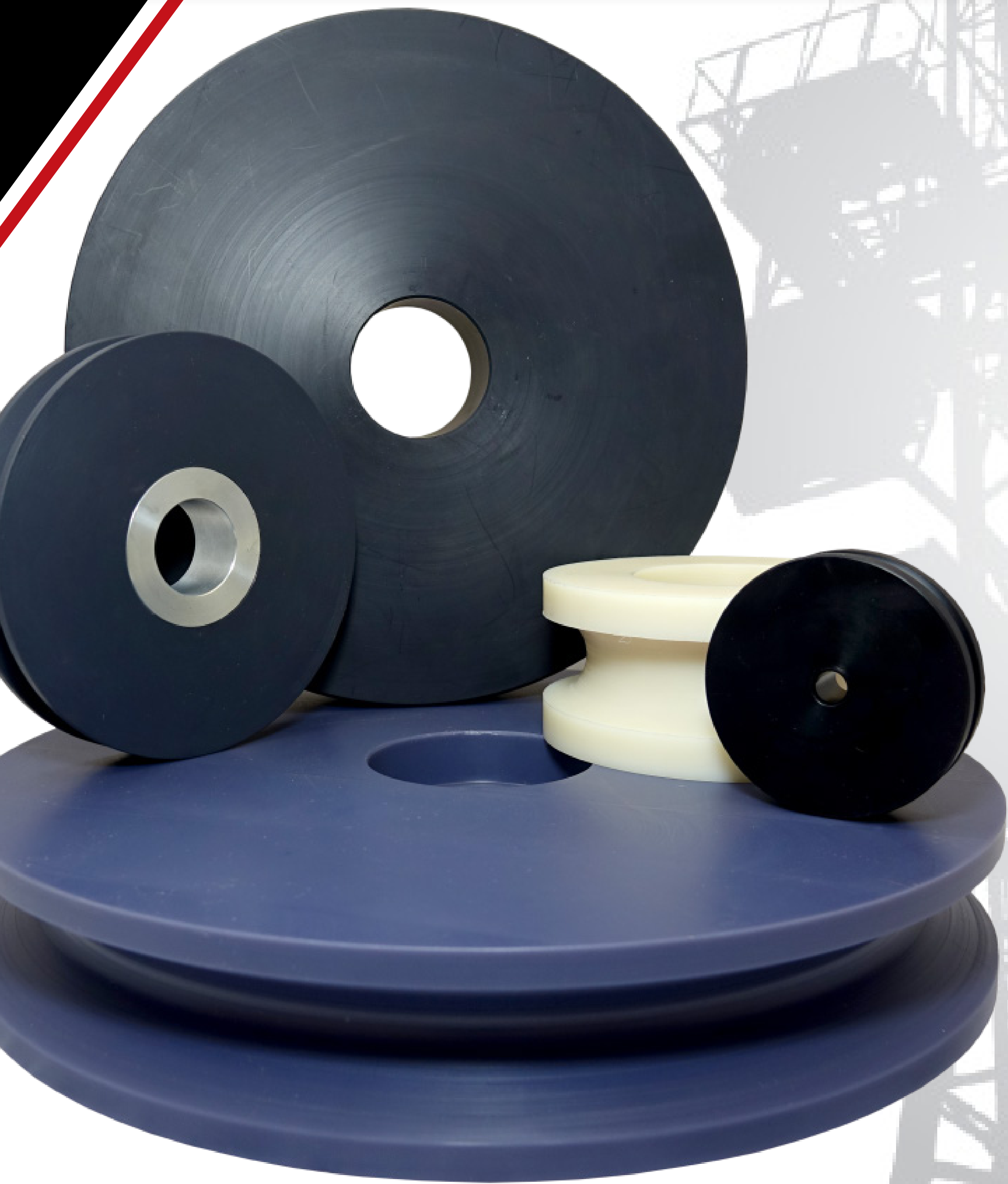
REDWOOD
PLASTICS AND RUBBER

SHEAVE Design Manual



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Higher Loads & Increased Safety

Redco™ Sheaves offer numerous advantages over conventional steel:

Lightweight Design

- 1/8th the weight of traditional steel and plastic sheaves
- Improves lifting capabilities and eases installation of mobile/fixed boom cranes

Longer Rope Life

- Suits "on again, off again" loading styles typical for this application
- Enhanced material memory and resiliency increases rope support

Increased Load Capacity

- Flexible design decreases telescoping crane arm weight & increases contact area between the groove and rope.

Reduce Operating Costs

- Lubricated grades of Redco™ Cast Nylon ensure the needs for regular lubrication is reduced/omitted.

Corrosion Resistant

- Redco™ Cast Nylon Sheaves will not rust or corrode.

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Sheave Diameter

The outer diameter of the sheave depends on the size of both the rope and load. The guideline for the sheave diameter is given by the Power Crane & Shovel Associations and American National Standards Institute.

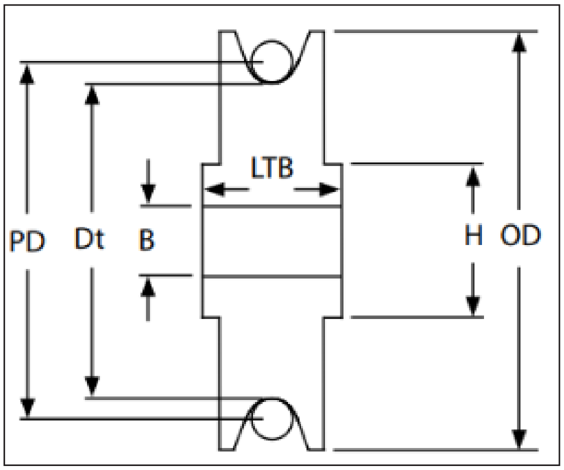
This guideline is given as a ratio between the "Pitch Diameter" of the sheave and the "Rope Diameter". The minimum recommended ratio is **18:1**; European standards require **24:1**.

To determine the Pitch Diameter and outer diameter of the sheave:

Rope Dia	PD Ratio 18:1	OD	PD Ratio 24:1	OD
1/4	4 1/2	5 1/8	6	6 5/8
3/8	6 3/4	7 11/16	9	9 15/16
1/2	9	10 1/4	12	13 1/4
5/8	11 1/4	12 13/16	15	16 9/16
3/4	13 1/2	15 3/8	18	19 7/8
7/8	15 3/4	17 15/16	21	23 3/16
1	18	20 1/2	24	26 1/2
1 1/4	22 1/2	25 5/8	30	33 1/8
1 1/2	27	30 3/4	36	39 3/4

The Outer Diameter is based on a recommended groove depth that is 1.75x the rope diameter.

Fig. 1



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Design Specifications

Hub Width

The hub width is usually determined by the space available for the sheave and other loading and stability requirements. The hub is typically as wide or wider than the rim. The outer diameter of the hub is calculated by:

$$H = 1.5B$$

H = Hub Diameter   B = Bore diameter

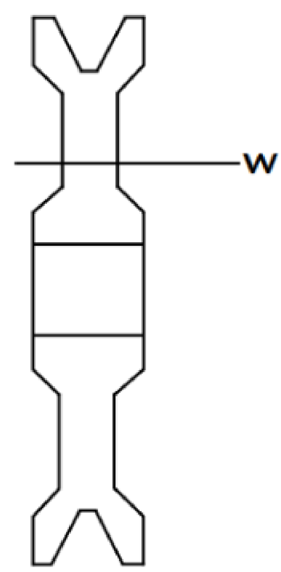
The minimum wall thickness of the hub is 1”. The transition between the hub and web should either be a radius or a slope to avoid sharp angles.

Web for Redco™ Sheave

To further reduce the weight of a Redco™ Sheave, material can be removed between the rim and the hub. Reducing the weight can ease installation and increase the carrying capacity of a boom style crane.

The minimum thickness of the web area is calculated as: **W=1.2r** (W = Web thickness r = rope diameter).

To avoid sharp angles, the transition between the web and the rim should either be a radius or a slope.



Design Specifications contd.

Rim Dimensions

For sufficient side-loading support, minimum shoulder width (distance between the outer edge of the rim and inside the groove) should be **1/8"**.

Below is a table to determine the rim width based on the rope diameter, 30° groove angle, and 1/8" shoulder. The minimum thickness of the sheave at the rim **(T)** can be expressed as a function of the rope diameter **(r)**.

$$T = \frac{1}{4} + 2.99r$$

30°	35°	40°	45°
¼ + 2.99r	¼ + 3.18r	¼ + 3.38r	¼ + 3.59r

T = Thickness at the rim   r = rope diameter

This helps calculate the Length-through-bore **(LTB)** on a straight-walled, machined Redco™ Sheave.

Groove Design

Groove depth should be at least 1.75x the rope diameter **(r)**. The radius at the bottom of the groove **(G)** should be slightly larger than the rope: **G = 1.05 * r/2**

Typically, the groove angle is 30° for better rope support. On occasion,a 45° angle is required for increased fleet angles (up to 4°).

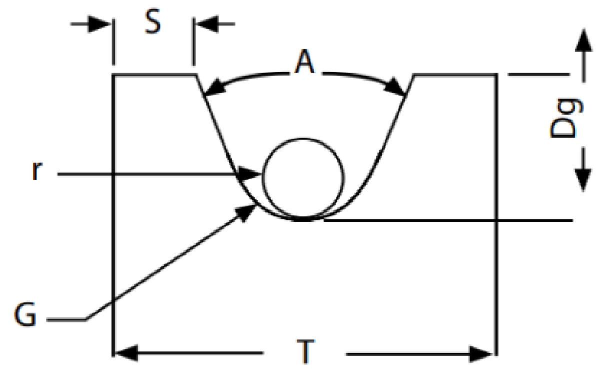


Fig. 2

Design Specifications contd.

Bore Dimension

To increase the load bearing capacity of a Redco™ Sheave, a metallic bushing or roller bearing can be used. The roller bearing increases PV (pressure velocity), as well as increases load capacity.

Special attention must be given to the press fit of the bearing or bushing into the sheave. A press fit that is too small will cause the sheave to walk-off the bearing at increased temperatures. The recommended amount of press fit can be calculated as:

$$p = .009 \sqrt{Db}$$

p = press fit   Db = Diameter of the bearing or bushing

The diameter of the bore must be machined to the size of the bearing/bushing less the calculated press fit. On larger sheaves, a hydraulic press is required to install the bearing. It is **not recommended** to heat up the sheave above 200°F as this can impart stress in the Redco™ Sheave.

For thin-walled bushings or bearings, a reduction in the press fit can be made. To avoid “walk-off” problems, the temperature swing should be kept to a minimum. For added bearing stability, retaining rings can be used. Thrust washers or collars can be attached to the shaft to keep the sheave from sliding from side-to-side.

Load Capacity (with bearings)

Groove and bore pressure can be calculated as follows:

For rope wrap angle of **180°**

$Pg = 2 \cdot T / r \cdot Dt$

$Pb = 2 \cdot T / B \cdot LTB$

For rope wrap angle of **90°**

$Pg = 1.414 \cdot T / r \cdot Dt$

$Pb = 1.414 \cdot T / B \cdot LTB$

Pg = Groove Pressure (psi)

r = rope diameter (in.)

Pb = Bore Pressure (psi)

LTB = Length through bore

T = Line Pull (lbs)

Dt = Tread Diameter (in.)

B = Bore Diameter

Please refer to Figure 1. on page 3

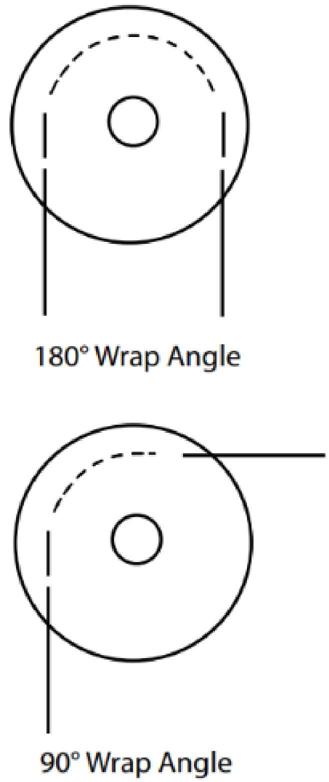


Fig. 4

To calculate the MAXIMUM BORE AND GROOVE PRESSURE acting on the sheave, substitute the rope's maximum line pull into the above equations.

The maximum static pressure for a Redco™ Sheave is 4,000 psi. Intermittently, Redco™ Sheaves can withstand up to 8,000 psi for a few minutes. Using 4,000 psi as the maximum pressures, the above equations can be used to calculate the maximum line pull (Tmax).

For rope wrap angle of **180°**

Groove $T_{max} = 2000 \cdot r \cdot Dt$

Bore $T_{max} = 2000 \cdot B \cdot LTB$

For rope wrap angle of **90°**

Groove $T_{max} = 2828 \cdot r \cdot Dt$

Bore $T_{max} = 2828 \cdot B \cdot LTB$

Note: For a sheave ratio greater than 18:1, calculate only bore pressure.

Load Capacity for Redco™ Sheaves

without bearings (Redco™ Sheave directly on shaft)

The main consideration for a sheave without bearings is Pressure Velocity (PV). In this case, the Redco™ Sheave is the bearing. To calculate the load capacity for this situation, use the maximum PV value of the grade of Redco™ Cast Nylon to be used.

From here, calculate the MAXIMUM BORE PRESSURE by:

$PB = PV/V$

PB = Maximum Bore Pressure (psi)

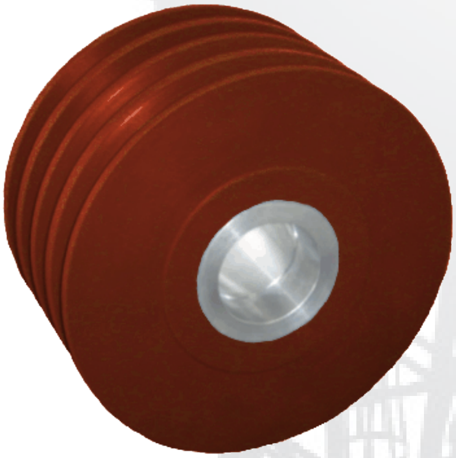
PV = Pressure Velocity rating for the grade to be used (psi·fpm)

V = Surface speed of the bore of the sheave on the shaft (fpm)

For a Redco™ MD sheave, the bore pressure should not exceed 1,000 psi. With this, the MAXIMUM LOAD can be calculated.

$$L_{max} = 1000 \cdot S \cdot LTB$$

Lmax = Maximum Load (lbs), **S** = Shaft Diameter (in.) **LTB** = Length through bore (in.)



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