Contents

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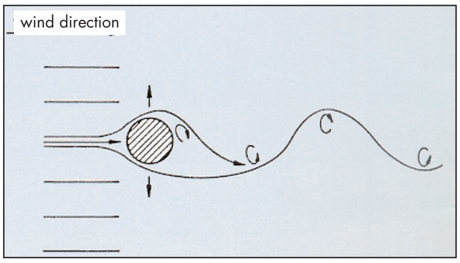
Dampers and preformed rods

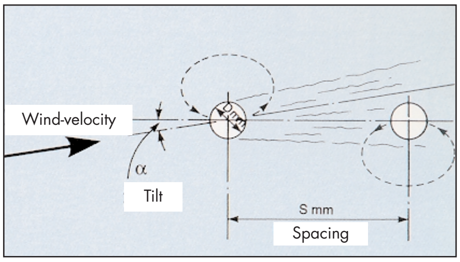
GENERAL

In principle, it is impossible to avoid wind-induced conductor vibrations on overhead lines, as already established in a CIGRE-study for the lifetime of overhead lines.
In the most unfavourable cases, fractures caused by vibrations on accessories and overhead lines can already occur directly after installation on the overhead line. However, fatigue fractures caused by continuous vibrations may occcur only some years after installation.
For many years, a range of effective damping measures such as reduction in tensile stress, damping by means of Stockbridge – or wide band – dampers for single conductors and twin bundles, as well as „spacer dampers" for bundle conductors, have been used for the purpose of reducing the intensity of vibrations. To be able to evaluate the need for and the effectiveness of such measures, mathematical models have been developed, which implemented in computer programmes, enable the provision of information on the vibration behaviour, and hence the lifetime, of overhead lines.



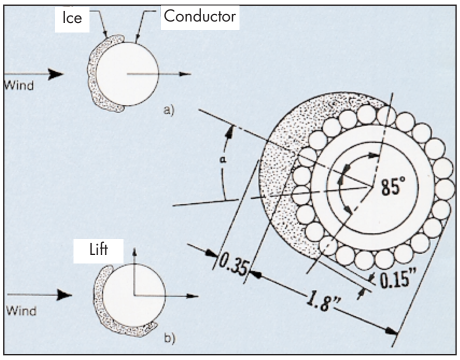
Aeolean vibrations perpenticular to the wind direction

Various types of wind-induced mechanical oscillations occur on overhead lines. All known types of vibrations are shown in the table below.



Subspan oscillations

	Aeolean vibrations	Galloping	Vibrations of bundled conductors
Wind	constant	constant	constant
Speed	1–7 m/s (9 m/s)	7–18 m/s	4–18 m/s
Frequency	(3) 5–50 (100) Hz	0.1–3 Hz	0.15–3 (10) Hz
Amplitude	up to 3 (5) cm	up to 10 m	Subconductor vibrations up to 50 cm Fixed vibration range up to 2 m
Conditions	Tensile stress Self-damping of conductors Armour rods Dampers Terrain	Climatic conditions (icing)	Distance of the subconductors Inclination of the conductors Positioning of the conductors distribution of the spacer-dampers
Damage	Conductor wires Fittings	Conductors Fittings Insulators	Conductors Fittings Dampers Spacers



Galloping on iced conductors

The terrain has an important influence. Overhead lines installed in flat and open areas are more susceptible to vibrations than those installed in mountainous areas or in urban areas, and therefore have to be studied more closely.

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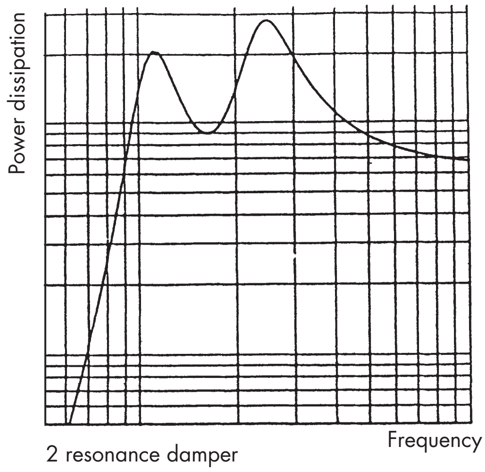
Design and function of Vibration-dampers

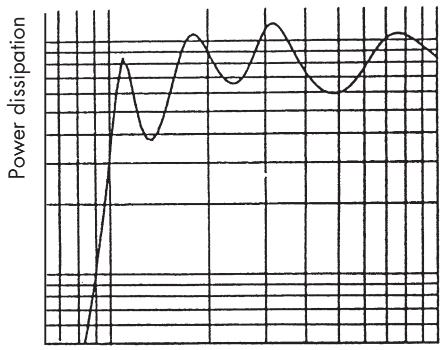
A short time after it was detected that there are vibrations on conductors, energy-absorbing dampers were installed. Up to now, this method is the most effective solution. Over the years, the design and function of these dampers has been improved, so that the current generation of dampers, gives a harmonious damping-characteristic over the full vibration-frequency-spectrum. As a result of the design of the weights and the lengths of the damper messenger cable, there will be created two, three or four resonances. It is very important that the damping-power does not decline too much between the resonances, as this would not give satisfactory damping through a wide frequency range.



2 resonance damper

The friction which is created by the bending of the damper messenger cable dissipates a large proportion of the induced wind-energy (Energy-balance). To achieve optimum damping, it is necessary to determine the correct place of installation of the dampers. This location and the expected bending-strain of the entire system of "Conductor – Damper"are calculated by a computer programme.

The function of the dampers can also be established by testing the entire system "Conductor-Damper", acc. to the applicable standards.



4 resonance damper

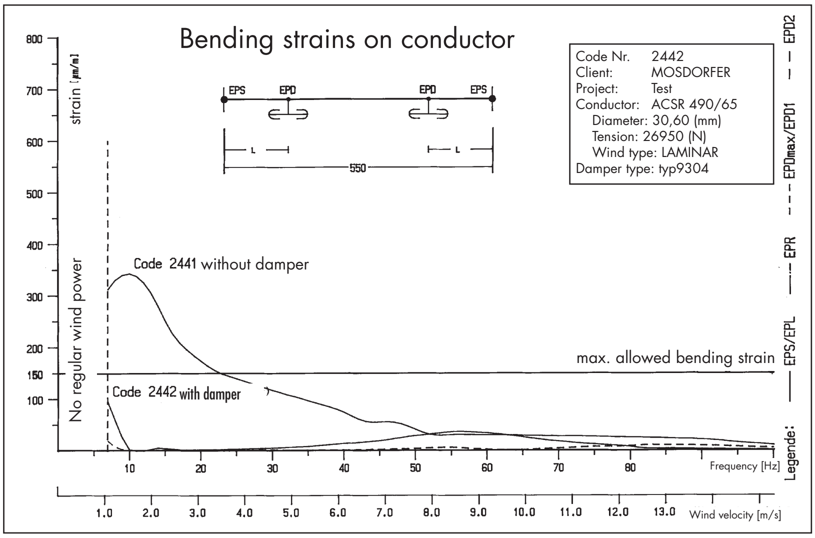
Not only optimum damping was the objective during the design of the dampers but also the quality of the clamping was a major consideration. Furthermore fracture of the damper messenger cable, which is also exposed to alternating loads during the operational lifetime should be prevented. Finally attention should be paid to the need to avoid bending-strain on the installation point of the dampers on the overhead lines.

For calculation of the correct solution, it is very useful to have long term measurements, of intensity and frequencies of the vibrations occurring on the lines.

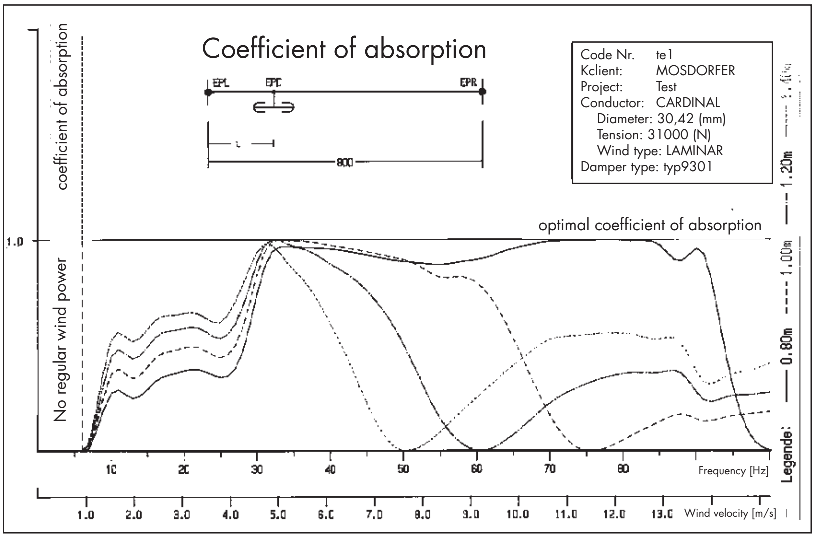
Methods of Computation

Mathematical methods have been developed, which permit the calculation of the optimum system "Conductor + Damper" (armour-rods) under all conditions. These calculations have compared favourably with measured values. In the computational model it is assumed that the conductor vibrates over the whole conductor length in the form of a standing harmonic wave in one of its natural oscillation modes, and in so doing is always in resonance.
In this stationary state the power of the wind forces over the entire conductor length is equal to the mechanical power dissipated by the conductor self-damping and the dampers.

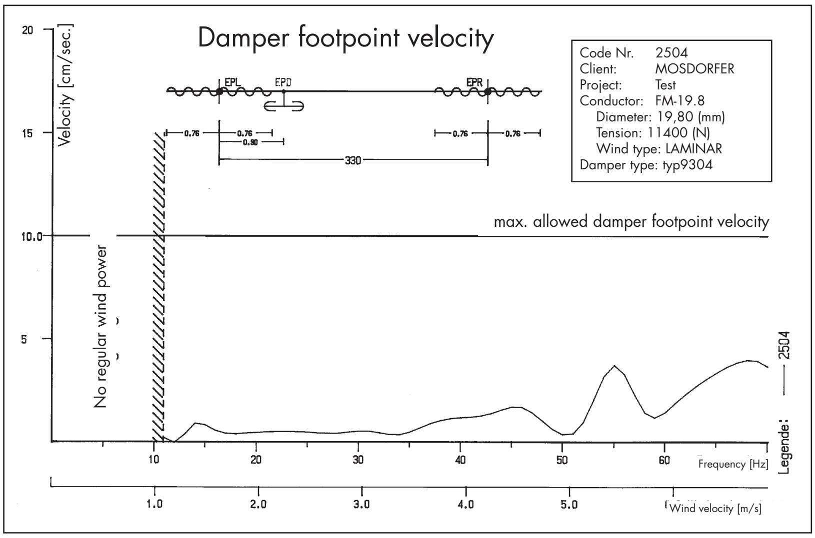
Pw = Ps + PD "Energy balance"



Bending strains on conductor with and without dampers.



Coefficient of absorption at various damper placements.



Damper footpoint velocity of the damper clamp.

The goal of an oscillation-study is to create an effective oscillation-concept at the tender stage of a project, in order to prevent problems in the field. An oscillation-study consists of the following:

Calculation of the **bending-strain** of the conductor at different frequencies and tensile-strengths, respectively with or without armour rods or dampers. Terrain can also be taken into consideration. The threshold value of the bending-strain of the conductor established by IEEE and CIGRE will also be taken into account.

A direct way to determine the effectiveness of a damping method, is to calculate the **absorption coefficient,** which is the central criteria for the analysis of vibration dampers. Damper, conductor and all other conditions will be regarded on the whole. Consideration is given to a harmonic wave approaching the damper from the middle of the field.
The absorption coefficient is defined as the fraction of the power of the incoming harmonic wave absorbed by the damper.

The calculation of the **footpoint velocity** of the damper clamp is the major criteria for the lifetime of the damper. Experience shows, failures of dampers almost always arise from wire ruptures in the messenger cable. Given a limitation of the alternating bending strain of the conductor, the admissible footpoint velocity can be computed using an equivalent mathematical model, and they thus represent a safety curve for the dampers.

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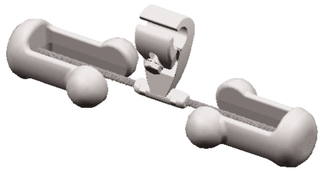
Stockbridge dampers with forged clamps

for aluminium-, al-alloy-, ACSR-, AACSR- and alumoweld conductors.
Weights are cast onto the messenger wire.

Material: Weights: cast iron, hot dip galvanised
Messenger cable: steel, hot dip galvanised
Clamp: aluminium-alloy, forged
Bolt: stainless steel

L.-Nr.	Dimensions in mm Conductor Ø	Length	Bolt	Torque Nm	Weight kg
9301.000/EA1	7,00– 9,00	380	M10	30	1,60
9301.010/EA1	9,01–11,00	380	M10	30	1,60
9301.020/EA1	11,01–14,50	380	M10	30	1,60
9301.030/EA1	14,51–17,00	380	M10	35	1,60
9301.040/EA1	17,01–19,50	380	M10	35	1,60
9301.050/EA1	19,51–22,00	390	M12	35	1,65
9301.060/EA1	22,01–24,50	390	M12	35	1,65
9301.070/EA1	24,51–28,00	400	M12	40	1,90
9301.080/EA1	28,01–31,00	400	M12	40	1,90
9301.090/EA1	31,01–33,00	400	M12	45	1,90
9301.100/EA1	33,01–35,00	400	M12	45	1,90
9301.110/EA1	35,01–38,00	400	M12	45	2,00
9301.120/EA1	38,01–42,00	400	M12	45	2,00
9301.130/EA1	42,01–46,00	400	M12	45	2,00
9303.000/EA1	7,00– 9,00	420	M10	30	2,10
9303.010/EA1	9,01–11,00	420	M10	30	2,10
9303.020/EA1	11,01–14,50	420	M10	30	2,10
9303.030/EA1	14,51–17,00	420	M10	35	2,10
9303.040/EA1	17,01–19,50	420	M10	35	2,10
9303.050/EA1	19,51–22,00	425	M12	35	2,20
9303.060/EA1	22,01–24,50	425	M12	35	2,20
9303.070/EA1	24,51–28,00	425	M12	40	2,40
9303.080/EA1	28,01–31,00	440	M12	40	2,40
9303.090/EA1	31,01–33,00	440	M12	45	2,40
9303.100/EA1	33,01–35,00	440	M12	45	2,60
9303.110/EA1	35,01–38,00	440	M12	45	2,60
9303.120/EA1	38,01–42,00	440	M12	45	2,60
9303.130/EA1	42,01–46,00	440	M12	45	2,60
9304.030/EA1	14,51–17,00	450	M10	35	3,70
9304.040/EA1	17,01–19,50	450	M10	35	3,70
9304.050/EA1	19,51–22,00	455	M12	35	3,80
9304.060/EA1	22,01–24,50	455	M12	35	3,80
9304.070/EA1	24,51–28,00	465	M12	40	4,00
9304.080/EA1	28,01–31,00	465	M12	40	4,00
9304.090/EA1	31,01–33,00	465	M12	45	4,00
9304.100/EA1	33,01–35,00	465	M12	45	4,10
9304.110/EA1	35,01–38,00	465	M12	45	4,10
9304.120/EA1	38,01–42,00	465	M12	45	4,10
9304.130/EA1	42,01–46,00	465	M12	45	4,10
9306.070/EA1	24,51–28,00	520	M12	40	5,80
9306.080/EA1	28,01–31,00	520	M12	40	5,80
9306.090/EA1	31,01–33,00	520	M12	45	5,80
9306.100/EA1	33,01–35,00	520	M12	45	6,00
9306.110/EA1	35,01–38,00	520	M12	45	6,00
9306.120/EA1	38,01–42,00	520	M12	45	6,00
9306.130/EA1	42,01–46,00	520	M12	45	6,00



Other types see next page

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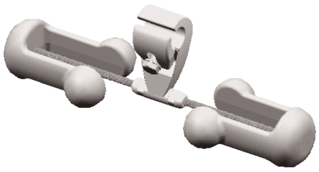
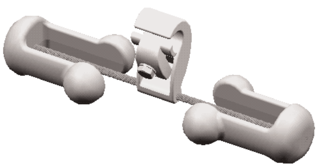


L.-Nr.	Dimensions in mm			Torque Nm	Weight kg
	Conductor Ø	Length	Bolt		
9308.070/EA1	24,51–28,00	570	M12	40	7,90
9308.080/EA1	28,01–31,00	570	M12	40	7,90
9308.090/EA1	31,01–33,00	570	M12	45	7,90
9308.100/EA1	33,01–35,00	570	M12	45	8,10
9308.110/EA1	35,01–38,00	570	M12	45	8,10
9308.120/EA1	38,01–42,00	570	M12	45	8,10
9308.130/EA1	42,01–46,00	570	M12	45	8,10

Special designs:
- Bolts hot dip galvanized L.-Nr. … **1**/EA1
  f. e. 9304.03**1**/EA1
- Weights fixed with cones L.-Nr. … /EA (without 1)
  f. e. 9304.030/EA

Stockbridge dampers with cast clamps

for aluminium-, al-alloy-, ACSR-, AACSR- and alumoweld conductors.
Weights are cast onto the messenger cable.



Material: Weights: cast iron, hot dip galvanised
Messenger cable: steel, hot dip galvanised
Clamp: aluminium-alloy, cast
Bolt: hot dip galvanised

L.-Nr.	Dimensions in mm			Torque Nm	Weight kg
	Conductor Ø	Length	Bolt		
9301.01/G/1	8,4–11,5	370	M10	46	1,60
9301.02/G/1	11,6–14,0	370	M10	46	1,60
9301.03/G/1	14,0–16,5	370	M10	46	1,80
9301.04/G/1	16,6–19,0	370	M10	46	1,80
9301.20/G/1	19,0–29,0	380	M10	35	1,90
9303.01/G/1	8,4–11,5	410	M10	46	2,10
9303.02/G/1	11,6–14,0	410	M10	46	2,10
9303.03/G/1	14,0–16,5	410	M10	46	2,30
9303.04/G/1	16,6–19,0	410	M10	46	2,30
9303.06/G/1	19,0–29,0	420	M10	35	2,40
9304.20/G/1	19,0–29,0	450	M10	35	4,20
9304.10/G/1	28,5–38,0	450	M12	55	4,30
9306.03/G/1	19,0–29,0	500	M10	35	6,10
9306.07/G/1	28,5–38,0	500	M12	55	6,10
9308.03/G/1	28,5–38,0	550	M12	55	8,00

Special design: stainless steel bolts
- L.-Nr. … /**R**
  f. e. 9304.20/G/**R**1
- Weights fixed with cones L.-Nr. …/ (without 1)
  f. e. 9304.20/G

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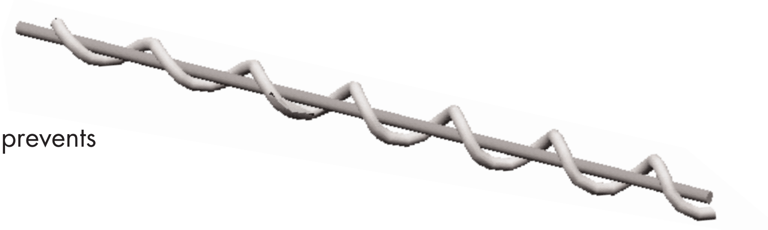
Dampers and preformed rods

MOSDORFER AUSTRIA

Spiral dampers for light conductors,

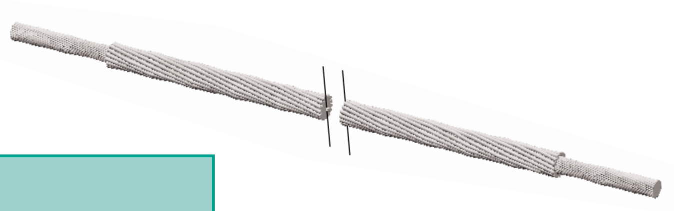
earth wires and optical cables.
The function of this type is to disturb the vibration and this prevents the building up of a standing wave.



Material: Weather resistant PVC			
L.-Nr.	Dimensions in mm		Weight kg
	Conductor Ø	Length	
9320.04	6,35– 8,30	1240	0,28
9320.05	8,31–11,72	1300	0,30
9320.06	11,73–14,32	1345	0,32
9320.07	11,33–19,30	1615	0,93

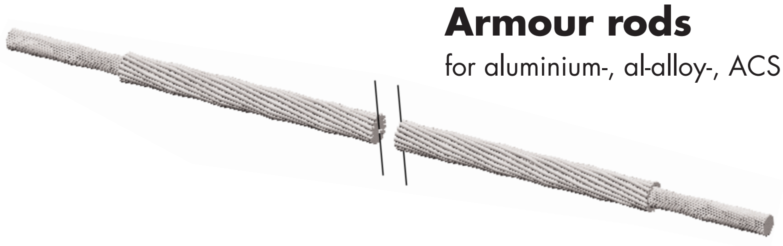
Line guards

for aluminium-, al-alloy-, ACSR-, AACSR- and alumoweld conductors



Material: Corrosion resistant aluminium-alloy					
L.-Nr.	Dimensions in mm			Number of rods	Weight kg/100
	Conductor Ø	Length	Rod Ø		
4772.309	9,91–10,51	640	3,07	11	16,10
4772.310	10,52–11,09	640	3,07	12	17,60
4772.311	11,10–11,78	690	3,07	13	20,50
4772.312	11,79–12,46	690	3,07	13	20,50
4772.313	12,47–13,25	740	3,07	14	23,60
4772.314	13,26–14,01	740	3,07	14	23,60
4772.315	14,02–14,87	790	3,07	15	27,10
4772.316	14,88–15,41	790	3,71	14	36,90
4772.317	15,42–16,02	840	3,71	14	39,20
4772.318	16,03–16,65	840	3,71	14	39,20
4772.319	16,66–17,26	890	3,71	15	44,60
4772.320	17,27–17,87	890	3,71	15	44,40
4772.321	17,88–18,81	940	3,71	16	50,00
4772.322	18,82–20,13	990	3,71	17	56,00
4772.323	20,14–21,35	990	3,71	18	59,50
4772.324	21,36–22,82	1040	3,71	19	65,80
4772.325	22,83–24,25	1090	3,24	18	85,40
4772.326	24,26–25,06	1140	4,62	17	100,20
4772.327	25,07–25,82	1140	4,62	18	100,10
4772.328	25,83–27,04	1190	4,62	18	109,20
4772.229	27,05–27,90	1240	5,18	17	136,90
4772.330	27,91–29,30	1240	5,35	15	181,50
4772.331	29,31–30,70	1300	5,35	15	190,40
4772.332	30,71–32,22	1350	5,35	16	210,90
4772.333	32,23–33,72	1350	5,35	17	220,00
4772.334	33,73–35,32	1400	5,35	15	232,40
4772.335	35,33–36,59	1450	5,87	15	320,00
4772.336	36,60–38,32	1500	5,87	16	359,90
4772.337	38,33–40,10	1550	5,87	16	371,90
4772.338	40,11–41,95	1600	5,87	17	415,50

Armour rods for other conductors and dimensions on request.
Please state the lay direction of the conductor.



Armour rods

for aluminium-, al-alloy-, ACSR-, AACSR- and alumoweld conductors

Material: Corrosion resistant aluminium-alloy

L.-Nr.	Dimensions in mm			Number of rods	Weight kg
	Conductor Ø	Length L	Rod Ø		
4772.207	7,85– 8,30	1120	3,45	9	28,90
4772.208	8,31– 8,80	1170	3,71	9	34,90
4772.209	8,81– 9,31	1220	3,71	9	36,50
4772.210	9,32– 9,90	1270	3,71	10	42,30
4772.211	9,91–10,51	1320	4,24	9	51,80
4772.212	10,52–11,09	1320	3,71	10	43,90
4772.213	11,10–11,78	1370	4,24	10	59,80
4772.214	11,79–12,46	1370	4,24	10	59,80
4772.215	12,47–13,25	1420	4,24	11	68,00
4772.216	13,26–14,01	1470	4,24	11	70,50
4772.217	14,02–14,87	1520	4,62	11	86,30
4772.218	14,88–15,41	1570	4,62	12	97,30
4772.219	15,42–16,02	1630	4,62	12	101,00
4772.220	16,03–16,65	1630	4,62	12	101,00
4772.221	16,66–17,26	1680	4,62	13	112,80
4772.222	17,27–17,87	1730	5,18	12	134,90
4772.223	17,88–18,81	1830	5,18	12	142,70
4772.224	18,82–19,88	1830	5,18	13	154,60
4772.225	18,89–20,69	1930	6,35	11	207,30
4772.226	20,70–21,48	1930	6,35	11	207,30
4772.227	21,49–23,05	1980	6,35	12	232,10
4772.228	23,06–23,61	2030	6,35	13	257,70
4772.229	23,62–24,81	2240	6,35	13	284,40
4772.230	24,82–25,82	2340	7,87	11	385,90
4772.231	25,83–26,30	2390	7,87	12	430,10
4772.232	26,31–27,04	2440	7,87	12	439,00
4772.233	27,05–27,90	2540	7,87	12	430,80
4772.234	27,91–28,95	2540	7,87	12	457,10
4772.235	28,96–29,50	2540	7,87	13	495,20
4772.236	29,51–30,70	2540	7,87	13	495,10
4772.237	30,71–32,25	2540	9,27	12	634,20
4772.238	32,26–33,72	2540	9,27	12	634,30
4772.239	33,73–35,32	2540	9,27	13	687,20
4772.240	35,33–36,59	2540	9,27	13	700,30
4772.241	36,60–38,32	2540	9,27	14	740,00
4772.242	38,33–40,10	2540	9,27	14	687,10
4772.243	40,11–41,95	2540	9,27	14	754,10
4772.244	41,96–43,91	2540	11,09	13	979,70

Armour rods for other conductors and dimensions on request.
Please state the lay direction of the conductor.

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