

**Government of India**  
**Ministry of Railways**



**SPECIFICATION  
FOR  
CABLE TRANSIT SYSTEM  
WITH  
EPDM RUBBER MODULES  
IN  
ELECTRIC  
LOCOMOTIVES/EMU/MEMU/Metro**

RDSO/2008/EL/SPEC/0067, Rev- 3  
xxxx - 2020

Approved by	Signature
PEDSE	

**Issued by:**  
**ELECTRICAL DIRECTORATE**  
**RESEARCH DESIGN & STANDARD ORGANISATION**  
**MANAK NAGAR, LUCKNOW-226 011**

### Status of Revision

S. N.	Date of Revision	Revision	Reasons for Revision/ Revised Clauses
1	19.07.2013	Rev '1'	Fire protection as per BS/UL
2			<b>Module:</b> Module shall be of Adjustable/multidiameter/fixed Type As per approved drawing along with central core/central plugs so that it can be adjusted for different cable diameters.
3			<b>Supplier:</b> - Supplier(OEM) should be manufacturer of cable transit system with EPDM module.
4			<b>Stay Plate:</b> Stayplate should be provided in row/column as per design of EPDM Rubber.
5			<b>Type Test:</b> IP 55 for cable retention system and IP 67 for sealing system i.e. in/out for (under frame/Roof top applications).
6			<b>Drawings:</b> As per CLW approved drawings detail as per Para -13.0.
7	30.01.2015	Rev '2'	Alternate Fire protection standards i.e. UL-1479 or EN 45545 –or IS: 12458-1988 or IMO FTP Code 2010 Part III with latest revision.
8			Frame material as MS or SS where welding involve has been included.
9			Properties of fire/flammability resistance shall be as per UL 94(V-0) has been included for clarify of reference statement.
10			Adding Fire rating class in Smoke & Toxicity index test.
11			Compression unit/wedge is added as a clause 5.2
12			Frame material grade standards is added in clause 6.0
13			CLW drawing of 3 Phase locomotives is added in clause 13.0
14	.....2020	Rev-'3'	<p>In compliance to</p> <ul style="list-style-type: none"> <li>i) Vigilance Cell Note no. CVO/RDSO/Confdl/2020 dtd.20/03/2020.</li> <li>ii) AML (Traction) letter no.97/Elect (TRS)/113/4 dated 05.06.2020</li> <li>iii) DG Secretariat's Note no. DG/Misc. dtd.10/06/2020.</li> <li>iv) QA/Mech Dte. Note No. QAM/Spl.DG/Misc.dtd 15.06.2020.</li> <li>v) Electrical Dte. Note no. EL/8.1.10 dated 22.06.2020.</li> <li>vi) Vigilance Cell Note no. CVO/RDSO/Confdl/2020 dtd. 23.06.2020.</li> <li>vii) Vigilance Cell Note no. CVO/RDSO/Confdl/2020 dtd.21/08/2020.</li> <li>viii) Spl. DG(VD) note no. Spl.DG(VD)/Misc.(20) dated 27.08.2020</li> </ul> <p>Clause 3.0: altitude has been changed as 1776m. Peeling off technology type module is included in respective clauses wherever applicable. Clause 5.1(ii): New Clause added. Clause 5.1.3.5: Normal operating temperature has been changed from( -60<sup>0</sup>C to +90<sup>0</sup>C ) to (-40<sup>0</sup>C to +90<sup>0</sup>C) Clause 12.0: The requirement of Quality Audit has been included in line with ISO procedure in vogue at RDSO. Clause 12(v): Smoke &amp; Toxicity Index has been changed to F1 class. Clause 12.2.3: The time for application of force has been specified. Clause 13.0: Following text has been added: All other latest drawings issued by PUs/Railways from time to time can also be used. Clause 14.0: New Clause added for test formats.</p>

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## 1.0 **BACKGROUND:**

In the recent past, Railways have been reporting failure of cables in trenches of the locomotives, transit point from the locomotive to under frame as well as traction motor terminal boxes. The matter has been investigated by RDSO and it is observed that initially the failures were reported on thin walled cables of one particular make. However, later on during the course of investigation, similar problems were also observed in the thin walled cables of other makes. On investigation, it was observed that these failures have been taking place particularly at SRBGF (Silicon Resistant Bonded Glass Fibre) cleat locations, mostly due to following reasons:

- (i) Damage and cutting of cables due to compression of the cables by hard cleat material.
- (ii) Overheating of cables due to high compression and very less spacing between the cables.
- (iii) Non-uniform load distribution leading to increased stress on cables at these points resulting in cutting, bending and their insulation failure.

Although rubber wrapping has been provided at the cleat locations by sheds/CLW, a number of cases have been observed wherein the rubber has fused with cable insulation. A past record also reveals that similar nature of failures on thick wall Elastomeric cables have taken place, although the cases were reportedly much less.

All the leading manufacturers' world over are presently using thin walled e-beam cables in Electric & Diesel loco motives without any problem. Hence it was considered essential to study the problems of failures of thin walled cables at the locations mentioned above in conventional electric locomotives viz. WAG7, WAP4 & WAG 5. At present globally the rolling stock manufacturers have started to use proper modular based cable and pipe sealing EPDM rubber modular system. Globally all the leading manufacturers have started following EN 50343 standards of May 2003 for proper cable management system with the following features:

- (i) Systematic distribution of cables and their separation according to their current rating.
- (ii) Cables are properly secured to provide cushion rather than compression thus providing protection to cables against cutting & damage.
- (iii) Maintaining gap between each cable of more than 2 mm & also clearance between each layer of cables if the cables are placed one above the other.
- (iv) Full proof sealing & protection of cables against fire, earth fault, insulation failure & Vibration.
- (v) Water protection against IP 55.

## 2.0 **OBJECTIVE:**

A systematic cable transit ,management & sealing is prerequisite for protection of cables against cutting, damage, fire, vibration, pull tension, temperature variation, dust, water, humidity & rodents as well. Cable Management Transit System must be fire resistant, smoke and gas tight, and the pressure/vibration shall not damage it or compromise its seal or security. The objective of this specification is to define the material and arrangement of the components to be used in trenches, under frame and the traction motor terminals where the cables are laid in the

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locomotives to ensure that they are held properly without any excessive pressure so as to cause their damage. The specification also gives the acceptance tests and type tests to be carried out on the complete transit system as mentioned in Clause 11.0 & 12.0 of this specification. The internal test results of the sealing system to be submitted by the supplier with EPDM rubber modules and the internal test results of the materials to be submitted by the supplier/manufacturer.

### 3.0 **CLIMATIC CONDITIONS:**

The climatic condition specified in this clause are average conditions; any specific conditions specified in the tender documents shall override these

Atmospheric temperature	Maximum temperature of metallic surface under the Sun: 75 degree Celsius and in shade: 55 degree Celsius Minimum temperature: - 10 degree Celsius (Also snow fall in certain areas during winter season)
Humidity	100% saturation during rainy season
Reference site conditions	i) Ambient temperature: 50 °C ii) Humidity: 100% iii) Altitude: 1776 m above mean sea level
Rain fall	Very heavy in certain areas.
Atmospheric conditions	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m <sup>3</sup> . In many iron ore and coal mine areas, the dust concentration is very high affecting the filter and air ventilation system.
Coastal area	Humid and salt laden atmosphere with maximum pH value of 8.5, Sulphate of 7 mg per liter, maximum concentration of chlorine 6 mg per liters and maximum conductivity of 130 micro Siemens /cm.
Wind speed	High wind speed in certain areas, with wind pressure reaching 150 kg/m <sup>2</sup> .

### 4.0 **STANDARDS/ REFERENCES:**

The Cable & Pipe Sealing system shall confirm to the following Indian Standards /International Standards as amended /revised till date unless stated otherwise, as applicable:

S.N	Specification No.	Description
1.	IEC:60529	i) Cable transit / Retention / Protection System assembled with EPDM Modules to be complied with IP 55 ii) Cable sealing system assembled with EPDM rubber Modules which is used at entry or exit of cable from loco wall at rooftop or bottom / under frame should comply to IP 67.
2.	UL-1479 or EN 45545-3:2013 or IS 12458-1988 with latest revision or IM O FTP Code	Fire protection certificate from reputed International/NABL approved national laboratories as per standards to be followed.

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	2010 Part-III with latest revision.	
3.	NF F 16-101, NF F 16-102	Low Smoke & Toxicity index.
4.	IEC 61373:1999-01	Vibration & Shock test
5.	IEC 60243-1:2013 or ASTM D149	Di- Electric Strength.

## 5.0 GENERAL ARRANGEMENT

Cable Transit System for power & control cables shall mainly consist of following sub assemblies:

- Module
- Frames (Non-metallic/ Metallic)
- Compression Unit/ (separated or integrated)
- Stay Plates(For rectangular frames)
- Lubricants/Gel

### 5.1 MODULE

- Module shall be of adjustable/Multidiameter/ fixed type (in case of fixed type module, the module can adjust different type of cables according to their dia with the tolerance given in RDSO specification No- ELRS/SPEC/ELC/0019 Rev '2' of Feb 2011 or latest, RDSO specification No. E-14/01(part I & II & III) Rev'2' of 1993 or latest and CLW specification NO. CLW/ES/3/0458 and CLW/ES/3/0459 or latest diameter along with central core /central plug so that it can be adjusted for different cable diameters. Adjustable /Multidiameter type module shall be of adding/peeling off technology so that the same block can be used by peeling off the excess layers / adding on layers suitable to the cable outer diameter without any requirement of replacing the blocks. The modules consist of two halves for each cable, and each module is 30 mm & 60 mm long. One single module can seal a cable of several different diameter simply by peeling away layers.The range of modules shall be able to accommodate cables of all sizes greater than 2.5 mm in diameter.The spare adjustable /Multidiameter type / peeling off technology type modules may be supplied with readjust able and reusable plug/wrap/Core for sealing the spares cables.

The range of modules shall accommodate cables of all sizes greater than 2.5mm diameter. Their sizes could be different but the length is always 30 or 60mm.

- EPDM Module with intumescent material which expands in case of fire may be used for Sealing of PMA Conduit / plastic pipes as per requirement.

#### 5.1.1 COMPOSITION:

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The adjustable /Multidiameter/fixed type modules will be of Low Smoke Index, Halogen free cross-linkable rubber compound based on Ethylene Propylene Diene Monomer (EPDM).

### **5.1.2 ARRANGEMENT OF MODULES**

The arrangement should be such that it ensures perfect sealing, regardless of the outside diameter of the cable without causing undue stress to the cables. Modules shall be adjustable/Multidiameter/fixed type/peeling of technology type module that can be adjusted for different cable diameters. The range of diameters of each adjustable /Multidiameter/fixed type/peeling of technology type module shall be wide enough to accommodate cables of different sizes.

### **5.1.3 PHYSICAL AND CHEMICAL PROPERTIES (OEM'S CERTIFICATE CAN BE ACCEPTED)**

- 5.1.3.1 Specific gravity: 1200-1600 kg/m<sup>3</sup>
- 5.1.3.2 Di-Electric Strength:  $\geq 20$  kV/mm
- 5.1.3.3 Temperature of Decomposition:  $>+300^{\circ}\text{C}$
- 5.1.3.4 Solubility: Insoluble in water
- 5.1.3.5 Normal operating Temperature range:  $-40^{\circ}\text{C}$  to  $+90^{\circ}\text{C}$

**5.1.4** The material (EPDM rubber) of the adjustable /Multidiameter/fixed type/peeling of technology type module with central plug/wrap/core shall ensure Protection against Dust, Water, humidity & penetrating solid objects as per IP 55/67 (IEC 60529). It should be able to withstand Vibration & Shock ( as per IEC 61373) and temperature variations in the cable. The material of the adjustable /Multidiameter/fixed type/peeling of technology type module shall also not be destroyed/affected by noise, rodents and flammable oils. The modules should be protected against Rodent. A certificate by any NABL approved / International laboratory to be submitted by manufacturers in this aspect.

### **5.2 COMPRESSION UNIT/WEDGE (SEPARATED OR INTEGRATED):**

The Compression Unit is used in frames with a rectangular packing space for uniformly compression of Cables, Pipes, Modules and Stay plates. The Wedge is a highly efficient compression unit, which saves valuable installation time both when it comes to installation and re-installation of the Multidiameter sealing System. The complete compression unit consists of only one piece, which, by turning the screws in the front, both compresses and decompresses the wedge.

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For Round Type Seals the compression unit is integrated in the seal.i.e for Round seal there is built in compression unit & no separate compression unit is required as in rectangular arrangements.

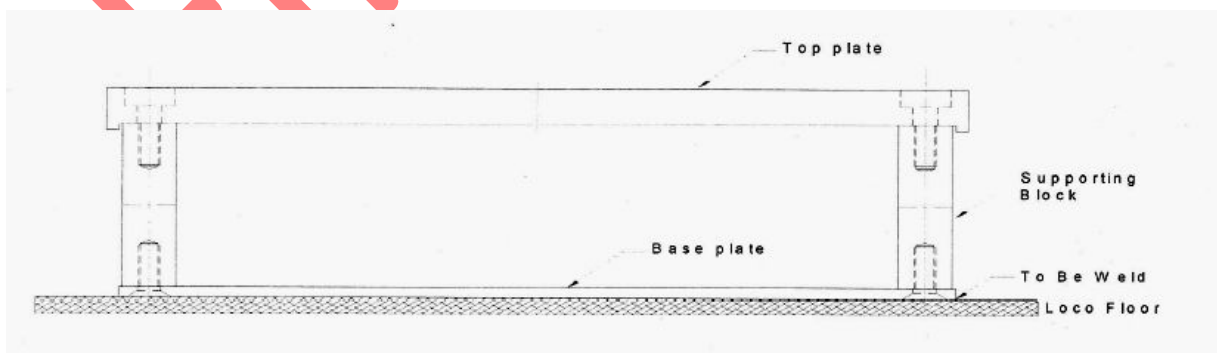
Material of wedge is similar to that of modules i.e Low Smoke Index, Halogen free cross-linkable rubber compound based on Ethylene- Propylene rubber (EPDM). The bolts are normally made of galvanized steel, if required the bolts can also be offered with acid proof stainless proof stainless steel (AISI-316) material.

## 6.0 FRAMES (METALLIC/NON METALLIC)

The frame shall consist of a Top plate and Base plate with two supporting blocks in between the two plates at either end. The choice of frame depends primarily on the material used in the application area and the method of attachment. The frames can either be cast, bolted, welded, riveted or fitted into sleeves. Materials used for frames shall be Nylon 6/6 with 30% glass fibres or SRBGF or Aluminum or Mild Steel or Stainless Steel. However, for the areas like rooftop, underframe etc. where welding is involved and fire and IP 67 protection are required only mild steel or stainless steel shall be used as frame material. The depth of the frames shall be such that they cover the complete EPDM modules. Refer Figure - 1 for Frames arrangements. Material used for frames should be such that it has good impact strength, tensile strength, withstands variation in temperatures and it should not be corrosive.

Frame material with grade shall be as per below mention standards:

- (i) SRBGF with Min. UP-1 Grade as per standard IS: 10192:1982.
- (ii) Mild Steel, Grade Fe 410 as per standard EN10204:2004 or equivalent material as per Indian standards.
- (iii) Galvanized coating (Min 50 micron) as per standard ISO 1461:1999 or equivalent coating as per Indian standards.
- (iv) Aluminum, Grade HA9 6063 as per EN 1676 and 1706 & EN -10025-2 or equivalent material as per Indian standards.
- (v) Stainless Steel as per AISI 316 or above.
- (vi) Nylon 6/6 with 30% glass fibres as per ASTM D-638 & ASTM D-785A.



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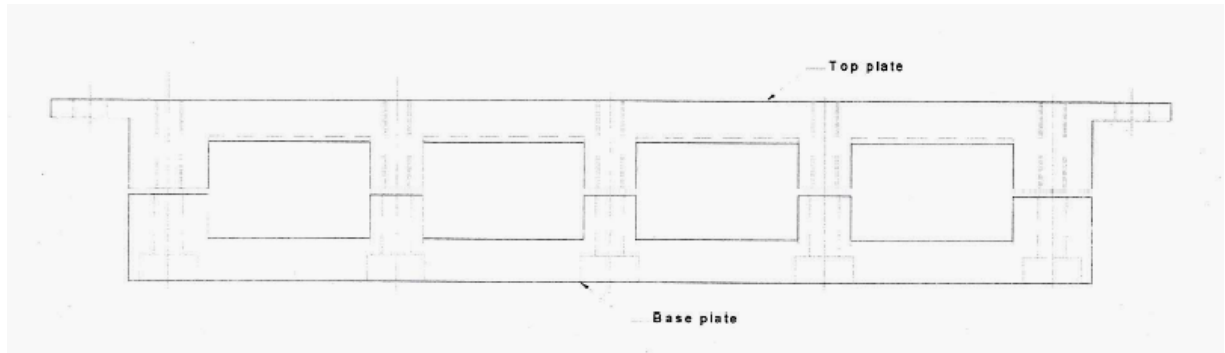


Figure – I

### 7.0 STAY PLATES

Material of construction of the stay plate shall be as per SS/AISI 316 or Galvanised mild steel. To increase stability and to secure mechanical anchorage within the frame, Stay Plate should be provided in row/column as per design of EPDM Rubber Module. Stay plates can vary depending upon the design & application.



### 8.0 LUBRICANTS/GEL

Lubricants/Gel are to be used in all installations to assure the proper sealing performance of the rubber modules and facilitate maintenance.

- 9.0 The manufacturers/supplier (OEM) of EPDM Modules shall supply relevant drawings and literature with the material for each type of module along with its arrangement consisting of frames, stay plates and type of lubricants/gel according the approved drawing of RDSO/CLW/Railways before submitting the tender bid/material.

### 10.0 TEST REPORTS

The supplier (OEM) should be manufacturer of cable transit system with EPDM module. The manufacturers/suppliers shall submit copies of Test reports evidencing the properties of the EPDM rubber material given in the specification viz. Low Smoke Index, halogen free cross linkable rubber, specific gravity, di-electric strength, and capability to withstood temperatures up to 300 ° C, insolubility in water. Documents supporting the

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properties of fire/flammability resistance as per UL-94(V-0 or latest) and protection of material from dust, water, humidity and penetrating solid objects as per IP 55/67 (IEC 60529) shall also be furnished. The capability of the material to withstand severe vibrations, shock and temperature variations in the cable shall also be given. Similarly, documents supporting the material characteristics of frames stay plates and lubricants given in Clause 6.0, 7.0 & 8.0 respectively of this specification shall also be furnished.

## **11.0 ACCEPTANCE TESTS:**

Tests carried out on samples taken specifically from an offered lot for the purpose of acceptance of the lot shall be performed. Following test shall be done to carry out the acceptance of the product.

### **11.1 VISUAL EXAMINATION:**

The Cable Transit System shall be examined physically for the workmanship and the design technology employed. It shall be checked for any flaw/defects, roughness of samples cracks visible to naked eye and shall consist of verifying manufacturer's identity & dimensional range, compression of system & system configuration.

#### **11.1.1 MANUFACTURER'S IDENTITY & DIMENSIONAL RANGE:**

Cable Transit System shall be examined visually to check the manufacturer's trademark. The location of the trademark on the system shall be matched with the concerned drawing of system. Each adjustable /Multi diameter/fixed type/ peeling of technology type module shall be visually checked for the range of diameters of cables it can hold & shall be verified by printed /marked dimensional range mentioned on each module.

#### **11.1.2 COMPRESSION OF SYSTEM:**

The Cable Transit System shall be examined visually to check the proper compression of adjustable /Multi diameter/fixed type-peeling of technology type modules. The rays of light shall not pass through system/ modules.

## **11.2 DIMENSIONAL TEST:**

**11.2.1 OBJECTIVE:** To check the manufacturing of Cable Transit System.

**11.2.2 METHOD:** Each adjustable /Multidiameter/fixed type/peeling of technology type module is printed/marked with dimensional range showing the minimum & maximum cable diameters it can hold. The adjustable /Multi diameter/fixed type/peeling of technology type module shall be verified by placing the cables falls under that dimensional range. The dimensional range shall broadly match the diameters of the module given in the drawings.

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**11.2.3** Refer the Drawing of the subjected Cable Transit System to check the dimension of the system.

**12.0** **TYPE TESTS:**

These tests shall be carried out to prove conformity of the material with the specification. These are intended to prove the general qualities and design of a given type of Cable Transit System. The quality Audit of Approved vendor will be undertaken as per RDSO ISO document no. QO-D-8.1-13 ver 1.3 (latest version) or as per latest guidelines issued by RDSO for the purpose.

The type tests shall be carried out in supplier's premises and firm should have the test facility in their premises to perform the test like Pull Test, Water ingress tests, dimensional check along with the visual appearance check.

Following shall constitute the type tests in addition to the Acceptance Tests mentioned in Clause 11.0

Certificate from international / national reputed agencies like UL, LNE, CPRI, ERDA and other similar agencies shall be considered against test mentioned at S No. (iii), (iv) &(v).

- (i) Water Ingress Test(In house)
- (ii) Pull Test(In house)
- (iii) Protection from dust, water, humidity and penetrating solid object as per IP 55 for cable retention system and IP 67 for sealing system i.e in/out for(under frame /Roof top applications)
- (iv) Fire protection test on cable transit system shall confirm to any one of the minimum requirement specified below.

SN	Standards	Minimum requirement specified
1.	EN45545-3:2013 or (latest)	E-30,I-15
2.	IS:12458:1988 or (latest)	30 minutes
3.	UL 1479	F-30,T-15
4.	IMO FTP code 2010 Part III or (latest)	A30

This test can be carried out at any international / national reputed & recognized laboratory authorized to carry out the test as per specification. Copy of the test certificate needs to be submitted.

- (v) Low smoke & Toxicity index test as per NF F 16-101 & NF F 16-102 complying with F1 class.

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## **12.1 WATER INGRESS TEST:**

**OBJECTIVE:** To determine the water tightness of the Cable Transit System when subjected to spray of water.

**12.1.1 TEST EQUIPMENT:** A holding arrangement / fixture of sufficient dimension to house the Cable Transit System.

**12.1.2 INITIAL EXAMINATION:** The Cable Transit System shall be assembled with all its components like modules, stay plates, wedge (if required) etc. and a continuous cable passing through its any module.

**12.1.3 CONDITIONING:** The cable transit system in its assembled condition shall be secured at holding arrangement / fixture. The water shall be sprayed with a pressure of 12.5 Liters/min and the distance between nozzle & test item shall be 2.5m to 3.0 m. at a normal room temperature. The test result should meet the requirement as per IP 55 as per clause.

**12.1.4 DURATION:** The test is to be done for a period of 3 minutes in the direction of Cable Transit.

**12.1.5 FINAL EXAMINATION:** The Cable Transit System shall be examined externally for any abnormality. The Cable Transit System shall be visually examined at other side of system for any ingress of water.

**12.1.6 ACCEPTANCE:** The Cable Transit System will be declared to have passed the water ingress test in case there is no water vapour present on other side of the transit system.

## **12.2 PULL TEST:**

**12.2.1 OBJECTIVE:** To check the strength and holding of the cable by module inside the Cable Transit System.

**12.2.2 TEST EQUIPMENT:** A holding arrangement / fixture of sufficient dimension to house the Cable Transit System.

**12.2.3 METHOD:** The Cable Transit System should be assembled with a long length of cable so that it can be pulled to the required force of at least 80N for a minimum period of 48 hours to check the strength of modules inside the Transit System.

**12.2.4 ACCEPTANCE:** The cable transit system will be declared to have passed the pull test in case there is no movement of cables or modules.

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### 13.0 PROVISION IN ELECTRIC LOCOMOTIVES:

1. Drawing for cable management system to be introduced in various types of Electric Locos Shall be prepared by CLW/Railway's as per their requirements.
2. CLW have already approved following drawing for certain class of locomotives which can be used by Railways also. All other latest drawings issued by PUs/Railways from time to time can also be used.
  - (i) CLW Drg. No- CLW/ES/SK-1/C-61 Alt-B for (EPDM Modules for Power Cables Trench for New WAG-7 Locomotives)
  - (ii) CLW Drg. No- CLW/ES/SK-2/C-61 Alt-C for (EPDM Modules for inside from to under frame & under frame to TM for New & Existing WAG-7 Locomotives)
  - (iii) CLW Drg. No- CLW/ES/SK-3/C-61/A .Sht.No.01 of 01/Alt-B (EPDM Modules transit from inside to under frame to TM for New & Existing WAP-4)
  - (iv) CLW Drg. No- CLW/ES/03/C-61/SK-4/1 (EPDM Modules for sealing of Roof Top Cables Near Resistor Harmonic Filter for Three Phase Locomotives (WAG9/WAP5/WAP7).
  - (v) CLW Drg. No- CLW/ES/03/C-61/SK-4/2 (EPDM Modules for underframe cables for TM Earthing & Sensor for Three Phase Locomotives (WAG9/WAP5/WAP7).
  - (vi) CLW Drg. No- CLW/ES/03/C-61/SK-4/3 (EPDM Modules for Copper Pipes Transit from Engine Room to Driver Cab(LHS &RHS) Cables for Three Phase Locomotives(WAG9/WAP5/WAP7).
  - (vii) CLW Drg. No- CLW/ES/03/C-61/SK-4/4 (EPDM Modules for Cables Transit From Inside to Outside for TM (Junction Box) for Three Phase Locomotives ( WAG9/WAP5/WAP7).
  - (viii) CLW Drg. No- CLW/ES/03/C-61/SK-4/5 (EPDM Modules for Traction Motor Terminal Box for Three Phase Locomotives (WAG9/WAP5/WAP7).
  - (ix) CLW Drg. No- CLW/ES/03/C-61/SK-4/6 (EPDM Modules for Cable Transit through Trench from Engine Room to Driver CAB 1 & 2 for Three Phase Locomotives (WAG9/WAP5/WAP7).
  - (x) CLW Drg. No- CLW/ES/03/C-61/SK-4/7 (EPDM Modules for Cable Transit through Trench from Engine Room to Driver CAB 1 & 2(At Door Top) for Three Phase Locomotives (WAG9/WAP5/WAP7).

### 14.0 TEST FORMATS:

The standard formats for various tests are enclosed under Annexure-A.

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**Annexure -A**

<b>Test Summary</b>	
Test Report No:	Date:
Test Name	<b>Water Ingress</b>
Product Description	
RDSO Specification No.	
Test Method / Standard	
PO/WO No. & dated	
Water pressure	
Distance	
Duration	
Final examination	
Acceptance	
Remarks ( if any)	
<b>Tested By</b>	<b>Witnessed By</b>

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<b>Test Summary</b>	
Test Report No:	Date:
Test Name	<b>Pull Test</b>
Product Description	
RDSO Specification No.	
Test Method / Standard	
PO/WO No. & dated	
Required Force	
Test start date&Time	
Test End Date & Time	
Duration (48 hours)	
Final examination	
Acceptance	
Remarks ( if any)	
<b>Tested By</b>	<b>Witnessed By</b>

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