

Exhaust System

Section 6B - Exhaust System Design

Table of Contents

Exhaust System Design.....	6B-2	T Junction With In-Line Muffler.....	6B-7
Exhaust System Specifications.....	6B-2	V-Pipe and In-Line Muffler.....	6B-9
Collector Inlet and Outlet Specifications		Water Lift Exhaust System.....	6B-10
.....	6B-2	Collector and Water Lift Muffler.....	6B-15
In-line Muffler.....	6B-3	S-pipe Used With Water Lift Muffler.....	6B-16

Exhaust System Design

Exhaust System Specifications

These engines are equipped with a wet exhaust system, in which exhaust is mixed with water in the exhaust elbows. This cools the exhaust and allows the use of heat resistant rubber hose on the outlet side of the system. The OEM and muffler manufacturer must observe these specifications when designing, manufacturing, and installing the exhaust system:

- Exhaust elbow outlets must be a specific distance above the water line. Install exhaust risers if necessary. See **Measuring Exhaust Elbow Height**.
- The riser height for systems using a water lift muffler is measured to the water line in the muffler.

Minimum Exhaust Elbow Height	
Model	Specification
Inboard and V-drive Tow Sports models	38 cm (15 in.)
Tow Sports inline models	33 cm (13 in.)

- Provide a minimum of 46 cm (18 in.) of exhaust hose between the exhaust elbows and the collector, Y-pipe, muffler, or first angular fitting. This portion of the exhaust hose must have a minimum of 10° downward slope. After the first 46 cm (18 in.), the exhaust system must have a minimum of 3° downward slope. See **Measuring Exhaust Elbow Height**.
- You can install exhaust hoses with up to a 5° angle relative to the exhaust elbow outlets. See **Exhaust Hose Connections**.
- Exhaust back pressure must meet the required specification. See **Exhaust Back Pressure Test**.

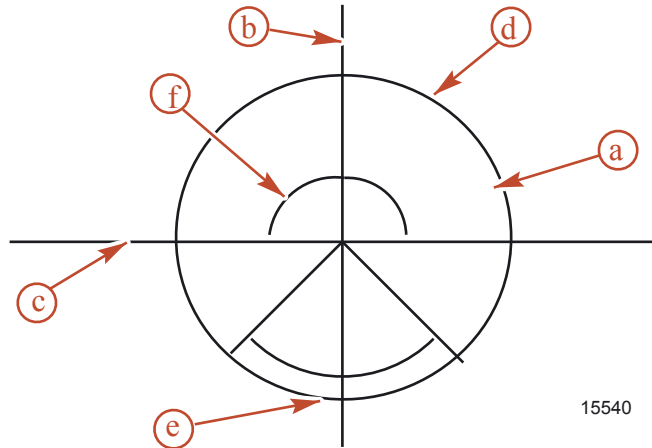
Models	Exhaust Back Pressure
All gasoline powered engines	1 psi (7 kPa) Minimum
	2 psi (14 kPa) Optimal
	11 psi (76 kPa) Maximum

IMPORTANT: Exhaust collectors must drain sufficiently during engine shutdown and idle to provide the drainage necessary for these operational conditions. Use the following specifications when designing the collector.

Collector Inlet and Outlet Specifications

1. The inlet hose for the collector must be placed above and within 180° of the horizontal centerline of the collector.

2. The outlet hose of the collector must be placed below the horizontal centerline of the collector and within 90° of the vertical centerline of the collector.

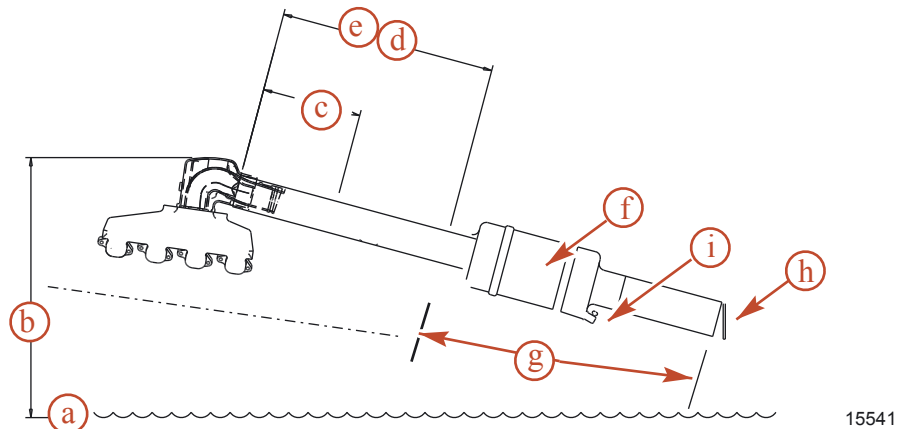


- a** - Collector
- b** - Vertical center line
- c** - Horizontal center line

- d** - Inlet side of collector
- e** - 90° range for placement of collector outlet
- f** - 180° above horizontal centerline

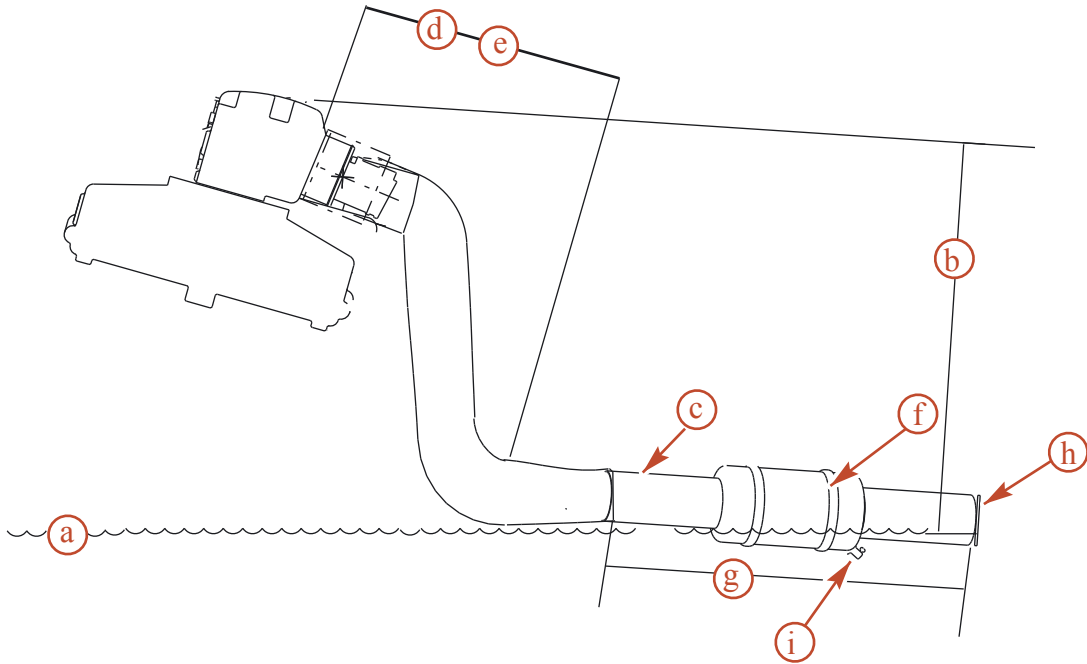
In-line Muffler

PRODUCTS WITHOUT EMISSIONS CONTROL



Typical single engine inboard without water standing in muffler

- a** - Water line
- b** - Minimum exhaust elbow height with maximum load
- c** - Exhaust back pressure check point
- d** - 46 cm (18 in.) minimum between exhaust elbow and muffler
- e** - Minimum of 10° downward slope in the first 46 cm (18 in.)
- f** - Muffler (must be self draining)
- g** - 3° downward slope minimum
- h** - External flappers
- i** - Drain fitting

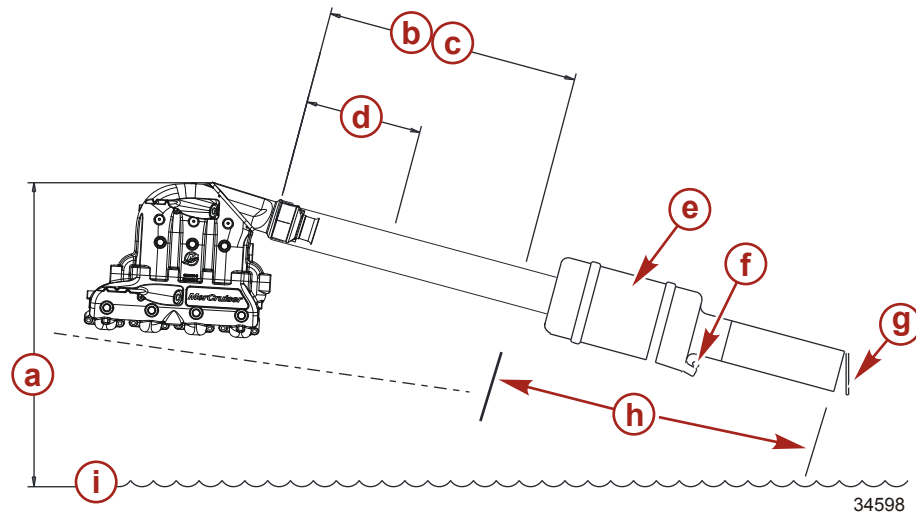


15631

Typical single engine inboard with water standing in muffler (Tow Sports)

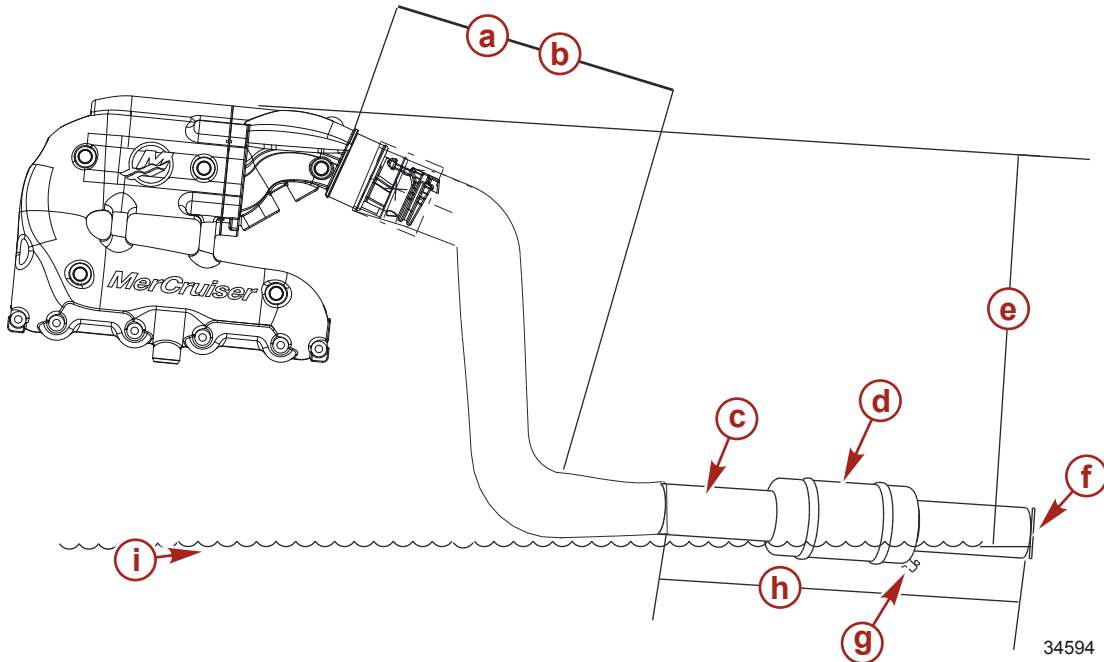
- a** - Water line
- b** - Minimum exhaust elbow height with maximum load
- c** - Exhaust back pressure check point
- d** - 46 cm (18 in.) minimum between exhaust elbow and muffler
- e** - Minimum of 10° downward slope in the first 46 cm (18 in.)
- f** - Muffler (must be self draining)
- g** - 3° downward slope minimum
- h** - External flappers
- i** - Drain fitting

PRODUCTS WITH EMISSIONS CONTROL



Typical single engine inboard without water standing in muffler

- | | |
|--|---|
| a - Minimum exhaust elbow height with maximum load | f - Drain fitting |
| b - Minimum of 10° downward slope in the first 46 cm (18 in.) | g - External flappers |
| c - Minimum of 46 cm (18 in.) between exhaust elbow and muffler | h - Minimum of 3° downward slope |
| d - Exhaust back pressure checkpoint | i - Water line |
| e - Muffler (must be self draining) | |



Typical single engine inboard with water standing in muffler (tow sports)

- a** - Minimum of 10° downward slope in the first 46 cm (18 in.)
- b** - Minimum of 46 cm (18 in.) between exhaust elbow and muffler
- c** - Exhaust back pressure checkpoint
- d** - Muffler (must be self draining)
- e** - Minimum exhaust elbow height with maximum load
- f** - External flappers
- g** - Drain fitting
- h** - Minimum of 3° downward slope
- i** - Water line

- Use exhaust flappers on applications with through-transom fittings to prevent the reverse flow of water into the engine. See **Exhaust Through The Hull Fittings**.
- Support the muffler, collector, and exhaust hoses for proper orientation and to prevent overstressing the exhaust manifolds and elbows. The support requirements will vary with exhaust system design and the amount of G-forces to be encountered.
- Use exhaust resonators on any models that may experience a water intrusion problem associated with the tuning effects of the exhaust system. See **Exhaust Resonators**.
- Use larger exhaust hoses on applications with long hose runs.

Minimum Exhaust Hose Size			
Model	Dual Outlet System	Single Outlet System	
		Dual Hose Portion	Single Hose Portion
8.1 H.O. and Horizon 8.1	102 mm (4 in.)	102 mm (4 in.)	127 mm (5 in.)
All others	76 mm (3 in.)	76 mm (3 in.)	102 mm (4 in.)

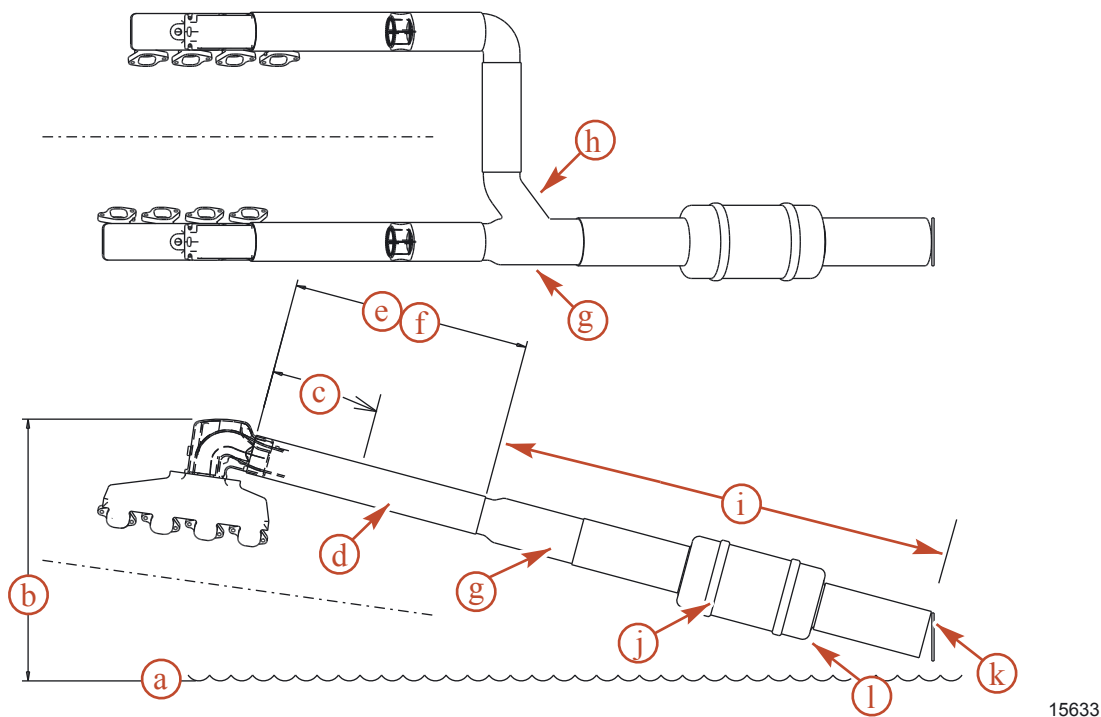
- Use a heat resistant exhaust hose that complies with specifications SAE J2006 or UL 1129 should be used (ABYC standard).
- Secure every exhaust hose connection with at least two hose clamps. Do not use spring tension clamps.

IMPORTANT: The exhaust system supplied by Mercury MerCruiser is compliant with the ABYC Standard P-1. If components are utilized in any portion of the exhaust system that modify the design of the supplied system, it is the boat builder's responsibility to ensure that the new system complies with the ABYC Standards. Exhaust system connections to components other than those supplied by Mercury MerCruiser must use two stainless steel clamps with a minimum width of 13 mm (1/2 in.) at each joint.

- The system must have the capability to be serviced, reassembled and replaced while maintaining all of the specifications. The boat builder must provide documentation such as manuals, drawings, or orientation marks on production assemblies.
- Use orientation marks on all production exhaust system assemblies.
- Ensure that all in-line mufflers, collectors, and hoses self drain after engine shutdown.

T Junction With In-Line Muffler

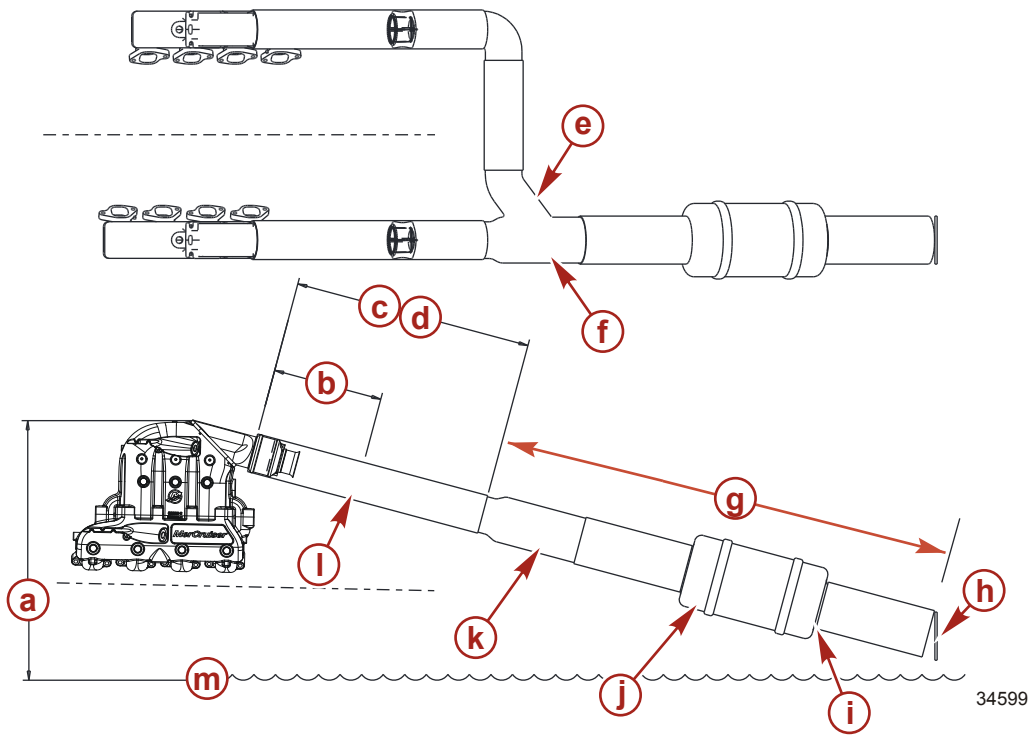
PRODUCTS WITHOUT EMISSIONS CONTROL



Typical

- | | |
|---|---|
| a - Water line | g - 3° downward slope minimum |
| b - Minimum exhaust elbow height with maximum load | h - 30°–60° degree angle at T-junction |
| c - Exhaust back pressure check point | i - 3° downward slope minimum |
| d - Resonator | j - Muffler |
| e - 46 cm (18 in.) minimum between exhaust elbow and collector | k - External flappers |
| f - 10° downward slope minimum | l - Drain fitting |

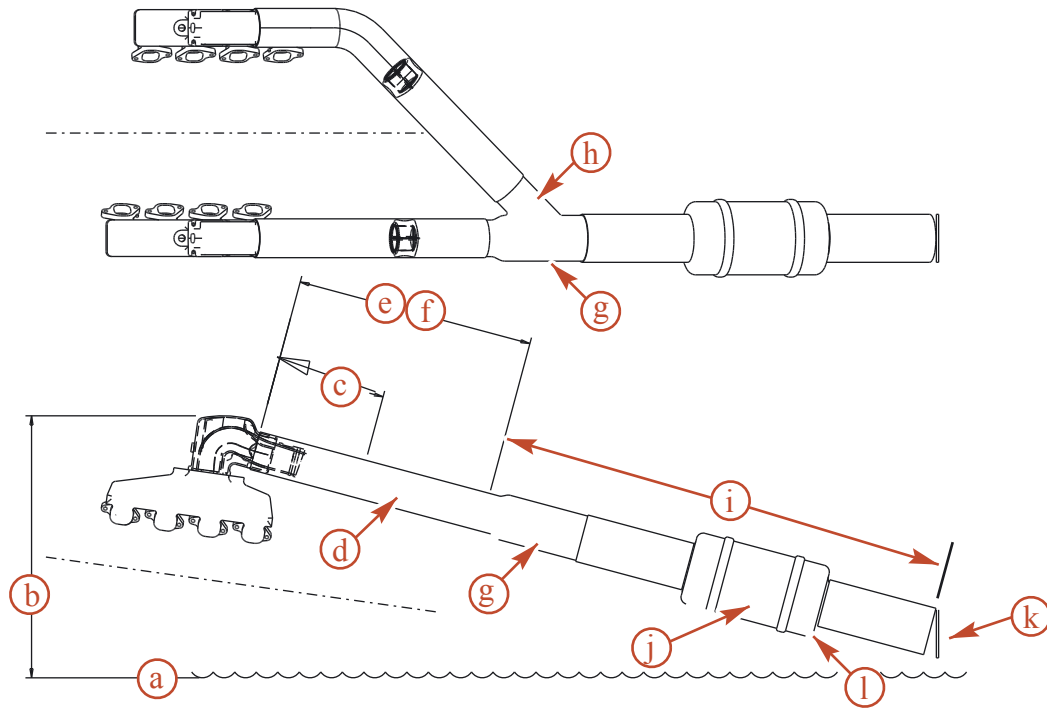
PRODUCTS WITH EMISSIONS CONTROL



- a** - Minimum exhaust elbow height with maximum load
- b** - Exhaust back pressure check point
- c** - Minimum of 46 cm (18 in.) between exhaust elbow and collector
- d** - 10° minimum downward slope
- e** - 30°–60° degree angle at T-junction
- f** - 3° downward slope minimum
- g** - 3° downward slope minimum
- h** - External flappers
- i** - Drain fitting
- j** - Muffler
- k** - 3° downward slope minimum
- l** - Resonator
- m** - Water line

V-Pipe and In-Line Muffler

PRODUCTS WITHOUT EMISSIONS CONTROL

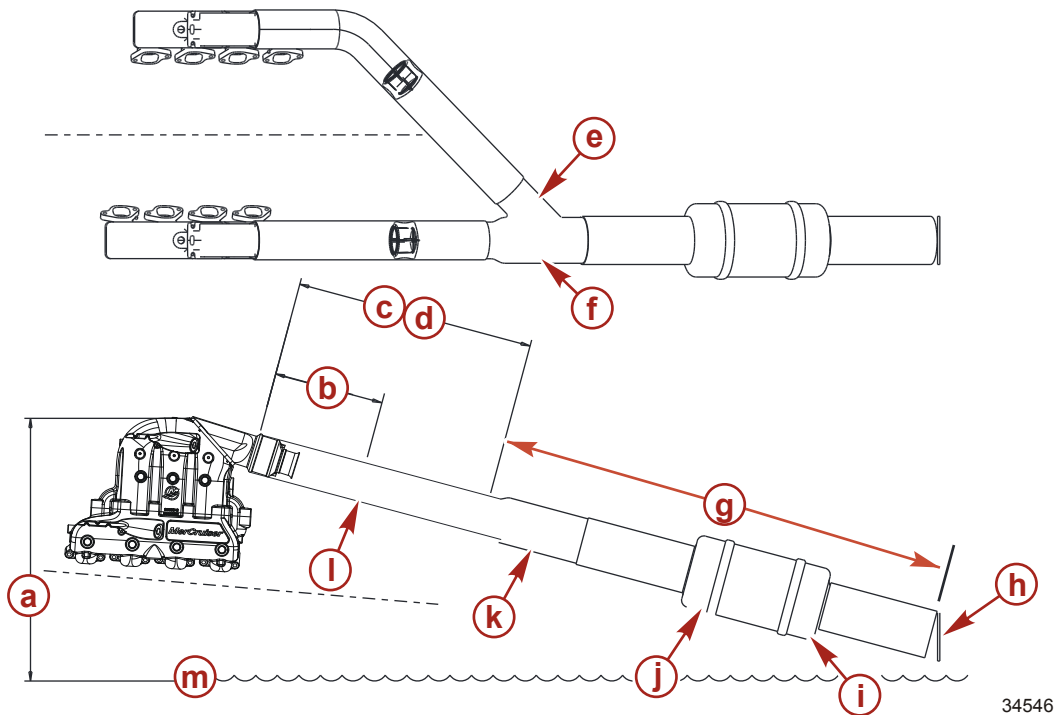


15635

Typical

- | | |
|---|--------------------------------------|
| a - Water line | g - Y-pipe |
| b - Minimum exhaust elbow height with maximum load | h - 30°–60° angle at junction |
| c - Exhaust back pressure check point | i - 3° downward slope minimum |
| d - Resonator | j - Muffler |
| e - 46 cm (18 in.) minimum between exhaust elbow and Y-pipe | k - External flappers |
| f - Minimum of 10° downward slope in the first 46 cm (18 in.) 46 cm (18 in.) | l - Drain fitting |

PRODUCTS WITH EMISSIONS CONTROL



34546

- | | |
|---|------------------------------|
| a - Minimum exhaust elbow height with maximum load | h - External flappers |
| b - Exhaust back pressure check point | i - Drain fitting |
| c - Minimum of 46 cm (18 in.) between exhaust elbow and Y-pipe | j - Muffler |
| d - Minimum of 10° downward slope in the first 46 cm (18 in.) | k - Y-pipe |
| e - 30°–60° angle at junction | l - Resonator |
| f - Y-pipe | m - Water line |
| g - Minimum of 3° downward slope | |

Water Lift Exhaust System

These engines are equipped with a wet exhaust system, in which exhaust is mixed with water in the exhaust elbows. This cools the exhaust and allows the use of heat resistant rubber hose on the outlet side of the system. The OEM and muffler manufacturer must observe these specifications when designing, manufacturing, and installing the exhaust system:

- Use heat resistant exhaust hoses that comply with specifications SAE J2006 or UL 1129.
- Use exhaust hoses no smaller than the minimum sizes. Use larger hoses on applications with long hose runs.

Minimum Exhaust Hose Size			
Model	Dual outlet system	Single outlet system	
		Dual hose portion	Single hose portion
8.1 H.O. and Horizon 8.1	10.2 cm (4 in.)	10.2 cm (4 in.)	12.7 cm (5 in.)
All others	10.2 cm (4 in.)	10.2 cm (4 in.)	10.2 cm (4 in.)

- Avoid sharp bends in exhaust hoses.
- You can install exhaust hoses with up to a 5° angle relative to the exhaust elbow outlets. See **Exhaust Hose Connections**.
- Exhaust elbows must be the specific distance above the water line. Install risers if needed. See **Measuring Exhaust Elbow Height**.
- Attach the exhaust hose to the exhaust elbow with a minimum of 10° downward slope. On longer hose applications, slope can be reduced to 3° in the portion of the exhaust system that is more than 46 cm (18 in.) away from elbow.

NOTE: Mercury MerCruiser's recommendations are more stringent than ABYC recommendations for the minimum drop in the exhaust system of ½ in. per foot with an overall drop of not less than 10.2 cm (4 in.) between the exhaust elbow outlets and the boat outlets.

Slope Conversion			
Degrees	Drop vs. run		Distance from elbow
3°	5/8 in./ft.	52 mm/m	> 18 in.
6°	1¼ in./ft.	105 mm/m	< 18 in.
7°	1-7/16 in./ft.	122 mm/m	< 18 in.
10°	2-1/8 in./ft.	176 mm/m	< 18 in.
12°	2½ in./ft.	212.5 mm/m	< 18 in.
14°	2-15/16 in./ft.	249 mm/m	< 18 in.
19°	4-1/8 in./ft.	344 mm/m	< 18 in.

- The drop in the exhaust hose must be continuously sloping downward so that a low spot does not exist at any point.
- Exhaust resonators can be used on all inboard models. Refer to Exhaust Resonators.
- Through the hull exhaust fittings (flanges, outlets) must be equipped with internal shutters and external flappers to prevent the reverse flow of water into the engine. Refer to Exhaust Through The Hull Fittings.
- Exhaust outlets must be above the water line with the boat at rest in the water and a full load aboard, as well as while underway. This is necessary to minimize engine back pressure.
- Every exhaust hose connection should be secured with at least two hose clamps. The clamps should be stainless steel and at least 13 mm (½ in.) wide. Clamps which rely solely on spring tension should not be used. (ABYC Standard)
- The exhaust system must be adequately supported for proper orientation and to prevent overstressing the exhaust manifolds and elbows. The support requirements will vary with exhaust system design and the amount of G-forces to be encountered.
- The through transom exhaust system must meet the exhaust back pressure specification.
- The system must have the capability to be serviced, reassembled, and replaced while maintaining all of the specifications. The boat builder must provide documentation, such as manuals, drawings, or orientation marks on production assemblies.

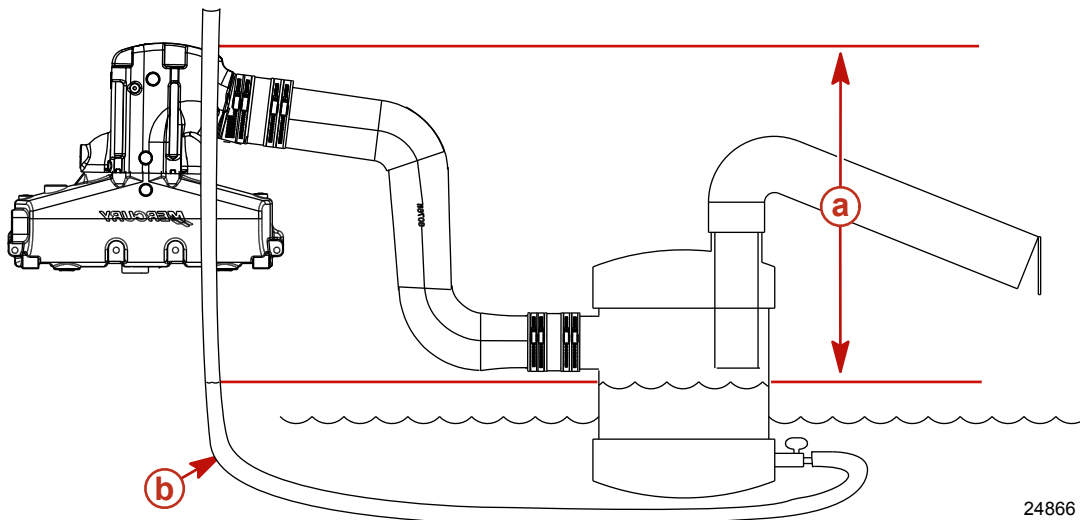
Exhaust System Design

- Check for absence of water intrusion and proper exhaust back pressure when finished. See Checking for Water Intrusion and Exhaust Back Pressure.
- If a waterlift/collector system is used, the waterline is defined as the waterline inside the collector. All measurements must be taken from that waterline to measure exhaust elbow weight.

WATER LIFT MUFFLER WITHOUT EMISSIONS CONTROL

When using water lift mufflers, Mercury MerCruiser recommends the following:

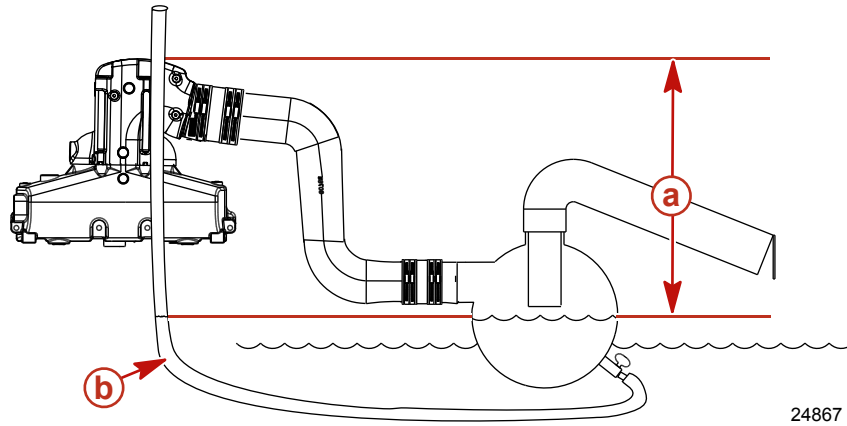
- Install mufflers per Mercury and the exhaust system manufacturer's specified distance below the top of the exhaust elbows to avoid water ingestion problems. Use the exhaust elbow risers if needed to obtain the specified distance.
- Ensure that the muffler exceeds Mercury's and the exhaust system manufacturer's specified distance above the waterline to prevent the engine from ingesting water.
- Install a siphon break (vacuum valve) in the exhaust cooling water circuit if the exhaust elbows or muffler are at or below water level. Refer to Mercury's and exhaust system manufacturer's recommendations.
- Provide a drain to the drain muffler.



Typical vertical water lift muffler

a - Minimum exhaust elbow height with maximum load

b - Clear hose for measuring the waterline

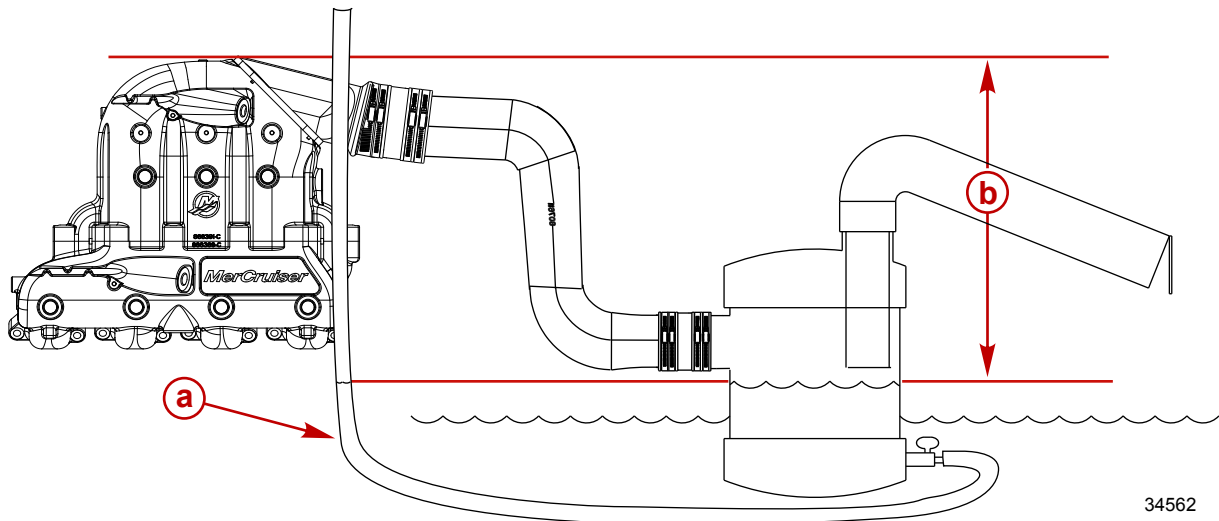


24867

Typical horizontal water lift muffler

- a** - Minimum exhaust elbow height with maximum load
- b** - Clear hose for measuring the waterline

WATER LIFT MUFFLER WITH EMISSIONS CONTROL

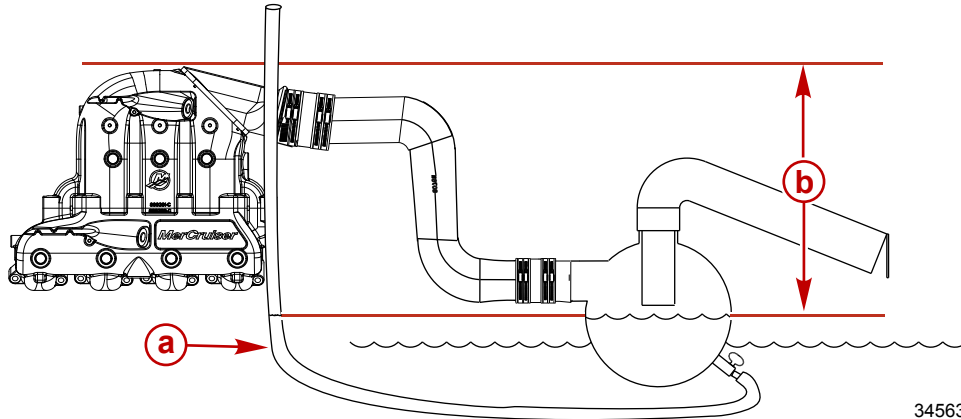


34562

Typical vertical water lift muffler with emissions control

- a** - Clear hose for measuring the waterline
- b** - Minimum exhaust elbow height with maximum load

IMPORTANT: Horizontal waterlift mufflers are permitted for use on emissions control models only if the bottom of the muffler is below the crankshaft centerline.



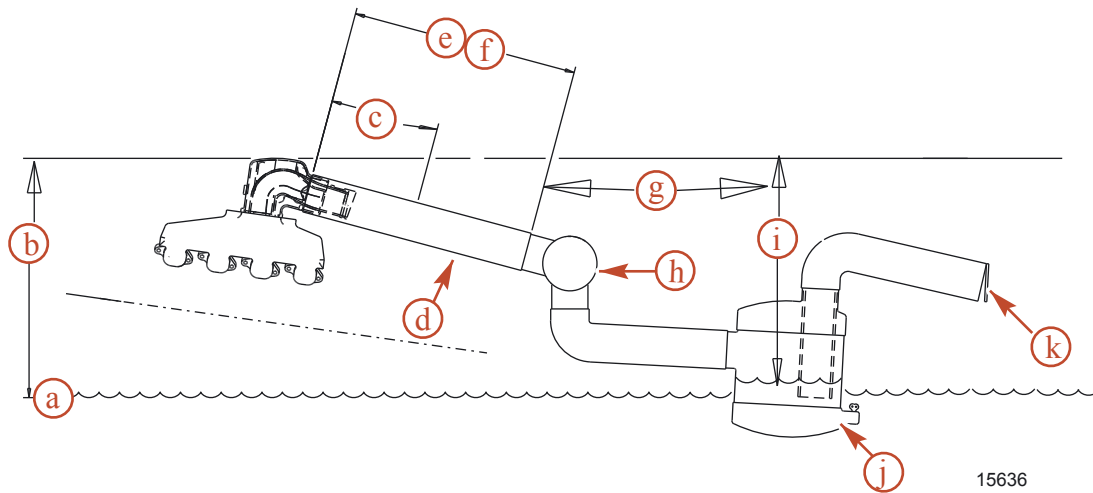
Typical horizontal water lift muffler with emissions control

- a** - Clear hose for measuring the waterline
- b** - Minimum exhaust elbow height with maximum load

- Install risers or lower the muffler if necessary to meet minimum exhaust elbow height.
- Begin your measurement point at the water line inside the muffler to determine the correct elbow height.

Collector and Water Lift Muffler

PRODUCTS WITHOUT EMISSIONS CONTROL

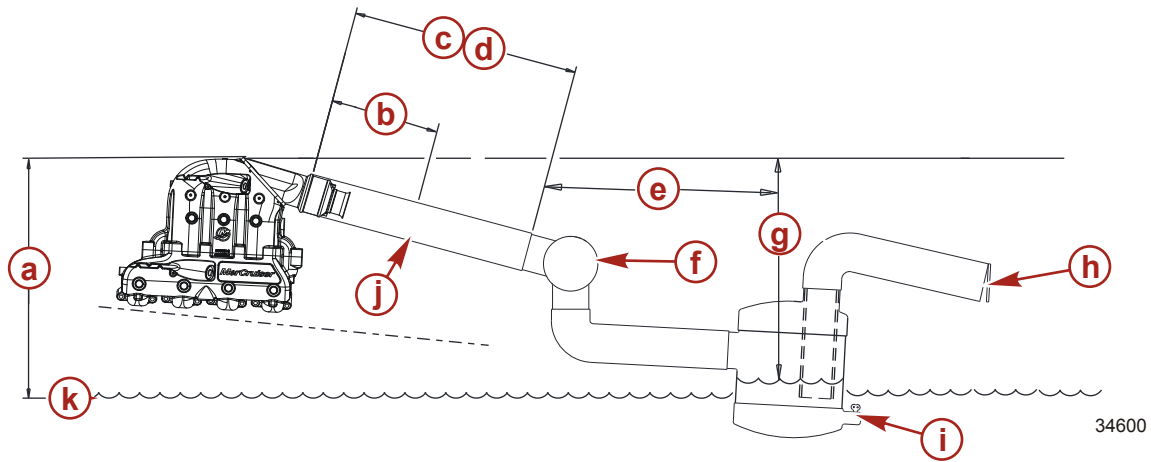


Typical

- a** - Water line
- b** - Siphon break (vacuum valve) Must be installed in cooling water circuit if exhaust elbows are at or below water level. Refer to muffler manufacturing recommendations.
- c** - Exhaust back pressure check point
- d** - Resonator
- e** - 46 cm (18 in.) minimum between exhaust elbow and collector
- f** - 10° downward slope minimum
- g** - 3° downward slope minimum
- h** - Collector
- i** - Minimum exhaust elbow height with maximum load
- j** - Drain fitting
- k** - External flappers

15636

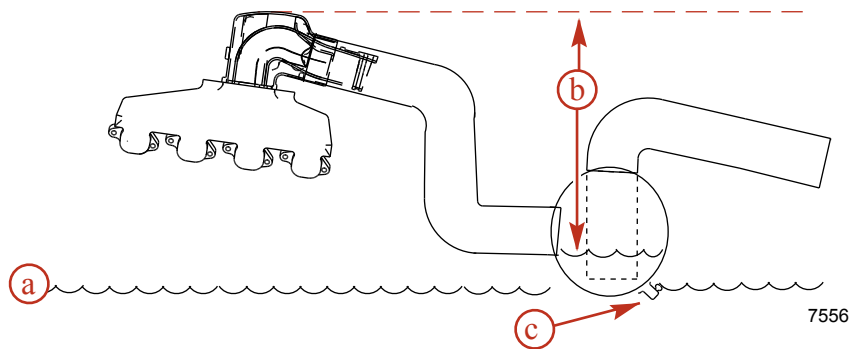
PRODUCTS WITH EMISSIONS CONTROL



- a** - Siphon break (vacuum valve) Must be installed in cooling water circuit if exhaust elbows are at or below water level. Refer to muffler manufacturing recommendations.
- b** - Exhaust back pressure check point
- c** - Minimum of 46 cm (18 in.) between exhaust elbow and collector
- d** - Minimum of 10° downward slope
- e** - Minimum of 3° downward slope
- f** - Collector
- g** - Minimum exhaust elbow height with maximum load
- h** - External flappers
- i** - Drain fitting
- j** - Resonator
- k** - Water line

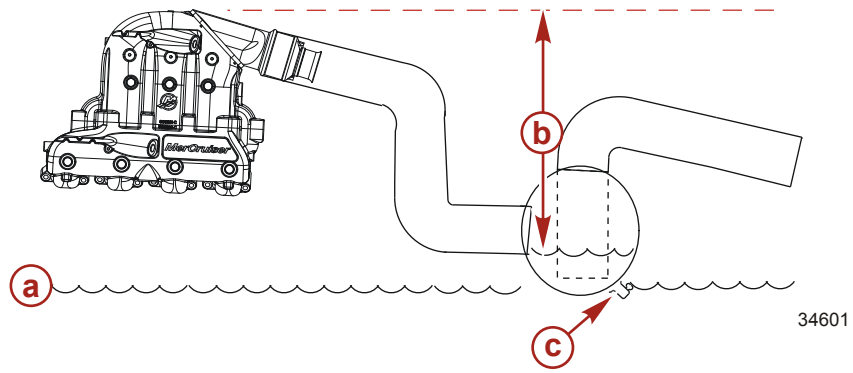
S-pipe Used With Water Lift Muffler

PRODUCTS WITHOUT EMISSIONS CONTROL



- a** - Water line
- b** - Minimum exhaust elbow height with maximum load
- c** - Drain plug

PRODUCTS WITH EMISSIONS CONTROL



- a** - Water line
- b** - Minimum exhaust elbow height with maximum load
- c** - Drain plug

Notes: