LAMIFIL

CATENARY WIRES

Solutions for urban transport systems
and high-speed rail networks

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LAMIFIL

Catenary wires

BRINGING CONNECTIONS TO LIFE

In order to meet the changing needs and expectations of passengers, governments and commercial entities, rail operators need to be increasingly adaptive and innovative. We see it as our purpose to help rail industry leaders to create value, progress and wellbeing by bringing connections to life with smart technology.

Our overhead conductors literally connect energy, people, cities and communities. We continuously develop new solutions enabling you to run more trains at a lower cost, to future-proof your rail systems, boost network conductivity and lower your CO_2 footprint.

With 90 years of experience and craftsmanship in producing copper and aluminium-based wires and cables, we build strong connections with our customers and partners. Together, we create new possibilities to exchange energy and unite people, businesses and things.

Let us show you how.

OUR MISSION

“We bring connections to life with smart wires forged by technology, innovation and mastery.”

OUR STRATEGY

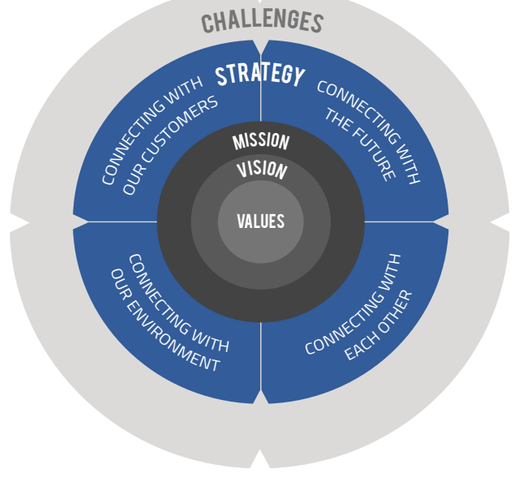
We have a clear strategy to deliver on our mission, reach our goals and respond to market and customer challenges. Built on four pillars, it is anchored in a strong and value-driven corporate identity and culture.

CONNECTING WITH OUR ENVIRONMENT
How we engage with our community and contribute to society at large.

CONNECTING WITH EACH OTHER
How we work together and with our customers, driven by strong values and a culture of safety, wellbeing and productivity.

CONNECTING WITH THE FUTURE
How we address market and customer needs with innovative products.

CONNECTING WITH OUR CUSTOMERS
How we provide added value and make sure our products answer your needs.



MARKET TRENDS AND NEEDS

We are yet to realise the full potential of rail. With an increasing demand for lower emissions and greater reliability, combined with an increased choice for passengers, rail network operators are looking for ways to increase efficiency and lower their operational costs. Which is why Lamifil designs and produces catenary wires that provide you with solutions to face these challenges and enable your rail network to reach its full potential.

DECREASING THE ECOLOGICAL FOOTPRINT

Since rail is two to five times more energy-efficient than road or air, the EU's Roadmap 2050 for a low-carbon Europe foresees rail as a major contributor to cutting oil dependency and reducing transport-related greenhouse gases by 60%. With goals of shifting 50% of road freight over 300km to rail by mid-century, we see more and more electrification projects appearing, old diesel lines being electrified and reliable catenary solutions playing an increasingly important role.

RELIABLE NETWORKS, RELIABLE RAIL SERVICES

Passenger expectations for reliable and on-time services are constantly increasing. Interruptions due to temperature conditions (snow, ice, etc.) and cable breakages are no longer acceptable, increasing the need for reliable catenary lines. Emergency interventions not only mean high costs but also loss of revenue due to service downtime.

Copper theft has also become a serious problem worldwide, posing a threat not only to daily operations and scheduling but also to passenger safety.

INCREASING PASSENGER MOBILITY

These days, rail has to compete with low-cost airlines and cars to offer passengers increased mobility. To compete effectively, however, it requires networks that offer reliable, high-speed, cross-border lines with good local tram connections. This puts increasing pressure on networks and their catenary systems to ensure those demands are met.

MARKET NEEDS

INCREASE CAPACITY
Innovative catenary wires enable you to upgrade the capacity of existing lines using existing infrastructure or build entirely new lines.

REDUCE LOSSES
Better-designed catenary wires reduce losses and increase efficiency, thus helping to lower your operational costs.

BOOST ENVIRONMENTAL PERFORMANCE
Saving energy means less CO_2 emissions, resulting in greener solutions.

REDUCE TOTAL PROJECT COSTS
Reducing the number of substations in new-build projects is another major benefit of innovative catenary wires.

INCREASE RELIABILITY AND OFFER BETTER SERVICE
Using high-quality products that withstand wear and tear minimise the need for maintenance and emergency interventions.

OUR HIGH-QUALITY ALLOYS

COPPER AND ITS ALLOYS

We ensure the quality of our alloy catenary wires by controlling the entire manufacturing process from raw materials all the way to the finished product, while testing at every stage. Our copper alloys are thus the result of our extensive metallurgical expertise and experience and allow our customers to use them with certainty and confidence.

CUMG 0.2 AND 0.5

Copper Magnesium has the highest tensile strength when compared to other alloys, making it the perfect alloy for contact wire in high-speed lines with speeds well above 300km/h.
Lamifil has developed its own Ultra High Conductivity alloys with superior properties and benefits compared to standard wires, including our brand new **PowerFil**. See p.8 for more information.

CUCD 0.7 AND 1.0

Copper Cadmium combines high strength with good conductivity. With unsurpassed flex life, CuCd is highly resistant to the frequent vibrations dropper wires need to withstand, making it the ideal choice for high energy efficiency, fewer voltage drops and reduced operational costs. When extra strength is required, Lamifil's CuCdSn alloy is an excellent choice.

CUSN 0.2

The development of a high-performance Copper-Tin alloy was an imperative, displaying a better conductivity at 80%, with only a small reduction in tensile strength compared to CuMg. CuSn is used in the contact wires for both conventional and high-speed railway lines, allowing speeds above 300km/h.

CUAG 0.1

Copper-Silver offers electrical and mechanical characteristics similar to those of ETP copper but with enhanced thermal stability. This allows higher overcurrent on DC lines, without increasing the wear on the contact wire. Ideal for contact wires in high frequency, conventional railway lines with speeds of up to 250km/h.

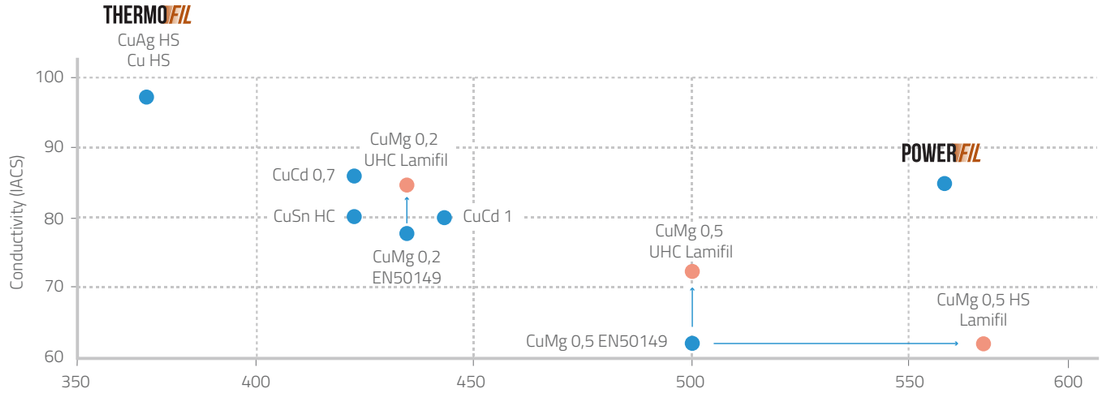
Lamifil's **ThermoFil**, composed of a unique and innovative alloy, delivers a powerful and cost-effective alternative to the CuAg alloy. See p.9 for more information.

CU ETP

Copper ETP is still the most universal metal but is increasingly being replaced by alloys with superior characteristics. Non-alloyed Cu offers the best possible conductivity and is typically used in contact wires for tramways and conventional railway lines with lower train speeds but is most appropriate for auxiliary conductors and feeder cables.

Our new **PowerFil** and **ThermoFil** offer a valuable alternative to Copper ETP. Discover them in more details on the following pages.

COMPARISON OF THE ELECTRICAL AND MECHANICAL CHARACTERISTICS OF SOME OF OUR COPPER ALLOYS



ALUMINIUM AND ITS ALLOYS

Aluminium, with its lower weight and lower cost, is best used in return and feeder cables. With its expertise in aluminium manufacturing, Lamifil offers an extensive range of in-house produced aluminium cables: All Aluminium Conductors (AAC), All Aluminium Alloy Conductors (AAAC) and Aluminium Core Steel Reinforced Conductors (ACSR).

ENERGISING RAIL FOR THE FUTURE

Backed by our certified laboratory, integrated production facilities and skilled staff, we pride ourselves on remaining at the forefront of innovation and helping our customers develop future-proof rail networks. We are continuously improving the performance and cost-effectiveness of our products by developing innovative new alloys. Our latest innovations include the CuMg UHC alloy, the all-new ThermoFil and leading-edge PowerFil.

Run more trains at a lower cost

Future-proof your rail system with innovative alloys

Boost network conductivity to unknown levels

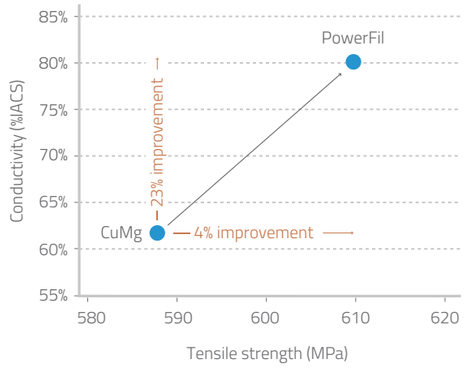
Lower your CO_2 footprint

POWERFIL

Lamifil yet again reinforces its position at the forefront of innovation with the release of PowerFil. This brand-new, unique alloy offers significantly superior properties compared to conventional CuMg. With 23% more conductivity compared to CuMg 0,5, PowerFil is the top alternative for a Cd-free world.

- **Minimised energy loss**
  PowerFil allows operators to save up to 12,000 euros per km during the lifetime of a messenger wire.
- **Reduced CO_2 and higher efficiency**
  This 'green' alloy offers approximately 23% better resistance than standard CuMg 0,5 alloys.
- **Increased rail capacity**
  PowerFil offers less resistance and heat losses, allowing more trains to run on the same track.

COMPARISON OF ELECTRICAL AND MECHANICAL CHARACTERISTICS OF CUMG VS LAMIFIL'S POWERFIL

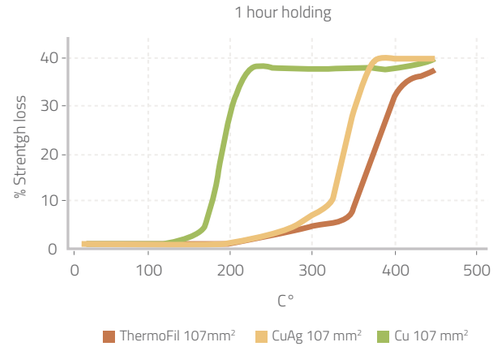


THERMOFIL

Composed of a unique and innovative alloy, ThermoFil offers a high-performance, cost-effective and sustainable solution. It can be used as a contact or messenger wire for conventional railway lines.

- **Excellent conductivity**
  Comparable to Cu or CuAg.
- **Increased reliability**
  Featuring high thermal resistance and low creep characteristics, ThermoFil reduces the probability of system interruptions.
- **Increased system lifecycle**
  Requiring low maintenance during operation, this new wire increases a railway system's lifecycle, while lowering the overall CO_2 footprint.

ANNEALING CURVE

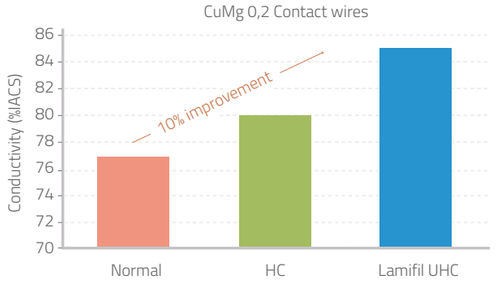


CUMG UHC

Lamifil's CuMg UHC alloy delivers 10 to 16% higher conductivity compared to the EN50149 standard, while maintaining the required tensile strengths. Our (ASTM compliant) UHC contact wires with 85% conductivity have already been successfully implemented in Canada and Asia.

- **Reduced material costs**
  Up to 6.5% savings in copper weight are possible, while maintaining high conductivity.
- **Lower costs**
  Allowing longer substation intervals or reducing voltage drops, CuMg UHC significantly reduces overall costs.
- **Increased rail capacity**
  Using the UHC alloy, operators can increase train frequency by up to 15%.

COMPARISON OF CONDUCTIVITY (%IACS) BETWEEN NORMAL, HC STANDARD AND LAMIFIL'S UHC CUMG ALLOY



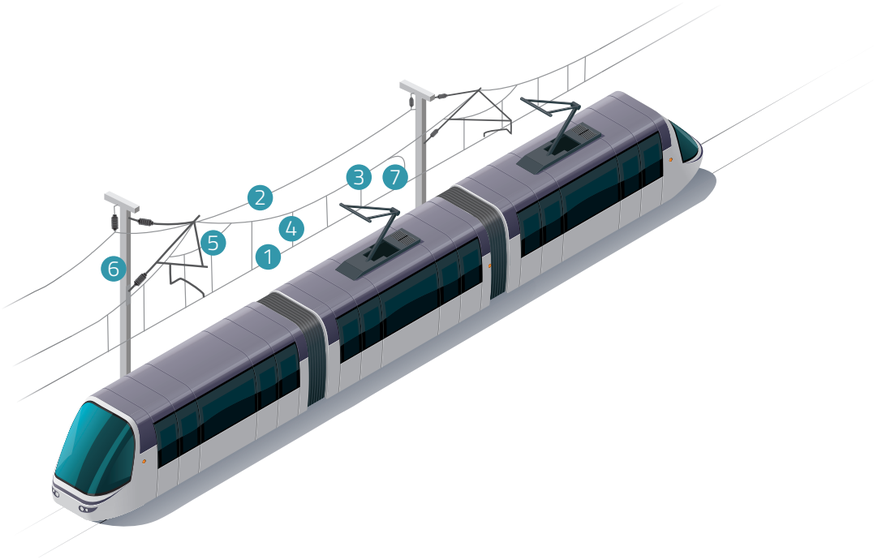
OUR PRODUCT RANGE

Building on over 90 years of experience in copper wire manufacturing, Lamifil has been pursuing innovation and quality from the very start. Our product range has been developed to meet the highest customer demands for diverse railway electrification projects in urban and cross-border settings, from conventional to high-speed lines.

Lamifil manufactures products to cover the entire spectrum of bare wires used in electrically operated railway infrastructure, including contact wires, messenger wires, feeder cables, dropper wires and auxiliary cables.

All our wires comply with common international standards, such as EN, DIN, BS and NF C. Offering the right mechanical and electrical properties for every need, our wires are also available in different sections, alloys, compositions or shapes.

Lamifil's integrated production facility ensures consistent quality and full control throughout the production and delivery process with full traceability. As a consequence, railway electrification projects can be commissioned faster, with fewer risks and at a much lower total cost of ownership.



1. Contact wire
2. Line feeder
3. Messenger wire
4. Dropper
5. Stitch wire
6. Earthing wire
7. Jumper

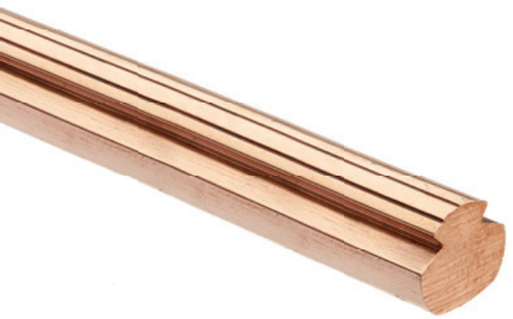
LAMIFIL PRODUCTS BY WIRE TYPE

WIRE TYPE	SUITABLE LAMIFIL PRODUCTS
Contact wire 1	Contact wire according to EN 50149 Contact wire according to DIN 43140-43141 Contact wire according to NF C 34-800 Contact wire according to UIC 870 Contact wire according to BS 23 Contact wire according to ASTM B9 Contact wire according to ASTM B47
Line feeder 2	Stranded conductor according to DIN 48201 T1 & T2 Stranded conductor according to NF C 34-110-2 & 3 Stranded conductor according to BS 7884 Alu cables according to EN 50182 Alu cables according to IEC 61089 Alu cables according to NF C 34-120
Messenger wire 3	Stranded conductor according to DIN 48201 T1 & T2 Stranded conductor according to NF C 34-110-2 & 3 Stranded conductor according to BS 7884
Dropper 4	Dropper according to DIN 43138 Dropper according to NF C 34-110-2
Stitch wire 5	Stranded conductor according to DIN 48201 T1 & T2 Stranded conductor according to NF C 34-110- 2 & 3 Stranded conductor according to BS 7884
Earthing wire 6	Stranded conductor according to DIN 48201 T1 & T2 Stranded conductor according to NF C 34-110-2 & 3 Stranded conductor according to BS 7884 Alu cables according to EN 50182 Alu cables according to IEC 61089 Alu cables according to NF C 34-120
Jumper 7	Stranded conductor according to DIN 48201 T1 & T2 Flexible stranded conductor according to NF F 55-681 Flexible stranded conductor according to DIN 43138

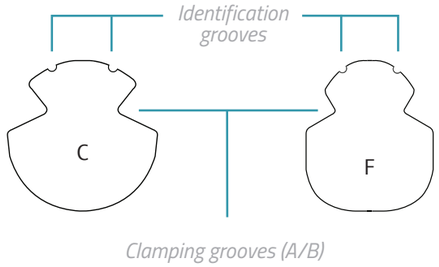
Other country specific specifications are also available

CONTACT WIRE ACCORDING TO EN 50149

Central to any catenary system, the contact wire provides electricity to metros, trams, trolley buses or trains. Lamifil contact wire is produced in our factory to EN 50149 and other standards. We also have the flexibility to meet any customer requirements in terms of shape, alloy and size, for both AC and DC lines.



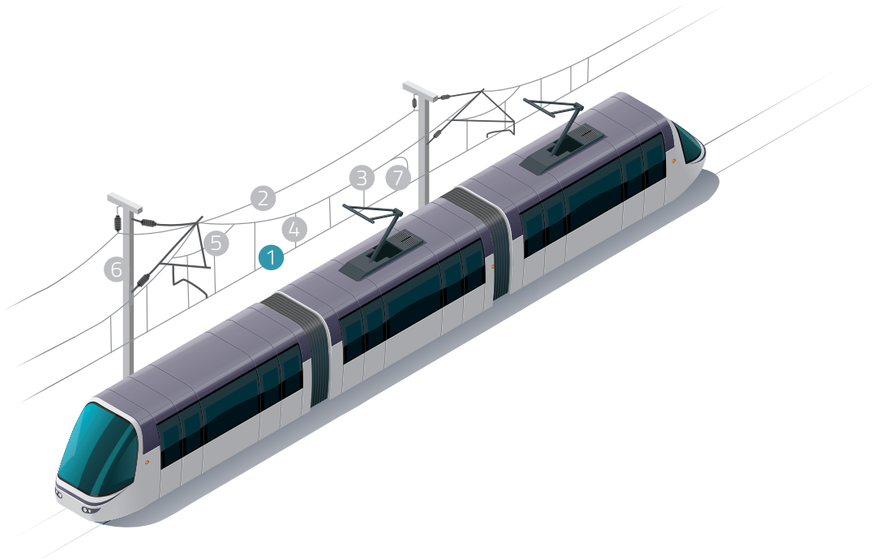
PROFILES



NOMINAL CROSS SECTION

Nominal cross section mm²		80	100	107	120	150
Ø (mm)	AC	10,60	12,00	12,30	13,20	14,80
	BC	-	12,00	12,24	12,85	14,50
	BF	-	11,04	11,35	12,27	13,60

E-module kN/mm²: 120 Linear expansion coefficient: 10-5/K Density 10³ Kg/m³: 8.89



1. Contact wire
2. Line feeder
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6. Earthing wire
7. Jumper

MECHANICAL AND ELECTRICAL PROPERTIES (EN 50149)

NOMINAL CROSS SECTION 80 MM²						
Type of alloy		**CuETp**	**CuAg 0,1**	**CuAg 0.1 HS**	**CuSn 0,2**	**CuSn 0.2 HC**
Min. breaking load Fm (1)	kN	29,1	28,3	29,1	35,7	35,7
Elongation at break A200	%	3 - 8	3-10	3-8	2-8	2-8
Min. tensile strenght Rm	N/mm²	375	365	375	460	460
Max. electrical resistance	Ohm/km	0,229	0,229	0,229	0,309	0,278
Min. electrical conductivity	% IACS	97	97	97	72	80
Max. resistivity	10-8 Ohm*m	1,777	1,777	1,777	2,395	2,155
Nominal mass	Kg/km	711,50	711,50	711,50	-	-
NOMINAL CROSS SECTION 100 MM²						
Type of alloy		**CuETp**	**CuAg 0,1**	**CuAg 0.1 HS**	**CuSn 0,2**	**CuSn 0.2 HC**
Min. breaking load Fm (1)	kN	36,4	34,9	36,4	43,7	43,7
Elongation at break A200	%	3 - 8	3-10	3-8	2-8	2-8
Min. tensile strenght Rm	N/mm²	375	360	375	450	450
Max. electrical resistance	Ohm/km	0,183	0,183	0,183	0,247	0,222
Min. electrical conductivity	% IACS	97	97	97	72	80
Max. resistivity	10-8 Ohm*m	1,777	1,777	1,777	2,395	2,155
Nominal mass	Kg/km	889,00	889,00	889,00	892,00	892,00
NOMINAL CROSS SECTION 107 MM²						
Type of alloy		**CuETp**	**CuAg 0,1**	**CuAg 0.1 HS**	**CuSn 0,2**	**CuSn 0.2 HC**
Min. breaking load Fm (1)	kN	37,4	36,3	37,4	44,6	44,6
Elongation at break A200	%	3 - 8	3-10	3-8	2-8	2-8
Min. tensile strenght Rm	N/mm²	360	350	360	430	430
Max. electrical resistance	Ohm/km	0,171	0,171	0,171	0,231	0,208
Min. electrical conductivity	% IACS	97	97	97	72	80
Max. resistivity	10-8 Ohm*m	1,777	1,777	1,777	2,395	2,155
Nominal mass	Kg/km	951,50	951,50	951,50	954,50	954,50
NOMINAL CROSS SECTION 120 MM²						
Type of alloy		**CuETp**	**CuAg 0,1**	**CuAg 0.1 HS**	**CuSn 0,2**	**CuSn 0.2 HC**
Min. breaking load Fm (1)	kN	41,9	40,7	41,9	48,9	48,9
Elongation at break A200	%	3 - 8	3-10	3-8	2-8	2-8
Min. tensile strenght Rm	N/mm²	360	350	360	420	420
Max. electrical resistance	Ohm/km	0,153	0,153	0,153	0,206	0,185
Min. electrical conductivity	% IACS	97	97	97	72	80
Max. resistivity	10-8 Ohm*m	1,777	1,777	1,777	2,395	2,155
Nominal mass	Kg/km	1067,00	1067,00	1067,00	1070,50	1070,50
NOMINAL CROSS SECTION 150 MM²						
Type of alloy		**CuETp**	**CuAg 0,1**	**CuAg 0.1 HS**	**CuSn 0,2**	**CuSn 0.2 HC**
Min. breaking load Fm (1)	kN	52,4	50,9	52,4	61,1	61,1
Elongation at break A200	%	3 - 8	3-10	3-8	2-8	2-8
Min. tensile strenght Rm	N/mm²	360	350	360	420	420
Max. electrical resistance	Ohm/km	0,122	0,122	0,122	0,165	0,148
Min. electrical conductivity	% IACS	97	97	97	72	80
Max. resistivity	10-8 Ohm*m	1,777	1,777	1,777	2,395	2,155
Nominal mass	Kg/km	1333,50	1333,50	1333,50	1338,00	1338,00

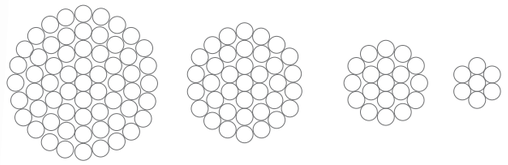
NOMINAL CROSS SECTION 80 MM²							
CuMg 0,2	**CuMg 0,2 HC**	**CuMg 0,2 UHC***	**CuMg 0,5**	**CuMg 0,5 UHC***	**CuMg / HS***	**CuCd 0,7**	**CuCd 1**
35,7	35,7	35,7	40,4	40,4	44,2	33,4	35,3
3-10	3-10	3-10	3-10	3-10	3-10	2-7	2-7
460	460	460	520	520	570	430	455
0,289	0,278	0,261	0,385	0,309	0,385	0,258	0,278
77	80	85	62	72	62	86	80
2,240	2,155	2,028	2,778	2,395	2,778	2,005	2,155
711,50	711,50	711,50	711,50	711,50	711,50	715,50	715,50
NOMINAL CROSS SECTION 100 MM²							
CuMg 0,2	**CuMg 0,2 HC**	**CuMg 0,2 UHC***	**CuMg 0,5**	**CuMg 0,5 UHC***	**CuMg / HS***	**CuCd 0,7**	**CuCd 1**
43,7	43,7	43,7	49,5	49,5	55,3	41,7	43,2
3-10	3-10	3-10	3-10	3-10	3-10	2-7	2-7
450	450	450	510	510	570	430	445
0,231	0,222	0,209	0,286	0,247	0,286	0,207	0,222
77	80	85	62	72	62	86	80
2,240	2,155	2,028	2,778	2,395	2,778	2,005	2,155
889,00	889,00	889,00	889,00	889,00	889,00	894,50	894,50
NOMINAL CROSS SECTION 107 MM²							
CuMg 0,2	**CuMg 0,2 HC**	**CuMg 0,2 UHC***	**CuMg 0,5**	**CuMg 0,5 UHC***	**CuMg / HS***	**CuCd 0,7**	**CuCd 1**
45,7	45,7	45,7	51,9	51,9	59,2	44,6	46,2
3-10	3-10	3-10	3-10	3-10	3-10	2-7	2-7
440	440	440	500	500	570	430	445
0,216	0,208	0,195	0,268	0,224	0,268	0,193	0,208
77	80	85	62	72	62	86	80
2,240	2,155	2,028	2,778	2,395	2,778	2,005	2,155
951,50	951,50	951,50	951,50	951,50	951,50	957,00	957,00
NOMINAL CROSS SECTION 120 MM²							
CuMg 0,2	**CuMg 0,2 HC**	**CuMg 0,2 UHC***	**CuMg 0,5**	**CuMg 0,5 UHC***	**CuMg / HS***	**CuCd 0,7**	**CuCd 1**
50,1	50,1	50,1	57,0	57,0	64,0	50,1	51,8
3-10	3-10	3-10	3-10	3-10	3-10	2-7	2-7
430	430	430	490	490	550	430	445
0,192	0,185	0,174	0,239	0,206	0,239	0,172	0,185
77	80	85	62	72	62	86	80
2,240	2,155	2,028	2,778	2,395	2,778	2,005	2,155
1067,00	1067,00	1067,00	1067,00	1067,00	1067,00	1073,50	1073,50
NOMINAL CROSS SECTION 150 MM²							
CuMg 0,2	**CuMg 0,2 HC**	**CuMg 0,2 UHC***	**CuMg 0,5**	**CuMg 0,5 UHC***	**CuMg / HS***	**CuCd 0,7**	**CuCd 1**
61,1	61,1	61,1	68,4	68,4	80,0	62,6	64,7
3-10	3-10	3-10	3-10	3-10	3-10	2-7	2-7
420	420	420	470	470	550	430	445
0,154	0,148	0,139	0,191	0,160	0,191	0,138	0,148
77	80	85	62	72	62	86	80
2,240	2,155	2,028	2,778	2,395	2,778	2,005	2,155
1333,50	1333,50	1333,50	1333,50	1333,50	1333,50	1341,50	1341,50

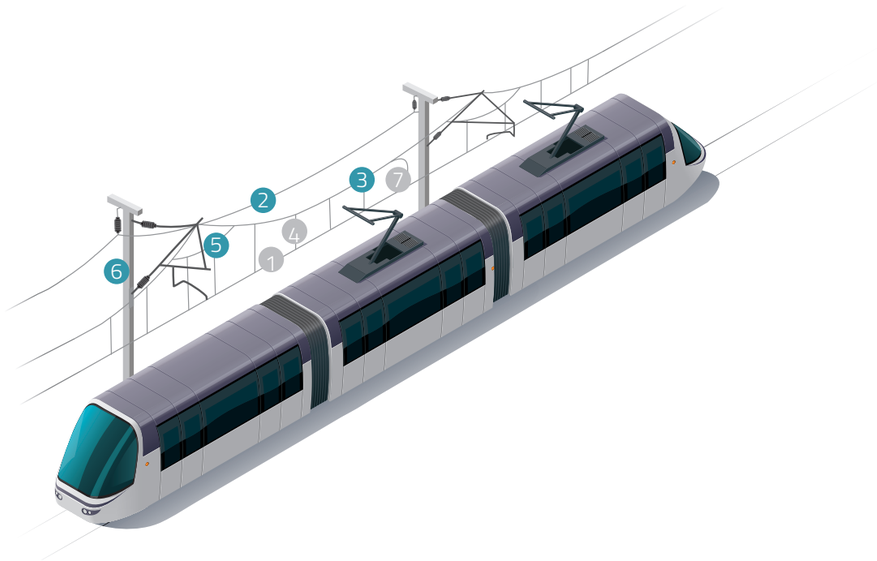
** Lamifil proprietary (1) Calculated on minimum cross sectional area*

STRANDED CONDUCTOR ACCORDING TO DIN 48201 T1 & T2

Supporting the catenary system, stranded conductors help to enable power transmission in overhead lines. Available for both AC and DC lines, these conductors are used as messenger cables, stitch wires, cross span conductors or earthing wire. Lamifil's stranded conductors are available in different sizes and alloys according to DIN 48201 T1&T2 standards and can be tailored to customer needs.

PROFILES





1. Contact wire
2. Line feeder
3. Messenger wire
4. Dropper
5. Stitch wire
6. Earthing wire
7. Jumper

MECHANICAL AND ELECTRICAL PROPERTIES

STRANDED CONDUCTOR ACCORDING TO DIN 48201 - T1

Material	Cross section		Number of wires	Wire Ø	Conductor Ø	Weight	Breaking load	Current (1)
	Nominal	Calculated					Calculated	
	mm²		#	mm	mm	kg/km	kN	A
Copper	10	10,02	7	1,35	4,1	90	4,02	90
	16	15,89	7	1,70	5,1	143	6,37	125
	25	24,25	7	2,10	6,3	218	9,72	160
	35	34,36	7	2,50	7,5	310	13,77	200
	50	49,48	7	3,00	9,0	446	19,84	250
	50	48,35	19	1,80	9,0	437	19,38	250
	70	65,81	19	2,10	10,5	596	26,38	310
	95	93,27	19	2,50	12,5	845	37,39	380
	120	116,99	19	2,80	14,0	1060	46,90	440
	150	147,11	37	2,25	15,8	1337	58,98	510
	185	181,62	37	2,50	17,5	1649	72,81	585
	240	242,54	61	2,25	20,3	2209	97,23	700
	300	299,43	61	2,50	22,5	2725	120,04	800
	400	400,14	61	2,89	26,0	3640	160,42	960
	500	499,83	61	3,23	29,1	4545	200,38	1110

(1) Conditions: frequency = 60Hz; wind velocity = 0,6m/s; ambient temperature = 35 °C; conductor temperature = 70 °C

STRANDED CONDUCTOR ACCORDING TO DIN 48201 - T2

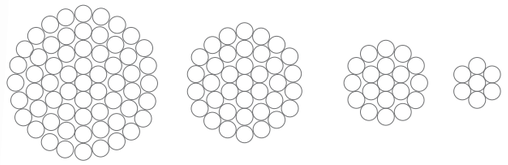
Material	Cross section		Number of wires	Wire Ø	Conductor Ø	Weight	Breaking load			Current (1)		
	Nominal	Calculated					Bz I	Bz II	Bz III	Bz I	Bz II	Bz III
	mm²	mm²	#	mm	mm	kg/km	kN			A		
Copper alloys	10	10,02	7	1,35	4,1	90	4,95	5,88	6,72	85	75	50
	16	15,89	7	1,70	5,1	143	7,85	9,33	10,66	115	100	70
	25	24,25	7	2,10	6,3	218	11,98	14,24	16,26	150	130	90
	35	34,36	7	2,50	7,5	310	16,97	20,17	23,05	185	160	115
	50	49,48	7	3,00	9,0	446	23,97	28,58	32,76	235	200	145
	50	48,35	19	1,80	9,0	437	23,88	28,39	32,43	235	200	145
	70	65,81	19	2,10	10,5	596	32,51	38,64	44,14	285	245	175
	95	93,27	19	2,50	12,5	845	46,08	54,76	62,56	355	305	215
	120	116,99	19	2,80	14,0	1060	56,68	67,57	77,46	410	350	250
	150	147,11	37	2,25	15,8	1337	72,67	86,37	98,67	470	410	290
	185	181,62	37	2,50	17,5	1649	89,72	106,63	121,81	540	465	330
	240	242,54	61	2,25	20,3	2209	119,81	142,40	162,67	645	560	395
	300	299,43	61	2,50	22,5	2725	147,92	175,80	200,83	735	635	450
	400	400,14	61	2,89	26,0	3640	193,87	231,12	264,95	890	765	540
	500	499,83	61	3,23	29,1	4545	242,17	288,70	330,96	1020	880	625

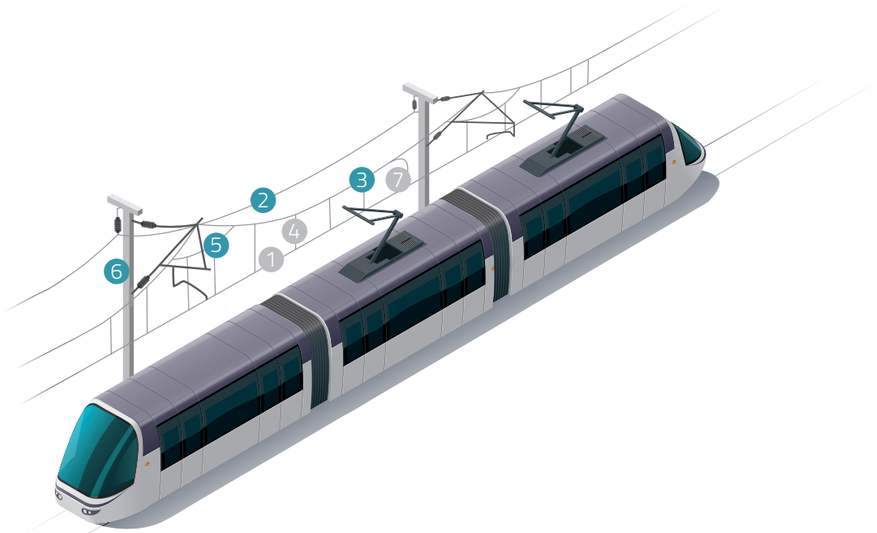
(1) Conditions: frequency = 60Hz; wind velocity = 0,6m/s; ambient temperature = 35 °C; conductor temperature = 70 °C

STRANDED CONDUCTOR ACCORDING TO NF C 34-110- 2 & 3 / NF F 55-681

Following other categories of conductivity than DIN, stranded conductors that meet NF C standards are produced according to slightly different specifications. These conductors can be used as messenger cables, stitch wires, cross span conductors or earthing wire. They are available for both AC and DC lines and can be produced by Lamifil to meet specific customer needs.

PROFILES





1. Contact wire
2. Line feeder
3. Messenger wire
4. Dropper
5. Stitch wire
6. Earthing wire
7. Jumper

MECHANICAL AND ELECTRICAL PROPERTIES

STRANDED CONDUCTOR ACCORDING TO NF C 34-110-2

Material	Designation	Composition		Conductors Ø	Nominal cross section	Linear resistance at 20°C	Max. load with accessories	Linear mass	Wire after untwisting: max. load lower limit		Calculated max. load
		Number of wires	Wire Ø								
			Nom.	Nom.		Max.	Min.	Nom.	Nom.	Min.	Min.
	mm²		mm	mm	mm²	Ω/km	daN	kg/km	daN	daN	daN
Alloy at 37%	116	37	2,00	14,0	116,24	0,451	8090	1050	239	222	8840
Alloy at 60%	22	7	2,00	6,00	21,99	1,35	1430	196	211	204	1470
	35	37	1,10	7,70	35,16	0,857	2330	317	68	63,4	2510
	48	19	1,80	9,00	48,35	0,620	3090	434	172	163	3260
	65	37	1,50	10,5	65,38	0,462	4190	590	123	114	4550
	93	37	1,80	12,6	94,15	0,320	5890	850	172	159	6360
	116	37	2,00	14,0	116,24	0,260	7190	1050	209	195	7730
	182	37	2,50	17,5	181,62	0,167	10420	1646	303	282	11210
Alloy at 72%	12	7	1,50	4,50	12,37	2,00	810	111	121	117	840
	22	7	2,00	6,00	21,99	1,12	1330	196	197	191	1370
	34	19	1,50	7,50	33,58	0,744	2150	303	120	113	2280
	48	19	1,80	9,00	48,35	0,518	2930	434	163	154	3090
	93	19	2,50	12,5	93,27	0,268	5360	840	297	281	5640
	116	37	2,00	14,0	116,24	0,216	6690	1050	195	181	7210
	148	19	3,15	15,8	148,07	0,169	7830	1330	445	413	8450
	182	37	2,50	17,5	181,61	0,138	10150	1646	296	275	10950
Alloy at 80%	16	7	1,70	5,10	15,89	1,40	930	142	137	133	950
	22	7	2,00	6,00	21,99	1,01	1270	196	187	181	1300
	35	19	1,50	7,50	33,58	0,669	1940	303	108	103	2050
	50	19	1,80	9,00	48,35	0,467	2740	434	152	144	2880
	70	19	2,10	10,5	65,81	0,343	3610	593	201	190	3810
	93	37	1,80	12,6	94,15	0,241	5220	850	152	141	5620
	116	37	2,00	14,0	116,24	0,195	6360	1050	186	172	6880
	148	37	2,25	15,7	147,11	0,154	7920	1330	230	214	8510
	182	37	2,50	17,5	181,62	0,125	9790	1646	286	265	10580

STRANDED CONDUCTOR ACCORDING TO NF F 55-681

Material	Designation	Composition	Wire Ø	Conductors Ø			Linear resistance at 20°C	Percentage elongation after fracture (l = 100)	Bendings on wires
		Number of wires		Min.	Nom.	Max.	Max.		Min.
	mm²		mm	mm	mm	mm	Ω/km	min %	#
Annealed copper	29,3	19	1,40	6,70	7,00	7,30	0,638	20	10
	48,3	19	1,80	8,60	9,00	9,40	0,386	20	7
	74,9	19	2,24	10,70	11,20	11,70	0,249	20	4
	240	61	2,24	19,30	20,15	21,00	0,078	25	4

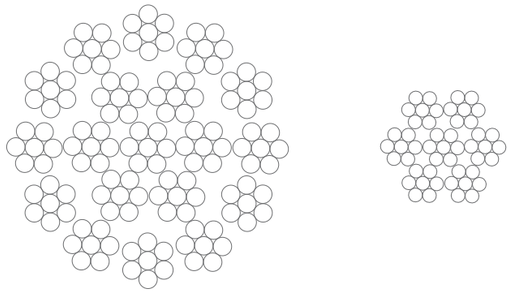
STRANDED CONDUCTOR ACCORDING TO NF C 34-110-3

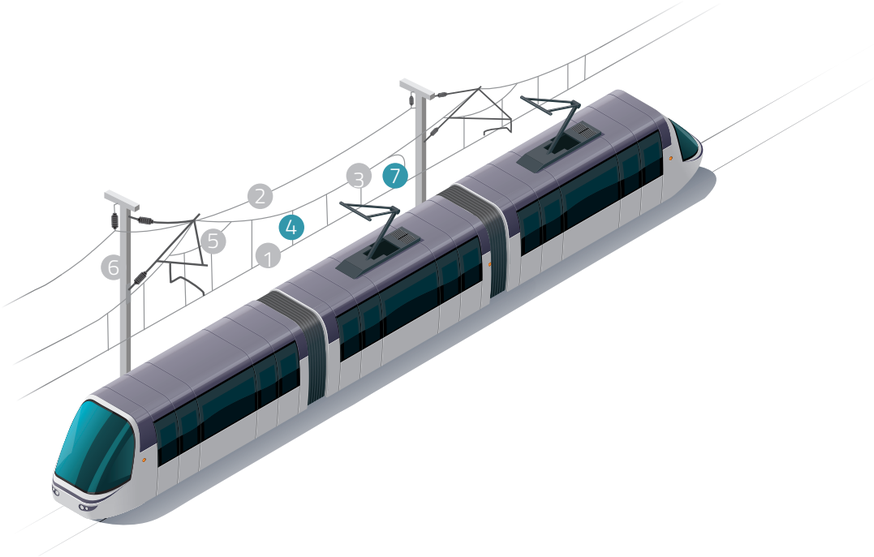
Material	Designation	Composition		Conductors Ø	Nominal cross section	Linear resistance at 20°C	Calculated max. load	Linear mass	Wire after untwisting: max. load lower limit	
		Number of wires	Wire Ø							
			Nom.	Nom.		Max.	Lower limit	Nom.	Mean value	Min.
	mm²		mm	mm	mm²	Ω/km	daN	kg/km	daN	daN
Hard drawn copper	5,5	7	1,00	3,0	5,5	3,34	236	48,2	35	31
	10,8	7	1,40	4,2	10,8	1,70	443	94,4	65	59
	12,4	7	1,50	4,5	12,4	1,48	509	108	75	67
	14,1	7	1,60	4,8	14,1	1,30	563	123	83	75
	17,8	7	1,80	5,4	17,8	1,03	713	156	105	95
	22	7	2,00	6,0	22,0	0,83	880	193	130	117
	24,2	7	2,10	6,3	24,2	0,76	944	212	139	125
	25,2	7	2,14	6,4	25,2	0,73	980	221	144	130
	27,6	7	2,24	6,7	27,6	0,67	1074	242	158	142
	34,4	7	2,50	7,5	34,4	0,53	1337	301	197	177
	29,2	19	1,40	7,0	29,2	0,63	1165	258	65	58
	38	19	1,60	8,0	38,2	0,486	1480	337	82	74
	48	19	1,80	9,0	48,3	0,384	1874	426	104	94
	60	19	2,00	10,0	59,7	0,311	2313	526	128	112
	75	19	2,24	11,2	74,9	0,248	2822	660	157	141
	93	19	2,50	12,5	93,3	0,199	3513	822	194	175
	116	37	2,00	14,0	116,2	0,161	4407	1028	128	116
	145,8	37	2,24	15,7	145,8	0,128	5374	1290	157	141
	181,6	37	2,50	17,5	181,6	0,103	6693	1606	195	175
	199,5	37	2,62	18,3	199,5	0,094	6930	1764	206	186
	228	37	2,80	19,6	227,8	0,082	7915	2015	236	212
	262	37	3,00	21,0	261,5	0,071	9086	2313	271	244
	288	37	3,15	22,0	288,3	0,065	9744	2550	290	261
	240	61	2,24	20,2	240,4	0,078	8564	2130	157	141
	299	61	2,50	22,5	299,4	0,063	10467	2653	195	175
	376	61	2,80	25,2	375,6	0,050	12604	3328	236	212
	522	61	3,30	29,7	521,7	0,036	17030	4622	319	287
	631	61	3,63	32,7	631,3	0,030	19975	5593	374	336
	886	91	3,52	38,7	885,6	0,021	28920	7856	351	316

FLEXIBLE STRANDED CONDUCTOR ACCORDING TO DIN 43138

Typically, flexible stranded conductors are used for jumpers, droppers and as bare auxiliary feeder cables in various railway applications. Fully compliant with DIN 43138 standards, these conductors can be custom-made according to your specific requirements. As jumper or connection cables are used to add extra current to the system, they need to provide the best possible conductivity. Dropper wires, in turn, require better mechanical strength as they are exposed to vibrations. Lamifil offers fatigue testing for dropper wires according to EN 50119 in its accredited lab.

PROFILES





1. Contact wire
2. Line feeder
3. Messenger wire
4. Dropper
5. Stitch wire
6. Earthing wire
7. Jumper

MECHANICAL AND ELECTRICAL PROPERTIES

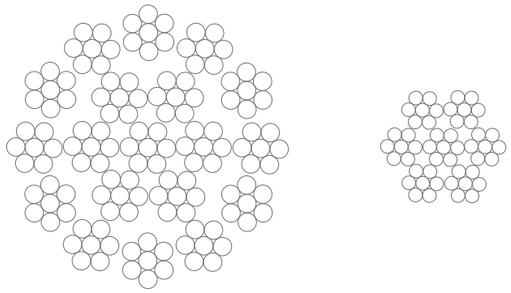
FLEXIBLE STRANDED CONDUCTOR ACCORDING TO DIN 43138												
Material	Designation	Cross section			Wire Ø	Conductor Ø	Weight	Wire after stranding			Current with wind velocity (1)	
		Nominal	Calculated				Conductor	Tensile strenght	Percentage elongation after	Test load	0,6 m/s	1 m/s
		mm²	mm²	#	mm ± 0,03	mm ± 5%	kg/km ± 8%	N/mm²	min %	N	A	A
Copper alloy	Bz II	10	9,6	49	0,50	4,5	89	589	-	116	-	-
		16	16,3		0,65	5,9	152			195		
		16	16,3	84	0,50	6,2	152			116		
		25	26,1	133	0,50	7,5	246			116		
		35	37,6		0,60	9,0	353			167		
Copper	E-Cu 58 DIN 1787 DIN 40 500 Teil 4	16	16,3	49	0,65	5,9	152	< 300	25	-	135	155
		25	26,1	133	0,50	7,5	246				180	205
		35	37,6		0,60	9,0	353				225	255
		50	51,2		0,70	10,5	482				280	310
		70	72,7	189		13,0	685	<300	25	-	340	370
		95	99,7	259		14,7	935				420	460
		120	118,5	336	0,67	16,4	1120				485	535
		150	150,9	392	0,70	18,3	1420				570	625
		185	185,1	525	0,67	20,4	1745	<300	25	-	660	720
		210	209,8	595		21,5	1980				720	780
		240	245,2	637	0,70	23,1	2320				785	850
		300	296,6		0,77	25,4	2800				895	970

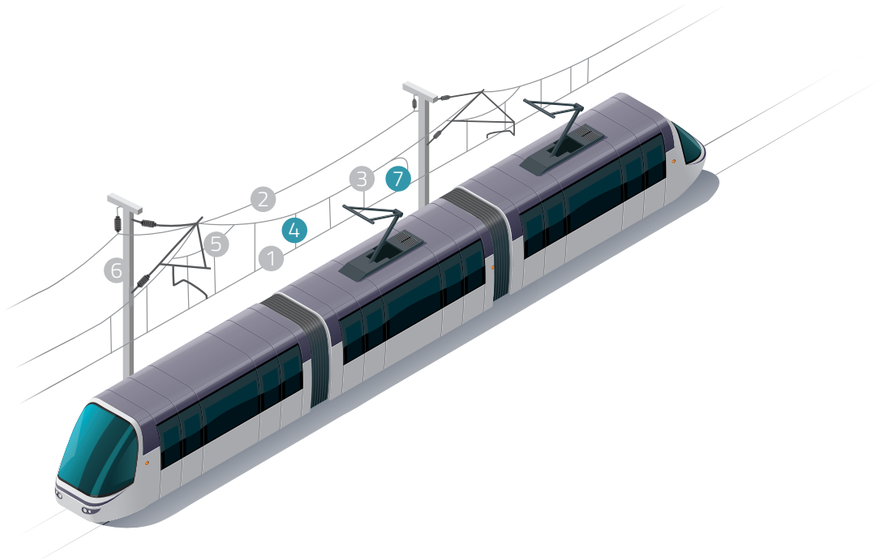
(1) Conditions: frequency = 60Hz, ambient temp. = 40 °C, conductor temp. = 80 °C

FLEXIBLE STRANDED CONDUCTOR ACCORDING TO NF C 34-110-2 / NF F 55-681

Lamifil provides flexible stranded conductors according to NF C/F standards, which are constructed according to slightly different specifications than DIN. They are used as jumpers (NF F 55-681), droppers (NF C 34-110-2) and as bare conductors in various catenary wire applications.

PROFILES





1. Contact wire
2. Line feeder
3. Messenger wire
4. Dropper
5. Stitch wire
6. Earthing wire
7. Jumper

MECHANICAL AND ELECTRICAL PROPERTIES

FLEXIBLE STRANDED CONDUCTOR ACCORDING TO NF C 34-110-2

Material	Designation	Composition: Number of wires		Composition: Wire Ø	Conductors Ø	Nominal cross section	Linear resistance at 20°C	Max. load with accessoiries	Linear mass	Wire after untwisting: max. load lower limit		Calc. max. load
				Nom.	Nom.		Max.	Min.	Nom.	Nom.	Min.	Min.
	mm²			mm	mm	mm²	Ω/km	daN	kg/km	daN		daN
Alloy at 72%	12 A	49	42	0,54	5,00	11,95	2,25	695	110	14,8	13,7	765
			7	0,65						20,6	19,2	
	12 B	49	42	0,54	5,00	11,95	2,120	695	110	14,8	13,7	765
			7	0,65						20,6	19,2	
Alloy at 80%	12 A	49	42	0,54	5,00	11,94	2,20	695	110	14,8	13,7	766
			7	0,65						20,6	19,2	
	12 B	49	42	0,54	5,00	11,94	2,05	695	110	14,8	13,7	766
			7	0,65						20,6	19,2	

FLEXIBLE STRANDED CONDUCTOR ACCORDING TO NF F 55-681

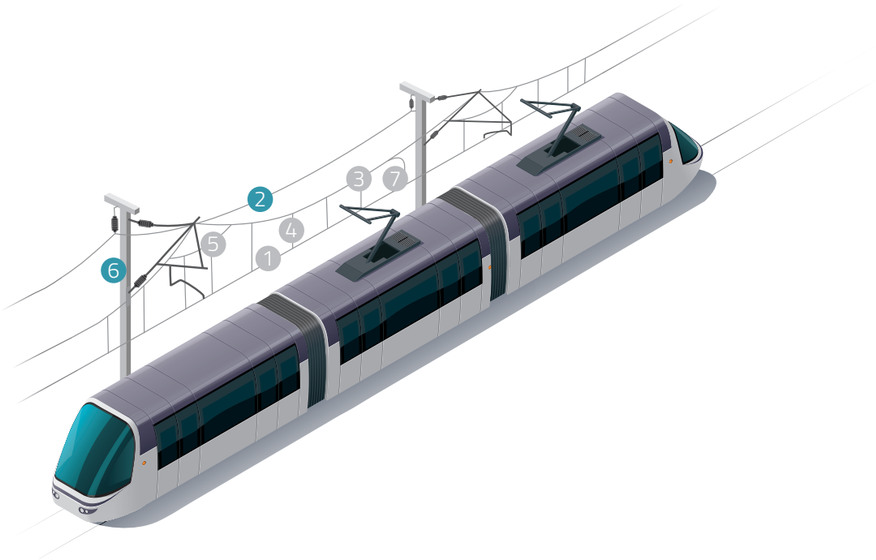
Material	Designation	Composition: Bunches	Composition: Number of wires per bunch	Composition: Wire Ø	Conductors Ø			Linear resistance at 20°C	Percentage elongation after fracture (l = 100)		Bendings on wires
					Min.	Nom.	Max.	Max.			Min.
	mm²			mm	mm	mm	mm	Ω/km	min %	max %	#
Annealed copper	26 (1)	19	7	0,50	7,30	7,50	7,70	0,735	10	20	27
	50	37	7	0,50	10,10	10,50	10,90	0,378	20		27
	75 (1)	37	7	0,61	12,50	12,70	12,90	0,263	10	20	21
	95	37	7	0,68	13,70	14,30	14,90	0,204	25		21
	104,5	19	7	1,00	14,40	15,00	15,60	0,184	28		11
	147	37	7	0,85	17,20	17,90	18,60	0,131	28		15
	164 (1)	37	7	0,90	18,10	18,35	18,60	0,122	10	20	15

(1) 95 % of the wires must have ≥ 10% elongation after fracture

ALU CABLES

With its expertise in Aluminium manufacturing, Lamifil offers an extensive range of in-house produced aluminium cable types to EN 50182 standards, including All Aluminium Conductors (AAC), All Aluminium Alloy Conductors (AAAC) and Aluminium (Alloy) Conductor Steel Reinforced Conductors (A(A)CSR).

Lamifil's aluminium product range covers the entire spectrum of bare conductors used in power grids and railway infrastructure. We also offer a full range of conventional conductors as well as exclusive designs used for high-temperature low-sag environments. In several conductor designs, Aluminium Zirconium is used to allow continuous operating temperatures of up to 230°C or 310°C peak. Other designs use fully annealed aluminium.



1. Contact wire
2. Line feeder
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6. Earthing wire
7. Jumper

MECHANICAL AND ELECTRICAL PROPERTIES

ALUMINIUM CABLE EXAMPLES

Code	Old code	Area	Nulber of wires	Wire Ø	Ø		Mass per unit length	Rated strength	DC resistance	Final modulus of elasticity	Current carrying capacity
AAC											
					Wire	Conductor					
		mm²			mm	mm	kg/km	kN	Ohm/km	N/mm²	A
93-AL1	95	93,3	19	/	2,50	12,5	256,3	16,32	0,3081	57000	340
243-AL1	240	242,5	61	/	2,25	20,3	671,1	43,66	0,1193	55000	625
AAAC											
					Wire	Conductor					
		mm²			mm	mm	kg/km	kN	Ohm/km	N/mm²	A
93-AL3	95	93,3	19	/	2,50	12,5	256,0	27,51	0,3546	57000	320
243-AL3	240	242,5	61	/	2,25	20,3	670,3	71,55	0,1373	55000	585
ACSR											
		Al	Steel	Total	Al	Steel	Al	Steel	Core	Conductor					
		mm²	mm²	mm²			mm		mm	mm	kg/km	kN	Ohm/km	N/mm²	A
94-AL1/ 15-ST1A	95/15	94,4	15,3	109,7	26	7	2,15	1,67	5,01	13,6	380,6	34,93	0,304	77000	350
243-AL1/ 39-ST1A	240/40	243,1	39,5	282,5	26	7	3,45	2,68	8,04	21,8	980,1	85,12	0,1188	77000	640

FLEXIBLE SERVICES

At Lamifil, we are not only committed to providing products that meet and exceed the highest possible standards. We are also dedicated to addressing your specific needs and challenges with flexible services. These range from product design, development and testing to marking and packaging.

MARKING

Lamifil offers different marking options for catenary wires, offering benefits for various industry challenges in terms of security, logistics, installation, maintenance and others.

TRACEABILITY

Imprinting a unique production code, project name or client name makes it easier for installation crews to recognise wires and their intended application. Furthermore, production lot coding enhances traceability for fault detection and maintenance.

THEFT

To discourage theft, anti-theft markings are a primary deterrence. We can also add an extra alloy that pollutes the value of the copper when melted. Both methods discourage theft and allow for traceability when stolen materials are intercepted.

IDENTIFICATION

Marking catenary wires with an extra groove or by using a Trapezoidal (T) shaped wire or tinned wire in the cable, makes it easier to identify the type of material used for replacement purposes.

PACKAGING

Efficient packaging reduces weight, volume and transportation costs while enabling faster, more reliable installation. We work together with you to determine the best solution and offer many options to suit your needs.

SPECIALLY DESIGNED DRUMS

Specially designed drums simplify on-site handling with square spindle holes instead of traditional round ones. These are easily fitted to the customer's installation devices.

MARKING OPTIONS

Marking options aid identification and allow for quicker, more accurate installation.

RETURN POLICY

The option of returning your drums is a quick, convenient and practical way of reducing waste and minimising your ecological footprint.

ACCREDITED LABORATORY

Our ISO 17025-accredited on-site laboratory not only enables us to guarantee the quality of products but also to pursue new innovations as well.

360° COMMITMENT

As part of the continuous monitoring of our production processes, we perform quality checks on samples at every step. This ensures full traceability and the highest quality of our products at all times.

We are continuously developing new designs either in collaboration with our clients or on our own initiative. Our independent materials laboratory is specifically equipped and recognised for all industry tests and international quality standards and can be sourced independently of production by Lamifil.

Our laboratory is open to our customers for Factory Acceptance Testing (FAT), enabling them to assess the performance of their own products.

CUSTOM DESIGN

At Lamifil, you and your project are always our highest priority. Including us in the design phase of your project allows us to produce a superior product that is better suited to your specific needs. We use our experience and expertise to tailor your catenary wires to the unique constraints of your project. At the same time, we work with you to identify methods of reducing your operational cost and your capex.

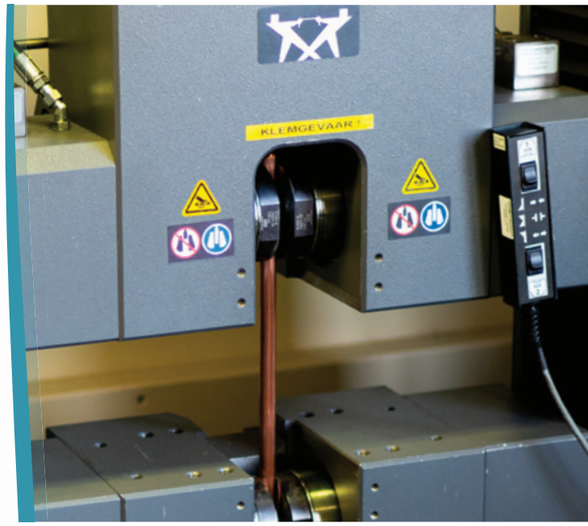
ISO 9001 - ISO 14001
OHSAS 18001
BUREAU VERITAS
Certification

Certificatenr.
494-TEST

MECHANICAL AND ELECTRICAL TESTING

Through our in-house ISO 17025 certified laboratory, Lamifil offers a complete range of mechanical and electrical test solutions for all common standards of copper and copper alloy wires. Thanks to its accreditation, field experience and state of the art testing environment, our lab covers the testing needs of owners and installers from around the world.

The facilities and expertise on offer at the Lamifil test lab enables our customers to perform a wide range of custom tests as well as join participatory research. In addition to Factory Acceptance Testing (FAT), our lab is also fully equipped for creep tests, featuring realistic simulations including temperature and load control. The laboratory also boasts extensive capabilities for mechanical fatigue and breaking load testing, with the latter featuring a 500kN and 18m long test bench. Current capacity and heat testing is possible with application of up to 2000A.



A RELIABLE PARTNER

meeting your standards

As a fully vertically integrated and independent manufacturer, Lamifil combines in-depth metallurgical knowledge with unrivalled flexibility to better serve our customers' needs. Our willingness to solve problems and overcome challenges has led to Lamifil being awarded the highest rating in customer satisfaction surveys.

"Let us show you the Lamifil difference at any and every stage of your project."

CONSTANT INNOVATION

From our founding expertise in copper and copper alloys 90 years ago, Lamifil continuously invests in production facilities and the latest technology to offer its customers the widest choice and best options for their needs. This investment in innovation ranges from 6 to 10% of our annual GVA. Ongoing investment in our laboratory enables us to remain at the forefront of technological development and place the latest innovative designs at your disposal.

A HIGHLY SKILLED TEAM

The majority of Lamifil's key personnel boast engineering backgrounds and a significant percentage of them work in Research & Development. Along with a continuous commitment and investment in training programmes, Lamifil's people make us what we are: a specialised, flexible organisation with an extraordinary capacity to design solutions that meet every customer need.

LOGISTICS SERVICES

Our own in-house logistics department ensures that we can meet your delivery schedules, including Just-In-Time delivery. Our location near the port of Antwerp gives us further shipping options, while optimising transport costs. Our multilingual team has considerable experience with international customers, having managed and successfully concluded projects in over 30 countries.

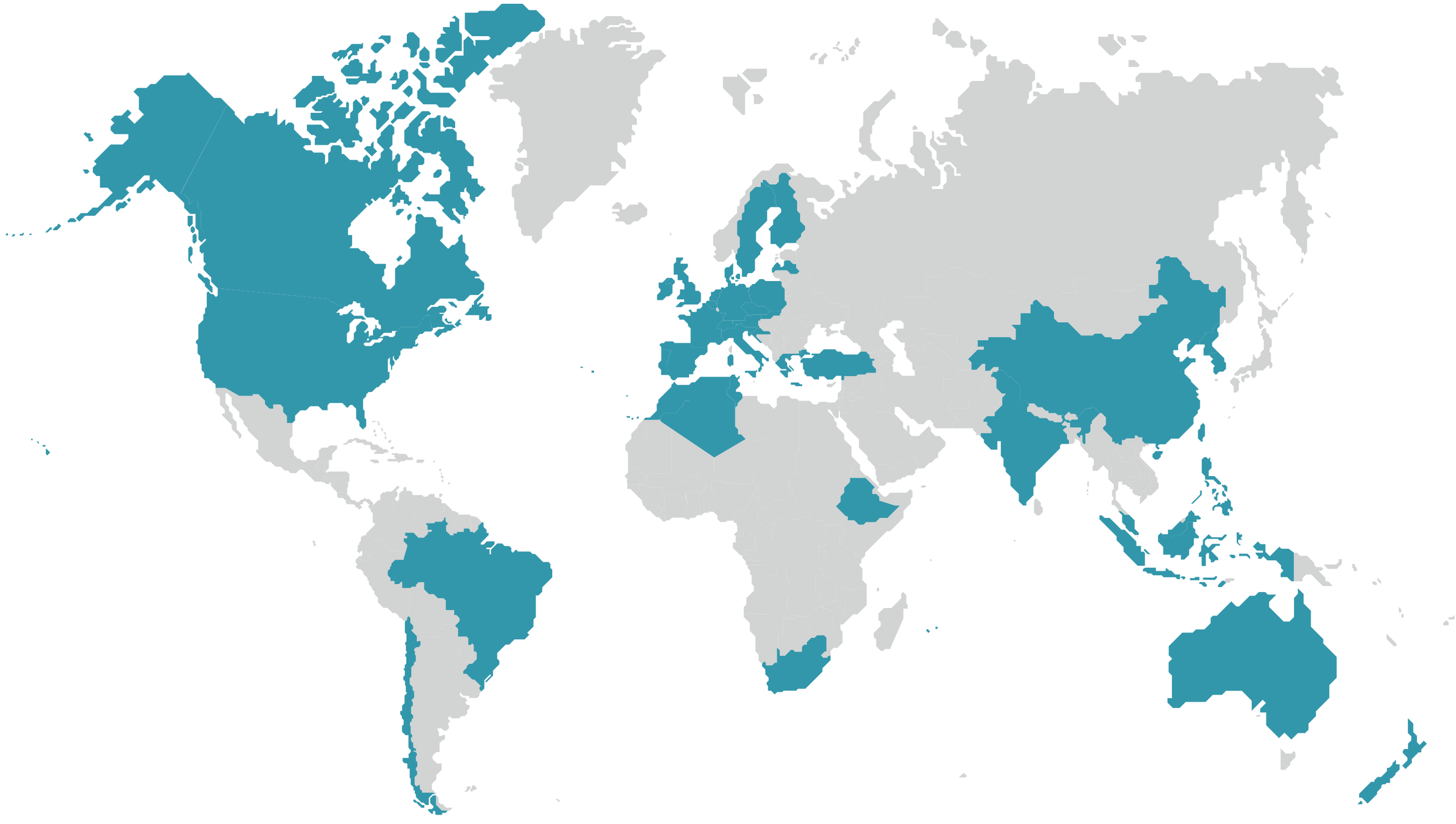
IN HOUSE PRODUCTION

Because Lamifil owns, manages and regularly tests the entire production process, we are able to start with raw materials and end with products whose quality we can guarantee with certainty. From the exact composition of the catenary wire to the size and consistency of contact wires, we offer our customers what few others can: the confidence to call us a reliable partner.

REFERENCES

Lamifil has over 90 years of experience in developing and manufacturing products for railway electrification with over 100,000km of wires installed in over 30 countries worldwide. We offer full technical support at any and every stage of your project: from the design phase to the tender phase, manufacturing and/or delivery.

> *“Over 100 000 km of wires installed in over 30 countries worldwide.”*



LAMIFIL

At Lamifil, 90 years of technology, innovation and mastery are forged into smart wires that bring connections to life. Today, Lamifil is one of the world's leading manufacturers of high-end cables, wires and wire-based products in copper v aluminium and their alloys. We help supply energy to millions of people with high-tech overhead conductors. Our catenary wires make trains run more efficiently in dozens of countries. Our innovative alloys are used in superior semi-finished products for the steel, automotive, aviation, aerospace and consumer products industry. Lamifil has production sites in Hemiksem (Belgium), close to the port of Antwerp, and in Uglich (Russia).

LAMIFIL NV
Frederic Sheidlaan
B-2620 Hemiksem, Belgium

T. + 32 (0)3 8700 611
F. + 32 (0)3 8878 059
info@lamifil.be
www.lamifil.be

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