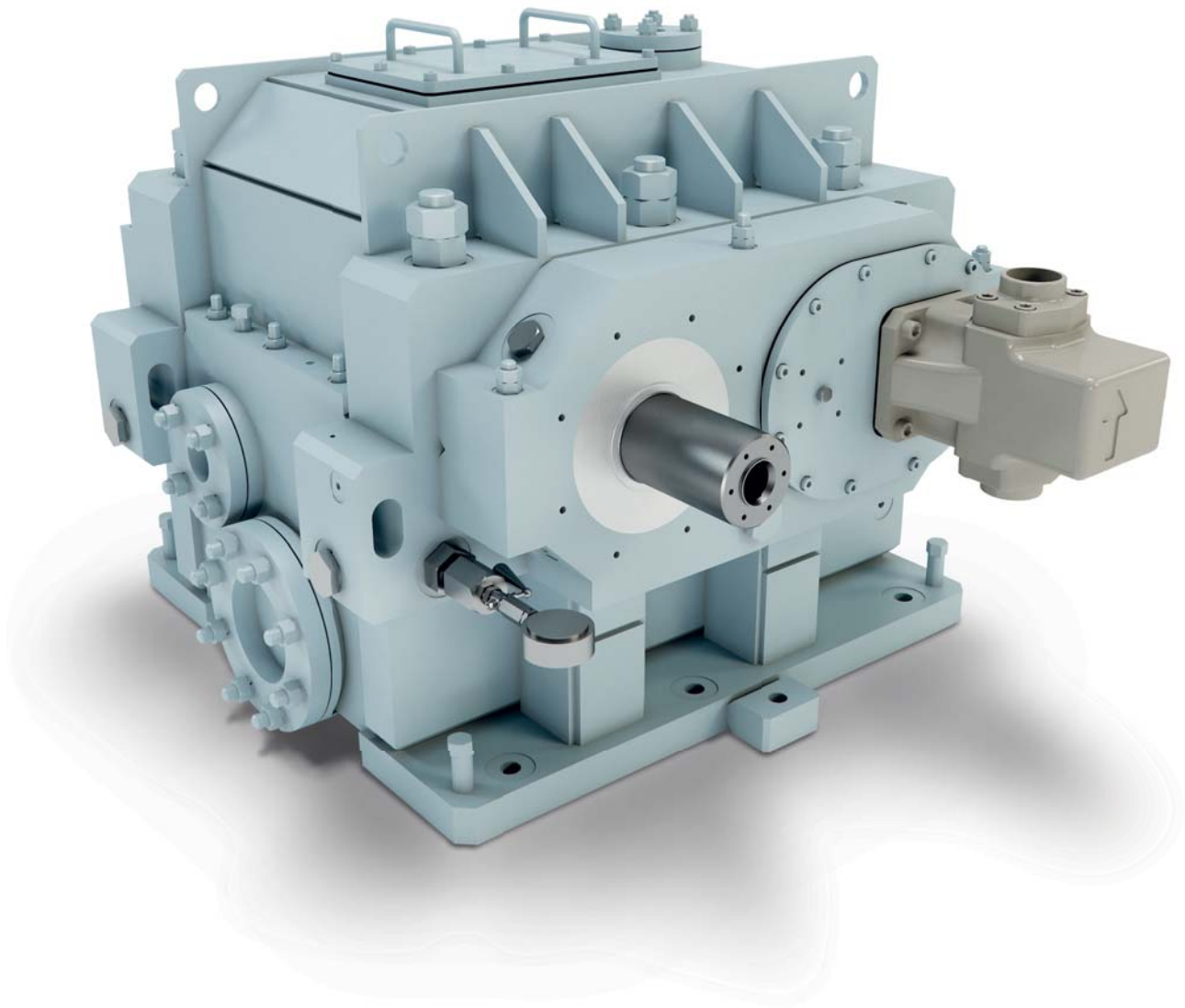


High Speed Series Catalogue

Parallel Shaft Gearboxes



WIKOV

The Essence of Engineering

The Essence of Engineering

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1 Introduction

1.1 Company introduction

Wikov has been active in mechanical engineering for almost 140 years. For nearly 100 years, we have been manufacturing gears and mechanical gearboxes under ŠKODA brand. Our aim is to keep delivering state-of-the-art products to our customers through intensive core engineering and product development. We apply a maximally creative approach while addressing technical problems and specific needs of our customers. Our goal is constant development of products with a higher level of functional and quality parameters. We propose optimal solutions on the basis of

1.2 Application range of Wikov highspeed gearboxes

High speed gearboxes are a key component for applications such:

- Turbogenerator drives
- Steam and gas turbine drives
- Turbocompressor drives
- Pump drives
- Test benches

Wikov has tradition in high speed applications since 1977. The worldwide installation base of the parallel shaft gearboxes totals over 800 units.



a thorough comprehension of every concrete application. We supply high-speed gear units particularly for thermal power station, heat plants, oil and gas sector or sugar refineries.

The calculation and design software **KISSsoft** and a 3D CAD program **SOLID-EDGE** along with other instruments enable us to be maximally fast and flexible. Our team of design engineers cooperates with universities, research institutes and leading specialists from all around the world. Wikov uses state-of-the-art finite element method (FEM) software tools for determining and optimizing gear units properties.



1 Introduction

1.3 Product portfolio

We have been delivering our products to many industries all around the world.

Detailed knowledge of various applications is our key strength in designing new products.

Oil & Gas



Mining Industry



Rail Vehicles



Wind and Tidal Energy



Cement & Mineral Processing Industry



Rubber, Plastic & Chemical Industry



Hydro Energy



Sugar Industry



Metallurgy



Thermal and Nuclear Power Plants



2 Product description and key features

2.1 Product introduction

High-speed gearboxes designed and manufactured in Wikov are designated primarily for power generation industry, compressor and pump applications. The manufacture is carried out on the modern machine tools and gearboxes are assembled using own components or components supplied by European manufacturers. All products undergo thorough testing on a dynamic test bench.

The design and gear strength calculation are performed according to API 613 5th Edition and AGMA 6011*.

Product types:

RS and RU gearbox type

is designed to withstand forces from meshing of double helical gears. They are not designed to withstand any external axial or radial load.

R1T and R2T gearbox type

is designed to withstand forces from meshing of single helical gears and external axial and radial load. The transmission of external axial load from HS shaft to LS shaft is by means of thrust collars.

The gearbox is self supporting and does not need any reinforcement. It has a foot flange for mounting to a foundation and jack bolts (levelling bolts) for easy installation. The gearbox does not require any special maintenance. It is recommended to change the oil on regular basis or when changing the climate conditions – see the Operating Manual for details.

* Other standard can be applied if requested.

Standard gearbox is adjusted for high speed operation in the temperature range between -50 / +50°C provided the oil preheating at low temperatures and oil cooling at high temperatures. Should the gearbox be operated in hazardous area or under other special conditions, it has to be contractually agreed.

The standard gearbox efficiency is usually higher than 98,5%. Total efficiency depends on plenty of factors, such as mesh losses, bearing losses, windage losses etc. Wikov is capable to prepare customized solution to increase the gearbox efficiency up to 99,5%.

mesh losses

gearing is sized based on the transmitted power. Power is given by a customer. It is not possible to reduce mesh losses considerably, however Wikov aims to optimize the losses to achieve the best compromise together with gear life, durability and NVH behaviour.

bearing losses

these losses have the biggest influence on the gearbox efficiency. It is necessary to design and size the bearing properly.

windage losses

windage losses have big influence on the gearbox efficiency if the gear circumferential velocity is high. It is possible to reduce these losses (up to approx 50%) by using the windage cover.

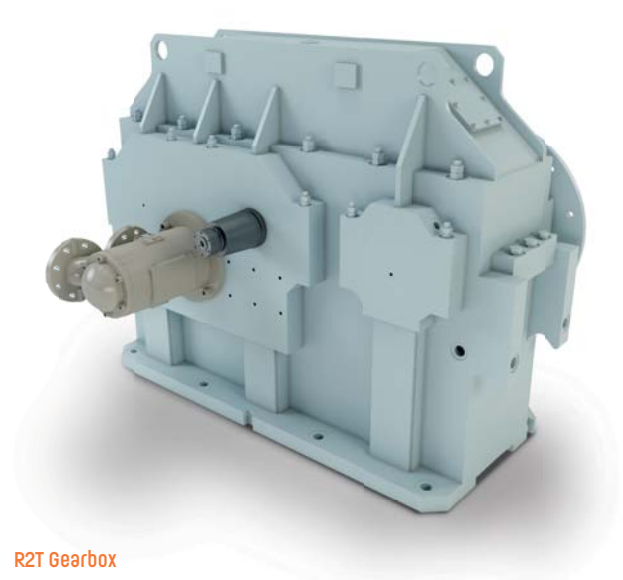
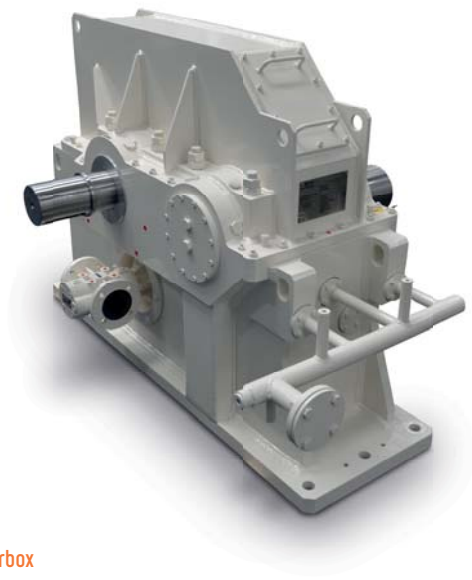
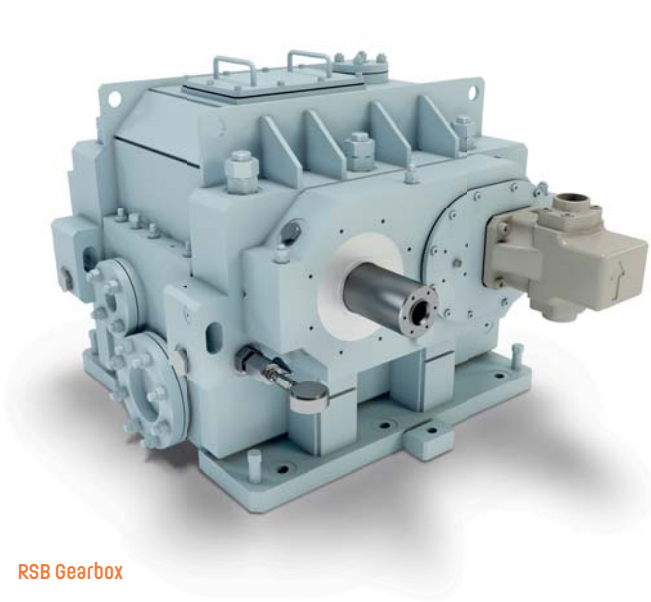
other losses

gearbox efficiency is also affected by the oil pump losses (if used), oil injection loss etc.

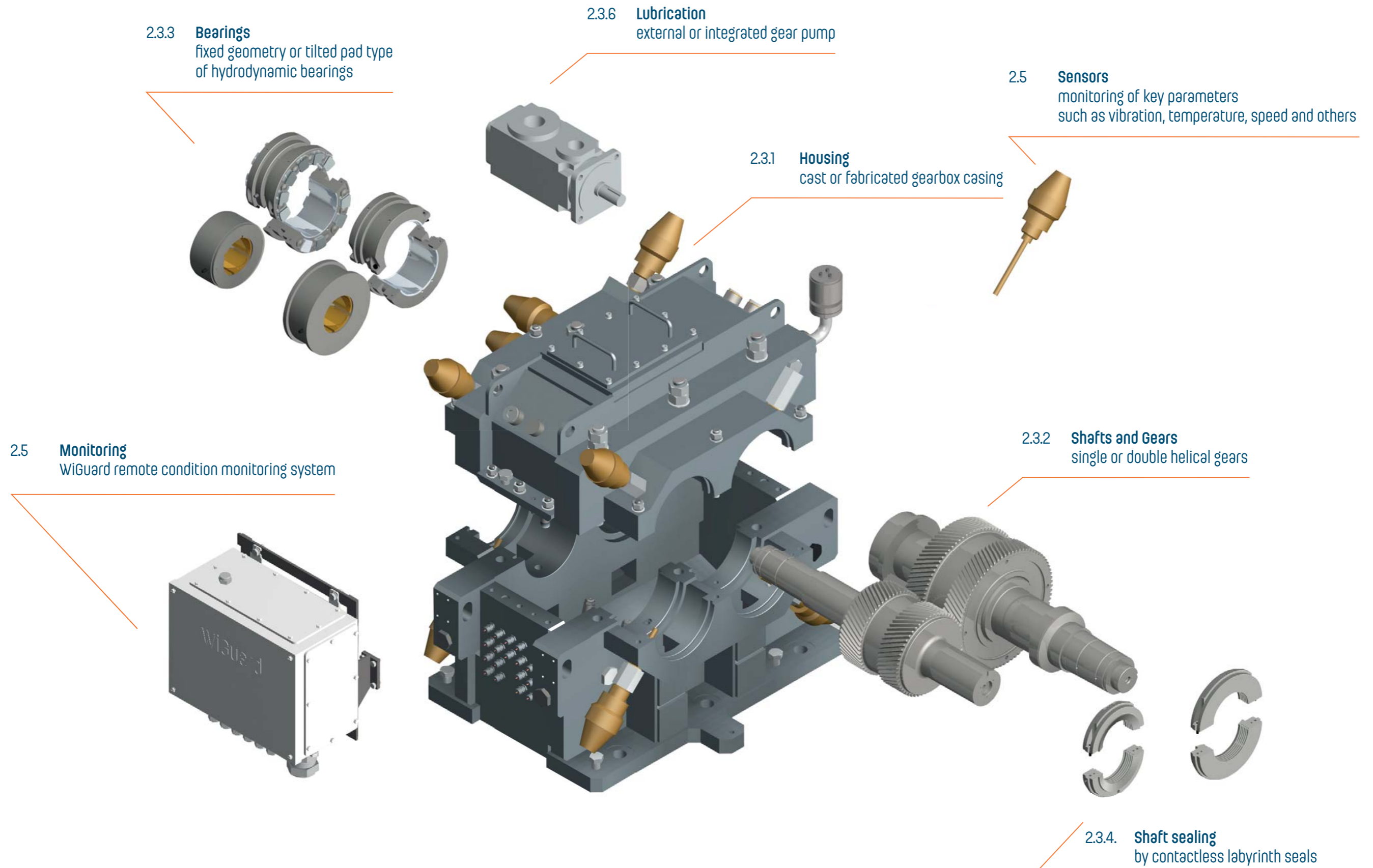


2 Product description and key features

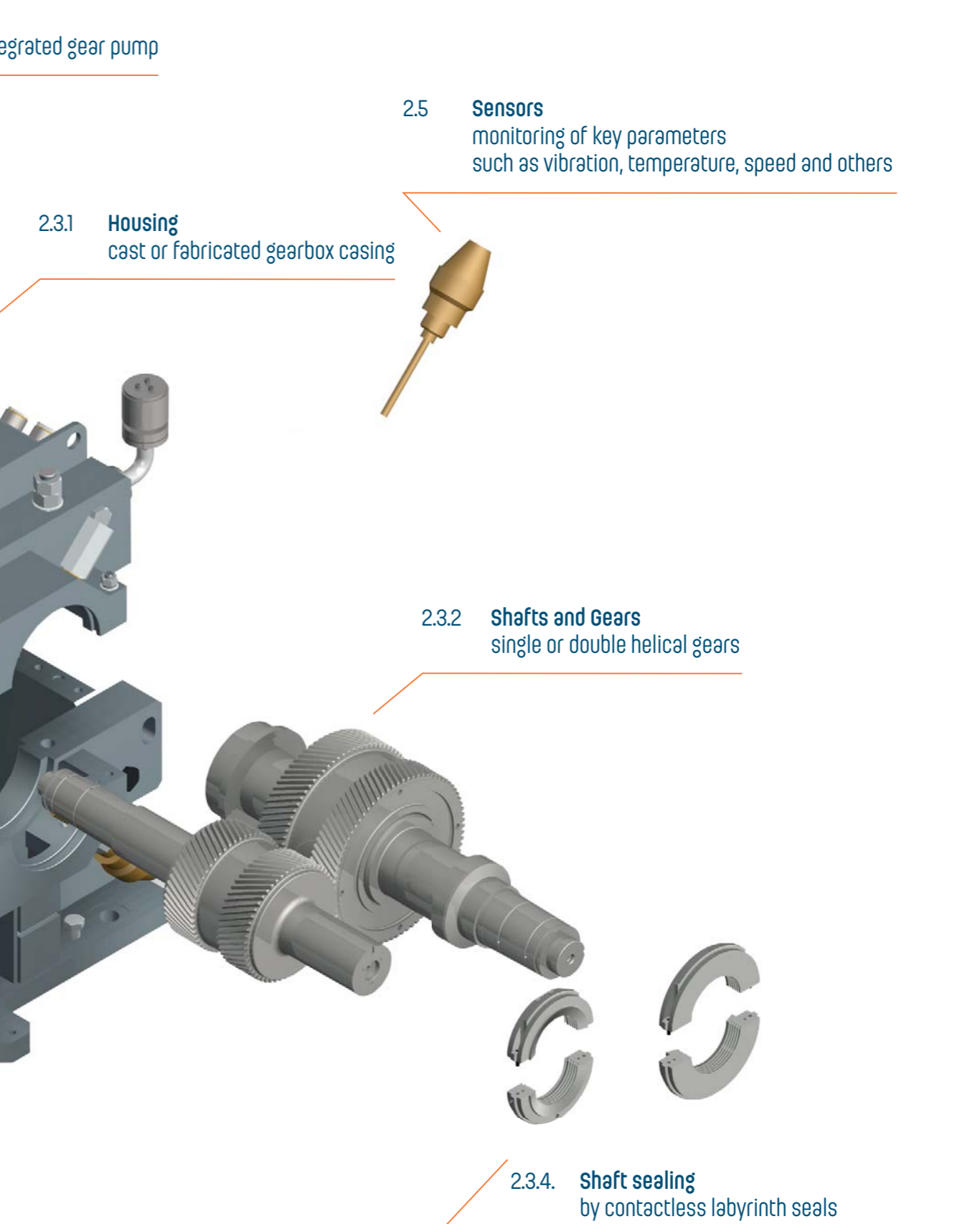
2.1 Product introduction



2.2 Turbo gearbox exploded view drawing



2.2 Turbo gearbox exploded view drawing



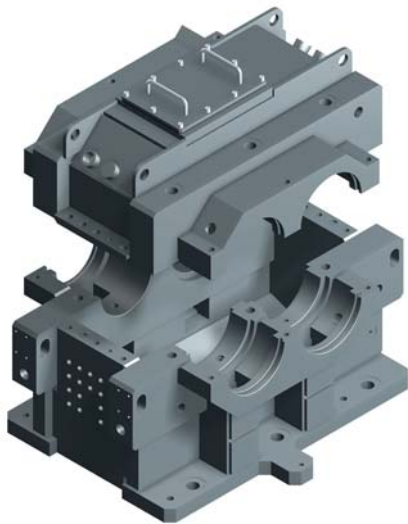
2 Product description and key features

2.3 Key technical features

Main Gearbox Components

2.3.1 Housing

The housing consists of 2 parts: the upper and the lower case. It is fabricated steel construction. The housing is optimized by CAE methods to ensure for good stiffness, low noise emissions, excellent cooling properties and minimum weight.



Casing - Pic. 1

In the lower part there are feet for fixing the gearbox to the foundation equipped by jack bolts and with provision for mounting of earthing screw (if the gearbox is determined to the hazardous area). There is also located the oil input/output flange and provision for temperature detectors conduction to the junction box. In the upper part there is an inspection cover, checking the proper lubrication of meshing gears, a breather and provision for vibration probes. Split face of the casing is horizontal, parallel to shaft axis. Both parts are connected by bolts and fixed by dowel pins.

2.3.2 Shafts and gears

Both shafts are forged pieces. HS shaft is forged from one piece along with gearing. LS shaft and the gear are forged separately and the gear is heat assembled on the shaft. The backslash ring is usually forged from one piece with the shaft or heat assembled. Both gears are ground to high precision. Teeth flanks of HS pinion have special modifications to reduce the noise level and compensate the deflection of shafts due to heavy load.

A hunting tooth combination exists for mating gears when a tooth on the pinion does not repeat contact with a tooth on the gear wheel until it has contacted all the other gear wheel teeth.

The shape of shafts ends depends on customer's request (cylindrical, tapered, flanged etc.).

Both shafts are dynamical balanced according to ISO 1940 or API 613.



Shafts with double helical gears and flanged shaft - Pic. 2

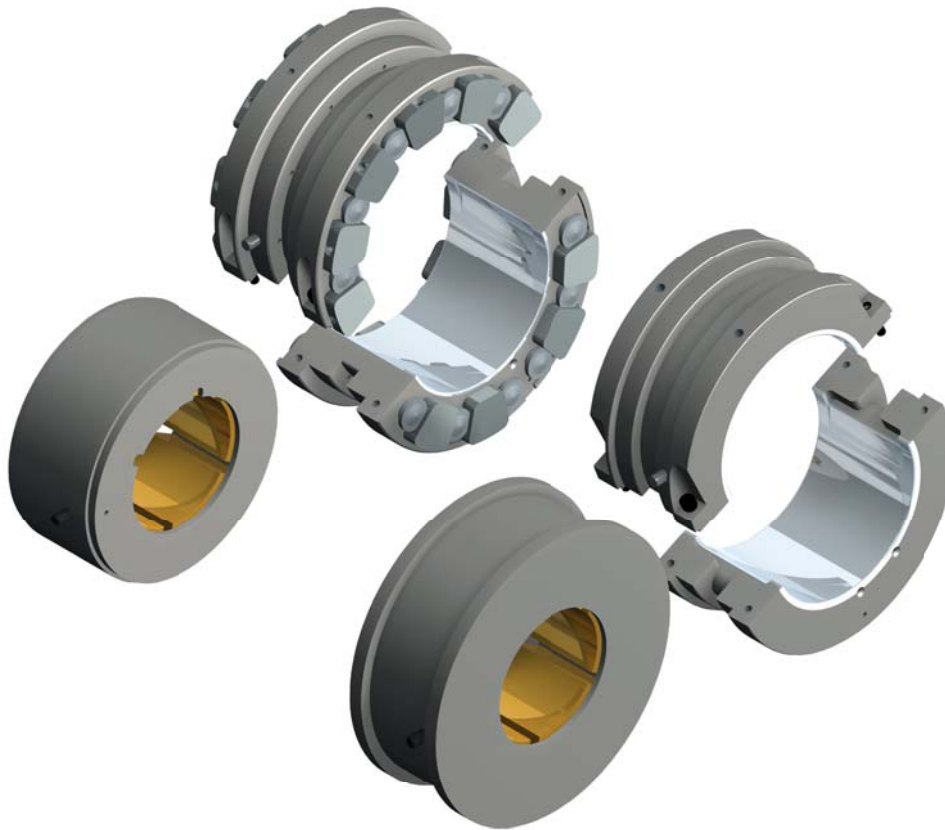
2.3.3 Bearings

Solely hydrodynamic bearings with more sliding faces are used due to high speeds and bearing load. These bearings are divided into bearings with:

- fixed geometry - there is no movement of sliding faces
- tilting pads - sliding faces are moving



2 Product description and key features



Bearings on LS shaft - Pic. 3

LS (low speed) shaft is usually placed in plain journal bearings with cylindrical clearance (fixed geometry). One of the bearings is radial (on the non-driving end) and the other one (on the driving end of the shaft) is combined radial-axial bearing. The design and calculation of the bearings are performed according to the latest methods.

Bearings on HS (high speed) shaft are usually tilting pad type due to high speed and pitchline velocity and both of them are radial bearings.

Tilting pad bearings usually have 4 or 5 pads and static load direction goes either on one pad or between pads. Lubrication of these bearings can be reached by overflowing the space between pads or oil injection between pads by means of several nozzles which also protects pads against circumferential

movement. When oil injection is used it is possible to reduce friction losses considerably.

These bearings have the highest resistance against rotor instability because they do not generate any load causing instability.



Tilting pad bearing Waukesha - Pic. 4



2 Product description and key features

2.3 Key technical features

2.3.4. Shaft sealing

Shafts sealing is provided by means of labyrinth seals and backsplash rings. Sealing design generally depends on the shaft revolution, operating conditions and environment. The advantage of labyrinth seal is that it is not exposed to friction scuff. That is very effective way of touch free sealing proper particularly for high speed and relatively dusty environment. It is possible to use it for low and high temperatures without any special provisions. Labyrinth seal shall operate in horizontal position. It is necessary to size the oil drain from bearing space the way to prevent the oil leakage.



Labyrinth seal - Pic. 5

2.3.5. Case sealing

The gear case sealing in the split face and under all lids is ensured by LOCTITE or another similar sealant.

2.3.6. Lubrication

Lubrication of gears is performed by internal piping with spraying nozzle. Bearing lubrication is provided through internal oil passages in the gearbox casing. Oil drain from bearing space is ensured by means of adjustment of gearbox casing.

The nominal oil pressure is in the range of 0.1 - 0.15 MPa. Oil viscosity is ISO VG 46 or 32. Oil working temperature at bearings should be between 80° and 95°C at maximum. It is necessary to prevent mechanical impurities getting in the lubrication system. The permitted size of oil impurities behind the oil filter is 10 - 25 µm.

2.3.7. Cooling

Sufficient cooling of the gearbox is ensured primarily by natural radiation, i.e. the heat accumulated in the oil is released into the surrounding area by radiation and convection. The temperature of oil entering the gearbox shall not exceed 50°C. Unobservance of this temperature results in reduced service life of the product. Standard lubrication unit (incl. cooler, filtration etc.) shall be used for gearbox cooling and lubrication.

2.3.8. Sensors and monitoring

Gearboxes can be fitted with various temperature, vibration, speed and shaft axial displacement probes. Remote gearbox diagnostics is optional equipment of the gearbox. The trade name of the

Wikov Condition Monitoring System is WiGuard.

2.4. NVH (Noise, Vibrations and Harshness)

For all gearboxes, noise emissions have been optimized to the lowest possible level by careful gear microgeometry optimization and gearbox housing design.



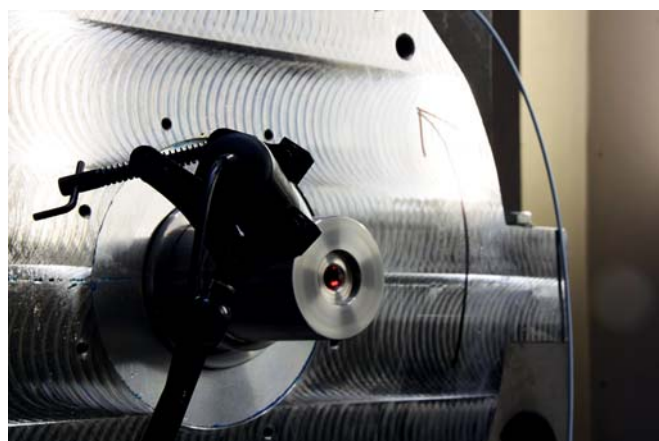
2 Product description and key features

2.5 Gearbox Testing

2.5.1 Load tests of high-speed gearboxes

Testing laboratory for high-speed gearboxes is a camera monitored modern workplace at Wikov manufacturing plant in Pilsen. The Dynamic Test Bench is a testing facility equipped with a computer controlled 1 MW motor with speed up to 3.600 rpm, controlled load by a generator up to 710 kW of power, auxiliary gearboxes enabling testing of the main gearbox with speed up to 35.000 rpm. The test bench have a lubrication centre with

adjustable oil flow from 10 to 1.600 liters/minute, controllable oil temperature and water cooling up to 800 kW of power. The lubrication is backed up with pneumatic pumps supplying full volume of oil in case of power outage. The testing process is automatically recorded while oil and bearing temperature, pressure, noise, absolute and relative vibrations are measured and transferred to a control room for assessment by a specialized software.



2 Product description and key features

2.6 Additional Information

2.6.1 Documentation

Documentation to the gearbox is supplied based on customer's requirement and has to be contractually agreed. Generally, following documentation is supplied in standard:

- gearbox drawing
- instruction manual
- testing report
- inspection plan

Any other request for documentation shall be specified in the purchase order.

For instance: instrument data sheet, wiring diagram, testing procedure, lateral and torsional analysis data, set point list, painting procedure, noise data sheet etc.

2.6.2 Spare Parts

Manufacturer recommends following spare part kits to be ordered along with the gearbox:

- **Commissioning spare parts**
 - gaskets
- **2 - years operation spare parts**
 - bearings incl. temperature sensors
 - labyrinth seals
- **3 - 5 years operation spare parts**
 - high speed shaft
 - low speed shaft
 - bearings incl. temperature sensors
 - labyrinth seals
 - gaskets

Manufacturer expressly declares that WIKOV is not liable for any damage caused by spare parts not supplied, tested or approved by us and may therefore adversely affect the structural properties of the gearbox and its active and passive safety features.

2.6.3 Other equipment

Other equipment, such as various types of gears or couplings, vibration sensors, drive-shafts, oil pumps or rotor turning device can be supplied on request. Electric, hydrostatic or pneumatic motors can be fitted on request.



2 Product description and key features

2.6 Additional Information

2.6.4 Certification

Wikov can deliver gearboxes with certification of any major independent certification body (e.i. DNV GL, ABS etc) if requested. Cooperation with customer is expected as detail information about the gearbox applications are required.

2.6.5 Explosion protection - ATEX certification

Gearboxes can be certified according to 94/9/EC (ATEX). Please contact us for further details.

2.6.6 Painting

Wikov gear units are painted in RAL 5013 „Cobalt Blue“ as standard. Any special painting available on request.

2.6.7 Technical changes

All parts of this catalogue, such as data, text, images, photos and other intellectual property, correspond to the current state at the time of their creation, and they represent non-binding information. Amendments carried out at a later date shall be subject to change without prior notice. Wikov shall not assume any liability for errors. Weights and dimensions are average values.

2.6.8 Copyright

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* Other standard can be applied if requested.



2 Product description and key features

2.7 Ordering procedure

2.7.1 Ordering data

Completed API 613 data sheet is the ideal mean to place your inquiry.

Otherwise the specification below is a minimum requirement to process your inquiry:

always:

1. Operating conditions (rated power, input and output speed, max. allowed deviation from required speed, ambient temperature etc.)
2. Application (type and size of driving and driven machine)
3. Pressure, temperature and viscosity of lubrication oil, required oil volume

optional:

4. Number of starts of the driving machine, daily time of gearbox operation etc.
5. Required way of fitting the coupling to the shaft ends
6. Gearbox designation (shafts arrangement)
7. Number and type of sensors
8. Gearbox accessory equipment
9. Requirement for testing and takeover
10. Documentation requirements
11. Requirement for preservation and coating
12. Other requirements



2 Product description and key features

2.8 Product identification

2.8.1. Gearbox name plate

Standard line of Wikov turbo gearboxes are fitted with a stainless steel name plate with parameters as shown below:

Wikov Gear s.r.o. Tylova 1/57 CZ-316 00 Pilsen Czech Republic www.wikov.com				
Gearbox serial N°:	1			
Atex serial N°:	2			
Gearbox model:	3	Rated power:	13	kW
Year:	4	Service factor:	14	
Purchase item N°:	5	Rated input speed:	15	min ⁻¹
Purchase order N°:	6	Rated output speed:	16	min ⁻¹
Teeth no. LS/HS:	7	Weight:	17	kg
Gear ratio:	8	1. HSS critical speed:	18	min ⁻¹
Oil viscosity:	9	1. LSS critical speed:	19	min ⁻¹
Oil flow:	10	l/min		
Oil pressure:	11	MPa		
Ex	12			

Gearbox Nameplate - Pic. 6

1. Serial number of the gearbox
2. Archive number of the Atex certification body
3. Wikov designation of the gearbox model
4. Year of manufacture
5. Customer's project reference number
6. Reference number of the purchase order
7. Number of teeth on the low-speed/high-speed
8. Actual gear ratio
9. Viscosity of the used oil
10. Volume of oil flow in litres per minute
11. Pressure of oil in MPa
12. Hazardous area classification
13. Power in kW
14. Service factor
15. Speed in rpm – input shaft
16. Speed in rpm – output shaft
17. Total dry weight of the gearbox
18. First critical speed of the high-speed shaft
19. First critical speed of the low-speed shaft



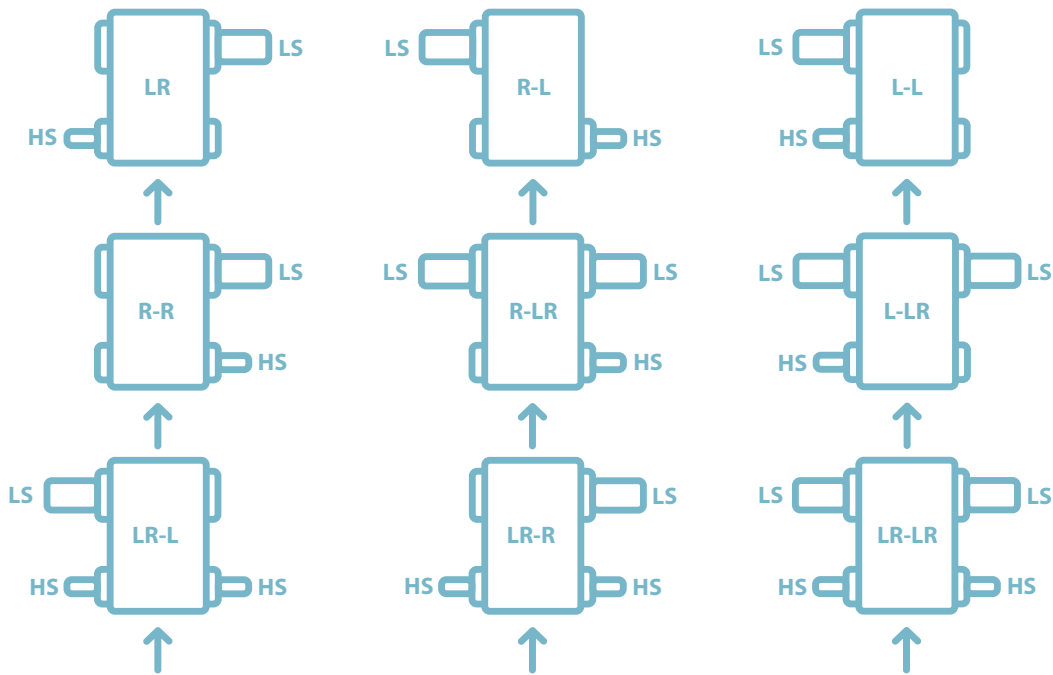
2 Product description and key features

2.9 Shaft Assembly Arrangement

The gearbox is mechanical, one-staged, designed for high speed operation. Shafts are in horizontal position and parallel to each other. Shaft

arrangement and rotation direction depends on customer's requirement.

The arrangement applies to RSB, RUB and RIT gearboxes



Shaft Assembly Designations acc. to API 613 - Pic. 7

Notes

1. LS = low-speed shaft
HS = high-speed shaft
2. L = left; R = right
3. Arrows indicate the line of sight used to determine the direction of the shaft extensions.
4. The letter or letters before the hyphen refer to the number and direction of high-speed shaft extensions; the letter or letters after the hyphen refer to the number and direction of low-speed shaft extensions.



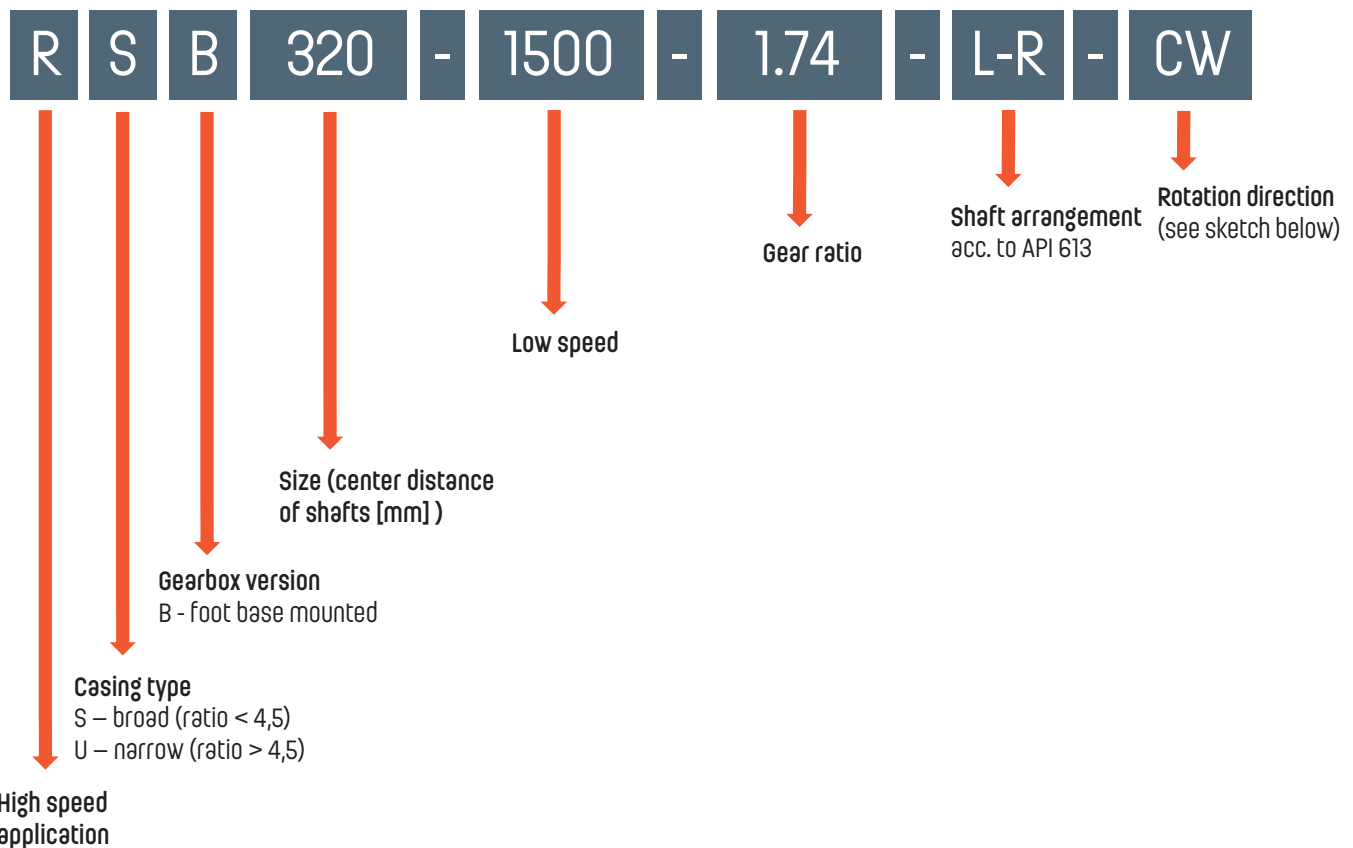
2 Product description and key features

2.10 Naming convention

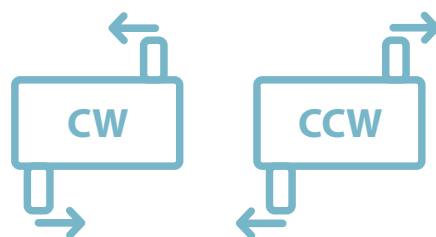
2.10.1. RSB gearbox naming convention

Gearbox arrangement can be clearly described by an ordering code. Please refer to this code when requesting a quotation.

- RS double helical large face width
- RU double helical narrow face width



Rotation direction



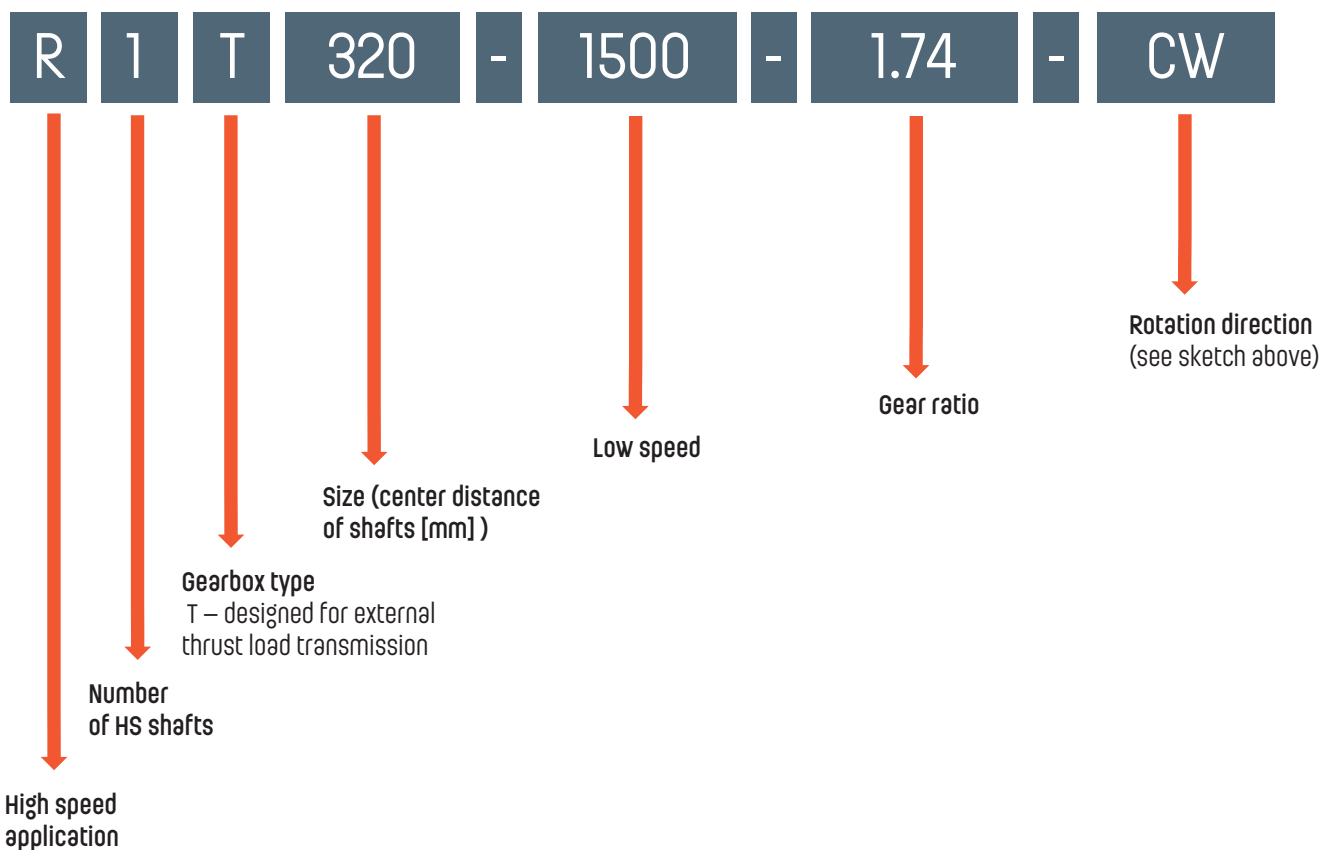
2 Product description and key features

2.10 Naming convention

2.10.2 RT gearbox naming convention

Gearbox arrangement can be clearly described by an ordering code. Please refer to this code when requesting a quotation.

- R1(T) single helical with one pinion
- R2(T) single helical with two pinions
- Any special gearbox arrangement available upon request (8-compressor, quill shaft)



3 Gearbox selection

3.1 Calculation formulas

3.1.1. Size Selection

The correct gear size can be selected in the gearbox size diagram by means of calculated **Power ratio** and **ratio** values.

Calculation formulas:

$$\text{Power ratio} = P \times SF/n^2$$

$$\text{Ratio} = n_1/n_2$$

- P [kW] Rated power of the gearbox
- SF Service factor according to API 613 (see Table 1.0)
- n1 [rpm] High speed shaft
- n2 [rpm] Low speed shaft

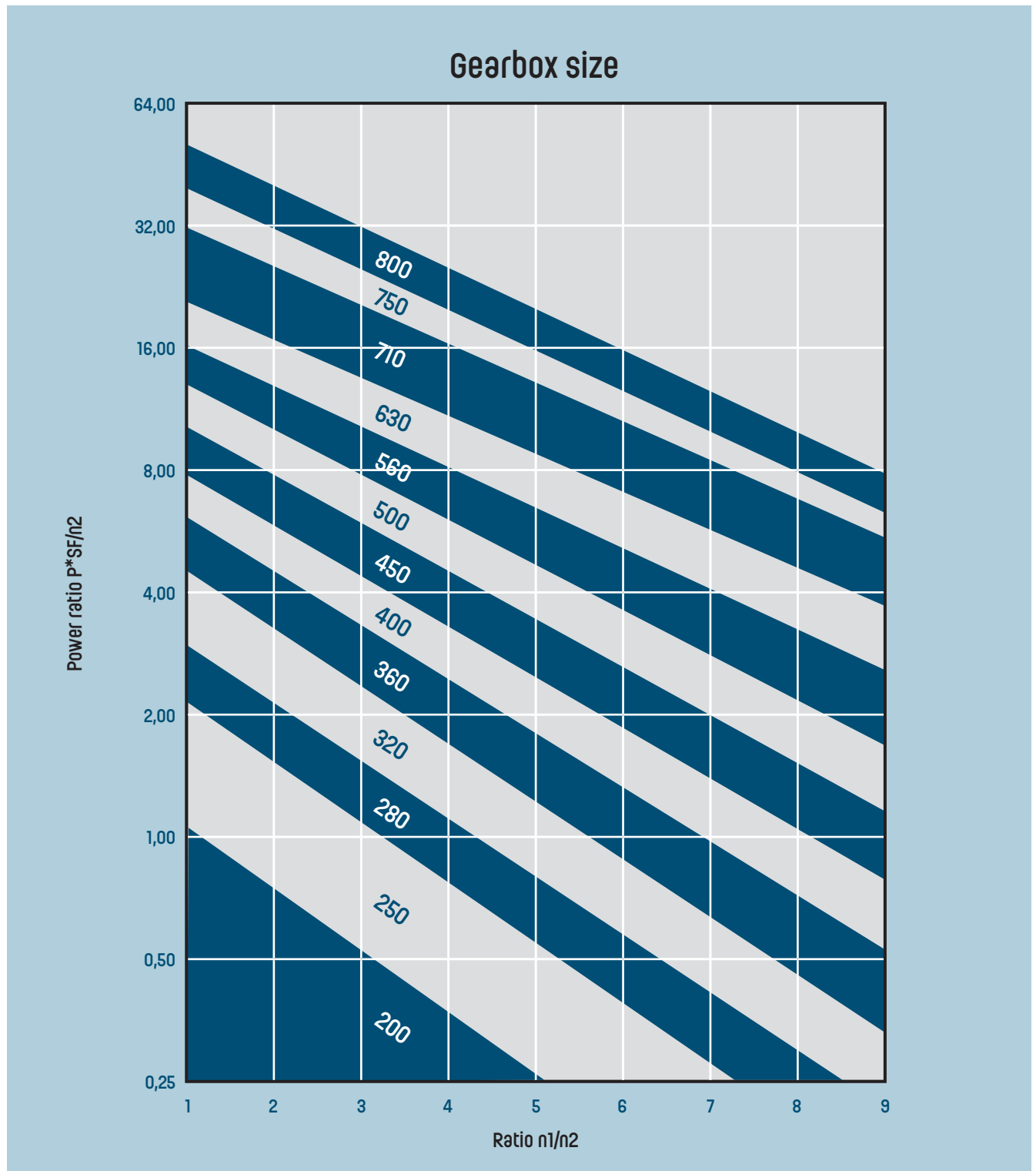
Table 1.0: Minimum Gear Service Factors

Driven Equipment	Synchronous & Variable Speed Motors	Induction Motors	Steam & Gas Turbines	Reciprocating Engines
Centrifugal blowers	1.6	1.4	1.6	1.7
Compressors				
Centrifugal	1.6	1.4	1.6	1.7
Axial	1.6	1.4	1.6	1.7
Rotary lobe	1.8	1.7	1.7	2.0
Reciprocating	2.1	2.0	2.0	2.3
Extruders	1.8	1.7	1.7	∅
Fans				
Centrifugal	1.5	1.4	1.6	1.7
Forced draft	1.5	1.4	1.6	1.7
Induced draft	1.8	1.7	2.0	2.2
Generators & exciters				
Base load continuous	1.1	1.1	1.1	1.3
Peak-duty-cycle	1.3	1.3	1.3	1.7
Pumps				
Centrifugal (all services, except those listed below)	1.5	1.3	1.5	1.7
Centrifugal, boiler feed	1.8	1.7	2.0	-
Centrifugal, hot oil	1.8	1.7	2.0	-
Centrifugal, high speed (over 3600 rpm)	-	1.7	2.0	-
Centrifugal, water supply	1.6	1.5	1.7	2.0
Rotary, axial flow/all types	1.6	1.5	1.5	1.8
Rotary, gear	1.6	1.5	1.5	1.8
Reciprocating	2.1	2.0	2.0	2.3



3 Gearbox selection

3.2 Gearbox size diagram of RS, RU and RIT type units



n_1 - high speed

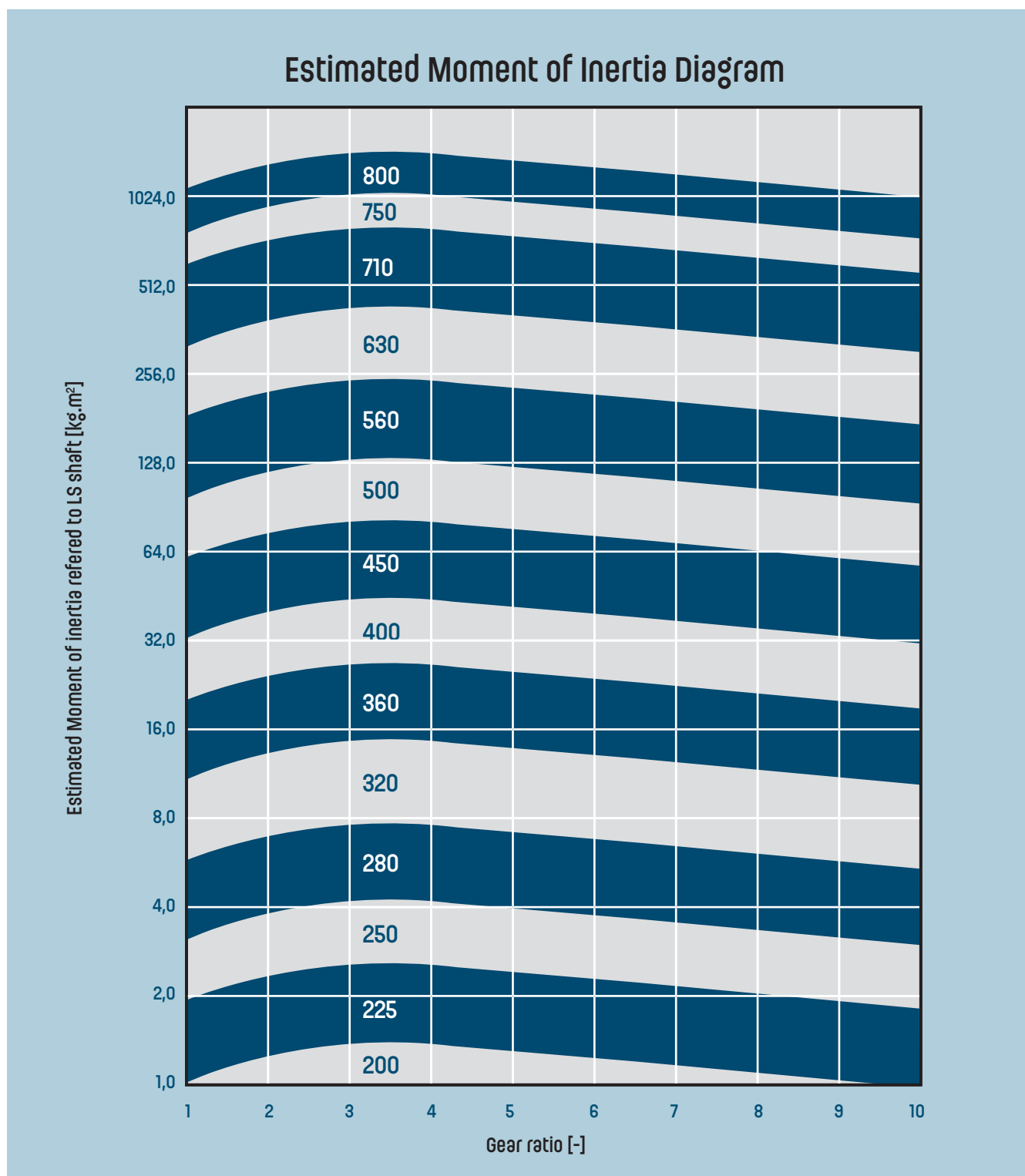
n_2 - low speed

P - nominal power; SF - service factor acc. to API 613



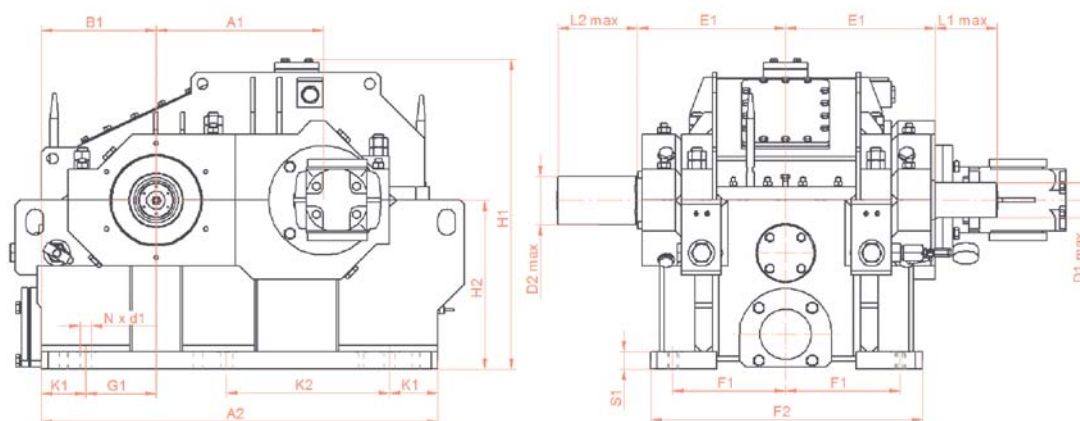
3 Gearbox selection

3.3 Estimated moment of inertia for the RS, RU and RIT type units



3 Gearbox selection

3.4 Dimension sheet of RS, RU and RIT type gearboxes



RS type	A1	A2	B1	E1	H1	H2	K1	K2	F1	F2	G1	N1	d1	D1 max	D2 max	L1 max	L2 max	S1	[kg]
200	200	575	145	260	580	310	80	250	160	380	65	6	22	90	100	140	150	35	700
225	225	650	165	270	630	340	80	290	180	420	85	6	22	100	110	150	170	40	850
250	250	725	195	320	690	370	80	325	220	490	115	6	22	120	130	180	200	45	1250
280	280	800	200	340	760	410	100	360	240	540	100	6	26	130	140	200	210	50	1500
320	320	925	245	370	850	460	100	420	260	590	145	6	26	140	160	210	240	55	1850
360	360	1025	255	420	930	500	120	470	310	700	135	6	33	170	180	260	270	60	2500
400	400	1150	300	470	1000	530	120	530	340	770	180	6	33	190	200	290	300	65	3300
450	450	1275	315	500	1110	590	140	595	360	830	175	6	39	200	220	300	330	75	4500
500	500	1425	365	550	1210	640	140	670	400	910	225	6	39	220	240	330	360	80	5000
560	560	1600	410	610	1340	710	140	770	460	1030	270	6	45	250	270	380	410	85	7100
630	630	1800	460	660	1480	780	160	865	510	1130	300	6	45	270	300	410	450	95	10000
710	710	2025	515	740	1640	860	160	995	580	1270	355	6	56	300	340	450	510	100	12000
750	750	2125	535	750	1716	900	160	1055	607	1328	375	6	56	310	350	470	520	100	13250
800	800	2250	560	810	1810	950	160	1130	640	1400	400	6	56	330	360	500	540	105	15000

RU type	A1	A2	B1	E1	H1	H2	K1	K2	F1	F2	G1	N1	d1	D1 max	D2 max	L1 max	L2 max	S1	[kg]
200	200	575	145	170	560	300	80	250	90	230	65	6	22	65	70	100	110	35	550
225	225	650	165	190	620	330	80	290	110	270	85	6	22	75	80	110	120	40	620
250	250	725	195	210	670	360	80	325	120	300	115	6	22	80	95	120	140	45	900
280	280	800	200	220	730	390	100	360	130	330	100	6	26	90	110	140	170	50	1180
320	320	925	245	250	830	440	100	420	160	380	145	6	26	110	120	170	180	55	1500
360	360	1025	255	280	910	490	120	470	170	430	135	6	33	120	140	180	210	60	1800
400	400	1150	300	310	1000	530	120	530	200	480	180	6	33	140	160	210	240	65	2200
450	450	1275	315	350	1110	590	140	595	230	560	175	6	39	150	180	230	270	75	2890
500	500	1425	365	370	1200	640	140	670	250	600	225	6	39	170	200	260	300	80	3900
560	560	1600	410	410	1340	710	140	770	280	670	270	6	45	190	220	290	330	85	5100
630	630	1800	460	450	1480	780	160	865	320	760	300	6	45	210	240	320	360	95	6200
710	710	2025	515	490	1640	860	160	995	360	840	355	6	56	230	270	350	410	100	8000
750	750	2125	535	517	1716	900	160	1055	387	894	375	6	56	250	290	370	440	100	9500
800	800	2250	560	550	1810	950	160	1130	420	960	400	6	56	260	310	390	470	105	11300

Dimensions of RIT gearboxes equals to the RS or RU types based on the ratio. Dimensions of R2T

gearboxes and other special types are given during the project processing if requested.



The Essence of Engineering

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