MAGNET WIRE
TECHNICAL GUIDE BOOK

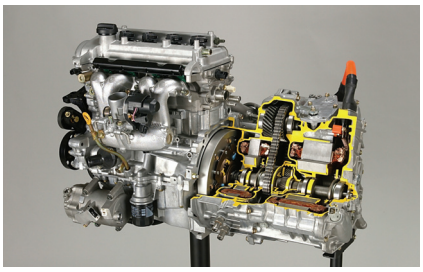
Sumitomo Electric Wintec, Inc.

Contents

1. Examples of Magnet Wire Application

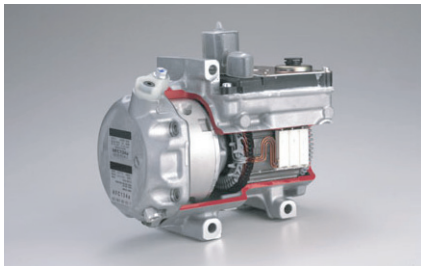
Automotive Electrical Components

Hybrid Car Drive Motor



Alternator

Electrical Compressor Motor



Starter

Ignition Coil

Electronic Power steering Motor

Wiper Motor

Types of Motor

Industrial Motor

Home Appliance Motor

Micro Motor

Types of Coil

Relay Coil

Clutch Coil

Types of Transformer

Power Transformer

Lighting Equipment Transformer

Micro Transformer

2. Magnet Wire Types, Features and Uses

Types	Symbol	Allowable Temperature Index (°C)	Standard Size Range (mm)	Applicable Standard		Characteristics	Main Uses
				JIS JCS	NEMA		
Polyvinyl Formal Enamelled Copper Wire	PVF	105	0.23-3.2	C3202	MW-15C	Good heat and humidity resistance.	Oil-Immersed Transformer
Polyurethane Enamelled Copper Wire	UEW	130	0.02-0.9	C3202	MW-75C	Solderable (380°C)without removing the film.	Electronic Parts of Small-Size Transformers (Small-Size Motor)
Polyurethane-Nylon Enamelled Copper Wire	UEW-N	130	0.08-0.9	C3202	MW-28C	Solderable (380°C) without removing the film. Excellent winding characteristics.	
Solderable Polyester Enamelled Copper Wire	SMPEW	155	0.02-0.9	JCS394		Solderable (400°C) without removing the film. Same thermal shock resistance level as PEW.	
Solderable Polyester-Nylon Enamelled Copper Wire	SMPEW-N	155	0.08-0.9		MW-27C	Solderable (400°C) without removing the film. Excellent winding characteristics.	
Polyester Enamelled Copper Wire	PEW	155	0.06-3.2	C3202		Film can be removed using chemicals.	Multipurpose motor, small-size transformer for electrical components and home appliances (Small-Size Motor)
Polyester-Nylon Enamelled Copper Wire	PEW-N	155	0.08-3.2	JCS393		Film can be removed using chemicals. Excellent winding characteristics, varnish compatibility, and thermal shock resistance compared to PEW.	
Solderable Polyester Imide Enamelled Copper Wire	SMHEIW	180	0.04-0.9		MW-77C	Solderable (460°C-480°C) without removing the film. Excellent thermal shock resistance compared to PEW.	High voltage transformer
Polyester Imide Enamelled Copper Wire	EIW	180	0.07-0.25	C3202	MW-30C	Excellent softening resistance, thermal shock resistance, solvent resistance and styrene resistance. Poor crazing resistance.	Electrical components (Alternator, Small hybrid car drive motor), for refrigerants (air conditioner, refrigerator)
Polyester Imide-Polyamide Imide Enamelled Copper Wire	ATZ-300	200	0.15-3.2	JCS392	MW-35C MW-73C	Excellent winding characteristics, and thermal shock resistance, solvent resistance, and heat/ humidity resistance compared to EIW.	
Highly Adhesive Polyester Imide-Highly Lubricated Polyamide Imide Enamelled Copper Wire	UTZ	200	0.3-1.6		MW-35C MW-73C	Excellent resistance to scrape windability compared to ATZ-300.	
Polyamide Imide Enamelled Copper Wire	AIW	220	0.05-2.4	JCS334	MW-81C	Excellent mechanical strength compared to EIW. Excellent heat and alkali resistance.	
Polyimde Enamelled Copper Wire	PIW	220	0.5-1.3		MW-16C MW-71C	Excellent heat resistance compared to AIW.	Special heat resistance use
Self-bonding Enamelled Copper Wire	Various Types	Various Types	0.04-1.0			Possible to harden the coil without using impregnated varnish. Self-bonding film can be selected based on various insulation films.	Electronic components, electrical components (small motor)
Rectangular Enamelled Copper Wire	Various Types	Various Types	Round Wire Equivalent Diameter: 1.2-2.6			Enables conversion to small-size and high-output by using square wires. Various insulation films can be selected in the same way as round wires.	Electrical components (alternator, hybrid car drive motor)

3. Magnet Wire Selection Criteria

〈Product Selection Criteria〉

Requirement		Related Characteristics		PVF	UEW	UEW-N	SMPEW	SMPEW-N	PEW	PEW-N	SMHEIW	EIW	ATZ-300	UTZ	AIW	PIW
Atmospheric Temperature for Heat Resistance of Device Applicable		Temperature Index	105℃	★												
			130℃		★	★										
			155℃				★	★	★	★						
			180℃								★	★				
			200℃										★	★		
			220℃												★	★
Operating Environment	Water	Heat and humidity resistance		○					×	×	○	○	○	○	○	○
	Oil	Oil-resistance (ATF)		○					×	×	○	○	○	○	○	○
	Solvent	Solvent resistance		○			○	○	○	○	○	○	○	○	○	○
Wire Winding Method	Bobbin Winding	Friction		○	○	○	○	○	○	○	○	○	○	○	○	○
	Flyer Winding	Friction, scratch resistance				○		○		○			○	◎	○	
	Insertion Winding	Friction, scratch resistance				○		○		○			○	◎	○	
	Direct Winding	Friction, scratch resistance				○		○		○			○	◎	○	
Terminal Treatment	Direct Soldering	Solderability		×	○	○	○	○	×	×	○	×	×	×	×	×
	Mechanically Removing			○	○	○	○	○	○	○	○	○	○	○	○	○
	Fusing	Heat resistance (thermal separation)		○	○	○	○	○	○	○	○	○	○	○		
Insulation Treatment	Impregnated Varnish	Solvent resistance		○							○	○	○	○	○	○
	Mold	Softening resistance, hydrolysis resistance		○							○	○	○	○	○	○
	Potting	Softening resistance, solvent resistance									○	○	○	○	○	○
Others	Reliability During Lock	Overload resistance											○	○	○	○
	Refrigerated Environment	Refrigerant resistance											○	○	○	
	Closed Atmosphere (Outgas)	Outgas property											○	○	○	

★: Heat Resistance Temperature Index　◎: Recommended　○: Usable Product (recommended after ◎)　×: Not recommended

〈Film Thickness Selection Criteria〉

・Please consult us concerning the details as it is necessary to take the working voltage and winding process deterioration rate into consideration before determining the film thickness.

4. Magnet Wire Characteristics

4-1. General Winding Wire

Characteristics \ Type (Symbol)			Polyvinyl Formal Enamelled Copper Wire	Polyurethane Enamelled Copper Wire	Polyurethane/ Nylon Enamelled Copper Wire	Polyester Enamelled Copper Wire	Polyester/ Nylon Enamelled Copper Wire
			PVF	UEW	UEW-N	PEW	PEW-N
Heat Resistance Temperature Index			105˚C	130˚C	130˚C	155˚C	155˚C
Dimension	Overall (mm)		1.066	1.066	1.066	1.066	1.066
	Conductor Diameter (mm)		1.000	1.000	1.000	1.000	1.000
	Film Thickness (mm)		0.033	0.033	0.033	0.033	0.033
Thermal Characteristics	Resistance to cut through (˚C)		290	230	230	320	300
	Heat Shock Resistance	Temperature	—	130˚C	130˚C	150˚C	150˚C
		Time	—	1hr	1hr	1hr	1hr
		Mandrel	—	1d ok	1d ok	2d ok	1d ok
Mechanical Characteristics	Flexibility		Good	Good	Good	Good	Good
	Adhesion		Good	Good	Good	Good	Good
	Abrasion Resistance (N)		13.0	12.9	13.7	12.7	13.7
	Static Friction Coefficient		0.12	0.12	0.05	0.10	0.05
Electrical Characteristics	Pinhole		0	0	0	0	0
	Dielectric Breakdown (kV)		11.5	11.5	11.5	11.5	11.5
Chemical Characteristics	Solderability	Solder Temperature	No	380˚C	380˚C	No	No
		Time		2 Seconds	2 Seconds		
	Solvent Resistance		4H	4H	4H	4H	5H
	Chemical Resistance		5H	5H	5H	5H	5H

The characteristic value is an example of the measured value and not a guaranteed value. (Type 1 : 1.0 mm)

4. Magnet Wire Characteristics

4-2. Solderable Winding Wire

Characteristics \ Type (Symbol)			Polyurethane Enamelled Copper Wire	Polyurethane/ Nylon Enamelled Copper Wire	Solderable Polyester Enamelled Copper Wire	Solderable Polyester /Nylon Enamelled Copper Wire	Solderable Polyester-Imide Enamelled Copper Wire
			UEW	UEW-N	SMPEW	SMPEW-N	SMHEIW
Heat Resistance Temperature Index			130˚C	130˚C	155˚C	155˚C	180˚C
Dimension	Overall (mm)		0.378	0.378	0.378	0.378	0.378
	Conductor Diameter (mm)		0.350	0.350	0.350	0.350	0.350
	Film Thickness (mm)		0.014	0.014	0.014	0.014	0.014
Thermal Characteristics	Resistance to cut through (˚C)		230	230	250	250	290
	Heat Shock Resistance	Temperature	130˚C	130˚C	150˚C	150˚C	180˚C
		Time	1hr	1hr	1hr	1hr	1hr
		Elongation	10% ok	10% ok	10% ok	10% ok	20% ok
Mechanical Characteristics	Flexibility		Good	Good	Good	Good	Good
	Adhesiveness		Good	Good	Good	Good	Good
	Abrasion Resistance (N)		5.0	5.0	5.0	5.0	5.0
	Static Friction Coefficient		0.12	0.05	0.10	0.05	0.10
Electrical Characteristics	Pinhole		0	0	0	0	0
	Dielectric Breakdown (kV)		7.0	7.0	7.0	7.0	7.0
Chemical Characteristics	Solderability	Solder Temperature	380˚C	380˚C	400˚C	400˚C	470˚C
		Time	1 Second	1 Second	1 Second	1 Second	5 Second
	Solvent Resistance		4H	4H	5H	5H	5H
	Chemical Resistance		5H	5H	5H	5H	5H

The characteristic value is an example of the measured value and not a guaranteed value.

(Type 2 : 0.35 mm)

4. Magnet Wire Characteristics

4-3. Heat-resistance Winding Wire

Characteristics \ Type (Symbol)			Polyester-Imide/ Polyamide-Imide Enamelled Copper Wire	Highly Adhesive Polyester-Imide/ Highly Lubricated Polyamide-Imide Enamelled Copper Wire	Polyamide-Imide Enamelled Copper Wire	Polyamide Enamelled Copper Wire
			ATZ-300	UTZ	AIW	PIW
Heat Resistance Temperature Index			200˚C	200˚C	220˚C	220˚C
Dimension	Overall (mm)		1.066	1.066	1.066	1.066
	Conductor Diameter (mm)		1.000	1.000	1.000	1.000
	Film Thickness (mm)		0.033	0.033	0.033	0.033
Thermal Characteristics	Resistance to cut through (˚C)		420	420	450	500 and above
	Heat Shock Resistance	Temperature	200˚C	200˚C	220˚C	300˚C
		Time	1hr	1hr	1hr	1hr
		Mandrel	1d ok	1d ok	1d ok	1d ok
	Dielectric Breakdown (kV) After Deterioration	220˚C/168hr	9.3	9.3	9.6	11.3
		240˚C/168hr	8.5	8.5	8.8	10.9
		280˚C/168hr	1.3	1.3	7.9	10.4
Mechanical Characteristics	Flexibility		Good	Good	Good	Good
	Adhesion		Good	Good	Good	Good
	Abrasion Resistance (N)		15.7	18.6	17.6	11.8
	Static Friction Coefficient		0.10	0.05	0.10	0.10
Electrical Characteristics	Pinhole		0	0	0	0
	Dielectric Breakdown (kV)		11.5	11.5	11.5	11.5
Chemical Characteristics	Solderability		No	No	No	No
	Solvent Resistance		6H	6H	6H	5H
	Chemical Resistance		6H	6H	6H	5H

The characteristic value is an example of the measured value and not a guaranteed value.

(Type 1 : 1.0mm)

4. Magnet Wire Characteristics

4-4. Scrape-resistance Winding Wire

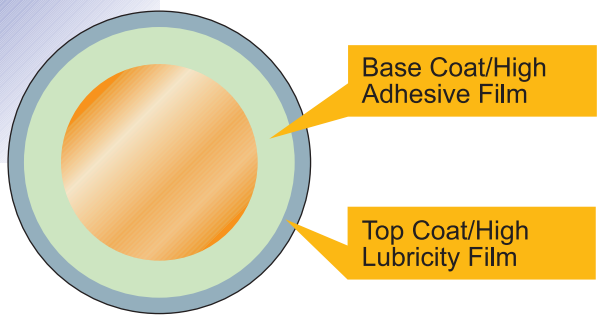
Characteristics \ Type (Symbol)			Highly Adhesive Polyester-Imide/ Highly Lubricated Polyamide-Imide Enamelled Copper Wire	Polyamide-Imide/Highly Lubricated Polyamide-Imide Enamelled Copper Wire	Highly Adhesive Polyamide-Imide/ Highly Lubricated Polyamide-Imide Enamelled Copper Wire
			UTZ	SLAIW	UAIW
Heat Resistance Temperature Index			200°C	220°C	220°C
Dimension	Overall (mm)		1.066	1.066	1.066
	Conductor Diameter (mm)		1.000	1.000	1.000
	Film Thickness (mm)		0.033	0.033	0.033
Thermal Characteristics	Resistance to cut through (°C)		420	450	450
	Heat Shock Resistance	Temperature	200°C	220°C	220°C
		Time	1hr	1hr	1hr
		Mandrel	1d ok	1d ok	1d ok
	Dielectric Breakdown (kV) After Deterioration	220°C/168hr	9.3	9.6	9.6
		240°C/168hr	8.5	8.8	8.8
		280°C/168hr	1.3	7.9	7.9
Mechanical Characteristics	Flexibility		Good	Good	Good
	Adhesion		Good	Good	Good
	Abrasion Resistance (N)		18.6	17.6	18.6
	Static Friction Coefficient		0.05	0.05	0.05
Electrical Characteristics	Pinhole (pcs)		0	0	0
	Dielectric Breakdown (kV)		11.5	11.5	11.5
Chemical Characteristics	Solderability		No	No	No
	Solvent Resistance		6H	6H	6H
	Chemical Resistance		6H	6H	6H

The characteristic value is an example of the measured value and not a guaranteed value.

(Type 1 : 1.0mm)

5. Scrape-resistance Winding Wire (Characteristics/Features)

Structure



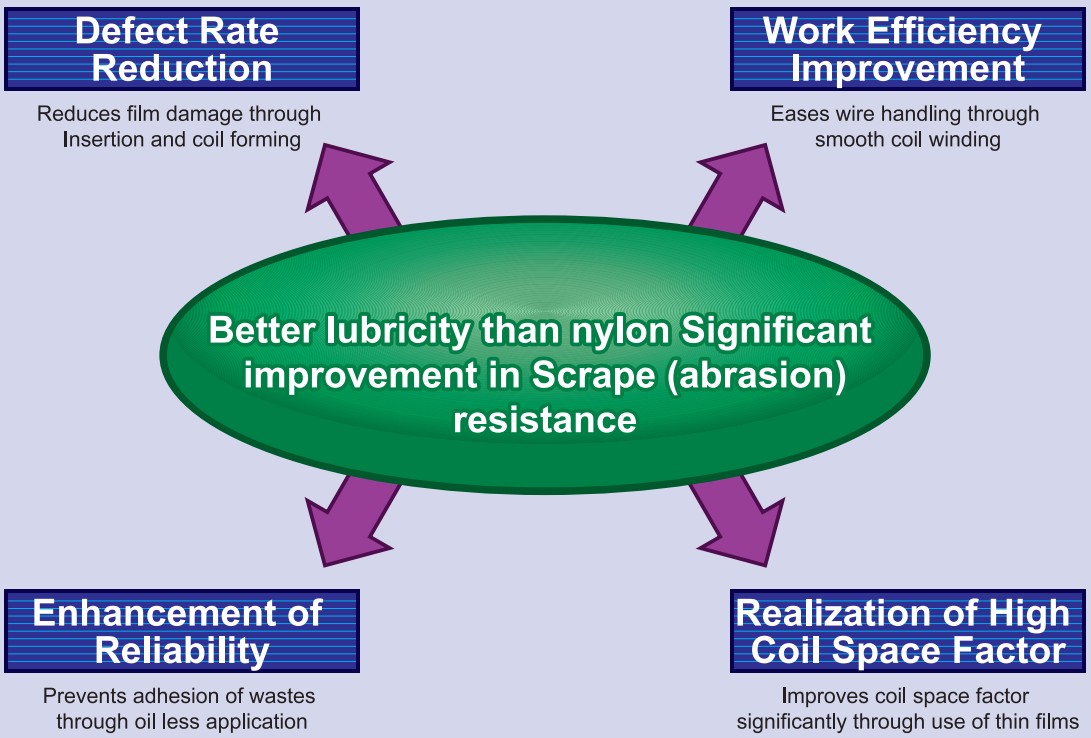
Thermal Class	200˚C	220˚C
Type	UTZ	UAIW
Base Coat	High Adhesive Polyester-imide	High Adhesive Polyamide-imide
Top Coat	High Lubricity Polyamide-imide	High Lubricity Polyamide-imide

Application Examples

- Drive motor for hybrid cars
- Electric power steering motor
- Electric fan motor

Features

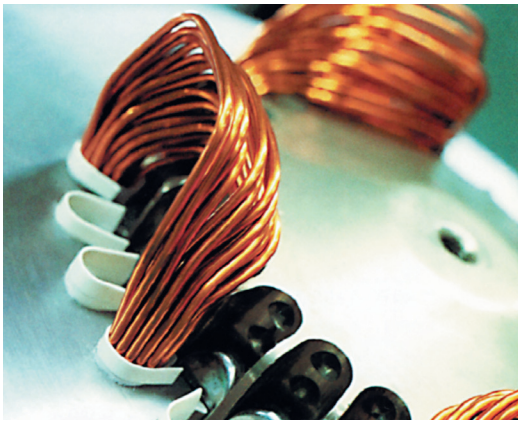
- Possesses excellent lubricity and abrasion resistance, enables coil miniaturization, and a high coil space factor.
- Further enhances work efficiency, reduces defect rate, and also contributes to reduction of coil processing costs.



5. Scrape-resistance Winding Wire (Characteristics/Features)

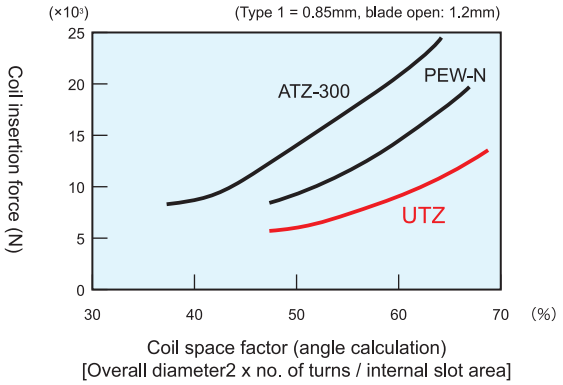
Features

1. Excellent Lubricity



The 30 mm x 100 mm coil is produced using a wire winding machine. The four coil poles are inserted simultaneously into the stator core, and the maximum insertion force is measured using the insertion test machine.

Coil insertion force during the insertion test



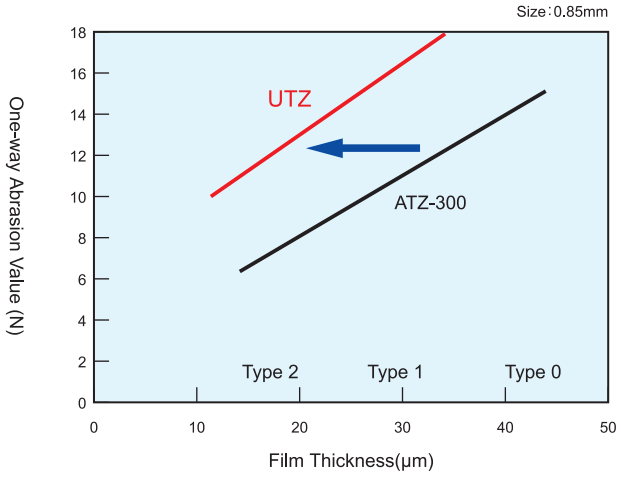
2. Excellent Abrasion Resistance

Film thickness for type 1 has the same or higher uni Scrape resistance intensity than type 0, whereas type 2 has the same or higher uni Scrape resistance intensity than type 1.

Thinner film

than existing products!

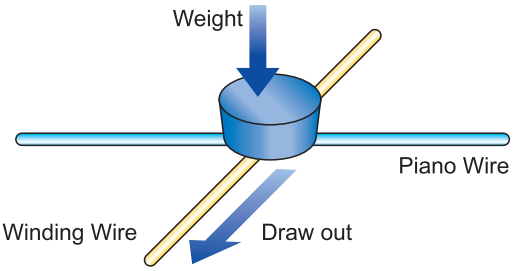
Relationship between film thickness and abrasion resistance



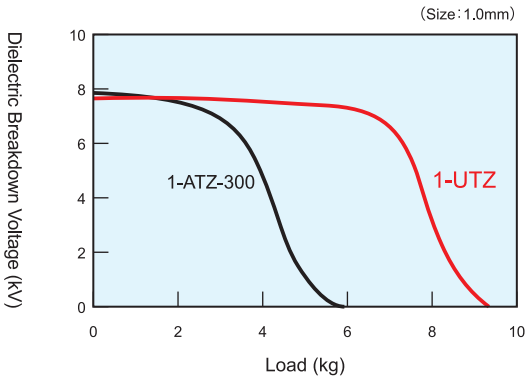
5. Scrape-resistance Winding Wire (Characteristics/Features)

3. Significant Improvement in Film Shear Strength

Place piano wire of 1.0mm in diameter across the 1m winding wire and place a weight on the intersection of the wires. Pull the winding wire by 5cm to cause deterioration, measure the dielectric breakdown voltage into glycerin water bath.



Dielectric Breakdown Voltage After Deterioration Via Wire Treatment



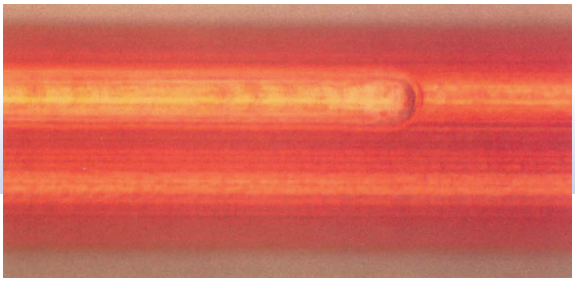
4. Significant Improvement in Repeated Abrasion Resistance

Repeated Scrape (old JIS method) test

Observe the winding wire surface after scrape 100 times with needle (load: 600g, diameter: 0.4mm).

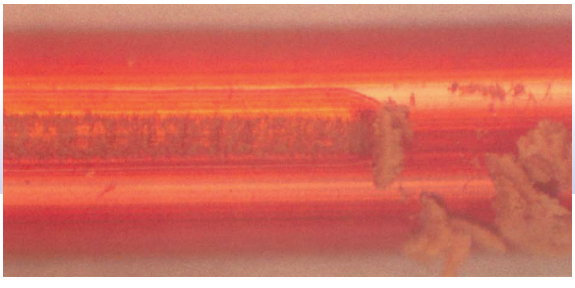
1-UTZ 1.0mm

The winding wire surface maintains its smoothness.



1-ATZ-300 1.0mm

Insulation film scrape off.



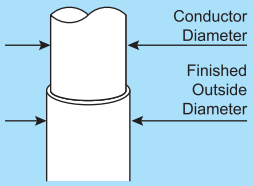
6. Magnet Wire Testing Method

6-1. Dimension

Measurements for the overall, conductor diameter and film thickness are indicated. The following types are available based on the film thickness.

Type 0: Thickest film
Type 1: Thick film
Type 2: Thin film
Type 3: Thinnest film

Summary of Test Method



Obtain the average diameter value by measuring at three different points that are almost at the same angle to the plane perpendicular to the conductor axis. The film thickness will be half of the difference between the overall and conductor diameter.

For details, please refer to item 5 of “Enamelled Wire Testing Method: JIS C 3003.”

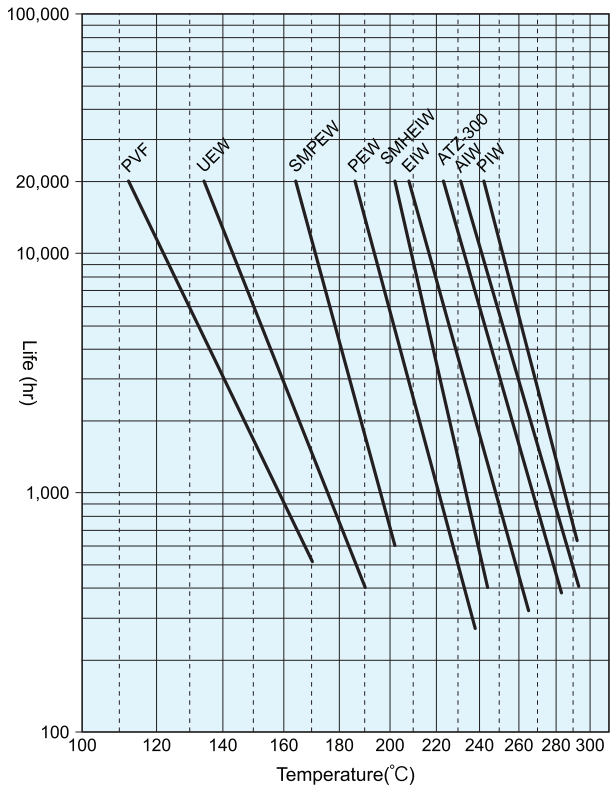
6-2. Thermal Characteristics

1)Heat Resistance Life

When selecting a winding wire for use with a device, first select the winding wire with a temperature index that meets the heat resistance of the device.
Temperature index can be calculated from the thermal life.
The testing method for heat resistance life is ASTM D2307. The heat resistance class and temperature index often used are classified in the following table.

Heat Resistance	Temperature
Y	90˚C
A	105˚C
E	120˚C
B	130˚C
F	155˚C
H	180˚C
200	200˚C
220	220˚C
250	250˚C

Heat Resistance Life of Various Winding Wires



2)Heat Shock Resistance

Heat shock resistance is used to check if crack occurs when heated under a condition where the film is being stressed by stretching or bending.
Normally, winding wire with a high heat resistance does not crack even under a high heating temperature.
Please note that the insulation may crack due to heat during the operation of an electrical device if it was wound on small mandrel or elongated greatly.

Stretch the test specimen to the specified elongation rate or wind the wire by 10 turns of the specified diameter ratio to tighten it, followed by checking if there is any film crack after heating it under the specified temperature and time.

For details, please refer to item 20 of “Enamelled Wire Testing Method: JIS C 3003.”

6. Magnet Wire Testing Method

3)Resistance to cut through

Resistance to cut through is used to check the temperature at which the film softens.
The winding wire wrapped around the electrical equipment experiences increased voltage depending on tension and molding during wire winding process. Heating under such conditions softens the film, and may lead to short circuit.
For electrical equipment with high allowable maximum temperatures, products with softening-resistance of high temperatures are used.
For electrical equipment with resin molding, products with softening-resistance of high temperature are necessary depending on the mold-parameters.

Stack two test specimens perpendicularly (forming a right angle) on a flat plate, put specified weight on its intersection, and raise the temperature in oven at 2˚C per minute.
Run 100V of voltage between both lines and measure the temperature when the film-softens and electrical conduction occurs.

For details, please refer to item 11 of “Enamelled Wire Testing Method: JIS C 3003.”

6-3. Electrical Characteristics

1)Pinhole

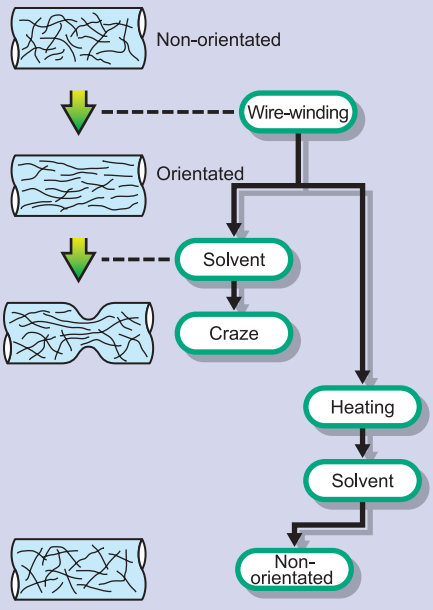
Pinhole is a method to check electrical defects such as tiny holes in the film.
The winding wire is insulated using the thin film.
Depending on the film type, pinhole may occur due to crazing when the pinhole test is performed after wire winding.

Check the number of pinholes that occur on wire when adding 12V of direct voltage for one minute. The liquid is positive pole and the test specimen is a negative pole. After soaking the wire with specified length (around 5m) into saline solution.

For details, please refer to item 6 of “Enamelled Wire Testing Method: JIS C 3003.”

※Crazing Phenomenon

Winding wire on electrical equipment will result in elongation of the wire due to bending or tension, and hence stress on the film.
This stress results in molecular chain orientation of the entire film.
When the wire comes into contact with water or solvent in this state, orientational concentration and relaxation due to local yielding occurs, which results in crazing. Performing the pinhole test when crazing occurs causes the crazed parts to become pinholes, hence losing their insulation properties.
Normally, heating PVF and UEW series at 125˚C and EIW series at 150˚C for ten minutes or more (differs according to the size and form of equipment) helps to remove stress from the film and prevent crazing.



State of molecular chain on winding wire film before winding.

Orientation takes place.

Contact with the solvent accelerates partial orientation dramatically and crazing occurs.
Other parts are restored to the non-oriented state.

Performing heating before contact with solvent helps to restore the orientation.
Contact with alcohols or amides also prevents crazing from occurring.

6. Magnet Wire Testing Method

2)Dielectric Breakdown Voltage

Dielectric breakdown voltage is used to check the insulation performance of films, thus it differs according to the film thickness of the winding wire. Normally, two-piece method is used, but metal cylinder method is used in the case of small wires.
Dielectric breakdown voltage shows a high value as the film becomes thicker. It is necessary to examine the film thickness based on the line voltage and inter-phase voltage of electrical equipment.

In the two-piece method, twist a 12cm-length test specimen according to the specified number of twists, apply an alternating voltage between the lines and increase the voltage at 500V per second to find the voltage when breakdown occurs.

For details, please refer to item 10 of “Enamelled Wire Testing Method: JIS C 3003.”

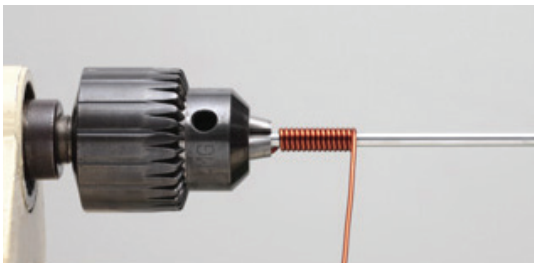
6-4. Mechanical Characteristics

1)Flexibility

Flexibility test is used for determining whether film crack occurs when the winding wire is bent, also is evaluated based on elongation or winding. Normally, crack does not occur in self-diameter coiling.

For 0.35mm and below, stretch the test specimen up to the specified value and check for cracks using a 15x magnifying glass.
For 0.37 mm and above, wind tightly 10 turns of the specified winding diameter, followed by checking visually for cracks.

For details, please refer to item 7 of “Enamelled Wire Testing Method: JIS C 3003.”



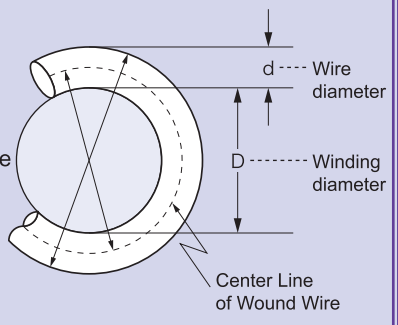
※Film elongation rate during wire winding

When the external film is stretched during wire winding, the values are as follow:

Winding diameter	Elongation of external film
Single diameter	50%
Double diameter	33%
Triple diameter	25%

Assuming that the center point is hardly stretched when wire is wound, the external film elongation of the wound wire is shown using the formula below:

$$\text{External film elongation (\%)} = \left[\frac{\pi(D+2d)}{\pi(D+d)} - 1\right] \times 100 = \left[\frac{d}{D+d}\right] \times 100$$



In other words, during double-diameter winding, D=2d.

$$\frac{d}{2d+d} \times 100 = \frac{1}{3} \times 100 \fallingdotseq 33\%$$

6. Magnet Wire Testing Method

2)Adhesion

Adhesiveness is used for investigating whether the adhesion between the film and conductor is maintained. When adhesion is poor, the film may peel off due to stress during wire winding.

When the test specimen is stretched at a tension speed of around 4m/s until it breaks, check whether film crack is found using a 15x magnifying glass.

For details, please refer to item 8 of “Enamelled Wire Testing Method: JIS C 3003.”

3)Abrasion Resistance

Abrasion resistance is used to investigate the amount of force needed to apply on the film in order to break it.
This is an index of the film’s strength against stress during wire winding.

Place the piano wire with a diameter of 0.23mm perpendicularly to the test specimen, and add load on the piano wire.
While moving the piano wire in the direction of the test specimen’s length at a speed of 400mm/min, add the load at the same time, determine the weight when the film peels off and when the conductor comes into contact with the piano wire.

For details, please refer to item 9 of “Enamelled Wire Testing Method: JIS C 3003.”

4)Coefficient of Static Friction

Coefficient of static friction indicates the smoothness of film surface.
The static friction coefficient (slip properties) of winding wires largely affects the wire winding properties on electrical equipment.
With the requirement in equipment miniaturization and efficiency, it will become more important to wind a larger amount of wire into a smaller space to enhance the space factor.

Stretch two wires across the mirror plate, place the slider where two wires are stretched across these wires such that wire perpendicularly intersect each other. Tilt the mirror plate gradually until the slider slides off and find the tan θ value of the inclination when this occurs.

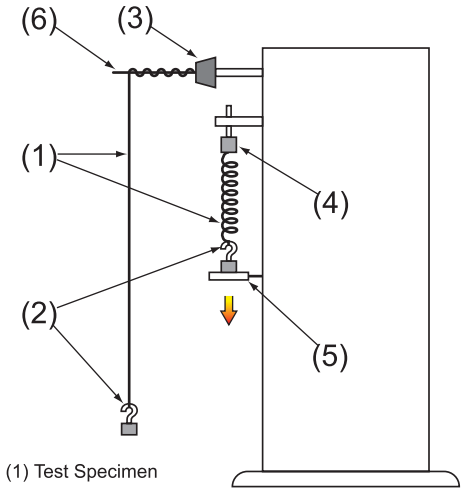
5)Softness

The winding wire softness largely affects the wire winding properties in electrical equipment. The softness index of winding wire applies elongation, spring elongation and springback.

(1) Elongation
Elongation indicates the increase in length in percentage against the original length.
Stretch the linear test specimen with gauge length of 200-250mm using a stretch test machine or pull test machine at the speed of 5±1mm/s until the conductor breaks. Calculate in percentage the increased length until breakage with respect to the original length.

For details, please refer item 18 of “Enamelled Wire Testing Method: JIS C 3003.”

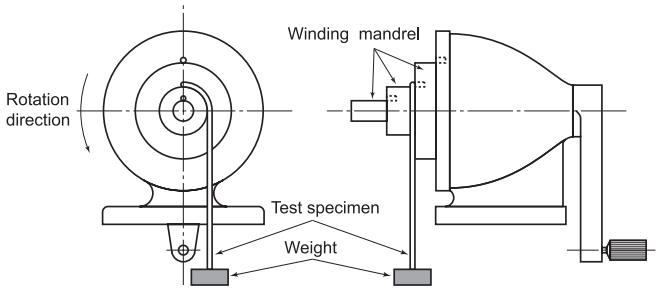
6. Magnet Wire Testing Method



(1) Test Specimen
(2) Weight
(3) Horizontal axis check
(4) Vertical axis check
(5) Supporting base
(6) Winding mandrel

(2) Spring Elongation
Take a test specimen with a length of around 1.2m, hang a 700g weight per cross sectional area of the conductor (mm2) with a center length of 1m. While making a coil on a winding mandrel with a diameter that is 10 times the conductor diameter. Measure the coil's length L1 (mm).
Fix one end of the coil, attach a 700g weight per cross section area of the conductor (mm2), and place it on the support base without stretching the coil.
Lower the support base at a speed of 50mm/s. After the weight is separated from the base, leave it intact for one minute. Remove the weight from the test coil, followed by measuring the coil length L2 (mm) after leaving it intact for one minute.
Calculate the spring elongation value using:
$\triangle L = L2 - L1$

For details please refer to item 19 of "Enamelled Wire Testing Method: JIS C 3003."



Conductor Diameter (mm)	Winding Mandrel Diameter (mm)	Weight Mass (g)
0.25～0.37	19	57
0.40～0.45	48	57
0.50～0.75	48	115
0.80～1.6	82	455

(3) Springback
Wind a test specimen with a length of about 1m to the winding mandrel on springback tester, with prescribed diameter at a rotation speed of 5-10 times/min. Press down one end of the coil after winding, release the other end slowly and read amplitude of the return from scale of springback tester.

For details please refer to item 19 of "Enamelled Wire Testing Method: JIS C 3003."

6-5. Chemical Characteristics

1)Solvent Resistance

Solvent resistance is used for investigating whether film swelling occurs when the wire is soaked in xylene. If the film is attacked by an organic solvent containing impregnating varnish during varnish treatment after winding, insulation performance may deteriorate.

After soaking the test specimen for 30 minutes in xylene at 60°C, take out the specimen and check whether there is any bubble, swelling on the film, and whether there is peeling using the squeeze method or pencil method.

For details please refer to item 13 of "Enamelled Wire Testing Method: JIS C 3003."

2)Chemical Resistance

Chemical resistance is used for investigating whether the film is attacked by alkali or acid. Insulation performance may deteriorate due to damage caused by the alkali or acid in the electrical equipment's operating environment.

Soak the test specimen for 24 hours at room temperature in chemicals (caustic soda, sulfuric acid) with the prescribed concentration. Check whether there is any bubbles or swelling of the film, and whether there is peeling using the squeeze method or pencil method.

6. Magnet Wire Testing Method

3)Solderability

Solderability is used for investigating whether soldering is possible under the prescribed temperature and time without peeling of film.

Dip 40mm of test specimen into solder bath, which is maintained at prescribed temperature, and leave it for the prescribed period of time. Upon taking the specimen out, check whether solder is attached uniformly to the dipped portion, excluding the top 10mm.

For details please refer item 14 of “Enamelled Wire Testing Method: JIS C 3003.”

4)Refrigerant Resistance

Winding wires used in refrigerating machines must maintain insulation performance against refrigerant and refrigerating oil, and must not allow leakage of extracts from electrical wires into the refrigerant.

Put the test specimen in an airtight pressure container together with the refrigerant and refrigeration oil. After heating under the specified temperature and time, take it out and check the characteristics of the wire.

For details please refer to item 16 of “Enamelled Wire Testing Method: JIS C 3003.”

5)Resistance to humidity

Resistance to humidity is used for investigating whether insulation performance of the film deteriorates due to hydrolysis.

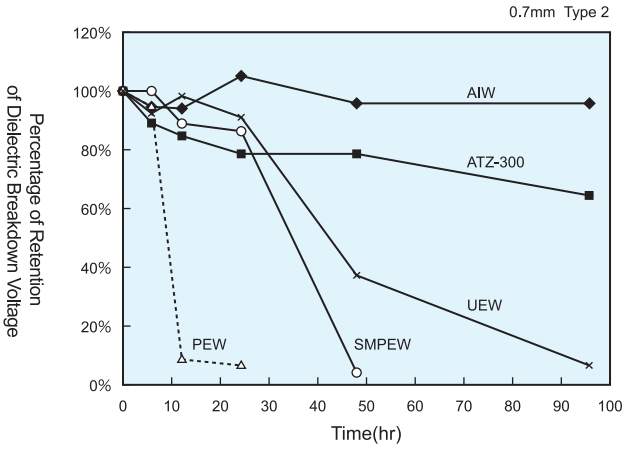
When electrical equipment is used under high temperature and humidity, hydrolysis occurs, which deteriorates insulation performance. Care is required as PEW is susceptible to hydrolysis.

Changes in insulation performance due to hydrolysis of the main winding wires are shown in the right graph.

The test specimen and 0.2Vol% of water are placed in an airtight container, and the dielectric breakdown voltage after heating at 150˚C is measured.

Put the test specimen and the specified quantity of water into the airtight pressure container. Perform heating under the specified temperature and time (e.g. 150˚C for 24 hours) and measure the dielectric breakdown voltage or insulation resistance.

Changes in Insulation Performance due to Hydrolysis



7. Safe Winding Wire Tension

The normal safety tension standard for copper wire is when the value of permanent set exceeds 0.2% (0.2% yield point).
As the 0.2% yield point of copper wire (soft copper wire) is about 69N/mm^2, make sure the tension during wire winding is below the safe tension to prevent deterioration of wire performance.
The tensible force of copper wire (soft copper wire) is around 250N/mm^2, thus a force larger than this will break the wire.

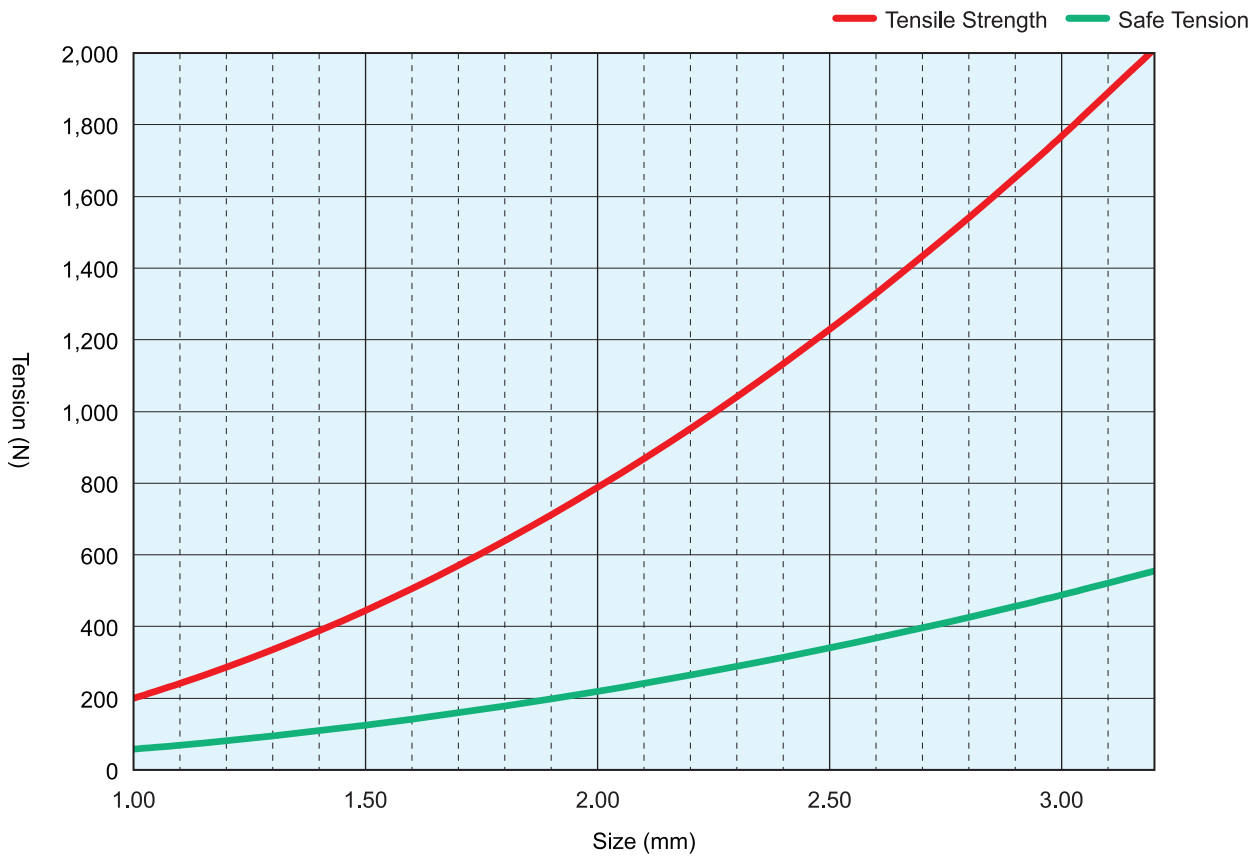
Safe Winding Wire Tension List

Size (mm)	Tension (N)	
	Safe Tension	Tensile Strength
0.020	0.022	0.079
0.025	0.034	0.12
0.030	0.049	0.18
0.035	0.066	0.24
0.040	0.086	0.31
0.05	0.13	0.49
0.06	0.19	0.71
0.07	0.26	0.96
0.08	0.35	1.3
0.09	0.44	1.6
0.10	0.54	2.0
0.11	0.65	2.4
0.12	0.78	2.8
0.13	0.91	3.3
0.14	1.1	3.8
0.15	1.2	4.4
0.16	1.4	5.0
0.17	1.6	5.7
0.18	1.7	6.4
0.19	1.9	7.1
0.20	2.2	7.9
0.21	2.4	8.7
0.22	2.6	9.5
0.23	2.9	10.4
0.24	3.1	11.3
0.25	3.4	12.3
0.26	3.6	13.3
0.27	3.9	14.3
0.28	4.2	15.4
0.29	4.5	16.5
0.30	4.9	17.7
0.32	5.5	20.1
0.35	6.6	24.1
0.37	7.4	26.9

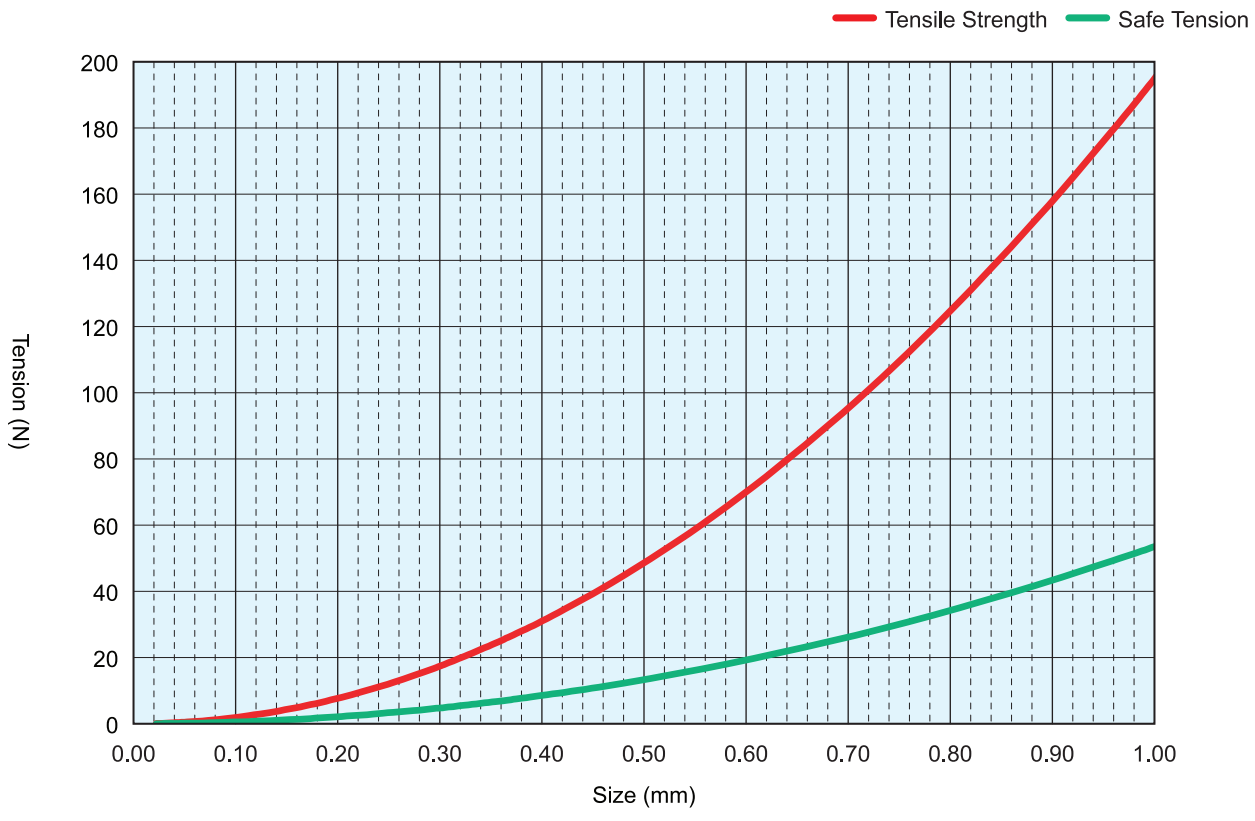
Size (mm)	Tension (N)	
	Safe Tension	Tensile Strength
0.40	8.6	31.4
0.45	10.9	39.8
0.50	13.5	49.1
0.55	16.3	59.4
0.60	19.4	70.7
0.65	22.8	83.0
0.70	26.4	96.2
0.75	30.3	110
0.80	34.5	126
0.85	39.0	142
0.90	43.7	159
0.95	48.7	177
1.0	53.9	196
1.1	65.2	238
1.2	77.6	283
1.3	91.1	332
1.4	106	385
1.5	121	442
1.6	138	503
1.7	156	567
1.8	175	636
1.9	195	709
2.0	216	785
2.1	238	866
2.2	261	950
2.3	285	1,039
2.4	311	1,131
2.5	337	1,227
2.6	364	1,327
2.7	393	1,431
2.8	423	1,539
2.9	453	1,651
3.0	485	1,767
3.2	552	2,011

7. Safe Winding Wire Tension

Safe Tension By Size (1.0～3.2mm)



Safe Tension By Size (1.0mm and below)



8. Dimension Table

Size (mm)	Conductor allowance (mm)		Type 0		Type 1			Type 2		Type 3		Maximum conductor resistance (Ω/km) 20℃	
			Minimum film thickness (mm)	Maximum Overall diameter (mm)	Minimum film thickness (mm)	Maximum Overall diameter (mm)	Approximate mass (kg/km)	Minimum film thickness (mm)	Maximum Overall diameter (mm)	Minimum film thickness (mm)	Maximum Overall diameter (mm)		
	Type 0, 1	Type 2, 3										Type 0/1	Type 2/ 3
0.020		±0.002						0.003	0.030	0.002	0.028		69850
0.025		±0.002						0.003	0.037	0.002	0.034		42780
0.030		±0.002						0.003	0.044	0.002	0.040		28870
0.040		±0.002						0.003	0.056	0.002	0.052		15670
0.050		±0.003						0.004	0.069	0.003	0.064		10240
0.060		±0.003						0.004	0.081	0.003	0.075		6966
0.070		±0.003						0.004	0.091	0.003	0.085		4990
0.080		±0.003						0.005	0.103	0.003	0.097		3778
0.090		±0.003						0.005	0.113	0.003	0.107		2959
0.10	±0.008	±0.003	0.016	0.156	0.009	0.140	0.077	0.005	0.125	0.003	0.118	2647	2381
0.11	±0.008	±0.003	0.016	0.166	0.009	0.150	0.092	0.005	0.135	0.003	0.128	2153	1957
0.12	±0.008	±0.003	0.017	0.180	0.010	0.162	0.11	0.006	0.147	0.004	0.139	1786	1636
0.13	±0.008	±0.003	0.017	0.190	0.010	0.172	0.13	0.006	0.157	0.004	0.149	1505	1389
0.14	±0.008	±0.003	0.017	0.200	0.010	0.182	0.15	0.006	0.167	0.004	0.159	1286	1193
0.15	±0.008	±0.003	0.017	0.210	0.010	0.192	0.17	0.006	0.177	0.004	0.169	1111	1037
0.16	±0.008	±0.003	0.018	0.222	0.011	0.204	0.19	0.007	0.189	0.005	0.181	969.5	908.8
0.17	±0.008	±0.003	0.018	0.232	0.011	0.214	0.21	0.007	0.199	0.005	0.191	853.5	803.2
0.18	±0.008	±0.003	0.019	0.246	0.012	0.226	0.24	0.008	0.211	0.005	0.202	757.2	715.0
0.19	±0.008	±0.003	0.019	0.256	0.012	0.236	0.27	0.008	0.221	0.005	0.212	676.2	640.6
0.20	±0.008	±0.003	0.019	0.266	0.012	0.246	0.30	0.008	0.231	0.005	0.222	607.6	577.2
0.21	±0.008	±0.003	0.019	0.276	0.012	0.256	0.32	0.008	0.241	0.005	0.232	549.0	522.8
0.22	±0.008	±0.004	0.019	0.286	0.012	0.266	0.36	0.008	0.252	0.005	0.243	498.4	480.1
0.23	±0.008	±0.004	0.020	0.298	0.013	0.278	0.39	0.009	0.264	0.006	0.255	454.5	438.6
0.24	±0.008	±0.004	0.020	0.308	0.013	0.288	0.42	0.009	0.274	0.006	0.265	416.2	402.2
0.25	±0.008	±0.004	0.020	0.318	0.013	0.298	0.46	0.009	0.284	0.006	0.275	382.5	370.2
0.26	±0.010	±0.004	0.020	0.330	0.013	0.310	0.49	0.009	0.294	0.006	0.285	358.4	341.8
0.27	±0.010	±0.004	0.020	0.340	0.013	0.320	0.53	0.009	0.304	0.006	0.295	331.4	316.6
0.28	±0.010	±0.004	0.020	0.350	0.013	0.330	0.57	0.009	0.314	0.006	0.305	307.3	294.1
0.29	±0.010	±0.004	0.020	0.360	0.013	0.340	0.61	0.009	0.324	0.006	0.315	285.7	273.9
0.30	±0.010	±0.005	0.021	0.374	0.014	0.352	0.66	0.010	0.337	0.007	0.327	262.9	254.0
0.32	±0.010	±0.005	0.021	0.394	0.014	0.372	0.74	0.010	0.357	0.007	0.347	230.0	222.8
0.35	±0.010	±0.005	0.021	0.424	0.014	0.402	0.89	0.010	0.387	0.007	0.377	191.2	185.7
0.37	±0.010	±0.005	0.022	0.446	0.014	0.424	0.99	0.010	0.407	0.007	0.397	170.6	165.9
0.40	±0.010	±0.005	0.023	0.480	0.015	0.456	1.16	0.011	0.439	0.007	0.429	145.3	141.7
0.45	±0.010	±0.006	0.024	0.532	0.016	0.508	1.46	0.011	0.490	0.007	0.479	114.2	112.1
0.50	±0.010	±0.006	0.025	0.586	0.017	0.560	1.80	0.012	0.542	0.008	0.531	91.43	89.95
0.55	±0.020	±0.006	0.025	0.646	0.017	0.620	2.17	0.012	0.592	0.008	0.581	78.15	74.18
0.60	±0.020	±0.008	0.026	0.698	0.017	0.672	2.58	0.012	0.644	0.008	0.632	65.26	62.64
0.65	±0.020	±0.008	0.027	0.752	0.018	0.724	3.02	0.012	0.694			55.31	53.26
0.70	±0.020	±0.008	0.028	0.804	0.019	0.776	3.50	0.013	0.746			47.47	45.84
0.75	±0.020	±0.008	0.030	0.860	0.020	0.830	4.02	0.014	0.798			41.19	39.87
0.80	±0.020	±0.010	0.031	0.914	0.021	0.882	4.57	0.015	0.852			36.08	35.17
0.85	±0.020	±0.010	0.032	0.966	0.022	0.934	5.16	0.015	0.904			31.87	31.11
0.90	±0.020	±0.010	0.033	1.020	0.023	0.986	5.78	0.016	0.956			28.35	27.71
0.95	±0.020	±0.010	0.034	1.072	0.024	1.038	6.43	0.017	1.008			25.38	24.84
1.0	±0.030	±0.012	0.036	1.138	0.025	1.102	7.13	0.017	1.062			23.33	22.49
1.1	±0.030		0.037	1.242	0.026	1.204	8.62					19.17	
1.2	±0.030		0.037	1.342	0.026	1.304	10.24					16.04	
1.3	±0.030		0.039	1.448	0.027	1.408	12.01					13.61	
1.4	±0.030		0.039	1.548	0.027	1.508	13.91					11.70	
1.5	±0.030		0.041	1.654	0.028	1.612	15.96					10.16	
1.6	±0.030		0.041	1.754	0.028	1.712	18.14					8.906	
1.7	±0.030		0.042	1.856	0.029	1.814	20.47					7.871	
1.8	±0.030		0.042	1.956	0.029	1.914	22.93					7.007	
1.9	±0.030		0.044	2.062	0.030	2.018	25.54					6.278	
2.0	±0.030		0.044	2.162	0.030	2.118	28.29					5.656	
2.1	±0.030		0.045	2.266	0.031	2.220	31.18					5.123	
2.2	±0.030		0.046	2.368	0.032	2.322	34.21					4.662	
2.3	±0.030		0.046	2.468	0.032	2.422	37.37					4.260	
2.4	±0.030		0.048	2.574	0.033	2.526	40.68					3.908	
2.5	±0.030		0.049	2.678	0.034	2.628	44.13					3.598	
2.6	±0.030		0.049	2.778	0.034	2.728	47.72					3.324	
2.7	±0.030		0.049	2.878	0.034	2.828	51.44					3.079	
2.8	±0.030		0.049	2.978	0.034	2.928	55.30					2.861	
2.9	±0.030		0.049	3.078	0.034	3.028	59.30					2.665	
3.0	±0.030		0.049	3.178	0.034	3.128	63.44					2.489	
3.2	±0.040		0.049	3.388	0.034	3.338	72.13					2.198	

9. Precautions When Using Magnet Wire

9-1. Precautions during Magnet Wire Storage

(1) Store inside a well-ventilated room. Avoid places with direct sunlight, especially high temperatures and high humidity.
Do not place directly on the floor. Create a space of around 10cm such as by using a pallet.

(2) Keep the wire away from specialty gases (chlorine gas, organic solvents, acids, or alkali chemicals), dust, and all types of metal powder.

(3) Do not throw, drop or roll the wire.

(4) Winding wire can be used for long periods of time if they are properly stored. It is recommended that checks be conducted on the characteristics of products that have been stored for two or more years before using them.

Condensation might occur in the winding-wire surface, resulting in characteristic deterioration.

There is a possibility where spool breaks, causing scratches on the flange and winding wire.

9-2. Precautions during Wire Winding

(1) **Check the wire appearance.**
Although the products have been inspected before delivery, damages might occur during transportation or storage. Please check again before using.

(2) **Minimize stretching of the wire during winding.**
When winding wires are stretched, the film becomes thinner, and this results in deterioration of their electrical and mechanical characteristics.
Minimize the tension during wire winding as much as possible. Refer to the page on winding wire safety tension (item 7).
The elongation rate of wound coil wires can be calculated as follows:

$$\text{Elongation rate due to winding of winding wire (\%)} = \left\{ \left(\frac{\text{Conductor diameter before winding}}{\text{Conductor diameter after winding}} \right)^2 - 1 \right\} \times 100$$

(3) **Pay careful attention to the flying of wire end.**
When there is no more winding wire on the spool, the wire head which is rotating at a high speed may fly out. Therefore, take safety precautions such as by installing automatic stop devices.

(4) **Pay attention to surface of wire after winding.**
Sometimes pinholes occur due to wire winding.
When pinholes occur, check for pinholes again by removing a sample of wire from spool.
Handle the wires carefully during winding to avoid damaging the film.

(5) **Pay attention not to spill releasing agents.**
When using chemical release agents for wire head treatment, be extremely careful not to allow the release agent to attach to portions other than the peeled area of the coil. Release agent on the peeled area should also be wiped away thoroughly.
Also, pay attention to safety by strictly following the handling instructions of the release agent manufacturer, such as wearing protective glasses during peeling operation.

(6) **Make sure workers do not inhale decomposition gas from the film during soldering by providing proper ventilation.**

9. Precautions When Using Magnet Wire

9-3. Precautions during Impregnating Varnish Treatment

(1) Examine the selection of impregnated varnish carefully.

When performing impregnated varnish treatment for protection of the coil after wire winding, examine the compatibility of the winding wire and the varnish carefully.

(2) Perform preheating before varnish treatment.

Performing varnish treatment immediately after wire winding may result in crazing of the wire. Therefore, make sure to perform preheating.

(3) Do not form coil after varnish treatment.

Be careful as bending the winding wire after the varnish treatment may cause the impregnating varnish to crack as it is not as flexible as the winding wire film. In addition, cracks may also occur on the film as adhesion of the varnish to the film is very strong.

9-4. Wire End Treatment of Magnet Wire

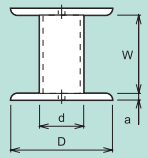
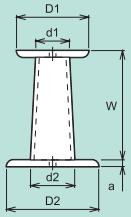
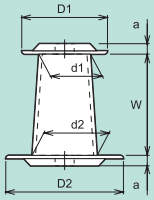
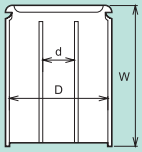
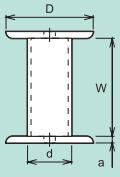
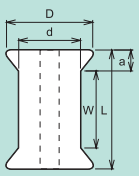
The following insulation film removal methods are available for connecting or soldering the coil ends. The most appropriate method must be adopted according to the requirements.

Method	Types	Content, Usage Condition, etc	Product												
			PVF	UEW	UEW-N	SMPEW	SMPEW-N	PEW	PEW-N	SMHEIW	EIW	ATZ-300	UTZ	AIW	PIW
Mechanical removal (method to shave off film)	Knife (file)	—	○	○	○	○	○	○	○	○	○	○	○	○	○
	Sandpaper	—	○	○	○	○	○	○	○	○	○	○	○	○	○
	Wire brush, *specialty stripper (*: ABISOFIX, wire stripper)	Toothbrush or blade type rotator	○	○	○	○	○	○	○	○	○	○	○	○	○
Pyrolytic removal (method to burn off film)	Gas burner	(It is important to quench the burner into aqueous ethanol solution to prevent conductor oxidation.)	○	○	○	○	○	○	○	○	○	○	○	○	○
	Alcohol lamp		○	○	○	○	○	○	○	○	○	○	○	○	○
Chemical removal (Method to chemically dissolve film with acid, alkali, or other chemicals)	Solcort	Used in common temperature	○				○	○	○						
	Depent		○					○	○						
	Fuji pellet, Neorever	Used at 400°C (within 30 sec)	○	○	○	○	○	○	○	○	○	○	○	○	○
Direct soldering		Used in solder bath temperature of 380°C to 480°C	×	○	○	○	○	×	×	○	×	×	×	×	×
Fusing	Fusing machine	Direct welding method	○	○	○	○	○	○	○	○	○	○	○	○	○
Spot welding	Spot welding machine		○	○	○	○	○	○	○	○	○	○	○	○	○
	Water welder		○	○	○	○	○	○	○	○	○	○	○	○	○

○ : Applicable × : Not applicable (Blank: Applicable but not recommended)

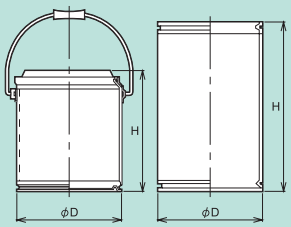
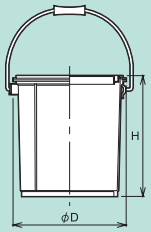
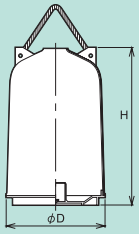
10. Magnet Wire Packing and Packaging Container

〈Packing〉

Type and Form	Packing Contents										
	Bobbin Symbol	Flange Diameter D1 (mm)	Flange Diameter D2 (mm)	Barrel Diameter d1 (mm)	Barrel Diameter d2 (mm)	Inner width W (mm)	Flange Thickness A (mm)	Shaft Hole Diameter h (mm)	Bobbin/ Pack Mass (g)	Standard Weight of Wire Capacity (kg)	Applicable Size (mm)
General Plastic Bobbin 	P-10	200	—	90	—	110	12	25	500	10	0.30~0.45
	P-30	300	—	130	—	130	15	30	1,300	25	1.50~3.20
Long Traverse Taper Type Plastic Bobbin 	PT-4	124	140	74	86	170	15	20	340	4	0.04~0.06
	PT-10	160	180	96	110	200	15	30	620	10	0.06~0.10
	PT-15	180	200	96	110	200	15	30	740	15	0.10~0.23
	PT-25	215	230	110	130	250	15	30	1,000	25	0.15~1.50
Large-sized and Long Traverse Taper Type Plastic Bobbin 	PT-90	300	315	180	200	425	38	100	3,900	90	0.23~1.60
	PT-200	375	400	224	250	530	50	100	7,000	200	0.80~3.20
	PT-270	435	460	255	280	530	50	100	10,600	270	0.80~3.20
Fiber Pack 	FP-100	510	—	310	—	570	—	—	7,500	100	1.00~3.20
	FP-500	661	—	405	—	765	—	—	12,500	500	1.00~3.20
Long Traverse Type Plastic Bobbin 	PL-2	100	—	65	—	125	10	20	160	2	0.03~0.05
	PL-4	125	—	80	—	160	15	25	240	4	0.04~0.10
	PL-8	160	—	100	—	200	15	30	470	8	0.05~0.20
Double-Taper Flange Type Plastic Bobbin 	PL-400	77	—	63	—	72	10.5	16	98	0.4	0.014~0.029
	PL-600	88	—	68	—	79	13.5	16	130	0.6	0.016~0.029
	PL-1000	106	—	82	—	80	16	16	168	1.0	0.018~0.029
	PL-1500	100	—	65	—	110	17.5	20	160	1.5	0.024~0.029

10. Magnet Wire Packing and Packaging Container

〈Packaging container for each packing type〉

Type and Form	Packaging Container Contents				
	Target Packing	External Diameter Measurement			No. of packages
		Depth : D (mm)	Width : W (mm)	Height : H (mm)	(Piece)
Pack 	PT-25	ϕ293	—	303	1
	PT-90	ϕ360	—	530	1
	PT-270	ϕ570	—	607	1
Polypack 	PT-15	ϕ235	—	245	1
	PT-25	ϕ297	—	302	1
Hood 	PT-90	ϕ385	—	608	1
	PT-200	ϕ480	—	765	1
Cardboard	P-10	212	414	163	2
	P-30	304	310	174	1
	PT-4	295	303	223	4
	PT-10	195	394	247	2
	PL-8	182	358	256	2
Cardboard (with plastic case)	PL-400	374	383	121	16
	PL-600	332	334	136	9
Foamed case	PL-1000	345	488	120	10
	PL-1500	454	454	145	9
	PL-2	345	488	131	8
	PL-4	330	330	245	4

11. ISO Acquisition Status

Manufacturing Base			ISO 9001			ISO 14001		
			Registration No.	Certification Organization	Acquired On (Yr/Mth)	Registration No.	Certification Organization	Acquired On (Yr/Mth)
Sumitomo Electric Wintec, Inc.	Japan	Shigaraki Works	JQA-0666	JQA	'94/11	JQA-EM1239	JQA	'00/12
		Taguchi Works	JQA-0574	JQA	'94/07	JQA-EM3717	JQA	'04/01
SIAM Electric Industries Co., Ltd.	Thailand		125564	BVQI	'02/12	2822/2	URS	'04/11
Sumitomo Electric Wintec (Singapore) Pte., Ltd.	Singapore		Q2837	SGS	'94/02	TW03/00358	SGS	'03/10
Sumitomo Electric Wintec (Malaysia) Sdn. Bhd.	Malaysia		Q5046	SGS	'95/05	0183	SIRIM	'04/02
Sumitomo Electric Wintec (Wuxi) Co., Ltd.	China		011020Q10130R1M	CESI	'02/08	09074E100021ROM	USC	'01/03
PT. Sumitomo Electric Wintec Indonesia	Indonesia		QEC13930	SAI Global	'01/04	AJA04/7531	AJA	'04/06
Sumitomo Electric Wintec America, Inc.	USA		CERT-8670-2002-AQ-HOU-ANAB	DNV	'05/11	C2006-00570	PJR	'06/03

12. UL Acquisition Status

〈UL Name for Standard Products〉

Type	Product Symbol	UL Name	Applicable Size (mm)	ANSI Type	TI(Temperature Index)
Polyvinyl Formal Enamelled Copper Wire	PVF	PVFU	—	MW15-C	105
Polyurethane Enamelled Copper Wire	UEW	UEX1, UEWU	0.32 and below	MW75-C	130
		UEX, UEW2U	0.45 and below	—	130
Polyurethane-Nylon Enamelled Copper Wire	UEW-N	UEW.EU	0.32 and below	MW28-C	130
		UEWE2U	0.45 and below	—	130
Polyester Enamelled Copper Wire	PEW	PEW2U	—	—	130
Polyester-Nylon Enamelled Copper Wire	PEW-N	PNX1	—	—	130
		PEW.N2U	—	—	130
		PNX2	—	MW24-C	155
Solderable Polyester Enamelled Copper Wire	SMPEW	SMPEWU	—	—	155
Solderable Polyester-Nylon Enamelled Copper Wire	SMPEW-N	SMPEWNU	—	MW27-C	155
Solderable Polyester Imide Enamelled Copper Wire	SMHEIW	SMHEIW2U	—	MW77-C	180
Polyester Imide Enamelled Copper Wire	EIW	DHW.U	0.22 and below	MW30-C	180
Polyester Imide-Polyamide Enamelled Copper Wire	ATZ-300	A3X, DHW.HU	—	MW35-C	200
		A3RX, DFW.FU	—	MW73-C	200
Highly Adhesive Polyester Imide-Highly Lubricated Polyamide Imide Enamelled Copper Wire	UTZ	UTX	—	MW35-C	200
		UTRX	—	MW73-C	200
Polyamide Imide Enamelled Copper Wire	AIW	AIX	—	MW81-C	220
		AIWU	—	—	220

※The wires with no applicable size stated (-) are based on NEMA standard.
For our company's (File No.: E82222) list of products that have acquired UL, please refer to the UL website.
(http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/gfilenbr.html)

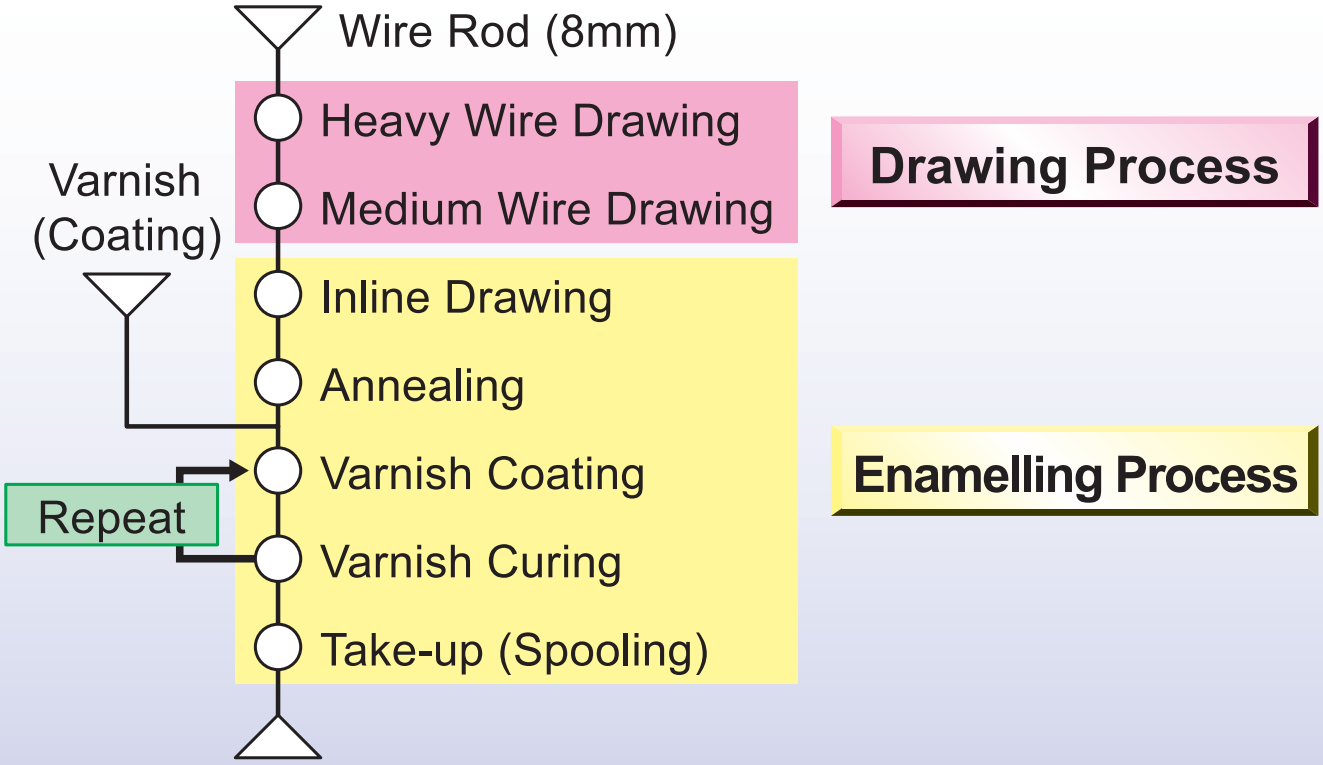
〈File No. of each Manufacturing Bases〉

Manufacturing Base		File No.
Sumitomo Electric Wintec, Inc.	Japan (Shigaraki & Taguchi)	E82222
SIAM Electric Industries Co., Ltd.	Thailand	E94303
Sumitomo Electric Wintec (Singapore) Pte Ltd.	Singapore	E94304

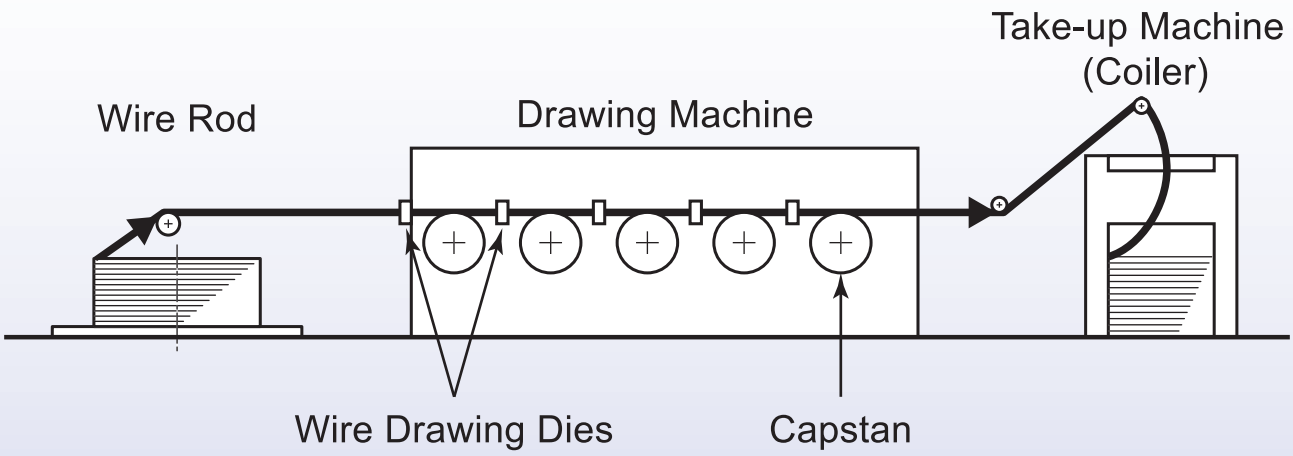
Sumitomo Electric Wintec(Malaysia)Sdn., Bhd	Malaysia	E135754
Sumitomo Electric Wintec (Wuxi) Co., Ltd.	China	E176066
PT.Sumitomo Electric Wintec Indonesia	Indonesia	E176282
Sumitomo Electric Wintec America, Inc	USA	E140764

13. Winding Wire Production Process

Winding Wire Production Process

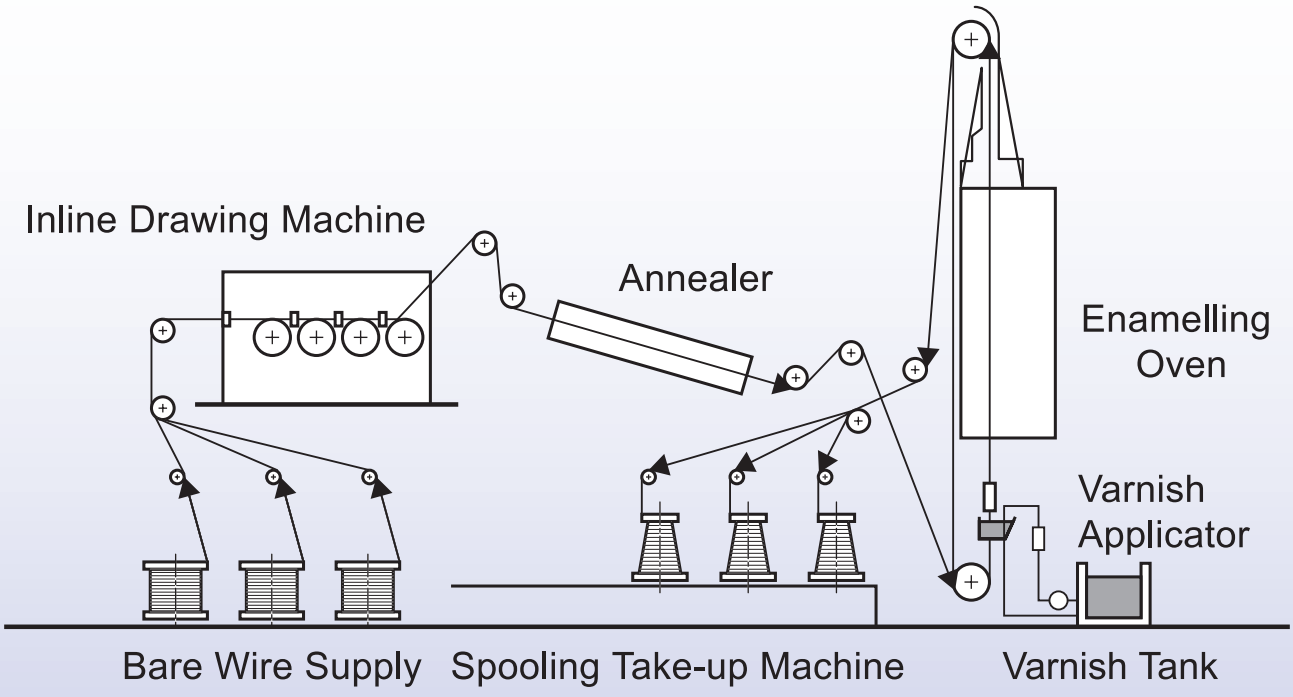


Drawing Process (Heavy Wire Drawing)

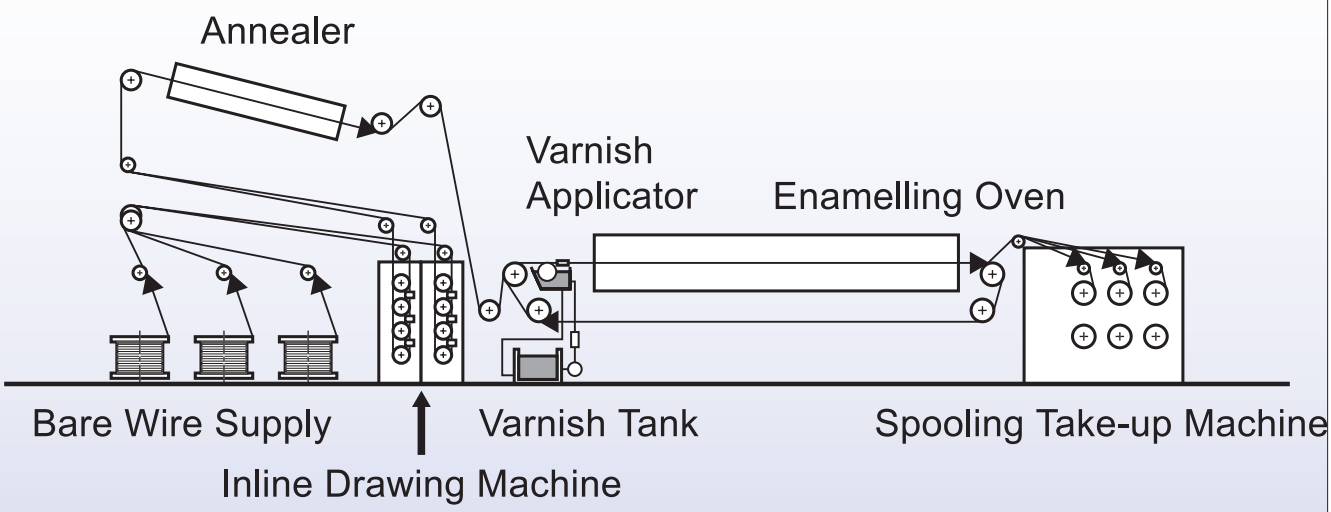


13. Winding Wire Production Process

Enamelling Process (Vertical Type)



Enamelling Process (Horizontal Type)



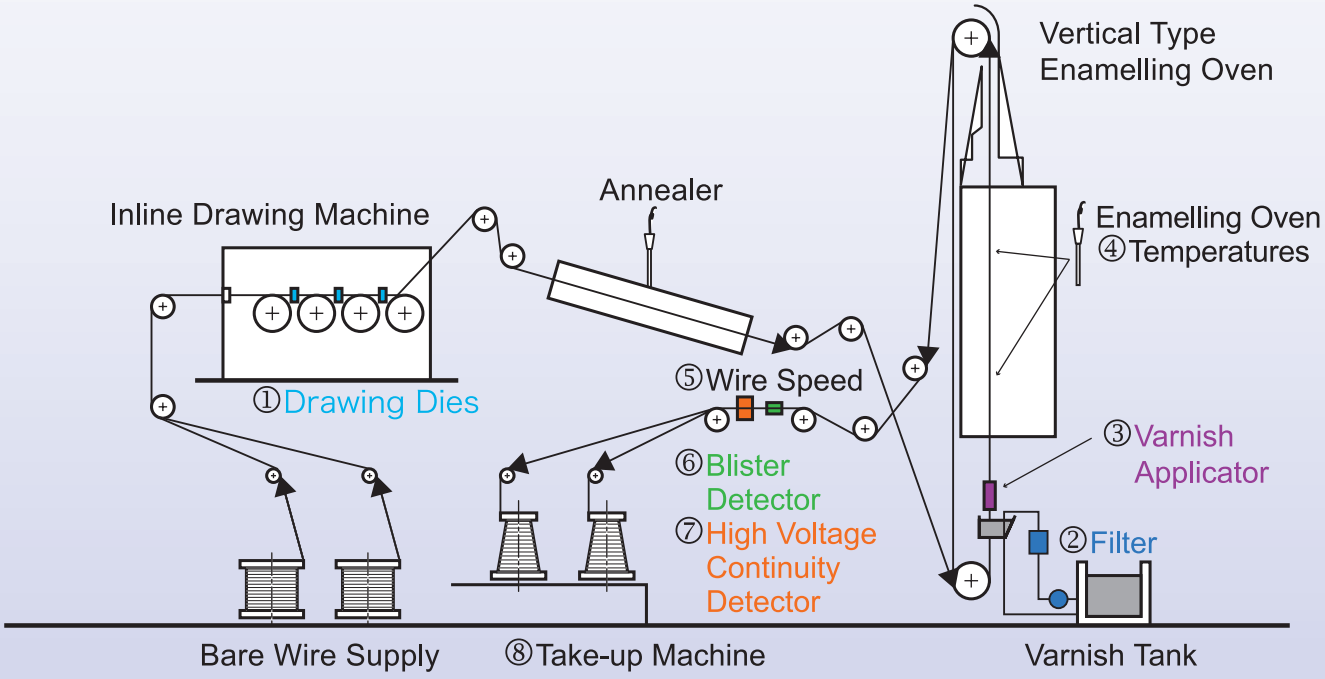
13. Winding Wire Production Process

Whole Length Assurance for Winding Wire

Important Winding-Wire Characteristics

Applicable to Total Length

Process	Control Item	No.	Film Baking Level is Appropriate	Stable Dimensional Control	Uniform Film Insulation
Inline Drawing Machine	Inner wire drawing dies diameter	①		◎	
Varnish Applicator	Foreign material removal by filter	②			◎
	Inner die coating diameter	③		◎	
Enamelling Oven	Temperatures	④	◎		
	Wire speed	⑤	◎		
Detector	Blister detector	⑥			◎
	High voltage continuity detector	⑦			◎
Take-up Machine	Take-up tension	⑧		◎	



14. Contact and Production Centers (Domestic and Overseas)

Contact

Eastern Sales Department
9th Floor, Takara Building,
2-6-2 Higashi Kanda, Chiyoda-ku, Tokyo, 101-0031
TEL (03)5835-2620
FAX (03)3863-8161

Central Sales Department
3rd Floor, Second Aster Building.
1-23-3 Meieki-Minami, Nakamura-ku, Nagoya, Aichi, 450-0003
TEL (052)587-2177
FAX (052)587-2187

Western Sales Department
6th Floor, Shin Osaka Toyo Building,
7-4-17 Nishinakajima, Yodogawa, Osaka-City, Osaka, 532-0011
TEL (06)6305-1361
FAX (06)6305-1363

Engineering & Development Department
1073 Eda, Shigaraki-cho, Koka-shi, Shiga, 529-1811
TEL (0748)82-7806
FAX (0748)82-7816

Domestic Production Centers

Shigaraki Works
1073 Eda, Shigaraki-cho, Koka-shi, Shiga, 529-1811
TEL (0748)82-7800
FAX (0748)82-7810

Taguchi Works
70 Nakagawara, Sekikawa, Myoko-shi, Niigata, 949-2212
TEL (0255)86-3111
FAX (0255)86-4463

Overseas Production Centers

SIAM Electric Industries Co., Ltd. (Thailand)
Bangpoo Industrial Estate, Soi 1B, 649 Moo 2 Bangpoomai, A.Muang,
Samutprakarn 10280 Thailand
TEL 66-2-709-4252 FAX 66-2-709-3286

Sumitomo Electric Wintec (Singapore) Pte., Ltd. (Singapore)
15 Gul Way, Jurong 629193 Singapore
TEL 65-6861-4477 FAX 65-6861-3096

Sumitomo Electric Wintec (Malaysia) Sdn. Bhd. (Malaysia)
Lot 499&500, Persiaran Sabak Bernam, Seksyen 26, 40000 Shah Alam,
Selangor, Darul Ehsan, Malaysia
TEL 60-3-5191-2299 FAX 60-3-5191-2255

Sumitomo Electric Wintec (Wuxi) Co., Ltd. (China)
No. 3 Xing Chuang 4 Road, Wuxi-Singapore Industrial Park,
Wuxi, Jiangsu, P.R. China
TEL 86-510-8528-0011 FAX 86-510-8528-0022

PT. Sumitomo Electric Wintec Indonesia (Indonesia)
Block T-7, MM2100 Industrial Town, Cikarang Barat, Bekasi 17520 Indonesia
TEL 62-21-898-0589 FAX 62-21-898-0546

Sumitomo Electric Wintec America, Inc. (USA)
909 Industrial Drive, Edmonton, KY 42129 USA
TEL 1-270-432-2233 FAX 1-270-432-2838

Sumitomo Electric Wintec, Inc.

Head Office : 1073 Eda, Shigaraki-cho, Koka-shi, Shiga, 529-1811