SPOORNET
(INFRASTRUCTURE) (POWER SUPPLIES)

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SPECIFICATION FOR THE INSTALLATION OF CABLES

This specification covers Spoornet's requirements for the installation, laying, terminating, jointing, testing and commissioning of the high and low voltage cables.

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1.0 SCOPE

1.1 This specification covers Spoornet's requirements for the installation, laying, terminating, jointing, testing and commissioning of high and low voltage cables.

2.0 REFERENCE LIST

The following publications, drawings and documents (latest edition) are referred to herein.

2.1 South African Bureau of Standards

SABS 97 - Impregnated paper insulated electric cables.

SABS 0142 - Code of practice for the wiring of premises.

SABS 150 - Polyvinylchloride (PVC) insulated electric cables and flexible cords.

SABS 763 - Hot-dip (galvanised) zinc coating.

SABS 1339 - Cross-linked polyethylene insulation of electric cables.

SABS 1299 - Direct-acting indicating electrical measuring instruments and their accessories.

2.2 British Standard Institution

BS 5467 - Armoured cables with thermosetting insulation for electricity supply.

BS 6480 - Impregnated paper-insulated cables.

2.3 Machinery and Occupational Safety Act, Act No. 6, 1983

2.4 Spoornet

CEE.0012 - Method of Tendering

CEE.0045 - Painting of steel components of electrical equipment.

CEE.0089 - Drawings of electrical equipment supplied under electric light and power contracts.

Safety Instructions - High Voltage Electrical Equipment

3.0 APPENDICES

The following appendices form an integral part of this specification.

3.1 Appendix 1 - "Scope of Work"

3.1.1 This appendix specifies the extent of the work required and the order of priorities.

3.2 Appendix 2 - "Drawings".

3.2.1 This appendix lists Spoornets drawings applicable to the installation,

3.2.2 Cable routes indicated on these drawings shall only be a general guide to the contractor.

3.3 Appendix 3 - "Schedule of Items, Estimated Quantities, Unit Rates and Prices".

3.3.1 To ensure a uniform basis for tendering purposes, tenders shall be based on the estimated quantities given in this schedule which shall be completed in full and returned as part of the tender.

3.3.2 The importance of full completion of this schedule cannot be overstressed as this will constitute the tenderer's quotation.

3.3.3 Rates specified in this schedule will be applicable if any adjustments to requirements become necessary.

3.3.4 Any additional items considered to be necessary by the tenderer for the satisfactory completion of the installation and fulfilment of his guarantee shall be added by the tenderer on a similar unit price basis to this schedule and included in his total tendered price.

3.3.5 Actual quantities required will be based on the final survey by the successful contractor, and payment will be based on the actual measurements.

4.0 DRAWINGS AND INSTRUCTIONS

4.1 All drawings submitted by the tenderer shall be in accordance with Spoornets Specification No. CEE.0089

4.2 Where joints and terminations are to be done by others, the contractor shall submit detailed instructions regarding the procedure recommended by the cable manufacturer.

5.0 STANDARD OF WORK

5.1 The electrical installation shall conform to the requirements of SABS Code of Practice 0142 and shall be to the satisfaction of Spoornet.

5.2 Galvanising, where specified, shall be in accordance with SABS 763.

6.0 SAFETY INSTRUCTIONS

6.1 Work on the high voltage equipment shall be carried out in accordance with the Safety Instructions High Voltage Electrical Equipment of Spoornet.

6.2 All work done must comply with the requirements of the MACHINERY AND OCCUPATIONAL SAFETY ACT, Act No. 6, 1983.

7.0 SURVEYS

7.1 Pre-installation Route Surveys.

7.1.1 The Contractor shall within 30 days after being awarded the contract, carry out a pre-installation route survey which shall include digging test holes and, guided by the drawings contained in appendix 2, determine a suitable route.

7.1.2 The contractor shall determine where cables are liable to be subjected to chemical, electrolytic, mechanical or other damage and shall submit his recommendation to the Engineer for approval.

7.1.3 The Contractor shall submit in triplicate plans of the cable routes selected to the Engineer for approval. Plans may be submitted in sections as the survey progresses.

7.1.4 No excavation of any section of the cable route shall commence before the Contractor is in possession of the relevant approved plans and the Engineer has authorised the commencement of work on the section concerned.

7.2 Post Installation Surveys

7.2.1 After completion of all cable laying and jointing and before commissioning of any cable the Contractor shall carry out a final "as laid" survey of the cable routes and submit plans on transparencies suitable for reproduction.

7.2.2 The cable route plans shall include the following information :

7.2.2.1 Overall length, type, size and voltage of each cable.

7.2.2.2 Accurate indication of the position of each cable joint by indicating two distances to each joint from permanent structures.

7.2.2.3 Pipes and chambers provided.

8.0 EXCAVATIONS

8.1 Excavations shall be carried out in strict compliance with the specification No. E.7 for works on, over, under or adjacent to a railway line.

8.2 Trenching procedure shall be programmed in advance, approved by the Engineer and shall not be departed from except with the consent of the Engineer.

8.3 The Contractor will be advised of any known buried services such as cables, pipes, etc. in the vicinity of the cable route.

8.3.1 When trenching the contractor shall take all necessary precautions to prevent damage to underground services.

8.3.2 On encountering any uncharted service, the Contractor shall promptly advise the Engineer who will give the necessary instructions. Additional excavations shall be paid for at scheduled rates.

8.4 Should any underground service, water mains, road pavement, drainage system, building or any other structure be damaged by the Contractor's staff, it shall be reported immediately to the Engineer, who shall arrange for the necessary repairs. The Contractor shall be responsible for the cost of repairs.

8.5 The removal of obstructions along the cable routes shall be subject to the approval of the Engineer and shall be paid for at the agreed rates.

8.6 The Contractor shall not trench beneath any railway line without departmental supervision. Should the contractor wish to carry out such work, a minimum of 14 working days notice is required by the Engineer to arrange for the necessary supervision. The cost of such supervision shall not be charged to the Contractor.

8.7 Excavations crossing oil pipe lines shall not commence until an authorised representative is present on site. The Engineer shall be advised 14 days in advance when such excavations will take place.

8.7.1 Cable crossings of oil pipe lines shall only be at right angles.

8.8 Trenches across roads, access ways or foot-paths shall not be left open. If trenching, cable laying and backfilling cannot be done during the same shift, the portion of trench across the full width of the road, etc., must be temporarily backfilled and consolidated sufficiently to carry the traffic concerned without subsidence. Alternatively, adequately strong cover plates shall be laid across the trench.

8.9 Power driven mechanical excavators may be used for trenching operations. Spoornet shall not be responsible for any damage to other Services in close proximity when using mechanical excavators.

8.10 The Contractor shall provide shuttering in places where the danger exists of the trench collapsing, and causing damage to formations or other nearby structures.

8.10.1 Shuttering shall be paid for at scheduled rates.

8.11 Trenches shall be as straight as possible and the bottom of each cable trench shall be firm and of smooth contour without sharp dips or rises which may cause tensile forces in the cable during backfilling.

8.11.1 Trenches shall have no sharp objects which may cause damage to the cable during laying or backfilling.

8.12 The unfinished depth of trenches unless otherwise stated shall be as follows :

8.12.1 HV cables and associated pilot cables = 1 000 mm

8.12.2 LV cables and separate pilot cables = 750 mm

8.13 The width of the trench unless otherwise stated shall be 500 mm for one or two HV cables and associated pilot cables, and shall increase by 300 mm for each additional HV cable and its associated pilot cable.

8.13.1 The width of the trench at any bend or places where cable slack is required, shall be such that the bending radius of the cables shall not be less than that specified for the particular cable as per specifications SABS 150, SABS 97 and SABS 1339.

8.13.2 Trenching in railway formations shall be in accordance with Spoornet's Chief Civil Engineer's drawing FG 263.

8.14 The material excavated from each trench shall be placed in such a manner as to prevent nuisance or damage to adjacent ditches, railway lines, drains, gateways and other properties and shall not interfere with traffic.

8.14.1 Where, owing to certain considerations, this is not possible the excavated materials shall be removed from site and be returned for refilling the trench on completion of laying.

8.15 When excavating close to railway tracks, the ballast must be covered by tarpaulins or other sheeting to prevent soiling.

8.16 Removal of accumulated water or other liquid from trenches shall be done by the Contractor at his expense. The Contractor shall provide all pumps and appliances required to carry out this operation. Water or any other liquid removed shall be disposed of without creating any nuisance or hazard.

8.17 Spoornet reserves the right to alter any cable route or portion thereof prior to cable laying. Payment in respect of any additional work involved shall be at scheduled rates.

9.0 CABLE LAYING

9.1 General

9.1.1 All possible care shall be exercised in handling cables on site.

9.1.2 Any drum of cable showing signs of damage shall not be used.

9.1.3 The outer covering of cables shall not be damaged in any way and cables shall not be bent at radii less than allowed by the manufacturer.

9.1.4 When cable is supplied by the contractor, the drums thereof remain the property of the Contractor and shall be removed from the site and disposed of by him.

9.1.5 Cable pulling and laying shall be done manually unless otherwise approved by the Engineer. No cable shall be subjected to a tension exceeding that stipulated by the cable manufacturer.

9.2 IN TRENCHES

9.2.1 High Voltage cables shall be spaced at a minimum of 300 mm apart (centre to centre).

9.2.2 Low Voltage cables shall be spaced at a minimum of 150 mm apart (centre to centre).

9.2.3 Pilot cables shall be laid beside the associated power cables.

9.2.4 High Voltage and Low Voltage cables (and pilot cables not associated with High Voltage cable) shall be spaced at a minimum of 300 mm apart.

9.2.5 Pilot cables, when they are routed separately from their associated power cables, may be run next to one another.

9.2.6 Cables shall not be buried on top of each other except where cable runs cross.

9.2.7 Where the cable cannot be laid down at the specified depth, prior authority shall be obtained from the Engineer by the Contractor to protect the cable by means of 150 mm diameter half round concrete pipes with 50 mm concrete slab coverings, or other approved methods.

9.2.8 Where cables have to be drawn around corners well lubricated skid plates shall be used. The skid plates shall be securely fixed and constantly examined during cable laying operations.

9.2.9 Suitable rollers may be used during the laying of cables.

9.2.10 Cables shall be visually inspected for damage during and after laying. Any damage shall be reported immediately to the Engineer who will issue the necessary instructions.

9.3 IN SLEEVE PIPES

9.3.1 All cables crossing beneath roads and pavements shall be enclosed in asbestos cement pipes with a minimum internal diameter of 150mm. The Engineer shall be advised timeously of the locations and quantity of pipes to be laid and chambers to be provided by others. Separate lengths of pipe shall be properly jointed.

9.3.2 Pipes shall maintain or exceed the specified cable spacing.

9.3.3 Only one High Voltage cable shall be laid per pipe.

9.3.4 Pipes shall extend at least 1 m on either side of the road- or pavement formations and shall maintain the specified cable depth. All pipes shall be graded for water drainage : the required grade is 1:400.

9.3.5 All cables crossings underneath railway tracks shall be in pipes in accordance with Chief Civil Engineer's drawing FG 263.

9.4 IN DUCTS AND BUILDINGS

9.4.1 Concrete ducts and pipes within buildings will be provided by others.

9.4.2 Before installing cables, the ducts are to be inspected to ensure that they are suitable and clean as not to damage the cables.

9.4.3 The cables are to be neatly positioned and cross overs are to be avoided.

9.4.4 Steel checker plates over ducts will be supplied by others. The tenderer will however be required to cut all the slots for emerging cables. These slots are to be neatly cut and smoothed to avoid damage to the cable.

9.4.5 The Contractor shall supply all cable trays, racks, wooden cleats or other supports required to adequately support cables not laid in ducts.

9.4.6 Cable trays or racks shall be of reinforced glass fibre or steel suitably treated to prevent corrosion, Steel trays, racks and other supports shall be galvanised in accordance with SABS 763 when used within 50 km of the sea or inland exposed conditions.

9.5 UNDER BRIDGES AND IN TUNNELS

9.5.1 Where a cable route can only be against the concrete wall of a bridge or tunnel the cable shall be supported on :

9.5.1.1 suitable brackets at 750 mm intervals.

or

9.5.1.2 straining wire secured at maximum 1 200 mm intervals.

9.5.2 Brackets shall be of robust design and shall be galvanised and painted in accordance with specification CEE.0045

9.5.3 The height of the cable route on the brackets or strain wire shall be determined and agreed upon on site.

9.5.4 The brackets or strain wire shall be supplied and installed by the contractor.

9.6 CROSSING OF PIPELINES AND OTHER CABLES

9.6.1 Cables shall pass beneath pipelines with a 300 mm minimum clearance between the top of any cable and the bottom of any oil pipe.

9.6.1.1 The level of any cable at an oil pipeline crossing shall be maintained for not less than 3 m on either side of the centre line of the pipeline or on either side of the centre line of the outermost pipelines where there is more than one pipeline on the same route.

9.6.2 Where cables cross communication or signal cables, at least 300 mm of fill shall be provided between the two cables. In addition a concrete slab in accordance with Spoornets drawing No. CEE 55/027367 shall be placed between the two cables parallel to the lower cable.

9.7 IN RAILWAY FORMATIONS

9.7.1 Cables to be accommodated in railway formations shall be laid in accordance with Chief Civil Engineer's drawing No. FG 263.

9.8 SECURED TO POLES

9.8.1 Cables to be terminated at disconnectors (isolators) mounted on wood, concrete or steel poles, shall be clamped onto such structures by means of stainless steel straps applied at such a tension that the cable or cable sheath is not damaged. Straps shall be located at intervals of not more than 1,2 m.

9.8.2 Cables shall be protected by a pipe or boxed section of galvanised steel or other approved material for a distance of 250 mm below and 600 mm above ground level, strapped or screwed to the pole at a minimum of two points and connected to the earth connection, if of steel construction.

9.8.3 Straps and pipes shall be supplied and installed by the Contractor.

9.9 EXPOSED CONDITIONS

9.9.1 Whenever cables enter buildings or tunnels, or where excavations are not permitted down banks or cuts, the exposed portion shall be suitably protected by means of concrete slabs, or suitable steel pipes or boxed sections which shall be galvanised in accordance with SABS 763.

9.9.2 These pipes or boxed sections shall be firmly secured to the bank or cut, at regular intervals.

9.9.3 All such material shall be supplied and installed by the Contractor.

9.9.4 Stake routes shall only be supplied when specifically called for in Appendix 1.

10.0 CABLE TERMINATIONS

10.1 General

10.1.1 All cables shall be terminated and connected to the respective equipment, whether provided by the Contractor or by others.

10.1.2 Jumpers between cable end boxes and disconnectors shall either be short enough to be rigidly self supporting, or shall be supported on suitably placed pin insulators.

10.1.3 Termination of cables on outdoor equipment shall not be done during inclement weather conditions.

10.1.4 Both ends of each cable shall be identified by means of embossed stainless steel strips clamped around the cables. The characters shall have a minimum height of 6 mm.

10.1.5 All materials necessary for cable termination shall be provided by the Contractor.

10.1.6 The contractor shall ensure that correct phase rotation is maintained throughout.

10.1.7 Glands of cables terminating on equipment provided with frame leakage protection shall be insulated from the frame by high grade non-deteriorating, non-hygroscopic insulation, at least 2 mm thick, capable of withstanding a test voltage of 4 kV DC for one minute.

10.2 HV Cables

10.2.1 The cable armouring shall be bonded with an approved copper bond to the cable end box at one end of the cable only as directed by the Engineer. This bond shall be easily removable for testing purposes.

10.2.2 Where for any reason a cable cannot be terminated, sufficient length of cable shall be left to reach the cable end box position. The cable shall be coiled and buried or otherwise protected, The cable end of paper insulated cables shall be capped immediately with a plumbed lead seal. Other cables shall be sealed with suitable tape.

10.3 LV Cables (and Pilot Cables)

10.3.1 All cut ends of cables are to be sealed with suitable tape, or other approved means until they are ready to be terminated.

10.3.2 The cables shall terminate in compression type glands, brass or bronze, suitable for PVC SWA ECC cables.

10.3.2.1 The glands shall be fitted with neoprene shrouds.

11.0 CABLE JOINTS

11.1 General

11.1.1 Jointing shall be carried out strictly in accordance with the manufacturer's jointing instructions and by artisans thoroughly experienced and competent in jointing the classes of cables used. They shall be adequately supervised to ensure the highest quality of workmanship.

11.1.2 Jointing shall not be carried out during inclement weather.

11.1.3 The cores of cables shall be jointed number to number or colour to colour.

11.1.4 The joints shall not impair the anti-electrolysis characteristics of the cables.

11.1.5 The conductor bridging the armouring shall be adequate to carry the prospective earth fault current.

11.1.6 A through joint shall only be permitted after every full drum length of cable.

11.1.7 Each cable joint shall be identified by a non-corrodible label fixed securely to the top of the joint. Each label shall have stamped on it, in characters having a minimum height of 10 mm, the identification of equipment at each end of the cable concerned.

11.1.8 Spoornet reserves the right to be present during jointing operations to familiarise themselves with any special techniques.

11.1.9 No joint shall be situated inside a cable pipe.

12.0 COVERING, BACKFILLING AND REINSTATEMENT

12.1 Filling of trenches shall not commence before the Engineer or his authorised representative has inspected and approved the cables and cable joints in situ in the section of trench concerned.

12.2 Trenches in railway formations shall be backfilled and reinstated in accordance with Spoornet's Chief Civil Engineer's drawing No. FG 263.

12.3 All other trenches shall be backfilled and reinstated as follows:

12.3.1 Two 75 mm thick layers of soil sifted through a 6 mm mesh shall be laid directly under and over the cables respectively and consolidated by hand ramming only.

12.3.1.1 Only soil with a thermal resistivity of 1,5 degrees C.m/watt, or lower may be used for this purpose.

12.3.1.2 When necessary imported fill shall be arranged by the Contractor and paid for at scheduled rates.

12.3.2 HV cables shall, where likely to be mechanically damaged as decided by the engineer, be protected by concrete slabs (to Drawing No. CEE 55/027367) to be supplied and laid by the Contractor on top of the sifted soil. These slabs shall be laid close-butted, convex end to concave end, directly above each HV cable throughout the underground portion except where otherwise protected as by pipes, etc. Only unbroken cable protection slabs may be used, and only slabs actually laid will be paid for.

12.3.3 The minimum dry densities of backfilling after compaction shall be not less than 1 600 kg/cubic metre.

12.3.4 All excavations made (whether for the purpose of cable laying, joint bays or trial holes) shall be back-filled in 150 mm layers, the earth in each layer being well rammed and consolidated and sufficient allowance being made for settlement. The back-filling shall be completed to the satisfaction of the Engineer. If necessary, water shall be used to obtain the specified compacted density. Any cable damaged during backfilling shall be replaced by the Contractor at his own expense.

12.3.4.1 Backfilling at pipe entries shall be such as not to stress or damage the cable during compaction from the top.

12.3.5 A continuous plastic cable warning tape, to drawing No. CEE-MA-307 shall be laid directly above each HV cable, 150 mm below the normal surface level and run for the full length of the cable before completing the back-filling.

12.4 The back filled trench shall be maintained in a thoroughly safe condition by the contractor for the duration of the contract.

12.5 All back filling of road crossings shall be mechanically rammed.

12.6 Final surfacing of roads shall be restored by others unless called for under "Scope of Work", Appendix 1.

12.7 Concrete cable route markers shall be provided and installed by the contractor in accordance with drawing CEE-PK-14.

12.8 Pipes shall be filled with a sand/water mixture to also have a thermal resistivity of 1,5 degrees C.m/watt or lower when dry. The sand used in the mixture shall be chemically tested not to be harmful to the cable outer sheath.

13.0 MEASUREMENTS

13.1 All measurements for payment purposes shall be made jointly by representatives of the Contractor and Spoornet and shall be agreed upon by both parties. The Contractor shall be responsible for obtaining the Engineer's signed approval of such measurements.

13.2 Measurements of cable length shall be made from centre to centre of cable joints and to the cable ends and will exclude any wastage due to jointing and terminating.

13.3 When cable is drawn through pipes, only the portion remaining in the pipe will be paid for at the rates quoted for "as installed in pipes".

13.4 Determination of trench volume for measurement purposes shall be based on measured length and specified width and depth. No allowance shall be made where trenches have to be widened at the bottom to accommodate cables, cable joints and protection slabs.

13.5 The classification of different types of ground for measurement purposes shall be as follows:

13.5.1 Soft rock will be taken as broken or friable rock which can be removed by pick or mechanical excavator or paving breaker. This includes hard clay.

13.5.2 Hard rock will be taken as rock which cannot be removed by a mechanical excavator and requires drilling and blasting or splitting. This includes reinforced or plain concrete.

14.0 TESTS

14.1 The costs of all post-installation tests shall be borne by the Contractor.

14.2 The Contractor shall be responsible for remedial work necessary due to damages caused during tests.

14.3 Spoornet reserves the right to carry out any further tests deemed necessary, using either the Contractor's instruments and equipment or its own, or both. The costs of such tests will not be charged to the Contractor.

14.4 Test instruments shall be of the accuracy class 1.0 or better in accordance with SABS 1229. Calibration certificates from a recognised testing authority shall be available for inspection and shall not be older than one year.

14.5 Time measurements shall be carried out using an approved digital timer.

14.6 The final commissioning site tests will be carried out by Spoornet.

14.6.1 A suitably qualified staff member of the Contractor shall assist Spoornet during the tests and shall carry out any remedial work where necessary.

14.7 The contractor shall notify the Engineer in writing 4 weeks before the commissioning date and shall have carried out the following site tests before such date :

14.7.1 Prove the continuity and insulation resistance of the multicore pilot cables.

14.7.2 Verify that the insulation level between frame and earth of switchboards fitted with frame leakage protection is not reduced by the installation of the cables.

14.7.3 The following voltage withstand tests on each completed cable run:

14.7.3.1 Paper insulated cables:

(i) rating up to 12,7/22 kV : test specified in paragraph D-3 of SABS 97.

(ii) rating 19/33 kV : test specified in paragraph B-3 of BS 6480, Part 1.

The extruded PVC impermeable serving shall withstand a test voltage of 10 kV DC between armouring and earth for 1 minute.

The insulation between armouring and lead sheath shall withstand a test v for 1 minute.

14.7.3.2 XLPE Insulated Cables:

All cables rated up to 19/33 kV shall be tested as specified in appendix E, clause 1.4, of SABS 1339, and cables rated up to 1,9/3,3 kV shall be tested as specified in appendix B, clause B.6, of BS 5467.

Note :

Where a new XLPE cable is to be joined to an existing XLPE Cable, the test shall differ, in that a 4 kV DC test voltage shall be applied for one minute between the brass screens of the cores and the armouring. The outer sheath shall withstand a test voltage of 10 kV DC for 1 minute between the armouring and earth.

14.7.4 PVC insulated cables shall be tested as specified in paragraph D-3 of SABS 150.

14.7.5 The Contractor shall submit three copies of certified test reports to the Engineer within three weeks after completion of the tests.

15.0 GUARANTEE

15.1 All work undertaken by the Contractor shall be subject to a guarantee for a period of one year against faulty and/or inferior workmanship and material.

15.2 The guarantee period shall commence the day the installation is formally handed over to and accepted by Spoornet.

15.3 The Contractor shall undertake to repair all faults or defects due to bad workmanship and/or faulty materials, and to replace all defective equipment or materials during the guarantee period.

15.4 Any defects that may become apparent during the guarantee period shall be rectified to the satisfaction of, and free of cost to Spoornet.

15.5 The Contractor shall undertake work on the rectification of any defects that may arise during the guarantee period within 7 days of his being notified by Spoornet of such defects.

15.6 Should the Contractor fail to comply with the requirements stipulated above, Spoornet shall be entitled to undertake the necessary repair work or effect replacement of defective apparatus or materials, and the Contract shall reimburse Spoornet the total cost of such repair or replacement, including the labour costs incurred in replacing defective material.

SCOPE OF WORK

1.0 Site inspection required/not required.

Date : .....

Time : .....

DRAWINGS

DRAWING NO.	TITLE
CEE 55/027367	Concrete slab, cable protection
CEE-PK-14	Route marker, cable, electrical.
CEE-MA-307	Tape, cable warning, underground
FG 263	Accommodation of cables in Railway formations.

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
1.0	Route surveys (clause 7.0)		complete		
2.0	Excavations in				
a)	Hard rock		/cubic metre		
b)	Soft rock		/cubic metre		
c)	Soil		/cubic metre		
3.0	Transportation of soil		/cubic metre		
4.0	Shuttering (clause 8.10)		/m		
5.0	Concrete slabs supplied and installed (clause 12.3.2)		each		
6.0	Plastic cable warning tape supplied and installed (clause 12.3.5)		/m		
7.0	150 mm dia. half round concrete pipes supplied and installed (clause 9.2.7.)		/m		
8.0	150 mm dia. asbestos cement pipes supplied and installed		/m		
9.0	Cutting of checker plates (clause 9.4.4)		/m cut		
10.0	Backfilling of trenches with soil (clause 12.3)		/cubic metre		
11.0	Backfilling of trenches with 10:1 soil/cement mix (clause 12.2)		/cubic metre		

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
12.0	Importation of soil		/cubic metre		
13.0	Concrete cable route markers		each		
14.0	Reinstate tarred surface		/cubic metre		
15.0	Reinstate concrete surface		/cubic metre		
16.0	Installation of cables				
16.1	Installed in trenches (Clause 9.2)				
16.1.1	High Voltage Cables		/m		
	240 mm sq 185 mm sq 120 mm sq 95 mm sq 16 mm sq Other sizes				
16.1.2	Low Voltage Cables		/m		
	..... core ..... mm sq ..... core ..... mm sq ..... core ..... mm sq ..... core ..... mm sq				
16.2	Installed in sleeve pipes (clause 9.3)				
16.2.1	High Voltage Cables		/m		
	240 mm sq 185 mm sq 120 mm sq 95 mm sq 16 mm sq Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
16.2.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
16.3	Installed in ducts (clause 9.4)				
16.3.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
16.3.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.0	Installation of cables (Special conditions)				
17.1	Cable supports (clause 9.4.5 and 9.4.6)				
17.1.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
17.1.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.2	Securing cables to poles (clause 9.8)				
17.2.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
17.2.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.3	Securing cables to concrete/tunnel walls				
17.3.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
17.3.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
17.4	Installation of cables in track formations				
17.4.1	High Voltage Cables		/m		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
17.4.2	Low Voltage Cables		/m		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
18.0	Cable terminations complete (Supply material, terminate and connect up).				
18.1	XLPE cable				
18.1.1	High Voltage terminations		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
18.1.2	Low Voltage terminations		each		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
18.2	PILC SWA cable				
18.2.1	High Voltage terminations		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
18.2.2	Low Voltage terminations		each		
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
	..... core ..... mm sq				
19.0	Cable joints complete (Supply material, terminate and connect up)				
19.1	PVC to PVC		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SCHEDULE OF ESTIMATED QUANTITIES AND UNIT RATES

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT RATE	TOTAL
19.2	XLPE to XLPE		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
19.3	PILC to PILC		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				
19.4	XLPE to PILC		each		
	240 mm sq				
	185 mm sq				
	120 mm sq				
	95 mm sq				
	16 mm sq				
	Other sizes				

SPOORNET

(INFRASTRUCTURE)(ELECTRICAL)

THIS ISSUE CANCELS SPECIFICATION NO. CEE.0166.95

INSULATING PADS, WASHERS AND BUSHES FOR TRACTION MAST BASES

This specification covers the supply of material for and the manufacture therefrom of insulating pads, washers and bushes required to insulate traction masts from mast foundations.

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1.0 **SCOPE**

This specification covers the supply of material for and the manufacture therefrom, of insulating pads, washers and bushes required to insulate traction masts from mast foundations.

2.0 **GENERAL INFORMATION**

This specification covers inter alia the manufacture and supply of insulating equipment to drawings specified by Spoornet. Whilst tenderers may offer material other than resin bonded woven glass fibre, Spoornet reserves the right to select the material or the type of resin which it considers will best meet the conditions encountered in service, bearing in mind that once the masts have been erected and under load, replacement, of the pads especially, is difficult and costly.

3.0 **REFERENCES**

3.1 The following publications and drawings are referred to herein :

3.1.1 British Standards Institute:

BS 3396 Part 1 and 3:	Woven Glass Fibre Fabrics for Plastics Reinforcement.
BS 5102	Phenolic Resin Bonded Paper Laminated Sheets for Electrical Applications.

3.1.2 Spoornet:

CEE.0012	Method of Tendering.

3.1.3 Nema:

GPO 1	Sheet Material.
G10 (LI-1-1989)	Tubes.

3.1.4 International Standards Organisation:

ISO 9000 Series:	Quality Systems: Quality Management and Quality Assurance Standards. Guidelines Selection and Use.

3.1.5 Drawings:

CEE-TU-143 Sheet 1-4.	Mast Base Insulation Component/Arrangements.

4.0 **METHOD OF TENDERING**

4.1 Tendering shall be in accordance with Spoornet Infrastructure (Electrical) Specification CEE.0012.
Complies/Does not comply

4.2 The technical data sheet (Appendix 1) shall be fully completed by tenderers. Failure to submit fully completed data sheet(s) may preclude a tenderer from further consideration.
Complies/Does not comply

5.0 APPENDIX

The following appendix forms an integral part of this specification.

Appendix 1: Technical Data Sheet.

6.0 **QUALITY ASSURANCE**

The manufacturer must indicate at the tendering stage what steps have been taken to implement a quality system in terms of ISO 9000. Preference shall be given to tenderers implementing a quality system to ISO 9000.

Complies/Does not comply

7.0 **COMPLIANCE**

Insulating equipment offered by the tenderer and accepted by Spoornet on the basis of the tender documents shall be supplied strictly in accordance with the requirements of the contract entered into between Spoornet and the successful tenderer. No changes or substitutes will be allowed without the written consent of Spoornet to such changes or substitutes.

Complies/Does not comply

8.0 **SERVICE CONDITIONS**

The insulating equipment offered shall operate satisfactorily under the following environmental conditions.

Altitude:	0 to 1800m above sea level.
Ambient temperature:	Minus 5 ^{0}C to plus 45 ^{0}C.
Relative humidity:	10 % to 90 %
Air pollution:	Heavy saline-laden and polluted by smoke and gases from locomotives and/or industrial sources.
Vibration:	Severe, train traffic in the immediate vicinity.

9.0 **PROCEDURE**

9.1 The traction masts have two 150 x 150 x 18mm mild steel angles forming the base of the mast which is bolted to the concrete foundation by means of four M36 steel bolts protruding from the concrete, as indicated in the tender documents.

9.1.1 The insulating pads are placed over the bolts between the concrete and the base angle while the bush is placed over the bolt to insulate it from the base angle. The washer is placed over the bolt above the base angle, under a steel washer and nut as shown on drawing CEE-TU-143 Sheet 1.

9.2 The maximum working compressive load on each of the two pads and on each of the two washers furthest away from the track is 80kN, due to the forces acting on the mast. In addition to these forces there is the compressive load resulting from tightening the nuts.

9.3 Whilst the top of the foundation is screeded to a reasonably smooth finish, imperfections and irregularities in the surface are prevalent and during erection of the mast, particles of grit and ash can be encountered around the bolts, all of which features are consistent with the practical difficulties arising during construction of this nature, and more especially when undertaken at night and/or during periods of track occupation when time is limited

9.4 In many cases the masts are lifted by crane and lowered on to their foundations, whilst in other cases, masts are raised by hand and man-handled on to the bolts with pads already in position.

9.5 The pads, washers and bushes have therefore to withstand the detrimental effects of all the above-mentioned conditions.

10.0 **TECHNICAL REQUIREMENTS**

10.1 The material from which the pads, bushes and washers are manufactured shall not flow, fracture or separate into laminae under the conditions stated above, nor shall it deteriorate, become brittle or curl at the edges. It shall have a low water absorption characteristic.
Complies/Does not comply

10.2 As the prime function of the items is to insulate traction masts from the concrete foundations and the bolts, the material shall also have a good electrical insulation value.
Complies/Does not comply

10.3 The material from which the pads, bushes and washers are to be manufactured shall be a glass fibre fabric, suitably bonded with synthetic resin.
Complies/Does not comply

10.4 The woven glass fibre fabric shall comply in all respects with BS 3396 Part 3, and shall have a fabric designation of P.2/11, or if mat glass fibre fabric is used it shall comply in all respects with Nema GPO 1.
Complies/Does not comply

10.5 Tenderers may offer glass fibre fabrics of construction differing from that for type P.2/11 provided that it is at least equivalent to this type, electrically and mechanically, and in such an event the tenderer shall submit the following information:-
Complies/Does not comply

10.5.1 Number of warp ends per 100mm.

10.5.2 Number of weft picks per 100mm.

10.5.3 The count of the warp yarn and the number of filaments per strand.

10.5.4 The count of the weft yarn and the number of filaments per strand.

10.5.5 The weave of the fabric offered.

10.5.6 The average mass per square metre.

10.5.7 The minimum average breaking strength for warp and weft.

10.5.8 The approximate thickness of the fabric.

10.6 The tolerances shall be the same as those given in table 1 of BS 3396 Part 1.
Complies/Does not comply

10.7 The glass fibre content of the material shall be not less than 50 % by volume.
Complies/Does not comply

10.8 The sheet material shall comply with all the non-optional clauses of BS 5102 for type 1 sheets.
Complies/Does not comply

10.9 The sheet material shall also comply with the optional requirements detailed in clause 3 of BS 5102.
Complies/Does not comply

10.10 The resin used shall be of one of the following types:-

Polyester, Epoxy, Phenolic or Melamine, the main requirement being that the material shall be the most satisfactory for the conditions of service as outlined in clauses 8 and 9 hereof. Tenderers shall comment on their choice of resin to be used.

Complies/Does not comply

10.11 Particular attention shall be given to the resin of the insulating pad to ensure that no alkaline reaction takes place between the concrete and the insulating pad.
Complies/Does not comply

10.12 The bushes shall be manufactured strictly in accordance with Nema G10 (LI-1-1989).
Complies/Does not comply

10.13 The pads, washers and bushes shall have smooth edges cleanly cut so as to resist water absorption and tracking, and shall in so far as dimensions are concerned, be strictly in accordance with drawings CEE-TU-143 Sheet 1-4.
Complies/Does not comply

10.14 Tenderers shall state in their tenders the method of manufacture of the three items from the basic material.
Complies/Does not comply

10.15 In the case of pads and washers, tenderers shall furnish the information called for on the technical data sheet (Appendix 1).
Complies/Does not comply

11.0 **INSPECTION AND TESTS**

11.1 All values of the properties for pads and washers stated on the technical data sheet shall have been determined in accordance with BS 5102 and, except for the water absorption figures, shall be applicable to material of nominal thickness 2,5mm for the pads and 4mm for the washers.
Complies/Does not comply

11.2 The water absorption shall be determined on actual finished pads, washers and bushes.
Complies/Does not comply

11.3 All tests on pads, washers and bushes shall be performed on "conditioned" samples.
Complies/Does not comply

11.4 Test certificates shall be submitted by the successful tenderer covering compliance of the woven glass fibre used with BS 3396 Part 3.
Complies/Does not comply

11.5 Test certificates shall also be submitted by the successful tenderer covering compliance of the tube material with Nema G10 (LI-1-1989).
Complies/Does not comply

11.6 Tenderers shall name the testing authority responsible for determining the properties of the materials which shall be detailed on the test certificates.
Complies/Does not comply

11.6.1 Should the tests be carried out by the tenderers themselves, full details of the test facilities available should be submitted with tenders.
Complies/Does not comply

11.7 Tenderers are required to submit with their tenders three samples each of the items offered in their final produced form to Spoornet drawings CEE-TU-143 Sheet 2-4 for M36 bolts, and in addition three sheets 300 x 300mm of the sheet material and three lengths of tubing 300mm long.

Complies/Does not comply

12.0 **PACKAGING AND MARKING**

12.1 The pads, washers and bushes shall be packed in suitable crates, boxes, cartons or other approved packing, so constructed as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the point of delivery, unless otherwise specified in the contract or order.

Complies/Does not comply

12.2 Each crate, box, carton or package shall be clearly marked with the following:

Contract no:

Manufacturer's name or symbol/logo.

Name and type of material.

Diameter, length and size of the pads, washers and bushes.

SPOORNET

Complies/Does not comply

TENDERER'S SIGNATURE……

DATE……

CHIEF ENGINEER (INFRASTRUCTURE)

(ELECTRICAL)

APPENDIX 1

TECHNICAL DATA SHEET

(To be completed by tenderers and submitted as part of their tender)

1.0 **PHYSICAL**

1.1 Percentage glass fibre by volume: _____(%)

1.2 Type of bonding resin: _____

1.3 Water absorption (after 24 hours)

Pad: _____(mg / gram)

Washer: _____(mg / gram)

Tube: _____(mg / gram)

1.4 Maximum working temperature: _____(^{0}C)

2.0 **MECHANICAL**

2.1 Resistance to compression (proof test, flat wise)
(clause 10.8) Percentage reduction in thickness: _____(%)

2.2 Shear strength: _____(Pa)

3.0 **ELECTRICAL**

3.1 Electric strength (proof test - normal to laminae): _____(kV/mm)

3.2 Insulation resistance: _____ (megohms)

4.0 **COMMENTS COVERING CHOICE OF RESIN (clause10.10)**

_____

_____

_____

5.0 **METHOD OF MANUFACTURE (clause 10.14)**

_____

_____

_____

TENDERER'S SIGNATURE .....

DATE .....

CHIEF ENGINEER (INFRASTRUCTURE)

(ELECTRICAL)