

Intake and Exhaust System

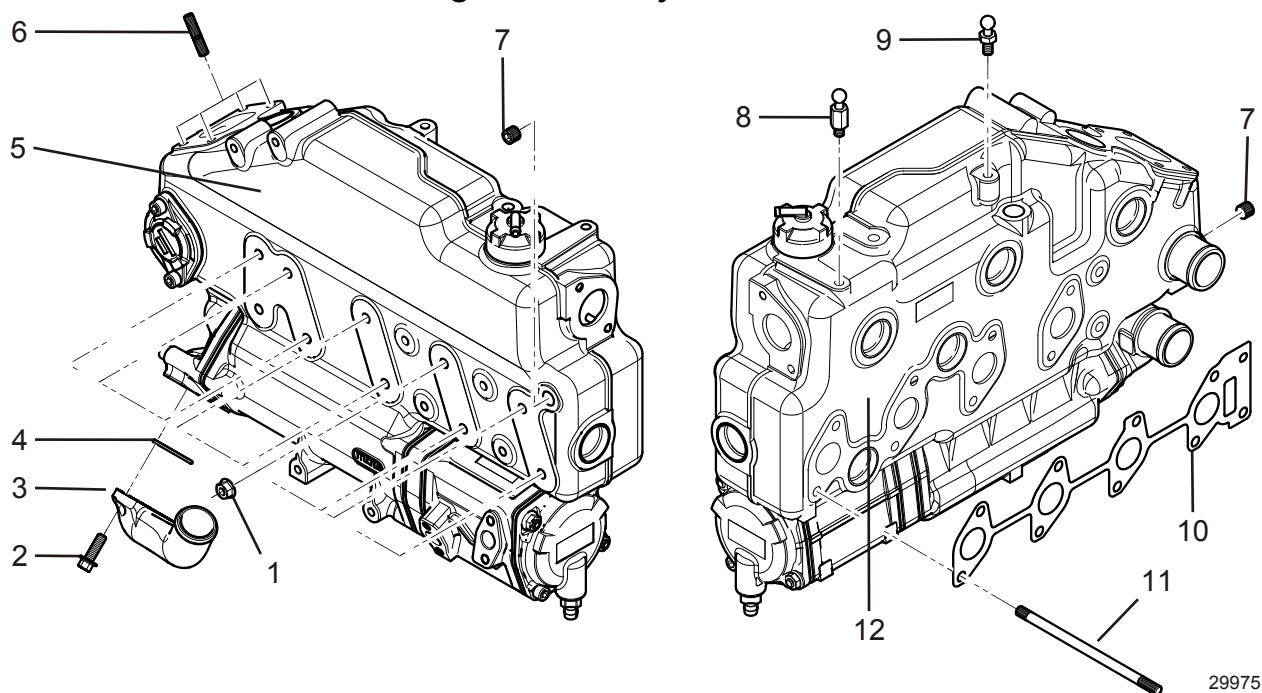
Section 7B - Exhaust Manifold and Elbow

Table of Contents

Exploded Views.....	7B-2	Removal.....	7B-9
Exhaust Manifold Heat Exchanger Assembly		Cleaning.....	7B-10
.....	7B-2	Installation.....	7B-10
Exhaust Elbow.....	7B-4	Exhaust Elbow.....	7B-11
Representative Views of Inboard Exhaust		Removal.....	7B-11
Systems.....	7B-6	Cleaning and Inspection.....	7B-13
Locating And Installing The Sterndrive Exhaust		Installation.....	7B-13
System.....	7B-6	Exhaust Manifold.....	7B-16
Locating And Installing The Inboard Exhaust		Important Information.....	7B-16
System.....	7B-7	Removal.....	7B-17
Additional Information.....	7B-8	Cleaning and Inspection.....	7B-18
Exhaust Pipe—Sterndrive Models.....	7B-9	Installation.....	7B-18

Exploded Views

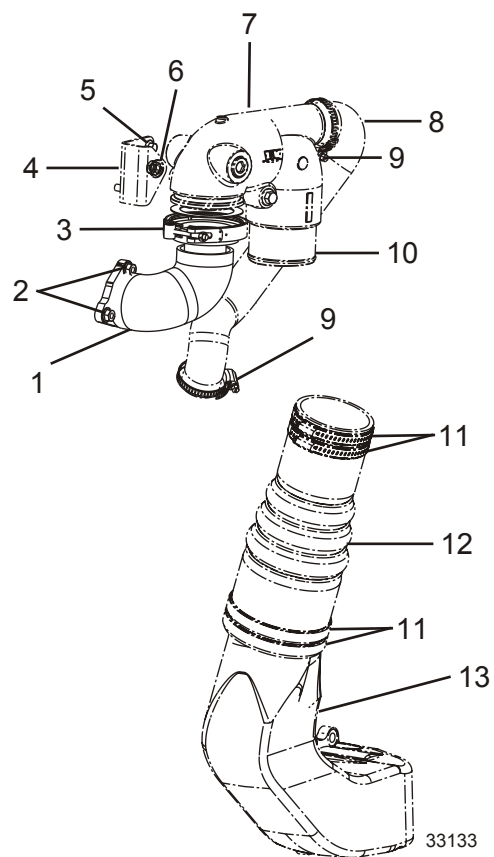
Exhaust Manifold Heat Exchanger Assembly



Exhaust Manifold Heat Exchanger Assembly

Ref. No.	Qty.	Description	Torque		
			Nm	lb. in.	lb. ft.
1	10	Nut	27.5	–	20
2	2	Screw	24.5	–	18
3	1	Water outlet			
4	1	O-ring			
5	1	Coolant expansion tank			
6	4	Stud			
7	2	Plug			
8	1	Spacer	24.5	–	18
9	1	Spacer	24.5	–	18
10	1	Exhaust manifold gasket			
11	10	Stud	16	142	–
12	1	Exhaust manifold heat exchanger assembly			

Exhaust Elbow

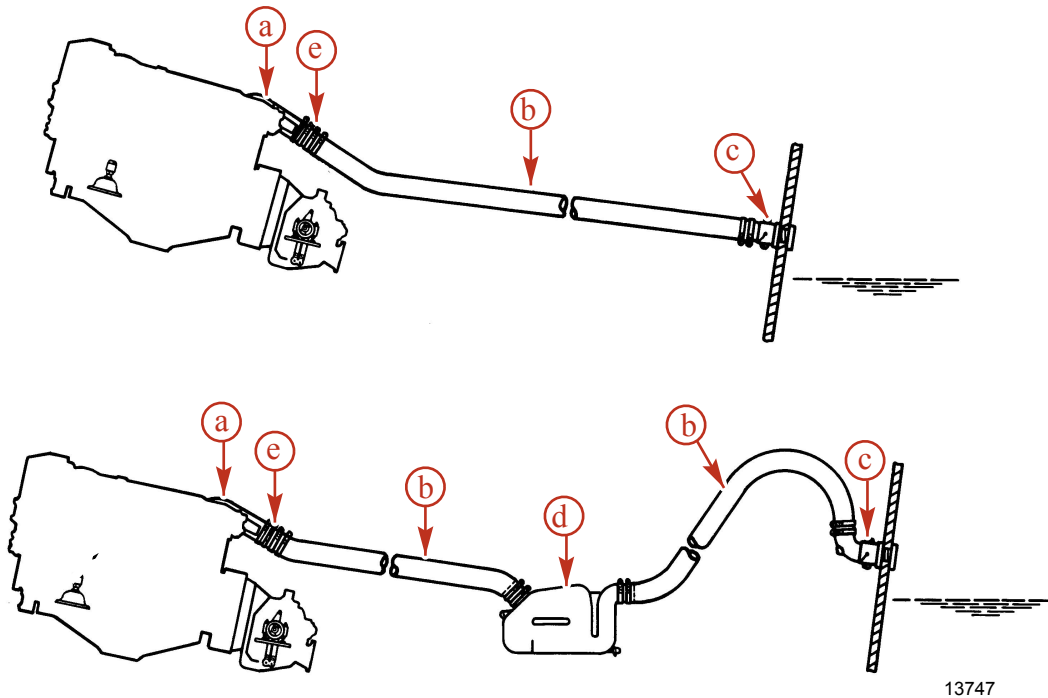


Exhaust Elbow

Ref. No.	Qty.	Description	Torque		
			Nm	lb-in.	lb-ft
1	1	Turbocharger elbow			
2	3	Nuts	32.4	–	24
3	1	Pipe clamp	10.8	96	–
4	1	Bracket			
5	2	Screw	24.5	–	18
6	1	Nut	24.5	–	18
7	1	Exhaust elbow			
8	1	Seawater inlet hose			
9	2	Hose Clamp	5.7	50	–
10	1	Exhaust outlet			
11	4	Hoe Clamp			
12	1	Adaptor hose			
13	1	Exhaust down-pipe (sterndrive models)			

Representative Views of Inboard Exhaust Systems

NOTE: Use diagrams for component identification only.



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Typical

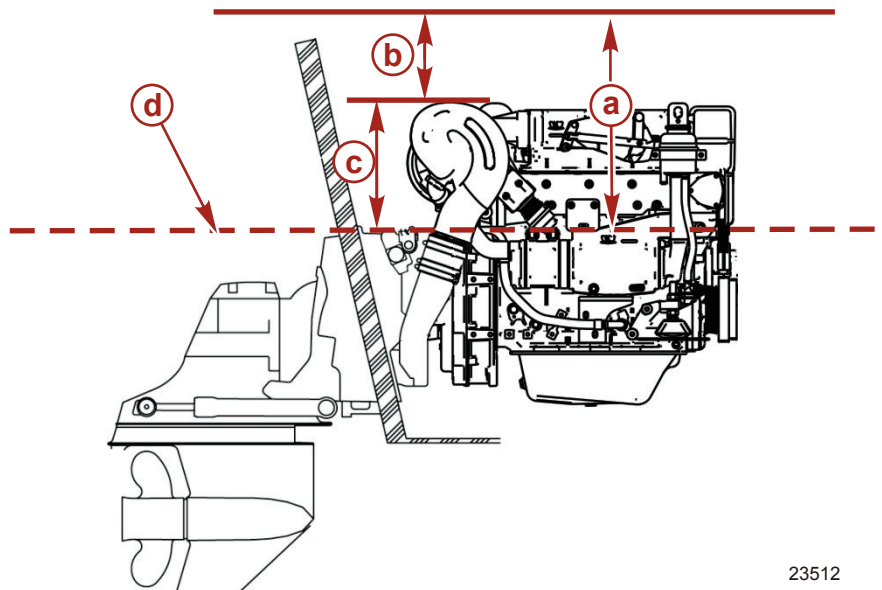
- | | |
|--|---|
| a - Exhaust elbow with gasket and clamp | d - Water-lift muffler |
| b - Exhaust pipe | e - Exhaust tube and hose clamps |
| c - Outlet with water shutter and flapper | |

Locating And Installing The Sterndrive Exhaust System

NOTE: It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine and install the exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers and severely damage the engine. Damage caused by water in the engine will not be covered by Cummins MerCruiser Diesel Warranty unless this damage is the result of defective parts.

Determine if a water lift muffler kit is required by taking measurements **a** and **b**, with the boat at rest in the water and maximum load aboard. Subtract **b** from **a** to find **c**. If **c** is less than specified in the chart, an exhaust riser kit must be installed.

Model	$c = a \text{ minus } b$
All models	c must be 11 in. (279 mm) or more



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Typical sterndrive engine

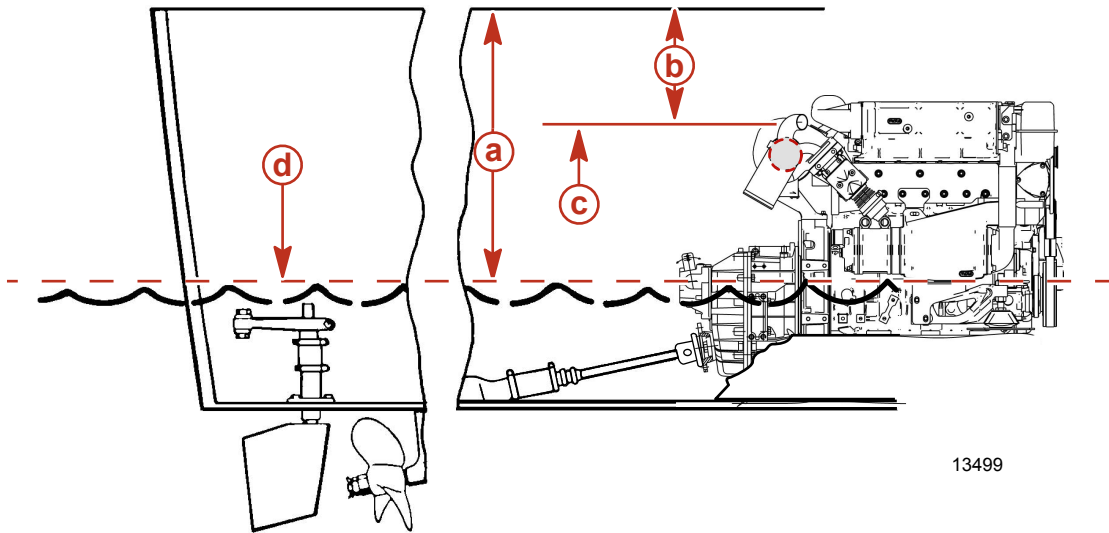
- a** - From waterline to top of transom
- b** - From highest point on exhaust riser to top of transom
- c** - Distance found by subtracting **b** from **a**
- d** - Waterline at rest

Locating And Installing The Inboard Exhaust System

IMPORTANT: It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine and install the exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers and severely damage the engine. Damage caused by water in the engine will not be covered by Cummins MerCruiser Diesel Warranty unless this damage is the result of defective parts.

Determine if an exhaust riser kit or a water lift muffler kit is required by taking measurements **a** and **b**, with the boat at rest in the water and maximum load aboard. Subtract **b** from **a** to find **c**. If **c** is less than specified in the chart, an exhaust riser kit or a water lift muffler kit must be installed.

Models	$c = a \text{ minus } b$
All models	c Must be 279 mm (11 in.) or more



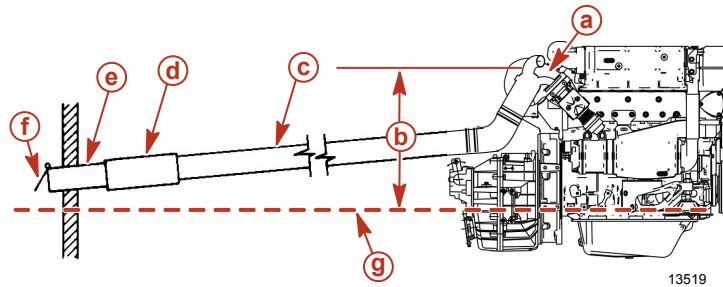
Typical inboard engines

- a** - From waterline to top of transom
- b** - From highest point on exhaust elbow to top of transom
- c** - Distance found by subtracting **b** from **a**
- d** - Waterline at rest

Additional Information

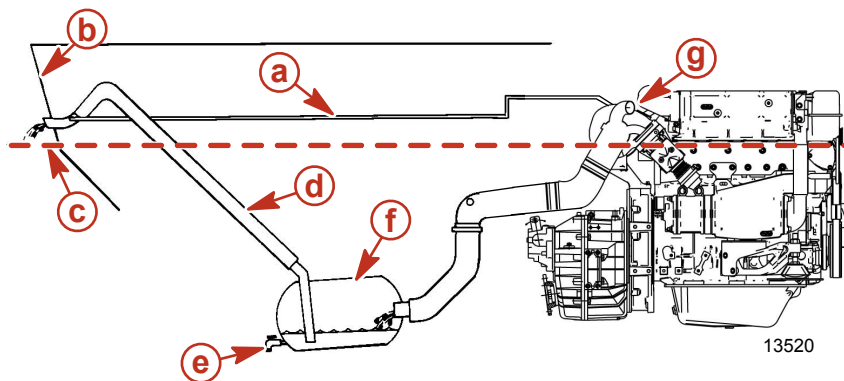
- If no exhaust riser or a water lift muffler kit is required, the exhaust outlet (for routing exhaust outside of the boat) must be located so that a minimum of 13 mm (1/2 in.) per 305 mm (12 in.) downward pitch exists in the exhaust hose or pipe from the engine exhaust elbow to the outlet.
- The exhaust hose or pipe must drop a minimum of 100 mm (4 in.) overall according to American Boat and Yacht Council recommendations. The drop must be constant so that a low spot does not exist at any point in the exhaust hose or pipe.
- The exhaust outlet must be slightly above the water line with boat at rest in the water and a full load aboard.
- An exhaust flapper on each outlet is recommended.
- The minimum exhaust hose size is 102 mm (4 in.).
- No exhaust hose bends are allowed within 203 mm (8 in.) of the water inlet hose connection.

- System back pressure when measured at exhaust elbow outlets must not exceed a 1000 mm (39-1/2 in.) water column, or 76 mm (3 in.) of mercury when measured with a mercury manometer . The minimum exhaust hose size is 102 mm (4 in.).



Typical continuously sloping exhaust line

- | | |
|---|--|
| a - Exhaust elbow | e - Exhaust outlet internal shutter |
| b - Measurement 379 mm (11 in.) minimum | f - Exhaust flapper valve |
| c - Exhaust hose or pipe (slope to specifications) | g - Waterline |
| d - Muffler | |



Typical waterlift muffler exhaust system

- | | |
|-------------------------------------|------------------------|
| a - Exhaust elbow | e - Drain valve |
| b - Vent line 6 mm (1/4 in.) | f - Transom |
| c - Waterlift muffler | g - Waterline |
| d - Exhaust hose | |

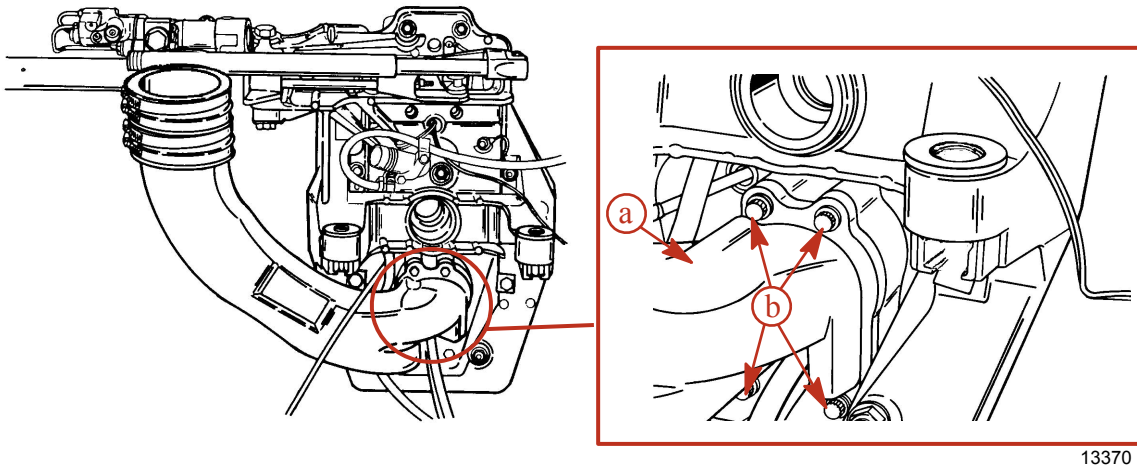
Exhaust Pipe—Sterndrive Models

Removal

IMPORTANT: The engine must be removed to gain access to exhaust pipe. See Section 2A for engine removal and installation procedures.

1. Remove the four bolts and thick lockwashers retaining the exhaust pipe to the gimbal housing.

2. Remove the exhaust pipe.



a - Exhaust pipe

b - Exhaust pipe bolts and thick lockwashers (four)

3. Remove the O-ring seal and discard.

Cleaning

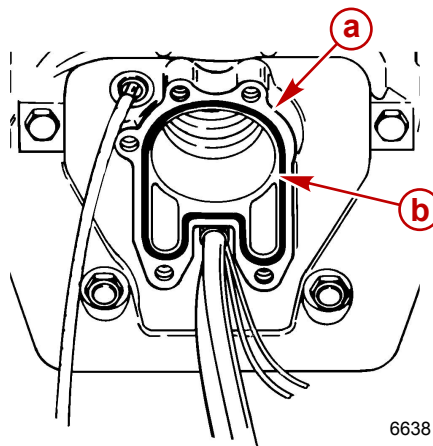
IMPORTANT: Exhaust pipe and gimbal housing assembly mating surfaces must be clean and free of nicks and scratches.

1. Clean the mating surfaces of the exhaust pipe.
2. Clean the mating surfaces of the gimbal housing.

Installation

IMPORTANT: Damaged O-rings can cause property damage from water leaks. Install all O-rings and seals properly before assembling components.

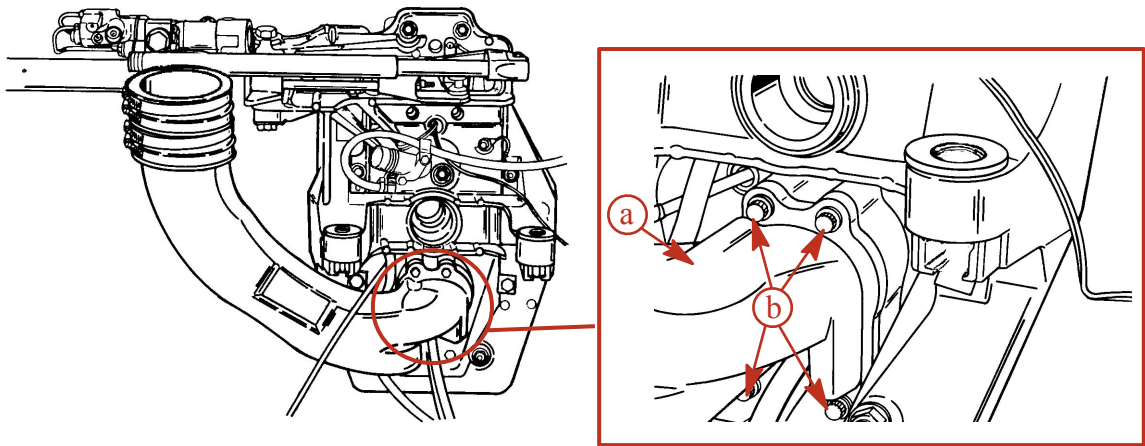
1. Install the new O-ring. Ensure that it is seated properly in the groove of the gimbal housing.



a - Gimbal housing

b - O-ring

2. Hold the exhaust pipe in position. Install the four thick washers and the exhaust pipe bolts. Torque the exhaust pipe bolts evenly in a diagonal pattern to specification.

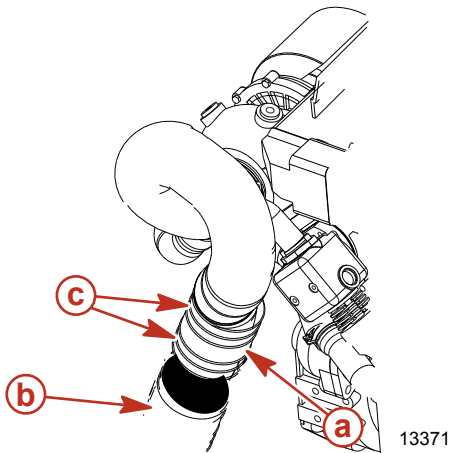


a - Exhaust pipe

b - Exhaust pipe bolts and thick lockwashers (four)

Description	Nm	lb. in.	lb. ft.
Exhaust pipe bolts	30		23

3. Lubricate the inside of the large end of the exhaust hose with a soap and water solution. Slide the exhaust hose over the exhaust pipe and install the four hose clamps.



a - Exhaust hose
b - Exhaust pipe

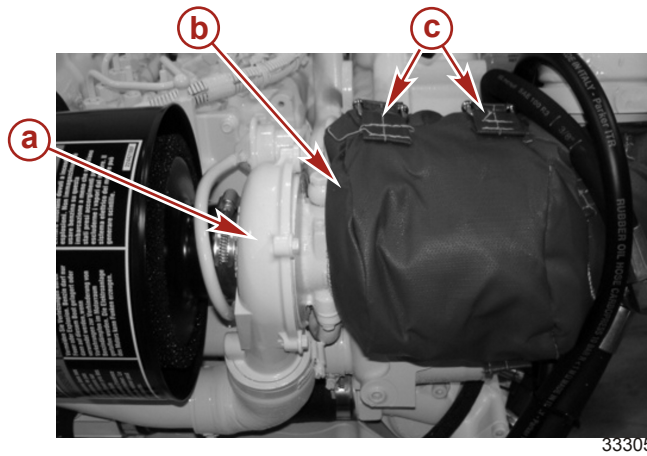
c - Hose clamp (four total)

Exhaust Elbow

Removal

1. Disconnect both battery cables from the battery terminals.
2. Close the seacock or remove and plug the seawater inlet hose.
3. Drain the seawater system.

4. Remove the turbocharger heat shield.



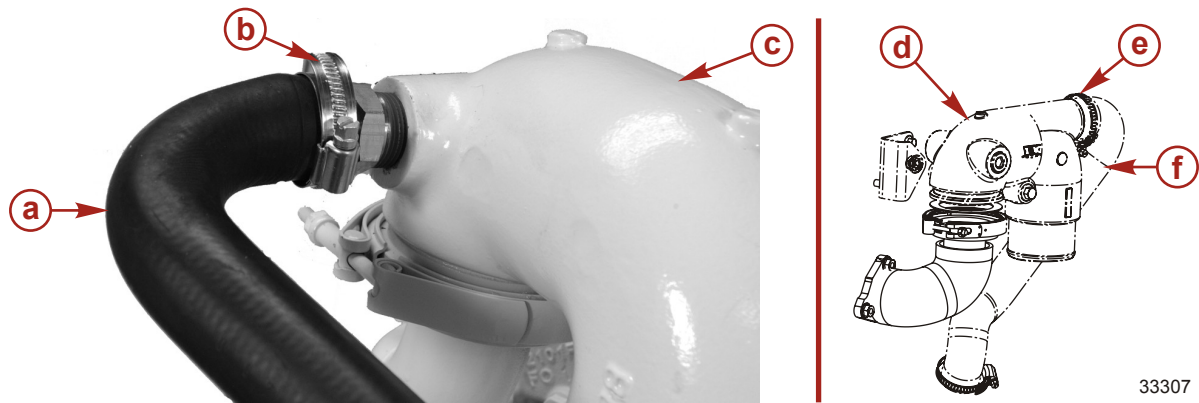
- a** - Turbocharger
b - Heat shield
c - Heat shield buckles

5. Loosen the hose clamps on the exhaust hose connected to the exhaust elbow.



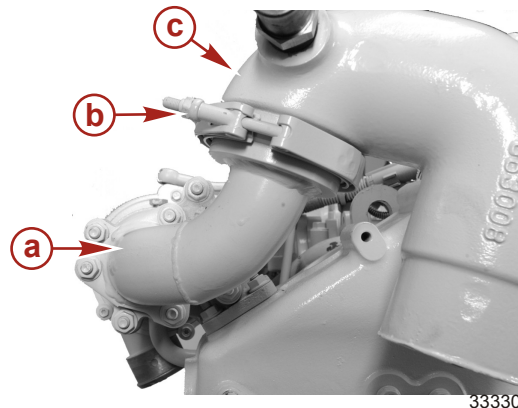
- a** - Exhaust hose
b - Hose clamps
c - Exhaust elbow

6. Disconnect the seawater hose from the exhaust elbow.



- a** - Seawater hose
- b** - Hose clamp
- c** - Early production exhaust elbow
- d** - Late production exhaust elbow
- e** - Hose clamp
- f** - Seawater hose

7. Loosen the exhaust elbow clamp and remove the exhaust elbow from the turbocharger exhaust outlet pipe. Discard the copper exhaust elbow gasket.



- a** - Turbocharger exhaust outlet pipe
- b** - Exhaust elbow clamp
- c** - Exhaust elbow

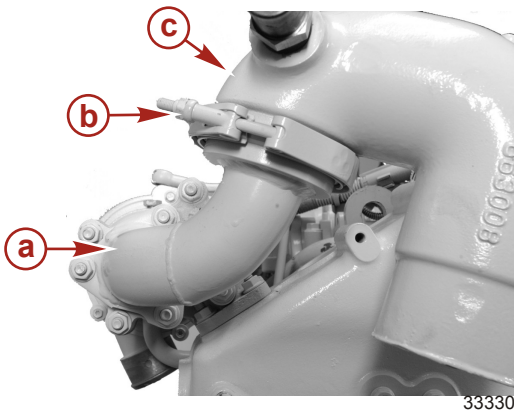
Cleaning and Inspection

1. Clean the exhaust elbow with solvent and air dry.
2. Inspect the seawater fitting for damage. Replace as necessary.
3. Inspect the interior of the exhaust elbow for corrosion damage. Replace as necessary.
4. Inspect the exhaust elbow to turbocharger exhaust outlet pipe mating surfaces for damage. Replace as necessary.
5. Inspect the exhaust elbow clamp for damage including bending or twisting of the clamp and binding operation. Replace as necessary.
6. Paint the exterior of the exhaust elbow to resist corrosion.

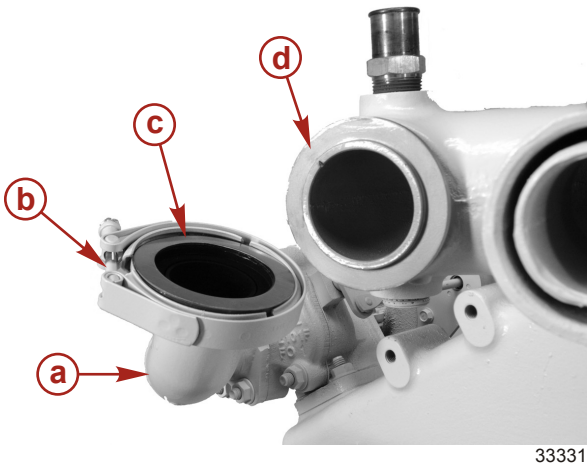
Installation

1. Place a new copper gasket on the turbocharger exhaust outlet pipe.

2. Install the exhaust elbow and the exhaust elbow clamp.



- a** - Turbocharger exhaust outlet pipe
- b** - Exhaust elbow clamp
- c** - Exhaust elbow

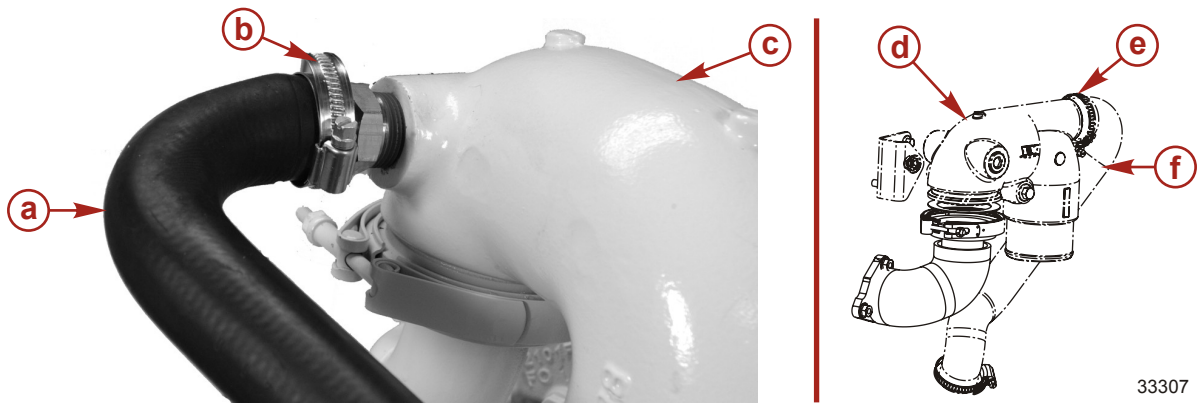


- a** - Turbocharger exhaust outlet pipe
- b** - Exhaust elbow clamp
- c** - Copper gasket
- d** - Exhaust elbow

3. Tighten the exhaust elbow clamp to specification.

Description	Nm	lb-in.	lb-ft
Exhaust elbow clamp	10.8	96	–

4. Connect the seawater hose to the exhaust elbow.



- a** - Seawater hose
- b** - Hose clamp
- c** - Early production exhaust elbow
- d** - Late production exhaust elbow
- e** - Hose clamp
- f** - Seawater hose

5. Tighten the hose clamp to specification.

Description	Nm	lb-in.	lb-ft
Hose clamp	5.7	50	–

6. Attach the exhaust hose to the exhaust elbow.

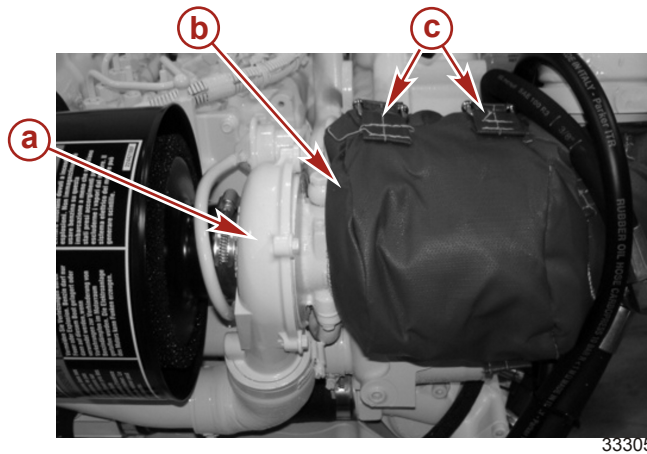


- a** - Exhaust hose
- b** - Hose clamps
- c** - Exhaust elbow

7. Torque both exhaust hose clamps to specification.

Description	Nm	lb-in.	lb-ft
Hose clamp	5.7	50	–

8. Install the turbocharger heat shield.



- a** - Turbocharger
- b** - Heat shield
- c** - Heat shield buckles

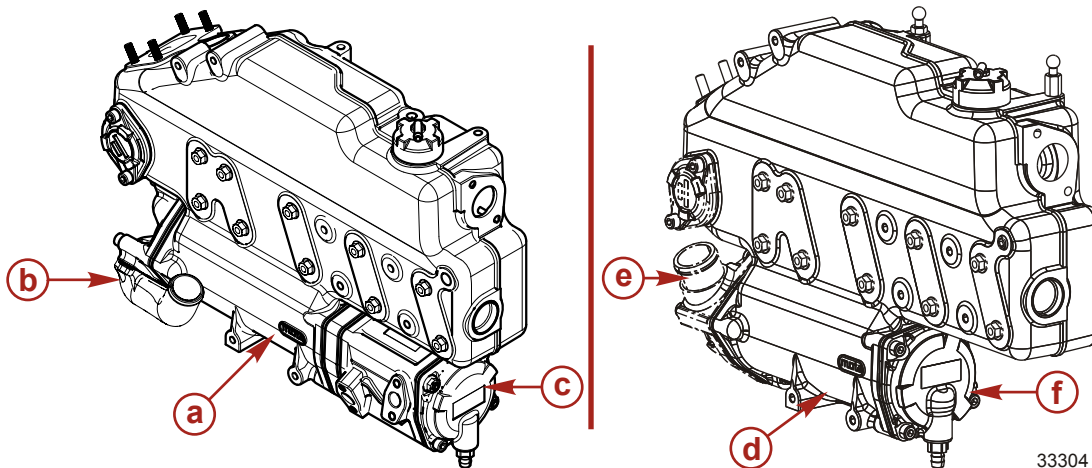
9. Open the seacock or unplug the seawater inlet hose.

10. Connect both battery cables.

Exhaust Manifold

Important Information

Early model exhaust manifold heat exchanger assembly incorporated an integrated engine oil cooler. Later production models incorporate an oil filter housing that includes an oil cooler. In these applications the oil cooler heat exchanger has been removed from the exhaust manifold heat exchanger assembly.



- a** - Early production exhaust manifold
- b** - Early production seawater outlet
- c** - Early production oil cooler

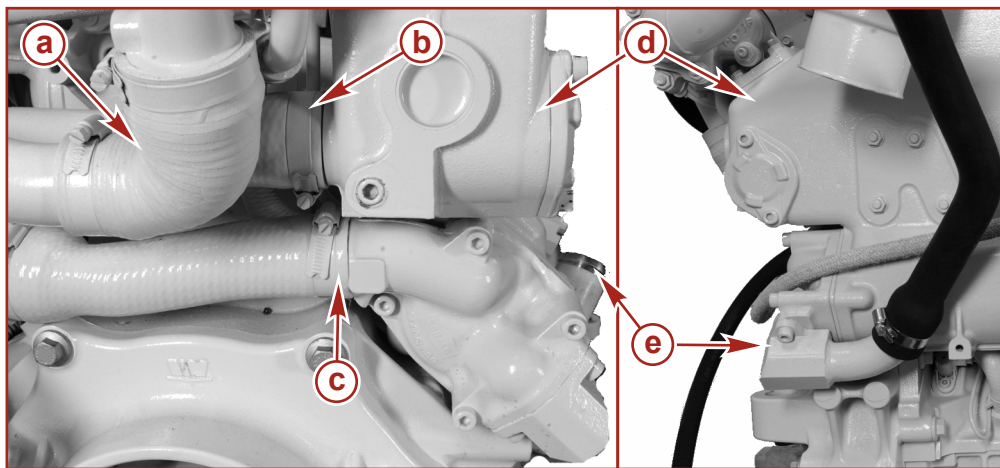
- d** - Late production exhaust manifold
- e** - Late production seawater outlet
- f** - Late production oil cooler

Removal

NOTICE

If the boat is at rest in the water with the engine off, an open seacock or water inlet hose could introduce water into the engine's cooling system or the boat. Keep the seacock or water inlet hose plugged until ready to start the engine. Attach a tag to the ignition switch or steering wheel to inform others of the water inlet connection.

1. Close the seacock, if equipped, or disconnect and plug the seawater inlet hose if the boat is to remain in the water.
2. Drain the seawater system. See **Section 6A—Draining the Seawater System**.
3. Drain the closed cooling system. Dispose of the coolant properly. See **Section 6A—Draining the Closed Cooling System**.
4. Disconnect and remove the gear lube monitor bottle.
5. Disconnect and remove the power assisted steering reservoir. Refer to **Section 9A—Power-Assisted Steering Pump and Related Components**.
6. For Sterndrive models, remove the engine mounted shift lever. See **Section 2—Removal and Installation**.
7. Disconnect the cabin water heater fitting, if equipped.
8. Remove the coolant manifold assembly. See **Section 6A—Coolant Manifold Assembly**.
9. Disconnect the turbocharger to intake manifold air tube elbow. See **Section 7B—Intake Manifold, Exhaust Manifold, Riser, and Elbow**.

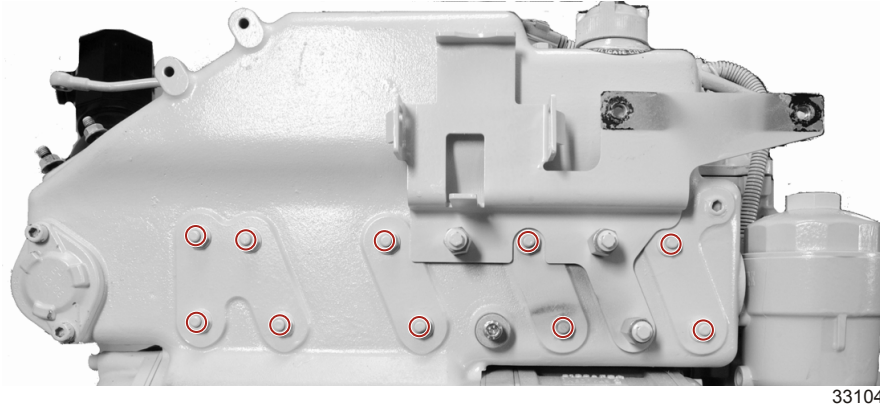


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- a** - Air tube elbow
- b** - Coolant hose
- c** - Seawater inlet hose
- d** - Heat exchanger and fluid cooler assembly
- e** - Seawater outlet hose

10. Disconnect the heat exchanger fluid cooler assembly coolant hoses.
11. Disconnect the heat exchanger fluid cooler assembly seawater hoses.
12. For early production models, remove the oil cooler tubes from the heat exchanger fluid cooler assembly. See **Section 3A—Oil Filter and Oil Cooler Assembly**.

13. Completely detach the turbocharger oil drain line and position so that it will not interfere with heat exchanger fluid cooler assembly removal. See **Section 7C—Turbocharger**.
14. Completely detach the turbocharger oil supply line and position so that it will not interfere with heat exchanger fluid cooler assembly removal. See **Section 7C—Turbocharger**.
15. Remove the turbocharger if required for the service or repair being performed. See **Section 7C—Turbocharger**.
16. Remove the 10 heat exchanger fluid cooler assembly attaching nuts from their studs.



Attaching nuts

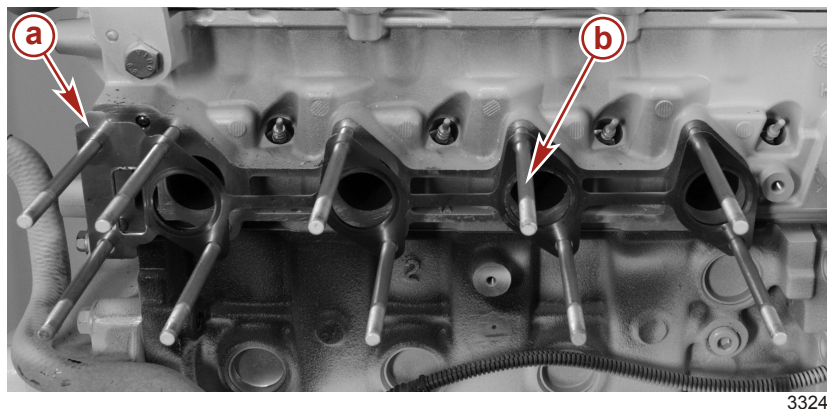
17. Dismount the exhaust manifold and heat exchanger assembly from the cylinder head by sliding straight off of the studs.
18. Discard the exhaust manifold and heat exchanger assembly to cylinder head gasket.

Cleaning and Inspection

1. Remove the old O-rings and clean the sealing flanges.
2. Use a suitable long rod or brush to clean out the radiator insert tubes.
3. Inspect each part for cracks, corrosion, or other damage. Replace as necessary.
4. Clean and paint the exterior surfaces as required to prevent corrosion.

Installation

1. Position a new exhaust manifold and heat exchanger assembly to cylinder head gasket on the heat exchanger fluid cooler assembly studs.

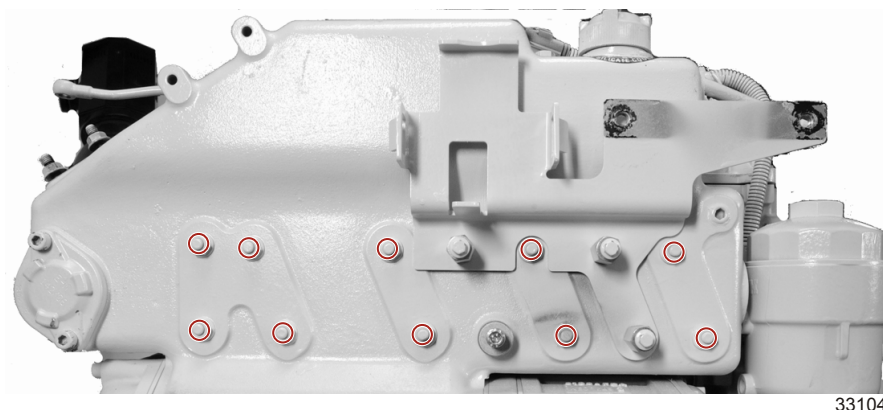


a - Gasket

b - Stud

2. Mount the exhaust manifold and heat exchanger assembly on the cylinder head by sliding straight on to the studs.

3. Install and tighten the 10 exhaust manifold and heat exchanger assembly attaching nuts in a alternating pattern starting in the middle and working outward.



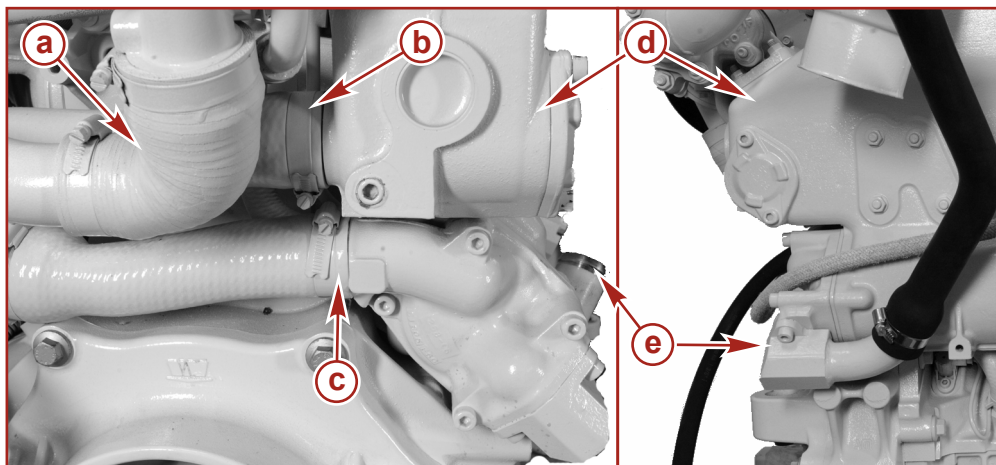
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Attaching nuts

4. Tighten the exhaust manifold and heat exchanger assembly attaching nuts in a alternating pattern starting in the middle and working outward. Tighten the nuts to specification.

Description	Nm	lb-in.	lb-ft
Exhaust manifold and heat exchanger assembly attaching nuts	27.5	–	20

5. For early production models, install the oil cooler tubes from the heat exchanger fluid cooler assembly. See **Section 3A—Oil Filter and Oil Cooler Assembly**.
6. Install the turbocharger. See **Section 7C—Turbocharger**.
7. Install the turbocharger oil supply and drain lines. See **Section 7C—Turbocharger**.
8. Connect the heat exchanger fluid cooler assembly seawater hoses.



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- a** - Air tube elbow
- b** - Coolant hose
- c** - Seawater inlet hose
- d** - Heat exchanger and fluid cooler assembly
- e** - Seawater outlet hose

Description	Nm	lb-in.	lb-ft
Hose clamps	5.7	50	–

9. Connect the heat exchanger fluid cooler assembly coolant hose.

10. Connect the turbocharger to intake manifold air tube elbow. See **Section 7B—Intake Manifold, Exhaust Manifold, Riser, and Elbow**.
11. Install the coolant manifold assembly. See **Section 6A—Coolant Manifold Assembly**.
12. Connect the cabin water heater fitting, if equipped.
13. For Sterndrive models, install the engine mounted shift lever. See **Section 2—Removal and Installation**.
14. Install and connect the power assisted steering reservoir. See **Section 9A—Power-Assisted Steering Pump and Related Components**.
15. Install and connect the gear lube monitor bottle.
16. Fill the closed cooling system. See **Section 6A—Draining the Closed Cooling System**.
17. Open the seacock, if equipped, or connect the seawater inlet hose.