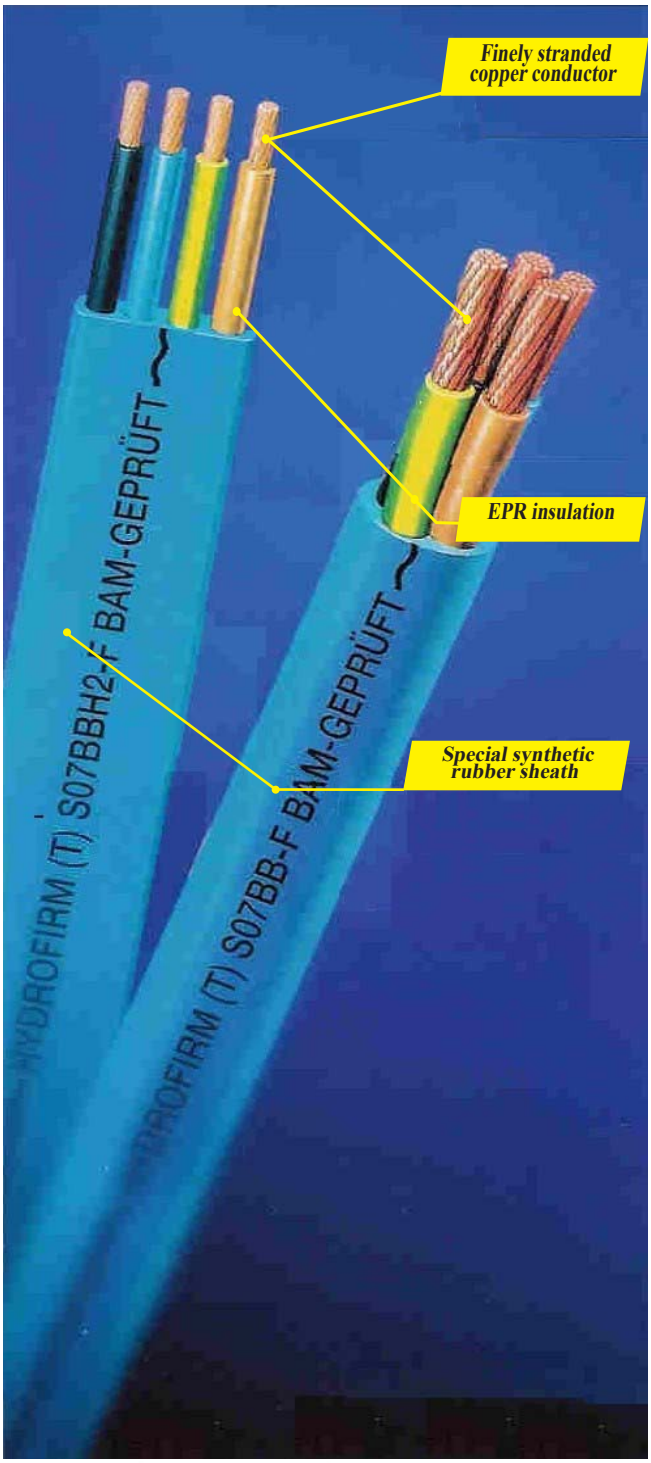
HYDROFIRM (T) Cables

for use in Ground Water
and Drinking Water



Until now, the renowned HYDROFIRM®TGK cables were available for use only in ground water at temperatures up to 40°C, while the TGW and TGFLW were suitable for ground water temperature up to 60°C. On the other hand, our HYDROFIRM(T) cable types TGKT and TGFLKT were designed for use in drinking water at temperatures up to 40°C (105°F). Consistent improvement of the sheathing materials has led to the development of a cable suitable for use in drinking water at temperatures up to 60°C (140°F). Just one type of cable is now available for the entire field of application. New type designations based on the harmonization code, S07BB-F and S07BBH2-F, have been established to clearly distinguish this new cable from former versions. In both instances, the letter B signifies the insulating and sheathing materials. As before, these materials are based on special ethylenepropylene rubber (EPR) compounds. Naturally, the insulating compound satisfies the rigorous electrical requirements even in the presence of moisture. The blue sheathing compound demonstrates the required mechanical properties along with an excellent resistance to water. It remains true that these highly water-resistant materials do not offer the same degree of oil-resistance or burning behavior as harmonized 07RN rubber cables. Our OZOFLEX® (PLUS) is ideally suited for this combination of requirements.
The new HYDROFIRM(T) cables have dimensions identical to their predecessors, which also correspond to the 07RN constructions. The flat versions, S07BBH2-F, employ the same wall thicknesses as their corresponding round types, S07BB-F. Therefore, apart from the obvious fact that flat cables may be flexed in only on plane, the flat versions are electrically and mechanically equivalent to their round counterparts. A light colored inner sheath is present within round constructions possessing conductor sizes above 16mm² or having more that 5 conductors.

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Application

HYDROFIRM(T) cables 07BB (round) and 07BBH2 (flat) are intended for continuous emersion in drinking or ground water to depths up to 500 m, for use under medium mechanical stresses, and for use as a connection cable for electrical equipment such as submersible pumps. They may also be submerged in rain, sea, or surface water, as well as in water employed for industrial processing or cooling purposes. However, the suitability of these cables for "mixed" water types, as defined by DIN 4045 and 4046, is limited.

They may not be used in water containing more than 0.5 mg/l of chlorine.

The cable's resistance to aggressive water or water of an atypical composition must be individually verified for each application.

The cable's suitability for continuous immersion in water is verified by a certificate that includes manufacturing supervision from the VDE Test and Certification Institute (German Institute of Electrical Engineers). Whereas tests conducted by the Federal Authority of Materials Testing (BAM), based on the KTW recommendations (Area C, "Installation Materials"), prove the suitability of this cable's use in drinking water.

HYDROFIRM(T) cables, 07BB and 07BBH2, may be used indoors and outdoors, but not in areas exposed to explosion hazards. For protected, fixed installation within equipment, pipes or wells, as well as for rotor connections, these cables may be operated with an AC voltage to 1000V or a DC voltage to 750V with respect to earth.

The permissible AC voltages for motor tests is 3 kV for a maximum duration of 3 minutes.

In all other respects, DIN VDE 0298 Part 3000 applies.

Technical details

The design is based on DIN VDE 0282 Part 810. HYDROFIRM(T) cables are at least equivalent to type 07RN rubber-insulated flexible cables with respect to their electrical and mechanical properties. Flat type 07BBH2 cables have the same sheathe thicknesses as their round counterparts.

- Finely stranded conductor of bare copper wires, Class 5 to DIN VDE 0295 and IEC 228

- Insulation and sheath consist of special EPR-bassed materials, adapted for use in ground water and drinking water.

- Insulation: Special rubber compound, at least equivalent to compound type 3G13 in DIN VDE 0207, color coding to DIN VDE 0293.

- Inner sheath (for sizes >16mm² or more than 5 conductors): Special rubber compound at least equivalent to compound type GM1b to DIN VDE 0207.

- Outer sheath: Special rubber compound, mechanical and thermal properties same as compound type 5GM3 to DIN VDE 0207 colored blue.

Outer marking: There is a wavy line on the outer sheath, interrupted with the type designation, number of conductors and conductor cross-section, the trademark HYDROFIRM(T), the message "BAM-geprüft" (tested by the federal authority of materials testing and the VDE (German institute of electrical engineers) registered number 9832. For example:

Permissible temperatures:		
at conductor	permanent load	90°C
	short circuit	250°C
during transportation, storage, installation, handling and operation	flexible	-25°C
	fixed	-40°C
Permissible water temperatures:		60°C

At higher water temperatures, a reduced cable service life must be expected.

~~~~~~~HYDROFIRM(T) S07BB-F 4G1.5
BAM-GEPRÜFT VDE-REG-NR 9832 ~~~~~~~

Current-carrying capacity

The values apply to a cable during continuos operation at an ambient temperature of 30°C. For other ambient temperatures, the current-carring capacities must be converted with the following factors.

°F	50	59	68	77	86	95	104	113	122	131	140	149	158	167	176
°C	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	1.15	1.12	1.08	1.04	1.00	0.96	0.91	0.87	0.82	0.76	0.71	0.65	0.58	0.50	0.40

In all respects, the provisions of DIN VDE 0298 Part 4 apply.

Continuous tensile stress

15 N/mm² with respect to the nominal conductor cross-section.

Minimum bending radii

Outer diameter of cable in mm	to 8	over 8 to 12	over 12 to 20	over 20
For fixed installation	3 d	3 d	4 d	4 d
For free movemnet and installation	3 d	4 d	5 d	5 d

d = overall diameter of cable

Voltages

Rated Voltage	U_o /U 450/750 V
Maximum permissible operation voltage for:	
three-phase and single-phase AC operation	U_o /U 476/825 V
DC operation	U_o /U 619/1238 V
AC test voltage	2.5kV
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Selection data

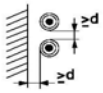
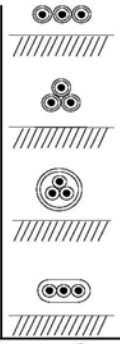
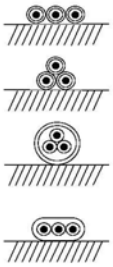
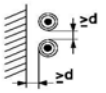
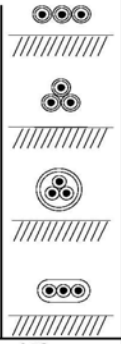
Number of Control Conductors	Pirelli Part Number	Approximate Number of Strands x	max. strand diameter	Diameter approximate mm	Overall diameter of cable min	Overall diameter of cable max	Cable Weight Lbs/ 1000 ft	Cable Weight kg/km	Current-carrying free in air	Current-carrying laid on surface
HYDROFIRM(T) S07BB-F 1 X...round, with black core insulation										
1 X 1.5	5DH1 302	28	0.26	1.5	5.5	7.0	34	50	35	23
1 X 10	5DH1 306	77	0.41	4.1	9.5	11.0	121	180	111	74
1 X 16	5DH1 307	123	0.41	5.6	11.5	13.5	178	265	149	99
1 X 25	5DH1 308	190	0.41	6.8	13.5	15.5	255	380	197	130
1 X 35	5DH1 310	268	0.41	8.1	15.0	17.5	336	500	244	162
1 X 50	5DH1 311	384	0.41	9.6	17.5	20.0	464	690	304	201
1 X 70	5DH1 312	545	0.41	11.2	20.0	22.5	618	920	376	249
1 X 95	5DH1 313	724	0.41	13.2	22.5	25.0	793	1180	453	300
1 X 120	5DH1 314	926	0.41	14.9	24.00	26.5	988	1470	529	350
HYDROFIRM(T) S07BB-F 3 X...round, without ground conductor										
3 X 1.5	5DH1 332	28	0.26	1.5	9.5	11.0	92	137	24	23
3 X 2.5	5DH1 333	45	0.26	1.9	11.0	13.0	132	197	32	30
3 X 4.0	5DH1 334	51	0.31	2.5	13.0	15.0	188	280	43	41
3 X 6.0	5DH1 335	75	0.31	3.2	14.5	16.0	249	370	56	53
3 X 10.0	5DH1 336	77	0.41	4.1	19.0	21.5	447	665	78	74
3 X 16.0	5DH1 337	123	0.41	5.6	23.5	26.0	672	1000	104	99
3 X 25.0	5DH1 338	190	0.41	6.8	28.5	31.0	968	1440	138	131
3 X 35.0	5DH1 340	268	0.41	8.1	32.0	35.5	1257	1870	171	162
3 X 50.0	5DH1 341	384	0.41	9.6	37.0	41.0	1720	2560	213	202
3 X 70.0	5DH1 342	545	0.41	11.2	42.0	45.5	2265	3370	263	250
HYDROFIRM(T) S07BB-F 3 G...round, with ground conductor										
3 X 1.5	5DH1 352	28	0.26	1.5	1.5	9.5	92	137	24	23
3 X 2.5	5DH1 353	45	0.26	1.9	1.9	11.0	132	197	32	30
3 X 4.0	5DH1 354	51	0.31	2.5	2.5	13.0	188	280	43	41
HYDROFIRM(T) S07BB-F 4 G...round, with ground conductor										
4 G 1.5	5DH1 362	28	0.26	1.5	10.0	12.0	118	175	24	23
4 G 2.5	5DH1 363	45	0.26	1.9	12.0	14.0	168	250	32	30
4 G 4.0	5DH1 364	51	0.31	2.5	14.0	16.0	239	355	43	41
4 G 6.0	5DH1 365	75	0.31	3.2	15.5	18.0	319	475	56	53
4 G 10.0	5DH1 366	77	0.41	4.1	21.0	23.5	554	825	78	74
4 G 16.0	5DH1 367	123	0.41	5.6	25.5	29.0	840	1250	104	99
4 G 25.0	5DH1 368	190	0.41	6.8	31.0	34.0	1210	1800	138	131
4 G 35.0	5DH1 370	268	0.41	8.1	35.0	39.0	1586	2360	171	162
4 G 50.0	5DH1 371	384	0.41	9.6	41.0	45.0	2184	3250	213	202
4 G 70.0	5DH1 372	545	0.41	11.2	46.5	50.0	2889	4300	263	250
4 G 95.0	5DH1 373	724	0.41	13.2	51.6	55.6	3797	5650	317	301
4 G 120.0	5DH1 374	926	0.41	14.9	56.1	60.1	4670	6950	370	352
HYDROFIRM(T) S07BBH2-F 3 X...flat, without ground conductor										
3 X 1.5	5DH1 502	28	0.26	1.5	6.0 x 12.5	7.5 x 14.0	81	120	24	23
3 X 2.5	5DH1 503	45	0.26	1.9	7.0 x 14.5	8.5 x 16.5	124	185	32	30
3 X 4.0	5DH1 504	51	0.31	2.5	8.0 x 17.0	9.5 x 19.0	175	260	43	41
3 X 6.0	5DH1 505	75	0.31	3.2	9.0 x 19.0	10.5 x 21.5	232	345	56	53
3 X 10.0	5DH1 506	77	0.41	4.1	12.5 x 25.0	14.5 x 28.0	417	620	78	74
3 X 16.0	5DH1 507	123	0.41	5.6	14.5 x 31.0	17.0 x 34.0	611	910	104	99
3 X 25.0	5DH1 508	190	0.41	6.8	17.0 x 36.5	19.0 x 40.0	874	1300	138	131
3 X 35.0	5DH1 510	268	0.41	8.1	19.0 x 42.0	21.5 x 45.5	1169	1740	171	162
3 X 50.0	5DH1 511	384	0.41	9.6	22.0 x 48.5	24.0 x 53.0	1599	2380	213	202
3 X 70.0	5DH1 512	545	0.41	11.2	24.0 x 54.5	26.5 x 59.0	2123	3160	263	250
HYDROFIRM(T) S07BBH2-F 4 G...flat, with ground conductor										
4 G 1.5	5DH1 522	28	0.26	1.5	6.0 x 16.0	7.5 x 18.5	118	175	24	23
4 G 2.5	5DH1 523	45	0.26	1.9	7.0 x 19.0	8.5 x 21.5	171	255	32	30
4 G 4.0	5DH1 524	51	0.31	2.5	8.0 x 22.5	9.5 x 21.5	242	360	43	41
4 G 6.0	5DH1 525	75	0.31	3.2	9.5 x 25.5	10.5 x 29.0	326	485	56	53
4 G 10.0	5DH1 526	77	0.41	4.1	12.5 x 33.0	14.5 x 36.5	642	955	78	74
4 G 16.0	5DH1 527	123	0.41	5.6	14.5 x 41.0	17.0 x 44.5	820	1220	104	99
4 G 25.0	5DH1 528	190	0.41	6.8	17.5 x 49.0	20.0 x 53.5	1210	1800	138	131
4 G 35.0	5DH1 530	268	0.41	8.1	19.5 x 56.5	22.0 x 60.5	1613	2400	171	162
4 G 50.0	5DH1 531	384	0.41	9.6	22.5 x 66.5	25.0 x 69.5	2197	3270	213	202
4 G 70.0	5DH1 532	545	0.41	11.2	25.0 x 73.0	28.0 x 77.5	2923	4350	263	250
4 G 95.0	5DH1 533	724	0.41	13.2	27.0 x 80.5	29.5 x 85.0	3897	5800	317	301
4 G 120.0	5DH1 534	926	0.41	14.9	29.5 x 85.5	32.5 x 70.0	4744	7060	370	352

Data in Water

Current rating

for continuous operation in air or underwater at 30 °C, or in the event of short-circuit conditions

The ampacity "in air on surfaces" is according to DIN VDE 0298-4:1998-1, table 13 and converted for installation "free in air" or "underwater"

Type	HYDROFIRM(T) 07BB, 07BBH						
Permissible operating temperature at conductor	90 °C						
Permissible short-circuit temperature at conductor						200 °C	250 °C
Number of loaded conductors	1	3	3	1	3	-	-
Method of installation	free in air		in air on surfaces	underwater		-	-
						tinned conductors	bare conductors
Nominal cross-section, copper conductor mm²	Current Carrying Capacity (A) in air | underwater *)					Permissible 1 s short-circuit current I_{thr} in kA	
1	-	19	18	-	23	0,12	0,14
1,5	35	24	23	42	29	0,18	0,21
2,5	45	32	30	54	38	0,31	0,36
4	62	43	41	74	52	0,49	0,57
6	80	56	53	96	67	0,73	0,86
10	111	78	74	133	94	1,22	1,43
16	149	104	99	179	125	1,95	2,29
25	197	138	131	236	166	3,05	3,58
35	244	171	162	293	205	4,27	5,01
50	304	213	202	365	256	6,10	7,15
70	376	263	250	451	316	8,54	10,0
95	453	317	301	544	380	11,6	13,6
120	529	370	352	635	444	14,6	17,2
150	608	425	404	730	510	18,3	21,5
185	693	485	461	832	582	22,6	26,5
240	823	576	547	988	691	29,3	34,3
300	952	666	633	1142	799	36,6	42,9

*) The underwater current rating is only valid, if the cable is completely submerged. The underwater ampacity is defined as 20 % higher than the ampacity in air.

At other ambient temperatures, the ampacities must be converted with the following factors f:

°C	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
f	1,15	1,12	1,08	1,04	1	0,96	0,91	0,87	0,82	0,76	0,65	0,58	0,50	0,41	0,29

Permissible short-circuit currents I_{thz} for other break times t_k up to 5 s are calculated using the formula $I_{thz} = I_{thr}\sqrt{\frac{1s}{t_k}}$