3. TECHNICAL APPENDIX

Instructions for crimping our cable lugs and connectors

Following we give some information about suitable tools and the realization of the crimping process when working with our cable lugs and connectors. **Please notice, that it is absolutely necessary to pay attention to the fact that cable connector, tool and die set are well suited to each other. Only under this condition it is possible to guarantee optimal solderless crimped connections. Therefore we recommend to work only with the suitable druseidt tools.**
To take notice of the various kinds of applications and the number of crimping operations we offer tools in a different price- and performance level. Generally we recommend only to work with ratchet assisted tools, especially when working in the industrial field. So it is possible to guarantee a constant crimping force and optimal crimping performance all over the time. Also we recommend to inspect the tools every year (by permanent working shorter periods after agreement).

With pleasure we'll check and repair your tools in our company. Please notice that it's not allowed to make any changes on our tools. It is not possible to give any form of guarantee by improper handling, incorrect repairing or changed tools. All cable lugs, connectors and tools are constructed for the crimping of stranded copper- and aluminium-conductors. By working with massive single wire conductors or cables made out of other materials it is necessary to consult our company. Our company offers a wide range of cable connectors. Based on this fact it is not possible to write down crimping instructions for all of the different kinds of conductors described in this catalogue. Therefore please be so kind and contact us in case of doubt. With pleasure our employees assist your company to find an optimal crimping solution for your application.

Direction for crimping cable lugs and connectors

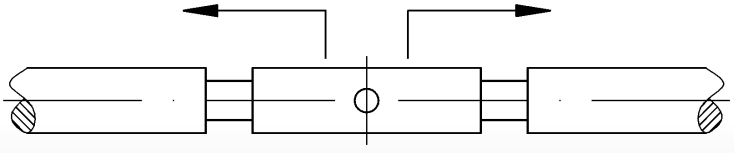
A general instruction is that cable lugs or connectors and the used cable must have the same cross-section. By working with fine stranded cables with a bigger outer-Ø it is necessary to work with cable lugs for fine stranded cables (described in this catalogue on pages 35-39) or cable lugs with a bigger cross-section as the cable. To work with cable lugs with a smaller cross-section as the cable is not allowed.

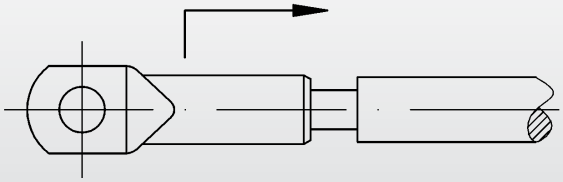
To guarantee an optimal filling of the crimp sleeve it is necessary that the difference of the inner-Ø of the sleeve and the outer-Ø of the stripped cable is not to much. You get an optimal crimping performance when the inner-Ø of the sleeve and the outer-Ø of the cable is nearly the same. The dimension of the cable lugs and connectors are described in our catalogue. Please compare these dimensions with the outer-Ø of your stripped cable.

Crimping procedure by working with tubular cable lugs and connectors:

- cutting of the cable (right angled to the conductor).
- stripping of the cable. Stripping length = length of the crimp sleeve + ca. 10 %, caused of the sleeve stretching when crimping.
- before starting the crimping process it is necessary to clean the stripped cable ends and make it free of dirt and oxides. Sector shaped cables must be rounded with special dies.
- insertion of the cable. By working with cable lugs up to the end of the crimping sleeve, by working with connectors up to the centre of the connector.
- checking up that cable lug or connector, tool and die set are the right ones.
- take also notice of the instructions for use of the crimping tool.
- realizing of the crimping process. Beginning from the flange of the cable lug in the direction to the conductor or by working with connectors from the connector-centre in the direction to the conductor (acc. to the following drawing). Number of crimpings in dependence of the crimping width and length of the crimping sleeves (please take also notice of the instructions on page 203).

Crimping direction by realizing the crimping process:





Number of crimpings

When working with tubular cable lugs and connectors the number of crimpings are in dependence of the used tool and the crimping width of the die sets. Such information are given in our tables and the description in this catalogue.

The recommend min. number of crimpings are contained in the following tables. When working with butt connectors it is necessary to double it. When crimping cable lugs please pay attention to our instructions on page 202 too.

	number x crimping width				
cross-section mm²	druseidt standard design	druseidt Euro-design	druseidt design for fine stranded cables	copper DIN-design 46235 / 46267/1	aluminium DIN-design 46239 / 46267/2
10	1 x 5 mm	1 x 5 mm	1 x 5 mm	1 x 5 mm	-
	1 x 7 mm	1 x 7 mm	1 x 7 mm	1 x 7 mm	-
16	1 x 5 mm	2 x 5 mm	2 x 5 mm	2 x 5 mm	3 x 5 mm
	1 x 7 mm	1 x 7 mm	1 x 10 mm	1 x 14 mm	2 x 7 mm
					1 x 12 mm
25	2 x 5 mm	2 x 5 mm	2 x 5 mm	2 x 5 mm	4 x 5 mm
	1 x 10 mm	1 x 12 mm	1 x 12 mm	2 x 7 mm	3 x 7 mm
				1 x 14 mm	2 x 12 mm
35	2 x 5 mm	2 x 5 mm	2 x 5 mm	2 x 5 mm	5 x 5 mm
	2 x 7 mm	2 x 7 mm	2 x 7 mm	2 x 7 mm	4 x 7 mm
	1 x 12 mm	1 x 12 mm	1 x 14 mm	1 x 12 mm	2 x 12 mm
50	2 x 5 mm	2 x 5 mm	2 x 5 mm	3 x 5 mm	5 x 5 mm
	2 x 7 mm	2 x 7 mm	2 x 7 mm	2 x 7 mm	4 x 7 mm
	1 x 12 mm	1 x 12 mm	1 x 14 mm	1 x 12 mm	2 x 12 mm
70	2 x 5 mm	2 x 5 mm	3 x 5 mm	3 x 5 mm	7 x 5 mm
	2 x 7 mm	2 x 7 mm	2 x 7 mm	2 x 7 mm	5 x 7 mm
	1 x 14 mm	1 x 14 mm	1 x 14 mm	1 x 12 mm	3 x 12 mm
95	3 x 5 mm	3 x 5 mm	3 x 5 mm	4 x 5 mm	7 x 5 mm
	2 x 7 mm	2 x 7 mm	2 x 7 mm	3 x 7 mm	5 x 7 mm
	1 x 14 mm	1 x 14 mm	1 x 14 mm	2 x 12 mm	3 x 12 mm
120	3 x 5 mm	3 x 5 mm	3 x 5 mm	4 x 5 mm	7 x 5 mm
	2 x 7 mm	2 x 7 mm	2 x 7 mm	2 x 7 mm	5 x 7 mm
	1 x 14 mm	1 x 14 mm	1 x 14 mm	2 x 12 mm	3 x 12 mm
150	3 x 5 mm	3 x 5 mm	3 x 5 mm	4 x 5 mm	7 x 5 mm
	2 x 7 mm	2 x 7 mm	2 x 7 mm	3 x 7 mm	5 x 7 mm
	1 x 14 mm	1 x 14 mm	1 x 14 mm	2 x 14 mm	3 x 12 mm
185	3 x 5 mm	3 x 5 mm	4 x 5 mm	4 x 5 mm	7 x 5 mm
	2 x 7 mm	2 x 7 mm	3 x 7 mm	3 x 7 mm	5 x 7 mm
	1 x 14 mm	1 x 14 mm	2 x 14 mm	2 x 14 mm	3 x 12 mm
240	4 x 5 mm	4 x 5 mm	5 x 5 mm	5 x 5 mm	8 x 5 mm
	3 x 7 mm	3 x 7 mm	4 x 7 mm	4 x 7 mm	6 x 7 mm
	2 x 14 mm	2 x 14 mm	2 x 14 mm	2 x 14 mm	3 x 12 mm
300	4 x 5 mm	4 x 5 mm	-	5 x 5 mm	8 x 5 mm
	3 x 7 mm	3 x 7 mm	-	4 x 7 mm	6 x 7 mm
	2 x 14 mm	2 x 14 mm	-	2 x 14 mm	3 x 12 mm
400	2 x 14 mm	2 x 14 mm	-	3 x 17 mm	3 x 17 mm
500	3 x 14 mm	3 x 14 mm	-	3 x 17 mm	4 x 17 mm
630	3 x 14 mm	3 x 14 mm	-	3 x 17 mm	4 x 17 mm
800	-	-	-	3 x 25 mm	4 x 25 mm
1000	-	-	-	3 x 25 mm	4 x 25 mm

Maximum allowable current load of cable lugs and connectors in conjunction with insulated leadings and conductors

The current load of cable lugs and connectors depends on the regulations of the VDE 0298 part 4 where the allowable current load of leadings and cables are regulated. Following a summary of some most used situations.

The information about current load apply by an ambient temperature of +30° C in dependence of the laying system of the cables.

Group 1: Leadings up to a nominal voltage 1 kV and heat resistant leadings acc. to VDE 0298 part 4 table 11 column 2. Air-cooled single wire leadings, rubber-insulated, PVC-insulated, heat resistant.

Group 2: Leadings up to a nominal voltage of 1 kV and heat resistant leadings acc. to VDE 0298 part 4 column 5. Multi-conductor leadings (but not for household appliance and hand-hold units) layed on or of free areas, rubber insulated, PVC-insulated, heat resistant.

Group 3: Leadings with a nominal voltage of 0,6/1 kV acc. to VDE 0298 part 4, column 7. Rubber insulated leadings 0,6/1 kV and 1,8/3 kV in special design (air cooled laying).

Group 4: Leadings with a nominal voltage of 0,6/1 kV acc. to VDE 0298, part 4 column 4. Multi conductor leadings rubber tube insulated and trailing cables up to 6/10 kV layed on or of free areas.

nominal cross-section mm²	current load for copper cables in ampere			
	Group 1	Group 2	Group 3	Group 4
0,75	15	12	-	-
1	19	15	-	-
1,5	24	18	30	-
2,5	32	26	41	30
4	42	34	55	41
6	54	44	70	53
10	73	61	98	74
16	98	82	132	99
25	129	108	176	131
35	158	135	218	162
50	198	168	276	202
70	245	207	347	250
95	292	250	416	301
120	344	292	488	352
150	391	335	566	404
185	448	382	644	461
240	528	453	775	-
300	608	523	898	-
400	726	-	-	-
500	830	-	-	-

Remark: Design of the leadings resp. all values deviates from VDE 0298 part 4 dated August 2003 and are only valid under the conditions of the VDE-regulations.

Tightening torques for screws

acc. to DIN EN 61238/DIN VDE 0220 part 2 for screws 8.8

thread M	tightening torque Nm
5	5
6	9
8	22
10	44

thread M	tightening torque Nm
12	75
14	120
16	190
20	380

Tightening force for leadings and cables

The tightening force is the identified value to pull out a leading or cable out of the crimped connector. The values deliver information about the mechanical stress of crimping connections. In dependence of the different cable lugs and connectors we have different regulations about the minimum tightening forces for crimping connections.

To pass the test acc. to the different norms and regulations it is necessary that the electrical conductor cannot pulled out inside of 60 seconds when testing with 100 % of the tightening force. Following a summary of such values under consideration of the different norms.

	Values for crimping copper connectors up to 10 mm² DIN EN 61238-1, 3/2004 (VDE 0220 part 100) exept cable end sleeves			Values for crimping aluminium connectors up to 16 mm² DIN EN 61238-1, 03/2004 (VDE 0220 part 100)		
	100%	130%	150%	100%	130%	150%
10 mm²	600 N	780 N	900 N	-	-	-
16 mm²	960 N	1248 N	1440 N	640 N	832 N	960 N
25 mm²	1500 N	1950 N	2250 N	1000 N	1300 N	1500 N
35 mm²	2100 N	2730 N	3150 N	1400 N	1820 N	2100 N
50 mm²	3000 N	3900 N	4500 N	2000 N	2600 N	3000 N
70 mm²	4200 N	5460 N	6300 N	2800 N	3640 N	4200 N
95 mm²	5700 N	7410 N	8550 N	3800 N	4940 N	5700 N
120 mm²	7200 N	9360 N	10800 N	4800 N	6240 N	7200 N
150 mm²	9000 N	11700 N	13500 N	6000 N	7800 N	9000 N
185 mm²	11100 N	14430 N	16550 N	7400 N	9620 N	11100 N
240 mm²	14400 N	18720 N	21600 N	9600 N	12480 N	14400 N
300 mm²	18000 N	23400 N	27000 N	12000 N	15600 N	18000 N
400 mm²	24000 N*			16000 N	20800 N	24000 N
500 mm²	30000 N*			20000 N	26000 N	30000 N
625 mm²	37500 N*			25000 N*		
800 mm²	48000 N*			32000 N*		
1000 mm²	60000 N*			40000 N*		

* VDE 0220 part 100: maximum value is limited up to 20000 N

	Values for crimp connections up to 10 mm² EN 60352 part 2, 10/2002 exept cable end sleeves			Values for connections with tabs and receptacles in combination with copper conductors DIN EN 61210 (VDE 0613 part 6), 06/2011		
cross-section	100%	130%	150%	100%		
0,2 mm²	-	-	-	28 N		
0,34 mm²	-	-	-	40 N		
0,5 mm²	60 N	78 N	90 N	56 N		
0,75 mm²	85 N	111 N	128 N	84 N		
1 mm²	108 N	140 N	162 N	108 N		
1,5 mm²	150 N	195 N	225 N	150 N		
2,5 mm²	230 N	299 N	345 N	230 N		
4 mm²	310 M	403 N	465 N	310 N		
6 mm²	360 N	468 N	540 N	360 N		
10 mm²	380 N	494 N	570 N	-		

Values for cable end sleeves			Values for cable end sleeves		
cross-section	EN 60947-1 (VDE 0660 part 100) release 04/2008	EN 60999-1 release 12/2000	cross-section	EN 60947-1 (VDE 0660 part 100) release 04/2008	EN 60999-2 release 4/2004
0,2 mm²	10 N	10 N	50 mm²	236 N	236 N
0,34 mm²	15 N	15 N	70 mm²	285 N	285 N
0,5 mm²	20 N	20 N	95 mm²	351 N	351 N
0,75 mm²	30 N	30 N	120 mm²	427 N	427 N
1 mm²	35 N	35 N	150 mm²	427 N	427 N
1,5 mm²	40 N	40 N	185 mm²	503 N	503 N
2,5 mm²	50 N	50 N	240 mm²	578 N	578 N
4 mm²	60 N	60 N			
6 mm²	80 N	80 N			
10 mm²	90 N	90 N			
16 mm²	100 N	100 N			
25 mm²	135 N	135 N			
35 mm²	190 N	190 N			

Temperature resistance of cable lugs and connectors

copper cable lugs without insulation	up to + 120° C
uninsulated cable end sleeves	up to + 120° C
cable lugs and connectors with PA-insulation	up to + 105° C
cable lugs and connectors with PC-insulation	up to + 100° C
cable lugs and connectors with PVC-insulation	up to + 70° C
cable lugs and connectors with shrinking insulation	up to + 95° C
insulated cable end sleeves	up to + 105° C

cable lugs and connectors out of nickel	up to + 500° C
cable lugs and connectors out of stainless steel	up to + 400° C
uninsulated tabs and receptacles, brass, uncoated	up to + 90° C
uninsulated tabs and receptacles, brass, tin plated	up to + 100° C
uninsulated tabs and receptacles, brass, silver plated	up to + 110° C
uninsulated tabs and receptacles, brass, nickel plated	up to + 250° C

Conductor cross-section comparison

AWG	30	29	28	27	26	25	24	23	22	21	20	19
cross-section mm²	0,0503	0,0646	0,0804	0,102	0,128	0,163	0,205	0,259	0,325	0,412	0,519	0,653
comparable metrical cross-section	0,05	-	-	0,1	0,14	-	0,2	0,25	-	-	0,5	-

AWG	18	17	16	15	14	13	12	11	10	9	8	7
cross-section mm²	0,823	1,04	1,31	1,65	2,08	2,63	3,31	4,15	5,27	6,62	8,35	10,6
comparable metrical cross-section	0,75	1	-	1,5	-	2,5	-	-	-	6	-	10

AWG	6	5	4	3	2	1	0	2/0	3/0	4/0	5/0	6/0
cross-section mm²	13,3	16,8	21,2	26,7	33,6	42,4	53,4	67,5	85,0	107,2	135,1	170,3
comparable metrical cross-section	-	16	-	25	35	-	50	70	95	120	150	185

Inspection and repair of crimping tools

In dependence of the frequency of use and the environmental influences crimping tools are subject of abrasion. Therefore we recommend to inspect the tools every year (by permanent working shorter periods after agreement). With pleasure we'll check and repair your tools in our company. Please notice that tools delivered by druseidt may not be changed in any way.

In particular it is not allowed to make diameter holes etc. Please use our tools only in accordance with our description and the regulations. Repairs of tools may only be executed by our service-department. With pleasure our employees assist your company in repairing and inspecting tools as well as in finding optimal crimping solutions.

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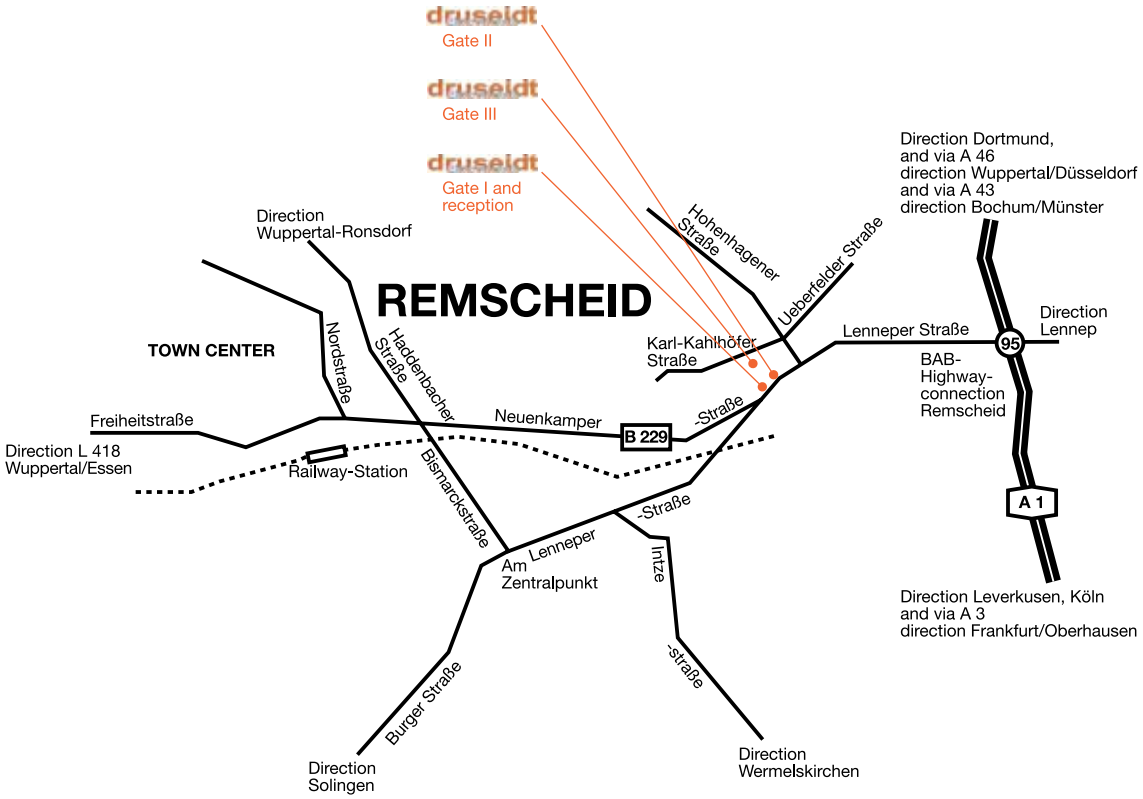

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