

RATIONAL
Paving the way for Copper Windings



RATIONAL
Paving the way for Copper Windings



**RATIONAL IS DRIVEN BY A TEAM OF OVER
150 SKILLED AND CAPABLE MANPOWER.**

OUR VALUE LIES IN OUR UNITY.

CORPORATE PROFILE

REL was started in 1989 and was later taken over by Mr. Mahendra Jain (B.E Mech) in 2006 with a vision of transforming the production and distribution landscape of copper. His son Mr. Jubin Jain (B.E Electrical) became a part of this vision in 2018. As a family enterprise, we have been a part of the copper business for 50 years, and have successfully managed, enhanced and transformed it since.

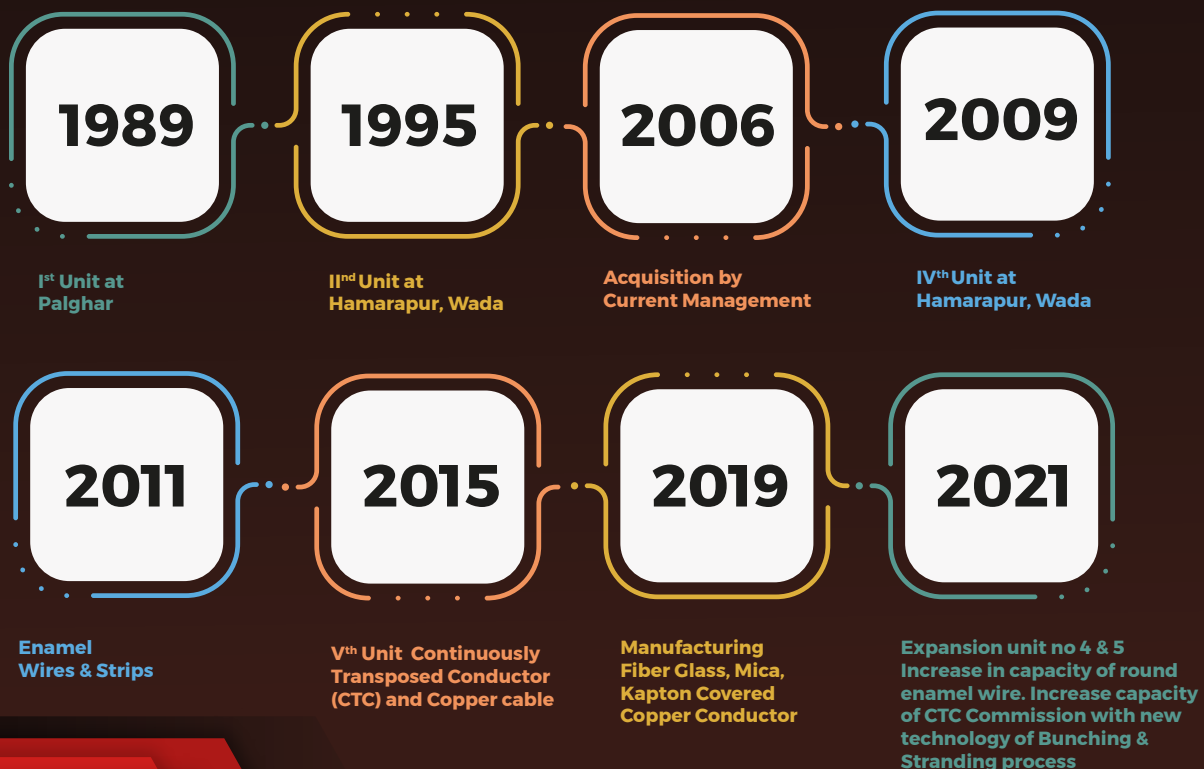
REL's futuristic and modern manufacturing facilities combined with uncompromising machinery and latest equipment's makes it a pioneer for stakeholders everywhere. Maintaining high standards of ethics and professionalism in every aspect of our business. We provide a complete range of copper products with one objective in mind, exceeding customer expectations.

REL Engineers Limited endeavors to have an almost ubiquitous presence in the array of copper. Conductors with certification indicates resilience to survive business cycles. The company has leveraged its growth in India and abroad, adhering to the following principles:

- Inbuilt proven quality norms
- Cognizant dedicated management and workforce
- Persistent pursue of business excellence

Our only aim is excellence in TOTAL CUSTOMER SATISFACTION which we achieve with our management's prudent knowledge and strong visionary leadership skills. Our entire work force constantly tries to leverage this expertise to expand the purview of our operations in electrical industry. With the diligent understanding of the need of every client, we have the most sophisticated and latest manufacturing technology to offer. Quality products in accordance with the International Standards. Today, REL is one of the big players as a proficient producer that exports 20-30% of manufactured products internationally, to Europe, USA, Africa, the Middle East and many more.

GROWING INNOVATION PATH



PRODUCTS

TRANSFORMERS

- Continuously Transposed Conductor (CTC)
- Paper Insulated Copper Conductor (PICC)
- Flexible Multistrand Covered Copper Cable
- Enamel Strips

MOTORS

- Fibre Glass covered Copper Conductor
- Mica Covered Copper Conductor
- Kapton Covered Copper Conductor
- Enamel Wires

LOCOMOTIVE AND TRACTION

- Mica Covered Copper Conductor
- Kapton Covered Copper Conductor
- Nomex Covered Copper Conductor

EARTHING CABLE

- Flexible Braided Earthing Copper Cable

APPLICATIONS

POWER AND DISTRIBUTION TRANSFORMER

OIL FILLED



DRY TYPE



CAST RESIN



HVDC



MOTORS

HIGH VOLTAGE



LOW VOLTAGE



APPLIANCES & SWITCHGEAR



RAILWAYS

TRACTION / LOCOMOTIVE
TRANSFORMER



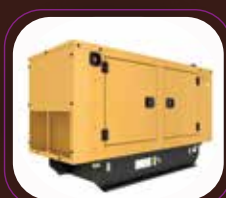
TRACTION / LOCOMOTIVE
MOTOR



ALTERNATOR



GENERATOR



TURBINE



WIND MILL



HYDRO





Continuously Transposed Conductor (CTC)

Continuously Transposed Conductor (CTC) consists of a group of enamelled rectangular strips, PVA or PVA epoxy with bonding layer type which are connected up parallel to the ends. In this group each strand successively and repeatedly takes on every possible position inside the conductor cross section.

Strands as a whole are wrapped with pure cellulose paper tapes (Diamond dotted epoxy paper, Cindus, Dennison, Kraft & Crepe Paper) for manufacturing low losses winding for electric machines.

Advantages

CTC offer decisive advantages in the design of transformers, compared to the conventional paper-insulated rectangular wires:

- Greater electric efficiency from minimized load losses
- Improved cooling from efficient heat dissipation
- Reduced winding time for increased productivity in transformers
- Improved mechanical strength of the windings due to composite construction

SINGLE STRIP MIN - MAX

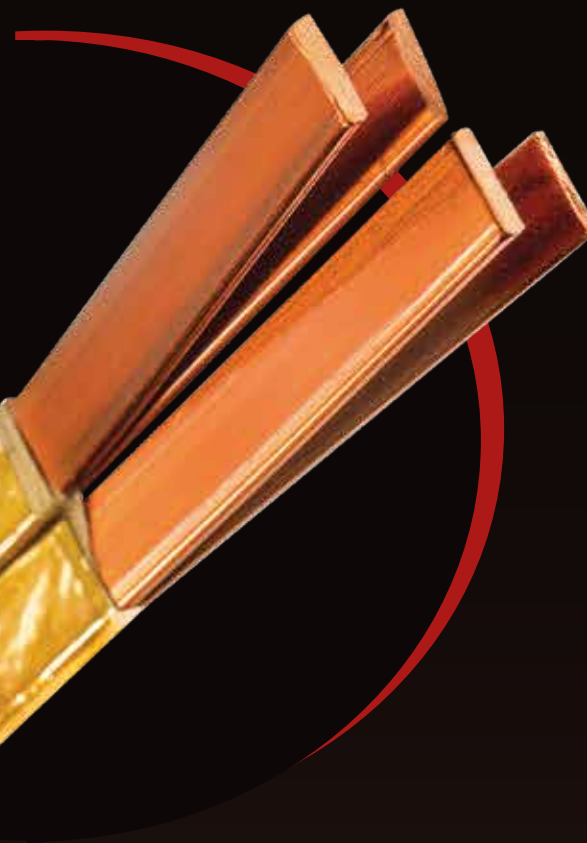
| | |
|-----------------------|-----------------|
| Thickness | 1.10 - 3.15 mm |
| Width | 3.00 - 12.50 mm |
| Width/Thickness Ratio | 3:1 - 8:1 |
| Proof stress (0.2) | 60 - 260 N/mm |
| Enamel increase | 0.08 - 0.18 mm |

CTC conductor MIN-MAX

| | |
|--------------------------|-----------------|
| Number of wires | 5 - 47 No's |
| Inter column layer | 0-0.5 mm |
| Height of CTC conductor | 5.50 - 70.00 mm |
| Width of CTC conductor | 6.00 - 26.00 mm |
| Transposing Pitch length | 35 - 225 mm |

CROSS OVER LENGTH MIN - MAX

| | |
|--------------------------|-----------|
| Until 6mm width | 25 mm |
| Over 6mm till 8 mm width | 30 mm |
| Over 8mm till 11mm width | 35 mm |
| Over 11mm width | 45 mm |
| Ratio height / width | 1:5 - 6:1 |



Paper Insulated Copper Conductor (PICC)

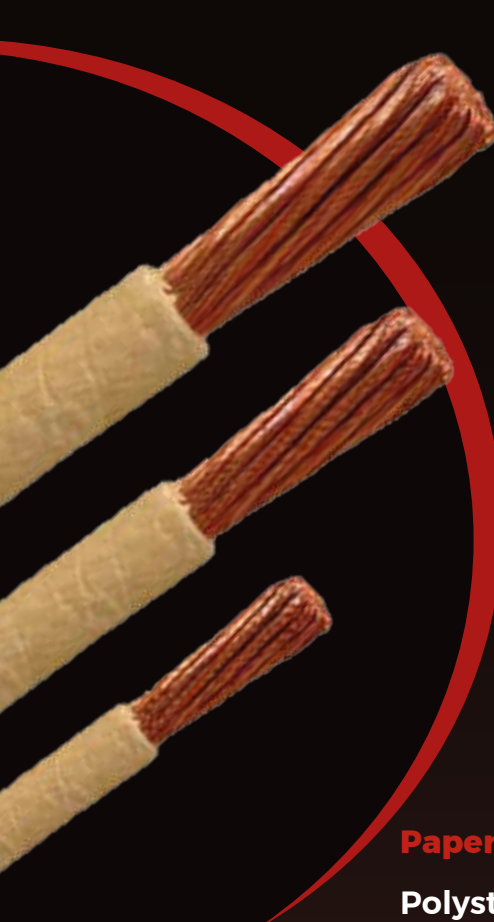
| | |
|--|---|
| Specification: | IEC, IS, DIN, BS |
| Width: | 5 mm to 20 mm |
| Thickness: | 0.8 to 9 mm |
| Periphery of Rectangular Conductor: | 50 mm max. |
| Conductor Width to Thickness ratio: | 10:1 |
| Insulation Thickness: | 0.3 mm to 6 mm |
| Insulation Types: | Kraft Paper, Thermally Stabilised Paper, Diamond Dotted Epoxy Paper, Nomex™, Polyester and Mica |
| Type of Lapping: | Butt lapped, 30-50% overlapped, Interlocked, in various combinations Of paper and tape widths and As per customer requirement, After mutual discussion. |

Types of PICC :-

- **Single Paper Covered Copper Conductor**
- **Twin Bunch Paper Covered Copper Conductor**
- **Triple Bunch Paper Covered Copper Conductor**
- **Quadra Bunch Paper Covered Copper Conductor**
- **Hexa Bunch Paper Covered Copper Conductor**

Paper Used:-

- **Kraft**
- **Crepe**
- **Nomex**
- **Thermally Upgraded Paper (Green Colour)**



Flexible Multistrand Covered Copper Cable

Bare Conductor Type :- Bare Wire, Bare Rod, Bare Cable, Flexible Stranded Cable

Paper Covered Cable :- Double Cotton Covered Cable, Paper Covered Cable, Double Paper Covered Cable (DPC), Triple Paper Covered Cable (TPC), Cotton Braided Cable, Semiconductor Paper Covered Cable, Polyester Covered Cable.

Paper Used :- Kraft, Crepe, Nomex, Semi Conductive Tape, Polyester Tape, Cotton Yarn, Thermally Upgraded Paper (Green Colour)

Bare Copper Wire : is used as a high quality electricity conductor in electronics & electrical appliances. Uncoated Copper Wire is durable & can last for years. Copper Wire is Cadmium free i.e. It is 100% pure & is also known as “Electrolyte Copper”.

Solid & Stranded : Solid wire is formed by one strand of copper metal wire, bare or surrounded by an insulator. Typically, single-strand copper conductors are used as magnet wire in motors and transformers. Compared to other wire, they are rigid, doesn’t get bended easily, and are usually installed in permanent, frequently handled, and low flex application.

A stranded wire is combination of copper wires bunched or twisted together. It is easier to install than a single-strand wire of the similar cross section. Stranding enhances the life of the wire in application with vibration.

Braided Copper Wires: The braided copper wire is used as flexible connector for electric appliance, electric stove and storage battery. It can be manufactured according to customer drawings and requirements.

SIZE RANGE

| STRANDED / FLEXIBLE | | |
|---------------------|------------|-----------|
| Diameter | 0.5 mm | 6 mm |
| Cross Section Area | 1.00 sq mm | 600 sq mm |



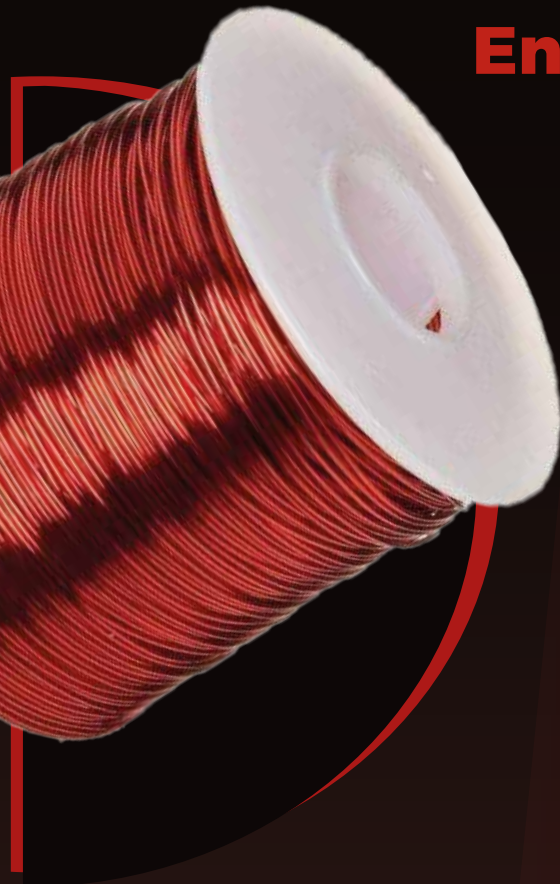
Earthing Cables

We provide Bunched Copper Ropes as high-tolerance cables substantially designed for extra strength, easy handling in-house as connectors for more flexibility. We also offer excellent quality earthing Cables for high flexibility in the power supply and for earthing applications in switchboards, flexible links, transformers and generators.

SIZE RANGE

| EARTHING CABLES | | |
|--------------------|--------------|-----------|
| Cross Section Area | Min 10 sq mm | 650 sq mm |

Enamel Wires & Enamel Strips



Enamelled copper wire, also called "Magnet Wire," is widely used in various Electrical Applications due to its superior Electrical, Thermal and Mechanical Properties. Enameled Copper Wire are insulated by coating it with enamel of different temperature class. Enamelled Copper Wire are primarily used in three types of applications - in transformers to transform one kind of electrical energy into other kinds. Copper Enameled Winding Wire are used in motors to transform electrical energy into mechanical energy.

Enamelled Copper Winding Wire is also used in generators to transform mechanical energy into electrical energy.

Types :- DC, F-class, Corona Resistant Wire / **Specification :-** IEC, IS, DIN, BS

Diameter :- 0.19 mm TO 5.00 mm / **Base Coat :-** Modified Polyvinyl Acetal, Polyimide, Polyesterimide, Theic-Polyester, Polyamideimide.

Top Coat :- Polyvinyl Butyral / Polyamide, Polyamideimide, Nylon, Polyamide.

Thermal Class :- Upto 220° Class / **Insulation Range :-** Grade 1, 2 and 3

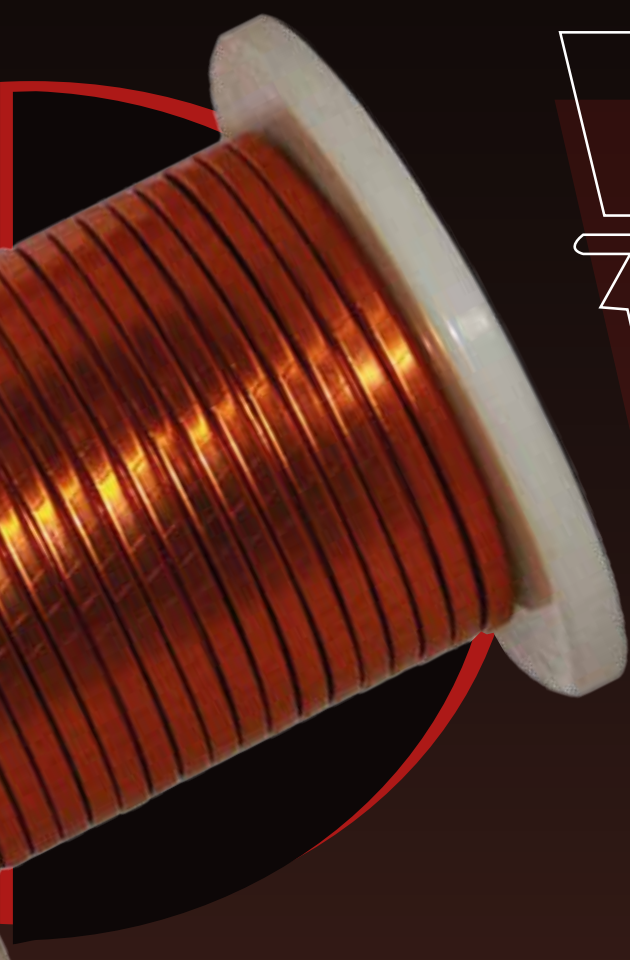
- Certified with major motors / transformers / electricity utilities customers Exports @ 40% of its production to > 20 countries
- Technical know - how from globally Recognized consultants who have had a long association with World's No. 1 wire producers Successfully supplied our products to major 765KV & HVDC transformer projects in India and abroad High speed wire drawing machines using German Technology Imported high speed enameling lines using latest environment friendly technology
- Online & Offline testing with state of the art equipment to avoid manual error
- ISO 9001 2015 certified units

Corona Resistant Wire is used in motors that may be subjected to high voltage spikes present in heavy duty inverter applications with improved voltage endurance and thermal properties.

| TYPES OF VARNISH | THERMAL CLASS | SPECIFICATION |
|-----------------------|---------------|---------------|
| Polyester | 130°C | IEC 60317 |
| Modified Polyester | 155°C | IEC 60317 |
| Polyesterimide | 180°C | IEC 60317 |
| Dual Coated | 200/220°C | IEC 60317 |
| Self-Solderable | 155°C & 180°C | IEC 60317 |
| Corona Resistant Wire | | |

Polyimide Film (Kapton)

Polyimide Film (Kapton ") is wrapped on bare rectangular strip to desired overlap in order to attain required Insulation thickness. Kapton covered wire meets requirements of corona discharge Resistant which provide higher resistance to voltage peaks.



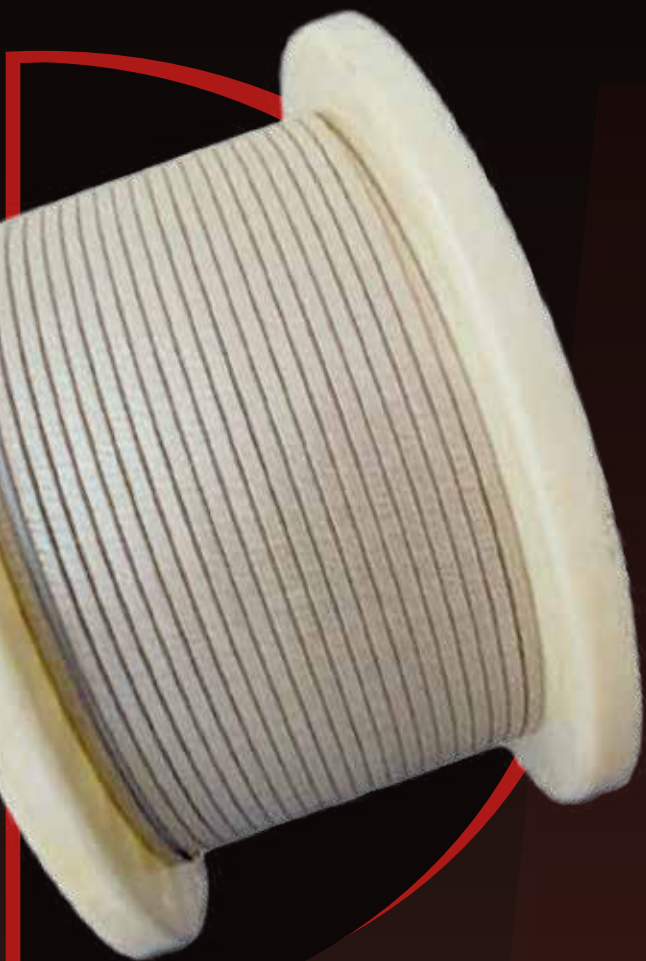
SPECIALIZATION MIN - MAX

| | |
|---------------------------|---------------------------------------|
| Width | 2.8 - 18.00 mm |
| Thickness | 0.80 - 2.8 mm |
| Cross Sectional Area | 2.25 - 50.00 sq mm |
| Insulation Material | Polyimide (Kapton) |
| Insulation Tape Width | 6 - 30mm |
| Insulation Tape Thickness | 0.01 - 0.06 mm |
| Insulation Application | One or Two layers, hot sealed overlap |
| Thermal Class | 240°C |
| IEC | 60317-43 & 44 IEC 851-1-6 |

Kapton® (Brand Name of DuPont's Polyimide Film) Covered Wires offers a wide range of applications in the construction of motors (specially in traction motors), aerospace equipments. It provides insulation with high electrical, thermal and mechanical properties over a temperature range of -196°C to +250°C. It provides higher Break Down Voltage (more than 8 KV BDV) as well as Temperature Class (220 °C) as compare with other insulated conductors. Insulating materials in traction motors have to withstand high temperatures and frequent changes of load and temperature.

Kapton provides exceptional overload protection and long motor life, even in the most demanding applications and environments.

| TEMP. CLASS | TYPE OF INSULATION | SIZE RANGE |
|-------------|--|--|
| 220°C | Kapton (Polymide Film) (50%, 67% Overlapping & As per customer requirement) | Width & thickness range Min. Size: 3.30 x 1.50 mm Max. Size: 12.00 x 4.20 mm |



Mica Covered Copper Conductor

Mica paper in MICA COVERED RECTANGULAR WIRE consists of tiny platelets of mica that are made into a paper.

This paper is extremely fragile and requires a carrier to render it usable, hence we use Polyester Film (PET). With respect to corona & thermal resistance requirements, Mica has shown itself to be the most suitable insulating material.

Its application is mainly in high voltage rotating machines due to its superior resistance to corona and it is therefore obvious to use it also as conductor insulation in inverter driven motors.

| TYPE OF INSULATION | TEMP. CLASS | SIZE RANGE |
|--------------------|-------------|--|
| 200°C | PET MICA | Width & thickness range Min. Size: 3.00 x 1.10 mm Max. Size: 15.00 x 5.00 mm |

Fibre Glass Covered Copper Conductor

The Glass in FIBRE GLASS covered copper conductor may be applied in woven tape form or as a continuous fibre. It has proved to be an efficient insulation providing coil winders with higher thermal stability, adequate electrical properties and good resistance to abrasion after varnishing. The glass is bonded with a varnish for dielectric strength to improve mechanical properties.

Fibre Glass conductors (bare or enamelled) are very suitable for windings of electric motor stators, generators, special transformers and high voltage motors. In general this insulation can be applied where high mechanical strength and high insulation properties are required. It exhibits a very high degree of mechanical and thermal stability.



SPECIALIZATION MIN - MAX

| | |
|----------------------|-----------------------------------|
| Round Wire Width | 2.00 ~ 6.00 mm |
| Flat Wire Width | 4.00 ~ 16.00 mm |
| Thickness | 1.00 ~ 4.00 mm |
| Cross Sectional Area | 4.00 ~ 60.00 sq mm |
| Thermal Class | 155°C 180°C 200°C |
| Insulation Class | F, H, Dual coat |
| Specification | Polyster Polyesteramide PEI + PAI |
| IEC | 60317-32 60317-31 60317-33 |

MANUFACTURING RANGE & SPECIFICATION

| TEMP. CLASS | TYPE OF INSULATION | SIZE RANGE | SPECIFICATION |
|-------------|---|--|-----------------------------|
| 'F', 155°C | Single /Double Layer of Glass Fibre Yarn & Impregnated with Class 'F' / 'H' Varnish | Width & thickness range Min. Size: 3.00 x 1.10 mm Max. Size: 16.00 x 6.00 mm | IEC-60317-31 IS-13730-33 |
| 'H', 180°C | | | IEC-60317-32 IS-13730-32 |
| 'C', 200°C | | | IEC-60317-33 IS-13730-31 |

ENVIRONMENTAL SAFETY

COMPREHENSIVE ANALYSIS REPORT

| | | |
|---|---|-----------------|
| Report No. : MWML/LAB/CA/10614 | Date : 07-May-2019 | Sample Ref. No. |
| ULR No. : TC7166190000049P | | 11871 |
| Name of Client : M/s Rational Engineers Ltd | Unit-4, Gut No. 296,297 & 298, Village Hamrapur, Tal-Wada, Dist Palghar | |
| Phone No. : | 9168641307 | |
| Member No. : | 3892 | |



Mumbai Waste Management Ltd.
 Plot No. P-32 & Part, MIDC Talaja, Tal. Panvel,
 Dist. Raigad, Maharashtra 410 208, India
 Phone : 8422877163 / 64/ 65/ 66 & 67
 Tel.: 022 2740 1468 to 71 & 2741 1473
 Email: mbdmwm@ramky.com
 www.mumbaiwastemanagement.com
 CIN:U90001AP2001PLC37829

Towards sustainable growth

| | | | |
|--|----------------------------|-------------------|----------------------|
| Name of Sample / Hazardous Waste : | Waste Enamel Sample | | |
| Description of Sample When Received : | Liquid Sample, Brown Color | | |
| Sample Received Date : | 03-Apr-2019 | Sample Drawn by : | Customer |
| Waste Category : | Schedule - 1 | Schedule - 2 | Schedule - 5 (A/B) |
| Raw Material List / Process Details Enclosed : | N | | |
| MSDS Provided by Client : | N | | |
| Quotation Number : | MWML/LAB/QUO/19-20/10695 | Date : | 03-Apr-2019 |
| Confirmation Date : | 19-Apr-2019 | Confirmation by : | MBO Conf. 19.04.2019 |
| Testing Period : | 19 Days | | |

| Sr. No. | Particular | Observation | Remarks |
|---------|---|--------------|---------|
| 1 | Does the waste have Odor? | Y | |
| 2 | Does the waste give fumes exposed to the atmosphere? | N | |
| 3 | Does the waste reacts with water? | N | |
| 4 | Does the waste is incompatible with any material? If so specify | N | |
| 5 | Physical State | Liquid | |
| 6 | Colour | Brown | |
| 7 | Texture | Thick Liquid | |

Note Y = Yes N= No

Note: ULR No. - Unique Lab Report No.

Prepared by

Verified by

Laboratory Incharge
(Authorized Signatory)

Page 1 of 3

MWML/LAB/CAR/17/23.01.2018

Certified by

bsi

Certificate No.: TC-7166
 SO 9001:2015 | ISO 14001:2015 | OHSAS 18001:2007
 C. No. FS 570487 | C. No. EMS 570497 | C. No. OHS 570500

Corporate Office:
 Ramky Enviro Engineers Ltd.
 Ramky Grandiose Floor, 12, 13, Ramky Tower Complex,
 Gachibowli Hyderabad - 500 032.
 Tel.: 040-2301 5000 (40 Lines) • Fax: 040-2330 2553 • Website: www.ramky.com

MILESTONES

Rational Engineers Limited approved for all the products upto 765KV by following entities:



& many more....

Our Customers:-



SIEMENS

TOSHIBA
Leading Innovation >>>



& many more....



RATIONAL

Paving the way for Copper Windings

RATIONAL ENGINEERS LIMITED

103, Dhanalaxmi Residency, 1st floor,
Near Tip Top Plaza, Naupada, L.B.S. Marg,
Thane West, Maharashtra 400604.

TEL NO : +91 9168643114

info@rationalengineers.com



Unit No.2 : Plot No. 1, Gut No. 18, 26 & 27, Kusum Indl. Complex, Hamarapur, Tal. Wada, Dist.
Palghar - 421303, Maharashtra.

Unit No. 4: Gut No. 296, 297 & 298, Village Hamarapur, Taluka :- Wada,
District :-Palghar - 421303, Maharashtra.

Unit No.5: Plot No. 21 & 22, Gut No. 18,26 & 27, Kusum Indl. Complex, Hamarapur, Tal.- Wada,
Dist-Palghar - 421 303, Maharashtra