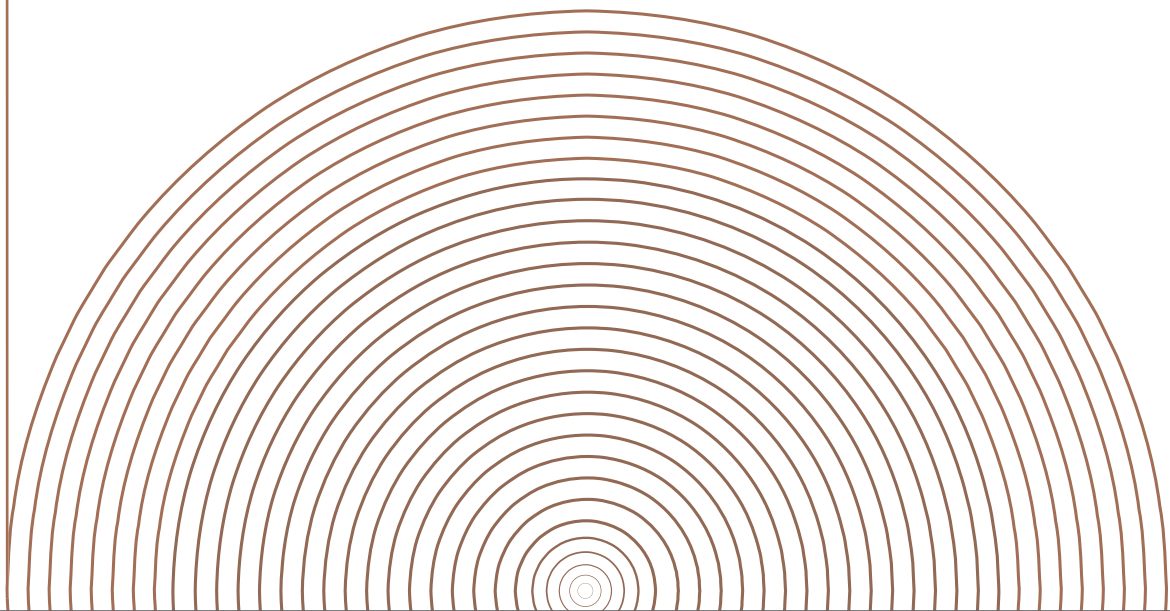


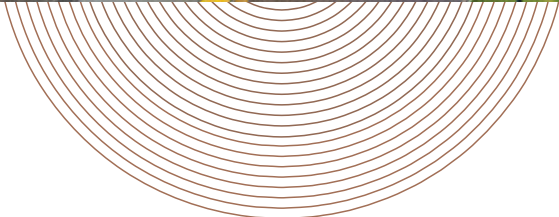


Technologically driven and inspired by innovation, we, at RR Shramik, work tirelessly to improve ourselves to meet the needs of the dynamic industry. Every product offered reflects the effort of the team that has endeavored to evolve the best the industry could receive.

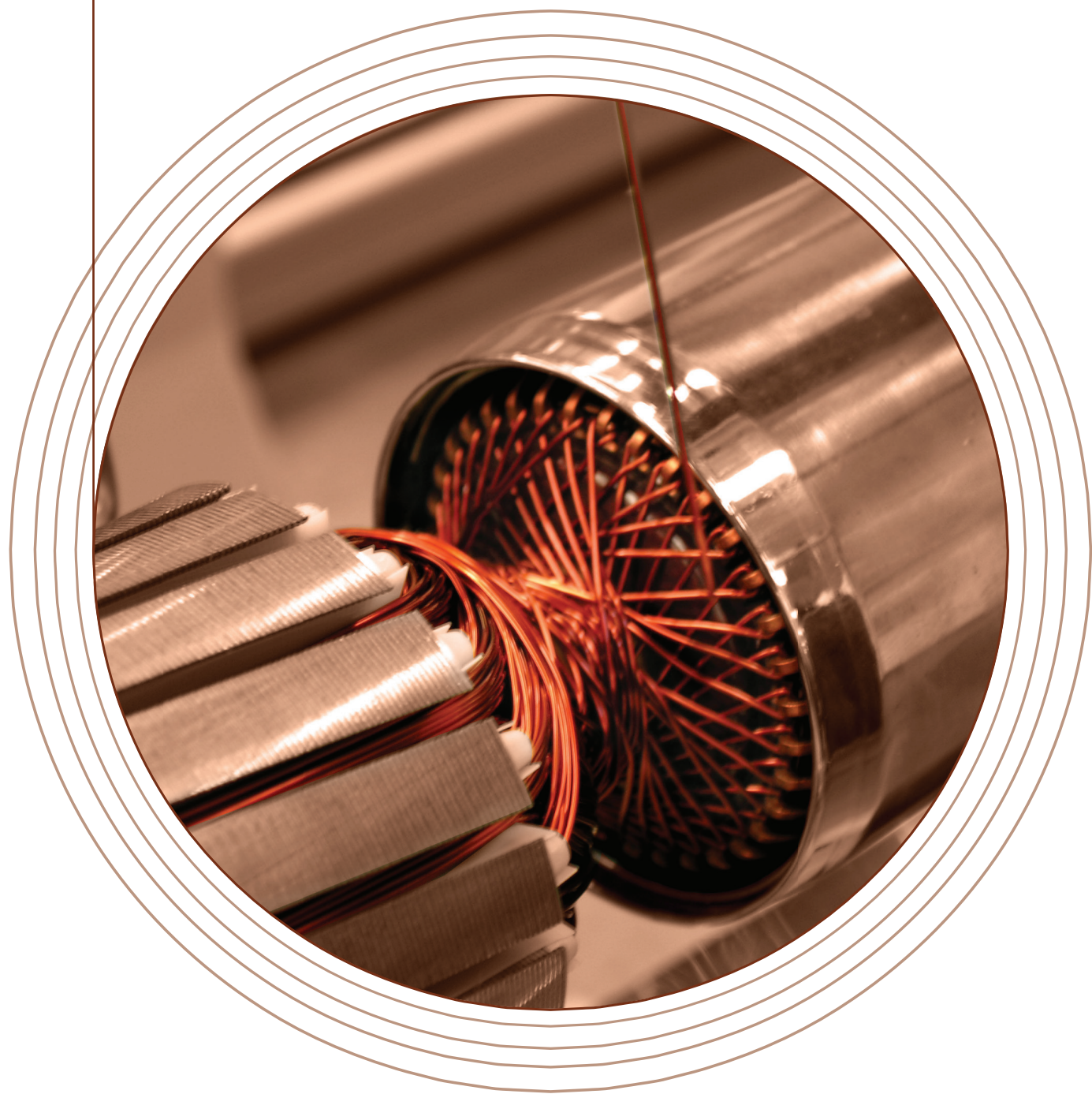
-Mr. Mahendra Kabra

Joint M.D. - Ram Ratna Wires Ltd.







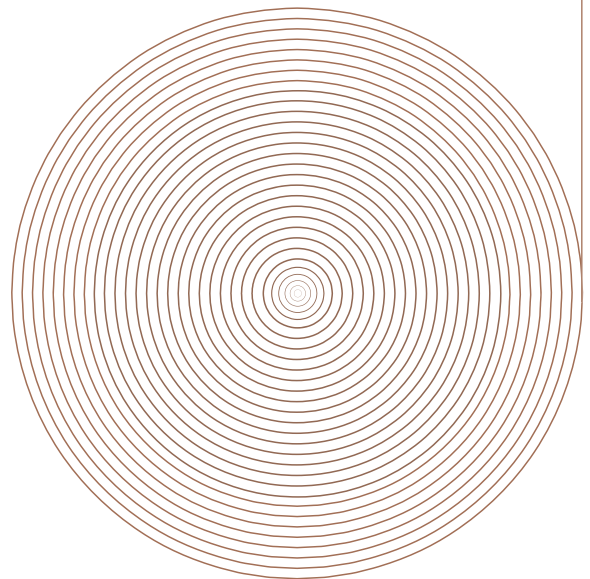


WINDING A PROMISING FUTURE

RR Shramik part of RR Global, is one of the leading conglomerates in the electrical and copper industry. For over 25 years, we have enjoyed unflinching patronage of our valued customers and are an established name in the Indian electrical industries, particularly known for our quality and commitment.

RR Shramik offers a wide range of high quality products to address the need of the ever evolving industry.

Being customer driven, we are constantly committed to keep powering ahead with the spirit of innovation to significantly enhance our abilities and optimize our potential to offer only the best to our customers.



Certificate

Standard **ISO 50001:2011**

Certificate Registr. No. 01 407 086546

TÜV Rheinland Cert GmbH certifies:

Certificate Holder: **RR Kabel Ltd. / Salasar Copper**
142/2, Madhuban Dam Road, Karad, Silvassa - 396 240 (UT of DNH)

Scope: Development and Manufacture of Solid and Rigid Conductor PVC Insulated Cables, Flexible Conductor PVC Insulated, Sheathed Cables and Cords, Thermosetting Cables, Halogen Free Cables and Foam Insulated RG Cables
Manufacture of Super Enameled Wires and Strips, Winding Wires and Bare Copper Wires and Strips

An audit was performed, Report No. 086546. Proof has been furnished that the requirements according to ISO 50001:2011 are fulfilled.

The due date for all future audits is 01-08 (dd.mm).

Validity: The certificate is valid from 13.01.2013 until 01.11.2015.

2013-01-13

TÜV Rheinland Cert GmbH
Am Grauen Stein 51105 Köln

DAKKS
Zertifizierungsstelle
D-50829 Köln

www.tuv.com

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Precisely Right.

Certificate

Standard **BS OHSAS 18001:2007**

Certificate Registr. No. 01 113 086546

TÜV Rheinland Cert GmbH certifies:

Certificate Holder: **R. R. Kabel Ltd. / Salasar Copper**
142/2, Madhuban Dam Road, Karad, Silvassa - 396 240, (Union Territory of Dadra & Nagar Haveli, India)

Including the locations according to annex

Scope: Development, Manufacture and Supply of Copper Cables and Flexible Cords.
Manufacture of Super Enameled and Bare Copper Wire and Strips.

An audit was performed, Report No. 086546. Proof has been furnished that the requirements according to BS OHSAS 18001:2007 are fulfilled.

The due date for all future audits is 17 - 04 (dd.mm).

Validity: The certificate is valid from 2014-06-03 until 2018-05-28. First Certification 2008-06-04.

2014-06-03

TÜV Rheinland Cert GmbH
Am Grauen Stein 51105 Köln

DAKKS
Zertifizierungsstelle
D-50829 Köln

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Certificate

Standard **ISO 14001:2004 + Cor. 1:2009**

Certificate Registr. No. 01 104 086546

TÜV Rheinland Cert GmbH certifies:

Certificate Holder: **R. R. Kabel Ltd. / Salasar Copper**
142/2, Madhuban Dam Road, Karad, Silvassa - 396 240, (Union Territory of Dadra & Nagar Haveli, India)

Including the locations according to annex

Scope: Development, Manufacture and Supply of Copper Cables and Flexible Cords.
Manufacture of Super Enameled and Bare Copper Wire and Strips.

An audit was performed, Report No. 086546. Proof has been furnished that the requirements according to ISO 14001:2004 + Cor. 1:2009 are fulfilled.

The due date for all future audits is 25 - 03 (dd.mm).

Validity: The certificate is valid from 2014-06-04 until 2017-06-03. First Certification 2008-06-04.

2014-06-04

TÜV Rheinland Cert GmbH
Am Grauen Stein 51105 Köln

DAKKS
Zertifizierungsstelle
D-50829 Köln

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CERTIFICATE

This is to certify that

Salasar Copper
(Prop: Ram Ratna Wires Limited)
Unit 1
142/2, Madhuban Dam Road
Opp Polytechnic College
Rakholi - 396 240
Silvassa (U.T of D & N H)
INDIA

Unit 2
212/2, Near Dadra Check Post
Dadra - 396 191
Silvassa
INDIA

BR No: 20002460 BR No: 20002459

has implemented and maintains a **Quality Management System**.

Scope:
The Manufacture of the following Products:
Enameled Round and Rectangular Copper Wire; Bare Round & Rectangular Copper Wire
Enameled Round Aluminum Wire; Submersible Winding Wire; Paper Covered Rectangular Copper Wire; Glass Fibre Covered Bare or Enameled Copper Wires
As Per the Specifications Agreed with the Various Marketing Offices.

Through an audit, documented in a report, it was verified that the management system fulfills the requirements of the following standard:

ISO 9001 : 2008

Certificate registration no. 20002460 QM08
Date of original certification 2000-03-14
Date of certification 2013-02-03
Valid until 2016-02-02

UL DQS Inc.
James R. Han
General Rep
Managing Director

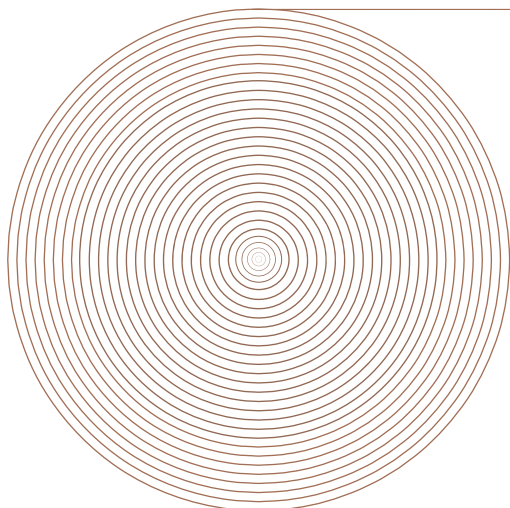
UL
Certification Body: UL DQS Inc., 1130 West Lake Cook Road, Suite 340, Buffalo Grove, IL 60089 USA

OUR COMMITMENT

RR Shramik aims to enhance customer satisfaction by consistently meeting the expectations related to product and services. We are a ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007, ISO 50001:2011 company located at Silvassa in Gujarat, manufacturing a variety of winding wires for various applications.

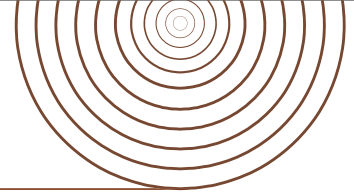
RR Shramik is India's only manufacturer of enameled copper wires that offers the widest range starting from 0.018 mm to 4.876 mm (SWG 06 - 52) with additional intermediate and mm sizes. Employing world class technology like German made Annealing and intermediate wire drawing NIEHOFF machines and catalytic enameling individual automatic and semi automatic take up units of European technology with inline wire drawing arrangement, we ensure superior consistency in products.

All our wires are UL certified, RDSO and BHEL approved along with RoHS (Halogen Free) & REACH compliance. Our client list includes reputed Indian & Multinationals like OEMs like ABB, Alstom, Bosch, Chheda Electricals, C&S, Crompton Greaves, Cummins, Emerson, Godrej, Jagdish Electronics, Larsen & Toubro, Legrand, Lucas, Luminous, Mecc Alte, Minda, Roots, Siemens, Schneider, Sukam & Varroc amongst others. All of this highlights the quality of our products, manufacturing processes and our global ability.

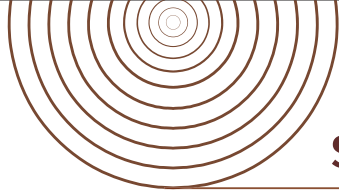




PRODUCTS WE OFFER



| | |
|--|---------|
| 01. Super Enamelled Copper Wires | 10 - 15 |
| 02. Fine And Ultra-fine Enamelled Copper Wires | 16 - 22 |
| 03. Super Enamelled Aluminium Winding Wires | 23 |
| 04. Super Enamelled Copper Strips | 24 |
| 05. Glass Fibre Covered Strips | 25 |
| 06. Triple Insulated Winding Wires | 26 - 27 |
| 07. Submersible Winding Wires | 28 - 29 |
| 08. Submersible Flat Cables | 30 |
| 09. Paper Covered Magnet Wires | 31 - 32 |
| 10. Corona Resistant Winding Wires | 33 |
| 11. Crepe Kraft Paper Insulated Copper Cables | 34 |
| 12. Cotton Covered Copper Conductors | 35 |
| 13. Nylon Coated Enamelled Wires | 36 |
| 14. Self Bonding Enamelled Wires | 37 |
| 15. Sole Coat AiW Enamelled Wires | 38 |
| 16. Litz Wires | 39 |
| 17. Super Enamelled Aluminium Strips | 40 |
| 18. Bunched and Braided Bare Copper Wire | 41 |
| 19. M. H. Classic Submersible Flat Cables | 42 |
| 20. M. H. Classic Submersible Winding Wire | 43 - 44 |



SUPER ENAMELLED COPPER WIRES

We offer a superior range of enamelled copper wires aiming to cater the wide variety of applications in the industry ranging from a common motor rewinding to most critical applications like in automobiles. Enamelled winding wire is a film insulated copper (or aluminum) electrical conductor used in form of coil windings in motors, transformers, generators and other electromagnetic equipments. When wound into coils, and energized, enamelled winding wire creates an electromagnetic field, which is utilized to generate the required output form of energy – viz electrical to mechanical (or vice versa) electrical to electrical, and electrical to magnetic energy.

PRODUCT RANGE & QUALITY SPECIFICATIONS

| Wire Type Properties | Modified Polyester | Modified Polyester | Polysterimide | Dual Coated Wire PE/PEI + PAI |
|---|--|---|---|--|
| Thermal Class Class Insulation Colour Range-Copper Range-Aluminium | 130 B Brown / Reddish-Golden 0.06 to 5.0 mm 0.25 to 5.0 mm | 155 F Light Brown to Dark Brown 0.06 to 3.0 mm 0.25 to 5.0 mm | 180 H Dark Brown (Mahogany) 0.06 to 5.0 mm 0.25 to 5.0 mm | 200 H+ Reddish Brown to Golden 0.06 to 4.0 mm 0.25 to 5.0 mm |
| Specifications-Copper Specifications-Aluminium | IS 13730-34 IEC 60317-34 IS 13730-9 IEC 60317-9 for 1.00 mm wire | IS 13730-3 IEC 60317-3 for 1.00 mm Wire | IS 13730-8 IEC 60317-8 IS 13730-15 IEC 60317-15 for 1.00 mm wire | IS 13730 -13 IEC 60317 - 13 NEMA MW 35A/35C IEC 60317 - 25 for Aluminium |
| Mechanical Tests Flexibility Peel Abrasion Av. N Aluminium | 1 x D N x D = 150 10.4 5.20 | 1 x D N x D = 130 10.4 – | 1 x D N x D = 110 10.9 5.45 | 1 x D N x D = 110 11.3 6.75 |
| Thermal Tests Heat Shock Cut Through Heat Shock - Aluminium | 6 x D 155°C - 30 min 240°C - 2 min 6.33Ø - 155°C - 30 min | 2.24 x D 175°C - 30 min 240°C - 2 min – | 2.24 x D 200°C - 30 min 300°C - 2 min 3.35Ø -200°C - 30 min | 2.24 x D 220°C - 30 min 320°C - 2 min 15% Str - 3xd - 240°C |
| Chemical Tests Solvent Resistance Refrigerant Resistant Solderability Transformer Oil | Good N.A. N.A. N.A. | Good N.A. N.A. N.A. | Very Good Very Good N.A. Excellent | Excellent Excellent N.A. Excellent |
| Resistance Electrical Resistance Breakdown Voltage Cont. of Covering (Pin Holes) Tandent Delta - Bending Point | Within Range Above 8.0 KV Normally - Nil 110 - 120 | Within Range Above 8.0 KV Normally - Nil 145 - 155 | Within Range Above 8.0 KV Normally - Nil 175 - 195 | Within Range Above 8.0 KV Normally - Nil 175 - 195 |
| Application | Domestic equipments, pumps, motors, stabilizers, transformers, fans and auto electricals requiring high mechanical properties. | General purpose rotating & static equipments like large pump motors, generators, air cooled transformers, voltage stabilizers, heavy duty domestic appliances like mixer - grinder, washing machines, where temprature is above class insulation B. | Continously rated heavy duty motors and tools, oil filled transformers, hermatic grade for AC and refriragerator compressor, furnace motors, and for all class insulation H applications. | Special purpose machines like wind generators, large motors and generators, extra heavy duty equipments like crane motors with heavy shock loads, AC and refrigerator compressor windings. |

| Wire Type Properties | Modified Polyester | Modified Polyester | Polysterimide | Dual Coated Wire PE/PEI + PAI |
|----------------------|---|--|---|--|
| Advantages | Balanced thermal properties. Very good flexibility and mechanical properties. | High continuous operating temperature. Good chemical stability. Excellent dry & wet di-electric characteristics. | Good thermal properties. High resistance to overloads. Good transformer oil resistance. Suitable for hermetic applications. | Excellent smooth surface compatible for high speed winding. Very high thermal & overload resistance. |
| Precautions | Not suitable for oil filled transformers & hermetic motors. | Not suitable for oil filled transformers & hermetic motors. | Not recommended for highspeed winding applications. | Excellent for A/C refrigerators and hermetic use. |

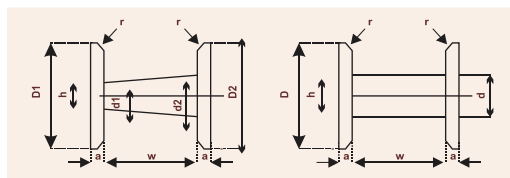
*These are only indicative values. Improvement is an ongoing process at RRWL and efforts are made to exceed average values.

PACKING OF ENAMELLED WIRES

| Type of Bobbin | Diameter of Flange | Diameter of Barrel (mm) | Thickness of Flange (mm) | Inside Spacing of Flange (mm) | Bevelling of Inside Flange Face (mm) | Diameter of Axle Hole (mm) | Mass of Bobbin (g) | Mass Enamelled Copper Wire (approx/kg) | Normal Range of Enamelled Copper Wire (mm) |
|----------------|--------------------|-------------------------|--------------------------|-------------------------------|--------------------------------------|----------------------------|--------------------|--|--|
| | D | d | a | W | r | h | | | |
| P-1 | 80±0.5 | 50±0.3 | 10±0.2 | 65±0.2 | 3 | 16±0.5 | 65 | 1 | 0.350 - 0.100 |
| P-3 | 125±0.5 | 26±0.3 | 10±0.2 | 71±0.2 | 3 | 22±0.5 | 110 | 3 | 0.350 - 0.100 |
| P-5 | 160±0.5 | 100±0.5 | 12±0.2 | 128±0.2 | 5 | 22±0.5 | 310 | 6 | 0.500 - 0.300 |
| P-10 | 200±0.5 | 88±0.5 | 12±0.2 | 115±0.2 | 5 | 38±0.5 | 460 | 10 | 0.600 - 0.450 |
| P-20 | 250±0.5 | 110±0.5 | 15±0.2 | 120±0.2 | 5 | 36±0.5 | 980 | 20 | 1.800 - 0.650 |
| W-25 | 265±1.0 | 110±1.5 | 12±0.2 | 115±0.2 | 5 | 38±0.5 | 1350 | 25 | 4.00 - 1.800 |

LONG TRAVERSE TAPERED TYPE

| Type of Bobbin | Diameter of Flange | Diameter of Barrel (mm) | Thickness of Flange (mm) | Inside Spacing of Flange (mm) | Bevelling of Inside Flange Face (mm) | Diameter of Axle Hole (mm) | Mass of Bobbin (g) | Mass Enamelled Copper Wire (approx/kg) | Normal Range of Enamelled Copper Wire (mm) |
|----------------|--------------------|-------------------------|--------------------------|-------------------------------|--------------------------------------|----------------------------|--------------------|--|--|
| | D | d | a | W | r | h | | | |
| PT-10 | 160 180±0.5 | 96 110±0.5 | 10±0.2 | 200±0.4 | 3 | 32±0.5 | 500±25 | 10 | 0.600 - 0.200 |
| PT-15 | 180 200±0.5 | 96 110±0.5 | 10±0.2 | 200±0.4 | 3 | 32±0.5 | 700±25 | 15 | 0.600 - 0.200 |
| PT-25 | 215 230±0.5 | 110 130±0.5 | 10±0.2 | 250±0.4 | 3 | 32±0.5 | 1000±25 | 25 | 1.000 - 0.400 |
| PT-45 | 236 250±0.5 | 140 160±0.8 | 32±0.3 | 335±1.0 | 5 | 100±0.5 | 2100±50 | 45 | 1.200 - 0.300 |
| PT-90 | 300 315±0.8 | 180 200±1.0 | 38±0.5 | 425±1.0 | 5 | 100±0.5 | 2800±100 | 90 | 1.200 - 0.500 |
| WT-45 | 265 275±2.0 | 110 120±2.0 | 15±2.0 | 190±1.0 | 5 | 40±0.5 | 2000±100 | 45 | 4.000 - 1.200 |
| WT-90 | 266 280±2.0 | 110 120±2.0 | 20±2.0 | 300±1.0 | 6 | 40±0.6 | 3600±100 | 86 | 4.000 - 1.200 |
| WT-180 | 375 400±0.8 | 224 250±1.0 | 50±0.8 | 530±1.0 | 5 | 100±0.5 | 3600±100 | 180 | 1.200 - 0.500 |
| WT-270 | 435 460±2.0 | 255 250±1.0 | 50±0.8 | 528±2.0 | 5 | 100±0.5 | 5500±100 | 270 | 4.000 - 1.200 |



P = Plastic
PT = Plastic Taper

W = Wooden
WT = Wooden Taper



GENERAL DATA FOR ENAMELLED ROUND COPPER WIRES AS PER IS 13730-0-1/IEC 60317-0-1 (SWG)

| SWG | Size mm Nom. | Conductor Tolerance ± mm | Resistance Min. @ 20° C Ohm/mtr. | Resistance Max. @ 20° C Ohm/mtr. | Grade 2 (Medium Covering) | | For Grade 2 Wires | | | SWG |
|-----|--------------|--------------------------|----------------------------------|----------------------------------|---------------------------|---------|-------------------|-----------|-------------|-----|
| | | | | | Min. Inc. | Max. OD | Elongation % | BDV Volts | Spring Back | |
| 5 | 5.384 | 0.054 | 0.000729 | 0.000772 | 0.096 | 5.527 | 36 | 2500 | 5.0° | 5 |
| 5½ | 5.131 | 0.052 | 0.000803 | 0.000851 | 0.095 | 5.273 | 36 | 2500 | 5.0° | 5½ |
| 6 | 4.877 | 0.05 | 0.000889 | 0.000942 | 0.094 | 5.018 | 36 | 2500 | 5.0° | 6 |
| 6½ | 4.674 | 0.048 | 0.000967 | 0.001025 | 0.094 | 4.815 | 36 | 2500 | 5.0° | 6½ |
| 7 | 4.470 | 0.045 | 0.001058 | 0.001121 | 0.092 | 4.607 | 36 | 2500 | 5.0° | 7 |
| 7½ | 4.268 | 0.045 | 0.001160 | 0.001230 | 0.092 | 4.405 | 36 | 2500 | 5.0° | 7½ |
| 8 | 4.064 | 0.043 | 0.001279 | 0.001357 | 0.092 | 4.201 | 36 | 2500 | 5.0° | 8 |
| 9 | 3.657 | 0.038 | 0.001580 | 0.001675 | 0.089 | 3.790 | 35 | 2500 | 5.0° | 9 |
| 9½ | 3.454 | 0.036 | 0.001771 | 0.001878 | 0.086 | 3.583 | 35 | 2500 | 5.0° | 9½ |
| 10 | 3.251 | 0.034 | 0.001999 | 0.002120 | 0.086 | 3.380 | 35 | 2500 | 5.0° | 10 |
| 10½ | 3.099 | 0.031 | 0.002203 | 0.002332 | 0.084 | 3.225 | 35 | 2500 | 5.0° | 10½ |
| 11 | 2.946 | 0.03 | 0.002436 | 0.002581 | 0.084 | 3.072 | 34 | 2500 | 5.0° | 11 |
| 12 | 2.642 | 0.027 | 0.003028 | 0.003209 | 0.081 | 2.764 | 34 | 2500 | 5.0° | 12 |
| 12½ | 2.489 | 0.025 | 0.003413 | 0.003614 | 0.079 | 2.607 | 33 | 5000 | 5.0° | 12½ |
| 13 | 2.337 | 0.024 | 0.003870 | 0.004102 | 0.079 | 2.455 | 33 | 5000 | 5.0° | 13 |
| 13½ | 2.184 | 0.024 | 0.004425 | 0.004703 | 0.077 | 2.299 | 33 | 5000 | 5.0° | 13½ |
| 14 | 2.032 | 0.02 | 0.005123 | 0.005421 | 0.077 | 2.147 | 33 | 5000 | 5.0° | 14 |
| 14½ | 1.930 | 0.02 | 0.005673 | 0.006015 | 0.075 | 2.042 | 33 | 5000 | 5.0° | 14½ |
| 15 | 1.829 | 0.019 | 0.006317 | 0.006698 | 0.075 | 1.941 | 33 | 5000 | 5.0° | 15 |
| 15½ | 1.727 | 0.018 | 0.007084 | 0.007513 | 0.073 | 1.836 | 32 | 5000 | 5.0° | 15½ |
| 16 | 1.626 | 0.017 | 0.007991 | 0.008476 | 0.073 | 1.735 | 32 | 5000 | 5.0° | 16 |
| 16½ | 1.524 | 0.016 | 0.009096 | 0.009650 | 0.071 | 1.630 | 32 | 5000 | 30 | 16½ |
| 17 | 1.422 | 0.015 | 0.010447 | 0.011085 | 0.071 | 1.528 | 32 | 5000 | 30 | 17 |
| 17½ | 1.320 | 0.013 | 0.012140 | 0.012846 | 0.069 | 1.422 | 32 | 5000 | 34 | 17½ |
| 18 | 1.219 | 0.013 | 0.014212 | 0.015088 | 0.067 | 1.318 | 31 | 5000 | 37 | 18 |
| 18½ | 1.118 | 0.011 | 0.016924 | 0.017907 | 0.065 | 1.215 | 30 | 5000 | 41 | 18½ |
| 19 | 1.016 | 0.0111 | 0.020449 | 0.021730 | 0.065 | 1.113 | 30 | 5000 | 41 | 19 |
| 19½ | 0.965 | 0.01 | 0.022692 | 0.024061 | 0.063 | 1.059 | 30 | 5000 | 45 | 19½ |
| 20 | 0.914 | 0.01 | 0.025267 | 0.026852 | 0.063 | 1.008 | 30 | 5000 | 45 | 20 |
| 20½ | 0.864 | 0.009 | 0.028305 | 0.030018 | 0.060 | 0.953 | 29 | 5000 | 48 | 20½ |
| 21 | 0.813 | 0.009 | 0.031926 | 0.033947 | 0.060 | 0.902 | 29 | 5000 | 48 | 21 |
| 21½ | 0.762 | 0.008 | 0.036384 | 0.038599 | 0.056 | 0.846 | 28 | 4900 | 43 | 21½ |
| 22 | 0.711 | 0.008 | 0.041729 | 0.044402 | 0.056 | 0.795 | 28 | 4900 | 43 | 22 |
| 22½ | 0.660 | 0.007 | 0.048489 | 0.051462 | 0.053 | 0.739 | 28 | 4800 | 47 | 22½ |
| 23 | 0.610 | 0.006 | 0.056850 | 0.060151 | 0.050 | 0.684 | 27 | 4800 | 50 | 23 |
| 23½ | 0.584 | 0.006 | 0.061971 | 0.065684 | 0.050 | 0.682 | 27 | 4800 | 50 | 23½ |
| 24 | 0.559 | 0.006 | 0.067576 | 0.071757 | 0.047 | 0.629 | 26 | 4600 | 44 | 24 |
| 25 | 0.508 | 0.006 | 0.081652 | 0.087078 | 0.047 | 0.578 | 26 | 4600 | 44 | 25 |

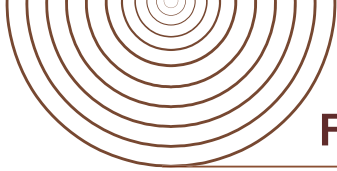
| SWG | Size mm Nom. | Conductor Tolerance ± mm | Resistance Min @ 20° C Ohm/mtr. | Resistance Max @ 20° C Ohm/mtr. | Grade 2 (Medium Covering) | | For Grade 2 Wires | | | SWG |
|-----|--------------------|--------------------------------|---------------------------------------|---------------------------------------|------------------------------|---------|-------------------|-----------|-------------|-----|
| | | | | | Min. Inc. | Max. OD | Elongation % | BDV Volts | Spring Back | |
| 25½ | 0.483 | 0.005 | 0.090584 | 0.096042 | 0.045 | 0.570 | 25 | 4600 | 47 | 25½ |
| 26 | 0.457 | 0.005 | 0.101067 | 0.107408 | 0.045 | 0.523 | 25 | 4600 | 47 | 26 |
| 27 | 0.417 | 0.005 | 0.121134 | 0.129277 | 0.042 | 0.480 | 25 | 4400 | 48 | 27 |
| 27½ | 0.397 | 0.005 | 0.133487 | 0.142805 | 0.042 | 0.475 | 24 | 4400 | 50 | 27½ |
| 28 | 0.376 | 0.005 | 0.148608 | 0.159429 | 0.042 | 0.435 | 24 | 4400 | 50 | 28 |
| 29 | 0.345 | 0.005 | 0.176098 | 0.189827 | 0.038 | 0.401 | 23 | 4300 | 53 | 29 |
| 30 | 0.315 | 0.004 | 0.211987 | 0.226879 | 0.035 | 0.367 | 23 | 4100 | 55 | 30 |
| 31 | 0.295 | 0.004 | 0.241295 | 0.259137 | 0.035 | 0.347 | 23 | 4100 | 55 | 31 |
| 32 | 0.274 | 0.004 | 0.279127 | 0.301015 | 0.033 | 0.323 | 22 | 4000 | 53 | 32 |
| 33 | 0.254 | 0.004 | 0.324080 | 0.351104 | 0.033 | 0.303 | 22 | 4000 | 53 | 33 |
| 34 | 0.234 | 0.004 | 0.380835 | 0.414820 | 0.032 | 0.281 | 22 | 3900 | 56 | 34 |
| 35 | 0.213 | 0.003 | 0.462364 | 0.497596 | 0.029 | 0.255 | 21 | 3700 | 59 | 35 |
| 36 | 0.193 | 0.003 | 0.561538 | 0.607866 | 0.027 | 0.232 | 21 | 3500 | 62 | 36 |
| 37 | 0.173 | 0.003 | 0.696411 | 0.759307 | 0.025 | 0.210 | 20 | 3300 | 65 | 37 |
| 38 | 0.152 | 0.003 | 0.897900 | 0.988423 | 0.023 | 0.186 | 19 | 3200 | 67 | 38 |
| 39 | 0.132 | 0.003 | 1.183651 | 1.318669 | 0.021 | 0.163 | 18 | 3000 | 67 | 39 |
| 40 | 0.122 | 0.003 | 1.380611 | 1.549606 | 0.019 | 0.155 | 17 | 2800 | 70 | 40 |
| 41 | 0.112 | 0.003 | 1.631156 | 1.846980 | 0.017 | 0.137 | 17 | 2700 | 73 | 41 |
| 42 | 0.102 | 0.003 | 1.956648 | 2.238952 | 0.017 | 0.127 | 17 | 2700 | 73 | 42 |
| 43 | 0.091 | 0.003 | 2.441381 | 2.833674 | 0.016 | 0.115 | 16 | 950 | 73 | 43 |
| 44 | 0.081 | 0.003 | 3.057262 | 3.066833 | 0.015 | 0.107 | 15 | 900 | 77 | 44 |
| 45 | 0.071 | 0.003 | 3.939379 | 4.745669 | 0.012 | 0.091 | 13 | 700 | - | 45 |
| 46 | 0.061 | 0.003 | 5.266612 | 6.523179 | - | 0.081 | 12 | 700 | - | 46 |
| 47 | 0.051 | 0.003 | 7.397819 | 9.524294 | - | 0.068 | 10 | 650 | - | 47 |
| 48 | 0.041 | 0.003 | 11.142583 | 15.196657 | - | 0.056 | 9 | 600 | - | 48 |
| 49 | 0.031 | 0.003 | 18.660935 | 27.989761 | - | 0.041 | 8 | 375 | - | 49 |
| 50 | 0.025 | 0.003 | 27.515358 | 45.338786 | - | 0.034 | 7 | 300 | - | 50 |

* These are only indicative values. Improvement is an ongoing process at RRWL and efforts are made to exceed average values.

GENERAL DATA FOR ENAMELLED ROUND COPPER WIRES AS PER IS 13730-0-1/IEC 60317-0-1 (MM SIZE)

| Size mm Nom. | Conductor Tolerance ± mm | Resistance Min @ 20° C Ohm/mtr. | Resistance Min @ 20° C Ohm/mtr. | Grade 2 (Medium Covering) | | For Grade 2 Wires | | | Size mm Nom. |
|-----------------|--------------------------------|---------------------------------------|---------------------------------------|------------------------------|--------|-------------------|-----------|-------------|-----------------|
| | | | | Min. Inc. | Max OD | Elongation % | BDV Volts | Spring Back | |
| 5.000 | 0.050 | 0.000846 | 0.000896 | 0.094 | 5.141 | 36 | 2500 | 5.0 | 5.000 |
| 4.500 | 0.045 | 0.001044 | 0.001106 | 0.092 | 4.637 | 36 | 2500 | 5.0 | 4.500 |
| 4.250 | 0.043 | 0.001170 | 0.001240 | 0.092 | 4.387 | 36 | 2500 | 5.0 | 4.250 |
| 4.000 | 0.040 | 0.001322 | 0.001399 | 0.089 | 4.133 | 35 | 2500 | 5.0 | 4.000 |
| 3.750 | 0.038 | 0.001503 | 0.001593 | 0.089 | 3.883 | 35 | 2500 | 5.0 | 3.750 |
| 3.350 | 0.034 | 0.001884 | 0.001996 | 0.086 | 3.479 | 35 | 2500 | 5.0 | 3.350 |
| 3.000 | 0.030 | 0.002350 | 0.002488 | 0.084 | 3.126 | 34 | 2500 | 5.0 | 3.000 |
| 2.800 | 0.028 | 0.002697 | 0.002856 | 0.081 | 2.922 | 34 | 2500 | 5.0 | 2.800 |
| 2.500 | 0.025 | 0.003384 | 0.003582 | 0.079 | 2.618 | 33 | 5000 | 5.0 | 2.500 |
| 2.240 | 0.022 | 0.00422 | 0.00446 | 0.077 | 2.355 | 33 | 5000 | 5.0 | 2.240 |
| 2.000 | 0.020 | 0.00529 | 0.00560 | 0.075 | 2.112 | 33 | 5000 | 5.0 | 2.000 |
| 1.900 | 0.019 | 0.00586 | 0.00620 | 0.075 | 2.012 | 33 | 5000 | 5.0 | 1.900 |
| 1.800 | 0.018 | 0.00653 | 0.00691 | 0.073 | 1.909 | 32 | 5000 | 5.0 | 1.800 |
| 1.700 | 0.017 | 0.00732 | 0.00775 | 0.073 | 1.809 | 32 | 5000 | 5.0 | 1.700 |
| 1.600 | 0.016 | 0.00826 | 0.00875 | 0.071 | 1.706 | 32 | 5000 | 30 | 1.600 |
| 1.500 | 0.015 | 0.00940 | 0.00995 | 0.071 | 1.606 | 32 | 5000 | 30 | 1.500 |
| 1.400 | 0.014 | 0.01079 | 0.01142 | 0.069 | 1.502 | 32 | 5000 | 34 | 1.400 |
| 1.320 | 0.013 | 0.01214 | 0.01285 | 0.069 | 1.422 | 32 | 5000 | 34 | 1.320 |
| 1.250 | 0.013 | 0.01352 | 0.01434 | 0.067 | 1.349 | 31 | 5000 | 37 | 1.250 |
| 1.180 | 0.012 | 0.01518 | 0.01609 | 0.067 | 1.279 | 31 | 5000 | 37 | 1.180 |
| 1.120 | 0.011 | 0.01686 | 0.01784 | 0.065 | 1.217 | 30 | 5000 | 41 | 1.120 |
| 1.060 | 0.011 | 0.01881 | 0.01994 | 0.065 | 1.157 | 30 | 5000 | 41 | 1.060 |
| 1.000 | 0.010 | 0.02115 | 0.02239 | 0.063 | 1.094 | 30 | 5000 | 45 | 1.000 |
| 0.950 | 0.010 | 0.02341 | 0.02483 | 0.063 | 1.044 | 30 | 5000 | 45 | 0.950 |
| 0.900 | 0.009 | 0.02611 | 0.02764 | 0.060 | 0.989 | 29 | 5000 | 48 | 0.900 |
| 0.850 | 0.009 | 0.02924 | 0.03103 | 0.060 | 0.939 | 29 | 5000 | 48 | 0.850 |
| 0.800 | 0.008 | 0.03304 | 0.03498 | 0.056 | 0.884 | 28 | 4900 | 43 | 0.800 |
| 0.750 | 0.008 | 0.03755 | 0.03986 | 0.056 | 0.834 | 28 | 4900 | 43 | 0.750 |
| 0.710 | 0.007 | 0.04196 | 0.04440 | 0.053 | 0.789 | 28 | 4800 | 47 | 0.710 |
| 0.670 | 0.007 | 0.04707 | 0.04992 | 0.053 | 0.749 | 28 | 4800 | 47 | 0.670 |
| 0.630 | 0.006 | 0.05333 | 0.05636 | 0.050 | 0.704 | 27 | 4800 | 50 | 0.630 |
| 0.600 | 0.006 | 0.05874 | 0.06219 | 0.050 | 0.674 | 27 | 4800 | 50 | 0600 |
| 0.560 | 0.006 | 0.06734 | 0.07150 | 0.047 | 0.630 | 26 | 4600 | 44 | 0.560 |
| 0.500 | 0.005 | 0.08459 | 0.08956 | 0.045 | 0.566 | 25 | 4600 | 47 | 0.500 |
| 0.450 | 0.005 | 0.1042 | 0.1108 | 0.042 | 0.513 | 25 | 4400 | 48 | 0.450 |
| 0.425 | 0.005 | 0.1167 | 0.1244 | 0.042 | 0.488 | 25 | 4400 | 48 | 0.425 |
| 0.400 | 0.005 | 0.1315 | 0.1406 | 0.040 | 0.459 | 24 | 4400 | 50 | 0.400 |
| 0.375 | 0.005 | 0.1494 | 0.1603 | 0.040 | 0.434 | 24 | 4400 | 50 | 0.375 |
| 0.355 | 0.004 | 0.1674 | 0.1781 | 0.038 | 0.411 | 23 | 4300 | 53 | 0.355 |
| 0.315 | 0.004 | 0.2120 | 0.2269 | 0.035 | 0.367 | 23 | 4100 | 55 | 0.315 |

| Size mm Nom. | Conductor Tolerance ± mm | Resistance Min @ 20° C Ohm/mtr. | Resistance Min @ 20° C Ohm/mtr. | Grade 2 (Medium Covering) | | For Grade 2 Wires | | | Size mm Nom. |
|-----------------|--------------------------------|---------------------------------------|---------------------------------------|------------------------------|--------|-------------------|-----------|-------------|-----------------|
| | | | | Min. Inc. | Max OD | Elongation % | BDV Volts | Spring Back | |
| 0.300 | 0.004 | 0.2334 | 0.2505 | 0.035 | 0.352 | 23 | 4100 | 55 | 0.300 |
| 0.280 | 0.004 | 0.2675 | 0.2881 | 0.033 | 0.329 | 22 | 4000 | 53 | 0.280 |
| 0.265 | 0.004 | 0.2981 | 0.3221 | 0.033 | 0.314 | 22 | 4000 | 53 | 0.265 |
| 0.250 | 0.004 | 0.3344 | 0.3626 | 0.032 | 0.297 | 22 | 3900 | 56 | 0.250 |
| 0.236 | 0.004 | 0.3745 | 0.4077 | 0.032 | 0.283 | 22 | 3900 | 56 | 0.236 |
| 0.212 | 0.003 | 0.4667 | 0.5024 | 0.029 | 0.254 | 21 | 3700 | 59 | 0.212 |
| 0.200 | 0.003 | 0.5235 | 0.5654 | 0.027 | 0.239 | 21 | 3500 | 62 | 0.200 |
| 0.190 | 0.003 | 0.5791 | 0.6275 | 0.027 | 0.228 | 21 | 3500 | 62 | 0.190 |
| 0.180 | 0.003 | 0.6442 | 0.7004 | 0.025 | 0.217 | 20 | 3300 | 65 | 0.180 |
| 0.170 | 0.003 | 0.7208 | 0.7868 | 0.025 | 0.205 | 20 | 3300 | 65 | 0.170 |
| 0.150 | 0.003 | 0.9215 | 1.0155 | 0.023 | 0.182 | 19 | 3200 | 67 | 0.150 |
| 0.140 | 0.003 | 0.0549 | 1.1692 | 0.021 | 0.171 | 18 | 3000 | 67 | 0.140 |
| 0.132 | 0.003 | 0.1837 | 1.3187 | 0.021 | 0.162 | 18 | 3000 | 67 | 0.132 |
| 0.125 | 0.003 | 0.3167 | 1.4743 | 0.019 | 0.154 | 17 | 2800 | 70 | 0.125 |
| 0.118 | 0.003 | 0.4734 | 1.6593 | 0.019 | 0.145 | 17 | 2800 | 70 | 0.118 |
| 0.112 | 0.003 | 0.6312 | 1.8470 | 0.017 | 0.139 | 17 | 2700 | 73 | 0.112 |
| 0.100 | 0.003 | 0.0334 | 2.3322 | 0.016 | 0.125 | 16 | 950 | 73 | 0.100 |
| 0.090 | 0.003 | 0.4942 | 2.8992 | 0.015 | 0.113 | 15 | 900 | 77 | 0.090 |
| 0.080 | 0.003 | 0.1314 | 3.7011 | 0.014 | 0.101 | 14 | 850 | 80 | 0.080 |
| 0.071 | 0.003 | 3.9394 | 4.7457 | 0.012 | 0.091 | 13 | 700 | 80 | 0.071 |
| 0.051 | 0.003 | 7.3978 | 9.5243 | - | 0.068 | 10 | 650 | - | 0.051 |
| 0.045 | 0.003 | 9.3629 | 12.4399 | - | 0.061 | 9 | 600 | - | 0.045 |
| 0.040 | 0.003 | 11.669 | 16.0292 | - | 0.054 | 9 | 600 | - | 0.040 |
| 0.036 | 0.003 | 14.1828 | 20.1506 | - | 0.049 | 8 | 600 | - | 0.036 |
| 0.032 | 0.003 | 17.6098 | 26.0927 | - | 0.043 | 8 | 375 | - | 0.032 |
| 0.028 | 0.003 | 22.4474 | 35.1104 | - | 0.038 | 7 | 375 | - | 0.028 |
| 0.025 | 0.003 | 27.5154 | 45.3388 | - | 0.340 | 7 | 300 | - | 0.025 |



FINE AND ULTRA-FINE ENAMELLED COPPER WIRES

RR Shramik offers an industry-leading range of high quality fine and ultra-fine enamelled copper wires. The enamelled wire properties governing proper selection not only require consideration of the end use conditions but system compatibility and ease of use in production.

PRODUCT RANGE & QUALITY SPECIFICATIONS

| Product Name / Code | RR Shramik SSFC 155°C | RR Shramik SSFC+N 155°C |
|--|---|--|
| General Description | Modified Polyurethane | Modified Polyurethane with Polyamide Overcoat |
| Standards : IEC (including the following norms) | IEC 60317-20 | IEC 60317-19 / IEC 60317-20 |
| NEMA (including the following norms) | MW 79-C | MW 80-C |
| JIS (including the following norms) | JIS 3202 | - |
| Diameters Available | 0.010 mm - 1.6 mm | 0.010 mm - 0.700 mm |
| Properties | Very Good Solderability & High Thermal Properties | Very Good Solderability & High Thermal Properties |
| Applications | Small Transformers, Linear Motors, Relays, Solenoids, Small Motors, Clock Coils, Watch Coils, Transformers, Magnetic Heads, Instruments | Appliance Motors, Encapsulated Coils, Solenoids, Transformers, Toroids |
| UL Approved | Yes | Yes |
| Thermal Values of Sole Coat | | |
| Temp. Index 20,000 h acc. to IEC 60172 | | |
| Cut Through Temperature | 157.9°C | 157.9°C |
| 0.05 mm : acc. to 0.250 mm IEC 60851-6.4 | ≥ 200°C | ≥ 200°C |
| Typical Value (RR Shramik) | 225°C | 225°C |
| 0.25 mm : acc. to 0.450 mm IEC 60851-6.4 | ≥ 200°C | ≥ 200°C |
| Typical Value (RR Shramik) | 230°C | 230°C |
| Heat Shock | | |
| 0.050 mm : acc. to 0.250 mm IEC 60851-6.3 | ≥ 175°C | ≥ 175°C |
| Typical Value (RR Shramik) | 190°C | 190°C |
| 0.251 mm : acc. to 0.450 mm IEC 60851-6.3 | ≥ 175°C | ≥ 175°C |
| Typical Value (RR Shramik) | 180°C | 180°C |
| Electrical Values | | |
| High Voltage Continuity for Grade 1 wires | | |
| 0.050 mm : acc. to 0.080 mm IEC 60851-5.1 | ≤ 40 | ≤ 40 |
| Typical Value (RR Shramik) | 0 | 0 |
| 0.081 mm : acc. to 0.125 mm IEC 60851-5.2 | ≤ 40 | ≤ 40 |
| Typical Value (RR Shramik) | 1 | 1 |
| 0.125 mm : acc. to 1.600 mm IEC 60851-5.2 | ≤ 25 | ≤ 25 |
| Typical Value (RR Shramik) | 1 | 1 |
| Break Down Voltage (at 20°C, 35% Humidity) | | |
| 0.050 mm : Typical Value (RR Shramik) | 220 V/μm | 210 V/μm |
| 0.081 mm : Typical Value (RR Shramik) | 210 V/μm | 200 V/μm |
| 0.125 mm : Typical Value (RR Shramik) | 180 V/μm | 180 V/μm |
| Pinholes acc. to JIS with 0.45 mm : 0% Elongation | Good | Good |
| Mechanical Values | | |
| Elongation for Grade 1 Wires | | |
| 0.05 mm : acc. to IEC 60851-3 Part 3.1 | ≤ 14% | ≤ 14% |
| Typical Value (RR Shramik) | 22% | 22% |
| 0.800 mm : acc. to IEC 60851-3 Part 3.1 | ≤ 29% | ≤ 29% |
| Typical Value (RR Shramik) | 38% | 38% |
| Solderability | | |
| Solderability for Grade 1 Wires | | |
| 0.05 mm : acc. to IEC 60851-3 Part 4.5 | 2.0s / 390°C | 2.0s / 390°C |
| Typical Value (RR Shramik) | 0.9s / 390°C | 0.9s / 390°C |
| 0.800 mm : acc. to IEC 60851-3 Part 4.5 | 8.0s / 390°C | 8.0s / 390°C |
| Typical Value (RR Shramik) | 5.0s / 390°C | 5.0s / 390°C |
| Chemical Compatibility | | |
| Compatibility to Standard Solution | | |
| Pencil Hardness acc. to IEC 60851-4.3 with treatment | 4H | 4H |
| Pencil Hardness acc. to IEC 60851-4.3 without treatment | 4H | 4H |

Solderability, abrasion resistance, bondability, flexibility, insulation builds, etc. are all typical production and design considerations. Higher temperature requirements and more complex systems dictate the need for knowledgeable selectivity of enamelled wires. In addition to the product featured in this catalogue, we can manufacture custom insulated wires to meet your requirements.

| RR Shramik SSFCP 155°C | RR Shramik SSHC 180°C | RR Shramik SSHC+N 180°C | RR Shramik SSPEI 180°C |
|---|---|--|---|
| Modified Polyurethane | Modified Polyurethane | Modified Polyurethane with Polyamide Overcoat | Self Solderable Polyurethane |
| IEC 60317-20 | IEC 60317-51 | IEC 60317-51 | IEC 60317-23 |
| MW 79-C | MW 82-C | MW 83-C | MW 77-C |
| JIS 3202 | JIS 3202 | JIS 3202 | - |
| 0.010 mm - 1.6 mm | 0.010 mm - 1.6 mm | 0.010 mm - 0.700 mm | 0.010 mm - 0.700 mm |
| Very Good Solderability & High Thermal Properties. No Elongation Pinholes | Good Solderability at 395°C, High Thermal Properties | Very Good Solderability with High Thermal Properties | Solderable at High Temperatures, High Thermal Properties & Good Chemical Resistance |
| Small Transformers, Timers, Relays, Small Motors, Solenoids, Clock Coils, Watch Coils, Magnetic Heads | Automotive Coils as Relays and Ignition Coils, Transformers and Solenoids | Appliance Motors, Encapsulated Coils, Solenoids, Transformers, Toroids | Automotive Coils as Relays and Ignition Coils, Transformers and Solenoids |
| Yes | Yes | Yes | Yes |
| | | | |
| 165°C | 200°C | 200°C | 200°C |
| ≥ 200°C | ≥ 230°C | ≥ 230°C | ≥ 265°C |
| 225°C | 260°C | 260°C | 280°C |
| ≥ 200°C | ≥ 230°C | ≥ 230°C | ≥ 265°C |
| 230°C | 265°C | 265°C | 290°C |
| | | | |
| ≥ 175°C | ≥ 200°C | ≥ 200°C | ≥ 200°C |
| 190°C | 210°C | 210°C | 260°C |
| ≥ 175°C | ≥ 200°C | ≥ 200°C | ≥ 200°C |
| 180°C | 200°C | 200°C | 250°C |
| | | | |
| | | | |
| ≤ 40 | ≤ 40 | ≤ 40 | ≤ 40 |
| 0 | 0 | 0 | 0 |
| ≤ 40 | ≤ 40 | ≤ 40 | ≤ 40 |
| 1 | 1 | 1 | 1 |
| ≤ 25 | ≤ 25 | ≤ 25 | ≤ 25 |
| 1 | 1 | 1 | 1 |
| | | | |
| 220 V/μm | 220 V/μm | 220 V/μm | 220 V/μm |
| 210 V/μm | 210 V/μm | 210 V/μm | 210 V/μm |
| 180 V/μm | 180 V/μm | 180 V/μm | 180 V/μm |
| Very Good | Very Good | Very Good | Very Good |
| | | | |
| | | | |
| ≤ 14% | ≤ 14% | ≤ 14% | ≤ 14% |
| 22% | 22% | 22% | 22% |
| ≤ 29% | ≤ 29% | ≤ 29% | ≤ 29% |
| 38% | 38% | 38% | 38% |
| | | | |
| | | | |
| 2.0s / 390°C | 2.0s / 390°C | 2.0s / 390°C | 2.0s / 470°C |
| 0.9s / 390°C | 0.9s / 390°C | 0.9s / 390°C | 1.8s / 470°C |
| 8.0s / 390°C | 8.0s / 390°C | 8.0s / 390°C | 8.0s / 470°C |
| 5.0s / 390°C | 5.0s / 390°C | 5.0s / 390°C | 5.0s / 470°C |
| | | | |
| | | | |
| 4H | 4H | 4H | 4H |
| 4H | 4H | 4H | 4H |

DIMENSIONS AND TECHNICAL DATA OF ENAMELLED COPPER WIRES BASED ON IEC 60317

| Nominal Diameter | Conductor (Bare Wire) | | Enamelled Copper Wire (Overall Diameter) | | | | | | Resistance at 20° C | | | Elongation acc. to IEC |
|------------------|-----------------------|---------------|--|-----------|-----------|-----------|-----------|-----------|---------------------|--------------|--------------|------------------------|
| | | | Grade 1 | | Grade 2 | | Grade 3 | | | | | |
| [mm] | Tolerance [mm] | Section [mm²] | Min. [mm] | Max. [mm] | Min. [mm] | Max. [mm] | Min. [mm] | Max. [mm] | Nom. [Ohm/m] | Min. [Ohm/m] | Max. [Ohm/m] | Min. [%] |
| 0.010 | * | 0.000078540 | 0.0111 | 0.0120 | 0.0121 | 0.0130 | 0.0131 | 0.0140 | 217.65 | 195.88 | 239.41 | 3 |
| 0.012 | * | 0.000113097 | 0.0132 | 0.0143 | 0.0144 | 0.0155 | 0.0156 | 0.0170 | 151.14 | 136.03 | 166.26 | 3 |
| 0.014 | * | 0.000153938 | 0.0154 | 0.0167 | 0.0168 | 0.0180 | 0.0181 | 0.0200 | 111.04 | 99.94 | 122.15 | 4 |
| 0.016 | * | 0.000201062 | 0.0175 | 0.0190 | 0.0191 | 0.0210 | 0.0211 | 0.0230 | 85.02 | 76.52 | 93.52 | 5 |
| 0.018 | * | 0.000254469 | 0.020 | 0.022 | 0.023 | 0.024 | 0.025 | 0.026 | 67.18 | 60.46 | 73.89 | 5 |
| 0.019 | * | 0.000283529 | 0.021 | 0.023 | 0.024 | 0.026 | 0.027 | 0.029 | 60.29 | 54.26 | 66.32 | 6 |
| 0.020 | * | 0.000314159 | 0.022 | 0.024 | 0.025 | 0.027 | 0.028 | 0.030 | 54.41 | 48.97 | 59.85 | 6 |
| 0.021 | * | 0.000346361 | 0.023 | 0.026 | 0.027 | 0.028 | 0.029 | 0.031 | 49.35 | 44.42 | 54.29 | 6 |
| 0.022 | * | 0.000380133 | 0.024 | 0.027 | 0.028 | 0.030 | 0.031 | 0.033 | 44.97 | 40.47 | 49.47 | 6 |
| 0.023 | * | 0.000417476 | 0.025 | 0.028 | 0.029 | 0.031 | 0.032 | 0.035 | 41.14 | 37.03 | 45.26 | 7 |
| 0.024 | * | 0.000452389 | 0.026 | 0.029 | 0.030 | 0.032 | 0.033 | 0.036 | 37.79 | 34.01 | 41.56 | 7 |
| 0.025 | * | 0.000490874 | 0.028 | 0.031 | 0.032 | 0.034 | 0.035 | 0.038 | 34.82 | 31.34 | 37.31 | 7 |
| 0.027 | * | 0.000572555 | 0.030 | 0.033 | 0.034 | 0.036 | 0.037 | 0.041 | 29.86 | 26.87 | 32.84 | 7 |
| 0.028 | * | 0.000615752 | 0.031 | 0.034 | 0.035 | 0.038 | 0.039 | 0.043 | 27.76 | 24.99 | 30.54 | 7 |
| 0.030 | * | 0.000706858 | 0.033 | 0.037 | 0.038 | 0.041 | 0.042 | 0.046 | 24.18 | 21.76 | 26.60 | 8 |
| 0.032 | * | 0.000804248 | 0.035 | 0.039 | 0.040 | 0.043 | 0.044 | 0.048 | 21.25 | 19.13 | 23.38 | 8 |
| 0.034 | * | 0.000907920 | 0.037 | 0.041 | 0.042 | 0.046 | 0.047 | 0.051 | 18.83 | 17.13 | 20.52 | 8 |
| 0.036 | * | 0.001017880 | 0.040 | 0.044 | 0.045 | 0.049 | 0.050 | 0.054 | 16.79 | 15.282 | 18.305 | 8 |
| 0.038 | * | 0.001134000 | 0.042 | 0.046 | 0.047 | 0.051 | 0.052 | 0.056 | 15.07 | 13.716 | 16.429 | 10 |
| 0.040 | * | 0.001257000 | 0.044 | 0.049 | 0.050 | 0.054 | 0.055 | 0.059 | 13.60 | 12.379 | 14.827 | 10 |
| 0.043 | * | 0.001452 | 0.047 | 0.052 | 0.053 | 0.058 | 0.059 | 0.063 | 11.770 | 10.712 | 12.831 | 12 |
| 0.045 | * | 0.001590 | 0.050 | 0.055 | 0.056 | 0.061 | 0.062 | 0.067 | 10.750 | 9.781 | 11.715 | 12 |
| 0.048 | * | 0.001810 | 0.053 | 0.059 | 0.060 | 0.065 | 0.066 | 0.070 | 9.447 | 8.596 | 10.297 | 14 |
| 0.050 | * | 0.001963 | 0.055 | 0.060 | 0.061 | 0.066 | 0.067 | 0.072 | 8.706 | 7.922 | 9.489 | 14 |
| 0.053 | * | 0.002206 | 0.058 | 0.064 | 0.065 | 0.070 | 0.071 | 0.076 | 7.748 | 7.051 | 8.446 | 15 |
| 0.056 | * | 0.002463 | 0.062 | 0.067 | 0.068 | 0.074 | 0.075 | 0.080 | 6.940 | 6.316 | 7.565 | 15 |
| 0.060 | * | 0.002827 | 0.066 | 0.072 | 0.073 | 0.079 | 0.080 | 0.085 | 6.046 | 5.502 | 6.590 | 16 |
| 0.063 | * | 0.003117 | 0.069 | 0.076 | 0.077 | 0.083 | 0.084 | 0.089 | 5.484 | 4.990 | 5.977 | 16 |
| 0.067 | * | 0.003526 | 0.074 | 0.080 | 0.081 | 0.088 | 0.089 | 0.093 | 4.848 | 4.412 | 5.285 | 17 |
| 0.070 | * | 0.003848 | 0.077 | 0.083 | 0.084 | 0.090 | 0.091 | 0.096 | 4.442 | 4.042 | 4.842 | 17 |
| 0.071 | * | 0.003959 | 0.078 | 0.084 | 0.085 | 0.091 | 0.092 | 0.097 | 4.318 | 3.929 | 4.706 | 17 |
| 0.075 | * | 0.004418 | 0.082 | 0.089 | 0.090 | 0.095 | 0.096 | 0.102 | 3.869 | 3.547 | 4.235 | 17 |
| 0.080 | ±0.003 | 0.005027 | 0.087 | 0.094 | 0.095 | 0.101 | 0.102 | 0.108 | 3.401 | 3.133 | 3.703 | 17 |
| 0.085 | ±0.003 | 0.005675 | 0.093 | 0.100 | 0.101 | 0.107 | 0.108 | 0.114 | 3.012 | 2.787 | 3.265 | 18 |
| 0.090 | ±0.003 | 0.006362 | 0.098 | 0.105 | 0.106 | 0.113 | 0.114 | 0.120 | 2.687 | 2.495 | 2.900 | 18 |
| 0.095 | ±0.003 | 0.007088 | 0.103 | 0.111 | 0.112 | 0.119 | 0.120 | 0.126 | 2.412 | 2.247 | 2.594 | 19 |
| 0.100 | ±0.003 | 0.007854 | 0.108 | 0.117 | 0.118 | 0.125 | 0.126 | 0.132 | 2.176 | 2.034 | 2.333 | 19 |
| 0.106 | ±0.003 | 0.008825 | 0.115 | 0.123 | 0.124 | 0.132 | 0.133 | 0.140 | 1.937 | 1.816 | 2.069 | 20 |
| 0.110 | ±0.003 | 0.009503 | 0.119 | 0.128 | 0.129 | 0.137 | 0.138 | 0.145 | 1.799 | 1.690 | 1.917 | 20 |

| Nominal Diameter | Breakdown Voltage acc. to IEC | | | Length of 1 kg of Enamelled Wire | | | Filling Factor Number of Enamelled | | | Tension | Nominal Diameter |
|------------------|-------------------------------|----------|----------|----------------------------------|--------------|--------------|------------------------------------|---------|---------|-----------|------------------|
| | Grade 1 | Grade 2 | Grade 3 | Grade 1 | Grade 2 | Grade 3 | Grade 1 | Grade 2 | Grade 3 | | |
| [mm] | Min. [V] | Min. [V] | Min. [V] | Approx. [km] | Approx. [km] | Approx. [km] | [n] | [n] | [n] | Max. [cN] | [mm] |
| 0.010 | 70 | 125 | 170 | 1358.2 | 1313.3 | 1267.9 | 865576 | 733132 | 628913 | 1.4 | 0.010 |
| 0.012 | 80 | 150 | 190 | 946.0 | 914.9 | 879.5 | 610751 | 516639 | 434604 | 2.0 | 0.012 |
| 0.014 | 90 | 175 | 230 | 694.9 | 672.9 | 645.6 | 448249 | 381391 | 318185 | 2.5 | 0.014 |
| 0.016 | 100 | 200 | 290 | 533.1 | 513.3 | 491.2 | 346692 | 287237 | 237494 | 3.2 | 0.016 |
| 0.018 | 115 | 240 | 380 | 417.6 | 398.3 | 382.7 | 261837 | 209090 | 177578 | 3.9 | 0.018 |
| 0.019 | 120 | 250 | 410 | 375.9 | 356.2 | 336.3 | 238574 | 184752 | 147283 | 4.3 | 0.019 |
| 0.020 | 120 | 250 | 410 | 340.1 | 323.2 | 306.2 | 218280 | 170814 | 137301 | 4.7 | 0.020 |
| 0.021 | 125 | 265 | 440 | 306.8 | 292.2 | 279.9 | 192370 | 152688 | 128300 | 5.1 | 0.021 |
| 0.022 | 130 | 275 | 470 | 280.2 | 265.4 | 252.6 | 177578 | 137301 | 112764 | 5.5 | 0.022 |
| 0.023 | 145 | 290 | 470 | 257.0 | 244.0 | 231.0 | 164429 | 128300 | 102892 | 6.0 | 0.023 |
| 0.024 | 150 | 300 | 470 | 236.5 | 225.1 | 213.6 | 152688 | 120156 | 97013 | 6.5 | 0.024 |
| 0.025 | 150 | 300 | 470 | 215.5 | 205.4 | 195.2 | 132686 | 106033 | 86673 | 7.0 | 0.025 |
| 0.027 | 165 | 315 | 510 | 185.6 | 177.6 | 168.3 | 116372 | 94261 | 75917 | 8.0 | 0.027 |
| 0.028 | 170 | 325 | 530 | 172.9 | 164.7 | 155.4 | 109321 | 86673 | 68691 | 8.5 | 0.028 |
| 0.030 | 180 | 350 | 560 | 150.3 | 142.8 | 135.2 | 94261 | 74007 | 59644 | 9.6 | 0.030 |
| 0.032 | 190 | 375 | 590 | 132.6 | 126.4 | 120.2 | 84346 | 67046 | 54570 | 10.8 | 0.032 |
| 0.034 | 210 | 400 | 620 | 117.8 | 112.1 | 106.3 | 75917 | 59644 | 48092 | 12.0 | 0.034 |
| 0.036 | 225 | 425 | 650 | 104.4 | 99.57 | 94.69 | 65459 | 52273 | 42703 | 13.2 | 0.036 |
| 0.038 | 240 | 450 | 680 | 93.97 | 89.87 | 85.72 | 59644 | 48092 | 39599 | 14.5 | 0.038 |
| 0.040 | 250 | 475 | 710 | 84.68 | 80.81 | 77.25 | 53403 | 42703 | 35540 | 15.9 | 0.040 |
| 0.043 | 265 | 520 | 710 | 73.55 | 70.15 | 67.01 | 47126 | 37487 | 31032 | 18.0 | 0.043 |
| 0.045 | 275 | 550 | 710 | 66.82 | 63.85 | 60.85 | 41894 | 33741 | 27756 | 19.4 | 0.045 |
| 0.048 | 290 | 580 | 780 | 58.73 | 56.08 | 53.81 | 36821 | 29560 | 24972 | 21.7 | 0.048 |
| 0.050 | 300 | 600 | 830 | 54.42 | 52.26 | 50.08 | 34925 | 28637 | 23906 | 23.2 | 0.050 |
| 0.053 | 315 | 625 | 860 | 48.42 | 46.45 | 44.62 | 31032 | 25343 | 21374 | 25.6 | 0.053 |
| 0.056 | 325 | 650 | 890 | 43.36 | 41.69 | 40.01 | 27756 | 22906 | 19225 | 28.2 | 0.056 |
| 0.060 | 355 | 680 | 960 | 37.79 | 36.33 | 34.97 | 24253 | 19991 | 16965 | 31.7 | 0.060 |
| 0.063 | 375 | 700 | 1020 | 34.27 | 32.92 | 31.74 | 21968 | 18042 | 15433 | 34.4 | 0.063 |
| 0.067 | 400 | 700 | 1060 | 30.31 | 29.19 | 28.21 | 19475 | 16172 | 13944 | 38.0 | 0.067 |
| 0.070 | 425 | 700 | 1020 | 27.83 | 26.91 | 26.06 | 18042 | 15256 | 13208 | 41.0 | 0.070 |
| 0.071 | 425 | 700 | 1100 | 27.07 | 26.19 | 25.37 | 17599 | 14911 | 12930 | 42.0 | 0.071 |
| 0.075 | 425 | 765 | 1140 | 24.26 | 23.52 | 22.82 | 15796 | 13495 | 11781 | 46.0 | 0.075 |
| 0.080 | 425 | 850 | 1200 | 21.39 | 20.73 | 20.11 | 14093 | 12023 | 10473 | 52.0 | 0.080 |
| 0.085 | 465 | 875 | 1250 | 18.92 | 18.37 | 17.86 | 12400 | 10676 | 9372 | 57.0 | 0.085 |
| 0.090 | 500 | 900 | 1300 | 16.92 | 16.43 | 15.96 | 11208 | 9630 | 8435 | 63.0 | 0.090 |
| 0.095 | 500 | 925 | 1350 | 15.19 | 14.75 | 14.35 | 10086 | 8656 | 7632 | 69.0 | 0.095 |
| 0.100 | 500 | 950 | 1400 | 13.72 | 13.31 | 12.97 | 9124 | 7822 | 6939 | 75.0 | 0.100 |
| 0.106 | 1200 | 2650 | 3800 | 12.22 | 11.88 | 11.56 | 8154 | 7048 | 6197 | 83.0 | 0.106 |
| 0.110 | 1300 | 2700 | 3900 | 11.34 | 11.03 | 10.74 | 7571 | 6528 | 5767 | 88.0 | 0.110 |

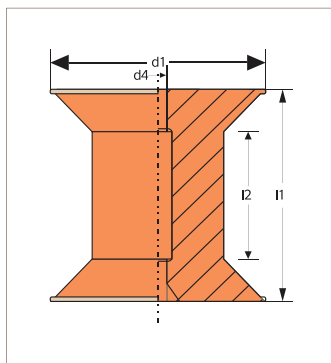
DIMENSIONS AND TECHNICAL DATA OF ENAMELLED COPPER WIRES BASED ON IEC 60317

| Nominal Diameter | Conductor (Bare Wire) | | Enamelled Copper Wire (Overall Diameter) | | | | | | Resistance at 20° C | | | Elongation acc. to IEC |
|------------------|-----------------------|---------------|--|-----------|-----------|-----------|-----------|-----------|---------------------|--------------|--------------|------------------------|
| | | | Grade 1 | | Grade 2 | | Grade 3 | | | | | |
| [mm] | Tolerance [mm] | Section [mm²] | Min. [mm] | Max. [mm] | Min. [mm] | Max. [mm] | Min. [mm] | Max. [mm] | Nom. [Ohm/m] | Min. [Ohm/m] | Max. [Ohm/m] | Min. [%] |
| 0.112 | ±0.003 | 0.009852 | 0.121 | 0.130 | 0.131 | 0.139 | 0.140 | 0.147 | 1.735 | 1.632 | 1.848 | 20 |
| 0.118 | ±0.003 | 0.010936 | 0.128 | 0.136 | 0.137 | 0.145 | 0.146 | 0.154 | 1.563 | 1.474 | 1.660 | 20 |
| 0.120 | ±0.003 | 0.011310 | 0.130 | 0.138 | 0.139 | 0.148 | 0.149 | 0.157 | 1.511 | 1.426 | 1.604 | 20 |
| 0.125 | ±0.003 | 0.012272 | 0.135 | 0.144 | 0.145 | 0.154 | 0.155 | 0.163 | 1.393 | 1.317 | 1.475 | 20 |
| 0.130 | ±0.003 | 0.013273 | 0.141 | 0.150 | 0.151 | 0.160 | 0.161 | 0.169 | 1.288 | 1.220 | 1.361 | 21 |
| 0.132 | ±0.003 | 0.013685 | 0.143 | 0.152 | 0.153 | 0.162 | 0.163 | 0.171 | 1.249 | 1.184 | 1.319 | 21 |
| 0.140 | ±0.003 | 0.015394 | 0.151 | 0.160 | 0.161 | 0.171 | 0.172 | 0.181 | 1.110 | 1.055 | 1.170 | 21 |
| 0.150 | ±0.003 | 0.017671 | 0.162 | 0.171 | 0.172 | 0.182 | 0.183 | 0.193 | 0.9673 | 0.9219 | 10.159 | 22 |
| 0.160 | ±0.003 | 0.020106 | 0.172 | 0.182 | 0.183 | 0.194 | 0.195 | 0.205 | 0.8502 | 0.8122 | 0.8906 | 22 |
| 0.170 | ±0.003 | 0.022698 | 0.183 | 0.194 | 0.195 | 0.205 | 0.206 | 0.217 | 0.7531 | 0.7211 | 0.7871 | 23 |
| 0.180 | ±0.003 | 0.025447 | 0.193 | 0.204 | 0.205 | 0.217 | 0.218 | 0.229 | 0.6718 | 0.6444 | 0.7007 | 23 |
| 0.190 | ±0.003 | 0.028353 | 0.204 | 0.216 | 0.217 | 0.228 | 0.229 | 0.240 | 0.6029 | 0.5794 | 0.6278 | 24 |
| 0.200 | ±0.003 | 0.031416 | 0.214 | 0.226 | 0.227 | 0.239 | 0.240 | 0.252 | 0.5441 | 0.5237 | 0.5657 | 24 |
| 0.212 | ±0.003 | 0.035299 | 0.227 | 0.240 | 0.241 | 0.254 | 0.255 | 0.268 | 0.4843 | 0.4669 | 0.5026 | 24 |
| 0.224 | ±0.003 | 0.039408 | 0.239 | 0.252 | 0.253 | 0.266 | 0.267 | 0.280 | 0.4338 | 0.4188 | 0.4495 | 24 |
| 0.236 | ±0.004 | 0.043744 | 0.253 | 0.267 | 0.268 | 0.283 | 0.284 | 0.298 | 0.3908 | 0.3747 | 0.4079 | 25 |
| 0.250 | ±0.004 | 0.049087 | 0.267 | 0.281 | 0.282 | 0.297 | 0.298 | 0.312 | 0.3482 | 0.3345 | 0.3628 | 25 |
| 0.265 | ±0.004 | 0.055155 | 0.283 | 0.297 | 0.298 | 0.314 | 0.315 | 0.330 | 0.3099 | 0.2982 | 0.3223 | 26 |
| 0.280 | ±0.004 | 0.061575 | 0.298 | 0.312 | 0.313 | 0.329 | 0.330 | 0.345 | 0.2776 | 0.2676 | 0.2882 | 26 |
| 0.300 | ±0.004 | 0.070686 | 0.319 | 0.334 | 0.335 | 0.352 | 0.353 | 0.369 | 0.2418 | 0.2335 | 0.2506 | 26 |
| 0.315 | ±0.004 | 0.077931 | 0.334 | 0.349 | 0.350 | 0.367 | 0.368 | 0.384 | 0.2193 | 0.2121 | 0.2270 | 26 |
| 0.335 | ±0.004 | 0.088141 | 0.355 | 0.372 | 0.373 | 0.391 | 0.392 | 0.408 | 0.1939 | 0.1878 | 0.2004 | 27 |
| 0.355 | ±0.004 | 0.098980 | 0.375 | 0.392 | 0.393 | 0.411 | 0.412 | 0.428 | 0.1727 | 0.1674 | 0.1782 | 27 |
| 0.375 | ±0.005 | 0.110447 | 0.396 | 0.414 | 0.415 | 0.434 | 0.435 | 0.453 | 0.1548 | 0.1494 | 0.1604 | 27 |
| 0.400 | ±0.005 | 0.125664 | 0.421 | 0.439 | 0.440 | 0.459 | 0.460 | 0.478 | 0.1360 | 0.1316 | 0.1407 | 27 |
| 0.425 | ±0.005 | 0.141863 | 0.447 | 0.466 | 0.467 | 0.488 | 0.489 | 0.508 | 0.1205 | 0.1167 | 0.1244 | 28 |
| 0.450 | ±0.005 | 0.159403 | 0.472 | 0.491 | 0.492 | 0.513 | 0.514 | 0.533 | 0.1075 | 0.1042 | 0.1109 | 28 |
| 0.475 | ±0.005 | 0.177205 | 0.499 | 0.519 | 0.520 | 0.541 | 0.542 | 0.562 | 0.09646 | 0.09366 | 0.9938 | 28 |
| 0.500 | ±0.005 | 0.196350 | 0.524 | 0.544 | 0.545 | 0.566 | 0.567 | 0.587 | 0.08706 | 0.08462 | 0.08959 | 28 |
| 0.560 | ±0.006 | 0.246176 | 0.585 | 0.606 | 0.607 | 0.630 | 0.631 | 0.653 | 0.06938 | 0.06734 | 0.07150 | 27 |
| 0.630 | ±0.006 | 0.311567 | 0.657 | 0.679 | 0.680 | 0.704 | 0.705 | 0.728 | 0.05482 | 0.05333 | 0.05540 | 28 |
| 0.710 | ±0.007 | 0.395719 | 0.738 | 0.762 | 0.763 | 0.789 | 0.790 | 0.814 | 0.04316 | 0.04196 | 0.04365 | 29 |
| 0.800 | ±0.008 | 0.502400 | 0.830 | 0.855 | 0.856 | 0.884 | 0.885 | 0.911 | 0.03399 | 0.03304 | 0.03439 | 29 |
| 0.900 | ±0.009 | 0.635850 | 0.932 | 0.959 | 0.960 | 0.989 | 0.990 | 1.018 | 0.02686 | 0.02611 | 0.02717 | 30 |
| 1.000 | ±0.01 | 0.785000 | 1.034 | 1.062 | 1.063 | 1.094 | 1.095 | 1.124 | 0.02176 | 0.02115 | 0.02201 | 30 |
| 1.120 | ±0.011 | 0.984704 | 1.154 | 1.184 | 1.185 | 1.217 | 1.218 | 1.248 | 0.01734 | 0.01686 | 0.01754 | 31 |
| 1.250 | ±0.013 | 1.226563 | 1.285 | 1.316 | 1.317 | 1.349 | 1.350 | 1.381 | 0.01392 | 0.01352 | 0.01410 | 32 |
| 1.400 | ±0.014 | 1.538600 | 1.436 | 1.468 | 1.469 | 1.502 | 1.503 | 1.535 | 0.01110 | 0.01079 | 0.01123 | 32 |
| 1.600 | ±0.016 | 2.009600 | 1.638 | 1.670 | 1.671 | 1.706 | 1.707 | 1.740 | 0.00850 | 0.00826 | 0.00860 | 32 |

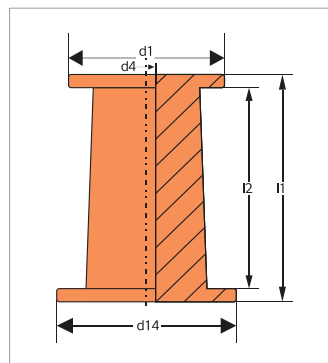
| Nominal Diameter | Breakdown Voltage acc. to IEC | | | Length of 1 kg of Enamelled Wire | | | Filling Factor Number of Enamelled | | | Tension | Nominal Diameter |
|------------------|-------------------------------|----------|----------|----------------------------------|--------------|--------------|------------------------------------|---------|---------|-----------|------------------|
| | Grade 1 | Grade 2 | Grade 3 | Grade 1 | Grade 2 | Grade 3 | Grade 1 | Grade 2 | Grade 3 | | |
| [mm] | Min. [V] | Min. [V] | Min. [V] | Approx. [km] | Approx. [km] | Approx. [km] | [n] | [n] | [n] | Max. [cN] | [mm] |
| 0.112 | 1300 | 2700 | 3900 | 10.95 | 10.65 | 10.37 | 7331 | 6336 | 5607 | 91.0 | 0.112 |
| 0.118 | 1400 | 2750 | 4000 | 9.870 | 9.626 | 9.379 | 6627 | 5808 | 5132 | 99 | 0.118 |
| 0.120 | 1500 | 2800 | 4100 | 9.550 | 9.305 | 9.057 | 6431 | 5607 | 4933 | 102 | 0.120 |
| 0.125 | 1500 | 2800 | 4100 | 8.803 | 8.575 | 8.356 | 5934 | 5166 | 4567 | 110 | 0.125 |
| 0.130 | 1550 | 2900 | 4150 | 8.131 | 7.928 | 7.733 | 5454 | 4775 | 4241 | 118 | 0.130 |
| 0.132 | 1550 | 2900 | 4150 | 7.891 | 7.697 | 7.511 | 5307 | 4655 | 4140 | 121 | 0.132 |
| 0.140 | 1600 | 3000 | 4200 | 7.030 | 6.860 | 6.687 | 4775 | 4190 | 3707 | 133 | 0.140 |
| 0.150 | 1650 | 3100 | 4300 | 6.125 | 5.987 | 5.840 | 4165 | 3686 | 3267 | 150 | 0.150 |
| 0.160 | 1700 | 3200 | 4400 | 5.390 | 5.265 | 5.139 | 3686 | 3250 | 2887 | 168 | 0.160 |
| 0.170 | 1700 | 3300 | 4700 | 4.771 | 4.667 | 4.561 | 3250 | 2887 | 2581 | 186 | 0.170 |
| 0.180 | 1700 | 3300 | 4700 | 4.263 | 4.168 | 4.072 | 2931 | 2594 | 2312 | 206 | 0.180 |
| 0.190 | 1750 | 3400 | 4900 | 3.823 | 3.743 | 3.664 | 2618 | 2332 | 2100 | 226 | 0.190 |
| 0.200 | 1800 | 3500 | 5100 | 3.456 | 3.384 | 3.312 | 2386 | 2127 | 1908 | 247 | 0.200 |
| 0.212 | 1850 | 3600 | 5150 | 3.075 | 3.010 | 2.944 | 2118 | 1885 | 1689 | 274 | 0.212 |
| 0.224 | 1900 | 3700 | 5200 | 2.759 | 2.704 | 2.648 | 1916 | 1715 | 1544 | 302 | 0.224 |
| 0.236 | 2000 | 3800 | 5350 | 2.481 | 2.429 | 2.376 | 1708 | 1521 | 1364 | 331 | 0.236 |
| 0.250 | 2100 | 3900 | 5500 | 2.215 | 2.171 | 2.127 | 1538 | 1378 | 1241 | 366 | 0.250 |
| 0.265 | 2150 | 3950 | 5650 | 1.972 | 1.934 | 1.895 | 1373 | 1233 | 1110 | 406 | 0.265 |
| 0.280 | 2200 | 4000 | 5800 | 1.769 | 1.737 | 1.704 | 1241 | 1121 | 1014 | 448 | 0.280 |
| 0.300 | 2200 | 4050 | 5950 | 1.542 | 1.514 | 1.485 | 1083 | 979 | 886 | 507 | 0.300 |
| 0.315 | 2200 | 4100 | 6100 | 1.400 | 1.376 | 1.351 | 990 | 898 | 817 | 553 | 0.315 |
| 0.335 | 2250 | 4200 | 6250 | 1.238 | 1.216 | 1.195 | 874 | 791 | 722 | 618 | 0.335 |
| 0.355 | 2300 | 4300 | 6400 | 1.104 | 1.086 | 1.068 | 785 | 715 | 655 | 687 | 0.355 |
| 0.375 | 2300 | 4350 | 6500 | 0.989 | 0.973 | 0.957 | 704 | 641 | 586 | 759 | 0.375 |
| 0.400 | 2300 | 4400 | 6600 | 0.871 | 0.858 | 0.844 | 625 | 571 | 525 | 854 | 0.400 |
| 0.425 | 2300 | 4400 | 6700 | 0.772 | 0.760 | 0.748 | 554 | 506 | 465 | 954 | 0.425 |
| 0.450 | 2300 | 4400 | 6800 | 0.689 | 0.679 | 0.669 | 498 | 457 | 421 | 1060 | 0.450 |
| 0.475 | 2350 | 4500 | 6900 | 0.618 | 0.609 | 0.601 | 446 | 410 | 379 | 1170 | 0.475 |
| 0.500 | 2400 | 4600 | 7000 | 0.559 | 0.551 | 0.543 | 405 | 374 | 347 | 1287 | 0.500 |
| 0.560 | 2.600 | 4600 | 7100 | 0.450 | 0.444 | 0.438 | 292.21 | 271.41 | 251.15 | 1681 | 0.560 |
| 0.630 | 2.600 | 4800 | 7200 | 0.356 | 0.352 | 0.347 | 231.67 | 216.26 | 201.2 | 2070 | 0.630 |
| 0.710 | 2.600 | 4800 | 7400 | 0.280 | 0.277 | 0.274 | 183.61 | 171.77 | 160.23 | 2556 | 0.710 |
| 0.800 | 2.700 | 4900 | 7600 | 0.221 | 0.219 | 0.216 | 145.16 | 136.47 | 127.68 | 3156 | 0.800 |
| 0.900 | 2.700 | 5000 | 7600 | 0.175 | 0.173 | 0.171 | 115.12 | 108.51 | 102.03 | 3886 | 0.900 |
| 1.000 | 2.700 | 5000 | 7600 | 0.142 | 0.140 | 0.139 | 93.532 | 88.498 | 83.401 | 4681 | 1.000 |
| 1.120 | 2.700 | 5000 | 7600 | 0.113 | 0.112 | 0.111 | 75.091 | 71.214 | 67.407 | 5719 | 1.120 |
| 1.250 | 2.700 | 5000 | 7600 | 0.091 | 0.090 | 0.089 | 60.561 | 57.654 | 54.87 | 6943 | 1.250 |
| 1.400 | 2.700 | 5000 | 7600 | 0.072 | 0.072 | 0.071 | 48.494 | 46.34 | 44.267 | 8481 | 1.400 |
| 1.600 | 2.700 | 5000 | 7600 | 0.056 | 0.055 | 0.055 | 37.271 | 35.814 | 34.319 | 10737 | 1.600 |

SPOOLS AND PACKAGING

| | Graph | Wire Sizes | Characteristics |
|-----------|-------|--------------------|---|
| Biconical | 1 | 0.010 mm - 0.15 mm | Biconical spool for fine and ultrafine wire, superb de-reeling capability, ideal for high speed winding machines. |
| Tapered | 2 | 0.070 mm - 1.60 mm | Stable winding due to tapered barrel spool for heavier sizes. |

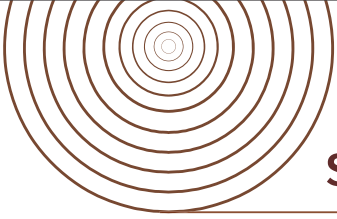


Graph 1: Biconical Spool



Graph 2: Tapered Spool

| Spool Types | d1 [mm] | d4 [mm] | l1 [mm] | l2 [mm] | d14 [mm] | Spool Weight [g] | Nom. net wire weight [kg] | Recommended for wires sizes [mm] | Spools per box | Boxes per pallet |
|-------------|---------|---------|---------|---------|----------|------------------|---------------------------|----------------------------------|----------------|------------------|
| Biconical | | | | | | | | | | |
| 76/45 | 63.4 | 16 | 86.3 | 60 | - | 70 | 0.3 | 0.010 - 0.019 | 6 | 120 |
| 79/45 | 80 | 16 | 100 | 70 | - | 70 | 0.7 | 0.020 - 0.024 | 4 | 72 |
| PL1S | 80 | 16 | 100 | 72 | - | 70 | 1.0 | 0.018 - 0.035 | 8 | 72 |
| PL2S | 100 | 16 | 100 | 47 | - | 130 | 1.2 | 0.025 - 0.040 | 8 | 24 |
| 124/45R | 125 | 16 | 125 | 57 | - | 160 | 2.5 | 0.040 - 0.080 | 4/9 | 24 |
| PL4-S | 135 | 20 | 175 | 110 | - | 260 | 4.2 | 0.040 - 0.132 | 4 | 24 |
| 159/45R | 160 | 22 | 160 | 73 | - | 315 | 5.5 | 0.040 - 0.132 | 4 | 18 |
| 199/45R | 200 | 22 | 200 | 92.5 | - | 600 | 11.0 | 0.050 - 0.150 | 1 | 21 |
| Tapered | | | | | | | | | | |
| PT 4 | 124 | 22 | 200 | 170 | 140 | 340 | 5.5 | 0.070 - 0.100 | 4 | 24 |
| PT 10 | 160 | 22 | 230 | 200 | 180 | 620 | 10 | 0.100 - 0.600 | 2 | 36 |
| PT 15 | 180 | 22 | 230 | 200 | 200 | 740 | 15 | 0.100 - 0.600 | 2 | 45 |
| PT 25 | 215 | 32 | 280 | 250 | 230 | 1000 | 26 | 0.160 - 0.500 | 1 | 36 |
| PT 45 | 236 | 100 | 400 | 335 | 250 | 2150 | 45 | 0.120 - 1.600 | Container | 8 |
| PT 60 | 270 | 45 | 400 | 350 | 300 | 2400 | 60 | 0.280 - 1.600 | Container | 12 |
| PT 90 | 300 | 100 | 500 | 425 | 3900 | 3900 | 90 | 0.200 - 1.600 | Container | 6 |



SUPER ENAMELLED ALUMINIUM WINDING WIRES

The demand of aluminum magnet wires in many industrial applications has sky rocketed due to unprecedented increase in copper rates. To cater this demand, We proudly declare the addition of super enamelled aluminum magnet wires in the product armory. These are manufactured as per Indian as well International standards and as per the specifications given by the customers. The product is available in different sizes, types and grades of coverings to cater to specific needs for special fields of applications. The latest technology is adopted for manufacturing to offer high quality products.

APPLICATIONS

Aluminum is an excellent electrical conductor next to copper. The super enamelled aluminum wire can be used to replace the copper enamelled wires with proper design modifications. Mainly it is used in electronic circuits, television degaussing coils and so on for many more applications including washing machine motors, fans and AC compressors. These wires have same properties for the enamel film but differ for the conductor properties when compared with enamelled copper wires. Our products have very good elongation and smooth surface.

SIZE RANGE, TYPES AND SPECIFICATIONS

- Wire Dia Sizes from 4.0 to 0.25 mm (8 to 33 SWG), Grade – 1, 2, and 3
- Modified Polyesters, Class 130, 155. As per IS 13730 part 9 / IEC 60317 part 9
- Hermetic Grade, Class 180. As per IS 13730 part 15 / IEC 60317 part 15
- Dual Coated, Class 200. As per IS 13730 part 25 / IEC 60317 part 25 and NEMA MW 35A

SIZE CALCULATION

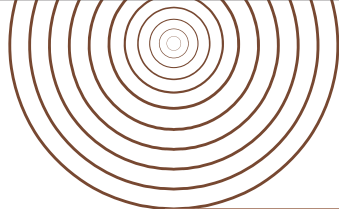
An indicative calculation for getting aluminum magnet wire size to replace copper magnet wire can be as below.

Resistivity (ρ) of Cu is $0.01709 \Omega\text{mm}^2/\text{m}$ & that of aluminum is $0.02789 \Omega\text{mm}^2/\text{m}$.

By using formula of resistance $R = \rho L/A$

D (diameter) for aluminum = $1.277 \times D$ of Copper





SUPER ENAMELLED COPPER STRIPS

Enamel film insulated rectangular copper conductors are known as enamelled copper strips. The manufacturing process of enamelled strips, are essentially same as round wires, but most critical. The rectangular shape of copper conductors with nominal corner radii, helps to pack maximum copper in small space. This characteristic is beneficial in design aspect of the transformer windings. At the same time the insulation strength and flexibility has to be excellent to withstand the winding stresses, bending / shaping etc. At Salasar Copper, we provide very special attentions towards the flexibility and adherence of the insulation film of enamelled strips. We are having many esteemed and satisfied customer using enamelled strips for critical applications.

GENERAL PROPERTIES

| Property | | Specification values |
|----------------------------------|-----------------|------------------------------|
| Elongation | | 32% Minimum |
| Conductor tolerances | | |
| Nominal width or thickness in mm | | Tolerance + in mm |
| Over | Up to including | |
| - | 3.15 | 0.030 |
| 3.15 | 6.30 | 0.050 |
| 6.30 | 12.50 | 0.070 |
| 12.50 | 16.00 | 0.100 |
| Flexibility | | 4 x W / T No crack |
| Adherence | | 15% pre-stretched shall pass |
| Corner Radius | | 0.50 to 1.0 mm |
| Springiness | | 5 degree max. |
| Break Down Voltage | | 1 to 2 Kv at RT |
| | | 0.05 - 0.5 Kv at ET |
| Packaging | | 40 to 100 kgs spools |
| W/T Ratio | | 1.4:1 min. 8:1 max. |

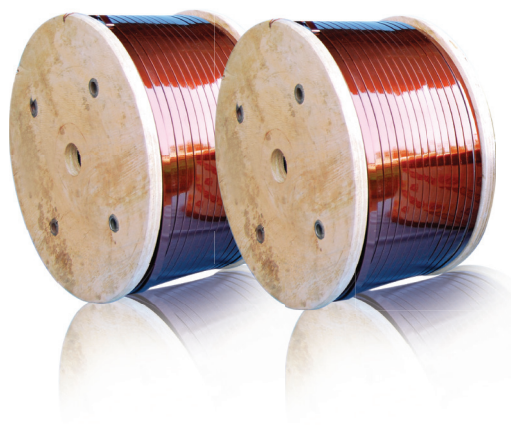
SIZE RANGE

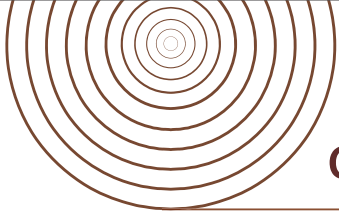
| | |
|----------------------|------------------------|
| Width | 14 mm max. |
| Thickness | 5 mm max. |
| Cross Sectional Area | 65 mm ² max |

| Specification | IS 13730 / 16 /28 / 29 | |
|-------------------|------------------------|---------|
| Grade of covering | Minimum | Minimum |
| 1 (Fine) | 0.06 mm | 0.11 mm |
| 2 (Medium) | 0.11 mm | 0.16 mm |

INSULATION TYPES

| A | Modified Polyster |
|---------------|------------------------------------|
| Thermal Class | 155°C |
| Specification | IS 13730-16 IEC 60317-16 |
| Heat Shock | 175°C - ½ Hour 6XW/T - No CRACK |
| B | Polystermide |
| Thermal Class | 180°C |
| Specification | IS 13730-28 IEC 60917-28 |
| Heat Shock | 200°C - ½ Hour 6XW/T - No CRACK |
| C | DC (PEI + PAI) |
| Thermal Class | 200°C |
| Specification | IS 13730-29 IEC 60317-29 |
| Heat Shock | 220°C - ½ Hour 6XW/T - No CRACK |





GLASS FIBRE COVERED STRIPS

The glass in glass fibre 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 thermal stability, and equate electrical properties and good resistance to abrasion after varnishing. The glass fibre is bonded with a varnish, to improve dielectric strength and mechanical properties.

Glass fibre-lapped conductors (bare or enamelled) are very suitable for windings of electric motor stators, generators, special transformers and high voltage motors heavy magnet coils etc. In general this insulation can be applied, where high mechanical strength and high insulation properties are required. Most common application is in traction motors. It exhibits a very high degree of mechanical and thermal stability; either for class F and H insulation, when impregnated with polyester, polyester-imide or epoxy based impregnating varnishes. For higher thermal class, the glass fibre-lapped conductors can be impregnated with silicone based resins of thermal class 200. The production machinery includes high speed double six spindle fiber lapping and varnish application with inline heating oven and automatic take up reeling.

MANUFACTURING RANGE (IN MM)

Glass Fibre Covered Copper Strips

| Width | | Thickness | | Cross Section Area (sq. mm) | | Width / Thickness Ratio | |
|-------|------|-----------|------|-----------------------------|------|-------------------------|------|
| Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| 4.0 | 16.0 | 1.6 | 5.6 | 6.0 | 80.0 | 1.4:1 | 8:1 |

| Nominal width of conductor | | Increase in Dimension (mm) | | | | | | | |
|----------------------------|---------------------|---------------------------------------|------|-----------------|------|---|------|-----------------|------|
| | | Glass fibre would over bare conductor | | | | Glass fibre would over Grade - 2 enamelled Wire | | | |
| | | Single Covering | | Double Covering | | Single Covering | | Double Covering | |
| Over | Up to and including | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| - | 3.15 | 0.13 | 0.20 | 0.20 | 0.32 | 0.24 | 0.36 | 0.31 | 0.48 |
| 3.15 | 6.30 | 0.14 | 0.22 | 0.22 | 0.37 | 0.25 | 0.38 | 0.34 | 0.52 |
| 6.30 | 12.50 | 0.16 | 0.23 | 0.25 | 0.41 | 0.27 | 0.44 | 0.36 | 0.56 |
| 12.50 | 16.00 | 0.18 | 0.32 | 0.27 | 0.45 | 0.28 | 0.48 | 0.38 | 0.61 |

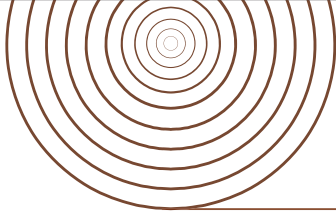
SPECIFICATIONS

CLASS : 155° : IEC 60317-32 (IS 13730-32)

CLASS : 180° : IEC 60317-31 (IS 13730-31)

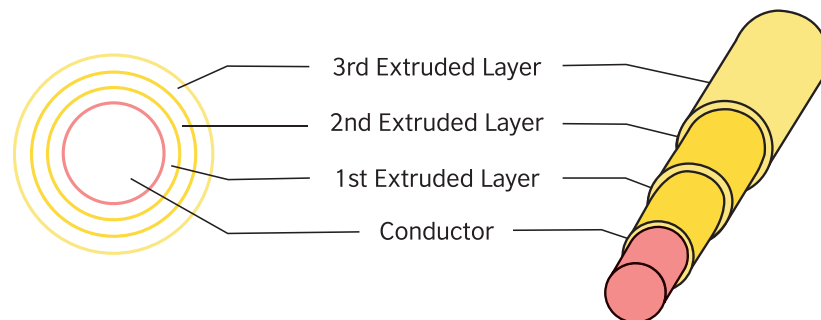
CLASS : 200° : IEC 60317-33 (IS 13730-33)



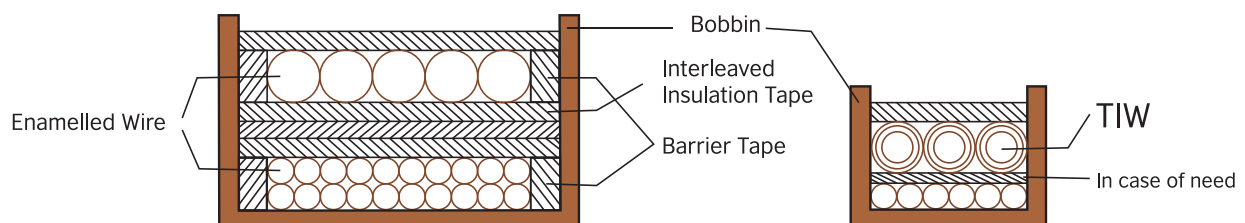


TRIPLE INSULATED WINDING WIRES

TIW, a unique product for small transformers. Three layer extruded coatings of high performance polymer resins gives excellent dielectric properties to this type of winding wires. Unlike enamelled wires, three layers of insulation are extruded over the copper conductor with automated manufacturing process ensure perfect central position of conductor. The conventional enamelled wire winding coils requires Insulation between the primary and secondary coils by means of barrier tape or interlayer tape, to isolate primary and secondary windings. Since three layers coating is having very high dielectric strength, it has very less creepage factor. This positive feature of TIW serves to downsize switching transformers, and promises high production efficiency and cost reduction. Depending on the design, the transformer size can be reduced up to 40% and weight up to 60% as compared to transformers made up of enamelled wires.



Third external layer of polyamide gives excellent flexibility and high mechanical strength to the wire, thus enabling high speed machine windings suitable. More over the insulation coating is directly solderable at the appropriate temperature, making the production process much faster.



ADVANTAGES

- Greatly reduces size and weight of transformer. No need of interlayer insulations, tapes, barriers etc.
- Very high dielectric strength withstands 6000V AC for 1 minute. Breakdown voltages above 10 kV.
- Polyamide covering gives mechanical strength. Ideal for automated winding.
- Auto controlled manufacturing process with fault detectors per length.
- Directly solderable - No need to strip off the insulation.
- Reliability of transformer winding. Conforms to Japanese standard JIS 3005.
- In addition to the reduction in size and economy in material cost of the transformer made, TIW has an advantage of improving its performance by reducing the distance between the coils.

TECHNICAL SPECIFICATIONS

| Conductor Diameter (mm) | Tolerance (mm) | Nominal Overall Diameter (mm) | Max. Overall Diameter (mm) | Breakdown Voltage (V) | Max Conductor Resistance (20°C) Ohm / km | Elongation (%) | Weight/ Length (kg/ km) | Spool Size |
|-------------------------|----------------|-------------------------------|----------------------------|-----------------------|--|----------------|-------------------------|--------------|
| 0.20 | ±0.008 | 0.400 | 0.420 | 6000 | 607.6 | 15 | 0.400 | PT 5 |
| 0.25 | ±0.008 | 0.450 | 0.470 | 6000 | 382.5 | 15 | 0.577 | PT 5 |
| 0.28 | ±0.008 | 0.480 | 0.500 | 6000 | 296.6 | 18 | 0.701 | PT-5 |
| 0.30 | ±0.010 | 0.500 | 0.520 | 6500 | 262.9 | 20 | 0.789 | PT 5 |
| 0.32 | ±0.010 | 0.520 | 0.540 | 6500 | 228.3 | 20 | 0.885 | PT-5 |
| 0.35 | ±0.010 | 0.550 | 0.570 | 6500 | 191.2 | 20 | 1.036 | PT 5 |
| 0.37 | ±0.010 | 0.570 | 0.590 | 6500 | 189.8 | 20 | 1.146 | PT-5 |
| 0.40 | ±0.010 | 0.600 | 0.625 | 7000 | 145.3 | 20 | 1.318 | PT 5 |
| 0.45 | ±0.010 | 0.650 | 0.675 | 7000 | 114.2 | 20 | 1.635 | PT 5, PT 10 |
| 0.50 | ±0.010 | 0.700 | 0.725 | 7000 | 91.43 | 20 | 1.987 | PT 5, PT 15 |
| 0.55 | ±0.020 | 0.750 | 0.780 | 7000 | 78.15 | 20 | 2.374 | PT 5, PT 10 |
| 0.60 | ±0.020 | 0.800 | 0.830 | 7000 | 65.26 | 20 | 2.796 | PT 5, PT 10 |
| 0.65 | ±0.020 | 0.850 | 0.880 | 7000 | 55.31 | 20 | 3.252 | PT 5, PT 10 |
| 0.70 | ±0.020 | 0.900 | 0.930 | 7000 | 47.47 | 20 | 3.744 | PT 10, PT 15 |
| 0.75 | ±0.020 | 0.950 | 0.980 | 7000 | 41.17 | 25 | 4.272 | PT 10, PT 15 |
| 0.80 | ±0.020 | 1.000 | 1.030 | 7000 | 36.08 | 25 | 4.832 | PT 10, PT 15 |
| 0.85 | ±0.020 | 1.050 | 1.08 | 7000 | 31.85 | 28 | 5.430 | PT 10, PT 15 |
| 0.90 | ±0.020 | 1.100 | 1.130 | 7000 | 28.35 | 28 | 6.059 | PT 10, PT 15 |
| 0.95 | ±0.020 | 1.150 | 1.180 | 7000 | 25.37 | 28 | 6.728 | PT 10, PT 15 |
| 1.00 | ±0.030 | 1.200 | 1.230 | 7000 | 23.33 | 28 | 7.427 | PT 10, PT 15 |

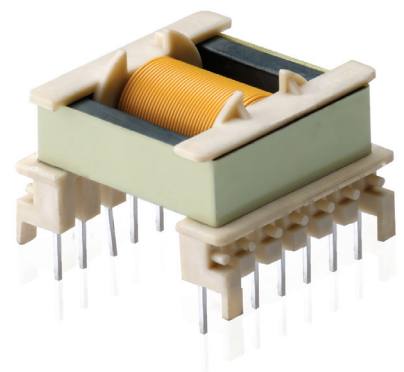
Product range : 0.200 mm to 1.00 mm • **Packing** : PT 5, PT 10 & PT 15 bobbin packing

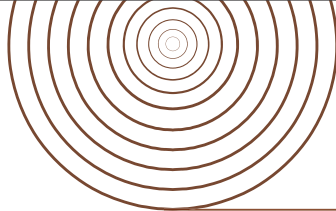
*Intermediate sizes can be customized as per specific requirements.

APPLICATIONS

- Their applications cover most switching transformers, information and telecommunications equipment, game machines, consumer goods, inverters and other similar devices.
- SMPS for units of printer, facsimile, memory, computer, monitor, inverter, game machine.
- Battery Charger for assemblies of digital camera, portable telephone, 8 mm VCR, AC adapter, personal computer, DVD.
- Operating Frequencies: Typically 85 kHz to 200 kHz but level with a maximum of 500 kHz

These products demonstrate considerable effects in terms of loss reduction and mitigating temperature rises when used in switching power transformers, which are widely used in industrial and consumer-use equipment.





SUBMERSIBLE WINDING WIRES

We also offer poly wrapped winding wire commonly known as “**Submersible Copper Winding Wire**”. The copper conductor is wrapped with thin polyester film and Biaxial oriented poly propylene (BOPP) films. The most modern plant with sophisticated wrapping heads and in line continuous heat shrinkage furnace is installed to get uniform covering. A complete quality assurance testing by instruments covering all governing standards is available. The test standards followed are IS 8783:1995.

APPLICATION

Used in submersible pumps motors of all sizes for domestic and industrial application.

PACKAGING

Available in coil form with suitable length as per size, in polythene bag and packed in inner and outer corrugated boxes.

• SPECIAL SALIENT FEATURES

- Saves energy - ETP grade high conductivity annealed copper used
 - Less current leakage - No air gap between the films.
 - Tear resistant - High mechanical strength - High tensile strength
 - Each coil tested at 3500 V
 - Heat shock test - at 150°C
 - Easy winding - Resistance annealed copper and controlled OD
- Manufactured by ultra modern automatic plant as per IS 8783 (Part 4 / Sec.3)

TESTING FACILITIES

The quality assurance having all the testing facilities with ultra modern, high precision instruments and rigorous testing plans. Details of test which conforms to IS 8783 (Part 4 / Sec. 3) is as follows.

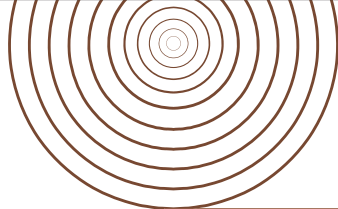
| Sr. No. | Name of the Tests | Units | Instruments Used |
|---------|----------------------|---|---------------------------------------|
| 1 | Size (Diameters) | mm | Micrometer |
| 2 | Elongation | Percentage | Tensile tester |
| 3 | Conductor resistance | Ohm / KM | Resistance meter |
| 4 | Volume resistivity | Ohm - cm | Million mega meter |
| 5 | High voltage test | kV | High voltage tester |
| 6 | Thermal ageing | Change in elongation and tensile | Ageing oven and tensile tester |
| 7 | Shrinkage test | Percent | Circulating hot air oven |
| 8 | Water absorption | mg / cm ² | Vaccum oven and pump desecrator |
| 9 | Hot deformation | Percent | Circulating hot air oven |
| 10 | Heat shock test | No sign of cracks / scales / separation of layers | Circulating hot air oven and mandrels |

GENERAL PROPERTIES

| Sr. No. | Nominal conductor diameter (mm) | Tolerance \pm (mm) | Nominal resistance Ohms/KM at 20°C | Over all diameter | Weight of poly wrapped (kg/km) | Elongation minimum (%) |
|---------|---------------------------------|----------------------|------------------------------------|-------------------|--------------------------------|------------------------|
| 1 | 0.40 | 0.004 | 137.15 | 0.80 | 1.467 | 24 |
| 2 | 0.50 | 0.005 | 87.78 | 0.90 | 2.154 | 25 |
| 3 | 0.60 | 0.006 | 60.96 | 1.00 | 2.980 | 26 |
| 4 | 0.70 | 0.007 | 44.78 | 1.10 | 3.946 | 28 |
| 5 | 0.80 | 0.008 | 34.29 | 1.20 | 5.052 | 28 |
| 6 | 0.90 | 0.009 | 27.09 | 1.30 | 6.298 | 29 |
| 7 | 1.00 | 0.010 | 21.94 | 1.40 | 7.683 | 30 |
| 8 | 1.10 | 0.011 | 18.14 | 1.50 | 9.208 | 30 |
| 9 | 1.20 | 0.012 | 15.24 | 1.60 | 10.873 | 31 |
| 10 | 1.30 | 0.013 | 12.98 | 1.70 | 12.678 | 32 |
| 11 | 1.40 | 0.014 | 11.20 | 1.90 | 14.891 | 32 |
| 12 | 1.50 | 0.015 | 9.75 | 2.00 | 16.989 | 32 |
| 13 | 1.60 | 0.016 | 8.57 | 2.10 | 19.227 | 32 |
| 14 | 1.70 | 0.017 | 7.59 | 2.20 | 21.605 | 32 |
| 15 | 1.80 | 0.018 | 6.77 | 2.30 | 24.122 | 32 |
| 16 | 1.90 | 0.019 | 6.08 | 2.40 | 26.780 | 32 |
| 17 | 2.00 | 0.020 | 5.49 | 2.50 | 29.576 | 33 |
| 18 | 2.10 | 0.021 | 4.98 | 2.60 | 32.513 | 33 |
| 19 | 2.20 | 0.022 | 4.53 | 2.70 | 35.589 | 33 |
| 20 | 2.30 | 0.023 | 4.15 | 2.80 | 38.805 | 33 |
| 21 | 2.40 | 0.024 | 3.81 | 2.90 | 42.161 | 33 |
| 22 | 2.50 | 0.025 | 3.51 | 3.00 | 45.656 | 33 |
| 23 | 2.60 | 0.026 | 3.25 | 3.10 | 49.291 | 34 |
| 24 | 2.70 | 0.027 | 3.01 | 3.20 | 53.066 | 34 |
| 25 | 2.80 | 0.028 | 2.80 | 3.30 | 56.980 | 34 |
| 26 | 2.90 | 0.029 | 2.61 | 3.40 | 61.035 | 34 |
| 27 | 3.00 | 0.030 | 2.44 | 3.50 | 65.228 | 34 |

* These are only indicative values.
Improvement is an ongoing process at RRWL and efforts exceed average values.





SUBMERSIBLE FLAT CABLES

(Three Core) voltage grade 1100 V, confirming to IS 694 -2010

- Fits perfect required grommet
- As per IS dimension
- Perfect sheathing for underwater appilcation

TECHNICAL SPECIFICATION

Conductor

Compactly bunched high purity bright, electrolytic grade, plain annealed copper with superb flexibility according to IS 8130 Class 2 & 5 available in various sizes. 'Unilay' conductor in the core will be provided on special order from 1 to 4 sq.mm.

Insulation and Sheathing

Generally available with 70°C insulation and PVC sheathing.

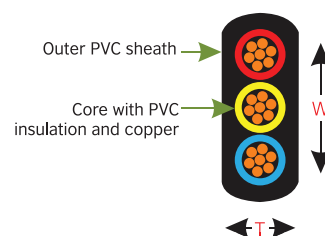
| Nom. Cross Section Area of Conductor (mm) ² | Number of Nominal Dia. of Strands | Nom. Insulation Thickness (mm) | Nom. Sheath Thickness (mm) | Max. Resistance Per Km at 20°C (Ω/km) | Overall Dimension (Max.) (W X H) (mm X mm) | Current Carrying Capacity at 40°C (Amps) |
|--|-----------------------------------|--------------------------------|----------------------------|---------------------------------------|---|--|
| 1.5 | 22 / 0.3 | 0.6 | 0.9 | 12.1 | 12.0 X 5.6 | 18 |
| 2.5 | 36 / 0.3 | 0.7 | 1.0 | 7.41 | 13.0 X 6.2 | 24 |
| 4 | 56 / 0.3 | 0.8 | 1.0 | 4.95 | 15.3 X 7.1 | 28 |
| 6 | 84 / 0.3 | 0.8 | 1.1 | 3.30 | 19.2 X 8.4 | 36 |
| 10 | 140 / 0.3 | 1.0 | 1.4 | 1.91 | 24.2 X 10.4 | 48 |
| 16 | 126 / 0.4 | 1.0 | 1.4 | 1.21 | 29.0 X 12.4 | 64 |
| 25 | 196 / 0.4 | 1.2 | 2.0 | 0.78 | 36.5 X 15.7 | 80 |

SELECTION GUIDE FOR CORE FLAT CABLES

HP vs Current:

The full load current for submersible pump motors, 3 phase, 50 Hz, 415-440 V

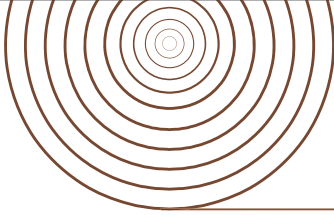
| | 5.0 | 7.5 | 10.0 | 12.5 | 15.5 | 17.5 | 20.0 | 25.0 | 30.0 |
|-------|-----|------|------|------|------|------|------|------|------|
| Amps. | 7.5 | 11.0 | 15.0 | 19.0 | 22.8 | 25.0 | 28.0 | 35.8 | 43.0 |



Note:

- Current derating factors as per IS 3961 part 5 shall be applicable for for different usage conditions.
- Standard sheath colours : Black
- Standard packing : 100 mtr. coils. Longer lengths supplied on order.





PAPER COVERED MAGNET WIRES

In spite of use of ever increasing number of new insulating materials, paper covered round and rectangular magnet wires found extensive use for the winding of large electrical machines especially oil cooled transformers, condensers, capacitors, UPS system etc. Standard paper covered magnet wires are manufactured by applying single, double or multiple layers of insulating paper tapes helically around conductors. The properties are determined by thermal, chemical & mechanical properties of the various types of insulating papers used.

Kraft Paper is a Class "Y" insulation suitable for use at a maximum operating temperature of 90°C & when impregnated or immersed in mineral transformer oil, it has a Class "A" rating (105°C). Also Kraft Paper insulation is characterized by outstanding dielectric strength when oil impregnated.

Nomex Paper: Nomex is aromatic polyamide, aramid fibrous material rolled in form of paper sheets. "Nomex" is trade name of DuPont and is mainly used in high temperature applications. The thermal class of insulation is 240 as per specification NEMA MW 60C and 61C.

APPLICATIONS

Kraft Paper covered conductors found it is main application in oil filled transformers where as Nomex paper covered conductors are used where very higher thermal class insulation is required like condensers, capacitors, UPS systems, special transformers. Multi paper covered stranded or single cables are commonly used for internal connections of the oil filled transformers.

SIZE RANGE AND TYPES

Rectangular conductor dimensions

Thickness: 2.00 - 8.00 mm

Width: 4.00 - 20.00 mm

Section: 8.00 - 100.0 mm²

Round or bunched conductor sizes are available from 1.32mm to 5.00mm diameters.

TYPE OF PAPERS

Electrical grade kraft paper

Nomex paper

Polyester films

Special papers as required

SPECIFICATIONS

Product conforms to IS 13730-27, IEC 60317 - 27, NEMA MW 31-C & 33-C specifications and as per customer specifications. Thermal class for Kraft paper covered shall be 90°C un-impregnated or 105°C impregnated or immersed in oil and for Nomex paper covered it shall be 240°C.

DIMENSIONS

The thickness of covering and no. of paper layers can be varied to suit the specific requirement. The increase in thickness as per NEMA standards for the paper covering shall be as below.

Minimum thickness increase = 2 (Equivalent no. of layers – 1) (Nom. tape thickness)

Maximum thickness increase = 2 (Equivalent no. of layers + 1) (Nom. tape thickness)

Note:

For rectangular wires, the increase in width due to paper covering shall be equal to or less than the increase in thickness.

PROCESS

The paper tapes are helically wrapped firmly, closely, evenly & continuously around the conductor. The taping operation is carefully controlled to provide a consistent insulation throughout multi layer buildups. Butt wrapping, overlapped wrapping, same or different direction wrapping can be done as per requirement.

The bare round and rectangular conductors used are manufactured from electrolytic grade copper rods by precision wire drawing and copper extrusion. The extruded rectangular conductors are fully annealed.

TESTING

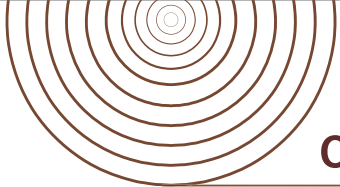
Below tests are carried out as per the specified specifications to ensure consistent good quality.

1. Dimension check
2. Visual inspection for continuity
3. Adherence
4. Flexibility
5. Elongation
6. Spring back
7. Dielectric breakdown

PACKING

The product shall be supplied on wooden or plastic spools as per requirement weighing from 40 kg to 100 Kg.





CORONA RESISTANT WINDING WIRES

In inverter driven motors, excessive surges and voltage peaks during speed variation, creates corona discharge in the stator windings, which induce extra thermal stress on the insulation, causing excessive thermal ageing there by weakening and even decomposing of the insulation, leading to premature failure of motors. Corona induced failure is a typical phenomenon. Mica based products are used in certain application where corona resistance is required. Mica is naturally occurring and is available easily. But it has it's own inherent weakness. It has poor flexibility and large area and as such, the space required is more for any mica based application. This result by increasing the size of the motor, making it unusable where space constraints are there. More over it has poor adhesion to most of the resins. Improved dielectric materials having resistance to corona discharge-induced deterioration would therefore be highly necessary. M/s. Dupont has been manufacturing corona resistant Wire enamel under the brand name "Voltatex".

PROCESSING OF CORONA RESISTANT ENAMELLED WIRES

Dual coated wire, with Polyesterimide as the base coat and Polyamideimide as the topcoat has been the most commonly used for applications up to thermal class 200. As discussed earlier, even these types of wires are susceptible to corona related failures. In order to overcome this deficiency, base coat is replaced with special corona resistant enamel.

- Basecoat of Corona resistant wire enamel class 200°C
- Top coat of Polyamide-imide (PAI) class 200°C +

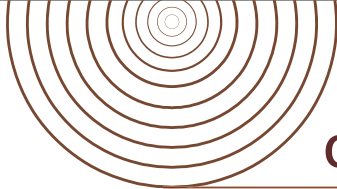
We process corona resistant wire in the range 3 mm to 0.63 mm. We can extend this range up to 0.3 mm by suitably modifying our machines. These corona resistant wires were tested for higher proof voltage and at elevated temperatures. There are certain guide lines about the voltage endurance test by RDSO. Our products conform to requirements of standards. Further to this, the wire was impregnated with class vinyl toluene based class 200 impregnating varnish (resin) and tested for proof voltage at elevated temperatures. Test results were found satisfactory.



Comparison of test results for 1.12 mm winding wire without impregnation

| Sr. No. | Tests | Test Method | DC Wire | Corona Resistant Wire |
|---------|--------------------------------|-------------------|------------|-----------------------|
| 1 | Cut through, 320°C, 2 min. | IEC 60317 Part-13 | Passes | Passes |
| 2 | Cut through, 400° C, 2 min. | Special test | Passes | Withstands >5min. |
| 3 | Break down voltage, kV | IEC 60317 Part-13 | 11.0 | 12.0 |
| 4 | Break down voltage at 200°C | IEC 60317 Part-13 | 10.0 | 11.0 |
| 5 | Proof Voltage, 2.0kV for 72hrs | Special test | 2/3 Passes | 3/3 Samples passes |
| 6 | Heat Shock 3xd, 220°C, 30 min | IEC 60317 Part-13 | Passes | Passes |
| 7 | Heat Shock 3d, 240°C, 30 min | Special test | Passes | Passes |
| 8 | Heat Shock 1xd, 260°C, 30 min. | Special test | 2/3 Passes | Passes |

From our evaluation which includes the above test results we found this special coated wire is having a higher lifetime compared to traditional DC wire (PEI+PAI), since this wire could with stand higher proof voltage of 2.0kV which is also the indirect effect of voltage surges and peaks under inverter drives.



CREPE KRAFT PAPER INSULATED COPPER CABLES

Kraft paper insulation is most commonly used in oil filled transformers. The plain kraft papers are wrapped in number of layers on conductors, to acquire the needed insulation strength. However, plain kraft paper has limitations of the flexibility and leads to breakage of insulation in tight shaping of the coils. For this purpose, kraft papers are fabricated or creped. The folds made in creping process, increases the elasticity and flexibility during shaping of coils. It also enlarges the surface area of insulation and absorbs insulating oils resulting in better insulation and heat dissipation during operation.

FLEXIBLE COPPER CABLES WITH CREPE KRAFT PAPER MULTI LAYERED INSULATION

Product Details: 120Sq. mm. stranded copper cable covered with crepe kraft paper

Insulation: 4 layers of krepe craft paper in 50% overlapping

Conductor dia: Approx 13-14mm

Overall Dia: 16.5 to 15.5mm

CONDUCTOR SIZE RANGE

70 sq mm to 150 sq mm. Copper flexible cables.

INSULATION THICKNESS

0.50 mm to 5.00 mm, as per customer specification / design requirement

Conductor sq mm and covering / lapping can change as per customer specifications or transformer design.

PACKAGING

Supplied in wooden reels of 100 Kg capacity.

APPLICATIONS

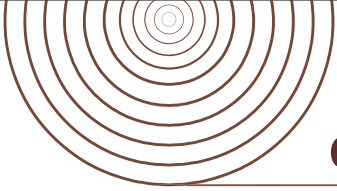
Mainly used as an insulation in oil cooled transformers, current transformers of type IMB, CT, CVT as leads and shields. Crepe paper has 300% more strength in machine and cross machine direction and hence is more resistant to breakage.

It can also take various shapes of the surface being insulated. The cable is wound on FRP Rings, 3 to 12 turns as per transformer application. This is also most suitable as lead wire and terminal wires of PT windings.

SIGNIFICANCE

Crepe kraft paper is used as an insulation in as it is elastic in properties and do not crack in bending of the cable in winding turns. Crepe paper also has greater surface area, which helps to retain more oil and hence lowers the working temperature of transformer. It is also a good insulator in presence of transformer oil.





COTTON COVERED COPPER CONDUCTORS

Cotton is one of the most useful naturally occurring insulators and is used from ancient time for its heat resistance. However, it also has moderate electrical insulation properties in dry condition. In certain low voltage applications, cotton yarns are used as wrapped around insulators, which proved to be long lasting, flexible and tough insulation. Cotton yarn soaked in impregnating resins and cured properly for the critical applications like servo stabilizer windings, magnet coils etc.

PRODUCT RANGE

SWG 5 to 15 (5.4 mm to 1.8 mm)

6 to 80 sq. mm. copper (Width 3 mm to 15 mm - Thickness 1.6 mm to 5 mm)

INSULATION

Double cotton yarn covering or first layer of fiber glass yarn covered with second layer of cotton yarn.

INSULATION THICKNESS

Can be supplied in range of 0.30 to 0.60 as per customer requirement.

INSULATION CONDITION

Dry, wrapped around tightly over copper conductor without varnish treatment.

SPECIFICATION

As per IS 7391 part 1 for round copper wires, IS 7391 part 2 for rectangular copper conductors.

APPLICATIONS

This product is exclusively used in dimmer stat windings of 40, 50, 75, 80, 90 Amp or even higher capacity. SWG 6, 9, and 11 are commonly used for this application. The wires are wound in form for toroid windings, which is further dipped in epoxy resins and cured / baked to form a solid, hard, tough insulation.

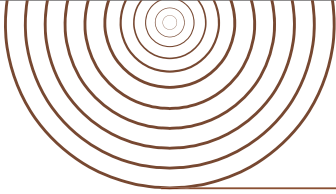
SIGNIFICANCE

There is very low voltage difference between turn to turn (approx. 2V) hence less insulation properties are required. Cotton, soaked in epoxy resin and cured, gives required insulation and toughness to the winding. It has better performance than enamelled wires for this application. As during the grinding application the cotton covering does not chip off. This is mainly used in variac servo windings above the range of enamelled wires windings (thicker wires).

OTHER APPLICATIONS

Antennas, high frequency coils, chokes, large magnet coils, servo windings etc.





NYLON COATED ENAMELLED WIRES

Nylon top coat is used over the regular enamelled copper wires to enhance the mechanical properties of insulation coat. Normal enamelled coating is stressed in coil winding applications like high speed auto winding and auto coil insertions in slots. Nylon top coat exhibits a smooth and tough slippery surface of top layer of insulation, thus, reducing chances of insulation damage and failures related to mechanical abuse of the thin insulation layer.

APPLICATIONS

Nylon top coat wires can be used in high speed windings for armature coils of home appliances, power tools, auto coiling machines for switch gears miniature coils in electronics etc. Nylon top coat applied over variety of primary insulation like polyester, polyester-imide, dual coated and solderable polyurethanes of class 130, 155 and 180.

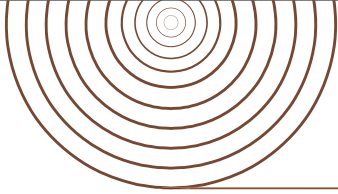
APPLICABLE STANDARDS

IEC 60317-19, Solderable polyurethane class 130 over coated with polyamide
IEC 60317-21, Solderable polyurethane class 155 over coated with polyamide
IEC 60317-22, Polyester or polyester-imide class 180 over coated with polyamide
IEC 60317-55, Solderable Polyurethane class 180 over coated with polyamide

PRODUCT RANGE

0.020 mm to 0.800 mm wire diameters.





SELF BONDING ENAMELLED WIRES

Normally enamelled copper conductors are used as coil components of various electrical products such as motors / transformers / home appliances / auto electrical components / chokes / AC compressors. Apart from AC compressors all other copper windings are under going for secondary insulation coating and curing of the same. The process is called as impregnation. The secondary insulation is used to get a firm compact winding, that can withstand the vibration and all the copper conductors are held firmly together. The voids in coil are also filled by the secondary insulation. It also prevents direct contact of moisture with the primary (enamel) insulation film. The basic property of secondary insulation (varnish) is to hold the winding together. However for certain applications (where the secondary insulation is not practical) self bonding enameled wires can be used. These wires have outer layer of bondable material which is usually thermoplastic and bonds the wires surfaces with each other once heated to the bonding temperature of the outer layer. Bondable wires, thus, benefits in reduction of cycle time and elimination of process of secondary insulation application / baking / curing cycle etc.

APPLICATIONS

Bondable wires can be used in power tools armature coils, electronics, miniature coils, TV yoke coils, continuous-transposed conductors etc. The bondable layer is applied over variety of primary insulation like polyester, polyester-imide, dual coated and solderable polyurethanes of class 130, 155 and 180.

TYPES OF BONDABLE COATS

Epoxy Resins - Mainly used along with lower temperature class base coats like PU / PVA / PVF. Used on the fine / ultra-fine solderable enamelled wires and enameled strips for CTC applications.

Polyamide - Moderate bonding temperatures and suitable over class 130, 155 and 180 enamelled insulations.

Aromatic Polyamide - Mainly used on higher temperature classes like class 180 and 200. These have higher re-softening temperatures hence can be used easily on higher thermal classes.

BONDING METHOD

Heat Bonding - The coils are heated either in oven or hot air, up to the bonding temperature of outer layers. On cooling of coil, to the room temperature, the wire turns are bonded with each other.

Solvent Bonding - The bonding is done by application of solvents on wound coils. The layers bond together due to chemical reaction with solvents.

Resistance Bonding - The entire coil is heated by circulating high current through conductor. This uniformly raises the temperature of coil up to the bonding temperature and cooling to room temperature gives rigid coil forming.

APPLICABLE STANDARDS

IEC 60317-35, Solderable Polyurethane, class 155 with a bonding layer

IEC 60317-36, Solderable Polyester-imide, class 180 with a bonding layer

IEC 60317-37, Polyester-imide, class 200 with a bonding layer

IEC 60317-38, Dual coated, class 200 with a bonding layer

BOND STRENGTHS

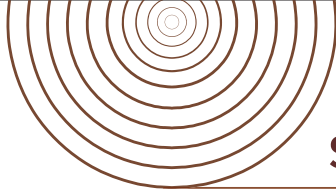
The bonding strength of bondable layers are usually determined by heating a helical coil of bondable wire up to the specified temperature and loading the coil with specified weights to observe that the coil turns do not separate at room temperature and also at resoftening temperature.

BONDING LAYERS THICKNESS

The thickness depends on the conductor dia as per IEC 60317 - 0 - 1 clause 4, the thickness of underlying layer can be grade 1B or grade 2B.

PRODUCT RANGE

0.20 mm to 1.00 mm grade 1B, 2B



SOLE COAT AIW ENAMELLED WIRES

The application of Polyamide-Imide top coat over Polyester / Polyester-imide base coat, is well known to the user industry. The Polyamide-imide is class 200+ insulation which gives added thermal properties and chemical resistance to the substrate base coat. However, for certain applications the thermal, mechanical and dielectric properties are highly demanding. A typical example is in the automotive industry where the reliability of components is the crucial factor. The development of sole coat Polyamide-imide (PAI or AIW) wires, have cutting edge advantages over previous dual coated class 200 wires.

APPLICATIONS

Mainly used in automobile industry in various component coils. The insulation is capable of withstanding harsh environments like extreme temperatures, chemicals, oils greases mechanical stresses and vibrations. The insulation thickness grade can be selected as grade 1, 2 and 3 depending upon the component design and slot filling factor.

APPLICABLE STANDARDS

IEC 60317-26, Polyamide-imide round copper wires, class 200

NEMA MW 81-C Polyamide-imide round copper wires, class 220

PRODUCT RANGE

0.040 mm to 2.00 mm grade 1, grade 2

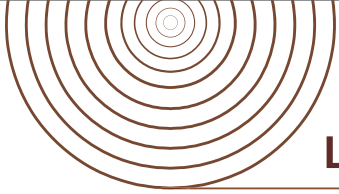
COLORED WIRES

We offer AIW wires in green OR black colour, as per customer requirements. This is helpful in colour coding and identification of AIW wound components at assembly lines.

ADVANTAGES

- Excellent high temperature characteristics
- Resistance to harsh chemicals and fuels
- High burnout resistance
- Lower dissipation factor at high temperature – Tan Delta values $>240^{\circ}\text{C}$
- Easily replaceable to Dual coated Class 200°C wires
- Durability





LITZ WIRE - BUNCHED ENAMELLED WIRES

Litz wire is a type of cable used in electronics to carry alternating current. The wire is designed to reduce the skin effect and proximity effect losses in conductors used at frequencies up to about 1 MHz. It consists of many thin wire strands, individually insulated and twisted / bunched, grouped or braided / woven together, as per the specific design and application. This often involves several levels (groups of twisted wires are twisted together etc.). This winding pattern equalizes the proportion of the overall length over which each strand is at the outside of the conductor. The individually insulated copper strands are basically the insulated magnet wires laid in form of cable strands.

APPLICATIONS

Typical applications for litz wire conductors include high-frequency inductors and transformers, motors, relays, inverters, power supplies, AC/DC converters, communication equipments, ultra-sonic equipments, sonar equipments, television equipments and heat induction equipments. The new innovations in information technology and communication devices have opened tremendous opportunities of usage of litz wires. A latest example can be a wireless mobile charger.

PRODUCT RANGE

Various AWG wire sizes range from 18 to 10 AWG comprising from enamelled copper winding wire individual strands of 0.050 to 0.500mm.

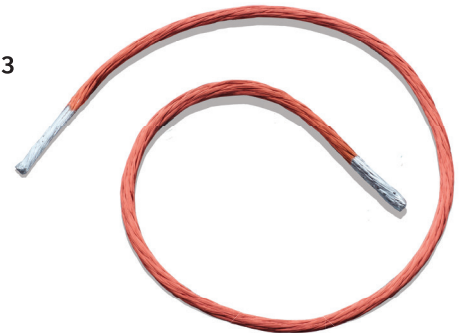
Insulation covering of enamelled strands can be
Polyurethane class 130, 155, 180 – Natural / Coloured
Polyesterimide class 180
Dual Coated class 200
Bunching / twisting can be customized as per customer drawing.

The term Litz wire originates from Litzendraht (coll. Litze), German, for braided / stranded wire or woven wire.

Litz Wire
Size: 0.125mm
Configuration: 5x3x28



Litz Wire
Size: 0.125mm
Configuration: 5x13

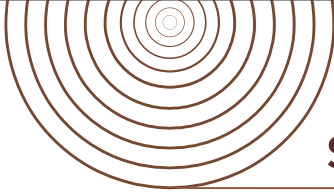


Litz Wire
Size: 0.315mm
Configuration: 7x7



Litz Wire
Size: 0.300mm
Configuration: (6x10)+(8x1)





SUPER ENAMELED ALUMINUM STRIPS

INTRODUCTION

Uncertainty and higher metal cost in copper have raised the need for alternate conductor metal in various electrical applications. Aluminum being the next good conductive material is most popular as replacement of copper. In certain applications like transformer windings this transition is happening rapidly. RR Shramik proudly announcing the addition of Super Enameled Aluminum Strips in the global product range. The manufacturing of bare aluminum strips is critical process, being the soft metal characteristics of aluminum. RR Shramik has most advanced technique machinery to make the aluminum conductors with precision controls in conductor dimensions and better surface properties. At the same time the insulation strength and flexibility has to be excellent to withstand the winding stresses bending / shaping etc. At Salasar Copper, We provide very special attention towards the flexibility and adherence of the insulation film of enameled strips.

PRODUCT RANGE

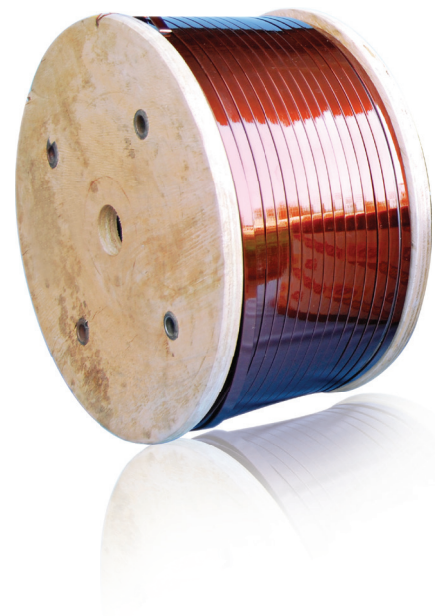
| | | |
|--------------------|------------------------|-----------------------|
| Width | 15 mm Max | 2.80mm Min |
| Thickness | 5 mm Max | 1.5mm Min |
| Cross section Area | 75 mm ² max | 5 mm ² Min |

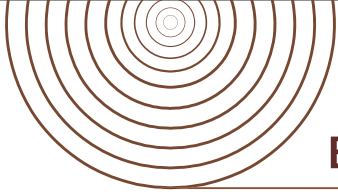
SPECIFICATION

| | |
|---------------------------|---|
| General | IEC 60317 -0 -9 General Requirements Aluminum Enameled Strips |
| PVA Class 105 | IEC 60317-67, NEMA MW 18A |
| PVA Class 120 | IEC 60317-68, |
| Dual Coat Class 200 | IEC 60317-73 |
| Dual Coat Class 220 | IEC 60317-69, NEMA MW 36A, |
| Polyester-imide Class 180 | IEC 60317-74 |

ADVANTAGES

- Automated machines for Aluminum strip making enameling
- Online quality monitoring through blister and pin hole detectors
- Variety of Class of insulations and Variety in packing spools
- Stringent test procedures for consistent quality.





BUNCHED AND BRAIDED BARE COPPER WIRE

INTRODUCTION BUNCHED WIRE

Copper is a pretty valuable metal in the electrical industry. It is used in various forms and is utilized in quite a wide variety of applications. It has several beneficial features such as resistance to corrosion, malleability, and ductility. It is also a great conductor of heat and electricity.

TYPES OF COPPER WIRES

Copper wires come in two types – solid and stranded or bunched. In a solid wire, there is just one single strand or core of wire. It can be bare or be surrounded by a non-conductive insulator. These wires do not bend easily since they are rigid. They are usually installed in low-flex, permanent, applications, such as magnet wire in transformers and motors, house electrical wiring, or wires for breadboards.

STRANDED WIRES

Stranded wires are a group of small gauge wires that are compressed and twisted or braided together. They too are coated with a non-conductive material. They are wound together in half-frame arcs, semi-concentric, and concentric loops. This allows the wire to retain its properties, along with saving inventory space. They can be looped around an iron rod or a wooden one- depending upon the nature of the application. In the same cross-section, a stranded wire would be much more flexible and easier to install than a large solid one. It is a lot more tolerant of strain and, in fact, the more it is bent, the harder it becomes. The most typical uses of stranded copper wire is in speaker wires, automotive wires, appliance cables, headphone cables, etc.

Many Copper Wire Manufacturers offer optimized Bunched Copper Wire for electrical and industrial purposes. This is because these are extremely popular in these fields on the back of features such as reliability and flexibility. They are used as connectors due to their strength. Since they are kinks-free, they are used as ropes to tie knots as well. They are easier to rout.

APPLICATION

Many high-frequency applications, proximity effect is more severe than skin effect, and in some limited cases, simple stranded wire can reduce proximity effect. For better performance at high frequencies, which has the individual strands insulated and twisted in special patterns, may be used.

SIZE RANGE BUNCHED WIRE

1. Diameter of single core: $\phi 0.05 \sim \phi 0.28 \text{mm}$
2. Outer diameter of wire: $\phi 0.15 \sim \phi 0.90 \text{mm}$
3. Cross section area: $\phi 0.0137 \sim \phi 0.45 \text{mm}^2$

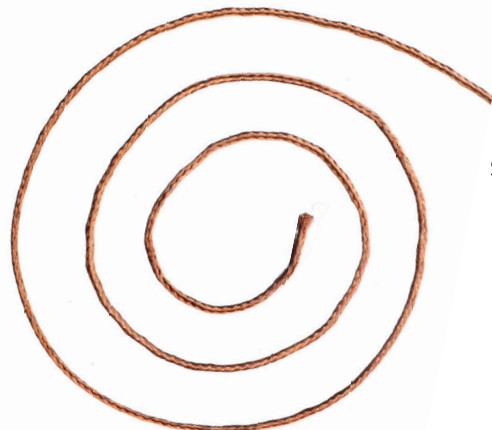
1. Single wire dia: $\phi 0.08 \sim \phi 0.25 \text{mm}$
2. Wire stranding outer dia: $\phi 0.15 \sim \phi 1.3 \text{mm}$
3. Cross section: $\phi 0.0137 \sim \phi 1.0 \text{mm}^2$

ADVANTAGES

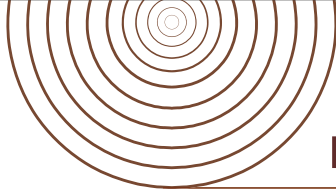
- Better Flexibility
- Excellent Current Carrying Capacity
- Higher Resistance
- Reduce skin effect
- Reduce corona effect

SIZE RANGE BRAIDED WIRE

- Braiding diameter 1-12mm
- Braiding pitch 6-68mm
- Material diameter 0.05mmX6-0.20mm/150D-900D



Braided Wire
Size: 0.070mm
No. of Strands: 651



M. H. CLASSIC SUBMERSIBLE FLAT CABLES

INTRODUCTION

Submersible flat cables are important accessories supplied along with the submersible pump. Flat cable provides the electrical supply to operate the pump. Good insulation properties and longer life is the technical demand from submersible flat cables.

From the beginning, flat cables have been developed with PVC insulation, which are having thicker insulations for getting required electrical properties. PVC cables are bulky and tend to lose the insulation properties over period of time. The thicknesses must be added to get the desired level of insulation, this cause more weight of wire and compromise the flexibility.

The latest development of PP core MH classic submersible flat cables is innovative product offered by RR Global. These cables are having less insulation thickness and better insulation properties. The insulation thicknesses are approx 50-60% less than the std PVC insulations, still it offers superior insulation, which are 4-20 times more than the normal PVC insulation.

Comparison of dimensions of cable 3C X 2.5sq mm

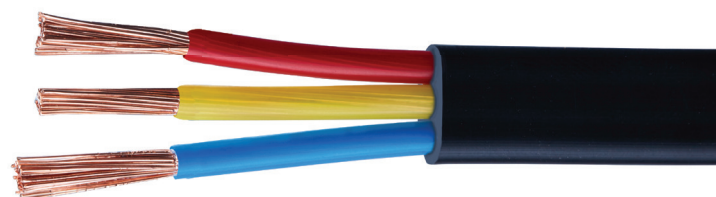
| Sr. No. | Core Insulation data | Unit | Normal PVC Core + Sheathing | MH Classic, PP Core + PVC Sheathing |
|-----------------|---|-------|-----------------------------|-------------------------------------|
| 11 | Material | ----- | Passes | Passes |
| 12 | Nom. Insulation Thickness | mm | Passes | Withstands >5min. |
| 13 | Core Diameter | mm | 11.0 | 12.0 |
| 14 | Core Identification | | 10.0 | 11.0 |
| Extruded Sheath | | | | |
| 15 | Material | ----- | 2/3 Passes | 3/3 Samples passes |
| 16 | Nom. Sheath Thickness | | Passes | Passes |
| 17 | Approx Overall Dimension Of Cable (W x H) | mm | Passes | Passes |
| 18 | Colour | ----- | 2/3 Passes | Passes |

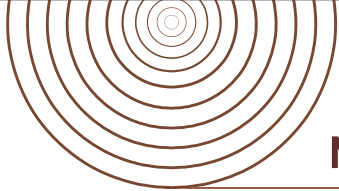
Comparison of Insulation resistance properties

| Sr. No. | Parameters as per IS 5831 | Unit | Normal PVC Core + Sheathing | MH Classic, PP Core + PVC Sheathing |
|---------|------------------------------------|--------|-----------------------------|-------------------------------------|
| 1 | Min. Volume resistivity at 27°C | Ω-Cm | 48.12 x 1013 | 216.04 x 1013 |
| 2 | Min. Volume resistivity at 70°C | Ω-Cm | 189.05 x 1010 | 452.03 x 1011 |
| 3 | Min. Insulation Resistance at 27°C | M-Ω-km | 1764.36 | 6984.596 |
| 4 | Min. Insulation Resistance at 70°C | M-Ω-km | 6.93 | 310.25 |

ADVANTAGES

- Lower Insulation thickness
- Better Flexibility
- Very high Insulation volume resistivity
- Very high Insulation resistance
- Better and stable polymer compound for water resistance
- Good high temperature characteristics





M. H. CLASSIC SUBMERSIBLE WINDING WIRES

INTRODUCTION

Submersible winding wires are the type of winding wires having close contact with water Or different liquids. In fact many submersible motors are designed in such a way that windings are immersed in the water itself, which works as a cooling media while the pump is in operation. In early years, submersible winding wires have been developed with PVC insulation, which were having thicker insulations for getting required electrical properties.

Later, with the development of Poly wrapped wires, which has less insulation thickness and better properties. This reduced size of motors to great extent. We are manufacturing and supplying the poly wrapped RR SHRAMIK brand wires to you since long time. Now with the technological advances, we have developed a special insulating material, extruded wires of thickness and electrical properties which are better than poly wrap wires and having more softness with better surface finish. The extrusion process is auto controlled with laser diameter and HV spark tester.

The continuous extrusion process with on line spark tester gives consistent 100 % checked quality of wire. It can give longer lengths as required by customer. This avoids joints in winding and reduces winding process scrap and integrity of the windings. The superior surface properties with extra softness give an excellent ease of slot filling, and shaping.

The sample motors wound and tested for long term tests found excellent operational results.

Applicable Standards:- NA - Guide lines and requirements taken from IS 8783- Part 4 Section 3

Comparison Test Analysis of SWW Wrapped v/s MH Classic SWW

| Sr. No. | Core Insulation data | | | |
|---------|--|--------------------------------|--|---|
| 1 | Surface | Smooth/ Wrapped | Wrapped wavy | Smooth |
| 2 | Dimension | As per Customer Specifications | OD ranges 0.300 to 0.500 | OD ranges 0.250 to 1.00m possible |
| 3 | Concentricity | - | Fully concentric insulation, due to wrapping | Full operational controls for proper Concentricity. 95% Concentric |
| 4 | Softness of Wire | Fully Annealing | Slight harness due to wrapping and shrinking process | Excellent Softness |
| 5 | Volume Resistivity at 27°C (IS 10810 Pt-43), IS 5831 | 1 X 10 ¹⁶ | 1.8 - 2.2 X 10 ¹⁶ | 2.5 - 3.5 X 10 ¹⁶ |
| 6 | Volume Resistivity at 90°C (IS 10810 Pt-43), IS 5831 | 1 X 10 ¹³ | 6.5 - 7.5 X 10 ¹³ | 7.9- 8.5 X 10 ¹³ |
| 7 | High Voltage test after 12 hours immersion in water | 3.0Kv for 1 mints to pass | Passes Leakage current slight more due to air gap in wrapping | Passes - Leakage current significantly less due to Extrude material, high integrity of insulation films |
| 7.1 | Shrinkage Test at 150°C for 15 Mints | 4% Max | 2 to 3.5% | 0 to 0.5% |
| 7.2 | Heat Shock Test | To pass at 150°C for 1 hrs | Passes- Layer separation forms at 170°C and HV/Megger mostly fails | Passes, No melting observed till 170°C for 10hr. HV/Megger passes after 10hrs |

BENEFITS

- Smooth insulation surface along with super soft annealed copper wire
- Very low co-efficient of friction, easy for slot insertion
- Less springiness, does not require hammering for shaping of coils.
- Longer lengths coils/ Reels possible
- Throughout Laser OD control and HV spark testing.
- Benefits of extra meter lengths/Kg lesser weight compared to Poly Wrapped wire
- Fixed lengths coils are provided by meter counters.

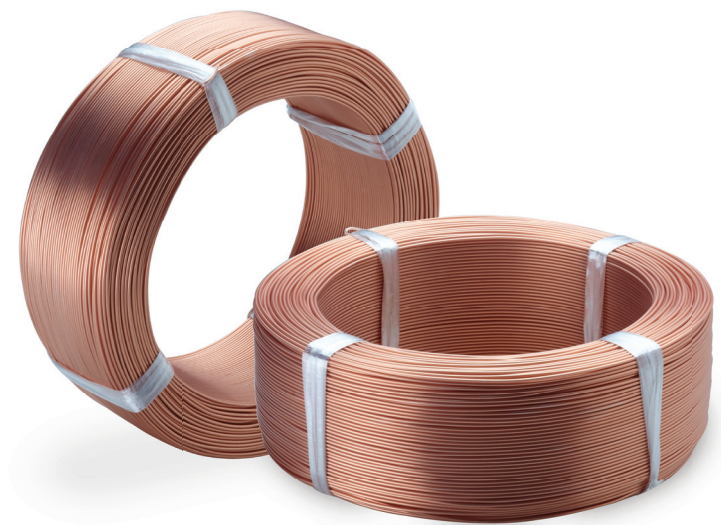
APPLICATIONS

All types of single phase, three phase submersible motor pumps. Conductor Dia range 0.40 to 2.50mm and Insulation covering range 0.30 to 1.00mm.

SAFETY AND PRECAUTIONS

Considering the fact that the insulation is softer than Poly wrapped wires, certain precautions must be taken during transit, handling usage of M. H. Classic Submersible Winding wires.

- Retain the original box packing till actual usage.
- Place the wire coils and wound coils on Rubber sheets to avoid damages.
- Use the provided bubble sheet to place coils – Do not place on corrugate boxes – they have staple pins, that can damage the insulations.
- Examine and rectify for any sharp Objects/Sharp corners which can come in wire path during coiling.
- Do not give more force on the coils to fit in slots. Avoid any sort of damages during coil fitting.
- Use proper grade of insulation paper to guide the coils through slots
- Only use smooth tipped wooden strip to push wires in slots
- If required, apply a small quantity of lubricant oil in holding cloth / felt tensioner
- Search for sharp objects on working stations and avoid contact with wound coils motors
- Check the wooden/plastic slot fillers. It should not damage the wires while pushing.
- Ensure proper transit/packaging of wound stator.



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