JOHNSON GEAR
Right Angle Gear Drive

1333 East 44th Street
Lubbock, Tx 79404
Phone: (806) 749-6400 Fax: (806) 749-6477

Ref: Diesel Engines vs. System Performance

For the past several years we have seen our customers being trapped by torsional problems that present themselves after a pumping system is manufactured and delivered.

Pump manufactures assume responsibility for system performance in most cases. Project specifications do not always require that a torsional analysis be performed on the system. When torsional problems present themselves, the pump manufacturer must resolve the problems. The cost to the pump manufacturer is very high at this point, and in most cases will cause a loss on the project.

During the past 25 years engines have changed. These changes have been accelerated during the past 36 months and are not limited to the following:

1. Reduction in weight and number of cylinders
2. Increase in speed to deliver horse power
3. Increase in peak cylinder pressure with turbo charging
4. Lower fuel consumption and exhaust emission – due to competition and government regulation (Engines now deliver 200 HP with 4 cylinders, where 6 cylinders and even 8 cylinders used to be required.)

There are two constants that should be remembered.

1. We, as a gear drive manufacturer, have not reduced the size or weight of the gear drive.
2. The pump manufacturer has not reduced the size or weight of the pump.

Modern lightweight engines produce much higher torsional disturbances than engines produced 3 to 4 years ago. The resulting higher vibratory stresses determine the limiting fatigue life of the pumping system components. (Vibratory stresses induce fatigue cycles, which destroy the pumping system components. The component in the system with the least amount of allowable fatigue cycles fails first.)

With the increase in torsional impulses, the pumping system must be carefully tuned by means of a torsional soft component (torsional coupling, torsionally resilient drive line) that should be located between the engine flywheel and the driven equipment.

With current diesel engines you have about a 1 in 100 chance of a pumping system running successfully without the incorporation of a soft coupling in the pumping system.

The pump manufacturer and the gear drive manufacturer will not warranty products that have been subject to torsional damage.

Ref: Diesel Engines vs. System Performance

It is very important for the system designer and the pump installer to educate the end user as to the importance of a torsional coupling in a system.

In these times of economic hardship, no one can afford the financial exposure of a torsionally unbalanced system. For this reason you should push and sell either a soft coupling or torsionally resilient drive line with every pumping system.

Advantages of the torsionally resilient component:

1. Buffering vibratory torque from the diesel engine at operating speed.
2. Protection from variation in operating speed. While, if fortunate enough to have no noticeable damaging vibratory torque at the pump operating speed, the torsionally soft component gives protection for operating near or at speeds where damaging vibratory torque is present.
3. Non-reverse protection. The non-reverse engages to stop the pump from reverse rotation. At the time the non-reverse engages, the engine stops forward rotation and decompresses (rolls back) against the non-reverse device. The resulting decompression is a metal-to-metal impact. (Example – Strike the discharge head with a sledgehammer. You knock a chunk out of it. Strike the discharge head with a soft- faced hammer of the same weight. There is no damage. The torsional coupling puts a soft face on the engines hammer reducing damage.

Every project, which requires a diesel engine driver, should have torsional protection. The initial cost of the torsionally resilient component is minimal compared to replacing equipment already purchased after the torsional problem is discovered.

We encourage engineering firms to require a coupling or torsional analysis in their specifications. Every effort to eliminate torsional damage to the pumping system must be taken during the design and material specification stages on the project.

We have enclosed our engineering bulletin and a list of torsional couplings which we have available from stock.

Engineering Bulletin – Torsional Damage

Over the past 10 years, the use of diesel engines to drive right angle drives, and pumping systems has increased. Competition among engine manufacturers has led to a drastic reduction in engine weight, increased compression ratios, and turbo charging. The end result is that the transfer of power from the engine to the driven equipment is not as fluent as it was. Along with the new engine innovations has come the premature failure of the components in the pump system caused by operating at or near a torsional resonate speed (+/- 10%). Typical modes of failure are broken crank shafts, drive line shafts twisting in two, broken input shafts, broken gear teeth, bearing cage failure, and broken head shafts. Vibratory torque much higher than the rated torque of driven components is not uncommon.

With engine drive systems, it is not uncommon for one or more resonate speeds to exist between zero and the operating speed of the system. Continued operation at a resonate speed will result in torsional vibrations which can be damaging to all components in the system. Unusual rumbling or clattering noise from the gear drive at a sharply defined speed is the most common indication of torsional vibrations. As the speed is increased or decreased the noise will disappear. This noise is not indicative of a defect but results when the vibratory torque exceeds the drive torque causing the gear teeth in the gear drive to separate and clash together very rapidly. Transition through a resonate speed range to a operating speed is not normally damaging, but operation of the system close to a resonate speed should be avoided. To avoid operation at a resonate speed it may be necessary to change the elastic characteristics of the rotating components in the system, or change the speed of the engine with respect to the pump. This can be accomplished by changing the gear ratio of the gear drive.

JOHNSON GEAR, is a supplier of only one component in the pumping system, we have no control over system design, or engine selection. It is the responsibility of those who select the equipment for the pumping project to assure that damage to any component does not occur due to Torsional Vibration.

JOHNSON GEAR does not warranty products that have been subject to torsional damage.

This torsional coupling is designed to be installed with systems using U-joint drivelines and standard gear drives. The bonded-rubber element is manufactured by Ringfeder and is self-supporting. The coupling has been selected with the best compromise of torsional characteristics for engines operating between 1200 and 2400 rpm. In most cases the standard element will work. If all operating parameters are known, a torsional vibration analysis can be performed at an extra cost. If needed, rubber elements with different torsional characteristics can be supplied. Different selections may be determined by operation or analysis.

(Ringfeder Corp. – 201-666-3320)

In most cases, the coupling can be installed with minimal modifications to the driveline shaft length and guarding system.

WARNING: ROTATING SHAFTS AND THE COUPLINGS ARE DANGEROUS AND CAN CAUSE SERIOUS INJURY. AN ADEQUATE GUARD MUST BE INSTALLED AROUND THE COUPLING AND THE DRIVE SHAFT BEFORE OPERATION OF THE GEAR DRIVE. THE GUARD IS NOT SUPPLIED BY JOHNSON GEAR.