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High frequency Litz wires (Standard)

Technical information

HF stranded wires are manufactured from several individual enameled copper wires by twisting in accordance with DIN 46447. For larger cables, different bundles of strands are combined with each other. With this type of stranded wire/cable, the exact position of the individual wires is not defined. To be fully effective, none of the fine wires must be interrupted. All wires must be stripped at the ends and connected to the circuits. In this way all individual conductors are connected in parallel. The higher quality in the high-frequency range is based on the increase in the cross-section effectively involved in the current flow, which is limited in the solid wire by the following effects:

Skin effect

Charge carrier displacement due to the magnetic field of the individual conductor. At high frequencies, most of the current flows along or near the surface of the conductor due to this effect. The loss resistance can be reduced by increasing the conductivity, especially of the surface, or by connecting many thin individual conductors (stranded wires) in parallel.

Proximity effect

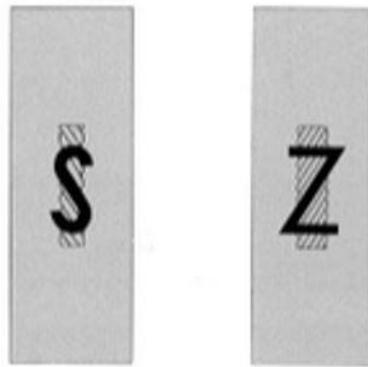
Charge carrier displacement to one side of the conductor by the magnetic field of a coil made from it, or currents running back and forth on both sides of the conductor due to an external time-varying magnetic field.

Twisting direction

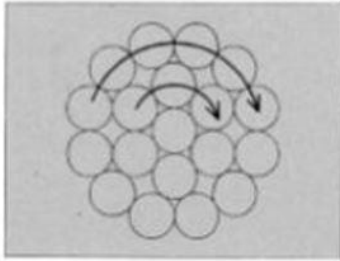
When stranding High Frequency Litz Wires, there is also the twisting direction parameter. It describes the direction in which the strand is twisted/twisted. A basic distinction is made between the lay directions S and Z.

Bundle

The standard direction of rotation is S (Z on request)



(left) | (right)

Twist direction

Calculation of the nominal outer diameter of strands

The nominal outer diameter produced from individual enameled copper wires with textile braiding is determined approximately by the following formula.

$$D = k \cdot \sqrt{n} \cdot d + \text{Thickness of the wrapping}$$

Where :

D = Nominal diameter of the insulated conductor (in mm)

k = Compression factor

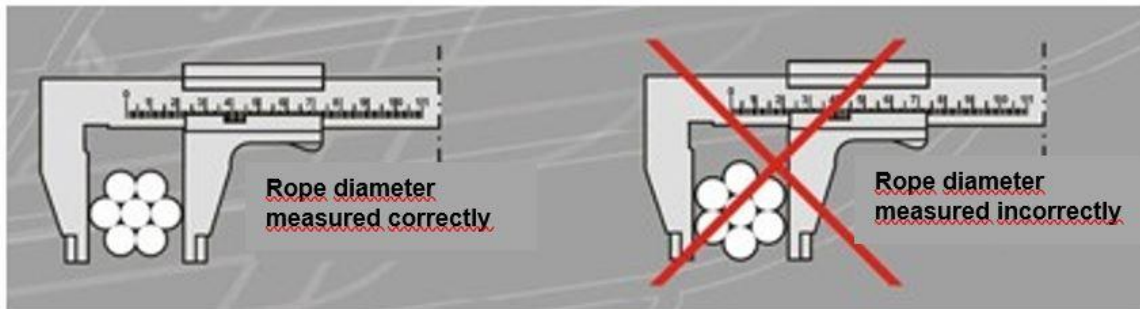
n = Number of individual enameled copper wires

d = Nominal diameter of an individual enameled copper wire

Number of individual enameled copper wires	Compression factor
from 3 to 6	1,25
7	1,15
from 8 to 12	1,25
16	1,26
20	1,27
from 25 to 400	1,28

Measuring the strand diameter

The strand diameter is the diameter of the circle drawn around the rope cross-section.



Length of twist

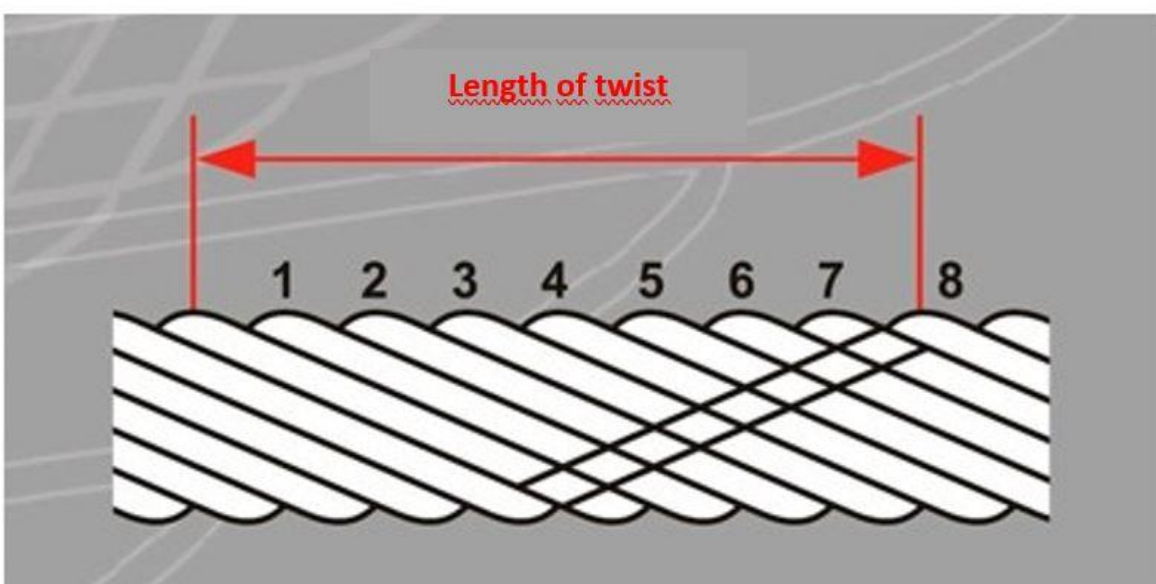
The length of twist of a specific strand layer in a wire rope is the pitch of the helical strands in this layer.

Short length of twist: high flexibility, good grip of the individual strands, better roundness of the strand.

Long length of twist: stiffer, less good grip of the individual strands, better fill factor.

The length of twist can be set between 1 mm and 500 mm. Possible tolerances $\pm 10\%$ and $\pm 20\%$ (standard).

Without your specifications the specialists at the factory will determine the length of twist .



HF stranded wires made of enameled copper wires (with and without additional insulation)

Conductor

	Bare copper wires	Enameled copper wires
Copper cross-sections >	up to 2000 mm ²	up to 2000 mm ²
Diameter of a single wire >	0.032 to 4.00 mm = AWG 41 to AWG 6	0.032 to 4.00 mm = AWG 42 to AWG 6
Number of wires >	From at least 9 x 0.023 mm (0.24 mm diameter) to several tens of thousands	
MW 79 -155°C		IEC 60317-20
MW 82 -180°C		IEC 60317-51
MW 77 - 180°C		IEC 60317-23
MW 30 -180°C		IEC60317- 8
MW 35 - 220°C		IEC 60317-13
MW 16 - 220°C		IEC 60317-7
		others on request
Cable dimensions min. to max. >	From 2.20 x 1.50 mm to 40.00 x 25.00 mm	
Additional insulation	Banding: Kraft paper or crepe, Nomex®, polyester, fiberglass mesh, fiberglass/mica or other tapes up to 20 mm thick on request Spinning: 1 or 2 layers of cotton, nylon, polyester, artificial silk or Nomex® Braiding: cotton, nylon, polyester or Nomex® Others: on request	

Banding

Type	Temp. Class	Thickness	Designation
Coated paper			
Kraft paper	105°C	50 to 125 µm	K 50 - K 60 - K 80 - K 100 - K 125
Heat-treated kraft paper or Insuldur kraft paper	120°C	50 to 10 µm	KI 50V - KI 80V - KI 100V
Kraft paper with increased mechanical strength	105 °C	50 and 75 µm	M 50 - M 75

Kraft paper coated on both sides with epoxy in installment form	120 °C	90 µm	KDD 9 0
Crepe kraft paper fine-creped			
Coated on both sides with epoxy in installment form	105 °C	65 µm	CDE 50
Coated on one side with epoxy in installment form	120 °C	50 and 80 µm	KCI 12dn - KCI 22dn
Crepe paper			
Crepe paper 80 µm 50 % creped	105 °C	315 µm	KC 105
Crepe paper 120 µm 90 % finely creped	105 °C	370 µm	KC 80
Crepe paper 75 µm 100 % creped	120 °C	500 µm	KCI 100V
Aramid paper			
Aramid paper	180 °C	50 µm	Nomex® 410-50
Aramid paper coated on one side with epoxy	180 °C	90 µm	Nomex® 410-80E
Polyester			
PET film	130 °C	8 to 50µm	FP 08 - FP 12 - FP 19 - FP 23 - FP 36 - FP 50
Semi-conductive polyester tape	155 °C	180µm	PSC 180
Mica paper			
Mica paper on polyester film	155 °C	80 to 90 µm	MFPE 80 - MFPE 90
Mica paper on polyester film coated with epoxy on one side	155 °C	80 to 90µm	MFPE 80 - MFPE 90
Mica paper on glass fabric	155 °C	130µm	MVT 130
Polyimide film			
Polyimide film	155 °C	25, 40µm	Kapton® 100HN
Polyimide film	220 °C	25, 40µm	Apical®
Glass fabric tape	220 °C	100 to 200µm	VT 100 - VT 130 - VT 200
Cotton tape	90 °C	180 and 300µ m	JAC 2380/0.18 - JAC 2380/0.30
Wrapping or braiding with cotton yarn	90 °C	60 and 120 nm	Cotton 60 nm Cotton 120 nm

HF stranded wires round



Dimensions:

Cross-sections up to 2,000 mm² max.

Diameter 65 mm max.

Diameter of individual wires from 0.032 mm to 4.00 mm

HF stranded wire



For space reasons, it is sometimes necessary to profile strands to create a rectangular or square profile instead of a round one.

Please always specify which dimension (width or height) must be adhered to (before any additional insulation).

Dimensions: Cross-sections up to 470 mm² max.

Profiling: 40 x 25 mm max.

Diameter of enameled copper wires according to IEC 60317-0-1

Nominal diameter	Nominal copper cross-section		AWG	Grade 1				Grade 2			
				Diameter				Diameter			
				minimum		maximum		minimum		maximum	
[mm]	[mm ²]	[Circ. Mils]		[mm ²]	[inch]	[mm ²]	[inch]	[mm ²]	[inch]	[mm ²]	[inch]
0,063	0,0031	6.1521	42	0,066	0.0260	0,076	.00299	0,073	.00287	0,083	0.00327
0,067	0,0035	6.9581		0,071	.00280	0,080	.00315	0,076	.00299	0,088	.00346
0,071	0,0040	7.8137	41	0,075	.00295	0,084	.00331	0,080	.00315	0,091	.00358
0,075	0,0044	8.7189		0,079	.00311	0,089	.00350	0,086	.00339	0,095	.00374
0,080	0,0050	9.9202	40	0,084	.00331	0,094	.00370	0,091	.00358	0,101	.00398
0,085	0,0057	11.1989		0,090	.00354	0,100	.00394	0,097	.00382	0,107	.00421
0,090	0,0064	12.5552	39	0,095	.00374	0,105	.00413	0,102	.00402	0,113	.00445
0,095	0,0071	13.9890		0,100	.00394	0,111	.00437	0,108	.00425	0,119	.00469
0,100	0,0079	15.5003	38	0,105	.00413	0,117	.00461	0,113	.00445	0,125	.00492
0,106	0,0088	17.4161		0,112	.00441	0,123	.00484	0,120	.00472	0,132	.00520
0,112	0,0099	19.4435	37	0,118	.00465	0,130	.00512	0,126	.00496	0,139	.00547
0,118	0,0109	21.5826		0,125	.00492	0,136	.00535	0,134	.00528	0,145	.00571
0,125	0,0123	24.2192	36	0,132	.00520	0,144	.00567	0,141	.00555	0,154	.00606
0,132	0,0137	27.0077		0,140	.00551	0,152	.00598	0,150	.00591	0,162	.00638
0,140	0,0154	30.3805	35	0,148	.00583	0,160	.00630	0,158	.00622	0,171	.00673
0,150	0,0177	34.8756		0,159	.00626	0,171	.00673	0,170	.00669	0,182	.00717
0,160	0,0201	39.6807	34	0,169	.00665	0,182	.00717	0,180	.00709	0,194	.00764
0,170	0,0227	44.7958		0,180	.00709	0,194	.00764	0,192	.00756	0,205	.00807
0,180	0,0254	50.2208	33	0,190	.00748	0,204	.00803	0,202	.00795	0,217	.00854
0,190	0,0284	55.9559		0,201	.00791	0,216	.00850	0,214	.00843	0,228	.00898
0,200	0,0314	62.0010	32	0,211	.00831	0,226	.00890	0,224	.00882	0,239	.00941
0,212	0,0353	69.6644		0,224	.00882	0,240	.00945	0,238	.00937	0,254	.01000

Nominal diameter	Nominal copper cross-section	AWG	Grade 1	Grade 2	Nominal diameter	Nominal copper cross-section	AWG	Grade 1	Grade 2	Nominal diameter	Nominal copper cross-section
			Diameter minimum	Diameter maximum				Diameter minimum	Diameter maximum		
0,224	0,0394	77.7741	31	0,236	.00929	0,252	.0099	0,250	.00984	0,266	.01047
0,236	0,0437	86.3302		0,249	.00980	0,267	.0105	0,264	.01039	0,283	.01114
0,250	0,0491	96.8766	30	0,263	.01035	0,281	.0110	0,278	.01094	0,297	.01169
0,265	0,0552	108.850		0,279	.01098	0,297	.0117	0,294	.01157	0,314	.01236
0,280	0,0616	121.522	29	0,294	.01157	0,312	.0123	0,309	.01217	0,329	.01295
0,300	0,0707	139.502		0,315	.01240	0,334	.0131	0,331	.01303	0,352	.01386
0,315	0,0779	153.801	28	0,330	.01299	0,349	.0137	0,346	.01362	0,367	.01445
0,335	0,0881	173.957		0,351	.01382	0,372	.0146	0,369	.01453	0,391	.01539
0,355	0,0990	195.342	27	0,371	.01461	0,392	.0154	0,389	.01531	0,411	.01618
0,375	0,1104	217.972		0,391	.01539	0,414	.0163	0,410	.01614	0,434	.01709
0,400	0,1257	248.004	26	0,416	.01638	0,439	.0173	0,435	.01713	0,459	.01807
0,425	0,1419	279.973		0,442	.01740	0,466	.0183	0,462	.01819	0,488	.01921
0,450	0,1590	313.880	25	0,467	.01839	0,491	.0193	0,487	.01917	0,513	.02020
0,475	0,1772	349.725		0,494	.01945	0,519	.0204	0,515	.02028	0,541	.02130
0,500	0,1963	387.506	24	0,519	.02043	0,544	.0214	0,540	.02126	0,566	.02228