# Energoservis Engineering Company


**Best Implemented Project for Russian States Grid company «Rosseti» in 2014.**

## Complex innovative products for overhead power lines of 35–750 kV

*Providing simple solutions to complex challenges*

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IEC 79th GM MINSK 2015

cigré INTERNATIONAL COUNCIL ON LARGE ELECTRIC SYSTEMS Session 2014

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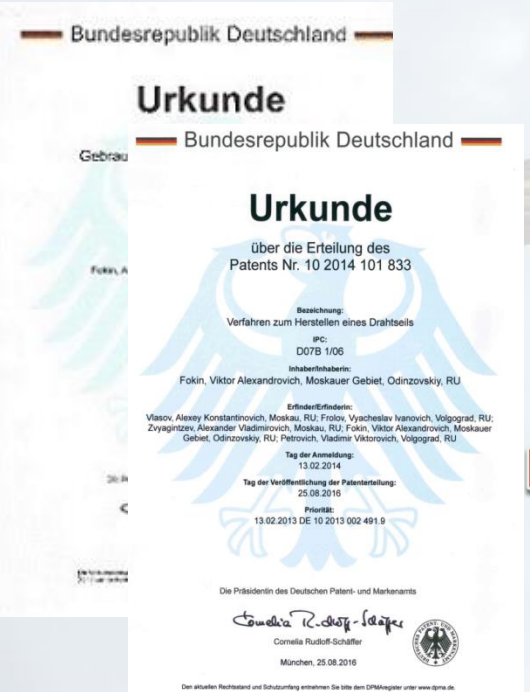
*The new principle of production of plastically deformed unidirectional twisted conductors and Ground-wire cables (including OPGW) turned out a very promising direction in the development of the conductors production technology. The most attractive features of new conductors type are: an effective use 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.*


Bundesrepublik Deutschland

Urkunde

Bundesrepublik Deutschland

Urkunde

über die Erteilung des
Patents Nr. 10 2014 101 833

Bezeichnung:
Verfahren zum Herstellen eines Drahtseils

IPC:
D07B 1/06

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Die Präsidentin des Deutschen Patent- und Markenamts

Cornelia Rudloff-Schäffer

München, 25.08.2016

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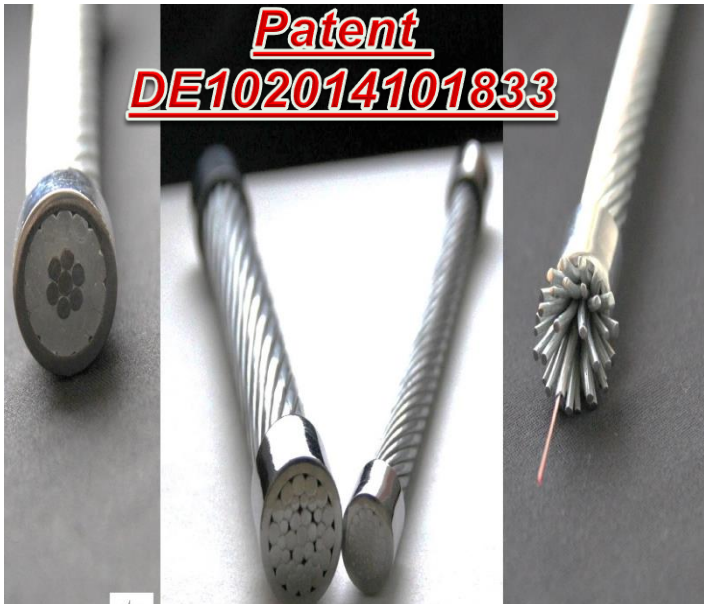
## *Maximum coefficient of filling in the least costly way*

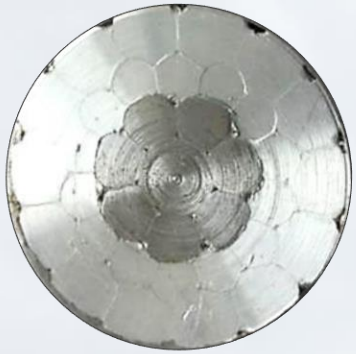
**Experience of 18,000 km of transmission lines**



# The general technological principle - plastic deformation

Deutsches Patent- und Markenamt

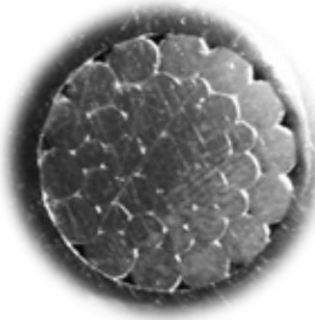
## Products for new overhead power lines (OHL)



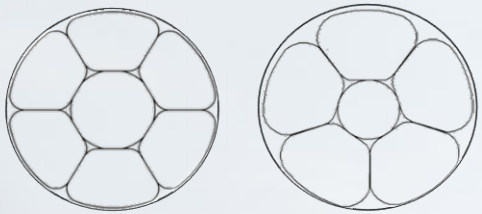
## Products for reconstruction of old OHL without replacement of supports

**High temperature (ASHT, $t_{cw}$=150°C,$t_{max}$=210°C) and high strength (ASHS, $t_{max}$=90°C) performance**

***The cross sections for aluminum from 128 to 700 mm² for OHL 35 - 750 kW.***



***The cross sections for aluminum from 46 to 112mm² for overhead power lines 6 - 35 kW.***

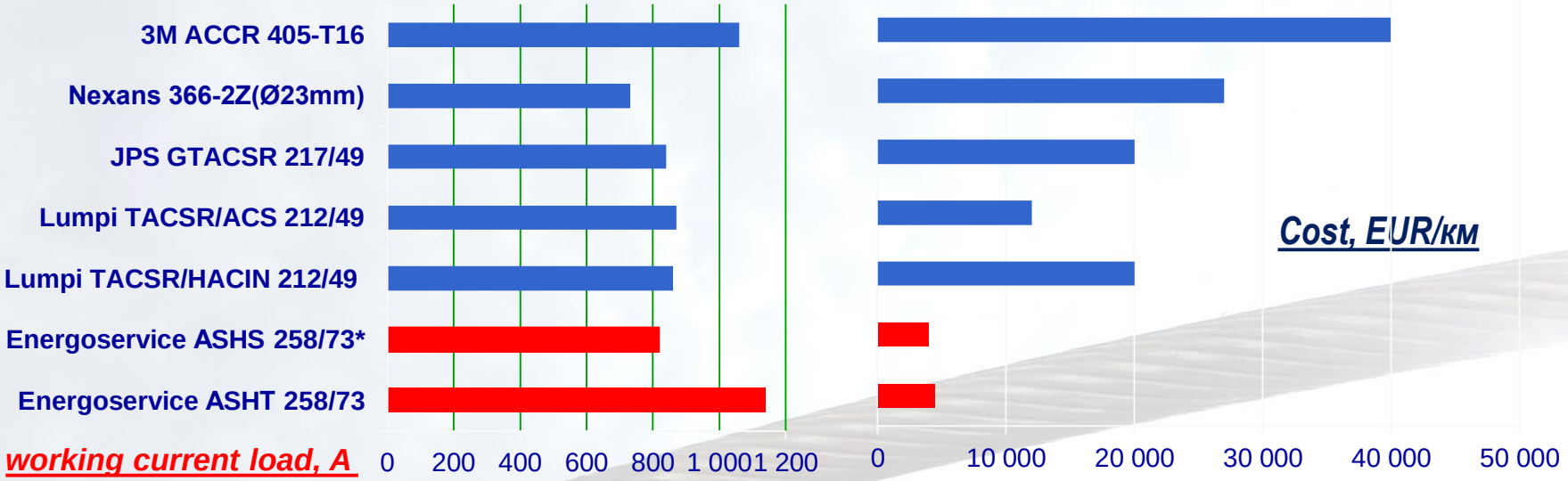


## ANHS

**Conductor made of high-strength aluminum alloy with no core. For overhead power lines 6 - 110 kW. ($t_{max}$=90°C)**

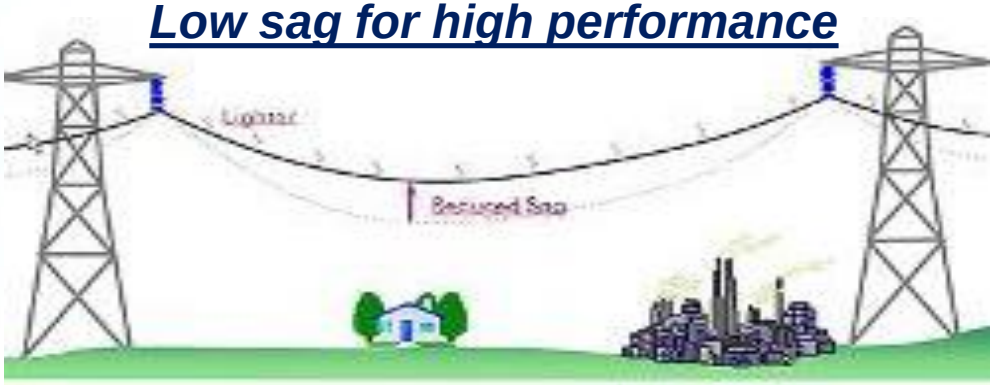
***The fundamentally new technology provides costs on conductors ASHS/ASHT and refurbishment of overhead line with these conductors almost in same extent as similar costs in using conventional conductors, with worst characteristics.***

## *Comparison of conductors Ø 21mm, with similar characteristics.*



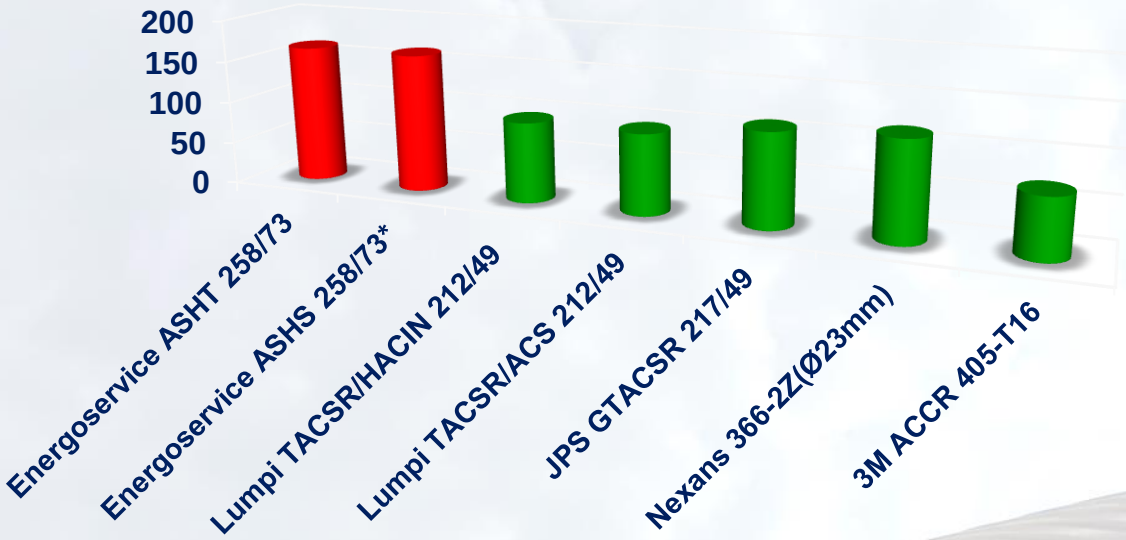

- ✓ **ASHS and ASHT conductors are expand designing of HV power lines and allow dealing with the goals that used to be unpractical or used to require great efforts and costs.**

***Low sag for high performance***



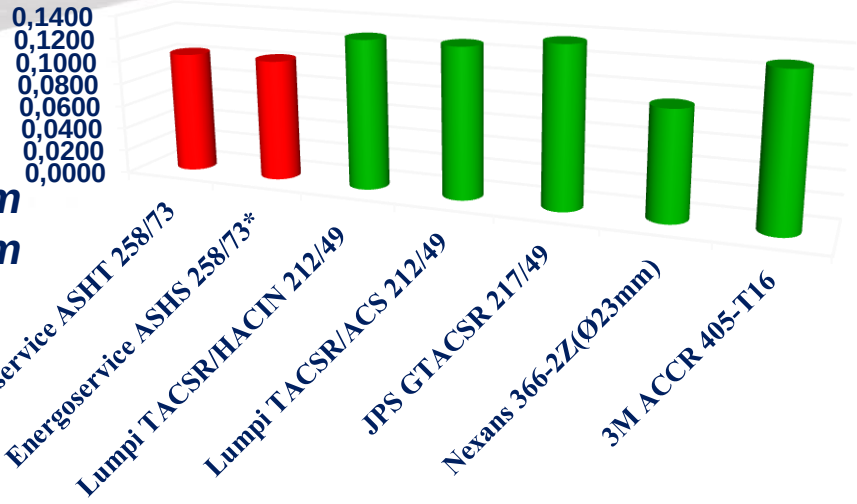
# Comparison of conductors Ø 21mm, with similar characteristics

## Breaking load, кN




***ASHT conductors on the complex technical and economic characteristics are superior to all similar articles.***

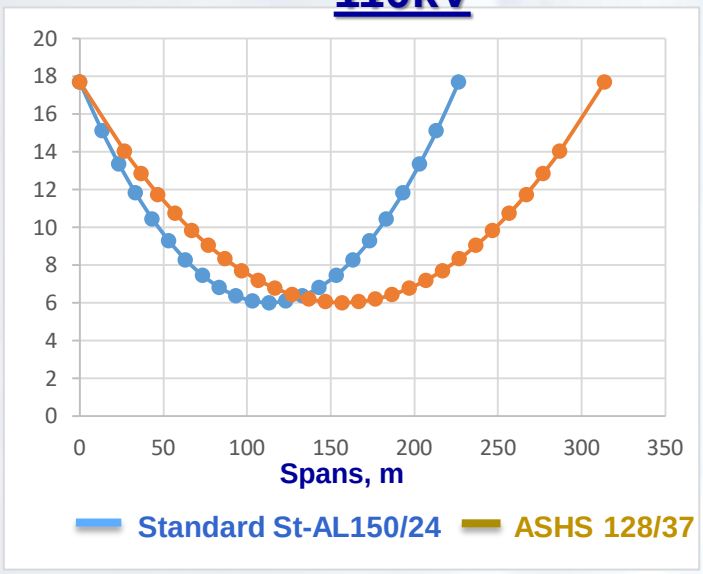
## Electrical resistance of 1 km of conductor DC at 20 ° C, Ohm




***Design provides increased fill factor of up to 95–97 %, a significant improvement of strength and cross-section for the same cable diameter, the reduction of aerodynamic loading (20-35 %) and icing (25-40%).***

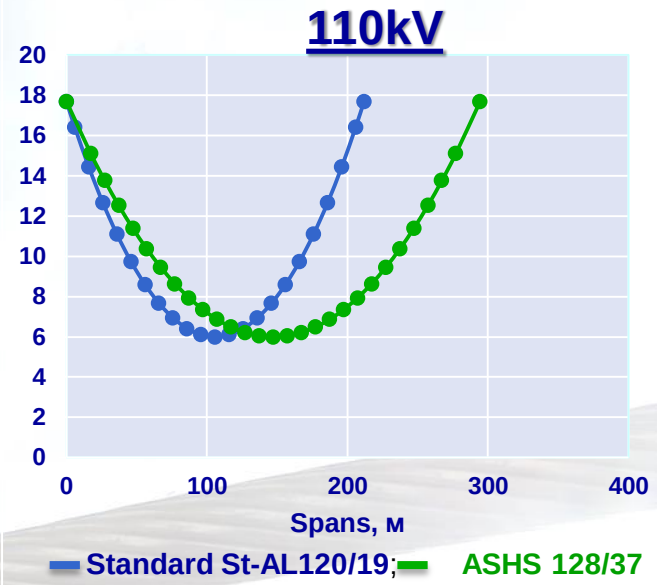
# Comparison spans with new (ASHS/ASHT) and standard conductor. Projects for OHL of different voltage classes

## 110kV

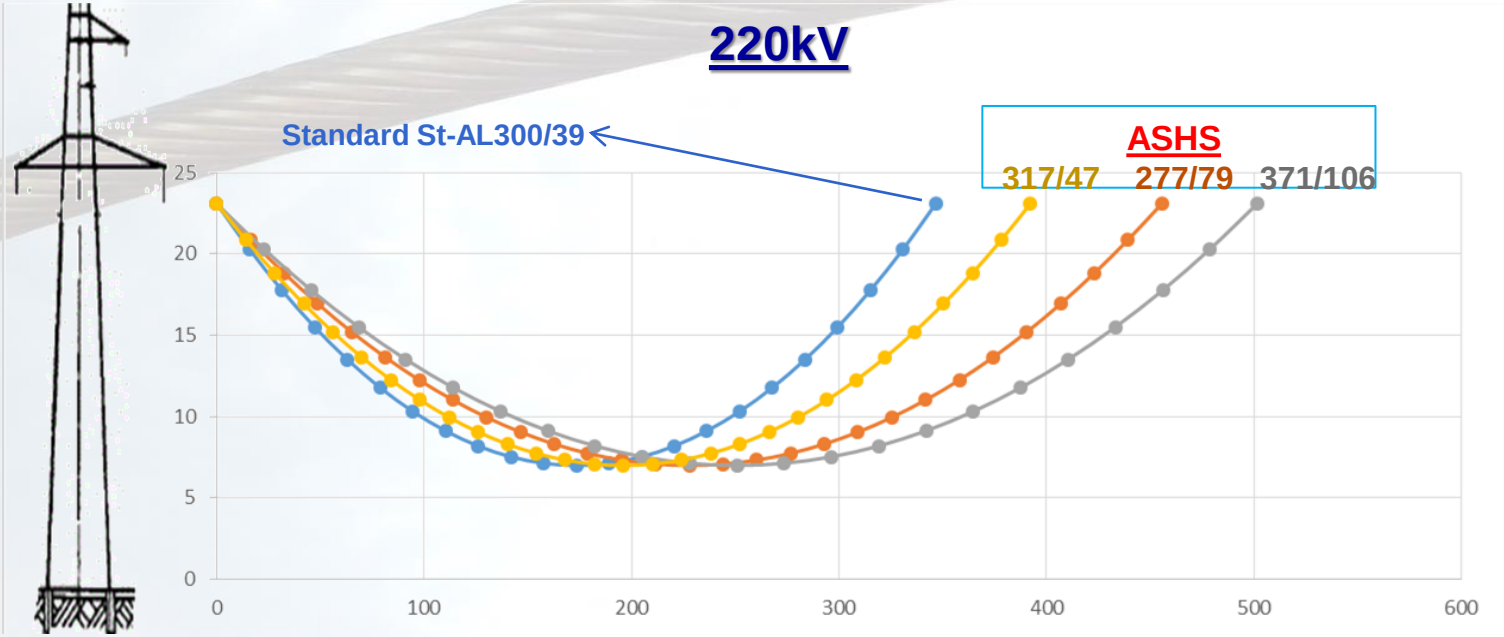



- Increase in the span of 38%
- Increase working current
- Resistance reduction
- Reduction of diameter

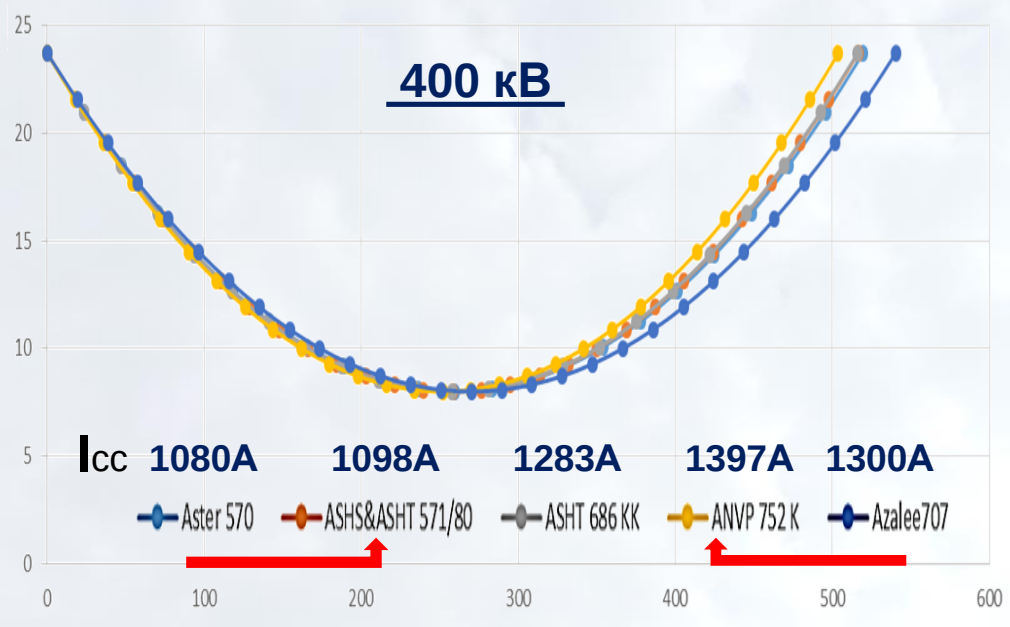
## 110kV

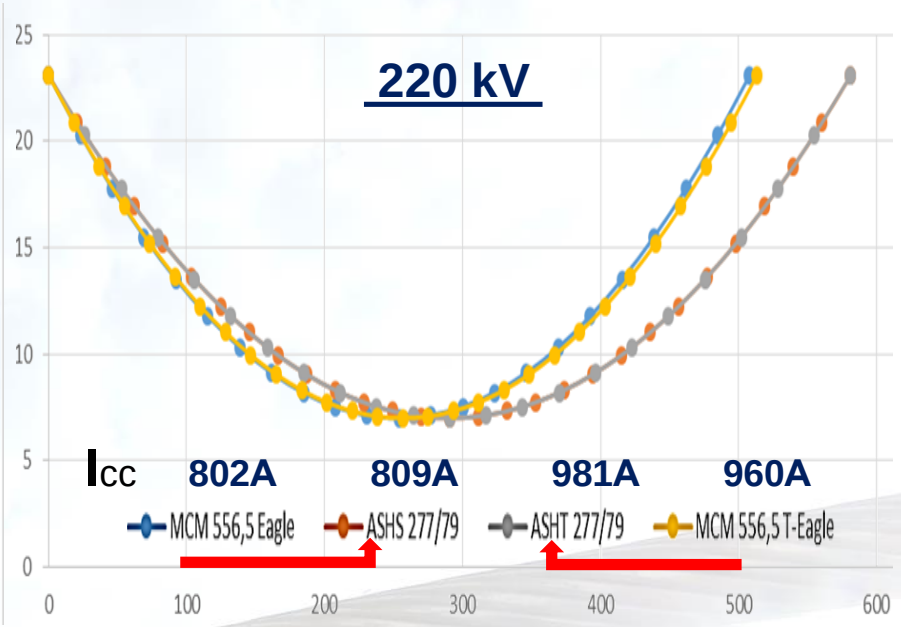



## 220kV

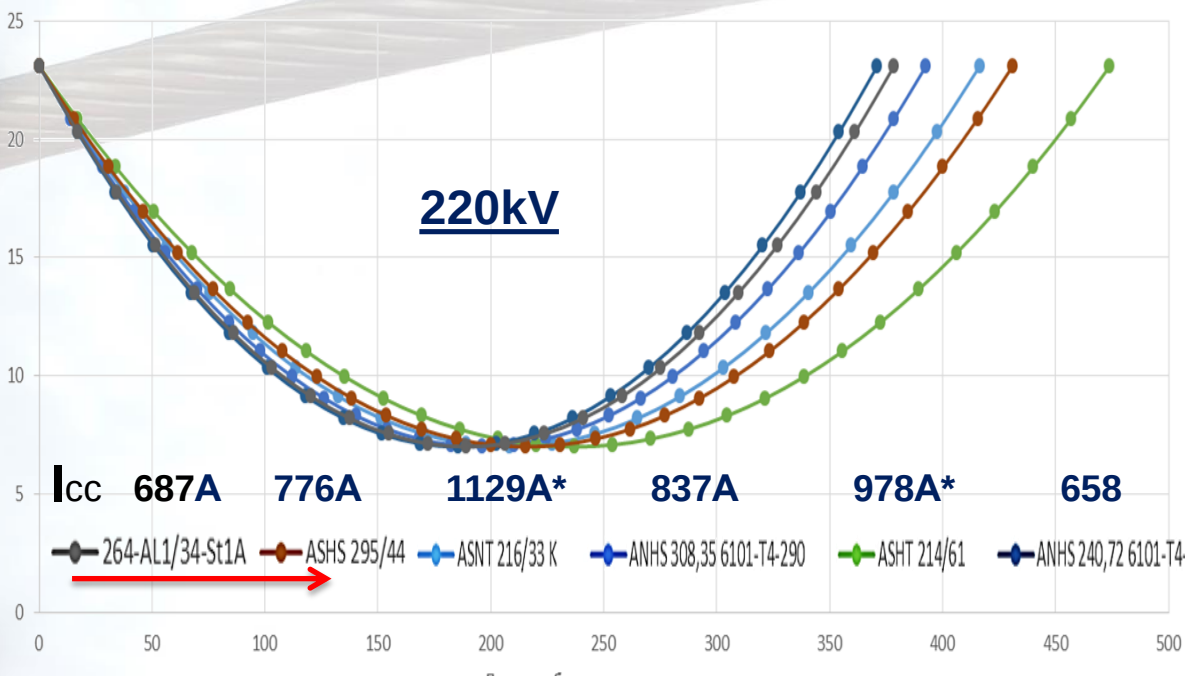


# Span length with allowable clearance spans for OHL in EU







# *Additional economic benefit due to high breaking strength:*

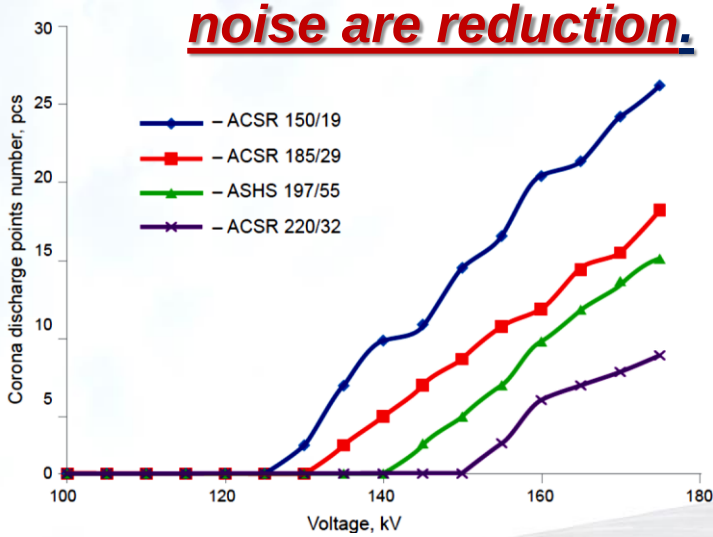
- ***decrease in the number of supports and reduce sag;***
- ***the reduce level of internal corrosion in the conductor;***
- ***the intensity of the formation of ice due to the surface shape;***
- ***the reduce amplitude of pitching conductors.***
- ***Significantly lower operating elongation***
- ***The application of plastic compression ASHS or ASHT conductors makes it possible to reduce the wind load by 10-26% compared to conventional wires with similar values of the area of aluminum layers.***
- ***In case of application for repair/upgrading works at the old OHL, new conductors in high-temperature execution are optimum, especially considering their rather low cost.***
- ***Practically standard fittings***

- **By results of the conducted comparative researches of conductors of identical diameter critical corona voltage for ASHS/ASHT Increase relative to the standard steel-Aluminum Wire.**
- **In the same time the corona-induced acoustic noise are reduction.**

**Same diameter 18.8 mm** ASHS 197/55 conductor by "Metsbytservis", has corona discharge voltage by 5.7% higher than ACSR 185/29

Similar tests were carried out for ASHS 216/33 **Ø18,5 - Ø21,6** ACSR 240/32 have the same corona discharge voltage.

## Corona-induced acoustic noise are reduction.




Calculated specific corona losses in good weather (330 kV overhead line with split phase consisting of 2 conductors with 40 cm spacing)

| Phase construction (conductor model; conductor radius $r_0$, cm) | Annual average losses change, % |
|---|---|
| 2 × ACSR 300/39; Ø 24,0 mm | + 18,52% |
| 2 × ACSR 400/51; Ø 27,5 mm | 0,00% |
| 2 × ASHS 317/47; Ø 22,3 mm | –7,41% |
| 2 × ASHS 295/44; Ø 21,5 mm | + 3,70% |

Calculated specific corona losses in good weather (220 kV overhead line)

| Phase construction (conductor model; conductor radius $r_0$, cm) | Annual average losses change, % |
|---|---|
| ACSR 240/32; Ø 21,6 mm | + 26,67% |
| ACSR 300/39; Ø 24,0 mm | 0,00% |
| ACSR 330/43; Ø 25,2 mm | –13,33% |
| ASHS 317/47; Ø 22,3 mm | –13,33% |
| ASHS 295/44; Ø 21,5 mm | –6,67% |

- **wind loads reduction;**
- **less susceptibility to conductor**
- **galloping and vibrations self-extinction**

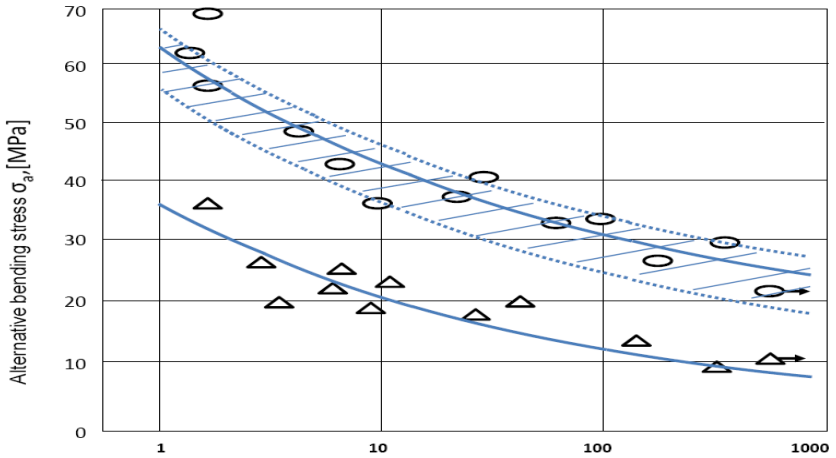
| Airflow speed $v_{AB}$, m/s | Wind load acting on the following conductors, N/m | | | | | |
|---|---|---|---|---|---|---|
| | ASHS 128/37 (Ø15,2 mm) | ACSR 120/19 (Ø15,2 mm) | ASHS 216/33 (Ø18,5 mm) | ACSR 240/32 (Ø21,6 mm) | ASHS 277/79 (Ø22,4 mm) | ACSR 240/56 (Ø22,5 mm) |
| 25 | 3,6 | 4,8 | 4,9 | 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 |

**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 added cost.**

- **The new conductors are excellent for new construction in regions with excessive wind/ice loads or for extended transition.**
- **In case of application for repair/upgrading works at the old OHL, new conductors in high-temperature execution are optimum, especially considering their rather low cost.**
- **In constructing the ring network circuits and network with the possibility of congestion during the post-emergency modes**
- **The most effective integrated use ACHS/ACHT together with Ground-wire cables (OPGW) possessing similar mechanical characteristics.**

- **A significant reduction lengthening in operatin 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***




**Stretching ASHS / ACHT (shaded area). Results for ASVP / ACBT (replacing the signs) and AC conductors (delta) are reproduced on the basis of experiments.**

# Comparison of ASHS and ASHT characteristics with standard conductor Ø 17,1mm

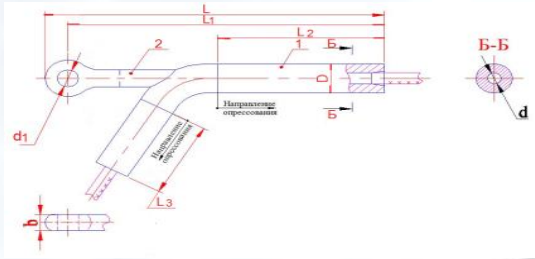
*An important task is: to identify where the use of new conductors will be most effective*

| Parameters of the conductors to be compared | ACSR 150/24 | ASHS, ASHT 162/47 | |
|---|---|---|---|
| | value | value | Change in percent to ACSR |
| Core cross section, $mm^2$ | 24,2 | 47,3 | +90 |
| Alum cross section, $mm^2$ | 149 | 162,3 | +8,9 |
| Diameter, mm | 17,1 | 17,1 | 0,0 |
| Rated Breaking strength, daN | 5227,9 | 9882,4 | +89,0 |
| Max current load, A | 554 | 590,5 (822) | + 6,6 (+ 48,4) |
| Span length of OHL at one and the same sag, m | 280 | 364 | + 30 |
| Towers on the 10 km of OHL | 37 | 27 | - 27 |
| Specific losses of electricity at the same current load (150 A), MWh/km per year | 41,7 | 36,4 | - 12,7 |
| Conductor temperature expansion coefficient, $10^{-6}$ 1/ °C | 19,2 | 16,7 | - 13 |
| Conductor elasticity modulus, E*10-3, N/mm2 | 82,5 | 88 | + 6,7 |
| Sag at the highest air temperature (+40 °C), m, for the spans:250 m<br>300 m | 6,29<br>9,26 | 3,32<br>4,87 | - 47,2 |
| Sag at ambient temperature - 5 ° C in the 3rd region of the wind and ice load, m:250/300 | 6,66<br>9,63 | 4,41<br>6,04 | - 33,8 |
| The electric field of the corona onset at dry weather, kV/cm | 34,04 | 40,0 | +17,5 |
| DC Resistance (20 $^0$C), Ohm/km | 0,2039 | 0,1780 | -12,7 |
| Assessment of the relative costs | 100 % | 100-120 % | |

***Our conductors don't demand difficult and expensive fittings.***

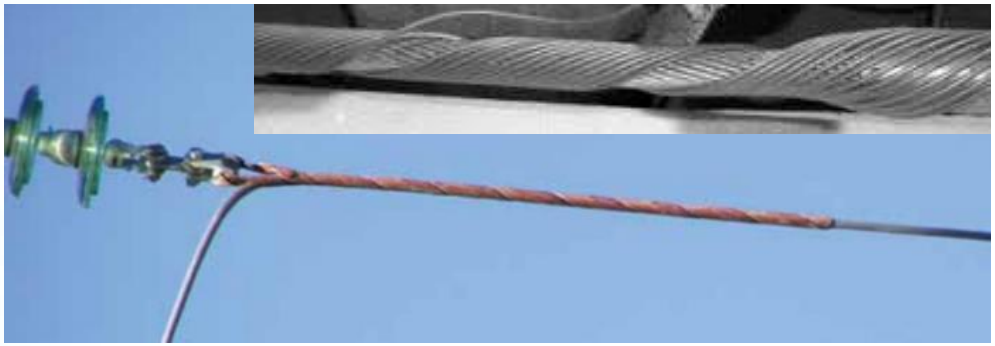
***The "conductor-fittings" systems have passed a series of tests in accordance with the rules of PJSC "Rosseti".***

*The types of fittings, with which conductors were tested*




## *The pressed fittings*

## *The Spiral fittings*



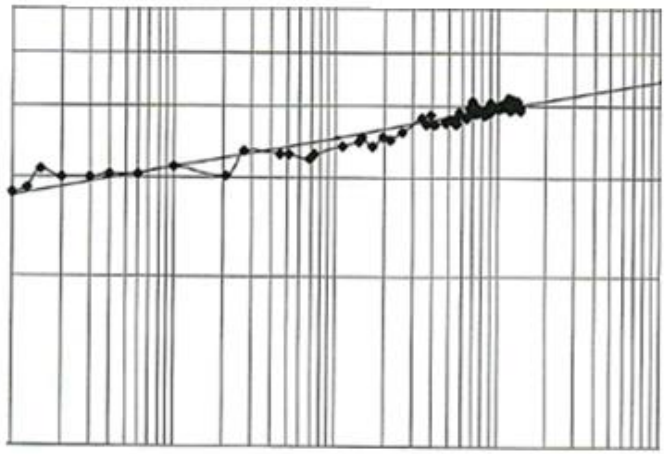
***Also vibration quenchers are developed***

# Ground-wire cable & OPGW

**The plastically deformed galvanized ground conductor resistant to lightning strikes with charges 147 ampere-second, and followi vibration exposure 10 . 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
- ✓ **The product plated by aluminum has lost mechanical durability after exposure to lighting 85 KL; its actual strength during the test reduced to 32.8 kN (49.6 % of the nominal breaking load).**

- **The operational stretching of conductors - one of the most important requirements for the overhead lines. Reducing of extraction plastically deformed, galvanized OPGW, confirmed experimentally.**



**The team of “Energoservice” 20 years has been supplying the market of steel ropes and bare conductors. For many years we have been developing, testing and introducing innovative rope products specially for the biggest national companies, such as Russian Grid, Norilsk Nickel, Russian Railways, Federal Grid Co, and others . Among our facilities are Ostankino TV Tower, deep mine hoists, thousands kilometers of power transmission lines, and many others. Production partner - "Severstal-Metiz", allows creating products that successfully compete with products of European companies.**

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