Carrier

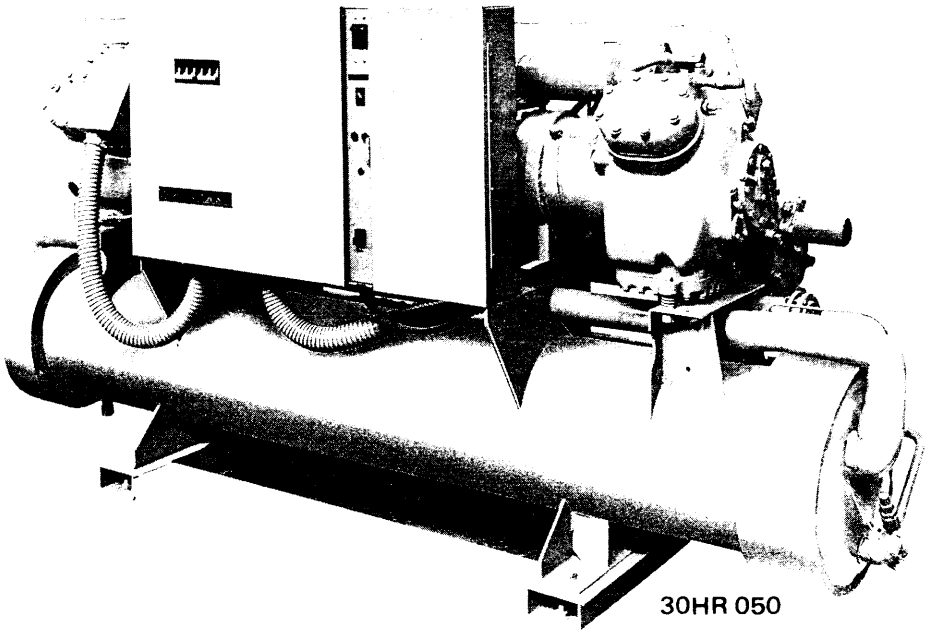
Le Compresseur Frigorifique

Subsidiary of
Carrier Corporation

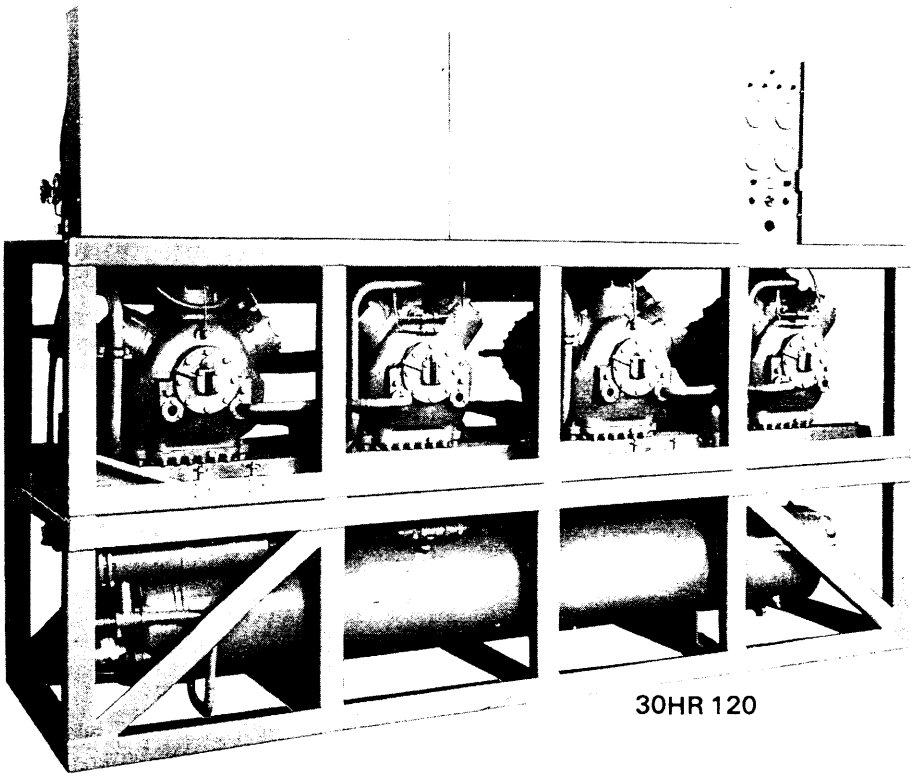
30HR,HS 020-160

Reciprocating liquid chilling packages

Nominal capacity
55,82 - 450 kW
48 000 - 387 000 kcal/h
50 Hz



30HR 050



30HR 120

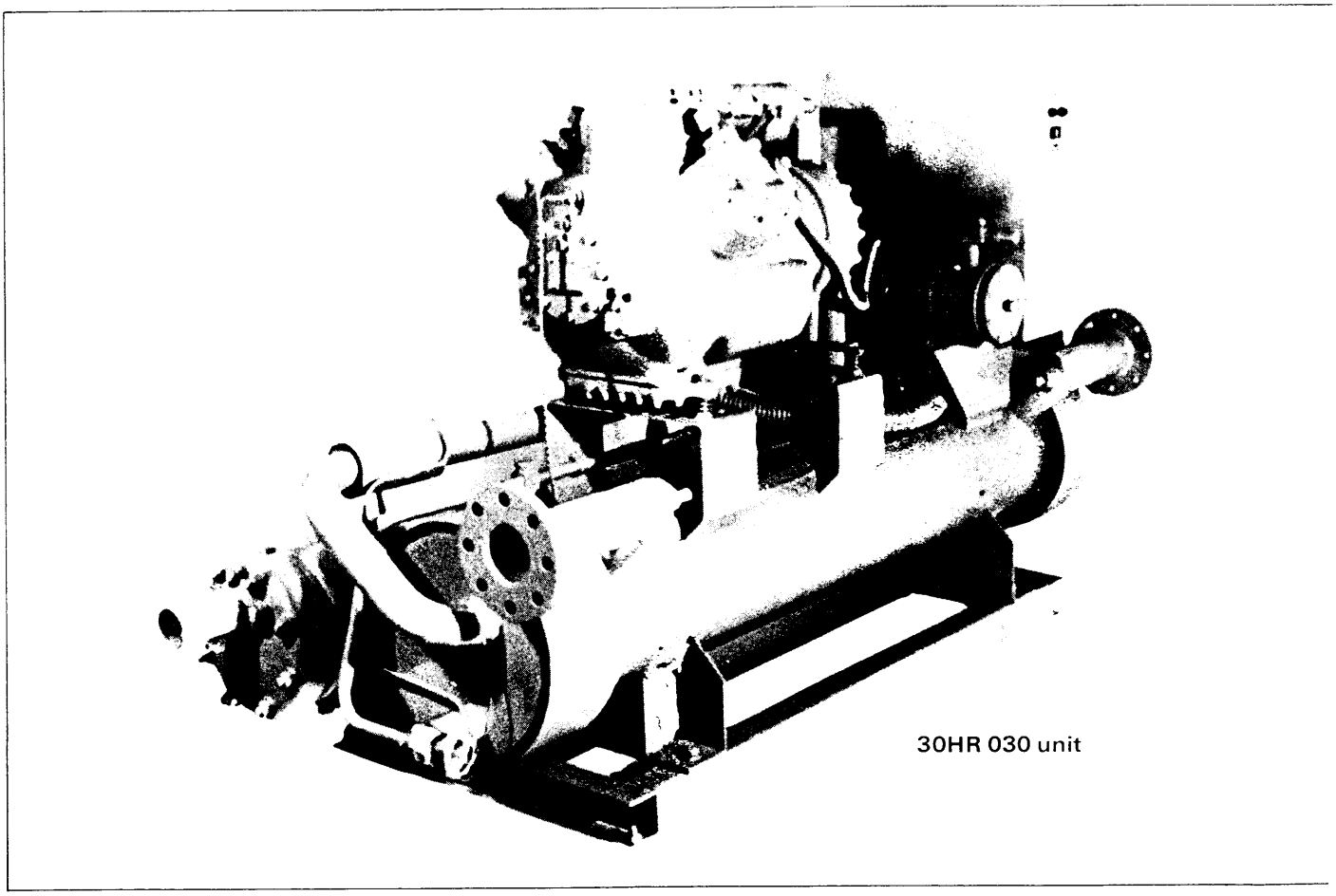
Description

These modern multiple-compressor liquid-chilling packages offer all the advantages of packaged design for use in chilled water air conditioning systems and various types of process cooling applications. Every machine is factory engineered and assembled to ensure a perfectly balanced refrigeration system. All components are matched to provide highest efficiency and lowest possible power consumption. Only external water and electrical connections are required to make the water-cooled unit operational. The condenserless models require, in addition, only refrigerant line connections to the remote condenser.

The water-cooled 30HR is a complete one-package system with two condensers having built-in subcoolers and a direct expansion cooler with two refrigerant circuits (one for each condenser on 30HR 040 to 160 units; the second circuit is by-passed when compressor runs on two cylinders on 30HR 020-030 units).

Model 30HS is a condenserless 30HR used with remote water-cooled, air-cooled or evaporative type condensers. It includes all features of the 30HR.

Multiple serviceable compressors are mounted on spring vibration isolators to minimize sound and vibration transmission to the building structure. Hot-gas mufflers dampen compressor gas pulsation, giving smooth, quiet operation.



30HR 030 unit

30HR, HS 020-030 units — The refrigerant circuit includes two thermal expansion valves, a filter-drier and combination liquid line sight glass and moisture indicator and a liquid line solenoid valve (2 on 30HS units).

30HR, HS 040 to 160 units — Each of the refrigerant circuits includes a thermal expansion valve, a liquid line solenoid valve (except 30HR 040-050-060) a filter-drier and combination liquid line sight glass and moisture indicator.

Compact size allows passage through normal door opening and means that little floor space is required for installation.

Physical data

A. Unit

Unit 30HR, HS			020	030	040	050	060	070	080	090	100	110	120	140	160
Nominal cooling capacity†	kW		56	78	137	155	178	223	247	262	315	340	351	405	450
	kcal/h		48 000	67 500	118 000	133 000	153 000	192 000	212 000	225 000	271 000	292 000	302 000	348 000	387 000
Approximate operating weight††	kg	HR	810	850	1246	1445	1503	2240	2325	2427	2903	2960	3020	3438	3630
		HS	560	600	825	1002	1035	1575	1600	1626	2028	2055	2082	2400	2450
Refrigerant charge R-22*	kg	HR	21	26	36	43	45	53	60	64	74	79	83	90	100
		HS	13	18	20	25	29	35	40	44	51	55	60	67	76
Compressor 06E			Reciprocating, semi-hermetic (24,2 rps; 1450 rpm)												
Number			1	1	2	2	2	3	3	3	4	4	4	4	4
% capacity															
Circuit 1			—	—	56,5	60	50	57	62,5	67	50	54,5	50	50	50
Circuit 2			—	—	43,5	40	50	43	37,5	33	50	45,5	50	50	50
No. control steps			2	3	4	4	4	6	6	6	8	8	8	8	8
Total no. cylinders			4	6	10	10	12	14	16	18	20	22	24	24	24
Total oil charge	l		6,6	9,0	13,2	15,6	18,0	22,2	24,6	27,0	31,2	33,6	36,0	36,0	36,0
Condenser 09RP (30HR units only)															
Circuit 1			022	022	022	027	027	043	054	070	054	070	070	070	084
Circuit 2			—	—	022	022	027	033	033	033	054	054	070	070	084
Refrig. connection no.size 00 in															
Liquid			1;1⅛	1;⅞	2;⅞	2;⅞	2;⅞	1,1⅛	1;1⅛	1;1⅛	2,1⅜	2,1⅜	2,1⅜	2,1⅜	2,1⅜
Discharge			1;1⅜	1;1⅜	2,1⅜	2;1⅜	2;1⅜	1,1⅜	1,1⅜	1;1⅜	2,1⅜	2,2⅛	2,2⅛	2,2⅝	2,2⅝
								1,1⅜	1,1⅜	1,1⅜					

B. Evaporator

Unit 30HR, HS		020, 030	040	050, 060	070, 080, 090	100,110 120	140, 160
Shell							
Net water volume	l	42,4	51,5	90	138	190	200
OD	mm	273	273	324	407	457	457
Length	mm	1515	1835	2286	2057	2286	2743
Tubes		Prime surface copper					
Number		200	200	294	468	646	646
Length	mm	1575	1892	2350	2122	2357	2807
Outside area	m²	12,2	14,7	26,4	40,9	60,0	70,8
Refrigerant circuits		2	2	2	2	2	2
Refrigerant passes		6	6	6	6	6	4
Water connection							
Inlet and outlet		80 mm*	3" Gas	3" Gas	100 mm*	125 mm*	150 mm*
Drain	in	1	1	1	1	1	1

C. Condenser (30HR units only)

Condenser 09RP		022	027	033	043	054	070	084
Shell								
OD	mm	273	273	273	324	324	324	356
Length	mm	1779	1779	1779	1779	2184	2184	2184
Tubes		Copper, finned (spacing 1,3mm)						
Number		45	56	64	84	84	106	124
Length	mm	1782	1782	1782	1782	2197	2197	2197
Area	m²							
Inside		3,34	4,16	4,76	6,20	7,69	9,61	11,28
Outside		10,86	13,47	15,40	20,12	24,90	31,21	36,60
Subcooler tubes								
Number		5	5	5	5	5	5	9
Length	mm	1782	1782	1782	1782	2197	2197	2197
Area	m²							
Inside		0,37	0,37	0,37	0,37	0,46	0,46	0,82
Outside		1,21	1,21	1,21	1,21	1,48	1,48	2,65
Water connection*	in							
Inlet		2½	2½	2½	3	3	3	2½†
Outlet		2½	2½	2½	3	3	3	4**
Water passes		3	3	3	3	3	3	3/6

NOTES

1. Unit
* 30HR shipped with full operating charge
30HS shipped with holding charge
charge for remote condenser and interconnecting piping added in the field

† Based on chilled water leaving temperature of 7 °C, saturated discharge temperature of 49 °C and chilled water rise of 5 °C (subcooling 8,3 °C)

†† Approximate operating weight includes refrigerant charge, cooling water and chilled water

3. Evaporator
* Welded nozzle flange
Nom. press. 16 bar (16,3 kg/cm²)
NFE 29262 — PN16
Nom. dia. 80 fixing holes ℄ 160 mm
8 holes Ø 18 mm
Nom. dia. 100 fixing holes ℄ 190 mm
8 holes Ø 18 mm
Nom. dia. 125 fixing holes ℄ 210 mm
8 holes Ø 18 mm
Nom. dia. 150 fixing holes ℄ 240 mm
8 holes Ø 22 mm

2. Condenser
* Steel connecting collar (ASA B 36.10)
with welded flange connection possibility

Nom. dia.	Ext. dia. of tube	Drill hole dia.
inches	mm	mm
2½	73,0	5,16
3	88,9	5,49

** Welded flange
Nom. press. 10,3 bar (10,5 kg/cm²)
ASA B 16.5
Nom. dia. 4
Ext. dia. of tube 114,3 mm
Fixing holes ℄ 190,5 mm
8 holes Ø 19 mm

Features

Sequential starting and stepping of multiple compressors means low inrush and running current (30HR, HS 040 to 160 units).

Bolted semi-hermetic compressors, easy to service.

Wide range of distribution voltages (220-240 and 380-415).

Manual reset, magnetic-trip circuit breakers ensure protection against single-phasing.

Multiple-step controller provides optimum control of chilled water temperature for closer capacity control.

Manual transfer switch (30HR, HS 040 to 160 units) which changes the lead compressor in starting sequence.

Refrigerant subcooling offers increased system capacity without raising the power requirements.

Compressor crankcase heaters, which are on during compressor off cycle provide protection against refrigerant migration and oil dilution.

Two separate refrigerant circuits (30HR, HS 040 to 160 units) enable partial load operation at higher suction temperatures which means reduced power costs.

Hot-gas bypass (30HR, HS 020, 030) factory-installed upon request (special order).

Accessories

Oil pressure safety switch package (standard on 30HS, accessory on 30HR units).

Condenser manifold package, available for all 30HR 040-140 units, provides common inlet and outlet water connections. Package contains two steel manifolds, each in two sections. Field welding required.

Chilled water flow switch prevents compressors from operating unless water is flowing.

Unit enclosure panels, with glass fibre insulation, completely enclose compressor and condenser section. (30HR 040 to 160).

Condenser conversion package, to field convert 3 pass to 6 pass condenser. (30HR 020 to 140).

Relay for part winding start.

Manometer panel measuring suction and discharge pressures, together with check valves to ensure correct operation of the unit at all times. Accessory for 30HR, HS 020-060 only, standard on 070-160. One panel required for each refrigerant circuit.

Conversion factors

To convert SI data in this text to imperial units of measurement, use the following conversion factors:

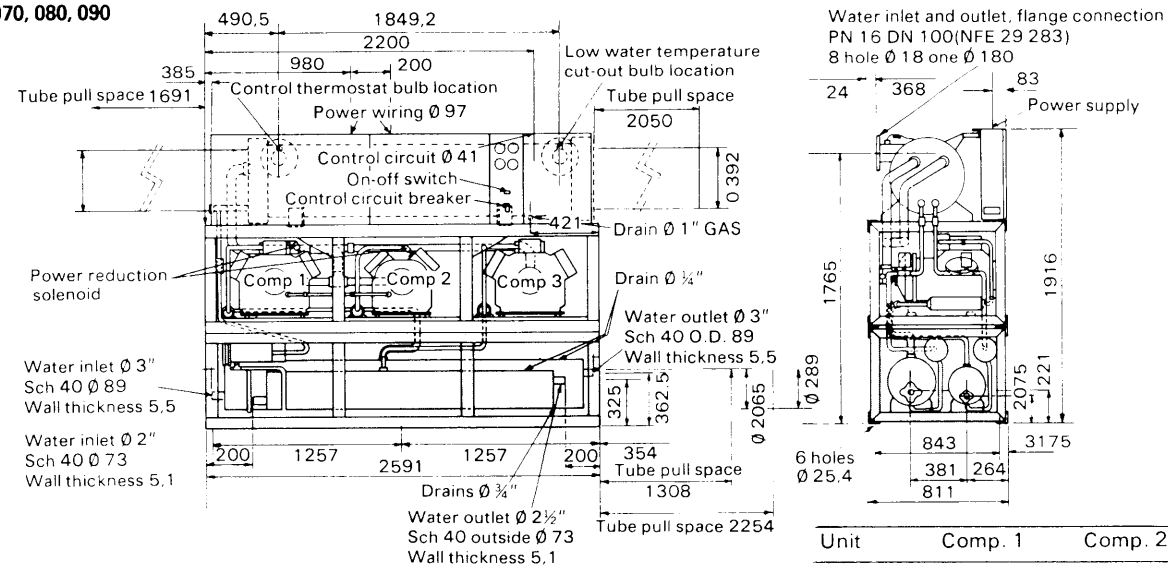
SI	Multiplier	Imperial
kW	3413,76	= Btu/h
kg	2,2	= lb
kg	35,18	= fl. oz. (UK)
mm	0,03937	= in
m/s	3,2808	= ft/s
m^2	10,7639	= ft^2
m^3/s	2119	= cfm
l	0,22	= gal (UK)
l/s	13,1981	= gpm (UK)
Pa	$1,4504 \cdot 10^{-4}$	= lb/in^2
bar	14,5038	= lb/in^2
kPa	4,0146	= in WG
°C	1,8+32	= °F

Fouling factor

$m^2°C/W$	5,6783	$ft^2h°F/Btu$
$0,88 \cdot 10^{-4}$		0,0005
$1,76 \cdot 10^{-4}$		0,001
$3,52 \cdot 10^{-4}$		0,002

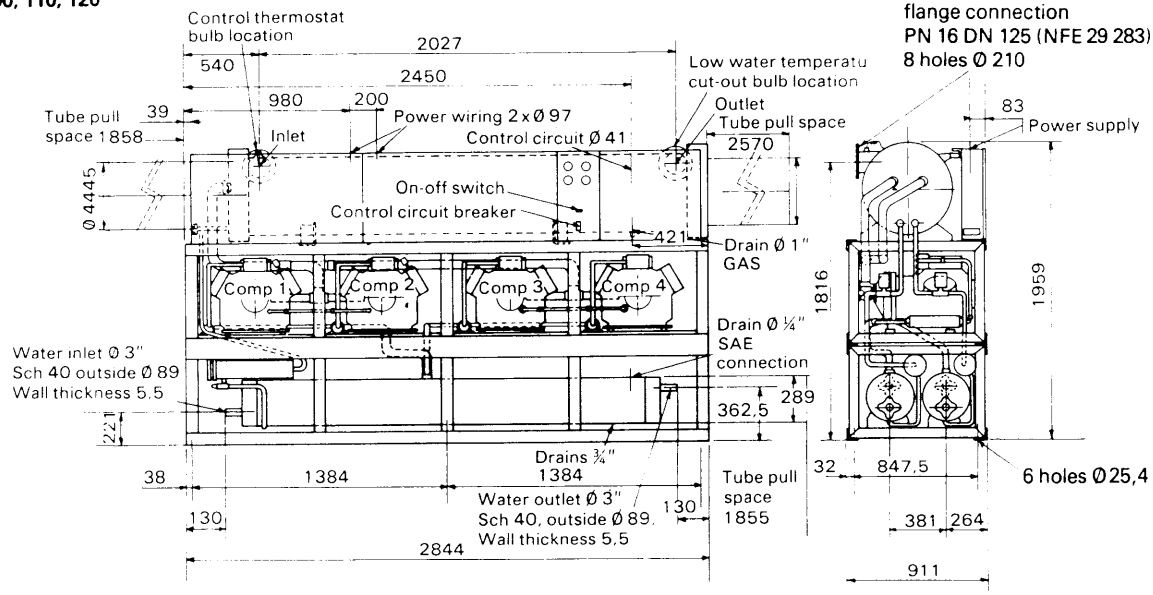
Dimensions (mm)

30HR/HS 070, 080, 090



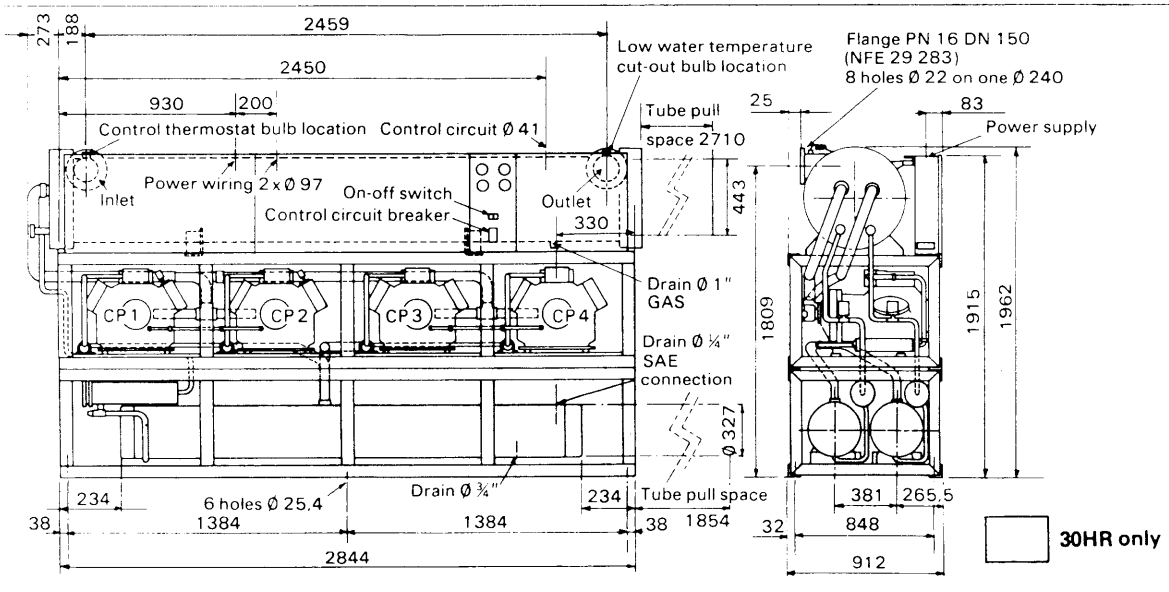
Unit	Comp. 1	Comp. 2	Comp. 3
070	4 cyl	4 cyl	6 cyl
080	6 cyl	4 cyl	6 cyl
090	6 cyl	6 cyl	6 cyl

30HR/HS 100, 110, 120



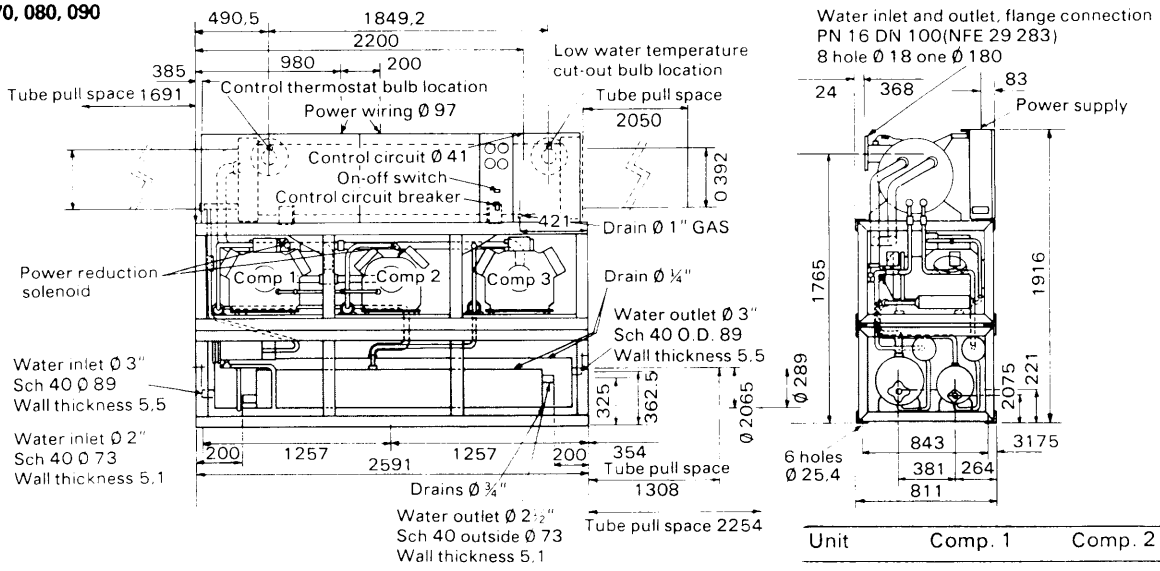
Unit	Comp. 1	Comp. 2	Comp. 3	Comp. 4
100	6 cyl	4 cyl	6 cyl	4 cyl
110	6 cyl	6 cyl	6 cyl	4 cyl
120	6 cyl	6 cyl	6 cyl	6 cyl

30HR/HS 140, 160



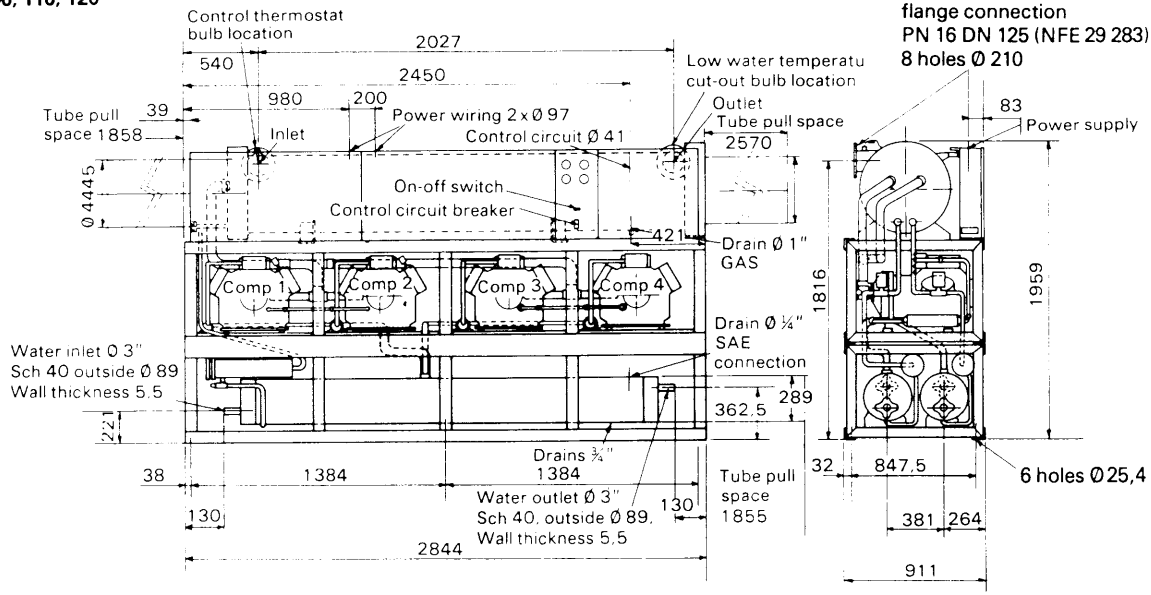
Dimensions (mm)

30HR/HS 070, 080, 090



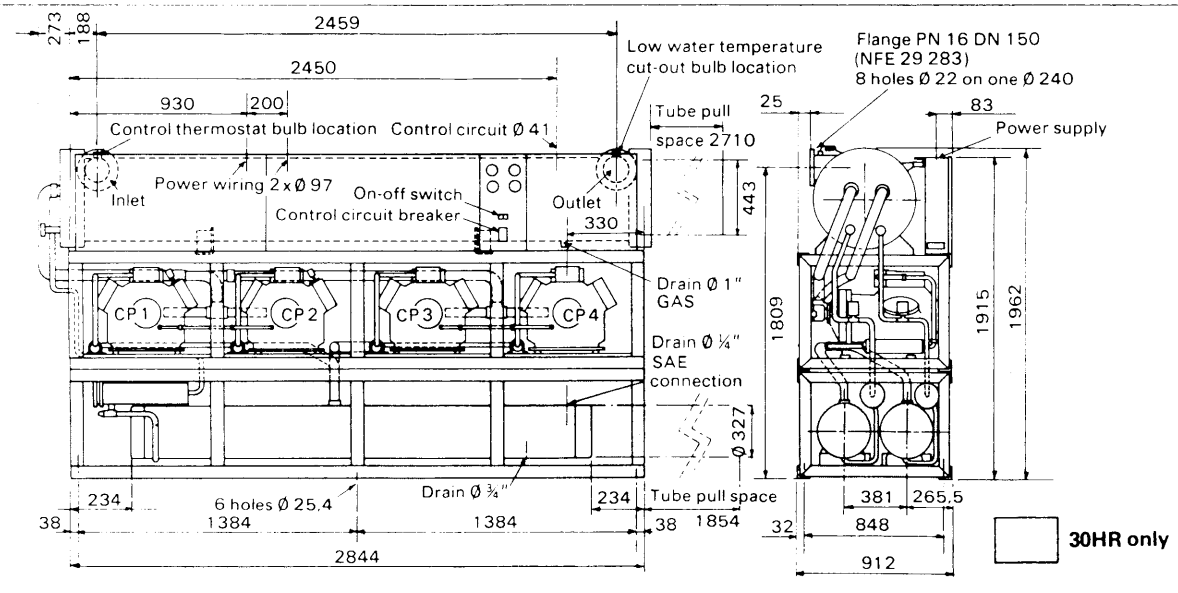
Unit	Comp. 1	Comp. 2	Comp. 3
070	4 cyl	4 cyl	6 cyl
080	6 cyl	4 cyl	6 cyl
090	6 cyl	6 cyl	6 cyl

30HR/HS 100, 110, 120



Unit	Comp. 1	Comp. 2	Comp. 3	Comp. 4
100	6 cyl	4 cyl	6 cyl	4 cyl
110	6 cyl	6 cyl	6 cyl	4 cyl
120	6 cyl	6 cyl	6 cyl	6 cyl

30HR/HS 140, 160



Selection procedure (with example)

LEGEND:
G — Water flow rate (m^3/s; m^3/h)
HTI — Heat transfer index
N — Compressor motor power input (kW)
Q_c — Cooling capacity (kW; kcal/h)
Q_{hr} — Condenser heat rejection (kW; kcal/h)
t_c — Condensing temperature (°C)
t_{ew} — Entering water temperature (°C)
t_{lcw} — Leaving chilled water temperature (°C)
t_{lw} — Leaving water, temperature (°C)
t_s — Saturated discharge temperature (°C)
Δt — Temperature difference (°C)

Determine the unit size and operating conditions required to meet the given capacity at the given conditions:

Given

Capacity	267,44 kW; 230 000 kcal/h
Leaving chilled water temperature	7°C
Chilled water rise	6°C
Cooling water entering temperature	27°C
Fouling factor (cooler and condenser)	$0,88 \cdot 10^{-4}$ m²°C/W 0,0001 m²h°C/kcal

Solution
Model 30HR (with water cooled condenser).
From the rating curves select a unit which delivers the required cooling of 267,44 kW (230 000 kcal/h) with a leaving chilled water temperature of 7°C and meeting the conditions above. From the curves, there are two possible units: 30HR 090 or 30HR 100. Final unit selection should be based on present and future job requirements and the economics of the job. For this example, a 090 unit is selected. From the relevant curves, read off the following.

Model	30HR 090
Cooling capacity Q_c	267,44 kW; 230 000 kcal/h
Leaving chilled water temperature t_{lcw}	7°C
Saturated discharge temperature t_s	38,8°C
Condensing temperature t_c*	38,0°C
Compressor motor power input N	62,5 kW

The condensing temperature must be at least 10°C higher than the cooling water entering temperature into the condenser, in order to maintain a reasonable water quantity and ensure a good heat evacuation. The required condenser water quantity must be determined as follows:

$$HTI = \frac{Q_{hr}\,(kW)}{1,163\,(t_c - t_{ew})}$$

$$= \frac{Q_c\,(kW) + N\,(kW)}{1,163\,(t_c - t_{ew})}$$

$$= \frac{267,44 + 62,5}{1,163\,(38 - 27)}$$

$$= \frac{329,94}{12,79} = 25,8$$

alternatively

$$HTI = \frac{Q_{hr}\,(kcal/h)}{t_c - t_{ew}} \cdot 10^{-3}$$

$$= \frac{Q_c\,(kcal/h) + [860 \cdot N\,(kW)]}{t_c - t_{ew}} \cdot 10^{-3}$$

$$= \frac{230\,000 + (860 \cdot 62,5)}{38 - 27} \cdot 10^{-3}$$

$$= \frac{283\,750}{11} \cdot 10^{-3} = 25,8$$

This factor of 25,8 cuts the fouling factor curve of $0,88\text{-}10^{-4}$ m²°C/W at $10,3 m^3/s.10^{-3}$ (0,0001 m²h°C/kcal at $37 m^3/h$).
The water side pressure drops are taken from the pressure drop curves:

Condenser:

16,6 kPa at $10,3 m^3/s.10^{-3}$ or 1,7 m WG for a cooling water quantity of 37 m^3/h.

The leaving condenser water temperature is:

$$t_{lw} = t_{ew} + \frac{Q_{hr}\,(kW)}{4186\,G\,(m^3/s)}$$

$$= 27 + \frac{329,94}{4186 \cdot 10,3\ m^3/s \cdot 10^{-3}}$$

$$= 27 + \frac{329,94}{43,12}$$

$$= 34,7°C$$

alternatively

$$t_{lw} = t_{ew} + \frac{Q_{hr}\,(kcal/h)}{G\,(m^3/h) \cdot 10^3}$$

$$= 27 + \frac{283\,750}{37\,000}$$

$$= 34,7°C$$

30HS Models (without condenser)
Except for cooling water calculations proceed as above. For application details of remote condensers, consult relevant literature.

Ratings correction

Ratings curves are based on 6°C chilled water rise (suitable for 3°C to 8,5°C rise without adjustment), 0,0001 m²h°C/kcal fouling factor in cooler, 8,3°C subcooling and R22.

On 30HR units, 8,3°C subcooling occurs at 16,7°C Δt (condensing temperature minus entering condenser water temperature).

If the unit is selected at conditions other than 16,7°C Δt, use the ratings correction curve (see page 29).

If Δt is above 16,7°C, add the correction factor to the ratings.

If Δt is below 16,7°C, subtract the correction factor from the ratings.

30HS units, matched with remote condensers which have greater than (less than) the 8,3°C subcooling in the ratings, have an increased (decreased) system capacity.

To adjust the ratings, multiply them by 0,94; then, adjust this result upwards by 0,75% for each °C of available subcooling (if subcooling is larger than 0°C).

NOTE
FOR LEAVING CHILLED WATER TEMPERATURE IF HIGHER THAN 10°C, PLEASE CONTACT THE FACTORY

*Condensing temperature = saturated discharge temperature − 0,8°C.

Selection procedure (with example)

LEGEND:
G — Water flow rate (m^3/s; m^3/h)
HTI — Heat transfer index
N — Compressor motor power input (kW)
Q_c — Cooling capacity (kW; kcal/h)
Q_{hr} — Condenser heat rejection (kW; kcal/h)
t_c — Condensing temperature (°C)
t_{ew} — Entering water temperature (°C)
t_{lcw} — Leaving chilled water temperature (°C)
t_{lw} — Leaving water, temperature (°C)
t_s — Saturated discharge temperature (°C)
Δt — Temperature difference (°C)

Determine the unit size and operating conditions required to meet the given capacity at the given conditions:

Given

Capacity	267,44 kW; 230 000 kcal/h
Leaving chilled water temperature	7°C
Chilled water rise	6°C
Cooling water entering temperature	27°C
Fouling factor (cooler and condenser)	$0{,}88 \cdot 10^{-4}$ $m^2°C/W$ 0,0001 $m^2h°C$/kcal

Solution
Model 30HR (with water cooled condenser).
From the rating curves select a unit which delivers the required cooling of 267,44 kW (230 000 kcal/h) with a leaving chilled water temperature of 7°C and meeting the conditions above. From the curves, there are two possible units: 30HR 090 or 30HR 100. Final unit selection should be based on present and future job requirements and the economics of the job. For this example, a 090 unit is selected. From the relevant curves, read off the following.

Model	30HR 090
Cooling capacity Q_c	267,44 kW; 230 000 kcal/h
Leaving chilled water temperature t_{lcw}	7°C
Saturated discharge temperature t_s	38,8°C
Condensing temperature t_c*	38,0°C
Compressor motor power input N	62,5 kW

The condensing temperature must be at least 10°C higher than the cooling water entering temperature into the condenser, in order to maintain a reasonable water quantity and ensure a good heat evacuation. The required condenser water quantity must be determined as follows:

$$HTI = \frac{Q_{hr}\,(kW)}{1{,}163\,(t_c - t_{ew})}$$

$$= \frac{Q_c\,(kW) + N\,(kW)}{1{,}163\,(t_c - t_{ew})}$$

$$= \frac{267{,}44 + 62{,}5}{1{,}163\,(38 - 27)}$$

$$= \frac{329{,}94}{12{,}79} = 25{,}8$$

alternatively

$$HTI = \frac{Q_{hr}\,(kcal/h)}{t_c - t_{ew}} \cdot 10^{-3}$$

$$= \frac{Q_c\,(kcal/h) + [860 \cdot N\,(kW)]}{t_c - t_{ew}} \cdot 10^{-3}$$

$$= \frac{230\,000 + (860 \cdot 62{,}5)}{38 - 27} \cdot 10^{-3}$$

$$= \frac{283\,750}{11} \cdot 10^{-3} = 25{,}8$$

This factor of 25,8 cuts the fouling factor curve of $0{,}88\text{-}10^{-4}$ $m^2°C/W$ at $10{,}3 m^3/s.10^{-3}$ (0,0001 $m^2h°C$/kcal at $37 m^3/h$).
The water side pressure drops are taken from the pressure drop curves:

Condenser:

16,6 kPa at $10{,}3 m^3/s.10^{-3}$ or 1,7 m WG for a cooling water quantity of 37 m^3/h.

The leaving condenser water temperature is:

$$t_{lw} = t_{ew} + \frac{Q_{hr}\,(kW)}{4186\,G\,(m^3/s)}$$

$$= 27 + \frac{329{,}94}{4186 \cdot 10{,}3\ m^3/s \cdot 10^{-3}}$$

$$= 27 + \frac{329{,}94}{43{,}12}$$

$$= 34{,}7°C$$

alternatively

$$t_{lw} = t_{ew} + \frac{Q_{hr}\,(kcal/h)}{G\,(m^3/h) \cdot 10^3}$$

$$= 27 + \frac{283\,750}{37\,000}$$

$$= 34{,}7°C$$

30HS Models (without condenser)
Except for cooling water calculations proceed as above. For application details of remote condensers, consult relevant literature.

Ratings correction

Ratings curves are based on 6°C chilled water rise (suitable for 3°C to 8,5°C rise without adjustment), 0,0001 $m^2h°C$/kcal fouling factor in cooler, 8,3°C subcooling and R22.

On 30HR units, 8,3°C subcooling occurs at 16,7°C Δt (condensing temperature minus entering condenser water temperature).

If the unit is selected at conditions other than 16,7°C Δt, use the ratings correction curve (see page 29).

If Δt is above 16,7°C, add the correction factor to the ratings.

If Δt is below 16,7°C, subtract the correction factor from the ratings.

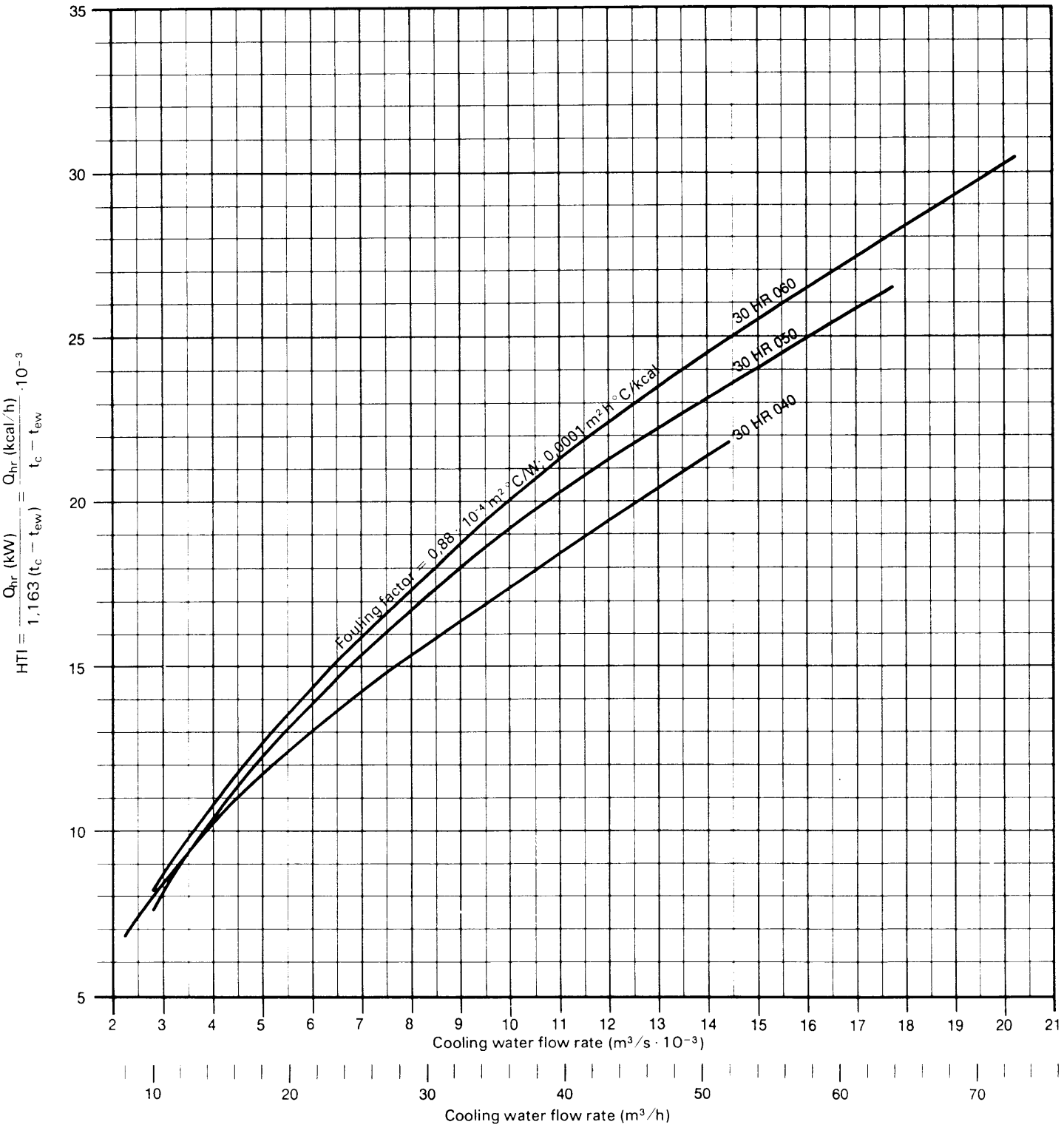
30HS units, matched with remote condensers which have greater than (less than) the 8,3°C subcooling in the ratings, have an increased (decreased) system capacity.

To adjust the ratings, multiply them by 0,94; then, adjust this result upwards by 0,75% for each °C of available subcooling (if subcooling is larger than 0°C).

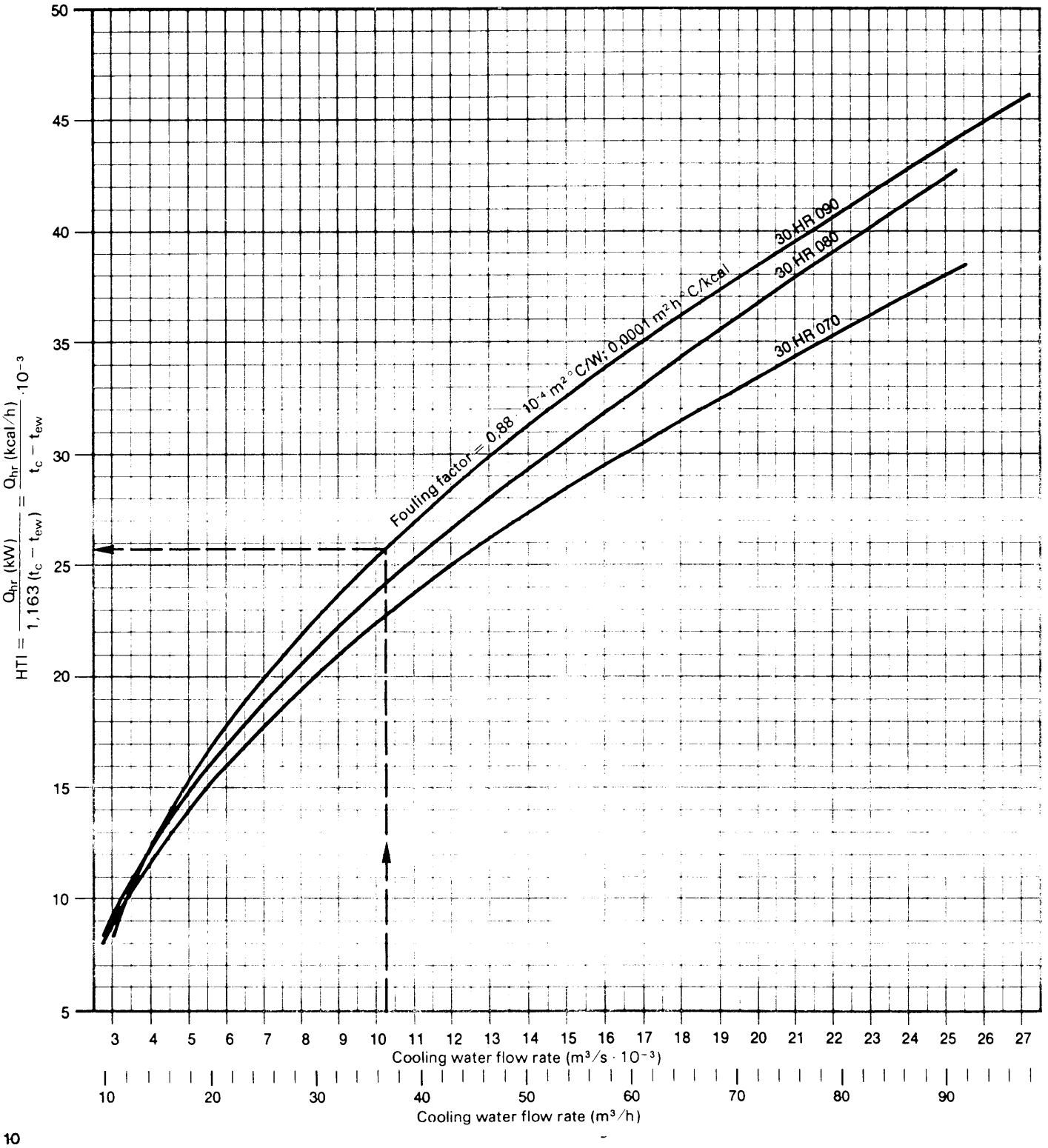
NOTE:
FOR LEAVING CHILLED WATER TEMPERATURE (t_{lcw}) HIGHER THAN 10°C, PLEASE CONTACT THE FACTORY.

*Condensing temperature = saturated discharge temperature − 0.8°C.

Condenser capacity 30HR 040–060

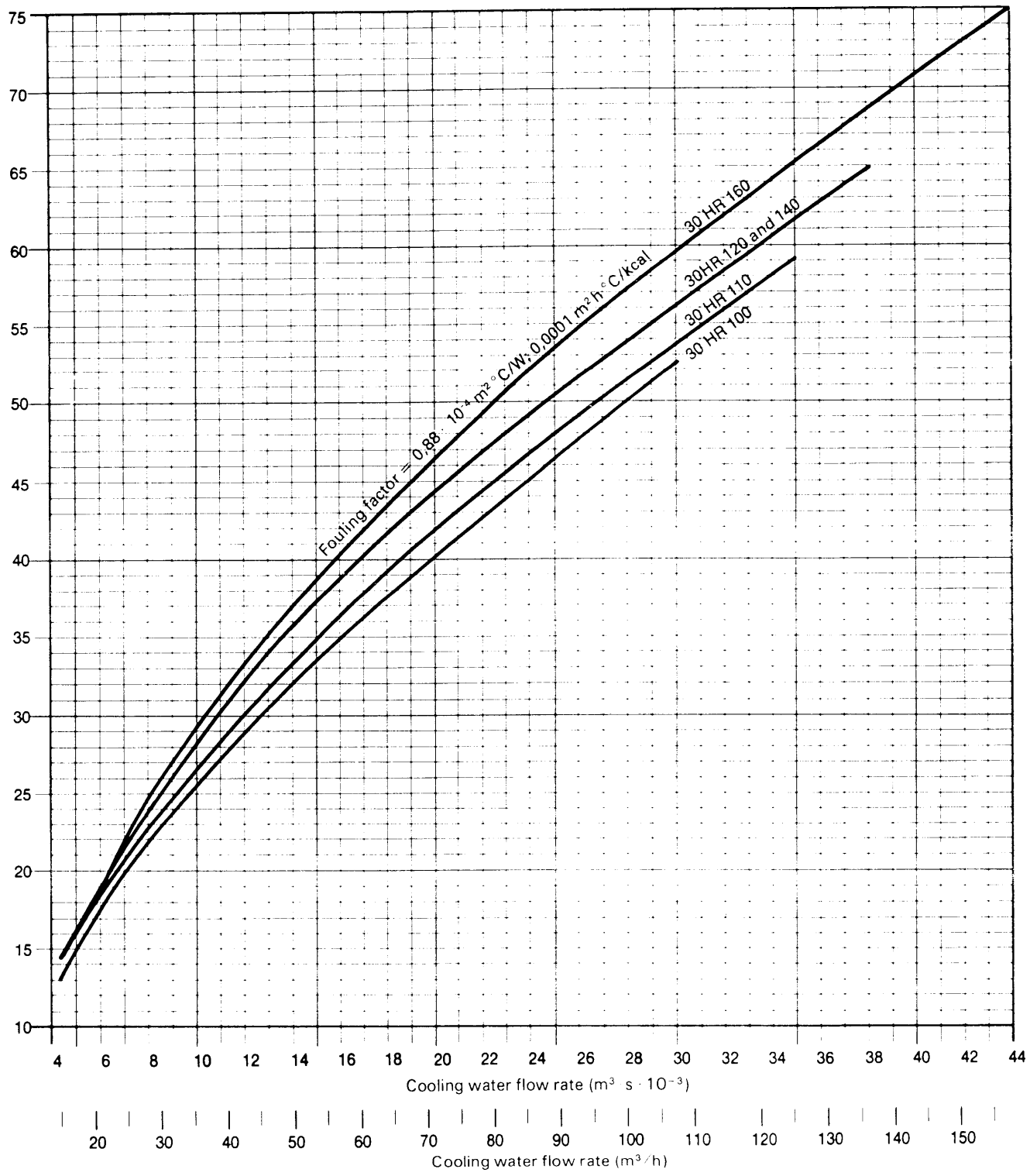


Condenser capacity 30HR 070–090



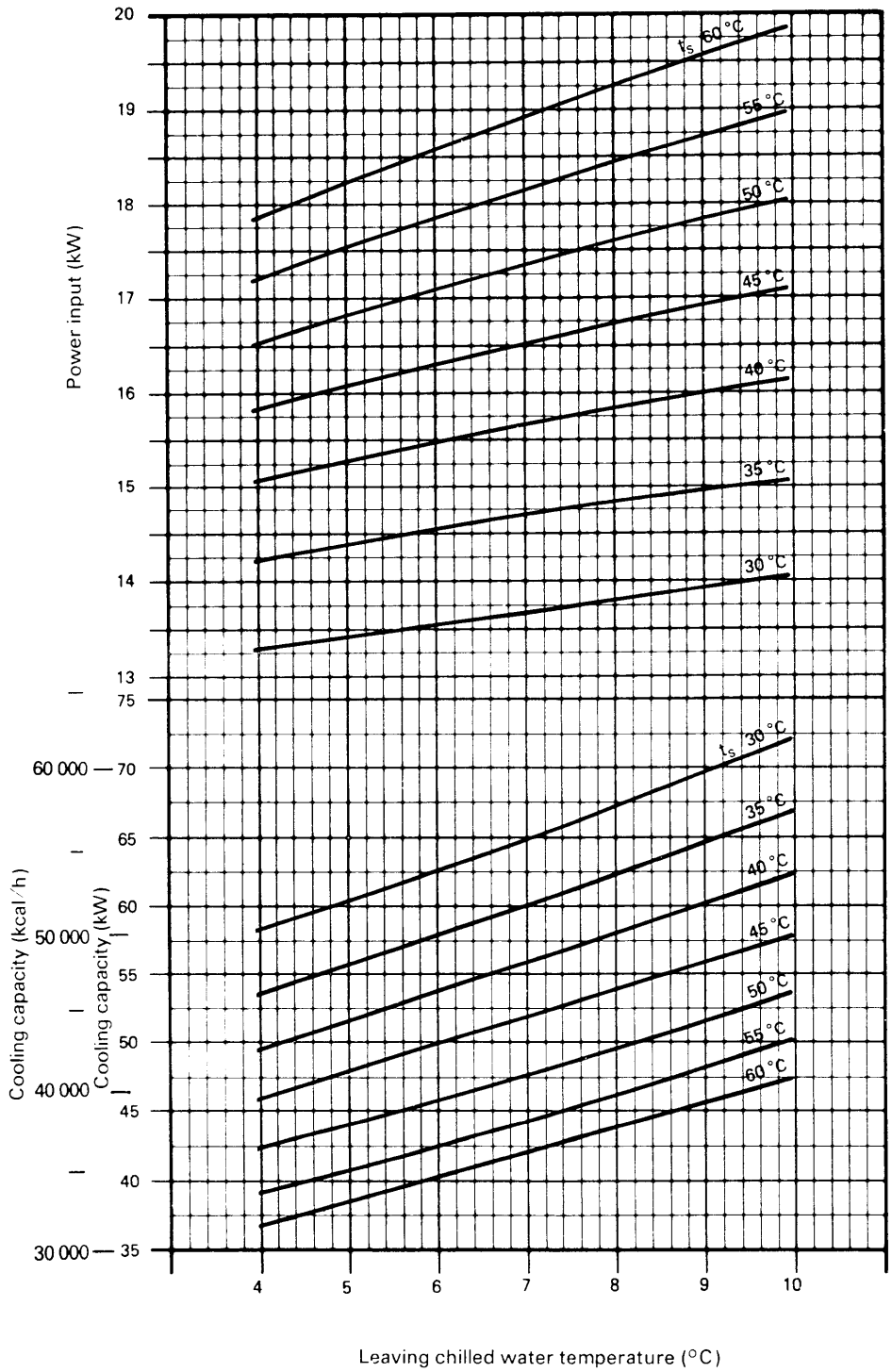
Condenser capacity 30HR 100–160

$$HTI = \frac{Q_{hr}\,(kW)}{1{,}163\,(t_c - t_{ew})} = \frac{Q_{hr}\,(kcal/h)}{t_c - t_{ew}} \cdot 10^{-3}$$



Rating curves 30HR/HS 020

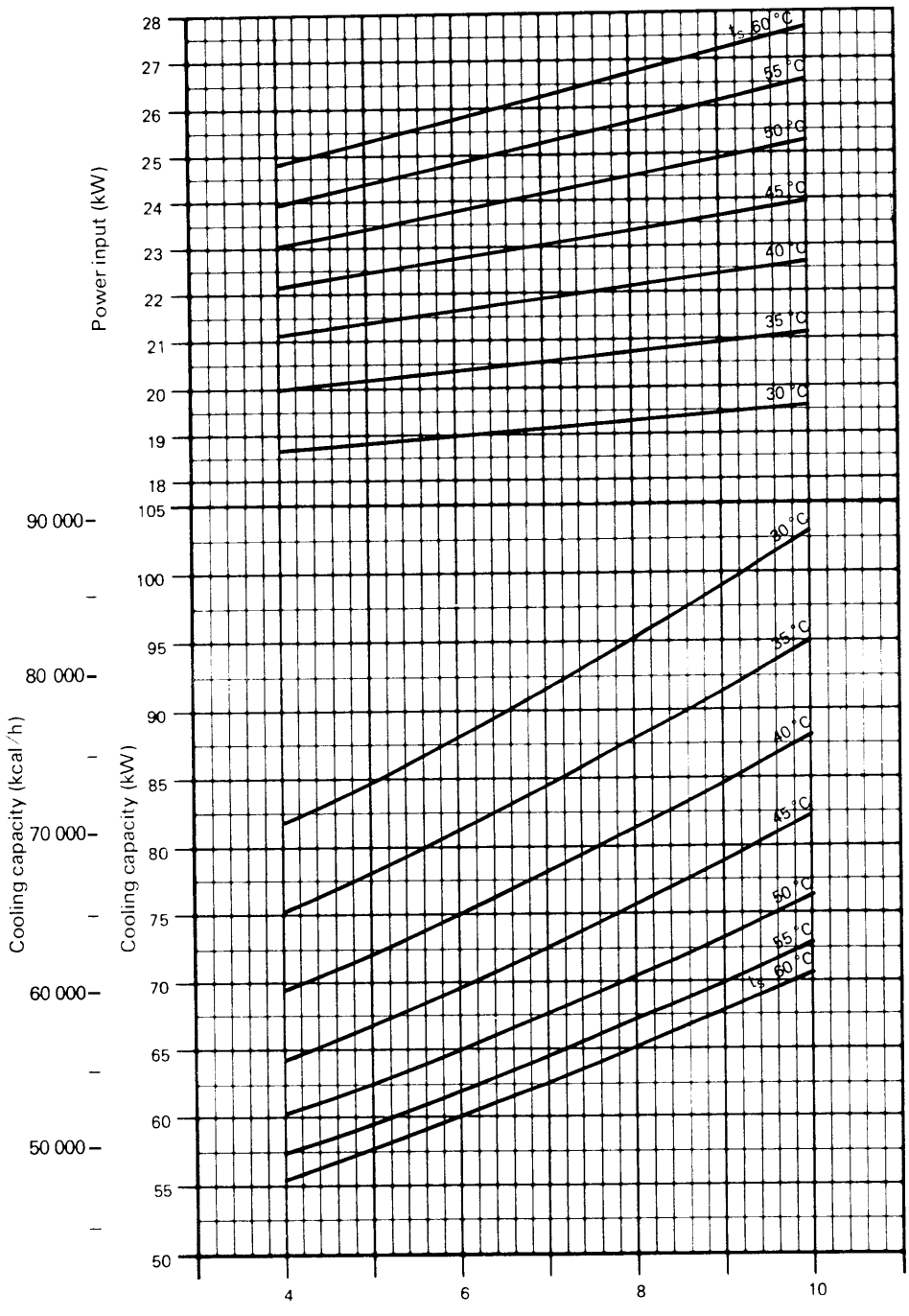
Subcooling 8,3°C



IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C

Rating curves 30HR/HS 030

Subcooling 8,3°C

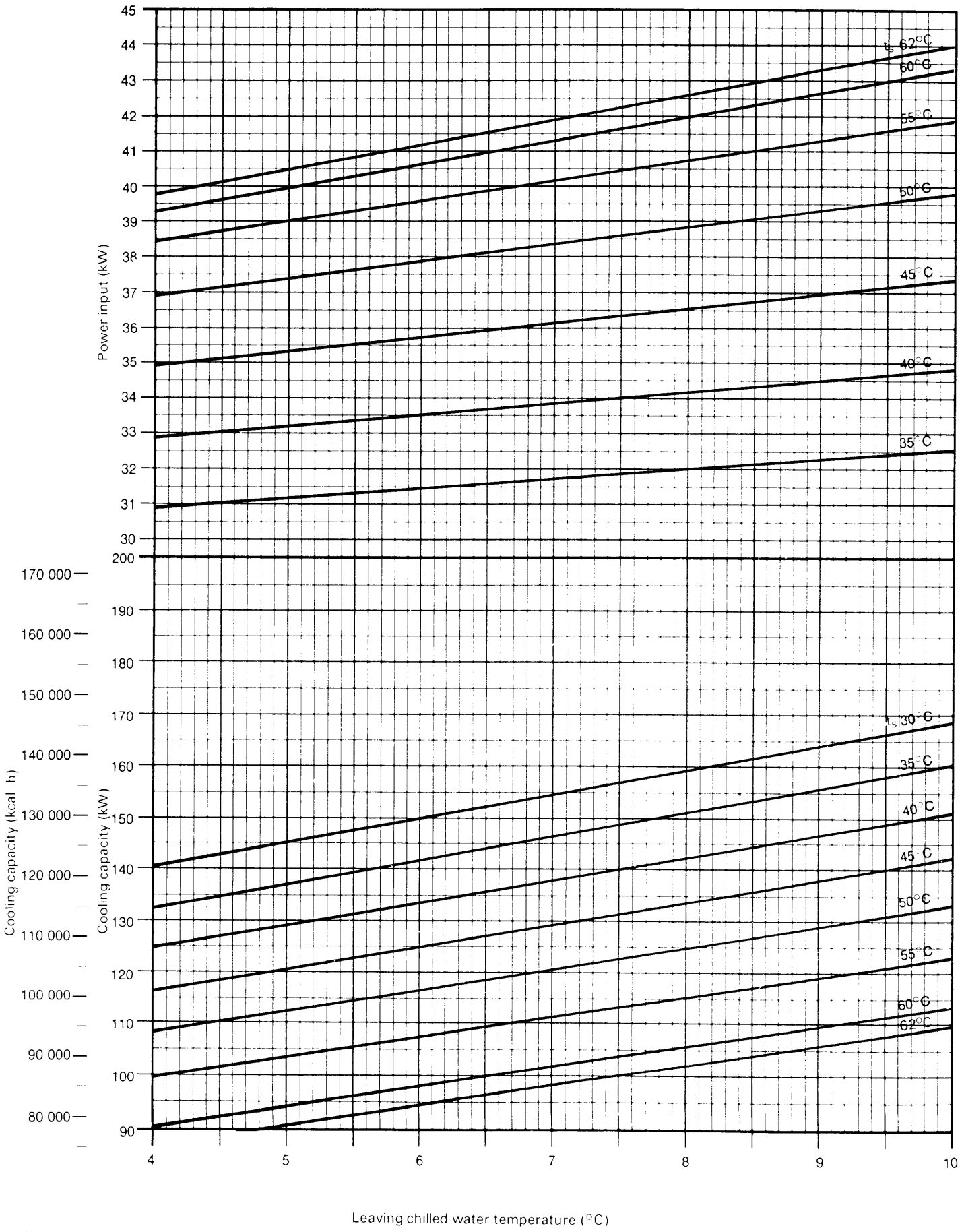


IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C

Rating curves 30HR/HS 040

Subcooling 8.3°C

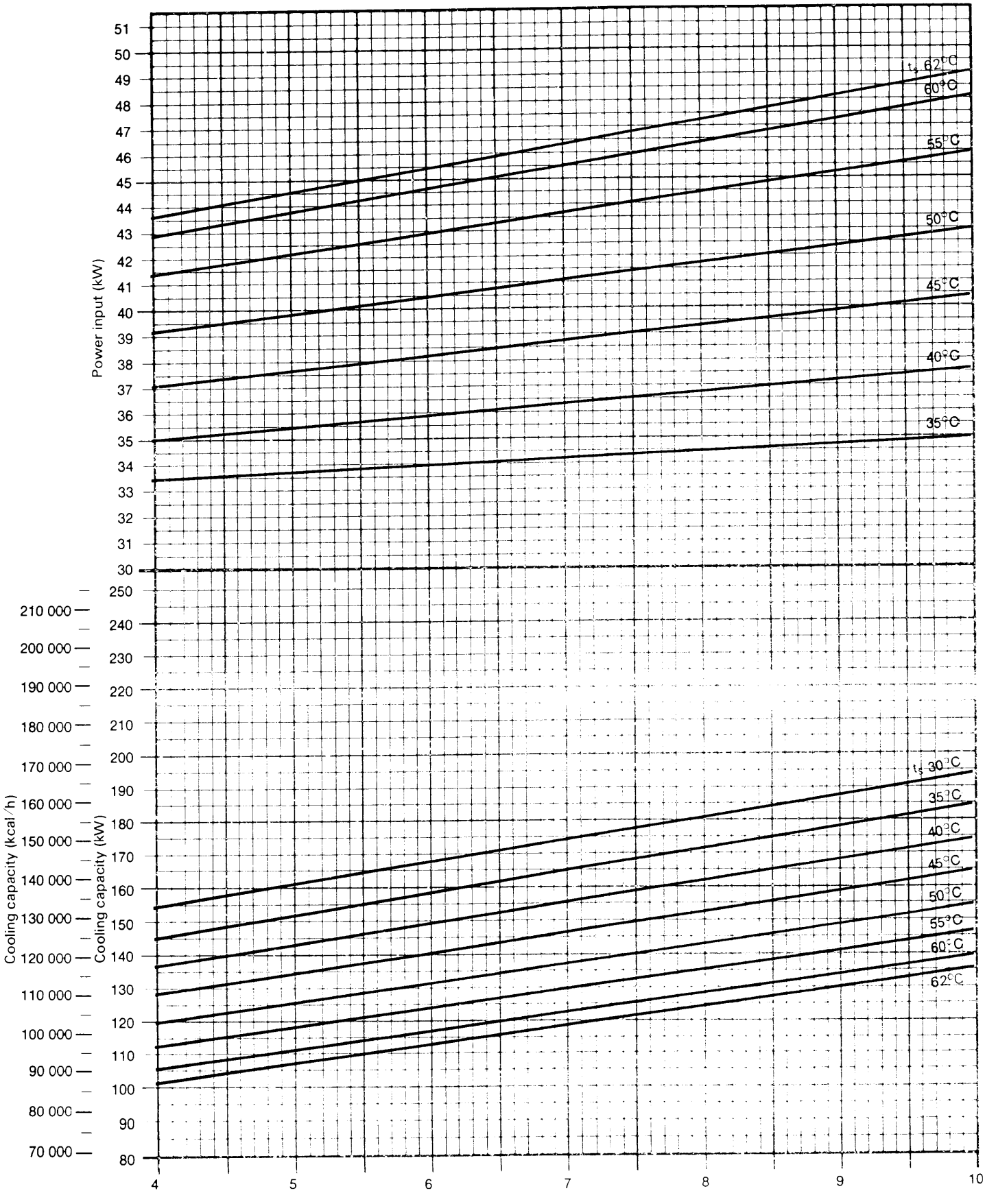
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 050

Subcooling 8,3°C

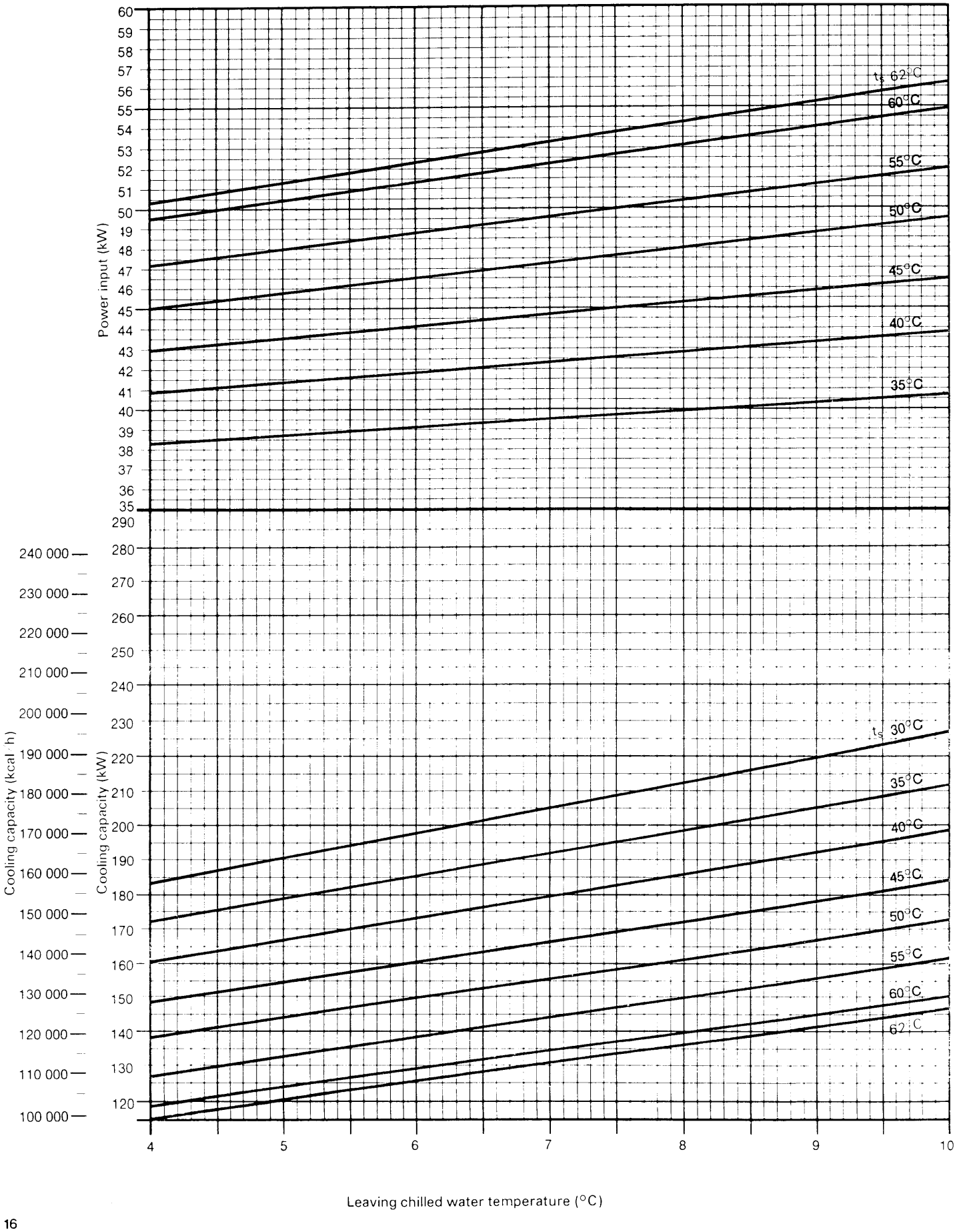
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 060

Subcooling 8.3°C

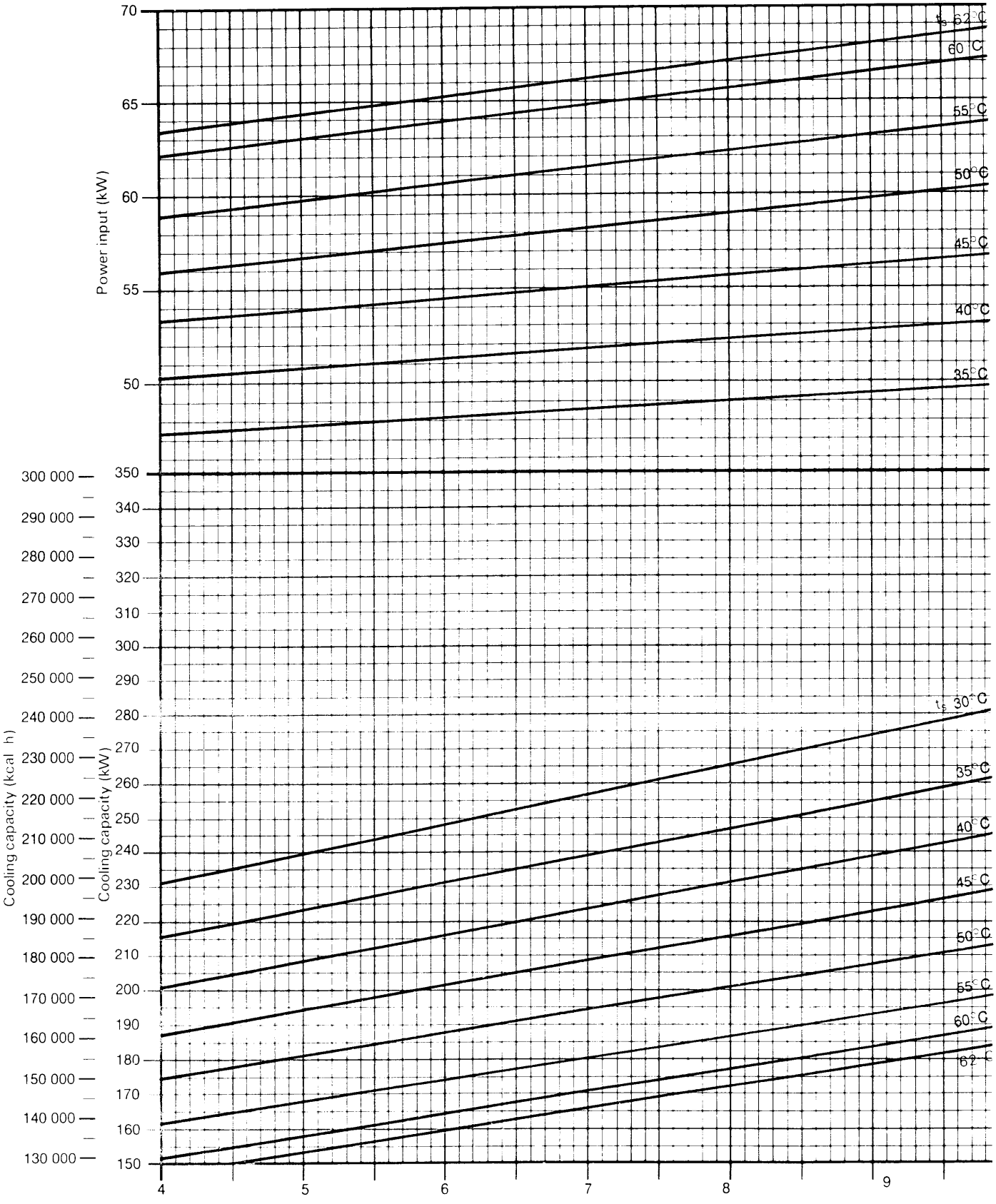
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 070

Subcooling 8.3°C

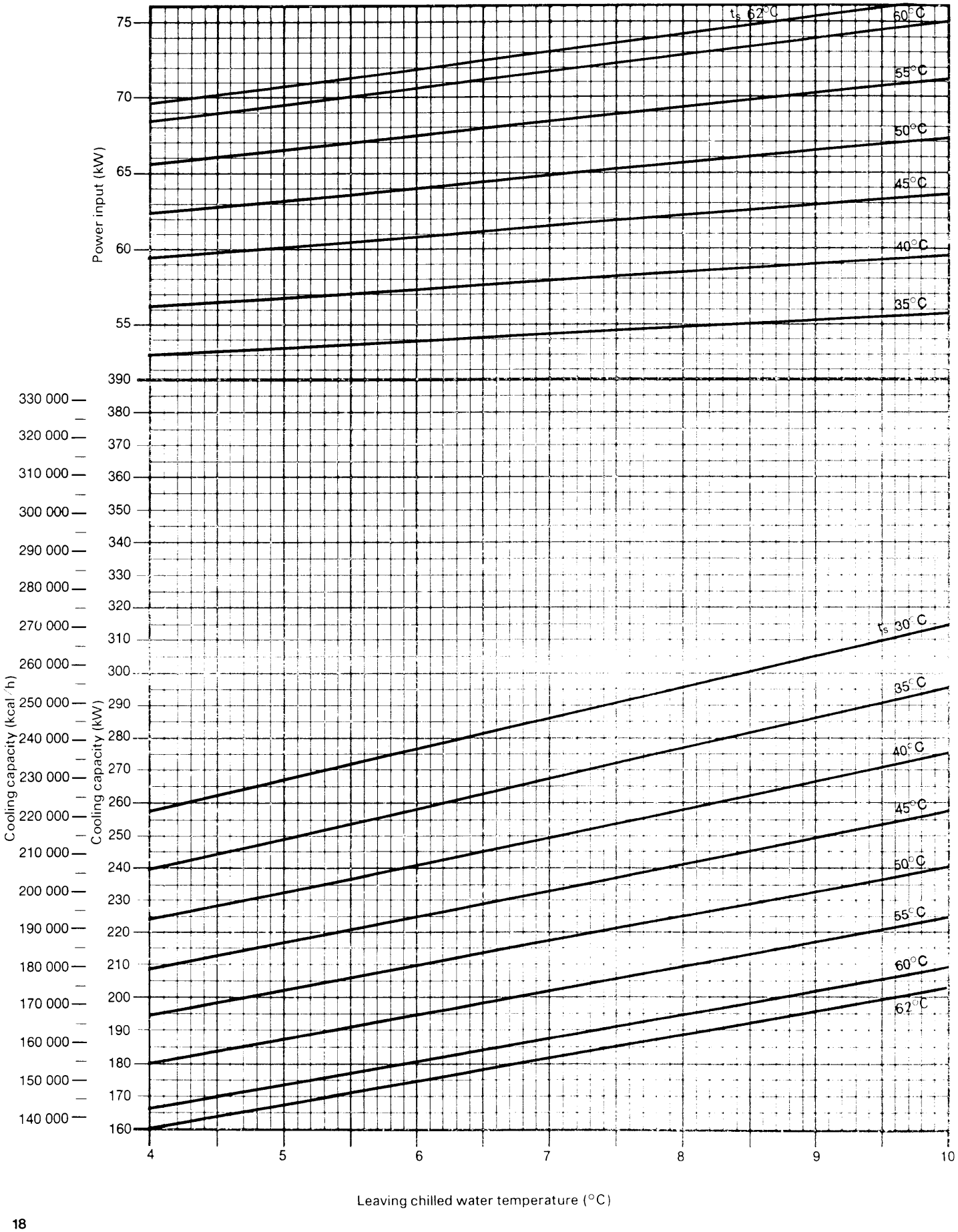
IMPORTANT NOTE:
Maximum t_s
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 080

Subcooling 8,3°C

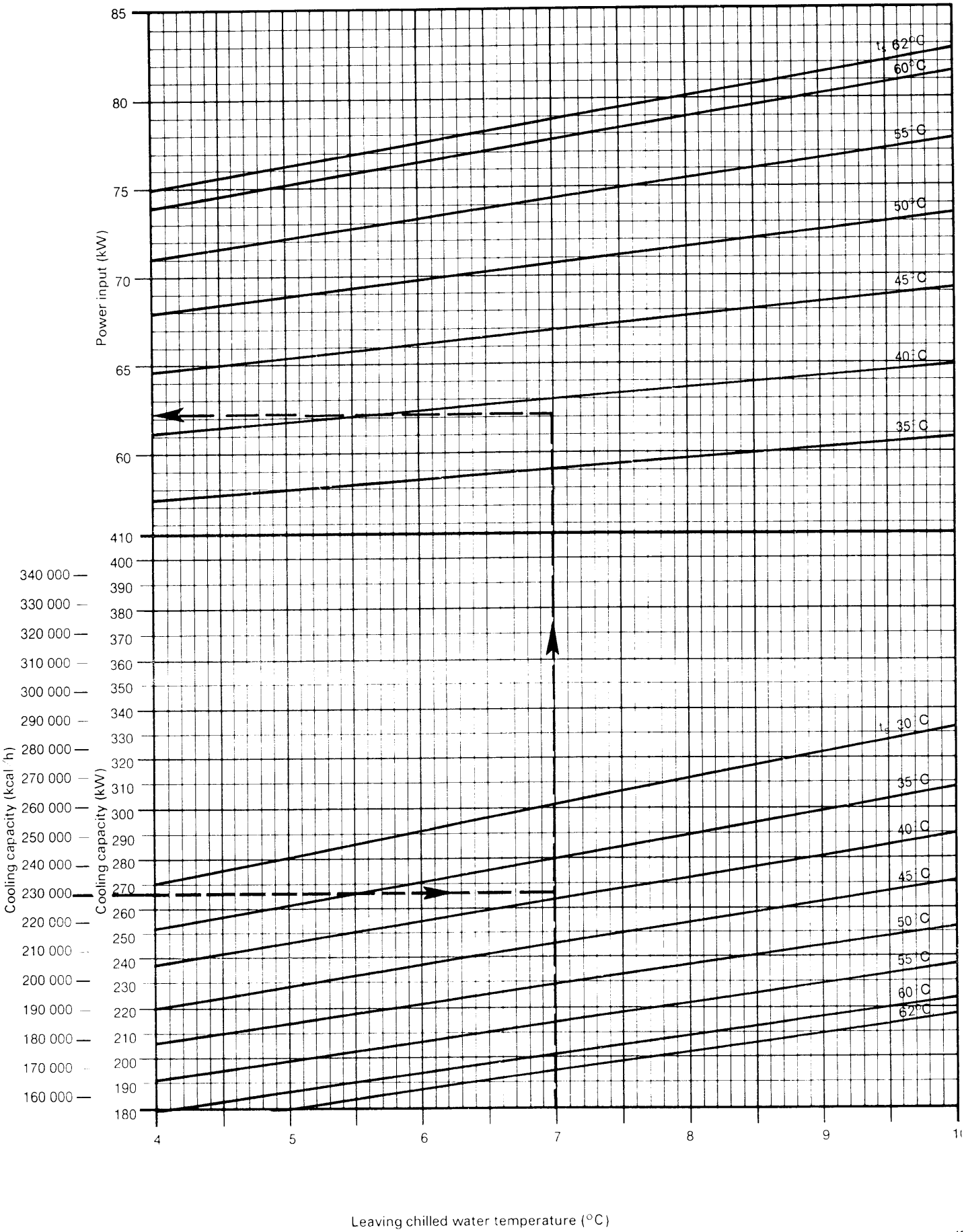
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 090

Subcooling 8.3°C

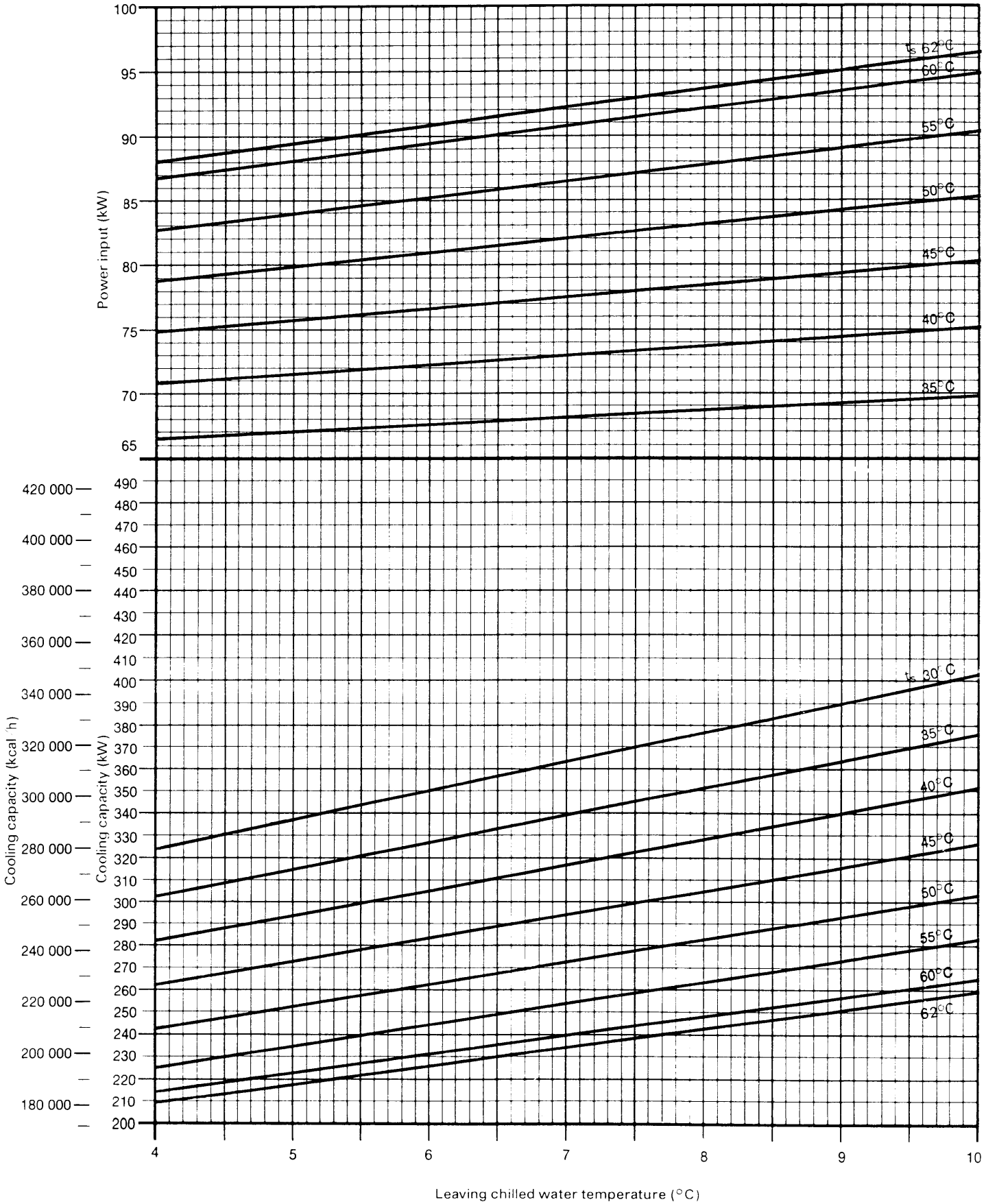
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 100

Subcooling 8.3°C

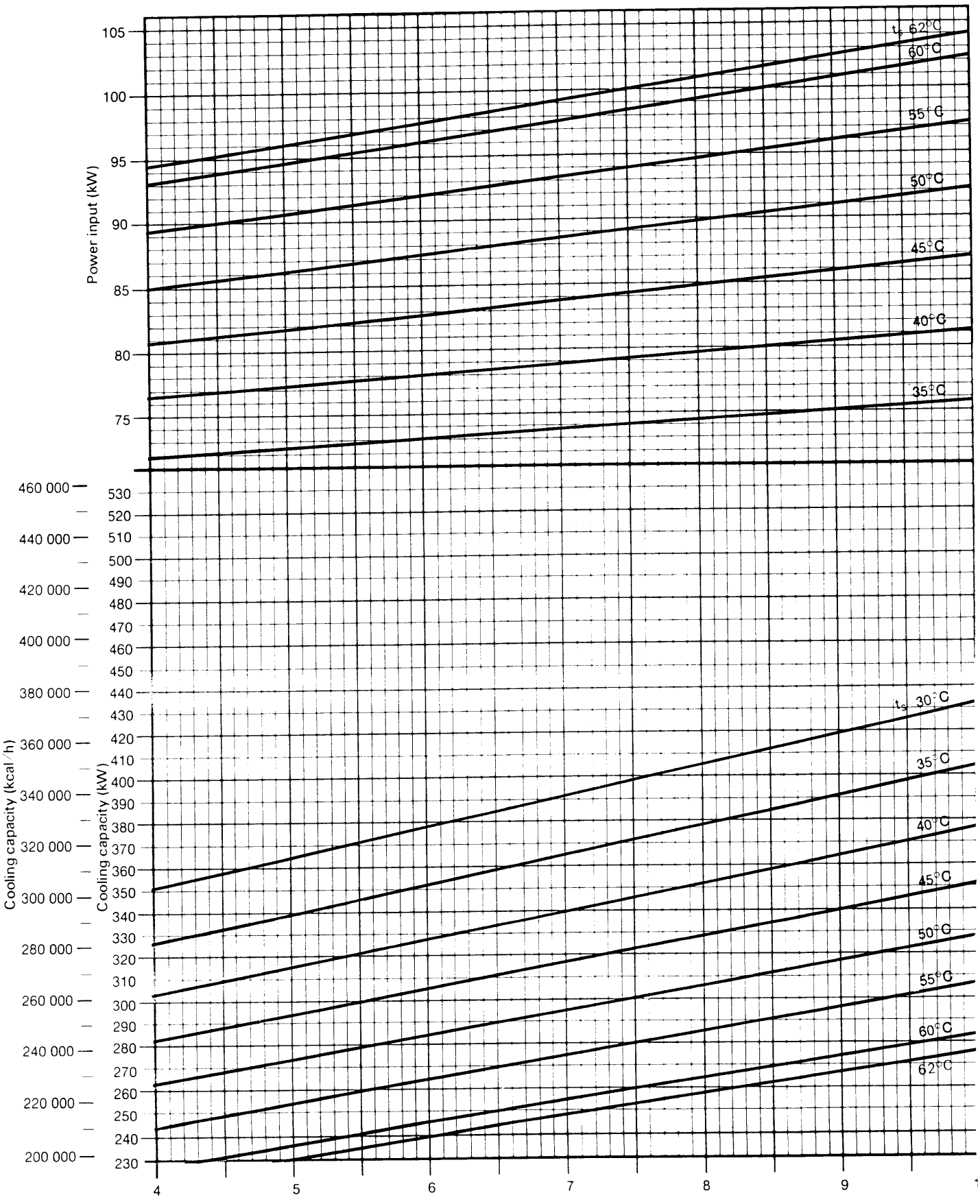
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 110

Subcooling 8,3°C

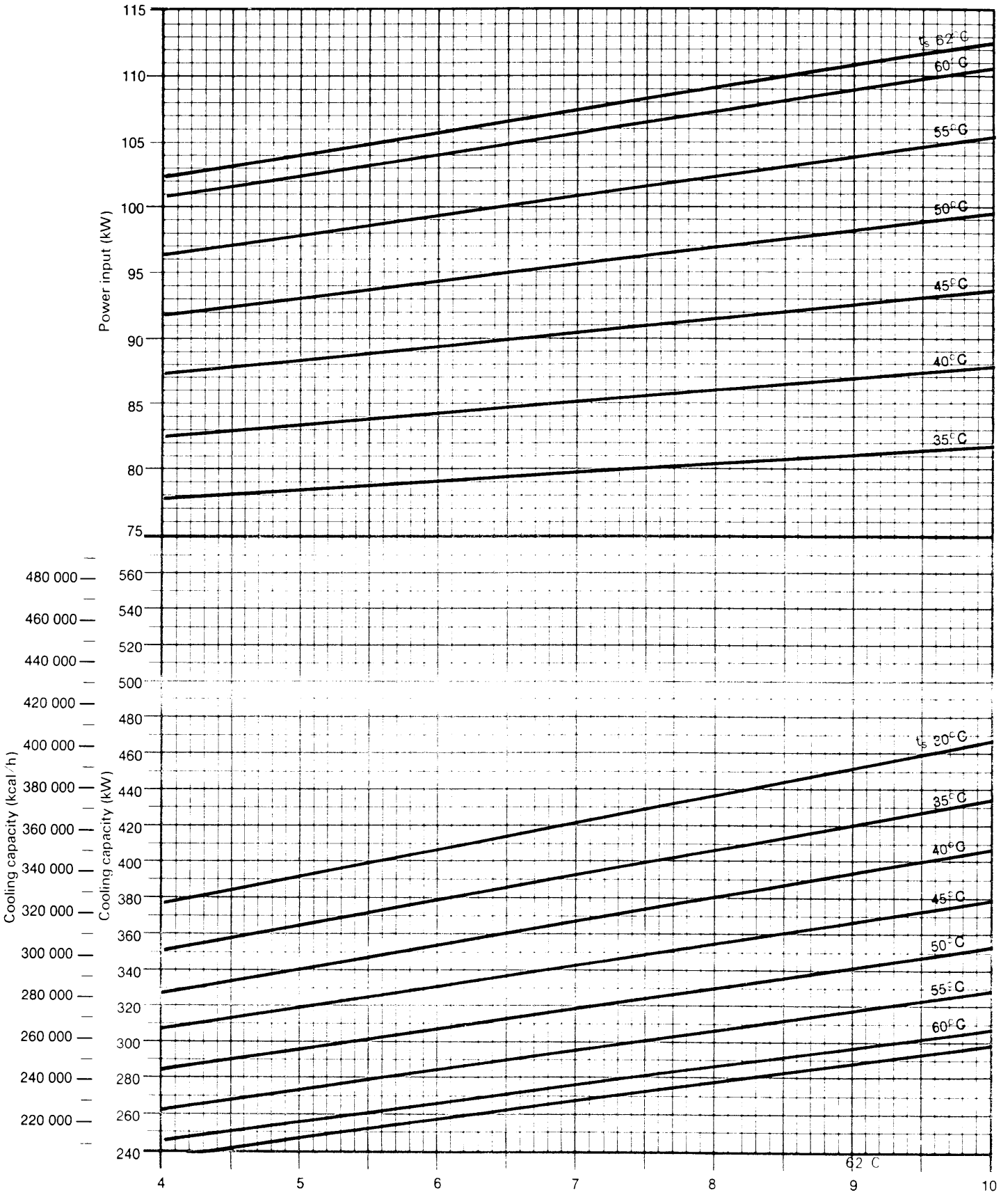
IMPORTANT NOTE:
Maximum t_s:
30HR standard units – 49°C
30HR units for heat reclaim duty – 57°C
30HS standard units – 63°C



Rating curves 30HR/HS 120

Subcooling 8.3°C

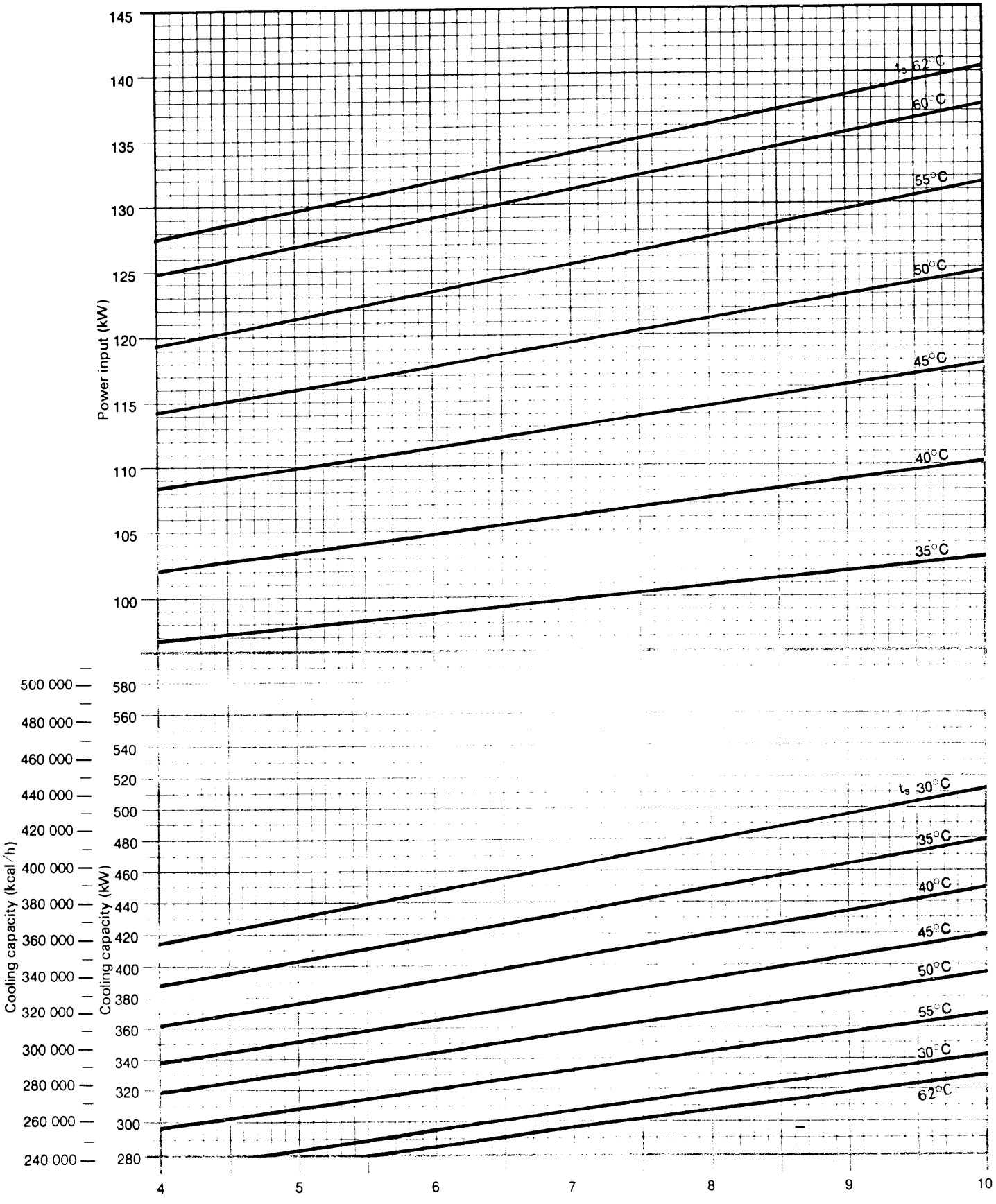
IMPORTANT NOTE
Maximum t_s
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Rating curves 30HR/HS 140

Subcooling 8,3°C

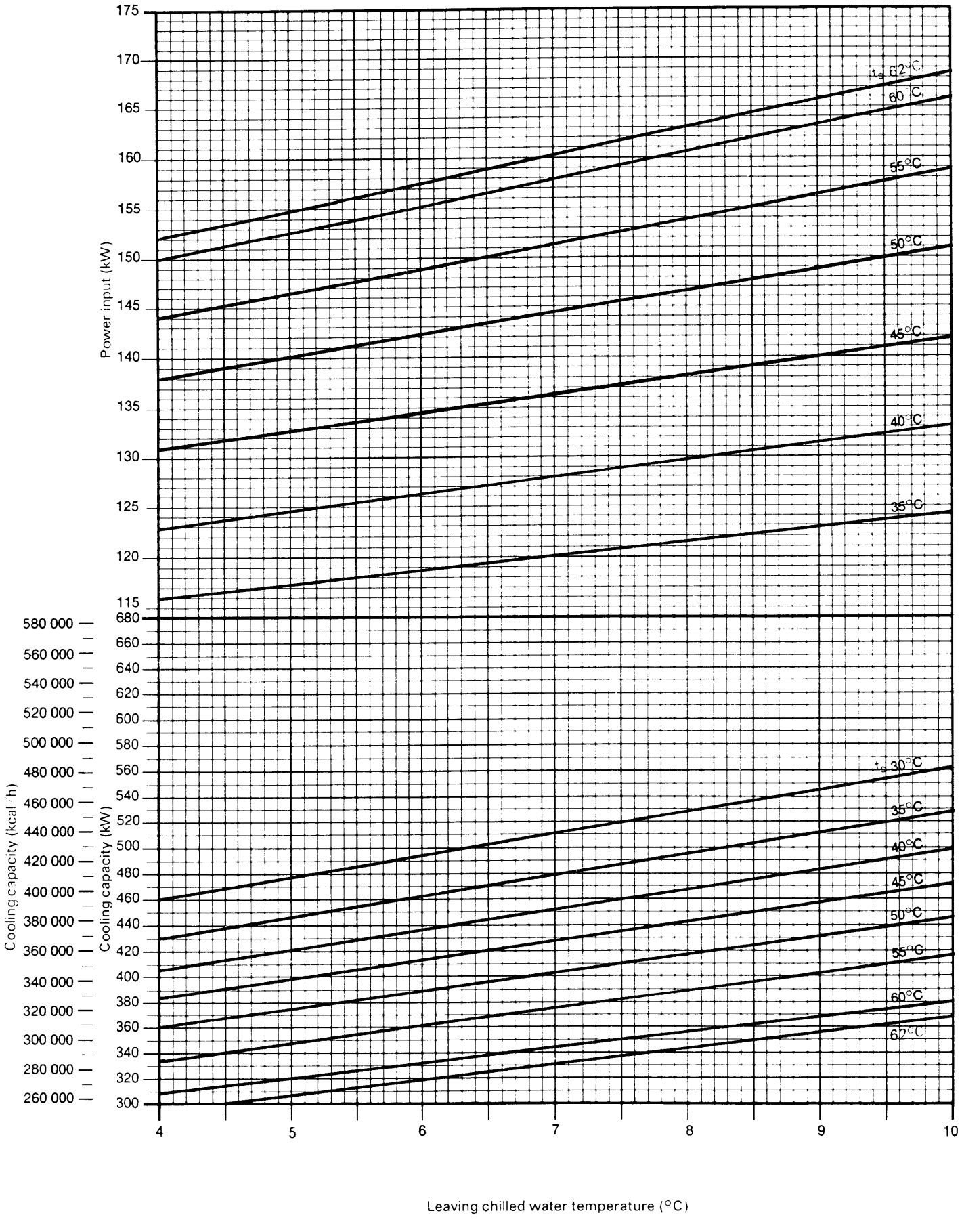
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



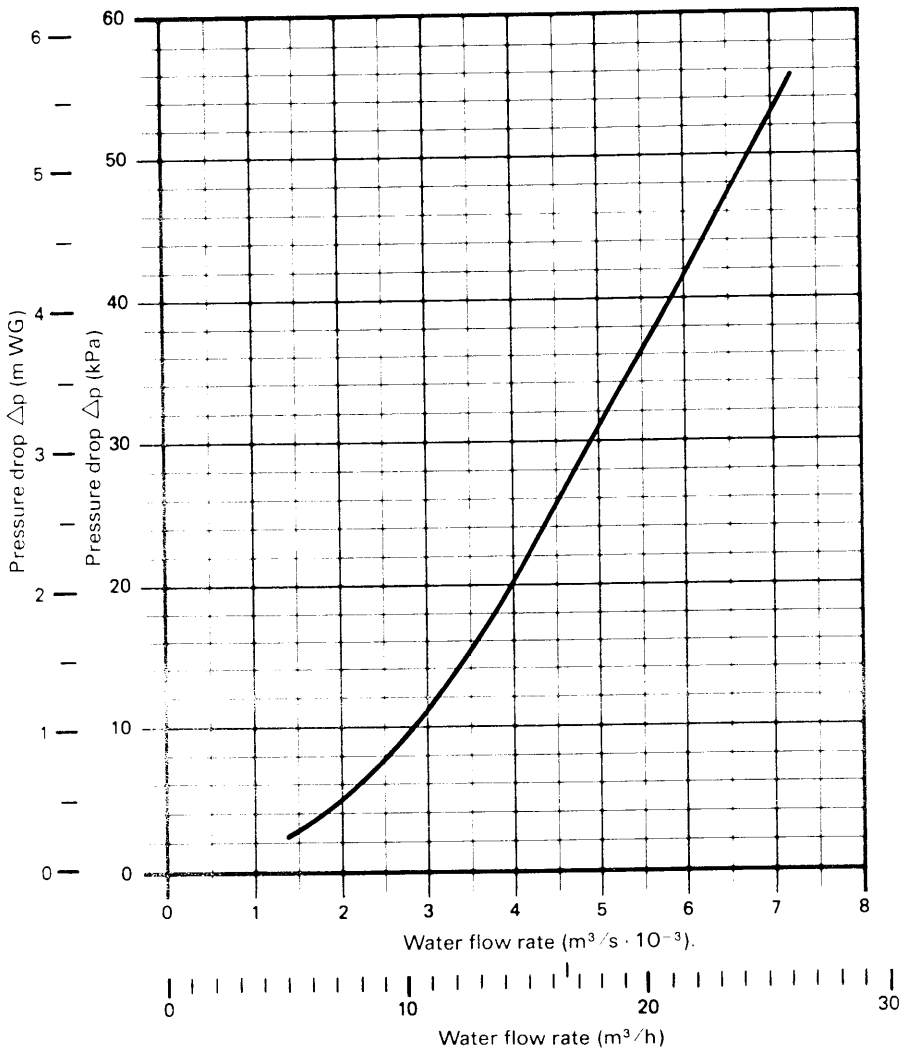
Rating curves 30HR/HS 160

Subcooling 8,3°C

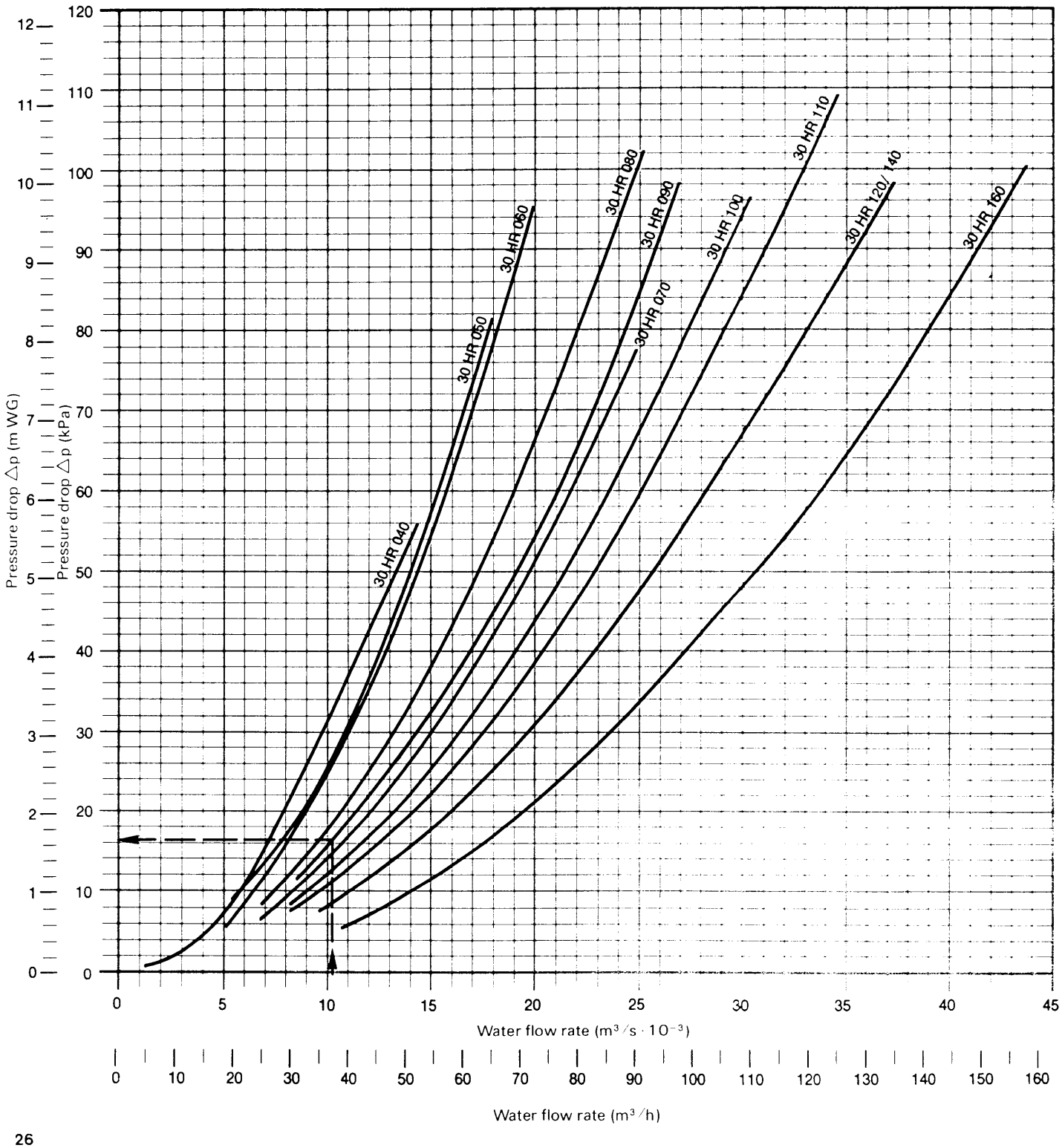
IMPORTANT NOTE:
Maximum t_s:
30HR standard units — 49°C
30HR units for heat reclaim duty — 57°C
30HS standard units — 63°C



Pressure drop in the condenser 30HR 020,030

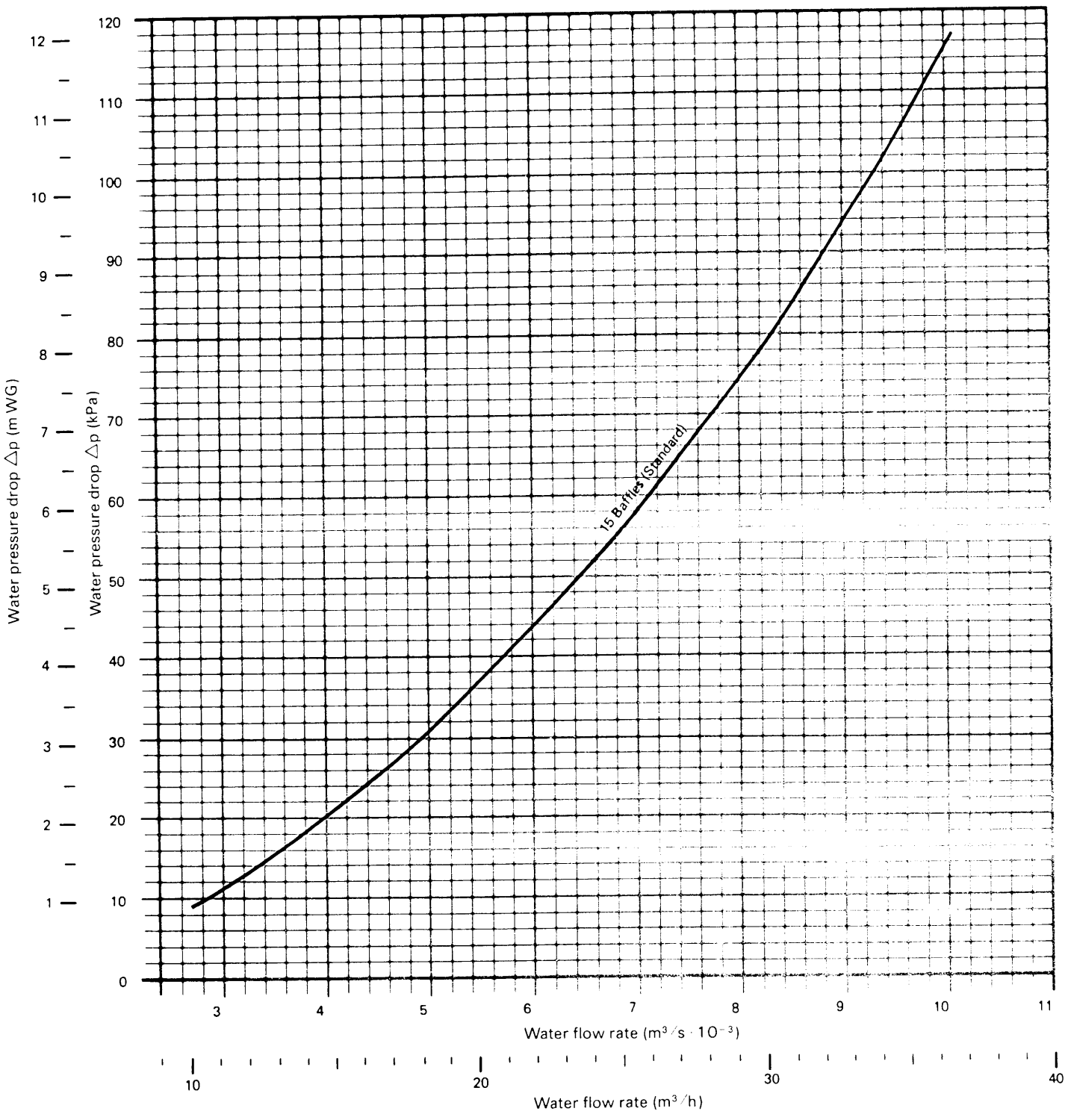


Pressure drop in the condenser 30HR 040–160



Pressure drop in the evaporator 30HR/HS 020,030

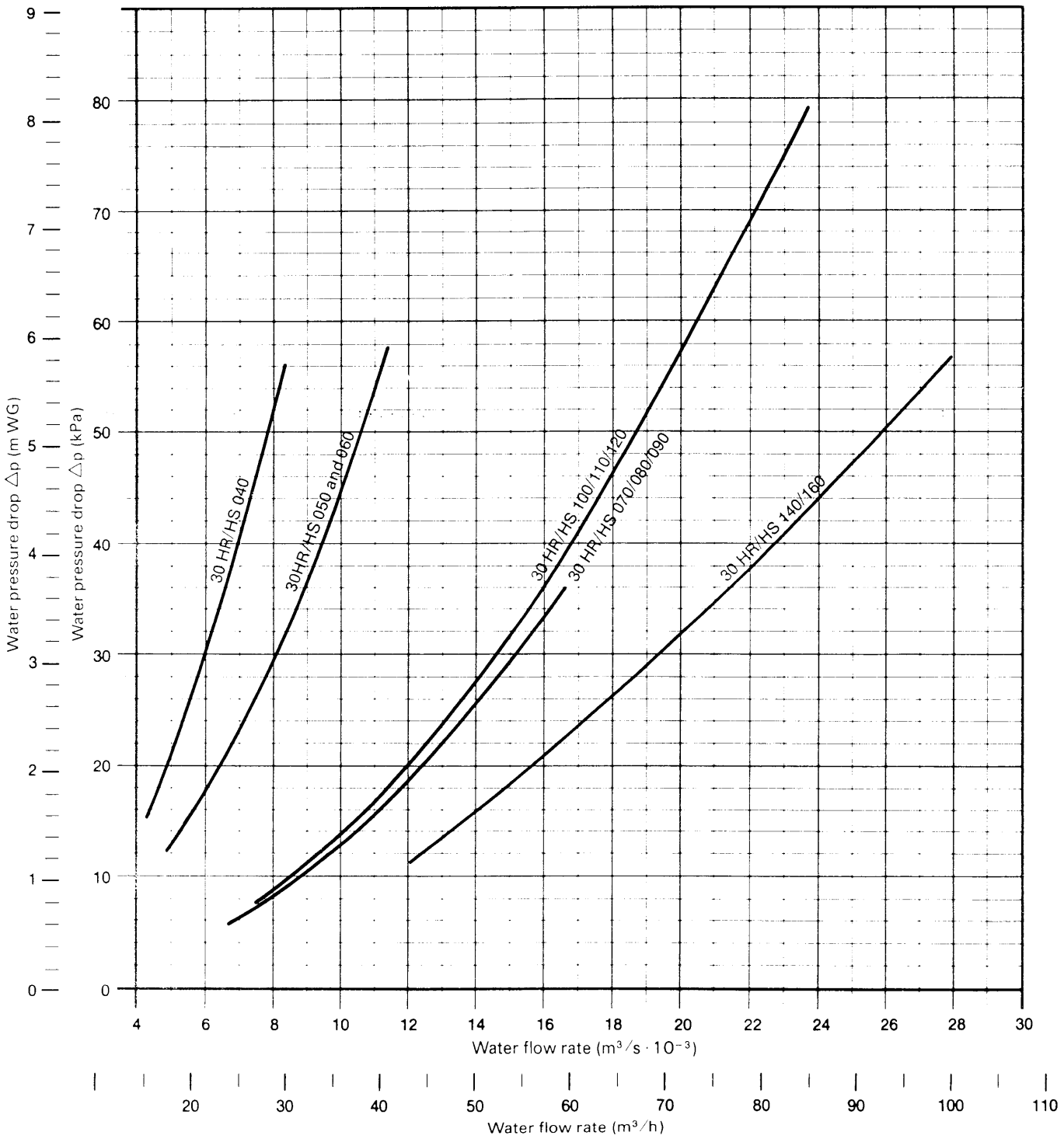
Interpolation is permitted.
Do not extrapolate.



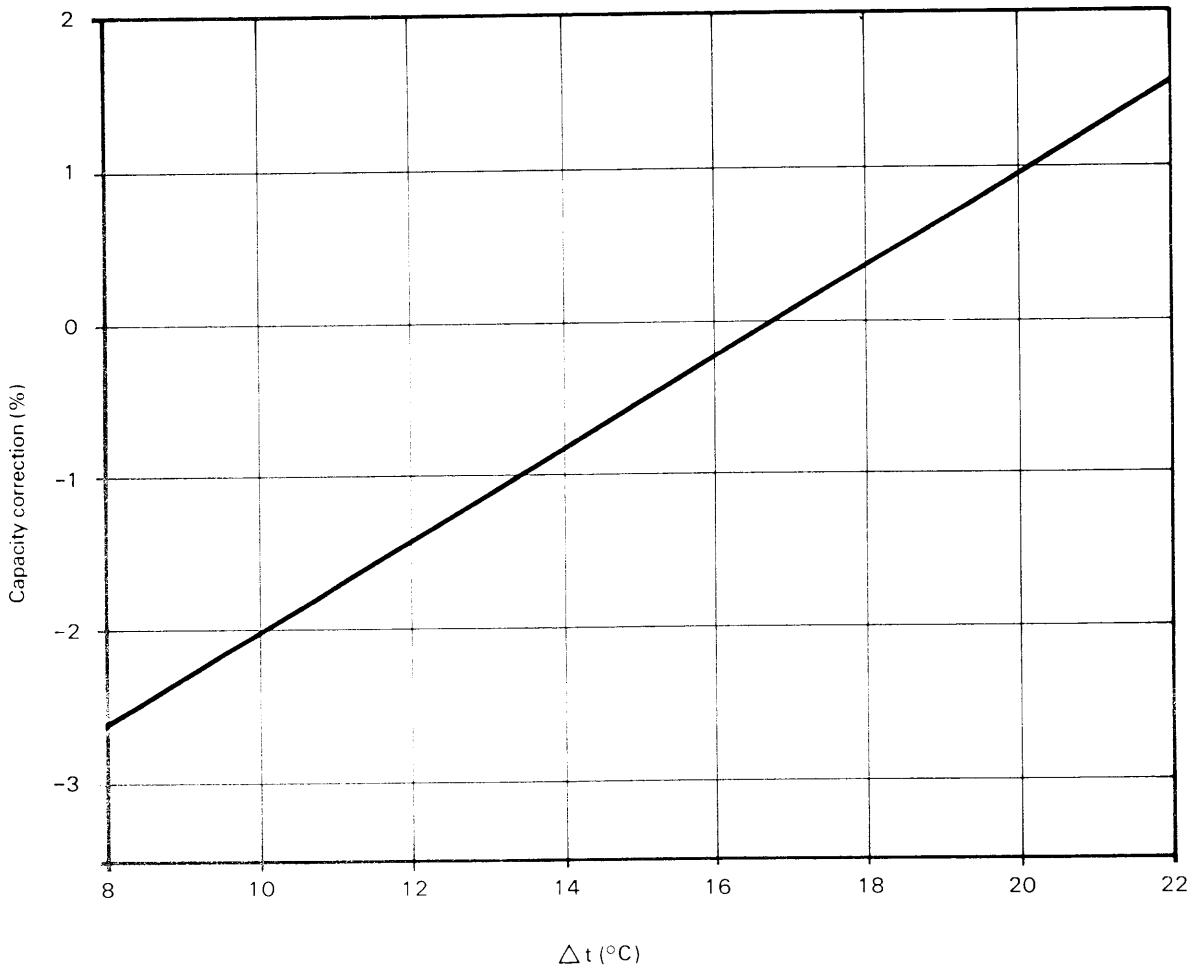
Pressure drop in the evaporator 30HR/HS 040–160

NOTE
The pressure drop is based on a standard number of evaporator baffles:

30HR, HS	No. of baffles
040	13
050 060	11
070 080, 090	9
100 110, 120	11
140 160	9



Ratings correction curve



Electrical data

LEGEND
FLA Full load amps
ICF Maximum instantaneous current flow during starting (any point in the starting sequence where the sum of LRA for the starting compressor plus FLA for all other running compressors is maximum) (A)
ICI Maximum incremental current inrush (LRA of the largest compressor motor) (A)
LRA Locked rotor amps.
MTA Must trip amps.
WSA Wire sizing amps. To size wires it is customary to take 125% of the largest motor FLA plus 100% of the FLA for the other motor in the circuit (or unit – 30HR, HS 040/050/060).

* One terminal block for each circuit on 3 and 4 compressor units. WSA values on the left are for circuit 1, those on the right are for circuit 2. On 3 and 4 compressor units, where only one value is shown, WSA is for each circuit.
** Compressor model prefix letters:
B,J: have one unloader
A, F: no unloader
K: has two unloaders
All motors have solid-state protection.

Nominal voltage (V – ph – Hz)		230–3–50			400–3–50			Compressor 06 E**			
Network voltage (V)		220–240			380–415			Circuit 1		Circuit 2	
Voltage limits for satisfactory operation (V)		198–264			342–457			Compressor number			
Model 30	kW	WSA*	ICF	ICI	WSA*	ICF	ICI	1	2	3	4
HR 020	17,4	61,25	—	—	36,25	—	—	B150	—	—	—
030	27,0	98,2	—	—	55,6	—	—	K175	—	—	—
040	43,5	138	391	342	81	234	205	J265	—	B150	—
050	44,4	107	391	342	84,5	234	205	J175	—	B150	—
060	54,0	176,5	420,5	342	100	249,5	205	J175	—	J175	—
070	61,8	110,5 98	391	342	65,5 55,5	234	205	B150	B150	F175	—
080	71,4	147 98	469,5	342	84,5 55,5	278,5	205	J175	B150	F175	—
090	81,0	176,5 98	499	342	100 55,5	294	205	J175	J175	F175	—
100	88,3	147	518	342	84,5	307,5	205	J175	B150	F175	A150
110	98,4	176,5 147	548	342	100 84,5	323	205	J175	J175	F175	A150
120	108	176,5	577,5	342	100	338,5	205	J175	J175	F175	F175
140	133,2	214,5	773	507	123	447	295	J299	J175	F299	F175
160	158,4	245	834	507	142	484	295	J299	J299	F299	F299
HS 020	20,0	71,25	—	—	41,25	—	—	B250	—	—	—
030	30,9	107,5	—	—	65,0	—	—	K275	—	—	—
040	49,6	156	399	342	84,5	238	205	J265	—	B250	—
050	50,9	164,5	423	366	98	247	214	J275	—	B250	—
060	61,8	193,5	452	366	117	266	214	J275	—	J275	—
070	70,3	128 107,5	423	366	74 65	247	214	B250	B250	F275	—
080	81,8	164,5 107,5	509	366	98 65	299	214	J275	B250	F275	—
090	92,7	193,5 107,5	538	366	117 65	318	214	J275	J275	F275	—
100	101,8	164,5	566	366	98	332	214	J275	B250	F275	A250
110	112,7	193,5 164,5	595	366	117 98	351	214	J275	J275	F275	A250
120	123,6	193,5	624	366	117	370	214	J275	J275	F275	F275
140	150,2	237	800	507	138	468	295	J299	J275	F299	F275
160	176,8	272	870	507	155	502	295	J299	J299	F299	F299

Compressors

Nominal voltage (V)			230			400		
Network voltage (V)			220–240			380–415		
Voltage limits for satisfactory operation (V)			198–264			342–457		
Model	Compressor 06 E	kW	FLA	LRA	MTA	FLA	LRA	MTA
30HR	150	17,4	49	205	69	29	120	41
	175	27	78,5	342	110	44,5	205	62
	265	26,1	71	342	98	41	205	47
	299	39,6	109	507	153†	63	295	88
30HS	250	20	57	250	80	33	146	46
	265	29,6	79	342	110	45	205	62
	275	30,9	86	366	120†	52	214	73
	299	44,2	121	507	170†	69	295	97

NOTE
1. Compressor models 150, 250 are 4-cylinder
2. Compressor models 175, 265, 275 and 299 are 6-cylinder
3. Starting sequence transfer switch:

Model 30HR, HS	040–060	070–090	100–160
Switch position	Compressor starting sequence		
1	1-3	1-3-2	1-3-4-2
2	3-1	2-3-1	2-3-4-1

4. From the front of the unit, compressors and circuits are numbered from left to right

† Protected by 7-pole switch. Switch MTA is half of the compressor MTA.

Capacity control

Model 30HR, HS	Step	Switch position 1						Switch position 2					
		% max. capacity	Operating cylinders					% max. capacity	Operating cylinders				
			Total	Circuit 1 | 2					Total	Circuit 1 | 2			
				Compressor						Compressor			
				1	2	3	4			1	2	3	4
020	1	50,0	2	2	—	—	—	—	—	—	—	—	—
	2	100,0	4	4	—	—	—	—	—	—	—	—	—
030	1	33,3	2	2	—	—	—	—	—	—	—	—	—
	2	66,6	4	4	—	—	—	—	—	—	—	—	—
	3	100,0	6	6	—	—	—	—	—	—	—	—	—
040	1	37,7	4	4	—	—	—	21,7	2	—	—	2	—
	2	46,5	6	6	—	—	—	43,5	4	—	—	4	—
	3	81,2	8	4	—	4	—	78,2	8	6	—	2	—
	4	100,0	10	6	—	4	—	100,0	10	6	—	4	—
050	1	40,0	4	4	—	—	—	20,0	2	—	—	2	—
	2	60,0	6	6	—	—	—	40,0	4	—	—	4	—
	3	80,0	8	4	—	4	—	80,0	8	6	—	2	—
	4	100,0	10	6	—	4	—	100,0	10	6	—	4	—
060	1	33,3	4	4	—	—	—	33,3	4	—	—	4	—
	2	50,0	6	6	—	—	—	50,0	6	—	—	6	—
	3	83,3	10	4	—	6	—	83,3	10	6	—	4	—
	4	100,0	12	6	—	6	—	100,0	12	6	—	6	—
070	1	14,3	2	2	—	—	—	14,3	2	—	2	—	—
	2	28,6	4	4	—	—	—	28,6	4	—	4	—	—
	3	57,2	8	2	—	6	—	57,2	8	—	2	6	—
	4	71,5	10	4	—	6	—	71,5	10	—	4	6	—
	5	85,8	12	2	4	6	—	85,8	12	4	2	6	—
	6	100,0	14	4	4	6	—	100,0	14	4	4	6	—
080	1	25,0	4	4	—	—	—	12,5	2	—	2	—	—
	2	37,5	6	6	—	—	—	25,0	4	—	4	—	—
	3	62,5	10	4	—	6	—	50,0	8	—	2	6	—
	4	75,0	12	6	—	6	—	62,5	10	—	4	6	—
	5	87,5	14	4	4	6	—	87,5	14	6	2	6	—
	6	100,0	16	6	4	6	—	100,0	16	6	4	6	—
090	1	22,2	4	4	—	—	—	22,2	4	—	4	—	—
	2	33,3	6	6	—	—	—	33,3	6	—	6	—	—
	3	55,5	10	4	—	6	—	55,5	10	—	4	6	—
	4	66,6	12	6	—	6	—	66,6	12	—	6	6	—
	5	88,8	16	4	6	6	—	88,8	16	6	4	6	—
	6	100,0	18	6	6	6	—	100,0	18	6	6	6	—

Model 30HR, HS	Step	Switch position 1						Switch position 2					
		% max. capacity	Total	Operating cylinders				% max. capacity	Total	Operating cylinders			
				Circuit 1 | 2						Circuit 1 | 2			
				Compressor						Compressor			
				1	2	3	4			1	2	3	4
100	1	20,0	4	4	—	—	—	10,0	2	—	2	—	—
	2	30,0	6	6	—	—	—	20,0	4	—	4	—	—
	3	50,0	10	4	—	6	—	40,0	8	—	2	6	—
	4	60,0	12	6	—	6	—	50,0	10	—	4	6	—
	5	70,0	14	4	—	6	4	60,0	12	—	2	6	4
	6	80,0	16	6	—	6	4	70,0	14	—	4	6	4
	7	90,0	18	4	4	6	4	90,0	18	6	2	6	4
	8	100,0	20	6	4	6	4	100,0	20	6	4	6	4
110	1	18,2	4	4	—	—	—	18,2	4	—	4	—	—
	2	27,3	6	6	—	—	—	27,3	6	—	6	—	—
	3	45,5	10	4	—	6	—	45,5	10	—	4	6	—
	4	54,6	12	6	—	6	—	54,6	12	—	6	6	—
	5	63,7	14	4	—	6	4	63,7	14	—	4	6	4
	6	72,8	16	6	—	6	4	72,8	16	—	6	6	4
	7	91,0	20	4	6	6	4	91,0	20	6	4	6	4
	8	100,0	22	6	6	6	4	100,0	22	6	6	6	4
120	1	16,6	4	4	—	—	—	16,6	4	—	4	—	—
	2	25,0	6	6	—	—	—	25,0	6	—	6	—	—
	3	41,6	10	4	—	6	—	41,6	10	—	4	6	—
	4	50,0	12	6	—	6	—	50,0	12	—	6	6	—
	5	66,6	16	4	—	6	6	66,6	16	—	4	6	6
	6	75,0	18	6	—	6	6	75,0	18	—	6	6	6
	7	91,6	22	4	6	6	6	91,6	22	6	4	6	6
	8	100,0	24	6	6	6	6	100,0	24	6	6	6	6
140	1	19,0	4	4	—	—	—	14,3	4	—	4	—	—
	2	28,4	6	6	—	—	—	21,5	6	—	6	—	—
	3	46,5	10	4	—	6	—	43,0	10	—	4	6	—
	4	57,0	12	6	—	6	—	50,0	12	—	6	6	—
	5	69,0	16	4	—	6	6	64,5	16	—	4	6	6
	6	78,6	18	6	—	6	6	71,5	18	—	6	6	6
	7	91,0	22	4	6	6	6	92,5	22	6	4	6	6
	8	100,0	24	6	6	6	6	100,0	24	6	6	6	6
160	1	16,6	4	4	—	—	—	16,6	4	—	4	—	—
	2	25,0	6	6	—	—	—	25,0	6	—	6	—	—
	3	41,6	10	4	—	6	—	41,6	10	—	4	6	—
	4	50,0	12	6	—	6	—	50,0	12	—	6	6	—
	5	66,6	16	4	—	6	6	66,6	16	—	4	6	6
	6	75,0	18	6	—	6	6	75,0	18	—	6	6	6
	7	91,6	22	4	6	6	6	91,6	22	6	4	6	6
	8	100,0	24	6	6	6	6	100,0	24	6	6	6	6

Pressure Limits refrigerant side

		Max. operating pressure		Test pressure	
		Bar	kg/cm²	Bar	kg/cm²
Condenser	Services des mines	25,0	25,5	50,0	51,0
	T.U.V.	25,0	25,5	32,5	33,1
	A.N.C.C.	24,5	25,5	30,6	31,25
Evaporator	Services des mines	13,0	13,3	Approval not required	
	T.U.V.	13,0	13,3	16,9	17,2
	A.N.C.C.	18,5	18,9	23,4	23,9

Maximum operating pressure – Water side

	Bar	kg cm²
Condenser	17	17,3
Evaporator	10	10,2

Control sequence

Control circuit power is 230 volts, supplied from separate source. Crankcase heaters are in control circuit, ahead of the "Start-Stop" switch; they are always operational as long as the control circuit power switch is on. They are not affected if unit shuts off by safety device action.

All units, 30HR, HS 020-160 have multiple-step temperature controller, factory set to maintain capacity control via return chilled water temperature. 30HR, HS 020-030 units are respectively equipped with a 2,3 step thermostat. 30HR, HS 040-160 have a four step temperature controller and an unloader on each compressor. On units 30HR, HS 070-160 the capacity control system includes a chilled water temperature controller, a step controller and solenoid operated cylinder unloaders on compressors no. 1 and 2. 30HR, HS 020-030 units have a fused control circuit. All other units have one double-pole circuit-breaker which serves as control circuit power switch.

Units 30HR, HS 020-030:
30HR, HS 020 have one four cylinder compressor with one solenoid-operated cylinder unloader. 30HR, HS 030 have one six cylinder compressor with two solenoid-operated unloaders. If the temperature controller is calling for cooling, the compressor will start immediately. Then the timer motor (TM) will stop and the multiple step temperature controller (TC) will take over to cycle compressor on and off and load or unload cylinders in the compressor to control the system capacity in response to load requirements.

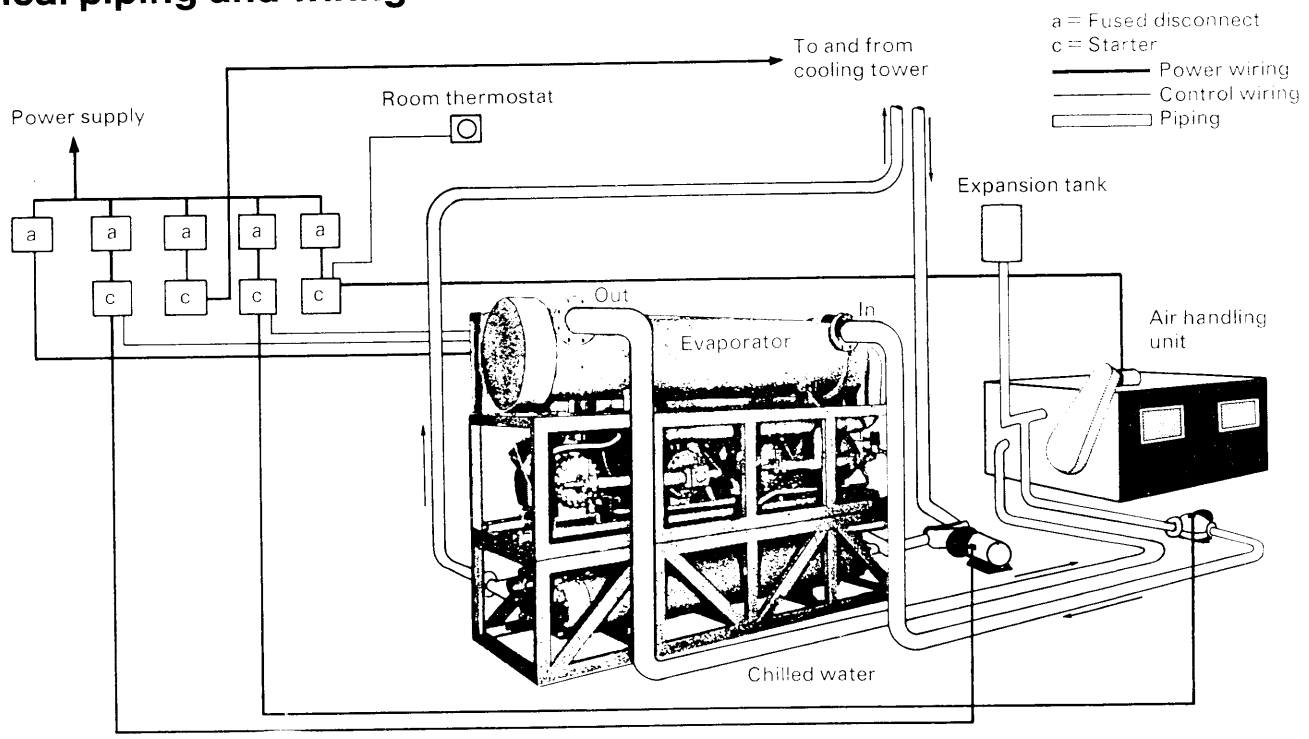
Units 30HR, HS 040-060:
If the temperature controller is calling for cooling, no. 1 compressor will start immediately and no. 2 compressor will start 18 seconds after, if required by load demand. Then, the timer motor (TM) will stop and the four step temperature controller (TC) will take over to cycle compressors on and off load or unload cylinders in each compressor control system capacity in response to load requirements.

Units 30HR, HS 070-160:
If the temperature controller is calling for cooling, it actuates the step controller. A 24-volt transformer in the step controller provides power to a low voltage motor with windings for rotating a camshaft clockwise and counter-clockwise. Factory-set cams operate load switches which start or stop compressors and load or unload cylinders. When unit is loading or unloading (respectively, counter-clockwise or clockwise rotation of the camshaft drive motor), each chilled water temperature corresponds to a position of the camshaft. Camshaft rotation is limited in each direction by limit switches.

A recycle relay in the step controller ensures that the camshaft will rotate clockwise (in the unload direction) to the correct position to begin the compressor starting sequence at initial start-up or after a power interruption. After completion of the reset cycle, the camshaft rotation changes to counter-clockwise and the compressor starting sequence begins.

Compressors start one at a time at brief intervals until the load demand is satisfied. After completing the starting sequence, the controller will stop and start, unload and load compressors to maintain unit cooling capacity to satisfy load requirements. Factory cam settings on the step controller protect compressors against rapid cycling. On resumption of power after power failure, all units will restart automatically under sequence starting control.

Typical piping and wiring



NOTES.
1. Wiring and piping shown are general points of connection guides only and are not intended to be used or to include all details for a specific installation.

2. All wiring must comply with applicable local and national codes.

3. All piping must follow standard piping techniques. Refer to Carrier System Design Manual for details.

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Supplied by

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