FLUXDRIVE®

ENERGY EFFICIENCY MADE EASY

Flux Drive FAQs

Frequently Asked Questions

VERSION 1.1

FLUX DRIVE MADE IN USA

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GENERAL QUESTIONS

Q What is a Flux Drive?

A Flux Drive manufactures Adjustable Speed Drives (ASDs) and 'Soft-Start' Couplings that transfer torque by means of magnetic induction across a 'soft-torque' air gap. These patented devices can be thought of as a frictionless transmission or clutch between a motor and pump, fan, blower, or other rotating machinery. The Coupling eliminates high-peak power demand during start-up and the ASD provides significant energy savings during reduced speed operation.

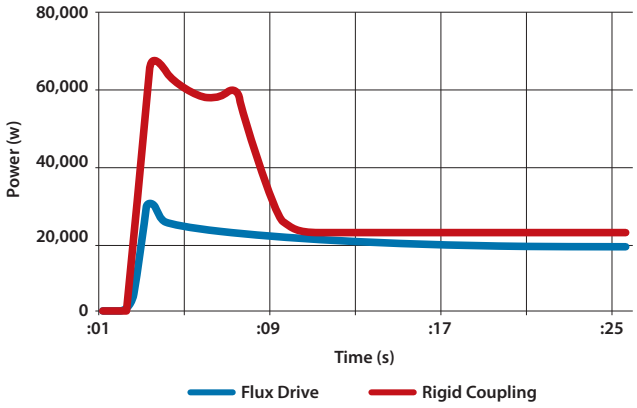
Q How does a Flux Drive work?

A A Flux Drive is made of two main components: (1) an outer 'magnet can' assembly containing an array of permanent magnets with (2) an induction rotor placed inside the magnet can, which provides a continuous (always on) magnetic flux source. These two components are separated by a small air gap and have no physical connection or surfaces in contact. As the magnet can turns on the motor shaft, the induction rotor located inside the can (and connected to the load shaft) starts to rotate due to magnetic induction which in turn creates a coupling force across the air gap. Slight relative motion (called slip) always occurs during the induction process which is designed to be less than 2 percent at full torque / power.

Q What's the benefit of the Flux Drive 'Soft-Start' Coupling?

A Flux Drive flexible 'Soft-Start' Couplings provide an almost one-to-one transfer of power from the motor to the load. Couplings are sized to transfer 100% of the motor's torque at 1.5% slip (therefore 98.5% efficient).

The 'soft-start' capability is inherent in the coupling design and ultimately limits the full torque / power at start-up to 140 percent of the coupling's full rated power. No longer is a motor subject to high locked-rotor currents nor does the electrical system have to provide high peak power during a motor starting event. In addition, the coupling provides over torque protection during a load shaft seizure event by also limiting the torque and power.



The couplings are simple mechanical devices that are easy to install and require no electrical training (unlike other soft-start solutions using sensitive electronics). Ongoing operation and maintenance is affordable with no touching parts or sensitive electrical components to replace.

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Q What is the difference between the Flux Drive Soft-Start Coupling and the Adjustable Speed Drive?

A The Flux Drive Adjustable Speed Drive (ASD) is a 'Soft-Start' Coupling with the ability to configure the linear engagement between the rotating magnet can and the induction rotor assemblies. Adjustable speed is achieved by controlling the overlap of the rotor inside the magnetic can. As the can and rotor are disengaged, the slip increases allowing the output rotor speed to decrease proportionally.

Q What's the biggest benefit of the Flux Drive - Adjustable Speed Drive?

A Substantial energy savings. In centrifugal applications, system power requirements vary with the cube of the pump speed or flow. Small decreases in speed or flow can significantly reduce energy use. For example, reducing the pump speed flow by only 20% will reduce input power requirements by as much as 30% with a Flux Drive ASD.

Q What are other benefits of Flux Drive Adjustable Speed Drives and Soft-Start Couplings?

A Beside lower power requirements, Flux Drive devices offer:

- Easy Installation
- Less Vibration & Noise
- Retrofitting to Existing Motors (no inverter duty motors required)
- Reduction in Life Cycle Costs (serviceable for 20+ years)
- Harsh Environment Operation (designed for wet, hot and corrosive operation)
- Elimination of Locked Rotor Conditions (with 'soft-start' and load shaft seizure protection)
- No Harmonic Interference (no harmonics created nor filtering required)

Q Are rare-earth permanent magnets really rare?

A A major component of the Flux Drive ASD and Coupling are rare-earth (RE), Neodymium, Iron, Boron (NdFeB) permanent magnets. These magnet materials are not actually rare, but are found in the rare-earth section of the Periodic table; specifically the fifteen lanthanoids plus scandium and yttrium. These magnet materials are actually very common and mined at various locations around the world as follows (including estimates % of deposits): 1) China (36%), 2) Russia (20%), 3) USA (15%), 4) Australia (5%), 5) India (3%), others (21%).

As noted by their name, permanent magnets are magnetized for life, and will operate the Flux Drive ASD and Coupling for hundreds of years if operated within the Flux Drive standard specifications. These RE magnets became commercially available in the early 1980's and have become the standard for permanent magnet motors and generators world-wide. They will retain their performance with temperatures up to 350 degrees F, and last for hundreds of years without loss in performance.

The Flux Drive magnet can contains an array of permanent magnets arranged to provide high strength magnet flux for torque transmission to the Induction Rotor. Patented magnetic circuits create the extremely high efficiency coupling and the base design for the adjustable speed drive. The magnetic circuit is completely contained inside the magnet can, with no magnetic flux leaking outside the can assembly.

All standard field maintenance can be performed without having to remove the induction rotor from the magnetic can. The magnet can pilot bearing can even be changed without disassembling the Flux Drive device. Removal of the Induction Rotor from the Magnet Can assembly will void the warrantee of the Flux Drive device and is not recommended.

COMPLIANCE AND DESIGN

Q Is the Flux Drive manufactured to some type of design standard?

A Yes. Flux Drive products are designed and built to standards based on rules and requirements of the Certificate of Design Assessment program (PDA – Product Design Assessment) – Issued by ABS (American Bureau of Shipping) USA

Product: Coupling, Speed Drive, Adjustable

Intended Service: Marine and offshore applications – pumps, blowers, and compressors

Comments: This Product Design Assessment (PDA) is valid for products intended for use on ABS classed vessels, MODUs or facilities which are in existence or under contract for construction on the date of the ABS Rules used to evaluate the product.

Term of Validity: Issued 12/Feb/2010 and expires 11/Feb/2015 and is renewable.

Q How does a Flux Drive withstand harsh environments?

A The Flux Drive ASD and Couplings are purely mechanical devices that have coatings designed for harsh environments. Steel components have standard Zinc (ASTM B633;SC2; Type II) and can be upgraded to nickel / chrome as may be required. Aluminum has hard coated anodizing (Mil-A-8625; Type II, Class 2). Magnets are coated with electroless nickel plated and all fasteners are either zinc or CAD coated or made of 304SS.

Q Will a Flux Drive ASD or Coupling operate on a medium voltage (4140 volt) motor application?

A Yes, since both the Flux Drive ASD and Coupling are purely mechanical devices, no additional design changes are required for different voltage motors.

Q Is a Flux Drive easy to install?

A Yes. It is a purely mechanical ASD requiring only hand tools to install and is easily maintained with off the shelf replacement components. There are no longer complicated VFD manuals to read and understand in order to setup and run in automatic mode.

Flux Drives are simple and economical to install and maintain:

- They do not require highly skilled and expensive personnel to maintain or service
- Will Operate in harsh environments without special enclosures or a dedicated machinery room
- Backup hand-wheel operation is provided with the 4-20mA automatic actuator
- They can be operated with just a manual actuator (no power required)

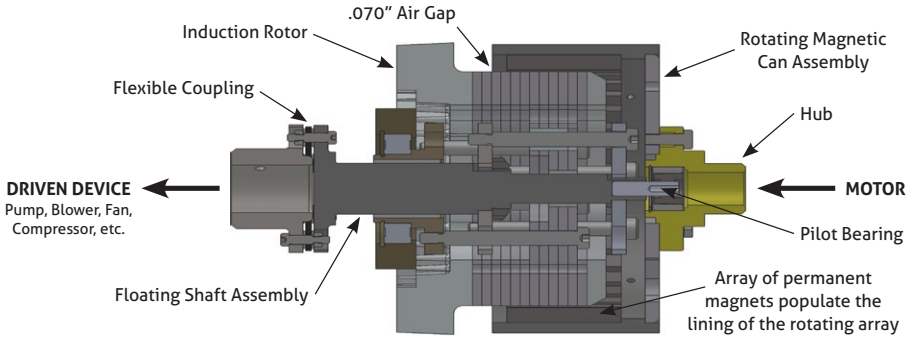
Q How can a Flux Drive be retrofit to an existing system?

A Flux Drive in-line ASDs or couplings are installed in-between a motor and the load / output shaft. In this case, the motor may need to be moved back by making slight modifications to the foundation or installing a rail kit that can often be fit onto the existing foundation. The Flux Drive belt sheave Coupling or ASD are mounted on the motor and replace the existing pulley/sheave. This simple installation requires no base modifications and is often accomplished in a few hours.

Q Does a Flux Drive ASD or Coupling require Laser Alignment?

A No. A novel design feature incorporating a floating shaft and a pilot bearing to center the Induction Rotor inside the Magnet Can (mounted on the motor) makes the alignment process easy. Plastic alignment spacers held in place with 4 jacking bolts (located at the 4 clock positions) keep the rotor centered at the free end of the magnet can. (See diagram below)

At this point, the output rotor (load) shaft is then rough aligned to the coupling flex pack hub by moving the motor up/down and side to side. When the coupling fitted bolts fit into the flex plates, the motor is tightened in place. Now the Magnet Can jack bolts can be loosened and the plastic shim spacers will be loose and can be removed – YOU ARE now aligned to within tolerance (0.010" – 0.015"). The acceptable alignment tolerance (off-set) for the coupling is 0.020". Mis-alignment can be tolerated at even greater off-sets with substantial increases in vibration levels. (Note: the design air gap = 0.070")



ENERGY SAVINGS AND ROI

Q How does the Flux Drive save power when the motor is running at a constant speed and not slowing down?

A In this case, the simplified motor power equation = Voltage (V) x Current (I). When the load on the pump decreases by slowing it down with a Flux Drive ASD, the motor continues to run at its constant speed (i.e., 1200, 1800 rpm) but the motor current (I) reduces, thereby reducing the load / power on the motor. Another good analogy is to look at riding a bike on a flat level grade. When keeping the pedal speed constant (no shifting) and starting to go up a hill, it takes much more energy (power) than going downhill. The person in this case is acting like a constant speed motor and consuming more or less power while operating at constant speed.

Q How does the Flux Drive ASD (Adjustable Speed Drive) influence the power factor?

A Operation of all AC induction motors at reduced power will decrease the power factor of the local system. This is a result of operation at reduced speed/power and not directly caused by the Flux Drive ASD. In rare occasions, Utility providers may charge a penalty if the facility's power factor is below an acceptable pre-determined level in that region. Experience to date has shown that power factor correction has not been an issue with the installation and operation of ASDs. In the rare case, that power factor correction may be required, inexpensive power factor correction capacitors can be easily installed at each motor, and sized as required.

Q What is the reliability and longevity of a Flux Drive?

A The Flux Drive is a mechanical device incorporating a simple design, with long life bearings that are serviceable and will easily last the lifetime of the motor, which can be 20–30 years. The Flux Drive is 100% re-buildable, unlike a VFD that can often be obsolete after 2–5 years. We estimate that over a 20 year period the average VFD user will have to replace a VFD every 3 to 5 years. That is roughly 4 VFDs to 1 Flux Drive over the life time of the application.

Q How can a Flux Drive reduce life cycle costs?

A The Flux Drive coupling and ASD are designed for long life (>20 years) with standard off the shelf bearings that are serviceable for life. In addition, the device does not have any torque bearing parts that touch between the magnetic can (on the input shafting) and the induction rotor (on the output shafting). The Flux Drive transfers torque through the air gap via magnetic flux transfer of torque / power. Coupling failures from misalignment or high torque loading / pulsations are now eliminated.

Q What is a typical ROI for the Flux Drive ASD?

A Typical ROI is 18–30 months (not including energy saving rebates). Power providers often provide grant rebates for saving power that can pay up to 70% of the total installation costs and reduce the ROI to months from years.

Q What are the drivers of the Total Cost of Ownership of Flux Drive products?

A While magnetic coupling technology can have higher up-front costs compared to electronic VFDs, the ROI and Total Cost of Ownership analysis show that there is more value for the dollar spent on the Flux Drive technology than the traditional VFD technology. While the VFD's "off the shelf" price may look appealing, the hidden cost to install, maintain and replace is far more expensive than the Flux Drive magnetic technology.

Other factors influencing Total Cost of Ownership of a Flux Drive ASD:

- 20 year serviceable life (compared to 5–7 year for VFD)
- Mechanical device, no high tech workforce required
- No A/C required nor does it need to be maintained
- No grounding brushes and required maintenance
- No line reactors or harmonic filtering required
- No upgrades to inverter duty motors
- No motor overheating due to harmonics
- Motor runs at design / best efficiency and full speed remaining cool
- No upgrade to NEMA-4 enclosures for tough environment
- Operates with medium voltage (2300, 3300, 4160 volt) motors

APPLICATION AND ENGINEERING

Q Does the Flux Drive ASD or Coupling create heat when running?

A During full power/torque operation of the ASD and Coupling, both are designed to operate with only 1.5% slip (at 98.5% efficiency) and will produce no noticeable heat on the Induction Rotor. This highly efficient power transfer is inverse to electronic VFDs, where losses and heat generation are a maximum at full power operations. This condition requires the VFD to provide maximum cooling at the highest power levels and results in substantial energy losses that are documented to be between 5–7%. In many VFD installations, climate controlled rooms are required at a cost of additional space and power.

During variable (reduced) speed and power operations for centrifugal systems (i.e., pumps, blowers, and fans) the Flux Drive ASD is slipping to adjust the output shafting to meet the required system flow rates. During this condition, heat will be generated on the induction rotor and dissipated by the cooling fin design.

A maximum fin temperature of 350 degrees F can be normal for steady state conditions at reduced RPMs and remain within design specifications. Exhaust air from the cooling fin is typically about 150 degrees F. The point in the speed range of maximum heat generation will be at 33% slip (note that the power is reduced to only 35% based on Affinity power curve), but is generated at a point in the cubic power curve that has much less power loss when compared to maximum VFD losses (4–6%) at 100% power.

Q How does the Flux Drive ASD and Coupling perform with constant torque loads?

A In constant torque applications, speed reduction is limited with all mechanical adjustable speed drives including the Flux Drive ASD. Since the power required is not actually reduced during the speed reduction to the driven load (the torque is constant), the Flux Drive ASD is limited to a ten (10) percent reduction in speed (turn down) unless the ASD is oversized for the specific application with Flux Drive pre-approval. This is due to direct heating issues that occur since the load torque (and corresponding power consumed) is constant throughout the entire speed / operating range.

It should also be noted that constant torque applications provide limited energy savings during any reduction in speed of the load shaft. There are no restrictions in operation for constant torque loads with the Flux Drive Coupling. The coupling's 'soft-start' capability is not limited and the performance is excellent with full torque/power performance at 98.5% efficient. Examples of constant torque loads are conveyor systems, feeders, winders, mixers and positive displacement pumps and compressors.

Q How does the Flux Drive eliminate locked rotor conditions or coupling failures?

A The 'soft-start' capability is inherent in the Coupling and ASD designs and ultimately limits the full torque / power at start-up (and all operating conditions) to 140 percent of the couplings full rated power. No longer is a motor subject to high locked-rotor currents nor does the electrical system have to provide high peak power during a motor starting event. In addition, the coupling provides over torque protection during a load shaft seizure by also limiting the torque and power to a maximum of 140 percent of full rated power / torque.

Q When using a Flux Drive ASD or Coupling, what happens during a load shaft seizure event?

A Both the ASD and Coupling will limit the maximum torque/power delivered during the seizure event to 140%–150% of the rating of the Motor and Flux Drive (if sized based on motor nameplate data). During this event, the Class 10 motor trip will trip the motor after the predetermined time (typical 30–40 sec) and save the system from catastrophic damage.

Q How does the Flux Drive ASD provide automatic (closed loop) control and hold a setpoint?

A The Flux Drive ASD uses a Rotork® electronic digital electric actuator to automatically adjust the speed of the ASD output shaft based on an analog control signal (4-20 mA or 0-10 volts). The actuator provides smooth, highly accurate positioning (speed control) with positive position-lock when not in motion. These rugged actuators may be mounted in any position and will withstand the most adverse environmental conditions.

Q Why is the Flux Drive, Magnet Can assembly installed on the motor?

A We recommend installing the Magnet can on the Motor shaft to make it easier to perform maintenance on the NDE (non-drive-end) pump, blower or fan. By leaving the entire Magnet Can and Rotor assemblies installed on the motor, the flexible disk pack can be dis-assembled (by removing only 3 fitted bolts) and then the complete Motor and Flux Drive assembly can now be moved to the side allowing access to the NDE machine. Note: during this process, the Induction Rotor assembly should be centered in the Magnet Can using the plastic shim spacers and the four (4) jacking bolts provided.

In the case of a gearbox, the Magnet Can should be mounted on the gearbox to allow the induction rotor fan to run at maximum speed all the time. This provides maximum cooling, which may be required for constant, high torque devices.

FLUX DRIVE VS. COMPETING TECHNOLOGIES

Q Who are Flux Drive competitors in the adjustable flow/speed control market?

A The most common type of flow control in the market is throttling control valves and dampers. These devices waste large amounts of energy in centrifugal applications where system power requirements vary with the cube of the pump speed/flow. The Flux Drive ASD is ultimately about saving energy by varying the drive speed and offers an elegant mechanical solution with the highest efficiencies possible without introducing damaging harmonics to motor / electrical systems.

Other types of speed / flow control devices are as follows: 1) fluid drives, (2) mechanical belt devices, (3) eddy current drives, and (4) electronic drives called variable frequency drives (VFDs). The major competitor to Flux Drive technology being the VFD; which is well developed and has also proven to have numerous operational issues and problems.

Q Why use a Flux Drive Adjustable Speed Drive instead of a Variable Frequency Drive (VFD)?

A Variable Frequency Drives adjust the output speed of a motor by varying the frequency of and the voltage supplied to the motor. This method of speed control has a number of drawbacks: it wastes energy by creating harmonics, it must be shielded for harmonic interference, it requires costly installation procedures, it doesn't work well in harsh or humid environments, and it is inherently an unreliable system due to its complex nature. The Flux Drive Adjustable Speed Drive, by contrast, is a simple mechanical device that saves energy, is easy to install, and is very reliable.

Q What are the principal advantages of a Flux Drive over a Variable Frequency Drive?

A While Variable Frequency Drives are also energy saving devices, their installation and operation is not always practical or cost effective. This is due to the inherent problems in their reliability, complex electronic components, and a need for extensive infrastructure and highly trained personnel to program and service these devices. The other major problem with the VFD technology is that electronic harmonics generated by the drive require mitigation with additional equipment to be installed and maintained.

The simple and reliable Flux Drive ASD is ideally suited for pump, fan and blower applications providing the energy savings of speed control without the problems often associated with VFDs. In these installations, system complexity is reduced, vibration is eliminated and harmonic distortion problems disappear. In addition, the Flux Drive technology makes adjustable speed control available to markets previously resistant to using VFDs.

Q What other advantages does a Flux Drive have over a Variable Frequency Drive?

A Unlike VFDs, Flux Drive devices:

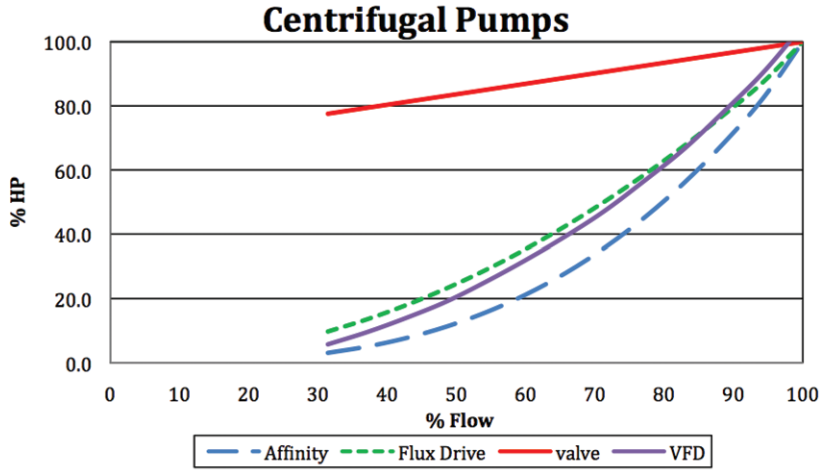
- Operate with any voltage motor without high cost upgrades
- Require no special filters and reactors
- Require no inverter duty motor
- Do not cause motor overheating at reduced pump or blower speeds
- Operate with zero harmonic interference and no power quality issues
- Create no motor noise as from harmonic (VFD) power sources
- Do not introduce stray shaft currents like VFDs causing bearing damage
- Do not require expensive bypass starters
- Are not affected by electrical disturbances or lightening
- Do not create system electrical problems (harmonics, heating, etc.)
- Eliminate nuisance dropouts that occur with VFD control/power circuits

Q Why does a Flux Drive have less vibration and noise than VFD?

A A Flux Drive does not introduce Harmonics that are created by electronic (VFD) drives. As a result of the harmonics, the VFD creates audible noise and vibration in the motor. The harmonics are always present and as a result, a motor powered by a VFD needs to be upgraded to Inverter Duty rated in order to run without failing. Even with this upgrade, the noise and vibration remains and can also cause stray shaft currents that will still destroy motor bearings. By switching to a Flux Drive ASD, all these problems are eliminated.

Q How does the efficiency of the Flux Drive ASD compare to a VFD?

A An example showing the Flux Drive ASD performance vs. a throttling valve and a VFD (at varying flow rates and horsepower) is shown below. Note that both the Flux Drive ASD and the VFD provide substantial energy savings over the Throttling Valve line, but operate with powers above the pure Affinity curve. This is because of real world conditions that take into account the complete pumping system including the efficiencies of the Motor, Flux Drive (or VFD), Pump, and the pump system curves.



Q How does the efficiency of the Flux Drive ASD compare to a VFD at full power?

A During full power/torque operation, the Flux Drive ASD and Coupling are designed to operate with only 1.5% slip (at 98.5% efficiency) and will produce no noticeable heat on the Induction Rotor. This highly efficient power transfer is inverse to electronic VFDs, where their losses and heat generation are at a maximum during full power operations. This condition requires the VFD to provide maximum cooling at the highest power levels and results in substantial energy losses that are documented to be between 5-7%. In many VFD installations, climate controlled rooms are also required at a cost of additional space and power.

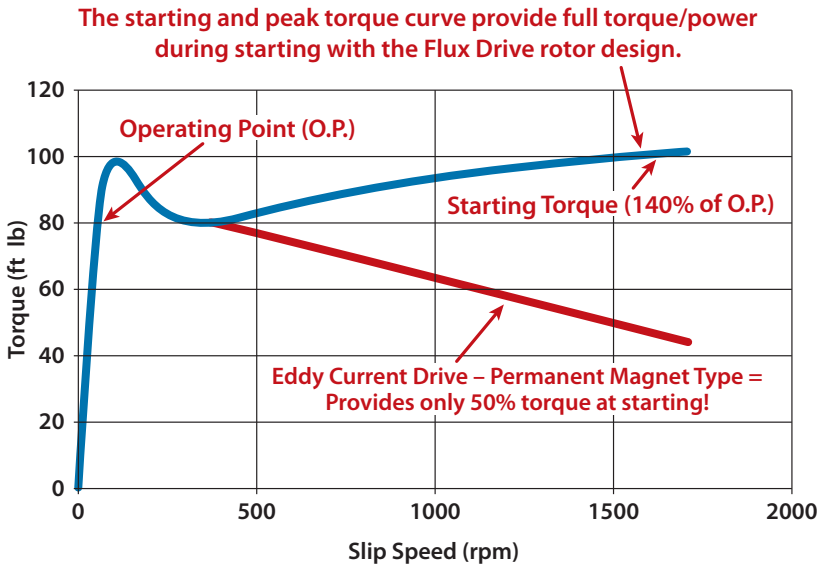
Q Are Flux Drive Couplings similar to older Hydrodynamic / Fluid Couplings?

A YES and NO. Yes, the Flux Drive 'soft-start' Couplings provide soft and smooth starting to insure maximum life of the system components but do so without the potential of leaking fluids or overheating oil. Environmental concerns are no longer an issue since the Flux Drive works with only magnetic flux that is completely contained inside the magnetic can assembly and provides high efficient power transfer at 98.5%. There are no contacting surfaces to wear out and virtually no maintenance. Serviceable design life is well over 20 years.

Q Is the Flux Drive an Eddy Current type device?

A NO. The Flux Drive is an Induction device that follows AC motor theory and design. As a result, the device is ½ the size of eddy current drives (for same HP) and operates at higher efficiencies (98.5% at full power/torque). In addition and most importantly, the torque curve of the Flux Drive produces up to 140% torque at 100% slip (during starting). This allows the Flux Drive to start high inertia loads (i.e., conveyors, etc.) with plenty of torque available.

To the contrary, Eddy Current drives have a distinctive torque profile that rolls off at 100% slip and can create a 'stall' or slip condition that will not allow the torque to be produced and eventually overheat the eddy current drive after not being able to start (accelerate) the load shaft. (see slip curve noted below)



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Q Are Flux Drive Adjustable Speed Drives similar to older Eddy Current Drives?

A NO. Older Eddy Current Drive technology used electromagnets that must continuously draw power to operate and create a magnetic field to develop variable torque. Those drives are also about twice as large due to being much less efficient than the Flux Drive ASD. Eddy current devices also have a completely different torque profile / curve over the entire speed range of operation. This is the biggest and most important difference between the Flux Drive and even the newer technology permanent magnet eddy current drives. All eddy current drives have torque curves that only produce about 50% of their full power / torque at a 100% slip condition (the starting event). In comparison, the Flux Drive produces 140% at start-up, thereby allowing high inertia loads (i.e., conveyors) to be started with product on the belt. This condition also allows the motor to trip off line (with standard Class 10/20 trip curves) in the event of an overload condition or load shaft seizure event.