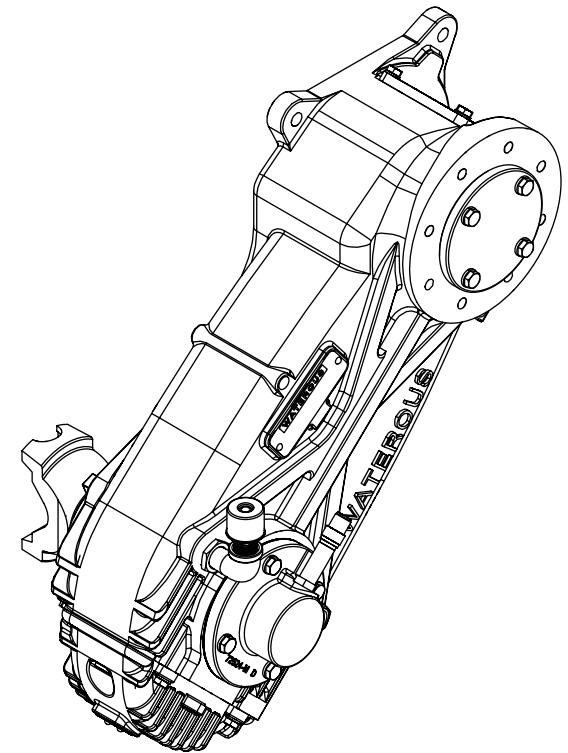
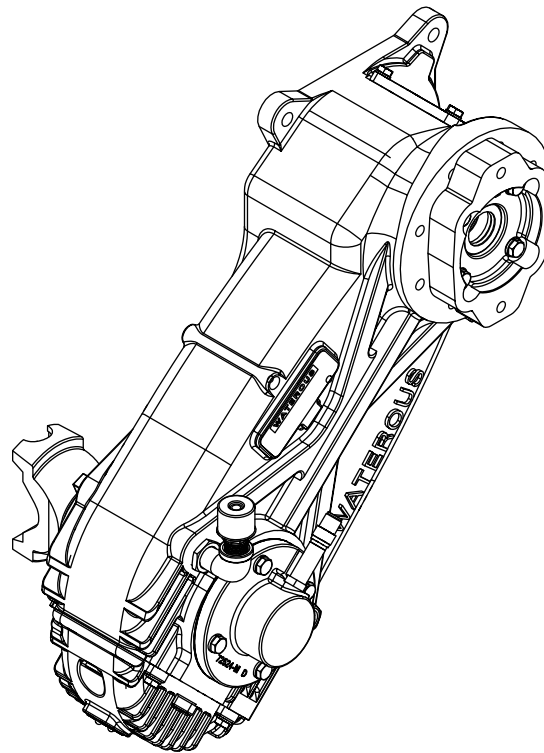
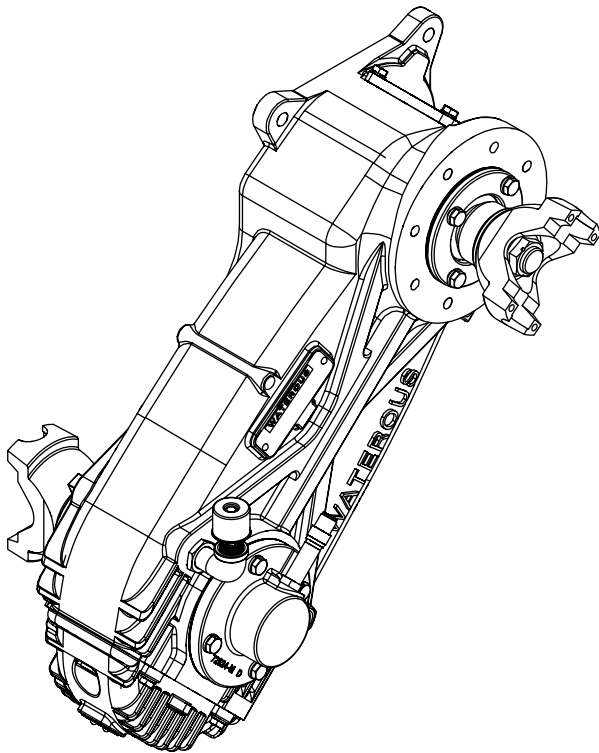


## Overhaul Instructions PA and TPA Transmission





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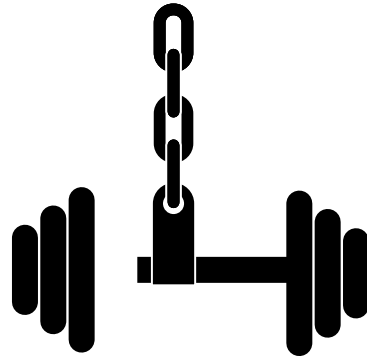
## Safety Precautions

- Read and understand this document before you begin the overhaul.
- Read and understand all the notices and safety precautions.
- Be aware that these instructions are only guidelines and are not meant to be definitive. Contact Waterous when you have questions.
- Do not overhaul this equipment if you are not familiar with the tools and skills needed to safely perform required procedures.
- Do not modify the equipment.
- Waterous reserves the right to make modifications to the instructions without notice.

### WARNING

#### Unsupported Equipment

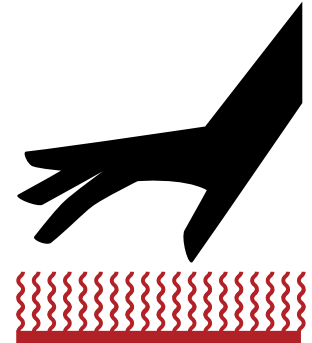
- Unsupported equipment may shift or fall during disassembly, causing injury or damage.
- Always support heavy equipment while servicing.



### WARNING

#### Hot Surface

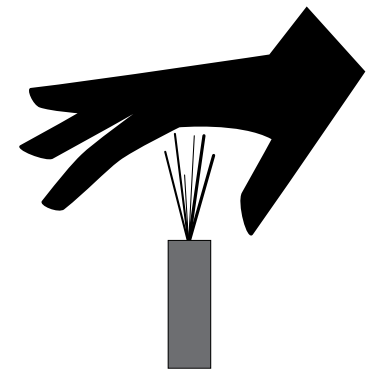
- Hot surface can burn you.
- Do not touch the surface during operation—allow it to cool after operating.



### WARNING

#### High Pressure

- Liquid ejected at high pressure can cause serious injury.
- Drain the pump after use and before servicing.



Use this document to overhaul your Waterous equipment. Please understand the following conditions:

- Be aware that these instructions are only guidelines and are not meant to be definitive. Contact Waterous when you have questions.
- Understand that your configuration may require additional steps, that are not described in the illustrations or instructions, to perform the overhaul.
- The equipment described in this document is intended to be overhauled by a person or persons with the necessary skills and knowledge to perform the overhaul.

This document is divided into the following sections:

### SAFETY

This section describes general precautions and alert symbols that are in this document.

### INTRODUCTION

This section is an overview of the document.

### CONFIGURATION

This section describes the pump configurations illustrated in the document.

### DISASSEMBLY

This section describes disassembly procedures.

### ASSEMBLY

This section describes assembly procedures.

## Using this Document

Use the guidelines below when viewing this document.

### Viewing the Document Electronically

- View this document in landscape orientation.
- Use the table of contents to navigate directly to that section.
- Text **with this appearance** is linked to a reference.

### Printing the Document

- This document is viewed the best when printed in color.
- The *print on both sides* and *flip on long edge* features can provide the best results.
- Use a 3-ring binder to store the document.

## Symbols

Symbols are used to illustrate additional tools or operations that are required to complete the instructions.



Discard—This symbol tells you to discard or recycle the part in accordance with local regulations.



Arbor press—This symbol tells you to use an arbor press to complete the step.



Lubrication—This symbol tells you to apply the appropriate lubricant to the part.



Sealant—This symbol tells you to apply a appropriate sealant to the part.



Anti-seize—This symbol tells you to apply anti-seize to the part.



Section reference—This symbol tells you to refer to the section reference for additional information.



Torque to specification—This symbol tells you to torque the hardware to the specified value.



Finger tight, then quarter turn—This symbol tells you to secure the hardware to finger tight, then use a wrench to turn the hardware an additional quarter turn.



High-pressure grease—This symbol tells you to apply high-pressure grease to the surfaces that you are pressing together.

## Locating the Serial Number

Locate and record the model and serial number of the pump. Have this information available when you call Waterous.

**Pump serial**

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**Transmission serial**

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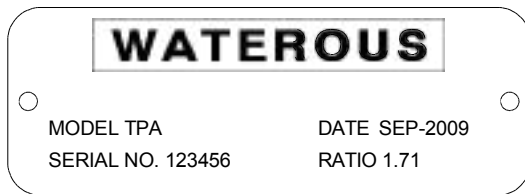
**Date**

**Ratio**

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## TPA Model PTO

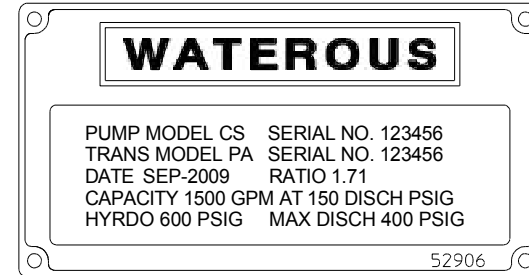
The serial number plate is located on the PTO.



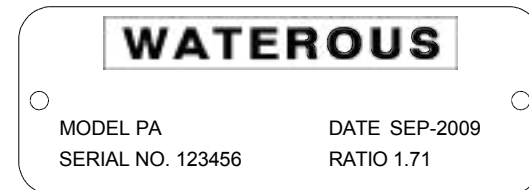
## PA Manual Transmission

### Pump Models—CM, CMU, CS, and CSU

Depending on your application, the serial number plate is located on the operator panel, the pump, the transmission, or some combination of the three.



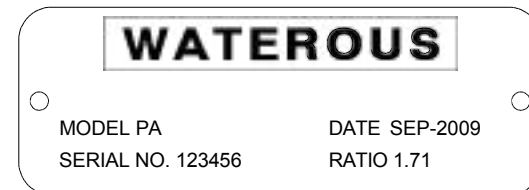
Operator panel serial number plate



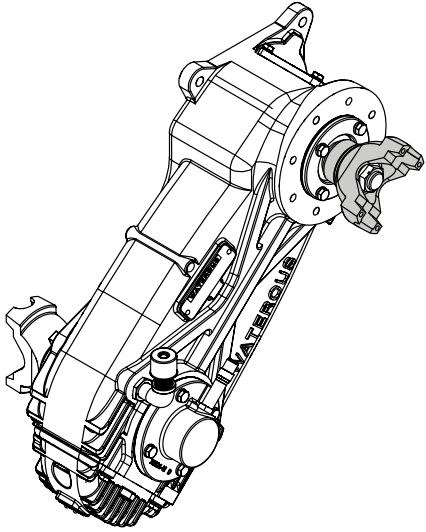
Pump serial number plate

### Pump Models—CG, CX, and S100

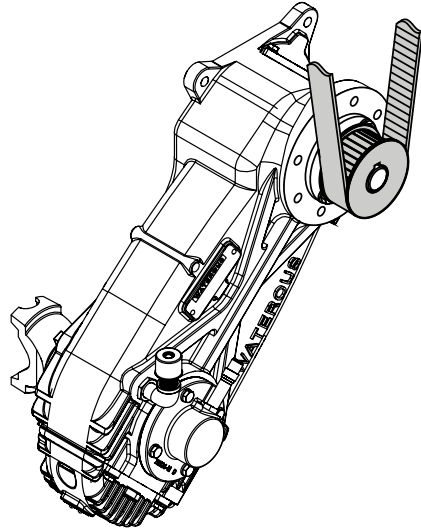
There are two serial number plates: One plate is located on the operator panel and the other is located on the pump.



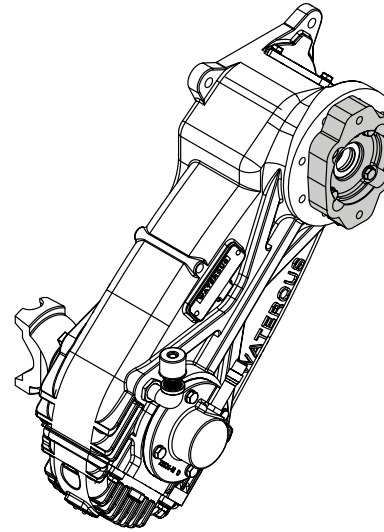
PA models—Driven Shaft Configurations



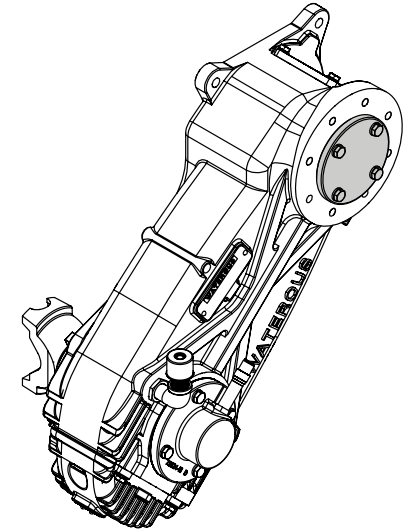
With End Yoke



With Compressor (Belt Drive)



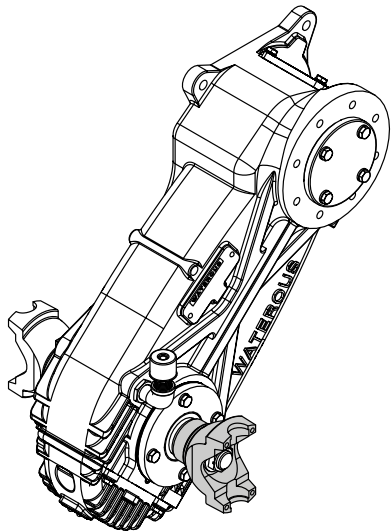
With Hydraulic Flange



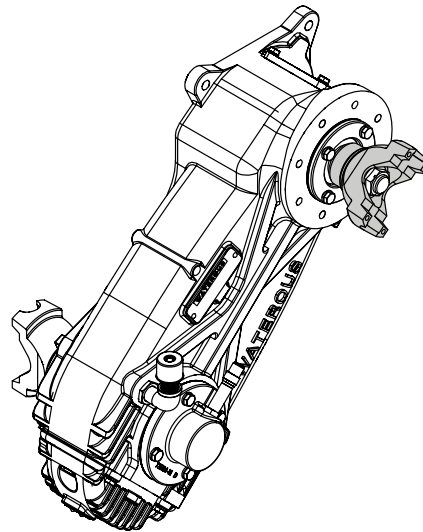
Without Output Shaft

PA models—Drive Shaft Configuration

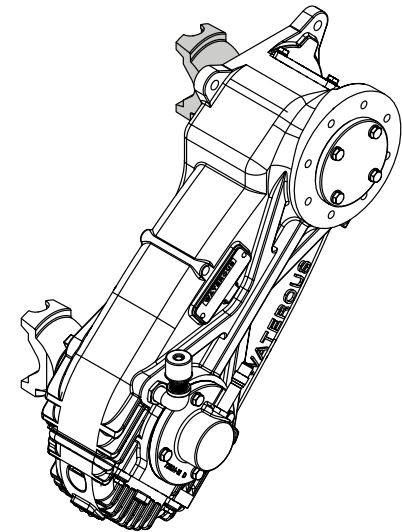
TPA PTO model—Driven Shaft Configurations



With End Yoke



With End Yoke (Opposite Side)



With End Yoke (Same Side)



## Preparing to Disassemble the Transmission

---

- Read and understand the instructions before disassembling the equipment.
- Prepare a workspace suitable to accommodate and support the transmission.
- Gather the necessary tools, cleaning cloths, brushes, and penetrating fluids.
- Understand that your configuration may require additional steps that are not described in the illustrations or instructions to perform the disassembly.
- This equipment is intended to be disassembled by a person or persons with the basic knowledge of servicing similar equipment. Contact Waterous with questions.

## Tools Required

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- Typical automotive mechanics hand tools.
- Suitable arbor press.
- Suitable support and lifting equipment.

## Preparing the Apparatus

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- Park the apparatus on a level surface in a well-lit area.
- Engage the parking brake.
- Shut off the engine and remove the key from the ignition switch.
- Allow the apparatus to cool before servicing.

## Best Practices

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- Remove any dirt, sand, grease, or oil from the enclosure before you disassemble the transmission. Surface debris can transfer into the pump interior and prematurely wear internal parts.
- Only use a clean lint-free cloth, a debris-free work surface, and properly-maintained tools to perform the disassembly.
- Replace any gaskets and O-ring seals during the overhaul.
- Do not reuse the self-locking nuts.
- Apply penetrating oil to screws and nuts before disassembly.

## Removing the Transmission

---

Removing the transmission for overhaul varies by application. Your application may require that components such as cooling lines, support brackets, plumbing connections, and other accessories be removed or disconnected before removing the transmission.

Furthermore, some applications require you to remove the transmission and pump together before separating the transmission from the pump. Other applications allow you to separate the transmission without removing the pump from the apparatus. Refer to the pump instructions before proceeding.

Record the process used to remove the equipment from the apparatus. Use this information to install the equipment into the apparatus after the overhaul.

## Disassembling the Transmission Components

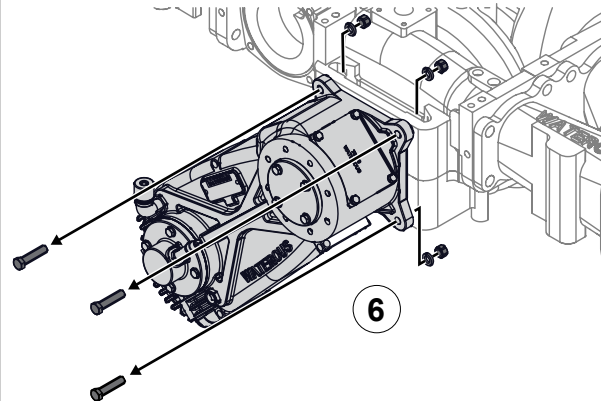
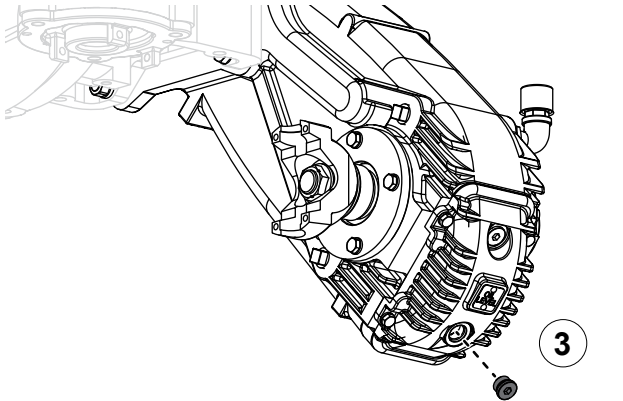
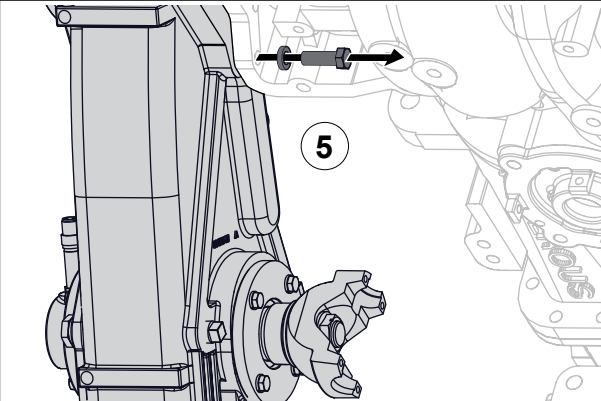
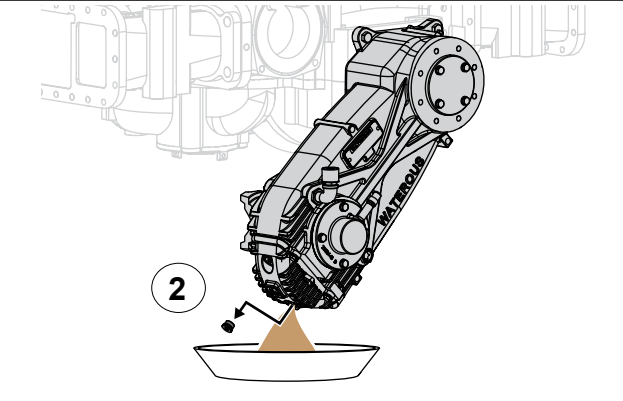
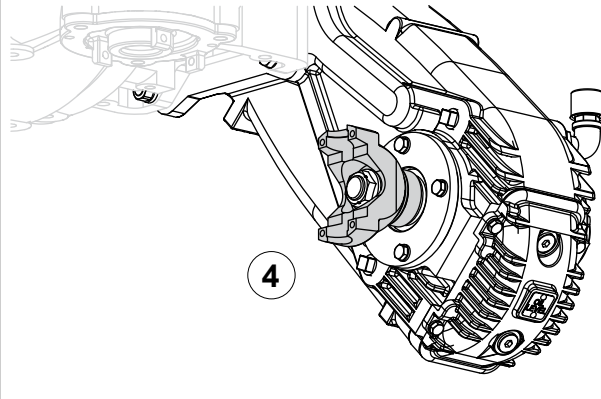
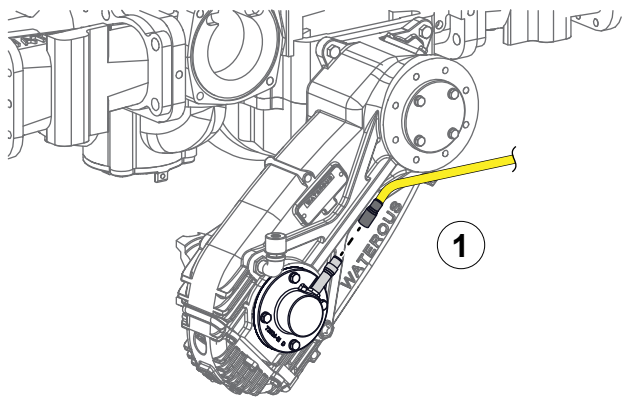
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- Refer to the service parts list (SPL) for part identification and disassembly order.
- The SPL specific to your application is determined by the following:
  - The pump connected to the transmission.
  - The transmission drive method.
  - Whether the transmission drives a CAFS compressor.

**Note:** Documents specific to your application are available through the MyWaterous login at [Waterousco.com](http://Waterousco.com) by entering the serial number for your system. Depending on the application, the serial number for your equipment is located on the operator panel, or the pump, or the transmission, or some combination of the three.

- Use established industry practices to disassemble the transmission.
- Record or mark components as you remove them to make sure that you install them in the same orientation.
- Discard or recycle drained fluids collected during the overhaul in accordance with your local regulations.

## Removing the Transmission



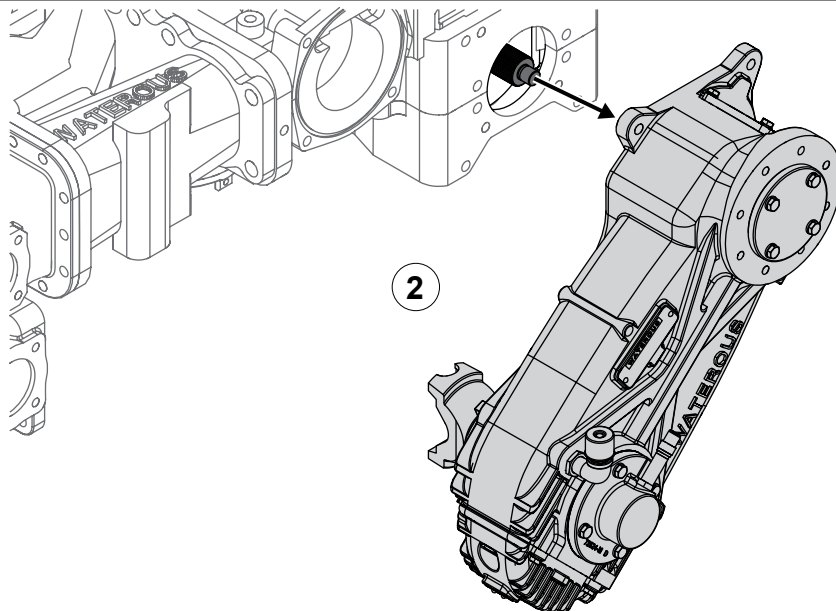
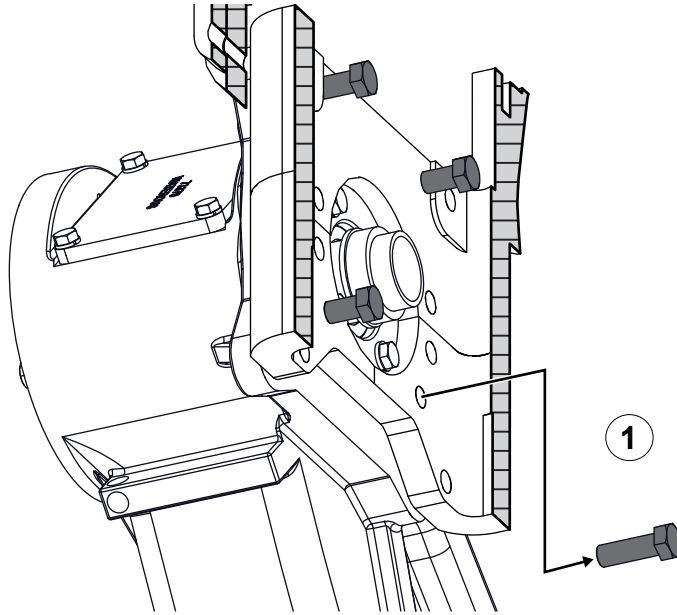
### With a Separable Shaft

Use the illustrations and instructions to drain and remove the transmission.

**Note:** Your configuration may require the pump and transmission to be removed from the apparatus before being separated.

- 1 Disconnect the magnetic pickup cable if included in your transmission configuration.
- 2 To drain the transmission fluid, do the following:
  - Place a suitable container under the drain plug to capture the fluid.
  - Locate, remove, and set aside the drain plug.
  - Drain the transmission fluid and dispose of it according to local regulations.
- 3 Install the drain plug.
- 4 Detach the apparatus driveline from the transmission.
- 5 Remove and set aside the mounting hardware located on the pump side of the transmission.
- 6 Remove and set aside the transmission mounting hardware.

## Removing the Transmission

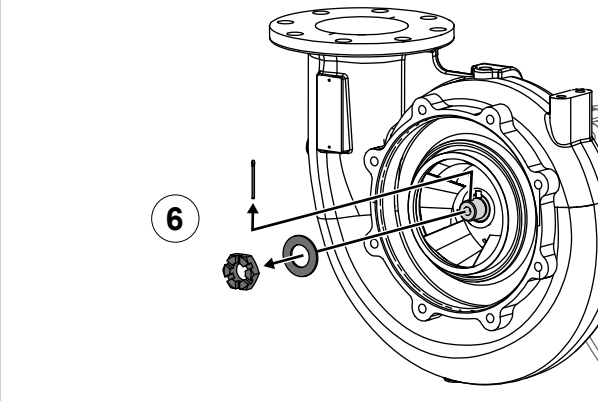
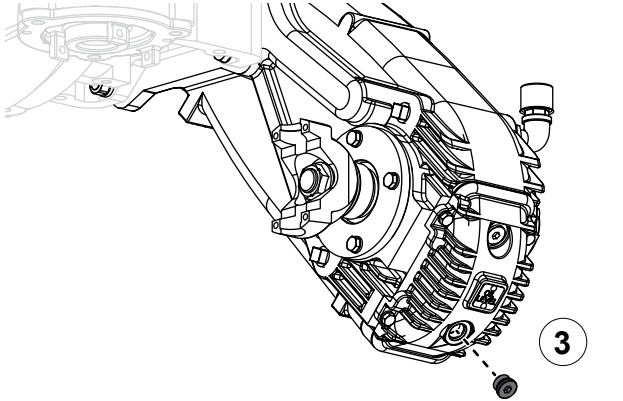
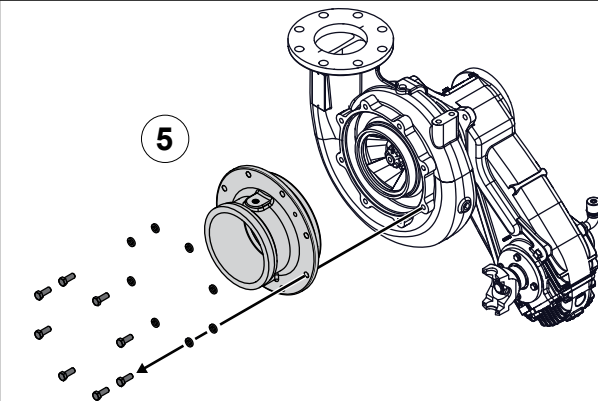
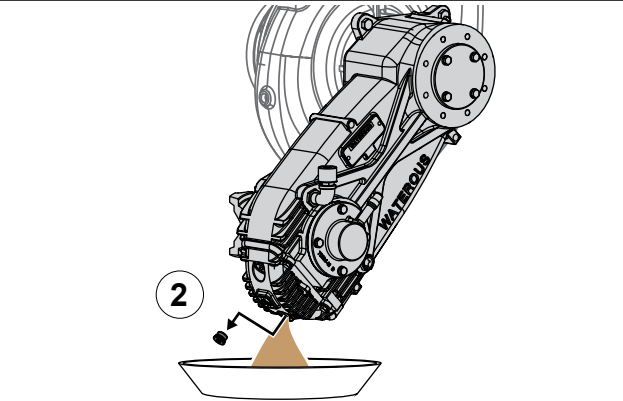
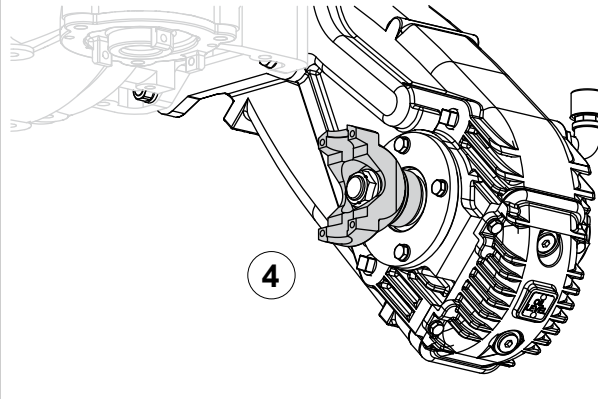
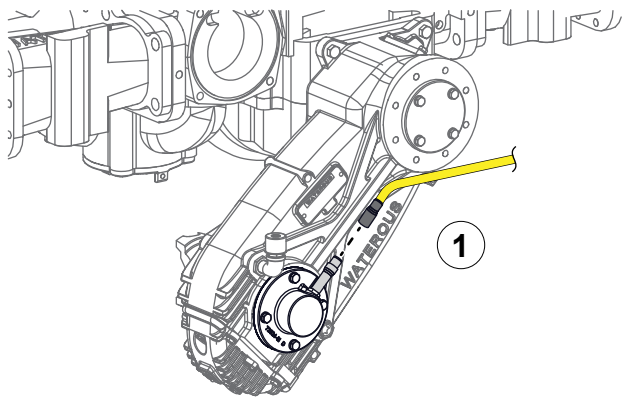


### With a Separable Shaft

Use the illustrations and instructions to remove the transmission.

- 1 Use locally-sourced jack screws to separate the transmission and pump.
- 2 Remove the transmission from the pump and place it on the workbench.

## Removing the Transmission



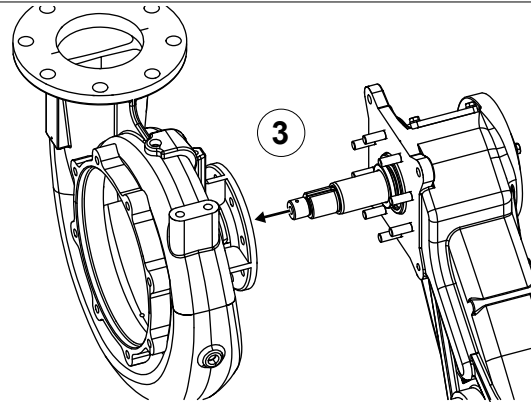
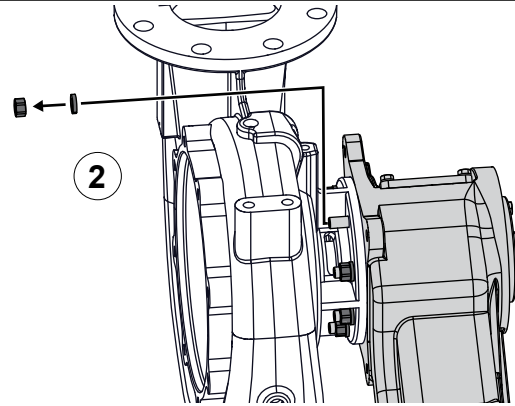
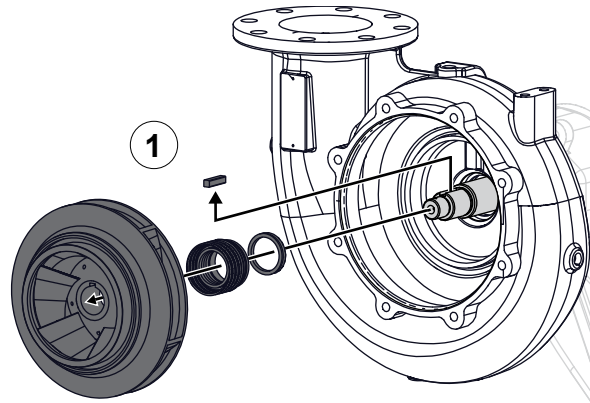
### With an Inseparable Shaft

Use the illustrations and instructions to drain and remove the transmission.

**Note:** Your configuration may require the pump to be disconnected from the apparatus and removed with the transmission.

- 1 Disconnect the magnetic pickup cable if included in your configuration.
- 2 To drain the transmission fluid, do the following:
  - Place a suitable container under the drain plug to capture the fluid.
  - Locate, remove, and set aside the drain plug.
  - Drain the transmission fluid and dispose it according to local regulations.
- 3 Install the drain plug.
- 4 Detach the apparatus driveline from the transmission.
- 5 Remove and set aside the mounting hardware and intake.
- 6 Remove and set aside the hardware securing the shaft to the impeller.

## Removing the Transmission

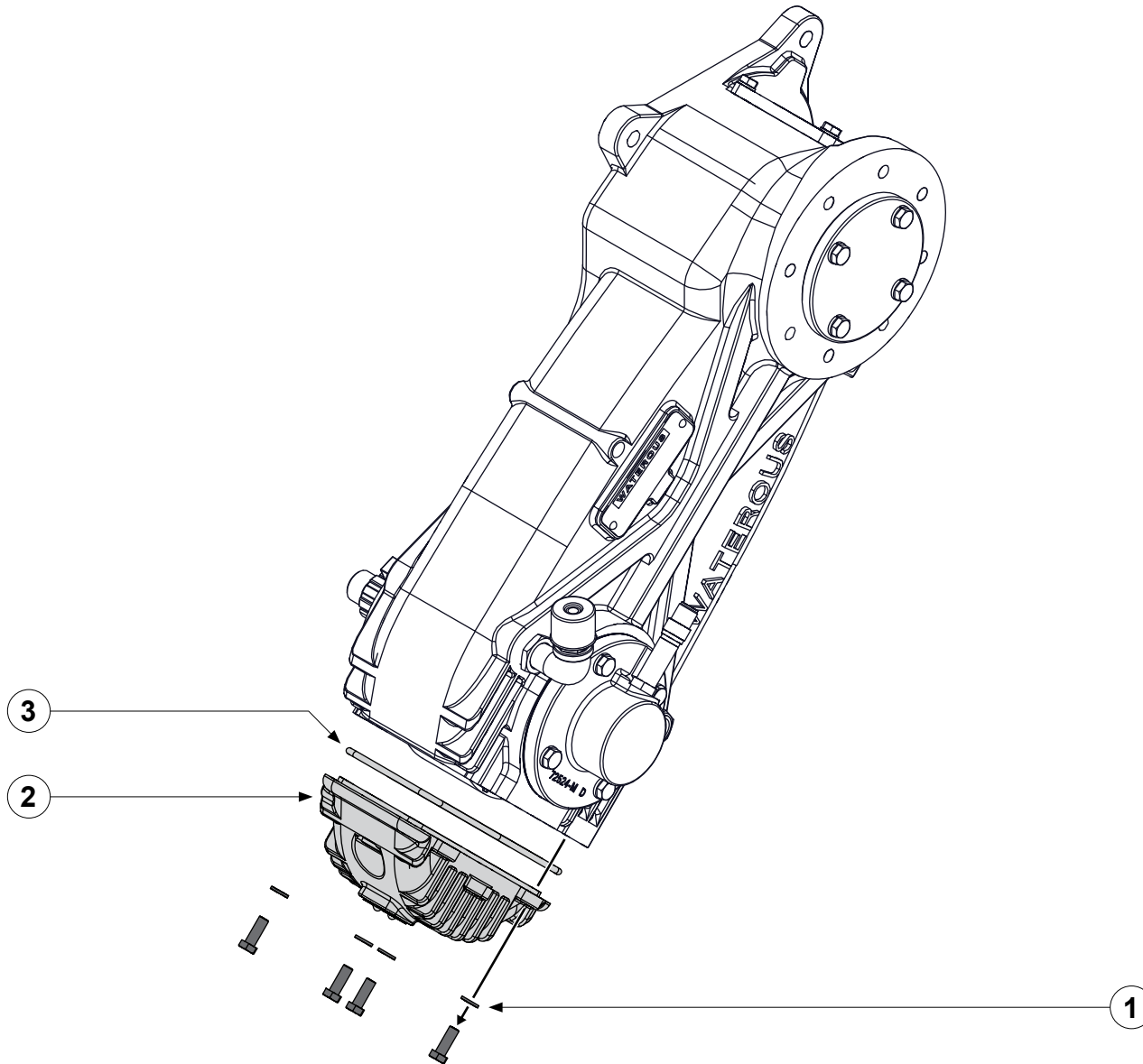


### With an Inseparable Shaft

Use the illustrations and instructions to remove the transmission.

- 1 Remove and set aside the impeller, packing material, oil flinger, and key.
- 2 Remove and set aside the transmission mounting hardware.
- 3 Separate the transmission from the pump.

## Removing the Bottom Cover

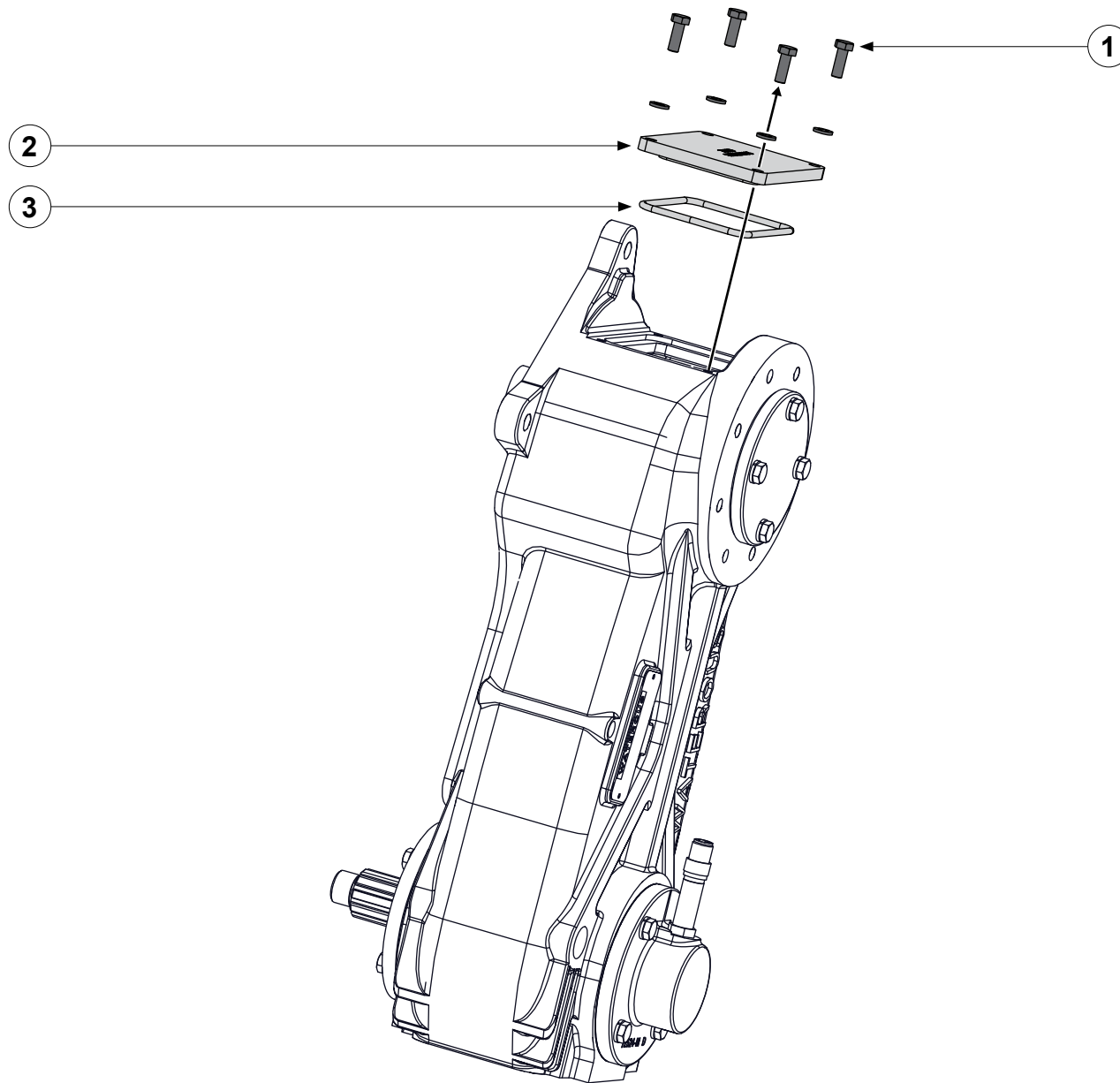


### All Models

Use the illustration and instructions to remove the bottom plate.

- 1 Remove and set aside the mounting hardware.
- 2 Remove and set aside the bottom cover.
- 3 Remove and discard the bottom gasket.

## Removing the Top Cover

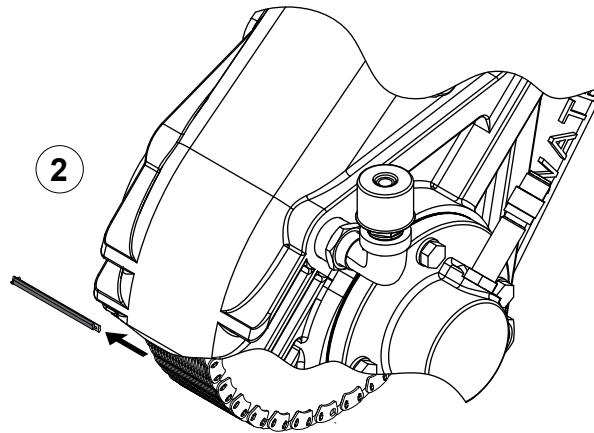
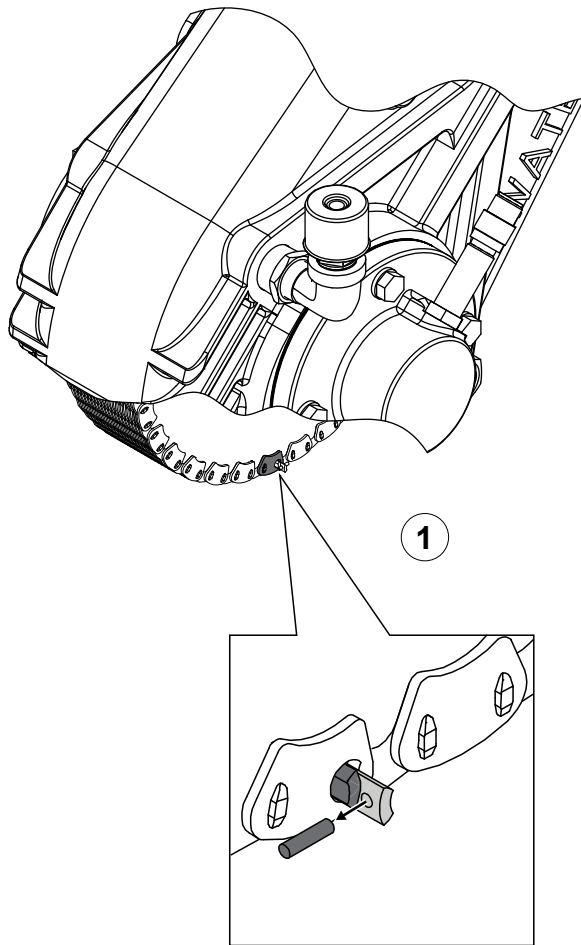


### All Models

Use the illustration and instructions to remove the top plate.

- 1 Remove and set aside the mounting hardware.
- 2 Remove and set aside the top cover.
- 3 Remove and discard the O-ring.

## Removing the Drive Chain



### All Models

Use the illustrations and instructions to separate and remove the drive chain. Replace components that are worn or damaged.

- 1 Locate the connecting link, then use the pin tool (part number 53402) to remove and set aside the removable pin.

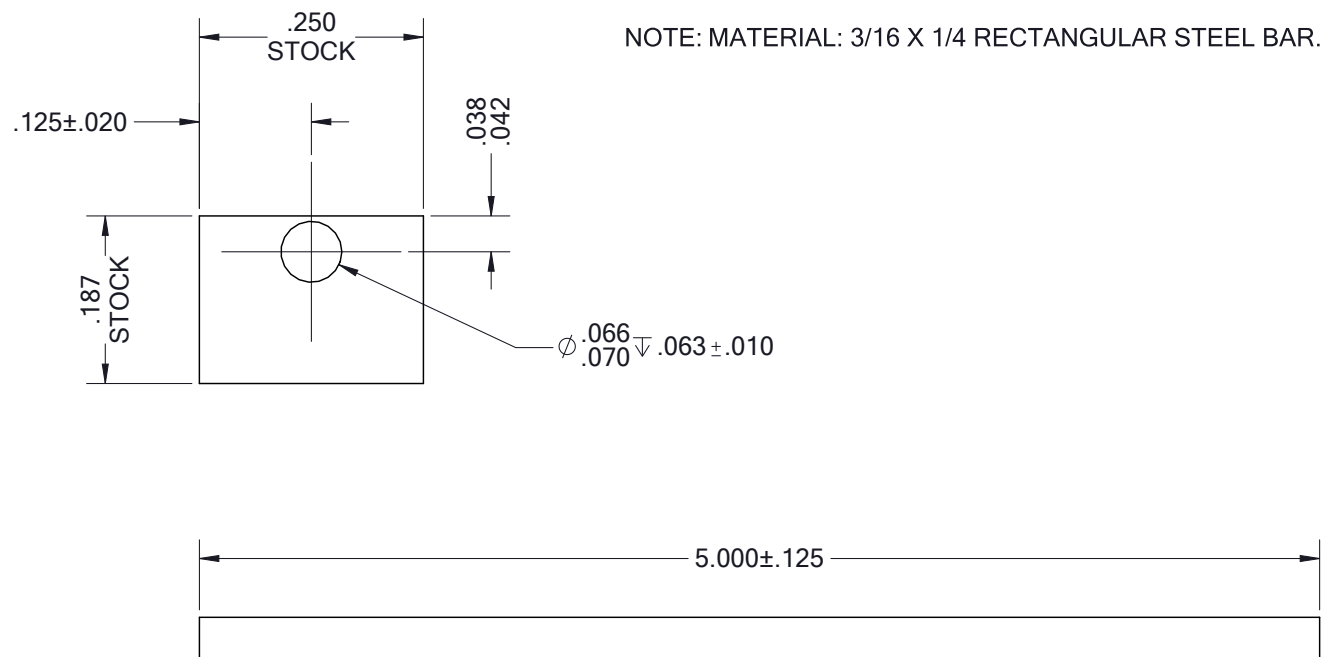
**Note:** To fabricate the pin install/removal tool, refer to: "**Fabricating the Removable Pin Tool**" on page 17.

- 2 Remove the connecting pin and rocker, then remove the chain from the transmission case. Set aside both.

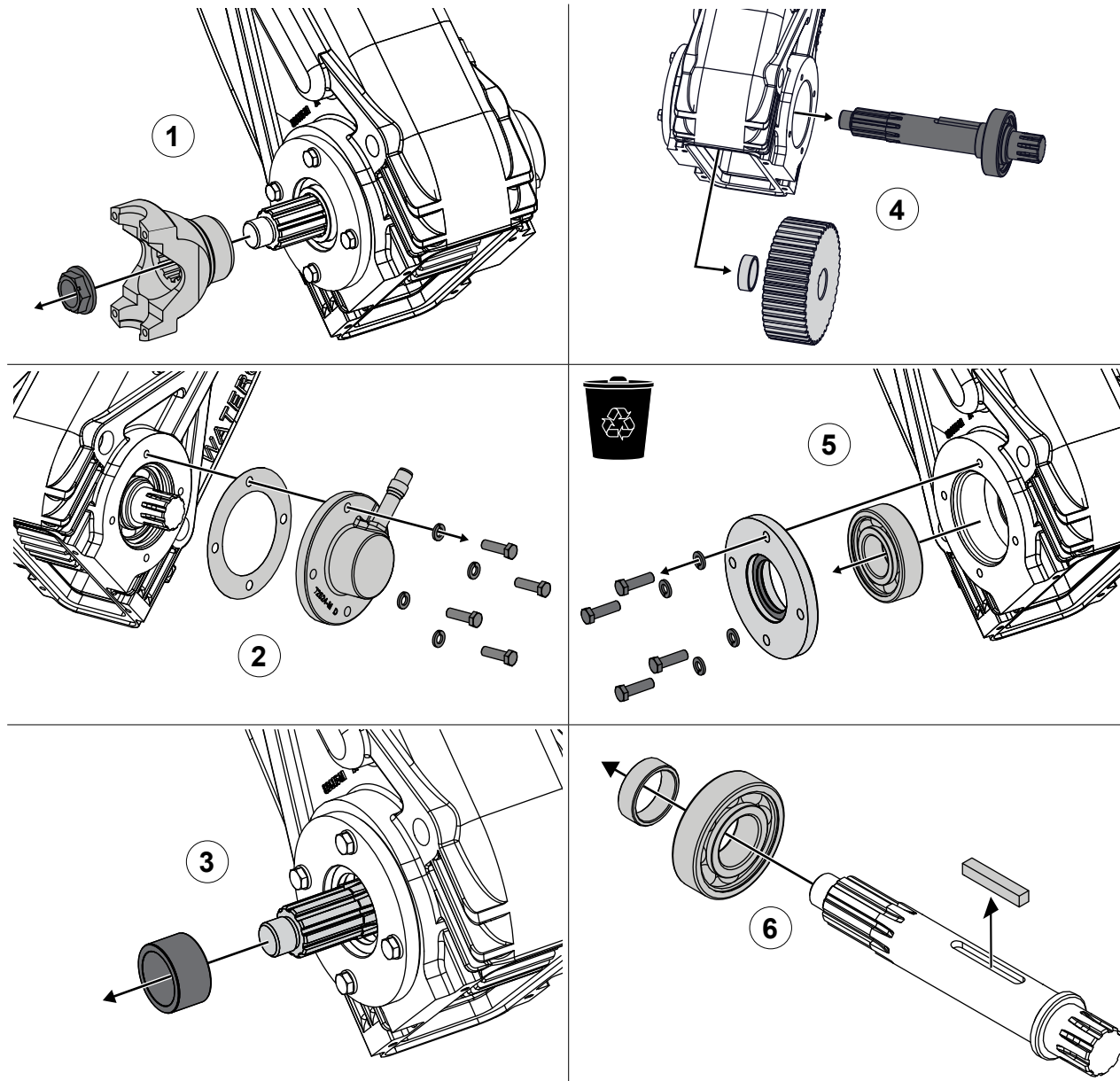


## Fabricating the Removable Pin Tool

Use the following information to fabricate a pin-removal tool.



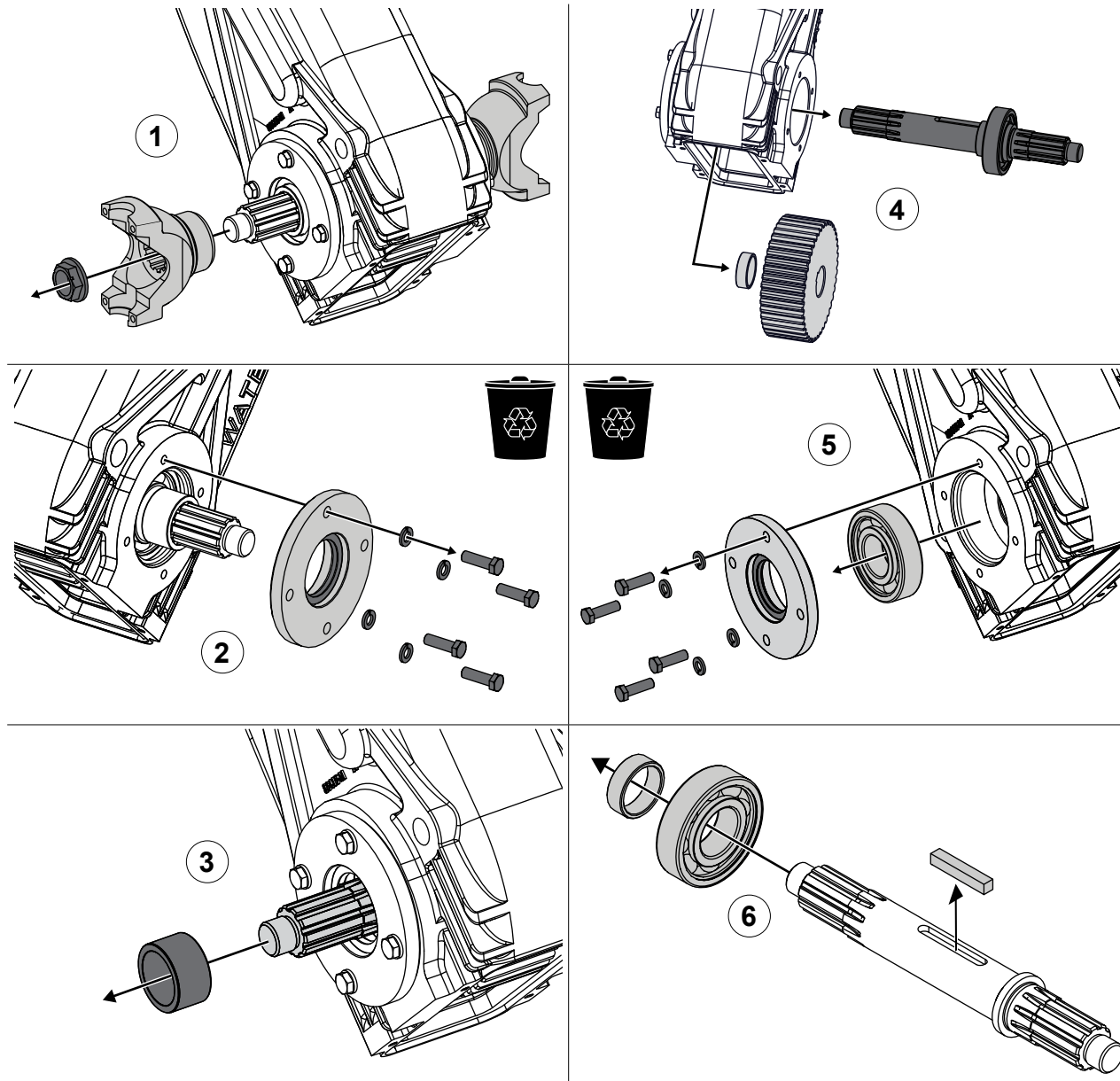
## Removing the Lower Drive Components—Without Output Shaft



Use the illustrations and instructions to remove the lower drive components from the transmission case.

- 1 Remove and set aside the locknut and end yoke.
- 2 Remove and set aside the mounting hardware, tachometer, and shims.
- 3 Remove and set aside the oil-seal sleeve.
- 4 Push the drive shaft out of the transmission case, then remove the drive-shaft spacer and drive sprocket. Set them aside.
- 5 Remove and set aside the mounting hardware, oil-seal housing, and bearing. Discard the oil seal.
- 6 Remove the key, drive-shaft spacer, and bearing from the drive shaft, then set them aside.

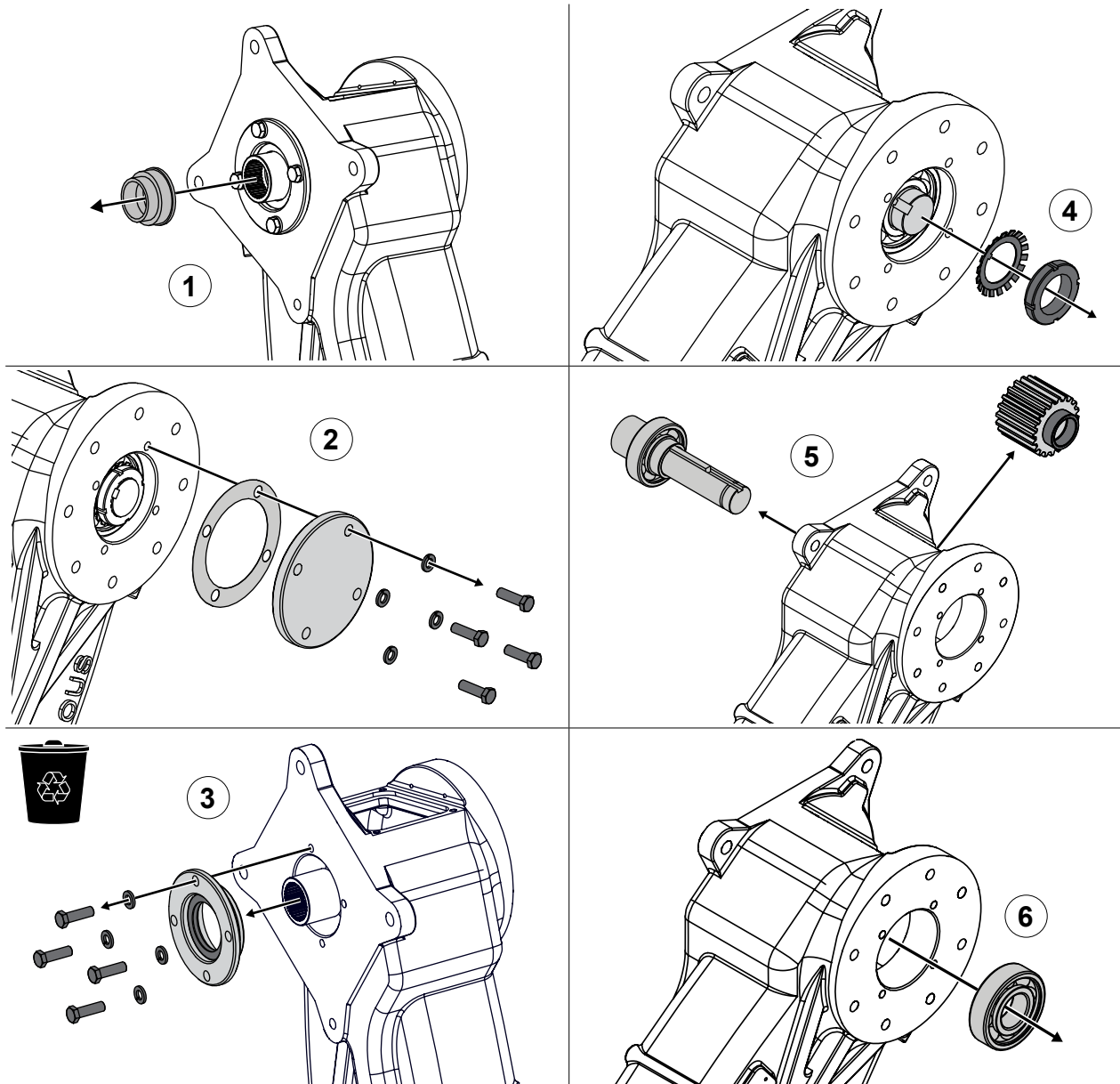
## Removing the Lower Drive Components—With Output Shaft



Use the illustrations and instructions to remove the lower drive components from the transmission case.

- 1 Remove and set aside the locknut and end yoke on both sides of the transmission case.
- 2 Remove and set aside the mounting hardware and oil-seal housing. Discard the oil seal.
- 3 Remove and set aside the oil-seal sleeve on both sides of the transmission case.
- 4 Push the drive shaft out of the transmission case, then remove the drive-shaft spacer and drive sprocket. Set them aside.
- 5 Remove and set aside the mounting hardware, oil-seal housing, and bearing. Discard the oil seal.
- 6 Remove the key, drive-shaft spacer, and bearing from the drive shaft, then set them aside.

## Removing the Upper Drive Components—CM and CS Pumps

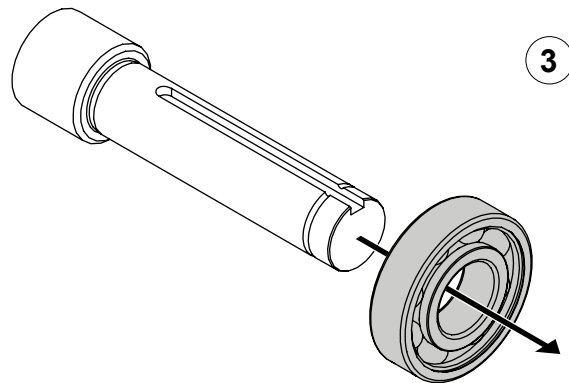
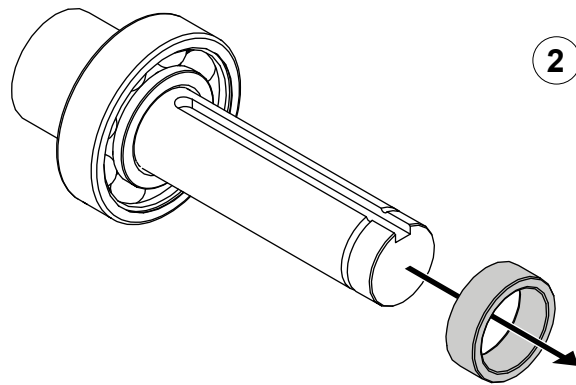
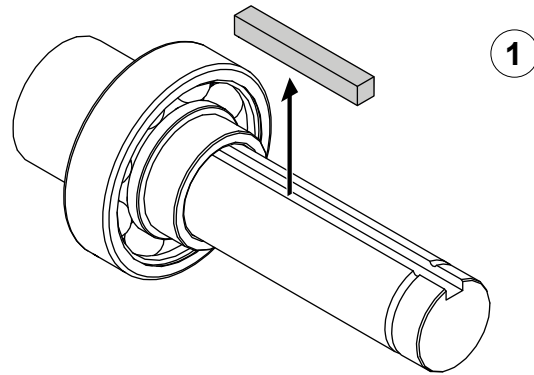


### Shaft without Output

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the sealing boot.
- 2 Remove and set aside the mounting hardware, oil-seal housing, and shims.
- 3 Remove and set aside the mounting hardware and oil-seal housing. Discard the oil seal.
- 4 Straighten the tab on the bearing lock washer, then remove the nut and washer. Set them aside.
- 5 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 6 Remove and set aside the bearing.

## Disassembling the Driven Shaft—CM and CS Pumps

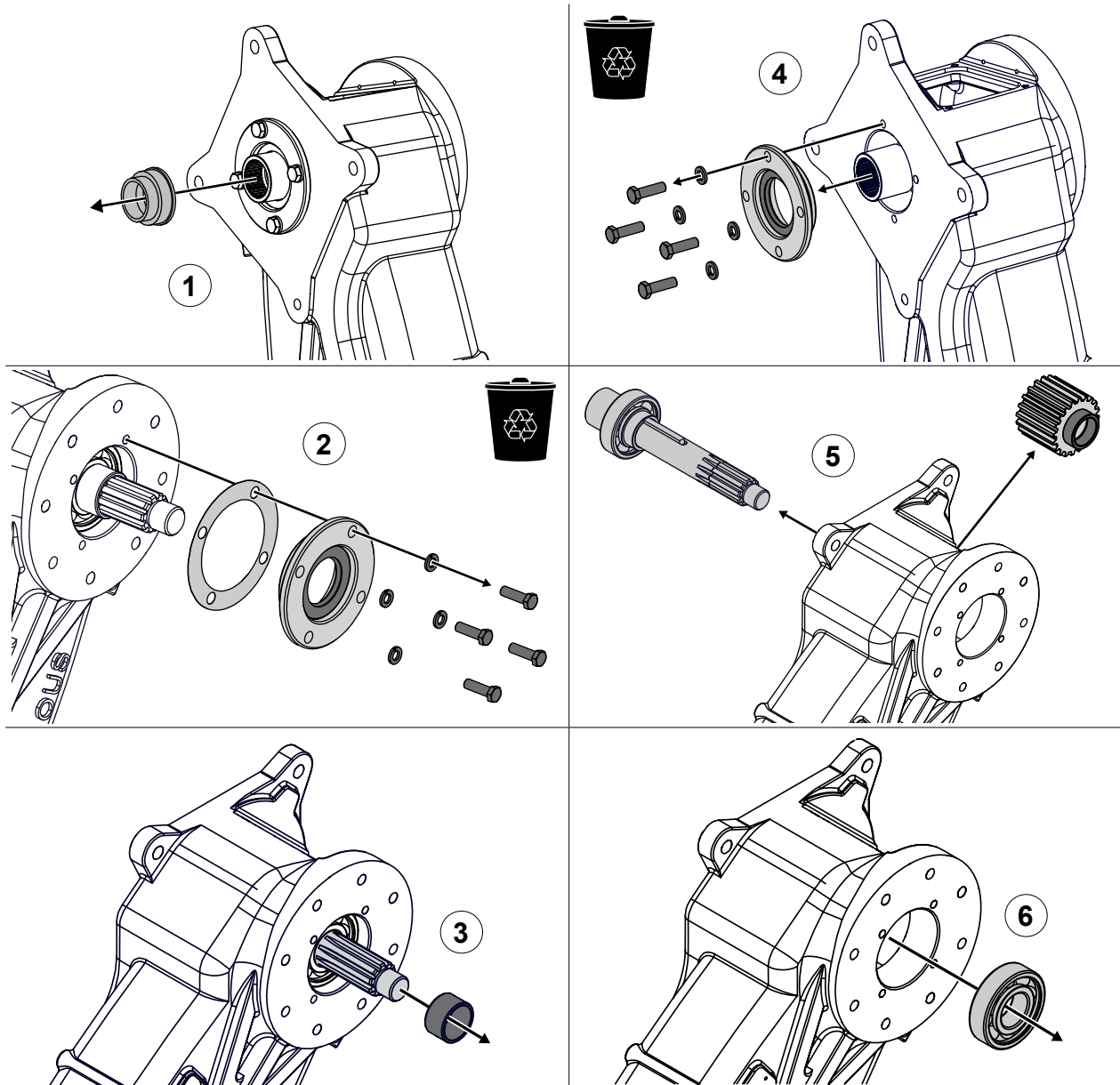


### Shaft without Output

Use the illustrations and instructions to disassemble the driven shaft assembly.

- 1 Remove the key from the key slot on the shaft.
- 2 Remove the spacer from the shaft.
- 3 Remove the bearing from the shaft.

## Removing the Upper Drive Components—CM and CS Pumps

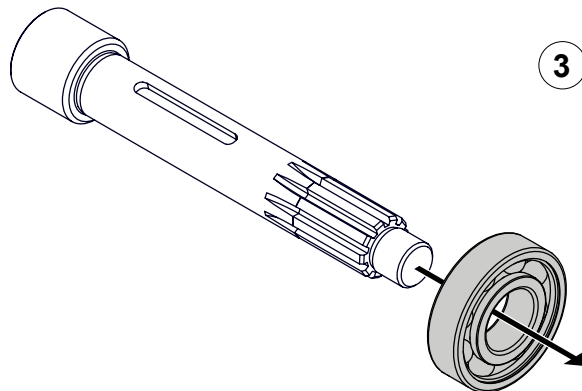
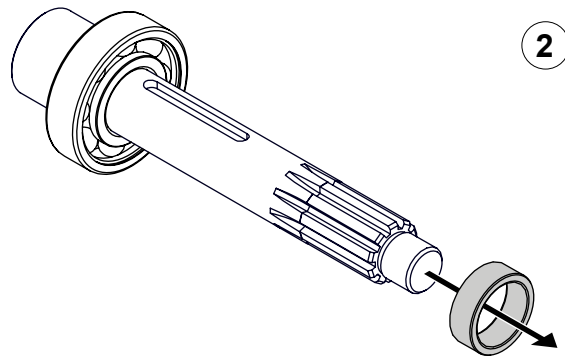
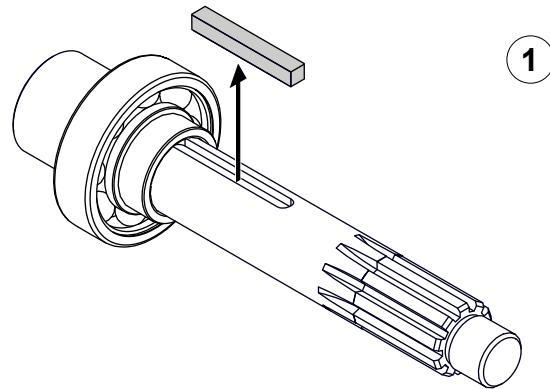


### Shaft with Spline Output

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the sealing boot.
- 2 Remove and set aside the mounting hardware, oil-seal housing, and shims. Discard the oil seal.
- 3 Remove and set aside the oil-seal sleeve.
- 4 Remove and set aside the mounting hardware and oil-seal housing. Discard the oil seal.
- 5 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 6 Remove and set aside the bearing.

## Disassembling the Upper Drive Shaft—CM and CS Pumps

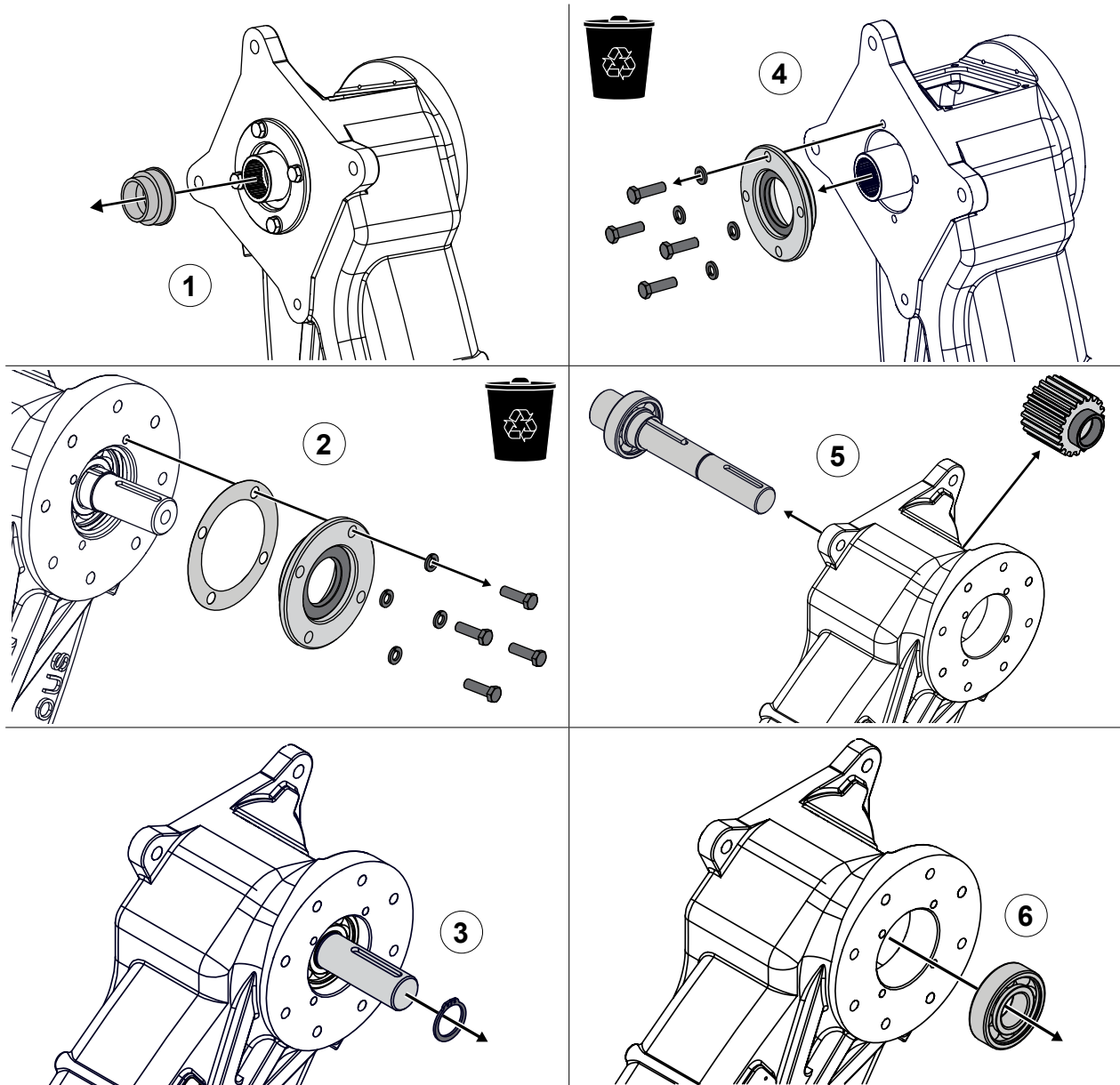


### Shaft with Spline Output

Use the illustrations and instructions to disassemble the driven shaft assembly.

- 1 Remove the key from the key slot on the shaft.
- 2 Remove the spacer onto the shaft.
- 3 Remove the bearing from the shaft.

## Removing the Upper Drive Components—CM and CS Pumps



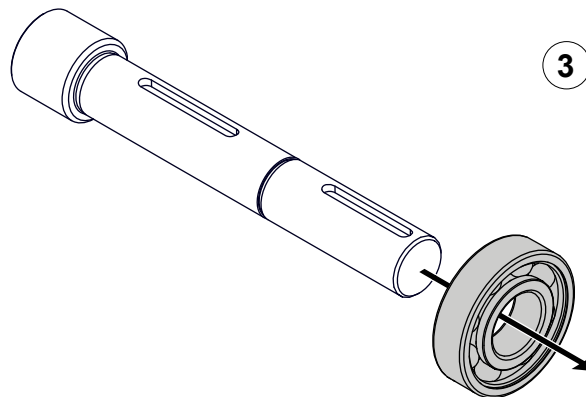
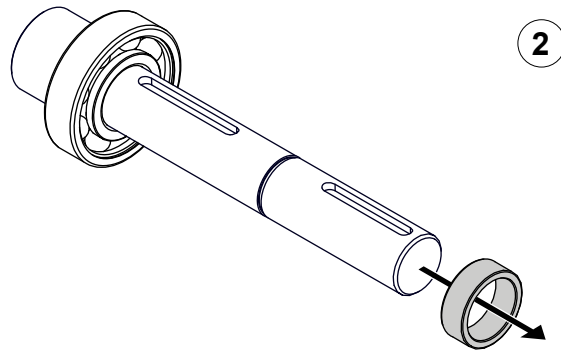
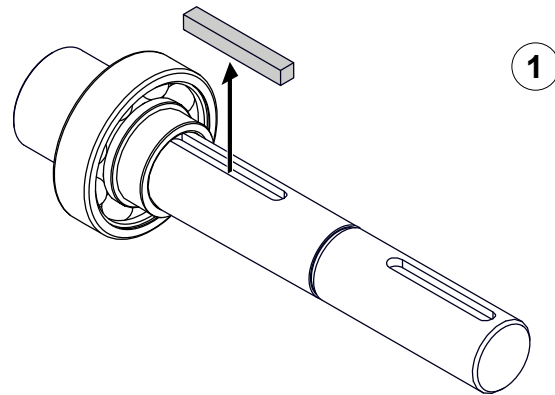
### Shaft with Keyed Output

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the sealing boot.
- 2 Remove and set aside the mounting hardware, oil-seal housing, and shims. Discard the oil seal.
- 3 Remove and set aside the retaining ring.
- 4 Remove and set aside the mounting hardware and oil-seal housing. Discard the oil seal.
- 5 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 6 Remove and set aside the bearing.



## Disassembling the Upper Drive Shaft—CM and CS Pumps

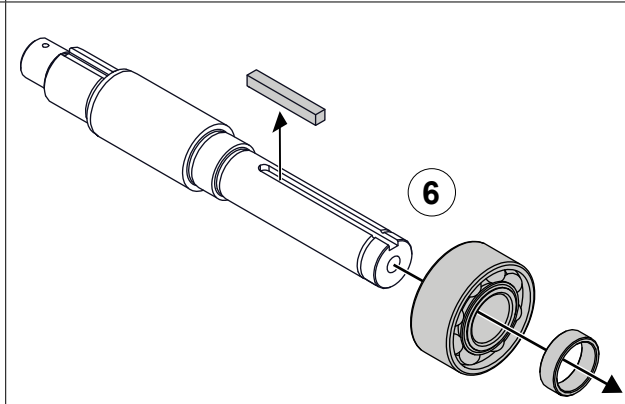
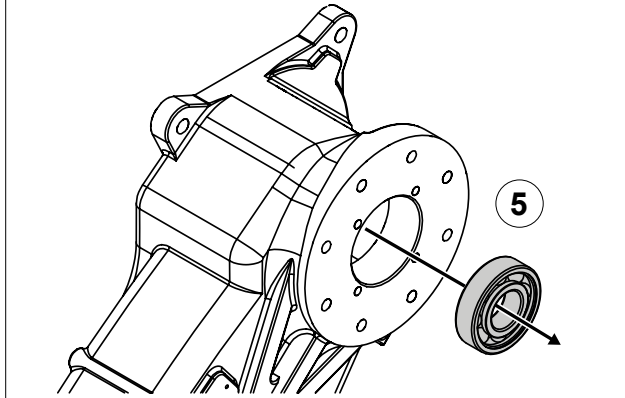
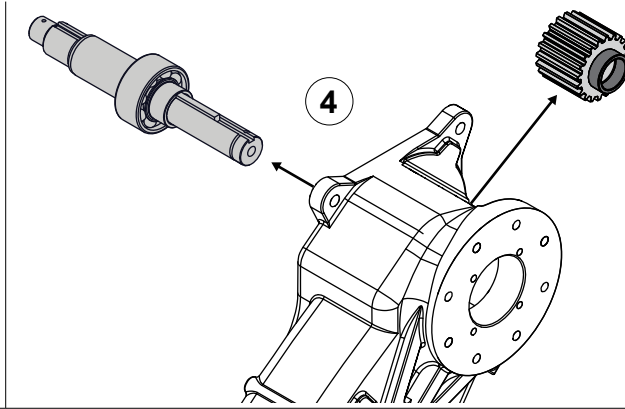
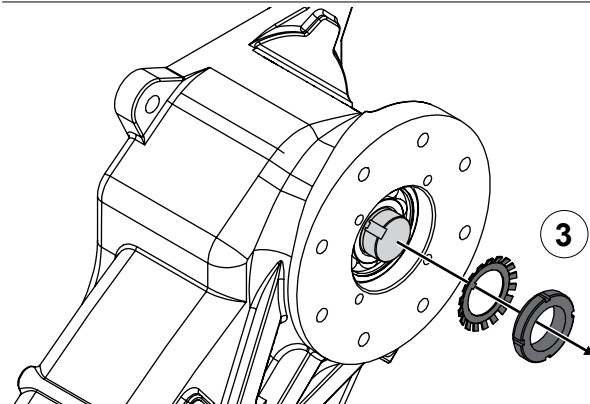
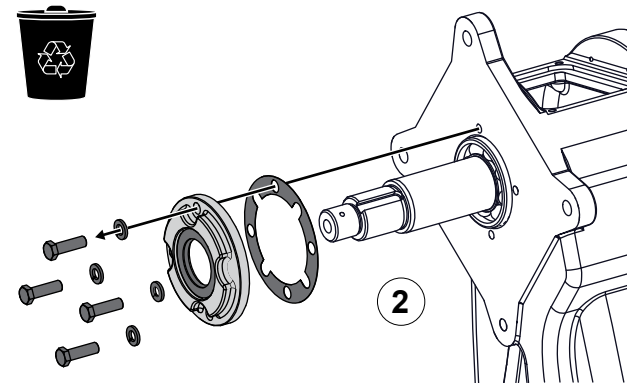
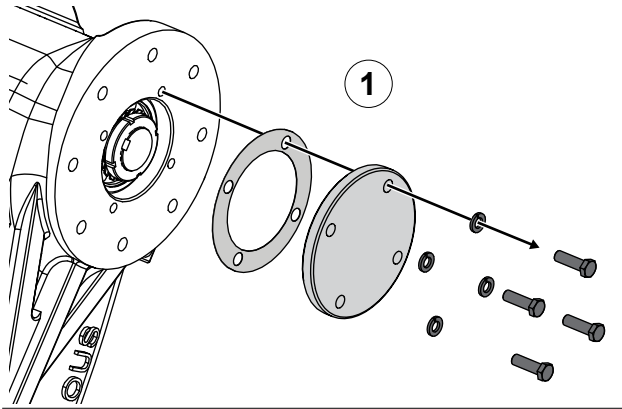


### Shaft with Keyed Output

Use the illustrations and instructions to disassemble the driven shaft assembly.

- 1 Remove the key from the key slot on the shaft.
- 2 Remove the spacer from the shaft.
- 3 Remove the bearing from the shaft.

## Removing the Upper Drive Components—CG, CL, and CX Pumps

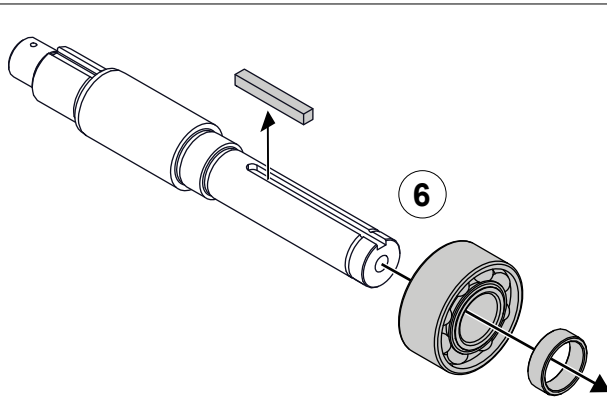
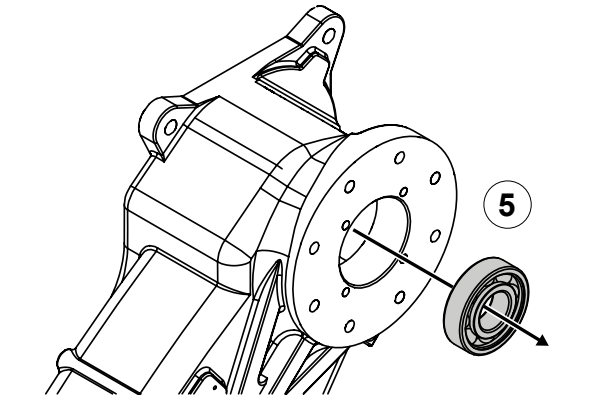
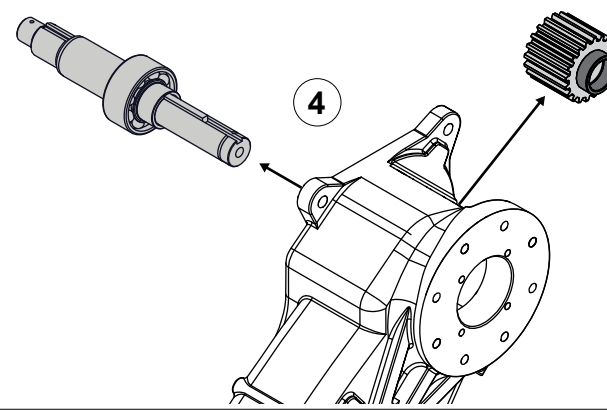
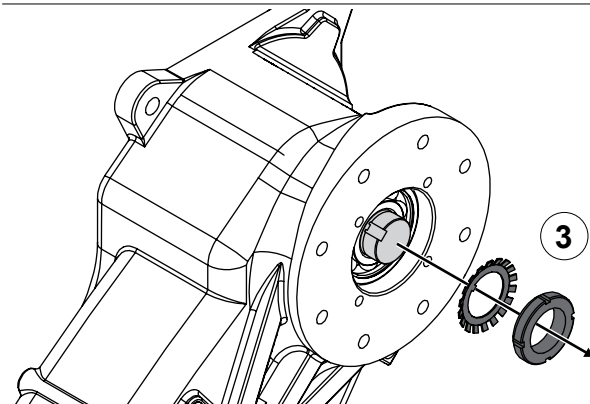
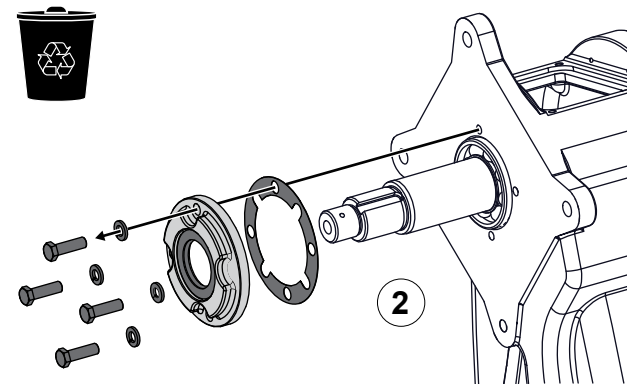
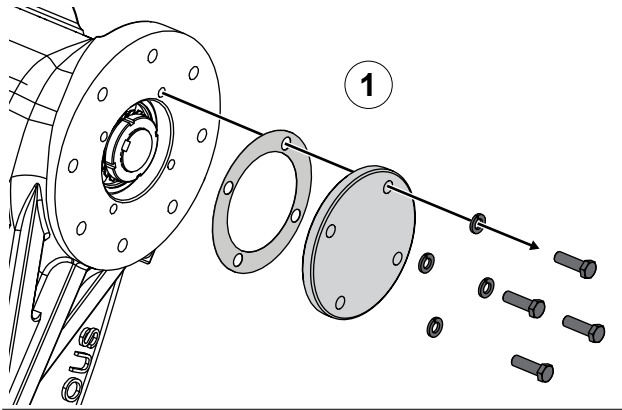


### Shaft without Output

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the mounting hardware, oil-seal housing, and shims.
- 2 Remove and set aside the mounting hardware, oil-seal housing, and gasket. Discard the oil seal.
- 3 Straighten the tab on the bearing lock washer, then remove the nut and washer. Set them aside.
- 4 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 5 Remove and set aside the bearing.
- 6 Remove the key, driven-shaft spacer, and bearing from the driven shaft, then set them aside.

## Removing the Upper Drive Components—CG, CL, and CX Pumps

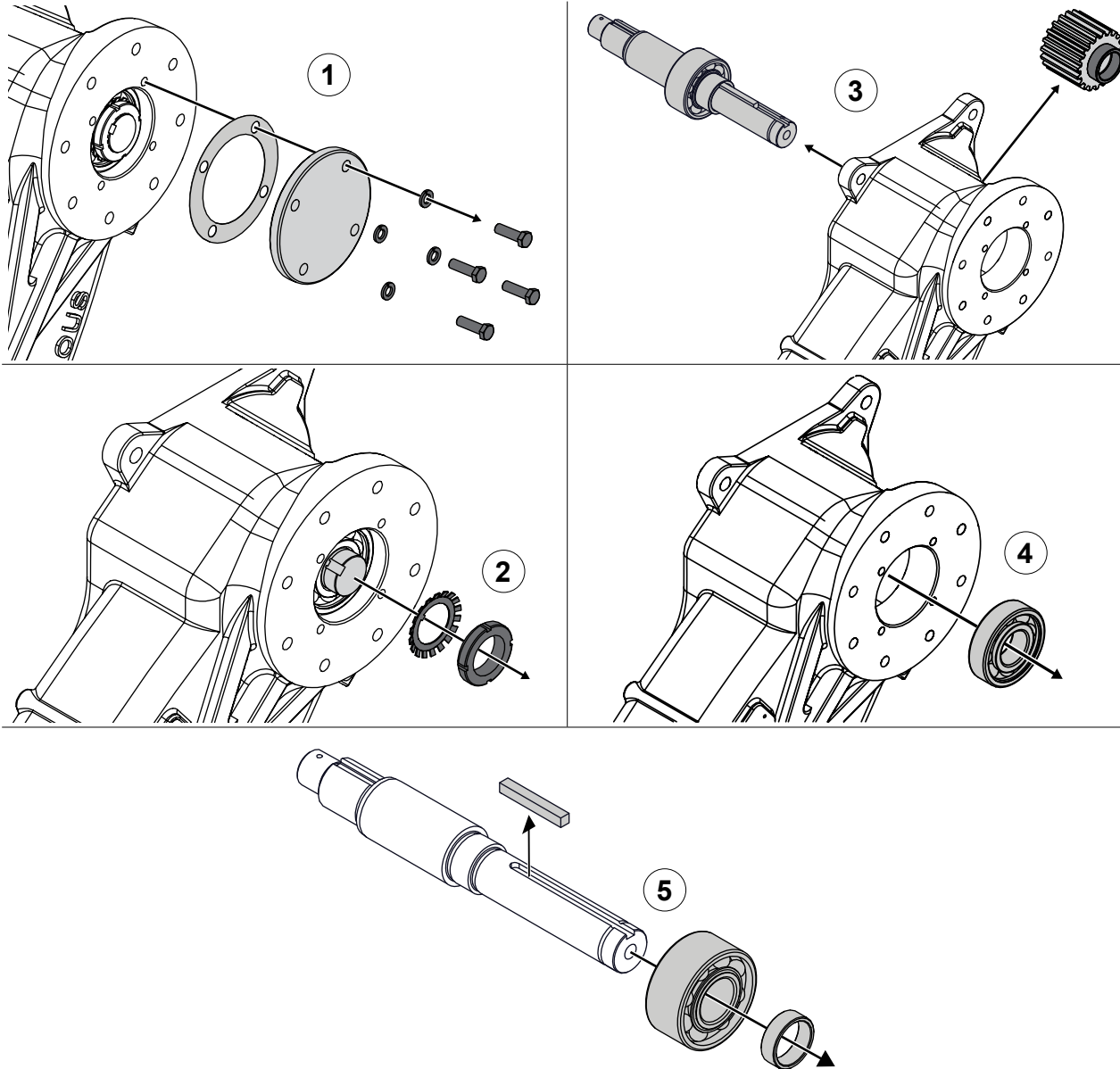


### Shaft with Keyed Output

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the mounting hardware, oil-seal housing, and shims.
- 2 Remove and set aside the mounting hardware, oil-seal housing, and gasket. Discard the oil seal.
- 3 Straighten the tab on the bearing lock washer, then remove the nut and washer. Set them aside.
- 4 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 5 Remove and set aside the bearing.
- 6 Remove the key, driven-shaft spacer, and bearing from the driven shaft, then set them aside.

## Removing the Upper Drive Components—S100 Pump

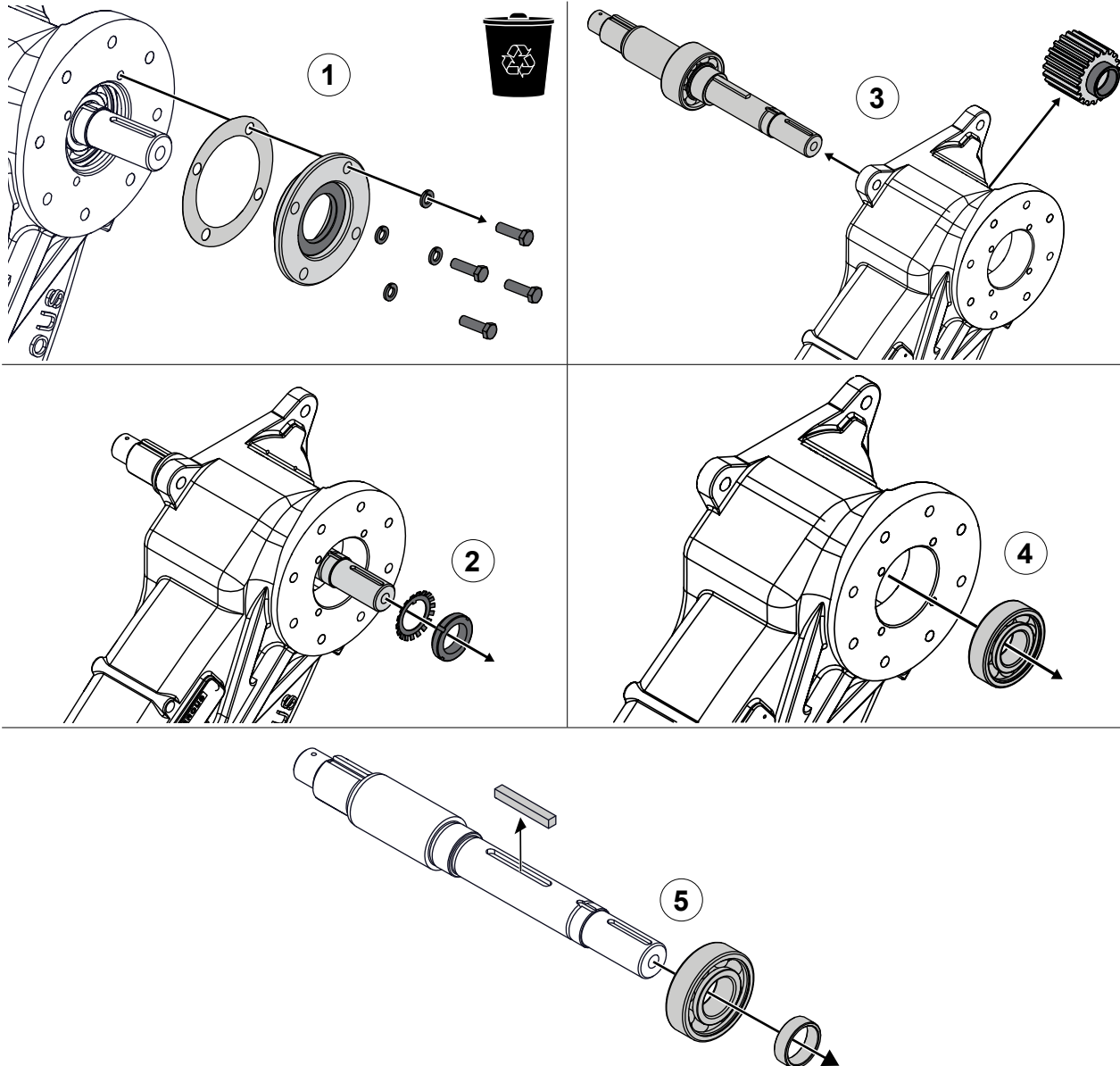


### Shaft without Output

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the mounting hardware, oil-seal housing, and shims.
- 2 Straighten the tab on the bearing lock washer, then remove the nut and washer. Set them aside.
- 3 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 4 Remove and set aside the bearing.
- 5 Remove the key, driven-shaft spacer, and bearing from the driven shaft, then set them aside.

## Removing the Upper Drive Components—S100 Pump

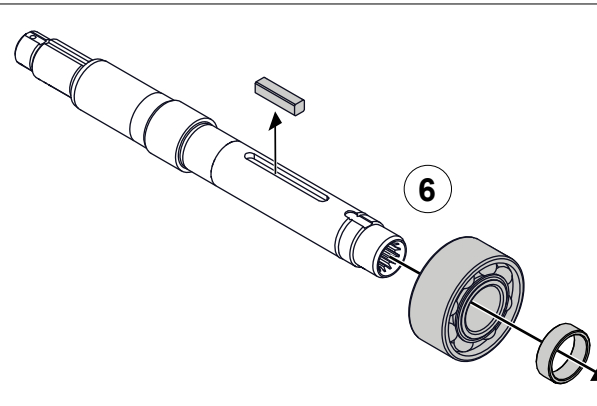
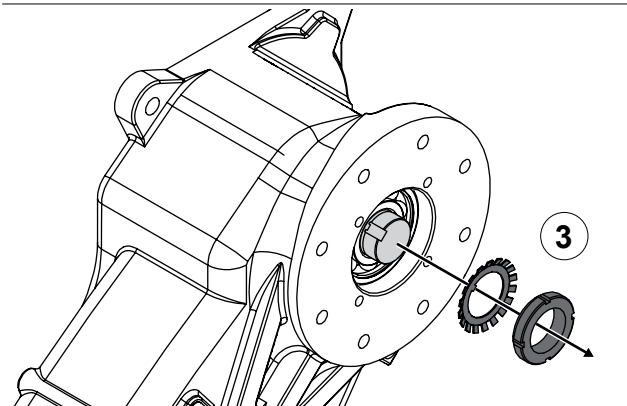
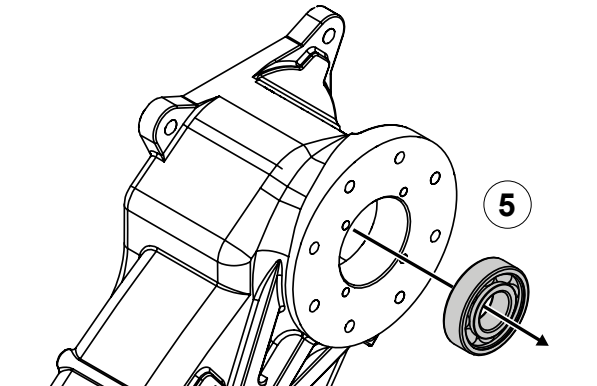
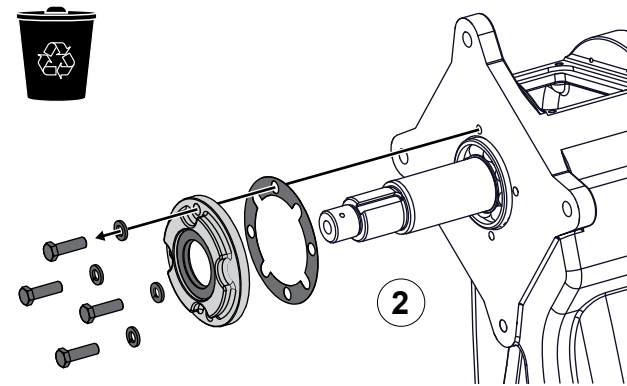
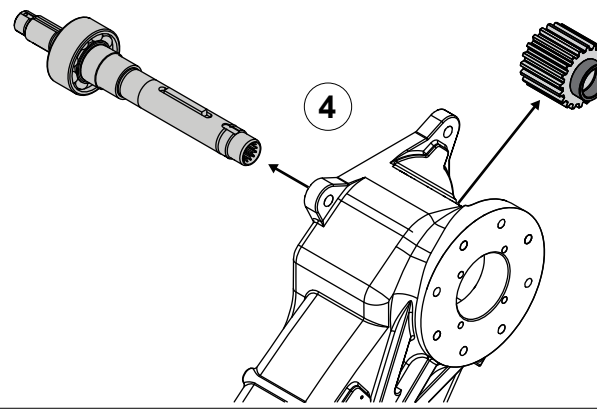
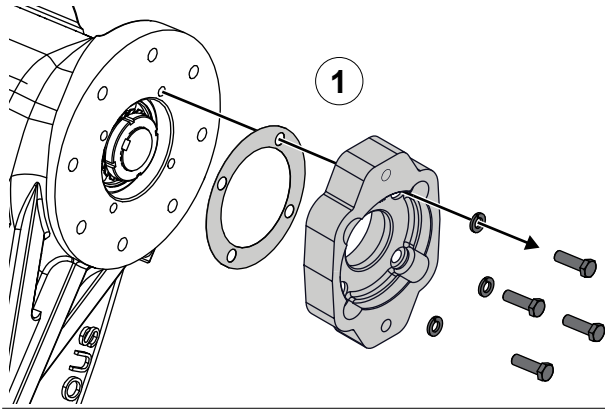


### Shaft with Keyed Output

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the mounting hardware, oil-seal housing, and shims. Discard the oil seal.
- 2 Straighten the tab on the bearing lock washer, then remove the nut and washer. Set them aside.
- 3 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 4 Remove and set aside the bearing.
- 5 Remove the key, driven-shaft spacer, and bearing from the driven shaft, then set them aside.

## Removing the Upper Drive Components—CX Pump



### Shaft with Hydraulic Flange

Use the illustrations and instructions to remove the upper drive components from the transmission case.

- 1 Remove and set aside the mounting hardware, hydraulic flange, and shims.
- 2 Remove and set aside the mounting hardware, oil-seal housing, and gasket. Discard the oil seal.
- 3 Straighten the tab on the bearing lock washer, then remove the nut and washer. Set them aside.
- 4 Push the driven shaft out of the transmission case, then remove the driven-shaft spacer and driven sprocket. Set them aside.
- 5 Remove and set aside the bearing.
- 6 Remove the key, driven-shaft spacer, and bearing from the driven shaft, then set them aside.

## Preparing to Assemble the Transmission

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- Read and understand the instructions before assembling the transmission.
- Prepare a workspace suitable to accommodate and support the transmission.
- Gather the necessary tools and assembly aids.
- Gather the overhaul components such as lubricant, bearings, seals, and O-rings—only use equivalent components.
- Understand that your configuration may require additional steps that are not described in the illustrations or instruction to perform the assembly.
- This equipment is intended to be assembled by a person or persons with the basic knowledge of servicing similar equipment. Contact Waterous for more information.

## Tools Required

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- Typical automotive mechanics hand tools.
- Suitable arbor press.
- Torque wrench capable of 450 ft-lb (610 N·m).
- Suitable support and lifting equipment.

## Best Practices

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- Remove any dirt, sand, grease, or oil from the enclosure before you begin the overhaul. Surface debris can transfer into the pump interior and prematurely wear internal parts.
- Replace any gaskets and O-ring seals during the assembly.
- Do not reuse the self-locking nuts.
- Apply anti-seize to the self-locking nut threads before installation.

## Assembling the Transmission Components

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- Refer to the service parts list (SPL) for part identification.
  - The SPL specific to your application is determined by the following:
    - The transmission drive method.
    - Whether the transmission drives a CAFS compressor.
- Note:** Documents specific to your application are available through the MyWaterous login at [Waterousco.com](http://Waterousco.com) by entering the serial number for your system. Depending on the application, the serial number for your equipment is located on the operator panel, or the pump, or the transmission, or some combination of the three.
- Use established industry practices to assemble the transmission.
  - Tighten hardware to industry standard torque specification—unless otherwise noted.
  - Make sure that you do not over-tighten plugs.
  - Install retaining rings with the flat face towards the component you are retaining.
  - Replace items such as O-rings, bearings, gaskets, oil seals, lubricants, and locknuts with their equivalent.

## Installing the Transmission

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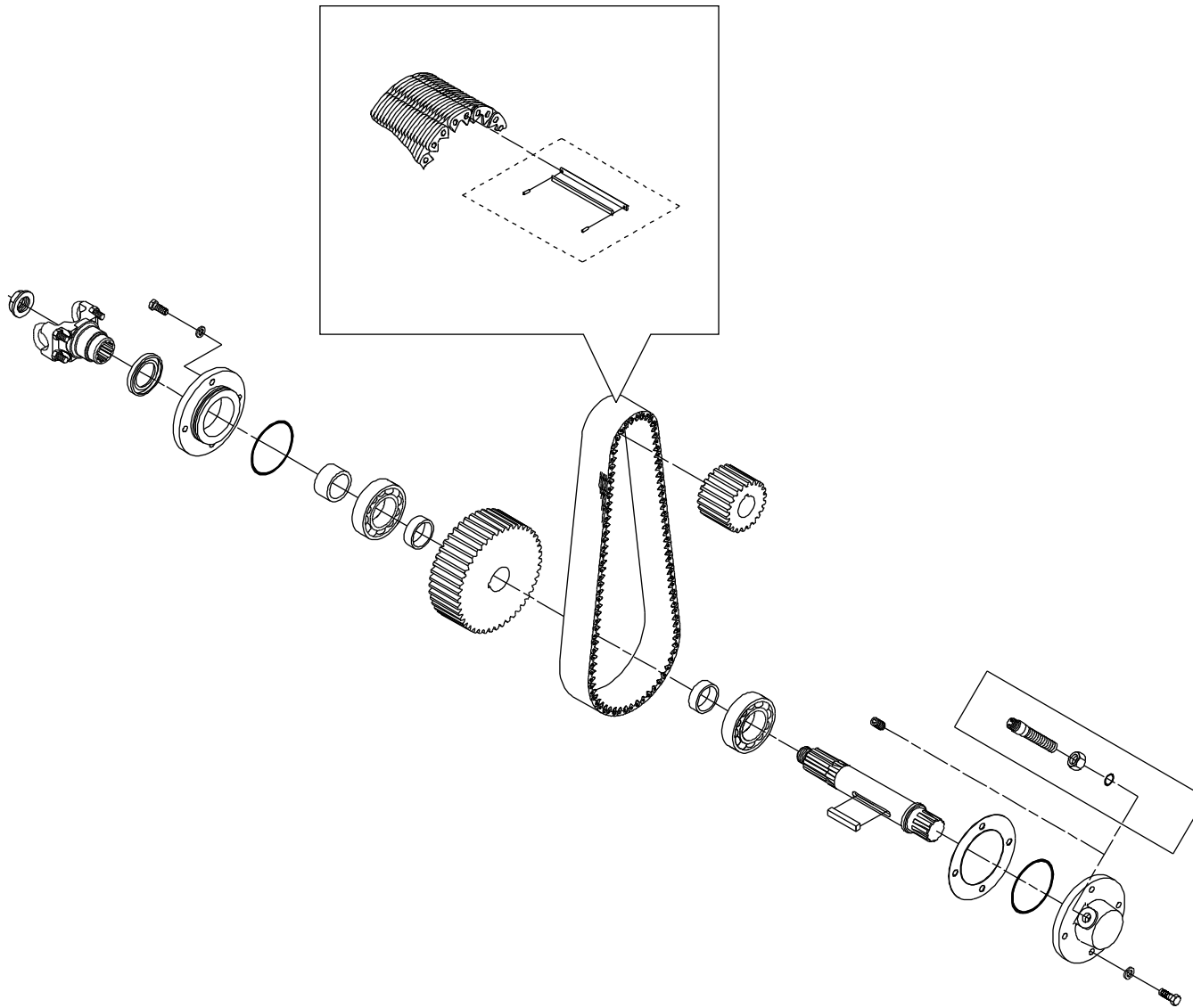
Use the information that you recorded when you removed the equipment to install it into the apparatus.

## Understanding the Illustrations

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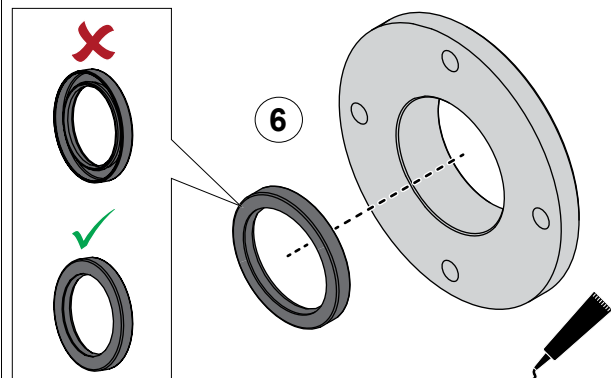
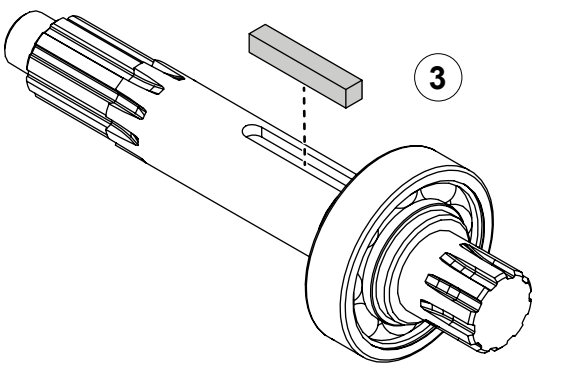
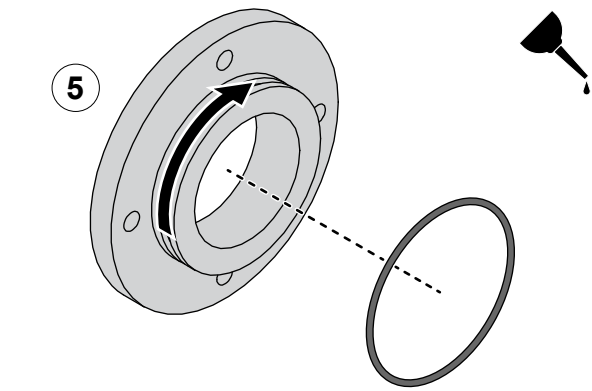
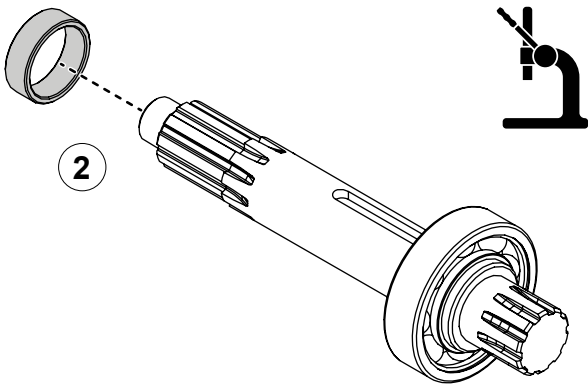
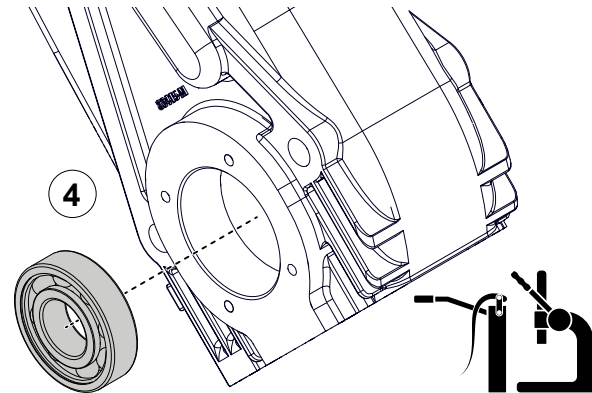
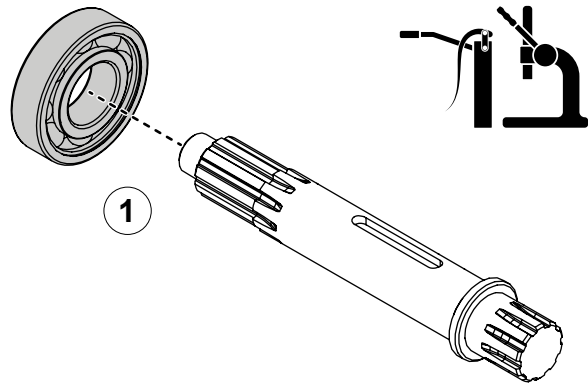
The assembly illustrations depict a typical application. Plugs, breathers, cooling hoses, and fittings are not illustrated as they may be in a different location in your application. Refer to the SPL for your application to identify the various plug locations.

## Assembling the Lower Drive Components—Without Output Shaft





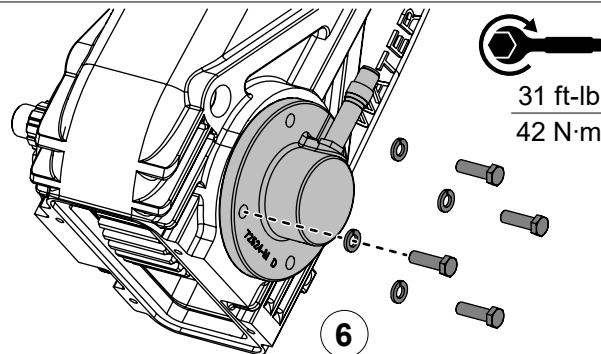
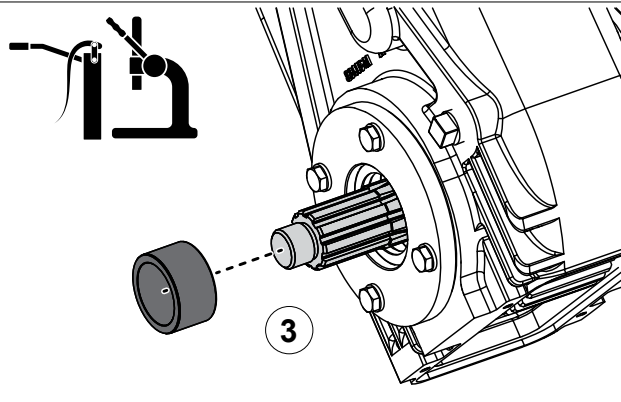
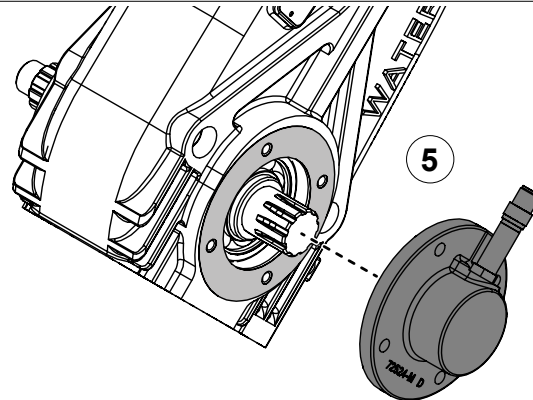
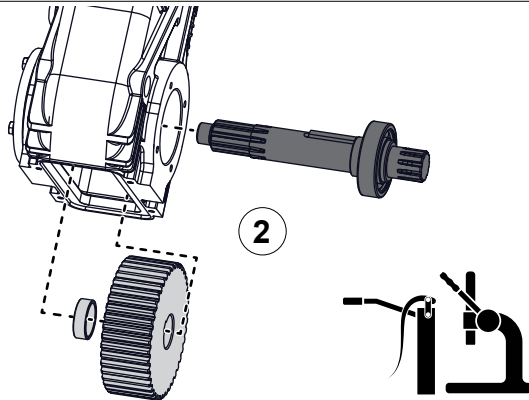
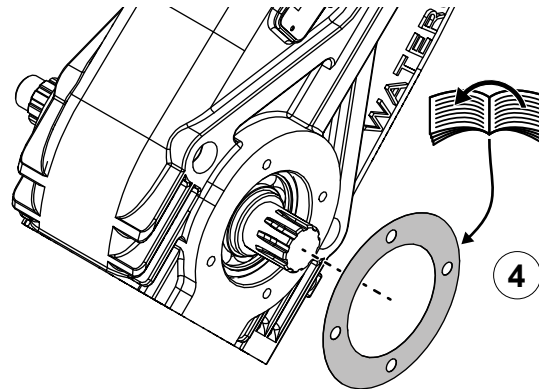
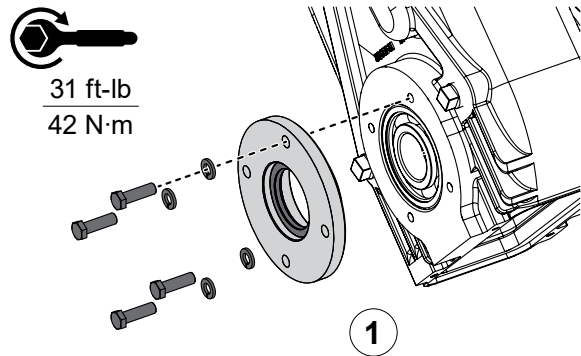
## Assembling the Lower Drive Components—Without Output Shaft



Use the illustrations and instructions to install the lower drive components into the transmission case.

- 1 Apply grease to the drive shaft, then press the bearing onto the drive shaft.
- 2 Press the drive-shaft spacer onto the drive shaft.
- 3 Insert the key into the key slot on the drive shaft.
- 4 Apply grease to the bearing, then press the bearing into the transmission case.
- 5 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 6 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.

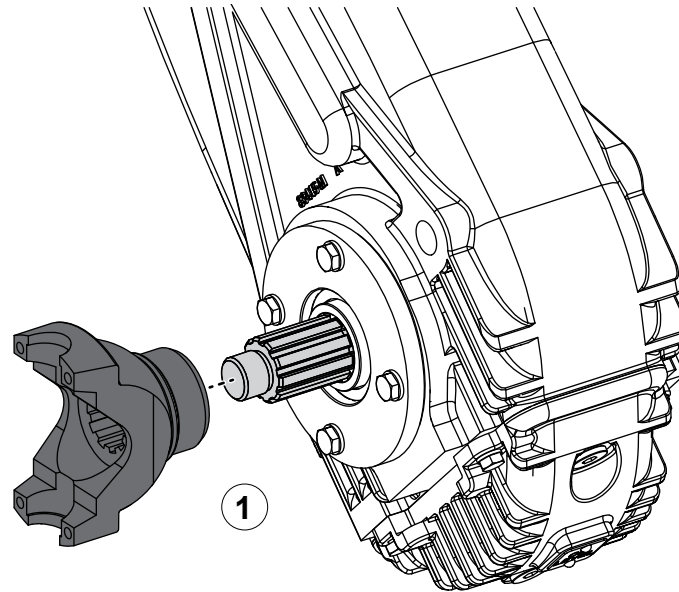
## Installing the Lower Drive Components—Without Output Shaft



Use the illustrations and instructions to install the lower drive components into the transmission case.

- 1 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 2 To install the lower drive components inside the transmission case, do the following:
  - Align the drive-shaft spacer with the drive sprocket.
  - Position the drive-shaft spacer and drive sprocket in the transmission case.
  - Align the drive shaft assembly with the drive-shaft spacer, drive sprocket, and transmission case, then press it through them.
- 3 Apply grease to the drive shaft, then press the oil-seal sleeve onto the shaft.
- 4 Determine the shim thickness required to install the tachometer housing. Refer to: **"Determining the Shim Thickness" on page 88.**
- 5 Align the tachometer housing with the transmission case.
- 6 Use the hardware that you removed earlier to secure the tachometer housing to the transmission case.

## Installing the End Yoke



If applicable, use the illustrations and instructions to install the transmission drive end yoke.

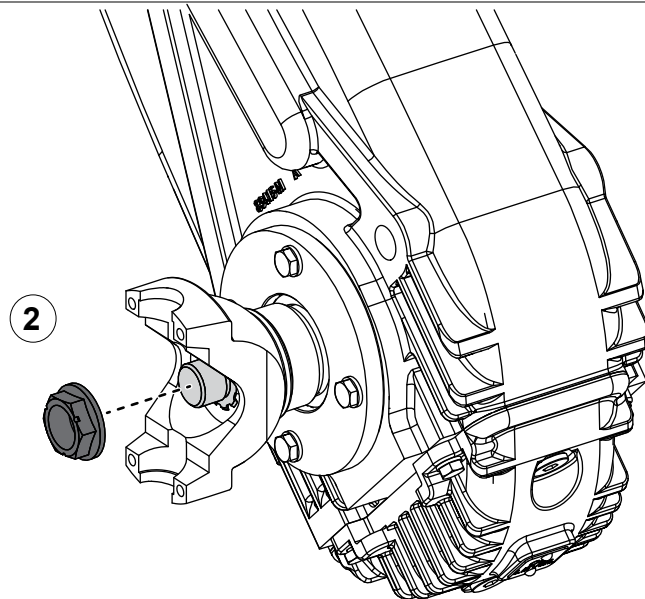
- 1 Apply grease to the drive shaft, then slide the end yoke onto the shaft.

**Note:** Make sure that you do not apply grease to the threads.

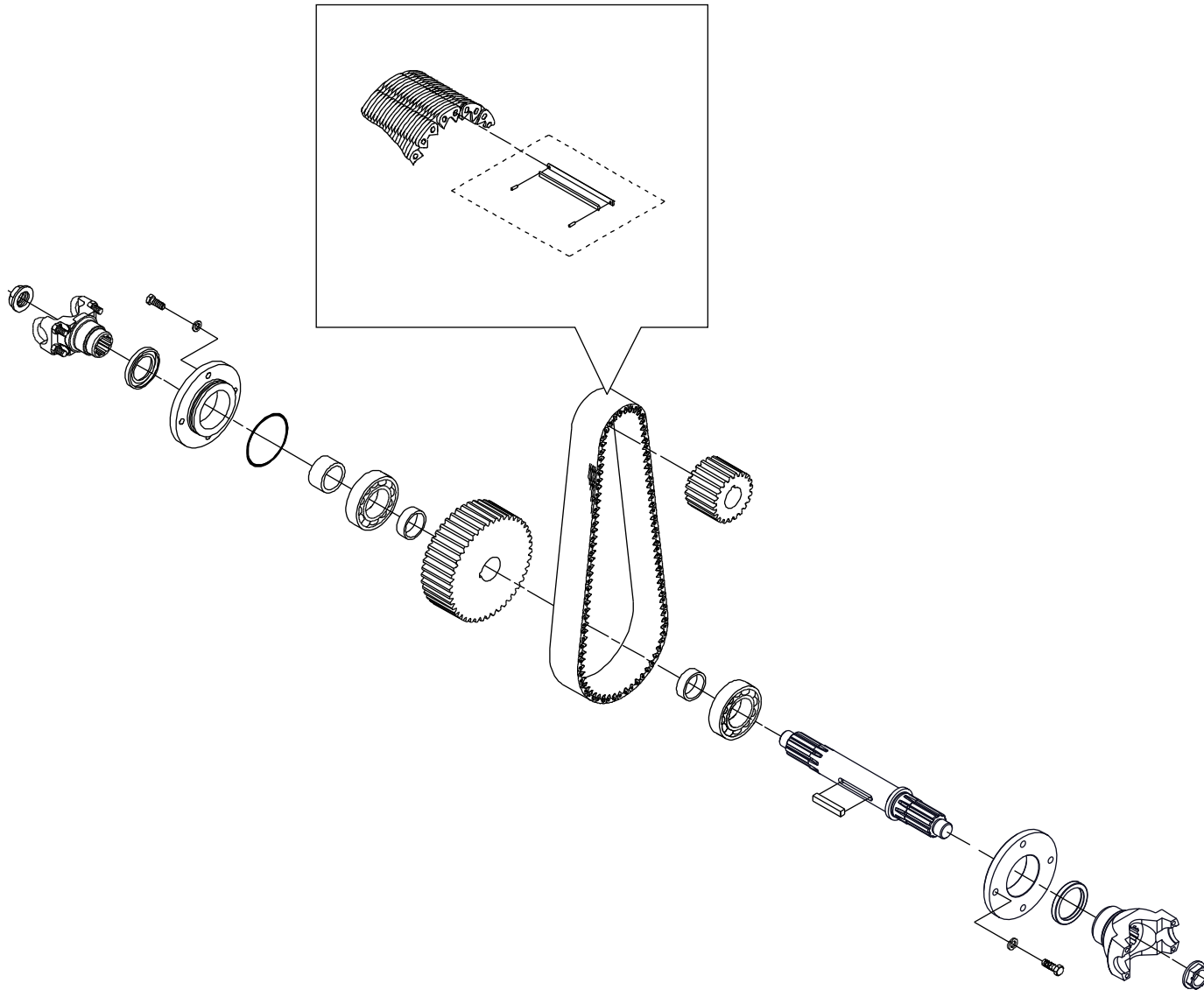
- 2 Apply anti-seize to the locknut threads, then install the locknut onto the shaft.



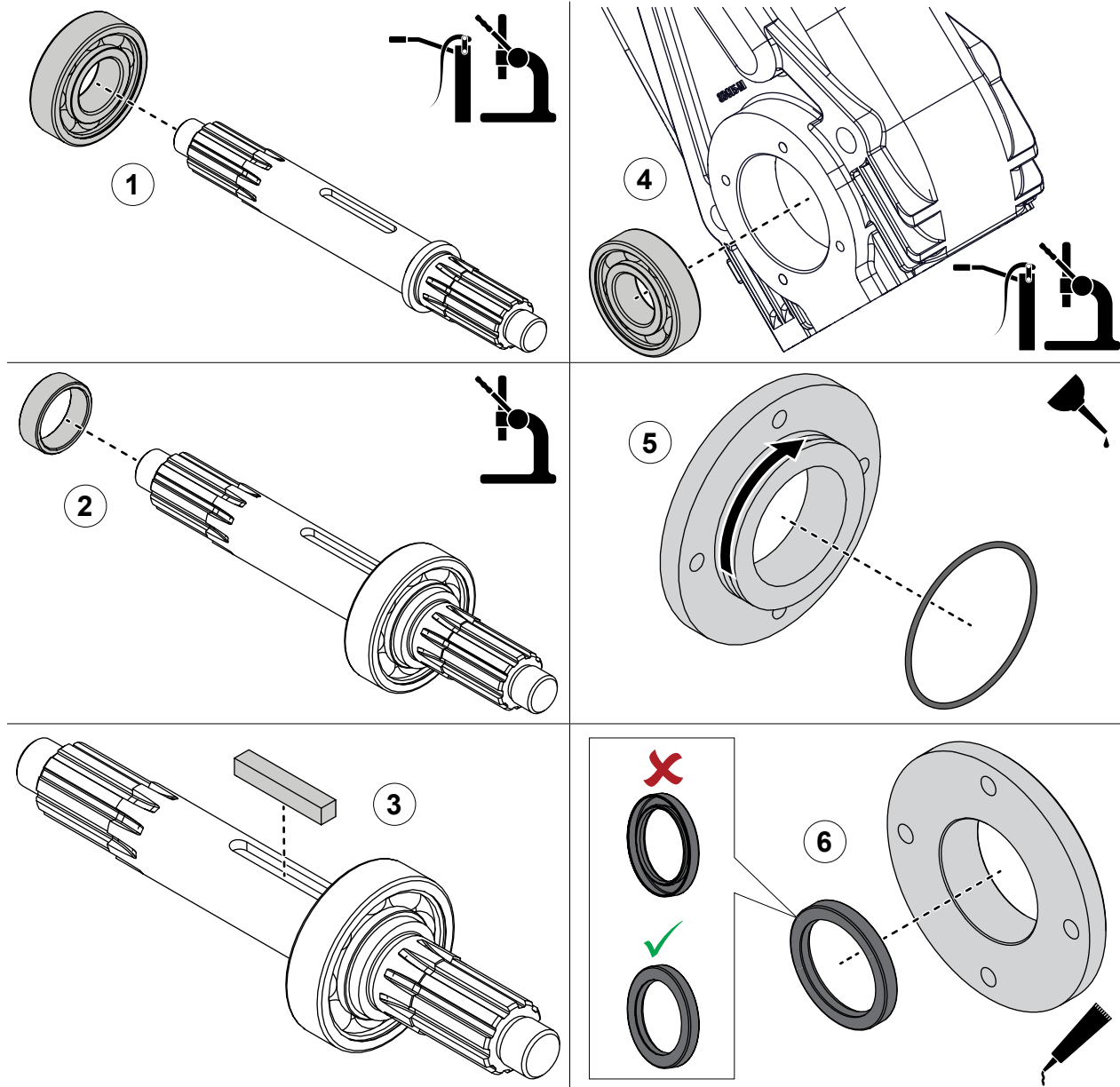
425 ft-lb  
576 N·m



## Assembling the Lower Drive Components—With Output Shaft



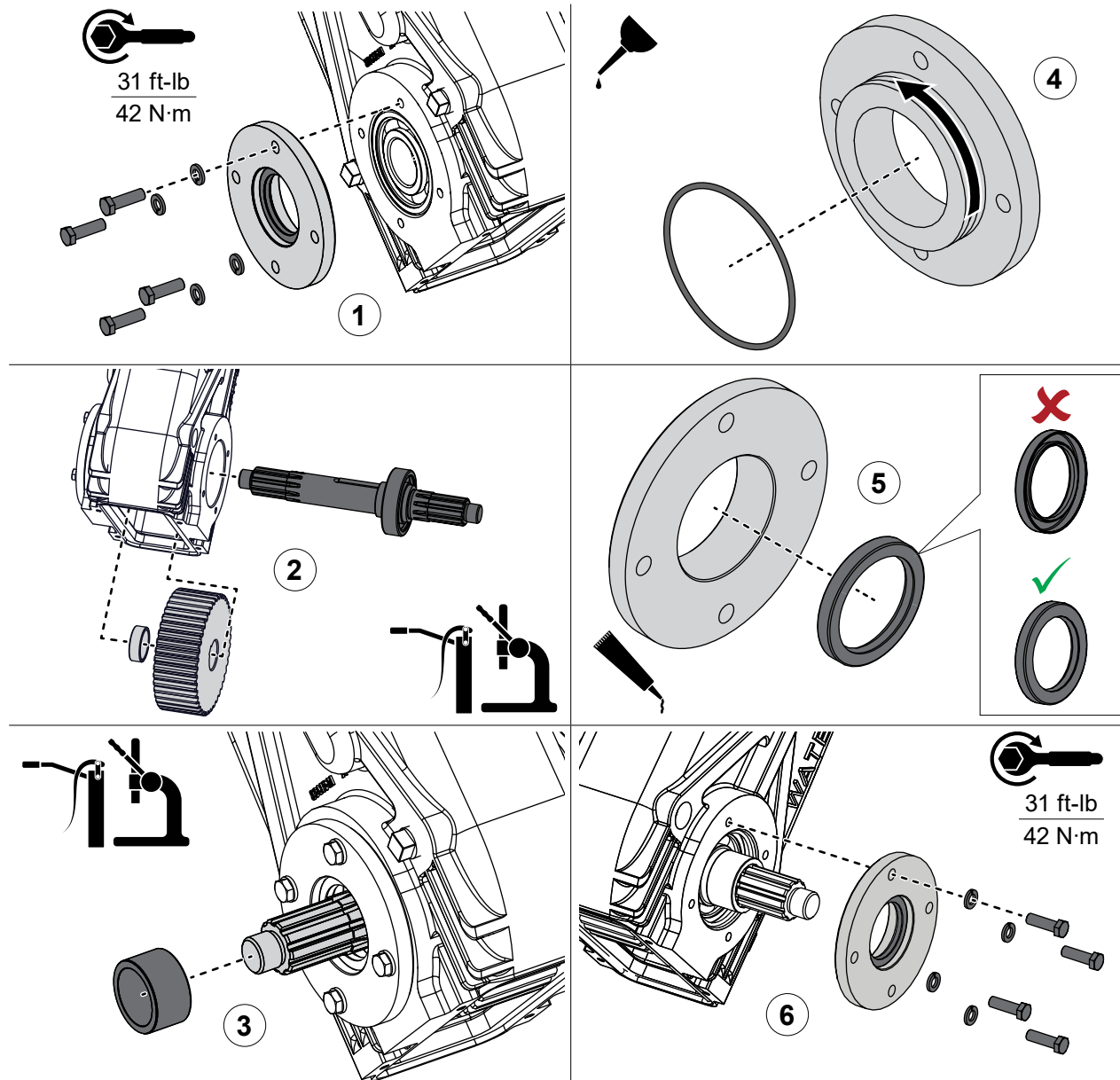
## Assembling the Lower Drive Components—With Output Shaft



Use the illustrations and instructions to install the lower drive components into the transmission case.

- 1 Apply grease to the drive shaft, then press the bearing onto the drive shaft.
- 2 Press the drive-shaft spacer onto the drive shaft.
- 3 Insert the key into the key slot on the drive shaft.
- 4 Apply grease to the bearing, then press the bearing into the transmission case.
- 5 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 6 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.

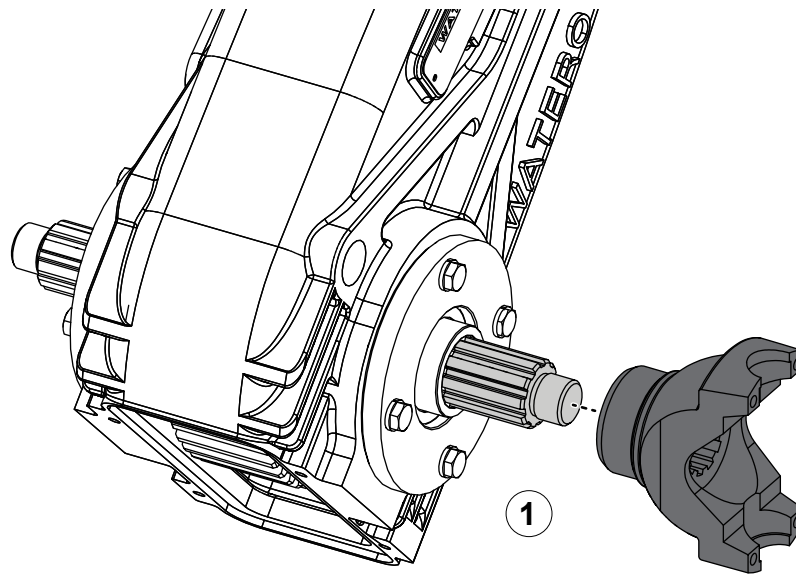
## Installing the Lower Drive Components—With Output Shaft



Use the illustrations and instructions to install the lower drive components into the transmission case.

- 1 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 2 To install the lower drive components inside the transmission case, do the following:
  - Align the drive-shaft spacer with the drive sprocket.
  - Position the drive-shaft spacer and drive sprocket in the transmission case.
  - Align the drive shaft assembly with the drive-shaft spacer, drive sprocket, and transmission case, then press it through them.
- 3 Apply grease to the drive shaft, then press the oil-seal sleeve onto the shaft.
- 4 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 5 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 6 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.

## Installing the Lower Drive Components—With Output Shaft



Use the illustrations and instructions to install the lower drive components into the transmission case.

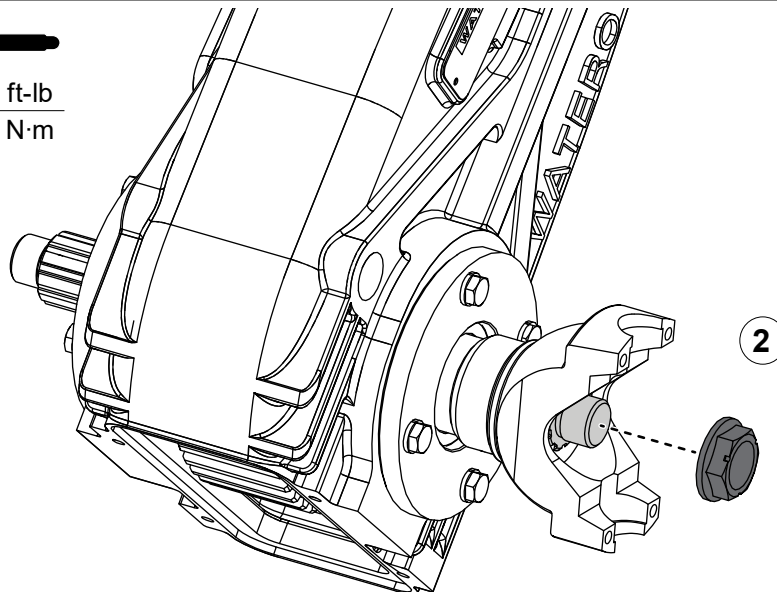
- 1 Apply grease to the drive shaft, then slide the end yoke onto the shaft.

**Note:** Make sure that you do not apply grease to the threads.

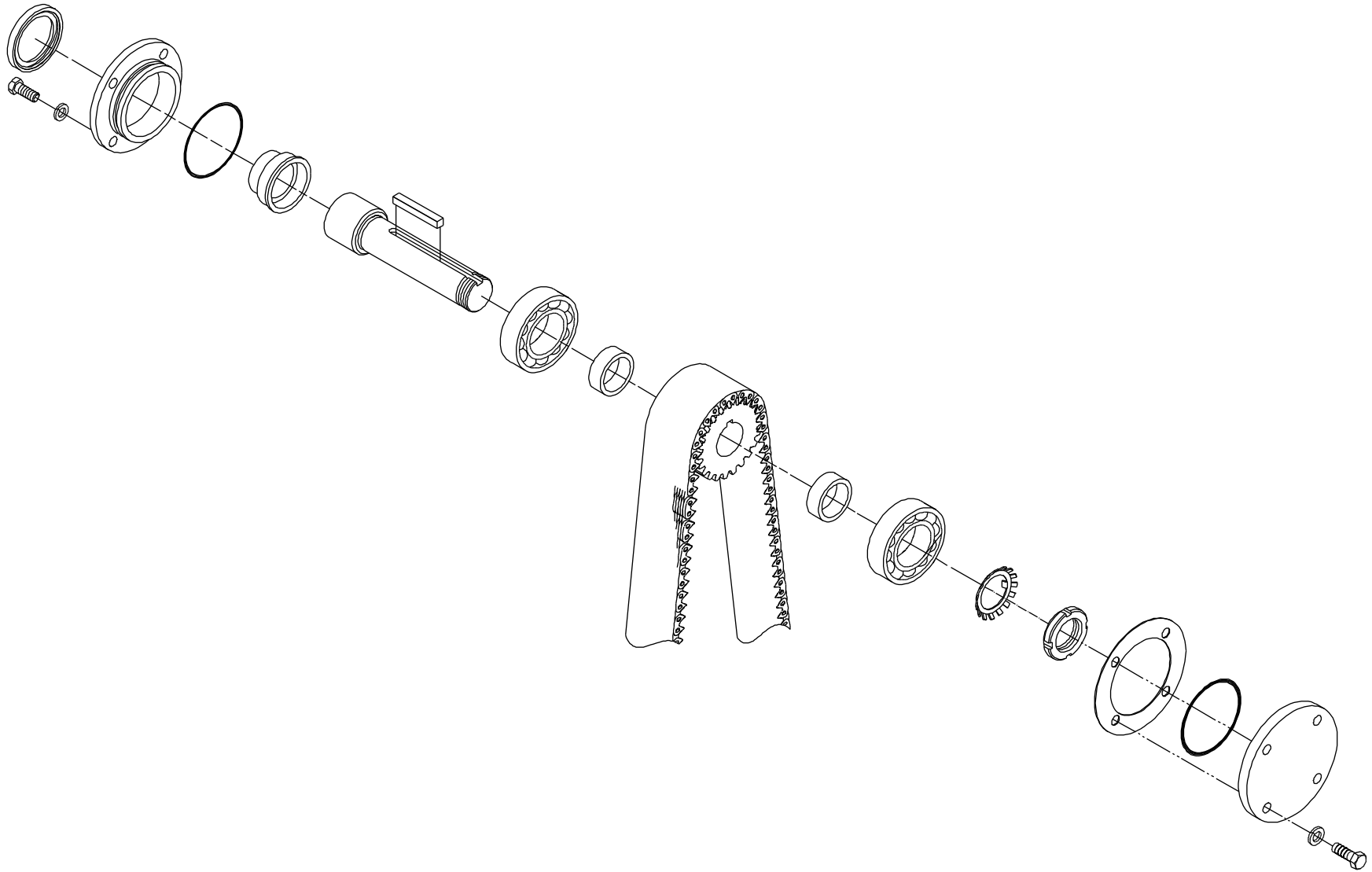
- 2 Apply anti-seize to the locknut threads, then install the locknut onto the shaft.



425 ft-lb  
576 N·m

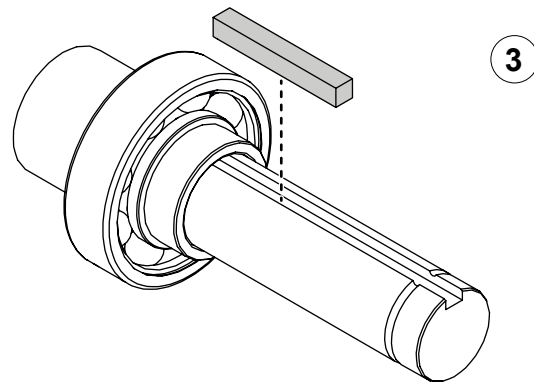
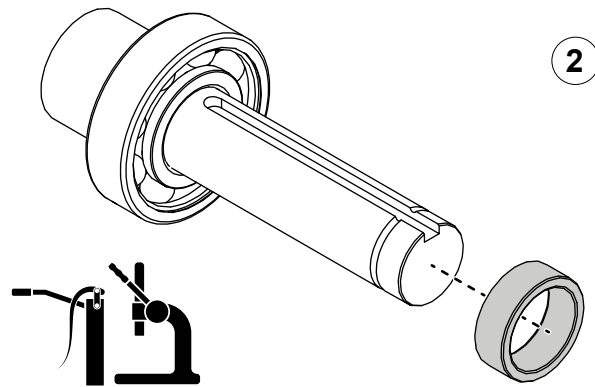
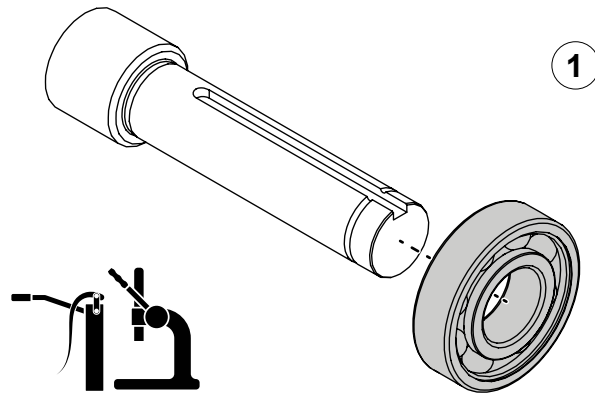


## Assembling the Upper Drive Components—CM and CS Pumps





## Assembling the Driven Shaft—CM and CS Pumps

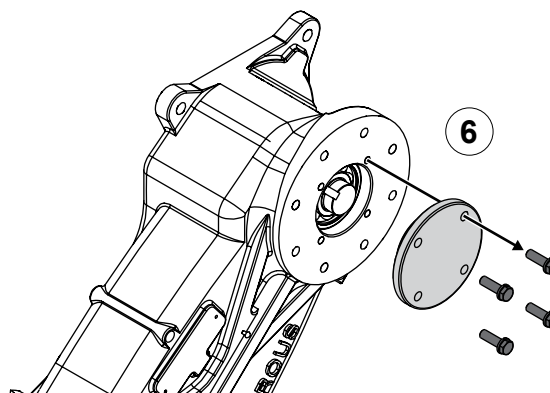
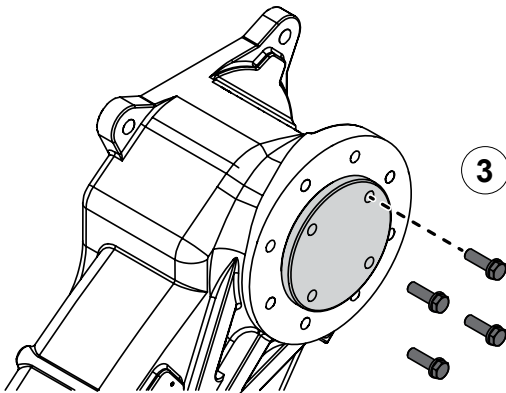
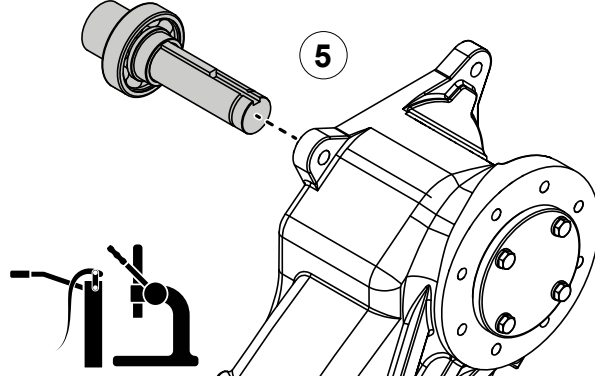
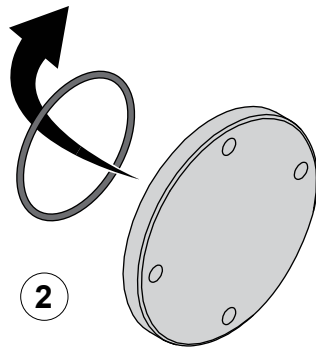
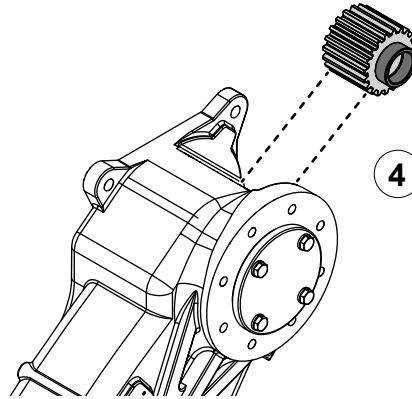
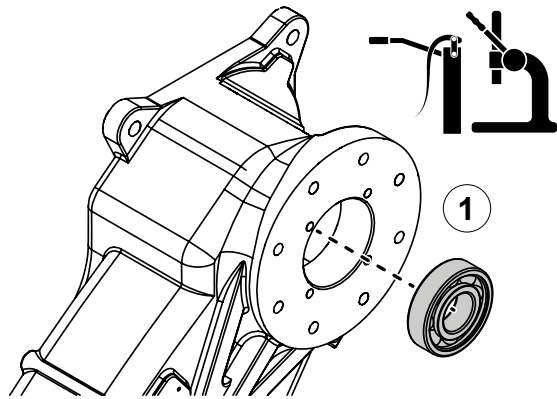


### Shaft without Output

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing onto the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

## Installing the Upper Drive Components—CM and CS Pumps

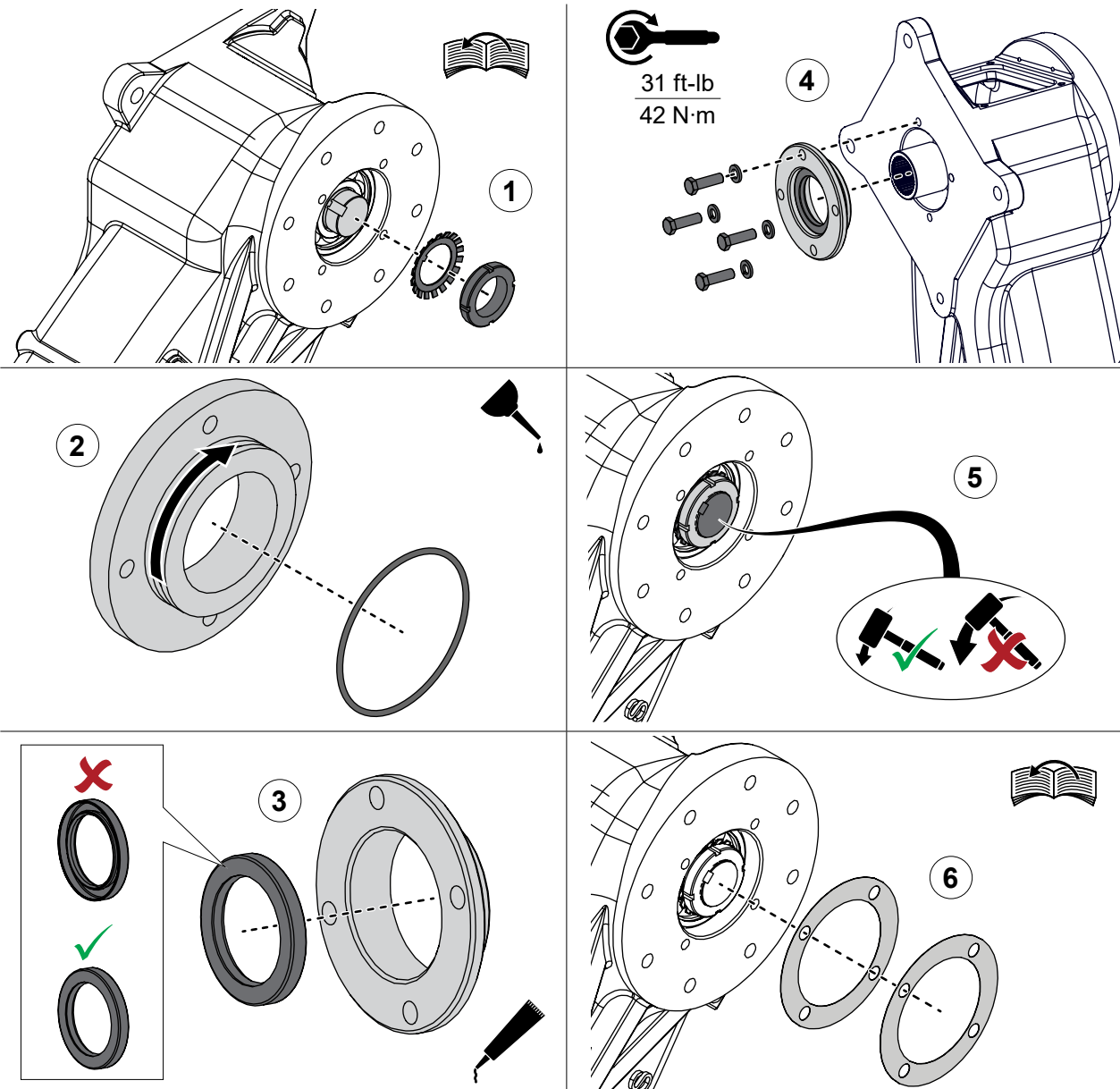


### Shaft without Output

Use the illustrations and instructions to install the driven shaft assembly and associated components.

- 1 Apply grease to the bearing, then press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.

## Installing the Upper Drive Shaft Assembly—CM and CS Pumps

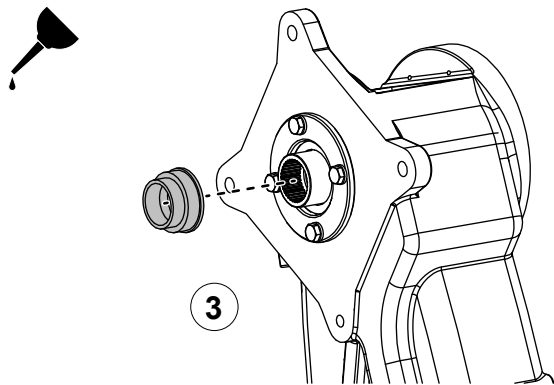
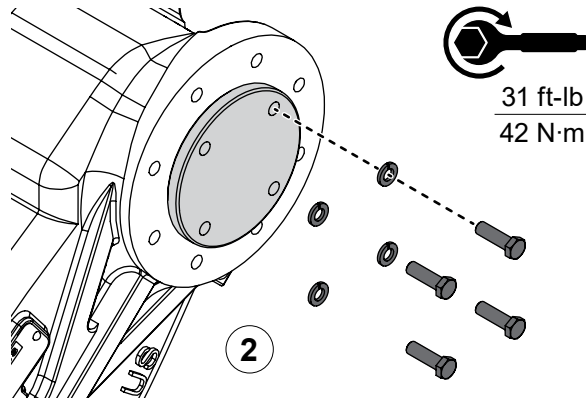
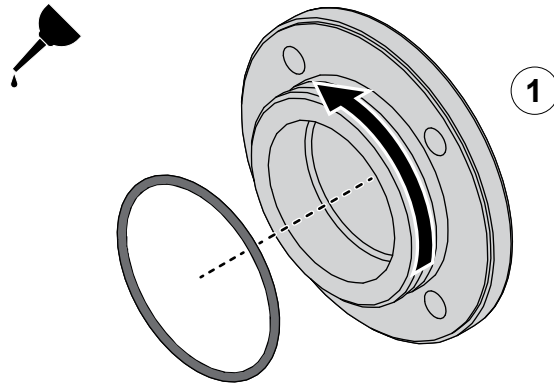


### Shaft without Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Install the bearing lock washer and nut. Refer to: **"Installing the Bearing Lock Washer and Nut" on page 87.**
- 2 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 3 Apply silicon sealant around the oil seal, then install it in the oil-seal housing.
- 4 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 5 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.
- 6 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness" on page 88.**

## Installing the Upper Drive Components—CM and CS Pumps



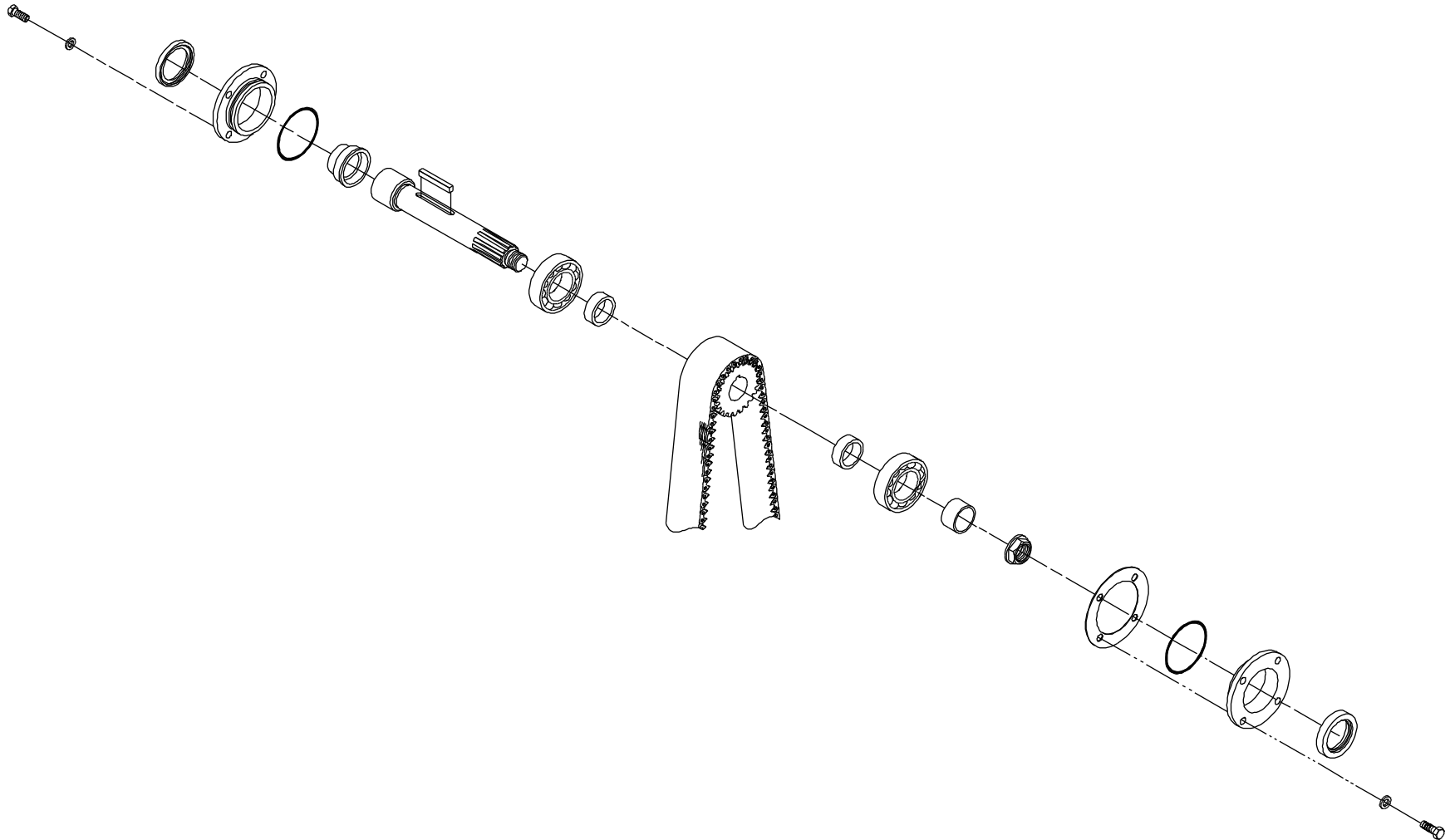
### Shaft without Output

Use the illustrations and instructions to install the driven shaft assembly and associated components.

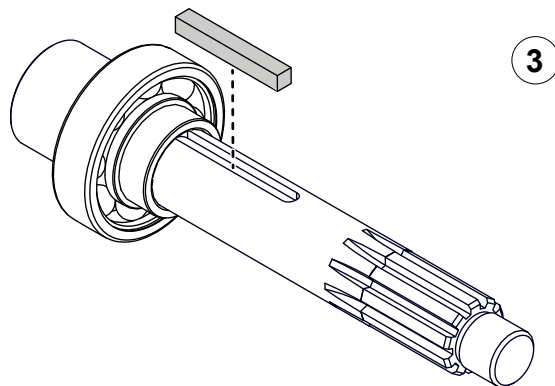
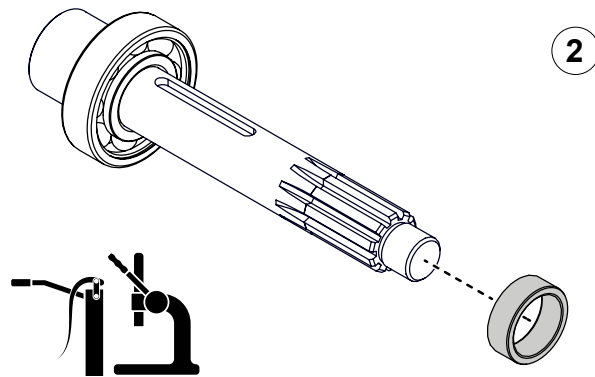
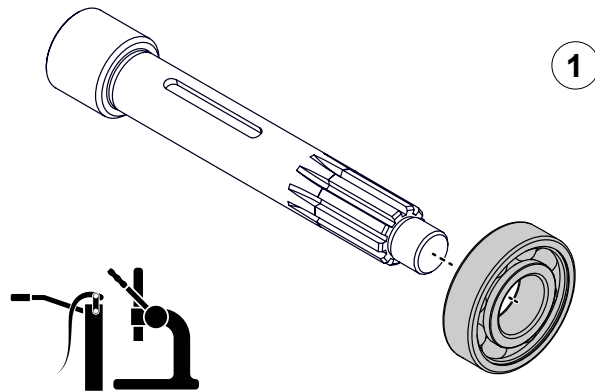
- 1 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 2 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 3 Apply oil to the pump end of the driven shaft, then install the sealing boot over the shaft.



## Assembling the Upper Drive Components—CM and CS Pumps



## Assembling the Upper Drive Shaft—CM and CS Pumps

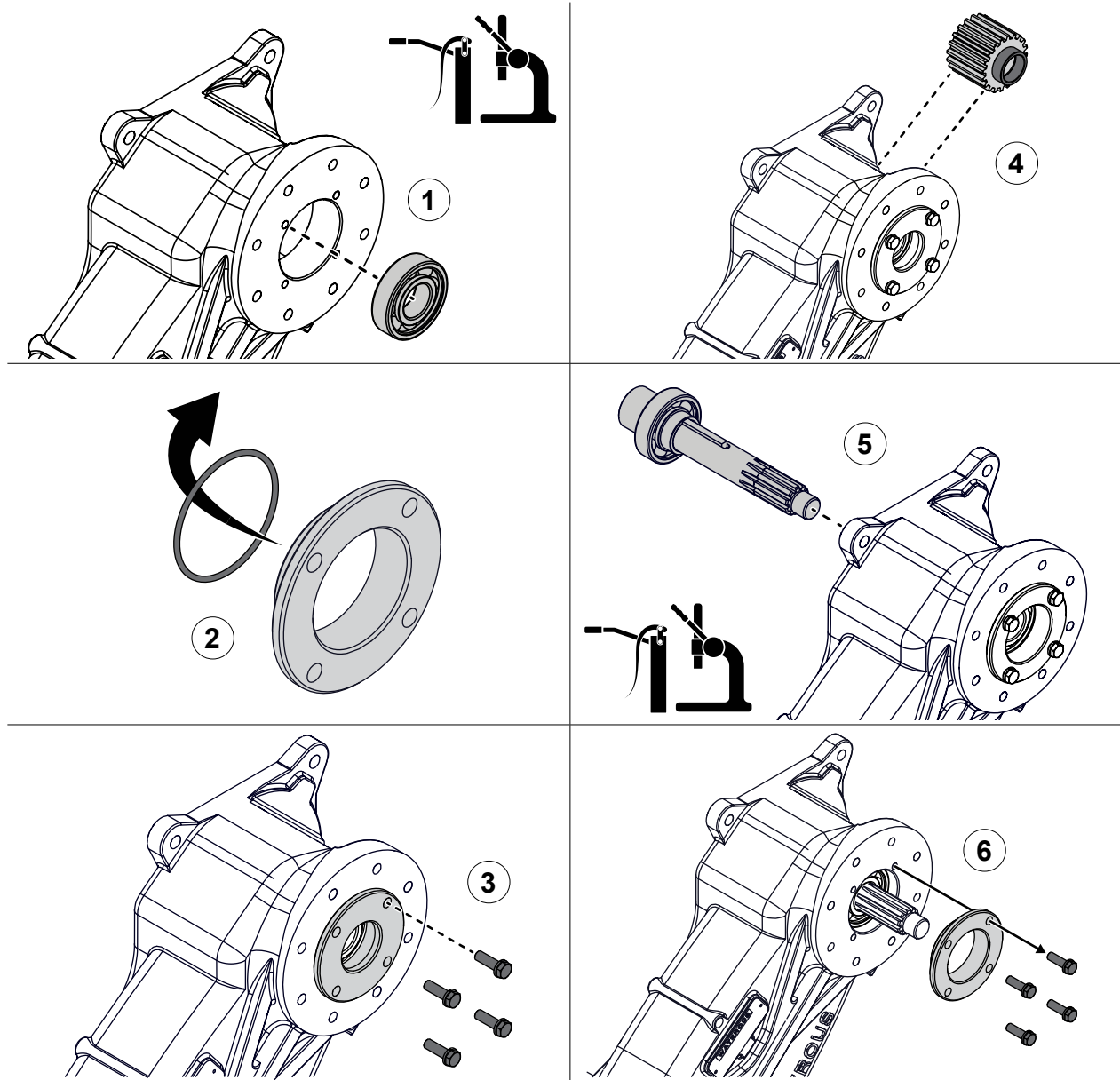


### Shaft with Spline Output

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing onto the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

## Installing the Upper Drive Shaft Assembly—CM and CS Pumps



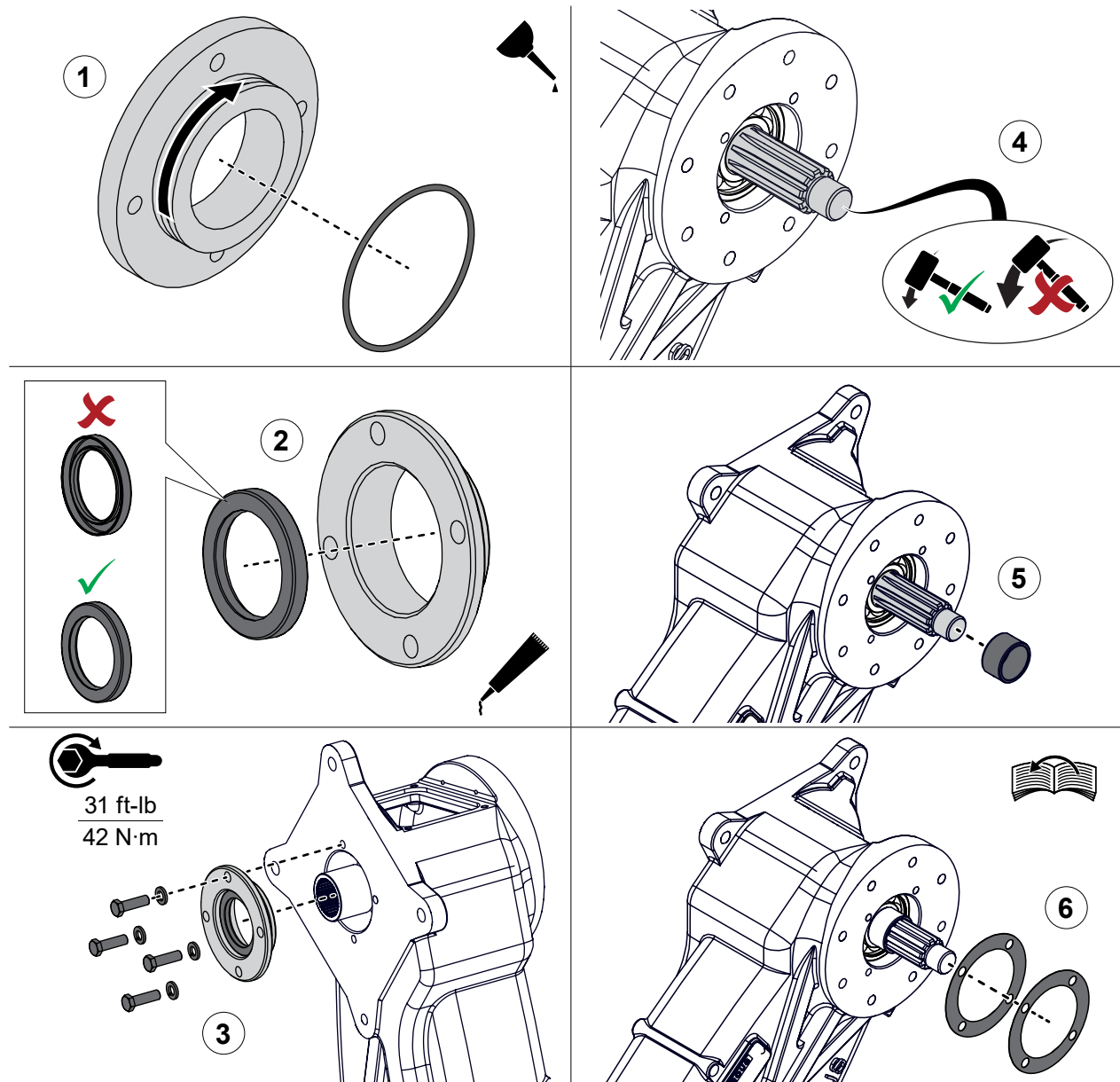
### Shaft with Spline Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply grease to the bearing and press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.



## Installing the Upper Drive Shaft Assembly—CM and CS Pumps

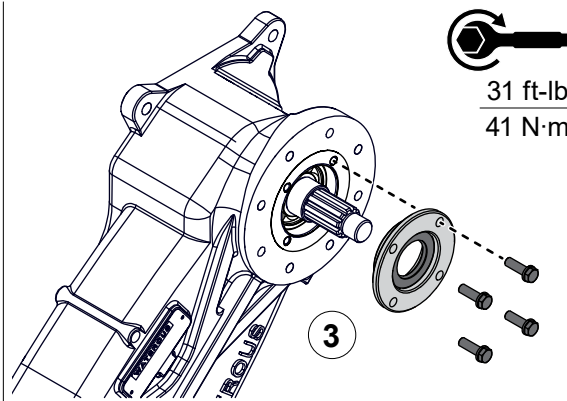
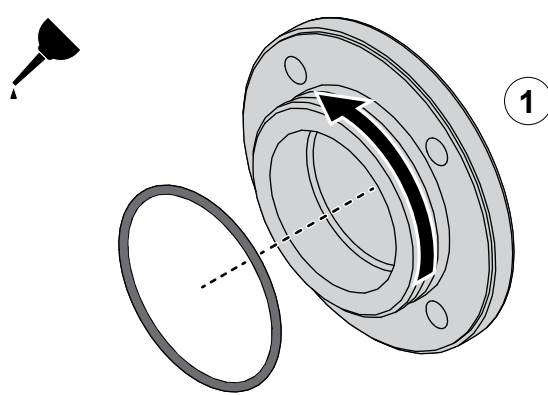


### Shaft with Spline Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 2 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.
- 5 Install the oil sleeve over the driven shaft.
- 6 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness" on page 88.**

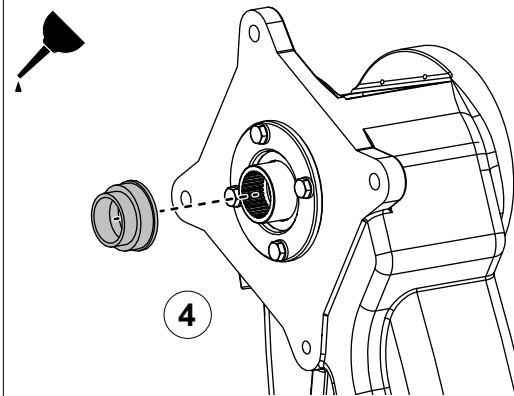
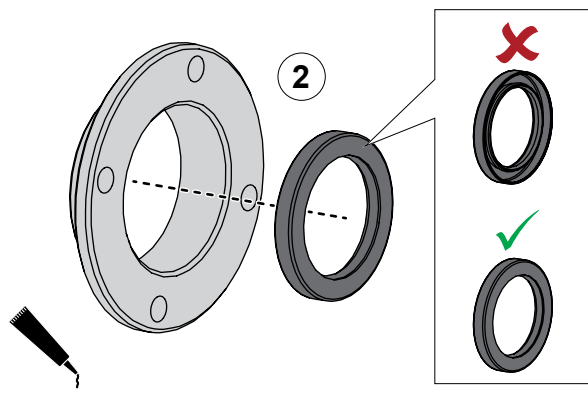
## Installing the Upper Drive Shaft Assembly—CM and CS Pumps



### Shaft with Spline Output

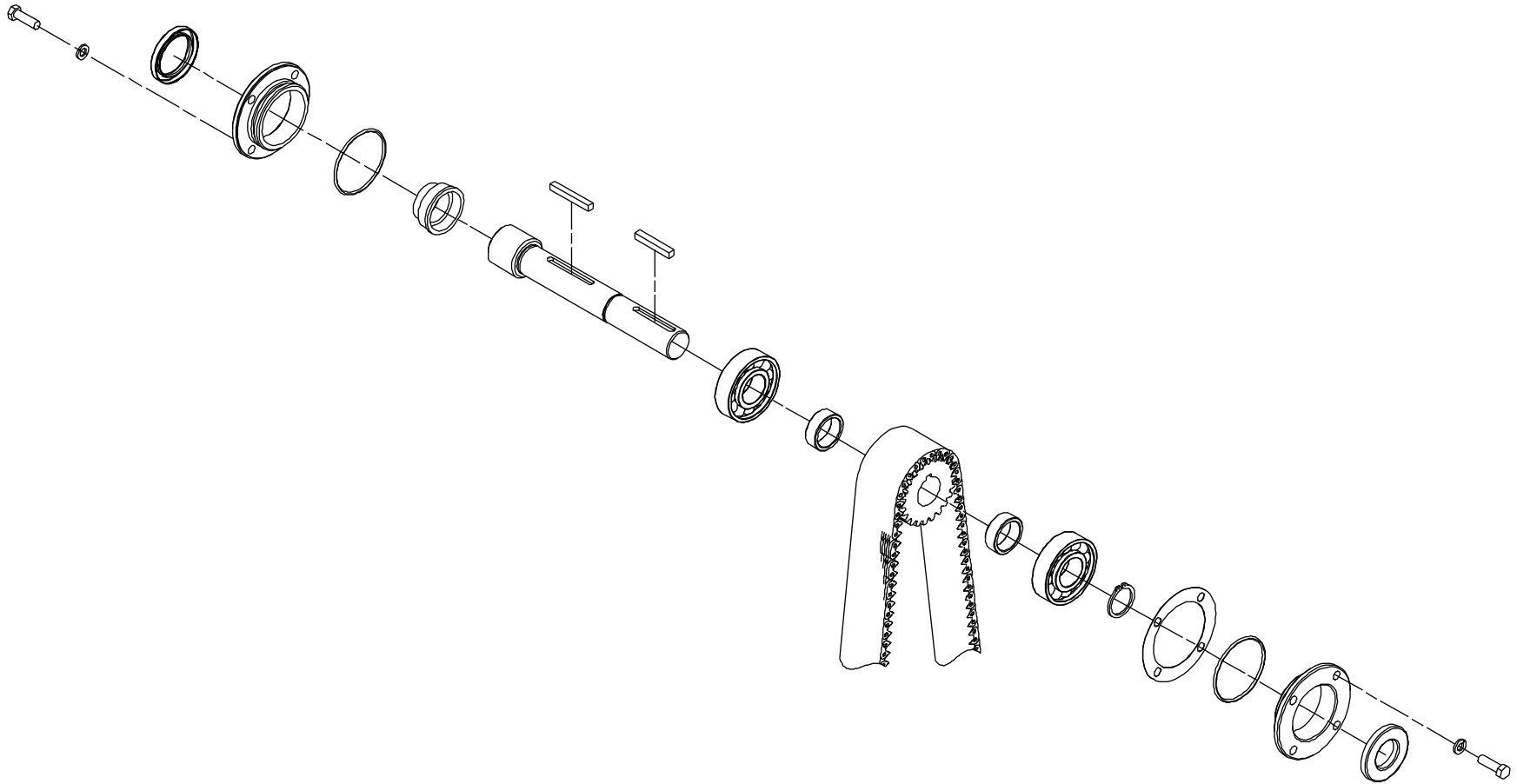
Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 2 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Apply oil to the pump end of the driven shaft, then install the sealing boot over the shaft.

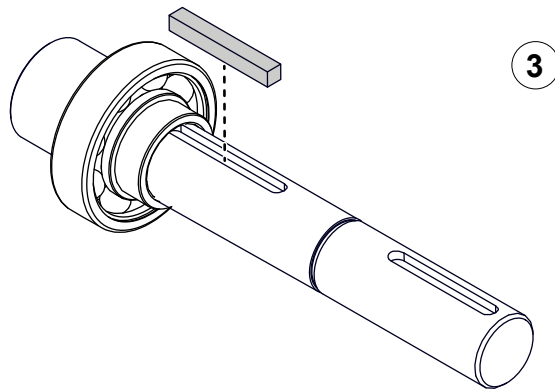
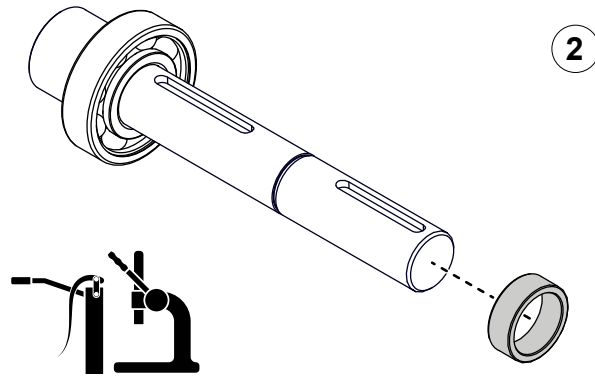
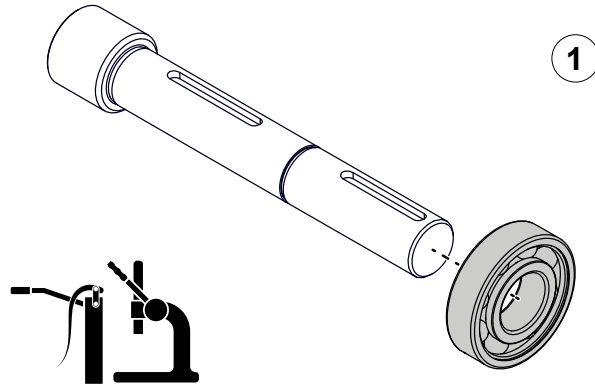




## Assembling the Upper Drive Components—CM and CS Pumps



## Assembling the Upper Drive Shaft—CM and CS Pumps

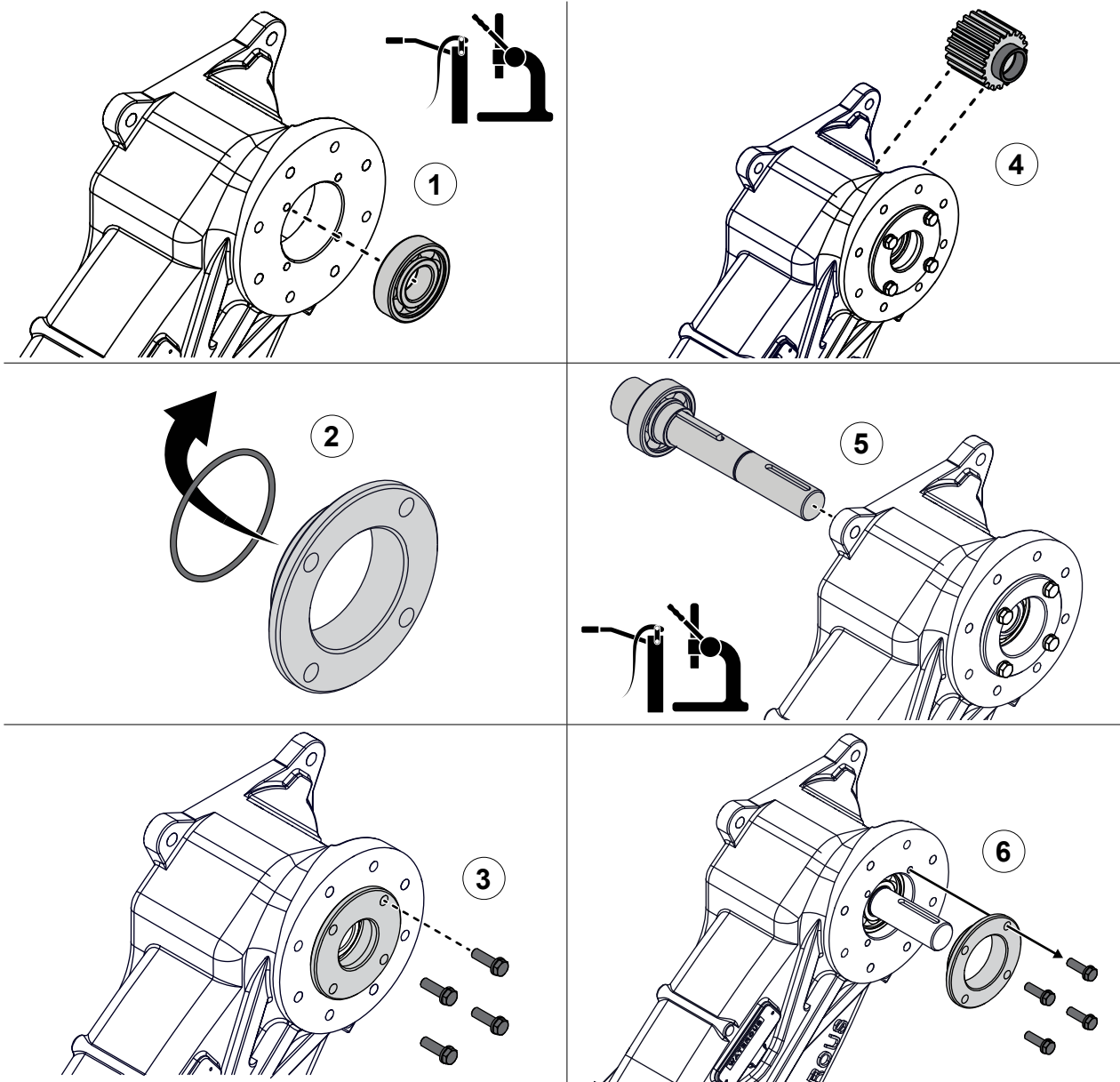


### Shaft with Keyed Output

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing onto the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

## Installing the Upper Drive Shaft Assembly—CM and CS Pumps

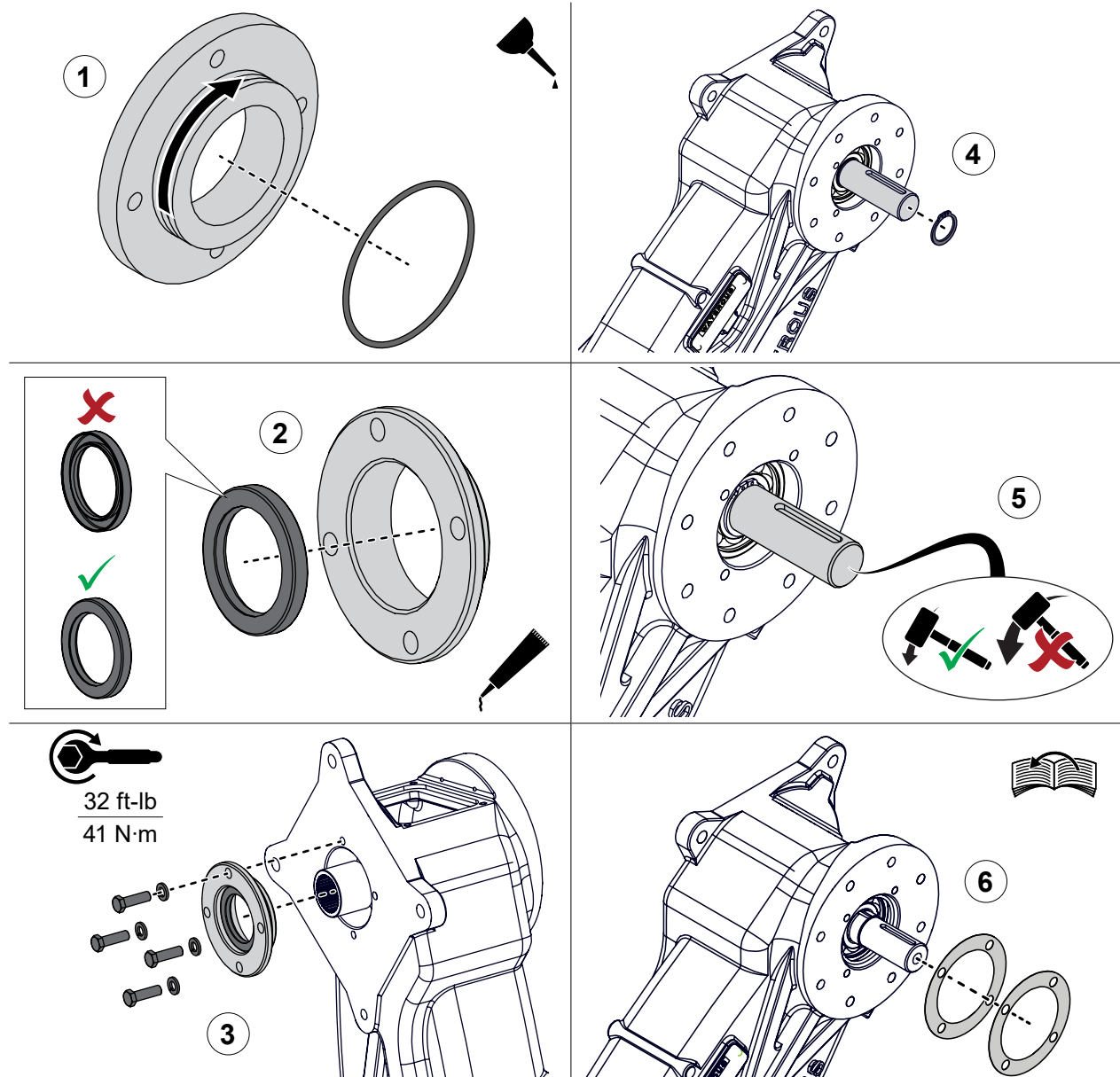


### Shaft with Keyed Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply grease to the bearing, then press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.

## Installing the Upper Drive Shaft Assembly—CM and CS Pumps

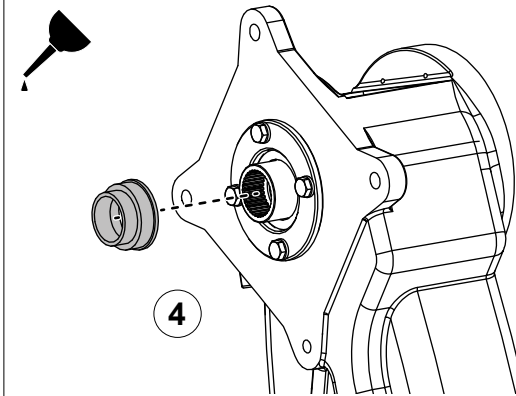
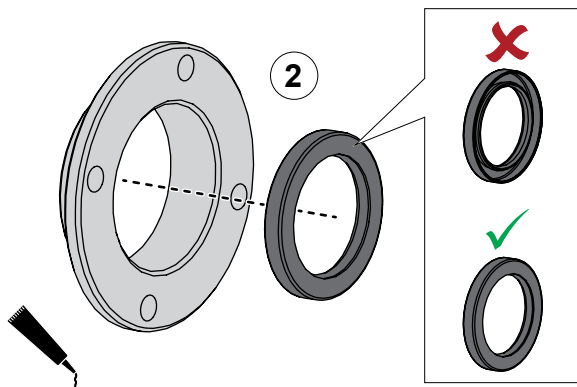
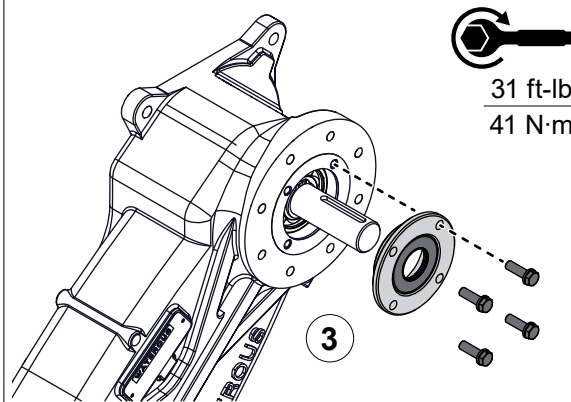
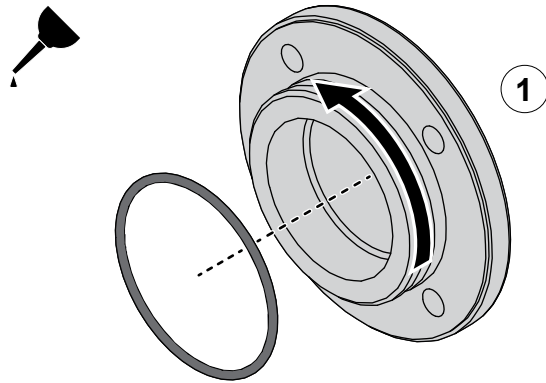


### Shaft with Keyed Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 2 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Install the retaining ring following the groove on the driven shaft.
- 5 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.
- 6 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness" on page 88.**

## Installing the Upper Drive Shaft Assembly—CM and CS Pumps



### Shaft with Keyed Output

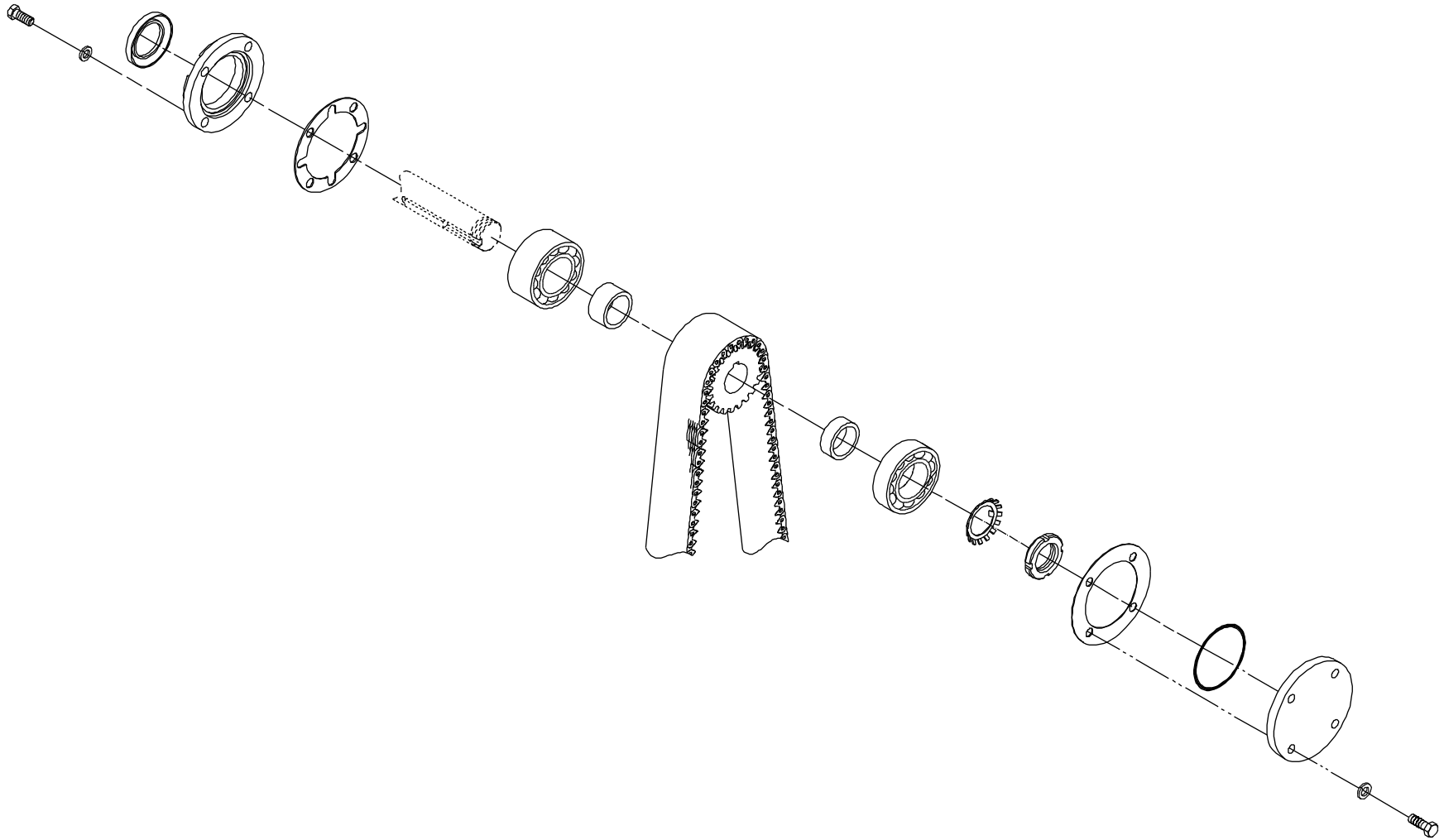
Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 2 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Apply oil to the pump end of the driven shaft, then install the sealing boot over the shaft.

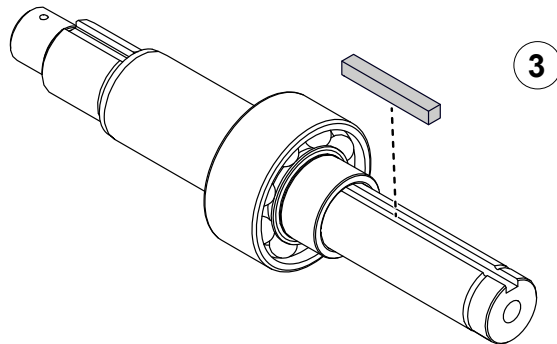
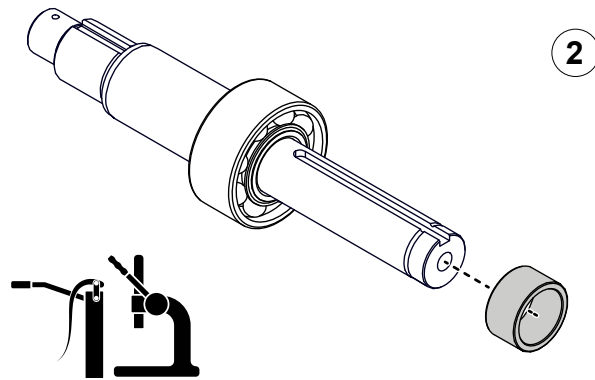
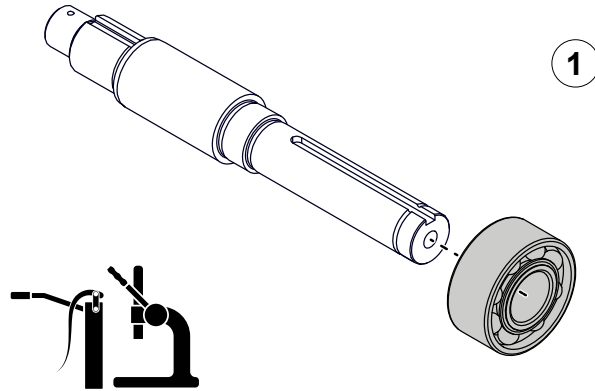




## Assembling the Upper Drive Components—CG, CL, and CX Pumps



## Assembling the Upper Drive Shaft—CG, CL, and CX Pumps

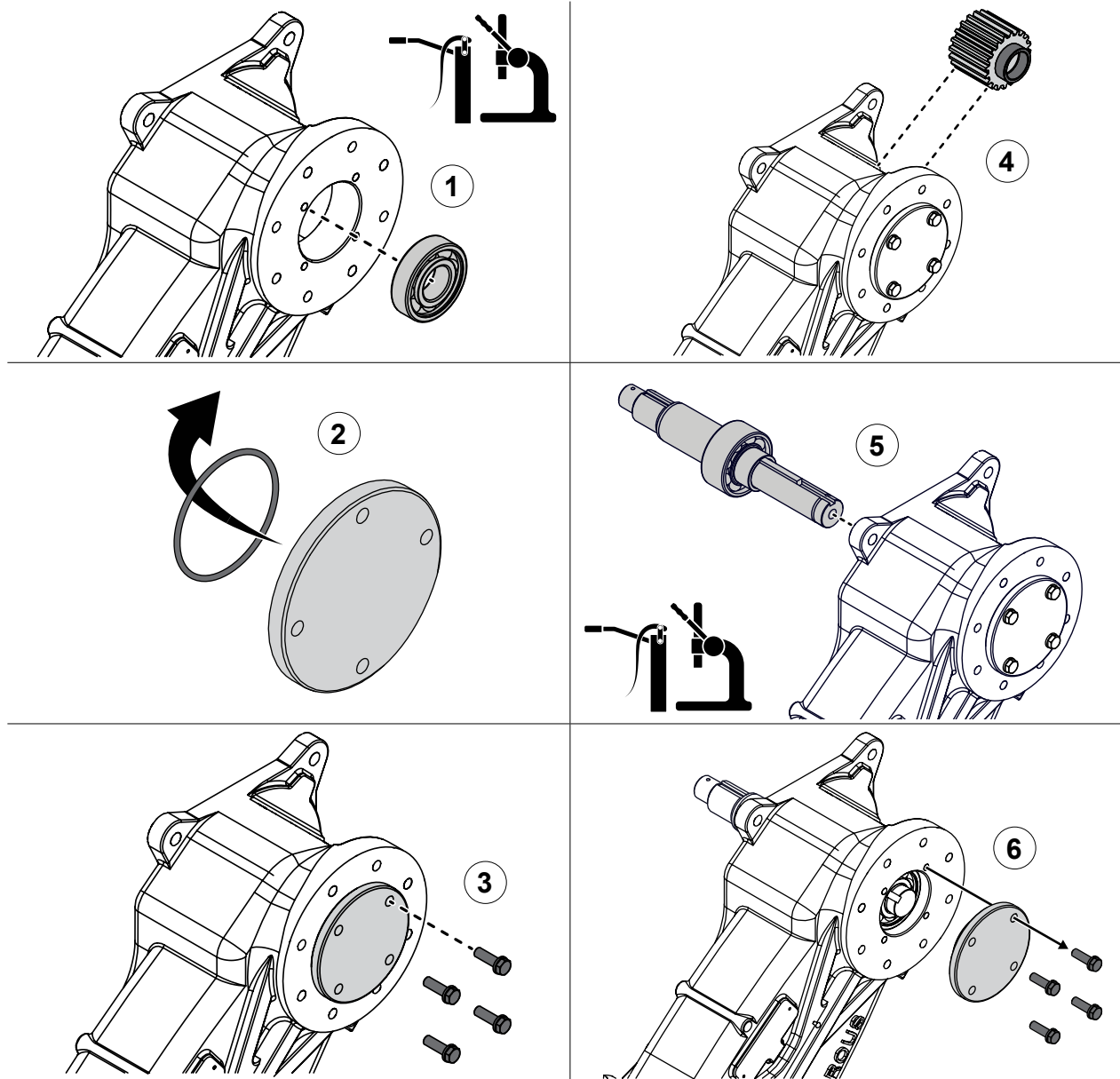


### Shaft without Output

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing onto the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

## Installing the Upper Drive Shaft Assembly—CG, CL, and CX Pumps

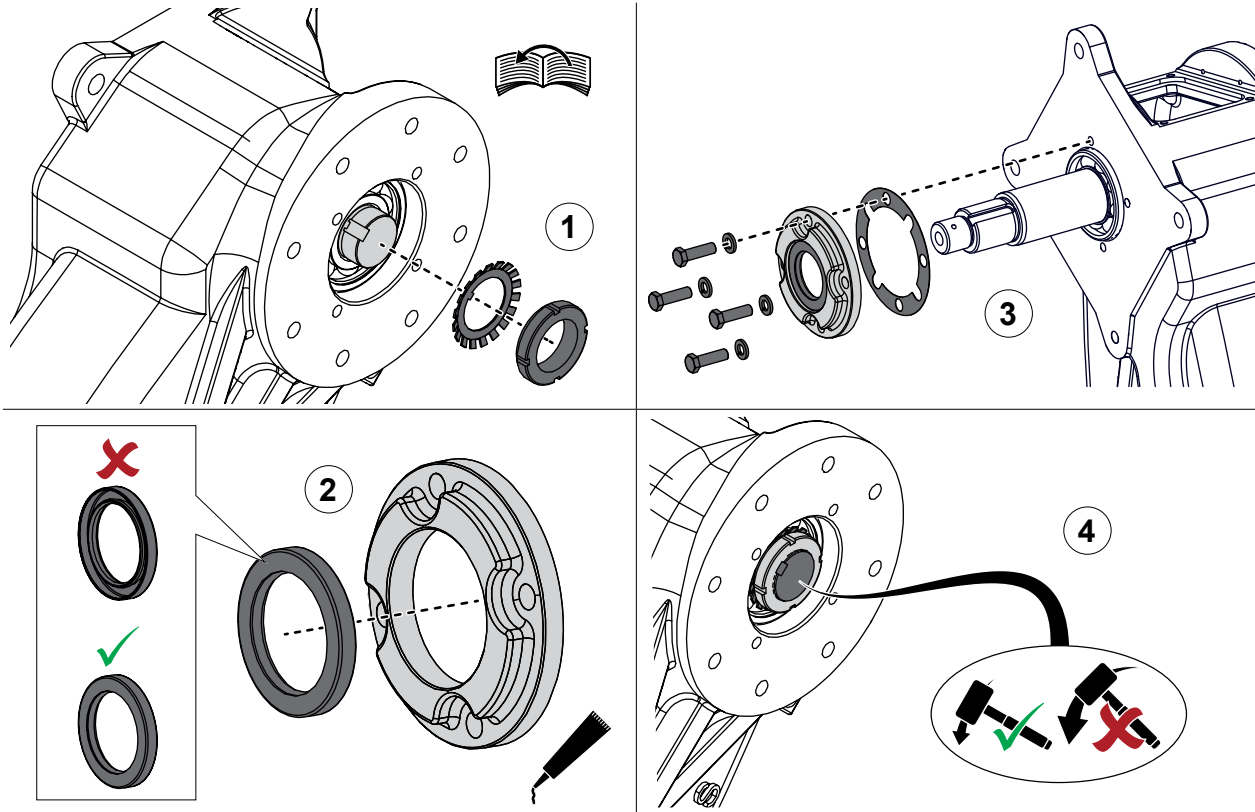


### Shaft without Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply grease to the bearing, then press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.

## Installing the Upper Drive Shaft Assembly—CG, CL, and CX Pumps

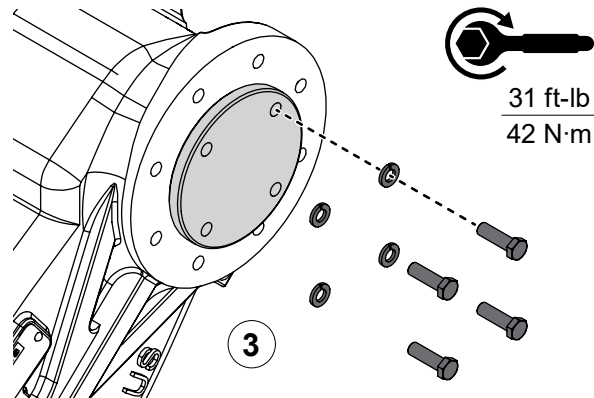
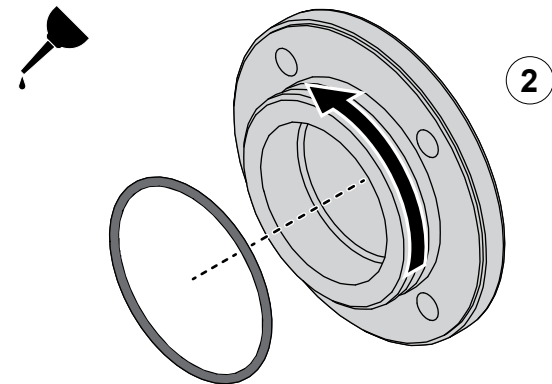
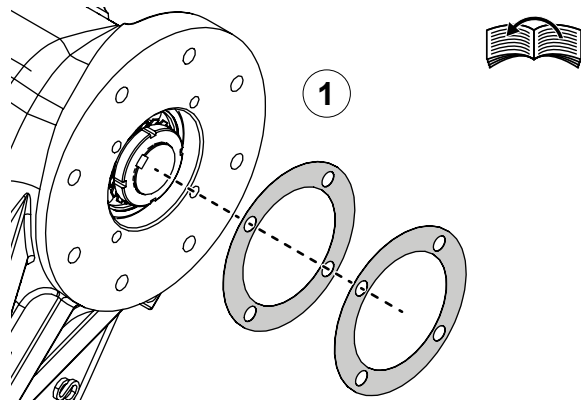


### Shaft without Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Install the bearing lock washer and nut. Refer to: **"Installing the Bearing Lock Washer and Nut"** on page 87.
- 2 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 3 Align the oil-seal housing and gasket, then use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.

## Installing the Upper Drive Shaft Assembly—CG, CL, and CX Pumps



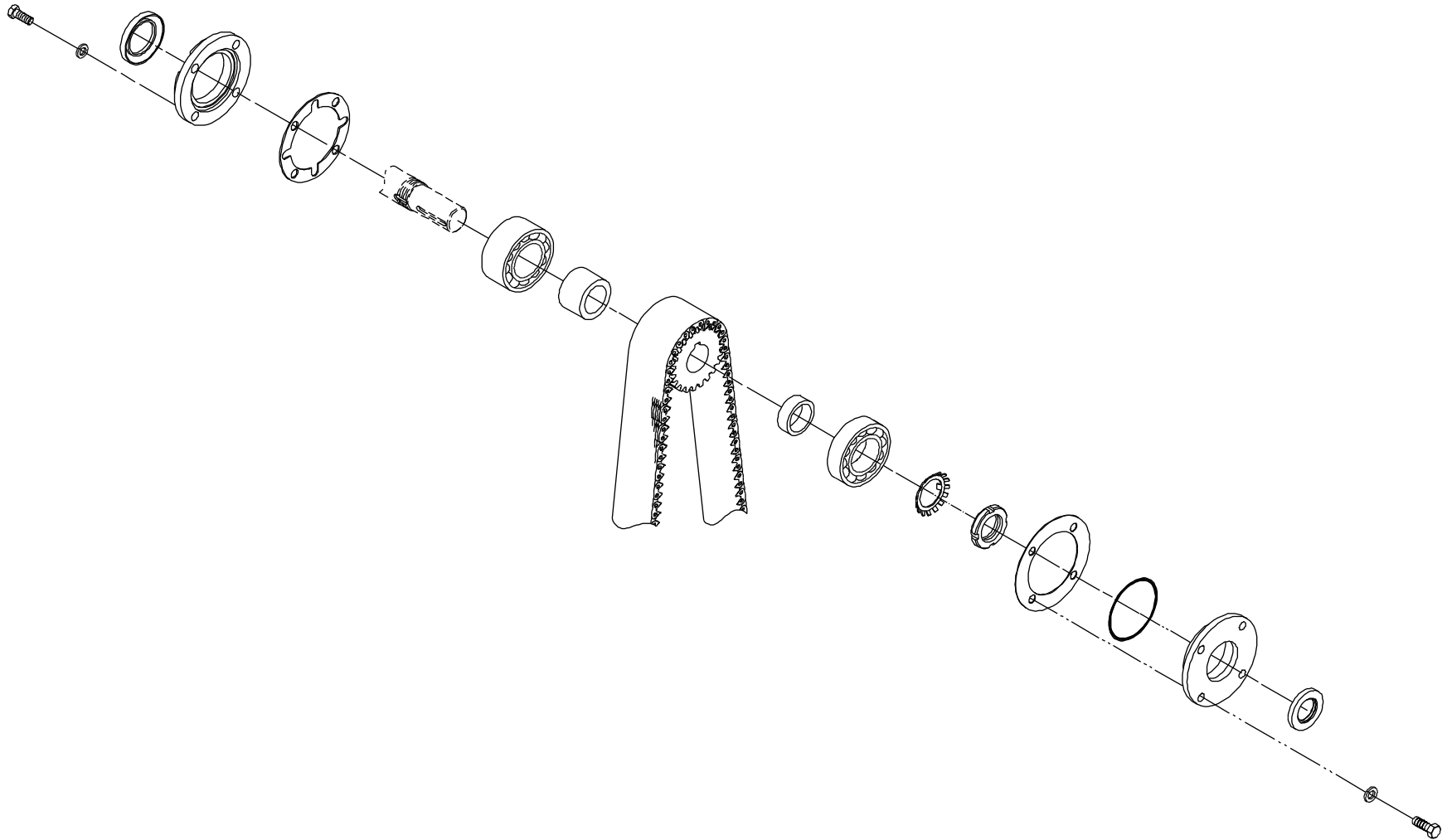
### Shaft without Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness" on page 88.**
- 2 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.

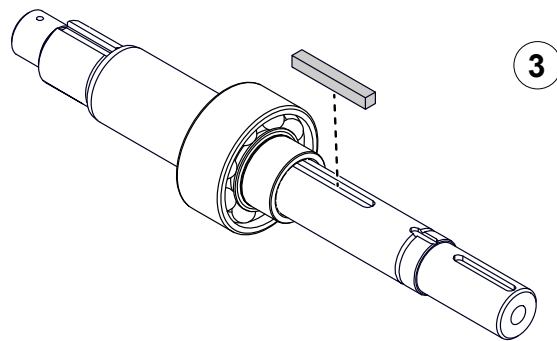
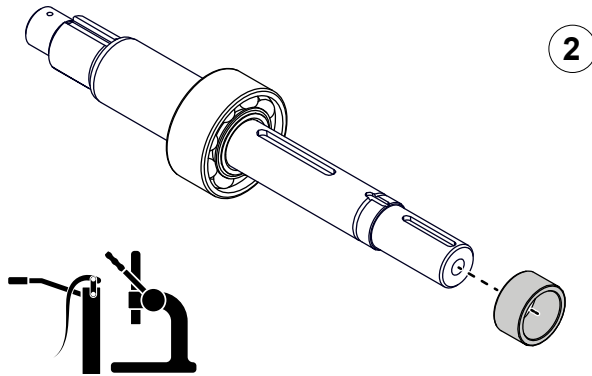
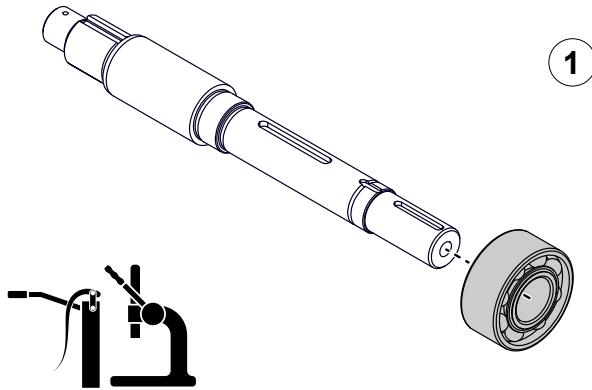


## Assembling the Upper Drive Components—CG, CL, and CX Pumps





## Assembling the Upper Drive Shaft—CG, CL, and CX Pumps

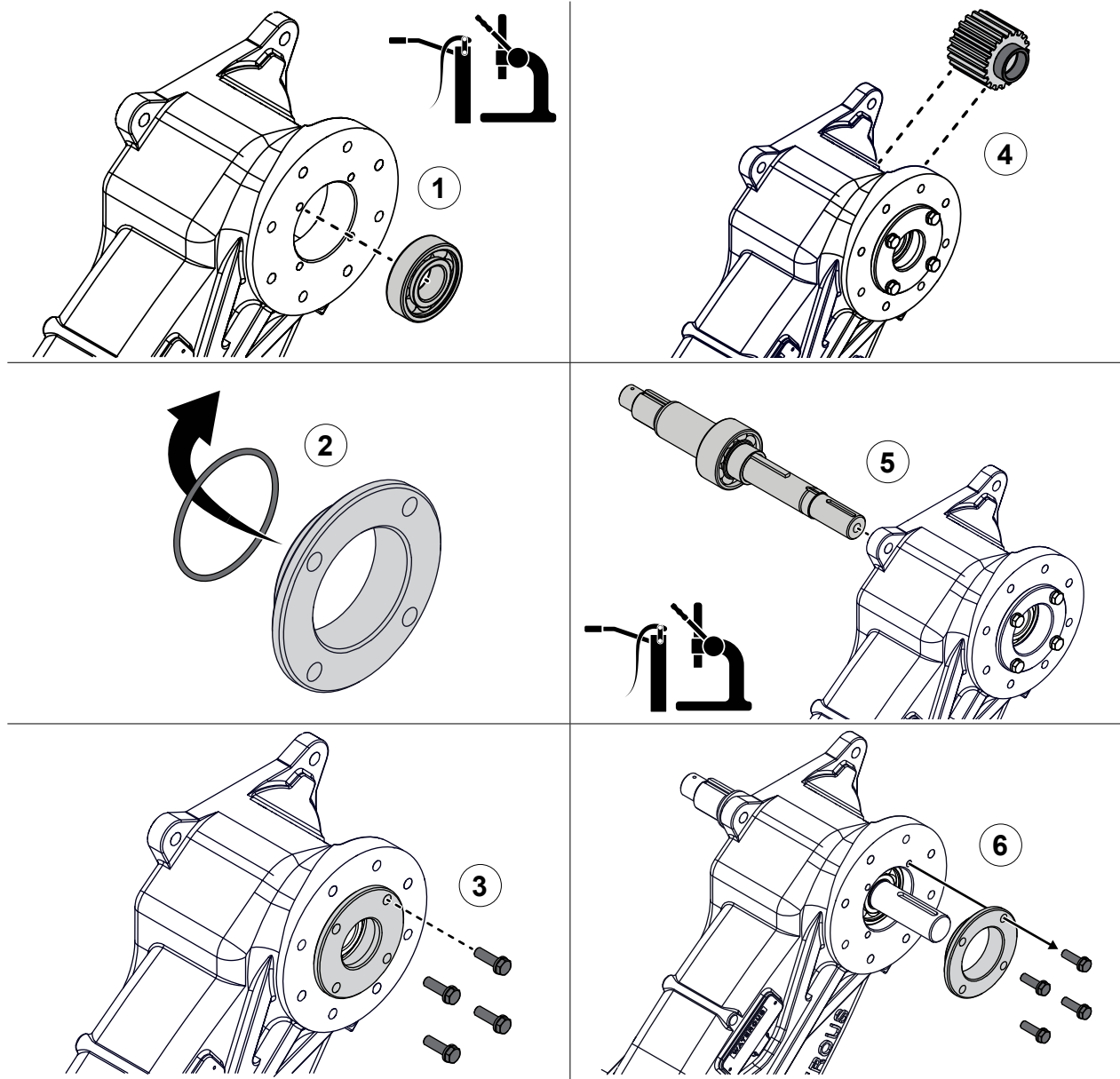


### Shaft with Keyed Output

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing onto the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

## Installing the Upper Drive Shaft Assembly—CG, CL, and CX Pumps

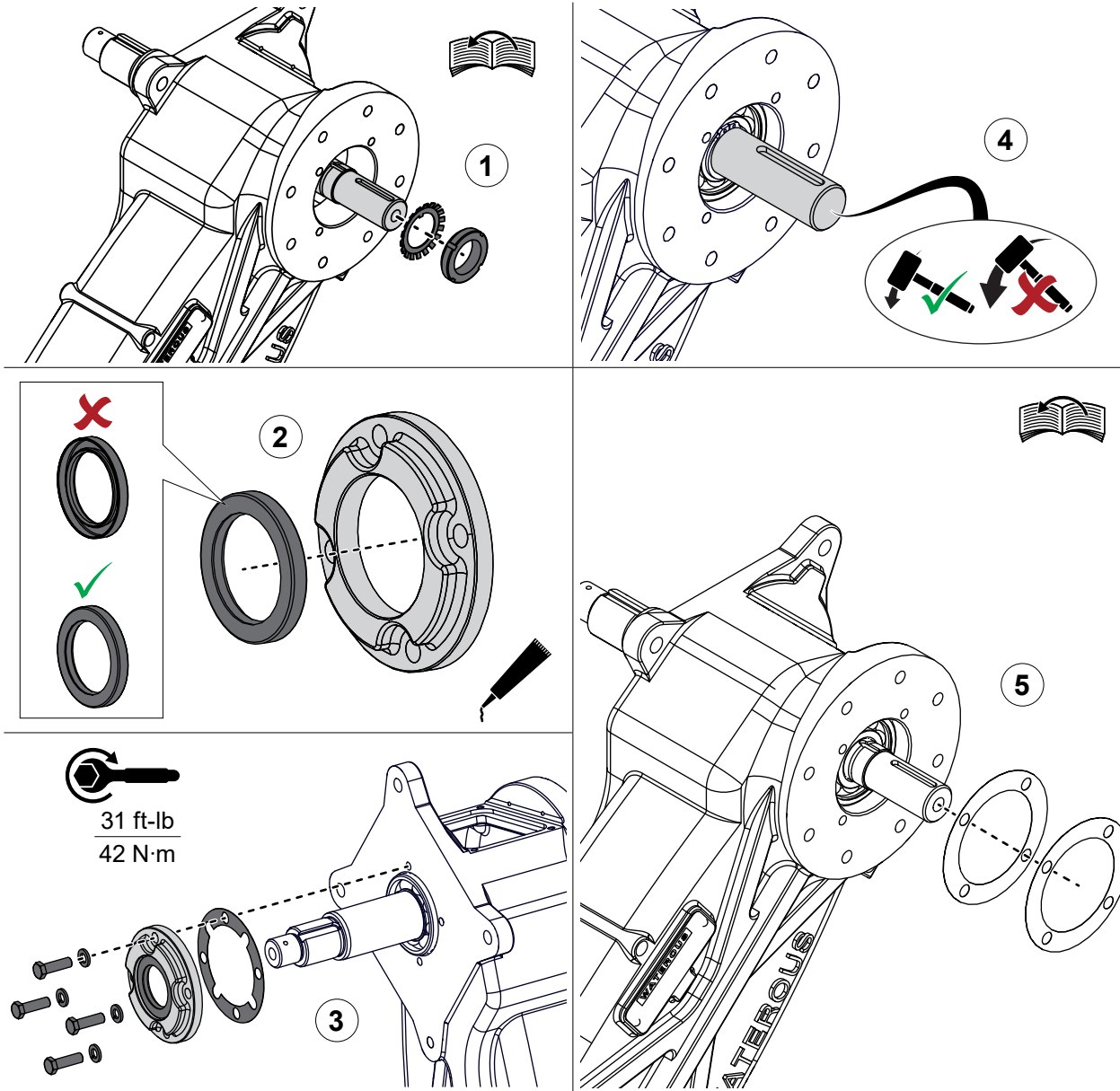


### Shaft with Keyed Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply grease to the bearing, then press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.

## Installing the Upper Drive Shaft Assembly—CG, CL, and CX Pumps

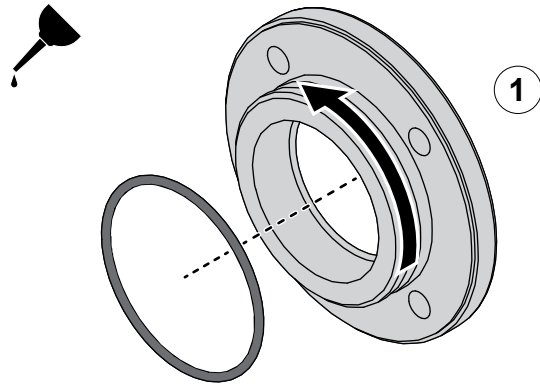


### Shaft with Keyed Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Install the bearing lock washer and nut. Refer to: **"Installing the Bearing Lock Washer and Nut"** on page 87.
- 2 Apply silicon sealant around the oil seal, then install the oil seal into the oil-seal housing.
- 3 Align the oil-seal housing and gasket, then use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.
- 5 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness"** on page 88.

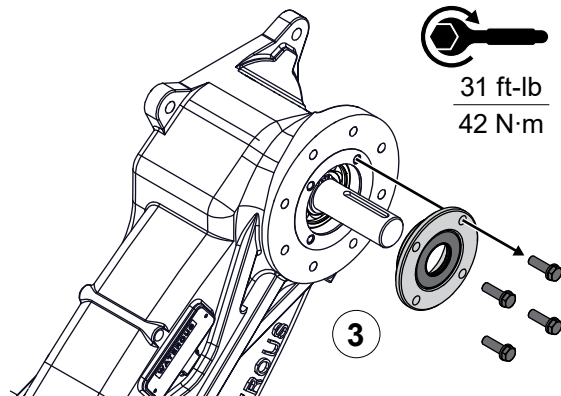
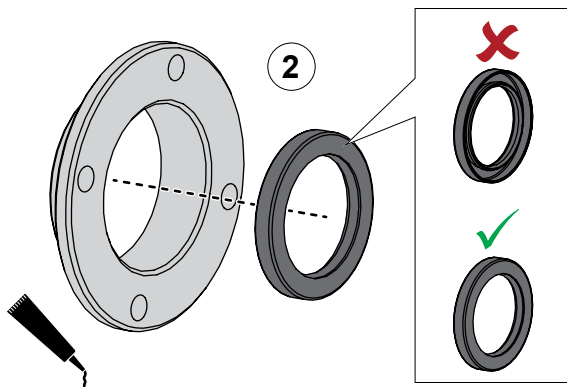
## Installing the Upper Drive Shaft Assembly—CG, CL, and CX Pumps



### Shaft with Keyed Output

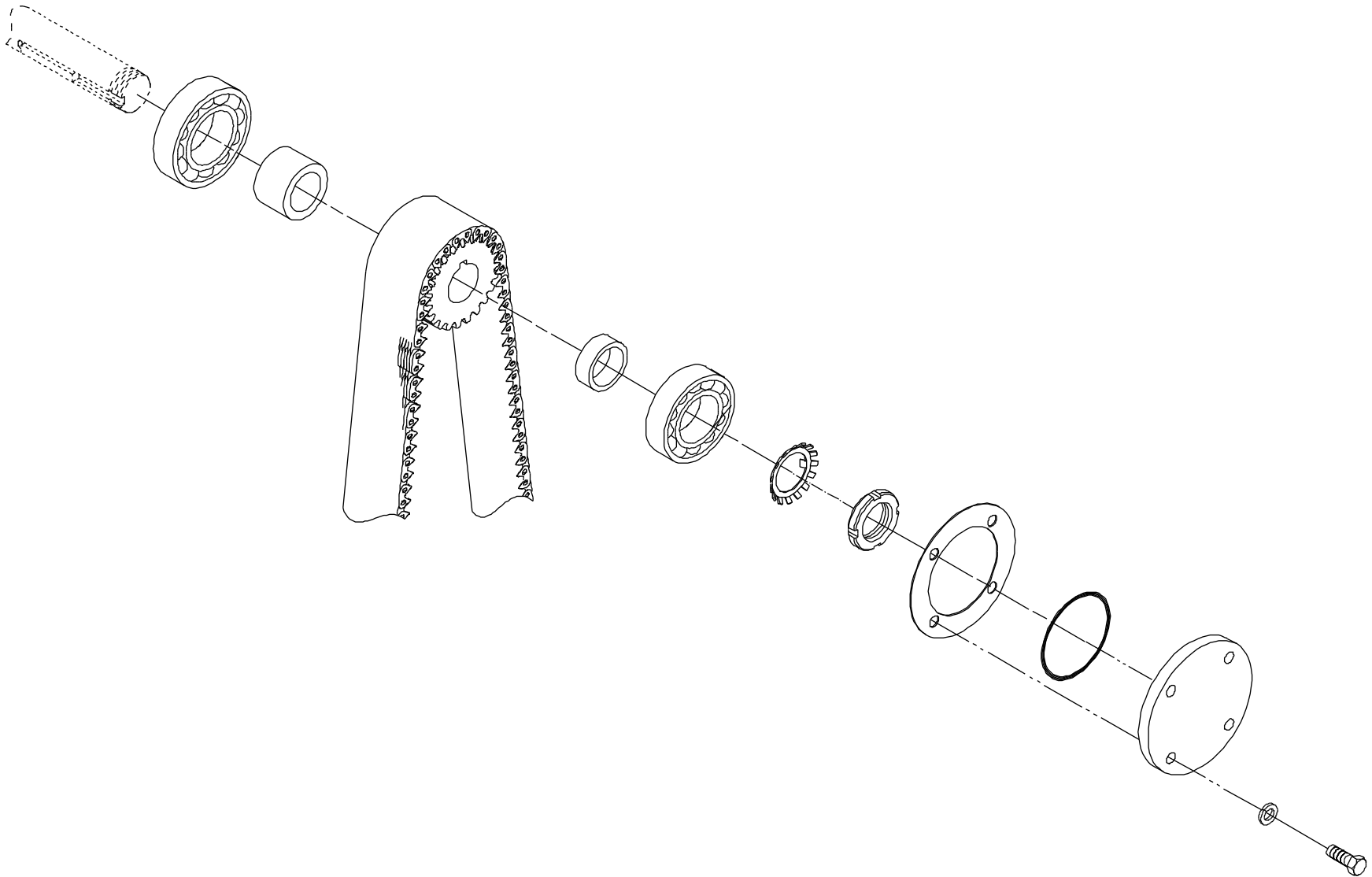
Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 2 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.

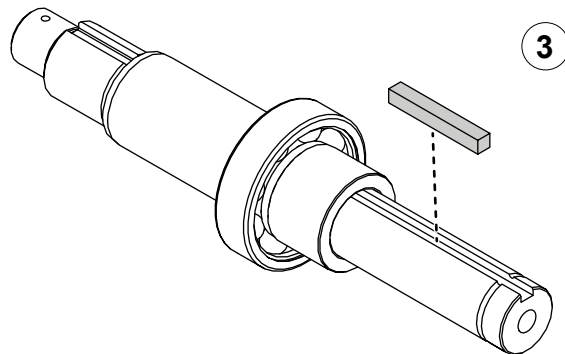
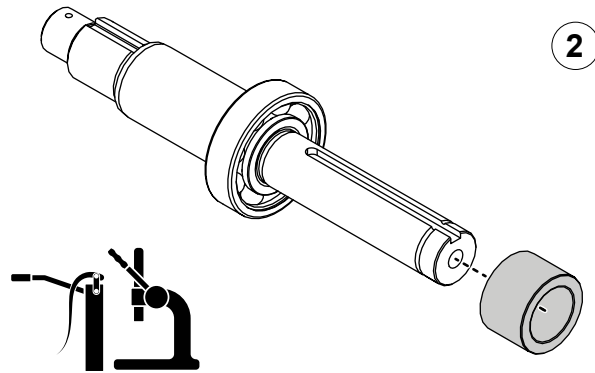
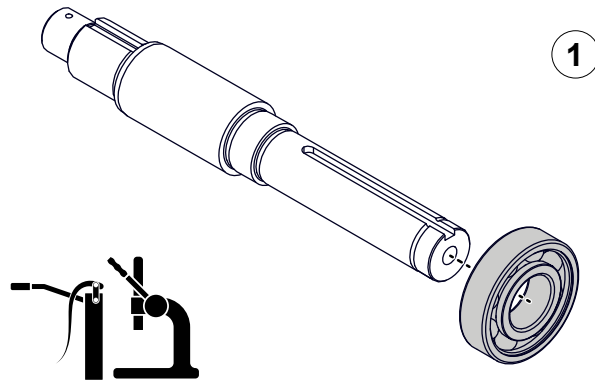




## Assembling the Upper Drive Components—S100 Pump



## Assembling the Upper Drive Shaft—S100 Pump

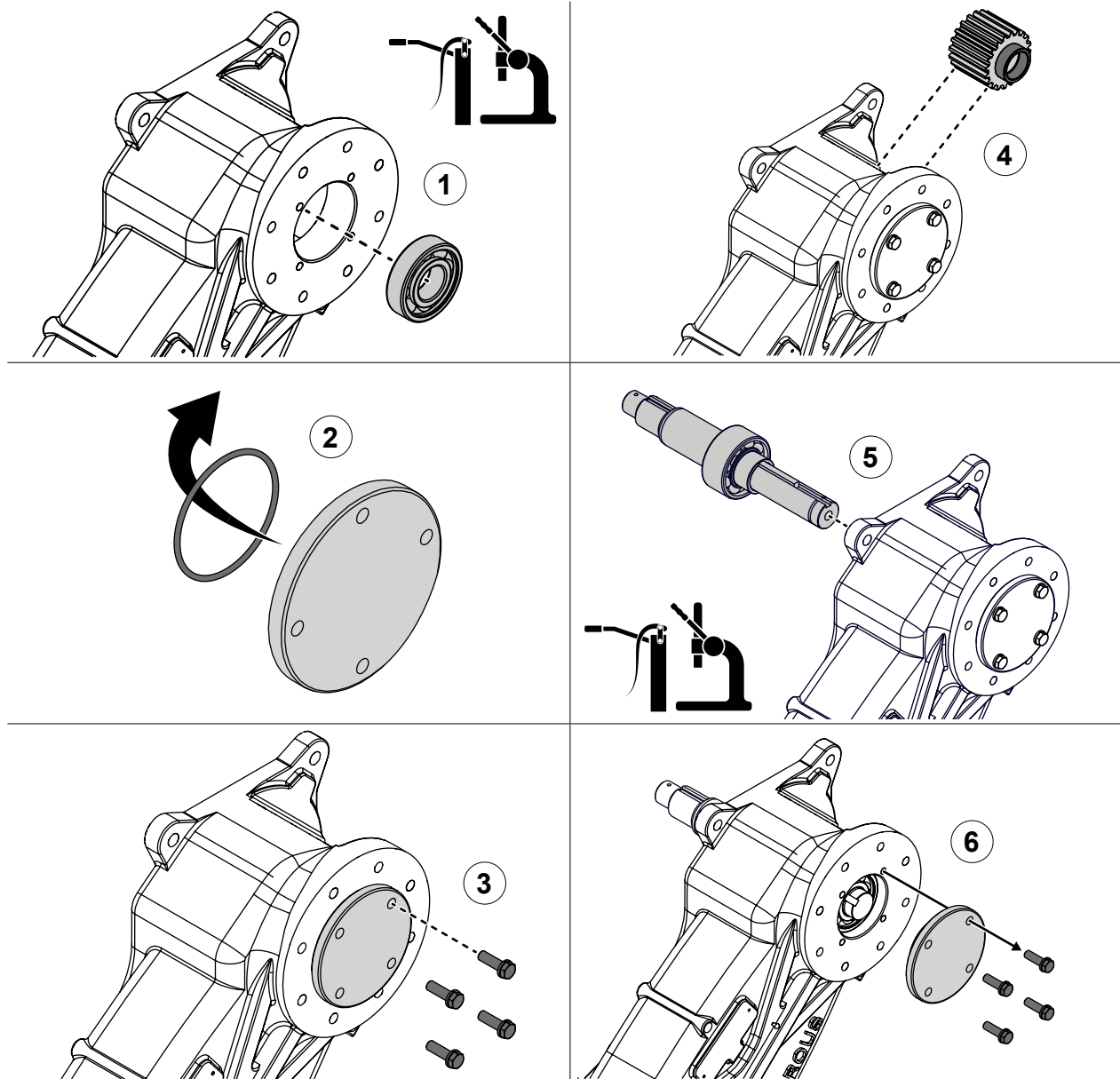


### Shaft without Output

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing to the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

## Installing the Upper Drive Shaft Assembly—S100 Pump



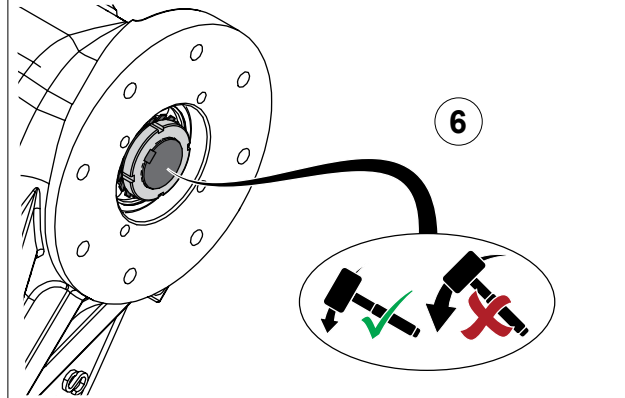
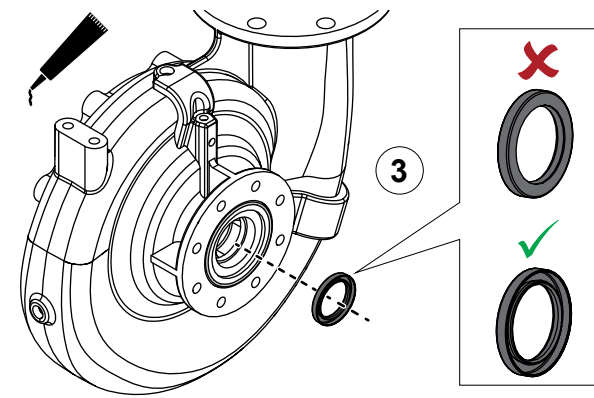
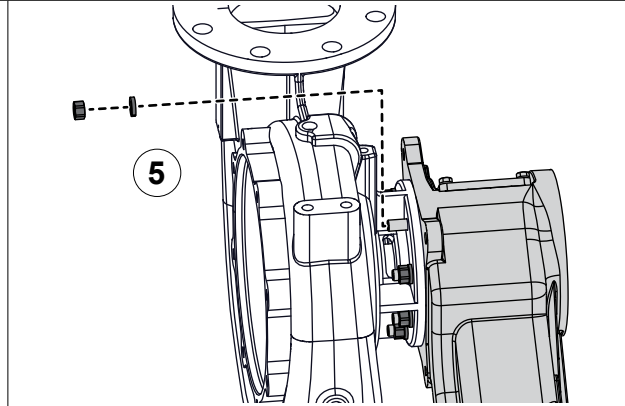
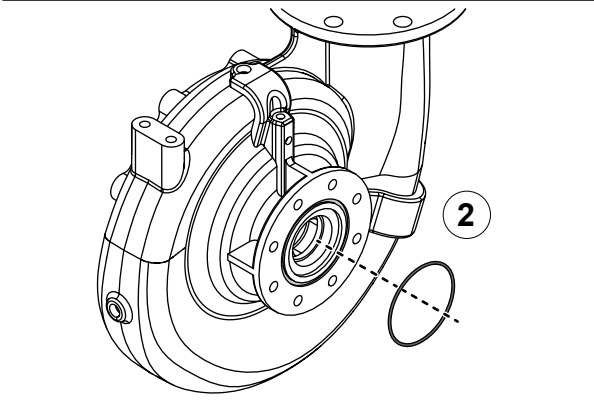
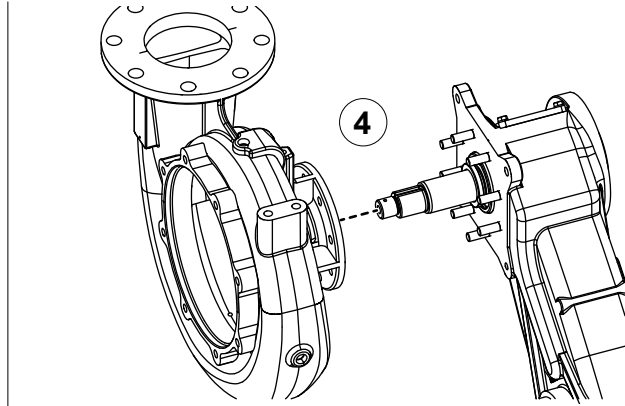
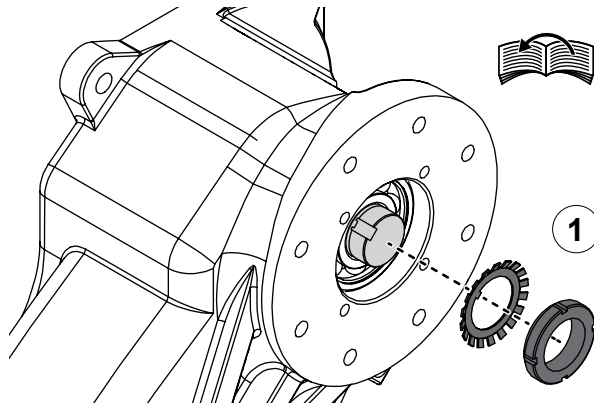
### Shaft without Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply grease to the bearing, then press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.



## Installing the Upper Drive Shaft Assembly—S100 Pump

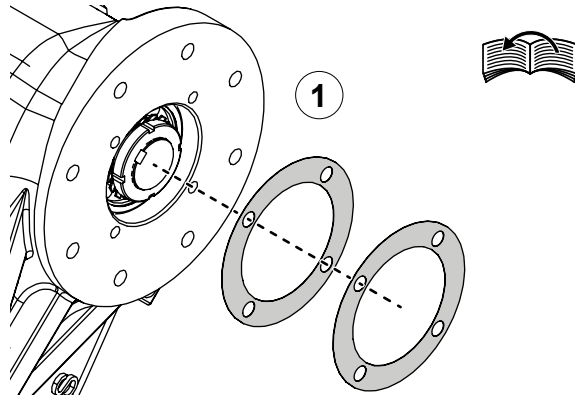


### Shaft without Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Install the bearing lock washer and nut. Refer to: **"Installing the Bearing Lock Washer and Nut"** on page 87.
- 2 Install the O-ring into the pump body.
- 3 Apply silicon sealant around the oil seal, then install it into the pump body.
- 4 Align the transmission with the pump body.
- 5 Use the hardware that you removed earlier to secure the transmission to the pump body.
- 6 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.

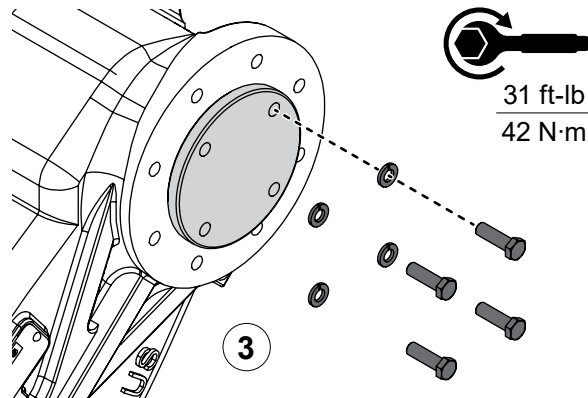
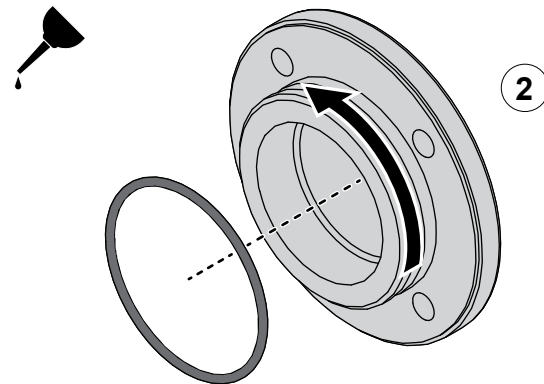
## Installing the Upper Drive Shaft Assembly—S100 Pump



### Shaft without Output

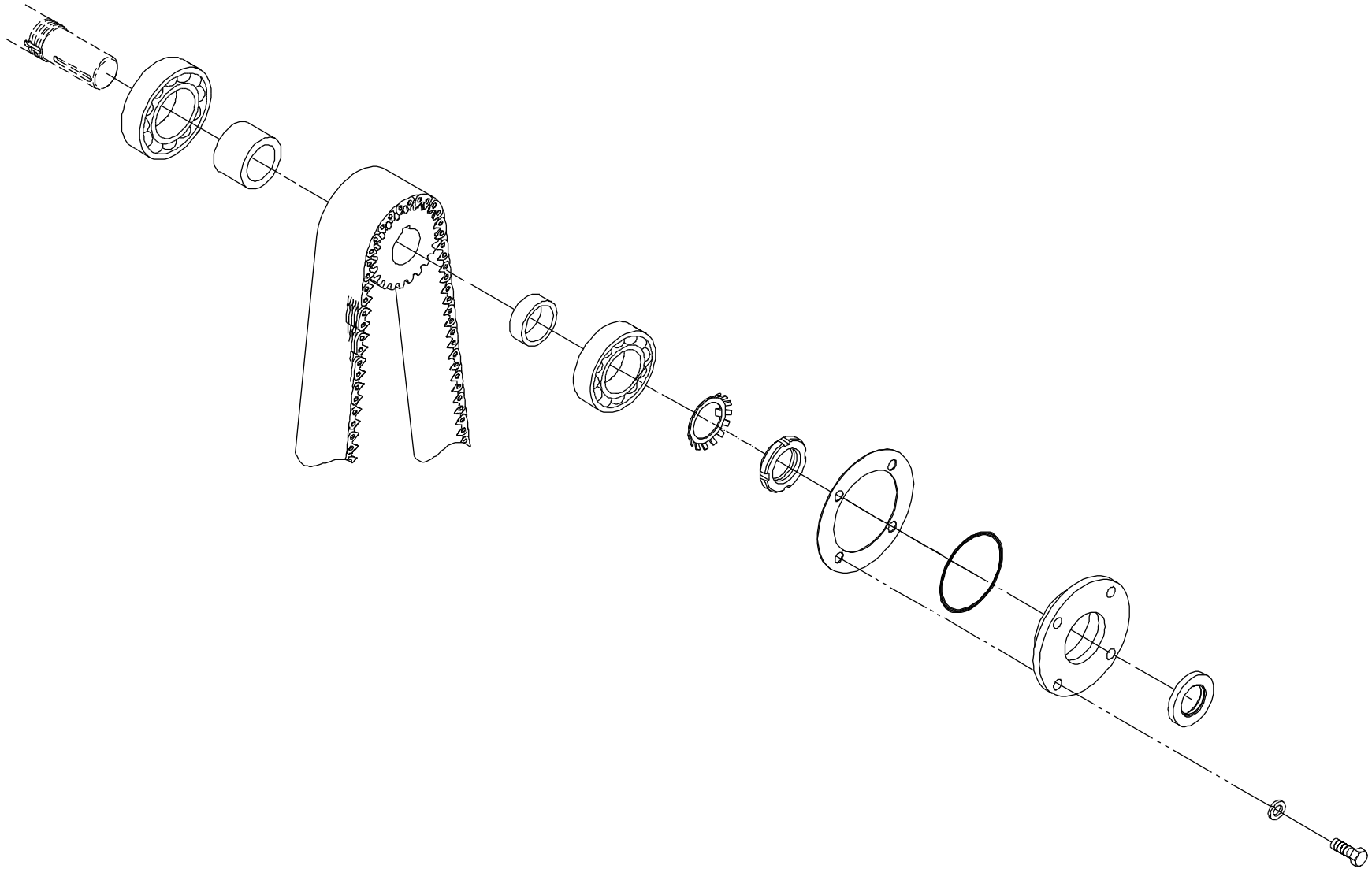
Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness" on page 88.**
- 2 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.

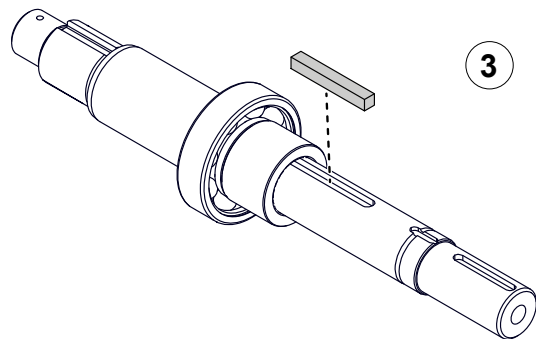
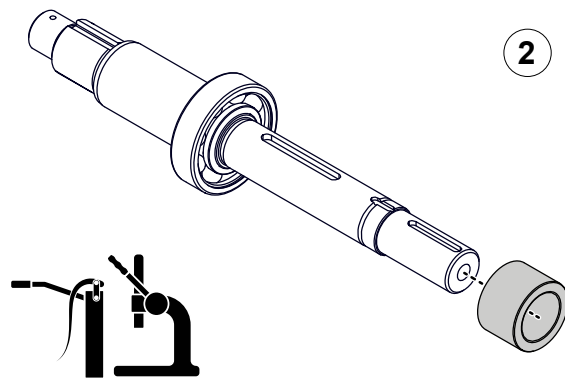
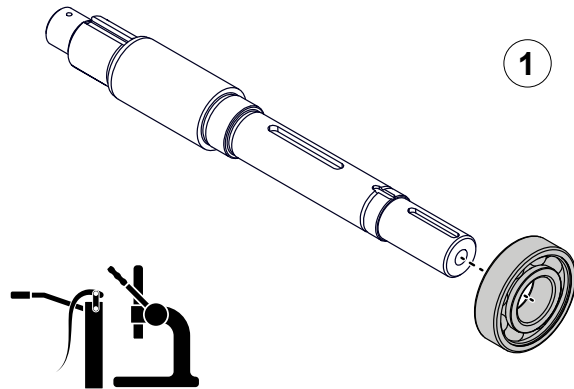




## Assembling the Upper Drive Components—S100 Pump



## Assembling the Upper Drive Shaft—S100 Pump

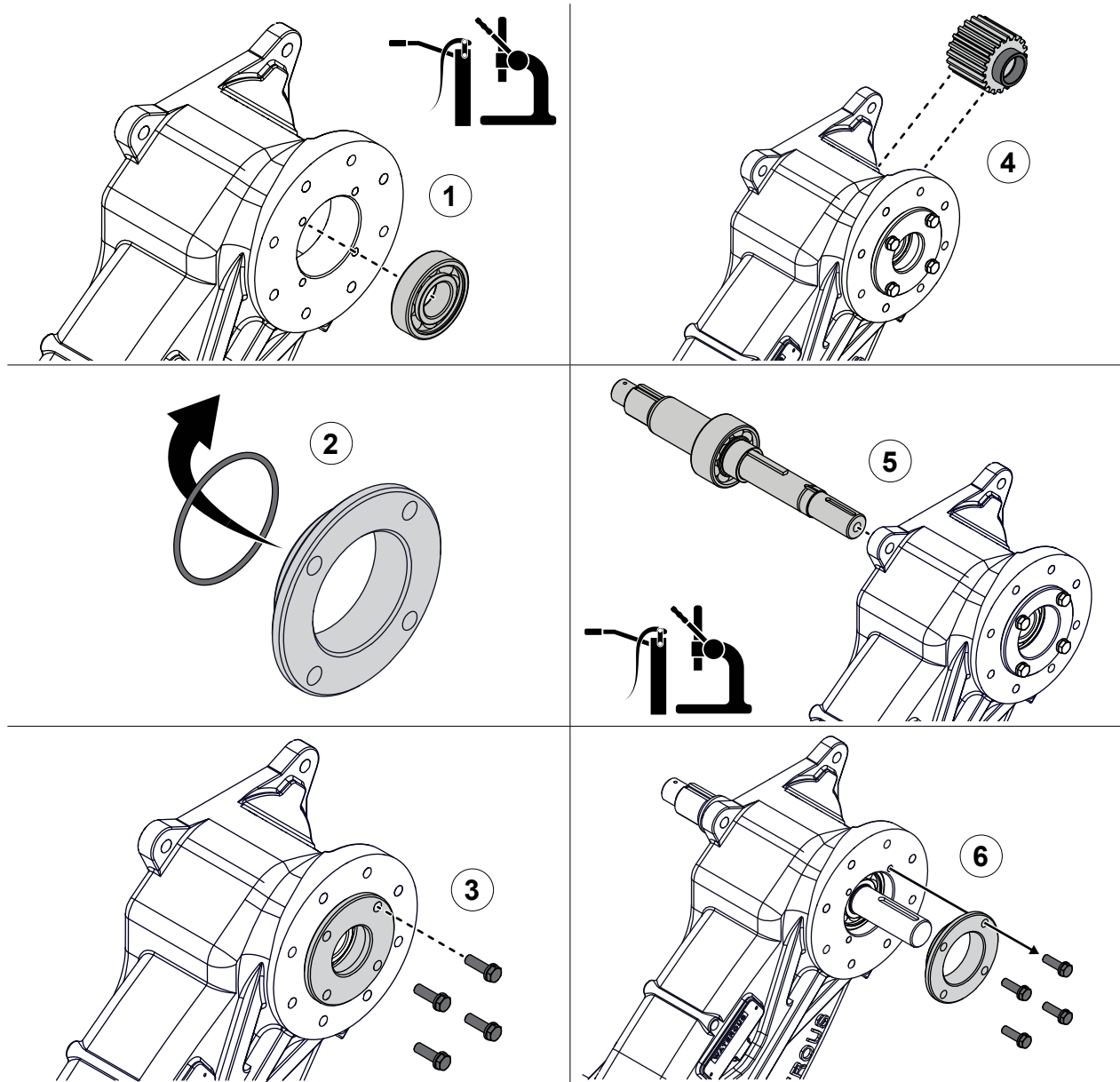


### Shaft with Keyed Output

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing onto the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

## Installing the Upper Drive Shaft Assembly—S100 Pump

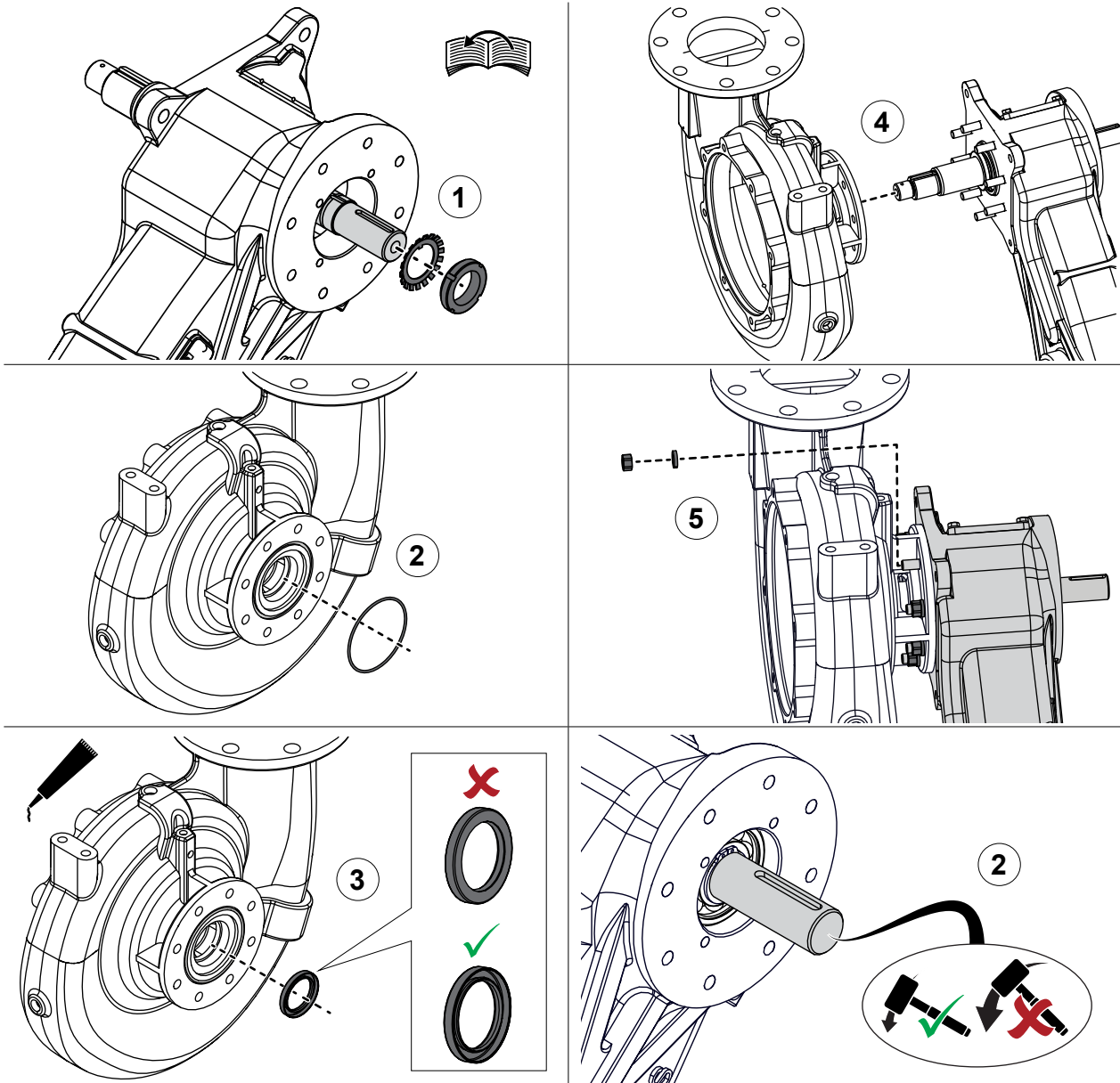


### Shaft with Keyed Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply grease to the bearing, then press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.

## Installing the Upper Drive Shaft Assembly—S100 Pump

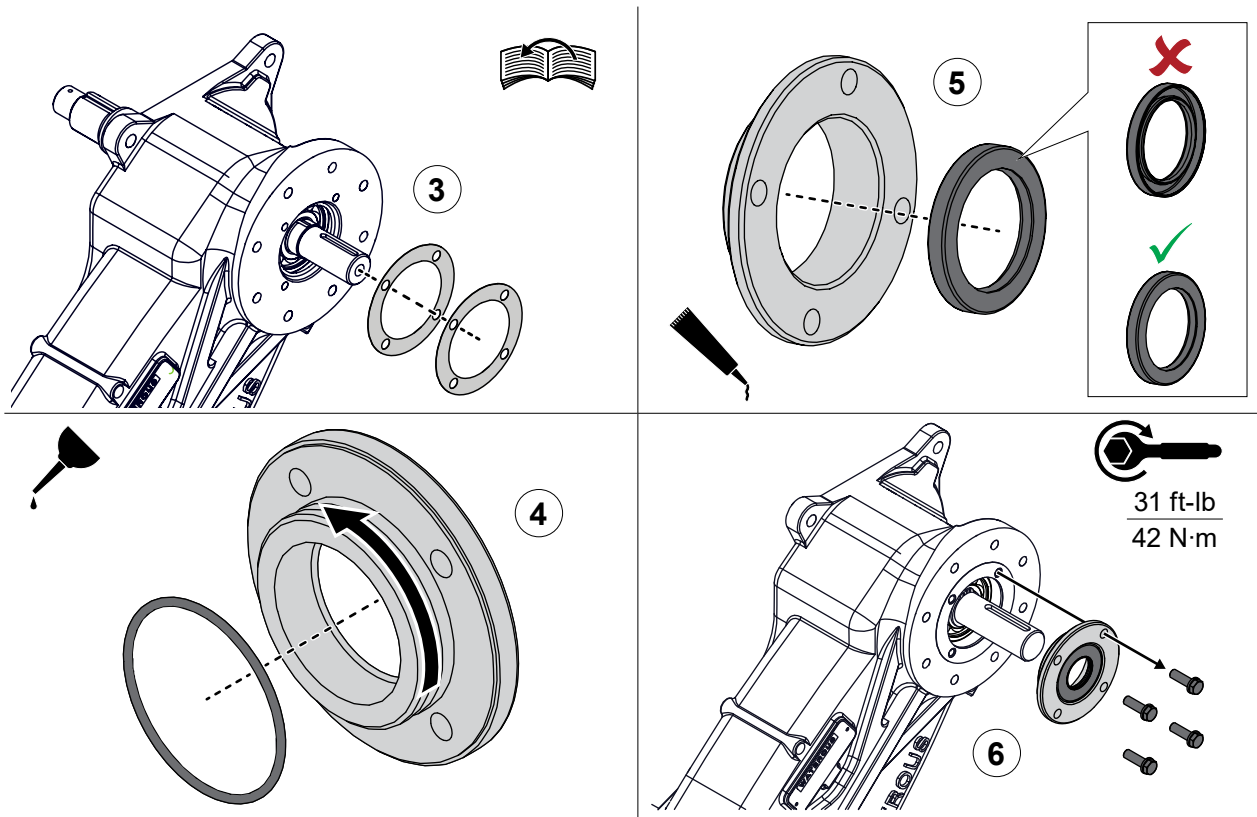


### Shaft with Keyed Output

Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Install the bearing lock washer and nut. Refer to: **"Installing the Bearing Lock Washer and Nut" on page 87.**
- 2 Install the O-ring into the pump body.
- 3 Apply silicon sealant around the oil seal, then install it into the pump body.
- 4 Align the transmission with the pump body.
- 5 Use the hardware that you removed earlier to secure the transmission to the pump body.
- 6 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.

## Installing the Upper Drive Shaft Assembly—S100 Pump



### Shaft with Keyed Output

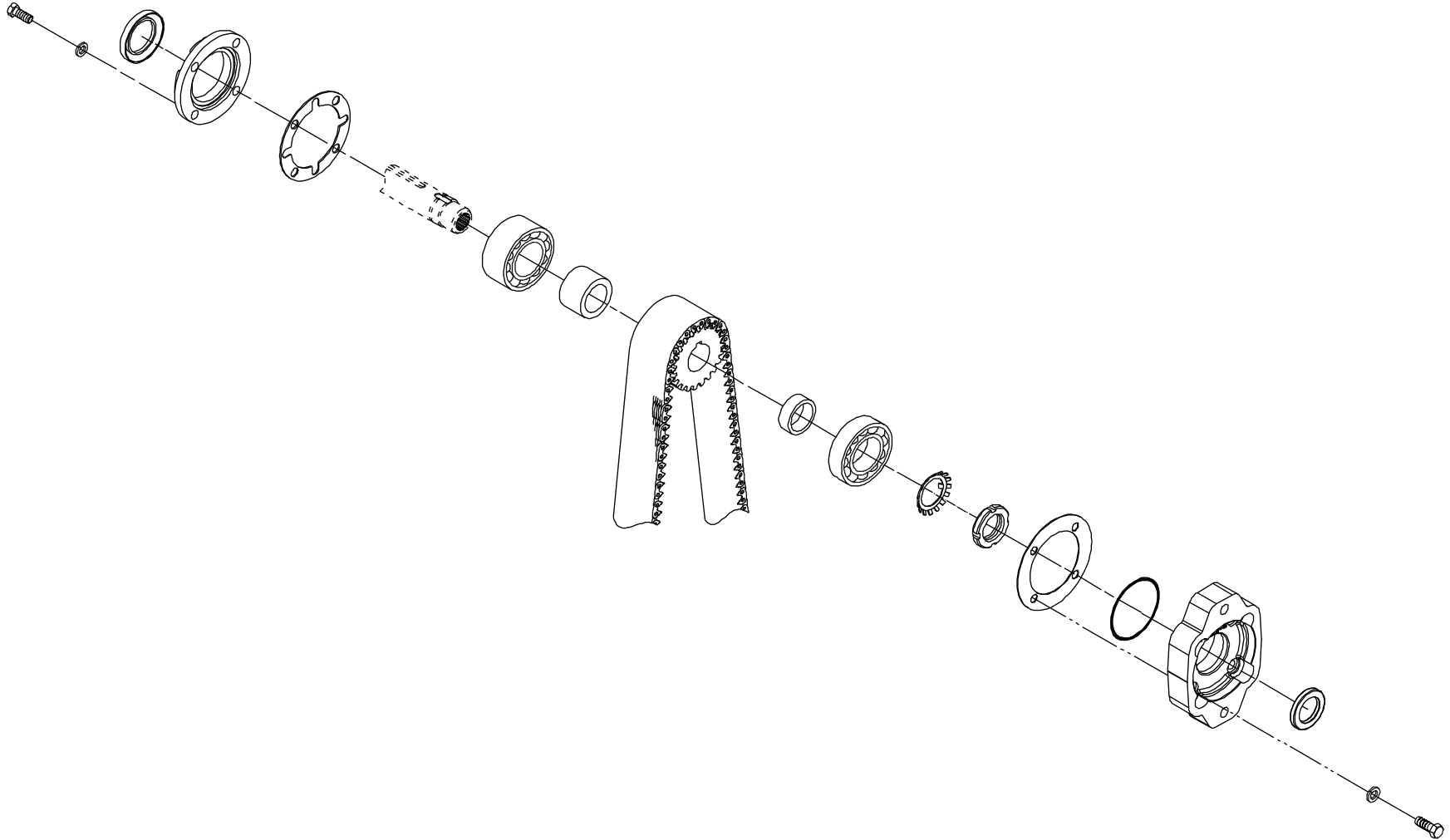
Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness" on page 88.**
- 2 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.
- 3 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 4 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.

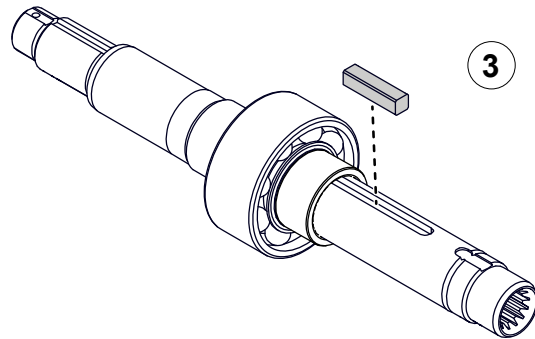
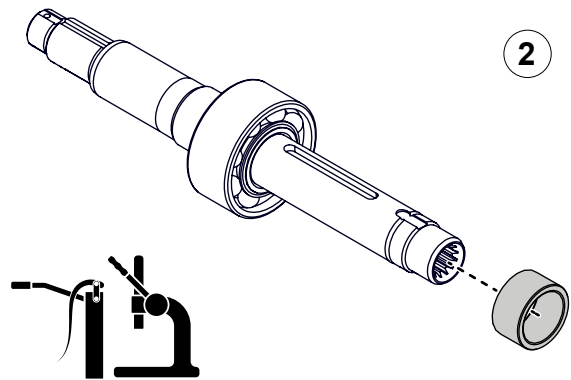
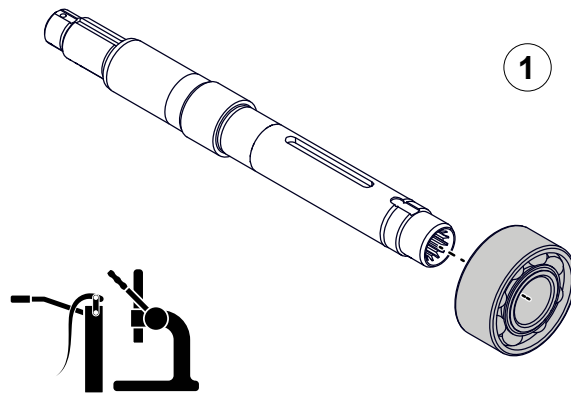




## Assembling the Upper Drive Components—CX Pump



## Assembling the Upper Drive Shaft—CX Pump

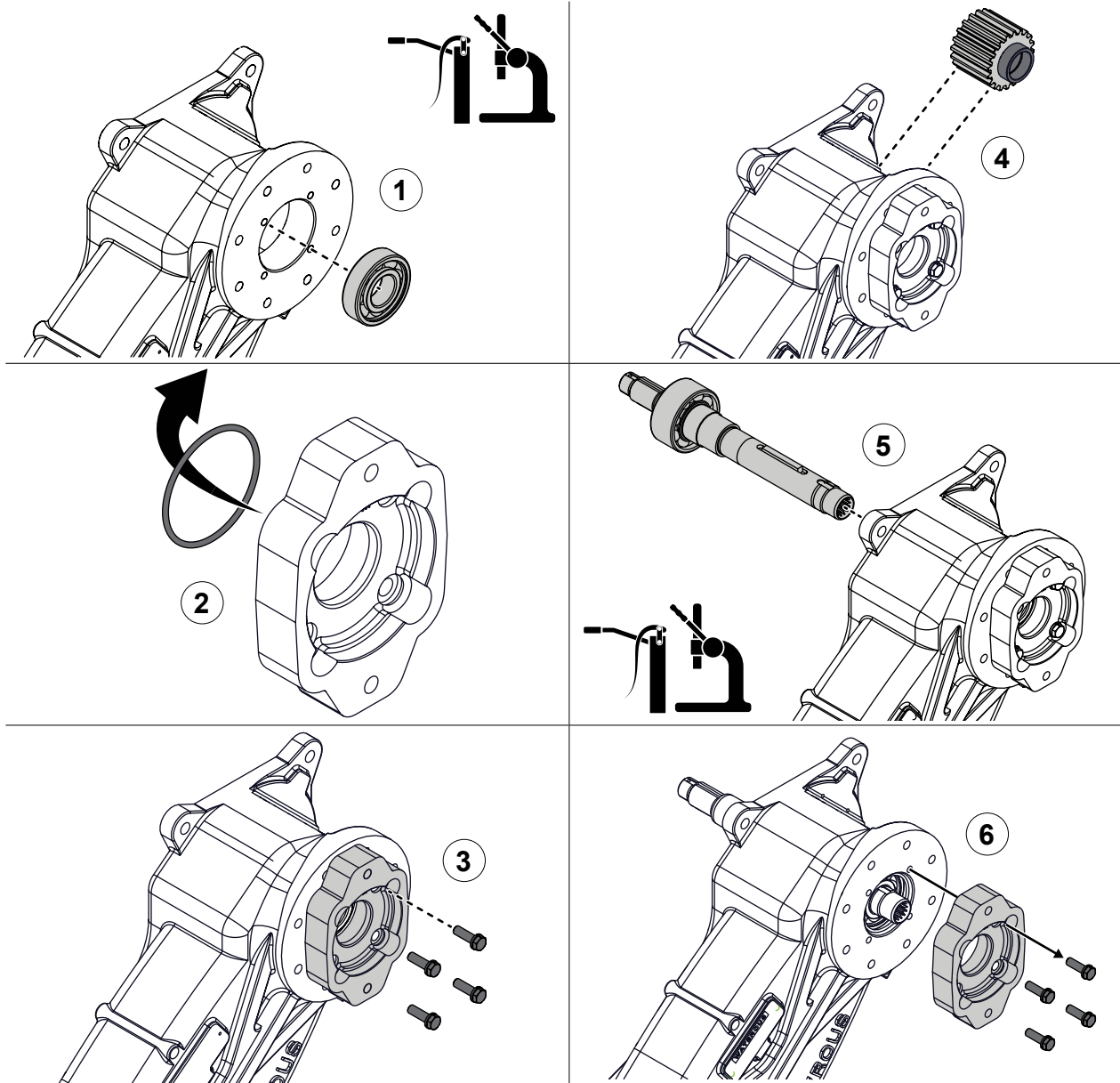


### Shaft with Hydraulic Flange

Use the illustrations and instructions to assemble the driven shaft assembly.

- 1 Apply grease to the shaft, then use an arbor press to press the bearing onto the shaft.
- 2 Press the spacer onto the shaft.
- 3 Insert the key into the key slot on the shaft.

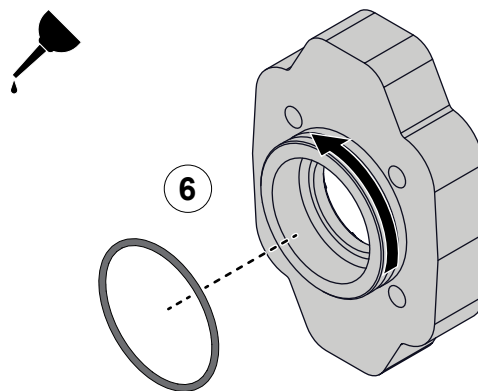
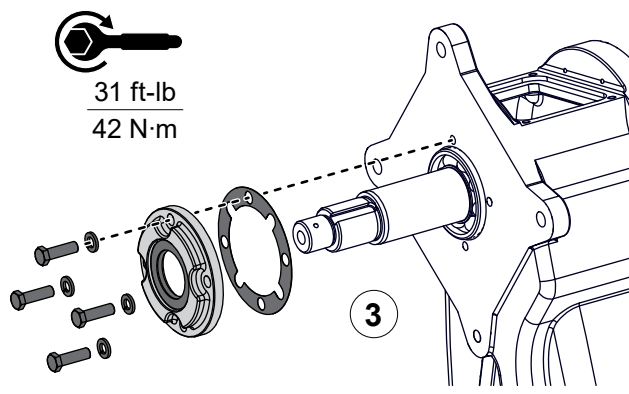
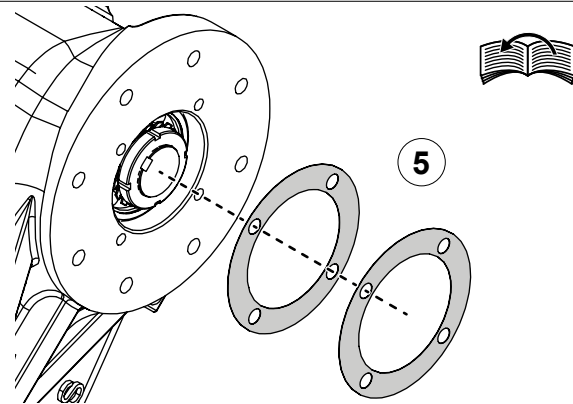
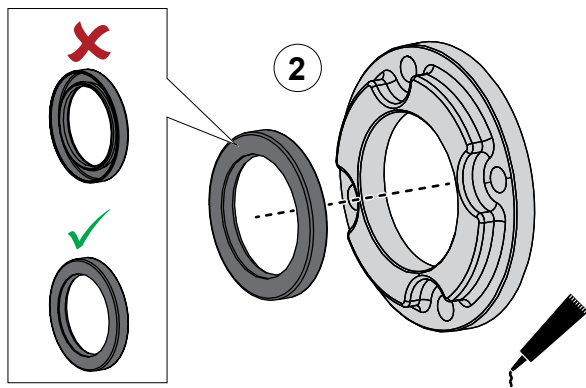
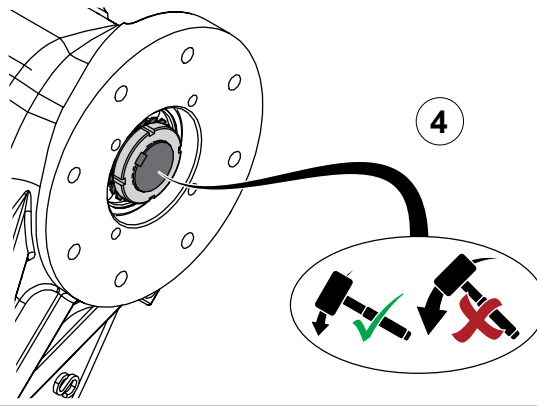
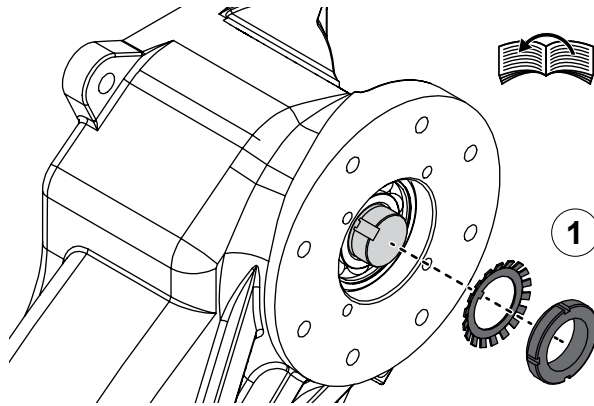
## Installing the Upper Drive Shaft Assembly—CX Pump



Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply grease to the bearing and press it into the transmission case.
- 2 Remove the O-ring from the oil-seal housing.
- 3 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Position the drive sprocket and drive-shaft spacer in the transmission case.
- 5 Align the driven shaft assembly with the driven-shaft spacer, driven sprocket, and transmission case, then press it through them.
- 6 Remove and set aside the mounting hardware and oil-seal housing.

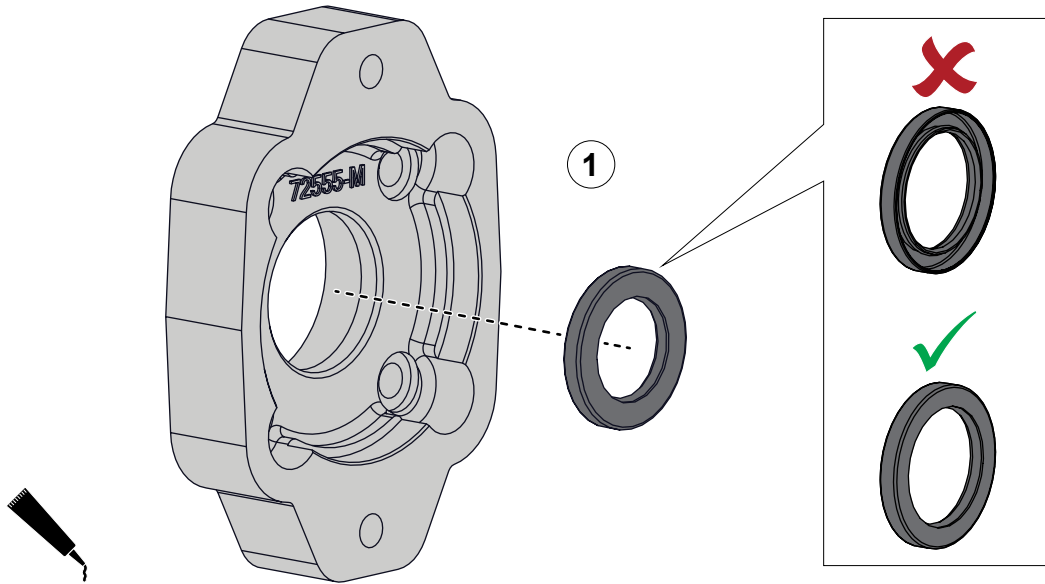
## Installing the Upper Drive Shaft Assembly—CX Pump



Use the illustrations and instructions to install the driven shaft and associated components.

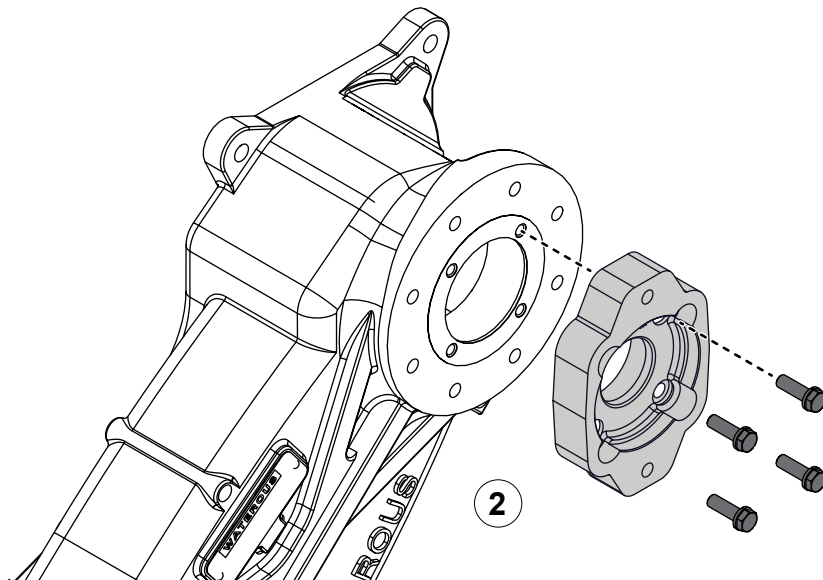
- 1 Install the bearing lock washer and nut. Refer to: **"Installing the Bearing Lock Washer and Nut" on page 87.**
- 2 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 3 Align the oil-seal housing and gasket, then use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.
- 4 Gently tap the driven shaft assembly to make sure that it is completely seated towards the pump side of the transmission case.
- 5 Determine the shim thickness required to install the oil-seal housing. Refer to: **"Determining the Shim Thickness" on page 88.**
- 6 Apply lubricant to the O-ring groove, then install the O-ring around the oil-seal housing.

## Installing the Upper Drive Shaft Assembly—CX Pump



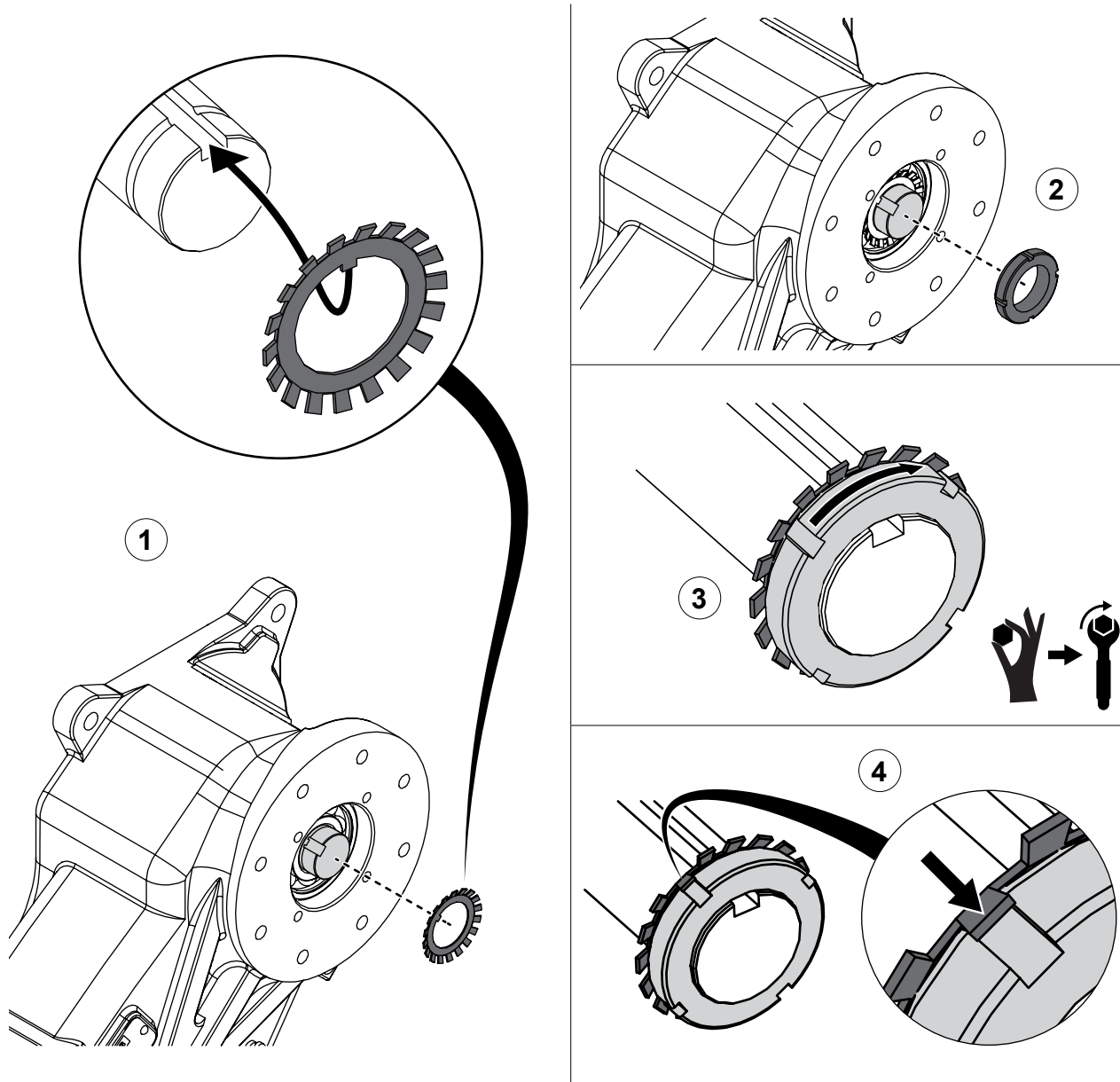
Use the illustrations and instructions to install the driven shaft and associated components.

- 1 Apply silicon sealant around the oil seal, then install it into the oil-seal housing.
- 2 Use the hardware that you removed earlier to secure the oil-seal housing to the transmission case.



31 ft-lb  
42 N·m

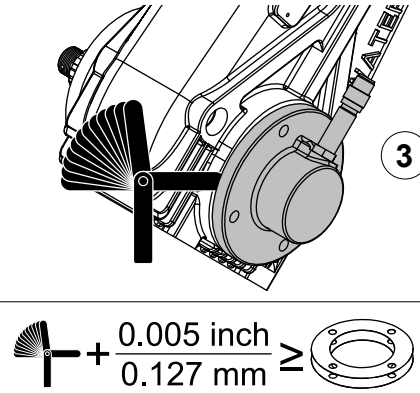
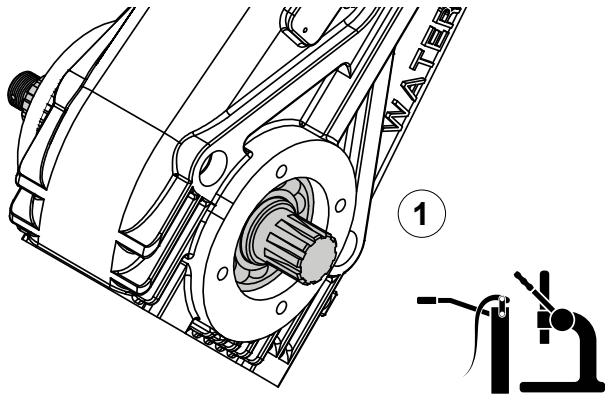
## Installing the Bearing Lock Washer and Nut



Use the illustrations and instructions to install the bearing lock washer and nut.

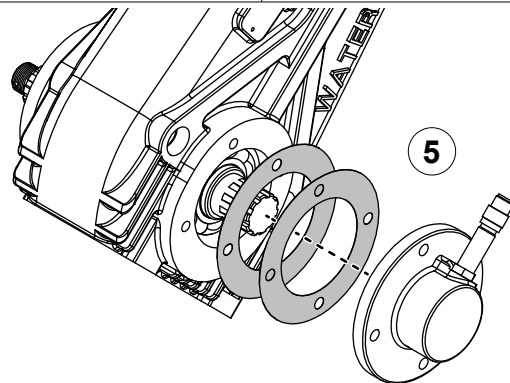
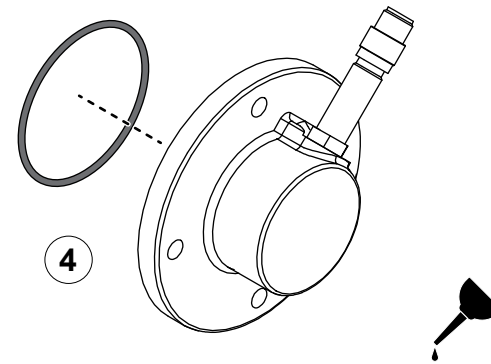
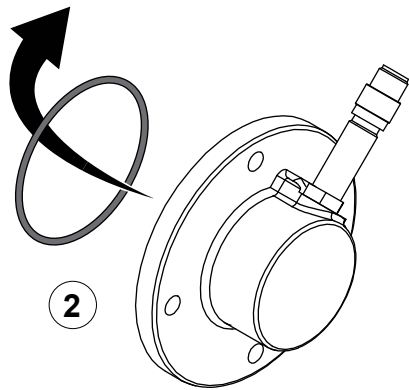
- 1 Install the bearing lock washer around the end of the driven shaft.  
*Note: Align the inner tab on the washer with the slot in the shaft.*
- 2 Thread the nut onto the shaft.
- 3 Finger-tighten the nut, then use a tool to add a quarter turn to the nut.
- 4 Align one of the washer's outer tabs to a slot on the nut, then bend the tab to lock it into position.

## Determining the Shim Thickness



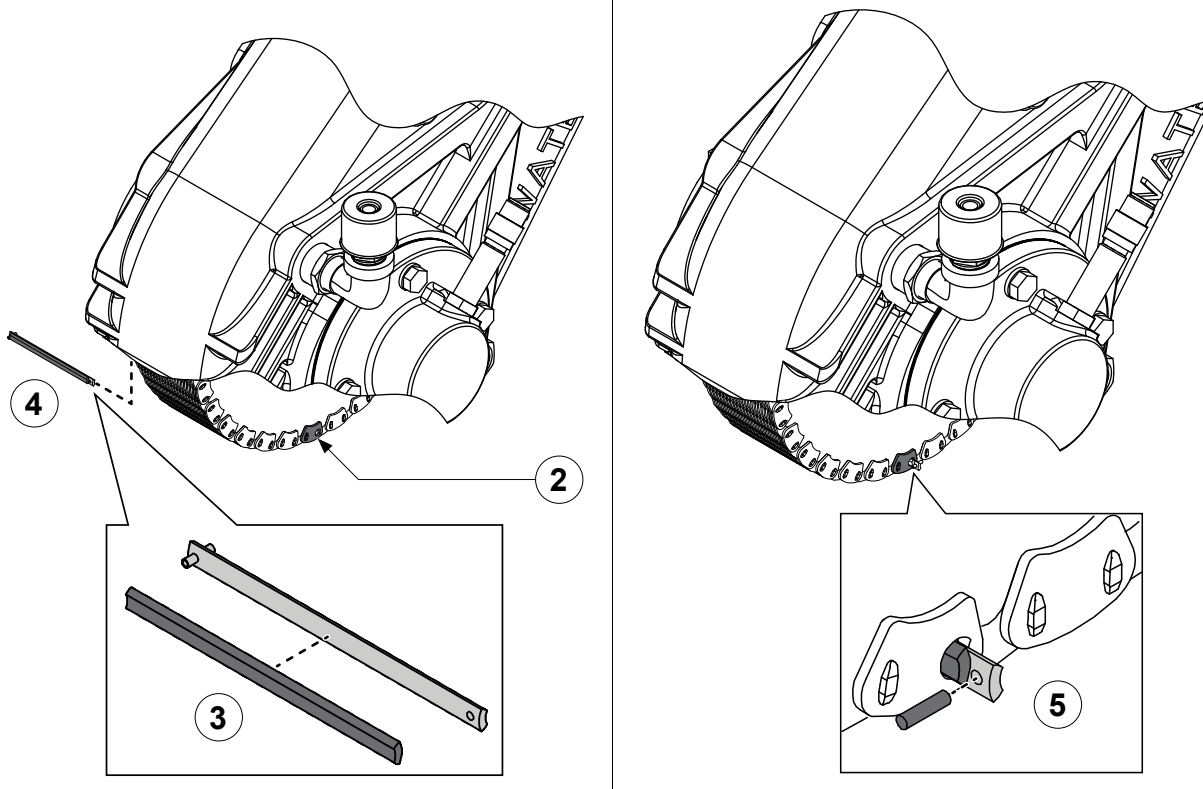
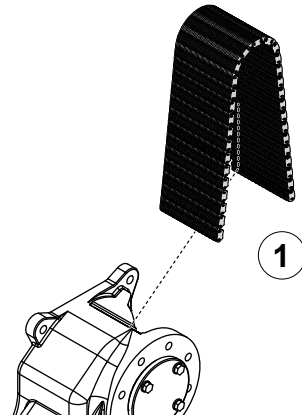
Use the illustrations and instructions to determine the shim thickness.

- 1 Make sure that the lower drive shaft is fully pressed into the transmission case.
- 2 Remove the O-ring from the tachometer housing.
- 3 Use a feeler gauge to determine the space between the transmission case and tachometer housing. Add 0.005 inch (0.127 mm) to the feeler gauge measurement.
- 4 Apply lubricant to the O-ring, then install it into the tachometer housing.
- 5 Arrange the shim configuration between the transmission case and tachometer housing.





## Installing the Chain



### All Models

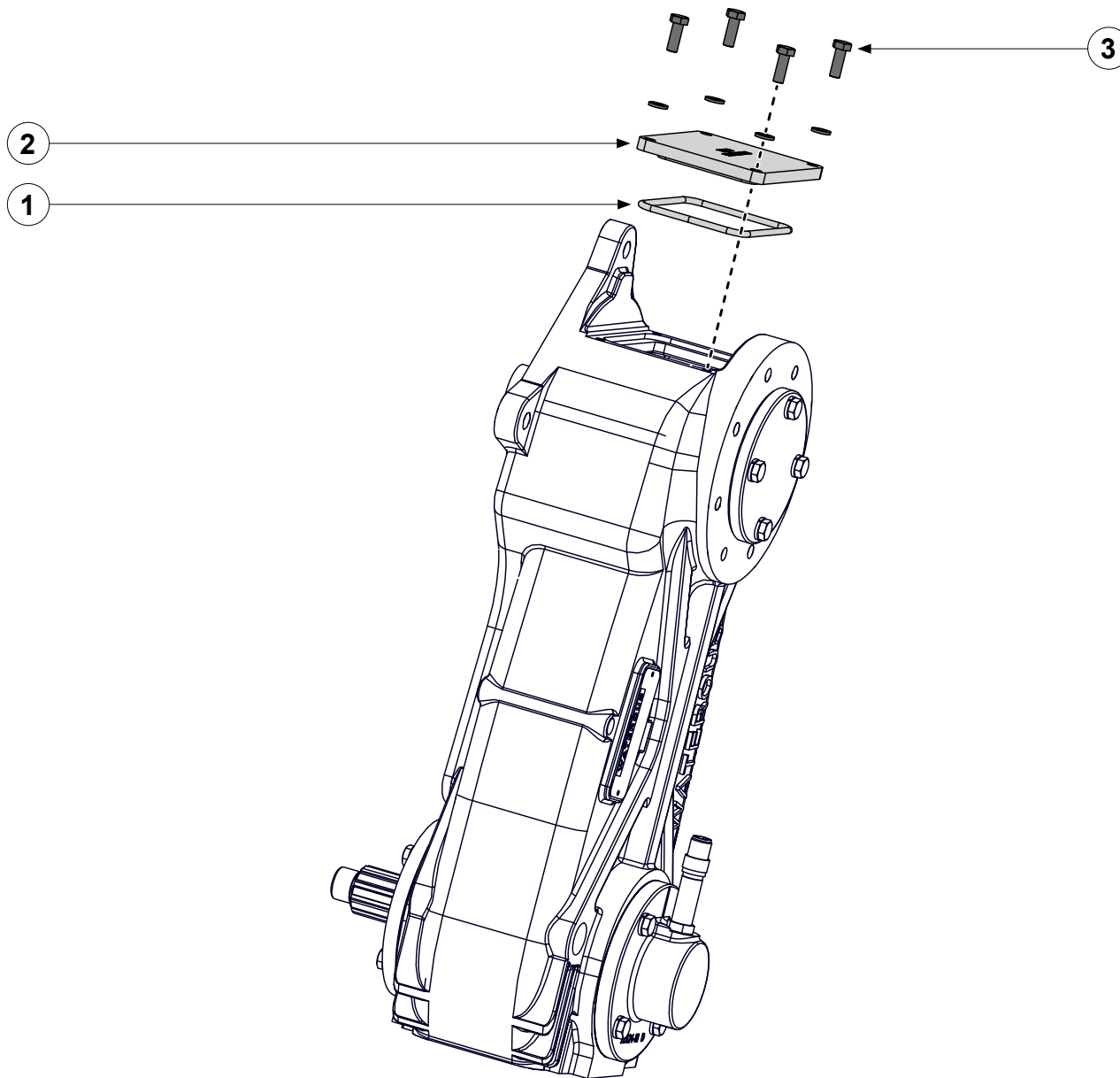
Use the illustrations and instructions to install and connect the drive chain.

- 1 Install the chain around the driven sprocket inside the transmission case.
- 2 Overlap the chain ends around the drive sprocket.
- 3 Position the connecting pin and rocker together and align them with the chain ends.
- 4 Push the connecting pin and rocker assembly through the drive chain ends.

**Note:** Depending on your application, the transmission case may have an access hole that allows you to install the connecting pin and rocker assembly.

- 5 Use the pin tool (part number 53402) to insert the removable pin. To fabricate the pin install/removal tool, refer to: **"Fabricating the Removable Pin Tool"** on page 17.

## Installing the Top Cover

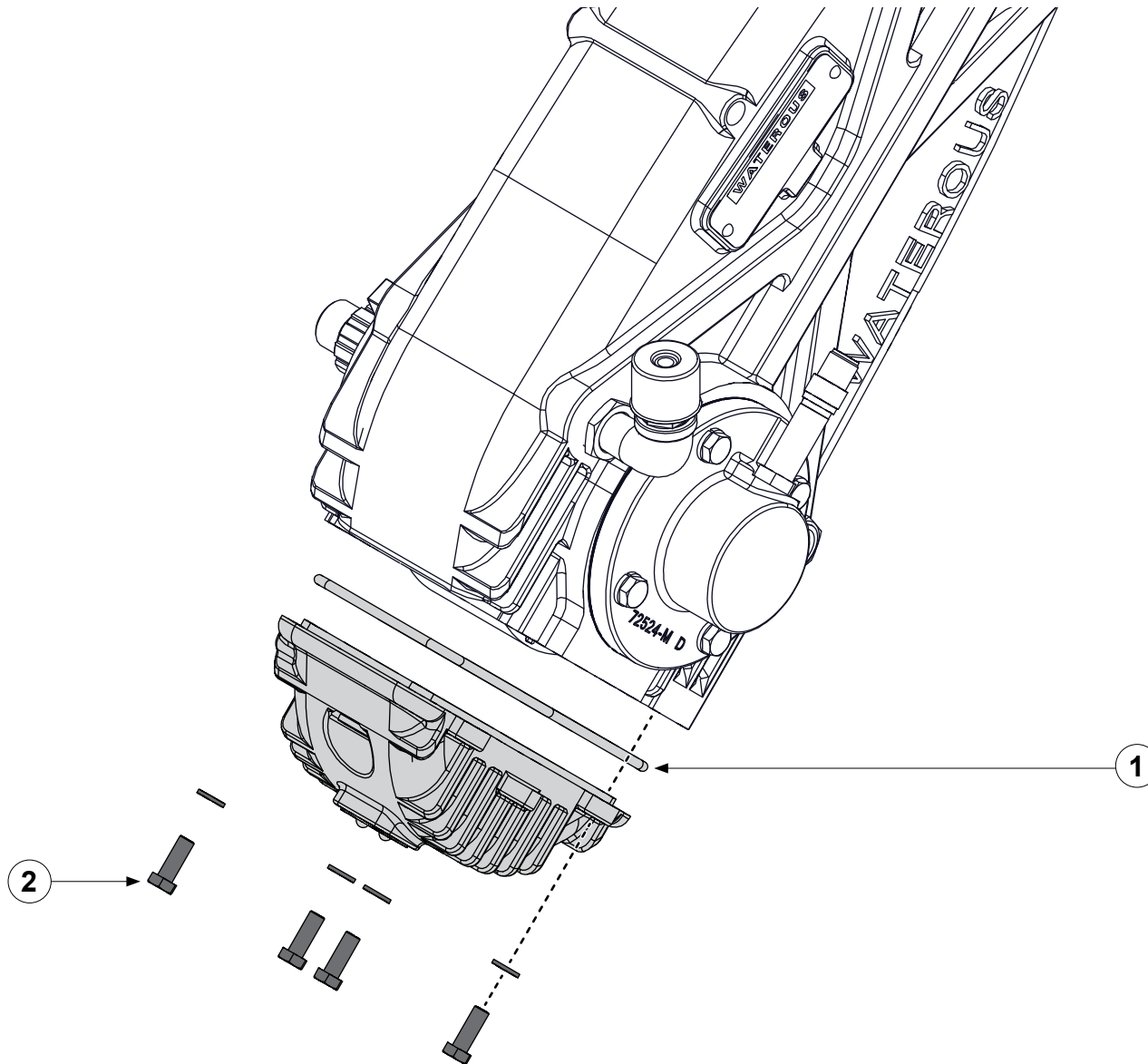


### All Models

Use the illustration and instructions to install the gasket and top plate of the transmission case.

- 1 Install the O-ring into the top cover.
- 2 Align the cover with the transmission.
- 3 Use the mounting hardware to secure the top cover to the transmission.

## Installing the Bottom Cover



### All Models

Use the illustration and instructions to install the gasket and bottom cover of the transmission case.

- 1 Align the gasket with the bottom cover.
- 2 Use the hardware that you removed earlier to secure the bottom cover to the housing.



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