1. APPLICATION

ÖLFLEX® CRANE cables are chloroprene rubber cables with supporting element for flexible use for medium mechanical load conditions. They are also suitable for use in dry and damp areas as well as wet industrial conditions. They are suitable for outdoor use if the indicated temperature range is observed. They are weatherproof and suitable for harsh environmental conditions.
For application the selection table A3 in Lapp download services (https://www.lapp.com) shall be considered.
Usage of these cables on drums or on guide pulleys under tensile load is not allowed.
Application range: Handling and hoisting equipment, construction machinery, dockyard installations etc.

2. CABLE MAKE UP (SHORT VERSION)

Conductor	extra fine wire strands of bare copper acc. to IEC 60228 resp. EN IEC 60228, class 6, except cross-sections from 1.5 to 4mm² with special strands of bare copper
Core insulation	Ethylen-Propylen-rubber compound 3GI3 acc. to VDE 0207-20
Core identification code	acc. to VDE 0293-1, with GN/YE ground conductor up to 5 cores coloured acc. to VDE 0293-308 resp. HD 308 S2 starting at 6 cores: black cores with white numbers acc. to EN 50334
Cable assembly	cores are stranded in layers depending on the number of cores and the conductor cross-section one or several support elements (elongation ≤ 15% at max. tensile load see 4.10) are used tensile load = number of cores x nominal cross section x 30 N/mm² tensile load ≥ 300 N
Wrapping over stranding	wrapped with a PET fleece tape; except cross-sections ≤ 2.5 mm² up to 5 cores
Outer sheath	Chloroprene rubber compound 5GM3 acc. to VDE 0207-21, colour: black, similar RAL 9005

3. TECHNICAL DATA

Design	based on VDE 0250-814
Volume resistivity (20°C)	≥ 1 TΩ x cm acc. to VDE 0207-20
Nominal voltage	U_0 / U: 300 / 500 V
Test voltage	core / core: 3000 V AC
Min. bending radius	occasional flexing: 12.5 x outer diameter fixed installation: 6 x outer diameter
Temperature range	flexing: - 25 °C up to +80 °C fixed installation: - 40 °C up to +80 °C max. conductor temperature: 90 °C
Flammability	acc. to IEC 60332-1-2 resp. EN 60332-1-2
Tests	acc. to VDE 0250-1 and IEC 60811 resp. EN 60811
EU directive	These cables are conform to the EU-Directive 2014/35/EU (Low Voltage Directive)

4. CABLE MAKE UP

Based on VDE 0250-814

4.1. Conductor

- Extra fine wire strands of bare copper acc. to IEC 60228 resp. EN IEC 60228, class 6, except cross-sections from 1.5 to 4mm² with special strands of bare copper (see maximal wire diameter in table below)
- Conductor resistance: acc. to IEC 60228 resp. EN IEC 60228, class 6
- To avoid chemical interaction with the rubber material, a separating layer of a plastic foil or a similar applicable material shall be used over the stranded conductor.

Cross section * [mm²]	Max. wire diameter [mm]	Max. stranded wire length of lay [mm]
2 - 36 cores		
1	0.16	max. 20 x outer conductor diameter
1.5-2.5	0.21**	max. 20 x outer conductor diameter
4 – 5 cores		
4	0.21**	max. 30 x outer conductor diameter
6-16	0.21	max. 30 x outer conductor diameter

* Cross section is reference value (for information only)
** Special strands of bare cooper

4.2. Core

Insulation of Ethylen-Propylen-rubber compound 3GI3 acc. to VDE 0207-20

4.3. Wall thickness and outer diameter of the insulation

Nominal wall thickness acc. to VDE 0250-814 table 1, column 3

Cross section * [mm²]	Conductor diameter [mm]	Nominal value [mm]	Minimum value [mm]	Core diameter ** [mm]	Insulation resistance Min. value at 20°C [MΩ x km]
1	1.4	0.8	0.62	3.0	1.313
1.5	1.65	0.8	0.62	3.25	1.157
2.5	2.1	0.9	0.71	3.9	1.042
4	2.7	1.0	0.80	4.7	0.937
6	3.2	1.0	0.80	5.2	0.814
10	4.3	1.2	0.98	6.7	0.764
16	5.55	1.2	0.98	7.95	0.625

* Cross section is reference value (for information only)
** Diameter is reference value (for information only)
The average of the measured values shall not be less than the nominal thickness.
The smallest value, measured at any point, shall not be smaller than the minimum value.

4.4. Identification

The labelling is carried out acc. to VDE 0293-1, with GN/YE ground conductor
up to 5 cores coloured acc. to VDE 0293-308 resp. HD 308 S2
starting at 6 cores black cores with white numbers acc. to EN 50334, but with numeral distance max. 50 mm for all cores.
acc. to Works Specification WN00-1005, in support to EN 50334.
acc. to Works Specification WN00-1008, in support to EN 60445.
The dye distribution of the GN/YE core complies with EN 60445.

4.5. Cable assembly

- Depending on the number of cores and conductor cross-section the cores are stranded together in the following way:
  - around a centre support element (stranding design see in table below)
  - several single support elements are used as interstice fillers (stranding design see in table below)
- Support element:
  - Support element made of hemp or at least comparable material, shall be available as a strain relief
  - tensile load = number of cores x nominal cross section x 30 N/mm²
    tensile load ≥ 300 N (values defined in 4.10)
  - The elongation of the support element at the maximum tensile load (see 4.10), shall not exceed a value of 15%
  - For flexibility improvement and modification into the free interstice space the support elements may be enlarged with an extruded rubber layer or an overlapping textile tape (rubber coating is only on tape inside allowed)
  - The support elements shall not adhere on the insulation or outer sheath
- Stranding design:
  - To achieve a round cable surface, additional interstice fillers made of cotton or synthetic may be used
  - Length of lay at cross-sections with ≤ 7 cores: max. 15 x diameter of the particular layer
  - Length of lay at cross sections with > 7 cores: max. 8 x diameter of the particular layer
  - Cores are stranded in the same direction and in concentric layers
  - The direction of each stranding layer: Z
  - Each stranded layer shall be powdered with talcum. This has to be visible at the finished product.
  - Each stranded layer shall be separated by textile tapes without rubber content; PET tape preferred.
  - Cross-sections ≤ 2.5 mm² up to 5 cores no textile tapes are required – only talcum applyment
  - Core connections are not allowed (welding- or solder connections). This also applies to the support element.

Stranding design	Support element design
2- and 3 cores at each cross-section	Support element divided in several interstice fillers Cores stranded in 1 layer
4 cores at cross-sections up to 2.5mm²	Support element divided in several interstice fillers Cores stranded in 1 layer
4 cores – up to 15 cores at cross-sections ≥ 4mm² up to 16mm²	Central support element Cores stranded in 1 layer
5 cores – up to 15 cores at cross-sections up to 2.5mm²	Central support element, Cores stranded in 1 layer
16 cores – up to 36 cores at each cross-section	Cores stranded in multilayer design around central support element: ≤ 30 cores: 2 layers ≤ 36 cores: 3 layers

4.6. Wrapping over stranding

- The outer stranding layer shall be wrapped with an overlapping PET fleece tape, except cross-sections ≤ 2.5 mm² up to 5 cores no PET fleece tape is required – only talcum shall be applied
- Tape requirements:
  - with or without rubber coating and may adhere to the outer sheath
  - the usage of rubber coating shall only be used on the outside of the tape
  - the inside wrapping shall not adhere on the cores
  - overlap: approx. 25 % (min. 20 %)
  - observe loose wrapping design, avoid necking of stranding assembly so that there is no impairment of the flexibility of the cable

4.7. Outer sheath

Chloroprene rubber compound 5GM3 acc. to VDE 0207-21.

The outer sheath shall be extruded with compression.

The surface of the outer sheath shall be structured that way, that a sticking together of the cables is not possible.

There shall be no contours of the stranding or wrapping

Over the total length the cores shall not stick or adhere on the outer sheath, so that the outer sheath can be easily pulled off after a peripheral and a longitudinal cut about 100 mm length.

4.8. Wall thickness of the outer sheath

The wall thickness is defined as follows:

For cross-sections < 2.5mm² with 2 to 5 cores the nominal wall thickness shall be equivalent to a value of 1.0 mm.

For all other cross-sections the wall thickness depends on the diameter over wrapping (see following table):

Diameter over wrapping* [mm]	Wall thickness [mm]
up to 12.5	1.3
up to 15.0	1.6
up to 20.0	1.9
up to 25.0	2.2
up to 30.0	2.5
up to 35.0	2.8
up to 40.0	3.1

For the given nominal values of wall thickness of the outer sheath as minimum values are valid:
minimum value = nominal value - (15 % + 0.1 mm).

4.9. Colour of outer sheath

Black, similar RAL 9005

4.10. Dimension table

Dimension	Diameter over stranding / wrapping*	Sheath wall th. Nominal value [mm]	Sheath wall th. Minimum value [mm]	Outer diameter [mm]	Min. strain relief addition** [N]	Tensile load cable *** [N]
2x1	5.4	1.0	0.75	7.4 ± 1.0	240	300
3G1	6.3	1.0	0.75	8.3 ± 1.0	210	300
4G1	6.9	1.0	0.75	8.9 ± 1.0	180	300
5G1	8.4	1.0	0.75	10.4 ± 1.5	150	300
7G1	9.8	1.3	1.01	12.9 ± 1.5	90	300
9G1	12.0	1.3	1.01	14.4 ± 1.5	30	300
12G1	14.5	1.6	1.26	18.5 ± 2.0	n/a	360
18G1	14.5	1.6	1.26	19.2 ± 2.3	n/a	540
24G1	17.5	1.9	1.52	22.1 ± 2.3	n/a	720
36G1	20.5	2.2	1.77	26.1 ± 2.3	n/a	1080
2x1.5	6.0	1.0	0.75	8.0 ± 1.0	n/a	300
3G1.5	6.7	1.0	0.75	8.7 ± 1.0	165	300
4G1.5	7.9	1.0	0.75	9.9 ± 1.0	220	300
5G1.5	8.9	1.0	0.75	10.9 ± 1.5	75	300
7G1.5	11.0	1.3	1.01	14.0 ± 1.5	n/a	315
8G1.5	12.0	1.3	1.01	15.2 ± 2.0	n/a	360
9G1.5	13.0	1.6	1.26	15.9 ± 2.0	n/a	405
10G1.5	14.0	1.6	1.26	17.0 ± 2.0	n/a	450
12G1.5	16.0	1.9	1.52	18.3 ± 2.0	n/a	540
18G1.5	16.0	1.9	1.52	20.9 ± 2.3	n/a	810
24G1.5	19.0	1.9	1.52	23.4 ± 2.3	n/a	1080
2x2.5	7.7	1.0	0.75	9.7 ± 1.0	150	300
3G2.5	8.2	1.0	0.75	10.2 ± 1.5	75	300
4G2.5	9.6	1.0	0.75	11.6 ± 1.5	n/a	300
5G2.5	10.4	1.0	0.75	12.4 ± 1.5	n/a	375
7G2.5	13.0	1.6	1.26	16.6 ± 2.0	n/a	525
9G2.5	15.5	1.9	1.52	18.9 ± 2.0	n/a	675
12G2.5	19.0	1.9	1.52	23.3 ± 2.3	n/a	900
16G2.5	18.0	1.9	1.52	22.8 ± 2.3	n/a	1200
18G2.5	19.0	1.9	1.52	24.4 ± 2.3	n/a	1350
24G2.5	23.0	2.2	1.77	28.5 ± 2.3	n/a	1800
4G4	11.5	1.3	1.01	15.2 ± 2.0	n/a	480
5G4	12.5	1.6	1.26	16.8 ± 2.0	n/a	600
4G6	12.5	1.6	1.26	16.8 ± 2.0	n/a	720
5G6	13.5	1.9	1.52	19.2 ± 2.0	n/a	900
4G10	16.0	1.9	1.52	21.8 ± 2.3	n/a	1200
5G10	18.2	1.9	1.52	24.6 ± 2.3	n/a	1500
4G16	19.0	1.9	1.52	25.4 ± 2.3	n/a	1920
5G16	20.4	2.2	1.77	28.0 ± 2.3	n/a	2400

*For cross-sections ≤ 2.5 mm² up to 5 cores without wrapping over stranding the diameter over stranding is specified.

**If the calculated value of the tensile load of the complete cable is < 300N, the missing difference must be ensured by the minimum strain relief addition.

***The values of the tensile load of the complete cable are defined with the calculation formula in 4.5 and must reach a minimum value of 300N.

5. IDENTIFICATION

The identification is effected by ink-jet printing on the outer sheath.

Text:

LAPP KABEL STUTTGART **ÖLFLEX® CRANE** AZ G/X Q CE RV MM

AZ	number of cores
G/X	with or without ground conductor
Q	conductor cross section
CE	Identification of the conformity acc. to 2014/35/EU (Low Voltage Directive) with the two stylised letters CE
RV	traceability coding
MM	meter sequence

The **supplier symbol** has to be printed additionally with a distance of approx. 5 mm ahead of **LAPP KABEL ...** (acc. to Works Specification WN00-2010).

Colour of the printing: white

The correct print performance is defined in Works Specification WN00-2010.
The identification text with traceability coding shall be printed twice within the meter sequence.
The meter sequence shall be printed on the cable.

6. GENERAL REQUIREMENTS

PWIS: All materials used for the cable during manufacturing must be free of **P**aint-**W**etting **I**mpairment **S**ubstances, e.g. silicone.

RoHS: All homogenous materials of all articles must not contain the substances of Annex II of the European Directive 2011/65/EU (RoHS) in excess of the concentration limits listed therein. Exemptions are allowable for the applications listed in Annex III and IV of the same Directive.

REACH: All materials used in the manufacturing process of the product are subject to the EC-Regulation No. 1907/2006 regarding Registration, Evaluation, Authorization and Restriction of Chemicals **(REACH)**. If substances based on the current Candidate List are used, they shall be listed with their designation and their concentration.

7. TESTS

7.1. Final production tests

Following tests shall be carried out during the production process and in the final test field for each production lot:

Electrical test	- Continuity (all cores) - Conductor resistance (at least one core): Voltage test core/core: 2kV AC for min. 5 minutes - Spark test (test of defects in the insulation) - Electric strength (see Table 1)
Mechanical test	- Wall thickness insulation - Wall thickness sheath - Outer diameter - Stripping ability of the sheath
Visual inspection	- Core identification and core sequence - Sheath surface and printing - Presence of talcum /wrapping

Providing the product features for the whole production length, further tests may be necessary.
Appearing claims will be solved by falling back on our manufacturing-internal documentation.

7.2. Type tests

Type tests shall be carried out by the supplier in case of modifications of materials or design, however at least every 36 months.
The detailed test report has to be sent to the PDC Department of U.I. LAPP GmbH (see Table 1).
When providing the initial sample inspection report, a type test report must be enclosed.
For product approval the designation of the compound has to be listed.

Deviations regarding the compound are subject to explicit consent of U.I. LAPP GmbH.

Table 1

Electrical tests

Test	EN/CENELEC	IEC/UL
Conductor resistance (min. 1 core)	EN 50395 clause 5	IEC 60228 appendix A
Voltage test at the core (in a water quench) Min. length: 5 m Min. time of water storage: 24 h Temperature of water quench: 20 ± 5 °C Test voltage 3 **kV AC**, min. 15 minutes	EN 50395 clause 7	
Electric strength of the complete cable (in a water quench) Min. length: 20 m Min. time of water storage: 24 h Temperature of water quench: 20 ± 5 °C Test voltage 3 **kV AC**, min. 15 minutes	EN 50395 clause 6	
Insulation resistance at 90 °C Min. length: 5 m Min. time of water storage: 2 h Desired values acc. to item 4.1	EN 50395 clause 8.1	
Surface resistance of the sheath Min. length: 0.25 m Required value: min. $10^9\ \Omega$	EN 50395 clause 11	
DC electrical strength Min. length: 5 m Min. time of water storage: 240 h Temperature of water quench: 60 ± 5 °C Applied direct voltage: 220 V	EN 50395 clause 9	
Test of defects in the insulation (On-line sparktest)	EN 50395 clause 10.2 (EN 62230)	
Electric strength of the complete cable (at each delivery length) Test voltage 3 **kV AC**, min. 1 minute	EN 50395 clause 10.3	

Design and measures

Test	EN/CENELEC	IEC/UL
Wall thickness of the insulation	EN 50396 clause 4.1	IEC 60811-201
Wall thickness of the outer sheath	EN 50396 clause 4.2	IEC 60811-202
Outer diameter of the cable	EN 50396 clause 4.4	IEC 60811-203
Ovality (max. 15 %)	EN 50396 clause 4.4	IEC 60811-203
Length of lay of the stranded conductor	Dimensional check	
Length of lay of the core	Dimensional check	
Powdering with talcum / wrapping	Visual inspection	

Mechanical characteristics before and after aging, thermal behaviour

Test	EN/CENELEC	IEC/UL
Test of the conductor		
Solderability test for plain conductors	EN 50396 clause 8.2	

Test	EN/CENELEC	IEC/UL
Test of the extruded insulation, 3GI3, acc. to VDE 0207-20		
Test at low temperature (cold bend) at –35 °C Only for test specimens with a diameter ≤ 12.5 mm	EN 60811-504	IEC 60811-504
Test at low temp. (cold elongation) at –35 °C Only for test specimens with a diameter > 12.5 mm	EN 60811-505	IEC 60811-505

Test	EN/CENELEC	IEC/UL
Test of the extruded outer sheath, 5GM3, acc. to VDE 0207-21		
Test at low temp. (cold bend) at –35 °C Only for test specimens with a diameter ≤ 12.5 mm	EN 60811-504	IEC 60811-504
Test at low temp. (cold elongation) at –35 °C Only for test specimens with a diameter > 12.5 mm	EN 60811-505	IEC 60811-505

Test	EN/CENELEC	IEC/UL
Test of the cable		
Alternate bending test , then after removing the sheath, water storage and applied voltage test at cores 300/500 V: Test voltage 3 **kV AC** Roll diameter ≤ 10xcable diamter Load weight: = 0.5 kg/mm² Min. length: 5 m Min. time of water storage: 1 h Temperature of water quench: 20 ± 5 °C		EN 50396 clause 6.2 EN 50395 clause 7
Test at low temp. (cold impact) at -35 °C	EN 60811-506	IEC 60811-506
Identification	EN 50396 clause 5.1	

Test	EN/CENELEC	IEC/UL
Flammability	EN 60332-1-2	IEC 60332-1-2

Test	EN/CENELEC	IEC
Internal tests		
PWIS test (Paint Wetting Impairment Substances)	WN1-25.000.4	