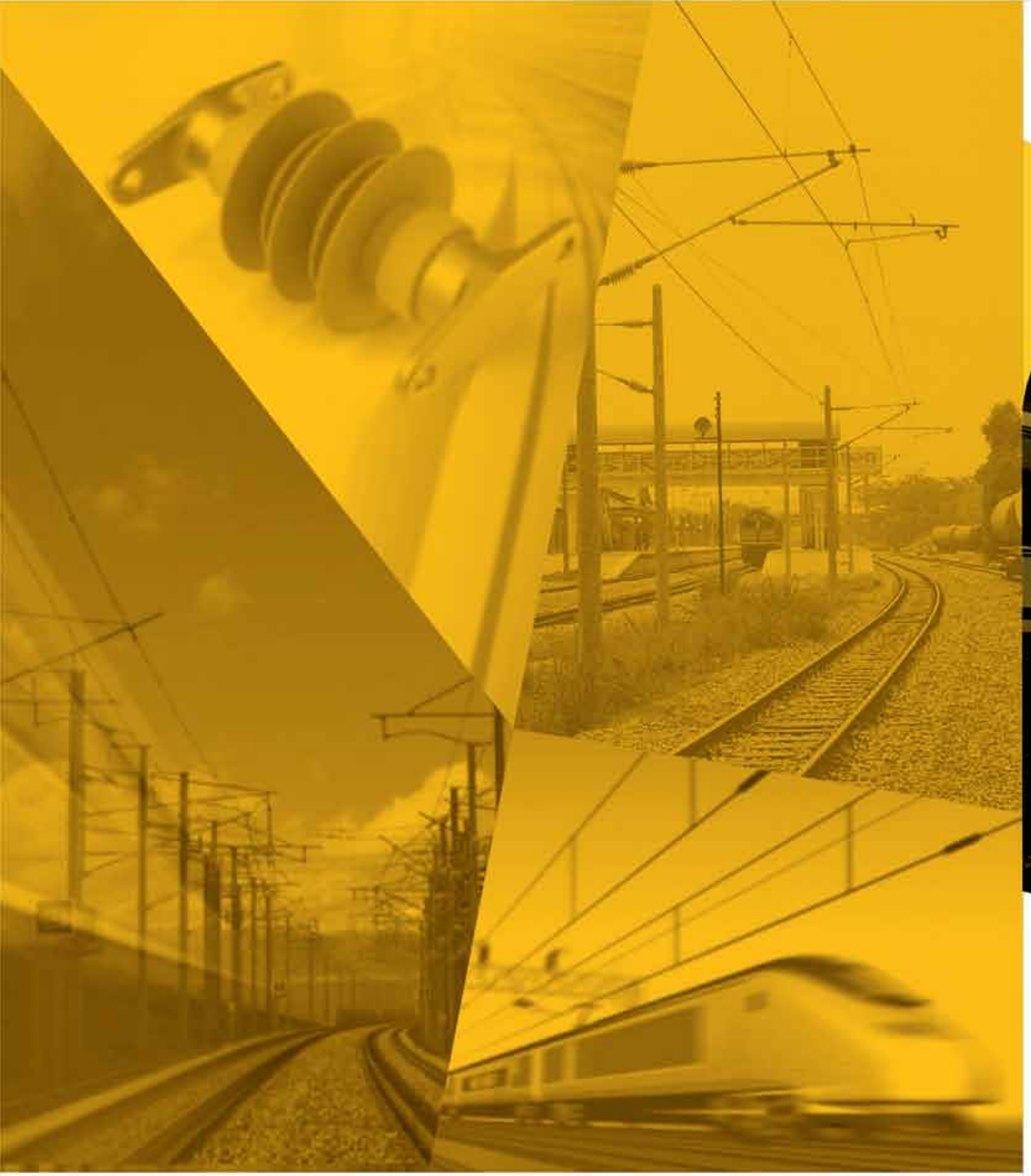

Raychem RPG

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Raychem RPG

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ENGINEERING GROWTH
PIONEERING EXCELLENCE

(A TE-Connectivity - RPG Enterprises JV)

Solutions for Railway OHE

The railway network is the backbone of the Indian transportation system, connecting remote villages and towns with metropolitan cities across the country. Recent government initiatives aim to revamp and modernize the entire network by 2030, and the past couple of years have already brought many changes to the rail system. From a technological perspective, we can expect two notable changes to Indian railways: the introduction of electric and solar-powered trains and an increase in the operating speeds of trains from 100 km/h to 160–220 km/h. To support these plans, suitable modifications must be made to the existing infrastructure and components, such as the overhead equipment (OHE), including catenary and contact lines, as well as pantograph assemblies.

Raychem RPG, a pioneer in innovative energy solutions for various sectors, has a dedicated team working on products that can meet the challenging requirements of the evolving railway network. The team of scientists and researchershas improved the designs of Overhead equipment devices such as Auto-Tensioning devices (ATD), Modular cantilevers (MCS), Short Neutral Section, Insulators& Connectors & fittings.

Raychemis a market leader in connection technology. It manufactures cable accessories up to 245 kV, and connector systems, viz. shear bolt, low power-loss wedge connectors, insulation piercing, deep step indentation, and bolted, up to 1200kV. Raychem Zero-Halogen Heat-shrink technology is widely used in Metro underground applications.

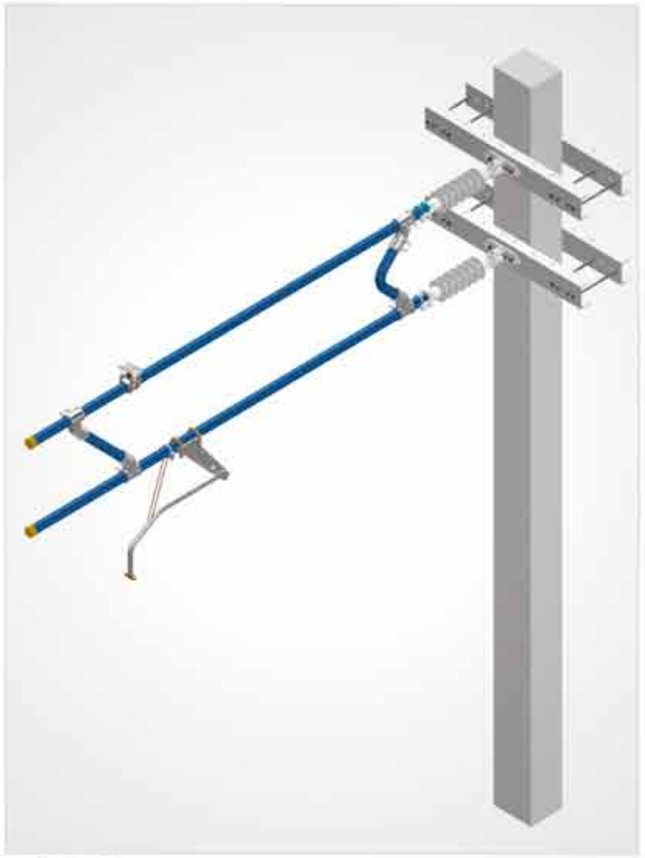
Raychem RPG Limited is a 50:50 joint venture between RPG and US group TE Connectivity (formerly Tyco Electronics), and is involved in engineering products and services catering to the infrastructure segments of the economy such as power, telecommunications, hydrocarbon, oil and gas, and water.

Modular Cantilever System (MCS)

Raychem Indigenous Modular Cantilever System is designed to support the assembly of overhead power transmission wires — i.e., catenary (1000/1200 kgf tension), contact (1000/1200 kgf tension), and droppers — to transfer the overall bending, transverse, and vertical loads to the mast via insulators. The quintessential cantilever is lightweight and robust enough to support the current-carrying assembly for semi-high speed and high-speed trains up to 250 km/h. In addition to these functional requirements, ease of maintenance, transportation, handling, and aesthetics have been considered. Raychem MCS come in two variants as Single Insulator (Foldable Design) and Two insulator based tubular design.

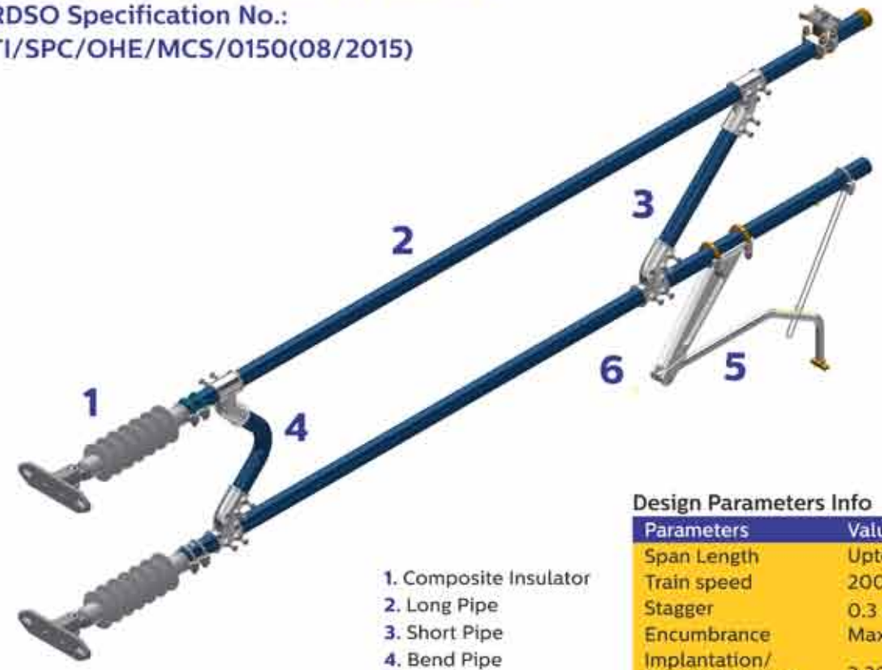
Pix Caption 1:

Pix Caption 2:



Pix Caption 3:

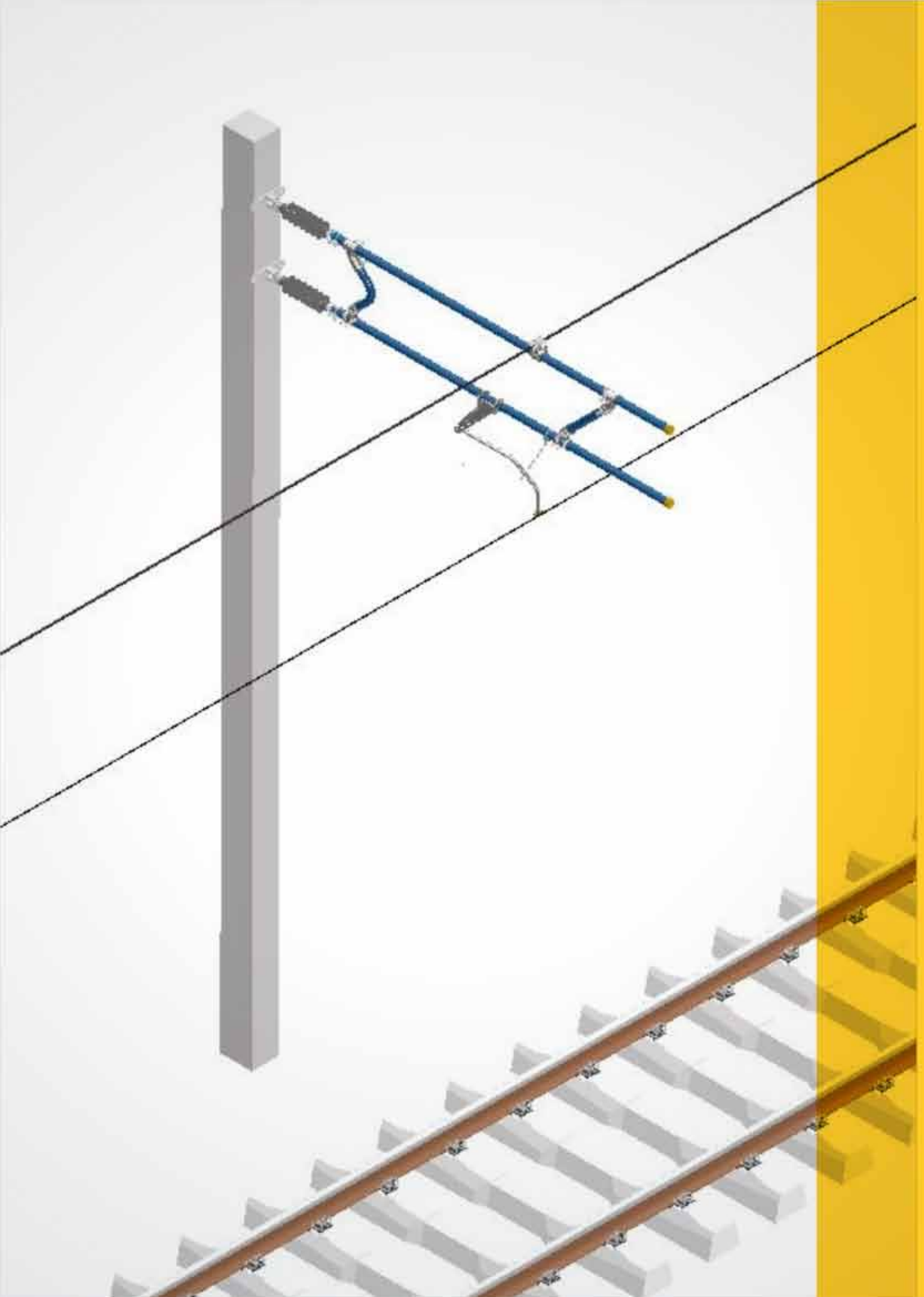
This tubular design complying with latest RDSO Specification No.: TI/SPC/OHE/MCS/0150(08/2015)



1. Composite Insulator
2. Long Pipe
3. Short Pipe
4. Bend Pipe
5. Steady Arm
6. Register Arm

Design Parameters Info

Parameters	Value
Span Length	Upto 72 m
Train speed	200 Kmph
Stagger	0.3 m
Encumbrance	Max 1.4 m
Implantation/ Setting Distance	2.36 m – 3.6 m
Max Wind Speed	57 m/s



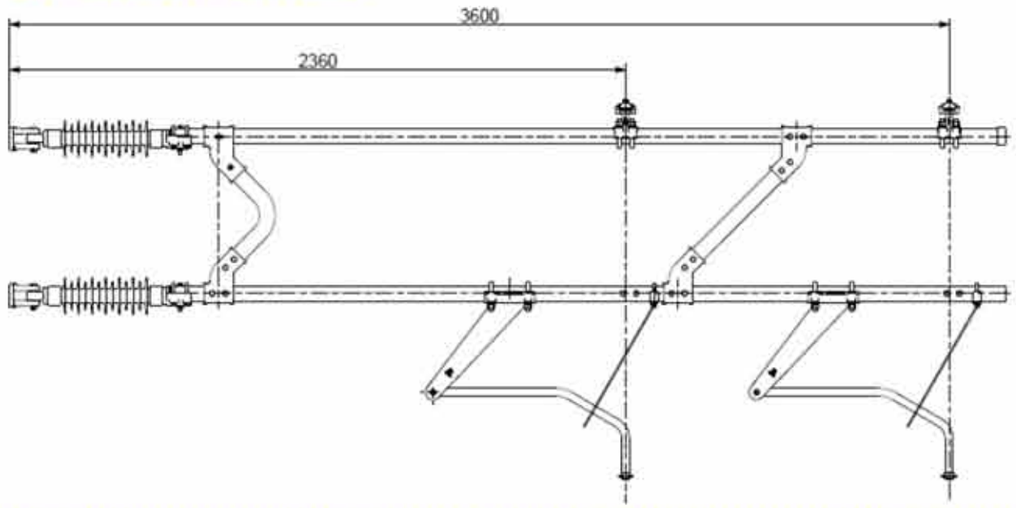
Features

- **Simple &Light weight Design**
  - Factory assembled product, ready to dispatch
  - Ease of on-siteinstallation and servicing
  - Low maintenance & onsite inspection
- **Structural integrity**
  - Validated for severe static & dynamic loading condition - considering Dead load of overhead lines, Ice load, vibration due to wind and passage of trains
  - Designed for high tension OHE lines for high-speed trains
- **Corrosion Resistant, Long Service life & High Reliability**
  - Can withstand worst polluting & corrosive atmosphere
- **Designed for operating 250kmph of train speed**
  - Can accommodate 350 km/hr with slight change in components
- **Ideal for Existing and New high-speed lines Railway lines, DFCC & for Metro Projects**
- **Best Insulator technology**
  - Polymeric insulator combines mechanical strength with excellent pollution performance.
  - The high tensile strength of glass fiber has been combined with our HV shredded profile, to produce rugged, lightweight tension insulator for OHE.
  - The production process ensures void free construction and optimal interfacial sealing
  - Proven track of 40+ Years in European and Japanese railways
  - Best Insulator material and design to prevent frequent flashovers in OHE
- **Suitable for different sizes of contact & catenary wire as given in Table below**
- **One solution for all variants: Different assembly/configurations possible**
  - Pull off & push off for implantation 2.36 m to 3.6 m.
  - Anti-creep Arrangement
  - Flexibility: Box Arrangement (1.0m) for yards
  - Stretched length for platform (upto 4.7m)
  - Overlap configurations for multiple MCS

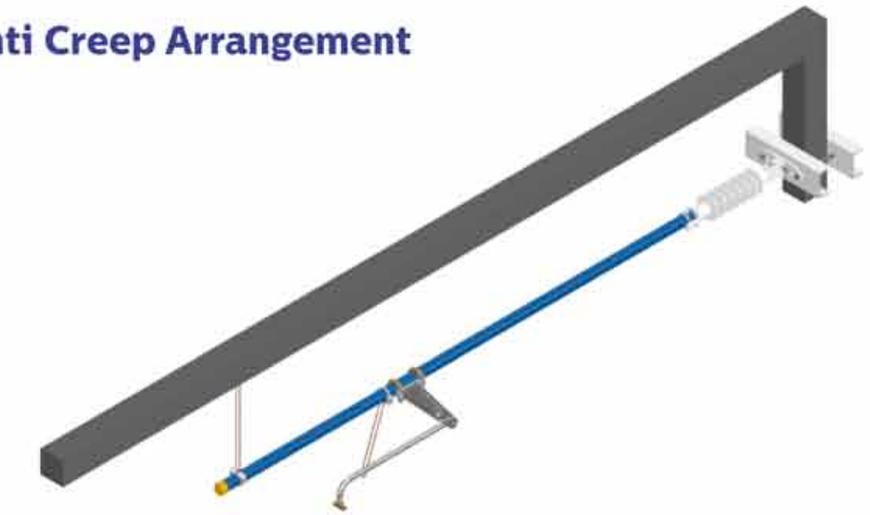
Sl. No.	Catenary Wire	Contact Wire
1.	19/2.10 mm, 65 mm^2 cadmium copper	107 mm^2
2.	19/2.10 mm, 65 mm^2 cadmium copper	150 mm^2
3.	19/2.79 mm, 65 mm^2 aluminum alloy	107 mm^2
4.	37/2.10 mm, 125 mm^2 cadmium copper	150 mm^2
5.	37/2.92 mm, 242 mm^2 cadmium copper	193 mm^2

Different Arrangements of MCS

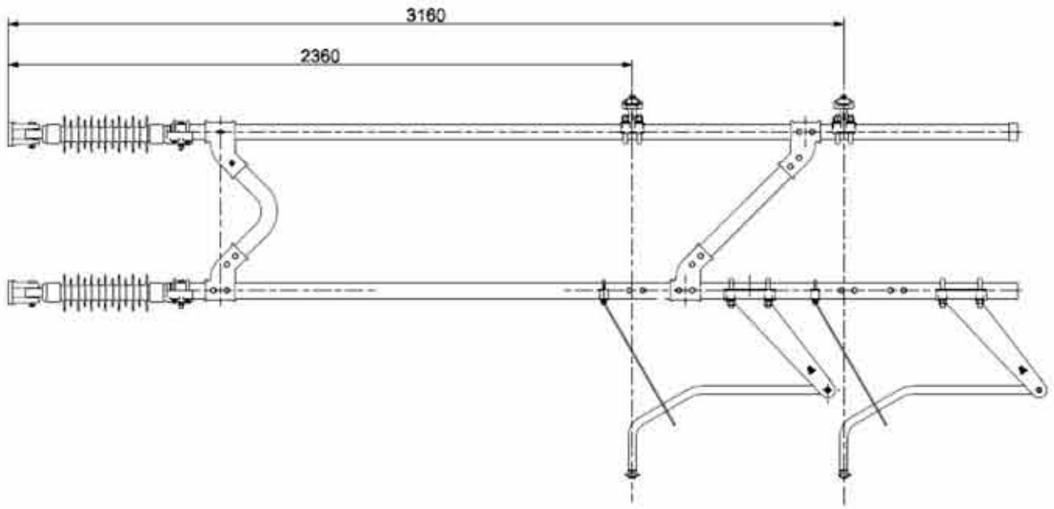
Pull Off Position



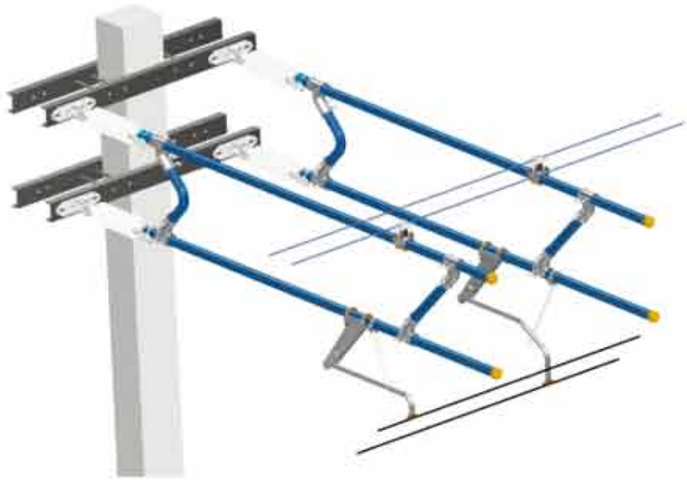
Anti Creep Arrangement



Push Off Position



Overlap Arrangement



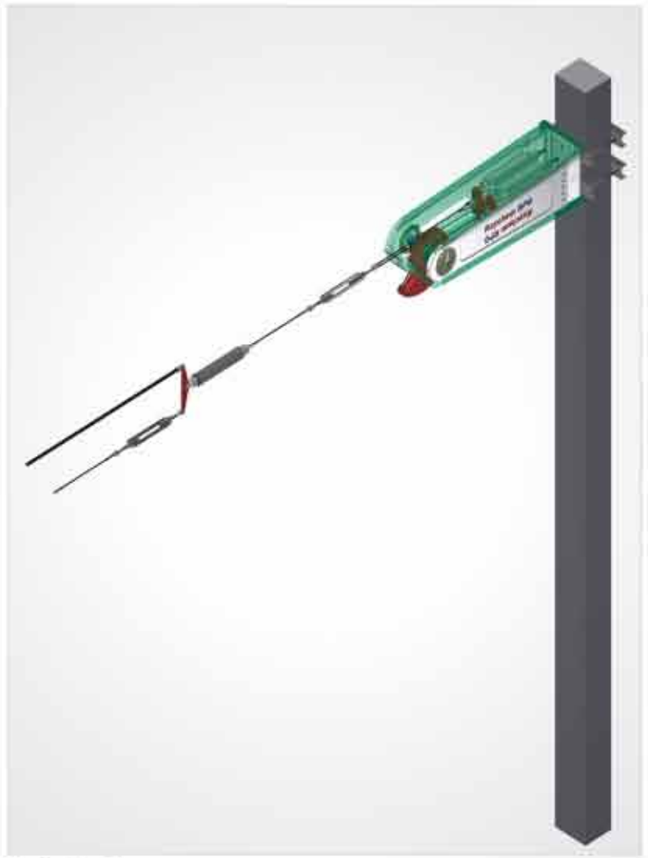
*Similarly, 3 MCS can be installed over a single mast

Auto Tensioning Device

In an electric rail system, power is supplied by overhead lines that run along the entire length of the railway track. This power is transferred to the train by means of the pantograph, which is a current collector mounted on top of the locomotive. The Auto tensioning Deices provides a mechanism for automatic tensioning of the OHE lines to assure smooth collection of current by moving pantograph. It does the function of maintaining constant tension in overhead line by compensating length due to temperature variation over a day cycle.The absence of tensioning causes the overhead lines to sag or tighten, leading to pantograph entanglement or snapping of the overhead equipment (OHE) lines. Raychem has introduced Indigenous spring ATD which is very light in weight and can cater to the load requirement up to 30 KN.

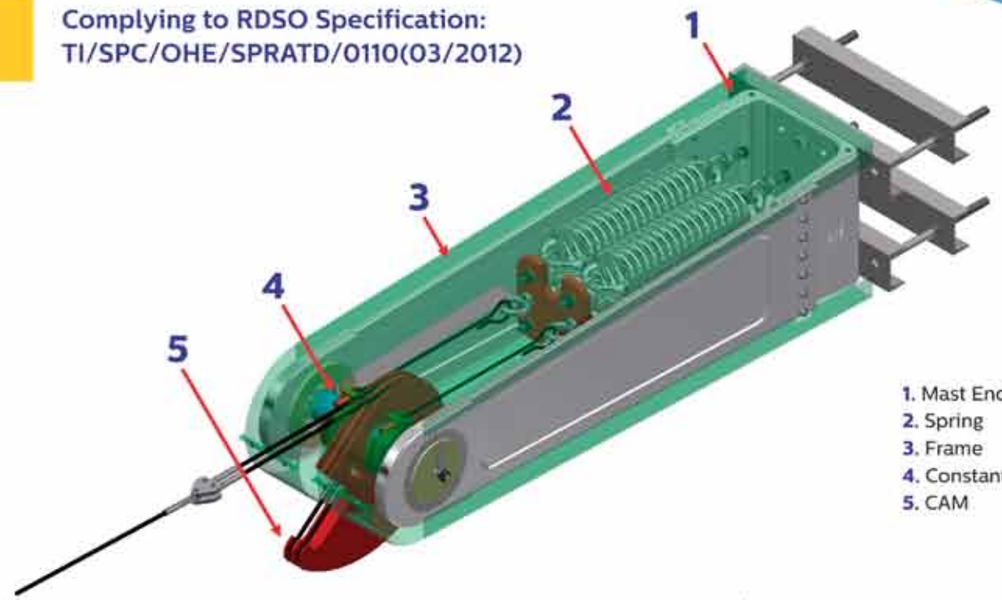
Pix Caption 1:

Pix Caption 2:

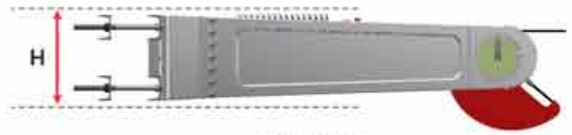


Pix Caption 3:

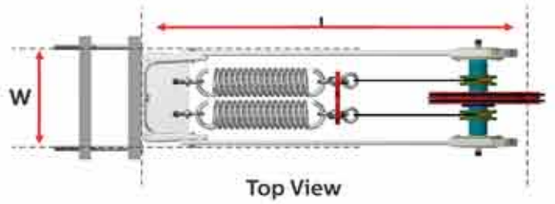
Complying to RDSO Specification: TI/SPC/OHE/SPRATD/0110(03/2012)



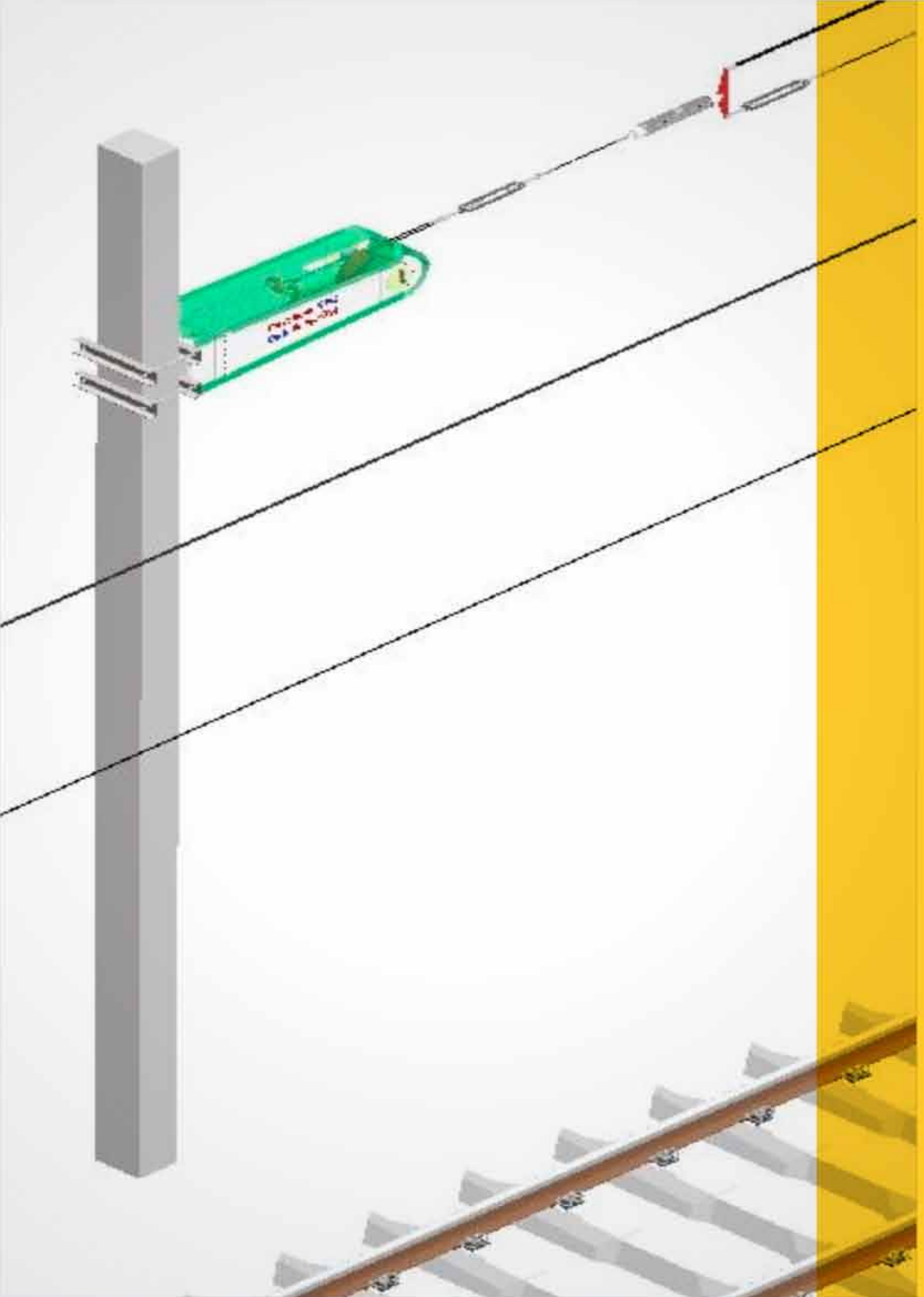
1. Mast End Fitting
2. Spring
3. Frame
4. Constant Radius Pulley
5. CAM



Side View



Top View



Features

- **Spring based ATD with**
  - Patented designs and Innovative technology
  - Factory fitted assembly, ready to install
  - Reduced Installation time
  - RRL Make in India initiative under Aatmanirbhar Bharat
- **Light weight & compact Design Innovative technology**
  - Ease of handling & transportation
  - Reduced maintenance
  - One fit for all-catering various configurations such has portals, tunnels etc.
  - Flexible to accommodate semi speed line to high speed line
  - Customizable for other requirements as well
- **Highest Safety**
  - No tensioning weight is required. Complete safety with no falling weight in case of any accident.
  - Designed for highest safety
- **High Precision**
  - Maintaining constant tension over desired compensating length.
- **Highest Reliability**
  - Undergoes testing & certification before shipping.

Design Parameters Info

Sl. No.	Parameters	Value
1.	Max Line Tension	1000/1200 kgf in each overhead wire (Overall 2000/2400 kgf)
2.	Max Tension Length	1500 m
3.	Half Tensioning Length*	750/600 m
4.	Working Temperature difference (ΔT)	65°C
5.	Weight	Approx. 200 Kg
6.	Length (L)	1580 mm
7.	Width (W)	360 mm
8.	Height (H)	350 mm

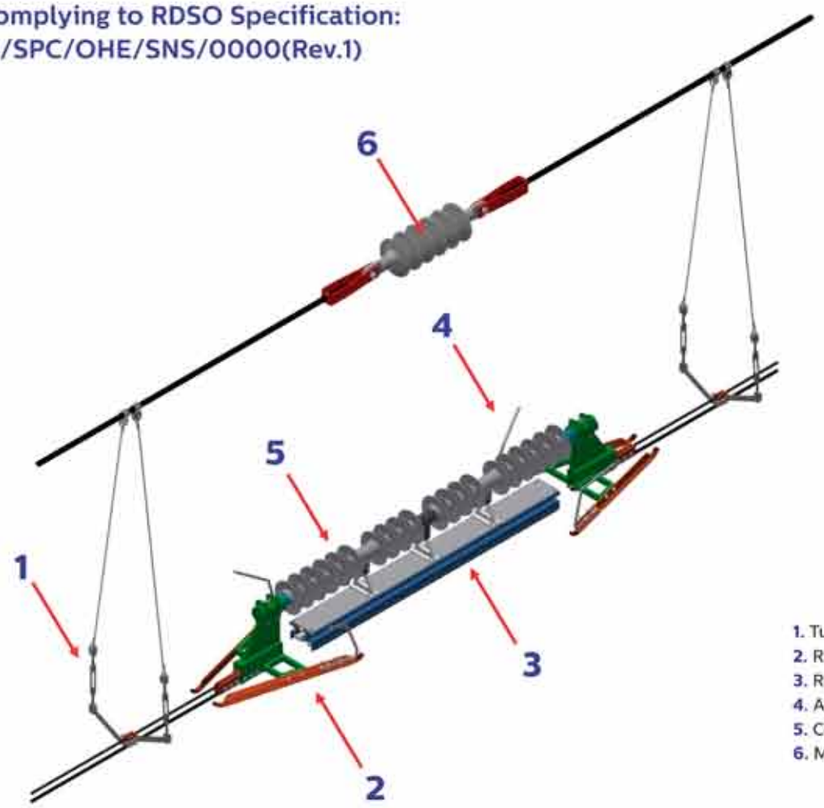
*Same Design can cater to 20kN & 24kN for max half tension length <750 m & <600 m respectively with change in CAM only

Short Neutral Section (SNS)

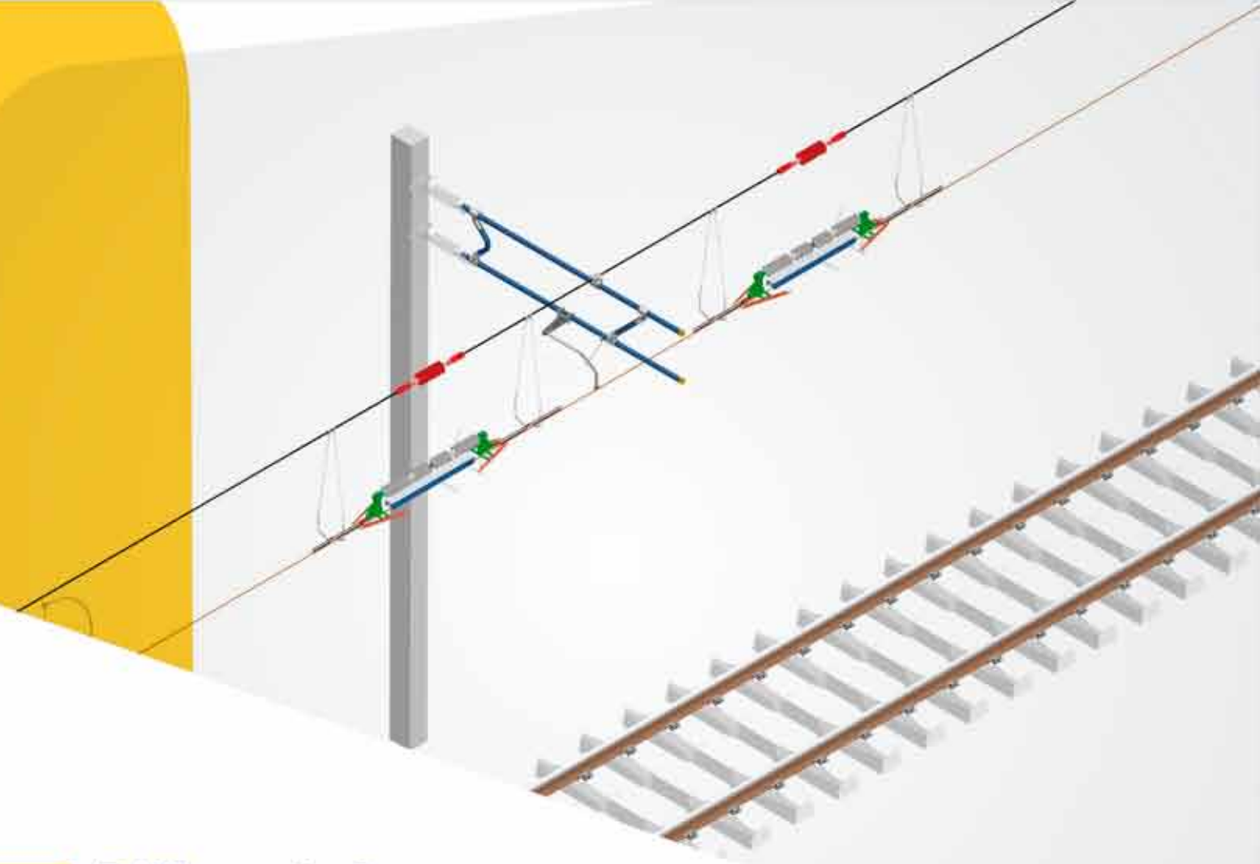
The utility power supply system expects equal loading on all phases. Traction power system works on single phase 25kV traction system. It now becomes important to use all the three phases equally and convert them into one phase traction supply. This is achieved by feeding single phase supply to the adjacent traction substation which is separated by a neutral section. Each feed covers a distance of about 30-40Km feeding all the trains in that zone.

Short Neutral sections are dead zones in the overhead line, used for isolating or separating different sections of the overhead electricity transmission line &also to provide smooth transition of pantograph from one section to another.To ensure strong Electrification drive, wear and tear nature of existing PTFE SNS needs a complete relook and design. Raychem RPG has introduced indigenous Short Neutral section for 25 KV line which is a moving roller-based technology and also, an alternative retrofit system for easy replacement of linings. A system which can eliminate the periodic maintenance and servicing issues.

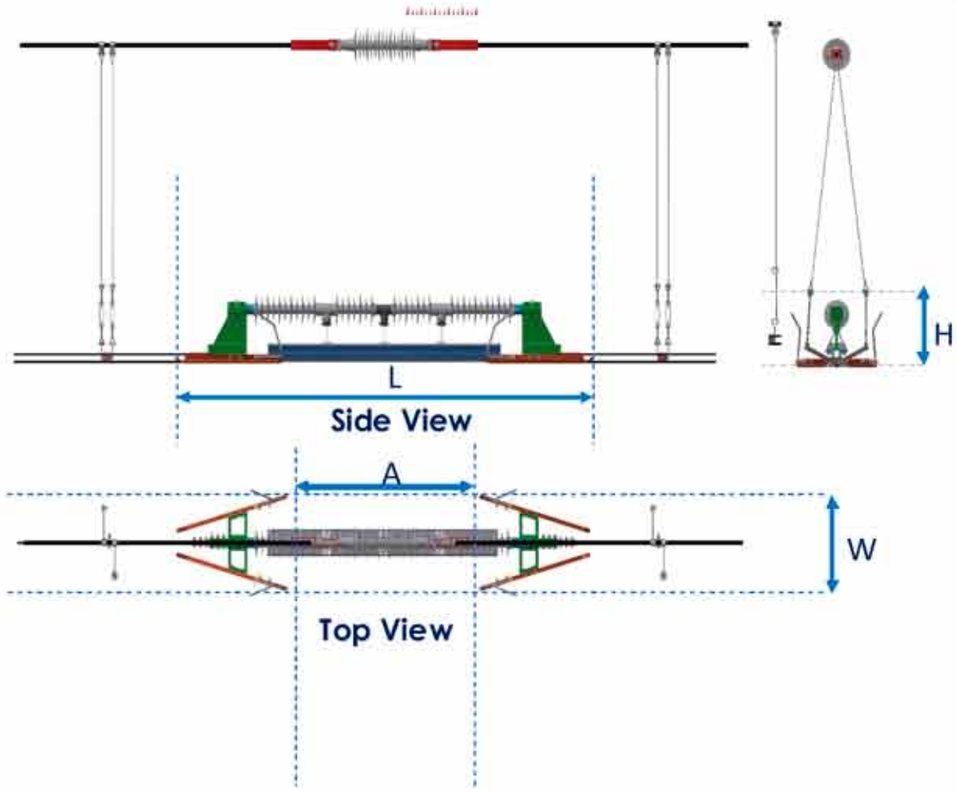
Complying to RDSO Specification: TI/SPC/OHE/SNS/0000(Rev.1)

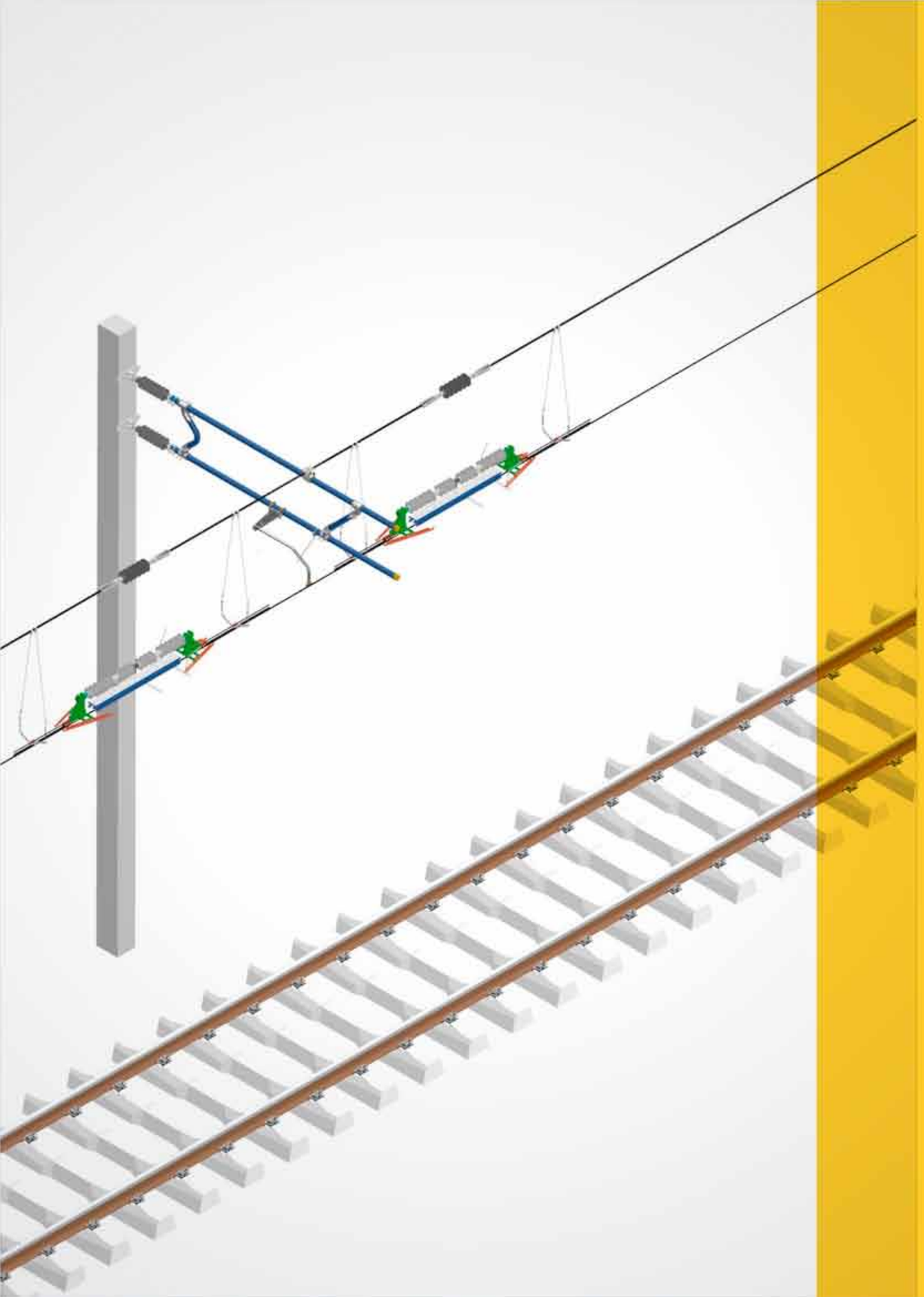


1. Turnbuckle Assembly
2. Runner
3. Roller Assembly
4. Arc Horn
5. Contact Wire Insulator
6. Messenger Wire Insulator



Different views of SNS





Features

- Uniform wearing of the contact – Long service life
- Best arc extinguishing capability
- Propriety PTFE technology assuring reduced friction with pantographs
- Reduced sliding friction between Pantograph & PTFE Roller
- Enhanced life of PTFE contact
- Smooth Transition from one section to other
- Bidirectional Crossing
- Insulator body revolvable in case of wear.
- For max. speed up to 250 km/h
- Minimum breaking load of the Neutral Section Element: 120 kN.
- SML of insulator rod: 80 kN.

Design Parameters Info

Sl. No.	Parameters	Value
1.	Loco Crossing Speed	200 Kmph
2.	Nominal Voltage	25 kV
3.	Highest System Voltage	52 kV
4.	Power Frequency Voltage	95 kV
5.	Impulse Voltage	250 kV
6.	Clearance (A)	900 mm
7.	Creepage	1800 mm
8.	Length (L)	2040 mm
9.	Width (W)	400 mm
10.	Height (H)	265 mm

Insulators

The Raychem RPG polymeric insulator combines mechanical strength with excellent pollution performance. The high tensile strength of glass fibre has been combined with our HV shedded profile, to produce this rugged, lightweight tension insulator for overhead line applications.

The Raychem RPG silicone insulator profile utilizes the similar design, materials, technology, and know-how that has been employed for over 40 years in Raychem, Bowthorpe EMP and Axicom medium and high voltage insulator product portfolios. Silicone is a hydrophobic material with a performance today of both proven tracking and erosion resistance and UV stability that gives a good balance of technical performance in a wide range of climatic and pollution conditions. The construction consists of compact creepage design insulator profile which has alternating diameter sheds to maximize flashover performance in polluted environments over a minimum insulator length. The production process ensures void free construction and optimal interfacial sealing. This is achieved by bonding the hydrophobic silicone insulating material directly to the FRP core and galvanized steel fittings using a proprietary bonding agent.

Bracket Tube

Stay Arm Tube

9 Ton

Features		Benefits		
Composite Design		• Light Weight - easy installation and reduced transport Cost • Vandal and Break Resistant		
Silicone Housing		• High tracking and erosion resistance • Excellent performance under polluted conditions • Reduced maintenance costs		
Patented Crimp Technology		• Maximum mechanical strength without damaging the fibre glass rod		
General Charateristics		**9 Ton**	**Bracket Tube**	**Stay Arm Tube**
Applicable Standard		IEC 61109, IEC 62217 & RDSO Specification No. T1/SPC/OHE/INSCOM/1071, Rev.1		
Material of FRP Rod		Boron Free, ECR Grade		
Material of Housing		Silicone, Grey		
Mechanical Charateristics				
Type of Shed Profile		Aerodynamic		
Applicable Standard for Shed Profile		IEC 60815		
Creepage Distance	mm	1600 & 1050		
Specified Tensile Load	kgf	11,000	7,000	7,000
Specified Cantilever Load	kgf.m	210	200	200
Electrical Charateristics				
Nominal System Voltage	kV rms	25		
Wet Power Frequency withstand Voltage				
(Horizontal Position)	kV rms	125		
(Vertical Position)	kV rms	100		
Dry Lighting Impulse withstand Voltage				
(Positive Polarity)	kVP	240		
(Negative Polarity)	kVP	260		
Visible Discharge Test Voltage	kV rms	35		

PCA Surge Arrester

Raychem's surge arresters provide active over-voltage protection that contributes directly to improved reliability of your system, reducing system outages and protecting expensive terminal equipment.

Raychem"PCA"siliconesurgearrestershavebeendesignedandtestedtomeetourcustomers' demands with reliability and offering optimum operationalperformance.

The Raychem arrester is made possible by:

- Proven moisture sealingtechnology.
- Non-tracking insulating siliconematerials.
- Fully integrated single piece and void lessdesign.
- Safe mode offailure.
- Quality.

ThePCAseriesarresterisdesignedtoperforminthetoughestenvironmentalconditionsandtomeet andexceedtherequirementsofIEC60099-4.

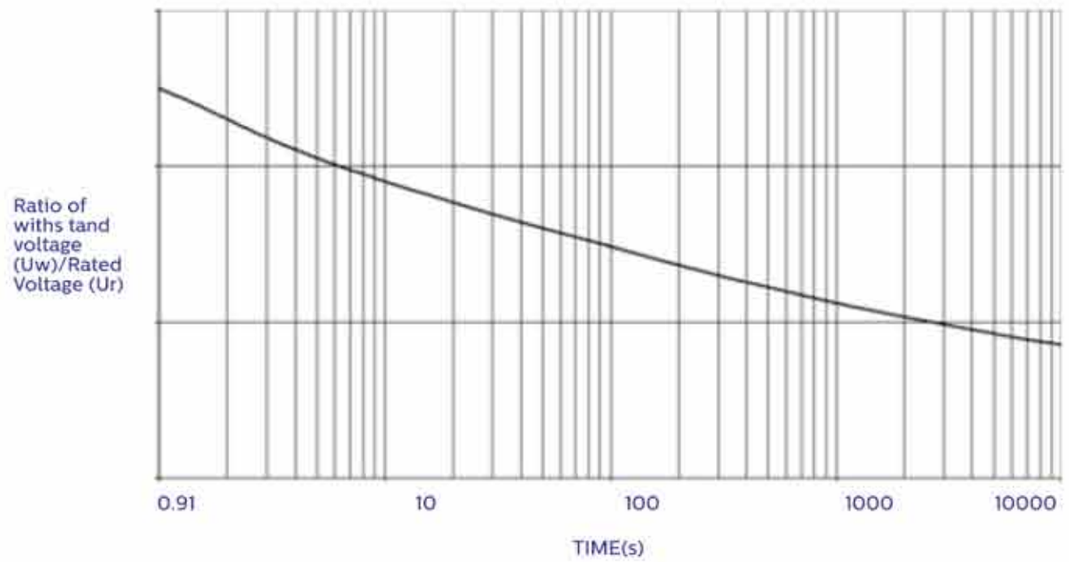
Also, Raychem RPG Disconnector is a device connected in series with a surge arrester that separates the ground lead from the bottom of the arrester if the arrester has overloaded and failed.

It is polymer housed with internal grading assembly and activating agent. The disconnector is intended to prevent permanent short-circuit of the line.

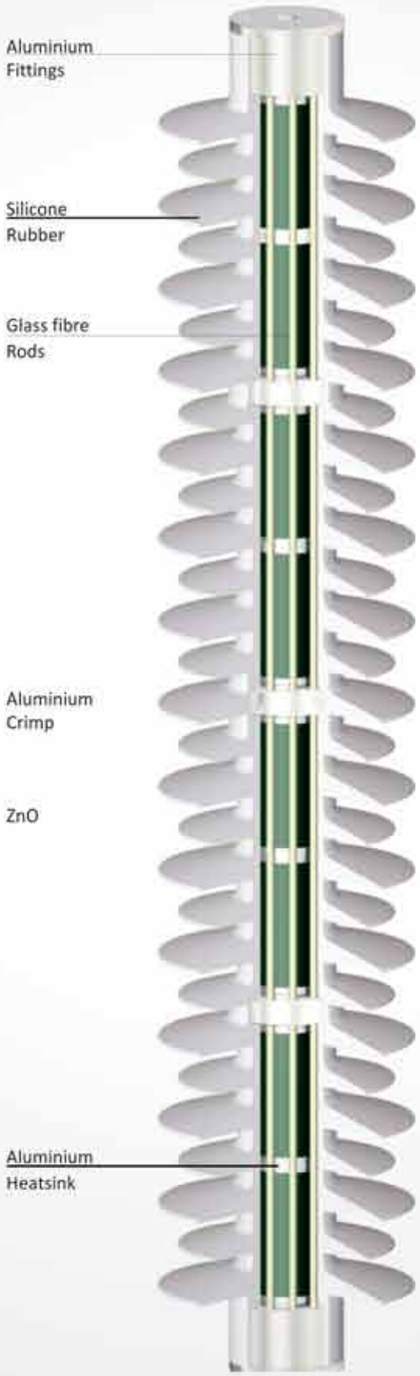
The primary function of disconnector is to disconnect the ground lead of the surge arrester in case of an internal failure of the arrester, preventing explosive failure of the arrester body and secondary function is to give visual indication of arrestor failure mounted on overhead distribution line which a lineman's sees and knows that a failure has occur and the device needs to be replaced.

Generic Technical Data	
PCA Series Ur Rating:	18 - 240 k
Rated discharge current (8/20):	V10 kA
Line discharge class 3 according to:	IEC 60099-4
Operatingdutyimpulsewithstandcurrent(4/10µs):	100 kA
Long duration current impulse (2400 µs):	640 A
1 second TOV (Uw/Ur):	1.15
High current short circuit: (pre-failing method) (Safe non-shattering failure mode):	65 kA
Energy based on Ur:	7.8 kJ/kV
Mechanical data	
Cantilever (Nm)	2500 Nm
Tension (N)	75 kN
Torque (Nm)	75 Nm

Power frequency voltage versus time with prior energy



Reliability, quality and protection excellence



Features

- Tested in accordance with IEC60099-4 at independent accreditedlaboratories.
- Direct moulded housing to prevent moistureingress.
- Low residualvoltages
- Safe non shattering short circuit behaviour to higher currentlevels
- Maintenancefree
- Hydrophobic silicone housing (Tracking and erosionresistant).
- Excellent cantilever and tensileperformance
- Quality design and manufacturing, ISO 9001 and 14001compliant.

Qualification testing:

Decades of arrester and materials, design and development experience has been combined to create the PCA surge arrester series. The basic construction comprises hig energy Zn Ovaristor assembled within a open cage design. The following IEC60099-4 design type tests have been carried out on the PCA surge arrester series.

- Insulation withstand tests on the arrester housing.
- Residual voltage test.
- Long duration current impulse with stand test.
- Operating duty tests.
- Short-circuit tests.
- Internal partial discharge test.
- Bending moment test(Cantilever).
- Moisture ingresstest.
- Weather Ageing Test.
- Power frequency voltage versus time characteristics on the arrester.

The silicone insulating material has been designed and optimised for arrester application. The following additional testing was performed in the qualification of the silicone.

- Tracking and Erosion.
- UV testing.
- Thermal endurance.
- Dielectric testing.
- Flammability testing.
- Long term water immersion testing.

Production and Quality:

All Raychem arrester production facilities are ISO accredited and internal procedures ensure test programs that guarantees quality conforming products. 100% of all varistors are tested and stamped with unique varistor residual and reference voltage. The following tests are performed on all varistors except where noted.

- Residual voltage.
- Reference voltage.
- Leakage current.
- LOT test: High current impulse test.
- LOT test: Aging test.

At the end of the arrester assembly process, the following mandatory IEC tests are carried out on 100% of the arresters.

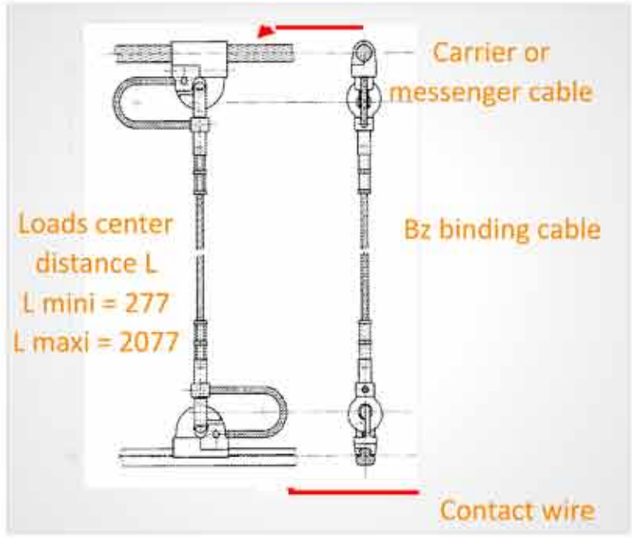
- Visua inspection
- Reference voltage measurement.
- Partial Discharge test.

Simel Connection Dropper

- Developed by Simel in collaboration with SNCF in order to designa dropper ableto
  - distribute the current on high speedline
  - support the catenaries wires on high speedline
- SNCFapproved:
  - Mechanical resistance under traction (2 Millionscycles)
  - Mechanical oscillation test (5 millionscycles)
  - Electrical ageingtest
- Simel connection dropper was used when TGV Est beat rail speed record (574.8 Km/h) on April 4 2007.
- Already installed:
  - France for Mediterranean High Speed line (70 000units)
  - Belgium for LGV2 line (28 000units)
  - UK for CTRL Section 1 (3 000units)
  - Greece for Olympic Games 2004 (5 000units)
  - France for the East TGV line (120 000units)

Features

- Distributes the current along the contact wire for 25kV high speed line
- Raw material: Cupro-Aluminium (CuAl10Fe2)
- Articulated at upper and lower part
- Dismountable on both side for messenger and contact wire
- Mechanical and electrical function provided altogether
- Can be fitted on:
  - Contact wire: 107/120/150 mm²
  - Messenger: 65.4/95/116.2 mm²
- Cross section of binding cable: 10 or 12 mm²
- Special automatic manufacturing process for intensive production
  - 100% traction tested
  - 100% lengths checked
- Possibility to cut to define lengths in workshop according to installation order

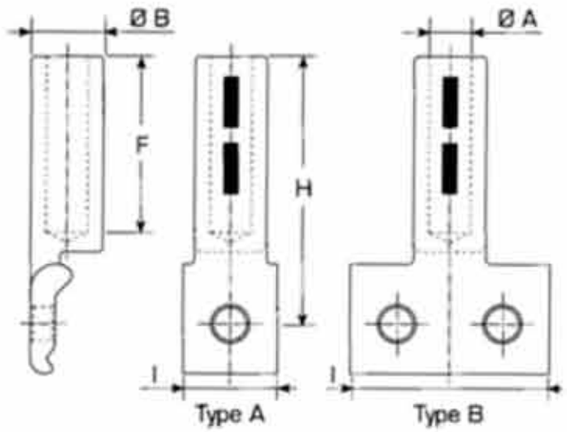


Branch tee and half clamp for contact wire

Mechanical and electrical connection between a copper conductor and the contact wire

Technical Characteristics

- SNCF approved
- In accordance with NFF 42-031
- 1.5 kV DC – 25 kV AC
- Good electrical contact
- Reduced weight
- Copper conductor crimped on FC Tee barrel



FC Tee

Designation	Cable to be connected	Type	Tools	Dimension (mm)				
				A	B	F	H	I
FC TEE 107-120-150/26	Annealed Cu 26mm²	A	SH16	7.9	18.5	40	73	31
FC TEE 107-120-150/104.5-145.8	Annealed Cu 104.5mm² or hard Cu 145.8mm²	B	SH20.4	17	25	55	87	65
FC TEE 107-120-150/147-164	Annealed Cu 147mm² or 164mm²	B	SH20.4	19	26	55	87	65

FC half clamp

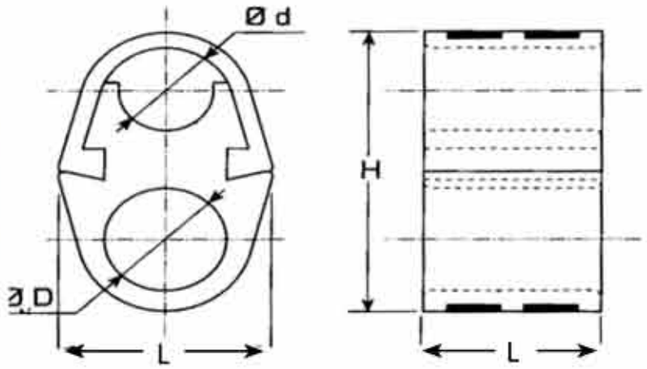
Designation	Contact Wire
FC Clamp/Bride FC	103-120-150mm²

Branch Connectors

Crimped connector to make mechanical and electrical branch between one end of a bare copper conductor to an intermediate point on a main bare copper conductor

Technical Characteristics

- SNCF approved
- Comply with NFF 42-031
- 1.5 kV DC – 25 kV AC
- Good electrical contact
- Reduced weight
- No tightening torque problem
- Crimp indent mark painted in black
- L dimension can be adapted on request



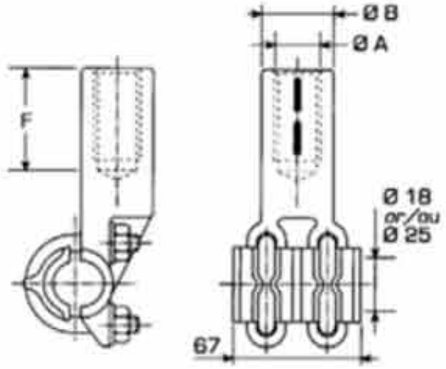
Designation	Tools	Dimension (mm)				
		H	L	I	D	d
DPH7 65.4/26	SV29	33.8	25	26	7.9	11
DPH7 65.4/95	SV42	47.8	30	32	13.5	11
DPH7 65.4/104.5-145.8	SV42	47.8	30	32	16.3	11
DPH7 65.4/147-164	SV42	47.8	30	32	19.1	11
DPH7 70/70	SV42	47.8	30	32	11.5	11
DPH7 95/95-104 B164	SV42	47.8	30	32	13	13.6
DPH7 95/185	Sv42	47.8	30	32	18.5	13.6
DPH7 116.2/147-164	SV42	47.8	30	32	19.1	15

Copper Branch Tee

Connection between a copper catenary conductor and a bare copper bar.

Technical Characteristics

- In accordance with NFF 42-031
- 1.5 kV DC – 25 kV AC
- Bolted connection on bare copper rod side
- Crimped connection on catenary conductor side
- Dia. A greased and blanked with protection cap
- Crimp indent marks painted in black



Designation	Branch Origin	Bar or cable to be connected	Dimension (mm)			
			A*	B	F	*or M
RAC T7 B18 104-145.8	Cu bar 18mm	Annealed copper cable 104.5mm² or hard copper 145.8mm²	17	25	55	-
RAC T7 B18 147-164	Cu bar 18mm	Annealed copper cable 147mm² or hard copper 164mm²	19	26	55	-
RAC T7 B18 240-261.5	Cu bar 18mm	Annealed copper cable 240mm² or hard copper 261.5mm²	22	34.2	65	-
RAC T7 B18 B18	Cu bar 18mm	Copper bar 18mm	19.5*	30	55	M22 or g5/8
RAC T7 B25 104-145.8	Cu bar 25mm	Annealed copper cable 104.5mm² or hard copper 145.8mm²	17	25	55	-
RAC T7 B25 147-164	Cu bar 25mm	Annealed copper cable 147mm² or hard copper 164mm²	19	26	55	-
RAC T7 B25 240-261.5	Cu bar 25mm	Annealed copper cable 240mm² or hard copper 261.5mm²	22	34.2	65	-