CHAPTER SEVEN

COUPLING

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7.1 Coupling

Coupling can be classified into two major types, flexible coupling and rigid coupling. The flexible coupling is mainly used in horizontal pumps while the rigid coupling is mainly used in vertical ones. Details of the rigid couplings are beyond the scope of this training manual.

A flexible coupling is a mechanical device used to connect two axially oriented shafts. Its purpose is to transmit torque or rotary motion without slip and at the same time compensate for angular, parallel, and axial misalignment. There are many supplementary functions, which include providing for or restricting axial movement of the connected shafts; minimizing or eliminating the conduction of heat, electricity, or sound; torsional dampening; and torsional tuning of a system. Basically, all flexible couplings can be categorized as either mechanical flexing or material flexing. While most available flexible couplings fall strictly into one or the other of these basic categories, a few combine both principles.

The mechanical-flexing group provides flexibility by allowing the components to slide or move relative to each other. Clearances are provided to permit movements to within specific limits. Lubrication is usually required to reduce wear within the coupling and to minimize the cross-loading in the connected shafts. The most prominent in this category are the chain, gear, grid, and Oldham flexible couplings. The material-flexing group provides flexibility by having certain parts designed to flex. These flexing elements can be of various materials, such as metal, rubber, plastic, or composite. Couplings of this type generally must be operated within the fatigue limits of the material of the flexing element.

Most metals have a predictable fatigue limit and permit the establishment of definite boundaries of operation. Elastomers (rubber, plastic, etc.) usually do not have well-defined fatigue limits, and service life is determined primarily by the operational conditions. The material-flexing group includes laminated-disk, diaphragm, spring, and elastomer flexible couplings

7.2 Gear Coupling

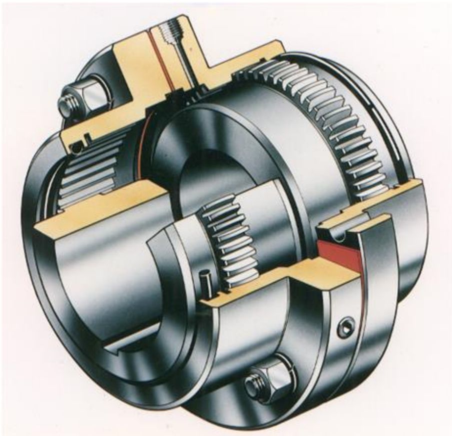

Figure 7.1 – Gear coupling

The most prominent type in the mechanical-flexing group, are available in a wide range of sizes and styles. They are capable of transmitting proportionately high torques at either low or high speeds. In their most common form, they are compact and consist of two identical hubs with external gear teeth and a sleeve or sleeves with matching internal gear teeth. Shaft misalignment is accommodated by clearances between the matching gear teeth. Special tooth forms are available which are designed to reduce wear and increase flexibility without increasing clearances. These include crowned tips, curved flanks, and curved roots. The sleeve may be a single tubular piece, or it may consist of two flanged halves bolted rigidly together.

Floating-shaft gear couplings usually consist of a standard coupling with a two-piece sleeve. The sleeve halves are bolted to rigid flanges to form two single-flexing couplings. These are connected by an intermediate shaft which permits the transmission of power between widely separated machines. On high-speed or short-span drives, spools are used to separate the two half couplings.

7.3 Metallic Grid Coupling

Figure 7.2 – Metallic grid coupling

Metallic-grid couplings are compact units capable of transmitting proportionately high torques at moderate speeds. They consist of two flanged hubs with special grooves or slots cut axially on the outside. The flanges are joined by interlacing a serpentine metallic grid.

Flexibility is achieved by sliding movement of the grid in the slots. Flexure of the grid in the curved slots provides some torsional resilience. The grid may be of one piece or may be provided in two or more sections.

Grids with tapered cross sections are available from some manufacturers and are designed to ease installation and removal. Covers are provided to retain the coupling's lubricant and to prevent dust, grit, and other foreign materials from coming in contact with or between the sliding parts. The cover may be split either horizontally or vertically. Grease holes permit lubrication without disturbing the gaskets or seals.

Proper lubrication is essential. The manufacturer's recommendations as to the type of lubricant should be followed. Seals must be in good condition and properly seated. The gasket must be whole and the cover joint tight. Plugs must be tight.

Regular intervals of inspection for leakage and condition of lubricant are recommended. If the lubricant is abnormal, the cover should be opened and all parts thoroughly flushed before the new lubricant is added. The grid members on this type of coupling are replaceable. If they are significantly worn, they should be replaced. Misalignment of the connected shafts should be kept within the manufacturer's recommendation. Excessive amounts can cause rapid wear of the grid and hub slots as well as early failure of the cover seals. A spacer bar of caliper and straightedge usually can be used to check angular and parallel misalignment as well as shaft gap.

7.4 Disk Ring Coupling

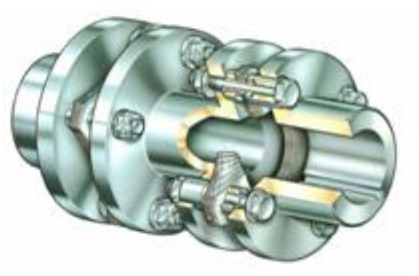


Figure 7.3 – Disk ring coupling

Laminated disk-ring couplings are the most prominent type in the material-flexing group and are available in a wide range of sizes and styles. They are capable of transmitting form; two flanged hubs are connected to a floating center member through laminated disk rings. Each of the disk rings is alternately bolted or riveted to a hub flange and center member.

The disk rings in tandem allow the coupling to accommodate angular and parallel misalignment as well as a limited amount of end float. In their single-flexing form, they consist of two flanged hubs and one laminated disk ring. The disk ring is alternatively bolted to the flanged hubs. These single-flexing units are capable of supporting a radial load and provide concentricity of connected three-bearing assemblies. They will accept only angular misalignment and a reduced amount of end float.
Shaft misalignment is provided for by flexure of the disk rings. Since these units are normally of all-metal construction, they are free of backlash and are relatively rigid in a torsional plane.

Under normal conditions, the metal parts are not subject to deterioration. Most manufacturers have available couplings that are resistant to corrosion. These units usually have the components plated or are made of a corrosion-resisting material such as stainless steel.

Laminated disk-ring couplings have no sliding parts that can wear, so no maintenance is required other than occasionally checking the condition of the laminated disk rings to make sure that all bolts are tight and that the equipment is still in proper alignment. Periodic visual inspection of the condition of the coupling is recommended. This can be done without disassembly or disturbing the connected equipment. When the equipment cannot be shut down conveniently, a stroboscopic light can be used.

During inspection, special consideration should be given to the outer sheets of the disk ring. If any deterioration or broken sheets are found, the entire disk ring should be replaced. Significant deterioration and breaking of the sheets are normally indications of excessive flexure due to misalignments beyond the coupling’s capacity. Realignment of the equipment must be done immediately.

If a coupling has been operating with loose bolts, they should be removed and inspected. If there are significant scour marks or indentations on the body, the bolts should be replaced. Most couplings of this style are completely repaired. Misalignment of the connected shafts should be restricted to within the manufacturer’s recommendations. When accurate measurements are required, dial indicators should be used. Alignment with a calliper and straightedge is usually satisfactory for slow-speed drives.

7.5 Diaphragm Coupling

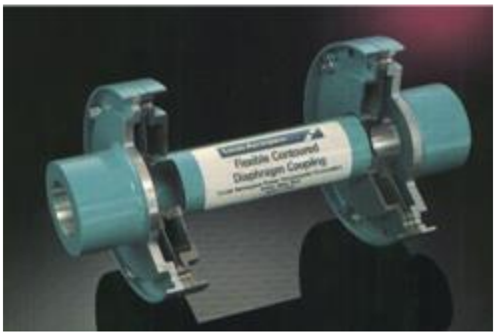

Figure 7.4 – Diaphragm coupling

Diaphragm couplings are also in the material-flexing group and are used primarily for the high-speed, high-horsepower applications. They are relatively light for the horsepower transmitted.

The diaphragm coupling is available in many sizes and styles, including a reduced-moment design. This coupling uses two flexing elements separated by a floating center member. The diaphragm is normally attached at the outside diameter and the inside diameter by bolts or E.B. welding to connect the hubs to the floating center member. The torque goes through the diaphragm assembly for the outside diameter to inside diameter, or vice versa.

The flexibility of the diaphragm design accommodates angular and parallel shaft misalignment as well as a limited amount of end float. Each flexing element is made up of one or more diaphragm elements depending on the design. The coupling is radially rigid and maintains its original balance because there are no wearing parts.

Under normal conditions, the metal parts are not subject to deterioration. Most manufacturers have available couplings that are resistant to corrosion. These units usually have the components plated or are made of a corrosion-resisting material. Misalignment of the connected shafts should be restricted to within the manufacturer's recommendation for long coupling life. If the connected equipment experiences high vibration, the coupling should be inspected for possible damage.

7.6 Elastomeric Coupling

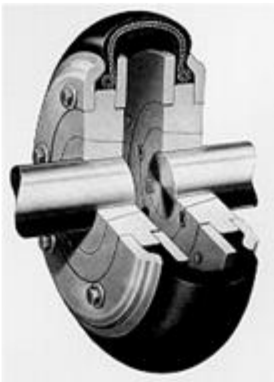

Figure 7.5 – Elastomeric coupling

Elastomeric couplings are available in an almost infinite number of versions. They are generally categorized into two types according to the elastomer placement:

1. The elastomer is placed in shear.
2. The elastomer is placed in compression.

Their ability to compensate for shaft misalignment is obtained by flexure and/or displacement of the elastomeric element. These couplings are generally relegated to light- or medium-duty service at moderate speeds.

In their basic concept, they consist of two hubs separated and connected by the elastomeric element. On shear-type couplings, the elastomer may be bonded, clamped, or fitted to matching sections of the hubs. The compression-type couplings usually utilize projecting pins, bolts, or lugs to connect the components. The elastomeric flexing elements may be polyurethane, rubber neoprene, or impregnated cloths and fibers.

Elastomeric couplings are normally maintenance-free, but it is suggested that occasional checks be made of the elastomer's condition and equipment alignment. If the elastomer shows signs of deterioration or wear, it should be replaced and the equipment aligned to within the coupling manufacturer's recommendations. This usually can be accomplished with the use of a calliper and straightedge.

7.7 Other types of Coupling

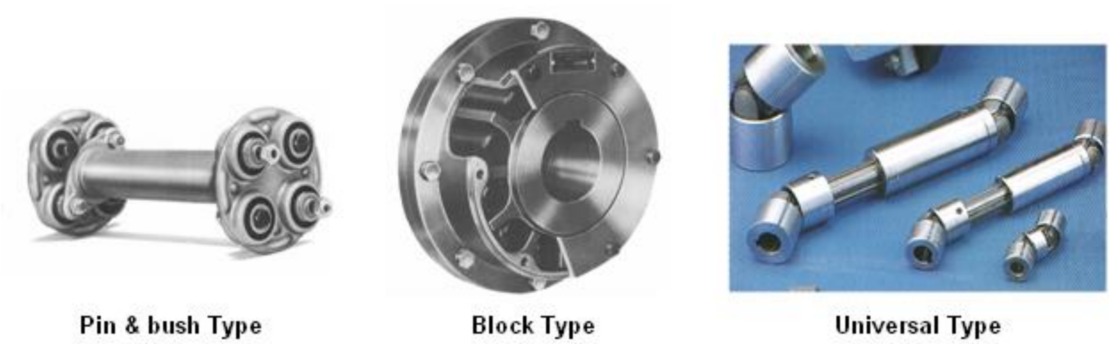

Figure 7.6 – Other coupling types

7.8 Coupling Selection

Maintenance personnel are frequently faced with the problem of replacing a worn-out or broken coupling. After the cause of failure has been determined, careful consideration should be given to the type, size, and style of coupling that will be used as a replacement. Whenever possible, it should satisfy all the needs of the drive. Proper selection as to type of coupling is the first step of good maintenance.

A well-chosen coupling will operate with low cross-loading of the connected shafts, have low power absorption, induce no harmful vibrations or resonances into the system, and have negligible maintenance costs. The primary considerations in selecting the correct type of flexible couplings, as well as its size and style, are:

1. Type of driving and driven equipment
2. Torsional characteristics
3. Minimum and maximum torque
4. Normal and maximum rotating speeds
5. Shaft sizes
6. Span or distance between shaft ends
7. Changes in span due to thermal growth, racking of the bases, or axial movement of the connected shafts during operation
8. Equipment position (horizontal, inclined, or vertical)
9. Ambient conditions (dry, wet, corrosive, dust, or grit)
10. Bearing locations
11. Cost (initial coupling price, installation, maintenance, and replacement)

The coupling should be selected conservatively for the torque involved. Consideration must be given to all peak and shock loads encountered in normal service. If the coupling is to operate at high speeds, it should be dynamically balanced. Special coupling modifications dictated by the connected equipment should be made. If any doubt exists as to the proper type or size of coupling to use, it is recommended that the manufacturer be consulted.