aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Low Speed High Torque Motors

MRT - MRTF - MRTE - MRTA

Calzoni Radial Piston Technology

Parker

ENGINEERING YOUR SUCCESS.

TABLE OF CONTENTS

GENERAL INFORMATION

Calzoni motors belong to fluid column radial piston type, designed for high mechanical and volumetric efficiency in a wide range of speed and torque.

Typical characteristics of Calzoni motors are:
- high volumetric efficiency (up to 98%);
- high mechanical efficiency;
- high starting torque;
- wide operating temperature range;
- smooth rotation even at lowest speeds;
- reversible operation (motor and pump);
- ATEX version available for usage in potentially explosive atmospheres (Directive 94/9/EC).

The MRT motors are combined in 5 different frame sizes, corresponding to 23 different displacements available, from 7100 cc/rev to 53000 cc/rev. Each motor can be customized by selecting different types of shaft, speed sensors, seals, connection flanges, and adding manifolds, gearboxes and brakes.
In this way we combine performances and efficiency with flexibilty, enabling the customers to optimize the drive system according to their needs.

Application examples:
- injection molding machine;
- winches;
- slewing drives;
- stone crushers;
- conveyors;
- material handling;
- mining industry;
- industrial applications;
- marine applications.

FEATURES

The double eccentric design of Calzoni MRT motors is such to have the radial forces generated during operations on each cam balancing each other: close to zero reaction on bearings. This characteristic, unique of MRT Calzoni design, guarantees an extremely long lifetime in service, high reliability with consequent very substantial reduction of downtime costs in demanding applications.

The motors can be also equipped with optional built-on manifold blocks (cross relief, anti-cavitation, internal flushing and internal drain valves) and customizations to suite customer needs.

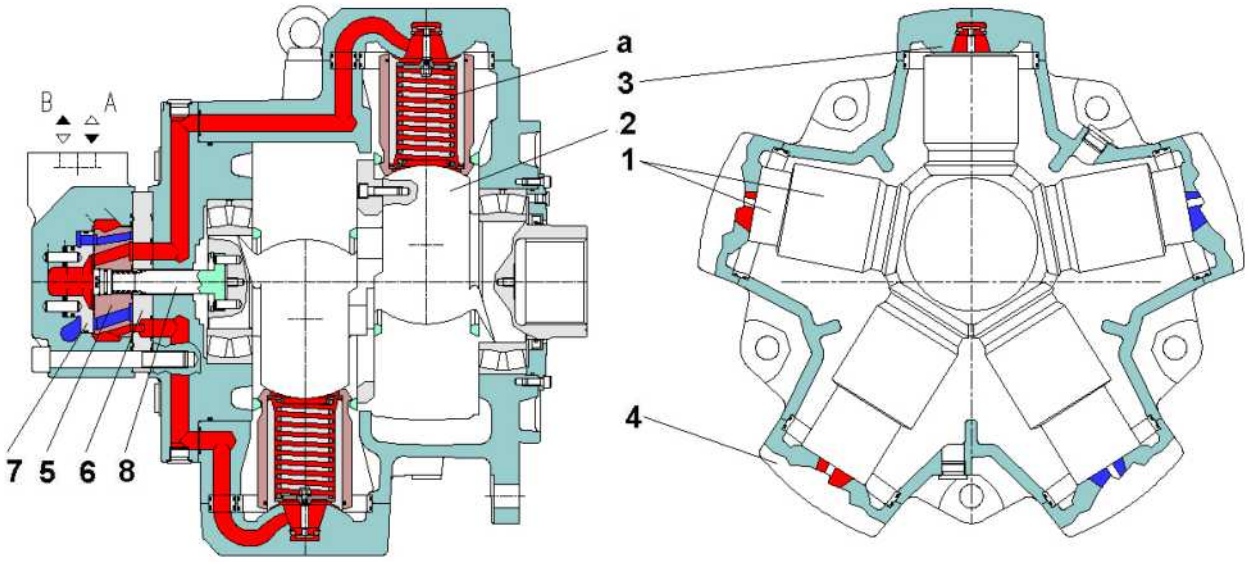
FUNCTIONAL DESCRIPTION

The outstanding performance is the result of an original and patented design. The principle is to transmit the effort from the stator to the rotating shaft **(1)** by means of a pressurized column of hydraulic fluid **(A)** instead of the more common connecting rods, pistons, pads and pins. This fluid column is contained by a telescopic cylinder **(2)** with a mechanical connection at the lips at each end which seal against the spherical surfaces **(3)** of the cylinder heads **(4)** and the spherical surface of the rotating shaft **(1)**. These lips retain their circular cross section when stressed by the pressure so there is no alteration in the sealing geometry. The particular selection of materials and optimisation of design has minimized both the friction and the leakage. Another advantage of this design stems from the elimination of any connecting rods, the cylinder can only expand and retract linearly so there are no transverse components of the thrust. This means no oval wear on the moving parts and no side forces on the cylinder joints. A consequence of this novel design as a 10 piston motor is the significant reduction in dimensions. Especially the diameter is limitated to a value of motors with half of its capacity. Performances reached by this motor type are improved with reference to other motors of same diplacement. Another advantage stems from the geometrical arrangement of the 10 - 14 pistons, that results in a static balance of the motor shaft and in a great reduction of the reaction forces on the bearings with consequent large extension of their life time.

The **timing system** is realized by means of a rotary valve **(5)** driven by the rotary valve driving shaft **(8)** that it is connected to the rotating shaft. The rotary valve rotates between the rotary valve plate **(6)** and the reaction ring **(7)** which are fixed with the motor's housing. This timing system is also of a patented design being pressure balanced and self compensating for thermal expansion.

Efficiency

The advantages of this type of valve coupled with a revolutionary cylinder arrangement produce a motor with extremly high values of mechanical and volumetric efficiency. The torque output is smooth even at very low speed and the motor gives a high performance starting under load.



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TECHNICAL DATA

MOTOR TYPE	DISPLACE-MENT	SPECIFIC TORQUE	MAXIMUM PRESSURE				MAXIMUM SPEED		MAXIMUM OUTPUT POWER		WEIGHT
							flushing		flushing		
			CONT.	INTER.	PEAK	A+B	without*	with	without*	with	
	cc/rev	Nm/bar	bar	bar	bar	bar	rpm	rpm	kW	kW	kg**
MRT 7100 P	7100	113	250	300	420	400	75	150	200	330	920
MRTF 7800 P	7809	124	210	250	350		70	130	174	280	
MRTE 8500 P	8517	136					60	120	164	290	
MRT 9000 P	9005	143	250	300	420		70	130	235	370	
MRTF 9900 P	9904	158	210	250	350		60	120	185	300	
MRTE 10800 P	10802	172					65	110	216	310	
MRTA 12000 P	12012	191	190	230	330		60	105	203	290	
MRT 13000 R	12921	206	250	300	420	400	65	110	220	355	1490
MRT 14000 R	13935	222					60	105	220	365	
MRTF 15200 R	15194	242					55	95	220	365	
MRTE 16400 R	16453	262					50	85	220	365	
MRTA 17500 R	17488	278	230	280	400		40	70	220	345	
MRT 17000 Q	16759	267	250	300	420	400	40	70	260	371	3100
MRTF 18000 Q	18025	287	210	250	350		35	65	208	316	
MRT 19500 Q	19508	310	250	300	420		35	60	269	371	
MRTE 20000 Q	19788	315	210	250	350		35	60	228	316	
MRTF 21500 Q	21271	339					30	55	211	311	
MRTE 23000 Q	23034	367					30	50	225	306	
MRTA 26000 Q	26029	414	190	230	330		25	40	150	258	
MRTA 30000 T	30030	478	190	230	330	400	25	35	155	262	3300
MRTA 35000 T	35025	557					20	30	155	270	
MRT 50000 U	49876	794	250	300	420	400	15	25	260	375	5000
MRTE 53000 U	53256	848	210	250	350		15	20	165	280	

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* When the first of the indicated values for speed and output power is achieved, flushing is required. See Operating Diagrams for details.

** Motors with female output shaft option are considered for weight calculation.

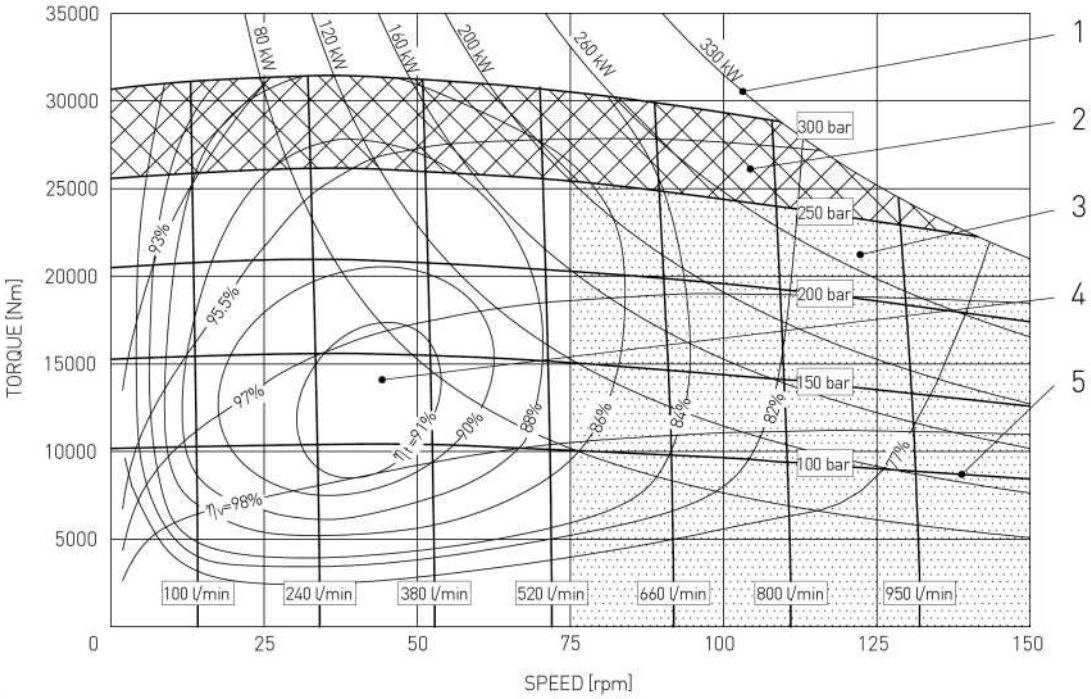
Construction	Fixed displacement radial piston motors
Max case drain pressure	5 bar with standard shaft seal; 15 bar with "F1" shaft seal
Viscosity range	18 to 1000 mm^2/s; recommended operating range 30 to 50 mm^2/s in motorhousing, must be adhered to with high constant powers. For different values of viscosity please contact the manufacturer.
Hydraulic fluid	HLP mineral oil to DIN 51524 part 2; HFB and HFC as well as bio-degradable fluids on request; with phosphate ester (HFD), FPM seals are necessary
Temperature range	-30 to 80 °C
Cleanliness class to ISO codes	Maximum permissible level of fluid contamination: class 9 according to NAS 1638. We therefore recommend a filter with a minimum grade of filtration $b_{10} \geq 75$. To ensure a long life we recommend class 8 according to NAS 1638; this can be achieved with a filter with a minimum grade of filtration $b_5 \geq 100$. For further information see page 42, "Hydraulic fluid selection".
Direction of rotation	Reversible (clockwise / anti-clockwise)

OPERATING DIAGRAM

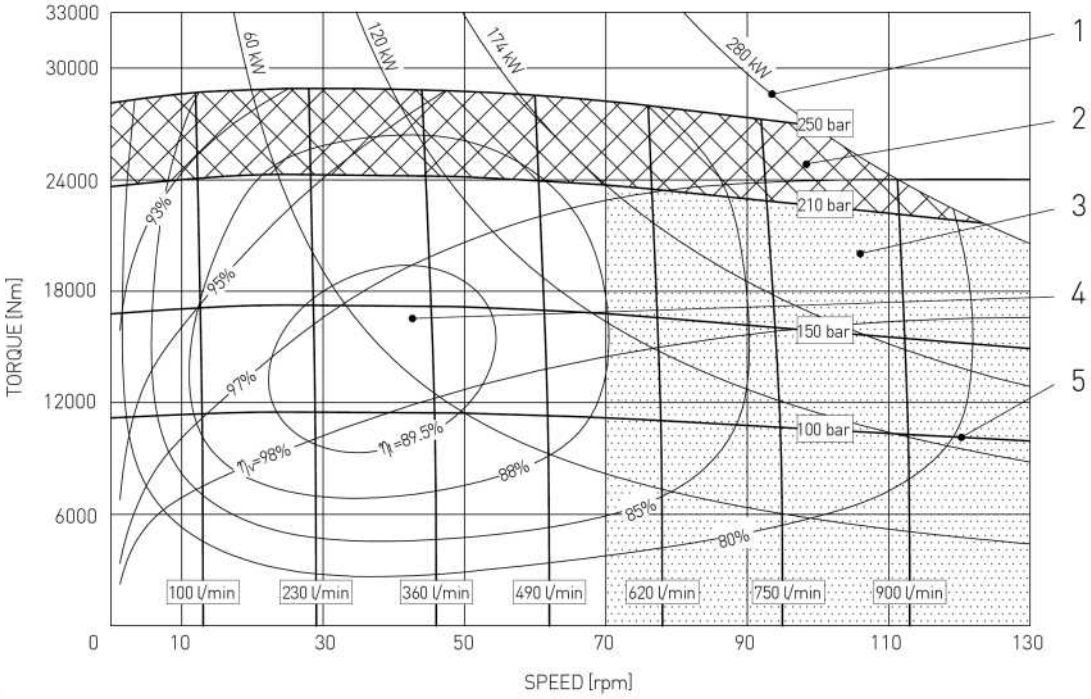
(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRT 7100 P



MRTF 7800 P

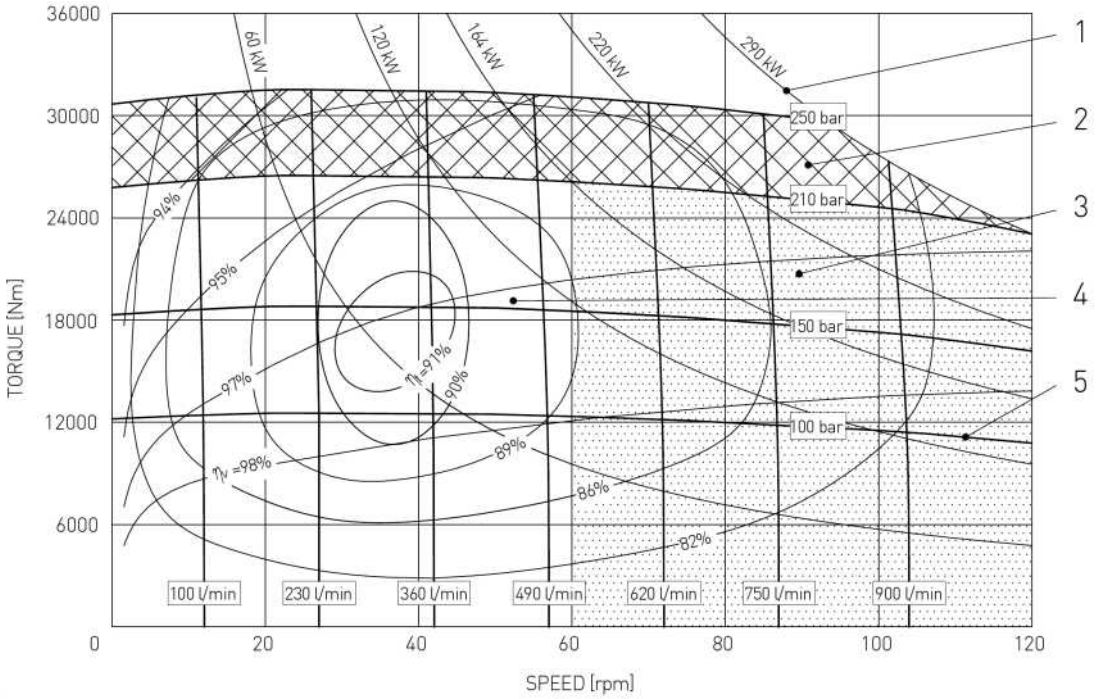


OPERATING DIAGRAM

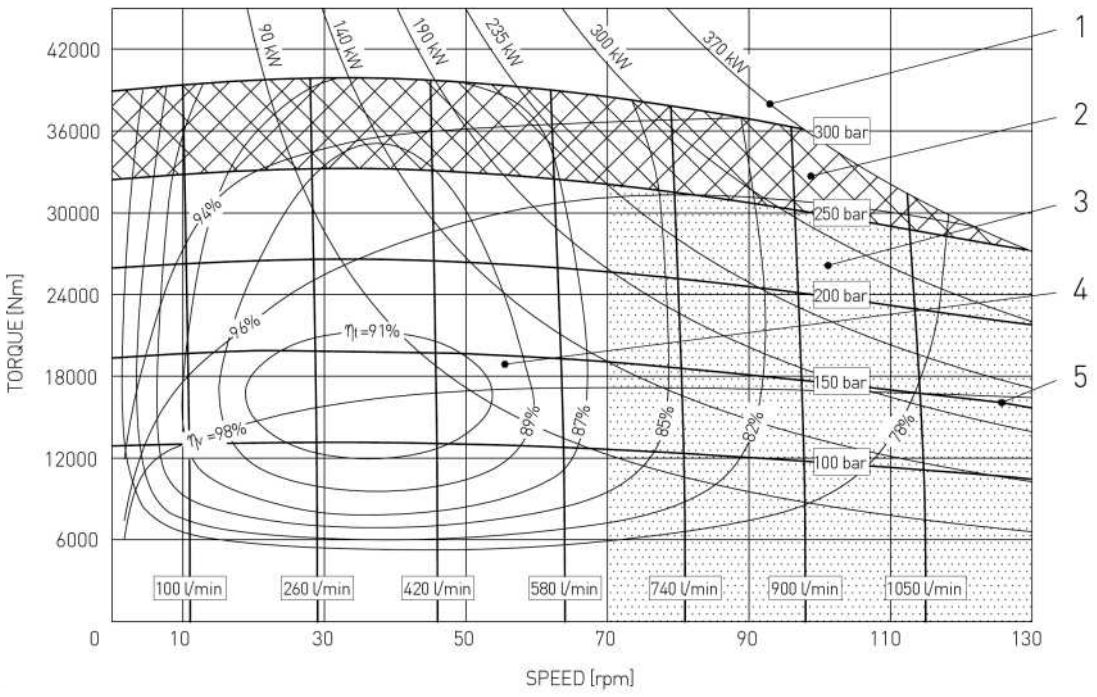
(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRTE 8500 P



MRT 9000 P



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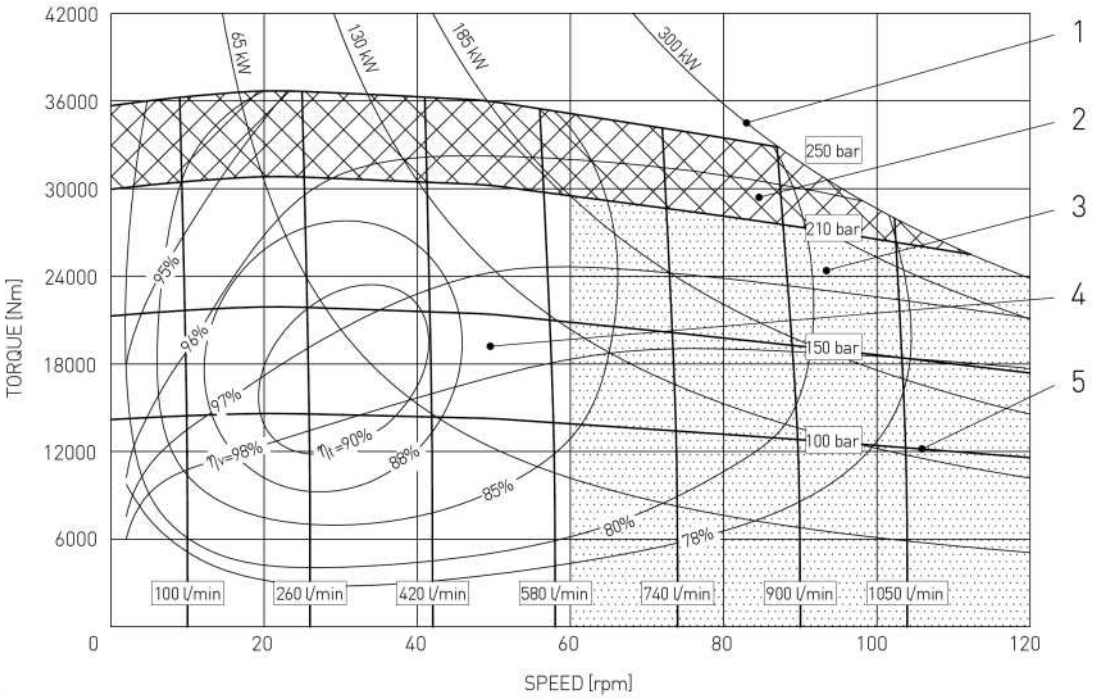
OPERATING DIAGRAM

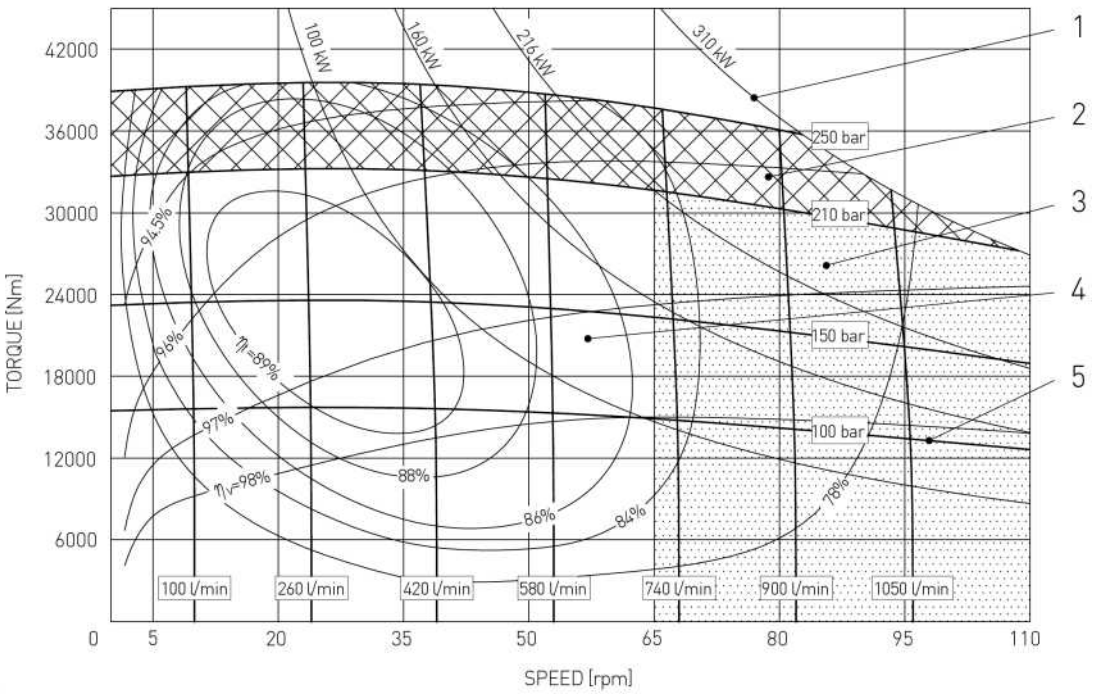
(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRTF 9900 P



MRTE 10800 P



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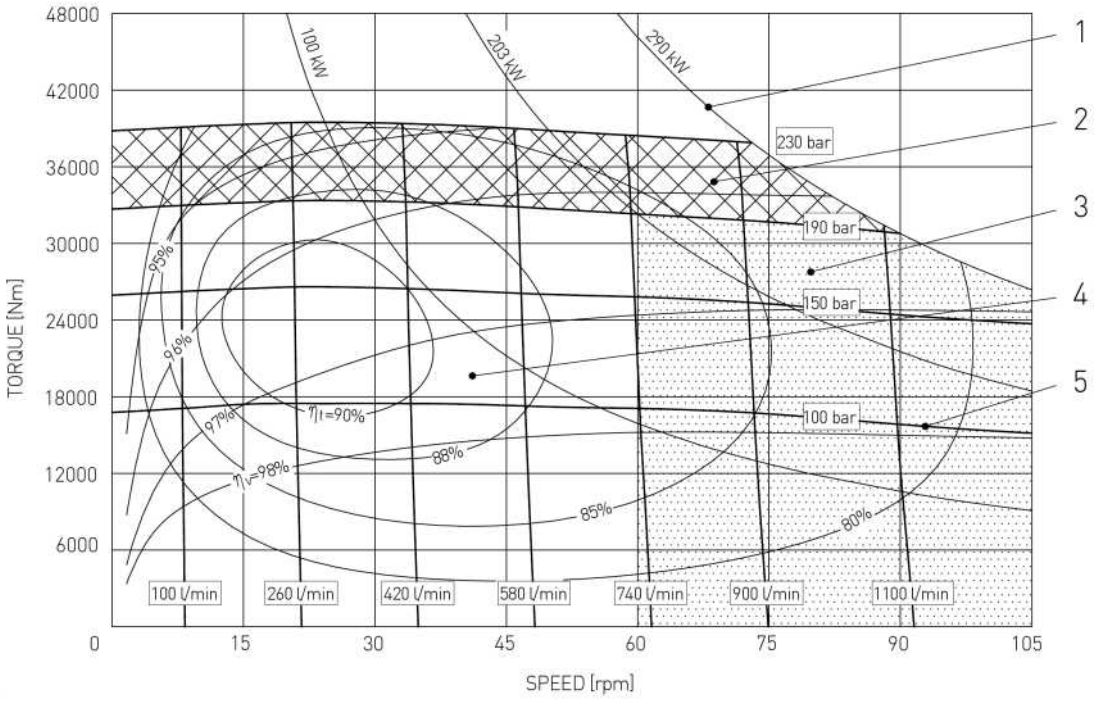
OPERATING DIAGRAM

(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRTA 12000 P



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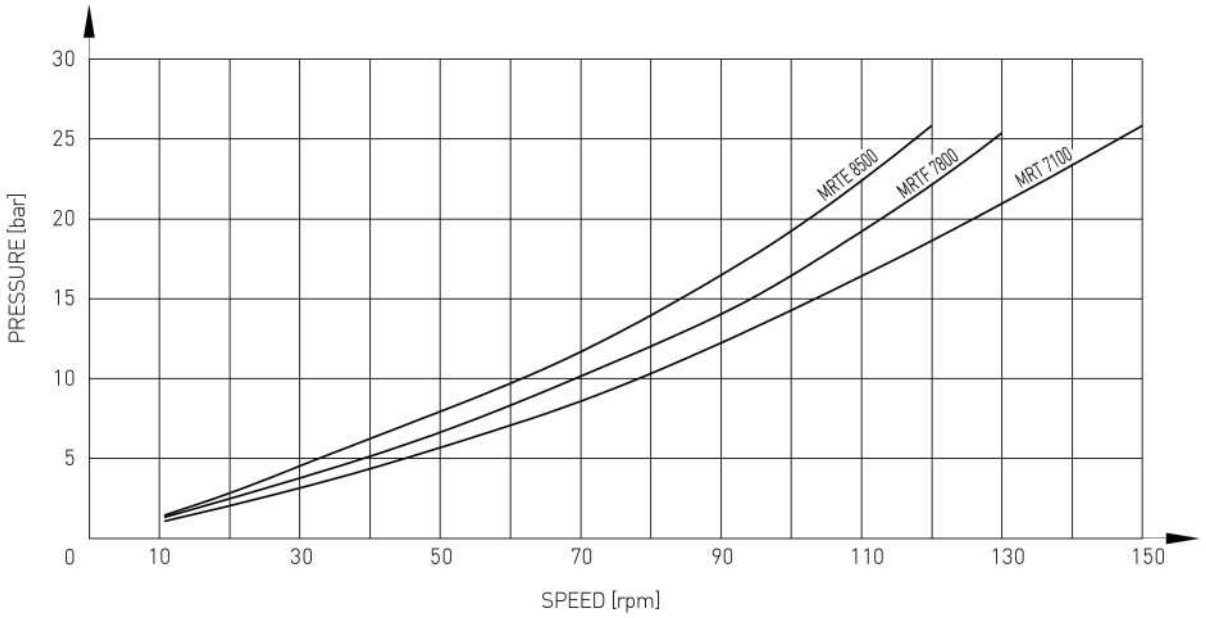
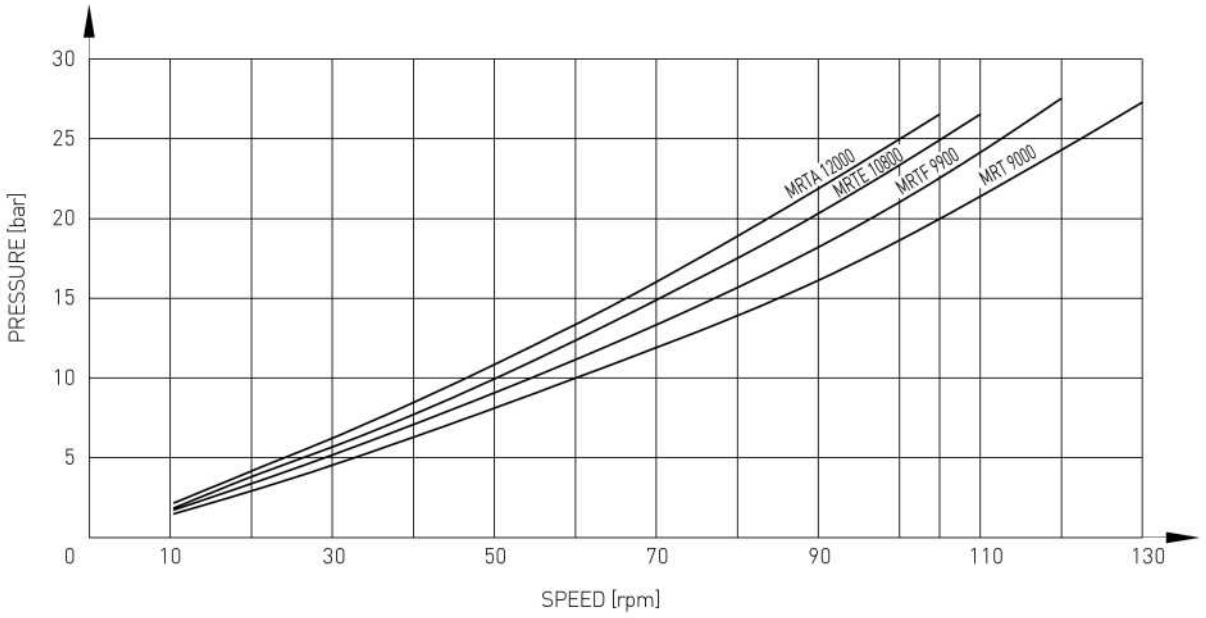
OPERATING DIAGRAM

(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

Min. required pressure difference Dp with idling speed (shaft unloaded)

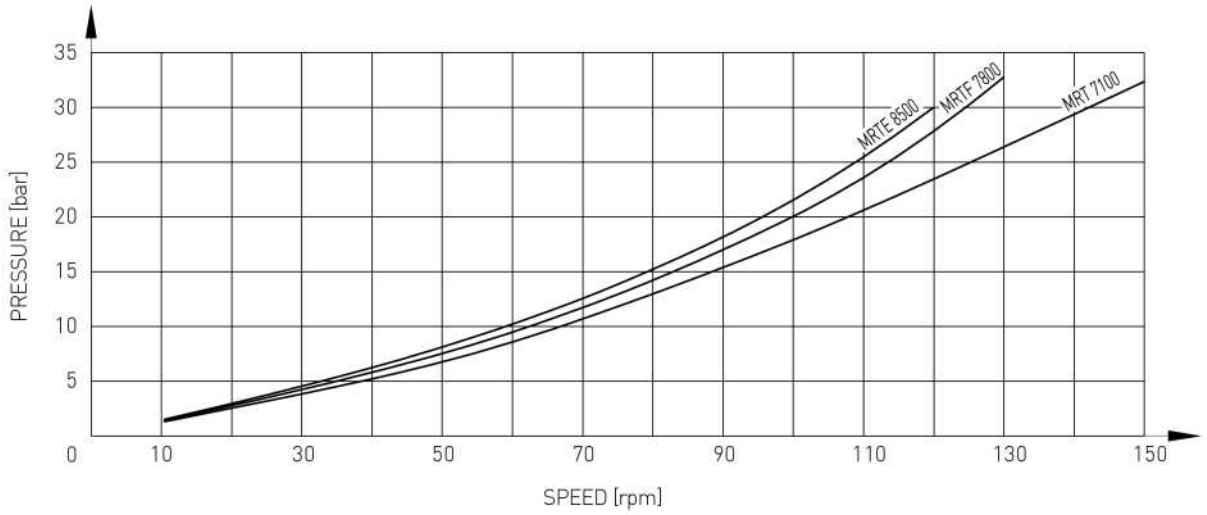


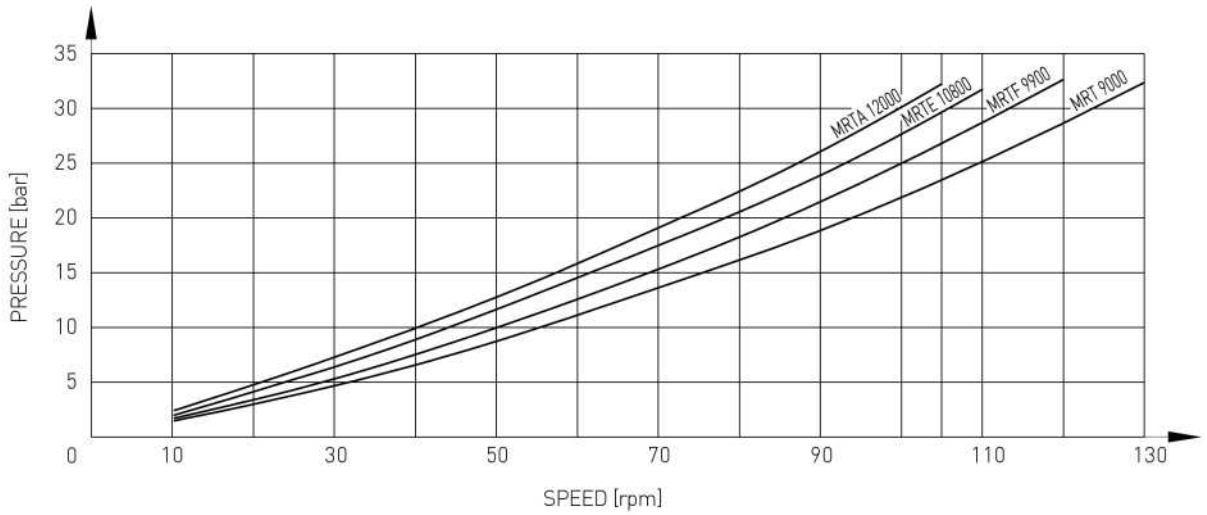


OPERATING DIAGRAM

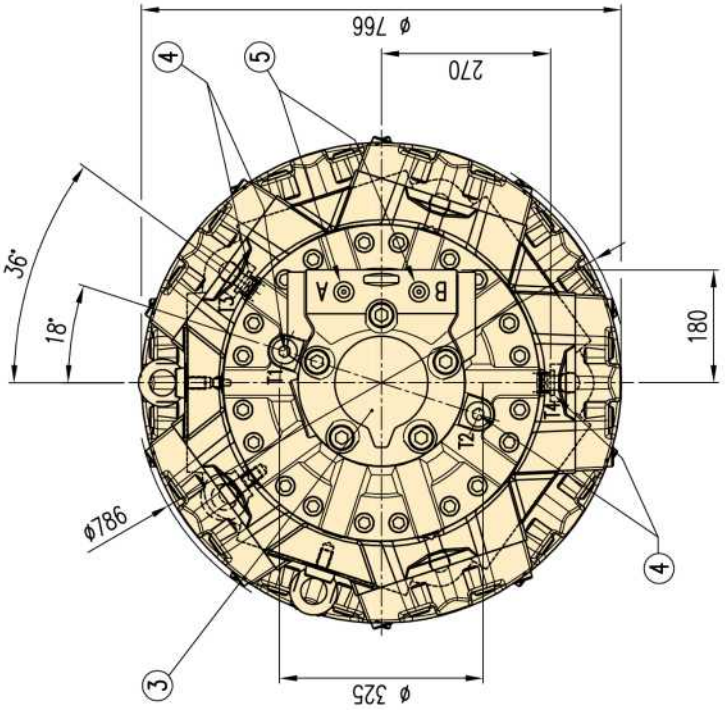
(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

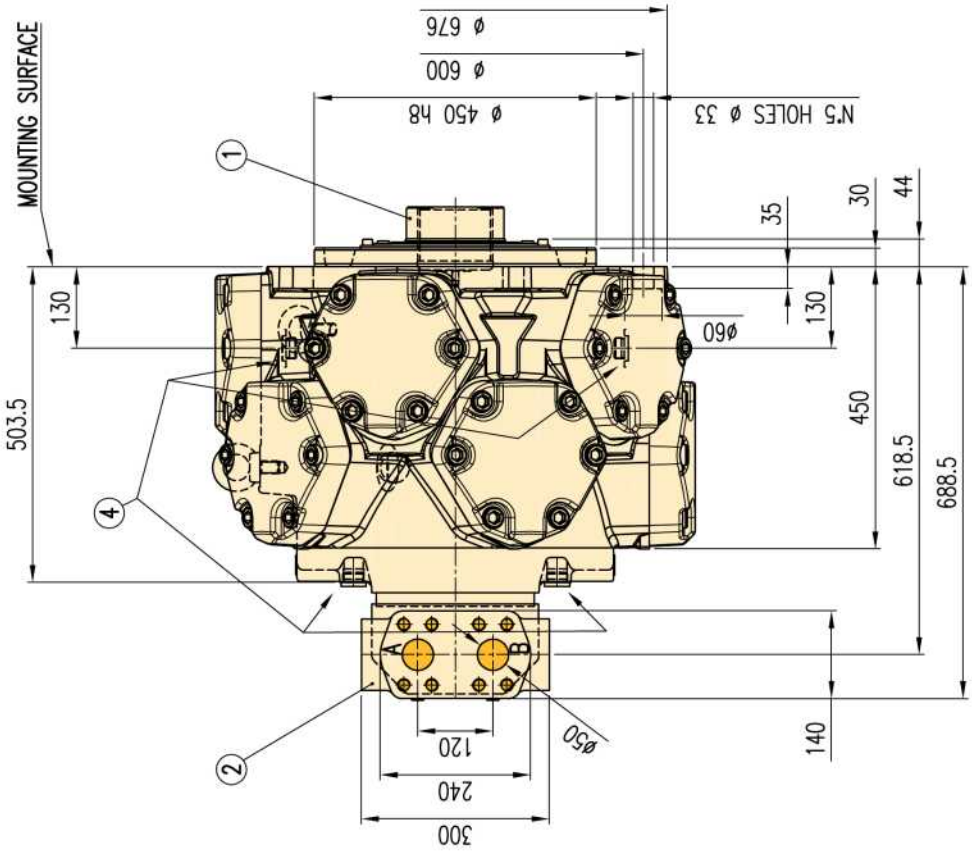
Minimum boost pressure during pump operation





OVERALL DIMENSIONS





1 **See output shaft options at page 15**

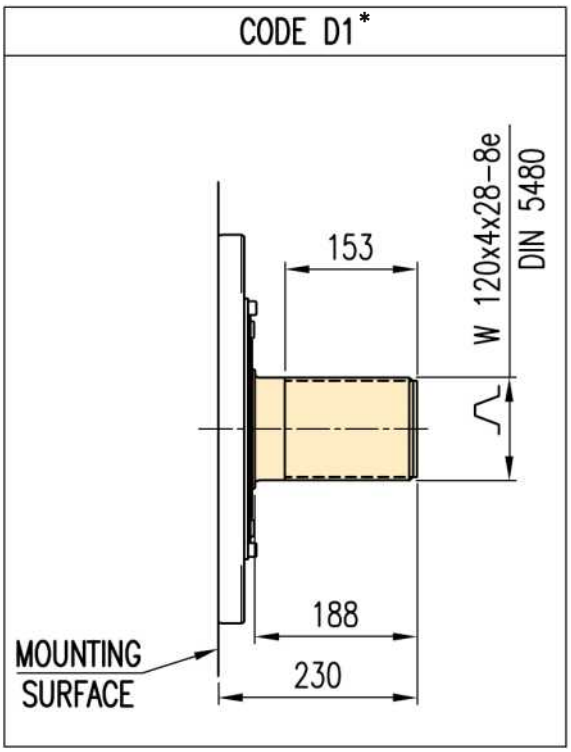
2 **See connection ports options at page 44**

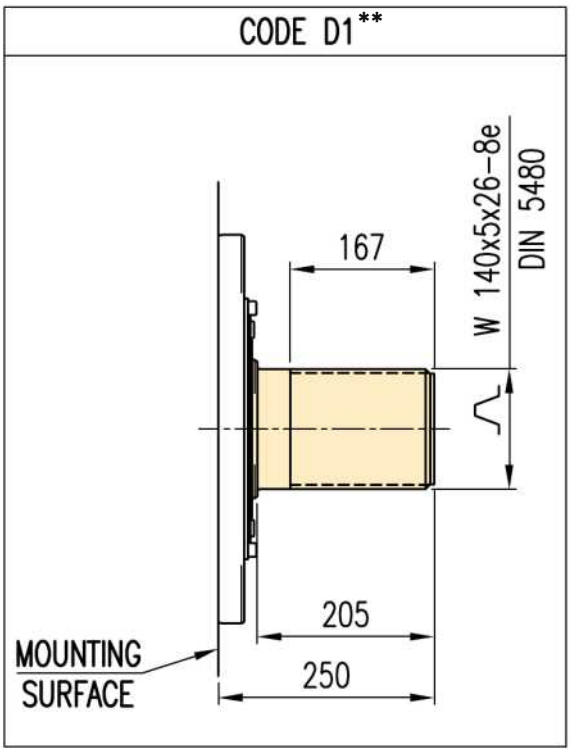
3 **On request the port flange can be rotated by 72°**

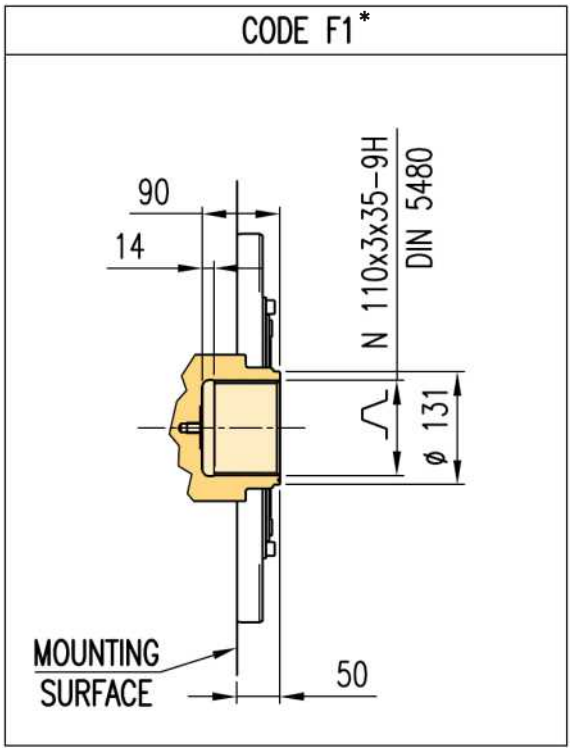
4 **Case drain ports: G 1"**

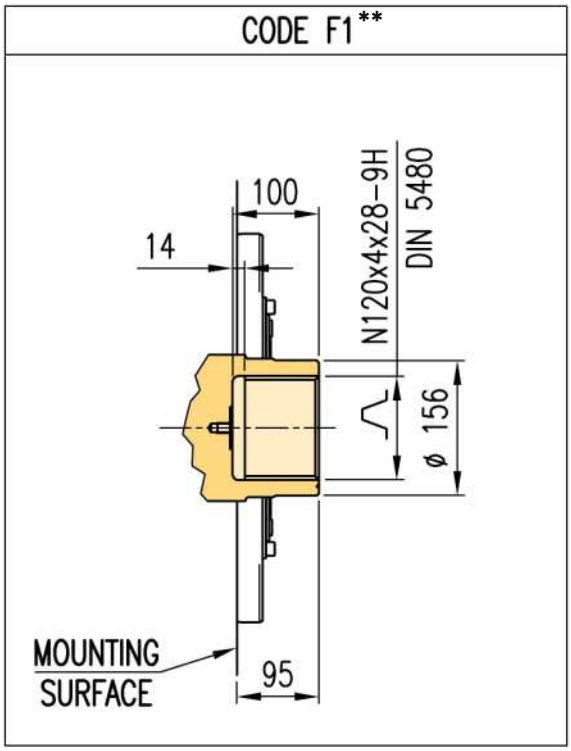
5 **Port 1/4" BSP threads to ISO 228/1 for pressure reading**

OUTPUT SHAFT OPTIONS AND DIMENSIONS









* Dimensions valid for motors:
MRT 7100, MRTF 7800, MRTE 8500

** Dimensions valid for motors:
MRT 9000, MRTF 9900, MRTE 10800,
MRTA 12000

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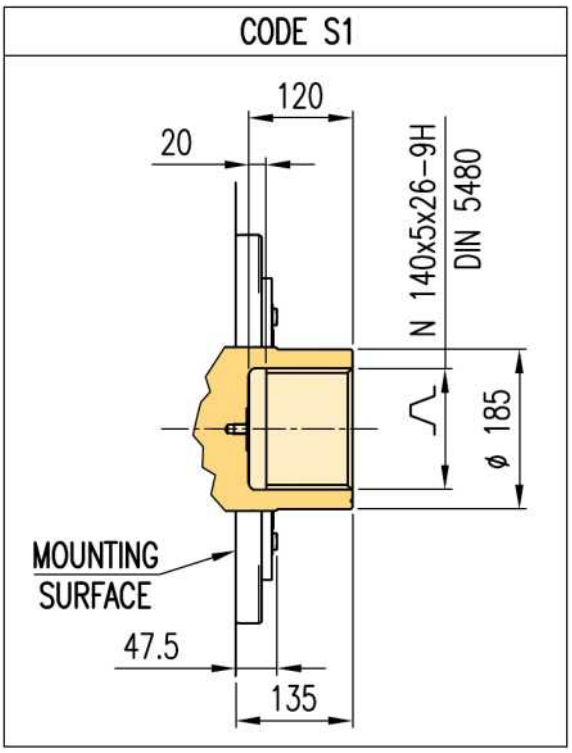
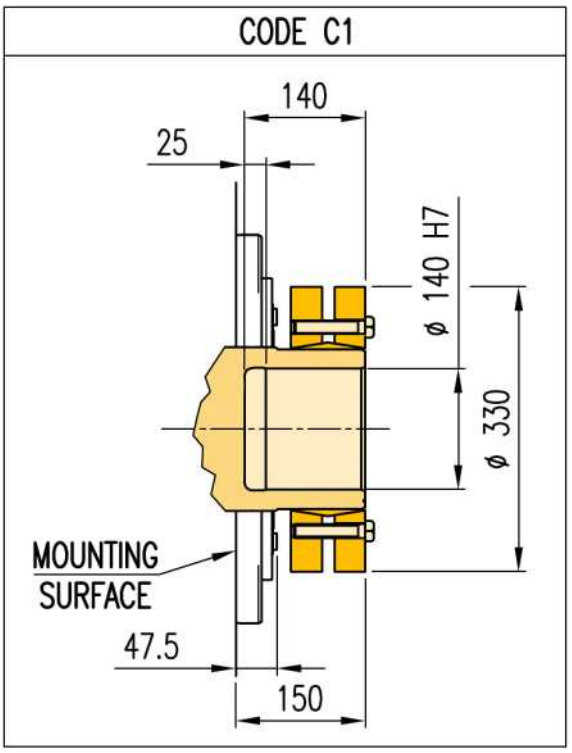
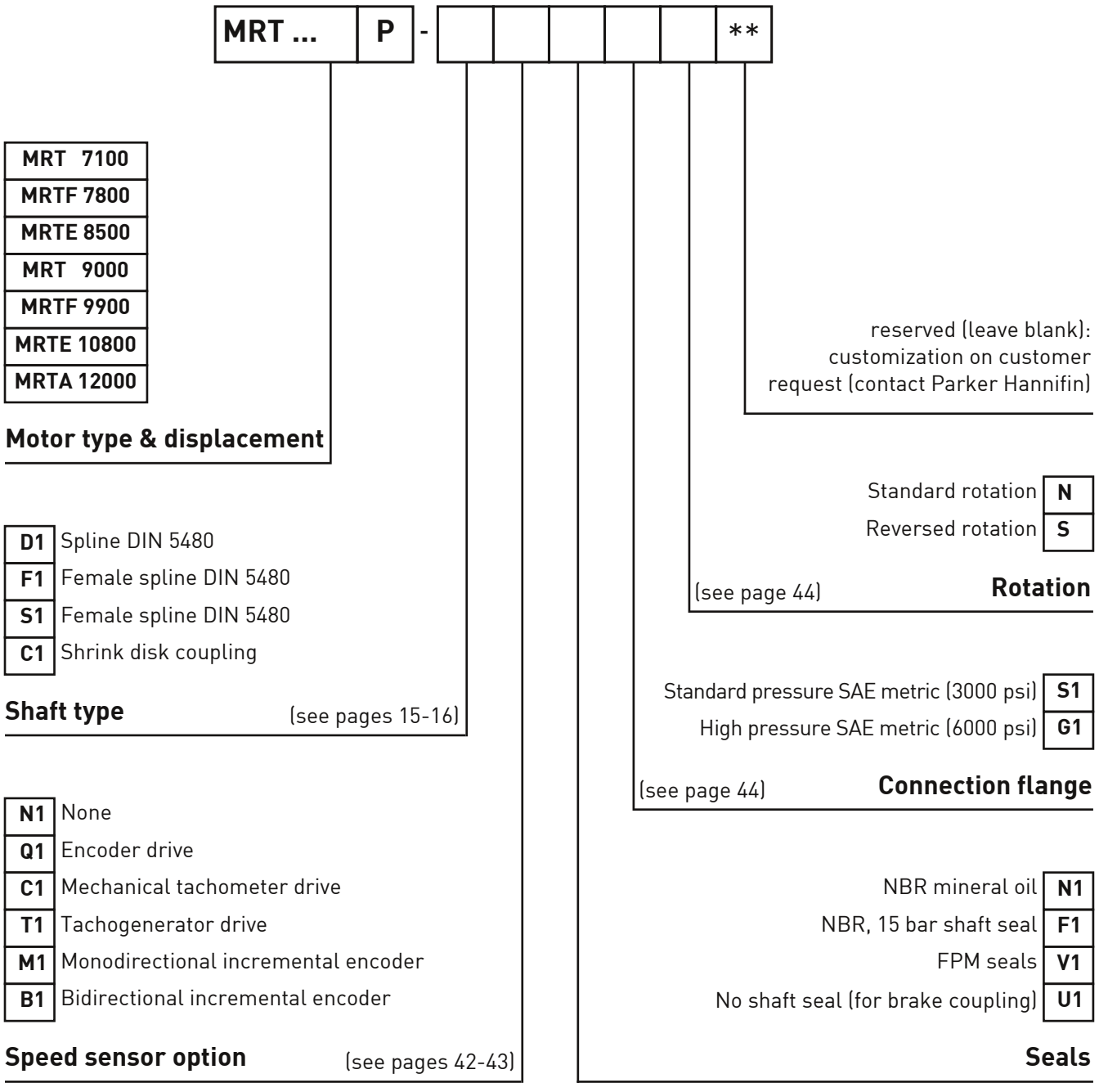
OUTPUT SHAFT OPTIONS AND DIMENSIONS





ORDERING INFORMATION



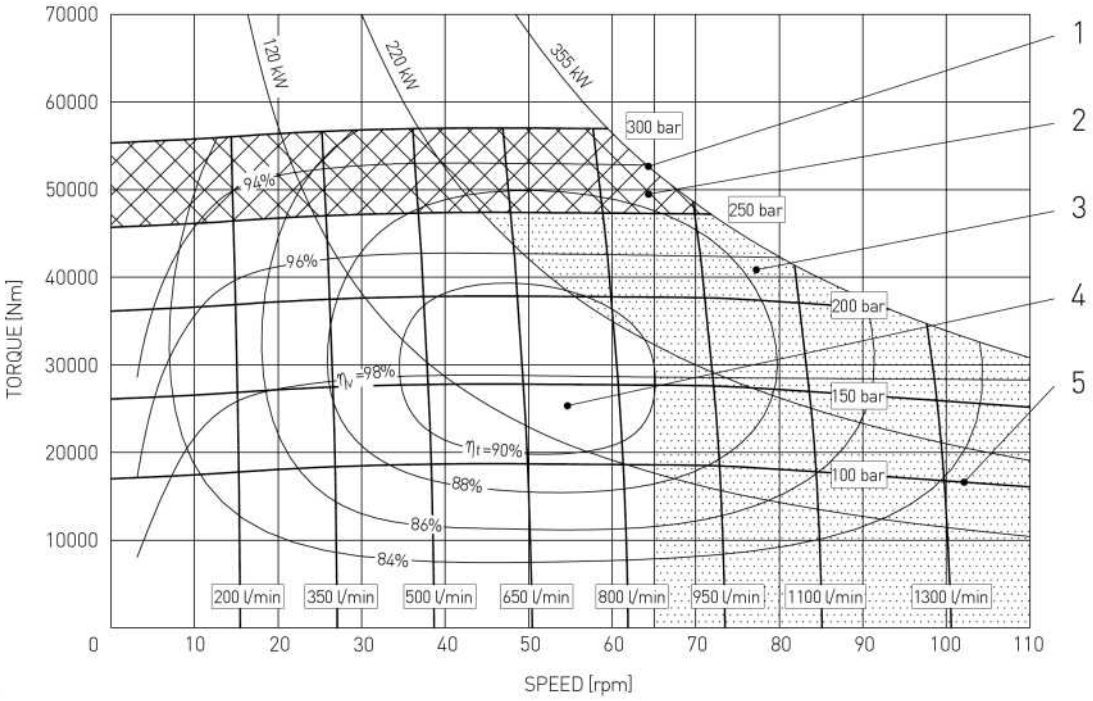
Ordering code example: **MRT 7100 P - D1 M1 N1 S1 N**

OPERATING DIAGRAM

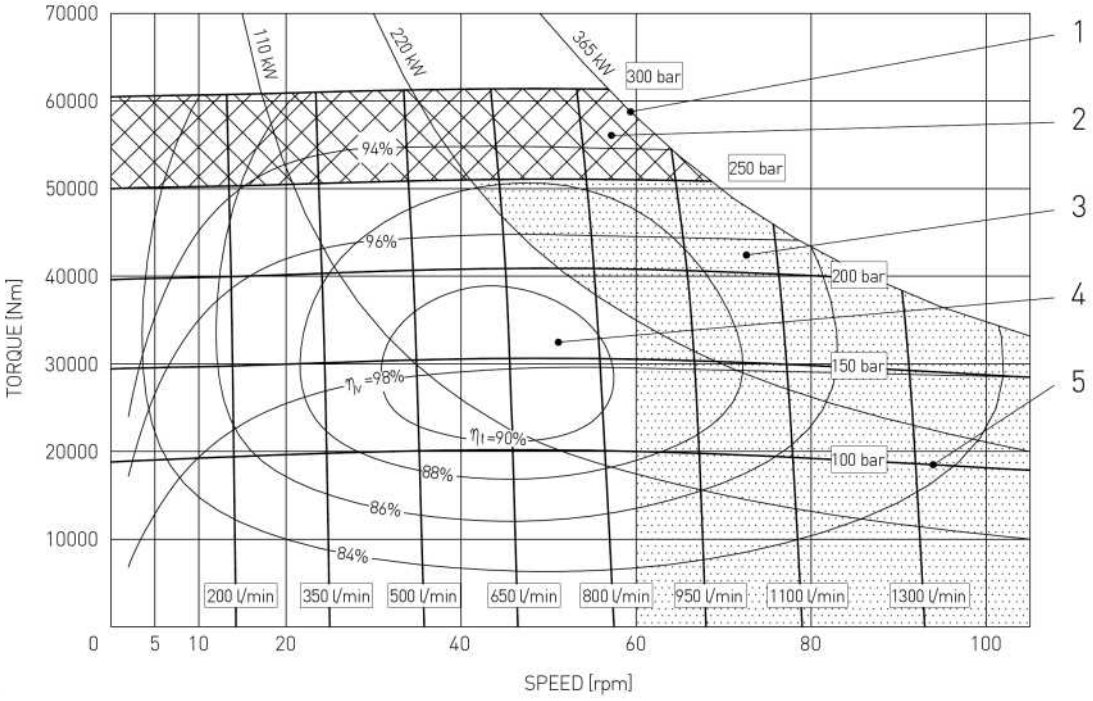
(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRT 13000 R



MRT 14000 R

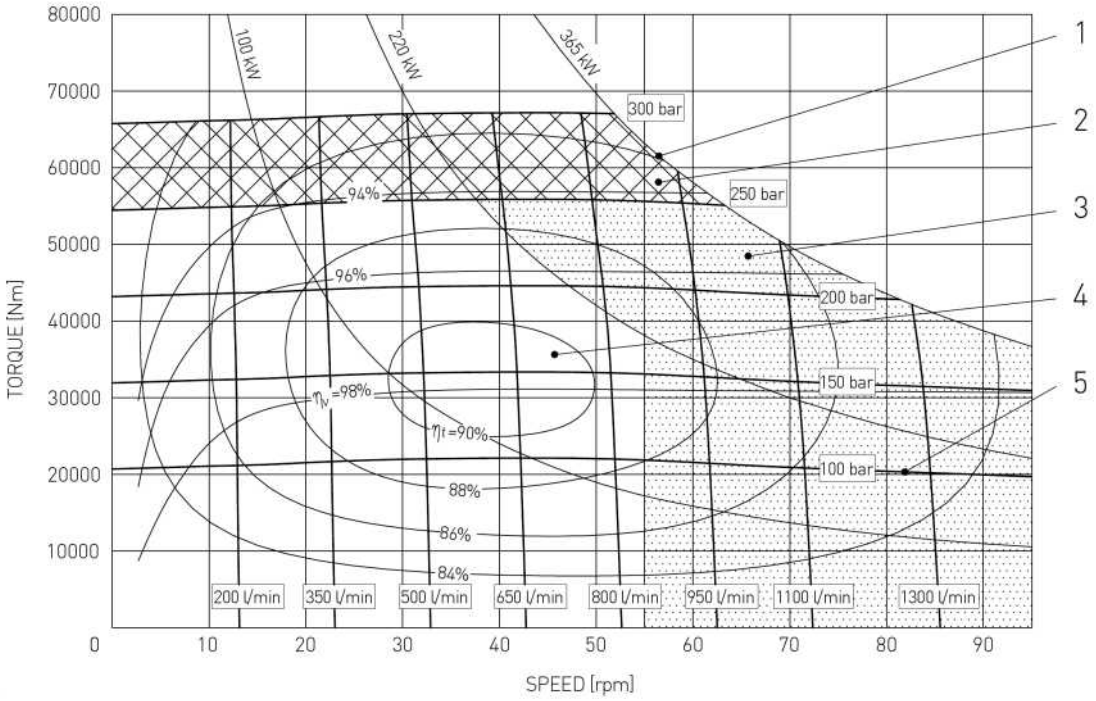


OPERATING DIAGRAM

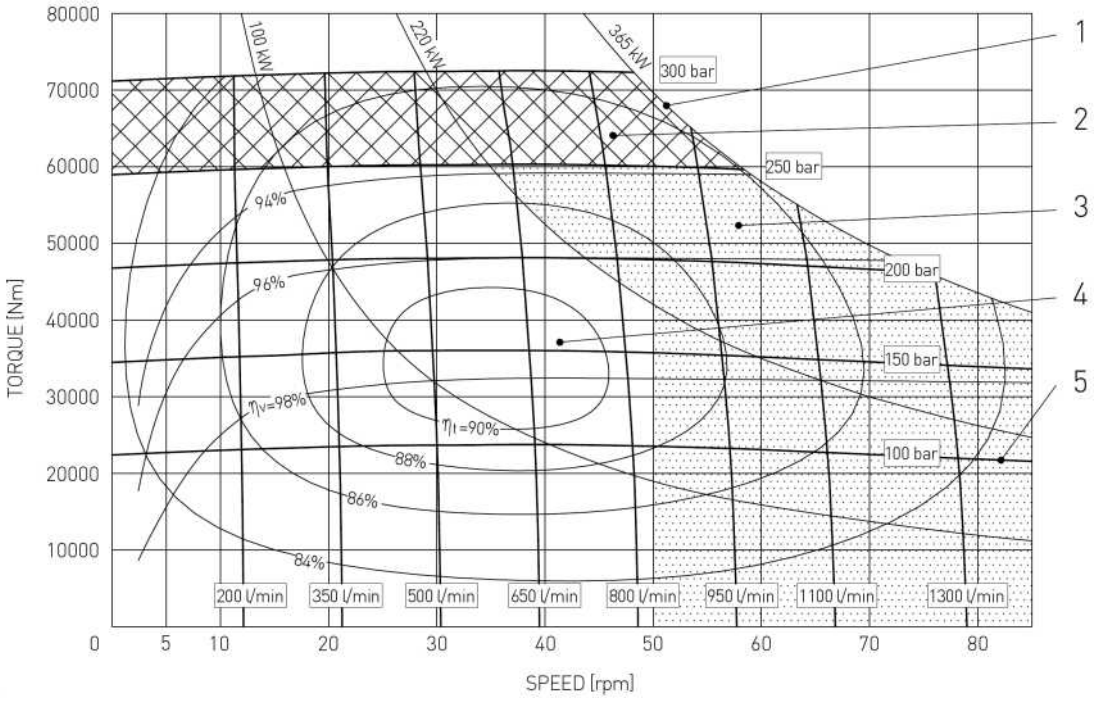
(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRTF 15200 R



MRTE 16400 R

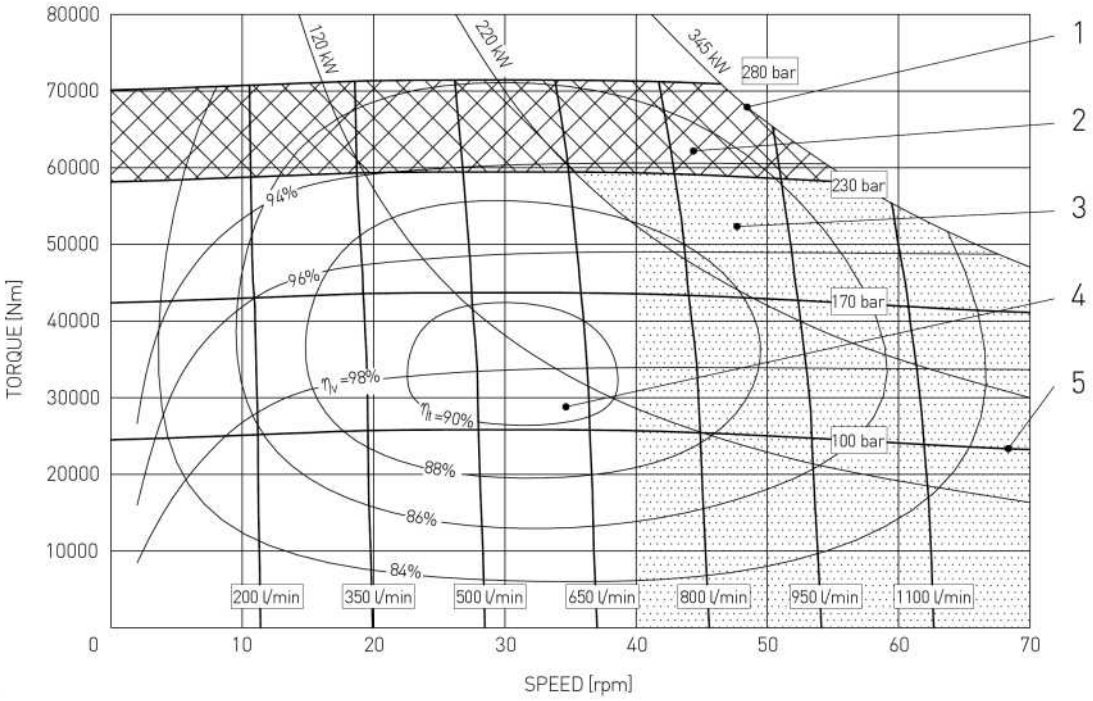


OPERATING DIAGRAM

(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

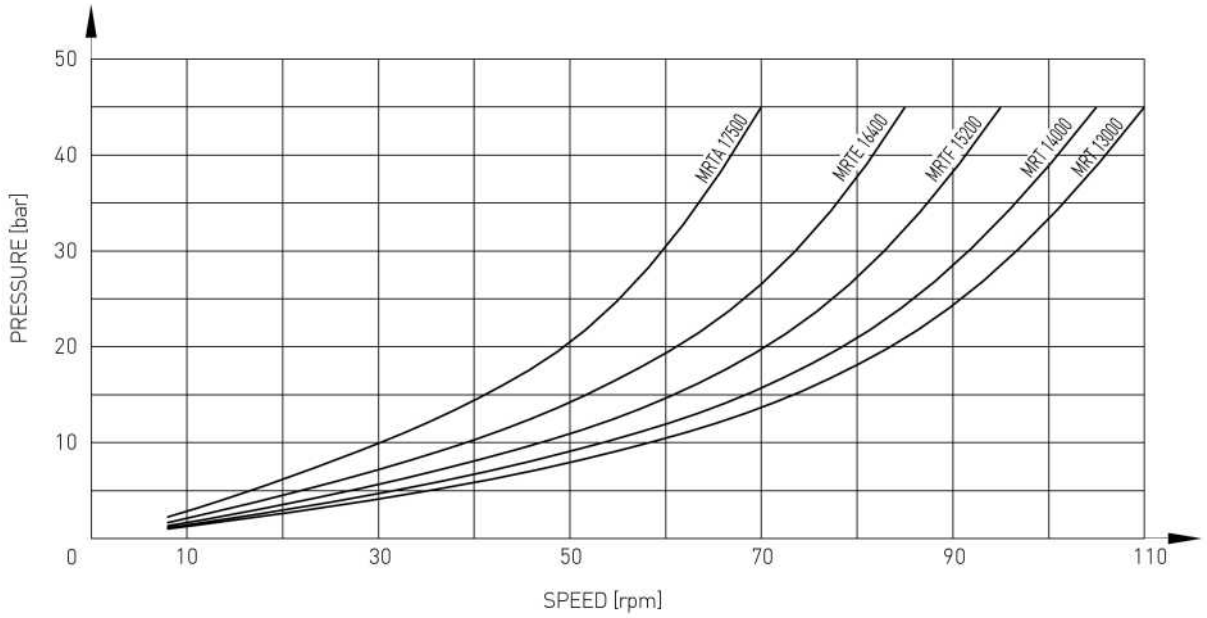
MRTA 17500 R



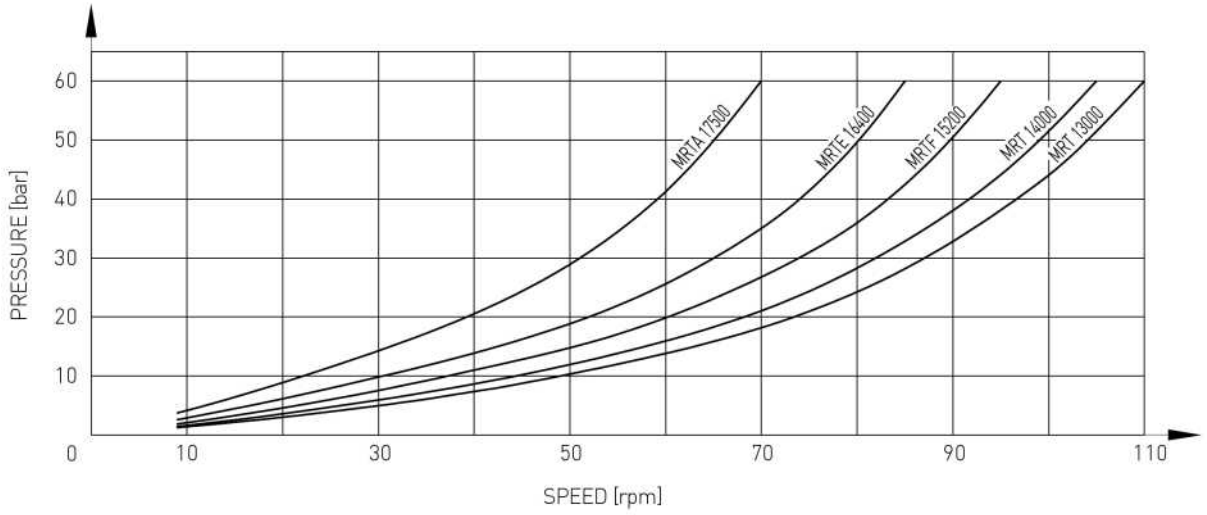
OPERATING DIAGRAM

(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

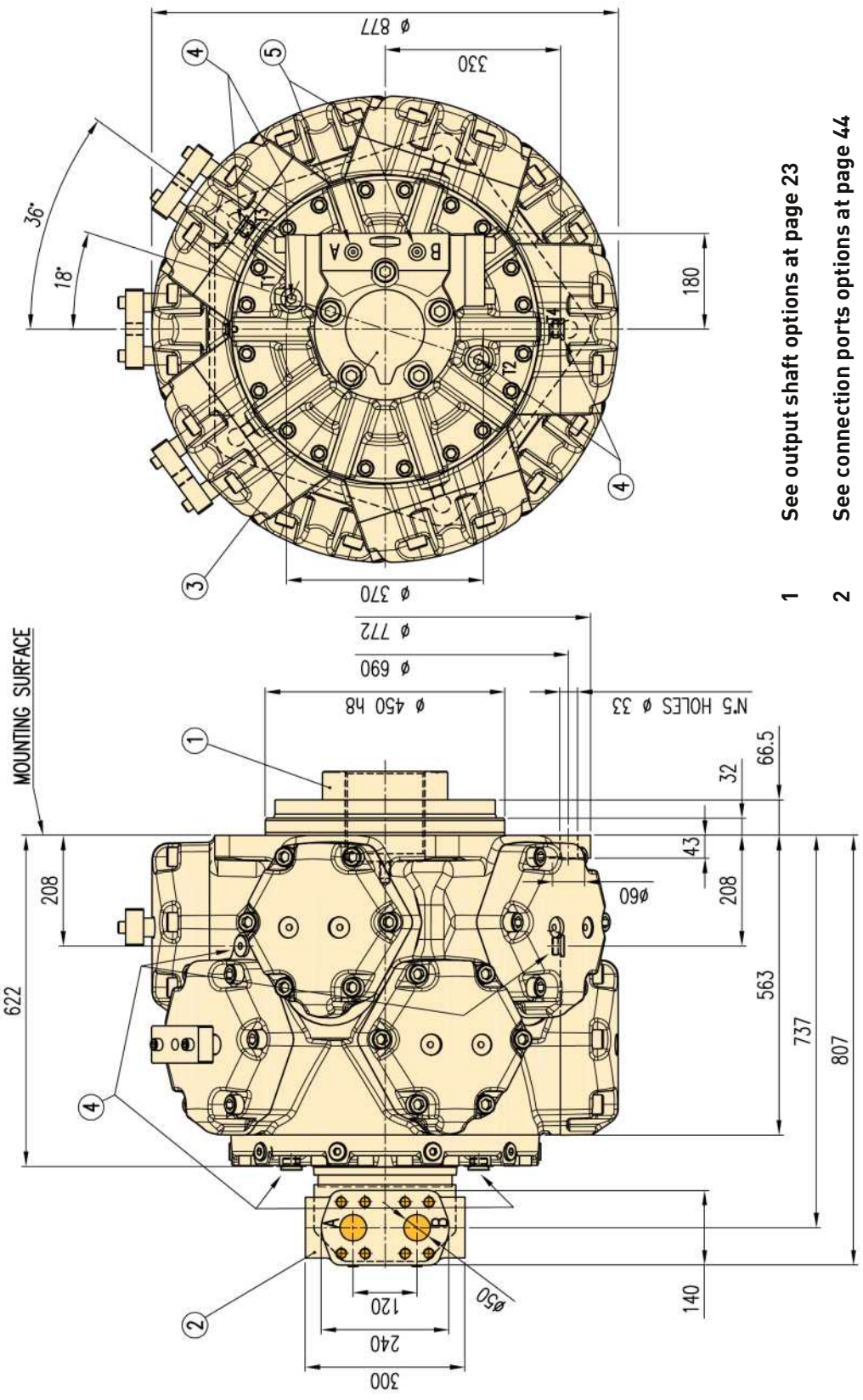
Min. required pressure difference Dp with idling speed (shaft unloaded)



Minimum boost pressure during pump operation



OVERALL DIMENSIONS



1 **See output shaft options at page 23**

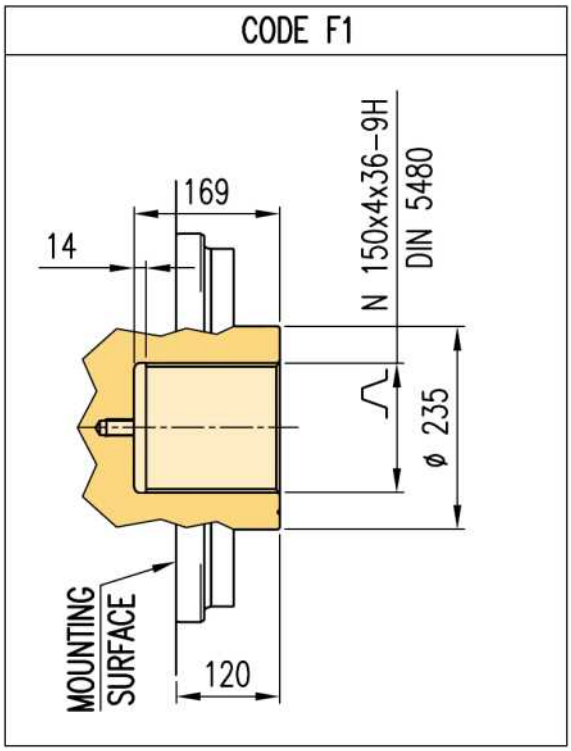
2 **See connection ports options at page 44**

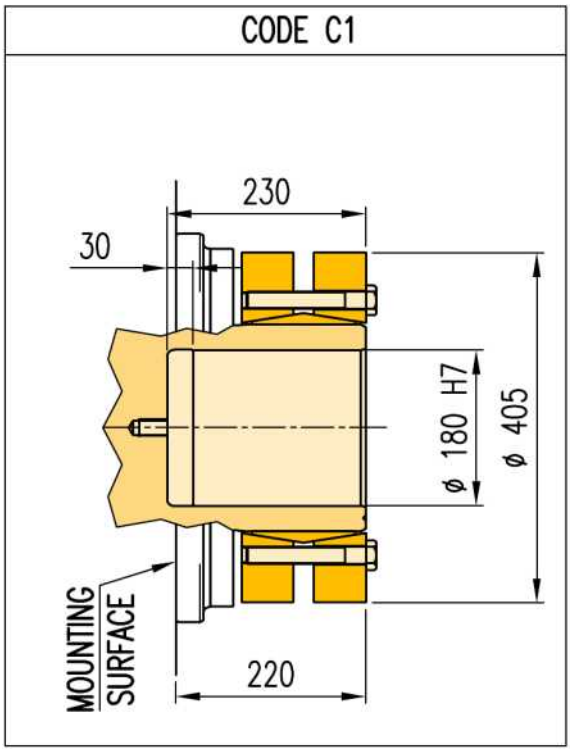
3 **On request the port flange can be rotated by 72°**

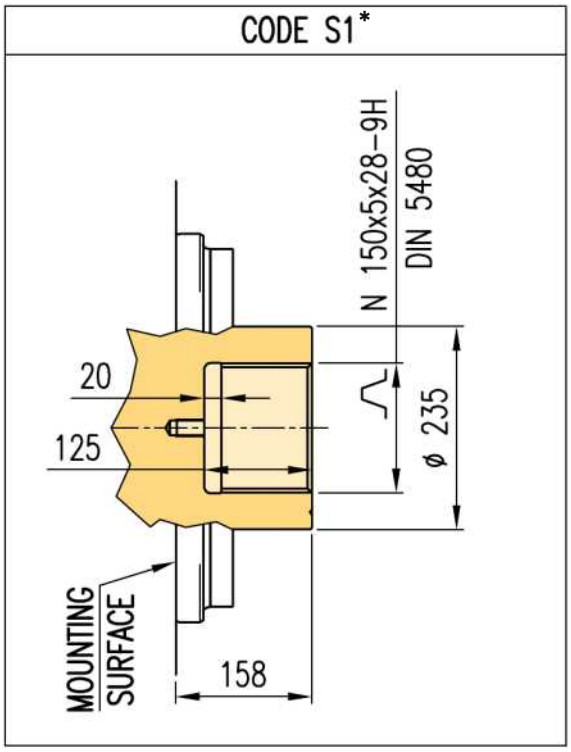
4 **Case drain ports: G 1"**

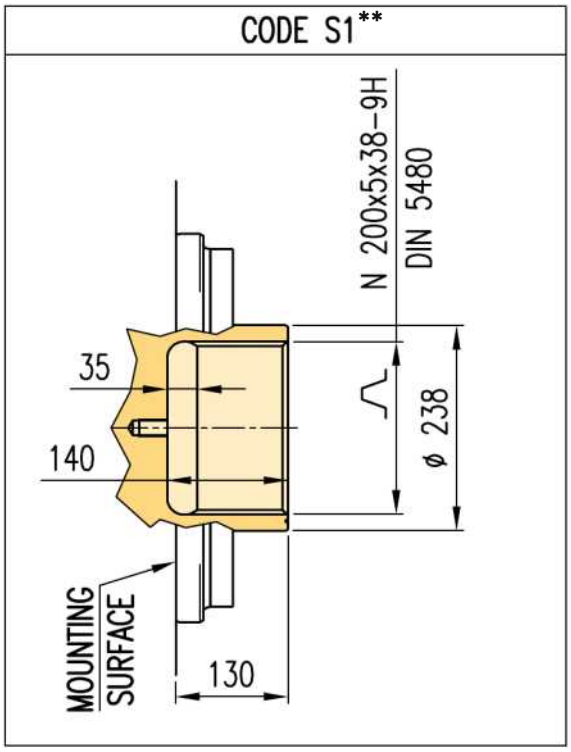
5 **Port 1/4" BSP threads to ISO 228/1 for pressure reading**

OUTPUT SHAFT OPTIONS AND DIMENSIONS





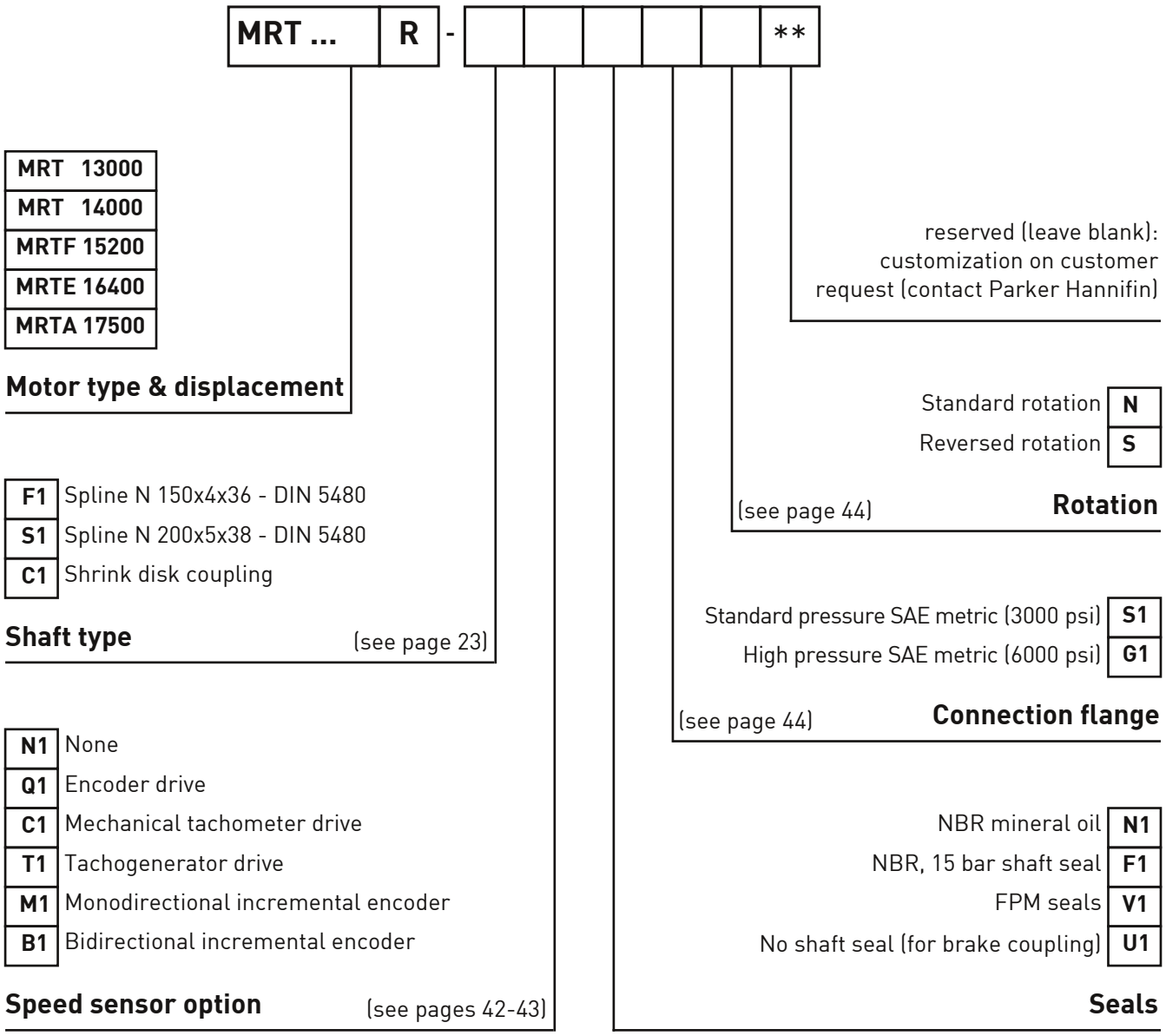




* Dimensions valid for motor MRT 13000

** Dimensions valid for motors:
MRT 14000, MRTF 15200, MRTE 16400,
MRTA 17500

ORDERING INFORMATION



Ordering code example: **MRTE 16400 R - F1 N1 V1 S1 N**

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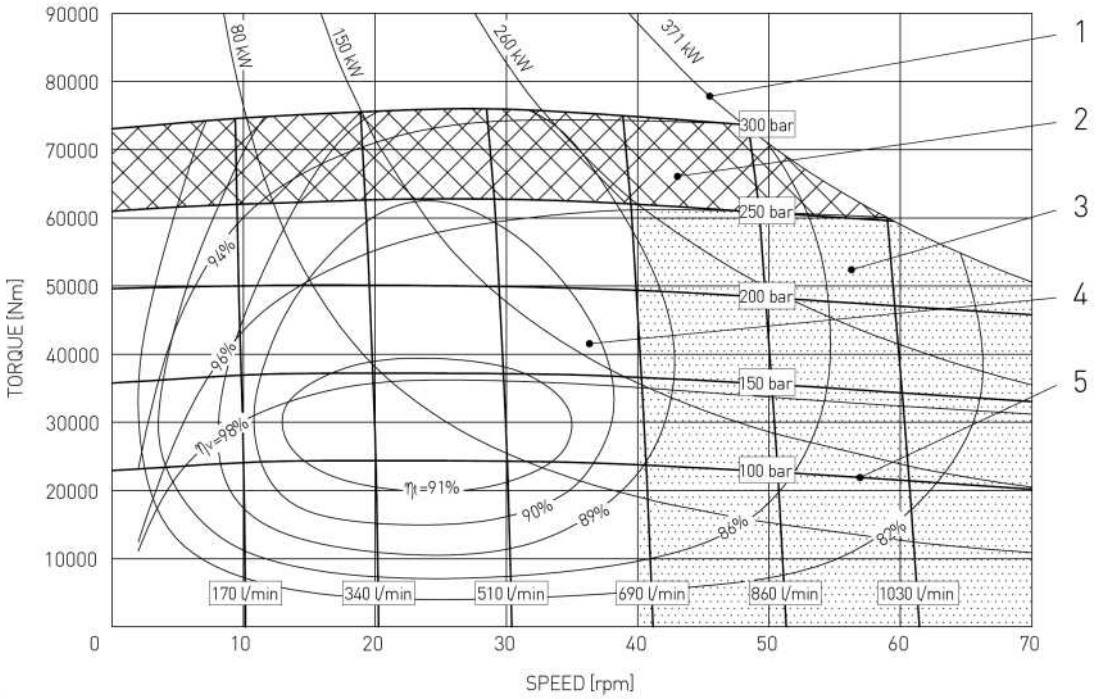
Anzola dell'Emilia, Italy

OPERATING DIAGRAM

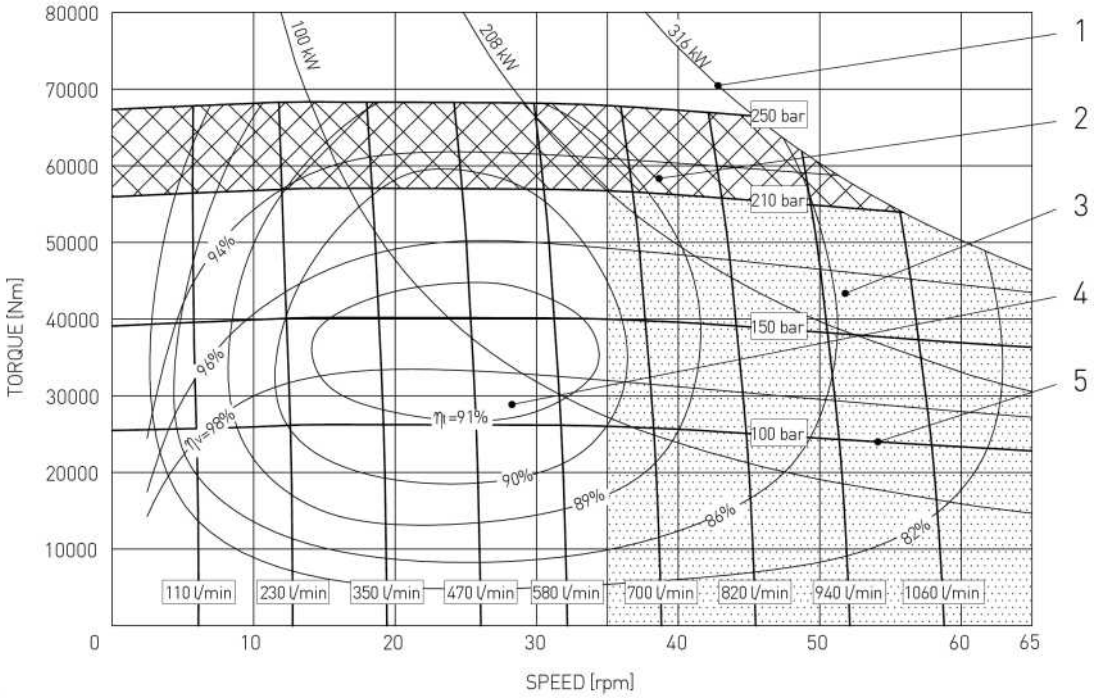
(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRT 17000 Q



MRTF 18000 Q



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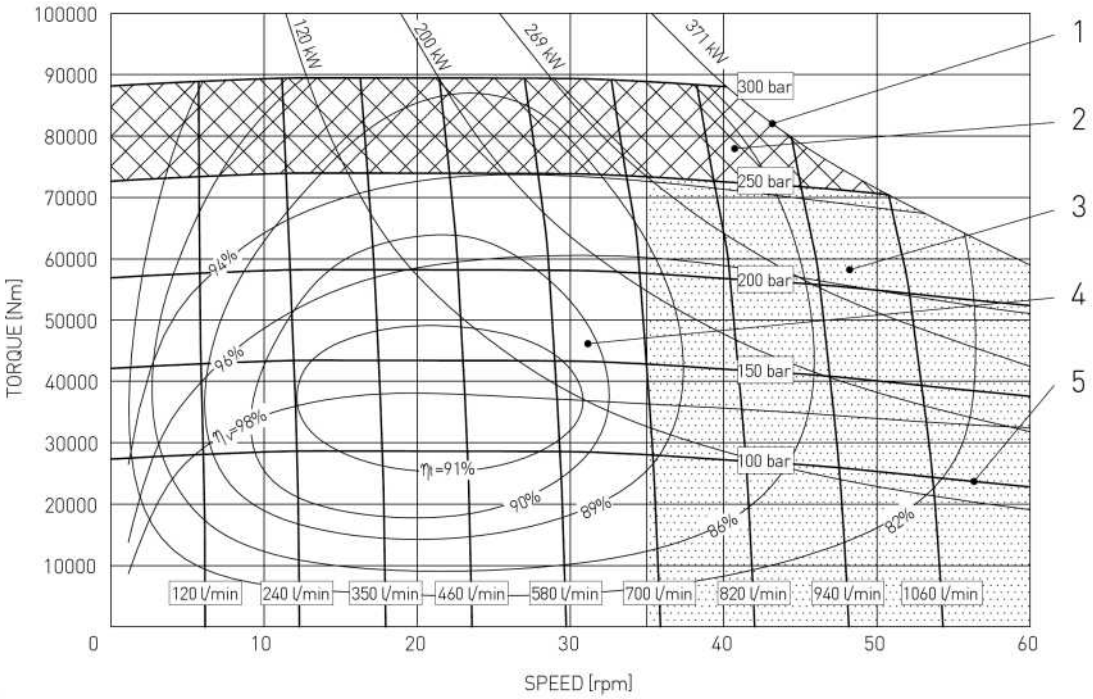
Anzola dell'Emilia, Italy

OPERATING DIAGRAM

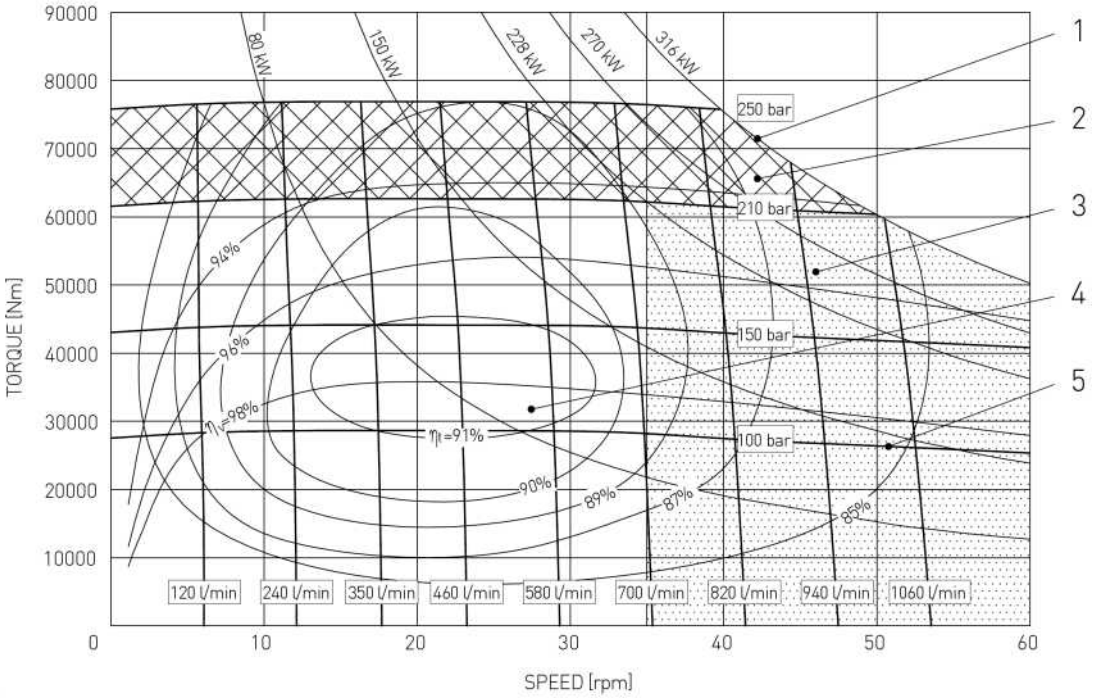
(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRT 19500 Q



MRTE 20000 Q



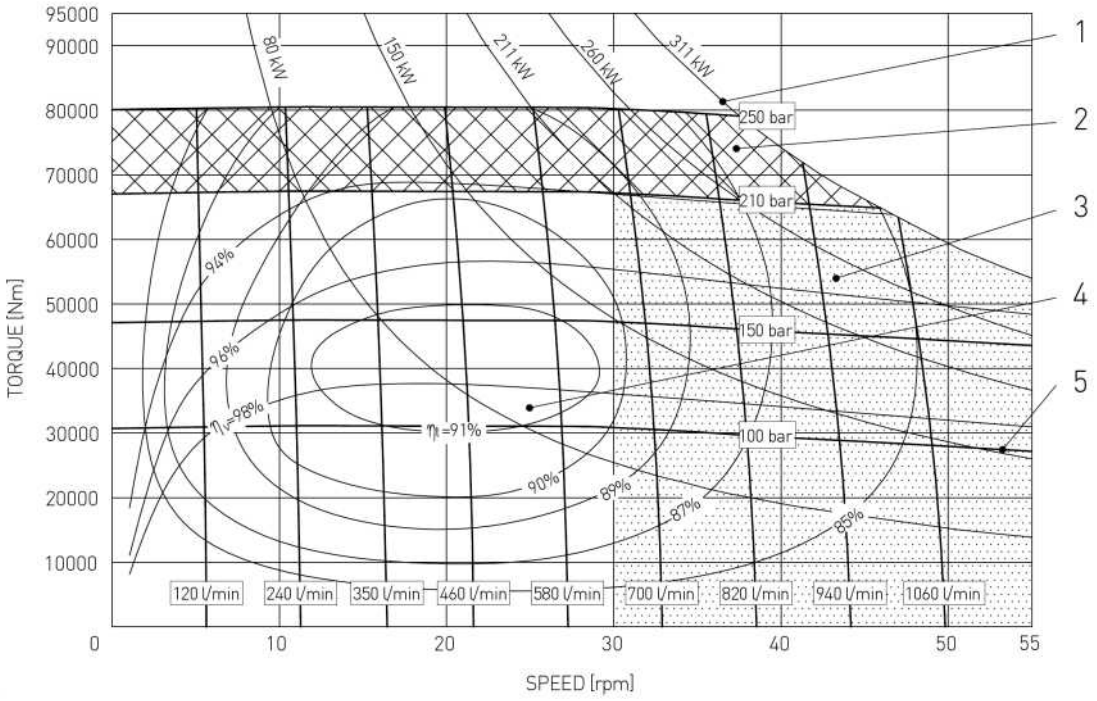
Parker Hannifin Corporation
Vane Pump Division/ Calzoni
Anzola dell'Emilia, Italy

OPERATING DIAGRAM

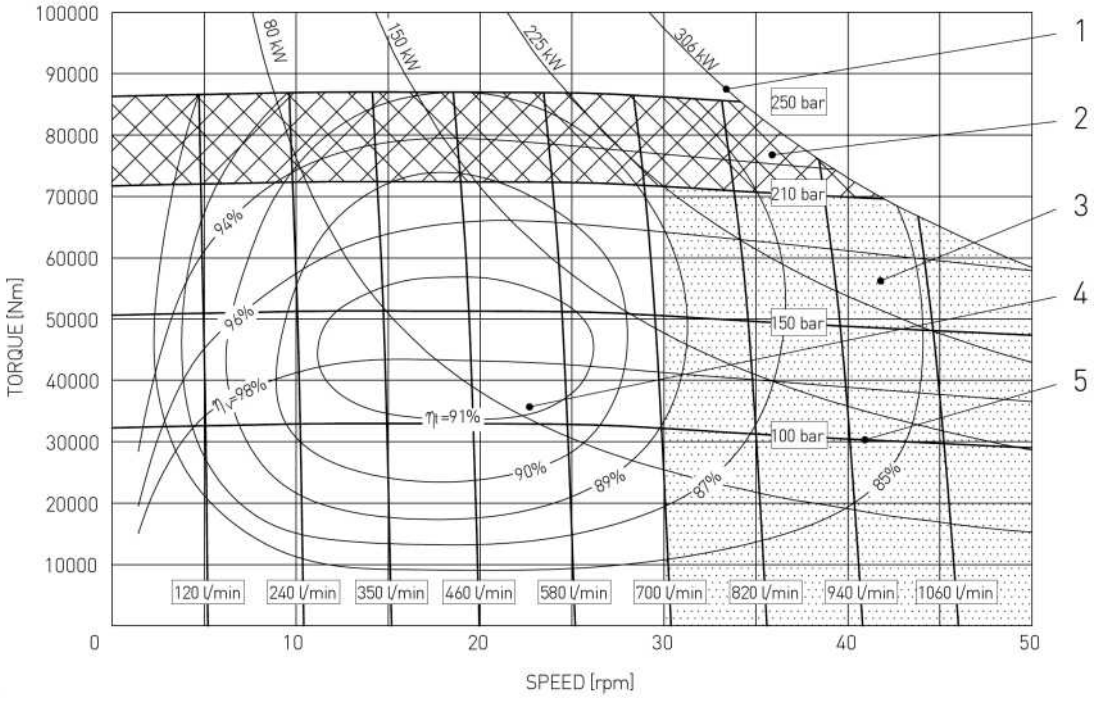
(average values) measured at n = 36 mm²/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRTF 21500 Q



MRTE 23000 Q



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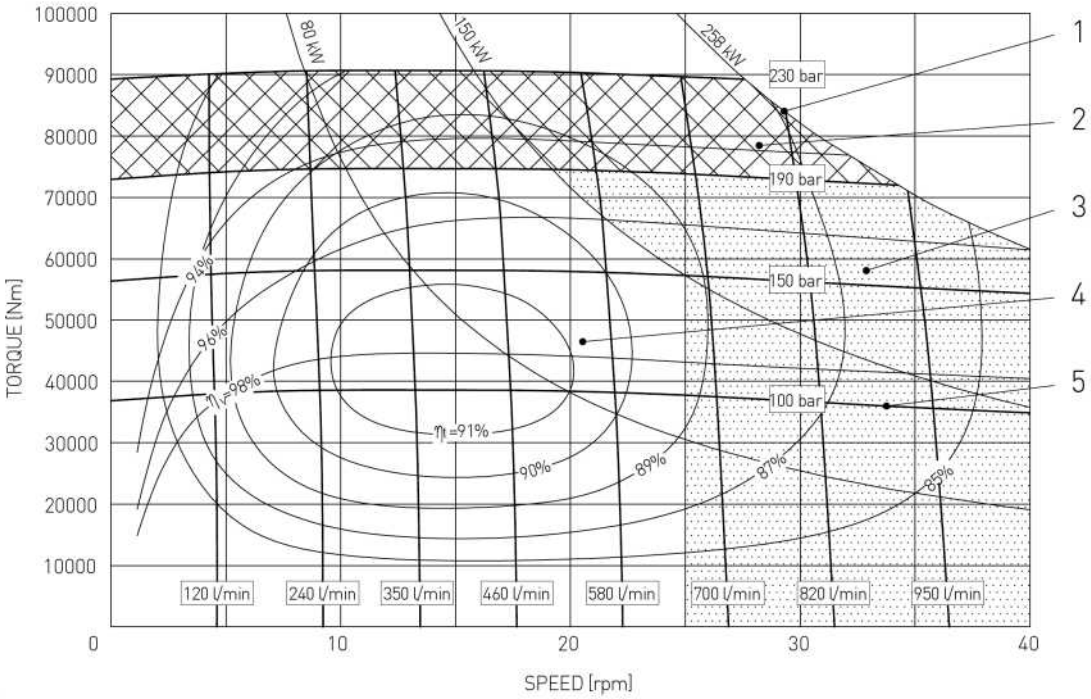
OPERATING DIAGRAM

(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

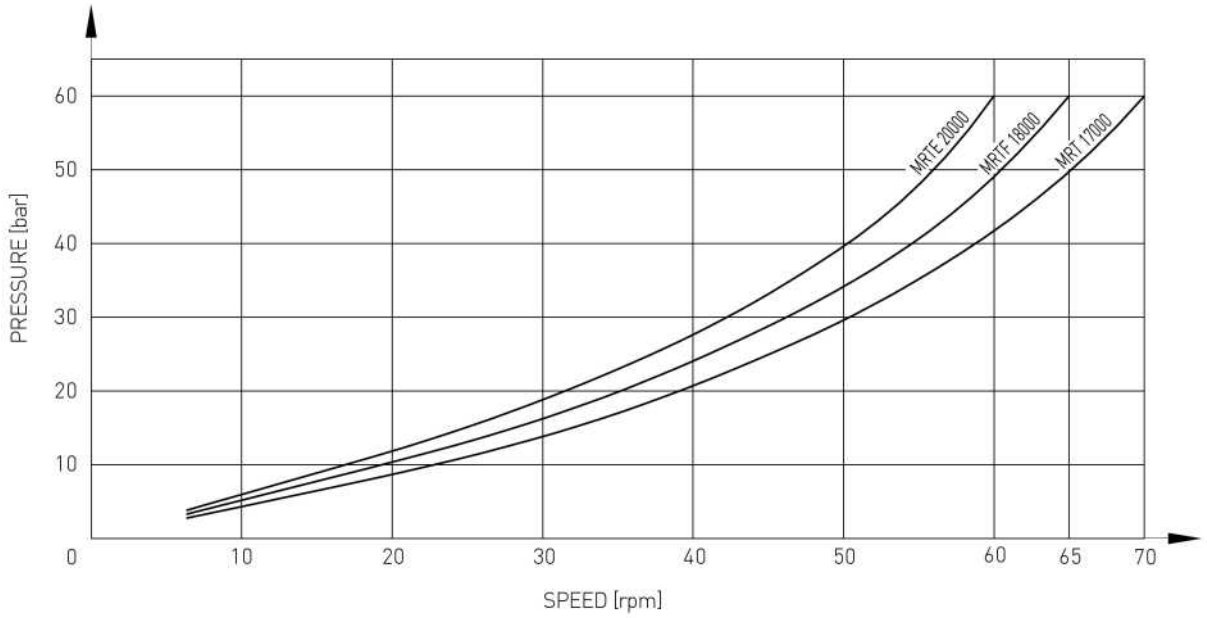
MRTA 26000 Q

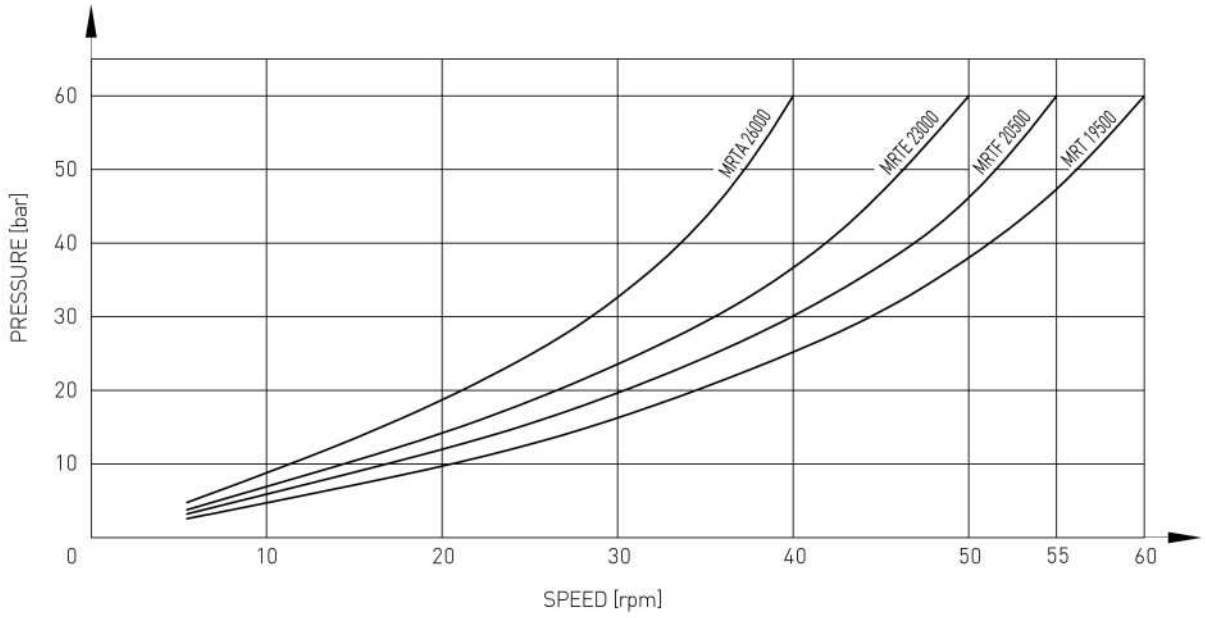


OPERATING DIAGRAM

(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

Min. required pressure difference Dp with idling speed (shaft unloaded)

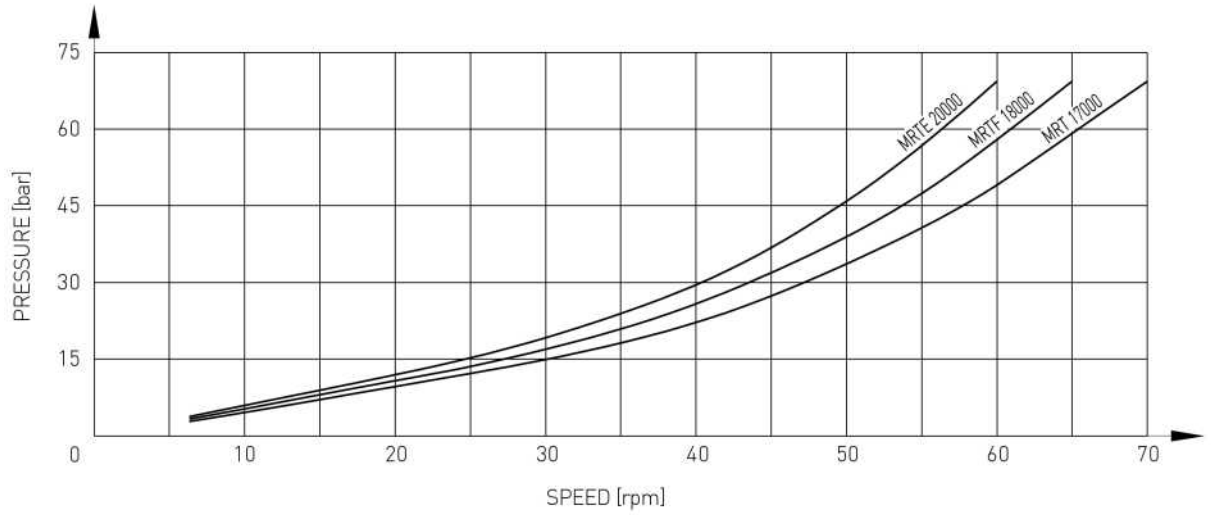


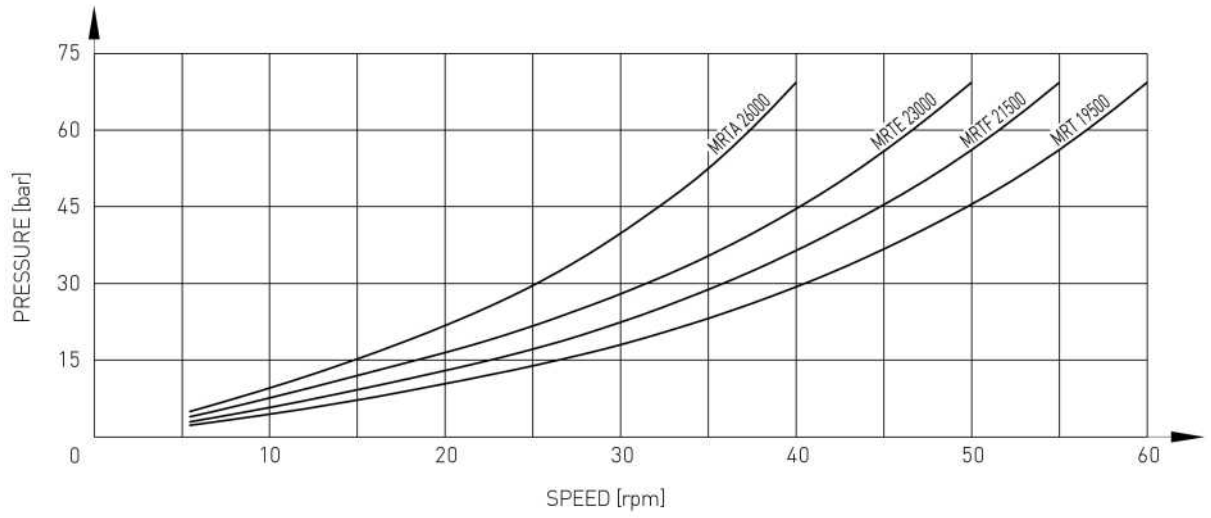


OPERATING DIAGRAM

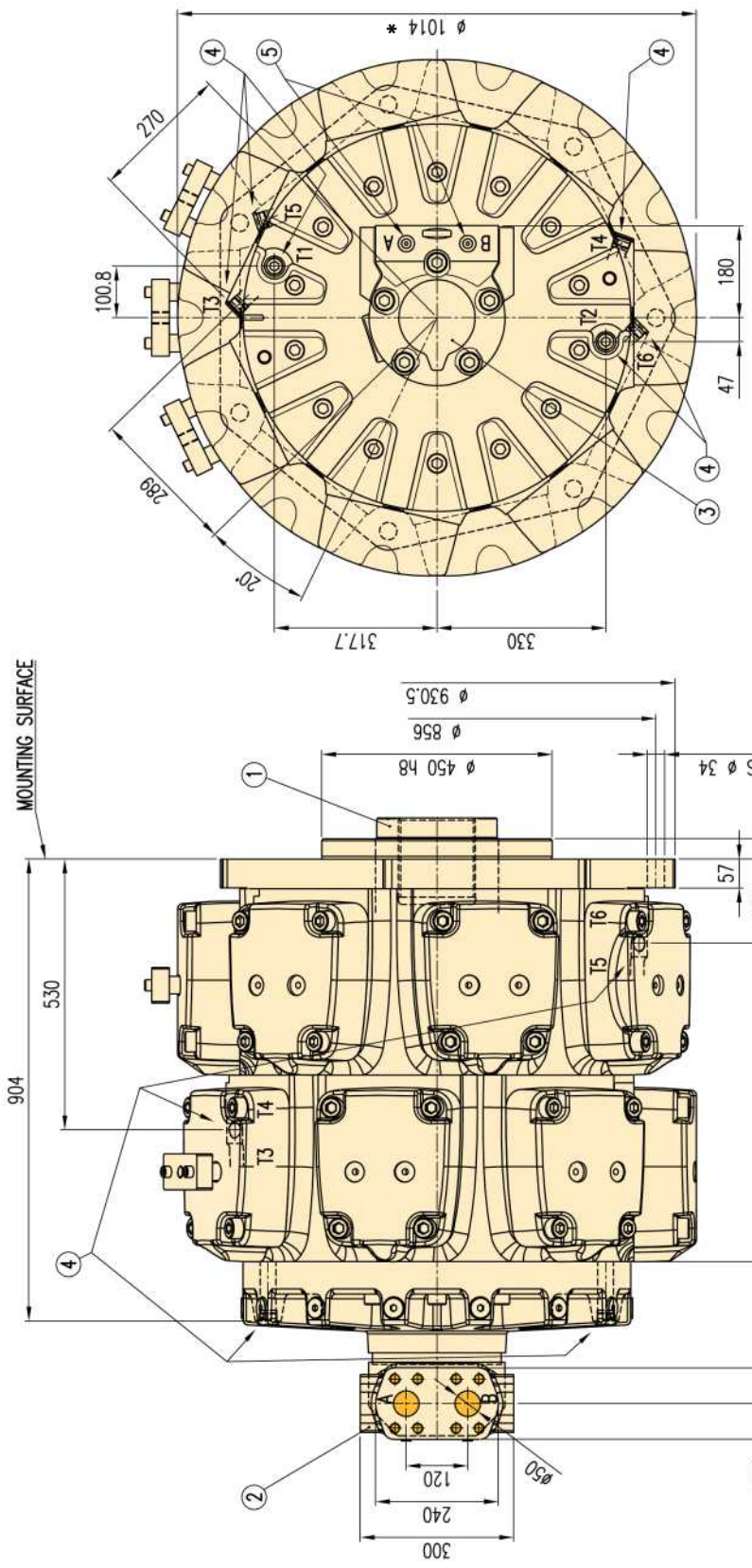
(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

Minimum boost pressure during pump operation





OVERALL DIMENSIONS



For MRTA26000: F 1052

* **See output shaft options at page 32**

1 **See connection ports options at page 44**

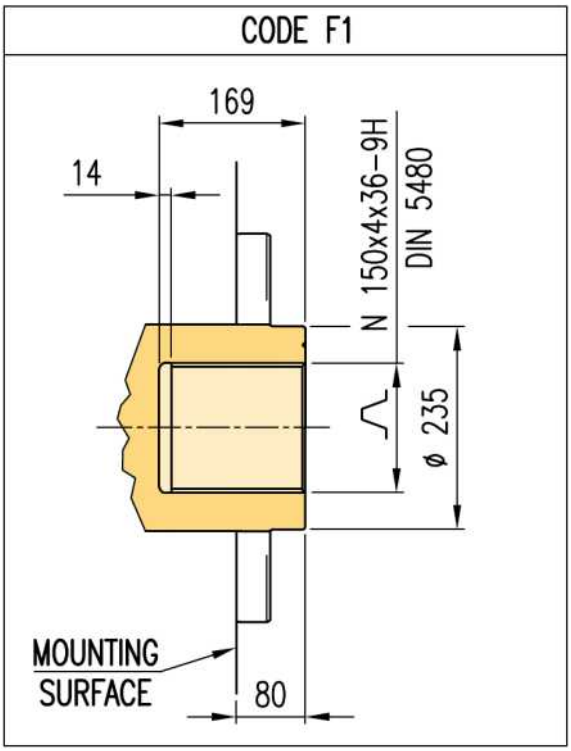
2 **On request the port flange can be rotated by 72°**

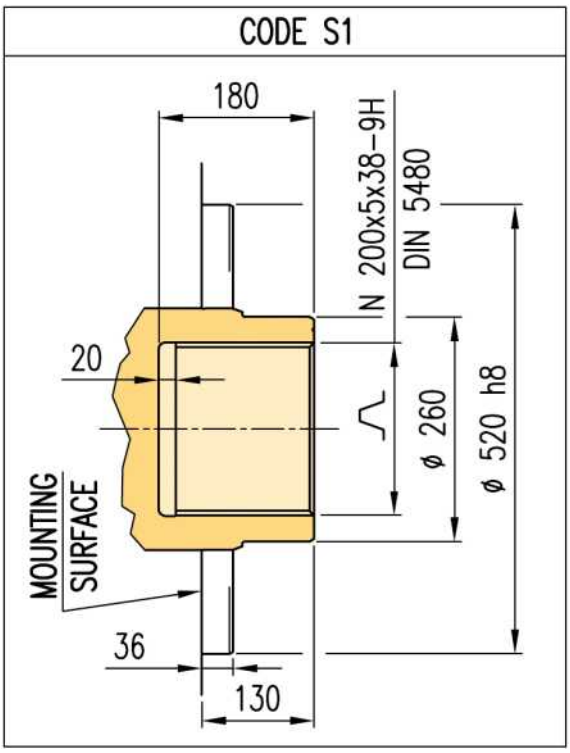
3 **Case drain ports: G 1"**

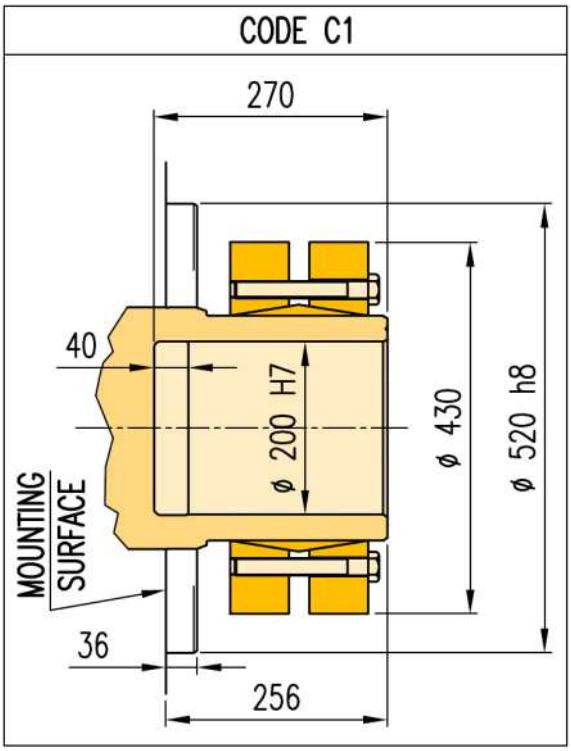
4 **Port 1/4" BSP threads to ISO 228/1 for pressure reading**

5

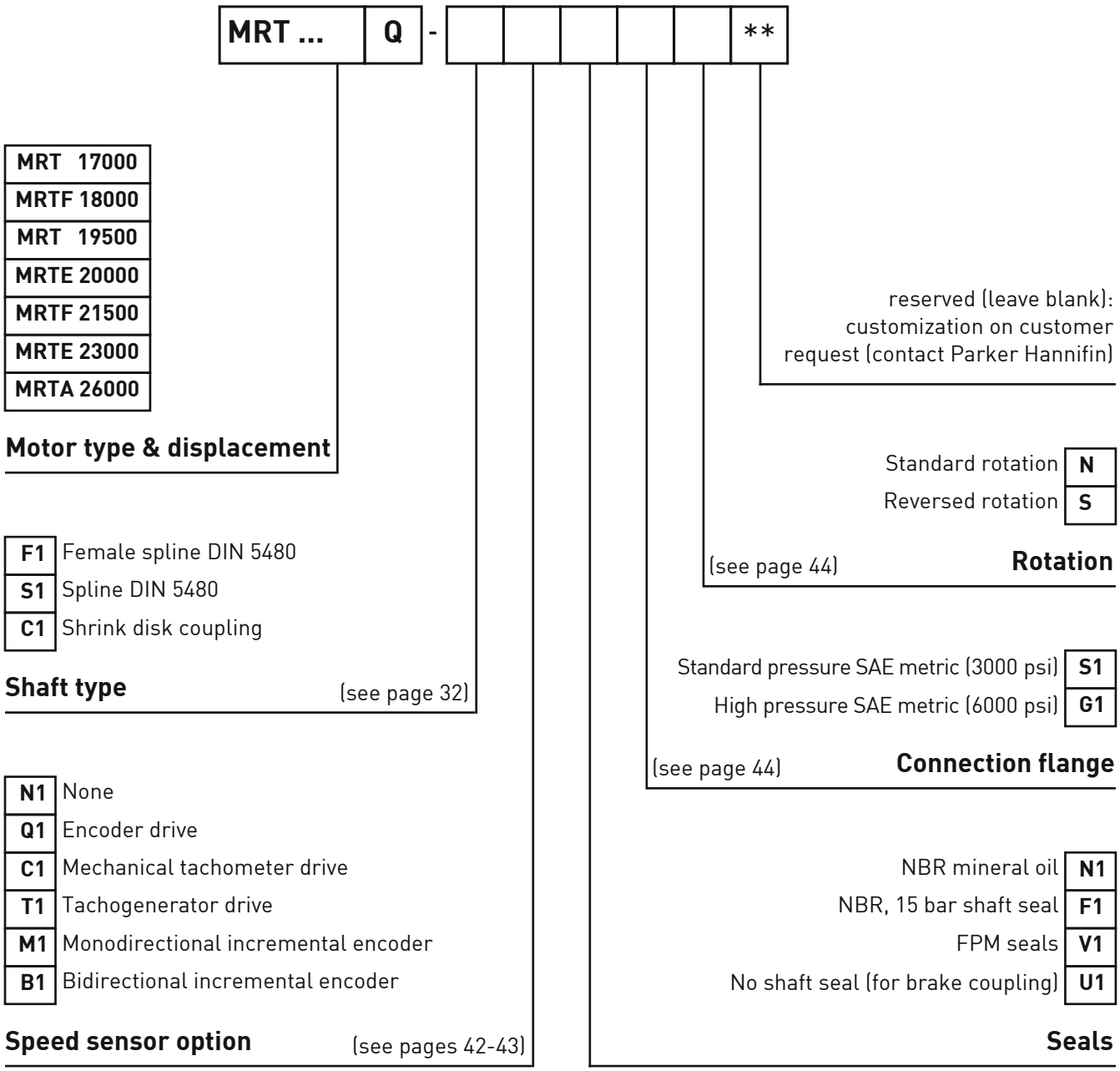
OUTPUT SHAFT OPTIONS AND DIMENSIONS







ORDERING INFORMATION



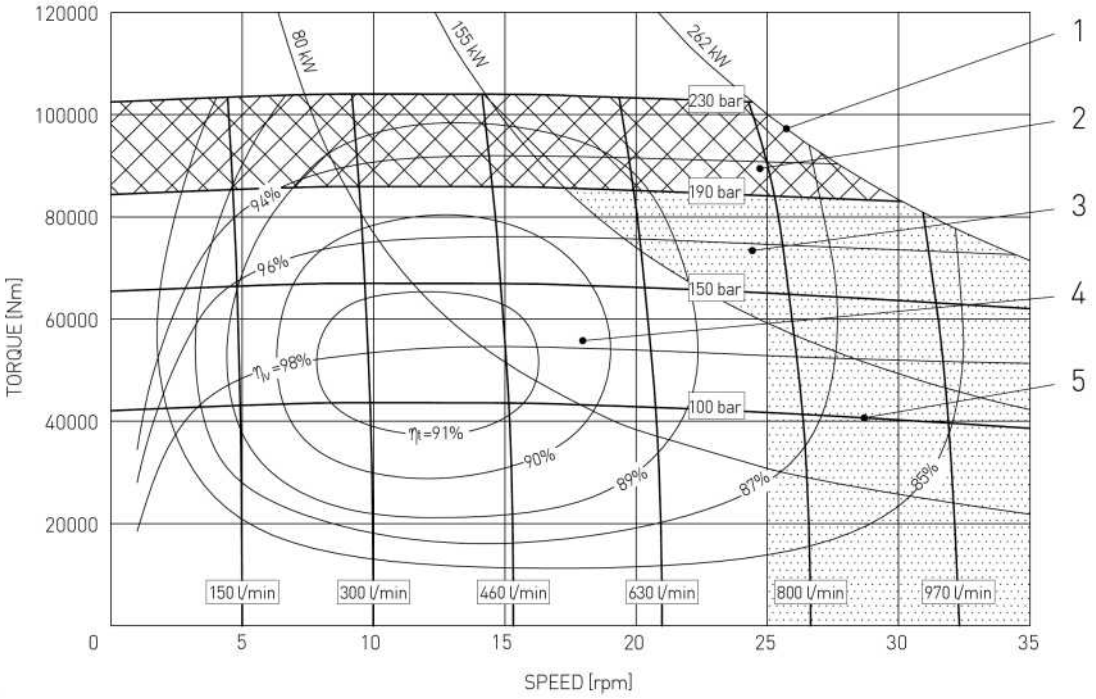
Ordering code example: **MRT 19500 Q - D1 M1 N1 S1 N**

OPERATING DIAGRAM

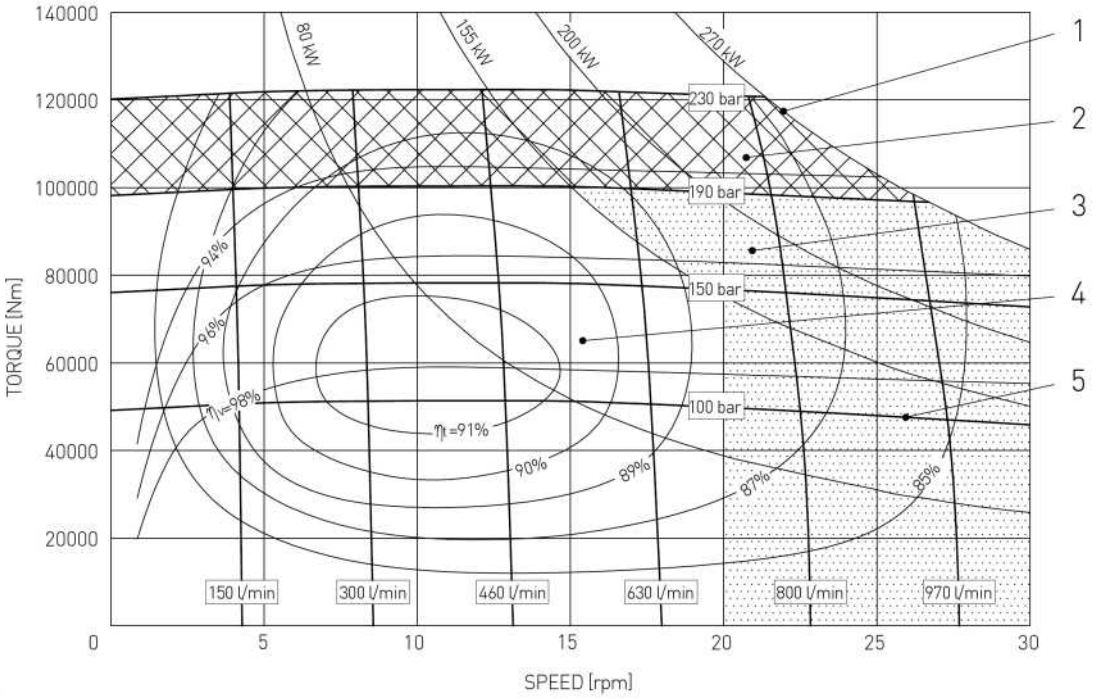
(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

1 Output power **2** Intermittent operating area **3** Continuous operating area with flushing
4 Continuous operating area **5** Inlet pressure h_t Total efficiency h_v Volumetric efficiency

MRTA 30000 T



MRTA 35000 T

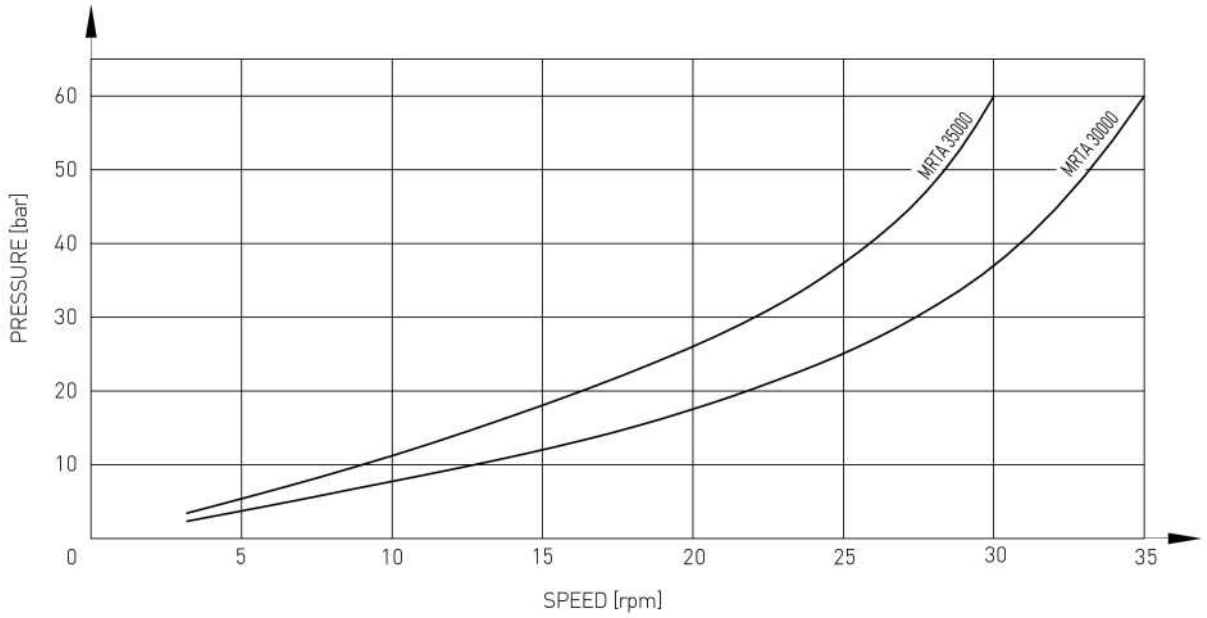


Parker Hannifin Corporation
Vane Pump Division/ Calzoni
Anzola dell'Emilia, Italy

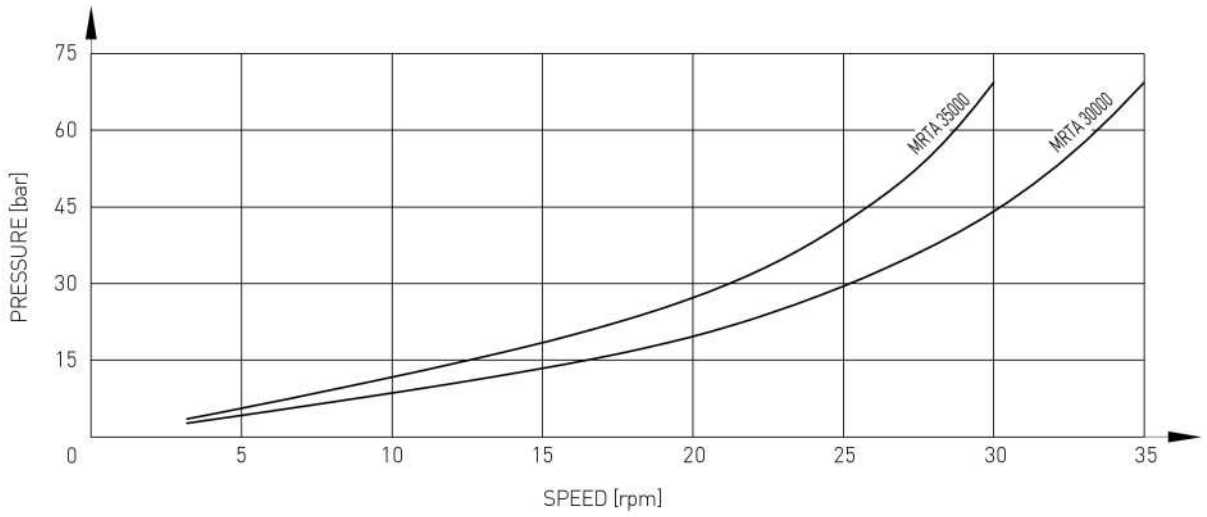
OPERATING DIAGRAM

(average values) measured at n = 36 mm^2/s; t = 45°C; P_{outlet} = 0 bar

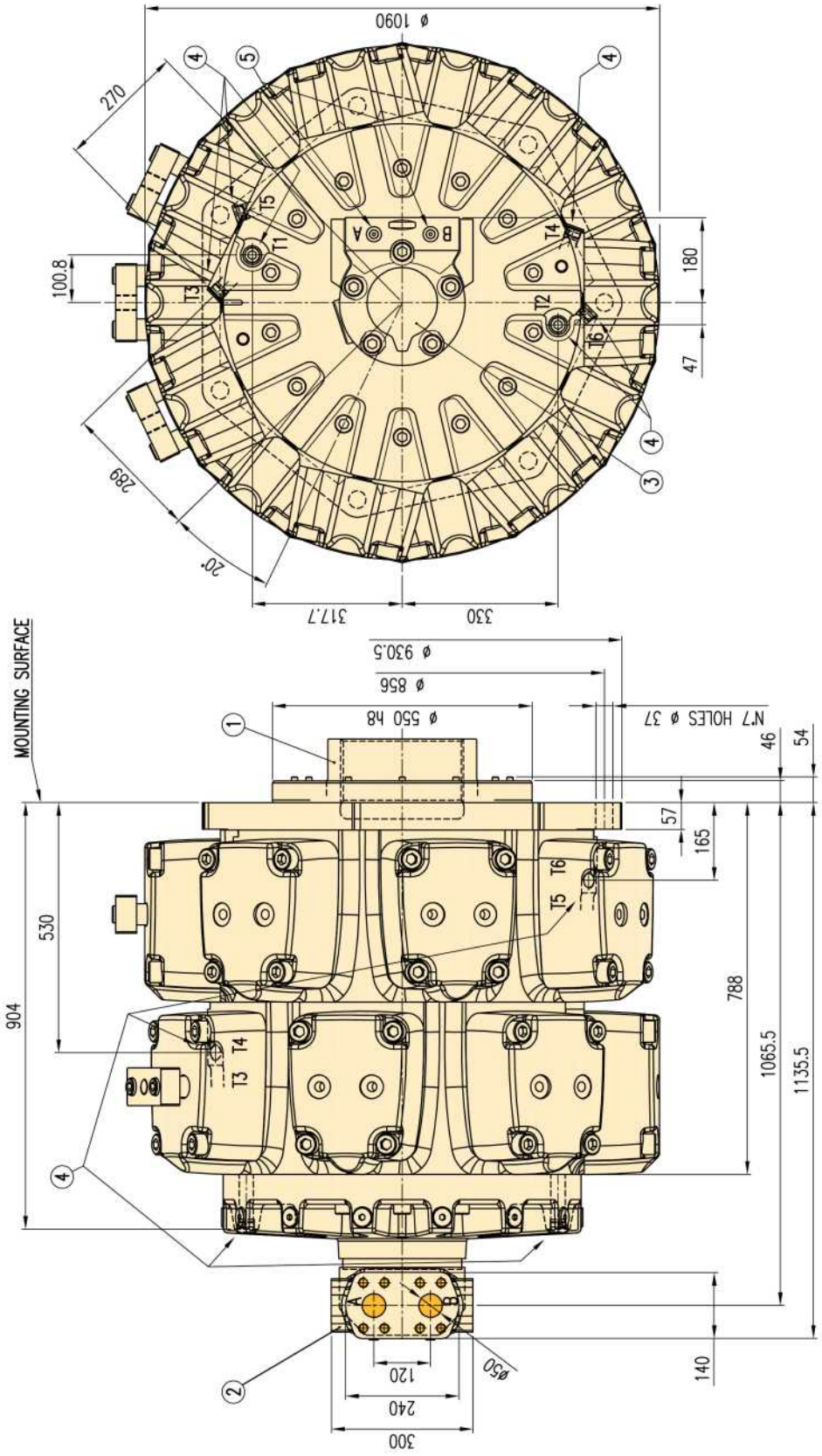
Min. required pressure difference Dp with idling speed (shaft unloaded)



Minimum boost pressure during pump operation



OVERALL DIMENSIONS



1 **See output shaft options at page 37**

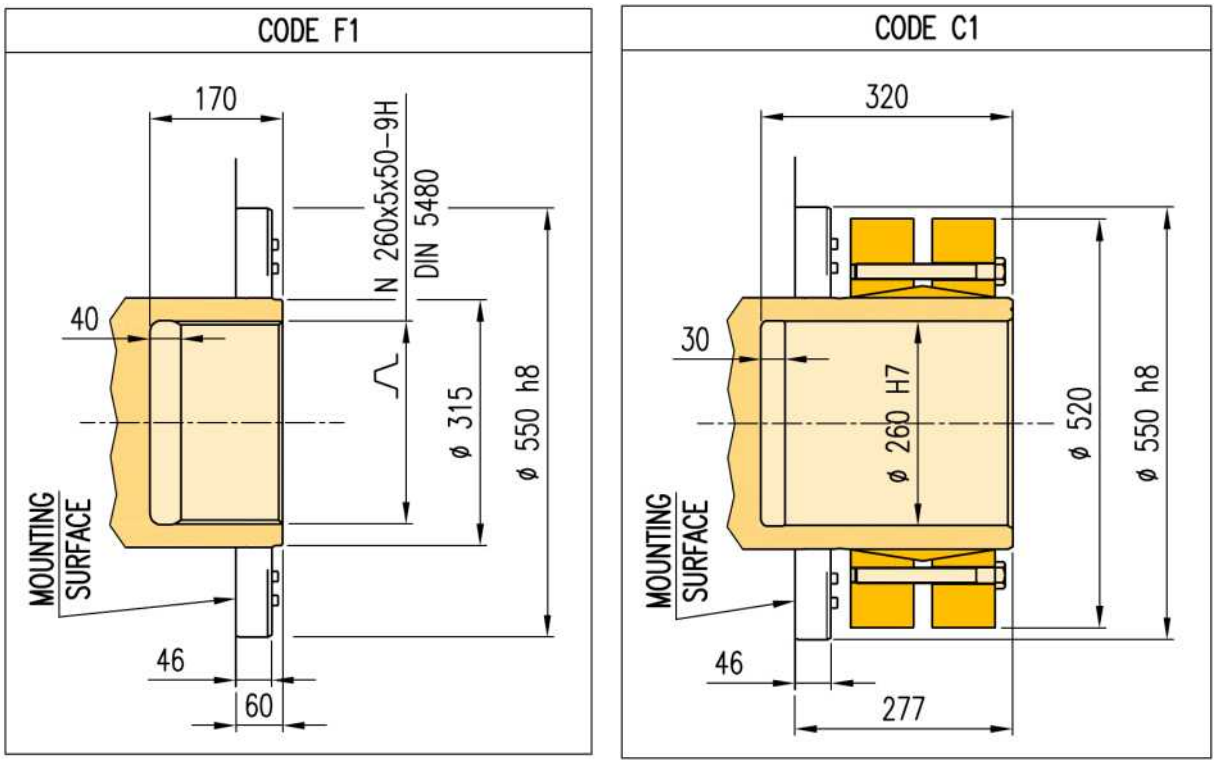
2 **See connection ports options at page 44**

3 **On request the port flange can be rotated by 72°**

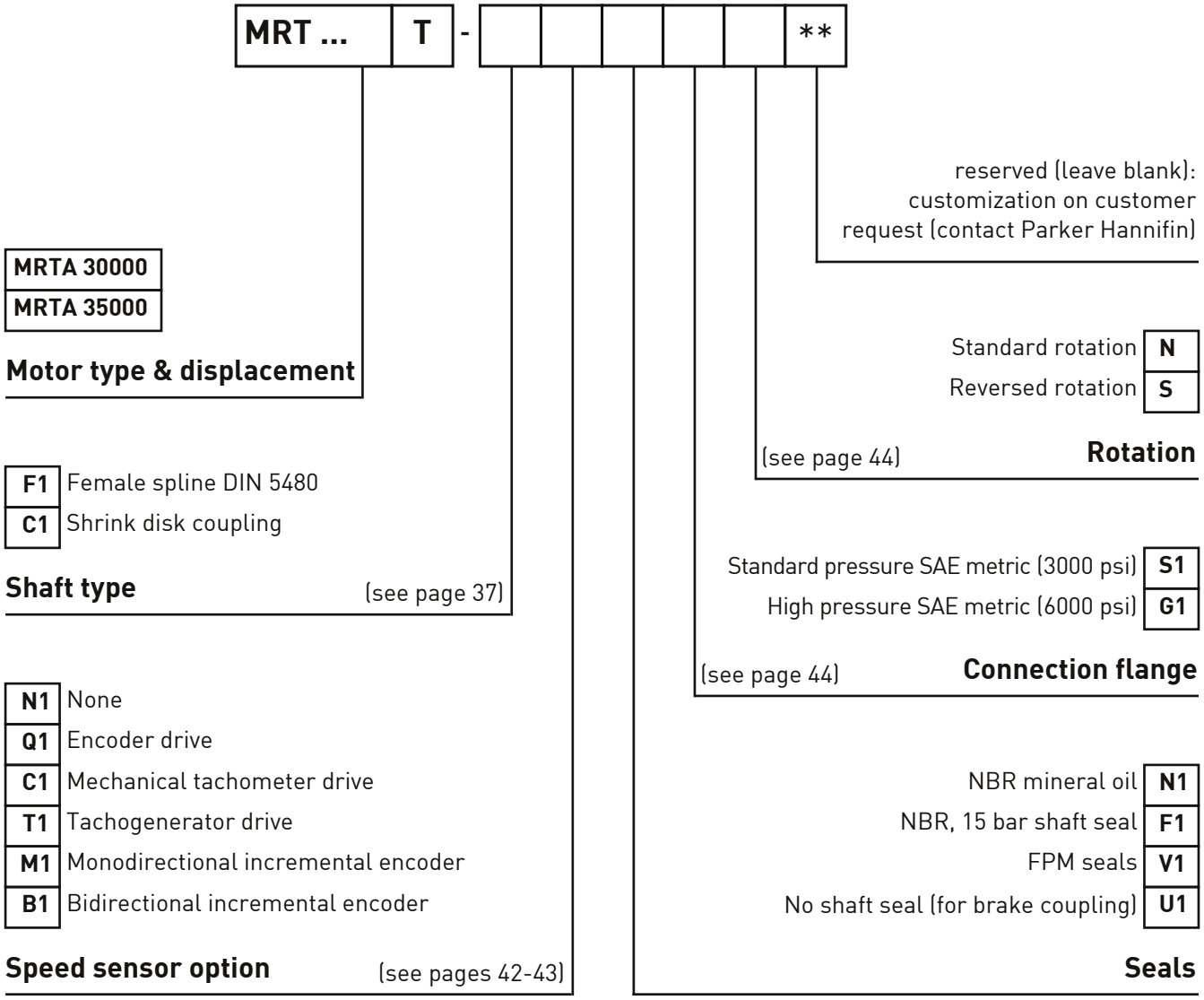
4 **Case drain ports: G 1"**

5 **Port 1/4" BSP threads to ISO 228/1 for pressure reading**

OUTPUT SHAFT OPTIONS AND DIMENSIONS



ORDERING INFORMATION



Ordering code example: **MRTA 35000 T - F1 N1 N1 S1 N**

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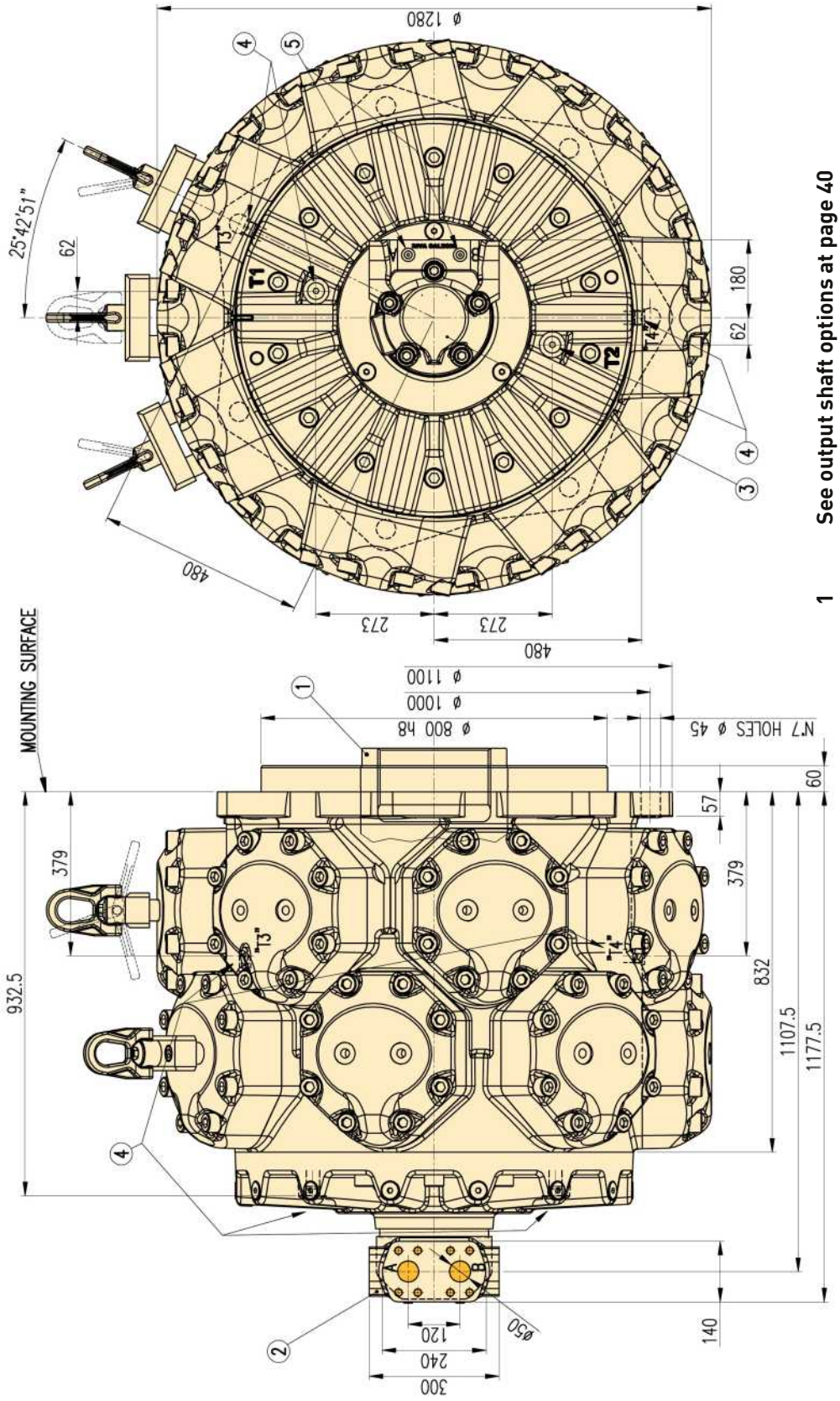
OVERALL DIMENSIONS



1 See output shaft options at page 40

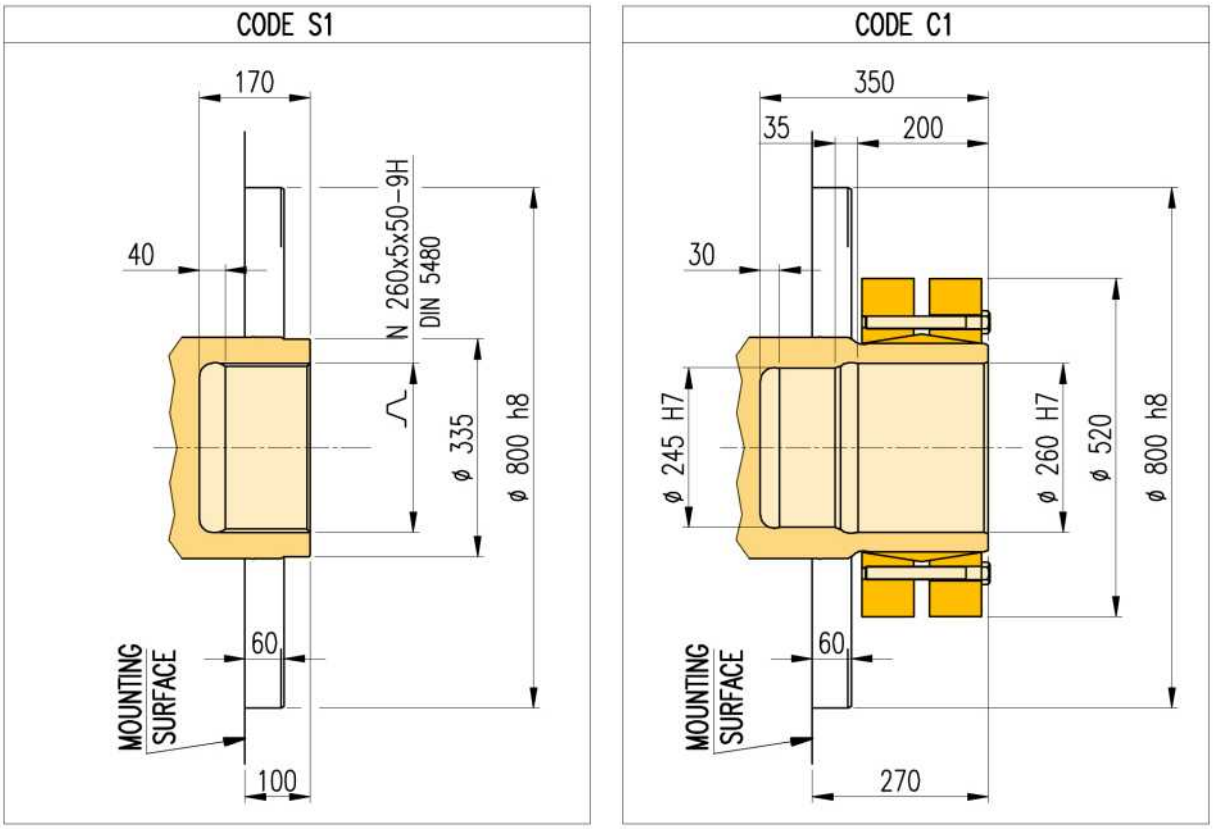
2 See connection ports options at page 44

3 On request the port flange can be rotated by 72°

4 Case drain ports: G 1"

5 Port 1/4" BSP threads to ISO 228/1 for pressure reading

OUTPUT SHAFT OPTIONS AND DIMENSIONS



Parker Hannifin Corporation
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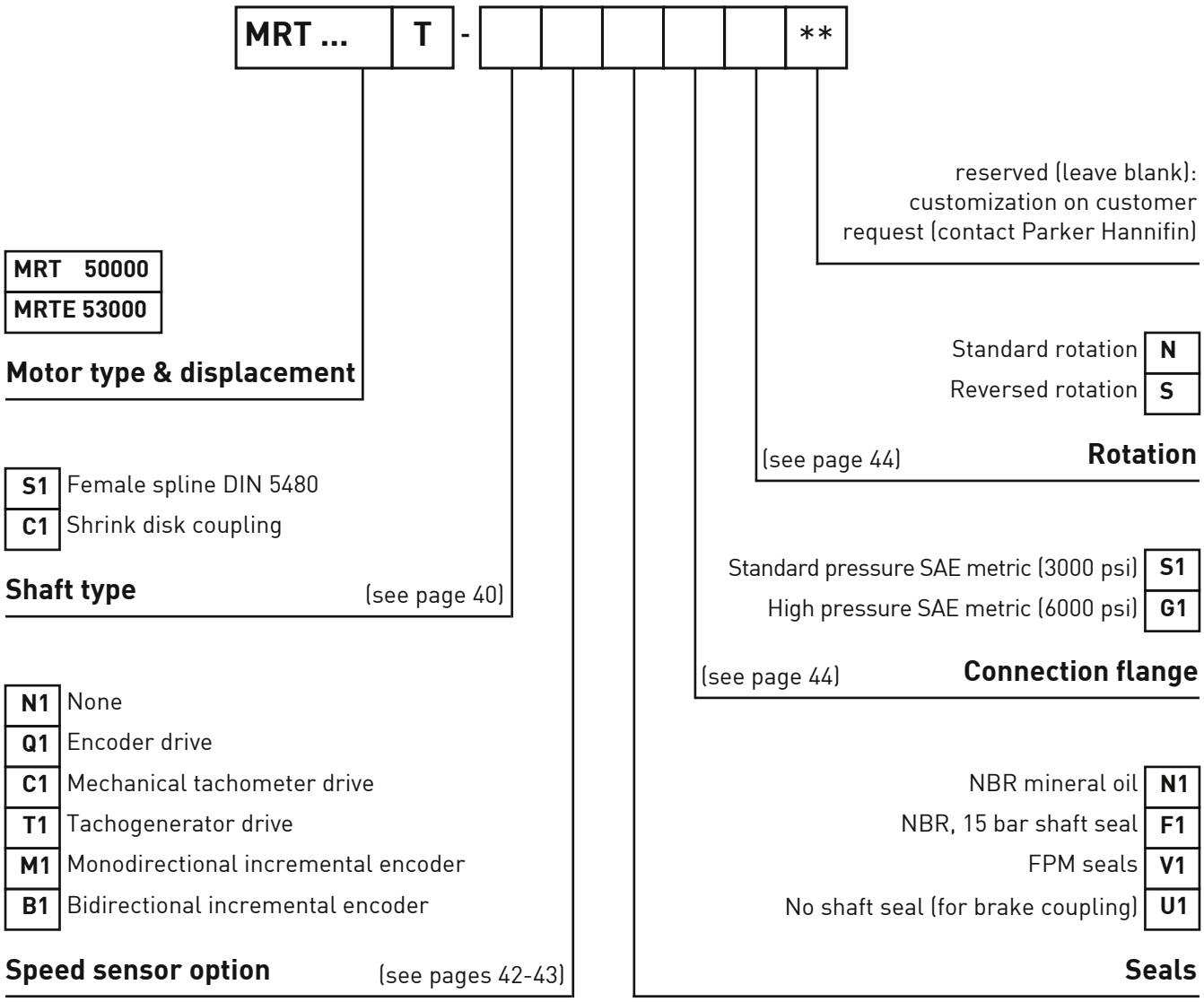
Anzola dell'Emilia, Italy

ORDERING INFORMATION



Ordering code example: **MRT 50000 T - C1 N1 N1 S1 N**

SPEED SENSOR OPTIONS

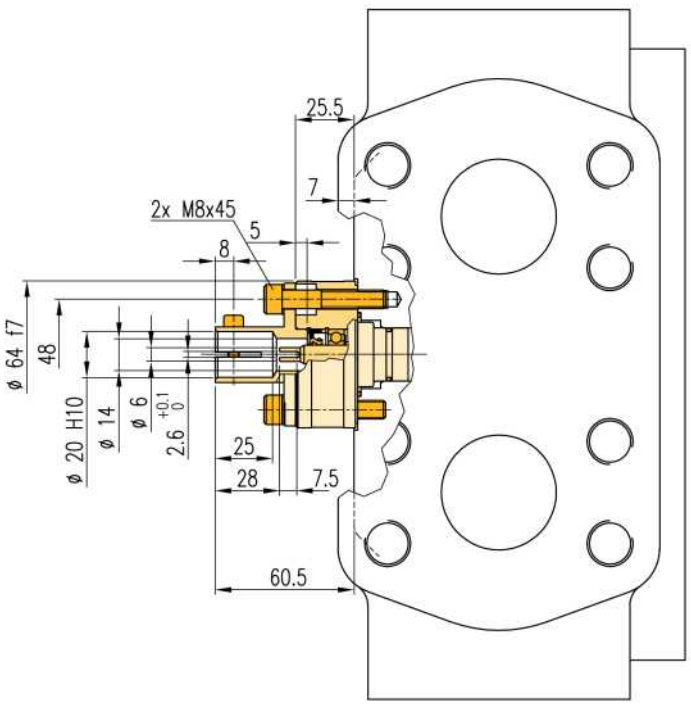
- **Standard:**

N1	**None**

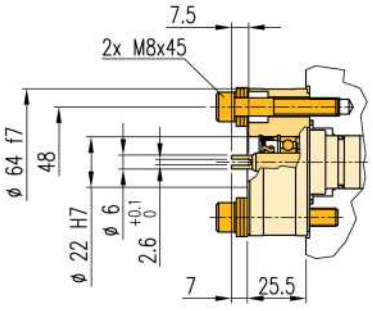
- **Speed sensor drives:**

C1	**Mechanical tachometer drive**
T1	**Tachogenerator drive**
Q1	**Encoder drive**

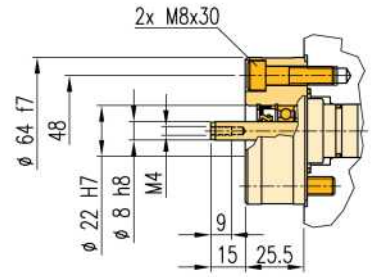
CODE C1



CODE T1



CODE Q1

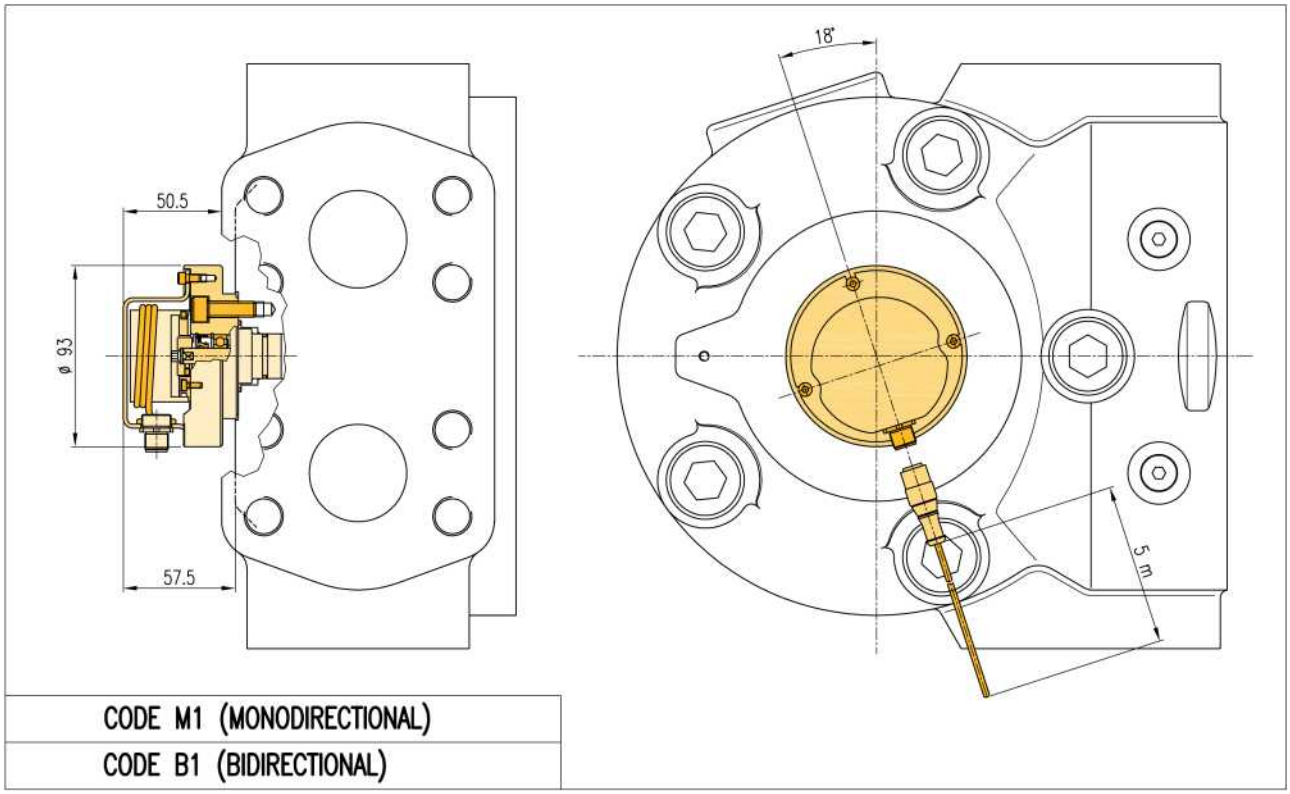


These codes consist on the predisposition for the desired speed sensors. For sensor specifications and connection look at the technical catalogue of the sensor manufacturer.

- **Incremental encoder:**

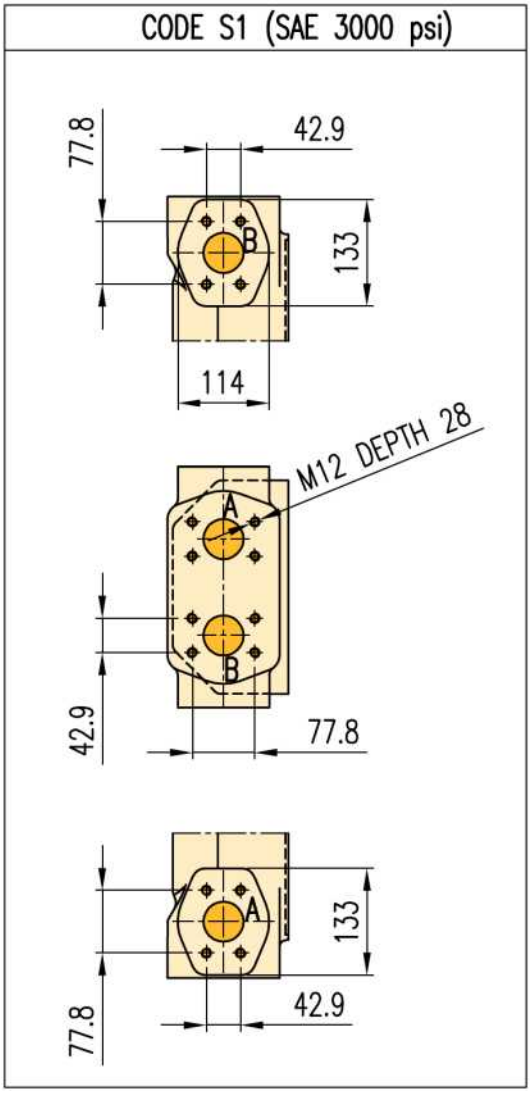
M1	**Monodirectional incremental encoder**
B1	**Bidirectional incremental encoder**

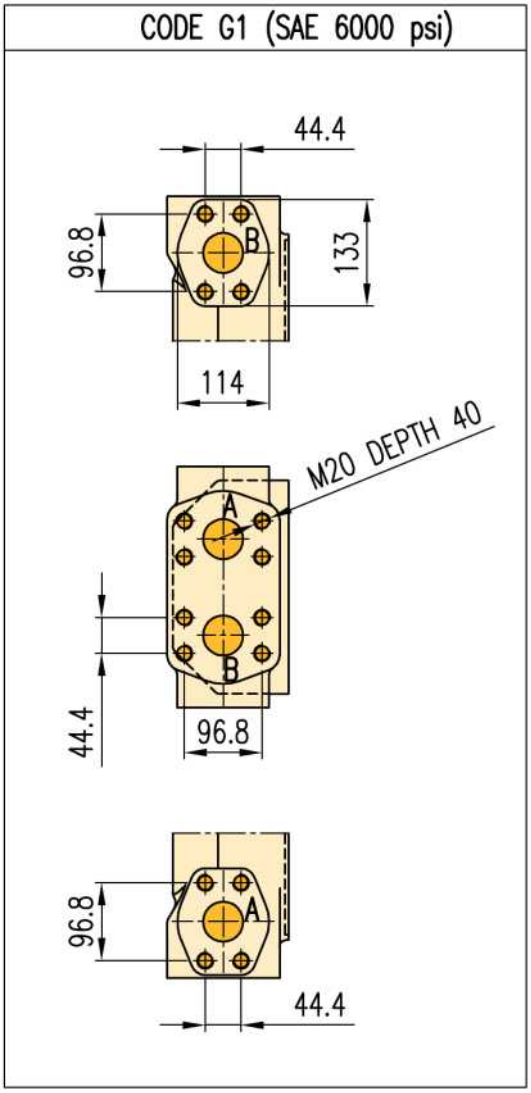
The 2 codes above consist on the whole incremental encoder kit, already installed on the rotary valve housing. For technical data see the table in the following page.



ENCODER TYPE	ELCIS mod. 478	
SUPPLY VOLTAGE	8 to 24 Vcc	
CURRENT CONSUMPTION	120 mA max	
CURRENT OUTPUT	10 mA max	
OUTPUT SIGNAL	A phase - MONODIRECTIONAL	**CODE M1**
	A and B phase - BIDIRECTIONAL	**CODE B1**
RESPONSE FREQUENCY	100 kHz max	
NUMBER OF PULSES	500 (others on request - max 2540)	
SLEW SPEED	Always compatible with maximum motor speed	
OPERATING TEMPERATURE RANGE	from 0 to 70°C	
STORAGE TEMPERATURE RANGE	from -30 to +85°C	
BALL BEARING LIFE	$1.5x10^9$ rpm	
WEIGHT	100 g	
PROTECTION DEGREE	IP 67 (with protection and connector assembled)	
CONNECTORS:		
MONODIRECTIONAL	RSF3/0.5 M (Lumberg)	male
	RKT3-06/5m (Lumberg)	female
BIDIRECTIONAL	RSF4/0.5 M (Lumberg)	male
	RKT4-07/5m (Lumberg)	female
NOTE: Female connectors cable length equal to 5 m.		

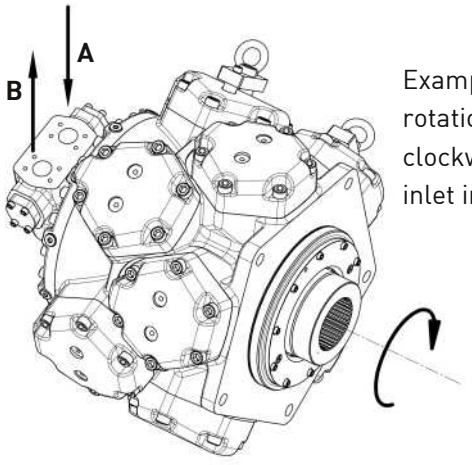
CONNECTION FLANGES





DIRECTION OF ROTATION

Direction of rotation (viewed from shaft end)	**Inlet port**	**Ordering code**
clockwise **counter-clockwise**	**A** **B**	**N**
clockwise **counter-clockwise**	**B** **A**	**S**



Example of standard rotation, code **N**: clockwise rotation, inlet in A.

HYDRAULIC FLUID SELECTION

General notes

More detailed information regarding the choice of the fluid can be requested to the manufacturer. When operating with HF pressure fluids or bio-degradable pressure fluids, possible limitations of the technical data must be taken into consideration; please consult the manufacturer.

Operating viscosity range

The viscosity, the quality and the cleanliness of the operating fluid are decisive factors in determining the reliability, the performances and the life time of an hydraulic component.
The maximum lifetime and performances of the motor are achieved within the recommended viscosity range. For applications exceeding this range, we recommend to contact the manufacturer.

n_{rec} = recommended operating viscosity 30....50 mm^2/s

The viscosity refers to the operating temperature of the motor, that is defined as the higher between the temperature of the fluid entering the motor and the temperature of the fluid inside the motor housing (case temperature). We recommend to select the viscosity of the fluid based on the maximum operating temperature, in order to remain within the recommended viscosity range. In order to reach the maximum continuous power, the operating viscosity should be within the recommended viscosity range.

Limits of viscosity range

The following limitations are applied:

- $n_{min.abs}$ = 10 mm^2/s for instants in case of emergency, with a maximum case fluid temperature of 80°C;
- n_{min} = 18 mm^2/s for continuous operation at reduced performances;
- n_{max} = 1000 mm^2/s short term, during cold start up.

Filtration

The motor life depends also on the fluid filtration. The contamination level should not exceed the following classes:

class 9 according to NAS 1638
class 6 according to SAE, ASTM, AIA
class 19/16/13 according to ISO 4406.

In order to ensure a longer life, the contamination level in our motors should not exceed class 8 according to NAS 1638; this condition is achieved by means of a filter with grade of filtration $b_5 = 100$.
In case the above mentioned classes cannot be achieved, please consult the manufacturer.

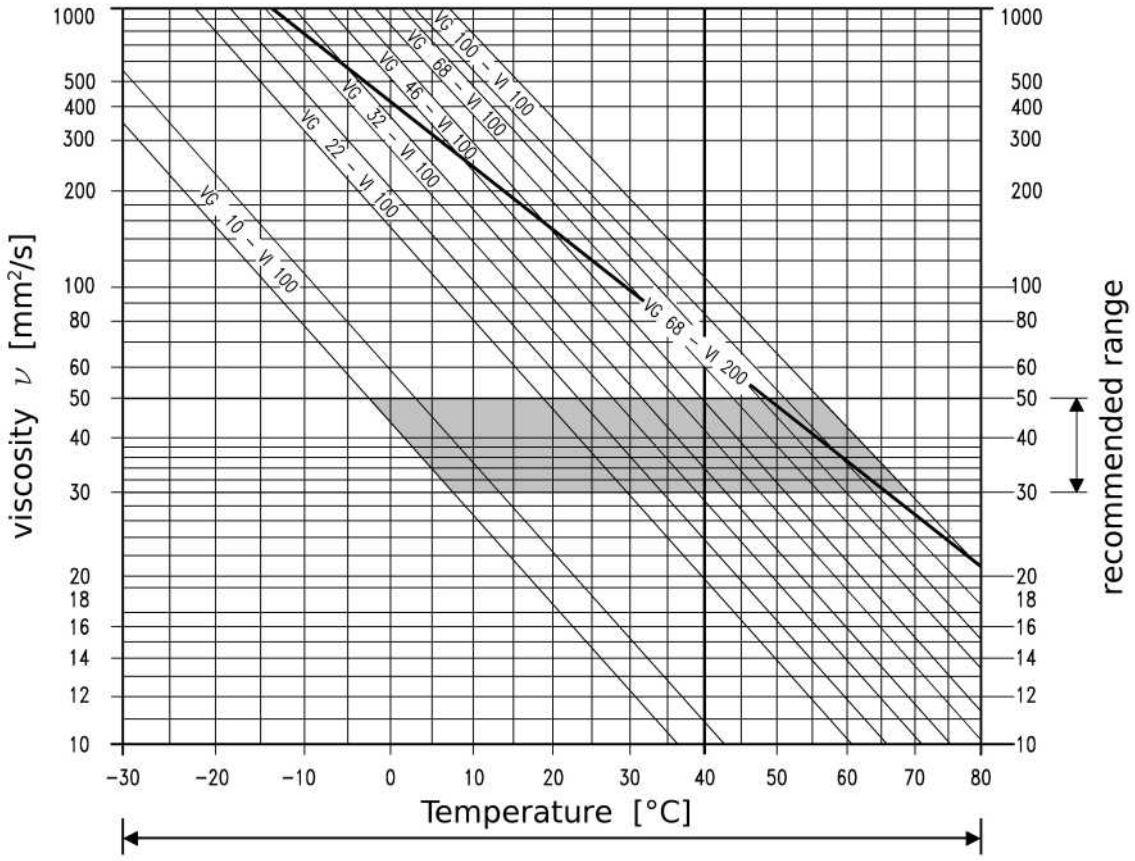
Case drain pressure

The lower the speed and the case drain pressure, the longer the life of the shaft seal. The maximum permissible motor case pressure is: P_{max} = **5 bar**.
If the case drain pressure is higher than 5 bar it is possible to use a special 15 bar shaft seal (seals ordering code "F1").

"FPM" seals

In case of operating conditions with high fluid temperature or high ambient temperature, we recommend to use "FPM" seals (seals ordering code "V1"). These seals should be used also with HFD fluids.

IMPORTANT: The drain fluid temperature is influenced by pressure and speed and is usually higher than the circuit temperature or the tank temperature. At no point in the system, however, may the temperature be higher than **80°C**. If the optimum conditions cannot be met due to the extreme operating parameters or high ambient temperature, we always recommend **flushing** the motor case in order to operate within the viscosity limits. Should it be absolutely necessary to use a viscosity beyond the recommended range, you should first contact the manufacturer for confirmation.

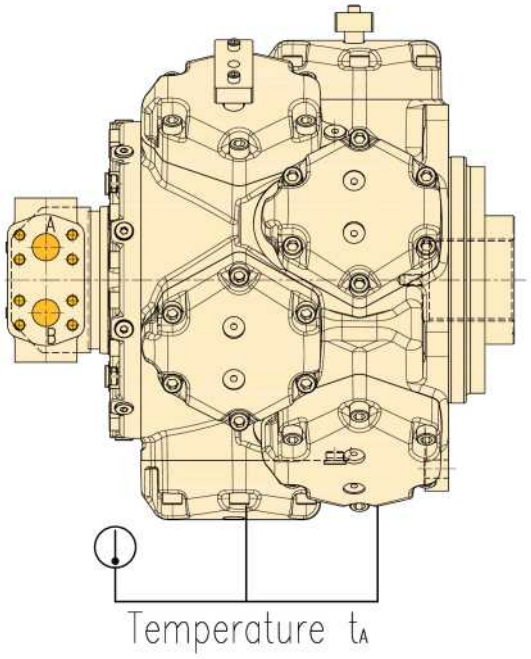


EXAMPLE: At a certain ambient temperature, the operating temperature in the circuit is 50°C. In the optimum operating viscosity range n_{rec}, this corresponds to viscosity grades VG 46 or VG 68; VG 68 should be selected.

FLUSHING PROCEDURE

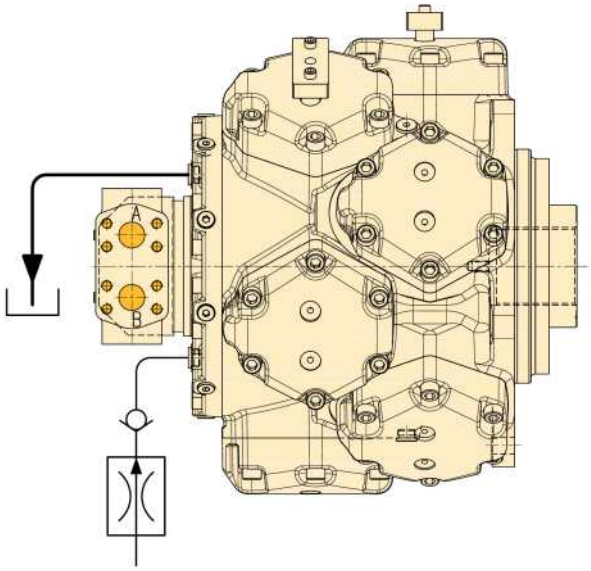
Motor case flushing is compulsory when the motor has to operate in the "Continuous operating area with flushing" (pls. refer to the Operating Diagrams), in order to ensure a minimum fluid viscosity inside the motor case of 30 mm^2/s.
Flushing may also be necessary out of the "Continuous operating area with flushing" when high temperature is reached in the motor case and the system is unable to ensure the minimum recommended degree of viscosity.

The fluid temperature inside the motor case can be obtained by adding 3°C to the motor case surface temperature t_A ,measered between two cylinders.

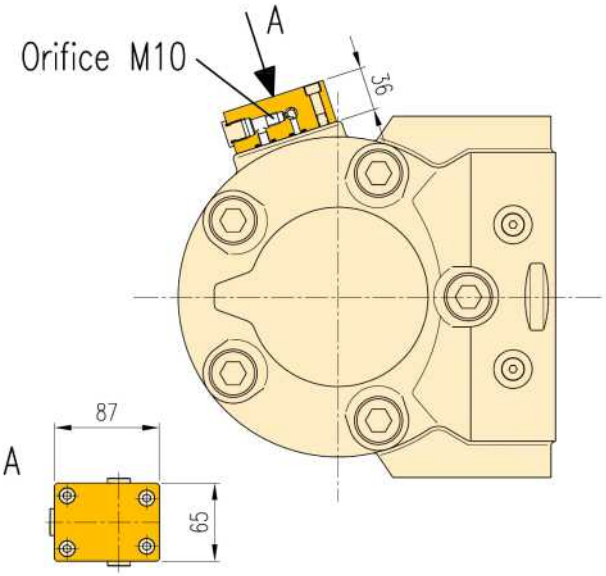


For MRT motors, the required flushing flow rate is **23 l/min**; the flushing line can be realized in two different ways:

- **External flushing**: flushing flow rate is obtained by means of an external source.

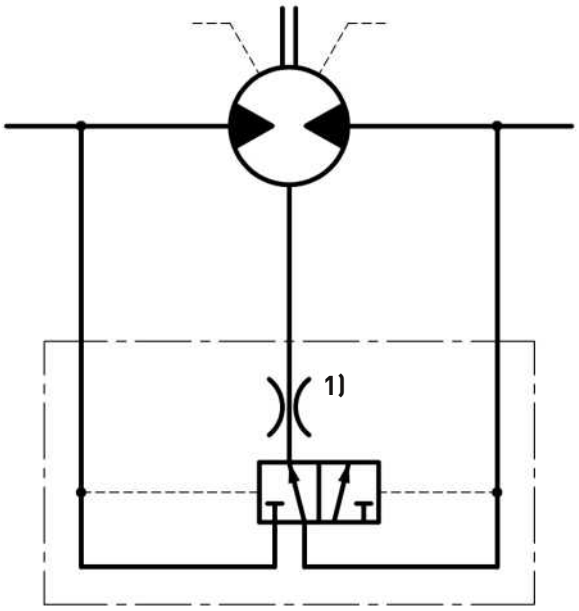


- **Internal flushing**: obtained by means of a flushing valve (type "VFC"), to be ordered separately.



The flushing valve takes the flushing flow always from the low pressure line of the motor. The diameter of the orifice has to be chosen in order to supply the recommended flushing flow rate of **23 l/min**.

The flushing circuit of the valve is shown in the following scheme.



BACK PRESSURE (bar)	ORIFICE DIAMETER [1]
3	4.8
6	4.0
9	3.6
15	3.2
20	3.0
25	2.9
30	2.8

Note: the flushing valve is delivered with a "closed" orifice.

CAUTION **Flushing does not work until the "closed" orifice is replaced by the proper one.**

CAUTION For all motor types, the maximum case pressure allowed with standard shaft seal is 5 bar; if higher case pressure is required by the application, pls. contact the manufacturer.

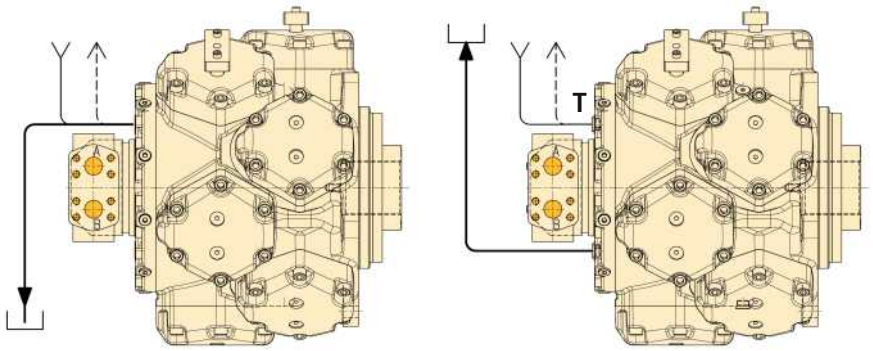
DRAIN AND FEEDING CONNECTION

Before installation, fill the motor with hydraulic fluid.

Note: Install leakage line in such a way that motor **cannot** run empty.

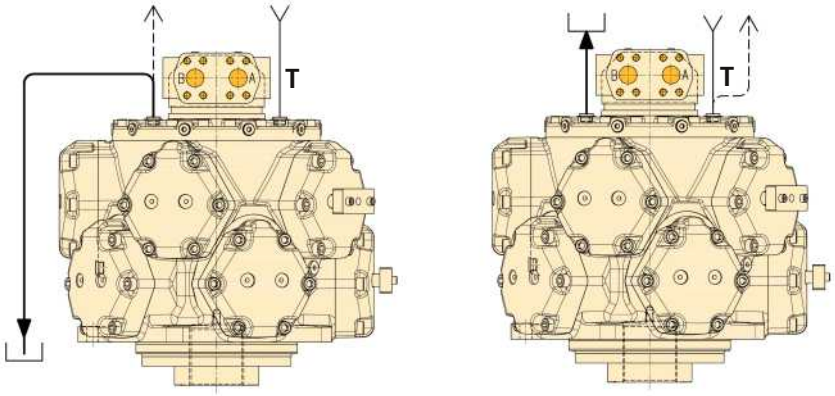
T = To be plugged after motor case feeding
Y = Motor case feeding point
= Air bleeding
= Drain line

Horizontal installation

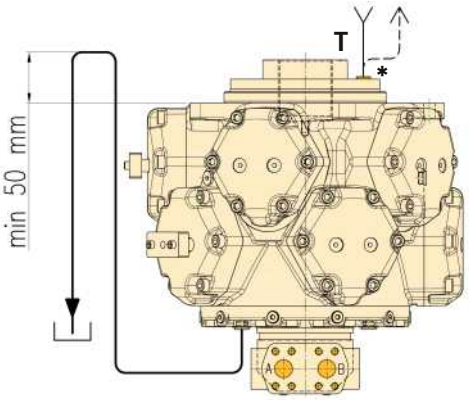


Choose the drain port in order to allow the complete filling of the motor case with hydraulic fluid.

Vertical installation - output shaft downward



Vertical installation - output shaft upward



* Optional plug for feeding and air bleeding (pls contact the manufacturer).

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Catalogue HY29-0503/UK
Effective: February 2012

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