



THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 252-2012

THE SUPPLY AND DELIVERY OF TRAFFIC SIGNALS CABLE

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PART B - BIDDING PROCEDURES

B1. CONTRACT TITLE

B1.1 THE SUPPLY AND DELIVERY OF TRAFFIC SIGNALS CABLE

B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 4:00 p.m. Winnipeg time, April 16, 2012.

B2.2 Bids determined by the Manager of Materials to have been received later than the Submission Deadline will not be accepted and will be returned upon request.

B2.3 The Contract Administrator or the Manager of Materials may extend the Submission Deadline by issuing an addendum at any time prior to the time and date specified in B2.1.

B3. ENQUIRIES

B3.1 All enquiries shall be directed to the Contract Administrator identified in D4.1.

B3.2 If the Bidder finds errors, discrepancies or omissions in the Bid Opportunity, or is unsure of the meaning or intent of any provision therein, the Bidder shall promptly notify the Contract Administrator of the error, discrepancy or omission at least five (5) Business Days prior to the Submission Deadline.

B3.3 If the Bidder is unsure of the meaning or intent of any provision therein, the Bidder should request clarification as to the meaning or intent prior to the Submission Deadline.

B3.4 Responses to enquiries which, in the sole judgment of the Contract Administrator, require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator to all Bidders by issuing an addendum.

B3.5 Responses to enquiries which, in the sole judgment of the Contract Administrator, do not require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator only to the Bidder who made the enquiry.

B3.6 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B3 unless that response or interpretation is provided by the Contract Administrator in writing.

B4. ADDENDA

B4.1 The Contract Administrator may, at any time prior to the Submission deadline, issue addenda correcting errors, discrepancies or omissions in the Bid Opportunity, or clarifying the meaning or intent of any provision therein.

B4.2 The Contract Administrator will issue each addendum at least two (2) Business Days prior to the Submission Deadline, or provide at least two (2) Business Days by extending the Submission Deadline.

B4.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/bidopp.asp>

B4.2.2 The Bidder is responsible for ensuring that he has received all addenda and is advised to check the Materials Management Division website for addenda regularly and shortly before the Submission Deadline, as may be amended by addendum.

B4.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 8 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B5. SUBSTITUTES

- B5.1 The Work is based on the materials, equipment, methods and products specified in the Bid Opportunity.
- B5.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.
- B5.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least seven (7) Business Days prior to the Submission Deadline.
- B5.4 The Bidder shall ensure that any and all requests for approval of a substitute:
- (a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the material, equipment, method or product as either an approved equal or alternative;
 - (b) identify any and all changes required in the applicable Work, and all changes to any other Work, which would become necessary to accommodate the substitute;
 - (c) identify any anticipated cost or time savings that may be associated with the substitute;
 - (d) certify that, in the case of a request for approval as an approved equal, the substitute will fully perform the functions called for by the general design, be of equal or superior substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the Contract;
 - (e) certify that, in the case of a request for approval as an approved alternative, the substitute will adequately perform the functions called for by the general design, be similar in substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the Contract.
- B5.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his sole discretion grant approval for the use of a substitute as an “approved equal” or as an “approved alternative”, or may refuse to grant approval of the substitute.
- B5.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, only to the Bidder who requested approval of the substitute.
- B5.6.1 The Bidder requesting and obtaining the approval of a substitute shall be entirely responsible for disseminating information regarding the approval to any person or persons he wishes to inform.
- B5.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.
- B5.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative may base his Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B13.
- B5.9 No later claim by the Contractor for an addition to the price(s) because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.
- B5.10 Notwithstanding B5.2 to B5.9, and in accordance with B6.7, deviations inconsistent with the Bid Opportunity document shall be evaluated in accordance with B13.1(a).

B6. BID SUBMISSION

- B6.1 The Bid shall consist of the following components:

- (a) Form A: Bid;
 - (b) Form B: Prices.
 - (c) Include the name and address of the firm proposed by the Bidder as the cable manufacturer, if not being manufactured directly by the Bidder.
- B6.2 Further to B6.1, the Bidder should include the written correspondence from the Contract Administrator approving a substitute in accordance with B5.
- B6.3 All components of the Bid shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely, to constitute a responsive Bid.
- B6.4 The Bid Submission may be submitted by mail, courier or personal delivery, or by facsimile transmission.
- B6.5 If the Bid Submission is submitted by mail, courier or personal delivery, it shall be enclosed and sealed in an envelope clearly marked with the Bid Opportunity number and the Bidder's name and address, and shall be submitted to:
The City of Winnipeg
Corporate Finance Department
Materials Management Division
185 King Street, Main Floor
Winnipeg MB R3B 1J1
- B6.5.1 Samples or other components of the Bid Submission which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder's Bid Submission.
- B6.6 Bidders are advised not to include any information/literature except as requested in accordance with B6.1.
- B6.7 Bidders are advised that inclusion of terms and conditions inconsistent with the Bid Opportunity document, including the General Conditions, will be evaluated in accordance with B13.1(a).
- B6.8 If the Bid Submission is submitted by facsimile transmission, it shall be submitted to (204) 949-1178.
- B6.8.1 The Bidder is advised that the City cannot take responsibility for the availability of the facsimile machine at any time.
- B6.9 Bids submitted by internet electronic mail (e-mail) will not be accepted.
- B7. BID**
- B7.1 The Bidder shall complete Form A: Bid, making all required entries.
- B7.2 Paragraph 2 of Form A: Bid shall be completed in accordance with the following requirements:
- (a) if the Bidder is a sole proprietor carrying on business in his own name, his name shall be inserted;
 - (b) if the Bidder is a partnership, the full name of the partnership shall be inserted;
 - (c) if the Bidder is a corporation, the full name of the corporation shall be inserted;
 - (d) if the Bidder is carrying on business under a name other than his own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.
- B7.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B7.2.

- B7.3 In Paragraph 3 of Form A: Bid, the Bidder shall identify a contact person who is authorized to represent the Bidder for purposes of the Bid.
- B7.4 Paragraph 10 of Form A: Bid shall be signed in accordance with the following requirements:
- (a) if the Bidder is a sole proprietor carrying on business in his own name, it shall be signed by the Bidder;
 - (b) if the Bidder is a partnership, it shall be signed by the partner or partners who have authority to sign for the partnership;
 - (c) if the Bidder is a corporation, it shall be signed by its duly authorized officer or officers and the corporate seal, if the corporation has one, should be affixed;
 - (d) if the Bidder is carrying on business under a name other than his own, it shall be signed by the registered owner of the business name, or by the registered owner's authorized officials if the owner is a partnership or a corporation.
- B7.4.1 The name and official capacity of all individuals signing Form A: Bid should be printed below such signatures.
- B7.5 If a Bid is submitted jointly by two or more persons, the word "Bidder" shall mean each and all such persons, and the undertakings, covenants and obligations of such joint Bidders in the Bid and the Contract, when awarded, shall be both joint and several.

B8. PRICES

- B8.1 The Bidder shall state a price in Canadian funds for each item of the Work identified on Form B: Prices.
- B8.1.1 Prices on Form B: Prices shall include:
- (a) duty;
 - (b) freight and cartage;
 - (c) Provincial and Federal taxes [except the Goods and Services Tax (GST) and Manitoba Retail Sales Tax (MRST, also known as PST), which shall be extra where applicable] and all charges governmental or otherwise paid;
 - (d) profit and all compensation which shall be due to the Contractor for the Work and all risks and contingencies connected therewith.
- B8.2 The quantities listed on Form B: Prices are to be considered approximate only. The City will use said quantities for the purpose of comparing Bids.
- B8.3 The quantities for which payment will be made to the Contractor are to be determined by the Work actually performed and completed by the Contractor, to be measured as specified in the applicable Specifications.

B9. QUALIFICATION

- B9.1 The Bidder shall:
- (a) undertake to be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, or if the Bidder does not carry on business in Manitoba, in the jurisdiction where the Bidder does carry on business; and
 - (b) be financially capable of carrying out the terms of the Contract; and
 - (c) have all the necessary experience, capital, organization, and equipment to perform the Work in strict accordance with the terms and provisions of the Contract.

- B9.2 The Bidder and any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:
- (a) be responsible and not be suspended, debarred or in default of any obligations to the City. A list of suspended or debarred individuals and companies is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/debar.stm>
- B9.3 The Bidder and/or any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:
- (a) have successfully carried out work similar in nature, scope and value to the Work; and
 - (b) be fully capable of performing the Work required to be in strict accordance with the terms and provisions of the Contract; and
 - (c) have a written workplace safety and health program, if required, pursuant to The Workplace Safety and Health Act (Manitoba); and
 - (d) have demonstrated the capability to quickly and efficiently effect repairs or remediation on issues with past orders to the satisfaction of officials of the City of Winnipeg.
- B9.4 The Bidder shall submit, within three (3) Business Days of a request by the Contract Administrator, proof satisfactory to the Contract Administrator of the qualifications of the Bidder and of any proposed Subcontractor.
- B9.5 The Bidder shall provide, on the request of the Contract Administrator, full access to any of the Bidder's equipment and facilities to confirm, to the Contract Administrator's satisfaction, that the Bidder's equipment and facilities are adequate to perform the Work.

B10. OPENING OF BIDS AND RELEASE OF INFORMATION

- B10.1 Bids will not be opened publicly.
- B10.2 Following the Submission Deadline, the names of the Bidders and their bid prices (unevaluated, and pending review and verification of conformance with requirements or evaluated prices) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>
- B10.3 After award of Contract, the name(s) of the successful Bidder(s) and the Contract amount(s) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt>
- B10.4 The Bidder is advised that any information contained in any Bid may be released if required by City policy or procedures, by The Freedom of Information and Protection of Privacy Act (Manitoba), by other authorities having jurisdiction, or by law.

B11. IRREVOCABLE BID

- B11.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 9 of Form A: Bid.
- B11.2 The acceptance by the City of any Bid shall not release the Bids of the next two lowest evaluated responsive Bidders and these Bidders shall be bound by their Bids on such Work for the time period specified in Paragraph 9 of Form A: Bid.

B12. WITHDRAWAL OF BIDS

- B12.1 A Bidder may withdraw his Bid without penalty by giving written notice to the Manager of Materials at any time prior to the Submission Deadline.

- B12.1.1 Notwithstanding C21, the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.
- B12.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 10 of Form A: Bid, and only such person, has authority to give notice of withdrawal.
- B12.1.3 If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials will:
- (a) retain the Bid until after the Submission Deadline has elapsed;
 - (b) open the Bid to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 10 of Form A: Bid; and
 - (c) if the notice has been given by any one of the persons specified in B12.1.3(b), declare the Bid withdrawn.
- B12.2 A Bidder who withdraws his Bid after the Submission Deadline but before his Bid has been released or has lapsed as provided for in B11.2 shall be liable for such damages as are imposed upon the Bidder by law and subject to such sanctions as the Chief Administrative Officer considers appropriate in the circumstances. The City, in such event, shall be entitled to all rights and remedies available to it at law.

B13. EVALUATION OF BIDS

- B13.1 Award of the Contract shall be based on the following bid evaluation criteria:
- (a) compliance by the Bidder with the requirements of the Bid Opportunity, or acceptable deviation therefrom (pass/fail);
 - (b) qualifications of the Bidder and the Subcontractors, if any, pursuant to B9 (pass/fail);
 - (c) Total Bid Price;
 - (d) economic analysis of any approved alternative pursuant to B5.
- B13.2 Further to B13.1(a), the Award Authority may reject a Bid as being non-responsive if the Bid Submission is incomplete, obscure or conditional, or contains additions, deletions, alterations or other irregularities. The Award Authority may reject all or any part of any Bid, or waive technical requirements or minor informalities or irregularities if the interests of the City so require.
- B13.3 Further to B13.1(b), the Award Authority shall reject any Bid submitted by a Bidder who does not demonstrate, in his Bid or in other information required to be submitted, that he is responsible and qualified.
- B13.4 Further to B13.1(c), the Total Bid Price shall be the sum of the quantities multiplied by the unit prices for each item 1-4 shown on Form B: Prices.
- (a) item 5, the reel deposit will not be evaluated.
- B13.5 This Contract will be awarded as a whole.

B14. AWARD OF CONTRACT

- B14.1 The City will give notice of the award of the Contract or will give notice that no award will be made.
- B14.2 The City will have no obligation to award a Contract to a Bidder, even though one or all of the Bidders are determined to be responsible and qualified, and the Bids are determined to be responsive.
- B14.2.1 Without limiting the generality of B14.2, the City will have no obligation to award a Contract where:
- (a) the prices exceed the available City funds for the Work;

- (b) the prices are materially in excess of the prices received for similar work in the past;
- (c) the prices are materially in excess of the City's cost to perform the Work, or a significant portion thereof, with its own forces;
- (d) only one Bid is received; or
- (e) in the judgment of the Award Authority, the interests of the City would best be served by not awarding a Contract.

B14.3 Where an award of Contract is made by the City, the award shall be made to the responsible and qualified Bidder submitting the lowest evaluated responsive Bid, in accordance with B13.

B14.3.1 Following the award of contract, a Bidder will be provided with information related to the evaluation of his Bid upon written request to the Contract Administrator.

B14.4 Notwithstanding C4 and Paragraph 6 of Form A:Bid, the City will issue a purchase order to the successful Bidder in lieu of the execution of a Contract.

B14.5 The Contract Documents, as defined in C1.1(n)(ii), in their entirety shall be deemed to be incorporated in and to form a part of the purchase order notwithstanding that they are not necessarily attached to or accompany said purchase order.

PART C - GENERAL CONDITIONS

C0. GENERAL CONDITIONS

- C0.1 The *General Conditions for the Supply of Goods* (Revision 2008 05 26) are applicable to the Work of the Contract.
- C0.1.1 The *General Conditions for the Supply of Goods* are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/gen_cond.stm
- C0.2 A reference in the Bid Opportunity to a section, clause or subclause with the prefix “**C**” designates a section, clause or subclause in the *General Conditions for Supply of Goods*.

PART D - SUPPLEMENTAL CONDITIONS

GENERAL

D1. GENERAL CONDITIONS

D1.1 In addition to the *General Conditions for the Supply of Goods*, these Supplemental Conditions are applicable to the Work of the Contract.

D2. SCOPE OF WORK

D2.1 The Work to be done under the Contract shall consist of the supply and delivery of traffic signal cable for the period from from the date of award until July 1, 2013, with the option of three (3) mutually agreed upon one (1) year extensions.

D2.1.1 The City may negotiate the extension option with the Contractor within sixty (60) Calendar Days prior to the expiry date of the Contract. The City shall incur no liability to the Contractor as a result of such negotiations.

D2.1.2 Changes resulting from such negotiations shall become effective on July 1st of the respective year. Changes to the Contract shall not be implemented by the Contractor without written approval by the Contract Administrator.

D2.2 The Work shall be done on an "as required" basis during the term of the Contract.

D2.2.1 The type and quantity of Work to be performed under this Contract shall be as authorized from time to time by the Contract Administrator and/or Users.

D2.2.2 Notwithstanding C7, the City shall have no obligation under the Contract to purchase any quantity of any item in excess of its actual operational requirements.

D3. DEFINITIONS

D3.1 When used in this Bid Opportunity:

- (a) "ANSI" means American National Standards Institute;
- (b) "ASTM" means American Society for Testing and Materials
- (c) "AWG" means American Wire Gauge ;
- (d) "IMSA" " means International Municipal Signal Association"

D4. CONTRACT ADMINISTRATOR

D4.1 The Contract Administrator is:

Jonathan Foord, EIT, M.Sc.,
Traffic Signals Asset Engineer
821 Elgin Avenue, Winnipeg MB R3E 3R1
Telephone No.: (204) 986-6619
Facsimile No.: (204) 772-6306

D5. NOTICES

D5.1 Notwithstanding C21.3, all notices of appeal to the Chief Administrative Officer shall be sent to the attention of the Chief Financial Officer at the following facsimile number:

The City of Winnipeg
Chief Financial Officer
Facsimile No.: (204) 949-1174

SUBMISSIONS

D6. AUTHORITY TO CARRY ON BUSINESS

- D6.1 The Contractor shall be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, or if the Contractor does not carry on business in Manitoba, in the jurisdiction where the Contractor does carry on business, throughout the term of the Contract, and shall provide the Contract Administrator with evidence thereof upon request.

SCHEDULE OF WORK

D7. COMMENCEMENT

- D7.1 The Contractor shall not commence any Work until he is in receipt of a notice of award from the City authorizing the commencement of the Work.
- D7.2 The Contractor shall not commence any Work until:
- (a) the Contract Administrator has confirmed receipt and approval of:
 - (i) evidence of authority to carry on business specified in D6;
 - (b) the Contractor has attended a meeting with the Contract Administrator, or the Contract Administrator has waived the requirement for a meeting.

D8. DELIVERY

- D8.1 Goods shall be delivered within sixty(60) Calendar Day(s) of the placing of an order, unless otherwise allowed by the User at the time of ordering, f.o.b. destination, freight prepaid, to:
- Public Works Stores
1277 Pacific Avenue
Winnipeg, MB
- D8.2 The Contractor shall confirm each delivery with the Contract Administrator or his/her designate, at least two (2) Business Days before delivery.
- D8.3 Goods shall be delivered between 8:30 a.m. and 2:30 p.m. on Business Days.
- D8.4 The Contractor shall off-load goods as directed at the delivery location.

D9. ORDERS

- D9.1 The Contractor shall provide a local Winnipeg telephone number or a toll-free telephone number at which orders for delivery may be placed.
- D9.2 A minimum order will consist of one full reel as per E3.2 of a given cable type specified.

D10. RECORDS

- D10.1 The Contractor shall keep detailed records of the goods supplied under the Contract.
- D10.2 The Contractor shall record, as a minimum, for each item listed on Form B: Prices:
- (a) user name(s) and addresses;
 - (b) order date(s);
 - (c) delivery date(s); and
 - (d) description and quantity of goods supplied.

D10.3 The Contractor shall provide the Contract Administrator with a copy of the records for each quarter year within fifteen (15) Calendar Days of the end of that quarter.

MEASUREMENT AND PAYMENT

D11. INVOICES

D11.1 Further to C10, the Contractor shall submit an invoice for each order delivered to:

The City of Winnipeg
Corporate Finance - Accounts Payable
4th Floor, Administration Building, 510 Main Street
Winnipeg MB R3B 1B9

Facsimile No.: (204) 949-0864
Email: CityWpgAP@winnipeg.ca

D11.2 Invoices must clearly indicate, as a minimum:

- (a) the City's purchase order number;
- (b) date of delivery;
- (c) delivery address;
- (d) type and quantity of goods delivered;
- (e) the amount payable with GST and MRST shown as separate amounts; and
- (f) the Contractor's GST registration number.

D11.3 The City will bear no responsibility for delays in approval of invoices which are improperly submitted.

D11.4 Bids Submissions must be submitted to the address in B6.5

D12. PAYMENT

D12.1 Further to C10, payment shall be in Canadian funds net thirty (30) Calendar Days after receipt and approval of the Contractor's invoice.

D12.2 Further to C10, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.

WARRANTY

D13. WARRANTY

D13.1 Warranty is as stated in C11.

PART E - SPECIFICATIONS

GENERAL

E1. APPLICABLE SPECIFICATIONS AND DRAWINGS

E1.1 These Specifications shall apply to the Work.

E1.2 The following are applicable to the Work:

<u>Drawing No.</u>	<u>Drawing Name/Title</u>
ST-127	Specifications for Traffic Signal Cable Geometry for 22 & 38 Conductor Cables

E1.3 Bidders are reminded that requests for approval of substitutes as an approved equal or an approved alternative shall be made in accordance with B5.

E2. GOODS

E2.1 The Contractor shall supply and deliver traffic signals cable in accordance with the requirements hereinafter specified.

E2.2 The materials used as specified for fabrication shall be new and not previously used

E2.3 **Item No. 1** – Twenty two (22) Conductor Polyethylene Insulated, Polyethylene Jacketed Traffic Signal Cable shall be as per Work Item Specification Details contained in E4 to E13.

E2.4 **Item No. 2** – Thirty-eight (38) Conductor Polyethylene Insulated, Polyethylene Jacketed Traffic Signal Cable shall be as per Work Item Specification Details contained in E4 to E13.

E2.5 **Item No. 3** – Six (6) Paired Conductors Polyethylene Insulated, Polyethylene Jacketed Traffic Signal Cable With Copper Shield shall be as per Work Item Specification Details contained in E14 to E26.

E2.6 **Item No. 4** – Four (4) Paired Conductors Polyethylene Insulated, Polyethylene Jacketed Traffic Signal Cable With Aluminum/Mylar Shield shall be as per Work Item Specification Details contained in E27 to E40.

E2.7 **Item No. 5** – Cable reels shall be as per E3.2.

E3. GENERAL REQUIREMENTS

E3.1 Cable Markings:

- (a) Each shipping length of cable shall be indelibly marked to show the remaining length of cable, in meters, on the outer surface of the cable jacket, one mark per meter. The **readily legible** "length remaining" digits shall be applied at one meter intervals on the outer jacket surface by means of "indent printing" or alternatively in indelible white, or light coloured ink providing high contrast that cannot be rubbed or washed off.
- (b) In most cases, each shipping length of cable will bear a "zero" mark at the inner end of the cable on the reel, with incrementing meter mark values throughout the length of the cable. Exceptions may be permitted to allow "non-zero" markings at the inner end of the reel, should defective sections of cable have to be removed as a consequence of failing the voltage rating tests on the finished cable.
- (c) The cable jacket shall also bear the legend "**WPG YYMM**" (YY = Year and MM = Month of manufacture) in legible characters, applied to the outer surface of the cable jacket by means "indent printing" or alternatively in indelible white, or light coloured ink providing high contrast that cannot be rubbed or washed off. This legend shall also **include the**

voltage rating of the cable, and shall be applied in one meter intervals along the entire length of cable.

- (d) All markings shall have a font minimum height of five (5) millimeters, and a bolded font.
- (e) If the markings come off at any time during the warranty period, or are incorrectly labelled, the cable will be returned to the Contractor for immediate remediation (maximum two (2) week turnaround from the date of notification). All costs for the cable marking repair including transportation, and repair work shall be borne by the Contractor.

E3.2 Reel Packaging And Markings:

- (a) Reels shall be substantially constructed and in good condition with wood free of existing rot. Broken flanges or torn arbour holes are not acceptable. The diameter of the reel drum shall be sufficient to prevent damage to the cables shipped on it. Reels shall have a maximum diameter of 48 inches and minimum diameter of 40 inches.
- (b) The width of each reel shall be 34-inches maximum and 28 inches minimum.
- (c) Each reel shall contain a continuous length of cable filled to within two (2) inches of the outer edge of the reel, except the last reel, which may be under-filled to complete the order.
- (d) The cable shall be secured on the reel to prevent inadvertent unspooling prior to delivery.
- (e) Each spool of cable shall be suitably protected. Each end of the cable shall be available for testing and visual inspection of the meter markings, and shall be properly sealed against moisture and protected against injury. The innermost cable end (normally bearing the "zero" mark) shall protrude no more than 0.5 meter through the side of the reel.
- (f) Reels shall be capable of being supported by a two (2) inch diameter shaft inserted in holes centered within the circular reel flanges. **Steel arbour hole plates shall be provided on all reels and securely bolted. Steel hubs or flanges without the bolted arbour hole plates are not acceptable.**
- (g) Each reel shall be plainly and permanently marked with a full description of the cable, giving the type and length of the cable on the reel, the number and size of the conductors in the cable, voltage rating, date of manufacture, name of Contractor, and name of manufacturer if different from Contractor. The marking shall be securely affixed on the outer side of the reel where the innermost cable end protrudes; the marking may be securely affixed on both sides of the reel. Each reel shall also bear a unique reel number. All required markings shall be 24 point minimum font size and independent of environmental storage effects (rain, snow, UV, etc.) remain legible for a period of not less than three years following delivery.

E3.3 Reel Deposit:

- (a) The Contractor shall include, if applicable, reel deposit charges on Form B: Prices. If deposit item unit price is not stated on Form B: Prices, it will be understood that there are no reel deposit charges that apply.
- (b) The Contractor shall pay all transportation charges both ways (delivery and return) on all reels in accordance with D8.1. The reels will be used by the City of Winnipeg. When the reel is emptied, the Contract Administrator will inform the Contractor for return instructions.

E4. TWENTY-TWO (22) CONDUCTOR CABLE AND THIRTY-EIGHT (38) CONDUCTOR CABLE

E4.1 This specification covers the supply and delivery of both twenty-two (22) conductor and thirty-eight (38) conductor polyethylene insulated, polyethylene jacketed traffic signal cable, rated 600 volts, for use in underground conduit or as aerial cable supported by a messenger as traffic signal cable

E4.1.1 Cable under this specification shall be composed of copper conductors individually insulated with heat-stabilized polyethylene. The insulated conductors shall be laid up in a compact cable form and bound with suitable moisture-resistant tape. Over top of the

moisture-resistant tape, shall be installed a single continuous length of cord (the "ripcord"). The cable core, moisture-resistant tape, and ripcord shall be completely enclosed in a tight fitting polyethylene compound jacket.

E5. CONDUCTORS

- E5.1 The conductors shall be copper and shall, before insulating, conform to the requirements of ASTM Designation B-3, latest revision.
- E5.2 The conductors shall be solid unless otherwise specified.
- E5.2.1 **For Both Item No. 1 (22 Conductors) and Item No. 2 (38 Conductors):** Two (2) - # 10 AWG stranded conductors shall be supplied.
- E5.2.2 **For Item No. 1 (22 Conductors):** Twenty (20) - # 14 AWG solid conductors shall be supplied.
- E5.2.3 **For Item No. 2 (38 Conductors):** Thirty-six (36)- # 14 AWG solid conductors shall be supplied.
- E5.3 The insulating compound shall be polyethylene.
- E5.4 The insulation shall be applied concentrically about the conductor.
- E5.4.1 For each stranded conductor #10 AWG, the minimum acceptable average thickness of the insulation shall be not less than 30 mils (0.762 mm). The minimum acceptable thickness at any point shall be 27 mils (0.635 mm).
- E5.4.2 For each solid conductor #14 AWG, the minimum acceptable average thickness of the insulation shall be not less than 25 mils (0.635 mm). The minimum acceptable thickness at any point shall be 22 mils (0.569 mm).
- E5.4.3 The method of insulation measurement and the apparatus used shall be in accordance with Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1).
- E5.5 The insulation after application to the conductors shall comply with the requirements specified for Class 30 Thermoplastic Polyethylene compound in Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1), except that the temperature for the cold bend test shall be minus 55.0 ± 2.0° C (minus 67.0 ± 3.6° F).
- E5.6 The insulation of the finished conductors before cabling shall withstand without break down the application of a 60 or 3,000 Hertz, 7,500 volt essentially sinusoidal spark test potential (RMS) in accordance with the method and using equipment specified in Underwriters Laboratories, Inc. Standard UL 83 (ANSI C33.8).

E6. CONDUCTOR COLOUR CODING

- E6.1 Standard colour coding for cables shall be in accordance with the City of Winnipeg Traffic Signals Colour Code Table E6.1. Base colours shall be obtained by the use of coloured insulation.

Table E6.1 City of Winnipeg Traffic Signals Colour Code
Twenty-two (22) Conductor Cables and Thirty-eight (38) Conductor Cables*
 (Note: This table content varies from IMSA Specification 20-1 (1997), Table 5.1)

Conductor Number**	Base Colour	Tracer Colour	Size	Style	22 Conductor	38 Conductor
1	Green	Black	10 ga.	Stranded	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	White	--	10 ga.	Stranded	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	Red	--	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	Red	Orange	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Red	Green	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	Orange	Red	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	Orange	--	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	Orange	Green	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
9	Brown	Red	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
10	Brown	Orange	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11	Brown	Green	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12	Blue	Red	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
13	Blue	Orange	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
14	Blue	Green	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
15	Black	--	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
16	Black	White	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
17	Yellow	--	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
18	Yellow	White	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
19	Violet	--	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
20	Violet	White	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
21	Slate***	--	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
22	Slate***	White	14 ga.	Solid	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
23	Black	Red	14 ga.	Solid	--	<input checked="" type="checkbox"/>
24	Black	Orange	14 ga.	Solid	--	<input checked="" type="checkbox"/>
25	Black	Green	14 ga.	Solid	--	<input checked="" type="checkbox"/>
26	Yellow	Red	14 ga.	Solid	--	<input checked="" type="checkbox"/>
27	Yellow	Orange	14 ga.	Solid	--	<input checked="" type="checkbox"/>
28	Yellow	Green	14 ga.	Solid	--	<input checked="" type="checkbox"/>
29	Violet	Red	14 ga.	Solid	--	<input checked="" type="checkbox"/>
30	Violet	Orange	14 ga.	Solid	--	<input checked="" type="checkbox"/>
31	Violet	Green	14 ga.	Solid	--	<input checked="" type="checkbox"/>
32	Slate***	Red	14 ga.	Solid	--	<input checked="" type="checkbox"/>
33	Slate***	Orange	14 ga.	Solid	--	<input checked="" type="checkbox"/>
34	Slate***	Green	14 ga.	Solid	--	<input checked="" type="checkbox"/>
35	Brown	Red	14 ga.	Solid	--	<input checked="" type="checkbox"/>
36	Brown	Orange	14 ga.	Solid	--	<input checked="" type="checkbox"/>
37	Brown	Green	14 ga.	Solid	--	<input checked="" type="checkbox"/>
38	Brown	--	14 ga.	Solid	--	<input checked="" type="checkbox"/>

* **NOTE:** See Drawing ST-127 for graphical representation of conductor assembly

** **NOTE:** HIGHER numbers represent the OUTER most conductors in the core.

*** **NOTE:** Grey may be substituted for slate.

E7. CONDUCTOR ASSEMBLY

- E7.1 Each single conductor shall be laid up symmetrically in layers with lay not more than 15 times the assembled core diameter.
- E7.2 The outer layer shall be left hand lay.
- E7.3 Fillers shall be used when necessary to secure a uniform assembly of conductors for a firm, compact cylindrical core.

E8. FILLERS

- E8.1 Fillers shall be used when necessary to ensure a firm compact cylindrical core. The core shall be fabricated so as to ensure the smallest possible core diameter. Fillers, when used, shall be of a non-metallic, moisture-resistant, non-wicking material which shall have no injurious effect upon other component parts of the cable. The filler shall not wick when tested as follows: One inch (25.4 mm) of the jacket shall be removed from one end of a one foot (30.48 cm) length of cable. This end shall be vertically supported in a two inch (50.8 mm) deep dye (Gentian Violet or equivalent) and water solution for 24 hours. The dye shall not have visibly coloured the top end of the cable.

E9. CABLE TAPE

- E9.1 The conductor assembly shall be covered with a wrapping of a moisture-resistant tape applied so as to lap at least 10 percent of its width.

E10. RIPCORDER

- E10.1 Overtop of the moisture-resistant taped conductor assembly shall be supplied a continuous length of nylon or polyester cord, known as the "ripcorder". The ripcorder shall be laid longitudinally along the entire length of the taped core assembly, immediately underneath the jacket material. The ripcorder may be moulded into the inner surface of the outer jacket material. The ripcorder shall be constructed of either one or two strands, the total diameter of which shall be no larger than 20 mils (0.508 mm), and sufficiently strong to sever the jacket material without breaking. The purpose of the ripcorder is to assist in the skinning and removal of the jacket material.

E11. JACKET

- E11.1 The taped conductor assembly shall be covered with a tight fitting black thermoplastic polyethylene compound jacket suitable for exposure to sunlight, atmospheric temperatures and stresses reasonably expected in normal installations.
- E11.2 The jacket shall be applied tightly over the core assembly and it shall be smooth, free from holes, splits, blisters and other imperfections. The jacket material shall meet the requirements of Table E11.2

Table E11.2 Physical Properties Of Polyethylene Jacket

Property	Test Method	Requirements
Tensile strength	ASTM D2633, Latest Rev.	1,700 Psi Min. (11.72 Mpa Min.)
Elongation	ASTM D2633, Latest Rev.	400% Min.
Cold Bend	ASTM D2633 at -55.0 ± 1.0°C	No Cracks
Environmental Cracking	ASTM D1693, Latest Rev.	No Cracks
Absorption Coefficient	ASTM D3349, Latest Rev.	3,200*

***NOTE:** Certification of Compliance with this requirement issued by the manufacturer of the polyethylene compound shall suffice in lieu of testing of the finished cable jacket.

- E11.3 The thickness of the jacket shall be UNIFORM at all points along the circumference and shall be 45 Mils (1.143 mm) minimum average acceptable thickness, with a minimum acceptable thickness at any point of 36 Mils (0.914 mm) and maximum acceptable thickness of 54 Mils (1.372 mm). The method of measurement and the apparatus used shall be in accordance with Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1).
- E11.4 The exterior surface of the jacket shall be smooth, free of wrinkles, grooves and undulations.
- E11.5 The jacket shall be durable and tough, yet flexible and capable of readily being skinned by means of the ripcord.

E12. SAMPLING, INSPECTION AND ACCEPTANCE

- E12.1 Inspection and tests shall be made at the place of manufacture and prior to shipment.
- E12.2 The manufacturer shall furnish the City's Contract Administrator in suitable form a certified report of the tests made on the cable to show compliance with this specification. This requirement shall apply to the manufacturer of this cable, regardless of whether that manufacturer has supplied cable of this or any other type of cable to the City in the past. No payment for any cable supplied shall be made until a satisfactory test report has been furnished to and accepted by the City.
- E12.3 The manufacturer shall be required to supply the City's Contract Administrator, in advance of the delivery of the required quantity of cable, a sample of the finished and tested cable, the sample being at least one (1) meter in length, containing at least two (2) sequential meter markings. No cable shall be delivered to the City until the sample length of cable has been examined, inspected and accepted by the City. The cost to provide the sample shall be borne solely by the Contractor.
- E12.4 Tests on Finished Individual Conductors – Each finished conductor shall meet the spark test requirement of Section E5.6 (7,500 volt) as soon as possible prior to cabling. All spark test failures shall be repaired before cabling.
- E12.5 Tests on Finished Cable – Each conductor shall be tested against other conductors. The individual conductors of each length of completed cable shall withstand without break down of either:
- E12.5.1 the application for one minute of a 60 Hertz, 2,500 volt essentially sinusoidal test potential (RMS) in accordance with the method and using equipment specified in Underwriters Laboratories, Inc. Standard UL 83 (ANSI C33.8); or
- E12.5.2 a DC test which shall be a short duration (5 second minimum) application of a DC voltage of ten times the Voltage Rating of the cable.
- E12.6 On delivery, an inspection of each reel will be conducted by City of Winnipeg's Stores personnel to ensure compliance to Section E3.1 & E3.2. Any reel and/or cable found to be non-compliant with this Specification will be noted by the Stores' personnel and be rejected and returned at the Contractors expense. The acceptance of the final reel and/or cable meeting both the total ordered amount and the Specification requirements shall occur within the approved delivery schedule as noted in Section D8.1.

E13. GUARANTEE

- E13.1 Notwithstanding Section D13, the manufacturer of cable under this specification shall agree to the replacement of any length of cable found to be defective in workmanship or material within one (1) year from the date of delivery to the City.

E14. SIX (6) PAIR CABLE

E14.1 This specification covers the supply and delivery of six pair polyethylene insulated, polyethylene jacketed traffic signal cable with copper electrical shielding, rated 300 volts, for use in underground conduit, as aerial cable supported by a messenger, or as traffic communications and data acquisition cable suitable for limited power use.

E14.1.1 Cable under this specification shall be composed of uncoated copper conductors individually insulated with heat-stabilized polyethylene. The insulated conductors shall be twisted into pairs and laid up in a compact form and bound with suitable moisture-resistant tape. The cable core and moisture-resistant tape, shall be completely wrapped in an electrically continuous copper metallic shield over top of which shall be installed a single continuous length of cord (the "ripcord"). The cable core, moisture resistant tape, copper shield and ripcord shall be completely enclosed in a polyethylene compound jacket.

E15. CONDUCTORS

E15.1 The conductors shall be copper and shall, before insulating, conform to the requirements of ASTM Designation B-3, latest revision.

E15.2 The conductors shall be solid and uncoated.

E15.3 Twelve (12) individual conductors shall be supplied, each conductor #19 AWG and twisted to form six (6) individual conductor pairs.

E16. INSULATION

E16.1 The insulating compound shall be polyethylene.

E16.2 The insulation shall be applied concentrically about the conductor. The minimum acceptable average thickness of the insulation shall be not less than 15 mils (0.38 mm). The minimum acceptable thickness at any point shall be 13 mils (0.33 mm). The method of measurement and the apparatus used shall be in accordance with Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1).

E16.3 The insulation after application to the conductors shall comply with the requirements specified for Class 30 Thermoplastic Polyethylene compound in Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1), except that the temperature for the cold bend test shall be minus 55.0 ± 2.0° C.

E16.4 The insulation of the finished conductors before cabling shall withstand without break down the application of a 60 or 3,000 Hertz, 4,000 volt essentially sinusoidal spark test potential (RMS) in accordance with the method and using equipment specified in Underwriters Laboratories, Inc. Standard UL 83 (ANSI C33.8).

E17. IDENTIFICATION OF PAIRS

E17.1 The polyethylene compound used for conductor insulation shall be coloured, so as to identify (1) the "wire" and "mate" conductor for each pair and (2) each pair in the completed cable.

E17.2 Base colours shall be obtained by the use of coloured polyethylene insulating compound. "Tracers" shall be extruded white stripes which shall be an integral part of the insulation, formed in such a manner as to afford distinctive circuit colour coding throughout the length of each "mate" conductor. The white tracer shall form a continuous longitudinal or spiral line throughout the length of the "mate" conductor.

E17.3 The colours of each "wire" and "mate" conductor of each pair, together with the pair numbers shall be in accordance with City of Winnipeg Traffic Signals Colour Code defined by Table E17.3.

TABLE E17.3
Conductor Colour and Sequence for Cables
 [Varies from IMSA Specification 40-2 (1997), TABLE 5.2]

Pair No.	Wire Colour	Mate Colour
1	Blue	Blue with White Tracer
2	Orange	Orange with White Tracer
3	Green	Green with White Tracer
4	Brown	Brown with White Tracer
5	Slate	Slate with White Tracer
6	Red	Red with White Tracer

E18. TWISTING

- E18.1 The insulated conductors shall be twisted into pairs.
- E18.2 Lengths of lay of pairs shall be staggered so that pairs having the same length of lay shall be separated by at least two pairs having different lengths of lay.
- E18.3 To help ascertain pair identity of the two wires comprising a pair, the maximum length of lay of pairs twisted shall not exceed six inches (152 mm).

E19. CORE ASSEMBLY

- E19.1 In multi-pair cables, the pairs shall be laid up symmetrically with lay not more than 15 times the assembled core diameter.
- E19.2 Each subsequent layer of twisted pairs may be laid in a direction opposite to that of adjacent layers, or alternatively, unidirectional lay may be used. The outer layer shall be left hand lay.
- E19.3 Fillers shall be used when necessary to secure a uniform assembly of conductors for a firm compact cylindrical core. The core shall be fabricated to ensure the smallest possible core diameter.

E20. FILLERS

- E20.1 Fillers shall be used when necessary to ensure a firm compact cylindrical core. The core shall be fabricated so as to ensure the smallest possible core diameter. Fillers, when used, shall be of a non-metallic, moisture-resistant, non-wicking material which shall have no injurious effect upon other component parts of the cable. The filler shall not wick when tested as follows: One inch (25.4 mm) of the jacket shall be removed from one end of a one foot (0.305 m) length of cable. This end shall be supported vertically in a two inch (50.8 mm) deep dye (Gentian Violet or equivalent) and water solution for 24 hours. The dye shall not have visibly coloured the top end of the cable.

E21. CABLE TAPE

- E21.1 The conductor assembly shall be covered with a wrapping of a moisture-resistant tape applied so as to lap at least 10 percent of its width.

E22. SHIELDING

- E22.1 The shield shall consist of a single fully annealed copper tape applied longitudinally or helically around the core. If applied longitudinally, it shall be corrugated. If helically, it must lap at least 15 percent of its width.
- E22.2 The copper tape employed for the shield shall have a thickness of not less than 4 Mils (0.10 mm).

E22.3 Where splicing of the shielding tape is necessary the shield tape shall be joined during the manufacturing process by means of cold weld, electric weld or soldering with non-acid flux.

E23. RIPCORD

E23.1 Overtop of the taped (i.e. both moisture-resistant tape and copper shield) conductor assembly shall be supplied a single continuous length of nylon or polyester cord, known as the "ripcored." The ripcord shall be laid longitudinally along the taped and shielded cable core assembly, immediately underneath the jacket material. The purpose of the ripcord is to assist in the skinning and removal of the jacket material.

E24. JACKET

E24.1 The taped conductor assembly and ripcord shall be covered with a tight fitting black thermoplastic polyethylene compound jacket suitable for exposure to sunlight, atmospheric temperatures and stresses reasonably expected in normal installation.

E24.2 The jacket shall be applied tightly over the core assembly and ripcord and it shall be smooth, free from holes, splits, blisters and other imperfections. The jacket material shall meet the requirements of Table E24.2.

**TABLE E24.2
 PHYSICAL PROPERTIES OF POLYETHYLENE JACKET**

Property	Test Method	Requirements
Tensile strength	ASTM D2633, Latest Rev.	1,700 Psi Min. (11.72 MPa)
Elongation	ASTM D2633, Latest Rev.	400% Min.
Cold Bend	ASTM D2633 at -55.0 ± 1.0°C	No Cracks
Environmental Cracking	ASTM D1693, Latest Rev.	No Cracks
Absorption Coefficient	ASTM D3349, Latest Rev.	3,200*

***NOTE:** Certification of Compliance with this requirement issued by the manufacturer of the polyethylene compound shall suffice in lieu of testing of the finished cable jacket.

E24.3 The thickness of the jacket shall be UNIFORM at all points along the circumference and shall be 45 Mils (1.14 mm) minimum average acceptable thickness, with a minimum acceptable thickness at any point of 36 Mils (0.91 mm) and maximum acceptable thickness of 54 Mils. The method of measurement and the apparatus used shall be in accordance with Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1).

E24.4 The exterior surface of the jacket shall be smooth, free of wrinkles, grooves and undulations.

E24.5 The jacket shall be durable and tough, yet flexible and capable of readily being skinned by means of the ripcord.

E25. SAMPLING, INSPECTION AND ACCEPTANCE

E25.1 Inspection and tests shall be made at the place of manufacture and prior to shipment.

E25.2 The manufacturer shall furnish the City's Contract Administrator in suitable form a certified report of the tests made on the cable to show compliance with this specification. This requirement shall apply to the manufacturer of this cable, regardless of whether that manufacturer has supplied cable of this or any other type of cable to the City in the past. No payment for any cable supplied shall be made until a satisfactory test report has been furnished to and accepted by the City.

E25.3 The manufacturer shall be required to supply the City's Contract Administrator, in advance of the delivery of the required quantity of cable, a sample of the finished and tested cable, the sample being at least one (1) meter in length, containing at least two (2) sequential meter

markings. No cable shall be delivered to the City until the sample length of cable has been examined, inspected and accepted by the City. The cost to provide the sample shall be borne solely by the Contractor.

- E25.4 Tests on Finished Individual Conductors – Each finished conductor shall meet the spark test requirement of Section E16.4 (4,000 volt) as soon as possible prior to cabling. All spark test failures shall be repaired before cabling.
- E25.5 Tests on Finished Cable – Each conductor shall be tested against other conductors and shield. The individual conductors of each length of completed cable shall withstand without break down either:
- E25.5.1 the application for one minute of a 60 Hertz, 1,000 volt essentially sinusoidal test potential (RMS) in accordance with the method and using equipment specified in Underwriters Laboratories, Inc. Standard UL 83 (ANSI C33.8); or
- E25.5.2 a DC test which shall be a short duration (5 second minimum) application of a DC voltage of ten times the Voltage Rating of the cable,
- E25.5.3 each processed length of finished cable shall have an Insulation Resistance of 13,000 Megohms per 1,000 feet (42,650 Megohms per kilometre) at 60°F. The test voltages must be not less than 200 Volts DC nor more than 500 Volts DC.
- E25.6 On delivery, an inspection of each reel will be conducted by City of Winnipeg's Stores personnel to ensure compliance to Section E3.1 & E3.2. Any reel and/or cable found to be non-compliant with this Specification will be noted by the Stores' personnel and be rejected and returned at the Contractors expense. The acceptance of the final reel and/or cable meeting both the total ordered amount and the Specification requirements shall occur within the approved delivery schedule as noted in Section D8.1.

E26. GUARANTEE

- E26.1 Notwithstanding Section D13, the manufacturer of cable under this specification shall agree to the replacement of any length of cable found to be defective in workmanship or material within one (1) year from the date of delivery to the City.

E27. FOUR (4) PAIR CABLE

- E27.1 This specification covers the supply and delivery of four paired conductors, polyethylene insulated, polyethylene jacketed traffic signal cable with aluminum/mylar shields on each conductor pair, rated 600 volts, for use in underground conduit, as aerial cable supported by a messenger, as traffic communications signalling cable or as lead-in cable for inductive loop detectors.
- E27.1.1 Cable under this specification shall be composed of copper conductors individually insulated with heat-stabilized polyethylene. The insulated conductors shall be twisted into pairs. Each conductor pair shall have a bare metallic drain wire, with each conductor pair and its associated drain wire completely enclosed in an electrically continuous aluminum/mylar metallic shield. The shielded pairs shall be laid up in a compact cable form and the cable core bound with a suitable moisture-resistant tape. Over top of the moisture-resistant tape, shall be installed a single continuous length of cord (the "ripcord"). The cable core, moisture-resistant tape, and ripcord shall be completely enclosed in a polyethylene compound jacket.

E28. CONDUCTORS

- E28.1 The conductors shall be copper and shall, before insulating, conform to the requirements of ASTM Designation B-3, latest revision.
- E28.2 The conductors shall be solid.

E28.3 Eight (8) individual conductors shall be supplied, each conductor #14 AWG and twisted to form four (4) individually shielded conductor pairs.

E29. INSULATION

E29.1 The insulating compound shall be polyethylene.

E29.2 The insulation shall be applied concentrically about the conductor. The minimum acceptable average thickness of the insulation shall be not less than 25 mils (0.635 mm). The minimum acceptable thickness at any point shall be 22 mils (0.569 mm). The method of measurement and the apparatus used shall be in accordance with Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1).

E29.3 The insulation after application to the conductors shall comply with the requirements specified for Class 30 Thermoplastic Polyethylene compound in Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1), except that the temperature for the cold bend test shall be minus 55.0 ± 2.0° C.

E29.4 The insulation of the finished conductors before cabling shall withstand without break down the application of a 60 or 3,000 Hertz, 7,500 volt essentially sinusoidal spark test potential (RMS) in accordance with the method and using equipment specified in Underwriters Laboratories, Inc. Standard UL 83 (ANSI C33.8).

E30. IDENTIFICATION OF PAIRS

E30.1 The polyethylene compound used for conductor insulation shall be coloured, so as to identify (1) the “wire” and “mate” conductor for each pair and (2) each pair in the completed cable.

E30.2 Base colours shall be obtained by the use of coloured polyethylene insulating compound. “Tracers” shall be extruded coloured stripes which shall be an integral part of the insulation, formed in such a manner as to afford distinctive circuit colour coding throughout the length of each “mate” conductor. The coloured tracer shall form a continuous longitudinal or spiral line throughout the length of the “mate” conductor.

E30.3 The colours of each “wire” and “mate” conductor of each pair, together with the pair numbers shall be in accordance with the City of Winnipeg Traffic Signals Colour Code defined by Table E30.3.

TABLE E30.3
City of Winnipeg Traffic Signals Colour Code
Conductor Colour and Sequence for Four (4) Paired Cables
 [Varies from IMSA Specification 20-2 (1997), TABLE 5.2]

Pair No.	Wire Colour	Mate Colour
1	Black	Black with Green Tracer
2	Red	Red with Green Tracer
3	Orange	Orange with Green Tracer
4	Blue	Blue with Green Tracer

NOTE: Higher pair numbers represent the outer-most conductors in the Core.

E31. TWISTING

E31.1 The insulated conductors shall be twisted into pairs.

E31.2 Lengths of lay of pairs shall be staggered so that pairs having the same length of lay shall be separated by at least two pairs having different lengths of lay.

E31.3 To help ascertain pair identity of the two wires comprising a pair, the maximum length of lay of pairs twisted shall not exceed six inches (152 mm).

E32. CORE ASSEMBLY

- E32.1 The pairs shall be laid up symmetrically with lay not more than 15 times the assembled core diameter.
- E32.2 Each subsequent layer of twisted pairs may be laid in a direction opposite to that of adjacent layers, or alternatively, unidirectional lay may be used. The outer layer shall be left hand lay.
- E32.3 Fillers shall be used when necessary to secure a uniform assembly of conductors for a firm compact cylindrical core. The core shall be fabricated to ensure the smallest possible core diameter.

E33. DRAIN WIRE

- E33.1 Each of the four (4) individual drain wires associated with each conductor pair shall be a 7-strand tinned copper, non-insulated conductor, having a cross-sectional area and equivalent current-carrying capacity of a #19 AWG copper conductor.

E34. SHIELDING

- E34.1 Each of the four (4) shields shall consist of a single aluminum/mylar tape applied longitudinally or helically over each individual conductor pair and attendant drain wire associated with each pair. If applied longitudinally it shall be corrugated. If helically, it must lap at least 15 percent of its width. The aluminum/mylar shield tape shall be applied with its aluminum side facing inward, such that it faces the conductor pair (and attendant drain wire) for which it forms a shield, and its mylar side facing outward, facing the moisture-resistant tape layer.
- E34.2 Each aluminum/mylar shield shall completely cover one single twisted conductor pair, and shall also cover the attendant drain wire associated with each pair.
- E34.3 The aluminum/mylar tape employed for the shield shall have a thickness of not less than 1 Mil (0.025mm).
- E34.4 Where splicing of the shielding tape is necessary the shield tape shall be joined during the manufacturing process by means of cold weld or electric weld. Any other process proposed by the manufacturer for splicing the shielding tape shall be submitted with complete manufacturing details and guaranteed performance specifications to the City of Winnipeg for approval prior to manufacture of the cable.

E35. FILLERS

- E35.1 Fillers shall be used when necessary to ensure a firm compact cylindrical core. The core shall be fabricated so as to ensure the smallest possible core diameter. Fillers, when used, shall be of a non-metallic, moisture-resistant, non-wicking material which shall have no injurious effect upon other component parts of the cable. The filler shall not wick when tested as follows:

One inch (25.4 mm) of the jacket shall be removed from one end of a one foot (0.305 m) length of cable. This end shall be supported vertically in a two inch (50.8 mm) deep dye (Gentian Violet or equivalent) and water solution for 24 hours. The dye shall not have visibly coloured the top end of the cable.

E36. CABLE TAPE

- E36.1 The conductor assembly shall be covered with a wrapping of a moisture-resistant tape applied so as to lap at least 10 percent of its width.

E37. RIPCORD

E37.1 Overtop of the moisture-resistant tape (and immediately below the outer jacket material) shall be supplied a single continuous length of nylon or polyester cord, known as the "ripcord." The ripcord shall be laid longitudinally along the entire length of cable core, immediately underneath the outer jacket material. The ripcord may be moulded into the inner surface of the outer jacket material. The ripcord shall be no larger than 20 mils (0.508 mm) in total diameter, and shall be constructed of either one or two strands, sufficiently strong to sever the jacket material without breaking. The purpose of the ripcord is to assist in the skinning and removal of the jacket material.

E38. JACKET

E38.1 The taped conductor assembly and ripcord shall be covered with a tight fitting black thermoplastic polyethylene compound jacket suitable for exposure to sunlight, atmospheric temperatures and stresses reasonably expected in normal installation.

E38.2 The jacket shall be applied tightly over the core assembly and ripcord and it shall be smooth, free from holes, splits, blisters and other imperfections. The jacket material shall meet the requirements of Table E38.2.

**TABLE E38.2
 PHYSICAL PROPERTIES OF POLYETHYLENE JACKET**

Property	Test Method	Requirements
Tensile strength	ASTM D2633, Latest Rev.	1,700 Psi Min. (11.72 Mpa Min.)
Elongation	ASTM D2633, Latest Rev.	400% Min.
Cold Bend	ASTM D2633 at $-55.0 \pm 1.0^{\circ}\text{C}$	No Cracks
Environmental Cracking	ASTM D1693, Latest Rev.	No Cracks
Absorption Coefficient	ASTM D3349, Latest Rev.	3,200*

***NOTE:** Certification of Compliance with this requirement issued by the manufacturer of the polyethylene compound shall suffice in lieu of testing of the finished cable jacket.

E38.3 The thickness of the jacket shall be UNIFORM at all points along the circumference, and shall be 45 Mil (1.14 mm) minimum average acceptable thickness, with a minimum acceptable thickness at any point of 36 Mil (0.91 mm) and maximum acceptable thickness of 54 Mil (1.37 mm). The method of measurement and the apparatus used shall be in accordance with Underwriters Laboratories, Inc. Standard UL 62 (ANSI C33.1).

E38.4 The exterior surface of the jacket shall be smooth, free of wrinkles, grooves and undulations.

E38.5 The jacket shall be durable and tough, yet flexible and capable of readily being skinned by means of the ripcord.

E39. SAMPLING, INSPECTION AND ACCEPTANCE

E39.1 Inspection and tests shall be made at the place of manufacture and prior to shipment.

E39.2 The manufacturer shall furnish the City's Contract Administrator in suitable form a certified report of the tests made on the cable to show compliance with this specification. This requirement shall apply to the manufacturer of this cable, regardless of whether that manufacturer has supplied cable of this or any other type of cable to the City in the past. No payment for any cable supplied shall be made until a satisfactory test report has been furnished to and accepted by the City.

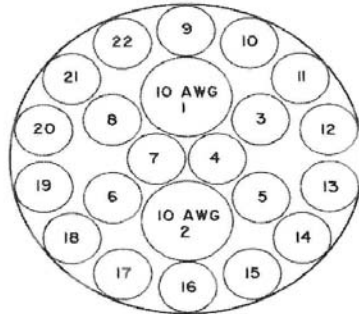
E39.3 The manufacturer shall be required to supply the City's Contract Administrator, in advance of the delivery of the required quantity of cable, a sample of the finished and tested cable, the

sample being at least one (1) meter in length, containing at least two (2) sequential meter markings. No cable shall be delivered to the City until the sample length of cable has been examined, inspected and accepted by the City. The cost to provide the sample shall be borne solely by the Contractor.

- E39.4 Tests on Finished Individual Conductors – Each finished conductor shall meet the spark test requirement of Section E29.4 (7,500 volt) as soon as possible prior to cabling. All spark test failures shall be repaired before cabling.
- E39.5 Tests on Finished Cable – Each conductor shall be tested against other conductors and shields. The individual conductors of each length of completed cable shall withstand without break down of either:
- E39.5.1 the application for one minute of a 60 Hertz, 2,500 volt essentially sinusoidal test potential (RMS) in accordance with the method and using equipment specified in Underwriters Laboratories, Inc. Standard UL 83 (ANSI C33.8); or
- E39.5.2 a DC test which shall be a short duration (5 second minimum) application of a DC voltage of ten times the Voltage Rating of the cable.
- E39.6 On delivery, an inspection of each reel will be conducted by City of Winnipeg's Stores personnel to ensure compliance to Section E3.1 & E3.2. Any reel and/or cable found to be non-compliant with this Specification will be noted by the Stores' personnel and be rejected and returned at the Contractors expense. The acceptance of the final reel and/or cable meeting both the total ordered amount and the Specification requirements shall occur within the approved delivery schedule as noted in Section D8.1.

E40. GUARANTEE

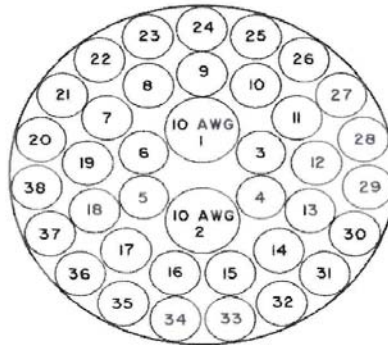
- E40.1 Notwithstanding Section D13, the manufacturer of cable under this specification shall agree to the replacement of any length of cable found to be defective in workmanship or material within one (1) year from the date of delivery to the City.



22 - CONDUCTOR CABLE
 CROSS SECTIONAL VIEW

NOTE FOR 22 CONDUCTOR CABLE:

1. 1 AND 2 ARE 10 GAUGE AWG COPPER STRANDED INSULATED WIRES .
2. 3-22 ARE 14 GAUGE AWG COPPER SOLID INSULATED WIRE



38 - CONDUCTOR CABLE
 CROSS SECTIONAL VIEW

NOTE FOR 38 CONDUCTOR CABLE:

1. 1 AND 2 ARE 10 GAUGE AWG COPPER STRANDED INSULATED WIRE .
2. 3-38 ARE 14 GAUGE AWG COPPER SOLID INSULATED WIRE .

REFERENCE SPEC. NO.		ENGINEER'S SEAL		THE CITY OF WINNIPEG PUBLIC WORKS DEPARTMENT TRANSPORTATION DIVISION	
DESIGNED BY AKB 04/05/30		CHECKED BY [Signature]		SPECIFICATIONS FOR TRAFFIC SIGNAL CABLE GEOMETRY FOR 22 AND 38 CONDUCTOR CABLES	
DRAWN BY B.H.		SCALE N.T.S.			
APPROVED BY [Signature]		DATE 2004.03.30		SHEET 1 OF 1	
NO. REVISIONS		DATE BY		CITY DRAWING NUMBER ST-127	