Litz Wire

specialist electronic materials

www.osco.uk.com

What is Litz Wire?

Litz Wire consists of a number of individually insulated magnet wires twisted or braided into a uniform pattern with the primary benefit of reducing A.C losses in high frequency windings. OSCO offer unlimited Litz Wire constructions with multiple layers of insulation to meet UL voltage withstand requirements.

The enamels commonly used for insulating individual strands are Polyurethane and Polyurethane with a Nylon topcoat because of the low electrical losses and ease of solderability however other insulations can also be used. In many cases, Litz Wire is insulated with an overall single or double wrap or serving, of a textile, but are also available unserved.

Why do you need Litz Wire?

Typically when manufacturing Motors, Transformers and other electromagnetic devices, magnetic fields are created by current in a wire. By raising the frequency, you create stronger fields and higher coupling resulting in a loss in the materials due to two effects – Skin Effect and Proximity Effect.

As the frequency rises, the current migrates to the skin and the current is pushed away by the field of its neighbouring strand making the core of the conductor useless.

Litz Wire mitigates both the Skin Effect and Proximity Effect Losses. OSCO design with strands that are smaller than the skin depth and transpose those strands throughout the length of the wire. The correct size of the skin depth is based on the frequency of the application.

The most important question to consider when designing your Litz Wire is what is your operating frequency for the application? This is due to the most well-known benefit of Litz Wire - a reduction of A.C losses. The operating frequency for your application will determine both the Litz construction and the individual wire gauge size. The table below highlights the recommended wire gauge verses frequency for most Litz Wire constructions.

Frequency	Recommended Wire Gauge	Nominal Diameter over Copper	DC Resistance Ohms/M' (Max)	Single Strand RAC / RDC
60 HZ to 1 KHZ	28 AWG	.0126	66.37	1.0000
1 KHZ to 10 KHZ	30 AWG	.0100	105.82	1.0000
10 KHZ to 20 KHZ	33 AWG	.0071	211.70	1.0000
20 KHZ to 50 KHZ	36 AWG	.0050	431.90	1.0000
50 KHZ to 100 KHZ	38 AWG	.0040	681.90	1.0000
100 KHZ to 200 KHZ	40 AWG	.0031	1152.30	1.0000
200 KHZ to 350 KHZ	42 AWG	.0025	1801.0	1.0000
350 KHZ to 850 KHZ	44 AWG	.0020	2873.0	1.0003
850 KHZ to 1.4 MHZ	46 AWG	.0016	4544.0	1.0003
1.4 MHZ to 2.8 MHZ	48 AWG	.0012	7285.0	1.0003

Benefits of Litz Wire

- Reduce A.C losses in high-frequency winding
- Increased efficiency
- Mitigation of Skin Effect
- Mitigation of Proximity Effect
- Minimum Eddy Current Losses
- Lowered Operating Temperatures
- Reduced Footprint of final product
- Substantial weight reduction
- Avoidance of “hot spots”

Round Type 1 Litz

A single twisting operation with optional outer insulation.

Round Type 2 Litz

Bundles of twisted wire twisted together with optional outer insulation.

Round Type 3 Litz

Insulated bundles of twisted wire twisted together with an optional outer insulation.

Round Type 4 Litz

Bundles of twisted wire twisted around a centre fiber core.

Square Shaped Profiles

Square Profiled Litz Wire allows for the best possible use of the available winding space in your application.

Cooled Profiles

Cooled Litz Wire uses a tube core to carry coolant through the Litz, increasing the current carrying capacity of the winding.

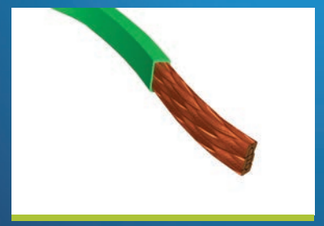
Round Type 5 Litz

Insulated bundles of Type 2 Litz Wire twisted around a fiber core.

Round Type 6 Litz

Insulated bundles of Type 4 Litz Wire twisted around a fiber core.

Rectangular Type 7 Litz



Insulated wire braided and formed into a rectangular profile..

Rectangular Type 8 Litz

Single insulated strands twisted and compressed into a rectangular profile.

Keystone Shaped Profiles

Keystone shaped Litz Wire gives the best wire packing density allowing for the winding of perfect segments.

Custom Profiles

Formed and compacted Litz Wire constructions for applications where limited space necessitates a conductor with excellent fill factor and copper density.

Products

Film Insulations

Insulation	Rating	AWG	Advantages	Considerations
Polyvinyl Formal	Class 105 MW 15-C	14 - 50	• Excellent abrasion resistance and compatibility with transformer oils • Good electrical properties • Used in Cryogenic Applications	• Must be stripped before soldering • Should be annealed before application of varnish
Polyurethane	Class 155 MW 79-C Class 180 MW 82-C	30 - 50 24 - 50	• Excellent electrical properties for high Q coils • Easily solderable 390°C/360°C • Excellent film adhesion and flexibility • Good moisture and chemical resistance	• Not recommended for applications with the possibility of severe thermal overload
Polyurethane-Nylon	Class 155 MW 80-C Class 180 MW 83-C	10 - 46 25 - 46	• Good electrical properties • Easily solderable 430°C/390°C • Excellent film adhesion and flexibility • Improved chemical and mechanical resistance from nylon topcoat • Nylon overcoat provides low coefficient of friction	• Not recommended for applications with the possibility of severe thermal overload • Nylon topcoat is hygroscopic
Solderable Polyester	Class 180 MW 77-C	14 - 50	• Solderable 470°C • Excellent thermal properties • Good electrical properties and moisture resistance • Good compatibility with varnishes and solvents • Improved thermal overload	• Low abrasion resistance compared to Nylon and amide imide topcoat materials • Preheat before varnishing is recommended
Solderable Polyester Nylon	Class 180 MW 78-C	14 - 50	• Solderable 470°C • Excellent thermal properties • Good electrical properties and compatibility with varnishes and solvents • Improved thermal overload • Good moisture resistance • Nylon overcoat provides low coefficient of friction	• Nylon topcoat is hygroscopic • Preheat before varnishing is recommended
Polyester(amide) (imide)	Class 200 MW 74-C	34 - 44	• Excellent flexibility and abrasion resistance • Excellent thermal overload, dielectric strength and moisture resistance • Good chemical resistance	• Must be stripped before soldering • Not recommended for use in oil-filled transformers • Preheat before varnishing
Polyester / Poly-amideimide Overcoat	Class 200 MW 35-C	8 - 33	• Excellent flexibility and abrasion resistance • Excellent thermal overload, dielectric strength and moisture resistance • Good chemical resistance	• Must be stripped before soldering • Preheat before varnishing
Polyimide	Class 240 MW 16-C	10 - 30	• Excellent flexibility, radiation resistance and thermal overload • Excellent chemical compatibility • High dielectric strength • Adequate abrasion resistance • Low outgas	• Must be stripped before soldering • Must be annealed before varnishing • Will solvent craze

Please note that other insulations can be used other than those listed above.

Tape and Fiber Insulations

Tape Insulation	Recommended Max. Use Temperature	Characteristics
Polyester (PET) Mylar® (heat sealable grades available)	135°C	• High dielectric strength • Good abrasion often used as a binder or moisture barrier under extruded jackets and textile serves or braids.
Nomex® (aromatic polyamide)	200°C (up to 220°C under certain conditions)	• Excellent thermal properties • Excellent electrical properties • Excellent compatibility with varnishes, adhesives and transformer fluids. • Thinner grades are flexible • Good resistance to tearing and abrasion.
Polyimide Kapton® (Heat sealable and adhesive grades available)	240°C (up to 400°C under certain conditions)	• Very high dielectric strength • Very good chemical resistance • UL 94 V-0 flame rating • Excellent mechanical properties.
Fiberglass Cloth	Ultimate operating temperature determined by application and glass type	• Excellent electrical properties at high temperatures • Conformable • Varnish compatible grades available • Excellent solvent resistance.
Mica	Ultimate operating temperature determined by application and glass type	• Excellent electrical properties at high temperatures • Flame resistant • Retains useful electrical properties during and after exposure to fire.

Fiber Insulation	Recommended Max. Use Temperature	Advantages	Limitations
Cotton	135°C	• Low cost serving • Good resistance to abrasion	• Poor space factor compared to Nylon or Celanese • Non-solderable
Nylon	155°C	• Good space factor • Excellent abrasion resistance • Solderable	• Hygroscopic
Dacron® (Polyester)	155°C	• Good abrasion resistance • Solderable • Slightly higher maximum operating temperature than Nylon	• Better space factor than Cotton or Glass but poorer space factor than Nylon
Nomex® (Hi-Temp Aramid)	250°C	• Good space factor • Good electrical properties at high temperatures	• Non-solderable • Higher cost than other fibers
Glass	260°C	• Good electrical properties at high temperatures	• Space factor equivalent to Cotton • Non-solderable

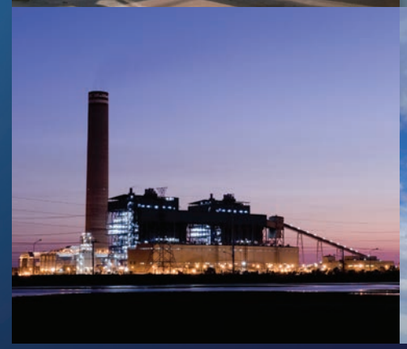
Applications

Litz Applications	Litz Wire Type	Examples
Wireless Power Transfer	2, 8	• Coils in the Car and in the Road
High Q Circuitry	1, 2, 7, 8	• Tuning Coils
Transformers and Torodial Transformers	1, 2, 8	• Power Transformers
Inductors / Chokes	1, 2, 8	• Motor Drive (Motor Controller) • Solar Inverters
Motors and Generators Linear Induction Motors Permanent Magnet Motors	2, 8	• Some Maglev Trains • Vehicle Propulsion • Oil and Natural Gas Drilling • Automatic Parts Movement • Wind Turbines
High Frequency Power Supplies	1, 2, 3, 8	• Drive the Coils for many of the applications listed
Inverters	1, 2, 7, 8	• DC to AC
Grounders	2, 7	• Industrial Machinery
Tuning circuitry in High Power Radio	5, 6	• VLF Radio Transmission
DC / DC Converters	2, 7, 8	• Electric Vehicles • Automotive • Medical • Electronics
Induction Heating Coils	1, 2, 7, 8	• Hospital Plate Warmer • Sealing Bottles (Adhesive Backed Aluminium) • Mold Preheat Before Plastic Injection • Molten Metal Processing
Ballast	1, 2	• Fluorescent Lighting
Propagation of High Frequency Power Litz Lead Wire	2, 3, 4, 5	• Leads to Thin Film Deposition Equipment • Leads for Plasma Coating of Glass • Leads to Induction Heating Blanket
Flywheel Energy Storage	2, 7, 8	• Energy Storage
Plasma Containment Coils	2	• Stellarator / Fusion Energy Experiments
Specialty Audio	All Litz Types	• High Fidelity Speaker Wire • Audio Interconnect

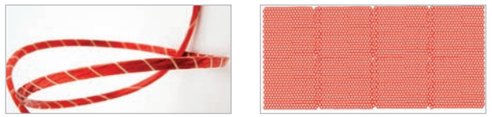
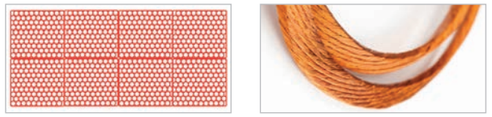
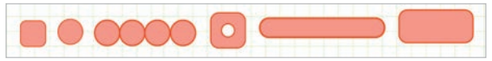
- Stator Windings
- High Frequency Inductors
- Power Transformers
- Motor Generators
- Hybrid Transportation
- Wind Turbine Generators
- Communication Equipment
- Marine Acoustic Control Systems
- Induction Heating Equipment
- Sonar Equipment
- Radio Transmitter Equipment
- Switch Mode Power Supplies
- Ultrasonic Equipment
- Linear Motors
- Sensors
- Antennas
- Grounding Applications
- Wireless Power Systems
- Electric Vehicle Chargers
- High Frequency Chokes
- Coils
- High Frequency Motors
- Medical Device Chargers





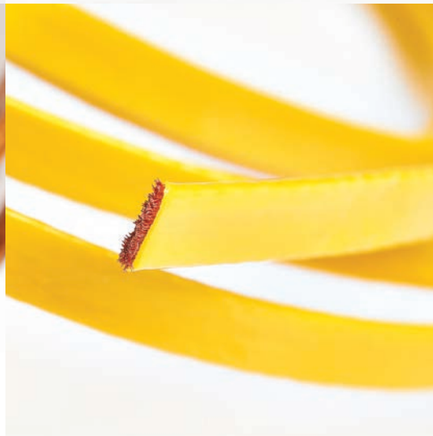



Design Solutions

400 HZ to 1 KHz Compactions tailored to your winding window to 90% Aspects to 18 to 1	**Type 8**	
1 KHz to 50 KHz Density to 88% Aspects to 7 to 1	**Type 8 Concentric**	
1 KHz to 850 KHz Density to 75% Aspects to 5 to 1	**Type 8 Bunched**	
1 KHz to 2 MHz Density to 70% Aspects to 4.5 to 1	**Type 8 Served**	
1 KHz to 2 MHz Density to 70% Aspects to 1.75 to 1	**Type 2 Formed**	
1 KHz to 2 MHz Density to 70% Aspects to 20 to 1	**Type 7**	
Type 8 Custom Shapes		






Testimonials

Vehicle Drivetrain Developer and Manufacturer of Motor Drives

"When working with OSCO on Litz Wire requirements we have always found them to be very knowledgeable with an understanding of the types of applications the wire is to be used for. We have no hesitation in working with OSCO when it comes to sourcing wire as they are a pleasure to do business with."

Transformer and Inductor Manufacturer

"We have been trading with OSCO now for a number of years buying quality wire to suit our manufacturing process."

Motorsport

"OSCO are considered a very valuable partner and their support through both the development phase and through production has made a significant difference in our competitive advantage. Their support always exceeds expectations and in effect they are an extension of our organisation. Any organisation that has very demanding requirements such as ours should consider using OSCO."

OSCO
Specialist Electronic Materials

OSCO Limited,
Avant Business Centre,
Third Avenue,
Bletchley,
Milton Keynes,
MK1 1DR

T: +44 (0) 1908 376 688
E: sales@osco.uk.com

www.**osco**.uk.com

NEW ENGLAND WIRE TECHNOLOGIES

Manufactured By
New England Wire Technologies