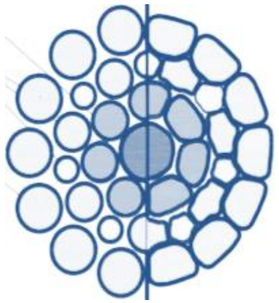
Energoservis Engineering Company

Complex innovative products for overhead power lines of 35–750 kV and energy infrastructure of Railways

Providing simple solutions to complex challenges

A comprehensive proper usage of plastically compacted wires for the new construction and reconstruction of OHL 35-750 kV and railway contact network can significantly increase their reliability when exposed to the entire range of climatic loads, increase throughput, reduce capital
and operating costs.

Maximum coefficient of filling in the least costly way



- The new principle of production of plastically deformed unidirectional twisted conductors and Ground-wire (including OPGW) turned out a very promising direction in the development of the conductors production technology. The most attractive features of new conductors type are: an effective use of the internal volumetric space, better mechanical strength and carrying capacity at a very moderate costs, reduction of aerodynamic load and icing, low operating elongation and excellent stability.

- **First Prize «For the Best Implemented Innovative Project for PJSC Rosseti» (Russian Grid Co)**
- **The wire is CERTIFIED in Russia and the EU!**
- **27 Patents in Germany, France, Austria and Russia**

Experience of 18,000 km of transmission lines

VDE INSTITUTE

cigré INTERNATIONAL COUNCIL ON LARGE ELECTRIC SYSTEMS

The general technological principle - plastic deformation

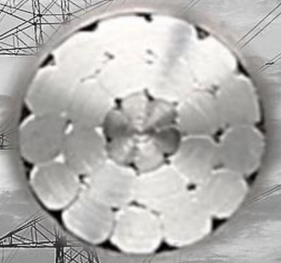
High strength (ASHS, tmax=90°C) and high temperature (ASHT, tcw=150°C,tmax=210°C) performance

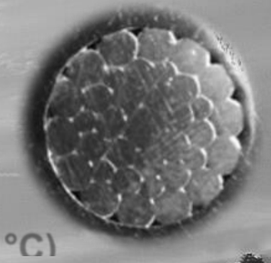
- Due to its design features, ASHT high-temperature wire is cheaper by several times regarding to analogs with a long-term permissible temperature of 150 °C.
- Continuous permissible current for high-temperature conductor is 30-70% higher than the value for standard conductor of the same diameter.

Products for new overhead power lines (OHL)

The cross sections for aluminum from 90 to 700 mm² for OHL 35 - 750 kV. (ASHT/ASHS)

Products for reconstruction of old OHL without replacement of supports





The cross sections for aluminum from 90 to 700 mm² for OHL 35 - 750 kV. (ASHT/ASHS)

For overhead power lines 6 - 110 kW. (tmax=90°C)

Comprehensive proper usage of plastically compacted ASHS/ASHT conductors for the new construction and reconstruction of OHL 35-750 kV can significantly increase their reliability when exposed to the entire range of climatic loads, increase throughput, reduce capital and operating costs.

Almost all the exploitation parameters of the new conductors important for the OHL designer do exceed greatly than those for ordinary ones, for a very moderate cost.

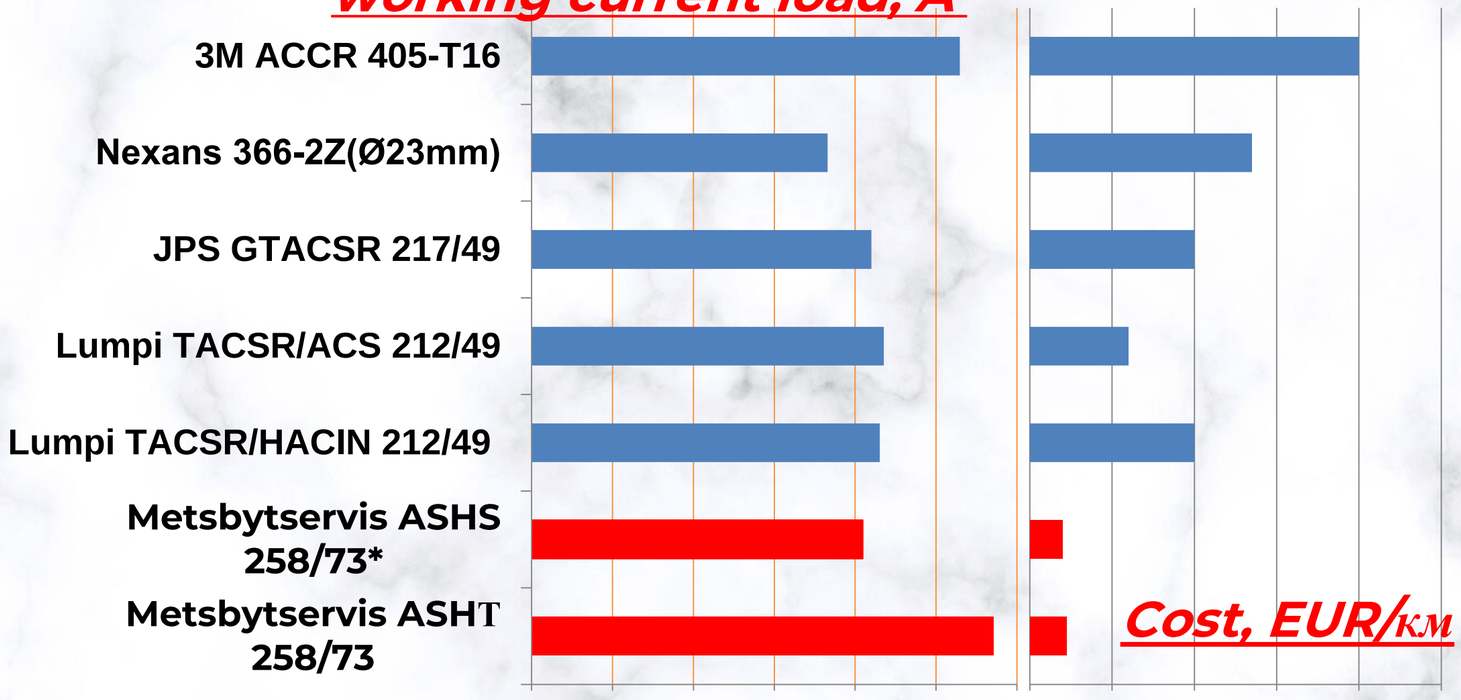
- ❖The new conductors are excellent for new construction in regions with excessive wind/ice loads or for extended transition.
- ❖Our conductors don't demand difficult and expensive fittings.
- ❖The high-temperature execution are optimum for:
- ✓ In case of application for repair/upgrading works at the old OHL, new conductors, especially considering their rather low cost.
- ✓ In constructing the ring network circuits and network with the possibility of congestion during the post-emergency modes
- ✓ In regions with high air temperatures

- ❖The most effective integrated use ACHS/ACHT together with Ground-wire cables (OPGW) by Energoservice, possessing similar mechanical characteristics.

Comparative analysis
by PJSC "Rosseti" (State Russian Grid Company)

The fundamentally new technology provides costs on conductors ASHS/ASHT and refurbishment of overhead line with these conductors.

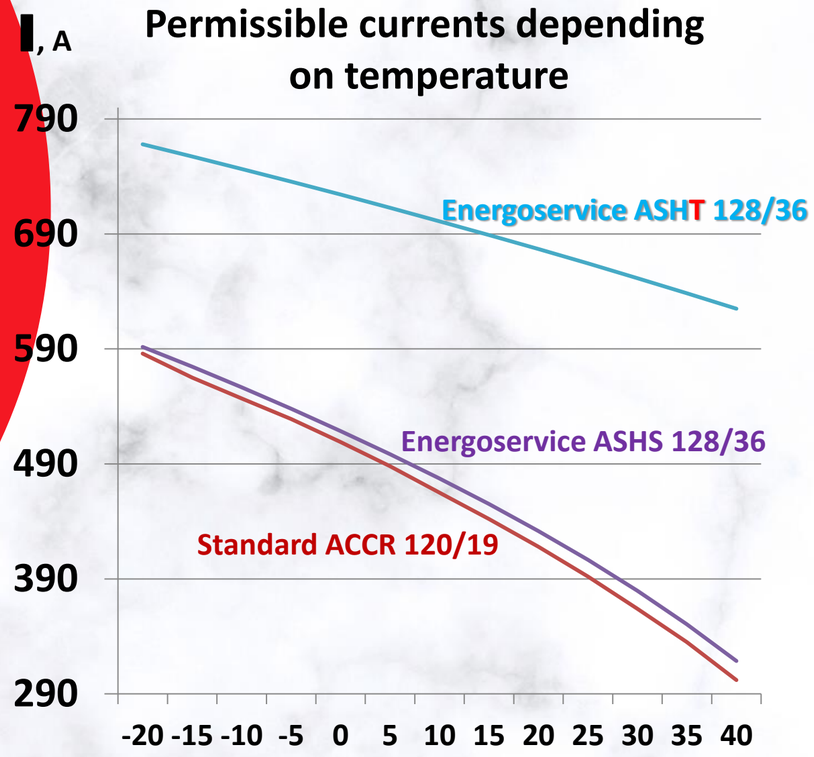
Comparison of conductors Ø 21mm, with similar characteristics.

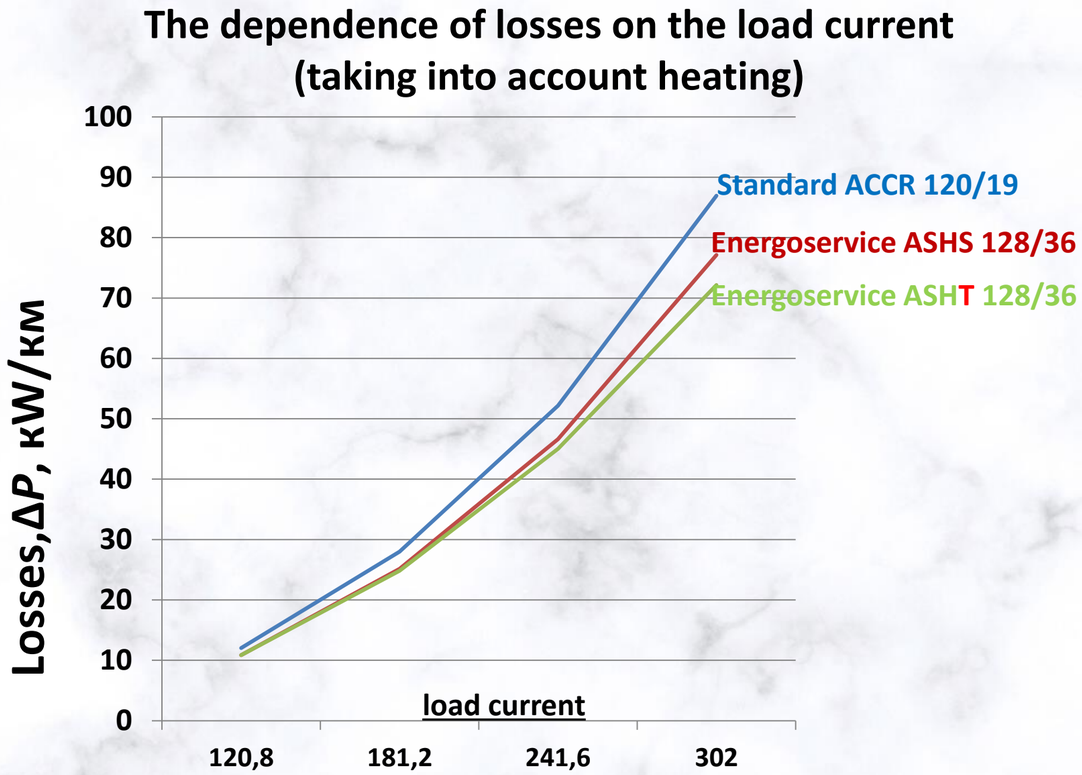


Electrical resistance of 1 km of conductor

The high-temperature wire provides a reserve of throughput and its specified values during heating, without requiring an increase in the cross section. In turn, the use of conventional wire, in regions with high temperatures, may generally entail risks of loss of system reliability.

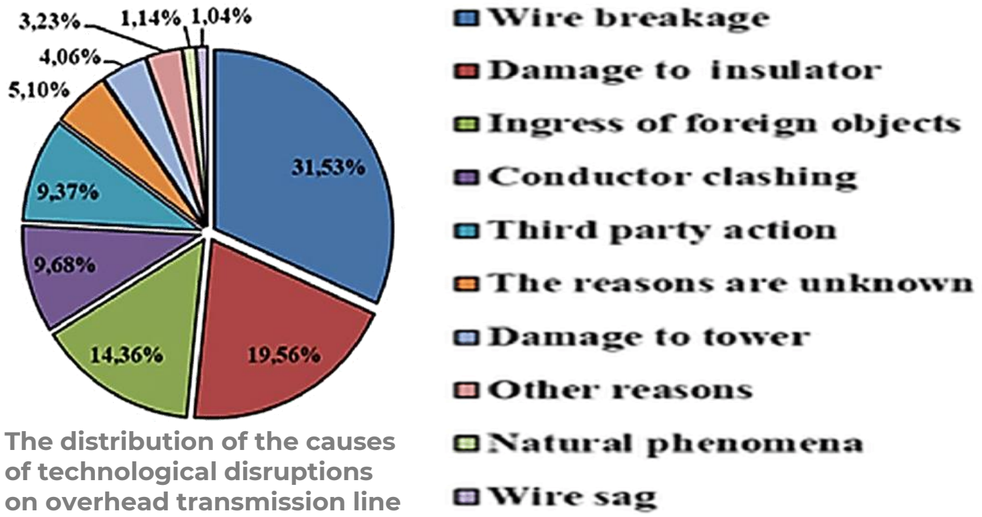
However, the use of our wire (ASVT) does not increase the cost.





- **Plastic deformation not only significantly increases the torsional rigidity and mechanical strength, but also reduces the stretching (elongation) during operation by several times..**

Line accident risk reduction



The distribution of the causes of technological disruptions on overhead transmission line

- The application of plastic compression products makes it possible to reduce the wind load. Conductors ASHS/ASHT by Energoservice, having streamlined design is lower by 33% on the average.

- The ASHS wire due to the closer contact of the single strands, the initial amplitude and period of oscillation is approximately 1.7 times less than that of the standard ACSR at the same dialed speed of the bent conductor under impulse action.
Vibration after the disturbing effect is extinguished due to the expenditure of energy on the internal friction between the strands.

- Provide reduced corona, noise Radio interference

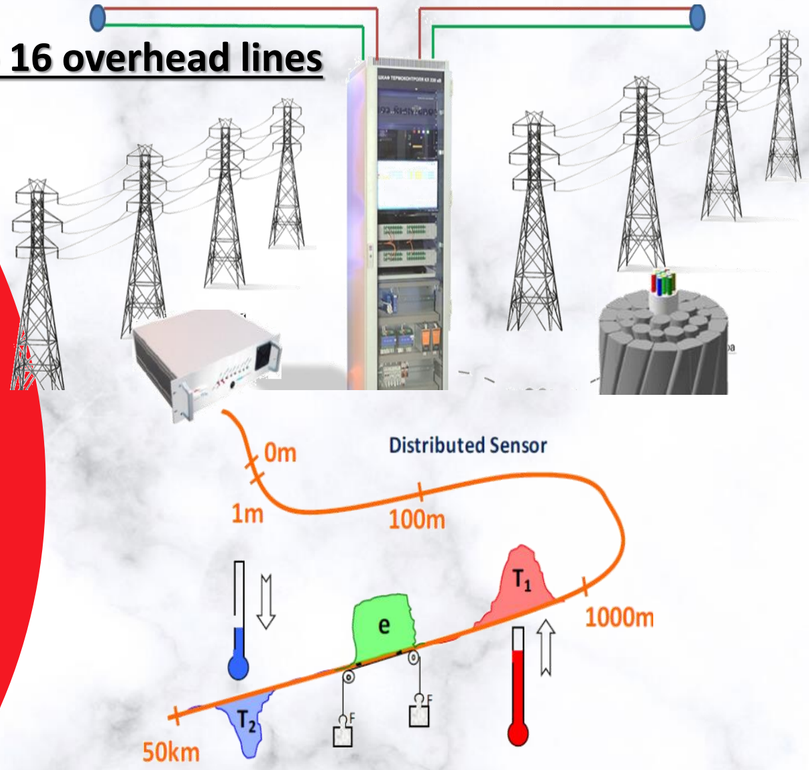
Conductors	Average annual losses, change, %
ASCR 240/32 ∅ 21,6 мм	+ 26,67%
ASCR 300/39 ∅ 24,0 мм	0,00%
ASCR 330/43 ∅ 25,2 мм	-13,33%
ASHS 317/47 ∅ 22,3 мм	-13,33%
ASHS 295/44 ∅ 21,5 мм	-6,67%

- The design ASHS/ASHT provides:
- Icing reduction - Due to high torsion stiffness and smaller diameter

- A significant reduction lengthening in operating drawing plastically deformed conductors are confirmed by series of experiments.

Integrated system for monitoring the status of all elements of the overhead line 35-750 kV in real time ("Smart Line")

One system controls up to 16 overhead lines



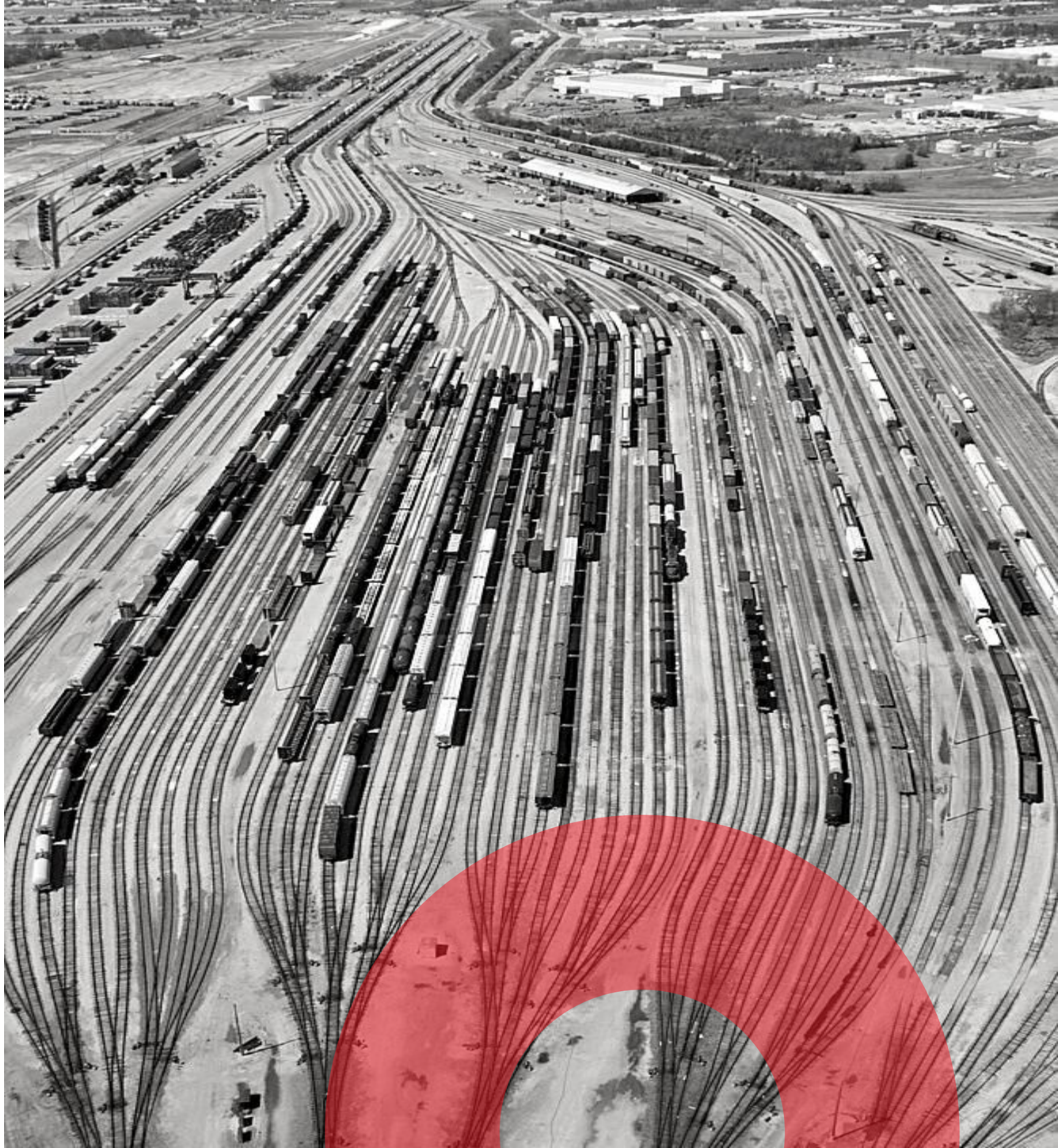
- ✓ The base conductor increases the capacity of high-voltage power lines (OHL) and reduces energy losses due to innovative designs of wires and conductors based on aluminum alloys micro-alloyed with zirconium

- ❖exclusion of catastrophic accidents on overhead lines, and the risks of failure of expensive equipment;
- ❖prevention of technological disturbances at enterprises of consumers, energy, associated with interruption of power supply;
- ❖optimization of overhead line repair planning;
- ❖detection of internal wire defects before the accident;
- ❖reduction of operating costs for the maintenance of overhead lines;
- ❖reduction of electricity losses (depends on the volume of implementation and replication);
- ❖the ability to take into account the reduction of the carbon footprint (minimization of generation to compensate for losses):increasing the reliability of life support for the population.

CARRIER CABLE OF CONTACT NETWORK

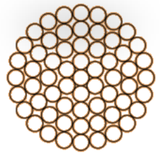
Experience of application - the busiest areas of the South-Ural, West Ɜ East Siberian and Sverdlovsk Railway

- The construction enables the production of a copper suspension rope with high strength and without the use of alloys, which i.a. leads to a significant cost reduction.
- Significantly higher permissible currents without overheating the rope are ensured.
- The construction ensures that the stress on all elements of the overhead lines caused by vibrations is significantly reduced.
- An increase in reliability and effectiveness at higher loads and utilization are ensured.



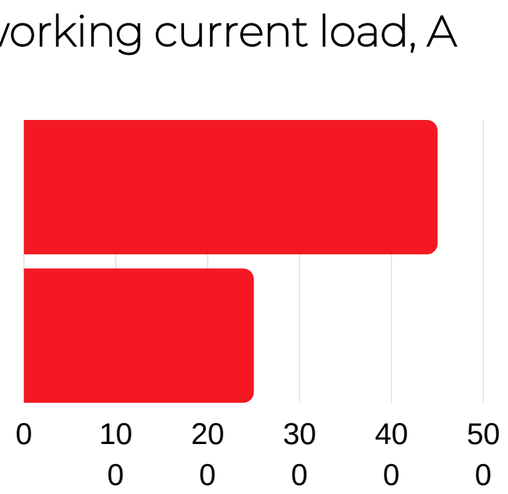
A plastically deformed CARRIER cable for railways

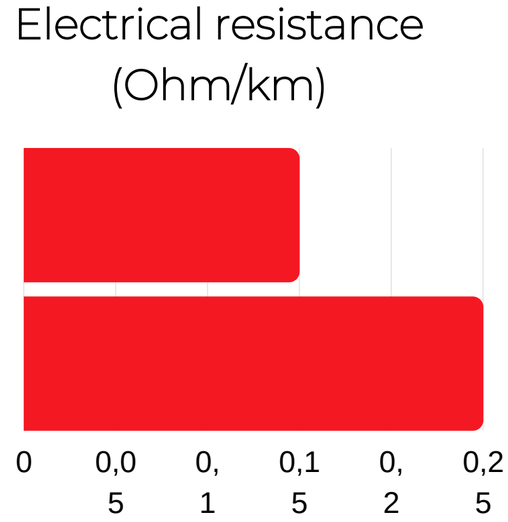
Comparison (diameter 14mm)



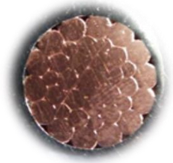
MK120-HS-4 Metsbytservis

Bz III (DIN48201) EU

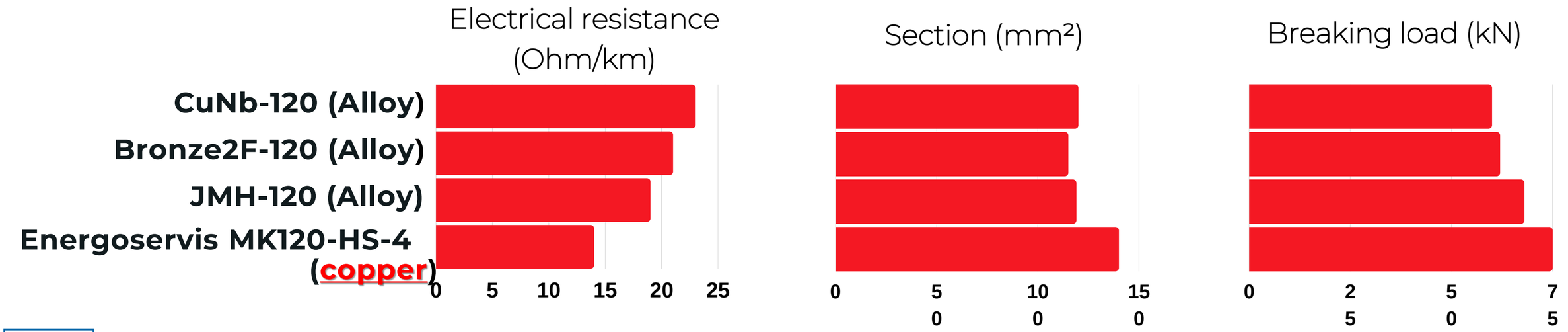




The 100% copper carrying rope MK (without steel inserts), with which we also supply the Russian Railways (RZD), corresponds almost completely to the properties of Bz II.



Compare with other similar products from global companies



Russian Railways

SNCF

DB NETZE

DB Netz AG

We thank you for your attention

We want to significantly improve our products in order to make your business more attractive and to reduce costs.

Applications

Testing of corona discharge

ASHS 197/55 wire manufactured by compacted technology has corona discharge voltage 142.2 kV by 5.7% higher than ACSR 185/29 conductor 134.5 kV with the same diameter 18.8 mm

Conductors	Average annual losses, change, %
ASCR 240/32 ∅ 21,6 мм	+ 26,67%
ASCR 300/39 ∅ 24,0 мм	0,00%
ASCR 330/43 ∅ 25,2 мм	-13,33%
ASHS 317/47 ∅ 22,3 мм	-13,33%
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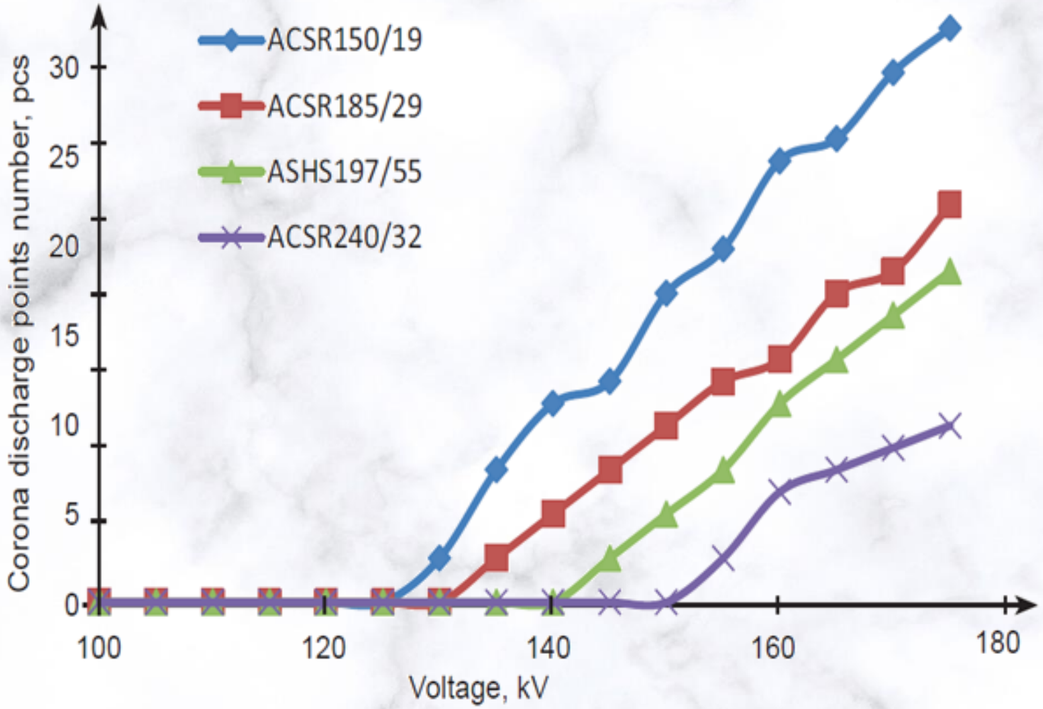


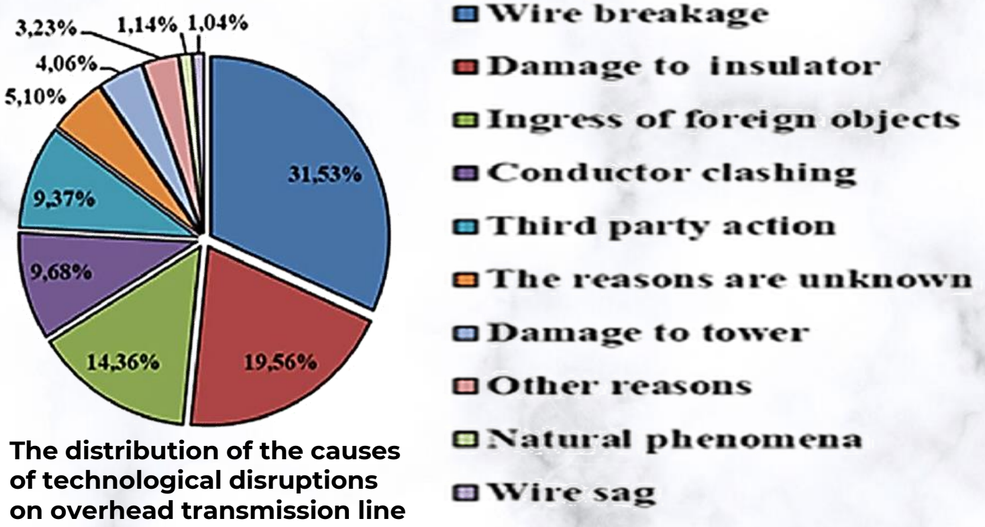
According to the conditions of the corona ASHS / ASHT 216/33 - Ø 18.5 mm, comparable to ASCR-240/32 - Ø 21.6 mm

Smaller diameter will reduce stress on all elements of OHL and cost, without increasing losses

Radio interference voltage test
(ASHT 216/33, FGH Engineering & Test GmbH)

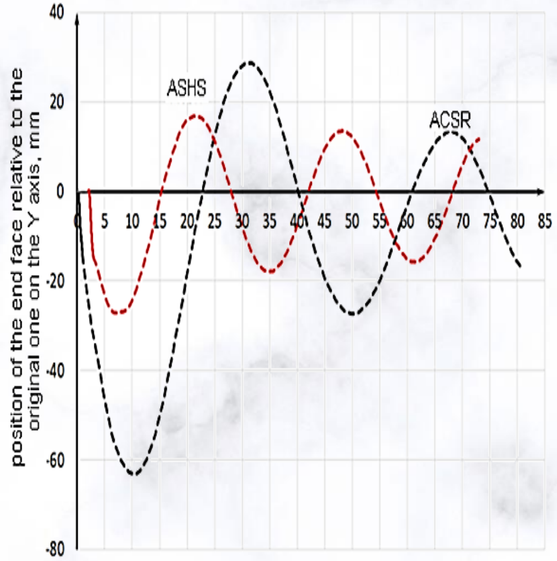
applied voltage kV	measured radio interference voltage		
	decreasing of applied voltage µV	increasing of applied voltage µV	decreasing of applied voltage µV
167,7	25000	25300	27400
153,7	13300	12400	12600
139,7	8750	9500	6600
125,7	84	4500	2066
111,8	79	3000	76
97,8	72	67	63
83,8	58	60	54
70,0	54	52	46
55,9	46	45	42
41,9	42	42	40

Line accident risk reduction



The distribution of the causes of technological disruptions on overhead transmission line

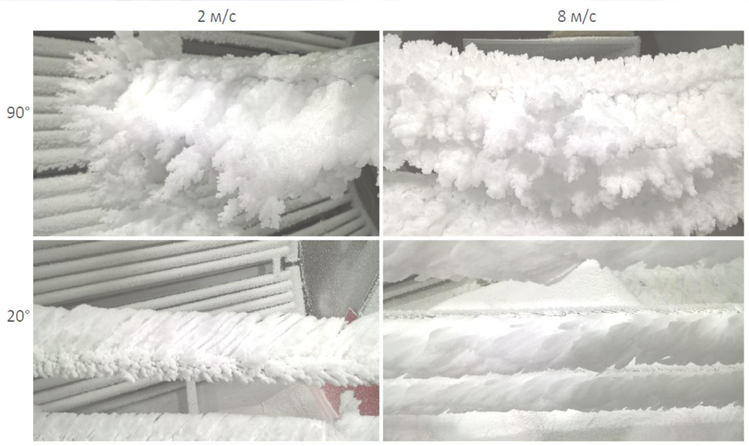
► **Oscillation:** The ASHS wire 128/36 due to the closer contact of the single strands, the initial amplitude and period of oscillation is approximately 1.7 times less than that of the ACSR wire 120/27 at the same dialed speed of the bent conductor under impulse action.
Vibration after the disturbing effect is extinguished due to the expenditure of energy on the internal friction between the strands.
In wires that are compacted due to plastic deformation, developed contact areas are obtained both inside the layer and they enter the empty space in neighboring layers, so the displacement of the layers relative to each other is difficult.
Self-quenching of vibrations is provided.



►The application of plastic compression products makes it possible to reduce the wind load. Conductors ASHS/ASHT by Energoservice, having streamlined design is lower by 33% on the average.

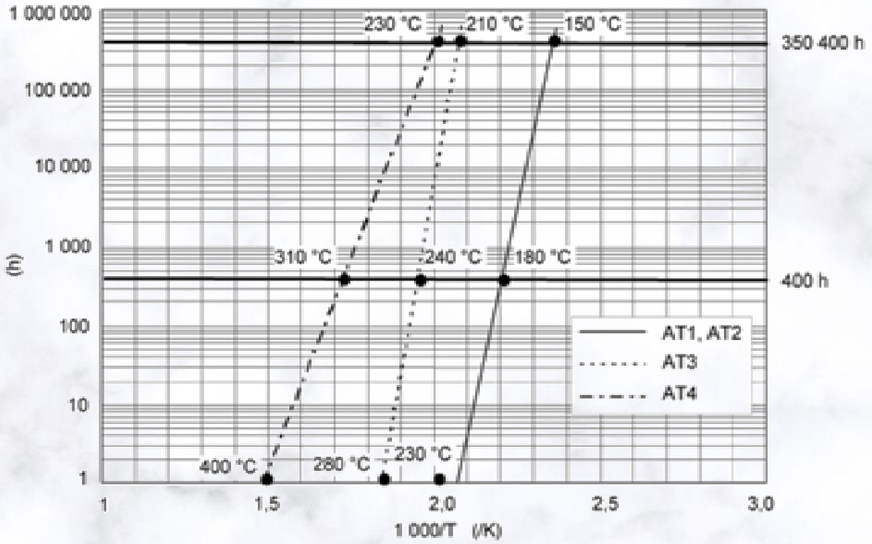
V, м/с	Wind load on wires, N / m					
	ASHS 128/37	ASCR 120/19	ASHS 216/32	ASCR 240/34	ASHS 277/79	ASCR 240/56
25	3.6	4.8	4.9	6.9	5.2	7.0
32	5.9	7.9	7.8	11.4	8.4	11.5
60	20.8	28.5	28.4	41.5	29.8	41.6

►The design ASHS/ASHT provides:
- Icing reduction - Due to high torsion stiffness and smaller diameter



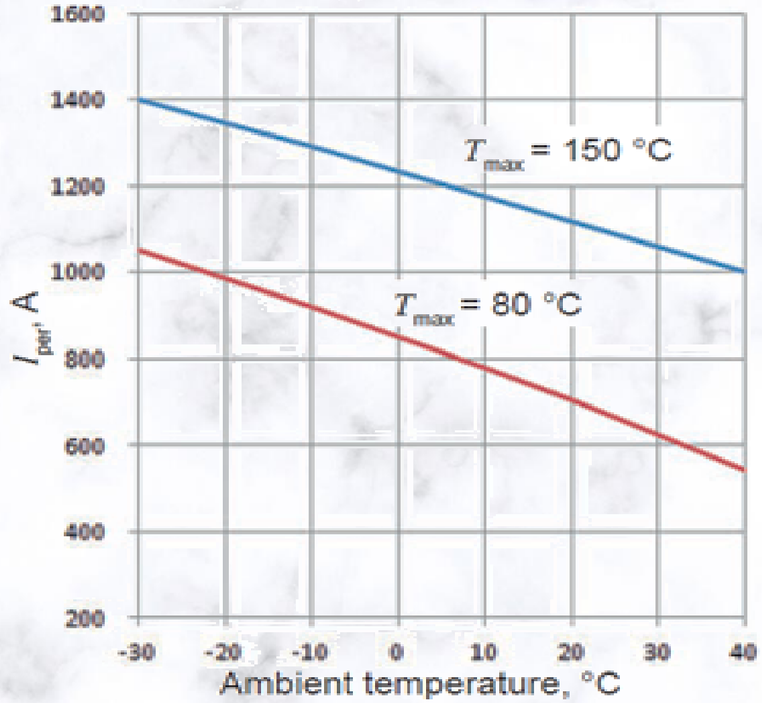
Transmission capacity OHL with high ambient temperature

- Due to its design features, ASHT high-temperature wire is cheaper by several times regarding to analogs with a long-term permissible temperature of 150 °C.
- Continuous permissible current for high-temperature conductor is 30-70% higher than the value for standard conductor of the same diameter.



- A significant reduction lengthening in operating drawing plastically deformed conductors are confirmed by series of experiments.

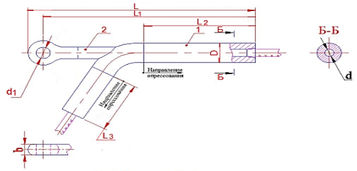
The correct definition of the conductors creep has recently become one of the important requirements arising from the Exploitation organizations, as it turned out that the capacity of many of the overhead Lines may not be fully utilized due to increased, after many years of service, sag of the conductors



Our conductors don't demand difficult and expensive fittings.

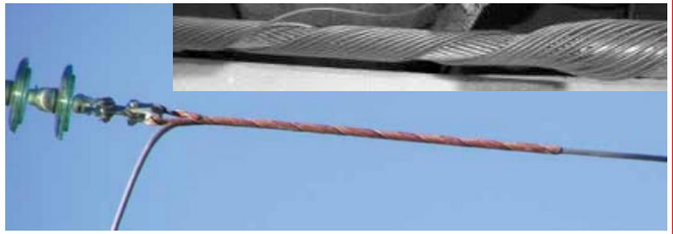
The "conductor-fittings" systems have passed a series of tests.

The types of fittings, with which conductors were tested



The pressed fittings

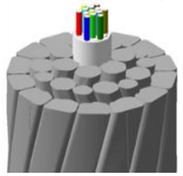
The Spiral fittings

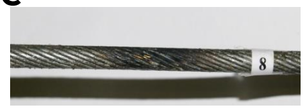


Also vibration quenchers are developed

Ground-wire cable & OPGW

The plastically deformed galvanized ground conductor resistant to to lightning strikes with charges 147 ampere-second, and following vibration exposure 10^8. After testing, the breaking strength was 100% of it's initial value. The tests were carried out several times with same result.





- **Optimum integrated use of our wires and our ground wire, taking into account the comparability of mechanical characteristics.**
- **The adequacy of the test and parameters for requirements (DIN & IEC), confirmed by SAG Deutschland - Versuchs- und Technologiezentrum**

VDE-Institute

Project report
Test sequence for aluminum-steel conductor rope

Project report for the test sequence for an aluminum-steel conductor rope for power lines
Type ASHT 19.6-216/33-1 and the corresponding fittings

The ASHT 19.6-216/33-1 conductor rope is a new development of a compact, high-temperature, aluminum-steel conductor for power lines for which a test program will be developed.

The manufacturer of this power line is the Volgograd (Russia) subsidiary of Severstal AG.

During the test sequence, both the mechanical and electrical characteristics will be examined in accordance with the required, latest European norms and standards.

During the course of the project, a testing matrix was created, which was discussed beforehand with various noteworthy and accredited testing institutes.

Two internationally renowned companies were commissioned with performing the tests:

The mechanical tests of the conductor rope, including the appropriate fittings, were performed by Spie/SAG in Langen.

FGH Engineering & Test GmbH in Mannheim was commissioned with the electrical tests.

The VDE Testing and Certification Institute carried out this project in conjunction and was responsible for the entire, general project management.

The individual tests defined in the test matrix were performed in a timely manner and successfully completed.

Therefore, the conductor rope meets the basic requirements for the European market.

Details on the execution, test setups, the results as well as expert commentary can be found in the respective test reports attached to this letter.

Matthias Felber

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Phone: +49 69 8306-806
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www.vde.com/institute

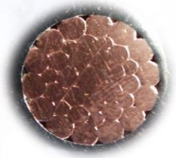
Compared to standard conductors DIN 48201 Bronze, alternative by Energoservice - copper + steel core

nominal cross-cut mm2	Target cross-section mm2	Wires number	Rope diameter, mm	Weight kg per km	Computational breaking strength, kN			Continuous current, A		
					Bz I	Bz II	Bz III	Bz I	Bz II	Bz III
70 DIN	65,81	19	10,5	596	32,51	38,64	44,14	285	245	175
МК 70	**83,4**	**36**	**10,7**	**780**	**32,944**			**366**		
MK70-HS-1	**83,4**	**36**	**10,7**	**774**		**38,3**			**347**	
MK70-HS-4	**83,4**	**36**	**10,7**	**766**			**44,2**			**343**
95 DIN	93,27	19	12,5	845	46,08	54,76	62,56	355	305	215
МК 95	**119**	**36**	**12,6**	1110	**45,73**			**457**		
MK95-HS-1	**119**	**36**	**12,6**	1102		**53,4**			**442**	
MK95-HS-4	**119**	**36**	**12,6**	1089			**62,2**			**435**
120 DIN	116,99	19	14	1060	56,68	67,57	77,46	410	350	250
МК 120	**138,7**	**36**	**14**	**1300**	**55,6**			**511**		
MK120-HS-1	**138,7**	**36**	**14**	**1281**		**69,56**			**501**	
MK120-HS-4	**138,7**	**36**	**14**	**1108**			**80,6**			**473**
150 DIN	147,11	37	15,8	1337	72,67	86,37	98,67	470	410	290
MK150	**182,2**	**36**	**15,8**	**1690**	**72,26**			**612**		
MK150-HS-1	**182,2**	**36**	**15,8**	**1678.3**		**87,6**			**577**	
MK150-HS-4	**182,2**	**36**	**15,8**	**1658**			**98,8**			**572**
185 DIN	181,62	37	17,5	1649	89,72	106,63	121,81	540	465	330

The test program included a thermal softening test at 155 °C, a test of low-temperature creep air resistance, a test of resistance to eolic vibration, a test with repeated heating up to 100 °C and a number of other tests, some of them being applied to suspension cable for the first time.

Strength loss is found to be within allowable limits even after multiple times of overheating to 155 °C during all tests. The cable does not stretch when heated.

- **With this, in view of a larger cross section of the cable the overheating is caused by amperage, which will be much higher in comparison with standard product.**
- **Additional investigations of tensile strength during heating to 200 °C gave successful results.**
- **Additional series of tests was carried out with a fragment of the product which worked a year at the most congested area of the South-Ural Railway.**



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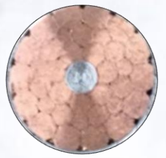

MK-HS-1

MK-HS-1