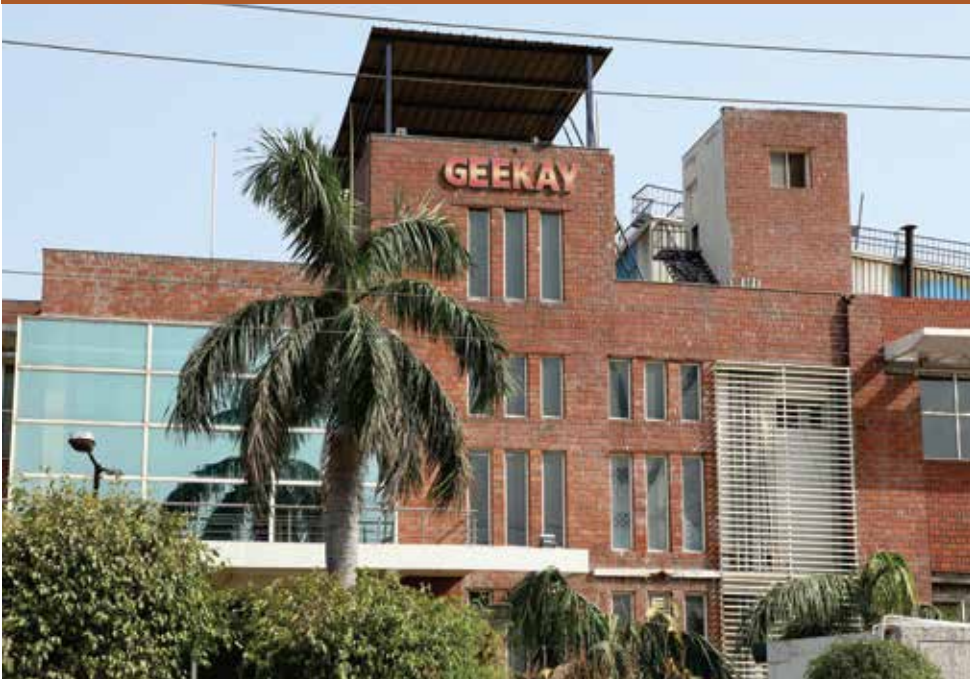


QUALITY THAT
INSPIRES TRUST



GEEKAY
WINDING WIRES

Leader in Copper & Aluminum Enamelled Winding Wires



Established in 1975, G.K. Winding Wires Limited is the leading manufacturer of Copper & Aluminium Enamelled Winding Wires in India, marketed under its brand GEEKAY. The market for copper winding wires is over 2.5 lac MT per annum and we are one of the leading players in the organized sector.

We have 4 manufacturing units with 2 in Noida (U.P.), and one each in Baddi (H.P.) and SriCity (A.P.), giving us the unique advantage of being able to service customers across India, for any scale of customer needs.

OUR MISSION

To always be at the core of our customer's business by adding value through our **systems driven, technology based and innovative solutions approach.**

OUR VALUES



INTEGRITY

To serve with integrity at all times



QUALITY

To manufacture with highest quality standards



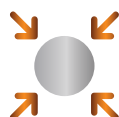
SOLUTIONS

To provide the best possible solutions to our customers



INNOVATION

To find innovative solutions to problems



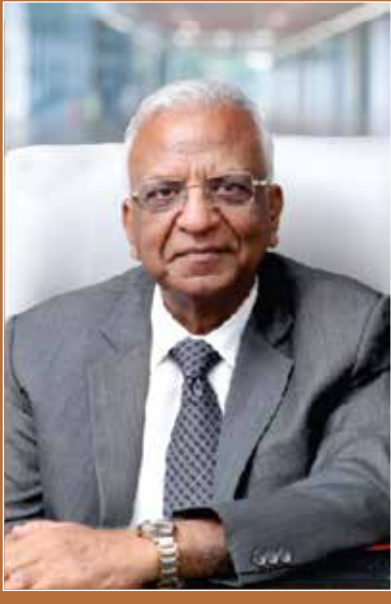
RESPONSIVE

To be responsive to our customer's needs



COMMITTED

To be committed to our customers, always



Mr. Sudhir Agarwal is one of the earliest entrepreneurs in the metal products industry and founded G. K. Winding Wires Limited in 1975.

He has been the force behind establishing GEEKAY as one of the leading enamelled wire brands in India. He has been honored for his contribution to the industry by being elected as the chairman of WWMAL.

SUDHIR AGARWAL
Chairman & Managing Director
B.E. (MNIT, Jaipur – Batch of 1970)



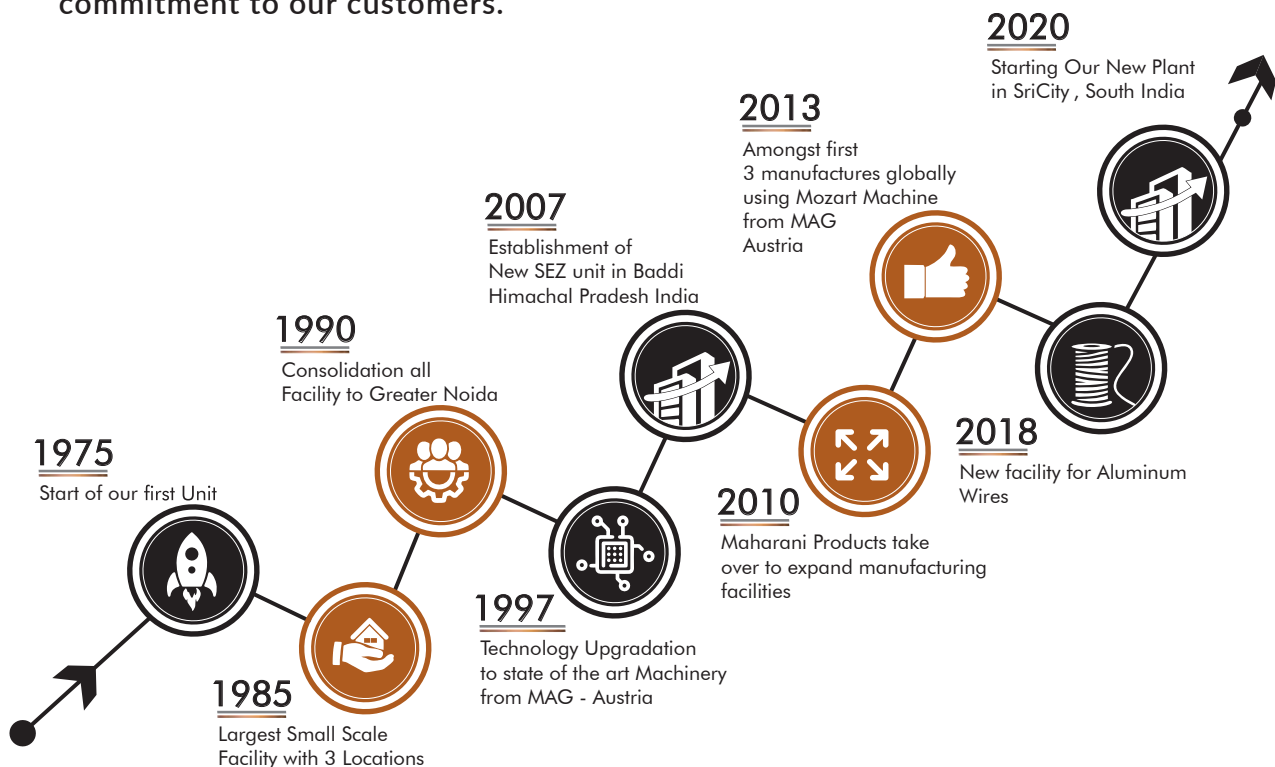
Mr. Sameer Agarwal joined G.K. Winding Wires Limited as an Executive Director in 2005 and since then the brand has seen a renewed focus on technology upgradation, new customer development and expansion.

An entrepreneur par excellence, he has put brand GEEKAY on the path to consistent double digit growth.

SAMEER AGARWAL
Managing Director
B.E. (Delhi College of Engineering),
PGDBM (XLRI, Jamshedpur)

OUR JOURNEY

From humble beginnings 4 decades ago, to becoming a leader in the Winding Wires industry in India, our journey has been the result of incredible entrepreneurship, long term vision, deep rooted values, continuous investments in technology and capacity development, a focus on quality and systems and a deep partnership and commitment to our customers.



Are you looking for a Solution to All your Winding Problems

Q

Quality

- Do you feel lack of consistency in quality of magnet wire?
- All properties are ok but there is an issue with runnability?
- Do you face insertion problems during operation & supplier says wire is ok?
- Do your operators sporadically complain of hardness in the wire?
- Is color of each lot supplied to you different every time?
- Are you concerned about the quality of raw material used by your supplier?
- Are you looking for a supplier with strict 4M management?

Cost

- Are you finding it difficult to strike a balance between quality and cost?
- Are you willing to look at your overall cost, rather than just price of what you buy?
- Are you okay with a higher price but a lower landed cost?
- Do you want 100% transparency in costing and ethical pricing from your supplier?

C

D

Delivery

- Are you interested in JIT or frequent deliveries that can result in minimum inventory levels?
- Are you looking at flexibility with speed in deliveries?
- Do you want bigger spool size - to reduce scrap% and changeover time?
- Do you face the problem of material getting damaged and the supplier is unable to offer a permanent solution?

Development

- Are you looking for a supplier with in depth knowledge of magnet wire & its application?
- Are you looking for a supplier who can meet special requirements - specifications & tolerance?
- Do you want to create special specifications - but your current supplier cannot meet them?
- Are you looking for a creative solution to your problems & your supplier is unable to contribute?

D

S

System

- Are you looking for a supplier who follows SYSTEMS, not just on paper but also in spirit?
- Are you tired of big promises but poor execution?
- Are you looking for a sustainable solution - dependent on SYSTEMS and not people?

Trust GEEKAY to provide you with the best solution to your Winding Wire needs

Why Choose GEEKAY for your Winding Wire Needs



Customized Solutions

- All grades & sizes available as per requirement
- Special Wires of Self Solderable & Self Bonding available
- Internal R&D Team
- Special Wires for Improving Fill Factor



Systems Driven Process

- 100% PO Fulfillment
- 100% Weight Accuracy
- Consistent On Time Delivery
- JIT Delivery available
- Strict 4M Change Management



Customer Service Focus

- Dedicated SPOC
- Real time Order Updates
- Accurate Billing & Account Reconciliation
- Periodic Winding Line Audit Report



Highest Quality Materials

- 100% Virgin Copper & Aluminium sourced from the largest suppliers Hindalco, Sterlite & Sumitomo
- Best quality Enamel with sourcing from global suppliers – Elantas & Fupao



World Class Technology

- Enamelling on imported machine from MAG, Austria with single line, single oven configuration
- RBD from Niehoff, Germany with Inline resistance annealing



Highest Quality Standards

- 100% ROHS Compliant Wires
- UL approved Products
- Inline Pinhole & Diameter Testing
- IATF16949 Certified
- Concentricity Measurement

We work to meet the need of the Times

OUR PRODUCTS



The GEEKAY brand is well known for its high quality range of Copper & Aluminium Enamelled Winding Wires, made with 100% virgin materials using world-class technology at our state of the art manufacturing plants.

Our products are available in industry standard specifications, as well as, can be customized to meet the unique needs of our customers. All our products meet international quality specifications and are UL certified.

OUR CUSTOMER SEGMENTS

At GEEKAY, we have always believed in making trusted partnerships and for us our customers are our credentials. Over the past 4 decades, our brand has become a symbol of quality and trust for leading OEMs and Motor Manufacturers across a wide variety of industries:

- Automobiles (4 wheelers & 2 wheelers)
- Auto Electricals
- Starters
- Alternators
- Small Motors
- Electric Vehicles
- Fans & Home Appliances
- Pumps & Motors
- Electricals & Electronics
- Capital Goods (Power & Transformers)



Winding wires (also called Magnet Wires) are used to generate a magnetic field when current flows through them and this helps in conversion of electrical energy into other forms of energy like motion, sound, light, etc and vice versa.

Winding wires are basically classified by

- Metal type
- Conductor size and insulation thickness
- Type of insulation – this in turn depends on thermal class required and application of the wire

The following are important characteristics of the wire

- Dimensional properties (Conductor and overall Diameter)
- Mechanical properties (Elongation, Springback, Coefficient of Friction)
- Electrical properties (Pin Hole, Break down Voltage)
- Thermal properties (Heat Shock, Cut Through)
- Insulation quality (Abrasion Resistance, Flexibility)
- Chemical properties (Resistance to Solvents that may be there in the application surroundings – Transformer Oil, Refrigerant, Water)

All these characteristics are essential. However, a wire cannot excel in all the properties in the same product, hence it is necessary to understand the application and relative importance of each of the characteristics in order to be able to choose the right product. In line with the same, at GEEKAY we have a system driven, technology based and innovative solutions approach to help get maximum performance at the most economical cost.

| Property of Wire | Testing Concept | Impact on final product | Controls at GEEKAY |
|--|---|--|--|
| Conductor Diameter & Overall Diameter | Testing of wire diameter before and after removing insulation | Wire with incorrect dimensions would result in: - Resistance of the wound coil not ok - Electrical properties including BDV, Pin hole, etc. not ok | Finely controlled pneumatic tension controllers Inline diameter measurement Use of diamond dies for drawing as well as enameling |
| Hardness in the Wire | Combination of mechanical properties | A hard wire will have: - Difficulty in insertion of coil after winding - Scratches observed during insertion | With years of experience, we have a best combination of mechanical properties suitable for best ease of application. We perform special indigenous tests on the wires and apply special kind of lubrication for obtaining the best fill factor |
| Surface Defect | Visual test, inline roughness detectors | Affects electrical properties and shortens life of the product | Careful control of dies, cleaning of conductor, choice of wire enamel, control of enamel viscosity during process |
| Abrasion Resistance | This depends of mechanical strength of coating. The force required to scratch the insulation is calculated in measuring abrasion resistance | Wire with poor abrasion resistance may get scratched during winding leading to failure of insulation | Use of most advanced tangent delta instruments from MAG and AMPAC to measure degree of cure of the wire |
| Flexibility | The wire is pre-elongated to a specified value and bent as per requirement. Thereafter the insulation must not crack. | Poor flexibility will result in cracks in insulation during winding process wherein there are various mechanical stresses induced on the wire. | Use of most advanced tangent delta instruments from MAG and AMPAC to measure degree of cure of the wire |
| Concentricity of Insulation | Make a mould and check for insulation thickness on all sides of the conductor | If the insulation is not uniform the life of final product is compromised | Concentricity measurement, Glycerine Break down Voltage Test |
| Heat shock, Cut Through (Softening Resistance) | To test these thermal properties - thermal and mechanical stresses are simultaneously put on the wire and testing is done for failure of insulation | If thermal properties are not ok - the life of the product and ability to sustain under extreme conditions is poor | Choice of the right insulation from reputed sources |
| Electrical Properties like Pin Hole and Break Down Voltage | Wire is subjected to a certain voltage and leakage current or point of short circuit is measured | Final coil is subjected to voltage and current and poor electrical properties may lead to failure of final product in field | Careful process controls & inline testing for pin holes |



UNIT I : Greater Noida

Total Area : 10,000 M²
Covered Area : 1,00,000 SFT
Cu Potential : 1800 MT/Month

UNIT II : Greater Noida

Total Area : 7,000 M²
Covered Area : 1,00,000 SFT
Al Potential : 700 MT/Month





We have 4 manufacturing units with 2 in Noida (U.P.), and one each in Baddi (H.P.) and SriCity (A.P.), giving us the unique advantage of being able to service customers across India, for any scale of customer needs.



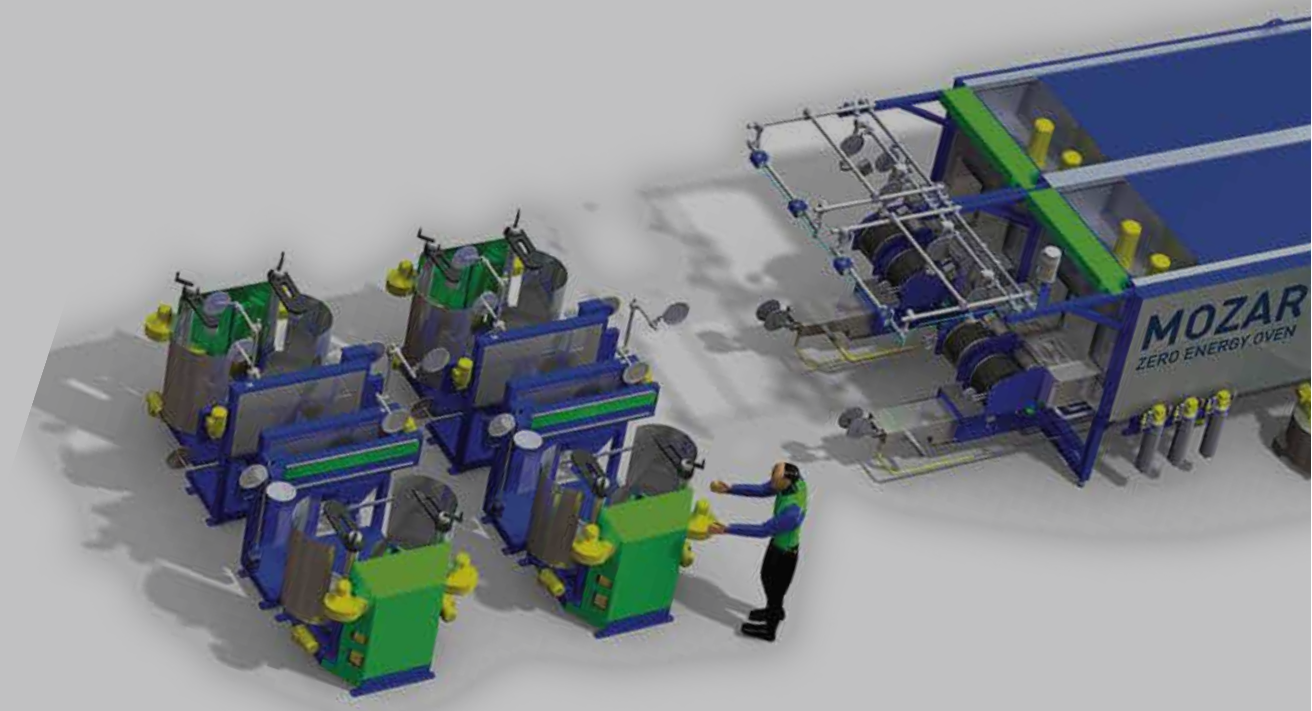
UNIT III : SriCity (A.P)

Total Area : 20,000 M²
Covered Area : 1,00,000 SFT
Cu Potential : 3000 MT/Month

UNIT IV: Baddi (H.P)

Total Area : 2,800 M²
Covered Area : 30,000 SFT
Cu Capacity : 400 MT/Month





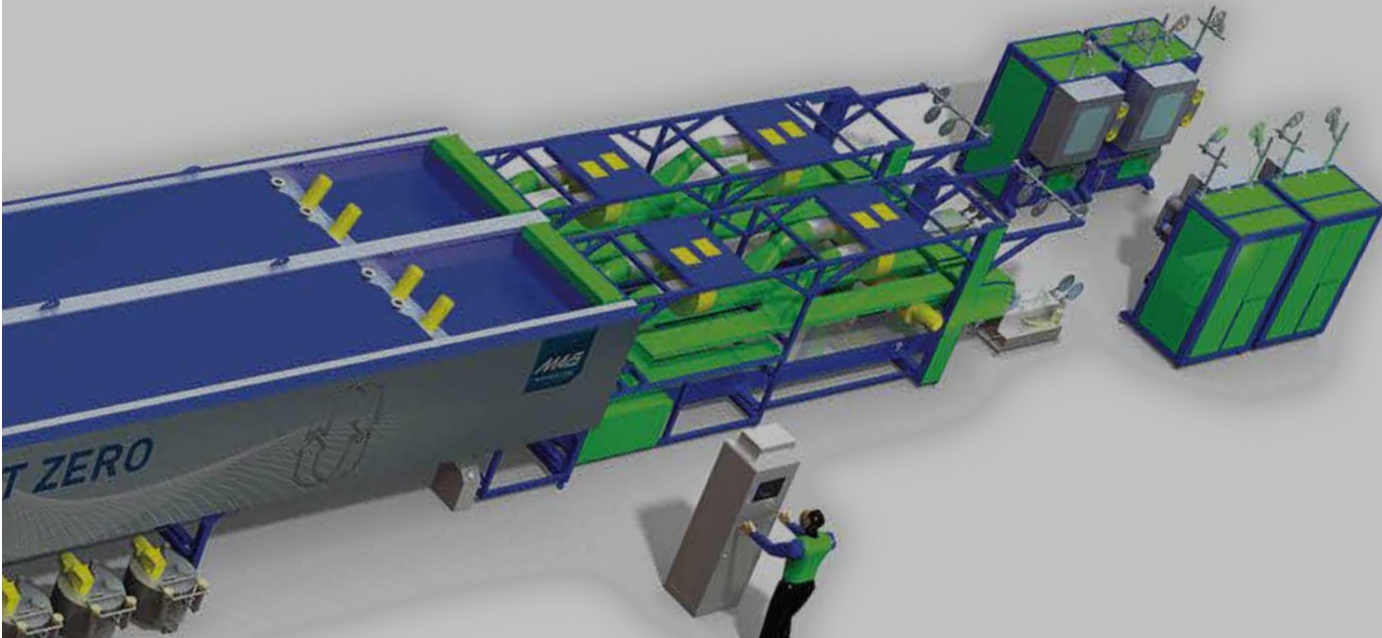
Single Line Single Oven Machine

To ensure a better reliability of your products, GEEKAY high quality enameled wires are made using the Single Line Single Oven Concept. This ensures better thermal equilibrium in the oven. Any breakage in a single line, does not impact the wire quality in the other lines, thus ensuring higher & consistent quality of the wire. The result is higher efficiency and longer life of your motor and better reliability of your products.

Wire Drawing Machine

To make sure that our customers receive the right kind of product they desire, we have installed the best wire drawing facility from Niehoff, Germany. The products are reliable which enables our customers to master the specific challenges of their respective industries.





World Class products need the best technology to power them. At GEEKAY, we have been the pioneers to use the most modern, world class winding wire technology using machinery from renowned global suppliers. Our manufacturing technology has evolved as per the latest industry trends as we believe that innovation is a way of life for us at GEEKAY.

Global Suppliers - Our Backbone

We have a global & trusted supplier base to ensure we deliver only the highest quality products.

COPPER



ALUMINIUM



WIRE ENAMEL





Best In Class Quality Standards

At GEEKAY, quality is a way of life and we strive hard to ensure that we follow quality processes and systems in all that we do, to deliver the best in class products for your needs. The GEEKAY Seal of Quality is our Trust Mark for your peace of mind.

Inline Testing & Quality Control Process



At GEEKAY, we have established our own set of standards which are more stringent than the standards set by our customers and we try to continuously improve on the same. The idea is to continuously improve the product quality and make a better and more reliable product. This is only possible by implementation of a very strict ILO (Incoming, Line and Outgoing) quality control system and having rigorous analysis and reviews on a regular basis. We also have world class inline diameter and pin hole measurement in our process for real time monitoring of product quality.

World Class Quality Certifications



Our products have consistently received A+ ratings from our customers and is reflected in the fact that we haven't lost a customer since 1975. We're a DOL supplier for major automotive OEMs such as Denso, Honda, LG, Subros among many other, winning their trust for a really long time.

Awards





“We have been dealing with your company for a long time. We cherish our relationship, which is more than a supplier and buyer. We wish you to grow with us with new developments and maintaining best quality and cost as always.”

NAVEEN AGARWAL, Director, Sanden Vikas (India) Limited

“G. K. Winding Wire is a business partner for Elin rather than an ordinary vendor. They are professionally managed and very particular about the quality & delivery. Such service is an example of transparent working culture and gearing up for ahead challenge. They are efficient with effectiveness. Good luck to GK for their bright future.”

SANJAY TYAGI, General Manager Operation, Elin Electronics Ltd.



“G.K.Winding have successfully made the transition from a home grown family business to a modern system oriented company approaching World Class.”

MOHAN NARAYANAN, President, Auto Ignition Ltd.

“Condor is sourcing major quantity of super enamelled Aluminium wire from M/s G.K. Winding Wires Ltd. since last several years and we are totally satisfied by the services and quality of the product being supplied. We are confident that our association with M/s G.K. Winding Wires Ltd. will continue for many years to come.”

B. B. SINGH, Chairman cum Managing Director, Condor Power Products Pvt. Ltd.



“You have been our supplier partner for the drawn-copper-wires since a long time and one-of-the-best at that. I must mention that you have been very proactive in resolving any issues that had come up and appreciate the best results in the recent past. You and your team has built the confidence for us to hold you in great esteem and consider you as our elite supply partner ! Just to mention, we appreciate that you are maintaining a 100% FTPR consistently ! This is superb ! Please convey my gratitude & appreciation to all the employees of GK Winding Wires.”

ARVIND KUMAR SINGH, Head – Manufacturing, Orient Electric Limited
a CK Birla Group Company



Product Technical Specifications

| Type | Enamel used | Temperature index | Standard (Cu) | Standard (Al) | Advantages | Operational Precautions | Applications |
|---------|--------------------------------|-------------------|---|---------------|--|--|--|
| PVF/PVA | Polyvinylformal Enamelled wire | 105°C | IEC 60317-12, MW 15-C, JIS-3202-2 | | Mechanically strong coating and good flexibility. Good thermal shock resistance. Strong in hydrolytic degradation. | Crazing prone (Preheating prevents crazing from developing.) | 1. Transformer |
| | Poly Vinyl Acetal | 120°C | IEC 60317-1 | | | | |
| PEW | Polyester Enamelled wire | 130°C | IEC 60317-34 | IEC 60317-9 | Good electrical characteristics. Good heat resistance. Good solvent resistance. | Mediocre resistance to thermal shock. Poor resistance to hydrolytic degradation; care must be taken when used in sealed equipment. | 1. General purpose motors 2. Magnet coils |
| PEW | Polyester Enamelled wire | 155°C | IEC 60317-3, NEMA-MW5C, JIS-3202 | | | | |
| UEW | Polyurethane Enamelled wire | 130°C | IEC 60317-4, MW 75-C | | Soldering is possible without stripping off coating. Excellent electrical characteristics with high frequency. | Coating is mechanically weak. Vulnerable to aromatic solvents. Crazing prone. (Preheating prevents crazing from developing.) | 1. Coils for electronic equipment 2. Coils for communication equipment 3. Coils for electric meters 4. Micromotors 5. Magnet coils |
| UEW | Polyurethane Enamelled wire | 155°C | IEC 60317-20, MW 79-C, JIS 3202 | | | | |
| UEW | Polyurethane Enamelled wire | 180°C | IEC 60317-51, MW 82-C JIS-3202 | | | | |
| EIW | Polyesterimide Enamelled wire | 180°C | IEC 60317-8, NEMA-MW30C NEMA-MW72-C, JIS-3202 | IEC 60317-15 | Good heat resistance. Good thermal shock resistance. Mechanically strong coating. Excellent resistance to hydrolytic degradation. Excellent resistance to refrigerants. | Film detachment is difficult. | 1. Class-F motors 2. Freon motors 3. Microwave oven transformers 4. Magnet coils for heat-resistance components 5. Motors for electrical equipment |
| AIW | Polyamideimide Enamelled wire | 220°C | IEC 60317-26, IEC 60317-57 MW 81-C, JIS-3202 | | Mechanically strong coating. Good heat resistance. Good overload characteristics. | Coating flexibility is slightly inferior to PEW. | 1. Transformers for heat-resistance equipment 2. Motors for electric tools 3. Hermetic motors 4. Motors for electrical equipment |
| | | 240°C | IEC 60317-59 | | | | |
| PUPEI | Solderable PEI wire | 180°C | IEC 60317-23, MW 77-C, JIS-3202 | | Soldering is possible without stripping off coating. Excellent electrical characteristics with high frequency. | Soldering temp is higher than normal solderable enamels | 1. Switchgear industry 2. Defence equipment |
| SB-EIW | Polyesterimide+Self bond wire | 180°C | IEC 60317-36 | | Coils can be fixed without varnishing. Coil winding is possible while applying methanol and ethanol. Solder reflow after coil winding causes only slight coil deformation due to heat from reflow furnace. Coil winding is possible while applying methanol and ethanol. | Store wires in a cool, dark place away from heat and moisture. | 1. Coils for flat motors 2. Clutch coils |
| SB-UEW | Polyurethane+Self bond wire | 130°C | IEC 60317-2, MW 130-C | | Coils can be fixed without varnishing. Coil winding is possible while applying methanol and ethanol. Solder reflow after coil winding causes only slight coil deformation due to heat from reflow furnace. Coil winding is possible while applying methanol and ethanol. | Store wires in a cool, dark place away from heat and moisture. | 1. Coils for flat motors 2. Clutch coils |
| SB-UEW | Polyurethane+Self bond wire | 155°C | IEC 60317-35, MW 131 C | | | | |
| SB-UEW | Polyurethane+Self bond wire | 180°C | IEC 60317-55 | | | | |

| Type | Enamel used | Temperature index | Standard (Cu) | Standard (Al) | Advantages | Operational Precautions | Applications |
|------------|-------------------------------|-------------------|--|--|---|--|--|
| EIW-AIW | Polyesterimide+Polyamideimide | 200°C, 220°C | IEC 60317-13, MW 35-C, MW 73-C MW 36-C, MW 38-C JIS-3202 | IEC 60317-25, MW 35-A, MW 36-A MW 73-A | Good heat resistance. Good thermal shock resistance. Mechanically strong coating. Excellent resistance to hydrolytic degradation. Excellent resistance to refrigerants. | Film detachment is difficult. | 1. Class-F motors 2. Freon motors 3. Microwave oven transformers 4. Magnet coils for heat-resistance components 5. Motors for electrical equipment |
| NY-UEW | Polyurethane+Nylon wire | 130°C | IEC 60317-19, MW 28-C | MW 28-A | Good surface slip characteristics; suited for high-speed machine winding. Good thermal shock resistance. Has all advantages of UEW wire | Poor resistance to hydrolytic degradation; care must be taken when used in sealed equipment. | 1. Coils for electronic equipment 2. Coils for communication equipment 3. Coils for electric meters 4. Micromotors 5. Magnet coils |
| NY-UEW | Polyurethane+Nylon wire | 155°C | IEC 60317-21, MW 80-C | MW 80-A | | | |
| NY-UEW | Polyurethane+Nylon wire | 180°C | MW 83-C | | | | |
| NY-EIW | Polyesterimide+ Nylon wire | 180°C | IEC 60317-22 | | Good surface slip characteristics; suited for high-speed machine winding. Good thermal shock resistance. Similar advantages to EIW. | Poor resistance to hydrolytic degradation; care must be taken when used in sealed equipment. | 1. General purpose motors 2. Small motors |
| NY-PEW | Polyester+Nylon wire | 155°C | MW 24-C | MW 24-A | Good surface slip characteristics; suited for high-speed machine winding. Good thermal shock resistance. Similar advantages to PEW. | Poor resistance to hydrolytic degradation; care must be taken when used in sealed equipment. | 1. General purpose motors 2. Small motors |
| NY-PEW | Polyester+Nylon wire | 180°C | MW 76-C | MW 76-A | | | |
| SB-PUPEI | Solderable PEI+Self bond wire | 180°C | IEC 60317-36 | | Coils can be fixed without varnishing. Coil winding is possible while applying methanol and ethanol. | Store wires in a cool, dark place away from heat and moisture. | 1. Coils for flat motors 2. Clutch coils |
| NY-PUPEI | Solderable PEI+Nylon wire | 180°C | MW 78-C | | Good surface slip characteristics; suited for high-speed machine winding. Good thermal shock resistance. Similar advantages to PUPEI. | Poor resistance to hydrolytic degradation; care must be taken when used in sealed equipment. | 1. Coils for flat motors 2. Clutch coils |
| SL-EIW-AIW | EIW+AIW+Self lubricating PAI | 200°C, 220°C | IEC 60317-13, MW 35-C, MW 73-C JIS-3202 | IEC 60317-25, MW 35-A, MW 36-A MW 73-A, JIS-3202 | Excellent surface slip characteristics and mechanical strength; suited for high space-factor motors. Similar advantages to EIW-AIW | Film detachment is difficult. | 1. High space factor motor 2. Freon motors 3. Motors for electrical equipment |
| SB-EIW-AIW | EIW+AIW+Self bond wire | 200°C | IEC 60317-38, MW 102-C | MW 102-A | Coils can be fixed without varnishing. Wires can be bonded tightly together by heat produced with current flow or by heating in a thermostatic chamber. Coil winding is possible while applying methanol and ethanol. | Store wires in a cool, dark place away from heat and moisture. | 1. Coils |

Self Bonding Enamelled Wires

Self Bonding Enamelled Wires are enamelled wires that allow coils to be bonded by heating or applying solvent during or after coil winding. A Self Bonding Enamelled Wire has an internal insulation layer & a bonding layer as the outside periphery. Self Bonding Enamelled Wires are provided with insulation properties at the insulation layer and coil fusion functionality at the fusion layer.

| Fusion Method | Contents | Applications |
|---------------------------|---|--|
| Alcohol bonding method | Method in which alcohol is applied onto wires immediately before coil winding or coils are soaked into alcohol after the winding process. Further heating after applying alcohol improves adhesive strength. Be aware of foam formation caused by rapid heating. | Electrical equipment Brush-less motors |
| Oven bonding method | Oven bonding is achieved by heat-sealing coils in a heat chamber. Suitable for fusion of narrow wires that cannot be electrified due to excessively high resistance or thick wire coils that require a large current. | Electrical equipment Microwave ovens |
| Resistance heating method | Method in which Joule heat caused by an electric current melts and fuses bonding films. In the resistance heating method, the temperature increase depends on the radiation effect as influenced by the conductor diameter, film thickness, wire turns, coil shape, and surrounding environment. Energizing conditions must be determined after examining the test results. | Electrical equipment Microwave ovens |

- Heating time depends on the coil size, shape, and fusion method.

Self Solderable Wires

When enamelled wires needs to connected to the terminals, the coating normally has to be removed either chemically or mechanically. With UEW (Urethane enamelled wire) or self solderable wires, we can perform the connections without removing the coating in a separate process.

This especially finds application in electronics industry, smaller wire sizes or where chances of contamination due to separate removal of coating affect the product performance. These wires can be of the following types:

- Class 130°C, 155°C, Class 180°C depending on thermal resistance required in the final product
- Overcoat of Nylon can be provided for better windability and better abrasion resistance
- Overcoat of self bonding layer can be provided as per product needs – especially for coreless winding, need for impregnation (but varnishing not advisable or feasible)

General Precautions

For winding operation using magnet wires, the treatment and operational precautions based on the properties thereof are described below.

1. Do dimensions (thickness and width) conform to the specifications?

Dimensions that passed inspection at the time of wire manufacture are put to use; there may be no need to inspect the dimensions again. In case of misuse for reasons related to storage, management, or other such processes, be sure to measure the outside diameter, width and thickness immediately before use, checking that the dimensions conform to the intended purpose.

2. Is there residual oxide film on bare wire surface?

Especially when winding a bare wire around a coil, the presence of an oxide film on the wire surface may pose a problem in soldering or the oxide film may come off as a fine powder and get into the coil insulation. Thus, when using a wire with a substantial oxide film, it is better to perform acid pickling, neutralization, and rinsing before use.

3. Are flaws or frictions checked for?

Wires may have been damaged due to poor handling during transport or storage. Accordingly, after inspecting the wires carefully, small flaws are repaired and significant flaws removed. Aluminum conductors are soft and easily deform; special care is needed during handling.

4. How to handle excess wires

After the coil winding process, excess wires shall be stored away from dust particles (metal powder in particular), moisture, and direct sunlight.

Precautions for Enamelled Wires

The insulation properties of enameled wires are generally ensured with a very thin coating. Therefore, take special note that these wires are susceptible to external damage by sharp-edged tools

1. Minimize stretching during the coil winding process!

Wire stretching shall be minimized during coil winding process. Stretching decreases the film thickness, leading to deterioration in properties. The smaller the stretching, the better it is. If stretching is limited to less than 5%, the property degradation of enameled wires, except for thin wires, will generally be lessened.

2. Exercise care in selecting treatment varnish

Generally, coils are varnish-treated after the coil winding process. However, various types of coil varnishes have been developed and are in use. Great care shall be exercised in combining these varnishes.

3. No releasing agent shall be dispersed

When using a chemical release agent to remove film before performing terminal soldering, special care must be exercised so that the release agent does not adhere to other portions of the coil. It is also important to neutralize the release agent and rinse it thoroughly with water after film removal. Failure to do so may cause narrow wires to become corroded and disconnected; due care must be exercised. When peeling films, be sure to wear protective gear such as goggles to prevent chemicals and separated chips from getting into the eyes.

STORAGE OF WIRES

Please pay attention to the following points when storing wires for a long period of time :

- Never store wires in an area exposed to direct sunlight.
- Avoid high-humidity environments.
- Avoid special environments
- Be sure that no electric wire will hit other articles or other wires.
- Never store wires in a dusty area.

If you have any questions, please contact us.

Since general notes for handling wires have already been described, the below paragraphs describes some considerations for forming coils.

1. Considerations for Coil Forming

Dies are used for forming coils in many cases. A flaw on a die surface causes damage to the wire coating; die surfaces should be checked for damages.

2. Automatic Machine Winding

There is a trend toward direct coil winding to electric equipment by using an automatic coil winding machine. In general, there are a number of factors that make wires subject to harsh bending and stretching. Careful consideration must be given in advance to check coils with wires wound by a machine for damage or decreased dimensions.

3. Repairing at Corners

In some cases, coating wires are bent with a few millimeters of bend radius by using the coil of a rotating machine. It is inevitable that films are damaged at the corners to some extent; detailed maintenance is required as described earlier. It is desirable for repair materials to be identical to those of coating. In cases of inevitable situation, materials with similar mechanical, electric and thermal properties should be selected.

4. Handling after Coil Forming

Formed coils as mentioned above will become finished products through further stages - insulating, drying, and varnishing. These coils are assembled to stators or rotors. Extra care must be exercised to check for deformed coil shape and damaged coating during transportation or other handling processes down to the wire mounting process.

This requires each worker to pay close attention and to be ingenious in arranging and placing coils or even to use appropriate tools as necessary. Coils shall be stored away from dust particles (particularly metal powder) and moisture.

There is a recent trend toward omitting preliminary drying. However, due to the presence of strain, sweat, or moisture from enamel coatings in winding wires, preliminary drying should be performed sufficiently to improve insulation properties.

5. For Aluminum Conductor Magnet Wires

When winding a coil by a coil winding machine, appropriate tension must be given to a wire. Therefore, a tension device, which also serves as a corrector of wire bending, is put into use. It is desirable that the pressure surface should not be a slide surface but a roll surface and it is important that the tension be selected to minimize wire stretching. Special care must be taken with narrow wires.

- **Precautions about Tension Device**

Since aluminum conductors have a low tensile strength, the tension device for these conductors should be about 30% or less than that of copper wires. A higher tension increases stretching, thereby deteriorating the properties.

- **Precaution in Automatic Machine Winding**

Aluminum conductors may be stretched locally by 10% or more due to impact force during machine winding; special care must be exercised.

- **Precaution in Moulding Process**

An aluminum conductor is soft and may deform before its coating is damaged; special care must be taken with pressurizing method during coil moulding.

STORAGE PERIOD

If magnet wires are stored properly in accordance with above, there will be no deterioration in properties even after 10 years or more have passed. However, if wires are not stored properly, for the wires for which more than three years have passed since delivery, be sure to examine the characteristics and check for problems before use.

If you have any questions, please contact us.

Impact of Conductor Diameter & Tolerance on increase in Diameter of Enamelled Round Winding Wire (Basis: IS 13730-0-1 IEC 60317-0-1)

| Conductor Dia (in mm) | Conductor Tolerance (in mm) | Grade 1 (in mm) | | Grade 2 (in mm) | | Grade 3 (in mm) | | Resistance at 20°C (Cu) Ohms per metre | | Conductor Wt in Kg/Km (Cu) | Conductor Wt in Kg/Km (Al) |
|-----------------------|-----------------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|--|--------|----------------------------|----------------------------|
| | | Min. Increase | Max. Overall Dia | Min. Increase | Max. Overall Dia | Min. Increase | Max. Overall Dia | Min. | Max. | | |
| 0.07 | 0.003 | 0.007 | 0.084 | 0.012 | 0.091 | 0.018 | 0.097 | 3.9410 | 4.7470 | 0.035 | 0.011 |
| 0.08 | 0.003 | 0.008 | 0.094 | 0.014 | 0.101 | 0.020 | 0.108 | 3.1330 | 3.7030 | 0.045 | 0.014 |
| 0.09 | 0.003 | 0.008 | 0.105 | 0.015 | 0.113 | 0.022 | 0.120 | 2.4950 | 2.9000 | 0.057 | 0.017 |
| 0.10 | 0.003 | 0.008 | 0.117 | 0.016 | 0.125 | 0.023 | 0.132 | 2.0340 | 2.3330 | 0.070 | 0.021 |
| 0.11 | 0.003 | 0.009 | 0.130 | 0.017 | 0.139 | 0.026 | 0.147 | 1.6320 | 1.8480 | 0.088 | 0.027 |
| 0.12 | 0.003 | 0.010 | 0.144 | 0.019 | 0.154 | 0.028 | 0.163 | 1.3170 | 1.4750 | 0.109 | 0.033 |
| 0.13 | 0.003 | 0.011 | 0.152 | 0.021 | 0.162 | 0.030 | 0.171 | 1.3192 | 1.1841 | 0.122 | 0.037 |
| 0.14 | 0.003 | 0.011 | 0.160 | 0.021 | 0.171 | 0.030 | 0.181 | 1.0550 | 1.1700 | 0.137 | 0.042 |
| 0.16 | 0.003 | 0.012 | 0.182 | 0.023 | 0.194 | 0.033 | 0.205 | 0.8122 | 0.8906 | 0.179 | 0.054 |
| 0.18 | 0.003 | 0.013 | 0.204 | 0.025 | 0.217 | 0.036 | 0.229 | 0.6444 | 0.7007 | 0.226 | 0.069 |
| 0.20 | 0.003 | 0.014 | 0.226 | 0.027 | 0.239 | 0.039 | 0.252 | 0.5237 | 0.5657 | 0.279 | 0.085 |
| 0.22 | 0.003 | 0.015 | 0.252 | 0.029 | 0.266 | 0.043 | 0.280 | 0.4188 | 0.4495 | 0.350 | 0.106 |
| 0.25 | 0.004 | 0.017 | 0.281 | 0.032 | 0.297 | 0.048 | 0.312 | 0.3345 | 0.3628 | 0.437 | 0.133 |
| 0.28 | 0.004 | 0.018 | 0.312 | 0.033 | 0.329 | 0.050 | 0.345 | 0.2676 | 0.2882 | 0.548 | 0.166 |
| 0.32 | 0.004 | 0.019 | 0.349 | 0.035 | 0.367 | 0.053 | 0.384 | 0.2121 | 0.2270 | 0.693 | 0.210 |
| 0.36 | 0.004 | 0.020 | 0.392 | 0.038 | 0.411 | 0.057 | 0.428 | 0.1674 | 0.1782 | 0.880 | 0.267 |
| 0.40 | 0.005 | 0.021 | 0.439 | 0.040 | 0.459 | 0.060 | 0.478 | 0.1316 | 0.1407 | 1.118 | 0.339 |
| 0.45 | 0.005 | 0.022 | 0.491 | 0.042 | 0.513 | 0.064 | 0.533 | 0.1042 | 0.1100 | 1.414 | 0.430 |
| 0.50 | 0.005 | 0.024 | 0.544 | 0.045 | 0.566 | 0.067 | 0.587 | 0.0846 | 0.0896 | 1.746 | 0.530 |
| 0.56 | 0.006 | 0.025 | 0.606 | 0.047 | 0.630 | 0.071 | 0.653 | 0.0674 | 0.0715 | 2.190 | 0.665 |
| 0.63 | 0.006 | 0.027 | 0.679 | 0.050 | 0.704 | 0.075 | 0.728 | 0.0534 | 0.0564 | 2.772 | 0.842 |
| 0.71 | 0.007 | 0.028 | 0.762 | 0.053 | 0.789 | 0.080 | 0.814 | 0.0420 | 0.0444 | 3.521 | 1.069 |
| 0.80 | 0.008 | 0.030 | 0.855 | 0.056 | 0.884 | 0.085 | 0.911 | 0.0331 | 0.0350 | 4.470 | 1.358 |
| 0.90 | 0.009 | 0.032 | 0.959 | 0.060 | 0.989 | 0.090 | 1.018 | 0.0261 | 0.0277 | 5.658 | 1.718 |
| 1.00 | 0.010 | 0.034 | 1.062 | 0.063 | 1.094 | 0.095 | 1.124 | 0.0212 | 0.0224 | 6.985 | 2.121 |
| 1.12 | 0.011 | 0.034 | 1.184 | 0.065 | 1.217 | 0.098 | 1.248 | 0.0168 | 0.0178 | 8.762 | 2.661 |
| 1.25 | 0.013 | 0.035 | 1.316 | 0.067 | 1.349 | 0.100 | 1.381 | 0.0135 | 0.0143 | 10.914 | 3.315 |
| 1.40 | 0.014 | 0.036 | 1.468 | 0.069 | 1.502 | 0.103 | 1.535 | 0.0110 | 0.0114 | 13.691 | 4.158 |
| 1.60 | 0.016 | 0.038 | 1.670 | 0.071 | 1.706 | 0.107 | 1.740 | 0.0083 | 0.0087 | 17.882 | 5.431 |
| 1.80 | 0.018 | 0.039 | 1.872 | 0.073 | 1.909 | 0.110 | 1.944 | 0.0066 | 0.0069 | 22.631 | 6.873 |
| 2.00 | 0.020 | 0.040 | 2.074 | 0.075 | 2.112 | 0.113 | 2.148 | 0.0053 | 0.0056 | 27.940 | 8.486 |
| 2.24 | 0.022 | 0.041 | 2.316 | 0.077 | 2.355 | 0.116 | 2.392 | 0.0042 | 0.0044 | 35.048 | 10.644 |
| 2.50 | 0.025 | 0.042 | 2.578 | 0.079 | 2.618 | 0.119 | 2.656 | 0.0034 | 0.0036 | 43.656 | 13.259 |
| 2.80 | 0.028 | 0.043 | 2.880 | 0.081 | 2.922 | 0.123 | 2.961 | 0.0027 | 0.0028 | 54.762 | 16.632 |
| 3.15 | 0.032 | 0.045 | 3.233 | 0.084 | 3.276 | 0.127 | 3.316 | 0.0021 | 0.0022 | 69.309 | 21.050 |
| 3.55 | 0.036 | 0.046 | 3.635 | 0.086 | 3.679 | 0.130 | 3.721 | 0.0017 | 0.0018 | 88.028 | 26.735 |
| 4.00 | 0.040 | 0.047 | 4.088 | 0.089 | 4.133 | 0.134 | 4.176 | 0.0013 | 0.0014 | 111.760 | 33.943 |
| 4.50 | 0.045 | 0.049 | 4.591 | 0.092 | 4.637 | 0.138 | 4.681 | 0.0010 | 0.0011 | 141.446 | 42.959 |
| 5.00 | 0.050 | 0.050 | 5.093 | 0.094 | 5.141 | 0.142 | 5.186 | 0.0008 | 0.0009 | 174.625 | 53.036 |

Impact of Conductor Diameter & Tolerance on increase in Diameter of Enamelled Round Winding Wire (Basis: IS 13730-0-1 IEC 60317-0-1)

| Size in SWG | Conductor Dia (in mm) | | | Grade - 1 (in mm) | | Grade - 2 (in mm) | | Grade - 3 (in mm) | | Resistance at 20°C (Cu) Ohms per metre | | Resistance at 20°C (Al) Ohms per metre | | Conductor Wtin Kg/Km (Cu) | Conductor Wtin Kg/Km (Al) |
|-------------|-----------------------|---------|-------|-------------------|------------------|-------------------|------------------|-------------------|------------------|--|--------|--|--------|---------------------------|---------------------------|
| | Min. | Nominal | Max. | Min. Increase | Max. Overall Dia | Min. Increase | Max. Overall Dia | Min. Increase | Max. Overall Dia | Min. | Max. | Min. | Max. | | |
| 8 | 4.023 | 4.064 | 4.104 | 0.047 | 4.152 | 0.089 | 4.197 | 0.119 | 4.240 | 0.0013 | 0.0014 | 0.0021 | 0.0022 | 115.36 | 35.04 |
| 9 | 3.622 | 3.657 | 3.693 | 0.047 | 3.745 | 0.087 | 3.790 | 0.116 | 3.828 | 0.0016 | 0.0017 | 0.0026 | 0.0027 | 93.41 | 28.37 |
| 10 | 3.218 | 3.251 | 3.284 | 0.046 | 3.336 | 0.084 | 3.380 | 0.114 | 3.421 | 0.0020 | 0.0021 | 0.0033 | 0.0034 | 73.82 | 22.42 |
| 11 | 2.915 | 2.946 | 2.976 | 0.045 | 3.029 | 0.084 | 3.072 | 0.127 | 3.112 | 0.0024 | 0.0026 | 0.0040 | 0.0042 | 60.62 | 18.41 |
| 12 | 2.615 | 2.641 | 2.667 | 0.043 | 2.722 | 0.081 | 2.764 | 0.123 | 2.803 | 0.0030 | 0.0032 | 0.0050 | 0.0052 | 48.72 | 14.8 |
| 13 | 2.313 | 2.336 | 2.359 | 0.042 | 2.415 | 0.079 | 2.455 | 0.119 | 2.492 | 0.0039 | 0.0041 | 0.0064 | 0.0066 | 38.12 | 11.58 |
| 14 | 2.012 | 2.032 | 2.052 | 0.041 | 2.108 | 0.077 | 2.147 | 0.116 | 2.184 | 0.0051 | 0.0055 | 0.0084 | 0.0088 | 28.84 | 8.76 |
| 15 | 1.810 | 1.829 | 1.848 | 0.040 | 1.903 | 0.075 | 1.941 | 0.113 | 1.977 | 0.0063 | 0.0067 | 0.0104 | 0.0108 | 23.37 | 7.1 |
| 16 | 1.607 | 1.626 | 1.643 | 0.039 | 1.698 | 0.073 | 1.735 | 0.110 | 1.770 | 0.0080 | 0.0085 | 0.0132 | 0.0137 | 18.47 | 5.61 |
| 17 | 1.407 | 1.422 | 1.437 | 0.038 | 1.492 | 0.071 | 1.528 | 0.107 | 1.562 | 0.0105 | 0.0111 | 0.0172 | 0.0179 | 14.12 | 4.29 |
| 18 | 1.206 | 1.219 | 1.232 | 0.035 | 1.285 | 0.067 | 1.318 | 0.100 | 1.350 | 0.0142 | 0.0151 | 0.0234 | 0.0244 | 10.38 | 3.15 |
| 19 | 1.005 | 1.016 | 1.027 | 0.034 | 1.080 | 0.065 | 1.113 | 0.098 | 1.144 | 0.0205 | 0.0217 | 0.0337 | 0.0351 | 7.21 | 2.19 |
| 20 | 0.904 | 0.914 | 0.924 | 0.034 | 0.976 | 0.063 | 1.008 | 0.095 | 1.038 | 0.0253 | 0.0269 | 0.0416 | 0.0434 | 5.84 | 1.77 |
| 21 | 0.804 | 0.813 | 0.822 | 0.032 | 0.872 | 0.060 | 0.902 | 0.090 | 0.931 | 0.0319 | 0.0340 | 0.0525 | 0.0549 | 4.62 | 1.40 |
| 22 | 0.703 | 0.711 | 0.719 | 0.030 | 0.766 | 0.056 | 0.795 | 0.085 | 0.822 | 0.0418 | 0.0444 | 0.0687 | 0.0718 | 3.53 | 1.07 |
| 23 | 0.604 | 0.610 | 0.616 | 0.027 | 0.659 | 0.050 | 0.684 | 0.075 | 0.708 | 0.0569 | 0.0602 | 0.0936 | 0.0973 | 2.60 | 0.79 |
| 24 | 0.553 | 0.559 | 0.565 | 0.025 | 0.605 | 0.047 | 0.629 | 0.071 | 0.652 | 0.0676 | 0.0718 | 0.1112 | 0.1161 | 2.18 | 0.66 |
| 25 | 0.502 | 0.508 | 0.514 | 0.025 | 0.554 | 0.047 | 0.578 | 0.071 | 0.601 | 0.0816 | 0.0871 | 0.1344 | 0.1409 | 1.80 | 0.55 |
| 26 | 0.452 | 0.457 | 0.462 | 0.024 | 0.501 | 0.045 | 0.523 | 0.067 | 0.544 | 0.1011 | 0.1075 | 0.1663 | 0.1738 | 1.46 | 0.44 |
| 27 | 0.412 | 0.417 | 0.422 | 0.022 | 0.458 | 0.042 | 0.480 | 0.064 | 0.500 | 0.1212 | 0.1293 | 0.1994 | 0.2091 | 1.21 | 0.37 |
| 28 | 0.371 | 0.376 | 0.381 | 0.021 | 0.417 | 0.040 | 0.435 | 0.060 | 0.454 | 0.1487 | 0.1595 | 0.2446 | 0.2579 | 0.99 | 0.30 |
| 29 | 0.341 | 0.345 | 0.349 | 0.020 | 0.382 | 0.038 | 0.401 | 0.057 | 0.418 | 0.1772 | 0.1888 | 0.2915 | 0.3053 | 0.83 | 0.25 |
| 30 | 0.311 | 0.315 | 0.319 | 0.019 | 0.349 | 0.035 | 0.367 | 0.053 | 0.384 | 0.2121 | 0.2269 | 0.3489 | 0.3671 | 0.69 | 0.21 |
| 31 | 0.291 | 0.295 | 0.299 | 0.019 | 0.329 | 0.035 | 0.347 | 0.053 | 0.364 | 0.2414 | 0.2592 | 0.3971 | 0.4192 | 0.61 | 0.18 |
| 32 | 0.270 | 0.274 | 0.278 | 0.018 | 0.306 | 0.033 | 0.323 | 0.050 | 0.339 | 0.2792 | 0.3011 | 0.4594 | 0.4870 | 0.52 | 0.16 |
| 33 | 0.250 | 0.254 | 0.258 | 0.018 | 0.286 | 0.033 | 0.303 | 0.050 | 0.319 | 0.3242 | 0.3512 | 0.5333 | 0.5680 | 0.45 | 0.14 |
| 34 | 0.230 | 0.234 | 0.238 | 0.017 | 0.265 | 0.032 | 0.281 | 0.048 | 0.296 | 0.3809 | 0.4149 | 0.6267 | 0.6711 | 0.38 | 0.12 |
| 35 | 0.210 | 0.213 | 0.216 | 0.015 | 0.241 | 0.029 | 0.255 | 0.043 | 0.269 | 0.4625 | 0.4978 | 0.7609 | 0.8050 | 0.32 | 0.10 |
| 36 | 0.190 | 0.193 | 0.196 | 0.014 | 0.219 | 0.027 | 0.232 | 0.039 | 0.245 | 0.5618 | 0.6081 | 0.9241 | 0.9834 | 0.26 | 0.08 |
| 37 | 0.170 | 0.173 | 0.176 | 0.013 | 0.197 | 0.025 | 0.210 | 0.036 | 0.222 | 0.6967 | 0.7596 | 1.1461 | 1.2284 | 0.21 | 0.06 |
| 38 | 0.149 | 0.152 | 0.155 | 0.012 | 0.174 | 0.023 | 0.186 | 0.033 | 0.197 | 0.8982 | 0.9888 | 1.4777 | 1.5991 | 0.16 | 0.05 |
| 39 | 0.129 | 0.132 | 0.135 | 0.011 | 0.152 | 0.021 | 0.162 | 0.030 | 0.171 | 1.1841 | 1.3192 | 1.9480 | 2.1334 | 0.12 | 0.04 |
| 40 | 0.119 | 0.122 | 0.125 | 0.010 | 0.141 | 0.019 | 0.151 | 0.028 | 0.160 | 1.3811 | 1.5502 | 2.2721 | 2.5070 | 0.10 | 0.03 |
| 41 | 0.109 | 0.112 | 0.115 | 0.009 | 0.130 | 0.017 | 0.139 | 0.026 | 0.147 | 1.6320 | 1.8480 | 2.6844 | 2.9881 | 0.09 | 0.03 |
| 42 | 0.099 | 0.102 | 0.105 | 0.009 | 0.119 | 0.017 | 0.128 | 0.026 | 0.136 | 1.9570 | 2.2400 | 3.2201 | 3.6222 | 0.07 | 0.02 |

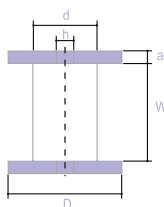
Maximum Permissible Wire Force during Winding

| Nominal Conductor Diameter (mm) | Maximum Winding Force N* | Nominal Conductor Diameter (mm) | Maximum Winding Force N* |
|---------------------------------|--------------------------|---------------------------------|--------------------------|
| 0.018 | 0.03 | 0.224 | 3.34 |
| 0.020 | 0.05 | 0.250 | 4.10 |
| 0.022 | 0.06 | 0.280 | 5.05 |
| 0.025 | 0.07 | 0.315 | 6.18 |
| 0.028 | 0.09 | 0.355 | 7.65 |
| 0.032 | 0.11 | 0.400 | 9.46 |
| 0.036 | 0.14 | 0.450 | 11.60 |
| 0.040 | 0.17 | 0.500 | 13.95 |
| 0.045 | 0.21 | 0.560 | 17.05 |
| 0.050 | 0.25 | 0.630 | 21.00 |
| 0.056 | 0.30 | 0.710 | 25.80 |
| 0.063 | 0.36 | 0.800 | 31.70 |
| 0.071 | 0.44 | 0.900 | 38.80 |
| 0.080 | 0.54 | 1.000 | 46.30 |
| 0.090 | 0.65 | 1.120 | 56.00 |
| 0.100 | 0.78 | 1.250 | 68.00 |
| 0.112 | 0.95 | 1.400 | 82.20 |
| 0.125 | 1.08 | 1.600 | 102.00 |
| 0.140 | 1.43 | 1.800 | 123.50 |
| 0.160 | 1.81 | 2.000 | 147.50 |
| 0.180 | 2.25 | 2.240 | 185.00 |
| 0.200 | 2.72 | 2.500 | 230.00 |

*1 N = 102 g

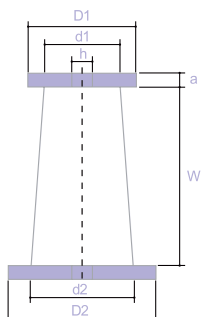
Spool Dimensions for Winding Wires

| Type | Bobbin | Flange Diameter | Barrel Diameter | Inside width | Flange Thickness | Hole Diameter | Maximum Weight of Enamelled Copper Wire per Spool | Maximum Weight of Enamelled Aluminium Wire per Spool |
|------|--------|-----------------|-----------------|--------------|------------------|---------------|---|--|
| | | D (mm) | D (mm) | W (mm) | A (mm) | H (mm) | Kg. | Kg. |



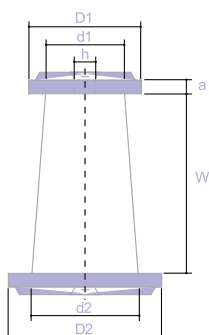
Cylindrical Plastic Spool

| | | | | | | | |
|--------|-----|-----|-----|----|----|----|---|
| GK25 | 265 | 155 | 165 | 15 | 45 | 25 | - |
| DIN160 | 160 | 100 | 128 | 16 | 22 | 7 | - |
| DIN200 | 200 | 125 | 200 | 20 | 22 | 14 | 5 |
| DIN250 | 250 | 160 | 200 | 20 | 22 | 22 | 7 |



Plastic Taper Spool

| | | | | | | | |
|-------|--------------------|--------------------|-----|----|----|----|----|
| PT-4 | D1 12.4 D2 14.0 | d1 7.4 d2 8.6 | 170 | 15 | 26 | 4 | - |
| PT-10 | D1 16.0 D2 18.0 | d1 9.6 d2 11.0 | 200 | 15 | 30 | 10 | 3 |
| PT-15 | D1 18.0 D2 20.0 | d1 9.6 d2 11.0 | 198 | 15 | 30 | 15 | 5 |
| PT-25 | D1 21.5 D2 23.0 | d1 11.0 d2 13.0 | 250 | 15 | 34 | 25 | 7 |
| PT-60 | D1 27.0 D2 30.0 | d1 15.0 d2 18.0 | 350 | 25 | 45 | 60 | 20 |



| | | | | | | | |
|--------|--------------------|--------------------|-----|----|-----|-----|----|
| PT-45 | D1 23.6 D2 25.0 | d1 14.0 d2 16.0 | 335 | 32 | 100 | 40 | 15 |
| PT-100 | D1 30.0 D2 31.5 | d1 18.0 d2 20.0 | 425 | 38 | 100 | 90 | 30 |
| PT-200 | D1 37.5 D2 40.0 | d1 22.4 d2 25.0 | 530 | 50 | 100 | 190 | 60 |
| PT-400 | D1 47.5 D2 50.0 | d1 28.0 d2 31.5 | 670 | 65 | 100 | 400 | - |

Any other specific spool requirements can be met on request

Lined area for notes with horizontal orange lines.

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