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**Government of India
Ministry of Railways**

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**RESEARCH DESIGN AND STANDARDS ORGANISATION
MINISTRY OF RAILWAYS**
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**SPECIFICATION
OF
POLYAMIDE CONDUIT SYSTEM FOR CABLE MANAGEMENT ON
COACHING STOCK**

Specification No. RDSO/PE/SPEC/AC-0138-2009 (Rev. 2)

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1.	Feb 2012	1	Sizes of conduit and fittings added
2.	July-2020	2	<ul style="list-style-type: none"> Rly Board letter no-97/Elect(TRS)/113/4, dated 05.06.2020 for review of STR & Specification. Addition of rigid polyamide conduits Addition of testing methods and technical parameters

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SPECIFICATION OF POLYAMIDE CONDUIT SYSTEM FOR CABLE MANAGEMENT ON COACHING STOCK

Foreword:

Presently, flexible/rigid conduits & fittings (mostly made of PVC) used in wiring/cabling in conventional coaches are as per IS: 9537. Whereas, in LHB variant coaches, flexible polyamide conduits of polyamide-6 (PA-6) are being used for wiring except roof wiring, which is being done by PVC rigid conduits. Railways/Pus are also demanding for polyamide-6 fire retardant rigid conduit for roof wiring in coaches. This specification is prepared to standardize the use of halogen free, fire retardant, flexible and rigid polyamide conduit & associated fitting for use in coaching stock.

1.0 Scope

1.1 This specification covers performance parameters, general & technical requirements, method of sampling, inspection, testing and supply of polyamide conduits system and fittings for cable management of coaching stock.

1.2 The conduit system of cable management shall comprise of polyamide-6: -

Flexible conduit and end fittings with threaded ends (both metric and Pg thread) provided with gaskets, O-rings and metallic lock nuts ensuring minimum IP-67 protection of the system.

Rigid conduits along with three way/ four way spouts & 90° bends (to be used for Roof wiring).

1.3 Any deviation to this specification proposed by the manufacturer, aimed to improve upon the performance, utility and reliability /efficiency of the equipment will be given due consideration, provided full particulars of the deviations with justification are furnished to RDSO. In such a case, the proposed product must be proven in rolling stock application in tropical countries for at least five years. The manufacturer shall submit full technical detail of the proposed product along with the test report from reputed national/international laboratory for evaluation to RDSO.

1.4 In case of any contradiction between the provisions of IEC/IS and this specification, the later shall prevail.

1.5 Manufacturers of this items shall obtain RDSO approval for their product for which the guidelines can be obtained from website www.rdso.indianrailways.gov.in. Such manufacturers shall have infrastructure for manufacture, testing and supply of conduits and its associated fittings as per requirements specified in governing STR no. RDSO/PE/STR/AC/0035-2011 (Rev.1 or latest). The conduit and its accessories shall be approved as a set. Vendor registration fee will be required on every occasion of application for any size of conduit supply.

2 Scope of supply

Purchaser shall specify the size & type (i.e. flexible/rigid) of conduit, accessories and type of threads in end fittings as per their requirement conforming to this specification. However, sizes of flexible or rigid conduit and fittings normally in use on coaching stock are as per Annexure-A and Annexure-B. Conduits and fittings of same make will only be acceptable.

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3 Governing Specifications

Following standards shall be considered as reference standards and its latest version should be available with the manufacture of conduit system for cable management:

Specifications/ Standards	Description
IEC- 61386-1,	Conduits system for cable management- General Requirement
IEC- 61386-21	Conduits system for cable management (Particular requirements - Rigid conduits systems).
IEC- 61386-23	Conduits system for cable management (Particular requirements - Flexible conduits systems).
IEC-61373	Railway applications- Rolling stock equipment -Shock and vibration tests
IEC-60529	Classification of degrees of protection provided by enclosures of equipment.
As per NFF 16-101 & 102, UL 94, V 0	Fire, smoke & toxicity requirements
IEC-60423	Conduit system of cable management (Threads for Metric End Fittings & lock Nuts)
DIN-40430	Threads for PG End Fittings

The latest version of the aforesaid standards and specifications shall be considered applicable.

4 Operating and Service Conditions:

The conduits system and fittings shall perform satisfactorily & shall be sturdy and suitable for the following service conditions normally to be met in service on board/under slung on coaching stock:

Ambient Temperature	-5 to 55°C
Temperature of Coach Standing under sun	70°C
Train speed	200 Km/h
Relative Humidity	Upto 98%
Altitude	Max 1600 m above sea level
Atmosphere	Extremely dusty and desert weather. The dust contents in the air may reach as high value as 1.6 mg/cubic meter.
Annual rain fall	Very high in certain areas: between 1750 to 6250 mm.
Coastal area	The equipment shall be designed to work in humid salt laden and corrosive atmosphere. The max values of the condition shall be as under: Maximum pH value : 8.5 Sulphate : 7 mg/litre Max. Concentration of chlorine 6 mg/litre Max. conductivity 130 micro siemens/cm
Shocks and Vibration	The conduits and its accessories shall withstand

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satisfactorily vibrations and shocks normally encountered in service as indicated below:

- a) Max. vertical acceleration : 3.0 g,
- b) Max lateral acceleration : 3.0 g,
- c) Max longitudinal acceleration : 3.0 g
(‘g’) being the value of acceleration due to gravity)

5 Design and Technical Requirements:

5.1 CONDUIT

The conduit system for cable management shall comprise of mainly Flexible corrugated conduits, Rigid conduits, 2/4 way spouts, 90° bends, end fittings, lock nuts, terminal sleeve etc.

- 5.1.1 The material for the conduit and its accessories shall be polyamide-6 (PA-6). It should be free from halogen, phosphorous, sulphur and cadmium. It should be UV resistant and resistant to abrasion and corrosive environment.

Rigid conduit will be plain conduit having even profile in the longitudinal section as described in clause no. 3.9 of IEC-61386-1. Flexible conduit shall be internally and externally corrugated.

- 5.1.2 The preferred length of a rigid conduit shall be 3 m. Other lengths are also permitted with agreement between the manufacturer and the purchaser.

- 5.1.3 Material used for manufacturing of rigid, flexible conduits & fittings should conforming to UL94 V0.

- 5.1.4 There shall be no sharp edges, burrs or surface projections which are likely to damage insulated conductors or cables or inflict injury to the user or installer.

- 5.1.5 The dimensions of the rigid Polyamide-6 conduits shall conform to IEC 60423.

- 5.1.6 The conduit and conduit fittings shall withstand the stresses likely to occur during transport, storage etc.

- 5.1.7 The colour of the conduits and accessories shall be black, unless otherwise specified.

- 5.1.8 Flexible and rigid conduit shall be suitable for provision in the under carriage/under roof of Railways with high impact strength. It should have following properties:-

- a. Conduit should be non-flame propagating as defined in IEC-61386-1.
- b. The conduit shall be suitable for A-2 application as per para 5.1 of NFF 16-101.
- c. Its self-extinguishing class shall be I3 as per NFF 16-101.
- d. Its smoke emission classification shall be F3 as per ISO 4589.
- e. Its oxygen index shall be greater than 25%, when tested as per ISO 4589.
- f. It should be suitable for continuous temperature range -10 to 105 °C.

- 5.1.9 Conduit shall have di-electric strength and insulation resistance as per para 11.3 of IEC 61386-1.

- 5.1.10 The complete cable protection system with end fittings shall be suitable for minimum IP-67 as per IEC- 60529 for its connection.

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5.1.11 The conduit shall be circular in section with concentricity of more than 90%. The concentricity shall be calculated as the ratio of the maximum and minimum thickness measured on the same cross section on the opposite sides.

5.2 CONDUIT ACCESSORIES

5.2.1 Flexible Conduit End Fittings:

The end fittings are the connectors provided at the ends of the flexible corrugated conduits, which in turn terminates in the equipment / sub-assembly used for outdoor application. The connection to the flexible conduit shall be such as not to become loose due to vibrations encountered in rolling stock. This shall include the end fittings and accessories such as Y-connector (for taking out two outputs from one).

For connection of flexible conduit with end fitting, system shall be such as the conduit is fitted with push in or safety lock retaining ring type arrangement to be inserted for fixing the conduit. Incidental dismantling or reduction in sealing performance shall not be permitted.

Threading provided at the end of the end fitting shall be as per the interface. If the interface is plastic then the threads & hexagonal locknuts shall be of Polyamide – 6 material and if the interface is metal then threads & hexagonal locknuts shall be of Nickel plated brass however the entire metal thread length shall be internally insulated with Polyamide – 6 Material. The thread design shall be as per the requirements for PG Threads conforming to DIN-40430 & Metric Threads conforming to IEC-60423 respectively. The minimum thread length shall be 10 mm for the various sizes & types of end fittings.

To achieve the IP-67 level of protection, the fitting shall be provided with Gaskets & O-ring. The material of O-ring shall be NBR. However, the gaskets shall be of Non Asbestos Reinforced NBR.

The fitting shall be provided with a metallic thread (insert part) to guarantee a secure and vibrations free fitting and the connection partner. No metallic part shall however have direct contact with cables traversing through it.

5.2.2 Rigid conduit end fittings:

Rigid conduit shall be provided external threads at its both ends as per IEC-60423. Supplier shall provide rigid conduit coupling fittings with internal threads at both side to connect two rigid conduit. Supplier shall also provide rigid conduit coupling fittings with flared-out at both ends to make bell joint between two rigid conduit pieces having no threads on ends. Railways/PUs are advised to use suitable adhesive for fixing the bell joint. Rigid conduit end coupling with one side internal threads and another side flared-out shape shall also be provided by the Supplier. Two way and four way spouts shall have flared-out ends for connection with rigid conduit.

5.2.3 Tube Clamps

The tube clamps are used for holding the conduits in place. The tube clamps should be made from Galvanized Steel coating and to be covered with Elastomeric profile for better grip & to avoid damage to conduits. Elastomeric material should be self-extinguishing & free from halogens, phosphorous and cadmium. The application temp range should be –10 Deg C to +105 Deg C. Ends of the Tube clamps to be provided with holes to install the fixing screws

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5.2.4 Terminal sleeves

These are cylindrical sleeves used for conduit end termination where no connector with threads are necessary to avoid the damage to cable insulation by sharp edges on the conduit after cutting.

5.2.5 Lock nuts

Lock nuts are used in conjunction with end fittings suitable for both metric and Pg thread. The material shall be brass nickel plated.

5.2.6 In-Line Connectors

These fittings are used to connect two corrugated conduit lengths of the same size (NW). Both the ends of these connectors shall be provided with the interface to fix the conduits. It shall also be of Polyamide – 6 materials.

5.2.7 Corrugated Conduits to Pipe Connector

The connectors are used to connect the corrugated conduits to the Steel pipes carrying electrical wires.

5.2.8 Flange Connectors

Flanged connectors (Straight and Elbow) are used to connect the interface of ZS coupling (in HOG/EOG coaches). The interface of the fittings should be able to accommodate NW70 and NW95 size conduits. It shall also be of Polyamide – 6 materials.

5.2.9 Plug Screws

Plug screws are used to block the female threaded interface wherever required. Plastic interface shall be of Polyamide-6 material and Metal interface of Nickel plated brass.

5.2.10 Spouts

2-Way & 4-Way Spouts are fitted at the ends of the Rigid & Corrugated PA-6 Conduits for the distribution of cables in the roof wiring of the coaches. These shall be of Polyamide –6 materials. The spouts used for corrugated flexible conduit should have the necessary locking arrangement to hold the conduits & attain the ingress protection of IP-67 level. The spouts used for rigid conduit shall have plain inner surface to accommodate the respective size conduit smoothly.

5.2.11 90° Bends

The right angle bends are to be fixed at the ends of the rigid PA-6 conduits.

6 Tests:

6.1 Type test:

6.1.1 Type test of conduit and fittings shall be carried out in two phases. In first phase, the manufacturing of the conduit and fittings shall be witnessed by RDSO/Railway representative official. The sample of raw material, which is used for manufacturing of conduit and fittings, shall be collected and sealed jointly with the manufacturer in two packets of approximate 5kg weight. Both sealed raw material samples shall be handed over to manufacture for further testing of raw material from NABL accredited/Govt lab. If required necessary, RDSO/Railway representative may also collect the sample of raw material for testing at their end.

6.1.2 At least six set (3 set for test & 3 test as spare) samples of newly manufactured conduit and fittings shall be conditioned for at least 240 hrs (10 days), at a

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temperature of $(23\pm 2)^{\circ}\text{C}$ and a relative humidity between 40% and 60%. All prototype tests shall be carried out immediately after general conditioning. (para 5.4 of IEC 61386-1)

- 6.1.3 Unless otherwise specified, each test shall be made on three new samples, and the requirements are satisfied if the tests are met. If only one of the samples does not satisfy a test, due to an assembly or a manufacturing defect, that test and any preceding one which may have influenced the result of the test shall be repeated, and also the tests which follow shall be carried out in the required sequence on another full set of samples, all of which shall comply with the requirements. (para 5.3 & 5.7 of IEC 61386-1).
- 6.1.4 Unless otherwise specified, the tests shall be carried out at an ambient temperature of $(20\pm 5)^{\circ}\text{C}$. (para 5.2 of IEC 61386-1)
- 6.1.5 Only after the detail drawings and the design have been approved and the clearance given to this effect, the manufacturer shall take up the manufacture of the prototype. It is to be clearly understood that any changes required to be done in the prototype or any additional tests other than specified herein are required to be conducted on the prototype unit or its components, the same shall be done expeditiously. During the process of manufacture of the item, if the purchaser so desires, may conduct/repeat any of the routine or additional tests to satisfy himself that the quality of the item being manufactured is of the required standards.
- 6.1.6 Subject to agreement between user and manufacturer, RDSO/ purchaser shall repeat some or all type tests once in three years on sample basis, so as to confirm the quality of the product to meet the specified requirements.
- 6.1.7 The type tests shall be carried out by RDSO representative on prototype unit either totally or in part under the following circumstances without any additional cost:
- A manufacturer undertakes to manufacture for the first time as per this specification.
 - An important change in design details of product has been introduced.
 - Specification is modified necessitating re-designing of product.
 - Unsatisfactory performance reported from user Railways.
 - Resumption of production after an interruption of more than two years.
 - Quality audit of firm
- 6.1.8 RDSO may conduct surprise check on manufacturing process and quality control along with any of the tests to ensure quality of product and its conformance to specification.
- 6.1.9 The tests shall be carried out at the works of the manufacturer or at any approved testing laboratory in presence of Indian Railway representative on the test sample of the conduits and its accessories as per relevant governing specifications modified or amplified. The manufacture shall have necessary arrangement for testing of conduits and its fittings.
- 6.1.10 The test protocol indicating relevant clause of the test, condition of the test, specified value and observed value of the parameter for conduits & accessories shall be submitted by the firm before offering the sample for testing.

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6.2 Routine test:

Routine tests are to be carried out on each unit to verify that properties & design of the product corresponds to those measured during type test. Proper documentation of routine tests results shall be made available by the firm to inspecting official on demand.

6.3 Acceptance test:

Each offered lot of supply shall be subjected to acceptance tests as per RDSO approved sampling plan or as per sampling plan specified in IS 2501, at manufacturer's works. Acceptance test shall be witnessed by inspecting official nominated by purchaser/RDSO. Manufacturer on demand by inspecting official shall produce the internal/routine test report carried out by manufacturer.

6.4 Test Description :

S. No	Description of test	Standard / Clause no.	Type Test	Acceptance Test	Routine Test
1.	Checking dimension of	IEC 60423 for Rigid non thread-able conduits and IEC 61386-1 for flexible conduits	Yes	Yes	Yes
2.	Compression test	10.2 of IEC 61386-1	Yes	Yes	Yes
3.	Impact test	10.3 of IEC 61386-1	Yes	Yes	Yes
4.	Flexing test (applicable to flexible conduit only)	IEC 61386-23	Yes	Yes	Yes
5.	Bending test (applicable to rigid conduit only)	IEC61386-21	Yes	Yes	Yes
6.	Collapse test (applicable to rigid conduit only)	IEC61386-21	Yes	Yes	Yes
7.	Tensile test	IEC 61386-1 & 23	Yes	Yes	No
8.	Suspended Load test	IEC 61386-1	Yes	No	No
9.	Thermal Properties	IEC 61386-1 & 23	Yes	Yes	No
10.	Di-Electric Strength & Insulation resistance test	IEC 61386-1	Yes	Yes	No
11.	Spread of fire	IEC 61386-1	Yes	Yes	No
12.	Degree of protection	IEC-60529	Yes	No	No
13.	Self extinguishing class & Smoke emission classification	NFF-16101 & 102	Yes	No	No
14.	Test of material composition	Clause 6.5 of this spec.	Yes	No	No

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Note:

- a. Test specified at S.No. 5, 6, 7, 8 & 10 in the above table shall be conducted on conduit along with its end fitting.
- b. Test at S.No. 1,3 & 11 shall also be conducted on the End Fittings.
- c. Conduit shall be subjected to all tests mentioned above.
- d. The product shall be of "medium" classification for flexible conduit size of NW 17 & above. However, size upto NW 12 shall be of "light" classification. Similarly, the product shall be of "medium" classification for rigid conduit size of 20 mm & above. However, size upto 16 mm shall be of "light" classification.
- e. To check the uniformity of the conduits, three samples, each taken from different lengths or place separated by approximately 3 metres, are cut along a plane perpendicular to the axis. The inside and outside diameter at each edge is measured at four places as far as possible equally spaced around the circumference.
- f. Conduit system duly assembled with its end fittings and accessories shall be tested to IP-67 grade protection as per IEC 60529.
- g. The material shall confirm to fire resistant class-as per NFF 16 101 & 102.

Note: Testing/measuring instruments duly calibrated from any NABL accredited /Govt laboratory shall be utilized during test.

6.5 Test of material composition: -

Conduit and its accessories shall be made up of virgin polyamide-6 material having following properties.

Properties	Standard	Testing Parameter	Value		Unit
GENERAL					
Density	ISO 1183-1		1.14-1.19		g/cm ³
Viscosity number	ISO 307		130-160		cm ³ /g
MECHANICAL CONDITION			Dry	Conditioned	
Tensile stress at yield	ISO 527-2	50 mm/min	>75	-	Mpa
Tensile strain at yield	ISO 527-2	50 mm/min	>2.8	-	%
Tensile strength at yield Tensile Modulus	ISO 527-2	1 mm/min	>3200	>1000	Mpa
Charpy impact strength	ISO 179/1 Eu	23°C	No Break	No Break	Kj/m ²
		-30°C	No Break	No Break	Kj/ m ²
Charpy notched impact strength	ISO 179/1eA	23°C	> 7	> 12	
		-30°C	> 5	-	
THERMAL					
VICAT Softening temperature	ISO 306	A50 (10N)		>210	°C
		B50 (50N)		>200	°C
Heat deflection temperature (HDT)	ISO 75	Af (1.80 Mpa)		>75	°C
		Bf (0.45 Mpa)		>200	°C

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BURNING BEHAVIOUR						
UL Internal test procedure	UL 94	0.75/1.5 mm		V-0/V-0		
Glow wire flammability index GWFI	IEC 695-2/12	2 mm		960		°C
	UL 746 A					
ELECTRICAL						
Comparative tracking index CTI	IEC 112	Solution A		600		V

Necessary IR Spectroscopy finger print of raw material shall be submitted to RDSO. The above properties are for guidelines and firm shall take prior approval of grade of PA-6 material to be used for manufacturing conduit & accessories. Firm shall submit test report on raw material covering the all tests above from NABL accredited/**Govt** lab. Firm shall also keep the record of procurement of virgin raw material and OEM's test certificate for each lot for verification by inspecting official. Firm will also submit the detail of raw material used for manufacturing of conduit fittings.

7 Details of Prototype Test Procedure:

7.1 Checking of Dimension and Weight of Conduit:

7.1.1 Outside diameters of conduits shall be measured at four places, approximately equally spaced around 360° of the conduit and mean value should be within the limits specified in the specification.

7.1.2 Measurement of the flexible / rigid conduit material thickness are taken at four places, approximately equally spaced around 360° of the conduit and the mean value shall be recorded in the prototype test results. For measurement of thickness, conduit is cut in perpendicular to cross section. Measurements of the flexible conduit material thickness are taken at the root of the corrugation (a) and the crest of the corrugation (b) at four places, approximately equally spaced, around 360° of the conduit, and the mean value calculated as follows:

$$\text{Mean material thickness} = (a_1 + b_1 + a_2 + b_2 + a_3 + b_3 + a_4 + b_4) / 8;$$

7.1.3 Weight of the flexible and rigid conduits are measured and the value of the same shall be recorded.

S.No.	Flexible Conduit Size	Weight of per meter conduit in gram
1.	NW10	40
2.	NW12	50
3.	NW17	85
4.	NW23	130
5.	NW29	170
6.	NW36	225
7.	NW48	290
8.	NW56	355
9.	NW70	430
10.	NW95	570

S.No.	Rigid Conduit Size	Weight of per meter conduit in gram
1.	16 mm+0.0/-0.3	80

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2.	20 mm+0.0/-0.3	100
3.	25 mm+0.0/-0.4	150
4.	32 mm+0.0/-0.4	225
5.	40 mm+0.0/-0.4	310
6.	50 mm+0.0/-0.5	450

Value of the actual measured weight of conduits shall be mentioned in the prototype test results.

7.2 Compression Test:

The sample shall be tested as per clause 10.2 of IEC 61386-1. The product shall be of medium classification for size NW 17 and above .However size upto NW -12 shall be of light classification for flexible conduit. Similarly, the product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.

7.3 Impact test:

The sample shall be tested as per clause 10.3 of IEC 61386-1. The product shall be of medium classification for size NW 17 and above .However size upto NW -12 shall be of light classification for flexible conduit. Similarly, the product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.

7.4 Flexing Test:

The sample shall be tested as per clause 10.5 of IEC 61386-23. The product shall be of medium classification for size NW 17 and above .However size upto NW -12 shall be of light classification for flexible conduit.

The test shall be made on six samples of conduit of an appropriate length. Three samples with adequate temperature defined for each size. Each size shall be tested in cold flexing & hot flexing.

7.5 Bending Test

The sample shall be tested as per clause 10.4 of IEC 61386-21. The product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.

7.6 Collapse test:

The sample shall be tested as per clause 10.6 of IEC 61386-21. The product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.

7.7 Tensile Test:

The sample shall be tested as per clause 10.7 of IEC 61386-1 & 23. The product shall be of medium classification for size NW 17 and above .However size upto NW -12 shall be of light classification for flexible conduit. Similarly, the product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.

7.8 Suspended Load Test:

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The sample shall be tested as per clause 10.8 of IEC 61386-1. The product shall be of medium classification for size NW 17 and above .However size upto NW -12 shall be of light classification for flexible conduit. Similarly, the product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.

7.9 Dielectric strength and insulation resistance :

The sample shall be tested as per clause 11.3.1 & 11.3.2 of IEC 61386-1. The product shall be of medium classification for size NW 17 and above .However size upto NW -12 shall be of light classification for flexible conduit. **Similarly, the product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.**

7.10 Thermal Properties:

The sample shall be tested as per clause 12 table 8 (classification-medium) of IEC 61386-1 and IEC 61386-23. The product shall be of medium classification for size NW 17 and above .However size upto NW -12 shall be of light classification for flexible conduit. Similarly, the product shall be of “medium” classification for rigid conduit for size of 20 mm & above. However, size upto 16 mm shall be of “light” classification.

7.11 Spread of Fire :

The test shall be conducted as per clause **13.1.3.1 and 13.1.3.2 of IEC-61386-1.**

7.12 Degree of Ingress Protection :

Conduit system when assembled shall have protection against dust & water ingress and tested to meet IP-67 grade protection as per IEC 60529.

7.13 Fire resistance class & smoke Class :

Test shall be conducted as per NFF 16-101 & 16-102.The material shall confirm to fire resistance class I3 & smoke class F3.

8 Technical Data

8.0 The manufacturer shall submit their compliance or comments against each clause and sub-clause of the technical specification with the offer. The manufacturer shall for this purpose enclose a separate statement, if necessary, indicating the Annexure and clause reference and compliance/comments. The manufacturer shall also furnish the full technical data and dimensions for each size of Flexible/**rigid** Polyamide conduits as per the format given as Annexure “C” of the specification.

9 Manufacturer’s responsibility

9.1 The supplier shall supply detailed instructions for proper installation of the equipment on Rolling stock. For this purpose, the supplier shall depute his engineers/supervisors to sites during installation of the conduit system.

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- 9.2** The supplier shall be responsible for commissioning, testing and field trials of the conduit system in service and depute team of engineers/supervisors for this purpose during developmental stage.
- 9.3** The supplier shall be responsible for carrying out improvements and modifications at his own expense on all the conduit systems supplied, provided such modifications/improvements are decided to be necessary for meeting the requirements of reliability, performance etc, jointly between manufacturer and purchaser.
- 9.4** For the purpose of technical decisions on improvements/ modifications etc. on conduit system the final authority from the purchaser's side will be RDSO.

10 Marking and packing

- 10.0** The following information shall be marked with laser printing at every one meter length of conduits :
- a. Size of conduit.
 - b. Name **or trade mark or identification mark** of the manufacturer.
 - c. Year and batch of the manufacture.
- 10.1** Accessories are also required to be marked with the vendor name or trademark or identification mark. The product identification mark, which may be, for example, a catalogue number, a symbol or the like, in such way that it can be identified in the manufacturer's literature however for the items where it is impractical, then the mark may be on the label attached to the product or on the smallest supplied package.
- 10.2** The marking shall be durable and clearly legible. Compliance is checked by inspection, using normal or corrected vision, without additional magnification and by rubbing the marking by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit n-hexane 95 % along its entire length at intervals of preferably 1 m but not longer than 3 m with each length being marked at least once.
- 10.3** It is mandatory to mention the classification code for conduit system on the supplied packet as per Annexure A of IEC61386-1. Classification code shall include at least the first four digits as per Annexure with detail of coding. Detail of first four digit is given below:
- First digit – Resistance to compression
 - Second digit – Resistance to impact
 - Third digit – Lower temperature range
 - Fourth digit-Upper temperature range.

11 Warranty period and liability

The supplier/manufacturer shall be responsible for any damage to the products due to defective design, materials and workmanship for a period as per Indian Railway stores (IRS) condition of contract.

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12 Infringement of patent right

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of the system and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/ supplier.

Details / design/documents given by firm are not infringing any IPR and they are responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of RDSO and right of Railways / RDSO on such IP is acceptable to them.

13 Schedule of Technical requirement:-

Firm desiring to get RDSO's approval for this product shall comply to schedule of technical requirement no. RDSO/PE/STR/AC/0035-2011(Rev-1 or **latest**).

14 Enclosures:

Annexure A & B : Dimensions of conduits and its accessories.

Annexure C : Conduit size and dimensions.

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Annexure - A:**A-1: Sizes of Flexible Polyamide Corrugated Conduits**

S.No.	Nominal Size	Outer Diameter (mm)
1.	NW10	13.0±0.2
2.	NW12	15.8±0.2
3.	NW17	21.2±0.2
4.	NW23	28.5±0.2
5.	NW29	34.4±0.2
6.	NW36	42.4±0.2
7.	NW48	54.4±0.2
8.	NW56	67.2±0.2
9.	NW70	80.0±0.2
10.	NW95	106.0±0.2

The minimum inside diameter of the conduit system shall be as declared by the manufacturer as specified in clause 8.2 of IEC 61386-23. The compliance is checked by measurement.

A-2: Sizes of Straight PG Metal Thread End Fittings

S.No.	Thread Size	Fits to Conduit Size
1.	Pg9	NW10
2.	Pg11	NW12
3.	Pg16	NW17
4.	Pg13.5	NW17
5.	Pg21	NW23
6.	Pg29	NW29
7.	Pg36	NW36
8.	Pg48	NW48

A-3 Sizes of 45° PG Metal Thread End Fittings

S.No.	Thread Size	Fits to Conduit Size
1.	Pg9	NW10
2.	Pg11	NW12
3.	Pg16	NW17
4.	Pg13.5	NW17
5.	Pg21	NW23
6.	Pg29	NW29
7.	Pg36	NW36
8.	Pg48	NW48

A-4 Sizes of 90° Elbow PG Metal Thread End Fittings

S.No.	Thread Size	Fits to Conduit Size
1.	Pg9	NW10
2.	Pg11	NW12
3.	Pg16	NW17
4.	Pg13.5	NW17
5.	Pg21	NW23
6.	Pg29	NW29
7.	Pg36	NW36
8.	Pg48	NW48

A-5 Sizes of Straight Metric Metal Thread End Fittings

S.No.	Thread Size	Fits to Conduit Size
1.	M12x1.5	NW10
2.	M16x1.5	NW10
3.	M16x1.5	NW12
4.	M20x1.5	NW12
5.	M20x1.5	NW17
6.	M25x1.5	NW17
7.	M25x1.5	NW23
8.	M32x1.5	NW23
9.	M32x1.5	NW29
10.	M40x1.5	NW29
11.	M40x1.5	NW36
12.	M50x1.5	NW36
13.	M50x1.5	NW48
14.	M63x1.5	NW48

A-6 Sizes of 45° Metric Metal Thread End Fittings

S.No.	Thread Size	Fits to Conduit Size
1.	M12x1.5	NW10
2.	M16x1.5	NW10
3.	M16x1.5	NW12
4.	M20x1.5	NW12
5.	M20x1.5	NW17
6.	M25x1.5	NW17
7.	M25x1.5	NW23
8.	M32x1.5	NW23
9.	M32x1.5	NW29
10.	M40x1.5	NW29
11.	M40x1.5	NW36
12.	M50x1.5	NW36
13.	M50x1.5	NW48
14.	M63x1.5	NW48

A-7 Sizes of 90° Elbow Metric Metal Thread End Fittings

S.No.	Thread Size	Fits to Conduit Size
1.	M12x1.5	NW10
2.	M16x1.5	NW10
3.	M16x1.5	NW12
4.	M20x1.5	NW12
5.	M20x1.5	NW17
6.	M25x1.5	NW17
7.	M25x1.5	NW23
8.	M32x1.5	NW23
9.	M32x1.5	NW29
10.	M40x1.5	NW29
11.	M40x1.5	NW36
12.	M50x1.5	NW36
13.	M50x1.5	NW48
14.	M63x1.5	NW48

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A-8 Sizes of Tube Clamps

S.No.	Fits to Conduit Size	Fixing Screw
1.	NW10	M4
2.	NW12	M4
3.	NW17	M5
4.	NW23	M5
5.	NW23	M6
6.	NW29	M6
7.	NW36	M6
8.	NW48	M6

A-9 Sizes of Hexagonal Metric Lock Nuts - Nickel Plated Brass

S.No.	Thread Size
1.	M12x1.5
2.	M16x1.5
3.	M20x1.5
4.	M25x1.5
5.	M32x1.5
6.	M40x1.5
7.	M50x1.5
8.	M63x1.5

A-10 Sizes of Hexagonal PG Lock Nuts - Nickel Plated Brass

S.No.	ThreadSize
1.	Pg9
2.	Pg11
3.	Pg13.5
4.	Pg16
5.	Pg21
6.	Pg29
7.	Pg36
8.	Pg48

A-11 Y-type connectors for branching of conduits.

S.No.	Size:
1.	NW 10/NW 7 x 2
2.	NW 12/NW10 x 2
3.	NW 17/NW12 x 2
4.	NW 23/NW17 x 2
5.	NW 29/NW23 x 2
6.	NW 36/NW29 x 2
7.	NW 48/NW36 x 2

A-12 Flanged End Fittings Straight

S.No.	Suitable for Conduit Size
1.	NW 70
2.	NW 95

A-13 Flanged End Fittings Elbow

S.No.	Suitable for Conduit Size
1.	NW 70
2.	NW 95

A-14 Fittings to connect Flexible Corrugated Conduit to Rigid Pipe/Conduits

S.No.	Flexible Conduit Size	Rigid Conduit Diameter
1.	NW17	20 mm
2.	NW23	25 mm
3.	NW29	32 mm
4.	NW36	40 mm
5.	NW48	50 mm

A-15 Spouts – 2 Way

S.No.	Flexible Conduit Size
1.	NW17
2.	NW23
3.	NW29
4.	NW36

A-16 Spouts – 4 Way

S.No.	Flexible Conduit Size
1.	NW17
2.	NW23
3.	NW29
4.	NW36

A-17 Sizes of In-Line Connector

S.No.	Fits to Conduit Size
1.	NW12
2.	NW17
3.	NW23
4.	NW29
5.	NW36
6.	NW48

A-18 Sizes of PG Thread Plug Screws

S.No.	Thread Size
1.	Pg9
2.	Pg11
3.	Pg13.5
4.	Pg16
5.	Pg21
6.	Pg29
7.	Pg36
8.	Pg48

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A-19 Sizes of Metric Thread Plug Screws

S.No.	Thread Size
1.	M12x1.5
2.	M16x1.5
3.	M20x1.5
4.	M25x1.5
5.	M32x1.5
6.	M40x1.5
7.	M50x1.5
8.	M63x1.5

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Annexure – B:**A-1 Sizes of Rigid PA-6 Conduits**

S.No.	Outside Diameter (As per IEC 60423)
1.	16 mm+0.0/-0.3
2.	20 mm+0.0/-0.3
3.	25 mm+0.0/-0.4
4.	32 mm+0.0/-0.4
5.	40 mm+0.0/-0.4
6.	50 mm+0.0/-0.5

A-2 Sizes of Rigid PA-6 Conduits with Bell Mouth at one end

S.No.	Outside Diameter (As per IEC 60423)
1.	16 mm+0.0/-0.3
2.	20 mm+0.0/-0.3
3.	25 mm+0.0/-0.4
4.	32 mm+0.0/-0.4
5.	40 mm+0.0/-0.4
6.	50 mm+0.0/-0.5

A-3 Sizes of 90° Bends for Rigid Conduits

S.No.	Outside Diameter (As per IEC 60423)
1.	16 mm
2.	20 mm
3.	25 mm
4.	32 mm
5.	40 mm
6.	50 mm

A-4 Spouts for Rigid Conduits – 2 Way

S.No.	Outside Diameter (As per IEC 60423)
1.	16 mm
2.	20 mm
3.	25 mm
4.	32 mm
5.	40 mm
6.	50 mm

A-5 Spouts for Rigid Conduits – 4 Way

S.No.	Outside Diameter (As per IEC 60423)
1.	16 mm
2.	20 mm
3.	25 mm
4.	32 mm
5.	40 mm
6.	50 mm

Annexure – C:**CONDUIT SIZE AND DIMENSIONS**

S.No	Manufacturer Model Number	Conduit Size(NW)	Outside Diameter (mm)	Inside Diameter (mm)	Minimum Bending Radius (mm)
1		10			
2		12			
3		17			
4		23			
5		29			
6		36			
7		48			
8		56			
9		70			
10		95			

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Distribution:

CHIEF ELECTRICAL ENGINEER:	
1.	Northern Railway, Baroda House, New Delhi – 110 001.
2.	Central Railway, II Floor, Parcel office, CST Mumbai – 400 001.
3.	Eastern Railway, Fairlie Place, Kolkata – 700 001.
4.	South Eastern Railway, Garden Reach, Kolkata – 700 043
5.	Southern Railway, Park Town, Chennai – 600 003.
6.	Western Railway, Churchgate, Mumbai – 400 020.
7.	South Central Railway, Rail Nilayam, Secunderabad – 500 371.
8.	East Central Railway, Dighi Distt- Vaishali, Hajipur Bihar- 844 101.
9.	North Central Railway, Subedarganj, Allahabad- 211 001.
10.	South Western Railway, 1st Floor, DRM Office, Hubli 580 020
11.	South East Central Railway, Bilaspur.495004
12.	North East Frontier Railway, Maligaon, Guwahati - 781001
13.	North Eastern Railway, Gorakhpur – 273001
14.	North Western Railway, Jaipur – 302006
15.	West Central Railway, Jabalpur - 482001
16.	East Coast Railway, Bhuvneshwar, Orrisa – 751016
17.	Konkan Railway, Belapur Bhavan, Sector-11, Belapur, Mumbai - 400614
18.	Metro Railway, 33 /1 J.L. Nehru road, Kolkata- 700071
19.	Integral coach factory, Perambur, Chennai - 600038
20.	Rail Coach Factory, Kapurthala (Punjab) – 144 602
CHIEF WORKS MANAGER:	
1.	Matunga Workshop, Central Railway, Mumbai 400 019.
2.	Liluah Workshop, Eastern Railway, Howrah
3.	C&W Workshop , Northern Railway, Alambagh, Lucknow-226 05
4.	C & W Workshop,N. Rly., Jagdhari – 135 002
5.	Mechanical Workshop, NER, Gorakhpur – 273 012
6.	Carriage Workshop, Southern Railway, Perambur, Ayanavaram, Chennai–600023.
7.	SCR, Lallagudda Workshop, Lallaguda, Secunderabad - 500017
8.	Carriage Workshop, Western Railway, Lower Parel, Mumbai-400013
9.	CRWS, W. C. Railway, Nishatpura, Bhopal-462010
10.	Carriage Workshop, NW Rly., Ajmer - 305001
11.	Carriage Repair Workshop, Gadag Road, SWR, Hubli – 580 020
12.	Carriage Workshop, S.W. Railway, Mysore Vishwanath.
13.	Carriage Workshop, SE Rly., Kharagpur - 721301
14.	New Bongaigaon , Railway Workshop, Dangtal, Distt. Bongaigaon, Assam-783380
15.	Carriage and Wagon Workshop, N. C. Rly., Jhansi – 248003
16.	Carriage and Wagon Workshop, WC Rly., Kota - 324002
17.	Carriage and Wagon Workshop, Eeastern Rly., Liluha - 711204
18.	Carriage and Wagon Workshop, W. Rly., Pratap Nagar, Vadodara - 390004
19.	Carriage and Wagon Workshop, N Rly., Amritsar - 143001
20.	Central Workshop, Goldenrock, S. Rly., Trichi - 620004
OTHERS:	
1.	Director, IRIEEN, Nasik Road (Maharashtra). - 422101
2.	Senior Professor (Elect.), Railway Staff College, Lalbaug, Vadodara. - 390004
3.	Director, IRCAMTECH, Maharajpur, Gwalior – 474 020.

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