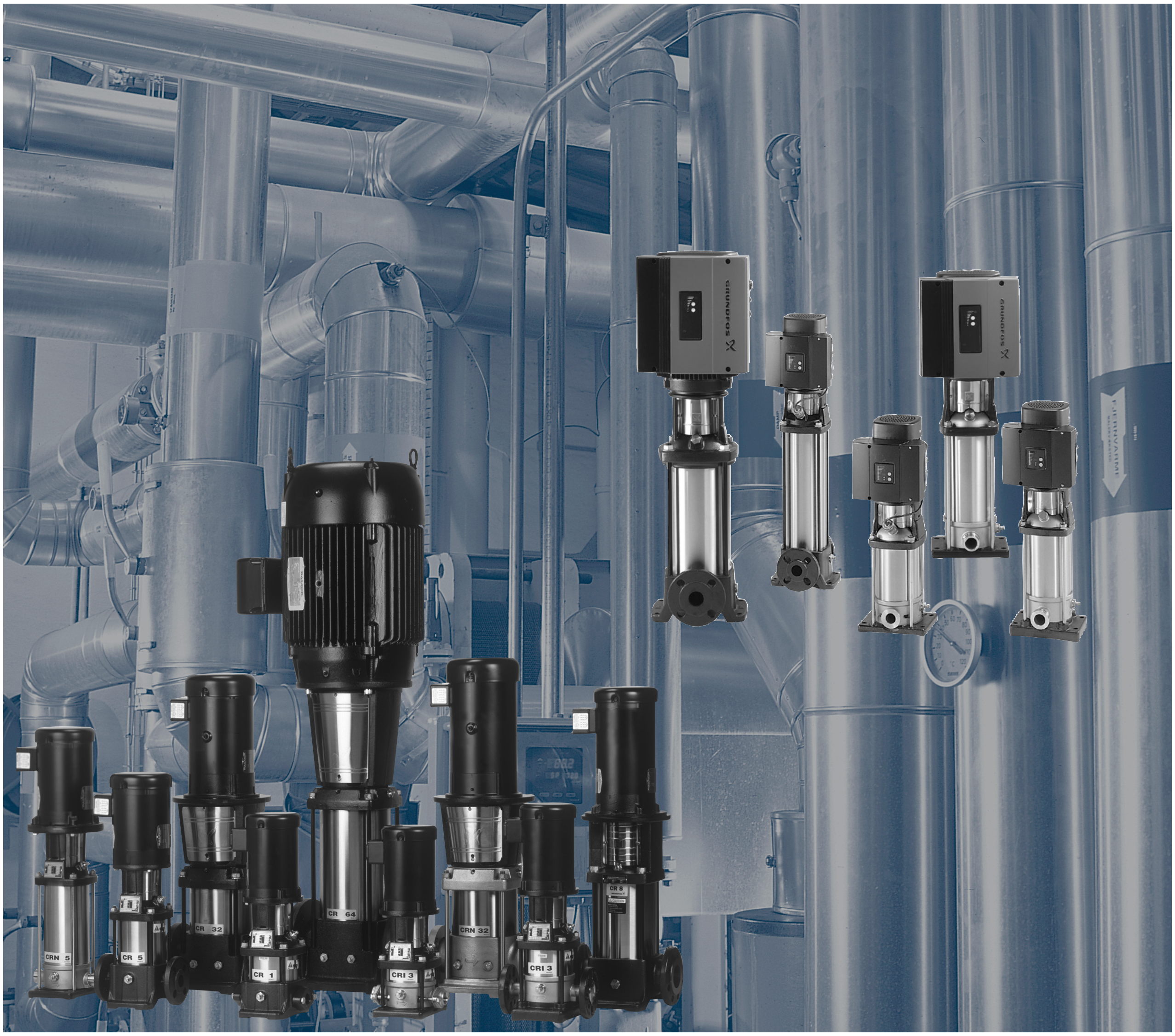
GRUNDFOS **PRODUCT GUIDE**

CR, CRI, CRN, CRE, CRIE, CRNE

Vertical multistage centrifugal pumps
60 Hz



BE > THINK > INNOVATE >

GRUNDFOS®

Contents

Mission

Product overview

Introduction 4
Product range 6
Applications 8
Pump 9
9
Motor 9
Terminal box positions 10
Ambient temperature 10
Viscosity 10

Product overview for E-pumps

Examples of E-pump applications 11

Control of E-pumps

Control options of E-pumps 12
Control modes for E-pumps 12

Construction

CR(E) 1s, 1, 3, 5, 10, 15 and 20 14
CRI(E), CRN(E) 1s, 1, 3, 5, 10, 15 and 20 14
CR(E) 32, 45, 64 and 90 15
CRN(E) 32, 45, 64 and 90 15
CR(E) 120 and 150 16
CRN(E) 120 and 150 16

Type keys and codes

Type keys 17
Codes 17

Operating and inlet pressure

Maximum operating pressure and temperature range 18
Operating range of the shaft seal 19
Maximum inlet pressure 20

Selection and sizing

Selection of pumps 21
How to read the curve charts 25
Guidelines to performance curves 25

Performance curves/ Technical data

CR, CRI, CRN 1s 26
CR(E), CRI(E), CRN(E) 1 30
CR(E), CRI(E), CRN(E) 3 34
CR(E), CRI(E), CRN(E) 5 38
CR(E), CRI(E), CRN(E) 10 42
CR(E), CRI(E), CRN(E) 15 46
CR(E), CRI(E), CRN(E) 20 50
CR(E), CRN(E) 32 54
CR(E), CRN(E) 45 57
CR(E), CRN(E) 64 60
CR, CRN 90 63
CR, CRN 120 66
CR, CRN 150 69

Motor data

Standard motors in the CR range 72
TEFC motors 72
ODP motors 73
2 Pole MLE motors 73

Pumped liquids

Pumped liquids 74
List of pumped liquids 74

Accessories

Pipework connection 77
Sensors for CRE, CRIE, CRNE 82
Gauges for CRE, CRIE, CRNE 82

Variants

Lists of variants - on request 83
Motors 83
Connections and other variants 83
Shaft seals 83
Pumps 83

Quotation text

WebCAPS 89
WinCAPS 90

Mission

It is our mission — the basis of our existence — to successfully develop, produce and sell high-quality pumps and pumping systems worldwide, contributing to a better quality of life and a healthy environment

Bjerringbro, Denmark

Fresno, California

Olathe, Kansas

Monterrey, Mexico

Allentown, Pennsylvania

Oakville, Ontario

- The world's leading pump company
- World's largest manufacturer of circulator pumps
- World headquarters in Denmark
- North American headquarters in Kansas City - Manufacturing in Fresno, California
- 80 companies in 45 countries
- More than 16 million motors and pumps produced annually worldwide
- North American companies operating in USA, Canada and Mexico
- Continuous reinvestment in growth and development enables the company to **BE** responsible, **THINK** ahead, and **INNOVATE**

Introduction

This data booklet deals with CR, CRI and CRN as well as CRE, CRIE and CRNE pumps.

CR, CRI, CRN

TM02 7698 3803

Fig. 1 CR, CRI and CRN pumps

CR, CRI, CRN pumps are vertical multistage centrifugal pumps. The in-line design enables the pump to be installed in a horizontal one-pipe system where the suction and discharge ports are in the same horizontal plane and have the same pipe dimensions. This design provides a more compact pump design and pipework.

Grundfos CR pumps come with various pump sizes and various numbers of stages to provide the flow and the pressure required.

CR pumps are suitable for a variety of applications from pumping of potable water to pumping of chemicals. The pumps are therefore used in a wide variety of pumping systems where the performance and material of the pump meet specific demands.

The CR pumps consist of two main components: the motor and the pump unit. The motor on a CR pump is a heavy-duty Grundfos specified motor.

The pump unit consists of optimized hydraulics, various types of connections, an outer sleeve, a top and various other parts.

CR pumps are available in various material versions according to the pumped liquid.

CRE, CRIE, CRNE

TM02 7397 3403

Fig. 2 CRE, CRIE and CRNE pumps

CRE, CRIE, CRNE pumps are built on the basis of CR, CRI, CRN pumps.

CRE, CRIE, CRNE pumps belong to the so-called E-pump family and are referred to as E-pumps.

The difference between the CR and the CRE pump range is the motor. CRE, CRIE, CRNE pumps are fitted with an E-motor, i.e. a motor with built-in frequency control.

The motor of the CRE pump is a Grundfos MLE motor.

Frequency control enables continuously variable control of motor speed, which makes it possible to set the pump to operation at any duty point. The aim of continuously variable control of the motor speed is to adjust the performance to a given requirement.

CRE, CRIE and CRNE pumps are available with an integrated pressure sensor connected to the frequency control.

The pump materials are the same as those of the CR, CRI, CRN pump range.

Selecting a CRE pump

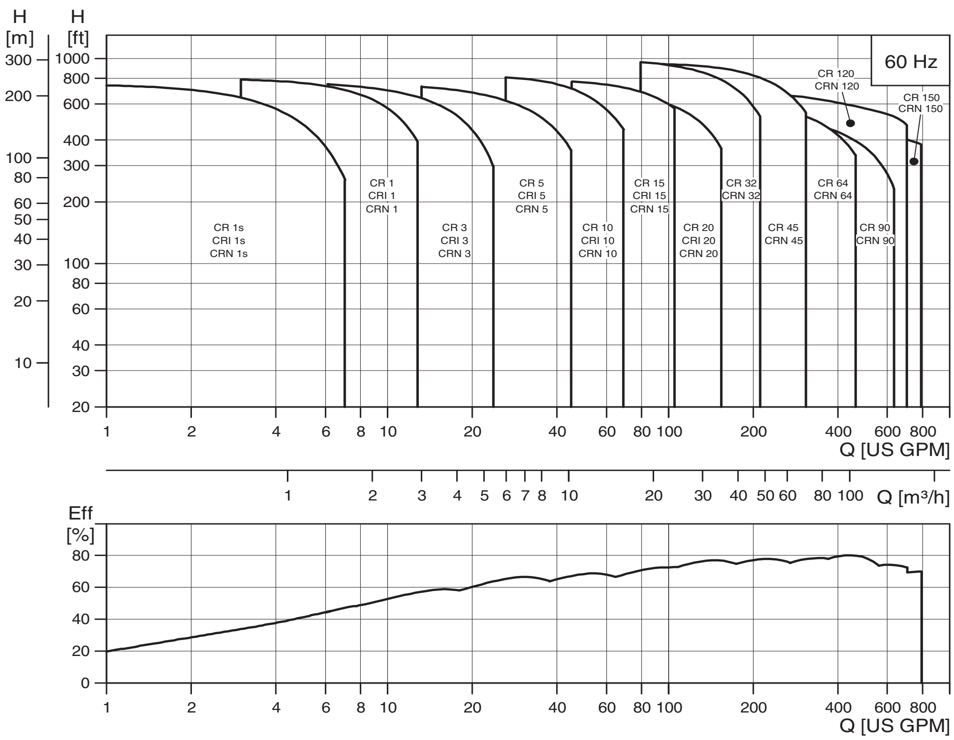
Select a CRE pump if:

- controlled operation is required, i.e. consumption fluctuates;
- constant pressure is required,
- communication with the pump is required.

Adaptation of performance through frequency-controlled speed control offers obvious advantages:

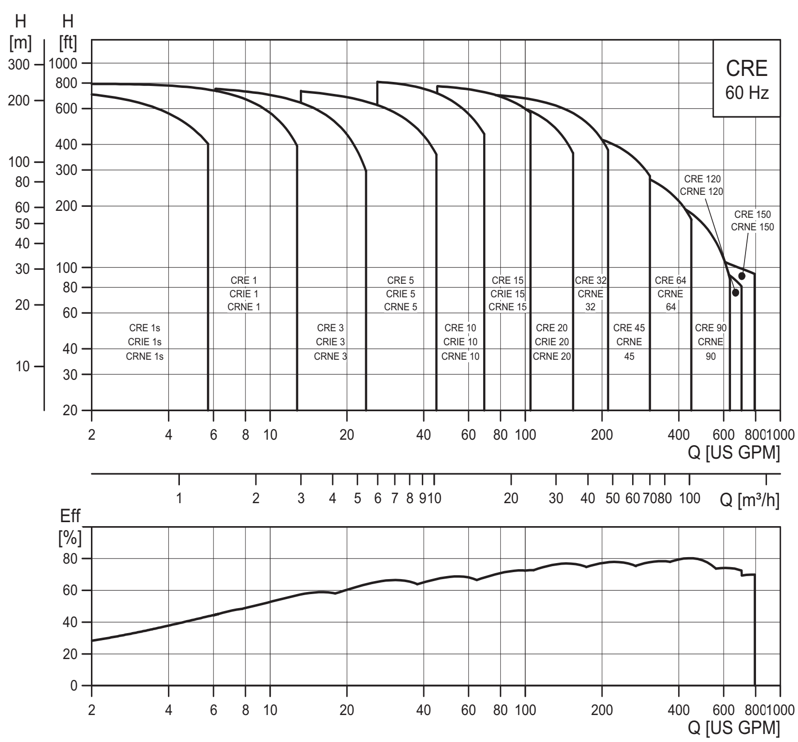
- Energy savings.
- Increased comfort.
- Control and monitoring of the pump performance.

Performance range - CR, CRI, CRN



TM02 5518 0209

Performance range - CRE, CRIE, CRNE



TM05 1598 3411

Product overview

Product range

Range	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20
Nominal flow rate [US GPM]	4.5	8.5	15	30	55	95	110
Temperature range [°F]				–4 to +250			
Temperature range [°F] – on request				–40 to +356			
Max. working pressure [psi]	362	362	362	362	362	362	362
Max. working pressure [psi] – on request	-	725	725	725	725	725	725
Max. pump efficiency [%]	35	49	59	67	70	72	72
CR pumps							
CR: Flow range [US GPM]	0.5-5.7	1 - 12.8	1.5 - 23.8	3 - 45	5.5 - 70	9.5 - 125	11-155
CR: Max. pump pressure (H[ft])	760	790	790	780	820	800	700
CR: Motor power [Hp]	.33 - 2	.33 - 3	.33 - 5	.75 - 7.5	.75 - 15	2 - 25	3-25
CRE pumps							
CRE: Flow range [US GPM]	-	0 - 12.8	0 - 23.8	0 - 45	0 - 70	0 - 125	0-155
CRE: Max. pump pressure (H[ft])	-	790	790	780	820	800	700
CRE: Motor power [Hp]	-	.33 - 3	.33 - 5	.75 - 7.5	.75 - 15	2 - 25	3-25
Version							
CR, CRE: Cast iron and stainless steel AISI 304	●	●	●	●	●	●	●
CRI, CRIE: Stainless steel AISI 304	●	●	●	●	●	●	●
CRN, CRNE: Stainless steel AISI 316	●	●	●	●	●	●	●
CRT, CRTE: Titanium	-			See CRT, CRTE product guide			-
CR, CRE pipe connection							
Oval flange (NPT)	1"	1"	1"	1.25"	2"	2"	2"
Oval flange (NPT) - on request	1.25"	1.25"	1.25"	1"	1.5"	-	-
ANSI flange size	1.25"	1.25"	1.25"	1.25"	2"	2"	2"
ANSI flange size - on request	-	-	-	-	-	-	-
ANSI flange class	250 lb.	250 lb.	250 lb.	250 lb.	250 lb.	250 lb.	250 lb.
CRI, CRIE pipe connection							
Oval flange (NPT)	1"	1"	1"	1.25"	2"	2"	2"
Oval flange (NPT) - on request	1.25"	1.25"	1.25"	1"	1.5"	-	-
ANSI flange size	1.25"	1.25"	1.25"	1.25"	2"	2"	2"
ANSI flange class	300 lb.	300 lb.	300 lb.	300 lb.	300 lb.	300 lb.	300 lb.
Clamp coupling (NPT) - on request	1", 1.25"	1", 1.25"	1", 1.25"	1", 1.25"	1.5", 2"	1.5", 2"	1.5" 2"
Union (NPT ext. Thread) - on request	2"	2"	2"	2"	-	-	-
CRN, CRNE pipe connection							
PJE (Victaulic)	1.25"	1.25"	1.25"	1.25"	2"	2"	2"
PJE (Victaulic) - on request	-	-	-	-	-	-	-
ANSI flange size	1.25"	1.25"	1.25"	1.25"	2"	2"	2"
ANSI flange size - on request	-	-	-	-	-	-	-
ANSI flange class	300 lb.	300 lb.	300 lb.	300 lb.	300 lb.	300 lb.	300 lb.
Clamp coupling (NPT) - on request	1", 1.25"	1", 1.25"	1", 1.25"	1", 1.25"	1.5", 2"	1.5", 2"	1.5", 2"
Union (NPT ext. Thread) - on request	2"	2"	2"	2"	-	-	-
CRT pipe connection							
PJE coupling (Vitaulic)	-	1.25"	1.25"	1.25"	2"	2"	-
ANSI flange size - on request	-	-	-	-	2"	2"	-

● Available

Product overview

Range	CR 32	CR 45	CR 64	CR 90	CR 120	CR 150
Nominal flow rate [US GPM]	140	220	340	440	610	750
Temperature range [°F]	–22 to +250 [1]				–22 to +250 [1) & 2)]	
Temperature range [°F] – on request	–40 to +356				-	-
Max. working pressure [psi]	435	435	360	360	360	360
Max. working pressure [psi] – on request	580	580	580	580	-	-
Max. pump efficiency [%]	76	78	79	80	75	73
CR pumps						
CR: Flow range [US GPM]	14-210	22-310	34-450	44-630	61-700	75-790
CR: Max. pump pressure (H[ft])	995	940	565	595	685	570
CR: Motor power [Hp]	5-50	7.5-60	10-60	15-60	20-100	25-100
CRE pumps						
CRE: Flow range [US GPM]	0-210	0-310	0-450	0-630	0-700	0-790
CRE: Max. pump pressure (H[ft])	720	490	335	285	140	155
CRE: Motor power [Hp]	5-30	7.5-30	10-30	15-30	20-25	25-30
Version						
CR, CRE: Cast iron and stainless steel AISI 304	●	●	●	●	●	●
CRI, CRIE: Stainless steel AISI 304	-	-	-	-	-	-
CRN, CRNE: Stainless steel AISI 316	●	●	●	●	●	●
CRT, CRTE: Titanium	-	-	-	-	-	-
CR, CRE pipe connection						
Oval flange (NPT)	-	-	-	-	-	-
Oval flange (NPT) - on request	-	-	-	-	-	-
ANSI flange size	2.5"	3"	4"	4"	5” [3]	5” [3]
ANSI flange size - on request	3"	4"	5" [3]	5" [3]	6”	6”
ANSI flange class	125/ 250 lb.	125/ 250 lb.	125/ 250 lb.	125/ 250 lb.	125/ 250 lb.	125/ 250 lb.
CRI, CRIE pipe connection						
Oval flange (NPT)	-	-	-	-	-	-
Oval flange (NPT) - on request	-	-	-	-	-	-
ANSI flange size	-	-	-	-	-	-
ANSI flange class	-	-	-	-	-	-
Clamp coupling (NPT) - on request	-	-	-	-	-	-
Union (NPT ext. Thread) - on request	-	-	-	-	-	-
CRN, CRNE pipe connection						
PJE (Victaulic)	-	-	-	-	-	-
PJE (Victaulic) - on request	3"	4"	4"	4"	4"	4"
ANSI flange size	2.5"	3"	4"	4"	5”	5”
ANSI flange size - on request	3"	-	-	5"	6"	6"
ANSI flange class	150/ 300 lb.	150/ 300 lb.	150/ 300 lb.	150/ 300 lb.	150/ 300 lb.	150/ 300 lb.
Clamp coupling (NPT) - on request	-	-	-	-	-	-
Union (NPT ext. Thread) - on request	-	-	-	-	-	-
CRT pipe connection						
PJE coupling (Vitaulic)	-	-	-	-	-	-
ANSI flange size - on request	-	-	-	-	-	-

● Available

[1] CRN 32 to CRN 90 with HQQE shaft seal: –40 °F to +250 °F

[2] CR, CRN 120 and 150 with 75 or 100 Hp motors with HBQE shaft seal: 0 °F to +250 °F

[3] CR 5" flange is not manufactured to ANSI specification. Gasket contact surface is approximately 0.25". CR 6" ANSI flange adapter is manufactured to ANSI B16.5 specification.

Product overview

Applications

Application	CR, CRI	CRN	CRE, CRNE
Water supply			
Filtration and transfer at waterworks	●	❍	●
Distribution from waterworks	●	❍	●
Pressure boosting in mains	●	❍	●
Pressure boosting in high-rise buildings, hotels, etc.	●	❍	●
Pressure boosting for industrial water supply	●	❍	●
Industry			
Pressure boosting in...			
process water systems	●	●	●
washing and cleaning systems	●	●	●
vehicle washing tunnels	●	❍	●
fire fighting systems	●		
Liquid transfer in...			
cooling and air-conditioning systems (refrigerants)	●	❍	●
boiler feed and condensate systems	●	❍	●
machine tools (cooling lubricants)	●	●	●
aquafarming★	●	❍	
Transfer of...			
oils and alcohols	●	●	●
acids and alkalis★		●	●
glycol and coolants	●		●
Water treatment			
Ultra-filtration systems		●	●
Reverse osmosis systems★		●	●
Softening, ion exchange, demineralizing systems		●	●
Distillation systems		●	●
Separators	●	●	●
Swimming pools★		●	●
Irrigation			
Field irrigation (flooding)	●	❍	
Sprinkler irrigation	●	❍	●
Drip-feed irrigation	●	❍	

● Recommended version.

❍ Alternative version.

★ CRT, CRTE version available. For further information about CRT, CRTE pumps see, "Pumped liquids" page 74 or related CRT, CRTE product guide.

Pump

The CR and CRE pump is a non-self-priming, vertical multistage centrifugal pump. The pumps are available with a Grundfos standard motor (CR pumps) or a frequency-controlled motor (CRE pumps).

The pump consists of a base and a pump head. The chamber stack and the outer sleeve are secured between the pump head and the base by means of staybolts. The base has suction and discharge ports on the same level (in-line).

All pumps are equipped with a maintenance-free mechanical shaft seal of the cartridge type.

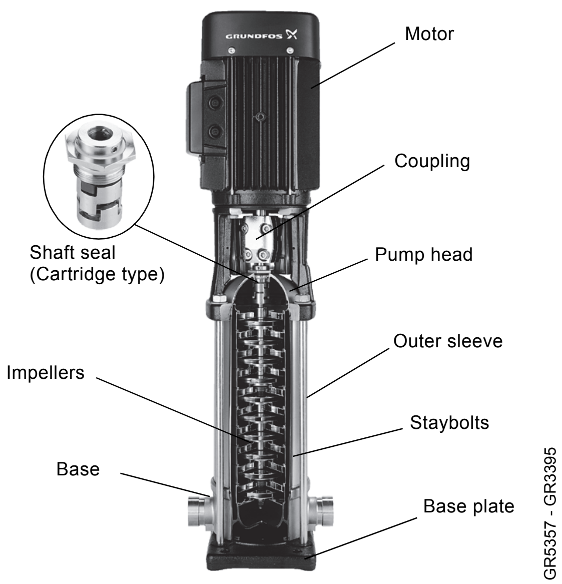


Fig. 3 CR pump

CR pump with ANSI/NSF 61 listing is available. See UL file MH26400 or contact Grundfos.

Motor

Grundfos standard motors - ML and Baldor® motors

CR, CRI and CRN pumps are fitted with a Grundfos specified motor. The motors are all heavy-duty 2-pole, NEMA C-face motors.

Frequency-controlled motors - MLE motors

CRE, CRIE and CRNE pumps are fitted with a totally enclosed, fan-cooled, 2-pole motor with integrated variable frequency drive.

From 0.5 Hp to 1.5 Hp Grundfos offers CRE pumps fitted with single-phase MLE motors (1 x 208-230 V). From 1.0 Hp to 30 Hp Grundfos offers CRE pumps fitted with three-phase MLE motors (3 x 460-480 V). From 1.5 Hp to 7.5 Hp Grundfos offers CRE pumps fitted with three-phase MLE motors (3 x 208-230 V).

Electrical data

Mounting designation	NEMA
Insulation class	F & B
Efficiency class*	Energy efficient Premium efficiency - on request for 15 Hp and above
Enclosure class	TEFC - Totally Enclosed Fan Cooled (Grundfos standard) ODP - Open Drip Proof - on request
60 Hz Standard voltages	1 x 115/208-230 V 3 x 208-230/460 V 3 x 575 V
Approvals	The motors are rated for: Baldor ML/MLE MLE LISTED

* 1 - 10 Hp ML motors are premium efficiency as standard

Optional motors

The Grundfos standard range of motors covers a wide variety of application demands. However, for special applications or operating conditions, custom-built motor solutions can be provided.

For special applications or operating conditions, Grundfos offers custom-built motors such as:

- explosion proof motors,
- motors with anti-condensation heating unit,
- low-noise motors,
- premium efficiency motors,
- motors with thermal protection.

Motor protection

Single-phase Grundfos specified motors up to 7.5 hp have a built-in thermal overload switch.

Three-phase motors **must** be connected to a motor starter in accordance with local regulations.

Terminal box positions

As standard the terminal box is mounted on the suction side of the pump.

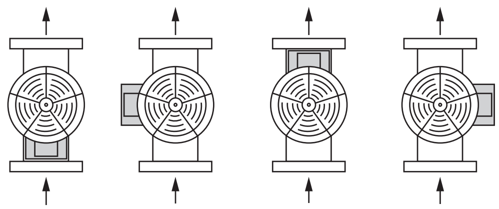


Fig. 4 Terminal box positions

Ambient temperature

Ambient temperature: Maximum +104 °F.

If the ambient temperature exceeds +104 °F or if the motor is located 3280 feet above sea level or higher, the motor output (P2) must be reduced due to the low cooling effect of the air. In such cases, it may be necessary to use a motor with a higher output.

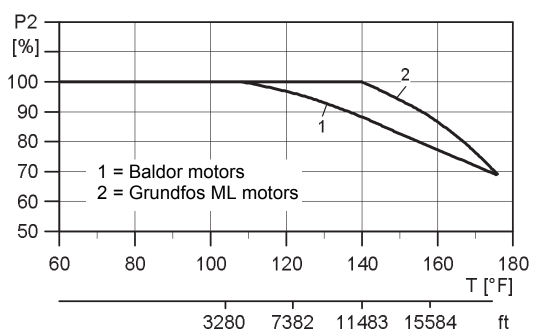


Fig. 5 Relationship between motor output (P2) and ambient temperature

Viscosity

The pumping of liquids with densities or kinematic viscosities higher than those of water will cause a considerable pressure drop, a drop in the hydraulic performance and a rise in the power consumption.

In such situations the pump should be equipped with a larger motor. If in doubt, contact Grundfos.

Examples of E-pump applications

CRE, CRIE and CRNE pumps are the ideal solution in a number of applications characterized by a need for variable flow at constant pressure. The pumps are suited for water supply systems and pressure boosting, but also industrial applications.

Depending on the nature of the application, the pumps offer energy-savings, increased comfort or improved processing.

E-pumps in the service of industry

Industry uses a large number of pumps in many different applications. Demands on pumps in terms of pump performance and mode of operation make speed control a must in many applications.

Below are mentioned some of the applications in which E-pumps are often used.

Constant pressure

- Water supply,
- Washing and cleaning systems,
- Distribution from waterworks,
- Humidifying systems,
- Water treatment systems,
- Process boosting systems, etc.

Example: Within industrial water supply, E-pumps with integrated pressure sensors are used to ensure a constant pressure in the piping network. From the sensor, the E-pump receives inputs about changes of pressure as a result of changes in the consumption. The E-pump responds to the input by adjusting the flow until the pressure is equalized. The constant pressure is stabilized once more on the basis of a preset setpoint.

Constant temperature

- Air-conditioning systems at industrial plants,
- Industrial cooling systems,
- Industrial freezing systems,
- Casting and molding tools, etc.

Example: In industrial freezing systems, E-pumps with temperature sensor increase comfort and lower operating costs compared with pumps without a temperature sensor.

An E-pump continuously adapts its performance to the changing demands reflected in the differences in temperature of the liquid circulating in the freezing system. Thus, the lower the demand for cooling, the smaller the quantity of liquid circulated in the system and vice versa.

Constant flow

- Steam boiler systems,
- Condensate systems,
- Sprinkler irrigation systems,
- Chemical industry, etc.

Example: In a steam boiler, it is important to be able to monitor and control pump operation to maintain a constant level of water in the boiler.

By using an E-pump with level sensor mounted in the boiler, it is possible to maintain a constant water level. A constant water level ensures optimum and cost-efficient operation as a result of a stabile steam production.

Dosing

- Chemical industry (i.e. control of pH-values),
- Petrochemical industry,
- Paint industry
- Degreasing systems,
- Bleaching systems, etc.

Example: In the petrochemical industry, E-pumps with pressure sensors are used as dosing pumps. The E-pumps help to ensure that the correct mixture ratio is achieved when more liquids are combined.

E-pumps functioning as dosing pumps improve processing and offer energy-savings.

E-pumps in commercial building services

Commercial building services use E-pumps to maintain a constant pressure or a constant temperature based on a variable flow.

E-pumps are used in applications such as

Constant pressure

- Water supply in high-rise buildings i.e. office buildings, hotels, etc.

Example: E-pumps with pressure sensors are used for water supply in high-rise buildings to ensure a constant pressure even at the highest draw-off point. As the consumption pattern and by that the pressure changes during the day, the E-pump continuously adapts its performance until the pressure is equalized.

Constant temperature

- Air-conditioning systems in hotels, schools,
- Building cooling systems, etc.

Example: E-pumps are an excellent solution in buildings where constant temperature is essential. E-pumps keep the temperature constant in air-conditioned high-rise glass buildings, irrespective of the seasonal fluctuations of the out-door temperature, and various heat impacts inside the building.

Control options of E-pumps

Communication with CRE, CRIE, CRNE pumps is possible by means of

- a central management system,
- remote control (Grundfos R100) or
- a control panel.

The purpose of controlling an E-pump is to monitor and control the pressure, temperature, flow and liquid level of the system.

Central management system

Communication with the E-pump is possible even though the operator is not present near the E-pump. Communication is enabled by having connected the E-pump to a central management system allowing the operator to monitor and change control modes and setpoint settings of the E-pump.

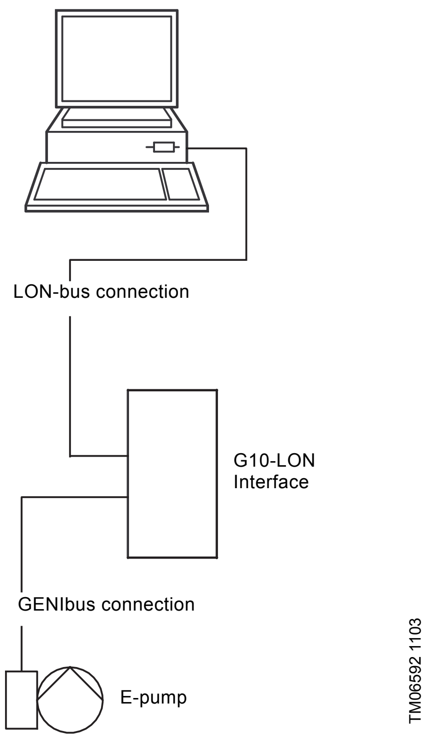


Fig. 6 Structure of a central management system

Remote control

The R100 remote control produced by Grundfos is available as an accessory.

The operator communicates with the E-pump by pointing the IR-signal transmitter at the control panel of the E-pump terminal box.

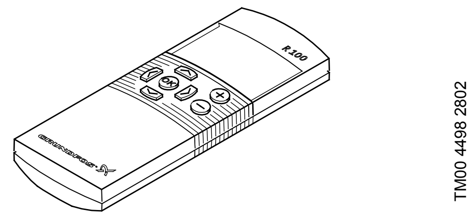


Fig. 7 R100 remote control

On the R100 display it is possible to monitor and change control modes and settings of the E-pump.

Control panel

The control panel of the E-pump terminal box makes it possible to change the setpoint settings manually.

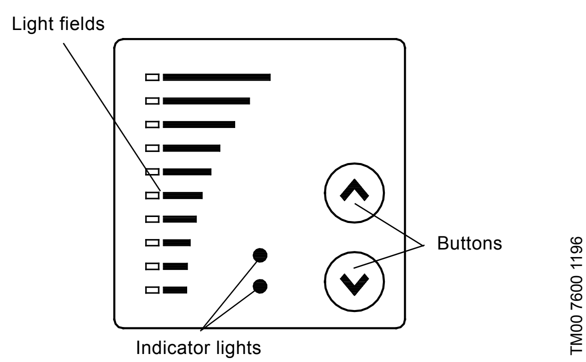


Fig. 8 Control panel on CRE pump

Control modes for E-pumps

Grundfos offers CRE, CRIE and CRNE pumps in two different variants:

- CRE, CRIE and CRNE with integrated pressure sensor
- CRE, CRIE and CRNE without sensor.

CRE, CRIE, CRNE with integrated pressure sensor

CRE, CRIE and CRNE pumps with integrated pressure sensors are suitable for applications where you want to control the pressure after the pump, irrespective of the flow. For further information, see the section *Examples of E-pump applications* on page 11. Signals of pressure changes in the piping system are transmitted continuously from the sensor to the pump.

The pump responds to the signals by adjusting its performance up or down to compensate for the pressure difference between the actual and the desired pressure. As this adjustment is a continuous process, a constant pressure is maintained in the piping system.

Fig. 9 CRE, CRIE and CRNE pumps

A CRE, CRIE or CRNE pump with integrated pressure sensor facilitates installation and commissioning. CRE, CRIE and CRNE pumps with integrated pressure sensor can be set to:

- constant-pressure mode (factory setting) or
- constant-curve mode.

In **constant-pressure** mode, the pump maintains a preset pressure after the pump, irrespective of the flow, see figure below.

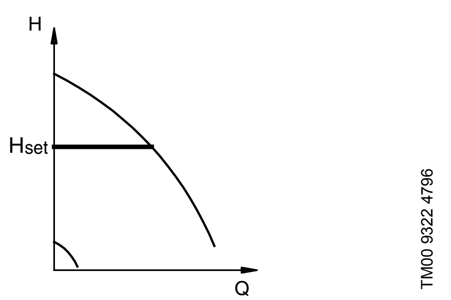


Fig. 10 Constant pressure mode

In **constant-curve** mode, the pump is not controlled. It can be set to pump according to a preset pump characteristic within the range from min. curve to max. curve, see figure below.

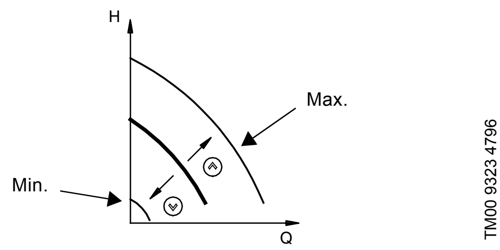


Fig. 11 Constant curve mode

CRE, CRIE and CRNE without sensor

CRE, CRIE and CRNE pumps without sensors are suitable for applications where

- uncontrolled operation is required
- you want to fit another sensor later in order to control the flow, temperature, differential temperature, liquid level, pH value, etc at some arbitrary point in the system.

CRE, CRIE and CRNE pumps without sensor can be set to:

- controlled-operation mode or
- uncontrolled-operation mode (factory-setting).

In **controlled**-operation mode, the pump adjusts its performance to the desired setpoint, see figure below.

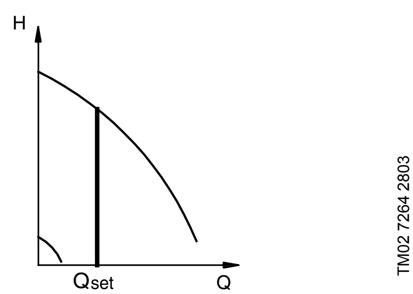


Fig. 12 Constant flow mode

In **uncontrolled**-operation mode, the pump operates according to the constant curve set, see figure below.

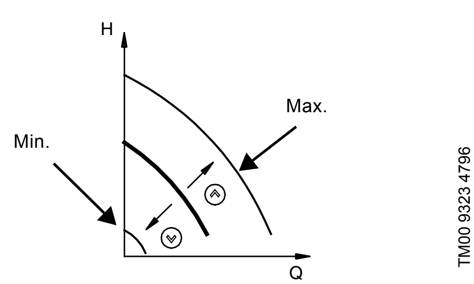


Fig. 13 Constant curve mode

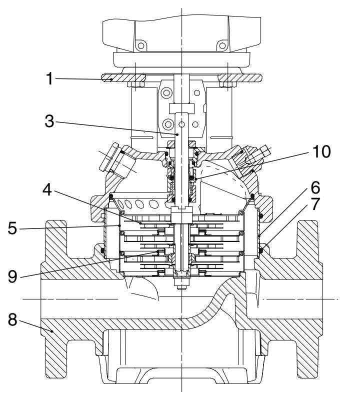
CRE, CRIE and CRNE pumps can be fitted with sensor types listed on page 82.

Construction

CR(E) 1s, 1, 3, 5, 10, 15 and 20

TM02 1198 0601 - GR7377 - GR7379

Sectional drawing



TM02 1194 1403

Materials: CR(E)

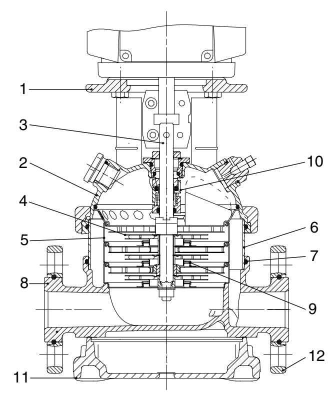
Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Cast iron	A 48-30 B
3	Shaft	Stainless steel	AISI 316 [1] AISI 431 [2]
4	Impeller	Stainless steel	AISI 304
5	Chamber	Stainless steel	AISI 304
6	Outer sleeve	Stainless steel	AISI 304
7	O-ring for outer sleeve	EPDM or FKM	
8	Base	Cast iron	A 48-30 B
9	Neck ring	PTFE	
10	Shaft seal	Cartridge type	
	Bearing rings	Silicon carbide	
	Rubber parts	EPDM or FKM	
12	FJG flange	Cast iron	A 48-30 B

[1] CR(E) 1s, 1, 3, 5
[2] CR(E) 10, 15, 20
[3] Stainless steel available on request.
[4] CF 8M is cast equivalent of AISI 316 stainless steel.
[5] CRI(E)/CRN(E) 1s, 1, 3, 5
[6] CRN(E) 10, 15, 20
[7] CRI(E) 10, 15, 20

CRI(E), CRN(E) 1s, 1, 3, 5, 10, 15 and 20

TM02 1808 2001 - GR7373 - GR7375

Sectional drawing



TM03 2156 3805

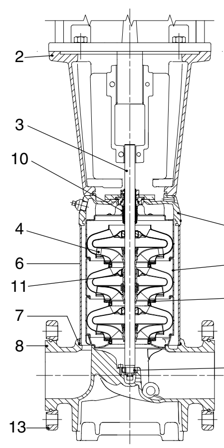
Materials: CRI(E), CRN(E)

Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Cast iron [3]	A 48-30 B
2	Pump head cover	Stainless steel	CF 8M[4]
3	Shaft	Stainless steel	AISI 316 [5] AISI 329 [6] AISI 431 [7]
8	Base	Stainless steel	CF 8M[4]
9	Neck ring	PTFE	
10	Shaft seal	Cartridge type	
11	Base plate	Cast iron [3]	A 48-30 B
	Bearing rings	Silicon carbide	
	Rubber parts	EPDM or FKM	
		CRI(E)	
4	Impeller	Stainless steel	AISI 304
5	Chamber	Stainless steel	AISI 304
6	Outer sleeve	Stainless steel	AISI 304
7	O-ring for outer sleeve	EPDM or FKM	
12	FGJ flange ring	Ductile iron [3]	A 65-45-12
	Oval flange	Stainless steel	AISI 316
		CRN(E)	
4	Impeller	Stainless steel	AISI 316
5	Chamber	Stainless steel	AISI 316
6	Outer sleeve	Stainless steel	AISI 316
7	O-ring for outer sleeve	EPDM or FKM	
12	FGJ flange ring	Ductile iron [3]	A 65-45-12

CR(E) 32, 45, 64 and 90

TM01 2150 1298

Sectional drawing



TM03 2157 3805

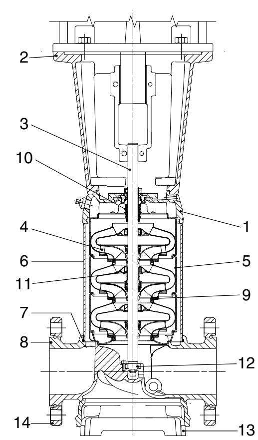
Materials: CR(E)

Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Ductile iron	A 65-45-12
2	Motor stool	Cast iron	A 48-30 B
3	Shaft	Stainless steel	AISI 431
4	Impeller	Stainless steel	AISI 304
5	Chamber	Stainless steel	AISI 304
6	Outer sleeve	Stainless steel	AISI 304
7	O-ring for outer sleeve	EPDM or FKM	
8	Base	Ductile iron	A 65-45-12
9	Neck ring	Acoflon 215	
10	Shaft seal	Cartridge type	
11	Bearing ring	Bronze	
12	Bottom bearing ring	Tungsten carbide/ Tungsten carbide	
13	Flange ring	Ductile iron[2]	A 65-45-12
	Rubber parts	EPDM or FKM	

CRN(E) 32, 45, 64 and 90

TM02 7399 3403

Sectional drawing



TM03 2158 3805

Materials: CRN(E)

Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Stainless steel	CF 8M [1]
2	Motor stool	Cast iron	A 48-30 B
3	Shaft	Stainless steel	SAF 2205
4	Impeller	Stainless steel	AISI 316
5	Chamber	Stainless steel	AISI 316
6	Outer sleeve	Stainless steel	AISI 316
7	O-ring for outer sleeve	EPDM or FKM	
8	Base	Stainless steel	CF 8M [1]
9	Neck ring	Acoflon 215	
10	Shaft seal	Cartridge type	
11	Bearing ring	Carbon-graphite filled PTFE	
12	Bottom bearing ring	Tungsten carbide/ Tungsten carbide	
13	Base plate	Ductile iron[2]	A 65-45-12
14	Flange ring	Ductile iron[2]	A 65-45-12
	Rubber parts	EPDM or FKM	

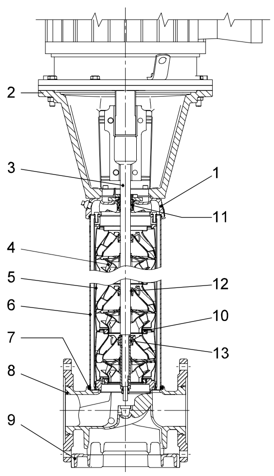
[1] CF 8M is cast equivalent of AISI 316 stainless steel.
[2] Stainless steel available on request.

Construction

CR(E) 120 and 150

GrA3731

Sectional drawing



TM03 8835 2607

Materials: CR(E)

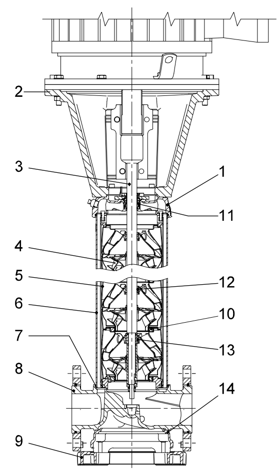
Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Ductile iron	A 536 65-45-12
2	Motor stool (15-60 Hp)	Cast iron	A48-30 B
	Motor stool (75-100 Hp)	Ductile iron	A 536 65-45-12
3	Shaft	Stainless steel	AISI 431
4	Impeller	Stainless steel	AISI 304
5	Chamber	Stainless steel	AISI 304
6	Outer sleeve	Stainless steel	AISI 316
7	O-ring for outer sleeve	EPDM or FKM	
8	Base	Ductile iron	A 536 65-45-12
9	Base plate	Ductile iron	A 536 65-45-12
10	Neck ring	PTFE	
11	Shaft seal[1)]	Cartridge type	
12	Support bearing	PTFE	
13	Bearing rings	Silicone carbide	
	Rubber parts	EPDM or FKM	

[1)] ∅22 mm shaft, 15-60 Hp. ∅32 mm shaft, 75-100 Hp.

CRN(E) 120 and 150

GrA3732 - GrA3735

Sectional drawing



TM03 8836 2607

Materials: CRN(E)

Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Stainless steel	A 351 CF 8M
2	Motor stool (15-60 Hp)	Cast iron	A48-30 B
	Motor stool (75-100 Hp)	Ductile iron	A 536 65-45-12
3	Shaft	Stainless steel	SAF 2205
4	Impeller	Stainless steel	AISI 316
5	Chamber	Stainless steel	AISI 316
6	Outer sleeve	Stainless steel	AISI 316
7	O-ring for outer sleeve	EPDM or FKM	
8	Base	Stainless steel	A 351 CF 8M
9	Base plate	Ductile iron[1)]	A 536 65-45-12
10	Neck ring	PTFE	
11	Shaft seal[2)]	Cartridge type	
12	Support bearing	PTFE	
13	Bearing rings	Silicone carbide	
14	Base plate	Ductile iron[1)]	A 536 65-45-12
	Rubber parts	EPDM or FKM	

[1)] Stainless steel available on request.
[2)] ∅22 mm shaft, 15-60 Hp. ∅32 mm shaft, 75-100 Hp.

Type keys and codes

Type keys

CR(E), CRI(E), CRN(E)

Example	CR E 32 (s) -4 -2 -A -G -G -E - HQQE
Type range: CR, CRI, CRN	CR
Pump with integrated frequency control	E
Nominal flow rate [m³/h]	32
All impellers with reduced diameter (applies only to CR, CRI, CRN 1s)	(s)
Number of impellers	-4
Number of reduced diameter impellers (CR(E), CRN(E) 32, 45, 64, 90, 120, and 150)	-2
Code for pump version	-A
Code for pipe connection	-G
Code for materials	-G
Code for rubber parts	-E
Code for shaft seal	- HQQE

Codes

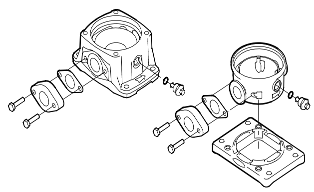
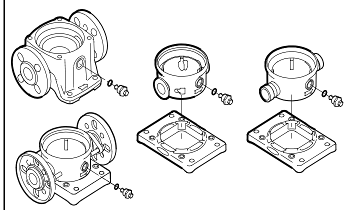
Example	A -G -A -E -H QQ E
Pump version	A
A	Basic version [1]
B	Oversize motor
E	Certificate/approval
F	CR pump for high temperatures (air-cooled top assembly)
H	Horizontal version
HS	High-pressure pump with high speed MLE motor
I	Different pressure rating
J	Pump with different max speed
K	Pump with low NPSH
M	Magnetic drive
N	Fitted with sensor
P	Undersize motor
R	Horizontal version with bearing bracket
SF	High pressure pump
T	Over size motor (two flange sizes bigger)
U	NEMA version [1]
X	Special version
Pipe connection	-G
A	Oval flange
B	NPT thread
CA	FlexiClamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)
CX	Triclamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)
F	DIN flange
G	ANSI flange
J	JIS flange
N	Changed diameter of ports
P	PJE coupling
X	Special version

Example	A -G -A -E -H QQ E
Materials	-A
A	Basic version
D	Carbon-graphite filled PTFE (bearings)
G	Wetted parts AISI 316
GI	All parts stainless steel, wetted parts AISI 316
I	Wetted parts AISI 304
II	All parts stainless steel, wetted parts AISI 304
K	Bronze (bearings)
S	SiC bearings + PTFE neck rings
X	Special version
Code for rubber parts	-E
E	EPDM
F	FXM
K	FFKM
V	FKM
Shaft seal	-H QQ E
A	O-ring seal with fixed driver
B	Rubber bellows seal
E	Cartridge seal with O-ring
H	Balanced cartridge seal with O-ring
K	Metal bellows cartridge seal
O	Double seal, back-to-back
P	Double seal, tandem
X	Special version
B	Carbon, synthetic resin-impregnated
H	Cemented tungsten carbide, embedded (hybrid)
Q	Silicon carbide
U	Cemented tungsten carbide
X	Other ceramics
E	EPDM
F	FXM
K	FFKM
V	FKM

[1] In August 2003 the NEMA version pump code was discontinued for all material numbers created by Grundfos manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or U as the pump version code depending on the date the material number was created.

Operating and inlet pressure

Maximum operating pressure and temperature range

			Oval flange		ANSI, Clamp, PJE	
			 TM02 1379 1101		 TM02 8835 0904	
			Max. permissible operating pressure	Liquid temperature range	Max. permissible operating pressure	Liquid temperature range
CR, CRI, CRN 1s			232 [psi]	–4 °F to +248 °F	362 [psi]	–4 °F to +248 °F
CR(E), CRI(E), CRN(E) 1			232 [psi]	–4 °F to +248 °F	362 [psi]	–4 °F to +248 °F
CR(E), CRI(E), CRN(E) 3			232 [psi]	–4 °F to +248 °F	362 [psi]	–4 °F to +248 °F
CR(E), CRI(E), CRN(E) 5			232 [psi]	–4 °F to +248 °F	362 [psi]	–4 °F to +248 °F
CR(E) 10-1	›	CR(E) 10-6	145 [psi]	–4 °F to +248 °F	-	-
CRI(E), CRN(E) 10-1	›	CRI(E), CRN(E) 10-10	232 [psi]	–4 °F to +248 °F	-	-
CR(E), CRI(E) 10-1	›	CR(E), CRI(E) 10-10	-	-	232 [psi]	–4 °F to +248 °F
CR(E), CRI(E) 10-12	›	CR(E), CRI(E) 10-17	-	-	362 [psi]	–4 °F to +248 °F
CRN(E) 10			-	- -	362 [psi]	–4 °F to +248 °F
CR(E) 15-1	›	CR(E) 15-5	145 [psi]	–4 °F to +248 °F	-	-
CRI(E), CRN(E) 15-1	›	CRI(E), CRN(E) 15-8	232 [psi]	–4 °F to +248 °F	-	-
CR(E), CRI(E) 15-1	›	CR(E), CRI(E) 15-8	-	-	232 [psi]	–4 °F to +248 °F
CR(E), CRI(E) 15-9	›	CR(E), CRI(E) 15-12	-	-	362 [psi]	–4 °F to +248 °F
CRN(E) 15			-	-	362 [psi]	–4 °F to +248 °F
CR(E) 20-1	›	CR(E) 20-5	145 [psi]	–4 °F to +248 °F	-	-
CRI(E), CRN(E) 20-1	›	CRI(E), CRN(E) 20-7	232 [psi]	–4 °F to +248 °F	-	-
CR(E), CRI(E) 20-1	›	CR(E), CRI(E) 20-7	-	-	232 [psi]	–4 °F to +248 °F
CR(E), CRI(E) 20-8	›	CR(E), CRI(E) 20-10	-	-	362 [psi]	–4 °F to +248 °F
CRN(E) 20			-	-	362 [psi]	–4 °F to +248 °F
CR(E), CRN(E) 32-1-1	›	CR(E), CRN(E) 32-5	-	-	232 [psi]	–22 °F to +248 °F
CR, CRN 32-6-2	›	CR, CRN 32-11-2	-	-	435 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 45-1-1	›	CR(E), CRN(E) 45-4-2	-	-	232 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 45-4-1	›	CR, CRN 45-8-1	-	-	435 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 64-1-1	›	CR(E), CRN(E) 64-3	-	-	232 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 64-4-2	›	CR(E), CRN(E) 64-5-2	-	-	435 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 90-1-1	›	CR(E), CRN(E) 90-3	-	-	232 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 90-4-2	›	CR(E), CRN(E) 90-4-1	-	-	435 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 120-1-1	›	CR(E), CRN(E) 120-5-1	-	-	435 [psi]	–22 °F to +248 °F
CR(E), CRN(E) 150-1-1	›	CR(E), CRN(E) 150-4-1	-	-	435[psi]	–22 °F to +248 °F

Operating and inlet pressure

Operating range of the shaft seal

The operating range of the shaft seal depends on operating pressure, pump type, type of shaft seal and liquid temperature. The following curves apply to clean water and water with anti-freeze liquids. For selecting the right shaft seal, see *List of pumped liquids* on page 74.

CR 1s - CR 20

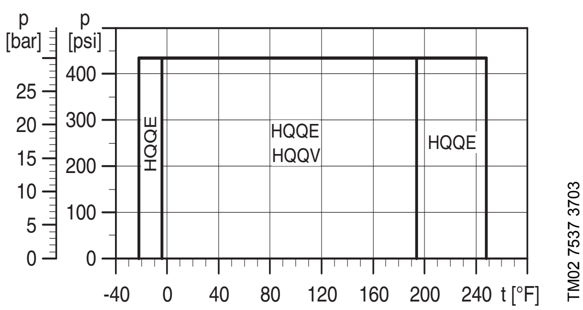


Fig. 14 Operating range of standard shaft seals for CR 1s - CR 20

CR 32 - CR 150 (3.0-60 Hp)

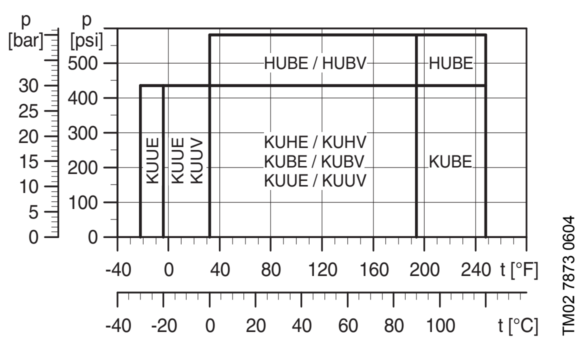


Fig. 15 Operating range of standard shaft seals for CR 32 - CR 150 (3.0-60 Hp)

CR 120 - CR 150 (75-100 Hp)

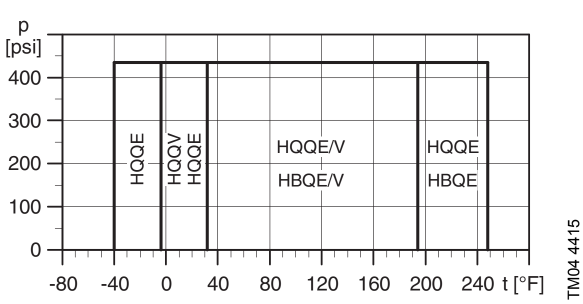


Fig. 16 Operating range of standard shaft seals for CR 120 - CR 150 (75-100 Hp)

Shaft seal	Description	Max. temp. range [°F]
HQQE	O-ring (cartridge) (balanced seal), SiC/SiC, EPDM	–22 °F to +248 °F
HBQE	O-ring (cartridge) (balanced seal), Carbon/SiC, EPDM	+32 °F to +248 °F
HQQV	O-ring (cartridge) (balanced seal), SiC/SiC, FKM	–4 °F to +194 °F
HUBE	O-ring (cartridge) (balanced seal), TC/carbon, EPDM	+32 °F to +248 °F
HUBV	O-ring (cartridge) (balanced seal), TC/carbon, FKM	+32 °F to +194 °F
KUBE	Bellows, metal (cartridge), TC/carbon, EPDM	+32 °F to +248 °F
KUBV	Bellows, metal (cartridge), TC/carbon, FKM	+32 °F to +194 °F
KUHE	Bellows, metal (cartridge), TC/Carbon with embedded TC, EPDM	+32 °F to +194 °F
KUHV	Bellows, metal (cartridge), TC/Carbon with embedded TC, FKM	+32 °F to +194 °F
KUUE	Bellows, metal (cartridge), TC/TC, EPDM	–22 °F to +194 °F
KUUV	Bellows, metal (cartridge), TC/TC, FKM	–4 °F to +194 °F

Note: TC= tungsten carbide

See section *Lists of variants - on request* on page 83, in case of extreme temperatures:

- low temperatures down to –40 °F or
- high temperatures up to +356 °F.

Operating and inlet pressure

Maximum inlet pressure

The following table shows the maximum permissible inlet pressure. However, the current inlet pressure + the pressure against a closed valve **must** always be lower than the maximum permissible operating pressure.

If the maximum permissible operating pressure is exceeded, the conical bearing in the motor may be damaged and the life of the shaft seal reduced.

CR, CRI, CRN 1s		
1s-2	› 1s-27	145 [psi]
CR(E), CRI(E), CRN(E) 1		
1-2	› 1-25	145 [psi]
1-27		218 [psi]
CR(E), CRI(E), CRN(E) 3		
3-2	› 3-15	145 [psi]
3-17	› 3-25	218 [psi]
CR(E), CRI(E), CRN(E) 5		
5-2	› 5-9	145 [psi]
5-10	› 5-24	218 [psi]
CR(E), CRI(E), CRN(E) 10		
10-1	› 10-5	116 [psi]
10-6	› 10-17	145 [psi]
CR(E), CRI(E), CRN(E) 15		
15-1	› 15-2	116 [psi]
15-3	› 15-12	145 [psi]
CR(E), CRI(E), CRN(E) 20		
20-1		116 [psi]
20-2	› 20-10	145 [psi]
CR(E), CRN(E) 32		
32-1-1	› 32-2	58 [psi]
32-3-2	› 32-6	145 [psi]
32-7-2	› 32-11-2	218 [psi]
CR(E), CRN(E) 45		
45-1-1	› 45-1	58 [psi]
45-2-2	› 45-3	145 [psi]
45-4-2	› 45-8-1	218 [psi]
CR(E), CRN(E) 64		
64-1-1		58 [psi]
64-1	› 64-2-1	145 [psi]
64-2	› 64-5-2	218 [psi]
CR(E), CRN(E) 90		
90-1-1	› 90-2-2	145 [psi]
90-2-1	› 90-4-1	218 [psi]
CR(E), CRN(E) 120		
120-1		145 [psi]
120-2-2	› 120-3	218 [psi]
120-4-2	› 120-5-1	290 [psi]
CR(E), CRN(E) 150		
150-1-1		145 [psi]
150-1	› 150-2	218 [psi]
150-3-2	› 150-4-1	290 [psi]

Example of operating and inlet pressures

The values for operating and inlet pressures shown in the tables must not be considered individually but must always be compared, see the following examples:

Example 1:

The following pump type has been selected:
CR 3-10 A-A-A

Max. operating pressure: **232 psi**
Max. inlet pressure: **145 psi**

Discharge pressure against a closed valve: **139.2 psi**, see page 34.

This pump is not allowed to start at an inlet pressure of 145 psi, but at an inlet pressure of 232.0 – 139.2 = **92.8 psi**.

Example 2:

The following pump has been selected:
CR 10-2 A-GJ-A

Max. operating pressure: **232 psi**
Max. inlet pressure: **116 psi**

Discharge pressure against a closed valve:
42 psi (97 ft), see page 42.

This pump is allowed to start at an inlet pressure of 116 psi, as the discharge pressure is only 42 psi, which results in an operating pressure of 116 + 42 = **158 psi**. On the contrary, the max. operating pressure of this pump is limited to 158 psi, as a higher operating pressure will require an inlet pressure of more than 116 psi.

In case the inlet or operating pressure exceeds the pressure permitted, see section *Lists of variants - on request* on page 83.

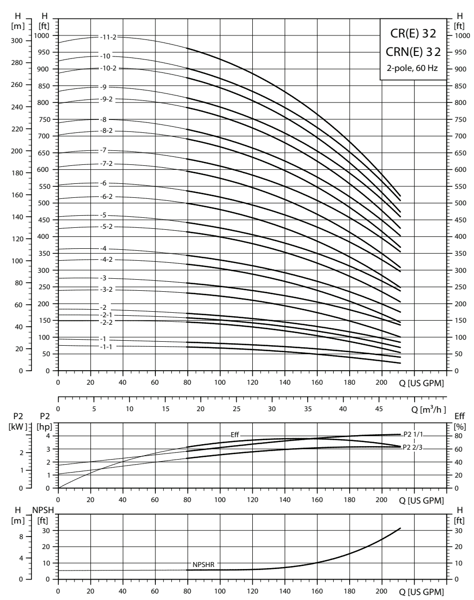
Selection of pumps

Selection of pumps should be based on

- The duty point of the pump (see section 1)
- Sizing data such as pressure loss as a result of height differences, friction loss in the pipework, pump efficiency etc. (see section 2)
- Pump materials (see section 3)
- Pump connections (see section 4)
- Shaft seal (see section 5).

1. Duty point of the pump

From a duty point it is possible to select a pump on the basis of the curve charts in the section *Performance curves/Technical data* starting on page 26.



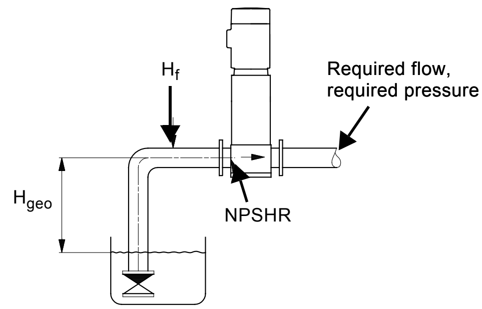
TM02 0039 1303

Fig. 17 Example of a curve chart

2. Sizing data

When sizing a pump the following must be taken into account.

- Required flow and pressure at the point of use.
- Pressure loss as a result of height differences (H_{geo}).
- Friction loss in the pipework (H_f).
  It may be necessary to account for pressure loss in connection with long pipes, bends or valves, etc.
- Best efficiency at the estimated duty point.
- NPSH value.
  For calculation of the NPSH value, see *Minimum inlet pressure - NPSHA* on page 24.

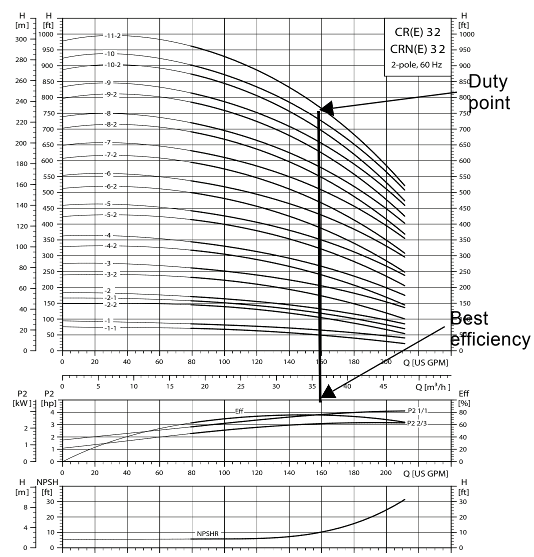


TM02 6711 1403

Fig. 18 Sizing data

Efficiency

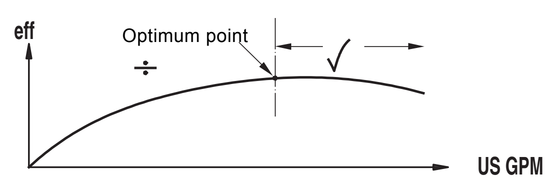
Before determining the point of best efficiency the operation pattern of the pump needs to be identified. Is the pump expected to operate at the same duty point, then select a CR pump which is operating at a duty point corresponding with the best efficiency of the pump.



TM02 0039 1303

Fig. 19 Example of a CR pump's duty point

As the pump is sized on the basis of the highest possible flow, it is important to always have the duty point to the right of the optimum efficiency point (see fig. 20, range with check mark). This must be considered in order to keep efficiency high when the flow drops.



TM02 8579 0504

Fig. 20 Best efficiency

Normally, E-pumps are used in applications characterized by a variable flow. Consequently, it is not possible to select a pump that is constantly operating at optimum efficiency.

In order to achieve optimum operating economy, the pump should be selected on the basis of the following criteria:

- The max. required duty point should be as close as possible to the QH curve of the pump.
- The required duty point should be positioned so that P2 is close to the max. point of the 100 % curve.

Between the min. and max. performance curve E-pumps have an infinite number of performance curves each representing a specific speed. Therefore it may not be possible to select a duty point close to the 100 % curve.

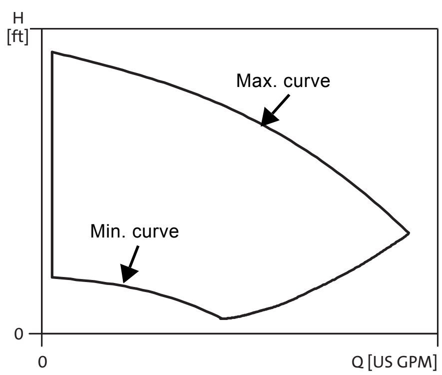


Fig. 21 Min. and max. performance curves

In situations where it is not possible to select a duty point close to the 100 % curve the affinity equations to the right can be used. The head (H), the flow (Q) and the input power (P) are all the appropriate variables for the motor speed (n).

Note:

The approximated formulas apply on condition that the system characteristic remains unchanged for nn and nx and that it is based on the formula H = k x Q2, where k is a constant.

The power equation implies that the pump efficiency is unchanged at the two speeds. In practice this is **not** quite correct.

Finally, it is worth noting that the efficiencies of the frequency converter and the motor **must** be taken into account if a precise calculation of the power saving resulting from a reduction of the pump speed is wanted.

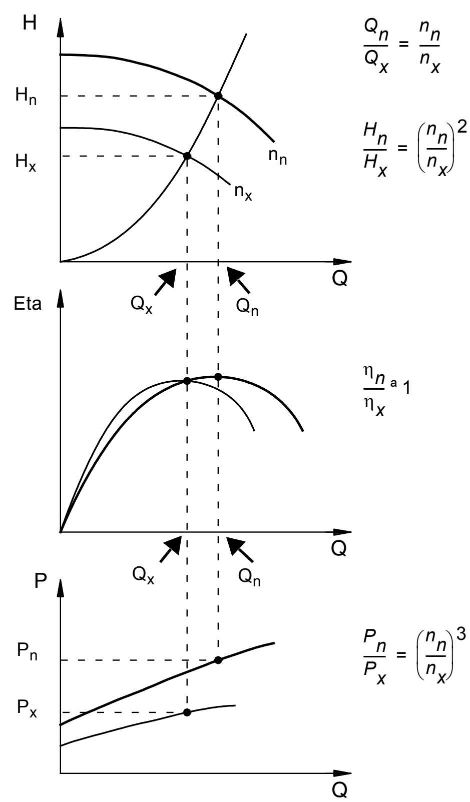


Fig. 22 Affinity equations

Legend

H_n	Rated head in feet
H_x	Current head in feet
Q_n	Rated flow in US GPM
Q_x	Current flow in US GPM
n_n	Rated motor speed in min^{-1} (n_n = 3500 min^{-1})
n_x	Current motor speed in min^{-1}
η_n	Rated efficiency in %
η_x	Current efficiency in %

WinCAPS and WebCAPS
WinCAPS and WebCAPS are both selection programs offered by Grundfos.

The two programs make it possible to calculate an E-pump's specific duty point and energy consumption.

By entering the sizing data of the pump, WinCAPS and WebCAPS can calculate the exact duty point and energy consumption. For further information see page 89 and page 90.

3. Material
The material variant (CR(E), CRI(E), CRN(E)) should be selected based of the liquid to be pumped. The product range covers three basic types.

- The CR(E), CRI(E) pump types are suitable for clean, non-aggressive liquids such as potable water, oils, etc.
- The CRN(E) pump type is suitable for industrial liquids and acids, see *List of pumped liquids* on page 74 or contact Grundfos.

For saline or chloride-containing liquids such as sea water, CRT(E) pumps of titanium are available.

4. Pump connection
Selection of pump connection depends on the rated pressure and pipework. To meet any requirement the CR(E), CRI(E) and CRN(E) pumps offer a wide range of flexible connections such as:

- Oval flange (NPT) - fig. 24
- ANSI flange - fig. 24
- PJE coupling - fig. 24
- Clamp coupling
- Union (NPT[M])
- Other connections on request.

5. Shaft seal
As standard, the CR(E) range is fitted with a Grundfos shaft seal (Cartridge type) suitable for the most common applications, see fig. 25.

The following three key parameters **must** be taken into account, when selecting the shaft seal:

- Type of pumped liquid
- liquid temperature and
- Maximum pressure.

Grundfos offers a wide range of shaft seal variants to meet specific demands see *List of pumped liquids* on page 74.

6. Inlet pressure and operating pressure
Do **not** exceed the limit values stated on page 18 and page 20 as regards these pressures:

- maximum inlet pressure and
- maximum operating pressure.

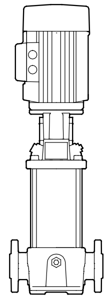


Fig. 23 CR pump

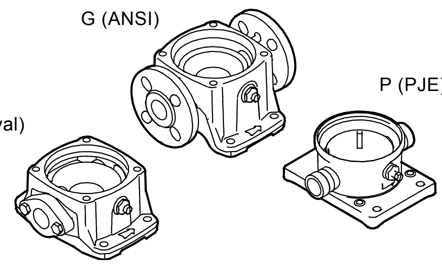


Fig. 24 Pump connections

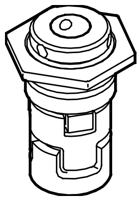


Fig. 25 Shaft seal (Cartridge type)

Minimum inlet pressure - NPSHA

Calculation of the inlet pressure "H" is recommended in these situations:

- The liquid temperature is high,
- The flow is significantly higher than the rated flow,
- Water is drawn from depths,
- Water is drawn through long pipes,
- Inlet conditions are poor.

To avoid cavitation, make sure that there is a minimum pressure on the suction side of the pump. The maximum suction lift "H" in feet can be calculated as follows:

$H = p_b - NPSHR - H_f - H_v - H_s$

P_b = Barometric pressure in feet absolute. (Barometric pressure can be set to 33.9 feet. At sea level. In closed systems, pb indicates system pressure in feet.)

NPSHR = Net Positive Suction Head Required in feet. (To be read from the NPSHR curve at the highest flow the pump will be delivering).

H_f = Friction loss in suction pipe in feet. (At the highest flow the pump will be delivering.)

H_v = Vapor pressure in feet. (To be read from the vapor pressure scale. "H_v" depends on the liquid temperature "T_m").

H_s = Safety margin = minimum 2.0 feet.

If the "H" calculated is positive, the pump can operate at a suction lift of maximum "H" feet.

If the "H" calculated is negative, an inlet pressure of minimum "H" feet is required.

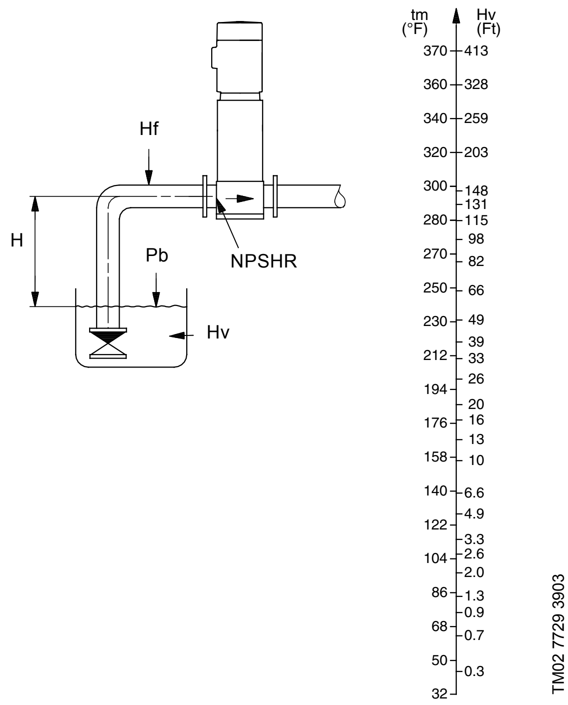


Fig. 26 Minimum inlet pressure - NPSHR

Note: In order to avoid cavitation **never**, select a pump whose duty point lies too far to the right on the NPSHR curve.

Always check the NPSHR value of the pump at the highest possible flow.

In case a lower NPSHR value is required, see *Lists of variants - on request* on page 83.

How to read the curve charts

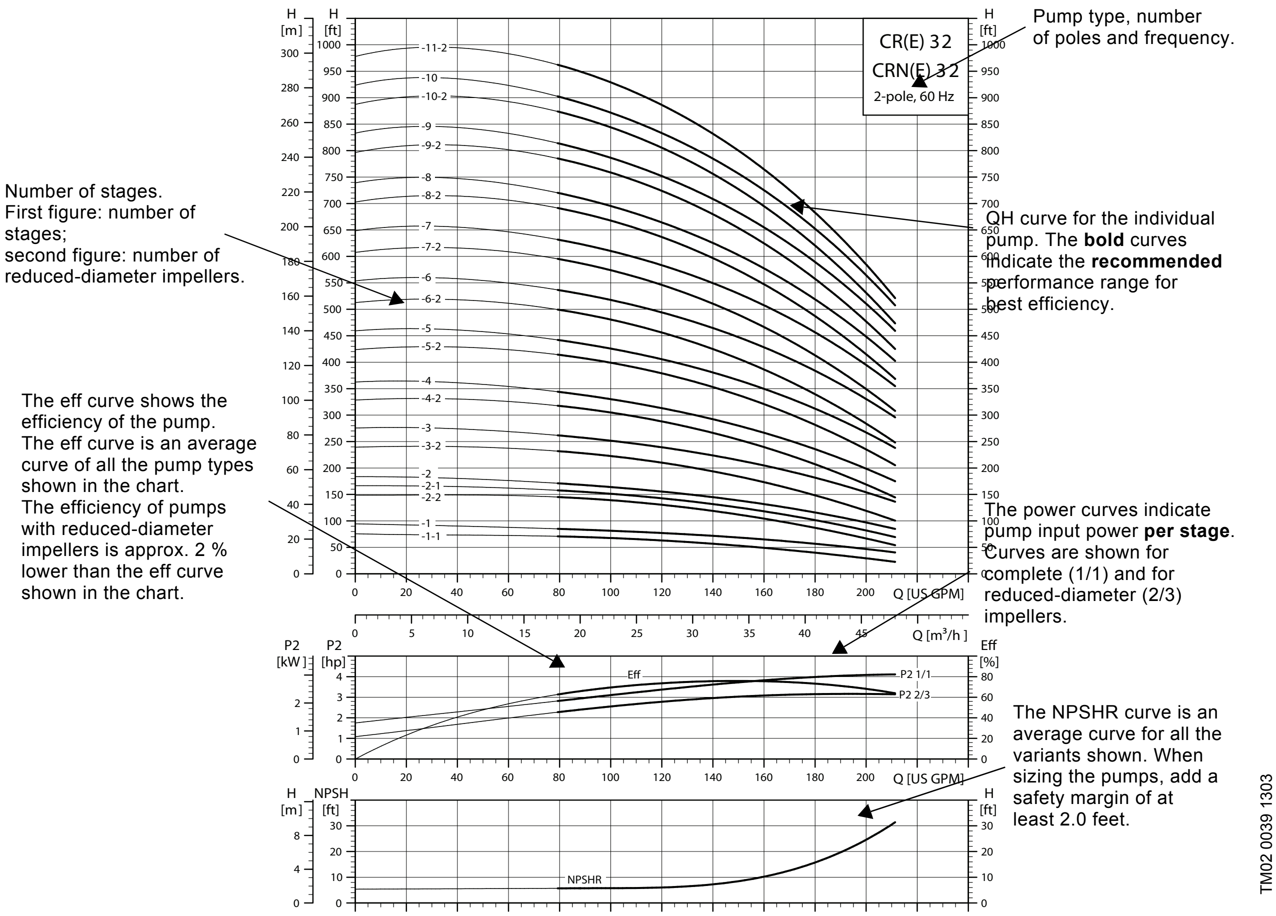


Fig. 27 How to read the curve charts

Guidelines to performance curves

The guidelines below apply to the curves shown on the following pages:

1. The motors used for the measurements are standard motors (ODP, TEFC or MLE).
2. Measurements have been made with airless water at a temperature of 68 °F.
3. The curves apply to a kinematic viscosity of $\upsilon = 1\ mm^2/s$ (1 cSt).
4. Due to the risk of overheating, the pumps should not be used at a flow below the minimum flow rate.
5. The QH curves apply to actual speed with the motor types mentioned at 60 Hz.

The curve below shows the minimum flow rate as a percentage of the nominal flow rate in relation to the liquid temperature. The dotted line shows a CR pump fitted with an air-cooled top assembly.

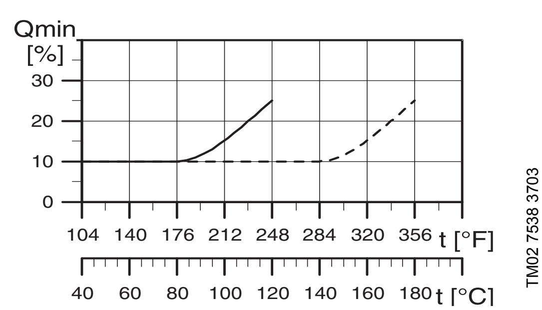


Fig. 28 Minimum flow rate