

Air- and water cooled current cables

List 502E

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This list incorporates:

- 1) Water cooled hollow-core conductors. Owing to the inner construction, hollow-core cables are particularly suitable for medium frequency applications and large cooling water quantities. Also, the cable ends can be prepared for termination of HOMA contact fittings.
- 2) Water cooled cables without hollow conductor with one or more parallel copper strands. Cable type 121 to 301 can be used up to 10kHz. The cable types 401 - 1417 for technical reasons should only be used up to 250Hz.
- 3) Copper cables without forced cooling. These cables can be supplied blank or with protective sleeves and used only, for example, in circuits with low current densities such as in induction channel furnaces of low power.

General:

Water cooled HOMA-cables are used for the transmission of high-currents in movable current dissipating installations, such as induction furnaces, arc furnaces etc. HOMA cables are made utilising special construction principles and special manufacturing techniques. For this reason, they are able to carry high currents, also for MF-operation, with low voltage drops. These cables are more economical and utilise less space than air cooled cables are also very flexible. Water cooled HOMA-cables may be continually overloaded without damage. An outer sheath protects the HOMA-cables from damage by molten metal splashes.

Heating losses:

The heating losses (KJ/h) are dependant on the specific loading per unit area and are proportional to the square of the current. For economical reasons (ration operating costs to purchasing costs), we suggest a current loading density of 8,4 A/mm² of the effective copper cross-sectional-area. This value may, however, be exceeded by 40% with corresponding higher heating losses.

Cooling:

The cable ends "F" with flange connection feature threaded holes for the cooling water connection in which the corresponding pipes, or hose sleeves, with suitable sealing tape can be fitted at the HOMA work's at extra charge. The threaded screw holes are designed to carry the maximum amount of cooling water (see diagram giving cooling water flow rate) in order to avoid a loss of pressure at the cable ends. The cooling circuits are larger than is required for dissipating the actual heating losses. Therefore, several cables can be connected for cooling in

Series, or the furnace induction coil as well, by using the cable-end fitting "R" incorporating a HOMA pipe contact connection. Cooling water hoses, between different potentials, must be of at least 1 meter in length per 1000V AC and 1 meter in length per 100V DC.

Cooling water:

The cooling water should contain little lime and must be filtered. In order to prevent incrustation and oxygen corrosion, a closed cooling water system should be used. Condensation can be avoided by keeping the cooling water inlet temperature slightly lower than the ambient temperature. The outlet temperature should not exceed 50° C.

Cooling water pressure:

HOMA-cables are tested at a pressure of 10 bar. The bursting pressure is considerably higher. Under normal conditions the pressure drop does not exceed 2 bar.

Hose sleeves:

The threaded screw holes for the cooling water connection can be rotated by 90° if necessary, and may be made smaller for lower cooling water flow rates.

The necessary cooling hose sleeves can be supplied, see page 9.

Cooling water monitor:

In the event the cooling water is interrupted, a copper conductor with a current loading of 8,4A/mm² would heat-up at a rate of 0,4K/s. The cooling water monitor, installed by the customer, must therefore switch-off the installation.

Resistive voltage drop:

The voltage drop, due the conductor resistance, on a cable 4m in length with the rated current flowing is 0,7V. This voltage drop varies linearly with length or current.

Inductive voltage drop:

The inductive voltage drop is dependant on the following factors: cable distribution, number of cables, cable length, load current, operating frequency and effective cable cross-sectional-area. The inductive voltage drop can occasionally be unacceptably high and must therefore be measured. At higher operating frequencies it is therefore essential to distribute the total current over a number of parallel, interspersed cables. As there are too many factors which influence the inductive voltage drop, we have omitted any tables. We are however prepared to calculate the inductive voltage drop if you supply us the following data:

- load current
- cable length
- operating frequency

Connection:

In the event that the circuit breaker is to be fed with water cooled copper pipes, then the pipes must be terminated with HOMA pipe contact fittings and connected to the cable end "R". The cable can be clamped, behind the hose clips, with hard-wood clamps in order to relieve the pipe contact assembly from any tensions. A similar connection is also to be used at the furnace. In the event that air-cooled feeder busbars are used to feed the circuit breaker, then the cable connection "F" is to be chosen in this position.

Bending radius and cable clamping:

The dimensions "o" and "p" in the cable on page 4 and 5 are the length of the non-bendable cable ends. From this point onwards the cables may be bent with the bending radius "r". A corresponding cable retainer must be fixed to the furnace chamber wall, as well as a cable guide on the furnace with the relevant cable bending radius. Due to the dynamic forces exerted on parallel cables by the current flowing through them, it is essential to clamp these closely together. The distance between the holding clamps, along the cable itself, should be approximately 1,5 to 2m.

Operating voltage:

Water cooled HOMA cables feature sheaths of high electrically insulating qualities. They are therefore suitable for voltages up to 3000V. A tough external sheath protects the cables against splashes from liquid metal.

Ordering details:

The following data is required: Number of length, type, length, cable and termination left or right, size and position of cooling water outlet for end termination type "F" with or without cooling hose sleeve for hose diameter ...mm, operating current per cable, operating voltage and frequency, with or without HOMA pipe contact fitting at cable-end "R".

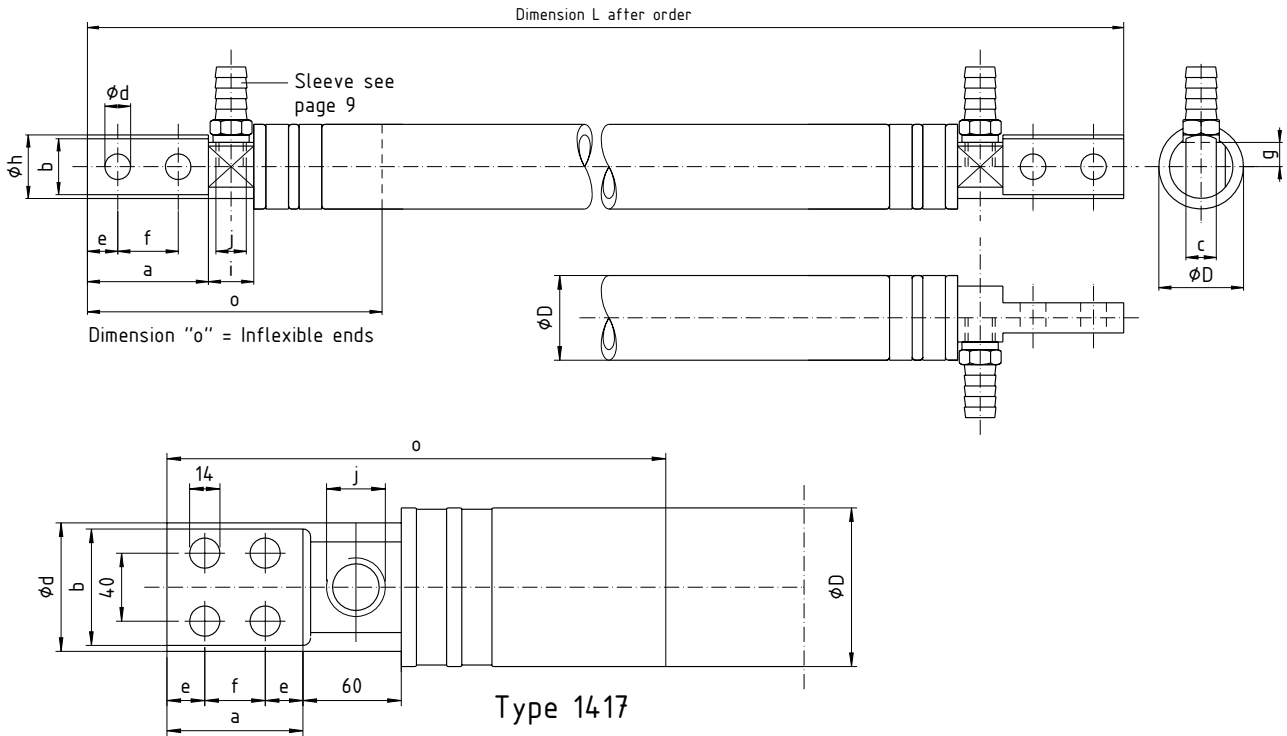
Special cable types:

Special types are available, also cables with other cable-end terminations. For special cable types a corresponding quantity must be ordered, which is available on request.

Other items available on request:

Highly flexible current straps from 25 to 4500mm² with or without PVC-sheath. Air-cooled cables 120 to 700mm² with high temperature protective cover. Water cooled cables with contact rings with detachable coupling between two copper pipes with simple and double heat, with hexagonal- and grooved nuts.

Dimension diagram for water cooled cable without hollow conductor



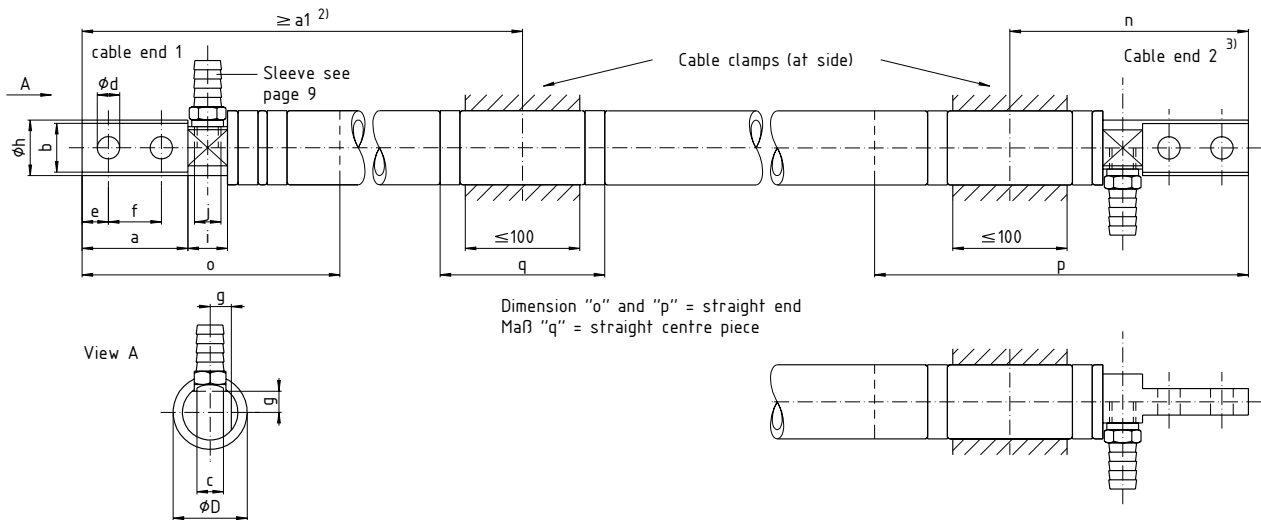
Note:

If required, cooling water connection drill holes and connection surfaces can be rotated by 90°. Sketch with order is essential.

Cable type	2) Rated current at 50Hz	Dimension table [mm]												
		a	b	c	ϕd	e	f	g	ϕh	ϕD	1) i	j	n	o
121	1000	50	23	10	10,5	12,5	25	10	25	35	20	R1/4"	148	170
181	1550	60	28	12	13	15	30	12,5	30	41	30	R3/8"	170	210
301	2500	60	31	15	13	15	30	15	35	47	30	R3/8"	170	210
401	3250	80	37	20	17	20	40	16	42	54	30	R1/2"	190	250
501	6780	80	37	20	17	20	40	16	42	54	30	R1/2"	190	250
706s	5500	80	43	25	17	20	40	22	50	66	30	R1/2"	220	250
706sl	5500	100	43	25	17	25	50	22	50	66	30	R1/2"	240	270
1008	8200	80	57	35	17	20	40	25	65	79	50	R1"	420	300
1417	10000	100	74	30	17	30	40	35	80	96	-	R1"	500	420

- 1) Outer diameter can be larger in tolerances.
- 2) Permissible continuous current may be 40% higher.

Dimension diagram for water cooled cable without hollow conductor but with clamping range



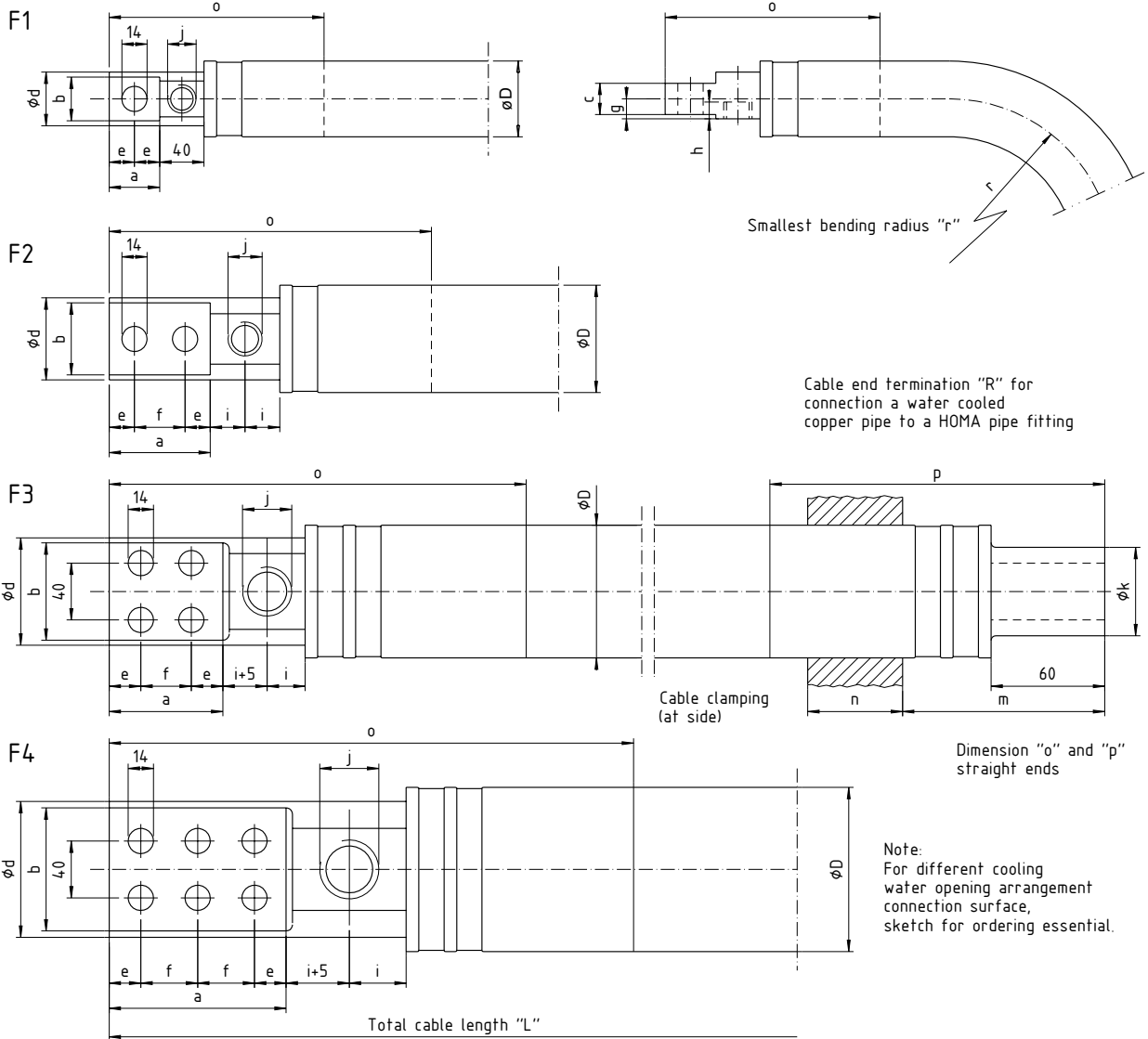
Note:

If required, cooling water connection drill holes and connection surfaces can be rotated by 90°. Sketch with order is essential.

Cable type	4) Rated current [A] at 50 Hz	Dimension table [mm]															
		a	a1	b	c	d	e	f	g	øh	øD	i	j	n	o	p	q
121	1000	50	280	23	10	10,5	12,5	25	10	25	35	20	R1/4	148	170	270	270
181	1550	60	310	28	12	13	15	30	12,5	30	41	30	R3/8	170	210	300	300
301	2500	60	260	31	15	13	15	30	15	35	47	30	R3/8	170	210	300	300
401	3250	80	300	37	20	17	20	40	16	42	54	30	R1/2	190	250	330	330
501	3780	80	300	37	20	17	20	40	16	42	54	30	R1/2	190	250	330	330
706s	5500	80	300	43	25	17	20	40	22	50	66	30	R1/2	220	250	330	330
706sl	5500	100	320	45	22	22	25	50	22	50	66	40	R3/4	210	255	350	350

- 1) Outer diameter can be larger in tolerances.
- 2) Required section a1 should be quoted in order (must not be less than a1).
- 3) If required, cable end 1 can be similar to cable end 2 (inter. clamp not required).
- 4) Permissible continuous current may be 40% higher.

Dimension diagram for water cooled hollow-core cable



Cable type	1) Rated current [A] at 50 Hz	Cable termination	Dimension table [mm]																
			2)																
			a	b	c	ød	øD	e	f	g	h	i	j	k	m	n	o	p	r
1401/20	1175	F1	30	39	15	42	54	15	-	16	8	20	R3/4"	28	100	60	140	180	280
3009/15	2520	F2	60	32	15	35	47	15	30	14	9	13	R3/8"	22	100	60	160	180	250
4011/18	3360		60	36	20	42	54	15	30	16	9	20	R1/2"	28	100	60	180	180	280
5010/24	4200		80	43	25	50	64	20	40	18	12	20	R3/4"	35	100	60	200	180	350
6012/28	5040		80	56	30	60	76	20	40	23	13	25	R1"	40	120	60	230	200	400
7014/30	5880		80	56	30	60	76	20	40	23	15	25	R1"	40	120	60	230	200	400
8016/36	7050	F3	80	63	30	70	86	20	40	25	10	30	R11/4"	50	120	80	260	220	450
10014/36	8275		100	63	30	70	86	25	50	25	15	25	R1"	50	120	80	260	215	450
10809/29	9240		100	72	35	80	96	25	50	30	15	30	R11/4"	50	120	80	270	215	500
12010/36	10330	F4	120	82	35	90	108	20	40	35	17	35	R11/2"	60	120	80	300	215	580
15008/25	11200		120	82	35	90	108	20	40	35	20	30	R11/4"	60	120	80	290	215	580
16609/35	12600		120	94	35	100	120	20	40	40	22	35	R11/2"	60	120	80	300	215	625

1) 40% higher current, producing double resistive heating, is permissible.

2) Outer diameter may possibly be larger within tolerances and selected sheath.

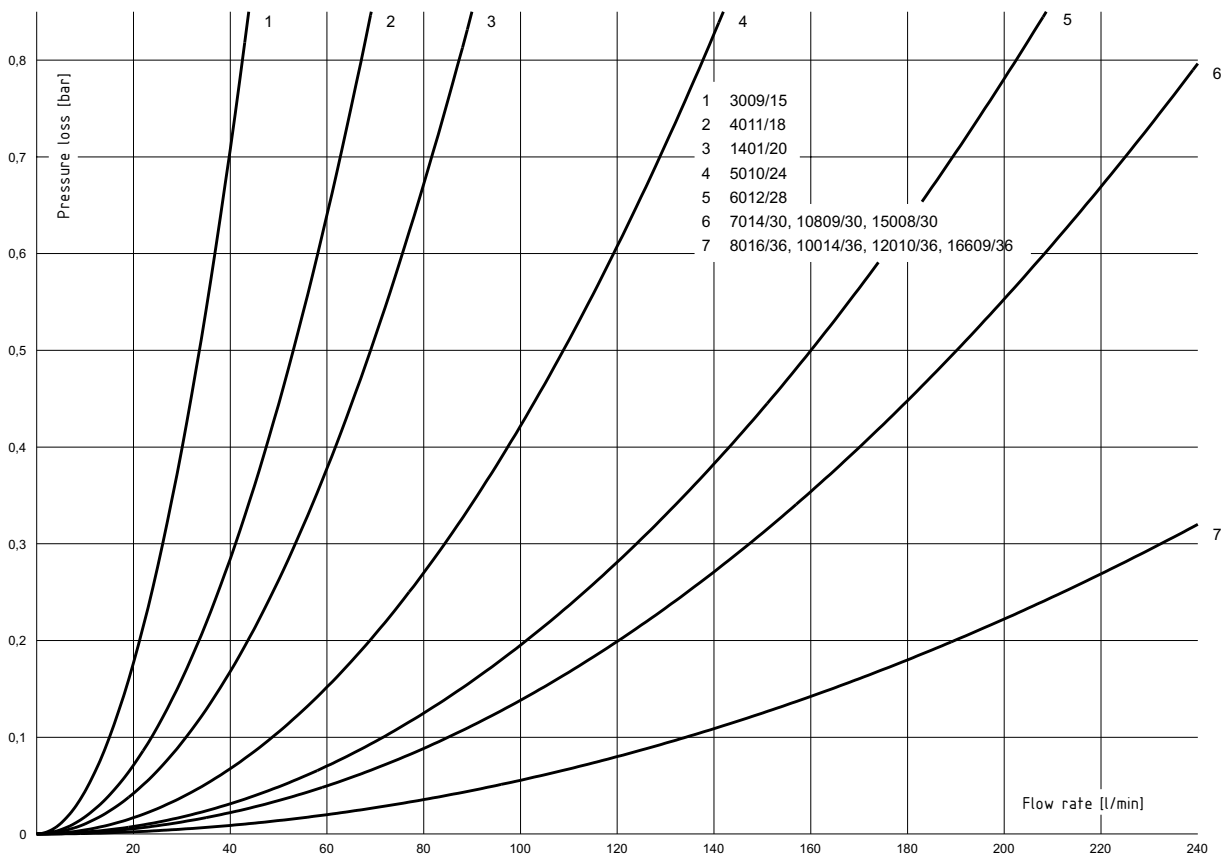
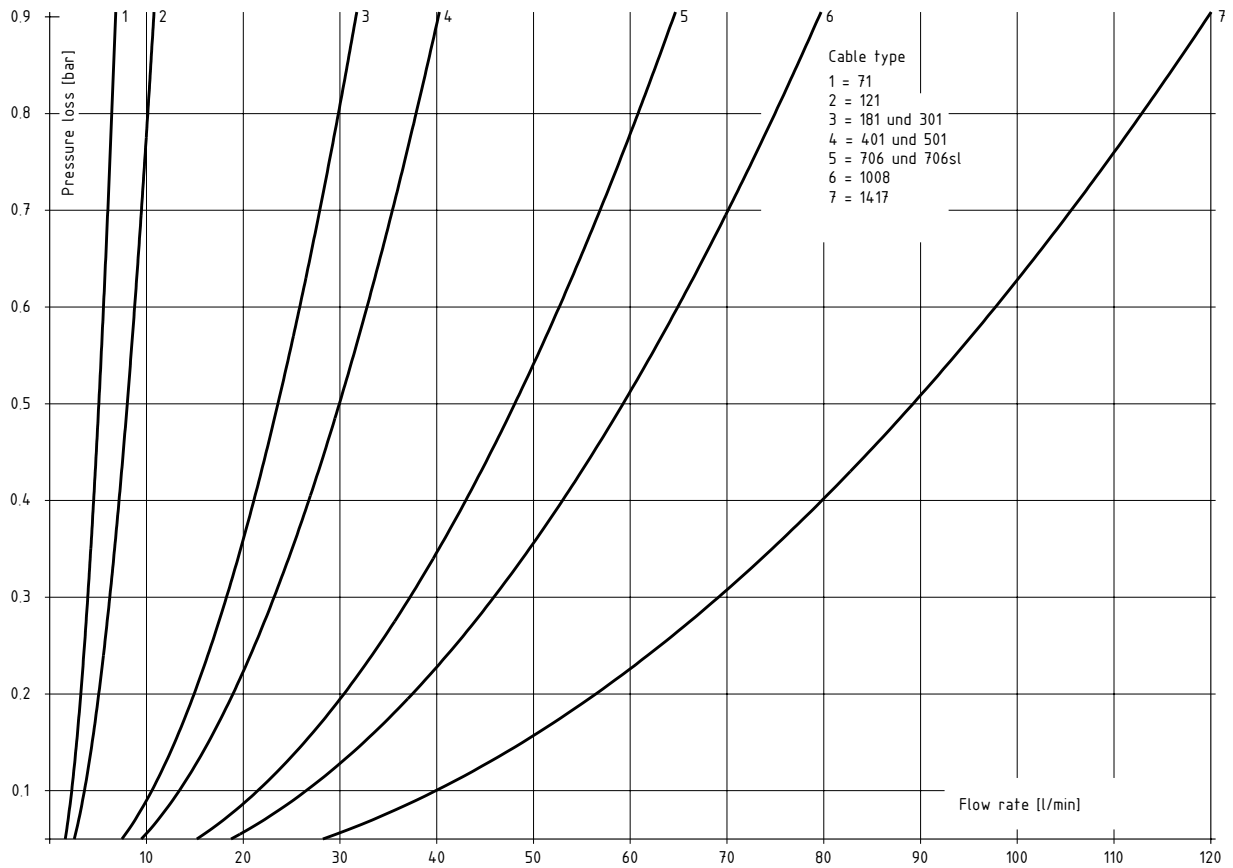
Rated current for water cooled cables without hollow inductor

Cable type	Rated current [A] at an operating frequency of [Hz]					
	50	150	250	500	1000	2000
121	1000	1000	965	915	840	725
181	1550	1480	1425	1330	1200	1040
301	2500	2250	2100	1950	1750	1500
401	3250	2750	2500	--	--	--
501	3780	3250	2900	--	--	--
706s	5500	4600	4200	--	--	--
706sl	5500	4600	4200	--	--	--

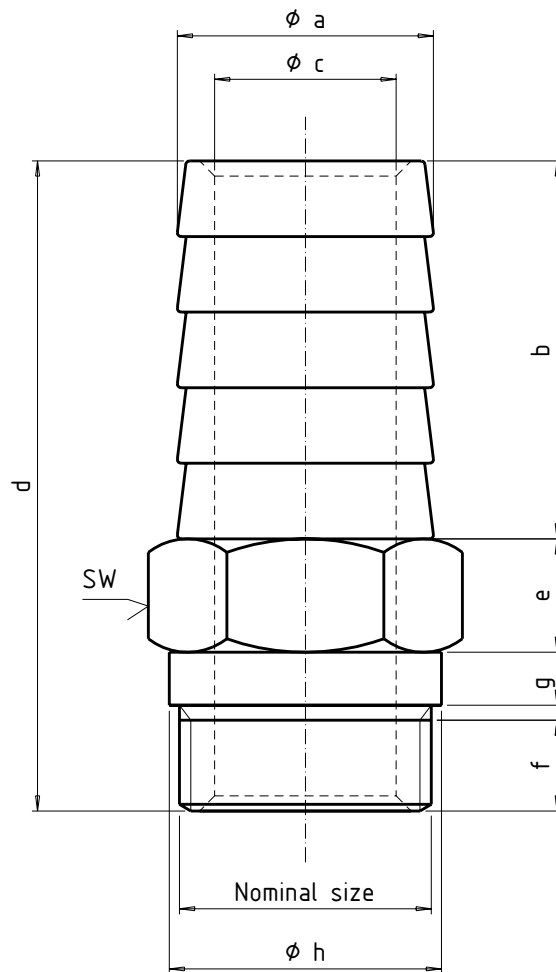
Rated current for water cooled hollow-core cables

Cable type	Rated current [A] bei at an operating frequency of [Hz]							
	50	150	250	500	1000	2000	4000	10000
1807/12	1000							
3009/15	2520	2435	2395	2300	2270	2185	1930	1210
4008/18	3360	3275	3200	3100	3020	2900	2560	1610
5010/24	4200	4075	3990	3860	3780	3650	3190	2000
6012/28	5040	4870	4740	4620	4530	4360	3820	2430
7014/30	5880	5630	5370	5200	4950	4500	3780	2350
8016/36	7050	6720	6550	6340	6050	5375	4530	2850
10014/36	8275	7390	7000	6550	5960	5250	--	--
10809/29	9240	8315	7900	7400	6720	--	--	--
12010/36	10330	9240	8730	8150	7390	--	--	--
15008/25	11200	10585	10250	9500	8650	--	--	--
16609/35	12600	11930	11500	10670	9740	--	--	--

Pressure loss for water cooled cables

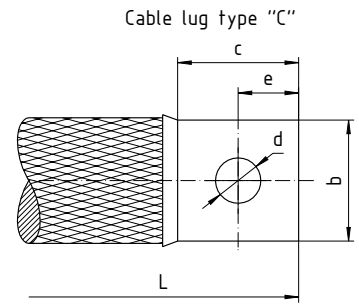
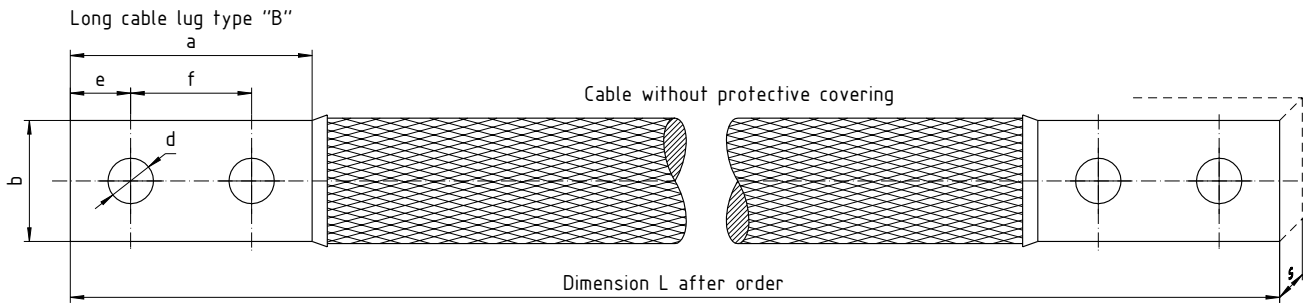


Dimensions diagram for cooling hose sleeves

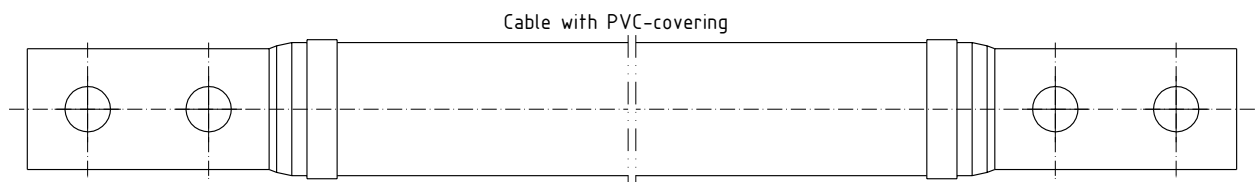


Nominal size	Dimension table [mm]								
	a	b	c	d	e	f	g	h	SW
R1/4"	11,3	20	7	40	7	8	1	14	14
R3/8"	14	30	10	50	8	8	1	17	17
R1/2"	21	35	14	60	10	9	1	24	24
R3/4"	27	42	18	73	12	9	1	30	30
R1"	34	50	24	86	15	12	2	36	36
R1 1/4"	40	50	30	92	18	12	2	46	46
R1 1/2"	46	50	36	100	20	18	2	50	50

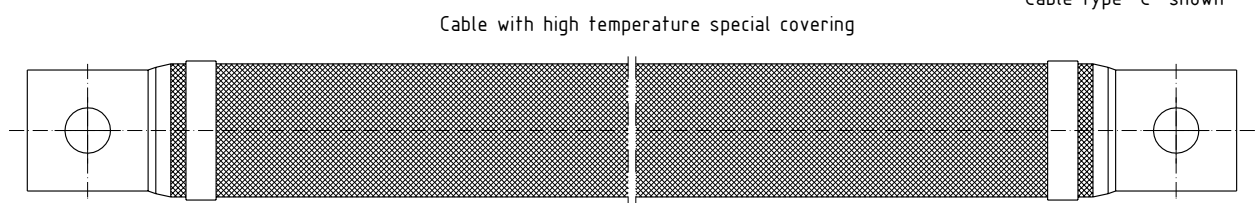
Dimension diagram for air cooled cables



Long cable type "B" shown



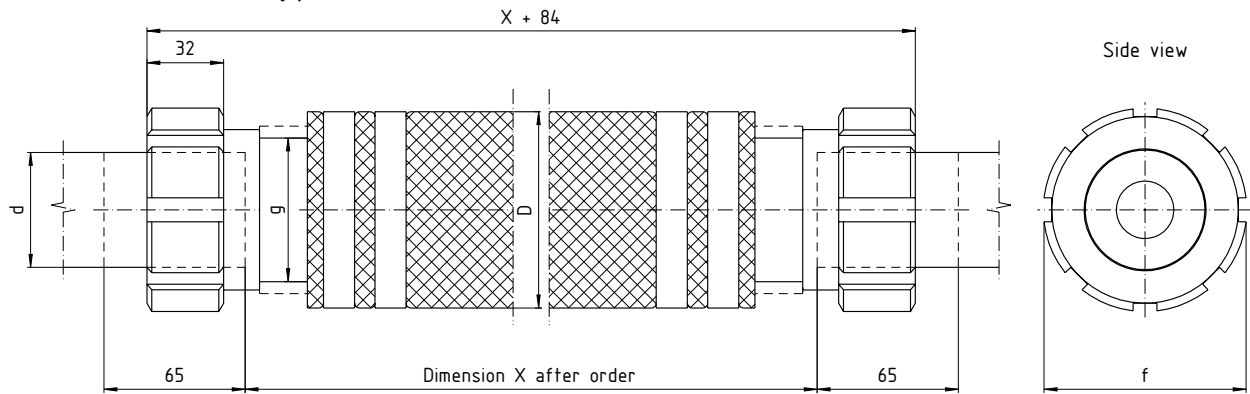
Cable type "C" shown



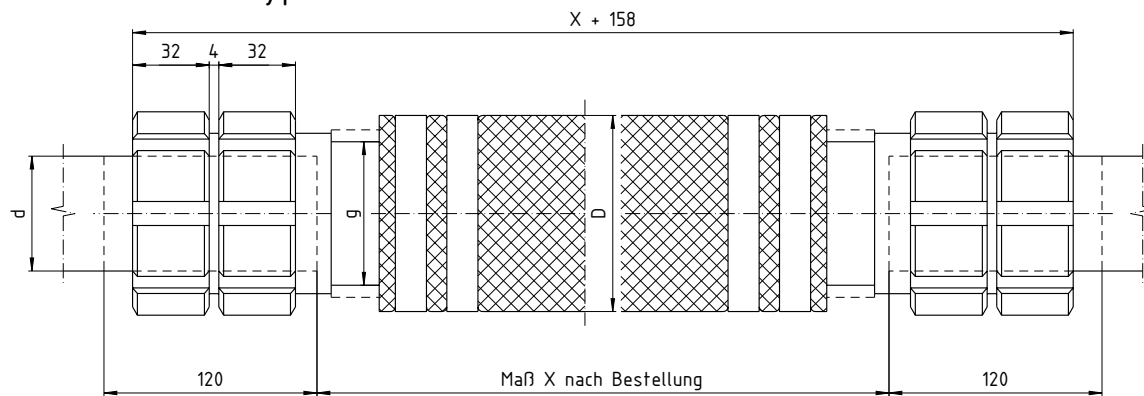
Cable type	Nominal cross section mm ²	Permissible load current [A] at 50 Hz		Dimension table [mm]						
		without protective covering	with protective covering	a	b	c	d	e	f	S
12	120	385	335	40	20	20	9	10	20	9
18,5	185	500	435	50	24	25	11	12,5	25	10
30	300	690	600	80	40	40	14	20	40	11
40	400	800	700	80	40	40	14	20	40	13
50	500	920	800	80	40	40	14	20	40	19
70	700	1150	1000	80	55	40	14	20	40	17

Dimension diagram for water cooled cables for pipe connection

Cable type E...



Cable type D...



Dimension X after order
 1) Required space to
 loosen screw connection
 Bending radius ca. $6 \times D$

Cable type	Cu-cross section [mm ²]	Rated current [A]		Dimension table [mm]				Netweight			Required tightening torque for slotted round nut [Nm]
		Typ E	Typ D	d	f	g	D	Type E at X = 2000 mm	Type D at X = 2000 mm	Added- or short-weight per 1000 mm	
1535-h	525	5500	6000	42 x 6	75	50	74	16,8	19,5	6,5	250
907-h	630	7200	7900	40 x 6	75	50	74	19,0	21,7	7,7	250
612-h	720	8400	9000	42 x 7	75	50	74	21,0	23,7	8,9	250
712-h	840	9600	10500	48 x 9	80	55	79	24,1	27,1	10,2	275
812-h	960	9600	11500	48 x 9	80	60	84	26,9	30,1	11,5	300
812-h	960	10000	12000	50 x 10	85	60	84	27,1	30,5	11,5	300
812-h	960	10000	12000	50.8 x 10	85	60	84	27,1	30,5	11,5	300
912-h	1080	11600	13800	58 x 9	90	65	89	30,3	34,2	12,8	330
912-h	1080	11600	13800	60 x 10	90	65	89	30,3	34,2	12,8	330
718-h	1295	12000	15000	60 x 10	95	70	96	34,8	39,2	14,7	350
818-h	1480	12000	15000	60 x 10	95	70	96	37,9	42,3	16,4	350

Manufacturing-program

026/1	pole-changing switches, change over switches, circuit breakers
145	NF and MF high-current switches (air-cooled)
280	NF and MF contactors for off-load switching
282	Damping resistors
350/1	DC- and NF-contactors for on-load switching
421	Prism-contacts (air- and water-cooled)
427	NF and MF high-current switches (watercooled)
460	insulator-supports and bus-bar-supports
467	MF-contactors for on-load switching
475/1	Prism-contacts (air-cooled)
502	<i>cable (air- and water-cooled)</i>
506	discharge- and dropping-resistors
507	capacitor-contactor for on-load switching
549	contactors with NC-contacts for on-load switching
559	Prism-contacts for the electrode-position
560	spare parts
600	pole-changing switches, with motor-drive (water-cooled)
615	NF and MF high-current circuit breaker for off-load switching (water-cooled)
617	NF and MF high-current circuit breaker for off-load switching (air-cooled)
624	contactors with NC-contacts off-load switching
625	DC-contactors with brake-contacts
641	Air-cooled-current-carrying leads