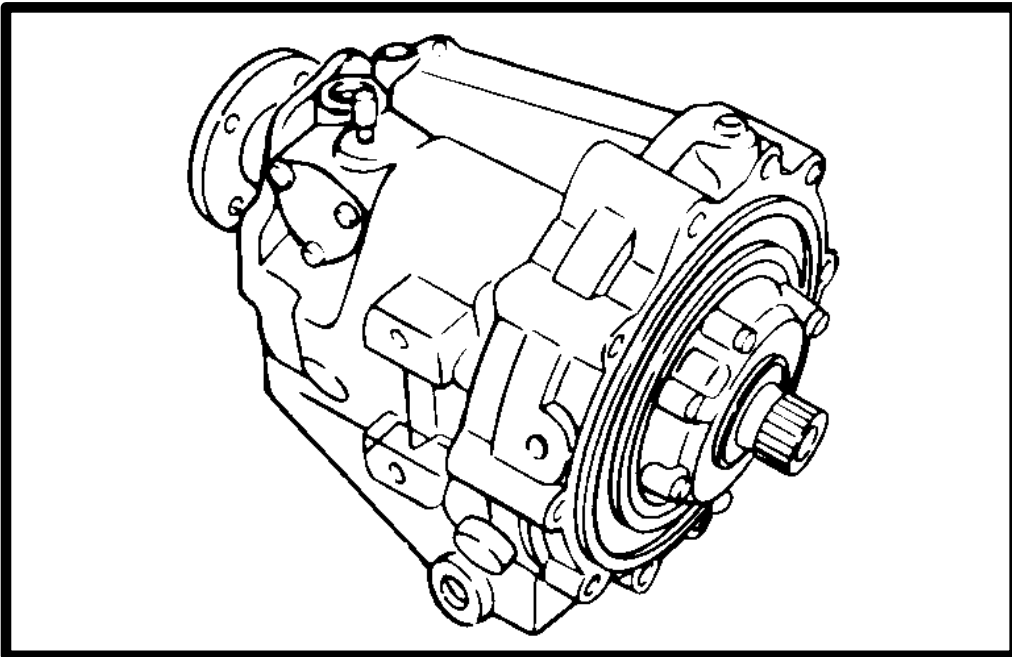


# DRIVES



**VELVET DRIVE IN-LINE  
TRANSMISSION**

**8**

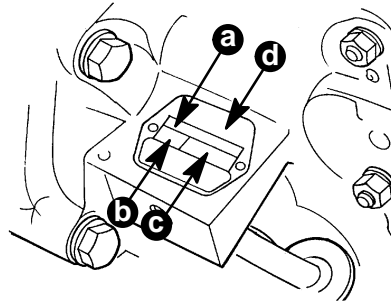
**A**

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# Velvet Drive In-Line (71C and 72C) Specifications

The transmission identification plate is located on the top left side of the transmission. Refer to charts following to determine engine and transmission combinations



72839

## Transmission Identification Plate

- a - Model Number
- b - Ratio (in Forward Gear)
- c - Serial Number
- d - Identification Plate Model Color Code

## Transmission Ratios

Ratio in Forward Gear (NOTE 1 & 2)	Identification Plate Color Code
1:1	Red
1:1	Green
1.5:1	
2.5:1	
2.91:1	Green

NOTE: 1. This ratio is shown on identification plate. Ratio may be rounded off in some cases.

NOTE 2: These transmissions are for LH (standard) rotation engines, and the propeller shaft rotation is LH (standard) when in forward gear.

## Torque Specifications

DESCRIPTION	Lb. Ft.	N-m
Drain Plug (Bushing)	25	34
Fluid Hose to Bushing	25	34
Pump Housing to Adapter	17-22	23-29
Rear Mounts to Transmission	45	61
Shift Lever to Valve	8-11	11-15
Transmission to Flywheel Housing	50	68
Neutral Start Switch	8-11	11-14

## Transmission Fluid Capacities

MODEL	U.S. QTS. (LITRES)
71C and 72C	1-1/2 (1.3) (See Note)
71C and 72C Reduction	2-1/2 (2.4) (See Note)

**NOTE:** Use dipstick to determine fluid exact level.

**Warm Fluid Level Check:** The transmission should be at operating temperature [190° F(90° C)] maximum to receive an accurate oil level reading.

**Cold Fluid Level Check:** To ease checking fluid level, the dipstick can be marked or scribed. First the procedure for warm fluid level must be performed, then allow boat to sit overnight. Remove and wipe clean the dipstick. Insert clean dipstick and mark the cold fluid level.

## Transmission Pressure Specifications

Engine RPM	Neutral Gear PSI (kPa)		Forward Gear PSI (kPa)		Reverse Gear PSI (kPa)	
	Min.	Max.	Min.	Max.	Min.	Max.
250			70 (483)		70 (483)	
600	115 (793)	135 (931)	115 (793)	140 (965)	120 (827)	140 (965)
2000			125 (862)	160 (1103)	125 (862)	160 (1103)
3000			135 (931)	180 (1241)		

## Transmission Output Shaft Rolling Torque

**NOTE:** Transmission is not installed on engine, no fluid in transmission. Use torque wrench and socket on coupling nut.

MODEL	RATIO	Lb. In.	N·m
71C	1:1	50 Max.	68 Max.
72C	1:1	50	70

## Transmission Fluid Specification

Transmission Type	ATF (Dexron III)	Mobil 424
71C Direct Drive	X	
71C Reduction Drive		X
71C V-Drive		X
72C Direct Drive	X	
72C Reduction Drive		X
72C V-Drive		X

**NOTE:** Transmissions (except reduction drive transmissions) supplied with Mobil 424 can be changed to ATF Dexron III, but transmission must be flushed and refilled at least twice (this includes lines and cooler).

# Important Information

## Shift Control and Cables

### CAUTION

Shift control and shift cable must position transmission shift lever exactly as stated in this manual, or transmission, as a result of improper shift lever positioning, will not be covered by Borg-Warner Warranty.

**IMPORTANT: Velvet Drive Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, or if shift lever is repositioned or changed in any manner.**

Remote control used must position transmission shift lever over the letter “F” embossed on transmission case when remote control is placed in forward gear position. Transmission failure will occur if transmission shift lever is positioned over the letter “R” and the wrong rotation propeller is used to propel boat forward.

Remote control also must provide a total shift cable travel (at transmission end) of at least 2-3/4 in. (70 mm). This is necessary to position transmission shift lever fully in the forward and reverse gear positions. Insufficient shift cable travel will cause transmission to slip and eventually fail.

## Engine

Engine rotation is indicated on engine specifications and serial number decal on flame arrestor cover. Engine rotation is described when observed from the rear of the engine (transmission end) looking forward (water pump end).

Installed angle of MIE inboard transmission and engine should not exceed a maximum of 18° of the water line.

## Transmission

Transmission gear ratio (in forward gear) is marked on transmission identification plate, which is located on the port (left) side of transmission. Transmission output shaft rotation and propeller rotation required is indicated on a decal on transmission case. Transmission rotation is described when viewed from the rear of transmission with transmission in forward gear selector position.

On MIE engines equipped with in-line transmissions having 1:1 or 3:1 gear ratios, transmission output shaft rotation is the same as engine rotation with transmission in forward gear. Engine rotation is LH (CCW), so a LH propeller is required.

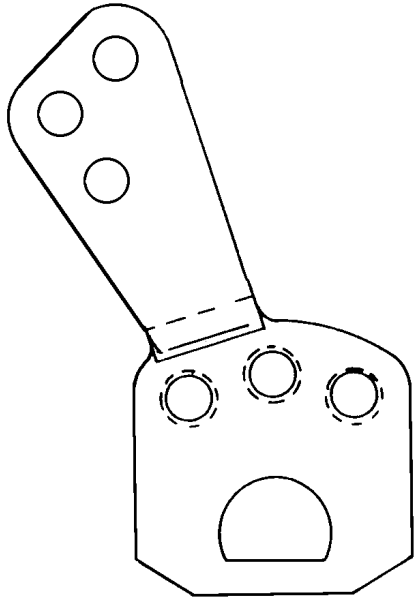
1. DO NOT start or crank engine without fluid in transmission.
2. Use only recommended fluid in transmission.
3. Except in an emergency, never shift transmission at engine speeds above 1000 RPM.
4. Free wheeling of one propeller (in a twin engine boat), at trolling speeds, will not cause damage to the transmission; however, boat operation above trolling speed should be avoided. Be sure proper fluid level exists before free wheeling propeller.
5. DO NOT paint shift lever poppet ball and spring. An accumulation of paint here will prevent proper action of the detent.
6. Always replace oil cooler and hoses after a transmission failure or prior to installing a new or rebuilt transmission. Metallic particles from a failure tend to collect in the cooler and hoses and will gradually flow back into the fluid system and damage transmission.
7. Always use specified oil cooler, hoses and fittings. Hoses must be at least 13/32 in. (10.5 mm) I.D. Oil cooler, hoses and fittings must be sufficient size to maintain transmission fluid (in sump) at 140-190°F (60-88°C).

## Propeller

Propeller rotation is described when observed from the rear of the boat (stern) looking forward (bow end). The term “left-hand” (LH) refers to rotation in the counterclockwise (CCW) direction. The term “right-hand” (RH) refers to rotation in the clockwise (CW) direction. A LH propeller will move the boat forward when rotated counterclockwise. A RH propeller will move the boat forward when rotated clockwise. Propeller rotation is not necessarily the same as engine rotation.

## Transmission Shift Lever

The lever has three holes as illustrated following.



71304

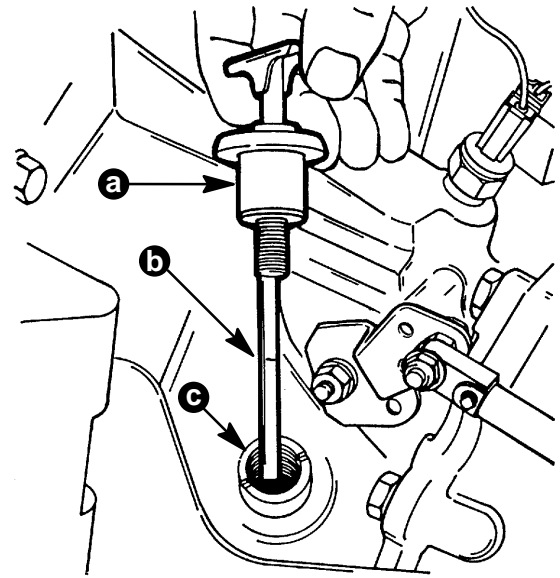
## Shift Cable Adjustment

Refer to Section 2C - "MIE Models - Borg-Warner Transmissions."

## Checking Transmission Fluid Level

**IMPORTANT:** Use only specified transmission fluid (see "Specifications").

**IMPORTANT:** To accurately check fluid level, engine must be run at 1500 RPM for 2 minutes immediately prior to checking level.



72526

- a - Dipstick
- b - Full Mark
- c - Dipstick Tube

1. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

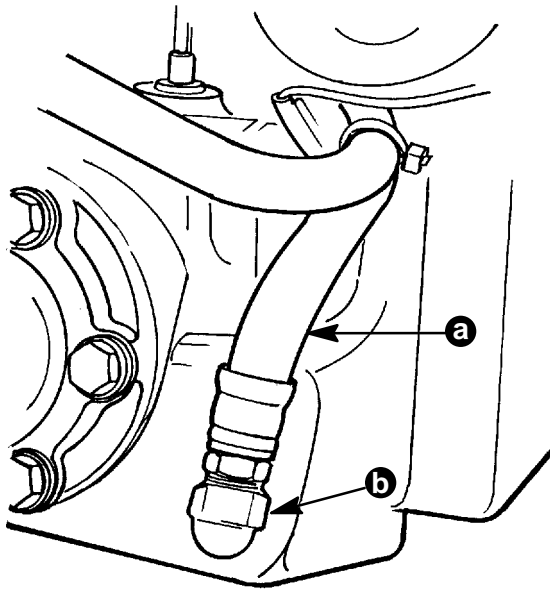
**IMPORTANT:** Be sure to push dipstick all the way down into dipstick tube when checking fluid level.

2. Stop engine and check fluid level. Add transmission fluid, if necessary, to bring level up to full mark on dipstick.
3. Reinstall dipstick. Be sure to tighten T-handle securely. DO NOT over tighten.
4. If transmission fluid level was extremely low, carefully check transmission, fluid cooler and hoses for leaks.

# Changing Transmission Fluid

## Draining Transmission

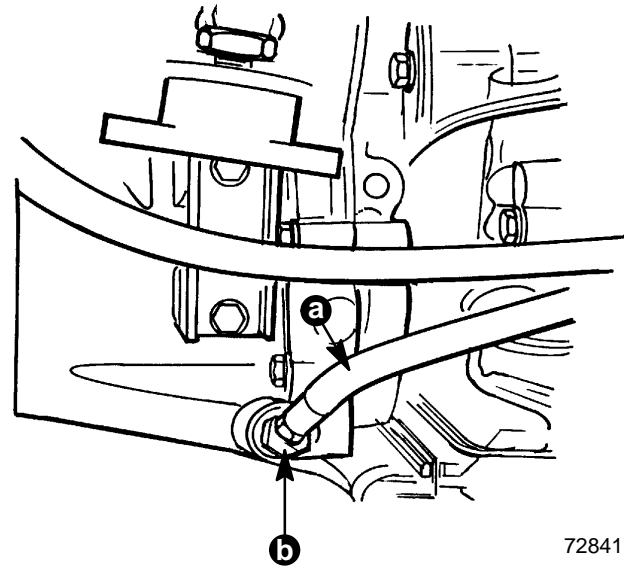
1. Clean area around cooler hose shown and proceed as follows:
  - a. Disconnect hose from elbow fitting.
  - b. Remove elbow fitting from bushing.
  - c. Drain oil from transmission, cooler, and cooler hoses into a suitable container.



72840

## Transmission With 1:1 Ratio

- a - Hose
- b - Elbow Fitting

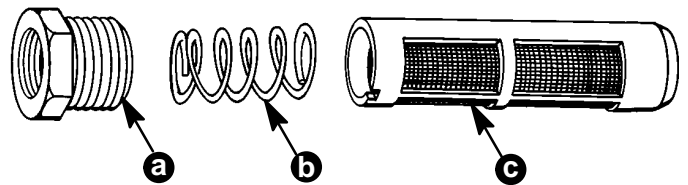


72841

## Transmission with Reduction Ratios

- a - Hose
- b - Bushing

2. Remove bushing, spring and strainer tube from transmission case. Allow transmission to drain completely.
3. Clean strainer tube in suitable solvent.



71307

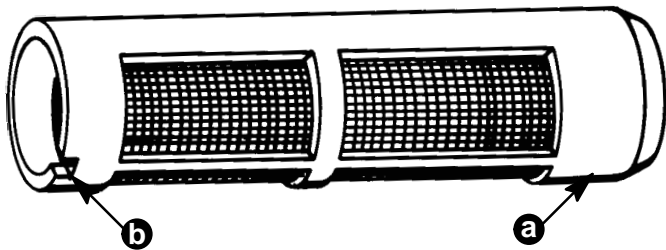
- a - Bushing
- b - Spring
- c - Plastic Strainer Tube

4. Check oil for the following foreign matter:
  - **Metal Particles** - A few small particles are normal. Larger metal chips are an early sign of transmission failure which may mean transmission should be disassembled and inspected for internal damage.
  - **Rubber Particles** - Indication of cooler hose wear. Hoses should be inspected for cracks or fraying. Replace damaged hoses.

**CAUTION**

**Avoid severe transmission damage or possible failure of transmission. Strainer must be properly installed as follows.**

5. Install plastic strainer tube with the notch DOWN and OUT toward the side of the case.



71306

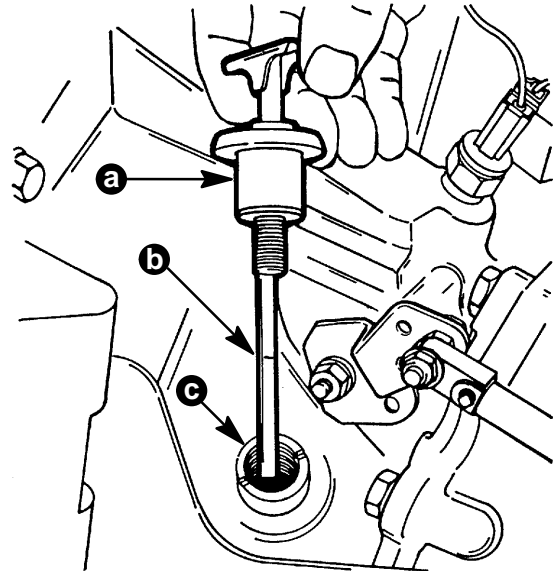
- a - Plastic Strainer Tube
- b - Notch

6. Install spring.
7. Coat bushing threads with Quicksilver Perfect Seal. Install and torque bushing to 25 lb. ft. (34 N·m).
8. Coat elbow fitting threads with Quicksilver Perfect Seal and install in bushing. Tighten securely.
9. Reconnect hose and tighten securely.

## Filling Transmission

**IMPORTANT: Use only specified transmission fluid (see "Specifications").**

1. Remove dipstick. Fill transmission with fluid, through dipstick hole, to bring up to full mark.



72526

- a - Dipstick
- b - Full Mark
- c - Dipstick Tube

**IMPORTANT: To accurately check fluid level, run engine at 1500 RPM for 2 minutes immediately prior to checking level.**

2. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

**NOTE:** Be sure to push dipstick all the way down into dipstick tube when checking fluid level.

3. Stop engine and quickly check fluid level. Add transmission fluid, if necessary, to bring level up to full mark on dipstick.
4. Reinstall dipstick. Be sure to tighten T-handle securely.



# Removal and Installation

## NOTICE

The following procedure describes removal of transmission without removing engine. If engine must be removed, refer to Section 2 (see "Table of Contents").

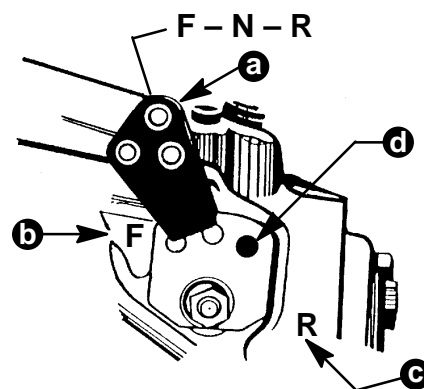
1. Drain transmission fluid.
2. Disconnect fluid cooler hoses.
3. Disconnect shift cable.
4. Disconnect wires from neutral start safety switch.
5. Disconnect TAN/BLUE wire from fluid temperature switch.
6. Disconnect propeller shaft coupling.
7. Remove four rear mount (to engine bed) bolts.
8. Support rear part of engine with either a hoist or by using wooden blocks under flywheel housing.
9. Remove two center transmission-to-flywheel housing attaching bolts and install two long studs.

**IMPORTANT: These two long studs will help support weight of transmission during removal and installation.**

10. Remove remaining transmission attaching bolts.
11. Pull transmission straight back and off engine.
12. Before installing transmission, check transmission pump indexing for correct rotation. Refer to "Pump Indexing."
13. Check transmission output shaft rolling torque. See "Specifications."
14. Apply Quicksilver Engine Coupler Spline Grease to transmission input shaft splines and engine drive plate splines.
15. If removed, install rear engine mounting brackets (to transmission) as outlined in Section 3 (see "Table of Contents"). Torque to 45 lb. ft. (61 N·m).
16. Align transmission splines with drive plate splines.
17. Slide transmission into place and secure with bolts.
18. Remove two long studs (installed in Step 9) and install remaining two bolts. Torque all bolts to 50 lb. ft. (68 N·m).
19. Relieve hoist tension and fasten rear engine mounts to engine bed. Tighten bolts securely.

20. Connect wires to neutral start safety switch.
21. Connect tan/blue wire to fluid temperature switch.
22. Connect fluid cooler hoses to transmission.
23. Connect and adjust shift cable(s) as outlined in Section 2C - "MIE Models - Velvet Drive Transmissions."

**IMPORTANT: Velvet Drive Transmission Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, if the shift lever is repositioned or changed in any manner, or if remote control and shift cable do not position shift lever exactly as shown.**



72601

- a - Transmission Shift Lever
  - b - Shift Lever Must Be Over This Letter when Propelling Boat FORWARD
  - c - Shift Lever Must Be Over This Letter when Propelling Boat in REVERSE
  - d - Poppet Ball Must Be Centered in Detent Hole for Each F-N-R Position (Forward Gear Shown)
24. Refer to Section 2C - "MIE Models - Velvet Drive Transmissions" and check engine final alignment as outlined.
  25. After engine has been properly aligned, connect propeller shaft coupler to transmission output flange. Attach couplers together with bolts, lock-washers and nuts. Torque to 50 lb. ft. (68 N·m).
  26. Refill transmission with specified fluid. Refer to "Filling Transmission."
  27. Check for leaks and check fluid level after first engine start-up.

## Pump Indexing

Pump must be correctly indexed to correspond with engine rotation. If pump is not indexed correctly, pump will not create fluid pressure allowing the transmission to shift. Pump housing has two arrows, each pointing in a different direction. Pump must be positioned so that the arrow (pointing in the direction that input shaft and pump will be turned by engine) is at the top of transmission.

### CAUTION

Position pump housing with cast arrow at top pointing in the same direction as engine rotation.

**IMPORTANT:** Some transmissions have letters "RH" and "LH" on pump housing. Letters **DO NOT** indicate shaft rotation.

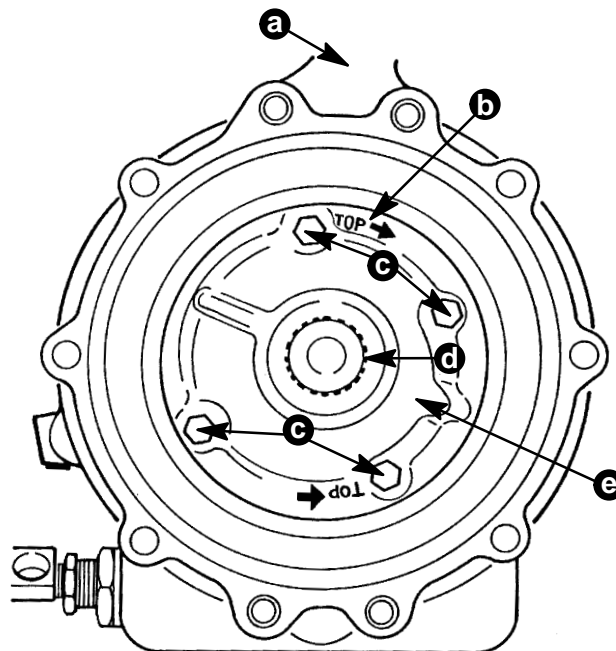
If pump must be indexed, proceed as follows:

1. Remove four pump attaching bolts.
2. Loosen the pump housing. A soft tip mallet may be used to tap the fluid passage boss. Do not strike the bolt bosses.

**IMPORTANT:** Do not remove the pump from the shaft unless a seal protector is used to prevent the shaft splines from cutting the pump seal. Care must be taken to ensure that seal, gasket, seal and bolt bosses are kept in good condition to prevent leaks in those critical areas.

3. Make sure that pump gasket is not sticking to housing (to prevent gasket from tearing or folding) when rotating pump.
4. Rotate pump until arrow indicating the proper direction of pump rotation is near the top of transmission.

5. Reinstall four pump-to-adaptor attaching bolts and torque to 204-264 lb. in. (23-29 N·m).



72842

### MIE LH (Standard) Rotation Engine

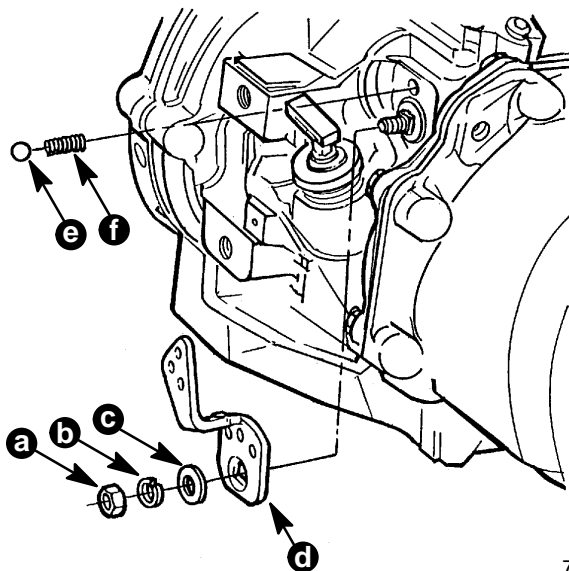
- a - Top Of Transmission
- b - Word "Top" and Cast Arrow
- c - Pump Attaching Bolts
- d - Input Shaft
- e - Pump Assembly

## Shift Lever Installation

**IMPORTANT:** Borg-Warner Warranty is jeopardized if the shift lever poppet spring and/or ball is permanently removed, or if the shift lever is changed in any manner, or repositioned, or if the linkage between the remote control and the transmission shift lever does not have sufficient travel in both directions.

Shift lever and related parts must be assembled as shown.

1. Lubricate poppet ball, spring, and holes in shift lever with Quicksilver 2-4-C Marine Lubricant.
2. Install poppet spring and ball. Retain ball by placing shift lever on shaft.
3. Install flat washer, lockwasher and nut on shaft.
4. Torque nut to 96-132 lb. in. (11-15 N·m).



72844

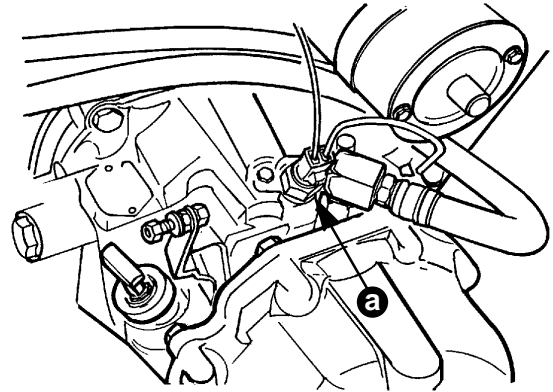
### Typical Shift Lever

- a - Nut
- b - Lockwasher
- c - Flat Washer
- d - Shift Lever
- e - Poppet Ball
- f - Poppet Spring

5. After installation, move shift lever through forward, neutral and reverse positions. No more than finger-tip effort should be required. If valve binds, cause for binding must be found and corrected.

## Pressure Test

1. Install pressure gauge.



72845

a - Main Line Pressure Tap - Remove Temperature Switch

2. With boat in water, start engine and run until normal operating temperature is reached.
3. Refer to "Specifications" (see "Table of Contents") for pressure readings.

## Transmission Repair

Mercury Marine does not stock or sell replacement parts for the in-line transmission. Velvet Drive has a network of distributors throughout the world to service their product. These distributors, in turn, have a dealer network to service the transmissions. Also, service manuals (for each transmission) can be obtained from .

**IMPORTANT:** Refer to "Special Replacement Part Information" before working on transmission.

For the location of your closest distributor or service literature contact:

Velvet Drive Transmissions  
Division Of Regal Beloit  
Theodore Rice Boulevard  
Industrial Park  
New Bedford, MA 02745  
Phone: (508) 995-2616

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