

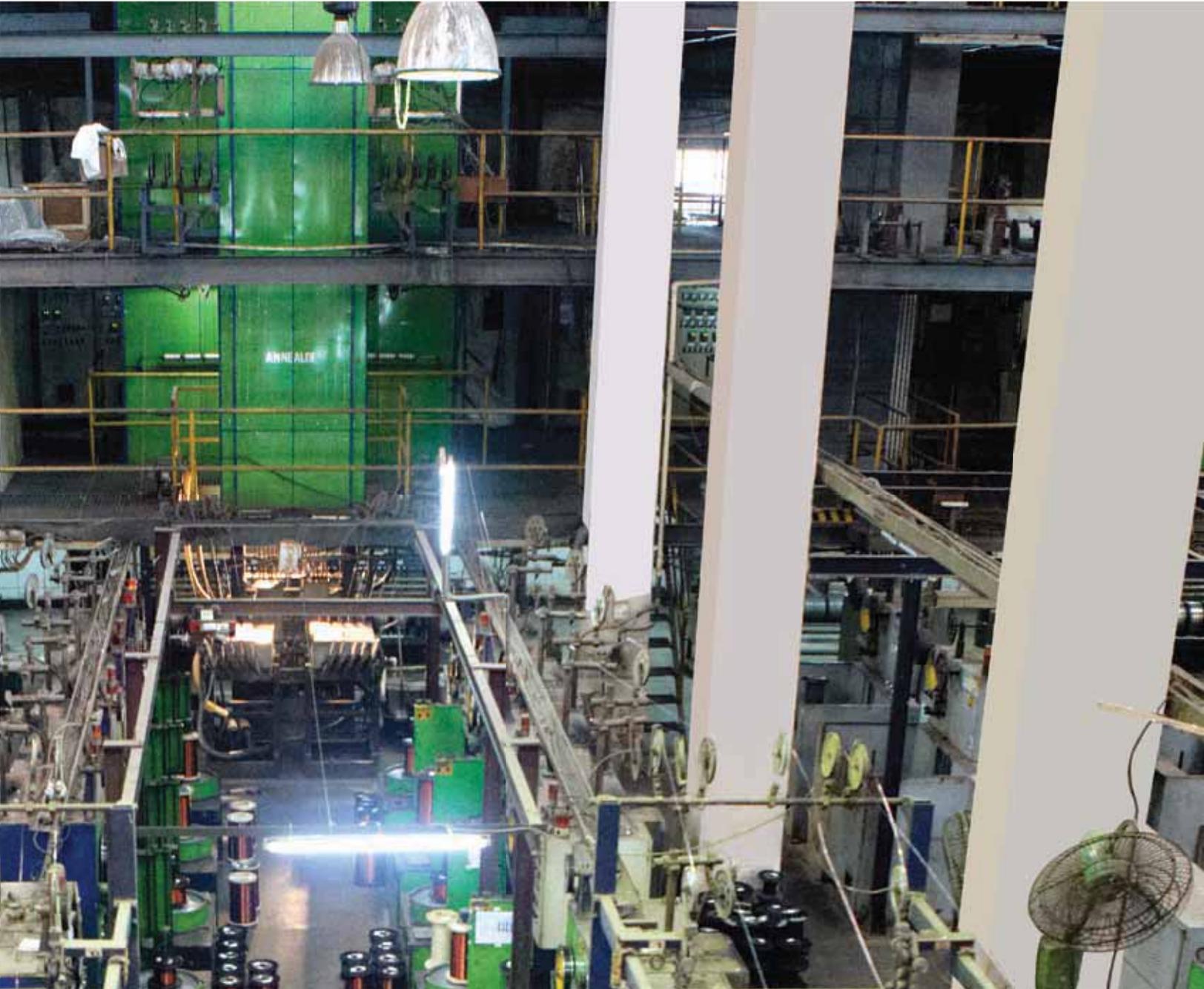


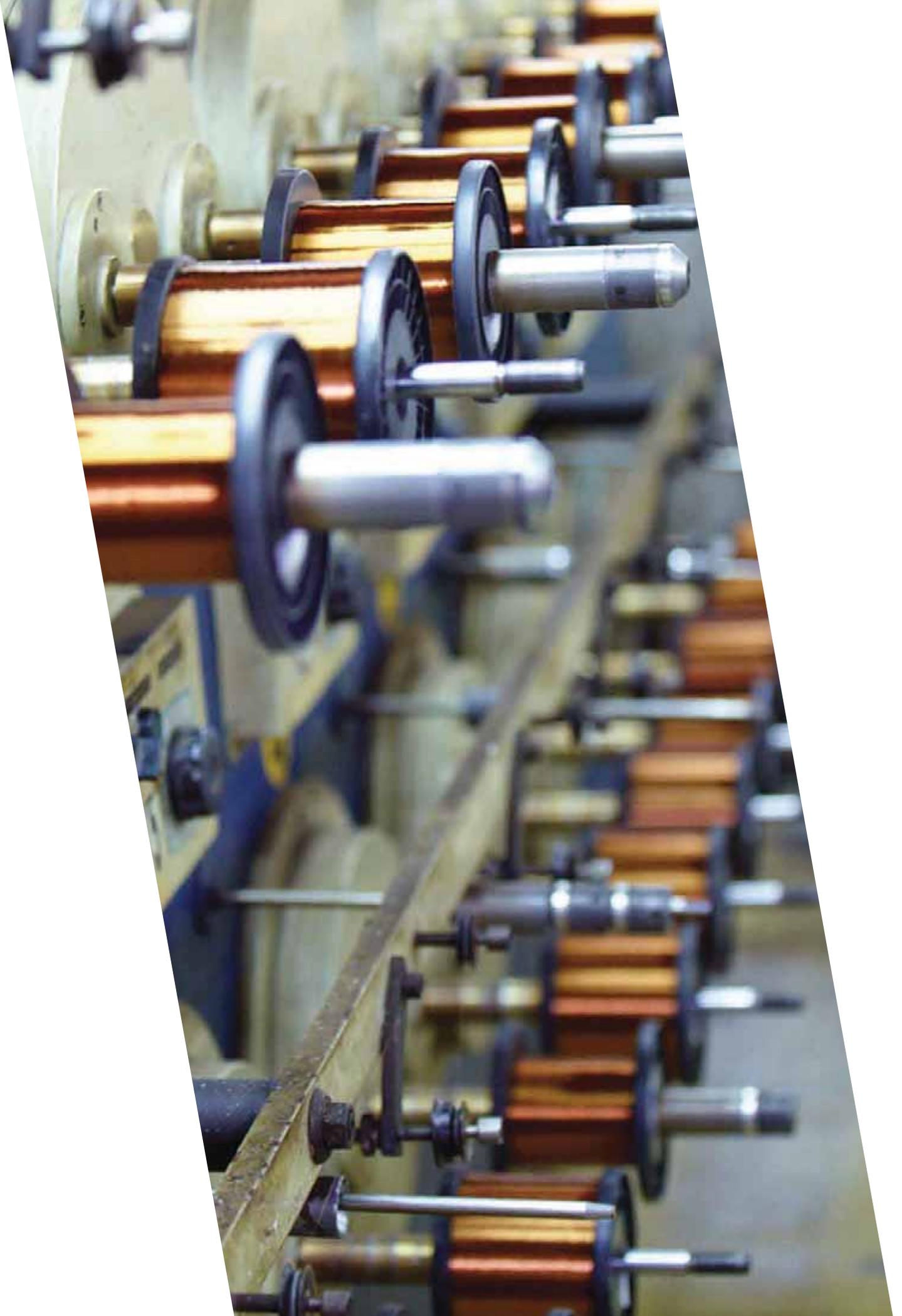


Technologically driven and inspired by innovation, we, at RR Shramik, work tirelessly to improve ourselves to meet the needs of the dynamic industry. Every product offered reflects the effort of the team that has endeavored to evolve the best the industry could receive.

-Mr. Mahendra Kabra
Joint M.D. - Ram Ratna Wires Ltd.







WINDING A PROMISING FUTURE

RR Shramik is a part of RR Global which is one of the leading conglomerates in the electrical and copper industry. For over 25 years, It has been enjoying unflinching patronage of its valued customers and is an established name in the Indian electrical industries for its quality & consistency.

Today, adding a set of more evolved products in its armoury, RR Shramik currently offers a wide range of high quality products to server the needs 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 the best at all times.

Certificate

Standard **ISO 50001:2011**

Certificate Registr. No. **01 07 086546**

TÜV Rheinland Cert GmbH certifies

Certificate Holder: **R.R.Kabel Ltd. / Salasar Copper**
1423, Mathuban Dam Road, Karad, Shivasa - 396 246 (IT of DRA)

Scope: **Development and Manufacture of Solid and Rigid Conductor PVC Insulated Cables, Flexible Conductor PVC Insulated, Stranded Cables and Conds, Transmission Cables, Halogen Free Cables and Fibre Insulated RG Cables**
Manufacture of Super Enamelled Wires and Strips, Winding Wires and Bare Copper Wires and Strips

An audit was performed, Report No. 086546. Proof has been submitted that the requirements according to ISO 50001:2011 are fulfilled.
The due date for all future audits is 01-08 (06 mos).

Validity: **This certificate is valid from 13.01.2013 until 01.01.2016.**

2013-01-16



TÜV Rheinland®
Priority Right

www.tuv.com

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**
1423, Mathuban Dam Road, Karad, Shivasa - 396 246 (Union Territory of Dadra & Nagar Haveli, India)

Scope: **Development, Manufacture and Supply of Copper Cables and Flexible Conds, Manufacture of Super Enamelled and Bare Copper Wire and Strips.**

An audit was performed, Report No. 086546. Proof has been submitted that the requirements according to BS OHSAS 18001:2007 are fulfilled.
The due date for all future audits is 17-04 (06 mos).

Validity: **This certificate is valid from 2014-06-02 until 2016-05-25. First Certification 2009-05-04.**

2014-06-02



TÜV Rheinland®
Priority Right

www.tuv.com

Certificate

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

Certificate Registr. No. **01 104 086546**

TÜV Rheinland Cert GmbH certifies

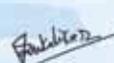
Certificate Holder: **R. R. Kabel Ltd. /Salasar Copper**
1423, Mathuban Dam Road, Karad, Shivasa - 396 246, (Union Territory of Dadra & Nagar Haveli, India)

Scope: **Development, Manufacture and Supply of Copper Cables and Flexible Conds, Manufacture of Super Enamelled and Bare Copper Wire and Strips.**

An audit was performed, Report No. 086546. Proof has been submitted that the requirements according to ISO 14001:2004 + Cor. 1:2009 are fulfilled.
The due date for all future audits is 23-03 (06 mos).

Validity: **This certificate is valid from 2014-06-04 until 2017-06-03. First Certification 2009-06-04.**

2014-06-04



TÜV Rheinland®
Priority Right

www.tuv.com

CERTIFICATE




This is to certify that

Salasar Copper
(Pvt.) Ltd. (Pvt. Limited)
1423, Mathuban Dam Road, Karad, Shivasa - 396 246 (Union Territory of Dadra & Nagar Haveli, India)
SR No. 20002460 SR No. 20002460

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

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

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

ISO 9001 : 2008

Certificate registration no. 20002460 0460
Date of original certification 2009-03-14
Date of certification 2013-02-05
Valid until 2016-02-02

UL DQS Inc.

General Manager

UL

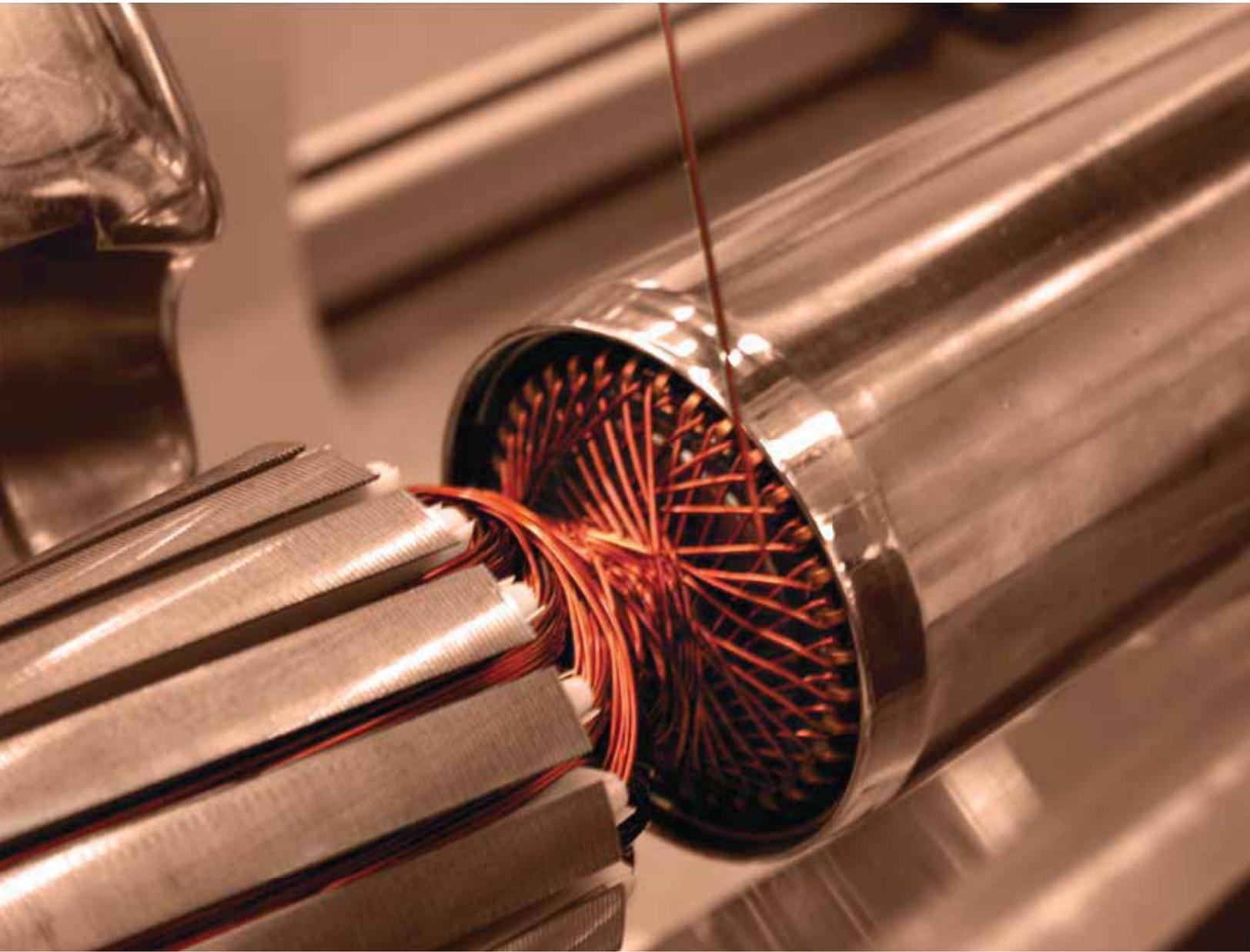
Certification Body 141-0202 Inc., 1148 West Lakeside Drive, Suite 501, South Plainfield, NJ 07080-1500

OUR COMMITMENT

RAM RATNA WIRES LTD. aims to enhance customer satisfaction by consistently meeting the expectations related to product and services. SALASAR COPPER, a unit of RAM RATNA WIRES LTD., an ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007, ISO 50001:2011 company located at Silvassa, near south Gujarat, manufactures a variety of winding wires for various applications under the brand name RR Shramik.

RR Shramik is India's only manufacturer of enamelled 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 Germany 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. With a client list that includes reputed 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, we are committed to evolve and deliver better products at all times.





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

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	Polyesterimide	Dual Coated Wire PE/PEI + PAI
Thermal Class Class Insulation Colour Range-Copper Range-Aluminium	130 B Brown / Reddish-Golden	155 F Light Brown to Dark Brown	180 H Dark Brown (Mahogany)	200 H+ Reddish Brown to Golden
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 refriragator 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.

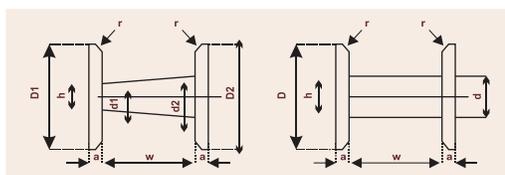
PACKING OF ENAMELLED WIRES

CYLINDRICAL 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			
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	0.600
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.

SALASAR COPPER ENAMELLED WIRES TYPE

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 [mm ²]	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

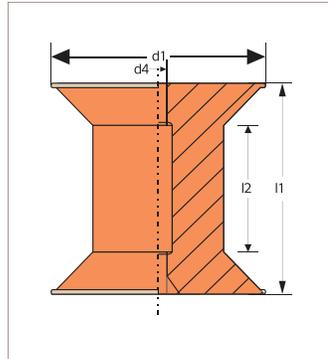
DIMENSIONS AND TECHNICAL DATA OF ENAMELLED COPPER WIRES BASED ON IEC 60317

Nominal Diameter	Conductor (Bare Wire)		Enamelled Copper Wire (Overall Diameter)						Resistance at 20° C			Elongation acc. to IEC
			Grade 1		Grade 2		Grade 3		Nom. [Ohm/m]	Min. [Ohm/m]	Max. [Ohm/m]	
[mm]	Tolerance [mm]	Section [mm ²]	Min. [mm]	Max. [mm]	Min. [mm]	Max. [mm]	Min. [mm]	Max. [mm]				
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

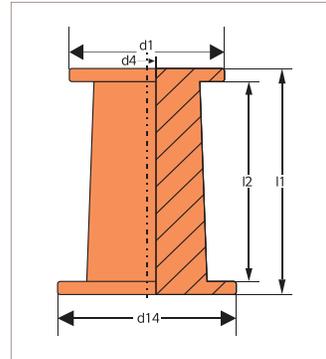
Nominal Diameter	Breakdown Voltage acc. to IEC			Length of 1 kg of Enamelled Wire			Filling Factor Number of Enamelled			Tension	Nominal Diameter
	Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3		
[mm]	Min. [V]	Min. [V]	Min. [V]	Approx. [km]	Approx. [km]	Approx. [km]	[n]	[n]	[n]	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.	

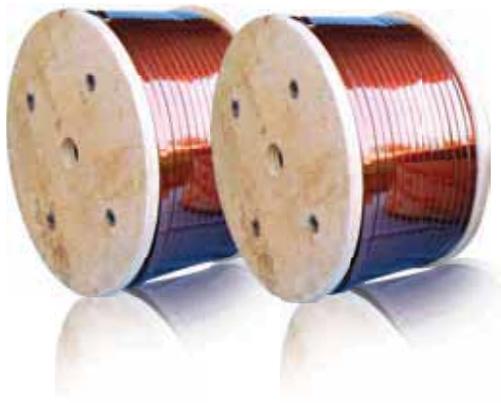
SIZE RANGE

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 Polyester
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)

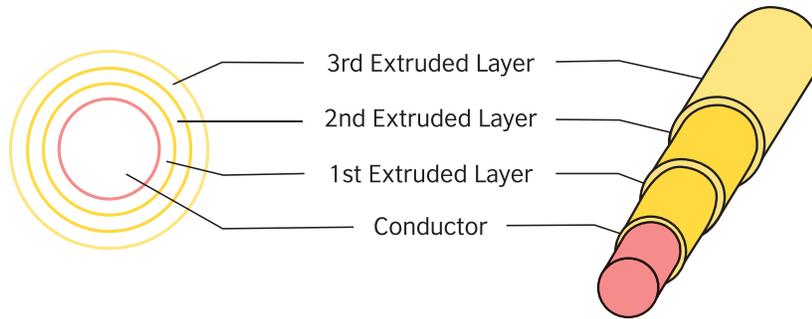
CLASS : 180° : IEC 60317-31 (IS 13730-31)

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

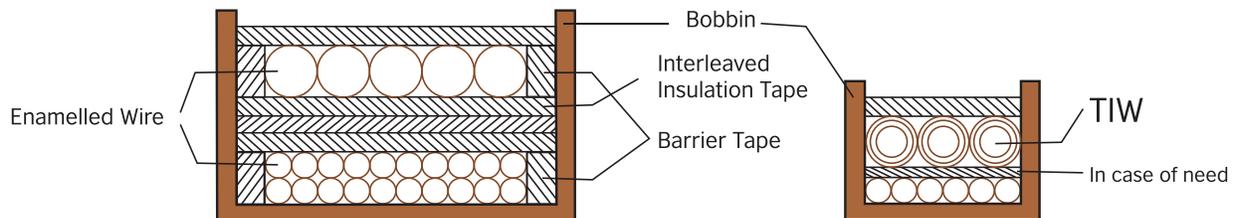


TRIPLE INSULATED WINDING WIRES

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

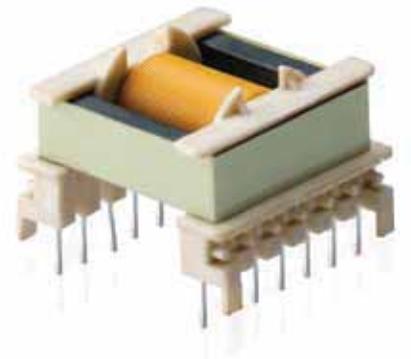
Product range : 0.200 mm to 1.00 mm • **Packing** : PT 5, PT 10 & PT 15 bobbin packing

*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 application

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.

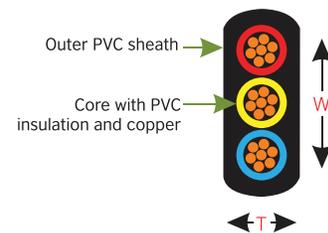
Nom. Cross Section Area of Conductor (mm) ²	Number of Nominal Dia. of Strands	Nom. Insulation Thickness (mm)	Nom. Sheath Thickness (mm)	Max. Resistance Per Km at 20°C (Ω/km)	Overall Dimension (Max.) (W X H) (mm X mm)	Current Carrying Capacity at 40°C (Amps)
1.5	22 / 0.3	0.6	0.9	12.1	12.0 X 5.6	18
2.5	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

HP	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 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 its 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

0.070 mm to 2.00 mm grade 1, grade 2



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.



SALASAR COPPER | RAM RATNA WIRES LTD. (RR Global Company)

Regd. Office :

Ram Ratna House, Oasis Complex, P. B. Marg, Worli, Mumbai - 400 013.

T : +91-22-2494 9009 / 2492 4144 • **F :** +91-22-2491 0586 • **E :** indsales@rrglobal.in

Corp. Office :

305/A, Windsor Plaza, R. C. Dutt Road, Alkapuri, Vadodara - 390 007.

T : +91-265-2321 891 / 2 / 3 • **F :** +91-265-2321 894 • **E :** vadodara@rrglobal.in

Waghodia (MEW Electricals Limited):

Plot No. 26/329 & 330, GIDC Estate, Waghodia, Vadodara - 391 760.

T : +91-2668-262 165

Silvassa (Salasar Copper Unit 1) :

Survey No. 142/2, Madhuban Dam Road, Rakholi, Silvassa - 396 240, U.T. of D. & N.H.

T : +91-260-2633 224

Silvassa (Salasar Copper Unit 2) :

Survey No. 212/2, Near Dadra Check Post, Dadra, Silvassa - 396 193, U.T. of D. & N.H.

T : +91-260-2668 287 / 559

Bengaluru: 080 - 4125 0079 / 4090 221, **Coimbatore:** 0422-2910 560, **Chennai:** 044-2829 2329 / 2429,

New Delhi: 011 - 4303 8395 / 2735 5477 / 78, **Secunderabad:** 040 - 2780 4098

www.rrglobal.in • www.rrshramik.com