AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		4

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0001	2 JULY 2002		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
US ARMY ENGINEER DISTRICT, FORT WORTH ATTN: CESWF-CT (RM 2A19) PO BOX 17300 FORT WORTH, TX 76102-0300			

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	9A. AMENDMENT OF SOLICIATION NO.
	☒	DACA63-02-B-0006
		9B. DATED *(SEE ITEM 11)* 14 JUNE 2002
	☐	10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED *(SEE ITEM 11)*

CODE	FACILITY CODE

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

The Solicitation for VEHICLE MAINTENANCE FACILITY, FORT HOOD, TEXAS, is amended as follows:

See Continuation Sheet.

NOTE: Bid Opening Date and Time remain 16 JULY 2002 AT 2 PM LOCAL TIME, as previously announced.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

Item 14. Continued.

CHANGES TO THE SPECIFICATIONS

1. New Sections - Add the accompanying new sections, each bearing the notation "ACCOMPANYING AMENDMENT NO. 0001 TO SOLICITATION NO. DACA63-02-B-0006," and add each to the Table of Contents:

02746 RESIN MODIFIED PAVEMENT SURFACING MATERIAL
07240 EXTERIOR FINISH SYSTEMS

2. Replacement Sections - Replace the following sections with the accompanying new sections of the same number and title, bearing the notation "ACCOMPANYING AMENDMENT NO. 0001 TO SOLICITATION NO. DACA63-02-B-0006:"

01000 CONSTRUCTION SCHEDULE
01368 SPECIAL PROJECT PROCEDURES FOR FORT HOOD
16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL
16711 TELEPHONE SYSTEM, OUTSIDE PLANT

CHANGES TO THE DRAWINGS

3. Replacement Drawings.- Replace the drawings listed below with the attached new drawings of the same number, bearing the notation "AM #0001":

G202.cal G202 VOLUME ONE INDEX SHEET
G401.cal G401 OVERALL SITE PLAN
G402.cal G402 OVERALL SITE & PAVEMENT PLAN
C105.cal C105 LAY OUT PLAN 5
C204.cal C204 GRADING PLAN 4
C205.cal C205 GRADING PLAN 5
C206.cal C206 GRADING PLAN 6
C402.cal C402 LAY OUT & GRADING PLAN BID OPTION #2
C502.cal C502 UTILITY PLAN 2
C505.cal C505 UTILITY PLAN 5
C506.cal C506 UTILITY PLAN 6 BID OPTION #4
C602.cal C602 PLAN-PROFILE 2 MAIN ROAD
C604.cal C604 PLAN-PROFILE 4 MAIN ROAD
C701.cal C701 SANITARY SEWER & FORCE MAIN PROFILES
C703.cal C703 SANITARY SEWER PROFILE BID OPTIN #4
C905.cal C905 UTILITY & LIFT STATION DETAILS
C906.cal C906 STORM DRAINAGE DETAILS 1
C907.cal C907 STORM DRAINAGE DETAILS 2
AA108.cal AA108"REFLECTED CEILING PLAN ZONE ""2"""
AA111.cal AA111"REFLECTED CEILING PLAN ZONE ""5"" "
AA112.cal AA112OVERALL ROOF PLAN
AA113.cal AA113ENLARGED PLANS INTERIOR ELEVATIONS I
AA115.cal AA115ENLARGED PLANS - SECTIONS STAIRS
AA116.cal AA116STAIR DETAILS - WALL TYPES
AA202.cal AA202"ELEVATIONS ZONE ""1"""
AA203.cal AA203"ELEVATIONS ZONE ""2"""

AA204.cal AA204"ELEVATIONS ZONE ""3"""
AA205.cal AA205"ELEVATIONS ZONE ""4"""
AA302.cal AA302"BUILDING SECTIONS ZONE ""1"""
AA303.cal AA303"BUILDING SECTIONS ZONE ""2"""
AA304.cal AA304"BUILDING SECTIONS ZONE ""3"""
AA305.cal AA305"BUILDING SECTIONS ZONE ""4"""
AA402.cal AA402WALL SECTIONS II
AA501.cal AA501DOOR & WINDOW DETAILS I
AA502.cal AA502WIRE MESH PARTITION DETAILS
AA506.cal AA506DOOR & WINDOW DETAILS II
AA507.cal AA507DOOR & WINDOW DETAILS III
AA601.cal AA601DOOR SCHEDULE
BA101.cal BA101DEPLOYMENT STORAGE BUILDING PLANS SECTIONS
CA101.cal CA101 MOTOR POOL DISPATCH PLANS
CA201.cal CA201 MOTOR POOL DISPATCH BUILDING DETAILS
DA201.cal DA201 LATRINE BUILDING ELEVATIONS BID OPTION 4
DA101.cal DA101 LATRINE BUILDING FLOOR PLAN BID OPTION 4
AI601.cal AI601 ROOM FINISH SCHEDULE
G203.cal G203 SHEET SEQUENCE ID AND CAD FILENAMING CONVENTION
G204.cal G204 VOLUME TWO INDEX SHEET
AS101.cal AS101MISCELLANEOUS NOTES & DETAILS
AS304.cal AS304FOUNDATION DETAILS II
AS701.cal AS701MISCELLANEOUS FRAMING DETAILS
CS201.cal CS201 "MOTOR POOL DISPATCH BUILDING C FOUNDATION PLAN, ROOF FRAMING PLAN, & DETAILS"
ES201.cal ES201LATRINE BUILDING E - BID OPTION 4 FOUNDATION PLAN & DETAILS
ES601.cal ES601LATRINE BUILDING E ROOF FRAMING PLAN & DETAILS
AM101.cal AM101 SCHEDULES AND GENERAL NOTES
AM102.cal AM102 MECHANICAL EQUIPMENT SCHEDULE
AM103.cal AM103 MECHANICAL EQUIPMENT SCHEDULE
AM703.cal AM703 GENERAL HVAC DETAILS
AM706.cal AM706 PAINT BOOTH EXHAUST DETAILS
EM201.cal EM201 LATRINE HVAC AND PLUMBING PLAN
AP101.cal AP101MECHANICAL EQUIPMENT SCHEDULES
AY201.cal AY201HVAC CONTROLS LEGEND
AY202.cal AY202MISC. HVAC & BOILER CHILLER CONTROL DIAGRAMS
AY203.cal AY203CONTROL DIAGRAMS FOR AHU-1 AND 2
U101.cal U101 "EXTERIOR LEGEND, SCHEDULES & ELECTRICAL KEY PLAN"
U305.cal U305 ELECTRICAL UTILITIES PLAN AREA F
U308.cal U308 "ELECTRICAL UTILITIES PLAN AREA A - OPTIONS 2, 3 & 4"
U401.cal U401 EXTERIOR TELECOMMUNICATIONS PLAN AREA B
U404.cal U404 EXTERIOR TELECOMMUNICATIONS PLAN AREA E
U405.cal U405 EXTERIOR TELECOMMUNICATIONS PLAN AREA I
U406.cal U406 EXTERIOR TELECOMMUNICATIONS PLAN AREA J
U407.cal U407 "EXTERIOR TELECOMMUNICATIONS PLAN AREA F - OPTIONS 2, 3 & 4"
U408.cal U408 EXTERIOR TELECOMMUNICATIONS PLAN AREA K - BID OPTION #3
U409.cal U409 EXTERIOR TELECOMMUNICATIONS PLAN AREA L - BID OPTION #3
U410.cal U410 EXTERIOR TELECOMMUNICATIONS PLAN AREA M - BID OPTION #3
U411.cal U411 EXTERIOR TELECOMMUNICATIONS PLAN AREA N - BID OPTION #3
U412.cal U412 EXTERIOR TELECOMMUNICATIONS PLAN AREA O - BID OPTION #3
U413.cal U413 EXTERIOR TELECOMMUNICATIONS PLAN AREA P - BID OPTION #3
U414.cal U414 EXTERIOR TELECOMMUNICATIONS PLAN AREA A - BID OPTION #3
U804.cal U804 POLE DETAILS
U807.cal U807 TOC YARD DETAILS

U808.cal U808 TOC YARD DETAILS 2
CE202.cal CE202 "TOC YARD GUARDSHACK LIGHTING, POWER & COMMO PLANS"
EE201.cal EE201LATRINE ELECTRICAL PLAN BID OPTION 4

END OF AMENDMENT

SECTION 01000

CONSTRUCTION SCHEDULE
AM#0001

PART 1 GENERAL

1.1 SCHEDULE

Commence, prosecute, and complete the work under this contract in accordance with the following schedule and Section 00700 CONTRACT CLAUSES COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK and LIQUIDATED DAMAGES:

Item of Work	Commencement of Work (calendar days)	Completion of Work (calendar days)	Liquidated Damages per calendar day[1]
(1) All work except Establishment of Turf	Within 10 days after receipt of Notice to Proceed	**AM#0001 720**	**AM#0001 $ 1,390**
(2) Establishment of Turf	**	**	---

*Establishment of Turf

Planting and maintenance for turfing shall be in accordance with Section 02926 ESTABLISHMENT OF TURF. No payment will be made for establishment of turf until all requirements of the section are adequately performed and accepted, as determined by the Contracting Officer.

1.1.1 Testing of Heating and Air-Conditioning Systems

The times stated for completion of this project includes all required testing specified in appropriate specification sections of heating, air conditioning and ventilation systems including HVAC Commissioning. Exception: boiler combustion efficiency test, boiler full load tests, cooling tower performance tests, and refrigeration equipment full load tests, when specified in the applicable specifications, shall be preformed in the appropriate heating/cooling season as determined by the Contracting Officer.

1.2 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (OCT 1989) (ER 415-1-15)(52.0001-4038 1/96)

a. This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: (Fixed Price Construction)." In order for the

Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

(1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

b. The following schedule of monthly anticipated adverse weather delays due to precipitation and temperature is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities. Wind is not considered in the Monthly Anticipated Adverse Weather Calendar Day Schedule.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK
KILLEEN, TX AREA (FORT HOOD, BELTON AND STILLHOUSE LAKES AND RESERVE CTRS. ALONG HWY 36 FROM HWY 79 TO HWY US67)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	4	4	4	6	4	3	3	4	4	3	4

c. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph "b", above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)."

1.3 WORK RESTRICTIONS

1.3.1 Working Hours

Normal working hours shall be Monday through Friday, 07:00 A.M. to 04:00 P.M.

1.3.2 Security Requirements

For the duration of this Contract, access to Fort Hood will be delayed between 5 minutes to 30 minutes or more due to increased security precautions, including the checking of vehicle occupants' IDs, vehicle manifests, and the searching of all vehicles. Any general or specific

threat to the safety of those working or living at Fort Hood could result in longer waiting times at the access points to Fort Hood.

The following are requirements for contractor employees entering Fort Hood:

a. One form of picture ID.

b. A memo from the construction company on their letterhead stating the reason for entry, contract number, and the location at Fort Hood where the jobsite is located.

c. All delivery trucks must have a bill of laden and delivery truck drivers must have a picture ID.

d. Employee Identification Badges: Contractor personnel shall wear visible Contractor-furnished employee identification badges while physically on the Installation. Each badge shall include, as a minimum, the company name, employee name, photograph, Contract Title, Contract Number, and the expiration date of the badge. See Section 01500 TEMPORARY CONSTRUCTION FACILITIES for additional requirements.

1.4 UTILITIES

1.4.1 Payment for Utility Services

Water, gas, and electricity are available from Government-owned and operated systems and will be charged to the Contractor at rates as provided in Contract Clause 52.236.14 AVAILABILITY AND USE OF UTILITY SERVICES.

1.4.2 Outages

The Contractor shall coordinate all requests for utility outages with the Contracting Officer in writing 14 days prior to date of requested outage:

a. Water, and sewer outages shall be held to a maximum duration of 4 hours unless otherwise approved in writing.

b. Electrical outages shall have a maximum duration of 4 hours.

c. All utility outages shall be scheduled only on Saturdays, Sundays, or holidays unless specific approval is otherwise received.

1.5 STREET CLOSINGS

The Contractor shall coordinate all requests for street closings with the Contracting Officer in writing 14 days prior to date of requested outage:

a. Two lane traffic shall be maintained at all times.

b. Maximum time for outages is 8 hours.

c. The final street repair shall be completed within 14 days after the start of any street crossing. Any part of the street returned to service prior to final repair shall be maintained smooth with hot-mix cold-lay surface course.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 01368

SPECIAL PROJECT PROCEDURES FOR FORT HOOD
AM#1

PART 1 GENERAL

This Section covers the project requirements unique to Fort Hood, Texas. These unique requirements relate to items such as the digging permit process; use of Fort Hood airfields; tracer wire and marking tape specifications for the location of utility systems; Fort Hood landfill operations and permit requirements; local jacking, boring, and tunneling requirements; backflow prevention assembly documentation; and Customer Service Inspection certifications.

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Casing Pipe; G

10 days prior to jacking, boring, and tunneling activity, furnish catalog data for casing pipe.

SD-04 Samples

Plastic Marking Tape and Tracer Wire; G

10 days prior to installation of utilities, furnish 305 mm long samples of marking tape for each applicable utility. Furnish 305 mm long sample of the tracer wire.

SD-07 Certificates

Customer Service Inspections; G.

The Contractor shall supply a "Customer Service Inspection" certificate for the water supply in accordance with the Texas Natural Resource Conservation Commission (TNRCC) regulations. The completed and signed certificate shall be submitted to the Contracting Officer for review and final approval. A blank certificate is located at the end of this section. See paragraph CUSTOMER SERVICE INSPECTIONS for additional information.

Digging Permits; G.

Digging permits must be obtained prior to any digging, drilling or excavation. See paragraph DIGGING PERMITS for additional information.

Fort Hood Airfield Use; G.

Installation Airfield use is prohibited unless DA Forms 5205-R, 5206-R and 5207-R are completed, submitted and approved. See paragraph FORT HOOD AIRFIELDS for additional information.

Landfill Permit; G.

Contractor shall obtain permission from Fort Hood's Directorate of Public Works (DPW) to use the Post's landfill. Submit documentation granting permission and a completed landfill permit to the Contracting Officer prior to start of construction. A blank permit form is located at the end of this section. See paragraph CONDITIONS FOR USE OF FORT HOOD LANDFILL for additional information.

Backflow Prevention Assembly Tests; G.

Certification of proper operation of backflow preventers shall be accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device to ensure the unit is properly installed and performing as intended. The Contractor shall complete and submit, at the time of the final inspection for the facility, the certificate "Appendix F. Sample Backflow Prevention Assembly Test and Maintenance Report" for the water supply, indicating that the tests have been performed and that the backflow preventers operate properly in accordance with SECTION 15400 PLUMBING, GENERAL and the Texas Natural Resource Conservation Commission (TNRCC) regulations. The TNRCC rule covering this requirement is Texas Code Title 30. Part I. Chapter 290. Subchapter F (see paragraph 290.47(f)). This certificate shall be signed by the individual performing the tests.The competed certificate shall be submitted to the Contracting Officer for review and final approval.

A copy of the rule and sample of the form (appendix D) can be obtained from the TNRCC's home page at the web site: www.tnrcc.state.tx.us or http://info.sos.state.tx.us/fids/30_0290_0047-23.html.

[AM#1]
Certification of Natural Gas Heating Equipment; G.

The Contractor shall comply with new TNRCC air emission requirement for water heaters, small boilers and process heaters. A document or certificate to verify the natural gas-fired heating equipment with a maximum rated rating capacity of 2.0 million Brtish Thermal Units per hour (MBtu/hr) or less shall be in compliance with Nitrogen Oxide limits as specified in 30 Texas Administrative Code (TAC), Part 1, Chapter 117, Subchapter D, division 1, Rule 117.465.

1.2 FORT HOOD AIRFIELD USE

Contractors performing work under this contract may use airfields at Fort Hood with prior written notification and approval, providing:

a. All requests for Installation Airfield use shall be coordinated through the Office of the Commander, Installation Airfields, AFZF-DPC-AC, Hood Army Airfield, Fort Hood, TX 76544, telephone (254) 287-4266/5838.

b. Potential users shall submit completed DA Forms 5205-R (Certificate of Insurance), 5206-R (Civil Aircraft Landing Permit), and 5207-R (Hold Harmless Agreement). Forms are available through the Point of Contact (POC) mentioned in paragraph (a) above. User requests and specified forms shall be submitted at least 60 days before the first intended landing.

1.3 DIGGING PERMITS

The Contractor shall obtain digging permits directly from the Fort Hood Post DPW before any drilling, digging, or excavation is undertaken. Provide a completed form FHT 420-X10, Coordination for Land Excavation, to the DPW building 4612, Fort Hood, Texas for each permit. Allow 20 days for Government review of digging permit requests. A digging permit for a specified area of excavation expires 30 days after the issue date; Contractor must re-apply for a new permit to perform excavation in the area if the excavation was not started within the 30-day period. Permits will identify all underground utilities within 1500 mm of the designated area. Contractor shall be responsible for all repairs, costs, and damages due to excavating without permit or damaging an identified utility. Unidentified utilities shall be repaired by the Contractor at Government expense.

1.4 UTILITY INSTALLATION REQUIREMENTS

1.4.1 Plastic Marking Tape and Tracer Wire

In lieu of furnishing marking tape manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried as specified in the Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, Part 2 paragraph PLASTIC MARKING TAPE, furnish and install the following marking tape and tracer wire:

a. Plastic Marking Tape

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 152 mm wide with minimum thickness of 0.102 mm (0.004 inch) . Tape shall have a minimum strength of 12.1 MPa (1750 psi) lengthwise and 10.3 MPa (1500 psi) crosswise. The tape shall be of a type specifically manufactured for marking underground utilities. Tape shall be color as specified in Table 1 and bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Yellow:	Gas
Blue	Water
Green	Wastewater

b. Tracer Wire

For gas, water, force sanitary sewer mains and other pressurized

utility systems, place No.10 AWG, THWN, CU, direct burial in trench bottom prior to sandbedding, and brought up in valve boxes and risers, with 12 inches minimum leads above finished grade. Only direct-burial splices shall be used. Tracer is not required for underground electrical.

1.4.2 Jacking, Boring, and Tunneling

Conduct boring and jacking in a manner which does not interfere with the operation of the railroad or street or weakens or damages the embankment or structure. Bore or jack from the low or downstream end wherever possible. Unless otherwise shown or specified, the top of the casing pipe shall be a minimum of 914 mm below the finished road surface and 1220 mm below the bottom of the railroad track ballast.

a. Utilities

Excavate where possible and verify the location and depth of buried utilities which will be crossed.

b. Casing Pipe

Smooth wall steel pipe, ASTM A 53 with welded joints. Minimum wall thickness of 4.76 mm unless otherwise shown or specified.

c. Casing

Unless otherwise indicated or specified, install a casing pipe of a diameter which provides a minimum of 50 mm clearance between the outside diameter of the carrier pipe joint and the inside wall of the casing. Upon installation of the carrier pipe, sand grout the entire annular space between the casing and carrier pipe walls.

d. Protection

Comply with the provisions of Part 3 paragraph "Trench Excavation Requirements" of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Sheath and brace end trenches which are cut in the sides of embankments and beyond.

1.5 CONDITIONS FOR USE OF FORT HOOD LANDFILL

Use of the Fort Hood Municipal Solid Waste Landfill, located at the intersection of Turkey Run Road and Clark Road, by the Contractor is subject to the operating requirements imposed on the landfill by the Landfill Operating Permit. All waste delivered to the landfill will be inspected by the landfill operating Contractor for materials that are not authorized in the landfill. Trucks that contain unauthorized waste will be diverted for removal of the unauthorized material before being allowed to proceed to the working facility to dump their load. Landfill operating hours are 0730-1700 Monday through Friday and 0730-1400 on Saturday. Questions concerning landfill policy and procedures may be answered by calling the landfill at 532-2256.

The following classes of materials are not authorized in the Fort Hood Municipal Solid Waste Landfill and will be diverted as described below:

Recycle Materials: Cardboard and paperboard, light metal, aluminum and steel containers, paper, and plastic containers. Trucks entering the

landfill with recyclable materials will be directed to a series of roll-off containers located at the entrance to the landfill for removal of the materials. Contractor/Transporters will be responsible for removing the unauthorized materials from the load and placing them in the properly marked container before proceeding to dump their load.

Compost Materials: Untreated wood, branches, shrubs, grass, woodchips, unserviceable or odd sized pallets should be separated from the refuse load and delivered to the Fort Hood Compose Center located across Turkey Run Road from the landfill.

Clean Fill Material and Inert Constructions and Demolition Wastes: Soil, sand, sod, rock, clean masonry, brick, concrete, and pavement. These materials are not accepted at the landfill. Trucks containing the materials must be disposed of as directed by the Contracting Officer (KO) or the KO's Authorized representative.

Salvageable Items: Tires, white goods and appliances, bulk scrap metal, lead-acid batteries, and engine and machine parts. Salvageable items should be delivered to DRMO Bldg. 4286, located at 80th St and Tank Destroyer Blvd, phone 287-2723, Monday-Thursday, 0730-1300.

Serviceable Pallets: Serviceable pallets are to be delivered to Post Recycling Center Bldg. 4621, located at 65th St. and Railhead Dr., phone 287-6732, Monday-Friday, 0730-1600.)

Freon: Freon shall be collected in 50 pound retrievable containers and turned in to DPW supply, Bldg. 4406, 77th and Warehouse, phone 288-2383, Monday-Thursday, 0630-1700. An empty container will be furnished upon turn-in of the full container. Each container must be labeled (R-12, R-22, etc.) and shall not be mixed. If Freon is unintentionally mixed, the Contractor shall properly label the container as mixed and inform the DPW supply of the suspected mixture.

Regulated Waste: Regulated wastes such as liquid waste, fluorescent light bulbs, oil filters, ordinance, explosives, pressurized gases, PCB ballasts, paints, solvents, antifreeze, pesticides, herbicides, radioactive material, and biohazardous material are not accepted at the landfill. Regulated waste shall be delivered to the DPW Waste Classification Unit, Bldg. 1345, located at 37th and North Ave., phone 288-SNAP, Monday-Friday, 0800-1600, unless otherwise specified in the Contract. **All turn-ins are by appointment only.** Call the DPW Classification Unit, 288-7627, to schedule an appointment. The DPW Classification Unit can help contractors with containers, packing procedures, waste classifications, and state notification.

Asbestos: Generator manifests must be obtained from the DPW Waste Classification Unit, Bldg. 1345, located at 37th and North Ave, phone 288-7627, Monday-Friday, 0800-1600. The transporter must have two originally signed manifests and then give the landfill 24 hours prior notice, phone 532-2256. Delivery of asbestos containing material (ACM), friable and non-friable, must be made prior to 1200 on the day of delivery. All ACM must be double bagged, in an enclosed trailer, off-loaded by hand and the driver must have two originally signed manifests. One large bundle is not acceptable due to the possibility of bag breakage upon off-loading and disposal activities. Non-friable ACM that has been damaged or has the potential of being damaged by offloading, grinding, cutting, sanding, disposal or other invasive actions must also be double bagged.

Special Wastes: Properly characterized special wastes including fuel (TPH) contaminated soils (<1500 ppm), and demolition debris contaminated with lead paint (TCLP <5.0 mg/L) are allowed in the landfill. Documentation of all characterization tests must be provided to the Fort Hood DPW Waste Classification Unit and the landfill manager a minimum 48 hours prior to delivery of the material to the landfill. The Transporter must have a properly completed manifest at the time of delivery to the landfill. Copies of the Landfill's Waste Acceptance Plan, which contains specific requirements for disposal of the materials may be obtained from DPW Environmental, phone 287-8713; DPW Services, phone 287-9606 or 288-7842; or the Landfill Operating Contractor, phone 532-2256.

The requirements of this clause are not intended to limit the Contractor's rights; the Contractor may dispose of recyclable, salvageable, regulated materials in any lawful manner the Contractor chooses outside of Fort Hood boundaries to the extent allowed by other contract provisions.

1.5.1 Landfill Permit

Contractor shall complete the attached Landfill Permit and give copies, laminated or inserted in page protectors, to drivers so that the drivers could leave them in their trucks. Drivers can just hand the permit to the scale operator at the landfill rather than having to remember all information.

1.6 CUSTOMER SERVICE INSPECTIONS

1.6.1 Certification Requirements

The Rules and Regulations for Public Water Systems (TNRCC publication number RG-193) require a customer service inspection certification before providing continuous water service for the following conditions: New construction involving plumbing or mechanical systems; or Material improvement, correction, or addition to plumbing or mechanical systems.

1.6.2 Inspection

The Customer Service Inspection certifies that for work done under this contract:

A. No direct connection between the public drinking water supply and a potential source of contamination exists;

B. No cross-connection between the public drinking water supply and a private water system exists;

C. No connection exists which would allow the return of water used for condensing, cooling industrial processes back to the public water supply;

D. No pipe or pipe fitting which contains more than 8.0 percent lead exists in private water distribution facilities installed on or after July 1, 1988; or

E. No solder or flux which contains more than 0.2 percent lead exists in private water distribution facilities installed on or after July 1, 1988.

1.6.3 Inspection Personnel

Customer Service Inspections must be performed by personnel meeting the requirements described in the *Rules and Regulations for Public Water Systems*. Examples are individuals licensed by the Plumbing Examiners Board (Licensed Plumbers or Plumbing Inspectors) or Certified Waterworks Operators and members of other water-related professional groups who hold an endorsement granted by the commission or its designated agent (have been to the 10 hour training approved by TNRCC).

1.6.4 Inspection Certification Form

Original copies of the Customer Service Inspection Certification shall be provided to the Contracting Officer's Representative prior to final inspection and acceptance. Certification forms will be maintained by the Fort Hood DPW Water and Wastewater Utility representative. A sample form is provided at the end of this section. The form (appendix D) can also be downloaded from the TNRCC's home page at the web site http://info.sos.state.tx.us/fids/30_0290_0047-22.html.

1.7 Appendix F Sample Backflow Prevention Assembly Test & Maint. Report

The certificate "Appendix F. Sample Backflow Prevention Assembly Test and Maintenance Report" is attached at the end of this section.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 FORMS
3.1.1 Landfill Permit

LANDFILL PERMIT
US ARMY Corps of Engineers

COE POC and telephone phone number: _____

Contract Name: _____

Contract Number: _____

Contract completion date or end of authorization date: _____

Building or areas affected (i.e., Soldier's Development Center):

_____

_____

_____

Prime Contractor's Name: _____

Contractor POC and phone (i.e. someone on site that can get immediate action): _____

3.1.2 Appendix D. Customer Service Inspection Certificate
Figure: 30 TAC §290.47(d)

Figure: 30 TAC §290.47(d)

Appendix D: Customer Service Inspection Certificate

Customer Service Inspection Certificate

Name of PWS _____PWS I.D.# _____
Location of Service _____

Reason for Inspection: New construction. [ ]
Existing service where contaminant hazards are suspected [ ]
Major renovation or expansion of distribution facilities [ ]

I _____, upon inspection of the private water distribution facilities connected to the aforementioned public water supply do hereby certify that, to the best of my knowledge:

	Compliance	Non-Compliance
(1) No direct connection between the public drinking water supply and a potential source of contamination exists. Potential sources of contamination are isolated from the public water system by an air gap or an appropriate backflow prevention assembly in accordance with Commission regulations.	[ ]	[ ]
(2) No cross-connection between the public drinking water supply and a private water system exists. Where an actual air gap is not maintained between the public water supply and a private water supply, an approved reduced pressure-zone backflow prevention assembly is properly installed and a service agreement exists for annual inspection and testing by a certified backflow prevention assembly tester.	[ ]	[ ]
(3) No connection exists which would allow the return of water used for condensing, cooling or industrial processes back to the public water supply.	[ ]	[ ]
(4) No pipe or pipe fitting which contains more than 8.0% lead exists in private water distribution facilities installed on or after July 1, 1988.	[ ]	[ ]
(5) No solder or flux which contains more than 0.2% lead exists in private water distribution facilities installed on or after July 1, 1988.	[ ]	[ ]

I further certify that the following materials were used in the installation of the private water distribution facilities:

http://info.sos.state.tx.us/fids/30_0290_0047-22.html

Figure: 30 TAC §290.47(d) Page 2 of 2

Service lines Lead [ ] Copper [ ] PVC [ ] Other [ ]
Solder Lead [ ] Lead Free [ ] Solvent Weld [ ] Other [ ]

I recognize that this document shall become a permanent record of the aforementioned Public Water System and that I am legally responsible for the validity of the information I have provided.

Remarks:

_____	_____
Signature of Inspector	Registration Number
_____	_____
Title	Type of Registration
_____	
Date	

http://info.sos.state.tx.us/fids/30_0290_0047-22.html

WHEN THE SECTION IS PDF'D, REPLACE THIS PAGE WITH THE CERTIFICATE Appendix F: Sample Backflow Prevention Assembly Test and Maintenance Report form. The pdf'd version of this certificate is located at G:\D2\New\PDF FORM \01368-F-Backflow.pdf.

-- End of Section --

SECTION 02746

RESIN MODIFIED PAVEMENT SURFACING MATERIAL
AM#1

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO MP 1	(1998)Provisional Specification for Performance Graded Asphalt Binder

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988; R 1993el) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(1999a) Portland Cement
ASTM C 566	(1997) Evaporable Total Moisture Content of Aggregate by Drying
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM D 70	(1982; R 1997) Specific Gravity and Density of Semi-Solid Bituminous Materials
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 140	(2000) Sampling Bituminous Materials
ASTM D 995	(1995b) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985; R 1994) Moisture or Volatile

	Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen From Bituminous Paving Mixtures
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 3381	(1992; R 1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4125	(1994el)Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

CORPS OF ENGINEERS (COE)

COE CRD-C 300	(1990) Specifications for Membrane-Forming Compounds for Curing Concrete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Open Graded Asphalt Job Mix Formula; G,
Job Mix Formula for Slurry Grout; G,

Materials required to produce the open graded asphalt mixture and slurry grout job-mix-formulas in the quantities indicated below.

Aggregates representing each stockpile to be used in the production of the open-graded asphalt mixture:

45 kg each

Bituminous Material	19 liters
Slurry Grout Sand	23 kg
Fly Ash	23 kg
Cement	23 kg
Cross Polymer Resin	4 liters

Samples shall be delivered, along with the Contractor's preliminary job mix formulas, 60 days before starting production to the Central Texas Resident Office.

SD-06 Test Reports

Coarse Aggregate; G
Coarse and Fine Aggregates; G
Open-Graded Mix Aggregate; G
Bituminous Material; G
Slurry Grout Sand; G
Filler (Fly Ash); G
Job Mix Formula for Slurry Grout; G
Contractor Quality Control; G
Contractor qualifications shall show that he has been engaged in the successfull installation of Resin Modified Pavement for at least one previous project; G

Aggregate and QC test results. Slurry grout viscosity tests shall be conducted immediately prior to application on the pavement surface and 30 minutes thereafter.

SD-07 Certificates

Cement; G
Cross Polymer Resin; G
Curing Compound; G

Copies of certificates.

1.3 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.3.1 Asphalt Mixing Plant

The bituminous asphalt plant shall have enough capacity to produce the quantities of bituminous mixtures required for the project. Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

b. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 1 hour.

(2) The asphalt plant shall have enough capacity to produce the quantities of asphalt mixtures required for the project. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working

condition to place the asphalt paving mixtures at a rate equal to the plant output.

1.3.2 Asphalt Paver

Asphalt pavers shall be self-propelled, with an vibrating screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.3.3 Receiving hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.3.4 Automatic Grade Control

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. The transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 9.14 m in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.3.5 Slurry Grout

The additional requirements for production of slurry grout for the Resin Modified Pavement (RMP) are a concrete batch plant, a ready mix truck, or portable mixer for grout mixing, and small 1.8 metric ton (2 ton) (maximum) tandem steel wheeled vibratory roller for compaction of RMP.

1.4 SAMPLING AND TESTING

1.4.1 Aggregates

1.4.1.1 General

ASTM D 75 shall be used in sampling coarse and fine aggregates. Points of sampling will be designated by the Contracting Officer. All tests necessary to determine compliance with the specified requirements shall be made by the Contractor, using a Corps of Engineers certified Commercial

Laboratory.

1.4.1.2 Sources

Sources of aggregates shall be selected well in advance of the time when the materials are required in the work. Samples shall be submitted 60 days before starting production. If a sample of material fails to meet the specified requirements, the material represented by the sample shall be replaced, and the cost of testing the replaced sample shall be at the Contractor's expense. Approval of the source of the aggregate does not relieve the Contractor of the responsibility to deliver aggregates that meet the specified requirements.

1.4.2 Bituminous Materials

Samples of bituminous materials shall be obtained in accordance with ASTM D 140. Sources shall be selected well in advance of the time materials will be required for the work. In addition to the initial qualification testing of bituminous materials, samples shall be obtained and tested before and during construction when shipments of bituminous materials are received, or when necessary to assure that some condition of handling or storage has not been detrimental to the bituminous material.

1.5 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.5.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such a manner as to preclude segregation or contamination with objectionable material.

1.5.2 Bituminous Materials

Bituminous materials shall be maintained below a temperature of 150 degrees C during storage and shall not be heated by the application of a direct flame to the walls of storage tanks or transfer lines. Storage tanks, transfer lines and weigh buckets shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system.

1.5.3 Slurry Grout Sand

Slurry grout sand shall be stored at the grout production site to prevent contamination with foreign materials and saturation with rain water. Moisture content of this sand shall be determined just prior to grout production so that corrections to the job mix formula water content can be made to compensate for any moisture in the sand.

1.5.4 Cementitious Materials

The temperature of the cementitious materials, as delivered to storage at the site, shall not exceed 65 degrees C.

1.6 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the bituminous plant for checking adequacy of any equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of the mixtures.

PART 2 PRODUCTS

2.1 AGGREGATE

Aggregate shall consist of crushed stone, or crushed gravel without sand or other inert finely divided mineral aggregate. The portion of materials retained on the 4.75 mm sieve shall be known as coarse aggregate, the portion passing the 4.75 mm sieve and retained on the O.075 mm sieve as fine aggregate. Sieve analysis of coarse and fine aggregates shall be conducted in accordance with ASTM C 136.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from adherent films of matter that would prevent thorough coating with the bituminous material. The percentage of wear shall not be greater than 40 percent when tested in accordance with ASTM C 131. The magnesium sulfate soundness loss shall not exceed 18 percent, after five cycles, when tested in accordance with ASTM C 88. Aggregate shall contain at least 75 percent by weight of crushed pieces having two or more fractured faces. The area of each fractured face shall be equal to at least 75 percent of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be obtained by artificial crushing.

2.1.2 Crushed Aggregates

Particle shape of crushed aggregates shall be essentially cubical. Quantity of flat (width to thickness ratio greater than 3) and elongated particles (width to length ratio greater than 3) in any sieve size shall not exceed 8 percent by weight, when determined in accordance with ASTM D 4791.

2.1.3 Open-Graded Mix Aggregate

The gradations in Table I represent the limits which shall determine the suitability of open-graded mix aggregate for use from the sources of supply. The aggregate, as finally selected, shall have a gradation within the limits designated in Table I and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be uniformly graded from coarse to fine.

TABLE I

OPEN-GRADED MIX AGGREGATE

Sieve Size	Percent by Weight Passing
19 mm	100
12.5 mm	54-76
9.5 mm	38-60
4.75 mm	10-20
2.36 mm	8-16
0.60 mm	4-10
0.075 mm	1-3

Table I is based on aggregates of uniform specific gravity; the percent passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentages passing various sieves may be directed by the Contracting Officer when aggregates vary more than 0.2 in specific gravity.

2.1.4 Slurry Grout Sand

Slurry grout sand shall consist of clean, sound, durable, particles of processed silica sand that meet the requirements for wear and soundness specified for coarse aggregate. The sand shall contain no clay, silt, or other objectionable matter. The gradations in Table II represent the limits which shall determine the suitability of silica sand for use from the sources of supply.

TABLE II

FINE SAND FOR SLURRY GROUT

Sieve Size	Percent by Weight Passing
1.18 mm	100
0.600 mm	95-100
0.075 mm	0-2

The sand gradations shown are based on sand of uniform specific gravity, and the percentages passing the various sieves will be subject to appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

2.1.5 Filler (Fly Ash)

Fly ash shall have at least 95 percent by weight of material passing the O.075 mm sieve. Fly ash shall conform to ASTM C 618 Class F requirements.

2.2 BITUMINOUS MATERIAL

Bituminous material shall conform to the requirements of ASTM D 3381 and shall be of the viscosity grade AC-20 with an original penetration of 40 to 100.

2.3 CEMENT

The cement used in the slurry grout shall be portland cement conforming to ASTM C 150, Type II.

2.4 CROSS POLYMER RESIN

A cross polymer resin of styrene and butadiene, Prosalvia L7, shall be utilized as a plasticizing and strength producing agent. After mixing the resin into the slurry grout, the mixture shall have a viscosity which would allow it to flow from a Marsh Cone in accordance with Table III. A Marsh cone has dimensions of 155 mm base inside diameter, tapering 315 mm to a tip inside diameter of 10 mm . The 10 mm diameter neck shall have a length of 60 mm .

TABLE III

SLURRY GROUT VISCOSITY

Time Elapsed After Addition of PL7	Marsh Flow Cone Viscosity
0 to 30 minutes	8 to 10 seconds
After 30 minutes	9 to 11 seconds

2.5 CURING COMPOUND

Membrane-forming curing compound shall be white pigmented compounds conforming to COE CRD-C 300.

2.6 JOB MIX FORMULA FOR OPEN-GRADED ASPHALT AND SLURRY GROUT

2.6.1 Open Graded Asphalt Job Mix Formula

The Job Mix Formula (JMF) for the open graded bituminous mixture shall be furnished by the Contractor and approved by the Government. No payment will be made for mixtures produced prior to the approval of the JMF by the Contracting Officer.

2.6.1.1 Initial Laboratory Procedure

(1) Sample aggregates according to ASTM D 75 and asphalt cement according to ASTM D 140. An open-graded asphalt concrete mix design requires a minimum of 45 kg of each aggregate stockpile and 15 L of asphalt cement.

(2) Oven dry aggregate stockpile samples and conduct a sieve analysis (ASTM C 136) on each sample. Determine the combination of aggregate stockpiles that results in a gradation closest to the center of the limiting gradation band. This stockpile combination will become the blending formula for the open-graded asphalt concrete.

(3) Measure apparent specific gravity of aggregates (ASTM C 127 and ASTM C 128) from each stockpile used in the final gradation. Calculate apparent specific gravity of combined aggregates using the blending formula percentages. Measure specific gravity of asphalt cement (ASTM D 70).

(4) Estimate the optimum asphalt content using the following equation:

$$\text{Optimum asphalt content} = 8.61(0.21G + 5.4S + 7.2s + 135f)^{0.2} \div SG$$

where

SG = apparent specific gravity of the combined aggregates
G = percentage of material retained on the 4.75 mm sieve
S = percentage of material passing the 4.75 mm and retained on the 0.6 mm sieve
s = percentage of material passing the 0.6 mm .sieve and retained on the 0.075 mm sieve

f = percentage of material passing 0.075 mm sieve

(5) Round the calculated optimum asphalt content value to the nearest tenth of a percent. Use this asphalt content value along with two asphalt contents above this amount and two asphalt contents below this amount in the production of mix design samples. Use 0.5 percent above and below the optimum and 1.0 percent above and below the optimum as the four additional asphalt contents. Calculate maximum theoretical specific gravities for each of these five asphalt cement contents using ASTM D 2041.

2.6.1.2 Specimen Production

Using the five mix design asphalt contents, produce three 100 mm diameter Marshall specimens at each asphalt content according to ASTM D 1559, except as stated below. Use approximately 800 grams of combined aggregates following the previously determined aggregate blending formula for each specimen. Just before mixing, the temperature of the aggregates should be 145 ± 5°C and the asphalt cement should be 135 ± 5°C . With normal mixing procedures, the temperature of the asphalt mixture during compaction is 120 ± 5°C . Compact the open-graded asphalt concrete specimens with 25 blows from a 4.5 kg Marshall hand hammer on one side of each specimen. Allow the specimens to air cool for a minimum of 4 hours before carefully removing from molds.

2.6.1.3 Measuring voids total mix (VTM)

(1) Measure the VTM of each open-graded specimen using the following formula:

VTM = (1 - WTAIR /Volume * 1/SGT) * 100

where

WTAIR = dry weight of specimen in grams
Volume $=0.785(D)^2(H)$
D = diameter in cm
H = height in cm
SGT = maximum theoretical specific gravity

(2) Calculate the average VTM for each of the five asphalt cement contents. Select the optimum asphalt content as that which resulted in a VTM value closest to 30.0 percent. If no VTM averages are in the 30.0 percent range, then make adjustments to the aggregate gradation to achieve the proper void content. Optimum asphalt contents resulting in average VTM values in the 25 to 35 percent range are acceptable, but due to normal production and construction variations, the JMF shall be based on a mix design that provides a 28 to 32 percent VTM value is required. Typical optimum asphalt contents are between 3.5 and 4.5 percent.

2.6.1.4 Job-Mix Formula Submittal

(1) The open-graded asphalt concrete job-mix formula will consist of the following information:

(a) Percentage of each aggregate stockpile.
(b) Percentage passing each sieve size for the blended aggregate.

(c) Percentage of bitumen.
(d) Temperature of discharged asphalt mixture.
(e) Voids total mix percentage.

(2) The target temperature of the asphalt mixture when it is discharged from the mixing plant should be 125 ± 5°C . The contractor shall adjust the temperature depending on the ambient temperatures and the haul distance from the asphalt plant to the job site to meet the lay-down temperature.

2.6.2 Job Mix Formula for Slurry Grout

The Job-Mix Formula (JMF) for the slurry grout shall be furnished by the Contractor and approved by the Government. The slurry grout job mix formula shall be developed using the proportions given in Table V.

TABLE V

RESIN MODIFIED CEMENT SLURRY GROUT MIXTURE PROPORTIONS

Material	Percent by Weight
Silica Sand	16-20
Fly Ash	16-20
Water	22-26
Portland Cement	34-40
Cross Polymer Resin	2.5-3.5

Approximately 12 to 15 kg of mixed slurry grout will fill in one square meter (25 mm thickness) of open graded bituminous mixture with 25 to 35 percent voids total mix.

2.6.2.1 Initial Laboratory Procedure

(1) Minimum sample size is 23 kg for cement, sand, and fly ash; and is 4 L for resin additive.

(2) Using the grout material proportions specified in Table V, develop a matrix of initial job-mix formulas for laboratory viscosity testing. The goal of the grout mix design is to produce a material formulation, which results in a field Marsh Flow Cone viscosity of 8.0 to 10.0 seconds. The initial formulations shall ensure that a grout formulation can be produced with a Marsh viscosity no greater than the 10.0 seconds maximum. This is accomplished by testing grout formulations with relatively high w/c ratios and the maximum allowable amount of resin additive.

(3) The grout's w/c ratio shall be between 0.65 to 0.75, unless approved by the Contracting Officer Representative. Higher w/c ratios are sometimes necessary to produce grout with Marsh Flow viscosity less than the 10.0-second maximum value. Therefore, the focus of the initial grout viscosity tests is to determine the minimum W/C ratio that will produce a grout viscosity less than or equal to 10.0 seconds. The resin additive serves as a plasticizer which reduces grout viscosity while reducing the amount of water required.

(4) The standard laboratory grout batch size should be in the 4 to

5 kg range. Calculate the material batch weights based on the desired proportions. Multiple grout viscosity tests are facilitated by first blending the dry ingredients (cement, sand, fly ash) for each test sample and then adding the appropriate amount of water and resin additive during the mixing process. These dry ingredient batches should be kept in air-tight containers to prevent loss of material or contamination before mixing. Replicate two samples per blend for grout viscosity testing.

2.6.2.2 Mixing

(1) The equipment needed to effectively mix the resin grout includes a laboratory mixer equipped with a wire whip mixing attachment and approximately 10 L capacity mixing bowl, a calibrated set of weight scales, and various small containers to weigh and transfer mix water and resin additive.

(2) Place dry ingredients into mixing bowl and adjust the bowl height so that the wire whip is just off of or touching the bottom and the sides of the bowl. Begin mixing the dry ingredients at a slow speed and immediately add the appropriate amount of water. Once all of the water is added, speed up the mixer to a point where the grout is being thrown onto the sides of the mixing bowl. Mix the grout at this high speed for 5 minutes, then add the appropriate amount of resin additive. Mix the grout again at a high mixing speed for an additional 3 minutes before testing for Marsh Flow viscosity.

2.6.2.3 Viscosity Testing

(1) The equipment needed to measure grout viscosity includes a Marsh Flow Cone, a 1,000 mL glass or clear plastic graduated cylinder beaker, a 1,500 mL (approximately) empty beaker or bucket, and a stopwatch.

(2) Immediately after mixing the grout, transfer the grout from the mixing bowl to the empty beaker or bucket. Take note of any lumps of material or excess sand in the bottom of the mixing bowl. Excess lumps indicate inadequate mixing and render the grout useless for viscosity testing. Immediately fill the Marsh Flow Cone with about 1,100 mL of grout. A consistent head of grout in the flow cone is achieved for all viscosity tests by marking an 1,100 mL fill line inside the flow cone. The flow cone outlet is plugged by simply placing one's finger over the outlet opening. Immediately after the flow cone is filled to the 1,100 mL fill line, position the cone over the 1,000 mL graduated beaker. Release the grout opening and start the stopwatch timer simultaneously. Measure the time of flow for 1 L of grout from the flow cone to the nearest tenth of a second.

(3) Record each test sample's viscosity, averaging the two replicates for each blend. Adjust the grout mix proportions as needed with the following considerations:

(a) Any grout viscosity between 8.0 and 10.0 seconds is acceptable. It should be noted; however, that when field construction temperatures are expected to be comparatively high (greater than 32°C) and/or the open-graded asphalt concrete voids

are expected to be considerably low (less than 30 percent), then lower viscosity grouts will help to ensure easy grout application and full grout penetration. In most cases, these variables are unknown; therefore, it is prudent to select the grout formulation which has the lowest viscosity.

(b) Select a grout job-mix formula with water and resin additive contents below the maximum allowable limits to allow the Contracting Officer Representative to approve small additions of these ingredients in the field if necessary to meet viscosity requirements.

(c) Low w/c ratios shall be selected, within the viscosity criteria, to produce grout with higher strengths; reduce the chances for drying shrinkage cracking; and produce grout which is more consistent and better able to keep the sand in suspension during mixing and placement.

(d) When the sand is noted to settle out of solution during or immediately after mixing, the JMF shall be adjusted by reducing the amount of sand and increasing the amount of fly ash (both within the specified tolerances).

(e) If the viscosity requirements cannot be met, the Contractor shall change the source of materials. Typical problems to investigate include the following: grout sand which is too coarse, portland cement which is highly reactive during the early stages of the hydration process, fly ash with excess cementitious nature.

2.6.2.4 Job-Mix Formula Submittal

The grout job-mix formula will consist of the following information:

(1) Percentage (by weight) of each mixture ingredient rounded to the nearest tenth of a percent.

(2) Type and source of portland cement.

(3) Source of fly ash, silica sand, and resin additive.

(4) Marsh Flow Cone viscosity of job-mix-formula grout.

PART 3 EXECUTION

3.1 WEATHER LIMITATIONS

The bituminous mixture shall not be placed upon a wet surface, in rain, or when the surface temperature of the underlying course is less than l0 degrees C. Once the bituminous mixture has been placed, and if rain is imminent, protective materials consisting of rolled polyethylene sheeting at least 0.l mm thick of sufficient length and width to cover the mixture shall be placed. If the open graded bituminous mixture becomes saturated, the Contractor shall allow the pavement voids to thoroughly dry out prior to applying the slurry grout.

3.2 PREPARATION OF OPEN GRADED MIXTURES

Rates of feed of aggregates shall be regulated so that moisture content and

temperature of aggregates will be within tolerances specified. Aggregates and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 135 degrees C. Temperature of aggregate in the mixer shall not exceed 150 degrees C when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

3.3 WATER CONTENT OF AGGREGATES

Drying operations shall reduce the water content of mixture to less than 0.75 percent. Water content shall be determined in accordance with ASTM D 2216; weight of sample shall be at least 500 grams. The water content shall be reported as a percentage of the total mixture.

3.4 STORAGE OF MIXTURE

The open graded bituminous mixture shall not be stored for longer than one hour prior to hauling to the job site.

3.5 TRANSPORTATION OF MIXTURE

Transportation from the mixing plant to the job site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of mixture to truck bodies. Diesel fuel shall not be used as a releasing agent. Excessive release agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from the weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or have become wet will be rejected. Hauling over freshly placed material will not be permitted.

3.6 TEST SECTION

Prior to full production, and in the presence of the Contracting Officer Representative, the Contractor shall prepare and place a quantity of open graded bituminous mixture and slurry grout according to the JMF. The test section shall be a minimum of 30 meters long and 6 meters wide placed in one section and shall be of the same depth specified for the construction of the course which it represents. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section. The test section shall meet the requirements specified in paragraph ACCEPTABILITY OF WORK. If the test section should fail to meet these requirements, the necessary adjustments to the mix design, plant operation, and/or construction procedures shall be made. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications at the Contractor's expense. A representative for the resin manufacturer shall be on site during the test section construction and during the initial placement.

3.7 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing of open graded bituminous mixture, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

3.8 TACK COATING

Immediately before placing open-graded asphalt mix, contact surfaces of previously constructed pavement shall be sprayed with a coat of bituminous material as specified in Section 02748 BITUMINOUS AND PRIME TACK COAT.

3.9 PLACING OPEN GRADED BITUMINOUS MIXTURE

The mix shall be placed at a temperature of not less than 80 degrees C. Upon arrival, the mixture shall be spread to the full width (minimum 3 meters) by a bituminous paver. It shall be struck off in a uniform layer to a depth that, when the work is completed, will produce the required thickness indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat. Unless otherwise directed, placement of the mixture shall begin along the center line of a crowned pavement or along the highest side of a sloped cross-section. The mixture shall be placed in consecutive adjacent strips. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread, raked, and luted by hand tools. The longitudinal joint in the RMP shall be offset from the longitudinal joint in the underlying asphalt pavement by at least 300 mm .

3.9.1 Rollers

Small (1.8 metric ton maximum) tandem steel wheel vibratory rollers shall be used to smooth over the surface of freshly placed open graded bituminous mixture. The vibratory unit shall be turned off during smoothing of the bituminous mixture. Rollers shall be in good condition, capable of operating at slow speeds to avoid displacement of the bituminous mixture. The number, type, and weight of rollers shall be sufficient to roll the mixture to the voids total mix requirement of 25 to 35 percent while it is still in a workable condition. The use of equipment which causes excessive crushing of the aggregate will not be permitted.

3.9.2 Smoothing of Open Graded Bituminous Mixture

The open graded bituminous mixture shall be smoothed with one to three passes of the prescribed roller without vibration. The temperature of the freshly placed open graded bituminous mixture shall be low enough to prevent excessive shoving or cutting of the mat under the roller.

3.9.3 Protection of Ungrouted Pavement

The Contractor shall protect the ungrouted pavement and its appurtenances from traffic and against contamination from mud, dirt, wind blown debris, waterborne material, or any other contamination which could enter the void spaces of the open graded bituminous mixture before grout application. Protection against contamination shall be accomplished by keeping the construction site clean and free of such contaminants and by covering the ungrouted pavement with protective materials when directed by the Contracting Officer. Such protective materials shall consist of rolled polyethylene sheeting as described in paragraph WEATHER LIMITATIONS. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the pavement surface.

3.10 PREPARATION OF SLURRY GROUT

The slurry grout shall be mixed using a batch plant, portable mixer and/or ready-mix truck and according to mix proportions stated in the approved

JMF. The cross polymer resin shall be added to the mixture after all other ingredients have been thoroughly mixed. When using ready-mix trucks for transporting slurry grout, the grout mixture shall be thoroughly mixed at the job site immediately before application for a minimum of 10 minutes. Thorough mixing shall be accomplished by rotating the mixing drum at the maximum allowable revolutions per minute.

3.11 PLACING SLURRY GROUT

Temperature of the bituminous mixture shall be less than 38 degrees C before applying grout. Each batch of slurry grout shall be tested at the job site immediately before placement and shall be used in the finished product only if it meets the requirements specified in paragraph ACCEPTABILITY OF WORK. The slurry grout shall be spread over the bituminous mixture using a spreader or squeegees. The application of the slurry grout shall be sufficient to fill the internal voids of the open graded bituminous mixture. The grouting operation shall begin at the lowest side of the sloped cross-section and proceed from the low side to the high side. The practical limit for the surface slope of an RMP section is 2 percent. Pavement slopes up to 5 percent can be constructed, but excess hand work and grout overruns are to be expected at slopes greater than 2 percent. The slurry grout shall be placed in successive paving lanes with a maximum width of 6 meters . The use of strips of wood lumber or foamed rubber to separate each of the grouting lanes and the RMP from adjacent pavements is optional. The direction of the grouting operation shall be the same as used to pave the open graded bituminous mixture. The small (1.8 metric ton maximum) tandem steel wheel roller (vibratory mode) passing over the grout covered bituminous mixture shall be used to promote full penetration of the slurry grout into the void spaces.

3.12 JOINTS

3.12.1 Joints Between Successive Lanes of RMP

Joints between successive lanes of RMP shall be made ensuring a continuous bond between the paving lanes. All RMP joints shall have the same texture, density, and smoothness as other sections of the course.

3.12.2 Joints Between RMP and Adjacent Pavements

Joints between the RMP and any surrounding pavement surfaced with portland cement concrete shall be saw cut to the full thickness of the RMP layer and filled with a joint sealant material approved by the Contracting Officer.

3.13 CURING

The curing compound shall be applied to the finished pavement surface within 2 hours of the completed slurry grout application. The curing compound shall be applied by means of a pressurized spraying machine. Application of the curing compound shall be made uniformly in one or two coats with a total application rate of not more than 10 square meters per liter .

3.14 PROTECTION OF GROUTED PAVEMENT

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents for a period of 21 days. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the

Contractor's expense. In order to properly protect the pavement against the effects of rain before the pavement is sufficiently hardened, the Contractor shall have available, at all times, materials for the protection of the edges and surfaces of the unhardened RMP. The protective materials and method of application shall be the same as previously described in paragraph WEATHER LIMITATIONS. When rain appears imminent, all paving operations shall stop, and all available personnel shall begin covering the surface of the hardened RMP with protective covering.

3.15 CONTRACTOR QUALITY CONTROL

3.15.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the Quality Control Plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l. Surface Smoothness

3.15.2 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, slurry grout viscosity, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.15.3 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per days production of open-graded asphalt mix, by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the ASTM D 6307, or the nuclear

method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.15.4 Gradation

Aggregate gradations shall be determined a minimum of twice per day from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.15.5 Temperatures

Temperatures shall be checked at least four times per day, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.15.6 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per day in accordance with ASTM C 566.

3.15.7 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

3.15.8 Air Voids

Voids total mix shall be determined from random core samples taken from in-place open-graded asphalt mixture. Sample voids shall be calculated as outlined in the Job Mix Formula criteria. Voids shall be between 25 and 35 percent. Material not meeting the void criteria shall be removed and replaced at no additional cost to the Government.

3.15.9 Grade and Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph ACCEPTABILITY OF WORK.

3.15.9.1 Grade

The final wearing surface of the pavement will be tested for conformance with specified plan grade requirements, before grout is applied. The grade will be determined by running lines of levels at intervals of 7.6 m , or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular area, the Contracting Officer will inform the Contractor in writing, of the results of the grade-conformance tests.

3.15.9.2 Smoothness

All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer Representative. After the the slurry grout has sufficiently cured, but not later than 48 hours after placement, the surface of the pavement shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified in table VI. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 8 m or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 6.1 m and at the third points for lanes 6.1 m or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

3.15.10 Job-Mix-Formula

Routine testing for acceptability of work shall be performed by a Corps of Engineers certified commercial laboratory hired by the contractor and approved by the Contracting Officer. Additional tests required to determine acceptability of non-conforming material shall be performed by the Contractor at its own expense. The contractor shall use a Marsh Flow Cone for testing the viscosity of grout.

3.16 ACCEPTABILITY OF WORK

3.16.1 General

When a section of pavement fails to meet the specification requirements, that section shall be totally removed and replaced at the Contractor's expense. The Contracting Officer reserves the right to sample and test any area which appears to deviate from the specification requirements.

3.16.2 Field Sampling of RMP Materials

3.16.2.1 Open Graded Bituminous Mixture

Samples of open graded bituminous mixture shall be taken from loaded trucks for every 1,000 square meters of pavement, but not less than two samples for each day of paving for determining asphalt content, aggregate gradation, and laboratory compacted voids total mix. Laboratory specimens of open graded bituminous material shall be compacted in 101.6 mm (4 inch) diameter molds to a 50.8 mm (2 inch) thickness using 25 blows on one side from a Marshall hand hammer. Test results from the sampled open graded bituminous mixture shall be compared to the approved job-mix-formula and approved by the Contracting Officer for acceptance. The tolerances given in Table IV for sieve analysis, bitumen content, and temperature shall be applied to quality control test results on the open graded bituminous mixture as discharged from the mixing plant.

TABLE IV

JOB-MIX-FORMULA TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing 4.75 mm or larger sieves	4 percent
Aggregate passing 2.36 and 0.60 mm sieves	3 percent
Aggregate passing 0.075 mm sieve	1 percent
Bitumen	0.20 percent
Temperature of discharge mix	10 degrees C
Voids Total Mix	2 percent

3.16.2.2 Slurry Grout

Each batch of slurry grout shall be tested for viscosity at the jobsite after thorough mixing and before application. Any batch of slurry grout failing to meet the specified viscosity shall be rejected and removed from the jobsite. Slurry grout with visible amounts of sand settling out of suspension during application shall be rejected and removed from the jobsite.

3.16.2.3 Core Samples

Random core samples shall be taken from the in-place open graded bituminous mixture before and after application of the slurry grout. The Contractor shall take at least two field core samples before grout application and two after grout application for every 1,000 square meters of finished RMP. Half of the core samples taken after grout application shall be taken from joints between successive grouting lanes. Field core samples shall be 102 or 152 mm (4 or 6 inch) diameter and extend the full depth of the RMP surface layer. The ungrouted core samples shall be tested for thickness. The grouted core samples shall be visually inspected for acceptable grout penetration. Acceptable grout penetration shall be through the full thickness of the RMP layer with a minimum of 90 percent of the visible void spaces filled with slurry grout. After testing, the Contractor shall turn over all cores to the Contracting Officer. Core holes in ungrouted RMP shall be filled with hot open graded bituminous material and leveled to match the surrounding pavement surface. Core holes in grouted RMP shall be filled within 24 hours from the time of coring with RMP material, low-shrinkage portland cement concrete material, or other approved patching material.

3.16.3 Thickness, Grade and Surface-Smoothness Requirements

Finished surface of RMP, when tested as specified below, shall conform to the thickness and grade specified and to surface smoothness requirements specified in Table VI. In areas where the thickness, grade or smoothness exceeds the tolerance, the Contractor shall remove the surface lift to full depth; the Contractor shall then replace the lift with open graded asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used, after grout has cured, to remove high spots to meet grade or smoothness requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

TABLE VI

SURFACE-SMOOTHNESS TOLERANCES

Direction of Testing	Resin Modified Pavement Tolerance, mm
Longitudinal	6
Transverse	6

3.16.3.1 Thickness

The thickness of the RMP shall meet the requirements shown on the contract drawings. The measured thickness of the RMP shall not exceed the design thickness by more than 13 mm, or be deficient in thickness by more than 6 mm .

3.16.3.2 Surface Smoothness

Finished surfaces shall not deviate from testing edge of a 3.7 meter (12 foot) straightedge more than the tolerances shown for the respective pavement category in Table VI.

3.16.3.3 Surface Texture

The surface texture shall be uniform and free of excess cement grout. Finished surface shall have all grout removed below the top of the open-graded asphalt concrete.

3.16.3.4 Grade

The finished surface of pavement shall conform to the elevations and the cross sections shown and shall vary not more than 15 mm from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements.

-- End of Section --

SECTION 07240

EXTERIOR FINISH SYSTEMS
10/01
AM# 0001

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 67	(2000)Sampling and Testing Brick and Structural Clay products
ASTM C 150	(2000) Portland Cement
ASTM C 473	(2000) Physical Testing of Gypsum Panel Products
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 847	1995 Metal Lath
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1177/C 1177M	(1999) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1186	(1999; Rev. A) Flat Non-Asbestos Fiber-Cement Sheets
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 2247	(1999) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 3273	(2000) Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM E 84	(2000) Surface Burning Characteristics of Building Materials
ASTM E 136	(1999) Behavior of Materials in Vertical Tube Furnace at 750 Degrees C
ASTM 330	(1997) Structural Performance of Exterior

	Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 695	(1997) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials

EXTERIOR INSULATION MANUFACTURERS ASSOCIATION (EIMA)

EIMA TM 101.01	(1995) Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS), Class PB.
EIMA TM 101.86	(1995, Rev. Aug. 1995) Resistance of Exterior Insulation and Finish Systems, Class PB, to the Effects of Rapid Deformation (Impact)
EIMA TM 105.01	(1995) Alkali Resistance of Glass Fiber Reinforcing Mesh for Use in Exterior Insulation and Finish Systems

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

UBC 26-4	Evaluation of Flammability Characteristics of Exterior, Non load-Bearing Wall Panel Assemblies using Foam Plastic Insulation
UBC 26-9	Evaluation of Flammability Characteristics of Exterior Non load-Bearing Wall Assemblies Containing Combustible Components using Intermediate-Scale, Multistory Test Apparatus Title

NATIONAL FIRE PROTECTION ASSOCIATION, INC. (NFPA)

NFPA 268	(1996) Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source

1.2 SYSTEM DESCRIPTION AND REQUIREMENTS

The exterior finish system (EFS) shall be a job-fabricated exterior wall covering consisting of sheathing, reinforcing fabric, base coat, finish coat, adhesive and mechanical fasteners as applicable. The system components shall be compatible with each other and with the substrate as recommended or approved by, and the products of, a single manufacturer regularly engaged in furnishing Exterior Finish Systems. All materials shall be installed by an applicator approved by the system manufacturer. E FS shall be Class PB and shall be color as specified in Section 09915: COLOR SCHEDULE.

1.2.1 System Requirements and Tests

The system shall meet the performance requirements as veryfied by the tests listed below. Where a wall system of similar type, size, and design as specified for this project has been previously tested under the condition specified herein, the resulting test reports may be submitted in lieu of job specific tests.

1.2.1.1 Water Penetration

Test the system for water penetration by uniform static air pressure in accordance with ASTM E 331. There shall be no penetration of water beyond the plane of the base coat/EPS board interface after 15 minutes at 300 Pa (, or 20% of positive design wind pressure, whichever is greater.

1.2.1.2 Wind Load

Test the system for wind load by uniform static air pressure in accordance with ASTM E 330 (procedure A) to a minimum pressure of 1920_____ Pa . There shall be no permanent deformation, delamination, or other deterioration.

1.2.1.3 Full scale or intermediate scale fire test

Conduct wall fire test using apparatus, specimen, performance criteria, and procedure in accordance with UBC 26-4. The specimen shall include the complete system. At the option of the contractor, UBC 26-9, Intermediate-Scale Test may be substituted in lieu of the Full-Scale Multi-Story Fire test. The following requirements shall be met:

a. No vertical spread of flame within core of panel from one story to the next.

b. No flame spread over the exterior surface.

c. No vertical flame spread over the interior surface from one story to the next.

d. No significant lateral spread of flame from compartment of fire origin to adjacent spaces.

1.2.2 Component Requirements and Tests

The components of the system shall meet the performance requirements as veryfied by the tests listed below.

1.2.2.1 Surface Burning Characteristics

Conduct ASTM E 84 test on samples consisting of base board, base coat, reinforcing fabric, and finish coat. Cure for 28 days. The flame spread index shall be 25 or less and the smoke developed index shall be 450 or less.

1.2.2.2 Radiant Heat

The system shall be tested in accordance with NFPA 268 with no ignition during the 20-minute period.

1.2.3 Sub-Component Requirements and Tests

Unless otherwise stated, the test specimen shall consist of reinforcement, base coat, and finish coat applied in accordance with manufacturer's printed recommendations to the base board to be used on the building. For mildew resistance, only the finish coat is applied onto glass slides for testing. These specimen shall be suitably sized for the apparatus used and be allowed to cure for a minimum of 28 days prior to testing.

1.2.3.1 Abrasion Resistance

Test in accordance with ASTM D 968, Method A. Test a minimum of two specimen. After testing, the specimens shall show only very slight smoothing, with no loss of film integrity after 500 liters of water.

1.2.3.2 Accelerated Weathering

Test in accordance with ASTM G 23, Method 1. After 2000 hours specimens shall exhibit no visible cracking, flaking, peeling, blistering, yellowing, fading, or other such deterioration.

1.2.3.3 Mildew Resistance

Test in accordance with ASTM D 3273. The specimen shall consist of the finish coat material, applied to clean 75 mm by 100 mm glass slides and shall be allowed to cure for 28 days. After 28 days of exposure, the specimen shall not show any growth.

1.2.3.4 Salt Spray Resistance

Test in accordance with ASTM B 117. The specimen shall be a minimum of 100 mm by 150 mm and shall be tested for 300 hours. After exposure, the specimen shall exhibit no observable deterioration, such as chalking, fading , or rust staining.

1.2.3.5 Water Resistance

Test in accordance with ASTM D 2247. The specimen shall be a minimum of 100 mm by 150 mm . After 14 days, the specimen shall exhibit no cracking, checking, crazing, erosion, blistering, peeling, or delamination.

1.2.3.6 Absorption-Freeze/Thaw

Class PB systems shall be tested in accordance with EIMA TM 101.01for 60 cycles of freezing and thawing. No cracking, checking, or splitting, and neglible weight gain. Class PM systems shall be tested in accordance with ASTM C 67 for 50 cycles of freezing and thawing. After testing, the specimens shall exhibit no cracking or checking,and have negligible weight gain.

1.2.3.7 Sample Boards

Unless otherwise stated, provide sample EFS Component300 by 600 mm (, on sheathing board specified, including finish color and texture, typical joints and sealant. If more than one color, finish, or pattern is used, provide one sample for each. The test specimen shall consist of reinforcement, base coat, and finish coat applied in accordance with manufacturer's printed recommendations to the base board specified to be used on the building.

1.2.4 Moisture Analysis

Perform a job specific vapor transmission analysis based on project specific climate and specified wall components and materials. Indicate the temperatures and relative humidities for the inside and outside of the building; a complete listing of the building components, their thickness, thermal resistance and permeance, as well as building location and use. If a mathematical model was used for the analysis, include the name of the model and the supplier/developer.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Shop drawings; G

Show wall layout, construction and expansion joints, decorative grooves, layout of sheathing board, thermal insulation board, and reinforcement mesh and strip reinforcing fabric; joint and flashing details; details at wall penetrations; types and location of fasteners; details required to provide complete installation of ceilings and soffits.

SD-03 Product Data

Sheathing board

Mechanical Fasteners

Accessories

Base coat

Portland cement

Reinforcing fabric

Finish coat

Joint Sealant

Primer

Bond breaker

Backer Rod

Warranty

Include joint and other details, such as end conditions, corners and walls and fascie. Include shelf life and recommended cleaning

solvents in data for sealants. Include material safety data sheets (MSDS)for all components of the EFS. The MSDS shall be available at the job site.

SD-04 Samples

Sample Boards; G

Color and Texture

SD-05 Design Data

Wind load Calculations

SD-06 Test Reports

Abrasion resistance

Accelerated weathering

Impact resistance

Mildew resistance

Salt spray resistance

Water vapor transmission

Absorption-freeze-thaw

Flame spread

Water penetration

Water resistance

Flame spread

Radiant heat

Wind load

SD-07 Certificates

Qualifications of EFS Manufacturer

Qualification of EFS Installer

Qualification of Sealant Applicator

Certify that EFS installer meets requirements specified under paragraph "Qualification of Installer," and that sealant applicator is approved by the EFS Manufacturer.

Qualifications of Third Party Inspector

Submit evidence that third party inspector has current certification from the Exterior Design Institute or equal inspector certification as inspector for the installation of EFS.

Inspection Check List; G

Submit filled-out inspection check list as required in paragraph "Quality Control," certifying that the installation of critical items meets the requirements of this specification.

SD-08 Manufacturer's Instructions

Installation

Manufacturer's standard printed instructions for the installation of the EFS. Include requirements for condition and preparation of substrate, installation of EFS, and requirements for sealants and sealing.

SD-10 Operation and Maintenance Data

EFS

Include detailed finish repair procedures and information regarding compatibility of sealants with base and finish coatings.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of EFS Manufacturer

The EFS shall be the product of a manufacturer who has been in the practice of manufacturing and designing EFS for a period of not less than 3 years, and has been involved in at least five projects similar to this project in size, scope, and complexity, in the same or a similar climate as this project.

1.4.2 Qualification of EFS Installer

The EFS Installer shall be trained and approved by the EFS manufacturer to install the system and shall have successfully installed at least five projects at or near the size and complexity of this project. The contractor shall employ qualified workers trained and experienced in installing the manufacturer's EIFS.

1.4.3 Qualification of Sealant Applicator

The sealant applicator shall be experienced and competent in the installation of high performance industrial and commercial sealants and shall have successfully installed at least five projects at or near the size and complexity of this project.

1.4.4 Pre-Installation Conference

After approval of submittals and before commencing any work on the EFS , including installation of any sheathing board, and associated work, the Contracting Officer will hold a pre-installation conference to review:

a. Drawings, specifications, and samples;

b. Procedure for on site inspection and acceptance of EFS substrate and pertinent details.

c. Contractor's plan for coordination of work of the various trades involved in providing EFS system and other components;

d. Inspection procedures; and

e. Safety requirements.

Pre-installation conference shall be attended by the Contractor, and all personnel directly responsible for installation of the EFS system, including sealant applicator, and personnel responsible for related work, such as flashing and sheet metal, windows and doors, and a representative of the EFS manufacturer. Before beginning EFS work, the contractor shall confirm in writing the resolution of conflicts among those attending the preinstallation conference.

1.5 DELIVERY AND STORAGE

Deliver materials to job site in original unopened packages, marked with manufacturer's name, brand name, and description of contents. Store materials off the ground and in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area. Protect stored materials from rain, sunlight, and excessive heat. Keep coating materials which would be damaged by freezing at a temperature not less than 4 degrees C. Do not expose insulation board to flame or other ignition sources.

1.6 ENVIRONMENTAL CONDITIONS

a. Do not prepare materials or apply EFS during inclement weather unless appropriate protection is provided. Protect installed materials from inclement weather until they are dry.

b. Apply sealants and wet materials only at ambient temperatures of 4 degrees C or above and rising, unless supplemental heat is provided. The system shall be protected from inclement weather and to maintain this temperature for a minimum of 24 hours after installation.

1.7 WARRANTY

Furnish manufacturer's standard warranty for the EFS. Warranty shall run directly to Government and cover a period of not less than 5 years from date Government accepted the work.

PART 2 PRODUCTS

2.1 COMPATIBILITY

Provide all materials compatible with each other and with the substrate, and as recommended by EFS manufacturer.

2.2 SHEATHING BOARD

2.2.1 Fiber Reinforced Cement Sheathing Board

a. Meet ASTM C 1186, Type B, Grade I.

b. Non-combustible per ASTM E 136.

c. Nail Pull Resistance: No less than 534 N (120 lbf) when tested in accordance with ASTM C 473.

d. Thickness no less than 16 mm

e. Water Absorption not to exceed 17 percent.

2.3 MECHANICAL FASTENERS

Corrosion resistant and as approved by EFS manufacturer. Select fastener type and pattern based on applicable wind loads and substrate into which fastener will be attached, to provide the necessary pull-out, tensile, and shear strengths.

2.4 BASE COAT

Manufacturer's standard product and compatible with other systems components.

2.5 PORTLAND CEMENT

Conform to ASTM C 150, Type I or II as required, fresh and free of lumps, and approved by the systems manufacturer.

2.6 REINFORCING FABRIC

Reinforcing fabric mesh shall be alkali-resistant, balanced, open weave , glass fiber fabric made from twisted multi-end strands specifically treated for compatibility with the other system materials, and comply with EIMA TM 105.01 and as recommended by EIFS manufacturer.

2.7 FINISH COAT

Manufacturer's standard product conforming to the requirements in the paragraph on Sub-Component Requirements and Tests. For color consistency, use materials from the same batch or lot number.

2.8 PRIMER

Non-staining, quick-drying type recommended by sealant manufacturer and EFS manufacturer.

2.9 ACCESSORIES

Conform to recommendations of EFS manufacturer, including trim, edging, anchors, expansion joints. All metal items and fasteners to be corrosion resistant.

2.10 JOINT SEALANT

Non-staining, quick-drying type meeting ASTM C 920, Class 25, compatible with the finish system type and grade, and recommended by both the sealant manufacturer and EFS manufacturer.

2.11 BOND BREAKER

As required by EFS manufacturer and recommended by sealant manufacturer and EIFS manufacturer.

2.12 BACKER ROD

Closed cell polyethylene free from oil or other staining elements and as recommended by sealant manufacturer and EFS manufacturer. Do not use absorptive materials as backer rod. The backer rod should be sized 25 percent larger than the width of the joint.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrate and existing conditions to determine that the EFS can be installed as required by the EFS manufacturer and that all work related to the EFS is properly coordinated. Surface shall be sound and free of oil, loose materials or protrusions which will interfere with the system installation. If deficiencies are found, notify the Contracting Officer and do not proceed with installation until the deficiencies are corrected. The substrate shall be plane, with no deviation greater than 6 mm when tested with a 3 m straightedge. Determine flatness, plumbness, and any other conditions for conformance to manufacturer's instructions.

3.2 SURFACE PREPARATION

Prepare existing surfaces for application of the EFS to meet flatness tolerances and surface preparation according to manufacturer's installation instructions but provide a flatness of not more that 6 mm in 3000 mm. Provide clean surfaces free of oil and loose material without protrusions adversely affecting the installation of the insulation board. For adhesively attached EIFS, existing deteriorated paint must be removed. Due to substrate conditions or as recommended by the system manufacturer, a primer may be required. Apply the primer to existing surfaces as recommended by the manufacturer. Use masking tape to protect areas adjacent to the EFS to prevent base or finish coat to be applied to areas not intended to be covered with the EFS. The contractor shall not proceed with the installation until all noted deficiencies of the substrate are corrected.

3.3 INSTALLATION

Install EFS as indicated, comply with manufacturer's instructionsexcept as otherwise specified, and in accordance with the shop drawings. EFS shall be installed only by an applicator trained and approved by the EIFS manufacturer. Specifically, include all manufacturer recommended provisions regarding flashing and treatment of wall penetrations.

3.3.1 Sheathing Board

Edges and ends of boards shall be butted snugly with vertical joints staggered to provide full and even support for the insulation. Do not align sheathing board joints with wall openings. Provide support at both vertical and horizontal joints. Attach sheathing board to metal studs with self-tapping drywall screws. Place fasteners sufficiently close to support imposed loads, but not more than:

a. 200 mm apart on each supporting stud

Space fasteners more closely when required for negative wind load resistance.

3.3.2 Base Coat and Reinforcing Fabric Mesh

3.3.2.1 Class PB Systems

Mix base coat in accordance with the manufacturer's instructions and apply to insulated wall surfaces to the thickness specified by the system manufacturer and provide any other reinforcement recommended by EFS manufacturer. Trowel the reinforcing fabric mesh into the wet base coat material. Fully embed the mesh in the base coat. When properly worked-in, the pattern of the reinforcing fabric mesh shall not be visible. Provide diagonal reinforcement at opening corners. Back-wrap all terminations of the EFS. Overlap the reinforcing fabric mesh a minimum of 50 mm on previously installed mesh, or butted, in accordance with the manufacturer’s instructions. Allow the adhered insulation board to dry for 24 hours, or longer if necessary, prior to proceeding with the installation of the base coat/reinforcing fabric mesh. Install reinforcing fabric in accordance with and manufacturer's instructions.

3.3.3 Finish Coat

Apply and level finish coat in one operation. Obtain final texture by trowels, floats, or by spray application as necessary to achieve the required finish matching approved sample. Apply the finish coat to the dry base coat maintaining a wet edge at all times to obtain a uniform appearance.The thickness of the finish coat shall be in accordance with the system manufacturer’s current published instructions. Apply finish coat so that it does not cover surfaces to which joint sealants are to be applied.The base coat/reinforcing mesh must be allowed to dry a minimum of 24 hours prior to the application of the finish coat. Surface irregularities in the base coat, such as trowel marks, board lines, reinforcing mesh laps, etc., shall be corrected prior to application of the finish coat.

3.4 JOINT SEALING

Seal EFS at openings as recommended by the system manufacturer. Apply sealant only to the base coat. Do not apply sealant to the finish coat.

3.4.1 Surface Preparation, Backer Rod, and Primer

Immediately prior to application, remove loose matter from joint. Ensure that joint is dry and free of paint, finish coat, or other foreign matter. Install backer rod. Apply primer as required by sealant and EFS manufacturer. Check that joint width is as shown on drawings but in no case shall it be less than 13 mm for perimeter seals and 20 mm for expansion joints. The width shall not be less than 4 times the anticipated movement. Check sealant manufacturer's recommendations regarding proper width to depth ratio.

3.4.2 Sealant

Apply sealant in accordance with sealant manufacturer's instructions with

gun having nozzle that fits joint width. Do not use sealant that has exceeded shelf life or can not be discharged in a continuous flow. Completely fill the joint solidly with sealant without air pockets so that full contact is made with both sides of the joint. Tool sealant with a round instrument that provides a concave profile and a uniformly smooth and wrinkle free sealant surface. Do not wet tool the joint with soap, water, or any other liquid tooling aid. Do not apply sealant until all EFS coatings are fully dry. During inclement weather, protect the joints until sealant application. Use particular caution in sealing joints between EFS and wall and at all other ceiling penetrations. Clean all surfaces to remove excess sealant.

3.5 FIELD QUALITY CONTROL

Throughout the installation, the contractor shall establish and maintain an inspection procedure to assure compliance of the installed EFS with contract requirements. Work not in compliance shall be removed and replaced or corrected in an approved manner. The inspection procedures, from acceptance of deliveries through installation of sealants and final acceptance shall be performed by qualified inspector trained by the manufactuter. No work on the EFS shall be performed unless the inspector is present at the job site.

3.5.1 Third Party Inspection

Provide full time third party inspection during the entire process of installing the EFS, from examination through cleanup. The third party inspector shall be certified by the Exterior Design Institute (EDI) or by an equivalent independent party and shall be trained in the proper installation of EIFS.

3.5.2 Inspection Check List

During the installation and at the completion of installation, perform inspections covering at the minimum all applicable items enumerated on the attached check list. The inspector shall initial and date all applicable items, sign the check list, and submit it to the Contracting Officer at the completion of the EFS erection.

CHECK LIST

Item	Description	Appr'd/Date
a.	Materials are handled and stored correctly.	
b.	Environmental conditions are within specified limits, including temperature not below 4 degrees C (40 degrees F), and the work is protected from the elements as required.	
c.	Preparation and installation is performed by qualified personnel using the correct tools.	
d.	Adjacent areas to which EFS is not to be applied (such as on window and door frames) are protected with masking tape, plastic films, drop cloths, etc. to prevent accidental application of EFS materials.	
e.	Control, expansion and aesthetic joints are installed as	

CHECK LIST

Item	Description	Appr'd/Date
	indicated or recommended. Accessories are properly installed.	
f.	Substrate is in-plane, properly attached, clean, dry, and free of contaminants. Concrete substrate is free of efflorescence.	_____ ____
g.	Materials are mixed thoroughly and in proper proportions.	_____ ____
h.	Adhesive is applied in sufficient quantity with proper-size notched trowel.	_____ ____
i.	Mechanical attachments have proper spacing, layout and fastener depth.	_____ ____
j.	Insulation boards are tightly abutted, in running bond pattern, with joints staggered with the sheathing, board corners interlocked, L-shaped boards around openings, edges free of adhesive, and provision for joints. Gaps are filled and surfaces rasped.	_____ ____
k.	Insulation adhesive must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.	_____ ____
l.	Reinforcing fabric mesh is properly back-wrapped at terminations.	_____ ____
m.	Reinforcing fabric mesh is fully embedded and properly placed. Corners are reinforced. Openings are diagonally reinforced. Mesh overlaps minimum 65 mm (2-1/2 inches).	_____ ____
n.	Base coat thickness is within specified limits.	_____ ____
o.	The base coat/reinforcing fabric mesh must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.	_____ ____
p.	Finish coat is applied with sufficient number of personnel and stopped at suitable points. Floats and methods of texturing are uniform.	_____ ____
q.	All Flashings are properly installed.	_____ ____
r.	All joints are properly sealed in their entire length at time and under environmental conditions as specified by the manufacturer.	_____ ____
s.	All scaffolding, equipment, materials, debris and temporary protection are removed from site upon completion.	_____ ____

Name of Inspector:_____ Signed:_____ Date:_____

3.6 CLEANUP

Upon completion, remove all scaffolding, equipment, materials and debris from site. Remove all temporary protection installed to facilitate installation of EFS.

-- End of Section --

SECTION 16370A

ELECTRICAL DISTRIBUTION SYSTEM, AERIAL
AM#1

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C29.2	(1992) Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.3	(1986; R 1995) Wet Process Porcelain Insulators - Spool Type
ANSI C29.4	(1989; R 1995) Wet-Process Porcelain Insulators - Strain Type
ANSI C29.5	(1984; R 1995) Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types
ANSI C29.6	(1996) Wet-Process Porcelain Insulators - High-Voltage Pin Type
ANSI C29.8	(1985; R 1995) Wet-Process Porcelain Insulators - Apparatus, Cap and Pin Type
ANSI C29.9	(1983; R 1996) Wet-Process Porcelain Insulators - Apparatus, Post-Type
ANSI C37.32	(1996) High-Voltage Air Switches, Bus Supports, and Switch Accessories - Schedules of Preferred Ratings, Manufacturing Specifications, and Application Guide
ANSI C57.12.20	(1997) Overhead Type Distribution Transformers, 500 KVA and Smaller: High Voltage 34 500 Volts and Below: Low Voltage, 7970/13 800 Y Volts and Below
ANSI C135.1	(1979) Galvanized Steel Bolts and Nuts for Overhead Line Construction
ANSI C135.2	(1999) Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction

ANSI C135.4	(1987) Zinc-Coated Ferrous Eyebolts and Nuts for Overhead Line Construction
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction
ANSI C135.22	(1988) Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 475	(1998) Zinc-Coated Steel Wire Strand
ASTM A 575	(1996) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 1995el) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 228	(1998) Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM B 230/B 230M	(1999) Aluminum 1350-H19 Wire for Electrical Purposes
ASTM B 231/B 231M	(1999) Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 232/B 232M	(1999) Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
ASTM B 398/B 398M	(1999) Aluminum-Alloy 6201-T81 Wire for Electrical Purposes
ASTM B 399/B 399M	(1999) Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors

ASTM B 416	(1998) Concentric-Lay-Stranded Aluminum-Clad Steel Conductors
ASTM D 923	(1997) Sampling Electrical Insulating Liquids
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography.

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C4	(1999) Poles - Preservative Treatment by Pressure Processes
AWPA C25	(1995) Sawn Crossarms - Preservative Treatment by Pressure Processes
AWPA P1/P13	(1995) Standard for Coal Tar Creosote for Land and Fresh Water and Marine (Coastal Water Use)
AWPA P5	(2000) Standards for Waterborne Preservatives
AWPA P8	(2000) Standards for Oil-Borne Preservatives
AWPA P9	(1998) Standards for Solvents for Organic Preservative Systems

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.34	(1994) Test Code for High-Voltage Air Switches
IEEE C37.41	(1994; C37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.60	(1981; R 1992) Requirements for Overhead, Pad Mounted, Dry Vault and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems
IEEE C37.63	(1997) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizer for AC Systems
IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

IEEE C57.13.2	(1991) IEEE Standard Conformance Test Procedures for Instrument Transformers
IEEE C57.15	(1986; R 1992) Requirements, Terminology, and Test Code for Step-Voltage and Induction-Voltage Regulators
IEEE C57.19.00	(1991; R 1997) IEEE Standard General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
IEEE C57.19.01	(1991; R 1997) Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 18	(1992) Shunt Power Capacitors
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-70-547	(1992) Weather Resistant Polyolefin Covered Wire & Cable

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA HV 2	(1984; R 1991) Application Guide for

	Ceramic Suspension Insulators
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LA 1	(1992) Surge Arresters
NEMA SG 2	(1993) High Voltage Fuses
NEMA WC 5	(1992; Rev 2 1996) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1999) National Electrical Code
U.S. DEPARTMENT OF AGRICULTURE (USDA)	
RUS REA Bull 1728H-701	(1993) REA Specification for WopdCrossarms (Solid and Laminated), Transmission Timbers and Pole Keys
UNDERWRITERS LABORATORIES (UL)	
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System;

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings. Detail drawings shall as a minimum include:

a. Constant current regulators.

b. Poles.

c. Calculations for steel poles and power installed screw foundations.

d. Crossarms.

e. Transformers.

f. Automatic circuit reclosers.

g. Pole top switches.

h. Conductors.

i. Insulators.

j. Surge arresters.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

As-Built Drawings;

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Nameplates;

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment;

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include the item number, the quantity of items proposed, and the name of the manufacturer of the item.

General Installation Requirements;

As a minimum, installation procedures for regulators, transformers and reclosers. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests;

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests specified in applicable publications or in these specifications.

Field Testing;

A proposed field test plan 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests;

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of 5 rings, and including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

SD-07 Certificates

Material and Equipment;

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided under this section of the specifications conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform thereto. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms thereto. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms thereto. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies.

SD-10 Operation and Maintenance Data

Electrical Distribution System;

Six copies of Operation and Maintenance manuals electrical distribution system shall be provided, within 7 calendar days following the completion of tests and shall include assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare-parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

Three additional copies of the instructions manual within 30 calendar days following the approval of the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the Contracting Officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Products shall conform to the following requirements. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.3 NAMEPLATES

2.3.1 General

Each major component shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Equipment containing liquid-dielectrics shall have the type of dielectric on the nameplate. Nameplates shall be made of noncorrosive metal. As a minimum, nameplates shall be provided for transformers, regulators, circuit breakers, capacitors, meters and switches.

2.3.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided in accordance with IEEE C57.12.00. Nameplates shall indicate the number of liters and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric in non-PCB classified, with less than 50 ppm PCb content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.4 CORROSION PROTECTION

2.4.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

2.4.2 Ferrous Metal Materials

2.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.4.2.2 Equipment

Equipment and component items, including but not limited to transformers and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The described test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with

a zinc rich paint conforming to the manufacturer's standard.

2.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

2.5 CONDUCTORS, CONNECTORS, AND SPLICES

(AM#1)**2.5.1 Aluminum-Composition Conductors**

Aluminum-conductor-steel-reinforced, ACSR, shall comply with ASTM B 232/B 232M.

2.5.2 Copper Conductors

Hard-drawn-copper conductors shall comply with ASTM B 1 and ASTM B 8 as appropriate for the conductor size.

2.5.3 Connectors and Splices

Connectors and splices shall be of copper alloys for copper conductors, aluminum alloys for aluminum-composition conductors, and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. Aluminum-composition and aluminum-composition to copper shall comply with UL 486B, and copper-to-copper shall comply with UL 486A.

2.6 MEDIUM-VOLTAGE LINES

2.6.1 Bare Medium-Voltage Lines

Bare medium-voltage line conductors shall be aluminum-conductor-steel-reinforced, ACSR; . Conductor types shall not be mixed on any project, unless specifically indicated. Conductors larger than No. 2 AWG shall be stranded.

2.7 LOW-VOLTAGE LINES

Low-voltage line conductors shall be of the neutral-supported secondary and service drop type with thermoplastic insulation in accordance with NEMA WC 5 cross-linked thermosetting polyethylene (XLP) insulation in accordance with NEMA WC 7 weather-resistant polyolefin-covered type conforming to ICEA S-70-547. Neutral-supported secondary and service drop conductors shall be insulated copper with bare hard-drawn-copper or copper-clad steel neutrals insulated aluminum with bare 1350 alloy aluminum or ACSR neutrals. Conductors on secondary racks may be provided in lieu of neutral-supported cable for pole line circuits where necessary clearances are available.

2.8 POLES AND HARDWARE

Poles shall be of lengths and classes indicated.

2.8.1 Wood Poles

Wood poles shall comply with ANSI O5.1, and shall be pressure treated in accordance with AWPA C4, with creosote conforming to AWPA P1/P13or with oil-borne preservatives and petroleum conforming to AWPA P8 and AWPA P9, respectively, and waterborne preservatives conforming to AWPA P5.

Waterborne preservatives shall be either chromated or ammoniacal copper arsenate. Any species listed in ANSI O5.1 for which a preservative treatment is not specified in AWPA C4, shall not be used; northern white cedar, if treated as specified for western red cedar, and western fir, if treated as specified for Douglas fir, may be used. Wood poles shall have pole markings located approximately 3 m from pole butts for poles 15.2 m (50 feet) or less in length, and 4 m from the pole butts for poles longer than 16.8 m (55 feet) in length. Poles shall be machine trimmed by turning smooth full length, and shall be roofed, gained, and bored prior to pressure treatment. Where poles are not provided with factory-cut gains, metal gain plates shall be provided.

2.8.2 Pole Line Hardware

Zinc-coated hardware shall comply with ANSI C135.1, ANSI C135.2, ANSI C135.4, ANSI C135.14 ANSI C135.22. Steel hardware shall comply with ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M. Pole-line hardware shall be hot-dip galvanized steel. . Washers shall be installed under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts shall be approximately 57.2 mm square and 4.8 mm (3/16 inch) thick. The diameter of holes in washers shall be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts shall be of the proper size to fit over square shanks of bolts. Eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

2.8.3 Armless Construction

Pole mounting brackets for line-post or pin insulators and eye bolts for suspension insulators shall be as shown. Brackets shall be attached to poles with a minimum of two bolts. Brackets may be either provided integrally as part of an insulator or attached to an insulator with a suitable stud. Bracket mounting surface shall be suitable for the shape of the pole. Brackets for wood poles shall have wood gripping members. Horizontal offset brackets shall have a 5-degree uplift angle. Pole top brackets shall conform to ANSI C135.22, except for modifications necessary to provide support for a line-post insulator. Brackets shall provide a strength exceeding that of the required insulator strength, but in no case less than a 12.5 kN (2800 pound) cantilever strength.

2.8.4 Guy Assemblies

Guy assemblies shall be aluminum-clad steel in accordance with ASTM B 416 copper-clad steel in accordance with ASTM B 228 or zinc-coated steel in accordance with ASTM A 475. Guy assemblies, including insulators and attachments, shall provide a strength exceeding the required guy strength. Three-eye thimbles shall be provided on anchor rods to permit attachment of individual primary, secondary, and communication down guys. Anchors shall provide adequate strength to support all loads. Guy strand shall be 7 strand. Guy material shall be Class 30 HS copper-clad steel Class B zinc-coated-steel utilities grade or aluminum-clad-steel-strand, with a minimum breaking strength not less than 26.7 kN (6000 pounds) kN (pounds) , except where two or more guys are used to provide the required strength. Guy rods shall be not less than 2.4 m (8 feet) in length by 19.1 mm (3/4 inch) in diameter.

2.9 INSULATORS

Insulators shall comply with NEMA HV 2 for general requirements. Suspension insulators shall be used at corners, angles, dead-ends, other areas where line insulators do not provide adequate strength, and as indicated. Mechanical strength of suspension insulators and hardware shall exceed the rated breaking strength of the attached conductors.

2.9.1 Medium-Voltage Line Insulators

Medium-voltage line insulators shall comply with ANSI C29.2, ANSI C29.5, and ANSI C29.6, and as applicable. Ratings shall not be lower than the ANSI classes indicated in TABLE I. Horizontal line-post insulators shall be used for armless construction and shall have the same mechanical and electrical ratings as vertical line-post insulators for the ANSI class indicated, but shall be modified to be suitable for horizontal installation. Where line-post insulators are used for angles greater than 15 degrees, clamp-top fittings shall be provided as well as for other locations shown. Conductor clamps for use with clamp-top, line-post insulators shall be hot-dip galvanized malleable iron for copper conductors and aluminum alloy for aluminum-composition conductors. Either line-post or pin insulators may be used for crossarm construction. Pin insulators for use on voltages in excess of 6 kV phase-to-phase shall be radio-interference-freed or else line-post insulators shall be used.

TABLE I

MINIMUM ANSI RATING OF MEDIUM-VOLTAGE INSULATORS BY CLASS

Voltage Level	Line-Post	Pin	Suspension
Up to 5 kV	57-1 or 11	55-3	One 52-1
	57-1 or 11	55-5	Two 52-1
6 kV to 15 kV	57-1 or 11	55-5	Two 52-2
	57-2 or 12	56-3	Two 52-3 or 4
16 kV to 25 kV	57-2 or 12	56-3	Two 52-3 or 4
	57-3 or 13	56-4	Three 52-3 or 4
26 kV to 35 kV	57-3 or 13	56-4	Three 52-3 or 4
	57-4 or 14	56-5	Four 52-3 or 4

2.9.2 Low-Voltage Line Insulators

Low-voltage line insulators shall comply with ANSI C29.2 and ANSI C29.3 as applicable. Spool insulators for use on low-voltage lines shall be mounted on clevis attachments or secondary racks and shall be not smaller than Class 53-2 . For No. 4/0 AWG and larger conductors, Class 53-4 shall be used. Suspension insulators on clevis attachments used at dead-ends shall be not smaller than Class 52-1.

2.9.3 Strain Insulators for Guy Wires

Strain insulators for use in insulated guy assemblies shall comply with ANSI C29.4 for porcelain or equivalent fiberglass, and shall have a mechanical strength exceeding the rated breaking strength of the attached guy wire. Insulators shall be not smaller than Class 54-1 for lines up to 5 kV, not smaller than Class 54-2 for lines of 6 kV to 15 kV, not smaller

than Class 54-4 for lines of 16 kV to 25 kV, and not smaller than Class 54-4 with two in tandem for lines of 26 kV to 35 kV.

2.9.4 Apparatus Insulators

Apparatus insulators shall comply with IEEE C57.19.00, IEEE C57.19.01, ANSI C29.8, and ANSI C29.9 as applicable.

2.10 CROSSARM ASSEMBLIES

2.10.1 Crossarms

Crossarms shall comply with RUS REA Bull 1728H-701 and shall be solid wood, distribution type, except cross-sectional area with pressure treatment conforming to AWPA C25, and a 6.4 mm (1/4 inch), 45 degree chamfer on all top edges. Cross-sectional area minimum dimensions shall be 108.0 mm (4-1/4 inches) in height by 82.6 mm (3-1/4 inches) in depth in accordance with IEEE C2 for Grade B construction. Crossarms shall be 2.4 m (8 feet) in length, except that 3.1 m (10 foot) crossarms shall be used for crossarm-mounted banked single-phase transformers or elsewhere as indicated. Crossarms shall be machined, chamfered, trimmed, and bored for stud and bolt holes before pressure treatment. Factory drilling shall be provided for pole and brace mounting, for four pin or four vertical line-post insulators, and for four suspension insulators, except where otherwise indicated or required. Drilling shall provide required climbing space and wire clearances. Crossarms shall be straight and free of twists to within 2.5 mm per 304.8 mm (1/10 inch per foot) of length. Bend or twist shall be in one direction only.

2.11 FUSES AND SWITCHES, MEDIUM-VOLTAGE

2.11.1 Fuse Cutouts

Medium-voltage fuses and cutouts shall comply with NEMA SG 2 and shall be of the loadbreak open type construction rated 15 kV and of the heavy -duty type . Open-link cut-outs are not acceptable. Fuses shall be either indicating or dropout type. Fuse ratings shall be as indicated. Fuse cutouts shall be equipped with mounting brackets suitable for the indicated installations.

2.12 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1 and IEEE C62.1, IEEE C62.2, and IEEE C62.11, and shall be provided for protection of aerial-to-underground transitions, automatic circuit reclosers, capacitor equipment, group-operated load-interrupter switches, transformers and other indicated equipment. Arresters shall be distribution class, rated as shown. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the valve or metal-oxide varistor or combination valve-metal-oxide varistor type suitable for outdoor installations.

2.13 GROUNDING AND BONDING

2.13.1 Driven Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 19.1 mm (3/4 inch) in diameter by 3.1 meter (10 feet) in length of the sectional type driven full length into the earth.

2.13.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as the phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.14 PADLOCKS

Padlocks shall comply with Section 08700 'Builders' Hardware.

2.15 WARNING SIGNS

Warning signs shall be porcelain enameled steel or approved equal. Voltage warning signs shall comply with IEEE C2.

2.16 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 tetrachlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts-per-million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.17 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing.

[AM#1]a. High-Voltage Fuses: Manufacturer's standard tests in accordance with IEEE C37.41.

[AM#1]b. Electric Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed in conduits or underground and splices and terminations for medium-voltage cable shall conform to the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Secondary circuits installed in conduit on poles shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of IEEE C2 for medium loading districts, Grade B construction. No reduction in clearance shall be made. The installation shall also comply with the applicable parts of NFPA 70.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall notify the Contracting Officer of any discrepancy before performing any work.

3.1.3 Tree Trimming

Where lines pass through trees, trees shall be trimmed at least 4.5 m clear on both sides horizontally and below for medium-voltage lines, and 1.5 m clear on both sides horizontally and below for other lines, and no branch shall overhang horizontal clearances. Where trees are indicated to be removed to provide a clear right-of-way, clearing is specified in Section 02230 CLEARING AND GRUBBING.

3.1.4 Disposal of Liquid Dielectrics

PCB-contaminated dielectric shall be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectric shall not be diluted to lower the level of contamination.

3.2 POLE INSTALLATION

Joint-use electric/roadway-lighting poles for overhead electric and communication lines shall be wood poles utilizing crossarm construction. Crossarm construction shall be provided for support of other equipment, except where direct-pole mounting is indicated. Provision for communication services is required on pole-line construction, except where specifically noted otherwise. A vertical pole space of not less than 600 mm (2 feet) shall be reserved at indicated locations.

3.2.1 Wood Pole Setting

Wood Pole Setting: Wood poles shall be set straight and firm. In normal firm ground, minimum pole-setting depths shall be as listed in Table II. In rocky or swampy ground, pole-setting depths shall be decreased or increased respectively in accordance with the local utility's published standards and as approved. In swampy or soft ground, a bog shoe shall be used where support for a pole is required. Poles in straight runs shall be in a straight line. Curved poles shall be placed with curvatures in the direction of the pole line. Poles shall be set to maintain as even a grade as practicable. When the average ground run is level, consecutive poles shall not vary more than 1.5 m in height. When the ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top end and roofed. If any pole is shortened after treatment, the shortened end of the pole shall be given an application of hot preservative. Where poles are set on hilly terrain, along edges of cuts or embankments, or where soil may be washed out, special precautions shall be taken to ensure durable pole foundations, and the setting depth shall be measured from the lower side of the pole. Holes shall be dug large enough to permit proper use of tampers to the full

depth of a hole. Earth shall be placed into the hole in 300 mm maximum layers, then thoroughly tamped before the next layer is placed. Surplus earth shall be placed around each pole in a conical shape and packed tightly to drain water away from poles.

TABLE II

MINIMUM POLE-SETTING DEPTH (METERS)

Length Overall Meters	Straight Lines	Curves, Corners, and Points of Extra Strain
6.1	1.5	1.5
7.6	1.7	1.7
9.2	1.7	1.7
10.7	1.8	1.8
12.2	1.8	1.8
13.7	2.0	2.1
15.2	2.1	2.3
16.7	2.3	2.5
18.3	2.5	2.6
19.8	2.6	2.6
21.3	2.8	2.9
22.9	2.9	3.0
24.4	3.0	3.2
25.9	3.2	3.3
27.4	3.3	3.5
28.9	3.5	3.7
30.5	3.7	3.8

3.2.2 Aluminum, Steel, and Concrete Pole Setting

Poles shall be mounted on cast-in-place or power-installed screw foundations. Concrete poles shall be embedded in accordance with the details shown. Conduit elbows shall be provided for cable entrances into pole interiors.

3.2.2.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufacturer's standard, and not less than necessary to meet the pole wind loading specified herein and other design requirements.

3.2.2.2 Power-Installed Screw Foundations

Power-installed screw foundations may be used if they have the required strength, mounting-bolt, and top plate dimensions. Screw foundations shall be of at least 6.4 mm (1/4 inch) thick structural steel conforming to ASTM A 36/A 36M and hot-dip galvanized in accordance with ASTM A 123/A 123M. Conduit slots in screw foundation shafts and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength

shall be approved before installation of screw foundation is permitted. Calculations shall be submitted in accordance with the detail drawings portion of paragraph SUBMITTALS.

3.3 CROSSARM MOUNTING

Crossarms shall be bolted to poles with 15.9 mm (5/8 inch) through-bolts with square washers at each end. Bolts shall extend not less than 3 mm nor more than 50 mm beyond nuts. On single crossarm construction, the bolt head shall be installed on the crossarm side of the pole. Metal crossarm braces shall be provided on crossarms. Flat braces may be provided for 2.4 m (8 foot) crossarms and shall be 6.4 by 31.8 mm (1/4 by 1-1/4 inches), not less than 700 mm (28 inches) in length. Flat braces shall be bolted to arms with 9.5 mm (3/8 inch) carriage bolts with round or square washers between boltheads and crossarms, and secured to poles with 50.8 by 101.6 mm (1/2 by 4 inch) lag screws after crossarms are leveled and aligned. Angle braces are required for 3.1 m (10 foot) crossarms and shall be 1.5 m (60 inch) span by 457.2 mm (18 inch) drop formed in one piece from 38.1 by 38.1 by 4.8 mm (1-1/2 by 1-1/2 by 3/16 inch) angle. Angle braces shall be bolted to crossarms with 50.8 mm (1/2 inch) bolts with round or square washers between boltheads and crossarms, and secured to poles with 15.9 mm (5/8 inch) through-bolts. Double crossarms shall be securely held in position by means of 15.9 mm (5/8 inch) double-arming bolts. Each double-arming bolt shall be equipped with four nuts and four square washers.

3.3.1 Line Arms and Buck Arms

Line arms and buck arms shall be set at right angles to lines for straight runs and for angles 45 degrees and greater; and line arms shall bisect angles of turns of less than 45 degrees. Dead-end assemblies shall be used for turns where shown. Buckarms shall be installed, as shown, at corners and junction poles. Double crossarms shall be provided at ends of joint use or conflict sections, at dead-ends, and at angles and corners to provide adequate vertical and longitudinal strength. Double crossarms shall be provided at each line-crossing structure and where lines not attached to the same pole cross each other.

3.3.2 Equipment Arms

Equipment arms shall be set parallel or at right angles to lines as required to provide climbing space. Equipment arms shall be located below line construction to provide necessary wire and equipment clearances.

3.4 GUY INSTALLATION

Guys shall be provided where shown, with loads and strengths as indicated, and wherever conductor tensions are not balanced, such as at angles, corners, and dead-ends. Where a single guy will not provide the required strength, two or more guys shall be provided. Where guys are wrapped around poles, at least two guy hooks shall be provided and pole shims shall be provided where guy tension exceeds 27 kN (6000 pounds). Guy clamps 152.4 mm (6 inches) in length with three 15.9 mm (5/8 inch) bolts, or offset-type guy clamps, or approved guy grips shall be provided at each guy terminal. Guy-strain insulators shall be provided in each guy for wood poles. Multiple-helix screw anchors shall be provided in marshy ground; rock anchors shall be installed in rock at right angles to guys, elsewhere anchors shall be of an expanding type, except that power installed screw anchors of equivalent holding power are acceptable. A half-round yellow

polyvinyl, fiberglass, or other suitable plastic guy marker, not less than 2.4 m (8 feet) in length, shall be provided at the anchor end of each guy shown, securely clamped to the guy or anchor at the bottom and top of the marker. Holding capacities for down guys shall be based on a lead angle of 45 degrees .

3.5 CONDUCTOR INSTALLATION

3.5.1 Line Conductors

Unless otherwise indicated, conductors shall be installed in accordance with manufacturer's approved tables of sags and tensions. Proper care shall be taken in handling and stringing conductors to avoid abrasions, sharp bends, cuts, kinks, or any possibility of damage to insulation or conductors. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor shall not be less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors shall be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension shall be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation as recommended by the manufacturer.

3.5.2 Connectors and Splices

Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors. Aluminum-composition conductors shall be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type. Noninsulated connectors shall be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.5.3 Conductor-To-Insulator Attachments

Conductors shall be attached to insulators by means of clamps, shoes or tie wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as indicated in TABLE II.

TABLE II

TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8

TABLE II

TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
4 and 2	6
1 through 3/0	4
4/0 and larger	2
AAC, AAAC, or ACSR (AWG)	AAAC OR AAC (AWG)
Any size	6 or 4

3.5.4 Armor Rods

Armor rods shall be provided for AAC, AAAC, and ACSR conductors. Armor rods shall be installed at supports, except armor rods will not be required at primary dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods shall be in accordance with the manufacturer's recommendations. For span lengths of less than 61 m, flat aluminum armor rods may be used. Flat armor rods, not less than 762.0 micrometers by 6.4 mm (0.03 by 0.25 inch) shall be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods shall be not less than 1.3 by 7.6 mm (0.05 by 0.30 inches). For span lengths of 61 m or more, preformed round armor rods shall be used.

3.5.5 Medium-Voltage Insulated Cables

Medium-voltage cable messengers shall be attached to poles with clamps providing a strength exceeding the required messenger strength and with not less than 15.9 mm (5/8 inch) through-bolts. Messengers shall be dead-ended, grounded, line-guyed at corners and dead-ends, and at intervals not exceeding 305 m along straight runs.

3.5.6 Low-Voltage Insulated Cables

Low-voltage cables shall be supported on clevis fittings using spool insulators. Dead-end clevis fittings and suspension insulators shall be provided where required for adequate strength. Dead-end construction shall provide a strength exceeding the rated breaking strength of the neutral messenger. Clevis attachments shall be provided with not less than 15.9 mm (5/8 inch) through-bolts. Secondary racks may be used when installed on wood poles and where the span length does not exceed 61 m. Secondary racks shall be two-, three-, or four-wire, complete with spool insulators. Racks shall meet strength and deflection requirements for heavy-duty steel racks, and shall be either galvanized steel or aluminum alloy. Tops of insulator saddles shall be rounded and smooth to avoid damage to conductor insulation. Each insulator shall be held in place with a 15.9 mm (5/8 inch) button-head bolt equipped with a nonferrous cotter pin, or equivalent, at the bottom. Racks for dead-ending four No. 4/0 AWG or four larger conductors shall be attached to poles with three 15.9 mm (5/8 inch) through-bolts. Other secondary racks shall be attached to poles with at least two 15.9 mm (5/8 inch) through-bolts. Minimum vertical spacing between conductors shall not be less than 200 mm.

(AM#1)**3.6 TRANSFORMER INSTALLATION**

Transformers shall be carefully installed so as not to scratch finishes or damage bushings. Transformers shall be installed in accordance with the manufacturer's instructions. After installation, surfaces shall be inspected and scratches shall be touched up with a finish provided by the transformer manufacturer for this purpose.

3.7 CONNECTIONS TO UTILITY LINES

The Contractor shall coordinate the work with the Contracting Officer and shall provide for final connections to the installation electric lines.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to poles by two-hole galvanized steel pipe straps spaced not more than 3 m apart and with one support not more than 300 mm from any bend or termination. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the riser conduit or guard. Cables guards shall be secured in accordance with the manufacturers published procedure. Risers shall be equipped with bushings to protect cables. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable.

3.9 CONNECTIONS TO BUILDINGS

3.9.1 Aerial Services

Connections to buildings shall be made at approximately the point indicated and shall be connected to the service entrance conductors. Supports at buildings shall be adequate to withstand required pulls; supports shall not be rated less than 4450 N (1000 pounds). Drip loops shall be formed on conductors at entrances to buildings, cabinets, or conduits. Service-entrance conduits with termination fittings and conductors within the building, including sufficient slack for connection to aerial service cables, shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

3.9.2 Underground Services

Connections to buildings shall be made at the point indicated and shall be terminated at the service entrance equipment terminals. Cable pulling shall be in accordance with Section 16375, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Service entrance conduits with termination fittings and conductors within the building shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

3.10 GROUNDING

Noncurrent-carrying metal parts of equipment and conductor assemblies, such as luminaires, medium-voltage cable terminations and messengers, metal poles, operating mechanisms of pole top switches, panel enclosures, transformers, capacitors, recloser frames (cases) and other noncurrent-carrying metal items shall be grounded. Additional grounding of equipment, neutral, and surge arrester grounding systems shall be installed at poles where indicated.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be located approximately 900 mm out from base of the pole and shall be driven into the earth until the tops of the rods are approximately 300 mm below finished grade. Multiple rods shall be evenly spaced at least 3 m apart and connected together 600 mm below grade with a minimum No. 6 bare copper conductor.

b. Pole butt electrodes - Pole butt electrodes shall be installed where indicated, except that this method shall not be the sole grounding electrode at transformer locations. The pole butt electrode shall consist of a coil of at least 4 m of minimum No. 6 bare copper conductor stapled to the butt of the pole.

c. Plate electrodes - Plate electrodes shall be installed in accordance with the manufacturer's instructions and IEEE C2 and NFPA 70.

d. Ground Resistance - The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors , to achieve the specified ground resistance. The additional electrodes will be up to three, 3 m (10 feet) rods spaced a minimum of 3 m (10 feet) apart, . In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notifies immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding Electrode Conductors

On multi-grounded circuits, as defined in IEEE C2, provide a single continuous vertical grounding electrode conductor. Neutrals, surge arresters, and equipment grounding conductors shall be bonded to this conductor. For single grounded or ungrounded systems, provide a grounding conductor for the surge arrester and equipment grounding conductors and a separate grounding conductor for the secondary neutrals. Grounding electrode conductors shall be sized as shown. Secondary system neutral conductors shall be connected directly to the transformer neutral bushings, then connected with a neutral bonding jumper between the transformer neutral bushing and the vertical grounding electrode conductor, as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 600 mm. On metal poles, a preformed galvanized steel strap, 15.9 mm (5/8 inch) wide by 0.853 (22 gauge) minimum by length, secured by

a preformed locking method standard with the manufacturer, shall be used to support a grounding electrode conductor installation on the pole and spaced at intervals not exceeding 1.5 m with one band not more than 75 mm from each end of the vertical grounding electrode conductor. Bends greater than 45 degrees in grounding electrode conductor are not permitted.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 30 days prior to conducting tests. The Contractor shall furnish materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each pole ground shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes shall be provided.

3.11.4 Medium-Voltage Preassembled Cable Test

After installation, prior to connection to an existing system, and before the operating test, the medium-voltage preassembled cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors at one terminal and connecting grounds or metallic shieldings or sheaths of the cable at the other terminal for each test. Prior to the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, and shall not exceed the recommendations of IEEE Std 404 for cable joints unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.5 Sag and Tension Test

The Contracting Officer shall be given prior notice of the time schedule for stringing conductors or cables serving overhead medium-voltage circuits and reserves the right to witness the procedures used for ascertaining that initial stringing sags and tensions are in compliance with requirements for the applicable loading district and cable weight.

3.11.6 Low-Voltage Cable Test

For underground secondary or service laterals from overhead lines, the low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations of conductors in the same trench, duct, or cable, with other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

Each cable failing this test shall be repaired or replaced. The repaired cable shall then be retested until failures have been eliminated.

3.11.7 Operating Tests

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16711A

TELEPHONE SYSTEM, OUTSIDE PLANT
AM#1

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.61	(1993) Gas Tube Surge Arrestors on Wire Line Telephone Circuits

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2239	(1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA 455-81A-91	(1992) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA ANSI/EIA/TIA-455-30B	(1991) FOTP-30 Frequency Domain Measurement of Multimode Optical Fiber Information Transmission Capacity
EIA ANSI/EIA/TIA-455-53A	(1990) FOTP-53 Attenuation by Substitution Measurement for Multimode Graded-Index Optical Fibers or Fiber Assemblies Used in Long Length Communications Systems
EIA ANSI/EIA/TIA-455-78A-98	(1990; R 1998) FOTP-78 Spectual Attenuation Cutback Measurement for Single Mode Optical Fibers
EIA ANSI/TIA/EIA-568-A	(1995) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-607	(1994) Commercial Building Grounding and Bonding Requirements for Telecommunications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-85-625	(1996) Airecore, Polyolefin Insulated, Copper Conductor Telecommunications Cable

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

REA Bulletin 345-39	(1985) Telephone Station Protectors
REA Bulletin 345-50	(1979) Trunk Carrier Systems (PE-60)
REA Bulletin 345-65	(1985) Shield Bonding Connectors (PE-33)
REA Bulletin 345-72	(1985) Filled Splice Closures (PE-74)
REA Bulletin 345-151	(1989) Conduit and Manhole Construction, REA Form 515c
REA Bulletin 1753F-205 (PE-39)	(1993) Filled Telephone Cables
REA Bulletin 1753F-207 (PE-87)	(1994) Terminating Cables
REA Bulletin 1753F-208	(1993) Filled Telephone Cables with Expanded Insulation (PE-89)
RUS Bulletin 1751F-635	(1996) Aerial Plant Construction
RUS Bulletin 1751F-643	(1998) Underground Plant Design
RUS Bulletin 1753F-302 (PE-91)	(1994) Outside Plant Housings and Serving Area Interface Systems
RUS Bulletin 1753F-401(PC-2)	(1995) Splicing Copper and Fiber Optic Cables
RUS REA Bulletin 1751F-641	(1995) Construction of Buried Plant
RUS REA Bull 1753F-201 (PC-4)	(1997) Acceptance Tests and Measurements of Outside Plant
RUS REA Bull 1753F-601 (PE-90)	(1994) Filled Fiber Optic Cables
RUS REA Bulletin 1755I-100	(1999) List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers

UNDERWRITERS LABORATORIES (UL)

UL 50	(1995; Rev thru Oct 1997) Enclosures for Electrical Equipment
UL 497	(1995; Rev Mar 1996) Protectors for Paired Conductor Communication Circuits

1.2 SYSTEM DESCRIPTION

The outside plant system shall consist of all cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, terminating cables, lightning and surge protection modules at the entry

facility. The work consists of furnishing, installing, testing and making operational a complete outside plant system for continuous use.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telephone System;
Installation;

Detail drawings, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, and catalog cuts. Detail drawings shall also contain complete configuration information, wiring diagrams and any other details required to demonstrate that the cable system has been coordinated to support the transmission systems identified in the specifications and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations.

Record Drawings;

Record drawings for the installed wiring system showing the actual location of all cable terminations, splices, routing, and size and type of all cables. The identifier for each termination and cable shall appear on the drawings. The drawings shall include gauge and pair or fiber count for each cable, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector block layout at the termination points after installation.

SD-03 Product Data

Spare Parts;
Equipment;

A data list of recommended spare parts, tools, and test equipment for each different item of material and equipment specified prior to beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Installation;

Printed copies of the manufacturer's recommendations for the material being installed, prior to installation. Installation of the item will not be allowed to proceed where installation procedures, or any part thereof, are required to be in accordance with those recommendations until the recommendations are received and approved.

Acceptance Tests;

Test plans defining all tests required to ensure that the system meets specified requirements. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

Cutover and Records;

The cutover plan shall provide procedures and schedules for relocation of facility station numbers without interrupting service to any active location.

SD-06 Test Reports

Acceptance Tests;

Test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

SD-07 Certificates

Telephone System;

Proof that the items furnished under this section conform to the specified requirements in FCC, ICEA, REA, RUS, ANSI, ASTM, NFPA, EIA, or UL, where materials and equipment are so specified.

Qualifications;

The qualifications of the manufacturer, splicer, and installation supervisor as specified.

1.4 QUALIFICATIONS

1.4.1 Cable Installers

Installation shall be under the direct supervision of an individual with a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.4.2 Cable Splicing and Termination

All cable splicers shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

1.4.3 Manufacturers

The cable, equipment, and hardware provided shall be from manufacturers that have a minimum of 3 years experience in producing the types of cable, equipment, and hardware specified.

1.5 DELIVERY AND STORAGE

1.5.1 Cable Requirements-

All cable shall be shipped on reels. The diameter of the drum shall be large enough to prevent damage to the cable during reeling and unreeling. The reels shall be constructed to prevent damage during shipment and handling. The outer end of the cable shall be securely fastened to the reel head to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel, or into a housing on the inner slot of the drum, with sufficient length to make it available for testing. The inner end shall be fastened to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 to plus 65 degrees C, with relative humidity from 0 to 100 percent.

1.5.2 Equipment

All equipment shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants, in accordance with the manufacturer's requirements.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 2 years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment. All products supplied shall be specifically designed and manufactured for use with outside plant communications systems. All items of the same class of equipment shall be the products of a single manufacturer.

2.2 CABLE

2.2.1 Copper Conductor Cable

Copper conductor cable shall conform to the following:

(AM#1)**2.2.1.1 Aerial**

a. Lashed: REA Bulletin 1753F-208.

b. Self Supporting: ICEA S-85-625.

2.2.1.2 Underground

Cable shall be manufactured per REA Bulletin 1753F-205 (PE-39) or REA Bulletin 1753F-208. A 0.2 mm coated aluminum or 0.12 mm copper metallic shield shall be provided.

2.2.1.3 Screened

Screened cable shall comply with REA Bulletin 1753F-205 (PE-39) orREA Bulletin 1753F-208.

2.2.2 Fiber Optic Cable

Fiber optic cable shall be specifically designed for outside use with tight or loose buffer construction. The tight buffer optical fiber cable shall consist of a central glass optical fiber surrounded by a soft intermediate buffer to allow for thermal expansions and proper fitting of the secondary buffer. The loose buffer optical fiber cable shall have the glass optical fiber within a filled loose tube. All fiber optic cables used shall conform to the requirements of RUS REA Bull 1753F-601 (PE-90)including any special requirements made necessary by a specialized design..

2.2.2.1 Cable Cores

A central, nonmetallic core member shall be included to serve as a cable core foundation to reduce strain on the fibers, but not to serve as a pulling strength member.

2.2.2.2 Optical Fiber

Single-mode optical fibers shall be Class IV.

2.2.2.3 Shielding or Other Metallic Covering

A copper, copper alloy, or copper and steel laminate metallic covering or shield shall be provided per RUS REA Bull 1753F-601 (PE-90).

2.2.2.4 Performance Requirements

The fiber optic cable shall comply with the specified mechanical performance requirements while used in buried and underground duct applications where the temperature varies from minus 20 to plus 60 degrees C. Optical performance degradation shall be less than 5 percent of the optical performance requirements in the temperature range of minus 20 to plus 60 degrees C. The fiber optic cable shall not be damaged in storage where the temperature may vary from minus 40 to plus 65 degrees C.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Aerial Closure

The aerial closure shall be free breathing and suitable for housing straight and butt splices of non-pressurized communications cables. The closure shall be constructed with ultraviolet resistant PVC.

2.3.1.2 Buried Closure

Buried closure shall conform to REA Bulletin 345-72.

2.3.1.3 Underground Closure

Underground closures shall conform to REA Bulletin 345-72. The closure shall be of thermoplastic, thermoset, or stainless steel material and be suitable for use in a vault or manhole.

2.3.2 Fiber Optic Closures

2.3.2.1 Fiber Optic Aerial

The aerial closure shall be free breathing and suitable for housing a

splice organizer of non-pressurized communications cables. The closure shall be constructed with ultraviolet resistant PVC.

2.3.2.2 Fiber Optic Buried

The buried closure shall be suitable for enclosing a splice organizer in a container into which can be poured an encapsulating compound. The closure shall protect the splice and be suitable for use in the buried environment. The encapsulating compound shall be re-enterable and shall not alter the chemical stability of the closure.

2.3.2.3 Fiber Optic Underground

The underground closure shall be suitable to house a splice organizer in a protective housing. An encapsulating compound shall be poured into this enclosure. The closure shall be of thermo-plastic, thermoset-plastic, or stainless steel material and suitable for use in a vault or manhole. The encapsulating compound shall be re-enterable and shall not alter the chemical stability of the closure.

2.4 CABLE SPLICES AND ORGANIZERS

2.4.1 Copper Cable Splices

All cables greater than 25 pairs shall be spliced using modular splicing connectors, which accommodate 25 pairs of conductors at a time. The correct connector size shall be used to accommodate the wire gauge of the cable to be spliced. The connectors used shall be listed in RUS REA Bulletin 1755I-100.

2.4.2 Fiber Optic Cable Splices

Each fiber optic splice shall be physically protected by a splice kit. The kit shall be specially designed for the splice.

2.4.3 Fiber Optic Splice Organizer

The splice organizer shall be suitable for housing fiber optic splices in a neat and orderly fashion. The splice organizer shall allow for a minimum of 1 m of fiber for each fiber within the cable to be neatly stored without kinks or twists. The splice organizer shall accommodate individual strain relief for each splice. The splice organizer shall allow for future maintenance or modification, without damage to the cable or splices. All required splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors shall be provided in the organizer kit.

2.5 CABLE TERMINALS

2.5.1 Pedestal-Type Cable Terminals

Pedestal-type cable terminals shall conform to RUS Bulletin 1753F-302 (PE-91).

2.5.2 Cross-connect Cable Terminals

Cross-connect cable terminals shall be weatherproofed for outdoor use and suitable for pole, pad, or stake mounting. The terminal shall be equipped with mounting columns and distribution rings for jumper-wire routing. The terminal shall be of aluminum or steel construction and ribbed for strength.

2.6 MANHOLE AND DUCT

All manhole and duct products shall conform to RUS Bulletin 1751F-643.

2.6.1 New Manholes

New manholes shall be equipped with pulling-in irons, cable racks, and ground rod, and conform to the requirements of REA Bulletin 345-151. Manholes shall be a minimum size as indicated on the drawings. Manholes shall be designed so that the main trunk conduits enter and exit near the center of the ends, and lateral conduits exit on the sides near the corners. Manholes may be pre-cast or cast in place.

2.6.2 Manhole Overbuilds

Existing manholes which are enlarged as part of this project shall be equipped with new pulling-in irons, cable racks, and ground rod.

2.6.3 Duct/Conduit

Conduit shall be furnished as specified in Sections 16415 ELECTRICAL WORK, INTERIOR and 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on project drawings.

2.6.4 Innerduct

Innerduct shall be SIDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

2.7 EQUIPMENT RACKS

Distribution frames, cabinets, and back-boards shall be provided as shown and designed to mount connector blocks, protector blocks, cross connects, and other hardware required to terminate and protect the outside telephone plant cable; to provide a demarcation point between inside and outside plant cable; and to allow inside and outside plant cable to be cross connected.

(AM#1)**2.8 CONNECTOR BLOCKS**

Connector blocks consisting of flame-retardant molded plastic fastened to a metal mounting bar shall be provided to terminate the outside plant cable as shown. The connector blocks shall be of 100-pair block size and equipped with protection modules. The connector blocks shall be 24 gauge stub type. The cable stubs shall be 100 pair and conform to REA Bulletin 1753F-207 (PE-87).

2.9 PROTECTOR MODULES

The protector modules shall be of the two-element gas tube type. Protection modules shall be heavy duty, A>10 kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current per ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, be equipped with an external spark gap and heat coils, and shall comply with UL 497.

2.10 FIBER-OPTIC TERMINATIONS

2.10.1 Fiber Optic Connectors

All outside plant fiber strands shall be terminated in a ST type fiber optic connector, with ceramic ferrule material and a maximum insertion loss of 0.5 dB. Connectors shall meet performance standards of EIA ANSI/TIA/EIA-568-A. If pre-connectorized cable assemblies or pigtails are used, the connectors shall be terminated on a 3 m length of single-fiber cable. The single-fiber cable shall contain a buffered optical fiber of the same type and specification as that used in the multi-fiber cable.

2.10.2 Fiber Optic Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Patch panels shall be 480 mm rack mounted panels. Patch panels shall provide strain relief for cables. Panels shall be labeled with alphanumeric x-y coordinates . Patch panel connectors and couplers shall be the same type and configuration as used elsewhere in the system.

2.11 MISCELLANEOUS ITEMS

2.11.1 Shield Connectors

Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire. The connector shall be made of tin-plated tempered brass. Shield bond connectors shall comply with REA Bulletin 345-65.

2.11.2 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. The braid shall be made from flat tin-plated copper.

2.11.3 Warning Tape

Marking and locating tape shall be acid and alkali resistant polyethylene film, 150 mm wide with a minimum strength of 12.1 MPa lengthwise and 10.3 MPa crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 1 m deep. The metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion and shall be specifically manufactured for marking and locating underground utilities. The warning tape shall be orange in color and continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 1.2 m intervals.

2.11.4 Cable Warning Signs

Cable warning signs, which identify the route of buried cable, shall be stake mounted. The stake shall be driven into undisturbed soil and the sign shall be mounted to the stake in accordance with the manufacturer's instructions. Warning signs shall be placed at intervals of no more than 152.5 m and at each change of direction in the cable route. Warning signs shall also be placed on each side of every crossing of surface obstacles such as roads, railroads, stream crossings, or any similar crossing where excavation is likely to occur.

PART 3 EXECUTION

3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All installation work shall be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and NFPA 70.

3.1.1 Cable Inspection and Repair

All cable and wire used in the construction of the project shall be handled with care. Each reel shall be inspected for cuts, nicks or other damage. All damage shall be repaired to the satisfaction of the Contracting Officer. The reel wrap shall remain intact on the reel until the cable or wire is ready to be placed.

3.1.2 Underground Cable

Underground cable installation shall be accomplished in accordance with the requirements set forth in RUS REA Bulletin 1751F-641.

3.1.2.1 Cable Pulling

For cable installed in ducts and conduit, a cable feeder guide shall be used, between the cable reel and the face of the duct and conduit, to protect the cable and guide it into the duct and conduit as it is paid off the reel. As the cable is paid off the reel, it shall be inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is paid off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-tension instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not cause the cable to be twisted or stretched.

3.1.2.2 Penetrations for Cable Access

Penetrations in walls, ceilings or other parts of the building, made to provide for cable access, shall be caulked and sealed. Where conduits and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in section 07840 FIRE STOPPING. Fire stopped penetrations shall not compromise the fire rating of the walls or floors. All underground building entries shall be through waterproof facilities.

3.1.2.3 Cable Bends

Telephone cable bends shall have a radius of not less than 10 times the cable diameter. Only large radius sweeps shall be used in conduit runs and shall not exceed a cumulative 90 degrees between manholes.

3.1.3 Manhole and Ducts

Manhole and duct systems shall be installed in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Manholes shall be placed in line with the main duct. Splice cases shall be mounted in the center on the long sides. Lateral conduits shall exit the long sides near the corners.

3.1.3.1 Innerduct Installation

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be plugged at both ends with polyurethane foam duct seal; this material shall also be inserted between the innerduct and the duct if cables are placed in the innerducts. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 50 mm exposed.

3.1.3.2 Pull Cord

Pull cords of 10 mm polypropylene shall be installed in all unused ducts and inner-ducts with a minimum of 610 mm spare cord protruding from each end.

3.1.4 Surge Protection

Except for fiber optic cable, all cables and conductors, which serve as communication lines, shall have surge protection meeting the requirements of REA Bulletin 345-50 installed at the entry facility.

3.2 SPLICING

3.2.1 Copper Conductor Splices

Copper conductor cable splicing shall be accomplished in accordance with RUS Bulletin 1753F-401(PC-2). Modular splicing shall be used on all cables larger than 25 pairs.

3.2.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with the manufacturer's recommendation; each splice shall have a loss of less than 0.1 dB.

3.3 GROUNDING

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals shall be grounded. Grounding shall be in accordance with requirements of NFPA 70, Articles 800-33 and 800-40.

3.3.1 Ground Bars

3.3.1.1 Telecommunications Master Ground Bar (TMGB)

A copper TMGB shall be provided, in accordance with EIA ANSI/TIA/EIA-607, to be the hub of the basic grounding system by providing a common point of connection for ground from outside cable, MDF, and equipment. The TMGB shall have a ground resistance, including ground, of 10 ohms or less.

3.3.1.2 Telecommunications Ground Bar (TGB)

Copper TGB shall be provided in accordance with EIA ANSI/TIA/EIA-607 in each communications closet and room and each frame. The TGB shall be connected to the TMGB in accordance with EIA ANSI/TIA/EIA-607. Each TGB shall be connected to the TMGB by the most direct route utilizing a copper wire conductor with a total resistance of less than 0.01 ohms.

3.3.2 Incoming Outside Plant Cables

All incoming outside plant cable shields shall be bonded directly to the TMGB or the closest TGB.

3.3.3 Cable Stubs

All shields of cable stubs shall be bonded to a TGB located on the frame.

3.3.4 Shields

The shields of all incoming cables shall not be bonded across the splice to the cable stubs.

3.3.5 Protection Assemblies

The protector assemblies shall be mounted directly on the vertical frame ironwork. The assemblies mounted on each vertical frame shall be connected with a No. 6 AWG copper conductor to provide a low resistance path to the TGB.

3.3.6 Manholes

The shields of all cables in each manhole shall be bonded together by a bonding wire or ribbon. At intermediate manholes, where the cable is pulled through without a sheath opening, bonds are not required. If the manhole has a lacerating bonding ribbon, the shields of spliced cables shall be attached to it.

3.4 CUTOVER AND RECORDS

All necessary transfers and cutovers, shall be accomplished by the Contractor.

3.5 ACCEPTANCE TESTS

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test; testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. The test plans shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

3.5.1 Copper Conductor Cable

The following acceptance tests shall be performed in accordance with RUS REA Bull 1753F-201 (PC-4):

a. Shield continuity.

b. Conductor continuity.

c. Conductor insulation resistance.

d. Structural return loss.

e. Cable insertion loss and loss margin at carrier frequencies.

f. Shield ground for single jacketed cables.

g. DC loop resistance.

3.5.2 Fiber Optic Cable

Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multi-mode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

3.5.2.1 OTDR Test

The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings, improper splices, for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 1 km minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. The OTDR test shall be conducted in accordance with EIA ANSI/EIA 455-81A-91 for single-mode fiber and EIA ANSI/EIA/TIA-455-78A-98 for multi-mode fiber. Splice losses shall not exceed 0.1db. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses shall not exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multi-mode fiber.

3.5.2.2 Attenuation Test

End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 850 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met. The measurement method shall be in accordance with EIA ANSI/EIA/TIA-455-53A.

3.5.2.3 Bandwidth Test

The end-to-end bandwidth of all multi-mode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with EIA ANSI/EIA/TIA-455-30B.

-- End of Section --