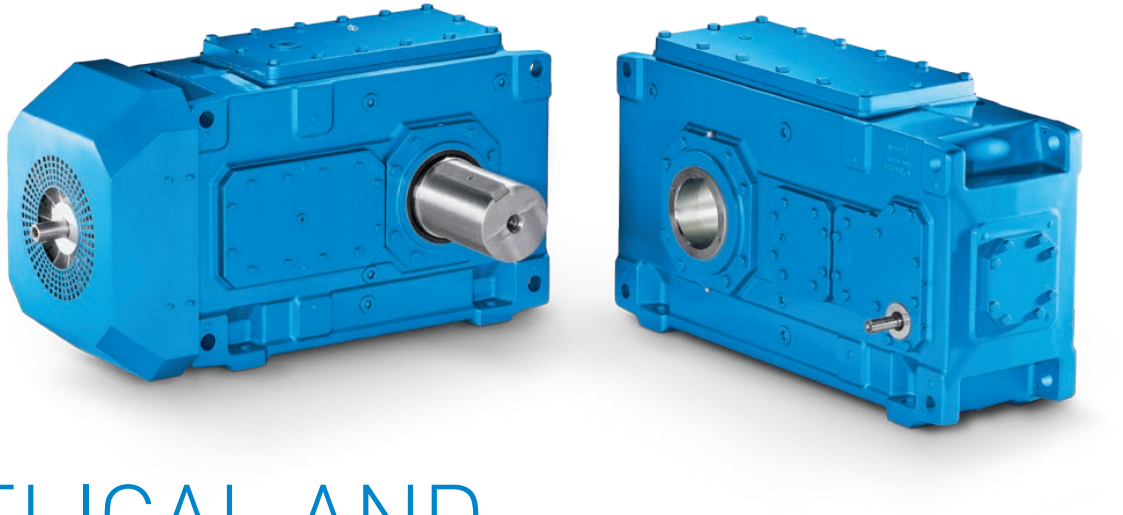
© Flender GmbH 2019

FLENDER GEAR UNITS
CATALOG **MD 20.1**
EDITION 2018 EN



HELICAL AND BEVEL HELICAL GEAR UNITS

Innovative technology, tried and tested modular system.
The original from Flender.

flender.com

FLENDER

© Flender GmbH 2019

RELATED CATALOGS

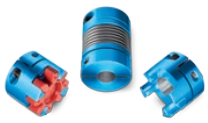
FLENDER couplings
Standard Couplings
MD 10.1
E86060-K5710-A111-A5-7600



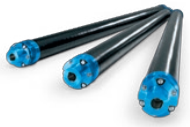
ARPEX
High Performance Couplings
MD 10.2
E86060-K5710-A121-A1-7600



SIPEX and BIPEX-S
Backlash-free Couplings
MD 10.3
E86060-K5710-A131-A1-7600



ARPEX
Composite Couplings
MD 10.5
E86060-K5710-A151-A2-7400



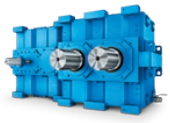
ARPEX
Torque Limiters
MD 10.11
E86060-K5710-A221-A2-7400



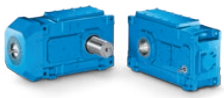
FLENDER SIP
Standard Industrial Planetary Gear Units
MD 31.1
E86060-K5731-A111-A5-7600



FLENDER CHG
Helical Gear Units
MD 20.10
E86060-K5720-A231-A1-7400



Gear Units
Fast Track
MD 20.12
E86060-K5720-A221-A1-6300



Bucket Elevator Drives

MD 20.2
E86060-K5720-A121-A4-6300



PLANUREX 2
Planetary Gear Units
MD 20.3
E86060-K5720-A131-A2-6300



Paper Machine Drives

MD 20.5
E86060-K5720-A151-A2-6300



Conveyor Belt Drives

MD 20.6
E86060-K5720-A161-A2-6300



Marine Reduction Gearboxes

MD 20.7
E86060-K5720-A171-A1-7400



DUORED 2
Helical Gear Units, Load-sharing
MD 20.8
E86060-K5720-A181-A1-6300



Pinion Drive for Tube Mills

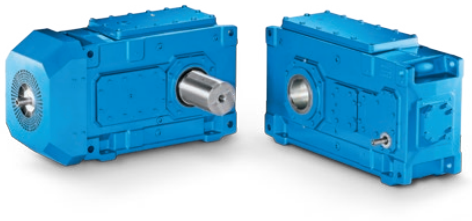
MD 20.9
E86060-K5720-A191-A1-7400



© Flender GmbH 2019

FLENDER GEAR UNITS

HELICAL AND BEVEL HELICAL GEAR UNITS



Catalog MD 20.1 · 2018

General 1

Introduction 2

Design of the gear units 3

Helical gear units horizontal mounting position 4

Helical gear units vertical mounting position 5

Bevel helical gear units horizontal mounting position 6

Bevel helical gear units vertical mounting position 7

Special mounting positions 8

Connection dimensions 9

Options for operation 10

Options for installation and add-on parts 11

Appendix 12

The products and systems described in this catalog are manufactured/distributed under application of a certified quality management system in accordance with EN ISO 9001 (Certified Registration No. 01 100 000708). The certificate is recognized by all IQNet countries.

© Flender GmbH 2019

COMPANY HISTORY

1899 Founding of A. Friedr. Flender & Co. by Alfred Friedrich Flender for the manufacture and sale of wooden belt pulleys in Düsseldorf-Reisholz (Germany).

1945 Resumption of small scale production after the production plants were largely destroyed during World War II.

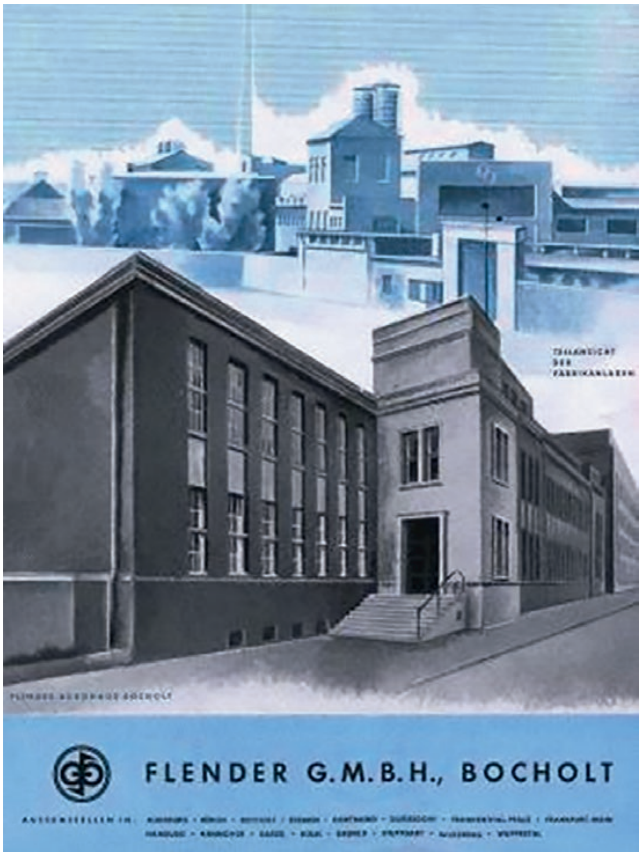
1982 Takeover of the Himmelwerke in Tübingen from the Bauknecht bankruptcy estate.

1986 Conversion of A. Friedr. Flender AG & Co. KG into a stock corporation.

1989 Transition of 95 percent of A. Friedr. Flender AG to the ownership of the Deutsche Babcock AG.



Company founder, Dr. A. Friedrich Flender (1876–1939)



1927 – Gear unit production gets underway in Bocholt

© Flender GmbH 2019

1990 Take-over of the Penig Getriebewerk in Saxony (the first acquisition of an East German company by a West German company).

2000 Divestiture of all shares of FLENDER AG by Babcock Borsig AG to the holding company Citicorp Venture Capital, London.

2001 Founding of Winergy AG as a separate legal entity.

2005 Take-over of Flender GmbH by Siemens AG into the A&D Division.

2010 Conclusion of the Flender integration as Business Unit Mechanical Drives (MD).

2013 Sale of Siemens Gusstechnik GmbH, Wittgensdorf, to Franken Guss GmbH & Co. KG (as part of a higher-level stream-lining program).

2015 Company-internal transfer of the geared motors and rail gear units business to the Business Unit PD LD. Start of the MD 2020 program.

2017 Conversion of MD into an independent company under the aegis of Siemens: Founding of Flender GmbH.



Company headquarters Bocholt today

© Flender GmbH 2019

Competence	Benefit from good advice through interdisciplinary know-how
Availability	We are there whenever and wherever you need us
Maximum performance	The largest applications in the world are driven by us
Quality	We see your most stringent demands as our duty
Responsibility	You can expect commitment and trustworthiness from us
Experience	Rely on modern thinking based on decades of experience
Innovation	We are always thinking ahead. The goal: Your perfect solution.
Digitalization	The path to the right solution leads through information
Reliability	You can rely on our products, as well as on us
Flexibility	We are flexible in all of our processes
Reliable partner	You can trust our products, our company, and us

© Flender GmbH 2019

FLENDER BY YOUR SIDE.

Flender stands for comprehensive knowledge of all aspects of mechanical drive technology and for maximum quality of products and services. For us, highly qualified and engaged employees have always been the key to innovative energy and performance capability. But they are also the basis for our special competence in consulting, which is supported by an almost unlimited range of products. Thanks to our comprehensive application know-how and decades of experience in many industries and in the acquisition of raw materials, we are able to competently advise our customers with an eye on their individual requirements.

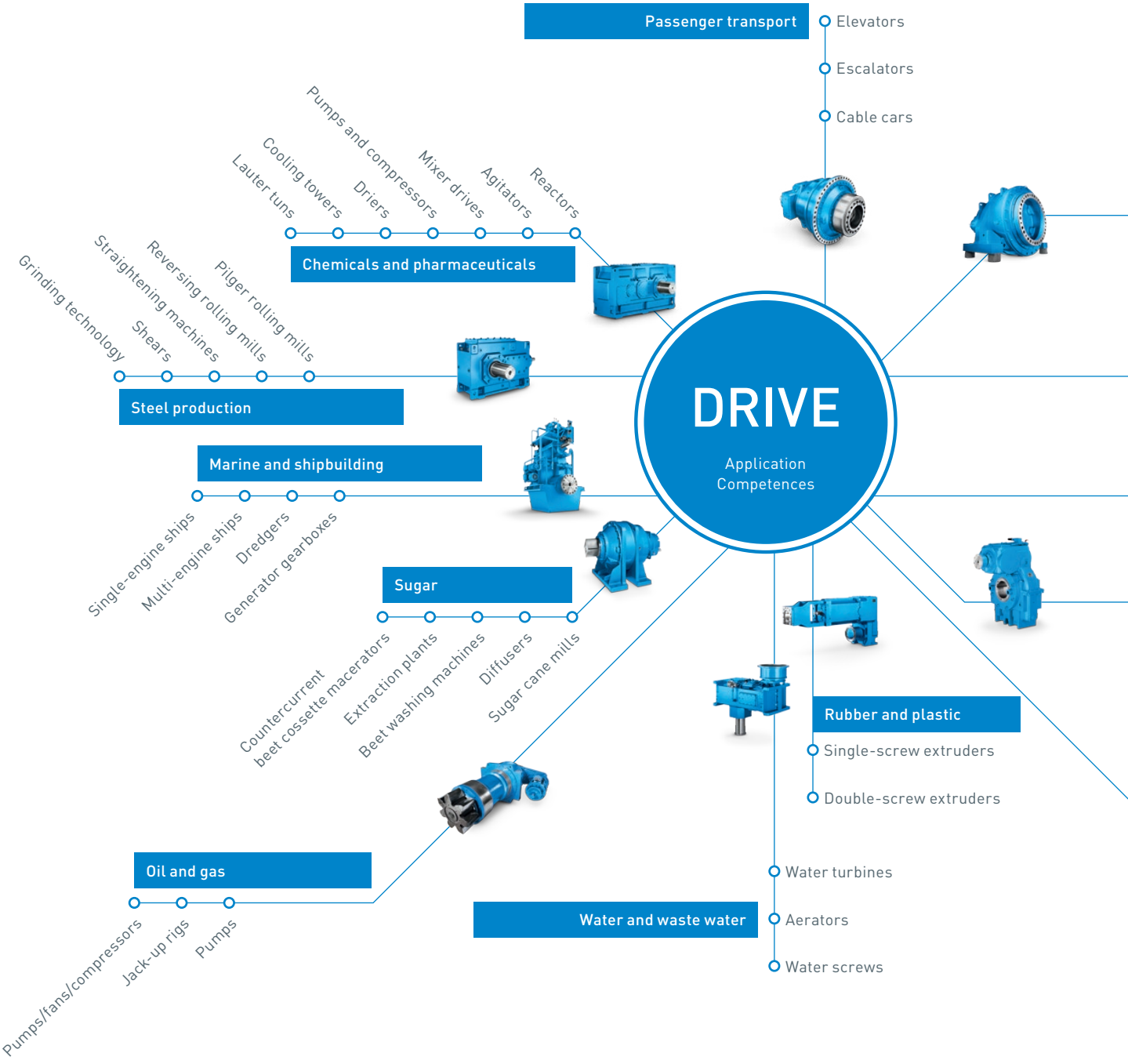
As a full subsidiary of Siemens, we combine the stability and process reliability of a world-renowned company with the customer proximity and pragmatism of a medium-sized company, thus combining the best of both worlds.

Our customers regard Flender as a reliable, investment-safe partner. All of our business relationships are based on trust, responsibility and traditional business ethics. In this spirit, together with our customers, we look forward to writing a new chapter in the history of Flender.



© Flender GmbH 2019

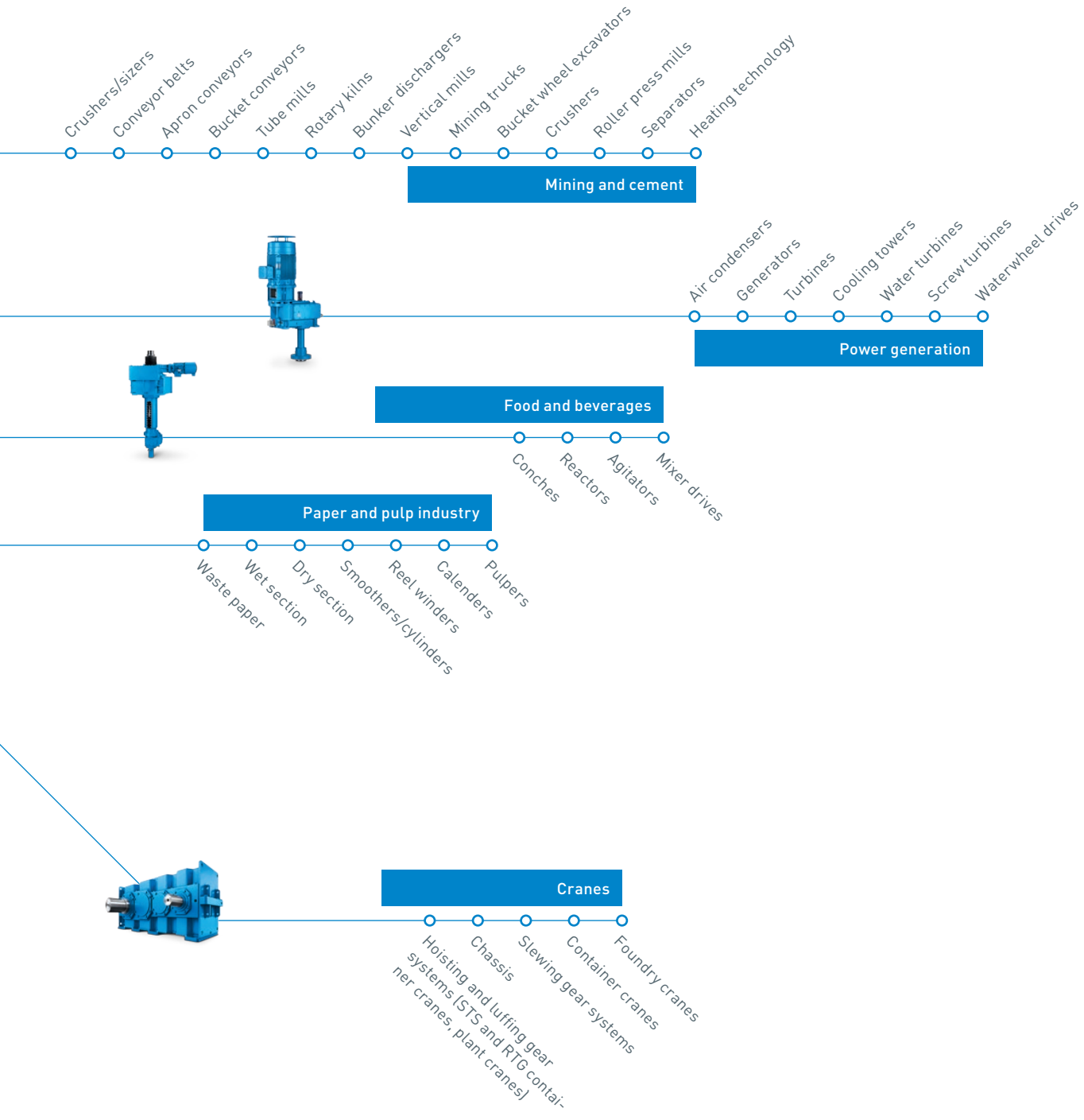
MILLIONS OF APPLICATIONS, ONE CONCLUSION: ABSOLUTE RELIABILITY



© Flender GmbH 2019

The drive technology of Flender is simply reliable. This is verified by reference projects from all industries around the entire world in which our gear units have often been running reliably for many decades. In many applications, our components and systems ensure unflagging continuous operation.

Flender stands for reliable drives and efficient production, for available systems and stabile processes, for dependable partnership and competent consulting, for responsible acting and sustainable thinking. This is our aspiration.



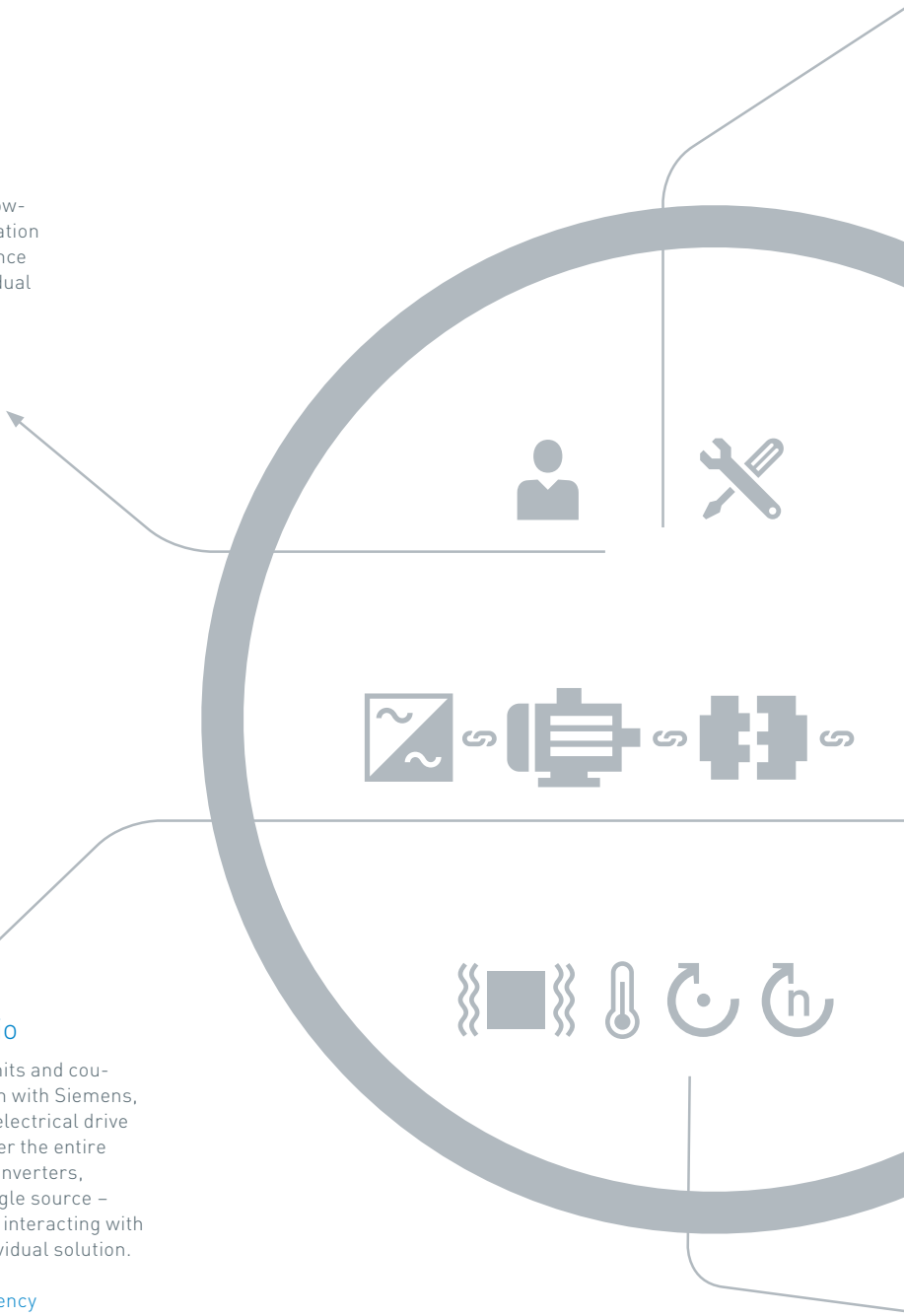
© Flender GmbH 2019

Flender's system competence turns first-class components into systems with tangible added value. Drive systems from Flender ensure maximum productivity, energy efficiency and reliability in any automation environment.

Consultation

Our customers use our interdisciplinary know-how, our application competence, our innovation strength and, last but not least, our experience to find the right drive system for their individual requirements.

Reduced engineering time, lower costs



Integrated drive portfolio

We provide more than just gear units and couplings. Thanks to the collaboration with Siemens, we also have the competence for electrical drive technology, which allows us to offer the entire drive train, including frequency converters, motors and controllers from a single source – perfectly integrated and optimally interacting with one another, as a standard or individual solution.

Fewer interface risks, more efficiency

© Flender GmbH 2019

INDIVIDUAL SOLUTIONS.

We have the right solution for you, even if your requirements are special. We no longer have to newly develop every special solution. Many solutions are already available.

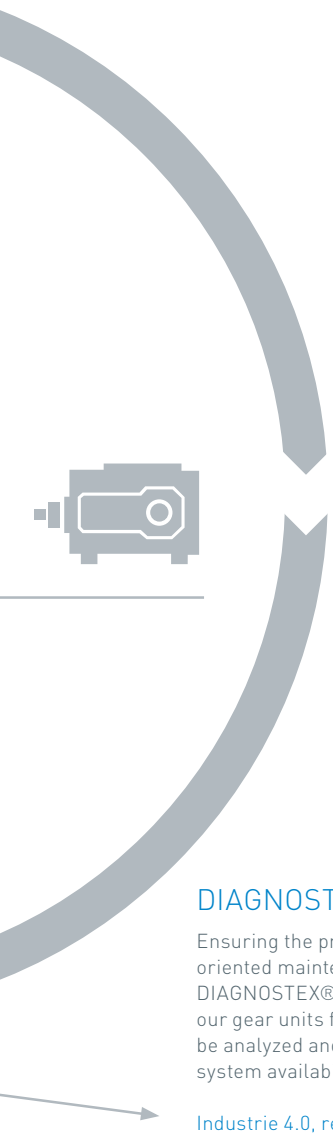
At **flender.com**, we provide application-specific solutions for your special requirements.

Use our online configurator, which allows you to create tailored product combinations.

Flender service

From diagnostics and support, replacement part and repair services, all the way to maintenance and retrofit services – the Flender service portfolio creates individual solutions, fully and completely tailored to the needs of our customers. In this way, a gear unit remains an original Flender gear unit.

Increased system availability, reduced lifecycle costs

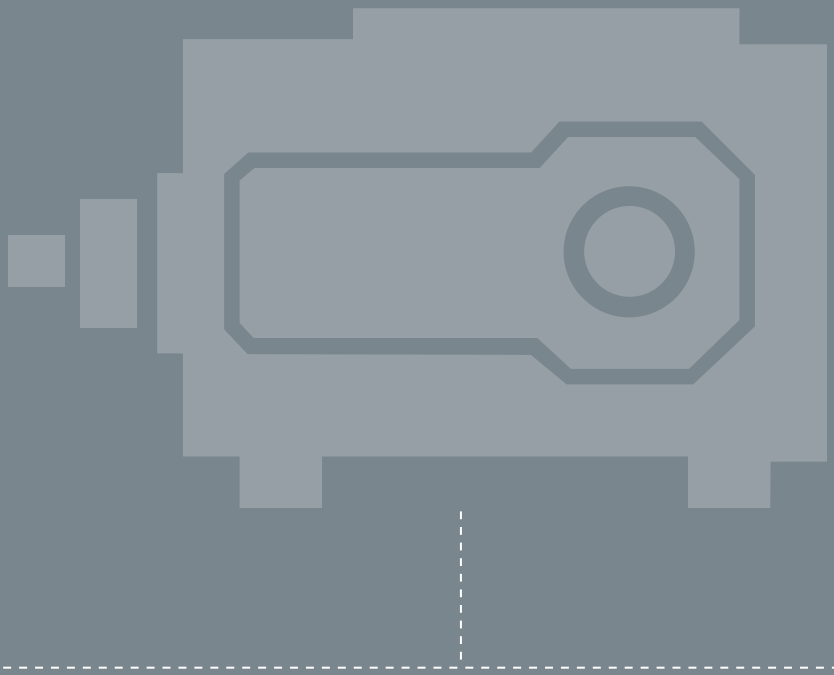


DIAGNOSTEX

Ensuring the process stability requires status-oriented maintenance of the drive train. With DIAGNOSTEX®, sensors measure deviations of our gear units from the target status. These can be analyzed and evaluated in terms of maximized system availability.

Industrie 4.0, reduced costs

© Flender GmbH 2019

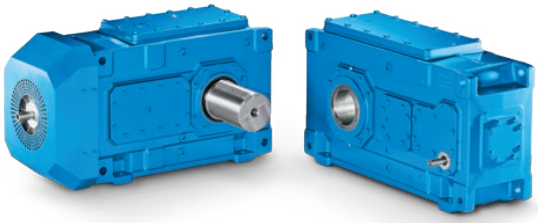


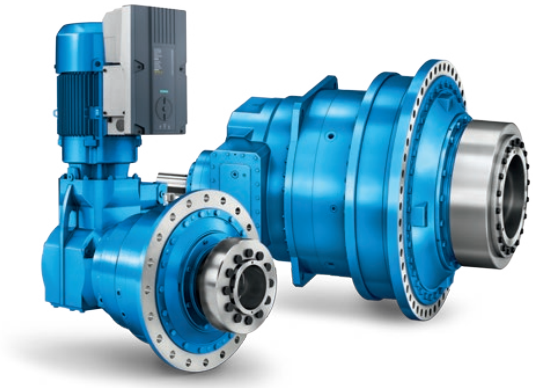
THE RIGHT GEAR UNIT SOLUTION FOR ANY REQUIREMENT

We provide helical and planetary gear units made up of standard modules or as a complete application solution.

Helical and planetary gear units from Flender are modern drive solutions that satisfy the most varying and extreme demands, day after day and year after year. For decades, plant operators have been achieving high system reliability and low lifecycle costs in every conceivable industry with our helical gear units.

© Flender GmbH 2019



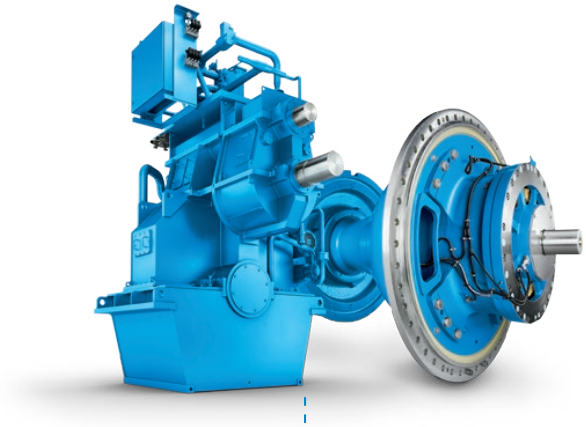


Helical and bevel helical gear units

Flender helical and bevel helical gear units are by far the most comprehensive range of industrial gear units in the world. It ranges from a multi-faceted universal gear unit portfolio and application-specific gear units to customer-specific solutions.
Nominal output torque: 3,300 Nm ... 1,400,000 Nm

Planetary gear units

With Flender planetary gear units, we provide a range of durable, reliable and finely graduated gear unit solutions. The series wins customers over due to its highly integrated planetary geared motor and maximum conformity with all international motor standards. It also brings quality and performance in a good ratio of lifecycle costs to price.
Nominal output torque: 10,000 Nm ... 5,450,000 Nm





Application-specific gear units

With application-specific gear units, Flender provides by far the most application solutions and thus covers nearly every drive-related need from hundreds of applications in industry and the acquisition of raw materials.
Nominal output torque: Up to 10,000,000 Nm

Customer-specific designs

Our experts are available at any time for special requirements during the development of new products. From designing and simulating complex drive solutions to implementing them, we work together with you to resolve multi-layered tasks.

© Flender GmbH 2019

GREAT EXPERTISE IN YOUR INDUSTRY TOO.

Each industry has its own conditions. Every application has its own specific requirements. We are looking forward to meeting your challenges.

We probably already have the right solution at hand. Here are a few examples:



Minerals and Mining

Requirement:
Perfectly coordinated drive system



Cement

Requirement:
Low maintenance effort and cost, sealing due to dirt in surroundings



Plastics and Rubber

Requirement:
Absorption of high axial forces, suitability for explosion protection



Environmental & Recycling

Requirement:
Highest possible reliability, rugged design



Pulp and Paper

Requirement:
Suitability for centrally located lubrication



Industrial Cranes

Requirement:
Quick availability, version with double drive shaft

© Flender GmbH 2019



Chemicals

Requirement:
Absorption of forces from the manufacturing process



Power Generation

Requirement:
Effective cooling, speed adjustment for motor to fan



Metals

Requirement:
Harsh working conditions, high peak loads



Harbour Cranes

Requirement:
Specific axle clearance, frequent start-up



Oil and Gas

Requirement:
Flexible adaptation to speed requirements



Water and Waste water

Requirement:
Absorption of external forces, oil-retaining pipe required

© Flender GmbH 2019

UNIVERSAL GEAR UNITS

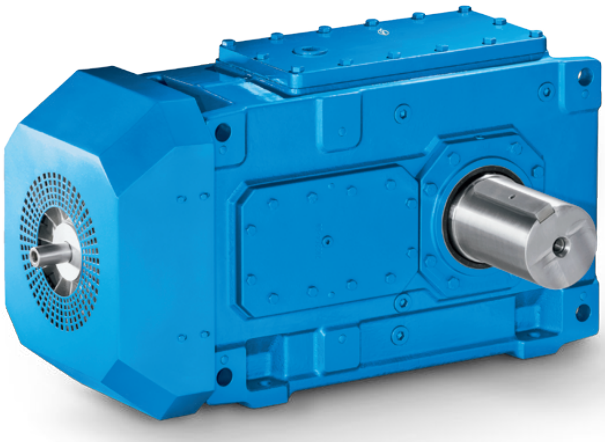
The huge modular system with its finely spaced series of helical and bevel-helical gear units probably already includes the right solution close to your desired torque.

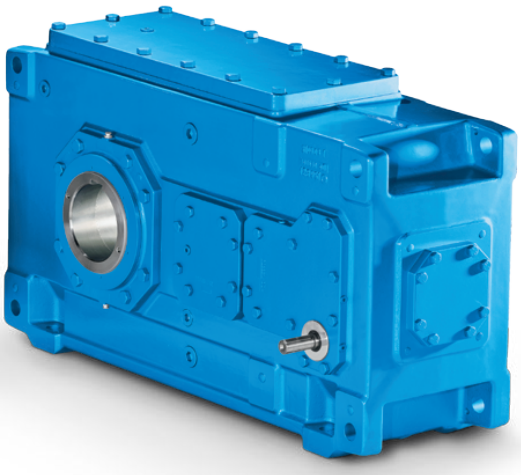
Nominal torque range Monoblock design Divided housing design

DESIGNS AND SIZES

TYPE	SIZE	03	04	05	06	07	08	09	10	11	12	13	14
Helical gear unit H1	Nominal torque class T2N	3,300 Nm	–	9,600 Nm	–	17,800 Nm	–	28,700 Nm	–	50,600 Nm	–	75,700 Nm	–
	Type__Size	H1__03	–	H1__05	–	H1__07	–	H1__09	–	H1__11	–	H1__13	–
	Ratio range (i)	1:1.25...5.6		1:1.25...5.6		1:1.25...5.6		1:1.25...5.6		1:1.6...5.6		1:1.6...5.6	
Helical gear unit H2	Nominal torque class T2N	3,500 Nm	6,700 Nm	11,200 Nm	14,400 Nm	20,300 Nm	25,600 Nm	33,700 Nm	42,200 Nm	59,300 Nm	73,800 Nm	86,000 Nm	107,000 Nm
	Type__Size	H2__03	H2__04	H2__05	H2__06	H2__07	H2__08	H2__09	H2__10	H2__11	H2__12	H2__13	H2__14
	Ratio range (i)	1:6.3...22.4	1:6.3...22.4	1:6.3...22.4	1:8...28	1:6.3...22.4	1:8...28	1:6.3...22.4	1:8...28	1:6.3...22.4	1:8...28	1:6.3...20	1:8...25
Helical gear unit H3	Nominal torque class T2N	–	–	11,600 Nm	15,500 Nm	21,700 Nm	27,200 Nm	35,700 Nm	43,800 Nm	63,500 Nm	77,200 Nm	88,000 Nm	109,000 Nm
	Type__Size	–	–	H3__05	H3__06	H3__07	H3__08	H3__09	H3__10	H3__11	H3__12	H3__13	H3__14
	Ratio range (i)			1:25...90	1:31.5...112	1:25...90	1:31.5...112	1:25...90	1:31.5...112	1:25...90	1:31.5...112	1:22.4...90	1:28...112
Helical gear unit H4	Nominal torque class T2N	–	–	–	–	21,700 Nm	27,200 Nm	35,700 Nm	44,200 Nm	61,600 Nm	78,000 Nm	90,700 Nm	113,000 Nm
	Type__Size	–	–	–	–	H4__07	H4__08	H4__09	H4__10	H4__11	H4__12	H4__13	H4__14
	Ratio range (i)					1:100...355	1:125...450	1:100...355	1:125...450	1:100...355	1:125...450	1:100...355	1:125...450
Bevel-helical gear unit B2	Nominal torque class T2N	–	6,200 Nm	9,400 Nm	12,000 Nm	19,000 Nm	23,800 Nm	29,900 Nm	38,000 Nm	54,000 Nm	66,300 Nm	81,100 Nm	101,000 Nm
	Type__Size	–	B2__04	B2__05	B2__06	B2__07	B2__08	B2__09	B2__10	B2__11	B2__12	B2__13	B2__14
	Ratio range (i)		1:5...18	1:5...18	1:6.3...22.4	1:5...18	1:6.3...22.4	1:5...18	1:6.3...22.4	1:5...18	1:6.3...22.4	1:5...18	1:6.3...22.4
Bevel-helical gear unit B3	Nominal torque class T2N	3,600 Nm	6,700 Nm	11,600 Nm	15,500 Nm	21,700 Nm	27,200 Nm	35,700 Nm	43,800 Nm	63,500 Nm	77,200 Nm	90,700 Nm	113,000 Nm
	Type__Size	B3__03	B3__04	B3__05	B3__06	B3__07	B3__08	B3__09	B3__10	B3__11	B3__12	B3__13	B3__14
	Ratio range (i)	1:20...71	1:12.5...71	1:12.5...71	1:16...90	1:12.5...71	1:16...90	1:12.5...71	1:16...90	1:12.5...71	1:16...90	1:12.5...71	1:16...90
Bevel-helical gear unit B4	Nominal torque class T2N	–	–	11,600 Nm	15,500 Nm	21,700 Nm	27,200 Nm	35,700 Nm	44,200 Nm	61,600 Nm	78,000 Nm	90,700 Nm	113,000 Nm
	Type__Size	–	–	B4__05	B4__06	B4__07	B4__08	B4__09	B4__10	B4__11	B4__12	B4__13	B4__14
	Ratio range (i)			1:80...315	1:100...400	1:80...315	1:100...400	1:80...315	1:100...400	1:80...315	1:100...400	1:80...315	1:100...400

© Flender GmbH 2019





15	16	17	18	19	20	21	22	23	24	25	26	27	28
130,000 Nm	–	173,000 Nm	–	245,000 Nm	–	–	–	–	–	–	–	–	–
H1__15 1:2...5.6	–	H1__17 1:2.8...5.6	–	H1__19 1:4...5.6	–	–	–	–	–	–	–	–	–
143,000 Nm	160,000 Nm	195,000 Nm	230,000 Nm	292,000 Nm	335,000 Nm	410,000 Nm	458,000 Nm	640,000 Nm	725,000 Nm	860,000 Nm	1,030,000 Nm	1,230,000 Nm	1,400,000 Nm
H2__15 1:6.3...20	H2__16 1:7.1...22.4	H2__17 1:6.3...20	H2__18 1:7.1...22.4	H2__19 1:6.3...20	H2__20 1:7.1...22.8	H2__21 1:7.1...20	H2__22 1:8...22.4	H2__23 1:6.3...20	H2__24 1:7.1...22.4	H2__25 1:6.3...20	H2__26 1:7.1...22.4	H2__27 1:8...20	H2__28 1:9...22.4
153,000 Nm	173,000 Nm	200,000 Nm	240,000 Nm	300,000 Nm	345,000 Nm	420,000 Nm	470,000 Nm	640,000 Nm	725,000 Nm	860,000 Nm	1,030,000 Nm	1,230,000 Nm	1,400,000 Nm
H3__15 1:22.4...90	H3__16 1:25...100	H3__17 1:22.4...90	H3__18 1:25...100	H3__19 1:22.4...90	H3__20 1:25...100	H3__21 1:22.4...90	H3__22 1:25...100	H3__23 1:22.4...90	H3__24 1:25...100	H3__25 1:22.4...90	H3__26 1:25...100	H3__27 1:22.4...90	H3__28 1:25...100
153,000 Nm	173,000 Nm	200,000 Nm	240,000 Nm	300,000 Nm	345,000 Nm	420,000 Nm	470,000 Nm	640,000 Nm	725,000 Nm	860,000 Nm	1,030,000 Nm	1,230,000 Nm	1,400,000 Nm
H4__15 1:100...355	H4__16 1:112...400	H4__17 1:100...355	H4__18 1:112...400	H4__19 1:100...355	H4__20 1:112...400	H4__21 1:100...355	H4__22 1:112...400	H4__23 1:100...355	H4__24 1:112...400	H4__25 1:100...355	H4__26 1:112...400	H4__27 1:100...355	H4__28 1:112...400
132,000 Nm	148,000 Nm	195,000 Nm	230,000 Nm	–	–	–	–	–	–	–	–	–	–
B2__15 1:5...18	B2__16 1:5.6...20	B2__17 1:5.6...18	B2__18 1:7.1...20	–	–	–	–	–	–	–	–	–	–
153,000 Nm	173,000 Nm	200,000 Nm	240,000 Nm	300,000 Nm	345,000 Nm	420,000 Nm	470,000 Nm	640,000 Nm	725,000 Nm	860,000 Nm	1,030,000 Nm	1,230,000 Nm	1,400,000 Nm
B3__15 1:12.5...71	B3__16 1:14...80	B3__17 1:12.5...71	B3__18 1:14...80	B3__19 1:12.5...71	B3__20 1:14...80	B3__21 1:12.5...71	B3__22 1:14...80	B3__23 1:20...71	B3__24 1:22.4...80	B3__25 1:20...71	B3__26 1:22.4...80	B3__27 1:20...71	B3__28 1:22.4...80
153,000 Nm	173,000 Nm	200,000 Nm	240,000 Nm	300,000 Nm	345,000 Nm	420,000 Nm	470,000 Nm	640,000 Nm	725,000 Nm	860,000 Nm	1,030,000 Nm	1,230,000 Nm	1,400,000 Nm
B4__15 1:80...315	B4__16 1:90...355	B4__17 1:80...315	B4__18 1:90...355	B4__19 1:80...315	B4__20 1:90...355	B4__21 1:80...315	B4__22 1:90...355	B4__23 1:80...315	B4__24 1:90...355	B4__25 1:80...315	B4__26 1:90...355	B4__27 1:80...315	B4__28 1:90...355

© Flender GmbH 2019



THE PERFECT COUPLING FOR THE PERFECT GEAR UNIT

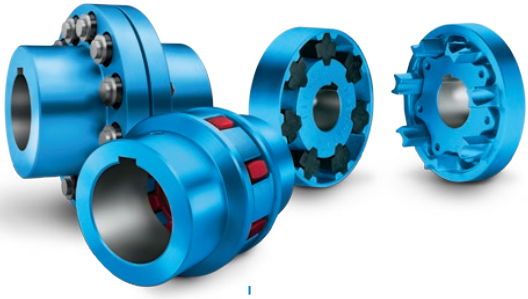
We provide elastic, highly elastic, rigid and hydrodynamic solutions.

Regardless of which demands are made on the coupling: Low or high performance, demanding operating conditions or high ambient temperatures, dusty or hazardous environments – we have the right portfolio. Our comprehensive range of couplings offers a large number of sizes and designs with a torque range from 0.5 to 10,000,000 Nm.

In over 90 years of development, conception and production, our product portfolio has grown to its current level of diversity. Nearly every matured coupling solution is available as a standard item in our modular system. This saves our customers time and money.

We are a powerful and flexible player in every market in the world – just like our customers. The production of our coupling components aims for maximum quality. As a trio, the setup, material and design result in optimal coupling solutions – rugged, dependable, largely low-maintenance and, above all, available at any time, anywhere. We provide high quality, first class delivery performance, and comprehensive service.

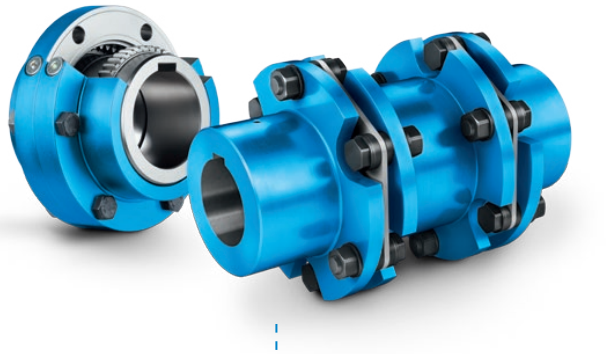
© Flender GmbH 2019



Flexible couplings

Our elastic couplings are pluggable and easy to install. The elastomer element equalizes the shaft offset and absorbs impacts from the motor or driven machine.

Nominal output torque: 12 Nm ... 1,300,000 Nm



Torsionally rigid couplings

Our compact steel couplings provide extremely precise transmission of high torques, especially in harsh operating conditions and extreme temperatures.

Nominal output torque: 5 Nm ... 10,000,000 Nm



Hydrodynamic couplings

Soft start, overload protection, torsional vibration damping – FLUDEX® fluid couplings allow the torque-limited approach and have very little slippage at rated load.

Nominal output torque: 1.2 kW ... 2,500 kW

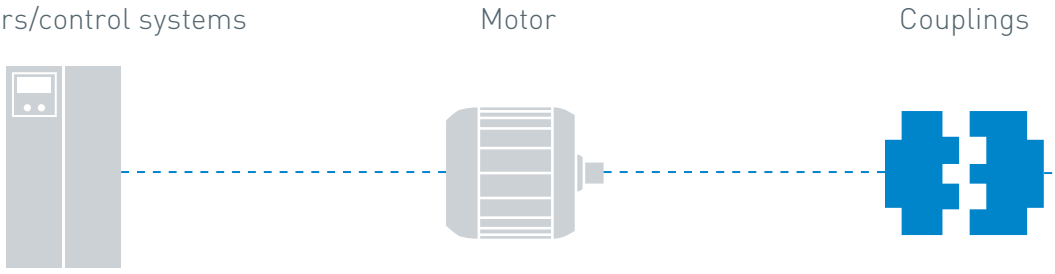


Highly-flexible couplings

Highly flexible couplings are well-suited for connecting machines that operate asymmetrically. They are preferred for use in systems that are periodically operated.

Nominal output torque: 24 Nm ... 90,000 Nm

© Flender GmbH 2019



THE COUPLING IN THE DRIVE TRAIN

FLUDEX

Hydrodynamic couplings

Soft start, overload protection, torsional vibration damping – FLUDEX fluid couplings allow the torque-limited approach and have very little slippage at rated load.

ZAPEX couplings and ARPEX all-steel couplings

Torsionally rigid couplings

Our compact steel couplings provide extremely precise transmission of high torques, especially in harsh operating conditions and extreme temperatures.



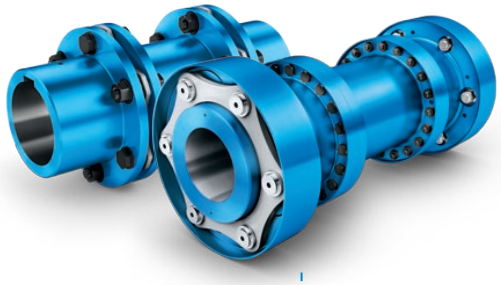
FLUDEX
fluid couplings

Power:
1.2 kW ... 2,500 kW



ZAPEX
couplings

Nominal output torque:
1,020 Nm ... 7,200,000 Nm



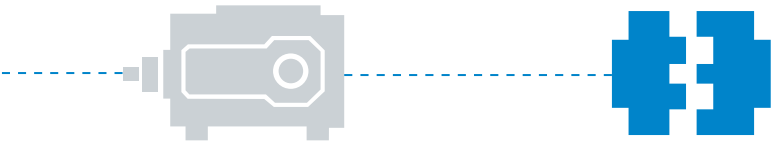
N-ARPEX and ARPEX
all-steel couplings

Nominal output torque:
5 Nm ... 10,000,000 Nm

© Flender GmbH 2019

Gear units

Couplings



N-EUPEX, RUPEX and N-BIPEX

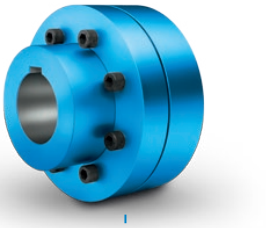
Flexible couplings

Flexible Flender couplings are pluggable and easy to install. The elastomer element equalizes the shaft offset and absorbs impacts from the motor or driven machine.

ELPEX, ELPEX-B and ELPEX-S

Highly-flexible couplings

Highly-flexible Flender couplings are well-suited for connecting machines that operate asymmetrically. They are preferred for use in systems that are periodically operated.



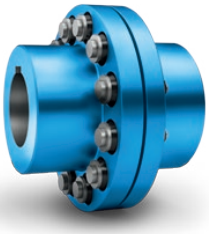
N-EUPEX
cam couplings

Nominal output torque:
19 Nm ... 62,000 Nm



ELPEX
elastic ring couplings

Nominal output torque:
1,600 Nm ... 90,000 Nm



RUPEX
pin-and-bush couplings

Nominal output torque:
200 Nm ... 1,300,000 Nm



ELPEX-B
elastic tire couplings

Nominal output torque:
24 Nm ... 14,500 Nm



N-BIPEX
cam couplings

Nominal output torque:
12 Nm ... 4,650 Nm



ELPEX-S
rubber disk couplings

Nominal output torque:
330 Nm ... 63,000 Nm

© Flender GmbH 2019



SERVICES

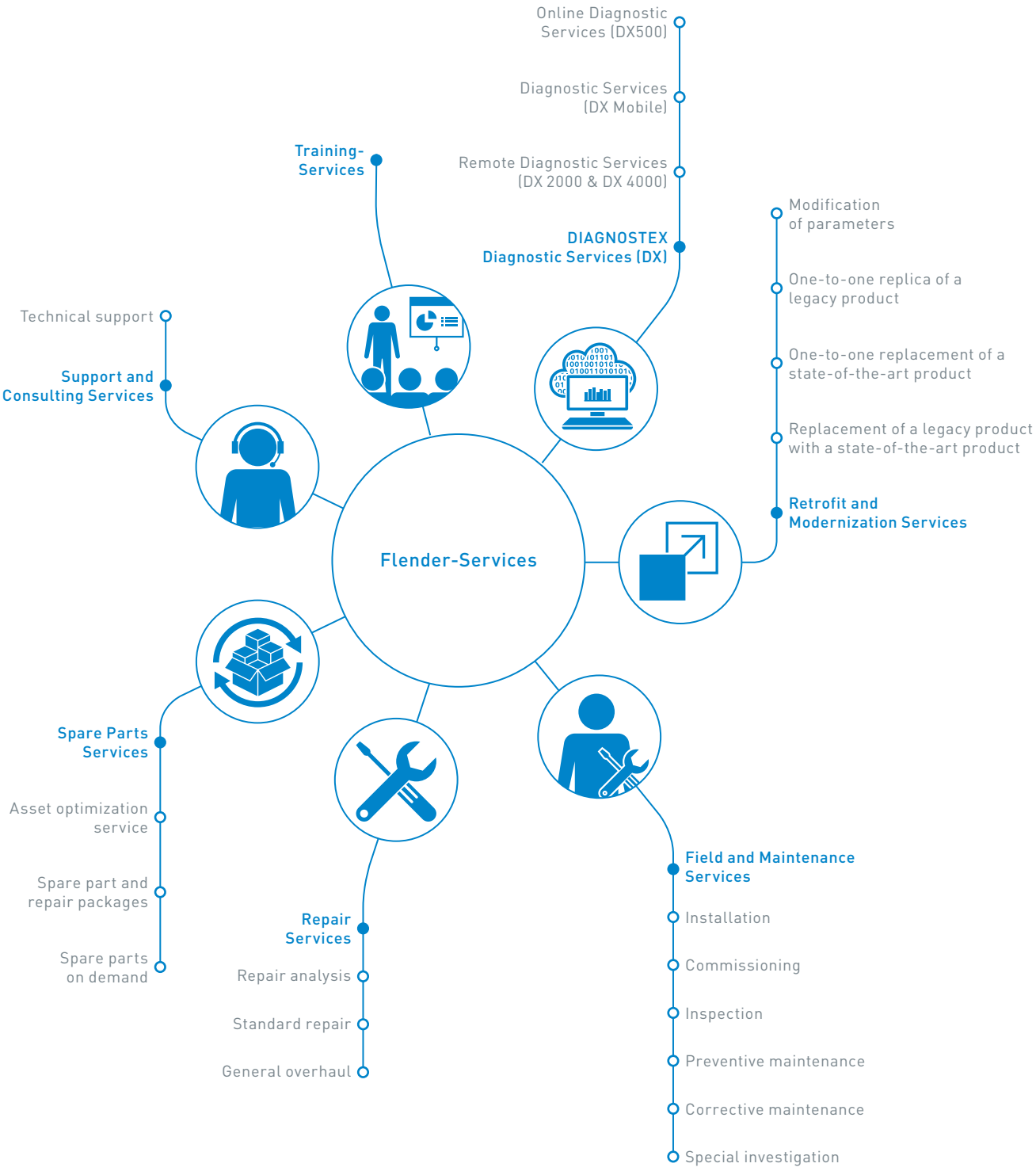
Ever increasing requirements make it more and more important for industrial plants to work with maximum productivity and efficiency. Flender Services give companies a decisive advantage over the competition in industry, the acquisition of raw materials and energy production. In view of the high cost pressure, increasing energy prices and stricter and stricter environmental stipulations, our services are becoming a decisive factor to success over the competition.

Enjoy the support of our service experts, from planning, development and operation to the modernization of your plant and benefit from our experience and in-depth know-how of your application – in more than 100 countries, seven days a week, 24 hours a day.

Reduce standstills, minimize downtimes due to failure, and increase the productivity, flexibility and cost efficiency of your plant.

© Flender GmbH 2019

OUR OFFER FOR GEAR UNITS AND COUPLINGS AT A GLANCE.



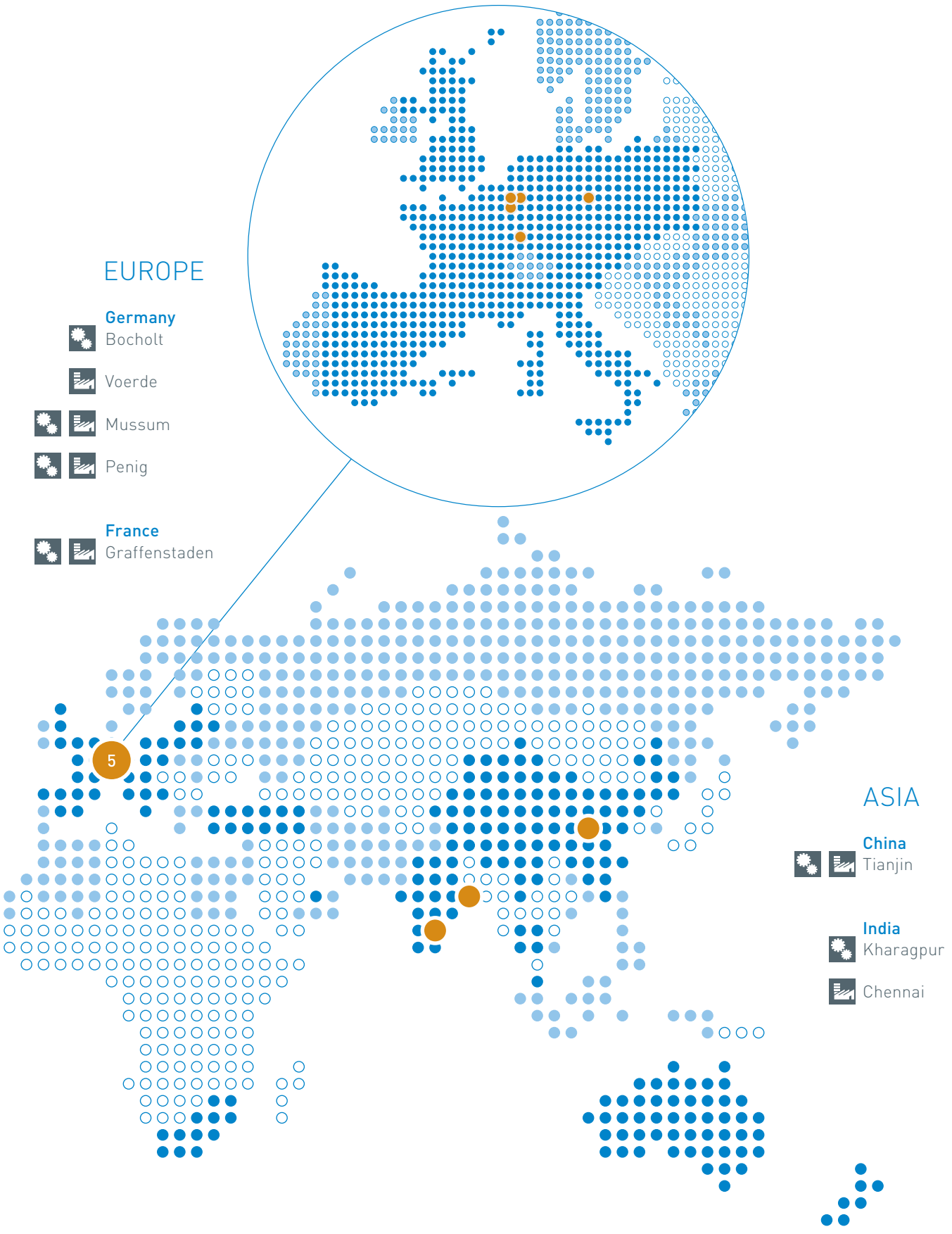
© Flender GmbH 2019

BY YOUR SIDE.

Competency, flexibility and top performance on-site: With our setup, we can offer customer proximity worldwide. In addition to seven plants, we are broadly represented on five continents by sales and service locations. Thanks to our global setup, we have achieved a very high level of efficiency in production, installation, sales and service.

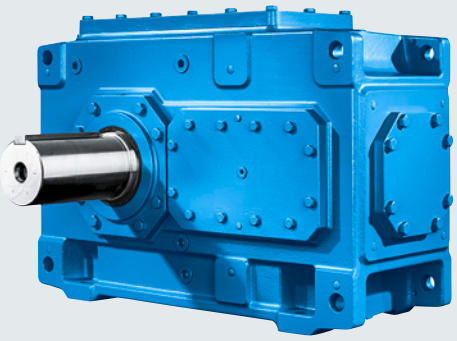


© Flender GmbH 2019



© Flender GmbH 2019

© Flender GmbH 2019



1/2 **General**
1/2 Certificates and approvals

© Flender GmbH 2019

Overview

ISO 9001



ISO 14001



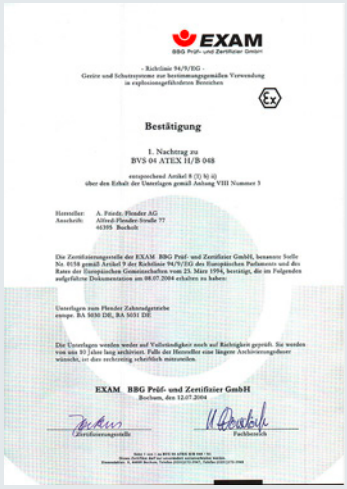
BS OHSAS 18001



ISO 50001



ATEX directive



© Flender GmbH 2019

Overview (continued)

Flender is represented in the FVA

Forschungsvereinigung Antriebstechnik e.V.

Test certificate for corrosion protection coating


DAkkS
Fraunhofer IFAM

Kurzfassung zum Prüfbericht KT-PB-110-3 A415326

Auftraggeber
GEHOLIT+WIEMER
Lack- und Kunststoff-Chemie GmbH
Herr Dr. Bayer
Sofienstraße 36

76676 Graben-Neudorf

Aufgabenstellung: Prüfung einer Korrosionsschutzbeschichtung, GEHOPON-EW19-Metallgrund, 2x GEHOPON-EW19-ZB und WIEREGEN-DW54 nach DIN EN ISO 12944-Teil 6; Korrosivitätskategorie C5 hoch

Folgender Lackaufbau wurde geprüft:

- Substrat: Stahlblech S 235 JR gemäß DIN EN 10025-1 (Maße 150 x 95 x 2 mm)
- Oberflächenvorbereitung: Strahlung im Oberflächenvorbereitungsgrad Sa 2 ½ gemäß DIN EN ISO 12944-4
- Rauheitsgrad: Mittel G gemäß DIN EN ISO 8503-1
- Lacksystem:
  1 x GEHOPON-EW19-Metallgrund + Härter EZ-19 (80 µm)
  2 x GEHOPON-EW19-ZB + Härter EZ-19 (160 µm)
  1 x WIEREGEN-DW54 + Härter DZ-13 (80 µm)

Gesamtschichtdicke ca. 320 µm

Das Fraunhofer Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM) hat für den Lackhersteller Geholit+Wiemer Lack- und Kunststoff-Chemie GmbH Korrosionsprüfungen nach DIN EN ISO 12944-Teil 6 durchgeführt.

Das geprüfte Beschichtungssystem GEHOPON-EW19-Metallgrund, 2x GEHOPON-EW19-ZB und WIEREGEN-DW54 auf Stahl entspricht bezüglich seiner Korrosionsschutzeigenschaften den Anforderungen der DIN EN ISO 12944 Teil 6 C5 hoch.

Fraunhofer Institut IFAM
Dr. Volkmar Stenzel
Dipl.-Ing. S. Buttgereit
Bremen, 18.08.2015

Prüfbericht KT-PB-110-3, A 415326

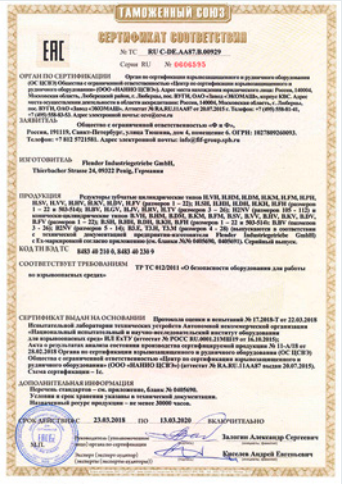
Flender has been a member of the
AGMA (American Gear Manufacturer Association) since 1988

MEMBER

Flender is a member of the Cooling Technology Institute
(relevant for cooling tower applications)

COOLING TECHNOLOGY INSTITUTE
CTI
EST. 1950

EAC certificate


ТАМОЖЕННЫЙ СОЮЗ
СЕРТИФИКАТ СООТВЕТСТВИЯ
EAC
№ ТС RU C-DE.AA87.B.00929
Серия RU № 0026353

ОРГАН ПО СЕРТИФИКАЦИИ

ИЗГОТОВИТЕЛЬ Flender Industriegetriebe GmbH, Thierbacher Strasse 24, 09322 Penig, Германия

ПРОДУКЦИЯ

КОД ТН ВЭД ТС 8483 40 210 0, 8483 40 230 9

СООТВЕТСТВУЕТ ТРЕБОВАНИЯМ ТР ТС 012/2011 «О безопасности оборудования для работы во взрывоопасных средах»

СЕРТИФИКАТ ВЫДАН НА ОСНОВАНИИ

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

СРОК ДЕЙСТВИЯ С 23.03.2018 ПО 13.03.2020 ВКЛЮЧИТЕЛЬНО

Залогин Александр Сергеевич
Киселев Андрей Евгеньевич

MA certificate


矿用产品安全标志证书
SAFETY CERTIFICATE OF APPROVAL FOR MINING PRODUCTS

© Flender GmbH 2019

General

Notes

© Flender GmbH 2019



2/2 **Notes**
2/2 Overview of types/ Gear unit designation
2/3 Orientation in space
2/4 Information about basics
2/8 Data regarding rating plate
2/9 Notes on selection and operation

© Flender GmbH 2019

Overview of types/Gear unit designation

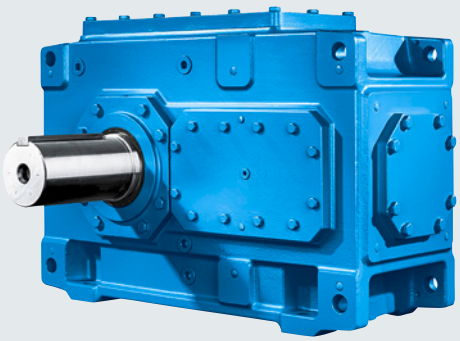
Overview

Types

Helical gear units

Types H1..., H2..., H3..., H4...

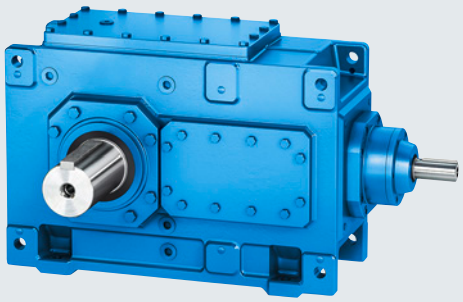
1- ... 4-stage, i_N = 1.25 ... 450



Bevel helical gear units

Types B2..., B3..., B4...

2- ... 4-stage, i_N = 5.6 ... 400



Structure of gear unit designation

Type		B	3	S	H	1	1
Type	Helical gear units	**H**					
	Bevel helical gear units	**B**					
No. of stages	1		**1**				
	2		**2**				
	3		**3**				
	4		**4**				
Design of the low speed shaft	Solid shaft with parallel key acc. to DIN 6885/1			**S**			
	Solid shaft with parallel key acc. to DIN 6885/1 with reinforced spigot			**V**			
	Solid shaft without parallel key			**C**			
	Hollow shaft with keyway acc. to DIN 6885/1			**H**			
	Hollow shaft with shrink disk			**D**			
	Hollow shaft with spline acc. to DIN 5480			**K**			
	Flanged shaft			**F**			
Mounting position	Horizontal				**H**		
	Vertical				**V**		
	Upright, low speed shaft (LSS) bottom *)				**H**		
	Upright, low speed shaft (LSS) top *)				**H**		
Gear unit size	3					**0**	**3**
	4					**0**	**4**
	5					**0**	**5**
	...						
	...						
	...						
	27					**2**	**7**
	28					**2**	**8**

Further details required in orders

- Ratio *i*
- Design of the shafts A, B, C, D, etc.

Example B3SH11A16

- 3-stage bevel helical gear unit
- Output in solid shaft design
- Horizontal mounting position
- Size 11
- Version A
- Ratio *i* = 16

*) Describe in the free text with "high speed shaft over low speed shaft" or "low speed shaft over high speed shaft" (observe oil supply and heat generation)

© Flender GmbH 2019

Overview

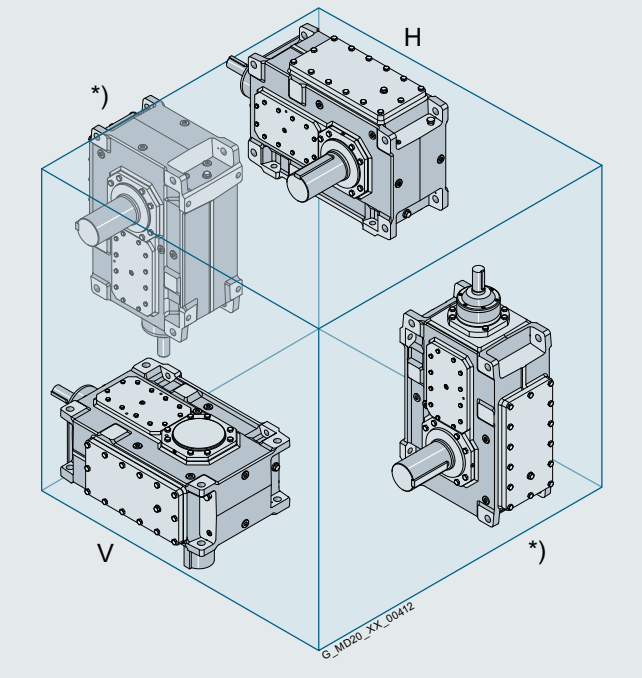
Mounting positions

Flender gear units are available for horizontal (H) and vertical (V) mounting position.

The upright mounting positions with low speed shaft at the bottom, low speed shaft at the top, and inclined or swiveling mounting positions are also possible following consultation:

* Order in the horizontal mounting position (H) and describe in the free text with "high speed shaft (HSS) over low speed shaft (LSS)" or "low speed shaft over high speed shaft" (observe oil supply and heat generation).

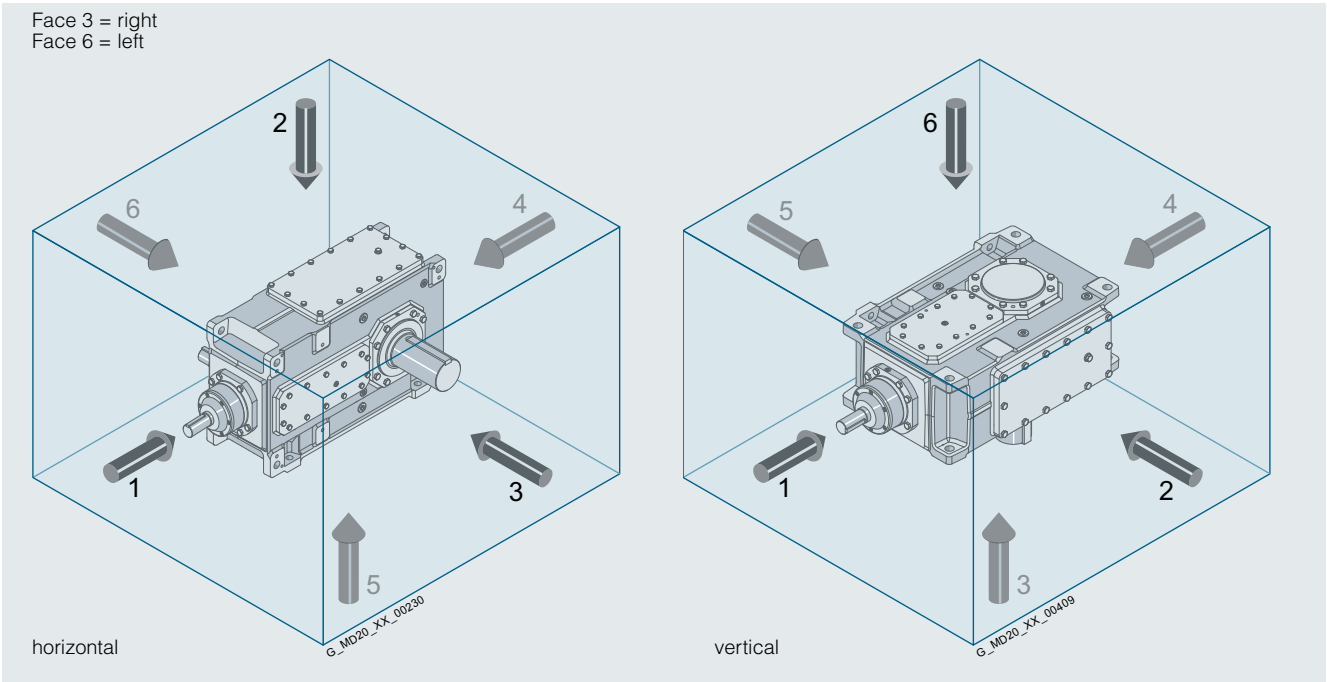
The basic gear unit can be optimally adapted to customer requirements by fitting different add-on parts such as base rail feet, housing flanges, motor lanterns, gear unit swing bases or backstops.



Designation of gear unit faces

Irrespective of the mounting position of the gear unit, the face designations "right" and "left" always refer to the horizontal mounting position with the view directed at the front of the housing for the high speed shaft (face 1). Face 2 describes the side of the housing with the mounting or inspection hole cover.

Mounting cover top (2), with the view directed at the front of the housing of the high speed shaft (1):



Standard mounting surfaces	
Mounting position	Surface
Mounting position H	Gear unit face 5
Mounting position V	Gear unit face 3

Alternative mounting surfaces to those specified above (depending on the mounting position) are available on request.

© Flender GmbH 2019

Information about basics

Overview

Technical design

Flender gear units are the most successful and widespread standard gear units in the world.

Advantages are:

- Very solid and harmonious torque grading
- Extremely high degree of flexibility thanks to ability to be set up and used in nearly all mounting positions
- Reliable system availability due to the high quality of roller bearings used
- Wide range of variants from 7 types with different solid shaft or hollow shaft output versions
- Reliable gear unit seal thanks to protection of the radial shaft seal lip due to optionally selectable dust-proof Taconite seal
- Internal cooling or standardized fan mounting, as required
- Fast availability worldwide
- Attractive price/performance ratio.

The gearing is designed according to DIN 3990/3991.
It is possible to calculate according to ISO 6336, ISO 10.300, AGMA 2003: AGMA 2001-B88; AGMA 2101-C95/D04; AGMA 6110-F97.

The shafts are calculated in accordance with DIN 743.

Roller bearings are designed in accordance with ISO 281.

Only roller bearings from certified suppliers which can meet the high quality demands over a long period of time are used.

The housings of the multi-stage gear units up to the torque ≤ 78000 Nm are laid out undivided in the monoblock design. The housings of the single stage gear units in horizontal mounting position are generally divided. All housings are extremely rugged and can be flexibly used.

The standard material for housings is lamellar graphite cast iron, which, at a minimum, satisfies the properties of EN-GJL-200. Upon request, housings made of spheroidal graphite EN-GJS-400 or welded versions can also be made available.

Application-specific drive solutions

A variety of special solutions can be serviced on the basis of Flender gear units.

A defined assortment of gear units can be built within 2 weeks using the "Fast Track" designator.

In addition, application-specific affiliate programs are available for nearly every use case, such as:

- Water screw gear units (pump application)
- Conveyor belt gear units
- Apron conveyor drives
- Scraper conveyor/scraper drives
- Bevel helical gear units for bucket elevator applications
- Gear units for crane applications/hoisting gear
- Traversing gear units
- Gear units for preparation engineering (crusher, shredder, etc.)
- Gear units for stirring and mixing processes for liquid media
- Single-screw extruder gear units
- Gear units for applications in paper production
- Sifter gear units
- Gear units for generating energy from hydro power (both water wheel drives and water turbine gear units)
- Auxiliary drives for rotary furnaces
- Gear units for cable railways
- Gear units for various pumps (both for centrifugal pumps and for oscillating pumps)

Many years of experience in the applications ensure maximum availability and efficient operation when Flender gear units are used.

Noise behavior

The noise levels of Flender gear units are well below the legal requirements.

This can be guaranteed throughout the series by the following solutions:

- Grinding the bevel gears
- Optimized gearing set
- Compact monoblock housings up to 78000 Nm for multi-stage gear units
- High contact ratios of the gearing.

Thermal behavior

Flender gear units have a favorable thermal behavior when the degree of efficiency is high.

The degree of efficiency of the gear units is directly proportional to the utilization of the gear units. Over-dimensioning leads to an increase in the amount of heat that needs to be dissipated.

Large fans with an air deflection hood that encompasses the entire housing already provide optimal heat dissipation in the basic design (costly solutions with 2 fans are not required).

The maximum oil temperature that is the basis for the gear unit selection lies within permitted ranges.

Due to the large number of factors that influence the determination of thermal capacities, a re-calculation of the exact drive application is recommended. The catalog data can only give a very limited depiction of the wide range of possibilities in regard to heat generation and dissipation. We recommend, especially for applications with low ratios or applications in which the gear unit is completely filled with oil, that the limits of the thermal capacities should not be fully utilized.

By that, the operational reliability will be increased and the maintenance overhead reduced due to longer oil change intervals.

The gear units up to and including size 22 are intended for use in an ambient temperature range of -25 °C to 40 °C. In addition, and for applications in hazardous environments (ATEX), -20° C is defined as the lower limit value. Contact Flender regarding deviating temperatures.

Stock

Flender gear units have a modular design. Through this, the variety of components could be reduced. The components are mainly on stock, enabling manufacturing plants worldwide to be delivered at short term.

© Flender GmbH 2019

Overview (continued)

Corrosion protection version

The Flender standard color RAL5015 and an assortment of preferred colors are primarily "silk-matt" and are applied using a solvent-free coating system.

The default coloring is comparable to corrosion protection category C3 "medium" according to EN ISO 12994-5.

Deviating coating systems possible on request.

The versions regarding corrosion protection according to the corrosivity categories according to EN ISO12994-5 refer to the gear unit itself in the standard program. Add-on parts such as air guides/covers/protective covers made of a sheet steel are coated with "signal yellow" powder RAL 1003. Flender confirms the suitability of powder-coated built-on components for all corrosion protection classes. An assignment of the corrosivity categories is omitted.

This powder-coating is applied independently of the color scheme ordered for the gear unit or the required layer thickness.

In the combination of electrostatic attraction between the coating powder and the part to be coated and the melting of this powder by applying heat (between 140 – 200 °C), a closed film, the Duroplast color layer, is formed.

Powder coating has the following advantages over liquid painting:

- Better corrosion protection
- Better chemical resistance
- Better surface quality, considerably more resistant to impacts, scratches and abrasions
- Can be immediately used after the surface has cooled down
- Solvent- and emission-free, therefore very environmentally friendly
- Considerably lower risk of damage to the color system during assembly processes.

This generally concerns components that must be dismantled when mounting the drive or for some other purpose. For multi-layer color structures, the risk of damage due to slings or tools is considerably higher than for the design with plastic powder.

The gears are delivered preserved.

Standard packaging

The packaging on wooden frames is included in the standard delivery kit (as far as possible). Upon request, the packaging can also be shrink-wrapped.

Optionally, deliveries can also be delivered in containers or in stackable wooden crates for container transport. Please contact Flender to find out about the additional efforts.

© Flender GmbH 2019

Overview (continued)

Interior preservation of gear units

Without additional measures, the corrosion protection for standard packaged gear units will last up to 6 months when transported and stored in a dry, draft-free and closed room without major temperature fluctuations.

The service life differs depending on the type of packaging.

Overview of the basic service life (in months) of the gear unit's interior preservation for hermetically sealed gear units:

	Transport/storage/non-operational setup under the following conditions (in months):	
Packaging/storage environment of the unit	• Air with little or no salt content and low or average humidity and • low or average air pollution acc. to EN ISO 9223 (Annex C) Corrosion category C1 or C2	• Medium or high salinity air and/or • high humidity and/or heavy air pollution acc. to EN ISO 9223 (Annex C) Corrosion category C3 or higher
No packaging or basic packaging outdoors	5	3
No packaging or basic packaging outdoors; seals taped with waterproof adhesive tape; gear units equipped with wet air filters	13	9
No packaging or basic packaging in closed, dry room	20	14
Seaworthy packaging	24	24

When labyrinth seals with a V-ring are used, the service life is halved (upper limit value 12 months).

The internal preservation of Flender gear units is dependent on the oil used and the shaft seals provided.

If the storage periods mentioned are exceeded, the anti corrosive agent in the gear unit must be renewed.

If gear units are stored outdoors, the maximum permissible storage time might be as little as 12 months depending on the packaging used.
Observe operating instructions!

Lubrication of Flender gear units

Dip lubrication

There are 2 types of dip lubrication.

1. Rotating components (toothed gears, roller bearings) are immersed in oil to the extent prescribed. Due to rotation at a high circumferential speed, all of the points of these components are immersed in oil during each rotation. The teeth generate a splashing effect. Some of the oil is also spattered onto the interior wall of the housing. An oil mist forms, which aids in the cooling, lubrication and heat dissipation during operation.

   This type of lubrication is typically found in gear units that are in a horizontal mounting position.

   If the temperatures are below the values as listed in the table on page 2/7, heating is required.

   In case of dip lubrication, the oil temperature must not drop below the pour point of the selected oil.
2. In case of dip lubrication, all parts to be lubricated are submersed in oil.

   The gear units are often inserted vertically and designed with an "oil expansion tank", to provide the space required by the change in volume of the oil due to the usual warming. This also applies to the "high speed shaft over low speed shaft" mounting position.

   If the temperatures are below the values as listed in the table on page 2/7, heating is required.

   In case of dip lubrication, the oil temperature must not drop below the pour point of the selected oil.

Forced lubrication/oil circulation lubrication

In an oil circulation lubrication system, all of the bearing points and meshing that are not located in oil are supplied with oil via a pump (motor pump, cooling/lubricating system pump or an attached flange-mounted pump).

For selection criteria, see Chapter 6.

When an oil circulation lubrication system is used, the operating viscosity must not exceed 1800 cSt.

At temperature limits below those listed in the table on page 2/7, dip lubrication or a gear unit heating system must be provided.

Combination of lubrication types

In practice, dip and forced lubrication are often provided together.

© Flender GmbH 2019

Overview (continued)

Selection of oil

The Flender gear units can be filled with oil from approved oil suppliers. The oil producer or supplier is responsible for the quality of the product. For the selection of oil grade and viscosity, the limits of application given in the table are to be taken into consideration.

A minimum operating viscosity of 25 cSt must be ensured.

	Temperature limits for oil in °C			
Viscosity ISO-VG at 40 °C in mm^2/s (cSt)	Mineral oil		PAO oil	
	Minimum	Maximum	Minimum	Maximum
Dip lubrication				
VG 220	-10	90 (briefly 100)	-30	100 (briefly 110)
VG 320	-10		-30	
VG 460	-6		-25	
Oil circulation lubrication				
VG 220	10	90 (briefly 100)	0	100 (briefly 110)
VG 320	15		10	

Depending on the environmental and operating conditions, the use of different viscosities may be possible. Please contact Flender in this regard.

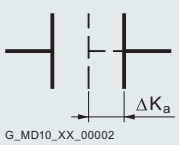
Data for other types of oils (e.g. oil suitable for foodstuffs) upon request.

Shaft misalignment

Shaft misalignment is the result of displacement during assembly and operation and, where machines constructed with two radial bearings each are rigidly coupled, will cause high loads being placed on the bearings. Elastic deformation of base frame, foundation and machine housing will lead to shaft misalignment, which cannot be prevented even by precise alignment. Furthermore, because individual components of the drive train heat up differently during operation, heat expansion of the machine housings causes shaft misalignment.

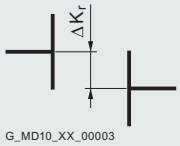
Poorly aligned drives are often the cause of seal or roller bearing failure. Alignment should be carried out by specialist personnel in accordance with the Flender operating instructions.

Depending on the direction of the effective shaft misalignment, a distinction is made between:



G_MD10_XX_00002

Axial misalignment



G_MD10_XX_00003

Radial misalignment



G_MD10_XX_00004

Angular misalignment

The shaft misalignment expected must be taken into account when the connection between the components and the low-speed or high-speed shaft is selected. Guidelines and limits for compensation of shaft misalignment can be obtained from the respective manufacturer.

© Flender GmbH 2019

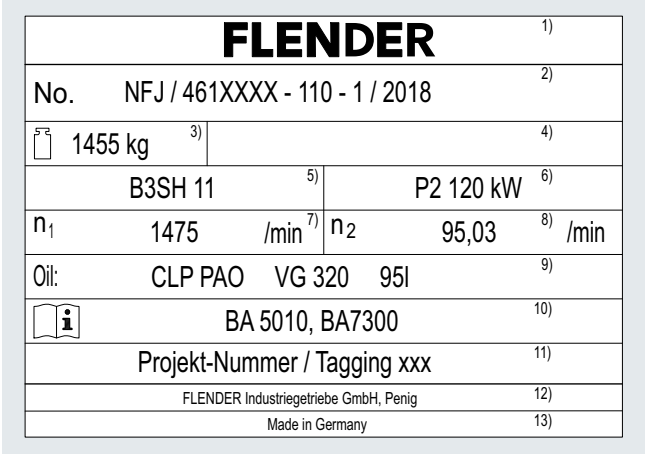
Overview (continued)

Maintenance

Compliance with the conditions for operation and installation is essential. To prevent damage to the gear unit or failure of the drive, regular inspection and maintenance must be performed as specified in the operating instructions.

Rating plate

The rating plate of the gear unit contains the most important technical specifications of the gear unit:



① Company logo
② Production no.: Production site code/
Order no. position serial no./year of manufacture
③ Total weight in kg
④ Special information 1 (for special information)
⑤ Type, size
⑥ Driven machine output power rating P2 in kW or torque T2 in Nm
⑦ High speed n_1
⑧ Slow speed n_2
⑨ Oil data: oil grade, oil viscosity, amount of oil
⑩ Numbers of the operating instructions
⑪ Special information 2
(entry of ATEX details; for special information)
⑫ Manufacturer and production site
⑬ Country of origin

This data and the agreements agreed contractually between Flender and the ordering party for the gear unit specify the limits for its proper use.

This label is designed as "printed" plastic label.

© Flender GmbH 2019

Overview

Overview

- Illustrations are examples only and are not strictly binding
- Dimensions are subject to change
- The weights are mean values and not strictly binding
- To prevent accidents, all rotating parts should be guarded
- Local and national safety regulations of the respective country must be observed
- Prior to commissioning, the operating instructions must be observed
- The gear units are delivered ready for operation but without oil filling
- Oil quantities given are recommended values only. The exact quantity of oil depends on the marks on the oil dipstick
- The oil viscosity has to correspond to the data given on the rating plate
- Approved lubricants only may be used. You will find current operating instructions and lubricant tables on the Internet at: http://support.automation.siemens.com/WW/view/en/44231658
- The gear units are supplied with radial shaft seals. For other sealing variants see Chapter 10
- The data regarding the direction of rotation refers to the low-speed shaft (output shaft d_2)
- The gear units are laid out by default for operating with 4-pole motors at 50 or 60 Hz
- The gear units are suitable for transmission in both low speed and high speed
- In case of outdoor installation, insulation is to be avoided. The customer has to provide adequate protection
  - Foundation bolts of minimum strength class 8.8
  - Tolerance of the fixing holes in the housing acc. to EN 20273 – "coarse" series.

Torque specifications in the catalog

- The nominal output torques specified in the catalog can be permanently transferred if the load direction is constant. The data applies to the drive speeds in the tables
- Since, as a rule, the actual motor speed can deviate from those in the tables and the usage and operating conditions also may not correspond to the laboratory conditions, a recalculation using the CFG calculating program and the actual operating data is recommended. When the gear units are well utilized (as a rule, in the range between 60 and 80% of the nominal output torque), the permitted load data lies above the values specified in the tables.

Symbols on the gear unit and in the dimensional drawing

The following symbols, some of which are color-highlighted, are provided for the gear unit:

Earth connection point		
Air relief point		Yellow
Oil filling point		Yellow
Oil draining point		White
Oil level indicator		Red
Oil level measurement		Red
Vibration monitoring connection point		
Lubrication point		Red
Apply grease		
Lifting eye		
Eyebolt		
Do not unscrew		
Alignment surface, horizontal		
Alignment surface, vertical		

© Flender GmbH 2019

Notes

© Flender GmbH 2019



3/2 **Determining the drive data – Checklist**

Guidelines for selection
3/3 Constant mechanical power rating
3/5 Variable power rating
3/6 Selection aid for low speed shaft (LSS)
3/7 Explanation of designations
3/8 Calculation example
3/10 Service factors
3/13 Designs for crane applications

Overview tables
3/14 Type H1
3/20 Type H2
3/28 Type H3
3/36 Type H4
3/42 Type B2
3/48 Type B3
3/62 Type B4
3/68 Types H1, H2, H3, H4 Mass moments of inertia J_1
3/72 Types B2, B3, B4 Mass moments of inertia J_1
3/74 Types H1, H2, H3, H4 Actual ratios
3/77 Types B2, B3, B4 Actual ratios

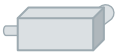
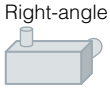
© Flender GmbH 2019

Design of the gear units
Standardized helical and bevel helical gear units

Determining the drive data – Checklist

General

Basic version and load data

Gear unit type: ☐ Helical gear units H  ☐ Bevel helical gear units B  ☐ Right-angle gear units W  ☐ Gear units with auxiliary drive

Quantity: _____ Unit

Motor power: _____ kW

Motor speed: _____ rpm

Power at low speed shaft (LSS): _____ kW

Speed at low speed shaft (LSS): _____ rpm

Service factor: _____

Circuits, peak loads/hour: _____ c/h ☐ Fluctuating direction of load

Line frequency: ☐ 50 Hz ☐ 60 Hz ☐ For converter operation ☐ Min./max. frequency _____ Hz

Torque at low speed shaft (LSS): _____ Nm

Max. peak torque: _____ Nm

Permissible ratio: _____ %

Required bearing lifetime $L_{10\,mh}$: _____ Hours

Max. permissible oil temperature: _____ °C

Ambient conditions

Installation altitude: _____ m

Air humidity: _____ %

Temperature: from _____ to _____ °C

☐ Outdoor operation
☐ Operation in large halls
☐ Operation in small rooms

Brief description of the system: (e.g. industry, conveyor system, etc.)

Gear unit

Mounting and mounting position

Mounting position:
☐ Horizontal H__H 
☐ Vertical H__V 
☐ B__H 
☐ B__V 

High speed shaft over low speed shaft
☐ H__H  ☐ B__H 

Low speed shaft over high speed shaft *)
☐ H__H  ☐ B__H 

*) Only shaft-mounted design

Mounting type:
☐ Foot-mounted design
☐ With motor lantern for IEC motors
☐ With HSS coupling
☐ With LSS coupling
☐ Shaft-mounted design
☐ Hydraulic coupling
☐ ☐ Flexible coupling
☐ ☐ Torsionally rigid coupling
☐ Wall mounting
☐ Housing flange, short, mounting flange - short spacer
☐ Housing flange, long, mounting flange - long spacer
☐ On housing side _____
☐ With gear unit swing base
☐ With base frame
☐ With torque reaction arm
☐ With trestle

Motor type: _____

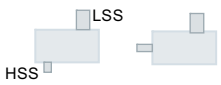
Shafts

Design of the low speed shafts:
☐ Solid shaft with parallel key S
☐ Solid shaft C for flange coupling with cylindrical drilled hole and zero-backlash conical clamping connection (without keyway)
☐ Flanged shaft F
☐ Flange coupling with cylindrical drilled hole and zero-backlash conical clamping connection for solid shaft C
☐ Hollow shaft with keyway H
☐ Hollow shaft with shrink disk D
☐ Hollow shaft with spline K

Special dimensions of high speed shaft: $(d_1 \times l_1)$ _____ × _____ mm Tol. _____ Shaft shoulder distance: (G_1) _____ mm

Special dimensions of low speed shaft: $(d_2 \times l_2)$ _____ × _____ mm Tol. _____ Shaft shoulder distance: $(G_2/G_4/G_5)$ _____ mm

Shaft arrangements: ☐ High speed shaft (HSS) on both sides ☐ Low speed shaft (LSS) on both sides

Example: 

Other options: (e.g. axial/radial forces)

General options

Surface treatment

Surface protection in accordance with ISO 12944-2 (m): ☐ C2 ☐ C3 ☐ C4 ☐ C5 ☐ Primer coat (C1) ☐ RAL 5015 ☐ RAL _____

Other options

Auxiliary cooling: ☐ Fan ☐ Cooling coil; cooling water input temperature _____ °C ☐ Cooling unit ☐ Oil/air ☐ Oil/water ☐ Heating, with temperature monitoring U = _____ V, _____ Hz, IP _____

Direction of rotation of low speed shaft: ☐ Clockwise ☐ Counterclockwise ☐ Backstop

ATEX

ATEX application?

☐ Yes ☐ No

If yes, please fill in ATEX checklist

© Flender GmbH 2019

Overview

1. Determination of gear unit type and size

1.1 Determination of the ratio

$$i_s = \frac{n_1}{n_2}$$

1.2 Determination of the nominal power rating of the gear unit

$$P_{2N} \geq P_2 \times f_1 \times f_2$$

It is not necessary to consult us, if:

$$3.33 \times P_2 \geq P_{2N}$$

1.3 Check for maximum torque
e.g.: Peak operating, starting torque or torque of a brake

$$P_{2N} \geq \frac{T_A \times n_1}{9550} \times f_3$$

Gear unit sizes and number of stages are given in rating tables depending on i_N and P_{2N}.

1.4 Check of whether additional forces on the low speed shaft (LSS) are permissible; it is essential to consult Flender!

1.5 Check whether the actual ratio i is suitable,
see pages 3/74 to 3/79.

2. Determination of oil supply:

Horizontal mounting position (H)

- Dip lubrication
  (all parts to be lubricated are immersed in the oil or are splash lubricated)
- Oil circulation lubrication by means of flange-mounted pump (type H1 only)

Vertical mounting position (V)

- Dip lubrication with oil expansion tank
- Forced lubrication on request

Upright mounting positions

- Dip lubrication with oil expansion tank
- Forced lubrication on request

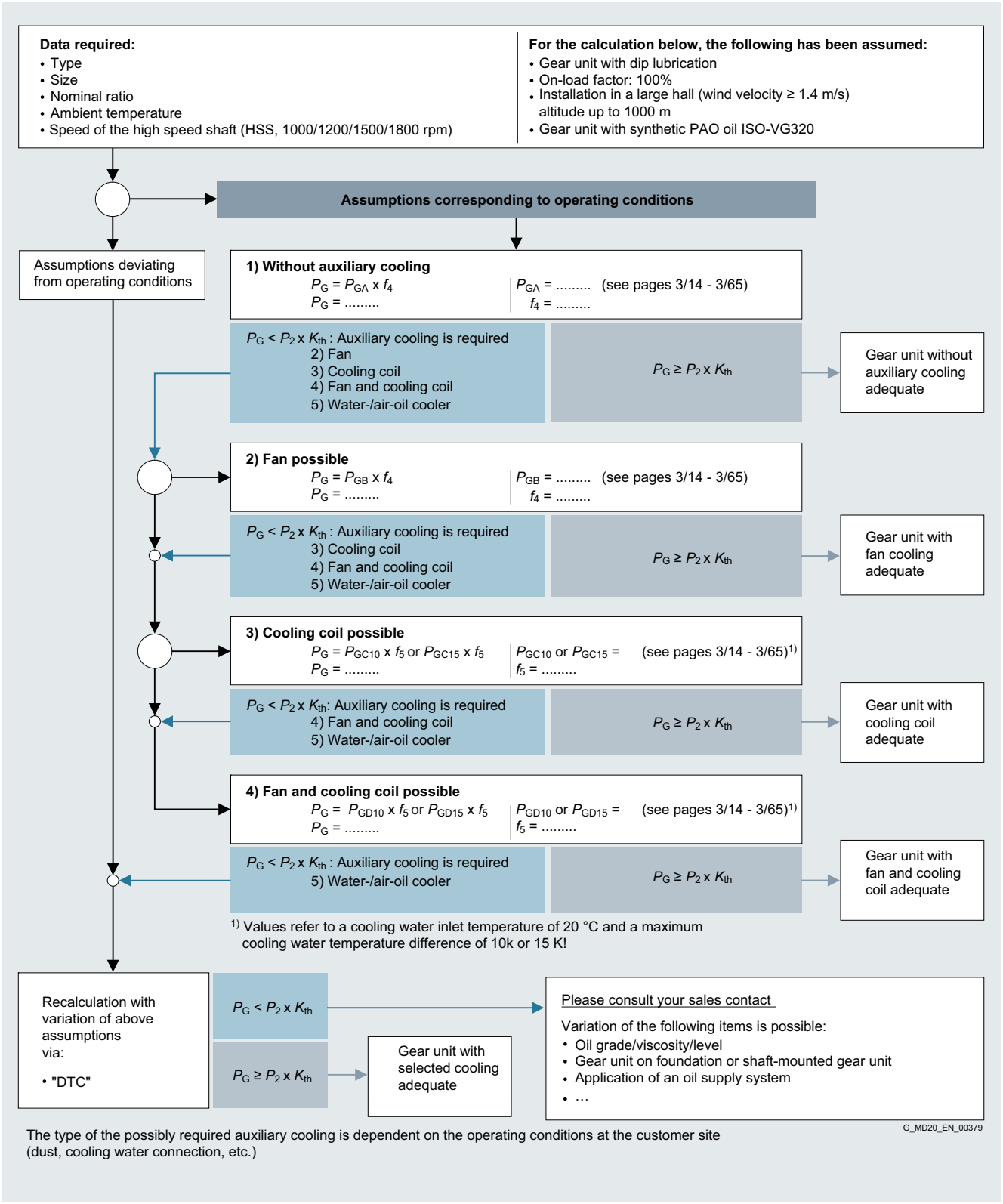
3. Thermal factor K_{th}

Depending on the application, it is not the gear unit nominal power rating that is used for determining the required size of the gear unit on the basis of the thermal capacity, but a lesser rated output based on the typical load curves. This is taken into account via the thermal factor K_{th}. See page 3/11.

© Flender GmbH 2019

Overview (continued)

3. Determination of required thermal capacity P_G



The type of the possibly required auxiliary cooling is dependent on the operating conditions at the customer site (dust, cooling water connection, etc.)

© Flender GmbH 2019

Overview

For driven machines with constant speeds and variable power ratings the gear unit can be designed according to the equivalent power rating. For this, a working cycle where phases I, II...n require power P_I, P_{II} ... P_n and the respective power ratings operate for percental time fractions X_I, X_{II}...X_n is taken as a basis. The equivalent power rating can be calculated from these specifications with the following formula:

$$P_{2eq} = \sqrt[6.6]{P_I^{6.6} \times \frac{X_I}{100} + P_{II}^{6.6} \times \frac{X_{II}}{100} + \ldots P_n^{6.6} \times \frac{X_n}{100}}$$

The size of the gear unit can then be determined analogously to points 1.1 ... 1.5 and 3.

The following applies:

$$P_{2N} \geq P_{2eq} \times f_1 \times f_2$$

Then, when P_{2N} has been determined, the power and time fractions must be checked by applying the following requirements.

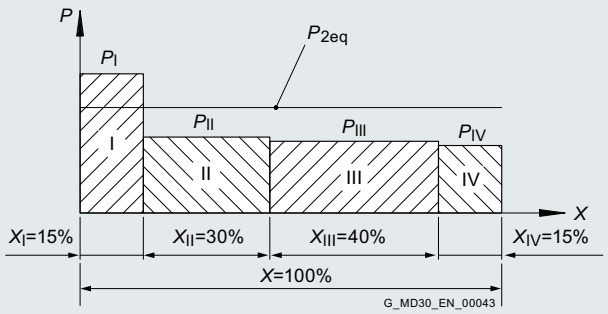
- The individual power fractions P_I, P_{II} ... P_n must be greater than 0.4 x P_{2N}.
- The individual power fractions P_I, P_{II} ... P_n must not exceed 1.4 x P_{2N}.
- For the power fractions P_I, P_{II} ... P_n that are greater than P_{2N}, the total of the time fractions X_I, X_{II} ... X_n must be a maximum of 10%.

If any one of these three requirements is not met, P_{2eq} must be recalculated.

Basically it has to be considered that a brief peak power rating not included in the calculation of P_{2eq} must not be greater than P_{max} = 2 x P_{2N}.

In applications where the torque is variable but the speed constant, the gear unit can be designed on the basis of the so-called equivalent torque.

Example: Service classification



Finite-life design

A gear unit design which is finite-life fatigue-resistant can be sufficient for certain applications. This includes such things as sporadic use (lock gate drives) or low speeds of the low speed shaft (LSS, n_2 <4 rpm).

In such case, consultation with Flender is required.

© Flender GmbH 2019

Selection aid for low speed shaft (LSS)

Overview

Low speed shaft (LSS)

The low speed shaft can be connected to the customer's machine in various different ways. A positively-driven or a friction-locked connection can be used. The following factors are important in selecting a suitable connection:

1. Operating mode and application

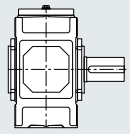
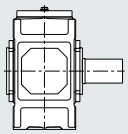
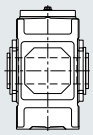
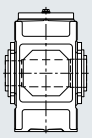
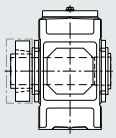
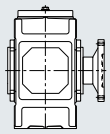
2. Ambient conditions

3. Requirements in terms of installation and detachability of the connection

4. General drive arrangement:

- Mounted on machine shaft (shaft mounted)
- Mounted on feet
  - Permanently
  - On foundation or
  - Metal substructure (base frame, base plate, etc.)
- Mounting on side of gear unit housing
  - Wall mounting, permanent
  - Flange mounting, permanent

The following overview is intended as a guide to assist with the selection of a suitable LSS:

						
Type	Solid shaft with parallel key (S/V)	Solid shaft without parallel key (C)	Hollow shaft with keyway according to DIN 6885/1 (H)	Hollow shaft with spline in acc. with DIN 5480 (K)	Hollow shaft with shrink disk (D)	Flanged shaft (F)
Characteristic	• Additional coupling element required • Machine shaft manufacture is moderately difficult • Positively-driven connection	• Additional coupling element required • Machine shaft manufacture is moderately difficult • Friction-locked connection	• No additional coupling element required • Machine shaft manufacture is moderately difficult • Positively-driven connection	• No additional coupling element required • Machine shaft manufacture is complex • Positively-driven connection	• No additional coupling element required • Machine shaft manufacture is simple • Friction-locked connection	• Additional coupling element required • Machine shaft manufacture is moderately difficult to complex • Friction-locked connection
Drive mounted directly on machine shaft with torque reaction arm	–	++	+++	+++	++	++
Drive mounted on foundation	+++	+	++	++	+	+
Drive mounted on machine flange	++	–	++	+++	–	–
Short overall length	+	+	+++	+++	++	++
Small installation space	++	+++	+	+	+	+++
Highly corrosive environment (C5)	++	++	+	+	++	+++
Easy to detach	++	+	+	++	+	+
Less complex connection including connecting element and machine shaft	+++	++	+++	+	++	+++
Intermittent operation, non-periodic and periodic operation (S3-S9)	+	+++	+	++	+++	++

– Not suitable
\+ possible
++ highly suitable
+++ extremely suitable

© Flender GmbH 2019

Overview

Explanation of designations

Designation	Explanation	Chapter/page
E_D	ON period per hour in % (e.g. ON period = 80% per hour)	
f_1	Factor for driven machine	3/10
f_2	Factor for prime mover	3/12
f_3	Peak torque factor	3/12
f_4	Thermal factor	3/12
f_5	Thermal factor	3/12
f_6	Altitude factor	3/12
f_7	Altitude factor	3/12
i	Actual ratio	3/74, 3/77
i_N	Nominal ratio	
i_s	Required ratio	
K_{th}	Thermal factor	
n_1	Speed of the high speed shaft (HSS, rpm)	
n_2	Speed of the low speed shaft (LSS, rpm)	
P_G	Required thermal capacity	3/4
P_{GA}	Thermal capacity for gear units without auxiliary cooling	
P_{GB}	Thermal capacity for gear units with fan cooling	
P_{GC}	Thermal capacity for gear units with built-in cooling coil	
P_{GC10}	Thermal capacity for gear units with built-in cooling coil, limitation of cooling water temperature difference to 10 K	
P_{GC15}	Thermal capacity for gear units with built-in cooling coil, limitation of cooling water temperature difference to 15 K	
P_{GD}	Thermal capacity for gear units with built-in cooling coil and fan	
P_{GD10}	Thermal capacity for gear units with built-in cooling coil and fan, limitation of cooling water temperature difference to 10 K	
P_{GD15}	Thermal capacity for gear units with built-in cooling coil and fan, limitation of cooling water temperature difference to 15 K	
P_{2N}	Nominal power rating of gear unit (kW), see rating tables	
P_2	Power of driven machine (kW)	
t	Ambient temperature (°C)	
T_A	Max. torque occurring on high speed shaft (HSS), e.g.: Peak operating, starting or braking torque (Nm)	
T_{2N}	Nominal output torque on the low speed shaft (LSS, kNm)	
T_{2max}	Max. permissible torque of low speed shaft (LSS, kNm)	
T_M	Nominal motor torque (Nm)	
T_{MA}	Motor starting torque (Nm)	
T_{MK}	Motor pull-out torque (Nm)	
P_{2eq}	Equivalent power rating (kW)	
P_I, P_{II}, P_n	Fractions of power (kW) from load spectrum	
X_I, X_{II}, X_n	Fractions of time (%) load spectrum	

Notes and legend for tables of thermal capacities

*	On request
P_{GA} (kW)	Gear unit without auxiliary cooling
P_{GB} (kW)	Gear unit with fan cooling
The values are applicable for:	Operation cycle 100% Installation in large hall Altitude 0 m

P_{GC10} / P_{GC15} (kW)	Gear unit with built-in cooling coil
P_{GD10} / P_{GD15} (kW)	Gear unit with fan and built-in cooling coil
The values are applicable for:	Operation cycle 100% Installation in large hall Altitude 0 m Cooling water inlet temperature of 20 °C with limiting of the cooling water temperature difference to 10 or 15 K

© Flender GmbH 2019

Calculation example

Overview

Known criteria for the calculation example

Prime mover

- Electric motor: P_1 = 75 kW
- Motor speed: n_1 = 1500 rpm
- Max. starting torque: T_A = 720 Nm

Driven machine

- Belt conveyor: P_2 = 71 kW
- Speed: n_2 = 26 rpm
- Duty: 12 h/day
- Starts per hour: 7
- ON period per hour: E_D = 100%
- Ambient temperature: 40 °C
- Installation in a large hall: Wind velocity ≥ 1.4 m/s
- Altitude: Sea level

Gear unit design

- Bevel helical gear units
- Mounting position: horizontal
- Low speed shaft (LSS): on the right, version C, solid shaft
- Direction of rotation of low speed shaft (LSS): counter-clockwise

Required

- Type of gear unit
- Gear unit size

1. Determination of gear unit type and gear unit size

1.1 Determination of the ratio

$$i_s = \frac{n_1}{n_2} = \frac{1500}{26} = 57.7 \qquad i_N = 56$$

1.2 Determination of the nominal power rating of the gear unit

$$P_{2N} \geq P_2 \times f_1 \times f_2 = 71 \times 1.3 \times 1 = 92.3 \text{ kW}$$

Selected from power rating table type B3SH, gear unit size 9 with P_{2N} = 100 kW.

$$3.33 \times P_2 \geq P_{2N} \qquad 3.33 \times 71 = 236.4 \text{ kW} > P_{2N}$$

It is not necessary to consult us

1.3 Check the starting torque

$$P_{2N} \geq \frac{T_A \times n_1}{9550} \times f_3 = \frac{720 \times 1500}{9550} \times 0.65 = 73.5 \text{ kW}$$

$$P_{2N} = 100 \text{ kW} > 73.5 \text{ kW}$$

2. Determination of oil supply

Gear unit with dip lubrication

© Flender GmbH 2019

Overview (continued)

3. Determination of required thermal capacity P_G

Data required:
- Type: B3SH
- Size: 9
- Nominal ratio: i_N = 56
- Ambient temperature: t = 40 °C
- Speed of the high speed shaft (HSS, n_1 = 1500 rpm)

For the calculation below, the following has been assumed:
- Gear unit with dip lubrication
- On-load factor: 100%
- Installation in a large hall (wind velocity ≥ 1.4 m/s) altitude up to 1000 m
- Gear unit with synthetic PAO oil ISO-VG320
- K_{th} = 0.85

Assumptions corresponding to operating conditions

Assumptions deviating from operating conditions

1) Without auxiliary cooling
$P_G = P_{GA} \times f_4$
P_G = 59.4 kW
P_{GA} = 79.2 kW (see page 3/56)
f_4 = 0.75

$P_G < P_2 \times K_{th}$: Auxiliary cooling is required
2) Fan
3) Cooling coil
4) Fan and cooling coil
5) Water-/air-oil cooler

→ Gear unit with auxiliary cooling required

2) Fan possible
$P_G = P_{GB} \times f_4$
P_G = 127 kW
P_{GB} = 169 kW (see page 3/56)
f_4 = 0.75

$P_G < P_2 \times K_{th}$: Auxiliary cooling is required
3) Cooling coil
4) Fan and cooling coil
5) Water-/air-oil cooler

$P_G \geq P_2 \times K_{th}$ → Gear unit with fan cooling adequate

3) Cooling coil possible
$P_G = P_{GC15} \times f_5$
$P_G \leq$ 195 kW
P_{GC15} = 224 kW (see page 3/56)[1)]
f_5 = 0.87

$P_G < P_2 \times K_{th}$: Auxiliary cooling is required
4) Fan and cooling coil
5) Water-/air-oil cooler

$P_G \geq P_2 \times K_{th}$ → Gear unit with cooling coil adequate

4) Fan and cooling coil possible
$P_G = P_{GD15} \times f_5$
$P_G \leq$ 264 kW
P_{GD15} = 303 kW (see page 3/56)[1)]
f_5 = 0.87

$P_G < P_2 \times K_{th}$: Auxiliary cooling is required
5) Water-/air-oil cooler

$P_G \geq P_2 \times K_{th}$ → Gear unit with fan and cooling coil adequate

[1)] Values refer to a cooling water inlet temperature of 20 °C and a maximum cooling water temperature difference of 15K!

Recalculation with variation of above assumptions via:
- "DTC"

$P_G < P_2 \times K_{th}$ → Please consult your sales contact

Variation of the following items is possible:
- Oil grade/viscosity/level
- Gear unit on foundation or shaft-mounted gear unit
- Application of an oil supply system
- …

$P_G \geq P_2 \times K_{th}$ → Gear unit with selected cooling adequate

G_MD20_EN_00380

The selected gear unit B3SH9 with i_N = 56 must be equipped with suitable auxiliary cooling.
Depending on the operating conditions at the customer site, a fan or cooling coil must be fitted.

© Flender GmbH 2019

Service factors

Overview

Driven machine factor f_1

Driven machines	Effective operating period under load in hours		
	≤ 0.5	> 0.5 - 10	> 10
Waste water			
• Thickeners (central drive)	–	–	1.2
• Filter presses	1.0	1.3	1.5
• Flocculation apparatus	0.8	1.0	1.3
• Aerators	–	1.8	2.0
• Raking equipment	1.0	1.2	1.3
• Combined longitudinal and rotary rakes	1.0	1.3	1.5
• Pre-thickeners	–	1.1	1.3
• Water screw pumps	–	1.3	1.5
• Water turbines	–	–	2.0
Pumps			
• Centrifugal pumps	1.0	1.2	1.3
• Displacement pumps			
- 1 piston	1.3	1.4	1.8
- > 1 piston	1.2	1.4	1.5
Excavators			
• Bucket conveyors	–	1.6	1.6
• Dumping devices	–	1.3	1.5
• Caterpillars	1.2	1.6	1.8
Bucket wheels			
- as pick-up	–	1.7	1.7
- for primitive material	–	2.2	2.2
• Cutter heads	–	2.2	2.2
• Swing gears [1]	–	1.4	1.8
Plate bending machines [1]	–	1.0	1.0
Chemical industry			
• Extruders	–	–	1.6
• Dough mills	–	1.8	1.8
• Rubber calenders	–	1.5	1.5
• Cooling drums	–	1.3	1.4
Mixers for			
- uniform media	1.0	1.3	1.4
- non-uniform media	1.4	1.6	1.7
Agitators for/media with			
- uniform density	1.0	1.3	1.5
- non-uniform density	1.2	1.4	1.6
- non-uniform gas absorption	1.4	1.6	1.8
• Toasters	1.0	1.3	1.5
• Centrifuges	1.0	1.2	1.3
Metal working mills			
• Plate tilters	1.0	1.0	1.2
• Ingot pushers	1.0	1.2	1.2
• Winding machines	–	1.6	1.6
• Cooling bed transfer frames	–	1.5	1.5
• Roller straighteners	–	1.6	1.6
Roller tables			
- continuous	–	1.5	1.5
- intermittent	–	2.0	2.0
• Reversing tube mills	–	1.8	1.8
Shears			
- Continuous cut [1]	–	1.5	1.5
- Crank type [1]	1.0	1.0	1.0
• Continuous casting drivers [1]	–	1.4	1.4
Rolls			
- Reversing blooming mills	–	2.5	2.5
- Reversing slabbing mills	–	2.5	2.5
- Reversing wire mills	–	1.8	1.8
- Reversing sheet mills	–	2.0	2.0
- Reversing plate mills	–	1.8	1.8
• Roll adjustment drives	0.9	1.0	–
Conveyor systems			
• Bucket conveyors	–	1.4	1.5
• Hauling winches	1.4	1.6	1.6
• Conveyor systems	–	1.5	1.8
• Belt conveyors ≤ 150 kW	1.0	1.2	1.3
• Belt conveyors ≥ 150 kW	1.1	1.3	1.4
• Goods elevators [1]	–	1.2	1.5
• Passenger elevators [1]	–	1.5	1.8
• Apron conveyors	–	1.2	1.5
• Escalators	1.0	1.2	1.4
• Railway vehicles	–	1.5	–
Piston compressors	–	1.8	1.9
Crane systems [2]			
• Slewing gears [1]	See designs for crane applications, page 3/13.		
• Luffing gears			
• Traveling gears			
• Hoisting gears			
• Derricking jib cranes			
Cooling towers			
• Cooling tower fans	On request		
• Blowers (axial and radial)	–	1.4	1.5
Food industry			
Cane sugar production			
• Cane knives [1]	–	–	1.7
• Cane mill	–	–	1.7
Beet sugar production			
• Beet cossettes macerators	–	–	1.2
• Extraction plants, mechanical refrigerators, juice boilers	–	–	1.4
• Sugar beet washing machines, sugar beet cutters	–	–	1.5
Paper machines			
• all types [3]	–	1.8	2.0
• Pulper drives (on request)			
Centrifugal compressors	–	1.4	1.5
Cable railways			
• Material ropeways	–	1.3	1.4
• To-and-fro system aerial ropeways	–	1.6	1.8
• T-bar lifts	–	1.3	1.4
• Continuous ropeways	–	1.4	1.6
Cement industry			
• Concrete mixers	–	1.5	1.5
• Breakers [1]	–	1.2	1.4
• Rotary furnaces	–	–	2.0
• Tube mills	–	–	2.0
• Separators	–	1.6	1.6
• Roll crushers	–	–	2.0

Design for driven machine output P_2

[1] Designed power corresponding to max. torque

[2] Load can be exactly classified, for instance, according to FEM 1001

[3] A check for thermal capacity is absolutely essential

Note: The listed load parameters are empirical values. Prerequisite for their application is that the machinery and equipment mentioned correspond to generally accepted design and load specifications. In case of deviations from standard conditions, please contact us. For driven machines which are not listed in this table, please refer to us.

© Flender GmbH 2019

Overview (continued)

Thermal factor K_{th}

Driven machines	K_{th}
Waste water	
• Thickeners (central drive)	1
• Filter presses	0.85
• Flocculation apparatus	0.85
• Aerators	1
• Raking equipment	0.85
• Combined longitudinal and rotary rakes	0.85
• Pre-thickeners	0.85
• Water screw pumps	0.85
• Water turbines	0.85
Pumps	
• Centrifugal pumps	1
• Displacement pumps	
- 1 piston	1
- > 1 piston	1
Excavators	
• Bucket conveyors	0.85
• Dumping devices	0.85
• Caterpillars	0.85
Bucket wheels	
- as pick-up	0.85
- for primitive material	0.85
• Cutter heads	0.85
• Swing gears [1]	0.85
Plate bending machines [1]	0.85
Chemical industry	
• Extruders	0.9
• Dough mills	0.85
• Rubber calenders	0.85
• Cooling drums	0.85
Mixers for	
- uniform media	0.85
- non-uniform media	0.85
Agitators for/media with	
- uniform density	0.85
- non-uniform density	0.85
- non-uniform gas absorption	0.85
• Toasters	0.85
• Centrifuges	0.85
Metal working mills	
• Plate tilters	0.85
• Ingot pushers	0.85
• Winding machines	0.85
• Cooling bed transfer frames	0.85
• Roller straighteners	0.85
Roller tables	
- continuous	0.85
- intermittent	0.85
• Reversing tube mills	0.85
Shears	
- Continuous cut [1]	0.85
- Crank type [1]	0.85
• Continuous casting drivers [1]	0.85
Rolls	
- Reversing blooming mills	0.85
- Reversing slabbing mills	0.85
- Reversing wire mills	0.85
- Reversing sheet mills	0.85
- Reversing plate mills	0.85
• Roll adjustment drives	0.85

Driven machines	K_{th}
Conveyor systems	
• Bucket conveyors	0.85
• Hauling winches	0.85
• Conveyor systems	0.85
• Belt conveyors ≤ 150 kW	0.9
• Belt conveyors ≥ 150 kW	0.9
• Goods elevators [1]	0.85
• Passenger elevators [1]	0.85
• Apron conveyors	0.85
• Escalators	0.85
• Railway vehicles	0.85
Piston compressors	1
Crane systems [2]	
• Slewing gears [1]	0.85
• Luffing gears	0.85
• Traveling gears	0.85
• Hoisting gears	0.85
• Derricking jib cranes	0.85
Cooling towers	
• Cooling tower fans	1
• Blowers (axial and radial)	1
Food industry	
Cane sugar production	
• Cane knives [1]	0.85
• Cane mill	0.85
Beet sugar production	
• Beet cossettes macerators	0.85
• Extraction plants, mechanical refrigerators, juice boilers	0.85
• Sugar beet washing machines, sugar beet cutters	0.85
Paper machines	
• all types [3]	1
• Pulper drives (on request)	0.85
Centrifugal compressors	1
Cable railways	
• Material ropeways	0.85
• To-and-fro system aerial ropeways	0.85
• T-bar lifts	0.85
• Continuous ropeways	0.85
Cement industry	
• Concrete mixers	0.85
• Breakers [1]	0.9
• Rotary furnaces	0.85
• Tube mills	0.85
• Separators	0.85
• Roll crushers	0.85
Further applications	*)

Exceptions	K_{th}
Hazardous environment (ATEX)	1
Installation deviating from horizontal mounting position	1
H1 and B2 gear units	1

Note: The listed load parameters are empirical values. Prerequisite for their application is that the machinery and equipment mentioned correspond to generally accepted design and load specifications. In case of deviations from standard conditions, please contact us. For driven machines which are not listed in this table, please refer to us.

*) To be evaluated individually, consultation required (0.85 ... 1).

Design for driven machine output P_2

1) Designed power corresponding to max. torque

2) Load can be exactly classified, for instance, according to FEM 1001

3) A check for thermal capacity is absolutely essential

© Flender GmbH 2019

Overview (continued)

Prime mover factor f_2

	Prime mover factor f_2
Electric motors, hydraulic motors, turbines	1.0
Piston-driven machines 4 - 6 cylinders, degree of uniformity 1 : 100 to 1: 200	1.25
Piston-driven machines 1 - 3 cylinders, degree of uniformity 1 : 100	1.5

Peak torque factor f_3

	Peak torque factor f_3			
	Load peaks per hour			
	1 - 5	6 - 30	31 - 100	> 100
Steady direction of load	0.5	0.65	0.7	0.85
Alternating direction of load	0.7	0.95	1.10	1.25

Thermal factor f_4

(Gear units without auxiliary cooling or with fan)

	Ambient temperature								
	10 °C	15 °C	20 °C	25 °C	30 °C	35 °C	40 °C	45 °C	50 °C
f_4 for PAO oil filling	1.11	1.06	1.00	0.94	0.88	0.82	0.75	0.69	0.63
f_4 for gear units filled with mineral oil	0.78	0.74	0.70	0.66	0.62	0.57	0.53	0.48	0.44

Thermal factor f_5

(For cooling with cooling coil, or with fan and cooling coil)

	Ambient temperature								
	10 °C	15 °C	20 °C	25 °C	30 °C	35 °C	40 °C	45 °C	50 °C
f_5 for PAO oil filling	1.05	1.03	1.00	0.97	0.93	0.90	0.87	0.84	0.81
f_5 for gear units filled with mineral oil	0.81	0.79	0.77	0.75	0.72	0.69	0.67	0.65	0.62

Altitude factor f_6

(Gear units without auxiliary cooling or with fan)

	Altitude (meters above sea level)				
	Up to 1000	Up to 2000	Up to 3000	Up to 4000	Up to 5000
Altitude factor f_6	1.00	0.95	0.90	0.85	0.80

Altitude factor f_7

(For cooling with cooling coil, or with fan and cooling coil)

	Altitude (meters above sea level)				
	Up to 1000	Up to 2000	Up to 3000	Up to 4000	Up to 5000
Altitude factor f_7	1.00	0.98	0.96	0.94	0.92

© Flender GmbH 2019

Overview

The Flender gear units are an economical solution for industrial and indoor cranes. The options often required for crane applications, such as high speed and/or low speed shafts on both sides, are available in the standard portfolio.

Service factors for crane systems

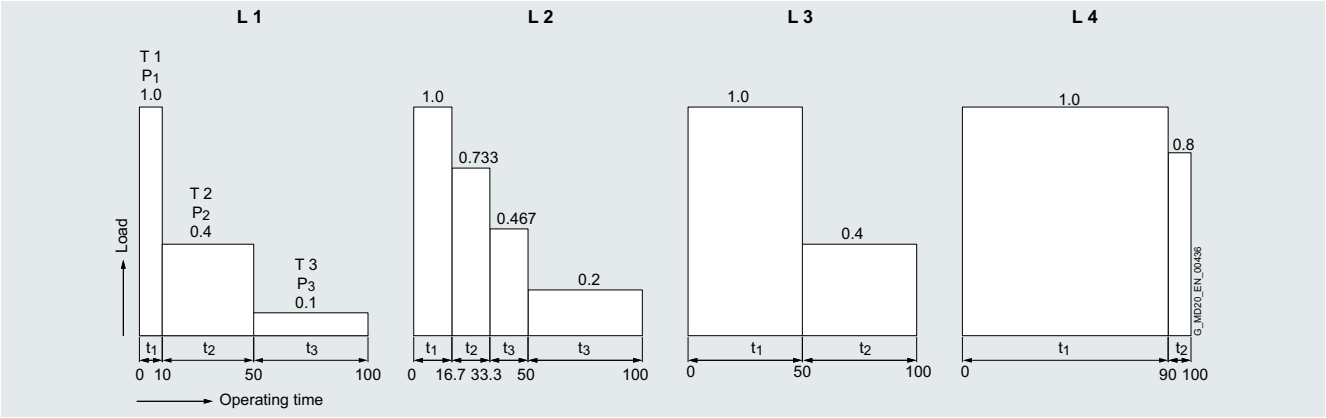
For the use of gear units with variable loads – such as those generally present in crane systems – an FEM classification is recommended. The driven machine factor f_1 and the peak torque factor f_3 corresponding to the mechanism group M1 to M8 – depending on the load (collective classes L1 to L4) and the duration of operation (operating classes T0 to T9) can be found in the tables below.

Regardless of the table values, a recalculation provides the basis for Flender for the right solution, because in many cases significantly smaller dimensioning is possible.

The cubic mean value K for the consideration of the load distribution for a variable load in a representative period of time "t" is calculated for:

$$K = \sqrt[3]{\left(\frac{P_1}{P}\right)^3 \cdot \frac{t_1}{t} + \left(\frac{P_n}{P}\right)^3 \cdot \frac{t_n}{t}}$$

For this, P_1 ... P_n is the operating cycle in the time cycle t_1 ... t_n.



Classification of the driving gears into groups		
Crane type Designation	Type of driving gear	
	Hoisting gear	Retractable luffing gear
Assembly cranes	M2 ... M3	M1 ... M2
Workshop cranes	M6	
Slipway cranes, dockyard cranes, disassembly cranes	M5 ... M6	M4 ... M5
Harbor cranes (rotatable, on portal, etc.) **Floating cranes and floating shearing cranes**	M6 ... M7	M5 ... M6

Helical gear units Type H3 and H4 for crane applications (sizes 5 to 22)

Collective	Cubic mean value	Service factors	**Operating service life class**																			
			T0		**T1**		**T2**		**T3**		**T4**		**T5**		**T6**		**T7**		**T8**		**T9**	
			Total operating time in hours																			
	k		≤ 100		> 200 … ≤ 400		> 400 … ≤ 800		> 800 … ≤ 1600		> 1600 … ≤ 3200		> 1600 … ≤ 6400		> 6400 … ≤ 12500		> 12500 … ≤ 25000		>25000 … ≤ 50000		> 50000	
L1	**0.42**	f_1	1.1	M1	1.1	M1	1.1	M1	1.1	M2	1.1	M3	1.1	M4	1.1	M5	1.1	M6	1.1	M7	1.2	M8
		$f_{3,stat}$ [1]	0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60	
L2	**0.51**	f_1	1.1	M1	1.1	M2	1.1	M1	1.1	M3	1.1	M4	1.1	M5	1.1	M6	1.1	M7	1.2	M8	1.5	M8
		$f_{3,stat}$ [1]	0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60	
L3	**0.64**	f_1	1.1	M1	1.1	M3	1.1	M2	1.1	M4	1.1	M5	1.1	M6	1.1	M7	1.3	M8	1.5	M8	1.6	M8
		$f_{3,stat}$ [1]	0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60	
L4	**0.81**	f_1	1.1	M2	1.1	M4	1.1	M2	1.1	M5	1.1	M6	1.1	M7	1.3	M8	1.6	M8	1.7	M8	2.0	M8
		$f_{3,stat}$ [1]	0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60		0.60	

A recalculation is absolutely required for the following gear units:
H3 size 6 i = 31.5 to 40
H3 size 11 i = 25 to 50
H3 size 12 i = 31.5 to 50
H3 size 19 i = 22.4
H3 size 20 i = 25

[1] For H3 size 12, a recalculation is required.

© Flender GmbH 2019

Type H1 – Nominal power ratings of gear unit sizes 3 to 19

Technical specifications

Nominal power ratings P_{2N} (kW) type H1

			Gear unit sizes								
i_N	n_1	n_2	3	5	7	9	11	13	15	17	19
1.25	1800	1440	437	1206	2291 *	3724 *	–	–	–	–	–
	1500	1200	364	1005	1909	3103	–	–	–	–	–
	1200	960	291	804	1527	2482	–	–	–	–	–
	1000	800	242	670	1273	2069	–	–	–	–	–
1.4	1800	1286	417	1104	2141 *	3447 *	–	–	–	–	–
	1500	1071	347	919	1783	2870	–	–	–	–	–
	1200	857	278	735	1426	2297	–	–	–	–	–
	1000	714	231	613	1188	1913	–	–	–	–	–
1.6	1800	1125	388	1013	1920 *	3192 *	*	*	–	–	–
	1500	938	324	844	1600	2661	4518	*	–	–	–
	1200	750	259	675	1280	2128	3612	*	–	–	–
	1000	625	215	562	1066	1773	3010	4410	–	–	–
1.8	1800	1000	282	921	1821 *	2931 *	4984 *	*	–	–	–
	1500	833	235	767	1517	2442	4151	*	–	–	–
	1200	667	188	614	1215	1955	3324	4951 *	–	–	–
	1000	556	157	512	1013	1630	2771	4127	–	–	–
2	1800	900	263	885	1677 *	2704 *	4627 *	*	*	–	–
	1500	750	219	738	1397	2253	3856	*	*	–	–
	1200	600	175	590	1118	1803	3084	4580 *	*	–	–
	1000	500	146	492	931	1502	2570	3816	*	–	–
2.24	1800	804	235	808	1498 *	2416 *	4259 *	*	*	–	–
	1500	670	196	673	1248	2013	3549	*	*	–	–
	1200	536	157	538	999	1610	2839	4220 *	*	–	–
	1000	446	130	448	831	1340	2363	3511	*	–	–
2.5	1800	720	218	723	1341 *	2163 *	3814 *	*	*	–	–
	1500	600	182	603	1118	1803	3179	4837 *	*	–	–
	1200	480	145	482	894	1442	2543	3870 *	*	–	–
	1000	400	121	402	745	1202	2119	3225	4900	–	–
2.8	1800	643	208	646	1151 *	1831 *	3406 *	*	*	*	–
	1500	536	173	538	959	1526	2839	4321 *	*	*	–
	1200	429	139	431	768	1221	2273	3458 *	*	*	–
	1000	357	115	358	639	1016	1891	2878	4485	*	–
3.15	1800	571	185	573	1040	1680	2875 *	4370 *	*	*	–
	1500	476	154	478	867	1400	2397	3643	*	*	–
	1200	381	123	382	694	1121	1918	2916	4947 *	*	–
	1000	317	102	318	577	932	1596	2426	4116	*	–
3.55	1800	507	169	504	944	1518	2665 *	3949 *	*	*	–
	1500	423	141	420	788	1266	2223	3295	*	*	–
	1200	338	113	336	629	1012	1776	2633	4459 *	*	–
	1000	282	94	280	525	844	1482	2196	3720	*	–
4	1800	450	150	452	838	1352	2384 *	3567 *	*	*	*
	1500	375	125	376	698	1126	1986	2972	*	*	*
	1200	300	100	301	559	901	1589	2378	4083 *	*	*
	1000	250	83	251	465	751	1324	1981	3403	4528	*
4.5	1800	400	104	322	661	1030	1926	2580 *	4565 *	*	*
	1500	333	87	268	550	857	1603	2147	3800	*	*
	1200	267	69	215	441	687	1286	1722	3047	4081 *	*
	1000	222	58	178	367	571	1069	1431	2533	3393	*
5	1800	360	90	271	520	885	1458	2197 *	3581 *	4674 *	*
	1500	300	75	226	433	738	1215	1831	2984	3895 *	*
	1200	240	60	180	346	590	972	1465	2387	3116 *	4372 *
	1000	200	50	150	289	492	810	1220	1989	2596	3643
5.6	1800	321	77	231	440	675	1226	1862 *	3038 *	3966 *	*
	1500	268	64	193	367	564	1024	1554	2536	3311 *	4209 *
	1200	214	51	154	293	450	817	1241	2025	2644	3361 *
	1000	179	43	129	245	376	684	1038	1694	2211	2811

Forced lubrication required for horizontal gear units
* on request

© Flender GmbH 2019

Technical specifications (continued)

Nominal output torque of low speed shaft (LSS) T_{2N} (kNm) type H1

	Gear unit sizes																				
i_N	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Type
1.25	2.9	–	8.0	–	15.2	–	24.7	–	–	–	–	–	–	–	–	–	–	–	–	–	H1
1.4	3.1	–	8.2	–	15.9	–	25.6	–	–	–	–	–	–	–	–	–	–	–	–	–	
1.6	3.3	–	8.6	–	16.3	–	27.1	–	46.0	–	67.4	–	–	–	–	–	–	–	–	–	
1.8	2.7	–	8.8	–	17.4	–	28.0	–	47.6	–	70.9	–	–	–	–	–	–	–	–	–	
2	2.8	–	9.4	–	17.8	–	28.7	–	49.1	–	72.9	–	129	–	–	–	–	–	–	–	
2.24	2.8	–	9.6	–	17.8	–	28.7	–	50.6	–	75.2	–	130	–	–	–	–	–	–	–	
2.5	2.9	–	9.6	–	17.8	–	28.7	–	50.6	–	77.0	–	117	–	–	–	–	–	–	–	
2.8	3.1	–	9.6	–	17.1	–	27.2	–	50.6	–	77.0	–	120	–	171	–	–	–	–	–	
3.15	3.1	–	9.6	–	17.4	–	28.1	–	48.1	–	73.1	–	124	–	173	–	–	–	–	–	
3.55	3.2	–	9.5	–	18.8	–	28.6	–	50.2	–	74.4	–	126	–	173	–	–	–	–	–	
4	3.2	–	9.6	–	17.8	–	28.7	–	50.6	–	75.7	–	130	–	173	–	245	–	–	–	
4.5	2.5	–	7.7	–	15.8	–	24.6	–	46.0	–	61.6	–	109	–	146	–	216	–	–	–	
5	2.4	–	7.2	–	13.8	–	23.5	–	38.7	–	58.3	–	95.0	–	124	–	174	–	–	–	
5.6	2.3	–	6.9	–	13.1	–	20.1	–	36.5	–	55.4	–	90.4	–	118	–	150	–	–	–	
6.3	–	6.3	10.7	–	20.3	–	33.7	–	59.3	–	86.0	–	143	–	195	–	292	–	410	–	
7.1	–	6.5	11.2	–	20.3	–	33.7	–	59.3	–	86.0	–	143	–	195	230	292	335	410	458	H2
8	–	6.7	11.2	13.5	20.3	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
9	–	6.7	11.2	14.4	20.3	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
10	–	6.3	10.5	14.4	20.3	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
11.2	–	6.3	10.6	14.4	20.3	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
12.5	–	6.7	11.2	13.5	20.2	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
14	–	6.7	11.2	13.5	20.3	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
16	–	6.7	11.2	14.4	20.3	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
18	–	6.3	10.5	14.4	19.0	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
20	–	6.6	11.2	14.4	19.0	25.6	33.7	42.2	59.3	73.8	86.0	107	143	160	195	230	292	335	410	458	
22.4	–	6.3	10.9	13.5	19.8	24	33.1	42.2	58.3	73.8	88.0	107	153	160	200	230	300	335	420	458	
25	–	–	11.6	14.3	21.7	24	35.7	42.2	63.5	73.8	88.0	107	153	173	200	240	300	345	420	470	H3
28	–	–	11.6	13.9	21.7	25	35.7	41.6	63.5	72.5	88.0	109	153	173	200	240	300	345	420	470	
31.5	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
35.5	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
40	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
45	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
50	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
56	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
63	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
71	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
80	–	–	11.6	15.5	21.7	27.2	35.7	43.8	63.5	77.2	88.0	109	153	173	200	240	300	345	420	470	
90	–	–	11.6	15.5	20.0	27.2	34.5	43.8	63.5	77.2	88.0	109	153	173	200	240	290	345	410	470	
100	–	–	–	14.5	21.7	27.2	35.7	43.8	61.6	77.2	90.7	109	153	173	200	226	300	335	420	465	
112	–	–	–	15.0	21.7	25.2	35.7	42.8	61.6	77.2	90.7	109	153	173	200	240	300	345	420	470	H4
125	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
140	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
160	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
180	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
200	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
224	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
250	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
280	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
315	–	–	–	–	21.7	27.2	35.7	44.2	61.6	78.0	90.7	113	153	173	200	240	300	345	420	470	
355	–	–	–	–	19.6	27.2	35.7	44.2	61.6	78.0	90.7	113	140	173	–	240	290	345	410	470	
400	–	–	–	–	–	27.2	–	44.2	–	78.0	–	113	–	158	–	223	–	335	–	465	
450	–	–	–	–	–	25.3	–	42.8	–	78.0	–	113	–	–	–	–	–	–	–	–	

Type **H2**, see page 3/22
Type **H3**, see page 3/30
Type **H4**, see page 3/38

© Flender GmbH 2019

Type H1 – Thermal capacities n_1 = 1000 rpm

Technical specifications (continued)

Thermal capacities P_G (kW) type H1
n_1 = 1000 rpm

i_N		Gear unit sizes 3	5	7	9	11	13	15	17	19
1.25	P_{GA}	73.2	*	*	*	–	–	–	–	–
	P_{GB}	222	517	698	763	–	–	–	–	–
	P_{GC10}	345	574	474	822	–	–	–	–	–
	P_{GD10}	472	963	1117	1631	–	–	–	–	–
1.4	P_{GA}	77.7	83.5	167	*	–	–	–	–	–
	P_{GB}	222	525	728	827	–	–	–	–	–
	P_{GC10}	335	581	514	880	–	–	–	–	–
	P_{GD10}	458	957	1133	1656	–	–	–	–	–
1.6	P_{GA}	81.7	123.9	*	*	*	*	–	–	–
	P_{GB}	218	550	790	883	1070	330	–	–	–
	P_{GC10}	316	603	582	933	674	329	–	–	–
	P_{GD10}	433	975	1184	1656	2047	1650	–	–	–
1.8	P_{GA}	93.5	138	*	*	*	*	–	–	–
	P_{GB}	239	516	761	908	1168	778	–	–	–
	P_{GC10}	337	565	572	955	820	254	–	–	–
	P_{GD10}	464	897	1121	1637	2081	1956	–	–	–
2.0	P_{GA}	92.4	145	*	*	*	*	*	*	*
	P_{GB}	231	502	750	919	1216	993	376	*	*
	P_{GC10}	319	550	575	965	919	509	376	*	*
	P_{GD10}	440	864	1092	1606	2079	2053	1529	*	*
2.24	P_{GA}	90.5	147	171	*	*	*	*	*	*
	P_{GB}	221	480	715	908	1237	1155	745	*	*
	P_{GC10}	300	528	561	957	968	710	666	*	*
	P_{GD10}	415	822	1025	1553	2045	2092	1772	*	*
2.5	P_{GA}	86.2	146	181	*	*	*	*	*	*
	P_{GB}	206	455	680	880	1253	1223	1068	*	*
	P_{GC10}	271	503	541	930	1011	858	824	*	*
	P_{GD10}	375	776	968	1480	2001	2081	1998	*	*
2.8	P_{GA}	81.8	142.7	197.3	*	*	*	*	*	*
	P_{GB}	192	426.3	692.8	914	1238.4	1250.3	1209.5	690.6	*
	P_{GC10}	247.8	473	556.4	969.3	1026.7	941.2	304.7	445.1	*
	P_{GD10}	345	724	982	1516	1930	2040	2050	1694	*
3.15	P_{GA}	85.6	165	239	286	307	*	*	*	*
	P_{GB}	189	429	739	931	1354	1437	1480	1197	*
	P_{GC10}	245	476	598	993	1157	1164	703	720	*
	P_{GD10}	335	711	1056	1549	2033	2177	2281	2066	*
3.55	P_{GA}	79.9	164	230	284	351	*	*	*	*
	P_{GB}	174	418	681	869	1275	1400	1494	1352	*
	P_{GC10}	220	466	559	933	1105	1163	824	330	*
	P_{GD10}	303	693	973	1440	1893	2076	2216	2124	*
4.0	P_{GA}	72.9	152	217	259	365	385	*	*	*
	P_{GB}	157	380	620	755	1189	1328	1498	1410	960
	P_{GC10}	194	428	514	816	1044	1128	924	587	*
	P_{GD10}	268	631	883	1248	1751	1940	2140	2095	*
4.5	P_{GA}	85.5	163	239	325	386	474	*	*	*
	P_{GB}	172	386	623	852	1112	1355	1704	1652	1424
	P_{GC10}	211	436	525	922	987	1166	1170	943	*
	P_{GD10}	288	634	878	1379	1637	1961	2330	2281	*
5.0	P_{GA}	78.0	157	235	302	404	473	519	*	*
	P_{GB}	155	367	602	769	1098	1301	1734	1936	1820
	P_{GC10}	187	416	512	837	989	1127	1245	1208	*
	P_{GD10}	256	604	849	1242	1612	1877	2330	2599	*
5.6	P_{GA}	70.5	143	214	298	391	459	536	*	*
	P_{GB}	139	328	538	738	1041	1185	1588	1837	2145
	P_{GC10}	164	375	462	812	943	1040	1168	1214	*
	P_{GD10}	225	540	760	1196	1529	1701	2115	2423	*

* on request

© Flender GmbH 2019

Technical specifications (continued)

Thermal capacities P_G (kW) type H1
n_1 = 1200 rpm

i_N		Gear unit sizes 3	5	7	9	11	13	15	17	19
1.25	P_{GA}	45.9	89.2	*	*	–	–	–	–	–
	P_{GB}	234	508	686	599	–	–	–	–	–
	P_{GC10}	368	500	306	502	–	–	–	–	–
	P_{GD10}	524	978	1137	1604	–	–	–	–	–
1.4	P_{GA}	56.2	104.8	*	*	–	–	–	–	–
	P_{GB}	236	530	730	729	–	–	–	–	–
	P_{GC10}	359	522	376	635	–	–	–	–	–
	P_{GD10}	510	985	1161	1661	–	–	–	–	–
1.6	P_{GA}	65.3	*	*	*	*	*	–	–	–
	P_{GB}	235	571	799	862	751	1146	–	–	–
	P_{GC10}	341	561	467	781	65	346	–	–	–
	P_{GD10}	485	1018	1217	1695	1911	826	–	–	–
1.8	P_{GA}	79.2	*	*	*	*	*	–	–	–
	P_{GB}	260	546	775	901	954	108	–	–	–
	P_{GC10}	364	539	474	828	320	108	–	–	–
	P_{GD10}	519	946	1158	1687	2009	1435	–	–	–
2.0	P_{GA}	80.4	92.2	128	*	*	*	*	*	*
	P_{GB}	252	536	780	915	1109	*	*	*	*
	P_{GC10}	346	531	501	853	518	487	1062	*	*
	P_{GD10}	494	916	1142	1657	2056	1724	539	*	*
2.24	P_{GA}	80.4	108	*	*	*	*	*	*	*
	P_{GB}	243	517	758	911	1188	767	*	*	*
	P_{GC10}	326	515	514	858	670	41.4	1230	*	*
	P_{GD10}	466	875	1087	1604	2060	1904	1081	*	*
2.5	P_{GA}	78.6	115	*	*	*	*	*	*	*
	P_{GB}	226	494	728	905	1219	975	*	*	*
	P_{GC10}	294	495	507	862	784	320	190	*	*
	P_{GD10}	422	829	1034	1546	2027	1970	1557	*	*
2.8	P_{GA}	75.6	117	124	168	*	*	*	*	*
	P_{GB}	211	465	747	954	1214	1120	751	1082	*
	P_{GC10}	269	469	529	916	832	528	356	1081	*
	P_{GD10}	389	776	1053	1595	1958	1982	1754	832	*
3.15	P_{GA}	82.9	153	201	*	*	*	*	*	*
	P_{GB}	210	476	809	996	1379	1363	1241	420	*
	P_{GC10}	268	484	586	969	1023	899	658	420	*
	P_{GD10}	380	771	1142	1647	2103	2163	2123	1545	*
3.55	P_{GA}	78.0	155	202	221	*	*	*	*	*
	P_{GB}	194	465	750	939	1327	1351	1362	898	*
	P_{GC10}	242	476	553	921	1019	944	329	209	*
	P_{GD10}	343	752	1055	1539	1986	2079	2147	1807	*
4.0	P_{GA}	71.7	146	197	216	222	*	*	*	*
	P_{GB}	175	424	685	822	1257	1330	1396	1169	997
	P_{GC10}	213	438	513	814	990	979	557	440	*
	P_{GD10}	304	686	961	1339	1855	1982	2093	1919	*
4.5	P_{GA}	87.7	163	231	297	315	*	*	*	*
	P_{GB}	194	434	698	941	1198	1396	1672	1500	831
	P_{GC10}	234	451	537	937	964	1075	914	458	*
	P_{GD10}	329	693	964	1496	1751	2037	2347	2187	*
5.0	P_{GA}	80.4	156	231	284	354	*	*	*	*
	P_{GB}	176	412	675	853	1193	1355	1769	1818	1457
	P_{GC10}	207	431	525	857	981	1055	1084	772	*
	P_{GD10}	292	660	933	1351	1734	1963	2403	2535	*
5.6	P_{GA}	72.9	143	213	286	350	370	*	*	*
	P_{GB}	158	370	604	823	1136	1252	1660	1801	1835
	P_{GC10}	182	391	476	836	940	997	1073	941	*
	P_{GD10}	257	594	837	1303	1647	1795	2219	2429	*

* on request

© Flender GmbH 2019

Type H1 – Thermal capacities n_1 = 1500 rpm

Technical specifications (continued)

Thermal capacities P_G (kW) type H1
n_1 = 1500 rpm

i_N		Gear unit sizes 3	5	7	9	11	13	15	17	19
1.25	P_{GA}	*	*	*	*	–	–	–	–	–
	P_{GB}	238	494	562	*	–	–	–	–	–
	P_{GC10}	390	383	427	*	–	–	–	–	–
	P_{GD10}	587	996	1089	1369	–	–	–	–	–
1.4	P_{GA}	*	*	*	*	–	–	–	–	–
	P_{GB}	245	524	662	*	–	–	–	–	–
	P_{GC10}	383	418	*	*	–	–	–	–	–
	P_{GD10}	575	1009	1145	1530	–	–	–	–	–
1.6	P_{GA}	*	*	*	*	*	*	–	–	–
	P_{GB}	250	572	784	657	*	*	–	–	–
	P_{GC10}	368	467	220	334	318	227	–	–	–
	P_{GD10}	550	1048	1239	1649	1285	1609	–	–	–
1.8	P_{GA}	45.2	*	*	*	*	*	–	–	–
	P_{GB}	281	557	781	778	*	*	–	–	–
	P_{GC10}	393	464	281	478	339	652	–	–	–
	P_{GD10}	591	983	1197	1682	1586	67	–	–	–
2.0	P_{GA}	52.4	*	*	*	*	*	*	*	*
	P_{GB}	275	558	792	863	637	*	*	*	*
	P_{GC10}	375	473	339	587	581	869	*	*	*
	P_{GD10}	564	963	1185	1682	1815	*	*	*	*
2.24	P_{GA}	56.8	*	*	*	*	*	*	*	*
	P_{GB}	266	548	779	895	865	*	*	*	*
	P_{GC10}	355	471	391	666	675	1042	*	*	*
	P_{GD10}	534	929	1135	1655	1918	*	*	*	*
2.5	P_{GA}	60.0	*	*	*	*	*	*	*	*
	P_{GB}	250	530	758	897	1028	*	*	*	*
	P_{GC10}	321	462	407	704	217	223	653	*	*
	P_{GD10}	485	886	1088	1600	1956	1459	*	*	*
2.8	P_{GA}	60.0	*	*	*	*	*	*	*	*
	P_{GB}	235	504	788	953	1117	*	*	*	*
	P_{GC10}	295	446	443	767	398	386	885	*	*
	P_{GD10}	447	835	1116	1655	1939	1686	*	*	*
3.15	P_{GA}	74.3	121	*	*	*	*	*	*	*
	P_{GB}	237	532	878	1033	1369	1133	350	*	*
	P_{GC10}	299	480	534	871	763	271	350	298	*
	P_{GD10}	440	844	1229	1730	2159	2051	1501	*	*
3.55	P_{GA}	71.3	130	*	*	*	*	*	*	*
	P_{GB}	220	523	825	993	1334	1226	814	762	*
	P_{GC10}	269	477	518	854	809	484	813	761	*
	P_{GD10}	399	826	1147	1633	2049	2031	1783	*	*
4.0	P_{GA}	66.7	127	146	*	*	*	*	*	*
	P_{GB}	199	479	759	885	1274	1237	1099	282	*
	P_{GC10}	237	442	492	774	816	628	250	282	*
	P_{GD10}	354	756	1051	1437	1923	1956	1885	*	*
4.5	P_{GA}	88.7	154	204	222	*	*	*	*	*
	P_{GB}	225	496	792	1039	1257	1344	1546	1091	*
	P_{GC10}	266	464	538	924	866	822	353	1090	*
	P_{GD10}	386	770	1073	1629	1850	2036	2291	*	*
5.0	P_{GA}	81.9	150	210	231	*	*	*	*	*
	P_{GB}	204	472	768	950	1282	1325	1715	1546	*
	P_{GC10}	235	445	532	857	920	843	692	405	*
	P_{GD10}	344	734	1040	1482	1858	1981	2409	2346	*
5.6	P_{GA}	74.7	139	199	248	*	*	*	*	*
	P_{GB}	183	425	689	925	1229	1271	1632	1622	*
	P_{GC10}	206	405	485	847	894	857	781	277	*
	P_{GD10}	302	662	935	1436	1773	1852	2243	2320	*

* on request

© Flender GmbH 2019

Technical specifications (continued)

Thermal capacities P_G (kW) type H1
n_1 = 1800 rpm

i_N		Gear unit sizes 3	5	7	9	11	13	15	17	19
1.25	P_{GA}	*	*	*	*	–	–	–	–	–
	P_{GB}	230	418	317	874	–	–	–	–	–
	P_{GC10}	396	192	184	352	–	–	–	–	–
	P_{GD10}	637	969	907	840	–	–	–	–	–
1.4	P_{GA}	*	*	*	*	–	–	–	–	–
	P_{GB}	240	483	463	962	–	–	–	–	–
	P_{GC10}	389	256	239	452	–	–	–	–	–
	P_{GD10}	624	998	1033	1117	–	–	–	–	–
1.6	P_{GA}	*	*	*	*	*	*	–	–	–
	P_{GB}	253	555	667	277	759	*	–	–	–
	P_{GC10}	379	347	320	276	759	–	–	–	–
	P_{GD10}	602	1058	1186	1428	*	*	–	–	–
1.8	P_{GA}	*	*	*	*	*	*	–	–	–
	P_{GB}	291	558	718	487	945	*	–	–	–
	P_{GC10}	411	380	344	486	945	–	–	–	–
	P_{GD10}	651	1007	1172	1557	*	*	–	–	–
2.0	P_{GA}	*	*	*	*	*	*	*	*	*
	P_{GB}	288	561	756	643	1090	*	*	*	*
	P_{GC10}	394	396	98	150	1089	*	*	*	*
	P_{GD10}	623	988	1182	1610	*	*	*	*	*
2.24	P_{GA}	*	*	*	*	*	*	*	*	*
	P_{GB}	282	552	774	752	*	*	*	*	*
	P_{GC10}	374	401	209	311	*	*	*	*	*
	P_{GD10}	591	953	1154	1620	*	*	*	*	*
2.5	P_{GA}	*	*	*	*	*	*	*	*	*
	P_{GB}	267	538	761	824	*	*	*	*	*
	P_{GC10}	341	403	261	428	*	*	*	*	*
	P_{GD10}	539	914	1114	1595	1694	*	*	*	*
2.8	P_{GA}	*	*	*	*	*	*	*	*	*
	P_{GB}	253	520	790	905	799	*	*	*	*
	P_{GC10}	314	400	308	542	371	761	*	*	*
	P_{GD10}	498	868	1143	1669	1785	*	*	*	*
3.15	P_{GA}	60.3	66.3	*	*	*	*	*	*	*
	P_{GB}	260	570	903	1040	1252	*	*	*	*
	P_{GC10}	323	461	444	746	298	*	*	*	*
	P_{GD10}	495	898	1274	1778	2110	*	*	*	*
3.55	P_{GA}	60.0	89.3	*	*	*	*	*	*	*
	P_{GB}	241	565	861	1002	1273	855	*	*	*
	P_{GC10}	292	463	453	743	481	369	804	*	*
	P_{GD10}	449	883	1201	1680	2046	1824	*	*	*
4.0	P_{GA}	57.7	96.2	*	*	*	*	*	*	*
	P_{GB}	219	521	804	901	1254	1022	*	*	*
	P_{GC10}	258	434	446	690	593	*	*	*	*
	P_{GD10}	399	811	1110	1484	1951	1834	*	*	*
4.5	P_{GA}	87.0	137	157	*	*	*	*	*	*
	P_{GB}	253	548	859	1092	1266	1252	*	*	*
	P_{GC10}	293	467	517	873	719	*	*	*	*
	P_{GD10}	439	834	1157	1715	1895	1990	2061	*	*
5.0	P_{GA}	81.0	135	173	*	*	*	*	*	*
	P_{GB}	230	523	840	1012	1304	1245	1551	*	*
	P_{GC10}	260	449	519	827	797	*	*	*	*
	P_{GD10}	391	797	1126	1573	1912	1941	2305	*	*
5.6	P_{GA}	74.6	129	172	183	*	*	*	*	*
	P_{GB}	207	472	758	996	1263	1204	1561	1219	*
	P_{GC10}	228	411	482	831	794	632	373	1218	*
	P_{GD10}	345	719	1014	1536	1837	1824	2220	*	*

* on request

© Flender GmbH 2019

Type H2 – Nominal power ratings of gear unit sizes 4 to 12

Technical specifications (continued)

Nominal power ratings P_{2N} (kW) type H2

			Gear unit sizes								
i_N	n_1	n_2	4	5	6	7	8	9	10	11	12
6.3	1800	286	188	320	–	607	–	1009	–	1775	–
	1500	238	157	266	–	505	–	839	–	1477	–
	1200	190	125	212	–	403	–	670	–	1179	–
	1000	159	104	178	–	337	–	561	–	987	–
7.1	1800	254	172	297	–	539	–	896	–	1577	–
	1500	211	143	247	–	448	–	744	–	1310	–
	1200	169	115	198	–	359	–	596	–	1049	–
	1000	141	95	165	–	299	–	497	–	875	–
8	1800	225	157	263	318	478	603	793	994	1397	1738
	1500	188	131	220	265	399	503	663	830	1167	1452
	1200	150	105	175	212	318	402	529	662	931	1159
	1000	125	87	146	176	265	335	441	552	776	965
9	1800	200	140	234	301	425	536	705	883	1241	1545
	1500	167	117	195	251	354	447	589	737	1036	1290
	1200	133	93	155	200	282	356	469	587	825	1027
	1000	111	77	130	167	235	297	391	490	689	857
10	1800	180	118	197	271	382	482	635	795	1117	1390
	1500	150	98	164	226	318	402	529	662	931	1159
	1200	120	79	131	180	255	321	423	530	745	927
	1000	100	65	109	150	212	268	352	441	620	772
11.2	1800	161	106	178	242	342	431	568	711	999	1244
	1500	134	88	148	202	284	359	472	592	832	1035
	1200	107	70	118	161	227	286	377	472	664	826
	1000	89	58	98	134	189	238	314	393	552	687
12.5	1800	144	101	168	203	304	386	508	636	894	1112
	1500	120	84	140	169	253	321	423	530	745	927
	1200	96	67	112	135	203	257	338	424	596	741
	1000	80	56	93	113	169	214	282	353	496	618
14	1800	129	90	151	182	274	345	455	570	801	996
	1500	107	75	125	151	227	286	377	472	664	826
	1200	86	60	100	121	182	230	303	380	534	664
	1000	71	49	83	100	150	190	250	313	440	548
16	1800	113	79	132	170	240	301	398	499	701	873
	1500	94	65	110	141	199	250	331	415	583	726
	1200	75	52	87	113	159	200	264	331	465	579
	1000	63	44	73	94	133	168	222	278	391	486
18	1800	100	65	109	150	198	268	352	441	620	772
	1500	83	54	91	125	165	222	292	366	515	641
	1200	67	44	73	101	133	179	236	296	416	517
	1000	56	36	61	84	111	150	197	247	347	432
20	1800	90	62	105	135	179	241	317	397	558	695
	1500	75	51	87	113	149	201	264	331	465	579
	1200	60	41	70	90	119	160	211	265	372	463
	1000	50	34	58	75	99	134	176	220	310	386
22.4	1800	80	52	91	113	165	201	277	353	488	618
	1500	67	44	76	94	138	168	232	296	409	517
	1200	54	35	61	76	111	135	187	238	329	417
	1000	45	29	51	63	93	113	155	198	274	347
25	1800	72	–	–	107	–	180	–	318	–	556
	1500	60	–	–	89	–	150	–	265	–	463
	1200	48	–	–	71	–	120	–	212	–	370
	1000	40	–	–	59	–	100	–	176	–	309
28	1800	64	–	–	93	–	167	–	278	–	485
	1500	54	–	–	78	–	141	–	235	–	409
	1200	43	–	–	62	–	112	–	187	–	326
	1000	36	–	–	52	–	94	–	156	–	273