

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-ELT-G00-EC-0019	Contract No. 66-6695
	TECHNICAL SPECIFICATIONS – LOW VOLTAGE CABLES			 नेपाल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
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<p>tkIS India / Vendor</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-submitted after revision. This drawing should be revised only to the extent of tkIS India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.</p> <p>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</p> <p>Date : ___/___/___ Name : _____</p>	<p>tkIS India / Owner / Client</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input checked="" type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Date : ___/___/___ Name : _____</p>
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INDEX SHEET

The document Cover Sheet indicates revisions made in this document along with the purpose of issue of the revised document. The details of revisions made in the enclosures of this document are listed in the table of *Contents* below and the enclosures listed therein are an integral part of this document.

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	LOW VOLTAGE CABLES Part-I - General Specifications			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.	
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1.0 INTRODUCTION

This specification is intended to cover general requirements of manufacture, testing, inspection and despatch for **Low Voltage power, control, lighting and earthing cables** for working voltages up to and including 1100V.

Design, manufacturing, testing and performance of Low Voltage Cables shall comply with all currently applicable Indian & IEC Standards and specific Standards & Codes specified under clause 'Codes' of Part-II of this specification.

Scope of supply and services covered under this specification shall be as per various parts of this specification. Standard and descriptive requirement is covered in Part-I while specific requirement is covered in Part-II. Requirements for testing at vendor's works are covered in Part-III.

2.0 GENERAL REQUIREMENTS

2.1 Conductor

The conductor shall be uniform, solid/ stranded, electrical grade aluminium/ copper as specified in Part-II.

2.2 Core Identification

For twin, three and multi-core cables (up to 5 cores), core identification shall be by different colors of PVC/ XLPE insulation as specified in relevant IS. For multicore cables having more than 5 cores, core identification shall be done by numbers. In this case, insulation of cores shall be of same colour and numbered sequentially starting by number 1 in the inner layer. For neutral conductor the core shall have number '0'.

2.3 Insulation

Conductor insulation shall be extruded PVC/ XLPE as specified in Part-II.

2.4 Inner Sheath

In case of multicore cables, extruded PVC inner sheath, as specified in Part-II, shall be applied over laid up cores.

Single core cables shall have no inner sheath.

2.5 Armouring

Armouring shall be provided for single/ multicore cables as specified in Part-II.

For multicore cables, armour type shall be galvanized round steel wire armour in case calculated diameter below armouring does not exceed 13 mm and galvanized steel formed wires/ strip armour in case calculated diameter below armouring is greater than 13 mm.

For single core cables armour shall be made up of hard-drawn aluminium round wire armour.

2.6 Outer Sheath

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PVC outer sheath shall be applied by extrusion over the insulation/ armour/ inner sheath as per relevant IS. Material & colour shall be as specified in Part-II. Suitable chemicals shall be added into the PVC compound of outer sheet to protect the cable against the rodent & termite attack. The outer sheath shall be embossed or printed with the following details at intervals as specified in Part-II:

- a. No. of cores and size of cable.
- b. Manufacturer's identification.
- c. Year of manufacture.
- d. Voltage grade.
- e. Length marking by embossing or printing (every one meter or as specified in Part-II).

2.7 Fire Retardant Properties

Cables shall have Fire Retardant Low Smoke (FRLS) properties as specified in Part-II.

3.0 FACTORY ACCEPTANCE TEST AND DESPATCH

Inspection & testing shall be carried out based on latest revision of this specification released for manufacture (order specification). LSTK Contractor/Owner/Consultant shall have the right to carry out stage inspection and shop visit to review the manufacturing progress. However, manufacturer need not hold any of the manufacturing activity for witnessing of stage inspection by LSTK Contractor/Owner/Consultant .

Tests as specified in Part-III of this specification shall be carried out during final inspection. A minimum fifteen days advance notice shall be given for witnessing final inspection.

Vendor/LSTK Contractor shall ensure that all meters and associated testing equipment are calibrated by an authorized testing laboratory and the calibration certificates are valid at the time of carrying out the testing of material.

After successful completion of inspection and testing, Vendor/LSTK Contractor shall furnish all as-built documents in required number of sets. Only after receipt of final documents , the release order for dispatch of material will be issued.

The cable shall be wound on a wooden drum, ends sealed and packed as specified in relevant standards. The cable drum shall carry the following information either stenciled on the drum or contained in a label attached to it:

- a. Reference to the relevant standards.
- b. Manufacturer's name or trade mark.
- c. Type of cable and voltage grade.
- d. Number of cores.
- e. Nominal cross-sectional area of conductor.
- f. Cable code.
- g. Length of cable on the drum.
- h. Number of lengths on the drum (if more than one).
- i. Direction of rotation of drum (by means of an arrow).
- j. Gross weight.
- k. Country of manufacture.
- l. Year of manufacture.

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4.0 GUARANTEE

The technical particulars for cables furnished in Part-II shall be guaranteed within the tolerance specified or as permitted by relevant standards. In case of failure of the equipment to meet the guaranteed performance, the LSTK Contractor/Owner reserves the right to reject the cables. If any of the cables supplied by the Vendor/LSTK Contractor fails at site during erection, commissioning or service (within guarantee period) the Vendor/LSTK Contractor shall replace the failed material within the time frame agreed with the Owner and at no extra cost to the Owner . The Owner also reserves the right to use rejected material till it is replaced.

The period of guarantee of the equipment shall be as per the agreed “Commercial Terms & Conditions”.

 नालको NALCO नेशनल एल्युमिनियम कंपनी लिमिटेड National Aluminium Company Ltd.		LOW VOLTAGE CABLES		Code		NAL	
				Contract no.		66-6695	
 thyssenkrupp		PART - II DESIGN DATA SHEET		Doc.		6695-ELT-G00-EC-0019	
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GENERAL	001	Make	: As per Vendor list - Electrical				
	002	Voltage Grade	: 1100 volts				
	003	Quantity	: *				
	004	Tolerance (on overall length for a particular size/ type)	: 1%				
	005	Tolerance (on drum length)	: + 2% (no negative tolerance)				
	006						
CODES & STANDARDS	007	IS-8130 : Specification for conductors for insulated electric cables and flexibles cords					
	008	IS-5831 : Specification for PVC insulation & sheath of electric cables					
	009	IS-7098 : Specification for cross linked polyethylene insulated PVC sheathed cables Part 1: for working voltage up to and including 1100 V					
	010	IS-1554 : Specification for PVC insulated (heavy duty) electric cables Part 1: for working voltages up to and including 1100 V					
	011	IS-3975 : Specification for low carbon galvanised steel wires, formed wires and tapes for armouring of cables					
	012	IS-10810 : Methods of test for cables					
	013	IS-10418 : Specification for drums for electric cables					
	014	CEA Regulations					
	015	Fire Insurance Authority Regulations					
CONSTRUCTION	016	Conductor					
	017	Material	: Al / Cu				
	018	Aluminium Conductor details					
		a) Type	: Circular/ sector shaped				*
		b) Grade	: H2 / H4				*
		c) Class	: Class 2 (Stranded) as per IS 8130				
		d) Stranded Conductor	: 6 mm ² and above (Power cables)				
		e) Solid Conductor	: NA				
	019	Copper Conductor details					
		a) Type	: Circular/ sector shaped				*
		b) Class	: Class 1 (Solid) / Class 2 (Stranded) as per IS 8130				
		c) Stranded Conductor	: 2.5 sq. mm and 4 sq.mm (Power & Control cables)				
		d) Solid Conductor	: 2.5 sq. mm for Lighting cables				
		e) Tin coating required	: No				
	020	Insulation					
		Type	: XLPE For Power & Lighting cables / PVC for Control cables				
	021	Extruded					
	022	Conductor Temperature					
		a) Rated	: 90 ⁰ C (XLPE) / 70 ⁰ C (PVC)				
		b) During short circuit	: 250 ⁰ C (XLPE) / 160 ⁰ C (PVC)				
023	Inner sheath						
	a) Material	: PVC Type ST1 for PVC cables					
		: PVC Type ST2 for XLPE cables					
	b) Type	: Extruded					
	c) Colour	: Black					
024							

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CONSTRUCTION	025	Armour					
	026	Single core cables					
		a) To be provided	:	Yes			
		b) Material	:	Aluminium			
		c) Type	:	Single layer round wire armour			
	027	Multi core cables					
		a) To be provided	:	Yes			
		b) Material	:	Galvanised steel			
		c) Type	:	Single layer round wire/ flat strip as			
				per cl. 2.5 of Part-I			
	028	Outer Sheath					
		a) Material	:	PVC Type ST1 for PVC cables			
			:	PVC Type ST2 for XLPE cables			
		b) Type	:	Extruded			
		c) Colour	:				
		i) For single core power cables	:	Black			
		ii) For single core earthing cables	:	Yellow-Green			
		iii) For twin, three & multicore cables	:	Black			
	d) Embossment / Printing interval	:	Every 1 m				
	e) Special requirements for outer sheath to suit						
	chemicals or fumes handled in plant	:	Yes				
	f) Anti-rodent and Anti-termite	:	Yes				
	g) UV rated	:	Yes				
029							
FRLS/FR DATA	030	Fire retardant properties					
		i) Fire retardant low smoke (FRLS)	:	Yes			
	031	FRLS / FR Data					
		a) Minimum oxygen index	:	29 at 27±2°C			
		b) Minimum Temperature index	:	21 at 250°C			
	032	Data for FRLS cables only					
		a) Maximum acid gas generation	:	20 % by weight			
	b) Smoke density rating	:	60% maximum				
	e) Light transmittance (Incase OISD compliance required)	:	>60%				

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 thyssenkrupp		PART - III INSPECTION TEST PLAN			Contract no.		66-6695				
		Reference documents		Sample Size		Doc.		6695-ELT-G00-EC-0019			
		Vendor		Owner / Consultant / LSTK Contractor		Rev.		00 Page 2 OF 3			
Sr. No.		Tests		Reference documents		Sample Size		Scope of Inspection			
B)		Routine Tests									
a)	Conductor Resistance Test		IS 1554, IS 7098, IEC 60502		100%		P		W		
b)	High Voltage test at room temperature		-do-				P		W		
c)	Visual Inspection of drum details, size, marking on end cappings/ outer sheath, Colour coding etc.		-do-				P		W		
d)	Dimensional checks - OD, conductor, insulation, sheath, armour etc.		-do-				P		W		
D)		Acceptance Tests									
a)	Dimensional checks - overall, individual cable part & under armour		IS 1554, IS 7098, IEC 60502		IS 1554/ IS 7098 as applicable		P		W		
b)	Visual Inspection of drum details, size, marking on end cappings/ outer sheath, Colour coding etc.		-do-		100% for drum details and sample drum for balance details		P		W		
c)		Tests on Conductor									
i	Annealing test (for Copper)		IS 1554, IS 7098		IS 1554/ IS 7098 as applicable		P		W		
ii	Tensile Test (for Aluminium)		-do-				P		W		See Note 1
iii	Wrapping test (for Aluminium)		-do-				P		W		See Note 1
iv	Conductor resistance test		-do-				P		W		
d)		Test for PVC insulation & sheath									
i	Test for thickness of insu. & sheath		IS 1554, IS 7098		IS 1554 / IS 7098 as applicable		P		W		
ii	Tensile strength & elongation at break of insulation & sheath		-do-				P		W		
iii	Insulation resistance (volume resistivity) test		-do-				P		W		
iv	High Voltage test at room temperature		-do-				P		W		
f)		Test for XLPE Insulation									
i	Tests for thickness of Insulation		IS 7098		IS 7098, IEC 60502 as applicable		P		W		
ii	Hot set test		IS 7098, IEC 60502				P		W		
iii	Tensile strength & elongation at break		IS 7098				P		W		
iv	High Voltage test at room temp.		IS 7098				P		W		
v	Insulation Resistance test(Volume resistivity) test		IS 7098				P		W		
Note:											
1. These tests are not applicable for stranded compacted circular conductors or shaped conductors (as per IS 8130)											

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 thyssenkrupp		PART - III			Contract no.		66-6695	
		INSPECTION TEST PLAN			Doc.		6695-ELT-G00-EC-0019	
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					Scope of Inspection			
Sr. No.	Tests	Reference documents	Sample Size	Vendor	Owner / Consultant / LSTK Contractor	Remark		
E) Additional Tests for FR/ FRLS cables								
a) Type Tests								
i	Oxygen Index test	IS 10810, Part-58/ ASTM D2863	IS 1554, IS 7098, IEC/ IEEE/ ASTM as applicable	P	R			
ii	Flame retardant test on single cable	IS 10810, Part-61		P	R			
iii	Flame retardant test on bunched cable	IS 10810, Part-62		P	R			
iv	Swedish chimney test	Swedish Standard No. SS: 4241475, Class F3		P	R	Note-2		
v	Flammability tests	IEC 60332 –Part I & III/ IEEE-383		P	R	Note-2		
vi	Temperature index	ASTM-D2863		P	R			
vii	Test for specific optical density of smoke	ASTM-D2843		P	R	For FRLS cables		
viii	Smoke density	IS 10810, Part-63/ ASTM-D2843		P	R	For FRLS cables		
ix	Test for Halogen acid gas generation	IS 10810, Part-59/ IEC-60754		P	R	For FRLS cables		
b) Acceptance Tests								
i	Oxygen Index test	IS 10810, Part-58/ ASTM-D2863	IS 1554, IS 7098, IEC/ IEEE/ ASTM as applicable	P	W			
ii	Flame retardant test on single cable	IS 10810, Part-61		P	W			
iii	Swedish chimney test	Swedish Standard No. SS: 4241475, Class F3		P	R	Note-2		
iv	Flammability tests	IEC 60332 –Part I & III/ IEEE-383		P	R	Note-2		
v	Test for specific optical density of smoke	ASTM-D2843		P	W	For FRLS cables		
vi	Test for Halogen acid gas generation	IS 10810, Part-59/ IEC-60754		P	W	For FRLS cables		
Notes :								
1) W = Witness, R = Review, P = Perform.								
2) Optional to Flame retardant test on single cable (IS 10810, Part-61) and Flame retardant test on bunched cables (IS 10810, Part-62) as applicable.								