

MAXe3 HX Motors for Belt-Driven Pumps & Fans | TECO

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Technical Articles

Bearing and Shaft Specification for Belt-Driven Pump and Fan Motor Applications: the TECO MAXe3 HX Frame Series

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PUMP & FAN MOTOR APPLICATIONS

Belt-driven machinery imposes a specific and continuous mechanical load on the motor that drives it. Unlike direct-coupled applications, where shaft loading is primarily axial or torsional, belt or chain drives generate a radial force on the drive-end shaft and bearing. That force is present whenever the motor operates under load, with its magnitude determined by belt tension, sheave geometry, and the distance between shaft centres.

In pump and fan applications across mining and heavy industrial environments, this load profile is further intensified by continuous S1 duty cycles, high ambient operating temperatures, and limited opportunities for early intervention when bearing degradation begins. The response to this is not a heavier-grade standard motor; it is a frame specification designed specifically for a higher radial load. The HX designation in the TECO MAXe3 Mining has been developed to meet this requirement.

Atheer Yaseen Nashi, Product Manager for Low Voltage Motors at TECO Australia and New Zealand, explains the engineering principles behind the TECO MAXe3 HX frame and its role in pump and fan motor selection.

Q: What does the HX designation refer to in the TECO MAXe3 Mining range, and what distinguishes it from a standard TECO MAXe3 frame?

A : HX refers to a reinforced frame specification applied to the larger frame sizes within the TECO MAXe3 Mining range , specifically D315MC through to D355CC.

The primary differences are at the drive end, where an oversized shaft and oversized drive-end bearings are included as standard features of the HX frame, rather than optional upgrades. The reinforcement is engineered into the motor from the outset.

This distinction is important in practice. When bearing or shaft modifications are made to a standard frame, the overall frame geometry may not be designed to accommodate the resulting load path.

By contrast, the TECO MAXe3 HX frame is designed around the reinforced drive-end specification from the beginning.

Q: What radial loads do belt-driven pump and fan applications typically impose on a motor drive-end bearing, and why does this differ from direct-coupled applications?

A : In a direct-coupled application, the motor shaft and driven equipment shaft are aligned, meaning torque transmission is the primary load and bearing loads in that arrangement are modest in the radial direction.

A belt or chain drive is fundamentally different. To transmit torque, the belt must be under tension, and that tension creates a radial force on the motor shaft acting perpendicular to the shaft axis.

The magnitude of this force depends on the transmitted power, the speed ratio, the belt type, and the sheave diameters. For pump and fan applications within the frame sizes covered by the HX specification, radial loads can be significant, particularly where long belt spans or high-tension narrow-belt arrangements are used.

Standard frame bearings are typically selected based on assumptions of moderate radial loading. By contrast, the TECO MAXe3 HX bearing specification is designed to accommodate higher radial load requirements, providing greater suitability for demanding belt-driven applications.

Q: How does the oversized shaft specification contribute to bearing life and overall drive-end durability in belt-driven applications?

A : The drive-end shaft diameter directly influences the bearing selection, as it determines the bearing bore size, and consequently the available load rating. A larger shaft diameter allows for a larger bore and, therefore, a higher dynamic load rating.

For a given radial load, a higher dynamic load rating relative to the applied load results in a longer calculated L10 bearing life. The benefits extend beyond the bearing itself. A larger shaft cross-section at the point of maximum bending stress increases shaft stiffness and reduces deflection under radial load. Excessive shaft deflection can affect the alignment between the bearing's inner and outer races. However, by minimising deflection, the bearing can operate closer to its intended design geometry, helping it achieve its rated service life.

The TECO MAXe3 HX shaft specification addresses both of these critical factors: enabling the use of higher-capacity bearings and increasing shaft stiffness at the point of load application, ultimately improving reliability in high-radial-load applications.

Q: What thermistor protection is built into the TECO MAXe3 HX frame, and how does it support condition monitoring in belt-driven applications?

A : Dual thermistors are standard on TECO MAXe3 HX frames and are connected to independent alarm and trip outputs via a dedicated auxiliary terminal box. This dual thermistor arrangement allows one sensor to trigger an early-warning alarm while the second initiates a trip if the winding temperature reaches a critical threshold.

In belt-driven applications, bearing deterioration often presents as increased friction and heat before progressing to mechanical failure. Thermistor-based temperature monitoring can therefore provide a

strong diagnostic signal, helping maintenance teams identify potential issues before they become critical. While it is not a substitute for vibration monitoring, it provides an additional data point that can be incorporated into a condition-based maintenance programme.

The dedicated auxiliary terminal box separates the monitoring circuit from the main power termination, which simplifies wiring and reduces the risk of interference during maintenance activities.

Q: What specific pump and fan applications in mining and industrial environments does the TECO MAXe3 HX frame series address?

A : The primary applications for the TECO MAXe3 HX range are belt-driven centrifugal pumps, axial and centrifugal fans, and blowers in process air applications.

In mining environments, this includes dewatering pump installations where belt drives are used to achieve a specific speed ratio, mine ventilation fan installations, and process water pump circuits supplying mineral processing equipment.

The TECO MAXe3 HX frame size range, from D315MC to D355CC, is designed to meet the power requirements typically associated with these installations, with the medium-to-large range.

For smaller frame sizes, where radial load demands remain within the capability of a standard bearing specification, the standard TECO MAXe3 Mining frame is suitable. It is worth noting that all TECO motors from the 250 frame size and above are fitted with a roller bearing at the drive end.

The HX specification is targeted at frame sizes where the combination of the power level and belt-driven load profile takes the application beyond what a standard bearing selection can comfortably support over a specified maintenance interval.

Q: What should a specifier confirm when selecting between a standard TECO MAXe3 Mining frame and a TECO MAXe3 HX frame for a belt-driven application?

A : The key inputs for motor selection are the radial load at the drive-end bearing and the expected duty cycle. Calculating radial load requires several parameters, including motor output power, drive-end shaft speed, motor sheave diameter, and the belt tension factor associated with the belt type being used. From these inputs, the radial force can be calculated in kilonewtons and compared against the bearing load rating at the relevant operating speed.

If the calculated radial load falls within the standard frame bearing specification while meeting the required L10 bearing life, a standard frame motor is generally suitable. If it does not, then the TECO MAXe3 HX specification becomes the appropriate choice.

In practice, for belt-drive applications, within the D315MC to D355CC frame size range, specifiers should consider the TECO MAXe3 HX frame as the default starting point and then determine whether the standard frame can adequately meet the application's load and life requirements, rather than approaching the selection process in reverse.

Additional factors that should be assessed include any overhung load imposed by external sheaves or couplings, the operating ambient temperature, and whether the motor will be controlled by a variable speed drive (VSD), as this can influence the motor's thermal profile.

Q: How does the HX specification integrate with the broader MAXe3 Mining range features in terms of IP protection, insulation, and efficiency?

A : The TECO MAXe3 HX frame specification retains all the core features of the standard TECO MAXe3 Mining range, including IP66 ingress protection , Class H insulation, high IE3 efficiency ratings, and the ability to operate at full output in.

The HX designation adds a reinforced drive-end shaft and bearing arrangement, along with dual thermistor protection connected through a dedicated auxiliary terminal box. Rather than being a separate product line, it is an extension of the TECO MAXe3 Mining specification into larger frame sizes where the drive-end reinforcement becomes a relevant engineering requirement.

IEC frame dimensions are maintained across the HX range, allowing the motors to integrate mechanically with existing installation geometries in most belt-driven pump and fan applications, including the direct replacement of motors that have reached the end of their service life.

PRODUCT REFERENCE

Product	TECO MAXe3 Mining (HX frame series)
HX frame range	D315MC to D355CC
Drive-end spec	Oversized shaft and bearings, standard on HX frames
Thermistor	Dual: independent alarm and trip outputs, dedicated auxiliary terminal box
IP Rating	IP66 Protection
Insulation	Class H (180°C)
Ambient rating	60°C at full output, no de-rating
Efficiency	IE3 (AS/NZS 1359.5 / IEC 60034-30-1)
Full power range	150kW to 450kW (complete MAXe3 Mining range starts from 0.18kW)
Primary applications	Belt-driven centrifugal pumps, mine ventilation fans, process air blowers
Company and Division	TECO Australia & New Zealand, Electric Motors Division

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