





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			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
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tkIS India / Vendor <div> Category Codes (Submission Purpose) <div> <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 </div> </div> <hr/> <div> Acceptance Codes (Approval Codes) <div> <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 </div> </div> <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>	tkIS India / Owner / Client <div> Category Codes (Submission Purpose) <div> <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 </div> </div> <hr/> <div> Acceptance Codes (Approval Codes) <div> <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 </div> </div> <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:

- No. of cores and size of cable.
- Manufacturer's identification.
- Year of manufacture.
- Voltage grade.
- 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:

- Reference to the relevant standards.
- Manufacturer's name or trade mark.
- Type of cable and voltage grade.
- Number of cores.
- Nominal cross-sectional area of conductor.
- Cable code.
- Length of cable on the drum.
- Number of lengths on the drum (if more than one).
- Direction of rotation of drum (by means of an arrow).
- Gross weight.
- Country of manufacture.
- 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".

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Contract no.	66-6695								
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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						
				: XLPE For Power & Lighting cables / PVC for Control cables					
	021		Type	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			Rev. 00 Page 1 OF 3	
Sr. No.	Tests	Reference documents	Sample Size	Scope of Inspection		
				Vendor	Owner / Consultant / LSTK Contractor	Remark
A)	Type Tests					
a)	Tests for Conductor					
i	Annealing test (for Copper)	IS 1554, IS 7098	IS 1554 / IS 7098 as applicable & IS 10810	P	R	
ii	Tensile Test (for Aluminium)	-do-		P	R	
iii	Wrapping test (for Aluminium)	-do-		P	R	
iv	Resistance test	-do-		P	R	
b)	Tests for Armouring					
i	Tensile Test	IS 3975	IS 1554 / IS 7098 as applicable & IS 10810	P	R	
ii	Torsion test (For Round wire Armour only)	-do-		P	R	
iii	Wrapping test	-do-		P	R	
iv	Resistance test (For round wire & strip Armour only)	-do-		P	R	
c)	Test for PVC Insulation and Sheath					
i	Tests for thickness of Insulation & Sheath	IS 1554, IS 7098, IEC 60502	IS 1554 / IS 7098 as applicable & IS 10810	P	R	
ii	Tensile strength & elongation at break	IS 1554, IS 7098		P	R	
iii	Ageing in air oven	IS 1554, IS 7098, IEC 60502		P	R	
iv	Shrinkage test	IS 1554, IS 7098		P	R	
v	Hot Deformation	IS 1554, IS 7098		P	R	
vi	Loss of mass in air oven	IS 1554, IS 7098, IEC 60502		P	R	
vii	Heat Shock test	IS 1554, IS 7098, IEC 60502		P	R	
viii	Thermal Stability	IS 1554, IS 7098		P	R	
ix	Insulation Resistance test	IS 1554, IS 7098, IEC 60502		P	R	
x	High Voltage test (Water immersion test)	IS 1554, IS 7098, IEC 60502		P	R	
xi	High Voltage test at room temp.	IS 1554, IS 7098		P	R	
xii	Flammability test	IS 1554, IS 7098		P	R	
d)	Test for XLPE Insulation					
i	Tests for thickness of Insulation	IS 7098, IEC 60502	IS 1554 / IS 7098 as applicable & IS 10810	P	R	
ii	Tensile strength & elongation at break	IS 7098		P	R	
iii	Ageing in air oven	IS 7098		P	R	
iv	Hot set test	IS 7098		P	R	
v	Shrinkage test	IS 7098, IEC 60502		P	R	
vi	Water absorption (gravimetric)	IS 7098, IEC 60502		P	R	
vii	Insulation Resistance test	IS 7098, IEC 60502		P	R	
viii	High Voltage test at room temp.	IS 7098		P	R	
ix	Flammability test	IS 7098, IEC 60502		P	R	

 		LOW VOLTAGE CABLES PART - III INSPECTION TEST PLAN			Code		NAL	
					Contract no.		66-6695	
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	Sr. No.	Tests	Reference documents	Sample Size	Scope of Inspection			
					Vendor	Owner / Consultant / LSTK Contractor	Remark	
	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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