


Electrical System

Section 8A - Electrical System

Table of Contents

Finding Other Diagrams.....	8A-2	Audio Warning System.....	8A-11
General Information.....	8A-2	Audio Warning System without Emissions	
Precautions.....	8A-2	Control.....	8A-11
Industry Standards and Regulations.....	8A-3	Audio Warning System with Emissions	
Battery and Battery Cables Requirements.....	8A-4	Control.....	8A-11
Battery	8A-4	Multiple EFI Engine Battery Precautions.....	8A-13
Battery Cables.....	8A-5	Situation.....	8A-13
Electrical Connections.....	8A-6	Recommendations.....	8A-13
SmartCraft Product.....	8A-6	Battery Switch.....	8A-14
Engine Harness.....	8A-6	Finding Other Diagrams.....	8A-14
Engine Connections.....	8A-9	Power Harness.....	8A-14
Continuity Wire Connection.....	8A-9	Battery Isolator.....	8A-15
Accessories.....	8A-11	Battery Isolator Diagram.....	8A-16

Lubricant, Sealant, Adhesives

Tube Ref No.	Description	Where Used	Part No.
 25	Liquid Neoprene	All electrical connections except the battery	92- 25711 3

Finding Other Diagrams

NOTICE
Refer to the appropriate Mercury MerCruiser Diagram Binder for wiring diagrams or other diagrams not found in this manual.

General Information

This section covers the engine portion of the electrical system. For instrumentation related information, see **Section 9**.

The electrical system is a 12-volt, negative ground system. High output (65/72 amp) alternators are included as standard equipment. Their high output design helps ensure that the battery remains fully charged for trouble-free starting, while providing extra capacity to handle the accessories used on today's boats. All alternators are equipped with an external sensing circuit to maintain the battery at the optimum voltage level, while providing for the use of a battery isolator, if desired. Special high-capacity marine starters are also employed to provide reliable starting and long life in the rigorous marine environment. Mercury MerCruiser starters, alternators, distributors, solenoids, circuit breakers, fuses, and other components that could generate a spark comply with external ignition standards and regulations to prevent the ignition of combustible fumes in the engine compartment should they exist. These components should not be confused with standard automotive components, which typically do not have this provision. The electrical system is equipped with numerous overcurrent protection devices (circuit breakers, fuses) to protect the engine against shorts and overloads. See **Wiring Diagrams** for the location of these devices. The engine compartment should be designed to allow access to these components.

IMPORTANT: No one component is more important in ensuring the reliability of the electrical system than is the battery and related hardware. The installation of the battery and cables is the responsibility of the boat manufacturer. The guidelines outlined in this section must be carefully followed when selecting and installing these items.

Precautions

WARNING

Avoid fire or explosion hazard. Electrical, ignition, and fuel system components on Mercury Marine products comply with federal and international standards to minimize risk of fire or explosion. Do not use replacement electrical or fuel system components that do not comply with these standards. When servicing the electrical and fuel systems, properly install and tighten all components.

WARNING

Performing service or maintenance without first disconnecting the battery can cause product damage, personal injury, or death due to fire, explosion, electrical shock, or unexpected engine starting. Always disconnect the battery cables from the battery before maintaining, servicing, installing, or removing engine or drive components.

⚠ CAUTION

Failure to protect wiring with an appropriate fuse can damage the wiring and start a fire. When installing any accessories, we recommend using a Mercury accessory kit. Always use the appropriate fuse to protect wiring.

IMPORTANT: Refer to the following precautions when working on or around the electrical harness, or when adding other electrical accessories, to avoid damage to the electrical system.

- Do not tap accessories into the engine harness.
- Do not puncture wires for testing (probing).
- Do not reverse the battery leads.
- Do not splice wires into the harness.
- Do not attempt diagnostics without the proper, approved service tools.

IMPORTANT: The accessory wire in the 14-pin harness will not support amperage in excess of 15 amps. Refer to Quicksilver Accessories for an optional relay kit that will accommodate a higher amperage draw.

Industry Standards and Regulations

⚠ WARNING

Improper design and installation of the electrical system can result in serious injury or death. Adhere to all applicable marine regulations (United States Coast Guard [USCG], European Union–Recreational Craft Directive [EU-RCD], etc.) and the standards they reference (American Boat and Yacht Council [ABYC], Society of Automotive Engineers [SAE], International Standards Organization [ISO], etc.) for the market in which the boat will be sold.

The following excerpts from the ABYC Standards should be observed when designing and installing the electrical system. These are just a few of the more fundamental standards that, if observed, can significantly improve the overall reliability and durability of the boat and engine package. The list is not intended to be all-inclusive, and should not be used as a substitute for reading the standards.

- Current carrying conductors shall be routed as high as practical above bilge water level and other areas where the water may accumulate. The wiring and connections must be water-tight.
- Conductors should be routed as far away as practical from exhaust pipes and other heat sources. Unless an equivalent thermal barrier is provided, a clearance of 51 mm (2 in.) should be provided between conductors and the water cooled Mercury MerCruiser exhaust system components.
- Conductors that may be exposed to physical damage shall be protected by self-draining loom, conduit, tape, raceways, or other equivalent protection.
- Conductors passing through bulkheads or structural members shall be protected to avoid insulation damage such as chafing by using grommets.
- Conductors should be routed to clear sources of chafing such as steering cable and linkages, throttle connections, and other moving engine components.
- Conductors should be supported throughout their length and should be secured at least every 46 cm (18 in.), using industry approved fasteners.

- All connections shall be in locations protected from the weather, in weatherproof enclosures or should be watertight. If connections are exposed to immersion, they must be watertight.
- Metals used for terminal studs, nuts, and washers shall be corrosion resistant and galvanically compatible with the conductor and terminal lug. Aluminum and unplated steel shall not be used for studs, nuts, and washers.
- No more than 4 conductors shall be secured to any one terminal stud.
- Only industry approved terminals shall be used, which typically include ring and captive spade types.
- Solder shall not be used as the sole means of mechanical connection in any circuit. Solder connections shall be properly supported to minimize flexing of the solder connection.
- Twist-on connectors (i.e. wire nuts) shall not be used.
- Wire size and insulation rating shall be selected in accordance with industry standards with the proper overcurrent protection being used.

Battery and Battery Cables Requirements

NOTICE

Reversing the battery cables can damage the electrical system. Connect the positive lead to the positive terminal and the negative lead to the negative terminal.

⚠ WARNING

Improper design and installation of the electrical system can result in serious injury or death. Adhere to all applicable marine regulations (United States Coast Guard [USCG], European Union–Recreational Craft Directive [EU-RCD], etc.) and the standards they reference (American Boat and Yacht Council [ABYC], Society of Automotive Engineers [SAE], International Standards Organization [ISO], etc.) for the market in which the boat will be sold.

⚠ CAUTION

Disconnecting or connecting the battery cables in the incorrect order can cause injury from electrical shock or can damage the electrical system. Always disconnect the negative (-) battery cable first and connect it last.

Battery

IMPORTANT: Follow all applicable regulations or industry standards when installing the battery. Ensure that the battery cable is installed so that it meets the pull test requirements and that positive battery terminal is properly insulated.

IMPORTANT: Some areas require that the battery be installed in an enclosed case. Refer to regulations for your area.

IMPORTANT: Always tighten battery cables with a wrench.

Select a battery that meets these specifications:

Use a 12-volt marine type battery with tapered post or side-terminal connectors. Do not use a battery with wing nut connectors. Ensure that the battery capacity rating meets or exceeds the recommended cranking battery specifications.

Cranking Battery Specifications	
Model	Minimum required rating

All carburated models	375 cca / 475 mca / 90 Ah
All MPI models	750 cca / 950 mca / 180 Ah
All DTS Models	800 cca / 1000 mca / 190 Ah

Ensure that the battery has a reserve capacity rating that meets or exceeds the electrical accessory loads of the particular application. Refer to applicable standards for calculation procedure.

- Install the battery according to the following specifications:
- As close to the engine as possible.
- In an accessible location for service.
- Ensure that the battery compartment is properly vented in accordance with the industry standards and regulations.
- Ensure that the battery is not installed above or below a fuel tank, fuel filter, or fitting in a fuel line.
- Ensure that the battery is installed so that the metallic objects cannot come in contact with the ungrounded (positive) battery terminal.
- Ensure that the fuel system components within 30.5 cm (12 in.) and above the horizontal plane of the battery top surface are shielded with dielectric material.
- Ensure that the battery parts that are continuously energized, such as the positive battery terminal and the cable connections are physically protected with boots or other forms of protection to prevent accidental short circuits.
- Ensure that the battery cable connections are tight and protected with a battery connection sealant.
- The battery installation for multiple engine installations require special battery considerations.

Battery Cables

IMPORTANT: Battery cables must comply with SAE J1127 or comparable standards.

- Select proper size positive (+) and negative (-) battery cables using the chart.

Battery Cable Length Requirements	
Average Cable Length	Cable Gauge
Up to 1.1 m (3-1/2 ft.)	25 mm ² (4)
1.1–1.8 m (3-1/2–6 ft.)	35 mm ² (2)
1.8–2.3 m (6–7-1/2 ft.)	50 mm ² (1)
2.3–2.9 m (7-1/2–9-1/2 ft.)	50 mm ² (0)
2.9–3.7 m (9-1/2–12 ft.)	70 mm ² (00)
3.7–4.6 m (12–15 ft.)	95 mm ² (000)
4.6–5.8 m (15–19 ft.)	120 mm ² (0000)

Refer to the following battery cable guidelines:

- Multiple engine installations (including generator sets) require that a negative cable be run between the engines. The cable must be of sufficient size to carry the highest cranking current that could be encountered.
- On applications with crossover (parallel) cranking motor circuits in multiple engine installations (including generator sets), a separate negative ground cable must be run between the engines (in addition to the cable mentioned above). The cable must be sized to handle the highest possible load in the cranking circuit.

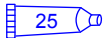
- Battery cables must be routed above normal bilge water levels throughout their length.
- Battery cables must be routed to avoid contact with metallic fuel system components.
- The positive battery cable must be routed to avoid contact with any portion of the engine or drive train.
- Cables that are exposed to physical damage should be protected by conduit, raceways, tape, etc.
- Cables that pass through bulkheads or other structural members should be protected against chafing with grommets, etc.
- To ensure good electrical contact, use only electrical grade (resin flux) solder when soldering battery cable terminals to cable ends. Some form of mechanical connection (for example, by swaging or crimping) is also recommended, and is required if length of solder connection is less than 1-1/2 times the diameter of the stranded area of the cable. See **Multiple EFI Engine Battery Precautions**.

Electrical Connections

Refer to the following precautions when working on or around the electrical harness, or when adding other electrical accessories, to avoid damage to the electrical system.

- Do not tap accessories into the engine harness.
- Do not puncture wires for testing (probing).
- Do not reverse the battery leads.
- Do not splice wires into the harness.
- Do not attempt diagnostics without the proper, approved service tools.

IMPORTANT: When routing all wire harnesses and hoses, ensure that they are routed and secured to avoid potential contact with moving parts hot spots on the engine.

Tube Ref No.	Description	Where Used	Part No.
 25	Liquid Neoprene	All electrical connections except the battery	92- 25711 3

SmartCraft Product

A Mercury SmartCraft System instrument package can be purchased for this product. A few of the functions the instrument package will display are engine RPM, coolant temperature, water pressure, battery voltage, fuel consumption, and engine operating hours.

The SmartCraft Instrument package also aids in Engine Guardian diagnostics, by displaying critical engine alarm data and indicating potential problems.

Refer to the **Mercury SmartCraft Operator's Supplement** for the warning functions and basic operation of the SmartCraft instrument package. Refer to the instructions included with the instruments for installation instructions.

Engine Harness

GENERAL INFORMATION

Fuel injected MerCruiser engine models are SmartCraft ready and may be rigged using the SmartCraft instrumentation, analog instrumentation, or a combination of the two.

If using an adapter, do not overtighten the clamp or deform the connector. Ensure that the connection is oriented at angle or installed in a location that places the connection at risk for exposure to moisture. Mount the connector with a downward slope of 30° from horizontal to provide additional protection from water intrusion. Ensure that the location does not interfere with moving parts on the engine or boat.

The adapter limits accessory current through the boat harness to 15 amps, even if the boat has a 10-pin harness that is capable of handling larger accessory loads.

SmartCraft data is carried in the 14-pin system without the use of a special data harness.

SmartCraft data is not supported across the adapters. A separate CAN line will be needed on a boat using SmartCraft instrumentation and an adapter harness.

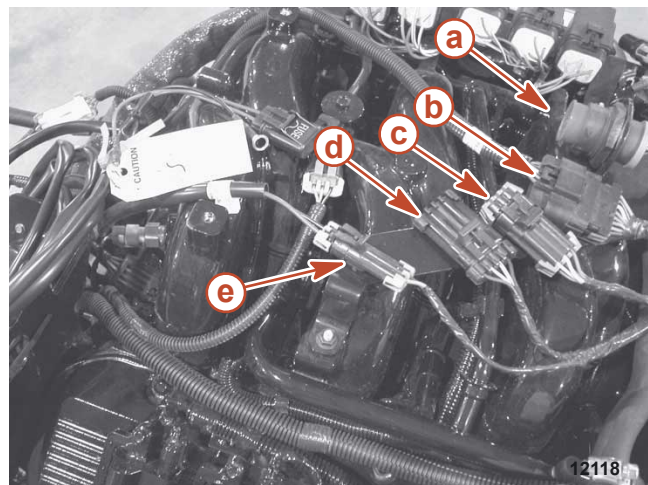
ENGINE HARNESS INSTALLATION

CAUTION

Failure to protect wiring with an appropriate fuse can damage the wiring and start a fire. When installing any accessories, we recommend using a Mercury accessory kit. Always use the appropriate fuse to protect wiring.

IMPORTANT: The accessory wire in the 14-pin harness will not support more than 15 amps. The main power relay fuse may blow if an excess of 15 amps is applied. Refer to the **Mercury Precision Parts Accessories Guide** for an optional accessory power relay kit that will accommodate higher amperage draw.

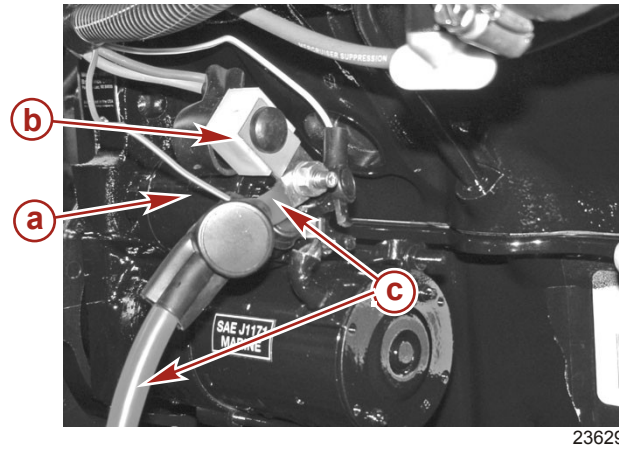
1. Route the instrumentation wiring harness back to the engine, making sure that the harness does not rub or get pinched. If an extension harness is required, be sure to secure the connection properly.
2. Fasten the harnesses to the boat at least every 45.7 cm (18 in.) , using appropriate fasteners.
3. Models with a 10-pin harness, connect the instrumentation wiring harness to the engine harness plug. Secure the connection with the hose clamp.
4. Tighten the hose clamp to secure the wiring harness to the engine harness plug.
5. Models with a 14-pin harness, connect the instrumentation wiring harness to the engine harness plug.
 - a. Connect the depth transducer connector to the DLC/Depth transducer connector on the engine harness.
 - b. Connect the paddle wheel/tank level connector.
 - c. Connect the power harness (Clean Power with 5-amp fuse) connector (DTS and PCM09 only).



Typical 14-pin DTS harness

- | | |
|--|---|
| a - Engine harness connector | d - DLC/depth transducer connector |
| b - Transmission harness connector | e - Power harness connector/clean power with 5-amp fuse (DTS and PCM09 only) |
| c - Paddle wheel/tank level connector | |

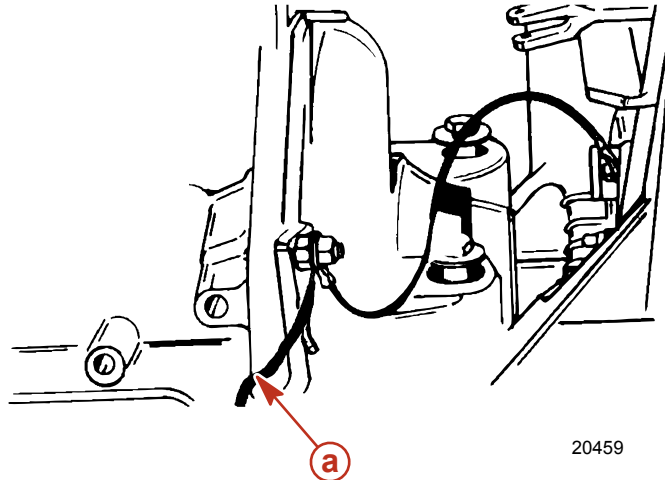
Engine Connections



a - Starter solenoid
b - 90-amp fuse

c - Positive (+) battery cable

NOTE: The negative (-) battery wire can be connected to the port or starboard flywheel housing ground stud.



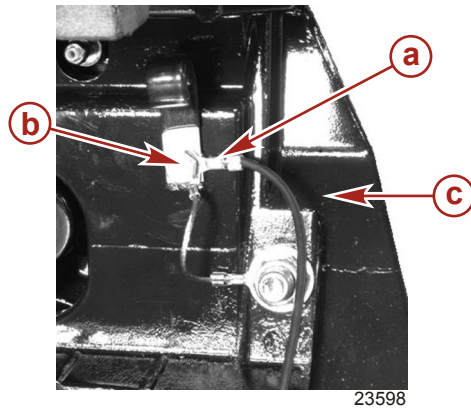
a - Negative (-) battery wire

Continuity Wire Connection

IMPORTANT: Do not attach any accessory ground (-) wires to the transom plate ground point. Accessory ground wires can only be attached to the ground stud on the engine.

IMPORTANT: Models equipped with a 14-pin engine wiring harness are equipped with a separate transom harness. Incorporated into the transom harness is a continuity circuit ground lead. Proper ground connection between the transom and the engine is required to ensure proper operation of the corrosion protection system.

1. For models equipped with a 14-pin engine harness, secure the transom harness continuity circuit ground lead to the inner transom plate using the grounding screw on the upper port side of the inner transom plate. Tighten the screw securely.



- a** - Transom harness ground lead **c** - Inner transom plate
b - Grounding screw

2. If the transom plate has a continuity wire attached, it can be removed or attached to the flywheel housing. Whether or not this additional continuity wire is used, the continuity wire in the transom harness must be connected to the continuity circuit at the transom plate.

⚠ WARNING

Excessive current load in the continuity wire may cause the potential for fire, leading to injury or property damage. Do not connect the negative (-) battery cable to the transom assembly.

IMPORTANT: Ensure that the continuity wire is connected between the engine and the inner transom plate. This lead is critical for the corrosion protection system to operate properly, especially when the MerCathode is being used.

- Do not connect the negative cable to other than the unpainted locations shown to ensure good electrical contact.

NOTICE

An improperly secured positive (+) battery cable or accessory lead can stress starter terminals or damage the starter solenoid. Secure accessory leads and the positive battery cable to the boat.

- Secure cables to the boat using industry-approved fasteners to prevent stressing the cable and terminals.
- Connections at the engine should be coated with liquid neoprene to prevent corrosion.
- Battery connections should be coated with battery connection sealant to help retard corrosion.

Accessories

⚠ WARNING

Improper design and installation of the electrical system can result in serious injury or death. Adhere to all applicable marine regulations (United States Coast Guard [USCG], European Union–Recreational Craft Directive [EU-RCD], etc.) and the standards they reference (American Boat and Yacht Council [ABYC], Society of Automotive Engineers [SAE], International Standards Organization [ISO], etc.) for the market in which the boat will be sold.

- Coat connections with liquid neoprene to prevent corrosion.

NOTICE

An improperly secured positive (+) battery cable or accessory lead can stress starter terminals or damage the starter solenoid. Secure accessory leads and the positive battery cable to the boat.

- Secure leads to the boat using industry-approved fasteners to prevent stressing the leads and starter terminal.
- Refer to industry standards and regulations for additional information.

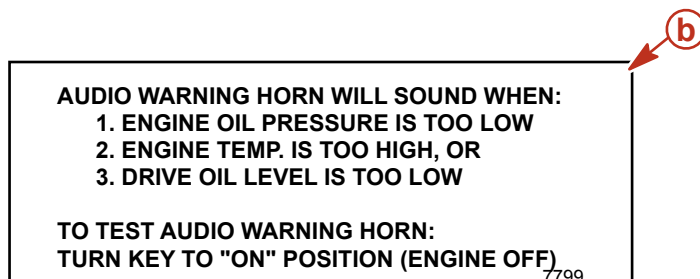
Audio Warning System

Audio Warning System without Emissions Control

1. Place the large decal on the instrument panel, or another location where the operator can see it easily.



**APPLY THE PROPER DECAL TO THE DASHBOARD
OR OTHER APPROPRIATE LOCATION:**



- a** - Small decal (transparent)
- b** - Large decal

2. Test audio warning system during pre-delivery preparation section.

Audio Warning System with Emissions Control

IMPORTANT: The audio warning system will indicate that a problem has occurred. It does not protect the engine from damage.

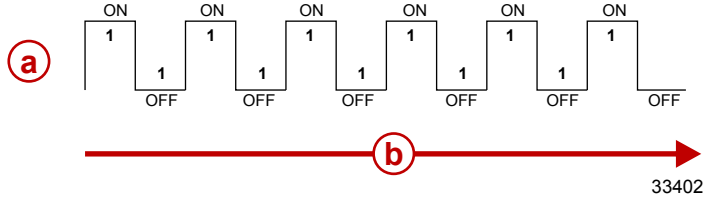
Your Mercury MerCruiser power package may be equipped with an audio warning system. Most faults cause the warning horn circuit to activate. How the warning horn activates depends on the severity of the problem.

There are three warning horn states:

- Caution
- Severe
- Onboard Diagnostic Marine (OBDM) fault

CAUTION

If a caution is detected, the audio warning system will sound for six one-second intervals.



- a** - Horn (on or off)
- b** - Time (in seconds)

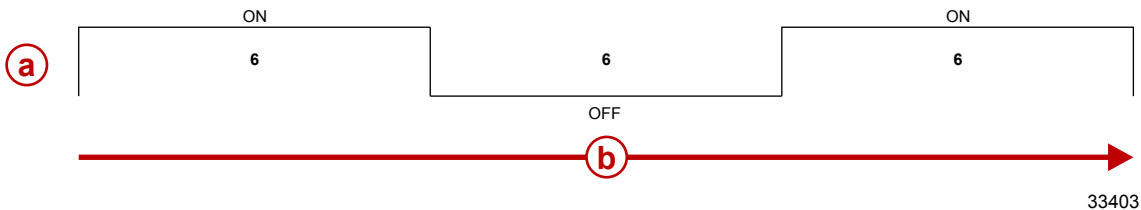
Below are some examples of a caution fault:

- Transmission fluid temperature is too hot
- Drive oil is low
- Sensor failure

SEVERE

IMPORTANT: If you experience a severe fault, contact your authorized Mercury MerCruiser dealer.

If a severe fault is detected, the audio warning system will sound for six seconds, turn off for six seconds, then sound for six more seconds.



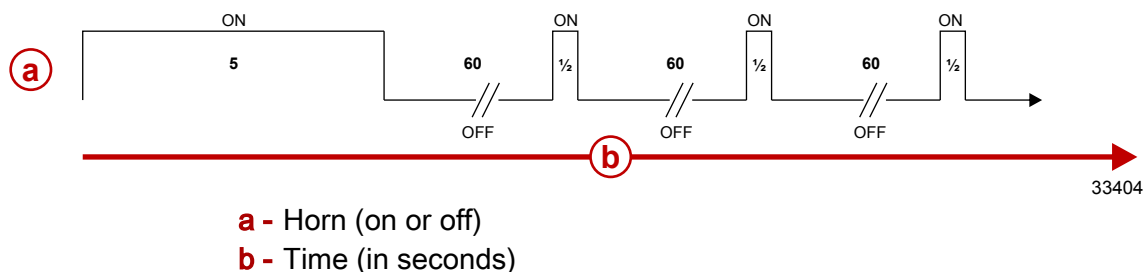
- a** - Horn (on or off)
- b** - Time (in seconds)

The following are examples of conditions that could trigger a sever fault:

- Engine oil pressure is too low
- Engine temperature is too hot
- Seawater pressure is too low
- Transmission pressure is low

OBDM

If an OBDM fault is detected, the audio warning system will sound for one five-second interval, followed by a 1/2-second interval every 60 seconds for certain faults related to the emissions or fuel system. See your authorized Mercury MerCruiser dealer for assistance.



TESTING THE AUDIO WARNING SYSTEM

1. Turn the ignition switch to the "ON" position without cranking the engine.
2. Listen for the audio alarm. The alarm will sound if the system is functioning correctly.

Multiple EFI Engine Battery Precautions

Situation

Alternators: Alternators are designed to charge the battery that supplies electrical power to the engine that the alternator is mounted on. When batteries for two different engines are connected, one alternator will supply all of the charging current for both batteries. Normally, the other engine's alternator will not be required to supply any charging current.

EFI Electronic Control Module (ECM): The ECM requires a stable voltage source. During multiple engine operation, an onboard electrical device may cause a sudden drain of voltage at the engine's battery. The voltage may go below the ECM's minimum required voltage. Also, the alternator on the other engine may now start charging. This could cause a voltage spike in the engine's electrical system.

In either case, the ECM could shut off. When the voltage returns to the range that the ECM requires, the ECM will reset itself. The engine will now run normally. This ECM shut down usually happens so fast that the engine just appears to have an ignition miss.

Recommendations

Batteries: Boats with multi-engine EFI power packages require each engine be connected to its own battery. This ensures that the engine's electronic control module (ECM) has a stable voltage source.

Battery Switches: Battery switches should always be positioned so each engine is running off its own battery. DO NOT operate engines with switches in **BOTH** or **ALL** position. In an emergency, another engine's battery can be used to start an engine with a dead battery.

Battery Isolators: Isolators can be used to charge an auxiliary battery used for powering accessories in the boat. They should not be used to charge the battery of another engine in the boat unless the type of isolator is specifically designed for this purpose.

NOTE: *Sure Power Industries Inc., Model 32023A meets this design specification.*

1. The boat may have 2 engines connected to a single Model 32023A battery isolator.
2. The Model 32023A battery isolator is connected to 2 banks of batteries.
3. Each bank contains 2 batteries with the cranking battery for 1 engine in each bank.
4. The second battery in each bank is connected in parallel to the cranking battery.

5. The Model 32023A battery isolator is designed for this type of use; 2 battery banks, 2 charging sources, 120 amps (maximum alternator output).
6. When the engines are running, either engine's alternator could be charging either bank of batteries through the Model 32023A battery isolator.

Any other manufacturer's battery isolator that is the same type as the Sure Power Inc., Model 32023A could also be used.

Generators: The generator's battery should be considered another engine's battery.

Battery Switch

⚠ WARNING

Improper design and installation of the electrical system can result in serious injury or death. Adhere to all applicable marine regulations (United States Coast Guard [USCG], European Union–Recreational Craft Directive [EU-RCD], etc.) and the standards they reference (American Boat and Yacht Council [ABYC], Society of Automotive Engineers [SAE], International Standards Organization [ISO], etc.) for the market in which the boat will be sold.

A battery switch may be desirable to allow the power to be turned off when the boat is not in use and to allow switching between batteries in multiple battery applications. Certain industry standard and regulations require the use of a battery switch and should be consulted for requirements.

- The intermittent rating of the switch shall not be less than the maximum cranking current of the largest engine cranking motor that it serves.
- The minimum continuous rating of the switch shall be the total of the ampacities of the main overcurrent protection devices connected to the battery switch or the ampacity of the feeder cable to the switch, whichever is less (ABYC Standard).
- Connect the battery switch into the positive (+) battery cable as close to battery as possible.
- The switch should be located in a readily accessible location for use in an emergency.
- The switch should never be turned off while the engine is running to avoid damage to the alternator. Switching between batteries should also be avoided while the engine is running (unless the switch has been specially designed for this purpose).
- The switch should not be used to connect multiple engines to one battery (or battery bank). See **Multiple EFI Engine Battery Precautions**.

Finding Other Diagrams

NOTICE

Refer to the appropriate Mercury MerCruiser Diagram Binder for wiring diagrams or other diagrams not found in this manual.

Power Harness

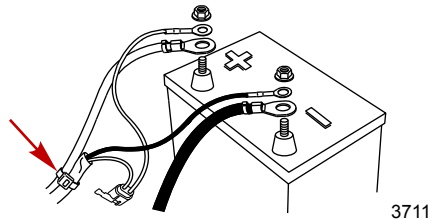
IMPORTANT: On all models equipped with DTS or Emissions Control you must install the appropriate power harness for your application. If your application is equipped with DTS and Emissions Control only one power harness is necessary.

1. Connect the power harness to the battery. Ensure the lead with the fuse is installed onto the positive battery terminal.
2. Install the lead without the fuse onto the negative battery terminal.

- Secure the battery cables and the power harness leads to the battery with hex nuts. Tighten the hex nuts to the specified torque.

Description	Nm	lb-in.	lb-ft
Hex nut	13.5	120	–

- Secure the power harness to the battery cable with a cable tie.



3711

Battery Isolator

⚠ WARNING

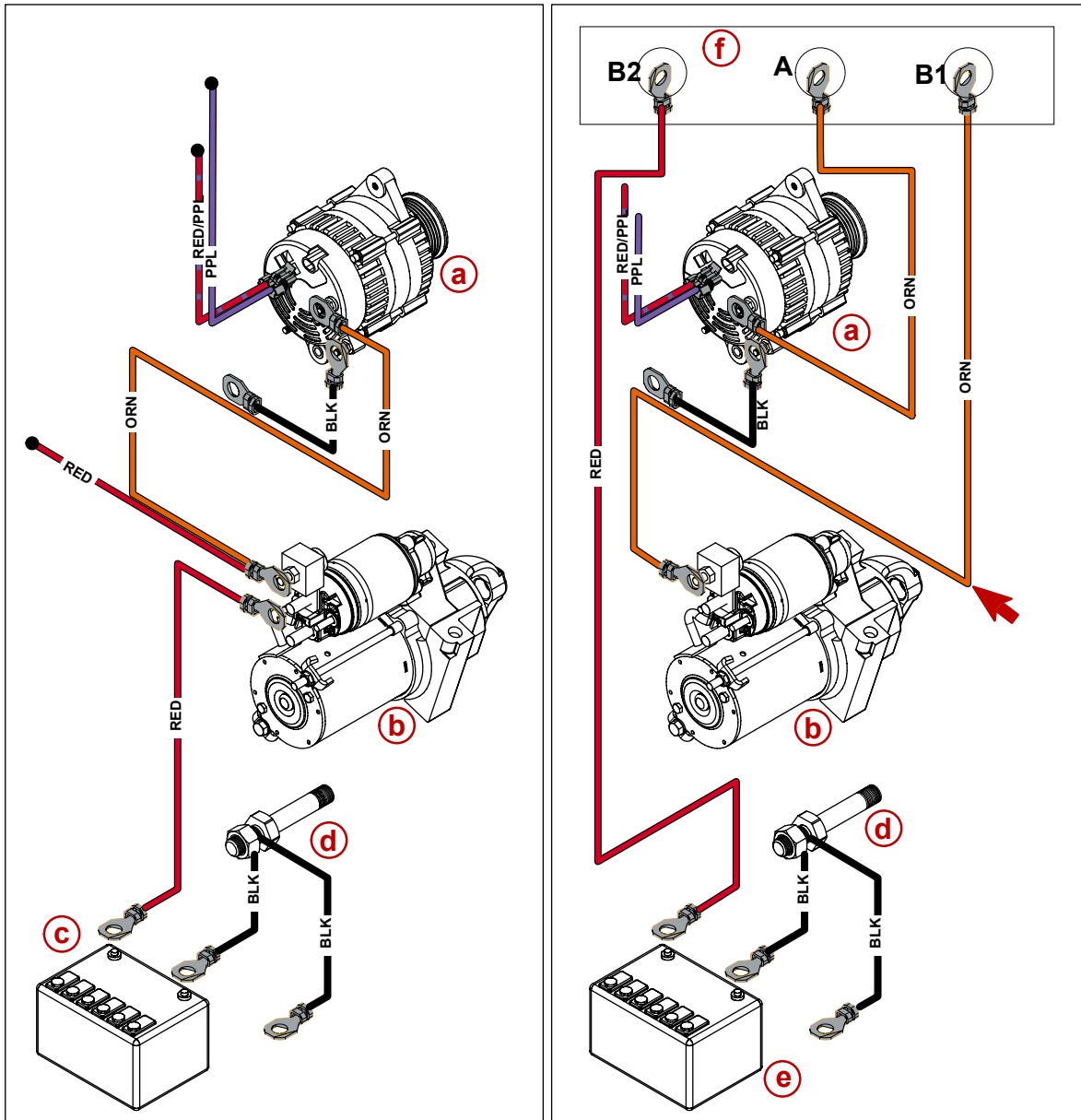
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You can install a battery isolator to charge of an auxiliary battery used to operate the accessories. The battery isolator will allow the alternator to charge both the cranking battery and auxiliary battery simultaneously, while preventing accessories connected to the auxiliary battery from discharging the cranking battery. The alternators used on Mercury MerCruiser products are equipped with a special external sensing circuit to ensure optimum charging performance in these types of applications by compensating for the voltage drop across the isolator.

A special isolator is required for multiple engine installations where the cranking batteries are to be charged from a common source. See **Multiple EFI Engine Battery Precautions**.

IMPORTANT: Mercury MerCruiser cannot be responsible for problems resulting from installation of the isolator. The installer and the isolator manufacturer must ensure that the installation and any modifications to the Mercury MerCruiser product comply with all applicable standards and regulations, including (but not limited to) wire size, type, routing, terminals, and overcurrent protection.

Battery Isolator Diagram



24376

- a - Alternator
- b - Starter
- c - Cranking battery

- d - Ground stud
- e - Auxiliary battery
- f - Isolator

IMPORTANT: Cutting the orange wire flush with the wiring loom will result in damage to the other wires in the loom.

The splice wire must be a minimum of 8 AWG.

1. Disconnect the orange wire from the alternator battery terminal. Splice the wire to the orange wire and connect as shown.
2. Insulate and seal the end of the wire with liquid neoprene and heat shrink tubing.