VOITH TURBO

Medium pressure internal gear pumps type IPC

The extremely silent-running medium-pressure pumps –
robust compact
reliable economical
any desired combination

Principle

IPC medium pressure pumps are internal gear pumps with radial and axial sealing gap compensation. As a result of special design features and an effective hydrostatic force balance, these pumps are suitable for operating pressures up to 250 bar with high overall efficiency.

Thanks to a new, volume-optimized involute gearing, IPC pumps are much smaller in outside dimensions than comparable IPH units.

Advantages

- High overall efficiency
- High volumetric efficiency due to radial and axial compensation
- Very low noise level (e.g. 62 dB (A) at 250 bar, 48 ltrs/min and 1,460 rpm)
- Long service life due to sleeve bearings and axial and radial force balance
- Good suction (up to 0.6 bar at pump intake union)
- Low delivery and pressure pulsation
- Favourable ratio of size to delivery
- Complete range of models from 3.5 to 250 cm^3 per rev delivery
- Wide viscosity range
- Wide speed range
- Can be combined to form multiple units
- Can be combined with Voith IPH high pressure pumps and Voith IPN low pressure pumps
- Compact design
- Straightforward construction for easy maintenance
- Any desired fitting position
- Radial loading of the drive shaft is under certain conditions without supplementary bearing possible

Applications

IPC pumps are employed in the medium pressure range at continuous operation pressures of up to 210 bar. Depending on viscosity, speed, and displacement, higher pressures are possible on request. The very low noise emission of IPC medium pressure pumps considerably reduces the noise level of the overall plant.

Combination

IPC pumps of similar or different sizes can be combined to form multiple flow units.

A particularly wide range of application is offered by the fact that IPC pumps can be combined with Voith high pressure pumps of type IPH and Voith low pressure pumps of type IPN.

Construction and mode of operation

Construction and mode of operation are described with reference to fig. 1.

Pinion shaft *1* is driven, and by virtue of its gear teeth drives the ring gear *2*. The pinion shaft is supported in specially designed sleeve bearings in casing *8*. The ring gear is also supported in the casing; radial forces exerted on the ring gear under pressure loading are largely absorbed in the hydrostatic bearing *9*.

The filler is comprised essentially of segment carrier *4a* and segment *4b*. Between these two components are sealing rollers which separate pressure and suction zones. Axially, the ring gear is guided by the axial discs *5* on its sides. These discs are carried by the pinion shaft and supported tangentially by the casing.

When the pair of gears rotate, oil is drawn into the casing and consequently into the space between pinion and ring gear. The two gears rotate completely freely through 180° which illustrates the reason for the outstanding suction behaviour of this pump. The tooth chambers are therefore filled at a low flow velocity.

Due to an almost gap-free sealing of tooth chambers of pinion and ring gear against the filler and axial discs, the oil is delivered almost without loss axially into the pressure union of the casing. In the interest of low bearing and friction stresses, the pressure chamber is maintained as small as possible by the special design of the segment filler. As a result of this, sealing members such as the axial discs and filler are very small, and relatively low bearing loads are obtained. The construction features of this pump are as follows:

Axial compensation

The axial compensation forces + F_A are generated by springs *6* in the axial discs and are proportional to operating pressure. The axial discs press with a small excess force in the pressure chamber area against the sides of the ring gear, pinion shaft and filler. As a result, the axial leak gaps between the rotating and stationary parts are extremely small.

By virtue of exactly determined compensation with relatively low excess force, the pressure chamber has the best possible axial sealing under all operating conditions, even after an extended period of service.

Radial compensation

The radial compensation force + F_R is exerted both on the segment carrier and the filler segment. Dependent upon operating pressure, these two filler components are pressed against the tip diameters of pinion shaft and ring gear teeth. The surface conditions and bearings of the two sealing rolls between the filler segments are so dimensioned that the filler components are always pressed against the tips of the teeth under a light excess pressure. The height of this pressure is such that under all operating conditions sealing is effected without wear. In this way, a sealing is produced between ring gear, filler segments and pinion shaft which is largely free of leak gaps.

In order that the filler segments are pressed against the tips of teeth even under very low delivery pressure, appropriate spring elements are arranged beneath the sealing rollers.

Bearings

A hydraulic load + F_W is exerted from the pressure chamber on the pinion shaft. This load is absorbed by the sleeve bearings *7* which are force-fed by the operating medium. The sleeve bearings on the pinion shaft guarantee a long service life and have a positive effect on the noise behaviour of IPC pumps.

The hydraulic force F_W is also exerted on the ring gear. This load is absorbed by a hydrostatically unloaded sleeve bearing *9* in casing *8*. The combination of a hydrodynamic bearing with hydrostatic unloading has a positive effect on service life, efficiency, and running noise.

Gearing

IPC gearing is of the involute type. The long contact path results in low delivery and pressure pulsation. These low pulsation rates contribute extensively to the low operating noise of the IPC system.

Suction capacity

The suction capacity of these internal gear pumps is extraordinarily good. They are fully self-priming throughout the entire permissible speed range. An absolute pressure of 0.6 bar is allowed as minimum intake pressure at the suction union of the pump. In continuous operation, pressure should not fall below 0.8 bar. With single pump units, the operating medium is sucked in via the radial intake union in the pump casing, with tandem and multi-pump units via the adaptor housing.

Characteristic data

Design	internal gear pump
Mounting	SAE J 744 c
Pipe fixing	SAE J 518 c code 61
Direction of rotation	Clockwise or anti-clockwise
Suction pressure	0.6 up to 2 bar absolute pressure
Continuous pressure	210 bar
Peak pressure	250 bar
Volumetric efficiency	Up to 97 % at 250 bar
Overall efficiency	Up to 92 % at 250 bar
Displacement*	3.5 up to 250 cm^3/rev
Pressure medium	Mineral oil as per DIN 51524 Part 2 or 3
Temperature of pressure medium	- 20° C up to + 80° C

Fig. 3
Efficiency curve of an IPC 4-32

Test conditions:
Operating temperature *t = 40° C*
η_v = *volumetric efficiency*
Viscosity *v = 46 cSt*
η_g = *overall efficiency*
Speeds *n = 1465 rpm*

Fig. 4 + 5
Test conditions:

Speed *1465 rpm*

Measuring point *1 m distance from the pump in axial direction*

Measuring room *Voith sound measuring room (not totally anechoic. If measured in an anechoic room, values will be 5 dB (A) lower.)*

Fig. 3

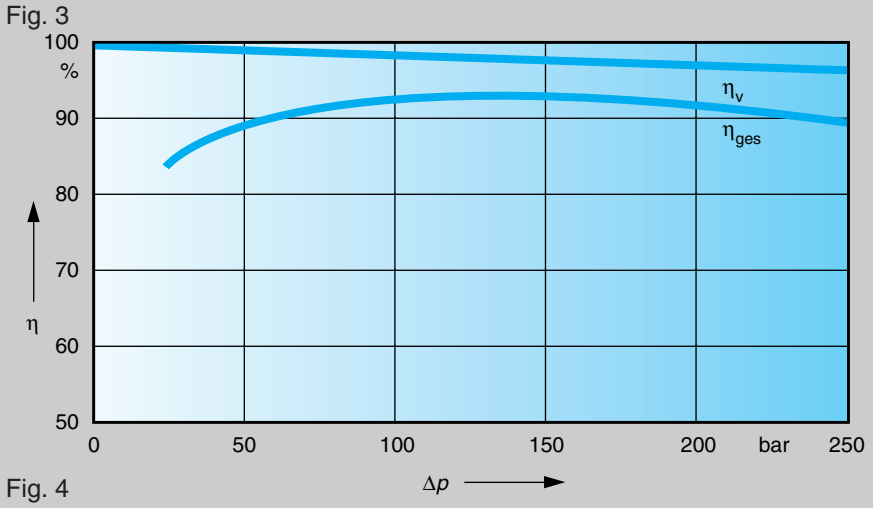


Fig. 4

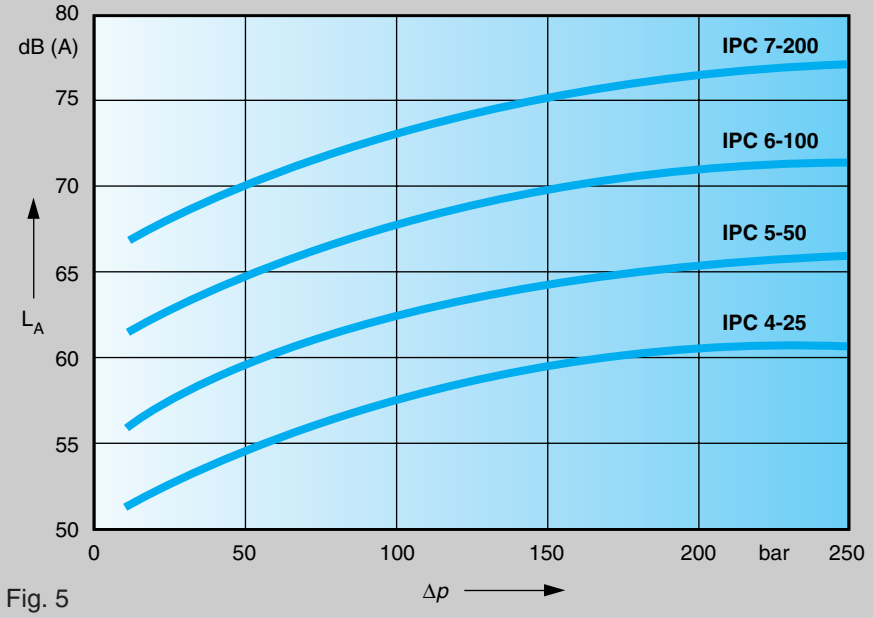
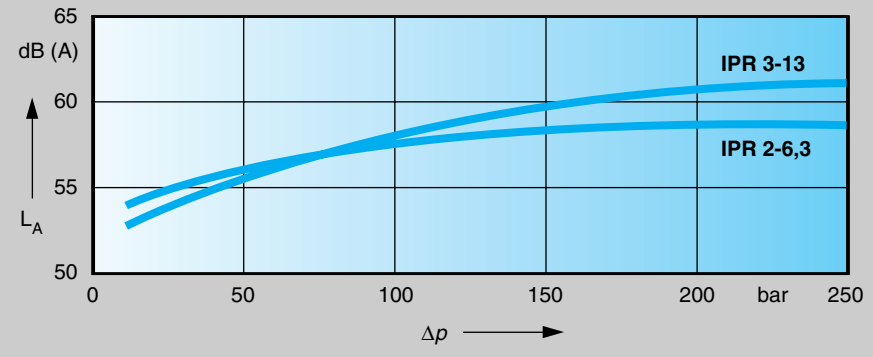


Fig. 5



Values and dimensions

The IPR pumps size 2 and 3 will be discontinued in favour of the corresponding IPV pumps size 3 and 4.

Basic model Delivery size	Displacem. cm^3/rev.	Speed rpm (P_{max})		Delivery litres/min	Pressure bar		Weight kp	Principlal dimensions mm						
					Conti.	Peak								
	(*)	min**	max	at 1500 rpm	press.	press.		*d*	*a*	*c*	*e*	*x*	*y*	*m*
IPR 2-3.5	3.6	600	4500	5.4	210	250	2.5	18_{h7}	19	64	20	98	41	34
IPR 2-5	5.24	600	4500	7.85	210	250	2.6	18_{h7}	19	69	20	98	41	34
IPR 2-6.3	6.55	600	4500	9.8	210	250	2.7	18_{h7}	19	73	20	98	41	34
IPR 2-8	8.18	600	4500	12.3	210	250	2.8	18_{h7}	19	78	20	98	41	34
IPR 3-10	10.2	600	3600	15.3	210	250	5.2	20_{h7}	22	89	25	119	41.5	36-40
IPR 3-13	13.3	600	3600	20.0	210	250	5.4	20_{h7}	22	95	25	119	41.5	36-40
IPR 3-16	15.8	600	3600	23.7	210	250	5.6	20_{h7}	22	100	25	119	41.5	36-40
IPC 4-20	20.7	400	3000	31.0	210	250	9.6	25_{h7}	18	98	31	122	56	66-70
IPC 4-25	25.4	400	3000	38.1	210	250	10.2	25_{h7}	18	104	31	122	56	66-70
IPC 4-32	32.6	400	3000	48.9	210	250	11.0	25_{h7}	18	113	31	122	56	66-70
IPC 5-40	41.0	400	2600	61.5	210	250	16.3	32_{h7}	20	125	36	148	68	80-90
IPC 5-50	50.3	400	2600	75.4	210	250	17.4	32_{h7}	20	132	36	148	68	80-90
IPC 5-64	64.9	400	2600	97.3	210	250	18.4	32_{h7}	20	143	36	148	68	80-90
IPC 6-80	80.7	400	2200	121.9	210	250	30.7	40_{h7}	22	148	35	195	88	90-110
IPC 6-100	101.3	400	2200	151.9	210	250	32.6	40_{h7}	22	158	35	195	88	90-110
IPC 6-125	126.2	400	2200	189.3	210	250	35.0	40_{h7}	22	170	40	195	88	90-110
IPC 7-160	160.8	400	1800	241.2	210	250	50	50_{h7}	63	162	48	242	75	90-110
IPC 7-200	202.7	400	1800	304.0	210	250	54	50_{h7}	63	174	48	242	75	90-110
IPC 7-250	251.7	400	1800	377.5	210	250	59	50_{h7}	63	188	48	242	75	90-110

**) Due to manufacturing tolerances, delivery can be up to 1.5 % less.*

***) Special variants are available for applications with variable drive speed where the min. speed is lower than 400 rpm. Please contact the manufacturer.*

The permissible peak pressures are based on a switch-on time of 15 % with a maximum cycle time of 1 minute.

In the event of radial load on the drive shaft, please consult the manufacturers or suppliers.

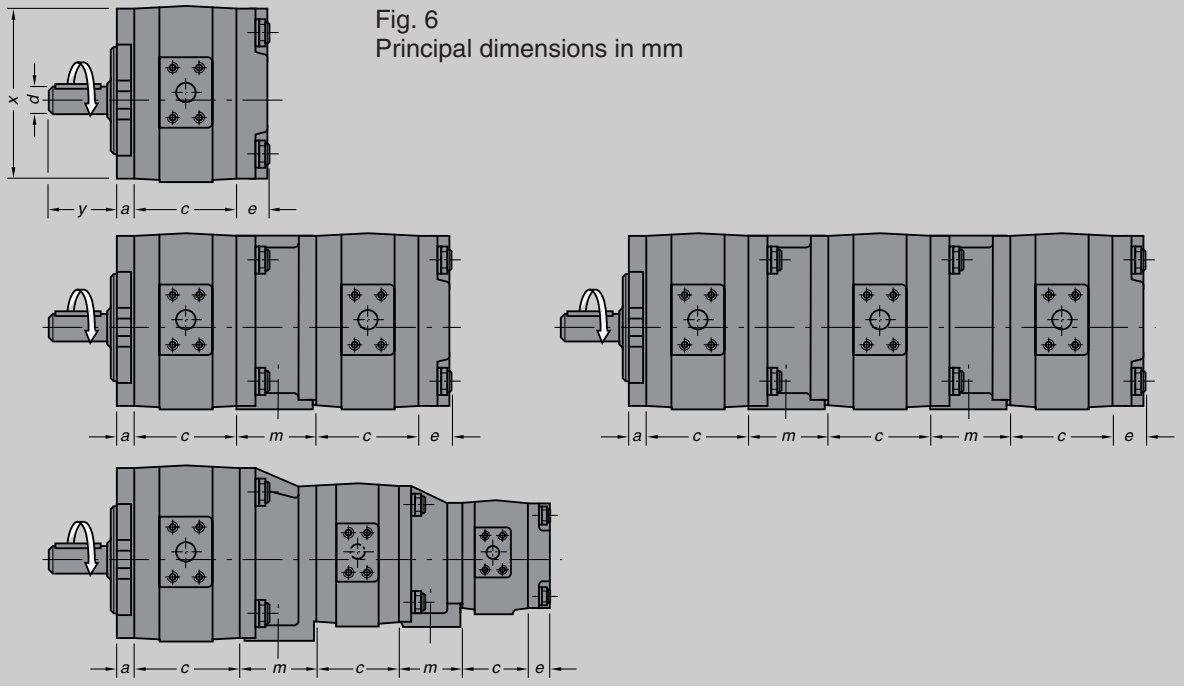


Fig. 6
Principal dimensions in mm

Constructions of the IPC pumps

Fig. 1
Simplified view shows construction of the IPC pumps

1 Pinion shaft
2 Ring gear
3 Filler pin
4a Filler, segment carrier
4b Filler, segment
5 Axial disc
6 Axial pressure
7 Plain bearings
8 Casing
9 Hydrostatisically relieved bearing

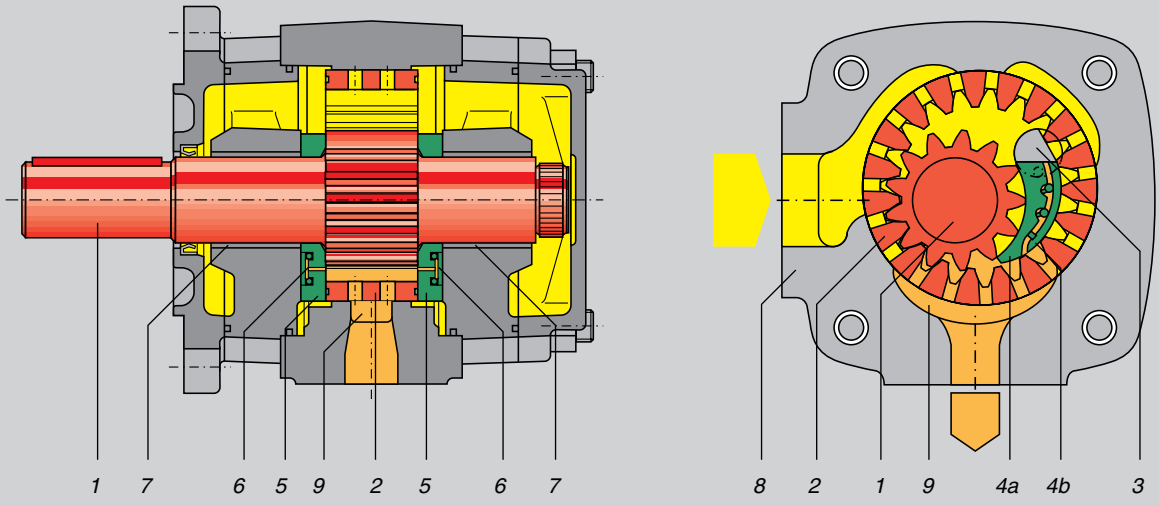
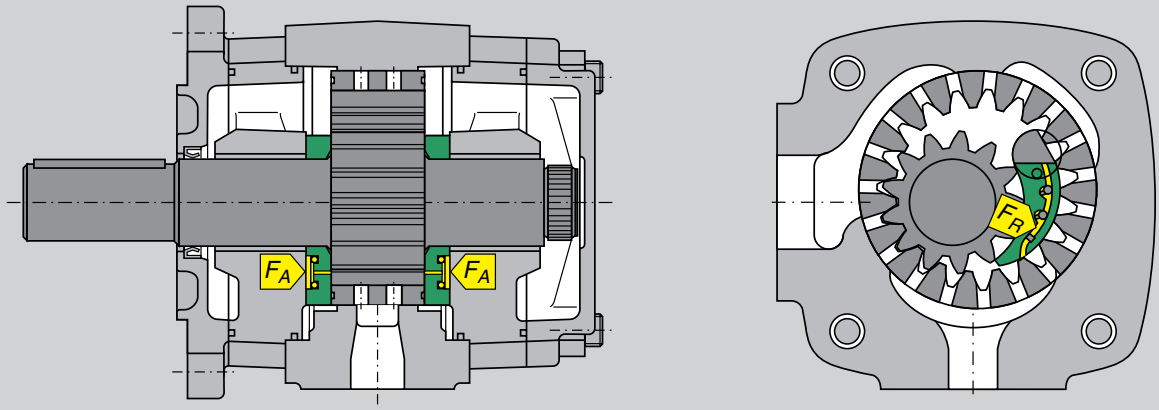


Fig. 2
Illustration of axial compensation and radial compensation

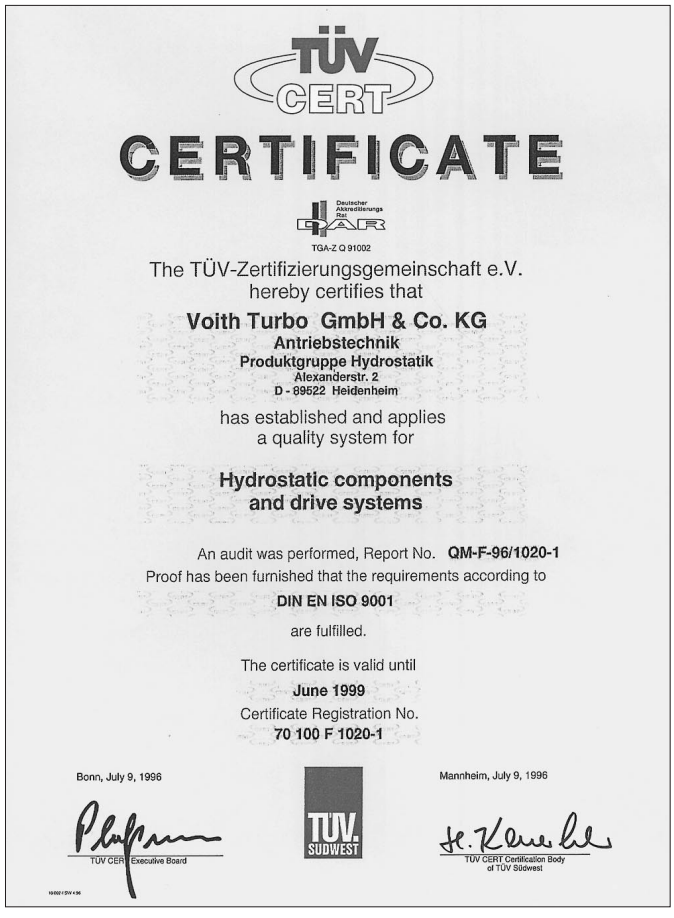
Axial compensation

Radial compensation



Certified Voith quality

Voith high-pressure, medium-pressure and low-pressure internal gear pumps are certified to DIN/ISO 9001.



TÜV CERT

CERTIFICATE

Deutscher Akkreditierungs Rat DAR

TGA-Z Q 91002

The TÜV-Zertifizierungsgemeinschaft e.V.
hereby certifies that

Voith Turbo GmbH & Co. KG
Antriebstechnik
Produktgruppe Hydrostatik
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D - 89522 Heidenheim

has established and applies
a quality system for

Hydrostatic components and drive systems

An audit was performed, Report No. **QM-F-96/1020-1**
Proof has been furnished that the requirements according to
DIN EN ISO 9001
are fulfilled.

The certificate is valid until
June 1999
Certificate Registration No.
70 100 F 1020-1

Bonn, July 9, 1996

TÜV CERT Executive Board

TÜV SÜDWEST

Mannheim, July 9, 1996

TÜV CERT Certification Body of TÜV Südwest

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