

# Twist and Torque

## Introduction

Certain system configurations and circumstances can force unusual rope rotation about its lengthwise axis. This condition is commonly referred to as rope torque or rope twist. Both of these words twist and torque, have been used synonymously to indicate the same condition. Common industry expressions are "the rope is all torqued up" or "the rope is twisted" or the rope is pigtailed" or "the rope is dish ragged". The torque normally shows up at the shackles and will look like either a corkscrew or a wrung-out dishrag.

## Causes of Rope Torque

There are generally two situations that will cause ropes to torque up. They are (1) very tight and undersized sheave grooves, and (2) misalignment of sheaves and/or excessive fleet angle. These two situations will be explained separately.

**Tight (Undersized) Sheave Grooves**  
(Refer to Technical Bulletin #10: *Sheaves and Grooves* for additional information.)

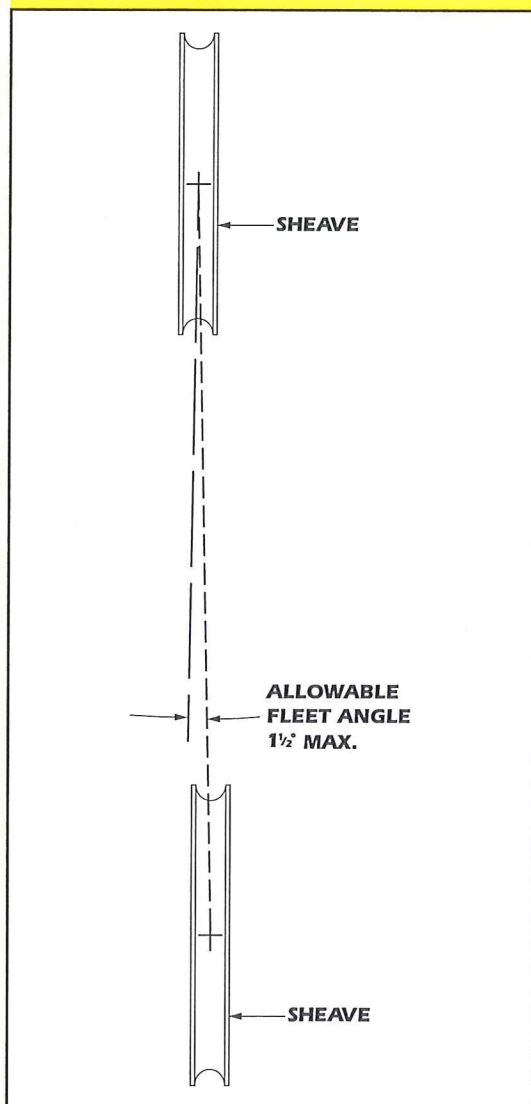
The rope is twisted as it passes around the drive sheave during normal operation. This twisting is more prevalent in double wrap systems. The rope is pinched and cannot roll through the drive sheave in a uniform pattern. Over repetitive cycles the rope lay length will get slightly longer and the system will push or "milk" this additional rope length to the shackles where the rope will bunch up. This rope torque at the shackles is commonly found during routine inspections. Many times the ropes can be "spun-out" by releasing and turning the shackles, thereby extending rope service life, but this is only a temporary fix as the condition will persist until the drive sheave is re-grooved or replaced. Care must be exercised as this torque condition can worsen to the point that the rope is twisted so much that a strand will break. In this case, the ropes will need to be replaced and the drive sheave will need to be serviced. An inspection of the failed rope will show rope wear in two planes caused by the tight pinching action of the drive sheave grooves; a lay lengthening of the portion

of the rope length that passes around the drive sheave; and a corresponding rope lay shortening at or near the torqued-up portion of the rope at the shackles. Tight drive sheave grooves are the most common cause of rope torque.

## Misalignment of Sheaves and Excessive Fleet Angle

Torquing of the ropes can also be caused by sheave misalignment and fleet angles in excess of  $1\frac{1}{2}$  degrees.

### Fleet Angle



**Wirerope Works, Inc.**

100 Maynard St. Williamsport, PA 17701 USA tel 570-326-5146 fax 570-327-4274 www.wireropeworks.com

## Twist and Torque

Improper equipment installation or certain design practices, coupled with less than ideal conditions, will cause rope torque. Basement drive systems and offset equipment rooms are two examples. Both of these systems have multiple or complex reeving arrangements that require precise design, installation, and maintenance practices in order to keep rope torque to a minimum. In these types of systems, the torque can manifest itself between the sheaves that cause the torquing action or at the end connections. It is difficult or impossible to relieve the torque in these systems. The overall system will need to be analyzed and actions taken in order to eliminate the problem.

Another type of system design that utilizes a unique 2:1 double wrap arrangement can also cause severe rope torque under certain circumstances. The secondary sheave in these systems is tilted off center, which introduces sideways bending of the rope between the primary and secondary sheaves and greatly increases the secondary sheave rope departure fleet angle. This tilted secondary sheave design causes minor or negligible rope torque if ropes are tensioned properly, but can cause severe torque and very early rope failure if the rope tensions vary significantly. (See Technical Bulletin #8: *Tensioning* for more information). The rope carrying the greatest load (the tightest rope) will torque up and break between the shackles and the mid-length of the rope on the car side, in many cases before any diameter reduction, abrasive wear, or wire breaks occur.

In these system indicators of severe torque and imminent rope failure are: ropes torqued up at the shackles (corkscrew, dish rag); broken shackle tie ropes (the torqued ropes spin the shackles to such a degree that the tie rope breaks); and shackle springs on either or both the car and counterweight sides that compress abnormally.

Many times the springs will compress several inches, may bottom out, or will break. If the torqued length of rope is long enough to run through the drive sheave then multiple wire breaks will occur in a short period of time. If any of these conditions exist, the elevator must be taken out of service immediately as rope failure is imminent. Depending on rope condition, rope service life can be extended by "spinning out" the ropes by turning the shackles and then properly tensioning the ropes. However, a system evaluation will need to be conducted by a competent technician or engineer in order to determine if further rope service is advisable.

For further information please contact WW's Sales or Engineering Departments.

Wire rope products will break if abused, misused or overused. Consult industry recommendations and ASME Standards before using. Wire Rope Works, Inc. warrants all Bethlehem Wire Rope® and strand products. However, any warranty, expressed or implied as to quality, performance or fitness for use of wire rope products is always premised on the condition that the published breaking strengths apply only to new, unused rope, that the mechanical equipment on which such products are used is properly designed and maintained, that such products are properly stored, handled, used and maintained, and properly inspected on a regular basis during the period of use. Manufacturer shall not be liable for consequential or incidental damages or secondary charges including but not limited to personal injury, labor costs, a loss of profits resulting from the use of said products or from said products being incorporated in or becoming a component of any product.

Bethlehem Wire Rope® and the Bethlehem Wire Rope® reel logo are registered trademarks of Wire Rope Works, Inc. ©2013



**Wire Rope Works, Inc.**

100 Maynard St. Williamsport, PA 17701 USA tel 570-326-5146 fax 570-327-4274 [www.wireropeworks.com](http://www.wireropeworks.com)

