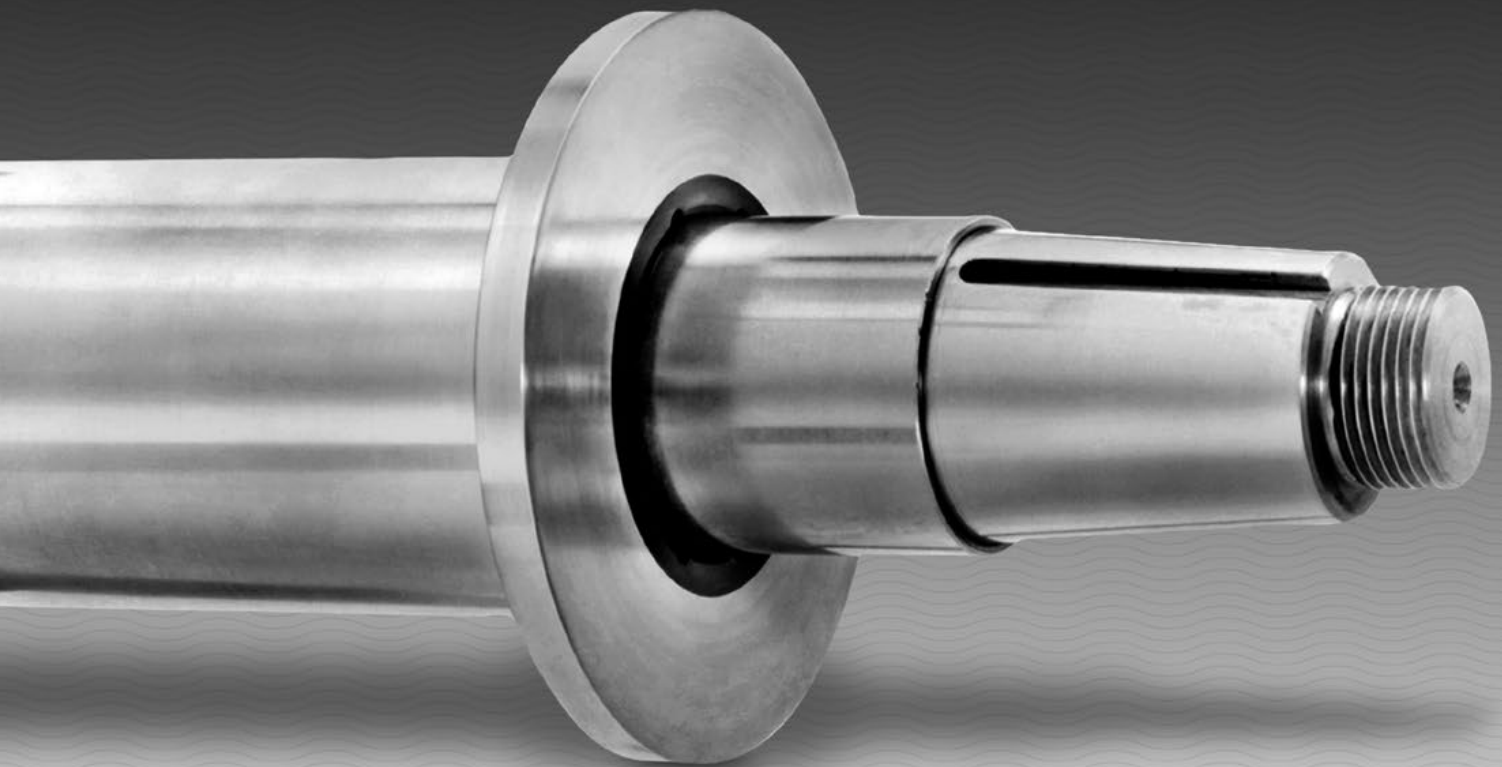


# Duramax<sup>®</sup> NCB Shaft Sleeves

- ▷ Nickel Chrome Boron Alloy
- ▷ Maximum protection for Rudder Stock and Tail Shafts
- ▷ Extends bearing and shaft life



## Installation Manual

Duramax Marine<sup>®</sup> is an ISO 9001:2015 Certified Company

**DURAMAX MARINE<sup>®</sup>**

World Leader in Water-Lubricated Rubber Bearings



## Introduction

### DURAMAX® NCB HARDCOATING RESISTS ABRASION AND CORROSION, EXTENDING SHAFT-ASSEMBLY LIFE:

**DURAMAX® NCB (Nickel-Chrome-Boron) SHAFT SLEEVES are guaranteed to double the life of conventional materials such as 316 or heat treated 410 stainless and will actually give 4-5 times increased wear life.** The 58 to 62 Rockwell "C" hardness rating of the DURAMAX® NCB (Nickel-Chrome-Boron) SHAFT SLEEVE increases service wear life of shafts and shaft sleeves where mechanical abrasion and corrosion take place (example – seal, packing, and bearing areas.)

The fused area of the shaft sleeve is undercut .065 to .070 inches per side. The undercut area is then thermal coated with the Nickel-Chrome-Boron (NCB) powder. Using multiple spraying passes, the sleeve is hard-coated to an oversize dimension. A heat treating process is used to fuse or metallurgically bond the NCB hard coating to the base metal at around 2000°F. After cooling, the shaft sleeve is ground to a 6-8 RMS finish and provides a 58-62 Rockwell "C" hardness.

### DURAMAX® SHAFT SLEEVE OPTIONAL BORE DIMENSIONS:

**Duramax® NCB Shaft Sleeves are supplied with either "FINISHED BORE" or "ROUGH BORE" inside diameters.**

#### **FINISHED BORE:**

Duramax® NCB Shaft Sleeves with "FINISHED BORE" dimensions are supplied ready for shrink-fit installation on the shaft and do not require machining of the sleeve bore diameter prior to installation. Duramax® NCB Shaft Sleeves ordered with "FINISHED BORE" dimensions require the customer to provide shaft diameter dimensions so the correct shrink fit and the "finish bore" dimensions can be calculated prior to the manufacture of the shaft sleeve.

#### **ROUGH BORE:**

When shaft dimensions are not readily available or the shaft must be modified or repaired at dry-docking, Duramax® NCB Shaft Sleeves with "ROUGH BORE" dimensions are available. The "ROUGH BORE" sleeve is supplied with an undersized bore diameter and requires a finish boring operation prior to installation.

## Installation of Duramax® NCB Rudder Stock & Tail Shaft Sleeves

### SHRINK-FIT INSTALLATION OF NCB SLEEVES:

Duramax® NCB Shaft Sleeves consist of a NCB (Nickel Chrome Boron) Coating that is fused to a base metal such as Carbon Steel or Stainless Steel. The NCB coating expands and contracts uniformly with the base metal. However, there are certain procedures and precautions that must be taken when preparing the shaft sleeve for installation and during the shrink fitting process.

#### **I. SHAFT PREPARATION**

The most important factor is the condition of the shaft onto which the shaft sleeve will be installed.

The shaft should be straight before attempting to install the shaft liner.

The shaft should be clean, concentric and free of excessive dimensional run out and/or tapers in the sleeve mounting area.

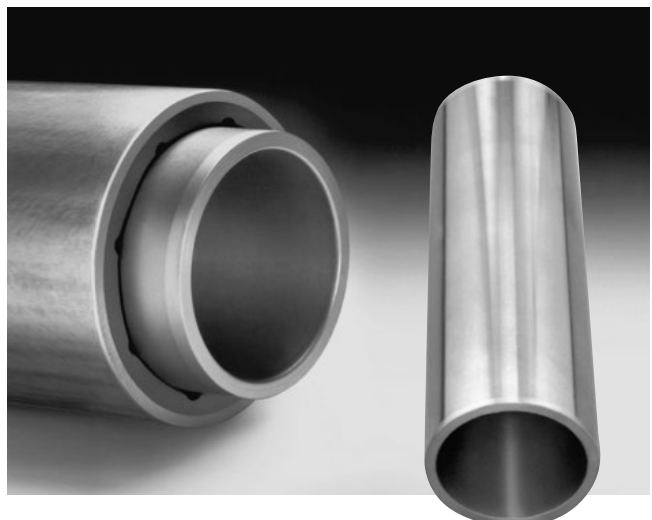
It is essential to remove all high spots or burrs on the shaft. They can cause the shaft sleeve to stick during the installation process and can create stress concentrations during the shrink fitting process that may damage the NCB coating.

#### **II. SHRINK FIT TOLERANCE**

For proper shrink fitting of the Duramax® NCB Shaft Sleeve onto a shaft, calculate an interference shrink fit of 0.0005 inches per inch of shaft diameter not to exceed 0.004 inches.

For example, a Duramax® NCB Shaft Sleeve bored to 6.000 inches inside diameter would require a maximum of .003 shrink fit.

**WARNING: The Maximum Interference fit should never exceed 0.004 inches.** Interference fits in excess of 0.004 inches may result in the fracture or cracking of the NCB Coating.



# Installation of Duramax® NCB Rudder Stock and Tail Shaft Sleeves (continued)

## III. SHAFT SLEEVE BORE MACHINING & TOLERANCES

The ideal machining method to maintain the required bore tolerances is to machine bore the I.D. on a lathe to within 0.002 to 0.003 inches of the required finished bore diameter.

Next, hone the I.D. to final dimension with a maximum surface finish of 63 RMS.

The better the bore finish, the easier the installation and the less probability of “sticking” the sleeve on the shaft before getting to the proper location.

SHAFT DIAMETER	SLEEVE I.D. TOLERANCE	MAXIMUM ID TO OD RUN OUT
up to 6.000 inches	-0.002 to -0.003 inches	0.002 inches
6.000 to 8.000 inches	- 0.003 to -0.0035 inches	0.003 inches
over 8.000 inches	- 0.0035 to -0.004 inches	0.003 in

## IV. SHRINK FITTING

**CAUTION:** The installation and shrink fitting of NCB Shaft Sleeves requires the handling and transporting of hot objects or materials that have been heated to temperatures in excess of 400° F. Improper handling or coming in contact with these heated objects can result in severe burns and injury to unprotected skin and tissues. **USE OF PROPER CLOTHING AND EYE PROTECTION IS REQUIRED.**

Prior to heating and shrink fitting the Duramax® NCB Shaft Sleeve, make sure the shaft is at room temperature and all surfaces are dry and in clean condition. Use an indelible ink to mark the area of the shaft where the NCB Shaft sleeve will be shrink-fitted. In addition to this marking, it is advisable to place a stop-block on the shaft in order to ensure the proper shrink fitting location of the shaft sleeve.

Using inside micrometers, set the micrometers to a heat expanded bore dimension of approximately 0.020 to 0.025 inches larger than the finished bore dimension of the shaft sleeve. The micrometers will be used as a gage to determine when the heated shaft sleeve’s bore has expanded to an oversize dimension for installation on the shaft.

Always heat the shaft sleeve slowly and uniformly to avoid rapid and localized thermal expansion. Heating the shaft sleeve for shrink fitting can be done with a convection oven or hot oil bath. These heating methods apply heat to the entire shaft sleeve, heat the shaft sleeve slowly and uniformly, and avoid thermal shocking of the NCB Coating. The best method is to heat the sleeve in a convection oven to a temperature range of 375° to 425° F.

We do not recommend using a torch for heating the shaft sleeve because of the difficulty in controlling the temperature of the shaft sleeve. **CAUTION: Concentrated torch heating of the shaft sleeve for extended periods of time can result in thermal shock damage to the shaft sleeve.**

## DO NOT HEAT THE SHAFT SLEEVE TO TEMPERATURES IN EXCESS OF 425° F.

The NCB shaft sleeve is ready for shaft installation when your pre-set micrometers can be dropped into or clear the inside diameter of the heated shaft sleeve.

Next, rapidly slide the heated shaft sleeve to the stop-block or the pre-marked shrink fit location on the shaft. When the NCB shaft sleeve is in the proper location, maintain its position at the stop-block and allow the shaft sleeve to slowly cool down and shrink fit to the shaft.

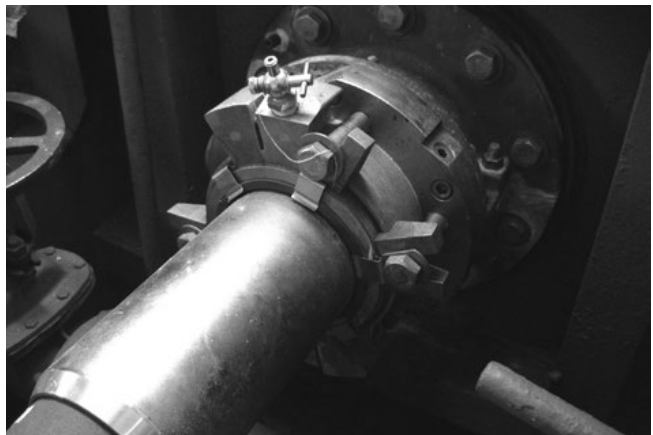
During the positioning of the heated shaft sleeve, take every precaution to avoid contact of the heated shaft sleeve to colder materials such as the shaft. The colder material will act as a heat sink, rapidly reduce the temperature of the heated shaft sleeve and will accelerate the shrinkage of the sleeve before it is in the proper location on the shaft.

In the event that the heated shaft sleeve should shrink and “stick” out of position, you must wait until both the shaft sleeve and the shaft have completely cooled before attempting to remove the shaft sleeve. **DO NOT** try to force the shaft sleeve on after it has shrunk to the shaft and is out of position. Galling, etc. will occur and permanent damage to the shaft or sleeve will occur.

After complete cooling of the shaft and shaft sleeve, reheat the sleeve to remove or to complete the installation. During the reheating process, wet cloths should be wrapped around the shaft at the ends of the shaft sleeve to avoid excessive heating of the shaft during this operation.

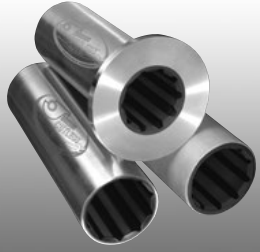
## REMOVAL OF USED SLEEVES:

Used shaft sleeves can be removed using an “air-arc” (argon mix/acetylene), gouging tool or “green grinding wheel” (diamond coated) to cut through the hard coating layer. After the NCB coating is cut, use an oxygen/acetylene torch to cut through the base liner holding it at a tangent to the shaft to avoid damaging the shaft. Any marks on the shaft should be turned off prior to installing replacement liner.



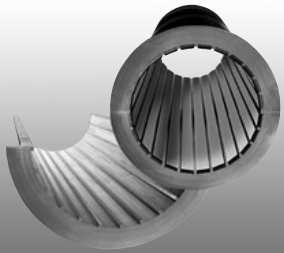
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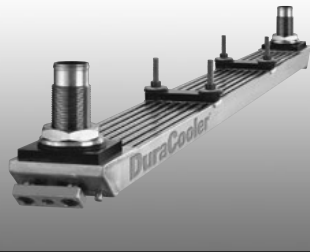
## JOHNSON CUTLESS® WATER-LUBRICATED BEARING SYSTEMS

Johnson Cutless® Sleeve and Flanged Bearings  
DX 490 Rudder Bushings



## DURAMAX® ADVANCED WATER-LUBRICATED BEARING SYSTEMS

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ROMOR® I Stave Bearings and Segmental Housings  
ROMOR® C- Partial Arc Bearings  
DMX® Polymer Alloy Bearings  
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Industrial Pump Bearing Systems



## DURAMAX® HEAT EXCHANGE SYSTEMS

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## DURAMAX® IMPACT PROTECTION SYSTEMS

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