Workshop Manual

Electrical, Ignition, Fuel

C
2(0)

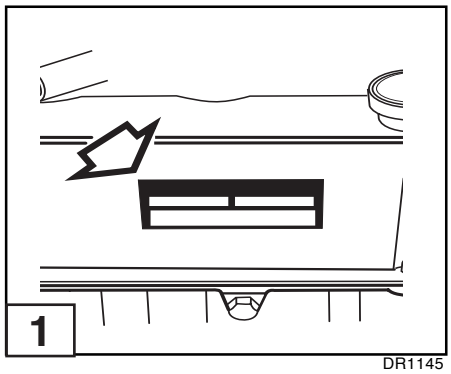
Contents

Model Identification

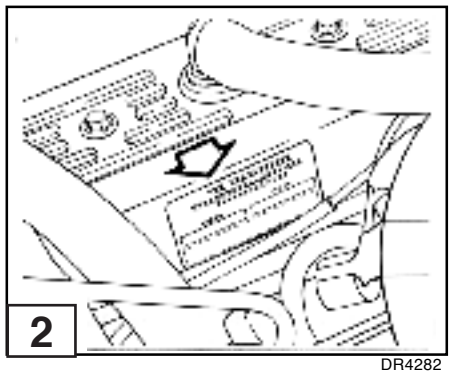
Ⓜ All stern drive system components must be matched for either single or dual engine installations. Failure to properly match engine, transom bracket and vertical drive will result in poor boat performance, and risk damage to engine and drive because of incorrect drive gear ratio.

Model identification is located on the engine valve cover, and **MUST** correspond with the transom bracket and vertical drive numbers as listed in this document.

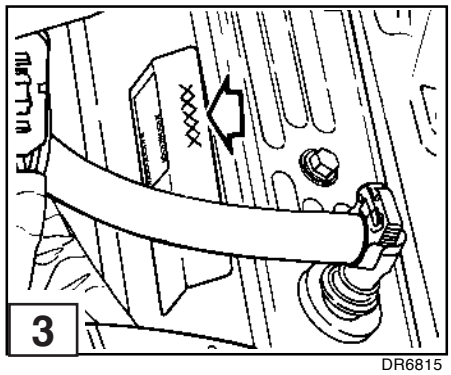
- Engine Model Number 1 2 3
- Transom Bracket Model Number 4
- Vertical Drive Model Number 5



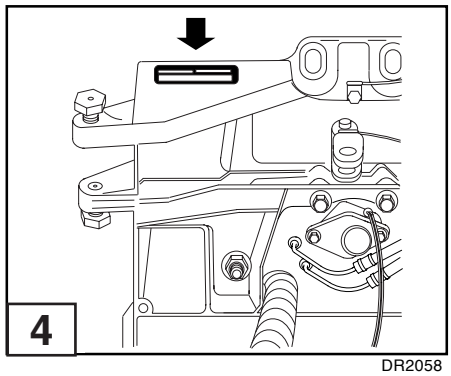
DR1145



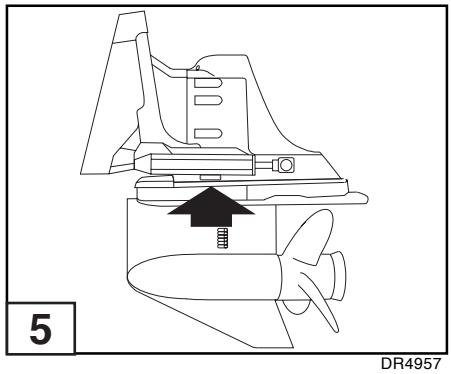
DR4282



DR6815



DR2058



DR4957

Section 1
General Information

Table of Contents

⚠ Safety Warnings

Before working on any part of the electrical system, read the section called Safety at the end of this manual.

The original mounting, support and routing of electrical system parts conform with U.S. Coast Guard requirements. It is important to maintain the original mounting, support and routing after servicing the electrical system to prevent possible fire and explosion in boat's engine compartment.

Do not substitute automotive parts. Volvo Penta marine components meet U.S. Coast Guard regulations for external ignition proof operation and marine use. Volvo Penta marine components are specially designed not to cause ignition of fuel vapors in the bilge or engine compartment. The use of automotive parts can result in fire and explosion.

Special Tools

Tool Name	Part No.	Panel Location
Crimping Pliers	-	B
Insert Tool	3854349-2	B
Pin Remover	-	B
Socket Remover	3854350-0	B

Sealants, Lubricants and Adhesives

DuraPlus™ Marine Fuel Conditioner
Black neoprene dip
Isopropyl alcohol
Terminal grease

Introduction

This service manual is divided into sections concerning various systems and assemblies. Refer to the **Contents** to locate the section covering the system or assembly requiring service. Each section title page has an additional listing that will describe the section's contents in more detail. Be sure to read the **Safety Section** at the end of this manual, and pay special attention to all safety warnings as they appear throughout the text. Since models are subject to change at any time, some photos may not depict actual product.

Good Service Practice

Service required for stern drives is generally one of three kinds:

- **Normal care and maintenance** - which includes putting a new stern drive into operation, storing engines, lubrication, and care under special operating conditions such as salt water and cold weather.
- **Operating malfunctions** - due to improper engine or drive mounting, propeller condition or size, boat condition, or the malfunction of some part of the engine. This includes engine servicing procedures to keep the engine in prime operating condition.
- **Complete disassembly and overhaul** - such as major service or rebuilding a unit.

It is important to determine before disassembly just what the trouble is and how to correct it quickly, with minimum expense to the owner.

When repairing an assembly, the most reliable way to ensure a good job is to do a complete overhaul on that assembly, rather than just to replace the bad part. Wear not readily apparent on other parts could cause malfunction soon after the repair job. Repair kits and seal kits contain all the parts needed to ensure a complete repair, to eliminate guesswork, and to save time.

Repair time can also be minimized by the use of special tools. Volvo Penta special tools are designed to perform service procedures unique to the product that cannot be completed using tools from other sources. They also speed repair work to help achieve service flat rate times. In some cases, the use of substitute tools can damage the part.

Note **Do not operate engine out of water even momentarily.** If operated in test tank, use proper test wheel. Failure to do so can damage water pump, overheat engine, or allow excessive engine RPM.

Preparation for Service

Proper preparation is extremely helpful for efficient service work. A clean work area at the start of each job will minimize tools and parts becoming misplaced. Clean an engine that is excessively dirty before work starts. Cleaning will occasionally uncover trouble sources. Obtain tools, instruments and parts needed for the job before work is started. Interrupting a job to locate special tools or repair kits is a needless delay.

⚠ Use proper lifting and handling equipment. **Working on stern drives without proper equipment can cause damage and personal injury.**

Always use clean fresh fuel when testing engines. Troubles can often be traced to the use of old or dirty fuel.

Service Policy

It is a policy of Volvo Penta to provide dealers with service knowledge so they can give professional service demanded by today's consumer. The Volvo Penta Training Centers, frequent mailing of Service Bulletins, Letters and Promotions, Special Tools and this Service Manual represent our continuing efforts to assist dealers in giving consumers the best and most prompt service possible. If a service question does not appear to be answered in this manual, you are invited to write to the Volvo Penta Service Department for additional help. Always be sure to give complete information, including engine model number and serial number.

When a brand-name product or specific tool is called for, another item may be used. However, the substitute must have equivalent characteristics, including type, strength, and material. You must determine if incorrect substitution could result in product malfunction and personal injury to anyone. To avoid hazards, equivalent products which are used must meet all current U.S. Coast Guard Safety Regulations and ABYC standards.

Replacement Parts

⚠ When replacement parts are required, always use genuine Volvo Penta parts, or parts with equivalent characteristics, including type, strength, and material. Failure to do so may result in product malfunction and possible injury to the operator and/or passengers.

Parts Catalogs

Parts catalogs contain exploded views showing the correct assembly of all parts, as well as a complete listing of the parts for replacement. These catalogs are helpful as a reference during disassembly and reassembly, and are available from Volvo Penta parts order.

Special Service Tools

Volvo Penta has specially designed tools to simplify some of the disassembly and assembly operations. These tools are illustrated in this Service Manual, in many cases in actual use. All Volvo Penta special tools can be ordered from Volvo Penta parts order. Individual purchasers of Service Manuals must order Special Tools through an authorized dealer.

Product References, Illustrations & Specifications

Volvo Penta reserves the right to make changes at anytime, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts at any time without incurring any obligation to equip same on models manufactured prior to date of such change. All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of printing. The right is reserved to make changes at anytime without notice.

All photographs and illustrations used in this manual may not depict actual models or equipment, but are intended as representative views for reference only. The continuing accuracy of this manual cannot be guaranteed.

Tuning The Engine

The purpose of an engine tune-up is to restore power and performance that has been lost through wear, corrosion or deterioration of one or more parts or components. In the normal operation of an engine, these changes can take place gradually at a number of points, so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be obtained by following a definite and thorough procedure of analysis and correction of all items affecting power and performance. Refer to the **Engine Service Manual** for all tune-up specifications.

Gasoline Requirements

Stern drive models in this manual are designed for maximum performance with the use of gasoline with the following minimum or higher octane specification:

- Anti-Knock Index Number (AKI) - 89
- Research Octane Number (RON) - 93

EFI Models Only: Some marinas sell fuel with lead additives. **Do not use such fuel as it may plug the fuel injectors.** Premium grade fuels contain injector cleaners and other additives that protect the fuel system and provide optimum performance. **The use of premium grade fuels is strongly recommended.**

Carbureted Models Only: Use of lead-free or leaded gasoline is acceptable.

If fuels with 89 AKI (93 RON) octane or higher are not available, lower octane fuels, with a minimum of 86 AKI (90 RON) octane, can be used. **Some engines may require timing adjustments if fuels lower than 89 AKI (93 RON) octane are used. See the General Information** section of the **Engine Service Manual.** When lower octane fuels are used, a slight decrease in power can be expected.

Note Engine damage resulting from the use of gasoline with octane lower than 86 AKI (90 RON) is considered misuse of the engine and will void the engine warranty. *Volvo Penta* suggests the use of 89 AKI or higher fuels. These fuels have additives that are beneficial to maximum engine performance and long life of service components.

To prevent gum formation and corrosion in the fuel system, use DuraPlus™ Marine Fuel conditioner in the gasoline. DuraPlus™ Marine Fuel conditioner is available from your authorized dealer.

⚠ Gasoline is extremely flammable and highly explosive under certain conditions. Always stop engine and do not smoke or allow open flames or sparks near the boat when refueling gas tanks. When filling the gas tank, ground the tank to the source of gasoline by holding the hose nozzle firmly against the side of the deck filler plate, or ground it in some other manner. This action prevents static electricity build-up which could cause sparks and ignite fuel vapors.

Gasolines Containing Alcohol

Many gasolines being sold today contain alcohol. Two commonly used alcohol additives are Ethanol (ethyl alcohol) and Methanol (methyl alcohol).

See the Owner's Manual for your boat to determine if the boat's fuel system is compatible with alcohol blended fuels. If it is compatible, your engine may be operated using gasolines blended with no more than 10% Ethanol (ethyl alcohol) meeting the minimum octane specification. **Do not use any gasoline which contains METHANOL (methyl alcohol).**

Note Serious damage to the boat or engine fuel systems will result from the continued use of fuel containing **METHANOL** (methyl alcohol).

If you use gasoline containing alcohol, be aware of the following:

- The engine will operate leaner with alcohol blended fuel. This may cause engine problems such as vapor lock, low speed stall, or hard starting.
- Alcohol blended fuels attract and hold moisture. Moisture inside fuel tanks can cause corrosion of the tank material. Inspect fuel tanks at least annually. Replace fuel tanks if inspection indicates leakage or corrosion.
- Inspect non-metallic parts of fuel system frequently and replace if excessive stiffness, deterioration or fuel leakage is found.

⚠ **Fuel leakage can contribute to a fire and/or explosion.**

Battery and Cables

Special Tools Required: Battery Hydrometer

The primary function of the battery is to provide power to operate the starter motor. The battery also supplies power to operate the lights and other electrical equipment which may be used when the engine is not running. On battery ignition systems, the battery must supply the ignition current during the starting period and during the time that the alternator is not producing a sufficient charge to meet operating requirements.

Battery Requirements

(3.0 GS, 4.3 GL & GS MODELS ONLY)

- Use a 12 volt battery having a minimum rating of 360 Cold Cranking Amps at 0° F (-18° C), and a 115 minute reserve capacity rating at 80° F (27° C).

(ALL OTHER MODELS)

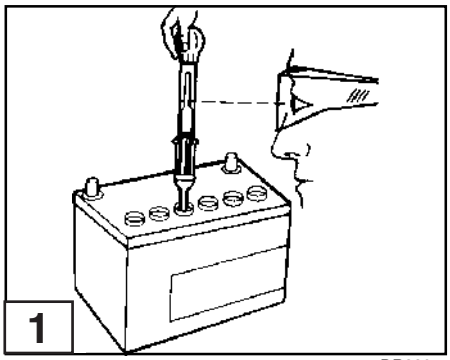
- Use a 12 volt battery having a minimum rating of 650 Cold Cranking Amps at 0° F (-18° C), and a 165 minute reserve capacity rating at 80° F (27° C).

Battery Maintenance

There are two things which must be done periodically in order to obtain long life from a battery.

1. The electrolyte must be kept above the plates and separators at all times. The liquid level should be brought up to the level specified by the battery manufacturer. Acid should never be added except when it is definitely known that some has been lost by spilling, and then only by an experienced battery man.

⚠ **Battery electrolyte is a corrosive acid and should be handled with care. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible.**



DR3201

1 2. Be sure that the battery is kept nearly at full charge at all times. The state of charge should be checked at frequent intervals by making specific gravity readings with a battery hydrometer. It is suggested that gravity readings and replacement of evaporated water be made every two weeks. Should the gravity fall more than 0.040 specific gravity below a fully charged gravity reading, remove the battery and have it charged.

Note Full charge specific gravity is 1.260 at 80° F (27° C).

⚠ **Do not use a jumper cable and a booster battery to start engine. Remove battery from boat and recharge. Fumes vented during charging battery can lead to an explosion.**

Good Battery Servicing Includes the Following Nine Points:

a. Protect boat against acid damage.
b. Clean battery.
c. Inspect cables.
d. Clean terminals.
e. Inspect hold-downs.
f. Inspect casing for leaks.
g. Make hydrometer test.
h. Remove battery from boat for tests. Recharge battery if less than 3/4 charged. Make load test.
i. Add water.

If battery is not in a good state of charge or if it uses an excessive amount of water, check the charging system.

Clean the battery and terminals with a solution of baking soda and water. This will neutralize the acid on the battery. After washing with this solution, flush top of battery with clear water. Care must be taken when washing the battery so that the baking soda and water solution does not enter the battery cells.

Cable Requirements

The battery should be mounted as close to the engine as practical to cut down on battery cable lengths. Follow the recommendations below.

- 0-10 Feet 0 Gauge
- 10-15 Feet 2/0 Gauge
- 15-20 Feet 4/0 Gauge

Note These specifications do not apply to aluminum battery cables. Volvo Penta does not recommend the use of aluminum battery cables.

⚠ **To prevent possible explosion or fire, do not substitute automotive parts for the following marine components: starter, alternator, distributor and related ignition parts, spark plug leads, solenoids, carburetor (and related parts), fuel pump or fuel filter canister. These components have been specifically designed not to emit fuel vapors or to cause ignition of fuel vapors in the bilge.**

Solenoids

Special Service Tools Required: Test Light or Continuity Meter and Carbon Pile

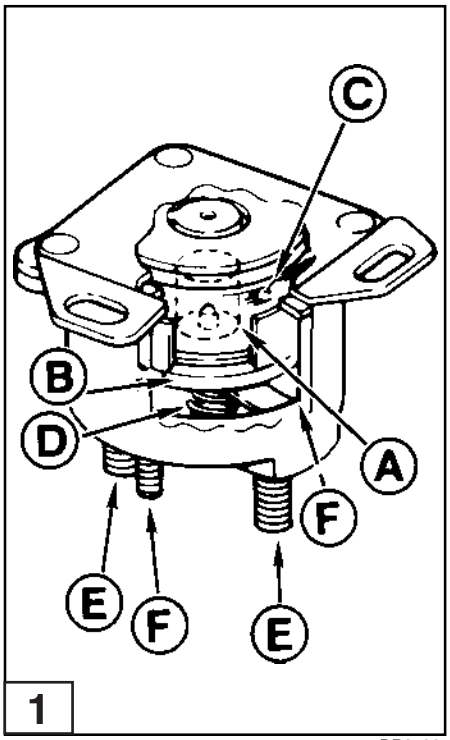
The purpose of the solenoid assembly is to perform mechanical jobs electromagnetically. In the case of the solenoid used with the starter, this job consists of completing the heavy electrical circuit between the battery and the motor.

1 The solenoid is a completely sealed unit which consists of a plunger Ⓐ and contact disk assembly Ⓑ, a coil winding Ⓒ, a contact disk return spring Ⓓ, and four terminals which protrude from the solenoid body. The two larger terminals Ⓔ are the battery and motor terminals, while the smaller ones Ⓕ are the switch control terminal, and terminal for sending battery voltage to the ignition system during engine cranking. Grounding is by an external ground wire in the engine harness, and internally (through bracket).

Note Coat all electrical connections after reassembly with black neoprene dip or equivalent.

In operation, when the ignition switch is closed, an electric current flows through the coil winding, causing the plunger and contact disk to be drawn inward. When drawn inward, the contact disk completes the circuit between the battery, motor and ignition terminals, allowing the battery current to flow.

A return spring is located just below the contact disk. When the electrical circuit as described above is completed, the spring is compressed by the magnetic pull on the plunger and contact disk. When the electrical circuit is broken (ignition switch released), the magnetic pull on the plunger and contact disk drops to zero. At this time, the compressed return spring breaks the circuit by pushing the contact disk away from the motor and battery studs of the solenoid.



DR3196

Inspection Procedure

The solenoid used with the starter motor has proven to be trouble free under normal operating conditions. No periodic service is required other than a check to ensure that all connections are clean and tight.

Test Procedure

Being a completely sealed unit, repair or troubleshooting of detail parts is impractical. If a solenoid is suspected of being inoperative, it should be tested as follows.

Note Ensure solenoid has a good ground.Grounding is done by a ground wire in the engine wiring harness and through the base.

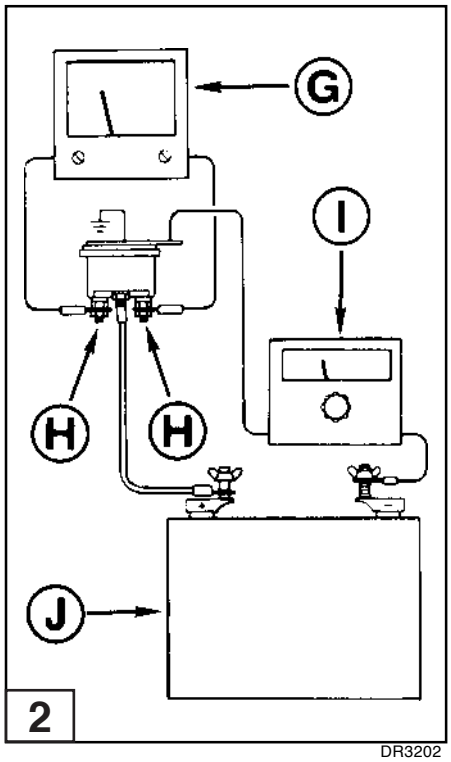
2 1. Connect a continuity light or ohmmeter Ⓖ, set to high ohms, to the two large terminals Ⓗ of the solenoid.

2 2. Connect a carbon pile Ⓘ in series with a battery Ⓙ and reduce the voltage to less than six volts. Connect battery leads to the one small terminal of the solenoid and the base.

3. Increase the voltage until the continuity meter or test light shows a completed circuit. Stop and note the voltage reading - it should be between six and eight volts. If the solenoid requires more than eight volts to complete the circuit it should be replaced since, in actual use, it may not perform satisfactorily.

Service and Repair Procedure

None - replace a malfunctioning unit.



DR3202

Relays

Special Service Tools Required: Ohmmeter or Test Light

The purpose of the relay assembly is to use a low amperage electrical circuit to control a high amperage circuit. In the case of a relay used in a starting circuit, the low amperage circuit from the key switch will control the high amperage circuit from the battery to the starter motor.

Inspection Procedure

The relays used in stern drive electrical circuits have proven to be trouble free under normal operating conditions. No periodic service is required. To prevent corrosion, all terminals of the relay and socket should be covered with terminal grease.

Relay Ohmmeter Tests

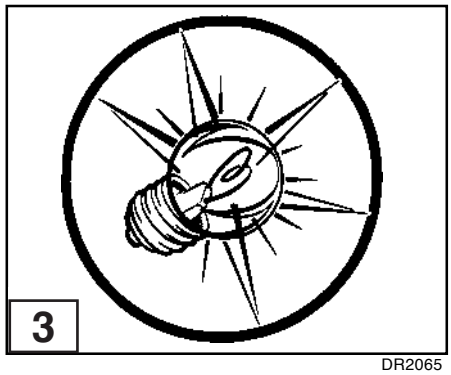
Note Throughout this section two symbols are used to interpret electrical troubleshooting results.

3 This symbol indicates continuity or very low resistance.

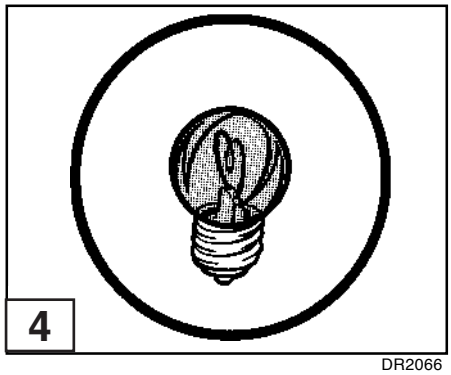
4 This symbol indicates no continuity or very high resistance (∞).

Note To avoid damaging components or troubleshooting equipment, disconnect the battery cables from the battery and remove the relays before proceeding.

1. Use a continuity light or ohmmeter calibrated on appropriate scale to test continuity.



DR2065



DR2066

1 2. Connect meter leads to relay terminals 87a and 30.

- The meter must show **continuity.**

2 3. Connect meter leads to relay terminals 87 and 30.

- The meter must show **no continuity.**

3 4. Calibrate an ohmmeter on appropriate scale and connect the leads to relay terminals 85 and 86.

- The meter must show 70 - 100 ohms.

4 5. Connect meter leads to relay terminals 87 and 30. Connect a 12 volt source to relay terminals 85 and 86.

- The meter must show **continuity.**

5 6. Connect meter leads to relay terminals 87a and 30. Connect a 12 volt source to relay terminals 85 and 86.

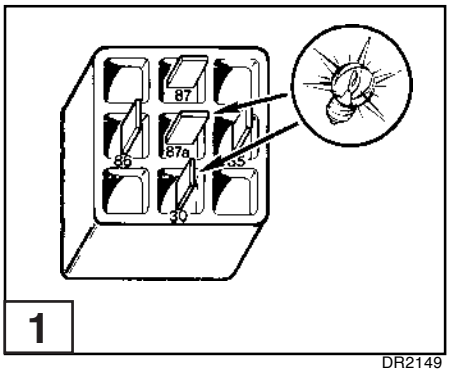
- The meter must show **no continuity.**

7. Replace relay if your test results vary.

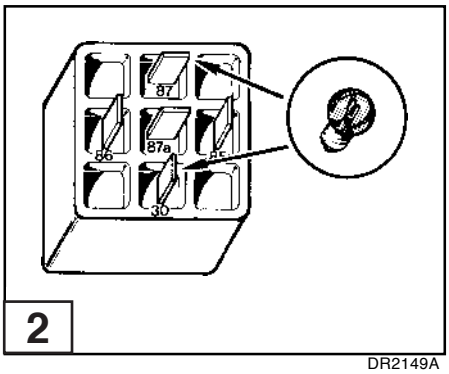
Circuit Protection

⚠ **Do not attempt to connect or disconnect any part of the electrical circuit while the engine is running.**

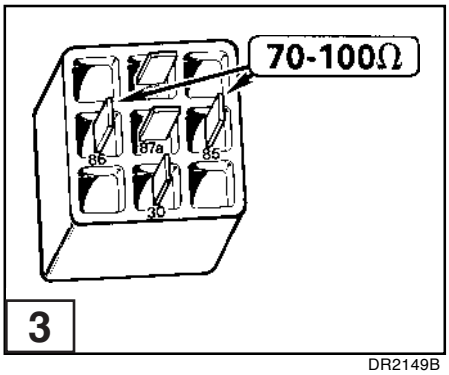
When installing additional electrical accessories always use individual fused circuits. Power takeoff should be made at a terminal strip powered by auxiliary accessory wire and protected by a 30 amp (maximum) fuse.



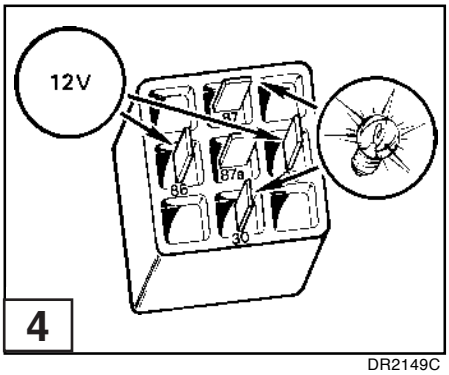
DR2149



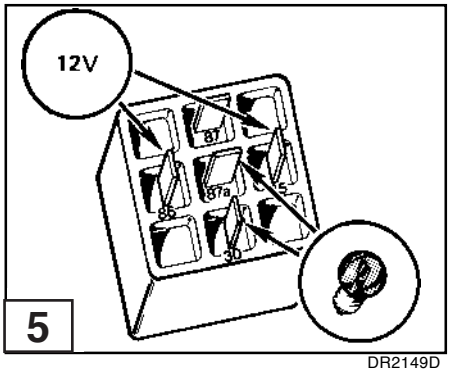
DR2149A



DR2149B



DR2149C



DR2149D

Circuit Protectors and Locations

10 Amp Fuse *

Protects trim switch. Located on trim/tilt pump.

SFE 20 Amp Fuse *

Protects ignition switch. Located under dash.

6 Amp Circuit Breaker ↓

Protects fuel pump. Located at starboard front of engine on fuel pump bracket.

15 Amp Fuse †

Protects ignition/injector relay and ECM. Located at front of starboard high-rise exhaust elbow

20 Amp Fuse †

Protects fuel pumps. Located at port front of engine.

50 Amp Circuit Breaker *

Protects trim/tilt motor. Located at front of starboard high-rise exhaust elbow.

40 Amp fuse *

Protects main harness. Located at front of starboard high-rise exhaust elbow.

* All Models

↓ 4.3 GL, 5.0 GL, and 5.7 GS Models Only

† All Gi and GSi Models Only

Oil and Water Sending Units

Special Tools Required: Ohmmeter

Inspection Procedure

Check wiring and connections between senders and gauges. Check to see that senders are operating properly. Inspect orifice in oil pressure sender for blockage.

Test Procedure - Gauge Sending Units

Oil Pressure Sender: To check oil gauge senders, start engine and run up from slow to fast. Observe gauge. If reading is unsatisfactory, check sender with an ohmmeter:

- 0 PSI ... 227-257 ohms
- 40 PSI ... 92-114 ohms
- 80 PSI ... 21.5-49.5 ohms

Replace sender with a new one if it fails the ohmmeter checks. Retest; if reading is still unsatisfactory, problem may be in gauge, engine lubrication system or excessive bearing wear. Refer to appropriate **Engine Section,** paragraph **Oil Pump Service.**

To check gauge, disconnect wire at sender, turn ignition switch on, and momentarily ground sender wire. Gauge needle will peg at high side of scale if gauge is operating properly.

Water Temperature Sender: To check water temperature senders, remove sender from engine. Connect sender to a digital ohmmeter. Immerse sender in a container of oil with a cooking thermometer. Heat oil over a flameless source. Observe meter and thermometer. Meter should indicate:

- 448 ohms ± 10% at 100° F (38° C)
- 128 ohms ± 7.5% at 160° F (71° C)
- 46.6 ohms ± 5% at 220° F (105° C)