

FLENDER Industrial Gearbox Selection



Engineering Training • Selection Methodology • Application Sizing • Retrofit

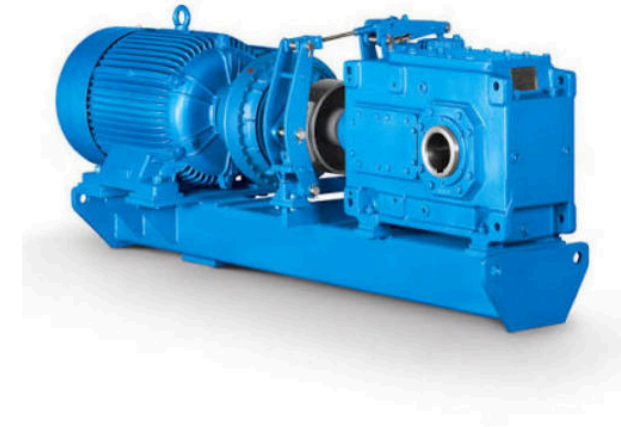
Helical & Bevel-Helical | PLANUREX Planetary | Conveyor & Bucket Elevator Drives

Technical reference edition • 52 slides • October 2026

FLENDER Industrial Gearbox Selection

52-slide technical training | MECHATRIC | Engineering • Replacement • RFQ

- Helical • Bevel-Helical • Planetary • Conveyor Drive Systems
- Selection methodology, calculations, mounting, thermal checks and retrofit
- Prepared for industrial engineering and technical sales teams



FLENDER catalogue figures require current manufacturer verification.

Training Objectives

A systematic approach to industrial gearbox specification

- Understand gearbox architectures and application fit
- Calculate speed ratio, output torque and selection margins
- Check thermal, mechanical, shaft and interface constraints
- Prepare complete RFQs and assess equivalent gearboxes

Selection Workflow

From duty definition to verified configuration

- Define machine and process requirements
- Determine power, input/output speeds and torque
- Apply duty factors and transient load assessment
- Check thermal capacity, shaft loads and mounting
- Validate against current FLENDER catalog/configurator

Duty definition

→ Mechanical rating

→ Thermal & shafts

→ Final validation

Industrial Gearbox: Core Function

Speed, torque and shaft arrangement

- Gear trains transform speed and torque
- Efficiency losses mean output power is below input power
- Gearbox may also change shaft orientation
- System-level selection includes motor, coupling and machine

Fundamental Relationships

Equations used in preliminary sizing

- Ratio $i = n_{in} / n_{out}$
- Torque $T \text{ [Nm]} = 9550 \times P \text{ [kW]} / n \text{ [rpm]}$
- $P_{out} = \eta \times P_{in}$ (consistent units)
- Required rating depends on load spectrum and manufacturer method

Engineering screening only

Preliminary calculation for screening; the final model and size require FLENDER rating data and load verification.

Worked Example: Conveyor

Illustrative preliminary calculation

- Motor: 160 kW at 1480 rpm; desired output 50 rpm
- Nominal ratio = $1480/50 = 29.6$
- Assume $\eta = 0.96$: $T_{\text{out}} = 9550 \times (160 \times .96) / 50 \approx 29.3 \text{ kNm}$
- Illustrative duty multiplier 1.5 $\rightarrow$ 44.0 kNm target
- Final model requires FLENDER rating and load verification

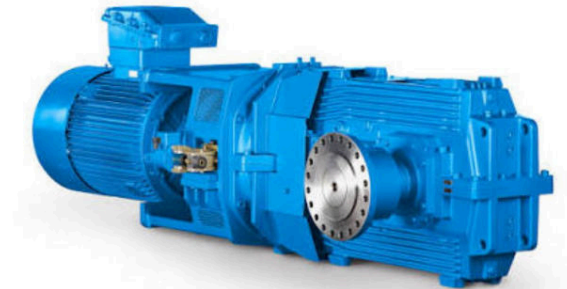
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Main FLENDER Gearbox Families

Technology overview

- Helical: parallel-axis high-efficiency drives
- Bevel-Helical: right-angle configurations
- Planetary: compact high torque density
- Application-specific: optimized for driven machine
- Conveyor drive: integrated system configuration



Architecture Selection Matrix

Choose by load, arrangement and envelope

- Helical | parallel axes | broad process applications
- Bevel-Helical | typically 90° | conveyor and material handling
- Planetary | coaxial/other configured arrangements | high torque
- Integrated drive | multiple components | interface-managed packages

FLENDER H / B Gear Unit Portfolio

MD 20.1 (2018) — catalog scope

- Nominal output torque: 3,100–1,400,000 Nm (portfolio)
- 28 sizes; overall nominal ratio range 1.25–450
- H1–H4: parallel-shaft; B2–B4: right-angle
- Check exact series/size tables before model approval

MD 20.1 historical portfolio. FLENDER official product page also states 3,100 Nm minimum.

Helical H1 / H2 / H3 / H4

Stage count and ratio matching

- H1: 1 stage; H2: 2; H3: 3; H4: 4
- Illustrative ratio families: H1 ~1.25–5.6; H2 ~6.3–28
- H3 ~22.4–112; H4 ~100–450 (size-dependent)
- Confirm mechanical/thermal ratings in MD 20.1 tables

Family	Stages	Ratio approx.
H1	1	1.25–5.6
H2	2	6.3–28
H3	3	22.4–112
H4	4	100–450

Ratio ranges are indicative across size variants; not a universal size rating.

Bevel-Helical B2 / B3 / B4

Right-angle drives — stage-dependent ratios

- B2: 2 stages, approximately $i = 5\text{--}22.4$
- B3: 3 stages, approximately $i = 12.5\text{--}90$
- B4: 4 stages, approximately $i = 80\text{--}400$
- Ranges vary by size; verify shaft arrangement and rating

Family	Stages	Ratio approx.
B2	2	5–22.4
B3	3	12.5–90
B4	4	80–400

B-series ratios depend on unit size and design.

Gearbox Mounting

Foundations and reaction forces

- Foot/base-mounted versus shaft-mounted arrangement
- Horizontal versus vertical mounting configuration
- Torque arm design and support reaction loads
- Foundation stiffness, alignment and maintenance access



Output Shaft Options

Connection to the driven machine

- Solid shaft: keyed or other engineered connection
- Hollow shaft: keyed, shrink disc or equivalent
- Check shaft diameter, fit, axial retention and tolerances
- External radial/axial loads must meet catalog limits



Accessory Selection

Common options

- Backstop to prevent reverse rotation where required
- Taconite sealing for abrasive dusty environments
- Motor bell housing and adapter options
- Oil cooler, heater, filter and monitoring interfaces

FLENDER ONE

Application-fit industrial gear unit platform

- Single-stage and multi-stage configurations
- More than 100 applications described by FLENDER
- Application-fit sizing reduces unnecessary oversizing
- Check model-specific ratings and current configurator

FLENDER ONE: Efficiency

Planning and operating considerations

- FLENDER reports average ~20% lower power loss vs predecessor
- Application-fit thermal design and efficient cooling
- Digital 3D planning data can shorten engineering time
- Reported gains depend on product and comparison basis

FLENDER ONE: Smart Monitoring

AIQ gearbox intelligence

- AIQ Core Sensor described as factory installed
- Monitor speed, temperature and vibration
- Condition monitoring complements inspection and maintenance
- Sensor availability/features require configuration verification

FLENDER ONE: Ratio Matching

Speed fit concept

- Fine ratio gradation supports target output speed
- Single-stage platform: FLENDER cites 103 ratios per size
- FLENDER reports >98.5% speed-fit coverage
- Check actual speed, driven process and motor tolerances

PLANUREX 3 Planetary

High torque density series

- Rated torque 480,000–5,450,000 Nm
- 17 sizes; nominal ratios $i = 45\text{--}300$
- Horizontal or vertical mounting configurations
- High overload capability subject to catalog limits

Planetary Load Sharing

Why torque density is high

- Multiple planet gears share transmitted torque
- Compact packaging for heavy-duty industrial drives
- Check radial/axial forces and bearing life
- Dynamic peak loads still require explicit verification

PLANUREX 3 Applications

Heavy industrial equipment

- Roller presses and vertical mill drives
- Apron feeders and central drives
- Sugar cane mills and travel drives
- Validate application-specific torque and duty spectrum

PLANUREX 3: Options

Installation and cooling

- Gear unit base for foot mounting
- Torque reaction support options
- Connections for oil cooling
- Cold ambient variants to -40°C (configuration dependent)

Overload Capacity

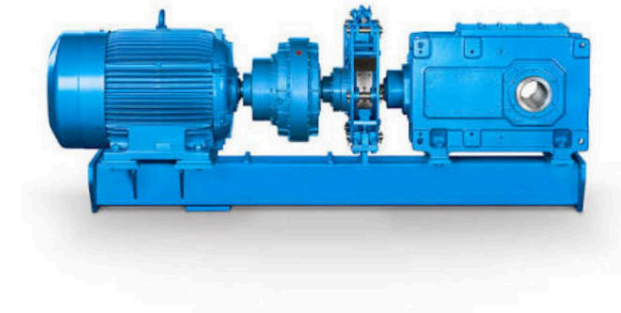
Interpret with caution

- FLENDER describes up to 2× nominal torque overload capacity
- Not a substitute for continuous torque sizing
- Duration, repetitions and thermal limits are critical
- Use catalog-specific load and fatigue verification

Conveyor Drive Engineering

System-level design

- Evaluate motor, gearbox, coupling, pulley and backstop
- Long conveyors require controlled starts and torque analysis
- Consider load distribution and transient dynamics
- Environment affects cooling, sealing and maintenance



Motor

→ Coupling

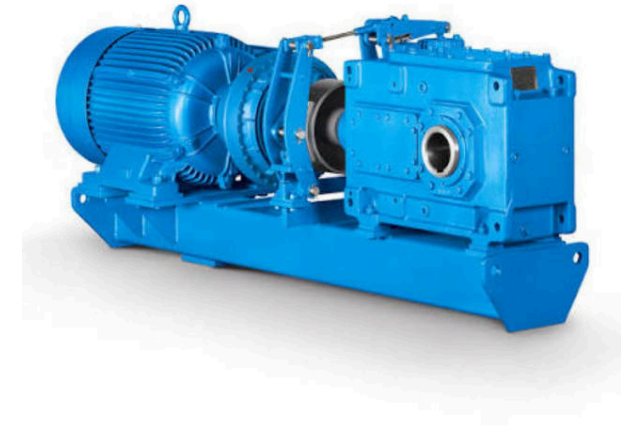
→ Gearbox

→ Pulley / belt

H-Conveyor Gear Unit

Comprehensive modular conveyor solution

- Broad modularity for conveyor drive requirements
- Applicable to high-capacity, long-distance conveyors
- Verify ratio, torque, mounting and shaft orientation
- Select accessories based on duty and environment



E-Conveyor Gear Unit

Difficult operating environments

- Targeted to severe mining and outdoor conditions
- Consider heat, dust, remote sites and accessibility
- Check sealing, cooling and oil management
- Assess serviceability and reliability needs



A-Conveyor Drive System

Ready-assembled drive package

- Designed for confined installation spaces
- Factory-integrated approach reduces site interfaces
- Verify transport dimensions and installation clearances
- Confirm scope: motor, coupling, brake, base and guards



Conveyor Start-Up

Starting torque and acceleration

- Direct-on-line, soft starter, VFD or fluid coupling
- Acceleration profile influences peak drive torque
- Check belt tension, pulley inertia and load distribution
- Review backstop/brake interaction and restart scenarios

Fluid Coupling Integration

Soft-start system considerations

- Hydrodynamic coupling can reduce start-up shocks
- Check slip, heat dissipation and startup frequency
- Coordinate coupling, motor and gearbox torque capacities
- Confirm manufacturer data for operating duty

Backstop and Brake

Safety-critical functions

- Backstop selection depends on reverse torque and speed
- Brake selection depends on stopping duty and heat
- Check rotation direction and mounting location
- Safety functions require engineering validation

Thermal Rating — Mandatory Check

Thermal capacity is not mechanical torque capacity

- Calculate operating output power and heat loss
- MD 20.1: verify $P_G \geq P_2 \times K_{th}$; take K_{th} from the exact catalog duty/ambient tables
- If thermal capacity is insufficient, evaluate cooling
- Check ambient, altitude, ventilation and oil viscosity

Catalog selection factor K_{th} must be taken from the applicable MD 20.1 table.

Lubrication & Viscosity

Mounting-specific oil supply requirements

- Dip, forced circulation or combined lubrication
- Oil grade selected for actual operating temperature
- Filter, heater and cooler where duty requires them
- Follow gearbox nameplate and approved oil specification

Shaft & Bearing Load Verification

Beyond transmitted torque

- External radial loads from pulley/sprocket drives
- Axial loads, bending moment and load application point
- Bearing life: $L_{10h} \propto (C/P)^p / n$; use $p = 3$ for ball, $10/3$ for roller bearings
- Compare load position and forces with manufacturer limits

Theory: Bearing rating life depends strongly on equivalent dynamic load; use ISO 281/manufacturer guidance.

Service Factor & Variable Duty

Avoid arbitrary safety multipliers

- Separate steady torque, start torque and peak torque
- Record load fractions, duration, starts/hour and reversing/impact events
- For MD20.1 variable duty, use catalog-specific equivalent-power method
- Check peak limits, thermal rating and fatigue independently

MD20.1 reference: $P_{2eq} = [\sum(P_i^{6.6} \times X_i/100)]^{(1/6.6)}$, subject to stated catalog applicability limits.

Torsional Dynamics

Beyond steady-state torque

- Motor torque curve and load inertia influence transients
- Resonance and torsional vibration can drive failures
- Flexible coupling stiffness and damping are relevant
- Critical drives: assess torsional natural frequencies, resonance and start/stop excitation

Coupling & Gearbox Compatibility

Interface engineering checklist

- Rated torque, peak torque and service conditions
- Bore/shaft fit, hub dimensions and key or locking assembly
- Misalignment, axial displacement and spacer length
- Balance, speed, torsional stiffness and maintenance access

Equivalent Gearbox Assessment

Functionally equivalent $\neq$ dimensionally identical

- Compare nominal/peak torque and thermal capacity
- Verify exact/acceptable ratio and output speed
- Check shafts, base holes, center height and envelope
- Review accessories, rotation, oil and monitoring



Criterion	Verify
Torque	continuous + peak
Ratio	actual n_out
Thermal	PG / cooling
Interfaces	shaft / base
Duty	starts + cycles

Duty match

→ Interfaces

→ Thermal / loads

→ Retrofit scope

Retrofit Engineering

Legacy gearbox replacement

- Record nameplate, photos and as-built drawings
- Evaluate motor and coupling changes
- Design foundation, guard or shaft modifications if needed
- Document installation and commissioning risks



Worked Example — Planetary Drive

Preliminary power and ratio screening

- Continuous output torque = 1,250 kNm
- Output speed = 12 rpm; $P_{out} \approx 1,571$ kW
- Select ratio from input speed, then check PLANUREX data
- Confirm transient torque, bearings, thermal and fatigue
- Example only: not a final FLENDER selection

Engineering screening only

Preliminary calculation for screening; the final model and size require FLENDER rating data and load verification.

Worked Example: Bevel-Helical

Illustrative ratio and torque

- Motor: 250 kW, 1490 rpm; target output 42 rpm
- Required ratio ≈ 35.48
- At $\eta = 0.96$, output torque ≈ 54.6 kNm
- Verify catalog ratio, thermal capacity and shaft loads
- Check service conditions before selecting size

Engineering screening only

Preliminary calculation for screening; the final model and size require FLENDER rating data and load verification.

Cement Industry

Typical FLENDER gearbox duties

- Clinker and raw material conveyors
- Crushers and grinding/mill auxiliary drives
- Rotary kiln and cooler-related equipment
- Dust sealing and 24/7 duty are major considerations

Mining & Minerals

Heavy material-handling applications

- Long-distance belt conveyors and apron feeders
- Crushers, roller presses and processing equipment
- High starting torque and abrasive dust
- Thermal performance at remote hot sites

Bucket Elevator Drives

Dedicated application-specific drive package

- Select for vertical bulk handling and loaded starts
- Assess backstop reverse torque and correct rotation
- Evaluate auxiliary/inching drive and maintenance operation
- Check gearbox, motor, coupling and mounting as a system



FLENDER reference family: Bucket Elevator Drives, catalog MD 20.2; verify current product data.

Bucket Elevator Engineering

Critical design and safety checks

- Ideal lifting power $P[\text{kW}] = \dot{m}[\text{kg/s}] \times 9.81 \times H[\text{m}] / 1000$; add mechanical losses
- Check boot loading, jam events and starting torque
- Assess backstop, auxiliary drive and overspeed hazards
- Validate shaft loads, lubrication, cooling and access



Theoretical lift power: $P_{\text{lift}}[\text{kW}] = \text{mass_flow}[\text{kg/s}] \times 9.81 \times \text{height}[\text{m}] / 1000$; allow for losses.

Digital Condition Monitoring

AIQ and DIAGNOSTEX

- Temperature, speed and vibration trending
- Identify developing anomalies and plan maintenance
- Sensor options differ by gearbox platform
- Monitoring does not replace mechanical design checks

RFQ — Mechanical Data

Minimum information for technical selection

- Existing type, serial number and nameplate photo
- Input power/speed; target output speed and torque
- Duty cycle, starts/hour, shock and overload spectrum
- Shafts, mounting position, center height and drawings

RFQ Data: Environment

Application-specific inputs

- Ambient temperature, altitude and dust
- Indoor/outdoor and hazardous area
- Operating hours and start frequency
- Cooling, lubrication, backstop and monitoring needs

Technical Bid Evaluation

Compare alternatives consistently

- Torque/rating basis and ratio deviation
- Thermal and external shaft load capacities
- Installation compatibility and modification scope
- Documentation, availability and lifecycle cost

Bid check	Evidence
Nominal torque	catalog rating
Thermal power	conditions
Radial loads	allowable load
Dimensions	GA drawing
Accessories	confirmed BOM

MECHATRIC Engineering Support

Technical selection • RFQ • replacement

- Industrial gearbox and drive-train selection
- Gearbox/coupling compatibility review
- Equivalent evaluation and retrofit support
- Industries: cement, mining, steel, petrochemical, power

References & Selection Gate

Technical sources and approval

- FLENDER Gear Units MD 20.1 (2018) — historical catalog basis
- FLENDER Bucket Elevator Drives MD 20.2; Conveyor Drives MD 20.6
- FLENDER ONE / PLANUREX 3 — verify latest manufacturer data
- Approval gate: torque, fatigue, ratio, thermal, shaft, safety, interfaces

Engineering-Led Drive Solutions



Gearbox Selection • Replacement & Equivalence • RFQ Technical Review

Cement | Mining | Steel | Petrochemical | Power Generation