

PUBLIC UTILITY DISTRICT NO. 1

OF

MASON COUNTY

SHELTON, WASHINGTON

INVITATION, INSTRUCTION TO BIDDERS, BID & CONTRACT FORMS, AND SPECIFICATIONS

FOR

BID DOCUMENT NO. 2023-FIBER

BROADBAND INFRASTRUCTURE MAINTENANCE, REPAIR AND OTHER RELATED SERVICES

September 15, 2023

CALL FOR BIDS

NOTICE IS HEREBY GIVEN THAT THE BOARD OF COMMISSIONERS OF PUBLIC UTILITY DISTRICT 1 OF MASON COUNTY, WASHINGTON, does hereby invite sealed proposals as described and in accordance with Bid Document No. 2023-FIBER Broadband Maintenance, Repair and Related Services, obtainable from the District upon request.

Proposals for this work must be sealed, marked Bid Document No. **2023-FIBER** and filed with the General Manager at the District's office, by **4:00 p.m.** on **Friday, September 29, 2023**. Bids received after the time fixed for receiving bids will not be considered or accepted. At the time and place named below such bids will be opened and read, and the District will proceed to canvass the bids, and may make recommendations to the board of commissioners to let a contract to the lowest responsible bidder or bidders of the specifications.

BIDDING DOCUMENTS

Bona fide Bidders may request bidding documents from Mason PUD 1, 21971 N. Hwy 101, Shelton, Washington, (360) 877-5239, email <u>kristinm@mason-pud1.org</u> and on the PUD's website: <u>https://mason-pud1.org/bids/</u>.

BID SECURITY AND BONDS

Each bid shall be accompanied by a certified check, bank cashier's check, or bid bond executed by a Washington State licensed surety company, in an amount not less than \$25,000. No bid will be considered unless accompanied by such a bond or security.

REJECTION OF BIDS

The District reserves the right in their sole and absolute discretion to waive any informalities and to reject any or all bids, and to accept the bid, which in their sole and absolute judgment will, under all circumstances, best serve the interest of the District.

Date: September 15, 2023

Publish: September 15, 2023

Bids Due: September 29, 2023, 4:00 p.m.

Bid Opening: October 2, 2023, 9:00 a.m.

Bid Opening Location: Online via Zoom: <u>https://us02web.zoom.us/j/89937856034</u>. Bidders without Zoom capabilities may contact the PUD to request reasonable accommodations.

BID DOCUMENT NO: 2023-FIBER

BROADBAND MAINTENANCE, REPAIR AND RELATED MAINTENANCE SERVICES

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INSTRUCTIONS TO BIDDERS

1. Preparation and Submission of Bids

Sealed bids will be received at Mason County PUD No. 1's office up to the date and time listed on the bid form. Any part of the bid proposal not received prior to the time specified will not be considered and the bid will be returned to the bidder unopened.

Sealed bids shall be mailed to:

Mason PUD 1 General Manager 21971 N. US Highway 101 Shelton, WA 98584, United States

Sealed bids shall be delivered by courier or hand delivery to: N

Mason PUD 1 General Manager 21971 N. US Highway 101 Shelton, WA 98584

Each bid shall be enclosed in a sealed envelope distinctly marked "Bid Proposal- 2023 FIBER" and marked in the upper left-hand corner with the Contractor's name and return address, the bid number, and project name.

It is the Contractor's responsibility to ensure the sealed bid is properly identified and delivered to the District by the date and time due. Late responses will not be accepted or considered. The District is not responsible for delays in delivery. The District's internal server shall be the official timeclock.

Each bid must be submitted on the prescribed form(s) and must be fully completed. All blank spaces for the bid price must be filled in, in ink or typewritten, and signed by an individual authorized to bind the company. Emailed proposals will not be considered.

2. Response Evaluation

Mason County PUD No. 1 will evaluate bids received for responsiveness and will evaluate the responsibility of the Bidder along with the pricing provided on the Bid Form. The District may consider commencement dates as part of the bid. Bid award may be subject to Commission approval.

Bids will be reviewed based on price, completeness and contributed design details that illustrate the Contractor's understanding of the requested scope-of-work or that enhance performance/aesthetics of the proposed work.

Bids which contain or are conditioned upon different terms provided by the Bidder may be rejected as nonresponsive. Any bid which attempts to disclaim liability for the Bidder's negligence or disclaim liability for damage, which arises from Bidder's acts to person or property, shall be deemed non-responsive.

The Commissioners of Mason County PUD No. 1 reserve the right in their sole and absolute judgment to reject any and all alternative offers or bids, without further explanation, and to accept an alternative or bid which will, in their sole and absolute judgment, under all circumstance best serve the interest of the District.

3. Job Show

There will not be a job show for this project.

4. Addenda

Should the Bidder find discrepancies in or omissions from the bid document or should the intent or meaning appear to be obscure or ambiguous, the Bidder should at once forward to the District a written request for interpretation, clarification, or correction thereof before submitting the bid. The Bidder making such request will be solely responsible for its timely receipt. All such requests must be received not later than two (2) business days prior to bid opening. Replies may be made in the form of addenda.

Engineering will transmit to prospective bidders of record such addenda as deemed necessary in response to questions arising. Oral statements may not be relied upon and will not be binding or legally effective.

5. Bidder's Data

The Bidder must submit:

- 1. One (1) hard copy of the Bid Form, Bidder's Information sheet and Wage Compliance form, with all signatures in ink. All responses must be complete and accurate.
- 2. Acknowledgement of receipt of Addenda (if any).
- 3. Bid Bond, or certified cashier's check, payable to Mason County PUD 1 in the amount indicated.

6. Additional Contractor Requirements

- A. This project is a prevailing wage project, and subject to all applicable RCW's and Washington State laws. Contractor shall comply with all requirements concerning public works, without limitation, prevailing wage. The work takes place in Mason County, Washington. View prevailing wage rates at: <u>http://www.lni.wa.gov/TradesLicensing/PrevWage/WageRates/default.asp</u>using the 2023, rates, or view a copy at Mason County PUD No. 's offices at 21971 N. US Highway 101, Shelton, WA 98584, United States If requested, a copy will be mailed.
- B. The Contractor shall maintain during the life of this contract, including warranty period, commercial general liability insurance, and automobile insurance as shall protect against claims for damages resulting from (1) bodily injury, including wrongful death, and (2) property damage including loss of use thereof, and products/completed operations with the minimum policy limits of \$1,000,000.00, naming the District as an additional insured. (See all insurance requirements in the Agreement and General Conditions.)
- C. The Contractor is to provide a good and sufficient Payment and Performance Bond acceptable to the District and in accordance with the provisions of Chapter 39 RCW, and payable to Mason County PUD No. 1 in an amount of not less than One Hundred Thousand dollars (\$100,000.00) as noted on the bid form.
- D. Each Bidder shall submit with its bid its work/delivery schedule including, if applicable, its proposed method of conducting the work, and the list of equipment and other materials it will use. This submittal data shall be sufficiently complete and detailed to show compliance with the bid document.

The District reserves the right to reject any bid if the District's review of the above submittals and its investigation fail to establish that the Bidder possesses, to the satisfaction of the District, in its discretion, the qualifications necessary to fully, properly and timely carry out all obligations described in this bid document.

7. Responsible Bidder

A. Bidder Responsibility Criteria

It is the intent of the District to award a contract to the low responsible Bidder. Before award, the Bidder must meet the following Bidder responsibility criteria to be considered a responsible Bidder. The Bidder may be required by the District to submit documentation demonstrating compliance with the criteria. The Bidder must:

- 1. Have a current certificate of registration as a contractor in compliance with Chapter 18.27 RCW, which must have been in effect at the time of bid submittal;
- 2. Have a current Washington Unified Business Identifier (UBI) number;
- 3. If applicable, have:
 - a. Industrial Insurance (workers' compensation) coverage for the contractor's employees working in Washington, as required in Title 51 RCW;
 - b. A Washington Employment Security Department number, as required in Title 50 RCW;
 - c. A Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW;
- 4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3).
- 5. If bidding on a public works project subject to the apprenticeship utilization requirements in RCW 39.04.320, not have been found out of compliance by the Washington State apprenticeship and training council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under Chapter 49.04 RCW for the one-year period immediately preceding the date of the bid solicitation.
- 6. Have received training on the requirements related to public works and prevailing wage under Chapter 39.04 RCW and Chapter 39.12 RCW.
- 7. Within the three-year period immediately preceding the date of the bid solicitation, the Bidder shall not have been determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of Chapter 49.46, 49.48 or 49.52 RCW. Before award of a public works contract, a Bidder shall submit to the contracting agency a signed statement in accordance with RCW 9A.72.085 verifying under penalty of perjury that the Bidder is in compliance with this requirement.

B. Subcontractor Responsibility

The Contractor shall include the language of this section in each of its first tier subcontracts and shall require each of its subcontractors to include the same language of this section in each of their subcontracts, adjusting only as necessary the terms used for the contracting parties. Upon request of the District, the Contractor shall promptly provide documentation to the District demonstrating that the subcontractor meets the subcontractor responsibility criteria below. The requirements of this section apply to all subcontractors regardless of tier.

At the time of subcontract execution, the Contractor shall verify that each of its first tier subcontractors meets the following Bidder responsibility criteria:

- 1. Have a current certificate of registration in compliance with Chapter 18.27 RCW, which must have been in effect at the time of subcontract bid submittal;
- 2. Have a current Washington Unified Business Identifier (UBI) number;
- 3. If applicable, have:
 - a. Industrial Insurance (workers' compensation) coverage for the subcontractor's employees working in Washington, as required in Title 51 RCW;

- b. A Washington Employment Security Department number, as required in Title 50 RCW;
- c. A Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW;
- 4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065 (3).
- 5. If bidding on a public works project subject to the apprenticeship utilization requirements in RCW 39.04.320, not have been found out of compliance by the Washington State apprenticeship and training council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under Chapter 49.04 RCW for the one-year period immediately preceding the date of the bid solicitation.
- 6. Have received training on the requirements related to public works and prevailing wage under Chapter 39.04 RCW and Chapter 39.12 RCW.
- 7. Within the three-year period immediately preceding the date of the bid solicitation, the Bidder shall not have been determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of Chapter 49.46, 49.48 or 49.52 RCW. Before award of a public works contract, a Bidder shall submit to the contracting agency a signed statement in accordance with RCW 9A.72.085 verifying under penalty of perjury that the Bidder is in compliance with this requirement.

8. Public Records Act

All bids, contract documents and related materials (collectively, "Materials") submitted in connection with any proposal or bid are subject to public review and approval by the Board of Commissioners. Contractor acknowledges and agrees to such public review and approval. With limited exceptions, all Materials submitted become public records and are subject to the provisions of RCW Chapter 42.56 (the "Act"). In most instances, all Materials will be subject to inspection and copying by the public.

Any specific part of the Materials that is claimed to be confidential information or otherwise exempt from disclosure under the Act must be clearly identified as such by the Contractor by marking each page "**PROPRIETARY AND CONFIDENTIAL**" in capital letters and in a manner that makes the claim immediately obvious and identifiable. Contractor agrees that Materials which are not so marked may be inspected, copied, or both by the public, at the District's discretion.

If a request is made for inspection, copying, or both of any Materials, the District will review the Materials to determine if any are marked "**PROPRIETARY AND CONFIDENTIAL**." For Materials appropriately marked, the District agrees that it will notify Contractor of such request and provide at least five (5) days written notice of such request prior to public disclosure of the documents. The Contractor may take such efforts to assert or exercise any rights available to Contractor under the Act to prevent or limit such public disclosure or access at Contractor's sole and exclusive expense.

SCOPE OF WORK

PUD 1 Triton Cove Broadband Maintenance and Repair Contract

1. Description and Location

The work consists of furnishing all supervision and labor, except as hereinafter specified, and performing maintenance, repair and related services including but not limited to emergency, storm after-hours repairs and requested by the District in accordance with District's specifications and plans within Mason County PUD 1's Triton Cove Telecommunications service territory. The work shall be equal to the best quality in the area.

The Contractor shall furnish all implements, equipment and supplies, and materials or products necessary for the completion of the work. It shall be the responsibility of the Contractor to determine the exact quantities of any materials or products necessary and to obtain such quantities. The District's General Manager shall approve any material or products supplied by the Contractor. Contractor will provide the General Manager Material Safety Data Sheets (MSDS) in an original form for all chemicals to be used in the performance of this contract. Duplicate MSDS sheets will also be kept at all bases of operation. The materials will be identical to the existing listed in this addenda, unless approved by the District.

Contractor's station of operation will be at sites mutually agreed upon and shall be no more than forty-five (45) minutes from the assigned work area. It is the intent of the District that the maximum possible amount of time shall be spent in productive work each day. With exception of travel to and from the job site, payment will only be made for active time during which work is actually performed.

Contractor MUST guarantee a response time of no more than 45 minutes to the Triton Cove Area of Mason County.

2. Equipment and Personnel

The Contractor shall employ an ample force of workers and provide properly adapted and maintained implementation plant of sufficient capacity and efficiency to complete the work in a workmanlike manner at the rate of progress equal to or better than the best in the area, necessary for completion of work.

- 2.1 Aerial lifts with a minimum height of thirty-six (36) feet from the ground to the floor of the buckets.
- 2.3 Required safety equipment, PPE, and all necessary miscellaneous items for an efficient operation.
- 2.4 Contractor is to provide names and experience of crewmembers and emergency phone numbers.
- 2.5 Crew structures are to be comprised of the minimum number of certified qualified people for work to be performed or as specified.
- 2.9 The Contractor will provide road-flagging personnel when required. However, traffic control supervision must be provided by the Contractor.
- 2.10 Additional personnel and equipment will be provided upon one week's notification to perform work in conformance with provisions of this contract.

3. Methods of Operations

The District's Contracting Officer will schedule and assign work. Any modifications to crew schedule, laborers, or equipment shall be reported to the Contracting Officer immediately.

Every effort shall be made, inasmuch as possible, to keep the District's facilities in service. In light of this, it shall be the Contractor's responsibility to coordinate with the District's customers with regard to any unavoidable outage. Planned outages shall be handled in accordance with Site Conditions and Coordination item 4. The Contracting Officer shall be kept fully informed of the condition of all District lines and facilities. A written report of any abnormal line situation shall be provided to the District's Contracting Officer or a designated representative, prior to the end of each working day.

4. Commencement, Duration, Prosecution and Completion

The Contractor shall be ready to commence work under the contract no later than the quoted commencement date or other mutually agreed upon date.

The District shall not be liable to the Contractor for anticipated earnings or profits hereunder in the event the Contractor and the District are prevented from completing the project as provided for in these specifications and contract.

The contract shall be for three (3) years, unless terminated as provided herein, or extended by mutual agreement.

The District may, at its discretion at any time, terminate the contract or to suspend work under this agreement by giving seven (7) days' written notice. The Contractor shall not have any claim for costs or other financial loss by reason of termination or suspension of work, other than for compensation of work performed satisfactorily up to the date of suspension or termination.

5. Availability of Contractor's Facilities and Data

The Contractor shall furnish the Contracting Officer with facilities in the vicinity of the site of the work for obtaining such information as the latter may desire respecting the character of materials or equipment and the progress and manner of carrying on the work, such as payrolls, source of labor and details of any other item in connection with the cost of labor, including all items of expense transporting persons to and from the work, invoices, bills, credit memoranda and claims for rebate for material, supplies, and freight including all costs in connection with the transporting of equipment and outfits to and from the work and such other cost records as may be required by the Contracting Officer. The Contractor shall keep available in the vicinity of the site of the work a description of all owned and rented equipment used in connection with this work; such shall include for each item or unit of equipment the maker's name, catalog reference, the size and the model year.

6. Inspection

The inspection of the work will be conducted under the general direction of the Contracting Officer and will be inspected by inspectors representing the Contracting Officer who will enforce a strict compliance with the terms of the contract. The presence or lack of presence of the inspector shall not relieve the Contractor or the Contractor's responsible agent of any responsibility for the proper execution of the work.

7. Interpretation of Specifications

All questions relating to the acceptability of material or machinery, classification of materials, the proper execution of the work, and the interpretation of these specifications, will be the decision of the Contracting Officer and shall be final.

9. Alternates and Exceptions

The District will consider any and all alternatives and exceptions to this specification if fully explained and included within the Bid Form.

10. Annual Cost Escalation / De-Escalation Adjustments

Cost adjustments will be allowed to the contract for the components listed in the Bid Form. Any proposed contract adjustment, beyond those listed in the Bid Form, must be presented in writing to the District at least thirty (30) days prior to the effective date of the change.

11. Payment

Contractor will be responsible for full compliance with all statutory and administrative requirements concerning public works (Chapter 39.04 RCW), including without limitation, prevailing wage (Chapter 39.12 RCW). Contractor will be responsible for submitting all Department of Labor and Industries (L&I) forms, associated form fees, or any other fees relating to this contract and compliance with the prevailing wage requirements of the L&I.

Before the District makes any payment to a Contractor, Contractor and/or any subcontractors must submit a "Statement of Intent to Pay Prevailing Wage." L&I industrial statistician must approve the statement before the Contractor can submit it to the District.

Payment will be processed on a weekly basis as documents submitted are correct and acceptable. All charges are to be included in the hourly price as stated on the Bid Form page(s). No charges other than verified hourly charges will be accepted for payment unless altered in writing by a change order.

Retainage may be released on a semi-annual basis following receipt of all required release documents. If the Director of L&I, through an administrative order, notifies the District that an amount is owed, the District must withhold that amount and release it to L&I for distribution.

12. Terminology

In the interpretation of these specifications and this contract or in any documents or instruments dealing with construction operations governed by these specifications, the following words and terms or pronouns in place of them shall be construed respectively, as follows:

Contracting Officer – The Manager of the District or an authorized representative.

Contractor – The person, firm, co-partnership, or corporation, and his/her, their, or its heirs, executor, administrator, successors and assigns, or the lawful agent of any such person, firm, partnership, or corporation, and his/her, their, or its surety under the contract bond, constituting one of the principals to the contract and undertaking to perform the work herein specified. Whenever any pronoun is used as referring to the word "Contractor," it shall mean the Contractor above defined.

District, PUD 1, Owner – Mason County Public Utility District No. 1 or Mason County PUD 1.

Property Owner – The owner of any real property adjacent to rights-of-way which may be affected by the Work, or whose property may be used for storing equipment of Bidder with the Property Owner's express permission.

SITE CONDITIONS AND COORDINATION

1. Examination of Site

Bidders shall make a complete examination of the site or general area so that all contracting hazards may be evaluated, and every condition relative to the work shall be considered. Failure to do so shall not relieve the Contractor from any provisions of the contract. Submission of a bid shall be considered as prima facie evidence that such examination has been made by the Bidder.

2. Rights-of-Way and Accessibility of Site(s)

All right-of-way has been provided by the District. The basic right-of-way for maintaining facilities is along county roads and transmission access roads or other properties designated by the District. It shall be the Contractor's responsibility to ensure coordination with the county road or state highway department and Property Owners to ensure their cooperation with regard to traffic rerouting, delays or stoppage.

Access to the rights-of-way will be from adjacent roads.

3. Existing Facilities

Existing known facilities consist of overhead and underground telephone, fiber optic, cable television, emergency fire and aid radio communications, natural gas pipelines, and water and sewer systems.

4. Outages

The Contractor will provide a minimum of two (2) weeks' notice to the District if a planned outage is required.

Planned outages are required whenever the outage will affect more than ten (10) District services (customers) or for any outage lasting for two (2) hours or more.

5. Use of Land for Storage, Offices, Etc.

Subject to the approval of the Contracting Officer, the Contractor will be allowed to utilize, for operation purposes other than camp sites, and for the life of this contract, any land or right-of-way that is the property of the District for its own use or for the use of other contractors and shall make all necessary arrangements with the Property Owner and shall pay all rentals or other costs connected therewith; provided, that such use shall not interfere with any parts of the work or with the work of other contractors or of the District in the vicinity; and provided further, that the District will assume no responsibility for damages or interference with the Contractor's use of such land due to any operations under the contract or otherwise.

6. Removed Material

All material and equipment, which are removed from service under this contract, shall remain the property of the District. The Contractor shall exercise due care during removal and handling to avoid damage. All material and equipment shall be returned to the District's warehouse or as directed by the Contracting Officer, in a manner and schedule determined by the Contracting Officer.

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7. Contractor will supply all materials to make necessary maintenance and emergency repairs of the fiber optic network

BID FORM

COMPANY NAME:

BID NUMBER: 2023-FIBER

PROJECT NAME: Broadband Maintenance, Repair and Related Services

DATE & TIME DUE:

In compliance with Mason County PUD No. 1's Invitation for Bids, Instructions to Bidders, Scope of Work, Site Conditions and Coordination, Agreement and General Conditions, and Supplemental Conditions, the undersigned hereby proposes and agrees to furnish all labor and supervision, material, tools and work equipment, except those materials and equipment specifically designated to be furnished by the Owner or by others, and perform the Work in strict accordance with the specifications designated and made a part of this Call for Bids for the bid amount as follows.

All bid pricing must state hourly pricing without sales tax.

Basic crew and equipment requirements for MAINTENANCI	E crew:	
1 each- Lineperson, 1 each- Grounds person 2 each- Flagger 1 each- Truck Driver 1 each- 36' Boom Truck 1 each- Pickup Truck		
Amount bid per hour	\$	
	Dollars and	Cents
Amount bid per hour for overtime, emergency storm, or any other after hours work required	/, \$	
	Dollars and	Cents
** Bid evaluation will be based on this Basic crew and equip	oment unit price. **	

1 each- Splice	er		
1 each- Fiber	Splicing Vehicle		
Amou	ınt bid per hour	\$	
		Dollars and	Cents
Amou storm	int bid per hour for overtime, emergency , or any other after hours work required	/, \$	
		Dollars and	Cents
evaluation wi	Il be based on this Basic crew and equip	oment unit price. **	
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evaluation wi crew and equ 1 each- Exca 1 each- Oper 1 each- Labo Amou Amou storm	II be based on this Basic crew and equip ipment requirements for UNDERGOUNE vator ator rer int bid per hour int bid per hour for overtime, emergency h, or any other after hours work required	<u>oment unit price. **</u> <u> O crew:</u> _ Dollars and /, \$	Cents

Bidder:_____

1 eac 1 eac	ch- Foreman ch- Pickup Truck		
	Amount bid per hour	\$	-
		Dollars and	Cents
	Amount bid per hour for overtime, storm, or any other after hours wo	emergency, rk required \$	_
		Dollars and	Cents
Additional C	rew Member Hourly Rates: Regular	Overtime	
Foreman	Rogala	ovortanio	
<u>Laborer</u>			
Sperator Flagger			
<u>Truck Driver</u> Fiber Splicer			
Equipment H	lourly Charges:		
	Regular	Overtime	
PICKUP I FUCK			
Splice Vehicle			
Excavator	-		
Vac Truck			
Fiber Splicing	Vehicle		

Bidder:

Bid Form – Page 4

LABOR RATE INCREASES

Labor base for this contract will be the prevailing wage statements or bargaining unit agreements, whichever is higher. If bidder's employees work under a bargaining unit agreement, state known increases in the table below and the effective dates.

Year 2024 Percentage increase	Effective Date
Year 2025 Percentage increase	Effective Date
Year 2026 Percentage increase	Effective Date

EQUIPMENT RATE INCREASES

State any equipment rate increases and effective dates.

Year 2024 Percentage increase	Effective Date
Year 2025 Percentage increase	Effective Date
Year 2026 Percentage increase	Effective Date

The District may require the use of one or more of the individuals or equipment listed above, or other individuals or equipment not listed. Please provide a list of rates (straight time and over time) for each classification of personnel or equipment that could be provided.

Additional Information Required:

Bid Bond / Certified Check Enclosed

Bidder's Data Enclosed (see item Instructions to Bidders, number 5)

It is understood that this quotation constitutes a firm offer, which cannot be withdrawn for sixty (60) calendar days after the date set for quotation opening.

The undersigned Bidder agrees, if awarded the Contract, to complete the Work of the Contract within the timeframe specified.

The Bidder acknowledges that it is in compliance with the bidder responsibility criteria described in the Instruction to Bidders. The Bidder agrees to provide proof of compliance with these requirements upon request by the Owner.

The undersigned certifies that the Bidder has examined and is familiar with document No_____; the Bidder is responsible for complying with the Agreement and General Conditions in their entirety; the Bidder has checked all the figures shown on this form and other attachments hereto; and understands that the Owner will not be responsible for any errors or omissions on the Bidder's part in making up quotation submitted.

Bidder:_____

All of the above work will be performed for the consideration of the sum designated, and the undersigned agrees, upon receipt of written notice of acceptance of this quotation, within ten (10) days to execute contract in accordance with the quotation as accepted and provide a public works contractor performance bond in the amount of One Hundred Thousand dollars (\$100,000.00).

Attached hereto and made a part hereof by this reference are the bidding schedule and drawings and data to be submitted with bid. There is enclosed herewith a Bid Bond or a Certified or Cashier's Check payable to the District in the amount of Twenty-Five Thousand dollars (\$25,000.00), which shall be and remain the property of the District in event of failure by the successful Bidder to execute the necessary contract and give the required bond within ten (10) calendar days after the form of agreement and bonds have been supplied, said failure will cause substantial injury to the District which is not easily reduced to monetary terms. It is therefore agreed that this sum is proper to be considered as liquidated damages for such injury.

Bidder:_____

BIDDER INFORMATION

Bidder's Business Name:			
Type of Business:			
□ Sole Proprietorship □ Partner	ship \Box Corporation (State of Inco	rporation:) □	Other
Physical Business Address:			
Mailing Address:			
City:	State:	Zip	Code:
Business Telephone Number:	Business Fax Number:	Business Email	Address:
City: Business Telephone Number:	State: Business Fax Number:	Zip Business Email	Code: Address:

State of Washington numbers for the following:

Contractor Registration No.:	UBI No.:		Employment Security Dept. No.:
Receipt is hereby acknowledged o	f Addenda No(s):	If none, so state	

Official Authorized to Sign for Bidder:

"I certify (or declare) under penalty of perjury under the laws of the sta foregoing is true and correct":	te of Washington that the
Signature:	Date:
Print Name and Title:	Location or Place Executed:

Please deliver your bid to:

By Courier Service or hand delivery:

Mason PUD 1 Attn: General Manager 29171 N. Hwy 101 Shelton, WA 98584

*Chapter 54.04.085 RCW requires that bid proposals be made on contract proposal forms supplied by the Utility, and in no other manner

Certification of Compliance with Wage Payment Statutes

The bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date (April 21, 2022), the bidder is not a "willful" violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

Bidder's Business Na	ame			
Signature of Authoriz	ed Officia	*		
Printed Name				
Title				
Date	City		State	
Check One:				
Sole Proprie	etorship	□Partnership		Joint Venture
□ Corporation		□Limited Liability Co	mpany	
State of Incorporation	, or if not	a corporation, State whe	ere business	entity was formed:
If a co-partnership, giv	ve firm na	me under which busines	s is transac	ted:

^{*} If a corporation, proposal must be executed in the corporate name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign). If a co-partnership, proposal must be executed by a partner.

SAMPLE AGREEMENT BETWEEN

OWNER AND CONTRACTOR

The Effective Date of this Contract is:	
The Parties to this Contract are:	
The "Owner"	Mason County Public Utility District No. 1
The "Contractor"	
Project Name:	Broadband Maintenance, Repair and Related Services
The "Architect" or "Engineer:"	N/A
The "Work:"	See "Scope of Work"
Alternates included in the Contract Sum:	
Contract Sum for the Work: (not including sales tax)	\$
Payments: (check one)	□ The Owner will make a single payment to the Contractor within thirty (30) days of Final Acceptance.
	See Supplemental Conditions
Date of Substantial Completion of the Work:	
Date of Final Completion of the Work:	10 days after Completion of Work Order
Liquidated Damages:	\$_0 per day for each calendar day beyond the Contract Time that Substantial Completion is not achieved.
Contractor's Permit Responsibilities:	All Permits as Required
Contractor's Permit Responsibilities: Unit Prices:	All Permits as Required
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u>	All Permits as Required
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u> Commercial General Liability:	All Permits as Required All least \$1 million per occurrence and general aggregate.
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u> Commercial General Liability: Automobile Liability:	All Permits as Required At least \$1 million per occurrence and general aggregate. At least \$1 million
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u> Commercial General Liability: Automobile Liability: Workers' Compensation (industrial insurance):	All Permits as Required At least \$1 million per occurrence and general aggregate. At least \$1 million At least the state statutory amount
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u> Commercial General Liability: Automobile Liability: Workers' Compensation (industrial insurance): Employer's Liability:	All Permits as Required At least \$1 million per occurrence and general aggregate. At least \$1 million At least the state statutory amount At least \$1 million
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u> Commercial General Liability: Automobile Liability: Workers' Compensation (industrial insurance): Employer's Liability: Aircraft Liability:	All Permits as Required All Permits as Required At least \$1 million per occurrence and general aggregate. At least \$1 million At least \$1 million At least the state statutory amount At least \$1 million N/A
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u> Commercial General Liability: Automobile Liability: Workers' Compensation (industrial insurance): Employer's Liability: Aircraft Liability: Watercraft Liability:	All Permits as Required All Permits as Required At least \$1 million per occurrence and general aggregate. At least \$1 million At least the state statutory amount At least the state statutory amount At least \$1 million N/A N/A
Contractor's Permit Responsibilities: Unit Prices: <u>Minimum Required Insurance:</u> Commercial General Liability: Automobile Liability: Workers' Compensation (industrial insurance): Employer's Liability: Aircraft Liability: Watercraft Liability: Property Insurance:	All Permits as Required All Permits as Required At least \$1 million per occurrence and general aggregate. At least \$1 million At least the state statutory amount At least \$1 million N/A N/A N/A
Contractor's Permit Responsibilities:Unit Prices:Minimum Required Insurance:Commercial General Liability:Automobile Liability:Automobile Liability:Workers' Compensation (industrial insurance):Employer's Liability:Aircraft Liability:Watercraft Liability:Property Insurance:Boiler and Machinery Insurance:	All Permits as Required At least \$1 million per occurrence and general aggregate. At least \$1 million At least \$1 million At least the state statutory amount At least \$1 million N/A N/A N/A

The Owner and Contractor agree as set forth below.

ARTICLE 1: THE WORK.

The Owner shall issue individual Work Orders for work to be accomplished under the Order. The Contractor shall fully execute and complete each Work Order issued as set forth in the Contract Documents, including the Alternates listed above.

ARTICLE 2: COMMENCEMENT AND SUBSTANTIAL AND FINAL COMPLETION.

2.1 The date of commencement of the Work Oder is the date of this set forth therein. The Contract Time is measured from the date of commencement to the date of Substantial Completion specified above, as it may be adjusted under the Contract Documents.

2.2 The Contractor shall achieve Substantial Completion and Final Completion of the entire Work within the dates specified above, subject to adjustments of the Contract Time as provided in the Contract Documents.

ARTICLE 3: THE CONTRACT SUM.

The Owner shall pay the Contractor the Work Order Sum for the Contractor's performance of each Work Order, subject to additions and deductions as provided in the Contract Documents. Sales tax is not included in the Contract Sum.

ARTICLE 4: PAYMENT.

The Owner will pay the Contractor within *thirty (30) days* of receipt of an approved Application for Payment in accordance with this Contract. Retainage will be released in accordance with statutory requirements.

ARTICLE 5: PERMITS AND FEES.

5.1 The Owner will secure and pay for only those governmental permits, approvals, fees, licenses, inspections, governmental charges and inspection fees listed on the cover page.

5.2 The Contractor shall secure and pay for all other governmental permits, approvals, fees, licenses, inspections, governmental charges and inspection fees required for the prosecution of the Work.

ARTICLE 6: ENUMERATION OF CONTRACT DOCUMENTS.

6.1 The Contract Documents form this Contract. This Contract represents the entire and integrated agreement between the parties and supersedes prior negotiations, representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor of any tier, between any Architect and the Contractor, or between any persons or entities other than the Owner and the Contractor.

6.2 The Contract Documents are enumerated as follows and, in the event of a conflict or discrepancy among or in the Contract Documents, interpretation shall be governed in the following order of priority:

- 1. Agreement
- **2.** Supplemental Conditions
- **3.** Prevailing wage rates set by L&I as of the bid date for Mason County (available at http://www.lni.wa.gov/TradesLicensing/PrevWage/WageRates/default.asp)
- 4. General Conditions
- 5. Scope of Work
- 6. Drawings and Specifications
- 7. Site Conditions and Coordination
- 8. ____

OWNER: Mason County PUD No. 1

CONTRACTOR:

By _____ (Signature) By _____ (Signature)

(Printed name and title)

(Printed name and title)

GENERAL CONDITIONS

ARTICLE 7 THE CONTRACT DOCUMENTS

7.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contractor's performance shall be consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

7.2 "Work" means the construction and services required Work Order and includes all labor, materials, equipment and services to be provided by the Contractor to fulfill its obligations.

7.3 If the Contractor finds a conflict, error or discrepancy in the Contract Documents, the Contractor shall report it to the Owner in writing at once. The Contractor shall not proceed with the affected Work until it receives a written interpretation or clarification from the Owner.

ARTICLE 8 ADMINISTRATION OF THE CONTRACT

8.1 The Owner will provide administration of the Contract. If an Architect or Engineer is also involved, its duties beyond those addressed in these General Conditions will be described in an attachment to this Contract.

8.2 Authority. The Owner must approve in writing all Work Orders and changes in the Work Order Sum or Work Order Time as well as all Change Orders, Construction Change Directives, and payments to the Contractor. The Owner will make any modification or release of any requirement of the Contract Documents, or any approval or acceptance of any portion of the Work, whether or not executed in accordance with the Contract Documents, exclusively in writing.

8.3 Rejection of Work. The Owner may reject Work that, in its opinion, does not conform to the Work Order. If the Contractor fails to correct Work that is not in accordance with the Contract Documents or fails to carry out the Work in accordance with the Contract Documents, the Owner may order the Contractor in writing to stop the Work, or any portion thereof, until the cause for that order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right.

8.4 Site Access. The Owner shall have access to and may visit the Work site at intervals it considers appropriate to the stage of the Work to become generally familiar with the progress and quality of the completed Work, but the Owner will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.

8.5 Submittals. The Contractor shall review, approve and submit to the Owner with reasonable promptness shop drawings, product data, samples and similar submittals required by the Contract Documents. The Owner will review and approve or take other appropriate action upon the Contractor's submittals for the limited purpose of checking for conformance with information given and the design concept expressed by the Contract Documents. The Work shall be in accordance with approved submittals. The Owner's review and approval does not relieve the Contractor of responsibility for compliance with the Contract Documents. The Contractor shall submit to the Owner any proposed change to or deviation from previously approved documents or submittals.

ARTICLE 9 THE CONTRACTOR

9.1 Using its best skill and attention, the Contractor shall perform, supervise and direct the Work. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, procedures and personnel, for safety, and for coordinating all portions of the Work under this Contract. The Contractor shall provide and pay for all labor, materials, equipment, tools and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

9.2 Subcontractors. A "Subcontractor" is a person or entity that has a direct contract with the Contractor to perform a portion of the Work at the site or to supply materials or equipment. A "Subcontractor of any tier" includes Subcontractors and lower-level subcontractors and suppliers.

9.2.1 <u>Identification</u>. As soon as practicable and no later than *fourteen (14) days* after award of this Contract, the Contractor shall confirm to the Owner in writing the names of the Subcontractors for each portion of the Work.

9.2.2 <u>Subcontracts.</u> Contracts between the Contractor and Subcontractors shall require each Subcontractor to be bound to the Contractor by the terms of the Contract Documents for the Work to

be performed by the Subcontractor and to assume toward the Contractor all the obligations and responsibilities that the Contractor, by the Contract Documents, assumes toward the Owner.

9.2.3 Payment. The Contractor shall promptly pay (and secure the discharge of any liens asserted by) all persons properly furnishing labor, equipment, materials or other items in connection with the performance of the Work for which the Owner has paid (including, but not limited to, workers and Subcontractors). The Contractor shall furnish to the Owner releases of liens and claims and other documents that the Owner requests from time to time to evidence such payment (and discharge). Nothing in the Contractor of any tier or other person or entity, except as may otherwise be required by law or regulation.

9.3 Workers. The Contractor shall enforce strict discipline and good order among persons carrying out the Work and shall not permit employment of unfit persons or persons not skilled in tasks assigned to them. At no change to the Contract Sum or Contract Time, the Owner may provide written notice requiring the Contractor to remove from the Work any employee or other person carrying out the Work that the Owner considers objectionable.

9.4 Warranty. The Contractor warrants that materials and equipment furnished under this Contract will be of good quality and new, that the Work will be performed in a workmanlike manner, free from defects not inherent in the quality required, and that the Work will conform with the requirements of the Contract Documents.

9.5 Progress Schedule. Within *fourteen (14) days* of execution of this Contract, the Contractor shall submit a schedule of the Work to the Owner ("Progress Schedule"). The Contractor will be responsible for planning, scheduling, managing, and reporting the progress of the Work in accordance with all of the specific methods and submittals described in the Contract Documents. The Contractor shall use the Progress Schedule (as updated) to plan, coordinate, and prosecute the Work in an orderly and expeditious manner.

9.6 Clean-Up. The Contractor shall keep the site and surrounding area free from accumulation of waste materials caused by operations under the Contract.

9.7 Indemnification.

9.7.1 Subject to the following conditions and to the fullest extent permitted by law, the Contractor shall defend, indemnify and hold harmless the Owner and its agents, employees, consultants, successors and assigns (together, the "Indemnified Parties") from and against all claims, damages, losses and expenses, direct and indirect, or consequential, including but not limited to costs, attorneys' fees, and other litigation expenses incurred on such claims and in proving the right to indemnification, arising out of or resulting from the performance of the Work by or any act or omission of the Contractor, its agents, any Subcontractor of any tier, and anyone directly or indirectly employed by them (together, the "Indemnitor").

.1 The Contractor will fully indemnify and defend the Indemnified Parties for the sole negligence of the Indemnitor.

.2 The Contractor will indemnify and defend the Indemnified Parties for the concurrent negligence of the Indemnitor only to the extent of the Indemnitor's negligence. The Contractor agrees to being added by the Owner as a party to any mediation, arbitration or litigation with third parties in which the Owner alleges indemnification or contribution from the Indemnitor. The Contractor agrees that all of its Subcontractors of any tier will similarly stipulate in their subcontracts. To the extent a court or arbitrator strikes any portion of this indemnification provision for any reason, all remaining provisions shall retain their vitality and effect.

9.7.2 After mutual negotiation of the parties, the indemnification obligation shall not be limited by the amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts in claims by an employee of the Contractor or a Subcontractor of any tier against any person or entity indemnified under this Paragraph 9.7. For the sole purpose of effecting the indemnification obligations under this Contract and not for the benefit of any third parties unrelated to the Owner, the Contractor specifically and expressly waives any immunity that may be granted it under Title 51 RCW, "Industrial Insurance." IF THE CONTRACTOR DOES NOT AGREE WITH THIS WAIVER, IT MUST PROVIDE A WRITTEN NOTICE TO THE OWNER PRIOR TO THE DATE FOR THE RECEIPT OF BIDS, OR THE CONTRACTOR WILL BE DEEMED TO HAVE NEGOTIATED AND WAIVED THIS IMMUNITY.

9.8 Records. The Contractor shall maintain and preserve books, ledgers, records, estimates, correspondence, logs, schedules, electronic data and other documents relating or pertaining to the costs and/or performance of the Contract ("records"). Within *seven (7) days* of the Owner's request, the Contractor shall make available at the Contractor's office all records for inspection, audit and reproduction (including electronic reproduction) by the Owner's representatives. These requirements apply to each

Subcontractor of any tier. The Contractor agrees, on behalf of itself and Subcontractors of any tier, that the invocation of any rights under RCW 42.56 shall initiate an equivalent right to disclosures from the Contractor and Subcontractors of any tier for the benefit of the Owner.

9.9 Compliance with Law. The Contractor, its employees, Subcontractors of any tier and representatives, shall comply with all applicable laws, ordinances, statutes, rules and regulations, federal and state, county and municipal.

9.9.1 <u>Prevailing Wages.</u> The Contractor shall comply with all applicable provisions of RCW 39.12, including but not limited to submission of approved "Statements of Intent to Pay Prevailing Wage," payment of all Labor & Industries' fees, submission and posting of approved "Statements of Intent to Pay Prevailing Wages" and payment of prevailing wages. The state of Washington prevailing wage rates applicable for this public works project, which is located in Mason County, may be found at the following website address of the L&I: <u>http://www.lni.wa.gov/TradesLicensing/PrevWage/WageRates/default.asp</u>. The Contractor shall keep a paper copy at the Project site.

9.9.2 <u>Hours of Labor</u>. The Contractor shall comply with all applicable provisions of RCW 49.28.

9.9.3 <u>Worker's Right to Know.</u> The Contractor shall comply with RCW 49.70 and WAC 296-62-054 regarding workplace surveys and material safety data sheets for "hazardous" chemicals at the Project site.

ARTICLE 10 CONSTRUCTION BY THE OWNER OR BY SEPARATE CONTRACTORS

10.1 The Owner may perform construction or operations related to the Project with its own forces and may award separate contracts in connection with other portions of the Project or other construction or operations on the site under contractual conditions consistent with those of the Contract Documents.

10.2 The Contractor shall afford the Owner and separate contractors' reasonable opportunity for the introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations.

ARTICLE 11 CHANGES IN THE WORK

11.1 The Owner, without invalidating this Contract, may order changes in the Work consisting of additions, deletions or modifications ("Changes"), and the Work Order Sum and Work Order Time will be adjusted accordingly. Changes in a Work Order, in the Contract Sum and/or in the Contract Time shall be authorized only by written Change Order signed by the Owner and the Contractor or by written Construction Change Directive signed by the Owner.

11.1.1 <u>Change Orders</u>. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement upon a change in the Work, the amount of any adjustment in the Contract Sum, and the extent of any adjustment in the Contract Time.

11.1.2 <u>Construction Change Directives</u>. A Construction Change Directive is a written order prepared and signed by the Owner that directs a change in the Work Order and states a proposed basis for any adjustment in the Work Order Sum and/or Work Order Time. It is used in the absence of total agreement on the terms of a Change Order. The Contractor shall promptly proceed with the change in the Work described in the Construction Change Directive. As soon as possible, and within *seven (7) days* of receipt, the Contractor shall advise the Owner in writing of the Contractor's agreement or disagreement with the cost or the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

11.2 Costs of Changes and Claims. If the parties cannot agree on the cost or credit to the Owner from a Construction Change Directive or other Change in the Work, the Contractor and all affected Subcontractors of any tier shall keep and present an itemized accounting with supporting data. The total cost of any Change or Claim shall be limited to the reasonable value of the direct labor costs, material costs, construction equipment usage costs for the actual time equipment appropriate for the Work is used solely on the Change in the Work, the cost of any change in insurance, Subcontractor costs, and a fee for all combined overhead and profit, including impact costs of any kind, limited to twelve percent (12%) of the cost for any materials or work performed by the forces of the Contractor or a Subcontractor and eight percent (8%) of amounts due to Subcontractors.

11.3 Claims for Concealed or Unknown Conditions. If conditions are encountered at the site that are (1) concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found and generally recognized as inherent in activities of the character provided for in the Contract Documents, then the Contractor shall give written notice to the Owner promptly before conditions are disturbed and in no event later than *seven (7) days* after the first observance of the

conditions. The Contractor shall make any Claim arising from such condition in accordance with the dispute resolution procedures of Article 19.

ARTICLE 12 TIME

12.1 Delay.

12.1.1 <u>Time</u>. If the Work is delayed by changes ordered in the Work, unanticipated general labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions not reasonably anticipatable, unavoidable casualties or any other causes beyond the Contractor's control, then the Contract Time shall be extended by Change Order to the extent the critical path is affected.

12.1.2 <u>Damages.</u> The Contractor and Subcontractors shall be entitled to damages for delay only where the Owner's actions or inactions were the actual, substantial cause of the delay and where the Contractor could not have reasonably avoided the delay by the exercise of due diligence.

12.1.3 <u>Contractor Delay</u>. If a delay was caused by the Contractor, a Subcontractor of any tier, or anyone acting on behalf of any of them, the Contractor is not entitled to an increase in the Contract Time or in the Contract Sum.

12.2 Completion and Liquidated Damages. The timely completion of the Project is essential to the Owner. The Owner will incur serious and substantial damages if Substantial Completion of the Work does not occur within the Contract Time. The Contractor is responsible for actual damages for delay unless an amount is inserted on the cover page for liquidated damages, in which case the liquidated damage amount shall apply. Liquidated damages shall not be affected by partial completion, occupancy, or beneficial occupancy.

ARTICLE 13 PAYMENTS AND COMPLETION

13.1 Payments. Payment shall be made as provided in this Contract, including any Supplemental Conditions.

13.2 Withheld Payment. The Owner may withhold payment in whole or in part, or it may nullify the whole or part of a payment previously issued, on account of (1) defective Work not remedied, (2) claims or liens filed by third parties, (3) failure of the Contractor to make payments due to Subcontractors or for labor, materials or equipment, (4) damage to the Owner or another contractor, (5) reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum, (6) reasonable evidence that the unpaid balance would not be adequate to cover actual or liquidated damages for delay for which the Contractor is responsible, (7) failure to carry out the Work in accordance with the Contract Documents, or (8) liquidated damages. The Owner will provide the Contractor with written notice of its intent to implement this provision and provide details supporting the Owner's intention. The Contractor will be afforded reasonable time following receipt of such notice to respond to or correct the circumstances provoking this action by the Owner.

13.3 Substantial Completion.

13.3.1 Substantial Completion is the stage in the progress of the Work when the construction is sufficiently complete, in accordance with the Work Orders, so the Owner can fully utilize the Work (or a designated portion) for its intended use. All Work other than incidental corrective or punch list work and final cleaning shall have been completed. The Work is not Substantially Complete if all systems and parts affected by the Work are not usable, any required occupancy or use permit has not been issued, or if utilities affected by the Work are not connected and operating normally. The fact that the Owner may use or occupy some or all of the Work does not indicate that the Work is Substantially Complete, nor does it toll or change any liquidated damages due the Owner.

13.3.2 When the Contractor believes that the Work has achieved Substantial Completion, it shall notify the Owner in writing. When the Owner agrees, it will issue a Certificate of Substantial Completion.

13.3.3 Immediately before any occupancy, the Owner will schedule an inspection tour of the area to be occupied. Representatives of the Owner and the Contractor will jointly tour the area and record items still remaining to be finished and/or corrected. The Contractor shall promptly supply and install any such items as well as items missed by the inspection but required or necessary for Final Completion as a part of the Contract Sum.

13.4 Final Completion. After the Contractor has notified the Owner that the Work has been concluded, and the Contractor has submitted the items listed below as may be required at the discretion of the Owner, the Owner will determine in writing that Final Completion has occurred.

13.4.1 A final Application for Payment.

13.4.2 An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or its property might in any way be responsible or encumbered, have been paid or otherwise satisfied.

13.4.3 Consent of surety to final payment.

13.4.4 A certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be cancelled or allowed to expire until at least thirty (30) days' prior written notice has been given to the Owner.

13.4.5 A written statement that the Contractor knows of no substantial reason why the insurance will not be renewable to cover the period required by the Contract Documents.

13.4.6 Other data establishing payment or satisfaction of or protection (satisfactory to the Owner) against all obligations, such as receipts, releases and waivers of liens and claims.

13.4.7 Pursuant to RCW 39.12.040, an "Affidavit of Wages Paid" from the Contractor and from each Subcontractor certified by the Industrial Statistician of the Department of Labor and Industries, with the fees paid by the Contractor or Subcontractor.

13.4.8 A certified statement that the Contractor has closed all necessary permits or otherwise met the requirements of all governing jurisdictions related to this Project.

13.4.9 Pursuant to RCW 60.28, certificates from the Department of Revenue and the Department of Labor and Industries.

13.4.10 Pursuant to RCW 50.24, a certificate from the Department of Employment Security.

13.4.11 All deliverables required by the Contract Documents.

13.4.12 A certification that the materials in the Work are "lead-free" and "asbestos free."

13.4.13 A legible hard copy of the as-built drawings.

13.5 Final Acceptance and Final Payment.

13.5.1 Pursuant to RCW 60.28, completion of the contract Work shall occur after Final Completion has been achieved and the Owner has formally accepted the Project ("Final Acceptance"). Final Payment shall not become due until after Final Acceptance.

13.5.2 If any Subcontractor of any tier refuses to furnish a release or waiver required by the Owner, the Owner may retain an amount to defray the cost of foreclosing the liens of such claims and to pay attorneys' fees, the total of which shall be no less than one hundred fifty percent (150%) of the claimed amount. If any such lien remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

13.6 Waivers.

13.6.1 <u>Final Payment by the Owner</u>. The making of final payment constitutes a waiver of claims by the Owner except those arising from (1) liens, claims, security interests, or encumbrances arising out of the Contract and unsettled; (2) failure of the Work to comply with the requirements of the Contract Documents; (3) Work subsequently found to be substandard and/or deficient; or (4) terms of warranties required by the Contract Documents or law.

13.6.2 <u>Final Payment to the Contractor</u>. Acceptance of final payment by the Contractor constitutes a waiver of Claims except those previously made in writing and specifically identified as unsettled on the final Application for Payment.

13.6.3 <u>Change Orders.</u> The execution of a Change Order constitutes a waiver of Claims by the Contractor arising out of the Work to be performed or deleted pursuant to the Change Order, except as specifically described in the Change Order.

13.6.4 <u>Reservation of Rights.</u> If the Contractor adds to a Change Order, a Construction Change Directive, or any other document a reservation of rights that has not been initialed by the Owner, any amounts previously agreed shall be considered disputed and not yet payable unless the costs are renegotiated or the reservation is withdrawn or changed in a manner satisfactory to and initialed by the Owner.

13.6.5 <u>Failure to Exercise</u>. The Owner's failure to exercise any of its rights under this Contract shall not constitute a waiver of any past, present or future right or remedy. Any waiver by the Owner of any right or remedy under this Contract must be in writing and shall apply only to the right or remedy specified.

13.7 Warranty of Title. The Contractor warrants and guarantees that title to the Work, materials and equipment covered by an Application for Payment, whether or not incorporated in the Project, will pass to the Owner no later than the time of payment, free and clear of liens.

ARTICLE 14 PROTECTION OF PERSONS AND PROPERTY

14.1 The Contractor shall be solely responsible, and the Owner shall not have responsibility, for all aspects of safety related to this Contract or the Work, including initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take reasonable precautions for the safety of, and shall provide reasonable protection to prevent damage, injury or loss to, persons or property.

14.2 The Contractor shall promptly remedy to the Owner's satisfaction damage or loss to property at the site caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, except for damage or loss attributable to acts or omissions of the Owner or by anyone for whose acts the Owner may be liable that are not attributable to the fault or negligence of the Contractor or a Subcontractor of any tier.

14.3 The Contractor shall not be required to perform without consent any Work relating to asbestos or polychlorinated biphenyl, unless identified as such in the Contract Documents.

ARTICLE 15 INSURANCE AND BONDS

15.1 The Contractor shall, at its own cost, purchase from a company or companies authorized to do business in the state of Washington possessing a Best's policyholder's rating of A- or better and a financial rating of no less than VII, and reasonably acceptable to the Owner, and maintain during the life of this Contract, at least the following insurance. The Contractor shall also cause its Subcontractors of any tier to secure and maintain at least the following insurance. The insurance shall be in force at the time the Work is commenced and shall remain in force until Substantial Completion, unless a later date is specified below.

15.1.1 <u>Contractor's Liability Insurance</u>. The Contractor shall purchase and maintain an occurrence-based Commercial General Liability Insurance Policy and such other insurance as will provide protection from claims set forth below which may arise out of or result from Contractor's operations under the Contract Documents, whether to be performed or furnished by Contractor, by any Subcontractor, by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

.1 Claims under workers' compensation, disability benefits and other similar employee benefit acts, as required by the laws of the state of Washington, including Contingent Employers Liability (Stop Gap) for all employees of the Contractor and Subcontractors;

.2 If there is an exposure for injury to Contractor's or Subcontractor's employees under the United States Longshoremen's and Harbor Workers' Compensation Act, the Jones Act or under laws, regulations or statutes applicable to maritime employees, or any similar laws, regulations or statutes, coverage shall be included for such injuries or claims.

.3 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees and of any person other than the Contractor's employees;

.4 Claims for damages insured by personal injury liability coverage that are sustained (a) by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or (b) by any other person for any other reason.

.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom;

.6 Claims arising out of operation of laws or regulations for damages because of bodily injury or death of any person or for damage to property;

.7 Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle, including coverage for Owned Motor Vehicles, Non Owned Motor Vehicles and Hired or Borrowed Motor Vehicles; and

.8 The comprehensive general liability insurance required by this paragraph must include contractual liability insurance applicable to Contractor's obligations under Paragraph 9.7.

15.2 The Owner's specification or approval of insurance in this Contract or of its amount shall not relieve, limit or decrease the liability of the Contractor under the Contract Documents or otherwise. Coverages are the minimum to be provided and are not limitations of liability under the Contract, indemnification, or applicable law provisions. The Contractor may, at its expense, purchase larger coverage amounts or additional insurance.

15.3 Bonding Requirements

15.3.1 The Contractor is to provide a good and sufficient payment and performance bond acceptable to the District and in accordance with the provisions of Chapter 39 RCW, and payable to the District in an amount of not less than one hundred percent (100%) of the total contract value, if with a surety company as surety, conditioned that such person or persons shall faithfully perform all provision of such contract and pay all laborers, mechanics, and s and material suppliers, and all persons who supply such person or persons, or Subcontractors, with provisions and supplies for the carrying on of such work, and any person or persons performing such services or furnishing material to any Subcontractor shall have the same right under the provisions of such bond as if such work, services or material was furnished to the original Contractor. A sample performance bond is attached.

15.3.2 On contracts of one hundred fifty thousand dollars (\$150,000) or less, at the option of the Contractor the respective public entity may, in lieu of the bond, retain ten percent (10%) of the contract amount for a period of forty-five (45) days after date of final acceptance, or until receipt of all necessary releases from the Department of Revenue and the Department of Labor and Industries and settlement of any liens, including any related attorney's fees, filed under RCW 60.28, whichever is later; provided further, that for contracts of one hundred fifty thousand dollars (\$150,000) or less, the public entity may accept a full payment and performance bond from an individual surety or sureties: and provided further, that the surety must agree to be bound by the laws of the state of Washington and subjected to the jurisdiction of the state of Washington.

15.3.3 Chapter 60.28 RCW requires the District to retain a percentage of the contract funds in a District account or in an interest-bearing escrow account. The chapter also requires the District to withhold an amount sufficient to pay any unpaid claims, taxes, and costs as well as attorney fees incurred in closing the lien. If the Director of the Department of Labor and Industries, through an administrative order, notifies the District that an amount is owed, the District must withhold that amount and release it to the Department for distribution.

15.4 Waiver of Rights

15.4.1 The Owner and Contractor waive all rights against each other for losses and damages caused by any of the perils covered by the policies of insurance provided in response to Paragraphs 15.1.2 and 15.1.3 and any other property insurance applicable to the Work, and also waive such rights against the Subcontractors, Architect, consultants and other parties named as insureds in such policies for losses and damages so caused. Each subcontract between the Contractor and a Subcontractor will contain similar waiver provisions by the Subcontractor in favor of the Owner, Contractor, Architect, consultants and all other parties named as insureds. None of these waivers shall extend to the rights that any of the insured parties may have to the proceeds of insurance held by the Owner as Trustee or otherwise payable under any policy so issued.

15.4.2 The Owner and Contractor intend that any policies provided in response to Paragraphs 15.1.2 and 15.1.3 shall protect the parties insured and provide primary coverage for losses and damages caused by the perils covered thereby. Accordingly, such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any of the parties named as insureds or additional insureds, and if the insurers require separate waiver forms to be signed by the Architect or its consultant, the Owner will obtain the same, and if such waiver forms are required of any Subcontractor, the Contractor will obtain the same.

15.5 Any insured loss under the policies of insurance required by Paragraphs 15.1.2 and 15.1.3 will be adjusted with the Owner and made payable to the Owner as Trustee for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause. The Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Contract Modification or Written Amendment, or be a separate contract, at the Owner's option.

15.6 Endorsements.

15.6.1 The Owner, its officer and employees shall be named as a primary, non-contributing additional insured and coverage shall apply on a primary and non-contributory basis on such policies other than Workers' Compensation. Additional insured status shall be evidenced by internal policy provision or by separate external endorsement. Policies shall contain a provision that the Owner shall be given *thirty (30) days'* written notice by certified mail before cancellation of any insurance or reduction of the amount thereof, or any alteration, modification, restriction or material change thereto. No such cancellation, reduction, alteration, modification, restriction or material change in any policy shall relieve the Contractor of its obligation to maintain coverages in accordance with the Contract Documents.

15.6.2 All insurance policies to be maintained by the Contractor shall provide for Waiver of Subrogation in favor of the Owner.

15.6.3 All insurance policies, except Workers' Compensation, to be maintained by the Contractor shall provide Severability of Interests or Cross Liability Clause and provide that the insurance shall be primary and not excess to or contributing with any insurance or self-insurance maintained by the Owner.

15.7 Certificates evidencing that satisfactory coverage of the type and limits set forth in the Contract Documents shall be furnished to the Owner in a form acceptable to the Owner and shall contain provisions consistent with Paragraph 15.6.

15.8 Irrespective of the requirements of the Contract Documents as to insurance to be carried by the Contractor, insolvency, bankruptcy or failure of any insurance company to pay all claims accruing, shall not be held to relieve the Contractor of any of its obligations.

15.9 The Contractor shall defend, indemnify and hold the Owner harmless from any failure of the Contractor or its Subcontractors of any tier to secure and maintain insurance as required by this Contract.

ARTICLE 16 CORRECTION OF WORK

16.1 The Contractor shall promptly correct Work rejected or failing to conform to the requirements of the Work Order at any time through a period of *one (1) year* from the date of Substantial Completion of the Work Order or by terms of a longer manufacturer's warranty or an applicable special warranty required by the Contract Documents.

16.2 If the Contractor fails to carry out or correct Work that is not in accordance with the Work Order, the Owner may, by written order, require the Contractor to stop the Work or any portions thereof until the cause for the order has been eliminated, and the Owner may take over and correct some or all of the non- conforming Work at the Contractor's cost.

16.3 Nothing in this Article shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents.

ARTICLE 17 MISCELLANEOUS PROVISIONS

17.1 Applicable Law. This Contract shall be governed by the internal law of the state of Washington, without regard to its choice-of-law provisions.

17.2 Compliance with Law. The Contractor shall give notices and comply with applicable laws, rules, regulations and orders of public authorities, including but not limited to RCW 39.06 and RCW 18.27 (Registration), RCW 49.60 (Discrimination), RCW 70.92 (Aged and Handicapped Persons), WAC 296-155 (Safety Standards), RCW 50.24 (Unemployment Compensation), RCW 51 (Industrial Insurance); RCW 82 (State Excise Tax Registration), RCW 39.12.065(3) (prevailing wage violations), Drug-Free Workplace Act of 1988 (Drug-Free Workplace) and RCW 49.26 (any asbestos removal).

17.3 Assignment. The Contractor shall not let, assign or transfer this Contract, or any interest in it or part of it, without the written consent of the Owner.

17.4 The Owner's Site Rules. The Contractor shall comply with the Owner's site and conduct rules.

17.5 Survival of Clauses. The warranty, dispute resolution, and indemnification provisions of this Contract shall survive the termination, cancellation or expiration of this Contract.

17.6 Writing Required. No addition to or modification of this Contract or waiver of any provisions of this Contract shall be binding on either Party unless explicitly made in writing and executed by the Contractor and the Owner.

ARTICLE 18 TERMINATION OF THE CONTRACT

18.1 Termination for Cause by the Contractor. If the Owner fails to make payment of undisputed amounts for a period of *sixty (60) days* through no fault of the Contractor, the Contractor may, upon *seven (7) additional days'* written notice (during which time the Owner has the right to cure), terminate the Contract and recover from the Owner payment for all Work executed in accordance with the Contract Documents.

18.2 Termination for Cause by the Owner. The Owner may, upon *seven (7) days'* written notice to the Contractor, terminate without prejudice the whole or any portion of the Work for cause, including but not limited to the Contractor's material breach of this Contract; failure to prosecute the Work or any portion thereof with sufficient diligence to ensure the Substantial Completion of the Work within the Contract Time; failure to supply a sufficient number of properly skilled workers or proper materials; material disregard of laws, ordinances, rules, regulations or orders of any public authority having jurisdiction; or being adjudged bankrupt, making a general assignment for the benefit of its creditors, or having a receiver appointed on account of the Contractor's insolvency.

18.3 Termination for Convenience by the Owner. The Owner may, at any time upon seven (7) days' written notice to the Contractor, terminate (without prejudice to any right or remedy of the Owner) the whole or any portion of the Work for the convenience of the Owner. The Owner shall be liable to Contractor only for the amount reasonably incurred to date and due under Article 13 for the performance of the Work terminated and other pre-approved costs, consistent with the Paragraph 11.2, necessary and reasonably incurred in connection with the termination of the Work.

18.4 Effects of Termination.

18.4.1 The total sum to be paid to the Contractor under this Article 18 shall not exceed the Contract Sum as reduced by the amount of payments otherwise made.

18.4.2 Unless the Owner directs otherwise, after receipt of a notice of termination by the Owner, the Contractor shall promptly stop Work as specified in the notice of termination; place no further orders or subcontracts, except as necessary for completion of non-terminated Work; procure cancellation of all orders and subcontracts to the extent related to the performance of terminated Work; assign to the Owner all of the right, title and interest of the Contractor under all orders and subcontracts; with the Owner's approval, settle outstanding liabilities and claims arising out of such termination of orders and subcontracts not assigned to the Owner; transfer title and deliver to the entity or entities designated by the Owner the fabricated or unfabricated parts, Work in process, partially completed supplies and equipment, materials, parts, tools, dies, jigs and other fixtures, completed Work, supplies and other material produced as part of, or acquired in connection with the performance of, the Work terminated, and the completed or partially completed plans, drawings, information and other property related to the Work; take such action as may be necessary or as directed by the Owner to preserve and protect the Work and property related to the Project in the possession of the Contractor in which the Owner has an interest; and continue performance only to the extent not terminated.

18.5 Suspension. The Owner may, at its option and at any time, suspend the Contractor's performance of some or all of the Work. The Owner will give the Contractor notice of any such suspension, including the scope of the suspension and the Owner's estimate of the duration of such suspension. During the period of suspension, the Contractor shall use its best efforts to minimize costs associated with such suspension and to protect and maintain the Work. As full compensation for any such suspension, the Contractor will be eligible for an equitable adjustment, which shall not include consequential or indirect damages. Upon receipt of the Owner's notice to resume the suspended performance, the Contractor shall immediately resume performance to the extent required in the notice.

ARTICLE 19 DISPUTE RESOLUTION

19.1 All claims, disputes and other matters in question of the Contractor, direct or indirect, arising out of, or relating to, the Contract Documents or the breach thereof ("Claims") shall be decided exclusively by the following dispute resolution procedure. Failure to comply with the requirements of this Article 19 shall constitute waiver of the Claim.

19.2 Notice of Claim. The Contractor shall submit notice of all Claims to the Owner in writing within seven (7) days of the event giving rise to them and shall include a reasonable description of the event and its probable effect.

19.3 Claim Submission. Within *thirty (30) days* of the effective date of submitting the notice in Paragraph 19.2, the Contractor shall provide the Owner with a written Claim that includes a clear description of the Claim, all changes in cost and in time (direct, indirect, impact, consequential, and otherwise) to which the Contractor and Subcontractors of any tier are entitled, and data supporting the Claim. No act, omission, or knowledge, actual or constructive, of the Owner or any Architect shall in any way be deemed to be a waiver of the requirement for a timely written notice and a timely written Claim unless the Owner and the Contractor sign an explicit, unequivocal written waiver.

19.4 Effective Date. Unless otherwise specified in the Contract Documents, the effective date of any notice or request given in connection with this Contract shall be the date on which it is delivered to the Owner.

19.5 Informal Resolution. The Owner will make a determination of the Claim submitted. If the Contractor disagrees with the determination and wishes to pursue the Claim further, the Contractor must, within *fourteen (14) days* of receipt of the determination, provide the Owner with a written request that a representative of the Contractor, any Architect, and the Owner meet, confer, and attempt to resolve the claim. This meeting will then take place at mutually convenient time and place within *fourteen (14) days* of the Contractor.

19.6 Mediation. The Contractor may not bring any litigation against the Owner unless the Claim is first subject to mediation under the Construction Industry Mediation Procedures of the American Arbitration Association ("AAA"). This requirement cannot be waived except by an explicit written waiver signed by the Owner and the Contractor. To initiate the mediation process, the Contractor shall submit a written mediation request to the Owner within thirty (30) days after the meeting undertaken in Paragraph 19.5. If the parties are unable to agree to a mediator within *thirty (30) days* after the Owner's receipt of the written request for mediation, either party may submit a request for mediation to the AAA. An officer of the Contractor and the General Manager or designee of the Owner, both having full authority to settle the Claim, must attend the mediation session. To the extent there are other parties in interest, such as Subcontractors and insurers, their representatives, with full authority to settle the Claim, shall also attend the mediation session. All unresolved Claims in the Project shall be considered at a single mediation session that shall occur prior to Final Acceptance by Owner.

19.7 Litigation. The provisions of Paragraphs 19.1, 19.2, 19.5, and 19.6 are each a condition precedent to the Contractor bringing litigation. All unresolved Claims of the Contractor shall be waived and released unless the Contractor has strictly complied with the time limits of the Contract Documents, and litigation is served and filed within *120 days* after the Date of Substantial Completion as designated in writing by the Owner. This requirement cannot be waived except by an explicit written waiver signed by the Owner and the Contractor. The pendency of mediation shall toll this filing requirement.

19.8 Maintenance of Responsibilities. The parties shall diligently carry on their respective obligations and responsibilities and maintain the Progress Schedule during any dispute resolution proceedings, unless otherwise agreed by both parties in writing.

19.9 Waiver. The requirements of this Article 19 cannot be waived except by an explicit written waiver signed by the Owner and the Contractor. The fact that the Owner and the Contractor may continue to discuss or negotiate a Claim that has or may have been defective or untimely under the Contract Documents shall not constitute waiver of the provisions of the Contract Documents unless the Owner and Contractor sign an explicit, unequivocal written waiver approved by the Owner's Board of Commissioners.

SUPPLEMENTAL CONDITIONS

1. The District may consider partial payments as set forth below. The Contracting Officer will be the final arbiter as to the amount of work completed for release of any payments.

2. **Progress Payments.** If approved, progress payments shall be for each Work Order that is duly approved and performed.

2.1 <u>Payment Request.</u> The Contractor may submit a payment request for Work performed during the prior period. The request shall constitute the Contractor's representation that (1) all payments due Subcontractors from the Owner's prior payments have been made and (2) the Work has been completed to the extent billed. If the Contractor believes it is entitled to payment for Work performed during the prior period in addition to the agreed-upon amount, the Contractor may, within the same time period, submit to the Owner a separate written payment request specifying the exact additional amount due, the specific Work for which the additional amount is due, and why the additional payment is due.

2.2 <u>Payments to Subcontractors.</u> No payment request shall include amounts the Contractor does not intend to pay to a Subcontractor. If, after making a request for payment but before paying a Subcontractor for its performance covered by the payment request, the Contractor discovers that part or all of the payment otherwise due to the Subcontractor is subject to withholding from the Subcontractor for unsatisfactory performance, the Contractor may withhold the amount as allowed under the subcontract, but it shall give the Subcontractor and the Owner written notice of the remedial actions that must be taken as soon as practicable after determining the cause for the withholding but before the due date for the Subcontractor payment, and pay the Subcontractor within *eight (8) working days* after the Subcontractor satisfactorily completes the remedial action identified in the notice.

2.3 <u>Retainage.</u> Pursuant to RCW 60.28, the Owner will reserve five percent (5%) from the moneys the Contractor earns on estimates during the progress of the Work, to be retained as a trust fund for the protection and payment of the claims of any person arising under this Contract and the state with respect to taxes imposed pursuant to Title 82 RCW, which may be due from the Contractor. The moneys reserved will be retained in a fund by the Owner until *forty-five (45) days* following formal acceptance of the Project by the Owner ("Final Acceptance"). The Contractor may retain payment of not more than five percent (5%) from the moneys earned by any Subcontractor.

3. Upon completion of the Work, Contractor shall submit a request for final payment, with an itemized invoice to the Owner for approval and payment.

4. Invoices: Invoicing shall be billed at the unit prices of basic crew and equipment. Modifications to the work crew and equipment due to unforeseen circumstances (illness, equipment issues etc.), shall be reflected by invoicing the individual hourly rates as provided in bid response for laborers and equipment.

PERFORMANCE BOND

the "Contractor," providing for

which agreement is on file at the District's office and by

this reference is made a part hereof.

WHEREAS said Contractor is required under the terms of said agreement and under the provisions of Section 39.08.010 et seq. of the Revised Code of Washington to furnish a bond for the faithful performance of said agreement.

NOW, THEREFORE,	we,	the	undersigned	Contractor,	as	principal,	and
			a corpor	ation organize	ed and	existing under	r and
by virtue of the law of the state of				a	and duly	/ authorized to	do a
surety business in the state of	Washin	gton, as	surety, are he	eld and firmly	bound	l unto the sta	te of
Washington and said Public Utility	/ Distric	t No. 1 o	f Mason Count	y in the sum of			

Dollars (\$_____) for the payment of which we do jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns by these presents.

THE CONDITIONS OF THIS OBLIGATION are such that if the said principal, his/her heirs, representatives or successors, shall well and truly keep and observe all of the covenants, conditions, and agreements in said contract, and pay all laborers, mechanics, subcontractors and material men with provisions and supplies for carrying on such work, and shall indemnify and save harmless the District, its officers and agents, from any pecuniary loss resulting from the breach of any said terms, covenants, or conditions to be performed by the Contractor.

AND FURTHER, that the Contractor will correct or replace any defective work or materials discovered by the said District within a period of one year from the date of acceptance of such work by said District, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

No change, extension of time, alteration or addition to the work to be performed under the agreement shall in any way affect Contractor or Surety's obligation on this bond, and surety does hereby waive notice of any change, extension of time, alterations or additions thereunder.

This bond is furnished in pursuance of the requirements of the agreement above mentioned and in addition thereto it is furnished to meet the requirements of Section 39.08.010 et seq. of Revised Code of Washington, and, in addition to other obligations herein contained, is made, executed and delivered by the Contractor and surety to the District for filing with the District Auditor for the use and benefit of said District together with all laborers, mechanics, subcontractors, material men and all persons who supply such person or persons, subcontractors with provisions and supplies for the carrying on of the work covered by the agreement to the extent required by said Revised Code of Washington, and, in addition, to the extent the District or its property may be held liable under any of said sections of the Revised Code of Washington.

IN WITNESS WHEREOF, the said Contractor and the said surety have caused this bond to be signed and sealed by their duly authorized officers this ______ day of ______, 20____.

SURETY:	CONTRACTOR:
BY:	BY:
SIGNATURE:	SIGNATURE:
TITLE:	TITLE:

SURETY'S AGENT:

Address

LIST OF DRAWINGS, SPECIFICATIONS AND ATTACHMENTS

- Attachment A: Map of Fiber Network Service Area
- Attachment B: List of Acceptable Materials
- Attachment C: RUS Bulletin 1753F-152 Specifications and Drawings for Construction of Aerial Plan
- Attachment D: RUS Bulletin 1753-601a Minimum Performance Specification for Fiber Optic Cables
- Attachment E: RUS Bulletin 1753-401F-401 (PC-2) Splicing of Copper and Fiber Optic Cables
- Attachment F: RUS Bulletin 1753-151 Specifications and Drawings for Construction of Underground Plant



Mason PUD1 Fiber Footprint

List of Acceptable Materials

For

Triton Cove Fiber Network

Fiber Optic Cable: Corning Lite Loose Tube, Gel-Free Single Jacket, Single Armored Cable, Single -mode or equivalent (Buy American)

Fiber Terminals: OptSheath MultiPort Terminal 4- 12 Ports

Aerial Strand: ¼" 1x7 Galvanized Strand

Vaults: Newbasis (17x30x24)

Fiber Distribution Hub (FDH): Clearfield FieldSmart
Attachment C

United States Department of Agriculture

Rural Utilities Service

RUS Bulletin 1753F-152 RUS Form 515c

September 2001



Specifications and Drawings for Construction of Aerial Plant

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UNITED STATES DEPARTMENT OF AGRICULTURE Rural Utilities Service

BULLETIN 1753F-152

SUBJECT: Specifications and Drawings for Construction of Aerial Plant, RUS Form 515c

Incorporated by reference in 7 CFR 1755.97

TO: All Telecommunications Borrowers

RUS Telecommunications Staff

EFFECTIVE DATE: September 17, 2001

OFFICE OF PRIMARY INTEREST: Outside Plant Branch, Telecommunications Standards Division.

AVAILABILITY: This bulletin supersedes RUS Bulletin 345-153, Specifications and Drawings for Construction of Pole Lines, Aerial Cables and Wires, RUS Form 515f, issued May 25, 1989. This bulletin can be accessed via the Internet at http://www.usda.gov/rus/telecom/publications/bulletins.htm

PURPOSE: This specification provides Contractors, Engineers, and RUS Borrowers with assembly unit descriptions, materials, construction and installation, and drawings for aerial plant associated with RUS Form 515, Telecommunications System Construction Contract.

Roberta D. Purcell

8/21/01 Date

Roberta D. Purcell Assistant Administrator Telecommunications Program

RUS Bulletin 1753F-152 Specifications and Drawings for Construction of Aerial Plant, RUS Form 515c

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ASSEMBLY UNITS: Cable Plant, Aerial CABLE: Aerial Cable Plant Construction Assembly Units CONSTRUCTION: Aerial Cable Plant Fiber Optic Cable Plant POLES LINES: Design of POLES: Numbering RIGHT-OF-WAY: Clearing and Trimming Assembly Units SPECIFICATIONS AND STANDARDS: Outside Plant WIRE: Seven Wire Aluminum Clad Steel Strand Steel, 7 Wire Galvanized Strand

LIST OF CHANGES

- 1. Modification of Pole Units from Section 1 to Section A.
- 2. Elimination of Section C and Section CF.
- 3. Addition of Section CFO, Self Supporting Filled Fiber Optic Cable Assembly Units.
- 4. Modification of CO and CW units as follows:
 - (a) Provide for compensation on a per foot basis;
 - (b) Redefined compensation to include the sum of the cable distances between supporting structures as indicated by the sequential foot markings;
 - (c) Specified utility grade galvanized steel strand as the default type.
- 5. Elimination of suffixes "N" and "R" under Section HA. For ready access splice closures specified under the "R" suffix, a new unit designated HR was created.
- 6. Addition of Section HR, Ready Access Splice Closure Assembly Unit.
- 7. Modification of Section HC as follows:
 - (a) Redefined unit to provide compensation on a single pair basis;
 - (b) Created HC5 unit in order to provide compensation for terminating cable pairs on a terminal block within a ready access closure.
- 8. Modification of Section HO to provide compensation for testing a fiber.
- 9. Elimination of section PC and section PDS.
- 10. Modification of Section PE to indicate utility grade galvanized steel as the default type.
- 11. Elimination of Section PG. The terminal blocks are now included under Section PM.
- 12. Modification of PM21 and PM22 to provide for a more generalized description.
- 13. Addition of PM25, Filled Terminal Block Assembly Unit.
- 14. Modification of Section R to provide compensation on a per foot basis.

- 15. In part III, section 2, elimination of information on pole facing.
- 16. In part III, the Figure 8 cable was changed to describe Self Supporting Fiber Optic Cable.
- 17. In part III, eliminated references to load coils, pressurized cable, and air-core cable.

For editorial or other minor technical changes, refer to the body of the document.

Part I - DESCRIPTION OF ASSEMBLY AND PROPOSAL AND CONTRACT SECTIONS

The Contractor's Proposal form is divided into sections and the sections approved for construction shall be listed in the Construction Agreement by the Owner. The sections are as follows:

Section	A	_	Pole Units
Section	CFO	_	Self Supporting Filled Fiber Optic Cable
			Assembly Units
Section	CO	_	Aerial Filled Fiber Optic Cable Assembly
			Units
Section	CW	_	Aerial Filled Copper Cable Assembly
			Units
Section	HA	_	Aerial Splice Closure Assembly Units
Section	HC	_	Copper Splicing Assembly Units
Section	НО	-	Fiber Optic Splicing Assembly Units
Section	HR	-	Ready Access Closure Assembly Units
Section	PE	_	Guy Assembly Units
Section	PF	_	Anchor Assembly Units
Section	PM	_	Miscellaneous Assembly Units
Section	R	-	Right-of-Way Clearing and Trimming Units
Section	W	_	Rearrangement Units
Section	XX	_	Nonreusable Materials Removal Units
Section	XZ	_	Reusable Materials Removal Units

Each assembly unit includes only the materials listed on the corresponding Installation and Construction Guide Drawings or description of unit where no drawing exists. The various installation and construction units, which are included in this Proposal and upon which quotations are required, are defined by the following descriptions:

Section A - POLE UNITS

Consists of one (1) pole in place. It does not include the pole top assembly units or other parts attached to the pole. Poles shall be of the height and class as designated by the Engineer. The pole plan, species of timber, kind of preservative and method of treatment are designated in the Proposal.

Example:

A35-7 A 35 foot [10.7 meters (m)] class 7 pole.

Section CFO - SELF SUPPORTING FILLED FIBER OPTIC CABLE ASSEMBLY UNITS

Consists of one (1) foot (0.305 m) of self supporting filled fiber optic cable in place including all supporting hardware, cable guards, insulating tapes, and bonding of the armor (when present) and supporting member in accordance with the Construction Sheets.

- A. The length of the self supporting cable measured for compensation purposes includes the sum of the cable distances between supporting structures as indicated by the sequential foot markings.
- B. This unit does not include labor and material for fiber splicing, splice closures, housings, or organizers. The labor and material for these items are provided for in other units.
- C. This unit includes the spiraling of the self supporting cable in accordance with the method shown in the Construction Sheets.

Each self supporting filled fiber optic cable unit is listed in accordance with the number of optical fibers. Each unit is prefixed by the letters CFO. The following illustration indicates the method of designating the material required.

Section CO - AERIAL FILLED FIBER OPTIC CABLE ASSEMBLY UNITS

Consists of one (1) foot (0.305 m) of aerial filled fiber optic cable in place including supporting messenger of galvanized steel strand, lashing wire, attachments to strand, bonding of the armor (when present) and strand in accordance with the Construction Sheets.

Options designated by the following suffixes apply:

- Suffix Description
 - A Aluminum-clad steel strand.
 - C Class C galvanized steel utility grade strand for corrosion areas.

CF016 A self supporting filled fiber optic cable with 16 fibers.

- D Two or more cables are to be initially lashed to the same suspension strand.
- E Cables are lashed to existing strand and cable(s).
- A. The length of aerial cable measured for compensation purposes includes the sum of the cable distances between supporting structures as indicated by the sequential foot markings.
- B. This unit does not include labor and material for fiber splicing, splice closures, housings or organizers. The labor and material for these items are provided for in other units.
- C. Class A galvanized steel utility grade strand shall be provided unless another type is specified by the appropriate suffix.

Each aerial filled fiber optic cable assembly unit is listed in accordance with the number of optical fibers. Each unit is prefixed by the letters CO. The following illustrations indicate the method of designating the material required.

- CO16(6M) An aerial filled fiber optic cable with 16 fibers, supported by 6000 pound (lbs) [26,688 Newtons (N)] Class A galvanized steel utility grade strand.
- CO8E An aerial filled fiber optic cable with 8 fibers, lashed to existing strand and cables(s).

Section CW - AERIAL FILLED COPPER CABLE ASSEMBLY UNITS

Consists of one (1) foot (0.305 m) of aerial filled copper cable in place including supporting messenger of galvanized steel strand, lashing wire, attachments to strand, bonding of the shield and strand in accordance with the Construction Sheets.

Options designated by the following suffixes apply:

Suffix	Description
А	Aluminum-clad steel strand.
C	Class C galvanized steel utility grade strand is required for corrosion areas.
D	Two or more cables are to be initially lashed to the same suspension strand.
E	Cables are to be lashed to existing strand and cable(s).

H Screened cable designated for T1 carrier systems.

H1C Screened cable designated for T1C carrier systems.

- A. This unit includes labor and material for installation of the splice closure, and other labor and materials for straight splicing cables of the same size and gauge required only for the purpose of joining such cables in one continuous length (reel ends).
- B. When specified in the Proposal, this unit includes the spiraling of cable around the suspension strand at the locations shown on the Construction Sheets.
- C. The length of aerial cable measured for compensation purposes includes the sum of the cable distances between supporting structures as indicated by the sequential foot markings.
- D. Where aerial cables are supported by separate through-bolts on the same pole, messenger bonds required as shown on the Construction Sheets are included as a part of this unit.
- E. Class A galvanized steel utility grade strand shall be provided unless another type is specified by the appropriate suffix.

Each aerial filled copper cable assembly unit is listed in accordance with the number of pairs and gauge of conductors. Each unit is prefixed by the letters CW. The following illustrations indicate the method of designating the material required.

- CW50-24(6M) A 50-pair, 24-gauge aerial filled copper cable supported by 6000 lbs (26,688 N) Class A galvanized steel utility grade strand.
- CW50-24(6M)C A 50-pair, 24-gauge aerial filled copper cable supported by 6000 lbs (26,688 N) Class C galvanized steel utility grade strand.

Section HA - AERIAL SPLICE CLOSURE ASSEMBLY UNITS

Consists of an aerial splice closure and the closure manufacturer's provided encapsulating material if required, installed in place and the labor and material for setting up in preparation for installing the closure, such as, opening the sheath or jacket of the cable, bonding of cable shields, filling the closure if required, closing the closure, and, when applicable, pressure testing, all in accordance with the manufacturer's instructions. It also includes all necessary hardware items to support the cable adjacent to the closure and to terminate the lashing wire. Cable splicing shall be compensated under the appropriate splicing units.

The assembly units are defined as follows:

- HAC() <u>Aerial Free-Breathing, Nonfilled Closure</u> A freebreathing, nonfilled splice closure with pair count and gauge for each cable to be spliced.
- HAF() <u>Aerial Filled Closure</u> A filled splice closure with pair count and gauge for each cable to be spliced.
- HAP() <u>Aerial Pressurized Closure</u> A pressurized splice closure with pair count and gauge for each cable to be spliced.

For Fiber Optic applications use the following suffix:

Suffix Description

0 Splice closure and organizer for fiber optic cables. The closure manufacturer shall specify the appropriate organizer.

The following illustrations indicate the method of designating the material required.

- HAC(100-24) Aerial free-breathing, nonfilled splice closure enclosing two cable ends with same pair count and gauge.
- HAF(100-24)(50-24) Aerial filled splice closure enclosing two cable ends with different pair counts.
- HACO(24) Aerial free-breathing, nonfilled fiber optic splice closure and organizer capable of accommodating a minimum of 24 fibers.
- HAP(100-24) Aerial pressurized splice closure enclosing two cable ends with same pair count and gauge.
- HAPO(12) Aerial pressurized fiber optic splice closure and organizer capable of accommodating a minimum of 12 fibers.

Section HC - COPPER SPLICING ASSEMBLY UNITS

- HC1 Consists of the labor and material necessary in the wire work and splicing of one (1) cable pair in any cable, including any non-working pair in an existing cable in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2) using individual mechanical splicing connectors. The splice may be straight, bridged, or pieced out and bridged. Pairs that are to be tested, capped, or tested and capped, when specified by the Engineer are considered to be part of this unit. Only those pairs on which splicing, testing, and/or capping operations are performed are counted and each pair is counted only once at each location. On aerial inserts, each end of the fuse link is considered as a splice.
- HC3 Consists of the labor and material necessary in the wire work and splicing of one (1) cable pair in any cable, including any non-working pair in an existing cable in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2) using splicing modules. The splice may be straight, bridged or pieced out and bridged. Pairs that are to be tested, capped, or tested and capped, when specified by the Engineer are considered to be part of this unit. Only those pairs on which splicing, testing, and/or capping operations are performed are counted and each pair is counted only once at each location. On aerial inserts, each end of the fuse link is considered as a splice.
- HC5 Consists of the labor and material necessary for terminating one (1) pair on a terminal block within a ready access closure, including a non-working pair in existing cables in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2). Pairs that are to be tested, when specified by the Engineer, are considered to be part of this unit.

Section HO - FIBER OPTIC SPLICING ASSEMBLY UNITS

Consists of all labor and material necessary to splice and/or test one (1) glass fiber in any cable in accordance with RUS Splicing Standard Bulletin 1753F-401(PC-2). The labor shall include initial measurement, minimizing the attenuation, splicing and stowing the spliced fiber in a fiber organizer. The labor and material for the fiber organizer is part of the appropriate splice closure unit.

Suffix Description

- HO1 Fusion Splice
- HO2 Mechanical Splice
- HO3 Connector Splice

Section HR - READY ACCESS SPLICE CLOSURE ASSEMBLY UNITS

Consists of a ready access closure containing unprotected filled terminal blocks installed in place and includes the labor and material for setting up in preparation for installing the ready access closure, such as, opening the sheath or jacket of the cable, bonding of cable shields, and closing the closure in accordance with the manufacturer's instructions. It also includes all necessary hardware items to support the cable adjacent to the closure and to terminate the lashing wire. Cable splicing shall be compensated under the appropriate splicing units. When protected filled terminal blocks are to be specified, the unit shall be suffixed by the letter "P".

Ready access closures not containing filled terminal blocks shall be suffixed with the letter "U". Under this option, installation of filled terminal blocks shall be compensated under other units.

The assembly units are defined as follows:

- HR1()() A straight splice ready access closure.
- HR2()() A branch splice ready access closure.

The first set of parentheses shall indicate the main cable diameter (dia.), in inches (in.) [millimeters (mm)], as shown in the illustration. The second set of parentheses shall indicate the number of terminals within the ready access closure. When the unit is suffixed with the letter "U" the second set of parentheses is not applicable.

The following illustrations indicate the method of designating the material required.

HR1(2.0)(12) Ready access closure, accommodating a straight splice with a maximum cable diameter of 2.0 in. (50.8 mm), and equipped with filled terminal blocks with a total of 12 terminations.

- HR2(1.0)(6) Ready access closure, accommodating a branch splice with a maximum cable diameter of 1.0 in. (25.4 mm), and equipped with filled terminal blocks with a total of 6 terminations.
- HR1(2.0)U Ready access closure, accommodating a straight splice with a maximum cable diameter of 2.0 in. (50.8 mm), without any terminal blocks installed.

Section PE - GUY ASSEMBLY UNITS

Consists of strand and hardware; and insulators or ground connection where required. For guying purposes, when a cable messenger strand is extended one or more spans to a deadend structure, the strand in each such span shall be considered as an overhead guy for the appropriate size of strand used.

The assembly units are defined as follows:

PE1-2	Down Guy for 6M strand
PE1-3	Down Guy for 10M strand
PE1-4	Down Guy for 16M strand
PE1-2G	Down Guy, Ground Connection Type for 6M strand
PE1-3G	Down Guy, Ground Connection Type for 10M strand
PE1-4G	Down Guy, Ground Connection Type for 16M strand
PE2-2	Overhead Guy for 6M strand
PE2-3	Overhead Guy for 10M strand
PE2-4	Overhead Guy for 16M strand
PE2-2G	Overhead Guy, Ground Connection Type for 6M strand
PE2-3G	Overhead Guy, Ground Connection Type for 10M strand
PE2-4G	Overhead Guy, Ground Connection Type for 16M strand

Note: When the above Guy Assembly Units are to be installed on existing poles, the assembly unit designation is prefixed by the letter "N".

Unless otherwise indicated by an additional suffix, the strand furnished on the Project will be seven-wire, Class A galvanized steel utility grade. The following suffix may be used:

Sullix Type of Schand

A Aluminum - Clad steel

C Class C galvanized steel utility grade

Section PF - ANCHOR ASSEMBLY UNITS

Consists of the anchor with rod, complete and in place, ready for attaching the guy strand.

The assembly units are defined as follows:

PF1-3	Expanding Anchor	-	6,000	lbs	(26,688	N)
PF1-5	Expanding Anchor	-	10,000	lbs	(44,480	N)
PFl-7	Expanding Anchor	-	16,000	lbs	(71,168	N)
PF2-3	Plate Anchor	_	6,000	lbs	(26,688	N)
PF2-5	Plate Anchor	_	10,000	lbs	(44,480	N)
PF2-7	Plate Anchor	-	16,000	lbs	(71,168	N)
PF3-3	Screw Anchor	_	6,000	lbs	(26,688	N)
PF3-5	Screw Anchor	_	10,000	lbs	(44,480	N)
PF3-7	Screw Anchor	-	16,000	lbs	(71,168	N)
PF5-3	Rock Anchor	_	3/4 in	n. dia	a. (19 mm	n) rod
PF5-4	Rock Anchor	-	1 in.	dia.	(25.4 mm	n) rod
PF6-3	Swamp Anchor	_	10 in.	dia.	(254 mm	n)
PF6-4	Swamp Anchor	-	12 in.	dia.	(305 mm	n)
PF6-5	Swamp Anchor	-	15 in.	dia.	(381 mm	n)

Note: When twineye rods are required for the above anchor assembly units, the unit designation is suffixed by the letter "A".

Section PM - MISCELLANEOUS ASSEMBLY UNITS

Consists of all labor and materials to construct and install the units defined individually below required for the installation and construction of the aerial portions of the Project:

PM1 Pole Lightning Protection Assembly

PM2	Pole Ground Assembly
PM2-1	Auxiliary Ground Rod Assembly
PM2A	Ground wire assembly for bonding aerial cable strand or support wire to electric system neutral or pole ground assembly.
PM4	Cable Extension Arm (Short)
PM4A	Cable Extension Arm (Long)
PM5	Pole Stepping Assembly

PM6 One Wood Pole Key

PM7 Two Wood Pole Keys

PM8One Wood Key and One Metal Expanding KeyPM9Two Wood Keys and One Metal Expanding Key

- PM11 Guy Guard
- PM12() Consists of all labor and material to install a sidewalk guy arm. The guy, guy guard and anchor assembly units will be specified separately. The length in feet (meters) of a single piece of 2 in.(50.8 mm) galvanized steel pipe shall be indicated in the parentheses.
- PM14 Push Brace Accessories
- PM21 <u>Cable Entrance</u> Consists of the necessary labor and material to terminate copper and/or fiber optic outside plant cables as shown on the detailed drawings as specified by the Engineer.
- PM22 <u>Grounding System</u> Consists of the necessary labor and material to construct a grounding system as shown on the detailed drawings as specified by the Engineer. This unit shall include all ground electrodes, trenching, backfilling, bonding the auxiliary ground electrodes to each other and to the primary ground electrodes, and bonding to the master ground bar (MGB).
- PM25() Filled Terminal Block Assembly Unit Consists of an unprotected filled terminal block, mounted in place in a ready access closure (separately specified) and connected to the conductors of the cable as specified by the Engineer. Splicing of the cable conductors shall be in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2). The pair count of the terminal block shall be indicated in the parentheses. When protected filled terminal blocks are to be specified, the unit shall be suffixed by the letter "P".

PM52 Pole Marking, Per Pole, Route and Pole Number.

Section R - RIGHT-OF-WAY CLEARING AND TRIMMING UNITS Aerial Plant

A. Clearing Units are defined as follows:

- R1-5 Is one (1) foot (0.305 m) in length and 5 feet (1.52 m) in width (to be measured on one side of the pole line) of actual clearing of right-of-way. The unit applies to clearing right-of-way along new or existing telecommunications pole lines and along existing power pole lines. This includes clearing of underbrush, tree removal, and such tree trimming as may be required to leave an unobstructed rightof-way from the ground up on one side of the line of poles carrying wire or cable. The length of actual clearing shall be measured in a straight line parallel to the line between poles and across the maximum dimension of foliage cleared (not trunk) projected to the ground line. All trees and underbrush across the width of the right-of-way shall be considered to be grouped together as a single length in measuring the total length of clearing. Lengths along the right-of-way in which no trees are to be removed or trimmed or underbrush cleared shall be omitted from the total measurement. This unit includes the removal, or topping (cutting out the top of the tree so that if the remaining portions of the tree fall, they will not endanger the line) at the option of the Contractor, of danger trees outside of the rightof-way when so designated by the Engineer. (Danger trees are defined as dead or leaning trees, which, in falling, would affect the operation of the line.) The Contractor shall not remove or trim shade, fruit, or ornamental trees unless so directed by the Engineer.
- R1-10 Identical to R1-5 except that width is 10 feet (3.05 m).
- R2-5 Identical with R1-5, except that width 10 feet (3.05 m); to be measured 5 feet (1.52m) on each side of the pole line.
- R2-10 Identical with R1-5, except that width 20 feet (6.1 m), to be measured 10 feet (3.05m) on each side of the pole line.

Note: The letter "M" added as a suffix to the above "R" units designates units for reclearing existing right-of-way. With the

exception of the substitution of the word "reclearing" for "clearing", the remaining description of the "R" assembly units applies for the units suffixed with the letter "M".

B. The Trimming Unit is defined as follows:

R3-5 Is one (1) foot (0.305 m) in length and consists of the trimming of foliage and branches from trees growing on or adjacent to the right-of-way so as to provide a clearance of not less than 5 feet (1.52 m) in all directions from telecommunications cable. This unit is measured parallel to the pole line across the maximum width of foliage trimmed. All trees, underbrush or shrubbery across the width trimmed shall be considered to be grouped together as a single length in measuring the total length of trimming. Lengths along the right-of-way in which no trimming is performed shall be omitted from the total measurement. Any trimming included in Rl or R2 right-of-way clearing units, shall not be considered a part of the measurement of the unit. The Contractor shall not trim any shade, fruit or ornamental trees unless so directed by the Engineer. When so designated by the Engineer, a tree may be trimmed of its branches with the trunk left extending into the zone to be trimmed.

Section W - REARRANGEMENT UNITS

Specific rearrangement units shall be designated and described by the Engineer on the "List of Special Arrangement Units" table of RUS Form 515. Existing plant assembly units to be rearranged are designated by a prefix "W".

Section XX - NONREUSABLE MATERIALS REMOVAL UNITS

These units cover the furnishing of all labor for the removal of construction assembly units from existing lines, and transportation of the removed materials for proper disposal. The Contractor will be permitted to use the most economical method of removing these units. The removal units are designated by the prefix "XX" followed by the assembly unit designation of the unit to be removed.

Section XZ - REUSABLE MATERIALS REMOVAL UNITS

These units cover the furnishing of all labor for the removal of construction assembly units from existing lines and all labor and transportation of the removed materials to a location designated by the Owner. The Contractor will be charged by the Owner for the materials removed under this section at the unit material values shown in column 2 of the "Value and Disposition of Units to be Removed" table of RUS Form 515. The number of units to be charged to the Contractor and the extended value of these units are shown in columns 3 and 4. Such charges will be placed against the Contractor as assembly units are removed and the unit material values will be deducted from the total value of assembly units constructed on this project for determination of the work accomplished for purposes of the monthly progress payments to the Contractor. Of the assembly units listed in the "Value and Disposition of Units to be Removed" table to be removed from existing lines certain units are to be reused in the construction of the project. The quantity of such units to be reused is listed in the "Value and Disposition of Units to be Removed" table, column 5. These units where installed in the project will be inventoried as new assembly units and compensated for at the unit bid prices. The quantity of assembly units listed in column 6 of the "Value and Disposition of Units to be Removed" table is the maximum quantity of removed assembly units that are to be returned to the Owner for credit which will be allowed at the unit material prices in column 2. Column 7 indicates the extended value of the units to be returned to the Owner. The Contractor will be allowed credit for assembly units listed in column 6 which, in the opinion of the Engineer, have not been damaged by the Contractor in removal and handling. Such credits will be allowed the Contractor as the assembly units are returned to a location designated by the Owner and shall be added to the total value of installed assembly units for determination of work accomplished for the purposes of the monthly progress payments to the Contractor. The removal units are specified by the prefix "XZ" followed by the assembly unit designation of the existing assembly unit to be removed.

Part II - SPECIFICATIONS FOR MATERIALS

1. SCOPE

This part of the specification is concerned with the various materials required for the construction of the outside aerial cable plant of the rural telecommunications system as shown on the Plans, Specifications, and Construction Sheets.

2. GENERAL

All materials used in the construction of the rural telecommunications system except those listed in Paragraph 4 below shall be listed in RUS Informational Publication (IP) 344-2, "List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers," unless specific written approval has been granted by the Administrator.

3. POLES

3.1 The pole plan, method of treatment, kind of preservative and general procedure applying to all poles shall be in accordance with the latest RUS specifications for these items in effect at the time the bids are received. All poles shall be framed in accordance with the framing guide attached to the specifications.

3.2 Poles shall be of the length and American National Standards Institute, Inc. (ANSI) class specified in the Proposal.

4. MISCELLANEOUS

Items which do not appear in RUS IP 344-2, "List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers," shall be of a quality suitable for the application for which they are intended.

Part III - SPECIFICATIONS FOR CONSTRUCTION AND INSTALLATION

1. GENERAL

1.1 All construction and installation work shall be done in a thorough and workmanlike manner in accordance with the Plans, Specifications and Construction Sheets and shall be subject to acceptance by the Owner and the Administrator.

1.2 All material to be used in construction of the Project shall be stored so as to be protected from deteriorating effects of the elements.

1.3 All guy strand, suspension strand, aerial cables, and accessory materials used in the construction of the Project shall be handled with care. Each reel of aerial cable shall be inspected for damage. All damage shall be repaired to the satisfaction of the Engineer and in accordance with the methods or other instructions described in the appropriate paragraphs of Part III. If reel wrap is present, the reel wrap shall remain intact on the reel until the cable is ready to be placed.

1.4 Deviations from the Plans, Specifications and Construction Sheets shall not be permitted except upon written permission of the Engineer.

1.5 The latest revision of the National Electrical Safety Code (NESC) and the National Electrical Code (NEC) shall be followed in every case except where local regulations are more stringent, in which case local regulations shall govern.

1.6 The Contractor shall maintain conductor polarity (tip and ring) identification at the main distributing frame, cable terminals, wire terminals, terminal blocks, and in the service entrance, all in accordance with the Specifications and Construction Sheets (see guide drawing 815).

2. POLE LINES

2.1 Poles shall be handled carefully. Damaged poles shall not be used.

2.2 The pole hole shall be of sufficient diameter to permit the pole to settle freely to the bottom of the hole without trimming the butt and still have sufficient space between the pole and the sides of the hole to permit proper tamping of the backfill at every point around the pole, and throughout the entire depth of the hole.

2.3 The setting depth, in feet (or meters), for poles of various lengths shall be as follows:

ngth of Le	Setting in Soil	Setting in Solid Rock
(6.10)	4.0 (1.22)	3.0 (0.91)
(7.62)	5.0 (1.52)	3.5 (1.07)
(9.14)	5.5 (1.68)	3.5 (1.07)
(10.67)	6.0 (1.83)	4.0 (1.22)
(12.19)	6.0 (1.83)	4.0 (1.22)
(13.72)	6.5 (1.98)	4.5 (1.37)
(15.24)	7.0 (2.13)	4.5 (1.37)
(16.76)	7.5 (2.29)	5.0 (1.52)
(18.29)	8.0 (2.44)	5.0 (1.52)
	ngth of Le (6.10) (7.62) (9.14) (10.67) (12.19) (13.72) (15.24) (16.76) (18.29)	hgth of LeSetting in Soil(6.10)4.0 (1.22)(7.62)5.0 (1.52)(9.14)5.5 (1.68)(10.67)6.0 (1.83)(12.19)6.0 (1.83)(13.72)6.5 (1.98)(15.24)7.0 (2.13)(16.76)7.5 (2.29)(18.29)8.0 (2.44)

2.4 The "Setting in Soil" depth as shown in paragraph 2.3, shall apply where poles are to be set in soil only; where there is a layer of soil more than 2 feet (0.61 m) in depth over solid rock; or where the pole in solid rock is not substantially vertical or the diameter of the hole at the surface of the rock exceeds approximately twice the diameter of the pole at the same level.

2.5 The "Setting in Solid Rock" depth as shown in paragraph 2.3, shall apply where solid rock is encountered at the ground line and where the hole is substantially vertical, approximately uniform in diameter, and large enough to permit the use of tamping bars the full depth of the hole.

2.6 Where there is a layer of soil 2 feet (0.61 m) or less in depth over solid rock, the depth of the hole shall be the depth of the soil in addition to the depth specified in paragraph 2.3 under "Setting in Solid Rock," provided, however, that such depth shall not exceed the depth specified under "Setting in Soil."

2.7 On sloping ground the depth of the hole shall be measured from the low side of the hole. Where a pole is to be set on the side of a steep grade where soil erosion appears to be a consideration, the hole should be one (1) foot (0.305 m) deeper than specified in paragraph 2.3 under "Setting in Soil."

2.8 When an earth boring machine is employed for holes for guyed poles, the bottom of the hole shall be thoroughly tamped to compact any loose earth that may be present.

2.9 All holes shall be backfilled with soil or small rock and all pole holes in rock shall be inspected and approved by the Engineer before being backfilled.

2.10 Backfill shall be thoroughly tamped the full depth of the pole hole. Earth must be banked around the pole to a minimum height of 6 in. [15.24 centimeters (cm)] above ground level.

2.11 Holes in soil for poles at unguyed corners where the pole will not be keyed shall be one (1) foot (0.305 m) deeper than the "Setting in Soil" depth as shown in paragraph 2.3. For holes in solid rock the "Setting in Solid Rock" depth will apply.

2.12 The Contractor shall be responsible for setting poles in alignment according to the staking sheets. If the Contractor should find stakes out of alignment, the Engineer shall, upon request of the Contractor, realign the stakes according to the construction sheets.

2.13 Poles shall be set plumb except at corners where they shall be set and raked against the load so that the pole top will be in line after the load is applied. The rake in pole shall not exceed 6 in. (15.24 cm) for each 10 feet (3.05 m) of pole length after the conductors are installed at the required tension. Deadend shall be set so as to be plumb and in line after the load it applied.

2.14 Pole lightning protection shall be a #6 AWG bare copper wire installed in accordance with assembly unit drawing PM1.

3. MOUNTING HARDWARE AND GUYS

3.1 All bolts employed for the mounting of hardware items on poles shall be long enough to fully engage the nut (including locknut, where applicable) but shall not extend more than 2 in. (50.8 mm) beyond the nut after the nut is tightened. The ends of bolts shall not be cut.

3.2 The Engineer shall determine all guy locations and shall specify the type of guy. Guys shall be installed before conductors or cable suspension strands are placed.

4. ANCHORS

4.1 Anchor assembly units shall be installed at locations designated on the construction sheets.

4.2 All anchors and rods shall be in line with the load and shall be so installed that the eye of the rod is above grade. Not more than 6 in. (152 mm) of rod shall remain out of the ground after the load is applied.

4.3 When an expansion type anchor is used, the anchor shall be fully expanded and shall be expanded into undisturbed earth before backfilling the anchor hole.

4.4 Backfill shall be thoroughly tamped the full depth of all anchor holes.

4.5 Rock anchors shall be placed in accordance with the detailed instructions of the Engineer. Where a rock is encountered below the surface of the ground, instructions from the Engineer shall be obtained before placing an anchor at that location.

5. SELF SUPPORTING FIBER OPTIC CABLE

5.1 Where physical obstructions make it necessary to pull cable along the line from a stationary reel, cable stringing blocks shall be used to support the cable during all placing and tensioning operations. Ladders, cable cars and other equipment shall not be placed on or against the cable.

5.2 Splicing of the optical fibers shall be performed in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2). Splicing of the support member shall be performed in accordance with the method specified by the Engineer.

5.3 During installation, maximum pulling tension and minimum bending radius of the self supporting fiber optic cable shall not exceed the cable manufacturer's recommendations.

5.4 Initial stringing tension, maximum permissible span length, and sagging shall be in accordance with the cable manufacturer's recommendations.

5.5 Self supporting fiber optic cable shall be spiraled in accordance with the method shown on Construction Guide Drawing 250-1. Spiraling of the cable shall be performed within 24 hours of the tensioning operation.

5.6 The insulation shall not be removed from the support member except at bonding and ground points; and at points where ends of the support member are terminated in splicing and deadend devices.

5.7 The support member of self supporting fiber optic cable shall be made electrically continuous throughout its entire length.

5.8 At junctions between self supporting fiber optic cable and aerial fiber cable, or buried fiber cable, the support messenger shall be bonded to the aerial cable strand or buried cable armor.

5.9 The support member of self supporting fiber optic cable shall be grounded at locations specified by the Engineer by connecting the support wire to a pole ground wire as shown on the Construction Sheets.

5.10 When specified by the Engineer, the insulation of the support member at deadend fittings, splices and bridged grounding connections shall be restored in accordance with the method shown in Construction Guide Drawing 360.

5.11 Damaged portions of the self supporting fiber optic cable shall be cut out and the support member spliced in accordance with the method specified by the Engineer.

6. SUSPENSION STRAND

6.1 The cable shall be installed within a reasonable time after the strand is installed and tensioned. If a delay in installing cable in excess of 24 hours is encountered, temporary dampers shall be installed on the strand.

6.2 When tensioning strand the cable suspension clamps shall be loose enough to allow free movement of the strand.

6.3 Suspension strand shall be placed in accordance with the Construction Sheets and shall be tensioned in accordance with instructions, which shall be furnished, to the Contractor by the Engineer.

6.4 The suspension strand shall be placed on the roadside of the pole line unless otherwise directed by the Engineer.

6.5 In tangent construction, the lip of the suspension strand clamp shall point toward the pole. At angles in the line, the suspension strand clamp lip shall point away from the load.

6.6 In level construction the suspension strand clamp shall be placed in such a manner that it shall hold the strand below the through-bolt. At points where there is an up-pull on the strand, the clamp shall be so placed that it shall support the strand above the through-bolt.

6.7 When a thimbleye bolt is used both to mount the suspension strand clamp and to make the guy attachment, the size of the suspension strand clamp shall be governed by the size of the thimbleye bolt required for the guy.

6.8 The air temperature at the time and place of tensioning the strand shall be determined by means specified by the Engineer.

6.9 The suspension strand shall be made electrically continuous throughout its entire length as indicated on the Construction Sheets.

6.10 Suspension strands shall be bonded to other bare cable suspension strands, and guys on the same pole and grounded by connection to ground leads at locations specified by the Engineer and in the manner specified by the Engineer. Where the strand is to be grounded to a multigrounded neutral on a pole which does not carry a vertical pole ground wire, a #6 AWG bare copper wire shall be left coiled and taped to permit it to be extended up the pole and connected to the multiground neutral by a representative of the power company.

7. FILLED AERIAL CABLE

7.1 The Contractor and Engineer shall jointly inspect all reels of cable for damage prior to installation.

7.2 Cable ends shall be kept sealed at all times, i.e., during transportation, in storage, and during cable placement to prevent moisture entry into the cable core. Acceptable cable end caps shall be used for this purpose.

7.3 Cable shall be taken from the reel only as it is placed. Bends of small radii and twists shall be avoided in handling cable.

7.4 If the jacket is deformed in handling the cable, the Engineer shall be notified. If directed by the Engineer, the deformed section of the jacket shall be removed; the insulation and conductors shall be examined and if damaged shall be repaired. The opening in the jacket shall then be closed by means of a suitable enclosure. Repairs so made shall be done in accordance with appropriate specifications.

8. FILLED AERIAL CABLE PLACEMENT

8.1 During placing operations, copper cables shall not be bent in a radius less than 10 times the outside diameter of the cable and fiber optic cables shall not be bent in a radius less than 20 times the outside diameter of the cable. Temporary supports where necessary, shall be placed sufficiently close together and proper tensioning of the cable shall be employed to prevent bending in excess of the above requirements.

8.2 In those instances where spiraling of cable is involved, the mounting of closures for purposes of splicing and distribution

shall be accomplished after the spiraling operation has been completed.

8.3 Cable guards shall be applied over the cable at points of potential abrasion such as at supports, and in locations where tree trimming is not permitted.

8.4 Cable shall be lashed with lashing wire to the suspension strand by means of a suitable lashing machine.

8.5 The pitch of the lashing wire may be from 10 to 15 in. (254 to 381 mm) but must be constant for any section of cable of the same size and gauge. For cables of 3/4 in. (19 mm) or larger in diameter, the lashing wire shall be placed with a tension of 35 to 40 lbs (156 to 178 N). Cables having a smaller diameter less than 3/4 in. (19 mm) shall be lashed with a lashing wire tension of 18 to 25 lbs (80 to 111 N).

8.6 During the placing operation, precautions shall be taken to prevent slippage of the cable sheath or jacket over the core.

8.7 The cable shall be snug against the suspension strand throughout the span. It shall be supported in a position directly below the strand insofar as possible, except where spiraling has been specified. Where more than one cable is placed on a strand, the cables shall be arranged as shown on the Construction Sheets so that the cables are snug against the suspension strand and against each other.

8.8 The lashing wire shall be terminated at each pole and the cable shall be supported and protected at the suspension clamp in accordance with the Construction Sheets.

8.9 At lashing wire terminating points, the tension placed in the lashing wire by the lashing machine shall be maintained. No slack in the lashing wire shall be permitted to run into the span.

8.10 When lashing wire is spliced in a span, the splice shall be made by means of a compression type splicing sleeve. The completed splice shall be placed on the strand in such a position that it shall not result in damage to the cable sheath or jacket.

8.11 Where suspension strand attachments such as suspension strand cross-over, suspension strand pull-offs, etc., are encountered in the span, a positive separation shall be provided between the suspension strand attachment and the cable, and the cable shall be supported and protected in accordance with the Construction Sheets.

8.12 At splices where the cable is not cut, no slack shall be left in the cable. So that no slack can run into the span, the lashing wire shall be securely clamped to the strand until the splice is completed, at which time the lashing wire shall be terminated in accordance with the Construction Sheets.

8.13 At cut splices in the cable, sufficient overlap shall be provided to permit splicing without piecing out the conductors.

8.14 Spiraling of lashed cable where specified shall be performed in accordance with the method shown on the Construction Guide Drawing 250. Spiraling of the cable shall be performed within 48 hours of the tensioning operation.

8.15 Where the new cable is to be lashed to existing strand and cable(s), the preceding requirements for placement of lashed cable shall also be adhered to, except as modified and/or supplemented as follows:

8.15.1 The cable shall be lashed to the existing strand and cable(s) so that it and the existing cable(s) shall be as snug against the existing strand as is practicable.

Note: If the existing cable is spiraled, the spiraling shall first be removed. The existing cable after unspiraling and the new cable shall then be lashed, without either being spiraled, to the existing strand in the same lashing operation.

8.15.2 The lashing wire shall be terminated on both sides of all splices and devices in/on the existing cable where interference with the lashing operation is encountered.

8.15.3 Cable spacers and cable straps, as required, shall be used at all points of lashing wire termination to maintain proper separation and support for the new cable.

8.15.4 Spacers shall be added to the existing suspension clamp mountings, where required, to maintain proper separation between the cable and the surface of the pole.

8.15.5 Ready-access closures to be installed on the new cable(s) shall be equipped with extension fittings so that they will be located below and separate from the existing cable.

8.16.6 The existing lashing wire, fittings and attachments shall be adjusted as necessary to maintain proper security of the new cable and the existing cable, and to maintain adequate separations and clearances.

9. CABLE SPLICING AND TERMINALS

9.1 Splicing for copper cable and fiber optic cable shall be in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2).
9.2 Aerial cable terminals and ready-access closures equipped with filled terminal blocks shall be installed in accordance with the Construction Sheets and connected in accordance with the cable schematic drawings furnished by the Engineer. Splicing shall be performed in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2).

10. CLEARING RIGHT-OF-WAY

10.1 In clearing the right-of-way, trees shall be removed or trimmed and underbrush cleared in accordance with the Construction Sheets. Trees fronting the side of the right-of-way shall be trimmed symmetrically unless otherwise directed by the Engineer.

10.2 Dead trees beyond the right-of-way, which would strike the line in falling, shall be removed.

10.3 Leaning trees beyond the right-of-way which would strike the line in falling and which would require topping if not removed, may be removed or topped at the option of the Contractor; however, the Contractor shall trim and not remove shade, fruit, or ornamental trees unless otherwise directed by the Engineer.

LIST OF CONSTRUCTION DRAWINGS AND PLANS

Assembly Unit Drawings

HR1		Ready-Access Enclosure, Lashed Cable Straight Splice		
HR2		Ready-Access Enclosure, Lashed Cable Branch Splice		
PE1-2, PE1-3, a PE1-2G, PE1-3G,	and PE1-4 and PE1-4G	Down Guy Down Guy, Ground Connections		
PE2-2, PE2-3, a PE2-2G, PE2-3G,	and PE2-4 and PE2-4G	Overhead Guy Overhead Guy, Ground Connections		
PF1-3, PF1-5, and PF1-7 PF3-3, PF3-5, and PF3-7 PF5-3 and PF5-4 PF6-3, PF6-4, and PF6-5		Expanding Anchor Assembly Screw Anchor Assembly Rock Anchor Assembly Swamp Anchor Assembly		
PM1		Pole Lightning Protection Assembly		
PM2 PM2-1 PM2A		Pole Ground Assembly Auxiliary Ground Rod Assembly Ground Wire Assembly		
PM4 PM4A		Cable Extension Arm Assembly (Short) Cable Extension Arm Assembly (Long)		
PM5		Pole Stepping Assembly		
PM6 and PM7 PM8 and PM9		Pole Key Assemblies Pole Key Assemblies		
PM12		Sidewalk Guy Arm Assembly		
PM14		Push Brace Accessories		
РМ52		Pole Marking		
	Constructi	on Guide Drawings		
201 201-1 202 202-1 202-3	Suspension Strand Mounting Self Supporting Filled Fiber Optic Cable Support Suspension Strand Mounting (Pull Away from Pole) Suspension Strand Mounting (Pull Against Pole) Self Supporting Filled Fiber Optic Cable Support, Corner			

- 203 Suspension Strand Mounting (Corners) 203-1 Self Supporting Filled Fiber Optic Cable Support, Corner
- 204 Suspension Strand Deadend
- 206 Branch Suspension Strand
- 207 Branch Suspension Strand
- 208 Suspension Strand Pull-Off
- 209-1 Suspension Strand Bonding
- 211 False Deadend
- 212 Strand Layouts
- 214 Arrangement Details of Cables at Pole Supports
- 241 Lashed Cable Support at Pole
- 242 Lashing Wire Terminations
- 243 Lashing Wire Terminations at Suspension Strand Crossovers
- 250 Method of Spiraling Aerial Cable 250-1 Method of Spiraling Self Supporting Filled Fiber Optic Cable (Figure 8 Design)
- 312-1 Aerial Plastic Cable, Details of Wire Connections to Terminal blocks
- 360 Method of Restoring Insulation on Support Member of Self Supporting Filled Fiber Optic Cable (Figure 8 Design)
- 812 Guy Hook, Details of Installation
- 815 Conductor Polarity (Tip and Ring) Diagram (Aerial Plant)

NOTE: On the Assembly Unit or Guide Drawings an asterisk (*) in the ITEM column indicates items that are no longer listed in RUS IP 344-2, "List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers."



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Assembly Unit Drawing



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Assembly Unit Drawing



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PM12



Scale: NTS

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ITEMS	MATERIALS			NO. REQ'D	
0C-C	Cable, filled, fiber optic, self-supporting (figure 8 design)			as required	
*wl	Support, double deadend			1	
*mu	Sleeves, splicing (deadending, preformed or automatic type)			2	
*ny	Spacers, cable			2	
*nz	Supports, lashed cable		2		
d	Washers, 2 1/4" x 2 1/4" x 3/16", 11/16" hole			1	
¢	Bolts, machine, 5/8" x required length			1	
RURAL TELECOMMUNICATIONS CONSTRUCTION PRACTICES SELF-SUPPORTING FILLED FIBER OPTIC CABLE SUPPORT, CORNEF					
		Scale: NTS		March 2001	
				202-3	

Notes: 1. Use for 60 to 2. An eq device provide the ap strand lieu of listed. 3. Square may b length extend short turning curved interfe placing 4. Refer drawin PE1-2 PE2-2 for gu 5. Size o govern	or corners from 90 degrees. uivalent terminating (mu) rated to e the strength of opropriate suspension may be used in ⁵ 3-bolt guy clamps e nut under eye nut be omitted when of bolt thread ling beyond pole is enough to permit g eye nut down to I washer without with the g of strand. to guy assembly gs PE1-2, -3, -4; G, -3G, -4G; 2, -3, -4; and 2G, -3G, -4G for ying materials. of thimbleye nut is bed by size of thimbleye	guy 4			me me and 5 e - 4 in.	- u 2 dz
DOIT U	sea тог диуs.		6M		1014	1614
ITEMS	ΜΛΤΕΡΙΛΙ Ο					
	Clamps auv 3-t		1	1		
ah	Nuts, thimbleve	2	1	1		
~~ 7 +d			1	1		1
me	Connectors, arounding		2	י ר		7
*al	Staples, ground v	as ren'd			as reaid	
*na	Wire, around, bare, #6 AWG copper				red'd	as reald
RURAL TELECOMMUNICATIONS CONSTRUCTION PRACTICES SUSPENSION STRAND MOUNTING (CORNERS)						
	Scale: NTS M			Mar	ch 2001	
						203



(1.) Use for corners from 60 to 90 degrees.

2. Size of thimbleye nut is governed by size of thimbleye bolt used for guy.

ITEMS	MATERIALS			NO. REQ'D
oc-c	Cable, filled, fiber optic, se	as required		
*mu	Sleeves, splicing (deadending, preformed or automatic type)			2
*n y	Spacers, cable			2
*nz	Supports, lashed cable			2
wg	Guard, plastic, cable			1
*nq	Wire, ground, bare, #6 AWG copper			as required
me	Connectors, grounding			2
ab	Nuts, thimbleye			2
*al	Staples, ground wire			as required
RURAL TELECOMMUNICATIONS CONSTRU SELF-SUPPORTING FILLED FIBER OPTIC CA				RUCTION PRACTICES ABLE SUPPORT, CORNER
		Scale: NTS		March 2001
				203–1























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or pole projectio pole.	and that pointed ons are imbedded into			
		6M	10M	16
ITEMS	MATERIALS	NO. REQ'D	NO REQ'D	NO. REQ
br	Hook, guy	1	1	1
С	Bolts, machine, $5/8$ " x required length	1	1	_
d	Washers, curved, 3" x 3" x 1/4", 13/16" hole	-	-	1
С	Bolts, machine, 3/4" x required length	-	-	1
d	Washers, curved, 2 1/2" x 2 1/2" x 3/16", 11/16" hol	e 1	1	-
	RURAL TELECOMMUNICATIONS CONS GUY HOOK, DETAILS OF	STRUCTION INSTALLA	N PRAC TION	TICES
Scale: NTS March 2001				
			812	

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Attachment D

Disclaimer: The contents of this guidance document does not have the force and effect of law and is not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

UNITED STATES DEPARTMENT OF AGRICULTURE Rural Utilities Service

RUS BULLETIN 1753F-601a (PE-90a) RD-GD-2009-61

SUBJECT: MINIMUM PERFORMANCE SPECIFICATION FOR FIBER OPTIC CABLES (FOR BACKBONE, FEEDER AND DISTRIBUTION PLANT)

TO: All Telecommunications Program Borrowers, Cable Manufacturers and Staff

EFFECTIVE DATE: Date of Approval.

OFFICE OF PRIMARY INTEREST: Technical Support Branch

INSTRUCTIONS: This bulletin replaces RUS Bulletin 1753F-601.

AVAILABILITY: This bulletin can be accessed via the Internet at http://www.usda.gov/rus/telecom/publications/bulletins.htm

PURPOSE: This bulletin updates the fiber optic cable specifications to meet current industry standards; includes additional requirements to meet the construction requirements of fiber-to-thehome construction; clarifies certain existing definitions; and separates the existing bulletin (RUS Bulletin 1753F-601) into two distinct bulletins. This bulletin covers minimum requirements for cables intended to be used for backbone, feeder and distribution plant systems (RUS Bulletin 1753F-601a). For service entrance cables, see RUS Bulletin 1753F-601b.

This bulletin is a user friendly guide and a reformat of the text codified in 7 CFR 1755.900, 1755.901, and 1755.902, published at 20560 Federal Register / Vol. 74, No. 85, dated Tuesday, May 5, 2009. Every effort has been made to ensure the accuracy of this document. However, in case of discrepancies, the regulations at 7 CFR 1755.900, 1755.901, and 1755.902 are the authorized sources.

ACKNOWLEDGMENT: The reproduction of copyrighted Insulated Cable Engineers Association (ICEA) tables is with permission of ICEA and is for information purposes. The reader is cautioned that the ICEA Standards are under constant revision and is advised to check ICEA for subsequent changes or modifications. RUS thanks ICEA for granting permission to reprint many of the tables found in ANSI/ICEA S-87-640-2006, *Standard for Optical Fiber Outside Plant Communications Cable*, 4th edition, December 2006. The reproduction of these tables makes available general information of interest to our borrowers, engineers, and contractors.

Yonathan Adelstein Administrator Rural Utilities Service



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- a Scope
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- d Fiber Identification
- e Optical Fiber Ribbon
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- g Cable Core
- h *Core Water Blocking*
- i Water Blocking Material
- j Core Wrap
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ABBREVIATIONS

ADSS	All dielectric self-supporting
ASTM	American Society for Testing and Materials
°C	Centigrade temperature scale
dB	Decibel
CSM	Central strength member
dB/km	Decibels per 1 kilometer
ECCS	Electrolytic chrome coated steel
EIA	Electronic Industries Alliance
EIA/TIA	Electronic Industries Alliance/Telecommunications Industry Association;
FTTH	Fiber-to-the-Home
Gbps	Gigabit per second or Gbit/s
GE	General Electric
HDPE	High density polyethylene
ICEA	Insulated Cable Engineers Association, Inc.
Km	kilometer(s)
LDPE	Low density polyethylene
m	meter(s)
Max.	Maximum
Mbit	Megabits
MDPE	Medium density polyethylene
MHz-km	Megahertz-kilometer
Min.	Minimum
MFD	Mode-Field Diameter
nm	Nanometer(s)
N	Newton(s)
NA	Numerical aperture
NESC	National Electrical Safety Code
OC	Optical cable
O.D.	Outside Diameter
OF	Optical fiber
OSHA	Occupational Safety and Health Administration
OTDR	Optical Time Domain Reflectometer
%	Percent
ps/(nm·km)	Picosecond per nanometer times kilometer
ps/(nm ² ·km)	Picosecond per nanometer squared times kilometer
PMD	Polarization Mode Dispersion
RUS	Rural Utilities Service
S	Seconds(s)
SI	International System (of Units) (From the French Système
	international d'unités)
μm	Micrometer

DEFINITIONS

Accept; Acceptance means Agency action of providing the manufacturer of a product with a letter by mail or facsimile that the Agency has determined that the manufacturer's product meets its requirements. For information on how to obtain Agency product acceptance, refer to the procedures listed at

http://www.usda.gov/rus/telecom/listing_procedures/index_listing_procedures.htm, as well as additional information in RUS Bulletin 345-3, *Acceptance of Standards, Specifications, Equipment Contract Forms, Manual Sections, Drawings, Materials and Equipment for the Telephone Program,* available for download at http://www.usda.gov/rus/telecom/publications/bulletins.htm.

Agency means the Rural Utilities Service, an Agency of the United States Department of Agriculture.

Armor means a metal tape installed under the outer jacket of the cable intended to provide mechanical protection during cable installation and environmental protection against rodents, termites, etc.

Attenuation means the loss of power as the light travels in the fiber usually expressed in dB/km.

Bandwidth means the range of signal frequencies that can be transmitted by a communications channel with defined maximum loss or distortion. Bandwidth indicates the information-carrying capacity of a channel.

Birefringence means the decomposition of a pulse of light entering the fiber into "two polarized pulses" traveling at different velocities due to the different refractive indexes in the polarization axes in which the electric fields oscillate. Different refractive indexes in the fiber may be caused by an asymmetric fiber core, internal manufacturing stresses, or through external stresses from cabling and installation of the fiber optic cable, such as bending and twisting.

Cable cutoff wavelength means the shortest wavelength at which only one mode light can be transmitted in any of the single mode fibers of an optical fiber cable.

Chromatic Dispersion means the broadening of a light pulse as it travels down the length of an optical fiber, resulting in different spectral components of the light pulse traveling at different speeds, due to the fact that the index of refraction of the fiber core is different for different wavelengths.

Cladding means the outer layer of an optical fiber made of glass or other transparent material that is fused to the fiber core. The cladding concentrically surrounds the fiber core. It has a lower refractive index than the core, so light travelling in the fiber is maintained in the core by internal reflection at the core-cladding interface.

Core means the central region of an optical waveguide or fiber which has a higher refractive index than the cladding through which light is transmitted.

Cutoff Wavelength means, in single mode fiber, the shortest wavelength at which only the fundamental mode of an optical wavelength can propagate.

Dielectric Cable means a cable which has neither metallic members nor other electrically conductive materials or elements.

Differential Group Delay means the arrival time differential of the two polarized light components of a light pulse traveling through the optical fiber due to birefringence.

Graded Refractive Index Profile means the refractive index profile of an optical fiber that varies smoothly with radius from the center of the fiber to the outer boundary of the cladding.

List of Acceptable Materials means the latest edition of RUS Informational Publication 344–2, "*List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers.*" This document contains a convenient listing of products which have been determined to be acceptable by the Agency. The List of Acceptable Materials is available on the Internet at *http://www.usda.gov/rus/telecom/materials/index_listomat.htm*.

Loose Tube Buffer means the protective tube that loosely contains the optical fibers within the fiber optic cable, often filled with suitable water blocking material.

Matched Cable means fiber optic cable manufactured to meet the requirement of this section for which the calculated splice loss using the formula below is ≤ 0.06 dB for any two cabled fibers to be spliced.

LOSS (dB) = $-10 \text{ LOG}_{10} [4/(\text{MFD}_1/\text{MFD}_2 + \text{MFD}_2/\text{MFD}_1)^2],$

where subscripts 1 and 2 refer to any two cabled fibers to be spliced.

Mil means a measurement unit of length indicating one thousandth of an inch.

Minimum Bending Diameter means the smallest diameter that must be maintained while bending a fiber optic cable to avoid degrading cable performance indicated as a multiple of the cable diameter (Bending Diameter/Cable Diameter).

Mode-Field Diameter means the diameter of the cross-sectional area of an optical fiber which includes the core and portion of the cladding where the majority of the light travels in a single mode fiber.

Multimode Fiber means an optical fiber in which light travels in more than one bound mode. A multimode fiber may either have a graded index or step index refractive index profile.

Numerical Aperture (NA) means an optical fiber parameter that indicates the angle of acceptance of light into a fiber.

Optical Fiber means any fiber made of dielectric material that guides light.

Optical Point Discontinuities means the localized deviations of the optical fiber loss characteristic which location and magnitude may be determined by appropriate OTDR measurements of the fiber.

Optical Waveguide means any structure capable of guiding optical power. In optical communications, the term generally refers to a fiber designed to transmit optical signals.

Polarization Mode Dispersion means, for a particular length of fiber, the average of the differential group delays of the two polarized components of light pulses traveling in the fiber, when the light pulses are generated from a sufficient narrow band source. The differential group delay varies randomly with time and wavelength. The term PMD is used in the industry in the general sense to indicate the phenomenon of birefringence (polarized light having different group velocities), and used specifically to refer to the value of time delay expected in a specific length of fiber.

 PMD_Q means the statistical upper bound for the PMD coefficient of a fiber optic cable link composed of M number of randomly chosen concatenated fiber optic cable sections of the same length. The upper bound is defined in terms of a probability level Q, which is the probability that a concatenated PMD coefficient value exceeds PMD_Q . ITU G recommendations for fiber optic cables call for M=20 and Q=0.01%. This PMD_Q value is the one used in the design of fiber optic links.

Ribbon means a planar array of parallel optical fibers.

Shield means a conductive metal tape placed under the cable jacket to provide lightning protection, bonding, grounding, and electrical shielding.

Single Mode Fiber means an optical fiber in which only one bound mode of light can propagate at the wavelength of interest.

Step Refractive Index Profile means an index profile characterized by a uniform refractive index within the core, a sharp decrease in refractive index at the core-cladding interface, and a uniform refractive index within the cladding.

Tight Tube Buffer means one or more layers of buffer material tightly surrounding a fiber that is in contact with the coating of the fiber.

APPENDIX

1 INCORPORATION BY REFERENCE

a The materials listed here are incorporated by reference where noted. These incorporations by reference were approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. These materials are incorporated as they exist on the date of the approval, and notice of any change in these materials will be published in the Federal Register. The materials are available for purchase at the corresponding addresses noted below. All are available for inspection at the Rural Utilities Service, during normal business hours at room 2849-S, U.S. Department of Agriculture, Washington, DC 20250. Telephone (202) 720-0699, and email norberto.esteves@wdc.usda.gov. The materials are also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of these materials at NARA, call (202) 741–6030, or go to:

http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locati ons.html.

- The American National Standards Institute/Institute of Electrical and Electronics Engineers, Inc. ANSI/IEEE C2-2007, *The National Electrical Safety Code*, 2007 edition, approved April 20, 2006 ("ANSI/IEEE C2-2007"), incorporation by reference approved for sections 2a and 2p. ANSI/IEEE C2-2007 is available for purchase from IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854, telephone 1-800-678-4333 or online at http://standards.ieee.org/nesc/index.html.
- (2) The following Insulated Cable Engineers Association standard is available for purchase from the Insulated Cable Engineers, Inc. (ICEA), P.O. Box 1568, Carrollton, GA 30112 or from Global Engineering Documents, 15 Iverness Way East, Englewood, CO 80112, telephone 1-800-854-7179 (USA and Canada) or 303-792-2181 (International), or online at http://global.ihs.com: ANSI/ICEA S-87-640-2006, *Standard for Optical Fiber Outside Plant Communications Cable*, 4th edition, December 2006 ("ANSI/ICEA S-87-640"), incorporation by reference approved for sections 2a, 2b, 2c, 2d, 2e, 2i, 2l, 2m, 2n, 2p, 2q, 2r and 2u.

- (3) The following American Society for Testing and Materials (ASTM) standards are available for purchase from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. Telephone (610) 832-9585, Fax (610) 832-9555, by email at service@astm.org, or online at http://www.astm.org or from ANSI, 1916 Race Street, Philadelphia, PA 19103, telephone (215) 299-5585, or online at http://webstore.ansi.org/ansidocstore/default.asp:
 - (a) ASTM A 640-97, (Reapproved 2002)^{ε1}, Standard Specification for Zinc-Coated Steel Strand for Messenger Support of Figure 8 Cable, approved September 2002 ("ASTM A 640"), incorporation by reference approved for section 2n;
 - (b) ASTM B 736-00, Standard Specification for Aluminum, Aluminum Alloy and Aluminum-Clad Steel Cable Shielding Stock, approved May 10, 2000 ("ASTM B 736"), incorporation by reference approved for section 2m;
 - (c) ASTM D 4565-99, Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable, approved March 10, 1999 ("ASTM D 4565"), incorporation by reference approved for 2c and 2m;
 - (d) ASTM D 4566-98, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable, approved December 10, 1998 ("ASTM D 4566"), incorporation by reference approved for sections 2f and 2t; and
 - (e) ASTM D 4568-99, Standard Test Methods for Evaluating Compatibility Between Cable Filling and Flooding Compounds and Polyolefin Wire and Cable Materials, approved April 10, 1999 ("ASTM D 4568"), incorporation by reference approved for section 2h.
- (4) The following Telecommunications Industry Association/Electronics Industries Association (TIA/EIA) standard is available from Electronics Industries Association, Engineering Department, 1722 Eye Street, NW, Washington, DC 20006; or from Global Engineering Documents, 15 Iverness Way East, Englewood, CO 80112, telephone 1-800-854-7179 (USA and Canada) or (303) 792-2181 (International), or online at http://global.ihs.com; or from TIA, 2500 Wilson Blvd, Suite 300, Arlington, VA 22201, telephone 1-800-854-7179 or online http://www.tiaonline.org/standards/catalog: TIA/EIA Standard 455-3A, *FOTP-3, Procedure to Measure Temperature Cycling on Optical Fibers,*

Optical Cable, and Other Passive Fiber Optic Components, approved May 1989 ("TIA/EIA Standard 455-3A"), incorporation by reference approved for section 2r.

- (5) The following International Telecommunication Union (ITU) recommendations may be obtained from ITU, Place des Nations, 1211 Geneva 20, Switzerland, telephone +41 22 730 6141 or online at http://www.itu.int/ITU-T/publications/recs.html:
 - (a) ITU-T Recommendation G.652, Series G: Transmission Systems and Media, Digital Systems and Networks, Transmission media characteristics—Optical fibre cables, Characteristics of a singlemode optical fibre and cable, approved June 2005 ("ITU-T Recommendation G.652"), incorporation by reference approved for sections 2b and 2q;
 - (b) ITU-T Recommendation G.655, Series G: Transmission Systems and Media, Digital Systems and Networks, Transmission media characteristics—Optical fibre cables, Characteristics of a nonzero dispersion-shifted single-mode optical fibre and cable, approved March 2006 ("ITU-T Recommendation G.655"), incorporation by reference approved for sections 2b and 2q;
 - (c) ITU-T Recommendation G.656, Series G: Transmission Systems and Media, Digital Systems and Networks, Transmission media characteristics—Optical fibre cables, Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport, approved December 2006 ("ITU-T Recommendation G.656"), incorporation by reference approved for sections 2b and 2q;
 - (d) ITU-T Recommendation G.657, Series G: Transmission Systems and Media, Digital Systems and Networks, Transmission media characteristics—Optical fibre cables, Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network, approved December 2006 ("ITU-T Recommendation G.657"), incorporation by reference approved for sections 2b(2) and 2q(1); and
 - (e) ITU-T Recommendation L.58, Series L: Construction, Installation and Protection of Cables and Other Elements of Outside Plant, Optical fibre cables: Special Needs for Access Network, approved March 2004 ("ITU-T Recommendation L.58"), incorporation by reference approved for 2a.

2. MINIMUM PERFORMANCE SPECIFICATION FOR FIBER OPTIC CABLES

- a *Scope*. This section is intended for cable manufacturers, Agency borrowers, and consulting engineers. It covers the requirements for fiber optic cables intended for aerial installation either by attachment to a support strand or by an integrated self-supporting arrangement, for underground application by placement in a duct, or for buried installations by trenching, direct plowing, and directional or pneumatic boring.
 - (1) General
 - (a) Specification requirements are given in SI units which are the controlling units in this part. Approximate English equivalent of units are given for information purposes only.
 - (b) The optical waveguides are glass fibers having directly-applied protective coatings, and are called "fibers," herein. These fibers may be assembled in either loose fiber bundles with a protective core tube, encased in several protective buffer tubes, in tight buffer tubes, or ribbon bundles with a protective core tube.
 - (c) Fillers, strength members, core wraps, and bedding tapes may complete the cable core.
 - (d) The core or buffer tubes containing the fibers and the interstices between the buffer tubes, fillers, and strength members in the core structure are filled with a suitable material or water swellable elements to exclude water.
 - (e) The cable structure is completed by an extruded overall plastic jacket. A shield or armor or combination thereof may be included under the jacket. The jacket may have strength members embedded in it, in some designs.
 - (f) Buried installation requires armor under the outer jacket.
 - (g) For self-supporting cable, the outer jacket may be extruded over the support messenger and cable core.
 - (h) Cables for mid-span applications for network access must be designed for easy mid-span access to the fibers. The manufacturer may use reversing oscillating stranding (SZ) described in section 6.4 of ITU-T Recommendation L.58, *Construction, Installation and Protection of Cables and Other Elements of Outside Plant*, 2004. The cable end user is cautioned that installed cable must be properly terminated. This includes properly securing rigid strength members (i.e.

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central strength member) and clamping the cable and jacket. It is important that cable components be secured to prevent movement of the cable or components over the operating conditions. Central strength member (CSM) clamps must prevent movement of the CSM; positive stop CSM clamps are recommended. The CSM must be routed as straight and as short as practical to prevent bowing or breaking of the CSM. The cable and jacket retention must be sufficient to prevent jacket slippage over the operating temperature range.

(2) The normal temperature ranges for cables must meet paragraph 1.1.3 of ANSI/ICEA S-87-640, Standard for Optical Fiber Outside Plant Communications Cable. (See reproduced Table 1.1 from ANSI/ICEA S-87-640 below for temperature ranges.)

Table 1.1 - Cable normal temperature ranges				
(°C) (°F)				
Operation	40 to +70	(-40 to +158)		
Storage and Shipping	-40 to +70	(-40 to +158)		
Installation	30 to +60	(-22 to +140)		

- (3) Tensile Rating. The standard installation tensile rating for cables is 2670 N (600 1bf), unless installation involves micro type cables that utilize less stress related methods of installation, i.e. blown micro-fiber cable or All-Dielectric Self-Supporting (ADSS) cables (see paragraph a(4) of this section).
- (4) ADSS and Other Self-Supporting Cables. Based on the storm loading districts referenced in Section 25, Loading of Grades B and C, of ANSI/IEEE C2-2007, National Electrical Safety Code, 2007 and the maximum span and location of cable installation provided by the end user, the manufacturer must provide a cable design with sag and tension tables showing the maximum span and sag information for that particular installation. The information included must be for Rule B, Ice and Wind Loading, and when applicable, information on Rule 250C, Extreme Wind Loading. Additionally, to ensure the proper ground clearance, typically a minimum of 4.7 m (15.5 feet), the end user should factor in the maximum sag under loaded conditions, as well as, height of attachment for each application.

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(5) Minimum Bend Diameter. For cable under loaded and unloaded conditions, the cable must have the minimum bend diameters indicated in paragraph 1.1.5, Minimum Bend Diameter, of the ANSI/ICEA S-87-640. (See table below for ANSI/ICEA S-87-640 bend diameters.) For very small cables, manufacturers may specify fixed cable minimum bend diameters that are independent of the outside diameter. For cables having a non-circular cross-section, the bend diameter is to be determined using the thickness of the cable associated with the preferential bending axis.

Minimum Bend Diameters		
Residual (Installed)	20 x Cable O.D.	
Loaded Condition (During Installation)	40 x Cable O.D.	

- (6) The cable is fully color coded so that each fiber is distinguishable from every other fiber. A basic color scheme of twelve colors allows individual fiber identification. Colored tubes, binders, threads, strippings, or markings provide fiber group identification.
- (7) Cables must demonstrate compliance with the qualification testing requirements of this section to ensure satisfactory end-use performance characteristics for the intended applications.
- (8) Optical cable designs not specifically addressed by this section may be allowed if accepted by the Agency. Justification for acceptance of a modified design must be provided to substantiate product utility and long term stability and endurance. For information on how to obtain Agency product acceptance, refer to the procedures listed at http://www.usda.gov/rus/telecom/listing_procedures/index_listing_p rocedures.htm, as well as additional information in RUS Bulletin 345-3, Acceptance of Standards, Specifications, Equipment Contract Forms, Manual Sections, Drawings, Materials and Equipment for the Telephone Program (hereinafter "RUS Bulletin 345-3"), available for download at http://www.usda.gov/rus/telecom/publications/bulletins.htm.
- (9) All cables sold to RUS telecommunications borrowers for projects involving RUS loan funds must be accepted by the Agency's Technical Standards Committee "A" (Telecommunications). Any design change to existing acceptable designs must be submitted to the Agency for acceptance. As stated in paragraph 2a(8) above, refer to the procedures listed at

http://www.usda.gov/rus/telecom/listing_procedures/index_listing_proced ures.htm as well as RUS Bulletin 345-3.

- (10) The Agency intends that the optical fibers contained in the cables meeting the requirements of this section have characteristics that will allow signals having a range of wavelengths to be carried simultaneously.
- b Optical Fibers
 - (1) The solid glass optical fibers must consist of a cylindrical core and cladding covered by either an ultraviolet-cured acrylate or other suitable coating. Each fiber must be continuous throughout its length.
 - (2) Zero-dispersion. Optical fibers must meet the fiber attributes of Table 2, G.652.B attributes, found in ITU-T Recommendation G.652. However, when the end user stipulates a low water peak fiber, the optical fibers must meet the fiber attributes of Table 4, G.652.D attributes, found in ITU-T Recommendation G.652; or when the end user stipulates a low bending loss fiber, the optical fibers must meet the fiber attributes of Table 7-1, G.657 class A attributes, found in the ITU-T Recommendation G.657.
 - (3) *Non-zero-dispersion*. Optical fibers must meet the fiber attributes of Table 1, *G.656 attributes*, found in ITU-T Recommendation G.656. However, when the end user specifies Recommendation A, B, C, D, or E of ITU-T Recommendation G.655, the optical fibers must meet the fiber attributes of ITU-T Recommendation G.655.
 - (4) *Multimode fiber*. Optical fibers must meet the requirements of paragraphs 2.1 and 2.3.1 of ANSI/ICEA S-87-640. (See reproduced Table 2.1 from ANSI/ICEA S-87-640 below for requirements.)

Table 2.1 Multimode optical fiber specification requirements (1)				
Fiber Type	TIA/EIA Specification Reference			
	Sectional Blank	Sectional Blank	Sectional Blank	
	Detail	Detail	Detail	
50 µm	492A000	492AA00	492AAAB	
50 µm (2)	492A000	492AA00	492AAAC	
62.5 µm	492A000	492AA00	492AAAA	
	Fiber Attributes	s (Informative) (3)		
Fiber Class	Diamete	ers (µm)	Numerical	
and Subclass	Core	Cladding	Aperture	
la	50 +/- 3.0	125.0 ± 2.0	0.200 +/- 0.015	
là	62.5 +/- 3.0	125.0 ± 2.0	0.275 +/- 0.015	
 Notes: Fiber specifications listed herein are provided for convenience, but are dynamic and subject to change. Users should refer to the relevant TIA-492 detailed fiber specification for current requirements. 850 nm laser-optimized 50 μm fiber. These attributes are defined by the detailed fiber specifications called out above. The values are subject to change, and are included here for information only. Refer to the latest fiber specifications for current normative values. 				

- (5) *Matched cable.* Unless otherwise specified by the buyer, all single mode fiber cables delivered to a RUS-financed project must be manufactured to the same MFD specification. However, notwithstanding the requirements of paragraphs 2b(2) and 2b(3), the maximum MFD tolerance allowed for cable meeting the requirements of this section must be of a magnitude meeting the definition of "matched cable," as defined in this bulletin. With the use of cables meeting this definition the user can reasonably expect the average bi-directional loss of a fusion splice to be ≤ 0.1 dB.
- (6) Buyers will normally specify the MFD for the fibers in the cable. When a buyer does not specify the MFD at 1310 nm, the fibers must be manufactured to an MFD of 9.2 μ m with a maximum tolerance range of \pm 0.5 μ m (362 \pm 20 microinch), unless the end user agrees to accept cable with fibers specified to a different MFD. When the end user does specify a MFD and tolerance conflicting with the MFD maximum tolerance allowed by paragraph 2b(5), the requirements of paragraph b(5) must prevail.
- (7) Factory splices are not allowed.
- (8) Coating. The optical fiber must be coated with a suitable material to preserve the intrinsic strength of the glass having an outside diameter of 250 ± 15 micrometers (10 ± 0.6 mils). Dimensions must be measured per the methods of paragraph 7.13 of ANSI/ICEA S-87-640. The protective coverings must be free from holes, splits, blisters, and other imperfections and must be as smooth and concentric as is consistent with the best commercial practice. The diameter of the fiber, as the fiber is used in the cable, includes any coloring thickness or the uncolored coating, as the case may be. The strip force required to remove 30 ± 3 millimeters (1.2 ± 0.1 inch) of protective fiber coating must be between 1.0 N (0.2 pound-force) and 9.0 N (2 pound-force).
- (9) All optical fibers in any single length of cable must be of the same type, unless otherwise specified by end user.
- (10) Optical fiber dimensions and data reporting must be as required by paragraph 7.13.1.1 of ANSI/ICEA S-87-640.
- c Buffers
 - (1) The optical fibers contained in a tube buffer (loose tube), an inner jacket (unit core), a channel, or otherwise loosely packaged must have a clearance between the fibers and the inside of the container sufficient to allow for thermal expansions of the tube buffer without constraining the fibers. The protective container must be manufactured from a material having a coefficient of friction sufficiently low to allow the fibers free

movement. The loose tube must contain a suitable water blocking material. Loose tubes must be removable without damage to the fiber when following the manufacturer's recommended procedures.

- (2) The tubes for single mode loose tube cables must be designed to allow a maximum mid-span buffer tube exposure of 6.096 meters (20 feet). The buyer should be aware that certain housing hardware may require cable designed for 6.096 meters of buffer tube storage.
- (3) Optical fibers covered in near contact with an extrusion (tight tube) must have an intermediate soft buffer to allow for thermal expansions and minor pressures. The buffer tube dimension must be established by the manufacturer to meet the requirement of this section. Tight buffer tubes must be removable without damage to the fiber when following the manufacturer's recommended procedures. The tight buffered fiber must be strippable per paragraph 7.20 of ANSI/ICEA S-87-640.
- (4) Both loose tube and tight tube coverings of each color and other fiber package types removed from the finished cable must meet the following shrinkback and cold bend performance requirements. The fibers may be left in the tube.
 - (a) Shrinkback. Testing must be conducted per paragraph 14.1 of ASTM D 4565, using a talc bed at a temperature of 95°C (203°F). Shrinkback must not exceed 5 percent of the original 150 millimeter (6 inches) length of the specimen. The total shrinkage of the specimen must be measured. (Buffer tube material meeting this test may not meet the mid-span test in paragraph 2r(16) of this bulletin).
 - (b) Cold Bend. Testing must be conducted on at least one tube from each color in the cable. Stabilize the specimen to $-30 \pm 1^{\circ}C$ (-22 $\pm 2^{\circ}F$) for a minimum of four hours. While holding the specimen and mandrel at the test temperature, wrap the tube in a tight helix ten times around a mandrel with a diameter to be greater than five times the tube diameter or 50 mm (2 inches). The tube must show no evidence of cracking when observed with normal or correctedto-normal vision.

Note to paragraph 2c(4)(b): Channel cores and similar slotted single component core designs do not need to be tested for cold bend.

- d *Fiber Identification*
 - (1) Each fiber within a unit and each unit within the cable must be identifiable per paragraphs 4.2.1 and 4.3.1 of ANSI/ICEA S-87-640.
 - (2) For the following items the colors designated for identification within the cable must comply with paragraphs 4.2.2 and 4.3.2 of ANSI/ICEA S-87-640: loose buffer tubes, tight tube buffer fibers, individual fibers in multifiber tubes, slots, bundles or units of fibers, and the units in cables with more than one unit. (See reproduced Table 4.1 from ANSI/ICEA S-87-640 below for identification colors.)

Position number	Base color and tracer	Abbreviation/print legend
1	Blue	1 or BL or 1-BL
2	Orange	2 or OP or 2 OP
2	Green	3 or GR or 3-GR
4	Brown	4 or BR or 4-BR
5	Slate	5 or SL or 5-SL
6	White	6 or WH or 6-WH
7	Red	7 or RD or 7-RD
8	Black	8 or BK or 8-BK
9	Yellow	9 or YL or 9-YL
10	Violet	10 or VI or 10-VI
11	Rose	11 or RS or 11-RS
12	Aqua	12 or AQ or 12-AQ
13	Blue with Black Tracer	13 or D/BL or 13-D/BL ⁽¹⁾
14	Orange with Black Tracer	14 or D/OR or 14-D/OR
15	Green with Black Tracer	15 or D/GR or 15-D/GR
16	Brown with Black Tracer	16 or D/BR or 16-D/BR
17	Slate with Black Tracer	17 or D/SL or 17-D/SL
18	White with Black Tracer	18 or D/WH or 18-D/WH
19	Red with Black Tracer	19 or D/RD or 19-D/RD
20	Black with White Tracer	20 or D/BK or 20-D/BK(2)
21	Yellow with Black Tracer	21 or D/YL or 21-D/YL
22	Violet with Black Tracer	22 or D/VI or 22-D/VI
23	Rose with Black Tracer	23 or D/RS or 23-D/RS
24	Aqua with Black Tracer	24 or D/AQ or 24-D/AQ
25	Blue with Double Black Tracer	25 or DD/BL or 25-DD/BL(3)
26	Orange with Double Black Tracer	26 or DD/OR or 14-DD/OR
27	Green with Double Black Tracer	27 or DD/GR or 15-DD/GR
28	Brown with Double Black Tracer	28 or DD/BR or 16-DD/BR
29	Slate with Double Black Tracer	29 or DD/SL or 17-DD/SL
30	White with Double Black Tracer	30 or DD/WH or 18-DD/WH
31	Red with Double Black Tracer	31 or DD/RD or 19-DD/RD
32	Black with Double White Tracer	32 or DD/BK or 20-DD/BK(2)
33	Yellow with Double Black Tracer	33 or DD/YL or 21-DD/YL
34	Violet with Double Black Tracer	34 or DD/VI or 22-DD/VI
35	Rose with Double Black Tracer	35 or DD/RS or 23-DD/RS
36	Aqua with Double Black Tracer	36 or DD/AQ or 24-DD/AQ

Notes:

1) "D/" denotes a dashed mark or tracer. That is, D/BL is Dash/Blue, meaning Blue with a tracer.

2) Pertaining to positions 20 and 32, yellow tracers are also allowed.

3) "DD/" denotes a double dashed mark or tracer. That is, DD/BL is Double Dash/Blue, meaning Blue with a double tracer.

- e Optical Fiber Ribbon
 - (1) Each ribbon must be identified per paragraphs 3.4.1 and 3.4.2 of ANSI/ICEA S-87-640. See table below.
 - (2) Ribbon fiber count must be specified by the end user, e.g. 2, 4, 6 and 12, etc.
 - (3) Ribbon dimensions must be as agreed by the end user and manufacturer per paragraph 3.4.4.1 of ANSI/ICEA S-87-640.
 - (4) Ribbons must meet each of the following tests. These tests are included in the paragraphs of ANSI/ICEA S-87-640, indicated in parenthesis below.
 - (a) Ribbon Dimensions (ANSI/ICEA S-87-640 paragraphs 7.14 through 7.14.2) measures ribbon dimension.
 - (b) Ribbon Twist Test (ANSI/ICEA S-87-640 paragraphs 7.15 through 7.15.2) – evaluates the ability of the ribbon to resist splitting or other damage while undergoing dynamic cyclically twisting the ribbon under load.
 - (c) Ribbon Residual Twist Test (ANSI/ICEA S-87-640 paragraphs 7.16 through 7.16.2) – evaluates the degree of permanent twist in a cabled optical ribbon.
 - (d) Ribbon Separability Test (ANSI/ICEA S-87-640 paragraphs 7.17 through 7.17.2) evaluates the ability to separate fibers.
 - (e) Ribbons must meet paragraph 3.4.4.6 of ANSI/ICEA S-87-640, Ribbon Strippability.

f Strength Members

- (1) Strength members may be an integral part of the cable construction, but are not considered part of the support messenger for self-supporting optical cable.
- (2) The strength members may be metallic or nonmetallic.
- (3) The combined strength of all the strength members must be sufficient to support the stress of installation and to protect the cable in service.
- (4) Strength members may be incorporated into the core as a central support member or filler, as fillers between the fiber packages, as an annular

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serving over the core, as an annular serving over the intermediate jacket, embedded in the outer jacket, or as a combination of any of these methods.

- (5) The central support member or filler must contain no more than one splice per kilometer of cable. Individual fillers placed between the fiber packages and placed as annular servings over the core must contain no more than one splice per kilometer of cable. Cable sections having central member or filler splices must meet the same physical requirements as unspliced cable sections.
- (6) In each length of completed cable having a metallic central member, the dielectric strength between the shield or armor, when present, and the metallic center member must withstand at least 15 kilovolts when tested per ASTM D 4566. The voltage must be applied for 3 seconds minimum; no failures are allowed.
- g Cable Core
 - (1) Protected fibers may be assembled with the optional central support member, fillers and strength members in such a way as to form a cylindrical group.
 - (2) The standard cylindrical group or core designs commonly consist of 4, 6, 12, 18 or 24 fibers. Cylindrical groups or core designs larger than the sizes shown above must meet all the applicable requirements of this section.
 - (3) When threads or tapes are used in cables using water blocking elements as core binders, they must be a non-hygroscopic and non-wicking dielectric material or be rendered by the gel or water blocking material produced by the ingress of water.
 - (4) When threads or tapes are used as unit binders to define optical fiber units in loose tube, tight tube, slotted, or bundled cored designs, they must be non-hygroscopic and non-wicking dielectric material or be rendered by the filling compound or water blocking material contained in the binder. The colors of the binders must be per paragraphs 2d(1) and 2d(2) of this bulletin.

h Core Water Blocking

- (1) To prevent the ingress of water into the core and water migration, a suitable filling compound or water blocking elements must be applied into the interior of the loose fiber tubes and into the interstices of the core. When a core wrap is used, the filling compound or water blocking elements, as the case may be, must also be applied to the core wrap, over the core wrap and between the core wrap and inner jacket when required.
- (2) The materials or elements must be homogeneous and uniformly mixed; free from dirt, metallic particles and other foreign matter; easily removed; nontoxic and present no dermal hazards. The filling compound and water blocking elements must contain a suitable antioxidant or be of such composition as to provide long term stability.
- (3) The individual cable manufacturer must satisfy the Agency that the filling compound or water blocking elements selected for use is suitable for its intended application by submitting test data showing compliance with ASTM D 4568. The filling compound and water blocking elements must be compatible with the cable components when tested per ASTM D 4568 at a temperature of 80°C (176°F). The jacket must retain a minimum of 85% of its un-aged tensile and elongation values.

i Water Blocking Material

- (1) Sufficient flooding compound or water blocking elements must be applied between the inner jacket and armor and between the armor and outer jacket so that voids and air spaces in these areas are minimized. The use of flooding compound or water blocking elements between the armor and outer jacket is not required when uniform bonding, paragraph 2m(9), is achieved between the plastic-clad armor and the outer jacket.
- (2) The flooding compound or water blocking elements must be compatible with the jacket when tested per paragraphs 7.19 and 7.19.1 of ANSI/ICEA S-87-640. The aged jacket must retain a minimum of 85% of its un-aged tensile strength and elongation values when tested per paragraph 7.19.2.3. The flooding compound must exhibit adhesive properties sufficient to prevent jacket slip when tested per paragraph 7.30.1 of ANSI/ICEA S-87-640 and meets paragraph 7.30.2 of ANSI/ICEA S-87-640 for minimum sheath adherence of 14 N/mm for armored cables.
- (3) The individual cable manufacturer must satisfy the Agency by submitting test data showing compliance with the appropriate cable performance testing requirements of this section that the flooding compound or water blocking elements selected for use is acceptable for the application.

- j Core Wrap
 - (1) At the option of the manufacturer, one or more layers of dielectric material may be applied over the core.
 - (2) The core wrap(s) can be used to provide a heat barrier to prevent deformation or adhesion between the fiber tubes or can be used to contain the core.
- k Inner Jackets
 - (1) For designs with more than one jacket, the inner jackets must be applied directly over the core or over the strength members when required by the end user. The jacket must be free from holes, splits, blisters, or other imperfections and must be as smooth and concentric as is consistent with the best commercial practice. The inner jacket must not adhere to other cable components such as fibers, buffer tubes, etc.
 - (2) For armored and unarmored cable, an inner jacket is optional. The inner jacket may absorb stresses in the cable core that may be introduced by armor application or by armored cable installation.
 - (3) The inner jacket material and test requirements must be the same as the outer jacket material, except that either black or natural polyethylene may be used and the thickness requirements are included in paragraph 2k(4) of this bulletin. In the case of natural polyethylene, the requirements for absorption coefficient and the inclusion of furnace black are waived.
 - (4) The inner jacket thickness must be determined by the manufacturer, but must be no less than a nominal jacket thickness of 0.5 mm (0.02 inch) with a minimum jacket thickness of 0.35 mm (0.01 inch).
- 1 Outer Jacket
 - (1) The outer jacket must provide the cable with a tough, flexible, protective covering which can withstand exposure to sunlight, to atmosphere temperatures, and to stresses reasonably expected in normal installation and service.
 - (2) The jacket must be free from holes, splits, blisters, or other imperfections and must be as smooth and concentric as is consistent with the best commercial practice.

- (3) The jacket must contain an antioxidant to provide long term stabilization and must contain a minimum of 2.35 percent concentration of furnace black to provide ultraviolet shielding measures as required by paragraph 5.4.2 of ANSI/ICEA S-87-640, except that the concentration of furnace black does not necessarily need to be initially contained in the raw material and may be added later during the jacket making process.
- (4) The raw material used for the outer jacket must be one of the types listed below.
 - (a) *Type L1*. Low density, polyethylene (LDPE) must conform to the requirements of paragraph 5.4.2 of ANSI/ICEA S-87-640.
 - (b) *Type L2*. Linear low density, polyethylene (LLDPE) must conform to the requirements of paragraph 5.4.2 of ANSI/ICEA S-87-640.
 - (c) *Type M*. Medium density polyethylene (MDPE) must conform to the requirements of A paragraph 5.4.2 of ANSI/ICEA S-87-640.
 - (d) *Type H*. High density polyethylene (HDPE) must conform to the requirements of paragraph 5.4.2 of ANSI/ICEA S-87-640.
- (5) Particle size of the carbon selected for use must not average greater than 20 nm.
- (6) The outer jacketing material removed from or tested on the cable must be capable of meeting the performance requirements of Table 5.1 found in ANSI/ICEA S-87-640. (See reproduced Table 5.1 from ANSI/ICEA S-87-640 on next page for jacket requirements.)

Table 5.1 - Requirements for jackets removed from completed cable ⁽¹⁾					
Polyethylene Material		PHYSICAL PERFORMANCE BY JACKET TYPE			
PROPERTY ⁽²⁾	Test Method	L1	L2	Μ	Н
Density(3) - g/cm3 - Minimum - Maximum	7.7	0.920 0.940	0.925 0.945	0.940 0.955	0.952 0.973
Ultimate Elongation - Unaged % Minimum	7.8	400	400	400	300
Yield Strength - Mpa (psi) Minimum	7.8	6.9 (1000)	8.3 (1200)	11.0 (1600)	19.3 (2800)
Absorption Coefficient ⁽⁴⁾ - ABS/mm Minimum	7.9	400	400	400	400
Environmental Stress Crack Resistance ⁽⁵⁾ - Hours – Minimum - Failures Allowed - ASTM D 1693 Cond	7.10	48 2/10 A	48 2/10 A	48 2/10 B	48 2/10 B
Environmental Stress Crack Resistance ⁽⁶⁾ (small diameter cables) - Failures Allowed	7.10	0/1	0/1	0/1	0/1
Jacket Shrinkback - Oven Temp °C - Test Time – hours - Shrinkback % Maximum	7.11	100 ± 1 4 5	100 ± 1 4 5	115 ± 1 4 5	115 ± 1 4 5

Notes:

1) Jackets shall be removed from bonded sheath constructions in accordance with one of the two procedures provided under the "Jacket Notch Test" of ASTM D 4565.

2) Test methods designating "clean sample" require that any residual flooding or bonding compounds be removed from the surface of the sample by other than chemical means. Those not so designated shall include these materials if they cling to the jacket.

For jackets with embedded strength members, all tests except Environmental Stress Crack Resistance are for the material without the strength members.

3) The material densities are listed in terms of the as-received resin. The density of the natural resin is characteristically lower by some amount, due to the addition of carbon black and other additives. As a rule-of-thumb, the density of the natural resin is 0.012 g/cm3 lower when using the nominal concentration of carbon black (2.6% by weight).

4) Requirements for Absorption Coefficient of the raw material may be substituted for tests on completed cable.

5) This Stress Crack Resistance requirement applies only to cables having an outside diameter of 30 mm (1.2 in) or greater.

6) For cables with outside diameters less than 30 mm (1.2 in), Stress Crack Resistance requirements shall be accomplished by testing the cable as a whole in accordance with 7.10.2.

- (7) *Testing Procedures*. The procedures for testing the jacket specimens for compliance with paragraph 2l(6) of this bulletin must be as follows:
 - (a) *Jacket Material density Measurement*. Test per paragraphs 7.7.1 and 7.7.2 of ANSI/ICEA S-87-640.
 - (b) *Tensile Strength, Yield Strength, and Ultimate Elongation*. Test per paragraphs 7.8.1 and 7.8.2 of ANSI/ICEA S-87-640.
 - (c) *Jacket Material Absorption Coefficient Test*. Test per paragraphs 7.9.1 and 7.9.2 of ANSI/ICEA S-87-640.
 - (d) Environmental Stress Crack Resistance Test. For large cables (outside diameter \geq 30 mm (1.2 inch), test per paragraphs 7.10.1 through 7.10.1.2 of ANSI/ICEA S-87-640. For small cables (Diameter < 30 mm (1.2 inch)), test per paragraphs 7.10.2 through and 7.10.2.2 of ANSI/ICEA S-87-640. A crack or split in the jacket constitutes failure.
 - (e) *Jacket Shrinkage Test.* Test per paragraphs 7.11.1 and 7.11.2 of ANSI/ICEA S-87-640.
- (8) *Jacket Thickness*. The outer jacket must meet the requirements of paragraphs 5.4.5.1 and 5.4.5.2 of ANSI/ICEA S-87-640. (See reproduced Table 5.2 from ANSI/ICEA S-87-640 below jacket thickness.)

Table 5.2 - Jacket thickness requirements				
Attribute	Construction	Measured Value		
	Inner jacket, multiple-jacket cables	Per manufacturers specification		
Minimum Jacket Thickness	Outer jacket, multiple-jacket cables	0.8 mm (0.031 in.)		
at any point	Single jacket, no armor	0.9 mm (0.035 in.)		
	Single jacket, armor	1.0 mm (0.039 in.)		
	Embedded strength members	0.5 mm (0.020 in.)		
Maximum Eccentricity	All types	40%		

(9) *Jacket Repairs*. Repairs are allowed per paragraph 5.5 of ANSI/ICEA S-87-640.

- m Armor
 - (1) A steel armor, plastic coated on both sides, is required for direct buried cable manufactured under this section. Armor is optional for duct and aerial cable, as required by the end user. The plastic coated steel armor must be applied longitudinally directly over the core wrap or the intermediate jacket and have a minimum overlap of 3.0 millimeters (118 mils), except for small diameter cables with diameters of less than 10 mm (394 mils) for which the minimum overlap must be 2 mm (79 mils). When a cable has a shield, the armor should normally be applied over the shielding tape.
 - (2) The uncoated steel tape must be electrolytic chrome coated steel (ECCS) and must meet the requirements of paragraph B.2.4 of ANSI/ICEA S-87-640. (See reproduced Table B.7 from ANSI/ICEA S-87-640 below for tape thickness.)

Table B.7 - Thickness of steel tapes				
Motorial	Specification	Tape Thickness - mm (in)		
Material	Number	Nominal	Minimum	
Carbon Steel	ASTM A 625	0.15 (0.006)	0.14 (0.0055	
Black plate steel	ASTM A 308	0.15 (0.006)	0.14 (0.0055	
Terne coated steel	ASTM A 624	0.15 (0.006)	0.14 (0.0055	
Electrolytic chrome coated steel, (ECCS)	ASTM A 657	0.15 (0.006)	0.14 (0.0055	
Tin-plated electrolytic chrome coated steel, (ECCS)	ASTM A 624 & ASTM A 657	0.15 (0.006)	0.14 (0.0055	

- (3) The reduction in thickness of the armoring material due to the corrugating or application process must be kept to a minimum and must not exceed 10 percent at any spot.
- (4) The armor of each length of cable must be electrically continuous with no more than one joint or splice allowed in any length of one kilometer of cable. This requirement does not apply to a joint or splice made in the raw material by the raw material manufacturer.
- (5) The breaking strength of any section of an armor tape, containing a factory splice joint, must not be less than 80 percent of the breaking strength of an adjacent section of the armor of equal length without a joint.

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- (6) For cables containing no flooding compound over the armor, the overlap portions of the armor tape must be bonded in cables having a flat, non-corrugated armor to meet the mechanical requirements of paragraphs 2r(1) through 2r(16)(b). If the tape is corrugated, the overlap portions of the armor must be sufficiently bonded and the corrugations must be sufficiently in register to meet the requirements of paragraphs 2r(1) through 2r(16)(b).
- (7) The armor tape must be so applied as to enable the cable to pass the Cable Low (-30°C (-22°F)) and High (60°C (140°F)) Temperatures Bend Test, as required by paragraph 2r(3).
- (8) The protective coating on the steel armor must meet the Bonding-to-Metal, Heat Sealability, Lap-Shear and Moisture Resistance requirements of Type I, Class 2 coated metals per ASTM B 736.
- (9) When the jacket is bonded to the plastic coated armor, the bond between the plastic coated armor and the outer jacket must not be less than 525 Newtons per meter (36 pound-force) over at least 90 percent of the cable circumference when tested per ASTM D 4565. For cables with strength members embedded in the jacket, and residing directly over the armor, the area of the armor directly under the strength member is excluded from the 90 percent calculation.
- n Figure 8 Aerial Cables
 - (1) When self-supporting aerial cable containing an integrated support messenger is supplied, the support messenger must comply with the requirements specified in paragraphs D.2.1 through D.2.4 of ANSI/ICEA S-87-640, with exceptions and additional provisions as follows:
 - (a) Any section of a completed strand containing a joint must have minimum tensile strength and elongation of 29,500 Newtons (6,632 pound-force) and 3.5 percent, respectively, when tested per the procedures specified in ASTM A 640.
 - (b) The individual wires from a completed strand which contain joints must not fracture when tested per the "Ductility of Steel" procedures specified in ASTM A 640, except that the mandrel diameter must be equal to 5 times the nominal diameter of the individual wires.

- (c) The support strand must be completely covered with a flooding compound that offers corrosion protection. The flooding compound must be homogeneous and uniformly mixed.
- (d) The flooding compound must be nontoxic and present no dermal hazard.
- (e) The flooding compound must be free from dirt, metallic particles, and other foreign matter that may interfere with the performance of the cable.
- (2) Other methods of providing self-supporting cable specifically not addressed in this section may be allowed if accepted. Justification for acceptance of a modified design must be provided to substantiate product utility and long term stability and endurance. To obtain the Agency's acceptance of a modified design, refer to the product acceptance procedures available at http://www.usda.gov/rus/telecom/listing_procedures/index_listing_proced ures.htm, as well as RUS Bulletin 345-3.
- (3) *Jacket Thickness Requirements*. Jackets applied over an integral messenger must meet the following requirements:
 - (a) The minimum jacket thickness at any point over the support messenger must meet the requirements of paragraph D.3 of ANSI/ICEA S-87-640. (See reproduced Table D.1 from ANSI/ICEA S-87-640 below for jacket thickness over messenger.)

Table D.1 - Outer jacket thickness requirements for figure-8				
messenger cables				
	Acceptable Thickness Calculated			
Calculated Average Diameter (D)	Average - mm (in.)			
Under Jacket	Minimum	Minimum		
	Average			
Jacket Over The Core(1)	1.02 (0.040)	0.86 (0.034)		
Jacket Over The Messenger	1.37 (0.054)	1.14 (0.045)		
Note (1) Jackets are also subject to a maximum eccentricity requirement of 50% for bonded sheaths and 40% for all other sheaths, with eccentricity calculated as required by ASTM D 4565.				

(b) The web dimension for self-supporting aerial cable must meet the requirements of paragraph D.3 of ANSI/ICEA S-87-640. (See reproduced Table D.2 from ANSI/ICEA S-87-640 below for web dimensions.)

Table D.2 - Dimension requirements for messenger webs			
Web Dimensions and Tolerances - mm (inch)			
Thickness of Web	Height of Web		
1.52 +0.51/-0.25	2.29 ± 0.76		
(0.060 + 0.020/-0.010)	(0.090 ± 0.030)		

- o Sheath Slitting Cord
 - (1) A sheath slitting cord or ripcord is optional.
 - (2) When a sheath slitting cord is used it must be capable of slitting the jacket or jacket and armor, at least one meter (3.3 feet) length without breaking the cord at a temperature of $23 \pm 5^{\circ}$ C ($73 \pm 9^{\circ}$ F).
 - (3) The sheath slitting cord must meet the sheath slitting cord test described in paragraph 2r(1).
- p Identification Markers
 - (1) Each length of cable must be permanently identified. The method of marking must be by means of suitable surface markings producing a clear distinguishable contrasting marking meeting paragraph 6.1.1 of ANSI/ICEA S-87-640, and must meet the durability requirements of paragraphs 7.5.2 through 7.5.2.2 of ANSI/ICEA S-87-640.
 - (2) The color of the initial marking must be white or silver. If the initial marking fails to meet the requirements of the preceding paragraphs, it will be permissible to either remove the defective marking and re-mark with the white or silver color or leave the defective marking on the cable and re-mark with yellow. No further re-marking is permitted. Any re-marking must be done on a different portion of the cables circumference where the existing marking is found and have a numbering sequence differing from any other marking by at least 3,000. Any reel of cable that contains more than one set of sequential markings must be labeled to indicate the color and sequence of marking to be used. The labeling must be applied to the reel and also to the cable.
 - (3) Each length of cable must be permanently labeled OPTICAL CABLE, OC, OPTICAL FIBER CABLE, or OF on the outer jacket and identified as to manufacturer and year of manufacture.

- (4) Each length of cable intended for direct burial installation must be marked with a telephone handset in compliance with requirements of the Rule 350G of the ANSI/IEEE C2-2007.
- (5) Each length of cable must be identified as to the manufacturer and year of manufacturing. The manufacturer and year of manufacturing may also be indicated by other means as indicated in paragraphs 6.1.2 through 6.1.4 of ANSI/ICEA S-87-640.
- (6) The number of fibers on the jacket must be marked on the jacket.
- (7) The completed cable must have sequentially numbered length markers in METERS or FEET at regular intervals of not more than 2 feet or not more than 1 meter along the outside of the jacket. Continuous sequential numbering must be employed in a single length of cable. The numbers must be dimensioned and spaced to produce good legibility and must be approximately 3 millimeters (118 mils) in height. An occasional illegible marking is permissible when it is located within 2 meters of a legible making for cables marked in meters or 4 feet for cables marked in feet.
- (8) Agreement between the actual length of the cable and the length marking on the cable jacket must be within the limits of +1 percent and -0 percent.
- (9) *Jacket Print Test*. Cables must meet the Jacket Print Test described in paragraphs 7.5.2.1 and 7.5.2.2 of ANSI/ICEA S-87-640.

q Performance of a Finished Cable

- (1) Zero Dispersion Optical Fiber Cable. Unless otherwise specified by the end user, the optical performance of a finished cable must comply with the attributes of Table 2, *G.652.B attributes*, found in ITU Recommendation G.652. However, when the end user stipulates a low water peak fiber the finished cable must meet the attributes of Table 4, *G.652.D attributes*, found in ITU-T Recommendation G.652; or when the end user stipulates a low bending loss fiber, the finished cable must meet the attributes of Table 7-1, *G.657 class A attributes*, found in ITU-T Recommendation G.657.
 - (a) The attenuation methods must be per Table 8.4, *Optical attenuation measurement methods*, of ANSI/ICEA S-87-640 (See reproduced Table 8.4 from ANSI/ICEA S-87-640 below for measurement methods.)

Table 8.4 - Optical attenuation measurement methods			
Fibers	Measurement Method		
Multimode, Graded Index only	FOTP-78		
Single-mode, Dispersion Unshifted	FOTP-78		
Single-mode only, Non-zero Dispersion-shifted	FOTP-78		

(b) The cable must have a maximum attenuation of 0.1 dB at a point of discontinuity (a localized deviation of the optical fiber loss). (See reproduced Table 8.3 from ANSI/ICEA S-87-640 for acceptance criteria for points of discontinuity.) Per paragraphs 8.4 and 8.4.1 of ANSI/ICEA S-87-640, measurements must be conducted at 1310 and 1550 nm, and at 1625 nm when specified by the end user.

Table 8.3 - Point discontinuity acceptance criteria (dB)requirements (dB/km)methods		
Fiber Type	Maximum Attenuation at Specified Operating Wavelengths	
Multimode (all)	0.2 ⁽¹⁾	
Single-mode (Class IVa)	0.1 ⁽²⁾	
Single-mode (Class IVd)	0.1 ⁽³⁾	
 Notes: 1) The operational wavelengths for Multimode fibers are 850 and 1300 nm. 2) The operational wavelengths for Class IVa fibers are 1310 and 1550 nm, but may also include 1383 nm and 1625 nm as agreed upon between manufacturer and end-user. 3) The operational wavelengths for Class IVd fibers is 1550 nm, but may also include 1625 nm as agreed upon between manufacturer and end-user. 		

- (c) The cable cutoff wavelength (γ_{cc}) must be reported per paragraph 8.5.1 of ANSI/ICEA S-87-640.
- (2) *Nonzero Dispersion Optical Fiber Cable*. Unless otherwise specified by the end user, the optical performance of the finished cable must comply with the attributes of Table 1, *G.656 attributes*, found in ITU-T Recommendation G.656. When the buyer specifies Recommendation A, B, C, D or E of ITU-T Recommendation G.655, the finished cable must comply with the attributes of ITU-T Recommendation G.655.
 - (a) The attenuation methods must be per Table 8.4, *Optical attenuation measurement methods* of ANSI/ICEA S-87-640. (See reproduced Table 8.4 from ANSI/ICEA S-87-640 below for attenuation methods.)

Table 8.4 - Optical attenuation measurement methods		
Fibers	Measurement Method	
Multimode, Graded Index only	FOTP-78	
Single-mode, Dispersion Unshifted	FOTP-78	
Single-mode only, Non-zero Dispersion-shifted	FOTP-78	

(b) The cable must have a maximum attenuation of 0.1 dB at a point of discontinuity (a localized deviation of the optical fiber loss). (See reproduced Table 8.3 from ANSI/ICEA S-87-640 for acceptance criteria for points of discontinuity.) Per paragraphs 8.4 and 8.4.1 of ANSI/ICEA S-87-640, measurements must be conducted at 1310 and 1550 nm, and at 1625 nm when specified by the end user.

Table 8.3 - Points discontinuity acceptance criteria (db) (dB)requirements (dB/km)methods		
Fiber Type	Maximum Attenuation at Specified Operating Wavelengths	
Multimode (all)	0.2 ⁽¹⁾	
Single-mode (Class IVa)	0.1 ⁽²⁾	
Single-mode (Class IVd)	0.1 ⁽³⁾	
Notes: 1) The operational wavelengths for Multimode fibers are 850 and 1300 nm. 2) The operational wavelengths for Class IVa fibers are 1310 and 1550 nm, but may also include 1383 nm and 1625 nm as agreed upon between manufacturer and end-user. 3) The operational wavelengths for Class IVd fibers is 1550 nm, but may also include 1625 nm as agreed upon between manufacturer and end-user.		

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- (c) The cable cutoff wavelength (γ_{cc}) must be reported per paragraph 8.5.1 of ANSI/ICEA S-87-640.
- (3) Multimode Optical Fiber Cable. Unless otherwise specified by the end user, the optical performance of the fibers in a finished cable must comply with Table 8.1, Attenuation coefficient performance requirement (dB/k), Table 8.2, Multimode bandwidth coefficient performance requirements (MHz-km) and Table 8.3, Points discontinuity acceptance criteria (dB), of ANSI/ICEA S-87-640. (See reproduced Table 8.1 and 8.3 from ANSI/ICEA S-87-640 below for attenuation and acceptance criteria for points of discontinuity, respectively.)

Table 8.1 - Attenuation coefficient performance requirements (dB/km)methods		
Fiber Type	Maximum Attenuation	
Multimode (50/125 (m) – All	3.5/1.0 @ 850/1300 nm	
Multimode (62.5/125 µm)	3.5/1.0 @ 850/1300 nm	
Single-mode (Class IVa)	0.4/0.3 @ 1310/1550 nm ⁽¹⁾	
NZDS Single-mode (Class IVd)	0.3 @ 1550 nm ⁽²⁾	
 Notes: 1) The attenuation coefficient for Class IVa fibers may also be specified at 1383 nm and 1625 nm as agreed upon between manufacturer and end-user. 2) The attenuation coefficient for Class IVd fibers may also be specified at 1625 nm as agreed upon between manufacturer and end-user. 		

Table 8.3 - Points discontinuity acceptance criteria (dB)requirements (dB/km)methods	
Fiber Type	Maximum Attenuation at Specified Operating Wavelengths
Multimode (all)	0.2 ⁽¹⁾
Single-mode (Class IVa)	0.1 ⁽²⁾
Single-mode (Class IVd)	0.1 ⁽³⁾
Notes: 1) The operational wavelengths for Multimode fibers are 850 and 1300 nm. 2) The operational wavelengths for Class IVa fibers are 1310 and 1550 nm, but may also include 1202 nm and 1005 nm as a stread wavelength and user.	

include 1383 nm and 1625 nm as agreed upon between manufacturer and end-user. 3) The operational wavelengths for Class IVd fibers is 1550 nm, but may also include 1625 nm as agreed upon between manufacturer and end-user.

Because the accuracy of attenuation measurements for single mode fibers becomes questionable when measured on short cable lengths, attenuation measurements are to be made utilizing characterization cable lengths. Master Cable reels must be tested and the attenuation values measured will be used for shorter ship lengths of cable.
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- (5) Because the accuracy of attenuation measurements for multimode fibers becomes questionable when measured on short cable lengths, attenuation measurements are to be made utilizing characterization cable lengths. If the ship length of cable is less than one kilometer, the attenuation values measured on longer lengths of cable (characterization length of cable) before cutting to the ship lengths of cable may be applied to the ship lengths.
- (6) Attenuation must be measured per Table 8.4, Optical Attenuation Measurement Methods, of ANSI/ICEA S-87-640. (See reproduced Table 8.4 from ANSI/ICEA S-87-640 below for measurement method.)

Table 8.4 - Optical attenuation measurement methods		
Fibers	Measurement Method	
Multimode, Graded Index only	FOTP-78	
Single-mode, Dispersion Unshifted	FOTP-78	
Single-mode only, Non-zero Dispersion-shifted	FOTP-78	

(7) The bandwidth of multimode fibers in a finished cable must be no less than the values specified in ANSI/ICEA S-87-640, Table 8.2 per paragraphs 8.3.1 and 8.3.2. (See reproduced Table 8.2 from ANSI/ICEA S-87-640 below for bandwidth of multimode fibers.)

Table 8.2 - Multimode bandwidth coefficient performance requirements (MHz•km)				
Source Conditions		Minin	num Modal Band	width
		50/125		62.5/125
		492AAAB	492AAAC	
OFL	850nm	500	1500	160
1300 nm		500	500	500
EMB	850 nm	NA	2000	NA

r Mechanical Requirements.

Fiber optic cables manufactured under the requirements of this section must be tested by the manufacturer to determine compliance with such requirements. Unless otherwise specified, testing must be performed at the standard conditions defined in paragraph 7.3.1 of ANSI/ICEA S-87-640. (See table below for testing conditions.) The standard optical test wavelengths to be used are 1550 nm single mode and 1300 nm multi-mode, unless otherwise specified in the individual test.

Standard Conditions for Testing per TIA/EIA-455			
Condition	Standard Ambient		
Temperature	23 + 5 °C		
Relative Humidity	20 to 70 %		
Atmospheric Pressure	Site Ambient		

- Sheath Slitting Cord Test. All cables manufactured under the requirements of this section must meet the Ripcord Functional Test described in paragraphs 7.18.1 and 7.18.2 of ANSI/ICEA S-87-640.
- (2) *Material Compatibility and Cable Aging Test*. All cables manufactured under the requirements of this section must meet the Material Compatibility and Cable Aging Test described in paragraphs 7.19 through 7.19.2.4 of ANSI/ICEA S-87-640.
- (3) Cable Low and High Bend Test. Cables manufactured under the requirements of this section must meet the Cable Low (-30°C (-22°F)) and High (60°C (140°F)) Temperatures Bend Test per paragraphs 7.21 and 7.21.2 of ANSI/ICEA S-87-640.
- (4) *Compound Flow Test*. All cables manufactured under the requirements of this section must meet the test described in paragraphs 7.23, 7.23.1, and 7.23.2 of ANSI/ICEA S-87-640.
- (5) *Cyclic Flexing Test*. All cables manufactured under the requirements of this section must meet the Flex Test described in paragraphs 7.27 through 7.27.2 of the ANSI/ICEA S-87-640.
- (6) *Water Penetration Test.* All cables manufactured under the requirements of this section must meet paragraphs 7.28 through 7.28.2 of ANSI/ICEA S-87-640.

- (7) Cable Impact Test. All cables manufactured under the requirements of this section must meet the Cable Impact Test described in paragraphs 7.29.1 and 7.29.2 of ANSI/ICEA S-87-640.
- (8) Cable Tensile Loading and Fiber Strain Test. Cables manufactured under the requirements of this section must meet the Cable Loading and Fiber Strain Test described in paragraphs 7.30 through 7.30.2 of ANSI/ICEA S-87-640. This test does not apply to aerial self-supporting cables.
- (9) Cable Compression Test. All cables manufactured under requirements of this section must meet the Cable Compressive Loading Test described in paragraphs 7.31 through 7.31.2 of ANSI/ICEA S-87-640.
- (10) *Cable Twist Test*. All cables manufactured under the requirements of this section must meet the Cable Twist Test described in paragraphs 7.32 through 7.32.2 of ANSI/ICEA S-87-640.
- (11) Cable Lighting Damage Susceptibility Test. Cables manufactured under the requirements of this section must meet the Cable Lighting Damage Susceptibility Test described in paragraphs 7.33 and 7.33.1 of ANSI/ICEA S-87-640.
- (12) Cable External Freezing Test. All cables manufactured under the requirements of this section must meet the Cable External Freezing Test described in paragraphs 7.22 and 7.22.1 of ANSI/ICEA S-87-640.
- (13) Cable Temperature Cycling Test. All cables manufactured under the requirements of this section must meet the Cable Temperature Cycling Test described in paragraph 7.24.1 of ANSI/ICEA S-87-640.
- (14) Cable Sheath Adherence Test. All cables manufactured under the requirements of this section must meet the Cable Sheath Adherence Test described in paragraphs 7.26.1 and 7.26.2 of ANSI/ICEA S-87-640.

- (15) Mid-Span Test. This test is applicable only to cables of a loose tube design specified for mid-span applications with tube storage. Cable of specialty design may be exempted from this requirement when this requirement is not applicable to such design. All buried and underground loose tube single mode cables manufactured per the requirements in this section and intended for mid-span applications with tube storage must meet the following mid-span test without exhibiting an increase in fiber attenuation greater than 0.1 dB and a maximum average increase over all fibers of 0.05 dB.
 - (a) The specimen must be installed in a commercially available pedestal or closure or in a device that mimics their performance, as follows: A length of cable sheath, equal to the mid-span length, must be removed from the middle of the test specimen so as to allow access to the buffer tubes. All binders, tapes, strength members, etc. must be removed. The buffer tubes must be left intact. The cable ends defining the ends of the mid-span length must be properly secured in the closure to the more stringent of the cable or hardware manufacturer's recommendations. Strength members must be secured with an end stop type clamp and the outer jacket must be clamped to prevent slippage. A minimum of 6.096 meters (20 feet) of cable must extend from the entry and exit ports of the closure for the purpose of making optical measurements. If a device that mimics the performance of pedestals or closures is used, the buffer tubes must be wound in a coil with a minimum width of 3 inches and minimum length of 12 inches.
 - (b) The expressed buffer tubes must be loosely constrained during the test.
 - (c) The enclosure, with installed cable, must be placed in an environmental chamber for temperature cycling. It is acceptable for some or all of the two 20 feet (6.096 meters) cable segments to extend outside the environmental chamber.
 - (d) Lids, pedestal enclosures, or closure covers must be removed if possible to allow for temperature equilibrium of the buffer tubes. If this is not possible, the manufacture must demonstrate that the buffer tubes are at temperature equilibrium prior to beginning the soak time.

- (e) Measure the attenuation of single mode fibers at 1550 ± 10 nm. The supplier must certify the performance of lower specified wavelengths comply with the mid-span performance requirements.
- (f) After measuring the attenuation of the optical fibers, test the cable sample per TIA/EIA Standard 455-3A. Temperature cycling, measurements, and data reporting must conform to TIA/EIA Standard 455-3A. The test must be conducted for at least five complete cycles. The following detailed test conditions must apply:
 - A TIA/EIA Standard 455-3A, Section 4.1 Loose tube single mode optical cable sample must be tested.
 - B TIA/EIA Standard 455-3A, Section 4.2 An Agency accepted 8 to 12 inch diameter optical buried distribution pedestal or a device that mimics their performance must be tested.
 - C Mid-span opening for installation of loose tube single mode optical cable in pedestal must be 6.096 meters (20 feet).
 - D TIA/EIA Standard 455-3A, Section 5.1 3 hours soak time.
 - E TIA/EIA Standard 455-3A, Section 5.2 Test Condition C-2, minimum –40°C (-40°F) and maximum 70° Celsius (158°F).
 - F TIA/EIA Standard 455-3A, Section 5.7.2 A statistically representative amount of transmitting fibers in all express buffer tubes passing through the pedestal and stored must be measured.
 - G The buffer tubes in the closure or pedestal must not be handled or moved during temperature cycling or attenuation measurements.

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- (g) Fiber cable attenuation measured through the express buffer tubes during the last cycle at -40°C (-40°F) and +70°C (158°F) must not exceed a maximum increase of 0.1 dB and must not exceed a 0.05 dB average across all tested fibers from the initial baseline measurements. At the conclusion of the temperature cycling, the maximum attenuation increase at 23°C from the initial baseline measurement must not exceed 0.05 dB which allows for measurement noise that may be encountered during the test. The cable must also be inspected at room temperature at the conclusion of all measurements; the cable must not show visible evidence of fracture of the buffer tubes nor show any degradation of all exposed cable assemblies.
- (16) *Aerial Self-Supporting Cables.* The following tests apply to aerial cables only:
 - (a) Static Tensile Testing of Aerial Self-Supporting Cables. Aerial self-supporting cable must meet the test described in paragraphs D.4.1.1 through D.4.1.5 of ANSI/ICEA S-87-640.
 - (b) Cable Galloping Test. Aerial self-supporting cable made to the requirements of this section must meet the test described in paragraphs D.4.2 through D.4.2.3 of ANSI/ICEA S-87-640.

s Pre-connectorized Cable

- (1) At the option of the manufacturer and upon request by the end user, the cable may be factory terminated with connectors.
- (2) All connectors must be accepted by the Agency prior to their use. To obtain the Agency's acceptance of connectors, refer to product acceptance procedures available at http://www.usda.gov/rus/telecom/listing_procedures/index_listing_procedures/index_listing_procedures.htm as well as RUS Bulletin 345-3.

- t Acceptance Testing
 - (1) The tests described in the Appendix to this section are intended for acceptance of cable designs and major modifications of accepted designs. What constitutes a major modification is at the discretion of the Agency. These tests are intended to show the inherent capability of the manufacturer to produce cable products that have satisfactory performance characteristics, long life, and long-term optical stability but are not intended as field tests. After initial RUS product acceptance is granted, the manufacturer will need to apply for continued product acceptance in January of the third year after the year of initial acceptance. For information on Agency acceptance, refer to the product acceptance procedures available at

http://www.usda.gov/rus/telecom/listing_procedures/index_listing_proced ures.htm, as well as RUS Bulletin 345-3.

- (2) Acceptance. For initial acceptance, the manufacturer must submit:
 - (a) An original signature certification that the product fully complies with each paragraph of this section;
 - (b) Qualification Test Data, per the Appendix to this section;
 - (c) A set of instructions for handling the cable;
 - (d) OSHA Material Safety Data Sheets for all components;
 - (e) Agree to periodic plant inspections;
 - (f) A certification stating whether the cable, as sold to RUS Telecommunications borrowers, complies with the following two provisions:
 - (1) Final assembly or manufacture of the product, as the product would be used by an RUS Telecommunications borrower, is completed in the United States or eligible countries (currently, Mexico, Canada and Israel); and
 - (2) The cost of United States and eligible countries' components (in any combination) within the product is more than 50 percent of the total cost of all components utilized in the product. The cost of non-domestic components (components not manufactured within the United States or eligible countries) which are included in the finished product must include all duties, taxes, and delivery charges to the point of assembly or manufacture;

- (g) Written user testimonials concerning performance of the product; and
- (h) Other nonproprietary data deemed necessary.
- (3) *Re-qualification acceptance*. For submission of a request for continued product acceptance after the initial acceptance, follow paragraph 2t(1) and then, in January every three years, the manufacturer must submit an original signature certification stating that the product fully complies with each paragraph of this bulletin, excluding the qualification sections (paragraphs 2t(2), 2t(3) and (2t(4)), and a certification that the products sold to RUS Telecommunications borrowers comply with paragraphs 2t(2)(f) through 2t(2)(f)(B) of this bulletin. The tests of the Appendix to this section must be conducted and records kept for at least three years and the data must be made available to the Agency on request. The required data must have been gathered within 90 days of the submission. A certification must be submitted to the Agency stating that the cable manufactured to the requirements of this section has been tested per the Appendix of this section and that the cable meets the test requirements.
- (4) Initial and re-qualification acceptance requests should be addressed to: Chairman, Technical Standards Committee "A" (Telecommunications), STOP 1550, Rural Utilities Service, Advanced Services Division, Telecommunications Program, Washington, DC 20250-1500.
- (5) Tests on 100 Percent of Completed Cable.
 - (a) The armor for each length of cable must be tested for continuity using the procedures of ASTM D 4566.
 - (b) Attenuation for each optical fiber in the cable must be measured.
 - (c) Optical discontinuities greater than 0.1 dB must be isolated and their location and amplitude recorded.
- (6) *Capability Tests.* The manufacturer must establish a quality assurance system. Tests on a quality assurance basis must be made as frequently as is required for each manufacturer to determine and maintain compliance with all the mechanical requirements and the fiber and cable attributes required by this section, including:
 - (a) Numerical aperture and bandwidth of multimode fibers;
 - (b) Cut off wavelength of single mode fibers;

- (c) Dispersion of single mode fibers;
- (d) Shrinkback and cold testing of loose tube and tight tube buffers, and mid-span testing of cables of a loose tube design with tube storage;
- (e) Adhesion properties of the protective fiber coating;
- (f) Dielectric strength between the armor and the metallic central member;
- (g) Performance requirements for the fibers;
- (h) Performance requirements for the inner and outer jacketing materials;
- (i) Performance requirements for the filling and flooding compounds;
- (j) Bonding properties of the coated armoring material;
- (k) Sequential marking and lettering; and
- (1) Mechanical tests described in paragraphs 2r(1) through 2r(16)(b) of this bulletin.

u Records Tests

- (1) Each manufacturer must maintain suitable summary records for a period of at least 3 years of all optical and physical tests required on completed cable by section as set forth in paragraphs 2t(5) and 2t(6) of this bulletin. The test data for a particular reel must be in a form that it may be readily available to the Agency upon request. The optical data must be furnished to the end user on a suitable and easily readable form.
- (2) Measurements and computed values must be rounded off to the number of places or figures specified for the requirement per paragraph 1.3 of ANSI/ICEA S-87-640.

v Manufacturing Irregularities

- (1) Under this section, repairs to the armor, when present, are not permitted in cable supplied to the end user.
- (2) Minor defects in the inner and outer jacket (defects having a dimension of 3 millimeter or less in any direction) may be repaired by means of heat fusing per good commercial practices utilizing sheath grade compounds.

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w Packaging and Preparation for Shipment

- (1) The cable must be shipped on reels containing one continuous length of cable. The diameter of the drum must be large enough to prevent damage to the cable from reeling and unreeling. The diameter must be at least equal to the minimum bending diameter of the cable. The reels must be substantial and so constructed as to prevent damage during shipment and handling.
- (2) A circumferential thermal wrap or other means of protection must be secured between the outer edges of the reel flange to protect the cable against damage during storage and shipment. The thermal wrap must meet the requirements included in the *Thermal Reel Wrap Test*, described below. This test procedure is for qualification of initial and subsequent changes in thermal reel wraps.
 - (a) Sample Selection. All testing must be performed on two 450 millimeter (18 inches) lengths of cable removed sequentially from the same fiber jacketed cable. This cable must not have been exposed to temperatures in excess of 38°C (100°F) since its initial cool down after sheathing.
 - (b) *Test Procedure:*
 - (1) Place the two samples on an insulating material such as wood.
 - (2) Tape thermocouples to the jackets of each sample to measure the jacket temperature.
 - (3) Cover one sample with the thermal reel wrap.
 - (4) Expose the samples to a radiant heat source capable of heating the uncovered sample to a minimum of 71°C (160 °F). A GE 600 watt photoflood lamp or an equivalent lamp having the light spectrum approximately that of the sun must be used.
 - (5) The height of the lamp above the jacket must be 380 millimeters (15 inches) or an equivalent height that produces the 71°C (160 °F) jacket temperature on the unwrapped sample must be used.

- (6) After the samples have stabilized at the temperature, the jacket temperatures of the samples must be recorded after one hour of exposure to the heat source.
- (7) Compute the temperature difference between jackets.
- (8) The temperature difference between the jacket with the thermal reel wrap and the jacket without the reel wrap must be greater than or equal to 17°C (63 °F).
- (3) Cables must be sealed at the ends to prevent entrance of moisture.
- (4) The end-of-pull (outer end) of the cable must be securely fastened to prevent the cable from coming loose during transit. The start-of-pull (inner end) of the cable must project through a slot in the flange of the reel, around an inner riser, or into a recess on the flange near the drum and fastened in such a way to prevent the cable from becoming loose during installation.
- (5) Spikes, staples or other fastening devices must be used in a manner which will not result in penetration of the cable.
- (6) The arbor hole must admit a spindle 63.5 millimeters (2.5 inches) in diameter without binding.
- (7) Each reel must be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.
- (8) Each reel must be stenciled or lettered with the name of the manufacturer.

(9) The following information must be either stenciled on the reel or on a tag firmly attached to the reel:

OPTICAL CABLE Type and Number of Fibers Armored or Non-armored Year of Manufacture Name of Cable Manufacturer Length of Cable Reel Number 7 CFR 1755.902 Minimum Bending Diameter for both Residual and Loaded Condition during installation Example: **OPTICAL CABLE** G.657 class A, 4 fibers Armored XYZ Company 1050 meters Reel Number 3 7 CFR 1755.902 Minimum Bending Diameter: Residual (Installed): 20 times Cable O.D Loaded Condition: 40 times Cable O.D

APPENDIX TO RUS Bulletin 1753F-601a

FIBER OPTIC CABLES

Bulletin 1753F-601a (PE-90) Qualifications Test Data

Initial qualification and three year re-qualification test data required for TELECOMMUNICATIONS PROGRAM product acceptance. Please note that some tests may apply only to a particular cable design.

		Initial	3 Year
Paragraph	Test	Qualification	Re-qualification
2c(4)(a)	Shrinkback	Х	
2c(4)(b)	Cold Bend	Х	
2r(1)	Sheath Slitting Cord	Х	
2r(2)	Material Compatibility	Х	
2r(3)	Cable Low & High Bend	Х	Х
2r(4)	Compound Flow	Х	
2r(5)	Cyclic Flexing	Х	Х
2r(6)	Water Penetration	Х	Х
2r(7)	Cable Impact	Х	Х
2r(8)	Cable Tensile Loading & Fiber Strain	х	Х
2r(9)	Cable Compression	Х	
2r(10)	Cable Twist	Х	Х
2r(11)	Cable Lighting Damage Susceptibility	х	
2r(12)	Cable External Freezing	Х	
2r(13)	Cable Temperature Cycling	Х	Х
2r(14)	Cable Sheath Adherence	Х	
2r(15)	Mid-Span	Х	Х
2r(16)(a)	Static Tensile Testing of Aerial Self-Supporting Cables	х	Х
2r(16)(b)	Cable Galloping	X	
2y(2)	Thermal Reel Wrap	Х	

Attachment E

Disclaimer: The contents of this guidance document does not have the force and effect of law and is not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

> UNITED STATES DEPARTMENT OF AGRICULTURE Rural Utilities Service

> > BULLETIN 1753F-401(PC-2) RD-GD-1995-17

SUBJECT: RUS Standard for Splicing Copper and Fiber Optic Cables

TO: All Telephone Borrowers RUS Telephone Staff

EFFECTIVE DATE: February 27, 1995

EXPIRATION DATE: Date of change in 7 CFR 1755.200 by rulemaking.

OFFICE OF PRIMARY INTEREST: Outside Plant Branch, Telecommunications Standards Division

PREVIOUS FILING INSTRUCTIONS: This bulletin replaces RUS Bulletin 345-6, REA Standard for Splicing Plastic-Insulated Cables, PC-2, issued January 12, 1978.

FILING INSTRUCTIONS: Discard RUS Bulletin 345-6, REA Standard for Splicing Plastic Insulated Cables, PC-2, dated January 12, 1978, and replace with this bulletin. File with 7 CFR 1755 and on RUSNET.

PURPOSE: This standard describes approved methods for splicing plastic-insulated copper and fiber optic cables. This bulletin is a user friendly guide and a reformat of the text in 7 CFR 1755.200 published at 60 FR 5096, dated January 26, 1995.

Every effort has been made to ensure the accuracy of this document. However, in case of discrepancies, the regulations at 7 CFR 1755.200 are the authorized sources.

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ABBREVIATIONS

ANSI AWG CFR CM CMR dB	American National Standards Institute American Wire Gauge Code of Federal Regulations Centimeters Communications Riser Cable Decibels
IEEE	Institute of Electrical and Electronics Engineers, Inc.
in.	Inches
mm	Millimeters
NEC	National Electrical Code
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
OTDR	Optical Time Domain Reflectometer
PIC	Plastic Insulated Conductor
RUS	Rural Utilities Service
SAI	Servicing Area Interface
TE&CM	Telecommunications Engineering and Construction Manual

1. SCOPE

1.1 This standard describes approved methods for splicing plastic insulated copper and fiber optic cables. Typical applications of these methods include aerial, buried, and underground splices.

1.2 Copies of the American National Standard Institute/National Fire Protection Association (ANSI/NFPA) 70, National Electrical Code (NEC), referenced in this standard, can be obtained from NFPA, Batterymarch Park, Quincy, Massachusetts 02269, telephone number 1 (800) 344-3555.

1.3 Copies of the American National Standard Institute/Institute of Electrical and Electronics Engineers, Inc. (ANSI/IEEE), National Electrical Safety Code (NESC), referenced in this standard, can be obtained from IEEE Service Center, 455 Hoes Lane, Piscataway, New Jersey 08854, telephone number 1 (800) 678-4333.

2. GENERAL

2.1 Only Rural Utilities Service (RUS) accepted filled cable and splicing materials shall be used on outside plant projects financed by RUS.

2.2 The installation instructions provided by the manufacturer of splicing materials shall be followed except where those instructions conflict with the procedures specified in this standard.

2.3 Precautions shall be taken to prevent the ingress of moisture and other contaminants during all phases of the splicing installation. When an uncompleted splice must be left unattended, it shall be sealed to prevent the ingress of moisture and other contaminants.

2.4 Minor sheath damage during construction may be repaired if the repair is completed immediately and is approved by the borrower's resident project representative. Minor damage is typically repaired by:

2.4.1 Scuffing the cable sheath associated with the damaged area;

2.4.2 Applying several layers of DR tape over the scuffed and damaged area;

2.4.3 Applying several layers of plastic tape over the DR tape; and

2.4.4 If damage is severe enough to rupture the cable shield, a splice closure shall be installed.

2.5 All splice cases installed on RUS toll trunk and feeder cables shall be filled, whether aerial, buried, or underground.

3. SPLICING CONSIDERATIONS FOR COPPER CABLES

3.1 <u>Preconstruction Testing</u>: It is desirable that each reel of cable be tested for grounds, opens, shorts, crosses, and shield continuity before the cable is installed. However, manufacturer supplied test results are acceptable. All cable pairs shall be free from electrical defects.

3.2 <u>Handling Precautions</u>: The cable manufacturer's instructions concerning pulling tension and bending radius shall be observed. Unless the cable manufacturer's recommendation is more stringent, the minimum bending radius shall be 10 times the cable diameter for copper cables and 20 times the cable diameter for fiber optic cables.

3.3 Cable Sheath Removal:

3.3.1 The length of cable sheath to be removed shall be governed by the type of splicing hardware used. Follow the splice case manufacturer's recommendations. For pedestals or large pair count splice housings, consider removing enough cable sheath to allow the conductors to extend to the top of the pedestal and then hang downward to approximately 15 centimeters (cm) (6 inches (in.)) above the baseplate.

3.3.2 Caution shall be exercised to avoid damaging the conductor insulation when cutting through the cable shield and removing the shield. Sharp edges and burrs shall be removed from the cut end of the shield.

3.4 Shield Bonding and Grounding: For personnel safety, the shields of the cables to be spliced shall be bonded together and grounded before splicing activities are started. (See Paragraphs 7.2, and 7.5.1 through 7.5.3 of this standard for final bonding and grounding provisions.)

3.5 Binder Group Identification:

3.5.1 Color coded plastic tie wraps shall be placed loosely around each binder group of the cables before splicing operations are attempted. The tie wraps shall be installed as near the cable sheath as practicable and shall conform to the same color designations as the binder ribbons. Twisted wire pigtails shall not be used to identify binder groups due to potential transmission degradation.

3.5.2 The standard insulation color code used to identify individual cable pairs within 25-pair binder groups shall be as shown in Table 1:

		TABLE	1		
Cable	Pair	Identification	Within	Binder	Groups
				Color	

Pair No.	Tip	Ring
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Slate
б	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Slate
11	Black	Blue
12	Black	Orange
13	Black	Green
14	Black	Brown
15	Black	Slate
16	Yellow	Blue
17	Yellow	Orange
18	Yellow	Green
19	Yellow	Brown
20	Yellow	Slate
21	Violet	Blue
22	Violet	Orange
23	Violet	Green
24	Violet	Brown
25	Violet	Slate

3.5.3 The standard binder ribbon color code used to designate 25-pair binder groups within 600-pair super units shall be as shown in Table 2:

Group No.	Color of Bindings	Group Pair Count
1	White-Blue	1-25
2	White-Orange	26-50
3	White-Green	51-75
4	White-Brown	76-100
5	White-Slate	101-125
6	Red-Blue	126-150
7	Red-Orange	151-175
8	Red-Green	176-200
9	Red-Brown	201-225
10	Red-Slate	226-250
11	Black-Blue	251-275
12	Black-Orange	276-300
13	Black-Green	301-325
14	Black-Brown	326-350
15	Black-Slate	351-375
16	Yellow-Blue	376-400
17	Yellow-Orange	401-425
18	Yellow-Green	426-450
19	Yellow-Brown	451-475
20	Yellow-Slate	476-500
21	Violet-Blue	501-525
22	Violet-Orange	526-550
23	Violet-Green	551-575
24	Violet-Brown	576-600

TABLE 2 Cable Binder Group Identification

3.5.4 Super unit binder groups shall be identified in accordance with Table 3:

TABLE 3 Super-Unit Binder Colors

Pair Numbers	Binder Color
1-600	White
601-1200	Red
1201-1800	Black
1801-2400	Yellow
2401-3000	Violet
3001-3600	Blue
3601-4200	Orange
4201-4800	Green
4801-5400	Brown
5401-6000	Slate

^{3.5.5} Service pairs in screened cables shall be identified in accordance with Table 4:

TABLE 4					
Screened	Cable	Service	Pair	Identification	

	Col	or
Service Pair No.	Tip	Ring
1	White	Red
2	White	Black
3	White	Yellow
4	White	Violet
5	Red	Black
б	Red	Yellow
7	Red	Violet
8	Black	Yellow
9	Black	Violet

3.6 <u>Cleaning Conductors</u>: It is not necessary to remove the filling compound from cable conductors before splicing. However, it is permissible to wipe individual conductors with clean paper towels or clean cloth rags. No cleaning chemicals, etc., shall be used. Caution shall be exercised to maintain individual cable pair and binder group identity. Binder group identity shall be maintained by using color coded plastic tie wraps. Individual pair identification shall be maintained by carefully twisting together the two conductors of each pair.

3.7 Expanded Plastic Insulated Conductor (PIC) Precautions: Solid PIC and expanded (foam or foam skin) PIC are spliced in the same manner, using the same tools and materials and, in general, should be treated the same. However, the insulation on expanded PIC is much more fragile than solid PIC. Twisting or forming expanded PIC into extremely compact splice bundles and applying excessive amounts of tension when tightening tie wraps causes shiners and, thus shall be avoided.

3.8 <u>Splice Connectors</u>:

3.8.1 Only RUS accepted filled splice connectors shall be used on outside plant projects financed by RUS.

3.8.2 Specialized connectors are available for splicing operations such as butt splices, in line splices, bridge taps, clearing and capping, and multiple pair splicing operations. The splice connector manufacturer's recommendations shall be followed concerning connector selection and use.

3.8.3 Caution shall be exercised to maintain conductor and pair association both during and after splicing operations.

3.8.4 Splicing operations that involve pairs containing working services shall utilize splice connectors that permit splicing without the interruption of service.

3.9 <u>Piecing Out Conductors</u>: Conductors may be pieced-out to provide additional slack or to repair damaged conductors. However, the conductors shall be pieced-out with conductors having the same gauge and type and color of insulation. The conductors used for piecing-out shall be from cables having RUS acceptance.

3.10 <u>Splice Organization</u>: Spliced pair bundles shall be arranged in firm lay-ups with minimum conductor tension in accordance with the hardware manufacturer's instructions.

3.11 <u>Binder Tape</u>: Perforated nonhygroscopic and nonwicking binder tape should be applied to splices housed in filled splice cases. The binder tape allows the flow of filling compound while holding the splice bundles near the center of the splice case to allow adequate coverage of filling compound.

3.12 <u>Cable Tags</u>: Cables shall be identified by a tag indicating the cable manufacturer's name, cable size, date of placement, and generic route information. Information susceptible to changes caused by future cable throws and rearrangements should not be included. Tags on load coil stubs shall include the serial number of the coil case, the manufacturer's name, and the inductance value.

3.13 <u>Screened Cable</u>: Screened PIC cable is spliced in the same manner as nonscreened PIC cable. However, special considerations are necessary due to differences in the cable design. The transmit and receive bundles of the cable shall be separated and one of the bundles shall be wrapped with shielding material in accordance with the cable manufacturer's recommendations. When acceptable to the cable manufacturer, it is permissible to use either the scrap screening tape removed from the cable during the sheath opening process provided the screening tape is edge coated or new pressure sensitive aluminum foil tape over polyethylene tape.

3.14 Service Wire Connections:

3.14.1 Buried service wires may be spliced directly to cable conductors inside pedestals using the same techniques required for branch cables. Buried service wires may also be terminated on terminal blocks inside pedestals in areas where high service order activity or fixed count cable administration policies require terminal blocks. However, only RUS accepted terminal block equipped with grease or gel filled terminations to provide moisture and corrosion resistance shall be used.

3.14.2 Only filled terminal blocks having RUS acceptance shall be used on aerial service wire connections.

3.15 <u>Copper Cable Testing</u>: Copper cable testing shall be performed in accordance with RUS Bulletin 345-63, RUS Standard for Acceptance Tests and Measurements of Telephone Plant, PC-4.

3.16 <u>Cable Acceptance</u>: Installed cable shall be tested and pass the inventory and acceptance testing specified in the Telephone System Construction Contract (Labor and Materials), RUS Form 515. The tests and inspections shall be witnessed by the borrower's resident project representative. All conductors shall be free from grounds, shorts, crosses, splits, and opens.

4. SPLICE ARRANGEMENTS FOR COPPER CABLES

4.1 Service Distribution Closures:

4.1.1 Ready access closures permit cable splicing activities and the installation of filled terminal blocks for service wire connections in the same closure. Ready access designs shall allow service technicians direct access to the cable core as well as the terminal block.

4.1.2 Fixed count terminals shall restrict service technician access to the cable core. Predetermined cable pairs shall be spliced to the terminal leads or stub cable in advance of service assignments.

4.2 <u>Aerial Splices</u>: Aerial splice cases accommodate straight splices, branch splices, load coils, and service distribution terminals. Aerial splicing arrangements having more than 4 cables spliced in the same splice case are not recommended. Stub cabling to a second splice case to avoid a congested splice is acceptable.

4.3 <u>Buried Splices</u>:

4.3.1 Direct buried splice cases accommodate straight splices, branch splices, and load coils. Direct buried splices shall be filled and shall be used only when above ground splicing inside pedestals is not practicable.

4.3.2 A treated plank or equivalent shall be placed 15 cm (6 in.) above the buried splice case to prevent damage to the splice case from future digging. Where a firm base for burying the splice cannot be obtained, a treated plank or equivalent shall be placed beneath the splice case.

4.3.3 Each buried splice shall be identified for future locating. One method of marking the splice point is the use of a

warning sign. Another method is the burying of an electronic locating device.

4.4 BD-Type Pedestals:

4.4.1 BD-type pedestals are housings primarily intended to house, organize, and protect cable terminations incorporating splice connectors, ground lugs, and load coils. Activities typically performed in pedestals are cable splicing, shield bonding and grounding, loading, and connection of subscriber service drops.

4.4.2 Recommended splice capacities for BD-type pedestals are shown in Table 5. However, larger size pedestals are permissible if service requirements dictate their usefulness. Table 5 is as follows:

TABLE 5 Splice Capacities for BD-Type Pedestals

Pedestal <u>Type</u>	Maximum Straight Splice Pair Capacity Using Single Pair Connectors or Multiple Pair Splice Modules	Maximum Load Splice Pair Capacity Using Single Pair Connectors or Multiple Pair Splice Modules (See Note 1)
BD3, BD3A	100 Pair	50 Pair
BD4, BD4A	200 Pair	100 Pair
BD5, BD5A	600 Pair	300 Pair
BD7	1200 Pair	600 Pair
BD14, BD14A	100 Pair	50 Pair
BD15, BD15A	400 Pair	200 Pair
BD16, BD16A	600 Pair	300 Pair

Note 1: This table refers to load coil cases that are to be direct buried with stub cables extending into the pedestal for splicing. Requirements involving individual coil arrangements inside the pedestal must be engineered on a case-by-case basis.

4.4.3 Special distribution pedestals having a divider plate for mounting filled terminal blocks are available. Distribution pedestals are also equipped with service wire channels for installation of buried service wires without disturbing the cabling and gravel inside the base of the pedestal. Distribution pedestals are recommended in locations where the connection of service wires is required.

4.5 Large Pair Count Splice Housings: Large pair count splice housings are recommended for areas not suitable for manholes. The recommended capacities are shown in Table 6:

TABLE 6 Splice Capacities for Large Pair Count Housings

Housing Type	Maximum Straight Splice Pair Capacity Using Single Pair Connectors or Multiple Pair Splice Modules	Maximum Load Splice Pair Capacity Using Single Pair Connectors or Multiple Pair Splice Modules (See Note 1)	
BD 6000	6,000 Pair	3,000 Pair	
BD 8000	8,000 Pair	4,000 Pair	
BD 10000	10,000 Pair	5,000 Pair	

4.6 Pedestal Restricted Access Inserts: Restricted access inserts may be used to protect splices susceptible to unnecessary handling where subsequent work activities are required or expected to occur after splices have been completed. Restricted access inserts also provide moisture protection in areas susceptible to temporary flooding. A typical restricted access insert is shown in Figure 1.

4.7 Serving Area Interface (SAI) Systems: SAI systems provide the cross-connect point between feeder and distribution cables. Connection of feeder to distribution pairs is accomplished by placing jumpers between connecting blocks. Only RUS accepted connecting blocks having grease or gel filled terminations to provide moisture and corrosion resistance shall be used.

4.8 Buried Cable Splicing Arrangements: Typical buried cable splicing arrangements are illustrated in Figures 2 through 5.

4.9 Underground Splices (Manholes): Underground splice cases accommodate straight splices, branch splices, and load coils. Underground splices shall be filled.

4.10 Central Office Tip Cable Splices:

4.10.1 Filled cable or filled splices are not recommended for use in central offices, except in cable vault locations. Outside plant cable sheath and cable filling compound are susceptible to fire and will support combustion. Fire, smoke, and gases generated by these materials during burning are detrimental to telephone switching equipment.

4.10.2 Tip cables should be spliced in a cable vault. However, as a last resort, tip cables may be spliced inside a central

office if flame retardant splice cases or a noncombustible central office splice housing is used to contain the splice.

4.10.3 Splices inside the central office shall be made as close as practical to the point where the outside plant cables enter the building. Except in cable vault locations, outside plant cables within the central office shall be wrapped with fireproof tape or enclosed in noncombustible conduit.

5. SPICING CONSIDERATIONS FOR FIBER OPTIC CABLES

5.1 <u>Connection Characteristics</u>: Splicing efficiency between optical fibers is a function of light loss across the fiber junctions measured in decibels (dB). A loss of 0.2 dB in a splice corresponds to a light transmission efficiency of approximately 95.5 percent.

5.2 Fiber Core Alignment: Fiber splicing techniques shall be conducted in such a manner that the cores of the fibers to be spliced will be aligned as perfectly as possible to allow maximum light transmission from one fiber to the next. Without proper alignment, light will leave the fiber core and travel through the fiber cladding. Light outside the fiber core is not a usable light signal. Core misalignment is illustrated in Figure 6.

5.3 Splice Loss:

5.3.1 Splice loss can also be caused by fiber defects such as nonidentical core diameters, cores not in center of the fiber, and noncircular cores. Such defects are depicted in Figure 7.

5.3.2 Undesirable splice losses are caused by poor splicing techniques including splicing irregularities such as improper cleaves and dirty splices. Typical cleave problems are illustrated in Figure 8.

5.4 <u>Handling Precautions</u>: The following precautions shall be observed:

5.4.1 Avoid damaging the cable during handling operations prior to splicing. Minor damage may change the transmission characteristics of the fibers to the extent that the cable section will have to be replaced;

5.4.2 The cable manufacturer's recommendations concerning pulling tension shall be observed. The maximum pulling tension for most fiber optic cable is 2669 newtons (600 pound-force);

5.4.3 The cable manufacturer's recommendations concerning bending radius shall be observed. Unless the cable manufacturer's recommendation is more stringent, the minimum

bending radius for fiber optic cable shall be 20 times the cable diameter;

5.4.4 The cable manufacturer's recommendations concerning buffer tube bending radius shall be observed. Unless the cable manufacturer's recommendation is more stringent, the minimum bending radius for buffer tubes is usually between 38 millimeters (mm) (1.5 in.) and 76 mm (3.0 in.). The bending limitations on buffer tubes are intended to prevent kinking. Buffer tube kinking may cause excessive optical loss or fiber breakage; and

5.4.5 Handle unprotected glass fibers carefully to avoid introducing flaws such as scratched or broken fibers.

5.5 Personnel Safety: The following safety precautions shall be observed:

5.5.1 Safety glasses shall be worn when handling glass fibers;

5.5.2 Never view open-ended fibers with the naked eye or a magnifying device. Improper viewing of a fiber end that is transmitting light may cause irreparable eye damage; and

5.5.3 Dispose of bare scrap fibers by using the sticky side of a piece of tape to pick up and discard loose fiber ends. Fiber scraps easily penetrate the skin and are difficult to remove.

5.6 Equipment Requirements:

5.6.1 Fiber optic splices shall be made in areas where temperature, humidity, and cleanliness can be controlled. Both fusion and mechanical splicing techniques may require a splicing vehicle equipped with a work station that will allow environmental control.

5.6.2 Both fusion and mechanical splicing techniques are permitted on RUS financed projects. When using the mechanical splicing technique, only RUS accepted mechanical fiber optic splice connectors can be used.

5.6.3 Fusion splicing machines shall be kept in proper working condition. Regular maintenance in accordance with the machine manufacturer's recommendations shall be observed.

5.6.4 Mechanical splicing tools shall be in conformance with the tool manufacturer's recommendations.

5.6.5 An optical time domain reflectometer (OTDR) shall be used for testing splices. The OTDR shall be stationed at the central office or launch point for testing individual splices as they are made and for end-to-end signature tests for the fiber optic link.

5.6.6 An optical power meter shall be used for end-to-end cable acceptance tests.

5.6.7 A prerequisite for the successful completion of a fiber optic splicing endeavor is the presence of a talk circuit between the splicing technician in the splicing vehicle and the operator of the OTDR in the central office. The splicing technician and the OTDR operator shall have access to communications with each other to inform each other as to:

- a. Which splices meet the loss objectives;
- b. The sequence in which buffer tubes and fibers are to be selected for subsequent splicing operations; and
- c. The timing required for the performance of OTDR testing to prevent making an OTDR test at the same time a splice is being fused.

5.7 Cable Preparation:

5.7.1 The engineering work prints shall prescribe the cable slack needed at splice points to reach the work station inside the splicing vehicle. Consideration should be given to the slack required for future maintenance activity as well as initial construction activities. The required slack may be different for each splice point, depending on the site logistics. However, the required slack is seldom less than 15 meters (50 feet). The amount of slack actually used shall be recorded for each splice point to assist future maintenance and restoration efforts.

5.7.2 The splice case manufacturer's recommendations concerning the amount of cable sheath to be removed shall be followed to facilitate splicing operations. The length of the sheath opening shall be identified with a wrap of plastic tape.

5.7.3 If the cable contains a rip cord, the cable jacket shall be ring cut approximately 15 cm (6 in.) from the end and the 15 cm (6 in.) of cable jacket shall be removed to expose the rip cord. The rip cord shall be used to slit the jacket to the tape mark.

5.7.4 If the cable does not contain rip cord, the cable jacket shall be slit using a sheath splitter. No cuts shall be made into the cable core nor shall the buffer tubes be damaged.

5.7.5 If the cable contains an armor sheath, the outer jacket shall be opened along the slit and the jacket shall be removed exposing the armor sheath. The armor shall be separated at the seam and pulled from the cable exposing the inner jacket. The armor shall be removed making allowances for a shield bond connector. The inner sheath shall be slit using a sheath

splitter or rip cord. The cable core shall not be damaged nor shall there be any damage to the buffer tubes. The jacket shall be peeled back and cut at the end of the slit. The exposed buffer tubes shall not be cut, kinked, or bent.

5.7.6 After the cable sheath has been removed, the binder tape shall be removed from the cable. The cable shall not be crushed or deformed.5.7.7 The buffer tubes shall be unstranded one at a time. The buffer tubes shall not be kinked.

5.7.8 If the cable is equipped with a strength member, the strength member shall be cut to the length recommended by the splice case manufacturer.

5.7.9 Each buffer tube shall be inspected for kinks, cuts, and flat spots. If damage is detected, an additional length of cable jacket shall be removed and all of the buffer tubes shall be cut off at the point of damage.

5.7.10 The cable preparation sequence shall be repeated for the other cable end.

5.8 Shield Bonding and Grounding: For personnel safety, the shields and metallic strength members of the cables to be spliced shall be bonded together and grounded before splicing activities are started. (See Paragraphs 7.4, and 7.5.1 through 7.5.3 of this standard for final bonding and grounding provisions.)

5.9 Fiber Optic Color Code: The standard fiber optic color code for buffer tubes and individual fibers shall be as shown in Table 7.

ber and buller	Tube Identification
Buffer Tube and Fiber No.	Color
1 2 3 4 5 6 7 8 9 10 11	Blue Orange Green Brown Slate White Red Black Yellow Violet Rose
12 13	Aqua Blue/Black Tracer

TABLE 7 Fiber and Buffer Tube Identification

14	Orange/Black	Tracer
15	Green/Black	Tracer
16	Brown/Black	Tracer
17	Slate/Black	Tracer
18	White/Black	Tracer
19	Red/Black	Tracer
20	Black/Yellow	Tracer
21	Yellow/Black	Tracer
22	Violet/Black	Tracer
23	Rose/Black	Tracer
24	Aqua/Black	Tracer

5.10 Buffer Tube Removal:

5.10.1 The splice case manufacturer's recommendation shall be followed concerning the total length of buffer tube to be removed. Identify the length to be removed with plastic tape.

5.10.2 Experiment with a scrap buffer tube to determine the cutting tool adjustment required to ring cut a buffer tube without damaging the fibers.

5.10.3 Buffer tubes shall be removed by carefully ring cutting and removing approximately 15 to 46 cm (6 to 18 in.) of buffer tube at a time. The process shall be repeated until the required length of buffer tube has been removed, including the tape identification marker.

5.11 Coated Fiber Cleaning:

5.11.1 Each coated fiber shall be cleaned. The cable manufacturer's recommendations shall be followed concerning the solvent required to clean the coated fibers. Reagent grade isopropyl alcohol is a commonly used cleaning solvent.

5.11.2 A tissue or cotton ball shall be soaked in the recommended cleaning solvent and the coated fibers shall be carefully wiped one at a time using a clean tissue or cotton ball for each coated fiber. Caution shall be exercised to avoid removing the coloring agent from the fiber coating.

5.12 Fiber Coating Removal:

5.12.1 Fiber coatings shall be removed. In accordance with the splicing method used, the splice case manufacturer's recommendation shall be followed concerning the length of fiber coating to be removed.

5.12.2 The recommended length of fiber coating shall be removed only on the two fibers to be spliced. Fiber coating removal

shall be performed on a one-fiber-at-a-time basis as each splice is prepared.

5.13 <u>Bare Fiber Cleaning</u>: After the fiber coating has been removed, the bare fibers shall be cleaned prior to splicing. Each fiber shall be wiped with a clean tissue or cotton ball soaked with the cleaning solvent recommended by the cable manufacturer. The bare fiber shall be wiped one time to minimize fiber damage. Aggressive wiping of bare fiber shall be avoid as it lowers the fiber tensile strength.
5.14 <u>Fiber Cleaving</u>: Cleaving tools shall be clean and have sharp cutting edges to minimize fiber scratches and improper

cleave angles. Cleaving tools that are recommended by the manufacturer of the splicing system shall be used.

5.15 <u>Cleaved Fiber Handling</u>: The cleaved and cleaned fiber shall not be allowed to touch other objects and shall be inserted into the splicing device.

5.16 Completion of the Splice:

5.16.1 In accordance with the method of splicing selected by the borrower, the splice shall be completed by either fusing the splice or by applying the mechanical connector.

5.16.2 Each spliced fiber shall be routed through the organizer tray one at a time as splices are completed. The fibers shall be organized one at a time to prevent tangled spliced fibers. The splice case manufacturer's recommendation shall be followed concerning the splice tray selection.

5.17 Fiber Optic Testing: Fiber optic testing shall be performed in accordance with RUS Bulletin 345-63, RUS Standard For Acceptance Tests and Measurements of Telephone Plant, PC-4.

5.18 <u>Cable Acceptance</u>: Installed cable shall be tested and pass the inventory and acceptance testing specified in the Telephone System Construction Contract (Labor and Materials), RUS Form 515. The tests and inspections shall be witnessed by the borrower's resident project representative.

6. SPLICE ARRANGEMENTS FOR FIBER OPTIC CABLES

6.1 <u>Aerial Splices</u>: Cable slack at aerial splices shall be stored either on the messenger strand, on the pole, or inside a pedestal at the base of the pole. A typical arrangement for the storage of cable slack at aerial splices is shown in Figure 9.

6.2 Buried Splices: Buried splices shall be installed in handholes to accommodate the splice case and the required splicing slack. An alternative to the handhole is a pedestal

specifically designed for fiber optic splice cases. Typical arrangements for buried cable splices are shown in Figures 10 and 11.

6.3 Underground Manhole Splices: Underground splices shall be stored in manholes on cable hooks and racks fastened to the manhole wall. The cable slack shall be stored on cable hooks and racks as shown in Figure 12.

6.4 Central Office Cable Entrance:

6.4.1 Filled cable or filled splices are not recommended for use inside the central offices except in cable vault locations. Outside plant cable sheath and cable filling compound are susceptible to fire and will support combustion. Fire, smoke, and gases generated by these materials during burning are detrimental to telephone switching equipment.

6.4.2 As a first choice, the outside plant fiber optic cable shall be spliced to an all-dielectric fire retardant cable in a cable vault with the all-dielectric cable extending into the central office and terminated inside a fiber patch panel.

6.4.3 As a second choice, the outside plant cable may be spliced inside the central office if a flame retardant fiber optic splice case or a noncombustible central office splice housing equipped with organizer trays is used to contain the splice.

6.4.4 In cases referenced in Paragraphs 6.4.2 and 6.4.3 of this standard, as a minimum the fire retardant all-dielectric cable used to provide the connection between the cable entrance splice and the fiber patch panel shall be listed as Communication Riser Cable (Type CMR) in accordance with Sections 800-50 and 800-51(b) of the 1993 National Electrical Code.

6.4.5 Splices inside the central office shall be made as close as practicable to the point where the outside plant cables enter the building. Except in cable vault locations, outside plant cables within the central office shall be wrapped with fireproof tape or enclosed in noncombustible conduit.

7. BONDING AND GROUNDING FIBER OPTIC CABLE, COPPER CABLE, AND COPPER SERVICE WIRE

7.1 <u>Bonding</u>: Bonding is electrically connecting two or more metallic items of telephone hardware to maintain a common electrical potential. Bonding may involve connections to another utility.

7.2 Copper Cable Shield Bond Connections:

7.2.1 Cable shields shall be bonded at each splice location. Only RUS accepted cable shield bond connectors shall be used to provide bonding and grounding connections to metallic cable shields. The shield bond connector manufacturer's instructions shall be followed concerning installation and use.

7.2.2 Shield bonding conductors shall be either stranded or braided tinned copper wire equivalent to a minimum No. 6 American Wire Gauge (AWG) and shall be RUS accepted. The conductor connections shall be tinned or of a compatible bimetallic design to avoid corrosion problems associated with dissimilar metals. The number of shield bond connectors required per pair size and gauge shall be as shown in Table 8:

> TABLE 8 Shield Bond Connectors Per Pair Size and Gauge

19 AWG	Pair Size 22 AWG	and Gauge 24 AWG	26 AWG	No. of Shield Bond Connectors
0.05	0 100	0 1 5 0		-
0-25	0 - 100	0-150	0-200	L
50-100	150-300	200-400	300-600	2
150-200	400-600	600-900	900-1500	3
300-600	900-1200	1200-2100	1800-3600	4

7.2.3 It is permissible to strap across the shield bond connectors of several cables with a single length of braided wire. However, both ends of the braid shall be terminated on the pedestal ground bracket to provide a bonding loop. Shield bond connection methods for individual cables are shown in Figures 13 through 15, and the bonding of several cables inside a pedestal using the bonding loop is shown in Figure 16.

7.3 <u>Buried Service Wire Shield Bond Connections</u>: Buried service wire shields shall be connected to the pedestal bonding and grounding system. Typical buried service wire installations are shown in Figures 17 and 18. In addition to the methods referenced in Figures 17 and 18, the shields of buried service wires may also be connected to the pedestal bonding and grounding system using buried service wire bonding harnesses listed on Page 3.3.1, Item "gs-b," of RUS Bulletin 1755I-100. RUS Bulletin 1755I-100 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When those harnesses are used they shall be installed in accordance with the manufacturer's instructions.

7.4 Fiber Optic Cable Bond Connections:
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7.4.1 The cable shield and metallic strength members shall be bonded at each splice location. Only RUS accepted fiber optic cable shield bond connectors shall be used to provide bonding connections to the metallic cable shields. The shield bond connector manufacturer's instructions shall be followed concerning installation and use.

7.4.2 Shield bonding conductors shall be either stranded or braided tinned copper wire equivalent to a minimum No. 6 AWG and shall be RUS accepted. The conductor connections shall be tinned or of a compatible bimetallic design to avoid corrosion problems associated with dissimilar metals.

7.5 Grounding:

7.5.1 Grounding is electrically connecting metallic telephone hardware to a National Electrical Safety Code (NESC) acceptable grounding electrode. Acceptable grounding electrodes are defined in the Rule 99A of the NESC.

7.5.2 The conductor used for grounding metallic telephone hardware shall be a minimum No. 6 AWG solid, bare copper conductor.

7.5.3 For copper and fiber optic cable plant, all cable shields, all metallic strength members, and all metallic hardware shall be:

7.5.3.1 Grounded at each splice location to a driven grounding electrode (ground rod) of:

- a. At least 1.5 meters (5 feet) in length where the local frost level is normally less than 0.30 meters (1 foot) deep; or
- b. At least 2.44 meters (8 feet) in length where the local frost level is normally 0.30 meters (1 foot) or deeper; and

7.5.3.2 Bonded to a multi-grounded power system neutral when the splice is within 1.8 meters (6 feet) of access to the grounding system of the multi-grounded neutral system. Bonding to the multi-grounded neutral of a parallel power line may help to minimize telephone interference on long exposures with copper cable plant. Consideration, thus, should be given to completing such bonds, at least four (4) times each mile, when splices are greater than 1.8 meters (6 feet) but less than 4.6 meters (15 feet) from access to the multi-grounded neutral.

7.6 Bonding and Grounding Splice Cases:

7.6.1 Splice cases are equipped with bonding and grounding devices to ensure that cable shields and metallic strength members maintain electrical continuity during and after cable splicing operations. The splice case manufacturer's recommendations shall be followed concerning the bonding and grounding procedures. Conductors used for bonding shall be either stranded or braided tinned copper wire equivalent to 6 AWG. Conductors used for grounding shall be a solid, bare, copper wire equivalent to minimum No. 6 AWG.

7.6.2 Buried splice cases installed in either handholes or pedestals shall be grounded such that the cable shield grounds are attached to a common ground connection that will allow the lifting of a ground on the cable shield in either direction to permit efficient cable locating procedures. As a first choice, buried grounding conductor(s) shall be bare. However, if two or more grounding conductors are buried in the same trench, they shall be insulated to avoid shorts when a locating tone is applied.

7.6.3 A typical bonding and grounding method for fiber optic splices is shown in Figure 19.

7.7 Bonding and Grounding Central Office Cable Entrances: The RUS Telecommunications Engineering and Construction Manual (TE&CM) Section 810 provides bonding and grounding guidance for central office cable entrances. Splicing operations shall not be attempted before all metallic cable shield and strength members are bonded and grounded.







Note: See Figures 13 through 16 for cable tags, tie wraps, and bonding and grounding details.



TYPICAL SPLICE USING SINGLE PAIR CONNECTORS



Note: Cable tags, bonding and grounding details, and plastic tie wraps have been omitted for clarity. See Figures 13 through 16 for cable tags, tie wraps, and bonding and grounding details.





Note: Cable tags, bonding and grounding details, and plastic tie wraps have been omitted for clarity. See Figures 13 through 16 for cable tags, tie wraps, and bonding and grounding details.

LARGE SPLICE USING MULTIPLE PAIR CONNECTORS MOUNTED ON ORGANIZER RACKS



Note: Cable tags, bonding and grounding details, and plastic tie wraps have been omitted for clarity. See Figures 13 through 16 for cable tags, tie wraps, and bonding and and grounding details. FIGURE 6 CORE MISALIGNMENT



SPLICE LOSS CAUSED BY FIBER MANUFACTURE

Different Core Diameters







FIGURE 8 IMPROPER CLEAVES VERSUS PROPER CLEAVE



Properly Cleaved Fiber



Note: See Figure 11 for details concerning storage of splice case inside pedestal.





Note: Ground wires omitted for clarity. See Figure 19 for bonding and grounding details.





BONDING AND GROUNDING CABLES INSIDE PEDESTALS



BONDING AND GROUNDING OF LARGE CABLES INSIDE PEDESTALS USING MULTIPLE SHIELD BOND CONNECTORS AND HARNESS WIRES



Note: The maximum number of harness wires that can be installed on each stud of the ground bracket shall be in accordance with the manufacturer's instructions.

FIGURE 15

ALTERNATIVE METHOD OF BONDING AND GROUNDING LARGE CABLES IN PEDESTALS USING MULTIPLE SHIELD BOND CONNECTORS AND 6 AWG WIRE BRAID



FIGURE 16 ALTERNATIVE METHOD OF BONDING AND GROUNDING SEVERAL CABLES IN PEDESTALS USING SHIELD BOND CONNECTORS AND 6 AWG WIRE BRAID LOOP $\langle 0 \rangle$ $\langle 0 \rangle$ Ó Shield - \bigcirc Bond Connector Ó 6 AWG Tinned Copper Wire Braid 80 Housing Ground 6 Bracket $\hat{\lambda}_{0}$ $(\mathbf{\hat{O}}$ (\hat{O}) $(\mathbf{0})$ Vinyl Tape Tie -Or Tie Wrap Wrap 6 AWG — Ground Wire To Telco Ground Rod Or Electric Power MGN Cable Tag

Top Of Ground Line Cover Plate

FIGURE 17

GROUNDING SERVICE WIRE SHIELDS USING SERVICE WIRE CLAMP



Note: Provide a loop in service drops to allow for movement of the drops without damage to the grounding connection.

ALTERNATIVE METHOD OF GROUNDING BURIED SERVICE WIRES INSIDE PEDESTALS





BONDING AND GROUNDING BURIED FIBER OPTIC SPLICES



Attachment F

United States Department of Agriculture

Rural Utilities Service

RUS Bulletin 1753F-151 RUS Form 515b

September 2001



Specifications and Drawings for Construction of Underground Plant

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UNITED STATES DEPARTMENT OF AGRICULTURE Rural Utilities Service

BULLETIN 1753F-151

SUBJECT: Specifications and Drawings for Construction of Underground Plant, RUS Form 515b

Incorporated by reference in 7 CFR 1755.97

TO: All Telecommunications Borrowers

RUS Telecommunications Staff

EFFECTIVE DATE: September 17, 2001

OFFICE OF PRIMARY INTEREST: Outside Plant Branch, Telecommunications Standards Division.

AVAILABILITY: This bulletin supersedes RUS Bulletin 345-151, Specifications and Drawings for Conduit and Manhole Construction, RUS Form 515c, issued May 25, 1989; and RUS Bulletin 345-152, Specifications and Drawings for Underground Cable Installation, RUS Form 515d, issued May 25, 1989. This bulletin can be accessed via the Internet at http://www.usda.gov/rus/telecom/publications/bulletins.htm

PURPOSE: This specification provides Contractors, Engineers, and RUS Borrowers with assembly unit descriptions, materials, construction and installation, and drawings for underground plant associated with RUS Form 515, Telecommunications System Construction Contract.

Roberta D. Purcell

8/21/01 Date

Roberta D. Purcell Assistant Administrator Telecommunications Program

RUS Bulletin 1753F-151 Specifications and Drawings for Construction of Underground Plant, RUS Form 515b

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ASSEMBLY UNITS: Conduit and Manhole CABLE: Assembly Units CONSTRUCTION: Fiber Optic Cable Plant Manholes Underground Cable (Physical Plant) Underground Conduit SPECIFICATIONS AND STANDARDS: Outside Plant

LIST OF CHANGES

- 1. Combination of RUS Form 515c and RUS Form 515d.
- 2. Modification of Section HC to provide compensation on a single pair basis.
- 3. Modification of Section HO to provide compensation for testing a fiber.
- 4. Modification of Section PM as follows:

 (a) Redefined PM21 to a more generalized description;
 (b) Added PM22 unit.
- 5. Elimination of Section U.
- 6. Modification of Section UD by elimination of suffix "P" and the adding of suffix "V" to allow placement of innerducts in new or existing conduit systems.
- 7. Modification of the UF and UO units to provide compensation on a per foot basis.
- 8. Elimination of Section UG.
- 9. Modification of Section UH to allow for installation in areas of vehicular traffic.
- 10. Modification of Section UM to indicate precast manholes as the default type.
- 11. In part III, section 2, added requirement that poured in place manholes are now to be constructed as specified by the Engineer. Other references to poured in place manholes were eliminated.
- 12. In part III, section 4, added requirement that when blowing of underground cable is specified, the installation shall be in accordance with the manufacturer of the blowing installation equipment.

For editorial or other minor technical changes, refer to the body of the document.

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Part I - DESCRIPTION OF ASSEMBLY UNITS AND PROPOSAL AND CONTRACT SECTIONS

The Contractor's Proposal form is divided into sections and the sections approved for construction shall be listed in the Construction Agreement by the Owner. The sections are as follows:

Section	HC	-	Copper Splicing Assembly Units
Section	HO	-	Fiber Optic Splicing Assembly Units
Section	HU	-	Underground Splice Closure Assembly Units
Section	ΡM	-	Miscellaneous Assembly Units
Section	UD	-	Underground Conduit Assembly Units
Section	UF	-	Underground Filled Copper Cable Assembly
			Units
Section	UH	-	Underground Handhole Assembly Units
Section	UM	-	Precast Manhole Assembly Units
Section	UO	-	Underground Filled Fiber Optic Cable
			Assembly Units

Each assembly unit includes only the materials listed on the corresponding Installation and Construction Guide Drawings or description of unit where no drawing exists. The various installation and construction units, which are included in this Proposal and upon which quotations are required, are defined by the following descriptions:

Section HC - COPPER SPLICING ASSEMBLY UNITS

- HC1 Consists of the labor and material necessary in the wire work and splicing of one (1) cable pair in any cable, including any non-working pair in an existing cable in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2) using individual mechanical splicing connectors. The splice may be straight, bridged, or pieced out and bridged. Pairs that are to be tested, capped, or tested and capped, when specified by the Engineer are considered to be part of this unit. Only those pairs on which splicing, testing, and/or capping operations are performed are counted and each pair is counted only once at each location. On aerial inserts, each end of the fuse link is considered as a splice.
- HC3 Consists of the labor and material necessary in the wire work and splicing of one (1) cable pair in any cable, including any non-working pair in an existing cable in accordance with RUS Splicing Standard Bulletin 1753F-401 (PC-2) using splicing modules. The splice may be straight, bridged or pieced out and bridged. Pairs that are to be tested, capped, or tested and capped, when specified by the Engineer are considered to be part of

this unit. Only those pairs on which splicing, testing, and/or capping operations are performed are counted and each pair is counted only once at each location. On aerial inserts, each end of the fuse link is considered as a splice.

Section HO - FIBER OPTIC SPLICING ASSEMBLY UNITS

Consists of all labor and material necessary to splice and/or test one (1) glass fiber in any cable in accordance with RUS Splicing Standard Bulletin 1753F-401(PC-2). The labor shall include initial measurement, minimizing the attenuation, splicing and stowing the spliced fiber in a fiber organizer. The labor and material for the fiber organizer is part of the appropriate splice closure unit.

- Suffix Description
- HO1 Fusion Splice
- HO2 Mechanical Splice
- HO3 Connector Splice

Section HU - UNDERGROUND SPLICE CLOSURE ASSEMBLY UNITS

Consists of an underground splice closure and the closure manufacturer's provided encapsulating material if required, installed in place and the labor and material for setting up in preparation for installing the closure, such as, opening the sheath or jacket of the cable, bonding of the cable shields, filling the closure if required, closing the closure, and, when applicable, pressure testing, all in accordance with the manufacturer's instructions. It also includes all necessary hardware items to support the closure and the cable adjacent to the closure on the cable racks in the manhole. Cable splicing shall be compensated under the appropriate splicing units.

The assembly units are defined as follows:

- HUF() <u>Underground Filled Closure</u> A filled splice closure with pair count and gauge for each cable to be spliced.
- HU0() <u>Underground Filled Fiber Optic Closure</u> A fiber optic closure and organizer with the number of fibers to be housed in the organizer.

HUP() <u>Underground Pressurized Closure</u> - A pressurized splice closure with pair count and gauge for each cable to be spliced.

The following illustrations indicate the method of designating the material required.

- HUF(100-24) Underground filled closure enclosing two cable ends same pair count and gauge.
- HUP(200-24)(100-24) Underground pressurized closure enclosing two cable ends with different pair counts.
- HUF(600-24)(200-24)Underground filled closure enclosing(200-24)(200-22)four cable ends with pair counts and
gauges as shown.
- HUO(24) Underground filled fiber optic splice closure and organizer capable of accommodating a minimum of 24 fibers.

Section PM - MISCELLANEOUS ASSEMBLY UNITS

Consists of all labor and materials to construct and install the units defined individually below required for the installation and construction of the underground cable portions of the Project.

- PM21 <u>Cable Entrance</u> Consists of the necessary labor and material to terminate copper and/or fiber optic outside plant cables as shown on the detailed drawings as specified by the Engineer.
- PM22 <u>Grounding System</u> Consists of the necessary labor and material to construct a grounding system as shown on the detailed drawings as specified by the Engineer. This unit shall include all ground electrodes, trenching, backfilling, bonding the auxiliary ground electrodes to each other and to the primary ground electrodes, and bonding to the master ground bar (MGB).

Section UD - UNDERGROUND CONDUIT ASSEMBLY UNITS

Consists of one (1) foot [0.305 meters (m)] of single or multiduct conduit in place. This unit includes all material and labor for the placement of the conduit to the depth indicated in the specifications.

The assembly unit is defined as follows:

UD () Underground Conduit

The number of conduits placed horizontally, and vertically, and the inside diameter (distance between opposite walls for square conduit), shall be indicated in the parentheses.

Options designated by the following suffixes apply:

Suffix Description

- E This unit consists of necessary labor and materials to encase the conduit in concrete. (Encasement shall consist of a 2 inch (in.) [51 millimeters (mm)] minimum cover over the conduit(s), a minimum of 1-1/2 in. (38 mm) at the sides and a minimum of 2 in. (51 mm) for the base.)
- S This unit consists of the necessary labor and materials to encase the conduit in sand or fine earth. (Encasement shall consist of a 4 in. (102 mm) cover over the conduit(s), a minimum of 1-1/2 in. (38 mm) at the sides and a minimum of 3 in. (76 mm) for the base.)
- B This unit consists of the necessary labor and materials to provide a concrete base for the conduit assembly unit as determined by the Engineer. (Concrete base will be 3 in. (76 mm) in thickness for the width of the trench.)
- C This unit consists of the necessary labor and materials to provide a concrete cover for the conduit assembly unit as determined by the Engineer. (The concrete cover shall have a minimum thickness of 3 in. (76 mm) and shall be at least as wide as the conduit.)
- A This unit consists of the necessary labor and materials to remove and restore paved surfaces. All work shall be performed as required in accordance with federal, state and/or local construction standards in effect at the time of bid date.

V This unit consists of the necessary labor and materials to place one or more vacant innerduct(s) in a conduit. The parentheses for the UD unit shall indicate the number of innerducts followed by the inside diameter of the innerduct to be placed in new or existing conduit, including rodding and cleaning of the conduit if necessary.

A. This unit also includes:

(1) All labor and material required for conduit jointing, such as, conduit bends, couplings, adapters, fittings, plugs or seals, and spacers.

(2) All material and labor required in the repair of streets, roads, sidewalks, drives, fences, lawns, shrubbery, trees, watermains, pipes, pipelines and contents, underground power and telecommunications facilities, and any other incidental property damaged during the installation of underground conduit.

(3) All labor and material for trenching, shoring, backfilling, tamping, and disposal of water and excess or unusable material.

(4) All labor required for rodding and cleaning of conduit as specified by the Engineer. When rodding and cleaning are not specified by the Engineer, these actions shall be in accordance with Part III, Section 2.10.

B. The length of conduit for compensation purposes is determined by taking the sum of distances paralleling the conduit between manholes or between manholes and termination points as specified by the Engineer.

The following illustrations indicate the method of designating the material required.

UD(4x4-2)E	Indicates concrete encased conduit having four ducts horizontally by four ducts vertically, (16 ducts total), with each duct having an inside diameter of 2 in. (51 mm).
UD(4x3-3-1/2)B	Indicates a concrete base for a conduit having 4 ducts horizontally by 3 ducts vertically, (12 ducts total), with each duct having an inside diameter of 3-1/2 in. (89 mm).

UD(3-1.25)V Indicates 3 innerducts of 1.25 in. (31 mm) inside diameter to be placed in a new or existing conduit.

Section UF - UNDERGROUND FILLED COPPER CABLE ASSEMBLY UNITS

Consists of 1 foot (0.305 m) of underground filled copper cable installed in underground conduits and manholes. This unit also consists of setting up the cable within the manhole, providing and placing cable supports and cable rack hooks, pulling-in wires, duct seals or plugs, cable tags, manhole cable racks and rodding and cleaning of ducts all as required in accordance with the detailed plans and specifications. This unit includes bonding together of all closures, but does not include cable closure assemblies or cable splicing in manholes. The splicing and closures will be specified separately. The length of cable for compensation purposes is determined by measuring the distances paralleling the cable plus the vertical lengths of cable installed on supporting structures. This unit shall include the cleaning out and/or pumping out of manholes when specified by the Engineer in advance of bidding.

Options designated by the following suffixes apply:

- Suffix Description
 - H Screened cable designated for T1 carrier systems.
 - H1C Screened cable designated for T1C carrier systems.

Each underground filled copper cable assembly unit is listed in accordance with the number of pairs and gauge of conductors. Each unit is prefixed by the letters UF. The following illustration indicates the method of designating the material required.

UF600-24H1C A 600 pair, 24 gauge underground filled copper cable with a screen designated for T1C carrier systems.

Section UH - UNDERGROUND HANDHOLE ASSEMBLY UNITS

Consists of labor and material for one (1) underground handhole installed in place, including the base, top cover and mounting hardware, and pea gravel. The handhole size, amount of pea gravel and the installation shall be as specified by the Engineer. The handhole assembly unit shall be used only in areas of nonvehicular traffic. When required for use in areas of vehicular traffic, the handhole shall be rated to withstand vehicular traffic. Where specified, vehicular traffic rated handholes shall be suffixed with the letter "T". The assembly units are defined as follows:

- UHC() Underground Handhole for copper systems.
- UHF() Underground Handhole for fiber optic systems.

The dimensions of length, width, and depth of the handhole shall be indicated in the parentheses in inches (millimeters).

Examples:

- UHC(13x24X24) Underground handhole for copper systems with dimensions of 13 x 24 x 24 in. (330 x 610 x 610 mm)(approximate).
- UHF(17x30x30)T Underground handhole for fiber optic systems with dimensions of 17 x 30 x 30 in. (432 x 762 x 762 mm) (approximate) which is rated for vehicular traffic.

Section UM - PRECAST MANHOLE ASSEMBLY UNITS

Consists of all labor and material necessary to install a precast concrete manhole in place. The unit shall include pit excavation, masonry materials, collar, manhole frame and cover, pulling-in irons, and other materials necessary to make an appropriate installation in accordance with the Construction Sheets. In addition, precast manhole assembly units also include all material and labor required in the repair and/or replacement of streets, roads, drives, fences, lawns, shrubbery, watermains, pipes, pipelines and contents, underground power and telecommunications facilities, buried sewerage and drainage facilities and any other property damaged during the construction of the manhole assembly unit. Backfilling shall include backfill compaction, removal of excess materials and site clearing. Each manhole is listed as a separate unit installed in place.

All manhole unit designations shall begin with the letters UM followed by a letter to indicate the type of the manhole and conduit arrangements shown in the unit drawings. The letters "A", "L", "T", "J", "X", or "Y" indicate rectangular manholes, and the letter "V" indicates a V-shaped manhole.

Immediately following the letter indicating the manhole type shall be a fourth letter, which shall indicate the type of frame, and cover with which the manhole is to be equipped. The letter "R" indicates a light duty frame and cover. The letter "B" indicates a heavy duty frame and cover. Following the letter indicating frame and cover type, and enclosed in parentheses shall be the nominal diameter of the frame opening in inches (millimeters). Examples:

- UM-AR(24) Rectangular manhole equipped with a 24 in. (610 mm) light duty frame and cover.
- UM-VB(30) V shaped manhole equipped with a 30 in. (762 mm) heavy duty frame and cover.

UO - UNDERGROUND FILLED FIBER OPTIC CABLE ASSEMBLY UNITS

Consists of one (1) foot (0.305 m) of underground filled fiber optic cable installed in underground conduit and manholes. This unit also consists of setting up the cable within the manhole, providing and placing cable supports and cable rack hooks, pulling-in wires, duct seals or plugs, cable tags, manhole cable racks, and rodding and cleaning of ducts, all as required in accordance with the detailed plans and specifications. This unit does not include cable closure assembly or cable splicing. They will be specified separately. The length of cable for compensation purposes is determined by measuring the distances paralleling the cable plus the vertical lengths of cable installed on supporting structures. This unit shall include cleaning out and/or pumping out of manholes when specified by the Engineer in advance of bidding.

Each underground filled fiber optic cable assembly unit is listed in accordance with the number of optical fibers. Each unit is prefixed by the letters UO. The following illustration indicates the method of designating the material required.

UO24 An underground filled fiber optic cable with 24 fibers.

Part II - SPECIFICATION FOR MATERIALS

1. SCOPE

This part of the specification is concerned with the various materials required for the construction of underground plant of a rural telecommunications system as shown on the Plans, Specifications, and Construction Sheets.

2. GENERAL

All materials used in the construction of the rural telecommunications system except those listed in Paragraph 3 below shall be listed in RUS Informational Publication (IP) 344-2, "List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers," unless specific written approval has been granted by the Administrator.

3. MISCELLANEOUS

Items which do not appear in RUS IP 344-2, "List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers," shall be of a quality suitable for the application for which they are intended.

Part III - SPECIFICATIONS FOR CONSTRUCTION AND INSTALLATION

1. GENERAL

1.1 All construction and installation work shall be done in a thorough and workmanlike manner in accordance with the Plans, Specifications and Construction Sheets and shall be subject to acceptance by the Owner and the Administrator.

1.2 All material to be used in construction of the Project shall be stored so as to be protected from deteriorating effects of the elements.

1.3 All underground cables and accessory materials used in the construction of the Project shall be handled with care. Each reel of underground cable shall be inspected for damage. Prior to installation, all damage shall be repaired to the satisfaction of the Engineer. If reel wrap is present, the reel wrap shall remain intact on the reel until the cable is ready to be placed.

1.4 Deviations from the Plans, Specifications and Construction Sheets shall not be permitted except upon written permission of the Engineer.
1.5 The latest revision of the National Electrical Safety Code (NESC) and the National Electrical Code (NEC) shall be followed in every case except where local regulations are more stringent, in which case local regulations shall govern.

2. UNDERGROUND CONDUIT AND MANHOLES

2.1 The underground conduit and manhole system shall be constructed in accordance with the instructions given herein unless otherwise specified by the Engineer or unless state or local requirements are more stringent in which case the latter requirements will govern.

2.2 The Engineer shall determine the location of all conduit and manholes and shall specify size, type, position, and depth at which they are to be constructed. The size, type and location of all main conduit and subsidiary ducts, location of foreign structures where known; and applicable right-of-way restrictions shall be shown on the Construction Sheets. The size, type, and location of all conduit entrances and size and location of the manhole frame opening shall be shown on the Construction Sheets.

2.3 All parties associated with excavations for the conduit and manhole system shall follow well-established safety rules and regulations to safeguard the public and workmen.

2.3.1 Testing shall be conducted in excavations and manholes to determine if there is an oxygen deficiency or a presence of harmful gas, in accordance with federal, state, and/or local requirements.

2.3.2 Gas and oil mains shall be given special attention and precautions shall be taken to guard against the fire hazards they present. Excavations in public streets shall always be checked for gas leakage, even though gas mains or sewers are not directly encountered. No flame of any sort shall be permitted around excavations when the odor of gas is detected. Workmen shall not be allowed to smoke; and precautions shall be taken to prevent pedestrians from throwing lighted cigars, cigarettes, or burning matches into such excavations. The owning company shall be notified when excavation involving such structures is undertaken so that a representative may be present if desired.

2.3.3 The Contractor shall provide adequate shoring, warning signs, lights, no parking signs, barricades, and removal of excess water and excavated material. Flagmen and guards shall be provided where required to maintain safe conditions for the workmen and the public.

2.3.4 Blasting shall only be permitted with approval from state or local authorities and with the warning to and protection of workmen and the public.

2.3.5 Excavations shall be closed and/or barricaded for public protection prior to leaving the job site at night with warning lights and/or guards.

2.3.6 Accessibility to fire hydrants, fire alarm boxes, and private driveways shall be maintained using temporary bridges over trenches as required.

2.4 The Contractor shall notify utilities, local authorities, regulatory bodies, and others when construction is to commence. When conflicts are encountered involving the relocation of manholes or conduits, the Engineer shall be notified.

2.5 Where deviations from the Construction Sheets are necessary or desirable, such construction shall proceed only with prior approval by the Engineer.

2.6 The depth of the trench shall be sufficient to obtain a cover of at least 24 in. (610 mm) over the conduit formation including top protection where employed unless otherwise approved by the Engineer.

2.7 The trench route and manhole locations shall be clearly marked by the Engineer before excavation is started.

2.8 In preparing the trench bed for the conduit installation, the trench bed shall be leveled to form an even base. In some cases it may be necessary to provide sand or fine earth to establish an even base. If, upon excavation, the trench bed appears to be incapable of firmly supporting the conduit, the Engineer shall determine whether a concrete base is required.

2.9 Backfilling next to the conduit shall be free from stones or other material which might damage the conduit or conduit joints. Large boulders shall not be included in any part of the backfill. In tamping the backfill at the sides of the conduit, extreme care shall be used to avoid damage to the joints or shifts in the conduit structure. Backfilling and tamping alongside the conduit shall be done in layers only an inch or two in thickness until the level of the top of the conduit is reached. Backfilling around conduit joined with mortar bandages shall proceed as soon as the joints are completed. Troweled joints shall be allowed to set at least 24 hours before backfilling. 2.10 Upon completion of conduit sections, a test mandrel 1/4 in. (6.4 mm) smaller in diameter than the inside diameter of the conduit shall be pulled through all single duct conduit and through two diagonally opposite ducts in multiduct conduit formations to ensure proper alignment. In addition, all conduits shall be cleaned of loose materials such as concrete, mud, dirt, stones, etc. Pull wire (type as specified by the Engineer) shall be placed in conduit if so indicated by the Engineer on the Construction Sheets. The ends of the conduit shall be sealed to prevent the entrance of foreign matter and to protect against water or gas from entering manholes of buildings. All conduit entering central offices or other buildings shall be kept plugged at all times. If the work extends over several days, the conduits shall be plugged at night temporarily and permanently upon completion of the work.

2.11 Where sod and/or top soil has been removed, finish off the surface of the trench with top soil and/or sod as removed. This work shall be done to the satisfaction of the property owner and authorities.

2.12 All surplus material and debris shall be promptly cleared from the job site.

2.13 All cement used in underground construction shall be Portland cement and shall conform to the latest specification for Portland cement of the American Society for Testing and Materials.

2.14 Cement shall be kept dry at all times prior to use in order to prevent deterioration. No cement shall be used which contains lumps, which will not pulverize readily in the hand. The presence of such lumps indicates that the cement has absorbed moisture and has deteriorated.

2.15 To ensure that concrete used in manhole construction will be watertight, water shall be prevented from flowing through or over the freshly placed concrete and washing away the cement paste. Admixtures shall not be used for the purpose of producing watertight concrete.

2.16 Each precast manhole shall be provided with hardware and equipment as specified below and shown in the Construction Sheets.

2.16.1 Type A, L, T, J, and V manholes shall be provided with either 37-hole or 18-hole cable racks as shown in the Construction Sheets. When 18-hole racks are used, they shall be attached to cable rack supports with three cable rack supports required for each set of two 18-hole racks. Type X and Y manholes shall be

provided with 8-hole racks as shown in the Construction Sheets. The cable racks shall be attached to the supports by means of 1/2 in. x 1-3/4 in. (12.7 mm x 44.4 mm) galvanized machine bolts and nuts. The cable rack supports shall be secured to the manhole walls by means of 1/2 in. x 2-1/2 in. (12.7 mm x 63.5 mm) galvanized machine bolts screwed into metal inserts which shall be cast in the walls when the manhole is constructed.

2.16.2 Rectangular manholes, except Type X and Y, shall be provided with four cable racks or sets of cable racks as shown in the Construction Sheets. Type Y manholes shall be provided with two racks and Type X manholes shall be provided with one rack as shown on the Construction Sheets.

2.16.3 Type V manholes shall be provided with six cable racks or sets of cable racks as shown on the Construction Sheets.

2.16.4 One pulling-in iron shall be cast in the wall opposite each conduit with which it is associated and shall be installed in accordance with the Construction Sheets.

2.17 The frame shall be supported on a collar as shown in the Construction Sheets. The collar shall be of sufficient height to bring the cover flush with the grade of the street or surrounding earth.

2.18 The sump or drain shall be located directly under the manhole cover.

2.19 Pulling-in irons shall be placed so as to extend into the manhole far enough to permit a clear opening of approximately 3 in. (76.2 mm) in the eye.

2.20 When poured-in-place manholes are specified, the construction and installation of the poured-in-place manhole shall be as specified by the Engineer.

3. UNDERGROUND HANDHOLES

3.1 The underground handholes shall be installed in accordance with the instructions given herein unless otherwise specified by the Engineer unless state or local requirements are more stringent in which case the latter requirements will govern.

3.2 The Engineer shall determine the location of the handhole and shall specify type, position and depth of installation.

3.3 A hole shall be dug large enough to accommodate the handhole.

3.4 The handhole shall be positioned and a suitable backfill shall be tamped around the handhole.

3.5 Pea gravel should be placed inside of the handhole to minimize condensation problems.

3.6 The Engineer shall ensure that the dimensions of the handhole shall be large enough to accommodate the splice case installation and when required, cable slack.

4. UNDERGROUND CABLE PLACEMENT

4.1 Prior to entry, testing shall be conducted in excavations and manholes to determine if there is an oxygen deficiency or a presence of harmful gas, in accordance with federal, state, and/or local requirements.

4.2 When working in manholes, care shall be taken to prevent damage to the cables in setting up the pulling apparatus or in placing tools or hardware. Cables shall not be stepped upon when entering or leaving the manhole.

4.3 Cable reels, which are delivered to the work location and are not set up immediately for placing operations shall be securely blocked or secured to a substantial support to prevent rolling.

4.4 The Contractor and Engineer shall jointly verify distances between splice points prior to ordering cable in specific cut lengths.

4.5 The duct assignment for each individual cable for any conduit section shall be specified on the Construction Sheets. Cables shall not be placed in ducts other than those specified on the Construction Sheets without prior approval of the Engineer.

4.6 It shall be the Contractor's responsibility to determine whether ducts assigned for occupancy shall be rodded and cleaned.

4.7 All ducts containing earth, sand or gravel shall be cleaned. Ducts, which cannot be cleaned, shall be reported to the Engineer.

4.8 Reels shall be rolled in the direction indicated by the arrows painted on the reel flanges.

4.9 Cable reels shall be set up on the same side of the manhole as the conduit section in which the cable is to be placed. The reel shall be leveled and brought into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under

no circumstances shall the cable be payed off from the bottom of a reel.

4.10 The Contractor shall check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started.

4.11 A cable feeder guide of suitable dimensions shall be used between the cable reel and the face of the duct to protect the cable and guide it into the duct as it is payed off the reel. Copper cable shall not be bent to a radius of less than 10 times the diameter of the cable. Fiber optic cable shall not be bent to a radius of less than 20 times the diameter of the cable.

4.12 The mechanical stress placed upon a cable during installation shall not be such that the cable is twisted or stretched. During installation, the Contractor shall not exceed the maximum pulling tension of the cable as specified by the cable manufacturer.

4.13 As the cable is payed off the reel, it shall be carefully inspected for jacket defects. If defects are noticed, the pulling operations shall be stopped immediately and the Engineer will determine what corrective action shall be taken.

4.14 As the cables are payed off the reel into the cable feeder guide, they shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole it shall also be sufficiently lubricated at the intermediate manhole.

4.15 Cable placement shall be stopped immediately if the cable on a reel binds or does not pay off freely. The cause of the binding must be cleared to the satisfaction of the Engineer before the pulling operation is continued.

4.16 When blowing of underground cable is specified, the installation shall be in accordance with the manufacturer of the blowing installation equipment.

4.17 Sufficient cable shall be provided in each manhole to properly rack and splice the cables as shown on the Construction Sheets.

4.18 All cable ends, shall be protected at all times with acceptable end caps except during actual splicing. During the splicing operations, protection shall be available for immediate installation in case water.

LIST OF CONSTRUCTION DRAWINGS AND PLANS

Construction Guide Drawings

UM-A, L, T, J	Types A, L, T and J Precast Manholes
UM-V	Type V Precast Manhole
UM-X, Y	Types X and Y Precast Service Manholes

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Construction Guide Drawing





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