

Tips For The Installation Of MCRT[®] Torquemeters

An MCRT[®] torquemeter must be installed properly as an integral part of a drive line network in order to achieve satisfactory operation. Proper installation will: a) transmit the desired torque load, b) compensate for misalignments in drive line components, and c) not introduce undesirable loading into the torquemeter shaft.

Optimum installation must therefore address several key areas: shaft misalignments, coupling types, and torquemeter mountings. This article discusses each of these areas, plus some additional considerations and diagrams of correct and incorrect installations.

Shaft Misalignments

Drive line component mechanical tolerances will always cause misalignments between the ends of

coupled shafts. The misalignment(s) that occur include parallel, angular, and end float. They can and will exist in any combination. **Figure 1** illustrates each form of misalignment.

Flexible shaft couplings are used to accommodate these misalignments and to transmit the desired torque. The coupling manufacturer will state both the coupling's torque capacity and misalignment capabilities.

Coupling Types

Shaft couplings may be divided into one of three types; single-flex, double-flex and rigid. A single-flex coupling accepts angular misalignment only, and cannot accept parallel misalignment. A double-flex coupling accepts both angular and parallel misalignment. The sketches shown in

SHAFT MISALIGNMENTS

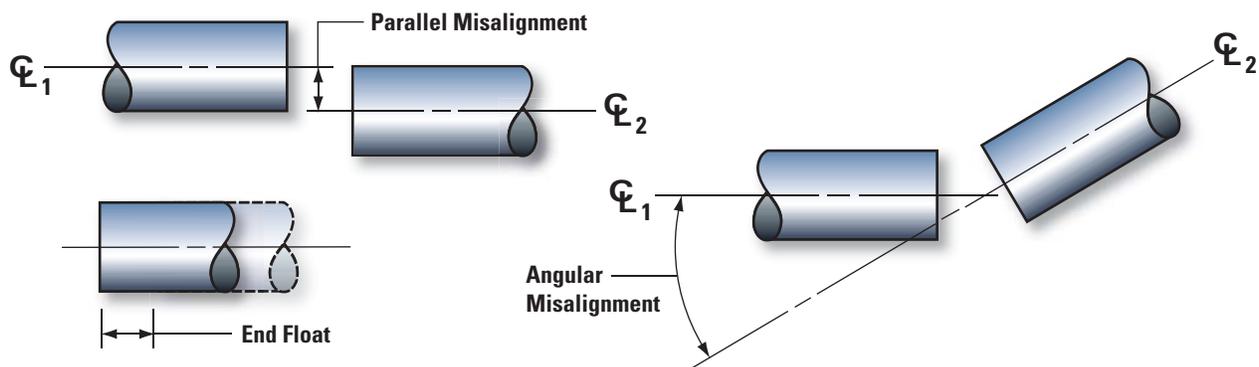


Figure 1.

Figure 2 illustrate these couplings as single pivots or double pivots to aid visualization. Depending on their design, both single-flex and double-flex types may or may not accept end float. A rigid coupling can neither compensate for nor permit any misalignment.

Torquemeter Mountings

In addition to the various coupling types available, the system installer has a choice of mounting the torquemeter as a “floating shaft” or as a “foot mounted” unit. A “floating shaft mount” means the stator portion of the torquemeter is actually supported by the shaft, i.e., the stator portion of the torquemeter is compliantly restrained (with a flexible strap, etc.) from rotating but its weight is supported through the torquemeter bearings via the shaft. A “foot mounted” unit has the stator rigidly mounted to a machine base and the shaft and any coupling weight is supported through the torquemeter bearings to the stator.

Correct Torquemeter Installations

The diagrams in Figure 3 show generalized mounting arrangements that are correct and practical.

These mountings are consistent with the following principles:

1) Whenever two shafts are joined that are fixed in both the radial direction and angle (shafts in two bearings installed in a foot mounted housing), a double-flex coupling is used. In this case, the use of a single-flex coupling is incorrect because it can only compensate for residual shaft parallel misalignment by bending the shafts which results in premature system failure and can lead to reading errors.

2) Whenever a single-flex coupling is used, one and only one, of the two shafts being joined must be free to move in the radial direction without constraint. Thus, the only shaft misalignment that will occur is angular misalignment. The

BEST INSTALLATIONS

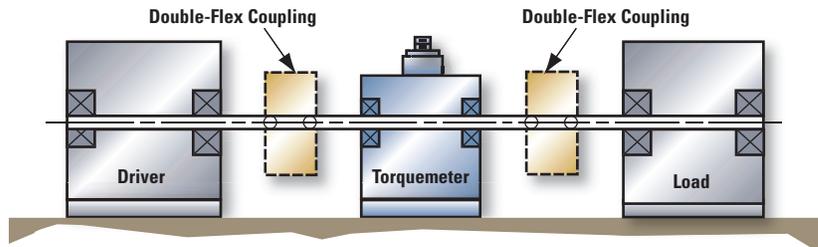


Figure 2-1. With foot mounted torquemeter

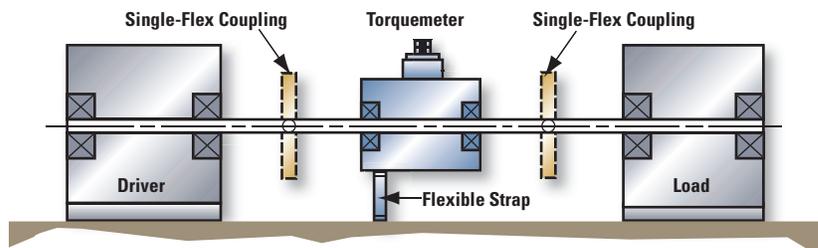


Figure 2-2. With floating stator mount

ACCEPTABLE INSTALLATIONS

(More care required in set-up to control possible runouts)

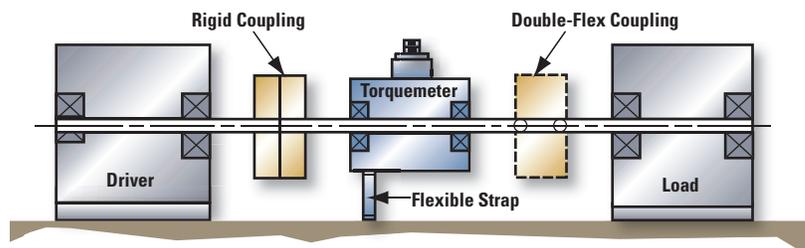


Figure 3-1.

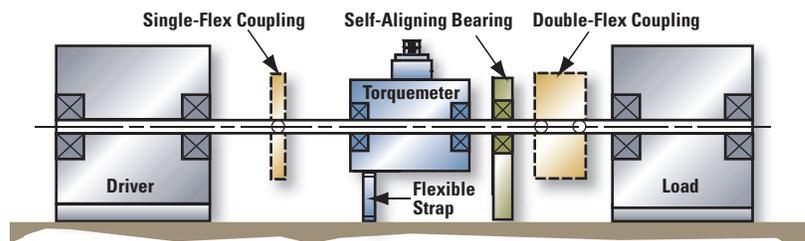


Figure 3-2.

use of a double-flex coupling in this case is incorrect because the shaft system will result in both high vibration and most likely immediate failure. Improper mountings are illustrated in **Figure 4.**

Other Considerations

Always consult the factory for recommendations when faced with unusual mounting requirements.

All rotating components should be properly covered with shields or guards to assure that personnel or other equipment in the area will not be harmed in the event of any drive line component(s) failure.

Besides safety, another important consideration is that the torque data be correct and accurately reflect loading conditions. A smooth running system is critical to the validity of torque measurements.

Non-uniform drive line velocity will cause improper instantaneous torque data – however, average readings will be correct. Many coupling designs (a single universal joint with angular misalignment is an example) cause non-uniform shaft velocity and instantaneous – not average – torque errors. This instantaneous error looks like a torsional oscillation usually at twice shaft rate. Constant Velocity couplings should be specified whenever possible to eliminate this source of error, particularly when instantaneous torque data is important. Constant velocity types include flexible disc, flexible diaphragm, bellows and precision, crowned-gear couplings.

When designing a high-speed system, refer to S. Himmelstein’s Technical Memorandum #7551 which contains information on critical speed calculations.

You are welcome to contact us at any time regarding your installation questions:

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 Email: sales@himmelstein.com

X INCORRECT INSTALLATIONS X

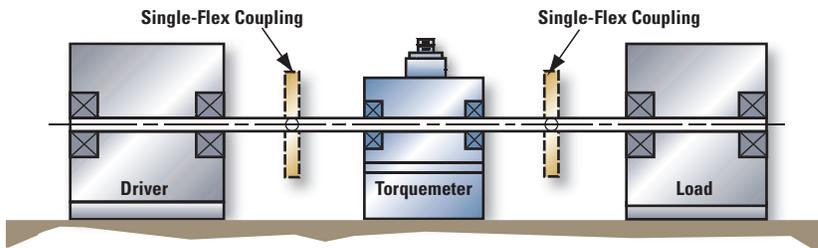


Figure 4-1. Single-flex couplings in the above installation will not accept the parallel shaft misalignment that will exist. Forcing the installation will result in bending moments on the shaft and premature system failure.

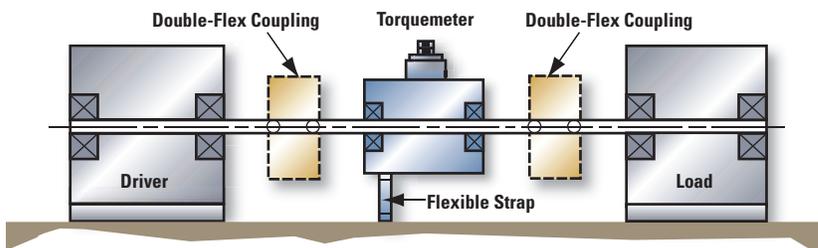


Figure 4-2. The torquemeter in the above installation is not constrained in the radial direction. This lack of constraint will allow the shaft system to rotate eccentrically, with resulting high vibrations and most likely catastrophic failure.

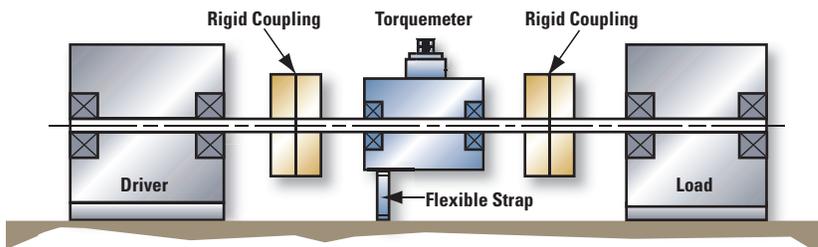


Figure 4-3. Rigid couplings as used above force the shafts into alignment by bending them. The degree of bending is unknown, but could be considerable if misalignment is high or if all components are extremely rigid, and will change with temperature growth. This bending load will cause excessive wear and premature failure.

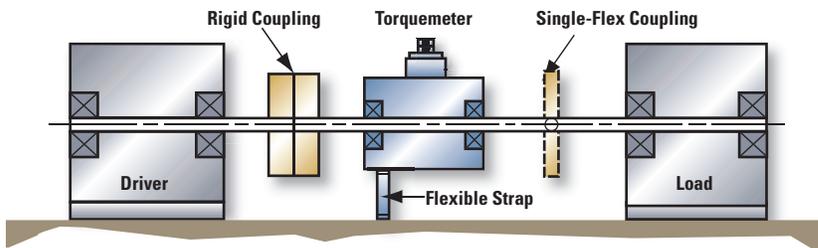


Figure 4-4. The substitution of one single-flex coupling, as shown above, in place of a rigid coupling in the previous example does not improve the installation. The shafts are still forced into alignment by bending them.

SOURCES FOR SHAFT COUPLINGS

INTRODUCTION

This document lists several manufacturers of flexible shaft couplings. Listings of other qualified sources can be found in industrial trade references. When designing a torque meter installation, obtain complete specifications from the coupling manufacturer. S. Himmelstein and Company Technical Memorandum 7850 should also be reviewed as part of the installation design process. Technical Memorandum 7551 contains information pertinent to high speed installations.

FLEXIBLE DIAPHRAGM COUPLINGS

Flexible Diaphragm Couplings are non-lubricated, constant velocity, zero backlash types. They are usually double flex devices. A wide range of torques and speeds are covered. Approved source:

- **Goodrich (Formerly TRW-Lucas Aerospace), Rome, NY**
315/838-1200, www.goodrichrome.com

FLEXIBLE DISC COUPLINGS

Flexible Disc Couplings are non-lubricated, constant velocity, zero backlash types. Both single and double flex are offered. Wide capacity and speed ranges are available. Approved source:

- **Rexnord Corporation, Thomas Coupling Operation Warren, PA**
814/723-6600, www.rexnord.com

PRECISION GEAR COUPLINGS

Precision Gear Couplings are constant velocity types, generally require lubrication, and exhibit backlash. They have the smallest size for a given load capacity. Both single and double flex types are available. Very wide capacity ranges and operation to moderately high speeds is common. Approved sources:

- **Browning Mfg. Division, Emerson Corporation, Maysville, KY**
606/564-2011, www.emerson-ept.com
- **Falk Corporation, Milwaukee, WI**
414/342-3131, www.falkcorp.com
- **Lovejoy, Inc., Downers Grove, IL**
630/852-0500, www.lovejoy-inc.com
- **Kop-Flex, Harmans, MD**
410/768-2000, www.emerson-ept.com

CONVENTIONAL (HOOKE OR CARDAN) U-JOINT COUPLINGS

Conventional (Hooke or Cardan) U-Joint Couplings are generally lubricated and available to medium torque capacity and speeds. They handle the greatest misalignment in a short space and have backlash. A single U-joint (single flex) is not constant velocity

but two properly phased U-joints, back-to-back, approximate constant velocity operation and are the equivalent of a double flex. Approved sources:

Dana Corporation, Spicer U Joint Division, Toledo, OH
419/866-3900, www.dana.com

Twin Disc, Inc., Racine, WI
414/634-1981, www.twindisc.com

Ameridrives International, Erie, PA
814/480-5100, www.ameridrives.com

CONSTANT VELOCITY U-JOINT COUPLINGS

Several types of Constant Velocity U-Joint Couplings are commercially available. They require lubrication and exhibit backlash. Variations include Rzeppa, Cross Groove, Double Offset (both end motion and fixed center) and Bendix-Weiss types. Approved source:

Dana Corporation, Spicer U-Joint Division, Toledo, OH
419/866-3900 www.dana.com

OTHER COUPLING TYPES

Elastomer Shear Couplings, Elastomer Jaw Couplings, Bellows Couplings, Oldham (double slider) Couplings, Spring Couplings, Chain Couplings, Steel Grid Couplings, and combination types are also available. They aren't recommended either because they exhibit large deformations under centrifugal stress (and therefore can't be balanced at high speed), or they have high backlash, or they aren't constant velocity, or they are only available as double flex types and have no compelling application advantage, or have high inertia and mass per unit of torque capacity.

Torsionally Resilient Couplings, Electrically Insulated Couplings, Shear Pin Couplings, and other special types are also available. Shear Pin Couplings can be used to provide positive overload protection. Electrically Insulated devices interrupt the flow of electrical current and magnetic flux through machinery shafts. Torsionally Resilient types dampen torsional vibrations and help cushion shock and starting loads. Because they absorb vibratory power, Torsionally Resilient Couplings can cause torque and power measurement errors. Avoid them when high measurement accuracy is important.

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