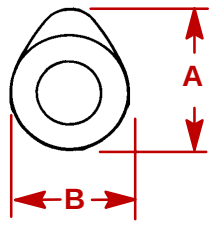
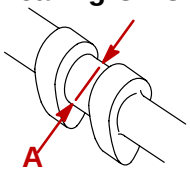
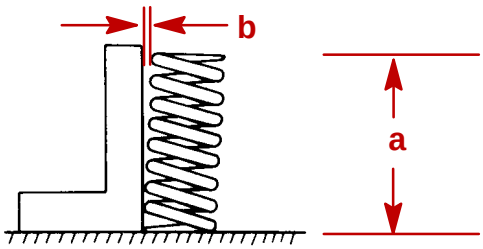
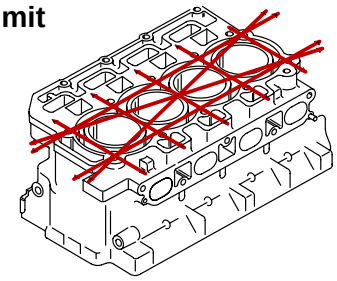
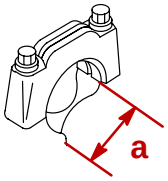
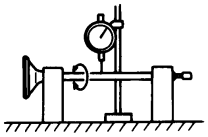
POWERHEAD

Section 4A - Cylinder Head

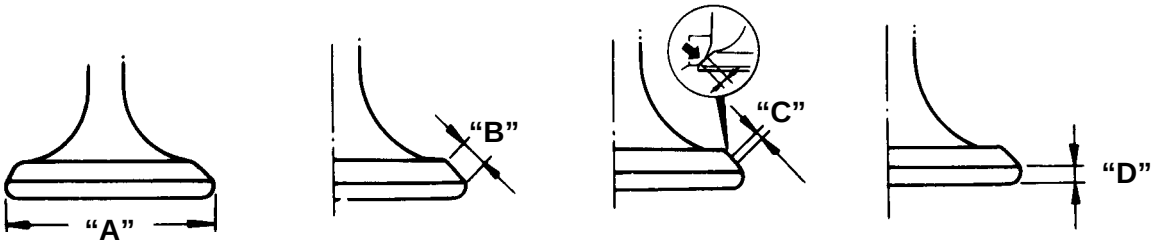
Table of Contents

Specifications

CAMSHAFT	**Camshaft Dimensions** **Intake "A"** **Exhaust "A"** **Intake "B"** **Exhaust "B"** **Valve Lift** **Intake** **Exhaust** **Run-out Limit** **Camshaft Bearing Diameter "a"** **Camshaft Bearing Oil Clearance**  	1.465 - 1.472 in. (37.22 - 37.38 mm) 1.453 - 1.459 in. (36.90 - 37.06 mm) 1.178 - 1.184 in. (29.92 - 30.08 mm) 1.178 - 1.184 in. (29.92 - 30.08 mm) 0.273 in. (6.94 mm) 0.259 in. (6.58 mm) 0.0039 in. (0.1 mm) 0.9827 - 0.9835 in. (24.96 - 24.98 mm) 0.0008-0.0024 in.(0.020-0.061 mm)
VALVE SPRING	**Free Length "a"** **Minimum Free Length** **Tilt Limit "b"** 	2.094 in. (53.20 mm) 2.057 in. (52.25 mm) Less than 0.10 in. (2.6 mm)
CYLINDER HEAD	**Warp Limit**  **Camshaft Bearing Inside Diameter**  **Valve Lifter Bore Inside Diameter**	0.004 in. (0.1 mm) 0.984 - 0.985 in. (25.000 - 25.021 mm) 1.102 - 1.103 in. (28.000 - 28.021 mm)

VALVES	**Valve/Valve Seat/Valve Guides:**	
	Valve Clearance (cold)	
	Intake	0.007 - 0.009 in. (0.17 - 0.23 mm)
	Exhaust	0.011 - 0.014 in. (0.31 - 0.34 mm)
	Valve Face Angle	
	Intake	120°, 91°, 110°
	Exhaust	140°, 91°, 110°
	Valve Dimensions:	
	“A” Head Diameter	
	Intake	1.142 - 1.150 in. (29.0 - 29.2 mm)
	Exhaust	0.945 - 0.953 in. (24.0 - 24.20 mm)
	“B” Face Width	
	Intake	0.079 - 0.096 in. (2.00 - 2.43 mm)
	Exhaust	0.090 - 0.107 in. (2.28 - 2.71 mm)
	“C” Seat Width	
	Intake	0.014 - 0.022 in. (0.35 - 0.55 mm)
	Exhaust	0.014 - 0.022 in. (0.35 - 0.55 mm)
	“D” Margin Thickness	
	Intake	0.018 - 0.026 in. (0.45 - 0.65 mm)
	Exhaust	0.026 - 0.033 in. (0.65 - 0.85 mm)
	Stem Outside Diameter	
	Intake	0.2352 - 0.2358 in. (5.975 - 5.990 mm)
	Exhaust	0.2346 - 0.2352 in. (5.960 - 5.975 mm)
	Guide Inside Diameter	
	Intake	0.2364 - 0.2369 in. (6.005 - 6.018 mm)
	Exhaust	0.2364 - 0.2369 in. (6.005 - 6.018 mm)
	Stem To Guide Clearance	
	Intake	0.0006 - 0.0017 in. (0.015 - 0.043 mm)
	Exhaust	0.0012 - 0.0023 in. (0.030 - 0.058 mm)
	Stem Run-out Limit (max.)	0.001 in. (0.03 mm)
		

Valve Dimensions

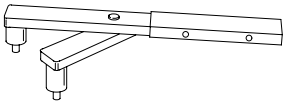


Head Diameter | Face Width | Seat Width | Margin Thickness

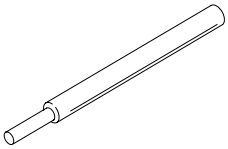
VALVE LIFTERS	**Valve Lifter Outside diameter**	1.1010 - 1.1016 in. (27.965 - 27.980 mm)
	Valve Lifter to Lifter Bore Clearance	0.0008 - 0.0022 in. (0.020 -0.056 mm)
VALVE SHIM	**Valve shim Thickness (in 0.025 mm increments)**	0.0787 - 0.1299 in. (2.000 - 3.300 mm)
THERMOSTAT	**Valve Opening Temperature**	140° F (60° C)
	Full Open Temperature	158° F (70° C)
	Valve Lift (Minimum)	0.12 in. (3 mm)

Special Tools

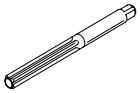
1. Flywheel Holder P/N 91-83163M



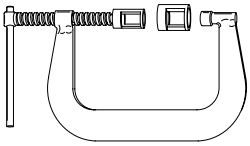
2. Valve Guide Remover/Installer P/N 91-804774



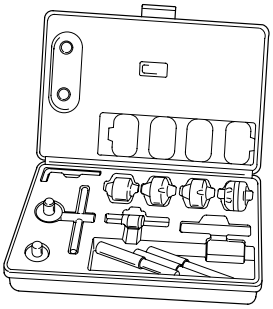
3. Valve Guide Reamer P/N 91-804775



4. Valve Spring Compressor P/N 91-809494A1

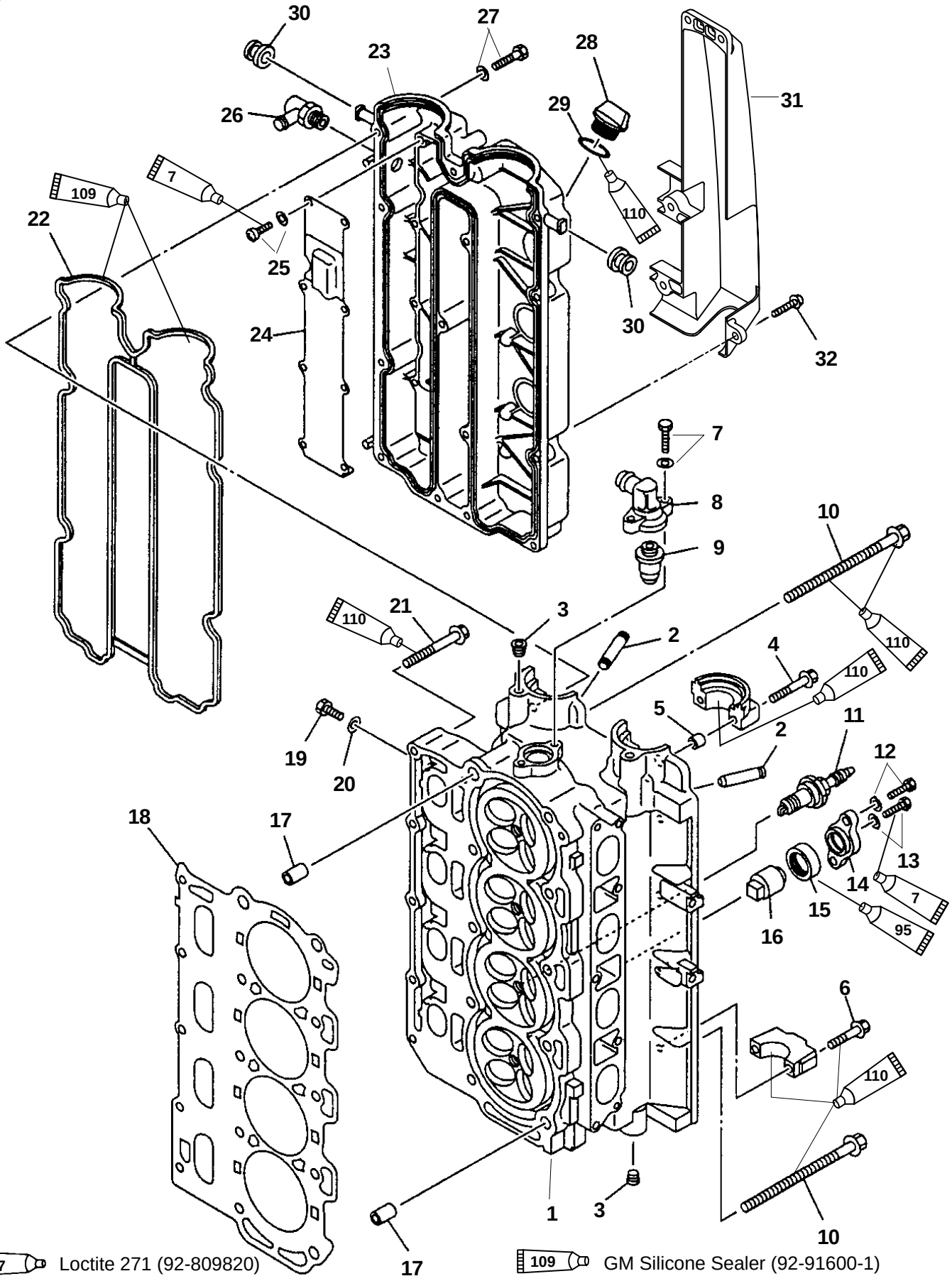


5. Valve Seat Cutter Kit (Obtain Locally).



Notes:

Cylinder Head



7 Loctite 271 (92-809820)

110 4-Stroke Outboard Oil (92-828000A12)

109 GM Silicone Sealer (92-91600-1)

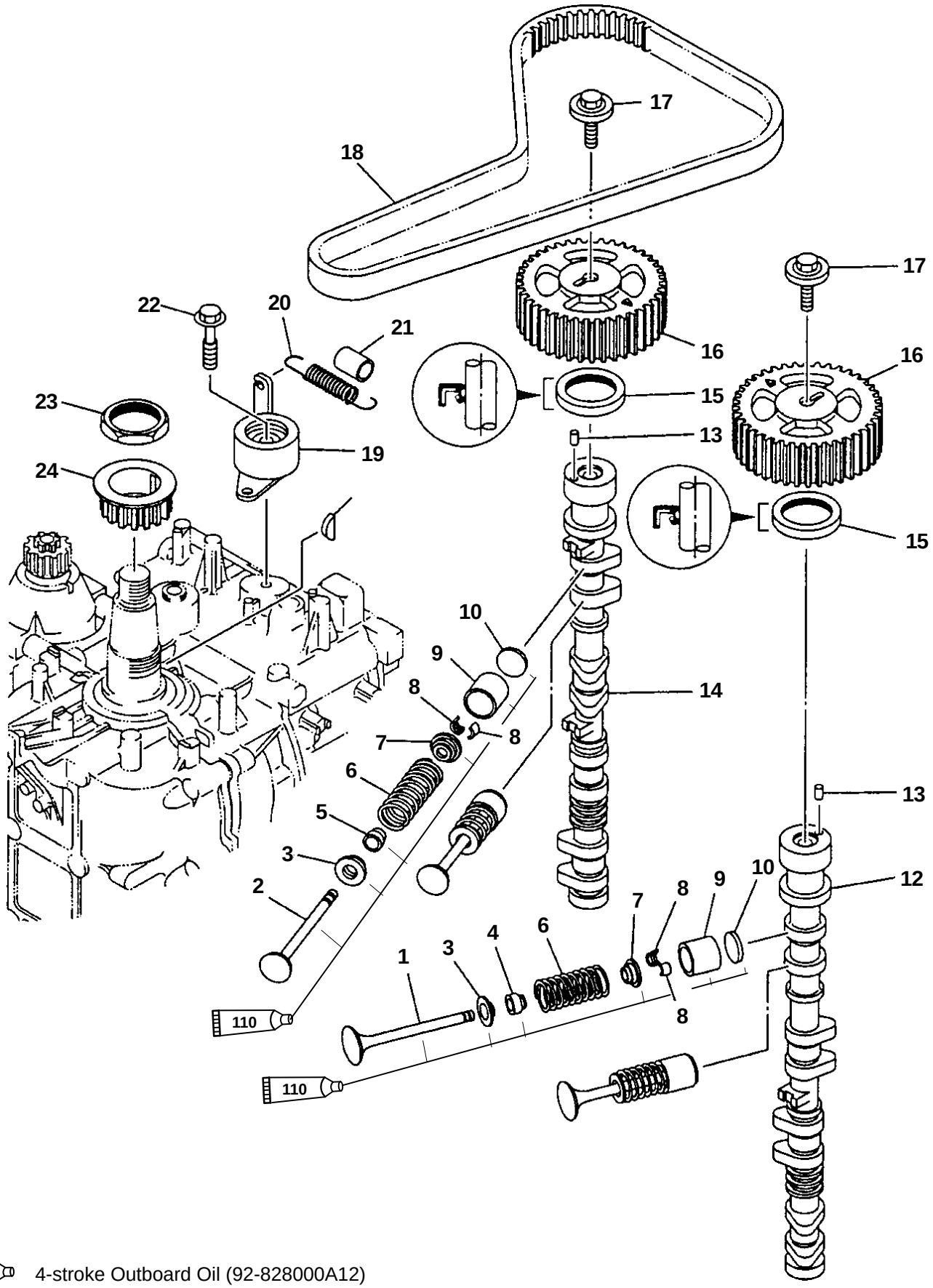
95 2-4-C w/Teflon (92-850736A1)

Cylinder Head

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in.	lb-ft	Nm
1	1	CYLINDER HEAD			
2	16	GUIDE PIN			
3	4	PLUG			
4	4	SCREW (M7 x 48 mm)	150		17
5	4	DOWEL PIN			
6	16	SCREW (M7 x 37 mm)	150		17
7	2	SCREW (M6 x 25 mm)	70		8
8	1	THERMOSTAT COVER			
9	1	THERMOSTAT 140 degree F (60 degree C)			
10	10	SCREW (M10 x 145 mm) T55 Torx			
11	4	SPARK PLUG (NGK LFR5A-11)		18	25
12	4	SCREW (M8 x 25 mm)		13	18
13	2	SCREW (M6 X 20 mm)	70		8
14	2	COVER			
15	2	GROMMET			
16	2	ANODE			
17	2	COLLAR			
18	1	GASKET			
19	4	SCREW			
20	4	GASKET			
21	5	SCREW (M8 x 55 mm)		21	28
22	1	GASKET			
23	1	COVER KIT			
24	1	COVER			
25	8	SCREW (M4 x 8 mm)	18		2
26	1	NIPPLE			
27	14	SCREW (M6 x 30 mm)	70		8
28	1	OIL PLUG			
29	1	O RING			
30	2	GROMMET			
31	1	COVER			
32	5	SCREW (M6 x 16)	65		7.5

NOTE: TORQUE TOLERANCE +/– 10%

Intake/Exhaust Valves



110 4-stroke Outboard Oil (92-828000A12)

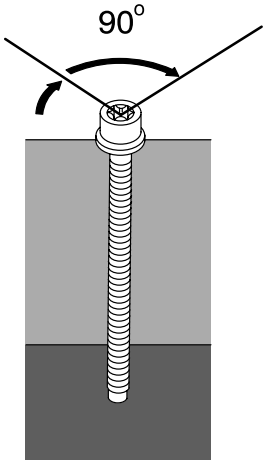
Intake/Exhaust Valves

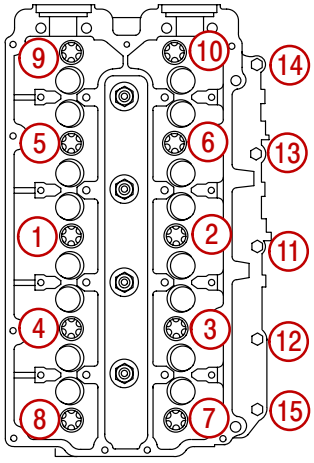
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in.	lb-ft	Nm
1	8	INTAKE VALVE			
2	8	EXHAUST VALVE			
3	16	SEAT			
4	8	SEAL			
5	8	SEAL			
6	16	VALVE SPRING			
7	16	RETAINER			
8	32	COTTER VALVE			
9	16	VALVE LIFTER			
10	AR	ADJUSTING PAD **(2.350)**			
11	AR	ADJUSTING PAD **(2.375)**			
	AR	ADJUSTING PAD **(2.400)**			
	AR	ADJUSTING PAD **(2.425)**			
	AR	ADJUSTING PAD **(2.450)**			
	AR	ADJUSTING PAD **(2.475)**			
	AR	ADJUSTING PAD **(2.500)**			
	AR	ADJUSTING PAD **(2.525)**			
	AR	ADJUSTING PAD **(2.550)**			
	AR	ADJUSTING PAD **(2.575)**			
	AR	ADJUSTING PAD **(2.600)**			
	AR	ADJUSTING PAD **(2.625)**			
	AR	ADJUSTING PAD **(2.650)**			
	AR	ADJUSTING PAD **(2.675)**			
	AR	ADJUSTING PAD **(2.700)**			
	AR	ADJUSTING PAD **(2.725)**			
	AR	ADJUSTING PAD **(2.750)**			
	AR	ADJUSTING PAD **(2.775)**			
	AR	ADJUSTING PAD **(2.800)**			
	AR	ADJUSTING PAD **(2.825)**			
	AR	ADJUSTING PAD **(2.850)**			
	AR	ADJUSTING PAD **(2.875)**			
	AR	ADJUSTING PAD **(2.900)**			
	AR	ADJUSTING PAD **(2.925)**			
	AR	ADJUSTING PAD **(2.950)**			
	AR	ADJUSTING PAD **(2.975)**			
12	1	CAMSHAFT			
13	2	DOWEL PIN			
14	1	CAMSHAFT			
15	2	OIL SEAL			
16	2	DRIVEN GEAR			
17	2	SCREW (M10 x 35 mm)		44	60
18	1	V-BELT			
19	1	TENSIONER			
20	1	SPRING			
21	1	HOSE			
22	1	SCREW (M10 x 45 mm)		29	40
23	1	NUT (M40) 46 mm Hex		195	265
24	1	DRIVE GEAR			

AR = As Required

Torque Sequence

Cylinder Head Bolts



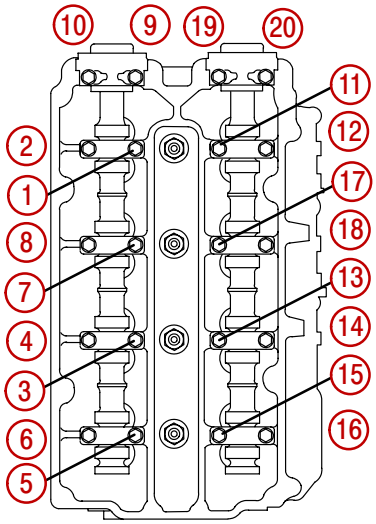


Cylinder Head Bolt Torque-M8 x 55 mm	
1st	120 lb-in. (14 Nm)
2nd	20 lb-ft (28 Nm)

Cylinder Head Bolt Torque-M10 x 145 mm	
1st	132 lb-in. (15 Nm)
2nd	24 lb-ft (33 Nm)
3rd	90° 51 lb-ft (70 Nm)*

*Torque value given for reference only.

Camshaft Caps Bolts



Camshaft Cap Bolt Torque	
1st	70 lb-in. (8 Nm)
2nd	144 lb-in. (17 Nm)

Adjustments

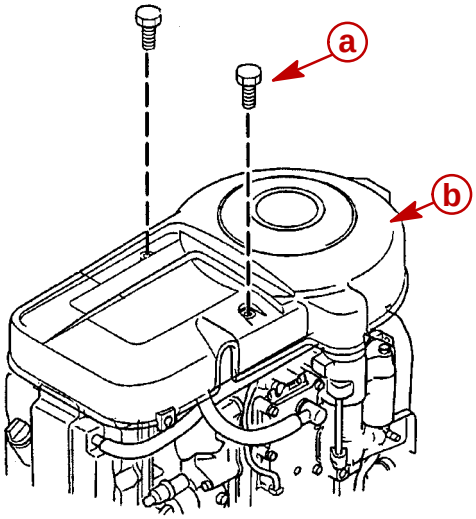
Valve Clearance

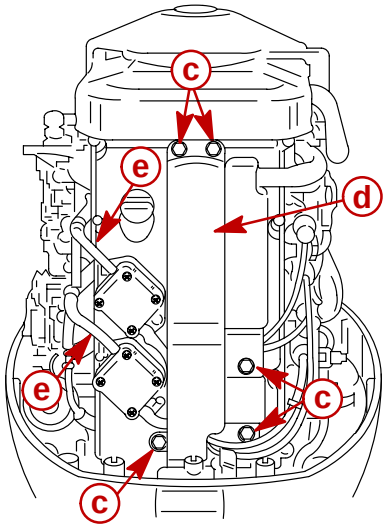
⚠ WARNING

Engine could possibly start when turning flywheel during adjustment. To prevent this type of accidental engine starting and possible serious injury, always remove spark plug leads from spark plugs.

NOTE: *Valve clearance adjustment should be made on a cold engine at room temperature.*

1. Remove flywheel cover and spark plug cover.
2. Disconnect spark plug leads and fuel hoses.



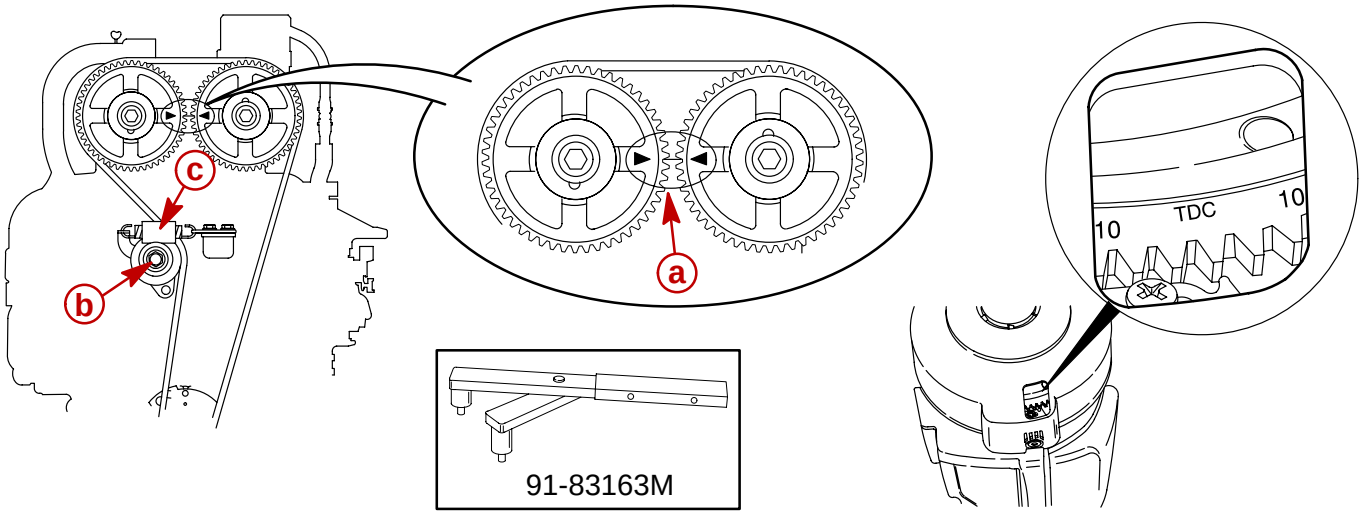


a - Screw (2) M6 x 20
b - Flywheel Cover
c - Screw (5) M6 x 16
d - Spark Plug Cover
e - Fuel Hoses

3. Align timing marks on driven cams.

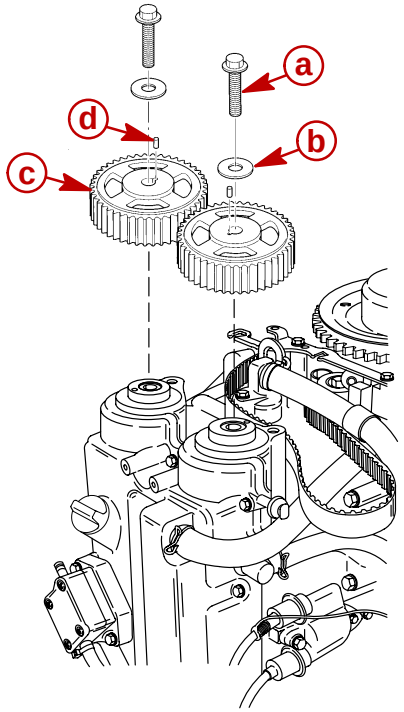
NOTE: *Use flywheel holder (91-83163M) to rotate flywheel and align timing marks.*

4. Loosen timing belt tensioner bolt and remove tensioner spring.

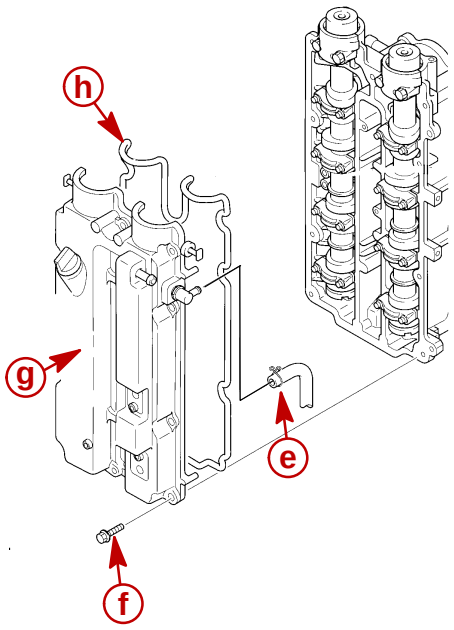


a - Timing Marks
b - Timing Belt Tensioner Screw M10 x 45
c - Tensioner Spring

5. Remove timing belt and driven sprockets.
6. Remove cylinder head cover and spark plugs.



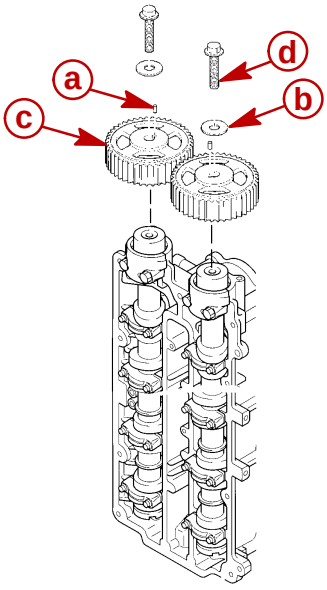
a - Driven Sprocket Screw (2) M10 x 35
b - Washer (2)
c - Driven Sprocket (2)
d - Pin (2)

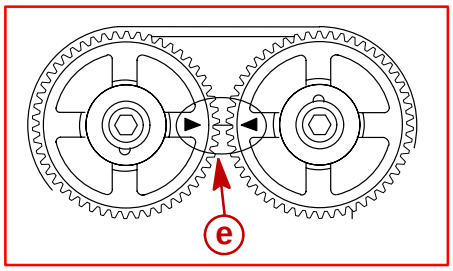


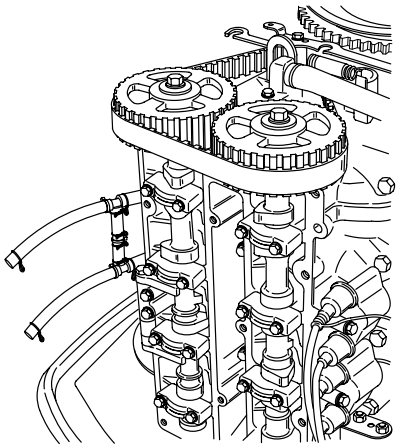
e - Breather Hose
f - Screw (14) M6 x 30
g - Cylinder Head Cover
h - Rubber Gasket

7. Re-install driven sprockets and timing belt.

NOTE: *Make sure timing marks are still aligned.*



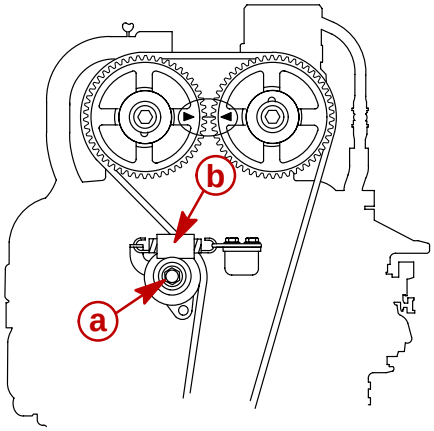




a - Pin (2)
b - Washer (2)
c - Driven Sprocket (2)
d - Driven Sprocket Screw (2) M10 x 35
e - Timing Marks Aligned

Driven Sprocket Screw Torque
44 lb-ft (60 Nm)

8. Install tensioner spring and tighten timing belt tensioner.



a - Timing Belt Tensioner Screw M10 x 45
b - Tensioner Spring

Timing Belt Tensioner Screw Torque
29 lb-ft (40 Nm)

9. Measure intake and exhaust valve clearance using the **Valve Clearance Measurement Steps** below.

VALVE CLEARANCE MEASUREMENT STEPS:

a. Turn flywheel clockwise until cylinder #1's piston is at TDC.

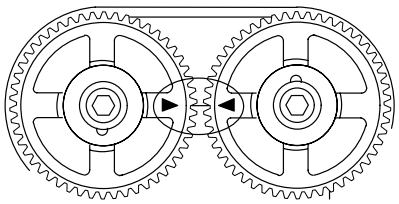
b. Measure and record the intake valve clearance for cylinders #1 and #2.

c. Measure and record the exhaust valve clearance for cylinders #1 and #3.

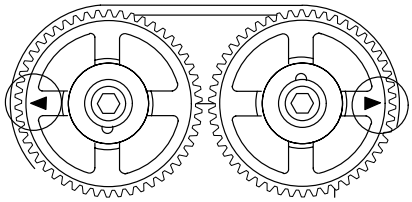
d. Turn the flywheel 360° clockwise.

e. Measure and record the intake valve clearance for cylinders #3 and #4.

f. Measure and record the exhaust valve clearance for cylinders #2 and #4.



Intake cylinders #1 and #2
Exhaust cylinders #1 and #3

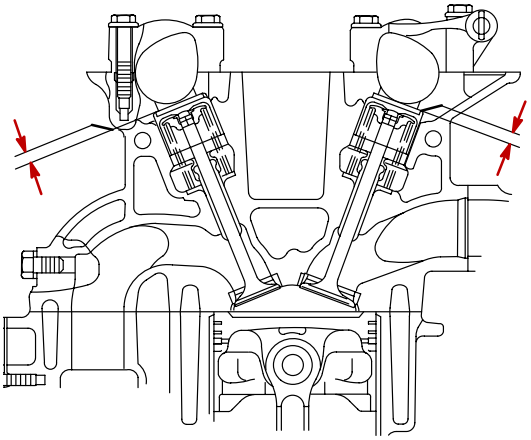


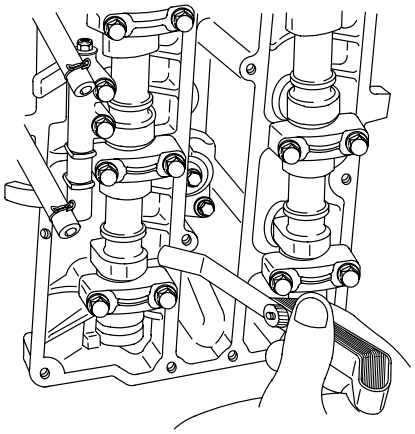
Intake cylinders #3 and #4
Exhaust cylinders #2 and #4

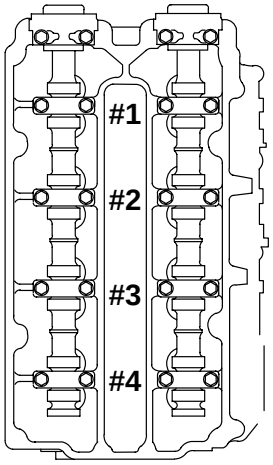
MEASUREMENT TABLE

INTAKE (cold) 0.007-0.009 in. (0.17-0.23 mm)				
CYL.	Clearance	Old Pad	New Pad	New Clearance
#1				
#2				
#3				
#4				

EXHAUST (cold) 0.012-0.014 in. (0.31-0.37 mm)				
CYL.	Clearance	Old Pad	New Pad	New Clearance
#1				
#2				
#3				
#4				







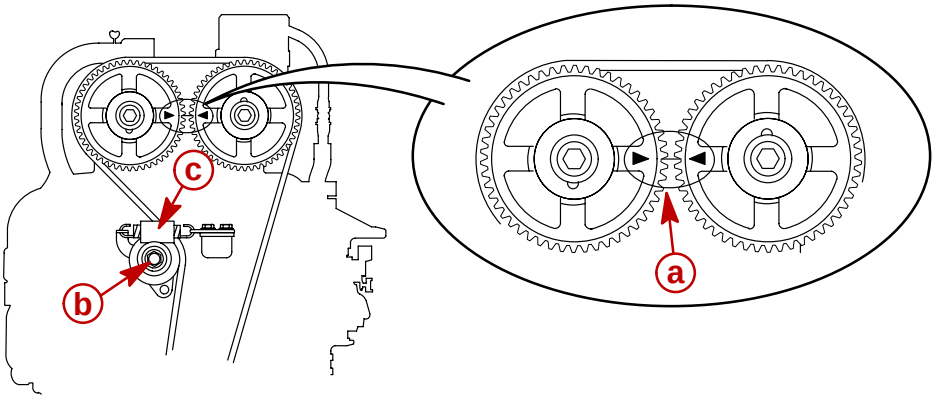
Intake **Exhaust**

10. If adjustment of intake or exhaust valve clearance is necessary (out of specification) follow **Changing Pad Thickness** below. If no adjustment is necessary skip to step #11 on page 18.

CHANGING PAD THICKNESS

1. Align timing marks on driven cams.
2. Loosen timing belt tensioner and remove tensioner spring.

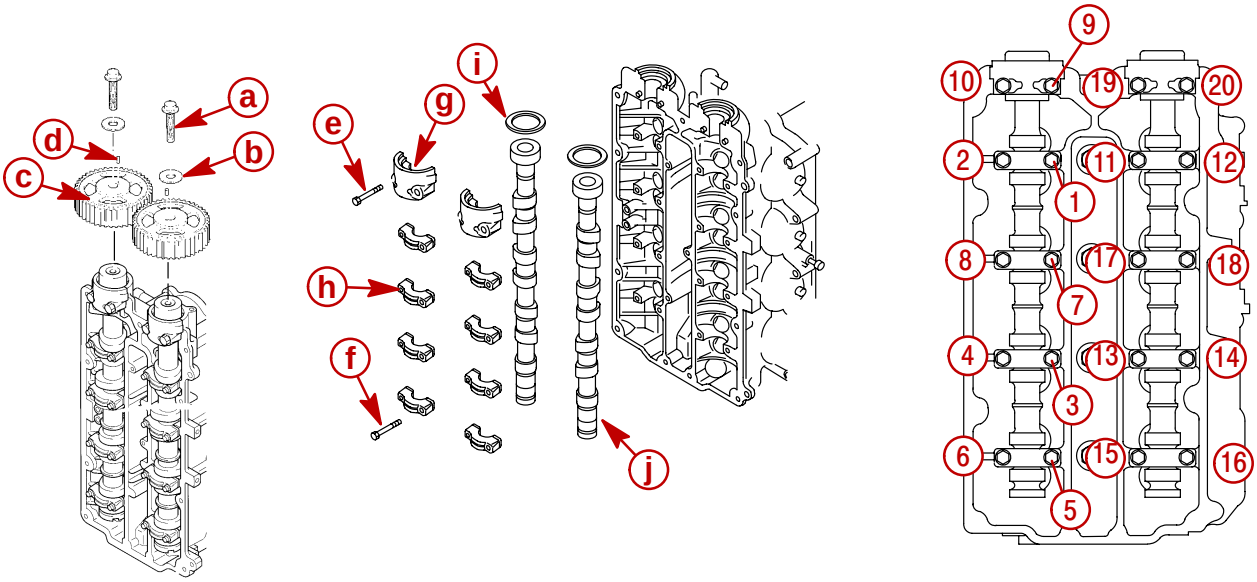
NOTE: *Do not mix valve train parts (valve pads, camshaft caps, camshafts). Keep individual cylinder parts together.*



a - Timing Marks
b - Timing Belt Tensioner Screw M10 x 45
c - Tensioner Spring

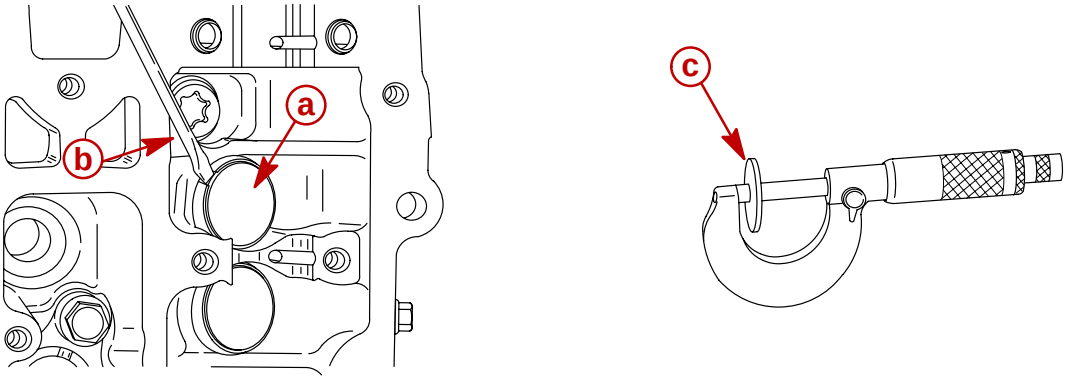
3. Remove timing belt and driven sprockets.
4. Remove camshaft caps and camshafts.

IMPORTANT: Remove camshaft cap bolts in reverse sequence (ex. #20→#1).



a - Driven Sprocket Screw (2) M10 x 35
b - Washer (2)
c - Driven Sprocket (2)
d - Pin (2)
e - Screw (4) M7 x 48
f - Screw (16) M7 x 37
g - Camshaft Cap - Top (2)
h - Camshaft Cap (8)
i - Oil Seal (2)
j - Camshaft (2)

5. Carefully pry up the valve pad and remove it.
6. Measure and record (in the **Measurement Table**) the thickness of the removed valve pad with a micrometer.



a - Valve Pad
b - Screwdriver
c - Measure Valve Pad Thickness With a Micrometer

a. Select a proper replacement valve pad by calculating its thickness with the following formula.

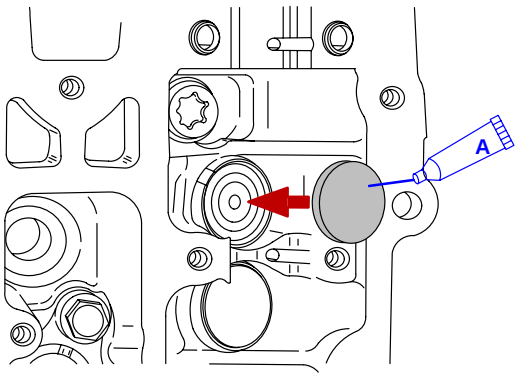
Removed Pad Thickness
+
Measured Valve Clearance
–
Specified Valve Clearance

= New Pad Thickness

NOTE: *Measure the thickness of the new valve pads with a micrometer (thickness is not indicated on the pad).*

NOTE: *Lubricate the valve pads with molybdenum disulfide before installing.*

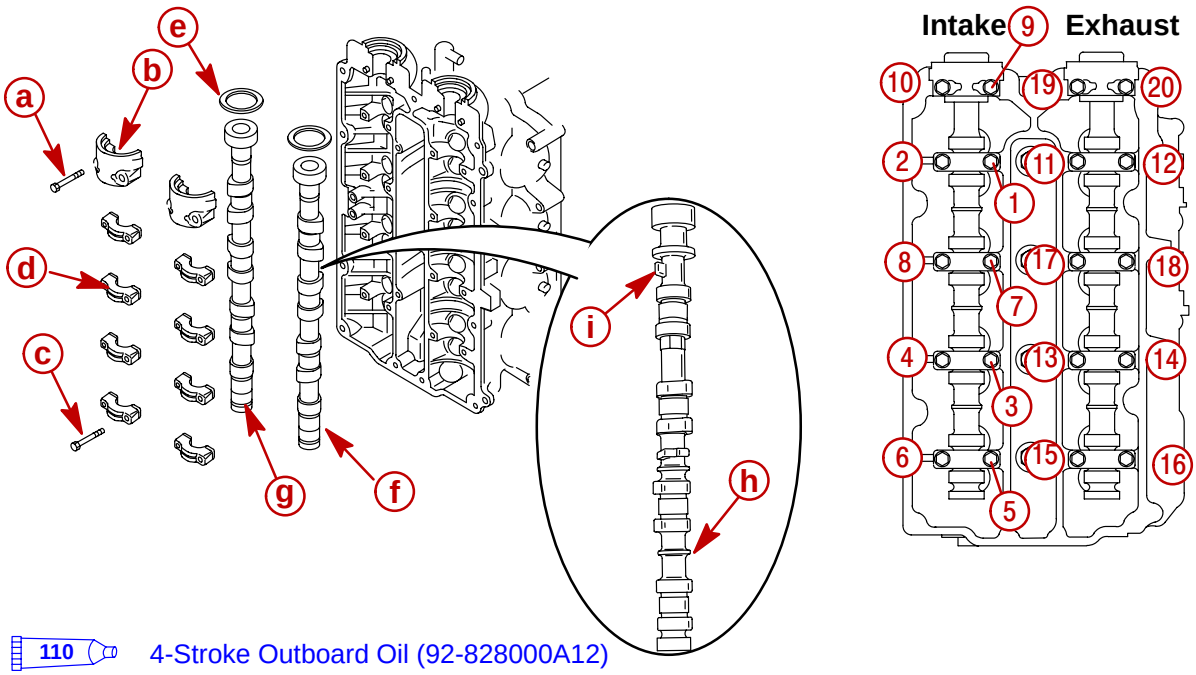
b. Insert the proper valve pad into the valve lifter.



A Molybdenum Disulfide Grease (Purchase Locally)

7. Install camshafts and camshaft caps

IMPORTANT: Install camshaft cap bolts in the proper sequence and torque.

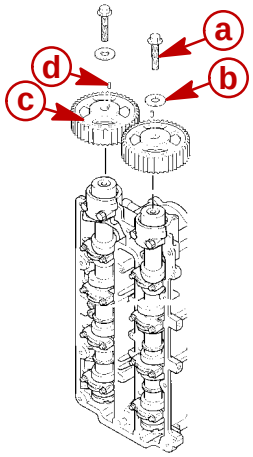


110 4-Stroke Outboard Oil (92-828000A12)

a - Screw (4) M7 x 48
b - Camshaft Cap Top (2)
c - Screw (16) M7 x 37
d - Camshaft Cap (8)
e - Oil Seal (2)
f - Camshaft - Intake
g - Camshaft - Exhaust
h - Pink Identification
i - Exhaust Cam Tang

Camshaft Cap Screw Torque	
1st	70 lb-in. (8 Nm)
2nd	150 lb-in. (17 Nm)

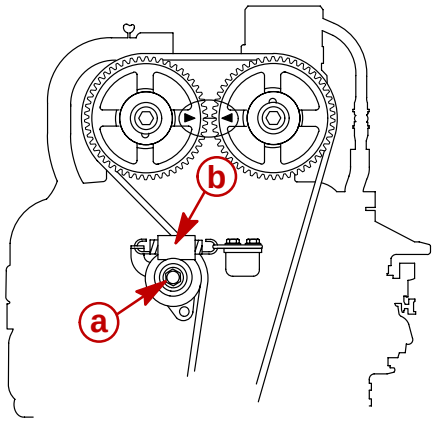
8. Install driven sprockets and timing belt.



a - Driven Sprocket Screw (2) M10 x 35
b - Washer (2)
c - Driven Sprocket (2)
d - Pin (2)

Driven Sprocket Screw Torque
44 lb-ft (60 Nm)

9. Tighten timing belt tensioner and install tensioner spring.



a - Timing Belt Tensioner Screw M10 x 45
b - Tensioner Spring

Timing Belt Tensioner Screw Torque
29 lb-ft (40 Nm)

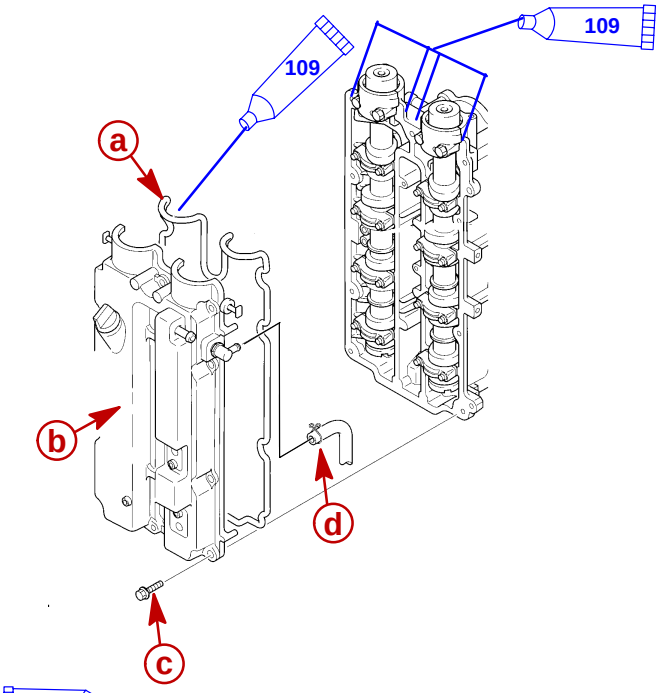
10. Re-check valve clearance using **Valve Clearance Measurement Steps**.

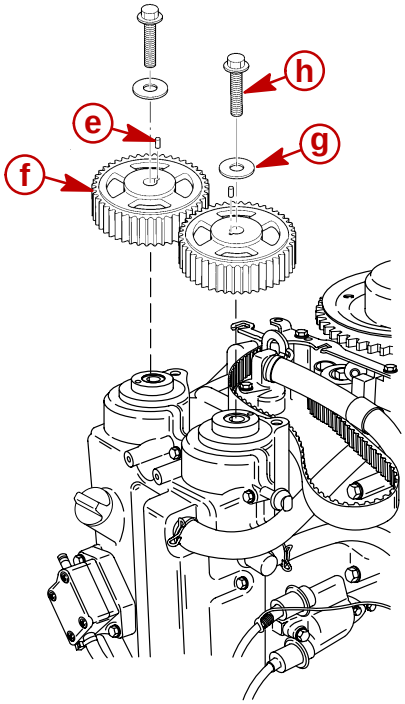
NOTE: *If any valve clearance is still out of specification, repeat all the valve clearance adjustment steps until the specified clearance is obtained.*

11. Loosen timing belt tensioner screw and remove tensioner spring.

12. Remove driven sprockets and timing belt.

13. Install cylinder head cover and driven sprockets.





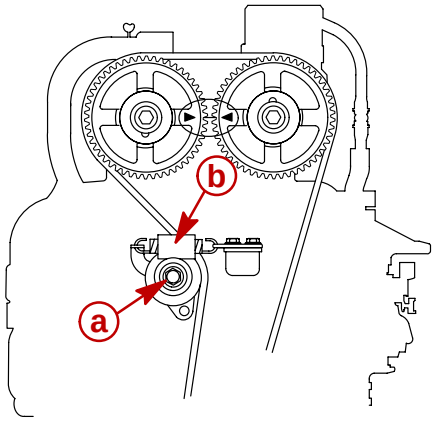
109 GM Silicone Sealer (92-91600-1)

a - Rubber Gasket
b - Cylinder Head Cover
c - Screw (14) M6 x 30
d - Breather Hose
e - Pin (2)
f - Driven Sprocket (2)
g - Washer (2)
h - Driven Sprocket Screw (2) M10 x 35

Cylinder Head Cover Screw Torque
70 lb-in. (8 Nm)

Driven Sprocket Screw Torque
44 lb-ft (60 Nm)

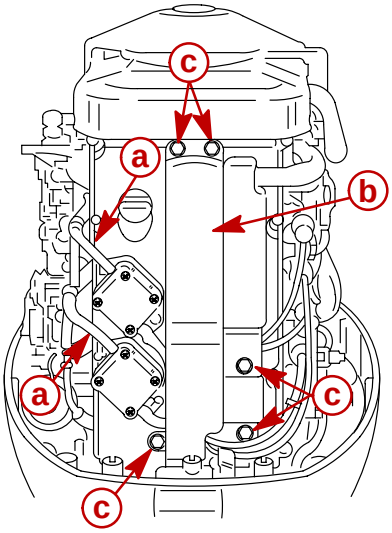
14. Install timing belt and spark plugs.
15. Install tensioner spring and tighten timing belt tensioner bolt.

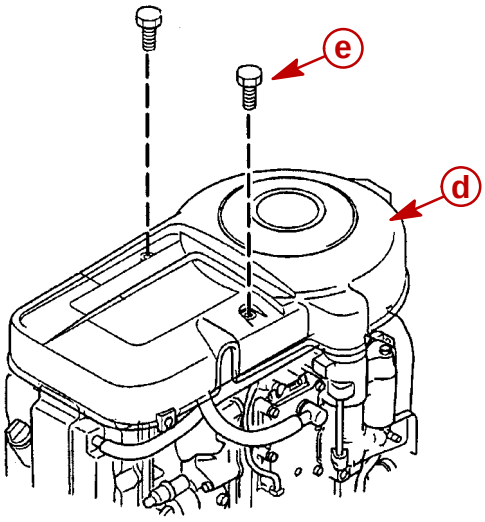


a - Timing Belt Tensioner Screw M10 x 45
b - Tensioner Spring

Timing Belt Tensioner Screw Torque
29 lb-ft (40 Nm)

16. Connect fuel hoses and spark plug leads.
17. Install spark plug cover and flywheel cover.

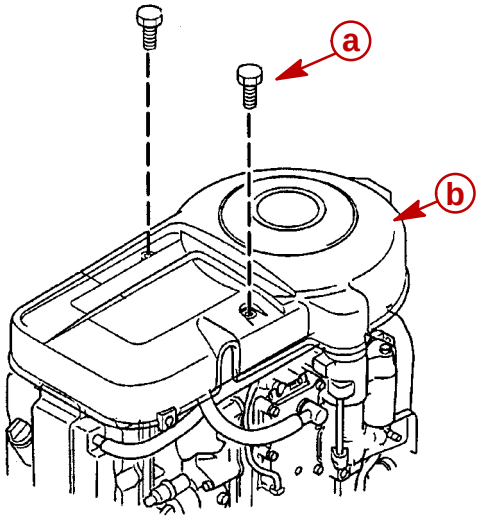


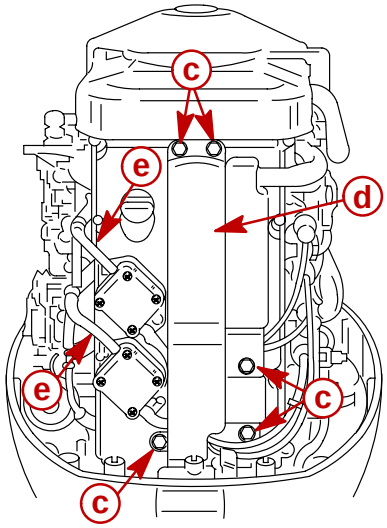


a - Fuel Hoses
b - Spark Plug Cover
c - Screw (5) M6 x 16
d - Flywheel Cover
e - Screw (2) M6 x 20

Preparing Cylinder Head for Removal

1. Remove flywheel cover and spark plug cap cover.
2. Disconnect fuel hoses and spark plug leads.

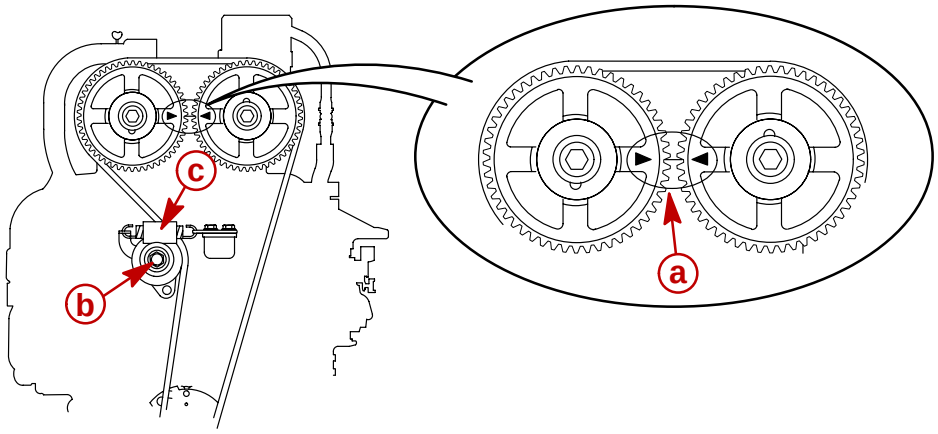


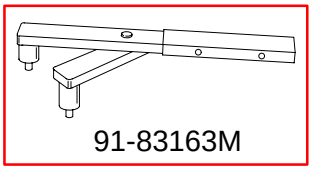


a - Screw (2) M6 x 20
b - Flywheel Cover
c - Screw (5) M6 x 16
d - Spark Plug Cover
e - Fuel Hoses

3. Align timing marks on driven cams.
4. Loosen timing belt tensioner and remove tensioner spring.

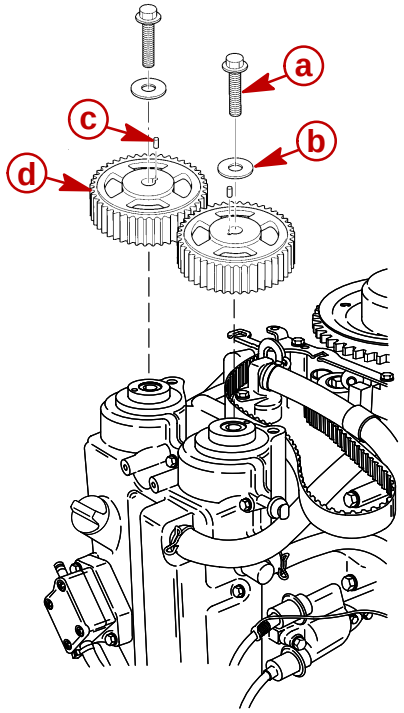
NOTE: *Use flywheel holder (91-83163M) to rotate flywheel and align timing marks.*

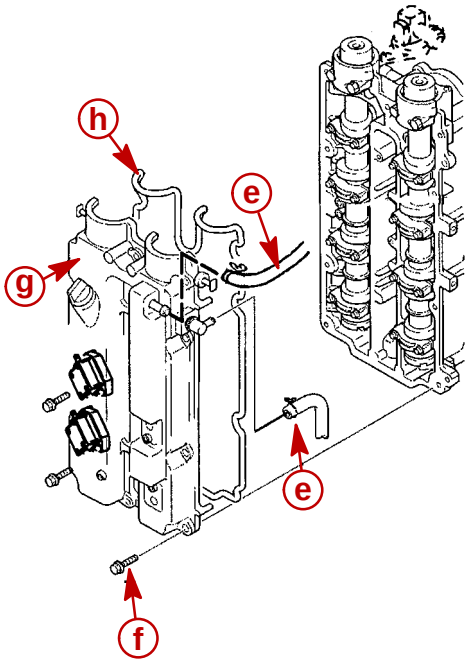




a - Timing Marks
b - Timing Belt Tensioner Screw M10 x 45
c - Tensioner Spring

5. Remove timing belt and driven sprockets.
6. Remove fuel pumps and cylinder head cover.



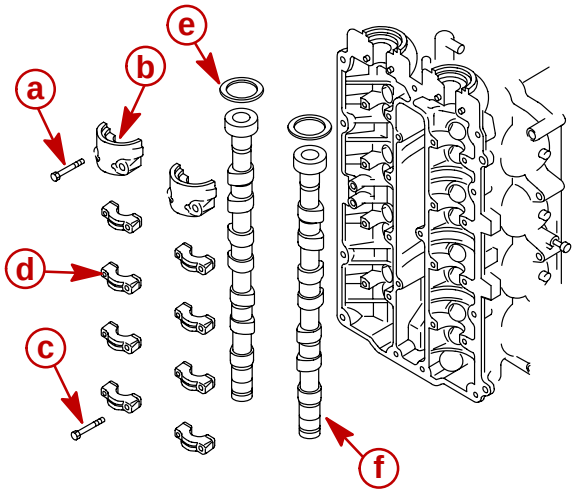


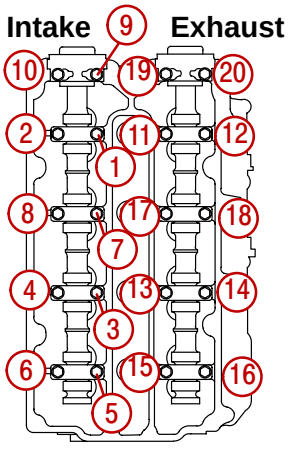
a - Driven Sprocket Screw (2) M10 x 35
b - Washer (2)
c - Pin (2)
d - Driven Sprocket (2)
e - Breather Hose
f - Screw (14) M6 x 30
g - Cylinder Head Cover
h - Rubber Gasket

7. Remove camshaft caps and camshafts.

NOTE: *Do not mix valve train parts (valve pads, camshaft caps, camshafts). Keep individual cylinder parts together.*

IMPORTANT: Remove camshaft cap bolts in reverse sequence (ex. #20→#1).





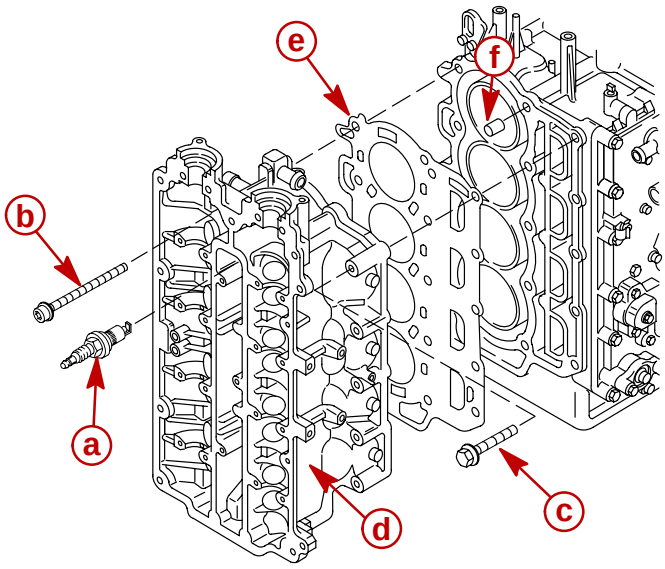
a - Screw (4) M7 x 48
b - Camshaft Cap - Top (2)
c - Screw (16) M7 x 37
d - Camshaft Cap (8)
e - Oil Seal (2)
f - Camshaft (2)

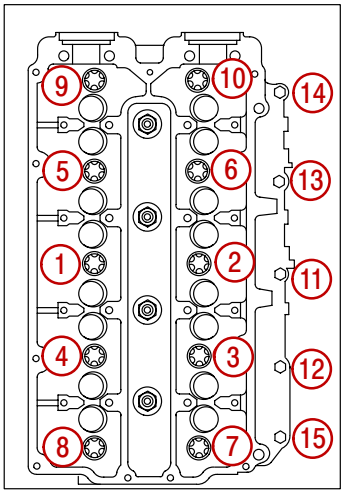
Cylinder Head Removal

1. Remove spark plugs and cylinder head assembly.
2. Remove gasket and discard dowel pins.

IMPORTANT: Remove cylinder head bolts in reverse order of torque sequence (ex. #15→►#1).

NOTE: *Use Torx® socket driver T55 for removal/installation of cylinder head bolts.*





a - Spark plugs
b - Screw (10) M10 x145
c - Screw (5) M8 x 55
d - Cylinder Head Assembly
e - Gasket (discard)
f - Dowel Pins (2)

Cylinder Head Disassembly

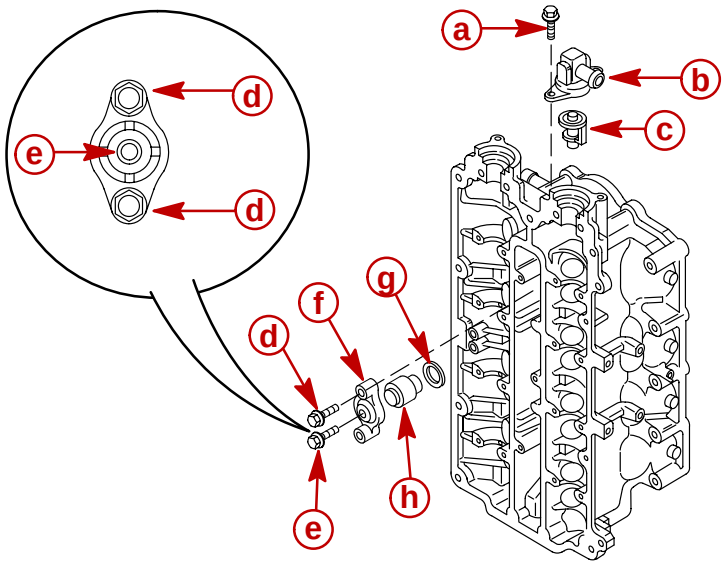
1. Remove thermostat and anodes.

IMPORTANT: To prevent anode from falling into water jacket use the following procedure for anode removal:

a. Remove anode cover screws “d”.

b. Remove anode assembly from cylinder block.

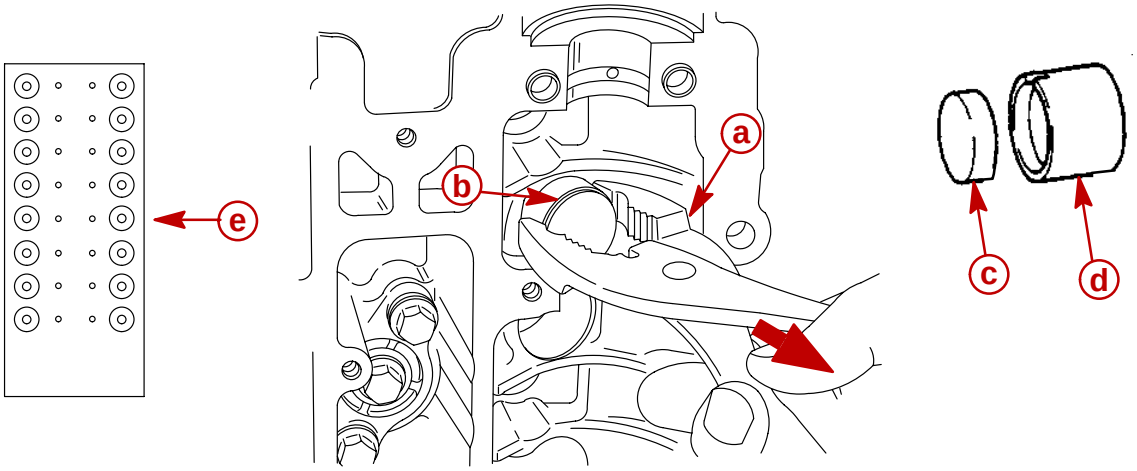
c. Remove anode center screw “e”.



a - Screw (2) M6 x 25
b - Thermostat Cover
c - Thermostat
d - Screw (4) M8 x 25
e - Screw (2) M6 x 20
f - Anode Cover (2)
g - O-Ring (2)
h - Anode (2)

2. Remove valve pad and valve lifter.

NOTE: *Keep valve pads and lifters organized to prevent them from being installed into the wrong location during cylinder head reassembly.*



a - Pliers
b - Valve Pad and Lifter
c - Valve Pad
d - Valve Lifter
e - Lifter Position Fixture

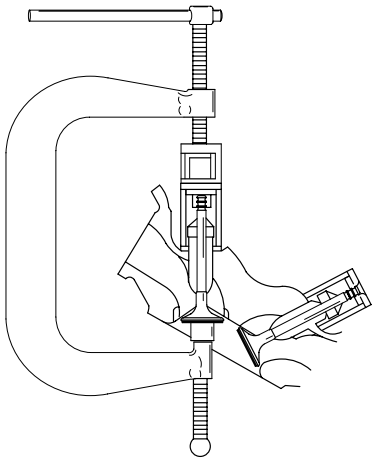
3. Remove valve cotter, spring retainer, and spring.

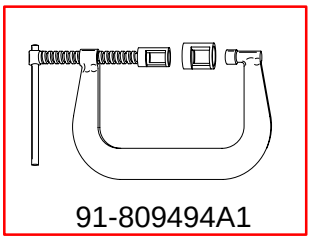
NOTE: *Use valve spring compressor (p/n 91-809494A1) for removal of valves. Compress valve and remove valve cotters first.*

4. Remove valve stem seal, spring seat, and valve guide* (see note below).

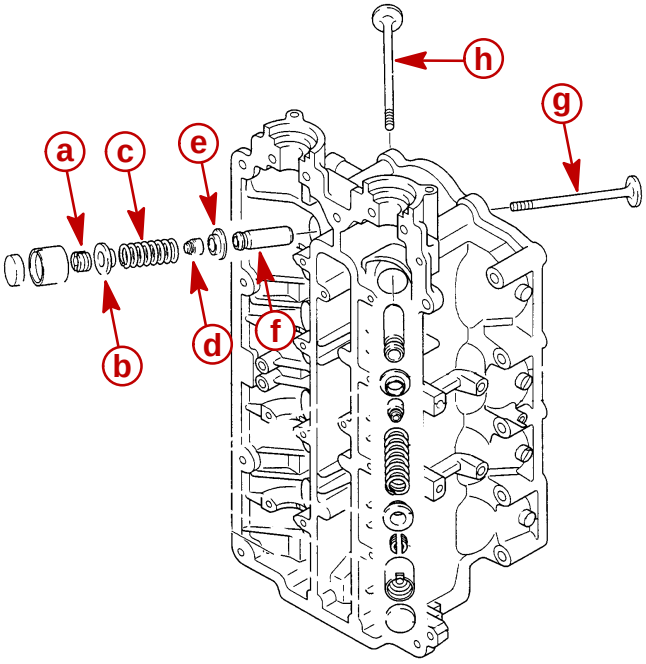
5. Remove valves (intake and exhaust).

NOTE: **Do not remove valve guide unless it is out of specification, refer to* ***"Cleaning/Inspection/Repair"*** *in this section for measurement and removal procedures.*





91-809494A1

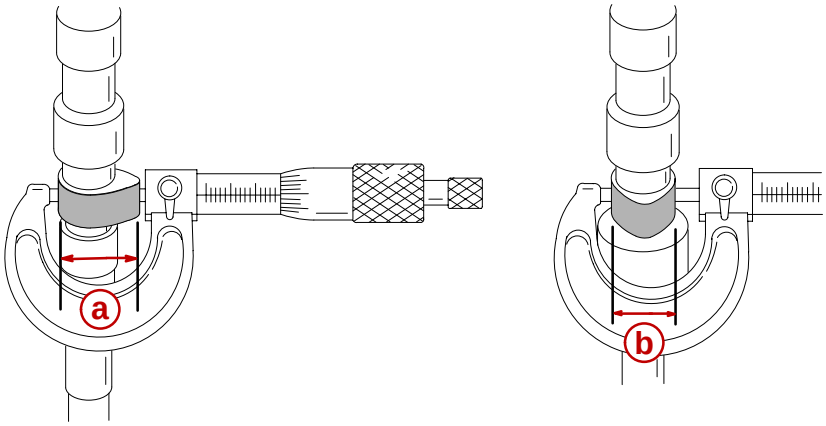


a - Valve Cotter
b - Spring Retainer
c - Valve Spring
d - Valve Stem Seal
e - Spring Seat
f - Valve Guide
g - Exhaust Valve
h - Intake Valve

Cleaning/Inspection/Repair

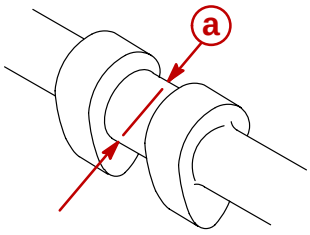
Camshaft

1. Measure camshaft lobe dimensions “a” and “b”. Replace the camshaft if out of specification.



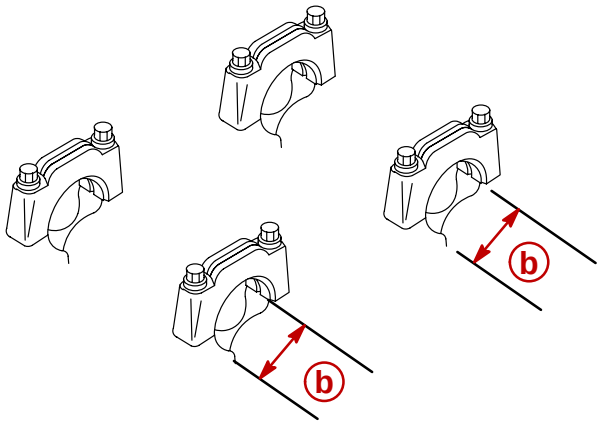
Cam Lobe Specifications		
a	Intake	1.465 - 1.472 in. (37.22 - 37.38 mm)
	Exhaust	1.453 - 1.459 in. (36.90 - 37.06 mm)
b	Intake	1.178 - 1.184 in. (29.92 - 30.08 mm)
	Exhaust	1.178 - 1.184 in. (29.92 - 30.08 mm)

2. Measure camshaft journal diameter “a”. Replace the camshaft if out of specification.



Camshaft Journal Diameter “a”
0.9827 - 0.9835 in. (24.96 - 24.98 mm)

3. Measure camshaft cap inside diameter “b”. Replace cylinder head if out of specification.



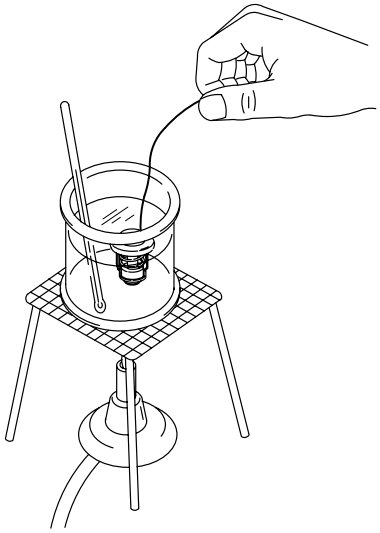
Camshaft Cap Inside Diameter “b”
0.984 - 0.985 in. (25.000 - 25.021 mm)

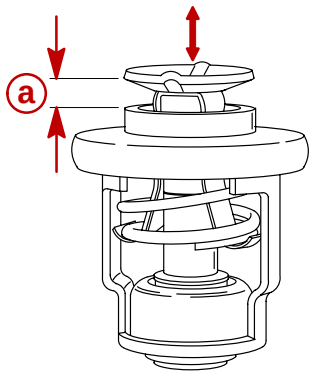
Thermostat

1. Inspect thermostat. Replace if damaged or valve does not open.
2. Measure valve opening temperature and valve lift “a” using the “**Measurement Test**” below. Replace thermostat if out of specification.

MEASUREMENT TEST

1. Tie a piece of thread (or other non-conductive material) onto the thermostat.
2. Suspend the thermostat in water.
3. Heat water slowly while observing the thermostat.



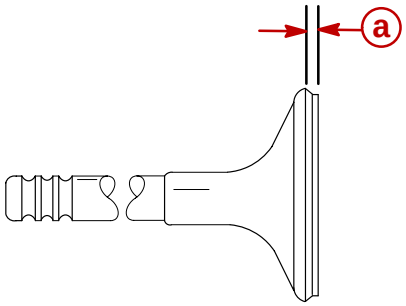


a - Valve Lift Distance

Water Temperature	Valve Lift
Below 140° F (60° C)	0 in. (0 mm)
Above 158° F (70° C)	Minimum 0.12 in. (3 mm)

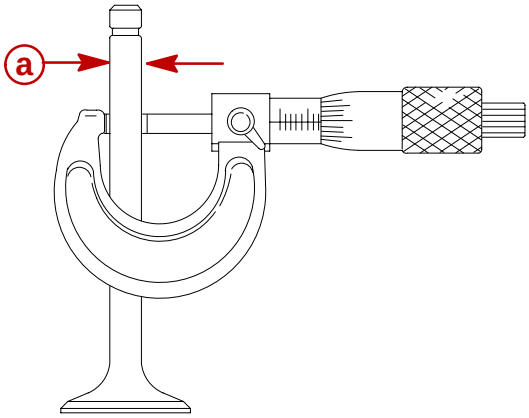
Valves

1. Inspect valve for damage/warpage. Replace if necessary.
2. Measure margin thickness “a”. Replace valve if out of specification.



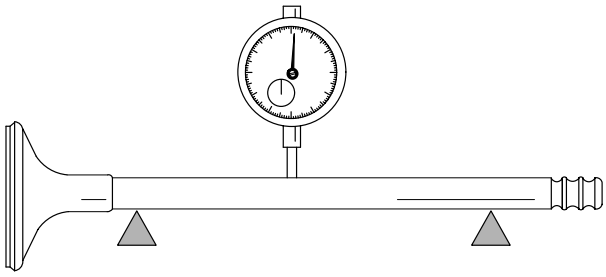
Margin Thickness “a”	
Intake Valve	0.018 - 0.026 in. (0.45 - 0.65 mm)
Exhaust Valve	0.026 - 0.033 in. (0.65 - 0.85 mm)

3. Measure the valve stem diameter “a”. Replace valves if out of specification.



Valve Stem Diameter “a”	
Intake Valve	0.2352 - 0.2358 in. (5.975 - 5.990 mm)
Exhaust Valve	0.2346 - 0.2352 in. (5.960 - 5.975 mm)

4. Measure valve stem runout. Replace valves if out of specification.

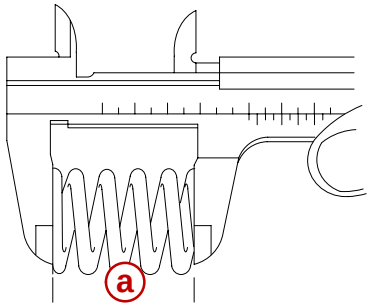


Valve Stem Runout Limit (Max.)	
Intake Valve Exhaust Valve	0.001 in. (0.03 mm)

NOTE: *Valve guides, valve seal, and valves should be replaced as a set.*

Valve Springs

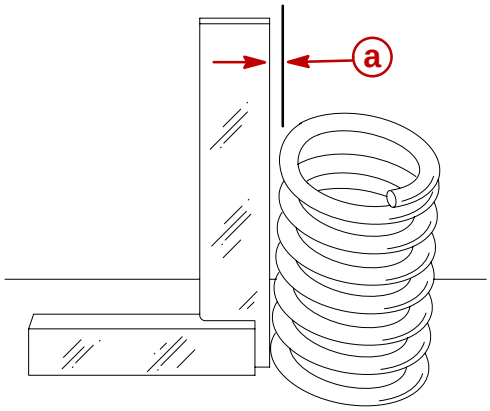
1. Check free length limit “a” of each spring. Replace valve springs if out of specification.



Valve Spring Free Length
2.057 in. (52.25 mm)

2. Measure valve spring tilt “a”. Replace valve springs if out of specification.

NOTE: Check each spring on a flat surface using a square. Rotate spring and check space between the top coil and square.

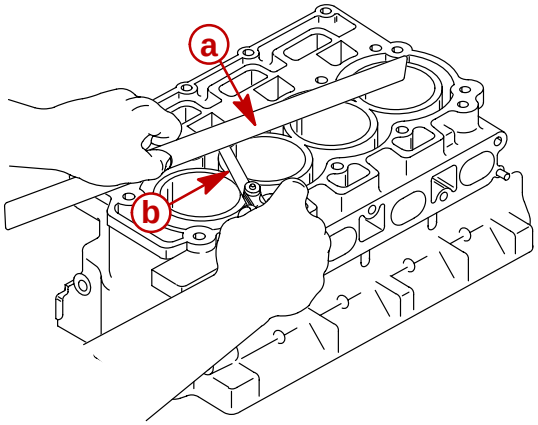


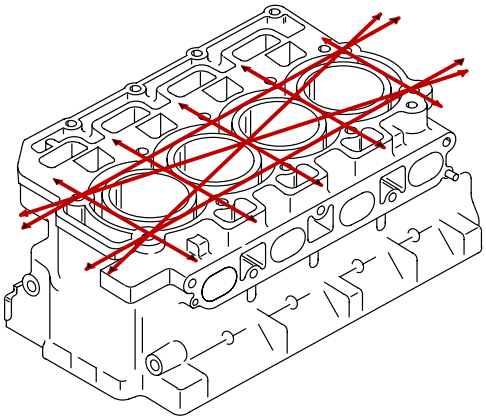
Valve Spring Tilt Specification “a”
Less than 0.10 in. (2.6 mm)

Cylinder Head

1. Inspect the cylinder head for mineral deposits/corrosion in the water passage ways. Clean any deposits/corrosion observed.
2. Inspect the cylinder head for carbon deposits in combustion chamber (use round scraper to clean away deposits). Be careful not to scratch or remove material.
3. Measure cylinder head warpage. Replace cylinder head if out of specification.

NOTE: *Use a straight edge and a thickness gauge to inspect cylinder head for warpage.*



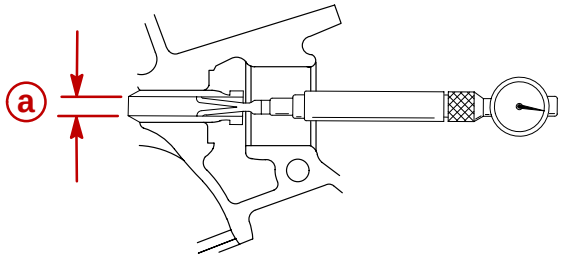


a - Straight Edge
b - Thickness Gauge

Cylinder Head Warpage Limit
0.004 in. (0.1 mm)

Valve Guides

1. Measure the valve guide bore “a”. If valve guide wear is out of specification, replace the valve guide by following **“Valve Guide Replacement”** below.

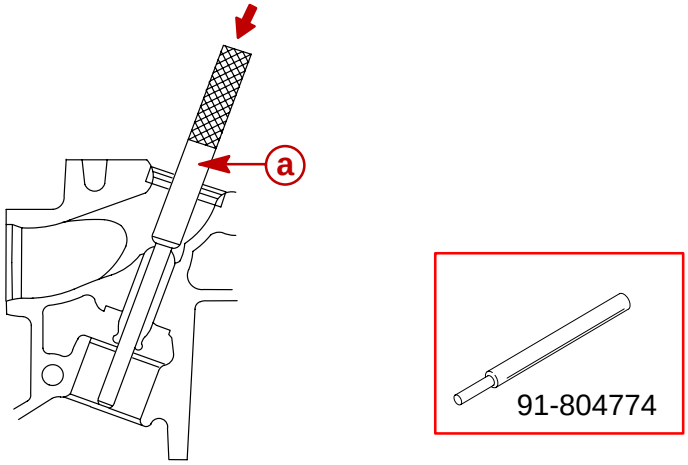


Valve Guide Inside Diameter	
Intake Valve / Exhaust Valve	0.2364 - 0.2369 in. (6.005 - 6.018 mm)

VALVE GUIDE REPLACEMENT

NOTE: *Heat the cylinder head in an oven to 390° F (200° C). This will help to ease guide removal and installation, and to maintain correct interference fit.*

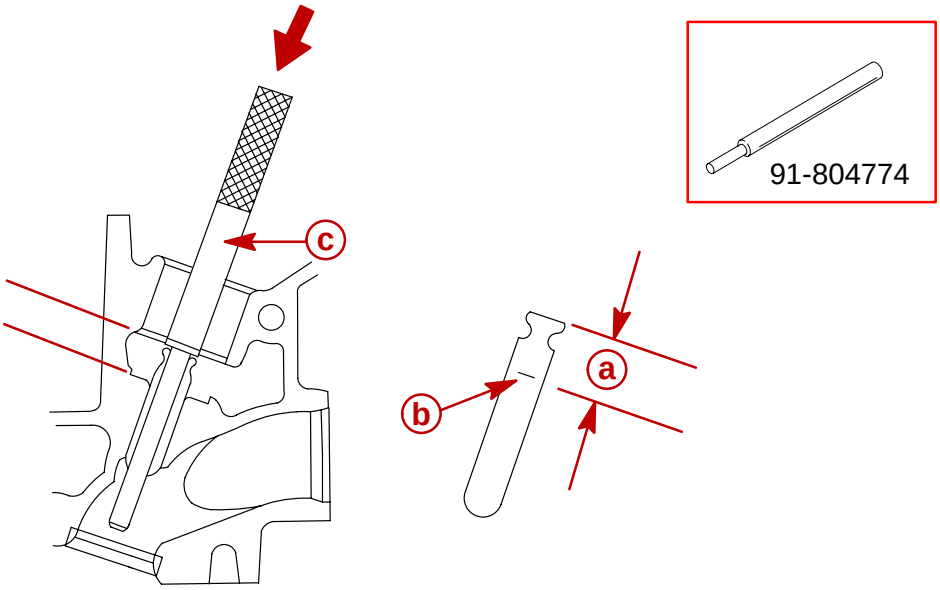
1. Remove the valve guide using a valve guide remover/installer.



a - Valve Guide Remover/Installer (91-804774)

2. Install the new valve guide to the specified position “a” using the valve guide remover/installer.

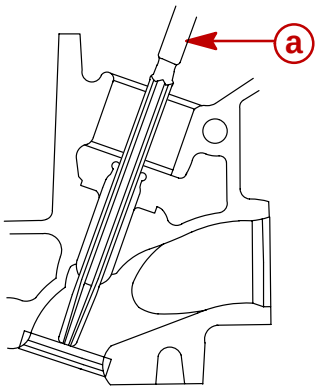
NOTE: *Before installing the valve guide, mark the installation depth “b” as shown.*

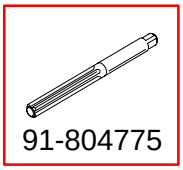


a - Valve Guide Depth Position “a”
b - Installation Depth Mark
c - Valve Guide Remover/Installer (91-804774)

Valve Guide Depth Position “a”
0.45 in. (11.5 mm)

3. After installing the valve guide, bore the valve guide using a valve guide reamer to obtain proper stem-to-guide clearance.





a - Valve Guide Reamer (91-804775)

Stem To Guide Clearance	
Intake	0.0006-0.0017 in. (0.015-0.043 mm)
Exhaust	0.0012-0.0023 in. (0.030-0.058 mm)

Valve Seats

VALVE SEAT RECONDITIONING

Clean the carbon deposits from the combustion chambers and valve seats and check for pitting.

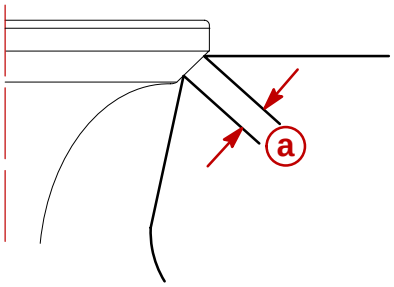
Several different types of equipment are available for reseating valve seats. Follow the equipment manufacturer's instructions.

Measure valve seat width "a". Resurface the valve seat if not in specification.

Reface valve seat. Use a 90° or 45° valve seat cutter.

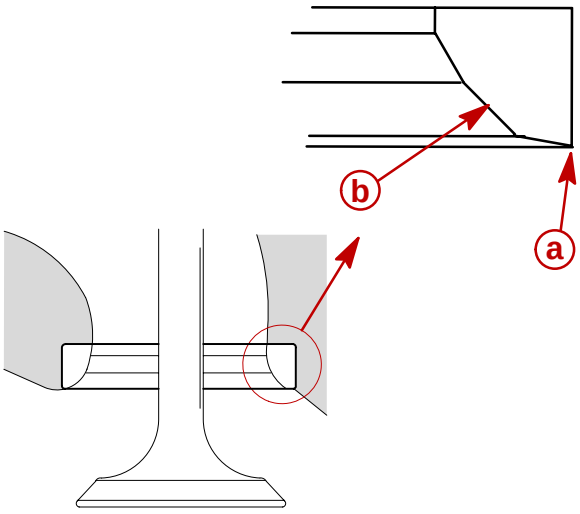
NOTE: *When twisting cutter, keep an even downward pressure to prevent chatter marks.*

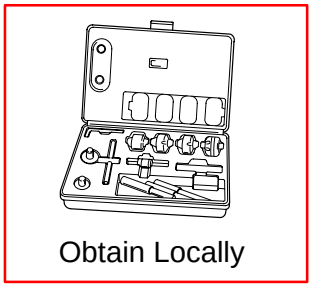
NOTE: *After refacing the valve seat or replacing the valve and valve guide, the valve seat and valve face should be lapped.*



Valve Seat Width Specification "a"	
Intake Valve/Exhaust Valve	0.014 - 0.022 in. (0.35 - 0.55 mm)

NOTE: *If resurfacing the valve seats is required, resurface the valve seats to the specified angles shown in chart following.*

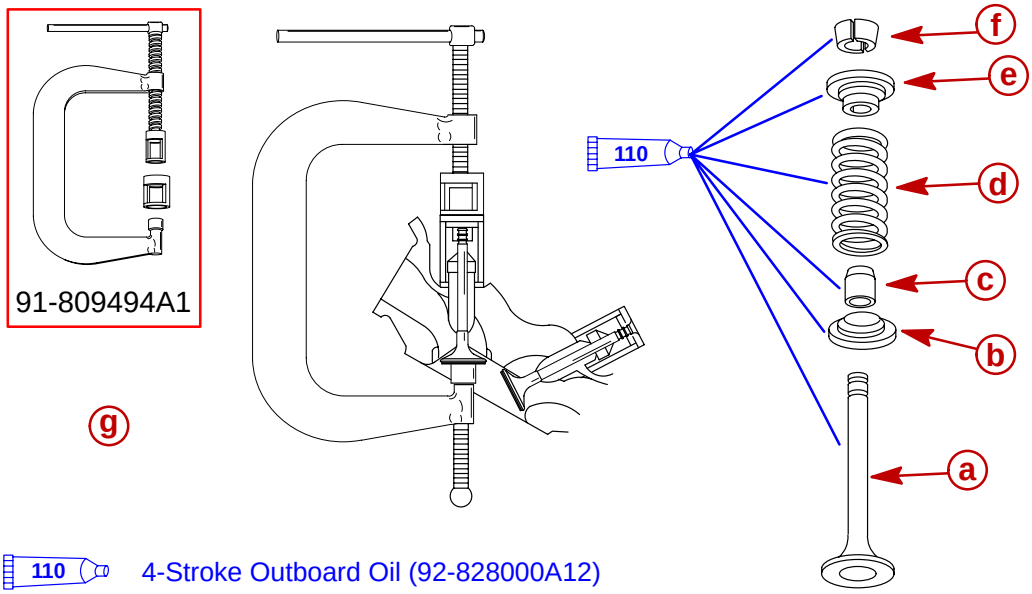




Valve Seat Area	Valve Seat Cutter
a	90°
b	45°

Cylinder Head Reassembly

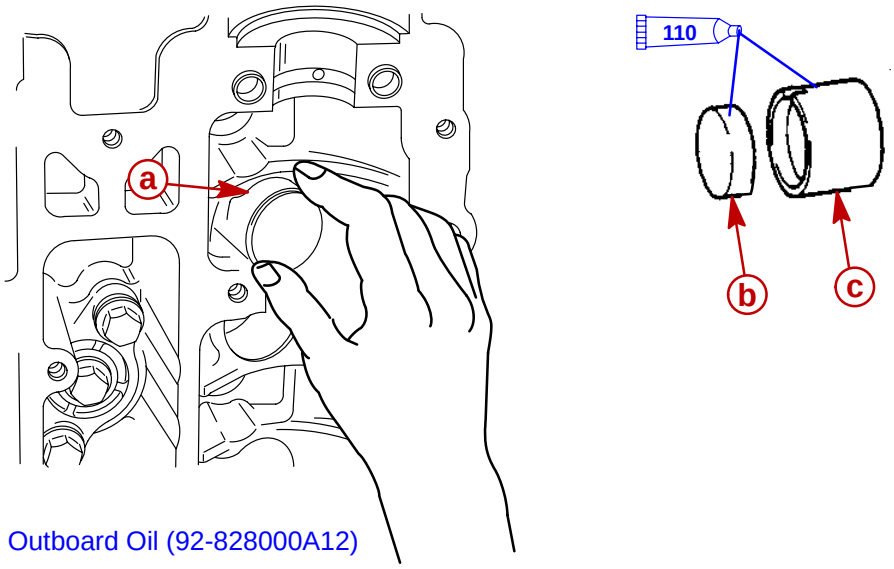
1. Install valves (intake and exhaust).
2. Install spring seat and valve stem seal.
3. Install spring and spring retainer.
4. Compress valve springs using valve spring compressor and install valve cotters onto their respective valves.



110 4-Stroke Outboard Oil (92-828000A12)

a - Valves (Intake And Exhaust)
b - Spring Seat
c - Valve Stem Seal
d - Valve Spring
e - Spring Retainer
f - Valve Cotter
g - Valve Spring Compressor

5. Install valve pad and valve lifter into their original locations.



110 4-Stroke Outboard Oil (92-828000A12)

a - Valve Pad and Lifter
b - Valve Pad
c - Valve Lifter

6. Install anode and thermostat.

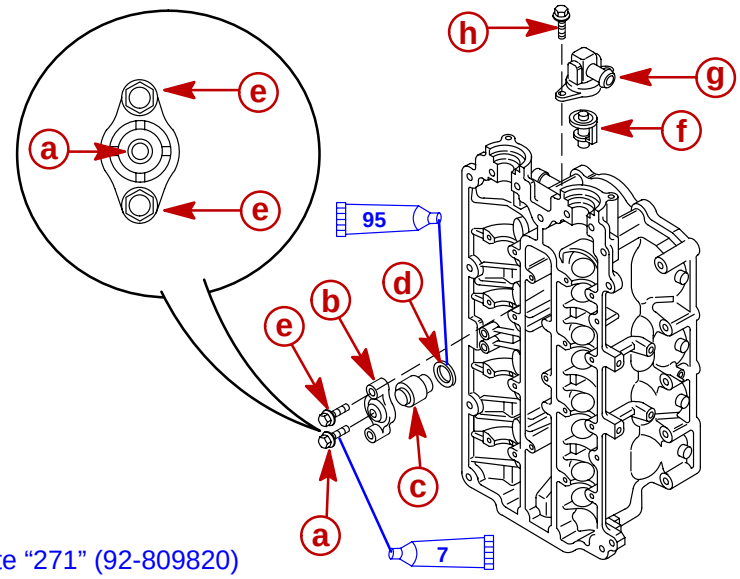
IMPORTANT: To prevent anode from falling into water jacket use the “Anode Assembly” procedure for anode installation:

Anode Assembly

a. Install anode bolt “a” to secure anode to anode cover.

b. Install anode assembly in cylinder block.

c. Install anode cover bolts “e”.



7 Loctite “271” (92-809820)

95 2-4-C w/Teflon (92-850736A1)

a - Screw-(2) M6 x 20
b - Anode Cover (2)
c - Anode (2)
d - O-Ring (2)
e - Screw (4) M8 x 25
f - Thermostat
g - Thermostat Cover
h - Screw (2) M6 x 25

Anode Screw Torque
70 lb-in. (8 Nm)

Anode Cover Screw Torque
156 lb-in. (18 Nm)

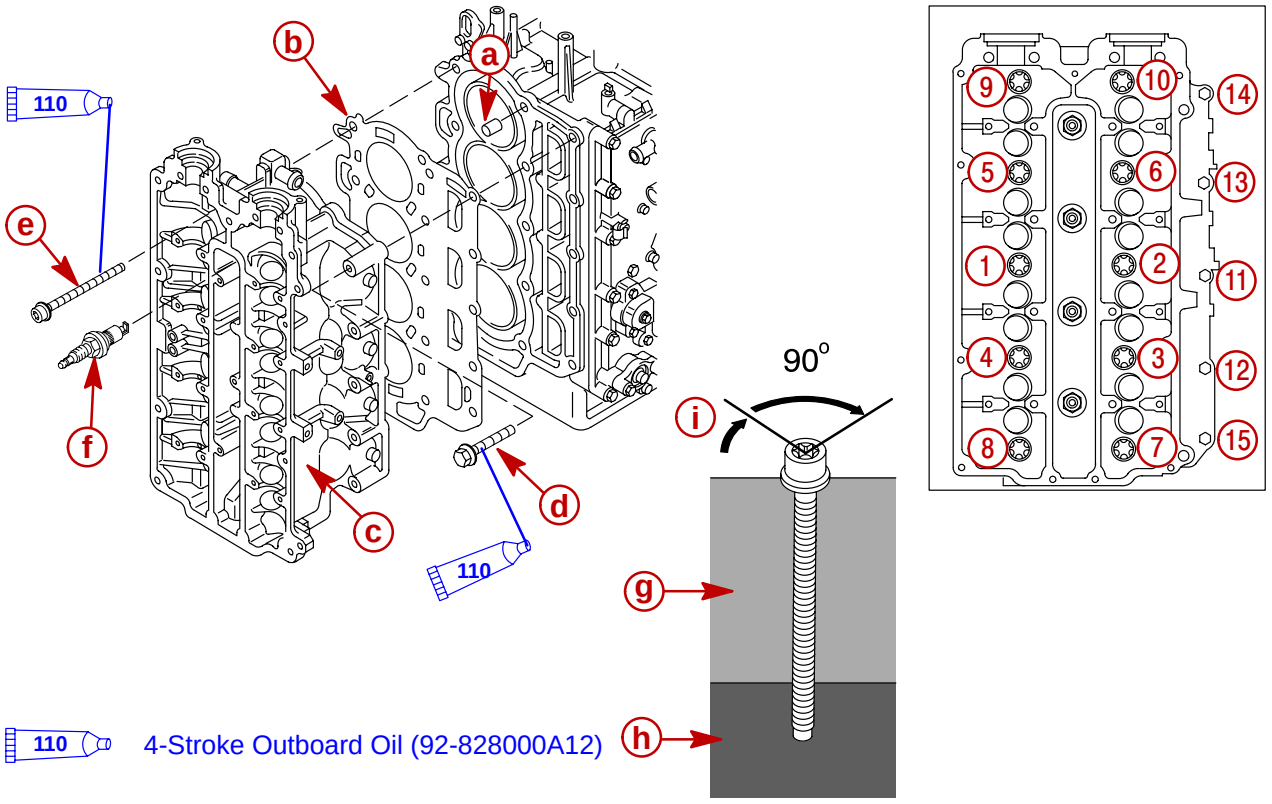
Thermostat Screw Torque
70 lb-in. (8 Nm)

Cylinder Head Installation

1. Install dowel pins and gasket (New).
2. Install cylinder head assembly and spark plugs.

IMPORTANT: Install cylinder head bolts in torque sequence (ex. #1 → #15) with proper torque.

NOTE: *Use Torx® socket driver T55 for removal/installation of cylinder head bolts.*



a - Dowel Pins (2)
b - Gasket (New)
c - Cylinder Head Assembly
d - Bolt (5) M8 x 55
e - Bolt (10) M10 x 145
f - Spark plugs
g - Cylinder Head
h - Cylinder Block
i - Specified Torque

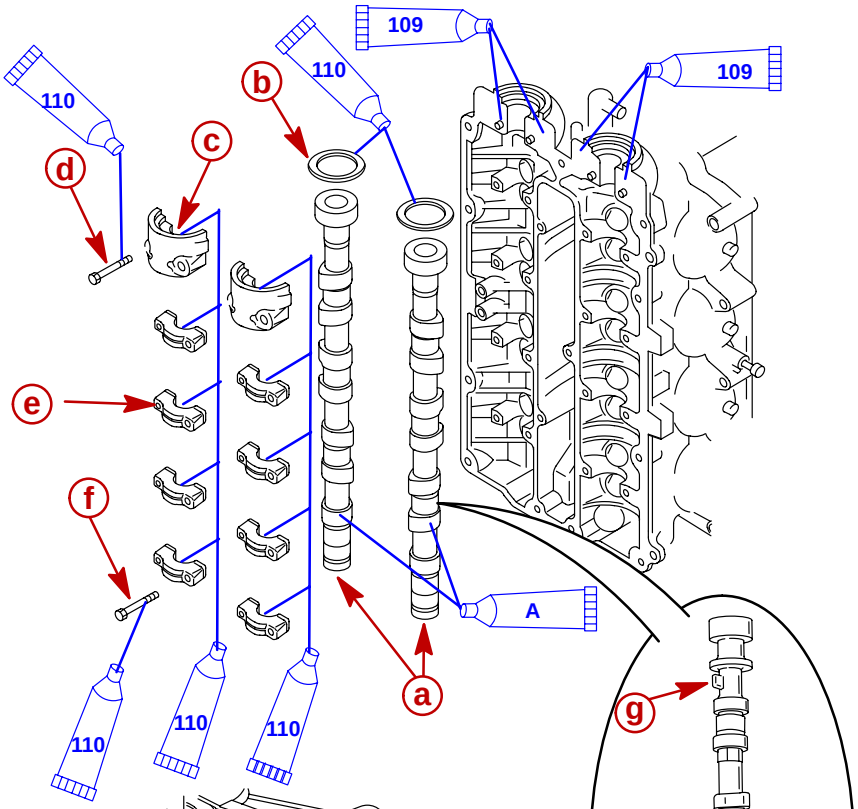
Cylinder Head Bolt Torque-M8 x 55 mm	
1st	120 lb-in. (14 Nm)
2nd	20 lb-ft (28 Nm)

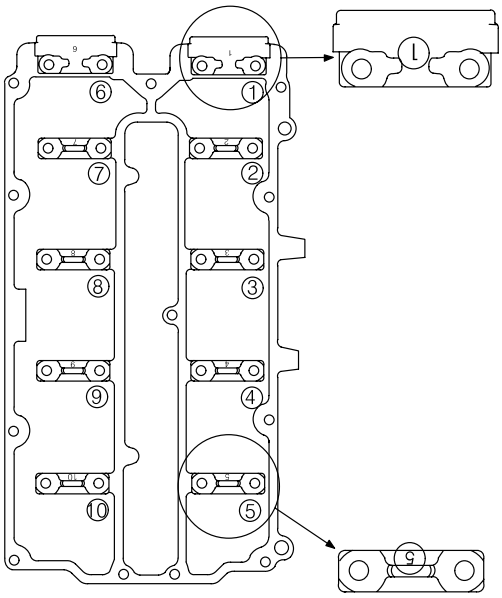
Cylinder Head Bolt Torque-M10 x 145 mm	
1st	132 lb-in. (15 Nm)
2nd	24 lb-ft (33 Nm)
3rd	90° 51 lb-ft (70 Nm)*

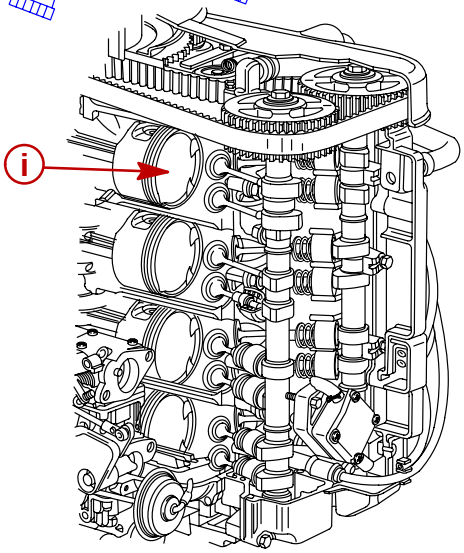
*Torque value given for reference only.

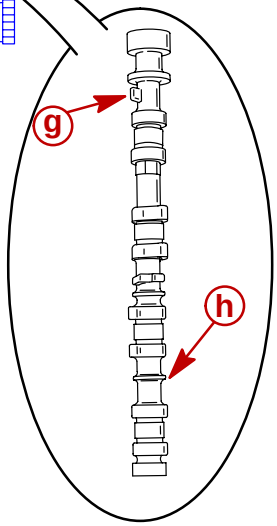
Following Cylinder Head Installation

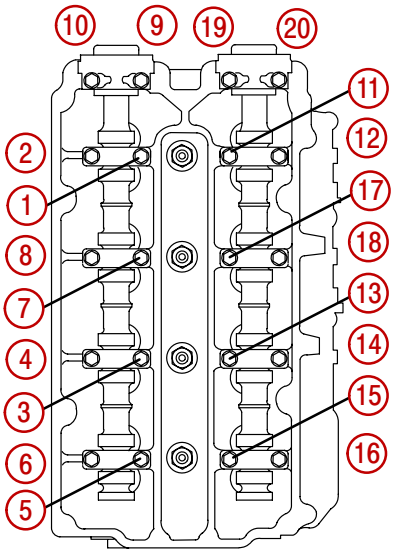
1. Install camshafts and camshaft caps.











109 GM Silicone Sealer (92-91600-1)
110 4-Stroke Outboard Oil (92-828000A12)
A Molybdenum Disulfide Grease (Obtain Locally)

a - Camshaft (2)
b - Oil Seal (2)
c - Camshaft Cap (2)
d - Screw (4) M7 x 48
e - Camshaft Cap (8)
f - Screw (16) M7 x 37
g - Exhaust Cam Tang
h - Pink Identification
i - Pistons Turned 90° Past TDC

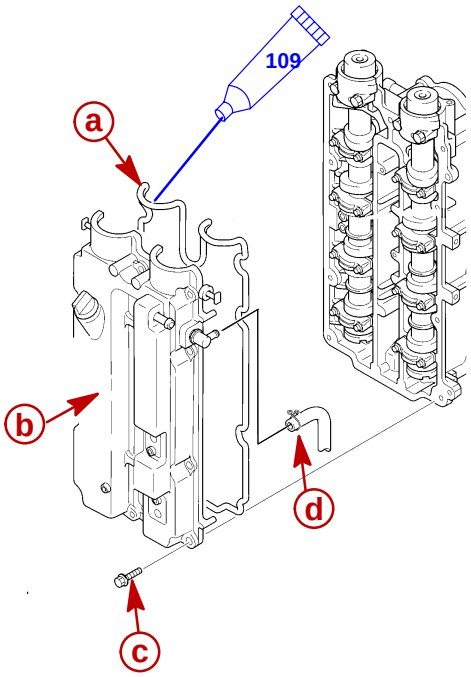
IMPORTANT: Install camshaft with tang and pink identifying mark on exhaust side of cylinder head.

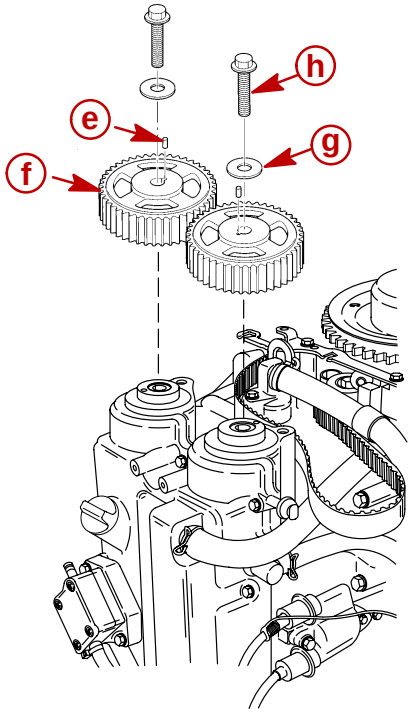
IMPORTANT: Before installing the intake and exhaust camshafts, turn the crankshaft 90° past TDC (either direction) to prevent bending of valves during cap installation.

NOTE: *Install the camshaft caps in the proper position and sequence as shown and with the stamped numbers facing* ***upside down****.*

Camshaft Cap Bolt Torque	
1st	70 lb-in. (8 Nm)
2nd	144 lb-in. (17 Nm)

2. Install cylinder head cover and driven sprockets.





109 GM Silicone Sealer (92-91600-1)

a - Rubber Gasket
b - Cylinder Head Cover
c - Screw (14) M6 x 30
d - Breather Hose
e - Pin (2)
f - Driven Sprocket (2)
g - Washer (2)
h - Driven Sprocket Screw (2) M10 x 35

Cylinder Head Cover Screw Torque
70 lb-in. (8 Nm)

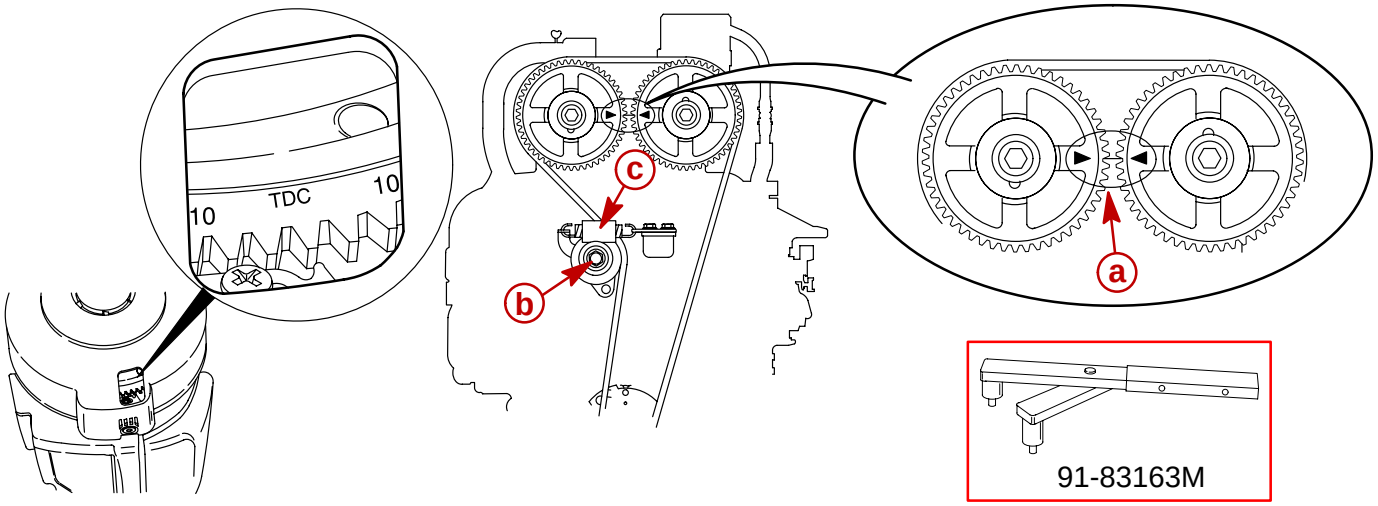
Driven Sprocket Screw Torque
43 lb-ft (60 Nm)

Timing Belt Installation

1. Align timing marks on driven cams.

NOTE: *Use flywheel holder (91-83163M) to rotate flywheel and align timing marks.*

2. Align pointer with TDC mark on flywheel.
3. Install timing belt.
4. Install tensioner spring and secure timing belt tensioner bolt.



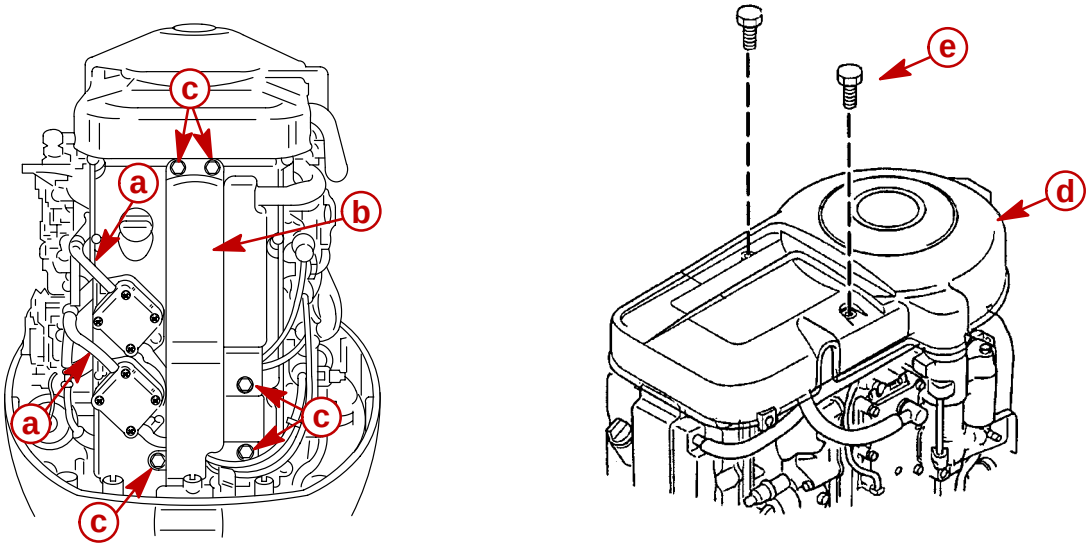
a - Timing Marks
b - Timing Belt Tensioner Screw M10 x 45
c - Tensioner Spring

Timing Belt Tensioner Screw Torque
29 lb-ft (40 Nm)

5. Connect fuel hoses and spark plug leads.

NOTE: *Secure fuel hoses with spring clips.*

6. Install spark plug cap cover and flywheel cover.



a - Fuel Hoses
b - Spark Plug Cap Cover
c - Bolts (5) M6 x 25 mm
d - Flywheel Cover
e - Bolts (2) M6 x 20 mm

Extra Valve Clearance Work sheets

NOTE: *Photocopy this page for extra valve clearance measurement work sheets.*

Measurement

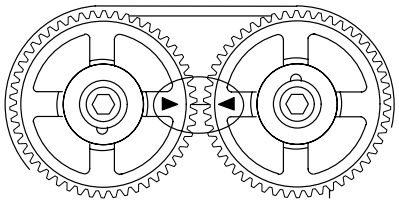
1. Turn flywheel clockwise until cylinder #1's piston is at TDC.
2. Measure and record the intake valve clearance for cylinders #1 and #2.
3. Measure and record the exhaust valve clearance for cylinders #1 and #3.
4. Turn the flywheel 360° clockwise.
5. Measure and record the intake valve clearance for cylinders #3 and #4.
6. Measure and record the exhaust valve clearance for cylinders #2 and #4.

Adjustment

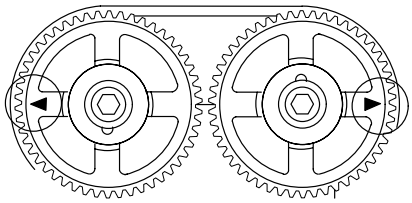
1. If clearance is out of specification, remove and measure the pad.
2. Add or subtract to that measurement a number to put the valve back into specification.
3. Use that measurement to select a new pad.

Removed Pad Thickness
+
Measured Valve Clearance
–
Specified Valve Clearance

= New Pad Thickness



Intake cylinders #1 and #2
Exhaust cylinders #1 and #3



Intake cylinders #3 and #4
Exhaust cylinders #2 and #4

MEASUREMENT TABLE

INTAKE (cold) 0.007-0.009 in. (0.17-0.23 mm)				
CYL.	Clearance	Old Pad	New Pad	New Clearance
#1				
#2				
#3				
#4				

EXHAUST (cold) 0.012-0.014 in. (0.31-0.37 mm)				
CYL.	Clearance	Old Pad	New Pad	New Clearance
#1				
#2				
#3				
#4				