

Optimizing the Versatility and Lifespan of Stainless Steel Sheaves

How Materials, Throat Angle, Groove Diameter, and Sheave Size Play a Critical Role

Sheaves are widely used throughout the manufacturing, marine, construction, agriculture, commercial, industrial, food processing, theatrical, and transportation industries to change the direction of a pulling force or lift loads. As sheave applications and uses continue to evolve, a clear need for a versatile, robust, and long lasting product line of sheaves has emerged. Suncor's new sheave program, PULLPRO™, aims to answer these challenges.

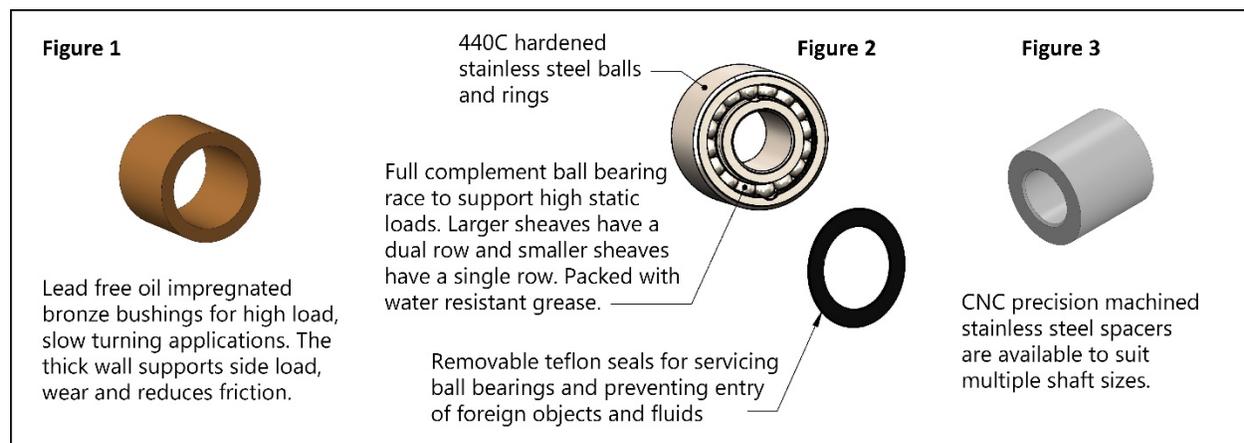
PULLPRO™ premium sheaves are available for fibrous rope or wire rope and are comprised of high quality grade 316 stainless steel. Grade 316 stainless steel offers maximum corrosion resistance and durability. The sheaves feature either bronze bushing or stainless steel bearing type hub styles. Stainless steel spacers are included with most of the bushing style sheaves.

Features and Benefits

Components

When designing the new and expanded range of sheave offerings, only the highest quality raw materials were used for the components. The bushings are made from lead free, oil impregnated bronze which wears extremely well, is tarnish-resistant, shows low oxidation rates at high temperatures, and is resistant to corrosion in seawater making it particularly useful in marine applications. Being completely lead free, they do not require prop 65 labelling. They have been designed with thicker walls to support side load and wear while also reducing friction. They are generally used for high load, slow turning applications (Figure 1).

The bearings are made from 440C hardened stainless steel balls and rings with a full complement ball bearing race to support high static loads. Smaller sheaves utilize a single row of ball bearings while larger higher load sheaves have a double row. The bearings are packed with water resistant grease to ensure consistent and smooth operation. A removable Teflon ring acts as a seal on the ball bearings and prevents dust and debris from entering the cavity while allowing for easy and convenient servicing of the ball bearings (Figure 2).

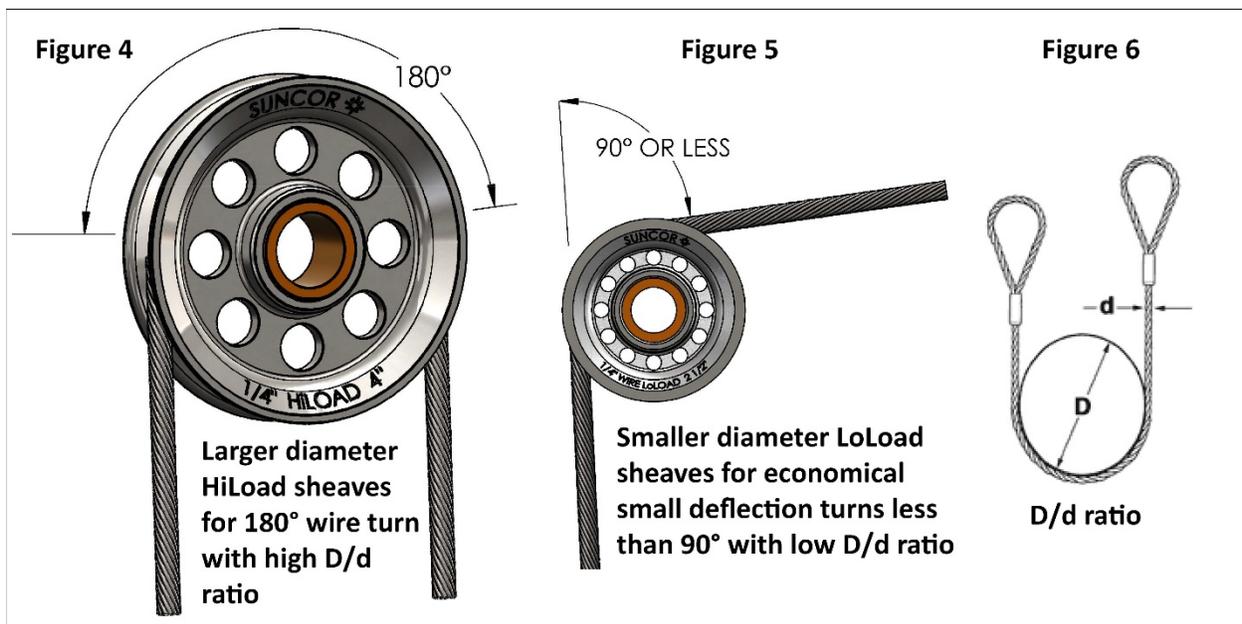


The spacers are CNC precision machined stainless steel and suit multiple shaft sizes. The outside of the spacer is polished for smooth contact on the bronze bushing. They are included with most of the bushing style sheaves as part of a kit (Figure 3). The inclusion of spacers adds a new level of versatility by allowing a standard sheave to adapt to various shaft sizes.

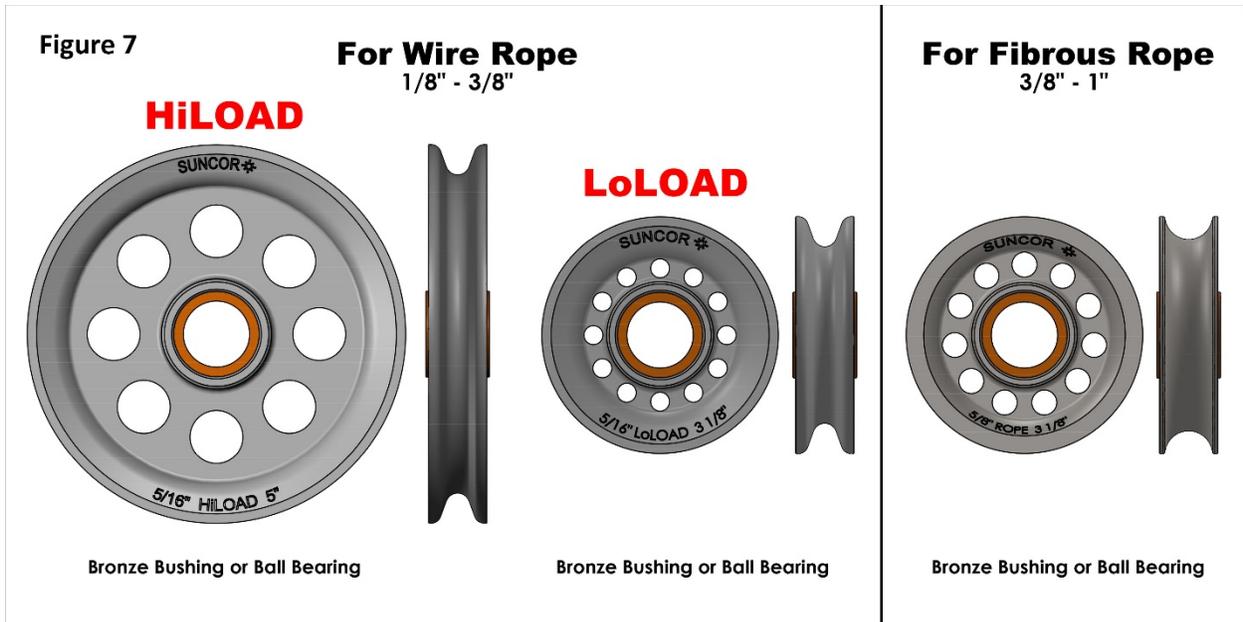
Design

When selecting a sheave, it is critical to understand the design and components. The design, quality of components used, type of groove, working load limits, annual usage, and application will play a major factor in the quality, safety, and lifespan of the sheave.

PULLPRO™ premium stainless steel sheaves were designed with versatility as a key feature with sheaves available in a variety of sizes tailored to fit the specific product application. Historically, end users have been limited by sheave offerings and large diameter sheaves are often used in situations where a smaller, less expensive sheave would meet the demands of the application. As a result, the PULLPRO™ sheave offering includes HiLOAD (Figure 4) and LoLOAD (Figure 5) sheaves for wire rope applications. HiLOAD indicates a premium, larger diameter sheave suitable for 180 degree rope turns with a high D/d ratio, which is the ratio of the diameter around which the rope is bent, divided by the body diameter of the rope (Figure 6). LoLOAD indicates a smaller diameter sheave designed for economical small deflection turns less than 90 degrees with a lower D/d ratio.



The LoLOAD and HiLOAD wire rope sheaves are available with either bronze bushings or 440C hardened stainless steel bearings. The LoLOAD sheaves are available for 3/16", 1/4", 5/16", and 3/8" wire rope sizes and the HiLOAD sheaves are available for 1/8", 3/16", 1/4", 5/16", and 3/8" wire rope sizes. Fibrous rope sheaves are also available with either bronze bushings or 440C hardened stainless steel bearings and are available for 3/8"-7/16", 1/2", 5/8", 3/4", and 1" fibrous rope sizes (Figure 7). All the sheaves incorporate a weight optimized design with recessed sides and lightening holes.



Working Load Limits

The working load limits (WLL) for PULLPRO™ premium sheaves were certified through extensive in-house laboratory testing. The WLL represents a 5:1 design factor (DF), and when used appropriately, the sheaves meet ASME B30.26-2610 and exceed the minimum 4:1 design factor. In most instances, the WLL for PULLPRO™ sheaves is significantly higher than comparable products and is often more than double what the competition offers. Proof loads are twice the WLL. All wire loads are based on grade 304, 7x19 stainless steel which are slightly higher than grade 316. Twice the WLL of the wire represents the wire maximum load with a 180° wire wrap around the sheave.

Wear

A critical, and often overlooked area, is the wear exerted on the sheave during use. Throat angle, groove diameter, and sheave size are three areas that significantly factor into the wear sheaves can experience (Figure 8). Sheaves are often designed with thin straight sided grooves which can cause scrubbing on the side walls and unnecessary wear on the rope and the sheave (Figures 9-11). PULLPRO™ sheaves were designed with wide sheave grooves that provide a proper throat angle to permit slight rope lead misalignment without damaging the rope or wearing the sheave groove.

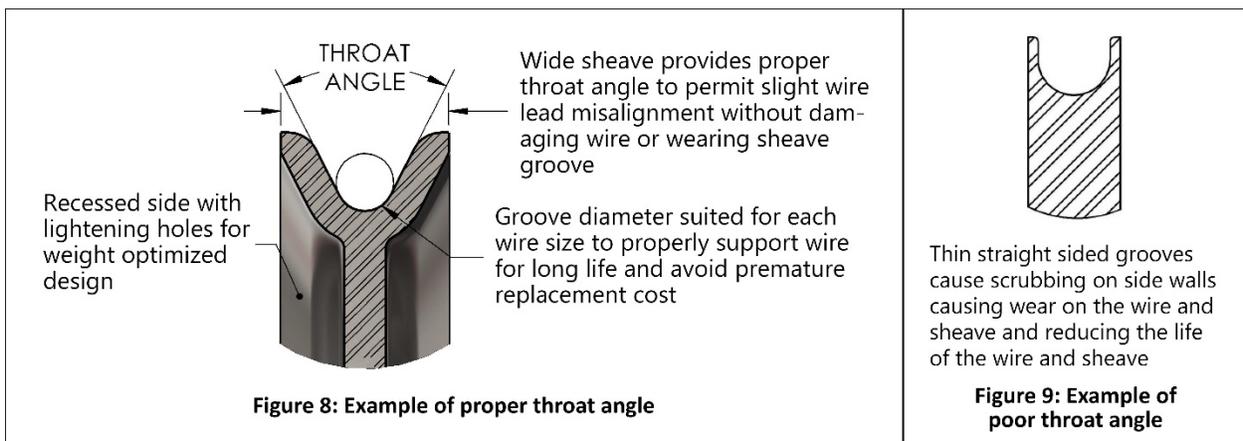


Figure 10



Wide groove permits lead misalignment without scrubbing the sheave or the block.

Figure 11



Narrow straight sided sheaves can cause wear on the wire and sheave and reduce their longevity.

The groove diameter is critical for proper rope support under load and has a significant effect on the overall safety and lifespan of the sheave and rope. If the sheave groove diameter has too much clearance, it will not support the rope properly (Figure 12). When tension is applied by the rope, the high radial pressures will flatten and distort the rope and that distortion leads to increased fatigue damage, early failure, costly repairs, and unplanned downtime. Conversely, if the sheave groove diameter has too little clearance, it will not fit properly in the groove and the rope will experience wear along two lines of contact. This results in distortion of the rope, and severe notching within the individual rope strands. Abrasive wear is accelerated, and additional force is required to move the rope over the sheave.

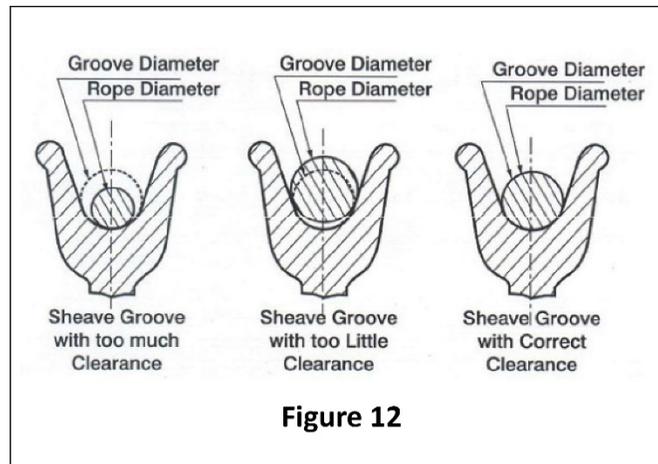


Figure 12

PULLPRO™ sheaves have been designed with the optimal sheave groove clearance suited for each rope size. The result is a maximized lifespan for the rope and sheaves.

Conclusion

PULLPRO™ premium stainless steel sheaves answer several challenges for sheave users. Specifically, the need for a versatile, robust, safe, and long-lasting sheave that is ideal for numerous applications, has consistency throughout the component parts, is appropriately labeled, and has a load capacity that is suited for the application.

PULLPRO™ sheaves are manufactured from the highest quality raw materials. They incorporate grade 316 electropolished stainless steel, lead free oil impregnated bronze, and hardened 440C stainless ball

bearings. The introduction of large diameter, HiLOAD sheaves and smaller diameter LoLOAD sheaves provides a new level of versatility for sheave users. The variety of sizes and hub styles allow the user to select a sheave tailored to fit their specific product application and the design provides optimal weight, groove diameter, and throat angle. The result is one of the most versatile, safe, long lasting, and high quality offerings of premium sheaves that has ever been introduced.