MPTA-C8c-2011

Sleeved Element Failure Analysis

MPTA Information Bulletin

Mechanical Power Transmission Association
5672 Strand Ct., Suite 2, Naples, FL 34110
www.mpta.org

1.0 Contributors

B&B Manufacturing, Inc.	**LaPorte, IN**	www.bbman.com
Baldor Dodge Maska	**Greenville, SC**	www.baldor.com
Carlisle PT Products, Inc.	**Miamisburg, OH**	www.carlislebelts.com
Custom Machine & Tool Co., Inc.	**Hanover Ma.**	www.cmtco.com
Diamond Chain Company	**Indianapolis, IN**	www.diamondchain.com
Diamond Precision Products A Division of Saelens Corporation	**Johnson Creek, WI**	www.diamondprecision.com
Drives, LLC	**Fulton, IL**	www.drivesinc.com
Emerson Power Transmission	**Maysville, KY**	www.emerson-ept.com
Frontline Industries, Inc.	**Irvington, NJ**	www.frontlineindustries.com
Gates Corporation	**Denver, CO**	www.gates.com
Goldens' Foundry & Machine Co.	**Columbus, GA**	www.gfmco.com
Lovejoy, Inc.	**Downers Grove, IL**	www.lovejoy-inc.com
Magnaloy Coupling Company	**Alpena, MI**	www.magnaloy.com
Martin Sprocket & Gear, Inc.	**Arlington, TX**	www.martinsprocket.com
Maurey Manufacturing Corp.	**Holly Springs, MS**	www.maurey.com
New Hampshire Industries, Inc. H. Neuman & Company Myers Manufacturing	**Lebanon, NH**	www.nhipulleys.com
Ramsey Products Corporation	**Belmont, NC**	www.ramseychain.com
Rexnord Industries, LLC	**New Berlin, WI**	www.rexnord.com
TB Wood's Incorporated	**Chambersburg, PA**	www.tbwoods.com
Torque Transmission	**Fairport Harbor, OH**	www.torquetrans.com
U.S. Tsubaki, Inc	**Wheeling, IL**	www.ustsubaki.com
Veyance Technologies, Inc. Goodyear Engineer Products	**Fairlawn, OH**	www.goodyearep.com/PTP
Webster Industries	**Tiffin, OH**	www.websterchain.com

2.0 Disclaimer Statement

This Informational Bulletin is presented for the purpose of providing reference information only. You should not rely solely on the information contained herein. Mechanical Power Transmission Association (MPTA) recommends that you consult with appropriate engineers and / or other professionals for specific needs. Again, this publication is for reference information only and in no event will MPTA be liable for direct, indirect, incidental, or consequential damages arising from the use of this information.

3.0 Abstract

This Informational Bulletin is intended to provide users with a general overview of the most common failures of elastomeric shear donut style couplings and their causes.

4.0 Copyright Position Statement

MPTA publications are not copyrighted to encourage their use throughout industry. It is requested the MPTA be given recognition when any of this material is copied for any use.

5.0 Forward

This forward is provided for informational purposes only and is not to be construed to be part of any technical specification. It is intended for informational purposes only.

6.0 Scope

This Information Bulletin is intended to provide users with a general overview of the most common failure modes with elastomeric sleeve style couplings and common causes for these failures. As with other elastomeric couplings, failures are not limited to just the elastomeric element, or sleeve. For this reason, this document contains brief reviews of common hub or flange failures along with the more common sleeve failures.

This overview will start with a brief description of elastomeric sleeve couplings as well as alignment limitations since an understanding of these details will often provide valuable assistance in diagnosing the cause of failures.

7.0 Introduction

7.1 Overview

Figure 1

Elastomeric Sleeve Couplings, sometimes referred to as 'Shear' donut, or 'shear' sleeve type couplings, consist of two flange style hubs and an elastomeric sleeve operating in 'shear'. The sleeve interlocks with the flanged hubs through meshing teeth, or serrations, with the driving hub pulling the driven hub through this sleeve (see figure 1) As torque is transmitted through the sleeve, the elastomeric element absorbs any sudden or shock loading, vibration (both lateral and torsional), and/or other torque related forces by being stretched through twisting or windup. The elastomeric sleeve style coupling is not a 'fail safe' coupling and upon failure of the sleeve, the coupling will cease to transmit torque. Since the driving and driven hubs are not intermeshed as in a jaw style coupling, this style coupling can accommodate greater amounts of misalignment through the distortion and stretching of the elastomeric element and through the sliding of the serrations or teeth on the sleeve in or over the flange hub teeth. The ability to accommodate greater amounts of parallel and angular misalignment actually decreases the level of reactionary loading on equipment bearings, but may impact the torque carrying capacity and life of the coupling. 'Shear' type elastomeric sleeve couplings tend to offer a higher level of torsional 'softness' which, in many cases, offers some degree of protection against damage that may be caused by torsional vibrations. Still, it is important to note, these couplings are not recommended for use in diesel or other reciprocating combustion engine applications. This torsional softness adds the benefit of producing less reactionary loading often caused by parallel misalignment.

7.2 Fuse

Caution should be practiced when using an elastomeric sleeve coupling as torque limiting device, or 'fuse', since the actual torque at which elastomeric couplings fails is quite difficult to determine. It is common for this type of coupling to fail at several times the rated torque.

8.0 Misalignment

The ability to accommodate misalignment is typically dependent on the manufacturers' specifications, but usually falls in the range of the following:

angular:	1° for EPDM or Neoprene sleeves sizes 3 through 16 1/4° for Hytrel sleeves sizes 6 through 14
radial/parallel:	0.010" for size 3 up to 0.062" for size 16.
axial:	refer to the appropriate manufacturers' Installation Instructions (Guides)

9.0 Failure Modes

Elastomeric sleeve couplings can be separated into flange hub type failures and elastomeric sleeve type failures.

9.1 Flanged Hub Failures

9.1.1 Keyway Burst

A keyway burst failure can be caused by two possible situations. The first is due to the hub being subjected to an over torque condition. The weakest point in the hub is usually over the top of the keyway where there is the smallest cross section of material between the top of the keyway and the outside diameter of the hub. This is where an overload fracture is most likely to originate (see figure 2).

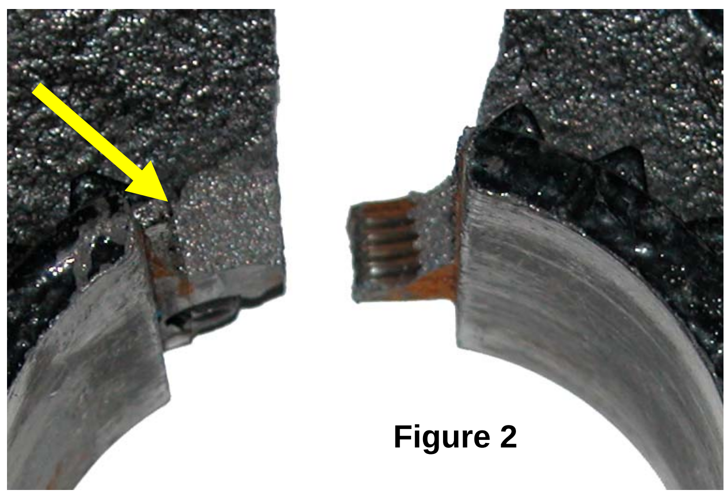

Figure 2

The second condition where this can occur is when a hub is forced onto a shaft in an interference fit condition or the key is too large. The pressure from this interference fit will cause the hub to burst at the weakest point which is typically at one of the top corners of the keyway.

9.1.2 Flange Fracture

Figure 3

A common reason a fracture might occur across the face of a flange outside the hub area may be attributed to a material defect in a casting due to inclusions that are not present in powder metal construction. A second common cause for this type of failure occurs when the flange is subjected to improper installation practices with installation abuse. Use of improper, or abusive techniques during installation, such as aggressive hammering can cause cracks in the face of the flange. These cracks can fracture during the installation as can be seen in figure 3 or in the presence of any sizable load when placed into operation.

9.2 Elastomeric Sleeve Failure

9.2.1 Diagonal Tear

Figure 4

Figure 5

When the elastomeric sleeves is subjected to an excessive load where the torque exceeds the ability of the sleeve to twist, or wind-up, the sleeve will fail or tear in a classical diagonal pattern as shown in figures 4 and 5 as a result of a torque overload. The sleeves are designed to operate with a certain level of wind-up and when the sleeve fractures it takes on a diagonal orientation due to the wind-up. This wind-up can be as much as 7° for Hytrel sleeves and 14° for EPDM rubber and Neoprene sleeves.

9.2.2 Straight Tear

Straight tear failures (see figure 6) typically occur along a stress line between the serrations and the center section of the sleeve. These are often caused by material defects created during the mold process of the sleeve. This particular defect is usually noticeable when installing the sleeve.

This type of failure can also occur as the result of fatigue from misalignment, particularly when the hubs are pressed too tightly together against the sleeve during installation. Usually the brake occurs completely across the sleeve prior to detection. The sleeve in figure 6 was caught early prior to complete separation.

Figure 6

9.2.3 Serrations Ground Off

Figure 7

Figure 8

When the serrations on the elastomeric sleeves are allowed to slide inside the flanges, the serrations literally grind off. See figure 7. If the wear is not detected relatively early, the serrations will wear off completely as in figure 9.

Figure 8 shows a new sleeve with normal serrations as should appear on any sleeve prior to that sleeve being installed in a coupling.

9.2.3.1 Misalignment

The elastomeric sleeve coupling is designed to operate with some degree of wind-up which places pressure between the serrations on the sleeve and the serrations in the flange. Compensation for misalignment takes place through the stretching of the elastomer, however, when the amount of misalignment exceeds the ability of the sleeve to stretch, the elastomer slides inside the serrations of the flange. This sliding action wears away the elastomer material until the serrations are compromised to the extend they spin inside the flange and no longer transmit any torque. Often the material that wears off builds up under the coupling guard.

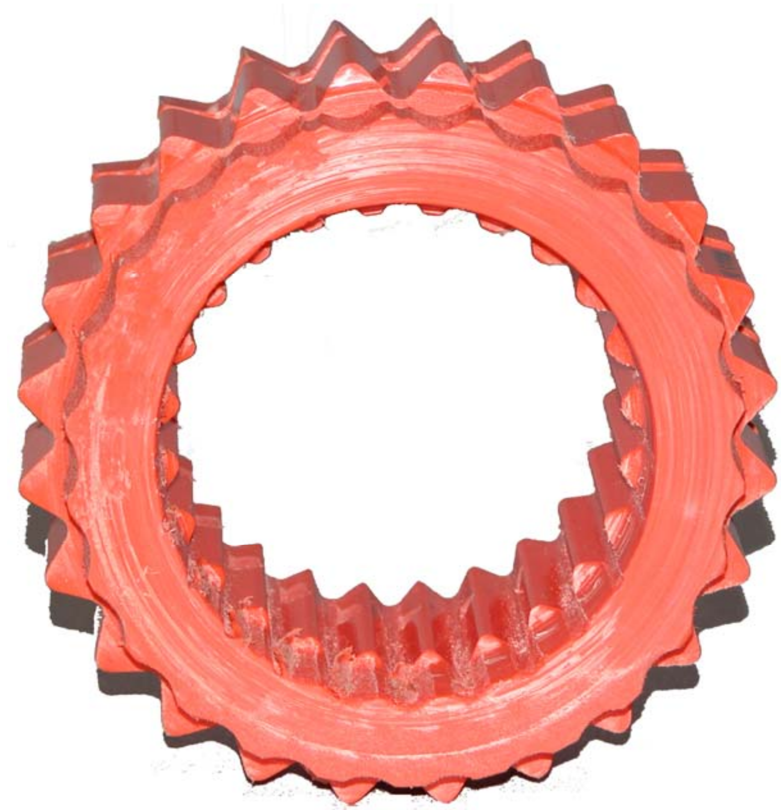

Figure 9

9.2.4 Torque Capacity of Coupling Overrated for the Application

The elastomeric sleeve coupling is designed to operate with some degree of wind-up which creates pressure between the serrations on the sleeve and the serrations in the flange. When this wind-up pressure is not adequate to maintain a non sliding surface, 'chatter', or rubbing occurs that wears away at the serrations on the sleeve. This 'chatter' can often be heard while the coupling is in operation and can be difficult to differentiate from the wearing noise generated due to misalignment. Wear patterns appear similar to the wear shown in figure 7 and figure 9. If the wear is not detected soon enough, the serrations can wear completely off the sleeve, usually only on one end, and the sleeve will spin freely inside the flange.