mercruiser STERN DRIVES & INBOARDS

service bulletin

TO: SERVICE MANAGER ☐ TECHNICIANS ☐
PARTS MANAGER ☐

No. 87-16

REVISED
11-11-87

Bravo One Power Packages MCM 7.4L Bravo One MCM 454 Magnum (Bravo One)

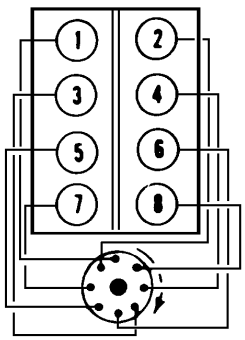
Tune-Up Specifications

Model	7.4L Bravo One	454 Magnum Bravo One
Horsepower (Kilowatts)	330 (246)	365 (272)
Displacement	454 CID (7.4 litres)	
Engine Type and Number of Cylinders	V-8	
Bore	4.25” (108mm)	
Stroke	4.00” (101.6mm)	
Compression Ratio	8.5:1	8.6:1
Compression Pressure	150 PSI (1035 kPa)	
Ignition	Thunderbolt IV	
Spark Plug Type	AC-MR43T or Champion RV8C	
Spark Plug Gap	.035” (.9mm)	
Timing at Idle RPM	8° BTDC	
Maximum RPM at Wide-Open-Throttle	4200–4600	4600–5000
Idle RPM in Forward Gear	650–700	
Firing Order	1-8-4-3-6-5-7-2	

Model	7.4L Bravo One	454 Magnum Bravo One
Fuel Required	86 Octane Minimum (Average Octane Rating)	
Fuel Pump Pressure	3 – 7 PSI	
Electrical System	12-Volt Negative Ground	
Alternator Rating	55 Amperes	
Recommended Battery Rating	Min. 450 Amps Cold Cranking Amperage	
Crankcase Oil Capacity with New Filter*	7 Qts. (6.6 Litres)	
Oil Pressure at 2000 RPM	30 – 70 PSI (207 – 483 kPa)	
Valve Lash	1 Turn Down From Zero Lash	3/4 Turn Down From Zero Lash
Thermostat	143° (62° C)	
Cooling System Capacity	20 Qts. (18.9 Litres)	
*Stern Drive Unit Oil Capacity (Approx.)	2 Qts. (1.95 Liters)	

NOTE 1: *Early engines: 7 Qts. (6.6 Litres)*
Later engines: 8 Qts. (7.5 Litres)

* Approximately,
ALWAYS use dipstick to determine exact quantity of oil required.



Firing Order
1-8-4-3-6-5-7-2

Figure 1. L.H. Rotation

Electrical Specifications

IGNITION SPECIFICATIONS

Spark Plug Type Spark Plug Gap Timing	Refer to "Tune-Up Specifications"
Coil	Part No. 392-7803A4
Coil Primary Resistance (Ohms) Minimum	.60
Coil Primary Resistance (Ohms) Maximum	.80
Coil Secondary Resistance (Ohms)	9.400 – 11,700

STARTER MOTOR SPECIFICATIONS

Identification Number	No Load Test					Brush Spring Tension
	Volts	Min. Amps	Max. Amps	Min. RPM	Max. RPM	
50-99418A1 (Delco-Remy) 1998314	10.6	70	120	5400	10,800	56 – 105 oz. (1588 – 2976.g)

Carburetor Specifications

ALL MEASUREMENTS ARE ± 1/64" (0.4mm)

Model	7.4 Litre Bravo One	454 Magnum Bravo One
Make (Model)	Rochester (4 MV)	
Part No. Mercury/Rochester	1347-8291/ 17080563	1342-7498/ 17059280
Float Level	15/64" (5.9mm)	
Pump Rod Hole Location	Inner	
Accelerator Pump (Note 1)	23/64" (9.1mm)	
Air Valve Dash Pot (Air Valve Rod)	.025" (.64mm)	
Vacuum Break	.080" [5/64" (2.0mm)]	
Air Valve Spring Wind Up	1/2 Turn 80 – 95 Gr.	5/8 Turn 70 – 90 Gr.
Choke Coil Rod (Note 2)	Top of Rod Even with Bottom of Hole	
Float Weight (Max.)	9.88 Gr.	

Model	7.4 Litre Bravo One	454 Magnum Bravo One
Primary Jet	.069"	.068"
Metering Rod (Primary)	.042"	.041"
Metering Rod (Secondary)	DB	DA
Idle Mixture Screw, Preliminary Setting	2 – 3 turns	

NOTE 1: *All measurements are ± 1/64" (.4mm).*

NOTE 2: *Accelerator pump measurement taken from flame arrestor surface to pump stem with throttle plate closed.*

NOTE 3: *Choke valve must be closed, choke rod in bottom of choke lever slot, and choke coil rod pushed down to end of travel.*

UNIT OF MEASUREMENT
in. (mm)

Internal Engine Specifications

CYLINDER BORE:

Model			7.4 Litre Bravo One	545 Magnum Bravo One
Diameter			4.2451 – 4.2525 (107.8255 – 108.0135mm)	
Out of Round	Production		.001” (.025) Max.	
	Service		.002” (.05) Max.	
Taper	Pro-duction	Thrust side	.005” (.0127) Max.	
		Relief Side	.001” (.025) Max.	
	Service		.001” (.025) Max.	

PISTON:

Clearance	Produc-tion	.0014–.0024 (.0356–.0610)	.0045–.0065 (.1143–.1651)
	Service	.0035 (.09) Max.	.0075 (.15) Max.

PISTON RING: (1) HI PRODUCTION LIMIT

Compression	Groove Side Clearance	Produc-tion	Top	.0017” – .0032” (.04 – .08)
			2nd	.0017” – .0032” (.04 – .08)
		Service		(1)+.001” (.025)
	Gap	Produc-tion	Top	.010” – .020” (.25 – .5)
			2nd	.010” – .020” (.25 – .5)
		Service		(1) + .010” (.25)
Oil	Groove Side Clearance	Production		.005” – .0065” (.13 – .15)
		Service		(1) + .001” (.02)
	Gap	Produc-tion	.015”–.055” (.35–1.35)	.020”–.035” (.5–.85)
		Service	(1) + .010” (.25)	

PISTON PIN:

Diameter		.9895” – .9898” (25.1333 – 25.1409)
Clearance	Production	.00025” – .00035” (.00635 – .00889)
	Service	.001” (.02) Max.
Fit in Rod		.0008” – .0016” (.0203 – .0406) Interference

CRANKSHAFT:

Main Journal	Diameter	No. 1	2.7485” – 2.7494” (69.8119 – 69 – 8348)
		No. 2, 3, 4	2.7481 ” – 2.7490” (69.8017 – 69.8246)
		No. 5	2.7478” – 2.7488” (69.7941 – 69.8195)
	Taper	Production	.0002” (.0051) Max.
		Service	.001” (.025) Max.
	Out of Round	Production	.0002” (.0051) Max.
		Service	.001” (.025) Max.
Main Bearing Clearance	Production	No. 1	.0013” – .0025” (.0330 – .0635)
		No. 2, 3, 4	
		No. 5	.0024” – .0040” (.0610 – .1016)
	Service	No. 1	.001” – .0015” (.03)
		No. 2, 3, 4	.001” – .0025” (.03 – .06)
		No. 5	.0025” – .0035” (.07 – .08)
Crankshaft End Play			.006” – .010” (.15 – .25)
Connecting Rod Journal	Diameter		2.1985” – 2.1995” (55.8419 – 55.8673)
	Taper	Production	.0005” (.0127) Max.
		Service	.001” (.025) Max.
	Out of Round	Production	.0005” (.0127) Max.
		Service	.001” (.025) Max.
Rod Bearing Clearance		Production	.0009” – .0025” (.0229 – .0635)
		Service	.003” (.07) Max.
Rod Side Clearance			.013” – .023” (.35 – .55)
Crankshaft Runout			.0015” (.0381) Max.

CAMSHAFT AND DRIVE:

Model		7.4 Litre Bravo One	454 Magnum Bravo One
Lobe Lift ± .002" (.051mm)	Intake	.271 (6.883)	.300 (7.62)
	Exhaust	.282 (7.163)	.300 (7.62)
Journal Diameter		1.9482" – 1.9492" (49.484 – 49.510)	
Journal Out-of-Round		.001" (.025) Max.	
Camshaft Run-Out		.002" (.051) Max.	
Timing Chain Deflection		3/8" (10mm) From Taut Position 3/4" (19mm)Total	

VALVE SYSTEM:

Lifter Type			Hydraulic	
Rocker Arm Ratio			1.70:1	
Valve Lash (Intake & Exhaust)			1 Turn Down from Zero Lash	3/4 Turn Down from Zero Lash
Face Angle (Intake & Exhaust)			45°	
Seat Angle (Intake & Exhaust)			46°	
Seat Runout (Intake & Exhaust)			.002" (.051) Max.	
Seat Width		Intake	1/32" – 1/16" (.79 – 1.59)	
		Exhaust	1/16" – 3/32" (1.59 – 2.38)	
Stem Clearance	Production	Intake	.001" – .0027" (.0254 – .0686)	
		Exhaust	.0012" – .0029" (.0305 – .0737)	
	Service	Intake	.0037" (.0940)	
		Exhaust	.0049" (.1245)	

MCM 7.4L BRAVO ONE			
Valve Spring	Free Length		2.12" (53.8)
	Pressure Lbs. @ In. (NOTE 1)	Closed @ 1.875 (47.6)	74 – 86 Lbs. Ft. (100 – 116 N.m)
		Open @ 1.396 (35.5)	288 – 12 Lbs. Ft. (390 – 423 N.m)
	Installed Height		1.875" (47.6)
Damper	Free Length Approximate No. of Coils		1.86" (47.24)
			4

NOTE 1: *Test spring pressure with damper removed.*

MCM 454 MAGNUM BRAVO ONE			
Valve Spring	Free Length		Outer – 2.38" (60.5) Inner – 2.23" (56.6)
	Pressure (NOTE 1)	Closed @ 1.875 (47.6)	60 – 70 Lbs. Ft. (81 – 95 N.m)
		Open @ 1.365 (34.7)	220 – 230 Lbs. Ft. (298 – 312 N.m)
	Installed Height		1.875 (47.6)

NOTE 1*: Test spring pressure inner & outer spring assembled.*

CYLINDER HEAD:

Gasket Surface Flatness	003" (07) in. 6 (152) .007" (.15) Overall Maximum

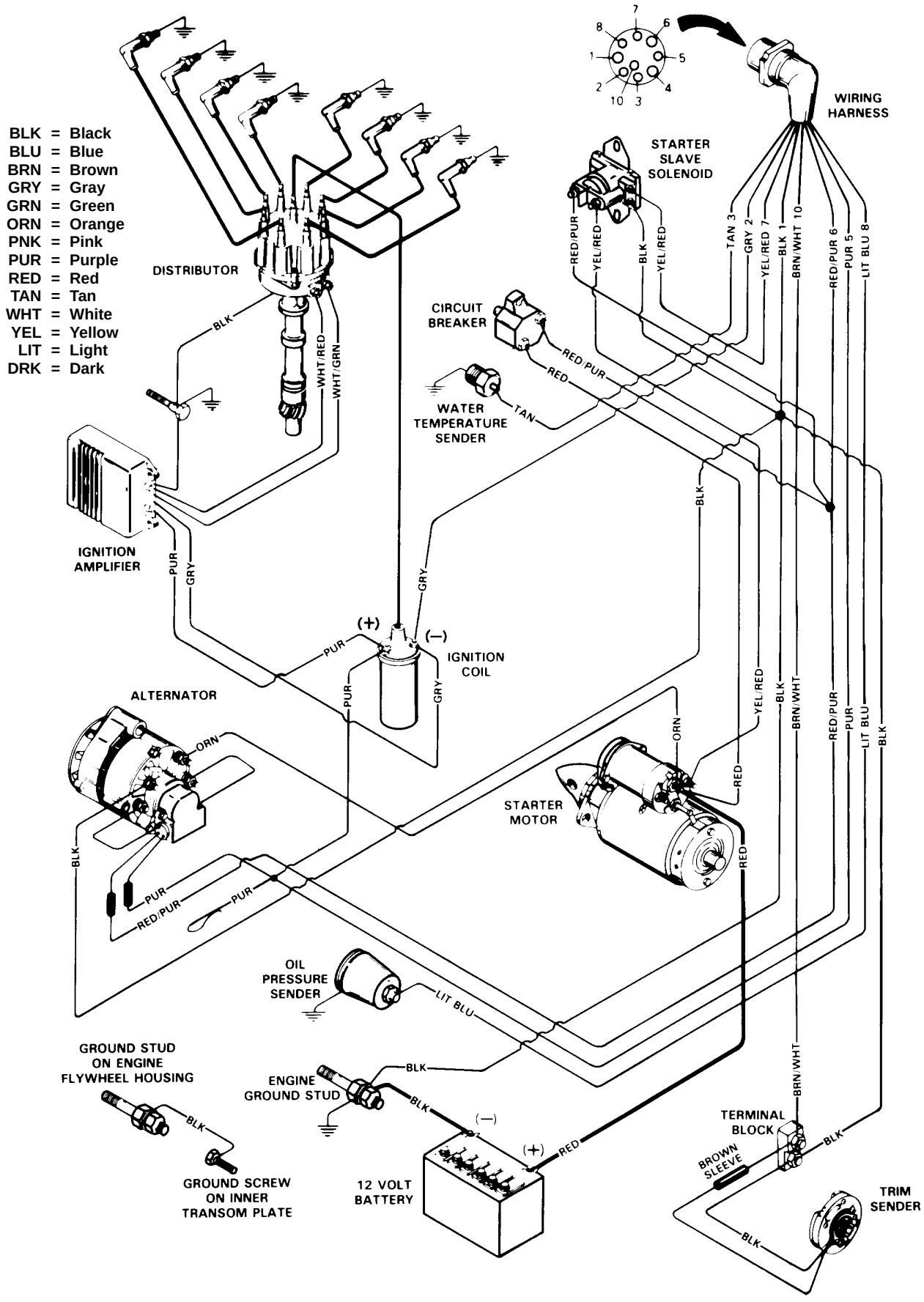
FLYWHEEL:

Runout	.008" (.203) Max.

Torque Specifications

Camshaft Sprocket	25 Lb. Ft. (34 N.m)
Conn. Rod Cap	65 Lb. Ft. (88 N.m)
Crankcase Front Cover	80 Lb. Ft. (9 N.m)
Cylinder Head	80 Lb. Ft. (109 N.m)
Distributor Clamp	25 Lb. Ft. (34 N.m)
Exhaust ManifoId (Bolts)	35 Lb. Ft. (48 N.m)
Exhaust Manifold (Nuts)	25 Lb. Ft. (34 N.m)
Flywheel	65 Lb. Ft. (88 N.m)
Coupler	35 Lb. Ft. (48 N.m)
Flywheel Housing	30 Lb. Ft. (41 N.m)
Intake Manifold	30 Lb. Ft. (41 N.m)
Main Bearing Cap	110 Lb. Ft. (149 N.m)
Oil Filter	25 Lb. Ft. (34 N.m)
Oil Filter By-Pass Valve	80 Lb. In. (9 N.m)
Oil Pan to Crankcase (5/16-18)	165 Lb. In. (19 N.m)
Oil Pan to Crankcase (1/4-20)	80 Lb. In. (9 N.m)
Oil Pan Drain Plug	20 Lb. Ft. (27 N.m)
Oil Pump	65 Lb. Ft. (88 N.m)
Oil Pump Cover	80 Lb. In. (9 N.m)
Rocker Arm Cover	50 Lb. In. (5.5 N.m)
Spark Plug	180 Lb. In. (20 N.m)
Torsional Damper	85 Lb. Ft. (115 N.m)
Water Pump	30 Lb. Ft. (41 N.m)

Wiring Diagram (Engine)

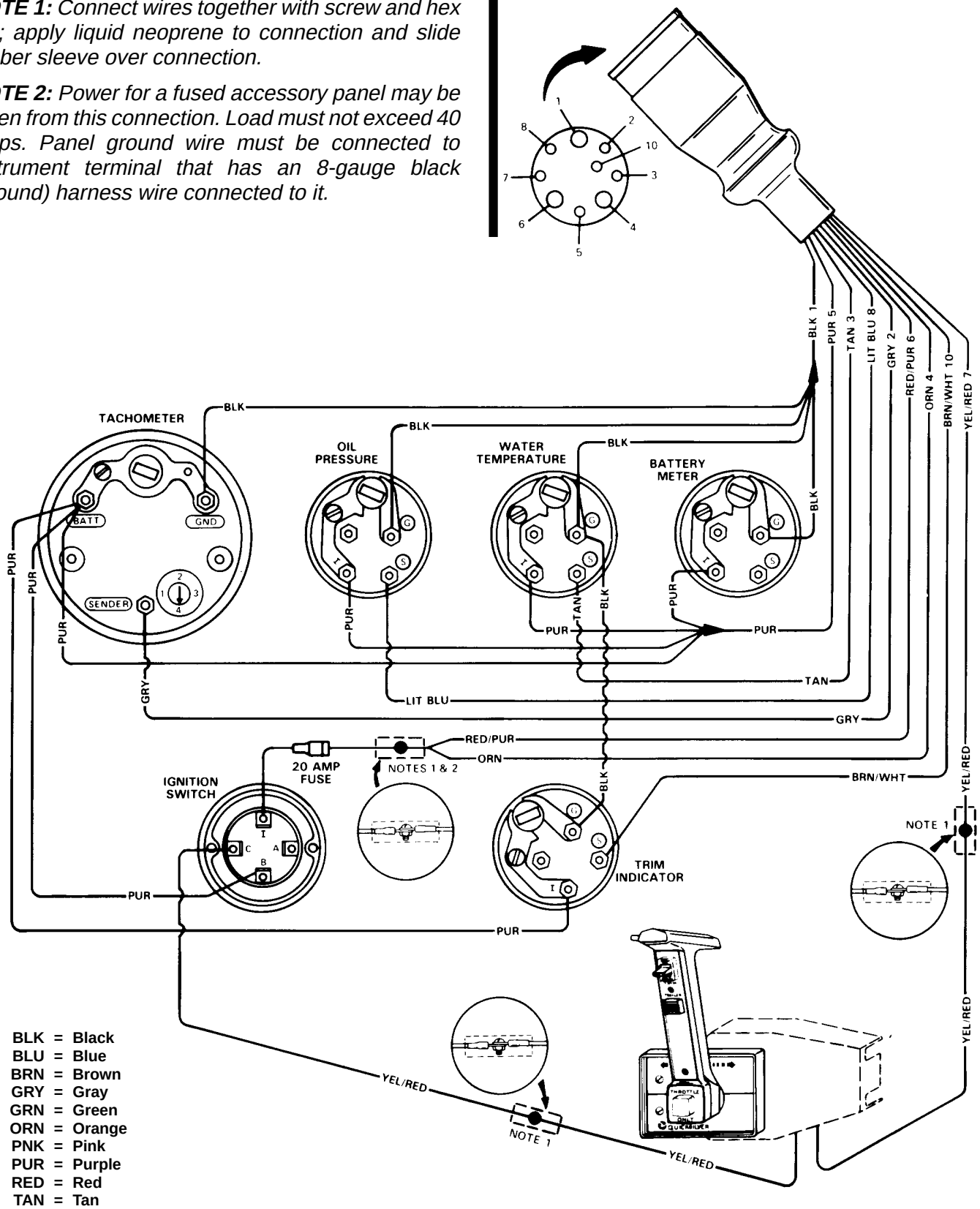


1058-H

Wiring Diagram (Quicksilver Instrumentation)

NOTE 1: *Connect wires together with screw and hex nut; apply liquid neoprene to connection and slide rubber sleeve over connection.*

NOTE 2: *Power for a fused accessory panel may be taken from this connection. Load must not exceed 40 amps. Panel ground wire must be connected to instrument terminal that has an 8-gauge black (ground) harness wire connected to it.*

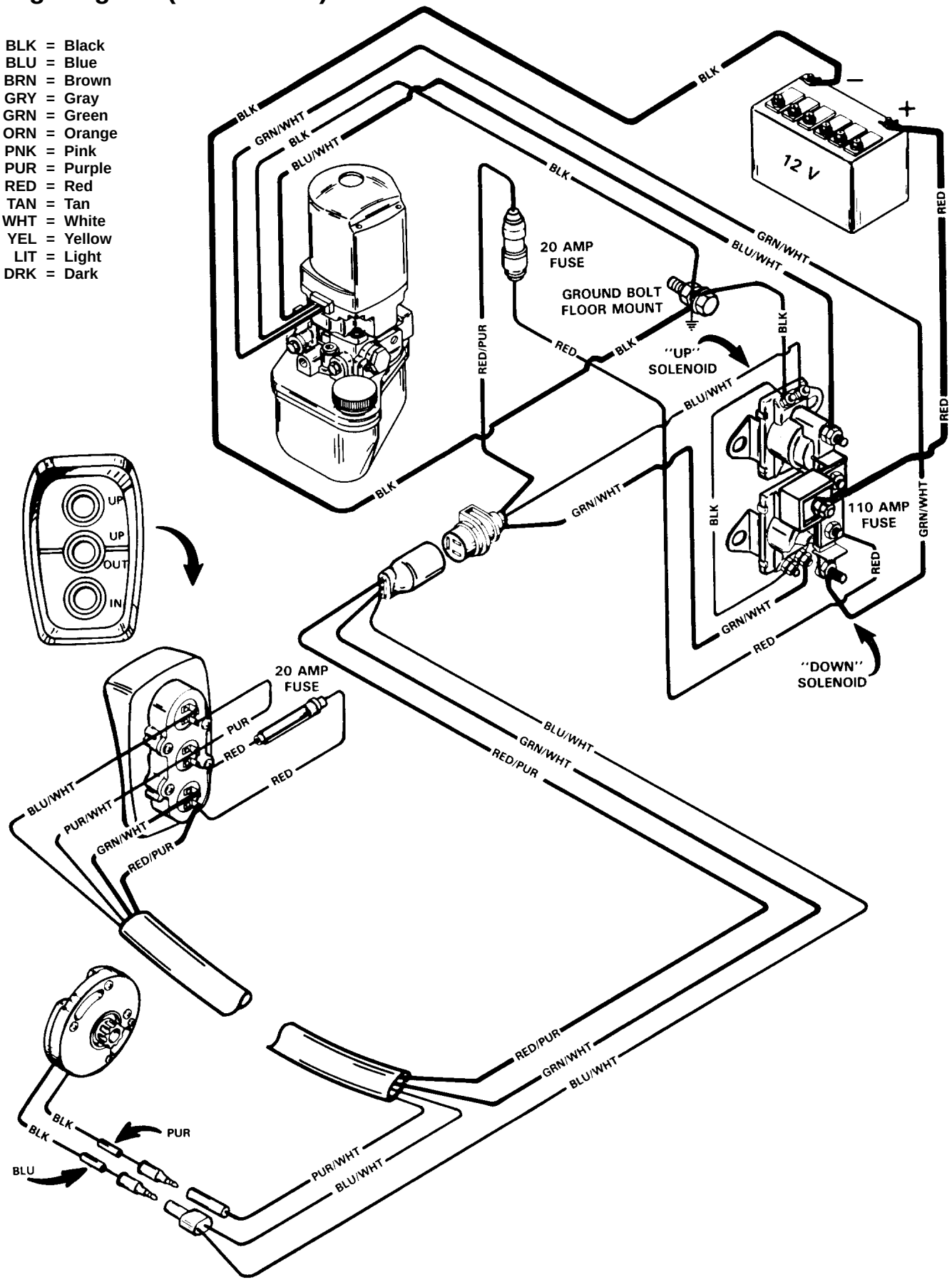


BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

877-H

Wiring Diagram (Power Trim)

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark



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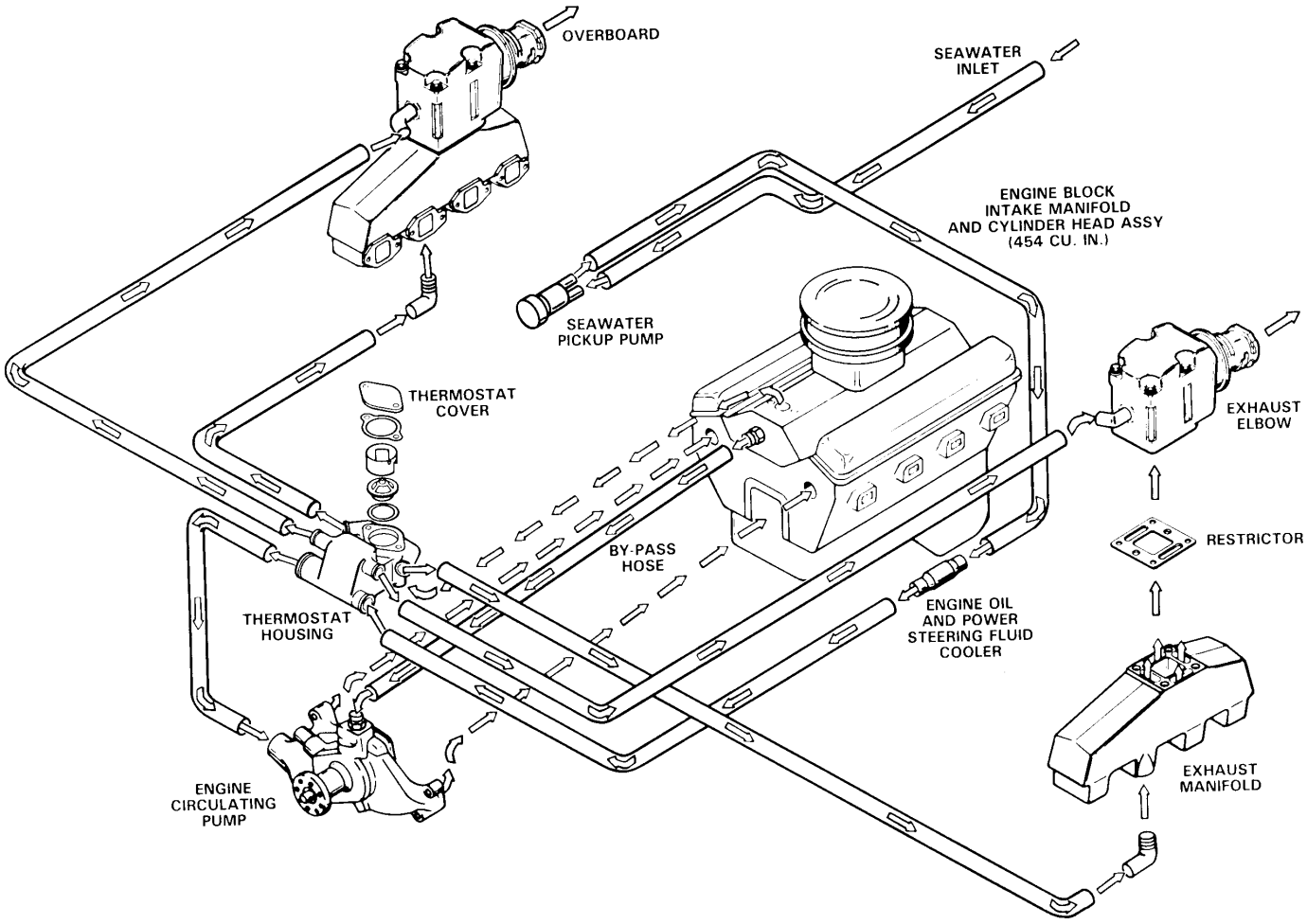
Water Flow Diagram



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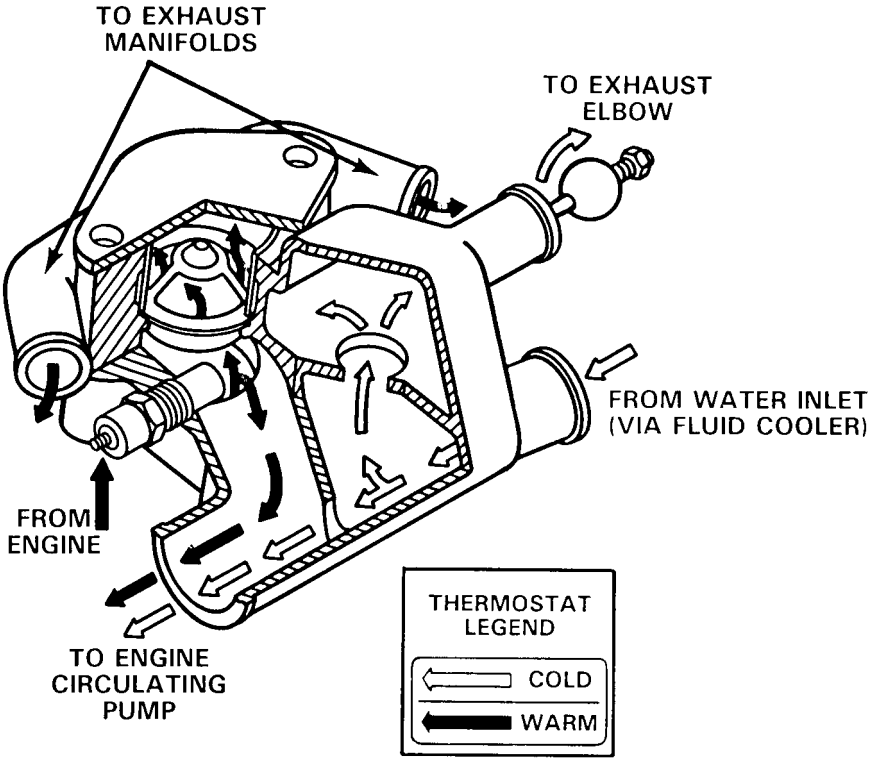
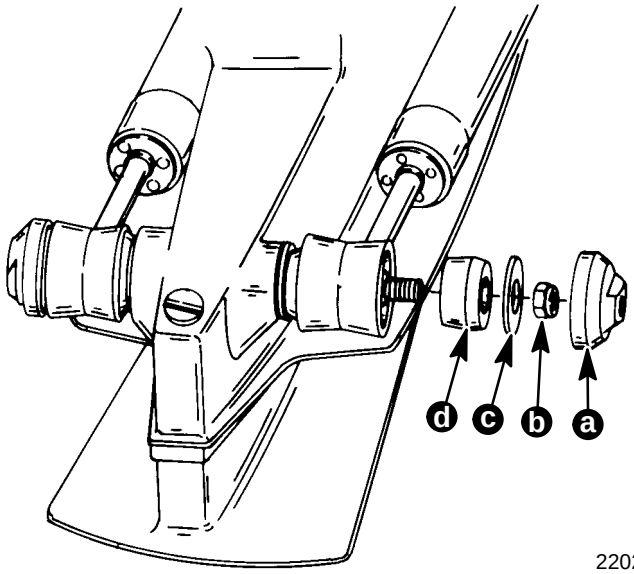


22380

Stern Drive Removal

1. Shift remote control into neutral.
2. Remove power trim cylinders (aft end) from drive shaft housing.



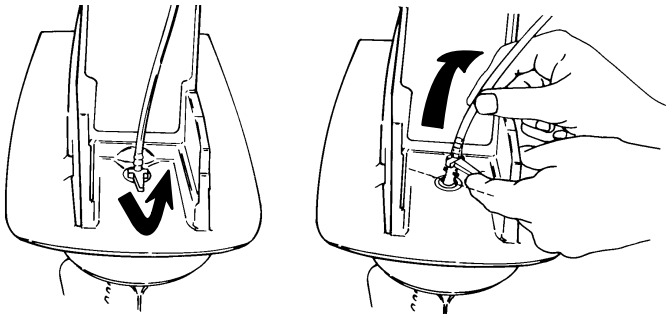
22029

a - Cap
b - Nut
c - Small I.D. Washer
d - Rubber Bushing

⚠ CAUTION

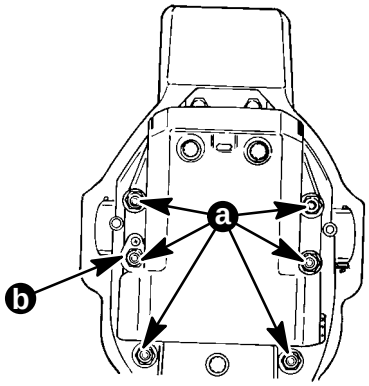
Be sure to disconnect speedometer hose fitting from drive shaft housing prior to removing stern drive unit. Failure to do so will damage fitting.

3. Disconnect speedometer hose fitting from drive shaft housing.



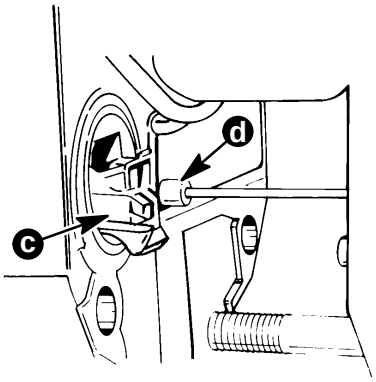
22025

4. Remove stern drive unit. Ensure shift slide jaws open and release shift cable end.



22031

a - Lock Nuts and Washers - Remove
b - Ground Plate - Washer Not Used at This Location



22025

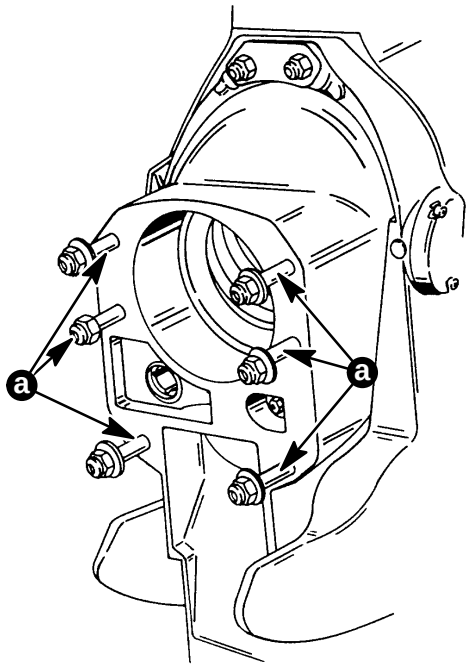
a - Shift Slide Jaws - Open
b - Shift Cable End - Released from Jaws

Stern Drive Installation

1. Install and align engine. (Refer to appropriate engine service manual).

NOTE: *If engine was removed and shift cable was disconnected, reinstall and adjust shift cable before proceeding.*

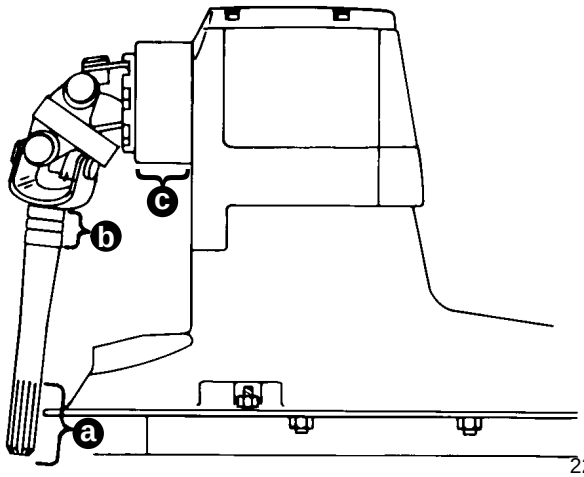
2. Place the remote control shift lever in the **neutral** position.
3. Lubricate bell housing studs with 2-4-C Marine Lubricant.



22030

a - Bell Housing Studs

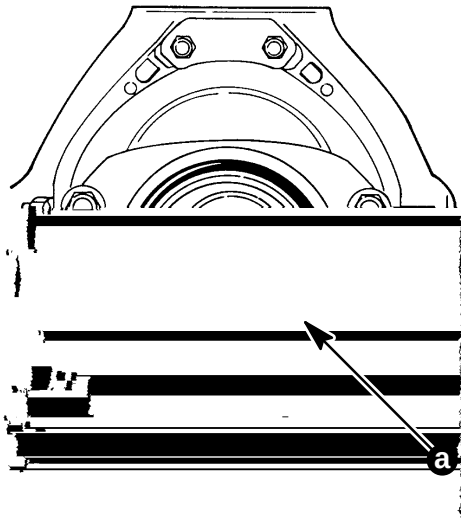
4. Lubricate areas shown with 2-4-C Marine Lubricant.



22026

a - U-Joint Shaft Splines
b - U-Joint Shaft O-Rings
c - Drive Shaft Housing Pilot

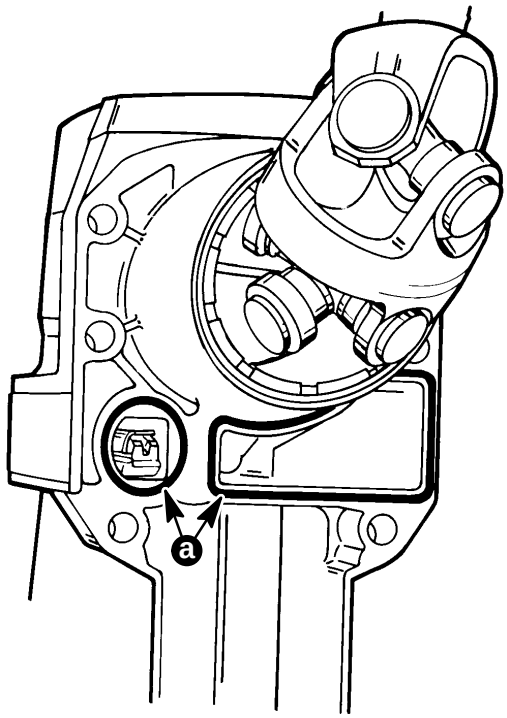
IMPORTANT: The edge of U-joint bellows acts as a seal between bell housing and drive shaft housing. Ensure surface is not damaged.



22030

a - Drive Shaft Bellows Edge

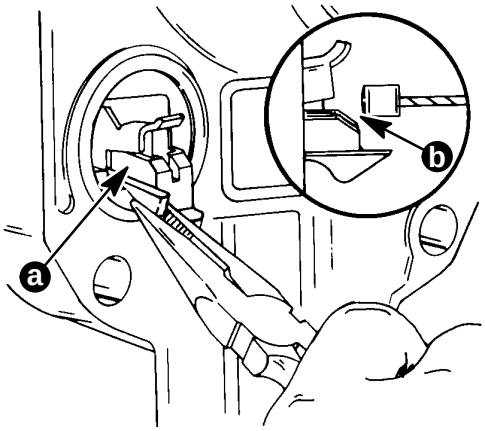
5. Inspect drive shaft bellows for cracks, nicks, and cleanliness.
6. Lubricate O-ring seals on face of drive shaft housing.



22031

a - O-Rings - Lubricate with 2-4-C Marine Lubricant

7. Pull out shift linkage as far as it moves. Jaws will open.

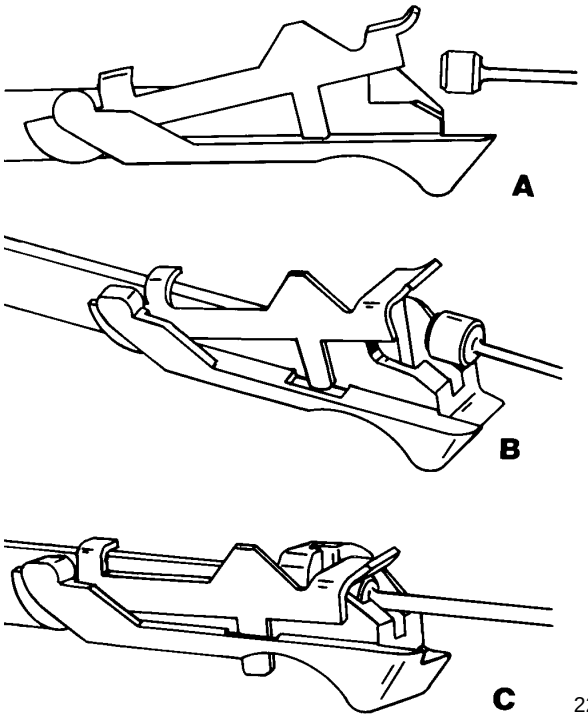


22025

a - Shift Linkage Assembly
b - Jaws - Open

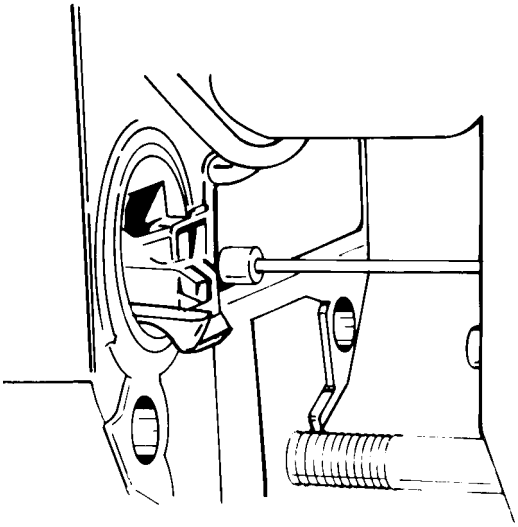
IMPORTANT: As you are inserting the stern drive unit into bell housing, the entrance of the bell housing shift cable must be closely checked to ensure cable enters the "Jaws" of shift linkage assembly in the drive unit.

NOTE: *As bell housing shift cable enters the shift linkage assembly, it pushes the assembly back into the drive shaft housing, and the jaw closes, securing the cable, as shown in "A", "B" and "C".*



22025

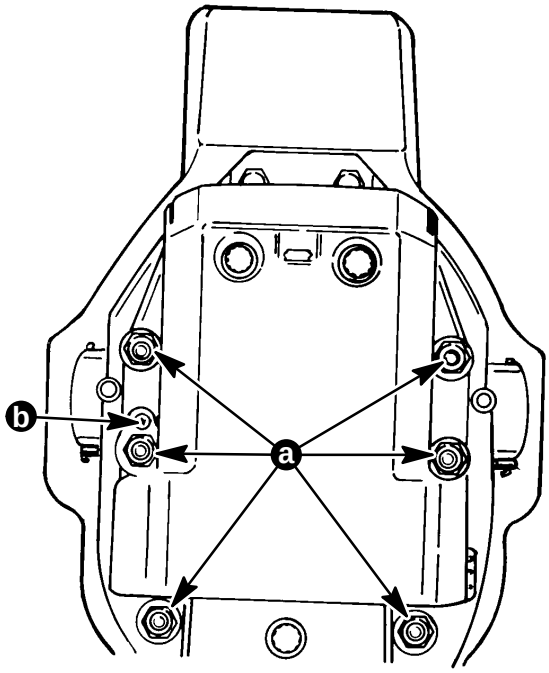
NOTE: *If bell housing shift cable does not line up to properly enter jaws of shift linkage assembly, use your hand to guide cable into place while installing stern drive unit.*



22025

8. Install stern drive unit.
   a. Position trim cylinders so they point straight backwards.
   b. Align universal joint shaft with bell housing bore.
   c. Guide u-joint shaft through gimbal bearing and into engine coupler. Make sure that shift linkage has engaged with shift cable.
   d. If necessary, rotate propeller shaft slightly to align u-joint shaft splines with engine coupler splines, then slide drive unit all-the-way into bell housing.
   e. Rotate propeller shaft slightly to ensure that drive unit is still in neutral once installed.

9. Fasten stern drive unit to bell housing. Starting from center, torque nuts to 50 lb. ft. (68 N.m).

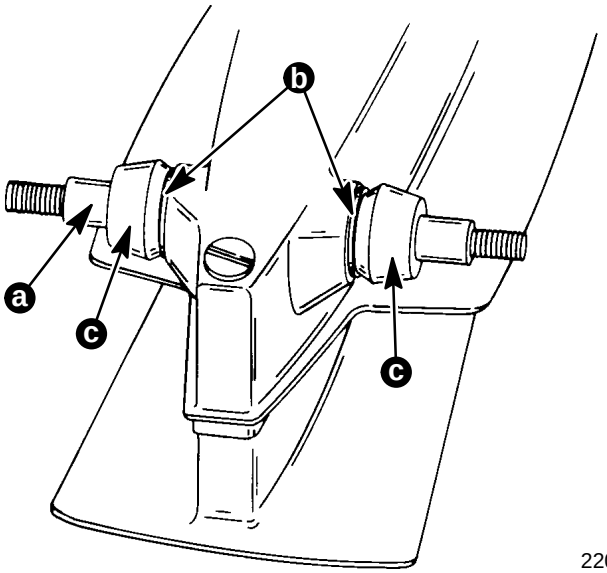


22031

a - Lock Nuts (6) and Flat Washers (5)
b - Ground Plate - Do Not Use Flat Washer at This Location

IMPORTANT: To aid in installing rubber bushings, use a water and soap solution.

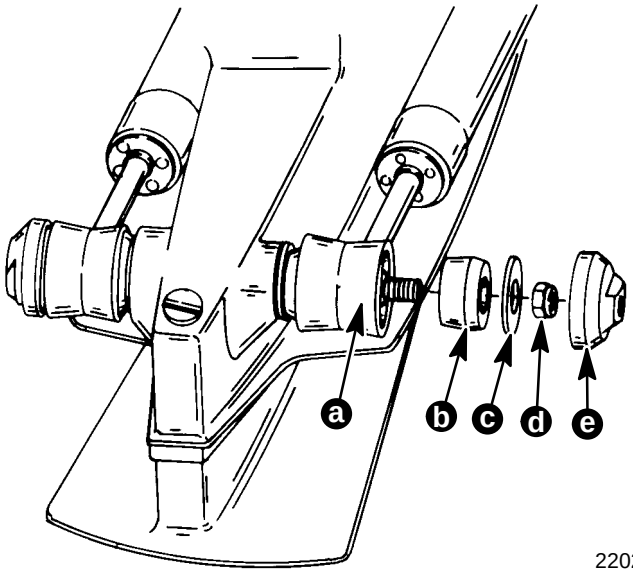
10. Insert aft anchor pin thru hole in drive shaft housing, then place large I.D. flat washer and rubber bushing on each end of pin. Be sure to install bushings with small diameter end facing outward.



22029

a - Anchor Pin
b - Large I.D. Washers
c - Rubber Bushings

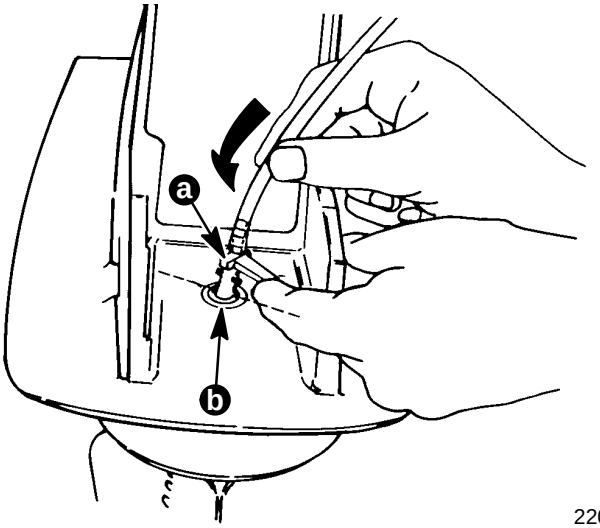
11. Loosen nuts, which secure trim cylinders to forward anchor pins. Move cylinder pivot ends outward and place over aft anchor pin.
12. Place rubber bushings (with smaller diameter end facing inward), and small I.D. flat washer onto each end of anchor pin. Install elastic stop nuts.
13. Tighten forward and aft anchor pin nuts until nuts and washers bottom out against anchor pin shoulder.
14. Attach trim cylinder caps, hand tighten only. If caps will not catch threads recheck tightness of anchor pin nuts.



22029

a - Trim Cylinder Pivot Ends
b - Rubber Bushing
c - Small I.D. Flat Washer
d - Lock Nut
e - Trim Cylinder Cap

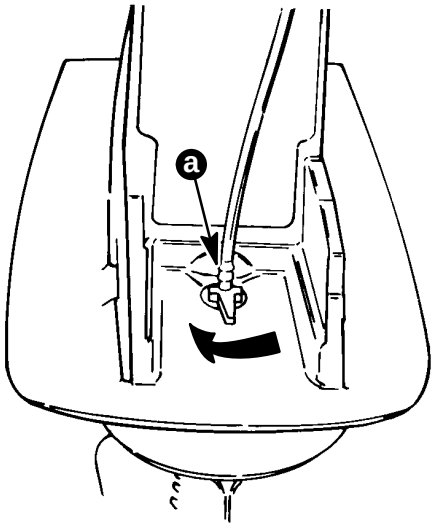
15. Attach speedometer hose fitting to stern drive unit.
    a. Raise drive unit to gain access to area between gimbal housing and drive unit, and locate opening in forward end of anti-ventilation plate.
    b. Insert speedometer hose fitting into opening.



22025

a - Speedometer Hose Fitting
b - Opening (In Drive Unit)

    c. With fitting fully seated, turn handle clockwise to a tightly seated position.



22025

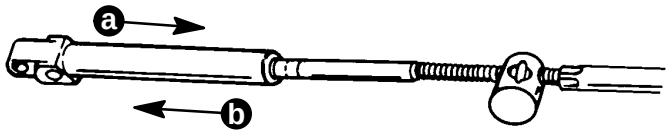
a - Fitting Installed (Handle Pointing Forward)

Shift Cable Adjustment

NOTE: *Shift Cable Adjustment Tool (91-12427) allows the shift cables to be installed and adjusted with or without the stern drive attached.*

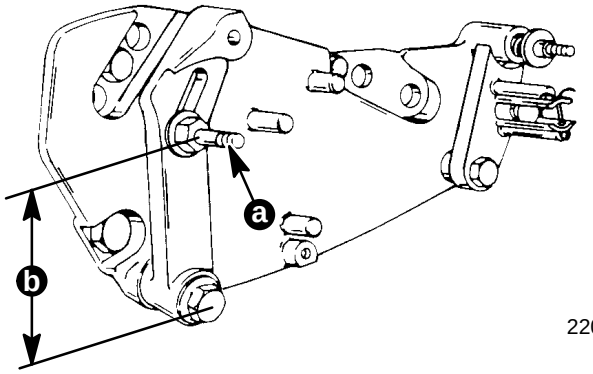
IMPORTANT: The direction of propeller rotation (RH or LH) for this drive unit is determined by the following method.

1. Determine desired propeller rotation.
    a. RIGHT HAND ROTATION - Control cable will have to be installed in remote control so that cable end will move in direction “a” when shift handle is placed in the forward position.
    b. LEFT HAND ROTATION - Control cable will have to be installed in remote control so that cable end will move in direction “b” when shift handle is placed in the forward position.



22024

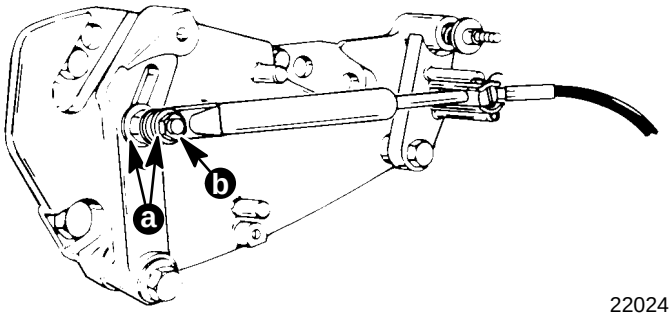
2. Install shift cable into remote control (Refer to appropriate remote control instructions).
3. Loosen stud and move it to dimension as shown. Retighten stud.



22024

a - Stud
b - 3 Inches (76 mm) - Center of Pivot Bolt to Center of Stud

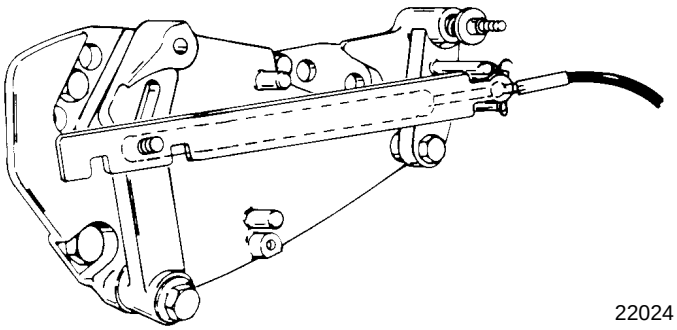
4. Install drive unit shift cable.



22024

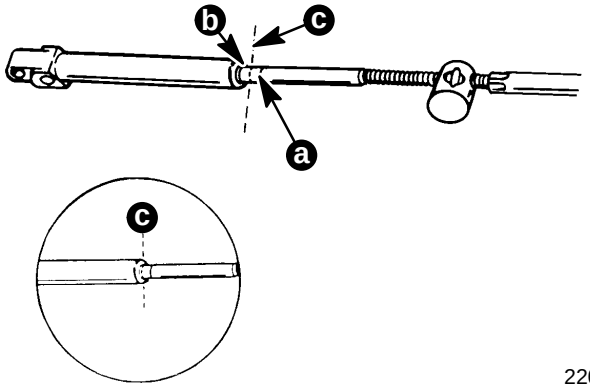
a - Washers (2)
b - Lock Nut - Tighten Until Contact, Then Back Off 1/2 Turn
c - Cotter Pin - Insert from Bottom and Spread Both Ends

5. Place adjustment tool over drive unit shift cable, as shown. Hold tool in place, using a piece of tape over the barrel retainer.



22024

6. Locate center of remote control and shift cable play (backlash).
   a. Shift remote control to neutral.
   b. Push in on control cable end with enough pressure to remove play, and mark position “a” on tube.
   c. Pull out on control cable end with enough force to remove play and mark position “b” on tube.
   d. Measure distance between marks “a” and “b” and mark position “c” half-way between marks “a” and “b”.



22024

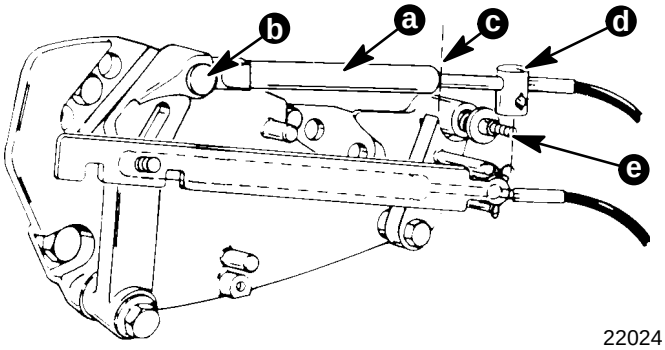
IMPORTANT: Be sure to keep center mark (c) aligned with control cable end guide edge when making the following adjustment.

7. Adjust remote control shift cable as follows:
   a. Temporarily install control cable end guide into shift lever, and insert anchor pin.
   b. Adjust control cable barrel so that hole in barrel centers with vertical centerline of stud. Ensure that backlash center mark is aligned with edge of control cable end guide.

⚠ CAUTION

DO NOT attempt to install or remove control cable barrel from stud, without first removing end guide anchor pin from shift lever, and removing cable. Attempting to bend control cable to install or remove barrel will place undue stress on cable end guide and shift lever, and damage to both could occur.

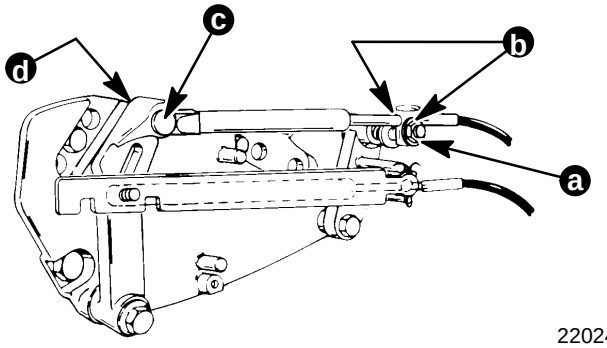
   c. Remove control cable end guide from shift lever, by removing anchor pin.



22024

a - Control Cable End Guide
b - Anchor Pin
c - Backlash Center
d - Control Cable Barrel
e - Stud

8. Install control cable.



22024

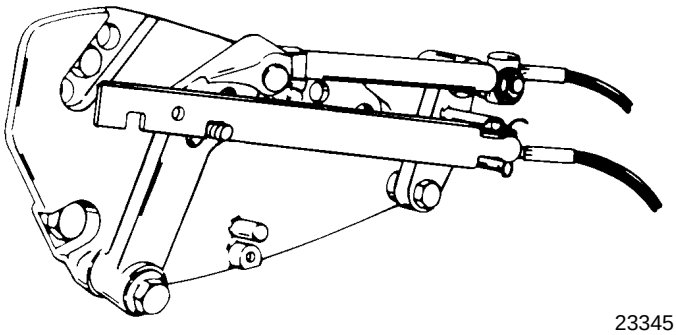
a - Lock Nut - Tighten Until Bottomed Out
b - Washers - Both Sides of Barrel
c - Anchor Pin
d - Cotter Pin (Not visible) - Spread Both Ends

9. Remove adjustment tool.
10. Shift remote control lever into full forward position. Place end of adjustment tool in barrel retainer.

RH ROTATION: Rear slot in tool should fit over shift lever stud.

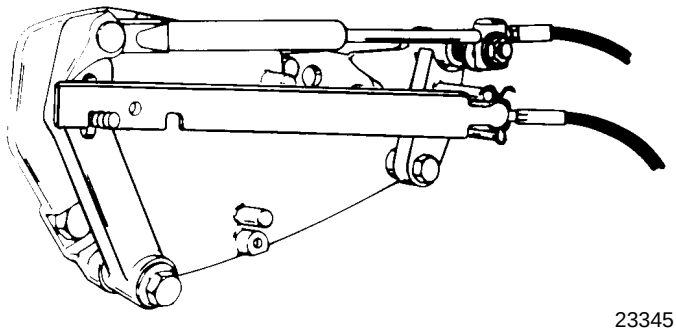
LH ROTATION: Forward slot in tool should fit over shift lever stud.

If slot does not fit over stud, loosen shift lever stud and slide stud up or down, until slot in tool fits over stud. When adjustment is correct, retighten stud.



23345

RH ROTATION



23345

LH ROTATION

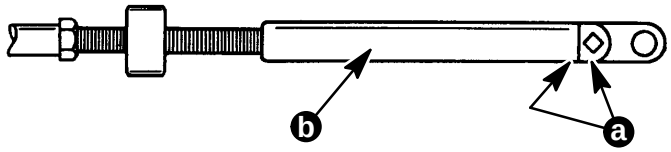
a - Adjustment Tool
b - Barrel Retainer
c - Shift Lever Stud
d - Shift Lever Adjustment Slot

11. Remove adjustment tool.
12. Lubricate shift cable pivot points with 30W oil.

Shift Cable Replacement

REMOVAL

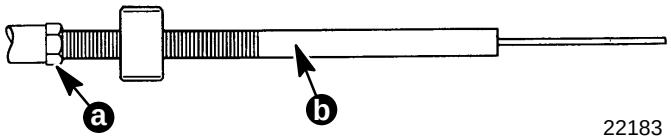
1. Remove stern drive unit.
2. Disconnect shift cable from shift plate and remove end guide.



22183

a - Anchor Screws (2) - Loosen
b - End Guide

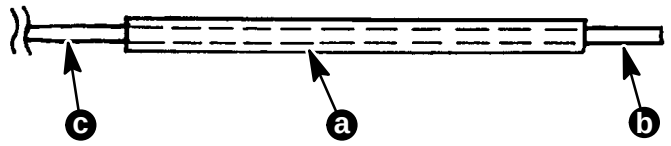
3. Remove threaded tube.



22183

a - Jam Nut - Loosen
b - Threaded Tube - Turn Out

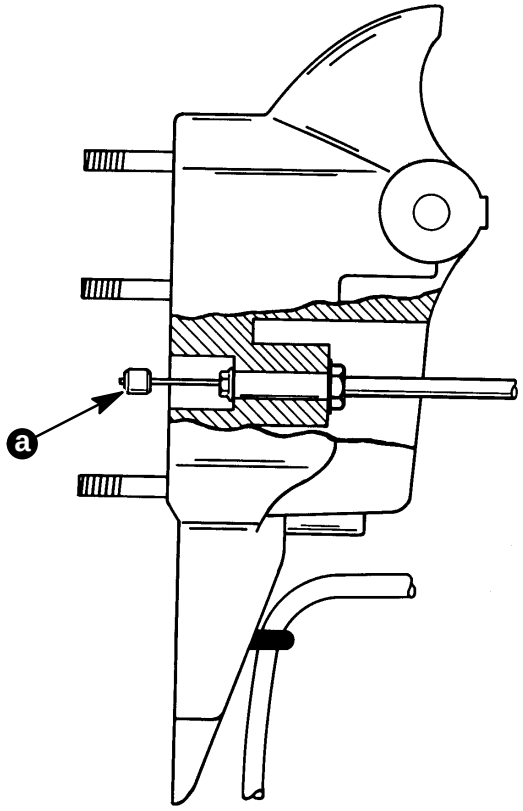
4. Remove support tube from core wire. Do not cut core wire unless absolutely necessary.



22183

a - Support Tube - Remove Crimp
b - Core Wire
c - Cut Here - If Absolutely Necessary

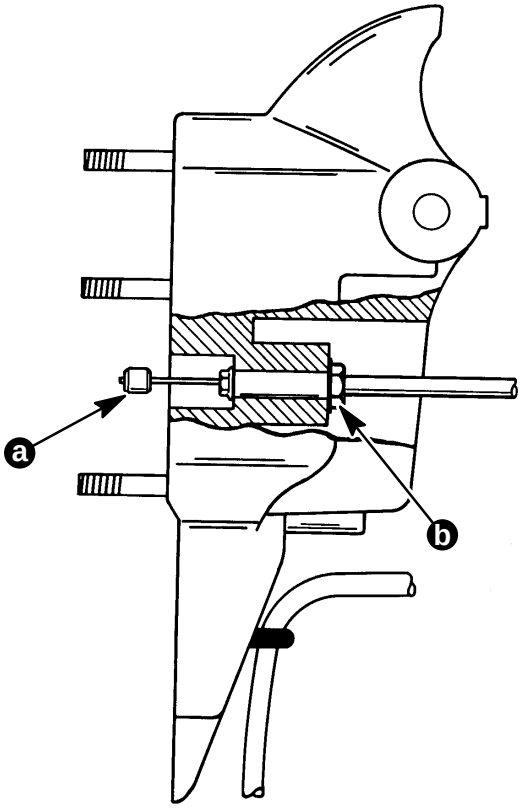
5. Remove inner core wire.



22121

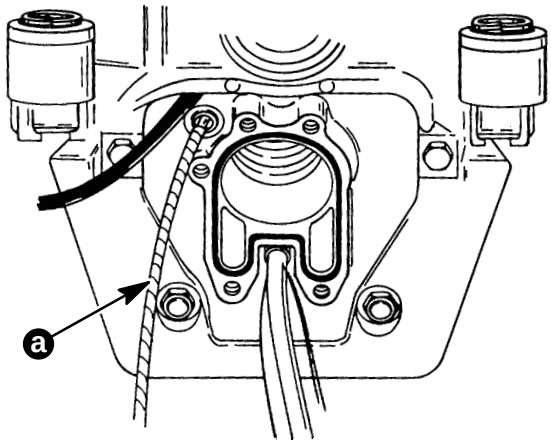
a - Core Wire - Pull Out

6. Remove shift cable retaining nut (a). Hold inside nut (b) with wrench.



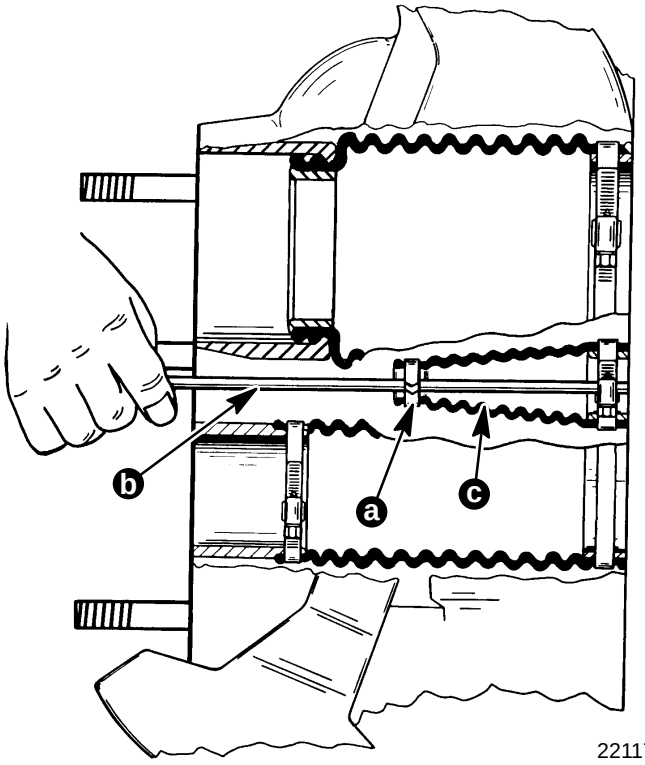
22121

7. Remove shift cable wrapping (a).



22030

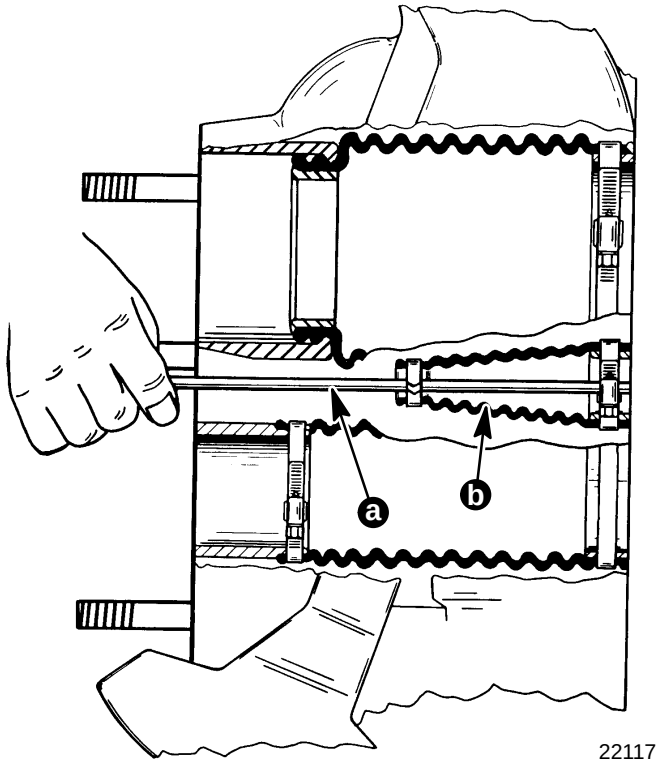
8. Loosen shift cable bellows crimp clamp (a).
9. Pull shift cable (b) thru shift cable bellows (c).



22117

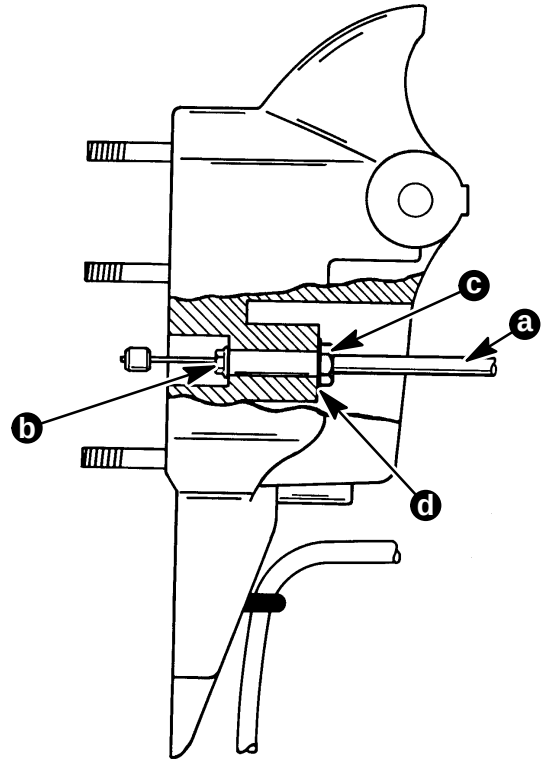
INSTALLATION

1. Insert shift cable end (a) into and thru shift cable bellows (b).



22117

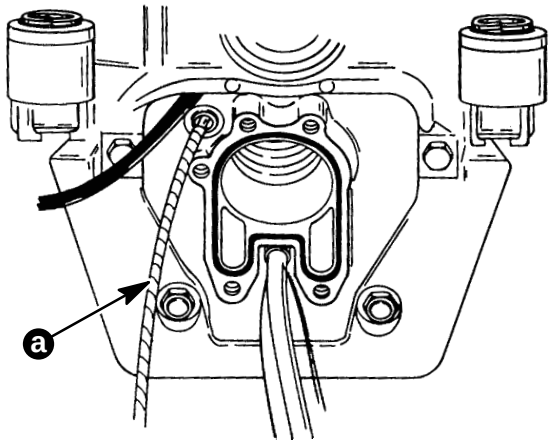
2. Apply Perfect Seal to shift cable retaining nut threads. Secure shift cable to bell housing.



22121

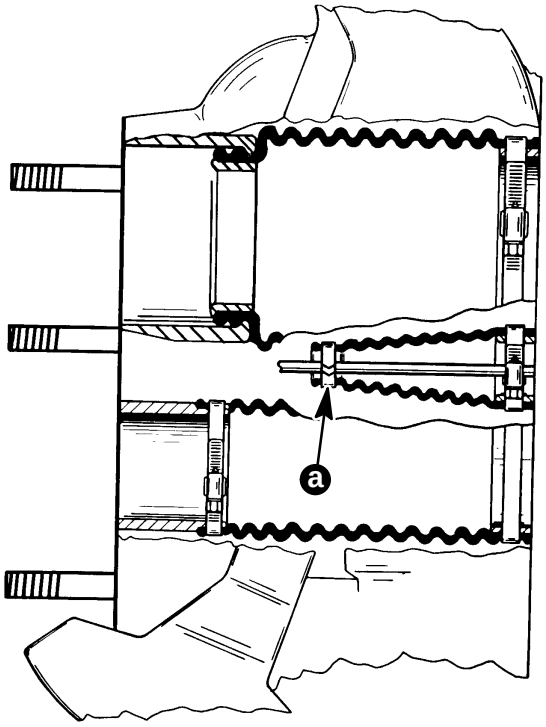
a - Shift Cable
b - Outer Retaining Nut - Torque to 65 lb. in. (7 N.m)
c - Inner Nut - Hold with Wrench
d - Seal Washer (Hidden by Nut)

3. Install shift cable wrapping (a).



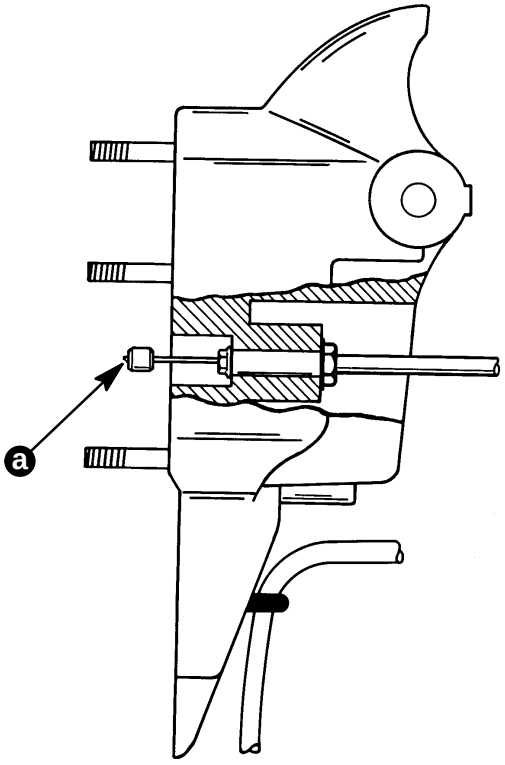
22030

4. Install and compress shift cable bellows crimp clamp (a). Be sure that clamp is crimped evenly so that a good seal is maintained between bellows and shift cable. (Do not allow bellows to flatten).



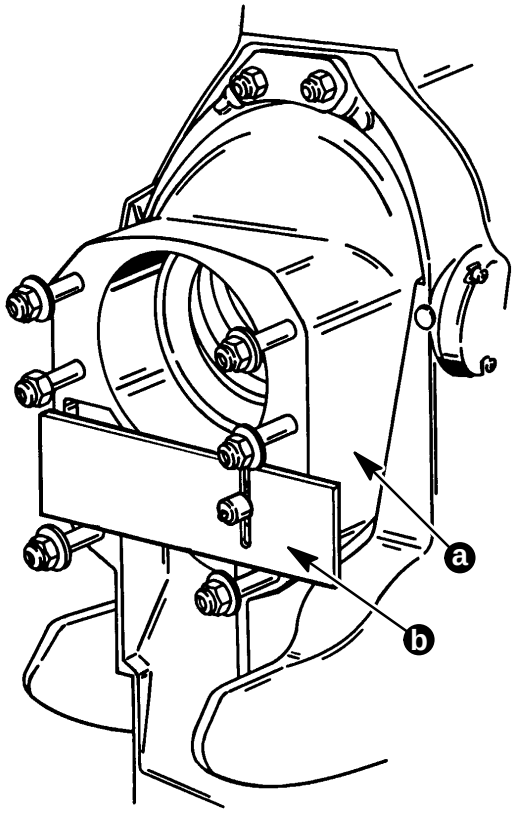
22117

5. Install inner core wire (a).



22121

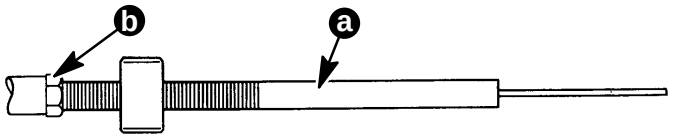
6. Install core wire locating tool (P/N 91-17263) on face of bell housing.



22121

a - Bell Housing
b - Core Wire Locating Tool (P/N 91-17263)

7. Install threaded tube until it bottoms. Tighten finger tight. Secure jam nut.

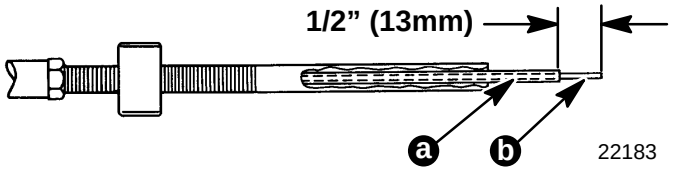


22183

a - Threaded Tube
b - Jam Nut - Tighten Securely

IMPORTANT: It is not necessary to cut this cable at any time. (As was the case with previous models.)

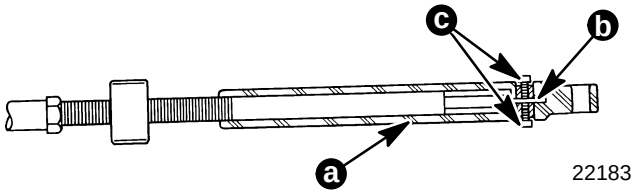
8. Install support tube over core wire. Position support tube so that 1/2” (13mm) of core wire extends from edge of support tube. Crimp end of support tube.



22183

a - Support Tube
b - Inner Core Wire

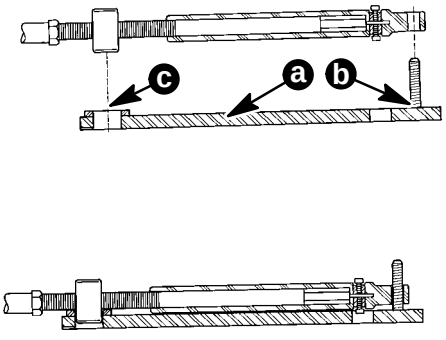
9. Install cable end guide over core wire and insert core wire thru cable anchor. Tighten anchor screws evenly.



22183

a - Cable End Guide
b - Cable Anchor
c - Anchor Screws - Torque to 20 lb. in. (2.3 N.m)

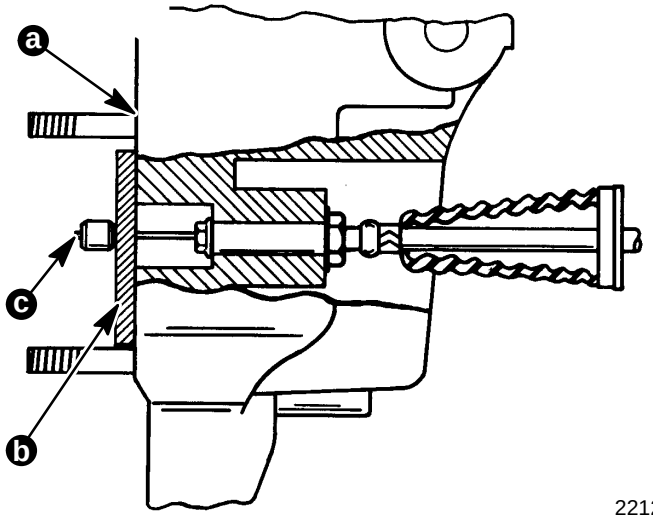
10. Place shift cable anchor adjustment tool (P/N 91-17262) on end of shift cable as shown.



22120

a - Shift Cable Anchor
b - Stud - Placed thru Hole in End Guide
c - Hole - Barrel Placed Here

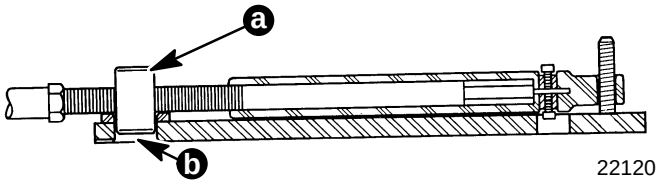
11. Ensure that bell housing end of core wire is positioned tight against core wire locating tool.



22121

a - Bell Housing
b - Core Wire Locating Tool
c - Core Wire

12. Adjust barrel to align with hole in tool. Remove tools.



22120

a - Barrel
b - Hole in Tool