

Fulfilling the highest demands Turbo gear units and components





Voith Turbo BHS Getriebe GmbH in Sonthofen, Germany, offers the highest quality and most technically advanced gear units, couplings and rotor turning gears. Over a period of 75 years more than 20 000 gear units with a total transmitted power of more than 100 000 MW been documented in the list of references.

Fulfilling the highest demands

The turbo gear market is challenging: the demand for high quality and reliable products, the requirement for high plant availability, the need for extended service performance by the suppliers plus intensive cooperation with the original equipment manufacturers (OEMs) and sub-suppliers characterize this segment. The trend to shorter delivery times is unrelenting.

As a manufacturer of turbo gear units, Voith Turbo BHS Getriebe sees itself faced with continually increasing challenges in engineering and order processing on the side of the OEMs. In large parts, these increased demands are driven by the plant operators. The consequences are higher speeds, more power and greater pitch-line velocities with lower power losses, lower noise levels, shortened delivery times and continued cost optimization. At the same time a very high level of operating reliability must be secured. Voith Turbo BHS Getriebe meets these requirements.

For decades OEMs and operators especially in the fields of power generation, oil & gas, petrochemicals, chemical production and other branches of industry have gained an appreciation for the turbo gear units, the high-speed couplings and rotor turning gears from Voith Turbo BHS Getriebe. Customers can choose from innovative products built according to specification from a range of designs and types available.

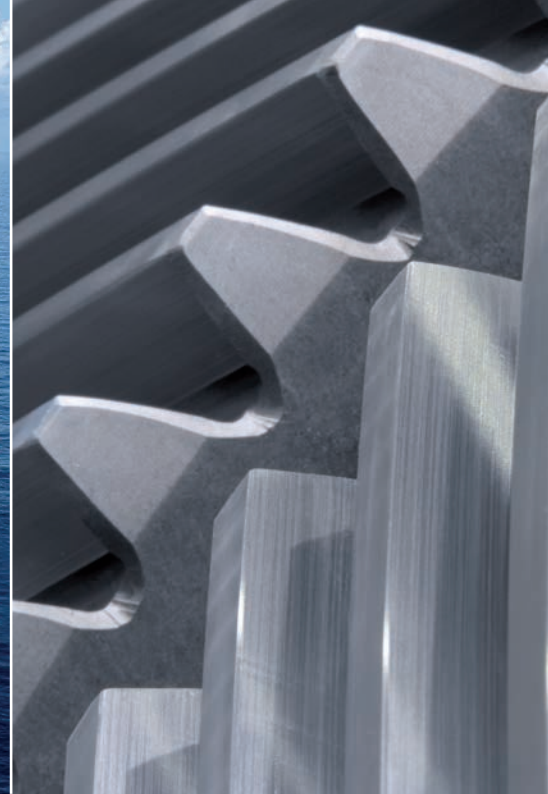
Product development at Voith Turbo BHS Getriebe

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| 1932 Engineering design and production of epicyclic gear units according to the Stoeckicht principle | 1980 Pitch line velocity >200 m/s (>39,400 fpm) |
| 1954 Engineering design and construction of turbo parallel shaft gear units | 1985 Development and construction of diaphragm couplings |
| 1960 Development and construction of rotor turning gear units according to the swiveling pinion principle | 1996 Parallel shaft gear units with 80 MW power |
| 1960 Engineering design and construction of tooth couplings | 2001 Engineering design and construction of integral gear units with wheel diameter of over 3 meters |
| 1965 Pitch line velocity >100 m/s (>19,700 fpm) at 18 MW power | 2004 Epicyclic gear unit with 31.5 MW power |
| 1970 Development and construction of gear units with integrated compressor stages (integral gear units) | 2006 Integral gear unit with 4.2 meter center distance between shaft lines |
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The products

Matrix of applications

	Turbo parallel shaft gear units	High-Speed integral gear units	Turbo epicyclic gear units	Rotor turning gear units	Diaphragm couplings
Technical data	<ul style="list-style-type: none"> Power: up to 80 000 kW Speed: 500–40 000 rpm 	<ul style="list-style-type: none"> Power: up to 35 000 kW Speed: up to 55 000 rpm 1 to 10 compressor stages 	<ul style="list-style-type: none"> Power: up to 45 000 kW Speed: up to 80 000 rpm 	<ul style="list-style-type: none"> Speed: 0.1–400 rpm Breakaway torque: up to 100 000 Nm 	<ul style="list-style-type: none"> Power: up to 70 000 kW Speed: up to 80 000 rpm Torque: up to 1 500 000 Nm
					
Gas Turbine – Generator	✓		✓	✓	✓
Steam Turbine – Generator	✓		✓	✓	✓
Expansion Turbine – Generator	✓	✓	✓	✓	✓
Water Turbine – Generator	✓		✓		✓
Electrical Motor – Compressor	✓	✓	✓	✓	✓
Gas Turbine – Compressor	✓	✓	✓	✓	✓
Steam Turbine – Compressor	✓	✓	✓	✓	✓
Diesel / Gas Engine – Compressor	✓	✓	✓		✓
Steam Turbine – Pump	✓		✓	✓	✓
Gas Turbine – Pump	✓		✓	✓	✓
Electrical Motor – Pump	✓		✓		✓
Electrical Motor – Fan	✓		✓		✓
Testbeds	✓		✓		✓



Reliable transmission of maximum power Turbo parallel shaft gear units

Voith Turbo BHS Getriebe is the preferred supplier of turbo parallel shaft gear units to original equipment manufacturers and operators because of the capacity to transmit very high powers and speeds with high efficiency. The basis for this capacity is the ability of an optimized gear design in accordance with decades of experience, all current technical guidelines, plus specialized in-house calculations.

With Voith Turbo BHS Getriebe turbo parallel shaft gear units, high power densities are achieved. Parallel shaft gear units are designed and manufactured at BHS for powers from 100 kW to 80 000 kW and speeds of up to approx. 40 000 rpm. Three single-stage gearbox ranges cover gear ratios up to 10:1. For higher ratios a two-stage model range is available. All gear units are characterized by quiet operation and a long service life. These units are employed in just those situations where a well-developed system with very high reliability is required.

Turbo parallel shaft gear units from Voith Turbo BHS Getriebe are well-engineered, high-quality products that have proven themselves continuously in many diverse turbomachinery and other applications. BHS turbo parallel shaft gear units are usually driven by electrical motors, gas turbines, steam turbines or combustion engines.

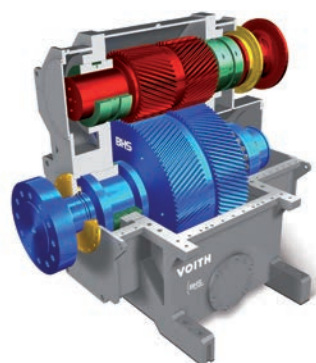
The driven machines are primarily generators, compressors, pumps or fans. These parallel shaft gear units are especially suited to high-speed applications and designed for continuous operation. Depending on application, the gear sets are

optimally designed and realized either as double helical or single helical gears with or without thrust collars. In many respects, the turbo parallel shaft gear units are customizable to the interface requirements of the customer. At the free ends of the gear shaft, accessories such as lube oil pumps and rotor turning gears can be attached. Voith Turbo BHS Getriebe possesses proprietary know-how in tooththing and bearing technology. Journal bearings of our own development can be tested under full load conditions, and can be adjusted according to special specifications to an extremely hot climatic ambient temperature.

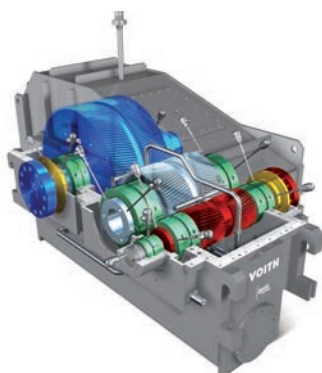
A-series, Type AD for a transmission ratio up to 4:1



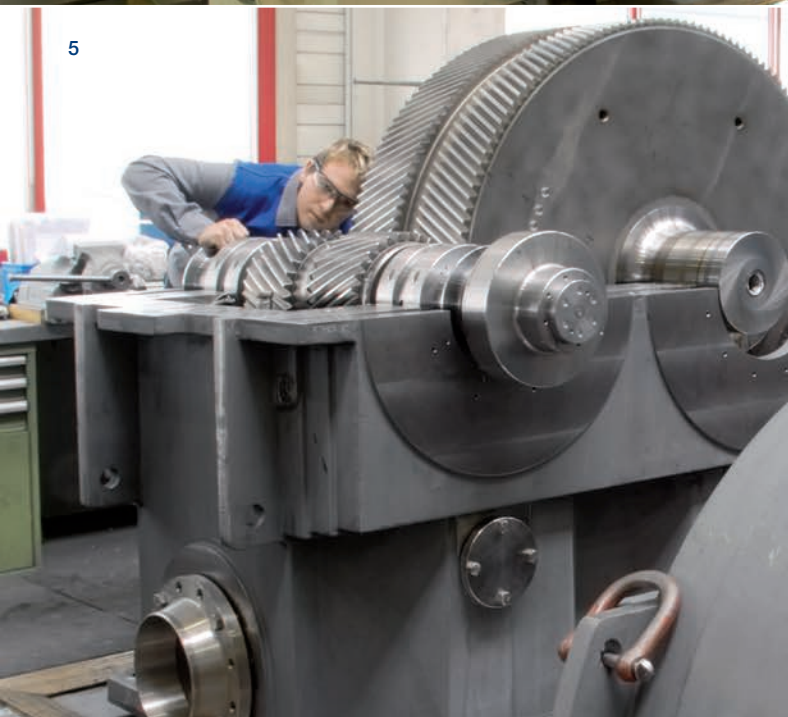
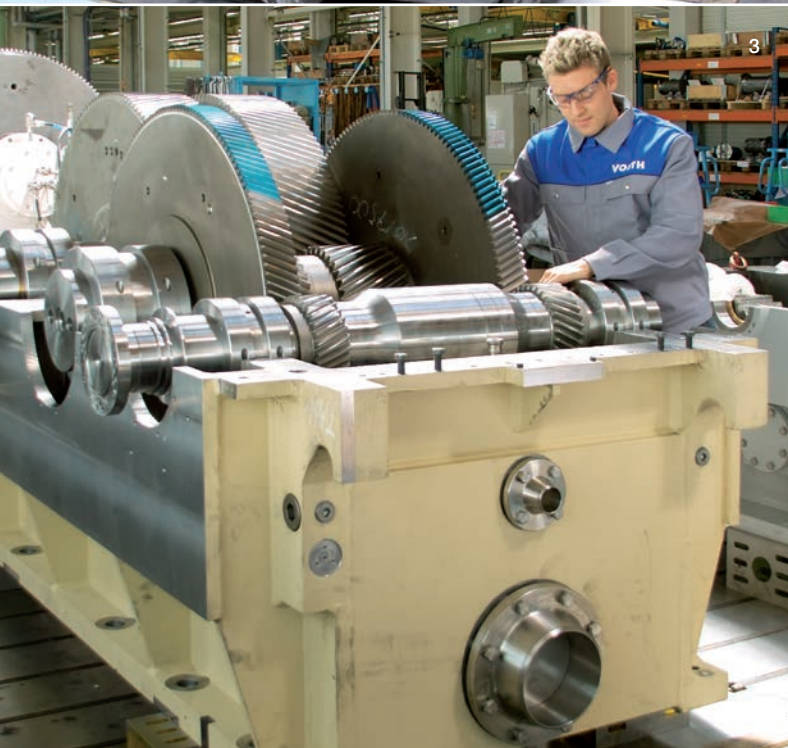
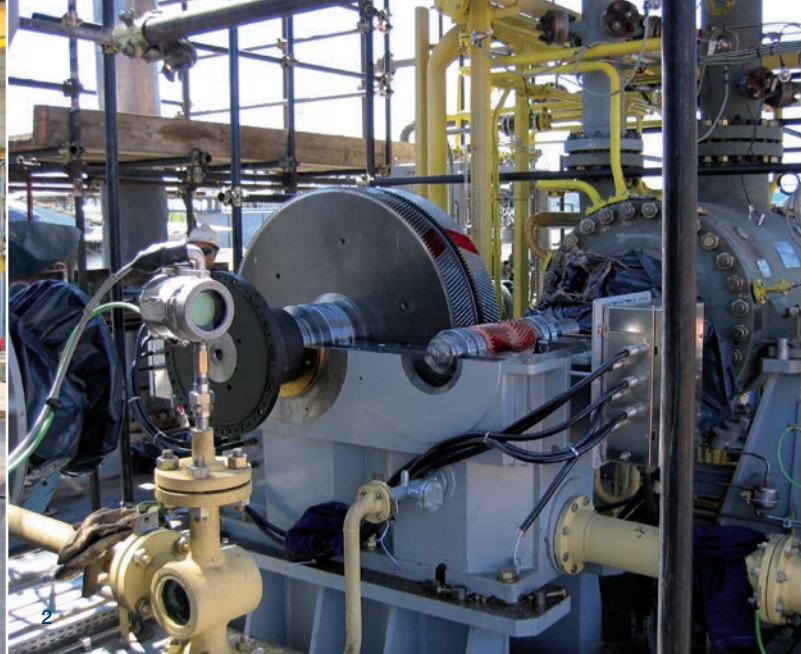
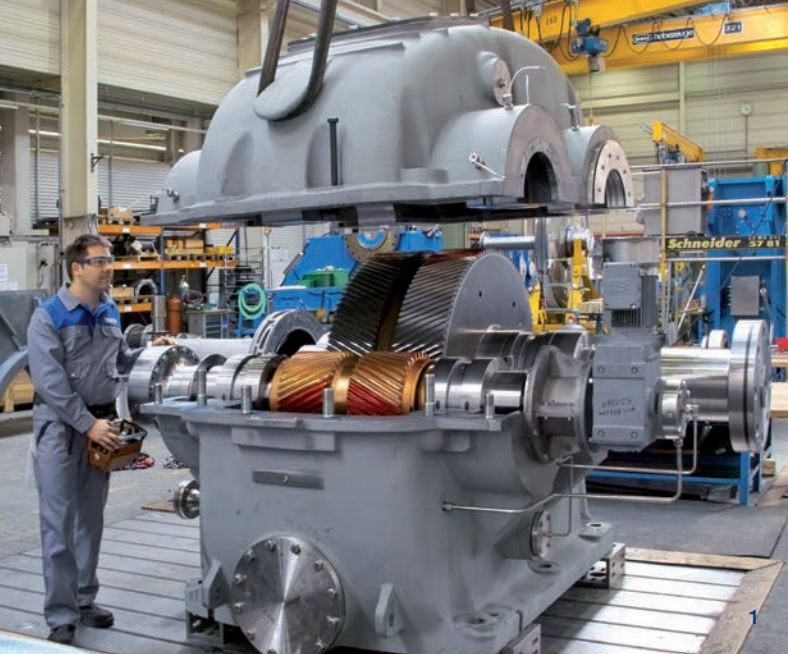
A-series, type AD 66UQ special vertical load gear unit for gasturbine applications



F-series, typ FD 150-3 ZQ with intermediate gear and quill shaft, realized for a test stand for gas turbines



- 1 A-series, Type AD 80-3 with 37 MW transmitted power for an air separation plant in China
- 2 H-series, type HD 63-2 with 6.2 MW transmitted power on a Petrobras offshore platform
- 3 B-series, type BD 140 with a gear ratio 20:1, P = 3 MW and API-Factor 2 for a natural gas compressor application in the Middle East
- 4 F-series, type FD 89-2 (P = 19 MW) with mounted rotor turning gear unit for an application between expansion turbine and generator in an PTA plant
- 5 H-series, type HD 80-2 for a compressor application of a natural gas pipeline in Russia with 20.0 MW





A high efficient compressor system Integral gear units

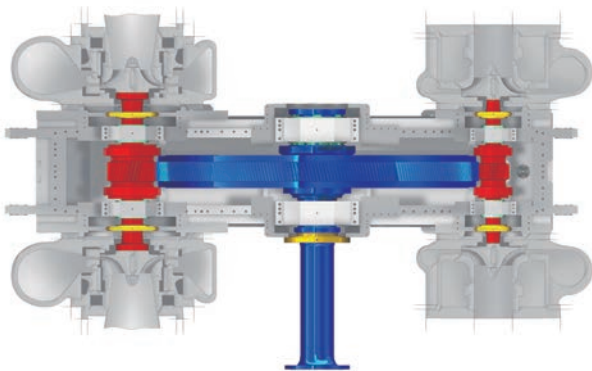
Integrally geared compressors have now established themselves in the process industry. Originally this was a field clearly reserved for free-standing axial, radial and also reciprocating piston compressors. Among the main reasons for this development is the lower space requirement and the higher total efficiency of the compressor package.

It is precisely in air separation, oil and natural gas processing, and the general chemical industry, that new solutions and designs are being sought. Voith Turbo BHS Getriebe as supplier of the 'core unit' of an integrally geared compressor is developing and offering exceptionally reliable and highly efficient custom-made solutions that provide benefits such as lower operating costs and less CO₂ emissions.

Tailor-made to the relevant application and customer specification, integral gear units are designed and manufactured at Voith Turbo BHS Getriebe with up to 10 compressor stages, total unit weights of more than 40 tonnes, and gear pitch wheel diameters over 3 meters. Gear ratios up to 24:1 have been achieved thus far. The gear set is typically designed with single helical toothing and thrust collars. BHS possesses the greatest wealth of experience worldwide in thrust collar technology.

Integral gear units are usually driven via electrical motors, sometimes also in combination with turbines. With an integral gear unit it is possible to combine several compressor and expansion stages on one gear unit (so-called “companders”). This and other types available, e.g. with intermediate gear lead to very compact and optimized plant designs.

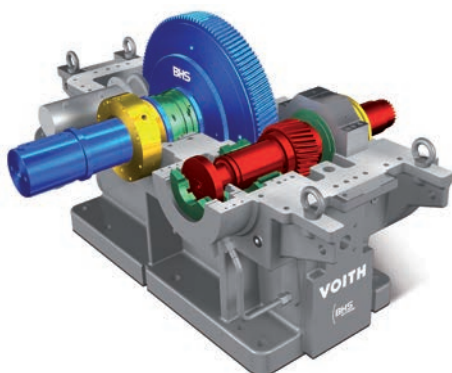
Cross-section drawing of a multi-pinion integral gear unit that mounts compressor and/or expander casings

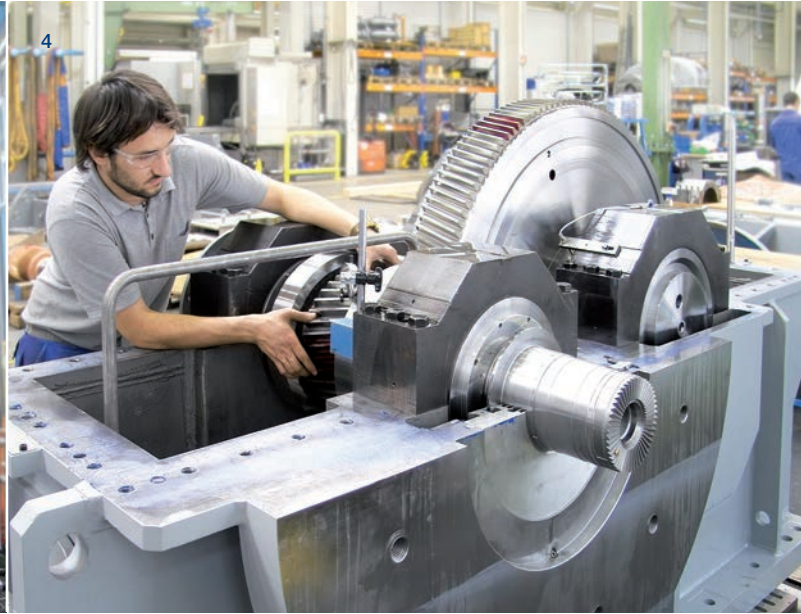


Multi-pinion integral gear unit WGseries, type WGC5-330T for steam turbine and an electrical motor as drivers

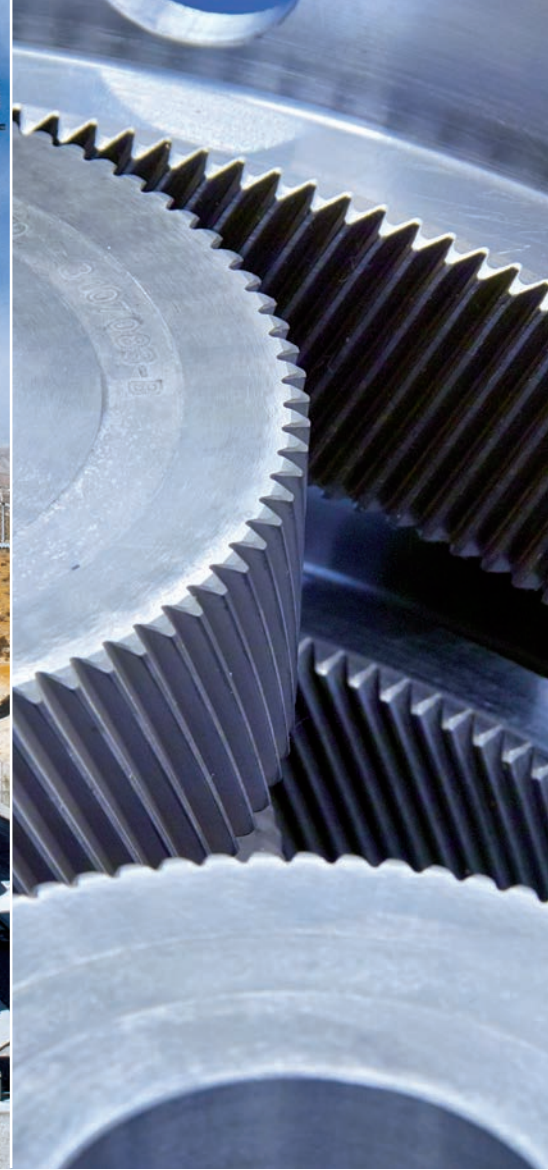


Type TGC for mounting of a 1-stage compressor casing





- 1 Type WGC 3-220 (P = 11 MW) and WGC 5-330T (P = 23.5 MW) on the customer's test bed (by courtesy of MAN Turbo AG, Oberhausen)
- 2 Integrally geared compressor with type WGC 3-110 (P = 5.4 MW) for re-liquefaction of natural gas on LNG tankers (by courtesy of Atlas Copco Energas, Cologne)
- 3 WG-series, Type WGC 5-330T (P = 31.5 MW) before test run at Voith Turbo BHS Getriebe company
- 4 Single pinion TG-series, type TGC 72 (P = 14.5 MW) for a geothermal power plant in the U.S.A. in an "expansion turbine to generator" application



High speeds or torques

Stoeckicht epicyclic gear unit

Worldwide Voith Turbo BHS Getriebe is known as the most experienced manufacturer of epicyclic gear units according to the Stoeckicht principle. With this design, the unsupported sun wheel plus the unsupported radially elastic annulus halves effect an equal load distribution on the planets and this in turn produces less wear and tear on the components. The consequence is a high power density with low space requirement, combined with lower weight. Furthermore, the long service life speaks for the Voith Turbo BHS Getriebe Stoeckicht epicyclic gear unit.

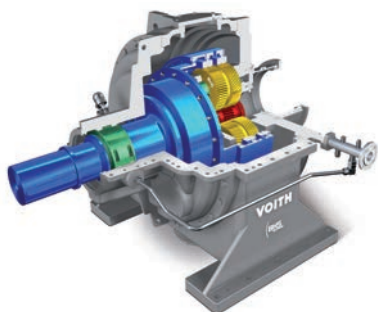
Voith Turbo BHS Getriebe constructs epicyclic gear units up to powers of 45 MW, speeds of up to 80 000 rpm and torques of over 550 kNm. With single-stage designs ratios up to 12:1 and with two-stage ratios up to 80:1 are achieved.

Stoeckicht epicyclic gear units from Voith Turbo BHS Getriebe are used between all typical main engines and output machines within turbo trains. Other drive arrangements, e.g. test beds, wind power or water power, are possible and can be integrated via standardized or specialized designs. Two basic housing variants can be chosen: freestanding and flange mounted. The model type determines the epicyclic gear unit, the rotational direction of the drive and output side can be made the same or opposing. Technical requirements determine the toothing (either as spur or double helical).

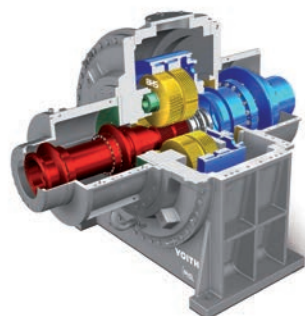
The coupling to the high-speed machine is already integrated into the Stoeckicht epicyclic gear unit. One variant of the coupling is likewise integrated into the low-speed side, where extremely compact gear dimensions are achieved. Coupling guards can be provided as part of the gear unit, upon request.

As a consequence of the growing requirements, new solutions have been brought into the product range with which the most compact dimensions have been achieved with transmission ratios of up to 80:1. Power distribution gear units transmit high power combined with high speed. Higher speeds than escalate to 100 000 rpm at 1 MW.

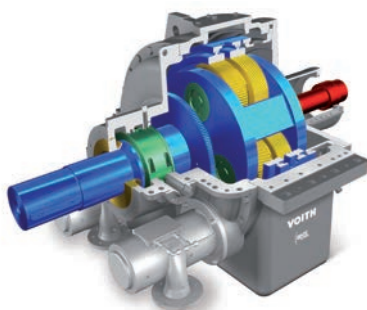
Type RTP for realization of high speeds, with opposite rotational direction of input and output shaft



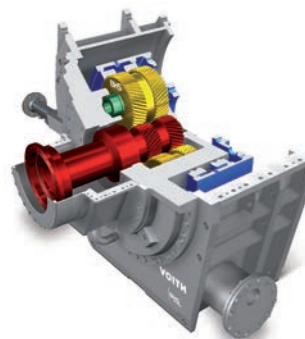
Type RTP_K with integrated couplings, both on low speed and high speed gearbox side



Type RHP for realization of bigger gear ratios with identical rotational direction of input and output shaft



Type RTP_E for flange-mounting to the electrical machine



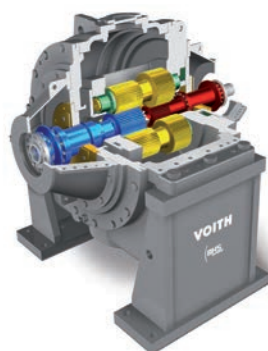


- 1 RT-series, type RTP 25 (P = 3.5 MW) for a compressor application in a power plant in a Balkan State
- 2 RT-series, type RTP 72K (P = 16 MW) for a biomass power plant in Latvia

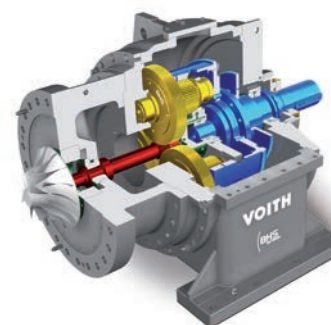
- 3 Type RHP 12 (P = 0.5 MW) for a chlorine gas compressor application in China (by courtesy of Siemens Turbomachinery Equipment, Leipzig)

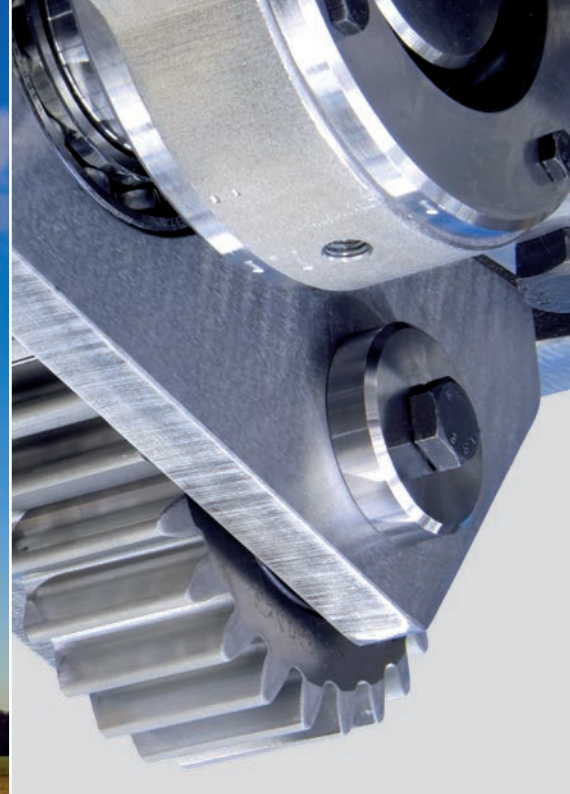
- 4 RT-series, type RTP 56E "E-Pack" (P = 26 MW) in steam turbine power plant in Germany
- 5 RH-series, type WRP 140 (P = 5.6 MW) for power generation via a Kaplan water bulb turbine

Power distribution gear unit for high power transmission at high speed



Type RTG_CS with mounted compressor wheel in a compound star design





Reliable turning of shaft trains

Rotor turning gears

Rotor turning gears from the Voith Turbo BHS Getriebe company are esteemed as a reliable and inexpensive aid for the turning of rotors. Compared with other design solutions they are wearresistant, long-lasting and require low-maintenance. They offer the plant operator greater safety even at high turning speeds, high breakaway torques and high mass moments of inertia.

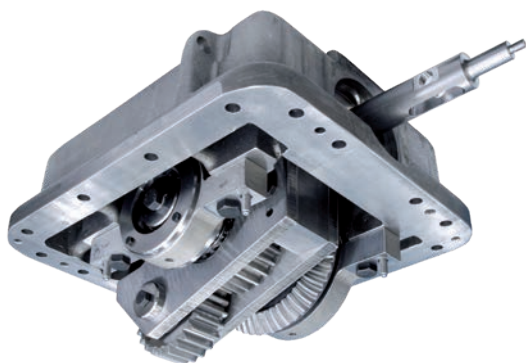
Rotor turning gear units are used primarily to break out and start shaft trains. They are also used to turn rotors slowly so that the armature cools down evenly and therefore remains dimensionally stable. At the same time, uneven debris in the blade channels is avoided. In addition, they are used to align and position shaft trains.

The speeds of rotor turning gears range from 0.2 to 400 rpm, the breakaway torques from 300 to 100 000 Nm.

Voith Turbo BHS Getriebe rotor turning gear units are available either positioned on a free shaft end or integrated into the shaft train.

By utilizing the hardened bevel and parallel shaft gears these components are particularly wear-resistant and show a high service life. Compared with worm gears, considerably smaller motors can be used – thus saves cost. Voith Turbo BHS Getriebe rotor turning gears are constructed of simple, standardized components, and spare parts can be delivered to customers at short notice. The rotor turning gear unit is available with various explosion protection types and automated operating control systems. Alongside the pure rotor turning gear unit, Voith Turbo BHS Getriebe also supplies as an additional specification, control cabinets for actuation, e.g. adapter flanges and gear rings. As a special model type the rotor turning gear unit is constructed for integration into the shaft train with a hydro-motor. A freely available shaft end, the rotor turning unit can be equipped with a return stop and hydraulically activated overload coupling and also a switchable SSS coupling (lock-out).

Mechanism of the rotor turning gear with swivelling pinion



Rotor turning gear unit with swivelling pinion for alignment above the pinion train



Rotor turning gear with overrunning clutch for a free shaft end





- 1 Turning gear unit with swivelling pinion, size 5 with automatic mode 3 ($n = 283 \text{ rpm}$, $BAT^* = 6000 \text{ Nm}$, $MOI^* = 4856 \text{ kgm}^2$)
- 2 Type RDV 120 ($n = 170 \text{ rpm}$, $BAT^* = 5679 \text{ Nm}$, $I = 2108 \text{ kgm}^2$) for a free shaft end in the assembly of Voith Turbo BHS Getriebe company
- 3 Type RDV 80 with overrunning clutch on the shaft end of a compressor ($n = 316 \text{ rpm}$, $BAT^* = 1663 \text{ Nm}$, $MOI = 138 \text{ kgm}^2$) (with courtesy of MAN Turbo AG, Oberhausen)
- 4 Type RDV 3 HSO ($n = 283 \text{ rpm}$, $BAT^* = 6000 \text{ Nm}$, $MOI = 4856 \text{ kgm}^2$) with hydro motor, mounted on top of a gas turbine pedestal
- 5 Type RDV 2A1 with swivelling pinion on the bearing block of a steam turbine ($n = 42 \text{ rpm}$, $BAT = 715 \text{ Nm}$, 2860 kgm^2) (with courtesy of MAN Turbo AG, Oberhausen)

* MOI = moment of inertia

* BAT = breakaway torque



Reliable within the threshold range Diaphragm couplings

The fully developed and high-quality Voith Turbo BHS Getriebe diaphragm couplings have proven their worth, especially in turbo systems. As a firstclass product with low weight, they are capable of transmitting high torque at high speed. At the same time, they compensate for axial, radial and angular misalignment of two coupled shafts.

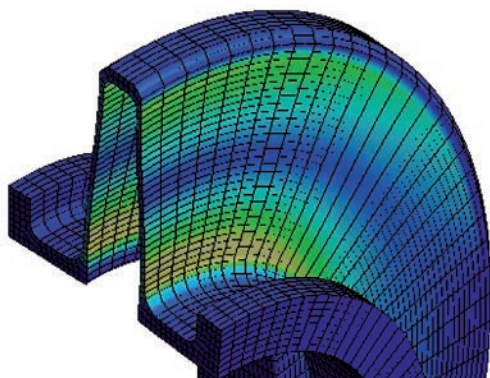
Diaphragm couplings are designed and manufactured by Voith Turbo BHS Getriebe for torques of up to 1 500 000 Nm and speeds of up to approx. 80 000 rpm. The standard program includes couplings suitable for angular misalignment up to 0.25° . Special model types for angular misalignments up to 0.5° are available. These high performance couplings meet the requirements of API 671 and ISO 10441. They are approved for Zone 1 and Zone 2, in accordance with ATEX.

According to requirement, the couplings can have single or double diaphragms. In principle, the Voith Turbo BHS Getriebe diaphragm couplings are designed as rigid all-metal couplings free of backlash. Special designs, e.g. with welded spacer sleeve, CFRP spacer sleeves or torque measuring shaft are possible.

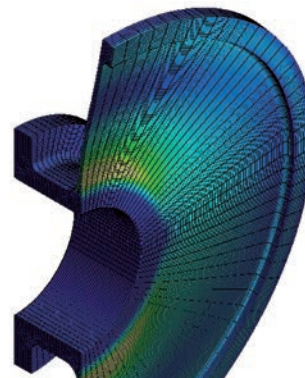
BHS diaphragm couplings generally operate free of lubrication, wear and maintenance. Throughout their entire operating life, the diaphragm elements retain their elastic properties. Even in the equalization of a large shaft offset, very small but exactly quantifiable reset forces occur. These top quality couplings are characterized by linear load deflection curves. The linear contour of the diaphragms and lack of screw connections on the diaphragm external diameter of the double diaphragm coupling cause lower noise levels and very small windage losses. Furthermore their high, reproducible momentum quality speaks for a Voith Turbo BHS Getriebe diaphragm coupling. In addition, the highest operational precision and minimized overhang moment characterizes the couplings. Detailed tests on endurance limits demonstrate a very high shape stability and confirm the design of the lightweight construction.

FEM drawing of the angular offset compensation

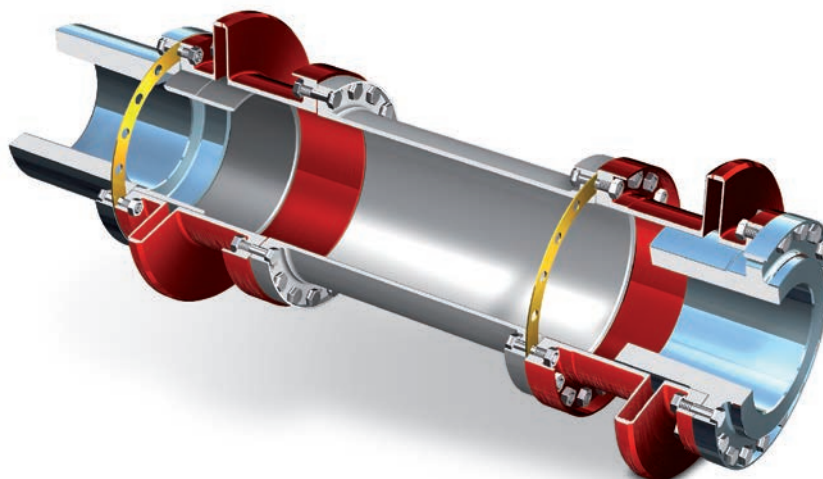
by the double diaphragm of the TwinTors coupling

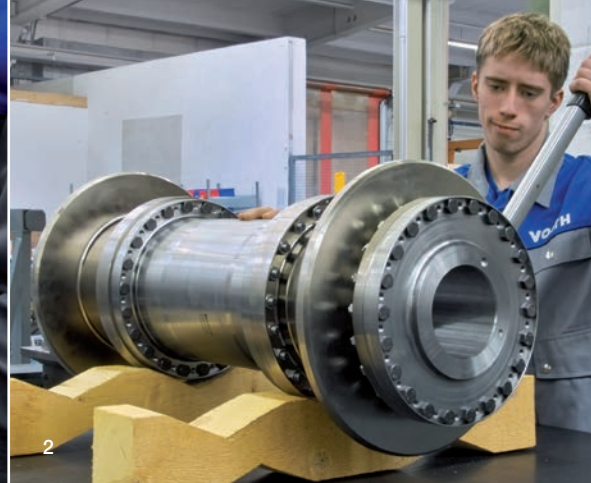
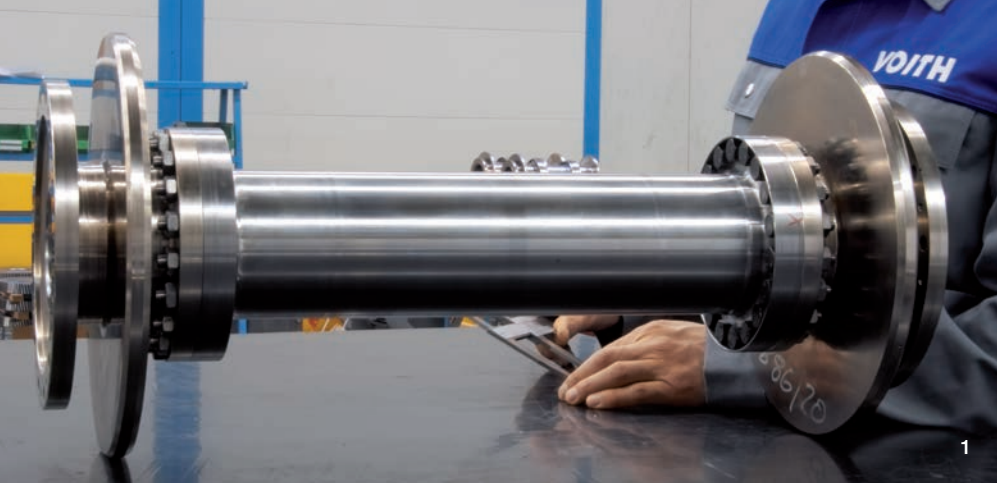


by the single diaphragm of the EconTors coupling



Double diaphragm coupling TwinTors MKB_AIS with outer hub on left and inner hub at right side





- 1 TwinTors double diaphragm coupling type MKA 300 FFS with two-sided flanges, (peak torque 43 808 Nm, max 20 000 rpm, 37.6 kg) for arrangement between gearbox and turbine
- 2 TwinTors double diaphragm coupling, type MKB 300 IIS (peak moment 65 800 Nm, max 20 000 rpm, 64.9 kg) with inner hub for reduced moment, to be installed between a steam turbine and a NO compressor
- 3 TwinTors double diaphragm coupling, type MKB 160 FFC with in molded CFRP spacer for an helicopter test stand (peak torque 6 040 Nm, max 30 000 rpm, 6.4 kg)
- 4 EconTors single diaphragm coupling, type MKS 450 AAS (peak torque 183 000 Nm, max 5 330 rpm, 321.5 kg), for arrangement between electrical motor and Voith Vorecon

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