NYLATECH

MEETING TODAY'S CAST NYLON NEEDS

SHEAVE DESIGN MANUAL

HIGHER LOADS & INCREASED SAFETY

NYLATECH SHEAVES

There are numerous advantages of a Nylatech sheave over conventional steel or iron sheaves. These advantages include:

LIGHT WEIGHT

Nylatech Sheaves are 1/8th the weight of steel or iron sheaves. This improves the lifting capabilities of mobile and fixed boom cranes and eases installation.

LONGER ROPE LIFE

Nylatech Monomer Cast Sheaves are better suited to the "on again, off again" loading typical for this application. With enhanced material memory and resiliency, the rope grooves will flex under the load of the rope providing increased support to the rope.

INCREASED LOADS

The arm weight of telescoping cranes is decreased because Nylatech Sheaves are lighter. Also, Nylatech Sheaves flex under the load of the rope increasing the contact area between the rope and groove which increases load capacity.

DECREASED OPERATING COSTS

With lubricated grades of Nylatech Cast Nylon, the need for regular lubrication can be reduced or omitted.

CORROSION RESISTANT

Nylatech 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 the rope and load. The guideline for the sheave diameter is given by the Power Crane & Shovel Associations and American National Standards Institute. That guideline is given as a ratio between the "Pitch Diameter" of the shave and the "Rope Diameter". The minimum recommended ratio is 18:1. European standards require 24:1.

The following table will assist in determining 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 1.75 times the rope diameter.

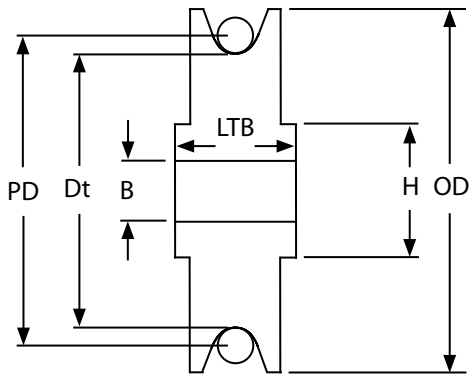


Fig. 1

Groove Design

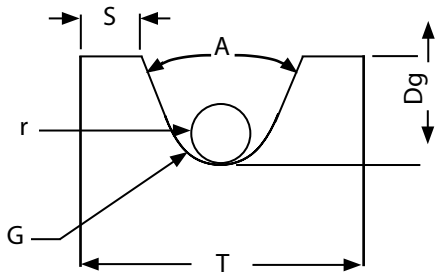
The groove depth should be at least 1.75 times the rope diameter.
The radius at the bottom of the groove should be slightly larger than the rope;

$G = 1.05 * r/2$

G = Groove radius r = rope diameter

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

Fig. 2



Rim Dimensions

It is recommended to have a minimum shoulder width (distance between the outer edge of the rim and inside the groove) of 1/8". This allows for sufficient side loading support. With this, a calculation can be done to determine the width of the sheave at the rim.

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 can be expressed as a function of the rope diameter (r).

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

30°	35°	40°	45°
$\frac{1}{4} + 2.99r$	$\frac{1}{4} + 3.18r$	$\frac{1}{4} + 3.38r$	$\frac{1}{4} + 3.59r$

T = Thickness at the rim r = rope diameter

This is useful for calculating the Length-through-bore (LTB) on a straight walled, machined Nylatech Sheave.

Web for Nylatech Sheave

To further reduce the weight of a Nylatech Sheave, material can be removed between the rim and the hub. Reducing the weight can ease installation as well as 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

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

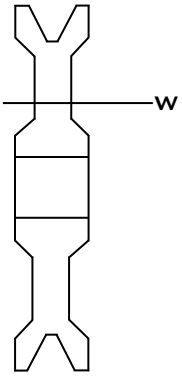


Fig. 3

Bore Dimension

To increase the load bearing capacity of a Nylatech Sheave a metallic bushing or roller bearing can be used. The roller bearing allows for increased PV (pressure velocity) as well as the ability to carry increased loads. 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 Nylatech 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. Also, thrust washers or collars can be attached to the shaft to keep the sheave from sliding from side to side.

Hub Width

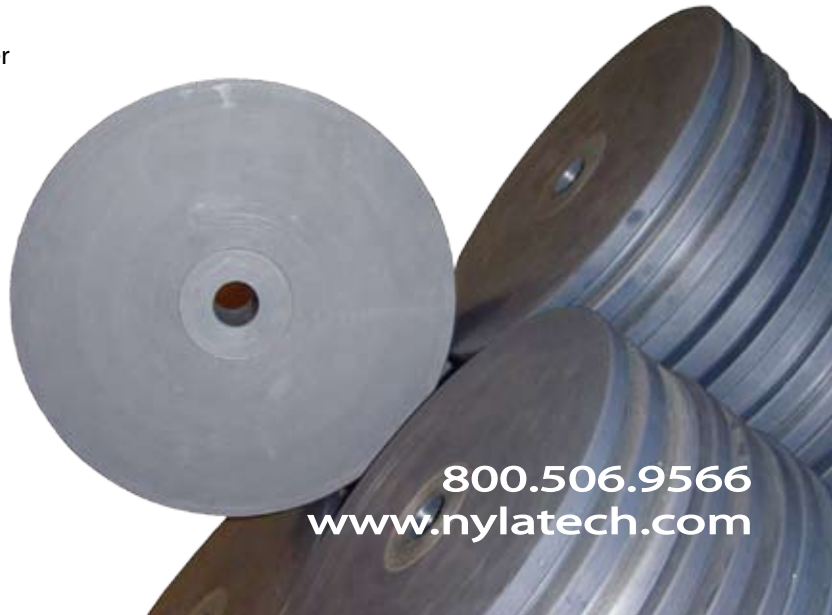
The hub width is usually determined by the space available for the sheave, loading and stability requirements. The hub is typically as wide or wider than the rim.

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.



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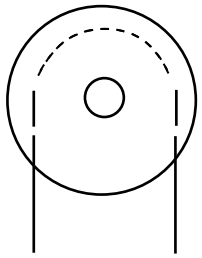
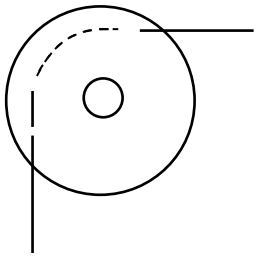
Load Capacity for Nylatech Sheaves:
with Bearings

Fig. 4



180° Wrap Angle



90° Wrap Angle

The GROOVE AND BORE PRESSURE can be calculated by:

For rope wrap angle of 180°	For rope wrap angle of 90°
Pg = 2·T/r·Dt	Pg = 1.414·T/r·Dt
Pb = 2·T/B·LTB	Pb = 1.414·T/B·LTB

Pg =	Groove Pressure (psi)	T =	Line Pull (lbs)
r =	rope diameter (in.)	Dt =	Tread Diameter (in.)
Pb =	Bore Pressure (psi)	B =	Bore Diameter
LTB =	Length through bore		

Please refer to Fig. 1 on Page. 3

To calculate the MAXIMUM BORE AND GROOVE PRESSURE acting on the sheave, substitute the maximum line pull for the rope to be used into the above equations.

The maximum static pressure for a Nylatech Sheave is 4,000 psi. Intermittently, Nylatech 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°	For rope wrap angle of 90°
Groove	Tmax = 2000·r·Dt	Tmax =2828·r·Dt
Bore	Tmax = 2000·B·LTB	Tmax = 2828·B·LTB

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

Load Capacity for Nylatech Sheaves:
without Bearings (Nylatech Sheave directly on shaft)

The main consideration for a sheave without bearings is Pressure Velocity (PV). In this case, the Nylatech Sheave is the bearing. To calculate the load capacity for this situation, use the maximum PV value of the grade of Nylatech 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 Nylatech MD sheave, the bore pressure should not exceed 1,000 psi. With this, the MAXIMUM LOAD can be calculated.

$$Lmax = 1000 \cdot S \cdot LTB$$

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

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