

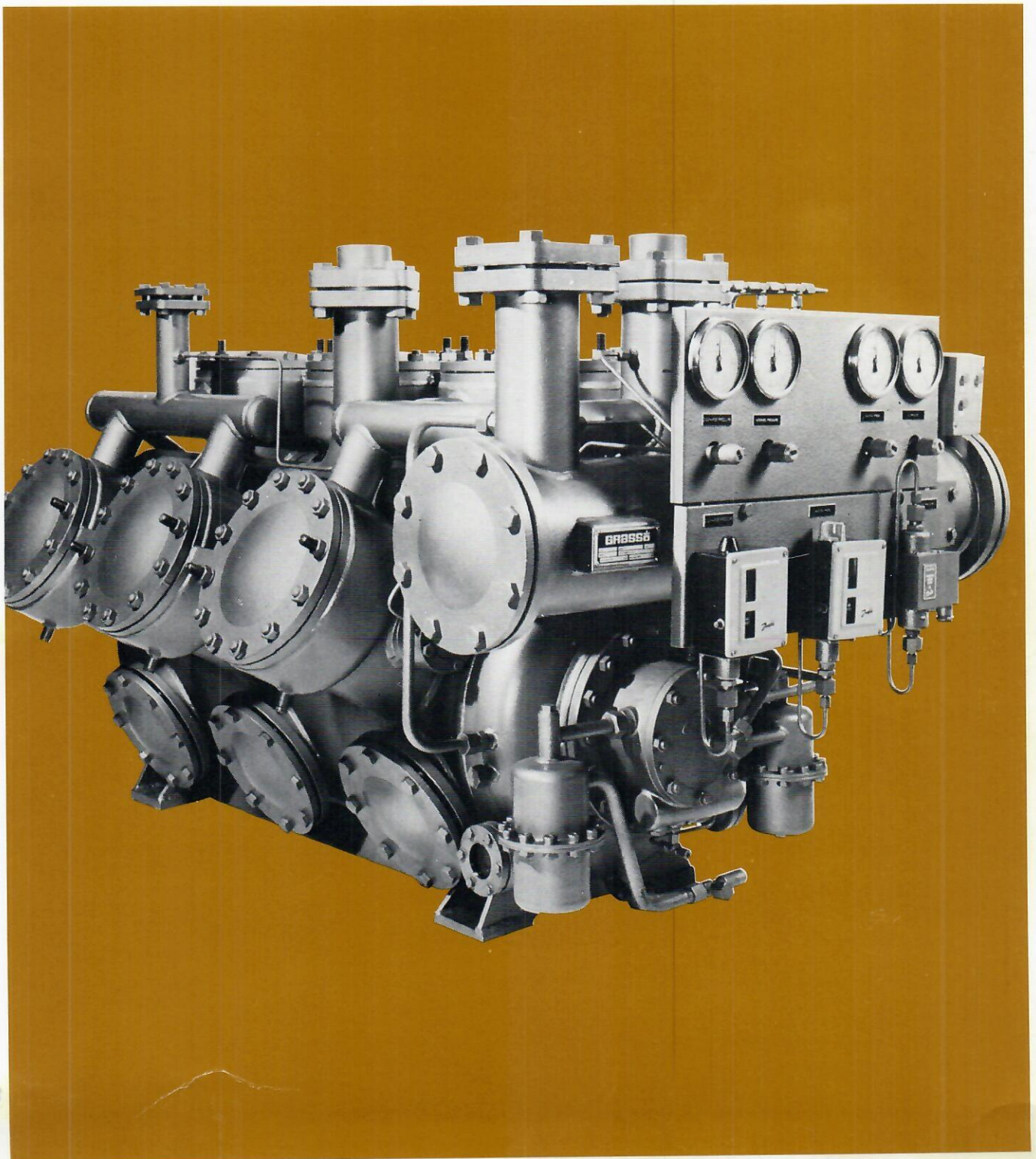
GRASSO

Refrigeration compressor

RC 11

Engineering Data

Single-stage, booster, two-stage
NH₃, R12, R22, R502



Preface

This brochure contains all engineering data for the range of RC11 refrigeration compressors and the corresponding recommended accessories.

It is therefore meant to be a guide to the selection of these compressors and accessories.

The brochure is divided into six main sections, viz.:

- Introduction and Scope
- Design Details of Standard Bare Compressor
- General Data
- Limits of Operation
- Compressor, Motor and Condenser Selection Procedure
- Description and Selection of Accessories

The first four sections give a detailed description of and technical information about the standard bare compressor; the last section deals with all available standard accessories with which the bare compressor can be provided.

For the selection of the appropriate compressor type (section five) on the basis of capacity, refrigerant and operating conditions, as well as for the determination of the corresponding power consumption and, in the case of two-stage compressors, the saturation intermediate temperature, reference has to be made to a separate brochure "Performance Tables" containing only the performances of the range of RC11 refrigeration compressors.

Basically, all texts are in English. However, for just French or German speaking readers the two sections "Introduction and Scope" and "Design Details of Standard Bare Compressor", covering the first seven pages of the brochure can, if desired, be presented in the French or German language.

Vorwort

Diese Broschüre enthält alle anwendungstechnischen Daten der Kälteverdichter der Baureihe RC11, sowie die entsprechenden, für diese Verdichter empfohlenen Zubehörteile, und dient somit als Leitfaden für die Auswahl dieser Verdichter und Zubehörteile.

Die Broschüre ist in folgenden sechs Hauptabschnitten unterteilt:

- Einleitung und Anwendungsbereich
- Konstruktionseinzelheiten des Standardverdichters
- Allgemeine Technische Daten
- Einsatzgrenzen
- Auswahlmethode für Verdichter, Motor und Verflüssiger
- Beschreibung und Auswahl der Zubehörteile

In den ersten vier Abschnitten findet man ausser technischen Informationen eine ausführliche Beschreibung des Standardverdichters; im letzten Abschnitt werden alle lieferbaren Standardzubehörteile behandelt, mit denen der Verdichter ausgerüstet werden kann.

Für die Auswahl der zweckentsprechenden Verdichtertypen (fünfter Abschnitt) je nach Leistung, Kältemittel und Betriebsbedingungen, wie auch zum Bestimmen des entsprechenden Kraftbedarfs und – bei zweistufigen Verdichtern – der Sättigungszwischentemperatur, wird auf die Einzelbroschüre „Performance Tables“ hingewiesen, in der nur die Leistungstabellen für die Kälteverdichter der Baureihe RC11 enthalten sind.

Alle Texte sind grundsätzlich in englischer Sprache abgefasst. Jedoch sind für französisch- oder deutschsprachige Benutzer die zwei Abschnitte „Einleitung und Anwendungsbereich“ und „Konstruktionseinzelheiten des Standardverdichters“, die auf den ersten sieben Seiten der Broschüre abgedruckt sind, auf Wunsch auch in französischer oder deutscher Sprache erhältlich.

Préface

La présente brochure contient toutes les données d'ingénierie relatives aux compresseurs frigorifiques de la série RC11, de même que les accessoires recommandés qui s'y rapportent, servant ainsi de guide pour la sélection de ces compresseurs et de leurs accessoires.

La brochure est divisée en six sections, à savoir:

- Introduction et domaine d'application
- Détails de construction du compresseur nu standard
- Données générales
- Limites de fonctionnement
- Méthode de sélection pour compresseur, moteur et condenseur
- Description et sélection des accessoires

Les quatre premières sections donnent une description détaillée du compresseur nu standard, ainsi que des renseignements techniques y relatifs; la dernière section traite de tous les accessoires standard livrables dont le compresseur nu peut être équipé.

Pour la sélection du type de compresseur (section cinq) approprié sur la base de la capacité, du fluide frigorigène et des conditions de fonctionnement, de même que pour déterminer la consommation de puissance correspondante et – dans le cas de compresseurs bi-étages – la température intermédiaire de saturation, on devra se reporter à la brochure séparée "Performance Tables" qui ne contient que les tableaux de performance destinés aux compresseurs frigorifiques de la série RC11.

En principe, tous les textes sont en anglais. Cependant, pour les utilisateurs francophones ou germanophones, les deux sections „Introduction et domaine d'application“ et „Détails de construction du compresseur nu standard“ couvrant ensemble les sept premières pages de la brochure, peuvent être présentées, sur demande, en français ou en allemand.

INTRODUCTION AND SCOPE

OUTLINE

RC11 is the designation of a series of open, single-acting, return-flow, reciprocating refrigeration compressors with trunk-type pistons and with 2 up to 12 cylinders in V- and W-arrangement.

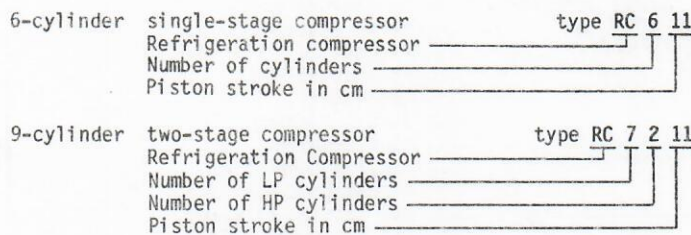
The series consist of 15 types, of which 6 single-stage and 9 integral two-stage (compound) compressors.

The single-stage types can also be used as booster compressors.

All types have the same main characteristics, viz. a cylinder bore of 160 mm and a piston stroke of 110 mm.

TYPE DESIGNATION

The following examples will explain the type designation:



APPLICATION

The compressors are designed for general industrial (heavy duty) operation at evaporating temperatures between -65 and +10 °C (cooling, freezing, air conditioning, heat pump systems) with the current refrigerants NH₃, R12, R22 and R502. For the exact limits of operation and fields of application, refer to Data Sheets No. 7, 8A, 8B and 8C.

The compressors are also suitable for other refrigerants such as R13 (cascade systems), R13B1 (two-stage systems only) or R114 (heat pump systems) and for compressing gases such as propane, butane, sulphur dioxide, ethylene, etc. in chemical processes or for pumping purposes.

For all these particular applications the compressor manufacturer should be consulted.

DRIVE SYSTEM

In principle the compressors are designed to be driven by an electric motor, either direct or by means of V-belts, the maximum speed (\approx normal service speed) being 1000/min. Using V-belt drive, a total of 10 standard service speeds are available down to a minimum of approx. 400/min.

The normal direction of rotation, determined by the operation of the standard oil pump, is counter-clockwise when facing the shaft end.

A special reversed-acting oil pump can be fitted at a surplus price, allowing a clockwise direction of rotation. This enables a tandem-arrangement of two-compressors, each of them installed on either side of one single electric drive motor with two drive ends or the compressor to be direct driven by an internal combustion engine (diesel or natural gas) which normally has a fixed direction of rotation.

SELECTION

Selection takes place on the basis of the standard bare compressor.

For methods of selection refer to Data Sheet No. 9.

The standard bare compressor can be extended with accessories to meet customers requirements. For a review of these accessories refer to Data Sheets No. 12A and 12B.

QUALITY CONTROL

During manufacturing the complete assembled compressor is given a pressure test with dry air to check it for mechanical strength and gastightness. The pressure for testing the mechanical strength is at least 1.5 times the max. design pressure.

Before leaving the works each reciprocating compressor undergoes a test run with air during approx. 15 hours as a general mechanical check only.

Moreover, approx. 3% of the total number of compressors manufactured is taken at random for a so-called "statistical check". This is a quality inspection carried out by the Laboratory of the Development Department according to the international Standard ISO 917*, whereby the compressor operates with refrigerant and under conditions prevailing in practice in order to determine capacity and power consumption at full load as well as at part load.

This inspection also includes a vacuum test and an examination of all important compressor functions.

* From this Standard only method D (refrigerant vapour flow meter in suction line) as so-called "Principal test" is used in actual practice.

ACCEPTANCE TEST

It is also possible, on special request and at an extra charge, to perform an "Acceptance Test" under design conditions, witnessed by the customer.

SURVEY CERTIFICATE

All compressor types can be delivered at an extra charge with a survey certificate of the following Classification Bureaus:

- Lloyds Register of Shipping
- Germanischer Lloyd
- Bureau Veritas
- Det Norske Veritas
- Register of Shipping USSR
- Deutsche Schiffs-Revision und -Klassifikation (D.S.R.K.)
- Rinave Portuguesa
- American Bureau of Shipping

The type designation of compressors with survey certificate is KRC11.

DELIVERY

As a standard the compressors are delivered without oil. All installation connections are blanked off and the compressor is filled with nitrogen at atmospheric pressure.

The external finish consists of blue hammertone paint or, if required to special order, green primer only.

Each compressor is accompanied by an instruction manual containing particulars on operation, inspection and maintenance as well as illustrated parts lists.

GENERAL TECHNICAL DATA OF SINGLE-STAGE COMPRESSORS
 (for two-stage compressors, see overleaf)

COMPRESSOR TYPE			RC211	RC311	RC411	RC611	RC911	RC1211
Number of cylinders	z		2	3	4	6	9	12
Cylinder arrangement			1 x V	1 x W	2 x V	2 x W	3 x W	4 x W
Cylinder bore	D	mm	160	160	160	160	160	160
Piston stroke	S	mm	110	110	110	110	110	110
Swept volume at full-load and n = 1000 /min	V _s	m ³ /h	265.4	398.1	530.8	796.2	1194.3	1592.4
Standard direction of rotation			counter-clockwise when facing shaft end					
Standard compressor speeds (with V-belt drive)			430 - 455 - 480 - 535 - 600 - 675 - 720 - 765 - 860 - 965					
motor speed 1450/min (50 Hz)	n	min ⁻¹	430 - 455 - 480 - 535 - 600 - 675 - 720 - 765 - 860 - 965					
motor speed 1750/min (60 Hz)	n	min ⁻¹	465 - 520 - 550 - 580 - 650 - 725 - 820 - 870 - 920					
Standard steps of capacity control ¹⁾ (expressed in % of full-load swept volume)								
manual control	single-stage	%	100-50	100-67-33	100-75-50	100-83-67 -50-33	100-89-67 -44-22	100-83-67 -50-25
		%	100-50	100-67-33	100-75-50	100-83-67 -50	100-67-44	100-75-58 -42
electrical control	single-stage	%	100-50	100-67-33	100-75-50	100-83-67 -50-33	100-89-78 -67-56-44 -33-22	100-92-83 -75-67-58 -50-42-33 -25
		%	100-50	100-67-33	100-75-50	100-83-67 -50	100-67-44	100-75-58 -42
Main dimensions			Refer to Data Sheet No. 2					
Connections and required free space			Refer to Data Sheet No. 2					
Mass of bare compressor (without flywheel and other accessories)		kg	435	535	665	900	1245	1585
Shipping mass (approx.) ²⁾		kg	505	605	735	1000	1360	1715
Shipping volume ²⁾		m ³	1.75	1.75	1.9	2.5	3.0	3.5
Oil charge in crankcase (centre-line of sight glass)		dm ³	9	10	12	13	20	32
Oil type to be used			Refer to Data Sheet No. 3					
Starting torque			Refer to Data Sheet No. 11					
action power at n = 1000/min and 55 °C oil temperature ³⁾	P _w	kW	3.2	3.8	4.4	5.5	7.2	8.9
Centre of gravity ⁴⁾			Refer to Data Sheet No. 5A.					
Free forces and moments ⁴⁾			Refer to Data Sheet No. 5A.					
Mass moment of inertia of crank mechanism (without flywheel) ⁵⁾	I _d	kg.m ²	0.27035	0.3119	0.3421	0.4741	0.6598	0.8410
Flywheel data (dimensions, mass, centre of gravity, mass moment of inertia, etc.)			Refer to Data Sheets No. 13 and 14					
Sound rating			Refer to Data Sheet No. 6					
Torsional elastic substitute systems of crankshaft ⁶⁾			Refer to Data Sheet No. 5B.					

¹⁾ See also Data Sheets No. 16 and 17B.

²⁾ The flywheel and small-sized accessories (whether separately or mounted) are packed with the compressor in the same case. This increases the shipping mass given here, but has no influence on the shipping volume.

³⁾ P_w is needed for calculating the condenser capacity Q_c. See also Data Sheet No. 10.

$$P_w = (n / 1000) \cdot (0.57 \cdot z + 2.06)$$

The centre of gravity and free forces and moments are of importance when calculating a vibration-free mounting of the compressor.

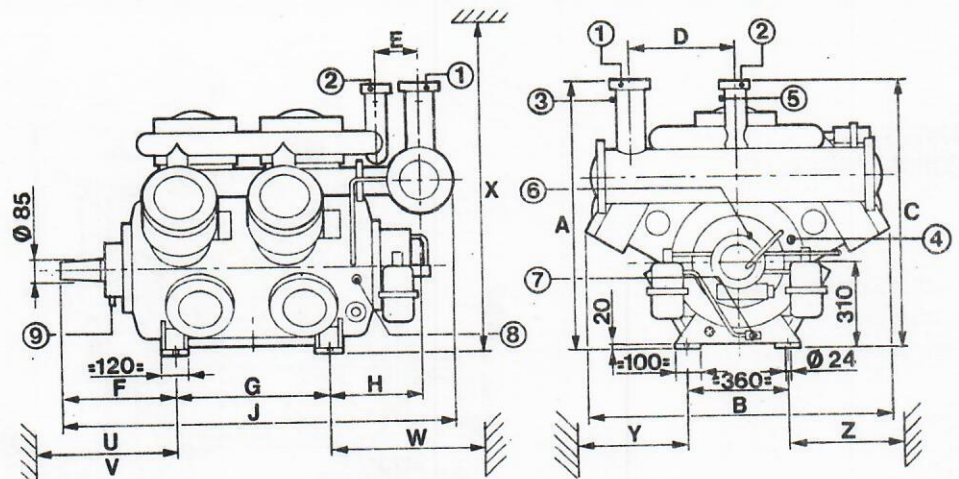
⁵⁾ The mass moment of inertia I_d, expressed in SI-units (equal to $\frac{GD^2}{4}$ (kgf.m²)), is required to determine the so-called coefficient of speed fluctuation.

⁶⁾ These crankshaft substitute systems are required to carry out torsional vibration calculations in case the compressor is driven by an internal combustion engine.

SINGLE-STAGE COMPRESSORS

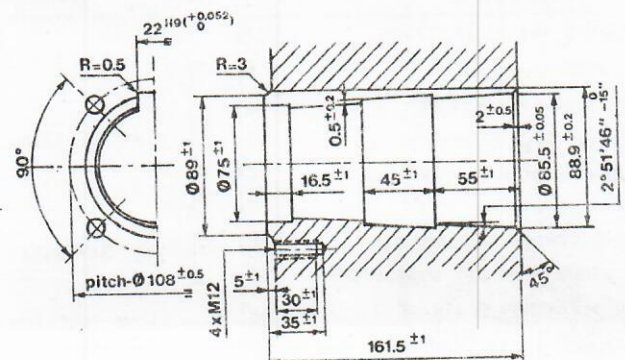
For two-stage compressors, see overleaf.

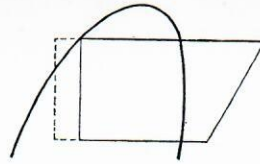
(all dimensions in mm)



COMPRESSOR TYPE		RC211	RC311	RC411	RC611	RC911	RC1211	
MAIN DIMENSIONS	A	938	961	938	993	993	995	
	B	970	1130	970	1130	1130	1130	
	C	906	901	900	976	983	979	
	D	350	350	350	375	375	375	
	E	360	150	150	150	150	150	
	F	385	385	402	402	426	426	
	G	215	215	380	570	960	2x675	
	H	220	253	265	345	345	345	
J	911	945	1140	1447	1861	2251		
MINIMUM REQUIRED FREE SPACE for removal of:	flywheel	U	905	905	920	915	940	
	crankshaft (V or W)	V	905	905	920	1015	1440	1875
		W	670	670	860	1015	1440	1875
	piston and cylinder liners	X	1085	1160	1085	1160	1160	1160
		Y	420	545	420	545	545	545
gas suction strainer element	Z	900	900	900	1100	1100	1100	
MAIN CONNECTIONS		hole diameter in (upper part of) counter flange						
suction	1	ø77	ø91	ø91	ø116	ø143	ø171	
discharge	2	ø61	ø61	ø77	ø91	ø116	ø116	
AUXILIARY CONNECTIONS		3 suction pressure 4 crankcase pressure 5 discharge pressure 6 oil pressure 7 oil charge and drain 8 return from oil separator 9 oil leakage drain of rotary shaft seal						
		} clamp coupling for ø6 x 1 mm steel precision tube } 1/2" BSP male — clamp coupling provided with ø12 x 1.5 mm steel precision tube						

Dimensions of shaft hole in coupling flange on compressor side (valid for all compressor types)

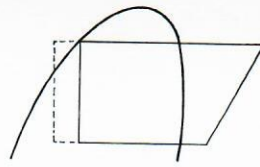




Single-stage

n = 1000 rpm

↓ t ₀ (°C)	↓ Δt ₀ (K)	→ t _c (°C)	+20	+25	+30	+35	+40	+45
+ 5	5	Q _o (kcal/h)	495 900	474 800	453 000	431 100	408 600	385 800
	15		490 000	469 800	448 800	427 800	406 100	384 200
	25		485 700	466 100	446 000	425 700	404 800	383 600
	—	P _e (kW)	76.4	83.8	91.7	100.0	108.6	117.5
0	5	Q _o (kcal/h)	415 800	397 200	378 000	358 800	339 000	318 900
	15		411 200	393 300	374 900	356 300	337 200	317 900
	25		407 600	390 300	372 500	354 600	336 100	317 400
	—	P _e (kW)	73.2	80.3	87.7	95.5	103.4	111.4
- 5	5	Q _o (kcal/h)	345 500	329 200	312 300	295 400	278 000	260 400
	15		341 800	326 100	309 900	293 500	276 700	259 700
	25		339 000	323 800	308 100	292 300	276 000	259 500
	—	P _e (kW)	70.0	76.6	83.5	90.6	97.7	104.6
-10	5	Q _o (kcal/h)	284 400	270 100	255 300	240 400	225 100	209 700
	15		281 500	267 700	253 400	239 000	224 200	209 300
	25		279 100	265 700	251 800	237 800	223 500	208 900
	—	P _e (kW)	66.7	72.8	79.0	85.2	91.3	97.0
-15	5	Q _o (kcal/h)	231 400	218 800	205 800	192 700	179 300	165 800
	15		229 000	216 800	204 200	191 600	178 600	165 400
	25		227 200	215 400	203 100	190 800	178 100	165 300
	—	P _e (kW)	63.2	68.6	74.0	79.2	84.0	88.2
-20	5	Q _o (kcal/h)	185 700	174 600	163 200	151 700	139 900	128 100
	15		183 800	173 000	161 900	150 700	139 300	127 700
	25		182 300	171 800	161 000	150 100	138 900	127 600
	—	P _e (kW)	59.3	63.9	68.3	72.2	75.4	77.7
-25	5	Q _o (kcal/h)	146 400	136 600	126 600	116 400	106 100	95 700
	15		145 000	135 500	125 700	115 800	105 700	95 600
	25		143 800	134 600	125 000	115 400	105 500	95 500
	—	P _e (kW)	54.9	58.5	61.6	64.0	65.3	65.2
-30	5	Q _o (kcal/h)	113 000	104 400	95 500	86 600	77 500	68 300
	15		111 900	103 500	94 800	86 100	77 200	68 200
	25		111 000	102 800	94 300	85 700	77 000	68 200
	—	P _e (kW)	49.8	52.1	53.6	54.0	52.9	50.0
-35	5	Q _o (kcal/h)	84 800	77 100	69 300	61 400	—	—
	15		83 900	76 500	68 800	61 000	—	—
	25		83 200	75 900	68 400	60 700	—	—
	—	P _e (kW)	43.7	44.4	43.9	41.8	—	—
-40	5	Q _o (kcal/h)	61 100	54 300	—	—	—	—
	15		60 500	53 800	—	—	—	—
	25		60 000	53 400	—	—	—	—
	—	P _e (kW)	36.1	34.8	—	—	—	—



Single-stage

n = 1000 rpm

↓ t ₀ (°C)	↓ Δt ₀ (K)	→ t _c (°C)						
			+20	+25	+30	+35	+40	+45
+ 5	5	Q _o (kcal/h)	516 100	487 400	458 300	428 800	399 100	369 200
	15		517 500	489 900	462 000	433 700	405 100	376 400
	25		519 800	493 300	466 400	439 100	411 500	383 800
	—	P _e (kW)	113.9	119.9	126.3	132.9	139.7	146.7
0	5	Q _o (kcal/h)	432 000	407 000	381 700	356 000	330 100	304 200
	15		433 900	409 900	385 500	360 700	335 800	310 800
	25		436 300	413 100	389 500	365 600	341 500	317 300
	—	P _e (kW)	104.6	110.3	116.3	122.4	128.7	135.0
- 5	5	Q _o (kcal/h)	359 000	337 200	315 200	292 900	270 500	248 100
	15		360 900	339 900	318 600	297 100	275 400	253 800
	25		363 300	343 000	322 400	301 600	280 600	259 500
	—	P _e (kW)	96.0	101.3	106.8	112.4	118.0	123.5
-10	5	Q _o (kcal/h)	294 700	275 800	256 700	237 400	218 100	198 800
	15		297 400	279 200	260 700	242 000	223 300	204 500
	25		299 700	282 000	264 100	245 900	227 700	209 400
	—	P _e (kW)	87.9	92.8	97.8	102.7	107.6	112.2
-15	5	Q _o (kcal/h)	240 700	224 300	207 800	191 200	174 500	158 000
	15		242 500	226 700	210 700	194 500	178 300	162 200
	25		244 600	229 200	213 600	197 800	182 100	166 300
	—	P _e (kW)	80.2	84.6	88.9	93.1	97.1	100.7
-20	5	Q _o (kcal/h)	193 700	179 500	165 300	151 000	136 800	122 600
	15		195 300	181 600	167 700	153 800	139 900	126 100
	25		197 100	183 700	170 200	156 600	143 000	129 400
	—	P _e (kW)	72.9	76.7	80.2	83.6	86.5	89.0
-25	5	Q _o (kcal/h)	153 300	141 200	129 000	116 700	104 600	92 600
	15		154 800	142 900	131 000	119 000	107 100	95 400
	25		156 300	144 700	133 000	121 300	109 600	98 000
	—	P _e (kW)	65.7	68.7	71.5	73.8	75.7	76.9
-30	5	Q _o (kcal/h)	119 200	108 800	98 300	87 900	77 600	67 500
	15		120 400	110 200	99 900	89 700	79 500	69 600
	25		121 600	111 600	101 600	91 500	81 500	71 600
	—	P _e (kW)	58.5	60.7	62.5	63.8	64.5	64.5
-35	5	Q _o (kcal/h)	90 500	81 500	72 600	63 700	55 000	46 600
	15		91 400	82 600	73 800	65 100	56 500	48 100
	25		92 400	83 700	75 100	66 400	57 900	49 500
	—	P _e (kW)	51.1	52.4	53.2	53.4	53.0	52.1
-40	5	Q _o (kcal/h)	66 300	58 600	51 000	43 600	36 300	29 300
	15		67 100	59 500	52 000	44 600	37 300	30 300
	25		67 900	60 400	53 000	45 600	38 300	31 300
	—	P _e (kW)	43.6	43.9	43.7	43.0	41.8	40.5
-45	5	Q _o (kcal/h)	46 400	39 900	33 400	27 100	—	—
	15		47 000	40 500	34 100	27 800	—	—
	25		47 500	41 100	34 700	28 400	—	—
	—	P _e (kW)	35.8	35.3	34.4	33.3	—	—
-50	5	Q _o (kcal/h)	30 000	24 400	—	—	—	—
	15		30 400	24 800	—	—	—	—
	25		30 700	25 200	—	—	—	—
	—	P _e (kW)	28.1	27.2	—	—	—	—