Boom Suspension

Boom pendants are a very critical part of draglines and shovels. Therefore, to avoid catastrophic failure and get maximum service life from pendants, it is imperative that end users follow proper handling and inspection guidelines as well as know and understand the removal criteria for pendants.

Galvanized Structural Strand (GSS) used for boom pendants is very high in strength compared with wire rope. For example, 3-3/4" diameter GSS has a breaking strength of 822 tons, where the same diameter wire rope has only a breaking strength of 599 tons. The increase in breaking strength is attributed to increased metallic area and improvement in the design of the strand's load carrying efficiency. The strand design, however, also decreases flexibility. GSS is designed to hold an axial load but will not accommodate repeated bending, as does wire rope. Due to its stiffness, GSS pendants must be treated with extra care during removal from the shipping reels and installation on the dragline or shovel.

Preparation for Installation

Boom pendants are shipped in two basic packages: coils or reels. Although each basic package requires certain specific handling, there are two general precautions to be followed that are common to both.

On all WW pendants where end fittings are attached, each fitting bears a tag identifying either "Front End" or "Rear End". The socket on the outside end of the pendant package will be marked with a tag "Front End". Begin uncoiling or unreeling with the socket so marked. Also, when the pendants are shipped on reels, tags identifying "Front End" and "Rear End" are stapled to the reel flange adjacent to the corresponding socket.

General Precautions

1. When unpacking the pendants in the field, attach lifting slings to the sockets. If, however, it is necessary to lift on the body of the assembly, WW strongly recommends using multiple nylon slings. When lifting on the body of the pendant, exercise care to keep the radius of curvature of the pendant large enough to minimize wire displacement. Use a bridle sling with a three or four foot spreader. **Never lift with a single hitch on the pendant because this may cause a permanent kink in the strand.** If wire rope slings must be used, cover the pendant with some protective material such as a piece of belting, a section of rubber tire, or the like. The purpose of this precaution is to prevent damage to the zinc coating or possible nicking of the outer wires of the pendant. Areas of damage to the zinc coating or the steel wire become probable sites of premature wire failure once the pendant is placed in service.

2. Do not pull pendants over sharp edges, create a singular, short bend radius, or drag the pendants through the dirt or across objects on the ground when handling. This may result in permanent damage to the arrangement and surface of the wires. Particular care must be taken to ensure that nothing is done during handling that may result in nicking the outer wires.

Coils

1. If the pendant is small enough to be uncoiled by hand, one man must hold the socket tagged "Front End". The second man should roll the coil along a level, obstacle-free, clean surface away from the first man. In this way, the pendant is permitted to uncoil naturally without spiralling or twisting. Do not attempt to uncoil pendants in the manner that is often

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Sheaves and Drums

used in uncoiling a garden hose – the coil being laid on the ground and one end carried away from the coil. This method could easily result in the total ruin of the pendant. If a swift or turntable is used (recommended for large diameter pendants shipped in coils), employ a drag-type braking device to prevent the swift speed from exceeding the pulling speed and causing kinking or looping. Also use great care to ensure that the strand is not damaged by dragging. Remember to attach the pulling device to the socket tagged "Front End".

2. Observe the aforementioned "General Precautions".

Reels

1. Place a shaft through the center hole in the reel and jack up the reel so that it clears the ground and revolves freely. If a relatively small shaft is used, use steel bushings in unprotected center holes for smooth unreeling of heavy reels.
2. Use a simple timber brake against the reel flange or flanges to provide uniform unwinding of the pendant from the reel and to prevent slack from developing.
3. Position the socket tagged "Front End" (to be removed first) as close to the bottom of the reel as practical and remove this socket from reel first.
4. Unwind the pendant by pulling the "Front End" away from the reel. WW recommends attaching a pulling hitch or sling to the socket; however, if the sling is attached on the pendant, care must be exercised so that a kink or dogleg does not develop at the base of the socket, and that the wires are not nicked or damaged. It is usually necessary to block out an area of the reel for positioning and securing of the sockets during shipment. Normal care should be exercised in removing the sockets from this section. Unbolt u-bolts, used for securing during shipping, from the outside of the flange. If the u-bolts must be cut, remove them from the outside of the flange to avoid damage to the strand.
5. When unwinding from the reel, pull the pendant in a straight line. As the pendant comes off the reel, it will try to turn, relieving the twist that is imparted to the pendant by the reeling process. Allow the socket to turn, keeping the longitudinal stripe straight. The same phenomenon also happens with coiled pendants, but to a lesser extent due to the shorter lengths. Do not pull the pendant over sharp edges, objects on the ground, or through the dirt.
6. After the pendant has been unwound from the reel, remove the socket tagged "Rear End".
7. If more than one pendant is packaged on the reel, remove the other lengths in the order in which they are tagged and proceed as above.
8. Upon removal, lay the pendants on timbers and inspect them for damage or proud wires. It is common to have steel bands installed around the strand (3" diameter and larger). However, sometimes outer wires become displaced during packaging and shipment. These may be tapped into place using a piece of hardwood.

Installation

If improper techniques are used during the lifting of the pendants for installation, kinks that cause excessive wire stress may occur, resulting in reduced pendant life. When lifting a pendant, it is important that it be supported by the use of **multiple** nylon, or like slings, to provide greater support to the pendant over a larger area. In handling the pendant in this manner, kinks are avoided and the weight of the socket is supported, thus avoiding stress to the wires at the critical area where they enter the nose of the socket.

Prior to installation, clean the pins and check them for proper fit to ensure easier assembly

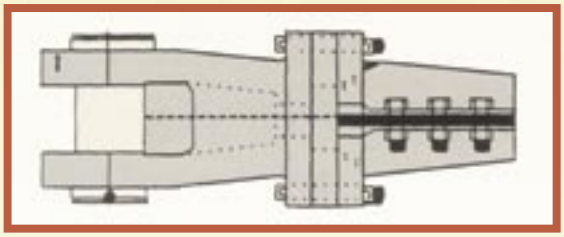
when attaching the sockets to the connecting links. Further, it is important that the sockets are free to self-align on the pin.

Take care not to scrape the galvanized coating or nick the wires. If the coating is scraped off, apply a zinc-rich spray paint to the bare area. If the wire or wires are nicked, mark the area for regular inspections because these areas may generate high stress points leading to wire failure.

During fabrication of the pendant, a longitudinal stripe is placed along the entire length. During installation, it is of utmost importance that this longitudinal stripe be kept in a straight line and not spiraled around the rope or strand. If it becomes necessary to rotate the pendant to line up the socket pin hole connection and straighten the paint stripe, if possible, rotate the pendant in a direction so as to tighten the wires in the case of a strand pendant and to tighten the strands in the case of a rope pendant.

Spreaders

Spreaders reduce movement in the pendants, break up the harmonic waves generated by regular load cycles, reduce tension variations, and generally prolong fatigue life. There are several types of spreaders in use, i.e. wood, plastic, and aluminum. Selection of spreader material is entirely dependent upon the likes and dislikes of each end use. However, WW recommends avoiding spreaders made from oak. When wet, oak wood forms tannic acid, a known corrosive agent. Ensure the spreaders have an insert to cushion the strand as it passes through the spreader block. To minimize harmonics, maintain sufficient distance between spreaders, and between spreaders and sockets. Place the first spreader no closer than six to eight feet from the nose of the socket. Positioning and re-tightening the spreaders are required maintenance items.



Vibration Damping System

Vibration Damping System

Originally designed by the Bethlehem Wire Rope Division of Bethlehem Steel, our vibration damping system consists of a split-flanged clamp secured to a flanged socket through an elastometric gasket. The system is designed to reduce vibration and fatigue in the wires adjacent to the end fitting, a critical wear area, and significantly increases the operating life of pendants. Dampers must be removed periodically for inspection, and removed permanently at 50% of the expected life of the pendant. For further inspection guidelines, please consult WW engineering.

Maintenance

Other than lubrication at the socket basket lubrication tube and the damper lubrication tube (if supplied), little maintenance is required on boom pendants. Boom pendants must be lubricated at these locations to prevent corrosion and fatigue at the socket nose. WW recommends a minimum of twice annually. To apply lubricant, pump grease into the re-lubrication tube(s). The lube tube ensures that lubricant reaches the internal areas of the socket connection. WW uses Lubriplate 630AAA.

Inspection

Inspection of boom pendants is normally accomplished by two methods – visual and nondestructive testing. The most critical area for pendant fatigue and deterioration is usually within 24 inches of the nose of the socket. A visual inspection consists of looking for broken wires, high or loose wires, rust and corrosion, and a reduction in diameter of the strand. A more thorough inspection may be accomplished by ultrasonic or x-ray (NDT) methods, which will detect internal broken wires. Many operators use this method annually. When broken wires are detected, the frequency of inspection is increased to twice annually, or as needed, to determine the rate of progression of broken wires.

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Removal Criteria

In the past, the removal criteria for pendants was always based on past experience and performance, and was measured in years, such as six, eight, or ten years. However, with the introduction of larger capacity buckets and shorter fill cycle times, pendants are now subjected to different load dynamics. **Today, pendant life needs to be reviewed based on the amount of material moved,** not years in service.

To determine when removal is required, a formula is applied based on the number of total broken wires (outer and inner wires) and the amount of strength each broken wire contributes to the total breaking strength of the pendant. When the known loss of breaking strength reaches a 10 to 12 percent loss, the pendants should be considered for removal. Depending on diameter, construction, and manufacturer, the pendant breaking strength and wire strength contribution may differ. Therefore, consult WW engineering.

Socket Reuse

Applying used sockets to new strand is a common practice at many mine locations. When applying used sockets, it is suggested that the used sockets be thermal treated and magnafluxed to detect any imperfections which would affect the integrity of the socket. The sockets should also be checked dimensionally, such as pinholes and any other dimension that can change due to wear or thermal treatments. WW will attach used sockets to new strand, but will guarantee only the strand and attachment, not the socket.

To improve pendant performance, several options are available during manufacturing and should be specified when purchasing pendants.

Strand Upgrade Options

Parallel Contact Core

For many years, GSS for boom pendants has been manufactured using a cross laid design, meaning each layer of wires is laid in the opposite direction of the preceding layer. Ultimately, this design creates notching, and eventual wire breaks, from the extreme pressures where the wires cross over each other. These crossover areas, or stress points, are critical at the core and decrease as diameter/layers of wire increase.

To combat this situation, a parallel contact core (PCC) design is required. This new design greatly increases the area of wire to wire contact from preceding layers in the core region. This gives greater wire to wire support, thus decreasing the internal notching in the core of the strand where the pressures are the greatest.

Socket Attachment

Sockets may be attached using the very stringent Accurate Socket Alignment and Concentricity (ASAC) method. The ASAC method ensures that the axis of the strand as it enters the socket basket is parallel to the centerline of the socket basket. When requested by the customer, this procedure is used for attaching sockets to main pendants on walking draglines. Sockets are inspected for dimensional limitations and machined on the base (or nose) and on the outside of the socket basket at the base. Sockets are attached to the strand using specially machined fixtures to ensure the desired accuracy.

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