE PIPING SYSTEM INCLUDING THE JOINT TO BE BRAZED, SHALL BE ISOLATED, AND PURGED WITH DRY NITROGEN IN AN AMOUNT EQUAL TO AT LEAST SIX TIMES THE VOLUME OF THE ISOLATED PIPING INTERIOR. DURING BRAZING, A STEADY FLOW OF NITROGEN SHALL BE FED INTO THE PIPING PIPING TO COMPENSATE FOR ANY DIFFUSION OF AIR INTO THE PIPING THROUGH THE VENT; THE PIPING SHALL BE EFFECTIVELY VENTED TO MAINTAIN PRESSURE EQUILIBRIUM WITH THE OUTSIDE OF THE PIPE. THE FLOW OF NITROGEN DURING BRAZING SHALL BE NOT LESS THAN ONE THIRD THE PIPING VOLUME PER MINUTE.

TEMPERATURE INDICATORS - - THE WELDER SHALL USE TEMPERATURE-INDICATING CRAYONS ON EACH JOINT. ONE SET OF MARKS SHALL BE MADE WITH A CRAYON DESIGNED FOR THE LOWER LIMIT OF THE FILLER METAL BRAZING TEMPERATURE RANGE; ANOTHER SET OF MARKS SHALL BE MADE WITH A CRAYON DESIGNED FOR THE UPPER TEMPERATURE OF THE FILLER METAL BRAZING TEMPERATURE RANGE; IN BOTH INSTANCES, THE CRAYONS SHALL BE THOSE COMMERCIALLY AVAILABLE CRAYONS WHOSE INDICATING TEMPERATURES ARE CLOSEST TO THESE TEMPERATURES. FULL INFORMATION ON THESE CRAYONS, INCLUDING MANUFACTURE, MANUFACTURER'S NUMBER AND

INDICATING TEMPERATURE SHALL BE SUBMITTED AS PART OF THE BRAZING PROCEDURE SPECIFICATIONS. BRAZERS SHALL NOT USE, CARRY OR HAVE AVAILABLE TO THEM ANY CRAYONS THAN THOSE WITHIN THE RANGE HEREIN SPECIFIED.

HEATING - - SHALL BE UNIFORM OVER THE JOINT. RING BURNERS SHALL BE USED ON CIRCUMFERENTIAL PIPE JOINTS WHICH ARE FLAME-BRAZED; RING INDUCTION UNITS SHALL BE USED ON SUCH JOINTS WHICH ARE INDUCTION BRAZED. HEATING EQUIPMENT SHALL BE SUCH, IN ALL CASES, AS TO SIMULTANEOUSLY AND UNIFORMLY HEAT ALL OF THE TO-BE-BRAZED AREA. HEATING LIMITS SHALL BE METICULOUSLY OBSERVED. HEAT SOURCE SHALL BE SUCH AS TO QUICKLY BRING THE BASE METAL TEMPERATURES UP TO THE BRAZING RANGE. IN NO INSTANCE SHALL THE BRAZING TEMPERATURE RANGE OF THE FILLER METAL, AS SHOWN ON TABLE QB - 432 OF SECTION IX OF THE ASME CODE BE EXCEEDED. THE BRAZER MAY USE ADDITIONAL TEMPERATURE-INDICATING CRAYONS, WITH INDICATING TEMPERATURES BELOW THE UPPER END OF THE FILLER METAL BRAZING TEMPERATURE RANGE, TO WARN OF THE APPROACH OF THE MAXIMUM ALLOWABLE TEMPERATURE.

CARE SHALL BE EXERCISED TO PREVENT DAMAGE TO ADJACENT OR CONTIGUOUS MATERIALS WHICH ARE NOT CAPABLE OF WITHSTANDING THE BRAZING TEMPERATURES.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACEMENT OF ANY MATERIALS WHICH HAVE BEEN DAMAGED BY OVERHEATING. THIS INCLUDES BASE METAL COMPONENTS WHICH WERE OVERHEATED IN BRAZING, AS WELL AS OTHER MATERIALS NOT INVOLVED IN THE BRAZING, WHICH WERE DAMAGED AS A RESULT OF INADEQUATE PROTECTION.

APPLICATION OF FILLER METAL - - SHALL BE BEGUN AFTER THE BASE METAL TEMPERATURE HAS PASSED THE LOWER TEMPERATURE OF THE FILLER-METAL BRAZING RANGE. APPLICATION SHALL BE TO THE BASE METAL; IN NO CASE SHALL THE FILLER METAL BE FLAME-MELTED. THE TEMPERATURE SHALL REMAIN IN THE BRAZING RANGE UNTIL CAPILLARY ACTION HAS CARRIED THE MOLTEN FILLER METALS TO THE ENTIRETY OF THE JOINT.

THE USE OF PREPLACED FILLER METALS IS PERMISSIBLE, PROVIDED THAT THE PLACEMENT OF THE METAL IN A JOINT INSPECTABLE FROM ONLY ONE END IS SUBSTANTIALLY CLOSER TO THE INACCESSIBLE END THAN TO THE ACCESSIBLE END, AND THAT THE FLOW OF FILLER METAL TO THE ACCESSIBLE END IS COMPLETE ACROSS THE END OF THE JOINT; AND THAT FULL PARTICULARS OF PLACEMENT ARE INCLUDED IN THE APPROVED BRAZING PROCEDURE SPECIFICATIONS. IN ALL OTHER RESPECTS THE USE OF PREPLACED FILLER METALS SHALL CONFORM TO PARAGRAPH (C) OF ARTICLE UB-15 OF PART UB OF DIVISION I OF SECTION VIII OF THE ASME CODE.

CLEANING - - POST-BRAZE CLEANING OF BRAZE-AFFECTED AREAS SHALL EFFECTIVELY REMOVE ALL FLUX AND FLUX PRODUCTS. EXCEPT FOR RAG-REMOVAL OF SOFT MATERIALS, THIS SHALL BE DONE ONLY AFTER THE JOINT HAS BEEN ACCEPTED BY THE CONTRACTING OFFICER.

---ACCEPTANCE STANDARDS

THE STANDARDS FOR ACCEPTANCE SHALL BE AS FOLLOWS:

COMPLETE CAPILLARY FLOW OF FILLER METAL

ASSEMBLY CONFORMING TO DRAWING DETAILS AND TOLERANCES

ABSENCE OF EVIDENCE OF INCOMPLETE MELTING OF FILLER METAL, OR THE ATTAINMENT OF TEMPERATURE WITHIN THE BRAZING TEMPERATURE RANGE OF THE FILLER METAL. *FILLETS SHALL BE EVIDENT FOR 90% OF THE LINEAR INCHES OF THE VISIBLE EDGE OF ALL BRAZED JOINTS.* (B)
ABSENCE OF CRACKS IN EITHER THE FILLER METAL OR THE ADJACENT BASE METAL.

ABSENCE OF VISIBLE PINHOLES OR OTHER DEVIATIONS FROM FILLER METAL HOMOGENEITY.

CORRECTIVE AND REPAIR PROCEDURES SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL.

---SOLDERING---

---GENERAL

SOLDERING, AS USED IN THESE SPECIFICATIONS, SHALL BE UNDERSTOOD TO MEAN THE JOINING OF METALS BY MOLTEN FILLER METAL WHOSE MELTING POINT IS BELOW 800 DEGREES FAHRENHEIT.

---JOINT CLEARANCES

SURFACES TO BE JOINTED BY SOLDERING SHALL BE PREPARED AND ALIGNED SO THAT THE DISTANCE BETWEEN THE SURFACE SHALL BE NOT LESS THAN 0.001 INCH OR GREATER THAN 0.005 INCH. THE CLEARANCES SHALL BE SUCH THAT THE MOLTEN FILLER METAL WILL FLOW INTO THE JOINT AREA BY CAPILLARY ACTION.

---SURFACE PREPARATION

THE SURFACES TO BE JOINED SHALL BE CLEANED OF ALL OIL, GREASE, PAINT, PRIMERS AND ORGANIC SOIL, AND MECHANICALLY CLEANED TO BRIGHT METAL BY FINE-WIRE BRUSHING OR EMERY CLOTH.

---FLUXING

FOR ALL TIN-LEAD SOLDERING ALLOYS, AND IN ALL APPLICATIONS EXCEPT ELECTRICAL CONNECTIONS, ONE OF THE "CORROSIVE" FLUXES SUCH AS ZINC CHLORIDE, AMMONIUM CHLORIDE MAY BE EMPLOYED. ROSIN FLUX SHALL BE USED FOR ELECTRICAL OR NONELECTRICAL WORK.

FLUX SHALL BE SEPARATELY APPLIED IN THE FORM OF A PASTE OR VISCOUS LIQUID BEFORE APPLICATION OF THE SOLDER. APPLICATION BEFORE HEATING PREVENTS OXIDE FORMATION DURING HEATING, SIMPLIFYING THE OPERATION.

FLUX MAY BE APPLIED SEPARATELY, OR IN A CORED SOLDER OF APPROVED COMPOSITION. IF A CORED SOLDER IS USED, THE CONTRACTOR SHALL BE RESPONSIBLE FOR APPLICATION IN SUCH A WAY THAT ALL TO-BE-JOINED SURFACES ARE GENEROUSLY FLUXED.

FLUX SHALL BE REMOVED AS SOON AS JOINT TEMPERATURE PERMITS. THE CORROSIVE FLUXES SUCH AS ACIDS AND CHLORIDES SHALL BE THOROUGHLY CLEANED FROM THE METAL; CORROSIVE RESIDUES WHICH ATTACK THE METALS AFTER SOLDERING WILL BE CAUSE FOR NONACCEPTANCE OF WORK.

FLUXES FOR ALL BUT THE TIN=LEAD SOLDERS SHALL BE THOSE RECOMMENDED BY THE MANUFACTURER OF THE SPECIFIC SOLDERING ALLOYS.

---HEATING

SOLDER JOINING SHALL BE DONE BY HEATING THE SURFACES TO BE JOINED ABOVE THE MELTING POINT OF THE SOLDERING ALLOY; THE SOLDERING ALLOY SHALL BE HEATED BY CONTACT WITH THE BASE METALS. HEATING SHALL BE UNIFORM; MULTI-JET BURNERS SHALL BE USED FOR LARGE JOINTS. GASES MAY INCLUDE NATURAL GAS, PROPANE OR L.P. GAS; OXY-ACETYLENE FLAME MAY NOT BE EMPLOYED, UNLESS APPROVED IN ADVANCE BY THE CONTRACTING OFFICER.

TEMPERATURE-INDICATING CRAYONS SHALL BE USED TO SIGNAL THE APPROACH OF THE UPPER END OF THE SOLDERING TEMPERATURE RANGE FOR THE ALLOY BEING USED. ANOTHER CRAYON, WHOSE INDICATING TEMPERATURE IS WITHIN 100 FAHRENHEIT DEGREES ABOVE THE UPPER TEMPERATURE OF THE SOLDERING RANGE SHALL BE USED TO INDICATE OVER-HEATING OF THE BASE METALS. EVERY JOINT SHALL HAVE TWO SUCH CRAYON MARKS PLACED UPON IT BEFORE HEATING IS BEGUN. THESE MARKS SHALL NOT BE DISTURBED UNTIL INSPECTION HAS BEEN COMPLETED. EACH CRAYON SHALL BEAR THE MANUFACTURER'S LABEL SHOWING THE INDICATING TEMPERATURE; NO OTHER CRAYONS SHALL BE IN THE POSSESSION OF THOSE PERFORMING THE SOLDERING OPERATION.

---SOLDERING ALLOYS

ONLY THOSE ALLOYS WHICH ARE SPECIFIED BY CONTRACT DRAWINGS OR CONTRACT SPECIFICATIONS FOR THE RESPECTIVE JOINTS SHALL BE USED.

---TECHNIQUE AND WORKMANSHIP

ONLY THOROUGHLY EXPERIENCED SOLDERERS WHO UNDERSTAND THE PROCESSES THEY EMPLOY SHALL BE USED BY THE CONTRACTOR. THE CONTRACTOR SHALL SUBMIT THE QUALIFICATIONS OF PERSONNEL INVOLVED IN SOLDERING TO THE CONTRACTING OFFICER FOR APPROVAL. THE CONTRACTING OFFICER SHALL HAVE THE RIGHT TO REQUIRE SUCH DEMONSTRATIONS AS HE REGARDS AS NECESSARY TO ESTABLISH THE SPECIFIC QUALIFICATION OF ANY WORKMAN PERFORMING SOLDERING, AND TO QUERY HIM AS TO HIS UNDERSTANDING OF THE SOLDERING PROCESS, ESPECIALLY AS IT HAS TO DO WITH THE SPECIFIC MATERIALS BEING USED. PERSONNEL WHOSE WORKMANSHIP IS FOUND TO BE UNSATISFACTORY SHALL BE REMOVED FROM THE PROJECT AND REPLACED WITH QUALIFIED SOLDERERS AT NO ADDITIONAL COST TO THE GOVERNMENT.

---*CERTIFICATION OF INSPECTORS*

(A)

INSPECTORS SHALL BE CERTIFIED TO MEET THE REQUIREMENTS OF MIL-STD-410D. THE EMPLOYER (CONTRACTOR OR SUBCONTRACTOR) MAY HAVE AN IN-HOUSE LEVEL III CERTIFIED INSPECTOR (AS A DESIGNATED REPRESENTATIVE OF THE EMPLOYER) TO CERTIFY OTHER INSPECTORS AT LEVELS I AND II. AS AN OPTION, HE MAY USE THE SERVICES OF A PRIVATE LABORATORY, APPROVED BY THE CONTRACTING OFFICER, TO PROVIDE A CERTIFIED LEVEL III INSPECTOR TO PROVIDE QUALIFICATION TRAINING AND EXAMINATION SERVICES OF THE EMPLOYER'S (CONTRACTOR/SUBCONTRACTOR) PERSONNEL AT LEVEL II. IN SUCH INSTANCES, THE RESPONSIBILITY OF CERTIFICATION MUST BE RETAINED BY THE EMPLOYER.

IF A PRIVATE LABORATORY IS USED TO PROVIDE QUALIFICATION TRAINING AND EXAMINATION OF THE EMPLOYER'S INSPECTORS, THE EMPLOYER IS REQUIRED TO HAVE AT LEAST LEVEL II NONDESTRUCTIVE TESTING (NDT) INSPECTORS OF THE APPLICABLE TESTING METHOD ON HIS STAFF FOR PERFORMANCE OF THE REQUIRED INSPECTIONS. THESE INSPECTORS ARE TO BE CERTIFIED TO PERFORM INSPECTIONS OF THE TYPE REQUIRED BY THE SPDCIFICATIONS, I.E., RADIOGRAPH, ULTRASONIC, MAGNETIC PARTICLE AND LIQUID PENETRANT METHOD OR METHODS AS REQUIRED.

THE CONTRACTOR/SUBCONTRACTOR MAY CERTIFY A LEVEL II INSPECTOR IN MAGNETIC PARTICLE OR LIQUID PENETRANT AND WAIVE THE REQUIRED TRAINEE OR LEVEL I DOCUMENTED WORK EXPERIENCE TIME IF THE EMPLOYER SPECIFICALLY ASCERTAINS THE EMPLOYEE IS QUALIFIED TO PROPERLY PERFORM THE REQUIRED INSPECTION AND SO STATES IN HIS CERTIFICATION TO THE CONTRACTING OFFICER. ONCE AN INSPECTOR IS CERTIFIED, NO FURTHER TRAINING IS REQUIRED FOR THE LIFE OF THE CONTRACT.

THE CONTRACTOR ALSO HAS THE OPTION OF USING THE SERVICES OF A PRIVATE LABORATORY, APPROVED BY THE CONTRACTING OFFICER, TO PROVIDE THE REQUIRED NDT INSPECTIONS.

SECTION 17K

WELDING OF CARBON STEEL

---GENERAL REQUIREMENTS---

---GENERAL

THIS SPECIFICATION COVERS STRUCTURAL WELDING, INSPECTION OF WELDED JOINTS, AND QUALIFICATION OF WELDERS, WELDING MACHINE OPERATORS AND WELDING PROCEDURES FOR CARBON STEEL.

THE NECESSARY EQUIPMENT, MATERIALS, AND QUALIFIED PROCEDURES AND WELDERS SHALL BE PROVIDED TO MEET THE REQUIREMENTS OF THIS SPECIFICATION. EXCEPT AS MODIFIED HEREIN, ALL WELDING SHALL BE IN ACCORDANCE WITH THE AMERICAN WELDING SOCIETY D1.1, SECTIONS 1 THRU 7, 9 AND 10, AND KSC-SPEC-Z-0004.

ALL WELDS SHALL BE CLASSIFIED AS FOLLOWS:

CLASS "A"-----HIGHLY CRITICAL WELD WHOSE FAILURE WOULD BE CATASTROPHIC IN EFFECT, AND HIGHLY STRESSED AND CHARACTERIZED AS A SINGLE POINT OF FAILURE WITH NO REDUNDANCY FOR REDISTRIBUTION OF STRESS INTO ANOTHER MEMBER. CLASS "A" WELDS FOR THIS PROJECT ARE SHOWN ON THE DRAWINGS. CLASS "A" WELDS REQUIRE RADIOGRAPHIC INSPECTION, EXCEPT AS NOTED HEREINAFTER UNDER PARAGRAPH ENTITLED "SOUNDNESS". CLASS "A" WELDS SHALL BE NOTED ON SHOP DRAWINGS. FILLET WELDS SHALL NOT BE CLASSIFIED AS CLASS "A" WELDS.

CLASS "B"-----HIGH GRADE STRUCTURAL WELDS MADE IN ACCORDANCE WITH AWS D1.1. ALL WELDING UNDER THIS CONTRACT SHALL BE CLASS "B", EXCEPT WHERE SPECIFICALLY DESIGNATED AS CLASS "A" OR CLASS "C" WELDING. COMPLETE PENETRATION WELDS REQUIRE MAGNETIC PARTICLE INSPECTION FOR EACH ONE-HALF INCH INTERVAL OF THICKNESS. PARTIAL PENETRATION WELDS REQUIRE VISUAL INSPECTION WITH AWS TYPE GAGES FOR SIZE AND GOOD WORKMANSHIP.

CLASS "C"-----NONCRITICAL WELDS FOR CONNECTIONS OF SECONDARY MEMBERS, NOT SUBJECT TO DYNAMIC ACTION, AND LOW STRESSED MISCELLANEOUS STEEL APPLICATIONS. WELDS FOR MEMBERS AND CONNECTIONS CARRYING PERSONNEL SHALL ALWAYS BE OF HIGHER CLASSIFICATION THAN CLASS "C". THESE WELDS SHALL BE CLEARLY DESIGNATED ON SHOP DRAWINGS AND REQUIRE APPROVAL OF THE CONTRACTING OFFICER. CLASS "C" WELDS REQUIRE VISUAL INSPECTION WITH AWS GAGES FOR GOOD WORKMANSHIP AND APPEARANCE. CLASS "C" WELDS SHALL BE NOTED ON SHOP DRAWINGS.

---REFERENCED SPECIFICATIONS

THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO. IN THE EVENT OF DIFFERENCE BETWEEN THIS SPECIFICATION OR ITS ACCOMPANYING DRAWINGS AND THE REFERENCED SPECIFICATION, THIS SPECIFICATION AND ITS ACCOMPANYING DRAWINGS SHALL GOVERN TO THE EXTENT OF SUCH DIFFERENCE.

MILITARY SPECIFICATIONS:

MIL-STD-410D	NON-DESTRUCTIVE TESTING PERSONNEL QUALIFICATION AND CERTIFICATION
MIL-I-6866B(2)	INSPECTION, PENETRANT METHOD OF
MIL-I-6868E	INSPECTION PROCESS, MAGNETIC PARTICLE
MIL-STD-00453A	INSPECTION, RADIOGRAPHIC

KENNEDY SPACE CENTER:

KSC-SPEC-Z-0004	SPECIFICATION FOR STRUCTURAL, CARBON STEEL, STAINLESS STEEL, LOW ALLOY STEEL AND ALUMINUM ALLOYS WELDING

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

A36-75	SPECIFICATION FOR STRUCTURAL STEEL
A53-76	WELDED AND SEAMLESS STEEL PIPE

AMERICAN WELDING SOCIETY (AWS):

A2.4-76	STANDARD WELDING *AND NDT SYMBOLS*
A5.1-69	SPECIFICATION FOR MILD STEEL COVERED ARC WELDING ELECTRODES
A5.17-76	SPECIFICATION FOR BARE MILD STEEL ELECTRODES AND FLUXES FOR SUBMERGED ARC WELDING
D1.1-REV 2-77	STRUCTURAL WELDING CODE

(B)

---MATERIALS---

---GENERAL

ALL MATERIALS USED IN THE WELDING PROCESSES MUST BE STORED SO THAT NO DEGRADATION WILL RESULT DURING STORAGE. HANDLING AND STORAGE METHODS WILL BE STATED IN THE WELDING PROCEDURE.

ASTM A36, ASTM A53 AND OTHER CARBON STEELS HAVING A CARBON CONTENT (NOMINAL) NOT GREATER THAN 0.30 PERCENT AND HAVING AN UPPER LIMIT OF MINIMUM ULTIMATE TENSILE STRENGTH OF 70,000 PSI, SHALL BE CONSIDERED WELDABLE TO THIS SPECIFICATION.

WELDING RODS, WELDING WIRE, AND ELECTRODES USED IN WELDING OF CARBON STEEL SHALL BE CAPABLE OF PRODUCING SATISFACTORY WELDS WHEN USED BY A CERTIFIED WELDING OPERATOR WITH ADEQUATE WELDING APPARATUS AND SHALL HAVE A COMPOSITION SUITABLE FOR PRODUCING WELDS CONFORMING TO THE REQUIREMENTS SPECIFIED HEREIN. (REFER TO TABLE II, KSC-SPEC-Z-0004).

FLUXES SHALL BE OF SUCH COMPOSITION THAT THE CARBON CONTENT OF THE RESULTING WELD METAL WILL BE WITHIN THE LIMITS FOR THE APPLICABLE BASE METAL. FLUXES FOR SUBMERGED ARC WELDING SHALL BE COMPATIBLE WITH THE FILLER METAL AND THE BASE METAL AND SHALL BE OF SUCH A COMPOSITION THAT THE QUALITIES OF THE RESULTANT WELDMENT SHALL BE EQUIVALENT TO OR BETTER THAN THOSE OBTAINED BY THE SHIELDED METAL ARC WELDING PROCESS. THE WELDMENT SHALL MEET THE REQUIREMENTS OF THIS SPECIFICATION AND THE APPLICABLE DRAWING.

WHEN USING ANTI-SPATTER COMPOUNDS, THEY SHALL BE OF A CONSISTENCY AND UNIFORMITY THAT DEGRADATION OF THE WELDMENT WILL NOT RESULT. EASE OF APPLICATION AND REMOVAL IS A REQUIREMENT.

---ELECTRODES FOR MANUAL SHIELDED METAL ARC WELDING

ELECTRODES FOR MANUAL SHIELDED METAL ARC WELDING SHALL MEET THE REQUIREMENTS OF AWS D1.1, AND SHALL BE COVERED MILD STEEL ELECTRODES CONFORMING TO AWS A5.1 AND AS FOLLOWS:

ELECTRODES SHALL BE E70 SERIES, LOW HYDROGEN.

---ELECTRODES AND FLUX FOR SUBMERGED ARC WELDING

THE BARE ELECTRODES AND FLUX USED IN COMBINATION FOR SUBMERGED ARC WELDING SHALL MEET THE REQUIREMENTS OF AWS D1.1 AND SHALL BE BARE MILD STEEL ELECTRODES AND FLUXES FOR SUBMERGED ARC WELDING CONFORMING TO AWS A5.17 AND AS FOLLOWS:

ELECTRODES AND FLUX SHALL BE F70 SERIES

THE FLUX USED FOR SUBMERGED ARC WELDING SHALL BE DRY AND FREE OF CONTAMINATION FROM DIRT, MILL SCALE, OR OTHER FOREIGN MATERIAL. FLUX FUSED IN WELDING SHALL NOT BE REUSED.

---JOINT PREPARATION

INTERPRETATION OF THE WELD SYMBOLS SHALL BE MADE IN ACCORDANCE WITH THE CURRENT STANDARD AWS *A2.4*. MISMATCH AND MISALIGNMENT OF FIT-UP SHALL NOT EXCEED THE ALLOWABLE AS SHOWN IN TABLE V, KSC-SPEC-Z-0004. THE ROOT OPENING OF THE JOINT SHALL BE CHECKED BEFORE TACKING OR DEPOSITING THE FIRST LAYER TO ENSURE THAT IT IS CORRECT. REMOVAL OF RUST AND PROTECTIVE COATINGS IS MANDATORY. SURFACES TO BE WELDED SHALL BE FREE OF FOREIGN MATTER. ANY METHOD OF REMOVAL MAY BE USED WHICH DOES NOT CONTAMINATE THE SURFACES. EDGES TO BE WELDED SHALL BE ESSENTIALLY FREE OF DEFECTS AND FINISHED TO A SURFACE ROUGHNESS AS NOTED IN AWS D1.1. △B

THERMAL OR MECHANICAL CUTTING MAY BE USED TO CUT MATERIALS. ANTI-SPATTER COMPOUND, WHEN USED, SHALL BE APPLIED TO ALL SURFACES ADJACENT TO THE JOINTS WHERE IT IS NECESSARY TO CONTROL SPATTER FROM WELDING.

---QUALIFICATION OF WELDING PROCEDURES AND WELDERS

PRIOR TO ANY PRODUCTION WELDING, THE CONTRACTOR SHALL DEMONSTRATE THE SATISFACTORY QUALITY OF REPRESENTATIVE WELDS BY MEANS OF TESTS SPECIFIED HEREINAFTER UNDER PARAGRAPH ENTITLED ---QUALITY PROVISIONS---. CERTIFICATES OF SUCH QUALIFICATION SHALL BE CURRENT FOR WELDERS AND WELDING PROCEDURES AND ARE SUBJECT TO THE CONTRACTING OFFICER'S APPROVAL.

---PROCEDURES

PREHEATING AND INTERPASS HEATING-----TEMPERATURES SHALL BE MEASURED BY A SURFACE PYROMETER, OR OTHER SUITABLE TEMPERATURE INDICATING MEANS, ACCURATE WITHIN PLUS OR MINUS 25 DEGREES FAHRENHEIT. HEATING AND MAINTAINING THE PROPER TEMPERATURE MAY BE ACCOMPLISHED, AS APPLICABLE, BY A FURNACE, BY INDUCTION, BY A GENTLE SOOT FREE GAS FLAME, BY HEAT LAMPS, OR BY OTHER SUITABLE MEANS CAPABLE OF PROVIDING A REASONABLY UNIFORM TEMPERATURE THROUGHOUT THE PART. WHEN A GAS FLAME IS USED FOR PREHEATING THE AREA TO BE WELDED SHALL BE BRUSHED CLEAN OF ANY SOOT,ACCIDENTALLY DEPOSITED FROM THE PREHEATING FLAME, BEFORE TACKING OR WELDING.

TACKING-----TACK WELDS SHALL BE USED AS REQUIRED. WHEREVER POSSIBLE, THE TACK WELDS SHALL BE SPACED SYMMETRICALLY ALONG OR AROUND THE JOINT. TACK WELDS SHALL BE OF SUFFICIENT SIZE AND LENGTH TO PERMIT EASE OF SUBSEQUENT WELDING, YET ASSURE HOLDING OF THE PARTS IN PLACE WITHOUT CRACKING OF THE TACK WELDS. CHIPPING OR GRINDING SHALL BE DONE TO FAIR BOTH ENDS OF TACK WELDS IN WITH BASE METAL. TACK WELDS WHICH HAVE CRACKED MUST BE REMOVED.

WELD BEADS-----WELD BEADS SHALL BE TERMINATED SO AS TO AVOID CRITICAL AREAS OF THE WELD. ASSEMBLIES SHALL BE WELDED IN THE FLAT POSITION WHENEVER PRACTICAL. THE BACK STEP AND SKIP METHODS OF WELDING SHALL BE USED TO LESSEN WARPAGE WHEN NECESSARY. TABS ON WHICH THE ARC CAN BE STRUCK OR EXTINGUISHED MAY BE USED WHEREVER PRACTICAL TO MINIMIZE POROSITY AT THE BEGINNING AND END OF THE WELD BEAD. WHEN MANUAL WELDING MULTIPASS WELDS IN CIRCUMFERENTIAL JOINTS IN TUBULAR SECTIONS OR DEPOSITING CONTINUOUS CIRCULAR BUTT OR FILLET TYPE WELDS, THE FIRST LAYER, WHENEVER PRACTICAL, SHOULD BE DEPOSITED BY WELDS IN OPPOSITE QUADRANTS. ALL MACHINE WELDING OR CIRCUMFERENTIAL OR CIRCULAR TYPE JOINTS SHALL BE ACCOMPLISHED UTILIZING A CONTINUOUS SINGLE PASS OR MULTIPLE STRINGER TECHNIQUE. ALL GROOVE WELDED JOINTS WHICH ARE TO BE WELDED FROM BOTH SIDES AND WHICH REQUIRE 100 PERCENT PENETRATION SHALL BE BACK GOUGED, AS NECESSARY, TO ENSURE COMPLETE PENETRATION OF THE JOINT. NORMALLY, TWO OR THREE PASSES SHALL BE DEPOSITED ON THE FIRST SIDE PRIOR TO BACK GOUGING OF THE BACK SIDE. BACK GOUGING TO SOUND METAL MAY BE DONE BY CHISEL, GRINDER, OR OTHER MECHANICAL METHOD. GOUGED AREAS SHALL BE SMOOTHED TO FAIR IN WITH ADJACENT METAL. THE STARTS AND STOPS OF EACH WELD BEAD SHALL BE CHIPPED OR GROUND AS NECESSARY TO REMOVE CRACKS AND VISIBLE POROSITY IN THE WELD METAL BEFORE DEPOSITING THE SUBSEQUENT WELD BEAD. THE GROUND AREAS SHALL FAIR IN SMOOTHLY WITH THE ADJACENT MATERIAL. WELD BEADS SHALL NOT TERMINATE IN INSIDE CORNERS OR IN OTHER CRITICAL AREAS SUCH AS CHANGES IN WELDING DIRECTION OR SUDDEN CHANGES IN SECTION THICKNESS. CORNER WELDS MAY BE A FILLET WELD, A BUTT WELD, OR A COMBINATION THEREOF DEPENDING ON FORMING OR DRAWING REQUIREMENTS. UNLESS OTHERWISE SPECIFIED, THERE SHALL BE COMPLETE PENETRATION TO THE INSIDE OF THE JOINT, WITH A WASH WELD (MELTING OF THE PENETRATING METAL WITH OR WITHOUT FILLER METAL) ON THE INSIDE OF THE JOINT PERMITTED FOR CONTOURING AND BLENDING WHEN AN INSIDE FILLET WELD IS NOT SPECIFIED. THE OUTSIDE OF THE JOINT SHALL BLEND SMOOTHLY WITH THE ADJACENT METAL, AND UNLESS OTHERWISE SPECIFIED, SUFFICIENT METAL SHALL BE ADDED TO PROVIDE A SUITABLE FILLET OR REINFORCEMENT.

POSTWELD HEAT TREATMENT-----STRESS RELIEF OR HEAT TREATMENT OF WELDED ASEMBLIES IS OPTIONAL UNLESS SPECIFICALLY CALLED FOR ON THE DRAWING.

POSTWELD CLEANING-----ALL WELDED ASSEMBLIES SHALL BE CLEANED FREE OF OXIDES, FLUX SCALE, OR OTHER FOREIGN MATTER PRIOR TO FINAL INSPECTION. BACKING BARS EXPOSED TO WEATHER SHALL BE REMOVED, JOINT DAMAGE FILLED WITH WELD METAL, AND FINISHED SMOOTH OR GROUND.

---SOUNDNESS

WELDS SHALL MEET THE STANDARDS OF TABLE V, KSC-SPEC-Z-0004, "ALLOWABLE DEFECT LIMITS", WHEN INSPECTED TO PARAGRAPHS, "---EXAMINATION OF WELDMENTS", AND "---ACCEPTANCE CRITERIA", HEREINAFTER SPECIFIED.

MAGNETIC PARTICLE AND/OR PENETRANT INSPECTION IS REQUIRED FOR 100 PERCENT OF ALL CLASS "B" COMPLETE PENETRATION WELDS FOR EACH ONE-HALF INCH INTERVAL OF THICKNESS.

RADIOGRAPHIC INSPECTION BY THE CONTRACTOR IS REQUIRED FOR 100 PERCENT OF CLASS "A" SHOP AND FIELD WELDS. CERTAIN CLASS B WELDS, WHOSE QUALITY CANNOT BE SATISFACTORILY DETERMINED BY THE CONTRACTING OFFICER, SHALL BE SUBJECT TO RADIOGRAPHIC INSPECTION AT GOVERNMENT EXPENSE BUT WITHOUT INCREASE IN CONTRACT PRICE.

USE ULTRASONIC OR MAGNETIC PARTICLE INSPECTION FOR CLASS "A" WELDS THAT ARE INACCESSIBLE FOR RADIOGRAPHIC INSPECTION. IF MAGNETIC PARTICLE INSPECTION IS USED, THE INSPECTION SHALL BE PERFORMED ON EACH ONE-HALF INCH INCREMENT OF WELD THICKNESS.

---IN PROCESS REPAIR OF WELDMENTS.

ALL DEFECTS OF THE WELD METAL SHALL BE CORRECTED AT THE DISCRETION OF THE DELEGATED GOVERNMENT AGENCY INSPECTOR, PROVIDED THE ASSEMBLIES HAVE NOT LEFT THE SHOP AND NO SUBSEQUENT OPERATION HAS BEEN PERFORMED. THE WELDING PROCEDURES SHALL BE THE SAME AS FOR THE ORIGINAL WELD. THE INITIAL WELD MAY BE REWELDED ONCE; AND IF A SATISFACTORY ASSEMBLY IS NOT ACHIEVED, APPROVAL OF THE PROCURING AGENCY IS REQUIRED FOR FURTHER REPAIR EFFORTS.

IF THE WELD IS OTHERWISE ACCEPTABLE, EXCESSIVE WELD UNDERFILL, UNDERCUT, LOW WELD BEADS, OR CRACK FREE CRATERS MAY BE CORRECTED BY LAYING AN ADDITIONAL BEAD JOINING THE ORIGINAL WELD AND THE BASE METAL AND FILLING THE DEPRESSION. IF PENETRATION CAN BE OBTAINED TO THE BOTTOM OF THE DEFECT, NONE OF THE ORIGINAL WELD NEED BE REMOVED.

DEFECTS EACH AS CRACKS AND SURFACE IMPERFECTIONS MUST BE REMOVED FROM THE ORIGINAL WELD BY GRINDING OR CHIPPING OR AIR GOUGE PRIOR TO REWELDING. AREAS WITH INADEQUATE JOINT PENETRATION MAY HAVE THE WELD DEPOSIT PARTIALLY REMOVED PRIOR TO REWELDING.

UNACCEPTABLE OVERLAP AND UNDERBEAD DEFECTS SHALL BE REMOVED BY DRESSING THE WELD DEPOSIT. DRESSING OF WELDS BELOW THE SIZE INDICATED ON THE DRAWING REQUIRE REWELDING.

GOVERNMENT INSPECTOR SHALL APPROVE THE PROPOSED CORRECTIVE ACTION, AS ABOVE, WHEN ACCEPTABLE. HE SHALL ENSURE THAT THE AREA ON THE WELDMENT TO BE CORRECTED IS MARKED FOR REINSPECTION AND THAT SATISFACTORY REPAIRS ARE MADE.

---PROCEDURE AND PERFORMANCE QUALIFICATIONS

QUALIFICATION AND CERTIFICATION SHALL BE ACCOMPLISHED IN ACCORDANCE WITH THE APPLICABLE PORTIONS OF AWS D1.1. COPIES OF CERTIFICATION SHALL BE SUBMITTED TO THE CONTRACTING OFFICER.

RETESTING IS NOT REQUIRED FOR RENEWAL OF PERFORMANCE QUALIFICATION IF THE WELDER HAS PERFORMED PRODUCTION WELDING MEETING THE REQUIREMENTS OF THIS SPECIFICATION WITHIN THE PREVIOUS SIX MONTHS.

---EXAMINATION OF WELDMENTS

VISUAL INSPECTION OF ALL WELDS SHALL BE ACCOMPLISHED USING SUCH VISUAL AIDS AS A 10-X MAGNIFIER AND AWS FILLET AND BUTT WELD GAUGES.

MAGNETIC PARTICLE INSPECTION OF CARBON STEEL WELDMENTS SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-I-6868.

PENETRANT INSPECTION SHALL BE CONDUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF MIL-I-6866.

RADIOGRAPHIC INSPECTION SHALL BE CONDUCTED, WHEN APPLICABLE, IN ACCORDANCE WITH AWS D1.1 AND MIL-STD-00453.

ULTRASONIC INSPECTION SHALL BE CONDUCTED IN ACCORDANCE WITH AWS D1.1.

---ACCEPTANCE CRITERIA

DEFECTS SHALL NOT BE IN EXCESS OF THOSE SPECIFIED IN TABLE V, KSC-SPEC-Z-0004, FOR THE APPLICABLE CLASS OF WELD AS DETERMINED BY EXAMINATIONS CARRIED OUT UNDER PARAGRAPH,---EXAMINATION OF WELDMENTS. IN CASE OF DOUBT, THE CONTRACTING OFFICER MAY REQUIRE COUPONS TO BE CUT FROM BASE AND/OR WELD MATERIAL FOR DESTRUCTIVE TESTS. IF THE MATERIAL OR WELD DOES NOT MEET THE APPLICABLE SPECIFICATIONS FOR STRENGTH AND SOUNDNESS, THE CONTRACTOR SHALL BE LIABLE FOR THE COST OF THE INVESTIGATION OF THE DEFECTIVE AREA. WHEN COUPONS ARE REMOVED FROM ANY PART OF THE STRUCTURE, THE MEMBERS SHALL BE REPAIRED IN A NEAT AND WORKMANLIKE MANNER, WITH JOINTS OF PROPER TYPE TO DEVELOP THE FULL STRENGTH OF THE MEMBERS AND JOINTS CUT, AND WITH PEENING AS NECESSARY OR AS DIRECTED TO RELIEVE RESIDUAL STRESS.

---INSPECTION RECORD

RECORDS OF MAGNETIC PARTICLE, PENETRANT, RADIOGRAPHIC AND ULTRASONIC INSPECTIONS SHALL BE PREPARED AND SUBMITTED TO THE CONTRACTING OFFICER.

---INSPECTION REQUIREMENTS

THE CONTRACTOR IS RESPONSIBLE FOR THE PERFORMANCE OF ALL PROCEDURES AND PERFORMANCE QUALIFICATION TESTING AND ALL INSPECTION REQUIREMENTS AS SPECIFIED HEREIN. THE CONTRACTOR MAY EMPLOY AN INDEPENDENT TESTING LABORATORY, ACCEPTABLE TO THE GOVERNMENT, TO PERFORM TESTING AND INSPECTION WORK. INSPECTION AND TEST RECORDS SHALL BE KEPT COMPLETE AND PROVIDED TO THE CONTRACTING OFFICER OR HIS DESIGNATED REPRESENTATIVE. THE CONTRACTING OFFICER, OR HIS DESIGNATED REPRESENTATIVE, RESERVES THE RIGHT TO PERFORM (AT GOVERNMENT EXPENSE AND WITHOUT ANY INCREASE IN CONTRACT PRICE) ANY OR ALL OF THE INSPECTIONS SET FORTH IN THIS SPECIFICATION TO ASSURE THAT THE END ITEM CONFORMS TO THE PRESCRIBED REQUIREMENTS.

---*CERTIFICATION OF WELDING INSPECTORS* (A)

WELDING INSPECTORS SHALL BE CERTIFIED TO MEET THE REQUIREMENTS OF MIL-STD-410D. THE EMPLOYER (CONTRACTOR OR SUBCONTRACTOR) MAY HAVE AN IN-HOUSE LEVEL III CERTIFIED INSPECTOR (AS A DESIGNATED REPRESENTATIVE OF THE EMPLOYER) TO CERTIFY OTHER INSPECTORS AT LEVELS I AND II. AS AN OPTION, HE MAY USE THE SERVICES OF A PRIVATE LABORATORY, APPROVED BY THE CONTRACTING OFFICER, TO PROVIDE A CERTIFIED LEVEL III INSPECTOR TO PROVIDE QUALIFICATION TRAINING AND EXAMINATION SERVICES OF THE EMPLOYER'S (CONTRACTOR/SUBCONTRACTOR) PERSONNEL AT LEVEL II. IN SUCH INSTANCES, THE RESPONSIBILITY OF CERTIFICATION MUST BE RETAINED BY THE EMPLOYER.

IF A PRIVATE LABORATORY IS USED TO PROVIDE QUALIFICATION TRAINING AND EXAMINATION OF THE EMPLOYER'S INSPECTORS, THE EMPLOYER IS REQUIRED TO HAVE AT LEAST LEVEL II NONDESTRUCTIVE TESTING (NDT) INSPECTORS OF THE APPLICABLE TESTING METHOD ON HIS STAFF FOR PERFORMANCE OF THE REQUIRED INSPECTIONS. THESE INSPECTORS ARE TO BE CERTIFIED TO PERFORM INSPECTIONS OF THE TYPE REQUIRED BY THE SPECIFICATIONS, I.E., RADIOGRAPH, ULTRASONIC, MAGNETIC PARTICLE AND LIQUID PENETRANT METHOD OR METHODS AS REQUIRED.

THE CONTRACTOR/SUBCONTRACTOR MAY CERTIFY A LEVEL II INSPECTOR IN MAGNETIC PARTICLE OR LIQUID PENETRANT AND WAIVE THE REQUIRED TRAINEE OR LEVEL I DOCUMENTED WORK EXPERIENCE TIME IF THE EMPLOYER SPECIFICALLY ASCERTAINS THE EMPLOYEE IS QUALIFIED TO PROPERLY PERFORM THE REQUIRED INSPECTION AND SO STATES IN HIS CERTIFICATION TO THE CONTRACTING OFFICER. ONCE AN INSPECTOR IS CERTIFIED, NO FURTHER TRAINING IS REQUIRED FOR THE LIFE OF THE CONTRACT.

THE CONTRACTOR ALSO HAS THE OPTION OF USING THE SERVICES OF A PRIVATE LABORATORY, APPROVED BY THE CONTRACTING OFFICER, TO PROVIDE THE REQUIRED NDT INSPECTIONS.

---SHOP DRAWINGS---

---CLASS "A" AND CLASS "C" WELDS

CLASS "A" WELDS SHALL BE IDENTIFIED ON THE SHOP DRAWINGS BY DESIGNATING "A" IN THE TAIL OF THE WELD SYMBOL. THE SHOP DRAWINGS SHALL INCLUDE NOTES SPECIFYING RADIOGRAPHIC INSPECTION FOR CLASS "A" WELDS. THESE NOTES SHALL BE DETAILED ENOUGH TO ASCERTAIN THAT A SATISFACTORY RADIOGRAPHIC INSPECTION CAN BE ACCOMPLISHED CONSIDERING TECHNIQUE, FABRICATION SEQUENCE, AND JOINT CONFIGURATION FOR EACH CLASS "A" WELD.

CLASS "C" WELDS, IF PERMITTED, SHALL BE IDENTIFIED ON THE SHOP DRAWINGS BY DESIGNATING "C" IN THE TAIL OF THE WELD SYMBOL.

Table II. Base Metal, Filler Metal, Weld Processes and Heating Requirements

Base Metal	Electrodes, Rods and Wire for Welding Processes				
	Gas Shielded Gas Tungsten Arc	Gas Shielded Metal Arc	Submerged Arc	Shielded Metal Arc	Heating
Carbon and high-strength low alloy steels	MIL-R-5632, CL2 (Alt) ASTM-A-251 GB-60, GA-65 GB-65	MIL-R-5632, CL2 (Alt) ASTM-A-559	MIL-R-5632, CL2 (Alt) ASTM-A-558	MIL-E-22200/1 7018; MIL-E-18038, 7015, 7016 (Alt) ASTM-A-233) E7015, ASTM-A-316) E7016, E7018	1/ 5/
Corrosion resisting steels Class 301, 302, 304, CF-8, 308	MIL-R-5031, CL1 (308) or CL16 (308ELC) (Alt) ASTM-A-371 ER 308L		To be specified on welding schedule submitted for approval of procuring activity.	MIL-E-22200/2 MIL-308, CL1 or 2 (Alt) ASTM-A-298 E308L	2/
304L					3/
316 CF-3M	MIL-R-5031, CL4 (316) or CL17 (316ELC) (Alt) ASTM-A-371 ER 316, ER 316L			MIL-E-22200/2, MIL-316, CL1 or 2 (Alt) ASTM-A-298 E316L	2/
309	MIL-R-5031, CL2 (309) (Alt) ASTM-A-371, ER309			MIL-E-22200/2 MIL-309 (Alt) ASTM-A-298 E309	3/

See footnotes at end of table, page 17K-9

Table II. Base Metal, Filler Metal, Weld Processes and Heating Requirements (Continued)

Base Metal	Electrodes; Rods and Wire for Welding Processes				
	Gas Shielded Gas Tungsten Arc	Gas Shielded Metal Arc	Submerged Arc	Shielded Metal Arc	Heating
310	MIL-R-5031, CL3 (310) (Alt) ASTM-A-371, ER310		To be specified on welding schedule submitted for approval of procuring activity	MIL-E-22200/2 MIL-310 (Alt) ASTM-A-298 E310	3/
316L	MIL-R-5031, CL17 (316ELC)			MIL-E-22200/2 MIL-316L, CL1 or 2 (Alt) ASTM-A-298, E318, E316L	4/
321, 347, CF-8C 348	MIL-R-5031, CL5A (347) (Alt) ASTM-A-371 ER347			MIL-E-22200/2 MIL-347, CL1 or 2 (Alt) ASTM-A-298, E347	3/

1/ Stress relief at 1000-1050 degrees F, when specified on the drawing.

2/ Shall be annealed at 1925±25 degrees F for 10 minutes (sheet and tubing), for 1/2 hour per inch thickness for bar stock. Must be bright annealed unless all surfaces are machined after annealing.

3/ Not required unless otherwise specified.

4/ Shall be annealed at 1600±25 degrees F for 10 minutes (sheet and tubing), for 1/2 hour per inch thickness for bar stock. Must be bright annealed unless all surfaces are machined after annealing.

5/ Steels of the 60,000 psi and under class may be welded in thicknesses up to and including 1" with the proper E.60 Series electrode per AWS A5.1.

Table V. Allowable Defect Limits

Defect	Class of Welding		
	A	B	C
1. Cracks	None	None	None
2. Mismatch	10%T or 0.02 in. 1/	20%T or 0.12 in. 1/	20%T or 0.15 in. 1/
3. Porosity Open to Surface	1 per in. 2/	2 per in. 2/ 0.2 in. min. spacing	4 per in. 2/ 0.2 in. min. spacing
4. Undercut	10%T or 0.03 in. 1/ 1T max. length	10%T or 0.05 in. 3T max. length 1/	20%T or 0.05 in. 1/ 5T max. length
5. Incomplete 3/ Penetration	20%T or 0.03 in. Depth 1/ 1T max. length	20%T or 0.05 in. Depth 1/ 2T max. length	20%T or 0.05 in. Depth 1/ 4T max. length
6. Cold Shut 3/	1T or 0.1 in. 4/ 1/	1T max. length 4/	2T max. length 4/
7. Overlap 3/	1T or 0.1 in. 1/	1T max. length	2T max. length
8. Concavity	20%T or 0.03 in. Depth 1/ 1T max. length	20%T or 0.05 in. Depth 1/ 1T max. length	20%T or 0.09 in. Depth 1/ 1T max. length
9. Craters	20%T or 0.03 in. Depth 1/ 1T max. length	20%T or 0.05 in. Depth 1/ 1T max. length	20%T or 0.09 in. Depth 1/ 2T max. length
10. Underbead Drop Through	20%T or 0.04 in. 1/ For T up to 0.25 in. and 0.07 in. For T 0.25 in.	Clearance for mating parts	Clearance for mating parts
11. Thinning	Not less than min. T	Not less than 80%T or 0.05 1/ in. 3T length	Not less than 80%T or 0.05 1/ in. 5T length
12. Accumulation of Defects 3 to 10 inclusive	10T minimum between any two defects	6T minimum between any two defects	4T minimum between any two defects

See footnotes at end of table, Page 17K- 11

Table V. Allowable Defect Limits - Continued

Defect	Class of Welding		
	A	B	C
13. Subsurface defects such as inclusions, porosity incomplete fusion. 5/	Maximum dim. of any single defect shall not exceed 50%T or 0.15 in. whichever is lesser. Accumulation per curve, Figure 1. 6/ 7/	Maximum dim. of any single defect shall not exceed 70%T or 0.2 in. whichever is lesser. Accumulation per curve, Figure 1. 6/7/8/	Not applicable

1/ Whichever is the lesser

2/ Maximum size 30 percent of "T" or 0.10 inch, whichever is the lesser

3/ If these defects exhibit sharp radii, sharp terminations, or cracklike, they shall be removed by grinding. If depression is not larger than permitted, they need not be rewelded.

4/ Where possible to determine, by metal removal, depth of cold shut shall not cause joint thickness to be less than thinnest material being welded.

5/ Any defect having a sharp termination or crack-like appearance shall be considered a crack. Two or more adjacent defects shall be treated as one when the space between them is less than the smallest defect.

6/ Alined defects (four or more) shall not be accepted when the spacing between them is less than three times the smallest defect.

7/ Alined fine porosity is acceptable in 1/4 inch length if less than 1/2 of length is composed of voids.

8/ If required by the drawing or purchase order.

SECTION 18A

SUMMARY OF TESTING

---GENERAL REQUIREMENTS---

---GENERAL

THIS SECTION COVERS TESTING OF SYSTEMS AND EQUIPMENT FURNISHED AS WORK OF OTHER SECTIONS OF THE SPECIFICATIONS. THE REQUIREMENTS OF THIS SECTION ARE SUPPLEMENTARY TO THE TESTING REQUIREMENTS SPECIFIED IN THE VARIOUS SECTIONS OF THE SPECIFICATIONS FOR THE TOTAL CONTRACT WORK.

---FUNCTIONAL TESTS

FUNCTIONAL TESTS SHALL BE PERFORMED TO PROVE THE CHARACTERISTICS OF THE SYSTEMS FURNISHED AND TO PROVIDE A RECORD OF THESE CHARACTERISTICS. FOR THIS REASON, A COMPLETE LOG SHALL BE KEPT OF ALL MEASUREMENTS TAKEN, ADJUSTMENTS AND REGULATIONS REQUIRED, AND ALL OBSERVATIONS MADE DURING THE PERFORMANCE OF THE TESTS. COPIES OF ALL RECORDS OF TESTS SHALL BE TURNED OVER TO THE CONTRACTING OFFICER.

---INSTRUMENTS

ALL TEST INSTRUMENTS SHALL BE PROVIDED BY THE CONTRACTOR AND SHALL BE ACCURATELY CALIBRATED AND CERTIFIED FOR ACCURACY BY AN APPROVED INDEPENDENT TESTING LABORATORY NOT MORE THAN TWO WEEKS PRIOR TO THE TEST. DURING THE PERFORMANCE OF THE TEST, SHOULD ANY DOUBT ARISE AS TO THE ACCURACY OF THE INSTRUMENTS, THEY SHALL BE RECALIBRATED AT THE DIRECTION OF THE CONTRACTING OFFICER AND AGAIN CERTIFIED BY AN APPROVED INDEPENDENT TESTING LABORATORY WITHOUT ADDITIONAL COST TO THE GOVERNMENT.

---SCHEDULING

THE CONTRACTOR AND THE CONTRACTING OFFICER SHALL AGREE ON ALL TESTING SCHEDULES TO PERMIT REPRESENTATION BY BOTH PARTIES. NO TEST WILL BE RECOGNIZED UNLESS IT IS PERFORMED IN THE PRESENCE OF THE CONTRACTING OFFICER OR HIS DESIGNATED REPRESENTATIVE. ALL TESTING AND TEST VALIDATIONS SHALL COMPLY WITH THE "TEST AND TEST VALIDATIONS" REQUIREMENTS AS STATED IN ARTICLE 3, NOTE 3, SECTION I OF THE "CONTRACT SCHEDULE". (A)

---LABOR, MATERIAL, INSTRUMENTS

EXCEPT WHERE OTHERWISE SPECIFIED IN THE VARIOUS SECTIONS OF THE SPECIFICATIONS, ALL COSTS OF TESTS AND

(A) 5-30-78

RETESTS INCLUDING LABOR, MATERIAL, TEST INSTRUMENTS, UTILITIES, COST OF FACTORY-TRAINED EXPERTS AND SIMILARLY TRAINED PERSONNEL SHALL BE BORNE BY THE CONTRACTOR. ITEMS AND SERVICES FURNISHED BY THE GOVERNMENT WILL BE LIMITED TO THOSE SPECIFICALLY LISTED IN THE SPECIFICATIONS.

---DEFECTS

ALL DEFECTS WHICH ARE REVEALED BY THE TESTS SHALL BE CORRECTED BY THE CONTRACTOR AND THE TESTS, OR PORTIONS THEREOF, REPEATED, UNTIL NO DEFECTS ARE REVEALED. EACH FAILURE TO MEET THE SPECIFIED REQUIREMENTS WILL BE CONSIDERED A DEFECT. ALL DEFECTS SHALL BE CORRECTED AT NO ADDITIONAL COST TO THE GOVERNMENT.

---TESTS AND INSPECTION---

---GENERAL

SINCE THIS SECTION OF THE SPECIFICATIONS CONSISTS OF A SUMMARY OF TESTING, NO ATTEMPT IS MADE TO ENUMERATE ALL THE REQUIRED TESTS. ALL TESTS CALLED FOR IN THE VARIOUS SECTIONS OF THE SPECIFICATIONS SHALL BE PERFORMED. CHECK ALL SYSTEMS AND WORK FOR BONDING AND GROUNDING PER SECTION 16X (PART 51).

---SECTION *1A* - SCOPE AND DESCRIPTION 

LOCATE BENCH MARKS FOR PROJECT ELEVATION AND ESTABLISH PROJECT BASELINES. 

---SECTION 1E - TRANSPORT AND ERECTION OF TOWER SEGMENTS, CRANE AND ELEVATORS

SUBMIT PLAN FOR ERECTION OF SSAT FOR APPROVAL OF CONTRACTING OFFICER.

---SECTION 2D - EXCAVATION, FILL AND BACKFILL FOR STRUCTURES AND UTILITIES

SAMPLING, SOIL AND COMPACTION TESTS AS SPECIFIED.

---SECTION 2E - EARTHWORK FOR SITE GRADING

SAMPLING AND SOIL TESTS AS SPECIFIED.

---SECTION 2K - PRECAST PRESTRESSED CONCRETE PILING

TESTS AS SPECIFIED.

---SECTION 2P - BITUMINOUS CONCRETE PAVING

TESTS OF PAVEMENT.

---SECTION 2T - TOPSOILING AND SEEDING

SAMPLING AND TESTING OF MATERIALS, ESTABLISHING GRASS, AND CERTIFICATES OF COMPLIANCE.

---SECTION 2W - STEEL FOUNDATION PILES

TEST PILES AND PILE DRIVING FOR FOUNDATIONS VERSUS UNDERGROUND UTILITIES. CATHODIC PROTECTION. CHECK FOR LIGHTNING/ELECTRICAL GROUNDING OF STRUCTURES.

---SECTION 3A - CAST-IN-PLACE CONCRETE

CONCRETE MIXES AND CYLINDER TESTS. CHECK FOR SPECIFIED AND DETAILED CRACK SEALANT. CHECK FOR PIPE SLEEVES THROUGH FOUNDATIONS AND ELEVATOR HOISTWAY AND PIT. GROUNDING OF ANCHOR BOLTS.

PROOFS OF COMPLIANCE FOR MATERIALS, WELDER QUALIFICATION, SAMPLING AND TESTING OF CONCRETE. CHECK FOR BONDING AND GROUNDING OF ANCHOR BOLTS TO REINFORCING PER DRAWINGS. CHECK SEALANT AT JOINTS.

---SECTION 3R - REFRACTORY COATING

CHECK MANUFACTURE AND APPLICATION AS SPECIFIED. CHECK FOR PROPER THICKNESS.

---SECTION 4D - FLAME TRENCH REFRACTORY BRICK WORK

PROOFS OF COMPLIANCE AND TESTS AS SPECIFIED.

---SECTION 5J - STRUCTURAL STEEL

FIELD TESTS SHALL BE PERFORMED TO DETERMINE THE EFFECTIVENESS AND QUALITY OF WELDED, BOLTED AND OTHER CONNECTIONS. SHOP INSPECTION SHALL BE AS SPECIFIED. CHECK FOR BONDING AND GROUNDING. CHECK FOR SQUARENESS OF COLUMNS ON LOWER TOWER SEGMENT.

---SECTION 5K - MISCELLANEOUS METALS

INSPECT FOR BONDING AND GROUNDING OF INSTALLED WORK.

---SECTION 7A - BUILT-UP ROOFING RESTORATION

CHECK APPLICATION AND OBTAIN WARRANTY AS SPECIFIED. CHECK FOR EVIDENCE OF LEAKAGE.

---SECTION 7H - CAULKING AND SEALING

INSPECT FOR SEALANT MATERIALS AND APPLICATION TO CONCRETE JOINTS.

---SECTION 9A - PAINTING AND FINISHING

CHECK FOR DATE OF MATERIAL MANUFACTURE. TEST COATING THICKNESS. CHECK APPLIED COATS AND APPEARANCE.

---SECTION 9L - PROTECTIVE COATING OF CARBON STEEL

PERFORM ALL TESTS SPECIFIED IN THE ABOVE SECTION OF THE SPECIFICATIONS. TEST FOR COATING THICKNESS.

---SECTIONS 13B - METAL BUILDINGS

INSPECT FOR COLUMN BASEPLATE ANCHORAGE TO CONCRETE PEDESTALS AND FOOTINGS. CHECK SIDING-TO-FLOOR AND SIDING-TO-ROOF WEATHER SEALS. PERFORM OPERATIONAL TEST OF AIR CONDITIONING UNITS AND SYSTEMS AS SPECIFIED. TESTS FOR BAKED ENAMEL COATINGS. LEAKAGE TESTS FOR ROOFING AND SIDING.

---SECTION 13F - GASEOUS NITROGEN PNEUMATIC SYSTEMS

FACTORY AND FIELD TESTING AS SPECIFIED.

---SECTION 13L - COLOR FINISH SCHEDULE AND PIPING IDENTIFICATION

CHECK FOR PROPER COLORS. CHECK FOR PROPER PIPING IDENTIFICATION AND MARKING AND TUBING TAGS.

---SECTION 14A - INSTALLATION OF HAMMERHEAD CRANE

SUBMIT PLAN FOR ERECTION OF HAMMERHEAD CRANE.

PERFORM OPERATIONAL AND LOAD TESTS AS SPECIFIED.

---SECTION 14B - REMOVAL/INSTALLATION OF HYDRAULIC PASSENGER ELEVATOR MACHINERY AND MACHINE ROOM ON PAD

SUBMIT PLAN FOR REMOVAL/INSTALLATION OF WEST PAD ELEVATOR MACHINERY. TEST REBUILT SYSTEM.

---SECTION 14D - INSTALLATION OF TWO ELECTRIC PASSENGER ELEVATORS ON SSAT

SUBMIT PLAN FOR INSTALLATION OF TWIN 600 FPM ELEVATOR SYSTEM. PERFORM ALL TESTS AS SPECIFIED.

---SECTION 14M - RAIL SYSTEM FOR PCR ROTARY BRIDGE

CHECK RAIL RADIUS, GAUGE AND ELEVATION VERSUS SPECIFIED TOLERANCES. CHECK LOCATIONS OF RAIL STOPS.

---SECTION 14N - LIGHTNING MAST FOR SSAT

TESTS AND PROOFS OF COMPLIANCE AS SPECIFIED.

---SECTION 14Q - SSAT SLIDEWIRE EMERGENCY EGRESS SYSTEM

PERFORM OPERATIONAL TESTS AS SPECIFIED.

---SECTION 14R - SIDE FLAME DEFLECTORS FOR SRB

PRESSURE TESTS AND OPERATIONAL TESTS OF NITROGEN GAS AND HYDRAULIC SYSTEMS AS SPECIFIED. TRANSPORT AND ANCHORAGE TESTS OF FLAME DEFLECTORS AS SPECIFIED. CHECK BONDING AND GROUNDING.

---SECTION 14S - SRB/ORBITER FLAME DEFLECTOR

CHECK WELDING, PIPE SUPPORTS AND CHOCKS FOR CREST SPRAY HEADER. CHECK ANCHORAGE TO FLAME TRENCH. CHECK WELDING OF SRB TO ORBITER DEFLECTOR AT MATING COLUMNS.

---SECTION 15A - ECS AND AMBIENT AIR DUCTS

PERFORM ALL TESTS REFERENCED IN THIS SECTION.

---SECTION 15E - PIPING - SOUND SUPPRESSION WATER SYSTEM

SHOP TESTS ON PIPING AND FITTINGS AS SPECIFIED.
MATERIAL CERTIFICATIONS
SHOP TESTS AND CERTIFICATIONS ON COAL-TAR COATINGS AND LININGS. CHECK FIELD TOUCH-UP.

TESTS OF ZINC-RICH AND COAL-TAR COATING THICKNESSES.
HYDROSTATIC TESTING OF PIPING SYSTEMS AND TEST SCHEDULE SUBMITTALS.
TESTS OF SOILS, BACKFILL AND COMPACTION.
CONTRACTOR REPRESENTATIVE ON-SITE DURING GOVERNMENT OPERATIONAL FLOW TESTS.
FACTORY SUPERVISION FOR FIELD CHECKOUT AND TESTING OF 48 INCH VALVES.

---SECTION 15F - LARGE CONTROL VALVES WITH OPERATORS - SOUND SUPPRESSION WATER SYSTEM

FACTORY PRESSURE, LEAKAGE AND OPERATIONAL TESTING. FIELD "DRY" AND "WET" SYSTEM TESTING.

---SECTION 15H - MISCELLANEOUS PIPING SYSTEMS

HYDROSTATIC PRESSURE AND OTHER TESTS SHALL BE PERFORMED AS OUTLINED IN THIS SECTION.

TESTING OF TANK T-3B SYSTEM AFTER MODIFICATIONS:

A. WITH AIR SUPPLY TO TANK T-3B "OFF" AND TANK AIR VENT VALVE "OPEN," FILL TANK WITH PUMP P-4B. DEMONSTRATE THAT PROBE NO. 2 DE-ENERGIZES PUMP P-4B. CLOSE AIR VENT VALVE AND SET AIR REGULATOR TO MAINTAIN 185 PSIG IN TANK T-3B DURING ALL FOLLOWING TESTS:

B. OPEN TANK DRAIN VALVE TO LOWER TANK LEVEL AND DEMONSTRATE THAT PROBE NO. 1 ENERGIZES PUMP P-4B.

C. LOWER TANK LEVEL FURTHER AND DEMONSTRATE THAT PUMP P-2B IS ENERGIZED BY PROBE NO. 3; THEN, MANUALLY "OPEN" POWER SWITCH FOR PUMP P-2B.

D. RAISE TANK LEVEL BY THROTTLING VALVE AND DEMONSTRATE THAT PUMP P-4B IS DE-ENERGIZED BY PROBE NO. 2.

E. DISCONNECT WIRING TO PROBLE NO. 3. CLOSE POWER SWITCH TO PUMP P-2B. REPEAT STEP "B" AND STEP "C" AND DEMONSTRATE THAT MODIFIED PROBE NO. 4 ENERGIZES PUMP P-2B. AFTER COMPLETING STEP "C", RE-CONNECT WIRING TO PROBE NO. 3.

F. "CLOSE" POWER SWITCH FOR PUMP P-2B. LOWER TANK LEVEL AGAIN AND DEMONSTRATE THAT PROBE NO. 1 ENERGIZES PUMP P-4B AND THAT FURTHER LOWERING OF TANK LEVEL TO PROBES NO. 3 AND 4 ENERGIZES PUMP P-2B.

G. "OPEN" POWER SWITCH FOR PUMP P-2B. SHUT "OFF" VALVE AND DEMONSTRATE THAT PUMP P-4B RAISES TANK LEVEL, AND THAT PROBE NO. 2 DE-ENERGIZES PUMP *P-4B*, AND THAT AIR PRESSURE REGULATOR MAINTAINS TANK PRESSURE AT 185 PSIG. (B)

H. "CLOSE" POWER SWITCH FOR PUMP P-2B, AND DEMONSTRATE THAT PUMP P-2B AND PUMP P-4B ARE BOTH DE-ENERGIZED WHEN FALLING TANK LEVEL IS BETWEEN PROBES NO. 1 AND NO. 2, AND

I. THAT WHEN TANK LEVEL FALLS TO PROBES NO. 3 AND 4, PUMP P-2B IS ALSO ENERGIZED. "OPEN" POWER SWITCH TO PUMP P-2B.

J. "CLOSE" VALVE AND DEMONSTRATE THAT TANK LEVEL RISES AND PROBE NO. 2 DE-ENERGIZES PUMP P-4B AND THAT TANK PRESSURE IS 185 PSIG.

K. "CLOSE" POWER SWITCH FOR PUMP P-2B.

L. REPEAT ABOVE TESTS AS REQUIRED BY CONTRACTING OFFICER AND TURN OVER TO GOVERNMENT.

FOLLOWING THE FLUSHING, HYDROSTATIC TESTING, FLOW TESTING AND STERILIZATION OF THE POTABLE AND FIREX PIPE SYSTEMS, EACH PIPING SYSTEM SHALL BE LEFT FILLED WITH WATER. DURING FILLING, ALL AIR SHALL BE VENTED FROM EACH SYSTEM. THE CHILLED WATER PIPING SYSTEM SHALL BE FILLED WITH THE CLEAN POTABLE WATER TO WHICH SHALL BE ADDED A RUST INHIBITOR CONSISTING OF A BUFFERED SOLUTION OF SODIUM DICHROMATE AS MANUFACTURED BY WARNER-PATTERSON COMPANY OF CHICAGO, ILLINOIS, AND IN THE MAXIMUM CONCENTRATION SPECIFIED ON THE CONTAINER (OR EQUAL RUST INHIBITOR HAVING PRIOR APPROVAL OF THE CONTRACTING OFFICER).

---SECTION 15P - FIRE PROTECTION SYSTEMS

PERFORM THE TESTS SPECIFIED IN THIS SECTION.

THE CONTRACTOR SHALL DEMONSTRATE THE OPERATION OF EACH FIRE HOSE STATION AND HYDRANT WITH FLOWING WATER, SAID STATIONS BEING ON THE SSAT, PAD, AND HYPERGOLIC FACILITIES.

DELUGE SPRINKLER SYSTEMS FOR THE HYPERGOLIC FACILITIES SHALL BE TESTED AND INSPECTED FOR ACCEPTANCE IN ACCORDANCE WITH THE APPLICABLE RECOMMENDATIONS AND PROVISIONS OF:

NFPA "STANDARDS NO. 13-1973 FOR THE INSTALLATION OF SPRINKLER SYSTEMS"; "NO. 13E-1973 FIRE DEPARTMENT OPERATIONS IN PROPERTIES PROTECTED BY SPRINKLER AND STANDPIPE SYSTEMS"; AND "NO. 24-1973 OUTSIDE PROTECTION."

FIXED SPRAY SYSTEM FOR THE GO_2 STORAGE TANKS SHALL BE INSPECTED FOR ACCEPTANCE IN ACCORDANCE WITH THE RECOMMENDATIONS OF NFPA STANDARD "NO. 15-1973 WATER SPRAY FIXED SYSTEMS FOR FIRE PROTECTION."

CHECK ALL ELECTRICAL ITEMS FOR COMPLIANCE WITH SECTION 16V (PART 2) FOR HAZARDOUS LOCATIONS. ANY DEFECTS FOUND SHALL BE REMEDIED AT NO ADDITIONAL COST TO THE GOVERNMENT.

---SECTION 15T - ELEVATED STEEL WATER TANK

HYDROSTATIC TESTING AND CHECKING OF FIELD WELDING AND COATING THICKNESSES AS SPECIFIED. CHECK LIQUID LEVEL TRANSMITTER OPERATION. CHECK LIGHTING AND LIGHTNING PROTECTION AND GROUNDING SYSTEM. CHECK TANK-FULL SWITCH OPERATION. (B)

---SECTIONS 16V, 16W AND 16X - ELECTRICAL WORK

THE CONTRACTOR SHALL PERFORM TESTING AS OUTLINED IN THESE SECTIONS OF THE SPECIFICATIONS. REFER TO PAGES 16V-7, 16V-14, 16V-19, 16V-21, 16V-36, 16W-9, 16X-23, 16X-31, 16X-36, AND 16X-38.
INSPECT FOR COMPLIANCE WITH BONDING AND GROUNDING REQUIREMENTS SPECIFIED IN SECTION 16X (PART 51).
INSPECT FOR COMPLIANCE WITH SECTION 16V (PART 2) - HAZARDOUS LOCATIONS.

---SECTION 17B - WELDING OF LOW PRESSURE WATER PIPING SYSTEMS

QUALIFICATION OF WELDERS AND OTHER TESTING SHALL BE ACCOMPLISHED AS SPECIFIED IN THE ABOVE SECTION OF THE SPECIFICATIONS.

---SECTION 17J - BRAZING AND SOLDERING

PERFORM TESTS AND INSPECTIONS AS SPECIFIED IN THIS SECTION OF THE SPECIFICATIONS.

---SECTION 17K - WELDING OF CARBON STEEL

QUALIFICATION OF WELDERS AND OTHER TESTING SHALL BE ACCOMPLISHED AS SPECIFIED IN THIS SECTION OF THE SPECIFICATIONS.

SECTION 18B

REPORT OF SUBSURFACE SOIL INVESTIGATION

---GENERAL REQUIREMENTS---

---GENERAL

THE FOLLOWING RECENT REPORT OF SUBSURFACE SOIL CONDITIONS IS INCLUDED AS INFORMATION TO PROSPECTIVE BIDDERS FOR USE IN THE PREPARATION OF FIRM BIDS FOR PILES AS SPECIFIED IN SECTIONS 2K AND 2W OF THESE SPECIFICATIONS.

---SITE INFORMATION

ORIGINAL BACKFILL UNDER ELEVATED PAD AREA IS HYDRAULICALLY DREDGED RIVER BOTTOM SAND AND SHELL FILL.

THE DATA ON SOIL SUBSURFACE CONDITIONS INDICATED ARE NOT INTENDED AS REPRESENTATIONS OR WARRANTIES OF THE CONTINUITY OF SUCH CONDITIONS BETWEEN BORINGS. IT IS EXPRESSLY UNDERSTOOD THAT THE GOVERNMENT WILL NOT BE RESPONSIBLE FOR ANY INTERPRETATION OR CONCLUSION DRAWN THEREFROM BY THE CONTRACTOR. THE DATA IS MADE AVAILABLE FOR THE CONVENIENCE OF THE CONTRACTOR.

ADDITIONAL SOIL BORINGS AND OTHER EXPLORATORY OPERATIONS MAY BE MADE BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT, PROVIDED SUCH OPERATIONS ARE APPROVED BY THE CONTRACTING OFFICER.

LAW ENGINEERING TESTING COMPANY
Geotechnical and Materials Engineers
P. O. BOX 5728 / JACKSONVILLE, FLORIDA 32207 / (904) 396-5173

18B-2

June 21, 1977

Reynolds, Smith and Hills
Architects, Engineers, Planners, Inc.
4019 Boulevard Center Drive
Jacksonville, Florida 32207

Attn: Mr. Ray Phillips, P.E.

Subject: Report of Subsurface Investigation
Modification to Launch Pad 39B
Kennedy Space Center, Florida
Job No. J-2798

Gentlemen:

As authorized by your acceptance of our proposal No. 77-638S, dated March 8, 1977, we have completed a subsurface investigation for the subject project. This report briefly outlines our investigative procedures and presents the findings.

We appreciate the opportunity to assist you with this phase of the project. Should you have any questions regarding this report or if we may be of further assistance, please contact us.

Very truly yours,

LAW ENGINEERING TESTING COMPANY

Curtis J. Roos, E.I.T.
Civil Engineer

R. T. Reynolds, P.E.
Senior Engineer
Registered, Florida 19551

CJR/RTR/slg

PAD 39B MODIFICATIONS - TASK I

79K11306

TABLE OF CONTENTS

FIELD AND LABORATORY INVESTIGATION

Field Investigation

Soil Test Borings - Eight soil test borings were initially planned to be made at Launch Pad 39B. Two of the borings (B-1, B-3) encountered obstructions within the launch pad and had to be relocated as directed by Mr. Alfredo Fernandez of your office. The boring depths ranged from 21 to 238½ feet.

The Test Boring Records, found in the Appendix, graphically give a description of the soil conditions encountered. The boring locations are shown on the attached Boring Plan. The ground surface elevations at the boring locations were given to us by Mr. Fernandez. For a brief description of the drilling and sampling techniques used, please see the Appendix section of this report.

Laboratory Investigation

Representative soil samples were selected for laboratory tests to determine the grain size and plasticity characteristics of the soils encountered. For a brief description of the laboratory procedures used and the test results, see the Appendix section of this report.

SITE AND SOIL CONDITIONS

The location of Launch Pad 39B is shown on the attached Location Map. The pad area is elevated approximately 40 feet above the surrounding ground surface. The top of the pad is covered with a 14 inch reinforced concrete slab. We understand that numerous utilities are located within the launch pad and surrounding areas.

Soil Conditions

Launch Pad 39B - Beneath 14 inches of reinforced concrete a dense to very dense fill was encountered to a depth of approximately 50 feet. The fill consisted of fine sand and slightly silty fine sand with some small shell fragments. Two obstructions were encountered within the fill. Boring B-1 encountered concrete at 21 feet and Boring B-3 encountered firm to very firm cemented shells underlain by steel at a depth of 42 feet. These borings could not penetrate the obstructing layers and had to be relocated. The supplemental Boring B-3A encountered a very dense to very firm layer of cemented shells between 49 and 52.5 feet. This layer was, however, penetrated by the rotary drilling equipment.

Beneath the fill very firm to very dense fine sands and slightly silty fine sands with some shell fragments were encountered. At elevation -43, stiff to hard silty clays and firm clayey sands were then encountered to approxmiately elevation -110.

From elevation -110 to elevation -120, a loose to firm green silty fine sand transitioning into a stiff green silt was penetrated. A 4 foot thick stratum of very dense calcareous silty fine sand alternating with 6-inch cemented limestone layers was encountered next. Firm to very firm slightly clayey sands were then penetrated to elevation -140 where a very stiff to hard silty clay was encountered.

At approximately elevation -176, a limestone stratum consisting of very dense cemented fine sand and shells and cherty limestone was penetrated until the deepest boring was terminated at elevation -186.

Sound Suppression Systems Area - Beneath the thin veneer of topsoil up to 8 feet of loose to dense fine sands and slightly silty fine sands with shell fragments were encountered. Firm to very dense fine sands and slightly silty fine sands were then penetrated to approximately elevation -23. Very loose to dense silty fine sands and clayey fine sands were then penetrated to about elevation -60.

Clayey silts, sands and clayey sands were penetrated from elevation -60 to -105. Loose green silty fine sands and clayey fine sands were then penetrated to approximately elevation -125. A 5 foot thick stratum of limestone consisting of grey-green cemented sands was then encountered. Very firm to dense silty and clayey fine sands were then penetrated to elevation -145 where very stiff to hard silty clays were encountered. At elevation -176 a limestone stratum consisting of cemented fine sands and shells and cherty limestone was encountered until the boring was terminated at elevation -186.

Ground Water The ground water level was measured at the boring locations and was found to range from elevation +3 to +5. This level will vary with seasonal climatic changes and the tidal level in the adjacent marshes.

Site Geology - The fine sands and slightly silty fine sands with shell fragments encountered to approximately elevation -20 are geologically classified as Pleistocene and Recent deposits. These are underlain by clayey sands and silty sands to approximately elevation -105 and are characterized as Upper Miocene or Pliocene deposits.

The next geologic unit encountered is the Hawthorne formation. This deposit is readily identified by its green color and consists of layers of silty clays, silts and clayey sands. The 5 foot thick layer of limestone encountered at approximately elevation -120 is also a part of the Hawthorne formation.

At approximately elevation -176 a limestone stratum of the Crystal River Formation was encountered.

The above soil descriptions and the Generalized Subsurface Profiles in the Appendix highlight the major subsurface stratification. For detailed descriptions of the soil conditions encountered at each boring location, the attached Test Boring Records should be consulted. When reviewing the soil profiles and the Test Boring Records, it should be understood that the soil conditions will vary between the boring locations.

APPENDIX

FIELD PROCEDURES

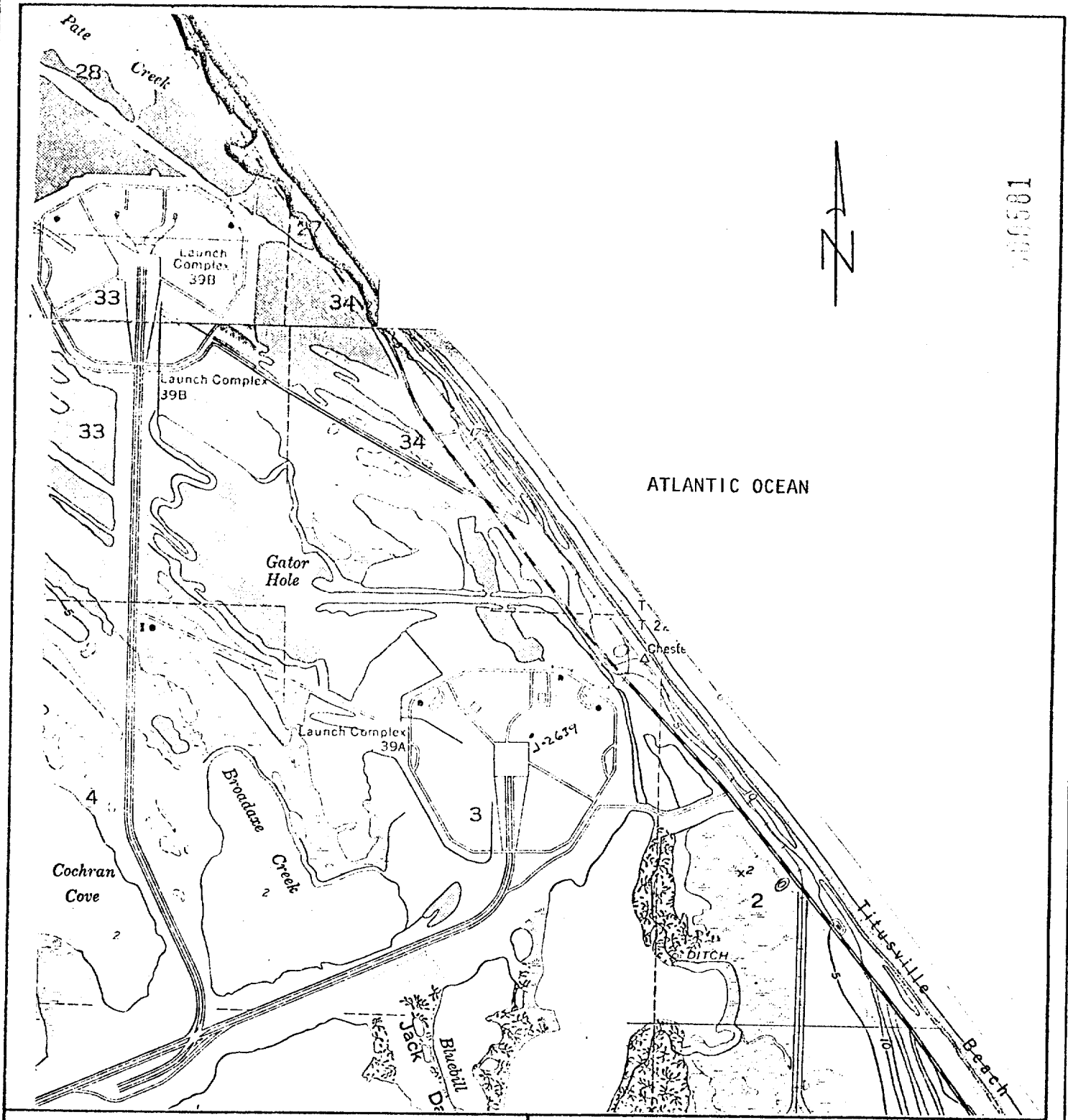
Soil Test Borings - The soil test borings were made in accordance with ASTM Designation D1586-67, Penetration Test and Split-Barrel Sampling of Soils. The borings were initially advanced by augering. A rotary drilling process was subsequently used and bentonite drilling fluid was circulated in the bore holes to stabilize the sides and flush the cuttings. In some borings it was also necessary to install casing to retain the sides of the bore holes. At regular intervals the drilling tools were removed and soil samples were obtained with a standard 1.4 inch I.D., 2.0 inch O.D., split-tube sampler. The sampler was first seated six inches and then driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "penetration resistance". The penetration resistance is an index to the soil strength and density.

Representative portions of the soil samples, obtained from the sampler, were placed in glass jars and transported to our laboratory. The samples were then examined by an engineer to verify the driller's field classifications.

Rock Coring - When the standard penetration resistance in the limestone formation exceeded 80 blows per foot, the layer was cored using a diamond studdded bit fastened to the end of a hollow double-tube core barrel. The procedure was similar to that described by ASTM 2113. The core barrel is rotated at high speeds and the core samples of the material penetrated are protected and retained in the swivel mounted inner tube. Upon completion of each 5 foot drill run, the core barrel was

brought to the surface and the samples removed and placed in storage boxes.

The rock was then identified in the field and the percentage recovery determined. The recovery is the ratio of the sample length obtained to the depth drilled expressed as a percent. The percent recovery is somewhat related to rock soundness and continuity. Rock descriptions, recoveries and coring times are shown on the appropriate Test Boring Record along with the bit size used. All the coring done for this investigation utilized a NX size bit which obtained a 2-1/8 inch diameter core.



Approximate Scale: 1" = 2000'

U. S. G. S.

False Cape & Wilson Quadrangles

LAW ENGINEERING TESTING COMPANY

Jacksonville, Florida

LOCATION MAP

Pad 39B

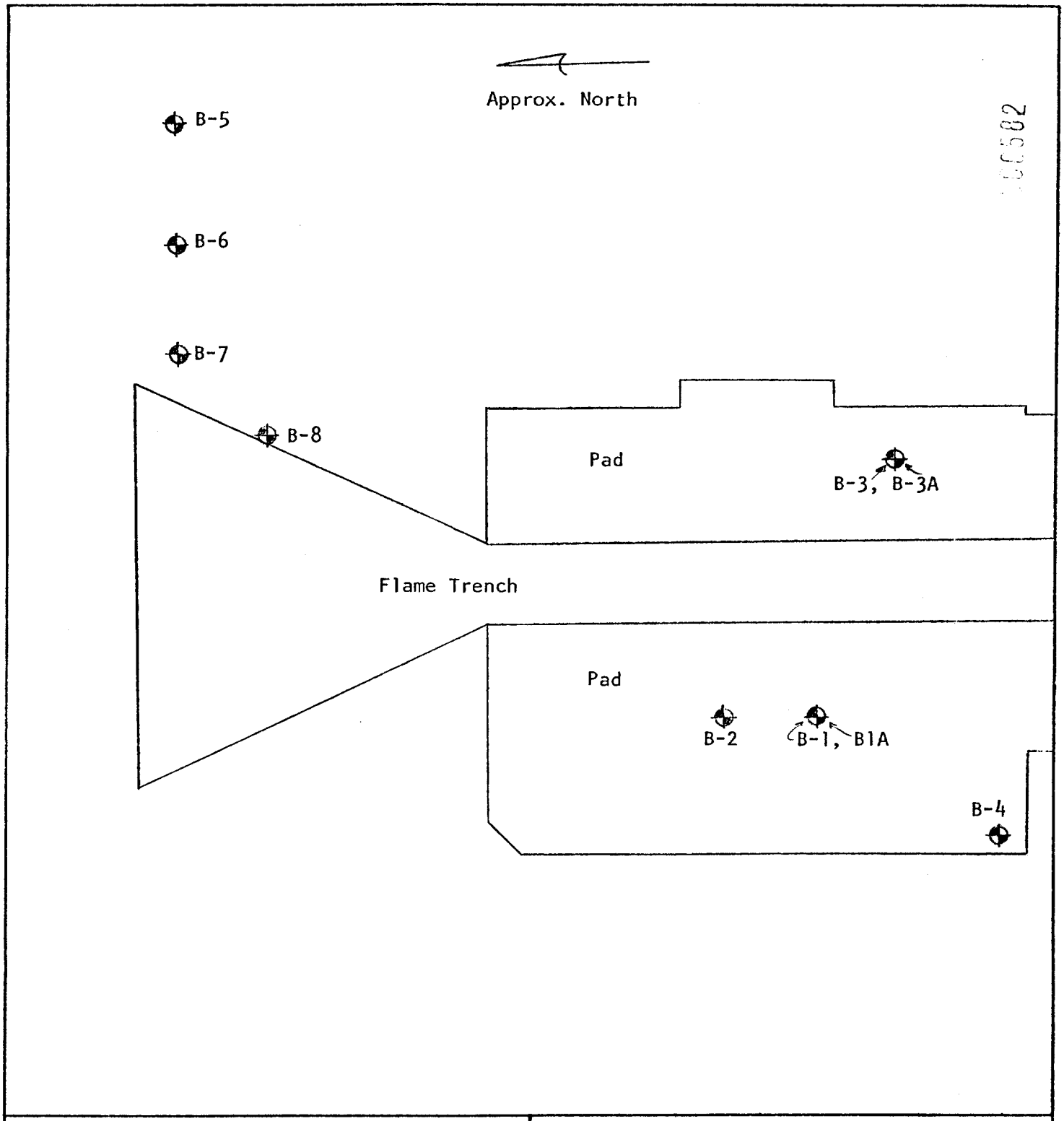
Kennedy Space Center, Florida

Job No. J-2798

18B-11

PAD 39B MODIFICATIONS - TASK I

79K11306



Approximate Scale: 1" = 100'

Soil Test Boring Location

LAW ENGINEERING TESTING COMPANY

Jacksonville, Florida

BORING PLAN

Pad 39B

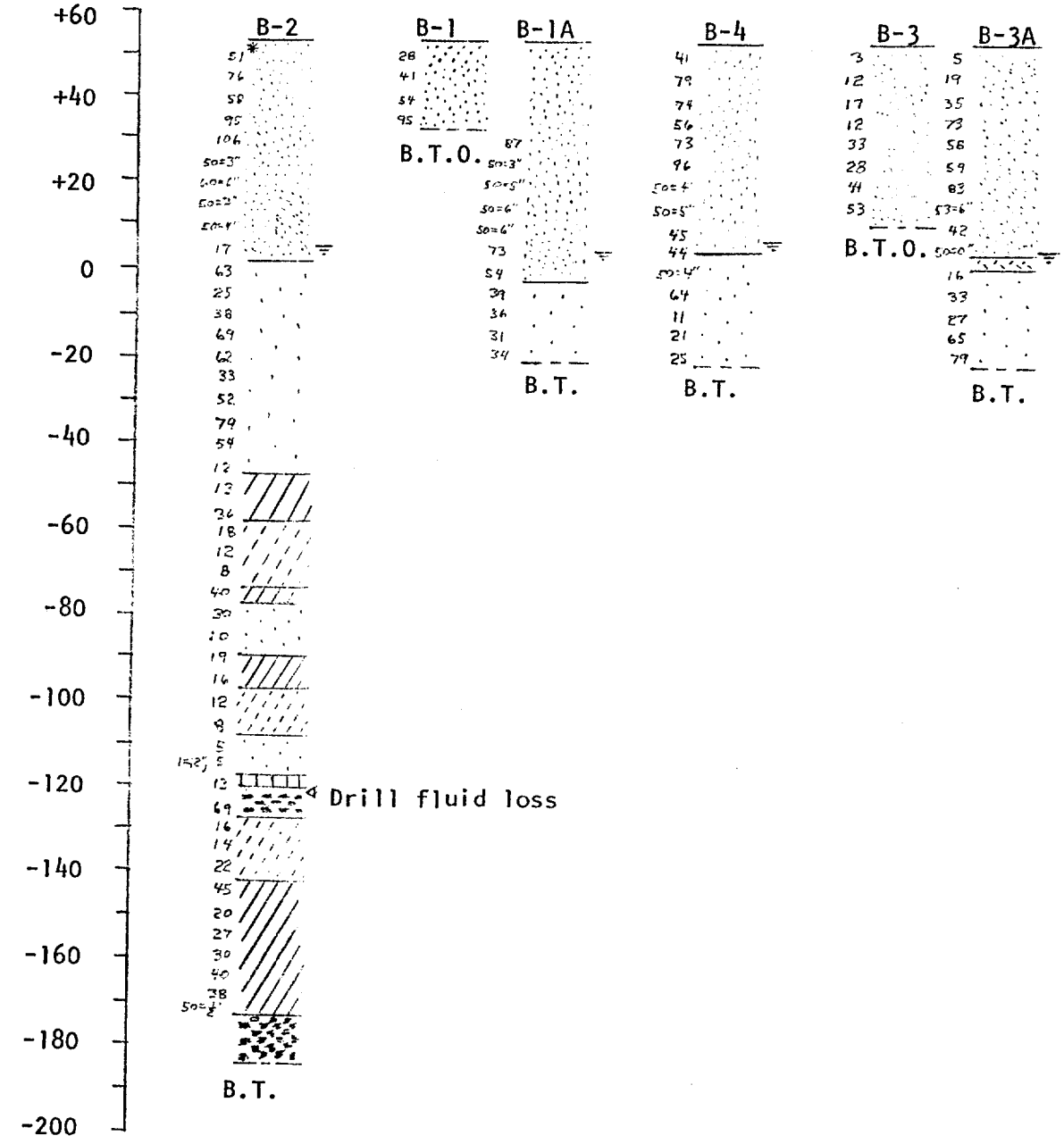
Kennedy Space Center, Florida

Job No. J-2798

18B-12

PAD 39B MODIFICATIONS - TASK I

79K11306



B.T. = Boring Terminated

B.T.O. = Boring Terminated when obstruction encountered

- Fine Sand, slightly silty fine Sand (SP-SM) w/shell fragments (Fill)
- Fine Sand, slightly silty fine Sand (SP-SM) w/shell fragments
- Clay (CL, CH)
- Clayey Sand (SP-SC)
- Cemented Shells
- Silt (MH, ML)
- Limestone
- Ground water level
- * Standard Penetration Resistance, blows/ft

GENERALIZED SUBSURFACE PROFILE

Pad 39B

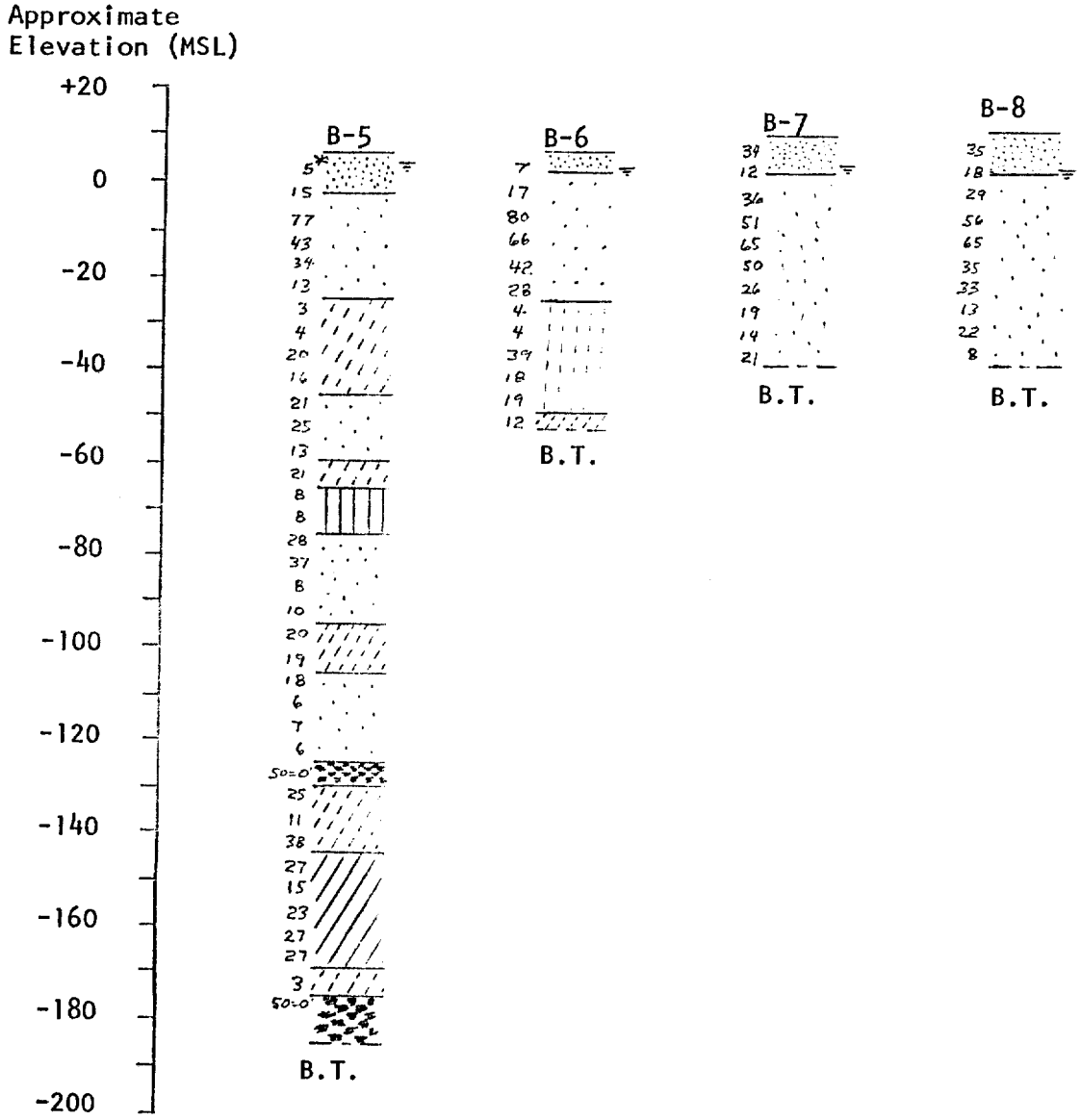
Kennedy Space Center, Florida

Job No. J-2798

18B-13

PAD 39B MODIFICATIONS - TASK I

79K11306



B.T. = Boring Terminated

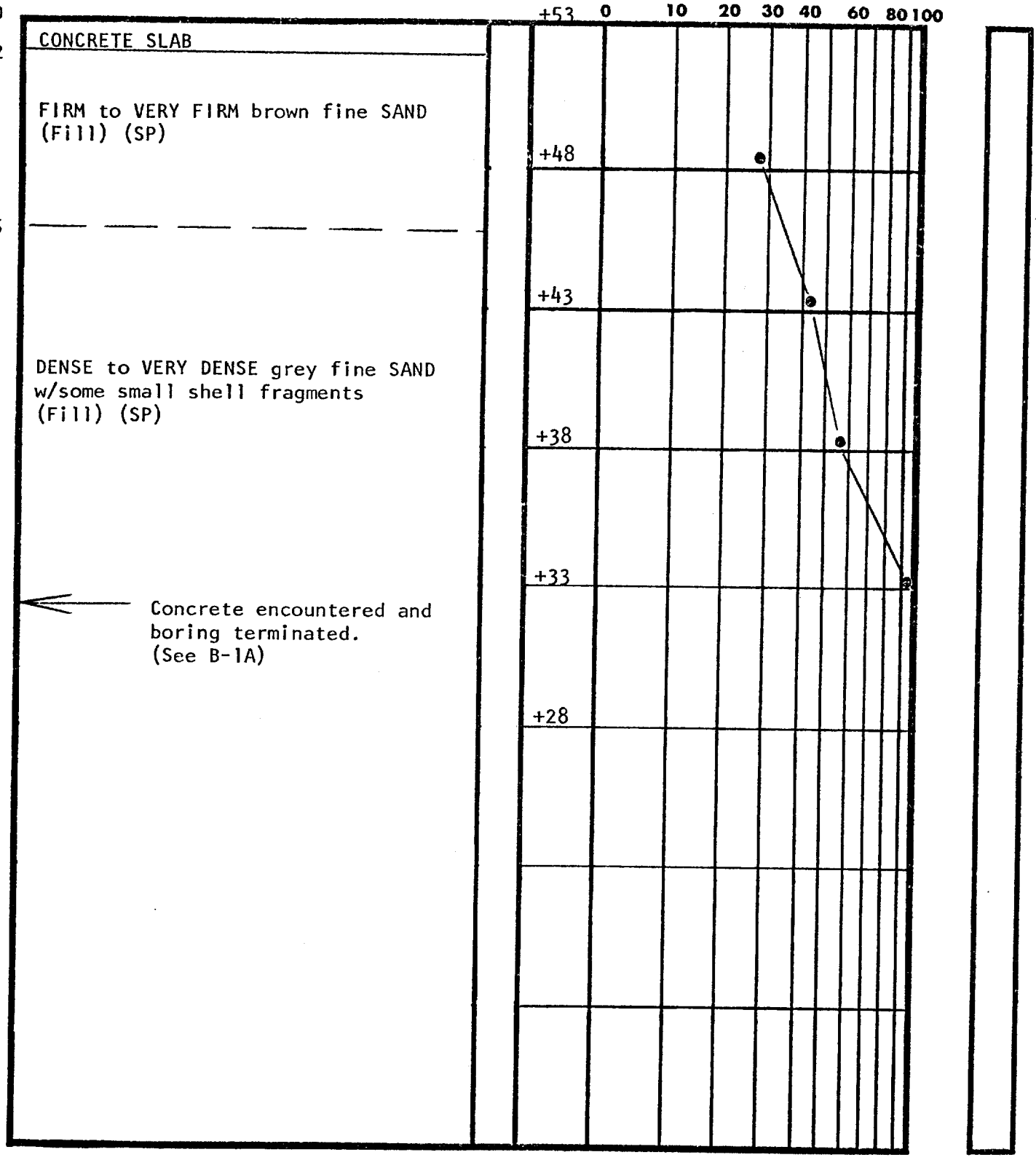
- Fine Sand, slightly silty fine Sand (SP-SM) w/shell fragments (Fill)
- Fine Sand, slightly silty fine Sand (SP-SM) w/shell fragments
- Clay (CL, CH)
- Clayey Sand (SP-SC)
- Silt (MH, ML)
- Very silty Sand (SP-MH)
- Limestone
- Ground water level
- Standard Penetration Resistance, blows/ft

GENERALIZED SUBSURFACE PROFILE

Pad 39B

Kennedy Space Center, Florida

Job No. J-2798



18B-15

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
LOSS OF DRILLING WATER

BORING NO. B-1
DATE DRILLED 5/16/77
JOB NO. J-2798

LAW ENGINEERING TESTING CO.

DEPTH FT.	DESCRIPTION	ELEV	• PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0.0		+53	
1.2	CONCRETE SLAB		
	FIRM to VERY DENSE brown and grey fine SAND w/some small shell fragments (Fill) (SP)	+48	
		+43	
	NOTE: Rotary drilled to 23.5 feet. See B-1 for penetration resistance.	+38	
		+33	
		+28	
	VERY DENSE grey fine SAND to slightly silty fine SAND w/some small shell fragments (Fill) (SP, SP-SM)	+23	50=3"
		+18	50=5"
0.0		+13	50=6"

B-1A is 3 feet northwest of B-1

PAD 39B MODIFICATIONS - TASK I

18B-16

79K11306

TEST BORING RECORD

(Page 1 of 2)

BORING NO. B-1A

DATE DRILLED 5/26/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

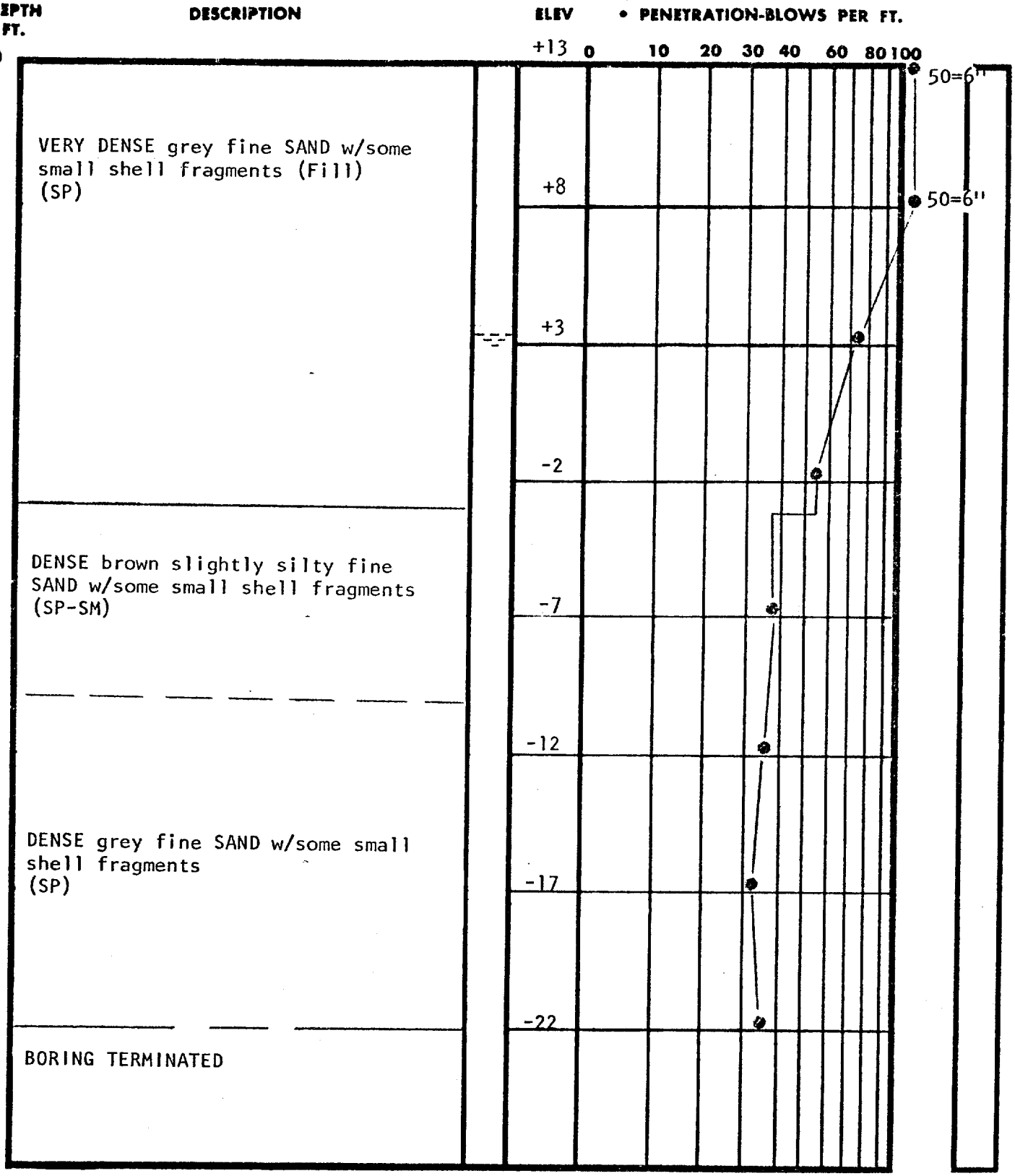
UNDISTURBED SAMPLE

|50| % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



18B-17

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 2 of 2)

BORING NO. B-1A

DATE DRILLED 5/26/77

JOB NO. J-2798

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

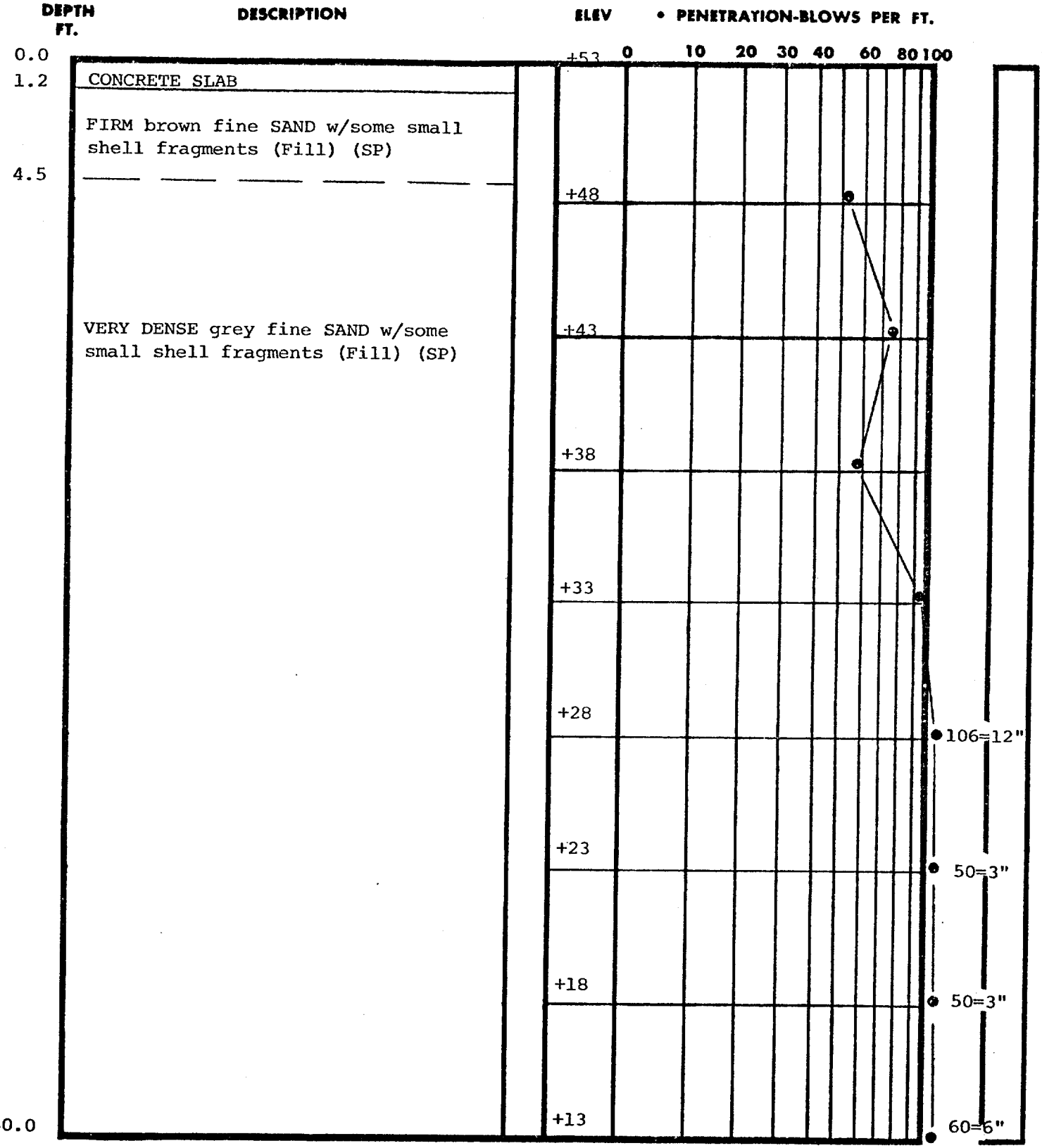
50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

LAW ENGINEERING TESTING CO.



NW casing to 192'

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
|50| % ROCK CORE RECOVERY
LOSS OF DRILLING WATER

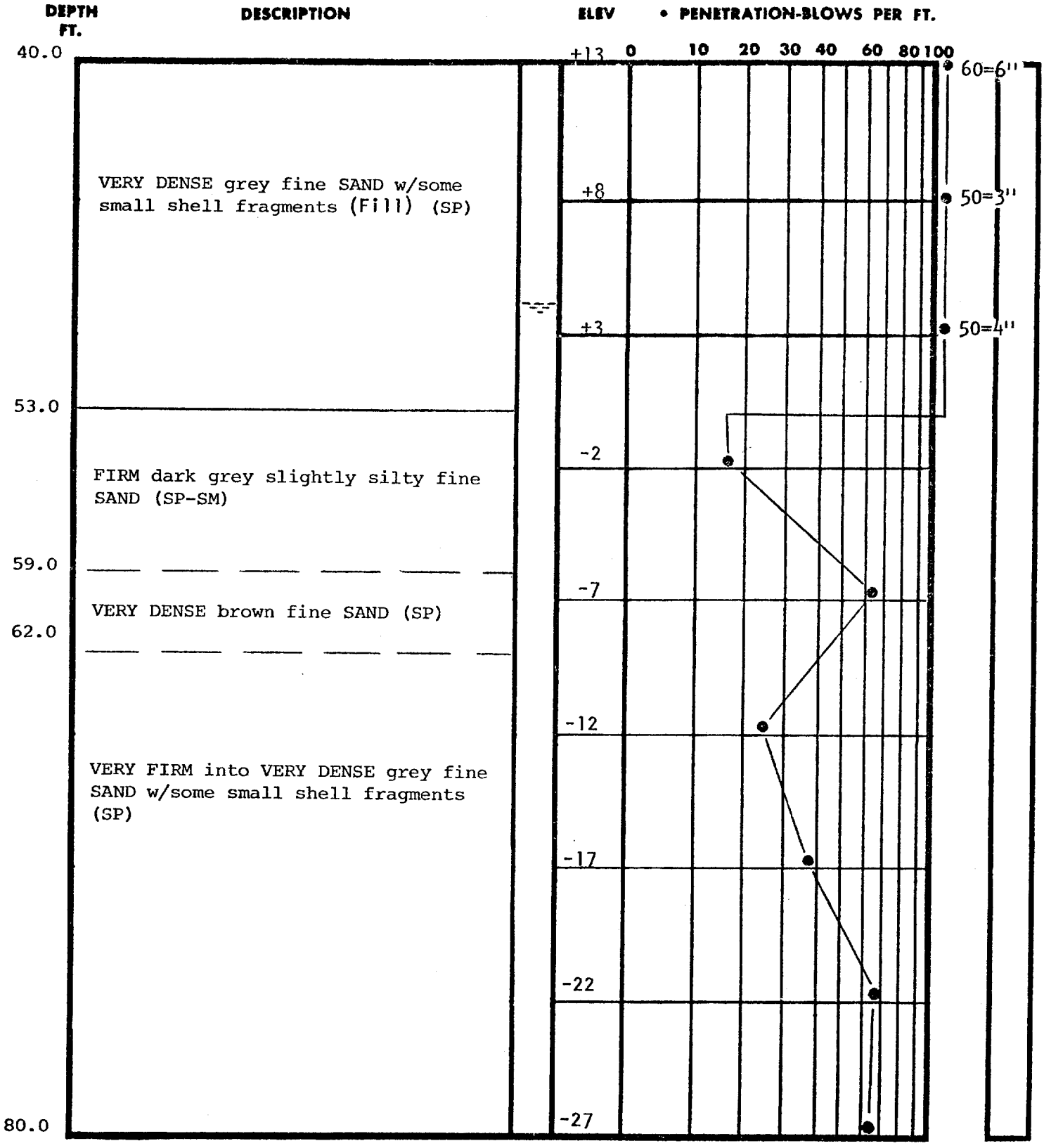
TEST BORING RECORD

(Page 1 of 6)

BORING NO. B-2
DATE DRILLED 5/17/77 - 5/24/77
JOB NO. J-2798

LAW ENGINEERING TESTING CO.

PAD 39B MODIFICATIONS - TASK I
79K11306



18B-19

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 2 of 6)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

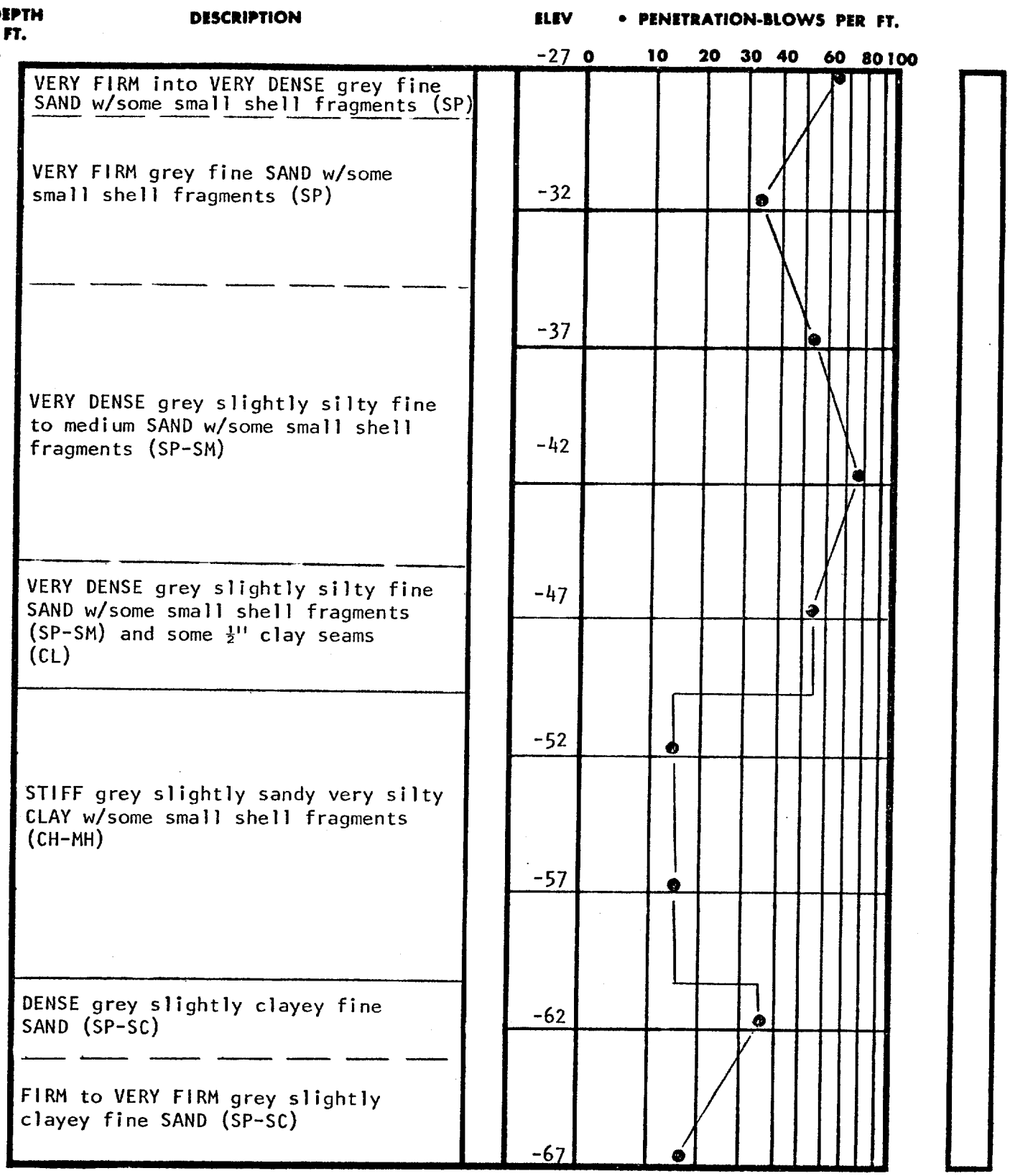
LOSS OF DRILLING WATER

BORING NO. B-2

DATE DRILLED 5/17/77 - 5/24/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.



PAD 39B MODIFICATIONS - TASK I

18B-20

79K11306

TEST BORING RECORD

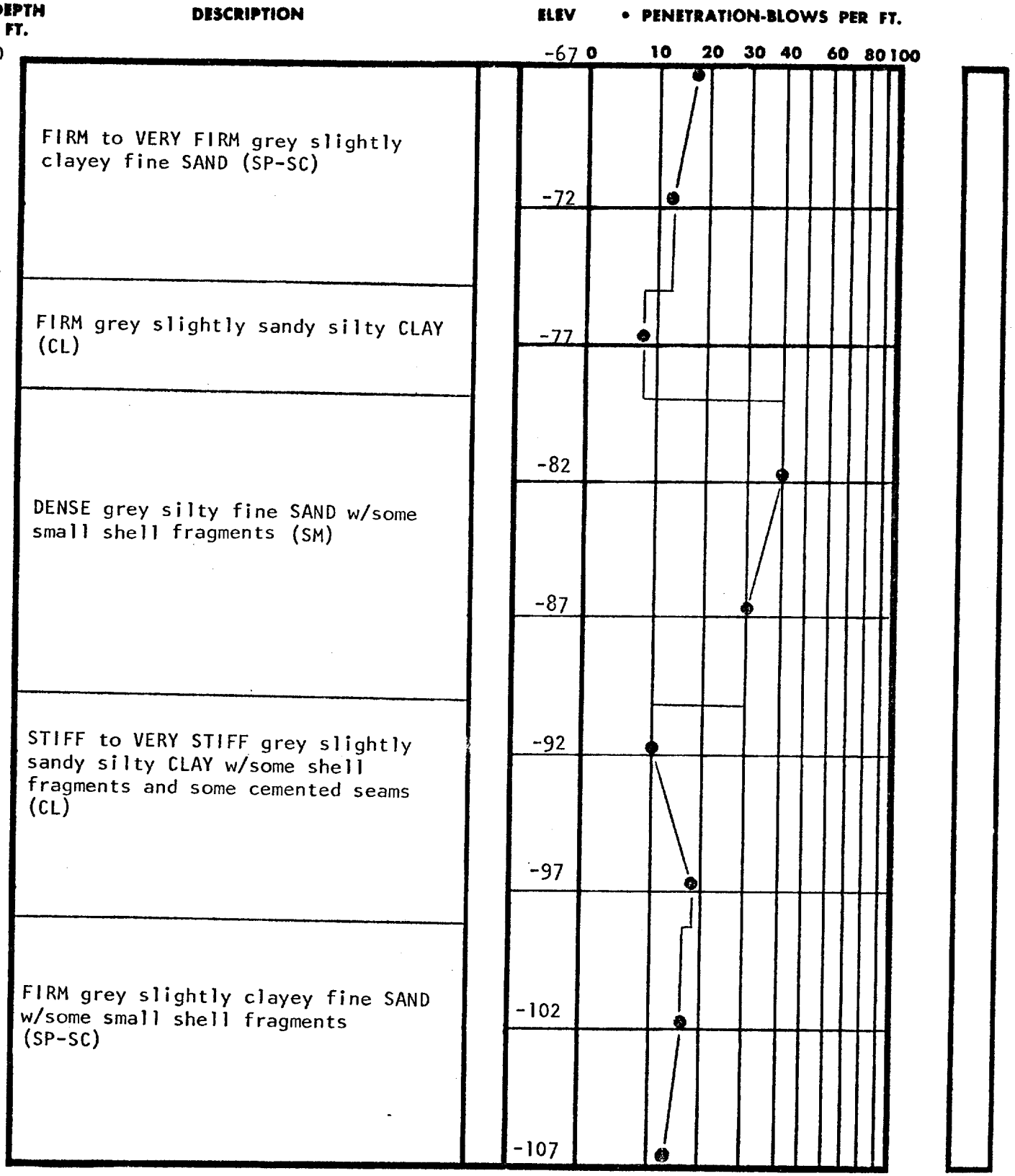
(Page 3 of 6)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
% ROCK CORE RECOVERY
LOSS OF DRILLING WATER

BORING NO. B-2
DATE DRILLED 5/17/77 - 5/24/77
JOB NO. J-2798

LAW ENGINEERING TESTING CO.



18B-21

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

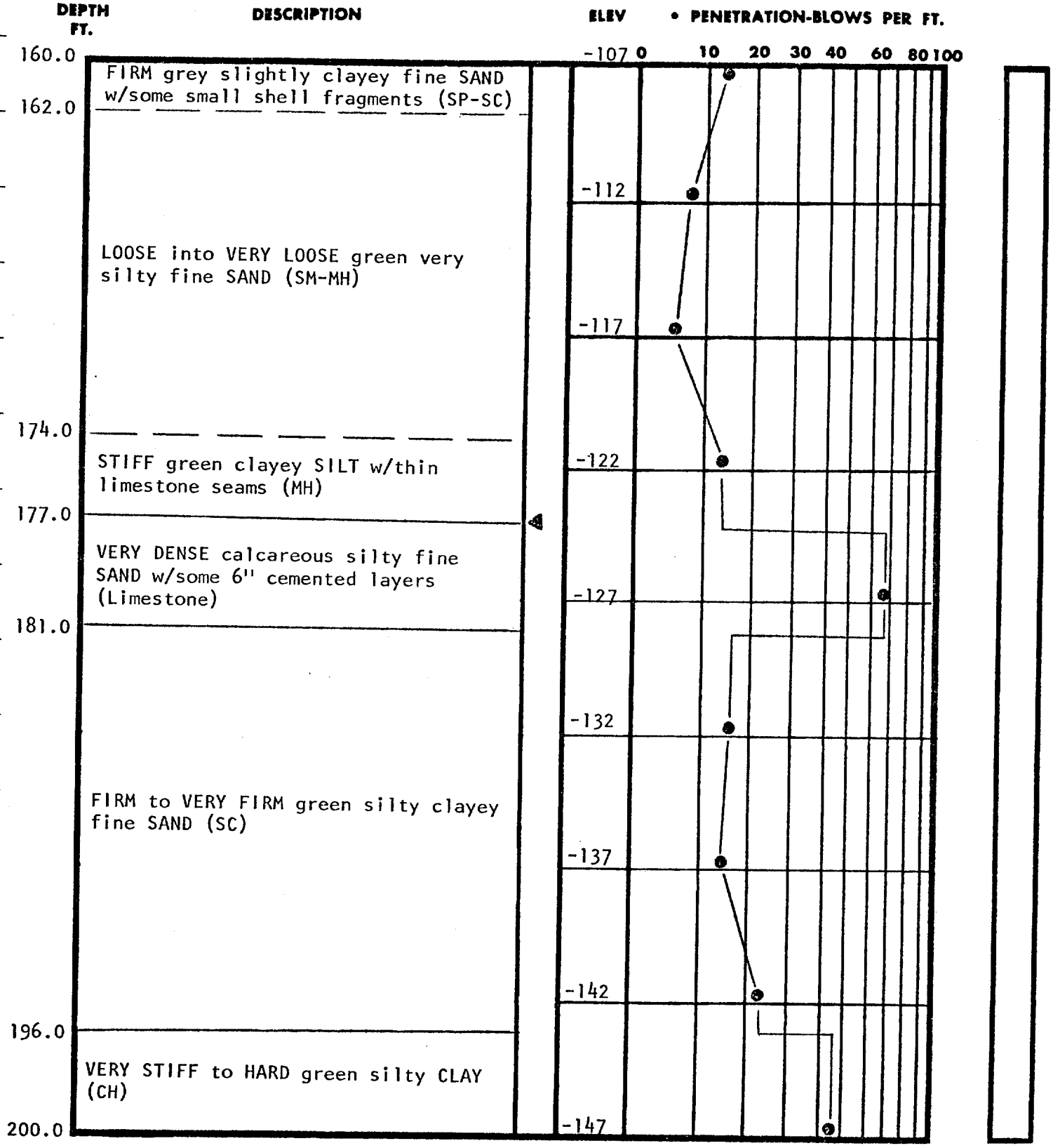
(Page 4 of 6)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
% ROCK CORE RECOVERY
LOSS OF DRILLING WATER

BORING NO. B-2
DATE DRILLED 5/17/77 - 5/24/77
JOB NO. J-2798

LAW ENGINEERING TESTING CO.



18B-22

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

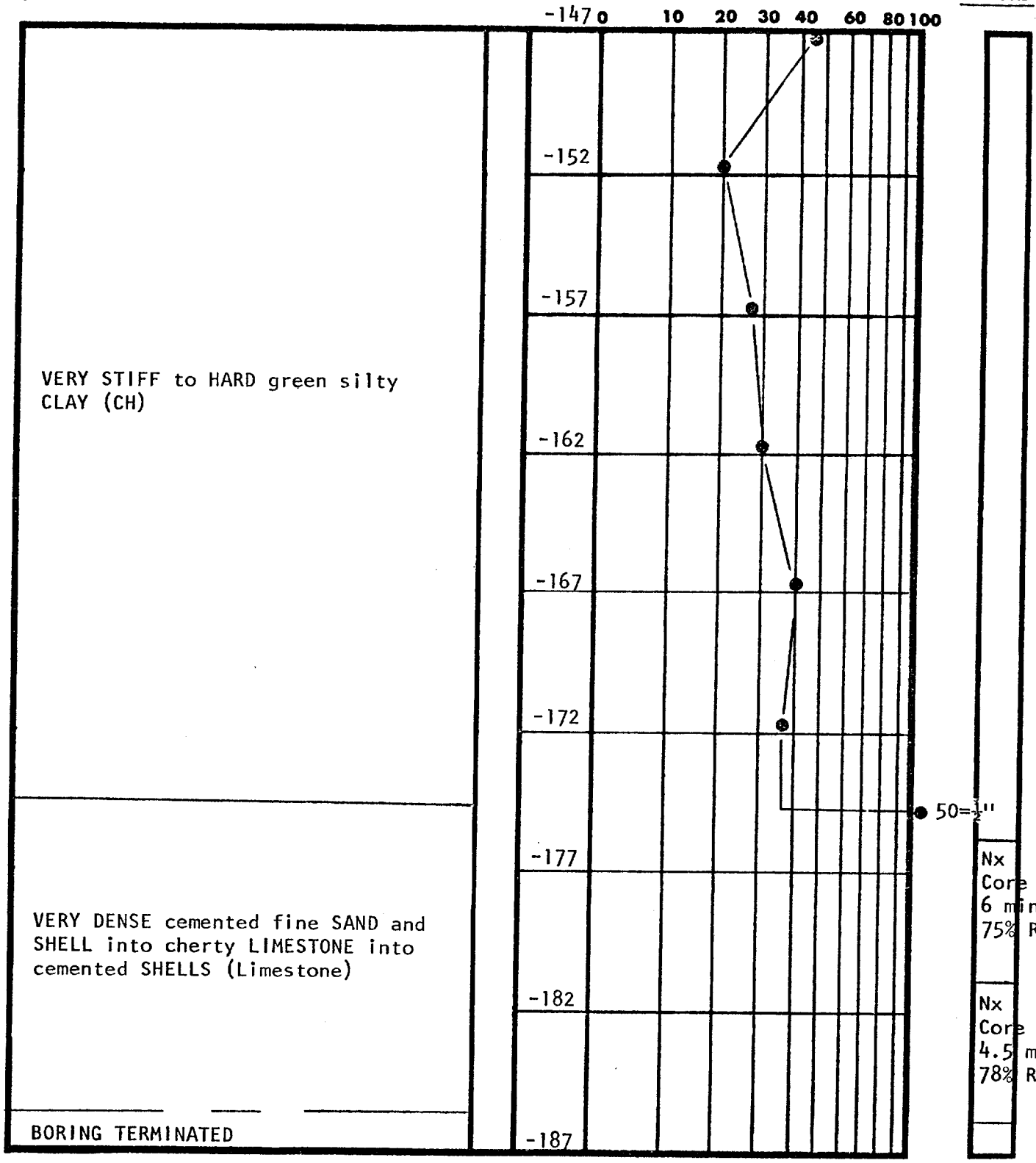
(Page 5 of 6)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER

BORING NO. B-2
DATE DRILLED 5/17/77 - 5/24/77
JOB NO. J-2798

LAW ENGINEERING TESTING CO.



18B-23

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 6 of 6)

BORING NO. B-2

DATE DRILLED 5/17/77 - 5/24/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

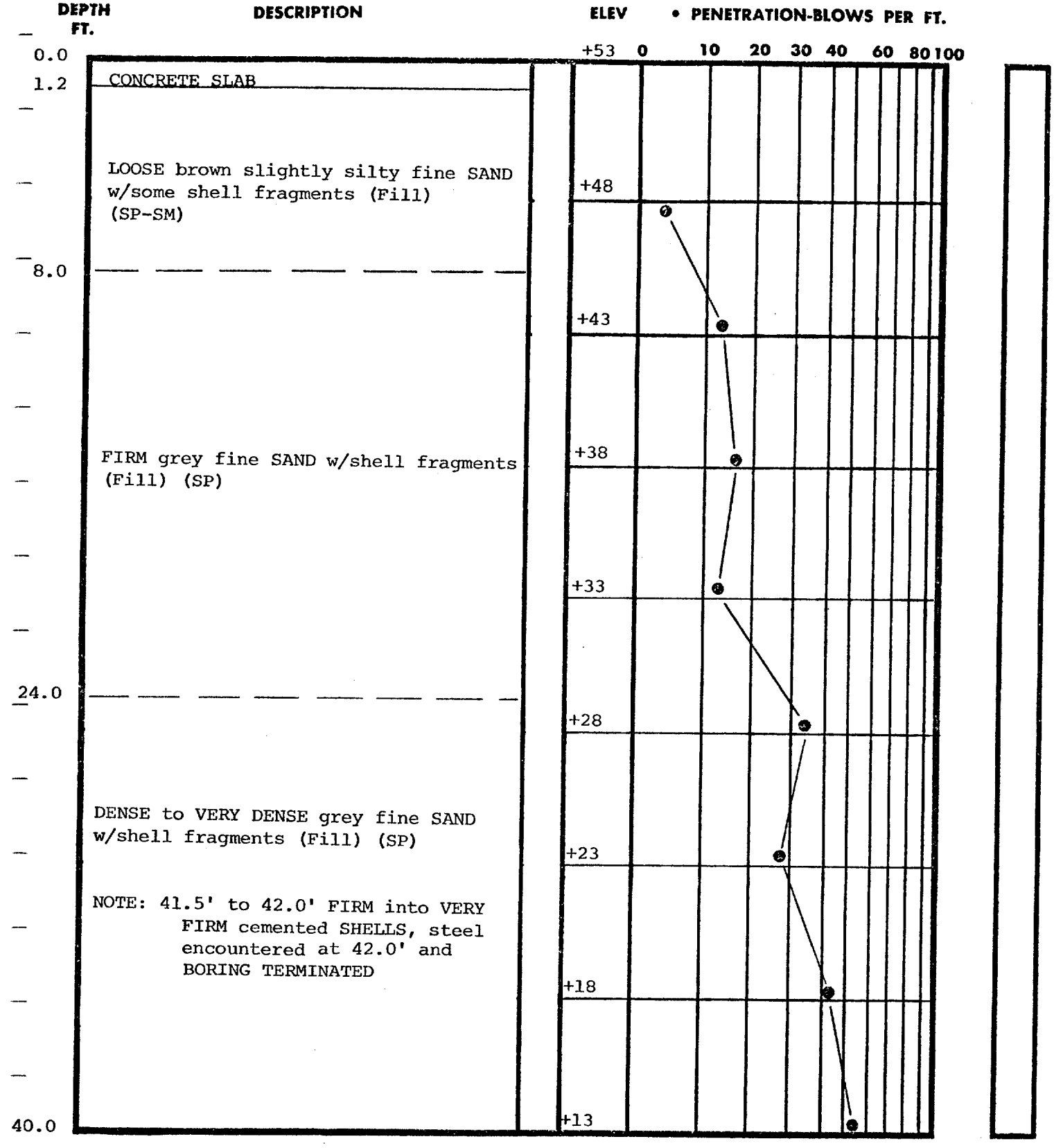
UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



Ground water level not encountered

TEST BORING RECORD

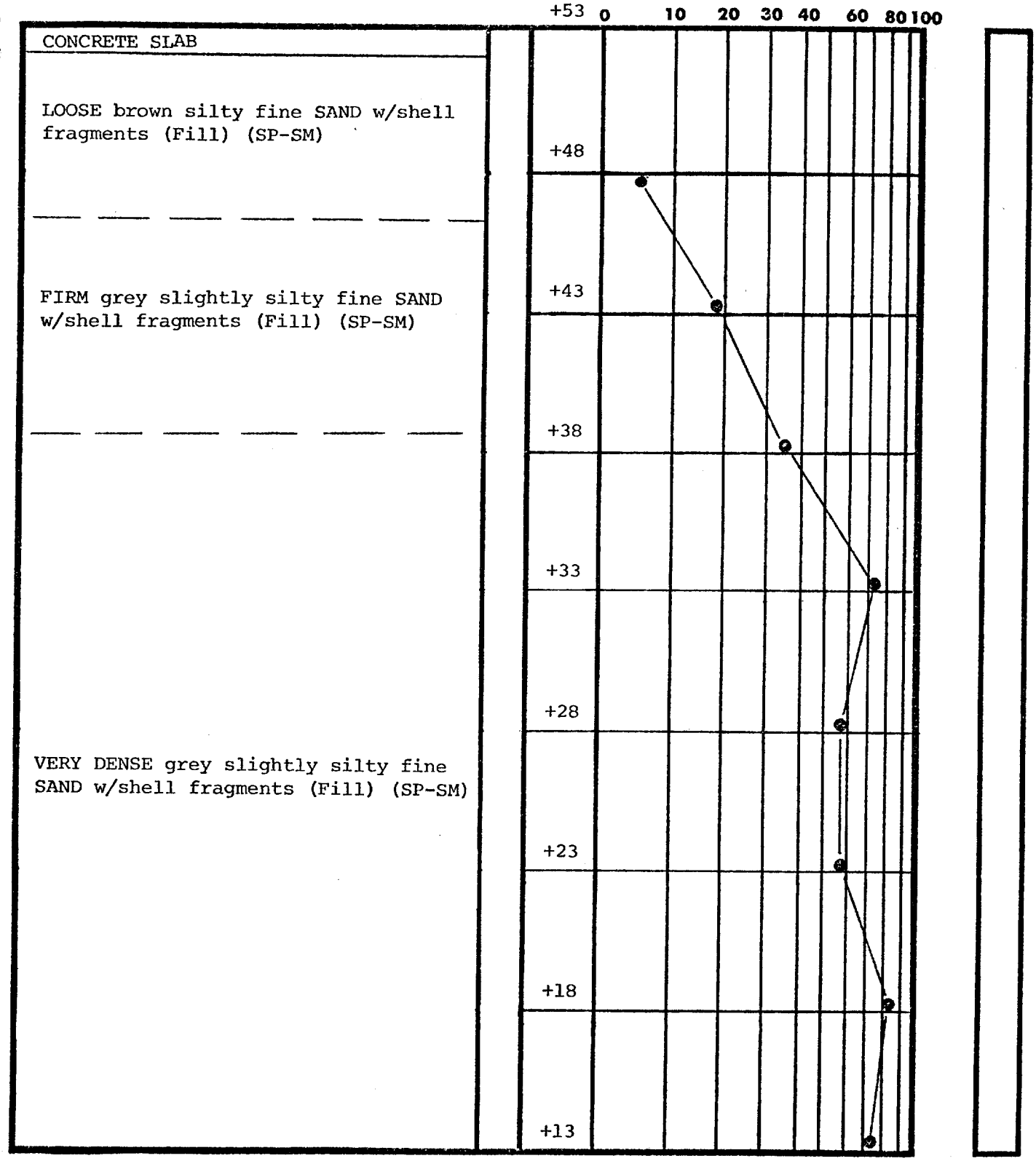
BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
% ROCK CORE RECOVERY
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
LOSS OF DRILLING WATER

BORING NO. B-3
DATE DRILLED 5/31/77
JOB NO. J-2798

LAW ENGINEERING TESTING CO.

PAD 39B MODIFICATIONS - TASK I
79K1306
18B-24



B-3A is 8' southeast of B-3

TEST BORING RECORD

(Page 1 of 2)

BORING NO. B-3A

DATE DRILLED 6/8/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

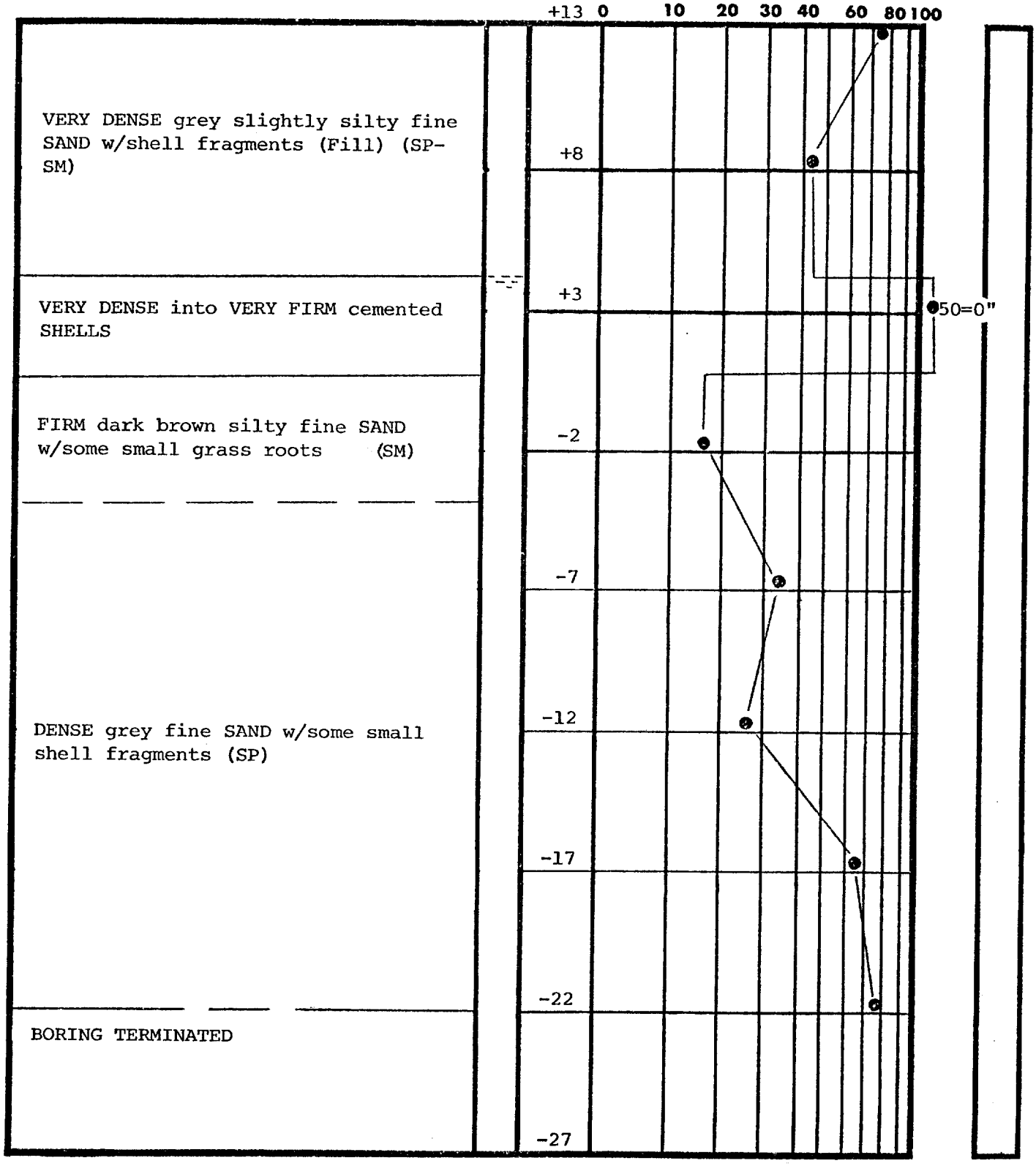
WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

PAD 39B MODIFICATIONS - TASK I

79K11306

18B-25



18B-26

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 2 of 2)

BORING NO. B-3A

DATE DRILLED 6/8/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

DEPTH FT.	DESCRIPTION	ELEV	• PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0.0		+53	
1.2	CONCRETE SLAB		
	DENSE to VERY DENSE grey fine SAND w/some small shell fragments (Fill) (SP)	+48	
		+43	
		+38	
		+33	
		+28	
		+23	
		+18	50=4"
40.0		+13	50=5"

18B-27

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 1 of 2)

BORING NO. B-4

DATE DRILLED 5/26/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

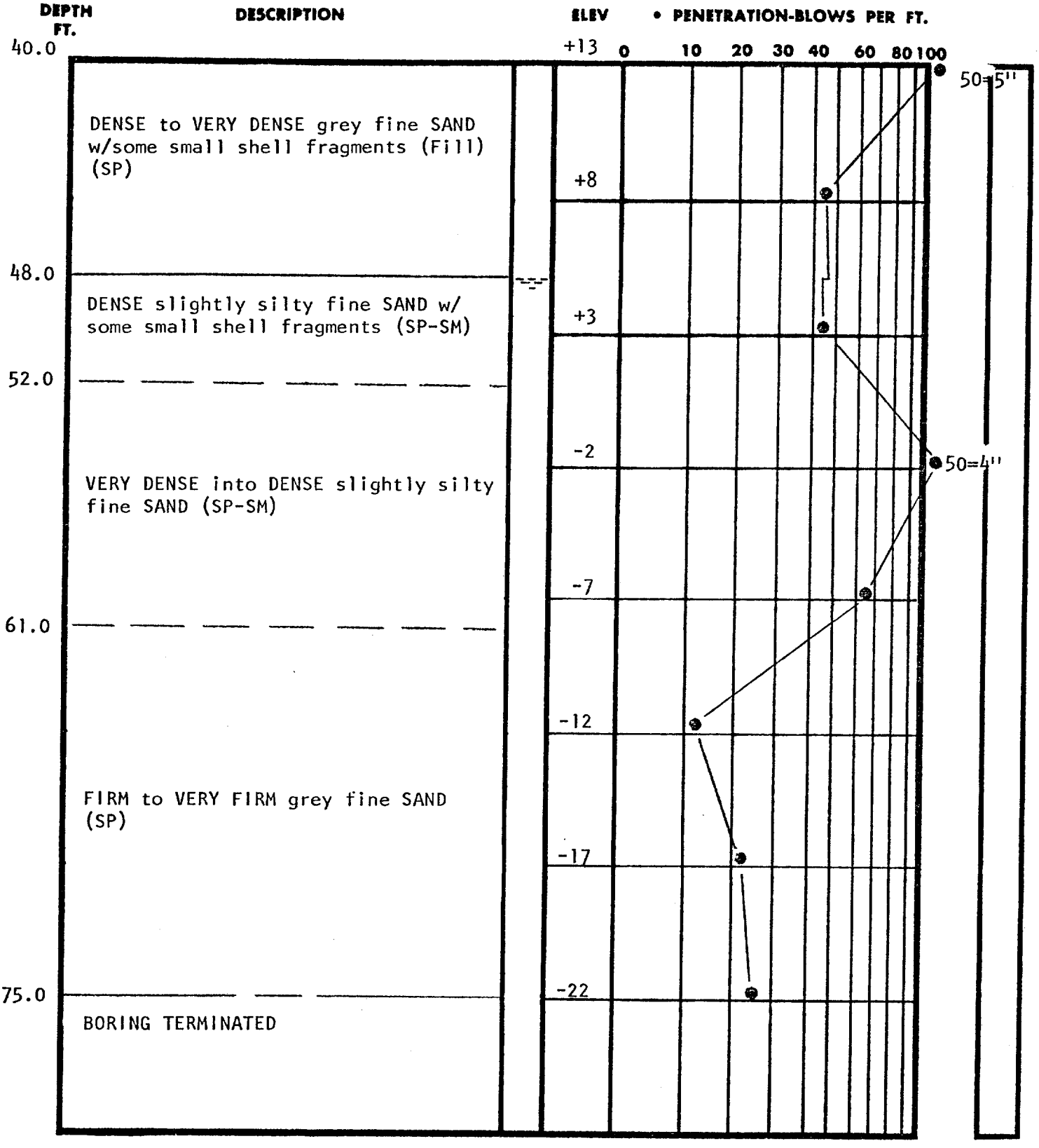
UNDISTURBED SAMPLE

|60| % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



18B-28

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 2 of 2)

BORING NO. B-4

DATE DRILLED 5/26/77

JOB NO. J-2798

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

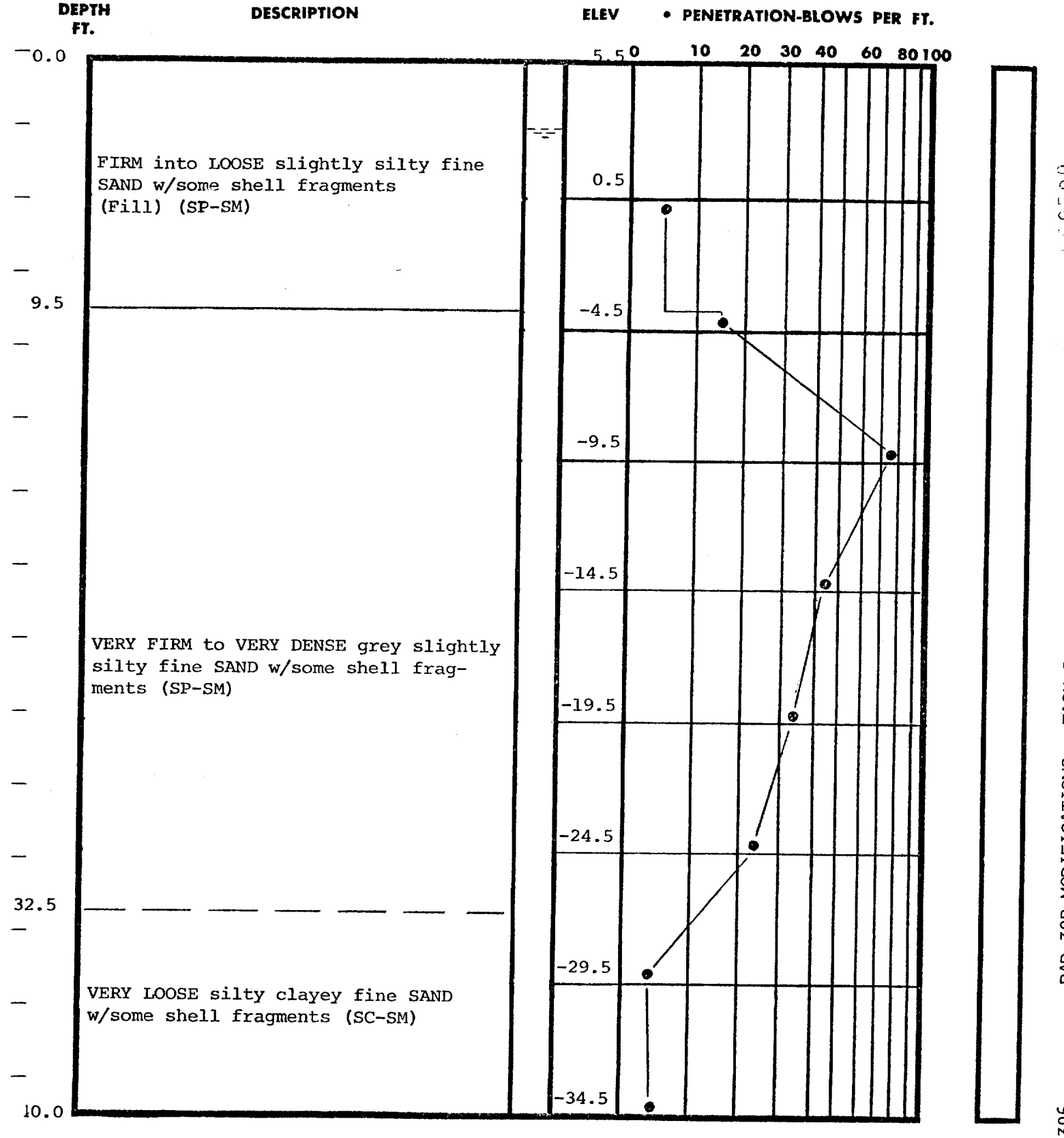
50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

LAW ENGINEERING TESTING CO.



18B-29

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 1 of 5)

BORING NO. B-5

DATE DRILLED 6/2/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

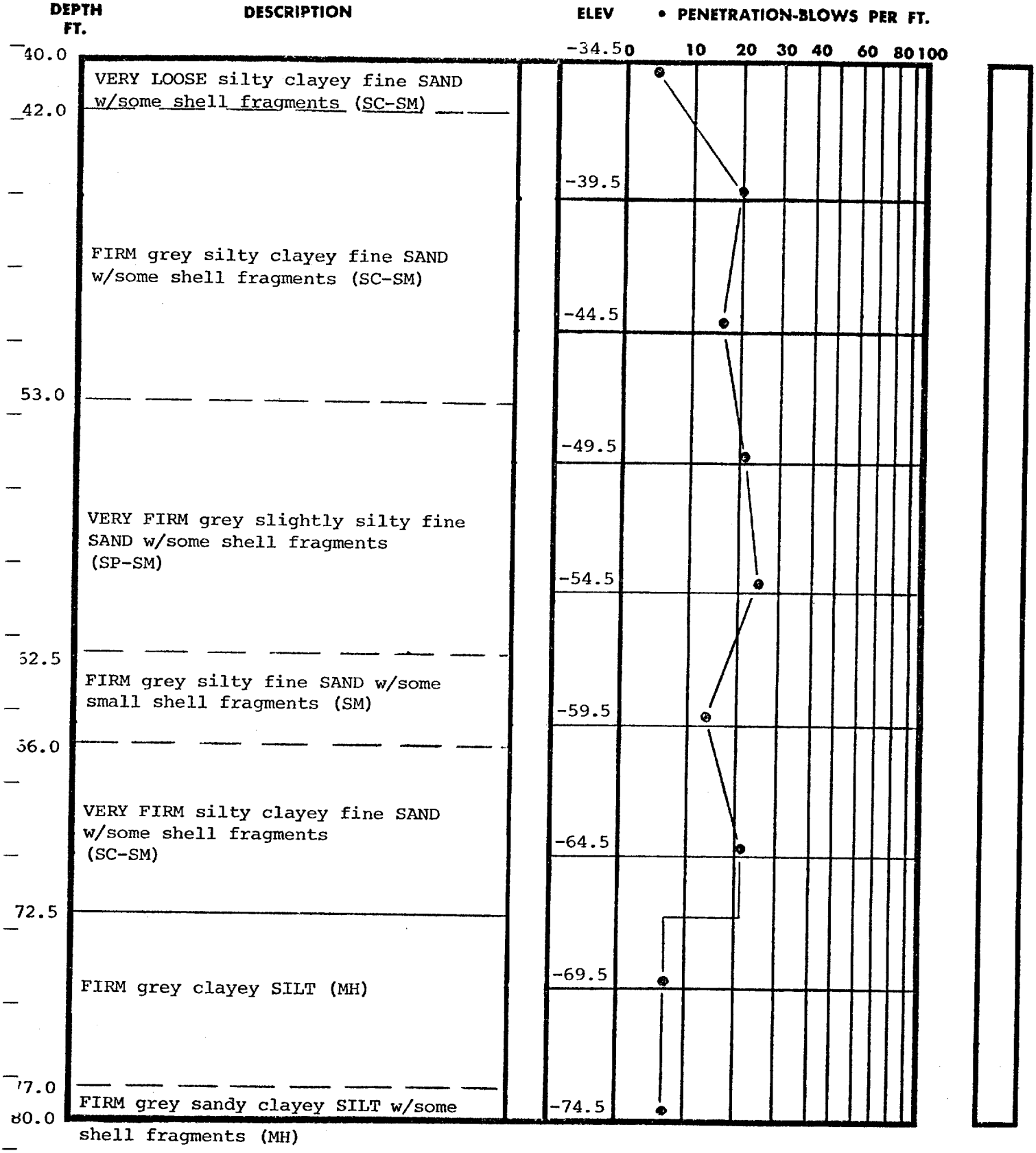
UNDISTURBED SAMPLE

|50| % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



18B-30

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 2 of 5)

BORING NO. B-5

DATE DRILLED 6/2/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

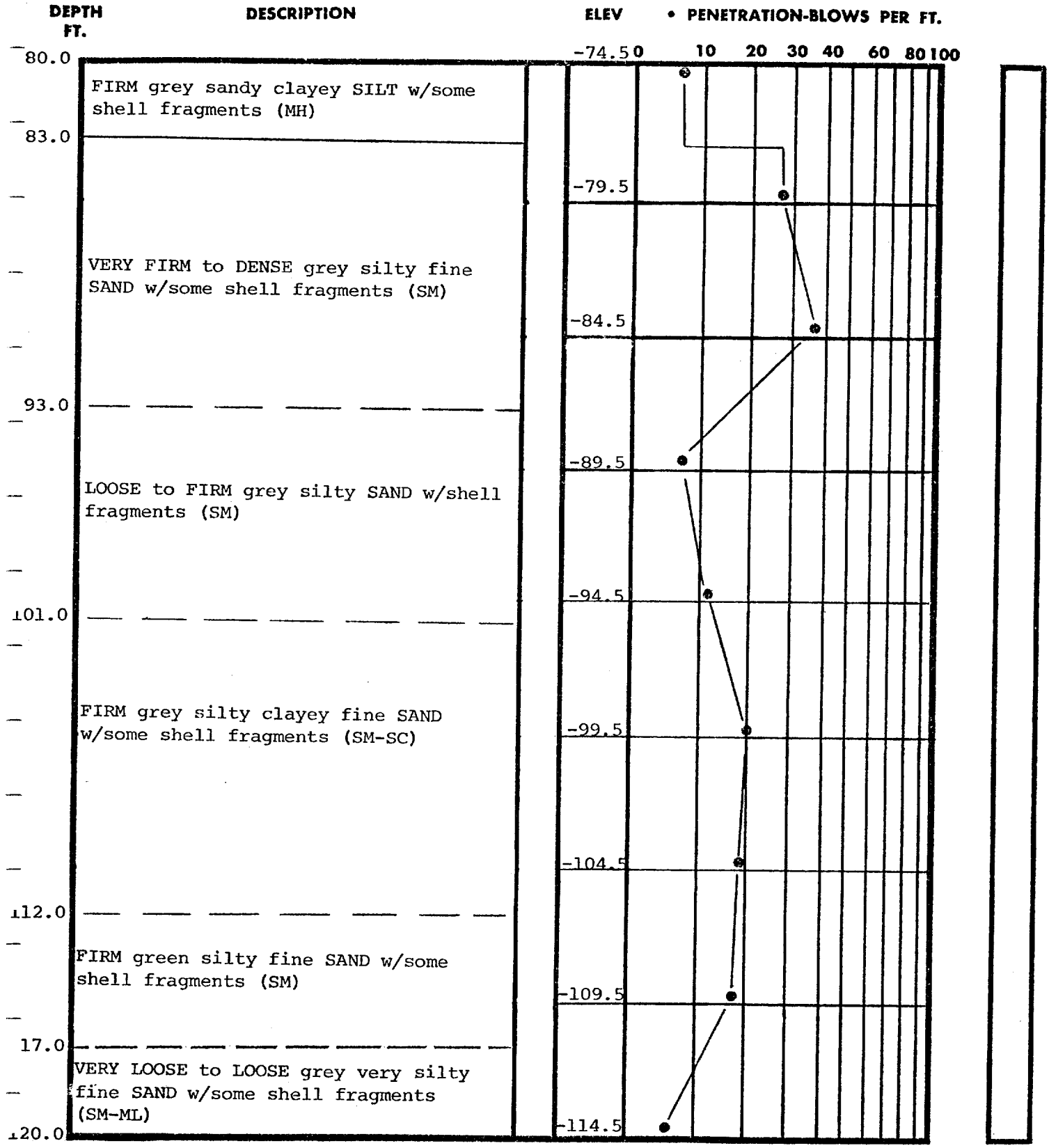
UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



18B-31

PAD 39B MODIFICATIONS - TASK I

79K1306

TEST BORING RECORD

(Page 3 of 5)

BORING NO. B-5

DATE DRILLED 6/2/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

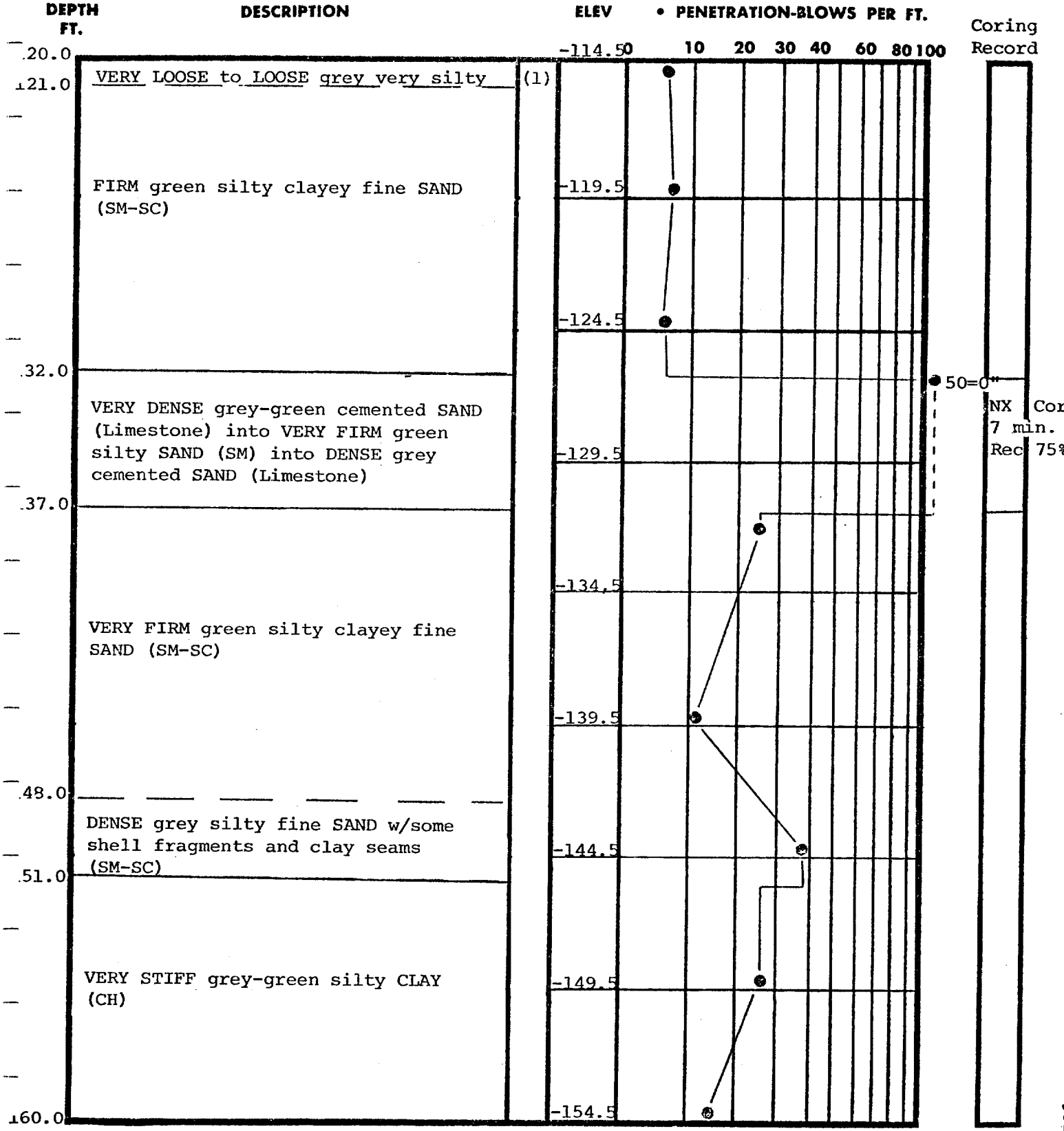
UNDISTURBED SAMPLE

|50| % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



(1) fine SAND w/some shell fragments (SM-ML)

NOTE: 5 to 10% drilling fluid loss from 132' to 192'

TEST BORING RECORD

(Page 4 of 5)

BORING NO. B-5

DATE DRILLED 6/8/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

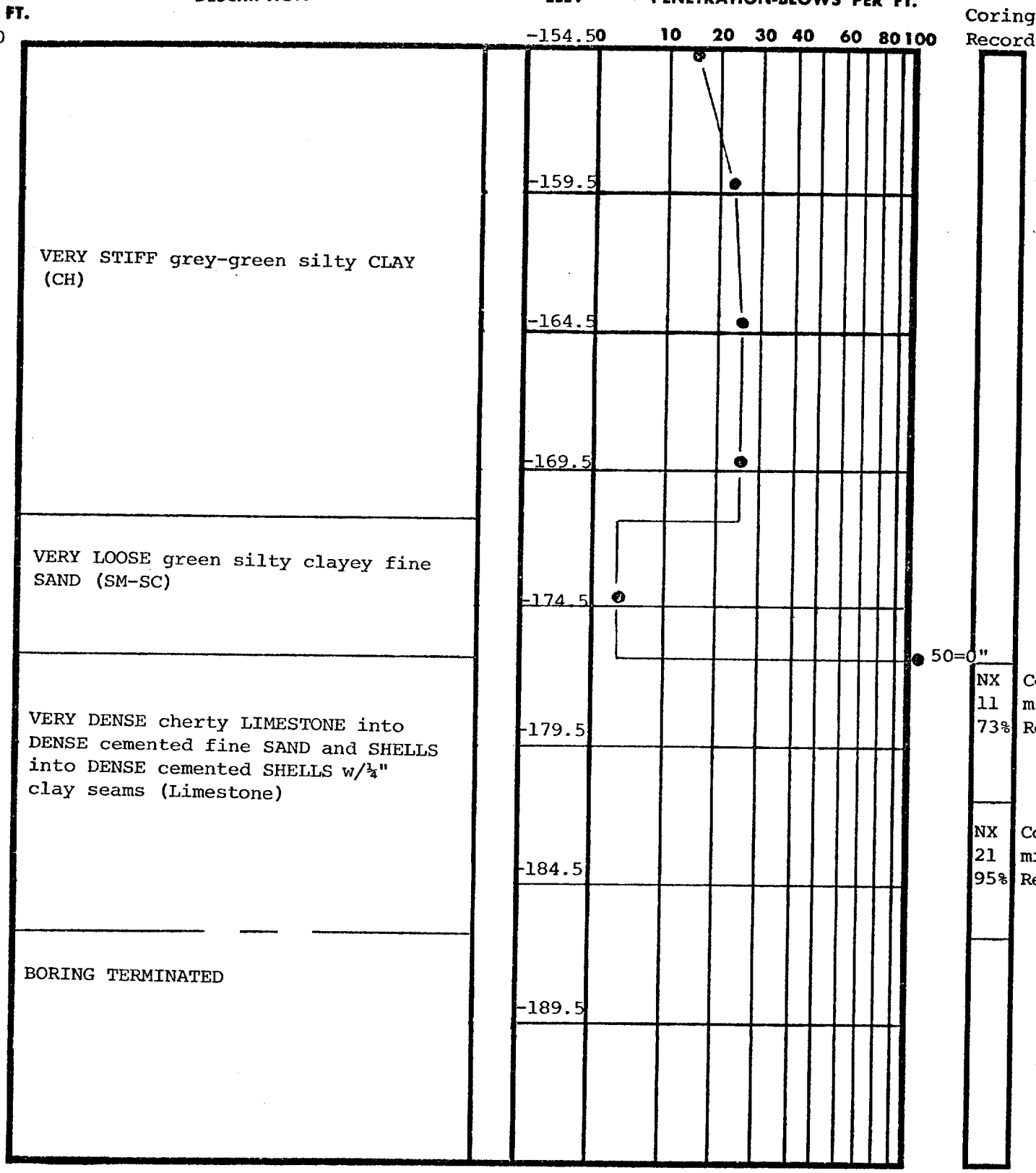
WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

18B-32

PAD 39B MODIFICATIONS - TASK I

79K11306



TEST BORING RECORD

(Page 5 of 5)

BORING NO. B-5

DATE DRILLED 6/8/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

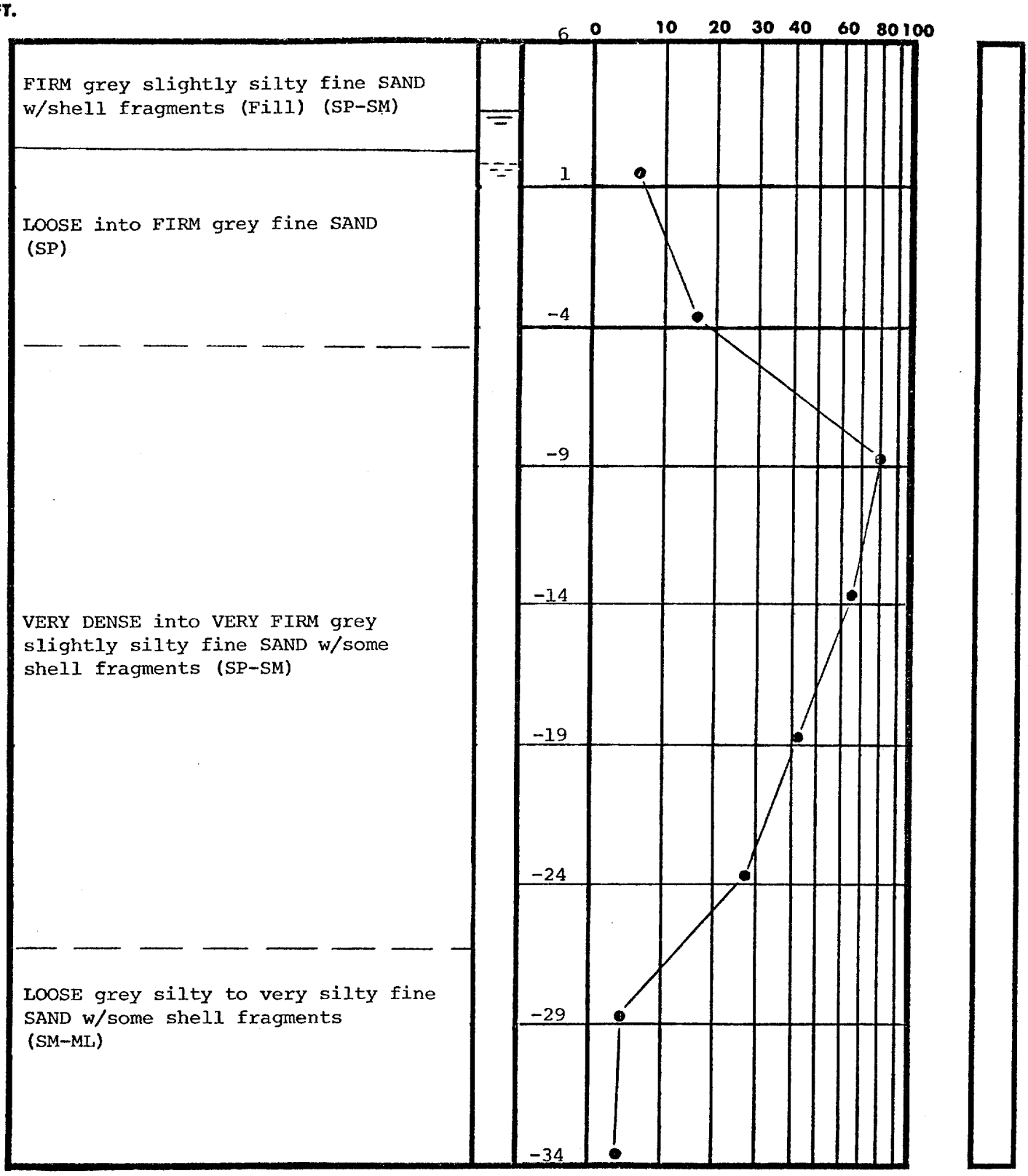
UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



18B-34

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 1 of 2)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

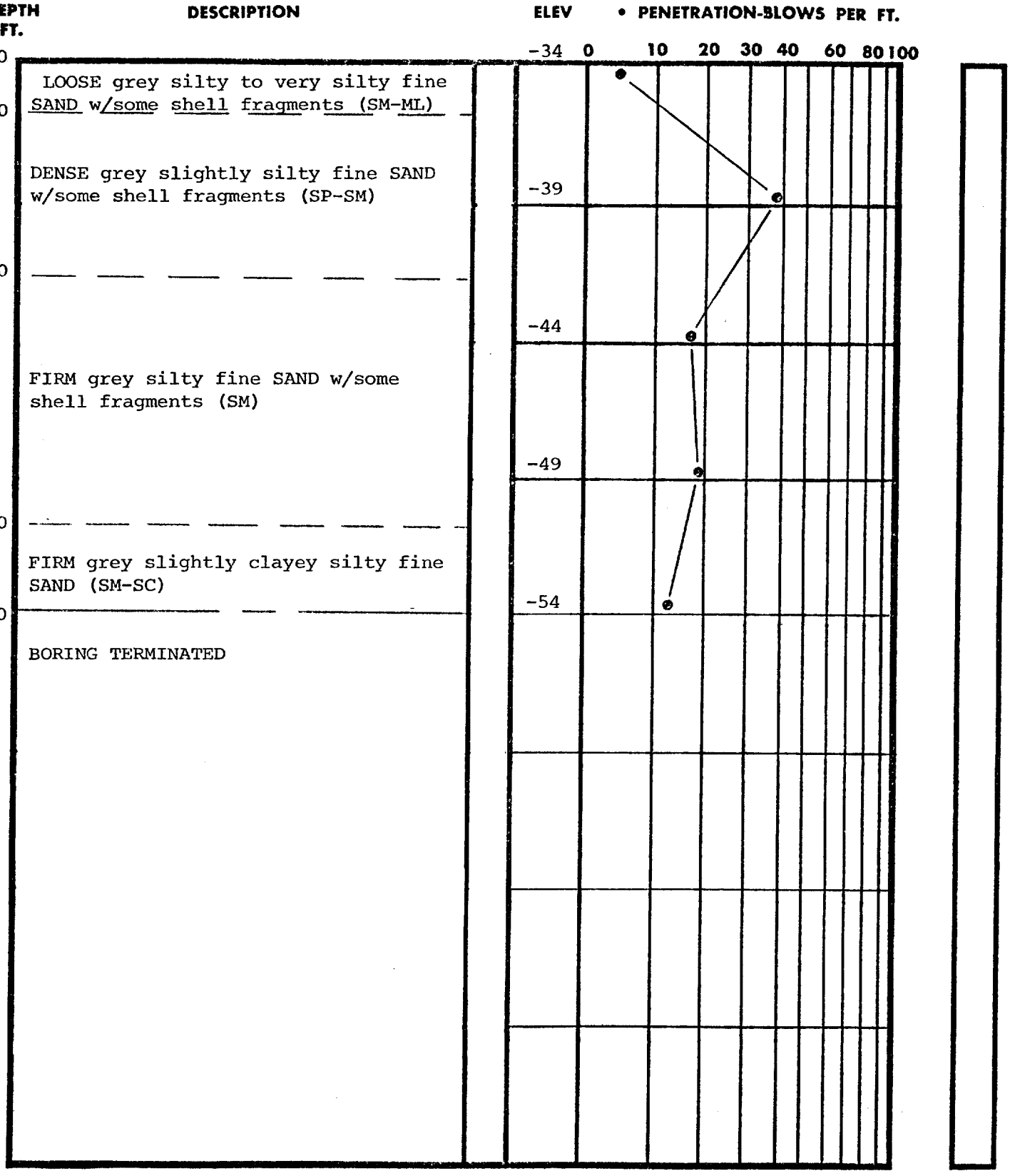
WATER TABLE, 24 HR.
UNDISTURBED SAMPLE
WATER TABLE, 1 HR.
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER

BORING NO. B-6

DATE DRILLED 6/1/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.



18B-35

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 2 of 2)

BORING NO. B-6

DATE DRILLED 6/1/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

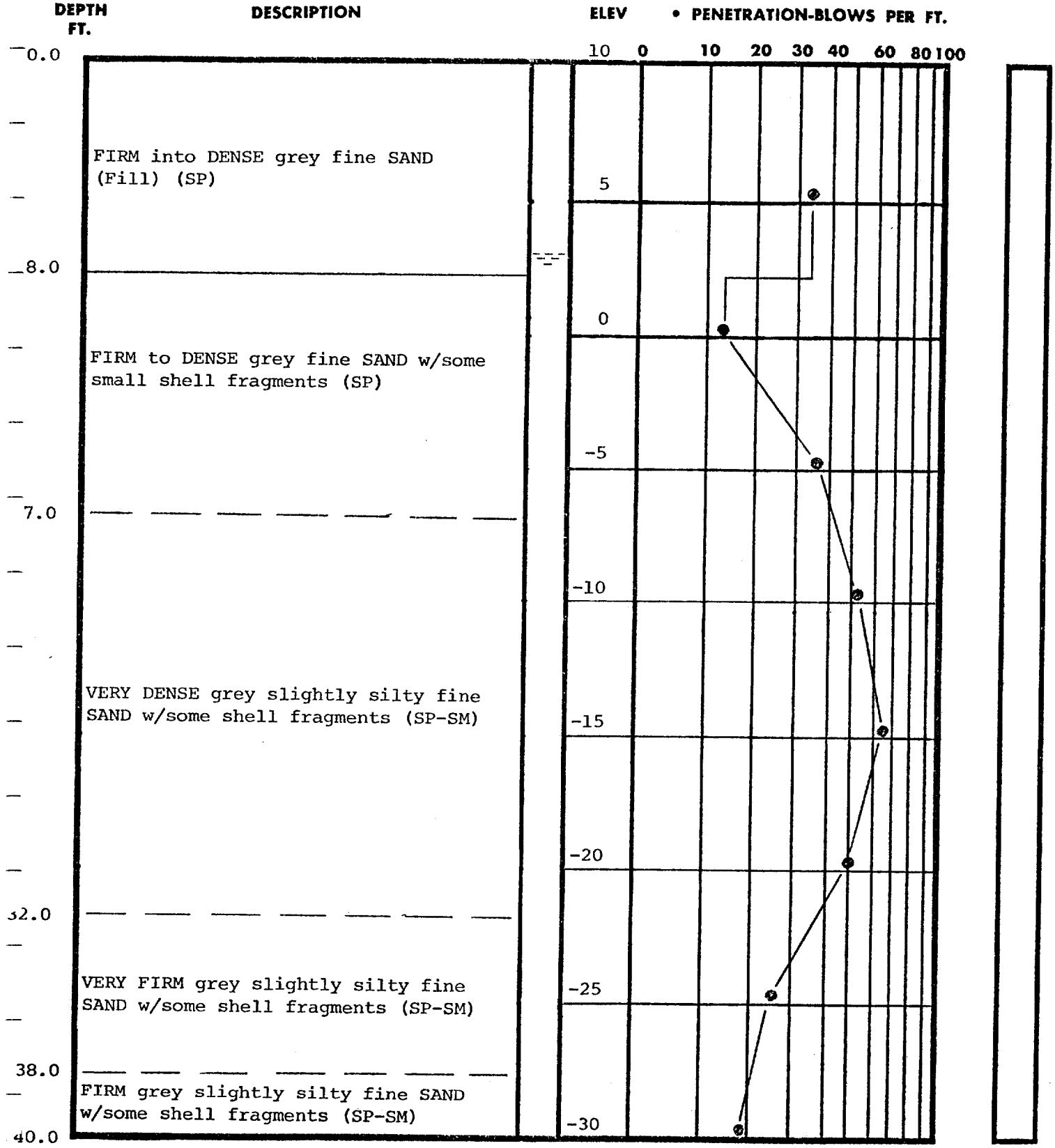
UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



18B-36

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 1 of 2)

BORING NO. B-7

DATE DRILLED 6/1/77

JOB NO. J-2798

LAW ENGINEERING TESTING CO.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

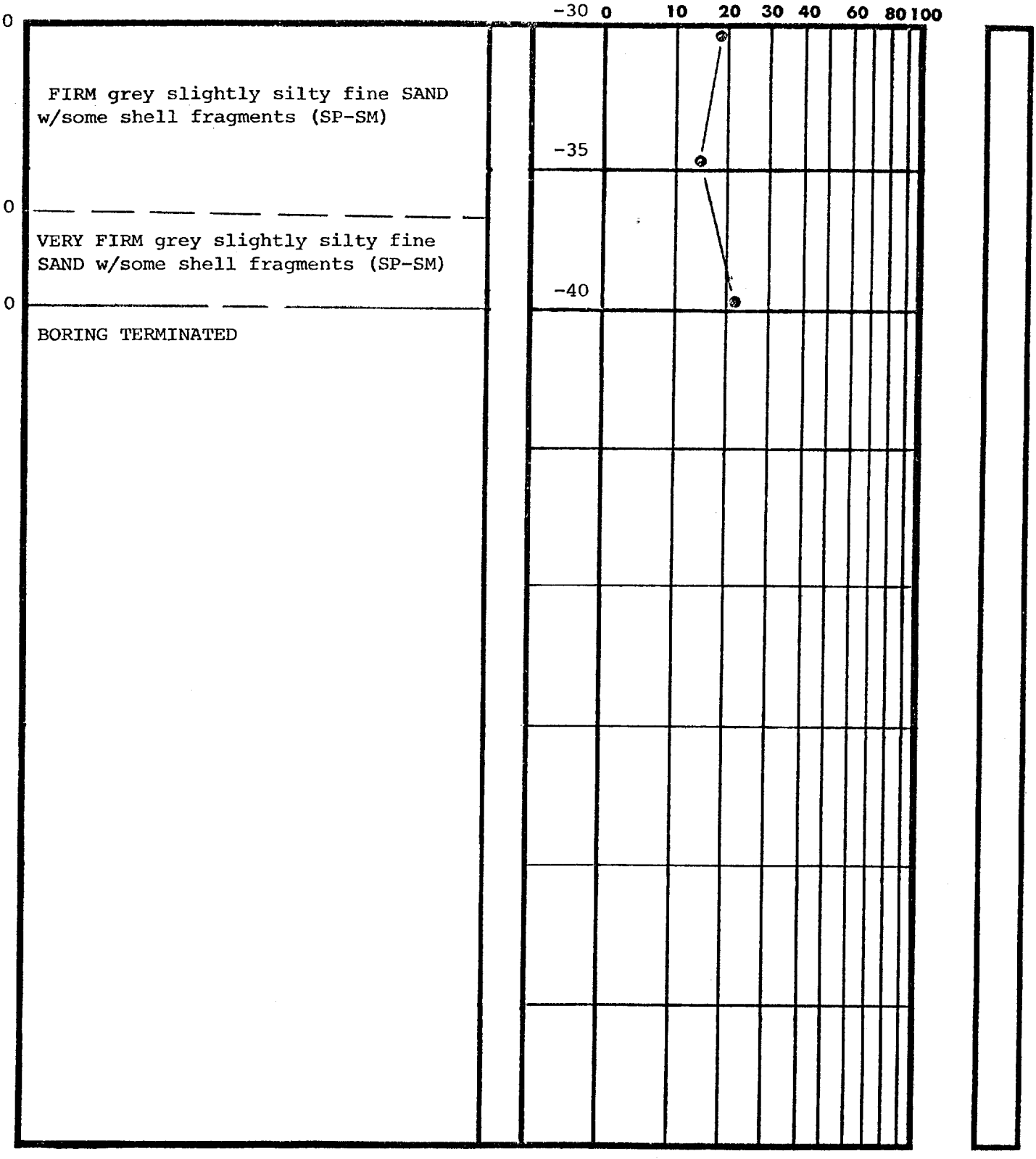
UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER



TEST BORING RECORD

(Page 2 of 2)

BORING NO. B-7

DATE DRILLED 6/1/77

JOB NO. J-2798

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

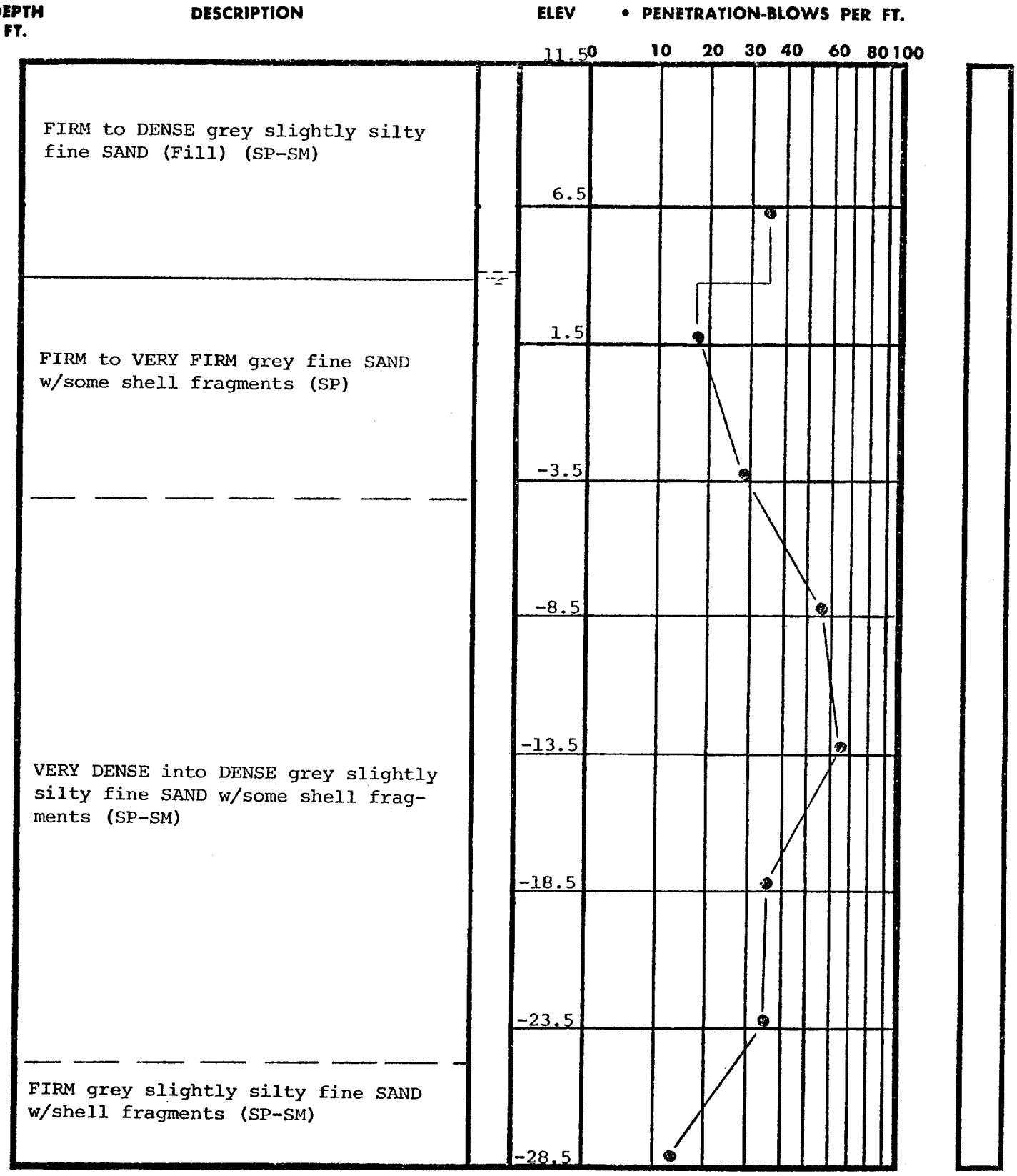
% ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

LAW ENGINEERING TESTING CO.



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PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 1 of 2)

BORING NO. B-8

DATE DRILLED 6/1/77

JOB NO. J-2798

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

% ROCK CORE RECOVERY

DEPTH FT.	DESCRIPTION	ELEV
40.0		-28.5
	FIRM grey slightly silty fine SAND w/some shell fragments (SP-SM)	
44.0		-33.5
	VERY FIRM grey slightly silty fine SAND w/shell fragments (SP-SM)	
47.0		
	LOOSE grey slightly silty fine SAND w/shell fragments (SP-SM)	
50.0		-38.5
	BORING TERMINATED	

• PENETRATION-BLOWS PER FT.

0 10 20 30 40 60 80 100

18B-39

609

PAD 39B MODIFICATIONS - TASK I

79K11306

TEST BORING RECORD

(Page 2 of 2)

BORING NO. B-8

DATE DRILLED 6/1/77

JOB NO. J-2798

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

Isol % ROCK CORE RECOVERY

LABORATORY TEST PROCEDURES

Water Content - The water content is the ratio expressed as a percentage of the weight of water in a given mass of soil to the weight of the solid particles. This test was conducted in accordance with ASTM D2216-66.

Percent Fines - In this test the sample is dried and then washed over a No. 200 mesh sieve. The percentage of soil by weight passing the sieve is the percentage of fines or portion of the sample in the silt and clay size range. This test was conducted in accordance with ASTM Designation D1140-54.

Grain Size Analysis - Representative samples were selected for sieve analysis. Samples selected were weighed, washed over a No. 200 mesh sieve, dried, and then reweighed to determine the weight of material finer than a No. 200 sieve. The dried sample was then passed through a standard set of nested sieves to determine the grain size distribution of the samples coarser than a No. 200 sieve. This test is similar to that described by ASTM Designation D422-63.

Atterberg Limits Tests - The soils' Plastic Index (PI) is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid and is determined in accordance with ASTM D-423. The PL is the moisture content at which the soil begins to crumble when rolled into a small thread and is determined in accordance with ASTM D-424.

SUMMARY OF LABORATORY TEST DATA

Boring No.	Sample No.	Depth - feet	Unified Soil Classification System Soil Type	Natural Water content, w - %	Liquid Limit LL - %	Plasticity Index PI - %	Water Plasticity Ratio, Rw - %	Specific Gravity G	Grain size: Gravel %	Grain size: Sand %	Grain size: Fines %	Dry Unit Weight γ_d - PCF	Compressive Strength: Type of Test	Compressive Strength: Lateral Stress σ_3 -ksf	Compressive Strength: Deviator Stress q_u or p - ksf	Compressive Strength: Strain (failure) ϵ_f - %	Compressive Strength: Water Content Before - w_n - %	Compressive Strength: Water Content After - w_f - %	Compressive Strength: Unit Weight γ_d - PCF	Consolidation: Water Content w_n - %	Consolidation: Overburden Stress, p_o - ksf	Consolidation: Preconsolidation Stress, p_c - ksf	Consolidation: Compression Index - C_c	Consolidation: Unit Weight γ_d -PCF
B1A	7	33.5-35	SP-SM						0	93	7													
B2	11	53.5-55	SP-SM	33							10													
B2	20	98.5-100	SP-SM	23							7													
B2	21	103.5-105	CH-MH	76	140	88																		
B2	22	108-110	CH-MH	34																				
B2	23	113.5-115	SP-SC	21							7													
B2	24	118-120	SC	35							20													
B2	25	123.5-125	SP-SC	51																				
B2	26	128.5-130	CL	32																				
B2	27	133.5-135	SM	29							14													
B2	28	138.5-140	SM	31																				
B2	29	143.5-145	CL	40																				

LAW ENGINEERING TESTING CO.
Jacksonville, Florida

Modification to Pad 39B
Kennedy Space Center, Florida

Job No. J-2798

File No.
Table No. 1 of 3

SUMMARY OF LABORATORY TEST DATA

Boring No.	Sample No.	Depth - feet	Unified Soil Classification System Soil Type	Natural Water content, w - %	Liquid Limit LL - %	Plasticity Index PI - %	Water Plasticity Ratio, Rw - %	Specific Gravity G	Grain size: Gravel %	Grain size: Sand %	Grain size: Fines %	Dry Unit Weight γ_d - PCF	Compressive Strength: Type of Test	Compressive Strength: Lateral Stress σ_3 -ksf	Compressive Strength: Deviator Stress q_u or p - ksf	Compressive Strength: Strain (failure) ϵ_f - %	Compressive Strength: Water Content Before - w_n - %	Compressive Strength: Water Content After - w_f - %	Compressive Strength: Unit Weight γ_d - PCF	Consolidation: Water Content w_n - %	Consolidation: Overburden Stress, p_o - ksf	Consolidation: Preconsolidation Stress, Pc- ksf	Consolidation: Compression Index - Cc	Consolidation: Unit Weight γ_d -PCF
B2	31	153.5-155	SP-SC	39																				
B2	33	163.5-165	SM-MH	49	55	13					40													
B2	34	168.5-170	SM-MH	57																				
B2	38	188.5-190	SC	50	90	55					19													
B2	42	208.5-210	CH	97																				
B2	44	218.5-220	MH	88	275	176																		
B3A	11	53.5-55	SM	28					0	85	15													
B4	11	53.5-55	SP-SM								6													
B5	7	33.5-35	SC-SM	41							35													
B5	8	38.5-40	SC-SM	51							36													
B5	15	73.5-75	MH	92	117	64					92													
B5	19	93.5-95		34							18													

LAW ENGINEERING TESTING CO.
Jacksonville, Florida

Modification to Pad 39B
Kennedy Space Center, Florida

Job No. J-2798

File No.
Table No. 2 of 3

SUMMARY OF LABORATORY TEST DATA

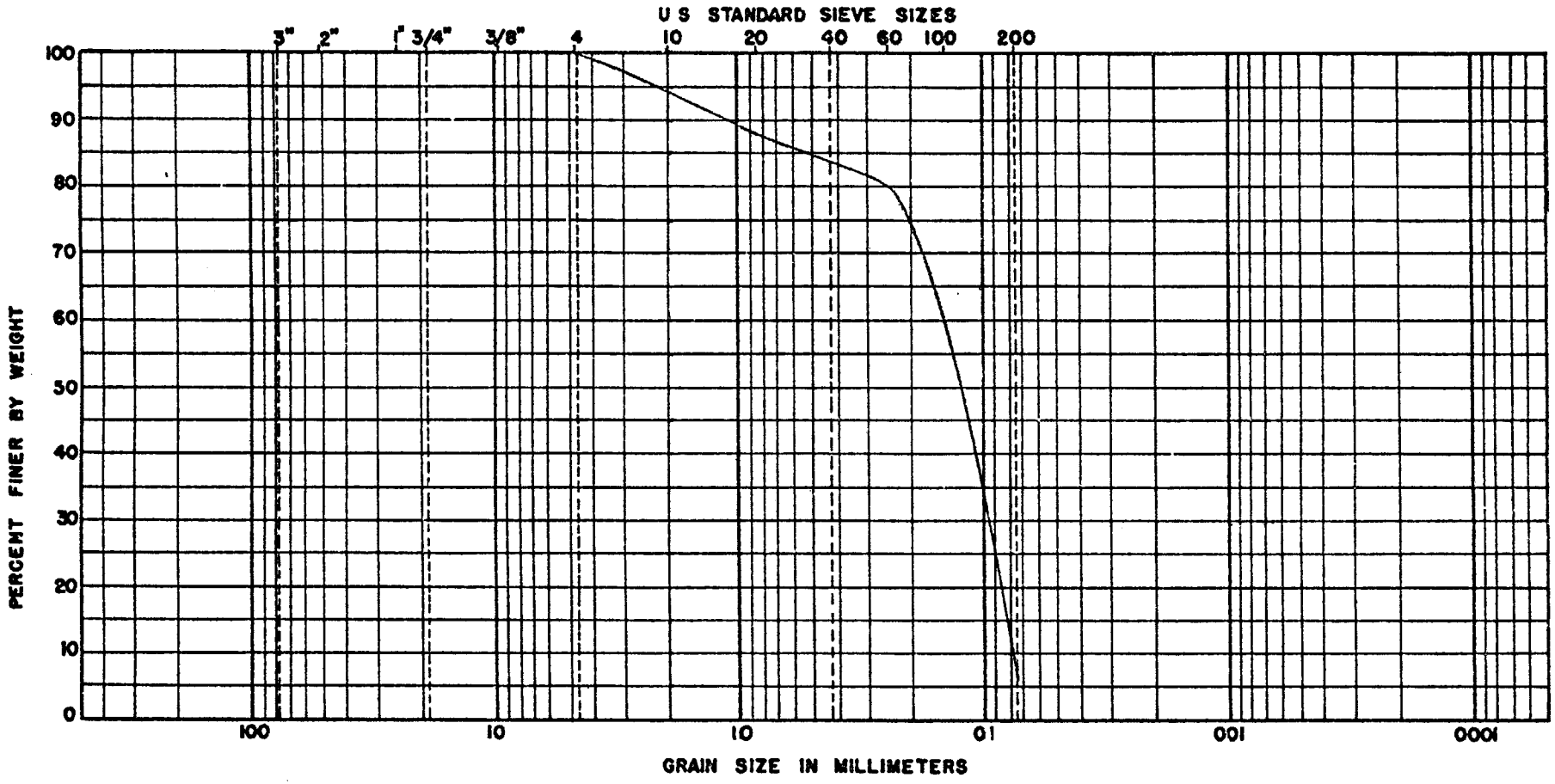
Boring No.	Sample No.	Depth - feet	Unified Soil Classification System: Soil Type	Natural Water content, w - %	Liquid Limit LL - %	Plasticity Index PI - %	Water Plasticity Ratio, Rw - %	Specific Gravity G	Grain size: Gravel %	Grain size: Sand %	Grain size: Fines %	Dry Unit Weight γ_d - PCF	Compressive Strength: Type of Test	Compressive Strength: Lateral Stress σ_3 -ksf	Compressive Strength: Deviator Stress q_u or p - ksf	Compressive Strength: Strain (failure) ϵ_f - %	Compressive Strength: Water Content Before - w_n - %	Compressive Strength: Water Content After - w_f - %	Compressive Strength: Unit Weight γ_d - PCF	Consolidation: Water Content w_n - %	Consolidation: Overburden Stress, p_o - ksf	Consolidation: Preconsolidation Stress, p_c - ksf	Consolidation: Compression Index - C_c	Consolidation: Unit Weight γ_d -PCF
B5	20	98.5-100	SM-ML	27							32													
B5	24	118.5-120	SM-ML	47							32													
B5	26	128.5-130	SM-SC	51							32													
B5	28	143.5-145	SM-SC	47							11													
B5	35	178.5-180	SM-SC	33							31													
B6	7	33.5-35	SM-ML	40							44													
B6	8	38.5-40	SM-ML	32																				
B7	9	43.5-45	SP-SM	27							12													
B8	8	38.5-40	SM	29							13													

LAW ENGINEERING TESTING CO.
Jacksonville, Florida

Modification to Pad 39B
Kennedy Space Center, Florida

Job No. J-2798

File No.
Table No. 3 of 3



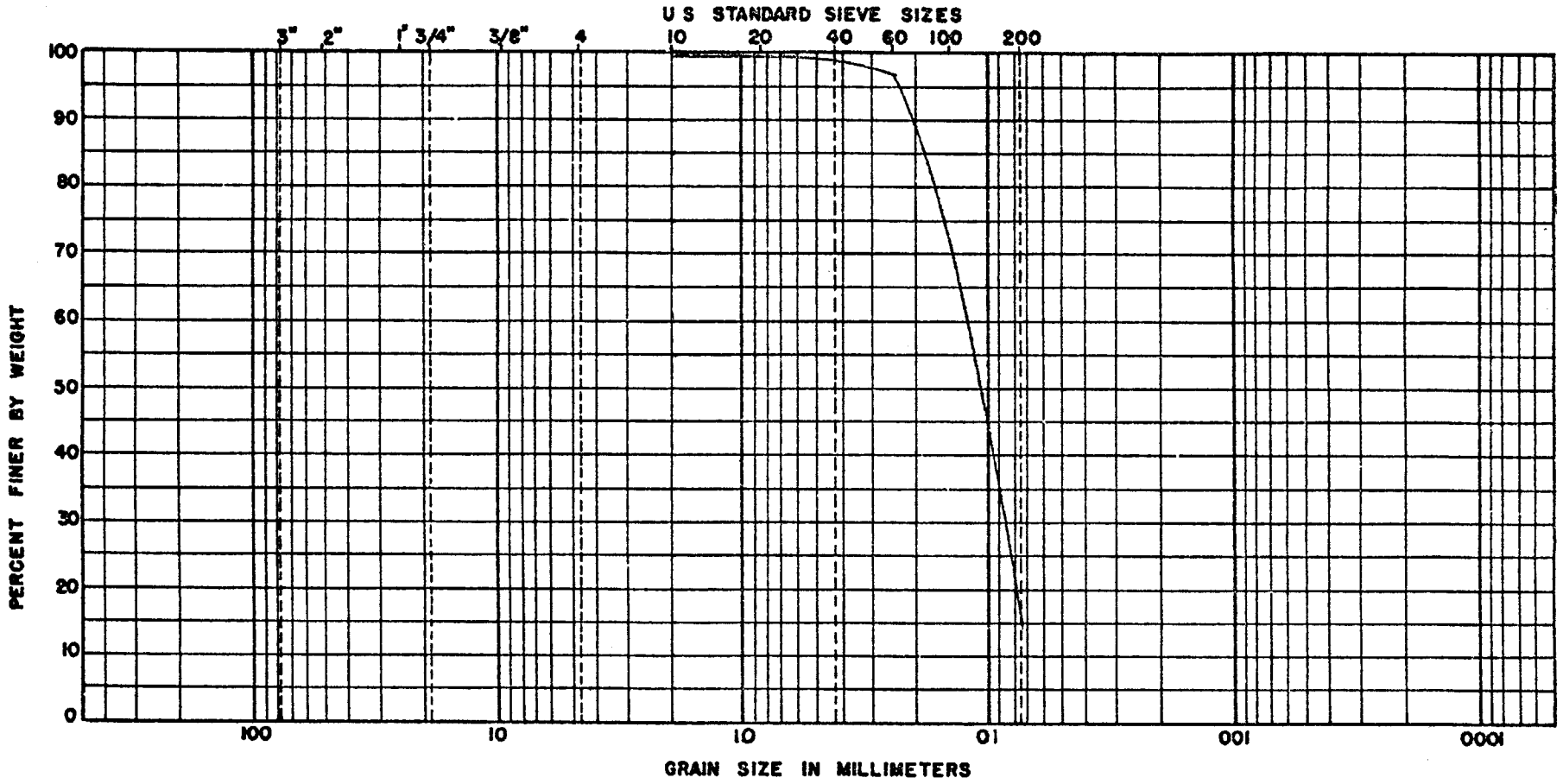
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
B-1A	33.5-35.0					Grey slightly silty fine SAND w/some shell fragments

GRAIN SIZE DISTRIBUTION

JOB NO. J-2798

LAW ENGINEERING TESTING COMPANY



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
B-3A	53.5/55.0					Brown silty fine SAND w/small grass roots

GRAIN SIZE DISTRIBUTION

JOB NO. J-2798

LAW ENGINEERING TESTING COMPANY

---DELIVERY AND STORAGE OF COATING MATERIALS

STORAGE SHALL BE IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" AND AS SPECIFIED HEREIN.

DELIVER ALL COATING MATERIALS TO THE PROJECT IN THEIR ORIGINAL CONTAINERS BEARING COATING MANUFACTURER'S NAME, LABEL AND PAINT FORMULATION. CONTAINERS SHALL BE NEW AND UPOPENED.

ALL COATING MATERIALS SHALL BE STORED IN TIGHTLY CLOSED CONTAINERS IN A COVERED, WELL-VENTILATED AREA WHERE THEY WILL NOT BE EXPOSED TO EXCESSIVE HEAT, FUMES, SPARKS, FLAME OR DIRECT SUNLIGHT. WATER BASED COATINGS SHALL BE PROTECTED AGAINST FREEZING.

---SHOP INSPECTION

ALL WORK SHALL BE SUBJECT TO SHOP INSPECTION. FOR THIS REASON, A SCHEDULE SHOWING THE DATE WHEN ALL THE STEEL WILL BE BLASTED AND COATED SHALL BE SUBMITTED TO THE CONTRACTING OFFICER. SURFACES THAT ARE COATED PRIOR TO THE TIME SHOWN BY THIS SCHEDULE WILL BE SUBJECT TO REJECTION UNLESS INSPECTION IS WAIVED BY THE CONTRACTING OFFICER. THE ABOVE REFERS TO INORGANIC ZINC-RICH COATINGS.

---INSULATED SURFACES

INSULATED SURFACES SHALL BE SIZED WITH A MATERIAL SUITABLE TO RECEIVE AND RETAIN THE PAINT COATS WHICH ARE TO BE APPLIED THEREON. THEY TYPE OF MATERIAL, APPLICATION AND THICKNESS OF COAT (OR COATS) SHALL BE SUCH THAT THE PAINT COATINGS, WHEN APPLIED, WILL ADHERE PERFECTLY AND WILL BE UNIFORM IN COLOR AND COVERAGE. THE SIZE SHALL BE A MATERIAL THAT WILL NOT STAIN OR ADVERSELY AFFECT THE PAINT IN ANY WAY.

---PROTECTION AND SAFETY PRECAUTIONS

PROTECT ALL ADJACENT MATERIALS AND EQUIPMENT AGAINST DAMAGE FROM SPILLAGE, DRIPPING AND SPATTER OF COATING MATERIALS. ALL BUILDING MATERIALS AND EQUIPMENT SHALL BE LEFT CLEAN, WITH ALL DAMAGED SURFACES CORRECTED. PROVIDE "WET PAINT" SIGNS TO INDICATE NEWLY PAINTED SURFACES.

PROVIDE ADEQUATE VENTILATION FOR ALL INTERIOR SPACES DURING APPLICATION AND DRYING OF COATINGS TO PREVENT THE BUILD-UP OF TOXIC OR EXPLOSIVE CONCENTRATIONS OF SOLVENT VAPORS.

PROVIDE ADEQUATE FIRE FIGHTING EQUIPMENT IN AREAS USED FOR STORAGE AND MIXING OF COATING MATERIALS.

RAGS USED TO WIPE UP COATING MATERIALS, SOLVENTS AND THINNERS SHALL BE DISPOSED OF BY DRENCHING THEM WITH WATER AND PUTTING THEM IN A COVERED METAL CONTAINER.

---CLEAN UP

APPLICATION EQUIPMENT SHALL BE CLEANED PROMPTLY AND THOROUGHLY WITH A SUITABLE SOLVENT AFTER EACH USE AND STORED IN A CLEAN, COVERED, WELL-VENTILATED CONTAINER.

AT THE END OF EACH WORKING DAY, CLEAN UP ALL DISCARDED PAINT MATERIALS, RUBBISH, RAGS AND OTHER SIMILAR MATERIALS AND REMOVE FROM PROJECT.

AT THE COMPLETION OF THE WORK, CLEAN OFF ALL PAINT SPOTS FROM FINISH SURFACES AND LEAVE THE PROJECT IN A CLEAN CONDITION.

---COATING MATERIALS---

---GENERAL

PIGMENTS BASED ON TITANIUM-CALCIUM MAY BE USED BUT ONLY THAT PORTION THAT IS TITANIUM DIOXIDE WILL BE CONSIDERED AS PRIME PIGMENT; THE BALANCE WILL BE CONSIDERED AS EXTENDER PIGMENTS.

---COATING TYPE MPC-1, METAL PRETREATMENT COATING

METAL PRETREATMENT COATING SHALL BE A TWO-COMPONENT VINYL BUTYRAL RESIN BASE WASH COATING CONFORMING TO MS MIL-P-15328C.

---COATING TYPE MP-2, METAL PRIMER

PRIMER, CORROSION RESISTANT, METAL SURFACES, CONFORMING TO MIL-P-28577.

---COATING TYPE MP-3, METAL PRIMER

PRIMER, CORROSION RESISTANT, METAL SURFACES, CONFORMING TO MIL-P-28577.

---COATING TYPE MP-4, METAL PRIMER

PRIMER, CORROSION RESISTANT, METAL SURFACES, CONFORMING TO MIL-P-28577.

---COATING TYPE IU-1, INTERIOR ENAMEL UNDERCOAT

INTERIOR ENAMEL UNDERCOAT SHALL CONFORM TO FS TT-E-543A, AS HEREIN MODIFIED.

THE PIGMENT SHALL CONTAIN A MINIMUM OF 12 PERCENT RUTILE TITANIUM DIOXIDE AND A MAXIMUM OF 40 PERCENT EXTENDER SUCH AS CALCIUM CARBONATE, SILICA AND SILICATES, BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

THE VEHICLE SHALL CONTAIN A MINIMUM OF 16 PERCENT OIL MODIFIED ALKYD RESIN SOLIDS BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

---COATING TYPE ESE-1, EXTERIOR SEMIGLOSS ENAMEL (FOR GALVANIZED SURFACES)

EXTERIOR ALKYD SEMIGLOSS ENAMEL SHALL CONFORM TO FS TT-E-529C(1) CLASS A, AS HEREIN MODIFIED.

THE PIGMENT SHALL CONTAIN A MINIMUM OF 20 PERCENT RUTILE TITANIUM DIOXIDE AND A MAXIMUM OF 20 PERCENT EXTENDER PIGMENTS SUCH AS CALCIUM CARBONATE, SILICA AND SILICATES, BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

THE VEHICLE SHALL CONTAIN A MINIMUM OF 20.0 PERCENT ALKYD RESIN SOLIDS AND A MAXIMUM OF 30 PERCENT THINNERS AND DRIERS, BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

---COATING TYPE ISE-1, INTERIOR ALKYD SEMIGLOSS ENAMEL PAINT

INTERIOR ALKYD SEMIGLOSS ENAMEL PAINT SHALL CONFORM TO FS TT-E-508B(4) AS HEREIN MODIFIED.

PIGMENT SHALL CONTAIN A MINIMUM OF 24 PERCENT RUTILE TITANIUM DIOXIDE AND A MAXIMUM OF 22 PERCENT EXTENDER PIGMENTS SUCH AS CALCIUM CARBONATE, BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

---COATING TYPE ELP-2, ACRYLIC LATEX EMULSION PAINT (FOR BLDG. #J7-385 INTERIOR WALLS & CEILING)

ACRYLIC LATEX EMULSION PAINT SHALL CONFORM TO FS TT-P-19B(1) AS HEREIN MODIFIED. COLOR SHALL BE WHITE, SEMI-GLOSS, FED. STD. #595, #27880.

PIGMENT SHALL CONTAIN A MINIMUM OF 13 PERCENT RUTILE TITANIUM DIOXIDE, A MAXIMUM OF 6 PERCENT ANATASE TITANIUM DIOXIDE AND A MAXIMUM OF 18 PERCENT EXTENDER PIGMENTS SUCH AS CALCIUM CARBONATE, SILICA AND SILICATES, BASED ON THE TOTAL WEIGHT OF THE MATERIAL. THE VEHICLE SHALL CONTAIN A MINIMUM OF 18 PERCENT ACRYLIC POLYMER AND A MAXIMUM OF 45 PERCENT WATER, BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

---COATING TYPE ZINC-RICH, FOR ABRASIVE BLASTED CARBON STEEL

AS SPECIFIED IN SECTION 9L OF THE SPECIFICATIONS.

---COATING TYPE TCZ-R, VINYL COLOR COAT PER SPECIFICATION MIL-P-22750 FOR ZINC-RICH COATING (B)

COLORED VINYL TOP COATING EQUAL TO AMERON NO. 1969, CON-LUX VINYLOID, PLAS-CHEM X72B, PRUFCOAT HSA 570-100-00, OR PLASITE NO. 2050. TOP COATS SHALL BE APPLIED OVER COATING TYPE BCZ-R.

---COATING TYPE BCZ-R, BOND COAT OVER ZINC-RICH COATING PRIOR TO COATING WITH TYPE TCZ-R

BOND COAT SHALL BE COMPATIBLE WITH ZINC-RICH COATING AND WITH TOP COATING TYPE TCZ-R AND AS RECOMMENDED BY MANUFACTURERS OF SAME, AND SHALL COMPLY WITH MIL-L-81352.

---COATING TYPE CFC-1 (FOR CONCRETE FLOOR, BLDG. J7-385)

COATING SHALL BE HIGH PERFORMANCE GLAZE (HIPAC) TYPE COMPLYING WITH FS TT-C-550C WITH NON-SKID ABRASIVE AGGREGATE EQUAL TO PITTSBURGH GLASS COMPANY "SAFE STEP" IN FINAL COAT OF NOT LESS THAN TWO COATS. COLOR SHALL BE GREY, FED. STD. 595, #26493. INITIAL COAT SHALL BE OF LIGHTER TINT THAN FINAL COAT. PRIMER SHALL BE AS RECOMMENDED BY "HIPAC" COATING MANUFACTURER.

---ALUMINUM SURFACES

ALUMINUM AND ALUMINUM-ALLOY SURFACES SCHEDULED TO BE PAINTED SHALL BE SOLVENT CLEANED TO REMOVE ALL OIL, GREASE, SOIL AND OTHER FOREIGN MATTER. HIGHLY SOILED SURFACES SHALL BE CLEANED WITH A STIFF BRISTLE BRUSH OR ALUMINUM WOOL.

AFTER CLEANING, THE ALUMINUM SURFACES SHALL BE TREATED WITH A COATING TYPE MPC-1 APPLIED IN ACCORDANCE WITH SSPC-PT3-64.

---COATING MATERIAL PREPARATION---
(OTHER THAN ZINC-RICH)

---GENERAL

COATING MATERIALS SHALL BE MIXED AND PREPARED IN ACCORDANCE WITH THE COATINGS MANUFACTURER'S DIRECTIONS FOR THE PARTICULAR MATERIAL AND COAT TO BE APPLIED. MATERIALS WHICH ARE NOT IN ACTUAL USE SHALL BE KEPT IN CLOSED CONTAINERS.

COATING MATERIALS WHICH AHVE BEEN MIXED WITH AN AUTOMATIC SHAKER SHALL BE ALLOWED TO STAND, TO LET AIR BUBBLES EXCAPE, THEN GIVEN A FINAL HAND MIXING BEFORE APPLICATION. MATERIALS SHALL BE STIRRED SO AS TO PRODUCE A MIXTURE OF UNIFORM DENSITY AND SHALL BE STIRRED AT FREQUENT INTERVALS DURING APPLICATION TO PREVENT SKINNING. ANY FILM WHICH MAY FORM ON THE SURFACE OF THE MATERIAL SHALL NOT BE STIRRED INTO THE MATERIAL. THE FILM SHALL BE REMOVED AND, IF NECESSARY, THE MATERIAL SHALL BE STRAINED BEFORE USING.

---THINNING

THINNING SHALL BE DONE IN ACCORDANCE WITH COATING MANUFACTURER'S DIRECTIONS FOR THE PARTICULAR MATERIAL AND COAT. THE ADDED SOLVENT SHALL NOT CHANGE THE SOLVENT-TO-SOLID BALANCE AS SPECIFIED.

---TINTING

PRIME AND INTERMEDIATE COATS OF PAINT SHALL BE A SLIGHTLY DIFFERENT TINT FROM THE FINISH COAT TO FACILITATE IDENTIFICATION OF EACH COAT. ALL TINTING SHALL BE DONE BY THE COATING MANUFACTURER AND CLEARLY IDENTIFIED AS TO COLOR AND COAT.

---ZINC-RICH COATINGS

THESE SHALL BE PREPARED AS OUTLINED IN SECTION 9L OF THE SPECIFICATIONS.

---ALUMINUM SURFACES

ALUMINUM AND ALUMINUM-ALLOY SURFACES SCHEDULED TO BE PAINTED SHALL BE SOLVENT CLEANED TO REMOVE ALL OIL, GREASE, SOIL AND OTHER FOREIGN MATTER. HIGHLY SOILED SURFACES SHALL BE CLEANED WITH A STIFF BRISTLE BRUSH OR ALUMINUM WOOL. STEEL WOOL SHALL NOT BE USED.

AFTER CLEANING, THE ALUMINUM SURFACES SHALL BE PRETREATED WITH A WASH PRIMER COATING TYPE MPC-1 APPLIED IN ACCORDANCE WITH SSPC-PT3-64.

---SURFACE PREPARATION---

---FOR ZINC-RICH COATINGS

ABRASIVE BLASTING IN ACCORDANCE WITH SECTION 9L OF THE SPECIFICATIONS. POWER TOOL CLEANING FOR TOUCH-UP.

---FERROUS METALS (OTHER THAN FOR ZINC-RICH COATINGS)

SHOP PRIMED FERROUS METAL SURFACES SHALL BE CLEANED AS REQUIRED TO PRODUCE A SURFACE FREE OF DIRT, OIL, GRIME AND OTHER SIMILAR CONTAMINANTS WHICH MAY HAMPER GOOD ADHESION OF TOP COATS.

---INTERIOR FERROUS METALS NOT HAVING ZINC-RICH PROTECTIVE COATING

FERROUS SURFACE TO BE FIELD PRIMED WITH MP-2 PRIMER SHALL BE CLEANED IN ACCORDANCE WITH SSPC-SP3-63 "POWER TOOL CLEANING". OIL, GREASE AND OTHER SIMILAR CONTAMINANTS SHALL BE REMOVED IN ACCORDANCE WITH SSPC SP1-63 "SOLVENT CLEANING".

---EXISTING CONCRETE SURFACES (INTERIOR OF BLDG. #J7-385)

EXISTING CONCRETE SURFACES SHALL BE CLEANED OF DIRT, DUST, OIL, GREASE, EFFLORESCENCE, LOOSE CHALK AND OTHER LOOSE MATERIAL OR FOREIGN MATTER.

GREASE AND OTHER OILY CONTAMINANTS SHALL BE REMOVED BY SCRUBBING THE SURFACE WITH A TRISODIUM PHOSPHATE AND WATER SOLUTION OR A 5 PERCENT TO 10 PERCENT SOLUTION OF MURIATIC ACID TO ETCH THE SURFACE. AFTER THE APPLICATION, THE SURFACES SHALL BE NEUTRALIZED AND WASHED DOWN WITH CLEAN WATER.

EFFLORESCENCE SHALL BE COMPLETELY REMOVED BEFORE PAINTING. REMOVE EFFLORESCENCE BY FIBER BRUSHING AND APPLYING A 5 PERCENT TO 10 PERCENT SOLUTION OF MURIATIC ACID. AFTER THE APPLICATION, THE SURFACE SHALL BE NEUTRALIZED AND WASHED DOWN WITH CLEAN WATER.

COMPLY WITH REQUIREMENTS OF COATING MANUFACTURER.

---GENERAL

EXTERIOR PAINTING WILL NOT BE ALLOWED IN DAMP OR RAINY WEATHER. INTERIOR PAINTING WILL NOT BE ALLOWED UNTIL THE BUILDING IS ENCLOSED AND HAS THOROUGHLY DRIED OUT. NO PAINTING WILL BE ALLOWED BELOW 50 DEGREES FAHRENHEIT OR ABOVE 95 DEGREES FAHRENHEIT. ALL PAINTING APPLICATION SHALL BE IN ACCORDANCE WITH THE COATING MANUFACTURER'S RECOMMENDATIONS, AND AS HEREIN SPECIFIED.

APPLICATION OF COATINGS SHALL BE DONE BY SKILLED APPLICATORS. APPLY COATINGS TO CLEAN AND PROPERLY PREPARED SURFACES. APPLY COATINGS CAREFULLY WITH CLEAN, HIGH QUALITY APPLICATION EQUIPMENT. ALLOW SUFFICIENT TIME BETWEEN COATS TO ASSURE COMPLETE DRYING AND CURING. SAND AND DUST THE SURFACES BETWEEN COATINGS AS REQUIRED TO PRODUCE SURFACE FREE OF VISIBLE DEFECTS. HIGH GLOSS COATINGS AND CLEAR FINISHES SHALL BE LIGHTLY SANDED BETWEEN COATS TO ASSURE BOND OF FOLLOWING COATS.

ALL COATS SHALL BE APPLIED TO THE SURFACES IN AN EVEN FILM. CLOUDINESS, SPOTTING, VOIDS, LAPS, APPLICATION MARKS, RUNS, SAGS, SOPPINESS AND OTHER SIMILAR SURFACE IMPERFECTIONS WILL NOT BE ACCEPTABLE. DEFECTIVE COATING APPLICATION WILL BE REMOVED AND RECOATED AS DIRECTED BY THE CONTRACTING OFFICER.

ALL COATING LINES SUCH AS WAINSCOTS SHALL BE SHARP, TRUE AND WELL DEFINED. TAPE MAY BE USED TO ESTABLISH COATING LINES PROVIDING TAPE IS REMOVED BEFORE RAGGED OR SAW-TOOTHED EDGES FORM.

ALL SURFACES INCLUDING EDGES, CORNERS, CREVICES, WELDS AND OTHER SIMILAR CHANGES IN SURFACE PLANE SHALL RECEIVE A DRY FILM THICKNESS NOT LESS THAN SPECIFIED HEREIN.

---COATING THICKNESS

TOTAL COATING SYSTEM SHALL HAVE A DRY FILM THICKNESS OF NOT LESS THAN 5 MILS, APPLIED IN COATS NOT LESS THAN SPECIFIED HEREIN. REFER TO THICKNESS TESTING ON PAGE 9A-3.

---BRUSH APPLICATION

BRUSHES SHALL BE CLEAN AND OF THE PROPER SIZE AND TYPE FOR HIGH QUALITY APPLICATION OF COATING MATERIALS. OIL BASED COATINGS SHALL BE BRUSHED OUT THOROUGHLY. QUICK DRY COATINGS SHALL BE BRUSHED ONLY ENOUGH TO SPREAD OUT EVENLY.

---SPRAY APPLICATION

SPRAY APPLICATION EQUIPMENT SHALL BE LIMITED TO AIRLESS SPRAY EQUIPMENT AND ELECTROSTATIC SPRAY EQUIPMENT. EQUIPMENT SHALL BE CLEAN AND OPERATED BY WORKMEN SKILLED IN HIGH QUALITY APPLICATION OF COATING MATERIALS.

SPRAYED COATINGS SHALL BE CAREFULLY APPLIED AND EQUIVALENT IN ALL RESPECTS TO THE SAME COATS APPLIED BY HIGH QUALITY BRUSH APPLICATION. EACH SPRAY COAT SHALL BE PERMITTED TO DRY BEFORE THE SUCCEEDING COAT IS APPLIED. DOUBLING BACK WITH APPLICATION EQUIPMENT FOR THE PURPOSE OF BUILDING UP FILM THICKNESS OF TWO COATS IN ONE OPERATION WILL NOT BE PERMITTED.

SURFACES ADJACENT TO AREAS TO BE SPRAY COATED SHALL BE COVERED AND CAREFULLY PROTECTED TO PREVENT DAMAGE FROM OVERSPRAY, COATING REBOUND AND SPRAY DRIFT.

---COATINGS FOR NEW INTERIOR FERROUS METAL SURFACES (NOT HAVING ZINC-RICH SHOP COATING PER SECTION 9L)

COATING SYSTEM TYPE IFM-5 - - PRIME COATING SHALL BE TYPE MP-2. SECOND COATING SHALL BE TYPE IU-1. FINISH COATING SHALL BE TYPE ISE-1.

---COATINGS FOR NEW INTERIOR FERROUS SURFACES (HAVING ZINC-RICH SHOP COATING PER SECTION 9L)

COATING SYSTEM TYPE IZR - - TWO COATS OF COATING TYPE TCZ-R OVER BOND COAT TYPE BCZ-R.

---COATINGS FOR EXISTING INTERIOR FERROUS SURFACES

COATING SYSTEM TYPE EIS - - TOUCH-UP AND SINGLE COAT OF COATING TYPE ISE-1.

---TOP COATINGS OVER ZINC-RICH COATINGS

COATING SYSTEM TYPE AZR - - BOND COAT TYPE BCZ-R AND TWO COATS OF COATING TYPE TCZ-R.

---COATINGS FOR INTERIOR GALVANIZED METAL SURFACES

COATING SYSTEM TYPE IGM-2 - - PRIME COATING SHALL BE TYPE MP-3. SECOND COATING SHALL BE TYPE IU-1. FINISH COATING SHALL BE TYPE ISE-1.

---COATINGS FOR EXTERIOR ALUMINUM SURFACES

COATING SYSTEM TYPE EA-2 - - PRIME COATING SHALL BE TYPE MP-4. FINISH COATINGS SHALL BE TYPE ESE-1.

---COATINGS FOR INTERIOR ALUMINUM SURFACES

COATING SYSTEM TYPE IA-2 - - PRIME COATING SHALL BE TYPE MP-4. SECOND COATING SHALL BE TYPE IU-1. FINISH COATING SHALL BE TYPE ISE-1.

---COATINGS AND CHILLED WATER PIPING

COATING SYSTEM SHALL BE COAL-TAR TYPE AS SPECIFIED IN SECTION 15H ---MISCELLANEOUS PIPING.

---COATINGS AND LININGS FOR SOUND SUPPRESSION PIPING AND ELEVATED WATER TANK

COATINGS AND LININGS SHALL BE AS SPECIFIED IN SECTIONS 15E AND 15T OF THESE SPECIFICATIONS.

---FINAL TOUCH-UP---

---TOUCH-UP BEFORE FINAL ACCEPTANCE

DURING THE 60 DAYS IMMEDIATELY PRECEDING THE DATE SCHEDULED FOR FINAL ACCEPTANCE , CONTRACTOR (A) SHALL CAREFULLY INSPECT ALL SURFACES INSTALLED AS WORK OF THIS CONTRACT AND HE SHALL TOUCH-UP ALL DAMAGED AND DETERIORATING PAINT FILMS. RUST AND LOOSE PAINT FILMS SHALL BE REMOVED BY POWER TOOL CLEANING, OR BY OTHER MEANS IF EFFECTIVE, AND THE PAINT FILM SHALL BE REPLACED IN ACCORDANCE WITH THE SPECIFICATION REQUIREMENTS FOR THE ORIGINAL COATING. IT IS THE INTENT THAT THE PROTECTIVE PAINT FILM BE IN EXCELLENT CONDITION, WITH ALL SURFACES UNIFORMLY COVERED, ON THE DATE OF FINAL ACCEPTANCE. (A)

SECTION 9L

PROTECTIVE COATING OF CARBON STEEL

---GENERAL REQUIREMENTS---

---GENERAL

THIS SPECIFICATION COVERS ALL SURFACE PREPARATION AND PAINTING OF ALL FERROUS METAL SURFACES PROVIDED UNDER THIS CONTRACT, AS WELL AS EXISTING FINISHES DAMAGED BY CONNECTION OF THE SPECIFIED NEW WORK AND BY ANY OTHER OPERATIONS OF THE CONTRACTOR. FACTORY FINISHES SHALL BE AS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS. THIS SPECIFICATION OUTLINES THE REQUIREMENTS FOR THE APPLICATION OF INORGANIC ZINC-RICH PROTECTIVE COATINGS (WITHOUT TOPCOAT EXCEPT WHERE SPECIFIED) FOR THE PROTECTION OF ALL FERROUS METALS. TOUCH-UP OF DAMAGED FINISH SHALL BE WITH ORGANIC ZINC-RICH PROTECTIVE COATINGS AS HEREINAFTER SPECIFIED. TOPCOATS SHALL BE APPLIED ONLY TO ACHIEVE COLOR FOR SPECIFIC AREAS.

THE WORD "PAINT" AS MAY BE USED HEREIN IS SYNONYMOUS WITH THE PHRASE "PROTECTIVE COATING."

ALL EQUIPMENT THAT MIGHT BE DAMAGED DURING OPERATIONS REQUIRED BY THIS SPECIFICATION SHALL BE PROTECTED BY COVERING WITH TARPAULINS, REMOVING FROM THE AREA, TAPING, OR OTHERWISE ENCLOSING. THE ABOVE APPLIES, BUT IS NOT LIMITED TO SAND BLASTING, POWER TOOL CLEANING AND PAINTING OPERATIONS.

UNLESS OTHERWISE SPECIFIED, SURFACE PREPARATION AND COATING OF FERROUS METALS AND ASSOCIATED FASTENERS SHALL BE ACCOMPLISHED PRIOR TO ERECTION OF THE FACILITY OR INSTALLATION OF FABRICATED SECTION. SURFACE DAMAGED DURING ERECTION SHALL BE TOUCHED UP AS SOON AS POSSIBLE. DAMAGED SURFACES SHALL BE CLEANED BY POWER TOOL CLEANING AS SPECIFIED HEREINAFTER, AND THE TOUCH-UP COATING SHALL BE TYPE II CLASS I ORGANIC ZINC-RICH COATING AS LISTED HEREINAFTER.

ADEQUATE DRAINAGE HOLES SHALL BE DRILLED TO ELIMINATE ALL WATER TRAPS PRIOR TO SURFACE PREPARATION WHERE THIS OPERATION MAY AFFECT STRUCTURAL INTEGRITY, THE DESIGNATED GOVERNMENT REPRESENTATIVE SHALL BE CONSULTED. MAXIMUM HOLE SIZE SHALL BE 3/8 INCH.

ALL SURFACES WHICH WILL BECOME INACCESSIBLE, INCLUDING FAYING SURFACES, WHICH ARE NOT PARTS OF FRICTION-TYPE JOINTS, SHALL BE CLEANED AND COATED PRIOR TO INSTALLATION, EXCEPT WHERE THESE SURFACES ARE SEALED AIR TIGHT BY WELDING.

GALVANIZED METAL SHALL NOT BE COATED, EXCEPT FOR THOSE AREAS THAT HAVE FAILED, HAVE BEEN DAMAGED, OR HAVE EXPOSED THREADED AREAS.

NO PAINT SHALL BE APPLIED ON THE EXTERIOR WHEN RAIN IS IMMINENT OR WHEN THE HUMIDITY OR TEMPERATURE EXCEEDS THE MANUFACTURER'S RECOMMENDATIONS. ENVIRONMENT FOR BLASTING SHALL BE AS HEREINAFTER SPECIFIED.

ALL FINISHED SURFACES SHALL BE SMOOTH, EVEN AND FREE FROM VOIDS, BARE SPOTS AND OTHER DEFECTS AND SHALL SHOW EVEN COATINGS. PAINT SHALL BE THOROUGHLY WORKED INTO ALL JOINTS, CREVICES, AND OPEN SPACES. ALL FRESHLY PAINTED SURFACES SHALL BE ADEQUATELY PROTECTED. NO PAINT SHALL BE APPLIED UNTIL THE SURFACES HAVE BEEN ADEQUATELY PREPARED AS SPECIFIED HEREINAFTER.

---REFERENCE SPECIFICATIONS

THE FOLLOWING PUBLICATIONS OF THE ISSUES IN EFFECT ON THE DATE OF ISSUANCE OF INVITATION FOR BIDS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO. IN THE EVENT OF DIFFERENCE BETWEEN THIS SPECIFICATION OR ITS ACCOMPANYING DRAWINGS AND THE REFERENCED SPECIFICATION, THIS SPECIFICATION AND ITS ACCOMPANYING DRAWINGS SHALL GOVERN TO THE EXTENT OF SUCH DIFFERENCE.

KENNEDY SPACE CENTER SPECIFICATIONS:

KSC-SPEC-F-0020	COATING, ORGANIC AND INORGANIC ZINC-RICH, SPECIFICATION FOR
KSC-SPEC-F-0020-KAPL-MAT-4	CORROSION CONTROL PRODUCTS QUALIFIED UNDER KSC-SPEC-F-0020, KENNEDY APPROVED PARTS LIST-MATERIAL
KSC-STD-F-0001	PROTECTIVE COATING OF CARBON STEEL, STANDARD FOR

MILITARY SPECIFICATIONS:

MIL-L-81352	COATING KIT, TOPCOAT, PIGMENTED FOR APPLICATION OVER INORGANIC ZINC PRIMER-COATED STEEL SURFACES
MIL-P-22750	COATING, EPOXY-POLYAMIDE
MIL-S-87733	SEALING COMPOUND - CORROSION INHIBITIVE

FEDERAL STANDARDS:

595	COLORS

STEEL STRUCTURES PAINTING COUNCIL:

SSPC-SP-10	SURFACE PREPARATION SPECIFICATION NO. 10, NEAR WHITE BLAST CLEANING
SSPC-SP-3	SURFACE PREPARATION SPECIFICATION NO. 3, POWER TOOL CLEANING

---PERSONNEL SAFETY

NECESSARY PRECAUTIONS SHALL BE TAKEN TO ENSURE SAFETY OF PERSONNEL ENGAGED IN THE OPERATIONS REQUIRED BY THIS SPECIFICATION, OR PERSONNEL WHO MAY BE AFFECTED BY SUCH OPERATIONS. SOME OF THE MATERIALS TO BE HANDLED UNDER THIS SPECIFICATION ARE COMBUSTIBLE AND/OR TOXIC. SUCH MATERIALS SHALL BE USED IN ACCORDANCE WITH SOP NO. 4, AFM 172-101 AND THE MANUFACTURER'S RECOMMENDATIONS.

---SEALING

ALL FAYING SURFACES, JOINTS OPEN LESS THAN 1/2 INCH, AND SKIP WELDED JOINTS SHALL BE TOTALLY SEALED. THE SEALANT SHALL BE A SELF CURING, SINGLE COMPONENT, POLYSULFIDE RUBBER TYPE, CONFORMING TO SPECIFICATION NO. MIL-S-87733A, GRAY COLOR, AND SHALL BE GUN-APPLIED TO THE JOINT AFTER COATING MATERIAL IS DRY.

---MIXING

UNLESS OTHERWISE SPECIFIED, THE MIXING AND APPLICATION OF ALL PAINT SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED DIRECTIONS. PAINT THAT HAS LIMITED "POT LIFE" AFTER MIXING SHALL BE PREPARED IN LIMITED BATCHES SO THAT IT MAY BE USED BEFORE ITS AGE EXCEES THE RECOMMENDED POT LIFE. ALL BATCHES OR PORTIONS OF BATCHES THAT EXCEED THE RECOMMENDED POT LIFE SHALL BE DISCARDED. THINNERS, OTHER THAN THOSE RECOMMENDED BY THE MANUFACTURER SHALL NOT BE USED. ALL PAINT SHALL BE THOROUGHLY AGITATED BEFORE AND DURING USE TO INSURE UNIFORMITY OF SOLID MATERIAL. ZINC-RICH COATINGS SHALL BE MIXED USING POWER MIXERS ONLY (NOT PAINT SHAKERS) AND APPLIED USING CONTINUOUSLY AGITATED PRESSURE POTS. THESE POTS SHALL BE ABOVE THE ELEVATION OF THE SPRAY GUNS.

---FILM THICKNESS

WHERE SPECIFIC FILM THICKNESSES ARE CALLED FOR HEREIN, IT IS OF UTMOST IMPORTANCE AND FINAL ACCEPTANCE OF THE WORK WILL NOT BE MADE UNTIL ALL PAINT FILMS ARE BUILT UP TO PROPER THICKNESS. REGARDLESS OF THE

NUMBER OF COATS THAT MAY BE SPECIFIED OR ANTICIPATED, SUCCEEDING COATS SHALL BE APPLIED TO THE SURFACE UNTIL THE FILM HAS REACHED SPECIFIED THICKNESS. THE FILM SPECIFIED IN THIS SECTION SHALL BE THE MINIMUM ACCEPTABLE. COATING THICKNESS SHALL BE CHECKED IN BOTH WET AND DRY CONDITION. A WET THICKNESS OF 10 MILS SHOULD RESULT IN A DRY THICKNESS OF APPROXIMATELY 6 MILS. APPROXIMATELY 15 MINUTES AFTER APPLICATION (OR WHEN COATING HAS LOST ITS TACKINESS) THE DRY THICKNESS SHALL BE CHECKED. THICKNESS SHALL BE CHECKED BY WET TEST GAGE; AND CALIBRATED MIKROTEST MAGNETIC GAGE AS MADE BY NORDSON CORPORATION, OR EQUAL, FOR DRY TEST. THE PROCEDURE FOR USING THE MIKROTEST MAGNETIC GAGE SHALL BE ACCORDING TO THE PRINTED INSTRUCTIONS SUPPLIED BY THE MANUFACTURER OF THE INSTRUMENT; FOR THIS PURPOSE THESE PRINTED INSTRUCTIONS SHALL BECOME A PART OF THIS SPECIFICATION. IT IS A REQUIREMENT THAT THE CONTRACTOR HAVE GAGES AVAILABLE ON THE JOB FOR USE BY HIS OWN PERSONNEL.

---DESCRIPTIVE LITERATURE

BEFORE ANY MATERIALS ARE INCORPORATED INTO THE WORK, THE FOLLOWING DESCRIPTIVE LITERATURE SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL:

PAINT	MANUFACTURER'S COMPLETE DESCRIPTION AND MIXING AND APPLICATION INSTRUCTIONS
ABRASIVE	SIEVE ANALYSIS

---SURFACE PREPARATION---

---BLAST CLEANING

ALL FERROUS METAL SURFACES, EXCEPT THOSE LISTED HEREINBELOW, SHALL BE BLAST CLEANED IN ACCORDANCE WITH STEEL STRUCTURES PAINTING COUNCIL SSPC-SP-10 "NEAR-WHITE BLAST CLEANING". SURFACES NOT TO BE BLAST CLEANED ARE:

GALVANIZED SURFACES

PISTON RODS, SLIDING BEARING SURFACES AND LUBRICATED SCREW THREADED RODS

PREFINISHED SURFACES HAVING CERAMIC OR BAKED ENAMEL FINISH COATS

CONDUIT

FACTORY PRIMED ELECTRICAL BOXES, PANELS AND SUPPORTING ACCESSORIES, LIGHTING FIXTURES, AND ELECTRICAL CABLE INSULATION

SURFACE PREPARATION SHALL BE ABRASIVE BLASTING IN ACCORDANCE WITH SSPC-SP-10 AND THE FOLLOWING:

DRY BLASTING SHALL BE USED.

BLASTING EQUIPMENT SHALL DELIVER 95 POUNDS PER SQUARE INCH MINIMUM CONTINUOUS NOZZLE PRESSURE THROUGHOUT ALL OPERATING PERIODS.

BLASTING ABRASIVE SHALL BE IN ACCORDANCE WITH 3.1.3.3 AND 3.1.3.6 OF SSPC-SP-10 AS REQUIRED TO ACHIEVE AN ANCHOR PROFILE BETWEEN 1.0 AND 1.5 MILS.

COMPRESSED AIR USED FOR ABRASIVE BLASTING SHALL BE FREE OF DETRIMENTAL AMOUNTS OF MOISTURE OR OIL.

SPECIAL CARE SHALL BE TAKEN TO ENSURE SURFACES ARE PROPERLY PREPARED AS FOLLOWS:

WELD SPATTER AND SHARP EDGES SHALL BE GROUND SMOOTH. WHEN THIS OPERATION IS PERFORMED AFTER BLAST CLEANING, AFFECTED AREAS SHALL BE REBLASTED.

ALL WELDS SHALL BE SUBJECTED TO A MINIMUM OF A DOUBLE-PASS, ONE IN EACH DIRECTION WITH THE BLASTER, DURING BLAST CLEANING OPERATION.

BLASTING AND COATING OPERATIONS SHALL BE SEQUENCED SO THAT FRESHLY COATED OR WET SURFACES SHALL NOT BE CONTAMINATED BY DUST.

BLAST CLEANING OPERATIONS SHALL NOT BE CONDUCTED ON SURFACES THAT WILL BE WET AFTER BLASTING.

PRIOR TO APPLICATION OF COATING MATERIAL, ALL TRACES OF DUST SHALL BE REMOVED BY BLOWING OFF SURFACES WITH CLEAN DRY AIR, OR BY USE OF INDUSTRIAL TYPE VACUUM CLEANERS.

NO ACID WASHES OR OTHER CLEANING SOLUTIONS OR SOLVENTS SHALL BE USED ON BLAST CLEANED METAL SURFACES AFTER BEING BLASTED. INHIBITIVE WASHERS INTENDED TO PREVENT RUSTING ARE PROHIBITED.

---INSPECTION OF BLASTED SURFACES

BLAST CLEANED SURFACES SHALL BE INSPECTED BY THE CONTRACTING OFFICER, AND, IF APPROVED, SHALL BE COATED WITH SUFFICIENT COATING THE SAME DAY AS BLASTED BEFORE ANY VISIBLE RUSTING OF THE BLASTED SURFACES OCCURS. ANY BLASTED SURFACES NOT COATED, OR WHICH SHOW RUST, SHALL BE REBLASTED UNTIL APPROVED.

---POWER TOOL CLEANING

SURFACE PREPARATION BY POWER TOOL CLEANING IN ACCORDANCE WITH SSPC-SP-3 SHALL BE LIMITED TO FIELD TOUCH-UP OF DAMAGED COATING REQUIREMENTS ONLY. WRITTEN APPROVAL FOR POWER TOOL CLEANING FOR ANY OTHER PURPOSES SHALL BE OBTAINED FROM THE CONTRACTING OFFICER OR HIS DESIGNATED REPRESENTATIVE. Ⓐ

EDGES OF COATING ADJACENT TO POWER TOOL CLEANED AREAS SHALL BE FEATHERED SO THAT RECOATED SURFACE WILL HAVE A SMOOTH APPEARANCE. OVERLAP OF FORMER AGED AND CURED ZINC-RICH COATING SHALL NOT EXCEED LIMITS OF TOOL CLEANING BY MORE THAN 3 INCHES.

---APPLICATION---

---GENERAL

INORGANIC ZINC-RICH COATING APPLIED OVER ABRASIVELY BLASTED STEEL IS THE BASIC COATING FOR CORROSIVE PROTECTION OF CARBON STEEL FURNISHED UNDER THIS CONTRACT. THIS COATING SHALL BE APPLIED BY SPRAY IN THE SHOP AND SHALL BE DESIGNATED AS THE "SHOP PRIME PAINT" OR "PRIMER."

ORGANIC ZINC-RICH COATING APPLIED OVER POWER TOOL CLEANED STEEL SHALL BE USED ONLY IN THE FIELD FOR TOUCH-UP OF DAMAGED AREAS OF THE SHOP PRIME PAINT, AT FIELD CONNECTIONS, AND DAMAGED GALVANIZED SURFACES. IT SHALL BE APPLIED BY SPRAY EXCEPT AS APPROVED BY THE CONTRACTING OFFICER.

SPECIAL ATTENTION SHALL BE GIVEN TO ALL WELDS, SEAMS, CORNERS, RIVETS AND OTHER FASTENERS, AND ROUGH SPOTS TO MAKE SURE THEY ARE COMPLETELY COVERED. PRIOR TO SPRAYING, A BRUSH COAT SHALL BE APPLIED TO ALL BOLTS, WELDS, CREVICES, EDGES, INVOLVED CORNERS AND POCKETS, FOLLOWED BY IMMEDIATE SPRAYING.

EXCEPT AS DESCRIBED ABOVE, BRUSH APPLICATION OF PRIMER IS PROHIBITED AND BRUSH APPLICATION OF THE FIELD PAINT WILL BE ACCEPTABLE ONLY WITH THE APPROVAL OF THE CONTRACTING OFFICER.

THE MATERIAL SHALL BE APPLIED BY SPRAY, TAKING CARE TO OBTAIN A UNIFORM FILM WITH NO BARE AREAS OR VOIDS. THE SPRAY GUN SHALL BE HELD AT RIGHT ANGLES TO THE SURFACE AND PASSES SHALL BE EVEN AND PARALLEL.

---ZINC COATING THICKNESS

TOTAL DRY FILM THICKNESS OF COATING SHALL BE 4 TO 6 MILS APPLIED IN ONE COAT UTILIZING CROSS AND MULTIPLE PASSES. SPECIAL CARE SHALL BE TAKEN TO ENSURE THAT EDGES, CORNERS, CREVICES, WELDS, BOLTS, AND RIVETS RECEIVE A FILM THICKNESS EQUIVALENT TO THAT OF ADJACENT SURFACES. FINISHED SURFACES SHALL

BE FREE FROM RUNS, DROPS, RIDGES, WAVES, LAPS, BRUSH MARKS, VARIATIONS IN COLOR, TEXTURE AND FINISH. TEST APPLICATIONS SHALL BE PERFORMED AT THE WORK AREA OF THE CONTRACTOR TO DETERMINE MATERIAL CHARACTERISTICS.

---SHOP COATING

ALL SURFACES SHALL BE COATED WITHIN 6 HOURS AFTER SURFACE PREPARATION. WHEN THE INTERVAL EXCEEDS 6 HOURS, OR SURFACES BECOME CONTAMINATED, PRIOR TO THIS TIME LIMIT, AREAS SHALL BE RECLEANED IN ACCORDANCE WITH THE ---BLAST CLEANING PARAGRAPH.

---FIELD COATING OF DAMAGED SURFACES

DAMAGED AREAS SHALL BE COATED THE DAY SURFACE PREPARATION IS PERFORMED. IF COATING OPERATION IS NOT ACCOMPLISHED, SURFACES SHALL BE RECLEANED IN ACCORDANCE WITH THE "---POWER TOOL CLEANING" PARAGRAPH.

---MATERIALS---

---GENERAL

COATINGS OR COMPONENTS OF COATING BY DIFFERENT MANUFACTURERS SHALL NOT BE INTERMIXED.

THE MANUFACTURER'S RECOMMENDATIONS FOR THINNING, MIXING, AND HANDLING HIS PRODUCT SHALL BE CONSIDERED A PART OF THIS SPECIFICATION.

COMPRESSED AIR USED FOR SPRAYING COATING MATERIALS SHALL BE FREE OF DETRIMENTAL AMOUNTS OF MOISTURE OR OIL.

ZINC-RICH COATINGS SHALL BE GRAY. NO TINT SHALL BE ADDED THAT WILL APPRECIABLY AFFECT CHANGE IN COLOR FROM THAT OF THE CHARACTERISTIC COLOR OF THE ZINC PIGMENT.

---INORGANIC ZINC-RICH COATING

INORGANIC ZINC-RICH COATING MATERIAL SHALL BE PROVIDED IN ACCORDANCE WITH SPECIFICATION KSC-SPEC-F-0020, TYPE 1, CLASS 1. PRODUCTS QUALIFIED UNDER THIS SPECIFICATION ARE LISTED IN APPROVED PARTS LIST KSC-SPEC-F-0020-KAPL-MAT-4.

---ORGANIC ZINC-RICH COATING

ORGANIC ZINC-RICH COATING: ORGANIC ZINC-RICH COATINGS SHALL ONLY BE EMPLOYED TO REPAIR DAMAGED AREAS OF INORGANIC ZINC-RICH COATINGS AND DAMAGED GALVANIZED SURFACES. SURFACE PREPARATION SHALL BE BY POWER TOOL CLEANING TO SSPC-SP-3 AS OUTLINED ABOVE UNDER THE "---POWER TOOL CLEANING" PARAGRAPH. ORGANIC ZINC-RICH COATING SHALL BE COMPATIBLE WITH THE INORGANIC ZINC-RICH COATING SELECTED AND SHALL BE PER KSC-SPEC-F-0020, TYPE II, CLASS 1.

PRODUCTS QUALIFIED UNDER THIS SPECIFICATION ARE LISTED IN APPROVED PARTS LIST KSC-SPEC-F-0020-KAPL-MAT-4.

---COLORED TOPCOATS (OVER ZINC-RICH COATINGS PER KSC-STD-F-0001)

THESE SHALL BE APPLIED OVER THE ZINC-RICH COATINGS ONLY WHERE INDICATED AND SHALL CONFORM TO MIL-L-81352 OR MIL-P-22750, AND SHALL BE COMPATIBLE WITH THE ZINC COATING. FILM THICKNESS SHALL BE SUFFICIENT FOR UNIFORM COLOR AND COVERAGE. COLORED TOPCOATS SHALL COMPLY WITH FEDERAL STANDARD 595. FOR TOP COATS REFER TO SECTION OF THE SPECIFICATIONS ENTITLED "PAINTING AND FINISHING." TOP COATS SHALL BE APPLIED NOT LESS THAN 7 DAYS AFTER APPLICATION OF ZINC-RICH COATING. WHERE A PRIME COAT IS REQUIRED FOR BONDING OF TOP COAT, THIS SHALL BE PROVIDED BY THE CONTRACTOR.

---INSPECTION---

---CONTRACTOR'S INSPECTION

THE CONTRACTOR SHALL PROVIDE INSPECTORS AS REQUIRED TO ASSURE THAT THE SPECIFICATION REQUIREMENTS ARE FULFILLED, THE COST OF SAID INSPECTION SERVICES TO BE INCLUDED IN THE CONTRACT PRICE AND AT NO FURTHER ADDITIONAL COST TO THE GOVERNMENT.

---GOVERNMENT INSPECTION

THE GOVERNMENT RESERVES THE RIGHT TO INSPECT THE WORK AT ANY TIME FOR CONTRACT COMPLIANCE INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING INSPECTIONS:

AREAS MAY BE INSPECTED PRIOR TO STARTING SURFACE PREPARATION FOR ADEQUATE EQUIPMENT PROTECTION.

CLEANED SURFACES MAY BE INSPECTED PRIOR TO COATING APPLICATION TO ENSURE SURFACE PREPARATION COMPLIES WITH THAT SPECIFIED.

---FINAL INSPECTION

FINAL INSPECTION FOR DRY FILM THICKNESS, POROSITY, AND JOINT SEALING WILL OCCUR AFTER COATING IS COMPLETELY DRY.

---SAFETY---

---GENERAL

SEE SECTION ENTITLED "CONTRACT SCHEDULE".

SECTION 10H

MISCELLANEOUS ITEMS

---GENERAL REQUIREMENTS---

---GENERAL

EACH OF THE ITEMS SPECIFIED HEREINAFTER BUT DO NOT FALL UNDER THE SCOPE OF ANY OF THE OTHER SPECIFICATION SECTIONS OF THIS SPECIFICATION. SUBMIT SHOP DRAWINGS AS OUTLINED IN THE "CONTRACT SCHEDULE".

---WATERPROOFING SEALS---

---URETHANE FOAM

URETHANE FOAM FILLER SHALL BE TWO COMPONENT, "FOAMED-IN-PLACE," USING POURING FORMULATION WHICH CAN BE SHAPED TO THE CONTOURS INDICATED. FOAM WHEN CURED SHALL HAVE 2 TO 6 LB. DENSITY WITH 94% CLOSED CELL CONTENT. FOAM SHALL BE THE PRODUCT OF UNITED FOAM CORPORATION, COMPTON, CALIFORNIA OR APPROVED EQUAL. FOAM SHALL BE PROVIDED TO WALL AND ROOF PENETRATIONS OF STRUCTURES WHERE NOTED ON THE DRAWINGS. *"CURED FOAM SHALL HAVE A FLAME SPREAD RATING OF NOT MORE THAN 25 WHEN TESTED IN ACCORDANCE WITH ASTM-E-84."* (A)

---ELASTOMERIC MEMBRANE

ELASTOMERIC MEMBRANE SHALL BE BLACK COLOR FLUID APPLIED SYNTHETIC RUBBER TYPE WITH SHORE HARDNESS OF 25 TO 33, TENSILE STRENGTH OF 110 TO 130 PSI AND 400% MINIMUM ELONGATION CAPABILITY. MATERIAL SHALL BE KARNAK "W-1" AS MANUFACTURED BY KARNAK CHEMICAL CO., CLARK, NEW JERSEY, OR APPROVED EQUAL. APPLY WITH BRUSH, ROLLER OR SPRAY TO A MINIMUM THICKNESS OF 60 MILS TO WATERPROOF WALL AND ROOF PENETRATIONS OF STRUCTURES WHERE NOTED ON THE DRAWINGS.

---LADDER HATCH---

---GENERAL

HATCH SHALL HAVE 24 INCH SQUARE CLEAR OPENING, SHALL BE FACTORY-FABRICATED OF NOT LESS THAN 14 GAUGE STEEL WITH HEAVY-DUTY HINGE, RIGID FIBERGLASS INSULATION FOR CURB AND COVER, COUNTER-BALANCE SPRINGS, HOLD OPEN ARM, AND INSIDE AND OUTSIDE LOCKABLE LATCH HANDLES. AFTER FABRICATION OF METAL, UNIT SHALL BE HOT-DIPPED GALVANIZED. LADDER HATCH SHALL BE EQUAL TO DUR-RED MODEL NO. LH 2'-0" X 2'-0" G AS MANUFACTURED BY RED PRODUCTS COMPANY, INC., 5716 ALBA ST., LOS ANGELES, CA. 90058.

METAL BUILDINGS FOR HYPERGOLIC FACILITIES

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AA	ALUMINUM ASSOCIATION
AAMA	ARCHITECTURAL ALUMINUM MANUFACTURERS ASSOCIATION
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
AREA	AMERICAN RAILWAY ENGINEERING ASSOCIATION
ASCE	AMERICAN SOCIETY OF CIVIL ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
USDC	UNITED STATES DEPARTMENT OF COMMERCE (COMMERCIAL STANDARDS)
FS	FEDERAL SPECIFICATIONS
MBMA	METAL BUILDING MANUFACTURERS ASSOCIATION
MIL	MILITARY SPECIFICATIONS
NAAMM	NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS
NBS	NATIONAL BUREAU OF STANDARDS
SSPC	STEEL STRUCTURES PAINTING COUNCIL
UL	UNDERWRITERS' LABORATORIES, INC.

---DEFINITION OF AWS CODE

AWS CODE SHALL MEAN "STRUCTURAL WELDING CODE," AWS D1.1-72 WITH THE FOLLOWING MODIFICATION:

DELETE AWS PARAGRAPH 1.1.2 AND SUBSTITUTE: ALL REFERENCES TO THE NEED FOR APPROVAL SHALL MEAN "APPROVAL BY THE CONTRACTING OFFICER", AND ALL REFERENCES TO THE "BUILDING COMMISSIONER" SHALL MEAN THE "CONTRACTING OFFICER".

---QUALIFICATIONS FOR WELDING WORK

WELDING PROCESSES SHALL BE QUALIFIED IN ACCORDANCE WITH AWS "STANDARD QUALIFICATION PROCEDURE".

ALL WELDING OPERATORS SHALL BE QUALIFIED UNDER THE PROVISIONS OF AWS "STANDARD QUALIFICATION PROCEDURE" OR UNDER AN EQUIVALENT QUALIFICATION TEST APPROVED IN ADVANCE BY THE CONTRACTING OFFICER. IN ADDITION TO THE ABOVE REQUIREMENTS, ALL TESTS SHALL BE PERFORMED ON TEST PIECES IN POSITIONS AND WITH CLEARANCES EQUIVALENT TO THOSE ACTUALLY ENCOUNTERED IN CONSTRUCTION. IF A TEST WELD FAILS TO MEET REQUIREMENTS, AN IMMEDIATE RETEST OF 2 TEST WELDS SHALL BE MADE, AND EACH TEST WELD SHALL PASS. FAILURE IN THE IMMEDIATE RETEST WILL REQUIRE THAT THE WELDER BE RETESTED AFTER FURTHER PRACTICE OR TRAINING, AND A COMPLETE SET OF TEST WELDS SHALL BE MADE.

---QUALIFICATIONS OF MANUFACTURER

THE METAL BUILDINGS SHALL BE THE DESIGN AND PRODUCT OF MANUFACTURER WHO IS REGULARLY ENGAGED IN THE FABRICATION AND ERECTION OF PRE-ENGINEERED METAL STRUCTURES OF THE TYPE AND QUALITY SPECIFIED HEREIN.

---CERTIFICATION

THE BUILDING MANUFACTURER SHALL FURNISH A CERTIFICATE, SIGNED BY A REGISTERED PROFESSIONAL ENGINEER, THAT THE BUILDING DESIGN MEETS THE REQUIREMENTS OF THE SPECIFICATIONS AND HAS BEEN DESIGNATED IN ACCORDANCE WITH THE INDICATED AND SPECIFIED DESIGN LOADS AND IS IN ACCORDANCE WITH ACCEPTED ENGINEERING PRACTICE.

---FOUNDATIONS

ALL INTERFACES OF THE STRUCTURE WITH THE FOUNDATIONS BASE PLATES, ANCHOR BOLTS, AND CURBS SHALL BE COORDINATED AND VERIFIED BY THE CONTRACTOR TO INSURE ACCURATE FIT OF THE WORK.

---SHOP DRAWINGS

SUBMIT SHOP AND ERECTION DRAWINGS AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

SHOP DRAWINGS SHALL PROVIDE COMPLETE CALCULATIONS AND STRUCTURAL ANALYSIS BASED ON DESIGN LOADS FOR EACH BUILDING. FURNISH ALL DATA FOR DETERMINING ANCHOR BOLT SIZING, PRIMARY AND SECONDARY STRUCTURAL FRAMING FOR SIDEWALL, ENDWALL AND ROOF; SPECIAL FRAMING DETAILS AND OPENINGS IN THE WALLS; SPECIAL REQUIREMENTS AND FRAMING FOR AUXILIARY LOADING. DRAWINGS SHALL SHOW ANCHOR BOLT LOCATIONS.

SHOP DRAWINGS SHALL INDICATE MATERIAL, GAGE THICKNESS, WIDTH, LENGTH AND PROFILE OF METAL ROOFING AND SIDING PANELS; THE METHOD OF FASTENING PANELS TO PRIMARY AND SECONDARY FRAMING MEMBERS; AND SHALL IDENTIFY THE TYPE OF FASTENER.

SHOP DRAWINGS SHALL INDICATE PLAN, ELEVATIONS AND SECTIONS OF ALL OPENINGS AND DOORS, AND SHALL SHOW HARDWARE, GLAZING, ASSEMBLY FRAMES; CONSTRUCTION, TRIM AND FITTINGS.

SHOP DRAWINGS SHALL INDICATE ACCESSORY ITEMS, METAL AND MASTIC CLOSURES, METHOD OF JOINT SEALING, CONSTRUCTION DETAILS OF CORNERS, RIDGES, EAVES, RAKES, CURBS, FLASHINGS, GUTTERS AND DOWNSPOUTS AND WALL PENETRATIONS.

SHOP DRAWINGS FOR ELECTRICAL BUILDING SHALL INDICATE AIR CONDITIONING UNIT AND FITTINGS PROPERLY LOCATED AND METHOD FOR SUPPORT, WALL PENETRATION AND CLOSURES.

MANUFACTURER'S DATA SHEETS ON THE AIR CONDITIONING UNITS SHALL VERIFY CONFORMANCE TO THE REQUIREMENTS SPECIFIED. OPERATION AND MAINTENANCE MANUALS ARE REQUIRED.

---SAMPLES

SUBMIT SAMPLES AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

METAL ROOFING AND SIDING - 1 PIECE, 8 INCHES BY 11 INCHES.

AVAILABLE COLORS FOR ROOFING AND SIDING.

---PROTECTION OF EXISTING WORK

PROTECT PREVIOUSLY PLACED CONCRETE FLOOR SLABS AND FOUNDATIONS FROM DAMAGE DUE TO ANY CAUSE. REMOVE AND REPLACE ALL CONCRETE WORK DAMAGED DUE TO ERECTION OF PREFABRICATED BUILDING.

---DELIVERY, HANDLING AND STORAGE

STRUCTURAL FRAME, ROOFING AND SIDING PANELS SHALL BE FACTORY FABRICATED AND SHIPPED TO THE PROJECT SITE "KNOCKED-DOWN" IN PROPERLY DESIGNED CRATES OR BUNDLES.

DOORS SHALL BE SHIPPED IN INDIVIDUAL CARTONS, SECURELY BUNDLED AND WRAPPED WITH MOISTURE RESISTANT COVERS.

PROTECT ALL MATERIALS FROM WEATHER, STAINING, RUST AND DAMAGE AND AT ALL TIMES IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS AND AS SPECIFIED HEREIN.

PROVIDE ADEQUATE PACKAGING AND PROTECTION DURING SHIPMENT AND DURING STORAGE. CHECK THE CONDITION OF SHEET MATERIAL UPON ARRIVAL AT THE JOB SITE, FOR DAMAGE, DAMPNESS AND WET STORAGE STAIN. REMOVE MOISTURE FROM DAMPENED OR WETTED SHEETS. REMOVE STAINED SHEETS OR PANELS FROM THE JOB SITE AND REPLACE.

HANDLE MATERIAL CAREFULLY TO AVOID DAMAGE TO SURFACES, EDGES AND ENDS. CRATED MATERIALS SHALL NOT BE UNCRATED UNTIL READY FOR USE. DAMAGED MATERIAL SHALL BE REMOVED PROMPTLY FROM THE SITE AND REPLACED.

STORE MATERIALS IN A DRY, LEVEL, WEATHER-TIGHT AND PROPERLY VENTILATED STRUCTURE. IF SUCH STRUCTURES ARE NOT AVAILABLE, MATERIAL SHALL NOT BE DELIVERED UNTIL REQUIRED FOR INSTALLATION. STRUCTURAL FRAMING, BOTH PRIMARY AND SECONDARY FRAMING MEMBERS, SHEET PANEL MATERIALS WHICH OF NECESSITY MUST BE STORED OUTDOORS BEFORE IMMEDIATE USE, SHALL BE PLACED IN ORDERLY PILES AND ON WOOD BLOCKING IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTION. MATERIAL SHALL BE PROTECTED FROM STAINING, MOISTURE AND THE WEATHER WITH A MOISTURE RESISTANT TARPULIN, COMPLETELY COVERING EACH STACK AND EXTENDING TO THE GROUND.

DELIVER FASTENERS, FILLER STRIPS AND ACCESSORIES IN THE ORIGINAL, UNBROKEN PACKAGE OR CONTAINER AND STORE IN A DRY WEATHER-TIGHT AREA UNTIL REQUIRED FOR USE.

---WORK SPECIFIED ELSEWHERE

THE FOLLOWING WORK AND MATERIALS ARE SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS OR SHOWN ON THE DRAWINGS:

CONCRETE FOOTINGS, AND CONCRETE CURBS.

ELECTRICAL, FIRE PROTECTION PIPING, POTABLE WATER PIPING AND FIRE ALARM SYSTEMS.

PROTECTIVE COATING FOR CARBON STEEL - SECTION 9L OF THE SPECIFICATIONS.

---PERFORMANCE REQUIREMENTS---

---PROPERTIES OF SECTIONS

THE PROPERTIES OF HOT ROLLED STRUCTURAL STEEL COLUMNS, BEAMS, RIGID FRAME MEMBERS AND OTHER PRIMARY FRAMING MEMBERS SHALL BE COMPUTED IN ACCORDANCE WITH AISC MANUAL OF STEEL CONSTRUCTION, SEVENTH EDITION, 1969, "SPECIFICATION FOR DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS."

THE PROPERTIES OF COLD ROLLED PURLINS, GIRTS, STRUTS AND OTHER SECONDARY FRAMING MEMBERS SHALL BE COMPUTED IN ACCORDANCE WITH AISI "SPECIFICATION FOR THE DESIGN OF COLD FORMED STEEL STRUCTURAL MEMBERS", 1968 EDITION.

ALL SECTION PROPERTIES SHALL EQUAL OR EXCEED THE REQUIRED VALUES OF SECTION PROPERTIES INDICATED.

---ALLOWABLE DESIGN STRESS, DEFLECTION AND LOADS

THE DESIGN OF ALL SPECIFIED METAL BUILDINGS SHALL BE IN ACCORDANCE WITH MBMA "METAL BUILDING SYSTEMS MANUAL", AS AMENDED AND AS MODIFIED HEREIN.

DESIGN OF STRUCTURAL STEEL MEMBERS SHALL CONFORM TO AISC "MANUAL OF STEEL CONSTRUCTION" SEVENTH EDITION, SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS.

DESIGN OF LIGHT GAGE STEEL MEMBERS SHALL CONFORM TO AISI "COLD-FORMED STEEL DESIGN MANUAL", LATEST EDITION.

HOT-ROLLED STEEL SHEET, PLATE AND STRIP USED IN THE FABRICATION END-WALL STRUCTURAL FRAMING OF WELDED ASSEMBLIES SHALL BE STRUCTURAL QUALITY STEEL WITH A MINIMUM YIELD POINT OF 42,000 PSI CONFORMING TO ASTM A529-72, OR TO ASTM A570-72, GRADE E, OR TO ASTM A572-72, GRADE 42.

STRUCTURAL STEEL TUBING SHALL BE HOT-FORMED WELDED AND SEAMLESS CARBON STEEL CONFORMING TO ASTM A501-71, OR COLD-FORMED WELDED AND SEAMLESS CARBON STEEL CONFORMING TO ASTM A500-72, GRADE B.

DIAGONAL ROD BRACING SHALL BE HIGH-STRENGTH, UNCOATED LOW-ALLOY SMOOTH ROUND BARS CONFORMING TO ASTM A572-72, OR CARBON STEEL BARS CONFORMING TO ASTM A36-70A NOT LESS THAN 5/8-INCH DIAMETER. THREADS SHALL BE ROLLED OR CUT. NUTS SHALL BE SEMIFINISHED HEX-HEAD.

ANCHOR BOLTS SHALL BE GALVANIZED STEEL CONFORMING TO ASTM A153-73.

SLOPED BEAMS OR RAFTERS SHALL BE FABRICATED TO INCLUDE THE DEAD LOAD CAMBER. SLOPED BEAMS OR RAFTERS WITH A SPAN OF 50 FEET OR LESS SHALL BE FURNISHED WITHOUT CENTER SPLICE.

PRIMARY FRAMING MEMBERS SHALL BE SHOP FABRICATED TO THE SPECIFIED SECTION, COMPLETE WITH BASE PLATES, BEARING PLATES, CAP PLATES AND OTHER PLATES AS REQUIRED FOR ERECTION, WELDED IN PLACE, AND WITH ALL REQUIRED HOLES FOR ANCHORING OR CONNECTIONS SHOP DRILLED OR PUNCHED TO TEMPLATE DIMENSIONS.

---SHOP PAINTING OF PRIMARY FRAMING

ALL PRIMARY FRAMING STRUCTURAL STEEL SHALL BE BLAST CLEANED AND COATED AS SPECIFIED IN SECTION 9L OF THESE SPECIFICATIONS WITH ZINC-RICH INORGANIC PAINT.

---SECONDARY FRAMING MEMBERS

SECONDARY FRAMING MEMBERS SHALL CONSIST OF PURLINS, GIRTS, STRUTS, SILL SUPPORTS, BRACES, STUB COLUMNS, AND SIMILAR MEMBERS WHICH ARE FRAMED INTO THE PRIMARY FRAME RAFTERS AND COLUMNS, AND TO WHICH THE ROOFING AND SIDING PANELS ARE FASTENED.

SECONDARY FRAMING MEMBERS SHALL BE FABRICATED FROM HOT-ROLLED STRUCTURAL QUALITY GALVANIZED STEEL WITH A MINIMUM YIELD POINT OF NOT LESS THAN 40,000 PSI AND SHALL CONFORM TO ASTM A446-71, GRADE C; OR TO ASTM A570-72, GRADE C OR D. ZINC COATING SHALL BE NOT LESS THAN 1.25 OUNCES PER SQUARE FOOT, COMMERCIAL CLASS COATING, CONFORMING TO ASTM A525-71.

SECONDARY FRAMING MEMBERS SHALL HAVE A MINIMUM THICKNESS OF 0.080 INCH, AND SHALL BE PREPUNCHED FOR BOLTED FIELD ASSEMBLY.

THE ZINC-COATED STEEL SHALL BE CHEMICALLY CLEANED WITH AN ALKALINE COMPOUND, FOLLOWED BY A HOT WATER RINSE, THEN TREATED WITH A ZINC PHOSPHATE CONVERSION COATING; RINSED WITH COLD WATER, THEN SEALED WITH A CHROMIC ACID RINSE AND DRIED, IN ACCORDANCE WITH FS TT-C-490B, METHOD III, TYPE I. MINIMUM DRY-FILM THICKNESS OF PRETREATMENT SHALL BE NOT LESS THAN 0.25 MILS.

THE PRETREATED ZINC-COATED STEEL SHALL BE GIVEN A 2 COAT, BAKED-ON THERMO-SETTING ACRYLIC ENAMEL ALKYD MELAMINE, VINYL SOLUTION, OR SILICONIZED POLYESTER RESIN FINISH WITH A MINIMUM DRY FILM THICKNESS OF 1 MIL.

ROOFING AND SIDING SHEETS SHALL HAVE FINISH COAT ONE SIDE, AND STANDARD WASH COAT ON THE REVERSE SIDE. COLOR OF SHEETS SHALL BE AS SELECTED FROM MANUFACTURER'S STANDARD COLORS WHICH SHALL BE SUBMITTED FOR SELECTION.

THE COATING SYSTEM SHALL BE TESTED IN ACCORDANCE WITH FEDERAL STANDARD 141A, METHOD AS SPECIFIED, BY ASTM TEST METHOD AND AS FOLLOWS:

FLEXIBILITY - - A TEST PANEL OF 20 TO 24 USS GAGE MATERIAL SHALL BE SUBJECTED TO A 180 DEGREES BEND OVER A 1/2-INCH DIAMETER MANDREL AT 77 DEGREES FAHRENHEIT IN ACCORDANCE WITH METHOD 6221. THERE SHALL BE NO LOSS OF ADHESION OR CRACKING OF THE COATING SYSTEM.

ABRASION RESISTANCE - - TEST PANEL SHALL BE SUBJECTED TO 1000 WEAR CYCLES OF A CS-10 TABER ABRASIVE WHEEL WITH A 1000 GRAM LOAD, IN ACCORDANCE WITH METHOD 6192. THE ABRASION TEST SHALL INDICATE A WEAR INDEX OF NOT MORE THAN 100 FOR THE COATING SYSTEM.

ACCELERATED WEATHERING - - THE ENAMEL COATING SYSTEM ON A SPECIMEN PLATE SHALL BE SUBJECTED TO AN ACCELERATING WEATHERING TEST CONDUCTED IN ACCORDANCE WITH ASTM G23-69, TYPE D MACHINE. THE TESTED COATING SYSTEM SHALL SHOW NO BLISTERING, CRACKING, CHECKING, COLOR CHANGES AND STABILITY, OR DELAMINATION AFTER 1000 HOURS EXPOSURE. SURFACE DEGRADATION SHALL BE LIMITED TO SURFACE GRANULATION OR CHALKING NOT IN EXCESS OF DEGREE NO. 6, AS DEFINED IN ASTM D659-44(1970). COLOR CHANGES WILL BE TESTED AS SPECIFIED UNDER THE ARTICLE ENTITLED "ACCEPTANCE PROVISIONS".

WATER IMMERSION - - THE COATING SYSTEM ON A SPECIMEN PLATE SHALL BE IMMERSED FOR 21 DAYS IN DISTILLED WATER AT 72 DEGREES FAHRENHEIT IN A GLASS CONTAINER, IN ACCORDANCE WITH METHOD 6011. COATING SYSTEM SHALL SHOW NEITHER BLISTERING NOR LOSS OF ADHESION BEYOND 1/8 INCH FROM EDGES.

COLOR AND APPEARANCE - - THE COLOR OF THE COATING SYSTEM SHALL MATCH THE SPECIFIED COLOR STANDARD. FADING SHALL NOT EXCEED 5 NBS UNITS WITHIN A 5-YEAR PERIOD AFTER INSTALLATION, WHEN MEASURED WITH AN ACCEPTABLE COLORIMETER AND EMPLOYING TESTS CONFORMING TO ASTM D2244-68. THE APPEARANCE OF THE COATING SHALL BE UNIFORM AND FREE FROM CRATERS, DRY SPRAY, MOTTLING, ORANGE PEEL, RUNS, SAGS, WRINKLING AND OTHER SURFACE IMPERFECTIONS.

SALT SPRAY - - THE COATING SYSTEM ON A SPECIMEN PLATE SHALL BE SUBJECTED TO 500 HOURS EXPOSURE IN A SALT SPRAY TEST IN ACCORDANCE WITH ASTM B117-64. TEST SPECIMENS SHALL HAVE AT LEAST ONE CUT EDGE AND SHALL BE SCORED THROUGH THE COATING SYSTEM TO EXPOSE THE GALVANIZING. THE COATING SYSTEM SHALL SHOW NO LOSS OF ADHESION 1/8-INCH BEYOND PANEL EDGES AND SCRATCH MARK, NO BLISTERS AND NO EVIDENCE OF CORROSION.

FILM THICKNESS - - THE DRY FILM THICKNESS OF THE PAINT COATING SHALL BE NOT LESS THAN 1 MIL AT ANY SPOT, AS DETERMINED BY ASTM D1005-51(1972).

---PROFILE OF ROOFING SHEET

ROOFING SHEETS SHALL BE PRECISION ROLL-FORMED STEEL OF NOT LESS THAN 0.0239 INCH THICKNESS, FABRICATED TO ONE OF THE FOLLOWING PROFILES:

ROOFING FOR THE HYPERGOLIC FUEL AND OXIDIZER BUILDINGS SHALL BE RIB PATTERN, 36-INCH NET WIDTH, WITH MAJOR RIBS NOT LESS THAN 1-1/4 INCHES DEEP BY 12 INCHES ON CENTER, AND WITH 2 ADDITIONAL MINOR RIBS SPACED BETWEEN THE MAJOR RIBS. MAJOR RIBS SHALL BE NOT LESS THAN 1 INCH WIDE, TAPERING TO NOT LESS THAN 2-7/8 INCHES WIDE.

ROOFING FOR THE TWO ELECTRICAL EQUIPMENT BUILDINGS SHALL BE RIB PATTERN EXTERIOR FACE AND NOMINAL FLAT PATTERN INTERIOR FACE, FULLY ENCLOSING 2" THICKNESS OF FIBREGLASS INSULATION MATERIAL. THE EXTERIOR FACE SHALL BE RIB PATTERN, 36-INCH NET WIDTH, WITH MAJOR RIBS NOT LESS THAN 1-1/4 INCHES DEEP BY 12 INCHES ON CENTER, AND WITH 2 ADDITIONAL MINOR RIBS SPACED BETWEEN THE MAJOR RIBS. MAJOR RIBS SHALL BE NOT LESS THAN 1-INCH WIDE TAPERING TO NOT LESS THAN 2-7/8 INCHES WIDE.

---PROFILE OF SIDING PANEL

SIDING SHEETS SHALL BE PRECISION ROLL-FORMED STEEL OF NOT LESS THAN 0.0239 INCH THICK, FABRICATED TO ONE OF THE FOLLOWING PROFILES:

SIDING FOR THE TWO ELECTRICAL EQUIPMENT BUILDINGS SHALL BE RIB PATTERN EXTERIOR FACE AND NOMINAL FLAT INTERIOR FACE FULLY ENCLOSING 2" THICKNESS OF FIBREGLASS INSULATION MATERIAL. THE EXTERIOR FACE SHALL BE RIB PATTERN, 36-INCHES NET WIDTH, WITH MAJOR RIBS NOT LESS THAN 1-1/4 DEEP BY 12 INCHES ON CENTER, AND WITH 2 ADDITIONAL MINOR RIBS SPACED BETWEEN THE MAJOR RIBS. MAJOR RIBS SHALL BE NOT LESS THAN 1-INCH WIDE TAPERING TO NOT LESS THAN 2-7/8 INCHES WIDE.

---METAL FASCIA AND TRIM---

---GENERAL

PROVIDE FASCIA TRIM END CAPS, SPLICES, CORNERS AND CLOSURES AT EAVES AND RAKE OF GABLES, OF PROFILE AND TYPE AS INDICATED, AND TRIM AT FRAMED OPENING AND CORNERS AS REQUIRED TO PROVIDE A WEATHERTIGHT AND FINISHED APPEARANCE.

GALVANIZED STEEL TRIM MEMBERS SHALL BE NOT LESS THAN 0.0239 INCH THICK, AND SHALL BE THE SAME MATERIAL AND COLOR FINISH AS THE SPECIFIED WALL AND ROOF PANELS.

---FASTENERS---

---SHEET PANEL FASTENERS

EXPOSED FASTENERS FOR SECURING SHEETS TO STRUCTURAL STEEL PRIMARY OR SECONDARY FRAMING SHALL BE NO. 12 AND NO. 14 SELF-TAPPING, TYPE B RECESSED HEX HEAD, TYPE 305 STAINLESS STEEL SCREWS WITH CADMIUM PLATE FINISH; LENGTH AS REQUIRED FOR THE APPLICATION. FASTENERS SHALL COMPLY WITH FS FF-S-107C(2). FASTENER ASSEMBLY SHALL INCLUDE A STAINLESS STEEL WASHER AND A NEOPRENE WASHER, OR AN INTEGRAL STAINLESS STEEL AND NEOPRENE WASHER. EXPOSED HEAD OF FASTENER SHALL MATCH COLOR OR ROOFING AND SIDING SHEETS, EITHER BY MEANS OF PLASTIC CAPS OR BY FACTORY-COATED FASTENERS. EXPOSED FASTENERS FOR SECURING OVERLAP TYPE SIDE LAPS OF CORRUGATED PROFILE STEEL MATERIALS AND FOR SECURING ACCESSORY STEEL FLASHING SHALL BE NO. 14 BY 3/4-INCH LONG TYPE B RECESSED HEX HEAD, TYPE 305 CORROSION RESISTING CHROMIUM NICKEL STEEL WITH A STAINLESS STEEL AND NEOPRENE WASHER.

NEOPRENE WASHERS SHALL BE 1/16 INCH TO 1/32 INCH THICK, CARBON-BLACK FILLED "W" TYPE FORMULATION WITH AT LEAST 50 PERCENT NEOPRENE BY VOLUME, AND WITH AN EFFICIENT ANTIOXIDANT. NEOPRENE SHALL HAVE A SHORE A DUROMETER HARDNESS OF 60 TO 90, TENSILE STRENGTH 1500 POUNDS PER SQUARE INCH WITH AN ELONGATION AT BREAK OF 500 PERCENT.

METAL WASHERS SHALL BE 0.040 INCH THICK, TYPE 305 STAINLESS STEEL, NOT LESS THAN 5/8 INCH OUTSIDE DIAMETER.

---FRAMING FASTENERS

FASTENERS FOR ALL PRIMARY FRAMING MEMBERS, FLANGE REINFORCING BRACING AND PURLIN-TO-PURLIN CONNECTIONS SHALL HAVE ALL COMPONENTS GALVANIZED AND SHALL BE HIGH-STRENGTH, STRUCTURAL, HEAVY HEXAGON BOLTS, HEAVY SEMIFINISHED HEXAGON NUTS AND HARDENED WASHERS CONFORMING TO ASTM A325-71.

FASTENERS FOR ALL SECONDARY FRAMING MEMBERS AND MISCELLANEOUS FRAMING SHALL BE REGULAR HEXAGON, LOW-CARBON STEEL BOLTS AND NUTS, AND CARBON STEEL WASHERS CONFORMING TO ASTM A307-68, GRADE A. ALL COMPONENTS SHALL BE GALVANIZED.

---METAL FLASHING AND CLOSURE STRIPS

METAL FLASHING AND CLOSURE STRIPS SHALL BE FACTORY FABRICATED ACCESSORIES, MATCHING THE TYPE, GAGE AND CORRUGATION PROFILE OF THE SPECIFIED ROOFING AND SIDING TYPE, GAGE AND CORRUGATION PROFILE OF THE SPECIFIED ROOFING AND SIDING SHEETS.

---CAULKING AND SEALANT MATERIALS---

---JOINT SEALING COMPOUND

JOINT SEALANT FOR FIELD APPLIED CAULKING SHALL BE AN APPROVED GUN GRADE, NONSAG 2-COMPONENT SILICONE RUBBER WITH AN INITIAL MAXIMUM SHORE "A" DUROMETER HARDNESS OF 25, AND SHALL CONFORM TO FS TT-S-00227E(3), TYPE II. COLOR SHALL MATCH PANEL COLOR.

JOINT SEALANT FOR SHOP APPLIED CAULKING SHALL BE AN APPROVED, GUN GRADE NONSAG OR SILICONE RUBBER SEALANT CONFORMING TO FS TT-S-00230C(2), TYPE II, AND WITH A CURING TIME TO INSURE THE SEALANT'S PLASTICITY AT THE TIME OF FIELD ERECTION.

ALL JOINTS SHALL BE PRIMED WITH A COMPATIBLE 1-COMPONENT OR 2-COMPONENT PRIMER, AS RECOMMENDED BY THE SEALANT MANUFACTURER.

---SEALING TAPE

SEALING TAPE FOR END LAPS AND SIDE LAPS OF METAL PANELS AND METAL FLASHING SHALL BE A 100 PERCENT SOLIDS, PRESSURE SENSITIVE GRAY POLYISOBUTYLENE COMPOUND WITH ASBESTOS FILLERS AND WITH RELEASE PAPER BACKING. TAPE SHALL BE NOT LESS THAN 1/2 INCH WIDE AND 1/8 INCH THICK, NONSAG, NONTOXIC, NONSTAINING AND PERMANENTLY ELASTIC. SERVICE TEMPERATURE SHALL BE FROM MINUS 20 DEGREES FAHRENHEIT TO PLUS 160 DEGREES FAHRENHEIT. FLASH POINT SHALL BE NOT LESS THAN 300 DEGREES FAHRENHEIT.

---GROUT MATERIALS---

---SHRINKAGE-RESISTANT GROUT

SHRINKAGE-RESISTANT GROUT SHALL BE A PREMIXED AND PACKAGED METALLIC AGGREGATE MORTAR CONFORMING TO CORPS OF ENGINEERS SPECIFICATION FOR SHRINKAGE RESISTANCE GROUTS, CRD-C588-62, TYPE M.

---INSULATING MATERIALS---

---GENERAL

THE ROOFING AND SIDING PANELS FOR THE TWO ELECTRICAL EQUIPMENT BUILDINGS SHALL FULLY ENCLOSE AN INSULATION MATERIAL OF 2-INCHES MINIMUM THICKNESS FIBREGLASS.

000227

---DOOR CLEARANCE TOLERANCE

DOOR CLEARANCE SHALL BE NOT MORE THAN 1/8 INCH AT JAMBS AND HEAD, NOT MORE THAN 1/4 INCH AT MEETING STILES OF PAIRS OF DOORS, AND NOT MORE THAN 1/4 INCH ABOVE THRESHOLD.

---DOOR FRAMES

DOOR FRAMES SHALL BE FABRICATED FROM COLD ROLLED GALVANIZED CARBON STEEL SHEETS CONFORMING TO ASTM A526-71, COMMERCIAL COATING OF NOT LESS THAN 1.25 OUNCES OF ZINC PER SQUARE FOOT, STEEL NOT LESS THAN 0.0747 INCH THICK, AND FREE FROM PITTING, SCALE, STRETCHER STRAINS, FLUTING AND SURFACE DEFECTS, AND FACTORY FINISHED TO MATCH WALL PANELS.

FRAMES SHALL HAVE A 2-INCH FACE, PROFILE AND WIDTH DIMENSION AS INDICATED, WITH MITERED, REINFORCED CORNERS, WELDED FULL DEPTH OF FRAME AND TRIM, AND WITH EXPOSED SURFACE GROUND SMOOTH AND FLUSH. ALL CONTACT EDGES SHALL BE CLOSED TO HAIRLINE JOINTS.

HARDWARE REINFORCEMENT SHALL BE CONCEALED AND SIZED AS REQUIRED FOR HARDWARE FUNCTION. HINGE REINFORCEMENT SHALL BE NOT LESS THAN 3/16 INCH THICK. LOCK STRIKE SHALL BE NOT LESS THAN 0.1196 INCH THICK, AND SURFACE APPLIED HARDWARE REINFORCEMENT SHALL BE NOT LESS THAN 0.1046 INCH THICK.

FRAME ANCHORS SHALL BE LOCATED NEAR TOP AND BOTTOM OF DOOR AND AT INTERMEDIATE POINTS NOT OVER 24 INCHES ON CENTER. PROVIDE NOT LESS THAN 3 ANCHORS PER JAMB.

---HINGES

BUTT HINGES SHALL BE BUTTON-TIP, TEMPLATE, OIL-IMPREGNATED BEARING, BRONZE, CONFORMING TO FS FF-H-116C(4) INT. AMD. 5, TYPE T2106, US26D OR US32D, WITH NONREMOVABLE PINS. HINGES SHALL BE NOT LESS THAN 4-1/2 INCHES BY 4-1/2 INCHES BY 0.134 INCH THICK. DOORS 5 FEET AND LESS IN HEIGHT SHALL HAVE NOT LESS THAN 2 HINGES. PROVIDE ONE ADDITIONAL HINGE FOR EACH ADDITIONAL 30 INCHES IN HEIGHT, OR FRACTION THEREOF. DOORS WIDER THAN 40 INCHES SHALL RECEIVE 5-INCH BY 4-1/2-INCH-WIDE HINGES.

---DOOR HOLDERS

DOOR HOLDERS SHALL BE OF THE SURFACE MOUNTED OVERHEAD SLIDE DOOR HOLDER, AUTOMATIC OPERATION, TYPE 1161 OR 1161A, OF BRASS, OR GALVANIZED OR CHROME PLATED STEEL.

---LOCKSETS

LOCKSETS SHALL CONFORM TO FS FF-H-00106B(1) PLAIN DESIGN, WROUGHT TRIM, HEAVY DUTY SERIES 86 OR 161, FUNCTION 86B OR 161B, US28 FINISH. EACH LOCKSET SHALL HAVE A BEST SECURITY CORE, AS FOLLOWS:

NOTWITHSTANDING THE PROVISION OF CLAUSE 9 OF THE GENERAL PROVISIONS (SF-23A) AND IN CONSONANCE WITH KENNEDY SPACE CENTER ESTABLISHED BEST UNIVERSAL MASTER KEY SYSTEM, *"THE 7-PIN TUMBLER REMOVABLE CORES OF THE BEST UNIVERSAL LOCK COMPANY, INC. WILL BE PROVIDED BY THE GOVERNMENT AND INSTALLED AFTER ACCEPTANCE OF THE PROJECT BY THE GOVERNMENT".* (A)

"THE CONTRACTOR SHALL FURNISH, INSTALL AND MAINTAIN TEMPORARY CONSTRUCTION CORES FOR ALL EXTERIOR DOORS PROVIDED UNDER THIS CONTRACT, AND SHALL FURNISH THE GOVERNMENT WITH TWO (2) KEYS FOR EACH CONSTRUCTION CORE, PROPERLY TAGGED AND DESIGNATED AS TO LOCATION. ALL CYLINDERS SHALL BE A 7-PIN REMOVABLE CORE TYPE AND SHALL BE CAPABLE OF RECEIVING BEST UNIVERSAL LOCK COMPANY'S CODE NO. 7A7A1 OR NO. 7A7A2. STANDARD MORTISE CYLINDERS SHALL HAVE AN OUTSIDE DIAMETER OF 1.150 INCHES WITH 32 THREADS PER INCH: DEPTH OF THREADS 0.027 INCHES. CYLINDERS FOR RIM LOCKS SHALL HAVE AN OUTSIDE DIAMETER OF 1.148 INCHES, ADJUSTABLE FOR DOORS FROM 3-3/8 INCH TO 2-7/8 INCH THICKNESS. ALL LOCKS FOR INTERIOR DOORS SHALL BE FINISHED AND INSTALLED WITHOUT CYLINDER OR CORE AND WITH A TEMPORARY WOOD, OR METAL, CYLINDER OPENING COVER".

---EXIT DEVICES (PANIC BOLTS)

THE INACTIVE PANEL OF DOUBLE DOORS SHALL BE PROVIDED WITH SURFACE-MOUNTED BOLT LATCHES AT THE INTERIOR HEAD AND SILL. HARDWARE SHALL BE GALVANIZED STEEL AND/OR MALLEABLE IRON, BRONZE OR BRASS.

---FASTENERS

PROVIDE FASTENERS OF THE PROPER TYPE, SIZE, QUANTITY AND FINISH FOR EACH HARDWARE ITEM. USE MACHINE SCREWS AND EXPANSION SHIELDS FOR ATTACHING HARDWARE TO CONCRETE, ALL VISIBLE FASTENERS SHALL BE PHILLIPS-HEAD BRONZE OR STAINLESS STEEL, FINISH TO MATCH SPECIFIED HARDWARE. HINGES SHALL BE A ONE-WAY TYPE OR OTHER APPROVED TAMPERPROOF TYPE.

---WEATHERSTRIPPING MATERIALS---

---DOOR WEATHERSTRIPPING

PROVIDE WEATHERSTRIPPING AT HEADS, JAMBS, AND MEETING STILES OF DOORS. WEATHERSTRIPPING SHALL BE SILICONE TREATED WOOL PILE CLOTH INSERTED IN A STAINLESS STEEL HOUSING. WEATHERSTRIPPING AT MEETING STILES OF PAIRS OF DOORS SHALL BE ADJUSTABLE. AN ADJUSTABLE WEATHER SEAL SHALL BE PROVIDED ALSO AT THE BOTTOM OF THE DOOR FOR INTERFACING WITH THE THRESHOLD SEAL. RAIN DRIP FOR DOOR EXTERIOR AT SILL SHALL BE STAINLESS STEEL.

---AIR CONDITIONING UNIT---

---AIR CONDITIONING UNIT

FOR EACH ELECTRICAL BUILDING, PROVIDE A SELF-CONTAINED, THROUGH-THE-WALL TYPE, AIR CONDITIONING UNIT HAVING AN OUTPUT COOLING CAPACITY OF 15,000 BTU/HR WHEN OPERATING FROM A 208 VOLTS, SINGLE PHASE, 60 HERTZ POWER SOURCE. THE UNIT SHALL NOT EXCEED 15 AMPS NORMAL RUNNING CURRENT. CONTRACTOR SHALL PROVIDE COMPLETE OPERATING AND MAINTENANCE MANUAL FOR EQUIPMENT IN MANNER OUTLINED IN THE "CONTRACT SCHEDULE."

(A) 5-30-78

THE COOLING SECTION SHALL BE A COMPLETE ASSEMBLY INCLUDING HERMETICALLY SEALED PERMANENT SPLIT CAPACITOR MOTOR-COMPRESSOR UNIT, CONDENSER COIL, CONDENSER FANS AND MOTOR, EVAPORATOR COIL, CONDENSATE REMOVAL SYSTEM AND AIR FILTER. THE ASSEMBLY SHALL INCLUDE ALL REFRIGERATION CIRCUIT TUBING, WIRING AND SAFETY CONTROLS AND BE SUITABLE FOR OPERATION DOWN TO 35 DEGREES F OUTDOOR AMBIENT.

THE CONDENSER FAN SHALL BE FORWARD CURVED CENTRIFUGAL AND SHALL BE OF ADEQUATE SIZE TO ASSURE QUIET OPERATION. THE CONDENSER FAN MOTOR SHALL BE PERMANENT SPLIT CAPACITOR TYPE WITH BUILT-IN AUTOMATIC RESET THERMAL OVERLOAD PROTECTION AND SHALL DRIVE THE FAN DIRECTLY.

THE CONDENSER MOTOR AND COMPRESSOR CAPACITORS SHALL BE LOCATED FOR EASY ACCESS AND SHALL HAVE PROTECTIVE RUBBER COVER SEALS OVER THE ELECTRICAL TERMINALS.

THE UNIT SHALL HAVE FRONT MOUNTED CONTROLS FOR VARIABLE TEMPERATURE REGULATION, SUPPLYING OUT-SIDE AIR AND EXHAUSTING INTERIOR AIR. ALSO, AIR DEFLECTORS SHALL BE PROVIDED FOR INDIVIDUAL CONTROL AND DISTRIBUTION OF AIR FLOW WITHIN THE INTERIOR SPACE.

THE CONTRACTOR SHALL PROVIDE WALL **SLEEVE, PERIMETER** SEAL, ARCHITECTURAL TRIM, AND SUPPORT FRAMING, COMPLETE, FOR WATERTIGHT AND AIRTIGHT WALL PENETRATION. ALL HARDWARE SHALL BE GALVANIZED STEEL. SEE PAGE 13B-24 FOR BUILDING LEAKAGE TEST REQUIREMENTS.

A COMPANION PLUG RECEPTACLE SHALL BE FURNISHED TO MATCH THE UNIT POWER PLUG AND SHALL BE INSTALLED COMPLETE FOR CONNECTION AND SERVICE OF THE AIR CONDITIONING UNIT.

---GUTTERS AND DOWNSPOUTS---

---MATERIALS

GUTTERS AND DOWNSPOUTS SHALL BE GALVANIZED STEEL, NOT LESS THAN 26 GAGE AND FORMED TO THE PROFILE INDICATED AND EXACTLY MATCHING THE SPECIFIED WALL AND ROOF PANELS IN COLOR AND FINISH. GUTTERS SHALL HAVE A CROSS-SECTIONAL AREA OF NOT LESS THAN 24 SQUARE INCHES. GUTTER ASSEMBLY SHALL INCLUDE FACTORY-FORMED GUTTER SECTIONS, END CAPS, ELBOWS, SLIP-JOINT CONNECTORS, MITERED AND SOLDERED INSIDE AND OUTSIDE CORNERS, DROP OUTLET SECTIONS, HANGERS, GUTTER SEALANT, AND FITTINGS. DOWNSPOUTS SHALL BE RECTANGULAR SECTION, WITH A CROSS-SECTIONAL AREA OF NOT LESS THAN 12 SQUARE INCHES.

---INSTALLATION

INSTALL WORK IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN INSTRUCTIONS AND THE APPROVED SHOP DRAWINGS.

FIELD CONNECTIONS SHALL BE BOLTED, EXCEPT WHERE WELDED CONNECTIONS ARE INDICATED AS FOLLOWS:

GALVANIZED HIGH-STRENGTH THREADED FASTENERS SHALL BE USED FOR ALL PRIMARY FRAMING BOLTED CONNECTIONS.

UNFINISHED THREADED FASTENERS SHALL BE USED ONLY FOR BOLTED CONNECTIONS OF SECONDARY MEMBERS TO PRIMARY MEMBERS AND FOR TEMPORARY BRACING TO FACILITATE ERECTION.

---ANCHOR BOLTS

ANCHOR BOLT ASSEMBLIES, THREADED TIE BARS AND RODS BETWEEN CLEAR SPAN PRIMARY FRAMING COLUMNS, BASE AND SPLICE PLATES, AND OTHER CONNECTIONS BETWEEN THE STRUCTURAL STEEL AND FOUNDATIONS SHALL BE PERFORMED AS PART OF THE WORK OF THIS SECTION INSTEAD OF AS SPECIFIED IN THE AISC CODE OF OF STANDARD PRACTICE, SECTION 7D.

ANCHOR BOLTS, ANCHOR BOLT AND SHEAR PLATE ASSEMBLIES, REINFORCING TIE RODS AND ANCHORS SHALL BE GALVANIZED AND SHALL BE CORRECTLY LOCATED AND BUILT IN BY THE USE OF ANCHOR BOLT LAYOUT, TEMPLATES OR OTHER METHODS AS MAY BE REQUIRED TO LOCATE THE ANCHOR BOLTS AND OTHER CONNECTIONS ACCURATELY.

ANCHOR BOLT INSTALLATION SHALL BE WITHIN A TOLERANCE OF PLUS OR MINUS 1/8 INCH.

---SETTING COLUMN BASE PLATES

COLUMN BASE PLATES SHALL BE FULLY BEDDED ON WEDGES OR SHIMS AND DAMP-PACK BEDDING MORTAR AS PART OF THE WORK OF THIS SECTION INSTEAD OF AS SPECIFIED IN THE AISC CODE OF STANDARD PRACTICE, SECTION 7E. INSTALLATION SHALL BE AS FOLLOWS:

CONCRETE BEARING SURFACES SHALL BE CLEANED FREE OF LAITANCE, DIRT, OIL, GREASE, AND OTHER FOREIGN MATERIAL AND ROUGHENED, BUT NOT ENOUGH TO INTERFERE WITH THE PLACING OF BEDDING MORTAR. THE BOTTOM SURFACE OF PLATE SHALL BE CLEANED OF ALL FOREIGN MATERIALS.

THE SPACE BETWEEN THE TOP OF THE BEARING SURFACE AND THE BOTTOM OF THE BASE PLATE SHALL BE APPROXIMATELY 1/24 OF THE WIDTH OF THE BASE PLATE, BUT NOT LESS THAN 1/2 INCH. THE BASE PLATE SHALL BE SUPPORTED AND ALIGNED ON STEEL WEDGES OR SHIMS.

THE BEDDING MORTAR MIX SHALL BE COMPOSED OF THE SPECIFIED SHRINKAGE-RESISTANT GROUT AND ENOUGH WATER TO PROVIDE WORKABLE MIXTURE WITHOUT SEGREGATION OR BLEEDING.

AFTER THE SUPPORTED MEMBERS HAVE BE PLUMBED AND CORRECTLY POSITIONED AND THE ANCHOR BOLTS NUTS TIGHTENED, THE SPACE BETWEEN THE TOP OF THE BEARING SURFACE AND THE BOTTOM OF THE BASE PLATE SHALL BE PACKED WITH THE BEDDING MORTAR MIX BY TAMPING OR RAMMING WITH A BAR OR ROD UNTIL THE VOIDS ARE COMPLETELY FILLED.

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LONGITUDINAL PURLIN-TO-PURLIN BOLTED CONNECTIONS SHALL PROVIDE NOT LESS THAN A 1/4 INCH EXPANSION SLOT IN 24 FEET.

ATTACH EACH PURLIN, GIRT AND EAVE STRUT TO PRIMARY FRAMING WITH NOT LESS THAN 2 FASTENERS AT EACH SUPPORT. FASTEN EACH PURLIN-TO-PURLIN CONNECTION WITH NOT LESS THAN 4 FASTENERS.

PROVIDE A CONTINUOUS SILL SUPPORT MEMBER TO WHICH THE BASE OF THE WALL PANEL MAY BE ATTACHED. MEMBER SHALL BE A GALVANIZED ANGLE WITH A MINIMUM THICKNESS OF 3/16 INCH, SECURED TO THE CONCRETE FLOOR WITH ADJUSTABLE CLIPS AND ANCHORED WITH HOOKED ANCHOR BOLTS; OR, MAY BE A TUBULAR SECTION OF NOT LESS THAN 18 USS GAGE GALVANIZED STEEL CAST INTEGRAL WITH THE CONCRETE FOUNDATION. ZINC COATING SHALL BE NOT LESS THAN 1.25 OUNCES PER SQUARE FOOT, IN ACCORDANCE WITH ASTM A525-71.

---INSTALLATION OF WALL AND ROOF PANELS---

---GENERAL

ERECT ROOFING AND SIDING IN ACCORDANCE WITH THE APPROVED SHOP AND ERECTION DRAWINGS, THE PRINTED INSTRUCTIONS AND SAFETY INSTRUCTIONS OF THE MANUFACTURER, AND AS SPECIFIED HEREIN.

SHEETS SHALL NOT BE SUBJECTED TO OVERLAPPING, ABUSE OR UNDUE IMPACT. BENT, CHIPPED OR DEFECTIVE SHEETS SHALL NOT BE APPLIED.

ERECT SHEETS TRUE AND PLUMB AND IN EXACT ALIGNMENT WITH THE HORIZONTAL AND VERTICAL EDGES OF THE BUILDING, SECURELY ANCHORED, AND WITH THE INDICATED RAKE, EAVE AND CURB OVERHANG.

WORK SHALL BE INSTALLED SO AS TO ALLOW FOR THERMAL MOVEMENT OF THE ROOFING AND SIDING, MOVEMENT OF THE BUILDING STRUCTURE AND TO PROVIDE PERMANENT FREEDON FROM NOISE DUE TO WIND PRESSURES.

ALL WELD BURNS AND ABRASIONS DUE TO ASSEMBLY SHALL BE TOUCHED UP WITH THE PROPER FINISH REPAIR MATERIAL.

SIDING AND ROOFING PANELS SHALL BE FURNISHED IN MAXIMUM LENGTHS SO AS TO MINIMIZE END LAPS. METAL SIDING FOR SIDEWALLS AND ENDWALLS SHALL BE CONTINUOUS FROM ROOF LINE TO BELOW COLUMN BASE PLATE AS SHOWN WITHOUT END LAPS.

ROOF PANELS SHALL BE CONTINUOUS FROM RIDGE TO EAVE FOR GABLE DESIGN BUILDINGS 60 FEET WIDE AND LESS. END LAPS SHALL OCCUR OVER ROOF PURLINS AND SHALL BE A MINIMUM OF 6 INCHES.

FASTENING SYSTEM FOR UNINSULATED BUILDINGS SHALL CONSIST OF EXPOSED FASTENERS OF MATERIALS AND SPACING AS SPECIFIED HEREINBEFORE; COLOR OF EXPOSED HEAD SHALL MATCH SPECIFIED ROOFING PANELS. CONCEALED FASTENERS SHALL BE USED FOR INSULATED BUILDINGS.

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---CLOSURES

PROVIDE METAL CLOSURE STRIPS AT THE FOLLOWING LOCATIONS:

AT OPEN ENDS OF METAL RIDGE ROLLS.

AT RAKE OF METAL ROOF, UNLESS OPEN END HAS A FORMED FASCIA OR FLASHING MEMBER.

AT OTHER AREAS AS INDICATED.

PROVIDE MASTIC CLOSURE STRIPS AT THE FOLLOWING LOCATIONS:

OPEN ENDS OF CORRUGATED OR RIBBED PATTERN ROOFS, AT INTERSECTION OF WALL AND ROOF, UNLESS OPEN ENDS ARE CONCEALED WITH FASCIA TRIM OR FORMED EAVE FLASHING.

AT HEADS OF ALL WALL OPENINGS, AS INDICATED

AT OTHER LOCATIONS AS INDICATED.

---DOOR INSTALLATION---

---GENERAL

SET ALL DOORS AND FRAMES PLUMB, LEVEL AND IN ALIGNMENT, WITHOUT FRAME DISTORTION AND SECURELY ANCHOR IN PLACE IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS, THE APPROVED SHOP DRAWINGS AND AS SPECIFIED HEREIN.

INSTALL SPECIFIED HARDWARE, THRESHOLD AND WEATHERSTRIPPING AND ADJUST AND LUBRICATE HARDWARE FOR OPERATION.

SEAL ALL JOINTS BETWEEN PERIMETER OF DOOR FRAME AND WALL PANELS WITH THE SPECIFIED JOINT SEALANT AS REQUIRED FOR A WATER-TIGHT INSTALLATION.

TOUCH-UP WITH REPAIR PAINT ALL FIELD WELDS AND ABRAIDED SURFACES ON DOORS, FRAMES AND ADJACENT PANELS AND FRAMING.

--- INSTALLATION TOLERANCES

DOORS AND FRAMES SHALL NOT EXCEED THE FOLLOWING INSTALLATION TOLERANCES:

DEVIATION FROM PLUMB OR LEVEL

IN 8 FEET — NOT MORE THAN 1/16 INCH

DOORS SHALL FIT ACCURATELY IN DOOR FRAMES WITHIN THE CLEARANCES SPECIFIED HEREINBEFORE.

---CLEANING

INTERIOR EXPOSED WALL AND ROOF PANELS AND EXTERIOR WALL PANELS, FASCIA, GUTTERS, DOWNSPOUTS AND TRIM SHALL BE CLEAN AND FREE OF DIRT, OIL, ERECTION SMUDGES AND SMEARS.

CLEANING OF DOORS SHALL BE AS SPECIFIED HEREINBEFORE.

---REPAIRS TO FINISH

SCRATCHES, ABRASIONS AND MINOR SURFACE DEFECTS OR FINISH MAY BE REPAIRED WITH THE SPECIFIED REPAIR MATERIALS, AS APPROVED BY THE CONTRACTING OFFICER. FINISHED REPAIRED SURFACES SHALL BE UNIFORM AND FREE FROM VARIATIONS OF COLOR AND SURFACE TEXTURE.

REPAIRED METAL SURFACES WHICH ARE NOT ACCEPTABLE TO THE GOVERNMENT SHALL BE IMMEDIATELY REMOVED AND REPLACED WITH A NEW PANEL AT NO ADDITIONAL EXPENSE TO THE GOVERNMENT.

SECTION 13F

GASEOUS NITROGEN PNEUMATIC SYSTEMS

---GENERAL REQUIREMENTS---

---GENERAL

INCLUDED IS THE FURNISHING OF ALL LABOR, MATERIAL, AND PLANT FOR THE COMPLETE FABRICATION, CLEANING, INSTALLATION, AND TESTING OF GASEOUS NITROGEN SYSTEMS AS SHOWN ON DRAWING 79K10338 AND WITHIN THE FOLLOWING GENERAL LIMITS AS SPECIFIED HEREIN BELOW:

A. FROM FUTURE SSAT PIPING RISER PROVIDE *3000* PSIG GASEOUS NITROGEN SUPPLY TUBING WORK TO THE SOUND SUPPRESSION WATER SYSTEM GN_2 STORAGE TANK, INCLUDING TANK CONTROL PANEL. SEE SHEETS M41, AND M66 THRU M69. (E)

B. INSTALL GASEOUS NITROGEN STORAGE TANK FURNISHED BY THE GOVERNMENT (GFE) IN CONCRETE REVETMENT. SEE SHEET M68.

C. FABRICATE AND INSTALL ONE NEW PNEUMATIC GN_2 TANK CONTROL PANEL. SEE SHEET M66.

D. PROVIDE ALL NEW INTERCONNECTING TUBING WORK BETWEEN THE FUTURE *3000* PSIG SSAT SUPPLY SOURCE, THE GASEOUS NITROGEN STORAGE TANK, AND THE NEW PNEUMATIC GN_2 TANK CONTROL PANEL. SEE SHEETS M66 AND M68. (E)

E. FROM FUTURE 3000 PSIG GASEOUS NITROGEN SUPPLY RISER AT THE SPACE SHUTTLE ACCESS TOWER (SSAT) PROVIDE ALL TUBING WORK TO THE TWO SIDE FLAME DEFLECTOR GN_2 SUPPLY PANELS LOCATED AT EACH BASE OF THE NORTH BRIDGE. SEE SHEETS M69 AND M78.

F. FABRICATE AND INSTALL TWO GN_2 SUPPLY PANELS FOR THE SIDE FLAME DEFLECTORS. SEE SHEET M78.

G. REMOVE AND BLANK OFF SPECIFIED GN_2 PIPING IN THE PAD WATER PIT AREA. SEE SHEETS M63, M64 AND M65.

H. OTHER PNEUMATIC SYSTEM REQUIREMENTS ARE AS DESCRIBED IN SPECIFICATION SECTION 14R - "SIDE FLAME DEFLECTORS FOR SRB" AND SECTION 15H - "MISCELLAENOUS PIPING SYSTEMS." SEE SHEETS M20, M61, M63, M65 AND M77 THRU M80.

I. NEW WORK SHALL INCLUDE PNEUMATIC SYSTEMS AND GENERAL INSTRUMENTATION REQUIREMENTS DESCRIBED ON THE DRAWINGS.

J. SUBMIT PROPOSED TEST SCHEDULES AND FIELD TEST PROCEDURES FOR APPROVAL BY THE CONTRACTING OFFICER. ALSO, REFER TO SECTION 18A.

K. SUBMIT SHOP DRAWINGS AND OPERATION, MAINTENANCE, INSTRUCTIONS, PARTS AND TESTING MANUALS AS OUTLINED HEREIN AND IN THE "CONTRACT SCHEDULE" FOR ALL EQUIPMENT FURNISHED.

---REFERENCE STANDARDS AND ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE

ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS	
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	
AWS	AMERICAN WELDING SOCIETY	
* KSC	KENNEDY SPACE CENTER	
* FS	FEDERAL SPECIFICATIONS	
* MIL	MILITARY SPECIFICATIONS	
MSS	MANUFACTURER'S STANDARDIZATION SOCIETY	
PFI	PIPE FABRICATION INSTITUTE	
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE	* = SEE "INSTRUCTIONS TO BIDDER"

COMMONLY USED TERMS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

GFE	GOVERNMENT FURNISHED EQUIPMENT
I.D.	INSIDE DIAMETER
IPS	IRON PIPE SIZE
O.D.	OUTSIDE DIAMETER
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH GAGE
USS	UNITED STATES STANDARD
WOG	WATER, OIL, GAS (PRESSURE RATING)
WSP	WORKING STEAM PRESSURE
SST	STAINLESS STEEL

---MATERIALS AND WORK

ALL MATERIALS AND COMPONENTS SHALL BE NEW. ALL WORK SHALL BE ACCOMPLISHED IN STRICT ACCORDANCE WITH THE REQUIREMENTS OF THE SPECIFICATIONS AND DRAWINGS. PNEUMATIC PANELS SHALL BE FABRICATED, CLEANED, ASSEMBLED AND TESTED IN THE CONTRACTOR'S SHOP. ALL TUBE SEGMENTS, VALVES, FILTERS, GAGES AND OTHER SYSTEM COMPONENTS SHALL BE CLEANED AND TESTED PRIOR TO INSTALLATION IN THE FIELD. THE GOVERNMENT SHALL RESERVE THE RIGHT TO WITNESS ALL SHOP TESTING AND CLEANING OPERATIONS. NO PANEL, VALVE, TANK, TUBING, FITTING AND ANY OTHER SYSTEM COMPONENT SHALL BE INSTALLED WITHOUT ATTACHED CERTIFICATION OF COMPLIANCES FOR CLEANLINESS AND PRESSURE TESTS. ANY SYSTEM TUBING OR COMPONENT INSTALLED BY THE CONTRACTOR WITHOUT PROPER CERTIFICATION SHALL BE REMOVED FROM THE SYSTEM IN ADDITION TO ADJOINING MEMBERS AND CLEANED, TESTED, AND CERTIFIED, AND REINSTALLED AT NO EXPENSE TO THE GOVERNMENT. IT SHALL BE GOVERNMENT'S PREROGATIVE TO DETERMINE THE EXTENT OF "ADJOINING MEMBERS" IN ORDER TO INSURE PROPER CLEANLINESS AND FUNCTIONAL RELIABILITY OF THE SYSTEM. FINAL ACCEPTANCE SHALL INCLUDE A REVIEW OF ALL SYSTEM TUBING AND COMPONENT'S CERTIFICATIONS OF COMPLIANCE PRIOR TO TOTAL SYSTEM TESTING. THE CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS, PLANT, TOOLS AND EQUIPMENT FOR A COMPLETE JOB.

---ENVIRONMENT

SYSTEMS WILL BE LOCATED NEAR AND ON THE LAUNCH PAD FROM WHICH THE SPACE SHUTTLE WILL BE LAUNCHED, THE ENGINES OF WHICH WILL CREATE EXTREME MECHANICAL VIBRATION. IN VIEW OF THE ABOVE, ALL TUBING SHALL BE ADEQUATELY SUPPORTED AND ANCHORED AS DETAILED ON THE DRAWINGS. OTHER SUPPORTS, STAYS AND HANGERS SHALL BE PROVIDED AS REQUIRED TO COMPLY WITH KSC-SPEC-Z-0008B.

---EXCEPTIONS

IF THE PROPOSED EQUIPMENT AND WORK DIFFER IN ANY MANNER FROM THAT SPECIFIED, THE CONTRACTOR SHALL STATE WHEREIN THE DIFFERENCE OCCURS, AND FAILURE TO STATE SHALL NOT RELIEVE THE CONTRACTOR FROM FURNISHING AND INSTALLING ALL WORK IN STRICT ACCORDANCE WITH THESE SPECIFICATIONS.

---ITEMS OF WORK INCLUDED

ITEMS OF WORK TO BE PROVIDED BY THE CONTRACTOR INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING:

ALL ANCHORS, TUBE SUPPORTS, TUBE CLAMPS, AND SPECIFIED OR NOTED HARDWARE. (A)

ALL SUPPLEMENTAL STRUCTURAL STEEL, UNISTRUT MEMBERS, UNISTRUT ACCESSORIES, ANCHOR BOLTS, CONCRETE INSERTS AND RELATED HARDWARE REQUIRED FOR THE PROPER INSTALLATION AND ERECTION OF THE PNEUMATIC SYSTEMS AND GENERAL INSTRUMENTATION WORK.

ALL MATERIALS AND LABOR FOR MACHINE SHOP, WELDING, CUTTING OPERATIONS, TUBE FORMING AND COMPONENT PROTECTION.

ALL MATERIALS, LABOR AND EQUIPMENT FOR PAINTING, CLEANING AND TESTING OF SYSTEM TUBING, COMPONENTS AND SUPPORT MEMBERS.

ALL TESTS AND TEST REPORTS OF COMPONENT AND SUBSYSTEM TESTS. SUBMITTAL OF ISOMETRIC, DRAWINGS AND SKETCHES OF EACH PNEUMATIC SYSTEM WITH IDENTIFYING PIECE MARK FOR EACH ITEM IN EACH SYSTEM.

PRESSURE TESTING OF ALL PNEUMATIC SYSTEMS INSTALLED BY THE CONTRACTOR, SAID TESTS TO BE WITNESSED BY THE CONTRACTING OFFICER WHO SHALL BE GIVEN NOT LESS THAN 3 DAYS NOTICE OF SUCH TESTS.

GASEOUS NITROGEN FOR FIELD TESTING SHALL BE FURNISHED BY THE CONTRACTOR.

OTHER MISCELLANEOUS WORK SHOWN ON THE DRAWING AND SPECIFIED HEREIN.

ALL TUBE FITTINGS WILL BE "KC STANDARD" TYPE AND MADE AVAILABLE TO THE CONTRACTOR UPON SUBMITTAL TO THE GOVERNMENT OF TUBE FITTING REQUIREMENT LISTING.
IN LIKE MANNER, ALL STAINLESS STEEL TUBING WILL BE GFE. (A)

---WITNESS OF FIELD TESTS

FIELD TESTS CONDUCTED WITHOUT PRESENCE OF CONTRACTING OFFICER, OR HIS DULY AUTHORIZED REPRESENTATIVE, WILL NOT SERVE AS ACCEPTANCE TESTS; HOWEVER, THIS SHALL NOT BE CONSTRUED TO LIMIT THE CONTRACTOR INSOFAR AS TESTS PRELIMINARY TO ACCEPTANCE ARE CONCERNED. THE TIME SELECTED FOR ACCEPTANCE TESTS SHALL BE MUTUALLY AGREEABLE TO ALL PARTIES CONCERNED AND AT A TIME AGREEABLE TO THE CONTRACTING OFFICER.

---FABRICATION

ALL TUBING SHALL BE FABRICATED AND INSTALLED IN STRICT COMPLIANCE TO KSC-SPEC-0008B. TUBING RUNS AND BENDS SHALL BE UNIFORMLY AND SYMMETRICALLY ARRANGED. PNEUMATIC PANELS SHALL BE FABRICATED, ASSEMBLED, AND TESTED AS SHOWN ON THE DRAWING AND AS SPECIFIED HEREIN BY EXPERIENCED TUBING CRAFTSMEN. REFER TO THIS SPECIFICATION PARAGRAPHS "PAINTING AND FINISHING" FOR REQUIREMENTS PERTINENT TO SUPPORT HARDWARE, MECHANICAL EQUIPMENT AND TUBING ASSEMBLIES.

---CLEANING OF PNEUMATIC SYSTEM COMPONENTS

THE SURFACES OF ALL TUBES, FITTINGS, AND PNEUMATIC SYSTEM COMPONENTS THAT WILL COME IN CONTACT WITH GASEOUS NITROGEN SHALL BE CLEANED TO MEET THE REQUIREMENTS OF KSC-SPEC-123(E), CLEANLINESS LEVEL 150, TEST METHOD A. PROTECTIVE COVERS, CLOSURES, CAPS OR PLUGS SHALL BE USED TO MAINTAIN CLEANLINESS AND SHALL REMAIN IN PLACE UNTIL THE PART OR ASSEMBLY IS INSTALLED. FIELD CONNECTIONS SHALL NOT BE MADE DURING RAINY CONDITIONS, BLOWING SAND, OR ANY OTHER CIRCUMSTANCES WHICH WILL CONTAMINATE A PART OR ASSEMBLY.

---INTERFERENCES

THE CONTRACTOR SHALL COORDINATE THE WORK OF THE DIFFERENT TRADES SO THAT INTERFERENCE BETWEEN TUBING, CABLES, PIPING, EQUIPMENT, ARCHITECTURAL AND STRUCTURAL WORK SHALL BE AVOIDED. ALL NECESSARY OFFSETS IN TUBING AND ALL FITTINGS, ETC., REQUIRED TO PROPERLY INSTALL THE WORK SHALL BE FURNISHED COMPLETE IN PLACE WITHOUT ADDITIONAL COST TO THE GOVERNMENT. IN CASE INTERFERENCE DEVELOPS, THE CONTRACTING OFFICER WILL DECIDE WHICH EQUIPMENT SHALL BE RELOCATED, REGARDLESS OF WHICH WAS FIRST INSTALLED, INCLUDING TUBING ASSOCIATED WITH SAID EQUIPMENT.

---DRAWINGS

BECAUSE OF THE SMALL SCALE OF THE DRAWINGS, IT IS NOT POSSIBLE TO INDICATE ALL OFFSETS, FITTINGS, AND ACCESSORIES WHICH MAY BE REQUIRED FOR PNEUMATIC TUBING. THE CONTRACTOR SHALL CAREFULLY INVESTIGATE THE STRUCTURAL AND FINISH CONDITIONS AFFECTING ALL HIS WORK AND SHALL ARRANGE HIS WORK ACCORDINGLY, FURNISHING SUCH SUPPORTS AND ACCESSORIES AS REQUIRED TO MEET SUCH CONDITIONS.

---REFERENCED DOCUMENTS

WHERE SPECIFIC REQUIREMENTS ARE SET FORTH IN THIS SECTION OF THE SPECIFICATIONS, AND WHERE SUCH SPECIFIC REQUIREMENTS DEPART FROM REQUIREMENTS OR ALTERNATIVES CONTAINED IN ANY DOCUMENTS REFERENCED HEREIN, THE SPECIFIC REQUIREMENTS CONTAINED IN THIS SECTION OF THE SPECIFICATIONS SHALL GOVERN AND TAKE PRECEDENCE.

---SHOP DRAWINGS

SHOP DRAWINGS, WHICH INCLUDE REQUIRED DRAWINGS OR SKETCHES AND OTHER DATA NECESSARY TO COMPLETELY IDENTIFY EACH OF THE FOLLOWING ITEMS, SHALL BE FURNISHED TO THE CONTRACTING OFFICER IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" ARTICLE ENTITLED "SHOP DRAWINGS." SHOP DRAWINGS ARE REQUIRED FOR ALL DEVIATIONS FROM SPECIFICATIONS AND DRAWINGS.

TUBING AND SIZES AND TYPES OF TUBE FITTINGS TO BE GOVERNMENT FURNISHED
PNEUMATIC SYSTEM SPECIALTIES (SUCH AS VALVES, FILTERS, GAGES, ETC.)
CONTROL AND SUPPLY PANELS COMPLETE WITH NEMA ENCLOSURES AND SUPPORTS
TUBING SUPPORT ELEMENTS
CLEANING PROCEDURES
TESTING PROCEDURES
TEST EQUIPMENT, RELATED COMPONENTS, AND CALIBRATION CERTIFICATES FOR GAGES.
COMPONENT IDENTIFICATION, MATERIALS, AND METHOD OF ATTACHMENT
SAMPLE CERTIFICATION COMPLIANCE FORMS
GRATING CUT-OUT DETAILS (FOR TUBE ROUTING)

NONE OF THE PRECEDING ITEMS SHALL BE PURCHASED, DELIVERED TO THE SITE, OR INSTALLED UNTIL APPROVAL HAS BEEN OBTAINED.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

PRESSURE TESTING CERTIFICATION
CLEANLINESS CERTIFICATION

NONE OF THE PRECEDING MATERIALS SHALL BE PURCHASED, DELIVERED TO THE SITE, OR INSTALLED UNTIL APPROVAL HAS BEEN OBTAINED.

---BONDING AND GROUNDING

BONDING OF METALS TO GROUND SHALL COMPLY WITH SECTION 16X (PART 51) OF THE SPECIFICATIONS.

---PAINTING AND FINISHING

GENERAL

HANGERS, SUPPORTS, AND ALL COMPONENT METAL SURFACES SHALL BE CLEANED, FREE OF FOREIGN MATTER, AND DISCOLORATION PRIOR TO FINAL SYSTEM ACCEPTANCE.
FINISH PAINTING OF SURFACES SHALL CONFORM TO REQUIREMENTS OF SECTIONS 9A, "PAINTING AND FINISHING," EXCEPT AS OTHERWISE SPECIFIED HEREIN.

WHERE MECHANICAL EQUIPMENT IS THE MANUFACTURER'S STANDARD PRODUCT, IT SHALL BE FURNISHED WITH THE MANUFACTURER'S STANDARD FINISH PAINT COAT, UNLESS OTHERWISE SPECIFIED.

ALL MANUFACTURER'S STANDARD FINISHED EQUIPMENT SURFACES DAMAGED DURING CONSTRUCTION SHALL BE BROUGHT TO "AS NEW" CONDITION BY TOUCH UP, OR REPAINTING, TO THE SATISFACTION OF THE CONTRACTING OFFICER.

STAINLESS STEEL TUBING ASSEMBLIES, FLEXIBLE HOSE ASSEMBLIES, AND TUBE CLAMPS SHALL BE PROTECTED FROM CORROSION BY APPLYING 3 MILS MINIMUM THICKNESS OF NAPKO 2Z, NAPCO CORPORATION; OR, SUBOX GALVANOZ TYPE I, WYANDOTTE CHEMICALS CORPORATION.
COATINGS SHALL BE APPLIED CONTINUOUSLY AND EXTENSIVELY TO EXTERIOR SURFACES, TUBE FITTINGS SHALL NOT BE COATED UNTIL AFTER ASSEMBLY. PRIOR TO COATING SURFACES SHALL BE DEGREASED BY SOLVENT CLEANING.

---EQUIPMENT AND SITE CLEANUP

CLEANING OPERATIONS DURING CONSTRUCTION AND UPON COMPLETION OF THE WORK OF THIS CONTRACT SHALL BE PERFORMED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF THE "CONTRACT SCHEDULE," AND THIS SECTION OF THE SPECIFICATIONS. SPECIFIC OPERATIONS SHALL INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING:

REMOVAL OF RUST AND ALL DIRT AND OBJECTIONABLE SUBSTANCES FROM EXTERIOR SURFACES OF ALL TUBING, EQUIPMENT, AND SUPPORTS TO THE SATISFACTION OF THE CONTRACTING OFFICER.

REFER TO THIS SPECIFICATION PARAGRAPH ENTITLED "PAINTING AND FINISHING" REGARDING TOUCH-UP OR REPAINTING OF EQUIPMENT.

UPON COMPLETION OF THE WORK, IMMEDIATELY PRIOR TO FINAL ACCEPTANCE, ALL EQUIPMENT PROVIDED UNDER THIS CONTRACT SHALL BE CLEANED TO THE SATISFACTION OF THE CONTRACTING OFFICER.

---DISPOSAL OF EXCESS AND WASTE MATERIALS

WASTE MATERIALS, TRASH AND DEBRIS, SHALL BE REMOVED FROM THE SITE AND DISPOSED OF AT NO ADDITIONAL COST TO THE GOVERNMENT AS SPECIFIED IN THE "CONTRACT SCHEDULE".

---SYSTEMS IDENTIFICATION---

---GENERAL

THE CONTRACTOR SHALL PROVIDE A COORDINATED SYSTEM OF TUBING IDENTIFICATION IN ACCORDANCE WITH SECTION 13L OF THE SPECIFICATIONS. ALSO, PROVIDE THE FOLLOWING:

ENGRAVED, 2-COLOR LAMINATED PLASTIC SCHEMATIC DIAGRAM OF THE PNEUMATIC SUBSYSTEMS IDENTIFYING AND SHOWING TUBING, EQUIPMENT, AND COMPONENT LOCATION AS HEREINBELOW DESCRIBED.

METAL TAG IDENTIFIED VALVES, OTHER SYSTEMS COMPONENTS, AND EQUIPMENT PER KSC-STD-E-0015.

METAL TAG IDENTIFIED TUBING SEGMENTS AND FLEXIBLE HOSE PER C75M04185 AND KSC-STD-E-0015.

THE CONTRACTOR SHALL SUBMIT THE IDENTIFICATION SYSTEM FOR APPROVAL PRIOR TO PROCEEDING WITH THE WORK. THE GOVERNMENT RESERVES THE RIGHT TO ASSIGN SIX DIGIT COMPONENT NUMBERS.

---SCHEMATIC DIAGRAM WITH LEGEND

THE SYSTEM SCHEMATIC DIAGRAMS SHALL SHOW ALL PRINCIPAL COMPONENTS OF EACH SYSTEM INCLUDING A LEGEND LISTING OF EACH COMPONENT COMPLETE WITH PERTINENT DATA SUCH AS SIZE, SET PRESSURE, CAPACITY, ETC. LETTERING SHALL BE NOT LESS THAN 0.125 INCHES HIGH. SCHEMATIC DIAGRAM WITH LEGEND SHALL BE SUBMITTED AND APPROVED PRIOR TO ENGRAVING. FINISHED DIAGRAM SHALL BE MOUNTED ON INTERIOR DOOR OF ENCLOSURES.

---METAL TAGS

IDENTIFICATION TAGS MADE OF STAINLESS STEEL INDICATING FUNCTIONS OF A VALVE OR SIMILAR COMPONENT, SHALL BE INSTALLED ON ALL SYSTEM DEVICES. TAGS SHALL BE TWO INCHES IN DIAMETER MINIMUM, AND MARKING SHALL BE DIE STAMPED.

ALL EQUIPMENT SHALL BE PROVIDED WITH METAL IDENTIFICATION TAGS GIVING EQUIPMENT DESIGNATION NUMBER, MATCHING DRAWING OR CONTROL DIAGRAM DESIGNATIONS.

TAGS SHALL BE WIRED TO VALVE OR EQUIPMENT ITEMS WITH SST WIRE PER MS 20995 C32.

TUBING AND FLEXIBLE HOSE SHALL BE IDENTIFIED PER 75M04185. (KSC DRAWING).

---SERVICE LABELLING

ALL TUBING RUNS INCLUDING THOSE UNDER PLATFORM LEVELS AND CONCEALED IN TRENCHES SHALL BE LABELLED TO DESIGNATE SERVICE. LABELS SHALL INCLUDE AN ARROW, OR ARROWS, TO INDICATE FLOW DIRECTION. LABELS SHALL BE PRESSURE SENSITIVE TAPE APPLIED AFTER PRINTING AND FINISHING.

---TUBING MATERIALS---

---GASEOUS NITROGEN SYSTEM

TUBING: SHALL BE STAINLESS STEEL CONFORMING TO KSC-SPEC-Z-0007A WALL THICKNESS AS NOTED ON THE DRAWING, TYPE 304 AND/OR TYPE 316. *TUBING WILL BE GOVERNMENT FURNISHED.* (A)

FITTINGS: KC FLARED TUBE FITTINGS IN ACCORDANCE WITH KSC ENGINEERING STANDARDS GP-425(D). FITTINGS WILL BE GOVERNMENT FURNISHED PER CONTRACT SCHEDULE SECTION X, ARTICLE 1. ALL BENDS SHALL BE FORMED TUBING. ELBOW FITTINGS ARE PROHIBITED. CONTRACTOR SHALL PROVIDE LISTING OF REQUIRED FITTINGS TO GOVERNMENT.

---TUBING SPECIALTIES---

---GENERAL

ALL TUBING SPECIALTIES SHALL BE TYPE 304 OR 316 STAINLESS PER KSC SPEC-Z-0007A, FABRICATED AND INSTALLED PER KSC SPEC-Z-0008B, AND HAVE CLEANLINESS LEVEL 300 PER TEST METHOD "A" IN ACCORDANCE WITH KSC-C-123(E).

---COMPONENT

FILTERS, CHECK VALVES, SOLENOID VALVES, PRESSURE SWITCHES, RELIEF VALVES, PRESSURE GAGES, HAND VALVES AND OTHER PRINCIPAL COMPONENTS SHALL BE AS SPECIFIED ON THE CONTRACT DRAWINGS.

---PNEUMATIC PANELS---

---GENERAL

THE CONTRACTOR SHALL FABRICATE AND INSTALL THE FOLLOWING PNEUMATIC PANELS: GN_2 TANK CONTROL PANEL LOCATED AT THE SOUND SUPPRESSION WATER SYSTEM MAIN VALVE STATION; EAST SIDE FLAME DEFLECTOR GN_2 SUPPLY PANEL; AND WEST SIDE FLAME DEFLECTOR GN_2 SUPPLY PANEL; AND JACKING CONTROL PANELS FOR BOTH SRB SIDE FLAME DEFLECTORS.

---ENCLOSURES

ALL PNEUMATIC PANELS HEREIN SPECIFIED AND SHOWN ON THE DRAWINGS SHALL BE FURNISHED COMPLETE WITH NEMA 4 FRONT AND REAR DOOR HOFFMAN ENCLOSURES, OR EQUAL. ENCLOSURES SHALL BE CONSTRUCTED FOR HAZARDOUS ENVIRONMENT AND SHALL INCLUDE PURGE FITTINGS AND CALIBRATED BLEED PLATES (SEE SECTION 16V, PART 2 OF THIS SPECIFICATION). ALL PENETRATION THRU THE ENCLOSURE WALLS SHALL UTILIZE STANDARD GP-425(D) PNEUMATIC BULKHEAD FITTINGS (GFE) TO PROVIDE AIRTIGHT ENCLOSURES. SEE KSC-SPEC-Z-0008B FOR BULKHEAD PENETRATION DETAILS. ENCLOSURES AND ALL FERROUS METALS SHALL BE BLASTED AND ZINC-RICH COATED PER SECTION 9L.

---PNEUMATIC PANEL INTERIOR HARDWARE

THE MOUNTING BRACKETS AND FASTENERS FOR COMPONENTS AND TUBING ON THE INTERIOR OF ALL PNEUMATIC PANELS SHALL BE STAINLESS STEEL CONSTRUCTION. BRACKETS SHALL BE FABRICATED OF 14 GAUGE (MINIMUM) STAINLESS STEEL MATERIAL.

---SUPPORTING ELEMENTS---

---GENERAL

PROVIDE ALL SUPPORT HARDWARE FOR THE SPECIFIED PNEUMATIC SYSTEM PANELS, COMPONENTS, TUBING AND GN_2 TANK. SUPPORTING ELEMENTS SHALL INCLUDE BUT NOT BE LIMITED TO: STRUCTURAL ATTACHMENTS, MASONRY ATTACHMENT, TUBE CLAMPS, ANCHORS, HANGERS, PLATES, STRUCTURAL MEMBERS, SPECIAL SHAPES, AND ALL ASSOCIATED BOLTING SCREWS, NUTS, LOCKWASHERS AND WELDING REQUIREMENTS. UNLESS OTHERWISE SPECIFIED, ALL SUPPORT HARDWARE SHALL BE GALVANIZED.

---TUBING ATTACHMENTS

UNLESS OTHERWISE SPECIFIED ON THE CONSTRUCTION DRAWINGS, TUBING SHALL BE SUPPORTED WITH PORCELAIN CABLE CLAMPS EQUAL TO UNISTRUT U462/U463 SERIES WITH STAINLESS STEEL STRAPS, SLOTTED HEX HEAD SCREW AND NUT. THE SPACING OF TUBING ATTACHMENTS SHALL NOT EXCEED THE REQUIREMENTS SPECIFIED IN KSC-SPEC-Z-0008B.

---SUPPLEMENTARY STEEL

WHERE IT IS NECESSARY TO FRAME STRUCTURAL MEMBERS BETWEEN EXISTING MEMBERS, OR WHERE STRUCTURAL MEMBERS ARE USED IN LIEU OF COMMERCIALLY RATED SUPPORTS, SUCH SUPPLEMENTARY STEEL SHALL BE DESIGNED AND FABRICATED IN ACCORDANCE WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION SPECIFICATIONS.

---TUBING SYSTEM INSTALLATION---

---GENERAL

TUBING SYSTEMS SHALL BE FABRICATED, IDENTIFIED, TESTED, AND INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF SPECIFICATION KSC-SPEC-Z-0008B.

THE PROVISIONS OF REFERENCED CODES AND STANDARDS SHALL CONSTITUTE MINIMUM REQUIREMENTS FOR SYSTEM MATERIALS, INSTALLATION AND WORKMANSHIP. STRICT COMPLIANCE THEREWITH SHALL BE REQUIRED FOR ALL SYSTEMS WORK EXCEPT WHERE THE DRAWINGS AND SPECIFICATION REQUIRE BETTER MATERIALS AND METHODS OF INSTALLATION THAN THE MINIMUM REQUIREMENTS SET FORTH IN THE CODE OR STANDARD, IN WHICH CASE, THE DRAWINGS AND SPECIFICATIONS SHALL SUPERSEDE CODE AND STANDARDS REQUIREMENTS.

INSTALLATION OF TUBING SYSTEMS MATERIALS SHALL CONFORM TO THE PUBLISHED OR WRITTEN INSTRUCTIONS OF THE MANUFACTURERS FOR THE PROJECT APPLICATION EXCEPT AS OTHERWISE SPECIFIED HEREIN.

WHERE THE CONTRACTOR PROPOSES TO DEVIATE FROM SPECIFIED INSTRUCTION, THE PROPOSED DEVIATION SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL AS OUTLINED IN THE "CONTRACT SCHEDULE".

EXACT LOCATION OF TUBING SHALL BE COORDINATED BETWEEN TRADES SO THAT THERE SHALL BE NO INTERFERENCES BETWEEN OTHER SYSTEMS AND RELATED CONSTRUCTION.

TUBING SHALL BE FABRICATED TO MEASUREMENTS ESTABLISHED ON THE JOB AND SHALL BE CAREFULLY WORKED INTO PLACE WITHOUT SPRINGING OR FORCING. ADEQUATE PROVISION SHALL BE MADE FOR ABSORBING ALL EXPANSION AND CONTRACTION WITHOUT UNDUE STRESS IN ANY PART OF THE SYSTEM.

ALL TUBING, FITTINGS, AND MISCELLANEOUS PNEUMATIC SYSTEMS COMPONENTS SHALL BE CLEANED, TESTED, CERTIFIED, IDENTIFIED AND WRAPPED FOR PROTECTION PRIOR TO BEING SHIPPED TO THE CONSTRUCTION SITE. DURING INSTALLATION ALL OPENINGS SHALL REMAIN COVERED UNTIL INTERCONNECTIONS ARE MADE AND SECURED.

COATINGS SHALL BE APPLIED IN ACCORDANCE WITH THIS SPECIFICATION PARAGRAPHS 'PAINTING AND FINISHING' TO ALL EXTERIOR METAL SURFACES AND CREVICES TO PRECLUDE ENTRY OF MOISTURE.

TUBING SHALL BE INSTALLED STRAIGHT AND TRUE, WITH APPROVED OFFSETS AROUND OBSTRUCTIONS, AND WITH NECESSARY EXPANSION BENDS OR FITTING OFFSETS, ESSENTIAL TO A SATISFACTORY INSTALLATION, AND AS MAYBE NECESSARY TO INCREASE HEADROOM OR TO AVOID INTERFERENCE WITH THE FACILITY CONSTRUCTION ELECTRIC CONDUITS OR FACILITIES EQUIPMENT.

ALL TUBING SHALL RUN PARALLEL WITH THE LINES OF WALLS, TRENCHES AND STRUCTURAL MEMBERS UNLESS OTHERWISE INDICATED. TUBING AND COMPONENTS SHALL BE SPACED AND INSTALLED IN ACCORDANCE WITH KSC-SPEC-Z-0008B.

PENETRATION OF GRATING AREAS SHALL BE MADE THROUGH SLOTTED OPENINGS. GRATING AREAS THROUGH WHICH TUBE PENETRATIONS MUST BE MADE SHALL BE MODIFIED BY THE CONTRACTOR BY SAWING THE GRATING MEMBERS TO PROVIDE A ONE INCH MINIMUM CLEARANCE TO THE SURFACE OF THE TUBE MEMBER. GRATING CUT-OUTS SHALL BE COATED WITH ORGANIC ZINC IN ACCORDANCE WITH SPECIFICATION SECTION 9L. CUT-OUTS SHALL BE MADE AT THE GRATING EDGES TO PERMIT GRATING REMOVAL WITHOUT REQUIRING DISCONNECTION OF TUBING. ALL PROPOSED CUT-OUTS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER AND NO CUT-OUTS SHALL BE PERMITTED UNTIL WRITTEN APPROVAL HAS BEEN RECEIVED FROM THE CONTRACTING OFFICER. SEE PARAGRAPH ENTITLED "----SHOP DRAWINGS".

---GENERAL

ALL TUBE SEGMENTS, VALVES, RELIEF DEVICES, GAGES, AND OTHER SYSTEM COMPONENTS SHALL BE INDIVIDUALLY PRESSURE TESTED, FUNCTIONALLY TESTED, CLEANED, TAGGED AND CERTIFIED PRIOR TO INSTALLATION IN THE FIELD. COMPLETE INSTALLED SYSTEM TESTS SHALL CONSIST OF 1) PROOF TESTING TO 1 1/2 TIMES MAXIMUM RATED WORKING PRESSURE, 2) LEAK TESTING OF TUBING CONNECTIONS, COMPONENT INTERFACES AND COMPONENT ASSEMBLIES. ALL PANELS SHALL BE SHOP FABRICATED AND SHOP TESTED AS HEREINABOVE OUTLINED PRIOR TO DELIVERY TO THE FIELD.

---TEST SCHEDULES AND PROCEDURES

THE CONTRACTOR SHALL GENERATE SCHEDULES AND PROCEDURES FOR ALL TESTS CONDUCTED UNDER THIS CONTRACT. APPROVAL BY THE CONTRACTING OFFICER IN WRITING IS REQUIRED PRIOR TO THE PERFORMANCE OF ANY TEST.

---TEST RECORDS

PREPARE AND MAINTAIN TEST RECORDS OF ALL TUBING SYSTEMS TESTS. RECORDS SHALL SHOW GOVERNMENTAL AND CONTRACTOR TEST PERSONNEL RESPONSIBILITIES, DATES, TEST GAGE CALIBRATION DATA, AMBIENT TEMPERATURES, PRESSURE RANGES, RATES OF PRESSURE DROP, AND LEAKAGE RATES. EACH ACCEPTANCE TEST SHALL BE SIGNED BY THE CONTRACTING OFFICER AFTER ACCEPTANCE.

---TEST GAGES

CONTRACTOR'S TEST GAGES SHALL CONFORM TO ANSI B40.1-1968 AND SHALL HAVE A DIAL SIZE 6 INCHES OR LARGER. MAXIMUM PERMISSIBLE SCALE RANGE FOR A GIVEN TEST SHALL BE SUCH THAT THE POINTER DURING A TEST SHALL HAVE A STARTING POSITION AT MIDPOINT OF THE DIAL OR WITHIN THE MIDDLE THIRD OF THE SCALE RANGE. CERTIFICATION OF ACCURACY AND CORRECTION TABLE SHALL BEAR A DATE WITHIN 90 DAYS OF THE TEST USE, TEST GAGE NUMBER, AND THE PROJECT NUMBER, UNLESS OTHERWISE APPROVED BY THE CONTRACTING OFFICER.

SECTION 13L

COLOR FINISH SCHEDULE AND PIPING IDENTIFICATION

---GENERAL REQUIREMENTS---

---GENERAL

SAMPLES SHALL BE SUBMITTED FOR APPROVAL. SAMPLES SHALL BE SUBMITTED IN ACCORDANCE WITH THE SPECIFICATION FOR FINAL SELECTION AND COORDINATION. COLOR RANGE ON BOTH SIDES OF THE COLORS LISTED SHALL BE SUBMITTED.

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREIN IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

FSC FEDERAL STANDARD COLORS 595

---INTERIOR AREAS

ELEVATED WATER TANK:	SEE SECTION 15T OF THE SPECIFICATIONS
STEEL FRAMING:	*INORGANIC ZINC-RICH SHOP COAT AND FIELD TOUCH-UP
BLDG. #J7-385	WALLS AND CEILING: WHITE 27880; FLOOR: GREY 26493
SSAT ELEVATOR MACHINE AND AUXILIARY EQUIPMENT ROOMS:	OFF-WHITE 27886

--EXTERIOR

ELEVATED WATER TANK:	SEE SECTION 15T OF THE SPECIFICATIONS
NORTH BRIDGE:	*INORGANIC ZINC-RICH SHOP COAT AND FIELD TOUCH-UP
HANDRAILS AND LADDERS:	*INORGANIC ZINC-RICH OR GALVANIZED
ALL OTHER STEEL (EXCEPT SSAT):	*INORGANIC ZINC-RICH SHOP COAT AND FIELD TOUCH-UP
FIRE HOSE STATIONS:	RED - NO. 11105
HOSE STATIONS - POTABLE WATER:	GREEN - NO. 14187
HAMMERHEAD CRANE:	TOUCH-UP AND INORGANIC ZINC-RICH*
SHUTTLE SERVICE & ACCESS TOWER (SSAT):	ALL NEW STEEL TO BE SHOP COATED WITH INORGANIC ZINC, FIELD BOND COAT AND TWO TOP COATS TO MATCH EXISTING COLORS. AREAS DAMAGED DUE TO DEMOLITION AND INSTALLATION TO BE TOUCHED-UP WITH ORGANIC ZINC AND BOND COAT AND TWO TOP COATS TO MATCH EXISTING COLORS. TOP COATS SHALL BE COATING SYSTEM TYPE AZR. REFER TO SECTIONS 9A AND 9L OF THE SPECIFICATIONS.

*REFER TO SECTION 9L OF THE SPECIFICATIONS.

SSAT ELEVATOR SYSTEM (EXCEPT CAR):	TO MATCH NEW SIDING (SEE DRAWING)
SSAT ELEVATOR CARS:	OFF-WHITE - NO. 27886
BLDGS. FOR HYPERGOLIC FACILITIES:	FACTORY FINISH - COLORS AS SELECTED BY CONTRACTING OFFICER
PIPING:	PER TABLE 13L-1 AND FIGURE NO. 1. ALSO SEE SECTIONS 15E, 15H, 15P AND 15T
AIR CONDITIONING/VENTILATING EQUIPMENT:	BUFF - NO. 23594

---MISCELLANEOUS METAL WORK

INTERIOR HANDRAILS AND LADDERS:	YELLOW - NO. 23655
HIDDEN METAL WORK (STRUCTURE TO BE COVERED UP):	GRAY - NO. 26440 OR INORGANIC ZINC*
GUTTERS, PIPE SUPPORTS, OTHER MISCELLANEOUS ITEMS NOT COVERED ABOVE:	SAME AS SURFACE TO WHICH THEY ARE ATTACHED.

---ELECTRICAL

ALL PANELS AND DISTRIBUTORS:	GRAY - NO. 26440
INTERIOR OF ALL ELECTRICAL EQUIPMENT ENCLOSURES:	OFF-WHITE - NO. 27886

---ITEMS NOT LISTED: AS SELECTED BY THE CONTRACTING OFFICER

---PIPING IDENTIFICATION---

---GENERAL

REFER TO TABLE 13L-1 FOR PAINTING OF PIPING, LEGEND, AND COLORS OF LETTERS, COLOR BAND AND FLOW ARROWS. ALSO, SEE FIGURE 1 FOR SIZE AND PLACEMENT OF IDENTIFICATION ON PIPING.

---LEGEND

WHERE THE VIEW IS OBSTRUCTED, LEGEND SHALL BE LETTERED ON THE TWO LOWER QUARTERS OF THE PIPE OR COVERING. WHERE LEGEND ON THE LOWER QUARTERS WOULD NOT BE VISIBLE FROM OPERATING POSITIONS, ESPECIALLY THOSE ADJACENT TO CONTROL VALVES, THEY SHALL BE PLACED ON THE PIPE'S TWO UPPER QUARTERS. STENCILS SHALL HAVE THE STANDARD SIZE LETTERS SPECIFIED IN TABLE 13L-2. FOR PIPE LINES 3/4 INCH OR SMALLER IN DIAMETER, SECURELY FASTENED METAL TAGS, WITH LETTERING ETCHED OR FILLED IN WITH ENAMEL OR PRESSURE SENSTIVE TAPE, MAY BE USED. ALL LEGENDS SHALL BE APPLIED USING UPPER CASE LETTERS AND ARABIC NUMERALS. MAXIMUM PIPE SIZE FOR THE USE OF TAPE IS 3-INCH. FOR ADDITIONAL IDENTIFICATION OF PNEUMATIC AND HYDRAULIC TUBING WITH PART NO., TUBE SIZE, TEST PRESSURE, ETC., SEE KSC-STD-169 AND DRAWING C75M04185 (FOR AVAILABILITY, SEE "INSTRUCTIONS TO BIDDERS").

PIPE SYSTEM	PIPE, OR COVERING (PAINT COLOR)	LEGEND	LETTERS LETTER COLORS	COLOR BAND BAND COLOR	ARROW ARROW COLOR	
POTABLE WATER	GALV. PIPE (*WHITE 17875)	POTABLE WATER	BLACK	WHITE	BLACK	
SOUND SUPPRESSION WATER	PAINTED & GALV. PIPE (*NONE)	SOUND SUPP. WATER	*BLACK*	*BLACK*	*BLACK*	F
FIREX & TANK FILL	PAINTED & GALV. PIPE (*NONE)	FIRE PROTECTION WATER	WHITE	RED	(1)	
10" SUCTION (PUMP P2)	PAINTED & GALV. PIPE (*NONE)	FIRE PROTECTION WATER	WHITE	RED	(1)	
18" DISCHARGE (PUMP P1)	PAINTED & GALV. PIPE (*NONE)	FIREX WATER	WHITE	RED	(1)	
PNEUMATIC NITROGEN	STAINLESS (GRAY)	NITROGEN-PNEU (GN_2)	BLACK	GRAY	BLACK	
HYDRAULIC FLUID	STAINLESS (GRAY)	HYDRAULIC FLUID	BLACK	YELLOW	GRAY	
CHILLED WATER SUPPLY	AL. JACKET (NONE)	CHILLED WATER SUPPLY	BLACK	BLACK	WHITE	
CHILLED WATER RETURN	AL. JACKET (NONE)	CHILLED WATER RETURN	BLACK	BLACK	WHITE	
A.C. COND. DRAINS	INSULATED (GREEN 24672)	CONDENSATE DRAIN	BLACK	BLACK	WHITE	
ECS AND AMBIENT AIR DUCTS	SEE NOTE "A"	SEE NOTE "A"	NOTE "A"	NOTE "A"	NOTE "A"	A
COMPRESSED AIR	PAINTED PIPE (WHITE 27875)	COMP. AIR-250 PSIG	GREEN	GRAY	GREEN	
SAFEWASTE	PAINTED & GALV. PIPE (*)	SAFEWASTE	WHITE	BLACK	WHITE	

TABLE 13L-1

(*) - CLEAN AND TOUCH-UP THREADS AND WELDS PER SECTION 9L. NOTE "A": SHALL BE AS DEFINED IN SECTION 15A

(1) - ARROW MAY BE SAME COLOR AS COLOR BAND, OR BLACK, OR WHITE.

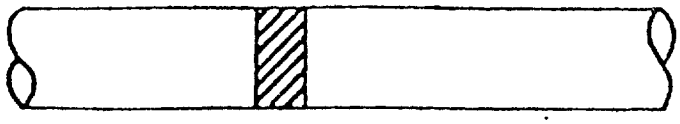
SIZE OF STANDARD STENCIL LETTERS

OUTSIDE DIAMETER OF PIPE AND COVERING (INCHES)	SIZE OF STENCIL LETTERS (INCHES)
*UNDER 1-1/2	1/2
1-1/2 TO 3-1/2	3/4
3-1/2 TO 6	1-1/4
6 TO 9	2
9 TO 13	3
OVER 13	3-1/2

TABLE 13L-2

*ADDITIONAL LETTER SIZES PERMITTED FOR SMALLER PIPING.

PRIMARY COLOR WARNING

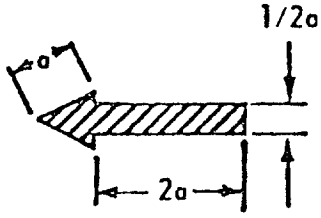


WIDTH OF BAND	OUTSIDE DIAMETER OF PIPE OF COVERING
1"	UNDER 3-1/2"
2"	3-1/2" TO 13"
6"	OVER 13"

SECONDARY COLOR WARNING

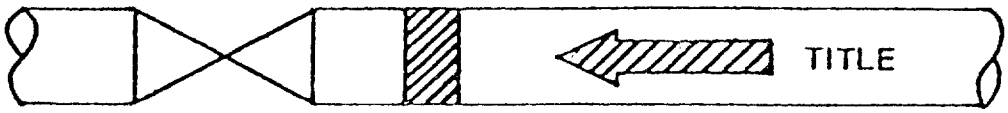
DIRECTION OF FLOW

REVERSIBLE FLOW



APPROX. 3/4 OF OUTSIDE DIAMETER OF PIPE OR COVERING (6" MAX)

EXAMPLE



SPACING: 40 FT. MAX ON CENTERS, EACH SIDE OF WALLS AND FLOORS, AT ALL FITTINGS AND VALVES.

Figure 1. Size and Placement of Flow Arrows and Colorbands

SECTION 14A

INSTALLATION OF HAMMERHEAD CRANE

---GENERAL REQUIREMENTS---

---GENERAL

TRANSPORT CRANE COMPONENTS AND SUBASSEMBLIES FROM PRESENT KSC STORAGE SITE TO LAUNCH PAD 39B ERECTION SITE, AND PROVIDE ALL PLANT AND LABOR TO ERECT, CHECKOUT, TEST, PLACE IN ACCEPTABLE OPERATION, ONE EXISTING, ELECTRIC-POWERED HAMMERHEAD CRANE AS HEREIN SPECIFIED AND INDICATED ON SHEETS M25 AND M26. CRANE SHALL BE MOUNTED APPROXIMATELY 247 FEET ABOVE EXISTING PAD SURFACE ON THE NEW SHUTTLE SERVICE AND ASSESS TOWER (SSAT). CRANE COMPONENTS ARE STORED *AT SALVAGE YARD ON RANSOM ROAD, SEE DWG SHEET 6(V7).* (A)

---REFERENCED SPECIFICATIONS

THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO. IN THE EVENT OF DIFFERENCE BETWEEN THIS SPECIFICATION OR ITS ACCOMPANYING DRAWINGS AND THE REFERENCED SPECIFICATION, THIS SPECIFICATION AND ITS ACCOMPANYING DRAWINGS SHALL GOVERN TO THE EXTENT OF SUCH DIFFERENCE:

AMERICAN STANDARDS ASSOCIATION:

B30.2.0-67	SAFETY CODE FOR OVERHEAD AND GANTRY CRANES
B30.4-73	SAFETY STANDARD FOR PORTAL, TOWER AND PILLAR CRANES
B18.2.1-72	SQUARE AND HEXAGON BOLTS AND NUTS
B27.2-65	PLAIN WASHERS
B30.7-71	SAFETY CODE FOR BASE MOUNTED DRUM HOISTS

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

PHAMPLET NO. 70 NATIONAL ELECTRIC CODE

AMERICAN INSTITUTE OF STEEL CONSTRUCTION:

SPECIFICATIONS FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS.

CODE OF STANDARD PRACTICE FOR BUILDINGS AND BRIDGES SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 BOLTS AND ACCOMPANYING COMMENTARY.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

APPLICABLE SAFETY REQUIREMENTS (FOR ERECTION).

AMERICAN WELDING SOCIETY:

A2.0-74	WELDING SYMBOLS
D2.0-69	STANDARD SPECIFICATION FOR WELDED HIGHWAY AND RAILROAD BRIDGES

INDUSTRIAL FASTENERS INSTITUTE PUBLICATION:

BOLT, NUT AND RIVET STANDARDS

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION:

ICS - INDUSTRIAL CONTROLS AND SYSTEMS (1970 ISSUE AND NO. 4 DATED 5/31/74)
MGI - MOTORS AND GENERATORS (1972 ISSUE AND NO. 3 DATED 3/28/74)

MILITARY SPECIFICATIONS:

MIL-V-173	VARNISH, MOISTURE AND FUNGUS RESISTANT, FOR TREATMENT OF COMMUNICATIONS, ELECTRONIC AND ASSOCIATED ELECTRICAL EQUIPMENT
MIL-V-1137	VARNISH, ELECTRICAL INSULATION (FOR ELECTROMOTIVE EQUIPMENT)
MIL-F-3541	FITTINGS, LUBRICATION
MIL-H-19925	HOISTS, WIRE ROPE, ELECTRIC POWERED

---GENERAL

THE HAMMERHEAD CRANE WAS RECENTLY REMOVED FROM THE TOP TOWER LEVEL OF MOBILE LAUNCHER NO. 2 (ML NO. 2), AND SHALL BE PROVIDED TO THE CONTRACTOR AS GOVERNMENT FURNISHED EQUIPMENT (GFE). TRANSPORT, ASSEMBLE AND INSTALL THE CRANE ON ITS MODIFIED STRUCTURAL BASE, WHICH SHALL FORM THE TOP LEVEL (EL. 300'-0") OF THE NEW SSAT TO BE ERECTED BY THE CONTRACTOR AT LAUNCH PAD 39B.

THE CONTRACTOR SHALL REUSE IN THE INSTALLATION ALL EXISTING HAMMERHEAD CRANE COMPONENTS, EXCEPT THAT ALL ASTM A325 BOLTING SHALL BE NEW AND BY CONTRACTOR. THE ONLY EXCEPTION TO COMPLETE REUSE OF EXISTING EQUIPMENT SHALL BE WHERE THE CONTRACTING OFFICER APPROVES THE REFURBISHMENT OR REPLACEMENT OF WORN OUT EQUIPMENT. ANY REFURBISHMENT OR REPLACEMENT OF EQUIPMENT WILL BE DONE BY THE GOVERNMENT AT THE EXPENSE OF THE GOVERNMENT. ALL NEW FASTENERS AND RELATED COMPONENTS SHALL BE GALVANIZED. CRANE SHALL BE MODIFIED AS SHOWN ON THE DRAWINGS AND SPECIFIED HEREIN.

---COORDINATION

GENERAL ARRANGEMENT SHALL BE IN ACCORDANCE WITH THE CONTRACT DRAWING 79K10338 AND THESE SPECIFICATIONS. AN EXISTING IDENTICAL OPERATIONAL CRANE (ATOP THE TOWER OF MOBILE LAUNCHER NO. 1) WILL BE MADE AVAILABLE TO THE CONTRACTOR FOR INSPECTION AND COMPARISON PURPOSES FOR THE NEW CRANE INSTALLATION.

ANY CHANGES MADE SHALL BE SUBJECT TO PRIOR APPROVAL OF THE CONTRACTING OFFICER. ADDITIONAL STRUCTURAL STEEL AT THE TOP LEVEL OF THE SSAT TOWER SHALL BE PROVIDED AS SHOWN ON THE DRAWINGS.

---GENERAL DESCRIPTION OF EXISTING CRANE---

---CAPACITY

RATED CAPACITY WITH LOAD HOOK FIFTY (50) FEET FROM CENTERLINE OF SSAT AND CRANE IS 25 TONS (50,000 LBS. AVOIRDUPOIS).

RATED CAPACITY WITH LOAD HOOK EIGHTY-FIVE (85) FEET FROM CENTERLINE OF SSAT AND CRANE IS *15* TONS. (A)

---LOAD HOOK RADII

MAXIMUM 85 FEET. MINIMUM: 24 FEET APPROXIMATELY.

---LOAD HOOK VERTICAL LIFT

HOOK TO TOUCH A POINT 290 FEET BELOW TOP OF SSAT (ELEV. 300'-0") AND HAVE NOT LESS THAN FOUR (4) TURNS OF ROPE ON DRUM. HOOK AT MAXIMUM HEIGHT TO BE NOT MORE THAN EIGHT (8) FEET BELOW TOP OF SSAT.

---MAXIMUM RATED SPEEDS (VARIABLE) WITH RATED CAPACITY LOAD

HOISTING: 30 FEET PER MINUTE WITH ROPE ON TOP LAYER OF DRUM.

TROLLEY: 100 FEET PER MINUTE.

ROTATE: ONE RPM IN BOTH DIRECTIONS, 720 DEGREES.

---CONTROL STATIONS

REMOTE VIA EXISTING PENDANT AND CORD WITH SPECIAL PLUG; CONTROL STATION RECEPTACLES; A RECEPTACLE FOR TESTING AND CHECKOUT IN MACHINERY HOUSE OF CRANE. THESE ARE IN STORAGE.

---WIRE ROPES, LOAD BLOCK AND FLEET AND EQUALIZER SHEAVES

WIRE ROPES ARE ON REELS. LOAD BLOCK WITH LOAD HOOK IS AVAILABLE. FLEET SHEAVES AND EQUALIZER SHEAVES ARE IN STORAGE AND/OR ATTACHED TO CRANE STRUCTURE.

---CRANE EQUIPMENT EXISTING ATOP ML NO. 2 TOWER SEGMENT

RAIL (LOWER) FOR ROLLER CIRCLE
ROLLER CIRCLE
BULL GEAR
SOCKETS (4) FOR WINDLOCK
CENTER BEARING JOURNAL
GROUNDING RING FOR CRANE BOOM LIGHTNING PROTECTION SYSTEM

---ELECTRIC CENTER WITH SLIP RINGS

ELECTRIC CENTER WITH SLIP RINGS AND INTEGRAL AIR PURGE PIPE (IN STORAGE)

---INSTALLATION OF CRANE---

---SUPERVISION

THE CONTRACTOR SHALL PROVIDE THE SERVICES OF A QUALIFIED SUPERINTENDENT OF ERECTION, CHECKOUT AND TESTING FROM THE COLBY CRANE AND MANUFACTURING COMPANY, SEATTLE, WASHINGTON; OR FROM ANOTHER SIMILARLY QUALIFIED CRANE MANUFACTURING COMPANY.

---SAFETY

APPLICABLE REQUIREMENTS OF OSHA SHALL BE COMPLIED WITH.

---PERFORMANCE

THE CONTRACTOR SHALL INSTALL THE CRANE IN SUCH A MANNER THAT ITS PERFORMANCE, AS DEMONSTRATED BY TESTING HEREINAFTER SPECIFIED, IS EQUAL TO THE PERFORMANCE HEREIN SPECIFIED.

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---ELECTRICAL WORK

THE WIRING TO MAJOR MOTORIZED EQUIPMENT WAS IN PLACE WHEN CRANE WAS REMOVED FROM ATOP THE TOWER OF ML NO. 2. THE ELECTRICAL CENTER (LOCATED AT THE CENTER PIN OF ROTATION) WAS ALSO REMOVED, AND REWIRING TO THE CRANE COMPONENTS SHALL BE ACCOMPLISHED. ALL WORK SHALL COMPLY WITH THE APPROPRIATE PARTS OF DIVISION 16 OF THE SPECIFICATIONS AND OTHERWISE WITH THE NATIONAL ELECTRIC CODE, PHAMPLET NO. 70, AND ARTICLE 610 THEREOF. POWER WIRING TO PANEL P2 AND ALL CRANE CONTROL WIRING SHALL BE ACCOMPLISHED AS PART OF THE CRANE INSTALLATION SECTION OF THE SPECIFICATIONS. PROVIDE NEW FLOODLIGHTS AS SHOWN.

---BONDING AND GROUNDING

ALL METALS SHALL BE BONDED TO GROUND AS SPECIFIED IN SECTION 16X (PART 51) OF THE SPECIFICATIONS.

---CONNECTIONS TO CRANE

ALL CRANE COMPONENTS (EXCEPT RAIL, ROLLER CIRCLE, BULLGEAR, WIND LOCK ANCHORS AND GROUNDING RING) SHALL BE MOUNTED ABOARD, AND ROTATE WITH, THE CRANE STRUCTURE. PROVIDE FIXED CONNECTIONS AND TERMINALS BELOW CRANE (WITH ROTATABLE FEATURES ON CRANE-SIDE ABOVE), FOR SUPPLYING ALL SERVICES TO CRANE INCLUDING ELECTRIC POWER FOR MOTIVATION AND LIGHTING, REMOTE CONTROL CIRCUITS AND NITROGEN SUPPLY. ALL SERVICES SHALL BE COMPLETE AND SHALL CONNECT TO RESPECTIVE COMPONENTS ON CRANE UNLESS OTHERWISE SPECIFIED. AIR PURGE/PRESSURIZATION PIPING ON THE CRANE SIDE OF THE ELECTRICAL CENTER SHALL BE PROVIDED TO FOUR NEW FLOODLIGHTS AS SHOWN.

---PROTECTION OF MATERIALS AND EQUIPMENT---

THE CONTRACTOR SHALL PROTECT ALL MATERIALS AND EQUIPMENT TURNED OVER TO HIM BY THE GOVERNMENT AGAINST LOSS AND DAMAGE. UNFINISHED SURFACES AND ROPING SHALL BE PROTECTED FROM CORROSION BY THE APPLICATION OF APPROVED LUBRICANTS.

---PAINTING AND FINISHING---

---GENERAL

ALL DAMAGED PAINTED SURFACES SHALL BE POWER TOOL CLEANED AND TOUCHED-UP TO MATCH EXISTING FINISH IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THESE SPECIFICATIONS.

UPPER HOIST LIMIT SWITCHES: TEST OPERATION OF EACH SWITCH SEPARATELY WHEN HOISTING AT TOP SPEED.

LOWER LIMIT SWITCH: TEST OPERATION WHEN LOWERING AT TOP SPEED. CHECK TURNS REMAINING ON HOIST DRUM. SHOULD BE NOT LESS THAN FOUR TURNS ON DRUM.

TROLLEY TRAVERSE LIMIT SWITCHES: TEST OPERATION OF HOOK MINIMUM RADIUS (INBOARD END OF BOOM) LIMIT SWITCH. TEST OPERATION OF SWITCH WHICH LIMITS HOOK SWING RADIUS TO 50 FEET. TROLLEY AT TOP SPEED FOR ABOVE TESTS.

BY-PASS ON TROLLEY LIMIT SWITCH: TEST OPERATION OF CONTROL SWITCH WHICH BY-PASSES LIMIT SWITCH AND REMOVES STOPS THAT LIMITS HOOK SWING RADIUS TO 50 FEET. TRAVERSE TROLLEY OUTWARD THROUGH LIMIT SWITCH AND STOPS TO HOOK RADIUS OF ABOUT 60 FEET AND THEN RETURN TROLLEY THROUGH SWITCH AND STOPS TO HOOK RADIUS OF ABOUT 40 FEET. DURING ABOVE TEST, CHECK OPERATION OF ELECTRICALLY OPERATED WHEEL STOPS VIA CONTROL SWITCH WHICH BY-PASSES LIMIT SWITCH. USE TOP TROLLEY SPEED FOR ABOVE LIMIT SWITCH AND STOP TESTS. FOLLOWING ABOVE TESTS, SIMULATE FAILURE OF LIMIT SWITCH FOR HOOK RADIUS OF 50 FEET AND TEST REMOVABLE TROLLEY STOPS FOR THIS TROLLEY POSITION. CHECK "MAX LOAD" INDICATOR LIGHT ON PENDANTS FOR "ON" WHEN HOOK IS BEYOND RADIUS OF 50 FEET.

TROLLEY POSITION INTERLOCK WITH SWING DRIVE: POSITION TROLLEY SO LOAD BLOCK JUST TOUCHES CORNER OF TOWER AND PROVE THAT BOOM CANNOT BE ROTATED VIA SWINGER DRIVE. WITH SWINGER DRIVE IN LOWEST SPEED POSITION, GRADUALLY INCREASE LOAD BLOCK-TO-TOWER CLEARANCES AND PROVE THAT WITH CLEARANCE OF BETWEEN 6 AND 8 INCHES THE SWINGER DRIVE WILL ROTATE CRANE. REPEAT ABOVE OTHER 3 CORNERS OF TOWER. WITH BOOM CENTERLINE SQUARE WITH EACH SIDE OF TOWER, TRAVERSE TROLLEY ACROSS LIMIT SWITCH AND PROVE THAT CRANE CAN ONLY BE ROTATED WHEN TROLLEY IS IN A POSITION WHICH PROVIDES CLEARANCE BETWEEN LOAD BLOCK AND CORNER OF TOWER. ROTATE BOOM AND TEST FOR STOPPING AND AUTOMATIC BRAKING.

ACCESS HATCH INTERLOCK WITH SWING DRIVE: WITH ACCESS HATCH AT TOWER LEVEL 295 IN "OPEN" POSITION, PROVE THAT CRANE SWING DRIVE CANNOT BE OPERATED. MOVE HATCH TO "CLOSED" POSITION AND PROVE OPERATION OF SWING DRIVE.

SETTING OF WINDLOCKS, INTERLOCKS AND INDICATOR LIGHT: PROVE THAT WINDLOCKS CAN BE REMOTELY SET, THAT INDICATOR LIGHT ON PENDANTS FUNCTIONS, AND THAT CRANE SWING DRIVE CANNOT BE ENERGIZED WHEN WINDLOCKS ARE SET. REMOTELY REMOVE WINDLOCK, CHECK INDICATOR LIGHT AND REVOLVE CRANE IN INCREMENTS OF 90 DEGREES AND SET WINDLOCK IN EACH OF THE FOUR BOOM POSITIONS. REVERSE CRANE ROTATION AND REPEAT ABOVE. IF NO ADJUSTMENTS ARE NECESSARY, ABOVE TESTS WILL BE SUFFICIENT.

WITH ONE PENDANT PLUGGED IN THE CONTROL STATION AT THE LOWEST LEVEL, SUCCESSIVELY PLUG THE SECOND PENDANT IN AT EACH HIGHER LEVEL AND DEMONSTRATE THAT THE PENDANT AT THE LOWER STATION ONLY IS IN COMMAND OF THE CRANE AND THAT WHEN THE LOWER PENDANT IS UNPLUGGED COMMAND SHIFTS TO THE HIGHER PENDANT. DEMONSTRATE THAT INDICATOR LIGHT ON EACH PENDANT HAS COMMAND OF CRANE. EXCHANGE PENDANTS AND DEMONSTRATE THAT ABOVE OPERATION IS MAINTAINED. DETERMINE THAT EACH PENDANT WILL OPERATE CRANE FROM ANY AND ALL OF THE CONTROL STATIONS.

TEST CHECK FOR STOPPING AND AUTOMATIC BRAKING. TEST CAPABILITY FOR LOWERING AT INCHING SPEED AND STOPPING AT PREDETERMINED ELEVATION AND THEN HOISTING AT INCHING SPEED WITHOUT MEASURABLE DOWNWARD DRIFT OF LOAD BELOW THE PREDETERMINED LEVEL. TEST FOR HOISTING AT INCHING SPEED, STOP, THEN CONTINUE HOISTING AT INCHING SPEED WITHOUT MEASURABLE DOWNWARD DRIFT OF LOAD BELOW PREDETERMINED LEVEL.

WITH RATED LOAD FOR HOOK AT RADIUS OF 50 FEET AND WITHIN SAME, THE HOOK SHALL BE HOISTED THROUGH FULL TRAVEL AT THE FOLLOWING DUTY CYCLE AND BETWEEN EACH SPEED CHANGE HOLDING WITH BRAKE FOR AT LEAST ONE MINUTE:

SPEED POINT	MINUTES
1ST	5
2ND	20
3RD	5
4TH	5
5TH	5 OR MORE

WITH RATED HOOK LOAD FOR RADIUS OF 50 FEET AND WITHIN SAME, TEST AUTOMATIC STOP FOR UPPER HOOK LIMIT.

WITH RATED HOOK LOAD FOR RADIUS OF 50 FEET AND WITHIN SAME, MOVE TROLLEY BETWEEN HOOK RADIUS OF 50 FEET AND MINIMUM HOOK RADIUS FOR TWO COMPLETE CYCLES AT VARYING SPEEDS WITH NOT LESS THAN ONE MINUTE AT EACH SPEED POINT. TEST AUTOMATIC BRAKING, DRIFT OF TROLLEY AND SPEED OF TROLLEY. TEST AUTOMATIC STOP AT RADIUS OF 50 FEET.

WITH RATED HOOK LOAD FOR RADIUS OF 50 FEET AND WITH HOOK AT RADIUS OF 50 FEET, ROTATE BOOM THROUGH 2 COMPLETE REVOLUTIONS IN EACH DIRECTION AT VARYING SPEEDS AND DEMONSTRATE STOPPING, AUTOMATIC BRAKING, DRIFT, INCHING AND MAXIMUM SPEED.

SIMULTANEOUS OPERATION: WITH RATED LOAD FOR HOOK RADIUS OF 50 FEET AND WITHIN SAME, DEMONSTRATE CAPABILITY FOR SIMULTANEOUS TROLLEY TRAVEL AND SWING WHEN HOISTING AND WHEN LOWERING.

WITH RATED LOAD FOR HOOK RADIUS OF 85 FEET, HOIST AND LOWER THROUGH FULL TRAVEL OF HOOK AT VARYING SPEEDS AND TEST CAPABILITY FOR HOISTING AND LOWERING, STOPPING AT PREDETERMINED LEVELS, AND INCHING IN REVERSE DIRECTION THEREFROM WITHOUT MEASURABLE DRIFT FROM PREDETERMINED LEVEL.

WITH RATED LOAD FOR HOOK RADIUS OF 85 FEET, DRIVE TROLLEY OVER FULL LENGTH OF BOOM AT VARYING SPEEDS FOR TWO COMPLETE CYCLES. TEST AUTOMATIC TROLLEY BRAKE AND REMOVABLE STOPS AT HOOK RADIUS OF 50 FEET AND PENDANT INDICATOR LIGHTS FOR SAME.

SECTION 14B

REMOVAL/INSTALLATION OF HYDRAULIC PASSENGER ELEVATOR MACHINERY AND MACHINE ROOM

---GENERAL REQUIREMENTS---

---GENERAL

TO PERMIT EXCAVATION OPERATIONS FOR THE FOUNDATIONS OF THE NEW SHUTTLE SERVICE AND ACCESS TOWER (SSAT), THE CONTRACTOR SHALL PROVIDE ALL MATERIAL AND LABOR, UNLESS OTHERWISE SPECIFIED, NECESSARY TO REMOVE THE WEST HYDRAULIC ELEVATOR MACHINE ROOM AND EQUIPMENT IN AND ON THE STRUCTURE. AFTER THE SSAT FOUNDATION WORK IS COMPLETED, REBUILD A NEW WEST HYDRAULIC ELEVATOR MACHINE ROOM AS DETAILED ON THE DRAWINGS AND REINSTALL THE EQUIPMENT PREVIOUSLY REMOVED; OR, REPLACEMENT EQUIPMENT FURNISHED BY THE GOVERNMENT. DEMONSTRATE OPERATION OF THE HYDRAULIC AND ELECTRIC EQUIPMENT SATISFACTORY TO THE CONTRACTING OFFICER PRIOR TO COMMENCING WORK, AND AFTER REBUILDING.

---APPLICABLE PUBLICATIONS

THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO:

ANSI A 17.1-1971 & A 17.1A & 17.1B — AMERICAN NATIONAL STANDARD SAFETY CODE FOR ELEVATORS, DUMBWAITERS AND ESCALATORS (HEREINAFTER REFERRED TO AS ASE CODE).

ANSI A 17.2-1971 — AMERICAN NATIONAL STANDARD PRACTICE FOR THE INSPECTION OF ELEVATORS - INSPECTOR'S MANUAL.

NFPA NO. 70-1975 NATIONAL ELECTRIC CODE (HEREINAFTER REFERRED TO AS THE NEC).

---GENERAL ARRANGEMENT

THIS SHALL BE IN ACCORDANCE WITH THE DRAWINGS, EXISTING CONDITIONS AND THESE SPECIFICATIONS.

---QUALIFICATIONS

THE CONTRACTOR SHALL PROVIDE THE SERVICES OF PERSONNEL REGULARLY ENGAGED IN THE BUSINESS OF INSTALLING AND SERVICING HYDRAULIC ELEVATOR EQUIPMENT.

---PAINTING AND FINISHING

ALL EQUIPMENT SHALL BE CLEANED AND PAINTED PRIOR TO INSTALLATION IN ACCORDANCE WITH SECTION 9A OF THE SPECIFICATIONS.

FERROUS METAL ITEMS FORMING PART OF THE NEW MACHINERY ROOM STRUCTURE (EXCEPT REINFORCING BARS) SHALL BE CLEANED AND HAVE ZINC-RICH COATING APPLIED TO ALL SURFACES IN ACCORDANCE WITH SECTION 9L OF THE SPECIFICATIONS.

FOLLOWING INSTALLATION, PAINTED AND COATED SURFACES WHICH ARE DAMAGED SHALL BE TOUCHED-UP TO MATCH SURROUNDING AREAS.

---STORAGE

AN AREA FOR STORAGE OF MATERIAL AND EQUIPMENT SHALL BE PROVIDED BY THE CONTRACTOR. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO TRANSPORT, HANDLE, AND PLACE ALL MATERIAL AND EQUIPMENT, AS REQUIRED. THE CONTRACTOR SHALL TAKE NECESSARY STEPS AS REQUIRED TO PROTECT EQUIPMENT FROM THE ELEMENTS.

---SUBMITTALS OF SHOP DRAWINGS

ALL SUBMITTALS SHALL CONFORM TO THE REQUIREMENTS OF THE ARTICLE "SHOP DRAWINGS" OF THE CONTRACT SCHEDULE.

SHOP DRAWINGS SHALL BE SUBMITTED OF THE FOLLOWINGS:

NEW MACHINE ROOM AND EQUIPMENT LAYOUT
REINFORCING BAR SCHEDULE
CONCRETE MIX

---SERVICE INTERRUPTIONS

SERVICE INTERRUPTIONS WILL BE GRANTED AT THE CONVENIENCE OF THE GOVERNMENT ONLY AND AS OUTLINED IN THE "CONTRACT SCHEDULE".

---INSPECTION, TEST AND CHECKOUT

THE CONTRACTOR SHALL CONDUCT ALL TESTS AND CHECKOUTS AS SPECIFIED. THE CONTRACTOR SHALL DEMONSTRATE AND OPERATE THE REINSTALLED EQUIPMENT. THE TESTS SHALL BE PERFORMED IN THE PRESENCE OF THE CONTRACTING OFFICER. THE CONTRACTOR SHALL FURNISH ALL INSTRUMENTS AND PERSONNEL REQUIRED FOR THE TESTS AND SUBMIT A WRITTEN TEST REPORT TO THE GOVERNMENT.

PLACE ALL THE REUSABLE MATERIAL AND EQUIPMENT IN STORAGE.

DEMOLISH THE MACHINE ROOM DOWN TO THE PAD SURFACE AND REMOVE ALL DEBRIS TO AN AREA DESIGNATED BY THE CONTRACTING OFFICER AND AS OUTLINED IN THE "CONTRACT SCHEDULE".

---INSTALLATION---

WHEN THE SSAT FOUNDATION HAS BEEN COMPLETED, REBUILD THE WEST ELEVATOR MACHINE ROOM AS DETAILED ON THE DRAWINGS UTILIZING EXISTING DOORS, FRAMES, COVERS, ETC. TO MATCH PRIOR INSTALLATION.

REINSTALL ALL USABLE MATERIAL AND EQUIPMENT PREVIOUSLY REMOVED FROM THE INTERIOR AND EXTERIOR OF THE MACHINE ROOM. ANY REPLACEMENT MATERIAL OR EQUIPMENT (EXCEPT ELECTRICAL CONDUIT, WIRING, AND MISCELLANOUS PIPING) WILL BE GOVERNMENT FURNISHED EQUIPMENT, EXCEPT THAT CONTRACTOR SHALL CLEAN HYDRAULIC SYSTEM, REMOVE EXISTING CHARGE OF HYDRAULIC FLUID AND REPLACE WITH NEW FLUID EQUAL TO "UNION CARBIDE CC 732". CLEANING SHALL CONFORM TO KSC-C-123E, TEST METHOD "B", SURFACE CLEANLINESS LEVEL "VC".

---FIELD TESTS---

---GENERAL

AFTER THE CONTRACTOR HAS ERECTED, ADJUSTED, LUBRICATED AND OTHERWISE PREPARED THE EQUIPMENT FOR OPERATION, IT SHALL BE TESTED IN THE PRESENCE OF THE CONTRACTING OFFICER TO PROVE THAT IT OPERATES THE ELEVATOR SYSTEM SUBSTANTIALLY THE SAME AS PRIOR TO REMOVAL OF THE EQUIPMENT FROM THE MACHINE ROOM, AND THAT PROVISIONS OF ANSI A17.1 AND ANSI A 17.2 ARE MET. THROUGHOUT THE CONDUCT OF TEST, ALL COMPONENTS SHALL BE CAREFULLY INSPECTED TO INSURE THAT ALL COMPONENTS OPERATE SMOOTHLY AND PROPERLY; THAT THERE IS NO EVIDENCE OF MALFUNCTIONING; THAT NONE OF THE COMPONENTS OVERHEAT TO THE EXTENT THAT THERMAL RATINGS ARE EXCEEDED; AND THAT THERE ARE NO INTERRUPTIONS DUE TO OPERATION OF THERMAL OR OVERCURRENT PROTECTION DEVICES. THE CONTRACTOR SHALL PROVIDE ALL OTHER NECESSARY EQUIPMENT, INSTRUMENTATION, AND ALL PERSONNEL REQUIRED FOR THE CONDUCT OF THE TESTS. ANY DEFICIENCIES IN THE ELEVATOR SYSTEM NOT ATTRIBUTABLE TO THE CONTRACTOR'S WORK WILL BE REPAIRED BY OTHERS.

---ACCEPTANCE

ACCEPTANCE TESTS SHALL INCLUDE APPLICABLE TESTS SPECIFIED IN ASE CODE RULE 1000.2, "ACCEPTANCE TEST SCHEDULE FOR CAR AND COUNTERWEIGHT SAFETIES AND GOVERNORS" THROUGH RULE 1000.4, "ADDITIONAL ACCEPTANCE TESTS AND INSPECTION FOR HYDRAULIC ELEVATORS."

---TEST REPORT

TEST REPORT SHALL BE SUBMITTED IN SIX (6) COPIES TO THE CONTRACTING OFFICER, AND SHALL BEAR SIGNATURES (IN EVIDENCE OF WITNESS OF THE TESTS) OF THE CONTRACTOR AND THE CONTRACTING OFFICER, OR THEIR DESIGNATED REPRESENTATIVES.

SECTION 14D

INSTALLATION OF TWO ELECTRIC PASSENGER ELEVATORS

---GENERAL REQUIREMENTS---

---SCOPE

THE DISMANTLED TWO (2) CAR ELECTRIC PASSENGER ELEVATOR SYSTEM (OTIS ELEVATORS, FORMERLY INSTALLED UNDER OTIS ELEVATOR COMPANY MACHINE NUMBERS 300779 AND 300780 ON MOBILE LAUNCHER NUMBER 2) SHALL BE TRANSPORTED BY THE CONTRACTOR FROM THE ML-2 STORAGE AREA AND INSTALLED AND PLACED IN OPERATION ON THE NEW SSAT AT PAD 39B. UNLESS OTHERWISE SPECIFIED, THE CONTRACTOR SHALL PROVIDE ALL PLANT, EQUIPMENT, MATERIAL AND LABOR NECESSARY TO:

MODIFY THE EXISTING ELEVATOR SYSTEM TO REDUCE THE RISE FROM 352 FEET TO 207 FEET, AND REDUCE THE NUMBER OF STOPS FROM EIGHTEEN (18) TO ELEVEN (11).

CHECKOUT, TEST AND PLACE THE COMPLETE TWO (2) CAR ELECTRIC PASSENGER ELEVATOR SYSTEM IN ACCEPTABLE OPERATING CONDITION AS HEREIN SPECIFIED AND SHOWN ON THE DRAWINGS.

---OPERATION DURING CONTRACT PERIOD

FOLLOWING INSTALLATION, CHECKOUT AND TESTING, THE CONTRACTOR MAY USE THE ELEVATOR SYSTEM TO FACILITATE HIS OPERATIONS. CAR INTERIORS AND DOOR SYSTEMS SHALL HAVE FINISH PROTECTED BY BLANKETS AND/OR PLYWOOD. PRIOR TO FINAL ACCEPTANCE, ANY DAMAGE TO SYSTEMS, FINISHED SURFACES, METALS, CONTROL STATIONS, EQUIPMENT, ETC. SHALL BE REPAIRED, OR REPLACED, TO THE FULL SATISFACTION OF THE CONTRACTING OFFICER.

---GENERAL

THE INSTALLATION SHALL CONFORM TO THE APPLICABLE MANDATORY RULES (THOSE CHARACTERIZED BY THE WORD "SHALL") OF ANSI A17.1, AMERICAN NATIONAL STANDARD SAFETY CODE FOR ELEVATORS, DUMBWAITERS, ESCALATORS AND MOVING WALKS AND NFPA NO. 70-1975, "NATIONAL ELECTRICAL CODE" (HEREINAFTER REFERRED TO AS THE ASE CODE AND NEC), EXCEPT WHERE THE SPECIFICATIONS OR DRAWINGS SPECIFICALLY EXCEED THE REQUIREMENTS OF THE ASE CODE OR THE NEC. IN ADDITION, ALL REQUIREMENTS OF THE OSHA STANDARDS SHALL BE MANDATORY FOR ALL CONSTRUCTION, INSTALLATION AND NEW EQUIPMENT COVERED BY THESE SPECIFICATIONS.

MATERIALS SHALL BE NEW, UNUSED, AND OF RECENT MANUFACTURE, EXCEPT WHERE REUSE OF EXISTING EQUIPMENT AND MATERIALS IS SHOWN ON THE DRAWINGS OR IDENTIFIED IN THE SPECIFICATIONS.

---ELECTRICAL WORK---

---GENERAL

ALL ELECTRICAL WORK SHALL COMPLY WITH THE APPROPRIATE PARTS OF DIVISION 16 OF THESE SPECIFICATIONS, AND ARTICLE 620 OF THE NEC.

---BONDING AND GROUNDING---

---GENERAL

ALL METALS SHALL BE BONDED AND GROUNDED AS OUTLINED IN SECTION 16X (PART 51) OF THESE SPECIFICATIONS.

---WORKMANSHIP

THE CONTRACTOR SHALL TAKE PHOTOGRAPHS AND MAKE SKETCHES TO ASSIST HIM IN THE REINSTALLATION OF THE REMOVED EQUIPMENT, PIPING AND WIRING.

NEW WORK SHALL BE CAREFULLY LAID OUT IN ADVANCE. WHERE CUTTING, CHANNELING, CHASING, OR DRILLING OF FLOORS, WALLS, PARTITIONS, CEILINGS, OR OTHER SURFACES IS NECESSARY FOR THE PROPER INSTALLATION OF NEW EQUIPMENT, THE WORK SHALL BE CAREFULLY PERFORMED. ANY DAMAGE TO PIPING OR EQUIPMENT SHALL BE REPAIRED AND REFINISHED BY SKILLED MECHANICS OF THE TRADES INVOLVED, AT NO EXTRA COST TO THE GOVERNMENT.

WORK SHALL BE ACCOMPLISHED BY WORKMEN SKILLED IN THEIR OWN PARTICULAR CRAFTS, AND ALL WORK SHALL BE CONDUCTED AND FINALIZED IN A MANNER CONSISTENT WITH ACCEPTED INDUSTRY PRACTICES.

---REMOVAL OF MACHINE ROOM---

ELEVATOR SYSTEM SHALL BE OPERATED AND WITNESSED BY THE GOVERNMENT PRIOR TO REMOVAL OF EQUIPMENT. A WRITTEN REPORT SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL DESCRIBING ANY DAMAGE, DETERIORATION AND OPERATIONAL MALFUNCTIONS THAT NEED REPAIR AND/OR CORRECTION. THE REPORT SHALL INCLUDE ESTIMATED COST TO REPAIR AND/OR CORRECT EACH ITEM NOT COVERED BY CONTRACT. REPAIRS WILL BE MADE AT GOVERNMENT EXPENSE, OR THE GOVERNMENT MAY ELECT TO FURNISH A NEW ITEM.

THE CONTRACTOR SHALL PROVIDE A WORK FORCE CONSISTING OF SUPERVISION AND MANPOWER HAVING SUFFICIENT EXPERIENCE AND SKILLS TO REMOVE THE EQUIPMENT IN SUCH A MANNER THAT IT CAN BE REINSTALLED AND OPERATED AS IT DID PRIOR TO REMOVAL.

REMOVE ALL HYDRAULIC MACHINERY, ELECTRIC EQUIPMENT, DEVICES, CONDUIT AND WIRING FROM THE INTERIOR AND EXTERIOR OF THE WEST ELEVATOR MACHINE ROOM. REMOVE ALL OPENING FRAMES AND COVERS, DOORS AND DOOR FRAMES.

---FINAL ACCEPTANCE TESTING

THE COMPLETE PNEUMATIC SYSTEM SHALL BE LEAK TESTED AT MAXIMUM WORKING PRESSURE, UTILIZING LEAK TEST SOLUTION PER MIL-L-25567, AND SHALL BE BUBBLE TIGHT.

ALL VISIBLE LEAKS OR DEFECTS IN THE PIPING SHALL BE IMMEDIATELY REPAIRED, AND THE SYSTEM RETESTED.

ONLY STANDARD PIPING FLANGES, PLUGS, CAPS AND VALVES MAY BE USED FOR SEALING OFF PIPING FOR TEST PURPOSES.

THE INFLATABLE SEALS SHALL BE INFLATED COLLECTIVELY TO THE OPERATING PRESSURE LEVEL AND MAINTAINED BY THE PRESSURE REGULATORS FOR 30 MINUTES. THE TIME OF INFLATION AND UNIFORMITY OF SEAL SHAPE VERSUS TIME SHALL BE NOTED. THE SEAL SUPPLY LINE SHALL BE VENTED TO ATMOSPHERE THROUGH THE DUMP VALVES AND THE VACUUM SYSTEM UTILIZED TO DEFLATE THE SEAL SEGMENTS TO A FULLY COLLAPSED POSITION. ALL TIME PERIODS BETWEEN EACH SEQUENCE SHALL BE NOTED. ANY MALFUNCTIONS OR ERRONEOUS SETTINGS SHALL BE ADJUSTED AND/OR CORRECTED.

THE HINGED FLOOR SECTIONS SHALL BE RAISED AND LOWERED BY USE OF THE AIR HOIST. EASE OF DISENGAGING AND ENGAGING THE HINGED FLOOR SECTIONS TO THE FIXED FLOOR AREA SHALL BE NOTED. ANY BINDING SHALL REQUIRE ADJUSTMENT OF LIFTING POINTS TO ACHIEVE FREEDOM OF MOVEMENT.

THE SIDE PANELS SHALL BE ROTATED TO DETERMINE FREEDOM OF ROTATION, ROTATING TIMES, ACCURACY OF LIMIT SWITCH SETTINGS, AND UNIFORMITY OF SEAL CONTACT AT THE GUIDE RAIL SEALING SURFACE. UNSATISFACTORY RESULTS SHALL REQUIRE ADJUSTMENTS AND/OR CORRECTIONS.

THE RETRACTABLE GUIDE RAIL SHALL BE ROTATED TO DETERMINE FREEDOM OF MOVEMENT, ROTATING TIMES, AND ACCURACY OF LIMIT SWITCH SETTINGS. UNSATISFACTORY RESULTS SHALL REQUIRE ADJUSTMENTS AND/OR CORRECTIONS.

THE STRONGBACK ACTUATORS SHALL BE OPERATED TO EXTEND AND RETRACT ALL STRONGBACKS TO DETERMINE THE FREEDOM OF MOVEMENT OF STRONGBACKS/SEAL UNITS AND ACTUATING TIME PERIODS. ANY UNEVEN MOVEMENT OR BINDING SHALL REQUIRE ADJUSTMENTS AND/OR CORRECTIONS. ALL FLOOR STRONGBACKS TESTING SHALL BE PERFORMED IN TWO STEPS. THE TEST FOR THE FIRST STEP SHALL BE PERFORMED WITHOUT THE FLOOR PLATES IN POSITION. THE TEST FOR THE SECOND STEP SHALL BE PERFORMED WITH THE FLOOR PLATES IN PLACE.

EACH ACCEPTANCE TEST SHALL BE SIGNED BY THE CONTRACTING OFFICER AND TWO RECORD COPIES SHALL BE DELIVERED TO THE CONTRACTING OFFICER AFTER ACCEPTANCE.

WITH RATED LOAD FOR HOOK RADIUS OF 85 FEET AND WITH HOOK AT RADIUS OF 85 FEET, ROTATE BOOM THROUGH 2 COMPLETE REVOLUTIONS IN EACH DIRECTION AT VARYING SPEEDS AND DEMONSTRATE STOPPING, AUTOMATIC BRAKING, DRIFT, INCHING AND MAXIMUM SPEED.

---ADJUSTMENTS

DURING THE TESTS, ADJUSTMENTS SHALL BE MADE AS REQUIRED, AND THE TEST REPEATED UNTIL THE REQUIREMENT IS MET, OR WAIVED BY THE CONTRACTING OFFICER.

---REPORTS AND ACCEPTANCE

TEST REPORTS SHALL HAVE SIGNATURES IN EVIDENCE OF WITNESSING BY THE CONTRACTOR AND THE CONTRACTING OFFICER, OR THEIR DESIGNATED REPRESENTATIVES. ALL TESTS SHALL HAVE BEEN SUCCESSFULLY COMPLETED, OR WAIVER NOTED ON THE TEST RECORD. SIX COPIES OF COMPLETED AND SIGNED TEST RECORDS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER.

---OVERLOAD TEST

DEMONSTRATE THAT CRANE WILL LIFT HOOK LOADS 25 PERCENT GREATER THAN THE RATED LOADS FOR THE RESPECTIVE SWING RADII (BOTTOM OF TEST LOAD SHALL BE APPROXIMATELY 2 FEET ABOVE PAVEMENT):

FOR HOOK SWING RADIUS OF 85 FEET: LIFT LOAD WITH TROLLEY AT INBOARD END OF BOOM AND TRAVERSE TROLLEY TO HOOK SWING RADIUS OF 85 FEET, THEN ROTATE BOOM THROUGH AT LEAST 720 DEGREES AT LESS THAN FULL SPEED.

FOR HOOK SWING RADIUS OF 50 FEET: LIFT LOAD WITH TROLLEY AT INBOARD END OF BOOM AND TRAVERSE TROLLEY TO STOP AT HOOK SWING RADIUS OF 50 FEET, THEN ROTATE BOOM THROUGH AT LEAST 720 DEGREES AT LESS THAN FULL SPEED.

---SPEED TEST

DURING THESE TESTS WITH LOAD, DATA SHALL BE RECORDED FOR EACH SPEED POINT WHEN HOISTING AND LOWERING AT THE BEGINNING OF EACH TEST WITH LOAD, AT NOT GREATER THAN 5-MINUTE INTERVALS DURING EACH TEST AND AT THE END OF EACH TEST. RECORDED DATA SHALL INCLUDE AT LEAST THE FOLLOWING FOR EACH DRIVE SYSTEM:

LOAD ON HOOK, LBS.
MOTOR VOLTS
MOTOR AMPS
LOAD BLOCK SPEED, FEET PER MINUTE
TROLLEY SPEED, FEET PER MINUTE
SWING SPEED, RPM
VIBRATION
LUBRICATION
AMBIENT TEMPERATURE 12 INS. FROM MOTOR
BRAKING DRIFT
UPPER LIMIT SWITCH SETTING AND DRIFT
SPECIAL NOTATIONS AND REMARKS

WITH RATED LOAD FOR HOOK AT RADIUS OF 50 FEET AND WITHIN SAME, HOIST AND LOWER THROUGH FULL HOOK TRAVEL AT VARYING SPEEDS, INCHING FOR NOT MORE THAN TWO MINUTES AND ON 2ND SPEED POINT NOT MORE THAN FIVE MINUTES AND FOR A TOTAL ELAPSED TIME NOT EXCEEDING 30 MINUTES. DURING

---GENERAL

AFTER THE CONTRACTOR HAS ERECTED, ADJUSTED, LUBRICATED, AND PERFORMED PRELIMINARY TESTS NECESSARY FOR ADJUSTMENT AND CHECKING TO CORRECT ANY MALFUNCTIONS, AND OTHERWISE PREPARED THE CRANE FOR FULL NORMAL OPERATION, IT SHALL BE TESTED IN THE PRESENCE OF THE CONTRACTING OFFICER AS SPECIFIED HEREINBELOW. THROUGHOUT THE CONDUCT OF TEST ALL COMPONENTS SHALL BE CAREFULLY INSPECTED TO INSURE THAT ALL COMPONENTS OPERATE SMOOTHLY AND PROPERLY IN ACCORDANCE WITH THE SPECIFICATION REQUIREMENTS; THAT THERE IS NO EVIDENCE OF MALFUNCTIONING; THAT NONE OF THE COMPONENTS OVERHEAT TO THE EXTENT THAT THERMAL RATINGS ARE EXCEEDED; AND THAT THERE ARE NO INTERRUPTIONS DUE TO OPERATION OF THERMAL OR OVERCURRENT PROTECTION DEVICES. ALL TEST DATA AND THE CHARACTERISTIC VALUES OF VOLTAGE AND CURRENT FOR THE VARIOUS CONTROL COMPONENTS UNDER BOTH FULL LOAD CONDITIONS AND NO-LOAD CONDITIONS SHALL BE MEASURED AND RECORDED IN EACH COPY OF THE TEST REPORT. THE GOVERNMENT WILL MAKE AVAILABLE AND DELIVER TO THE CONTRACTOR AT PAD 39A, WEIGHTS FOR THE LOAD TESTS. THE CONTRACTOR SHALL PROVIDE ALL OTHER NECESSARY EQUIPMENT, INSTRUMENTATION, CONNECTIONS AND ALL PERSONNEL REQUIRED FOR THE CONDUCT OF THE TESTS.

---TEST OF LIMIT SWITCHES, TROLLEY STOPS AND PENDANT

WITH NO LOAD ON THE HOOK MAKE THE FOLLOWING TESTS. MAKE ALLOWANCES FOR DRIFT OF HOOK. DURING TESTS, CHECK FOR STOPPING AND AUTOMATIC BRAKING. MAKE ANY REQUIRED ADJUSTMENTS AND RETEST AFTER MAKING FINAL ADJUSTMENT. PRELIMINARY TESTS SHALL BE MADE AS REQUIRED. PRIOR TO TESTS, CHECK FOR TROLLEY BUMPERS BEING IN PLACE AND ATTACHED TO STRUCTURE:

---TEST OF ROLLER CIRCLE WHEELS-TO-RAILS ALIGNMENT

ADJUST RAIL ANCHORAGE SYSTEMS AS REQUIRED TO ACHIEVE ALIGNMENT OF THE ROLLER CIRCLE WHEELS WITH THE RAIL AND OBTAIN VERIFICATION AND APPROVAL OF THE SPECIFIED QUALIFIED SUPERINTENDENT OF ERECTION, CHECK-OUT AND TESTING THAT THE ALIGNMENT OBTAINED IS WITHIN THE CRANE MANUFACTURER'S ALLOWABLE TOLERANCE.

------CRANE OPERATION

FOLLOWING TESTING AND FINAL ACCEPTANCE OF THE CRANE, THE GOVERNMENT WILL PROVIDE A CRANE OPERATOR AND WILL HAVE OPERATIONAL CONTROL OF THE CRANE. PRIOR TO FINAL ACCEPTANCE, THE CONTRACTOR MAY USE AND MAINTAIN THE CRANE FOR PROJECT CONSTRUCTION PURPOSES.

---ERECTION PROCEDURE

THE GOVERNMENT WILL MAKE AVAILABLE TO THE CONTRACTOR ANY SHOP DRAWINGS AND OPERATION AND MAINTENANCE DATA IN ITS POSSESSION.

THE CONTRACTOR SHALL PROVIDE ADEQUATE AND SAFE ERECTION EQUIPMENT AND TACKLE AS REQUIRED TO HOIST AND ERECT THE CRANE COMPONENTS ATOP THE SSAT. THE CONTRACTOR SHALL SUBMIT HIS ERECTION PLAN TO THE CONTRACTING OFFICER FOURTEEN (14) DAYS PRIOR TO COMMENCING OPERATIONS.

THE CRANE SHALL BE ERECTED AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS AND UNDER THE DIRECTION OF THE SPECIFIED SUPERINTENDENT OF ERECTION.

THE ROLLER CIRCLE RAIL AND CENTER PIN ASSEMBLY SHALL BE INSPECTED BEFORE INSTALLATION OF CRANE. THE CONTRACTOR SHALL INSURE THAT ANY DISTORTION OF ROLLER CIRCLE RAIL AND CENTER PIN GEOMETRY IS WITHIN THE CRANE MANUFACTURER'S ALLOWABLE TOLERANCES. THE JOINTS BETWEEN RAIL SECTIONS SHALL BE SMOOTH, LEVEL AND IN TRUE CIRCULAR ALIGNMENT, SO AS TO OFFER NO OBSTRUCTION TO HAMMERHEAD CRANE ROTATION. WELDED JOINTS SHALL BE GROUND SMOOTH. FOR ALIGNMENT OF ROLLER CIRCLE AND RAILS SEE PAGE 14A-8.

ALL MOVING PARTS OF THE CRANE SHALL BE LUBRICATED, AND GEAR CASES DRAINED AND REFILLED PRIOR TO OPERATION. BEARINGS AND HOISTING ROPES SHALL BE LUBRICATED PRIOR TO USE WITH OXYGEN COMPATIBLE LUBRICANTS EQUAL TO THOSE PREVIOUSLY UTILIZED. HYDRAULIC FLUID EQUAL TO EXISTING FLUID SHALL BE PROVIDED. ABOVE LUBRICANTS AND FLUIDS WILL BE FURNISHED BY GOVERNMENT UPON DEMAND OF CONTRACTOR.

PRIOR TO LOAD TESTING, THE CRANE SHALL BE INTERMITTENTLY OPERATED FOR NOT LESS THAN THREE HOURS UNDER VARIOUS LOADS, DURING WHICH TIME ALL MOVING PARTS, FASTENERS, BEARINGS, LIMIT SWITCHES, ROPING, ETC. SHALL BE INSPECTED AND ADJUSTED AS REQUIRED.

VERIFY THAT ROLLER CIRCLE WHEELS CONTACT BOTH THE CRANE (UPPER) AND STRUCTURE (LOWER) RAILS AND THAT THE WHEEL FLANGES DO NOT BIND ON EITHER RAIL THROUGH ONE COMPLETE ROTATION OF THE CRANE IN EACH DIRECTION (720°). PERFORM ALIGNMENT CHECK OF SLEW GEAR PINION AND BULL GEAR BY CHECKING BACKLASH OF A MINIMUM OF SIX (6) PLACES (EVERY 60 DEGREES).

---WELDING

WELDERS SHALL BE QUALIFIED AND ALL WELDING SHALL BE IN ACCORDANCE WITH AWS D2.0, AND OTHERWISE SHALL COMPLY WITH SECTION 17K OF THE SPECIFICATIONS.

---POWER SUPPLY

277/480 VOLTS, 3 PHASE, 4 WIRE, 60 CYCLE.

---DIMENSIONS AND WEIGHT

CONTROL DIMENSIONS AND APPROXIMATE WEIGHTS ARE SHOWN ON DRAWING 79K10338.

---HOIST CONTROL

D.C. ADJUSTABLE VOLTAGE, 5 POINT WITH SPOTTING FOR SPECIFIED DUTY CYCLE, FROM REMOTE PENDANT.

---TROLLEY AND SWING CONTROLS

A.C. SECONDARY SATURABLE REACTOR, STEPPED, NON-REGULATED SPEED CONTROL, PLUGGING BRAKING, 5 POINT, 30 MINUTE DUTY.

---ELECTRICAL WORK

EXISTING COMPONENTS CONFORM TO NATIONAL ELECTRICAL CODE REQUIREMENTS FOR CLASS I, GROUP B, DIVISION 1 (HYDROGEN); OR, HAVE ENCLOSURES WITH PROVISIONS FOR HAZARD-PROOFING BY PURGING WITH DRY, CLEAN AIR.

---LIMIT SWITCHES

FOR ALL CRANE MOTIONS AND TO LIMIT BOOM ROTATION TO ASSURE LOAD BLOCK CLEARING CORNERS OF TOWER. LIMIT SWITCH WITH BY-PASS TO LIMIT MINIMUM HOOK RADIUS TO 50 FEET (25 TON HOOK LOAD LIMIT).

---LIGHTNING PROTECTION

PROVISIONS FOR A LIGHTNING PROTECTION SYSTEM SHALL BE PROVIDED AS SPECIFIED ON THE DRAWINGS. A NEW LIGHTNING MAST, WITH SUPPORT AND PLATFORMS AS SHOWN ON THE DRAWINGS, SHALL BE PROVIDED BY THE CONTRACTOR.

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AMERICAN WELDING SOCIETY:

A2.0-74	WELDING SYMBOLS
D2.0-69	STANDARD SPECIFICATION FOR WELDED HIGHWAY AND RAILROAD BRIDGES

INDUSTRIAL FASTENERS INSTITUTE PUBLICATION:

BOLT, NUT AND RIVET STANDARDS

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION:

ICS - INDUSTRIAL CONTROLS AND SYSTEMS (1970 ISSUE AND NO. 4 DATED 5/31/74)
MG1 - MOTORS AND GENERATORS (1972 ISSUE AND NO. 3 DATED 3/28/74)

MILITARY SPECIFICATIONS:

MIL-V-173	VARNISH, MOISTURE AND FUNGUS RESISTANT, FOR TREATMENT OF COMMUNICATIONS, ELECTRONIC AND ASSOCIATED ELECTRICAL EQUIPMENT
MIL-V-1137	VARNISH, ELECTRICAL INSULATION (FOR ELECTROMOTIVE EQUIPMENT)
MIL-F-3541	FITTINGS, LUBRICATION
MIL-H-19925	HOISTS, WIRE ROPE, ELECTRIC POWERED

---GENERAL

THE HAMMERHEAD CRANE WAS RECENTLY REMOVED FROM THE TOP TOWER LEVEL OF MOBILE LAUNCHER NO. 3 (ML NO. 3), AND SHALL BE PROVIDED TO THE CONTRACTOR AS GOVERNMENT FURNISHED EQUIPMENT (GFE). THE CONTRACTOR SHALL INSTALL THE HAMMERHEAD CRANE ON ITS ORIGINAL STRUCTURAL BASE, WHICH SHALL FORM THE TOP LEVEL (EL. 295'-0") OF THE NEW SSAT TO BE ERECTED AT LAUNCH PAD 39A.

THE CONTRACTOR SHALL REUSE IN THE INSTALLATION, ALL EXISTING HAMMERHEAD CRANE COMPONENTS AND ASSOCIATED HARDWARE, EXCEPT THAT ALL ASTM A325 BOLTING SHALL BE NEW. THE ONLY EXCEPTION TO COMPLETE REUSE OF EXISTING EQUIPMENT SHALL BE WHERE THE CONTRACTING OFFICER APPROVES THE REFURBISHMENT OR REPLACEMENT OF WORN OUT EQUIPMENT. ANY REFURBISHMENT OR REPLACEMENT OF EQUIPMENT WILL BE DONE BY THE GOVERNMENT AT THE EXPENSE OF THE GOVERNMENT. ALL NEW FASTENERS AND RELATED COMPONENTS SHALL BE GALVANIZED.

---COORDINATION

GENERAL ARRANGEMENT SHALL BE IN ACCORDANCE WITH THE CONTRACT DRAWING 79K04400 AND THESE SPECIFICATIONS. TWO EXISTING IDENTICAL OPERATIONAL CRANES (ATOP THE TOWERS OF MOBILE LAUNCHERS NO. 1 AND NO. 2) WILL BE MADE AVAILABLE TO THE CONTRACTOR FOR INSPECTION AND COMPARISON PURPOSES FOR THE NEW CRANE INSTALLATION.

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SECTION 13K

PCR MAIN DOORS

---GENERAL REQUIREMENTS---

---GENERAL

THE PAYLOAD CHANGEOUT ROOM MAIN DOORS SHALL PROVIDE AN ENVIRONMENTAL SEPARATION BETWEEN THE PCR INTERIOR AND THE EXTERIOR ELEMENTS AT THE LAUNCH SITE WHEN THE PCR IS NOT MATED TO THE ORBITER.

---DESIGN OBJECTIVES

THE PCR MAIN DOORS SHALL BE BI-FOLDING TYPE DOORS, CONSISTING OF FOUR PANELS WHICH WHEN CLOSED FORM A SYMMETRIC CAVITY ENCOMPASSING THE ORBITER WHEN THE PCR IS MATED TO THE SAME. THE REMAINING SPACE BETWEEN THE PCR MAIN DOORS AND ORBITER SHALL BE PURGED WITH CLEAN, CONDITIONED AIR FROM THE PCR PROPER PRIOR TO OPENING THE PCR MAIN DOORS, WHICH EXPOSES THE ORBITER TO THE PCR INTERIOR. THE PCR MAIN DOORS SHALL FOLD BACK FLUSH AGAINST THE INSIDE FACE OF THE PCR WALLS AND PERMIT MAXIMUM USE OF PCR FLOOR SPACE.

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AA	ALUMINUM ASSOCIATION
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
FS	FEDERAL SPECIFICATIONS
SSPC	STEEL STRUCTURES PAINTING COUNCIL

----QUALIFICATIONS FOR DOORS AND SUPPORTING COMPONENTS INSTALLER

DOORS AND SUPPORTING COMPONENTS SHALL BE INSTALLED BY A CONTRACTING ORGANIZATION AUTHORIZED BY THE MANUFACTURER THAT IS THOROUGHLY EXPERIENCED IN THE INSTALLATION OF THE HEREIN SPECIFIED WORK.

SUBMIT A WRITTEN DESCRIPTION OF THE DOORS AND SUPPORTING COMPONENTS INSTALLER GIVING THE NAME OF THE DOORS AND SUPPORTING COMPONENTS MANUFACTURER, THE QUALIFICATIONS OF PERSONNEL, YEARS OF CONCURRENT CONTRACTING EXPERIENCE, LIST OF PROJECTS SIMILAR IN SCOPE TO SPECIFIED WORK, AND OTHER INFORMATION AS MAY BE REQUIRED BY THE CONTRACTING OFFICER.

---BONDING AND GROUNDING OF METALS---

---GENERAL

THE HYPERGOLIC FUEL AND HYPERGOLIC OXIDIZER BUILDINGS ARE CLASSIFIED AS ZONE 1 HAZARDOUS AREAS PER KENNEDY SPACE CENTER STANDARD KSC-STD-E-0012A WHICH REQUIRES THAT ALL METALS EXCEEDING 48 INCHES IN ANY DIMENSION BE BONDED TO GROUND.

---BONDING METHODS

BONDING OF METALS SHALL BE AS SPECIFIED IN SECTION 16X (PART 51) OF THE SPECIFICATIONS.

---ACCEPTANCE PROVISIONS---

---ERECTION TOLERANCES

METAL ROOFING AND SIDING SHALL BE ERECTED STRAIGHT AND TRUE, WITH PLUMB VERTICAL LINES, CORRECTLY LAPPED AND SECURED IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN INSTRUCTIONS. HORIZONTAL LINES SHALL NOT VARY MORE THAN 1/8 INCH IN 40 FEET. VERTICAL LINES SHALL NOT VARY FROM THE VERTICAL BY MORE THAN 1/16 INCH IN 30 FEET.

---INSPECTION OF HIGH-STRENGTH BOLT CONNECTIONS

INSPECTION OF HIGH-STRENGTH BOLT CONNECTIONS WILL BE PERFORMED IN ACCORDANCE WITH AISC SPECIFICATIONS FOR STRUCTURAL JOINTS, SECTION 6 "INSPECTION".

---LEAKAGE TESTS

WHEN FINISHED, ALL BUILDINGS PROVIDED BY THE CONTRACTOR SHALL HAVE A LEAK TEST PERFORMED BY THE CONTRACTOR AND WITNESSED BY GOVERNMENT INSPECTORS. WALLS, ROOF, DOORS, AND WALL A/C UNIT WALL SLEEVE AND A SEAL SHALL NOT LEAK WHEN TESTED AS FOLLOWS:

WALLS SHALL BE SUBJECTED TO A 15 MINUTE WATER HOSE SPRAY TEST. HOSE SHALL BE HELD AT A DISTANCE OF 15 FEET FROM WALLS AND SHALL PRODUCE A CIRCLE OF IMPACT OF NOT LESS THAN 5 FEET NOR MORE THAN 7 FEET IN DIAMETER, AT A WATER PRESSURE OF APPROXIMATELY 50 POUNDS PER SQUARE INCH AND A FLOW RATE OF NOT LESS THAN 5 GALLONS PER MINUTE, AND DIRECTED AT END LAPS AND JOINTS.

ROOFS SHALL BE SUBJECTED TO SPOT LEAKAGE TESTS WITH A HOSE HELD AT A DISTANCE OF NOT MORE THAN 50 FEET AND ADJUSTED FOR MAXIMUM IMPACT SPRAY, AT A WATER PRESSURE OF APPROXIMATELY 50 POUNDS PER SQUARE INCH AND A FLOW RATE OF NOT LESS THAN 5 GALLONS PER MINUTE. ALL LEAKS SHALL BE REPAIRED AND RETESTED AS DESCRIBED ABOVE UNTIL FINAL ACCEPTANCE BY THE GOVERNMENT.

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---UNINSULATED METAL ROOFING

ATTACH ROOFING PANELS TO FRAMING SUPPORTS IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTION, WITH FASTENERS OF A LENGTH TO PENETRATE THE SUPPORT MEMBER AND EXTEND AT LEAST 1/4 INCH ON THE INSIDE OF THE MEMBER, AND AS FOLLOWS:

SPACE FASTENERS FOR RIBBED CONFIGURATION ROOF PANELS AT NOT MORE THAN 6 INCHES ON CENTER AT RIDGE AND EAVE AND NOT MORE THAN 12 INCHES ON CENTER AT INTERMEDIATE PURLIN SUPPORTS AND AT SIDE LAPS.

---PANEL SEALING

ALL JOINTS SHALL BE MADE WEATHERTIGHT. ALL JOINTS OF METAL ROOFING PANELS SHALL BE SEALED, ALL END JOINTS OF METAL SIDING, FLASHING AT CORNERS, RIDGES, EAVES, RAKES, CURBS AND OPENINGS IN WALLS AND ROOFS SHALL BE SEALED BEFORE FASTENING WITH THE SPECIFIED JOINT TAPE.

SEALING TAPE SHALL BE APPLIED IN A CONTINUOUS RIBBON NOT LESS THAN 1/2 INCH, APPLIED TO ASSURE WEATHERTIGHT JOINT.

---FLASHING AND CLOSURE INSTALLATION---

---METAL FLASHING

PROVIDE CONCEALED METAL FLASHING AT HEADS AND SILLS OF OPENINGS AS INDICATED, AT CURBS AND HOLDERS FOR CLOSURE AND FILLER STRIPS, FORMED TO THE PROFILE AND GAGE INDICATED.

PROVIDE EXPOSED METAL FLASHING AT BUILDING CORNERS, JAMBS AND SILLS, AT RAKE AND EAVES, AT JUNCTION BETWEEN METAL SIDING AND ROOFING, AT VALLEYS AND AT CHANGES OF SLOPE OR DIRECTION IN METAL ROOFING, AND AT BUILDING EXPANSION JOINTS AND GUTTERS, OF GAGE AND PROFILE AS INDICATED.

EXPOSED METAL FLASHING SHALL BE THE SAME MATERIAL, COLOR AND FINISH AS THE SPECIFIED METAL ROOFING AND SIDING.

FASTEN FLASHING AT NOT MORE THAN 8 INCHES ON CENTER FOR ROOFS AND NOT MORE THAN 12 INCHES ON CENTER FOR WALLS, EXCEPT WHERE FLASHINGS ARE HELD IN PLACE BY THE SAME SCREWS WHICH SECURE COVERING SHEETS.

FURNISH FLASHING IN NOT LESS THAN 10-FOOT LENGTHS. EXPOSED FLASHING SHALL HAVE 1 INCH LICKED AND BLIND SOLDERED END JOINTS, AND EXPANSION JOINTS AT INTERVALS OF NOT MORE THAN 16 FEET.

EXPANSION JOINTS SHALL BE FORMED TO THE PROFILE INDICATED, WITH END JOINTS FLAT SEAMED, LOCKED AND SOLDERED, AND WITH FREE SLIDING SLEEVE TYPE SLIP JOINTS AT 16-FOOT INTERVALS, DESIGNED TO ALLOW EXPANSION AND CONTRACTION, AND TO REMAIN WEATHERTIGHT.

WEDGES OR SHIMS SHALL NOT BE REMOVED, BUT WHEN PROTRUDING, SHALL BE CUT OFF FLUSH WITH THE EDGE OF THE BASE, OR BEARING, PLATE.

---ASSEMBLY OF PRIMARY FRAMING

STRUCTURAL STEEL FRAMES SHALL BE ACCURATELY ASSEMBLED AND ALIGNED TO THE LINES AND ELEVATIONS INDICATED. FASTENING OF SPLICES OF COMPRESSION MEMBERS SHALL BE DONE AFTER THE ABUTTING SURFACES HAVE BEEN BROUGHT COMPLETELY INTO CONTACT. BEARING SURFACES AND SURFACES WHICH WILL BE IN PERMANENT CONTACT SHALL BE CLEANED BEFORE THE MEMBERS ARE ASSEMBLED.

SPLICES WILL BE PERMITTED ONLY WHERE INDICATED. ALL ERECTION BOLTS USED IN WELDED CONSTRUCTION MAY BE TIGHTENED SECURELY AND LEFT IN PLACE; OR, IF ERECTION BOLTS ARE REMOVED, THE HOLES SHALL BE FILLED WITH PLUG WELDS AND PAINTED.

DIAGONAL BRACING SHALL BE PROVIDED IN BOTH ROOF AND SIDEWALL FRAMING. BRACING SHALL CONSIST OF THE SPECIFIED DIAGONAL BRACING RODS, BOLTED OR WELDED TO THE PRIMARY FRAMING AT END BAYS AND AT INTERMEDIATE BAYS IN ACCORDANCE WITH DESIGN LOADING AND BUILDING DIMENSION CRITERIA. PROVIDE NOT LESS THAN 1 BRACING ASSEMBLY FOR BUILDINGS FROM 70 FEET TO 100 FEET IN WIDTH AND AT LEAST 2 LINES OF BRACING FOR BUILDINGS FROM 102 FEET THROUGH 180 FEET IN WIDTH.

THE INSIDE FLANGE OR RIGID FRAME SHALL BE BRACED LATERALLY BY ANGLES, CHANNELS, OR BEAM SECTION MEMBERS, CONNECTED TO THE FLANGE AND WEB OF THE FRAME AND TO THE WEB OF THE PURLIN OR GIRT, AND SIZED AS REQUIRED FOR THE SPECIFIED LOADING.

---GAS CUTTING

THE USE OF A GAS CUTTING TORCH IN THE FIELD FOR CORRECTING FABRICATION ERRORS WILL NOT BE PERMITTED ON ANY PRIMARY STRUCTURAL FRAMING MEMBER. THE USE OF A GAS CUTTING TORCH WILL BE PERMITTED ONLY ON MINOR MEMBERS, WHEN THE MEMBER IS NOT UNDER STRESS, AND THEN ONLY AFTER THE APPROVAL OF THE CONTRACTING OFFICER HAS BEEN OBTAINED.

---SECONDARY FRAMING

ERECT SECONDARY FRAMING IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS, AND THE APPROVED SHOP DRAWINGS.

ROOF PURLINS SHALL BE ERECTED AS SINGLE-SPAN BEARING MEMBERS OR AS CONTINUOUS SPAN, WITH OVERLAP BOLTED CONNECTIONS. OVERLAP SHALL BE NOT LESS THAN 2 FEET FOR EACH MEMBER.

ROOF PURLINS SHALL BE ALIGNED AND BRACED WITH A PURLIN SPACER OR CROSS BRIDGING OR SOLID BRIDGING EACH LINE SPACED AT MIDPOINT BETWEEN PRIMARY FRAMING RAFTER MEMBERS.

PROVIDE GUTTERS IN NOT LESS THAN 16 FEET LENGTH SECTIONS, WITH SLIP JOINT OR TELESCOPING CONNECTORS AND WITH PROVISION FOR LEAKPROOF EXPANSION AT NOT MORE THAN 24 FEET ON CENTER. GUTTER APRON SHALL EXTEND NOT LESS THAN 4 INCHES UNDER THE ROOF PANELS AND SHALL PROVIDE POSITIVE COUNTERFLASHING.

SUPPORT THE OUTSIDE FACE OF THE GUTTER WITH METAL CHANNEL OR STRAPS, SPACED AT NOT MORE THAN 32 INCHES ON CENTER. PITCH GUTTER TO DRAIN AT NOT MORE THAN 1/4 INCH IN 24 FEET.

LOCATE DOWNSPOUTS AS SHOWN ON THE DRAWINGS AND SUPPORT WITH BRACKET AND STRAPS AT APPROXIMATELY 6 FEET ON CENTER. TERMINATE DOWNSPOUT WITH 75 DEGREE ELBOW AT SPLASH BLOCKS AS INDICATED ON THE DRAWINGS.

SEAL ALL JOINTS WITH MATERIAL AS RECOMMENDED BY MANUFACTURER.

---REPAIR AND FINISH PROTECTION MATERIALS---

---GALVANIZING REPAIR PAINT

GALVANIZING REPAIR PAINT SHALL BE AN ORGANIC ZINC-RICH COATING AS SPECIFIED IN SECTION 9L OF THE SPECIFICATIONS.

---DISSIMILAR MATERIALS

DISSIMILAR METALS EXCEPT STAINLESS STEEL AND ZINC, SHALL BE INSULATED FROM EACH OTHER BY PAINTING OR OTHER APPROVED SYSTEM, AS SPECIFIED HEREIN.

---FABRICATION AND ERECTION OF STEEL FRAMING---

---GENERAL

PRIMARY AND SECONDARY STRUCTURAL STEEL FRAMING SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH AISC "MANUAL OF STEEL CONSTRUCTION," SEVENTH EDITION, THE AISI "COLD-FORMED STEEL DESIGN MANUAL," 1968 EDITION, AND IN ACCORDANCE WITH THE APPROVED SHOP DRAWINGS.

ALL FRAMING MEMBERS SHALL BE SHOP FABRICATED FOR BOLTED FIELD ASSEMBLY. WELDING, FIELD CUTTING OR DRILLING, WHERE REQUIRED, SHALL BE INDICATED ON THE SHOP DRAWINGS.

---CONNECTIONS

SHOP CONNECTIONS SHALL BE WELDED. ALL FLANGE-TO-WEB WELDS SHALL BE CONTINUOUS SUBMERGED ARC FILLET WELDS. ALL OTHER WELDED CONNECTIONS SHALL BE SUBMERGED-ARC OR SHIELDED-ARC PROCESS.

NOTWITHSTANDING THE PROVISION OF CLAUSE 9 OF THE GENERAL PROVISIONS (SF-23A) AND IN CONSONANCE WITH KENNEDY SPACE CENTER ESTABLISHED BEST UNIVERSAL MASTER KEY SYSTEM, THE 6-PIN TUMBLER REMOVABLE CORES SHALL BE MANUFACTURED BY THE BEST UNIVERSAL LOCK COMPANY, INC.

FURNISH, INSTALL AND MAINTAIN TEMPORARY CONSTRUCTION CORES IN ALL LOCKS DURING CONSTRUCTION OF THE FACILITY AND REMOVE THE CONSTRUCTION CORES WHEN DIRECTED BY THE CONTRACTING OFFICER. SECURITY CORES MANUFACTURED BY THE BEST UNIVERSAL LOCK COMPANY, INCORPORATED, AND COMBINATED BY THE BEST UNIVERSAL LOCK COMPANY, INCORPORATED, TO THE KENNEDY SPACE CENTER MASTER KEYING SYSTEM SHALL BE PROVIDED TO THE GOVERNMENT PRIOR TO ACCEPTANCE OF THE WORK BY THE GOVERNMENT.

---EXIT DEVICES (PANIC BOLTS)

THE INACTIVE PANEL OF DOUBLE DOORS SHALL BE PROVIDED WITH SURFACE-MOUNTED BOLT LATCHES AT THE INTERIOR HEAD AND SILL. HARDWARE SHALL BE GALVANIZED STEEL AND/OR MALLEABLE IRON, BRONZE OR BRASS.

---FASTENERS

PROVIDE FASTENERS OF THE PROPER TYPE, SIZE, QUANTITY AND FINISH FOR EACH HARDWARE ITEM. USE MACHINE SCREWS AND EXPANSION SHIELDS FOR ATTACHING HARDWARE TO CONCRETE, ALL VISIBLE FASTENERS SHALL BE PHILLIPS- HEAD BRONZE OR STAINLESS STEEL, FINISH TO MATCH SPECIFIED HARDWARE. HINGES SHALL BE A ONE-WAY TYPE OR OTHER APPROVED TAMPERPROOF TYPE.

---WEATHERSTRIPPING MATERIALS---

---DOOR WEATHERSTRIPPING

PROVIDE WEATHERSTRIPPING AT HEADS, JAMBS, AND MEETING STILES OF DOORS. WEATHERSTRIPPING SHALL BE SILICONE TREATED WOOL PILE CLOTH INSERTED IN A STAINLESS STEEL HOUSING. WEATHERSTRIPPING AT MEETING STILES OF PAIRS OF DOORS SHALL BE ADJUSTABLE. AN ADJUSTABLE WEATHER SEAL SHALL BE PROVIDED ALSO AT THE BOTTOM OF THE DOOR FOR INTERFACING WITH THE THRESHOLD SEAL. RAIN DRIP FOR DOOR EXTERIOR AT SILL SHALL BE STAINLESS STEEL.

---AIR CONDITIONING UNIT---

---AIR CONDITIONING UNIT

FOR EACH ELECTRICAL BUILDING, PROVIDE A SELF-CONTAINED, THROUGH-THE-WALL TYPE, AIR CONDITIONING UNIT HAVING AN OUTPUT COOLING CAPACITY OF 15,000 BTU/HR WHEN OPERATING FROM A 208 VOLTS, SINGLE PHASE, 60 HERTZ POWER SOURCE. THE UNIT SHALL NOT EXCEED 15 AMPS NORMAL RUNNING CURRENT. CONTRACTOR SHALL PROVIDE COMPLETE OPERATING AND MAINTENANCE MANUAL FOR EQUIPMENT IN MANNER OUTLINED IN THE "CONTRACT SCHEDULE".

OR EQUIVALENT INSULATING CORE MATERIAL, AND SHALL PROVIDE AN OVERALL HEAT TRANSMISSION "U" FACTOR NOT TO EXCEED 0.11 BTU/HR/SQ.FT/DEG. F. INSULATING SYSTEM SHALL HAVE FLAMMABILITY RATING OF SELF-EXTINGUISHING (FLAME SPREAD NOT MORE THAN 25) IN ACCORDANCE WITH ASTM D-1692-67T.

---STEEL DOORS AND FRAMES---

---GENERAL

PROVIDE HOLLOW METAL STEEL DOORS AND FRAMES COMPLETE WITH HARDWARE FACTORY-FINISHED TO MATCH WALL PANELS.

---EXTERIOR DOOR CONSTRUCTION

DOORS SHALL BE FABRICATED FROM COMMERCIAL QUALITY COLD-ROLLED GALVANIZED, PHOSPHATIZED CARBON STEEL SHEETS, CONFORMING TO ASTM A526-71, 0.75 OUNCE LIGHT COMMERCIAL ZINC COATING, OR ELECTROLYTIC ZINC COATED SHEETS CONFORMING TO ASTM A591-68, COATING CLASS C, E FINISH AND STRETCHER-LEVEL STANDARD OF FLATNESS CONFORMING TO ASTM A568-71, NOT LESS THAN 0.0359 INCH THICK AND FREE FROM PITTING, SCALE AND SURFACE DEFECTS.

DOORS SHALL BE NOT LESS THAN 1-3/4 INCH THICK, DIMENSIONS AS INDICATED ON THE DRAWINGS, WITH FULL FLUSH AND SEAMLESS FACE SHEETS AND EDGES, AND WITH A WATERPROOF HONEYCOMB CORE, ALL CONFORMING TO FS RR-D-5758 TYPE I, STYLE 3. FACE SHEETS SHALL BE LAMINATED TO THE HONEYCOMB CORE WITH A WATERPROOF ADHESIVE. PERIMETER CHANNELS SHALL BE NOT LESS THAN 0.0747 INCH THICK, AND SHALL BE CONTINUOUS WELDED TO FACE SHEETS. DOOR ASSEMBLY SHALL BE SEALED AS REQUIRED FOR WEATHERTIGHT, EXTERIOR INSTALLATIONS.

HARDWARE REINFORCEMENT SHALL BE WELDED IN PLACE AND DRILLED AND TAPPED TO TEMPLATE REQUIREMENTS. PROVIDE NOT LESS THAN 3/16 INCH STEEL FOR HINGE REINFORCEMENT, NOT LESS THAN 0.1196 STEEL FOR LOCKSETS, AND NOT LESS THAN 0.1046 INCH THICK STEEL FOR SURFACE APPLIED HARDWARE. PROVIDE AN INTEGRAL STEEL LOCK BOX, SECURELY WELDED INTO PLACE.

DOOR LEAVES SHALL BE MORTISED FOR NOT LESS THAN 1-1/2 PAIR OF TEMPLATE HINGES AND FOR THE TYPE OF LOCKSET AS SPECIFIED.

DOOR SURFACE SHALL BE OPTICALLY FLAT AND FREE FROM WARP, WAVINESS AND OTHER SURFACE IRREGULARITIES AND DEFECTS. MAXIMUM ALLOWABLE WARP OR TWIST SHALL NOT EXCEED 1/8 INCH, WHEN MEASURED WITH A 7-FOOT STRAIGHTEDGE ALONG THE DIAGONAL, AND SHALL NOT EXCEED 1/16 INCH, WHEN MEASURED WITH A 7-FOOT STRAIGHTEDGE ACROSS THE WIDTH OR IN ANY POSITION ALONG THE LENGTH OF THE DOOR.

DOORS SHALL BE FINISHED TO EXACTLY MATCH THE SPECIFIED WALL PANEL FINISH.

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---WELDING ELECTRODES---

---ELECTRODES FOR MANUAL SHIELDED METAL-ARC WELDING

ELECTRODES FOR MANUAL SHIELDED METAL-ARC WELDING SHALL MEET THE REQUIREMENTS OF AWS CODE, ARTICLE 4.9, AND SHALL BE COVERED MILD STEEL ELECTRODES CONFORMING TO AWS A5.1-69, E60XXX.

---CLOSURE AND FLASHING MATERIALS---

---MASTIC CLOSURE STRIPS

MASTIC CLOSURE STRIPS SHALL BE VULCANIZED, CLOSED-CELL, EXPANDED CELLULAR RUBBER, SELF EXTINGUISHING, CONFORMING TO ASTM D1056-68, TYPE S, CLASS SCE-42-CMP. CLOSURE STRIPS SHALL BE CUT OR PREMOULDED TO THE EXACT CONFIGURATION OF THE SPECIFIED ROOFING AND SIDING MATERIAL.

THE CLOSURE STRIPS SHALL BE UNIFORM IN APPEARANCE, NONPOROUS, FREE OF WEAK SECTIONS, BUBBLES, CRACKS AND DEFECTS AFFECTING SERVICEABILITY. MATERIAL SHALL CAUSE NO DETERIORATION OR STAINS TO GALVANIZED OR ENAMEL SURFACES.

TEST CLOSURE STRIPS FOR THE BASIC REQUIREMENTS LISTED IN ASTM D1056-68, TABLE 2, FOR THE SPECIFIED TYPE OF FILLER AND FOR THE ADDITIONAL SUFFIX TEST REQUIREMENTS AND AS FOLLOWS:

BRITTLENESS TEMPERATURE - - SHALL BE MINUS 40 DEGREES FAHRENHEIT WHEN TESTED IN ACCORDANCE WITH ASTM D746-70.

FLAMMABILITY RESISTANCE - - SHALL BE "SELF-EXTINGUISHING" WHEN TESTED IN ACCORDANCE WITH ASTM D1692-68.

RESISTANCE TO OZONE - - SHALL BE "NO CRACKS" AFTER EXPOSURE OF A SAMPLE KEPT UNDER A SURFACE TENSILE STRAIN OF 25 PERCENT, TO AN OZONE CONCENTRATION OF 100 PARTS PER MILLION OF AIR BY VOLUME, IN AIR FOR 100 HOURS AT 104 DEGREES FAHRENHEIT, WHEN TESTED IN ACCORDANCE WITH ASTM D1149-64(1970).

---ADHESIVES FOR CLOSURE STRIPS

ADHESIVE FOR USE WITH CLOSURE STRIPS SHALL BE A TYPE AS RECOMMENDED AND AS FURNISHED BY THE CLOSURE STRIP MANUFACTURER.

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SALT SPRAY - - THE COATING SYSTEM ON A SPECIMEN PLATE SHALL BE SUBJECTED TO 500 HOURS EXPOSURE IN A SALT SPRAY TEST IN ACCORDANCE WITH ASTM B117-64. TEST SPECIMENS SHALL HAVE AT LEAST ONE CUT EDGE AND SHALL BE SCORED THROUGH THE COATING SYSTEM TO EXPOSE THE GALVANIZING. THE COATING SYSTEM SHALL SHOW NO LOSS OF ADHESION 1/8-INCH BEYOND PANEL EDGES AND SCRATCH MARK, NO BLISTERS AND NO EVIDENCE OF CORROSION.

FILM THICKNESS - - THE DRY FILM THICKNESS OF THE PAINT COATING SHALL BE NOT LESS THAN 1 MIL AT ANY SPOT, AS DETERMINED BY ASTM D1005-51(1972).

MATERIAL WARRANTY - - THE CONTRACTOR SHALL WARRANT THE FINISH COATING FOR A PERIOD OF NOT LESS THAN 5 YEARS FROM THE DATE OF INSTALLATION AGAINST CRACKING, BLISTERING, PEELING, AND FADING. CHALKING SHALL NOT EXCEED THAT ALLOWED WHEN TESTED IN ACCORDANCE WITH ASTM D659-44 (1970), DEGREE NO. 8. FADING SHALL NOT EXCEED 5.0 NBS UNITS, USING DELTA 'E' FROM THE MODIFIED ADAMS COLOR COORDINATE SYSTEM.

---PROFILE OF ROOFING SHEET

ROOFING SHEETS SHALL BE PRECISION ROLL-FORMED STEEL OF NOT LESS THAN 0.0239 INCH THICKNESS, FABRICATED TO ONE OF THE FOLLOWING PROFILES:

ROOFING FOR THE HYPERGOLIC FUEL AND OXIDIZER BUILDINGS SHALL BE RIB PATTERN, 36-INCH NET WIDTH, WITH MAJOR RIBS NOT LESS THAN 1-1/4 INCHES DEEP BY 12 INCHES ON CENTER, AND WITH 2 ADDITIONAL MINOR RIBS SPACED BETWEEN THE MAJOR RIBS. MAJOR RIBS SHALL BE NOT LESS THAN 1 INCH WIDE, TAPERING TO NOT LESS THAN 2-7/8 INCHES WIDE.

ROOFING FOR THE TWO ELECTRICAL EQUIPMENT BUILDINGS SHALL BE RIB PATTERN EXTERIOR FACE AND NOMINAL FLAT PATTERN INTERIOR FACE, FULLY ENCLOSING A 1-INCH THICK FOAMED-IN-PLACE INSULATING CORE MATERIAL. THE EXTERIOR FACE SHALL BE RIB PATTERN, 36-INCH NET WIDTH, WITH MAJOR RIBS NOT LESS THAN 1-1/4 INCHES DEEP BY 12 INCHES ON CENTER, AND WITH 2 ADDITIONAL MONOR RIBS SPACED BETWEEN THE MAJOR RIBS. MAJOR RIBS SHALL BE NOT LESS THAN 1-INCH WIDE TAPERING TO NOT LESS THAN 2-7/8 INCHES WIDE.

---PROFILE OF SIDING PANEL

SIDING SHEETS SHALL BE PRECISION ROLL-FORMED STEEL OF NOT LESS THAN 0.0239 INCH THICK, FABRICATED TO ONE OF THE FOLLOWING PROFILES:

SIDING FOR THE TWO ELECTRICAL EQUIPMENT BUILDINGS SHALL BE RIB PATTERN EXTERIOR FACE AND NOMINAL FLAT INTERIOR FACE FULLY ENCLOSING A 1-INCH THICK FOAMED-IN-PLACE INSULATING CORE MATERIAL. THE EXTERIOR FACE SHALL BE RIB PATTERN, 36-INCHES NET WIDTH, WITH MAJOR RIBS NOT LESS THAN 1-1/4 DEEP BY 12 INCHES ON CENTER, AND WITH 2 ADDITIONAL MINOR RIBS SPACED BETWEEN THE MAJOR RIBS. MAJOR RIBS SHALL BE NOT LESS THAN 1-INCH WIDE TAPERING TO NOT LESS THAN 2-7/8 INCHES WIDE.

---SUBGIRTS AND FORMED SHAPES

PANEL SUBGIRTS, TEE BARS, ZEE BARS, BASE SUPPORTS AND ANGLE CLOSERS SHALL BE DIE-FORMED SHAPES FABRICATED FROM HOT-DIP GALVANIZED STEEL CONFORMING TO FS QQ-S-775D, TYPE 1, CLASS D; WITH THE REQUIREMENT OF A MINIMUM YIELD POINT OF 33,000 PSI, OR MAY BE BAR SIZE SHAPES CONFORMING TO ASTM A36-70A, ZINC COATED WITH A 1.25 OUNCE COATING PER SQUARE FOOT.

DIE-FORMED SUBGIRTS SHALL HAVE A MINIMUM UNCOATED THICKNESS OF 0.0478 INCHES AND BAR SHAPES SHALL BE AT LEAST 1/4 INCH BY 1 INCH. TEE BARS SHALL HAVE A MINIMUM UNCOATED THICKNESS OF 0.0299 INCH AND ZEE BARS SHALL HAVE A MINIMUM UNCOATED THICKNESS OF 0.0747 INCH.

CONCEALED CLIPS SHALL BE FABRICATED FROM HOT-DIP GALVANIZED STEEL CONFORMING TO ASTM A366-72, WITH 1.25-OUNCE ZINC COATING PER SQUARE FOOT OF SURFACE.

---STEEL ROOFING AND SIDING MATERIALS---

---GENERAL

ROOFING AND SIDING SHEETS AND PANELS SHALL BE STEEL SHEETS, ROLL FORMED TO THE SPECIFIED PROFILE AND TO GAGE AND DEPTH AS INDICATED. MATERIAL SHALL BE PLUMB AND TRUE, AND WITHIN THE SPECIFIED TOLERANCES.

FLASHINGS, CLOSERS, FILLERS, METAL EXPANSION JOINTS, RIDGE COVERS, FASCIAS, FASCIA CLOSURES, AND OTHER SHEET METAL ACCESSORIES SHALL BE FACTORY FORMED MATERIAL OF THE SAME TYPE AND QUALITY FINISH AS SPECIFIED FOR ROOFING AND SIDING SHEETS, AND SHALL BE NOT LESS THAN 0.0239 INCH THICK.

ROOFING SHEETS SHALL BE OF SUFFICIENT LENGTH TO BRIDGE AT LEAST THREE PURLIN SPANS PLUS THE REQUIRED END LAP. SIDING SHEETS SHALL EXTEND FULL HEIGHT OF WALLS WITHOUT HORIZONTAL JOINTS. ROOFING SHEETS SHALL EXTEND FULL WIDTH FROM RIDGE TO EAVE, IN BUILDINGS 60 FEET AND LESS IN WIDTH.

ROOFING AND SIDING MATERIAL, BEFORE COATING, SHALL BE NOT LESS THAN 0.0239 INCH THICK (24 GAGE).

---BAKED ENAMEL, ZINC-COATED STEEL

ROOFING AND SIDING SHEETS SHALL BE ENAMEL-COATED, HOT-DIP GALVANIZED STEEL CONFORMING TO FS QQ-S-775D. TYPE II, CLASS D, WITH THE ADDITIONAL PHYSICAL REQUIREMENT PROPERTY OF A MINIMUM YEILD POINT OF 33,000 PSI, AND THAT CORRUGATION DIMENSIONS AND PROFILE SHALL BE AS SPECIFIED HEREIN. SHEETS SHALL HAVE A MINIMUM OF 1.25 OUNCE PER SQUARE FOOT OF ZINC, IN ACCORDANCE WITH ASTM A525-71, COMMERCIAL WEIGHT COATING.

WIND PRESSURE LOADING SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MBMA FOR A HURRICANE WIND VELOCITY OF 125 MPH AND WIND LOADING DIAGRAMS SHOWN ON THE DRAWINGS.

TOTAL LOADING, DEAD, LIVE AND AUXILIARY LOADS, UNIFORM OR CONCENTRATED, SHALL BE AS INDICATED.

---PRIMARY FRAMING SYSTEM---

---BEAM AND COLUMN PRIMARY FRAMING - ELECTRICAL BUILDINGS

PRIMARY FRAMING SYSTEM FOR THE TWO ELECTRICAL EQUIPMENT BUILDINGS SHALL CONSIST OF STRAIGHT SECTION, HOT-ROLLED STRUCTURAL STEEL COLUMNS, AND THE REQUIRED SPLICE PLATES FIELD BOLTED TO HOT-ROLLED STRUCTURAL STEEL RAFTERS, OF SPAN, EAVE HEIGHT AND BAY SPACING AS INDICATED.

---RIGID FRAME PRIMARY FRAMING - HYPERGOLIC BUILDINGS

PRIMARY FRAMING SYSTEMS FOR THE HYPERGOLIC FUEL BUILDING AND FOR THE HYPERGOLIC OXIDIZER BUILDING SHALL CONSIST OF HOT-ROLLED STRUCTURAL STEEL TAPERED SECTION, WELDED-UP PLATE SECTION COLUMNS AND ROOF BEAMS COMPLETE WITH REQUIRED SPLICE PLATES FOR FIELD ASSEMBLY, OF SPAN, ROOF PITCH, EAVE HEIGHT AND BAY SPACING AS INDICATED.

---ROOF SLOPE

ROOF SLOPE FOR THE ELECTRICAL EQUIPMENT BUILDING SHALL BE 1/4 INCH OF RISE FOR EACH 12 INCHES OF HORIZONTAL RUN.

ROOF SLOPE FOR THE HYPERGOLIC FUEL AND OXIDIZER BUILDINGS SHALL BE 4 INCHES OF RISE FOR EACH 12 INCHES OF HORIZONTAL RUN.

---STRUCTURAL STEEL MATERIALS---

---PRIMARY FRAMING STRUCTURAL STEEL - ALL BUILDINGS

PRIMARY FRAMING SHALL CONSIST OF STRAIGHT OR TAPERED SECTION HOT-ROLLED STEEL COLUMNS, UNIFORM SECTION BEAMS, WELDED-UP PLATE SECTION COLUMNS, BEAMS AND RAFTER ASSEMBLIES, HOT ROLLED PLATES, BARS AND WIND BRACING, AND HOT OR COLD-ROLLED STRUCTURAL SHAPES DESIGNED FOR END-WALL FRAMING.

HOT-ROLLED UNIFORM SECTION COLUMNS, BEAMS, ROLLED MILL SHAPES, PLATES AND BARS SHALL CONFORM TO ASTM A36-70A.

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---FOUNDATIONS

ALL INTERFACES OF THE STRUCTURE WITH THE FOUNDATIONS AND CURBS SHALL BE COORDINATED AND VERIFIED BY THE CONTRACTOR TO INSURE ACCURATE FIT OF THE WORK.

---SHOP DRAWINGS

SUBMIT SHOP AND ERECTION DRAWINGS AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

COMPLETELY DIMENSIONED SHOP DRAWINGS INDICATING STRUCTURAL ANALYSIS AND DESIGN LOADING; ANCHOR BOLT SETTINGS, PRIMARY AND SECONDARY STRUCTURAL FRAMING FOR SIDEWALL, ENDWALL AND ROOF; SPECIAL FRAMING DETAILS AND OPENINGS IN ROOF AND WALLS; SPECIAL REQUIREMENTS AND FRAMING FOR AUXILIARY LOADING.

SHOP DRAWINGS SHALL INDICATE MATERIAL, GAGE THICKNESS, WIDTH, LENGTH AND PROFILE OF METAL ROOFING AND SIDING PANELS; THE METHOD OF FASTENING PANELS TO PRIMARY AND SECONDARY FRAMING MEMBERS; AND SHALL IDENTIFY THE TYPE OF FASTENER.

SHOP DRAWINGS SHALL INDICATE PLAN, ELEVATIONS AND SECTIONS OF ALL OPENINGS AND DOORS, AND SHALL SHOW HARDWARE, GLAZING, ASSEMBLY FRAMES; CONSTRUCTION, TRIM AND FITTINGS.

SHOP DRAWINGS SHALL INDICATE ACCESSORY ITEMS, METAL AND MASTIC CLOSURES, METHOD OF JOINT SEALING, CONSTRUCTION DETAILS OF CORNERS, RIDGES, EAVES, RAKES, CURBS, FLASHINGS, GUTTERS AND DOWNSPOUTS.

SHOP DRAWINGS FOR ELECTRICAL BUILDING SHALL INDICATE AIR CONDITIONING UNIT AND FITTINGS PROPERLY LOCATED AND METHOD FOR SUPPORT, WALL PENETRATION AND CLOSURES.

MANUFACTURER'S DATA SHEETS ON THE AIR CONDITIONING UNITS SHALL VERIFY CONFORMANCE TO THE REQUIREMENTS SPECIFIED.

---SAMPLES

SUBMIT SAMPLES AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

METAL ROOFING AND SIDING - 1 PIECE, 8 INCHES BY 11 INCHES.

AVAILABLE COLORS FOR ROOFING AND SIDING

COLOR PANELS - 3 PIECES, APPROXIMATELY 4 INCHES BY 4 INCHES, TO INDICATE MAXIMUM COLOR RANGE.

EXPOSED FASTENERS - 1 OF EACH TYPE.

ALL WELDING OPERATORS SHALL BE QUALIFIED UNDER THE PROVISIONS OF AWS "STANDARD QUALIFICATION PROCEDURE" OR UNDER AN EQUIVALENT QUALIFICATION TEST APPROVED IN ADVANCE BY THE CONTRACTING OFFICER. IN ADDITION TO THE ABOVE REQUIREMENTS, ALL TESTS SHALL BE PERFORMED ON TEST PIECES IN POSITIONS AND WITH CLEARANCES EQUIVALENT TO THOSE ACTUALLY ENCOUNTERED IN CONSTRUCTION. IF A TEST WELD FAILS TO MEET REQUIREMENTS, AN IMMEDIATE RETEST OF 2 TEST WELDS SHALL BE MADE, AND EACH TEST WELD SHALL PASS. FAILURE IN THE IMMEDIATE RETEST WILL REQUIRE THAT THE WELDER BE RETESTED AFTER FURTHER PRACTICE OR TRAINING, AND A COMPLETE SET OF TEST WELDS SHALL BE MADE.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

ANALYSIS OF STRUCTURAL STEEL.

TEST REPORTS FOR COATINGS AND BASE METAL OF METAL ROOFING AND SIDING PANELS. TYPE OF TEST AS SPECIFIED.

CERTIFICATES OF CONFORMANCE FOR FASTENERS, GALVANIZING REPAIR PAINT AND PAINT FOR REPAIR OF PAINTED SURFACES.

TEST REPORTS FOR MASTIC FILLER STRIPS AND JOINT SEALANT.

TEST REPORTS FOR INSULATING MATERIALS.

MANUFACTURER'S CERTIFICATION FOR LEAKPROOF CONSTRUCTION.

TEST REPORTS SHALL BE CERTIFIED TESTS PERFORMED BY AN INDEPENDENT NATIONALLY RECOGNIZED LABORATORY EQUIPPED TO PERFORM THE REQUIRED TESTS.

---QUALIFICATIONS OF MANUFACTURER

THE PREFABRICATED BUILDING SHALL BE THE DESIGN AND PRODUCT OF MANUFACTURER WHO IS REGULARLY ENGAGED IN THE FABRICATION AND ERECTION OF PRE-ENGINEERED METAL STRUCTURES OF THE TYPE AND QUALITY SPECIFIED HEREIN.

---CERTIFICATION

THE BUILDING MANUFACTURER SHALL FURNISH A CERTIFICATE, SIGNED BY A REGISTERED PROFESSIONAL ENGINEER, THAT THE BUILDING DESIGN MEETS THE REQUIREMENTS OF THE SPECIFICATIONS AND HAS BEEN DESIGNATED IN ACCORDANCE WITH THE INDICATED AND SPECIFIED DESIGN LOADS AND IS IN ACCORDANCE WITH ACCEPTED ENGINEERING PRACTICE.

---COATINGS FOR CHILLED WATER PIPING

COATING SYSTEM CWS/CWR - - ABRASIVE BLAST OUTSIDE SURFACE (PROTECT THREADS) IN ACCORDANCE WITH SECTION 9L OF THE SPECIFICATIONS. WITHIN 6 HOURS AFTER BLASTING, APPLY ONE COAT OF PRIMER COATING TYPE MP-5 TO ALL SURFACES (EXCEPT THREADS) AND TO WITHIN 12 INCHES OF ENDS TO BE BUTT-WELDED. AFTER PRIMER HAS DRIED, APPLY COAL TAR COATING TYPE CTR. AFTER INSTALLATION, CLEAN EXPOSED THREADS AND CHIP AND POWER TOOL CLEAN ALL WELDS. PRIME ABOVE AREAS WITH COATING TYPE MP-5 AND WHEN DRY APPLY COATING TYPE CTR. TOUCH-UP OTHER AREAS OF COATING DAMAGED DURING INSTALLATION WITH COATING TYPE CTR.

--- TOUCH-UP BEFORE FINAL ACCEPTANCE ---FINAL TOUCH-UP---

DURING THE 60 DAYS IMMEDIATELY PRECEDING THE DATE SCHEDULED FOR FINAL ACCEPTANCE OF THE MLP, CONTRACTOR SHALL CAREFULLY INSPECT ALL SURFACES INSTALLED AS WORK OF THIS CONTRACT AND HE SHALL TOUCH-UP ALL DAMAGED AND DETERIORATING PAINT FILMS. RUST AND LOOSE PAINT FILMS SHALL BE REMOVED BY POWER TOOL CLEANING, OR BY OTHER MEANS IF EFFECTIVE, AND THE PAINT FILM SHALL BE REPLACED IN ACCORDANCE WITH THE SPECIFICATION REQUIREMENTS FOR THE ORIGINAL COATING. IT IS THE INTENT THAT THE PROTECTIVE PAINT FILM BE IN EXCELLENT CONDITION, WITH ALL SURFACES UNIFORMLY COVERED, ON THE DATE OF FINAL ACCEPTANCE OF THE MLP.

---APPLICATION OF COATING MATERIALS---
(OTHER THAN ZINC-RICH)

---GENERAL

EXTERIOR PAINTING WILL NOT BE ALLOWED IN DAMP OR RAINY WEATHER. INTERIOR PAINTING WILL NOT BE ALLOWED UNTIL THE BUILDING IS ENCLOSED AND HAS THOROUGHLY DRIED OUT. NO PAINTING WILL BE ALLOWED BELOW 50 DEGREES FAHRENHEIT OR ABOVE 95 DEGREES FAHRENHEIT. ALL PAINTING APPLICATION SHALL BE IN ACCORDANCE WITH THE COATING MANUFACTURER'S RECOMMENDATIONS, AND AS HEREIN SPECIFIED.

APPLICATION OF COATINGS SHALL BE DONE BY SKILLED APPLICATORS. APPLY COATINGS TO CLEAN AND PROPERLY PREPARED SURFACES. APPLY COATINGS CAREFULLY WITH CLEAN, HIGH QUALITY APPLICATION EQUIPMENT. ALLOW SUFFICIENT TIME BETWEEN COATS TO ASSURE COMPLETE DRYING AND CURING. SAND AND DUST THE SURFACES BETWEEN COATINGS AS REQUIRED TO PRODUCE SURFACE FREE OF VISIBLE DEFECTS. HIGH GLOSS COATINGS AND CLEAR FINISHES SHALL BE LIGHTLY SNADED BETWEEN COATS TO ASSURE BOND OF FOLLOWING COATS.

ALL COATS SHALL BE APPLIED TO THE SURFACES IN AN EVEN FILM. CLOUDINESS, SPOTTING, HOLIDAYS, LAPS, APPLICATION MARKS, RUNS, SAGS, SOPPINESS AND OTHER SIMILAR SURFACE IMPERFECTIONS WILL NOT BE ACCEPTABLE. DEFECTIVE COATING APPLICATION WILL BE REMOVED AND RECOATED AS DIRECTED BY THE CONTRACTING OFFICER.

ALL COATING LINES SUCH AS WAINSCOTS SHALL BE SHARP, TRUE AND WELL DEFINED. TAPE MAY BE USED TO ESTABLISH COATING LINES PROVIDING TAPE IS REMOVED BEFORE RAGGED OR SAW-TOOTHED EDGES FORM.

ALL SURFACES INCLUDING EDGES, CORNERS, CREVICES, WELDS AND OTHER SIMILAR CHANGES IN SURFACE PLANE SHALL RECEIVE A DRY FILM THICKNESS NOT LESS THAN SPECIFIED HEREIN.

---COATING THICKNESS

TOTAL COATING SYSTEM SHALL HAVE A DRY FILM THICKNESS OF NOT LESS THAN 5 MILS, APPLIED IN NOT LESS THAN SPECIFIED HEREIN.

---BRUSH APPLICATION

BRUSHES SHALL BE CLEAN AND OF THE PROPER SIZE AND TYPE FOR HIGH QUALITY APPLICATION OF COATING MATERIALS. OIL BASED COATINGS SHALL BE BRUSHED OUT THOROUGHLY. QUICK DRY COATINGS SHALL BE BRUSHED ONLY ENOUGH TO SPREAD OUT EVENLY.

---SPRAY APPLICATION

SPRAY APPLICATION EQUIPMENT SHALL BE LIMITED TO AIRLESS SPRAY EQUIPMENT AND ELECTROSTATIC SPRAY EQUIPMENT. CONVENTIONAL SPRAY EQUIPMENT IF ZINC DUST COATINGS ARE SPECIFIED. EQUIPMENT SHALL BE CLEAN AND OPERATED BY WORKMEN SKILLED IN HIGH QUALITY APPLICATION OF COATING MATERIALS.

---CLEAN UP

APPLICATION EQUIPMENT SHALL BE CLEANED PROMPTLY AND THOROUGHLY WITH A SUITABLE SOLVENT AFTER EACH USE AND STORED IN A CLEAN, COVERED, WELL-VENTILATED CONTAINER.

AT THE END OF EACH WORKING DAY, CLEAN UP ALL DISCARDED PAINT MATERIALS, RUBBISH, RAGS AND OTHER SIMILAR MATERIALS AND REMOVE FROM PROJECT.

AT THE COMPLETION OF THE WORK, CLEAN OFF ALL PAINT SPOTS FROM FINISH SURFACES AND LEAVE THE PROJECT IN A CLEAN CONDITION.

---COATING MATERIALS---

---GENERAL

PIGMENTS BASED ON TITANIUM-CALCIUM MAY BE USED BUT ONLY THAT PORTION THAT IS TITANIUM DIOXIDE WILL BE CONSIDERED AS PRIME PIGMENT; THE BALANCE WILL BE CONSIDERED AS EXTENDER PIGMENTS.

---COATING TYPE MPC-1, METAL PRETREATMENT COATING

METAL PRETREATMENT COATING SHALL BE A TWO-COMPONENT VINYL BUTYRAL RESIN BASE WASH COATING CONFORMING TO MS MIL-P-15328C.

---COATING TYPE MP-2, ZINC YELLOW, IRON OXIDE, ALKYD RESIN TYPE METAL PRIMER

ZINC YELLOW, IRON OXIDE, ALKYD RESIN TYPE METAL PRIMER SHALL CONFORM TO FS TT-P-57B, TYPE II.

---COATING TYPE MP-3, ZINC DUST-ZINC OXIDE PRIMER

ZINC DUST - ZINC OXIDE PRIMER SHALL BE ON ALKYD RESIN BASED MATERIAL CONFORMING TO FS TT-P-641F, TYPE II, AS HEREIN MODIFIED.

THE PIGMENT SHALL CONTAIN A MINIMUM OF 14.8 PERCENT ZINC OXIDE AND A MINIMUM OF 61.5 ZINC DUST, BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

THE VEHICLE SHALL CONTAIN A MINIMUM OF 10 PERCENT LONG OIL, LINSEED - MODIFIED ALKYD RESIN SOLIDS AND A MAXIMUM OF 12.5 PERCENT VOLATILE THINNER AND DRIERS, BASED ON THE TOTAL WEIGHT OF THE MATERIAL.

ZINC DUST SHALL BE NOT LESS THAN 93 PERCENT OF THE TOTAL DRY FILM WEIGHT AS APPLIED TO THE METAL SUBSTRATE, TO INSURE EFFECTIVE PARTICLE-TO-PARTICLE CONTACT IN THE DRY FILM.

CONCRETE DELIVERED TO THE POINT OF FINAL PLACEMENT HAVING A SLUMP OR TOTAL AIR CONTENT OUTSIDE THE VALUES SPECIFIED HEREINBEFORE IN THE ARTICLE ENTITLED "CLASSIFICATION AND QUALITY OF CONCRETE" SHALL NOT BE USED IN THE WORK.

THE ACCEPTABILITY OF CONCRETE IN PLACE WITH REGARD TO ACCEPTABILITY WILL BE EVALUATED IN ACCORDANCE WITH ACI 318-71. EACH STRENGTH TEST RESULT SHALL BE THE AVERAGE OF TWO CYLINDERS FROM THE SAME SAMPLE TESTED AT 28 DAYS.

THE STRENGTH LEVEL OF AN INDIVIDUAL CLASS OF CONCRETE WILL BE CONSIDERED SATISFACTORY IF BOTH OF THE FOLLOWING REQUIREMENTS ARE MET:

THE AVERAGES OF ALL SETS OF THREE CONSECUTIVE STRENGTH TEST RESULTS EQUALS OR EXCEEDS THE REQUIRED f'_c

AND NO INDIVIDUAL STRENGTH TEST RESULT FALLS BELOW THE REQUIRED f'_c BY MORE THAN 500 PSI.

IF THE COMPRESSIVE STRENGTH TESTS FAIL TO MEET THE MINIMUM REQUIREMENTS SPECIFIED HEREINBEFORE, THE CONCRETE REPRESENTED BY SUCH TESTS WILL BE CONSIDERED DEFICIENT IN STRENGTH AND SUBJECT TO THE PROVISIONS HEREINAFTER SPECIFIED IN "TESTING CONCRETE STRUCTURE FOR STRENGTH".

---TESTING CONCRETE STRUCTURE FOR STRENGTH

WHEN THERE IS EVIDENCE THAT THE STRENGTH OF THE CONCRETE STRUCTURE IN PLACE DOES NOT MEET SPECIFICATION REQUIREMENTS, CORES DRILLED FROM HARDENED CONCRETE SHALL BE MADE AND EVALUATED IN ACCORDANCE WITH ACI 318-71, CHAPTER 4.

CORE HOLES SHALL BE FILLED SOLID WITH PATCHING MORTAR AND FINISHED TO MATCH THE ADJACENT CONCRETE SURFACES.

IF THE RESULTS OF THE CORE TESTS ARE UNSATISFACTORY OR IF CORE TESTS ARE IMPRACTICABLE TO OBTAIN, STATIC LOAD TESTS SHALL BE MADE, AND WILL BE EVALUATED, IN ACCORDANCE WITH CHAPTER 20 OF THE ACI BUILDING CODE. IN THOSE CASES WHERE LOAD TESTS ARE IMPRACTICAL THE EVALUATION MAY BE BASED UPON CORE TESTS.

CONCRETE WORK THAT IS FOUND INADEQUATE BY THE CORE TESTS, OR BY THE RESULTS OF A STATIC LOAD TEST, SHALL BE CORRECTED IN A MANNER APPROVED BY THE CONTRACTING OFFICER.

SECTION 3R

REFRACTORY COATING

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ACI AMERICAN CONCRETE INSTITUTE

---SHOP DRAWINGS

SHOP DRAWINGS SHALL BE SUBMITTED FOR APPROVAL IN ACCORDANCE WITH THE "CONTRACT SCHEDULE." MATERIAL SHALL NOT BE FABRICATED OR DELIVERED TO THE SITE BEFORE THE APPROVED SHOP DRAWINGS HAVE BEEN RETURNED TO THE CONTRACTOR. DRAWINGS SHALL SHOW LAYOUT OF THE WORK, INSTALLATION OF GRIDSTEEL AND SPACER BARS, AND FINISH THICKNESS OF REFRACTORY FOR EACH AREA SCHEDULED ON THE DRAWINGS TO RECEIVE REFRACTORY COATING. SHOP DRAWINGS SHALL IDENTIFY ALL MATERIALS AND SHOW ALL DIMENSIONS NECESSARY FOR FABRICATION AND/OR INSTALLATION AND GRIDSTEEL CONNECTIONS TO OTHER WORK. ALL WELDS, BOTH SHOP AND FIELD, SHALL BE INDICATED BY STANDARD WELDING SYMBOLS IN AWS A2.4. DRAWINGS SHALL SHOW THE SIZE, LENGTH, AND TYPE OF EACH WELD.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

PROVIDE CERTIFICATION FOR SPECIFIED REFRACTORY COATING MATERIAL CERTIFYING THAT MATERIAL IS "FONDU-FYRE WA-1" AS HEREINAFTER SPECIFIED.

---DESCRIPTIVE DATA

SUBMIT DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

MANUFACTURER'S NAME, AND IDENTIFICATION OF EACH MATERIAL.

DETAILED ANALYSIS OF MATERIALS FOR THE PROJECT.

MATERIAL MANUFACTURER'S DATA CONCERNING APPLICATION AND OTHER SIMILAR ITEMS.

PERFORMANCE DATA OF APPLICATION EQUIPMENT INCLUDING NAME, CAPACITIES, RATINGS AND OTHER OPERATING CHARACTERISTICS RELEVANT TO THE PROPER APPLICATION OF REFRACTORY.

---SAMPLES

PROVIDE SAMPLES AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

LABELED GALLON CAN OF DRY REFRACTORY MATERIAL.

ONE SQUARE FOOT OF SPECIFIED GRIDSTEEL.

---TESTING

AT LEAST ONE PRECONSTRUCTION TEST SPECIMEN SHALL BE PREPARED BY THE CONTRACTOR IN ACCORDANCE WITH PARAGRAPH 1.6.4 OF ACI 506-77. TESTING OF MIX PROPORTIONS, EQUIPMENT AND/OR APPLICATION CREW ON THE SURFACES TO RECEIVE REFRACTORY COATING WILL NOT BE PERMITTED. IN ADDITION, NEW TEST SPECIMENS WILL BE PREPARED WHEN THERE IS A CHANGE IN THE MIX PROPORTIONS, EQUIPMENT OR APPLICATION CREW DURING THE COURSE OF THE WORK.

CORE SHALL BE TAKEN FROM EACH TEST SPECIMEN AND SHALL BE TESTED FOR COMPRESSIVE STRENGTH PER ASTM C4 2-74 BY AN APPROVED INDEPENDENT LABORATORY PROVIDED BY THE CONTRACTOR AND A WRITTEN REPORT SHALL BE SUBMITTED TO THE CONTRACTING OFFICER. IF THE RESULTS ARE UNSATISFACTORY, COMPRESSIVE TESTS OF CORES FROM THE WORK SHALL BE MADE AS DIRECTED BY THE CONTRACTING OFFICER AT NO ADDITIONAL COST TO THE GOVERNMENT TO VERIFY COMPLIANCE WITH THE SPECIFICATIONS. COMPRESSIVE STRENGTH SHALL BE AS HEREINAFTER SPECIFIED.

---DELIVERY AND STORAGE OF COATING MATERIALS

DELIVER ALL MATERIALS TO THE PROJECT IN THEIR ORIGINAL CONTAINERS BEARING MANUFACTURER'S NAME, LABEL AND FORMULATIONS. CONTAINERS SHALL BE NEW AND UNOPENED.

REFRACTORY MATERIAL SHALL BE STORED IN TIGHTLY CLOSED CONTAINERS IN A WEATHER-TIGHT AREA WHERE THEY WILL NOT BE EXPOSED TO EXCESSIVE HEAT, WATER, FLAME OR DIRECT SUNLIGHT.

---PROTECTIONS AND SAFETY PRECAUTIONS

PROTECT ALL ADJACENT MATERIALS AND EQUIPMENT AGAINST DAMAGE FROM SPILLAGE, DRIPPING AND SPATTER OF REFRACTORY MATERIAL. ALL BUILDING MATERIALS AND EQUIPMENT SHALL BE LEFT CLEAN, WITH ALL DAMAGED SURFACES CORRECTED.

---CLEAN-UP

APPLICATION EQUIPMENT SHALL BE CLEANED PROMPTLY AND THOROUGHLY WITH A SUITABLE SOLVENT AFTER EACH USE.

AT THE END OF EACH WORKING DAY, CLEAN-UP ALL DISCARDED MATERIALS, RUBBISH, RAGS AND OTHER SIMILAR MATERIALS AND REMOVE FROM THE PAD.

AT THE COMPLETION OF THE WORK, CLEAN OFF ALL SPOTS FROM FINISH SURFACES AND LEAVE THE PAD IN A CLEAN CONDITION.

---REFRACTORY COATING---

---GENERAL

PROVIDE REFRACTORY SURFACING FOR SIDE FLAME DEFLECTORS, SRB/ORBITER FLAME DEFLECTOR, WALLS OF FLAME TRENCH AND PATCHES THEREIN AT NEW PIPE PENETRATIONS, ROTARY BRIDGE SUPPORT PIER IN FLAME TRENCH, AND ALL OTHER MISCELLANEOUS SURFACES AS SHOWN ON THE DRAWINGS. REFRACTORY SHALL BE APPLIED OVER GRIDSTEEL.

---REFRACTORY MATERIAL

REFRACTORY COATING SHALL BE FONDU-FYRE WA-1 AS SUPPLIED BY THE DESIGNED CONCRETES COMPANY, 10,000 SANTA FE SPRINGS ROAD, SANTA FE SPRINGS, CALIFORNIA 90670. NO OTHER MATERIAL WILL BE ACCEPTED AS A SUBSTITUTE FOR THIS PRODUCT. THE THICKNESS OF THE REFRACTORY COATING SHALL CONFORM TO THE DRAWING, AS INDICATED FOR EACH PARTICULAR APPLICATION. COMPRESSIVE STRENGTH OF COATING SHALL BE 5000 PSI AT SEVEN DAYS.

---GRIDSTEEL

A GRIDSTEEL BASE SHALL BE ATTACHED TO ALL SURFACES TO WHICH REFRACTORY COATINGS ARE APPLIED AND SHALL FIRMLY HOLD THE REFRACTORY TO THE SURFACE. THE GRIDSTEEL SHALL BE 14 GAUGE BY 3/4 INCH DEEP WITH 1-7/8 INCH HEXAGON OPENINGS EQUAL TO IRVING GRIDSTEEL OR BUFNEL GRIDSTEEL.

GRIDSTEEL THAT IS TO BE ATTACHED TO STEEL SURFACES SHALL BE WELDED TO BARS WHICH ARE FIRST WELDED TO THE STEEL SURFACE AS INDICATED ON THE DRAWINGS.

GRIDSTEEL THAT IS TO BE ATTACHED TO CONCRETE OR MASONRY SURFACES SHALL BE WELDED TO BARS WHICH ARE FIRST WELDED TO STEEL ANCHOR PLATES WITH A COMPLEMENT OF ANCHOR STUDS AS INDICATED ON THE DRAWINGS.

---COATING MATERIAL PREPARATION---

---GENERAL

REFRACTORY MATERIAL SHALL BE MIXED AND PREPARED IN ACCORDANCE WITH THE MANUFACTURER'S DIRECTIONS. MATERIAL WHICH IS NOT IN ACTUAL USE SHALL BE KEPT IN CLOSED CONTAINERS.

---GENERAL

APPLICATION OF REFRACTORY SHALL CONFORM TO ALL APPLICABLE REQUIREMENTS OF SPECIFICATION FOR MATERIALS, PROPORTIONING AND APPLICATION OF SHOTCRETE (ACI 506-77) EXCEPT AS MODIFIED HEREIN.

REFRACTORY MATERIAL SHALL NOT BE APPLIED IN RAINY WEATHER. NO COATING WILL BE ALLOWED BELOW 50 DEGREES FAHRENHEIT AND ABOVE 95 DEGREES FAHRENHEIT. ALL COATING APPLICATION SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS, AND AS HEREIN SPECIFIED.

APPLICATION SHALL BE DONE BY SKILLED APPLICATORS. APPLY TO CLEAN AND PROPERLY PREPARED SURFACES. CONFORM TO PARAGRAPH 3.2 PREPARATION OF SURFACES OF ACI 506-77. APPLY COATINGS CAREFULLY WITH CLEAN, HIGH QUALITY APPLICATION EQUIPMENT.

DEFECTIVE: APPLICATIONS WILL BE REMOVED AND REAPPLIED AS DIRECTED BY THE CONTRACTING OFFICER, OR HIS DESIGNATED REPRESENTATIVE, AT NO ADDITIONAL COST TO THE GOVERNMENT. REPAIRS SHALL CONFORM TO PARAGRAPH 3.4 OF ACI 506-77. A

THE CONTRACTOR SHALL APPLY REFRACTORY COATING TO SPECIFIED GRIDSTEEL PREPARED SURFACES WITH GUNITE CREW ACCORDING TO THE MANUFACTURER'S WRITTEN INSTRUCTIONS, WHICH SHALL BE SUBMITTED TO THE CONTRACTING OFFICER, AS HEREINBEFORE SPECIFIED FOR SHOP DRAWINGS, FOR APPROVAL PRIOR TO COMMENCING WORK.

---FIELD SUPERVISION---

---MANUFACTURER'S REPRESENTATIVE

THE CONTRACTOR SHALL PROVIDE THE ON-SITE SERVICES OF A REPRESENTATIVE OF THE REFRACTORY MANUFACTURER WHO SHALL SUPERVISE THE PREPARATION, APPLICATION AND TESTING OF THE REFRACTORY MATERIAL.

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SECTION 4 D

FLAME TRENCH REFRACTORY BRICK WORK

---GENERAL REQUIREMENTS---

---SCOPE

THE WORK COVERED BY THIS SECTION OF THE SPECIFICATIONS CONSISTS OF FURNISHING ALL PLANT, LABOR, EQUIPMENT, APPLIANCES AND MATERIALS, AND IN PERFORMING ALL OPERATIONS IN CONNECTION WITH THE INSTALLATION OF REFRACTORY SURFACING OF PAVEMENT AND WALLS IN FLAME TRENCH, COMPLETE, IN STRICT ACCORDANCE WITH THIS SECTION OF THE SPECIFICATIONS AND APPLICABLE DRAWINGS, AND SUBJECT TO THE TERMS AND CONDITIONS OF THE CONTRACT. THE SUPPLIER OF THE ORGANIC BONDING AGENT SHALL, AT THE START OF USAGE OF THE MATERIAL, PROVIDE THE SERVICES OF A COMPETENT FIELD ENGINEER TO ADVISE ON MIXING OPERATIONS, SPREADING AND SCHEDULING OF OPERATIONS.

---APPLICABLE PUBLICATIONS

THE FOLLOWING PUBLICATIONS OF THE ISSUES LISTED BELOW FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO:

FEDERAL SPECIFICATIONS

CCC-C-467A	CLOTH, JUTE (OR ZENAF), BURLAP
DDD-M-148	MATS, COTTON (FOR CONCRETE CURING)
MMM-G-650	GROUT, ADHESIVE, EPOXY RESIN, FLEXIBLE FILLED

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

C 24-56	METHOD OF TEST FOR PYROMETRIC CONE EQUIVALENT (PCE) OF REFRACTORY MATERIALS
C 27-60	STANDARD CLASSIFICATION OF FIRECLAY REFRACTORY BRICK

C 113-46	STANDARD METHOD OF TEST FOR REHEAT CHANGE OF REFRACTORY BRICK
C 133-55	STANDARD METHOD OF TEST FOR COLD CRUSHING STRENGTH AND MODULUS OF RUPTURE OF REFRACTORY BRICK AND SHAPES
C 134-41	STANDARD METHOD OF TEST FOR SIZE AND BULK DENSITY OF REFRACTORY BRICK
C 154-41	STANDARD METHODS OF TEST FOR WARPAGE OF REFRACTORY BRICK AND TILE
C 122-52	METHOD OF PANEL SPALLING TEST FOR SUPER DUTY FIRECLAY BRICK

CORPS OF ENGINEERS

CRD-C 20-55	METHOD OF TEST FOR RESISTANCE OF CONCRETE SPECIMENS TO RAPID FREEZING AND THAWING IN WATER
CRD-C 400-57	REQUIREMENTS FOR WATER FOR USE IN MIXING OR CURING CONCRETE

---MATERIALS---

---REFRACTORY BRICK

THE REFRACTORY BRICK SHALL BE IN GENERAL SUPER DUTY, SPALL RESISTANT CATEGORY OF ASTM DESIGNATION C 27, EXCEPT THE REFRACTORY BRICK SHALL BE UNBRANDED AND SHALL MEET THE FOLLOWING REQUIREMENTS:

THE SIZE OF REFRACTORY BRICK FOR FLOOR SHALL BE 9 INCHES LONG BY 4-1/2 INCHES WIDE BY 3 INCHES AND 4-1/2 INCHES THICK. BRICK SHALL HAVE EVEN FACES AND EDGES.

THE SIZE OF REFRACTORY BRICK FOR WALLS SHALL BE 13-1/2 INCHES LONG BY 3 INCHES THICK, BY 3 INCHES, 4-1/4 INCHES AND 6 INCHES WIDE. BRICK SHALL BE TONGUE AND GROOVE TYPE AS INDICATED AND BOND BRICK SHALL HAVE DEPRESSION FOR METAL ANCHORS.

THE PERMISSIBLE SIZE VARIATION, DETERMINED IN ACCORDANCE WITH ASTM C 134, SHALL BE NOT MORE THAN PLUS OR MINUS 2 PERCENT OF THE SPECIFIED DIMENSION. WARPAGE OF 95 PERCENT OF REFRACTORY BRICK, WHEN DETERMINED IN ACCORDANCE WITH ASTM C 154, SHALL BE NOT GREATER THAN ONE PERCENT OF THE DIAGONAL USED IN MAKING THE MEASUREMENT.

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THAT THOROUGH BLENDING AT THE WORK SITE MAY BE ACCOMPLISHED USING A LOW POWERED (PREFERABLY AIR DRIVEN) MIXER WITH A PROPELLER TYPE BLADE.

---MORTAR

MORTAR FOR BED AND END JOINTS IN SETTING WALL BRICKS SHALL BE CALCIUM ALUMINATE CEMENT MORTAR.

---TESTS AND PROCEDURES---

---SUBMISSION OF SAMPLES

THE SAMPLES TO BE SUBMITTED TO THE U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISSISSIPPI FOR TESTS TO DETERMINE COMPLIANCE WITH THE SPECIFICATION REQUIREMENTS SHALL CONSIST OF:

25 REFRACTORY BRICKS FROM EACH LOT PROPOSED FOR USE BY THE CONTRACTOR. EACH LOT OF REFRACTORY BRICK WILL BE TESTED PRIOR TO SHIPMENT TO THE PROJECT. IN NO CASE WILL THE MANUFACTURERS' "CERTIFICATE OF COMPLIANCE" BE ACCEPTED IN LIEU OF TESTS.

SAMPLES OF THE EPOXY BONDING MORTAR (GROUT) SHALL BE AS SPECIFIED IN FEDERAL SPECIFICATIONS MMM-G-650B. SUBMIT ONE-HALF GALLON FOR TESTING.

---GENERAL SPECIFICATION TESTS

THE APPROPRIATE TESTING PROCEDURES DELINEATED IN ASTM DESIGNATION C 27 AND OTHERS CITED OR DELINEATED IN THIS SPECIFICATION SHALL BE FOLLOWED IN TESTING OF BONDING GROUT SPECIFIED IN FEDERAL SPECIFICATIONS MMM-G-650B.

---RESISTANCE TO FREEZING AND THAWING

THE RESISTANCE TO FREEZING AND THAWING SHALL BE DETERMINED ON NOT LESS THAN 8 REFRACTORY BRICKS SELECTED AT RANDOM FROM THE SAMPLES SUBMITTED IN ACCORDANCE WITH PARAGRAPH "SUBMISSION OF SAMPLES", ABOVE. THE SAMPLES SELECTED, INCLUDING DUMMY SECTIONS, SHALL BE IMMERSED IN WATER

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73° F. PLUS OR MINUS 5° F. FOR 24 HOURS. IMMEDIATELY FOLLOWING THIS WATER IMMERSION PERIOD THE SAMPLES SHALL BE TRANSFERRED TO THE SPECIMEN CONTAINERS AND THE CYCLES OF FREEZING AND THAWING COMMENCED AS DESCRIBED IN CORPS OF ENGINEERS TEST PROCEDURE CRD-C 20-55.

---COMPRESSIVE (DOUBLE) SHEAR STRENGTH TESTS FOR BONDING MORTAR (GROUT)

NOT LESS THAN 9 SHEAR TEST SPECIMENS SHALL BE PREPARED IN ACCORDANCE WITH INSTRUCTION CONTAINED IN FEDERAL SPECIFICATIONS MMM-G-650B. THE TEST SPECIMENS FOR THE VERTICAL SHEAR TESTS SHALL REMAIN UNDISTURBED FOR NOT LESS THAN 96 HOURS AFTER THE APPLICATION OF THE EPOXY BONDING MORTAR. AFTER 96 HOURS AND PRIOR TO 120 HOURS SIX OF THE TEST SPECIMENS SHALL BE OVEN CURED AT 200° F. FOR 3 HOURS. IMMEDIATELY FOLLOWING REMOVAL FROM THE 200° F. OVEN, THREE OF THE TEST SPECIMENS SHALL BE TESTED FOR VERTICAL SHEAR STRENGTH AND THE BALANCE OF THE SPECIMENS PERMITTED TO COOL TO ROOM TEMPERATURE. THE LABORATORY CURED SPECIMENS (3) AND THE COOLED OVEN CURED SPECIMENS SHALL BE TESTED FOR VERTICAL SHEAR STRENGTH AT APPROXIMATELY THE SAME TIME. THE RATE OF LOADING FOR ALL VERTICAL SHEAR TESTS SHALL BE 750 POUNDS PER MINUTE. THE UNIT VERTICAL SHEAR STRENGTH SHALL BE COMPUTED AS FOLLOWS:

$$\text{VERTICAL SHEAR STRENGTH, PSI} = \frac{\text{TOTAL LOAD, IN POUNDS}}{\text{TOTAL CONTACT AREAS, SQ. IN.}}$$

THE AVERAGE OF NOT LESS THAN THREE DETERMINATIONS SHALL BE REPORTED AS THE VERTICAL SHEAR STRENGTH VALUE FOR EACH TEST CONDITION.

---PLACEMENT OF REFRACTORY BRICK---

---SMOOTHNESS OF BASE PAVEMENT AND WALL SURFACES

THE SURFACE OF THE PORTLAND CEMENT CONCRETE PAVEMENT WHICH IS TO BE OVERLAID WITH FORMED REFRACTORIES SHALL NOT DEVIATE FROM THE TESTING EDGE OF AN APPROVED 12 FOOT STRAIGHTEDGE MORE THAN 1/8 INCH WHEN TESTED LONGITUDINALLY, NOR MORE THAN 3/16 INCH WHEN TESTED TRANSVERSELY. WALL SURFACES SHALL BE SMOOTHLY FORMED AND SHALL NOT DEVIATE MORE THAN 1/8 INCH FROM AN APPROVED 12 FOOT STRAIGHTEDGE. A RELATIVELY SMOOTH FLOAT FINISH SHALL BE OBTAINED ON THE BASE PAVEMENT.

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---GROUTING

FOLLOWING COMPLETION OF PLACEMENT OF ALL REFRACTORY PAVEMENT BRICK, ALL JOINTS, EXCEPT AS NOTED IN PARAGRAPH "SEALING JOINTS", SHALL BE FILLED WITH A CALCIUM ALUMINATE CEMENT ("LUMITE", OR EQUAL) GROUT OF A CONSISTENCY SUITABLE TO FILL THE VOIDS OR INTERSTICES BETWEEN THE BRICK BUT NOT FLOW OUT OF THE JOINTS. APPLICATION OF THE CALCIUM ALUMINATE CEMENT GROUT SHALL NOT BE INITIATED UNTIL AT LEAST 48 HOURS AFTER COMPLETION OF REFRACTORY BRICK PLACEMENT. THE PROCEDURE EMPLOYED SHALL BE AS APPROVED BY THE CONTRACTING OFFICER. THE CEMENT GROUT SHALL BE CURED BY COTTON OR BURLAP MATS KEPT CONTINUOUSLY WET FOR NOT LESS THAN 48 HOURS, AND FOR A PERIOD OF 96 HOURS FOLLOWING COMPLETION SHALL BE BLOCKED OFF TO UNNECESSARY PERSONNEL.

---CONTROL JOINTS

CONTROL JOINTS IN PAVEMENT AND WALL SURFACES SHALL BE AS DETAILED ON DRAWINGS AND JOINTS SHALL BE FILLED WITH ASBESTOS ROPE.

---SEALING JOINTS

JOINTS BETWEEN REFRACTORY BRICK AND THE SURROUNDING CONCRETE PAVEMENTS AND CURBS AND THE CONTROL JOINTS IN PAVEMENT AND WALLS, SHALL BE SEALED WITH A JOINT SEALING COMPOUND. THE JOINT SEALER AND SEALING PROCEDURE SHALL BE THE SAME AS THAT STATED IN THE SECTION "CONCRETE PAVEMENT" OF THESE SPECIFICATIONS.

---SMOOTHNESS TOLERANCE

THE COMPLETED REFRACTORY BRICK PAVED AND WALL SURFACE AREAS SHALL COMPLY WITH THE SMOOTHNESS TOLERANCE PROVISIONS HEREINBELOW SPECIFIED. POWER GRINDING OF AREAS NOT MEETING THESE PROVISIONS WILL BE REQUIRED.

NO REFRACTORY BRICK, WHERE THEY BUTT TOGETHER IN THE VERTICAL DIRECTION, SHALL HAVE AN OFFSET IN EXCESS OF 1/16 INCH.

SURFACE SMOOTHNESS SHALL BE SUCH THAT THERE IS NO DEVIATION FROM A PLANE SURFACE IN EXCESS OF 1/8 INCH WHEN TESTED IN ANY DIRECTION WITH AN APPROVED 12 FOOT STRAIGHTEDGE.

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SECTION 5J

STRUCTURAL STEEL

---GENERAL REQUIREMENTS---

---GENERAL

UNLESS OTHERWISE INDICATED, THE SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION SHALL GOVERN THE WORK. WELDING SHALL BE IN ACCORDANCE WITH SECTION 17K OF THESE SPECIFICATIONS.

DESIGN OF CONNECTIONS FOR ANY PORTION OF THE STRUCTURE NOT INDICATED ON THE CONTRACT DRAWINGS SHALL BE COMPLETED BY THE FABRICATOR AND INDICATED ON THE SHOP DRAWINGS.

SUBSTITUTIONS OF SECTIONS OR MODIFICATIONS OF DETAILS, OR BOTH, AND THE REASONS THEREFOR, SHALL BE SUBMITTED WITH THE SHOP DRAWINGS FOR APPROVAL. APPROVED SUBSTITUTIONS, MODIFICATIONS, AND NECESSARY CHANGES IN RELATED PORTIONS OF THE WORK SHALL BE COORDINATED BY THE CONTRACTOR WITH THE CONTRACTING OFFICER OR HIS DESIGNATED REPRESENTATIVE.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ERRORS OF DETAILING, FABRICATION, AND FOR THE CORRECT FITTINGS OF THE STRUCTURAL MEMBERS.

---REFERENCE SPECIFICATIONS

THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY, ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO. IN THE EVENT OF DIFFERENCE BETWEEN THIS SPECIFICATION OR ITS ACCOMPANYING DRAWINGS AND THE REFERENCED SPECIFICATION, THIS SPECIFICATION AND ITS ACCOMPANYING DRAWINGS SHALL GOVERN TO THE EXTENT OF SUCH DIFFERENCE:

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AMERICAN INSTITUTE OF STEEL CONSTRUCTION PUBLICATIONS (AISC)

CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES

SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR ASTM A490 BOLTS

SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, WITH COMMENTARY.

AMERICAN WELDING SOCIETY (AWS):

AWS A2.4-76	STANDARD WELDING SYMBOLS
AWS D1.1-REV. 2-77	STRUCTURAL WELDING CODE

AMERICAN PETROLEUM INSTITUTE (API):

API 5LX-73	HIGH TEST LINE PIPE

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS (ASTM):

A6-76A	GENERAL REQUIREMENTS FOR DELIVERY OF ROLLED STEEL PLATES, SHAPES, SHEET PILING AND BARS FOR STRUCTURAL USE
A36-75	STRUCTURAL STEEL
A153-73	ZINC COATING (HOT DIP) ON IRON AND STEEL HARDWARE
A307-76B	CARBON STEEL EXTERNALLY AND INTERNALLY THREADED STANDARD FASTENERS
A325-76C	HIGH STRENGTH BOLTS FOR STRUCTURAL STEEL JOINTS, INCLUDING SUITABLE NUTS AND PLAIN HARDENED WASHERS
A370-74	METHODS AND DEFINITIONS FOR MECHANICAL TESTING OF STEEL PRODUCTS
A441-75	HIGH STRENGTH LOW ALLOY STRUCTURAL MANGANESE VANADIUM STEEL
A490-76A	QUENCHED AND TEMPERED ALLOY STEEL BOLTS FOR STRUCTURAL STEEL JOINTS
A501-76	HOT FORMED WELDED AND SEAMLESS CARBON STEEL STRUCTURAL TUBING

---SHOP DRAWINGS

SHOP DRAWINGS SHALL BE SUBMITTED FOR APPROVAL IN ACCORDANCE WITH THE SECTION ENTITLED "CONTRACT SCHEDULE". DRAWINGS SHALL INCLUDE ALL SHOP AND ERECTION DETAILS, INCLUDING CUTS, COPES, CONNECTIONS, HOLES, BOLTS AND WELDS IN STRUCTURAL STEEL. ALL WELDS, BOTH SHOP AND FIELD, SHALL BE INDICATED BY STANDARD WELDING SYMBOLS IN AWS A2.4. DRAWINGS SHALL SHOW THE SIZE, LENGTH, AND TYPE OF EACH WELD. ALONG WITH THE SHOP DRAWINGS, THE CONTRACTOR SHALL FURNISH FOR APPROVAL A DETAILED ERECTION PROCEDURE, INCLUDING SEQUENCE OF ERECTION AND TEMPORARY STAYING AND BRACING. THE CONTRACTOR SHALL INDICATE THE REUSE OF EXISTING STEEL ON SHOP DRAWINGS WHERE APPLICABLE. CLEAN-UP AND TOUCH-UP OF EXISTING REUSED STEEL WILL BE INDICATED.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE IN TWO CERTIFIED COPIES AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

REPORTS OF LADLE CHEMICAL ANALYSIS OF ALL STEEL.

REPORTS OF TENSILE PROPERTIES AND BEND TESTS, AS SPECIFIED IN THE PARTICULAR REFERENCED SPECIFICATION FOR THE MATERIAL AND ASTM A370 FOR ROLLED STEEL PLATES, SHAPES AND BARS, AND STRUCTURAL TUBULAR PRODUCTS; AND OF TENSILE PROPERTIES FOR STEEL CASTINGS AND FORGINGS; AND OF MECHANICAL TESTS FOR HIGH STRENGTH BOLTS.

REPORTS OF CHEMICAL COMPOSITION, AND MECHANICAL, USABILITY AND SOUNDNESS TESTS AS SPECIFIED IN THE PARTICULAR REFERENCED SPECIFICATION FOR THE MATERIAL, AND FOR ALL WELDING ELECTRODES AND FLUX.

CERTIFICATE OF CONFORMANCE FOR ZINC-RICH SHOP AND FIELD TOUCH-UP COATINGS.

CERTIFICATE OF CONFORMANCE FOR EPOXY RESIN GROUT.

---STORAGE OF MATERIALS

STRUCTURAL STEEL MEMBERS WHICH ARE STORED AT THE PROJECT SITE SHALL BE STORED ABOVE THE GROUND AND NOT IN CONTACT WITH THE GROUND.

MATERIALS SHALL BE KEPT FREE FROM DIRT, GREASE, AND OTHER FOREIGN MATTER, AND SHALL BE PROTECTED FROM CORROSION.

PACKAGED MATERIALS SHALL BE STORED IN THEIR ORIGINAL, UNBROKEN PACKAGE OR CONTAINER IN A WEATHERTIGHT AND DRY PLACE UNTIL READY FOR INSTALLATION.

---PAINTING

ALL PAINTING SHALL BE IN ACCORDANCE WITH SECTION 9L, "PROTECTIVE COATING OF CARBON STEEL", OF THESE SPECIFICATIONS.

---BONDING AND GROUNDING

BONDING OF ALL JOINTS AND CONNECTIONS SHALL BE ACCOMPLISHED AS OUTLINED IN SECTION 16X (PART 51), "GROUNDING AND LIGHTNING PROTECTION".

---WELDED CONSTRUCTION

WELDED CONSTRUCTION SHALL CONFORM TO THE AISC "SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS" EXCEPT THAT THE WELDING SHALL CONFORM TO SECTION 17K, "WELDING OF CARBON STEEL".

---SAFETY

SEE SECTION ENTITLED "CONTRACT SCHEDULE" AND SECTION 2A, "DEMOLITION WORK".

---MATERIALS---

---STEEL

ROLLED STEEL PLATES, SHAPES, AND BARS-----ROLLED STEEL PLATES, SHAPES, AND BARS ARE DEFINED IN ASTM A6 AND SHALL BE STRUCTURAL QUALITY CARBON STEEL CONFORMING TO ASTM A36 AND A441.

STEEL PIPE-----WELDED AND SEAMLESS STEEL PIPE, CONFORMING TO API 5LX, GR. 42 (OR GR. 46, LB./FT. AS NOTED).

STRUCTURAL STEEL TUBING-----STRUCTURAL STEEL TUBING SHALL BE HOT FORMED, STRUCTURAL QUALITY CARBON STEEL, WELDED OR SEAMLESS, CONFORMING TO ASTM A501.

STANDARD FASTENERS-----UNFINISHED BOLTS AND NUTS SHALL CONFORM TO ASTM A307, GRADE A, UNLESS OTHERWISE SHOWN ON THE DRAWINGS. ROUND WASHERS SHALL BE PLAIN WASHERS CONFORMING TO ANSI B18.22.1-1965, TYPE B. BEVELED WASHERS SHALL BE SQUARE, SMOOTH, AND SLOPED SO THAT CONTACT SURFACES OF BOLT HEAD AND NUT ARE PARALLEL. THE DIAMETER OF HOLE FOR SQUARE BEVELED WASHERS SHALL BE 1/16 INCH GREATER THAN THE BOLT SIZE FOR BOLTS NOT LARGER THAN ONE INCH, AND 1/8 INCH GREATER THAN THE BOLT SIZE FOR BOLTS LARGER THAN ONE INCH. ALL FASTENERS AND COMPONENTS SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A153.

ANCHOR BOLTS-----SHALL BE AS SPECIFIED IN SECTION 5K.

HIGH STRENGTH THREADED FASTENERS-----HIGH STRENGTH THREADED FASTENERS SHALL CONSIST OF HEAVY HEXAGON STRUCTURAL BOLTS, HEAVY HEXAGON NUTS, AND HARDENED WASHERS. HIGH STRENGTH BOLTS SHALL BE QUENCHED AND TEMPERED MEDIUM CARBON STEEL BOLTS FOR STRUCTURAL JOINTS, INCLUDING SUITABLE NUTS AND HARDENED WASHERS CONFORMING TO ASTM A325, EXCEPT WHERE ASTM A490 BOLTS ARE INDICATED. ALL COMPONENTS SHALL BE GALVANIZED CONFORMING TO ASTM A153. REUSE OF HIGH STRENGTH BOLTS IS NOT PERMITTED. ALL BOLTING SHALL BE NEW.

HIGH STRENGTH BOLTS-----HIGH STRENGTH BOLTS CONFORMING TO ASTM A490 SHALL BE USED WHERE INDICATED ON THE DRAWINGS. ASTM A490 BOLTS MAY BE NON-GALVANIZED (AFTER ERECTION, COAT EXPOSED PARTS WITH ORGANIC ZINC).

ANY EXISTING BOLT REMOVED OR LOOSENED DURING THE RE-ERECTION OF THE SSAT SHALL BE DISCARDED AND REPLACED BY A NEW BOLT OF THE SAME SIZE AND TYPE. ALL BOLTS REQUIRED IN THE RE-ERECTION OF THE SSAT SHALL BE NEW AND SHALL BE FURNISHED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT.

---BEDDING MORTAR MATERIALS

UNLESS OTHERWISE NOTED, GROUT SHALL BE NON-SHRINKING, NON-CORROSIVE TYPE SUPPLIED IN PRE-MIXED AND PACKAGED CONTAINERS AND EQUAL TO "FIVE STAR GROUT" AS MANUFACTURED BY U. S. GROUT CORPORATION, AND SHALL OBTAIN A STRENGTH OF NOT LESS THAN 7,000 PSI IN 7 DAYS. GROUT SHALL BE APPLIED IN STRICT CONFORMANCE TO MANUFACTURER'S RECOMMENDATIONS AND AS HEREINAFTER SPECIFIED.

---FABRICATION---

---GENERAL

STRUCTURAL MATERIAL SHALL BE FABRICATED AND ASSEMBLED IN THE SHOP TO THE GREATEST EXTENT POSSIBLE. SHEARING, FLAME CUTTING, AND CHIPPING SHALL BE DONE CAREFULLY AND ACCURATELY. PARTS NOT COMPLETELY ASSEMBLED IN THE SHOP SHALL BE SECURED BY BOLTS, INSOFAR AS PRACTICABLE, TO PREVENT DAMAGE IN SHIPMENT AND HANDLING.

HOLLOW OR TUBULAR MEMBERS SHALL BE SEAL WELDED AT THE ENDS AND WHEREVER PIERCED TO EXCLUDE MOISTURE.

SHOP SPLICES OF MEMBERS BETWEEN FIELD SPLICES SHALL BE PERMITTED ONLY WHERE SPECIFICALLY SHOWN OR NOTED ON THE DRAWINGS OR WHERE MILL LENGTHS DO NOT PERMIT OBTAINING FULL SIZE PLATES OR SHAPES. SPLICES NOT SHOWN OR NOTED ON THE DRAWINGS MUST BE APPROVED BY THE CONTRACTING OFFICER. FIELD SPLICES IN COMPOUND JOINTS SHALL NOT BE PERMITTED.

HOLES SHALL BE PROVIDED AS REQUIRED BY THE DRAWINGS FOR SECURING OTHER WORK TO STEEL FRAMING, AND FOR THE PASSAGE OF SUCH WORK THROUGH STEEL FRAMING MEMBERS. ADDITIONAL HOLES THROUGH STEEL FRAMING MEMBERS WILL NOT BE PERMITTED EXCEPT WITH WRITTEN APPROVAL FROM THE CONTRACTING OFFICER.

---TOLERANCES

TOLERANCES IN FABRICATION AND ERECTION SHALL CONFORM TO THE AISC "CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES" EXCEPT AS OTHERWISE INDICATED ON THE DRAWINGS OR AS HEREINAFTER LISTED.

PLUMBNESS OF COLUMNS-----THE DISPLACEMENT OF THE CENTERLINE OF COLUMNS FROM THE VERTICAL OR INDICATED SLOPED LINE SHALL NOT BE MORE THAN 1:1000 OF THE HEIGHT ABOVE THE BOTTOM OF THE COLUMN, NOR ONE INCH TOTAL.

BEARING SURFACES-----BEARING SURFACES SHALL BE MILLED OR MACHINED EXCEPT AS OTHERWISE NOTED ON THE DRAWINGS.

---CONNECTIONS

CONNECTIONS SHALL BE AS INDICATED ON THE DRAWINGS. CONNECTIONS NOT INDICATED SHALL BE MADE IN ACCORDANCE WITH THE AISC MANUAL OF STEEL CONSTRUCTION. ONE SIDED OR OTHER TYPES OF ECCENTRIC CONNECTIONS WILL NOT BE PERMITTED UNLESS SHOWN IN DETAIL AND APPROVED ON THE SHOP DRAWINGS. UNFINISHED BOLTS SHALL NOT BE USED EXCEPT WHERE INDICATED.

SHOP CONNECTIONS SHALL BE WELDED UNLESS OTHERWISE INDICATED.

FIELD CONNECTIONS SHALL BE BOLTED, EXCEPT WHERE WELDED CONNECTIONS ARE INDICATED.

HIGH STRENGTH BOLTING SHALL CONFORM TO THE AISC SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR ASTM A490 BOLTS, AND SHALL BE BEARING TYPE CONNECTIONS UNLESS OTHERWISE NOTED AND AS MODIFIED BY THE BONDING AND GROUNDING REQUIREMENTS HEREIN. THE BOLTS SHALL BE TIGHTENED USING TURN-OF-THE-NUT METHOD. REUSE OF HIGH STRENGTH BOLTS IS NOT PERMITTED.

HOLES SHALL BE CUT, DRILLED, OR PUNCHED AT RIGHT ANGLES TO THE SURFACE OF THE METAL AND SHALL NOT BE MADE OR ENLARGED BY BURNING. HOLES IN BASE OR BEARING PLATES SHALL BE DRILLED. HOLES SHALL BE CLEAN CUT WITHOUT TORN OR RAGGED EDGES. OUTSIDE BURRS RESULTING FROM DRILLING OR REAMING OPERATIONS SHALL BE REMOVED WITH A TOOL MAKING A 1/16 INCH BEVEL.

BOLTS SHALL BE INSERTED ACCURATELY INTO THE HOLES WITHOUT DAMAGING THE THREAD. BOLT HEADS SHALL BE PROTECTED FROM DAMAGE DURING DRIVING. BOLT HEADS AND NUTS SHALL REST SQUARELY AGAINST THE METAL. WHERE BOLTS ARE TO BE USED ON BEVELED SURFACES HAVING SLOPES GREATER THAN 1 IN 20 WITH A PLANE NORMAL TO THE BOLT AXIS, BEVELED WASHERS SHALL BE PROVIDED TO GIVE FULL BEARING TO THE HEAD OR NUT.

UNFINISHED BOLTS TRANSMITTING SHEAR SHALL BE OF THE LENGTH THAT WILL EXTEND ENTIRELY THROUGH BUT NO MORE THAN 1/4 INCH BEYOND THE NUTS. BOLT HEADS AND NUTS SHALL BE DRAWN TIGHT AGAINST THE WORK WITH A SUITABLE WRENCH NOT LESS THAN 15 INCHES LONG. BOLT HEADS SHALL BE TAPPED WITH A HAMMER WHILE THE NUT IS BEING TIGHTENED. AFTER HAVING BEEN FINALLY TIGHTENED, NUTS SHALL BE LOCKED. WHERE SELF-LOCKING NUTS ARE NOT FURNISHED, BOLT THREADS SHALL BE UPSET TO PREVENT THE NUTS FROM BACKING OFF.

---COLUMN BASES AND BEARING PLATES

COLUMN BASES SHALL BE PROVIDED UNDER COLUMNS WHERE SHOWN.

BEARING PLATES SHALL BE PROVIDED UNDER BEAMS, GIRDERS, AND TRUSSES RESTING ON FOOTINGS, PIERS, OR WALLS.

COLUMN BASES SHALL BE MILLED AND ATTACHED TO COLUMNS.

BEARING PLATES MAY BE ATTACHED OR LOOSE.

---TRUSSES

CONNECTIONS SHALL BE AS DETAILED ON THE APPROVED SHOP DRAWINGS. CAMBER OF THE STRUCTURES SHALL BE AS NOTED ON THE DRAWINGS.

---SHOP BLASTING AND INORGANIC ZINC-RICH COATING

SHOP PRIME PAINT ALL STEELWORK (EXCEPT SURFACES OF STEEL TO BE ENCASED ON CONCRETE, SURFACES TO BE WELDED, SURFACES OF CRANE RAILS AND AS REQUIRED FOR BONDING AND GROUNDING. CONTACT SURFACES WITH FRICTION TYPE JOINTS SHALL BE FREE OF OIL, PAINT, LACQUER OR GALVANIZING) BY ABRASIVE BLASTING FOLLOWED BY INORGANIC ZINC-RICH COATING PER SECTIONS 9A AND 9L OF THESE SPECIFICATIONS.

---ERECTION---

---GENERAL

THE ERECTION OF STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH THE AISC SPECIFICATIONS AND AISC CODE OF STANDARD PRACTICE, WITH THE MODIFICATIONS AND REQUIREMENTS SPECIFIED HEREIN.

WELDING WILL BE PERMITTED ONLY WHERE INDICATED OR APPROVED ON THE SHOP DRAWINGS. FASTENERS SHALL BE INSTALLED AS SPECIFIED ABOVE UNDER "---CONNECTIONS". ERECTING EQUIPMENT SHALL BE SUITABLE AND SAFE FOR THE WORKMEN. ERRORS IN SHOP FABRICATION OR DEFORMATION RESULTING FROM HANDLING AND TRANSPORTATION THAT PREVENT THE PROPER ASSEMBLY AND FITTING OF PARTS SHALL BE REPORTED IMMEDIATELY TO THE CONTRACTING OFFICER AND APPROVAL OF THE METHOD OF CORRECTION SHALL BE OBTAINED.

AFTER ASSEMBLY, THE VARIOUS MEMBERS FORMING PARTS OF A COMPLETED FRAME OR STRUCTURE SHALL BE ALIGNED AND ADJUSTED ACCURATELY BEFORE BEING FASTENED.

FASTENING OF SPLICES OF COMPRESSION MEMBERS SHALL BE DONE AFTER THE ABUTTING SURFACES HAVE BEEN BROUGHT COMPLETELY INTO CONTACT. BEARING SURFACES AND SURFACES THAT WILL BE IN PERMANENT CONTACT SHALL BE CLEANED BEFORE THE MEMBERS ARE ASSEMBLED. AS ERECTION PROGRESSES, THE WORK SHALL BE SECURELY FASTENED TO TAKE CARE OF ALL DEAD LOAD, WIND, AND ERECTION STRESSES. SPLICES WILL BE PERMITTED ONLY WHERE INDICATED OR AS NOTED ON THE DRAWINGS. REMOVE ALL ERECTION BOLTS AND CLIP ANGLES USED IN WELDED CONSTRUCTION UNLESS OTHERWISE APPROVED BY THE GOVERNMENT. IF ERECTION BOLTS ARE REMOVED, THE HOLES SHALL BE FILLED WITH PLUG WELDS. WELDING FOR REDRILLING WILL NOT BE PERMITTED. HOLES SHALL NOT BE ENLARGED MORE THAN 1/16 INCH GREATER THAN THE SPECIFIED HOLE SIZE WITHOUT APPROVAL OF THE GOVERNMENT.

THE USE OF A GAS CUTTING TORCH IN THE FIELD FOR CORRECTING FABRICATION ERRORS WILL NOT BE PERMITTED ON ANY MAJOR MEMBER IN THE STRUCTURAL FRAMING. THE USE OF A GAS CUTTING TORCH WILL BE PERMITTED ONLY ON MINOR MEMBERS, WHEN THE MEMBER IS NOT UNDER STRESS, AND THEN ONLY AFTER THE APPROVAL OF THE CONTRACTING OFFICER HAS BEEN OBTAINED.

---SETTING COLUMN BASES AND BEARING PLATES

LOOSE AND ATTACHED COLUMN BASE PLATES AND BEARING PLATES FOR BEAMS AND SIMILAR STRUCTURAL MEMBERS SHALL BE ALIGNED WITH WEDGES OR SHIMS AND SHALL BE BEDDED WITH DAMP-PACK BEDDING MORTAR AS PART OF THE WORK OF THIS SECTION. INSTALLATION OF BASE AND BEARING PLATES SHALL BE AS FOLLOWS:

1. CONCRETE BEARING SURFACES SHALL BE CLEANED FREE OF LAITANCE, DIRT, OIL, GREASE, AND OTHER FOREIGN MATERIAL. CONCRETE SURFACES SHALL BE ROUGHENED, BUT NOT ENOUGH TO INTERFERE WITH THE PLACING OF THE BEDDING MORTAR. THE BOTTOM SURFACE OF BASE OR BEARING PLATES SHALL BE CLEANED FREE OF DIRT, OIL, GREASE, OR OTHER FOREIGN MATERIALS.

2. THE BASE OR BEARING PLATE SHALL BE SUPPORTED AND ALIGNED ON STEEL WEDGES OR SHIMS.

3. AFTER THE SUPPORTED MEMBERS HAVE BEEN PLUMBED AND CORRECTLY POSITIONED, THE SPACE BETWEEN THE TOP OF THE BEARING SURFACE AND THE BOTTOM OF THE BASE OR BEARING PLATE SHALL BE PACKED WITH THE BEDDING MORTAR MIX BY TAMPING OR RAMMING WITH A BAR OR ROD UNTIL THE VOIDS ARE COMPLETELY FILLED.

4. FORMS SHALL BE PROVIDED TO RETAIN THE BEDDING MORTAR OR NONSHRINK GROUT UNTIL SUFFICIENTLY HARD TO SUPPORT ITSELF.

5. THE BEDDING MORTAR SHALL BE A MIX COMPOSED OF THE SPECIFIED SHRINKAGE RESISTANT GROUT AND ENOUGH WATER TO PROVIDE A FLOWABLE MIXTURE WITHOUT SEGREGATION OR BLEEDING.

6. WEDGES OR SHIMS SHALL NOT BE REMOVED, BUT WHEN PROTRUDING SHALL BE CUT OFF FLUSH WITH THE EDGE OF THE BASE OR BEARING PLATE, PRIOR TO PACKING WITH BEDDING MORTAR.

7. AFTER THE BEDDING MORTAR HAS RECEIVED ITS INITIAL SET IT SHALL BE KEPT DAMP FOR NOT LESS THAN 24 HOURS.

---INSPECTION AND TESTS---

---GENERAL

ALL MATERIAL AND WORKMANSHIP FURNISHED UNDER THIS CONTRACT SHALL BE INSPECTED BY THE CONTRACTOR'S QUALITY CONTROL ORGANIZATION, MEETING THE REQUIREMENTS SET FORTH IN THE "CONTRACT SCHEDULE" SECTION OF THE CONTRACT. MATERIAL AND WORKMANSHIP SHALL BE SUBJECT TO INSPECTION AND TESTS IN THE MILL, SHOP AND FIELD BY GOVERNMENT INSPECTORS. WHEN MATERIALS AND WORKMANSHIP DO NOT CONFORM TO THE SPECIFICATION REQUIREMENTS, THE CONTRACTING OFFICER RESERVES THE RIGHT TO REJECT MATERIAL OR WORKMANSHIP, OR BOTH, AT ANY TIME BEFORE FINAL ACCEPTANCE OF THE STRUCTURE. IN CASE OF DOUBT, THE CONTRACTING OFFICER MAY REQUIRE COUPONS TO BE CUT FROM BASE AND/OR WELD MATERIAL FOR DESTRUCTIVE TESTS. IF THE MATERIAL OR WELD DOES NOT MEET THE APPLICABLE SPECIFICATIONS FOR STRENGTH AND SOUNDNESS, THE CONTRACTOR SHALL BE LIABLE FOR THE COST OF THE INVESTIGATION OF THE DEFECTIVE AREA. WHEN COUPONS ARE REMOVED FROM ANY PART OF THE STRUCTURE, THE MEMBERS SHALL BE REPAIRED IN A NEAT AND WORKMANLIKE MANNER, WITH JOINTS OF PROPER TYPE TO DEVELOP THE FULL STRENGTH OF THE MEMBERS AND JOINTS CUT, AND WITH PEENING AS NECESSARY OR AS DIRECTED TO RELIEVE RESIDUAL STRESS.

INSPECTION BY THE CONTRACTING OFFICER WILL INCLUDE PROPER PREPARATION, SIZE, GAGING LOCATION, AND DEFECTS OF WELDS; IDENTIFICATION MARKING; OPERATION AND CURRENT CHARACTERISTICS OF WELDING SETS IN USE; AND CALIBRATION OF WRENCHES FOR HIGH STRENGTH BOLTS.

INSPECTION OF WELDING SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 17K OF THESE SPECIFICATIONS.

---INSPECTION OF HIGH STRENGTH BOLT CONNECTIONS

INSPECTION OF HIGH STRENGTH BOLT CONNECTIONS WILL BE PERFORMED IN ACCORDANCE WITH AISC SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS, SECTION 6 "INSPECTION".

---GENERAL

FIELD PAINTING SHALL INCLUDE TOUCH-UP OF SHOP COATED AREAS DAMAGED BY WELDING, CUTTING, SHIPPING, HANDLING, AND OTHER CAUSES, AND DAMAGED GALVANIZED SURFACES BY POWER TOOL CLEANING AND APPLYING ORGANIC ZINC-RICH COATING ALL IN THE MANNER OUTLINED IN SECTIONS 9A AND 9L OF THESE SPECIFICATIONS.

---COLOR TOP COATS WITH PRIMER (WHERE SPECIFIED)

THESE COATINGS SHALL BE AS SPECIFIED IN SECTIONS 9A AND 13L OF THESE SPECIFICATIONS.

---NEW STEEL SHAPE SERIES--- (B)

---GENERAL

THE DRAWINGS NOTE STRUCTURAL STEEL SHAPES LISTED BY AISC PRIOR TO SEPTEMBER 1978. THE FOLLOWING NEW SERIES SHAPES MAY BE SUBSTITUTED THEREFOR AS TABULATED BELOW: (B)

OLD SERIES	*NEW SERIES WEIGHT*	*OLD SERIES*	*NEW SERIES WEIGHT*	*OLD SERIES*	*NEW SERIES WEIGHT*
W33x240	*x241*	*W24x100*	*x104*	*W18x70*	*x71*
W33x220	*x221*	*W24x61*	*x62*	*W18x64*	*x65*
W33x200	*x201*	*W21x142*	*x147*	*W18x45*	*x46*
W30x210	*x211*	*W21x127*	*x132*	*W16x96*	*x100*
W30x190	*x191*	*W21x112*	*x111*	*W16x88*	*x89*
W30x172	*x173*	*W21x96*	*x93*	*W16x78*	*x77*
W27x177	*x178*	*W21x82*	*x83*	*W16x71*	*x77*
W27x160	*x161*	*W21x55*	*x57*	*W16x64*	*x67*
W27x145	*x146*	*W21x49*	*x50*	*W16x58*	*x57*
W24x160	*x162*	*M18x114*	*x119*	*W14x314*	*x311*
W24x145	*x146*	*W18x105*	*x106*	*W14x287*	*x283*
W24x130	*x131*	*W18x96*	*x97*	*W14x264*	*x257*
W24x120	*x131*	*W18x85*	*x86*	*W14x245*	*x257*
W24x110	*x117*	*W18x77*	*x76*	*W14x237*	*x233*

OLD SERIES	NEW SERIES WEIGHT
W14x228	x233
W14x219	x233
W14x202	x211
W14x184	x193
W14x157	x176
W14x158	x159
W14x150	x159
W14x142	x145
W14x136	x132
W14x127	x132
W14x119	x120
W14x111	x109
W14x103	x109
W14x95	x99
W14x87	x90
W14x84	x82

OLD SERIES	NEW SERIES WEIGHT
W14x78	x82
W12x161	x170
W12x133	x136
W12x99	x96
W12x92	x96
W12x85	x87
W12x36	x35
W12x31	x30
W12x27	x26
W12x16.5	x16
W10x89	x88
W10x72	x77
W10x66	x68
W10x29	x30
W10x25	x26

OLD SERIES	NEW SERIES WEIGHT
W10x21	x22
W10x11.5	x12
W8x20	x21
W8x17	x18
W6x15.5	x15
W6x8.5	x9
W5x18.5	x19
W4x13	x13
W4x8.5	x9
W5x10.5	x11
W5x44.5	x44
W8x29	x28.5
W9x35	x35.5
W15x86	x86.5
W15x95	x95.5

SECTION 5K

MISCELLANEOUS METALS

---GENERAL REQUIREMENTS---

---GENERAL

ALL MISCELLANEOUS METAL ITEMS INDICATED ON THE DRAWINGS SHALL BE FURNISHED AND INSTALLED BY THE CONTRACTOR. FOR ITEMS NOT SPECIFICALLY DESCRIBED IN THESE SPECIFICATIONS, MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE ACCEPTED STANDARD PRACTICES OF THE TRADES. SUPPLEMENTARY PARTS NECESSARY TO COMPLETE EACH ITEM SHALL BE FURNISHED AND INSTALLED. ALL ANCHORS, SOCKETS, OR FASTENINGS REQUIRED FOR SECURING METALWORK TO OTHER STRUCTURES SHALL BE FURNISHED TO THE APPROPRIATE TRADES PROMPTLY. DETAILS AND SPECIFICATIONS OF ITEMS FOR WHICH STANDARD PRODUCTS ARE AVAILABLE ARE REPRESENTATIVE GUIDES OF MINIMUM REQUIREMENTS FOR SUCH ITEMS. STANDARD PRODUCTS, GENERALLY MEETING SUCH REQUIREMENTS, WILL BE ACCEPTED SUBJECT TO APPROVAL BY THE CONTRACTING OFFICER. GAGES OF SHEET IRON AND STEEL SPECIFIED ARE U.S. STANDARD FOR SHEET AND PLATE. GAGES OF NONFERROUS METALS ARE BROWN AND SHARPE. EXTRUDED SECTIONS SHALL BE NOT LESS THAN 1/8-INCH THICK, UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS. WELDING SHALL BE CONTINUOUS ALONG ENTIRE AREA OF CONTACT EXCEPT WHERE TACK WELDING IS NOTED. TACK WELDING WILL NOT BE PERMITTED ON EXPOSED SURFACES. ITEMS SPECIFIED TO BE GALVANIZED SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION. WEIGHT OF COATING SHALL BE NOT LESS THAN 1.25 OUNCES PER SQUARE FOOT OF SURFACE. ALL WELDING SHALL BE IN ACCORDANCE WITH SECTION 17K OF THE SPECIFICATIONS.

TEMPLATES AND PATTERNS FOR PROPER FITTING OF HARDWARE AND OTHER ACCESSORIES SHALL BE USED WHEREVER PRACTICABLE.

SUBSTITUTIONS OF MATERIALS OR MODIFICATION OF DETAILS, OR BOTH, SHALL BE MADE ONLY WHEN WARRANTED AND APPROVED BY THE CONTRACTING OFFICER.

FIELD MEASUREMENTS SHALL BE TAKEN PRIOR TO PREPARATION OF SHOP DRAWINGS AND FABRICATION TO INSURE PROPER FITTING OF THE WORK.

"ALL FERROUS METALS PROVIDED UNDER THIS SECTION OF THE SPECIFICATION SHALL BE GALVANIZED WHERE SPECIFIED AND, WHERE NOT SPECIFIED TO BE GALVANIZED, SHALL BE SHOP BLASTED AND SHOP INORGANIC ZINC-RICH COATED IN ACCORDANCE WITH SECTION 9L OF THESE SPECIFICATIONS." (A)

---REFERENCE SPECIFICATIONS

THE FOLLOWING PUBLICATIONS FORM A PART OF THIS SPECIFICATION AND, WHERE REFERRED TO THEREAFTER BY BASIC DESIGNATION ONLY ARE APPLICABLE TO THE EXTENT INDICATED BY THE REFERENCES THERETO. IN THE EVENT OF DIFFERENCE BETWEEN THIS SPECIFICATION OR ITS ACCOMPANYING DRAWINGS AND THE REFERENCED SPECIFICATION, THIS SPECIFICATION AND ITS ACCOMPANYING DRAWINGS SHALL GOVERN TO THE EXTENT OF SUCH DIFFERENCES.

(A) 5-30-78

FEDERAL SPECIFICATIONS

FF-B-561C	BOLTS, (SCREW), LAG
FF-B-575C	BOLTS, HEXAGON AND SQUARE
FF-N-836D(1)	NUT: SQUARE, HEXAGON, CAP, SLOTTED, CASTLE, KNURLED, WELDING AND SINGLE BALL SEAT
FF-S-92A(3)	SCREWS, MACHINE: SLOTTED, CROSS-RECESSED OR HEXAGON HEAD
FF-W-84A(2)	WASHERS, LOCK (SPRING)
FF-W-92A(1)	WASHERS, METAL, FLAT (PLAIN)
QQ-F-461C	FLOOR PLATE, STEEL, ROLLED
QQ-S-763D	STEEL BARS, WIRE, SHAPES AND FORGINGS, CORROSION-RESISTING
RR-C-271B	CHAINS AND ATTACHMENTS, WELDED, WELDLESS, AND ROLLER CHAIN
RR-G-661C	GRATING, METAL, BAR TYPE

AMERICAN INSTITUTE OF STEEL CONSTRUCTION PUBLICATIONS (AISC)

CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES

MANUAL OF STEEL CONSTRUCTION

SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, WITH COMMENTARY

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4-76	STANDARD WELDING SYMBOLS
AWS D1.1-REV. 2-77	STRUCTURAL WELDING CODE

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS (ASTM)

A1-76	CARBON STEEL TEE RAILS
A6-76A	GENERAL REQUIREMENTS FOR DELIVERY OF ROLLED STEEL PLATES, SHAPES, SHEET PILING AND BARS FOR STRUCTURAL USE

A27-73	MILD TO MEDIUM STRENGTH CARBON STEEL CASTINGS FOR GENERAL APPLICATION
A36-75	STRUCTURAL STEEL
A47-74	MALLEABLE IRON CASTINGS
A53-76	WELDED AND SEAMLESS STEEL PIPE
A123-73	ZINC (HOT GALVANIZED) COATINGS ON PRODUCTS FABRICATED FROM ROLLED, PRESSED, AND FORGED STEEL SHAPES, PLATES, BARS, AND STRIP
A153-73	ZINC COATING (HOT DIP) ON IRON AND STEEL HARDWARE
A283-75	LOW AND INTERMEDIATE TENSILE STRENGTH CARBON STEEL PLATES OF STRUCTURAL QUALITY
A307-76B	CARBON STEEL EXTERNALLY AND INTERNALLY THREADED STANDARD FASTENERS
A325-76C	HIGH STRENGTH BOLTS FOR STRUCTURAL STEEL JOINTS, INCLUDING SUITABLE NUTS AND PLAIN HARDENED WASHERS
A354-76B	QUENCHED AND TEMPERED ALLOY STEEL BOLTS AND STUDS WITH SUITABLE NUTS
A386-73	ZINC COATING (HOT DIP) ON ASSEMBLED STEEL PRODUCTS
A441-75	HIGH STRENGTH LOW ALLOY STRUCTURAL MANGANESE VANADIUM STEEL
A501-76	HOT FORMED WELDED AND SEAMLESS CARBON STEEL STRUCTURAL TUBING
A525-75	STEEL SHEET, ZINC COATED (GALVANIZED) BY THE HOT DIP METHOD
A526-71	STEEL SHEET, ZINC COATED (GALVANIZED) BY THE HOT DIP PROCESS, COMMERCIAL QUALITY
A569-72	STEEL CARBON (0.15 MAXIMUM PERCENT) HOT ROLLED SHEET AND STRIP, COMMERCIAL QUALITY
A575-73	MERCHANT QUALITY HOT ROLLED CARBON STEEL BARS

---SHOP DRAWINGS

SHOP DRAWINGS SHALL BE SUBMITTED FOR APPROVAL IN ACCORDANCE WITH "CONTRACT SCHEDULE". ALL SHOP DRAWINGS SHALL INCLUDE EACH MISCELLANEOUS METALS ITEM LOCATION IN THE BUILDING, DIMENSIONS, SIZE AND WEIGHT OR GAGE AS APPLICABLE OF THE MEMBERS, TYPE AND LOCATION OF SHOP AND FIELD CONNECTIONS, AND OTHER PERTINENT CONSTRUCTION AND ERECTION DETAILS. ALL WELDS SHALL BE INDICATED BY THE AWS STANDARD WELDING SYMBOLS, AWS A2.0.

---DESCRIPTIVE DATA AND SAMPLES

SUBMIT DESCRIPTIVE DATA AND SAMPLES AS SPECIFIED IN THE "CONTRACT SCHEDULE". DESCRIPTIVE DATA SHALL INCLUDE THE MANUFACTURER'S PRINTED INSTRUCTIONS COVERING INSTALLATION OF CATALOG MISCELLANEOUS METAL ITEMS. SUBMIT SAMPLES OF ANCHORAGE DEVICES AND FASTENERS, ONE FULL SIZE SAMPLE OF EACH TYPE TO BE USED IN THE WORK. AFTER APPROVAL, FULL SIZE SAMPLES MAY BE USED IN THE CONSTRUCTION PROVIDED EACH SAMPLE IS CLEARLY IDENTIFIED AND ITS LOCATION RECORDED.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE IN TWO CERTIFIED COPIES AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR MATERIALS, MISCELLANEOUS METAL ITEMS OR COMPONENTS THEREOF, THAT ARE SPECIFIED BY A REFERENCED SPECIFICATION, EXCEPT THOSE MATERIALS REQUIRING A LABORATORY TEST REPORT, AND WEIGHT OF GALVANIZED COATINGS.
REPORTS ON RAILS: LADLE ANALYSIS OF STEEL; CONTROLLED COOLING; AND BRINELL HARDNESS AS HEREINAFTER SPECIFIED AND PER ASTM A-1.

---STORAGE OF MATERIALS

MISCELLANEOUS METAL ITEMS STORED AT THE PROJECT SITE BEFORE INSTALLATION SHALL BE STORED ABOVE THE GROUND AND NOT IN CONTACT WITH THE GROUND.

MATERIALS SHALL BE KEPT FREE FROM DIRT, GREASE, AND OTHER FOREIGN MATTER, AND SHALL BE PROTECTED FROM CORROSION.

PACKAGED MATERIALS SHALL BE STORED IN THEIR ORIGINAL, UNBROKEN PACKAGE OR CONTAINER IN A WEATHERTIGHT AND DRY PLACE, UNTIL READY FOR INSTALLATION.

---PAINTING

ALL PAINTING AND GALVANIZING REPAIR SHALL BE IN ACCORDANCE WITH SECTION 9L "PROTECTIVE COATING OF CARBON STEEL".

---BONDING AND GROUNDING

BONDING OF ALL JOINTS AND CONNECTIONS SHALL BE ACCOMPLISHED AS OUTLINED IN SECTION 16X (PART 51) "GROUNDING AND LIGHTNING PROTECTION".

---WELDED STEEL CONSTRUCTION

WELDED CONSTRUCTION SHALL CONFORM TO THE AISC SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS EXCEPT THAT THE WELDING SHALL CONFORM TO SECTION 17K "WELDING OF CARBON STEEL".

---SAFETY

SEE SECTION ENTITLED "CONTRACT SCHEDULE".

---FERROUS METALS---

---STRUCTURAL STEEL PLATES, SHAPES AND BARS

STRUCTURAL STEEL PLATES, SHAPES, AND BARS ARE DEFINED IN ASTM A6, AND SHALL BE AS FOLLOWS:

STRUCTURAL STEEL,STRUCTURAL SIZE SHAPES AND PLATES, EXCEPT PLATES TO BE BENT OR COLD FORMED, SHALL BE STRUCTURAL QUALITY CARBON STEEL CONFORMING TO ASTM A36.

STRUCTURAL STEEL PLATES TO BE BENT OR COLD FORMED SHALL CONFORM TO ASTM A283, GRADE C.

STRUCTURAL STEEL BARS AND BAR SIZE SHAPES SHALL CONFORM TO ASTM A36.

---STRUCTURAL STEEL PIPE

STRUCTURAL STEEL PIPE SHALL CONFORM TO ASTM A53, GRADE B.

---STRUCTURAL STEEL TUBING

STRUCTURAL STEEL TUBING SHALL BE HOT FORMED, STRUCTURAL QUALITY CARBON STEEL, WELDED OR SEAMLESS, CONFORMING TO ASTM A501.

---HOT ROLLED CARBON STEEL BARS AND BAR SIZE SHAPES

HOT ROLLED CARBON STEEL BARS AND BAR SIZE SHAPES SHALL BE MERCHANT QUALITY CONFORMING TO ASTM A575, GRADE DESIGNATION M1020.

---HOT ROLLED CARBON STEEL SHEETS AND STRIP

HOT ROLLED CARBON STEEL SHEETS AND STRIP SHALL BE UNCOATED AND COMMERCIAL QUALITY CONFORMING TO ASTM A569.

---GALVANIZED CARBON STEEL SHEETS

GALVANIZED CARBON STEEL SHEETS SHALL BE HOT DIP GALVANIZED AND COMMERCIAL QUALITY CONFORMING TO ASTM A526, WITH G-90 COATING DESIGNATION CONFORMING TO ASTM A525.

FACTORY PAINTED HEAVY GAUGE GALVANIZED SIDING SHALL BE PROVIDED WHERE INDICATED.

---CRANE RAILS FOR ROTARY BRIDGE TRUCKS

RAILS AND TOLERANCES SHALL BE AS SPECIFIED IN SECTION 14M OF THESE SPECIFICATIONS.

---FASTENING MATERIALS---

---STANDARD BOLTS AND NUTS

STANDARD BOLTS SHALL BE REGULAR HEXAGON HEAD TYPE, LOW CARBON STEEL, COARSE THREAD SERIES, CONFORMING TO FS FF-B-575, TYPE 2, GRADE 1, GALVANIZED IN ACCORDANCE WITH ASTM A153.
UNLESS OTHERWISE NOTED, STANDARD ANCHOR BOLTS AND NUTS SHALL CONFORM TO ASTM A307.
NUTS SHALL BE PLAIN HEXAGON TYPE, REGULAR STYLE, CARBON STEEL, CONFORMING TO FS FF-N-836, TYPE II, STYLE 4, GRADE A, GALVANIZED IN ACCORDANCE WITH ASTM A153.

---HIGH STRENGTH BOLTS AND NUTS

HIGH STRENGTH BOLTING SHALL CONFORM TO ASTM A325, AND GALVANIZED PER ASTM A153. ALL HIGH STRENGTH BOLTS SHALL BE NEW AND BY THE CONTRACTOR. EXISTING BOLTS SHALL NOT BE REUSED.

---HIGH STRENGTH ANCHOR BOLTS AND NUTS

HIGH STRENGTH ANCHOR BOLTS SHALL CONFORM TO ASTM A354, GRADE BC, WITH ASTM A563, GRADE "D", NUTS. SHOP GREASE ALL THREADS. PROVIDE FEMALE THREADED STEEL SHIPPING PROTECTORS, OR SPECIFIED NUTS, OVER FULL LENGTH OF ALL MALE THREADS.

---MACHINE SCREWS

MACHINE SCREWS SHALL BE CARBON STEEL, CROSS RECESS DRIVE TYPE, FLAT HEAD STYLE, CONFORMING TO FS FF-S-92, TYPE III, STYLE 2C OR STYLE 3C, GALVANIZED PER ASTM A153.

---PLAIN WASHERS

PLAIN WASHERS SHALL BE ROUND TYPE, GENERAL ASSEMBLY PURPOSE GRADE, CARBON STEEL CLASS, CONFORMING TO FS-FF-W-92, TYPE A, GRADE 1, CLASS A, GALVANIZED PER ASTM A153.

---LOCK WASHERS

LOCK WASHERS SHALL BE HELICAL SPRING TYPE, CARBON STEEL CLASS, OF THE STYLE BEST SUITED FOR THE WORK, CONFORMING TO FS FF-W-84, CLASS A.

---WEDGE TYPE CONCRETE INSERTS (CONCRETE ANCHORS OTHER THAN CAST-IN-PLACE)

WEDGE TYPE CONCRETE INSERTS SHALL BE GALVANIZED, BOX TYPE, FERROUS CASTINGS WITH INTEGRAL ANCHOR LOOP AT THE BACK OF BOX AND DESIGNED TO ACCEPT 1/2 INCH OR 3/4 INCH DIAMETER BOLTS HAVING SPECIAL WEDGE SHAPED HEADS. FERROUS CASTINGS SHALL BE FERRITIC MALLEABLE IRON CONFORMING TO ASTM A47, GRADE 32510 OR GRADE 35018, OR MAY BE MEDIUM STRENGTH CAST STEEL CONFORMING TO ASTM A27, GRADE U-60-30. INSERTS SHALL BE HOT DIP GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH ASTM A153.

THE INSERTS SHALL NOT BE REMOVABLE WHEN EMBEDDED IN CONCRETE OF 3000 POUNDS PER SQUARE INCH COMPRESSIVE STRENGTH AND SUBJECTED TO A 9000 POUND FOR 1/2 INCH OR 16,000 POUND TENSION LOAD FOR 3/4 INCH, TEST IN AN AXIAL DIRECTION, NOR SHALL THE CONCRETE SHOW ANY EVIDENCE OF FAILURE ATTRIBUTABLE TO THE ANCHORING DEVICE ITSELF. CARBON STEEL BOLTS HAVING SPECIAL WEDGE SHAPE HEADS, NUTS, WASHERS, AND SHIMS SHALL BE PROVIDED. SUCH HARDWARE ITEMS SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.

---STAINLESS STEEL SHAPES

STAINLESS STEEL SHAPES AND BARS SHALL BE TYPE 304 COMPLYING WITH FS QQ-S-763.

---FABRICATION IN GENERAL---

---GENERAL

MISCELLANEOUS METAL WORK, INCLUDING ALL NECESSARY MATERIALS AND PARTS, SHALL BE FABRICATED AND DELIVERED TO THE PROJECT SITE IN AMPLE TIME SO AS NOT TO DELAY THE PROGRESS OF THE WORK.

---WORKMANSHIP

MISCELLANEOUS STRUCTURAL STEEL WORK SHALL BE FABRICATED IN ACCORDANCE WITH AISC "SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS" AND AS SPECIFIED HEREIN.

METALWORK SHALL BE WELL FORMED TO SHAPE AND SIZE, WITH LINES AND ANGLES SHARP, AND WITH CURVES TRUE. THE NECESSARY REBATES, LUGS AND BRACKETS SHALL BE PROVIDED SO THAT THE WORK CAN BE ASSEMBLED. FASTENERS SHALL BE CONCEALED WHERE PRACTICABLE.

HOLES FOR FASTENERS SHALL BE DRILLED OR PUNCHED. POORLY MATCHING HOLES SHALL BE CAUSE FOR REJECTION. DRILLING AND PUNCHING SHALL PRODUCE CLEAN TRUE LINES AND SURFACES.

JOINTS SHALL BE MILLED TO A CLOSE FIT. CORNER JOINTS SHALL BE COPED OR MITERED, WELL FORMED, AND IN TRUE ALIGNMENT. JOINTS EXPOSED TO THE WEATHER SHALL BE FORMED AND FABRICATED TO EXCLUDE WATER.

---HOLES FOR OTHER WORK

HOLES SHALL BE PROVIDED FOR SECURING OTHER WORK TO MISCELLANEOUS METAL WORK.

---GALVANIZING

MISCELLANEOUS METAL ITEMS SPECIFIED TO BE GALVANIZED SHALL BE COVERED WITH A ZINC COATING APPLIED BY THE HOT DIP PROCESS AFTER FABRICATION.

GALVANIZING OF IRON AND STEEL HARDWARE SHALL BE IN ACCORDANCE WITH ASTM A153.

GALVANIZING OR ROLLED, PRESSED, AND FORGED STEEL SHAPES, PLATES, BARS, AND STRIP, 1/8 INCH THICK AND HEAVIER, SHALL BE IN ACCORDANCE WITH ASTM A123.

GALVANIZING OF ASSEMBLED STEEL PRODUCTS SHALL BE IN ACCORDANCE WITH ASTM A386.

---SHOP PAINTING

SHOP PRIME PAINT ALL FERROUS MISCELLANEOUS METAL WORK (EXCEPT METAL SURFACES EMBEDDED IN CONCRETE, RAILS, SURFACES AND EDGES TO BE FIELD WELDED, AND GALVANIZED SURFACES UNLESS OTHERWISE SPECIFIED HEREINAFTER) IN ACCORDANCE WITH THE SECTION OF THE SPECIFICATIONS 9L "PROTECTIVE COATING OF CARBON STEEL" USING ABRASIVE BLASTING AND INORGANIC ZINC_RICH COATING.

---GENERAL

MISCELLANEOUS METAL WORK SHALL BE INSTALLED IN ACCORDANCE WITH THE APPROVED SHOP DRAWINGS AND DESCRIPTIVE DATA FOR EACH MISCELLANEOUS METAL ITEMS AND AS SPECIFIED HEREINAFTER.

SECURELY FASTEN MISCELLANEOUS METAL ITEMS PLUMB AND TRUE TO LINES AND LEVELS.

---FASTENING TO CONSTRUCTION IN PLACE

PROVIDE ANCHORAGE DEVICES AND FASTENERS WHERE NECESSARY FOR FASTENING MISCELLANEOUS METAL ITEMS TO CONSTRUCTION IN PLACE. SUCH FASTENING SHALL INCLUDE CONNECTIONS FOR STRUCTURAL STEEL AND OTHER METAL SURFACES INDICATED. FASTENING SHALL BE PROVIDED AS INDICATED ON THE DRAWINGS AND SPECIFIED HEREIN. REUSE OF HIGH STRENGTH BOLTS IS NOT PERMITTED.

---CUTTING AND FITTING

PERFORM ALL CUTTING, DRILLING, AND FITTING REQUIRED FOR THE INSTALLATION OF MISCELLANEOUS METAL WORK. EXECUTE CUTTING, DRILLING AND FITTING CAREFULLY.

---FIELD WELDING

THE PROCEDURES OF MANUAL SHIELDED METAL ARC WELDING, THE APPEARANCE AND QUALITY OF WELDS MADE, AND THE METHODS USED IN CORRECTING WELDING WORK SHALL CONFORM TO SECTION 17K "WELDING OF CARBON STEEL".

WELDING SHALL BE CONTINUOUS ALONG THE ENTIRE AREA OF CONTACT EXCEPT WHERE TACK WELDING IS PERMITTED. EXPOSED CONNECTION OF MISCELLANEOUS METAL WORK IN PLACE SHALL NOT BE PERMITTED. EXPOSED CONNECTION OF MISCELLANEOUS METAL WORK IN PLACE SHALL NOT BE TACK WELDED. EXPOSED WELDS SHALL BE GROUND SMOOTH.

---THREADED CONNECTIONS

WHERE EXPOSED TO VIEW, BOLT AND SCREW HEADS SHALL BE FLAT AND COUNTERSUNK, UNLESS OTHERWISE SPECIFIED HEREINAFTER OR SHOWN ON THE DRAWINGS. THREADED CONNECTIONS SHALL BE MADE UP TIGHTLY SO THAT THE THREADS WILL BE ENTIRELY CONCEALED BY FITTING.

---TOUCH-UP PAINTING

AFTER INSTALLATION OF MISCELLANEOUS METAL WORK, TOUCH-UP PAINT FIELD WELDS, FIELD BOLT HEADS AND NUTS, SCREW HEADS, AND SCARRED SURFACES ON MISCELLANEOUS METAL WORK AND ON ADJACENT FERROUS METAL SURFACES. TOUCH-UP PAINTING SHALL BE IN ACCORDANCE WITH SECTION 9L "PROTECTIVE COATING OF CARBON STEEL".

---MISCELLANEOUS FERROUS METAL ITEMS---

---FLOOR GRATINGS AND FRAMES (GALVANIZED STEEL)

FLOOR GRATING SHALL BE CARBON STEEL, PARALLEL BEARING BARS WITH STEEL RIGHT ANGLE WELDED CROSS MEMBERS, BANDED, CONFORMING TO FS RR-G-661, TYPE I, GALVANIZED. GRATING PANEL SIZES AND BEARING BAR DEPTH SHALL BE AS INDICATED. MINIMUM THICKNESS OF BEARING BARS SHALL BE 3/16 INCH. STEEL BAR GRATING FLOOR PANELS SHALL BE WELDED TO STEEL SUPPORTING MEMBERS, EXCEPT FLOOR PANELS INDICATED AS REMOVABLE. REMOVABLE FLOOR PANELS SHALL BE FABRICATED TO SIZES INDICATED AND SECURED WITH STUD BOLT ANCHORS WELDED TO SUPPORTING MEMBERS; ANCHORS SHALL BE DESIGNED TO FIT OVER TWO BEARING BARS; AND FOUR ANCHORS SHALL BE PROVIDED FOR EACH REMOVABLE PANEL. JOINTS IN FLOOR PANELS SHALL ONLY OCCUR OVER SUPPORTS. NOTCHING OF BEARING BARS AT SUPPORTS TO MAINTAIN ELEVATIONS WILL NOT BE PERMITTED. OPENINGS IN FLOORING SHALL BE PROVIDED AS INDICATED. A PLAIN WASHER AND NUT SHALL BE FURNISHED WITH EACH STUD BOLT. REFER TO DRAWINGS FOR SPECIAL DETAILS. OPEN SPACE BETWEEN BEARING BARS SHALL NOT EXCEED ONE INCH.

FRAMES SHALL BE STRUCTURAL STEEL ANGLES, ALL WELDED CONSTRUCTION, AND FABRICATED SO THAT THE TOPS OF FRAMES AND FLOOR GRATING WILL FINISH FLUSH WITH THE FINISHED FLOOR ELEVATION. PROVIDE ANCHORS WELDED TO THE FRAME, SPACED NOT MORE THAN SIX INCHES FROM ENDS OF FRAME SECTIONS, NOT MORE THAN SIX INCHES FROM CORNERS, AND NOT MORE THAN 24 INCHES ON CENTERS BETWEEN END AND CORNER ANCHORS. ANCHORS SHALL BE STRUCTURAL STEEL BARS, 3/4 INCH WIDE BY 3/8 INCH THICK UNLESS OTHERWISE INDICATED, AND LENGTH AS REQUIRED FOR A MINIMUM EMBEDMENT OF SIX INCHES IN THE CONCRETE.

ALL FLOOR GRATINGS AND FRAMES, INCLUDING FASTENERS AND CLIPS, SHALL BE GALVANIZED.

FLOOR GRATING PANELS IN FRAMES SHALL BE REMOVABLE. STUD BOLTS TO RECEIVE SADDLE CLIP ANCHORS SHALL BE FIELD WELDED TO THE FRAME.

---FLOOR PLATE, COVERS AND FRAMES (STEEL)

FLOOR PLATE AND FLOOR PLATE COVERS SHALL BE CARBON STEEL HAVING A RAISED FIGURE PATTERN AT REGULAR INTERVALS ON THE SURFACE, CONFORMING TO FS QQ-F-461, CLASS I, AND PATTERN AS FOLLOWS:

PATTERN NUMBER 7, 12 OR 17.

FLOOR PLATES SHALL BE WELDED TO STEEL SUPPORTING MEMBERS, EXCEPT FLOOR PLATES INDICATED AS REMOVABLE. REMOVABLE FLOOR PLATES SHALL BE FABRICATED TO SIZES INDICATED, AND SECURED WITH FLUSH COUNTERSUNK BOLTS. JOINTS IN FLOOR PLATES SHALL ONLY OCCUR OVER SUPPORTS. OPENINGS IN FLOORING SHALL BE PROVIDED AS INDICATED.

FLOOR PLATE COVER SECTIONS SHALL BE THE WIDTH AND THICKNESS INDICATED. LENGTH OF REMOVABLE PANELS SHALL BE LIMITED BY TOTAL WEIGHT NOT TO EXCEED 100 POUNDS. COVERS SHALL BE FREE OF SHARP EDGES AND BURRS. COVERS SHALL BE PROVIDED WITH HOLES TO RECEIVE FLAT HEAD STYLE MACHINE SCREWS. LIFTING DEVICES SHALL BE AS SHOWN ON THE DRAWINGS.

FRAMES SHALL BE STRUCTURAL STEEL ANGLES AND STEEL BAR STOPS, ALL WELDED CONSTRUCTION, AND FABRICATED SO THAT THE TOPS OF FRAMES AND FLOOR PLATE COVERS WILL FINISH FLUSH WITH THE FINISHED FLOOR ELEVATION. PROVIDE ANCHORS WELDED TO THE FRAME, SPACED NOT MORE THAN SIX INCHES FROM ENDS OF FRAME SECTIONS, NOT MORE THAN SIX INCHES FROM CORNERS, AND NOT MORE THAN 24 INCHES ON CENTERS. ANCHORS SHALL BE STRUCTURAL STEEL BARS, 3/4 INCH WIDE BY 3/8 INCH THICK UNLESS OTHERWISE INDICATED, AND LENGTH AS REQUIRED FOR A MINIMUM EMBEDMENT OF SIX INCHES IN THE CONCRETE. FRAMES SHALL BE DRILLED AND TAPPED TO RECEIVE MACHINE SCREWS.

ALL FLOOR PLATES AND FRAMES SHALL BE GALVANIZED.

---LADDERS

LADDERS SHALL BE FIXED RAIL TYPE, LOCATED AND DETAILED AS INDICATED AND SPECIFIED HEREIN. RUNGS SHALL BE 3/4 INCH SOLID SECTION STRUCTURAL STEEL RODS, SPACED 12 INCHES ON CENTERS. SIDE RAILS SHALL BE STRUCTURAL STEEL FLAT BARS, WITH ROUNDED EDGES, 2-1/2 INCHES BY 3/8 INCH UNLESS OTHERWISE INDICATED, AND SPACED 18 INCHES APART. SIDE RAILS SHALL EXTEND AT LEAST 42 INCHES ABOVE THE LAST RUNG. CLEARANCE BETWEEN SIDE RAILS AND THE SUPPORTING STRUCTURE: NOT LESS THAN 6-1/2". RUNGS SHALL BE FITTED INTO PUNCHED HOLES IN THE SIDE RAILS, WELDED, AND GROUND SMOOTH. ALL SPLICES AND CONNECTIONS SHALL HAVE A SMOOTH TRANSITION WITH ORIGINAL MEMBERS WITHOUT PROJECTIONS THAT ARE SHARP OR MORE EXTENSIVE THAN REQUIRED FOR JOINT STRENGTH. LADDERS SHALL BE PROVIDED WITH STRUCTURAL STEEL BRACKETS, DRILLED TO RECEIVE ANCHOR BOLTS, AND WELDED TO SIDE RAILS. BRACKET SPACING SHALL NOT EXCEED TEN FEET ON CENTERS. RUNGS: 12" MAXIMUM FROM LANDING.

ALL LADDERS, INCLUDING BRACKETS AND FASTENERS, SHALL BE GALVANIZED.

---MISCELLANEOUS STEEL FRAMING AND SUPPORTS

MISCELLANEOUS STEEL FRAMING AND SUPPORTS THAT DO NOT FORM A PART OF THE STRUCTURAL STEEL FRAMEWORK SHALL BE PROVIDED TO COMPLETE THE WORK.

MISCELLANEOUS STEEL FRAMING AND SUPPORTS SHALL BE FABRICATED OF STRUCTURAL STEEL PLATES, SHAPES, BARS, AND TUBING OF SIZES AND ARRANGEMENT INDICATED AND, UNLESS OTHERWISE INDICATED, SHALL BE SHOP BLASTED AND INORGANIC ZINC-RICH COATED PER SECTIONS 9A AND 9L OF THESE SPECIFICATIONS.

---SAFETY CHAINS/FLEXIBLE GUARDRAILS

SAFETY CHAINS COMPLETE WITH SAFETY LATCH TYPE HOOKS AND EYE BOLTS FOR ATTACHMENT OF CHAINS, SHALL BE PROVIDED FOR EACH GUARDED OPENING WHERE INDICATED AND DETAILED AND SPECIFIED ON THE DRAWINGS. (F)

TWO CHAINS SHALL BE PROVIDED FOR EACH GUARDED OPENING OF A LENGTH WHICH PROVIDES AT LEAST 2 INCHES SAG FOR FASTENING AND UNFASTENING, BUT IN NO CASE SHALL THE SAG EXCEED 4 INCHES BELOW THE CHAIN ATTACH POINTS. THE TOP CHAIN SHALL BE MOUNTED NOT LESS THAN 3 FEET 6 INCHES ABOVE THE FLOOR ELEVATION AND THE SECOND CHAIN SHALL BE MOUNTED 1'-9" ABOVE THE FLOOR ELEVATION. THE ENTIRE STANCHION POST AND CHAIN ASSEMBLY SHALL CONFORM TO THE OSHA REQUIREMENT THAT THE COMPLETE STRUCTURE SHALL BE CAPABLE OF WITH-STANDING A LOAD OF AT LEAST 200 POUNDS APPLIED IN ANY DIRECTION ON ANY POINT ON THE POST OR CHAIN.

---STEEL PIPE RAILINGS

STEEL PIPE RAILINGS SHALL INCLUDE GUARDING AT OPEN SIDED AREAS CONSISTING OF TOP RAIL, INTERMEDIATE RAIL AND POSTS, AND HANDRAILS AT WALLS, AS INDICATED.

RAILINGS SHALL BE MADE OF 1-1/2 INCHES NOMINAL SIZE, STANDARD WEIGHT FOR TOP AND INTERMEDIATE RAIL AND EXTRA STRONG FOR POSTS, CARBON STEEL WELDED OR SEAMLESS PIPE CONFORMING TO ASTM A53, TYPE E OR TYPE S, GRADE B.

JOINING OF POST, RAILS, AND CORNERS SHALL BE DONE BY ONE OF THE FOLLOWING METHODS:

MITERED AND WELDED JOINTS MADE BY FITTING POST TO TOP RAIL AND INTERMEDIATE RAIL TO POST, MITERING CORNERS, GROOVE WELDING JOINTS, AND GRINDING SMOOTH. RAILING SPLICES SHALL BE BUTTED AND REINFORCED BY A TIGHT FITTING INTERIOR SLEEVE NOT LESS THAN SIX INCHES LONG.

RAILINGS MAY BE BENT AT CORNERS INSTEAD OF JOINING, PROVIDED THE BENDS ARE MADE IN SUITABLE JIGS AND THAT THE CYLINDRICAL CROSS SECTION OF THE PIPE IS MAINTAINED THROUGHOUT THE ENTIRE BEND.

RAILINGS SHALL BE ADJUSTED PRIOR TO SECURING IN PLACE TO INSURE PROPER MATCHING AT BUTTING JOINTS AND CORRECT ALIGNMENT THROUGHOUT THEIR LENGTH. POSTS SHALL BE SPACED NOT MORE THAN SIX FEET ON CENTERS.

POSTS SHALL BE PLUMB IN EACH DIRECTION. POSTS AND RAIL ENDS SHALL BE SECURED PERMANENTLY TO STRUCTURE, OR SHALL BE OF REMOVABLE TYPE, AS INDICATED ON DRAWINGS OR AS FOLLOWS:

UNLESS OTHERWISE INDICATED, POSTS SHALL BE ANCHORED IN CONCRETE BY MEANS OF GALVANIZED, STANDARD WEIGHT, STEEL PIPE, NOT LESS THAN SIX INCHES LONG, AND HAVING AN INSIDE DIAMETER NOT LESS THAN 1/2 INCH GREATER THAN THE OUTSIDE DIAMETER OF THE INSERTED PIPE POST. PROVIDE STEEL PLATE CLOSURE SECURED TO THE BOTTOM OF THE SLEEVE AND OF WIDTH AND LENGTH NOT LESS THAN ONE INCH GREATER THAN THE OUTSIDE DIAMETER OF THE SLEEVE. AFTER THE POSTS HAVE BEEN INSERTED INTO THE SLEEVES, THE ANNULAR SPACE BETWEEN POST AND SLEEVE SHALL BE FILLED SOLID WITH MOLTEN LEAD OR SULPHUR OR A QUICK SETTING HYDRAULIC CEMENT, EXCEPT ANNULAR SPACE SHALL BE VOID FOR REMOVABLE POSTS.

CONCRETE ANCHORAGE FOR RAIL ENDS SHALL BE BY MEANS OF STEEL ROUND FLANGES WELDED TO RAIL ENDS AND ANCHORED INTO THE WALL CONSTRUCTION WITH LEAD EXPANSION SHIELDS AND BOLTS, GALVANIZED.

STEEL ANCHORAGE FOR RAIL ENDS SHALL BE BY MEANS OF WELDING TO THE STRUCTURAL STEEL MEMBERS.

KICKPLATES SHALL BE PROVIDED BETWEEN RAILING POSTS AT PLATFORMS AND AS DETAILED.

HANDRAILS SHALL BE SECURED TO WALLS BY MEANS OF WALL BRACKETS, AND WALL RETURN FITTING AT HANDRAIL ENDS. BRACKETS SHALL BE MALLEABLE IRON CASTINGS WITH NOT LESS THAN THREE INCHES PROJECTION FROM THE FINISH WALL SURFACE TO THE CENTER OF THE PIPE HANDRAIL, AND WITH THE WALL PLATE PORTION OF THE BRACKET DRILLED TO RECEIVE ONE 3/8 INCH BOLT. LOCATE BRACKETS NOT MORE THAN 60 INCHES ON CENTERS. WALL RETURN FITTINGS SHALL BE OF STEEL WITH THE SAME PROJECTIONS AS THAT SPECIFIED FOR WALL BRACKETS. WALL BRACKETS AND WALL RETURN FITTINGS SHALL BE SECURED TO BUILDING CONSTRUCTION AS FOLLOWS:

CONCRETE ANCHORAGE SHALL BE BY MEANS OF BOLT ANCHOR EXPANSION SHIELDS AND LAG BOLTS, GALVANIZED.

POSTS AND RAILINGS, INCLUDING PIPE, FITTINGS, BRACKETS, FASTENERS AND OTHER FERROUS METAL COMPONENTS SHALL BE GALVANIZED, UNLESS OTHERWISE INDICATED.

---STEEL STAIRS

STEEL STAIRS SHALL BE CONSTRUCTED TO CONFORM TO THE SIZES AND ARRANGEMENTS AS INDICATED. PROVIDE ALL STEEL FRAMING, HANGERS, COLUMNS, STRUTS, CLIPS, BRACKETS, BEARING PLATES, AND OTHER COMPONENTS AS REQUIRED FOR THE SUPPORT OF STAIRS AND PLATFORMS.

STAIR FRAMING:

STRINGERS SHALL BE STRUCTURAL STEEL CHANNELS OR STRUCTURAL STEEL PLATES, OR A COMBINATION THEREOF, AS INDICATED. EXPOSED ENDS OF STRINGERS SHALL BE CLOSED.

PLATFORM CONSTRUCTION SHALL BE STRUCTURAL STEEL CHANNEL HEADERS AND STRUCTURAL STEEL FRAMING MEMBERS, AS INDICATED ON THE DRAWINGS.

FLOOR GRATING TREADS AND PLATFORMS OF STAIRS:

FLOOR GRATING SHALL BE CARBON STEEL, ALL WELDED, PARALLEL BEARING BARS WITH RIGHT ANGLE CROSS MEMBERS, CONFORMING TO FS RR-G-661, TYPE I, BANDED, AND HOT DIPPED GALVANIZED.

GRATING TREADS SHALL BE FABRICATED OF FLOOR GRATING HAVING THE BEARING BAR SIZE INDICATED, STEEL FLOOR PLATE NOSING AND TOE PLATE ON EDGES, AND WITH STEEL ANGLE, OR STEEL PLATE CARRIER, AT EACH END FOR STRING CONNECTIONS AND THREADS SHALL BE SECURED TO STRINGERS WITH BOLTING. ALL ABOVE ITEMS SHALL BE GALVANIZED.

PLATFORMS SHALL BE FABRICATED OF FLOOR GRATING HAVING THE BEARING BAR SIZE INDICATED. PROVIDE NOSING MATCHING THAT ON GRATING TREADS AT ALL LANDINGS. OPEN SIDED EDGES OF FLOOR GRATING PLATFORMS SHALL BE PROVIDED WITH TOE PLATES, AND ALL OTHER EDGES SHALL BE PROVIDED WITH END BANDING BARS. GRATING SHALL BE SECURED TO PLATFORM FRAMING MEMBERS AS INDICATED ON DRAWINGS. ALL COMPONENTS SHALL BE GALVANIZED.

STAIR RAILINGS AND HANDRAILS:

STAIR RAILINGS AND HANDRAILS AT WALLS SHALL BE STEEL PIPE RAILINGS AS HEREINBEFORE SPECIFIED IN THE PARAGRAPH ENTITLED "STEEL PIPE RAILINGS".

EXTERIOR STAIRS, INCLUDING PLATFORMS, RAILINGS AND OTHER FERROUS METAL COMPONENTS, SHALL BE GALVANIZED.

USE WELDING FOR JOINING PIECES TOGETHER UNLESS OTHERWISE HEREINBEFORE SPECIFIED. BOLTS OR SIMILAR FASTENINGS SHALL NOT APPEAR ON FINISH SURFACES. MAKE JOINTS TRUE AND TIGHT, AND CONNECTIONS BETWEEN PARTS LIGHT PROOF TIGHT. ALL WELDS SHALL BE CONTINUOUS AND GROUND SMOOTH.

ERECT STAIR WORK TO LINE, PLUMB, SQUARE, TRUE, AND LEVEL. RUNS SHALL REGISTER LEVEL WITH FLOOR AND PLATFORM LEVELS.

---RAILS FOR SIDE FLAME DEFLECTORS

TOLERANCES IN THE FABRICATION AND INSTALLATION OF RAILS SHALL BE AS INDICATED ON THE DRAWINGS AND AS FOLLOWS: RAIL ALIGNMENT, RAIL GAGE, AND ELEVATION OF TOP OF RAIL SHALL EACH BE TO WITHIN $\pm$0.125 INCHES.

RAIL CROSS-SECTION SHALL CONFORM TO 100 POUND ASCE (OR 100 POUND AREA). RAILS SHALL MEET THE REQUIREMENTS OF ASTM A1-76, CLASSIFICATION NO. 1, AND SUPPLEMENTARY REQUIREMENT S2 THEREOF. RAILS SHALL BE HEAT TREATED TO A HARDNESS OF NOT LESS THAN 350 BRINELL.

JOINTS OF RAILS SHALL BE STAGGERED WITH RESPECT TO EACH OTHER. JOINTS SHALL BE CUT, IN PLAN VIEW, AT 45 DEGREES, UNLESS OTHERWISE NOTED ON THE DRAWINGS. THE TOP OF THE RAILS SHALL BE FLUSH AT ALL JOINTS.

RAIL STOPS SHALL BE PROVIDED WHERE SHOWN ON THE DRAWINGS.

FOR RAIL SYSTEM FOR PCR ROTARY BRIDGE SEE SECTION 14M OF THESE SPECIFICATIONS.

---TOILET ENCLOSURES ON SSAT---

---ENCLOSURE

FRAMING, SIDING, ROOF *AND PARTITIONS* SHALL BE AS SHOWN ON THE DRAWINGS. *MATERIALS FOR* SIDING, *ROOF AND PARTITIONS* SHALL MATCH NEW ELEVATOR HOISTWAY SIDING IN FORM AND COLOR. (B)

---STEEL FLOOR PLATE FOR SSAT TOILETS

FLOORING SHALL BE 1/8 INCH THICK STEEL PLATES JOINED WITH A FULL PENETRATION BUTT WELD, AND SEAL WELDED TO FLOOR ANGLE, OR KICK PLATE, ON THREE SIDES OF ENCLOSURE. AFTER WELDING, PLATES AND WELDS SHALL BE CLEANED AND A TROWELED ABRASIVE COATING APPLIED PER MANUFACTURER'S INSTRUCTIONS AND AS NOTED ON THE DRAWINGS.

---SPLASHBOARDS FOR URINALS (B)

URINAL SCREENS SHALL BE MOUNTED TO THE GIRT SYSTEM AND BRACED TO THE FLOOR. SIZE SHALL BE ONE INCH THICK, 24 INCHES WIDE BY 54 INCHES HIGH. CONSTRUCTION SHALL BE TWO SHEETS OF 20 GAGE GALVANIZED STEEL ASSEMBLED OVER AND BONDED TO A WATERPROOF CORE. SEAMS IN METAL SHALL BE WATERPROOF FOR OUTSIDE EXPOSURE. GALVANIZED METAL SHALL HAVE A SUITABLE PHOSPHATIZED COAT, BOND COAT AND HARD GRAY ENAMEL FINISH. PROVIDE SUITABLE CHROME-PLATED OR STAINLESS STEEL MOUNTING HARDWARE.

---TOILET FIXTURES

SEE SECTION 15H OF THE SPECIFICATIONS.

---FLUSH HOLLOW METAL DOORS (B)

FLUSH DESIGN COMMERCIAL HOLLOW METAL DOORS SHALL BE SWINGING TYPE, 1-3/4 INCHES THICK, TYPE AND CONSTRUCTION STYLE HEREINAFTER SPECIFIED, 2'-0" x 6'-8" NOMINAL SIZE, AND WITH WEATHERPROOF, NON-SEE-THROUGH METAL VENTILATION LOUVER IN LOWER THIRD OF PANEL.

FLUSH DESIGN DOORS SHALL BE COMMERCIAL TYPE, FLUSH-HOLLOW STEEL CONSTRUCTION STYLE, CONFORMING TO FS RR-D-575B, TYPE I, STYLE I, AND THE MODIFICATIONS AS FOLLOWS: (B)

FS SECTION 3.1.1, DELETE SECOND SENTENCE AND SUBSTITUTE: THE STEEL SHALL BE COLD ROLLED OR HOT ROLLED, PICKLED AND OILED. THE STEEL FOR EXTERIOR DOORS SHALL BE ELECTROLYTIC ZINC-COATED AND PHOSPHATIZED.

FS SECTION 3.2.4.1, FIRST PARAGRAPH. DELETE SECOND SENTENCE AND SUBSTITUTE: NO SEAMS SHALL OCCUR ON THE DOOR FACE, BUT SHALL EXIST ON THE VERTICAL DOOR EDGE.

FS SECTION 3.2.4.1, FIRST PARAGRAPH. DELETE SECOND SENTENCE AND SUBSTITUTE: NO SEAMS SHALL OCCUR ON THE DOOR FACE OR VERTICAL EDGE.

FS SECTION 3.2.4.1, SECOND PARAGRAPH. PANELS SHALL BE REINFORCED BY METHOD A, METHOD B, OR METHOD C.

FS SECTION 3.2.4.1, SECOND PARAGRAPH. PANELS SHALL BE REINFORCED BY METHOD D, METHOD F, OR METHOD G.

REINFORCING FOR FINISH HARDWARE SHALL BE PROVIDED FOR DOORS IN ACCORDANCE WITH THE FOLLOWING:

HARDWARE ITEM	*MINIMUM SHEET EQUIVALENT THICKNESS*
HINGES	*0.1345 INCH (NO. 10 MANUFACTURER'S STANDARD GAGE) OR EQUIVALENT NUMBER OF THREADS*
MORTISE LOCKSETS AND DEADLOCKS; BORED OR CYLINDRICAL LOCKS	*CONFORM TO FS FF-H-00106B(1) SERIES 86A-5S-32D AS SPECIFIED IN SECTION 8P OF THESE SPECIFICATIONS*
SURFACE-APPLIED CLOSERS	*0.1046 INCH (NO. 12 MANUFACTURER'S STANDARD GAGE)*

---COMMERCIAL HOLLOW METAL FRAMES (B)

COMMERCIAL HOLLOW METAL FRAMES SHALL BE MANUFACTURER'S STANDARD STOCK FRAMES CONFORMING TO FS RR-D-575B, AND THE REQUIREMENTS AS SPECIFIED HEREINAFTER. MATERIAL SHALL CONFORM TO FS RR-D-575B, EXCEPT AS FOLLOWS: FS SECTION 3.1.1, DELETE SECOND SENTENCE AND SUBSTITUTE: THE STEEL FOR EXTERIOR FRAMES SHALL BE ELECTROLYTIC ZINC-COATED AND PHOSPHATIZED. FRAMES SHALL BE FULL WELDED UNIT TYPE. FRAMES SHALL HAVE 2-INCH TRIM, 5/8-INCH STOP, EQUAL RABBETS, 1/2-INCH BACKBEND, AND THROAT OPENING TO SUIT THE WALL CONSTRUCTION. REINFORCING FOR FINISH HARDWARE SHALL BE PROVIDED FOR FRAMES AS HEREINBEFORE SPECIFIED UNDER THE PARAGRAPH HEADING "---FLUSH HOLLOW METAL DOORS."

---*INSTALLATION MATERIALS FOR DOORS AND FRAMES* (B)

MACHINE SCREWS FOR CONCEALED WORK SHALL BE GALVANIZED OR CHROME-PLATED CARBON STEEL, SLOTTED ON CROSS-RECESSED DRIVE TYPE, ROUND HEAD STYLE, CONFORMING TO FS FF-S-92A(3), TYPE I, STYLE 1S OR TYPE III, STYLE 1C. MACHINE SCREWS FOR EXPOSED-TO-VIEW WORK SHALL BE GALVANIZED OR CHROME-PLATED CARBON STEEL CROSS-RECESSED DRIVE TYPE, FLAT HEAD STYLE CONFORMING TO FS FF-S-92A(3), TYPE III, STYLE 2C or STYLE 3C TAPPING SCREWS SHALL BE THREAD FORMING, GIMLET PAINT TYPE, CONFORMING TO FS FF-S-107C(2), TYPE A.

---*INSTALLATION OF DOORS AND FRAMES* (B)

GENERAL: INSTALL HOLLOW METAL DOORS, FRAMES AND ACCESSORIES IN ACCORDANCE WITH THE APPROVED SHOP DRAWINGS AND DESCRIPTIVE DATA, AND AS SPECIFIED HEREINAFTER.

PLACING FRAMES: FRAMES SHALL BE SET ACCURATELY IN POSITION, PLUMBED, ALIGNED, AND BRACED SECURELY UNTIL PERMANENT ANCHORS ARE SET. THE BOTTOM OF FRAMES SHALL BE SECURELY ANCHORED WITH MACHINE SCREWS OR WITH POWDER-ACTIVATED FASTENERS.

HOLLOW METAL DOOR INSTALLATION: HOLLOW METAL DOORS SHALL FIT ACCURATELY IN THEIR RESPECTIVE FRAMES WITHIN THE REQUIRED DOOR CLEARANCES. DOOR CLEARANCES FOR COMMERCIAL DOORS SHALL BE AS SPECIFIED IN FS RR-D-575B.

FINISH HARDWARE INSTALLATION: FINISH HARDWARE FOR HOLLOW METAL DOORS SHALL BE INSTALLED AND ADJUSTED IN ACCORDANCE WITH THE FINISH HARDWARE MANUFACTURER'S PRINTED DIRECTIONS. DRILL AND TAP AS REQUIRED FOR THE APPLICATION OF SURFACE MOUNTED FINISH HARDWARE; LOCATE BY TEMPLATE TO INSURE ACCURATE PLACEMENT. AFTER INSTALLATION IS COMPLETED, ALL FINISH HARDWARE SHALL BE ADJUSTED AND LUBRICATED TO INSURE PROPER PERFORMANCE.

FINAL ADJUSTMENT: BEFORE FINAL ACCEPTANCE, CHECK AND READJUST AS REQUIRED ALL OPERATING HARDWARE ITEMS INSTALLED HEREIN. LEAVE WORK IN COMPLETE AND OPERATING CONDITION AS APPROVED BY THE CONTRACTING OFFICER.

---*HARDWARE FOR DOORS* (B)

HINGES: *1-1/2 PAIR OF BUTTS, T2115-4 1/2 x 4 1/2 STAINLESS STEEL.*

LATCHSET: *EQUAL TO SARGENT "MAGNALOCK" CORROSION RESISTANT SERIES 9 LINE WITH STAINLESS STEEL AND BRONZE PARTS AND SHALL OTHERWISE CONFORM TO FEDERAL SPECIFICATION 161N, AND COMPLETE WITH STRIKE.*

DEADLOCK: *DEADBOLT THROWN OR RETRACTED FROM INSIDE BY THUMB-TURN AND FROM OUTSIDE BY KEY, 5/8 INCH THROW, BRONZE OR STAINLESS STEEL CONSTRUCTION, EQUAL TO SCHLAGE B160P, FEDERAL SPECIFICATION BHMA NO. E2152, AND COMPLETE WITH BOX STRIKE.* (B)

CLOSER: *EQUAL TO SARGENT NO. 153, SURFACE MOUNTED ON INSIDE OF DOOR.*

FLOORSTOP: *EQUAL TO SARGENT NO. 3377, WITHOUT HOOK.*

---MATERIALS FOR LIGHTNING MAST---

---GENERAL

METALS SHALL BE AS NOTED ON THE DRAWINGS, AS SPECIFIED HEREIN, AND IN SECTION 5J.

---GROUNDING WIRE

ONE-HALF INCH DIAMETER, 6 X 19, IWRC, STAINLESS STEEL WIRE ROPE HAVING A BREAKING STRENGTH NOT LESS THAN 22,800 POUNDS. CONTRACTOR SHALL SUBMIT CERTIFICATION OF CONFORMANCE. ROPE SHALL BE CONTINUOUS BETWEEN NORTH AND SOUTH ANCHOR POINT CONNECTIONS.

---FIELD PAINTING---

---GENERAL

FIELD PAINTING SHALL INCLUDE TOUCH-UP OF GALVANIZED AREAS AND SHOP COATED AREAS DAMAGED BY WELDING, CUTTING, SHIPPING, HANDLING AND OTHER CAUSES BY POWER TOOL CLEANING AND APPLYING ORGANIC ZINC-RICH COATING ALL IN ACCORDANCE WITH SECTIONS 9A AND 9L OF THESE SPECIFICATIONS. COLOR TOP COATS, WHERE SPECIFIED, SHALL COMPLY WITH SECTIONS 9A AND 13L OF THESE SPECIFICATIONS.

---LADDER SAFETY CAGES

LADDER SAFETY CAGES SHALL BE BASKET GUARD HOOP TYPE, LOCATED AND DETAILED AS INDICATED ON THE DRAWINGS AND AS SPECIFIED HEREIN. CAGES SHALL BE FABRICATED FROM STRUCTURAL STEEL FLAT BARS AND ASSEMBLED BY WELDING. TOP AND BOTTOM HOOPS SHALL BE 2-1/2 INCHES BY 5/16 INCH. INTERMEDIATE HOOPS SHALL BE 2 INCHES BY 1/4 INCH AND SPACED NOT MORE THAN 4 FEET ON CENTERS. VERTICAL BARS SHALL BE 2 INCHES BY 1/4 INCH AND SPACED NOT MORE THAN 40 DEGREES ON CENTERS. △B

ALL LADDER SAFETY CAGES, INCLUDING FASTENERS, SHALL BE GALVANIZED.

SECTION 7A

BUILT-UP ROOFING RESTORATION

---GENERAL REQUIREMENTS---

---GENERAL

THE CONTRACTOR SHALL RESTORE THE BUILT-UP ROOFS OF EACH OF THE FOLLOWING FACILITIES AT KENNEDY SPACE CENTER, FLORIDA:

FACILITY NAME	BUILDING NUMBER
LOX ELECTRIC EQUIPMENT BLDG.	J7-231
RP-1 & LH_2 ELECTRIC EQUIPMENT BLDG.	J7-241
FOAM BLDG.	J7-242
OPERATIONS SUPPORT BLDG.	J7-243
COMPRESSED AIR BLDG.	J7-338
REPEATER BLDG. NO. 6	J7-986
REPEATER BLDG. NO. 5	J7-1736
ARMORED VEHICLE PARK NO. 1 (AT ECS BUILDING)	J7-337

RESTORATION INCLUDES RESATURATING THE ASPHALT FELTS, INSTALLING NEW PITCH PANS, REFILLING EXISTING PITCH PANS, INSTALLING NEW SURFACE-MOUNTED FLASHING, COATING EXISTING BITUMINOUS FLASHINGS AND PERFORMING ALL OTHER WORK AS SHOWN ON THE DRAWINGS AND AS SPECIFIED HEREIN.

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
FS	FEDERAL SPECIFICATIONS

---SHOP DRAWINGS AND DESCRIPTIVE DATA

SUBMIT DRAWINGS AND DATA AS SPECIFIED IN SECTION I, ARTICLE 7 OF THE CONTRACT SCHEDULE AND AS FOLLOWS:

MANUFACTURER'S SPECIFICATIONS FOR RESATURANT, PLASTIC CEMENT, ASPHALT PRIMER, SEALANT, FLASHING, AND FLASHING FASTENERS.

MANUFACTURER'S SPECIFICATIONS FOR APPLICATION AND/OR INSTALLATION OF ITEMS LISTED ABOVE.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS FOLLOWS:

PROVIDE LABORATORY REPORT FOR EACH MATERIAL PROPOSED FOR USE, PREPARED BY A QUALIFIED AND INDEPENDENT TESTING LABORATORY. REPORT SHALL INDICATE THE RESULTS OF TESTS AS REQUIRED IN THE REFERENCE SPECIFICATIONS, AND MATERIAL REQUIREMENTS AS SPECIFIED HEREIN.

CERTIFICATION BY MATERIALS MANUFACTURER THAT ALL MATERIALS TESTED ARE TYPICAL OF MATERIALS SHIPPED TO THE PROJECT SITE.

---DELIVERY AND STORAGE

ALL ROOFING MATERIALS SHALL BE ON THE PROJECT SITE BEFORE WORK IS BEGUN.

DELIVER ALL MATERIALS TO THE SITE IN THE MANUFACTURER'S UNBROKEN LABELLED PACKAGE. ORIGINAL PACKAGING SHALL NOT BE DISTURBED UNTIL MATERIALS ARE TO BE APPLIED. LIQUID MATERIALS SHALL BE USED DIRECTLY FROM THE FULLY LABELLED CANS IN WHICH THEY WERE SHIPPED BY THE MANUFACTURER. ONLY APPROVED ROOFING MATERIALS MAY BE BROUGHT TO, OR STORED AT, THE SITE.

ROOFING MATERIALS SHALL BE STORED IN AN APPROVED MANNER. STORAGE LOCATIONS SHALL BE APPROVED BY THE CONTRACTING OFFICER.

---PROTECTION OF PROPERTY

ANY PROPERTY OR MATERIALS DAMAGED BY CONTRACTOR'S OPERATIONS SHALL BE RESTORED TO THE ORIGINAL CONDITION, OR REPLACED WITH NEW MATERIALS, AS DETERMINED BY THE CONTRACTING OFFICER. EXTREME CARE SHALL BE TAKEN TO AVOID DRIPPAGE AND SPILLAGE OF BITUMENS AND LIQUIDS, AND DAMAGE TO GRAVEL STOPS FROM LADDERS, SCAFFOLDS, HOISTS, ETC.

---ROOF RESATURANT

ROOF RESATURANT SHALL BE AN ASPHALT-BASED MATERIAL CONTAINING ASBESTOS FIBERS AND PENETRATING OILS AND SHALL BE CAPABLE OF RESTORING PLASTIC FLOW IN AGE-HARDENED ASPHALT-IMPREGNATED FELTS AND SHALL BE CAPABLE OF BINDING SURFACE AGGREGATE. RESATURANT SHALL MEET THE REQUIREMENTS OF FS SS-A-694D. RESATURANT SHALL BE KOPPERS ROOF RESATURANT 425, TREMCO TRP ROOF PRESERVATIVE, OR COLD FLOW I AS SUPPLIED BY THE MONROE COMPANY, OR EQUAL.

---PITCH FILL

PITCH PANS SHALL BE REFILLED WITH ASPHALTIC-BASE BITUMINOUS PLASTIC CEMENT CONFORMING TO FS SS-C-153C, 1974, TYPE 1 AND COMPATIBLE WITH THE EXISTING ROOF ASPHALTS AND ASPHALT PRIMERS.

---FLASHING

FLASHING REQUIRED AT THE BASE OF WALLS INTERSECTING THE ROOF SHALL BE SURFACE-MOUNTED TYPE, CONSISTING OF ALUMINUM EXTRUSIONS AND ELASTOMERIC MEMBRANE, CAPABLE OF ACCOMMODATING MOVEMENT DUE TO VARYING TEMPERATURES, EQUIPPED WITH CONCEALED FASTENERS AND MISCELLANEOUS ACCESSORIES AND SHALL BE TREMLINE WALL FLASHING AS MANUFACTURED BY TREMCO, CLEVELAND, OHIO, OR EQUAL.

---SEALANT

SEALANT SHALL BE AN ACRYLIC TERPOLYMER TYPE, WHITE, CONFORMING TO FS TT-S-00230C, 1970, TYPE I, CLASS A.

---ASPHALT

ASPHALT USED TO SEAL ELASTOMERIC MEMBRANE OF FLASHING TO ROOF SHALL CONFORM TO ASTM D312-71, TYPE III.

---FELT

FELT FOR ROOFING REPAIRS SHALL CONFORM TO ASTM D226-75, OF WEIGHTS AS NOTED ON THE DRAWINGS.

---WOOD BLOCKING

WOOD BLOCKING SHALL BE CUT FROM NO. 2, OR BETTER, SOUTHERN PINE PRESSURE-TREATED IN ACCORDANCE WITH ASTM D1760-76, TABLE I, FOR ABOVEGROUND USE.

---COATING FOR BITUMINOUS FLASHING

COATING FOR BITUMINOUS FLASHING SHALL BE AN ASPHALT BASED ALUMINUM ROOF COATING CONFORMING TO ASTM D2824-69.

---ASPHALT PRIMER

ASPHALT PRIMER SHALL BE AN ASPHALTIC-BASE MATERIAL CONFORMING TO ASTM D41-73.

---AGGREGATE

AGGREGATE FOR ROOF SURFACING SHALL BE CRUSHED WASH CRYSTALLINE WHITE MARBLE CHIPS, OPAQUE, DRY AND FREE FROM DIRT, CLAY, LOAM, SAND, ELONGATED FLAT OR SHARP-EDGED PARTICLES. FOREIGN MATERIALS, WHICH BY THEMSELVES OR IN SOLUTION WITH WATER WOULD CAUSE DETERIORATION OR STAINING OF ANY METAL WITH WHICH THEY WOULD COME IN CONTACT, SHALL BE REMOVED.

GRADING OF AGGREGATE AT TIME OF APPLICATION SHALL CONFORM TO THE FOLLOWING:

PERCENTAGE PASSING A 5/8 INCH SIEVE AND RETAINED ON A 1/4 INCH SIEVE NOT LESS THAN	100

AN ALTERNATE AGGREGATE MAY BE PROVIDED CONFORMING TO ASTM D1863-64 (1970), EXCEPT THAT SLAG SHALL NOT BE USED.

---INSTALLATION---

---RESATURATION

EACH OF THE FACILITY ROOFS LISTED IN THE "GENERAL" PARAGRAPH OF THIS SECTION SHALL RECEIVE A RESATURANT APPLICATION AS FOLLOWS:

ALL LOOSE ROOF SURFACE AGGREGATE (MARBLE CHIPS) SHALL BE REMOVED FROM THE ROOF. THEN, THE ROOF SURFACE SHALL BE CLEANED BY AIR PRESSURE, VACUUM CLEANER OR BY OTHER METHOD APPROVED BY THE CONTRACTING OFFICER SO THAT ALL SILT, DUST AND OTHER FOREIGN PARTICLES ARE REMOVED. MECHANICAL EQUIPMENT, PLUMBING PENETRATIONS AND OTHER EXISTING ROOF STRUCTURES SHALL BE PROTECTED FROM RESATURANT OVERSPRAY AND OTHER CONTRACTOR OPERATIONS.

WHEN THE ROOF IS CLEAN AND DRY, THE CONTRACTOR SHALL APPLY RESATURANT TO THE ROOF SURFACE EVENLY AT THE RATE OF AT LEAST SEVEN GALLONS PER ONE HUNDRED SQUARE FEET AND IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

SURFACE AGGREGATE SHALL BE REPLACED ON THE ROOF AND SPREAD EVENLY TO COVER THE SURFACE AT FIVE LBS. PER SQUARE FOOT. EXISTING AGGREGATE MAY BE RE-USED ONLY AFTER IT IS WASHED AND DRY AND FREE OF DIRT, CLAY, SILT, LOAM, SAND AND OTHER FOREIGN PARTICLES. IF THE EXISTING AGGREGATE IS NOT SUFFICIENT TO PROVIDE A SURFACE COATING OF FIVE LBS. PER SQUARE FOOT, THE CONTRACTOR SHALL PROVIDE THE DIFFERENCE IN NEW AGGREGATE MEERING THIS SPECIFICATION AT NO ADDITIONAL COST TO THE GOVERNMENT. ALL NEW AGGREGATE MAY BE PROVIDED AT THE CONTRACTOR'S OPTION.

---OTHER RESTORATION

THE CONTRACTOR SHALL ACCOMPLISH THE FOLLOWING WORK AT EACH OF THE FACILITIES LISTED BELOW:

LOX ELECTRIC EQUIPMENT BLDG. (J7-231)

REFILL TWO PITCH PANS WITH PLASTIC CEMENT. FINISHED SURFACE OF CEMENT SHALL BE CONVEX TO SHED WATER.

COAT BITUMINOUS FLASHINGS AT TWO ROOF OPENINGS ON THE VERTICAL SURFACE AND ON THE CANTS WITH REFLECTIVE ALUMINUM COATING AT THE MINIMUM RATE OF 3/4 GALLON PER HUNDRED SQUARE FEET AND IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. PRIOR TO APPLICATION OF THE COATING, SURFACES TO RECEIVE COATING SHALL BE CLEANED AS FOR RESATURATION AND PRIMED WITH ASPHALT PRIMER AT THE RATE OF 3/4 GALLON PER HUNDRED SQUARE FEET. APPLY COATING TO FLASHINGS PRIOR TO RESATURATION OF ROOF.

RP-1 & LH_2 ELECTRIC EQUIPMENT BLDG. (J7-241)

COAT BITUMINOUS FLASHINGS AT TWO ROOF OPENINGS. (SEE LOX ELECTRIC EQUIPMENT BLDG. - J7-231 FOR REQUIREMENTS.)

FOAM BLDG. (J7-242)

COAT BITUMINOUS FLASHINGS AT ONE ROOF OPENING. (SEE LOX ELECTRIC EQUIPMENT BLDG. - J7-231 FOR REQUIREMENTS.)

OPERATIONS SUPPORT BLDG. (J7-243)

ROOF DECK CONSISTS OF OPEN WEB STEEL JOISTS SUPPORTING GYPSUM FORMBOARDS WHICH ARE SEPARATED BY STEEL BULB TEES. CONTRACTOR SHALL CLEAN EXPOSED STEEL OF OPEN WEB JOISTS AND TEES WITH POWER TOOLS IN ACCORDANCE WITH STEEL STRUCTURES PAINTING COUNCIL (SSPC) SURFACE PREPARATION SPECIFICATION NO. 3 (PER SPEC SECTION 9L) AND PAINT SAME WITH TWO COATS OF ORGANIC ZINC-RICH COATING, FOUR MILS DRY FILM THICKNESS EACH COAT IN ACCORDANCE WITH SPEC SECTION 9L.

COMPRESSED AIR BLDG. (J7-338)

COAT BITUMINOUS FLASHINGS AT TWO ROOF OPENINGS. (SEE LOX ELECTRIC EQUIPMENT BLDG. - J7-231 FOR REQUIREMENTS.)

REPEATER BLDG. NO. 6 (J7-986)

REFILL FOUR PITCH PANS.

COAT BITUMINOUS FLASHINGS AT TWO ROOF OPENINGS.

SEE LOX ELECTRIC EQUIPMENT BLDG. - J7-231 FOR REQUIREMENTS FOR BOTH ITEMS.

REPEATER BLDG. NO. 5 (J7-1736)

REFILL SIX PITCH PANS.

COAT BITUMINOUS FLASHINGS AT TWO ROOF OPENINGS.

SEE LOX ELECTRIC EQUIPMENT BLDG. - J7-231 FOR REQUIREMENTS FOR BOTH ITEMS.

ARMORED VEHICLE PARK NO. 1 (AT J7-337)

INSTALL SEVEN PITCH PANS AND FILL WITH PLASTIC CEMENT AT SEVEN EXISTING PIPE SUPPORTS ON THE ROOF. SEE DRAWINGS.

PRIOR TO RESATURATION, REPAIR ALL SOFT AREAS AND LARGE BLISTERS (TWO FEET OR MORE IN SIZE IN ANY DIRECTION) AS ENCOUNTERED AS FOLLOWS:

A CROSS-CUT INCISION SHALL BE MADE, CUTTING ONLY THE BLISTERED PLIES OF FELT. THE FOUR SEGMENTS SHALL BE FOLDED BACK, AND ANY WATER IN THE BLISTER SHALL BE MOPPED OUT AND THE AREA ALLOWED TO DRY. TROWEL ASPHALTIC-BASE BITUMINOUS PLASTIC CEMENT CONFORMING TO FS SS-C-153C,

TYPE 1 INTO THE BLISTER AND FOLD DOWN THE FOUR SEGMENTS INTO THE CEMENT. TROWEL ANOTHER COAT OF THE CEMENT OVER THE BLISTER AND EMBED REINFORCED GLASS MEMBRANE CONFORMING TO ASTM D1668-73, TYPE 1 TO COVER AT LEAST SIX INCHES BEYOND THE EDGE OF THE BLISTER. TOP-DRESS WITH A LIBERAL COAT OF PLASTIC CEMENT.

REMOVE AND DISPOSE OF EXISTING ALUMINUM BASE FLASHING AT INTERSECTING WALLS TO THE EXTENT SHOWN ON THE DRAWINGS AND REPLACE WITH A NEW SURFACE-MOUNTED FLASHING SYSTEM. INSTALL NEW SYSTEM IN ACCORDANCE WITH FLASHING MANUFACTURER'S INSTRUCTIONS. AT EXISTING OBSTRUCTIONS (INCLUDING DUCT WORK AND PIPE VENT), TERMINATE ALUMINUM SECTION, RUN ELASTOMERIC MEMBRANE BENEATH OBSTRUCTION AND SEAL ALUMINUM SECTION TERMINATION AND ELASTOMERIC MEMBRANE ALL AROUND AT TERMINATION WITH THE SPECIFIED SEALANT ON THE WALL AND ASPHALT ON THE ROOF. SPLICE JOINT BETWEEN NEW AND EXISTING FLASHING SHALL BE MADE BY EXTENDING ELASTOMERIC MEMBRANE AT LEAST 12" UNDER EXISTING FLASHING AND SEALING EXPOSED EDGES OF THE MEMBRANE AS REQUIRED TO MAKE THE JOINT WATER-TIGHT.

ALL FASTENERS FOR ALUMINUM SHALL BE ALUMINUM; OR, STAINLESS STEEL WITH NYLON, OR NEOPRENE, WASHERS UNDER HEADS AND NUTS ON FASTENER SHANK.

REPLACE WOOD BLOCKING AND REPAIR DETERIORATED FELTS AT SOUTH EDGE OF ROOF AS SHOWN. NEW WOOD BLOCKING SHALL BE PRESSURE-TREATED AND CUT TO SIZE AND FASTENED AS DETAILED. FELTS SHALL BE REPAIRED TO THE EXTENT SHOWN ON THE DRAWINGS AND AS SPECIFIED HEREIN.

SECTION 7H

CAULKING AND SEALING

---GENERAL REQUIREMENTS---

---GENERAL

THE CONTRACTOR SHALL PROVIDE THE HEREINAFTER SPECIFIED COMPATIBLE SEALANTS AT JOINTS OF NEW CONCRETE PAVEMENT. ON THE LAUNCH PAD 39B SURFACE THE CURED SEALANT MATERIAL SHALL BE CAPABLE OF WITHSTANDING THE HIGH TEMPERATURES ASSOCIATED WITH LAUNCH CONDITIONS (UP TO 400°F IN CONTINUOUS SERVICE, AND AS HIGH AS 6000°F FOR SEVERAL SECONDS). FOR SEALING OF STEEL SURFACES, SEE SECTION 9L, PAGE 9L-3.

---REFERENCE STANDARDS: ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
FS	FEDERAL SPECIFICATIONS

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATE OF CONFORMANCE FOR MATERIALS.

CERTIFIED LABORATORY REPORTS FOR POLYETHYLENE BACK-UP MATERIAL PROPERTIES.

---DESCRIPTIVE DATA

SUBMIT DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

SEALANT COMPOUND MANUFACTURER'S PRINTED INSTRUCTIONS COVERING THE PROPER MIXING PROPORTIONS, PROCEDURES, AND SUGGESTED EQUIPMENT FOR MIXING TWO COMPONENT SEALANTS.

MANUFACTURER'S PRINTED INSTRUCTIONS FOR THE TYPE OF SEALANT COMPOUND PROPOSED FOR USE IN THE WORK, COVERING SURFACE PREPARATION, RECOMMENDED JOINT DIMENSIONS, AND SEALANT COMPOUND APPLICATION.

---SAMPLES

SUBMIT SAMPLES AS SPECIFIED IN THE "CONTRACT SCHEDULE" OF THE FOLLOWING:

SAMPLE CONTAINERS OF SEALANTS AND CONDITIONERS SHALL INCLUDE THE FOLLOWING INFORMATION ON THE LABEL: SUPPLIER, NAME OF MATERIAL, FORMULA OR SPECIFICATION NUMBER, LOT NUMBER, COLOR, DATE OF MANUFACTURE, MIXING INSTRUCTIONS, LIFE EXPECTANCY OF THE APPLICATION, CURING TIME, AND SHELF LIFE, AND CONFORMITY TO REFERENCED SPECIFICATIONS.

POLYETHYLENE BACK-UP MATERIAL SAMPLES OF EACH ROD SIZE TO BE USED IN THE WORK, FULL-SIZE BY 12 INCHES LONG.

---DELIVERY AND STORAGE OF MATERIALS

MATERIALS SHALL BE STORED IN THEIR ORIGINAL UNBROKEN PACKAGE OR CONTAINERS IN A WEATHER-TIGHT, DRY LOCATION PROTECTED FROM MOISTURE AND HIGH HUMIDITY.

---MATERIALS---

---SOLVENT

SOLVENT FOR CLEANING OF BONDING SURFACE SHALL BE OIL-FREE AND AS SPECIFIED BY THE SEALANT MANUFACTURER.

---POLYETHYLENE BACK-UP MATERIAL

POLYETHYLENE BACK-UP MATERIAL SHALL BE EXPANDED CLOSED-CELL POLYETHYLENE ROD. ROD DIAMETER SHALL BE AT LEAST 30 PERCENT GREATER THAN JOINT WIDTH. POLYETHYLENE PROPERTY VALUES SHALL BE AS FOLLOWS:

PROPERTY	TEST METHOD	VALUE
DENSITY	ASTM D1622-73 (1970)	2 TO 5 POUNDS PER CUBIC FOOT
COMPRESSION DEFLECTION, 25 PERCENT DEFLECTION LIMITS	ASTM D1056-68	NOT LESS THAN 20 POUNDS PER SQUARE INCH
TENSILE STRENGTH	ASTM D1623-72	NOT LESS THAN 20 POUNDS PER SQUARE INCH
WATER ABSORPTION	ASTM D1056-68	NOT MORE THAN 5 PERCENT BY WEIGHT

---SURFACE CONDITIONER - PRIMER

PRIMERS SHALL BE AS SPECIFIED BY THE SEALANT MANUFACTURER FOR CONCRETE SURFACES.

---SEALANT FOR ALL AREAS EXCEPT TOP OF LAUNCH PAD 39B

SHALL BE DOW CORNING NO. 790 BUILDING SEALANT CONFORMING TO FS TT-S-001543; OR, GENERAL ELECTRIC "SILPRUF" WEATHER-PROOFING SEALANT CONFORMING TO FS TT-S-001543.

---SEALANT FOR TOP OF LAUNCH PAD (EL. 53'-0"±) - HIGH TEMPERATURE

SHALL BE GENERAL ELECTRIC COMPANY RTV-577 WITH SS-4004 PRIMER; OR, DOW CORNING E2619-129B WITH 1200 PRIMER.

---INSTALLATION---

---GENERAL

INSTALL SEALING MATERIALS IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

---WEATHER LIMITATIONS

SEALANT COMPOUNDS SHALL NOT BE APPLIED IN DAMP OR RAINY WEATHER NOR UNTIL THE SURFACES OF JOINTS TO BE SEALED HAVE THOROUGHLY DRIED FROM THE EFFECTS OF SUCH WEATHER.

---PREPARATION FOR SEALING - SURFACE CLEANING

THE SURFACE OF JOINTS TO BE SEALED SHALL BE CLEANED FREE OF LOOSE PARTICLES, SURFACE DUST, AND OTHER FOREIGN MATTER BY BRUSHING, GRINDING OR OTHER APPROVED METHODS.

THE BONDING SURFACES SHALL BE WASHED USING CLEAN BRUSHES AND/OR RAGS WET WITH MANUFACTURER'S RECOMMENDED CLEAN OIL-FREE SOLVENT.

THE SOLVENT SHALL BE ALLOWED TO AIR DRY COMPLETELY PRIOR TO APPLICATION OF SURFACE CONDITIONER, OR PRIMER.

JOINTS PREPARED FOR SEALING SHALL BE INSPECTED PRIOR TO INSTALLATION OF BACK-UP MATERIAL AND PRIOR TO APPLICATION OF SEALANT COMPOUND TO INSURE CLEANLINESS AND FREEDOM FROM CONSTRUCTION DUST.

---APPLICATION OF SURFACE CONDITIONER - PRIMER

A THIN COAT OF SURFACE CONDITIONER (PRIMER), WHERE REQUIRED, SHALL BE APPLIED TO THE SURFACES OF THE JOINTS TO BE SEALED BY SPRAYING OR BRUSHING IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

---INSTALLATION OF POLYETHYLENE BACK-UP MATERIAL

POLYETHYLENE FOAM ROPE OR RODS SHALL BE ROLLED INTO THE JOINT CAVITY IN A MANNER TO AVOID LENGTHWISE STRETCHING, TWISTING AND BRAIDING, BUT TO PROVIDE A CONCAVE SHAPE TO THE BOTTOM OF THE SEALANT AND TO PARTIALLY FILL THE JOINT SO THAT THE DEPTH OF THE SEALANT BEAD IS NOT TOO GREAT FOR GOOD JOINT DESIGN.

BACK-UP MATERIAL SHALL BE INSTALLED AFTER THE SURFACE CONDITIONER IS APPLIED TO PREVENT BONDING OF SEALANT TO BACK-UP MATERIAL.

---PREPARING SEALANT COMPOUNDS

THE SEALING COMPOUND SHALL BE PREPARED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

UNIFORMITY OF COLOR SHALL INDICATE THOROUGH MIXING.

---APPLICATION OF SEALANT COMPOUNDS

SEALANT SHALL BE APPLIED BY LOADING INTO CARTRIDGES FOR PRESSURE APPLICATION.

SEALANT SHALL BE FORCED INTO JOINTS TO INSURE SURFACE CONTACT. SEALANT BEAD AND FINISH TOOLING SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

SEALANT BEAD DEPTH SHALL NOT EXCEED ONE-HALF ITS WIDTH. MAXIMUM SEALANT WIDTH SHALL NOT EXCEED ONE INCH.

FINISHED JOINTS SHALL HAVE A CONCAVE SHAPE BETWEEN BONDING SURFACES AS INDICATED ON THE DRAWINGS.

---INSPECTION AND ACCEPTANCE PROVISIONS---

---FINISHED SEALING REQUIREMENTS

SEALING WORK WILL BE REJECTED FOR ANY OF THE FOLLOWING DEFICIENCIES:

SEALANT COMPOUND-IN-PLACE THAT FAILS TO ADHERE TO THE JOINT SURFACES AT THE SIDES OF JOINT.

SEALANT USED DOES NOT COMPLY WITH MATERIAL SPECIFIED.

---REPAIR OF DEFECTIVE WORK

DEFECTIVE WORK SHALL BE REMOVED AND REPLACED WITH SEALANT MATERIALS THAT MEET THE REQUIREMENTS OF THIS SECTION AND AT NO ADDITIONAL COST TO THE GOVERNMENT.

SECTION 9A

PAINTING AND FINISHING

---GENERAL REQUIREMENTS---

---GENERAL

THE COMPLETE SSAT, INCLUDING STRUCTURAL STEEL, ELEVATOR MACHINERY ROOM, EXTERIOR HAMMERHEAD CRANE, ASSOCIATED CATWALKS AND ALL OTHER NEW NON-GALVANIZED STRUCTURAL AND OTHER MISCELLANEOUS STEEL WORK SHALL HAVE APPLIED AN INORGANIC ZINC-RICH PROTECTIVE COATING TO CARBON STEEL AS OUTLINED IN SECTION 9L OF THE SPECIFICATION. ALL CORRODED OR DAMAGED COATING AREAS OF THE EXISTING ML TOWER WHICH SHALL BE USED TO CONSTRUCT THE NEW SSAT, SHALL BE REPAIRED AND CLEANED PRIOR TO APPLICATION OF FINAL PROTECTIVE COATING IN ACCORDANCE WITH SECTION 9L. SEE SECTION 13L FOR FINISH COLOR SCHEDULE.

ALL NEW, NON-GALVANIZED STEEL AS ABOVE SPECIFIED AND THE EXTERIOR OF ALL NEW NON-GALVANIZED AND NON-COAL-TAR-COATED FERROUS PIPE AND FITTINGS SHALL HAVE A SHOP-APPLIED INORGANIC ZINC-RICH PROTECTIVE COATING AS OUTLINED IN SECTION 9L OF THE SPECIFICATIONS.

ALL STRUCTURAL STEEL SURFACES HAVING ZINC-RICH COATINGS THAT ARE DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE CLEANED AND TOUCHED-UP WITH ZINC-RICH PROTECTIVE COATING OF THE TYPE SPECIFIED IN SECTION 9L OF THE SPECIFICATIONS. ALSO, INTERIOR OF BLDG. #J7-385 SHALL BE PAINTED.

THIS SECTION OF THE SPECIFICATIONS COVERS THE PAINTING AND FINISHING FOR ALL METAL SURFACES, IN ADDITION TO THOSE HEREIN SPECIFIED TO RECEIVE THE HEREINAFTER REFERENCED ZINC-RICH PROTECTIVE COATING OF CARBON STEEL (SECTION 9L).

CERTAIN ZINC-RICH COATED SURFACES SHALL HAVE A PRIMER AND COLOR TOP COATS APPLIED. MATERIALS SHALL BE AS HEREINAFTER SPECIFIED. COLORS FOR TOP COATS SHALL BE AS SPECIFIED UNDER SECTION 13L - COLOR FINISH SCHEDULE AND PIPING IDENTIFICATION.

---SPECIAL COATINGS

SOUND SUPPRESSION PIPING AND UNDERGROUND PIPING SHALL BE COATED AND LINED AS SPECIFIED IN SECTIONS 15E AND 15H OF THE SPECIFICATIONS.

CHILLED WATER SUPPLY AND RETURN PIPING SHALL BE ABRASIVE BLASTED, PRIMED, EPOXY COAL-TAR COATED, INSTALLED AND TOUCHED-UP AS HEREINAFTER SPECIFIED IN SECTION 15H OF THE SPECIFICATIONS.

---SURFACES NOT TO BE CLEANED BY BLASTING

GALVANIZED SURFACES. CONCRETE SURFACES. GLASS.
PREFINISHED SURFACES HAVING CERAMIC OR BAKED ENAMEL FINISH COATS
FACTORY PRIMED ELECTRICAL BOXES, ELECTRICAL PANELS AND SUPPORTING ACCESSORIES
BRASS AND BRONZE
STAINLESS STEEL PIPE AND PLATE BOLT AND SCREW THREADS

---REFERENCED STANDARDS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

FS	FEDERAL SPECIFICATIONS
MS	MILITARY SPECIFICATIONS
SSPC	STEEL STRUCTURES PAINTING COUNCIL

THE TOPSOIL SURFACE SHALL BE MADE SMOOTH BY HARROWING WITH A SPIKE-TOOTH HARROW OR FLOAT DRAG.

---CLEAN-UP

AFTER SMOOTH GRADING, THE TOPSOIL SURFACE SHALL BE CLEARED OF STONES OR OTHER OBJECTS LARGER THAN 2 INCHES IN ANY DIMENSION, AND OF ROOTS, BRUSH, WIRE, GRADE STAKES, OR OTHER OBJECTS THAT MIGHT BE A HINDERANCE TO PLANTING OR MAINTENANCE OPERATIONS.

ANY TOPSOIL OR OTHER MATERIAL WHICH HAS BEEN BROUGHT UPON THE SURFACING OF PAVED AREAS BY HAULING OPERATIONS SHALL BE REMOVED PROMPTLY WITH DUE CARE TO PREVENT DAMAGE TO PAVEMENTS. THE WHEELS OF VEHICLES SHALL BE CLEANED TO AVOID BRINGING DIRT UPON THE SURFACING OF PAVED AREAS.

---SEEDING---

---METHOD OF SOWING

A METHOD OF SOWING SATISFACTORY TO THE CONTRACTING OFFICER SHALL BE EMPLOYED, USING A MECHANICAL SPREADER OR OTHER APPROVED SOWING EQUIPMENT.

SEEDING, MAKING USE OF A MIXTURE OF SEED, FERTILIZER, AND WATER APPLIED BY SPECIAL MOBILE EQUIPMENT DESIGNED FOR THE PURPOSE MAY BE EMPLOYED, SUBJECT TO THE APPROVAL OF THE CONTRACTING OFFICER. IF THE ABOVE METHOD OF SEEDING IS EMPLOYED, THE COVERING OF SEED AND COMPACTION OPERATION SPECIFIED HEREINAFTER SHALL BE WAIVED.

---PREPARATION OF SEEDBED

THE SEEDBED SHALL BE LOOSE AND POROUS AT TIME OF SEEDING. IF NECESSARY, THE SEEDBED SHALL BE LOOSENED TO A DEPTH OF AT LEAST 3 INCHES BY HARROWING OR OTHER SUITABLE MEANS, AND THE SURFACE SMOOTH GRADED AND CLEARED OF OBJECTIONABLE MATERIAL AS SPECIFIED FOR "SMOOTH GRADING" AND "CLEAN-UP" IN THE ARTICLE ENTITLED "TOPSOILING".

---PLANTING SEED

GRASS SEED SHALL BE UNIFORMLY DISTRIBUTED OVER THE PREPARED SEEDBED AS FOLLOWS:

RATE OF SEEDING SHALL BE 5 POUNDS PER 1000 SQUARE FEET.

IMMEDIATELY AFTER PLANTING SEED, THE AREA SHALL BE LIGHTLY RAKED OR LIGHTLY HARROWED (BY MEANS OF A SPIKE-TOOTH HARROW OR OTHER SUITABLE EQUIPMENT) SO AS TO COVER THE SEED TO AN AVERAGE DEPTH OF 1/4 INCH.

---COMPACTING

IMMEDIATELY AFTER COMPLETION OF PLANTING SEED OPERATIONS, THE ENTIRE AREA SHALL BE COMPACTED BY MEANS OF SUITABLE COMPACTING EQUIPMENT.

COMPACTING EQUIPMENT SHALL CONSIST OF A CULTIPACKER, ROLLER, OR OTHER APPROVED EQUIPMENT WEIGHING 60 TO 90 POUNDS PER LINEAR FOOT OF ROLLER WIDTH, AND SHALL BE SUITABLE FOR THE SOIL MATERIAL BEING COMPACTED. THE WHEELS OF PNEUMATIC-TIRED ROLLERS SHALL OSCILLATE BUT NOT WOBBLE, AND SHALL BE SO SPACED THAT ONE PASS OF THE ROLLER WILL ACCOMPLISH ONE COMPLETE COVERAGE EQUAL TO THE ROLLING WIDTH OF THE EQUIPMENT.

---MULCHING---

---PLACING MULCH

NOT MORE THAN 48 HOURS AFTER THE COMPLETION OF SEEDING OPERATIONS, MULCH SHALL BE SPREAD UNIFORMLY OVER THE ENTIRE AREA IN A CONTINUOUS BLANKET HAVING A DEPTH OF NOT MORE THAN 1-1/2 INCHES LOOSE MEASUREMENT, AND USING APPROXIMATELY 90 POUNDS OF MULCH PER 1000 SQUARE FEET.

THE MULCH SHALL BE SPREAD BY HAND OR BY BLOWERS OR OTHER SUITABLE EQUIPMENT. MULCHING SHALL BE STARTED AT THE WINDWARD SIDE OF RELATIVELY FLAT AREAS, AND AT THE UPPER PART OF STEEP SLOPES, AND SHALL CONTINUE UNIFORMLY UNTIL THE AREA IS COMPLETELY COVERED.

---ANCHORING MULCH WITH MACHINERY

THE MULCH SHALL BE ANCHORED IN PLACE BY A COULTER DISK TYPE MULCH ANCHORING MACHINE, OR OTHER SUITABLE EQUIPMENT THAT WILL SECURE THE MULCH FIRMLY IN THE GROUND TO FORM A SOIL-BINDING MULCH, AND TO PREVENT LOSS OR BUNCHING OR THE MULCH BY WIND. THE NUMBER OF PASSES OVER THE MULCH NEEDED TO SECURE IT FIRMLY TO THE SOIL SHALL IN NO CASE EXCEED THREE.

ON SLOPES AND OTHER AREAS WHERE MACHINERY CANNOT BE USED SATISFACTORILY, THE MULCH SHALL BE ANCHORED IN PLACE BY A SPRAY COATING OF ASPHALT EMULSION, OR BY TWINE AND SOFTWOOD STAKES, OR BY OTHER APPROVED MEANS WHICH WILL NOT BE DETRIMENTAL TO SUBSEQUENT MAINTENANCE.

---GENERAL

GRASS ESTABLISHMENT SHALL BEGIN IMMEDIATELY AFTER THE COMPLETION OF MULCHING IN AN AREA AND SHALL CONTINUE FOR A PERIOD OF TWO MONTHS AFTER THE COMPLETION OF THE SEEDING ON THE ENTIRE PROJECT, UNLESS THE DESIRED GRASS COVER IS ESTABLISHED IN A SHORTER PERIOD OF TIME, AND THE SHORTENING OF THE GRASS ESTABLISHMENT PERIOD IS AUTHORIZED BY THE CONTRACTING OFFICER.

---WATERING

FURNISH, INSTALL, AND MAINTAIN TEMPORARY PIPING, GARDEN HOSE, SLOW ROTATING SPRINKLER HEADS, AND OTHER LAWN WATERING EQUIPMENT REQUIRED TO CONVEY WATER FROM THE WATER SOURCES AND TO UNIFORMLY WATER THE SEEDED AREAS. WATER SHALL BE FREE FROM OIL, ACID, ALKALI, SALT, AND OTHER SUBSTANCES DETRIMENTAL TO THE GROWTH OF VEGETATION. WATER SOURCES LOCATED ON GOVERNMENT PROPERTY SHALL BE SUBJECT TO THE APPROVAL OF THE CONTRACTING OFFICER PRIOR TO USE. TEMPORARY WATERING EQUIPMENT SHALL BE REMOVED AFTER GRASS AREA ACCEPTANCE.

ARRANGE WATERING SCHEDULES AND LAY OUT LAWN WATERING EQUIPMENT IN MANNER TO AVOID WALKING OVER MUDDY AND NEWLY SEEDED AREAS.

WATERING SHALL BE DONE IN A MANNER TO PREVENT THE DISPLACEMENT OF SEED AND MULCH, AND TO PREVENT PUDDLING AND WATER EROSION.

IMMEDIATELY AFTER THE COMPLETION OF MULCHING IN ANY AREA, THOROUGHLY MOISTEN THE AREA TO A DEPTH OF THREE INCHES OR MORE.

AFTER THE INITIAL WATERING, THE SEEDED AREAS SHALL BE WATERED AS REQUIRED TO MAINTAIN THE SOIL IN MOIST CONDITION FOR THE ENTIRE GRASS ESTABLISHMENT PERIOD.

---MOWING

THE SEEDED FIELD GRASS AREAS SHALL BE MOWED WITH APPROVED EQUIPMENT TO A GRASS HEIGHT OF FOUR INCHES WHENEVER THE AVERAGE HEIGHT OF GRASS BECOMES EIGHT INCHES OR WHENEVER THE GRASS GROWTH TENDS TO SMOTHER THE SEEDLINGS.

---WEEDING

IF WEEDS OR OTHER UNDESIRABLE VEGETATION THREATEN TO SMOTHER THE GRASS, SUCH VEGETATION SHALL BE UPROOTED AND REMOVED FROM THE AREA.

---REFERTILIZING

AFTER THE FIRST MOWING, AND DURING A PERIOD WHEN THE GRASS IS DRY, FERTILIZER SHALL BE UNIFORMLY DISTRIBUTED OVER THE SEEDED AREA AT A RATE OF TWO POUNDS OF ACTUAL NITROGEN PER 1000 SQUARE FEET. FERTILIZER SHALL BE AS SPECIFIED IN THE ARTICLE ENTITLED "MATERIALS".

---RESEEDING

AFTER THE FIRST MOWING, BARE AREAS SHALL BE RESEEDED.

RESEEDING SHALL BE WITH THE GRASS SEED HEREINBEFORE SPECIFIED FOR EACH SEEDED AREA, AND SHALL BE SOWN AT A RATE SPECIFIED IN THE ARTICLE ENTITLED "SEEDING", IN A MANNER THAT WILL CAUSE A MINIMUM OF DISTURBANCE TO THE EXISTING STAND OF GRASS AND TO THE MULCH.

---REMULCHING

IN AREAS WHERE MULCH HAS BEEN DISTURBED SUFFICIENTLY BY THE WIND, OR IN THE PROCESS OF RESEEDING, OR FROM OTHER CAUSES TO NULLIFY ITS PURPOSE, THE MULCH SHALL BE REPLACED WITH NEW MULCH AND ANCHORED AS SPECIFIED IN THE ARTICLE ENTITLED "MULCHING".

---DISPOSAL OF WASTE MATERIALS---

---REMOVAL OF WASTE MATERIAL

WASTE MATERIALS, INCLUDING EXCAVATED SUBSOIL MATERIAL, GRASS CUTTING, WEED PLANTS, TRASH AND DEBRIS, SHALL BE REMOVED TO THE DESIGNATED GOVERNMENT AREA AT NO ADDITIONAL COST TO THE GOVERNMENT.

---INSPECTION AND ACCEPTANCE PROVISIONS---

---NOTICE OF INSPECTION

INSPECTION OF SPECIFIED WORK TO DETERMINE ITS COMPLETION WILL BE MADE BY THE CONTRACTING OFFICER AT THE CONCLUSION OF THE GRASS ESTABLISHMENT PERIOD. THE CONTRACTOR SHALL SUBMIT A WRITTEN NOTICE REQUESTING SUCH INSPECTION AT LEAST 10 CALENDAR DAYS PRIOR TO THE ANTICIPATED DATE OF INSPECTION.

---ACCEPTANCE REQUIREMENTS

THE COMPLETED GRASS AREAS SHALL BE RECENTLY MOWED, COVERED WITH A UNIFORM STAND OF THE SPECIFIED GRASS, FREE OF RANK GROWTHS OF WEEDS OR OTHER UNDESIRABLE VEGETATION, AND FREE OF IRREGUALR SURFACE CHANGES AND OTHER DEPRESSIONS WHERE WATER WILL STAND.

SCATTERED BARE SPOTS, NONE OF WHICH IS LARGER THAN 6 INCHES IN ANY DIMENSION, WILL BE ALLOWED, UP TO A MAXIMUM OF THREE PERCENT OF ANY GRASS AREA.

THE CONDITION OF GRASS AREAS AT THE TIME OF INSPECTION WILL BE NOTED AND DETERMINATION MADE BY THE CONTRACTING OFFICER WHETHER THE LAWN ESTABLISHMENT PERIOD SHALL BE EXTENDED FOR ANY AREA. SUCH EXTENSION OF THE GRASS ESTABLISHMENT PERIOD TO PROVIDE ACCEPTABLE GRASS AREAS SHALL BE AT NO ADDITIONAL COST TO THE GOVERNMENT.

GRASS ESTABLISHMENT REMAINING TO BE DONE SHALL BE SUBJECT TO REINSPECTION BY THE CONTRACTING OFFICER.

---REPAIRS

IF AT ANY TIME BEFORE COMPLETION AND ACCEPTANCE OF THE ENTIRE WORK COVERED BY THIS CONTRACT, ANY PORTION OF THE SURFACE BECOMES GULLIED OR OTHERWISE DAMAGED FOLLOWING SEEDING, OR THE GRASS SEEDLINGS HAVE BEEN DESTROYED, THE AFFECTED AREA SHALL BE REPAIRED TO RE-ESTABLISH THE CONDITION AND GRADE OF THE SOIL PRIOR TO SEEDING AND SHALL THEN BE RESEEDED, REMULCHED AND THE GRASS ESTABLISHED AS SPECIFIED IN THE ARTICLES ENTITLED "SEEDING", "MULCHING" AND "GRASS ESTABLISHMENT". REPAIRS SHALL BE AT NO ADDITIONAL COST TO THE GOVERNMENT. CONTRACTOR SHALL REGRADE AND SEED ALL DISTURBED AREAS.

SECTION 2V

SITE STORM DRAINAGE SYSTEM

---GENERAL REQUIREMENTS---

---REFERENCE STANDARDS, ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS.

AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
ACI	AMERICAN CONCRETE INSTITUTE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWPA	AMERICAN WOOD PRESERVERS ASSOCIATION
FS	FEDERAL SPECIFICATIONS
MIL	MILITARY SPECIFICATIONS
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
DOT	FLORIDA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 1977"

---DEFINITIONS

BACKFILL-----EARTH MATERIALS PLACED ON TOP OF BEDDING MATERIAL. BACKFILL MATERIALS MAY BE SELECTED TYPE GRANULAR MATERIAL OR APPROVED SOIL MATERIAL FROM THE IMMEDIATE EXCAVATIONS, PROJECT SITE, OR BORROW.

BEDDING-----SELECTED TYPE CONCRETE OR GRANULAR MATERIAL PLACED AROUND A CONDUIT AS A FOUNDATION AND ENVELOPE, TO PERMIT THE DEVELOPMENT OF THE FULL USEFUL STRENGTH OF THE CONDUIT.

BORROW MATERIALS-----FILL MATERIAL SECURED FROM BORROW SITES.

COHESIONLESS SOIL MATERIALS-----INCLUDES GRAVELS, CRUSHED STONE, GRAVEL-SAND MIXTURES, SANDS AND GRAVELLY-SANDS. MOISTURE DENSITY RELATIONS TO COMPACTED COHESIONLESS SOILS WHEN PLOTTED ON GRAPHS WILL SHOW STRAIGHT LINES OR REVERSE SHAPED MOISTURE/DENSITY CURVES.

COHESIVE SOIL MATERIALS-----INCLUDES CLAYEY AND SILTY GRAVELS, SAND-CLAY MIXTURES, GRAVEL-SILT MIXTURES, CLAYEY AND SILTY SANDS, SAND-SILT MIXTURES, CLAYS, SILTS, AND VERY FINE SANDS. MOISTURE DENSITY RELATIONS OF COMPACTED COHESIVE SOILS WHEN PLOTTED ON GRAPHS WILL SHOW NORMAL MOISTURE DENSITY CURVES.

CONDUIT-----PIPE, DRAIN, TUBE, UNDERDRAIN, PERFORATED PIPE, NONPERFORATED PIPE, SEWER PIPE, OR CULVERT.

CRADLE-----CONCRETE BEDDING PLACED UNDER AND UP AROUND A CONDUIT TOWARDS THE SPRINGING LINE.

ENCASEMENT-----CONCRETE BEDDING WHICH ENVELOPES THE CONDUIT.

GRANULAR MATERIAL-----COHESIONLESS SOIL.

SOIL MATERIALS-----EARTH MATERIAL NATIVE TO THE PROJECT SITE OR FILL MATERIAL SECURED FROM BORROW SITES.

SATISFACTORY SOIL MATERIALS-----AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-2-4, A-2-5 AND A-3.

UNSATISFACTORY SOIL MATERIALS-----AASHTO M145-73 SOIL CLASSIFICATION GROUPS A-2-6, A-2-7, A-4, A-5, A-6 AND A-7, PEAT AND OTHER HIGHLY ORGANIC SOILS, AND SOIL MATERIALS OF ANY CLASSIFICATION THAT HAVE A MOISTURE CONTENT AT THE TIME OF COMPACTION BEYOND THE RANGE OF ONE PERCENTAGE POINT BELOW AND THREE PERCENTAGE POINTS ABOVE THE OPTIMUM MOISTURE CONTENT OF THE SOIL MATERIAL AS DETERMINED BY MOISTURE DENSITY RELATIONS TEST.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR PROPOSED CONDUIT MATERIALS

CERTIFICATES OF CONFORMANCE FOR PROPOSED SOIL MATERIALS INCLUDING SIEVE ANALYSIS CURVES

CERTIFICATES OF CONFORMANCE FOR CONCRETE

CERTIFIED COPIES OF TEST REPORTS DEMONSTRATING CONFORMANCE TO THE APPLICABLE PIPE SPECIFICATIONS TO BE DELIVERED TO THE CONTRACTING OFFICER BEFORE THE PIPE IS INSTALLED. STRENGTH TESTS FOR CONCRETE, CLAY, AND ASBESTOS-CEMENT PIPE AS REQUIRED IN THE APPLICABLE SPECIFICATIONS SHALL BE THE THREE-EDGE BEARING TESTS.

---EXISTING UTILITIES

BEFORE STARTING MECHANICAL EARTHWORK OPERATIONS, CAREFUL HAND METHODS SHALL BE USED TO VERIFY THE LOCATION OF UNDERGROUND UTILITIES. IF UTILITIES ARE TO BE LEFT IN PLACE, PROTECTION AGAINST DAMAGE SHALL BE PROVIDED.

---USE OF EXPLOSIVES

THE USE OF EXPLOSIVES WILL NOT BE PERMITTED.

---SOIL SAMPLING AND TESTING---

---GENERAL

SOIL SAMPLING AND TESTING SHALL BE AS SPECIFIED IN SECTION 2E "EARTH WORK FOR SITE GRADING".

---CONCRETE SAMPLING AND TESTING SERVICE

CONCRETE SAMPLING AND TESTING FOR QUALITY CONTROL WILL BE PROVIDED BY THE CONTRACTOR. TESTING WILL BE FOR QUALITY CONTROL OF THE CONCRETE DELIVERED TO THE PROJECT SITE. TESTING SHALL BE BY QUALIFIED LABORATORY.

---CERTIFICATES OF CONFORMANCE

PRIOR TO THE PLACING OF ANY CONCRETE, CERTIFICATES OF MATERIALS CONFORMANCE SHALL BE SUBMITTED TO THE CONTRACTING OFFICER.

CONCRETE MATERIALS CERTIFICATIONS SHALL CONTAIN THE NAME OF THE PROJECT, DATE OF CONCRETE PLACEMENT, LOCATION OF CONCRETE BATCH IN THE WORK, DESIGN COMPRESSION STRENGTH, CONCRETE MIX PROPORTIONS AND MATERIALS, PERCENTAGE OF AIR ENTRAINMENT WATER CONTENT EXPRESSED AS WATER-CEMENT RATIO, TYPE AND BRAND OF MATERIALS.

---EVALUATION OF TEST RESULTS

CONCRETE DELIVERED TO THE PROJECT SITE WITH A SLUMP GREATER THAN THAT SPECIFIED, SHALL NOT BE USED. ADDITION OF CEMENT TO CONCRETE REJECTED FOR EXCESSIVE SLUMP OR WATER CONTENT WILL NOT BE PERMITTED.

---FAILURE TO MEET STRENGTH REQUIREMENTS

CONCRETE WHICH FAILS TO MEET THE SPECIFIED MINIMUM COMPRESSIVE STRENGTH REQUIREMENTS SHALL BE REJECTED.

CONCRETE WHICH HAS BEEN REJECTED MAY BE SUBJECTED TO FURTHER TESTS OR ADJUSTMENT, AS DIRECTED BY THE CONTRACTING OFFICER.

---CONDUIT MATERIALS---

---CONDUIT

CONDUIT SHALL BE STANDARD CONCRETE PIPE WITH JOINTS FOR ROUND RUBBER GASKETS AND SPECIFIED IN DOT 941-1 UNLESS OTHERWISE NOTED ON THE DRAWINGS.

---GASKETS

PIPE GASKETS SHALL CONFORM TO DOT 942-1.

---BEDDING AND BACKFILL MATERIALS---

---GENERAL

BEDDING AND BACKFILL MATERIALS SHALL BE SATISFACTORY SOIL MATERIALS.

---CONCRETE MATERIALS---

---MATERIALS

PORTLAND CEMENT-----PORTLAND CEMENT SHALL CONFORM TO ASTM C150-77, TYPE I OR II.

COARSE AGGREGATE-----SHALL BE CRUSHED STONE OR CRUSHED OR UNCRUSHED GRAVEL AND SHALL MEET THE REQUIREMENT OF DOT SECTION 901.

FINE AGGREGATE-----SHALL BE NATURAL SAND OR STONE SAND AND SHALL MEET THE REQUIREMENTS OF DOT SECTION 902-1.

MIXING WATER-----SHALL MEET THE REQUIREMENTS OF DOT SECTION 923.

AIR ENTRAINING ADMIXTURE-----SHALL CONFORM TO ASTM C260-74.

---CONCRETE WORK

CONCRETE SHALL BE 4000 PSI AND SHALL MEET ALL REQUIREMENTS OF SECTION 3A OF THESE SPECIFICATIONS.

---STEEL REINFORCEMENT FOR CONCRETE

REINFORCING BARS SHALL COMPLY WITH ALL REQUIREMENTS OF SECTION 3A OF THESE SPECIFICATIONS.

---CURING MATERIALS

ABSORPTIVE COVERING FOR CURING CONCRETE SHALL BE BURLAP CLOTH MADE FROM JUTE OR KENAF, WEIGHING 9 OUNCES, PLUS OR MINUS 5 PERCENT, PER SQUARE YARD WHEN CLEAN AND DRY, CONFORMING TO AASHO M182-60, CLASS 3, OR MAY BE COTTON MATS APPROVED BY THE CONTRACTING OFFICER. MOISTURE RETAINING COVERING FOR CURING CONCRETE SHALL BE WATERPROOF PAPER CONFORMING TO ASTM C171-69(1975) TYPE I OR TYPE II, OR MAY BE POLYETHYLENE SHEETING CONFORMING TO AASHO M171-70 OR MAY BE POLYETHYLENE COATED BURLAP CONSISTING OF A LAMINATE OF BURLAP, AND A WHITE OPAQUE POLYETHYLENE FILM PERMANENTLY BONDED TO THE BURLAP; BURLAP SHALL CONFORM TO AASHO M182-60 CLASS 3, AND POLYETHYLENE FILM SHALL CONFORM TO AASHTO M171-70. WHEN TESTED FOR WATER RETENTION IN ACCORDANCE WITH ASTM C156-74 THE WEIGHT OF WATER LOST 72 HOURS AFTER APPLICATION OF THE MOISTURE RETAINING COVERING MATERIAL SHALL NOT EXCEED 0.055 GRAM PER SQUARE CENTIMETER OF THE MORTAR SPECIMEN SURFACE.

---CONCRETE PIPE JOINTS---

---RUBBER GASKET JOINTS

CONCRETE PIPE JOINTS SHALL BE SEALED WITH ROUND RUBBER GASKETS. JOINTS SHALL CONFORM TO THE APPLICABLE PORTIONS OF DOT SECTION 430-7.

---EARTHWORK PROTECTION---

---GENERAL

ALL EXCAVATION, TRENCH WORK, BEDDING TESTING AND BACKFILLING SHALL BE DONE IN THE PRESENCE OF THE CONTRACTING OFFICER, WHO SHALL BE NOTIFIED BY THE CONTRACTOR 48 HOURS IN ADVANCE OF THE WORK.

THE METHODS OF EXCAVATION, THE MEANS OF EARTH SUPPORT, AND THE MANNER OF BACKFILL SHALL BE CONDUCTED WITH PRIMARY CONSIDERATION FOR THE SAFETY OF THE MEN AND THE WORK, AND PREVENTION OF DAMAGE TO ADJACENT PAVEMENT, UTILITIES, STRUCTURES AND OTHER FACILITIES, DUE TO SETTLEMENT, LATERAL MOVEMENT, UNDERMINING AND WASHOUT.

---CONDUIT PROTECTION

NO SUPERFICIAL LOAD, INCLUDING THAT OF CONSTRUCTION EQUIPMENT, SHALL BE PLACED ON THE EXPOSED SURFACE OF A CONDUIT BACKFILL UNLESS ALL COMPACTION REQUIREMENTS ARE MET AND UNTIL APPROVAL OF THE CONTRACTING OFFICER IS OBTAINED. PROVIDE PLANKING OR OTHER MEANS OF ALLEVIATING LINE OR IMPACT LOADS AT POINT OF CONSTRUCTION EQUIPMENT CROSSING OR PARALLELING.

---EXCAVATION---

---GENERAL

EXCAVATIONS SHALL BE SHEETED, SHORED, BRACED, OR LINED WITH MATERIALS OF SUCH QUALITY AND SIZE, AND USED IN SUCH MANNER AND ARRANGEMENT THAT EARTH MOVEMENT WILL BE EFFECTIVELY RESTRAINED.

ALL EXCAVATION METHODS SHALL BE APPROVED BY THE CONTRACTING OFFICER IN ADVANCE OF THE WORK.

ALL EXCAVATIONS SHALL BE BARRICADED AND POSTED WITH WARNING SIGNS FOR THE SAFETY OF PERSONS, WARNING LIGHTS SHALL BE PROVIDED DURING HOURS OF DARKNESS.

---EXPLORATION AND SAMPLING

RECONNAISSANCE AND PRELIMINARY EXPLORATION, INCLUDING TEST BORINGS ALONG CONDUIT ROUTES OR OVER THE SITE, WHERE INDICATED, SHALL BE CONSIDERED AS INFORMATION ONLY AND THE CONTRACTOR SHALL MAKE ADDITIONAL DETAILED EXPLORATIONS, INCLUDING SAMPLES, BORING LOGS, SUB-SOIL PERMEABILITY TESTS AS NECESSARY FOR THE PROPER EXECUTION OF THE WORK.

---STABILITY OF EXCAVATIONS

SIDES AND SLOPES OF EXCAVATIONS SHALL BE MAINTAINED UNTIL COMPLETION OF BACKFILLING IN A SAFE CONDITION BY SCALING, BENCHING, SHELVING, OR BRACING.

PRECAUTIONS SHALL BE TAKEN TO PREVENT SLIDES OR CAVE-INS WHEN EXCAVATIONS ARE MADE IN LOCATIONS ADJACENT TO BACKFILLED EXCAVATIONS, AND WHEN SIDES OF EXCAVATIONS ARE SUBJECTED TO VIBRATIONS FROM VEHICULAR TRAFFIC OR THE OPERATION OF MACHINERY OR ANY OTHER SOURCE.

---SHORING AND BRACING

MATERIALS USED FOR SHORING AND BRACING, SUCH AS SHEET PILING, UPRIGHTS, STRINGERS AND CROSSBRACES, SHALL BE IN GOOD SERVICEABLE CONDITION, AND TIMBER USED SHALL BE SOUND AND FREE FROM LARGE OR LOOSE KNOTS.

SHORING AND BRACING IN EXCAVATIONS SHALL BE MAINTAINED REGARDLESS OF THE LENGTH OF TIME EXCAVATIONS WILL BE OPEN. ALL SHORING AND BRACING SHALL BE CARRIED DOWN WITH THE EXCAVATION.

MINIMUM REQUIREMENTS FOR TRENCH SHORING AND BRACING SHALL BE IN ACCORDANCE WITH OSHA CONSTRUCTION REGULATION SECTION 1926, SUBPART "P", 1926.650 THROUGH 1926.653.

WHERE IT IS NECESSARY IN THE OPINION OF THE CONTRACTING OFFICER, ANY SHEETING AND/OR PORTIONS OF BRACING USED SHALL BE LEFT IN PLACE, AND THE CONTRACT WILL BE ADJUSTED ACCORDINGLY. UNTREATED SHEETING SHALL NOT BE LEFT IN PLACE BENEATH STRUCTURES OR PAVEMENTS.

ALL STEEL SHEET PILING SHALL BE REMOVED AFTER COMPLETION OF CONSTRUCTION.

---WATER REMOVAL

EXCAVATION SHALL BE PERFORMED IN A MANNER TO PREVENT SURFACE WATER AND SUBSURFACE OR GROUND WATER FROM FLOWING INTO THE EXCAVATIONS AND TO PREVENT WATER FROM FLOODING THE CONDUIT TRENCH AND ANY ADJACENT OR SURROUNDING AREA.

EXCAVATION WORK BELOW GROUND WATER IN PERMEABLE SOILS SHALL REQUIRE USE OF TRENCH SHEETING, WELL-POINT SYSTEMS, PUMPING WELLS, RELIEF WELLS, SHEETED SUMPS, ELECTRO-OSMOSIS OR OTHER APPROVED DEWATERING METHODS SO THAT SOFTENING OF FOUNDATION BOTTOM, UNDERCUTTING OF STRUCTRUES, AND CHANGES DETRIMENTAL TO THE STABILITY OF NEW AND EXISTING CONSTRUCTION WILL NOT OCCUR. PROVIDE AND MAINTAIN PUMPS, SUMPS, SUCTION AND DISCHARGE LINES, AND OTHER DEWATERING SYSTEM COMPONENTS NECESSARY TO CONVEY THE WATER AWAY FROM THE EXCAVATIONS.

PIEZOMETERS SHALL BE INSTALLED BELOW THE BASE OF EXCAVATIONS AND BEHIND SLOPES OR COFFERDAMS TO CHECK THE ADEQUACY OF THE DRAINAGE SYSTEM.

DEWATERING OPERATIONS SHALL BE CONTINUED UNTIL THE COMPLETION OF BACK FILLING AND UNTIL CONSTRUCTION SUBJECT TO WATER PRESSURE HAS OBTAINED THE FULL SPECIFIED STRENGTH. IN ALL INSTANCES, DEWATERING OPERATIONS SHALL CONTINUE AS LONG AS WATER CAN ENTER OR ACCUMULATE IN THE EXCAVATIONS.

WATER REMOVED FROM EXCAVATIONS AND RAIN WATER SHALL BE CONVEYED TO COLLECTING OR RUNOFF AREAS, AS APPROVED BY THE CONTRACTING OFFICER. PROVIDE AND MAINTAIN TEMPORARY DRAINAGE DITCHES AND OTHER DIVERSIONS OUTSIDE THE EXCAVATION LIMITS FOR EACH CONSTRUCTION. THE USE OF CONDUIT EXCAVATIONS AS TEMPORARY DRAINAGE DITCHES WILL NOT BE PERMITTED.

---TRENCHING

OPEN-CUT TRENCH EXCAVATIONS SHALL BE RESTRICTED IN SIZE TO THAT WHICH WILL PROVIDE SUFFICIENT WIDTH AND DEPTH TO ALLOW ADEQUATE WORKING SPACE FOR THE PROPER LAYING AND BEDDING OF CONDUIT WITH TIGHT JOINTS, TRUE TO LINE AND AT THE REQUIRED GRADES, EXCEPT AS OTHERWISE INDICATED.

RECOMMENDED CONDUIT * TRENCH WIDTHS ARE AS FOLLOWS:

CONDUIT INTERNAL DIAMETER (INCHES)	2	3	4	6	8	10	12	14	16	18	20	21	24	30	36	42	48
TRENCH WIDTH (INCHES)*	18	18	18	21	24	26	28	30	31	32	33	34	40	47	54	61	68

* ALLOW ADDITIONAL WIDTH FOR CONCRETE CONDUIT WALL THICKNESS WHERE NECESSARY.

THE TRENCH SHALL NOT FLARE BEYOND RECOMMENDED WIDTH AT ANY POINT LESS THAN 12 TO 24 INCHES BEYOND THE TOP OF BEDDED CONDUIT, AND IF SOIL AND WORKING CONDITIONS PERMIT, THE SAME UNIFORM WIDTH SHALL BE MAINTAINED TO GRADE.

THE WIDTH OF TRENCHES AT ANY POINT BELOW THE TOP OF THE PIPE SHALL BE NOT GREATER THAN THE OUTSIDE DIAMETER OF THE PIPE PLUS 30 INCHES.

---UNAUTHORIZED EXCAVATIONS

EXCAVATION BEYOND THE SPECIFIED OR INDICATED DIMENSIONS, WHEN NOT SO DIRECTED BY THE CONTRACTING OFFICER, WILL BE DEEMED UNAUTHORIZED, AND THE SPACE OF SUCH EXCESS EXCAVATION SHALL BE FILLED WITH CLASS 2000A

CONCRETE, SAND-GRAVEL, OR CRUSHED STONE, AS DIRECTED BY THE CONTRACTING OFFICER, BUT AT NO ADDITIONAL COST TO THE GOVERNMENT.

WHERE TRENCH WIDTHS ARE EXCEEDED, CONTRACTOR SHALL REDESIGN WITH A RESULTANT INCREASE IN COST OF STRONGER PIPE OR SPECIAL INSTALLATION PROCEDURES SHALL BE NECESSARY. COST OF THIS REDESIGN AND INCREASED COST OF PIPE OR INSTALLATION SHALL BE BORNE BY THE CONTRACTOR WITHOUT ADDITIONAL COST TO THE GOVERNMENT.

---UNSTABLE SOIL

SHOULD THE SOIL AT THE BOTTOM OF THE EXCAVATION AT THE REQUIRED ELEVATION BECOME UNSUITABLE AS A CONDUIT FOUNDATION DUE TO CONTRACTOR'S NEGLECT, IN THE JUDGEMENT OF THE CONTRACTING OFFICER, THE EXCAVATION SHALL BE TAKEN DOWN TO FIRM SOIL AS DIRECTED AND MEASURED BY THE CONTRACTING OFFICER. THE RESULTING EXCESS EXCAVATION SHALL THEN BE FILLED TO THE REQUIRED GRADE, AT THE CONTRACTOR'S EXPENSE, WITH TYPE 2000A CONCRETE, SAND-GRAVEL OR CRUSHED STONE, AS DIRECTED BY THE CONTRACTING OFFICER.

SHOULD SOIL AT THE BOTTOM OF THE EXCAVATION AT THE REQUIRED ELEVATION BE, IN THE JUDGEMENT OF THE CONTRACTING OFFICER, UNSUITABLE AS A CONDUIT FOUNDATION, THE EXCAVATION SHALL BE TAKEN DOWN TO FIRM SOIL AS DIRECTED AND MEASURED BY THE CONTRACTING OFFICER. THE RESULTING EXCESS EXCAVATION SHALL THEN BE FILLED TO THE REQUIRED GRADE WITH CLASS 2000A CONCRETE, SAND-GRAVEL, OR CRUSHED STONE, AS DIRECTED BY THE CONTRACTING OFFICER. SUCH ADDITIONAL WORK WILL BE PAID FOR AS EXTRA WORK.

ROCK IN EITHER LEDGE OR BOULDER FORMATION SHALL BE REMOVED AND REPLACED WITH SELECTED MATERIALS TO PROVIDE A COMPACTED EARTH CUSHION HAVING A THICKNESS BETWEEN UNREMOVED ROCK AND THE PIPE OF AT LEAST 8 INCHES OR ONE-HALF INCH FOR EACH FOOT OF FILL OVER THE TOP OF THE PIPE, WHICHEVER IS GREATER, BUT NOT MORE THAN THREE-FOURTHS THE NOMINAL DIAMETER OF THE PIPE. WHERE BELL-AND-SPIGOT PIPE IS USED, THE CUSHION SHALL BE MAINTAINED UNDER THE BELL AS WELL AS UNDER THE STRAIGHT PORTION OF THE PIPE.

---MATERIAL STORAGE

MATERIALS REQUIRED IN THE WORK SHALL BE LOCATED AND RETAINED A SUFFICIENT DISTANCE FROM THE EDGE OF EXCAVATIONS TO PREVENT SUCH MATERIAL FALLING OR SLIDING BACK INTO THE EXCAVATIONS, AND TO PREVENT CAVE-INS.

---GENERAL

INSTALLATION OF CONDUIT SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF THE DOT SECTION 430-4.

---INTERIOR INSPECTION

CONDUIT WILL BE CHECKED BY THE CONTRACTING OFFICER TO DETERMINE WHETHER LINE DISPLACEMENT OR OTHER DEFECTS HAVE OCCURRED. INSPECTION WILL TAKE PLACE WHEN TWO FEET OF EARTH COVER IS IN PLACE AND UPON COMPLETION OF

THE PROJECT. A FLASHLIGHT, NARROW BEAM SPOTLIGHT, OR MIRROR REFLECTED SUNLIGHT WILL BE FLASHED THROUGH THE CONDUIT. IF THE ILLUMINATED INTERIOR INDICATES POOR ALIGNMENT, DEBRIS, DISPLACED PIPE, INFILTRATION, OR ANY OTHER DEFECTS, THE DEFECTS DESIGNATED BY THE CONTRACTING OFFICER SHALL BE REMEDIED BY THE CONTRACTOR. IF THE CONTRACTING OFFICER DEEMS IT NECESSARY, THE CONTRACTOR SHALL RE-EXCAVATE FOR INSPECTION OR REPLACEMENT OF MATERIALS, ALL AT NO ADDITIONAL COST TO THE GOVERNMENT.

---CONCRETE WORK---

---GENERAL

HEADWALLS SHALL BE CAST IN PLACE CONCRETE. FORM WORK, CASTING, CURING AND FINISHING SHALL BE AS SPECIFIED HEREINAFTER IN SECTION 3A.

---BACKFILLING---

---GENERAL

BACKFILL SHALL CONSIST OF THE PLACEMENT OF SPECIFIED BACKFILL MATERIAL, IN LAYERS, IN THE EXCAVATIONS TO THE ELEVATIONS AT WHICH EXCAVATION WAS BEGUN, FOR EACH AREA CLASSIFICATION LISTED BELOW.

BACKFILLING OF OPEN-CUT CONDUIT TRENCHES SHALL CLOSELY FOLLOW LAYING, JOINTING AND BEDDING OF PIPE. TO MINIMIZE LOCAL AREA TRAFFIC INTERRUPTION, THE DISTANCE BETWEEN THE POINT OF COMPLETE BACKFILLING AND PIPE LAYING OPERATIONS SHOULD NOT EXCEED APPROXIMATELY 100 FEET.

---PREPARATIONS PRIOR TO BACKFILL PLACEMENT

EXCAVATIONS SHALL BE BACKFILLED AS PROMPTLY AS THE WORK PERMITS, BUT NOT UNTIL COMPLETION OF THE FOLLOWING:

APPROVAL OF CONSTRUCTION BELOW FINISH GRADE.

INSPECTION, TESTING AND RECORDING OF LOCATIONS OF UNDERGROUND UTILITIES AND "AS BUILT" DETAILS.

REMOVAL OF CONCRETE FORMWORK.

REMOVAL OF SHORING AND BRACING, AND BACKFILLING OF VOIDS WITH SATISFACTORY SOIL MATERIAL; TEMPORARY SHEET PILING DRIVEN BELOW BOTTOM OF STRUCTURES AND UTILITIES SHALL BE CUT OFF AND REMOVED IN MANNER TO PREVENT SETTLEMENT OF THE STRUCTURE OR UTILITIES.

WHERE TRENCH SHEETING IS PULLED, WITHDRAWAL SHALL BE IN INCREMENTS OF NOT MORE THAN ONE FOOT AND BACKFILLING AND COMPACTION OPERATIONS SHALL BE CARRIED ON SIMULTANEOUSLY WITH TRENCH SHEETING PULLING.

WHERE TRENCH SHEETING IS DRIVEN FOR THE PROTECTION OF TRENCH WALLS IN WATER BEARING SOIL, NO PORTION OF SUCH SHEETING BELOW A LEVEL THREE FEET OVER THE TOP OF THE CONDUIT SHALL BE REMOVED.

---SELECTION OF BACKFILL MATERIALS

SOIL MATERIALS FOR BACKFILL SHALL BE FREE OF CLAY CLODS, ROCK OR GRAVEL LARGER THAN TWO INCHES IN ANY DIMENSION, DEBRIS, WASTE, FROZEN MATERIALS, AND OTHER DELETERIOUS MATTER, AND SHALL BE SATISFACTORY SOIL MATERIALS AS FOLLOWS:

EXCAVATED NATIVE SOIL MAY BE USED FOR BACKFILL PROVIDED SUCH MATERIAL IS ABOVE GROUND WATER LEVEL AND PROVIDED ITS USE IS NOT PRECLUDED BY OTHER REQUIREMENTS OF THE SPECIFICATIONS.

---COMPACTION---

---GENERAL

THE COMPACTION OF MATERIALS FOR BEDDING AND BACKFILLS SHALL BE PERFORMED BY USE OF THE SPECIFIED COMPACTION EQUIPMENT THAT IS SUITABLE FOR THE MATERIAL BEING COMPACTED AND FOR USE IN THE LOCATION OF THE WORK AREA.

SOIL COMPACTION SHALL BE CONTROLLED DURING CONSTRUCTION FOR COMPLIANCE WITH THE PERCENTAGE OF MAXIMUM DENSITY SPECIFIED FOR EACH AREA CLASSIFICATION AS SPECIFIED HEREIN AND IN THE ARTICLE ENTITLED "SOIL SAMPLING AND TESTING".

COMPACTION SHALL PROCEED IN A MANNER TO PRECLUDE MOVEMENT OF A STRUCTURE OR CONDUIT DUE TO UNBALANCED SIDE THRUST.

---PLACEMENT AND COMPACTION

BACKFILL MATERIALS SHALL BE PLACED IN LAYERS NOT MORE THAN SIX INCHES LOOSE MEASURE BEFORE COMPACTION, EACH LAYER OF BACKFILL MATERIAL SHALL BE MOISTENED OR AERATED AS NECESSARY TO PROVIDE THE OPTIMUM MOISTURE CONTENT, AND SHALL THEN BE COMPACTED TO THE PERCENTAGE OF MAXIMUM DENSITY FOR EACH AREA CLASSIFICATION. NO BACKFILL MATERIAL SHALL BE PLACED ON SURFACES THAT ARE MUDDY, FROZEN, OR CONTAIN SNOW OR ICE.

BACKFILL MATERIALS ADJACENT TO STRUCTURES SHALL BE BROUGHT UP EVENLY AROUND THE STRUCTURES AND SHALL BE CARRIED UP TO THE INDICATED ELEVATIONS.

COMPACTION ADJACENT TO STRUCTURES, WITHIN A HORIZONTAL DISTANCE FROM THE FACE OF THE STRUCTURE EQUAL TO THE DEPTH OF BACKFILL MATERIAL, MEASURED FROM THE BOTTOM OF THE BASE OR FOUNDATION, TO FINAL GRADE, SHALL BE DONE WITH POWERDRIVEN HAND TAMPERS.

CARE SHALL BE TAKEN TO INSURE THOROUGH COMPACTION OF THE FILL UNDER THE HAUNCHES OF THE PIPE. EACH LAYER SHALL BE THOROUGHLY COMPACTED WITH MECHANICAL TAMPERS OR RAMMERS. THIS METHOD OF FILLING AND COMPACTING SHALL CONTINUE UNTIL THE FILL HAS REACHED AN ELEVATION OF AT LEAST 12 INCHES ABOVE THE TOP OF THE PIPE. THE REMAINDER OF THE TRENCH SHALL BE BACKFILLED AND COMPACTED BY SPREADING AND ROLLING OR COMPACTED BY MECHANICAL RAMMERS OR TAMPERS IN LAYERS NOT EXCEEDING EIGHT INCHES.

FOR PIPE PLACED IN FILL SECTIONS, THE FILL MATERIAL SHALL BE UNIFORMLY SPREAD IN LAYERS LONGITUDINALLY ON BOTH SIDES OF THE PIPE, NOT EXCEEDING SIX INCHES IN COMPACTED DEPTH, AND SHALL BE COMPACTED BY ROLLING PARALLEL WITH PIPE OR BY MECHANICAL TAMPING OR RAMMING. PRIOR TO COMMENCING NORMAL FILLING OPERATIONS, THE CROWN WIDTH OF THE FILL AT A HEIGHT OF 12 INCHES ABOVE THE TOP OF THE PIPE SHALL EXTEND A DISTANCE OF NOT LESS THAN TWICE THE OUTSIDE PIPE DIAMETER ON EACH SIDE OF THE PIPE OR 12 FEET, WHICHEVER IS LESS. AFTER THE BACKFILL HAS REACHED AT LEAST 12 INCHES ABOVE THE TOP OF THE PIPE, THE REMAINDER OF THE FILL SHALL BE PLACED AND THOROUGHLY COMPACTED IN LAYERS NOT EXCEEDING 12 INCHES.

---COMPACTION EQUIPMENT

COMPACTION EQUIPMENT SHALL CONSIST OF TAMPER ROLLERS, VIBRATING TAMPERS, OR OTHER COMPACTION EQUIPMENT SUITABLE FOR THE SIZE OF EXCAVATION AND SOIL MATERIAL BEING COMPACTED AND CAPABLE OF OBTAINING THE REQUIRED DENSITY THROUGHOUT THE ENTIRE LAYER BEING COMPACTED.

HAND TOOL COMPACTION IS NECESSARY IN AREAS INACCESSIBLE TO MECHANICAL EQUIPMENT, ADJACENT TO CONDUIT, AND DIRECTLY ABOVE THE CROWN OF THE CONDUIT, TO A HEIGHT OF APPROXIMATELY FOUR FEET. LIGHT TRAVELLING VIBRATORS MAY BE USED WHERE APPROVED BY THE CONTRACTING OFFICER.

MOVEMENT OF CONSTRUCTION MACHINERY OVER A CULVERT OR STORM DRAIN AT ANY STAGE OF THE CONSTRUCTION SHALL BE AT THE CONTRACTOR'S RISK. ANY PIPE DAMAGED THEREBY SHALL BE REPAIRED OR REPLACED AT THE EXPENSE OF THE CONTRACTOR.

---PERCENTAGE OF MAXIMUM DENSITY REQUIREMENTS

THE ACTUAL DENSITY OF EACH LAYER OF SOIL MATERIAL-IN-PLACE SHALL BE NOT LESS THAN THE FOLLOWING PERCENTAGES OF THE MAXIMUM DENSITY OF THE SAME SOIL MATERIAL COMPACTED AT OPTIMUM MOISTURE CONTENT.

TEST METHODS USED: ASTM D2167-66(1972) RUBBER BALLOON METHOD OR ASTM D1556-64(1974) SAND CONE METHOD.

CONDUIT	SOIL MATERIAL	
AREA CLASSIFICATION	PERCENT MAXIMUM DENSITY	
BACKFILL UNDER GRASSED AREAS	COHESIONLESS	COHESIVE
TOP SIX INCHES OF SUBGRADE AND EACH LAYER OF BACKFILL MATERIAL	95	90
BACKFILL UNDER PAVEMENTS		
EACH LAYER OF BACKFILL MATERIAL TO TEN FEET ON EITHER SIDE OF PAVEMENT	100	---

LABORATORY TESTS FOR MOISTURE DENSITY RELATIONS SHALL BE MADE IN ACCORDANCE WITH MIL-STD-621A AND CHANGE 2, TEST METHOD 100, COMPACTION EFFORT DESIGNATION CE 55, EXCEPT THAT MECHANICAL TAMPERS MAY BE USED PROVIDED THE RESULTS ARE CORRELATED WITH THOSE OBTAINED WITH THE SPECIFIED HAND TAMPER.

---MOISTURE CONTROL

THE MOISTURE CONTENT IN THE SOIL MATERIAL AT THE TIME OF COMPACTION SHALL BE WITHIN THE LIMITS, HEREINBEFORE SPECIFIED IN "DEFINITIONS", FOR UNSATISFACTORY SOIL MATERIALS.

TEST METHOD USED: AASHTO T180-74, METHOD "D".

WHERE THE SOIL MATERIAL MUST BE MOISTURE CONDITIONED BEFORE COMPACTION, THE REQUIRED AMOUNT OF WATER SHALL BE UNIFORMLY APPLIED TO THE SOIL MATERIAL IN SUCH MANNER AS TO PREVENT FREE WATER FROM APPEARING ON THE SURFACE DURING OR SUBSEQUENT TO COMPACTION OPERATIONS.

ANY SOIL MATERIAL THAT IS TOO WET TO PERMIT COMPACTION TO SPECIFIED PERCENTAGE OF MAXIMUM DENSITY SHALL BE REMOVED AND REPLACED WITH SATISFACTORY SOIL MATERIAL.

SOIL MATERIAL THAT HAS BEEN REMOVED BECAUSE IT IS TOO WET TO PERMIT COMPACTION MAY BE STOCKPILED OR SPREAD ON THE SURFACE WHERE DIRECTED BY THE CONTRACTING OFFICER AND PERMITTED TO DRY, ASSISTED BY DISCING, HARROWING OR PULVERIZING, UNTIL THE MOISTURE CONTENT IS REDUCED TO A SATISFACTORY VALUE AS DETERMINED BY MOISTURE DENSITY RELATION TESTS, AFTER WHICH THE SOIL MATERIAL MAY BE USED IN COMPACTED BACKFILL.

THE CONTRACTOR MAY, AT HIS OPTION, COMBINE MATERIALS WHICH ARE TOO WET TO PERMIT COMPACTION WITH A QUANTITY OF IDENTICAL MATERIALS SO THAT THE MOISTURE CONTENT OF THE COMPOSITE IS REDUCED TO A DEFINED SATISFACTORY VALUE.

---GRADING---

---GENERAL

ALL AREAS WITHIN THE LIMITS OF EARTHWORK UNDER THIS SECTION, INCLUDING ADJACENT TRANSITION AREAS, SHALL BE UNIFORMLY GRADED. THE FINISHED SURFACE SHALL BE SMOOTH WITHIN THE SPECIFIED TOLERANCES, COMPACTED, AND WITH UNIFORM LEVELS OR SLOPES BETWEEN POINTS WHERE ELEVATIONS ARE INDICATED, OR BETWEEN SUCH POINTS AND EXISTING GRADES.

GRASSED AREAS

THE FINISHED SURFACE OF AREAS TO RECEIVE TOPSOIL SHALL BE NOT MORE THAN 0.10 FOOT ABOVE OR BELOW THE INDICATED ELEVATIONS.

PAVEMENTS

THE SURFACE OF AREAS UNDER PAVEMENTS SHALL BE SHAPED TO LINE, GRADE AND CROSS SECTION, AND THE FINISHED SURFACE SHALL BE NOT MORE THAN 1/2 INCH ABOVE OR BELOW THE INDICATED ELEVATION.

---COMPACTION

AFTER GRADING, SURFACES SHALL BE COMPACTED TO THE DEPTH AND PERCENTAGE OF MAXIMUM DENSITY FOR EACH AREA CLASSIFICATION AS SPECIFIED UNDER "COMPACTION" HEREINBEFORE.

---RESTORATION AND MAINTENANCE---

---RESTORATION

THE CONTRACTOR SHALL PROVIDE ALL LABOR AND MATERIAL INCIDENTAL TO THE RESTORATION OR REPLACEMENT OF ALL REMOVED OR DAMAGED PAVING, CURBING, SIDEWALKS, GUTTERS, SHRUBBERY, FENCES, SOD OR OTHER DISTURBED SURFACES OR STRUCTURES TO A CONDITION EQUAL TO THAT BEFORE THE WORK BEGAN. ALL WORK SHALL BE DONE BY TRADES SKILLED IN THAT PARTICULAR WORK AND SHALL BE APPROVED BY THE CONTRACTING OFFICER.

---MAINTENANCE OF SURFACES

WHERE INSTALLATION OF PERMANENT SURFACE HAS BEEN DELAYED, THE SUPPORTING SURFACE SHALL BE INSPECTED IN THE PRESENCE OF THE CONTRACTING OFFICER, PRIOR TO FURTHER CONSTRUCTION THEREON, FOR COMPACTION, MOISTURE CONTENT AND SURFACE TOLERANCES. ALL DEVIATIONS FROM SPECIFIED TOLERANCES SHALL BE CORRECTED BY THE CONTRACTOR PRIOR TO PROCEEDING WITH THE WORK. RECOMPACTION OVER UNDERGROUND UTILITIES SHALL BE BY METHODS SPECIFIED HEREINBEFORE.

THE CONTRACTOR SHALL REPAIR AND RE-ESTABLISH GRADES IN SETTLED, ERODED AND RUTTED AREAS AND MAINTAIN THE SURFACE OF UNPAVED EXCAVATIONS, AND ADJACENT SIDEWALKS, SHRUBBERY, FENCES, SOD AND OTHER DISTURBED SURFACES, AT NO ADDITIONAL COST TO THE GOVERNMENT FOR A PERIOD OF NOT LESS THAN THREE MONTHS AFTER DATE OF ACCEPTANCE OF THE WORK BY THE CONTRACTING OFFICER.

"MOUNDING" OF SOIL OR BITUMINOUS PAVEMENTS IN EXCESS OF SPECIFIED LIMITS TO PROVIDE FOR SUBSIDENCE IS STRICTLY FORBIDDEN. SLAB JOINTS SHALL BE SEALED WITH BITUMEN.

THE CONTRACTOR SHALL BE REQUIRED TO REPAIR SUBSIDENCE AND MOUNDING IN EXCESS OF SPECIFIED OR INDICATED GRADING LIMITS FOR ALL REPAVED AREAS AND CURBS, GUTTERS AND SIDEWALKS THAT HAVE BEEN REPLACED, FOR A PERIOD OF NOT LESS THAN THREE MONTHS AFTER ACCEPTANCE OF THE WORK BY THE CONTRACTING OFFICER, AT NO ADDITIONAL COST TO THE GOVERNMENT.

---DISPOSAL OF EXCESS AND WASTE MATERIALS---

---REMOVAL OF WASTE MATERIAL

WASTE MATERIALS, INCLUDING EXCAVATED MATERIAL CLASSIFIED AS UNSATISFACTORY SOIL MATERIAL, TRASH AND DEBRIS, SHALL BE REMOVED TO THE DESIGNATED GOVERNMENT AREA AT NO ADDITIONAL COST TO THE GOVERNMENT.

SECTION 2W

STEEL FOUNDATION PILES

---GENERAL REQUIREMENTS---

---REFERENCES

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS.

AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY

---QUALIFICATIONS FOR PILING WORK

PILING INSTALLATION SHALL BE PERFORMED BY A CONTRACTING ORGANIZATION THOROUGHLY EXPERIENCED IN PILING WORK.

SUBMIT A WRITTEN DESCRIPTION OF THE PROPOSED PILING ORGANIZATION GIVING QUALIFICATIONS OF PERSONNEL, LIST OF PROJECTS SIMILAR IN SCOPE TO SPECIFIED WORK, AND OTHER INFORMATION AS MAY BE REQUESTED BY THE CONTRACTING OFFICER. WELDERS SHALL BE QUALIFIED IN ACCORDANCE WITH SECTION 17K.

---SITE INFORMATION

ORIGINAL BACKFILL UNDER ELEVATED PAD AREA IS HYDRAULICALLY DREDGED RIVER BOTTOM SAND AND SHELL FILL.

THE DATA ON SOIL SUBSURFACE CONDITIONS INDICATED ARE NOT INTENDED AS REPRESENTATIONS OR WARRANTIES OF THE CONTINUITY OF SUCH CONDITIONS BETWEEN BORINGS. IT IS EXPRESSLY UNDERSTOOD THAT THE GOVERNMENT WILL NOT BE RESPONSIBLE FOR ANY INTERPRETATION OR CONCLUSION DRAWN THEREFROM BY THE CONTRACTOR. THE DATA IS MADE AVAILABLE FOR THE CONVENIENCE OF THE CONTRACTOR.

ADDITIONAL SOIL BORINGS AND OTHER EXPLORATORY OPERATIONS MAY BE MADE BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE GOVERNMENT, PROVIDED SUCH OPERATIONS ARE APPROVED BY THE CONTRACTING OFFICER.

REFER TO THE DRAWINGS, AND SECTION 18B ENTITLED "REPORT OF SUBSURFACE SOIL INVESTIGATION."

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

TEST REPORT OF STEEL MATERIALS IN ACCORDANCE WITH ASTM A6-76A, INCLUDING LADLE ANALYSIS AND MECHANICAL PROPERTIES.

TEST REPORT FOR EACH PILE LOAD TEST. QUALIFICATION REPORTS OF WELDERS.

---SHOP DRAWINGS AND DESCRIPTIVE DATA

SUBMIT SHOP DRAWINGS AND DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

SHOP DRAWINGS SHALL INDICATE PHYSICAL DIMENSIONS OF PILE, PLAN LAYOUT, DETAIL OF SPLICES, POINT REINFORCEMENT, UPLIFT CONNECTIONS, PILE CAPS, AND DETAILS OF THE PILING IN THE PERMANENT STRUCTURE.

DESCRIPTIVE DATA, AS THE CONTRACTING OFFICER MAY REQUIRE, SHALL DEMONSTRATE COMPLIANCE OF PILE DRIVING EQUIPMENT WITH THE CONTRACT DOCUMENTS AND ILLUSTRATE THE PROCEDURES TO ENSURE THE SPECIFIED TOLERANCES.

SUBMIT PILE LOAD TESTING PLAN FOR APPROVAL.

---DRIVING RECORDS

SUBMIT TWO COPIES OF THE DRIVING RECORDS OF EACH PILE TO THE CONTRACTING OFFICER NOT LATER THAN TWO WORKING DAYS AFTER DRIVING. SUCH RECORDS SHALL CONTAIN THE PROJECT NAME AND NUMBER, DATE, NAME OF CONTRACTOR, THE PILE LOCATION AND NUMBER, COMPUTED PILE CAPACITY, THE TYPE AND SIZE OF HAMMER USED, THE TYPE OF DRIVING CAP USED, RATE OF OPERATION OF PILE DRIVING EQUIPMENT, ALL PILE DIMENSIONS, ELEVATION OF POINT, ELEVATION OF BUTT BEFORE AND AFTER CUT OFF, GROUND ELEVATION, CONTINUOUS RECORD OF THE NUMBER OF BLOWS FOR EACH FOOT OF PENETRATION, PILE DEVIATION, AND ANY UNUSUAL OCCURRENCE DURING THE DRIVING OF THE PILE.

---DELIVERY AND STORAGE

MATERIALS SHALL BE DELIVERED TO THE PROJECT SITE IN SUCH QUANTITIES AND AT SUCH TIMES AS WILL ASSURE THE CONTINUITY OF PILE DRIVING OPERATIONS AND MAINTENANCE OF THE PROGRESS SCHEDULE.

PILES SHALL BE PROPERLY STORED IN ORDERLY PILES ABOVE GROUND AND BLOCKED DURING STORAGE TO MINIMIZE THE POSSIBILITY OF PERMANENT DISTORTION. PILES EXHIBITING VARIATIONS BEYOND LIMITS OF MILL TOLERANCES SHALL BE CONSIDERED DISTORTED AND SHALL BE REMOVED FROM THE SITE.

---PROTECTION OF PERSONS AND PROPERTY

PILE DRIVING OPERATIONS SHALL BE CONDUCTED TO INSURE SAFETY OF PERSONS AND PROPERTY.

STRUCTURES AND UNDERGROUND UTILITIES ABOVE AND BELOW GROUND AND OTHER CONSTRUCTION AS INDICATED ON THE DRAWINGS SHALL BE PROTECTED FROM DAMAGE CAUSED BY PILE DRIVING OPERATIONS.

WHERE STRUCTURES ARE ADJACENT TO PILE DRIVING OPERATIONS, PROVIDE SURVEYED ELEVATION BENCH MARKS ON STRUCTURES WHERE DESIGNATED BY CONTRACTING OFFICER BEFORE COMMENCING WORK.

RECORD AND REPORT THE ELEVATION OF EACH BENCH MARK BEFORE AND AFTER DRIVING EACH PILE AND AT LEAST TWICE A DAY WHILE PILE DRIVING IS IN PROGRESS.

IN THE EVENT THAT BENCH MARK READINGS INDICATE ANY DISPLACEMENT OF ADJACENT STRUCTURES, DRIVING OPERATIONS SHALL CEASE AND SHALL BE RESUMED ONLY WHEN CORRECTIVE ACTION AS APPROVED BY THE CONTRACTING OFFICER HAS BEEN PROVIDED. SUCH ADDITIONAL WORK SHALL BE MEASURED AND PAID FOR BY THE GOVERNMENT IN ACCORDANCE WITH THE "CONTRACT SCHEDULE" RELATIVE TO CHANGES IN THE WORK.

---MATERIALS---

---STEEL PILES

STEEL PILES SHALL BE SEAMLESS OR ELECTRIC WELDED PIPE AND SHALL CONFORM TO ASTM A252-75, GRADES 2 OR 3. IN ADDITION, THE MATERIAL USED IN THE MANUFACTURE OF THE PIPE SHALL CONFORM TO THE CHEMICAL COMPOSITION REQUIREMENTS OF ASTM A139-74, GRADE B. ALL MATERIALS SHALL BE NEW. PIPE SHALL BE 14 INCHES OUTSIDE DIAMETER BY 0.5 INCH WALL THICKNESS OR 16 INCHES OUTSIDE DIAMETER BY 0.375 INCH WALL THICKNESS. PILES THAT ARE TO BE SPLICED SHALL BE CUT TO MILL TOLERANCES.

---PILE DRIVING EQUIPMENT---

---GENERAL

PILE DRIVING EQUIPMENT SHALL BE AN APPROVED TYPE.

---HAMMER

THE HAMMER SHALL BE A STEAM, AIR OR COMBUSTION TYPE, AND SHALL HAVE A RATED DRIVING ENERGY OF NOT LESS THAN 25,000 FOOT-POUNDS PER BLOW. HAMMER SHALL BE OPERATED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS TO DEVELOP THE RATED ENERGY PER BLOW.

---DRIVING CAPS

THE HAMMER SHALL BE EQUIPPED WITH A CAST STEEL OR STRUCTURAL STEEL DRIVING CAP, WITH A GROOVED BASE, CONFORMING TO THE PILE SHAPE. THE BEARING SURFACES OF THE GROOVES SHALL BE TRUE AND SMOOTH.

---LEADS

PILE DRIVER LEADS SHALL BE OF THE FIXED OR RIGID TYPE THAT WILL HOLD THE PILE FIRMLY IN POSITION AND ALIGNMENT, AND IN AXIAL ALIGNMENT WITH THE HAMMER. LEADS SHALL EXTEND TO WITHIN TWO FEET OF THE ELEVATION AT WHICH THE PILE ENTERS THE GROUND.

---TESTING---

---GENERAL

TEST PILES OF THE SAME CROSS SECTION AND TYPE AS THE PERMANENT PILES SHALL BE INSTALLED AND STATICALLY LOADED IN ORDER TO VERIFY THE ASSUMED SAFE COMPRESSION OR TENSION VALUE OF THE PILES. A SPECIFIED FORCE SHALL BE APPLIED AXIALLY TO THE PILE AND THE BEHAVIOR OF THE PILE AND SUPPORTING SOILS SHALL BE MEASURED AND RECORDED. THE TEST PILES SHALL BE DRIVEN WITH THE SAME EQUIPMENT THAT IS TO BE USED BY THE CONTRACTOR IN DRIVING THE PERMANENT PILES SHOWN ON THE DRAWINGS. ALL TEST PILES SHALL BE DRIVEN UNDER THE OBSERVATION OF THE CONTRACTING OFFICER AND TO THE PENETRATION SPECIFIED HEREINAFTER.

TEST LOADS SHALL NOT BE APPLIED TO PILES FOR AT LEAST 48 HOURS AFTER DRIVING. THE ARRANGEMENT OF THE LOAD SHALL BE SUCH THAT READINGS CAN BE TAKEN DIRECTLY ON THE PILE. IF JACKING EQUIPMENT IS USED, THE CONTRACTOR SHALL FURNISH A RECENT CALIBRATION CERTIFICATE BY A REPUTABLE TESTING LABORATORY SHOWING A CALIBRATION OF GAGE READINGS FOR ALL STAGES OF LOADING.

---LOCATION

THE TEST PILES SHALL BE LOCATED AT THE POINTS SHOWN ON THE DRAWINGS OR DESIGNATED BY THE CONTRACTING OFFICER. WHERE PRACTICABLE, TEST PILES SHALL BE SO LOCATED THAT THEY MAY BE LEFT IN PLACE, IF SUITABLE, AND BECOME A PART OF THE PERMANENT STRUCTURE.

---NUMBER OF TEST PILES

ONE COMPRESSION TEST PILE SHALL BE DRIVEN AND LOADED. ONE TENSION TEST PILE SHALL BE DRIVEN AND LOADED. AT THE DISCRETION OF THE CONTRACTING OFFICER, THE NUMBER OF LOAD TESTS MAY BE INCREASED OR DECREASED, OR THE ENTIRE ITEM OF LOAD TESTS MAY BE OMITTED.

(B) *AMEND #1*

---COMPRESSIVE LOAD PILE TEST

THE COMPRESSIVE LOAD PILE TEST SHALL BE IN ACCORDANCE WITH ASTM D1143-74, EXCEPT AS OTHERWISE SPECIFIED. THE DESIGN COMPRESSIVE LOAD OF STEEL PIPE PILES FOR THIS PROJECT IS 100 TONS. THE TOTAL TEST LOAD SHALL BE 200 TONS. THE TEST LOAD SHALL BE APPLIED TO THE PILE IN FOUR INCREMENTS. THE FIRST INCREMENT SHALL CONSIST OF THE DESIGN LOAD, AND EACH OF THREE ADDITIONAL INCREMENTS SHALL CONSIST OF ONE-THIRD THE DESIGN LOAD. EACH LOADING INCREMENT SHALL BE KEPT IN PLACE UNTIL THERE IS NO SETTLEMENT IN A TWO HOUR PERIOD. THE TOTAL TEST LOAD SHALL REMAIN IN PLACE UNTIL SETTLEMENT DOES NOT EXCEED ONE-ONE THOUSANDTH OF A FOOT IN FORTY-EIGHT HOURS. THE TOTAL TEST LOAD SHALL BE REMOVED IN DECREMENTS NOT EXCEEDING ONE-FOURTH OF THE TOTAL TEST LOAD WITH INTERVALS OF NOT LESS THAN ONE HOUR. THE REBOUND SHALL BE RECORDED AFTER EACH DECREMENT IS REMOVED, AND THE FINAL REBOUND SHALL BE RECORDED TWENTY-FOUR HOURS AFTER THE ENTIRE TEST LOAD HAS BEEN REMOVED. THE MAXIMUM ALLOWABLE PILE LOAD SHALL BE ONE-HALF THAT WHICH CAUSES A NET SETTLEMENT AFTER DEDUCTING THE REBOUND OF NOT MORE THAN ONE-ONE HUNDREDTH OF AN INCH PER TON OF TOTAL TEST LOAD OR SHALL BE ONE-HALF THAT WHICH CAUSES A GROSS SETTLEMENT OF ONE INCH, WHICHEVER IS LESS. THE GOVERNMENT WILL DELIVER TO PAD 39B WEIGHTS FOR THE LOAD TEST. CONTRACTOR SHALL UNLOAD AND LOAD THE WEIGHTS.

---TENSION TEST PILES

THE DESIGN LOAD FOR ALL TENSION PILES ON THIS PROJECT IS 50 TONS AND THIS LOAD SHALL BE DESIGNATED AS "P". THE PULL OUT AND TEST SHALL BE LOADED TO 1.5 P. THE CONTRACTOR SHALL SUBMIT TO THE CONTRACTING OFFICER FOR APPROVAL A DETAILED DRAWING OF HIS TEST SET UP BEFORE ANY TESTS CAN BE MADE. PROCEDURE FOR PULL OUT TEST WILL BE AS FOLLOWS:

THE LOADING SHALL BE APPLIED IN INCREMENTS AS FOLLOWS: 1/2 P FOR 15 MINUTES; P FOR 30 MINUTES; THE LOAD WILL THEN BE RELEASED TO ZERO; P FOR 30 MINUTES;1-1/2 P FOR TWO HOURS; THE LOAD WILL THEN BE RELEASED TO ZERO. AT THE OPTION OF THE CONTRACTING OFFICER, THE JACK MAY THEN BE BROUGHT UP TO MAXIMUM CAPACITY AND RELEASED. MOVEMENT OF THE PILE DURING A LOADING OF MORE THAN 1-1/2 P WILL NOT BE CONSIDERED A FAILURE. A PILE WHICH HAS BEEN TEST LOADED WILL BE CONSIDERED UNSATISFACTORY FOR USE WHEN THE PERMANENT SET EXCEEDS 1/4 INCH. SUCH PILES SHALL BE REDRIVEN AND RETESTED.

READINGS WILL BE MADE BEFORE AND AFTER EACH INCREMENT OF LOAD IS APPLIED AND AT ANY OTHER INTERVALS NECESSARY TO RECORD MOVEMENT OF THE PILES. IF FAILURE OCCURS BEFORE THE 1-1/2 P IS REACHED, THE PILES WILL BE REDRIVEN TO A DEPTH SPECIFIED BY THE CONTRACTING OFFICER AND RELOADED. ONE PILE MAY BE DRIVEN AND PULLED TO A MAXIMUM OF THREE TIMES AND THIS WILL BE CONSIDERED TO CONSTITUTE ONE TEST. THE RESULTS OF THIS TENSION TESTING SHALL BE USED TO ESTABLISH MINIMUM PENETRATION CRITERIA FOR THE TENSION PILES IN THE PROJECT.

AFTER THE TEST IS COMPLETED, TEST APPARATUS SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR IN A MANNER SATISFACTORY TO THE CONTRACTING OFFICER. WHERE SO DIRECTED BY THE CONTRACTING OFFICER, TEST PILES SHALL BE CUT OFF, IF NECESSARY, AND LEFT IN PLACE AS PERMANENT PILES. WHEN NOT SUITABLE TO BE LEFT IN PLACE AS PERMANENT PILES, TEST PILES SHALL BE PULLED. UNLESS OTHERWISE DIRECTED BY THE CONTRACTING OFFICER, TEST PILES THAT ARE PULLED SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF BY HIM.

---CONTRACTING OFFICER'S REPRESENTATIVE

IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE CONTRACTING OFFICER SUFFICIENTLY IN ADVANCE OF DRIVING OR TESTING ANY PILES SO THAT HIS REPRESENTATIVE MAY BE PRESENT. NO PILES SHALL BE DRIVEN OR TESTED UNLESS HIS REPRESENTATIVE IS PRESENT OR UNLESS SPECIAL PERMISSION IS OBTAINED FROM THE CONTRACTING OFFICER IN WRITING.

---REPORT

PILE LOAD TEST REPORTS SHALL CONFORM TO SECTION 6 OF ASTM D1143-74. SUBMIT 5 COPIES OF EACH TEST REPORT WITHIN TWO WORKING DAYS AFTER COMPLETION OF TESTS.

---CAPACITY AND PENETRATION OF PILES---

---PILE CAPACITY

PILES SHALL BE DRIVEN TO A SAFE BEARING CAPACITY OF 100 TONS PER PILE.

---PILE PENETRATION

MINIMUM PENETRATION OF ALL PILES SHALL BE TO THE STRATUM OF LIMESTONE ENCOUNTERED AT APPROXIMATELY ELEVATION -125 FEET, AND TO THE BLOWS PER FOOT ESTABLISHED FROM THE FOLLOWING FORMULAS *(SEE "---RESULTS OF PILE TESTING" HEREINAFTER):* (C)

(B) (C)

$R = \frac{2E}{S + 0.1 + 0.01P}$ FOR POWER HAMMERS; AND: $S = \frac{2E}{R} - 0.1 - 0.01P$; AND: BLOWS PER FOOT = $\frac{12}{S}$

WHERE: R = SAFE BEARING CAPACITY, IN TONS.
S = THE AVERAGE PENETRATION PER BLOW, IN INCHES.
P = WEIGHT OF PILE AS DRIVEN, IN TONS.
H = HEIGHT OF HAMMER FALL, IN FEET.
W = WEIGHT OF STRIKING PART OF HAMMER, IN TONS.
E = ENERGY PER BLOW OF HAMMER, IN FOOT-TONS; (WHICH SHALL BE THE PRODUCT WH, FOR SINGLE ACTING HAMMERS, AND THE MANUFACTURER'S RATED CAPACITY FOR THE SPEED USED IN DRIVING, FOR DOUBLE ACTING HAMMERS. THE ENERGY PER BLOW FOR COMBUSTION HAMMERS SHALL BE DETERMINED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS)

SEE "---RESULTS OF PILE TESTING" HEREINAFTER

THE TOTAL BLOWS FOR THE LAST 12 INCHES OR LESS OF PENETRATION SHALL NOT BE LESS THAN THE BLOWS PER FOOT OF PENETRATION AS DETERMINED BY THE ABOVE FORMULAS.

IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE PILE LENGTHS TO BE ORDERED TO ACHEIVE THE ABOVE REQUIREMENTS. WHEN DETERMINING LENGTHS OF PILE TO BE ORDERED THE CONTRACTOR SHALL MAKE ALLOWANCE FOR VARYING SUBSOIL CONDITIONS.

---RESULTS OF PILE TESTING

AS A RESULT OF PILE TESTING COMPLETED 12-15-78, THE FOLLOWING CHANGES ARE HEREWITH MADE TO THE ABOVE BID REQUIREMENTS:

THE MINIMUM PENETRATION OF ALL PILES SHALL BE TO ELEVATION MINUS 122 FEET AND TO THE BLOWS PER FOOT ESTABLISHED FROM THE FOLLOWING FORMULAS:

$R = \frac{2E}{S + 0.1\left(\frac{P}{W}\right)}$ *FOR POWER HAMMERS;*

$S = \frac{2E}{R} - \frac{0.1P}{W}$; *AND BLOWS PER FOOT* $= \frac{12}{S}$

(B) 10-6-78

~~TOTAL CONTRACT PRICE AS APPLI~~ ~~THE GOVERNMENT RESERVES THE RIGHT TO VARY THE ACTUAL FOOTAGE FROM THE~~
~~APPROXIMATE FOOTAGE MENTIONED~~ *PARAGRAPH DELETED BY* ~~50% MORE OR LESS THAN THE APPROXIMATED~~
~~AMOUNT AT THE SAME UNIT PRICE~~ *AMENDMENT #1 DURING* ~~VARYING EITHER THE TOTAL NUMBER OF PILES~~
~~OR LENGTH OF PILES. SUCH PRI~~ *BIDDING PERIOD.* ~~ENSATION FOR ALL WORK SPECIFIED IN THIS OR~~
~~OTHER SECTIONS OF THESE SPECI~~ ~~WINGS AND SHALL INCLUDE THE PILES, PILE~~
~~DRIVING, RE-DRIVING, CUTTING~~ ~~HER MATERIALS, EQUIPMENT, TOOLS, LABOR AND~~
~~INCIDENTALS NECESSARY TO COMPLETE THE WORK.~~

(B) *AMEND #1*

---PREPARATION BEFORE DRIVING---

---CONDITIONS BEFORE DRIVING

PILES SHALL NOT BE DRIVEN UNTIL THE EARTHWORK IN THE AREA WHICH PILES ARE TO OCCUPY HAS BEEN COMPLETED UNLESS INDICATED OTHERWISE AS FOLLOWS:

IN THE CASE OF EXCAVATIONS, EARTH EXCAVATION SHALL STOP AT AN ELEVATION OF 8 TO 12 INCHES ABOVE THE BOTTOM OF THE FOOTING BEFORE PILES ARE DRIVEN. FINAL EXCAVATION TO THE REQUIRED ELEVATION OF FOOTING BOTTOMS SHALL BE DONE AS A PART OF EARTHWORK FOR STRUCTURES AFTER THE PILES HAVE BEEN INSTALLED AND TESTED.

IN THE CASE OF FILLS, SUCH FILLS SHALL BE CONSTRUCTED AND COMPACTED TO THE ELEVATION OF THE GRADE INDICATED.

NO PILES SHALL BE DRIVEN WITHIN 20 FEET OF ANY CONCRETE OR MASONRY STRUCTURE WHICH HAS NOT ATTAINED ITS FULL DESIGN STRENGTH.

---PILE LENGTH MARKING

BEFORE DRIVING IS BEGUN, PILE LENGTH SHALL BE MARKED ON EACH PILE BY PAINTING A BAR AND THE NUMBER OF FEET DISTANT FROM THE PILE POINT AT INTERVALS OF ONE FOOT.

---WELDING WORK

ALL WELDING SHALL BE IN ACCORDANCE WITH SECTION 17K, WELDING OF CARBON STEEL, OF THESE SPECIFICATIONS.

---SPLICES

SURFACES TO BE WELDED SHALL BE CLEAN AND FREE FROM RUST, SCALE, OIL, PAINT AND FOREIGN MATERIAL. UNLESS OTHERWISE AUTHORIZED IN WRITING BY THE CONTRACTING OFFICER,

SPLICES SHALL NOT EXCEED THREE SPLICES PER PILE. IF A WELDED SPLICE IS MADE DURING THE DRIVING OPERATION IT SHALL BE DONE WHEN THE TOP OF THE LOWER PILE IS AT LEAST THREE FEET ABOVE THE GROUND TO PERMIT OBSERVATION OF THE WELDED CONNECTION DURING DRIVING.

SPLICES SHALL BE 100 PERCENT BUTT WELDED USING A BACK-UP SLEEVE AND SHALL BE MADE BY AN APPROVED PROCEDURE. SPLICES SHALL BE MADE AND INSTALLED SO AS TO PRODUCE A STRAIGHT PILE ALIGNMENT THROUGH THE SPLICE AND SO DESIGNED TO DEVELOP THE FULL STRENGTH OF THE PILE IN BOTH BEARING TENSION AND BENDING. COMMENCE REDRIVING WHEN WELD HAS COOLED TO TOUCH.

---PILE DRIVING---

---GENERAL

EACH PILE SHALL BE DRIVEN OPEN ENDED. BEFORE DRIVING THE LEADS AND THE PILE SHALL BE CAREFULLY PLUMBED. WHEN HANDLING AND DRIVING LONG PILES, SPECIAL PRECAUTIONS SHALL BE TAKEN TO INSURE AGAINST OVERSTRESS OR LEADING AWAY FROM A TRUE POSITION WHEN DRIVING.

---DRIVING TOLERANCES

PILES SHALL BE DRIVEN WITHIN THE FOLLOWING MAXIMUM TOLERANCES:

LOCATION-----THREE INCHES FROM THE LOCATION INDICATED ON THE DRAWINGS.

PLUMBNESS-----TWO INCHES IN TEN FEET FROM THE VERTICAL, MEASURED WHEN PILE IS ABOVE GROUND IN THE LEADS.

BATTER ANGLE-----TWO INCHES IN TEN FEET FROM THE REQUIRED ANGLE, MEASURED WHEN PILE IS ABOVE GROUND IN THE LEADS.

---SURVEY

AFTER THE PILES IN ANY ONE GROUP OR AREA HAVE BEEN DRIVEN, THE CONTRACTOR SHALL PROMPTLY PROVIDE THE CONTRACTING OFFICER WITH A SURVEY SHOWING ACTUAL LOCATIONS OF PILES AS DRIVEN. THE CONTRACTOR SHALL NOT PROCEED WITH CONSTRUCTION OF PILE CAPS OR OTHER CONSTRUCTION RELATED TO THE PILES UNTIL THE CONTRACTING OFFICER HAS RECEIVED AND REVIEWED THE SURVEY AND VERIFIED THE SAFE LOADS FOR THE PILES AS DRIVEN.

---JETTING

JETTING FOR INSTALLATION OF THE PILES WILL NOT BE PERMITTED. JETTING MAY BE USED TO ASSIST IN REMOVAL OF PLUGS AS HEREINAFTER SPECIFIED PROVIDED THE CONTRACTOR REMOVES WASTE WATER FROM THE JETTING OPERATIONS.

---PREDRILLING

CONTROLLED PREDRILLING OF ALL PILES, EXCEPT PILES FOR WATER TANK AND PIPE RISER FOUNDATIONS, SHALL BE REQUIRED TO ELEVATION PLUS TEN FEET TO PROTECT EXISTING STRUCTURES AT LAUNCH PAD. DRILLING SHALL BE SO CONTROLLED THAT THE DIAMETER OF THE PREDRILLED HOLE DOES NOT EXCEED THE DIAMETER OF THE PILE LESS 0.5 INCHES.

---REMOVAL OF SOIL INSIDE PIPE PILES

AFTER THE PILES, EXCEPT PILES FOR WATER TANK AND PIPE RISER FOUNDATIONS, HAVE BEEN DRIVEN TO APPROXIMATELY ELEVATION - 10 FEET, THE DRIVING OPERATION SHALL BE STOPPED AND THE SOIL INSIDE THE PIPE PILE SHALL BE REMOVED TO THE PILE POINT.

---FILLING

AFTER ALL PILES IN A GROUP OR FOOTING HAVE BEEN DRIVEN, HAVE BEEN INSPECTED FOR VERTICALITY AND CONDITION, AND A SURVEY HAS BEEN PREPARED SHOWING THE PRECISE LOCATION OF THE TOP OF EACH PILE, THE PILES SHALL BE FILLED TO CUTOFF LEVEL WITH THE SAND LOCALLY AVAILABLE ON THE GROUND SURFACE AT THE SITE. PRIOR TO FILLING WITH SAND THE OPEN PORTION OF THE PIPE SHALL BE FILLED COMPLETELY WITH WATER. THE SAND FILLING SHALL BE POURED INTO THE PIPE AT A UNIFORM CONTINUOUS RATE THROUGH A DISCHARGE APERTURE NOT LARGER IN INSIDE DIAMETER THAN 0.6 TIMES THE INSIDE DIAMETER OF THE PIPE. THE SAND FILLING THROUGH WATER IN THE PIPE SHALL CONTINUE UNTIL THE SURFACE OF THE SAND UNDER WATER REACHES THE CUTOFF ELEVATION. BEFORE PILE CAP CONCRETE IS PLACED THE SAND FILL SHALL BE REMOVED TO A DEPTH OF ONE FOOT BELOW CUTOFF AND THE SAND REMAINING IN THE PIPE COMPACTED SUFFICIENTLY TO SUSTAIN THE WEIGHT OF CAP CONCRETE WHICH WILL FILL THE TOP OF THE PILE.

---REDRIVING OF HEAVED PILES

INSTRUMENT OBSERVATIONS SHALL BE MADE DURING PILE DRIVING TO DETERMINE WHETHER A DRIVEN PILE HAS LIFTED FROM ITS ORIGINAL SEAT DURING THE DRIVING OF ADJACENT PILES. IF UPLIFT OCCURS, PILES SO AFFECTED SHALL BE

REDRIVEN TO A POINT ELEVATION AT LEAST AS DEEP AS THE ORIGINAL POINT ELEVATION AND A DRIVING RESISTANCE AT LEAST AS GREAT AS THE ORIGINAL DRIVING RESISTANCE, AS DIRECTED BY THE CONTRACTING OFFICER, AT NO ADDITIONAL COST TO THE GOVERNMENT.

---DAMAGED AND MISDRIVEN PILES

DAMAGED PILES, AND PILES DRIVEN OUTSIDE THE SPECIFIED DRIVING TOLERANCES WILL NOT BE ACCEPTED.

PILES REJECTED AFTER DRIVING SHALL BE WITHDRAWN AND REPLACED BY NEW PILES, AT NO ADDITIONAL COST TO THE GOVERNMENT.

DEVIATION OF THE CENTERLINE LOCATION OF THE TOP OF A PILE FROM THE INDICATED LOCATION SHALL NOT EXCEED THREE INCHES. WHERE THE DEVIATION EXCEEDS THREE INCHES, AND A REDESIGN INDICATES A LOAD ON ANY PILE EXCEEDING 110 PERCENT OF THE DESIGN LOAD, AN ADDITIONAL PILE OR PILES SHALL BE DRIVEN AND PILE CAP AND REINFORCING MODIFIED AS REQUIRED AT NO ADDITIONAL COST TO THE GOVERNMENT.

WHERE PERMITTED BY CONTRACTING OFFICER, PILES REJECTED AFTER DRIVING MAY BE ABANDONED AND CUT OFF, AND ADDITIONAL PILES DRIVEN TO REPLACE THE REJECTED PILES AT THE NEWLY DESIGNATED LOCATIONS.

WHEN THE SPACE LEFT BY A WITHDRAWN PILE WILL NOT BE FILLED BY THE PILE DRIVEN TO REPLACE THE WITHDRAWN PILE SUCH SPACE SHALL BE FILLED SOLID WITH COHESIONLESS SOIL MATERIAL CONFORMING TO AASHTO M145-73 SOIL CLASSIFICATIONS A-1, A-2-4, A-2-5, AND A-3, SUCH AS GRAVEL, BROKEN STONE AND GRAVEL-SAND MIXTURES.

---CUTTING OFF PILES

THE TOPS OF DRIVEN PILES SHALL BE CUT OFF SQUARE WITH THE PILE AXIS AT THE CUT OFF ELEVATIONS INDICATED, UNLESS A DIFFERENT ANGLE IS REQUIRED TO FIT A CAP OR OTHER MEMBER.

THE CUT OFF OF A PILE WILL REMAIN THE PROPERTY OF THE CONTRACTOR AND DISPOSED OF AS SPECIFIED.

---BONDING AND GROUNDING

SEE SECTION ENTITLED "GROUNDING AND LIGHTNING PROTECTION" SECTION 16X (PART 51).

---CATHODIC PROTECTION

SEE SECTION ENTITLED "CATHODIC PROTECTION" SECTION 16X (PART 56).

---WITHDRAWING AND REDRIVING---

---WITHDRAWING PILES FOR TEST AND INSPECTION

WHEN DIRECTED BY THE CONTRACTING OFFICER, SELECTED PILES SHALL BE WITHDRAWN FOR TEST AND INSPECTION TO DETERMINE THE CONDITION OF THE PILES AFTER DRIVING.

---REDRIVING

PILES WITHDRAWN FOR TEST AND INSPECTION SHALL BE REDRIVEN, UNLESS DAMAGED OR FOUND NOT MEETING THE SPECIFICATION REQUIREMENTS.

WITHDRAWING AND REDRIVING OF PILES FOUND SATISFACTORY SHALL BE PAID FOR BY THE GOVERNMENT IN ACCORDANCE WITH THE "GENERAL PROVISIONS" RELATIVE TO CHANGES IN THE WORK.

REJECTED PILES SHALL BE REPLACED WITH NEW PILES AT NO ADDITIONAL COST TO THE GOVERNMENT AS SPECIFIED IN "DAMAGED AND MISDRIVEN PILES".

---CLEAN UP AND DISPOSAL OF WASTE MATERIALS---

---GENERAL

THE CONTRACTOR SHALL CLEAN UP THE SITE AND SHALL REMOVE WASTE, SCRAP AND REJECTED MATERIALS FROM THE PROJECT SITE IN ACCORDANCE WITH THE "CONTRACT SCHEDULE".

SOIL FROM AUGERED HOLES SHALL BE DISPOSED OF IN DESIGNATED SPOIL AREAS ON GOVERNMENT PROPERTY.

SECTION 3A

CAST-IN-PLACE CONCRETE

---GENERAL REQUIREMENTS---

---REFERENCE STANDARD, ABBREVIATIONS

REFERENCE STANDARDS ARE REFERRED TO HEREINAFTER IN ACCORDANCE WITH THE FOLLOWING ABBREVIATIONS:

AASHTO	AMERICAN ASSOCIATION OF STATE AND HIGHWAY AND TRANSPORTATION OFFICIALS
ACI	AMERICAN CONCRETE INSTITUTE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
FS	FEDERAL SPECIFICATION
USDC	UNITED STATES DEPARTMENT OF COMMERCE

---DEFINITION OF ACI BUILDING CODE

ACI BUILDING CODE SHALL MEAN ACI STANDARD "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE", ACI 318-71 WITH THE FOLLOWING MODIFICATION:

ALL REFERENCES TO THE "BUILDING OFFICIAL" AND THE "ENGINEER" SHALL MEAN THE "CONTRACTING OFFICER".

---QUALIFICATIONS FOR CONCRETE TESTING SERVICE

CONCRETE TESTING SHALL BE PERFORMED BY A LABORATORY AND INSPECTION SERVICE THOROUGHLY EXPERIENCED IN SAMPLING AND TESTING CONCRETE.

SUBMIT A WRITTEN DESCRIPTION OF PROPOSED CONCRETE TESTING SERVICE GIVING QUALIFICATIONS OF PERSONNEL, LABORATORY EQUIPMENT AND FACILITIES, LISTS OF PROJECTS SIMILAR IN SCOPE TO SPECIFIED WORK, AND OTHER INFORMATION AS MAY BE REQUIRED BY THE CONTRACTING OFFICER.

---QUALIFICATIONS FOR READY-MIX CONCRETE MANUFACTURER

CONCRETE SHALL BE MANUFACTURED AND DELIVERED TO THE PROJECT SITE BY A READY-MIX CONCRETE MANUFACTURER THOROUGHLY EXPERIENCED IN READY-MIX CONCRETE.

SUBMIT A WRITTEN DESCRIPTION OF PROPOSED READY-MIX CONCRETE MANUFACTURER GIVING QUALIFICATIONS OR PERSONNEL, LOCATION OF BATCHING PLANT, LIST OF PROJECTS SIMILAR IN SCOPE TO SPECIFIED WORK AND OTHER INFORMATION AS MAY BE REQUESTED BY THE CONTRACTING OFFICER.

---QUALIFICATION FOR WELDING WORK

ANY WELDING OF STEEL REINFORCEMENT SHALL BE DONE BY WELDING OPERATORS QUALIFIED UNDER THE PROVISIONS OF AWS D12.1-75, SECTION 6. CERTIFICATES OF SUCH QUALIFICATION SHALL BE CURRENT FOR WELDERS AND WELDING PROCEDURES AND ARE SUBJECT TO THE CONTRACTING OFFICER'S APPROVAL.

---PROOFS OF COMPLIANCE

SUBMIT PROOFS OF COMPLIANCE AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

CERTIFICATES OF CONFORMANCE FOR ALL MATERIALS, EXCEPT MATERIALS REQUIRING A LABORATORY TEST REPORT.

LABORATORY TEST REPORTS AS SPECIFIED IN THE ARTICLE ENTITLED "CONCRETE SAMPLING AND TESTING".

CERTIFIED LABORATORY TEST REPORTS OF THE CHEMICAL REQUIREMENTS OF REINFORCING BARS TO BE WELDED.

REPORTS OF CHEMICAL COMPOSITION, AND MECHANICAL USABILITY AND SOUNDNESS TESTS AS SPECIFIED IN AWS A5.1-1969 FOR ELECTRODES FOR MANUAL SHIELDED METAL ARC WELDING.

MILL CERTIFICATES OF TESTS ON BAR STEEL. CERTIFICATES OF WELDER QUALIFICATION.

---SHOP DRAWINGS AND DESCRIPTIVE DATA

SUBMIT SHOP DRAWINGS AND DESCRIPTIVE DATA AS SPECIFIED IN THE "CONTRACT SCHEDULE" AND AS FOLLOWS:

SHOP DRAWINGS FOR REINFORCEMENT SHALL INDICATE DIMENSIONS AND DETAILS NECESSARY FOR THE FABRICATION AND PLACING OF REINFORCEMENT AND ACCESSORIES WITHOUT REFERENCE TO THE PROJECT DRAWINGS.

MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS OF THE FOLLOWING:

AIR ENTRAINING ADMIXTURE
CONCRETE BONDING AGENT
EPOXY-RESIN ADHESIVE BINDER
WATERSTOPS
LIQUID CHEMICAL FLOOR HARDENER
JOINT SEALING COMPOUND
CURING COMPOUND

---SAMPLES

SUBMIT SAMPLES AS SPECIFIED IN THE "CONTRACT SCHEDULE" OF THE FOLLOWING:

WATERSTOP SAMPLES, FULL SIZE BY 12 INCHES LONG
SUPPORTS FOR REINFORCEMENT
PREFORMED JOINT FILLER STRIPS
WATER BARRIERS

---DELIVERY AND STORAGE OF MATERIALS (EXCEPT READY-MIX CONCRETE)

PACKAGED MATERIALS SHALL BE DELIVERED TO THE PROJECT SITE IN THEIR ORIGINAL, UNOPENED PACKAGE OR CONTAINER BEARING LABEL CLEARLY IDENTIFYING MANUFACTURER'S NAME, BRAND NAME, MATERIAL, WEIGHT OR VOLUME, AND OTHER PERTINENT INFORMATION. PACKAGED MATERIALS SHALL BE STORED IN THEIR ORIGINAL, UNBROKEN PACKAGE OR CONTAINER IN A WEATHERTIGHT AND DRY PLACE, UNTIL READY FOR USE IN THE WORK.

REINFORCEMENT AND OTHER METAL ITEMS SHALL BE PROTECTED FROM CORROSION AND SHALL BE KEPT FREE FROM GREASE AND OTHER COATINGS THAT WOULD DESTROY OR REDUCE BOND.

---CONCRETE MATERIALS---

---CONCRETE AGGREGATES

CONCRETE AGGREGATES SHALL BE FINE AND COARSE AGGREGATES CONFORMING TO ASTM C33-74A.

THE MAXIMUM SIZE OF COARSE AGGREGATE SHALL BE ONE INCH.

---PORTLAND CEMENT

PORTLAND CEMENT SHALL CONFORM TO ASTM C150-76A, TYPE 1. ONLY ONE BRAND AND TYPE OF PORTLAND CEMENT SHALL BE USED FOR ALL FORMED CONCRETE HAVING EXPOSED-TO-VIEW FINISHED SURFACES.

---AIR ENTRAINING ADMIXTURE

AIR ENTRAINING ADMIXTURE FOR CONCRETE SHALL CONFORM TO ASTM C260-74.

---WATER FOR MIXING CONCRETE

WATER FOR MIXING CONCRETE SHALL MEET THE REQUIREMENTS OF AASHTO T26-72.

---READY-MIX CONCRETE

READY-MIX CONCRETE SHALL MEET THE REQUIREMENTS OF ASTM C94-74A.

---FORM FACING MATERIALS---

---CONCRETE FORM PLYWOOD

CONCRETE FORM PLYWOOD SHALL CONFORM TO USDC PRODUCT STANDARD PS1-74, CONCRETE FORM PLYWOOD, CLASS II, OR BETTER, NOT LESS THAN 5/8 INCH IN THICKNESS, B-B EXTERIOR TYPE, MILL OILED AND EDGE SEALED.

---OVERLAID CONCRETE FORM PLYWOOD

OVERLAID CONCRETE FORM PLYWOOD SHALL CONFORM TO USDC PRODUCT STANDARD PS1-74, CONCRETE FORM PLYWOOD, CLASS I, NOT LESS THAN 5/8 INCH IN THICKNESS, B-B EXTERIOR HIGH DENSITY OVERLAY TYPE.

---REINFORCEMENT MATERIALS---

---REINFORCING BARS

REINFORCING BARS SHALL BE DEFORMED BILLET STEEL BARS FOR CONCRETE REINFORCEMENT WITH 60,000 POUNDS PER SQUARE INCH MINIMUM YIELD POINT CONFORMING TO ASTM A615-76A, GRADE 60.

---STEEL WIRE

STEEL WIRE SHALL BE COLD-DRAWN, PLAIN, STEEL WIRE FOR CONCRETE REINFORCEMENT CONFORMING TO ASTM A82-76.

---WELDED WIRE FABRIC

WELDED WIRE FABRIC SHALL BE WELDED STEEL WIRE FABRIC FOR CONCRETE REINFORCEMENT CONFORMING TO ASTM A185-73.

---SUPPORTS FOR REINFORCEMENT

SUPPORTS FOR REINFORCEMENT SHALL INCLUDE BOLSTERS, CHAIRS, SPACERS, AND OTHER DEVICES SUITABLE FOR PROPER SPACING, SUPPORTING, AND FASTENING REINFORCING BARS AND WELDED WIRE FABRIC IN PLACE.

SUPPORTS SHALL BE WIRE BAR TYPE CONFORMING TO USDC PRODUCT STANDARD PS7-66.

THE LEGS OF SUPPORTS IN CONTACT WITH FORMWORK SHALL BE HOT DIP GALVANIZED AFTER FABRICATION, PLASTIC COATED, OR CORROSION RESISTING CHROMIUM-NICKEL STEEL, TYPE 302 OR TYPE 304.

---JOINT MATERIALS---

---WATERSTOPS

WATERSTOPS SHALL BE FLAT DUMBBELL TYPE, HAVING THICKNESS NOT LESS THAN 3/16 INCH FOR WIDTHS UP TO FIVE INCHES AND HAVING THICKNESS NOT LESS THAN 3/8 INCH FOR WIDTHS FIVE INCHES AND OVER.

WATERSTOPS SHALL BE MADE OF RUBBER AND SHALL CONFORM TO CORPS OF ENGINEERS SPECIFICATION CRD C513-64.

WATERSTOPS SHALL BE MADE OF POLYVINYLCHLORIDE (PVC) AND SHALL CONFORM TO CORPS OF ENGINEERS SPECIFICATION CRD C572-66.

---PREFORMED JOINT FILLER STRIPS

PREFORMED JOINT FILLER STRIPS SHALL BE NONEXTRUDING AND RESILIENT NONBITUMINOUS TYPE CONFORMING TO ASTM D1752-67, TYPE I OR TYPE II.

---JOINT SEALING COMPOUND (LIQUID OXYGEN & HYPERGOL COMPATIBLE AND HEAT & BLAST RESISTANT)

JOINT SEALING SYSTEM SHALL BE AS SPECIFIED IN SECTION 7H OF THESE SPECIFICATIONS.

SURFACE CONDITIONER: CONDITIONER, OR PRIMER, SHALL BE OF A TYPE THAT IS COMPATIBLE WITH THE SEALANT USED.

APPLICATION OF SURFACE CONDITIONER: SURFACE PRIMER SHALL BE APPLIED TO THE BONDING SURFACES IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

APPLICATION OF SEALANT: SEALANT SHALL BE FORCED INTO THE JOINT WITH A POWER ACTIVATED PRESSURE NOZZLE APPARATUS TO INSURE SURFACE CONTACT. THE METHOD OF LAYING SEALANT BEAD AND TOOLING, IF REQUIRED, SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS FOR SEALANT USED.

SEALING BEAD DEPTH SHALL NOT EXCEED ONE-HALF ITS WIDTH. MAXIMUM SEALANT WIDTH SHALL NOT EXCEED ONE INCH.

THE FINISHED JOINT SHALL HAVE A CONCAVE SHAPE BETWEEN BONDING SURFACES.

CARE OF EQUIPMENT: NOZZLES, HOSES, RESERVOIRS, AND ASSOCIATED COMPONENTS OF EQUIPMENT THAT COME IN CONTACT WITH THE SEALANT SHALL BE MAINTAINED IN A CLEAN PETROLEUM AND/OR RESIDUE FREE CONDITION DURING THE SEALING OPERATION.

EQUIPMENT SHALL BE THOROUGHLY CLEANED WITH AN OIL FREE SOLVENT SUCH AS XYLOL OR METHYL KEY TONE (MEK) IMMEDIATELY AFTER USE AND SHALL BE ALLOWED TO DRY BEFORE RECHARGING WITH SEALANT.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR PERFORMING INSPECTION AND TEST OF MATERIALS, EQUIPMENT AND PROCEDURES TO INSURE CONFORMANCE TO THIS DOCUMENT.

IMMEDIATELY PRIOR TO APPLICATION OF PRIMER AND SEALANT, SURFACES SHALL BE EXAMINED TO INSURE THEY HAVE BEEN PROPERLY CLEANED.

SEALING MATERIALS PURCHASED SHALL BE ACCEPTED WITH THE MANUFACTURER'S ASSURANCE THAT THE REMAINING SHELF LIFE UNDER WARRANTY WILL BE ADEQUATE TO COMPLETE THE PROJECT FOR WHICH THEY ARE PURCHASED.

SEALING MATERIALS SHALL BE STORED IN A COOL DRY LOCATION AWAY FROM MOISTURE AND HIGH HUMIDITY.

---SUBGRADE COVER MATERIALS---

---WATER BARRIER SUBGRADE COVER

WATER BARRIER SUBGRADE COVER SHALL BE WATER RESISTANT BARRIER PAPER, UNCREPED AND REINFORCED, CONFORMING TO FS UU-B-790A, TYPE 1, GRADE B, STYLE 4: OR MAY BE SUBGRADE PAPER CONFORMING TO AASHTO M74-55; OR CLEAR POLYETHYLENE SHEETING,0.004 INCH IN THICKNESS, CONFORMING TO USDC COMMERCIAL STANDARD PS1.7-69.

---WATER VAPOR BARRIER SUBGRADE COVER

WATER VAPOR BARRIER SUBGRADE COVER SHALL BE RESISTANT TO DECAY WHEN TESTED IN ACCORDANCE WITH ASTM E154-68, SECTION II, SHALL HAVE A WATER VAPOR PERMEANCE AFTER EXPOSURE IN THE RESISTANT TO DECAY TEST NOT EXCEEDING 0.5 PERM WHEN TESTED IN ACCORDANCE WITH ASTM E96-66, PROCEDURE B, AND SHALL BE ONE OF THE FOLLOWING MATERIALS:

CLEAR POLYETHYLENE SHEETING, 0.008 INCH IN THICKNESS

POLYETHYLENE COATED BARRIER PAPER CONSISTING OF 0.002 INCH THICK POLYETHYLENE FILM LAMINATED TO ONE SURFACE OF ROT RESISTANT, WATER RESISTANT, UNCREPED AND REINFORCED, BARRIER PAPER. PAPER SHALL CONFORM TO FS UU-B-790A, TYPE 1, GRADE A, STYLE 4.

ASPHALT CORE BOARD, SURFACED BOTH SIDES WITH ASPHALT SATURATED AND COATED FELT, WEIGHT NOT LESS THAN 60 POUNDS PER 100 SQUARE FEET, AND NOT LESS THAN 1/8 INCH THICK.

ADHESIVE FOR SEALING LAPPED JOINTS SHALL BE AS RECOMMENDED BY THE SUBGRADE COVER MANUFACTURER.

---BONDING MATERIALS---

---CONCRETE BONDING AGENT

CONCRETE BONDING AGENT SHALL BE AN AQUEOUS PHASE, FILM FORMING, NONOXIDING, FREEZE-THAW RESISTANT COMPOUND SUITABLE FOR BRUSH OR SPRAY APPLICATION CONFORMING TO MILITARY SPECIFICATION MIL-B-19235 (DOCKS).

---EPOXY RESIN ADHESIVE BINDER

EPOXY RESIN ADHESIVE BINDER SHALL BE TWO COMPONENT, EPOXY POLYSULFIDE POLYMER TYPE WITH AMINE TYPE CURING AGENT CONFORMING TO FS MMM-B-350B, TYPE I OR TYPE II.

---FLOOR FINISHING MATERIALS---

---LIQUID CHEMICAL FLOOR HARDENER

LIQUID CHEMICAL FLOOR HARDENER SHALL BE A COLORLESS AQUEOUS SOLUTION CONTAINING A BLEND OF MAGNESIUM FLUOSILICATE AND ZINC FLUOSILICATE COMBINED WITH A WETTING AGENT. THE SOLUTION SHALL CONTAIN NOT LESS THAN TWO

POUNDS OF FLUOSILICATES PER GALLON. A PROPRIETARY CHEMICAL HARDENER OF PROVEN AND SATISFACTORY PERFORMANCE MAY BE USED PROVIDED THE HARDENER IS DELIVERED TO THE PROJECT SITE READY FOR USE IN THE MANUFACTURER'S ORIGINAL CONTAINERS.

---CONCRETE CURING MATERIALS---

---ABSORPTIVE COVER

ABSORPTIVE COVER FOR CURING CONCRETE SHALL BE BURLAP CLOTH MADE FROM JUTE OR KENAF, WEIGHING NINE OUNCES PLUS OR MINUS FIVE PERCENT SQUARE YARD WHEN CLEAN AND DRY, CONFORMING TO AASHTO M182-60, CLASS 3, OR MAY BE COTTON MATS APPROVED BY THE CONTRACTING OFFICER.

---MOISTURE RETAINING COVER

MOISTURE RETAINING COVER FOR CURING CONCRETE SHALL BE WATERPROOF PAPER CONFORMING TO ASTM C171-69, TYPE 1 OR TYPE 2, OR MAY BE POLYETHYLENE SHEETING CONFORMING TO AASHTO M171-70, OR MAY BE POLYETHYLENE COATED BURLAP CONSISTING OF A LAMINATE OF BURLAP, AND A WHITE OPAQUE POLYETHYLENE FILM PERMANENTLY BONDED TO THE BURLAP: BURLAP SHALL CONFORM TO AASHTO M182-60, CLASS 3, AND POLYETHYLENE FILM SHALL CONFORM TO AASHTO M171-70.WHEN TESTED FOR WATER RETENTION IN ACCORDANCE WITH ASTM C156-74 THE WEIGHT OF WATER LOST 72 HOURS AFTER APPLICATION OF THE MOISTURE RETAINING COVERING MATERIAL SHALL NOT EXCEED 0.055 GRAM PER SQUARE CENTIMETER OF THE MORTAR SPECIMEN SURFACE.

---WATER FOR CURING CONCRETE

WATER FOR CURING CONCRETE SHALL BE CLEAN, CLEAR, AND FREE OF OIL, ACID, SALT, ALKALI, ORGANIC MATTER OR OTHER DELETERIOUS SUBSTANCES.

---MEMBRANE-FORMING CURING COMPOUND

MEMBRANE-FORMING CURING COMPOUND SHALL BE LIQUID TYPE CONFORMING TO ASTM C309-74, TYPE 1, CLEAR WITH FUGITIVE DYE FOR INTERIOR WORK AND TYPE 2 WHITE PIGMENTED FOR EXTERIOR WORK.

---CONCRETE SAMPLING AND TESTING---

---CONCRETE TESTING SERVICE

CONCRETE TESTING SERVICE SHALL BE PROVIDED BY THE CONTRACTOR. TESTING SERVICE SHALL BE APPROVED BY THE CONTRACTING OFFICER.

TESTING SERVICE SHALL INCLUDE SAMPLING AND TESTING CONCRETE MATERIALS PROPOSED FOR USE IN THE WORK, DESIGN MIX FOR EACH CLASS OF CONCRETE, AND QUALITY CONTROL TESTING DURING CONSTRUCTION.

TESTING SERVICE SHALL INCLUDE DESIGN MIX FOR EACH CLASS OF CONCRETE AND QUALITY CONTROL TESTING DURING CONSTRUCTION.

---CONCRETE DESIGN MIXES

PROPORTIONING: CONFORM TO SECTION 4.2 OF ACI 318-71, EXCEPT AS MODIFIED BELOW AND HEREIN.

SUBMIT TEST DATA INDICATING THAT THE CONCRETE MADE FROM THE PROPOSED PROPORTIONS MEETS THE REQUIREMENTS OF THIS SECTION BY EITHER THE EXPERIENCE METHOD OR THE TRIAL BATCH METHOD.

ALL TESTING SHALL BE CERTIFIED BY AN INDEPENDENT TESTING LABORATORY.

ALL MATERIALS USED IN THE TRIAL BATCH METHOD OR IN THE CONCRETE YIELDING A COMPUTED STANDARD DEVIATION SHALL BE THE MATERIALS TO BE USED ON THE PROJECT.

MAKE ALLOWANCE FOR THE TIME INHERENT TO THE TRIAL BATCH METHOD. EVALUATION SHALL BE MADE USING 28-DAY COMPRESSIVE STRENGTHS.

DELETE SECTION 4.2.4.

MINIMUM CEMENT CONTENT SHALL BE 5-1/4 BAGS PER CUBIC YARD FOR 3000 PSI AND 6 BAGS FOR 4000 PSI AND 5000 PSI.

SLUMP: CONFORM TO THE FOLLOWING TABLE:

TYPE OF CONSTRUCTION	SLUMP IN INCHES MAXIMUM	MINIMUM
FOOTINGS & PILE CAPS	4	2
SLABS, BEAMS AND REINFORCED WALLS	5	2
MASS CONSTRUCTION	2	1
PEDESTALS	5	3
PAVEMENTS	2	1

A REPORT IN WRITING OF THE DESIGN MIX FOR EACH CONCRETE CLASS SHALL BE SUBMITTED TO THE CONTRACTING OFFICER FOR APPROVAL AT LEAST 15 CALENDAR DAYS PRIOR TO THE START OF THE SPECIFIED WORK. SUCH REPORT SHALL CONTAIN

THE PROJECT NAME AND NUMBER, DATE, NAME OF CONTRACTOR, NAME OF CONCRETE TESTING SERVICE, CONCRETE CLASS, SOURCE OF CONCRETE AGGREGATES, MANUFACTURER AND BRAND NAME FOR MANUFACTURED MATERIALS, THE EXACT PROPORTIONS OF THE CONCRETE MIX, THE PROPERTIES SPECIFIED FOR THE CONCRETE CLASS IN THE ARTICLE ENTITLED "CLASSIFICATION AND QUALITY OF CONCRETE", AND THE TEST RESULTS FOR EACH PROPERTY SPECIFIED FOR THE DESIGN MIX.

---QUALITY CONTROL TESTING DURING CONSTRUCTION

CONCRETE SHALL BE SAMPLED AND TESTED FOR QUALITY CONTROL DURING THE PLACEMENT OF THE CONCRETE AS FOLLOWS:

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
SAMPLING FRESH CONCRETE	ASTM C172-71 EXCEPT MODIFIED FOR SLUMP PER ASTM C94-74A SECTION 8.4	AS REQUIRED FOR EACH TEST
SLUMP TEST	ASTM C143-74	ONE FOR EACH CONCRETE LOAD AT POINT OF DISCHARGE: AND ONE FOR EACH SET OF COMPRESSIVE STRENGTH TESTS
AIR CONTENT BY PRESSURE METHOD	ASTM C231-75	ONE FOR EACH SET OF COMPRESSIVE STRENGTH TESTS
COMPRESSION TEST SPECIMENS	ASTM C31-69	ONE SET OF 6 STANDARD CYLINDERS FOR EACH COMPRESSIVE STRENGTH TEST
COMPRESSIVE STRENGTH TEST	ASTM C39-72	ONE SET FOR EACH 150 CUBIC YARDS, OR FRACTION THEREOF, OF EACH CONCRETE CLASS PLACED IN ANY ONE DAY; 2 SPECIMENS TESTED AT 7 DAYS, 3 SPECIMENS TESTED AT 28 DAYS, AND ONE SPECIMEN RETAINED FOR RESERVE FOR TESTING IF REQUIRED.

TEST RESULTS SHALL BE REPORTED IN WRITING TO THE CONTRACTING OFFICER AND THE CONTRACTOR ON THE SAME DAY THAT TESTS ARE MADE.

ALL TEST RESULTS THAT FAIL TO MEET THE VALUE FOR ANY REQUIREMENT AS HEREINAFTER SPECIFIED IN THE ARTICLE ENTITLED "CLASSIFICATION AND QUALITY OF CONCRETE" SHALL BE DISTINCTLY NOTED IN THE REPORT FOR ATTENTION.

REPORTS OF COMPRESSIVE STRENGTH TESTS SHALL CONTAIN THE PROJECT NAME AND NUMBER, DATE OF CONCRETE PLACEMENT, NAME OF CONTRACTOR, NAME OF CONCRETE SUPPLIER AND TRUCK NUMBER, NAME OF CONCRETE TESTING SERVICE, CONCRETE CLASS, LOCATION OF CONCRETE BATCH IN THE STRUCTURE, DESIGN COMPRESSIVE STRENGTH AT 28 DAYS, CONCRETE MIX PROPORTIONS AND MATERIALS; AND COMPRESSIVE BREAKING STRENGTH AND TYPE OF BREAK.

---CLASSIFICATION AND QUALITY OF CONCRETE---

---CONCRETE CLASSIFICATION AND USAGE

CONCRETE COMPRESSIVE STRENGTH AND USAGE SHALL BE AS FOLLOWS:

MIN. 28-DAY DESIGN COMPRESSIVE STRENGTH POUNDS PER SQ. IN.	USAGE
5000	ALL CONCRETE FOR STEEL RAIL BEAM PIER AND END PEDESTALS (BELOW BEARING PLATES). PRECAST PRESTRESSED PILES.
4000	PILE CAPS, PEDESTALS AND STRUT BEAMS. RAIL CONCRETE BEAMS. REPAIRS OF EXISTING CONCRETE WALLS AND ANY OTHER LOCATION NOT OTHERWISE SPECIFIED. RETAINING WALLS AND FOOTINGS.
3000	SLAB ON GRADE AND RISER PIPE ENCASEMENT.

---AIR ENTRAINMENT

ALL CONCRETE SHALL HAVE 4-1/2 PERCENT ENTRAINED AIR WITH A TOLERANCE IN EITHER DIRECTION FROM THIS OPTIMUM OF 1-1/2 PERCENT.

---ADMIXTURES

THE ADMIXTURE TO BE USED SHALL BE SUBJECT TO APPROVAL OF THE CONTRACTING OFFICER. USE OF CALCIUM CHLORIDE IS FORBIDDEN.

---BEDDING GROUT---

---BEDDING MORTAR MATERIALS

BEDDING MORTAR MATERIALS AND BEDDING PROCEDURES SHALL BE AS SPECIFIED IN SECTION 5J ENTITLED "STRUCTURAL STEEL".

---GENERAL

FORMS SHALL BE CONSTRUCTED TO CONFORM WITHIN THE TOLERANCES SPECIFIED HEREINAFTER TO THE SHAPES, LINES, DIMENSIONS, ELEVATIONS AND POSITIONS OF THE CAST IN PLACE CONCRETE MEMBERS AS INDICATED. FORMS SHALL BE SUPPORTED, BRACED, AND MAINTAINED SUFFICIENTLY RIGID TO PREVENT DEFORMATION UNDER LOAD.

---DESIGN OF FORMWORK

THE FORMWORK SHALL BE DESIGNED IN ACCORDANCE WITH ACI 347-68 USING THE LOADS, LATERAL PRESSURE OF WET CONCRETE, AND UNIT STRESSES SPECIFIED IN ACI 347-68 SECTIONS 1.2 AND 1.3, UNLESS OTHERWISE INDICATED.

FORMS SHALL BE SUFFICIENTLY TIGHT TO PREVENT LEAKAGE OF CEMENT PASTE DURING CONCRETE PLACING.

FORM FACING MATERIALS SHALL BE SUPPORTED BY STRUCTURAL MEMBERS SPACED SUFFICIENTLY CLOSE TO PREVENT DEFLECTION OF THE FORM FACING MATERIAL. FORMS PLACED IN SUCCESSIVE UNITS FOR CONTINUOUS SURFACES SHALL BE FITTED TO ACCURATE ALIGNMENT TO ASSURE A SMOOTH COMPLETED SURFACE FREE FROM IRREGULARITIES WITHIN THE TOLERANCES HEREINAFTER SPECIFIED. WHERE NECESSARY TO MAINTAIN THE TOLERANCES SPECIFIED, SUCH AS LONG SPANS WHERE IMMEDIATE SUPPORTS ARE NOT POSSIBLE, THE FORMWORK SHALL BE CAMBERED FOR ANTICIPATED DEFLECTIONS IN THE FORMWORK DUE TO THE WEIGHT AND PRESSURE OF THE FRESH CONCRETE AND DUE TO CONSTRUCTION LOADS.

ALL EXPOSED JOINTS, EDGES, AND EXTERNAL CORNERS SHALL BE CHAMFERED A MINIMUM OF 3/4 INCH BY MOLDINGS PLACED IN THE CORNERS OF COLUMN, BEAM AND WALL FORMS.

SHORES AND STRUTS SHALL BE PROVIDED WITH A POSITIVE MEANS OF ADJUSTMENT CAPABLE OF TAKING UP ALL FORMWORK SETTLEMENT DURING CONCRETE PLACING OPERATIONS. ADJUSTMENT SHALL BE OBTAINED WITH WEDGES OR JACKS, OR A COMBINATION THEREOF. WHEN ADEQUATE FOUNDATIONS FOR SHORES AND STRUTS CANNOT BE SECURED, TRUSSED SUPPORTS SHALL BE PROVIDED.

TEMPORARY OPENINGS SHALL BE PROVIDED IN WALL FORMS, COLUMN FORMS, AND AT OTHER POINTS WHERE NECESSARY TO PERMIT INSPECTION AND TO FACILITATE CLEANING.

FORMS SHALL BE READILY REMOVABLE WITHOUT IMPACT, SHOCK OR DAMAGE TO THE CONCRETE.

---FORMS FOR STANDARD ROUGH FORM FINISH

FORM FACING MATERIAL FOR FORMED SURFACES TO HAVE STANDARD ROUGH FORM FINISH AS HEREINAFTER SPECIFIED IN THE ARTICLE ENTITLED "FINISHING OF FORMED SURFACES" SHALL BE THE SPECIFIED CONCRETE FORM PLYWOOD OR OTHER

APPROVED FORM FACING MATERIAL THAT WILL PRODUCE CONCRETE SURFACES EQUIVALENT IN SMOOTHNESS AND APPEARANCE TO THAT PRODUCED BY NEW CONCRETE FORM PLYWOOD PANELS.

FOR CONCRETE SURFACES EXPOSED ONLY TO THE GROUND, UNDRESSED, SQUARE EDGE, 1-INCH NOMINAL THICKNESS LUMBER MAY BE USED. ALL HORIZONTAL JOINTS SHALL BE LEVEL. ALL VERTICAL JOINTS SHALL BE PLUMB.

---FORMS FOR STANDARD SMOOTH FORM FINISH

FORM FACING MATERIAL FOR FORMED SURFACES TO HAVE STANDARD SMOOTH FINISH AS HEREINAFTER SPECIFIED IN THE ARTICLE ENTITLED "FINISHING OF FORMED SURFACES" SHALL BE THE SPECIFIED OVERLAID CONCRETE FORM PLYWOOD OR OTHER APPROVED FORM FACING MATERIAL THAT IS NONREACTIVE WITH CONCRETE AND THAT WILL PRODUCE CONCRETE SURFACES EQUIVALENT IN SMOOTHNESS AND APPEARANCE TO THAT PRODUCED BY NEW OVERLAID CONCRETE FORM PLYWOOD PANELS.

THE MAXIMUM DEFLECTION OF THE FORM FACING MATERIAL BETWEEN SUPPORTS AND THE MAXIMUM DEFLECTION OF FORM SUPPORTS, SUCH AS STUDS AND WALLS, SHALL NOT EXCEED 0.0025 TIMES THE SPAN.

THE ARRANGEMENT OF FORM FACING SHEETS SHALL BE ORDERLY AND SYMMETRICAL, AND THE SHEETS SHALL BE IN AS LARGE SIZES AS ARE PRACTICABLE.

PANELS SHALL BE ARRANGED TO MAKE A SYMMETRICAL PATTERN OF JOINTS. ALL HORIZONTAL AND VERTICAL JOINTS SHALL BE SOLIDLY BACKED AND BUTTED TIGHT TO PREVENT LEAKAGE AND FINS.

---FORM TIES

FORM TIES SHALL BE FACTORY FABRICATED, ADJUSTABLE IN LENGTH, REMOVABLE OR SNAP-OFF METAL TYPE OF DESIGN THAT WILL NOT ALLOW FORM DEFLECTION OR WILL NOT SPALL CONCRETE UPON REMOVAL. THE PORTION OF THE FORM TIES REMAINING WITHIN THE CONCRETE AFTER REMOVAL OF THE EXTERIOR PARTS SHALL BE AT LEAST 1-1/2 INCHES BACK FROM THE CONCRETE SURFACE. FORM TIES SHALL BE FREE OF DEVICES THAT WILL LEAVE A HOLE LARGER THAN 7/8 INCH OR LESS THAN 1/2 INCH IN DIAMETER IN THE CONCRETE SURFACE. FORM TIES FABRICATED AT THE PROJECT SITE OR WIRE TIES OF ANY TYPE ARE NOT ACCEPTABLE.

---TOLERANCES FOR FORM CONSTRUCTION

FORMWORK SHALL BE CONSTRUCTED SO AS TO ASSURE THAT, AFTER REMOVAL OF THE FORMS AND PRIOR TO PATCHING AND FINISHING OF FORMED SURFACES, THE CONCRETE SURFACES SHALL BE IN ACCORDANCE WITH THE TOLERANCES SPECIFIED IN ACI 347-68, SECTION 2.4.

---PREPARATION OF FORM SURFACES

THE CONTACT SURFACES OF FORMS SHALL BE COATED WITH A FORM COATING COMPOUND BEFORE REINFORCEMENT IS PLACED. FORM COATING COMPOUND SHALL BE A COMMERCIAL FORMULATION OF SATISFACTORY AND PROVEN PERFORMANCE THAT WILL NOT BOND WITH, STAIN, OR ADVERSELY AFFECT CONCRETE SURFACES, AND WILL NOT IMPAIR SUBSEQUENT TREATMENT OF CONCRETE SURFACES DEPENDING UPON BOND OR ADHESION OR IMPEDE THE WETTING OF SURFACES TO BE CURED WITH WATER OR CURING COMPOUNDS. EXCESS FORM COATING COMPOUND SHALL NOT BE ALLOWED TO STAND IN PUDDLES IN THE FORMS NOR TO COME IN CONTACT WITH CONCRETE AGAINST WHICH FRESH CONCRETE WILL BE PLACED. ANY THINNING OF FORM COATING COMPOUND SHALL BE MADE ONLY WITH THINNING AGENT OF THE TYPE, IN THE AMOUNTS, AND UNDER THE CONDITIONS RECOMMENDED BY THE FORM COATING COMPOUND MANUFACTURER'S PRINTED OR WRITTEN DIRECTIONS.

---REMOVAL OF FORMS

FORMWORK THAT DOES NOT SUPPORT THE WEIGHT OF CONCRETE, SUCH AS SIDES OF BEAMS, WALLS, COLUMNS, AND SIMILAR VERTICAL PARTS OF THE WORK, MAY BE REMOVED 24 HOURS AFTER PLACING THE CONCRETE, PROVIDED THE CONCRETE IS SUFFICIENTLY HARD NOT TO BE DAMAGED FROM THE FORM REMOVAL OPERATIONS.

FORMWORK THAT SUPPORTS THE WEIGHT OF CONCRETE, SUCH AS BEAM SOFFITS, SLABS, AND SIMILAR HORIZONTAL PARTS OF THE WORK, SHALL REMAIN IN PLACE AT LEAST UNTIL THE CONCRETE HAS ATTAINED THE DESIGN MINIMUM LABORATORY COMPRESSIVE STRENGTH AT 28 DAYS FOR THE APPLICABLE CONCRETE STRENGTH SPECIFIED HEREINBEFORE IN THE ARTICLE ENTITLED "CLASSIFICATION AND QUALITY OF CONCRETE".

RESULTS OF SUITABLE CONTROL TESTS WILL BE USED AS EVIDENCE THAT CONCRETE HAS ATTAINED SUFFICIENT STRENGTH TO PERMIT REMOVAL OF SUPPORTING FORMS. TEST SPECIMENS SHALL BE REMOVED FROM MOLDS AT THE END OF 24 HOURS AND STORED IN THE STRUCTURE AS NEAR POINTS OF SAMPLING AS POSSIBLE; SHALL RECEIVE INSOFAR AS PRACTICABLE THE SAME PROTECTION FROM THE ELEMENTS DURING CURING AS IS GIVEN THOSE PORTIONS OF THE STRUCTURE WHICH THEY REPRESENT; AND SHALL NOT BE REMOVED FROM THE STRUCTURE FOR TRANSMITTAL TO THE LABORATORY PRIOR TO EXPIRATION OF THREE-FOURTHS OF THE PROPOSED PERIOD BEFORE REMOVAL OF FORMS.

IN GENERAL, SUPPORTING FORMS OR SHORING SHALL NOT BE REMOVED UNTIL STRENGTH OF CONTROL TEST SPECIMENS HAS ATTAINED A VALUE OF AT LEAST 1500 PSI FOR COLUMNS AND 2000 PSI FOR ALL OTHER WORK, EXCEPT PILES. EXERCISE CARE THAT THE NEWLY UNSUPPORTED PORTIONS OF THE STRUCTURE ARE NOT SUBJECTED TO HEAVY CONSTRUCTION OR MATERIAL LOADING. FOR FORM REMOVAL FROM PRECAST PRESTRESSED PILES, SEE SECTION 2K.

TIE ROD CLAMPS TO BE ENTIRELY REMOVED FROM THE WALL SHALL BE LOOSENED 24 HOURS AFTER CONCRETE IS PLACED, AND FORM TIES, EXCEPT FOR A SUFFICIENT NUMBER TO HOLD FORMS IN PLACE, MAY BE REMOVED AT THAT TIME. TIES WHOLLY WITHDRAWN FROM WALL SHALL BE PULLED TOWARD INSIDE FACE.

WHENEVER THE FORMWORK IS REMOVED DURING THE CONCRETE CURING PERIOD, THE EXPOSED CONCRETE SHALL BE CURED AS SPECIFIED IN "CONCRETE CURING AND PROTECTION".

---REUSE OF FORMS

THE SURFACES OF FORMS THAT ARE TO BE REUSED SHALL BE THOROUGHLY CLEANED AND REPAIRED, EXCEPT THAT SPLIT, FRAYED, OR DELAMINATED FORM FACING MATERIAL SHALL NOT BE REUSED. THE CONTACT SURFACES OF REUSED FORMS SHALL BE COATED AS SPECIFIED HEREINBEFORE IN THE PARAGRAPH ENTITLED "PREPARATION OF FORM SURFACES".

---REINFORCEMENT FABRICATION AND INSTALLATION---

---GENERAL

THE DETAILS OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE ACI BUILDING CODE, CHAPTER 7, AND AS SPECIFIED HEREIN.

---FABRICATION

REINFORCING BARS SHALL BE SHOP FABRICATED TO CONFORM TO THE SHAPES AND DIMENSIONS INDICATED ON THE APPROVED SHOP DRAWINGS FOR REINFORCEMENT, AND AS FOLLOWS:

FABRICATION TOLERANCES SHALL BE IN ACCORDANCE WITH ACI 315-74, SECTION 4.3.

THE REINFORCEMENT SHALL BE BENT COLD TO SHAPES INDICATED ON APPROVED SHOP DRAWINGS. ALL BENDING SHALL BE DONE IN THE SHOP.

REBENDING OF A REINFORCING BAR THAT HAS BEEN BENT INCORRECTLY SHALL NOT BE PERMITTED. BENDING SHALL BE IN ACCORDANCE WITH STANDARD APPROVED PRACTICE AND BY APPROVED MACHINE METHODS.

ALL REINFORCING BARS SHALL BE DELIVERED TO THE PROJECT SITE BUNDLED, TAGGED, AND MARKED. TAGS SHALL BE METAL WITH BAR SIZE, LENGTH, MARK, AND OTHER INFORMATION PRESSED IN BY MACHINE. MARKS SHALL CORRESPOND WITH THOSE USED ON THE PLACING DRAWINGS.

REINFORCEMENT WHICH HAS ANY OF THE FOLLOWING DEFECTS SHALL NOT BE USED IN THE WORK:

- BAR LENGTHS, DEPTHS, AND BENDS BEYOND THE SPECIFIED FABRICATION TOLERANCES,
- BENDS OR KINKS NOT INDICATED ON THE DRAWINGS OR APPROVED SHOP DRAWINGS, AND
- BARS WITH REDUCED CROSS SECTION DUE TO RUSTING OR OTHER CAUSE.

DEFECTIVE REINFORCEMENT SHALL BE REPLACED WITH NEW REINFORCEMENT HAVING THE REQUIRED SHAPE, FORM, AND CROSS SECTION AREA.

TESTING OF REINFORCEMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. THE TESTING AGENCY SHALL BE APPROVED BY THE CONTRACTING OFFICER. REINFORCEMENT BARS SHALL BE TESTED AS PRESCRIBED IN FS QQ-S-632C. MESH REINFORCEMENT SHALL BE TESTED AS PRESCRIBED IN ASTM A185-73.

---PLACING REINFORCEMENT

PLACING REINFORCEMENT SHALL BE IN ACCORDANCE WITH ACI BUILDING CODE, CHAPTER 7, WITH THE FOLLOWING ADDITIONAL PLACING TOLERANCES:

THE HEIGHT OF TOP BARS IN SLABS, BEAMS, AND GIRDERS SHALL BE THE DIMENSION INDICATED PLUS NOT MORE THAN 1/4 INCH AND MINUS ZERO INCH.

ANY ONE STIRRUP SHALL BE LOCATED WHERE INDICATED PLUS OR MINUS ONE INCH, BUT THE OVERALL GROUP OF STIRRUPS SHALL BE THE DIMENSION INDICATED PLUS OR MINUS ONE INCH.

FOR SLABS ON GRADE (OVER EARTH OR OVER CAPILLARY WATER BARRIER) AND FOR FOOTING REINFORCEMENT, BARS OR MESH SHALL BE SUPPORTED ON PRECAST CONCRETE BLOCKS, SPACED AT INTERVALS REQUIRED BY SIZE OF REINFORCEMENT USED, TO KEEP REINFORCEMENT THE MINIMUM HEIGHT SPECIFIED ABOVE THE UNDERSIDE OF SLAB OR FOOTING.

FOR SLABS OTHER THAN ON GRADE, SUPPORTS FOR WHICH ANY PORTION WILL BE LESS THAN ONE INCH FROM CONCRETE SURFACES THAT WILL BE EXPOSED TO VIEW OR WILL BE PAINTED SHALL BE OF PRECAST CONCRETE UNITS, PLASTIC COATED STEEL, OR NONFERROUS METAL THAT IS NOT REACTIVE WITH CONCRETE. PRECAST CONCRETE UNITS SHALL BE WEDGE SHAPED, NOT LARGER THAN 3-1/2 BY 3-1/2 INCHES AND OF THICKNESS EQUAL TO THAT INDICATED FOR CONCRETE PROTECTION OF REINFORCEMENT. THE PRECAST UNITS SHALL HAVE CAST-IN GALVANIZED TIE WIRE HOOKED FOR ANCHORAGE AND SHALL BLEND WITH CONCRETE SURFACES AFTER FINISHING IS COMPLETED.

THE CONTRACTOR SHALL COOPERATE WITH OTHER TRADES IN SETTING OF ANCHOR BOLTS, INSERTS, AND OTHER EMBEDDED ITEMS. WHERE CONFLICTS OCCUR BETWEEN LOCATION REINFORCING AND EMBEDDED ITEMS, THE CONTRACTING OFFICER SHALL BE NOTIFIED SO THAT CONFLICTS MAY BE RECONCILED BEFORE PLACING CONCRETE, ANCHORS AND OTHER EMBEDDED ITEMS SHALL BE POSITIONED AND SUPPORTED WITH APPROPRIATE ACCESSORIES.

ALL REINFORCEMENT SHALL BE SUPPORTED AND SECURED TOGETHER TO PREVENT DISPLACEMENT BY CONSTRUCTION LOADS OR BY THE PLACING OF WET CONCRETE.

---WELDING

WELDING OF REINFORCING BARS NOT INDICATED ON THE DRAWINGS SHALL BE APPROVED BY THE CONTRACTING OFFICER. WELDING SHALL BE IN ACCORDANCE WITH AWS D12.1-75, WITH THE FOLLOWING MODIFICATION:

REFERENCES IN AWS D12.1 TO AWS D1.0 SHALL MEAN AWS D1.1-REV. 2-77, WITH THE FOLLOWING MODIFICATION:

DELETE AWS SECTION 1.1.3 AND SUBSTITUTE: ALL REFERENCES TO THE NEED FOR APPROVAL SHALL MEAN "APPROVAL BY THE CONTRACTING OFFICER", AND ALL REFERENCES TO THE "BUILDING COMMISSIONER" SHALL MEAN THE "CONTRACTING OFFICER".

PRIOR TO FIELD WELDING, THE WELDABILITY OF THE REINFORCING BARS TO BE WELDED SHALL BE DETERMINED BY A CHEMICAL ANALYSIS OF THE STEEL PERFORMED BY A LABORATORY APPROVED BY THE CONTRACTING OFFICER. ONLY STEEL CONFORMING TO THE CHEMICAL REQUIREMENTS SPECIFIED IN AWS D12.1-75, SECTION 1.2, SHALL BE WELDED.

---MECHANICAL SPLICES

GENERAL

MECHANICAL BUTT SPLICES SHALL BE PROVIDED WHERE INDICATED ON THE DRAWINGS. THE SPLICE SHALL BE CAPABLE OF TRANSFERRING 125 PERCENT OF THE SPECIFIED YIELD STRENGTH OF THE BAR. THE SPLICING SHALL BE DONE IN ACCORDANCE WITH THE WRITTEN MANUFACTURER'S INSTRUCTIONS. APPROVED SYSTEM: "CADWELD".

TEST

THE CONTRACTOR SHALL CONTRACT AN INDEPENDENT TESTING LABORATORY TO PERFORM LOAD TESTS ON SAMPLES OF MECHANICAL SPLICE DONE IN THE PRESENCE OF THE CONTRACTING OFFICER. THREE SAMPLES PER EACH BAR SIZE TO BE SPLICED SHALL BE PREPARED AND TESTED.

---JOINTS---

---CONSTRUCTION JOINTS

CONSTRUCTION JOINTS NOT INDICATED SHALL BE MADE AND LOCATED SO AS NOT TO IMPAIR THE STRENGTH AND APPEARANCE OF THE STRUCTURE AND SHALL BE APPROVED BY THE CONTRACTING OFFICER.

CONSTRUCTION JOINTS, IF REQUIRED BUT NOT INDICATED, SHALL BE LOCATED AS FOLLOWS:

IN WALLS, AT NOT MORE THAN 60 FEET IN ANY HORIZONTAL DIRECTION; AT TOP OF FOOTING; AT TOP OF SLABS ON GROUND; AND AT THE UNDERSIDE OF THE DEEPEST BEAM OR GIRDER FRAMING INTO WALL.

IN COLUMNS OR PIERS, AT THE TOP OF FOOTING; AND AT THE UNDERSIDE OF THE DEEPEST BEAM OR GIRDER FRAMING INTO COLUMN OR PIER.

NEAR THE MIDPOINT OF SPANS FOR SUPPORTED SLABS, BEAMS, AND GIRDERS UNLESS A BEAM INTERSECTS A GIRDER AT THE CENTER, IN WHICH CASE THE CONSTRUCTION JOINTS IN THE GIRDER SHALL OFFSET A DISTANCE TO TWICE THE WIDTH OF THE BEAM. PROVISION FOR THE TRANSFER OF SHEAR THROUGH THE CONSTRUCTION JOINT SHALL BE MADE BY THE USE OF SHEAR KEYS AS APPROVED BY THE CONTRACTING OFFICER.

IN SLABS ON GROUND, SO AS TO DIVIDE THE SLAB INTO AREAS NOT IN EXCESS OF 1200 SQUARE FEET.

KEYWAYS AT LEAST 1-1/2 INCHES DEEP SHALL BE PROVIDED IN ALL CONSTRUCTION JOINTS IN WALLS, SLABS, AND BETWEEN WALLS AND FOOTINGS; APPROVED BULKHEADS DESIGNED FOR THE PURPOSE MAY BE USED FOR SLABS.

CONSTRUCTION JOINTS SHALL BE PERPENDICULAR TO THE MAIN REINFORCEMENT. ALL REINFORCEMENT SHALL BE CONTINUED ACROSS CONSTRUCTION JOINTS.

---ISOLATION JOINTS IN SLABS ON GROUND

ISOLATION JOINTS IN SLABS ON GROUND SHALL BE PROVIDED AT ALL POINTS OF CONTACT BETWEEN SLABS ON GROUND AND VERTICAL SURFACES, SUCH AS COLUMN PEDESTALS, FOUNDATION WALLS, GRADE BEAMS, AND ELSEWHERE AS INDICATED.

ISOLATION JOINTS SHALL BE FILLED WITH PREMOLDED JOINT FILLER STRIPS, 1/2 INCH THICK AND EXTENDING THE FULL SLAB DEPTH UNLESS OTHERWISE INDICATED. INSTALL FILLER STRIPS AT THE PROPER LEVEL BELOW THE FINISH FLOOR ELEVATION WITH A SLIGHTLY TAPERED, DRESSED AND OILED WOOD STRIP TEMPORARILY SECURED TO THE TOP OF THE FILLER STRIP TO FORM A GROOVE NOT LESS THAN 3/4 INCH IN DEPTH WHERE THE JOINT WILL BE SEALED WITH SEALING COMPOUND AND NOT LESS THAN 1/4 INCH IN DEPTH WHERE JOINT SEALING IS NOT REQUIRED. REMOVE THE WOOD STRIP AFTER THE CONCRETE HAS SET. CLEAN GROOVE, WHEN SURFACE DRY, OF FOREIGN MATTER AND LOOSE PARTICLES.

---CONTROL JOINTS IN SLABS ON GROUND

CONTROL JOINTS IN SLABS ON GROUND SHALL BE PROVIDED TO FORM PANELS AS INDICATED.

UNDER AND ON THE EXACT LINE OF EACH CONTROL JOINT 50 PERCENT OF THE STRANDS OF THE WELDED WIRE FABRIC OR OTHER REINFORCEMENT SHALL BE CUT BEFORE PLACING THE CONCRETE.

CONTROL JOINTS SHALL BE 1/4 INCH WIDE BY 1/5 TO 1/4 OF THE SLAB DEPTH, AND SHALL BE FORMED BY INSERTING A PREMOLDED HARDBOARD OR FIBERBOARD STRIP INTO THE FRESH CONCRETE UNTIL THE TOP SURFACE OF THE STRIP IS FLUSH WITH THE SLAB SURFACE. AFTER THE CONCRETE HAS CURED FOR AT LEAST 7 DAYS, REMOVE INSERTS AND CLEAN GROOVE OF FOREIGN MATTER AND LOOSE PARTICLES.

---SEALING JOINTS IN SLABS ON GROUND

ISOLATION AND CONTROL JOINTS IN SLABS ON GROUND SHALL BE SEALED WITH JOINT SEALING COMPOUND AFTER THE CONCRETE CURING PERIOD. THE GROOVE SHALL BE SLIGHTLY UNDERFILLED WITH JOINT SEALING COMPOUND TO PREVENT EXTRUSION OF THE COMPOUND. ANY EXCESS MATERIAL SHALL BE REMOVED AS SOON AFTER SEALING AS POSSIBLE.

---INSTALLATION OF ANCHORAGE DEVICES---

---GENERAL

ALL ANCHORAGE DEVICES AND OTHER EMBEDDED ITEMS REQUIRED FOR OTHER WORK THAT IS ATTACHED TO, OR SUPPORTED BY, CAST-IN-PLACE CONCRETE SHALL BE SET AND BUILT IN AS PART OF THE WORK OF THIS SECTION, USING THE SETTING DRAWINGS, INSTRUCTIONS, AND DIRECTIONS FOR THE WORK TO BE ATTACHED THERETO.

---PLACING ANCHORAGE DEVICES

ANCHORAGE DEVICES AND OTHER EMBEDDED ITEMS SHALL BE POSITIONED ACCURATELY AND SUPPORTED AGAINST DISPLACEMENT. OPENINGS IN ANCHORAGE DEVICES, SUCH AS SLOTS AND THREADED HOLES, SHALL BE FILLED TEMPORARILY WITH AN APPROVED REMOVABLE MATERIAL TO PREVENT THE ENTRY OF CONCRETE INTO THE OPENINGS.

---PREPARATIONS FOR CONCRETE PLACING---

---GENERAL

ALL SURFACES AGAINST WHICH CONCRETE IS TO BE PLACED SHALL BE FREE OF DEBRIS, LOOSE MATERIAL, STANDING WATER AND ANY OTHER DELETERIOUS SUBSTANCES BEFORE THE START OF CONCRETE PLACING.

STANDING WATER SHALL BE REMOVED WITHOUT WASHING OVER FRESHLY DEPOSITED CONCRETE. ANY FLOW OF WATER SHALL BE DIVERTED THROUGH SIDE DRAINS PROVIDED FOR SUCH A PURPOSE.

---SUBGRADE UNDER FOUNDATIONS AND FOOTINGS

THE SUBGRADE UNDER FOUNDATIONS AND FOOTINGS SHALL BE UNDISTURBED CLEAN SURFACES, FREE FROM MUD AND WATER BEFORE CONCRETE IS DEPOSITED. WHEN THE SUBGRADE MATERIAL IS SEMI-POROUS AND DRY THE SUBGRADE SURFACE SHALL BE SPRINKLED WITH WATER AS REQUIRED TO ELIMINATE SUCTION AT THE TIME THE CONCRETE IS DEPOSITED. WHEN THE SUBGRADE MATERIAL IS POROUS, THE SUBGRADE SURFACE SHALL BE SEALED BY COVERING THE SURFACE WITH THE SPECIFIED WATER BARRIER SUBGRADE COVER; THIS MAY ALSO BE USED OVER SEMI-POROUS, DRY SUBGRADE MATERIAL INSTEAD OF WATER SPRINKLING.

---SUBGRADE UNDER SLABS ON GROUND

BEFORE CONSTRUCTION OF SLABS ON GROUND, UNDERGROUND WORK ON PIPES AND CONDUITS SHALL HAVE BEEN COMPLETED AND APPROVED.

THE PREVIOUSLY CONSTRUCTED SUBGRADE OR FILL SHALL BE CLEANED OF ALL FOREIGN MATERIALS AND SHALL BE INSPECTED BY THE CONTRACTOR IN THE PRESENCE OF THE CONTRACTING OFFICER FOR ADEQUATE COMPACTION AND SURFACE TOLERANCES AS SPECIFIED IN SECTION 2D - EXCAVATION, FILL AND BACKFILL FOR STRUCTURES.

THE FILL SURFACE UNDER INTERIOR SLABS ON GROUND SHALL BE COVERED WITH THE SPECIFIED WATER VAPOR BARRIER SUBGRADE COVER IMMEDIATELY PRIOR TO PLACING REINFORCEMENT. THE SUBGRADE COVER SHALL BE CAREFULLY INSTALLED TO AVOID PUNCTURE OR TEAR. PUNCTURES OR TEARS OCCURRING DURING SUBSEQUENT OPERATIONS SHALL BE PATCHED. THE SUBGRADE COVER SHEETS SHALL BE LAID WITH NOT LESS THAN 6-INCH LAP AT EDGES AND ENDS, AND IN THE DIRECTION IN WHICH CONCRETE IS TO BE PLACED. PATCHES AND LAPPED JOINTS SHALL BE SEALED WITH A VAPOR BARRIER ADHESIVE OR PRESSURE SENSITIVE VAPOR BARRIER TAPE NOT LESS THAN TWO INCHES WIDE. THE SUBGRADE OR FILL SURFACE UNDER EXTERIOR SLABS ON GROUND SHALL BE PREPARED AS HEREINBEFORE SPECIFIED FOR THE SUBGRADE UNDER FOUNDATIONS AND FOOTINGS.

---FORMWORK

FORMWORK SHALL BE COMPLETE AND APPROVED. ALL HARDENED CONCRETE, DEBRIS, AND FOREIGN MATERIAL SHALL BE REMOVED FROM THE INTERIOR OF FORMS, BEFORE THE START OF CONCRETE PLACING.

---REINFORCEMENT AND OTHER EMBEDDED ITEMS

REINFORCEMENT, JOINT MATERIALS, AND OTHER EMBEDDED MATERIALS SHALL BE SECURED IN POSITION, INSPECTED, AND APPROVED BEFORE THE START OF CONCRETE PLACING. NOTE: ALL CONCRETE SPLATTER SHALL BE REMOVED FROM EXISTING REINFORCING DOWELS IN FOUNDATIONS OR OTHER EXPOSED STEEL PRIOR TO NEXT POUR.

---WEATHER LIMITATIONS AND PROTECTION

CONCRETE SHALL NOT BE PLACED WHEN THE TEMPERATURE OF THE ATMOSPHERE IS BELOW 40 DEGREES FAHRENHEIT UNLESS ADEQUATE PROTECTION IS PROVIDED.

PROTECTION DURING INCLEMENT WEATHER SHALL BE SUFFICIENTLY WATERTIGHT TO PREVENT THE ENTRY OF RAIN ONTO THE SURFACES TO RECEIVE CONCRETE, AND INTO THE FRESH CONCRETE.

PROTECTION MATERIALS SHALL BE STORED AT THE PROJECT SITE FOR USE IN THE EVENT OF UNFORESEEN WEATHER CHANGES AFTER THE START OF CONCRETE PLACING OPERATIONS.

---GENERAL PLACING REQUIREMENTS

CONCRETE SHALL BE DEPOSITED CONTINUOUSLY OR IN LAYERS OF SUCH THICKNESS THAT NO CONCRETE WILL BE PLACED ON CONCRETE WHICH HAS HARDENED SUFFICIENTLY TO CAUSE THE FORMATION OF SEAMS OR PLANES OF WEAKNESS WITHIN THE SECTION. IF A SECTION CANNOT BE PLACED CONTINUOUSLY, CONSTRUCTION JOINTS SHALL BE PROVIDED AS SPECIFIED HEREINAFTER. CONCRETE PLACING SHALL BE PERFORMED AT SUCH A RATE THAT CONCRETE WHICH IS BEING INTEGRATED WITH FRESH CONCRETE IS STILL PLASTIC. CONCRETE SHALL BE DEPOSITED AS NEARLY AS PRACTICABLE IN ITS FINAL POSITION TO AVOID SEGREGATION DUE TO REHANDLING OR FLOWING. CONCRETE SHALL NOT BE SUBJECTED TO ANY PROCEDURE WHICH WILL CAUSE SEGREGATION.

CONCRETE TO RECEIVE OTHER CONSTRUCTION SHALL BE SCREEDED TO THE PROPER LEVEL TO AVOID EXCESSIVE SKIMMING OR GROUTING.

CONCRETE WHICH BECOMES NONPLASTIC AND UNWORKABLE, OR DOES NOT MEET THE QUALITY CONTROL LIMITS HEREINAFTER SPECIFIED IN THE ARTICLE ENTITLED "INSPECTION AND ACCEPTANCE PROVISIONS", OR HAS BEEN CONTAMINATED BY FOREIGN MATERIALS SHALL NOT BE USED IN THE WORK. THE USE OF RETEMPERED CONCRETE SHALL NOT BE PERMITTED. REJECTED CONCRETE SHALL BE REMOVED FROM THE PROJECT SITE AND DISPOSED OF IN AN APPROVED LOCATION.

---PLACING CONCRETE IN FORMS

CONCRETE SHALL BE PLACED IN THE FORMS, AS CLOSE AS POSSIBLE IN FINAL POSITION, IN UNIFORM, APPROXIMATELY HORIZONTAL LAYERS NOT OVER 12 INCHES DEEP. FORMS SPLASHED WITH CONCRETE AND REINFORCEMENT SPLASHED WITH CONCRETE OR FORM COATING SHALL BE CLEANED IN ADVANCE OF PLACING SUBSEQUENT LIFTS. CONCRETE SHALL NOT BE ALLOWED TO DROP FREELY MORE THAN FIVE FEET IN UNEXPOSED WORK NOR MORE THAN THREE FEET IN EXPOSED WORK; WHERE GREATER DROPS ARE REQUIRED, A TREMIE OR OTHER APPROVED MEANS SHALL BE EMPLOYED. THE DISCHARGE OF THE TREMIES SHALL BE CONTROLLED SO THAT THE CONCRETE MAY BE EFFECTIVELY COMPACTED INTO HORIZONTAL LAYERS NOT MORE THAN 12 INCHES THICK, AND THE SPACING OF THE TREMIES SHALL BE SUCH THAT SEGREGATION DOES NOT OCCUR.

TEMPORARY SPREADERS IN FORMS SHALL BE REMOVED WHEN THE CONCRETE PLACING HAS REACHED THE ELEVATION OF THE SPREADERS.

ALL CONCRETE PLACED IN FORMS SHALL BE CONSOLIDATED BY MECHANICAL VIBRATING EQUIPMENT SUPPLEMENTED BY HAND SPADING, RODDING OR TAMPING. VIBRATORS SHALL BE DESIGNED TO OPERATE WITH VIBRATORY ELEMENT SUBMERGED IN THE CONCRETE, AND SHALL MAINTAIN A SPEED OF NOT LESS THAN 6000 IMPULSES PER MINUTE WHEN SUBMERGED IN THE CONCRETE. THE VIBRATING EQUIPMENT SHALL BE AT ALL TIMES ADEQUATE IN NUMBER OF UNITS AND POWER OF EACH UNIT TO PROPERLY CONSOLIDATE THE CONCRETE. VIBRATION OF FORMS AND REINFORCEMENT SHALL NOT BE PERMITTED. VIBRATORS SHALL NOT BE USED TO TRANSPORT CONCRETE INSIDE FORMS. VIBRATORS SHALL BE INSERTED AND WITHDRAWN VERTICALLY AT UNIFORMLY SPACED POINTS NOT FARTHER APART THAN THE VISIBLE EFFECTIVENESS OF THE MACHINE. THE VIBRATOR SHALL NOT BE INSERTED INTO LOWER COURSES OF CONCRETE THAT HAVE BEGUN TO SET. AT EACH INSERTION THE DURATION OF VIBRATION SHALL BE LIMITED TO THE TIME NECESSARY TO CONSOLIDATE THE CONCRETE AND COMPLETE EMBEDMENT OF REINFORCEMENT AND OTHER EMBEDDED ITEMS WITHOUT CAUSING SEGREGATION OF THE CONCRETE MIX.

THE PLACING OF CONCRETE IN SUPPORTING ELEMENTS SHALL NOT BE STARTED UNTIL THE CONCRETE PREVIOUSLY PLACED IN COLUMNS AND WALLS IS NO LONGER PLASTIC.

---BONDING NEW TO IN-PLACE CONCRETE

THE SURFACES OF THE SET CONCRETE AT ALL JOINTS SHALL BE ROUGHENED, EXCEPT WHERE BONDING IS OBTAINED BY USE OF A CONCRETE BONDING AGENT, AND CLEANED FREE OF LAITANCE, COATINGS, LOOSE PARTICLES AND FOREIGN MATTER AND THEN SLUSHED WITH 1:2 GROUT. SURFACES OF EXISTING CONCRETE SHALL BE COATED WITH AN EPOXY BONDING AGENT PRIOR TO PLACEMENT OF NEW CONCRETE AND IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS, UNLESS OTHERWISE NOTED. PREPARE SURFACES OF EXISTING CONCRETE TO EXPOSE AGGREGATE BY SAND BLASTING, CHIPPING OR WIRE BRUSHING.

---FINISHING OF FORMED SURFACES---

---REPAIRING AND PATCHING DEFECTIVE AREAS

IMMEDIATELY AFTER REMOVAL OF FORMS ALL DEFECTIVE AREAS SHALL BE REPAIRED AND PATCHED WITH CEMENT MORTAR.

HONEYCOMB, ROCK POCKETS, VOIDS OVER 1/2 INCH IN DIAMETER, AND HOLES LEFT BY TIE RODS AND BOLTS SHALL BE CUT OUT TO SOLID CONCRETE; BUT IN NO CASE TO A DEPTH OF LESS THAN ONE INCH. THE EDGES OF CUTS SHALL BE PERPENDICULAR TO THE SURFACE OF THE CONCRETE. BEFORE PLACING THE CEMENT MORTAR, THE AREA TO BE PATCHED AND AT LEAST SIX INCHES ADJACENT THERETO SHALL BE THOROUGHLY CLEANED, DAMPENED WITH WATER, AND BRUSH COATED WITH NEAT PORTLAND CEMENT GROUT. THE CEMENT MORTAR FOR PATCHING SHALL CONSIST OF ONE PART STANDARD

PORTLAND CEMENT TO TWO PARTS FINE AGGREGATE PASSING NO. 16 MESH SIEVE, AND AS LITTLE WATER AS NECESSARY FOR HANDLING AND PLACING. WHERE THE CONCRETE SURFACE WILL BE EXPOSED TO VIEW, THE PORTLAND CEMENT PORTION OF THE CEMENT MORTAR SHALL BE A BLEND OF WHITE AND STANDARD PORTLAND CEMENT SO THAT, WHEN DRY, THE CEMENT MORTAR SHALL MATCH THE SURROUNDING CONCRETE IN COLOR. THE CEMENT MORTAR SHALL BE THOROUGHLY COMPACTED IN PLACE AND STRUCK OFF SLIGHTLY HIGHER THAN THE SURROUNDING SURFACE. HOLES EXTENDING THROUGH THE CONCRETE SHALL BE FILLED BY MEANS OF A PLUNGER TYPE GUN OR OTHER SUITABLE DEVICE FROM THE UNEXPOSED FACE, USING A STOP HELD AT THE EXPOSED FACE TO INSURE COMPLETE FILLING.

---STANDARD ROUGH FORM FINISH

STANDARD ROUGH FORM FINISH SHALL BE THE CONCRETE SURFACE HAVING THE TEXTURE IMPARTED BY THE FORM FACING MATERIAL USED, DEFECTIVE AREAS REPAIRED AND PATCHED AS SPECIFIED HEREINBEFORE, AND ALL FINS AND OTHER PROJECTIONS EXCEEDING 1/4 INCH IN HEIGHT RUBBED DOWN WITH WOOD BLOCKS.

STANDARD ROUGH FORM FINISH SHALL BE GIVEN ALL CONCRETE FORMED SURFACES THAT ARE TO BE CONCEALED BY OTHER CONSTRUCTION, UNLESS OTHERWISE SPECIFIED HEREINAFTER.

---STANDARD SMOOTH FINISH

STANDARD SMOOTH FINISH SHALL BE THE AS-CAST CONCRETE SURFACE AS OBTAINED WITH THE FORM FACING MATERIAL FOR STANDARD SMOOTH FINISH, DEFECTIVE AREAS REPAIRED AND PATCHED AS SPECIFIED HEREINBEFORE, AND ALL FINS AND OTHER PROJECTIONS ON THE SURFACE COMPLETELY REMOVED.

STANDARD SMOOTH FINISH SHALL BE GIVEN ALL CONCRETE FORMED SURFACES THAT ARE TO RECEIVE A GROUT FINISH, OR THAT ARE TO BE COVERED WITH A COATING MATERIAL APPLIED DIRECTLY TO THE CONCRETE OR WITH A COVERING MATERIAL BONDED TO THE CONCRETE, SUCH AS WATERPROOFING,DAMPPROOFING, PAINTING, OR OTHER SIMILAR COATING SYSTEM.

---GROUT FINISH

GROUT FINISH SHALL BE A STANDARD SMOOTH FINISH COATED WITH GROUT AS SPECIFIED HEREINAFTER.

GROUT FINISH SHALL BE GIVEN ALL INTERIOR AND EXTERIOR CONCRETE VERTICAL SURFACES THAT ARE TO BE EXPOSED TO VIEW.

GROUT SHALL CONSIST OF ONE PART PORTLAND CEMENT TO 1-1/2 PARTS FINE AGGREGATE BY VOLUME, MIXED WITH SUFFICIENT WATER TO PRODUCE A CONSISTENCY OF THICK PAINT. THE PORTLAND CEMENT PORTION SHALL BE A BLEND OF STANDARD PORTLAND CEMENT AND WHITE PORTLAND CEMENT, PROPORTIONED AS DETERMINED BY TRIAL MIXES SO THAT THE FINAL COLOR OF THE GROUT, WHEN DRY, WILL BE APPROXIMATELY THE SAME AS THE COLOR OF THE SURROUNDING CONCRETE. FINE AGGREGATE SHALL PASS THE NO. 30 MESH SIEVE.

THE SURFACE OF THE CONCRETE SHALL BE THOROUGHLY WETTED AND THE GROUT SHALL BE APPLIED IMMEDIATELY TO THE WETTED SURFACES. GROUT SHALL BE SPREAD OVER THE SURFACE WITH CLEAN BURLAP PADS OR SPONGE RUBBER FLOATS IN A MANNER TO FILL ALL PITS, AIR BUBBLES, AND SURFACE HOLES. EXCESS GROUT SHALL BE REMOVED BY SCRAPING AND THEN RUBBING THE SURFACE WITH CLEAN BURLAP TO REMOVE ANY VISIBLE GROUT FILM. IN HOT, DRY WEATHER THE GROUT SHALL BE KEPT DAMP BY MEANS OF FOG SPRAY DURING THE SETTING PERIOD. THE FINISH IN ANY AREA SHALL BE COMPLETED THE DAY IT IS STARTED, AND THE LIMITS OF A FINISHED AREA SHALL BE MADE AT NATURAL BREAKS IN THE FINISHED SURFACE.

---RELATED UNFORMED SURFACES

THE TOPS OF WALLS, HORIZONTAL OFFSETS, AND SIMILAR UNFORMED SURFACES OCCURRING ADJACENT TO FORMED SURFACES SHALL BE STRUCK OFF SMOOTH AFTER THE CONCRETE IS PLACED AND SHALL BE FINISHED TO A TEXTURE MATCHING THAT OF THE ADJACENT FORMED SURFACES. THE FINAL SURFACE TREATMENT ON FORMED SURFACES SHALL CONTINUE UNIFORMLY ACROSS THE ADJACENT UNFORMED SURFACES.

---FINISHING OF MONOLITHIC SLABS---

---FLOAT FINISH

A FLOAT FINISH TO A TRUE AND UNIFORM PLANE WITH NO AGGREGATE VISIBLE SHALL BE GIVEN MONOLITHIC SLAB SURFACES THAT ARE TO RECEIVE TROWEL FINISH AND OTHER FINISHES AS HEREINAFTER SPECIFIED.

---TROWEL FINISH

TROWEL FINISH SHALL BE GIVEN ALL MONOLITHIC SLAB SURFACES THAT ARE TO BE EXPOSED TO VIEW, UNLESS OTHERWISE INDICATED.

AFTER THE COMPLETION OF THE FLOAT FINISH AS SPECIFIED ABOVE, THE SURFACE SHALL RECEIVE A TROWEL FINISH. THE FIRST TROWELING AFTER THE COMPLETION OF THE FLOAT FINISH SHALL BE DONE BY A POWER DRIVEN TROWEL AND SHALL PRODUCE A SMOOTH SURFACE WHICH IS RELATIVELY FREE OF DEFECTS BUT WHICH MAY CONTAIN SOME TROWEL MARKS.

ADDITIONAL TROWELINGS SHALL BE DONE BY HAND AFTER THE SURFACE HAS HARDENED SUFFICIENTLY. THE FINAL TROWELING SHALL BE STARTED WHEN A RINGING SOUND IS PRODUCED AS THE TROWEL IS MOVED OVER THE SURFACE. THE SURFACE SHALL BE THOROUGHLY CONSOLIDATED BY THE HAND TROWELING OPERATION. THE FINISHED SURFACE SHALL BE FREE OF ANY TROWEL MARKS, UNIFORM IN TEXTURE AND APPEARANCE, AND BE PLANE TO A TOLERANCE NOT EXCEEDING 1/8 INCH IN 10 FEET WHEN TESTED WITH A 10-FOOT STRAIGHTEDGE PLACED ANYWHERE ON THE SURFACE IN ANY DIRECTION. ANY SURFACE DEFECTS OF SUFFICIENT MAGNITUDE TO SHOW THROUGH THE FLOOR COVERING SHALL BE REMOVED BY GRINDING.

---CHEMICAL HARDENER FINISH

CHEMICAL HARDENER FINISH SHALL BE GIVEN INTERIOR FLOOR SURFACES OF TWO HYPERGOLIC AND TWO ELECTRICAL BUILDINGS , AND ALL OTHER INTERIOR FLOORS, AND SHALL MEET ASTM C309 (TYPE 1) CLASS B. THE LIQUID CHEMICAL FLOOR HARDENER SHALL BE APPLIED AFTER COMPLETE CURING AND DRYING OF THE CONCRETE SURFACE. EACH COAT SHALL BE APPLIED EVENLY AT THE RATE OF APPLICATION OF 400 SQUARE FEET PER GALLON AND ALLOWED TO DRY 24 HOURS BETWEEN COATS. IF THIS MATERIAL IS USED AS THE CURING MEMBRANE, THE CURING APPLICATION WILL BE CONSIDERED THE FIRST COAT AND THE SECOND AND THIRD COATS SHALL BE APPLIED AFTER ALL MORTAR WORK AND PAINTING HAVE BEEN COMPLETED IN THE AREA.

APPROVED PROPRIETARY CHEMICAL HARDENERS SHALL BE APPLIED IN THREE COATS AND IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED DIRECTIONS.

AFTER FINAL COAT OF CHEMICAL HARDENER SOLUTION IS COMPLETED AND DRY, ANY SURPLUS HARDENER SHALL BE REMOVED FROM THE SURFACE BY SCRUBBING AND MOPPING WITH WATER.

---NONSLIP BROOM FINISH

NONSLIP BROOM FINISH SHALL BE GIVEN THE SURFACES OF EXTERIOR SLABS, PAVEMENTS, CONCRETE STEPS AND PLATFORMS, CONCRETE RAIL REAM, AND ELSEWHERE WHERE INDICATED.

IMMEDIATELY AFTER THE COMPLETION OF TROWEL FINISH, THE SURFACE SHALL BE SLIGHTLY ROUGHENED BY BROOMING WITH A FIBER BRISTLE BRUSH IN A DIRECTION TRANSVERSE TO THAT OF THE MAIN TRAFFIC.

---CONCRETE CURING AND PROTECTION---

---GENERAL

FRESHLY PLACED CONCRETE SHALL BE PROTECTED FROM PREMATURE DRYING AND EXCESSIVELY COLD OR HOT TEMPERATURE AND SHALL BE MAINTAINED WITHOUT DRYING AT A RELATIVELY CONSTANT TEMPERATURE FOR THE PERIOD OF THE TIME NECESSARY FOR THE HYDRATION OF THE CEMENT AND PROPER HARDENING OF THE CONCRETE.

INITIAL CURING SHALL START AS SOON AS FREE WATER HAS DISAPPEARED FROM THE SURFACE OF THE CONCRETE AFTER PLACING AND FINISHING. THE CONCRETE SHALL BE KEPT CONTINUOUSLY MOIST FOR NOT LESS THAN 72 HOURS.

FINAL CURING SHALL IMMEDIATELY FOLLOW INITIAL CURING AND BEFORE THE CONCRETE HAS DRIED. THE FINAL CURING SHALL CONTINUE UNTIL THE CUMULATIVE NUMBER OF HOURS OR FRACTION THEREOF (NOT NECESSARILY CONSECUTIVE) DURING WHICH THE TEMPERATURE OF THE AIR IN CONTACT WITH THE CONCRETE IS ABOVE 50 DEGREES FAHRENHEIT, HAS TOTALLED 168 HOURS, RAPID DRYING AT THE END OF THE FINAL CURING PERIOD SHALL BE PREVENTED.

---CURING METHODS

CURING SHALL BE ACCOMPLISHED BY MOIST CURING, BY MOISTURE RETAINING COVER CURING, BY MEMBRANE CURING, AND BY COMBINATIONS THEREOF, AS SPECIFIED HEREINAFTER.

MOIST CURING

MOIST CURING SHALL BE ACCOMPLISHED BY ANY OF THE FOLLOWING METHODS:

KEEPING THE SURFACE OF THE CONCRETE CONTINUOUSLY WET BY COVERING WITH WATER,

CONTINUOUS WATER SPRAYING,

COVERING THE CONCRETE SURFACE WITH THE SPECIFIED ABSORPTIVE COVER FOR CURING CONCRETE THOROUGHLY SATURATED WITH WATER AND KEEPING THE ABSORPTIVE COVER WET BY WATER SPRAYING OR INTERMITTENT HOSING. THE ABSORPTIVE COVER SHALL BE PLACED SO AS TO PROVIDE COVERAGE OF THE CONCRETE SURFACES AND EDGES WITH A SLIGHT OVERLAP OVER ADJACENT ABSORPTIVE COVERS.

MOISTURE COVER CURING

MOISTURE RETAINING COVER CURING SHALL BE ACCOMPLISHED BY COVERING THE CONCRETE SURFACES WITH THE SPECIFIED MOISTURE RETAINING COVER FOR CURING CONCRETE. THE COVER SHALL BE PLACED DIRECTLY ON THE CONCRETE IN THE WIDEST PRACTICABLE WIDTH, WITH SIDES AND ENDS LAPPED AT LEAST THREE INCHES AND SEALED CONTINUOUSLY WITH WATERPROOF ADHESIVE OR PRESSURE SENSITIVE WATERPROOF TAPE. THE COVER SHALL BE WEIGHTED TO PREVENT DISPLACEMENT; TEARS OR HOLES APPEARING DURING THE CURING PERIOD SHALL BE IMMEDIATELY REPAIRED BY PATCHING WITH PRESSURE SENSITIVE WATERPROOF TAPE OR OTHER APPROVED METHOD.

MEMBRANE CURING

MEMBRANE CURING SHALL BE ACCOMPLISHED BY APPLYING THE SPECIFIED MEMBRANE FORMING CURING COMPOUND TO DAMP CONCRETE SURFACES AS SOON AS THE MOISTURE FILM HAS DISAPPEARED. THE CURING COMPOUND SHALL BE APPLIED UNIFORMLY IN A TWO COAT CONTINUOUS OPERATION BY POWER SPRAYING EQUIPMENT USING A SPRAY NOZZLE EQUIPPED WITH A WING GUARD. THE SECOND COAT SHALL BE APPLIED IN A DIRECTION APPROXIMATELY AT RIGHT ANGLES TO THE DIRECTION OF THE FIRST COAT. THE TOTAL COVERAGE FOR THE TWO COATS SHALL BE NOT MORE THAN 200 SQUARE FEET PER GALLON OF CURING COMPOUND. CONCRETE SURFACES WHICH ARE SUBJECTED TO HEAVY RAINFALL WITHIN THREE HOURS AFTER CURING COMPOUND HAS BEEN APPLIED SHALL BE RESPRAYED BY THE METHOD, AND AT THE RATE SPECIFIED ABOVE. CONTINUITY OF THE COATING SHALL BE MAINTAINED FOR THE ENTIRE CURING PERIOD AND ANY DAMAGE TO THE COATING DURING THIS PERIOD SHALL BE REPAIRED IMMEDIATELY.