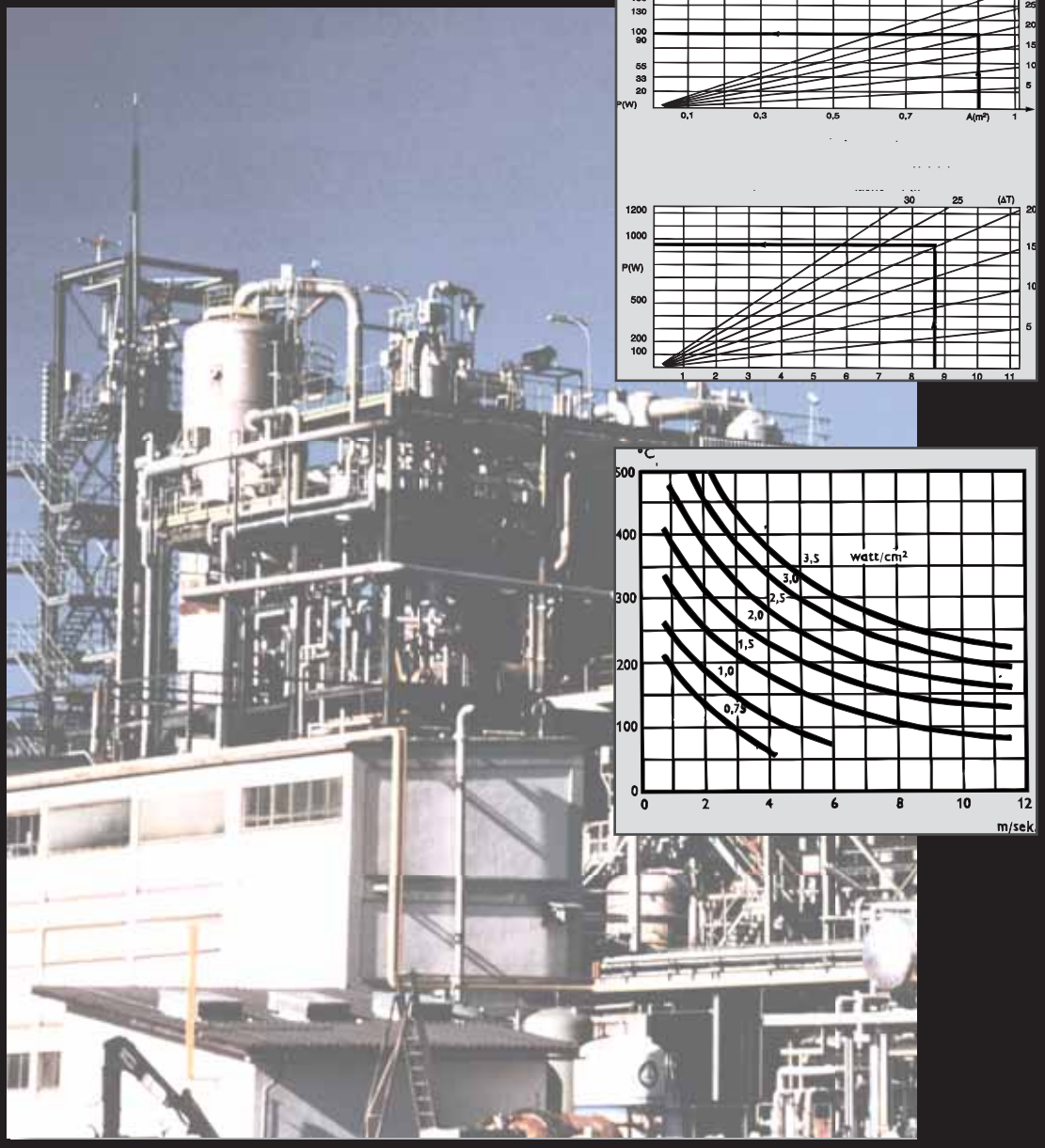
SAN®

Electro Heat

Process HEATING



Technical Information

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CVR No.: 42 16 59 13 - A/S reg. No.: 53 053

11. TECHNICAL INFORMATION

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POWER CALCULATION

$$Q = m \cdot Cp \cdot \Delta t \quad \text{Joule}$$

$$= \frac{m \cdot Cp \cdot \Delta t}{3600} \quad \text{Wh}$$

The amount of heat (Q), to be added a media to be heated, is calculated from the following formula.

m = Weight of media in kg.
C_p = Specific heat of media in J/kg°C.
Δt = Required temperature increase in °C.

NB! Heat loss must be added this amount of heat.

$$P = \frac{m \cdot \rho \cdot Cp \cdot (t_2-t_1)}{3600 \cdot h} \text{ kW}$$

For calculation of required power for heating of a fluid the shown formula is used. Heat loss and possible voltage variations have not been considered. This normally requires a 5-20% addition.

P = required power in kW.
m = amount of fluid in l/h (or dm^3/h).
ρ = specific gravity of the fluid in kg/dm^3.
C_p = specific heat of the fluid in kJ/kgK.
t_2-t_1 = final temperature - starting temperature
h = required heating time in hours.

For water P = 1 and C_p = 4.19.

$$P = v \cdot \rho \cdot Cp \cdot (t_2-t_1) \text{ kW}$$

For calculation of required power for heating of streaming air (gasses) the following formula is used

P = required power in kW.
v = flow amount in m^3/sec.
ρ = specific gravity of the air in kg/m^3.
C_p = specific heat of the air in kJ/kg·K.
t_2-t_1 = final temperature - starting temperature

For normal atmospherical air applies

t°C	0	100	200	300	400	500
ρ kg/m^3	1.293	0.946	0.746	0.616	0.524	0.456
C_p kJ/kg K	1,005	1,009	1,026	1,047	1,068	1,093

DEW POINT TEMPERATURE

		Temperature °C in cabinet							
		20	25	30	35	40	45	50	55
Relative humidity (%)	40	6	11	15	19	24	28	33	37
	50	9	14	19	23	28	32	37	41
	60	12	17	21	26	31	36	49	45
	70	14	19	24	29	34	38	43	48
	80	16	21	26	31	36	41	46	51
	90	18	23	28	33	38	43	48	53
	100	20	25	30	35	40	45	50	55

If the temperature in a cabinet is ≤ the dew point, heat must unconditionally be supplied to the cabinet.
From the present table you can determine the dew point temperature from the relative humidity and temperature in the cabinet.
Example: Relative humidity = 70%, temperature in cabinet = 25°C. This gives a dew point temperature of 19°C. That means that condensing on the walls of the cabinet will occur, if this is equal to or less than 19°C,
It is therefore neccessary to install a combined thermostat and hygrostat in the cabinet, which measures the outer temperature and moisture, and thus controls the anti-condensing element in the cabinet.
Calculation of the power of the anti-condensing element: See next page

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POWER CALCULATION for control boxes, boards etc.

Any control box emits a certain amount of heat to the surroundings through the surface, and the required power in the cabinet can thus be calculated from the following equations:

$P_H = P_S \div P_V$
$P_S = K \cdot A \cdot \Delta T$

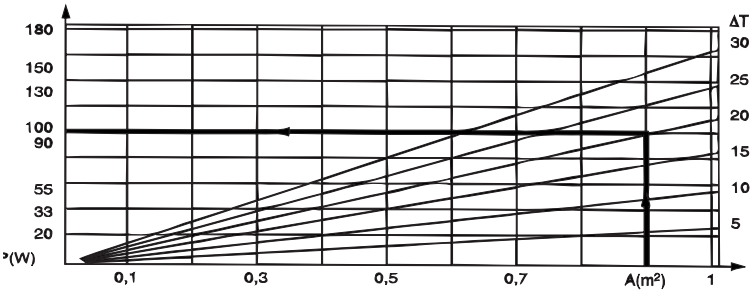
P_H = Required power of the heating element
P_V = Self-heating installed in the cabinet
P_S = Radiation loss through the cabinet surface (heatloss)
K = Heat loss factor (W/m^2 °C).
A = Effective heat loss providing cabinet surface
ΔT = Required temperature increase in the cabinet in relation to the ambient air temperature (min. 5°C).

In the diagramme the power requirement can be read, when P_V = 0 W (standstill output when plant is shut off) and the heat loss factor is set to be 5.5 W/m^2 °C (sheet steel in stationary air).

When mounting in air stream or outdoor:
Multiply the power need (P_H) by a factor of 2-3.

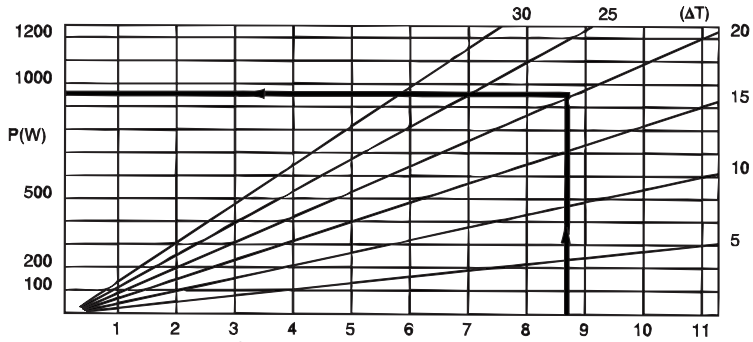
For aluminium cabinet: K = 12 W/m^2 °C.
For s.s. cabinet: K = 3.7 W/m^2 °C.
For synthetic cabinet: K = 3.5 W/m^2 °C.

Selection diagramme for stating of required power (when plant shut off) for cabinets, with surface ≤ 1 m^2.



Example (1): A = 0,9 m^2, ΔT ($T_{S\ min.}$, $T_{u\ min.}$) = 20 K = P_H 95 W.
A control box heating with an effective heating power P_H = 100 W is chosen

Selection diagramme for stating of required power (when plant shut off) for cabinets with surface ≥ 1 m^2.



Example (2): A = 8,7 m^2, ΔT = 20 K = P_H 950 Watt.
E.g. 2 x 400 W + 1 x 150 W or 2 x 400 W with fan is chosen.

POWER CALCULATION when heating water, oil and metal

In the tables the neccessary amount of heat (energy) Q is stated at various temperature increases for water, oil and various metals respectively.

For calculation of the power requirement the following formula is used

$$P = \frac{Q}{h \ \eta} = W$$

h = heating time in hours and η = efficiency.

Example:

50 l water are to be increased 50°C in 2 hours.

The table states Q = 2905 Wh, and setting the heat loss to be 20%, i.e. an efficiency of 1.8, the following applies

$$P = \frac{2905}{2 \quad 0.8} \cong 1815 \text{ W}$$

WATER	10°C	20°C	50°C	90°C	200°C
10 l	116	232	580	1046	-
20 l	232	464	1160	2092	-
50 l	580	1160	2905	5330	-
100 l	1160	2320	5810	10260	-

OIL	10°C	20°C	50°C	90°C	200°C
10 l	58	116	290	523	1160
20 l	116	232	580	1046	2320
50 l	290	580	1453	2664	5800
100 l	580	1160	2905	5230	11600

METAL 1 kg	10°C	20°C	50°C	90°C	200°C
alu	2.49	4.98	12.5	22.4	50.0
lead	0.36	0.72	1.8	3.3	7.2
cast iron	1.40	2.8	7.0	12.6	28.0
copper	1.08	2.2	5.4	9.7	22.0
silumin	2.44	4.9	12.0	22.0	49.0

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SURFACE LOAD

Media °C	Temp. range W/cm^2	recom-mend.
Alcalic baths	100	4-6
Ammonia-, sal ammoniac baths	100	2-3
Etylenglykol 100% mech. mov.	100	3
Etylenglykol 100% stationary	100	1
Phosphating baths	90	2-4
Oil, viscous	100	1-1.5
Oil, fluid	50	2.5-3
same as above	100	2-2.5
same as above	250	1.5-2
same as above	350	1-1.5
Water, stationary	100	6-10
Water in movement	100	10-15
Water soluble acids and salts	100	1-2
Wax and paint	60	0.5
Mounted in rails	200	3-6
Casted in metal		4-6
same, however with adjustment	8-10	

In the scheme is stated a guiding load of tubular heating elements when used in various medias.

In medias with high heat transmission the surface load can be increased considerably, in relation to the load in air.

In corrosive medias, with certain demands for tube jacket materials, tubular heating elements in acid proof steel, Monell 400, Incoloy 800, Inconel 600 and Titanium as well as PTFE-coated can be delivered. Also quartz tubular heating elements can be delivered.

In medias, where considerations must be made concerning danger of fire, EX-danger and similar, the surface load must be especially low.

Our sales department is at your service for dimensioning of your electrical heating assignment.

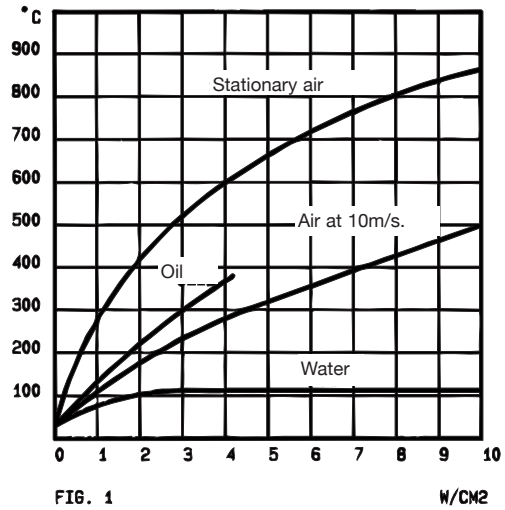

FIG. 1

The lifetime of a tubular heating element is primarily determined by the operating temperature of the heating threads. The temperature of the heating threads is directly dependant of the surface load of the tubular heating element (Watt pr. cm^2).

The diagramme fig. 1 shows surface temperature of tubular heating elements in various medias. The stated values are approximate values, dependant of current velocity and pressure.

The diagramme fig. 2 shows approximate temperature of tubular heating elements mounted in air stream at various velocities as function of surface load.
Ambient temperature is 20°C.

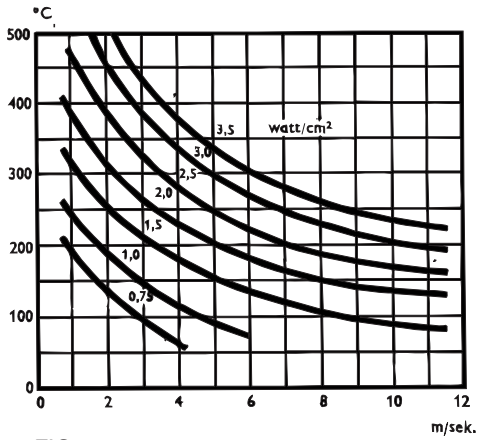

FIG. 2

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DIMENSIONING OF SELFREGULATING HEATING CABLES.

Projecting guidance frost protection +5°C
for selfregulating heating cables series ELSR-...-BO(T)- - Table 1 -

Basis: Heat conduction of insulation 0.04 W/mK, wind velocity 10 m/s, safety add 20%

Pipe dimension:	Inches:	1/2	3/4	1	11/4	11/2	2	2 1/2	3	4	5	6	7	8	9	10	12
	DN	15	20	25	32	40	50	65	80	100	125	150	175	200	225	250	300
Insulation thickness (mm)	Min. ambient temperature (°C)	Heating cable type ELSR-...-BO(T)															
10	-15	10	10	20	20	20	30	30	30	40	2x30	2x30	2x40	2x40	2x40	3x30	3x40
	-20	10	20	20	20	30	30	40	40	2x30	2x30	2x40	2x40	3x30	3x40	3x40	4x40
	-25	10	20	20	30	30	40	40	2x30	2x30	2x40	2x40	3x40	3x40	3x40	4x40	4x40
20	-15	10	10	10	10	10	20	20	20	30	30	30	40	40	40	2x30	2x30
	-20	10	10	10	10	20	20	20	30	30	30	40	2x30	2x30	2x30	2x30	2x40
	-25	10	10	20	20	20	20	30	30	40	40	2x30	2x30	2x30	2x30	2x40	2x40
30	-15	10	10	10	10	10	10	10	20	20	20	20	30	30	30	40	40
	-20	10	10	10	10	10	20	20	20	20	20	30	30	40	40	40	2x30
	-25	10	10	10	10	20	20	20	20	30	30	30	40	40	2x30	2x30	2x30
40	-15	10	10	10	10	10	10	10	10	20	20	20	20	20	30	30	30
	-20	10	10	10	10	10	10	20	20	20	20	20	30	30	30	30	40
	-25	10	10	10	10	10	20	20	20	20	20	30	30	30	40	40	2x30
50	-15	10	10	10	10	10	10	10	10	10	20	20	20	20	20	20	30
	-20	10	10	10	10	10	10	10	10	20	20	20	20	30	30	30	30
	-25	10	10	10	10	10	10	20	20	20	20	20	30	30	30	30	40
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	-20	10	10	10	10	10	10	10	10	20	20	20	20	20	20	30	30
	-25	10	10	10	10	10	10	10	20	20	20	20	20	30	30	30	30
80	-15	10	10	10	10	10	10	10	10	10	10	10	20	20	20	20	20
	-20	10	10	10	10	10	10	10	10	10	10	20	20	20	20	20	20
	-25	10	10	10	10	10	10	10	10	20	20	20	20	20	20	20	30
100	-15	10	10	10	10	10	10	10	10	10	10	10	10	10	20	20	20
	-20	10	10	10	10	10	10	10	10	10	10	10	20	20	20	20	20

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Heating cable add (m) for : **- Table 2 -**

	DN	15	20	25	32	40	50	65	80	100	125	150	175	200	225	250	300
Flange couple		0.2	0.2	0.25	0.3	0.3	0.35	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.5
Flanged armature		0.4	0.45	0.5	0.55	0.6	0.8	0.9	1.1	1.5	2.0	2.4	2.8	3.3	3.8	4.2	5.0
Pumps		1.5	1.5	2.0	2.0	2.5	2.5	3.0	4.0	5.0	5.0	6.0	6.0	6.5	6.5	7.0	8.0

For uninsulated pipe fittings the following applies: Heating cable add = 4 × holder length. Each heating cable connection in terminal box/thermostat = heating cable add approx. 0.5 m. **Please note!** If the heating cable is mounted in several lengths, the above add must be doubled accordingly.

Example 1

Application: Frost protection of a pipeline DN 100, 25 m long with 2 flange couples, 1 armature, 1 pump, 4 supports, 0.1 m wide at -25°C ambient temperature and a 50 mm thick heating insulation. Voltage 230 V.

Calculation: From table 1: Heating cable ELSR-20-BO laying single length.

Length of pipeline:	25 m x one single laying.		= 25 m
From table 2:	Flange couple	2 × 0.6 m	= 1.2 m
	Armature	1 off × 1.5 m	= 1.5 m
	Pump	1 off × 5.0 m	= 5.0 m
	Support	4 off × 0.1 m × 4	= 1.6 m
	Connection	1 off × 0.5 m	= 0.5 m
			34.8 m

35 m ELSR-20-BO are to be ordered.

For other maintenance temperatures, temperature differences respectively, heat loss, add respectively, are taken from table 3 and corresponding heating cable type from the temperature-power diagramme.

Heat loss on pipelines in W/m at 10 K temperature difference - Table 3 -

Pipe dimension	Inches:	1/2	3/4	1	11/4	11/2	2	21/2	3	4	5	6	7	8	9	10	12
	DN	15	20	25	32	40	50	65	80	100	125	150	175	200	225	250	300
Insulation thickness (mm)	DELTA																
10	10	4.4	5.2	6.1	7.8	8.7	10.5	12.9	14.8	18.6	22.3	26.6	30.3	34.1	37.8	41.9	49.3
20	10	2.9	3.3	3.7	4.5	5.0	5.9	7.1	8.1	10.0	11.9	14.1	16.0	17.8	19.7	21.9	25.6
30	10	2.2	2.6	2.9	3.4	3.7	4.2	5.2	5.8	7.1	8.4	9.8	11.1	12.4	13.7	15.1	17.6
40	10	1.9	2.2	2.5	2.8	3.1	3.5	4.2	4.7	5.7	6.6	7.7	8.7	9.6	10.6	1.7	13.6
50	10	1.7	2.0	2.2	2.5	2.7	3.0	3.6	4.0	4.8	5.6	6.4	7.2	8.0	8.8	9.6	11.2
60	10	1.6	1.8	2.0	2.2	2.4	2.7	3.2	3.6	4.2	4.9	5.6	6.2	6.9	7.5	8.2	9.5
80	10	1.4	1.6	1.7	1.9	2.1	2.3	2.7	3.0	3.4	3.9	4.5	5.0	5.5	6.0	6.5	7.5
100	10	1.3	1.4	1.5	1.7	1.8	2.0	2.4	2.6	3.0	3.4	3.8	4.2	4.6	5.1	5.5	6.3
120	10	1.2	1.3	1.4	1.6	1.7	1.9	2.2	2.3	2.7	3.0	3.4	3.7	4.1	4.4	4.8	5.4

Basis: The heat conducting figure for the insulation 0.04 W/mK, wind velocity 10 m/s, safety add 20%;

At other heat conductions the values must be multiplied by a corresponding factor.

Example: Heat conducting figure for the insulation $\frac{0.045\ \text{W/mK}}{0.040\ \text{W/mK}} = 1.125$

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Type SAN EL-MIX

Cable length	Total W/ cable	Centre dimension 7 cm	Centre dimension 8 cm	Centre dimension 9 cm	Centre dimension 10 cm	Centre dimension 11 cm	Centre dimension 12 cm
9	91		126 W/m^2 (0.72 m^2)	112 W/m^2 (0.81 m^2)	100 W/m^2 (0.90 m^2)	91 W/m^2 (1.00 m^2)	84 W/m^2 (1.08 m^2)
20	220		137 W/m^2 1.60 m^2)	122 W/m^2 (1.80 m^2)	110 W/m^2 (2.00 m^2)	100 W/m^2 (2.20 m^2)	91 W/m^2 (2.40 m^2)
25	265	151 W/m^2 (1.75 m^2)	132 W/m^2 (2.00 m^2)	118 W/m^2 (2.25 m^2)	106 W/m^2 (2.50 m^2)	96 W/m^2 (2.75 m^2)	88 W/m^2 (3.00 m^2)
36	368	146 W/m^2 (2.52 m^2)	127 W/m^2 (2.90 m^2)	113 W/m^2 (3.25 m^2)	102 W/m^2 (3.60 m^2)	92 W/m^2 (4.00 m^2)	85 W/m^2 (4.32 m^2)
44	462	150 W/m^2 (3.08m^2)	131 W/m^2 (3.52 m^2)	113 W/m^2 (3.96 m^2)	105 W/m^2 (4.40 m^2)	95 W/m^2 (4.85 m^2)	87W/m^2 (5.28 m^2)
53	554	150 W/m^2 (3.70 m^2)	131 W/m^2 (4.24 m^2)	116 W/m^2 4.77 m^2)	105 W/m^2 (5.30 m^2)	95 W/m^2 (5.83 m^2)	87 W/m^2 (6.36 m^2)
63	646	147 W/m^2 (4.41 m^2)	128 W/m^2 (5.04 m^2)	114 W/m^2 (5.67 m^2)	103 W/m^2 (6.30 m^2)	93 W/m^2 (6.93 m^2)	85 W/m^2 (7.56 m^2)
71	745	150 W/m^2 (4.97 m^2)	131 W/m^2 (5.68 m^2)	117 W/m^2 (6.39 m^2)	105 W/m^2 (7.10 m^2)	95 W/m^2 (7.81 m^2)	87 W/m^2 (8.52 m^2)
79	826	150 W/m^2 (5.53 m^2)	131 W/m^2 (6.32 m^2)	116 W/m^2 (7.11 m^2)	105 W/m^2 (7.90 m^2)	95 W/m^2 (8.70 m^2)	87 W/m^2 (9.48 m^2)
89	914	147 W/m^2 (6.23 m^2)	128 W/m^2 (7.12 m^2)	114 W/m^2 (8.01 m^2)	103 W/m^2 (890 m^2)	93 W/m^2 (9.79 m^2)	86 W/m^2 (10.68 m^2)
107	1098	147 W/m^2 (7.49 m^2)	128 W/m^2 (8.56 m^2)	114 W/m^2 (9.63 m^2)	103 W/m^2 10.70 m^2)	93 W/m^2 (11.77 m^2)	86 W/m^2 (12.84 m^2)
118	1245	150 W/m^2 (8.26 m^2)	132 W/m^2 (9.44 m^2)	117 W/m^2 (10.62 m^2)	106 W/m^2 (11.80 m^2)	96 W/m^2 (12.98 m^2)	88 W/m^2 (14.16 m^2)
141	1500	152 W/m^2 (9.87 m^2)	133 W/m^2 (11.28 m^2)	118 W/m^2 (12.69 m^2)	106 W/m^2 (14.10 m^2)	97 W/m^2 (15.51 m^2)	89 W/m^2 (16.92 m^2)
160	1653	148 W/m^2 (11.20 m^2)	129 W/m^2 (12.80 m^2)	115 W/m^2 (14.40 m^2)	103 W/m^2 (16.00 m^2)	94 W/m^2 (17.60 m^2)	86 W/m^2 (19.20 m^2)

Watt per m^2 heated area.

The formula used is m^2 x 100 / cable length = CC-distance on the cable

Based on the CC-distance the formula is CC-distance x cable length per cable = m^2

DIMENSIONING SCHEME FOR FLOOR HEATING CABLES

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TABLE 1 HEAT LOSS ON PIPES (Q) W/m SAFETY FACTOR: 1,2

Insulation-thickness (mm)	$\Delta t=t_o-t_i$ t (°C)	ND (mmØ) NPS (Inches) OD (mmØ)	6 ¼ 14	9 3/8 17	12 ½ 21	20 ¾ 27	25 1 34	32 1¼ 42	40 1½ 48	50 2 60	65 2½ 76	80 3 89	100 4 114	125 5 140	150 6 168	200 8 219	250 10 273	300 12 324	350 14 356	400 16 406	450 18 457	500 20 508	600 24 610
20	20		4.1	4.6	5.3	6.6	7.2	8.3	9.2	10.9	13.1	15.0	18.5	22.1	26.0	33.0	40.5	47.5	52.0	58.9	65.9	73.0	87.0
	30		6.1	7.0	8.0	9.2	10.8	12.5	13.8	16.3	19.7	22.5	27.7	33.1	38.9	49.5	60.7	71.3	77.9	88.3	98.9	109.4	130.6
	40		8.2	9.3	10.5	12.3	14.4	16.7	18.4	21.8	36.3	29.9	36.9	44.1	51.9	66.0	81.0	95.1	103.9	117.8	131.8	145.9	174.1
	60		12.9	14.6	16.6	19.4	22.6	26.3	29.0	34.4	41.5	47.2	58.2	69.9	81.8	104.1	127.6	149.8	163.8	185.6	207.8	230.0	274.4
	80		17.2	19.5	22.1	25.9	30.2	35.1	38.7	45.8	55.3	62.9	77.6	92.8	109.1	138.8	170.2	199.8	218.4	247.4	277.0	306.6	365.8
	100		24.1	27.3	31.0	36.3	42.3	49.1	54.2	64.2	77.4	88.1	108.6	129.9	152.7	194.3	238.2	279.7	305.7	346.4	387.8	429.2	512.1
30	20		3.3	3.7	4.2	4.8	5.5	6.4	6.9	8.1	9.7	10.9	13.3	15.7	18.4	23.1	28.2	33.0	36.0	40.6	45.4	50.1	59.6
	30		5.0	5.6	6.3	7.2	8.3	9.5	10.4	12.2	14.5	16.4	19.9	23.6	27.5	34.7	42.3	49.5	53.9	60.9	68.1	75.2	89.5
	40		6.7	7.5	8.4	9.7	11.1	12.7	13.0	16.2	19.3	21.8	26.6	31.5	36.7	46.3	56.4	65.9	71.9	81.2	90.8	100.3	119.3
	60		10.5	11.8	13.2	15.2	17.5	20.0	21.9	25.6	30.5	34.4	41.9	49.6	57.9	73.0	89.0	104.0	113.4	128.0	143.1	158.1	188.1
	80		14.1	15.8	17.6	20.3	23.3	26.7	29.2	34.2	40.6	45.9	55.9	66.2	77.2	97.4	118.6	138.6	151.2	170.8	190.8	210.8	250.8
	100		19.7	22.1	24.7	28.5	32.7	37.5	41.0	47.9	57.0	64.3	78.3	92.8	108.3	136.5	166.3	194.4	212.0	239.5	267.6	295.6	351.7
	120		23.7	26.5	29.7	34.2	39.3	45.0	49.2	57.5	68.4	77.2	94.0	111.4	130.0	163.8	199.6	233.3	254.4	287.4	321.1	354.7	422.0
	180		39.4	44.2	49.4	56.9	65.4	74.8	81.8	95.6	113.8	128.4	156.3	185.1	216.1	272.3	331.6	387.6	422.8	477.6	533.6	589.4	701.2
	200		43.8	49.1	54.9	63.2	72.6	83.2	90.9	106.2	126.4	142.6	173.6	207.5	240.1	302.5	368.5	430.7	469.7	530.7	592.8	654.9	779.1
40	20		2.9	3.3	3.6	4.1	4.7	5.3	5.8	6.7	7.9	8.8	10.6	12.5	14.5	18.1	21.9	25.5	27.8	31.3	34.9	38.5	45.7
	30		4.4	4.9	5.4	6.2	7.0	8.0	8.7	10.0	11.8	13.2	15.9	18.7	21.7	27.2	32.9	38.3	41.7	47.0	52.4	57.8	68.5
	40		5.9	6.5	7.2	8.2	9.4	10.6	11.5	13.4	15.7	17.6	21.2	25.0	29.0	36.2	43.9	51.1	55.6	62.6	69.8	77.0	91.4
	60		9.3	10.3	11.4	13.0	14.8	16.8	18.2	21.1	24.8	27.8	33.5	39.4	45.7	57.1	69.2	80.6	87.7	98.8	110.2	121.5	144.2
	80		12.4	13.7	15.2	17.3	19.7	22.4	24.3	28.1	33.1	37.1	44.7	52.5	61.0	76.2	92.3	107.4	116.9	131.8	146.9	162.0	192.2
	100		17.4	19.3	21.4	24.3	27.7	31.4	34.1	39.5	46.4	52.1	62.7	73.7	85.5	106.9	129.5	150.7	164.1	184.9	206.1	227.3	269.7
	120		20.8	23.1	25.6	29.2	33.2	37.7	40.9	47.3	55.7	62.5	75.3	88.5	102.6	128.3	155.4	180.9	196.9	221.9	247.3	272.7	323.6
	180		34.7	38.5	42.7	48.6	55.3	62.7	68.1	78.8	92.7	103.9	125.2	147.2	170.7	213.4	258.4	300.8	327.4	368.9	411.3	453.6	538.1
	200		38.5	42.8	47.4	54.0	61.4	69.6	75.7	87.5	103.0	115.5	139.1	163.6	189.7	237.1	287.1	334.3	363.8	409.9	457.0	504.0	598.0
50	20		2.7	3.0	3.2	3.7	4.1	4.7	5.0	5.8	6.8	7.5	9.0	10.5	12.1	15.0	18.1	21.0	22.8	25.7	28.6	31.5	37.2
	30		4.0	4.4	4.9	5.5	6.2	7.0	7.6	8.7	10.1	11.3	13.5	15.8	18.2	22.6	27.2	31.5	34.3	38.5	42.9	47.2	55.8
	40		5.3	5.9	6.5	7.3	8.3	9.3	19.1	11.6	13.5	15.1	18.0	21.0	24.2	30.1	36.3	42.1	45.7	51.4	57.1	62.9	74.5
	60		8.4	9.3	10.3	11.6	13.1	14.7	15.9	18.3	21.3	23.8	28.4	33.2	38.3	47.5	57.2	66.3	72.1	81.0	90.1	99.3	117.5
	80		11.3	12.4	13.7	15.5	17.4	19.6	21.2	24.4	28.4	31.7	37.1	44.2	51.0	63.3	76.3	88.5	96.1	108.0	120.2	132.4	156.6
	100		15.8	17.5	19.2	21.7	24.5	27.6	29.8	34.2	39.9	44.5	53.2	62.1	71.6	88.9	107.1	124.2	134.9	151.7	168.7	185.8	219.9
	120		19.0	20.9	23.1	26.1	29.4	33.1	35.8	41.0	47.9	53.4	63.8	74.5	86.0	106.7	128.5	149.0	161.9	182.0	202.5	222.9	262.8
	180		31.6	34.9	38.4	43.4	49.0	55.1	59.6	68.3	79.7	88.9	106.2	124.0	143.0	177.5	218.8	248.0	269.4	302.8	336.9	370.9	438.9
	200		35.1	38.7	42.7	48.2	54.4	61.2	66.2	75.9	88.6	98.7	118.0	137.8	158.9	197.2	237.5	275.5	299.3	336.5	374.3	412.1	487.7

To be continued on next page

Svend A. Nielsen A/S

Conversion factor when using another type of insulation

Insulation	Heat cond. figure(λ)	Factor
Glass wool	0.036 W/m°C	0.90
Cell glass	0.039 W/m°C	1.03
Calsium Silicate	0.054 W/m°C	1.42
Uretan foam	0.024 W/m°C	0.63

The heat loss calculations are based on metal pipe insulated with mineral wool pipe-cups and wind velocity 10 m/s

Heat conduction figure mineral wool:
Temp. < 60°C : λ = 0.038 W/m°C
Temp. > 60°C < 100°C :λ = 0.040 W/m°C
Temp. > 100°C < 180°C : λ = 0.045 W/m°C
Temp. > 180°C: λ = 0.050 W/m°C

Example:
A 6" pipe with dT = 80°C and insulation thickness 50 mm glass wool cups, has according to table 1 a heat loss of 51.0 W/m pipe.

TABLE 1 HEAT LOSS ON PIPES (Q) W/m SAFETY FACTOR: 1.2

Insulation thickness (mm)	$\Delta t=t_o-t_i$ t (°C)	ND (mmØ) NPS (Inches) OD (mmØ)	6 ¼ 14	9 3/8 17	12 ½ 21	20 ¾ 27	25 1 34	32 1¼ 42	40 1½ 48	50 2 60	65 2½ 76	80 3 89	100 4 114	125 5 140	150 6 168	200 8 219	250 10 273	300 12 324	350 14 356	400 16 406	450 18 457	500 20 508	600 24 610
60	20		2.5	2.7	3.0	3.4	3.8	4.2	4.5	5.2	6.0	6.7	7.9	9.2	10.5	13.0	15.6	18.0	19.5	21.9	24.3	26.7	31.5
	30		3.7	4.1	4.5	5.0	5.7	6.3	6.8	7.8	9.0	10.0	11.8	13.8	15.8	19.5	23.3	27.0	29.3	32.8	36.5	40.1	47.3
	40		5.0	5.5	6.0	6.7	7.5	8.4	9.1	10.4	12.0	13.3	15.8	18.3	21.1	26.0	31.1	36.0	39.0	43.8	48.6	53.4	63.1
	60		7.9	8.6	9.5	10.6	11.9	13.0	14.3	16.3	18.9	21.0	24.9	28.9	33.2	41.0	49.1	56.8	61.6	69.1	76.7	84.3	99.6
	80		10.5	11.5	12.6	14.1	15.9	17.7	19.1	21.8	25.3	28.0	33.2	38.6	44.3	54.6	65.5	75.7	82.1	92.1	102.3	112.4	132.7
	100		14.7	16.2	17.7	19.9	22.3	24.9	26.9	30.6	35.5	39.4	46.7	54.2	62.2	76.7	92.0	106.3	115.3	129.3	143.6	157.9	186.4
	120		17.7	19.4	21.2	23.9	26.7	29.9	32.2	36.7	42.6	47.2	56.0	65.1	74.7	92.1	111.4	127.6	138.4	155.2	172.3	189.5	223.7
	180		29.4	32.3	35.4	39.7	44.5	49.8	53.7	61.2	70.9	78.6	93.3	108.3	124.3	153.3	183.7	212.4	230.3	258.3	286.8	315.3	372.2
	200		32.7	35.9	39.3	44.1	49.5	55.4	59.6	67.9	78.7	87.4	103.6	120.3	138.1	170.3	204.1	236.0	255.9	287.0	318.7	350.3	413.6
80	20		2.2	2.4	2.7	2.9	3.3	3.6	3.9	4.4	5.0	5.5	6.5	7.5	8.5	10.4	12.3	14.2	15.3	17.1	18.9	20.8	24.4
	30		3.4	3.7	4.0	4.4	4.9	5.4	5.8	6.6	7.5	8.3	9.7	11.2	12.8	15.6	18.5	21.3	23.0	25.7	28.4	31.1	36.6
	40		4.5	4.9	5.3	5.9	6.6	7.3	7.8	8.8	10.1	11.1	13.0	14.9	17.0	20.7	24.7	28.3	30.6	34.2	37.9	41.5	48.8
	60		7.1	7.7	8.4	9.3	10.4	11.5	12.3	13.9	15.9	17.5	20.5	23.6	26.9	32.7	38.9	44.7	48.4	54.0	59.8	65.5	77.0
	80		9.4	10.3	11.2	12.4	13.8	15.3	16.4	18.5	21.2	23.3	27.3	31.4	35.8	43.7	51.9	59.6	64.5	72.0	79.7	87.4	102.7
	100		13.2	14.4	15.7	17.4	19.4	21.5	23.0	26.0	29.7	32.8	38.4	44.2	50.3	61.3	72.9	83.8	90.6	101.2	112.0	122.7	144.4
	120		15.9	17.3	18.8	20.9	23.3	25.8	27.6	31.1	35.7	39.3	46.1	53.0	60.4	73.6	87.5	100.5	108.7	121.4	134.4	147.3	173.1
	180		26.5	28.8	31.3	34.9	38.7	42.9	46.0	51.9	59.4	65.5	76.7	88.3	100.5	122.6	145.7	167.4	180.9	202.1	223.7	245.2	288.1
	200		29.4	32.0	34.8	38.7	43.0	47.7	51.1	57.6	66.1	72.7	85.3	98.1	111.7	136.2	161.9	186.0	201.1	224.6	248.5	2724	320.2
100	20		2.1	2.2	2.4	2.7	3.0	3.3	3.5	3.9	4.4	4.8	5.6	6.4	7.3	8.8	10.4	11.8	12.8	14.2	15.7	17.2	20.1
	30		3.1	3.4	3.6	4.0	4.4	4.9	5.2	5.8	6.6	7.3	8.4	9.6	10.9	13.2	15.5	17.8	19.2	21.3	23.5	25.7	30.1
	40		4.1	4.5	4.9	5.4	5.9	6.5	7.0	7.8	8.8	9.7	11.3	12.9	14.5	17.6	20.7	23.7	25.6	28.4	31.4	34.3	40.2
	60		6.5	7.1	7.7	8.5	9.4	10.3	11.0	12.3	14.0	15.3	17.8	20.3	23.0	27.7	32.7	37.4	40.3	44.9	49.5	54.1	63.4
	80		8.7	9.4	10.2	11.3	12.5	13.7	14.6	16.4	18.6	20.4	23.7	27.0	27.0	30.6	37.0	43.6	53.8	59.8	66.0	72.2	84.5
	100		12.3	13.3	14.4	15.9	17.5	19.3	20.6	23.0	26.2	28.7	33.3	38.0	43.0	52.0	61.3	70.1	75.6	84.1	92.8	101.4	118.7
	120		14.7	15.9	17.2	19.1	21.0	23.2	24.7	27.6	31.4	34.4	40.0	45.6	51.6	62.3	73.6	84.1	90.7	100.9	111.3	121.7	142.5
	180		24.5	26.6	28.7	31.7	35.0	38.6	41.1	46.0	52.3	57.3	66.6	76.0	86.0	103.8	122.5	140.1	151.0	168.1	185.4	202.7	237.7
	200		27.2	29.5	31.9	35.3	38.9	42.9	45.7	51.2	58.1	63.6	74.0	84.4	95.5	115.4	136.1	155.6	167.8	186.7	206.0	225.2	263.6
120	60		6.2	6.6	7.2	7.9	8.6	9.5	10.1	11.2	12.7	13.8	15.9	18.0	20.3	24.3	28.5	32.5	34.9	38.8	42.6	46.5	54.2
	80		8.2	8.9	9.6	10.5	11.5	12.6	13.4	14.9	16.9	18.4	21.2	24.1	27.1	32.5	38.1	43.3	46.6	51.7	56.9	62.0	72.3
	100		11.5	1.5	13.4	14.8	16.2	17.8	18.9	21.0	23.7	25.8	29.8	33.8	38.1	45.6	53.5	60,9	65.5	72.6	79.9	87.2	101.6
	120		13.9	15.0	16.1	17.7	19.5	21.3	22.6	25.2	28.5	31.0	35.8	40.6	45.7	54.7	64.2	73.0	78.6	87.1	95.9	104.6	121.9
	160		18.5	20.0	21.5	23.6	25.9	28.4	30.2	33.6	37.9	41.4	47.7	54.1	60.9	73.0	85.6	97.4	104.7	116.2	127.8	139.4	162.6
	170		19.6	21.2	22.8	25.1	27.6	30.2	32.1	35.7	40.3	43.9	50.7	57.5	64.7	77.5	90.9	103.5	111.3	123.5	135.8	148.2	172.8
	180		23.1	24.9	26.8	29.5	32.4	35.5	37.7	42.0	47.4	51.7	59.6	67.6	76.1	91.2	106.9	121.6	130.8	145.1	159.7	174.2	203.1
	200		25.6	27.7	29.8	32.8	36.0	39.4	41.9	46.7	52.7	57.4	66.2	75.1	84.5	101.3	118.8	135.2	145.4	161.3	177.4	193.5	225.7
150	60		5.8	6.2	6.6	7.2	7.9	8.6	9.1	10.1	11.3	12.3	14.0	15.8	17.6	20.9	24.3	27.5	29.5	32.6	35.7	38.8	45.0
	80		7.7	8.2	8.8	9.7	10.5	11.5	12.6	13.4	15.1	16.3	18.7	21.0	23.5	27.9	32.4	36.7	39.3	43.4	47.6	51.8	60.1
	100		10.8	11.6	12.4	13.6	14.8	16.1	17.1	18.9	21.2	23.0	26.2	29.5	33.0	39.2	45.6	51.5	55.3	61.1	66.9	72.8	84.4
	120		12.9	13.9	14.9	16.3	17.8	19.4	20.5	22.7	25.4	27.5	31.5	35.4	39.6	47.0	54.7	61.9	66.3	73.3	80.3	87.3	101.3
	160		17.2	18.5	19.9	21.7	23.7	25..8	27.3	30.2	33.9	36.7	42.0	47.2	52.8	62.7	72.9	82.5	88.4	97.7	107.1	116.4	135.1
	170		18.3	19.7	21.1	23.1	25.2	27.4	29.0	32.1	36.0	39.0	44.6	50.2	56.1	66.6	77.5	87.6	93.9	103.8	113.8	123.7	143.5
	180		21.5	23.1	24.8	27.1	29.6	32.3	34.2	37.8	42.3	45.8	52.4	59.0	66.0	78.3	91.1	103.0	110.5	122.0	133.8	145.5	168.7
	200		23.9	25.7	27.6	30.2	32.9	35.9	38.0	42.0	47.0	51.0	58.2	65.6	73.3	87.0	101.2	114.5	122.7	135.6	148.6	161.6	187.5

SAN
Electro Heat

TABLE 2 **PIPE EQUIVALENTS**

TYPICAL FACTORS FOR VALVE-PIPE EQUIVALENTS																	
VALVE TYPE	NOMINAL DIAMETER IN MM																
	15	20	25	40	50	65	80	100	150	175	200	250	300	350	400	500	600
Ball v.	0.15	0.23	0.30	0.45	0.61	0.76	0.95	1.22	2.13	2.90	3.81	4.57	5.49	6.55	7.77	8.69	10.36
Welded sluice v.	0.30	0.45	0.61	0.76	0.81	0.91	1.07	1.52	2.44	3.35	4.27	5.03	5.94	7.01	8.23	9.14	10.97
Throttle v.	-	-	0.30	0.46	0.61	0.76	0.81	0.981	1.07	1.22	1.35	1.52	1.68	1.83	1.98	2.13	2.44

Please note! The factors for valve-pipe equivalents are based on average surface on the most common valve types, and on the fact that the valves are insulated with same insulation type and thickness as the pipes.

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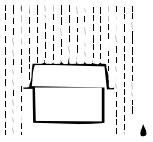
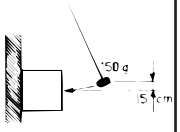
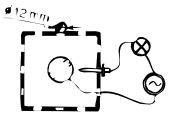
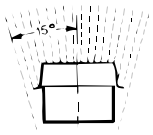
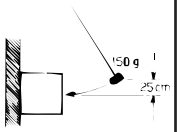
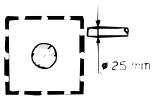
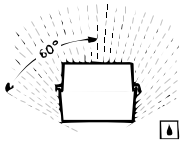
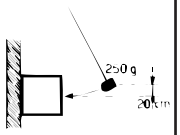
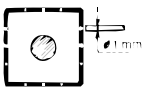
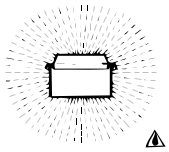
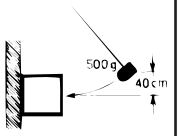
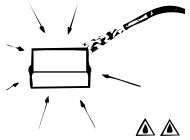
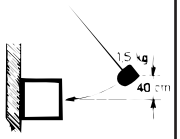
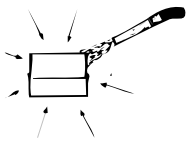
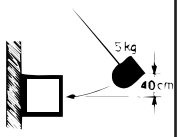
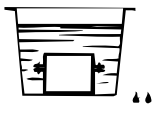
ENCLOSURE - RATES IP

PROTECTION AGAINST PENETRATION OF SOLIDS			PROTECTION AGAINST PENETRATION OF WATER			MECHANICAL PROTECTION AGAINST STROKE		
1st. figure	Description		2nd. figure	Description		3rd. figure	Description	
0	No protection		**0**	No protection		**0**	No protection	
1	Protected a-gainst penetration of particles bigger than Ø 50 mm.		**1**	Protected a-gainst vertically falling water drops.		**1**	Resistant to strokes from a weight of 150 g falling from 15 cm.	
2	Protected a-gainst penetration of particles bigger than Ø 12 mm.		**2**	Protected against falling water drops coming from a 15 degrees angle.		**2**	Resistant to strokes from a weight of 150 g falling from 25 cm.	
3	Protected a-gainst penetration of particles bigger than Ø 2.5 mm.		**3**	Rain tight		**3**	Resistant to strokes from a weigth of 250 g falling from 20 cm.	
4	Protected a-gainst penetration of particles bigger than Ø 1 mm.		**4**	Splash tight		**5**	Resistant to strokes from a weight of 500 g falling from 40 cm.	
5	Protected a-gainst dust.		**5**	Jet tight		**7**	Resistant to strokes from a weight of 1500 g falling from 40 cm.	
6	Completely dust tight.		**6**	Flush tight		**9**	Resistant to strokes from a weight of 5000 g falling from 40 cm.	
			7	Can resist being immersed into water.				
1st. figure is valid according to CEI 70-1 - IEC 529 - IEC 144 - UTE C 20-010- DIN 40050 standards			2nd. figure is valid according to CEI 70-1 - IEC 529 - IEC 144 - UTE C 20-010- DIN 40050 standards			3rd. figure is valid according to UTE C 20-010- French standard		

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Temperature difference between flat surface and room, based on room temperature 10°C

INSULATION THICKNESS	Δt °C	20	40	60	80	100	120	140	160	180
	0	180	420	710	1000	1400	1900	2300	2900	3500
	20	28	60	97	140	190	240	290	360	430
	30	20	43	69	98	130	170	210	250	300
	40	16	34	54	76	100	130	160	190	230
	50	13	27	44	62	82	100	130	160	190
	60	11	23	37	52	69	88	110	130	160
	80	8	18	28	40	53	67	83	100	120
	100	7	14	23	32	43	54	67	81	96
	120	6	12	19	27	36	45	56	68	81
	150	5	10	15	22	29	37	45	54	65
	200	4	7	12	16	22	28	34	41	49
	250	3	6	9	13	17	22	27	33	39
	300	2	5	8	11	15	19	23	28	33

Table values are W/m^2.

HEAT LOSS from flat surface

Example:

The heat loss of a surface must be replaced by mounted heating elements. How much power is required?
Given: Δt (t_2 - t_1) = 60°C, insulation thickness = 100 mm.
Theoretical heat loss: 23 W/m^2.

Use hereafter a safety factor of approx. 1.2.

The theoretical power calculation is added the below percentage rates

Small tools or metal parts without heat insulation	approx.30% - 40%
Small tools or metal parts with heat insulation	approx. 5% - 10%
Big tools or metal parts without heat insulation	approx.15% - 25%
Big tools or metal parts with heat insulation	approx. 5% - 10%
Heated baths, according to size	approx.20% - 30%
Heated baths with heat insulation	approx.10% - 20%

HEAT LOSS for metal parts and vessels

$P = \frac{U^2}{R}$	$I = \frac{U}{R}$
$P = I^2 \times R$	$I = \frac{P}{U}$
$P = U \times I$	$I = \sqrt{\frac{P}{R}}$
$U = \sqrt{P \times R}$	$R = \frac{U}{I}$
$U = \frac{P}{I}$	$R = \frac{U^2}{P}$
$U = I \times R$	$R = \frac{P}{I^2}$

OHM's LAW

For a pure ohmic resistor, e.g. a tubular heating element, the following formula applies, also known as Ohm's Law.

$$U = R \times I$$

U = voltage in Volt
I = current in Amp
R = resistance in Ohm
P = power in Watt

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SERIES-PARALLEL CONNECTION

SERIES:

The total resistance is calculated from the formula:

$$R_S = R_1 + R_2 + R_3 + ... + R_n$$

The current intensity is the same through all the resistors, while the voltage drop over each resistor varies, dependant of the size of the resistor (Ohm-value).

PARALLEL:

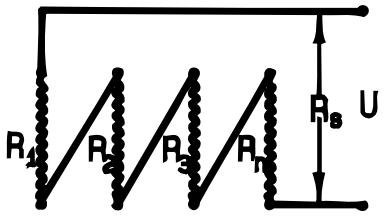
The total resistance is calculated from the formula:

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ... + \frac{1}{R_n}$$

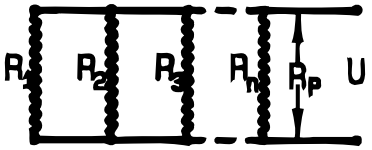
At 2 equal resistors: $R_p = \frac{R_1 \ R_2}{R_1 + R_2}$

The voltage is the same over all resistors, while the current intensity through each resistor varies, dependant of the size of the resistor (Ohm-value).

SERIES



PARALLEL



Δ/Y- CONNECTION

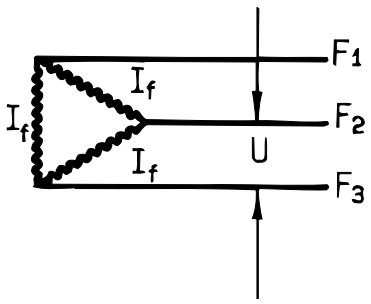
DELTA Δ:

Total power: $P = U \ I \ \sqrt{3}$

Main current: $I = I_f \ \sqrt{3}$

Main voltage: $U = U_f$

DELTA



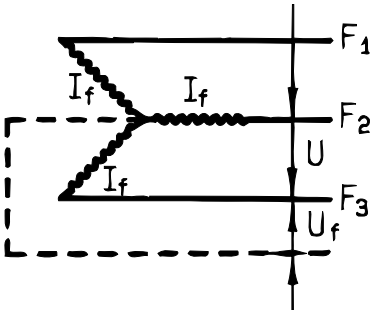
STAR Y:

Total power: $P = U \ I \ \sqrt{3}$

Main current: $I = I_f$

Main voltage: $U = U_f \ \sqrt{3}$

STAR



When connecting from delta connection to star connection the total power decreases to one third of the original power.

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TECHNICAL DATA

As help for direct calculation assignments, the below data are used.

	Specific heat	Melting heat*	Density	Heat conduction coefficient	Melting point**
	KJ/kg °C	KJ/kg	kg/m^3	W/m °C	°C
Aluminium	0.92	394	2700	225.0	659
Alcohol	2.68	1100	789	0.18	72
Asphalt	2.09	-	1300	0.7	120
Benzol	1.76	394	900	0.14	80
Concrete	0.84	-	2000	1.0	-
Lead	0.13	25	11340	35.0	327
Grease	2.09	42	980	-	15
Glycerine	2.26	201	1260	0.285	-18
Gravel (dry)	3.34	-	1950	0.34	-
Resin	2.09	167	-	-	60
Ice (0°C)	1.93	335	917	2.2	0
Iron	0.47	272	7860	67.0	1530
Copper	0.39	209	8900	393.0	1083
Air (0°C)	1.00	-	1.275	0.025	-
Magnesium	1.01	209	1740	171.0	650
Brass	0.38	-	8350	135.0	925
Oil light	1.80	-	900	0.145	-
Oil heavy	1.95	-	900	0.13	-
Paraffin	2.20	146	900	-	215
Silumin	0.90	350	2700	160.0	570
Silver	0.24	105	10500	460.0	960
Tin	0.23	59	7280	63.0	232
Water(10°C)	4.19	2257	1000	0.587	100

Table values stated at 1 bar and ~0°C.

* States the evaporation heat for fluids at constant pressure and the melting heat at constant temperature for bulk materials.

** States the melting temperature for bulk materials and boiling point for fluids.

Energy

joule (=Nm= J	kilo-joule kJ	kilo-watt-hour kWh	kilo-pond-meter kpm	kilo-calories kcal	horse-power-hour hkh	British thermal unit Btu	foot pound-force ft-lb f
1	0,001	$0.278\ 10^{-6}$	0.1020	$0.239\ 10^{-6}$	$0.378\ 10^{-6}$	$0.948\ 10^{-3}$	0.7376
1000	1	$0.278\ 10^{-3}$	102	0.239	$0.378\ 10^{-3}$	0.948	737.56
3600000	3600	1	367000	860	1.360	3413	$2656\ 10^3$
9.80665	$9.807\ 10^{-3}$	$2.724\ 10^{-6}$	1	0.00234	$3.70\ 10^{-6}$	0.009293	7.2313
4186.8	4.1868	0.00117	427	1	$1.581\ 10^{-3}$	3.968	$3.088\ 10^3$
$2648\ 10^3$	2648	0.736	270000	632	1	2510	$1953\ 10^3$
1055.06	1.055	$0.293\ 10^{-3}$	107.59	0.252	$0.398\ 10^{-3}$	1	778.169
1.35582	$1.356\ 10^{-3}$	$0.377\ 10^{-6}$	0.1383	$0.324\ 10^{-3}$	$0.512x10^{-6}$	$1.285\ 10^{-3}$	1

Power

watt (= Nm/s) (= J/s) W	kilopond-meter per sec. kpm/s	kilo-calories per hour kcal/h	horse-power (metric) hk	horse-power (UK) hp	foot pound-force per sec. ft·bf/s	British thermal unit per h. Btu/h
1	0.102	0.860	0.00136	0.00134	0.738	3.410
9.81	1	8.44	0.0133	0.0132	7.23	33.5
1.163	0.119	1	0.00158	0.00156	0.858	3.97
735.5	75.0	632	1	0.986	542	2510
745	76	642	1.014	1	550	2544
1.356	0.138	1.17	0.00184	0.00182	1	4.63
0.293	0.0299	0.252	$0.399\ 10^{-3}$	$0.393\ 10^{-3}$	0.216	1

Temperature

Kelvin-scale	Celsius-scale	Fahrenheit-scale
0 K	-273.15°C	-459.67 °F
255.37 K	17.78°C	0 °F
273.15 K	0 °C	32 °F
373.15 K	100 °C	212 °F

°C to°F

°C	0	5	10	15	20	25	30	35	40	60	80	100
°F	32	40	50	60	70	75	85	95	105	140	175	212

CONVERSION TABLES

Pressure and surface load:

newton per m^2 (= pascal)	kilopond p., cm^2 (= mm) water coll.)	kilopond per mm^2 (= technical atmosphere)	kilopond per mm^2	bar	millibar	atmosphere,	millimeter physical silver coll. (= Torr)	inch quick-mercury	pound-of force per square inch
N/m^2	kp/m^2	kp/cm^2	kp/mm^2	b	mb	atm	mm Hg	in. Hg	lbf/in^2 psi
1	0.10197	$10.2\ 10^{-6}$	$10\ 10^{-6}$	$0.10\ 10^{-6}$	0.01	$9.87\ 10^{-6}$	0.0075	$0.295\ 10^{-3}$	$0.145\ 10^{-3}$
9.8067	**1**	$0.1\ 10^{-3}$	-	$98.07\ 10^{-6}$	0.09807	$96.78\ 10^{-6}$	0.07356	0.00290	0.00142
98067	10000	**1**	0.01	0.98067	980.67	0.9678	735.56	28.959	14.2233
9806650	-	100	**1**	98.0665	-	96.78	73556	2895.9	1422.33
100000	10197.2	1.01972	0.01097	**1**	1000	0.98969	750.1	29.53	14.504
100	10.1972	0.00102	-	0.001	**1**	$0.987\ 10^{-3}$	0.750	0.0295	0.0145
101325	10332.3	1.03323	0.01033	0.01325	1013.25	**1**	760	29.921	14.696
133.32	13.595	0.00136	-	0.00133	1.3332	0.00132	**1**	0.03937	0.01934
3386.4	345.3	0.03453	-	0.03386	33.864	0.03342	25.400	**1**	0.4912
6894.8	703.1	0.07031	$0.703\ 10^{-3}$	0.06895	68.948	0.06804	51.715	2.036	**1**

Dimensions:

Metres	Danish dim.	English dim.
Length:		
1 cm = 10 mm	0.3823 tommer	0.3937 in
1 dm = 10 cm	3.8234 tommer	3.9370 in
1 m = 100 cm	3.1862 fod/1.5932 alen	3.2808 ft = 1.0936 yd
1 km = 1000 m	0.1328 mil	0.6213 mile
26.1545 mm	1 tomme	1.0297 in
31.3853 cm	1 fod = 12 tommer	1.0297 ft
0.6277 m	1 alen = 2 fod	2.0594 ft
7.5325 km	1 mil	4.6805 miles
25.4 mm	0.9712 tommer	1 inch
30.48 cm	0.9712 fod	1 foot
0.9144 cm	2.9135 fod	1 yard
1.6093 km	0.2137 mil	1 mile = 1760 yd
Area:		
1 cm^2 = 100 mm^2	0.1462 kv.tommer	0.155 sq.in
1 m^2 = 10,000 cm^2	10.1519 kv.fod = 2.5380 kv.alen	10.7639 sq.ft. = 1.1960 sq.yd
1 km^2 = 1,000,000 m^2	0.0176 kv.mil	0.3861 sq.mile
1 ha = 10,000 m^2	1.8128 td.land	2.4711 acres
6.8406 cm^2	1 kv.tomme	1.0603 sq.in
0.0985 m^2	1 kv.fod	1.0603 sq.ft
0.3940 m^2	1 kv.alen	4.2412 sq.ft
56.7383 km^2	1 kv.mil	21.9067 sq.miles
0,5516 ha = 5516.23 m^2	1 td. land	1.3631 acres
6.4516 cm^2	0.9431 kv.tomme	1 sq.in
0.0929 m^2	0.9431 kv.fod	1 sq.ft
0.8361 m^2	8.4882 kv.fod	1 sq.yd
0.4047 ha	0.7336 td. land	1 acre
2.59 km^2	469.5134 td.land	1 sq.mile = 640 acres
Volume:		
1 cm^3	0.0590 kubiktommer	0.0610 cu.in
1 m^3 = 1,000,000 cm^3	32.3459 kubikfod	35.3150 cu.ft = 1.3080 cu.yd
1 l = 1 dm^3	1.0351 pot	0.22 gallon
17.8911 cm^3	1 kubiktomme	1.0918 cu.in
0.0309 m^3	1 kubikfod	1.0918 cu.ft
0.9661 l	1 pot	0.2125 gallon
16.3871 cm^3	0.9159 kubiktomme	1 cu.in
0.0283 m^3	0.9159 kubikfod	1 cu.ft = 277.42 cu.in
0.7446 m^3	24.7283 dubikdos	1 cu.yd
4.5460 l	4.7054 pot	1 gallon
Weight:		
1 g	0.2 kvint	0.0022 lb
1 kg = 1000 g	2.0 pund	2.2049 lb
1 t = 1000 kg	2000 pund	2204.85 lb
5.0 g	1 kvint	0.0110 lb
0.5 kg	1 pund	1.1024 lb
28.349 g	5.699 kvint	1 oz (ounce) = 1/16 lb
0.4536 kg	0.9072 pund	1 lb (pound)
		14 pound = 1 stone
1.0165 t	2032.0941 pund	1 ton = 2240 lb

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Process HEATING

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- Flow Heaters
- Air Duct Heaters
- High-voltage
- Resistors
- Controllers

With more than 50 years of experience SAN Electro Heat's most valuable asset is special knowhow about design, product development and manufacturing of professional electrical heating equipment for industrial use.

The company is geared to deliver 100% customized products, and thus functions both as a catalyst for a development project and as supplier of the final product. At the same time we insure and maintain the required quality level, mechanical and electrical dimensioning, approvals and documentation.