

2.7 SCOPE OF WORK

- a) The intercom scope was excluded during implementation of the Lethabo Smoke-Stack Lifts Upgrade Project. The hardwired telephone intercom has been provided with the lifts and it is not connected to EOD hence cabling is required to establish the interface.
- b) The *Contractor* shall procure, supply, pull and install two 10 pair armoured telephone cables that is required to comply with 240-64813568 standard for Indoor and Outdoor Telephone Cable.
- c) The *Contractor* pulls and run the first 10 pair armoured telephone cable from smoke-stack 2 lift PLC box to smoke stack 1 lift telephone PLC box. The second 10 pair armoured telephone cable is pulled from smoke stack 2 PLC box to the telecoms junction box in the OPCR switchgear room as shown on Figure 1 below.

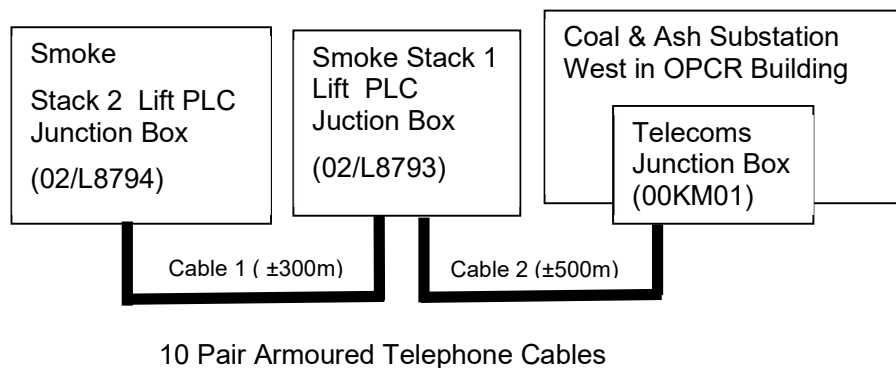


Figure 1: Cable Block Diagram

- d) The *Contractor* shall run the cables on the existing cable racks in the cable tunnels and leave a cable slack of 6m.
- e) The *Contractor* shall install new cable racks between the Smoke Stack lift PLC box and the existing cable racks in the cable tunnel.
- f) Termination of the cable to the PLC box shall be done by Eskom Telecoms technician not the *Contractor*.
- g) The estimated length of a cables is approximately 800m. The *Contractor* shall measure, fill the correct measurements in the cable schedule on Appendix C and submit the cable schedule to the *Employer* for approval prior the installation of cabling.

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3 REQUIREMENTS - TECHNICAL SPECIFICATIONS

3.1 CABLE REQUIREMENTS

3.1.1 Conductors

- a) Each conductor shall consist of annealed, electrolytic copper wire, smoothly drawn, approximately circular in section, uniform in quality, free from all defects and having a diameter in accordance with Table 1.

Table 1: Diameter of conductors and insulation thickness

DIAMETER OF THE CONDUCTOR (mm)			MINIMUM THICKNESS ON INSULATION (mm)	MAXIMUM OVERALL DIAMETER (mm)
NOM	MIN	MAX		
0.5	0.49	0.51	0.18	1.02

- b) The electrical resistance of the conductors shall comply with those quoted in Table 2 below

Table 2: Resistance of conductors at 20°C

DIAMETER OF THE CONDUCTOR (mm)			MAXIMUM AVERAGE RESISTANCE OF CONDUCTORS (Ω /km)
NOM	MIN	MAX	
0.5	0.49	0.51	90.31

- c) The conductors shall withstand the following elongation before fracture.
- 1) 15% for 0.5mm conductors
- d) Any joint in the conductor shall be made by a method approved by inspecting officer and shall fulfil the following conditions:

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- 1) The tensile strength of a 250 mm length of conductor containing a joint not to less than 90% of that similar sample of conductor without a joint.
- 2) The overall diameter of the conductor shall not be increased at a joint.

3.1.2 Insulation

3.1.2.1 Material

- a) The conductors shall be uniformly covered with insulating material consisting of coloured polyethylene. The polyethylene shall be compliant with SANS 1411-7, type PD1 Shrink Back Test.
- b) The conductor insulation shall not shrink back more than 6mm overall or more than 4mm from either end of the sample cable, when subjected to 100°C for 24 hours.

3.1.2.2 Thickness

- a) Insulation shall be applied concentrically around the conductor and shall fit closely thereto.

3.1.2.3 Colours of Insulation

- a) The colours shall be in accordance with SANS 1091 National colour standard
- b) Slight deviation from the colour standards defined in SANS 1091 shall not constitute grounds for rejection provided the colours are easily identifiable.
- c) The insulation of each conductor shall be colour coded in accordance to Table 3 below.

Table 3 :Colour Code for Cables

PAIR	PAIR INSULATION COLOUR	
NUMBER	A	B
1	Blue	White
2	Orange	White
3	Green	White
4	Brown	White
5	Grey	White
6	Blue	Red
7	Orange	Red
8	Green	Red

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9	Brown	Red
10	Grey	Red

3.1.3 Twinning

- a) Two insulated conductors shall be uniformly twisted together. The twist length of a pair shall not be greater than 100mm for 0.5mm diameter conductor cable.
- b) The twisting of cable pairs shall be such that cross-talk-attenuation between any two unscreened pairs of a cable shall be greater than 50 dB/km at audio frequencies (300-3400Hz).

3.1.4 Stranding of Cables

- a) Two insulated conductors shall be uniformly twisted together. The twist length of a pair shall not be greater than 100mm for 0.5mm conductor cable.
- b) The twisting of cable pairs shall be such that cross-talk-attenuation between any two unscreened pairs of a cable shall be greater than 50 dB/km at audio frequencies (300-3400Hz).

3.1.5 Tape Lapping of Cables

- a) The cable core shall be covered with lapping of suitable paper to provide at least two layers at any point.
- b) There shall be no adhesion between the core covering and the conductor insulation and no softening of the insulation on the conductors shall occur during the sheathing process.

3.1.6 Screen Moisture Barrier

- a) The cable core shall be completely covered with aluminium foil coated on one side with polyethylene applied longitudinally and with an overlap of not less than 6mm. Where the specified overall diameter of the cable sheath is 25mm or less, the minimum overlap shall be 3mm. The polyethylene coating shall be outside.
- b) The nominal thickness of the Aluminium / Polyethylene Laminate film shall be 0.15mm and 0.04mm respectively.

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- c) The peel strength of polyethylene from the aluminium shall not be less than 0.25 N/mm width of the foil when tested.

3.1.7 Identification

- a) The number of pairs conductor size, manufacturers name and the year of manufacture shall be clearly embossed or indelibly marked on the outer sheath of the cable. Alternatively, a tape bearing the information shall be run under the sheath of the cable. Such information shall be repeated at least once every 350mm.

3.1.8 Amouring

- a) The nominal diameter of the wire is specified in Table 4 below:

Table 4: Physical Demensions of Armoured Cables

Cable Pairage	10
Nominal conductor diameter (mm)	0.5
Minimal Sheath Thickness (mm)	1
Nominal Overall Cable Diameter (mm)	15
Nominal diameter of steel wire armouring (mm)	0.9

3.1.9 Sheath

- a) All cables sheath and bedding where applicable, shall be of halogen-free, low smoke and flame retardant compounds to SANS 1411-1,4&5.
- b) Alternatively the bedding shall be general purpose PVC and the sheath shall be flame retardant PVC to SANS 1507.
- c) The sheath shall form a smooth surfaced close fitting tube, approximately circular in shape free from pin holes and any other defects. Ovality shall not be the difference between the maximum and minimum diameters at the same cross section expressed as a percentage of the minimum diameter.
- d) The sheath shall be applied in such a manner that no undue residual strain is left in the material. There shall be no adhesion between and the conductor insulation.

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3.2 TESTING AND COMMISSIONING OF CABLES

3.2.1 TYPE TESTS

General

- a) The armoured telephone cables supplied in this specification must be tested at the *works* as detailed in SANS 1507-6 as minimum requirement. Eskom will however, accept standard European or American test methods on imported cable if evidence provided indicates that these are equal to, or more stringent, than the test specified.
- b) In view of the above requirements, all details of the manufacture's intended "Type", "Sample" and "Routine" tests are to be supplied with the tender documentation.
- c) The *Contractor* indicates in Schedule B the specific tests performed on the cables and shall provide type test certificates before the first delivery of cables.

3.2.1.1 Diameter of Wires

- a) The diameter of wire forming the conductor shall be taken as an average of not fewer than six measurements made at random on a representative piece of wire 300mm long. A method of measurement giving an accuracy of not less than 0.0025mm shall be used.

3.2.1.2 Conductor Resistance

- a) The DC resistance shall be measured at room temperature, care being taken that at commencement of test the samples and reference standard have same temperature as the surrounding air. The measurement shall be carried out to an accuracy of within 0,5%. The length of conductor and method of testing shall be adequate to provide the accuracy required.

3.2.1.3 Conductor Elongation before fracture

- a) Samples of conductor, 250mm long taken from a completed cable shall when slowly and steadily stretched at a rate of 50mm/min give an elongation before fracture of 15% for 0.5 mm cables and 20% for 0.63mm and 0.9 mm cables .

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3.2.1.4 Thickness of insulation

- a) The *Contractor* shall measure the thickness of insulation at three or more sections along the length of a representative sample of the PE insulated conductor 300mm long , and taken not less than 300mm from the end of a factory.
- b) This measurement shall be made by taking two measurements on each of the two diameter at right angles to one another through the centre of the conductor i.e. at least 12 individual measurements shall be taken on the sample.
- c) A method of measurement capable of reading accurately to 0.025 shall be used.
- d) No reading shall fall below the specified minimum in Table 1 (Diameter of conductors and Insulation thickness).
- e) The thickness of sheathing shall be measured by the same method except that the measurement shall be taken at those points of a section where the sheath thickness is at its geometrical minimum.
- f) No reading shall fall below the specified minimum in Table 4 (Physical Dimensions of Armoured Cables).

3.2.1.5 High Voltage Test

- a) A voltage of 2000 V RMS at a frequency of 50Hz, or 3000V DC shall be applied between each conductor in the cable and the remaining conductors bunched and earthed. The voltage shall be applied gradually and maintained at the full value for one minute without breakdown

3.2.1.6 Insulation Resistance

- a) Sample lengths (10 m or longer) of insulated conductor shall be immersed in tap water for at least one hour. The after 500V DC shall be applied between the conductor and water. After steady electrification for one minute the insulation resistance shall not be less than 37.5 MΩ per 1000m at 20°C.

3.2.1.7 Shrink Back Test

- a) Sample lengths of insulated wires shall be selected, at random, from a multi-conductor cable or from rolls of a wire and cut to length of 150mm. These lengths shall be placed in a convection type circulating oven at -100°C for 24 hours.

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- b) The total shrink back of insulation after cooling, as represented by the sum of the lengths of bare conductor protruding from the insulation at each end, shall not exceed 6mm and the length of bare conductor at either end shall not exceed 4mm. In addition shall have no visible signs of cracking.

3.2.1.8 Spark Test

- a) Conductors shall be spark tested after insulation in accordance with SANS 1507-6 or an approved alternative method at 3W AC or 5W DC.

3.2.1.9 Capacitive Unbalance

- a) Unless otherwise specified the capacitive unbalance between pairs in the cable measured at audio frequency and corrected in accordance with this sub-clause, shall not exceed 400pF per 500m.
- b) The measured values shall be corrected as follows :lengths less than 100m being considered as 100m. The measured values shall be divided by X if shorter than 500m and multiplied by X if longer than 500m.

3.2.1.10 Continuity of Moisture Barrier

- a) The moisture barrier shall be electrically tested for continuity and its resistance recorded in Ω/km .

3.2.1.11 Sheath Spark Test

- a) The sheath shall be spark tested in accordance with SANS 1507-6 or any other approved alternative method at 2kV AC or 1Kv DC.

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3.2.1.12 Type Tests Table

- a) All type tests must be performed in accordance with Table 5 below,

Table 5: Type Tests

COMPONENT	TEST PROPERTY	REFERENCE
Conductor	Elongation at break	According to SANS 6282-3 Section 2.Elongation at break of wire
Insulation	Physical properties	According to SANS 1411-2: Polyvinyl chloride (PVC)
Insulation	Spark test	According to SANS 62230
Sheath	Physical properties	According to SANS 1411-2: Polyvinyl chloride (PVC)
Finished Cable	Voltage withstand	According to SANS 6284-3

3.2.1.13 Test Certificates

- a) Records of all type and routine tests shall be available for inspection by Eskom's representative at any time during the contract period. Test results are to be kept by supplier for a period of 5 years after expiry of contract.
- b) Where cables are to SANS specifications, the SANS specification should be embossed on the cable and SANS mark should be imprinted on the cable drum.

3.2.2 Witnessing of Tests

- a) Eskom reserves the right to appoint a representative to inspect the cable at any stage of manufacture or to be present at any time that tests are performed.
- b) If witnessed type tests apply, the samples must be selected according to the procedure detailed in SANS 1507-6. Such inspection shall not prevent the subsequent rejection if goods are later found to be defective

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3.2.3 Samples

- a) Eskom requires samples of cables together with test data to be submitted with a tender.

3.2.4 PACKAGING

- a) Cables shall be supplied in drum lengths of 500m unless otherwise indicated. All cables shall be marked with the following:
- Eskom order number.
 - Eskom cable code and specification to which the cable is manufactured.
 - Gross mass of drum and cable in kilograms.
 - The words "Not to be laid flat" shall be written visibly on the drum.
 - The name of the manufacturer and Trade mark.
 - Arrow indicating the correct direction of rolling.
 - The length of the cable.

3.2.5 DELIVERY

- a) The equipment shall be delivered to the destination stated in the enquiry document
- b) The delivery dates to site shall be indicated in the relevant schedule of the enquiry document
- c) The equipment shall be protectively packed in such a way that it can be safely transported handled and stored at site, as it will not necessarily be possible for installation to commence immediately upon delivery.
- d) Attention is drawn to the fact that Eskom will not accept delivery at the specified destination only, and that the supplier shall make all necessary arrangements for acceptance, off loading and trans-shipping at all intermediate points, as well as the ultimate off-loading at the specified destination.

3.2.6 SITE TESTS

- a) All tests shall be in accordance to SANS 1507 and other relevant standards.
- b) Testing and Commissioning of cables shall be done by *Contractor* and witnessed by the commissioning team.

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- c) The commissioning team comprises of the the *Contractor*, Eskom C&I engineer, Thole Lift Technician and Eskom Telecoms Technician.
- d) The Eskom C&I Engineer shall have the right to call for or to carry out any additional tests, which may be necessary to prove that the requirements of the specification have been met. The *Contractor* shall assist with the conducting of these tests without delay.

4 COMMON REQUIREMENTS

4.1 DOCUMENTATION

- a) The *Contractor* shall furnish Eskom with the following following product documentation:
 - Cable specification.
 - Cable construction details.

4.1.1 Drawings

- a) The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of 240-86973501 (Engineering Drawing Standards – Common Requirements) to be supplied as part of the enquiry documents. All drawings must be issued to Eskom in both native CADD format (.dwg/.dgn) and PDF format as per 240-86973501 (Engineering Drawing Standards – Common Requirements).
- b) *Contractor* shall fully complete and certify drawings for compliance with the Contract requirements. Drawings shall have title block entries that clearly indicate the drawing is certified.
- c) Each submitted drawing shall be project unique and shall be clearly marked with the name of the project, *Employer's* Contract title, *Employer's* Contract file number, project equipment or structure nomenclature, component identification numbers, and *Employer's* name.
- d) The project name shall be listed on all drawings, including manufacturers' drawings. Tag numbers and equipment names shall be listed on all manufacturers' drawings.
- e) The language of all documentation shall be in the English language. The units of measure shall be metric.

4.1.2 Drawing Submittal

- a) All documents and records management will be performed according to Project/Plant Specific Documents and Records Procedure. Any uncertainty regarding this should be clarified with the

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Employer. The *Contractor* shall comply with all minimum document metadata as specified in Technical Documentation Classification and Designation Standard (240-54179170).

- b) Transmittal letters shall be provided with each document submittal. The transmittal letter shall include the *Contractor* drawing number, revision number, and title for each drawing attached. Each drawing title shall be unique and shall be descriptive of the specific drawing content.
- c) Catalog pages are not acceptable, except as drawings for standard non engineered products and when the catalog pages provide all dimensional data, all external termination data, and mounting data. The catalog page shall be submitted with a typed cover page clearly indicating the name of the project, unit designation, specification title, specification number, component identification numbers, model number, *Contractor* drawing number, and *Employer's* name. Drawings shall be submitted with all numerical values in metric units.

4.1.3 Documentation Requirements

- a) All documents supplied by the *Contractor* shall be subject to Eskom's approval. For consistency, it is important that all documents used within the project follow the same layout, style and formatting as described in the Technical Documents and Records Management Work Instruction (240-53114186).
- b) Documents such as QCP's, Method Statements and other documents impacting the work shall be approved by the *Employer* at least 3 working days prior to commencement of the Works.
- c) Each revision of a document or drawing shall be accompanied with a list of the comments made by the *Employer* on the previous revision if applicable and the response/corrective action taken by the *Contractor*. Changes shall be recorded in a revision table contained in each drawing/document.
- d) Documents and drawings shall indicate the *Employer's* number as allocated by the *Employer*. The *Contractor* may have his own internal document or drawing number on the document or drawing, but where reference is made among documents, the *Employer's* number shall be used as the reference number.
- e) The *Contractor* shall compile a complete data book for all work done during manufacturing, construction and commission containing the following as a minimum if applicable:
 - Approved "As built" drawings
 - Approved QCP / ITP
 - Inspection reports

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- The manufacturer's certificate.

4.1.4 Data Books

- a) The *Contractor* compiles data Books progressively for all manufacturing and construction/erection inspection, and test records and documents pertaining to the new 10 pair armoured telephone cables. The *Contractor* submits data books to the *Employer* for their review for all Plant and Materials and work undertaken with the applicable requirements and specifications.

4.2 GENERAL REQUIREMENTS

- a) The *Contractor* shall include the *Employer's* drawing number in the drawing title block. This requirement only applies to design drawings developed by the *Contractor* and his Sub-*Contractors*. It shall not apply to drawings developed by manufacturers for equipment and material such as valves, instruments, etc. Drawing numbers shall be assigned by the *Employer* as drawings are developed.
- b) The project name shall be listed on all drawings, including manufacturers' drawings. A separate sheet may be attached to the submittal if needed to adequately list all tag numbers associated with the drawings such as valves or instruments which may have numerous tag numbers associated with it.
- c) The language of all documentation shall be in the English language. The units of measure shall be metric.

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4.3 PLANT IDENTIFICATION

4.3.1 Identification of Cable Types

- a) Cable types shall be identified by means of seven character code, details of which are set out in drawing 0.00/1744 see Appendix A.
- b) The **first** character is “**T**” denotes the cable type as telephone, the **second** character is “**Q**” denotes the conductor insulation is coloured Polyethylene, the **third** character is “**H**” denotes construction of pair overall screened, the **fourth** character is “**10**” denotes the number of pairs, the **fifth** character is “**A**” denotes the conductor diameter of 0.5mm, the **sixth** character is “**C**” denotes the conductor material which is stranded copper and the last character is “**X**” which denotes the cable finish/protection which is steel wire armoured PVC sheathed.
- c) The copper conductors shall be of stranded or solid construction and annealed to the requirements of SANS1507. A minimum of seven strands shall be used on all core cables.
- d) The conductor insulation shall be flexible grade PVC as detailed on SANS 1507, of thickness to withstand the spark test specified.

4.3.2 Plant Labelling

- a) It is the responsibility of the *Contractor* to manufacture and install coded labels. Labels are manufactured and installed according to Plant Labelling standard (240-71432150).
- b) The *Contractor* will label the new 10 pair armoured telephone cables with coded labels.
- c) The Coding technician will do a quality check on the adherence to the Coding and labelling standards before installation on plant.

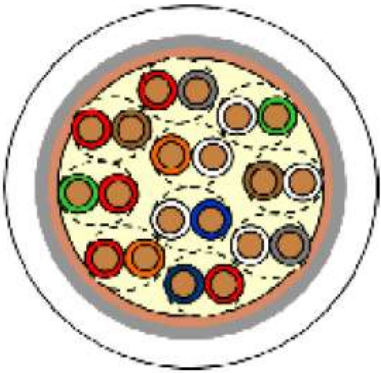
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10 APPENDIX B: COMPLIANCE SCHEDULE A&B

-		- TENDERER TO PLEASE COMPLETE SCHEDULE B	
- Item	- Description	- Requirement (Schedule A)	- Schedule B
- 1	- Conductors - -Wire	- Annealed, Circular, Electrolytic Copper	-
-	- -Diameter Tolerance	- 0.5mm - 0.49/ 0.51	-
-	- -Maximum Electrical Resistance	- 0.5mm – 90,31 ohm/km	-
-	- -Maximum Elogation before Fracture	- 0.5mm – 15%	-
- 2.	- Conductor Insulation - -Material	- Coloured Polyethylene	-
-	- -Minimum Thickness of Insulation	- 0.5mm – 0,18mm -	-
-	- -Maximum tolerated shrink back when subjected to 100 degrees Celsius for 24 hours	- 6mm overall, less than 4mm per end	-
-	- -Maximum force required to strip insulation from conductor	- 0.5mm – 17.7 N -	-
- 3.	- Conductor Twinning - -Twist	- 0.5mm – <100mm -	-
-	- -Crosstalk Attenuation	- > 50 db/km at audio -	-
-	- -Maximum capacitive unbalance	- 400Pf per 500m -	-
-	- -Pair Insulation Colour	- Pair 1 - Blue/White	-

**Lethabo Power Station Installation of 10 Paired
Armoured Telephone Cabling for Smoke Stack Lifts
Intercom System Scope of Work**

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	<ul style="list-style-type: none"> - Pair 2 -Orange/White - Pair 3 - Green/White - Pair 4 - Brown/White - Pair 5 -Grey/White - Pair 6 –Blue/Red - Pair 7 –Orange/Red - Pair 8 –Grey/Red - Pair 9 –Brown/Red - Pair 10 – Grey/Red 	<ul style="list-style-type: none"> - - - - - - - - - -
<ul style="list-style-type: none"> - 4 - Stranding of Cables - Ten pairs and below 	<ul style="list-style-type: none"> - Single Unit 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - 5. - Tape Lapping of Cables - Material 	<ul style="list-style-type: none"> - - Paper 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - 6. - Aluminium/Polyethylene Laminate - -Nominal thickness 	<ul style="list-style-type: none"> - 0.15mm – Aluminium - 0.04mm – PE 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - - Construction 	<ul style="list-style-type: none"> - Aluminium on inside 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - - Overlap 	<ul style="list-style-type: none"> - 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - - Cables< 25mm diam - Cables> 25mm diam 	<ul style="list-style-type: none"> - 3mm - 6mm 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - 7 - Identification of Cables - -Information required on outer Sheath 	<ul style="list-style-type: none"> - - Number of pairs - -Conductor size - -Manufacturer - -Year of manufacture 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - - Identification marks repeated 	<ul style="list-style-type: none"> - Every 350mm or less 	<ul style="list-style-type: none"> -
<ul style="list-style-type: none"> - 8 - Sheath 	<ul style="list-style-type: none"> - Steel Wire Armoured PVC 	<ul style="list-style-type: none"> -

**Lethabo Power Station Installation of 10 Paired
Armoured Telephone Cabling for Smoke Stack Lifts
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-	-Material	Sheath	
-	-HV spark withstand capability	- 2kV AC or 1kV DC	-
-	-Internal pressure test	- 100kPa for 3hours	-
-	-No ripple or damage to sheath and moisture barrier when cable bent	- For at least one turn at 15 x diameter	-
-	-Water vapour permeation rate	- < 0.13 Dg/100mm/week	-
-	-Colour	- Black Armoured	-
-	-Minimum thickness - (Armoured cable thickness in brackets)	10 Pair - 0.7mm (1.0)	-
- 9	- Armouring of Cables - Material	- - Galvanised Steel Wire	-
-	-Nominal diameter of wire	- 10 pair 0.5mm	-
- 10	- Drumming and Sealing of Cables	-	-
-	- Cables shall be supplied in drum length of 500m.All cables shall be marked with the following:	-	-
- 10.1	- Eskom Order number	- YES/NO	-
- 10.2	- Eskom Cable Code and Spec to which cable is manufactured	- YES/NO	-
- 10.3	- Gross mass of drum and cable in kilograms	- YES/NO	-
- 10.4	- The words "Not to be laid flat" shall be written visibly on the drum	- YES/NO	-
- 10.5	- Sling with bar through centre of drum	- YES/NO	-
- 10.6	- Name of Manufacturer	- YES/NO	-
- 10.7	- Indication of rolling direction	- YES/NO	-
- 10.8	- Cable length	- YES/NO	-

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