

City of Fort Collins

Bid Proposal

BID 5930 LP Cable Underground, 15kV Jacketed

BID DATE: August PM (Our clock) , 2005

**CITY OF FORT COLLINS
INVITATION TO BID
BID # 5930**

Sealed bids will be received and publicly opened at the office of the Director Of Purchasing and Risk Management, PO Box 580, 215 North Mason St., 2nd floor, Fort Collins, Colorado 80524, at the time and date noted on the bid proposal and/or contract documents. If delivered, they are to be delivered to 215 North Mason Street, 2nd Floor, Fort Collins, Colorado 80524. If mailed, the address is P.O. Box 580, Fort Collins, 80522-0580.

Bids must be received at the Purchasing Office prior to :00p.m. (our clock), , 2005.

Special Instructions

All bids must be properly signed by an authorized representative of the company with the legal capacity to bind the company to the agreement. Bids may be withdrawn up to the date and hour set for closing. Once bids have been accepted by the City and closing has occurred, failure to enter into contract or honor the purchase order will be cause for removal of supplier's name from the City of Fort Collins' bidders list for a period of twelve months from the date of the opening. The City may also pursue any remedies available at law or in equity. Bid prices must be held firm for a period of forty-five (45) days after bid openings.

Submission of a bid is deemed as acceptance of all terms, conditions and specifications contained in the City's specifications initially provided to the bidder. Any proposed modification must be accepted in writing by the City prior to award of the bid.

Only bids properly received by the Purchasing Office will be accepted. All bids should be clearly identified by the bid number and bid name contained in the bid proposal.

No proposal will be accepted from, or any purchase order awarded, to any person, firm or corporation in default on any obligation to the City.

Bids must be furnished exclusive of any federal excise tax, wherever applicable.

Bidders must be properly licensed and secure necessary permits wherever applicable.

Bidders not responding to this bid will be removed from our automated vendor listing for the subject commodities.

The City may elect where applicable, to award bids on an individual item/group basis or on a total bid basis, whichever is most beneficial to the City. The City reserves the right to accept or reject any and all bids, and to waive any irregularities or informalities.

Sales prohibited/conflict of interest: no officer, employee, or member of City Council, shall have a financial interest in the sale to the City of any real or personal property, equipment, material, supplies or services where such officer or employee exercises directly or indirectly any decision-making authority concerning such sale or any supervisory authority over the services to be rendered. This rule also applies to subcontracts with the City. Soliciting or accepting any gift, gratuity, favor, entertainment, kickback or any items of monetary value from any person who has or is seeking to do business with the City of Fort Collins is prohibited.


Freight terms: unless otherwise noted, all freight is F.O.B. Destination, Freight Prepaid. All freight charges must be included in prices submitted on proposal.

Discounts: any discounts allowed for prompt payment, etc., must be reflected in bid figures and not entered as separate pricing on the proposal form.

Purchasing restrictions: your authorized signature of this bid assures your firm's compliance with the City's purchasing restrictions. A copy of the resolutions are available for review in the Purchasing Office or the City Clerk's Office. Request Resolution 91-121 for cement restrictions.

Collusive or sham bids: any bid deemed to be collusive or a sham bid will be rejected and reported to authorities as such. Your authorized signature of this bid assures that such bid is genuine and is not a collusive or sham bid.

Bid results: for information regarding results for individual bids send a self-addressed, self-stamped envelope and a bid tally will be mailed to you. Bid results will be posted in our office 7 days after the bid opening.


James B. O'Neill II, CPPO, FNIGP
Director of Purchasing and Risk Management

FIRM NAME _____

CITY OF FORT COLLINS
BID PROPOSAL
BID # 5930
BID OPENING: 3:00 p.m. – August

WE HEREBY ENTER OUR QUOTE FOR THE CITY OF FORT COLLINS' REQUIREMENTS FOR LP **CABLE, UNDERGROUND, 15kV, JACKETED** PER THE BID INVITATION AND ANY REFERENCED SPECIFICATIONS.

QUANTITY

DESCRIPTION

300,000 Ft.

CABLE, UNDERGROUND, 15kV, JACKETED #1/0 AWG, 19 STRD., AL, .012" MINIMUM THICKNESS SEMI-CONDUCTING XLP CONDUCTOR SHIELD, .220" NOMINAL THICKNESS UNFILLED TRXLPE INSULATION, .860" +/-30 MILS DOI, .030" MINIMUM THICKNESS SEMI-CONDUCTING XLP INSULATION SHIELD, .940" +/-50 MILS DOS, 16-#14 BARE, UNTINNED COPPER CONCENTRIC NEUTRAL, .040" MINIMUM THICKNESS BLACK LLDPE ENCAP JACKET, PER SPEC. NO. 367-102, REV. J,

SHIP ON 5032 N/R 2500' REELS +/-200' (SUPPLEMENTAL INSTRUCTIONS FOR SHIPPING CONTAINED IN SPEC)

Certified test report on each production run, including actual production test values, are required.

\$ _____/Mft. _____ Total,
Including applicable tariffs and duties, if manufactured outside the

U.S.A

Mfr. _____ Mfr.# _____

Bid shall be a firm bid without escalation.

DESIRED SHIPPING SCHEDULE

75,000 FT - February
75,000 FT - March
75,000 FT - April
75,000 FT – May

Manufacturer's Shipping Schedule

Feet	Date
_____ Ft.	_____
_____ Ft.	_____
_____ Ft.	_____
_____ Ft.	_____

Delivery times may be evaluated in the award of this bid. Stated delivery will be expected to be met; failure to perform can result in the removal of your firm from the City's bid list for up to three years.

If reel size varies, please list specific details:

- PLEASE RECORD GROSS AND TARE REEL WEIGHTS
- PLEASE WEIGH EMPTY REEL, AND VERIFY WEIGHTS PRIOR TO SHIPPING.
- REFUSAL TO COMPLY WITH THESE TERMS MAY RESULT IN REMOVAL FROM THE BIDDER'S LIST FOR FUTURE ORDERS.

AWARD:

The City of Fort Collins reserves the right to split the award between two or more bidders to expedite delivery or for evaluation of the cable in actual conditions prior to subsequent requirements. Consideration for the best price and delivery will be evaluated and an award will be made which is considered to be in the best interest of the City.

Additional charges, if any, in \$/mft. Please give explanation of charges. Extra charges not included on bid sheet will not be paid.

_____/Mft. For _____

_____/mft. For _____

Items bid meet or exceed specifications. YES _____ NO _____. If not, please list exceptions on a separate sheet and attach to your bid documents.

For purposes of warranty and service ONLY approved manufacturers or distributors authorized by an approved manufacturer to serve the Fort Collins area may bid.

Please see supplemental instructions to bidders.

SPECIFICATION FOR
15 KV, CONCENTRIC NEUTRAL, TREE-RETARDANT
CROSS - LINKED POLYETHYLENE INSULATED, JACKETED CABLE

SPECIFICATION NO: 367-102

REV. J


April 2005

THE CITY OF FORT COLLINS

Light and Power Department
 P.O. Box 580
 Fort Collins, CO 80522

SPECIFICATION NO: 367-102

15 KV, Concentric Neutral, Tree-Retardant
 Cross - Linked Polyethylene Insulated, Jacketed Cable

APPROVED BY: 
 Craig Eader
 Standards Engineering Manager

ORIGINAL ISSUE: 6/20/92

REVISED: June 14, 2005

ITEMS COVERED BY THIS SPECIFICATION			
DESCRIPTION	DESIGN CODE		
	SPECIFICATION NO.	SERIAL	STORES NO.
1/0 AWG TRXLPE INSULATED CABLE W/ LLDPE JACKET	367-102	-01	7503-1093
750 kcmil TRXLPE INSULATED CABLE W/ LLDPE JACKET	367-102	-04	7503-1130

REVISION DESCRIPTIONS

REVISION DESCRIPTION (Previous Revision Descriptions on File)	CHANGE NOTICE	APPROVED
NEW	6-19-92	Tim M. Sagen 6-19-92
REVISION A: <ul style="list-style-type: none"> • Paragraph 3.2.2.10: Add jacket marked in accordance with NESC. • Paragraph 3.2.2.2 and 3.3.2: Change Union Carbide number from 0802 to 0800. • Paragraph 3.3.7: Define jacket shrink back 0.250. • Table IV: Add jacket shrink back references. • Paragraph 4.7.7.2: Add "insulation" to shrink back to differentiate from jacket shrink back. • Paragraph 4.7.7.3: Require aging before high voltage time test. Change step from 639 to 620v/mil. • Add paragraph 4.7.12: Jacket shrink back. • Appendix A: Delete Canada Wire and Reynolds, add Southwire and correct CABLEC's name. • Reissue 		Tim Sagen Sue Coram 5/4/93
REVISION B: <ul style="list-style-type: none"> • Paragraph 3.3.7; 4.7.12 change jacket shrinkback from .25" to 100 mils. • Paragraph 3.2.2.9: change jacket shrinkback to match 3.3.> • Paragraph 3.2.2.7: Correct DOI from .935 to .947. • Paragraph 3.1.1: add "-87" to AEIC standard on priority list. 		Tim Sagen Sue Coram 3/24/95
REVISION C: <ul style="list-style-type: none"> • Updated Appendix A 		Tim Sagen Sue Coram 8/6/97
REVISION D: <ul style="list-style-type: none"> • Reformatted (no reissue) 		Bill Bray 7/11/2000
Revision E: <ul style="list-style-type: none"> • Completely revised to reflect ICEA S94-649-2000 and AEIC CS8-2000. • Insulation and shield thickness requirements are now specified using min and max points rather than minimum averages. • Changed insulation thickness on 750 kCM cable from 220 mils to 175 mils. 	1/16/02	Kraig Bader Tim Sagen
Revision F: <ul style="list-style-type: none"> • 750 kcmil stock number on title page changed from 7503-1120 to 7503-1130 • Rephrased "true triple extrusion" definition. • Changed Union Carbide Corporation to Dow Chemical. • Changed insulation codes in Table 11. • Changed the conductor shield compound to Dow Chemical HFDA-0802 from HFDA-0800. 0802 is the correct compound for aluminum conductors. Corrected General Cable's conductor shield number from LS-5502 to XFB-5502. • Flexible jacket material DFDB 6433 added to specification for use on 750kcmil cable. • Deleted the Insulation Heat Distortion Test. • Changed the number of reels requiring an insulation resistance test from all to three from each cable core extruder run. 	4/17/2002	Kraig Bader Tim Sagen 4/25/02

REVISION DESCRIPTION (Previous Revision Descriptions on File)	CHANGE NOTICE	APPROVED
<p>Revision G:</p> <ul style="list-style-type: none"> 750 kcmil Serial code changed to "04" in tables to reflect reference on page 2. Insulation shield thickness reduction values in Table 10 removed. Values are redundant and are already specified by Table 9. 	5/9/2002	Kraig Bader 5/9/2002 Tim Sagen
<p>Revision H</p> <ul style="list-style-type: none"> Removed Equistar 320TR-XLPE insulation compound from the approved list. Equistar has ceased to manufacture medium voltage compounds. Amended Table 11 to reflect the change in insulation identification requirements. Removed optional "low density nonconductive, flexible polyethylene compound Dow Chemical compound number DFDB-6433 (367-102-04)" from the approved jacketing compounds. 		Kraig Bader 01/29/2003 Tim Sagen
<p>Revision I</p> <ul style="list-style-type: none"> Adjusted product description from "15 KV Two Conductor Tree-Retardant Cross - Linked Polyethylene Insulated Jacketed Cable" to "15 KV, Concentric Neutral, Tree-Retardant Cross - Linked Polyethylene Insulated, Jacketed Cable" More clearly list the approved compounds for use in conductor shield, insulation, and insulation shield (Sections 3.2.2.2, Removed reference to Dow insulation compound preference over AT Plastics in 3.2.2.3 Amended shipping instructions to remove the requirement for wooden lagging on the shipping reels. Several failures of new cable related to nail-holes indicate that the lagging installation step places the cable at risk. 		Kraig Bader 5/2/2005
<p>Revision J</p> <ul style="list-style-type: none"> Included "Special Conditions & Instructions to Bidders as Appendix B. Updated list of approved polymer compounds that may be used in the manufacture of cable purchased by Fort Collins Utilities Amended conductor shield volume resistivity requirements to make them more consistent with industry standards. Removed 50 Ω-m at 25°C & 500 Ω-m at 90°C, and require less than 1000Ω-m for operating and emergency conditions. Moved Electrical testing requirements in paragraphs 3.2.2.3.1, 3.2.2.3.2 and 3.2.2.3.3 (AC Voltage, insulation resistance, and partial discharge tests) out of the cable design section and into the "functional tests" section. (Moved Table 4 to Table 13, which necessitated renumbering of all subsequent tables.) Remove eccentricity requirement of 30 mils in Table 3 and reference to table 3 in clause 3.2.2.3. The specified minimum and maximum insulation thickness points should control eccentricity to 40 mils. 		Kraig Bader 6/14/2005

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SPECIFICATION FOR
TWO-CONDUCTOR CROSS-LINKED POLYETHYLENE INSULATED CABLE

1 SCOPE

This specification establishes the minimum requirements for two-conductor insulated, shielded, and jacketed concentric-neutral underground distribution cable, insulated with a thermosetting dielectric based on cross-linked polyethylene (XLPE). Cable described herein is intended for 60 Hz, single and three-phase applications in wet or dry locations in conduit, underground duct systems, direct buried and aerial installations in open air in sunlight.

2 APPLICABLE DOCUMENTS

The following documents of the issue shown form a part of this specification to the extent specified herein. In those cases when the document is not dated, the latest issue in effect on the date of invitation for bids shall form a part of this specification.

2.1 AEIC NO. CS-8-2000 (1st Edition) -*Specifications for Extruded Dielectric , Shielded Power Cables Rated 5 through 46 kV*, first edition.

2.2 ICEA PUB. NO. S-94-649-2000 -*Standard for Concentric Neutral Cables Rated 5,000 – 46,000 Volts*.

2.3 OTHER STANDARDS

- Applicable ASTM standards
- Applicable ANSI standards
- Other applicable ICEA/NEMA standards

3 REQUIREMENTS**3.1 GENERAL REQUIREMENTS FOR DESIGN****3.1.1 Basic Design Standards**

Cables purchased under these specifications shall, unless otherwise specified, meet the requirements of AEIC No. CS8, applicable ANSI/ICEA Standards, and the modifications and additions given in the subsequent paragraphs. In case of conflict, the requirements of the following documents shall apply in the priority shown:

- 1) This specification.
- 2) AEIC No. CS8-2000
- 3) ANSI/ICEA S-94-649-2000
- 4) Other applicable ANSI, ICEA-NEMA and ASTM Standards.

3.1.2 Temperature Ratings

The following maximum temperature ratings shall apply:

Operating (Continuous)	Emergency Overload	Short Circuit
90°C (194°F)	130°C (266°F)	250°C (482°F)

3.1.3 General Construction

Cable covered by this specification consists of a blocked strand central conductor, conducting strand shielding layer, TRXLPE insulation, semi-conducting XLPE insulation shield, concentric neutral applied helically overall, and an overall insulating thermoplastic jacket. The conductor shield, insulation, and insulation shield shall be applied to the conductor through a single crosshead in one manufacturing pass; i.e., true triple extrusion is required. The

insulation compound shall be extra clean and transported and stored in contamination-free bulk handling systems. Insulation compound handling systems shall be closed systems approved by the City of Fort Collins. Systems shall subject 100% of the insulation compound to filtering and metal detectors to eliminate streamers, fines, off-color pellets, and ferrous and non-ferrous metal contaminants. The insulation and shield layers shall be cross-linked by a dry cure method approved by the City of Fort Collins.

3.1.4 Guarantee

Seller warrants that cable furnished under these specifications is free of defects in material and workmanship, that it has been manufactured and tested in accordance with these specifications and that the results of said tests comply with the requirements of said specifications. Seller agrees to provide replacement product for (i) any cable found defective in material or workmanship regardless of the age of the cable, or (ii) any cable failing during normal and proper use within one year of the date of placing in service. The date of placing in service is the date on which operating voltage is first applied. All replacements shall be made free of charge, f.o.b. the delivery point called for in the original order. The requirements of paragraph 4.1 of this specification, requiring independent testing laboratory certification, shall in no way limit the liability of the vendor regarding the guarantee.

3.1.5 Approved Manufacturers

Cable purchased under this specification shall be of the manufacturers listed in Appendix A. Only direct bids from approved manufacturers with current AEIC qualification test reports for the insulation and shield compound combinations used in the proposed cable design on file with the City of Fort Collins will be accepted. Manufacturers not listed may submit written proposals demonstrating compliance with these specifications for consideration of addition to the accepted manufacturers list prior to the next request for bids. In addition to inclusion on the list in Appendix A, manufacturer's cable must satisfy all requirements of this specification to be acceptable.

3.2 SPECIFIC REQUIREMENTS FOR DESIGN OF 367-102-01 and 367-102-04

3.2.1 Functional Description

The cable shall be 15 kV triple extruded TRXLPE insulated, with concentric neutral and LLDPE jacket, suitable for direct burial, for use on a 7.960/13.8kV grounded "Y" distribution system.

3.2.2 Design and Construction

3.2.2.1 Conductor

Stranded inner conductors shall be uncoated 1350 aluminum with no softer than an H-16 intermediate to hard temper and shall conform to Section 2 of ICEA S-94-649-2000 and ASTM B-609 and B-231. Stranding shall be concentric-lay Class B compressed. The inner conductors shall be free of moisture, corrosion and excess drawing lubricant before, during, and after processing.

The central conductor shall have the interstices of the strands filled to render the conductor impervious to longitudinal water transmission per ICEA Publication T-31-610 and shall meet a minimum requirement of 5 psig. The compound shall be flexible, stable, and compatible with the conductor, conductor shield, insulation, insulation shield, jacket, terminators, elbows, splices, and synthetic base oxide inhibitors throughout the conditions experienced during normal cable maintenance and operation (-40°C or lower to 130°C or higher). There shall be no trace of compound on the outside layer of the conductor strands.

The center conductor for 367-102-01 shall be compressed # 1/0 AWG, 19 strand aluminum.

The center conductor for 367-102-04 shall be compressed 750 kcmil, 61 strand aluminum.

3.2.2.2 Conductor Shielding

Conductor shielding shall be in accordance with section C of AEIC CS8-00 except as modified herein. The conductor shield compounds approved by Fort Collins Utilities are listed below:

- a) Dow Chemical HFDA-0800 over copper or aluminum
- b) Dow Chemical HFDA-0802 over aluminum
- c) General Cable XFB-5502 over aluminum
- d) Borealis LE 0504 over aluminum

The conductor shield compound shall be extruded semi-conducting supersmooth cross-linked polyethylene compound or ethylene vinyl acetate (EVA) appropriate for the specific conductor material and insulation compound to be used in the cable construction. The conductor shield shall be non-adhering to the conductor but securely bonded to the insulation. The cable will be rejected if the interface between the strand shield and the insulation is not cylindrical, if it exhibits voids, bumps, protrusions, or irregularities in excess of 3 mils into the insulation or 7 mils into the conductor shield, or if visual inspection by the naked eye reveals that the interface is bumpy (i.e., polygonation is visible). Volume resistivity shall be determined using the method described in section 9.8.1 of ICEA S-94-649-2000 and shall not exceed the values set forth in Table 1 of this specification.

Table 1 – Conductor Shield Volume Resistivity

Temperature	Volume Resistivity (ohm-m)
90°C (Normal Operation)	< 1000 ohm-m
130°C (Emergency Operation)	< 1000 ohm-m

Physical and aging requirements shall be in accordance with ICEA S-94-649-2000, except that the brittleness temperature shall be not warmer than -30°C. The conductor shielding shall also pass the wafer boil test of ICEA S94-649-2000, paragraph 9.4.12. Requirements for maximum allowable size and density of voids in the conductor shield shall be the same as the requirements for voids in the insulation.

If the compounds specified above are found to fail the physical requirements set forth in this document, the City of Fort Collins may disqualify them.

The thickness of the conductor shield at any location on the completed cable shall be in accordance with Table 2 of this specification.

Table 2 – Conductor Shield Minimum Extrusion Thickness

Specification	Cable Description	Conductor Shield Minimum Point
367-102-01	#1/0 AWG Aluminum	12 mils
367-102-04	750kcmil Aluminum	20 mils

3.2.2.3 Insulation

The approved insulation compounds are listed below:

- a) Dow Chemical HFDA-4202 or
- b) Dow Chemical HFDB-4202
- c) Borealis LE 4212

The insulation shall be extruded tree retardant cross-linked thermosetting polyethylene having a minimum and maximum thickness as defined in Table 3 of this specification. Nominal thickness is shown in Table 3 for reference purposes only.

Table 3 – Insulation Thickness

Specification	Cable Description	Nominal Insulation Thickness	Insulation Minimum Point	Insulation Maximum Point
367-102-01	#1/0 AWG Aluminum	220 mils	210 mils	250 mils
367-102-04	750kcmil Aluminum	175 mils	165 mils	205 mils

The insulation shall meet the requirements of AEIC CS8-00, Section D. The electrical and physical characteristics shall be in accordance with ICEA S94-649-2000, paragraph 4.3.1.2. The insulation shall not contain voids larger than 3 mils. The number of voids larger than 2 mils shall not exceed 30 per cubic inch. Contaminants shall not exceed 5 mils in their greatest dimension, and shall number no greater than 15 per cubic inch. The insulation shall be free of ambers, gels, or agglomerates larger than 10 mils.

3.2.2.4 Diameter Over Insulation

The diameter over the insulation anywhere along the cable length shall conform to the values listed in Table 4 of this specification. The diameters in Table 4 are consistent with the requirements in Appendix 2 of AEIC CS8-00 and differ from those shown in ICEA.

Table 4 –Diameter Over Insulation

Specification	Cable Description	Nominal Insulation Thickness	Diameter Over Insulation (Inches)
367-102-01	#1/0 AWG Aluminum	220 mils	0.860 ± 30 mils
367-102-04	750kcmil Aluminum	175 mils	1.400 ± 30 mils

3.2.2.5 Insulation Shielding (Insulation Screen)

The approved insulation shield compounds are listed below:

- a) Dow Chemical HFDA-0692 or HDDA-0693
- b) General Cable LS-567A
- c) Borealis LE 310MS-44

The insulation shielding shall be extruded, black, semi-conductive, cross-linked polyethylene, complying with the physical and aging characteristics for discharge free thermoset shields in section 5.4 of ICEA S-94-649-2000, except that the brittleness temperature shall be not warmer than -30°C. The insulation shielding shall be appropriate for and compatible with the specific insulation compound to be used in the cable construction and shall be free stripping. The insulation shield shall have minimum and maximum thickness limits as detailed in Table 5 of this specification.

Table 5 – Insulation Shield Minimum and Maximum Extrusion Thickness

Specification	Cable Description	Insulation Shield Minimum Point (mils)	Insulation Shield Maximum Point (mils)
367-102-01	#1/0 AWG Aluminum	30	60
367-102-04	750kcmil Aluminum	40	75

The insulation shield volume resistivity shall not exceed the values in Table 6 of this specification.

Table 6 – Insulation Shield Volume Resistivity

Ambient Temperature	Volume Resistivity (ohm-m)
25°C	50 ohm-m
90°C	500 ohm-m
110°C	500 ohm-m

All other requirements shall be in accordance with AEIC No. CS8 Section E, except that the minimum stripping force shall be six (6) pounds. Stripping tensions outside the 6-24 pound requirement are unacceptable regardless of the results of any repeat test.

3.2.2.6 Diameter Over Shield

The diameter over the insulation shielding anywhere along the cable length shall conform to the values listed in Table 7 of this specification. The diameters in Table 7 are consistent with the requirements in Appendix 2 of AEIC CS8-00 and differ from those shown in ANSI/ICEA.

Table 7 –Diameter Over Insulation Shield

Specification	Cable Description	Nominal Insulation Thickness	Diameter Over Insulation Shield (inches)
367-102-01	#1/0 AWG Aluminum	220 mils	0.940 ± 50 mils
367-102-04	750kcmil Aluminum	175 mils	1.50 ± 50 mils

3.2.2.7 Concentric Neutral

A concentric neutral consisting of bare solid untinned soft-drawn copper wires shall be spirally wrapped over the insulation shield with uniform spacing between the wires and shall meet the provisions of Sections 2 and 6 of ICEA S-94-649-2000 and applicable ASTM standards. Neutral wires shall be sized according to Table 8 of this specification. They shall be in firm contact with the insulation shield, shall not cause indentations in the primary insulation and shall indent the insulation shield no more than specified in Table 8 of this specification. The length of the lay of the concentric wires shall be not less than six (6) times and not more than ten (10) times the diameter over the concentric wires.

Table 8 – Concentric Neutral Requirements

Specification	Cable Description	Number and Size of Concentric Neutral Wires	Maximum allowable Concentric neutral Indent (mils)
367-102-01	#1/0 AWG Aluminum	Sixteen (16) #14 AWG Cu (Full Neutral)	15
367-102-04	750kcmil Aluminum	Nineteen (19) #14AWG Cu (One-Sixth Neutral)	15

3.2.2.8 Jacket

The jacket shall be a linear low density, nonconductive, high molecular weight polyethylene compound (367-102-01). Both compounds must meet or exceed the requirements in ICEA S-94-649-2000, Section 7.1, and shall have a maximum and minimum thickness as defined in Table 9 of this specification. The jacket shall encapsulate all neutral wires and fill all the space around insulation shield, and shall be free stripping from the insulation shield and the neutral wires. The jacket shall be smooth and uniform, free of blisters, cracks and holes. Application of the jacket shall not cause concentric neutral indentation of the insulation shield in excess of that shown in Table 8.

Table 9 – Jacket Requirements

Specification	Cable Description	Jacket Minimum Point	Jacket Maximum Point	Jacket Shrinkback
367-102-01	#1/0 AWG Aluminum	40	70	300 mils
367-102-04	750kcmil Aluminum	40	70	300 mils

Total combined linear shrinkage of the jacket shall not exceed the values listed in Table 9 when tested in accordance with paragraph 4.7.12 of this specification. The jacket shall not alter its physical or electrical properties from exposure to sunlight or the elements.

3.2.2.9 Cable Identification

Cable identification is required on the insulation shield and jacket and shall be in accordance with ICEA S-94-649-2000. In addition, the cable shall be durably marked with sequential footage marking printed directly on the jacket. The footage marking shall be printed at least every two (2) feet. The footage marking on the mandrel end of the cable shall be permanently marked on the reel. The insulation compound used shall be indicated on the jacket using the codes in Table 10 of this specification for the insulation compounds approved by the City of Fort Collins:

Table 10 - Insulation Code for jacket markings

Insulation Code	Insulation Compound Description
4202A	Dow Chemical HFDA 4202
4202B	Dow Chemical HFDB 4202
4212	Borealis LE4212

The NESC identification symbols for supply cables shown in Figure 350-1 of ANSI C2 latest edition of the "National Electrical Safety Code" shall be indented or embossed in the outermost cable jacket. The jacket shall be permanently marked with three red stripes equally spaced around the entire length. The red stripes, measuring a nominal 0.250" wide by .010" deep shall be extruded into and become an integral part of the black jacketed cable surface.

4 QUALITY ASSURANCE

4.1 RESPONSIBILITY FOR INSPECTION

Unless otherwise specified, the vendor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the vendor may utilize his own facilities or any commercial laboratory acceptable to the City of Fort Collins. The City reserves the right to perform or witness any of the inspections set forth in this specification where such inspections are deemed necessary. If the cable is not manufactured on the North American continent, the manufacturer shall pay transportation expenses for the City's inspector. In addition to the foregoing, the requirements of AEIC CS8-00, part G, H, and M apply unless otherwise specified.

4.2 CLASSIFICATION OF TESTS

The inspection and testing of cable shall be classified as follows:

- a. Qualification tests (core material, thermomechanical, jacket material, CV extrusion, and other ICEA S-94-649-2000 qualification tests).

- b. Functional/Production tests (full reel and sampling electrical and physical tests on completed cable).

4.3 TEST REPORT

The manufacturer shall furnish to the purchaser certified copies of the results of all qualification, production sampling, and completed cable tests on all orders for more than 10,000 feet prior to authorization to ship. Actual test values shall be furnished for all tests including those tests required for engineering information.

The following general information shall be included on all CTR documentation:

- CTR number.
- Plant identification.
- Shipment number.
- Reel count.
- Shipment footage.
- City of Fort Collins Purchase Order Number.
- City of Fort Collins Specification Number.
- Specification number of other applicable specifications including issue date.
- Reference number to track compound quality assurance tests.
- Cable core extruder/CV line identifier.
- Jacket line identifier.
- Cable description and reel number.

In addition, certified copies of test reports shall be furnished for each reel of cable to be shipped and shall contain at least the following information:

- Extrusion (conductor shield, insulation, and insulation shield) dimensions and physical properties.
- Void and contaminant examination results.
- Jacket extrusion dimensions and physical properties.
- Minimum and maximum diameter over insulation, insulation shielding, and jacket.
- Minimum and maximum shield stripping tension
- AC test voltage and time applied.
- Insulation resistance constant and temperature.
- DC resistance of conductors at 25°C.
- A graph of cable stress in volts per mil (or line-to-ground voltage) vs. apparent discharge in picocoulombs.

The above test report shall be certified by an independent testing laboratory unless the City specifically approves manufacturer certification only. A representative of the certifying laboratory shall witness all tests. Reel numbers used in these test reports shall correspond to reel numbers required by paragraph J.3.2 of AEIC No. CS8-00. Reel numbers not corresponding to test report numbers will be rejected and returned at the manufacturer's expense. In the case of duplicates **both** reels will be rejected and returned.

4.4 SIMILARITY OF TESTS

With written concurrence from the City of Fort Collins, partial fulfillment of qualification testing requirements on the basis of similarity of the article to previously qualified articles is permissible, provided the similarity is clearly defined and provided no modifications which could affect the test results or integrity of the article have been made.

Any nonidentical construction and/or materials in the similar article and all differences shall be described in detail. Pictorial and written evidence shall be provided. All similar data shall be submitted in a single report and only directly applicable data shall be included. The test report for the similar article shall also be submitted.

4.5 QUALIFICATION AND SAMPLING TESTS

Qualification tests and related requirements are cross-referenced in Table 11. The qualification tests consist of sampling tests on conductor shield, insulation, insulation shield, jacket material, partially completed, and completed cable. The impulse test, cyclic aging test, resistance stability test, accelerated water treeing test, accelerated water absorption test, and thermomechanical qualification test may be run on a qualification basis as defined by ICEA if they conform to ICEA and paragraph 4.4 of this specification. All other qualification tests shall be performed **on each order and on each cable design** included on the order. Sampling and frequency of tests shall be in accordance with paragraph 9.16/Table 9.5 of ICEA S-94-649-2000 unless otherwise specified.

Table 11 – Fort Collins Qualification Tests (production sampling tests and AEIC tests)

Test	Classification	Requirement Paragraph	Test Reference		
			This Document	AEIC-CS8	ICEA S-94-649
Examination Of Product	P,Q,F	Section 3	4.7.1		9.6
Conductor Shielding Volume Resistivity	P	3.2.2.2	4.7.3		9.8
Wafer Boil	P	3.2.2.2,3.2.2.5	4.7.4		9.4.12
Shielding Physical & Aging Tests (Conductor & Insulation)	P	3.2.2.2, 3.2.2.5	4.7.5		3.5, 5.4.1.3, 9.4.14
Insulation Physical & Aging Tests	P	3.2.2.3	4.7.6		4.3.1.1, 9.2, 9.4
Physical Test Procedures	P	3.2.2.3	4.7.6.1		9.4.8
Aging Tests	P	3.2.2.3	4.7.6.2		9.4.9
Hot Creep – Insulation	P	3.2.2.3	4.7.6.4		4.3.1.1, 9.4.10
Shrink Back Test – Insulation	P	3.2.2.3	4.7.7.1		4.3.1.4, 9.10
High Voltage Time Test	P, Q	3.2.2.3	4.7.7.2		10.1.3
Impulse Breakdown	Q	3.2.2.3	4.7.7.3		10.1.4
Cyclic Aging	Q	3.2.2.3	4.7.7.4		10.1.5
Accelerated Water Absorption	Q	3.2.2.3	4.7.7.5		10.5.2
Accelerated Water Treeing	Q	3.2.2.3	4.7.7.6	M.2	10.1.6
Thermomechanical Qualification Test	Q	3.2.2.3	4.7.7.7	M.3	10.2
Dissipation Factor	Q	3.2.2.3	4.7.7.8		10.4.2
Amber, Protrusion, Void & Contaminant Determination	P	3.2.2.3	4.7.8	G.1	9.4.13
Internal Irregularity Test	P	3.2.2.3	4.7.9	G.2	
Insulation Shielding Volume Resistivity	P	3.2.2.5	4.7.10	C.5, G.3.7	9.8.2
Insulation Shielding Strippability	P	3.2.2.5	4.7.11	E.3, G.3	9.9
Resistance Stability Test	Q	3.2.2.5	4.7.12		3.6.1, 9.8, 10.5.3
Shrink Back Test – Jacket	P	3.2.2.8	4.7.13		
Heat Distortion – Jacket	P	3.2.2.8	4.7.14		9.7.2

P – production sampling test (includes some tests not identified by AEIC/ICEA as production sampling tests)

Q – AEIC/ICEA qualification test

F – functional test on completed cable (also see Table 12)

4.6 FUNCTIONAL (PRODUCTION) TESTS (ELECTRICAL AND PHYSICAL TESTS ON COMPLETED CABLES)

Functional tests shall consist of those tests and related requirements listed in Table 12 and shall be performed on each shipping length of completed cable.

Table 12 – Functional Tests

TEST	Test Paragraph
Examination of Product	4.7.1
Conductor Tests	4.7.2
Alternating-Current Voltage	4.8.1
Insulation Resistance	4.8.2
Partial Discharge	4.8.3

4.7 TEST METHODS (QUALIFICATION AND SAMPLING)

4.7.1 Examination of Product

Each shipping length of completed cable shall be inspected to determine compliance with respect to freedom from water under the jacket or in the conductor, insulation thickness, conductor diameter and cross-sectional area, dimensions, material, workmanship, construction and marking. **If, when inspecting dimensions, either diameter at either end of a shipping reel is outside the permissible tolerance range, the entire reel shall be rejected.**

4.7.2 Conductor Tests

Conductor resistance of each shipping reel shall be measured and recorded in ohms per 1000 feet at 25°C. Other conductor tests shall be in accordance with ICEA S-94-649-2000, paragraph 9.3.

4.7.3 Conductor Shielding Volume Resistivity

The volume resistivity of the conductor shielding shall be measured and recorded at 25°C, 90°C, 100°C \pm 2°C in accordance with paragraph 9.8 of ICEA S-94-649-2000.

4.7.4 Wafer Boil Test (Conductor And Insulation Shielding Solvent Extraction)

Conductor and insulation shielding wafer boil tests shall be in accordance with ICEA S-94-649-2000, paragraph 9.4.12.

4.7.5 Physical and Aging Tests Of Semiconducting Shields

Physical and aging tests shall be performed on the conductor shielding and insulation shielding in accordance with ICEA S-94-649-2000, paragraph 9.4.14.

4.7.6 Insulation Tests (Physical And Aging)

Physical and aging testing shall be in accordance with ICEA S-94-649-2000, paragraphs 9.2 and 9.4 and paragraphs 4.7.6.1 through 4.7.6.4 of this specification.

4.7.6.1 Physical Test Procedures

Tensile strength tests and elongation tests shall be performed in accordance with the applicable procedures of ICEA S-94-649-2000, paragraph 9.4.8.3.

4.7.6.2 Aging Tests

Air oven aging tests shall be performed in accordance with ICEA S-94-649-2000, paragraphs 9.4.9.1 and 9.4.9.2. The test specimens shall be heated at 121°C \pm 1°C for 168 hours.

4.7.6.3 Deleted

4.7.6.4 Hot Creep – Insulation

Hot creep tests shall be in accordance with ICEA S-94-649-2000, paragraph 9.4.10. Hot creep and set requirements shall be determined at 150°C \pm 2°C in accordance with ICEA T-28-562. Elongation and set shall comply with the requirements for unfilled insulation given in table 4.2 of ICEA S-94-649-2000.

4.7.7 Physical and Electrical Tests – Insulated Conductor

Samples of insulated conductor shall be tested in accordance with the following procedures:

4.7.7.1 Insulation Shrink Back Test

Tests to determine shrink back shall be in accordance with ICEA S-94-69 paragraph 9.10.

4.7.7.2 High Voltage Time Test

High voltage time tests (HVTT) shall be performed in accordance with ICEA S94-649-2000, paragraph 10.1.3. In addition to a qualification test, **the HVTT SHALL BE PERFORMED AS A PRODUCTION TEST**. Cable shall be aged in accordance with paragraph 10.1.5.4 of ICEA S94-649-2000 and the first step shall be held for one hour with each successive step held for ½ hour. This test shall be performed on each cable design included on an order. Sampling frequency shall be one test for each 100,000 feet of cable or fraction thereof. A sample that fails to withstand the 620v/mil step shall be considered to have failed.

4.7.7.3 Impulse Breakdown Test

Impulse breakdown tests shall be performed in accordance with ICEA S94-649-2000, paragraph 10.1.4.

4.7.7.4 Cyclic Aging

Cyclic aging tests shall be performed in accordance with ICEA S94-649-2000, 10.1.5.

4.7.7.5 Accelerated Water Absorption Test

The accelerated water absorption test shall be performed in accordance with paragraph 10.5.2 of ICEA S94-649-2000.

4.7.7.6 Accelerated Water Treeing Test

Accelerated water treeing test shall be performed in accordance with paragraph 10.1.6 of ICEA S94-649-2000.

4.7.7.7 Thermomechanical Qualification Test

A thermomechanical qualification test shall be performed in accordance with section M.3 of AEIC CS-00 and paragraph 10.2 of ICEA S94-649-2000.

4.7.7.8 Dissipation Factor Verification Tests

Dissipation factor tests shall be performed in accordance with paragraph 10.4.2 of ICEA S94-649-2000.

4.7.8 Void and Contaminant Determination

Tests for and reporting of voids and contamination shall be in accordance with AEIC No. CS8, paragraph G.1.

4.7.9 Internal Irregularity Test

Internal irregularity tests shall be performed in accordance with AEIC No. CS8, paragraph G.2.

4.7.10 Insulation Shielding Volume Resistivity

Insulation shielding volume resistivity tests shall be performed in accordance with paragraph 9.8.2 of ICEA S94-649-2000. The volume resistivity of the insulation shielding shall be measured at 25°C, 90°C, and 110°C ± 2°C.

4.7.11 Shield Stripping

Insulation shield stripping tests shall be performed in accordance with paragraph 9.9 of ICEA S94-649-2000 and AEIC No. CS8, paragraph G.3. **A minimum of one sample shall be taken from each shipping reel.**

4.7.12 Radial Resistivity Test

Tests for shield resistance stability shall be in accordance with paragraph 10.5.3 of ICEA S94-649-2000.

4.7.13 Jacket Shrinkback Test

A 3-foot sample shall be taken from the first 10,000 feet of production and one sample every 50,000 feet thereafter. Square cut a 1-foot specimen from the center of the 3-foot sample and place in an air oven @ 75 C for 20 hours. Remove sample and allow to cool at room temperature. Measure the shrinkback at each end. The total combined allowable shrinkback shall not exceed 300 mils.

4.7.14 Heat Distortion – Jacket

Heat distortion testing shall be performed in accordance with ICEA T-27-581/NEMA WC-53.

4.8 TEST METHODS - FUNCTIONAL (PRODUCTION) TESTS

Each shipping reel of completed cable shall be tested in accordance with paragraph 9.12 of ICEA S-94-649-2000 and/or the following procedures:

4.8.1 Alternating - Current Voltage Test

The dielectric strength of the insulation shall be tested at the applicable voltage given in Table 13 of this specification in accordance with paragraph 9.12.2 of ICEA S-94-649-2000. The insulation of completed cable shall withstand the alternating-current test voltage shown in Table 13 for five (5) minutes.

Table 13 – AC Test Voltage

Specification	Cable Description	AC Test Voltage (kV)
367-102-01	#1/0 AWG Aluminum	44
367-102-04	750kcmil Aluminum	35

4.8.2 Insulation Resistance

The insulation resistance shall be measured after the voltage tests on a minimum of three shipping reels per cable core extruder run. Where the voltage tests are made on wire or cable immersed in water, the insulation resistance shall be measured while the cable is still immersed. The insulation resistance shall be measured and recorded in megohms per 1000 feet in accordance with ICEA T-27-581/NEMA WC-53. The insulated conductor shall have an insulation resistance not less than that corresponding to a constant (K) of 30,000 at 15.6°C (60°F) per the table in ICEA T-27-581 for converting insulation resistance, using a coefficient of 1.03.

4.8.3 Partial Discharge Test

Each shipping reel of completed cable shall be tested for compliance with paragraph 3.2.2.3.3 of this specification in accordance with the procedures given in paragraph 9.13 of ICEA S-94-649-2000. The apparent discharge characteristic shall be reported on an x-y plot. Partial discharge of each shipping reel of completed cable shall not exceed five (5) picocoulombs during any portion of the partial discharge test specified in ICEA S-94-649-2000.

5 PREPARATION FOR DELIVERY

Packaging and marking of the articles procured under this specification shall be in accordance with AEIC No. CS8, section J and the following requirements. Nails used in reels shall be galvanized, resin coated, or self-clenching and set so they cannot work free and damage the cable. All reels shall be inspected for protruding nails and, if required, corrective action taken **before** cable is put on the reel.

5.1 Each reel shall be protected with a covering in conformance with NEMA WC-26 Class 2 as approved in writing by Fort Collins Utilities, Electric Department, Engineering Standards. The covering shall be banded in place with a minimum of two 1/2" steel bands. Reels shall be shipped on open-bed truck(s) with reels in the upright position; i.e., on flanges, and blocked to prevent movement during shipping.

5.2 Each reel shall be marked with the following information.

5.2.1 Description of the product.

5.2.2 Name of the manufacturer, manufacturing plant location, and lot number as referenced in all test reports.

5.2.3 Tare, gross and net weights.

5.2.4 Total footage as well as the sequential footage marking numbers of each end

5.2.5 Fort Collins Utilities purchase order number and item number

5.2.6 Month and year of manufacture

5.3 Reel numbers not corresponding to test report numbers will be rejected and returned at the manufacturer's expense. In the case of duplicate reel numbers, both reels will be rejected and returned. The supplier shall also comply with all modifications and additions required in the purchase order and supplemental instructions.

6 DEFINITIONS AND ABBREVIATIONS

°C - Degree Celsius (Centigrade)

°F - Degree Fahrenheit

AC or a.c. - Alternating current

ARTICLE, UNIT, ASSEMBLY - All refer to the cable defined by this specification

AWG - American Wire Gauge

CPS OR Hz - Cycles per second

DC or d.c. - Direct current

kcmil – thousands of circular mils (formerly MCM)

kV - 1000 volts

PSI - Pounds per square inch

SHIPPING REEL – A completed reel of cable cut into the final length to be shipped to the customer

SIC - Specified Inductive Capacity (Dielectric Constant)

TRXLPE – Tree-Retardant Crosslinked Polyethylene

V or v – Volts

VENDOR OR SUPPLIER - The manufacturer and/or manufacturer's agent supplying or quoting on the specified article

XLP - Cross-linked thermosetting polyethylene

APPENDIX A - Approved Manufacturers

General Cable Corporation
4 Tesseneer Drive
Highland Heights, Kentucky 41076-9753
c/o Preferred Sales Agency
P.O. Box 1410
316 Sabine
Carthage, TX 75633
Ph.: 903/693-4466
FAX: 903/593-2222

Hendrix Wire and Cable
Old Wilton Rd.
P.O. Box 326
Milford, NH 03055-0326
c/o Power Equipment Specialists, Inc.
10200 W. 44th Ave. Suite 120
Wheatridge, CO 80033-2838

Pirelli Cable Corporation
700 Industrial Drive
Lexington, SC 29072
c/o Aspen Power & Telecommunication Sales, Inc.
1160 Huron St. Ste. 37-100
Northglenn, CO 80234
Off: 720-929-8550
Fax: 720-929-8549

Southwire Company
455 W. Diamond Drive, Suite 106
Tempe, AZ 85283
c/o The Peterson Company
4949 Colorado Ave.
Denver, CO 80216
Ph: (303) 388-6322
Fax: (303) 399-0033

APPENDIX B - SUPPLEMENTAL INSTRUCTIONS TO BIDDERS SPECIFICATION 367-102

In addition to the requirements of the "Invitation to Bid" and the "Purchase Requisition", the following shall apply:

A. Data to be Supplied With Bidder's Proposal

The following data shall be supplied with the Bidder's proposal in addition to that information required by the "Invitation to Bid" and the "Purchase Requisition".

1. A graph of Average Stress in volts per mil vs. Apparent Discharge Magnitude in picocoulombs. This graph shall be taken from a production cable run of cable similar in design to that of specification 367-102. The graph shall be labeled with the cable length and rated voltage of the cable, as well as the voltage level at which corona inception occurred.
2. Current AEIC qualification test reports.

B. Price Quotation

IF metals escalation is quoted, the following statement and information shall be included on the bid sheet: "Prices quoted herein are firm except for metal escalation/de-escalation on date of shipment based on producer's price of metal as reported in the Metals Week U.S. Market and the following quantities:"

Material	Pounds of Material	Quoted prices based on Metals Week U.S. Market. (Cents per pound)
Copper		
Aluminum		

Aluminum adjustments upward or downward will be based on Metals Week U.S. Market price as published in "Metals Week" for the entire month prior to quoted ship date.

Copper adjustments upward or downward will be based on Metals Week composite monthly average price for U.S. Producers Copper Cathode as published in "Metals Week" for the entire month prior to quoted ship date.

If any other escalation is quoted, the bidder shall indicate on the bid sheet the specific items or materials subject to escalation and shall give the method, the current index and the reporting publication or source of the index to be used in computing the amount thereof.

Escalation occurring after quoted delivery date will not be paid.

C. Preparation for Delivery

Cable shall be shipped in the lengths specified below on N-R reels meeting the following requirements:

STOCK NO.	MAX. FLANGE DIA. (in.)	MAX O/A WIDTH (IN.)	MIN. DRUM DIA. (IN.)	MIN. RIM CLEAR (IN.)	FEET PER REEL
367-102-01 (15kV #1/0 AWG)	50	37	16	2	2500 ± 200
367-102-04 (15kV 750kcmil)	70	37	28	2	1400 ± 25 *

For orders greater than 50,000 feet, 3 reels shall be at 1500 +25 / -0 feet, and the remaining balance shall be as shown above unless otherwise specified in the bid document.

Negotiated shorts and overages are not acceptable unless specifically allowed on bid sheet.

Shipping Terms: F.O.B. point of delivery, freight prepaid and allowed.

Shipment shall be by truck with reels in an upright position; i.e., reels shall not be shipped flat.

D. FAILURE TO MEET QUOTED DELIVERY

If a manufacturer fails to meet quoted delivery that manufacturer may be debarred from consideration for award of contracts for a period not to exceed three years.

E. DATE OF RECEIPT OF ORDER DEFINED

The purchase order will be sent by certified mail, return receipt requested and the date shown on the return receipt shall be considered the date of receipt of order. In special cases, confirming orders may be telephoned to the manufacturer, and the date shown on the purchase order shall be considered the date of receipt of order.

F. DATE OF SHIPMENT DEFINED

The date of shipment shall be defined as the date the bill of lading is signed by **carrier**.