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# *Warranty*


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## HOLIDAY RAMBLER
## MOTORHOME LIMITED WARRANTY

**What the Period of Coverage Is:**

If you use your Holiday Rambler® motorhome only for recreational travel and family camping purposes, the Limited Warranty provided by Holiday Rambler ("Warrantor") covers your new motorhome when sold by an authorized dealer, for twelve (12) months from the original retail purchase date or the first 24,000 miles of use, whichever occurs first. However, the Limited Warranty provided by Warrantor covers the steel or aluminum frame structure of the sidewalls (excluding slide outs), roof, and rear and front walls for sixty (60) months from the original retail purchase date or the first 50,000 miles of use, whichever occurs first.

If you use your motorhome for any rental, commercial or business purposes whatsoever, the Limited Warranty provided by Warrantor covers your new motorhome when sold by an authorized dealer for ninety (90) days from the original retail purchase date or the first 24,000 miles of use, whichever occurs first. In addition, the Limited Warranty provided by Warrantor covers the steel or aluminum frame structure of the sidewalls (excluding slide outs), roof, and rear and front walls for twelve (12) months from the original retail purchase date or the first 24,000 miles of use, whichever occurs first. A conclusive presumption that your motorhome has been used for commercial and/or business purposes arises if you have filed a federal or state tax form claiming any business tax benefit related to your ownership of the motorhome.

The above Limited Warranty coverage applies to all owners, including subsequent owners, of the motorhome. However, a subsequent owner must submit a warranty transfer form by filing the form through an authorized Holiday Rambler dealer. A subsequent owner's warranty coverage period is the remaining balance of the warranty coverage period the prior owner was entitled to under this Limited Warranty. Warranty transfer forms can be obtained by contacting the Customer Relations Department. There is no charge for the transfer.

### Limitations of Implied Warranties

**ANY IMPLIED WARRANTIES ARISING BY WAY OF STATE LAW, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE TERM OF THIS LIMITED WARRANTY AND ARE LIMITED IN SCOPE OF COVERAGE TO THOSE PORTIONS OF THE MOTORHOME COVERED BY THIS LIMITED WARRANTY**. Warrantor disclaims all implied and express warranties, including the implied warranty of merchantability and the implied warranty of fitness for a particular purpose, on components and appliances excluded from coverage as set forth below. There is no warranty of any nature made by Warrantor beyond that contained in this Limited Warranty. No person has authority to enlarge, amend or modify this Limited Warranty. The dealer is not the Warrantor's agent but is an independent entity. Warrantor is not responsible for any undertaking, representation or warranty made by any dealer or other person beyond those expressly set forth in this Limited Warranty. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

### What the Warranty Covers

Warrantor's Limited Warranty covers defects in the manufacture of your motorhome and defects in materials used to manufacture your motorhome. Also see the section "What the Warranty Does Not Cover" set out below.

### What We Will Do to Correct Problems

Warrantor will repair and/or replace, at its option, any covered defect if: (1) you notify Warrantor or one of its authorized servicing dealers of the defect within the warranty coverage period and within five (5) days of discovering the defect; and (2) you deliver your Motorhome to Warrantor or Warrantor's authorized servicing dealer at your cost and expense. It is reasonable to expect some service items to occur during the warranty period. The performance of warranty repairs shall not extend the original warranty coverage period. Further, any performance of repairs after the warranty coverage period has expired or any performance of repairs to component parts and appliances excluded from coverage shall be considered "good will" repairs, which shall not alter the express terms of this limited warranty.

Warrantor may use new and/or remanufactured parts and/or components of substantially equal quality to complete any repair.

Defects and/or damage to interior and exterior surfaces, trim, upholstery and other appearance items may occur at the factory during manufacture, during delivery of the motorhome to the selling dealer or on the selling dealer's lot. Normally, any such defect or damage is detected and corrected at the factory or by the selling dealer during the inspection process performed by the Warrantor and the selling dealer. If, however, you discover any such defect or damage when you take delivery of the motorhome, you must notify your dealer or Warrantor within five days of the date of purchase to have repairs performed to the defect at no cost to you as provided by this Limited Warranty.

If either three or more unsuccessful repair attempts have been made to correct any covered defect that you believe substantially impairs the value, use or safety of your motorhome or repairs to any covered defect(s), which you believe substantially impairs the value, use or safety of your motorhome,, have taken 30 or more days to complete, you must, to the extent permitted by law, notify Warrantor directly in writing of the failure to successfully repair the defect(s) so that Warrantor can become directly involved in exercising a final repair attempt for the purpose of performing a successful repair to the identified defect(s).

## *How to Get Service*

The Warranty Registration form must be returned to Warrantor promptly upon purchase to assure proper part replacement and repair of your motorhome. Failure to return the warranty registration form will not affect your rights under the Limited Warranty so long as you can furnish proof of purchase. For warranty service simply contact one of Warrantor's authorized service centers for an appointment, then deliver your motorhome (at your expense) to the service center. If you need assistance in locating an authorized warranty service facility, contact:

**Warrantor's Warranty Department**
**1-877-466-6226**
**91320 Coburg Industrial Way**
**Coburg, Oregon 97408.**

In the event the motorhome is inoperative due to malfunction of a warranted part, Warrantor will pay the cost of having the motorhome towed to the nearest authorized repair facility provided you notify Warrantor prior to incurring the towing charges to receive directions to the nearest repair facility.

Because Warrantor does not control the scheduling of service work by its authorized servicing dealers, you may encounter some delay in scheduling and/or in the completion of the repairs.

### What the Warranty Does Not Cover

This Limited Warranty does not cover: any motorhome sold or registered outside of the United States or Canada; items which are added or changed after the motorhome leaves Warrantor's possession; items that are working as designed but which you are unhappy with because of the design; normal wear and usage, such as fading or discoloration of fabrics, or the effects of condensation inside the motorhome; defacing, scratching, dents and chips on any surface or fabric of the motorhome, not caused by Warrantor; routine maintenance, including by way of example wheel alignments; the automotive chassis and power train, including, by way of example the engine, drivetrain, steering and handling, braking, wheel balance, muffler, tires, tubes, batteries and gauges; appliances and components covered by their own manufacturer's warranty including, by way of example the microwave, refrigerator, ice maker, stove, oven, generator, roof air conditioners, hydraulic jacks, VCR, television(s), water heater, furnace, stereo, radio, compact disc player, washer, dryer, inverter and cellular phone; or flaking, peeling and chips or other defects or damage in or to the exterior or finish caused by rocks or other road hazards, the environment including airborne pollutants, salt, tree sap and hail.

### Events Discharging Warrantor from Obligation Under Warranty

Misuse or neglect, accidents, unauthorized alteration, failure to provide reasonable and necessary maintenance (See Owner's Manual), damage caused by off road use, collision, fire, theft, vandalism, explosions, overloading in excess of rated capacities, and odometer tampering shall discharge Warrantor from any express or implied warranty obligation to repair any resulting defect.

### Disclaimer of Consequential & Incidental Damages

**THE ORIGINAL PURCHASER OF THE MOTORHOME AND ANY PERSON TO WHOM THE MOTORHOME IS TRANSFERRED, AND ANY PERSON WHO IS AN INTENDED OR UNINTENDED USER OR BENEFICIARY OF THE MOTORHOME , SHALL NOT BE ENTITLED TO RECOVER FROM WARRANTOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE MOTORHOME . THE EXCLUSION OF CONSEQUENTIAL AND INCIDENTAL DAMAGES SHALL BE DEEMED INDEPENDENT OF, AND SHALL SURVIVE, ANY FAILURE OF THE ESSENTIAL PURPOSE OF ANY LIMITED REMEDY**. Some states do not allow the exclusion or limitation of consequential or incidental damages, so the above exclusions may not apply to you.

## Legal Remedies

T**HESE WARRANTIES ARE NOT INTENDED TO "EXTEND TO FUTURE PERFORMANCE" AND ANY ACTION TO ENFORCE THESE EXPRESS OR ANY IMPLIED WARRANTY SHALL NOT BE COMMENCED MORE THAN ONE (1) YEAR AFTER THE EXPIRATION OF THE RESPECTIVE WARRANTY COVERAGE PERIOD DESIGNATED ABOVE. THE PERFORMANCE OF REPAIRS SHALL NOT SUSPEND THIS ONE YEAR LIMITATIONS PERIOD FROM EXPIRING. THESE TERMS AND ALL EXPRESS AND IMPLIED WARRANTY DISPUTES BETWEEN WARRANTOR AND PURCHASER SHALL BE GOVERNED BY THE SUBSTANTIVE LAWS OF THE STATE OF INDIANA, WITHOUT REGARD TO CONFLICTS OF LAW RULES**. Some states do not allow the reduction in the statute of limitations or a choice of law provision, so the above reduction in the statute of limitations and/or choice of law provision may not apply to you.

**THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.**

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## WARRANTY LIMITED -ROADMASTER CHASSIS

**What the Period of Coverage Is:**

If you use the Roadmaster Chassis that your motorhome is mounted upon for only recreational travel and family camping purposes, the Limited Warranty provided by Roadmaster ("Warrantor") covers your Roadmaster Chassis for thirty-six (36) months from the original retail purchase date or the first 36,000 miles of use, whichever occurs first.

If you use the Roadmaster Chassis that your motorhome is mounted upon for any rental, commercial or business purposes whatsoever, the Limited Warranty provided by Warrantor covers your new Roadmaster Chassis for Ninety (90) days from the original retail purchase date of the motorhome or the first 24,000 miles of use, whichever occurs first. A conclusive presumption that the Roadmaster Chassis has been used for commercial and/or business purposes arises if you have filed a federal or state tax form claiming any business tax benefit related to your ownership of the motorhome.

### Limitations of Implied Warranties

**ANY IMPLIED WARRANTIES ARISING BY WAY OF STATE LAW, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE TERM OF THIS LIMITED WARRANTY AND ARE LIMITED IN SCOPE OF COVERAGE TO THOSE PORTIONS OF THE ROADMASTER CHASSIS COVERED BY THIS LIMITED WARRANTY.** Warrantor disclaims all implied and express warranties, including the implied warranty of merchantability and the implied warranty of fitness for a particular purpose, on components and appliances excluded from coverage as set forth below. There is no warranty of any nature made by Warrantor beyond that contained in this Limited Warranty. No person has authority to enlarge, amend or modify this Limited Warranty. Any dealer selling a motorhome assembled upon a Roadmaster Chassis is not the Warrantor's agent but is an independent entity. Warrantor is not responsible for any undertaking, representation or warranty made by any dealer or other person beyond those expressly set forth in this Limited Warranty. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

### What the Warranty Covers

Warrantor's Limited Warranty covers defects in the manufacture of the Roadmaster Chassis (as defined herein) and defects in materials used to manufacture the Roadmaster Chassis. The term "Roadmaster Chassis" as used herein means only the frame; frame cross members; steering axle, including the axle king pins and bushings; hubs and bearings; brake calipers; rotors, brake backing plates and related parts of the axle; tie rods; drag links; drive shafts, including the U-joints; carrier bearings; and, the axle housing and its internal parts. Also see the section "What the Warranty Does Not Cover" set out below.

### What We Will Do to Correct Problems

Warrantor will repair and/or replace, at its option, any covered defect if: (1) you notify Warrantor or one of its authorized servicing dealers of the defect within the warranty coverage period and within five (5) days of discovering any such defect; and (2) you deliver the Roadmaster Chassis to Warrantor or Warrantor's authorized servicing dealer at your cost and expense. It is reasonable to expect some service items to occur during the warranty period. The performance of warranty repairs shall not extend the original warranty coverage period. Further, any performance of repairs after the warranty coverage period has expired or any performance of repairs to component parts and appliances excluded from coverage shall be considered "good will" repairs, which shall not alter the express terms of this limited warranty.

Warrantor may use new and/or remanufactured parts and/or components of substantially equal quality to complete any repairs.

Defect and/or damage to the Roadmaster Chassis may occur during manufacture at the factory, during delivery of the motorhome to the selling dealer or on the selling dealer's lot. Normally, any factory defect or damage is detected and corrected at the factory or by the selling dealer during the inspection process performed by the Warrantor and the selling dealer. If, however, you discover any such defect or damage when you take delivery of the Roadmaster Chassis, you must notify your dealer or Warrantor within five days of the date of purchase to have repairs performed to any such defect at no cost to you as provided by this Limited Warranty.

If either three or more unsuccessful repair attempts have been made to correct any covered defect that you believe substantially impairs the value, use or safety of your motorhome or repairs to any covered defect(s), which you believe substantially impairs the value, use or safety of your motorhome,, have taken 30 or more days to complete, you must, to the extent permitted by law, notify Warrantor directly in writing of the failure to successfully repair the defect(s) so that Warrantor can become directly involved in exercising a final repair attempt for the purpose of performing a successful repair to the identified defect(s).

## *How to Get Service*

For warranty service simply contact one of Warrantor's authorized service centers for an appointment, then deliver your Roadmaster Chassis (at your expense) to the service center. If you need assistance in locating an authorized warranty service facility, contact:

**Warrantor's Warranty Department**
**1-877-466-6226**
**91320 Coburg Industrial Way**
**Coburg, Oregon 97408**

In the event the Roadmaster Chassis is inoperative due to malfunction of a warranted part, Warrantor shall pay the cost of having the Roadmaster Chassis that the motorhome is mounted upon towed to the nearest authorized repair facility provided you notify Warrantor prior to incurring the towing charges to receive directions to the nearest repair facility.

Because Warrantor does not control the scheduling of service work by its authorized servicing dealers, you may encounter some delay in scheduling and/or in the completion of the repairs.

### What the Warranty Does Not Cover

This Limited Warranty does not cover: modifications and alterations to the Roadmaster Chassis by others; the motorhome that is mounted upon the Roadmaster Chassis, including by way of example the motorhome manufacturer's design, manufacture, assembly and/or installation of the side walls, roof, windows, flooring, electrical system, plumbing system, LP gas system, appliances and slide outs; items that are working as designed but which you are unhappy with because of the design; normal wear and usage; routine maintenance including by way of example wheel alignments; component parts covered by their own manufacturer's warranty, including by way of example the engine, transmission, tires, tubes, batteries, exhaust system and the emission control systems; and, flaking, peeling rusting and chips or other defects or damage in or to the frame and frame cross members caused by rocks or other road hazards and the environment including airborne pollutants and salt.

### Events Discharging Warrantor from Obligation Under Warranty

Misuse or neglect, accidents, unauthorized alteration, failure to provide reasonable and necessary maintenance (See Owner's Manual), damage caused by off road use, collision, fire, theft, vandalism, explosions overloading in excess of rated capacities, and odometer tampering shall discharge Warrantor from any express or implied warranty obligation to repair any resulting defect.

### Disclaimer of Consequential & Incidental Damages

T**HE ORIGINAL RETAIL PURCHASER OF THE ROADMASTER CHASSIS AND ANY PERSON TO WHOM THE ROADMASTER CHASSIS IS TRANSFERRED, AND ANY PERSON WHO IS AN INTENDED OR UNINTENDED USER OR BENEFICIARY OF THE ROADMASTER CHASSIS, SHALL NOT BE ENTITLED TO RECOVER FROM WARRANTOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE MOTORHOME. THE EXCLUSION OF CONSEQUENTIAL AND INCIDENTAL DAMAGES SHALL BE DEEMED INDEPENDENT OF, AND SHALL SURVIVE, ANY FAILURE OF THE ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.** Some states do not allow the exclusion or limitation of consequential or incidental damages, so the above exclusions may not apply to you.

T**HESE WARRANTIES ARE NOT INTENDED TO "EXTEND TO FUTURE PERFORMANCE" AND ANY ACTION TO ENFORCE THESE EXPRESS OR ANY IMPLIED WARRANTY SHALL NOT BE COMMENCED MORE THAN ONE (1) YEAR AFTER THE EXPIRATION OF THE RESPECTIVE WARRANTY COVERAGE PERIOD DESIGNATED ABOVE. THE PERFORMANCE OF REPAIRS SHALL NOT SUSPEND THIS ONE YEAR LIMITATIONS PERIOD FROM EXPIRING. THESE TERMS AND ALL EXPRESS AND IMPLIED WARRANTY DISPUTES BETWEEN WARRANTOR AND PURCHASER SHALL BE GOVERNED BY THE SUBSTANTIVE LAWS OF THE STATE OF INDIANA, WITHOUT REGARD TO CONFLICTS OF LAW RULES.** Some states do not allow the reduction in the statute of limitations or a choice of law provision, so the above reduction in the statute of limitations and/or choice of law provision may not apply to you.

**THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.**

**ROADMASTER CHASSIS DIVISION**
**MONACO COACH CORPORATION**
**91320 COBURG INDUSTRIAL WAY**
**COBURG, OREGON 97408**

***122002***

## WARRANTY INFORMATION FILE

In addition to this Owner's Manual you will find a Warranty Information File in your unit. This file contains valuable documents about your motorhome's systems and equipment. Many of the component manufacturer's warranty registration cards can be found in the box. They will need to be filled out and mailed. Be sure you read and understand all the information in this file to help you safely operate, maintain and troubleshoot those items.

## WOOD FINISH

Monaco Coach Corporation Wood Finish:

Because no two trees look alike, authentic woods vary in colorand character markings such as streaks, knots and grain patterns.Since the stains may attach differently to these grain patterns,some natural light and dark areas may result. The beauty liesin these natural variations of color and grain that giveeach cabinet its own individual charm.

The beauty of these products is protected with a furniture-qualityexterior finish. After a period of time, there may be minimal changes in the finish color as it ages in its surrounding conditions.This is an inherent characteristic of this particular finish, and thenatural aging process adds to the unique appearance of the cabinetry.Due to the minor differences in tone, it may not be possible tomatch the finish color of existing cabinets exactly when replacing doors or adding additional cabinets at a later date.

***Monaco Coach Corporation***

The foregoing is not a warning. See the Limited Warranty or call (877) 466-6226 for warranty information and limitations.

# General Information

## section 1


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The information contained in this document is intended to reflect standard and optional equipment included in a typically equipped model at the time of delivery to the initial retail owner. Your actual unit may vary from this document as a result of optional equipment that is not generally offered on this model. In the case that you are not the initial retail owner of this unit, this document will not reflect modifications that may have been performed by previous owners.

Product information and specifications are shown herein as of the time of printing.
The motorhome manufacturer reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligation.

©Copyright Holiday Rambler Corporation. All rights reserved. The Scepter is a trademark of Holiday Rambler Corporation. All other trademarks or registered trademarks are property of their respective holders. Brand name products of other companies mentioned in this manual are not endorsed by the manufacturer of the motorhome.

## SAFETY SYMBOL LEGEND

Indicates a **WARNING**. Information pertaining to personal safety and/or potential extensive damage to the motorhome.

Indicates a **CAUTION**. Information pertaining to potential damage to the motorhome and/or its components.

Indicates electrical **DANGER**. Information pertaining to danger or caution of potential electrical shock to person(s) or component(s), and/or risk of electrical fire to motorhome.

Indicates **FLAMMABLE** or **EXPLOSIVE**. Information concerning fire or explosive material pertaining to personal safety and/or protection of the motorhome and its components.

Indicates **POISON**. Information pertaining to safety and/or use of a poisonous substance or harmful chemical.

Indicates a **NOTE**. Information and reminders concerning operation of motorhome and/or components.

Indicates **INSPECT**. Inspection of the motorhome and/or its components is required. Additional instruction may follow.

Indicates **LUBE**. Lubrication, or addition of lubricant product, to the motorhome and/or a specified component or part is required. Additional instruction may follow.

Indicates **ASSEMBLE/REPAIR**. Assembly, disassembly or installation of a component or part, and/or repair to the motorhome may be required. Assistance of Technical Support or Technician may be necessary.

Indicates **INFO (Information)**. References to additional information regarding operation of the motorhome and/or its components found in additional sources other than the Owner's Manual. Also refers to the WARRANTY INFORMATION FILE, found within the Warranty Information Box inside the motorhome.

Indicates a **TIP**. Information regarding helpful hints and/or suggestion for ease of operation of the motorhome and/or its components.

## INTRODUCTION

This section contains warranty information and knowledge for the operation and care of the motorhome. Not all information may be applicable to your model of motorhome. More detailed information with CAUTION or WARNING instructions, other than what is found in this chapter, can be found in the manufacturer's owner manuals located in the owner information box.

Changes, additions and supplemental information in the form of Manual Addendums can be obtained by visiting our Website at www.holidayrambler.com. Select one of the products from the product lineup. Go to the Service menu. A submenu will appear. Browse our other product lines Technical Tips. These Tips may not completely apply to your particular model but information contained therein can be useful.

In time you will develop a knack for spotting wonderful little roadside locations by turning off the main highway and exploring. There are many modern recreational vehicle parks (including state, county and federal parks) with good facilities where you can obtain hook-ups for electrical, water and sewage connections. Directories are published which describe these parks and the availability of services and hook-ups. On overnight or weekend trips, chances are you will probably not fill up the sewage holding tanks, deplete the water or LP-Gas supply, or run down the batteries which supply the living area with 12 Volt DC current. On longer trips, when you have stayed where sewer connections and utility hook-ups were not available, it will be necessary to occasionally empty the holding tanks and replenish the water and LP-Gas supply.

Many gas stations have installed sanitary dumping stations. Publications are available which list these dumping stations. When stopped for the night, the motorhome is built to be safely parked in any spot that is relatively level and where the ground is firm. Try to pick as level a parking spot as possible. Your facilities are with you and the motorhome is fully self-contained.

Many of the safety alert symbols are "Personal Safety Instructions." Definitions for the symbols are located on a previous page under "Safety Symbol Legend." It is important to thoroughly read and understand these safety instructions where the symbols are displayed throughout the manual. Failure to comply with specific instructions may result in personal injury or death. Many instructions are required by National Safety Associations.

## CUSTOMER RELATIONS

Only by ensuring your confidence and satisfaction with our products and services can we have continued success as a manufacturer of motorhomes. We believe a good relationship with our customers is just as important as improving the technical excellence of our products. Your authorized dealer is pleased to help you with instructions about your motorhome and to offer service when you need it. If problems remain after you have consulted your dealer you are invited to contact our Consumer Affairs Department. Please have all pertinent information (serial numbers, model number, etc.) when calling. We will work with the dealer and see that every attempt to resolve the matter is made.

**Customer Service Department**
**91320 Coburg Industrial Way**
**Coburg, Oregon 97408**
**877-466-6226**

## REPORTING SAFETY DEFECTS

If you believe that your motorhome has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Holiday Rambler. If NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of motorhomes, it may order a recall or remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer or Holiday Rambler. To contact NHTSA you may either call the Auto Safety Hot line toll-free at 1-800-424-9393 (or 1-202-366-0123 in the Washington D.C. area) or write to:

**NHTSA**
**U.S. Department of Transportation**
**400 Seventh Street**
**Washington, DC 20590**

## TAKING DELIVERY

### *Holiday Rambler Responsibilities*

Your motorhome has been manufactured to the highest quality and standards by factory trained personnel. Quality inspections are performed throughout the manufacturing process of your motorhome. The motorhome has been carefully and almost completely hand assembled in our factory. Prior to the motorhome arriving at the dealership, all systems have been carefully tested and inspected to ensure optimum performance. The necessary forms and required manuals have been placed in the motorhome at the time of shipment to the dealership.

### Dealer Responsibilities

The dealer must perform additional pre-delivery inspections and system checks, assist in the customer's understanding of the Limited Warranty and assist in completing any necessary forms. They must do a customer orientation to the motorhome, its systems, components and their operation.

The dealer should also ensure the customer receives a complete Owner's Packet with warranty cards and registrations for the motorhome and for separately warranted products, including detailed operating and maintenance instructions. The dealer is responsible for performing a review of the Limited Warranty provisions with the customer, while stressing the importance of mailing warranty cards and registrations to the manufacturers within the prescribed time limit to avoid loss of warranty coverage. They must assist the customer in completing these forms and locating serial numbers. They should request that the customer reads all warranty information when possible and explain any provision not clearly understood.

The dealer should instruct the customer on how to obtain local and out-of-town service on the motorhome and its various individual warranted components, whether the service is warrantable or out of warranty.

### Customer Responsibilites

As a new motorhome owner you are responsible for regular and proper maintenance. This will help you prevent conditions arising from neglect that are not covered by your Limited Warranty. Maintenance services should be performed in accordance with this Owner's Manual, and any other applicable manuals. As the owner, it is your responsibility and obligation to return the motorhome to an authorized dealer for repairs and service (See the Limited Warranty). Since the authorized dealer where you purchased your new motorhome is responsible for its proper servicing before delivery, and has an interest in your continued satisfaction, we recommend that Inspection, Warranty and Maintenance Services be performed by the dealership. We suggest that you take your new motorhome on a weekend shakedown before leaving on an extended trip.

### SERVICE SUGGESTIONS

Know when to take your motorhome in for service. Give some thought to the appointment time. There are several things to consider when selecting a time for service. Location of the service center and the time of year can be a major issue. Monday and Friday are busy days for most dealers. Therefore, it makes sense to make a mid-week appointment whenever possible. Ask your dealer if additional time is needed for check in and completion of paperwork.

### Prepare for the Appointment

If you're having warranty work done, be sure to have your warranty registration papers with you. All work to be performed may not be covered by the warranty; be sure to discuss additional charges with the service manager. Keep a maintenance log of your motorhome service history. This can often provide a clue to the current problem.

### Prepare a List

Make a written list of specific repairs needed. It is important the service manager be aware of all previous work which has been done on your motorhome. For example: if the motorhome has been repaired due to an accident. While this may not seem important, it could have a significant effect on the dealer's diagnosis of a problem.

### Be Reasonable With Your Requests

Do not leave a list of 20 items to be serviced and expect to have the motorhome back by 5:00 p.m. If you list a number of items, and must have your motorhome back by the end of the day, discuss the situation with the service manager and list items in order of priority. Some items may not be able to be repaired due to work loads or parts availability. Expect to make a second appointment for work not completed or for the long, drawn-out repair item.

### No Looking Over the Technician's Shoulder

Please do not be offended when you are told you cannot watch the work being done. Many service area insurance requirements forbid the admission of customers into the service work area.

### Inspect the Work Properly

Check out the service or repair job when you pick up your motorhome and notify the service manager of any dissatisfaction. If circumstances prevent returning for immediate corrective work, make an appointment as soon as possible.

FOR YOUR OWN REFERENCE

# OWNER'S RECORD - SERIAL NUMBERS

**INFORMATION: Many of the serial numbers for various items and components are filed on the Data Card located in the Warranty Information File box. Refer to the Manufacturer's individual Owner's Manuals for serial number locations that are not listed below.**

**Motorhome** Serial Number _____

**Motorhome** Federal Vehicle Identification Number (VIN) _____

**Entry Door Key** Number _____

**Compartment Door Key** Number_____

**Cooktop/Range** Model & Serial Number _____
(Located under top burner plate)

**Microwave** Model & Serial Number_____
(Located behind door on case)

**Refrigerator** Model & Serial Number _____
(Located inside refrigerator compartment)

**Generator** Model & Serial Number_____
(Located in outside compartment on generator)

**Roof Air Conditioner(s)** Model & Serial Number_____
(Located under top cover on air conditioner)_____

**Inverter** Model & Serial Number_____

FOR YOUR OWN REFERENCE

# OWNER'S RECORD - PERSONAL PROPERTY

| Item | Serial Number | Value |
|---|---|---|
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FOR YOUR OWN REFERENCE

# OWNER'S RECORD - INSURANCE

Company: _____

_____

Policy #: _____

_____

Agent's Name & Address: _____

_____

Business Phone #: _____

_____

Emergency Phone #: _____

_____

Renewal Date(s): _____

_____

Notes: _____

_____

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## GLOSSARY OF TERMS

**AC Electricity -** Alternating current also known as household power.

**Air Compressor -** Pumps air to and builds air pressure in an air system.

**Air Dryer -** Cools, filters and dries the air delivered by an air compressor.

**Air Governor -** Controls the operation of the air compressor by constantly monitoring air pressure in the supply tank of the air system. The air governor initiates the unload cycle when the cut-out pressure is reached. The air governor also controls the air dryer by sending an air signal (at the beginning of the compressor unload cycle) to the control port of the air dryer, initiating the purge cycle. When this air signal is removed by the governor (at the beginning of the compressor load cycle) the purge valve closes and the drying cycle begins.

**Ampere (Amp) -** The unit of measure of electron flow rate of current through a circuit.

**Ampere-hour (Amp-hr. AH) -** A unit of measure for a battery electrical storage capacity, obtained by multiplying the current in amperes by the time in hours of discharge. (Example: A battery which delivers 5 amperes for 20 hours, delivers 5 amperes times 20 hours, or 100 Amp-Hr. of capacity.)

**Black Water -** Term associated with the sewage holding tank. The toilet drains directly into this tank.

**Chassis Battery -** Powers chassis 12 Volt accessories and starts engine.

**Circuit -** An electric circuit is the path of an electric current. A closed circuit has a complete path. An open circuit has a broken or disconnected path.

**City Water -** A term associated with the water supply that you hook-up to at campgrounds. It is called city water because water is pulled from a central source (like in a city) and not the fresh water tank.

**Compressor Load Cycle -** The time during which the air compressor is building air pressure in an air system.

**Compressor Unload Cycle -** The time during which the air compressor is idling and is not building air pressure in an air system.

**Curbside -** This refers to the side of the motorhome which faces the curb when it is parked. Often called the door side or the passenger's side.

**Current - Alternating (AC) -** A current that varies periodically in magnitude and direction. A battery does not deliver alternating current. Also referred to as shore power, utility power, inverter power, generator power, etc.

**Current -** The rate of flow of electricity or the movement rate of electrons along a conductor. It is comparable to the flow of a stream of water. The unit of measure for current is the ampere.

**Cut-In Pressure -** The pressure level in the air system supply tank which triggers the compressor load cycle.

**Cut-Out Pressure -** The pressure level in the air system supply tank which triggers the compressor unload cycle.

**Cycle -** In a battery, one discharge plus one recharge equals one cycle.

**DC Electricity -** Direct current also known as battery power.

**Desiccant -** A granular substance that has a high affinity for water and is used to retain moisture from the air stream flowing through the air dryer cartridge.

**Direct Current (DC) -** Power that is stored in a battery bank or supplied by photovoltaics, alternator, chargers and DC generators.

**Drain Trap -** This is a curve that is in all drains. Water is trapped in the curve and this creates a barrier so tank odors cannot escape through the drain.

**Dry Camping -** Camping in the motorhome when there is no city water hook-up or shore power. In other words, using only the water and power that is in the motorhome and not from another source.

**Drying Cycle -** The time during which the air dryer cools, filters and removes moisture from the air delivered by the air compressor. The drying cycle begins and ends the same as the compressor load cycle.

**Dump Station -** A site where the waste (grey) and sewage (black) tanks can be drained. In most states it is illegal to drain waste tanks anywhere other than at a dump station.

**Dump Valve -** Another name for the T-handle valve used to drain the sewage (black) and waste (grey) tanks.

**Egress Window -** The formal name for the emergency window located in the rear of the motorhome. Egress windows can be easily identified by their red handles.

**Full Hook-Up Site -** A campground that has city water, shore power and sewer hook-ups or connections available.

**Grey Water -** Term associated with the waste water holding tank. Water from the sink drains, the shower and the washer/dryer (if equipped) go into this tank.

**House Battery -** Powers 12 Volt lights and accessories inside motorhome.

**LED -** (Light Emitting Diode) Indicator light.

**Low Point Drain -** The lowest point in the plumbing. Drains are placed here so that water will drain out of the lower end of the motorhome. These drains must be closed when you fill the water tank.

**OHM -** A unit for measuring electrical resistances.

**Ohm's Law -** Express the relationship between Volt (E), amperes (I) in an electrical circuit with resistance (R). It can be expressed as follows: E = IR. If any two of the three values are known, the third value can be calculated by using the above formula.

**Pounds Per Square Inch Gauge (psig) -** Pressure measured with respect to that of the atmosphere. This is a pressure gauge reading in which the gauge is adjusted to read zero at the surrounding atmospheric pressure. It is commonly called gauge pressure.

**Purge -** The initial blast of air (decompression) from the air dryer purge valve at the beginning of the air compressor.

**Purge Cycle -** The time during which the air dryer is undergoing purge and regeneration. This cycle starts at the beginning of the compressor unload cycle and normally ends well before the beginning of the compressor load cycle.

**Regeneration -** The mild backflow of air through the air dryer and out the purge valve that begins immediately after the purge and lasts normally 10 to 15 seconds. This backflow of air, from the air system and through the air dryer, removes moisture from the desiccant cartridge and prepares the air dryer for the next compressor load cycle.

**Roadside -** This refers to the side of the motorhome which faces the road when it is parked. Often called the off-door side or the driver's side.

**Shore Line -** This is the electrical cord which runs from the motorhome to the campground 120 Volt electrical supply.

**Shore Line Plug -** The 120 Volt outlet allows the motorhome to be hooked up to a campground facility.

**Stinger -** An arm attachment on a tow truck that is used to lift motorhome slightly so that it can be towed.

**VIM -** Vehicle Interface Module.

**Volt -** The unit of measure for electric potential.

**Watt -** The unit for measuring electrical power, i.e. the rate of doing work, in moving electrons by or against an electric potential.

**Wet Cell Battery -** A type of battery that uses liquid as an electrolyte. This type of battery requires periodic maintenance such as cleaning the connections and checking the electrolyte level.

**Air Bags**
Firestone
317-818-8600
www.bridgestone-firestone.com

**Air Conditioner**
SCS/Frigette
800-545-6341
www.scsfrigette.com

**Air Conditioner - Roof**
Dometic Corp
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**Alternator**
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www.prestolite.com

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800-338-2378
www.carefreeofcolorado.com

Girard Systems
800-382-8442
www.girardrv.com

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800-535-5560
www.meritorauto.com

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800-328-6687
www.truck.eaton.com

**Batteries**
Interstate
800-272-6548
www.interstatebatteries.com

**Brake-Anti-Lock Brake System**
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www.eaton.com

**Brakes (Exhaust)**
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**Carbon Monoxide Detector**
Safe-T-Alert
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**Cooktop**
Atwood Products
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www.atwoodmobile.com

Seaward Products
562-699-7497
www.seawardproducts.com

**Dash Radio**
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**DVD Player (Optional)**
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Cummins
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www.onan.com

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Power Gear
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**Leveling Jacks - Air**
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Sharp Electronics Corp.
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Velvac Mirror
800-783-8871
www.velvac.com

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Kenwood
800-536-9663
www.kenwoodusa.com

**Rear Vision System**
Weldex Corporation
562-404-8736

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800-543-1219
www.norcold.com

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www.kvh.com

**Shock Absorbors**
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800-880-7580
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www.powergear.com

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www.trw.com

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www.rca.com

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www.winegard.com

**Tires**
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www.goodyear.com

**Toilet**
Thetford
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www.thetford.com

Headhunter
800-662-8557
www.headhunter.com

Sealand
800-321-9886
www.sealandtechnology.com

**Transfer Switch**
Iota Engineering
800-866-4682
www.iotaengineering.com

**Transmission**
Allison Transmission
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www.allisontransmission.com

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RCA
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www.rca.com

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Everpure
630-654-4000
www.everpure.com/consumer/rv

**Water Heater**
Atwood Mobile Products
800-873-4328
www.atwoodmobile.com

**Washer/Dryer (Optional)**
Splendide
(503) 655-2563
www.splendide.com

**Water Pump**
Shurflo
800-854-3218
www.shurflo.com

**Wheels - Aluminum**
Accuride
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www.accuridecorp.com

**Windshield Wipers**
Diesel Equipment
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Click **ENTER** to enter the main web page.
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***WWW.HOLIDAYRAMBLER.COM***

***CLICK ON ENTER TO ACCESS THE MAIN WEB PAGE. THEN CLICK ON THE SERVICE LINK AND CHOOSE TECH TIPS FROM THE DROP DOWN MENU.***

# S C E P T E R  2 0 0 4

Your suggestions are very important to us and we are continually striving to improve the quality of our manuals. After becoming familiar with your new recreational vehicle and the accompanying manual, please take the time to answer the following questions. When you are finished please return the survey via mail to our Technical Publications Department, or you may fax the survey to (541) 681-8031, Attention: Technical Publications Department. Feel free to attach an additional page if you desire.

**1. Is this your first recreational vehicle? YES / NO**

**2. Was the overall appearance and lay-out of this manual what you expected to see in your new recreational vehicle?**

_____
_____
_____
_____
_____

**3. Was the information within this manual helpful in acquainting you with your new recreational vehicle? If not please address any area(s) we need to expand or improve on.**

_____
_____
_____
_____
_____

**4. Were the operating instructions clearly written, and were you able to follow the steps without any difficulty?**

_____
_____
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**5. Is there any additional information you would like to see incorporated within the owner's manual?**

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**NAME:** _____ **PHONE: (____)**_____
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**91320 COBURG INDUSTRIAL WAY**
**COBURG, OR 97408-9908**

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# Limited Warranty Transfer Application

Mail Monaco Coach Limited Warranty Transfer Application to:

Monaco Coach Corporation
Warranty Transfer
91320 Coburg Industrial Way
Coburg, OR 97408

Please read terms and representations below before signing.

DEALER IMPRINT

**A** PRIOR OWNER INFORMATION

TRANSFER COVERAGE FROM:

FIRST NAME | INITIAL | LAST NAME | VEHICLE IDENTIFICATION NUMBER

**B** NEW OWNER INFORMATION

TRANSFER COVERAGE TO:

FIRST NAME | INITIAL | LAST NAME | TELEPHONE NUMBER

STREET ADDRESS | DATE OF TRANSFER

CITY | STATE | ZIP | ODOMETER READING AT TRANSFER

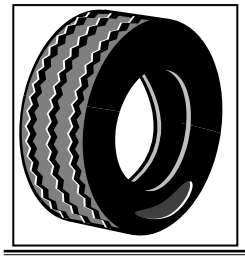
**C** SIGNATURES

NEW OWNER'S SIGNATURE | SELLING DEALER SIGNATURE

## TERMS & REPRESENTATIONS

By your signature(s) on this form, and in order to induce Monaco Coach Corporation to transfer its Limited Warranty, you represent the following:

1. That you have received and read a copy of the Limited Warranty.
2. You understand that the unit is to be used only for family camping and cross country travel on improved roads.
3. All information provided by you on this form is true and correct.
4. You understand that you are purchasing a pre-owned recreational vehicle and Monaco Coach Corporation does not make any representation as to its present condition.
5. You understand that the Limited Warranty does not cover the chassis, component parts and appliances if they are covered by a separate warranty issued by the chassis, component part or appliance manufacturer.



# Driving & Safety

## section 2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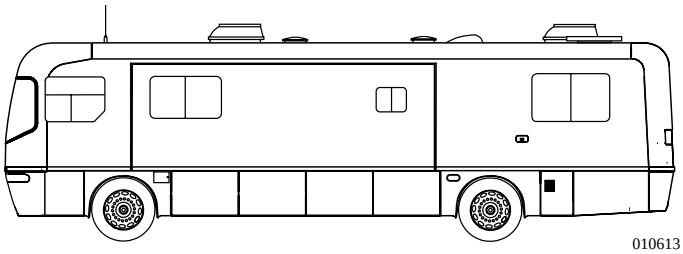
## DRIVING & SAFETY

Section two contains information on driving tips, emergency situations,towing, safety devices, weighing the motorhome and tires.



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### *Inspections*

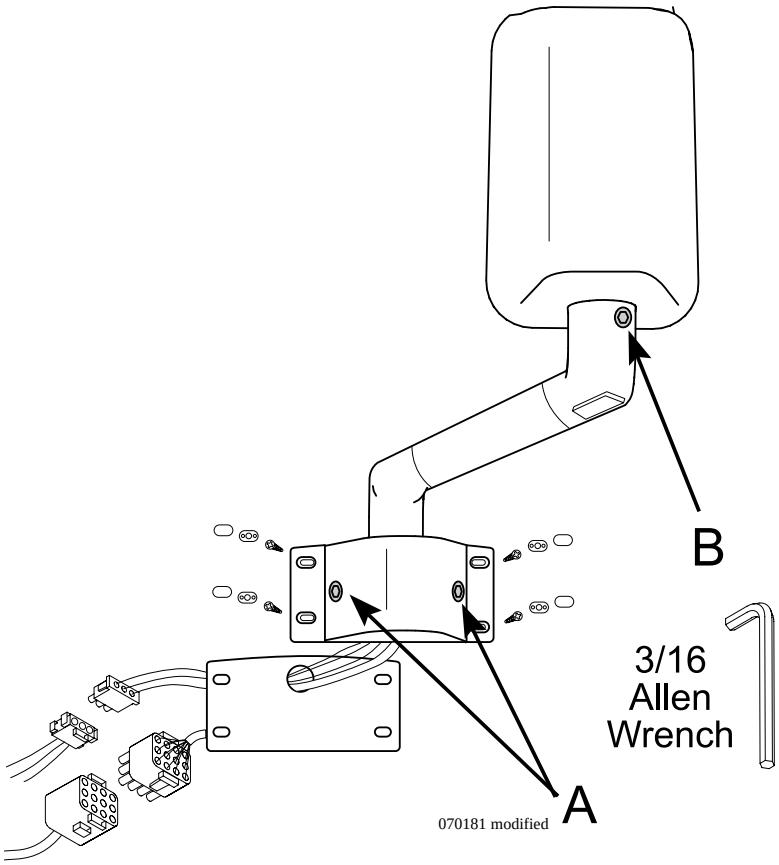
There are significant differences between a passenger automobile and a motorhome. Always be aware of these differences when traveling. The key to safely operating a motorhome is inspection. Any defect found could result in problems on the road that may cause lost time and money. Several states require that the motorhome be inspected prior to registration. Know and observe the laws of the states in which you will be traveling. Laws may vary from state to state. A systematic inspection conducted prior to moving the motorhome will ensure nothing is overlooked and will assist in familiarizing the owner with the motorhome. Prior to moving the motorhome perform a general **inspection** which includes examining the condition of the vehicle and the surrounding area of the motorhome for hazards. Look high and low when walking around the motorhome.

### *Familiarize Yourself*

The location of the driver's seat in the motorhome is higher and farther to the left than most vehicles. This creates a different perspective of the roadway. Rely on the outside mirrors to line up with the center of the road and to check the conditions behind the motorhome. The dashboard may contain more gauges and controls than are normally found in passenger automobiles. Become familiar with these gauges and their indications before starting out.

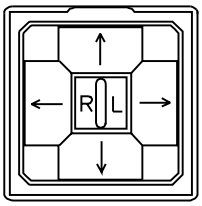
### *Mirror Adjust (Manually)*

The mirrors will need to be adjusted before starting out, it is recommended that you have someone assist with these procedures. This will also prevent any damage to the mirror or the coach.




**Mirror Adjusting:**

- Tools needed: Allen wrench.
- Adjust the driver's seat to the travel position.
- Using an "Allen wrench" have the assistant loosen the two 3/16" Allen set screws located at the base of the mirror. (See point "A" on the drawing.)
- Adjust the mirror so that there is a clear side view of the coach.
- Tighten the two base screws once the proper adjustments are made.
- To adjust the "head" of the mirror, loosen the screw located above the turn signal shown on point "B". Now adjust the head of the mirror to the left or right.
- Make sure all Allen set screws are tight.

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**NOTE: Use the mirror adjust switch located on the road side console to fine tune the view.**

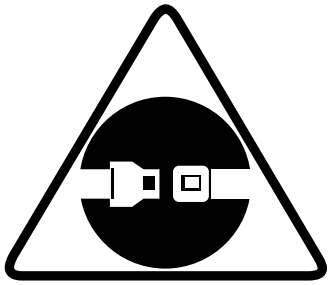
**Mirror Removal:**

- Tools needed: #3 Phillips screw driver, or a #2 Square tip.
- Remove the screw covers carefully.
- Have someone assist in holding the mirror steady. Unscrew the four screws.
- Unplug the 12-wire plug and the 3-wire plug by using the tabs located on the side.

**Mirror Installation:**

- Place the gasket on the back side of the mirror, run the plugs and wires through the hole in the gasket.
- Align index terminals and push plugs together until locking tabs engage.
- While holding the mirror steady, line up the holes.
- Install the screws and screw covers.

## Safety Seat Belts



All occupants must be furnished with and use seat belts while the motorhome is moving. The driver's seat, and all other seats designed to carry passengers while the motorhome is in motion, are equipped with safety seat belts. Do not occupy beds or any seats that are not equipped with a safety belt while the motorhome is in motion. Safety belts are supplied at affixed seating positions. Do not occupy seats not equipped with safety belts while the motorhome is in motion. The driver's seat must be locked in the forward facing position while motorhome is in motion. Do not use a seat belt on more than one person.

To fasten the seat belt, pull the belt out of the retractors and insert the tab into the buckle; you will hear a click when the tab locks into the buckle. Seat belt lengths automatically adjust to size and sitting position. Do not route belts over armrest.

**WARNING: Safety belts are supplied at affixed seating positions. Do not occupy seats not equipped with safety belts while the motorhome is in motion. Do not use a single seat belt on more than one person. Pilot and Co-pilot seats must be locked in a forward facing position with seat belts fastened while the motorhome is in motion. Avoid seat rotation while in transit.**

**Child Safety Seat:**

Children that fit into example 1 and example 2 require the use of a child safety seat. In the motorhome, the child safety seat can be positioned in two places. On the front passenger (co-pilot) seat and on the forward facing permanently mounted booth dinette seat.

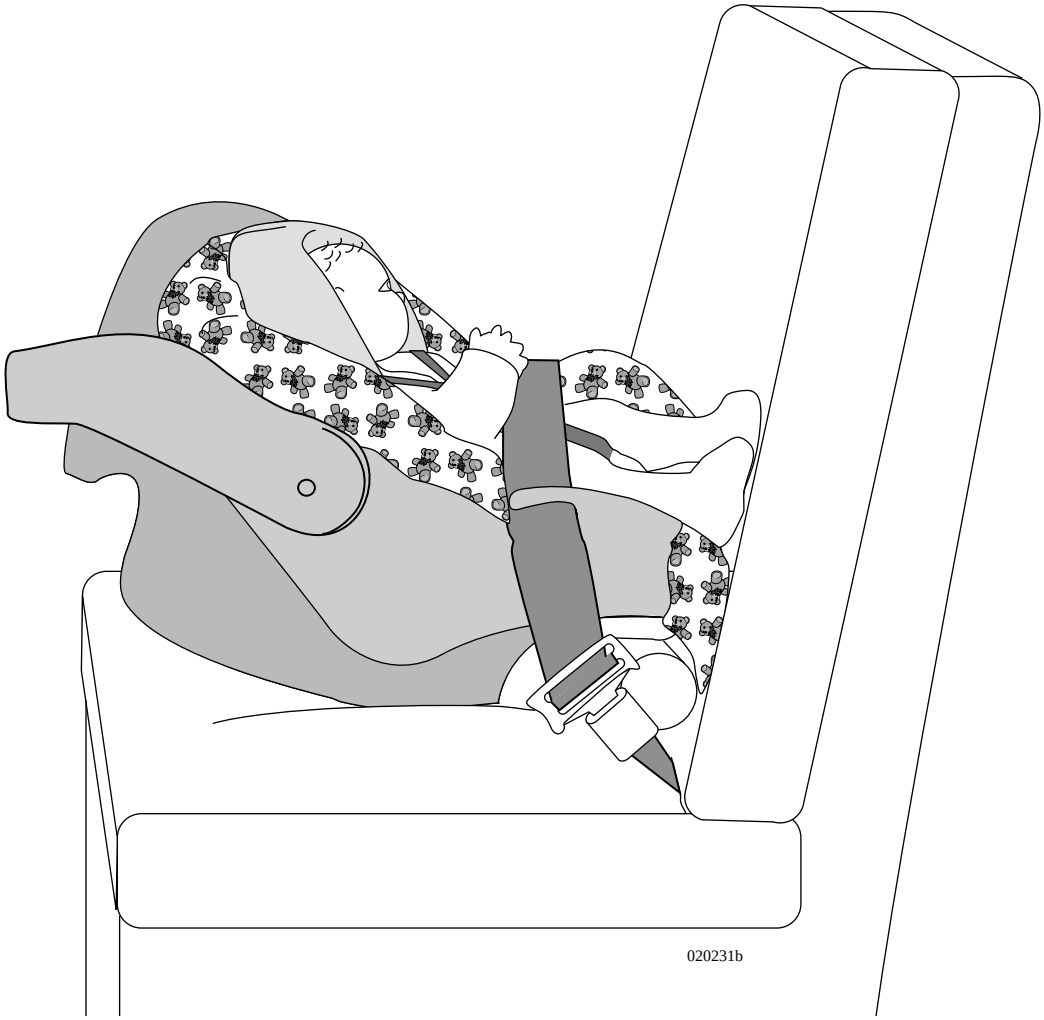
**WARNING: Children must not be transported unrestrained. Infants must be placed in approved safety seats. Small children must be restrained in child safety seats. Failure to comply with these rules can lead to injury or death.**

**NOTE: Individual states and Canadian provinces may prohibit use of a safety or booster seat in the front seat.**

**A child safety seat is required for a child:**

- From birth to one year, or up to 21 pounds, the child is considered an infant. A (convertible) safety seat for an infant must be secured facing rearward. The top of the head must be below the top of the safety seat. Secure safety seat harness straps at or below the shoulders. (**See Example 1**).

- Children over 40 pounds (ages 4 to 8) unless over 4' 9" require a booster seat. The booster seat places the child's waist and shoulders at the proper height for the supplied safety belt to be effective. The top of the head must be below the top of the safety seat. (**See Example 2**).




***Example 1: Convertible Seat Facing to the Rear.***

***Example 2: High back booster seat facing forward.***

**CAUTION: Installation illustrations are for reference only, and are not to be used as a guide. Refer to the safety seat manufacturer's guide.**

**WARNING: Because there are many styles of safety and booster seats, refer to the manufacturer's manual for proper installation and how to properly secure the safety or booster seat.**

**CAUTION: Seat belts must only be used on permanently mounted seats. Do not use a single seat belt on more than one person.**

**NOTE: Individual states and Canadian provinces may have laws that can exceed the requirements described above. It is your obligation to know and comply with the laws in the state or province in which you travel.**

**Seat Belt Care:**

Keep the belt clean and dry. To clean, use a mild soap and lukewarm water. Never use bleach, dye or abrasive cleaners as they may weaken the belt. Inspect the belts periodically. Check for cuts, frays or loose parts. Replace any damaged parts. Do not disassemble or modify the system. Replace the belt assembly if it has been in a severe impact, even if damage is not obvious.

## *Driving Tips*

downhill.eps

The motorhome is a complex vehicle and requires an increased level of driving awareness because of its size and various components. Due to the motorhome length the turning radius will be much wider than that of a standard automobile. Always pay close attention to all perimeters of the motorhome: front, sides, rear, roof and undercarriage. Insure the surrounding area is clear of obstacles. Utilize the driving mirrors to observe traffic conditions as well as the motorhome exterior: tires, bay doors, blind spots, etc. Use a push-pull method of steering, with both hands parallel on the steering wheel. The motorhome is also heavier than an automobile with a higher center of gravity. These factors affect the reaction time of the motorhome. Swerves and sharp turns, especially performed at high speeds, could result in the loss of control of the motorhome. Keep the size of the motorhome in mind and drive with extra caution to avoid situations which might require quick momentum changes. Increase reaction time by paying attention to traffic and road conditions 12-15 seconds ahead of the motorhome's position.

The motorhome will travel safely and comfortably at highway speed limits. However, it takes more time to reach highway speed. When passing another vehicle, allow extra time and space to complete the pass due to the added length of the motorhome. When descending a long hill, use the exhaust or engine brake. The transmission and engine will help control downhill speed and can extend the service life of the brake lining. The distance required to stop the motorhome is greater than an automobile. The brakes are designed for the (GVWR) Gross Vehicle Weight Rating. Practice stopping away from traffic to get the "feel" of the distance required to stop the motorhome.

When backing up, have the co-pilot stand at the road side rear corner so the co-pilot remains visible in the roadside mirror. The co-pilot can watch for any obstacles and give hand signals during the backing up process.

When traveling, make sure bridges being crossed can support the weight of the motorhome. Check the tonnage limit of the bridges before crossing them. Signs should be posted at bridge entrances. Check the posted height of all overpasses or situations where overhead clearance is limited. Keep in mind, road surfaces may have been repaved or become packed with snow and therefore the actual posted clearance height would not apply in such conditions.

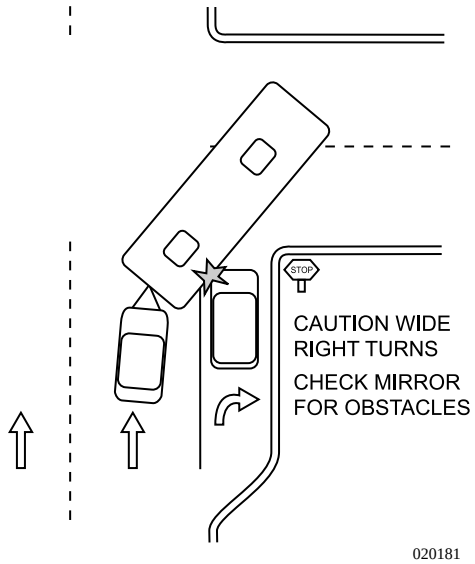
**Driving Cautions:**

- Avoid getting too close to the edge of the road, a soft shoulder may not support the weight of the motorhome.
- Side spacing is best maintained by keeping the motorhome centered in the driving lane.
- Driving lanes in work zones can be uneven, congested and narrower than usual.
- Be cautious of road debris which can damage the undercarriage of the motorhome or become lodged in the dual tires causing damage to the tires, wheel rims or tow car.
- Keep in consideration that posted speed signs are passenger automobile rated. Therefore, an extra awareness of the driving conditions and appropriate speed for a motorhome are necessary, especially on corners and mountain roads.
- Downgrade speed should be at least 5 mph less than upgrade speed, or downgrade speed should be attainable within three seconds of a brake application.
- Use a four second rule when following other vehicles at speeds under 40 mph. Use a five second rule when following at speeds over 40 mph.

**Right Turns:**

Negotiating a right hand turn in a motorhome can be difficult. Many drivers fear they can not make the turn without entering into the other lane or jumping the curb. Here are a few tips to make a right hand turn easier:

- As the turn approaches, look into the mirror to ensure the lane to the left is clear, then move wide over to the left.
- When you are about to make the turn; the left rear wheel should touch the center line of the road and your hips should be parallel to the roadside curb of the corner being turned. This will aid in avoiding a premature turn.
- Make the turn slowly.
- Check mirrors frequently, being aware of necessary clearance and space management of the motorhome, while negotiating the turn.




**Left Turns:**

- Do not start the turn until the center of the intersection is reached with your hips. If there are two lanes available, take the right hand lane. A car or driver on the left hand side is easier seen.

**Ascending a Grade:**

When approaching an uphill grade, try to assess how steep and long it is before beginning to climb. Prepare early for long climbs.

Unlike gasoline engines, diesels do not necessarily produce more power by pressing further on the accelerator! A gasoline engine will happily work at full throttle (at least for a short period of time), but a diesel usually just wastes fuel at full throttle. The power output from a diesel engine is dependent upon the following:

- **RPM -** Every engine has a range of RPM where it produces power most efficiently.
- **Fuel/Air mixture -** At a given RPM, an engine, even with the help of a turbo-charger, can only "pump" a given volume of air into the combustion chamber. This volume of air can combine with only so much fuel efficiently; so it follows logically that feeding more fuel to the fire will simply waste fuel.

Determine the ranges where the motorhome works best by driving long grades in a way that temperatures will remain stable for the duration of the climb.

**IMPORTANT SAFETY TIP: If the road speed degrades to the point where the motorhome is moving significantly below the posted speed, turn on the four way flashers. Take advantage of pullouts if traffic is building. Once in the pullout, if there is sufficient clearance for safety, take a break. Idle the engine to allow the exhaust and the turbo to cool. While these are cooling, the transmission also cools. Monitor the gauges and enjoy the view while you wait.**

**Descending a Grade:**

When descending a long grade, use the braking force of the engine and the auxiliary braking device (i.e. the Jake Brake or exhaust Pac Brake) to maintain a safe, slow speed. Do not rely entirely on the service brakes to slow the motorhome when descending long grades. "Pumping" and riding the service brakes is not recommended when descending a grade, as the brakes can overheat. Over-use can result in the loss of brake effectiveness.

downhill

If it is necessary to use the service brakes for additional braking, use moderately heavy pressure on the brake pedal to reduce the motorhome speed to the desired speed of travel, then release it.

Before descending a grade, downshift the transmission to a lower gear and use the engine to slow the vehicle. Monitor the motorhome speed while descending the grade.

If the motorhome begins to accelerate while proceeding down the grade, or it becomes necessary to slow the motorhome, activate the auxiliary braking device.

**Night Driving:**

- As always be well rested and alert when driving. If necessary, find a safe stopping place to rest until ready to continue.
- Avoid using any interior lights while driving. They can create a glare on the windshield, decreasing visibility.
- Dim the dash lights to a comfortable level to reduce the level of glare.

**Extreme Heat and Hot Weather Conditions:**

- Observe all gauges frequently. Any variations from the normal conditions should be evaluated promptly.
- Check tire pressure before traveling in hot conditions. Tire air pressure increases with heat. It is not advisable to let air out of a hot tire. When the tires cool down they will return to the correct/previous tire pressure.
- Pay extra attention to hoses and belts which are more susceptible to fatigue in extreme heat.

**Winter and Cold Climate Conditions:**

- The motorhome should be prepared for Cold Weather Use.
- Keep speeds slow and steady. Make moves gradually and increase visual distance for a gain in reaction time.
- If road or weather conditions are treacherous find a safe stopping place and wait for conditions to improve.
- Avoid using an engine retarding device on wet or slippery surfaces, which can cause the drive wheels to skid.
- Wipers should be in good condition and the washer reservoir should have sufficient window wash fluid that has antifreeze included within it.
- Use the mirror heat to keep the mirrors clear.
- Remove any ice build-up from the entry step to avoid accidental slipping.

**Wet Conditions:**

- The risk of hydroplaning is increased if tires are worn or improperly inflated.
- Be aware that heavy rain or deep standing water can affect brake application causing them to apply unevenly or grab.

**Fuel Economy:**

Many factors contribute to the amount of fuel consumed during driving. Driving styles, wind resistance, terrain, vehicle weight, and engine-driven accessories are some of the factors that affect the fuel economy.

**Guidelines to Help Increase Fuel Efficiency:**

- When starting out, apply the throttle lightly and accelerate gradually, avoid using excessive throttle and accelerating quickly.
- Check the tire pressure. A low tire is not only a safety hazard, it also increases rolling resistance which increases fuel consumption.
- While operating the motorhome, keep the engine at a low to mid operating range of 1100 to 1500 RPM. This will use less fuel than operating at higher RPM.
- Avoid using full throttle when ascending a long hill. This wastes fuel and increases engine operating temperature from incomplete combustion. Manually downshift to a lower gear and use less throttle. Fuel will burn more efficiently.
- Avoid extended idling to "warm-up" the engine. Start the engine and wait long enough for normal oil pressure to register. Engage the high idle feature until the engine coolant temperature gauge rises. The engine is now ready for travel. Whenever coolant temperature is below 160° F (as in an idling engine) incomplete combustion occurs. This causes carbon buildup and raw fuel will wash the lubricating oil from the cylinder walls diluting the crankcase oil.
- Excessive idling (more than 15 or 20 minutes) can clog fuel injectors and may eventually cause piston rings and valves to stick.
- Operate the transmission with the **MODE** function set to **Economy** whenever possible; this allows for earlier shifts and enhanced fuel economy.
- Follow the maintenance schedule for the engine, transmission and chassis. Proper maintenance will lead to enhanced fuel economy, motorhome performance, and overall longevity.

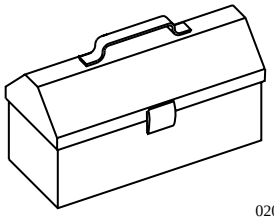
**Refueling:**

- Truck stops are good refueling points for motorhomes.
- Know which side the fuel port is on. There may not be adequate space to turn around in the parking lot to reposition for the pump.
- Check overhead clearance heights before pulling through the fuel island.
- Be aware of the concrete/steel posts installed around the fuel island.
- Avoid running over the fuel hose as it can get hung up on the motorhome, causing body damage.
- Use of gloves is recommended for refueling. Store the gloves in the outside compartment.
- To prevent grease and fuel deposits from being tracked into the motorhome when refueling, change shoes before entering the motorhome. Store the extra pair near the entry door.

**WARNING: Avoid the risk of fire or explosion. Turn off all pilot lights and appliances before entering a refueling station.**

## PRE-TRIP PREPARATIONS - CHECKLIST

The following list highlights items that need to be checked on the motorhome before traveling. Prior to departing several items will need to be prepared. Some suggestions are listed below. Use the lists as general guidelines when preparing to depart. By doing so, there is a better chance of not facing problems during the trip. For chassis maintenance details, please refer to the chassis section.



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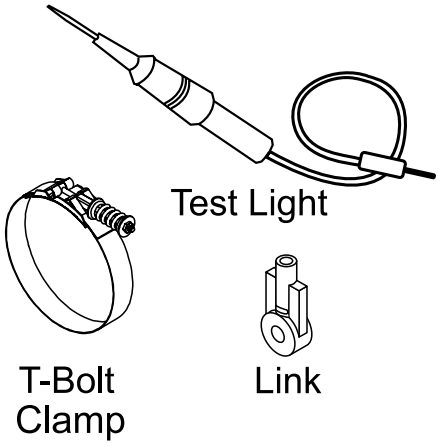
**Items To Carry:**

- Local, State and National Maps. Truck atlases can be useful for showing maps, refueling stations and truck repair facilities.
- An emergency road kit containing a flashlight, road flares, warning signs and a fire extinguisher.
- Potable/non-potable water hoses and a water pressure regulator.
- Hand tools.
- 12 Volt DC test light and a 110 AC Polarity Tester. These may be helpful when on the phone with a technician.
- A battery hydrometer to check the condition of battery electrolyte.
- A spare 12 Volt DC continuous duty solenoid (if applicable).
- An assortment of spare fuses.
- A link kit for ride height control assembly (air suspension only).
- A spare alternator serpentine belt.
- Charge air cooler T-bolt clamp.

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**Interior Items:**

- Start refrigerator operation the night before departure to get a head start on the cooling process. Pre-cool items prior to loading the refrigerator.
- If necessary, load pots, pans, utensils, soap, linens, etc.
- Secure and fasten the bi-fold and pocket doors. Lock the shower door.
- Close roof vents and windows.
- Secure any loose, heavy or sharp objects in case of a sudden stop.
- Close all cabinet doors and drawers.
- Walk the interior and check for items not secured.
- Test the appliances before leaving home.
- Turn interior lighting off.

Polarity Tester

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**Exterior Items:**

- Check operation of all exterior lights, headlamps, taillights, brake and clearance lights.
- Check the battery fluid level of Liquid Lead Acid batteries.
- Check all fluid levels on the chassis and generator. (See **Chassis Information** section and the generator manual for details.)
- Check the fuel/water separator in the engine service compartment. Clean and drain if needed.
- Adjust the mirrors.
- Check the windshield wipers.
- Fill the LP-Gas tank.
- Test the generator.
- Make sure the following items are in the motorhome: sewer connection hose, water fill hose, awning rod and electrical adapters.

**Engine Checklist:**

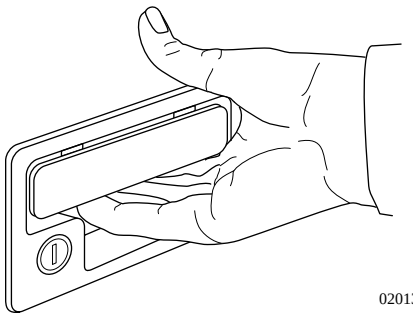
- **Inspect** the engine, transmission and engine compartment for fluid leaks.
- **Inspect** the area under the motorhome for fluid leaks or puddles.
- Check all fluid levels, oil, antifreeze, transmission, hydraulic fluid and washer fluid.
- **Inspect** belts and hoses for wear.
- **Inspect** wiring for loose, frayed or corroded connections.
- Start engine and listen for any unusual noises.

**Driving Preparations:**

- **Inspect** fluid level (if applicable) in oil bath hubs.
- Fill the water tank and make sure the waste tanks are empty. Test the water pump.
- Disconnect and store the fresh water hose (if applicable).
- Check all tire pressures.
- **Inspect** tires for cuts, punctures, weather damage or cracks in the sidewalls and tread areas.
- Check for foreign objects lodged between dual tires.
- Make sure all lug nuts are tight. This should be done by an approved repair facility.
- Secure all awning locks.
- Check storage bays to prevent shifting or damage to items.
- Outside compartment doors should be closed and locked.
- Look around, above and under the motorhome for obstructions.
- Check fuel level gauge. Fill the fuel tank if necessary.
- Check all other dash gauges for operation and correct level indications.
- Secure and lock the entry door for travel.

**Storing Cargo:**

Caution must be exercised when opening as cargo may shift during traveling. When closing the bay doors, be sure to keep fingers away from the openings. When opening the bay doors, use thumb at position shown while opening. Cargo may shift while driving. Push on bottom of door to relieve tension on lock.



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**WARNING: To avoid injury, never place your hands or fingers near the top of the bay door when opening or closing. Always use the latch handle. Apply pressure with the other hand just above the latch handle.**

It is important to remember that regardless of how large the motorhome, there is a limit to storage capacity. Pack as lightly as possible to allow for additional storage during the trip. It is often easier to purchase needed items at the final destination rather than to discard items to make room for additional cargo.

While packing the motorhome, keep two things in mind, turning and braking. For the motorhome to handle well, the load will need to be evenly distributed side-to-side and front-to-back. Additionally, heavy items should be stored as low as possible to keep the motorhome from becoming top heavy. Make sure that everything is secure and safe from quick turns, bumps and sudden stops.

**TIP: Multi-purpose items, versatile clothing and periodic removal of unused cargo enables storage of more of what is usually used.**

**When loading the motorhome, please follow these guidelines:**

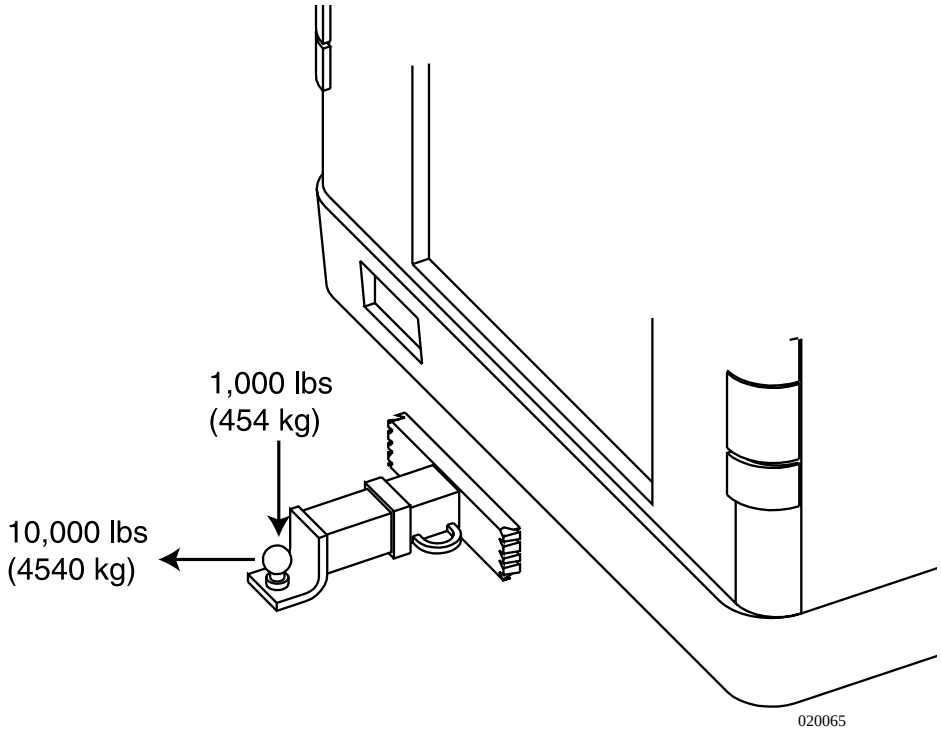
- Distribute the cargo weight evenly from side-to-side and front-to-back. This practice will prevent both handling problems and uneven stress on the components throughout the life of the motorhome.
- Heavy items should be stored near the rear axle, lighter items stored toward the front.
- To maintain a low center of gravity and reduce sway, store light items in the overhead cabinets and heavier items near the floor.
- Secure loose items to prevent weight shifts that could affect the balance of the motorhome.

## HITCH - *Using the Rear Receiver*

When using the rear hitch remember that the motorhome is intended for towing light loads. The motorhome is designed to be used primarily as a recreational vehicle. Towing will affect durability and economy. Safety and satisfaction require proper receiver use. Avoid excessive loads or other misuse. Weight pushing down on the rear hitch must not exceed 10% of the hitch capacity. It is recommended to weigh the motorhome when fully loaded to ensure proper weight distribution of the GCVW (Gross Combined Vehicle Weight). When weighing the motorhome add all passenger weight to the GCVW total. The motorhome fully loaded, and any vehicle or trailer towed by it, must not exceed the GCVW.

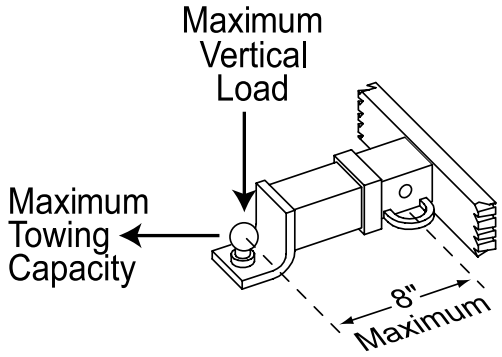
**WARNING: Most states and Canadian provinces require any trailer or vehicle being towed have adequate auxiliary brakes. Failure to comply with these State and Canadian province requirements may result in fines and/or pose a safety hazard, which may result in an accident.**

**WARNING: Towing a trailer or vehicle which exceeds the rated capacity of the hitch should be avoided, as it will place undue stress on components and cause unusual handling characteristics in the motorhome. It could also void the warranty. If there are any questions, call a factory technician.**



**Tow Car or Trailer:**

1. Connect tow car or trailer with light harness to motorhome and perform a light check.
2. Connect safety chains.
3. Check the tow car or trailer and the motorhome before starting a trip and at each rest stop.
4. Flat tires on a towed vehicle cannot be detected from the motorhome while driving. A flat tire is a safety hazard and may cause extensive damage. Check tires on the tow vehicle frequently.

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MONACO
COACH CORPORATION

Coburg, Oregon
Springfield, Oregon
Wakarusa, Indiana
Elkhart, Indiana
Nappanee, Indiana

Do Not Cut,
Weld or Modify

Do Not Exceed Vehicle Ratings

| | |
|---|---|
| Maximum Towing Capacity | 10,000-Lbs (4,536 Kg.) |
| Maximum Vertical Load | 1,000-Lbs (454 Kg.) |

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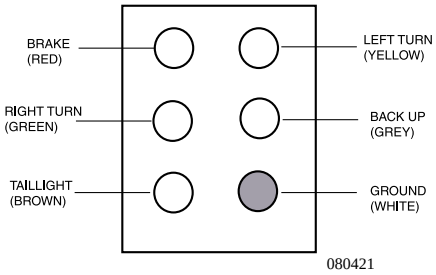
### *Tow Plug Connection*

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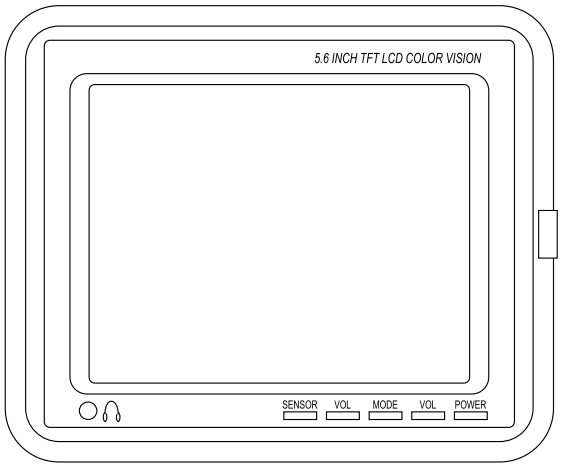
The motorhome is pre-wired from the factory with an electrical harness for towing. The harness is located on or near the hitch receiver. Convoluted tubing protects the tow harness wires until ready for use. Current draw should not exceed ten amps for each designated light circuit. Depending on the light configuration of the tow car, an electrical taillight converter may be required.

**NOTE: When towing a trailer or vehicle with a tow-wire system, a turn signal/brake light converter will be needed to adapt the tow plug wiring to the item being towed.**

## REAR VIEW CAMERA

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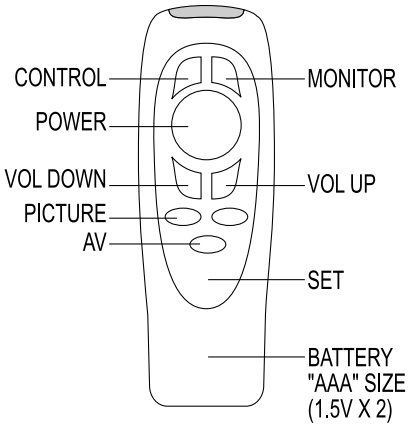


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The motorhome is equipped with a rear vision and voice system. This system is designed to provide the driver with a view of the rear of the motorhome. The rear vision system consists of a camera with a microphone, located at the rear of the motorhome. The monitor is equipped with several features:

- Stereo Headphone Output
- Full OSD Remote Control
- On Screen Display

The Aladdin System must be powered up for the back-up monitor to switch ON automatically when the shift selector is placed in reverse. For more detailed instructions regarding the back-up monitor see the manufacturer's manual.

## BACKING UP A MOTORHOME

Whether you are a long time owner of recreational vehicles or just starting out, backing up can be a challenge. Following some simple guidelines may help reduce the challenge. When backing up, the driver (pilot) should be comfortable using the mirrors, the back-up camera and the co-pilot's directions (ground guide) for assistance. Practice first, backing up with the co-pilot's guidance in a large unobstructed parking lot. Backing up is a team effort.

The backing up process should begin while the motorhome is in forward motion. Maneuver the motorhome to align with the chosen site. This allows straight alignment with the site. Aligning the motorhome with the site after the backing process begins will require considerably more room than an automobile, and may require more than one attempt. When the motorhome is properly aligned with the site, the parking area will be visible in both mirrors. Use straight lines, such as road markings, as reference points when possible.

If the destination does not have "pull-through" sites, try to pick a solid, level site. If possible, pick a site located on the left side. This is the preferred side. The driver will have a better field of vision by using the roadside mirror. If the site is on the right side, the driver will have to use the curbside mirror for backing up, which leaves a blind spot. When a potential site is spotted, stop the motorhome before the site. Get out and observe the area for soft ground, posts, large rocks, low hanging limbs or other obstacles. If the site meets the particular criteria, prepare to back in carefully. Have the co-pilot provide guidance using the five hand signals.

The co-pilot will perform just as important a job as the driver. When guiding the driver, the co-pilot should be located safely at the left rear corner of the motorhome, facing forward, while remaining visible in the roadside mirror at all times. The co-pilot should make a conscious effort to maintain sight of the driver through the roadside mirror as the front of the motorhome maneuvers.

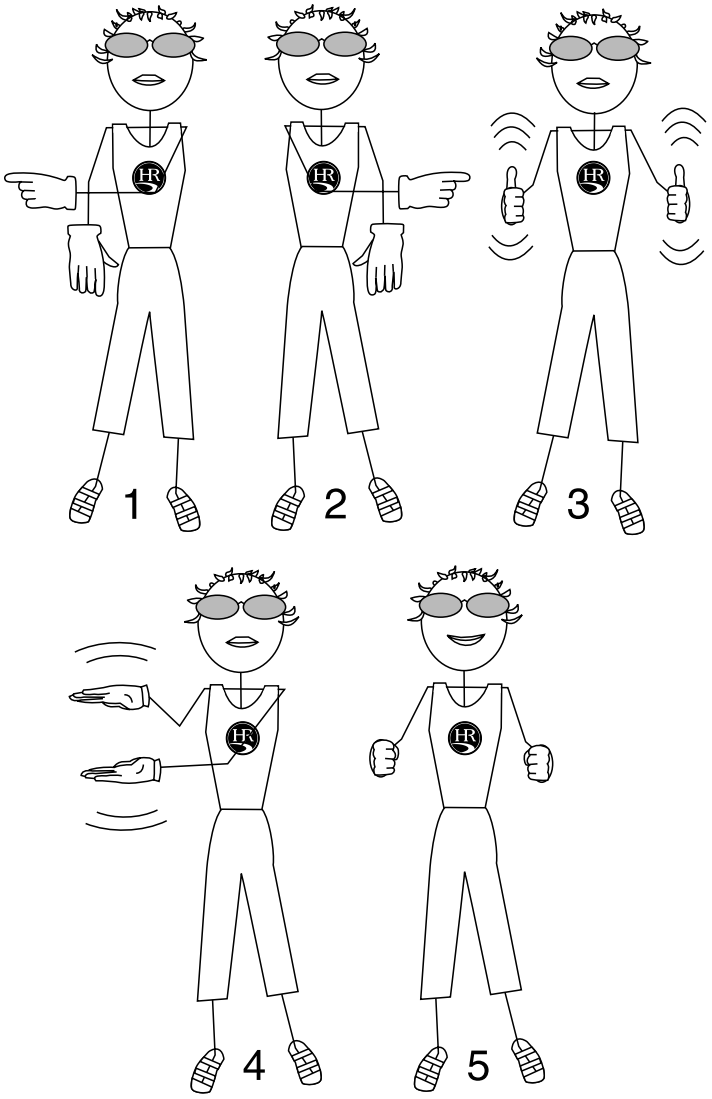
If the driver loses sight of the co-pilot, stop the backing up process until the co-pilot returns to view. To avoid mishaps, the co-pilot should be focused only on what the driver is doing, with brief observation moments. The driver should receive directions only from the co-pilot. If necessary, stop the backing up process to have co-pilot inspect other areas or angles of concern. Use of walkie-talkies will aid in guidance.

When the co-pilot is guiding the driver, only five clearly defined signals should be used, with only one signal given at a time. Flailing arms with indecisive signals only confuse the driver. Signals should be given with purpose and confidence. Directional signals are directing travel of the rear of the motorhome.

If the desired direction is left, the co-pilot points left. For example: The co-pilot will use his/her right arm and forefinger pointing distinctly left with arm and finger held on a horizontal plane, indicating desired direction of travel of the rear of the motorhome. This type of directional signal is easily discerned in the mirror by the driver. The directional signal given will remain steady until desired movement is completed.

**The five directional signals are as follows:**

1. Co-pilot uses left hand and arm held horizontal, with forefinger pointing right, to direct rear of motorhome to the right.
2. Co-pilot uses right hand and arm held horizontal, with forefinger pointing left, to direct rear of motorhome to the left.
3. Co-pilot uses both arms and hands parallel with thumbs pointing up and to rear in a waving vertical motion. This signals driver to maintain a straight back direction.
4. Co-pilot holds arms horizontally, hands open with palms facing one another. Start with a wide separation, gradually closing distance of hands, in a rate appropriate to vehicle speed, to indicate amount of distance to the stop point.
5. Closed fists indicates STOP.

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**Backing Up Trailers:**

Trailers have only one pivot point. Trailers may be backed up. Towed vehicles using a tow bar or tow dolly have more than one pivoting point which makes this type of equipment not suitable for backing. If using this type of towing equipment, plan ahead. Park safely along the road and walk a distance, if necessary, to avoid a possible back up situation. Avoid putting the motorhome and tow vehicle in a backing situation. To back up this combination, completely disconnect the tow vehicle from motorhome. Trying to back up the motorhome with a tow vehicle connected will result in damage to the motorhome, tow vehicle and towing device.

The same rules for backing a motorhome may be applied when backing a trailer. When preparing to back a trailer into a space, maneuver the motorhome sweeping wide, then turn back to the opposite direction. This sets the motorhome and trailer in a position to maneuver the trailer into the space. When backing up a trailer, the driver may become disoriented with the direction of the steering wheel in relation to the direction of the trailer. The bottom of the steering wheel must be moved in the desired direction of the trailer. For example: If the desired direction of the trailer is left, rotate the bottom of the steering wheel left. If the trailer moves in an undesired direction, use a short "pull-up" method, pulling forward just far enough to align the trailer with the space. The co-pilot should stand safely at the left rear corner of the trailer within view of the driver in the roadside mirror, using the five hand signals for guiding.

**CAUTION: Tow bars or car dollies generally are made to travel in a forward direction only. Most towing equipment of this type is not designed for backing. Never attempt short back up distances with a tow bar or tow dolly. Damage to the motorhome, vehicle or towing device will result.**

## SET-UP PROCEDURES - CHECKLIST

If the site for the motorhome has full hook-ups, use this quick reference hook-up checklist. This hook-up list is only a guide. This checklist has information on hooking up the utilities and preparing the appliances for use. Specific information on the slide room, awning and leveling system operations is discussed in detail in other sections.

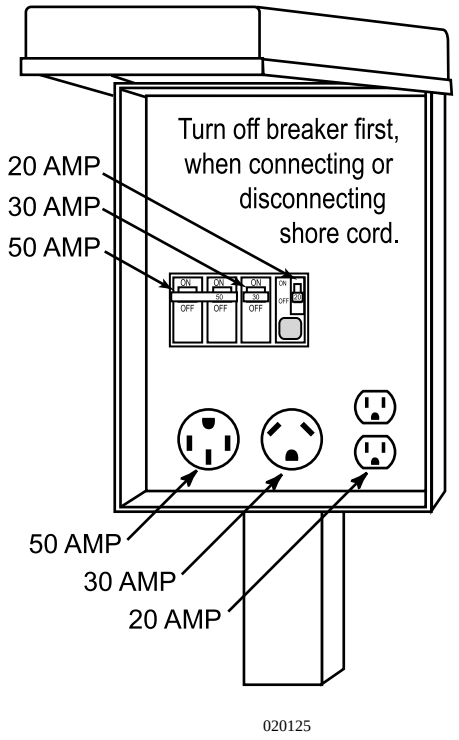
- If applicable, unlock any travel locks which may be securing the slide room. Check for lateral clearance before extending the slide-out room.

**NOTE: To operate any slide room: The ignition must be OFF and the park brake must be set.**

Follow the procedures and guidelines for "Leveling the Motorhome." If the motorhome is equipped with hydraulic jacks, be certain the parking surface will accommodate the weight placed on the jacks.

**CAUTION: Before leveling the motorhome survey the area around and under the motorhome for obstructions which can damage the motorhome or undercarriage components when the air bags are deflated.**

**CAUTION: Hot asphalt may not support the weight that is placed on the hydraulic jack pads. Place thick plywood under the jack pads to help disperse the weight. Never use the leveling system to support the entire weight of the motorhome. Damage from excessive torsional twists can result.**




- Open the LP-Gas tank primary valve.
- If possible, begin appliance operation on LP-Gas for the first 60 minutes. Switch the refrigerator operation to gas, start the water heater and furnace (if needed). This will allow time for the inverter to stabilize the battery charging.
- Prepare the shore cord to be plugged in. Extend and inspect the cord. Perform any necessary cord maintenance. Install proper electrical adapters if anything other than 50 Amp service is provided. Turn shore power circuit breaker OFF prior to plugging in the shore cord. Operate electrical appliances in sequence when hooked to a limited shore power service.

**CAUTION: If shore power service is limited to 15 or 20 Amps, use of light duty extension cords and electrical adapters will create a voltage loss through the cord and at each electrical connection. Line voltage loss and the resistance at each electrical connection can be a hazardous combination. Damage to sensitive electronic equipment may result!**

- If cable service is provided, hook-up a 75 Ohm RG59 or RG6 cable to the cable connection in the service center. If the motorhome has a video selector box, press the appropriate viewing button for the item desired.
- A phone connection port is provided in the service center. Phone utility outlets are placed throughout the motorhome, including a phone line attached to the satellite receiver for Pay-Per-View movies and events.

- Hook the potable water hose to the city water connection in the service center. Install a water pressure regulator to protect the water hose from excess pressure. Turn the hand valve to “city water.”

**NOTE: Attach a water pressure regulator between the city water faucet and the potable fresh water hose to protect the hose from swelling or bursting under high city water pressure. Securing the pressure regulator to the hose with pliers will prevent the regulator from being misplaced.**

- Hook-up the sewer hose. Sewer drain pipe diameters are generally either three or four inches. Proper sewer hose adapters will ensure against leaks or spillage. Check to make sure all hose clamps are tight, with the sewer hose properly connected open the grey water valve. The black water valve remains closed until the tank is full or until time of departure.

## DRY CAMPING

The key to a successful dry camping trip is having a reasonable understanding how the different electrical systems work and interface. Each electrical system operates as a single entity but is usually connected or dependent upon operation of another electrical system. If one electrical system malfunctions, it generally effects the operation of another electrical system. To obtain satisfactory performance, all electrical systems must be in proper working order and operated in the parameters for which they are intended.

When it comes to dry camping, the state of the charge of the house batteries is going to determine how long the interior lighting will last or how long the TV operates from the inverter. Starting a dry camping trip with batteries in a low state of charge, or one battery in the battery bank that is damaged, will ultimately result in a disappointing time. There are several different charging systems, all of which are designed to either charge or offset battery draw. There are three basic charging systems on the motorhome: inverter/converter, alternator and solar panels.

Each charging system performs a specific type of charge profile. The inverter/converter is the preferred method to charge the house batteries. The inverter/converter uses 120 Volts AC supplied by either shore power or the generator. It converts 120 Volts AC to 13.5 to 14.5 Volts DC, depending on state of charge of the batteries and the load placed on them. The alternator maintains battery voltage while traveling and supplies the current necessary to operate various loads placed on the engine and house batteries. Solar panels offset various parasitic loads that are on the house and engine batteries.

Begin with a full fresh water tank and empty waste holding tanks. When the fresh tank is low, the waste holding tanks will more than likely be full. Empty the waste holding tanks before refilling the fresh water tank. Learning ways to save water will ease the burden of camping without hookups. Bottled water is a good alternative for you and your pets to eliminate demands put on the fresh and gray water tanks.

By placing a small plastic tub in the sink, gray water can be collected and recycled for use in the toilet. Instead of rinsing dishes under a running faucet, use two plastic sink tubs - one for washing and one for rinsing. When possible, take advantage of campground facilities offering restroom, shower and laundry service.

While showering, turn the water off while soaping and shampooing your hair. Alternate a shower and a sponge bath every other day. A plastic tub from the kitchen sink works well for sponge baths and allows you to save that gray water resource. When brushing teeth, rinse the brush in a cup of water, and gargle with bottled water. A battery charged razor would cut down on water usage while shaving.

Before arriving at your destination, fill up with fuel for the generator. Carefully monitor for voltage draw while dry camping. Plan ahead and conserve resources while dry camping. Dry camping requires fully charged and properly maintained batteries (corrosion cleaned, terminals tightened, cables checked, etc.)

Solar panels are a valuable addition to help charge the batteries Adding a second panel (and adding a third if possible) will charge the batteries during daylight hours. Clean the solar panels regularly for optimum performance. Dust, dirt, grime and pollution from the road and air will decrease their efficiency. Clean the solar panels with window cleaner and a soft cloth.

Most dry camping locations can accommodate motorhomes of various lengths. Confirm that the facility you plan on visiting can accommodate your motorhome's length and size. Arrive during daylight hours to properly set-up the motorhome and prepare for the night ahead. Getting to a site on narrow and winding campground roads takes skill and patience. Avoid low hanging limbs, tree trunks and barriers lining the roadway. The co-pilot or the campground host should provide assistance when maneuvering the motorhome around curves and bends.

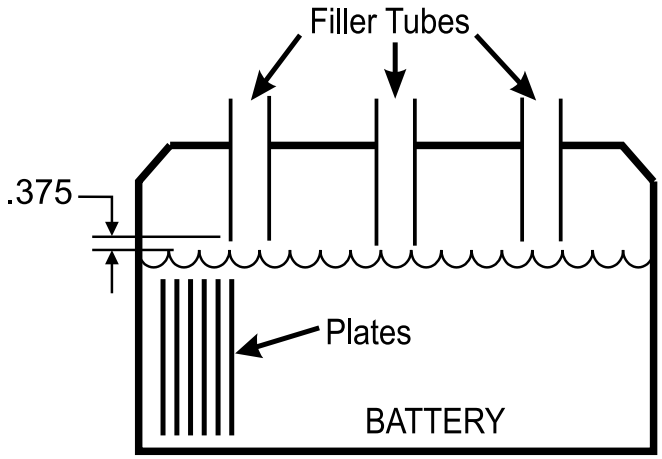
**Setting Up for Dry Camping:**

- Switch refrigerator operation from Auto to LP-Gas.
- Operate the water heater on LP-Gas. Turn it on about an hour before hot water is needed.
- If the furnace is needed during the nighttime, set the thermostat temperature a bit lower to prevent the furnace from cycling all through the night.
- Check on small items that use battery power, such as the porch light, bay lights, the light under the step, generator compartment lights, engine compartment lights, etc. If the television is not being used, turn off the 12 Volt booster. Even one light accidentally left on, such as under the front cap, reduces battery reserves quickly.
- Some battery draw is unavoidable. The battery cut-off switch at the entry door must be on to operate many interior items such as lights or the furnace.
- Keep flashlights handy. Build a campfire when spending nighttime hours outdoors. Extinguish the flames before retiring for the evening. Many campgrounds place wood or cement barriers between the site space and fire pit. Illuminate any barriers or obstacles in the pathway to the motorhome.

- Place a large flashlight inside the front door for navigating through the coach during the night without having to use interior lights. If interior lighting is needed, use one light in a central location, such as the vanity.
- During the day it is still important to conserve on energy. Turn on the water pump only when using water. Turn the pump off when not in use. The water pump does not draw an abundance of power, however all battery amp hours are important and should be conserved.
- If it is too early in the morning or too late in the day to run the generator, use the inverter for AC power. Remember to turn off the inverter when not in use. When the rest of the campers are up and about, turn on the generator and run it for a couple of hours to help charge the batteries. The generator may seem loud, however, the noise is minimal just a short distance away from the coach. Run the generator during clean up and preparation for the day.
- Check the monitor panel frequently and keep track of water usage and battery consumption. Routinely check the LP-Gas level. Remember the furnace uses more gas in cold weather.
- Careful management of water is critical when dry camping. Know the motorhome tank capacities. Picture the amount of liquid in a gallon container. Visualize that amount each time you run the water. If you are dry camping for extended period, limit shower usage. Turn the water off when soaping down in the shower. If water conservation is critical, take a sponge bath. Conserve water while brushing your teeth. Chances are a campground without hookups will not have large comfortable shower rooms or bathroom, but it may only be equipped with primitive facilities. However, if it helps to economize on water, use them.
- Do not fill the sink full of water to wash a few dishes. Use disposable dishes whenever possible. Conserve propane by cooking dinner over the campfire. However, if cooking over the campfire is not desired, use the cook top or microwave. If you use the inverter to operate the microwave, battery power will be consumed quickly. If possible, use the generator to operate the microwave. It is healthy for the generator to operate under a heavy load such as the microwave.
- Allow the generator to power up for a couple of minutes before applying a load.
- To conserve on battery power, plan what is needed from the refrigerator prior to opening it. If weather does not permit eating at the picnic table, or if no picnic table is available, eat at the dinette table by candlelight.
- Leave shoes outdoors or at the entry step to avoid tracking in dirt. Open windows during the day instead of using the roof air conditioner.
- Get back to nature and still enjoy the comforts of the motorhome. With a little imagination, the ways to conserve available resources while dry camping are endless.

**Typical Current Draw:**

- Interior Coach Power requires using a continuous duty solenoid that has a .7 Amp draw.
- A 13" TV has a 1.7 Amp draw.
- Rope lights (10 ft) are a 1.3 Amp draw.
- The porch light is a 2.0 Amp draw.
- One fluorescent dual bulb light has a 2.1 Amps draw.
- One halogen ceiling light has a .09 Amp.
- Remote LP-Gas tank solenoid = .66 Amps.




The distilled water level in the battery should be 3/8” below the vent tube.

**Battery State of Charge vs Voltage/Specific Gravity**

| VOLTAGE | SPECIFIC GRAVITY | STATE OF CHARGE | DEPTH OF DISCHARGE |
|---|---|---|---|
| 12.66 | 1.265 | 100% | 0% |
| 12.45 | 1.225 | 75% | 25% |
| 12.25 | 1.190 | 50% | 50% |
| 12.05 | 1.145 | 25% | 75% |
| 11.90 | 1.100 | 0% | 100% |

*Battery Voltage: Fully charged with battery at rest for one hour.*

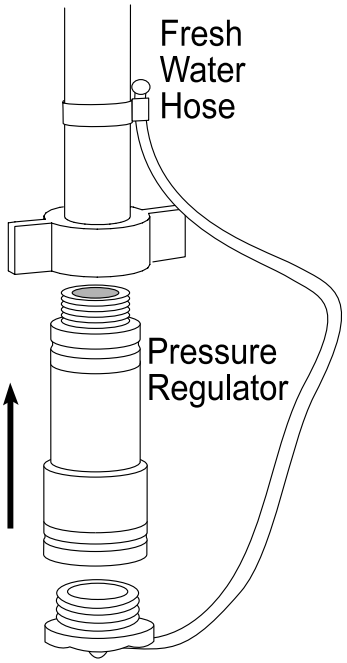
Battery Charge Voltage chart

## BREAKING CAMP

Below is a checklist guide to reference when preparing to break camp. Preparing the motorhome for travel will require several small tasks. Properly securing and storing items will help prevent them from getting lost or being damaged during travel.

**Outside Checklist:**

- Disconnect the cable TV, lower the television antenna and (if applicable) the satellite dish.
- Disconnect and stow the phone line.
- Retract the awnings and secure them for travel.
- Close LP-Gas tank valve. Check the level of the LP-Gas Tank to ensure a sufficient amount is available.
- Drain and flush the holding tanks. First close the grey water valve, run enough cold water down the sink and shower drains until the grey tank is at least 50% full. Be careful not to overfill or flood the grey tank. Next, open the black tank valve allowing the drain cycle to complete. **If applicable**, connect a **non-potable** water hose to the No-Fuss hose bib and flush the black tank system. Close the black tank valve, open the grey water valve. The water from the grey tank will help flush the solids from the drain hose.
- Disconnect the sewer hose. Flush hose with clean water from a **non-potable** hose. Store the hose. Install the sewer cap.
- Fill the fresh water tank (using the potable hose). Disconnect and store the fresh water hose. Remove any hose protected water pressure regulator from the city water faucet.
- Turn shore power breaker off and disconnect the shore line. Wind up and store the shore cord.
- **Inspect** fluid level in oil bath hubs if applicable and check all tire pressures.
- Secure all compartment doors and entry door.
- **Inspect** tires and wheels.
- Check for fluid leaks under or around the motorhome.

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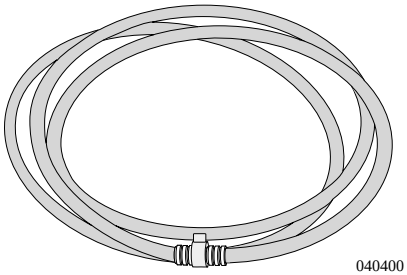

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*Screw the ends of the hose together before storage to prevent leakage and to prevent dust and insects from entering the hose.*

**Engine Checklist:**

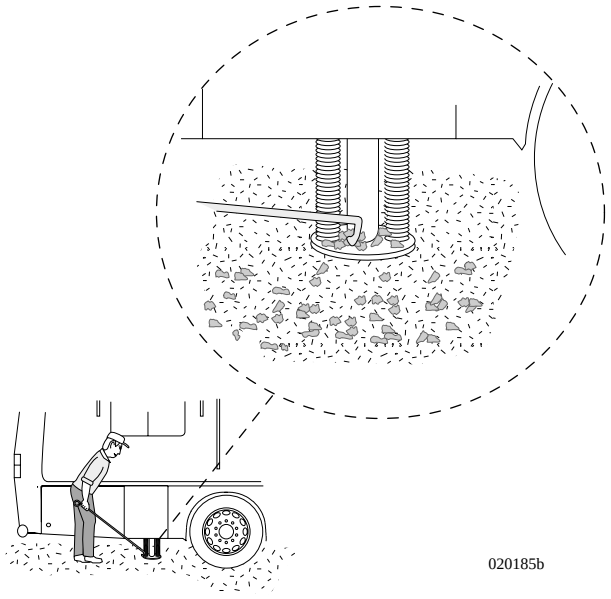
- **Inspect** the engine, transmission and the engine compartment for fluid leaks.
- **Inspect** the area under the motorhome for fluid leaks or puddles.
- Check all fluid levels: oil, antifreeze, transmission, hydraulic fluid and washer fluid.
- **Inspect** belts and hoses for wear.
- **Inspect** wiring for loose, frayed or corroded connections.
- Start engine and listen for any unusual noises.
- **Inspect** gauges and controls for proper operation.

**Interior Checklist:**

- If applicable, clear the slide room path, clean the floor, move the driver seat forward and make sure the bay doors are shut. Retract the slide room. When the slide room is fully retracted secure any slide room locks.

**NOTE: To operate the slide-out the ignition must be OFF and the park brake must be set.**

- Secure and fasten the bi-fold and pocket doors. Lock the shower door.
- Close roof vents and windows.
- Secure any loose, heavy or sharp objects in case of a sudden stop.
- Close all cabinet doors and drawers.
- Turn off interior lights.
- Turn off water heater, water pump and furnace.
- Walk through the interior and check for any unsecured items.
- Turn the interior lighting off.
- Check the fuel level gauge. Check all other dash gauges for operation and correct level indications.



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**Departure Checklist:**

- Check items in storage bays to make sure shifting or damage of items will not occur.
- Look around, above and under the motorhome for obstructions. Check for debris stuck between the rear dual tires.
- Walk around the motorhome and camp area checking for forgotten items.
- Outside compartment doors should be closed and locked.
- Check operation of all exterior lights, headlamp, taillamp, brake and clearance lights.
- Secure and lock the entry door for travel.
- Secure all awning travel locks.
- When using the hydraulic jacks ensure the jack pad is clear of debris when retracted. Loose rocks, gravel and debris can be thrown from the jack pad and can possibly damage the tow car.
- Carefully pull forward out of the campsite. If necessary, clean the site and check for any forgotten items.

## EMERGENCY PROCEDURES - ROADSIDE

If an emergency situation occurs, use the appropriate braking technique and pull off the roadway a safe distance from traffic (if possible). Set the parking brake and turn on the hazard warning flashers, especially when parked alongside traffic lanes. In the event of an emergency stop due to a mechanical breakdown or other motorhome related problems, contact the manufacturer's **Customer Support** at **(1-877-466-6226)** or an emergency service provider.

An emergency road kit should include at least three reflective warning signs, road flares, a flashlight, spare automotive fuses and an assortment of hand tools. For added safety a separate fire extinguisher should be considered. The motorhome is equipped with a fire extinguisher located inside next to the co-pilot seat. Road flares or reflective warning signs should be displayed if the motorhome is alongside of the road for any length of time.

Guidelines for placing the warning triangles depend upon the road characteristics and visibility. For example: The standard placement is 10 feet, 100 feet and 200 feet from the rear of the motorhome when on a divided highway or one-way road. On a two-way road, with traffic traveling both directions, the same placement would also be required at the front of the motorhome. Roads with curves and hills may require the placement of the last/furthest triangle to be 500 feet behind the motorhome in order to safely warn approaching traffic.

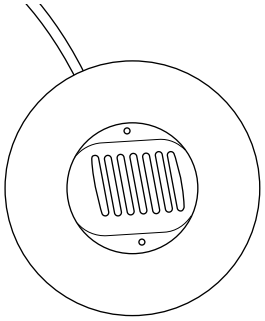
## *OnStar (Optional)*

OnStar® combines existing wireless technology with a sophisticated Global Positioning System (GPS) to track and monitor the motorhome. OnStar® can provide instant customer assistance such as, driving directions, contacting emergency services, as well as other beneficial features.

**OPERATION:**

OnStar® operates using the motorhomes electrical system and is powered by the house batteries. If the house battery cut-off switch is in the **OFF** position, or the batteries are drained, damaged, or disconnected, the OnStar® system will not function.

The components associated with the OnStar® system are; the microphone, the three-button interface with volume control and jack for use of the headset for hands-free communication.



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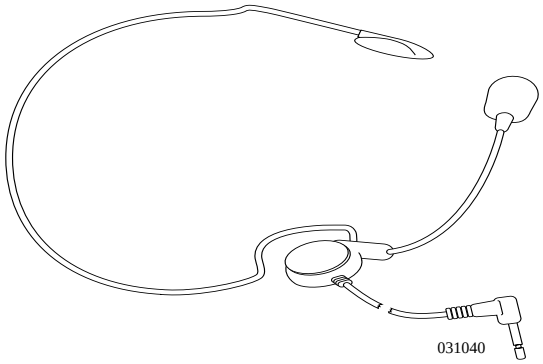

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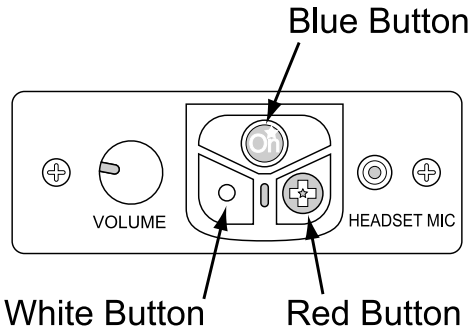
**Three-Button Keypad:**

- The blue On* button connects directly to the OnStar® center.

- The primary function of the red emergency button is to send for medical help. This button alerts OnStar® of a medical emergency and will place that call as a priority. OnStar® will ask the nature of the emergency. If there is no response, OnStar® will utilize the GPS system to locate the motorhome and immediately direct emergency services to that location. OnStar® will not determine if medical attention is necessary regardless of customer description of symptoms.

- The white o button answers and ends calls from OnStar® connections, personal calling and virtual advisor.

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In the event of a motorhome breakdown, press the blue On* button to contact an advisor at the OnStar® center. Calls concerning the interior operations, that do not impede travel, should be directed to the Monaco Coach Corporation Customer Services Department.

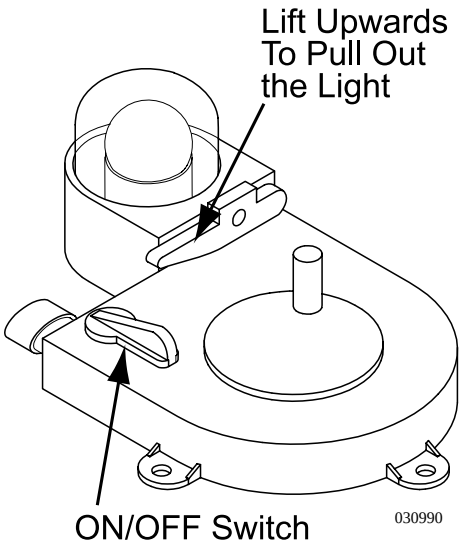
**NOTE: Before any contact with OnStar® the motorhome will need to be registered with Monaco Coach Corporation. A service contract is required in order to activate OnStar®. Service can be started by pushing the blue OnStar® button or by calling OnStar® direct at 800-ONSTAR7.**

## Light - Retractable

The retractable light is located in places of limited lighting for emergency purposes. Normally, one will be located in the engine service compartment and in the front generator compartment.

**To use:**

1. Activate light by moving ON/OFF switch to the ON position.
2. The light is on an 18’ rectractable reel cord. To operate, lift the lever and pull the light out.
3. The light has a magnetic base attached. Locate a place to attach the light so you can work hands free.
4. To replace bulb push down on clear plastic cover and twist.
5. To rewind, crank the handle in the retract direction. When fully retracted, push down on the lever handle to keep the light locked into place.



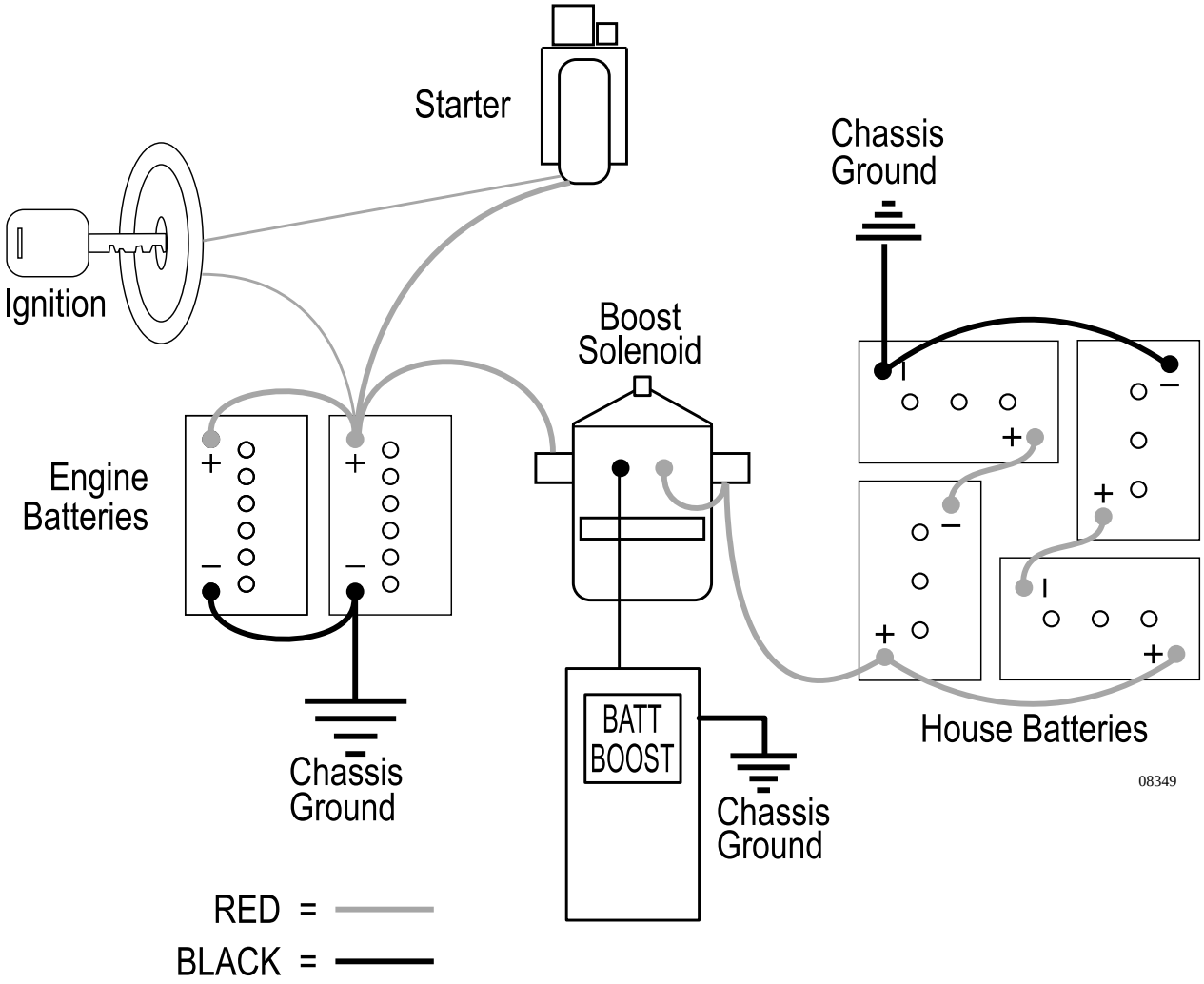
## Jump Starting

**Alternative Starting Procedure:**

A weak or discharged battery will not supply the amount of CCA (Cold Cranking Amps) necessary to initiate and maintain cranking the engine while supplying the required voltage to start the engine. If the engine fails to crank, or cranks slowly due to a weak chassis battery, there are electrical back-up systems in place that will increase chassis battery voltage.

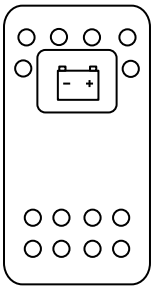
**Battery Boost Switch:**

The Battery Boost switch engages a heavy-duty solenoid to electrically connect the house batteries to the engine battery in the event the engine won't crank or cranks slowly. The solenoid is designed for short-term high current intermittent use. Engaging the boost solenoid for an extended period will damage the solenoid.



**To Use the Solenoid:**

- With the ignition key off, press and hold the Battery Boost switch for 10 seconds. After 10 seconds, continue to hold the switch down and turn on the ignition. Observe the battery volt gauge on the dash, it should read at least 12 Volts. If voltage is sufficient, try to start the engine.
- If the engine fails to crank, or does not crank fast enough, discontinue the attempt. Continued attempts will only diminish any remaining surface charge in the chassis battery ending any future alternative attempts.
- Next, start the generator. This may require using the Battery Boost switch as the generator starts from the engine battery. When the generator is operating, the electrical combination of the generator and the inverter will charge the house batteries.
- Allow the generator to run approximately ½ hour before attempting to start the engine.
- After ½ hour of generator operation, with the generator operating, hold down the Battery Boost switch for one minute. Release the switch for one minute, then engage the switch for one minute. Alternate this cycle 3 to 5 times. This will avoid overheating the Boost solenoid.
- Next, hold the switch down for one minute and turn the ignition on. The battery voltage gauge on the dash should indicate at least 12 Volts. If voltage is sufficient with the Boost switch held down, try to start the engine.
- If the engine fails to crank, or fails to crank quickly, the chassis battery may be depleted and the motorhome will require jump-starting or an external charger hooked to the chassis battery. When using jumper cables to start the engine, the cables must connect in a parallel configuration. That is positive (+) to positive (+) and negative battery (-) to negative chassis (-). Always connect the positive (+) before connecting the negative (-). To prevent arcing when disconnecting the cables, disconnect the negative (-) before disconnecting the positive (+).



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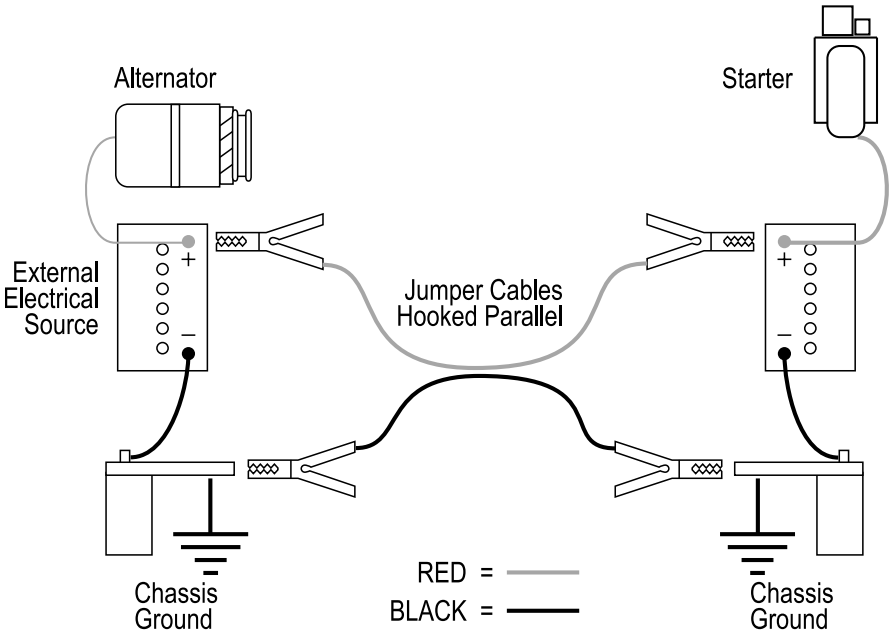
**WARNING: Batteries can emit explosive gases. Always ventilate the battery compartment prior to any work or service to the batteries. Extinguish all smoking material and keep all open flame and spark producing devices away from battery area.**

**CAUTION: A large amount of electrical current is required to jump-start an engine. The sizes of the battery, alternator and jumper cables supplying the "jump" are current limiting factors. Voltage fluctuations that occur during a jump-start procedure can damage sensitive electronic equipment and charging systems. Wait a sufficient amount of time for a surface charge to build before attempting to crank an engine when using a jump-start procedure. If uncertain about performing a jump-start procedure, contact a professional. Damage and personal injury can occur if this procedure is not performed correctly.**




**Jump Starting:**

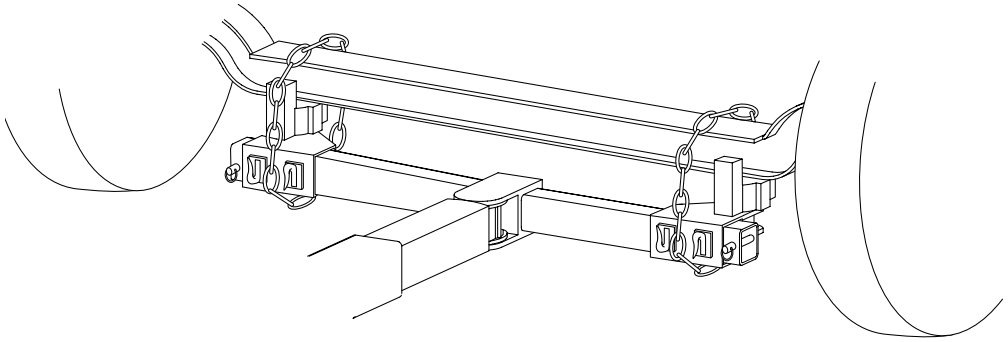
- When using an external electrical source to connect to the chassis battery, turn the main battery disconnect switches **OFF** prior to hooking up the jumper cables.
- Hook up the cables then wait several minutes to allow a surface charge to build in the chassis battery before attempting to start the engine.
- Turn **ON** the battery disconnect switches and attempt to start the engine. **DO NOT crank the engine more than a few seconds.**
- After the engine has started disconnect the cables. Disconnect the negative (-) cables before disconnecting the positive (+) cables to prevent arcing.
- If the engine does not crank, or cranks slowly, **DO NOT CONTINUE**. Obtain assistance from a qualified technician. Extensive damage, fire or injury can occur.

In the event of a roadside emergency, contact the nearest **Cummins Center** at **1-800-DIESELS (800-343-7357)** for Cummins Customer Assistance Center.

**WARNING: The gases around the battery can explode if exposed to flames, sparks or lit cigarettes. An explosion can result in injury or vehicle damage. Batteries contain sulfuric acid, which burns skin, eyes and clothing. Do not connect the end of the second cable to the negative (-) terminal of the battery to be jumped. A spark may cause an explosion of the gases that surround the battery. Connect only to the chassis, away from the battery.**

## TOWING PROCEDURES

If calling a towing company for service, it is recommended to use a lowboy/ landall type of trailer. If a tow truck is used it needs to have a support arm that goes under the motorhome and secures to the front axle. Inform the tow company of the axle weights and total weight of the motorhome. Other important information is the length of the motorhome, number of passengers and milepost location. Two tow trucks may be necessary. One to tow the motorhome and the other to tow a trailer or the tow vehicle if it is not operational.



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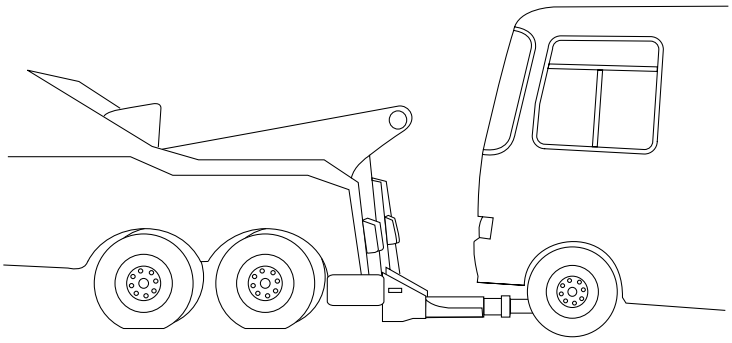

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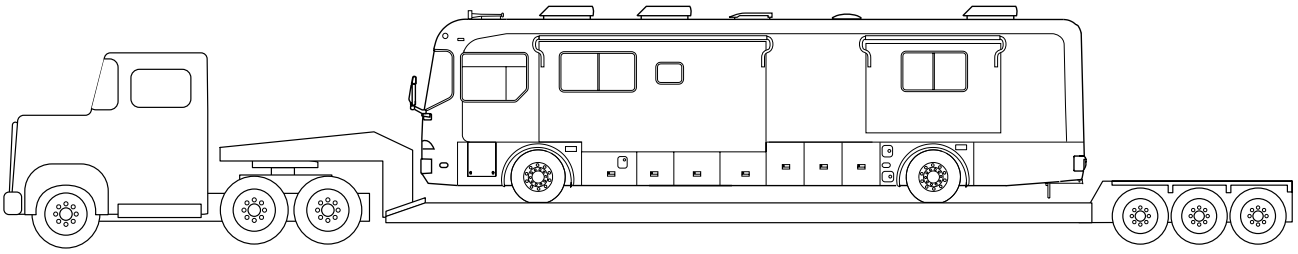
**Use the following instructions for towing the motorhome:**

- Secure any loose or protruding parts if the motorhome is damaged.
- **Inspect** the points of attachment on a disabled motorhome. If attachment points are damaged, select other attachment points at a substantial frame structural member.
- Never allow anyone to go under a motorhome while it is being lifted by towing equipment unless the disabled motorhome is adequately supported by safety stands.
- Do not tow the motorhome from the rear. Towing from the rear will severely overload the front tires and suspension possibly resulting in tire and/or front suspension failure. Rear frame extensions are not designed to support weight loads imposed by lifting the motorhome from the rear.

- If the rear wheels are disabled, place the motorhome on a flat bed trailer or use a heavy duty dolly under the rear wheels and tow the motorhome from the front.
- The drive shaft must be removed to prevent damage to the transmission. Secure the end caps to prevent losing or contaminating the needle bearings.
- The mud flap may need to be removed to prevent damage due to limited ground clearance.

**WARNING: In case the motorhome requires towing, ensure all precautions are followed. The drive shaft must be disconnected and the mud flap may need to be removed. The manufacturer WILL NOT cover damage to the motorhome caused by a towing company.**



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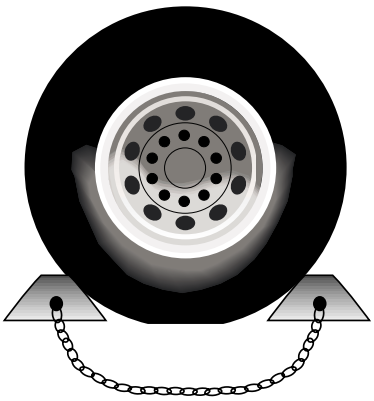
## *Disabling the Parking Brake*



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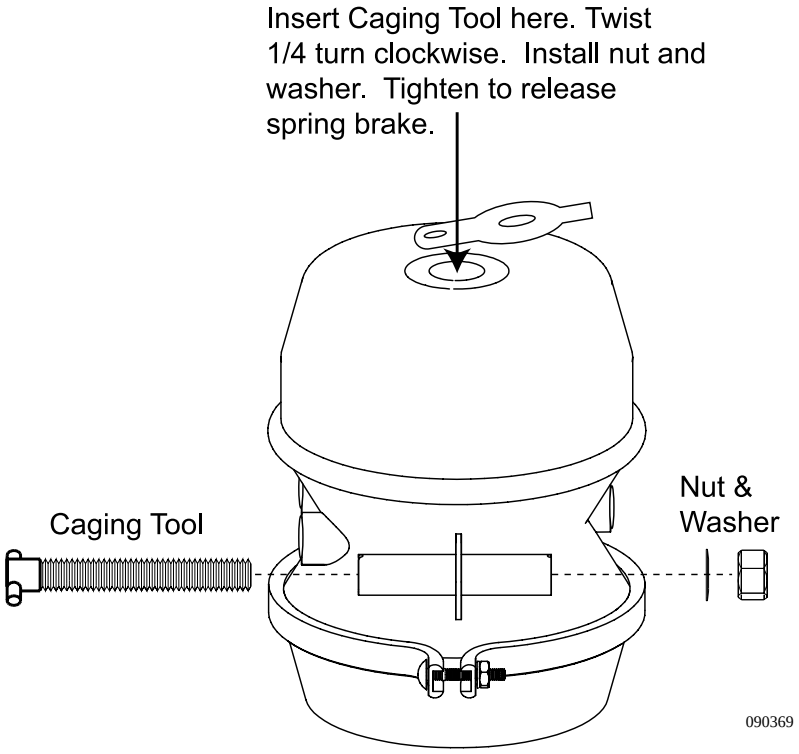
Chock the wheels securely prior to disabling (caging) the park brake. This procedure is for emergency conditions only. Exhaust all other means of releasing the brakes prior to performing this procedure.

**Drum Brake Models:**

- Place wheel chocks firmly against the wheel before performing this procedure.
- Remove the plug from the center of rear brake chamber on the drive axle.
- Remove the caging tool from its holder on the brake chamber and insert the tool into hole. Turn the tool clockwise to engage.
- Screw nut and washer onto caging tool. Use a wrench to tighten the nut compressing the internal spring releasing the brake.
- Repeat procedure for the other side.
- After towing, or when air pressure is again available, loosen the nut and remove the tool. Return the caging tool to its original location and replace the plug.
- Repeat for the other side.

**WARNING: Failure to securely chock the wheels can result in the motorhome rolling when the spring brakes are released. Severe injury or death can occur.**



## TIRES

A tire designed for a motorhome is a very technical and precisely engineered product. To obtain maximum wear and the best service out of the tires, it is helpful to understand their function. A tire is a "container" that holds air. A combination of air and the tire casing support the motorhome and its contents.

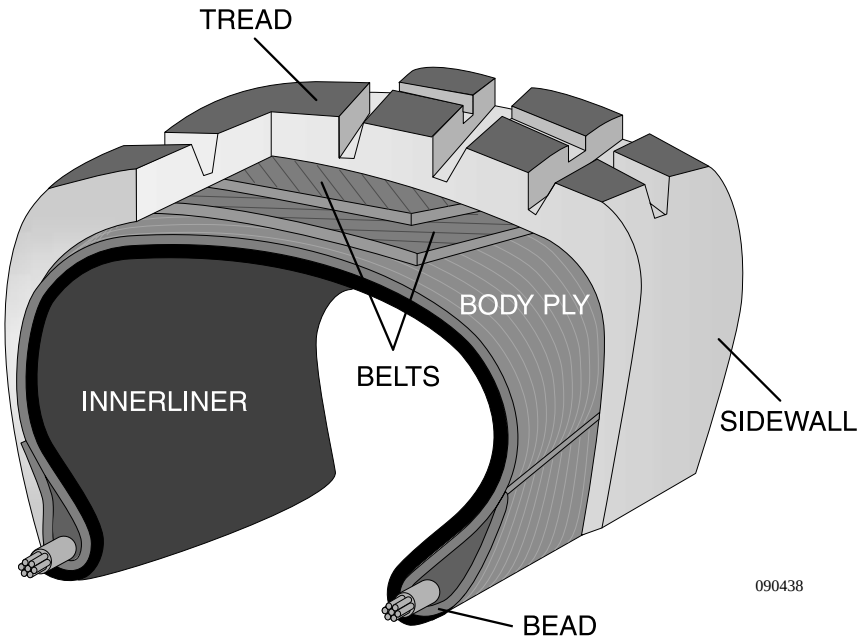
The following information concerning tires, weighing the motorhome and subsequent tire information are set in the order in which the process is performed or experienced. The motorhome must be weighed fully loaded before the proper tire inflation pressure can be obtained. Since the tire is the only contact the motorhome has with the road surface, it is critical that proper tire pressure be maintained so that it will properly support the weight of the motorhome. Improper tire pressure will lead to abnormal wear or sudden tire failure.

The tire performs other functions, such as traction for moving, stopping, steering and providing a cushion for the motorhome.

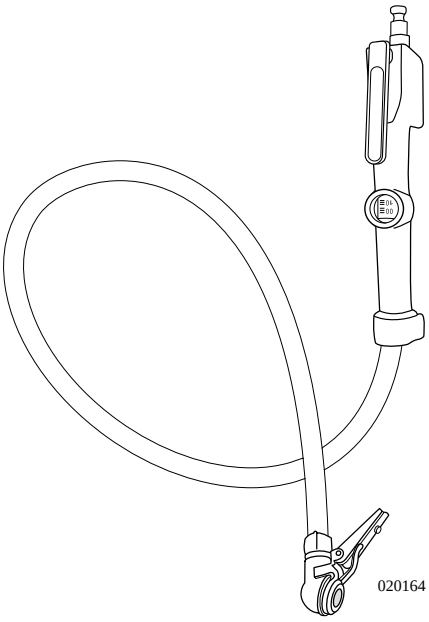
Modern tire technology blends a unique mix of chemistry, physics and engineering to provide a high degree of comfort, performance, efficiency, reliability and safety. To obtain the maximum wear and best service of the tires it is helpful to understand the components and function of the tires.

**Tire Components:**

**Tread:** Provides traction and cornering grip.
**Belts:** Stabilize and strengthen the tread.
**Sidewall:** Protects the side of the tire from road and curb damage.
**Body Ply:** Gives the tire strength and flexibility.
**Bead:** Assures an air-tight fit with the wheel.
**Inner liner:** Keeps air inside the tire.



## Importance of Air Pressure




The most important factor in maximizing the life of the tires is maintaining proper inflation. Driving on any tire that does not have the correct inflation pressure for the load of the motorhome is dangerous and may cause premature wear, tire damage and/or loss of control of the motorhome.

An under-inflated tire will build up excessive heat that may go beyond the design limits of the rubber and radial cords, which could result in sudden failure. An under-inflated tire will also cause poor motorhome handling, rapid and/or irregular tire wear and an increase in rolling resistance that results in a decreased fuel economy.

An over-inflated tire will reduce the tire's footprint/contact patch with the road, thus reducing traction, braking capacity and handling of the motorhome. Over-inflation of a tire for the load will result in a harsh ride, uneven tire wear and is susceptible to impact damage.

Maintaining correct tire inflation pressure for each loaded wheel position on the motorhome is of the utmost importance and must be a part of regular motorhome maintenance.

**WARNING: Driving on a tire that is under-inflated can exceed the design limits of the tire and may damage the sidewall. A damaged sidewall can burst upon inflation resulting in serious damage, injury or death. Aged tires are also susceptible to sidewall damage. For safety purposes clear the area of people and pets during tire inflation. Inflate the tires using a remote inflation device.**

## Tire Pressure Inflation Guideline

Federal law requires that the specifications for the tire's maximum load rating be molded into the sidewall of the tire. The amount of air pressure to use is dependent on the weight of the motorhome when it is fully loaded. The chart within this section indicates the weights that can be properly supported by varying air pressures. Decreasing air pressure decreases load carrying capacity.

Always comply with the tire manufacturer's recommended pressure inflation guideline. The actual weight of the motorhome can vary significantly depending on how it is loaded. For optimum tire wear, ride and handling always comply with the manufacturer guideline. A tire inflation chart listing proper inflation pressure for different loads is contained in this section of the manual.

The tires of the motorhome are inflated to pressure(s) appropriate for the actual weight on each axle in the unloaded, shipped condition. When the motorhome is loaded, check and adjust the inflation pressure on each tire as needed.

Always inflate tires to the pressure indicated in the tire chart for the load carried by the tire. **DO NOT OVERINFLATE OR UNDERINFLATE THE TIRES**.

The Gross Axle Weight Rating (GAWR) of the axles listed on the federal certification label attached to the motorhome is the maximum allowable loaded weight on an axle.

When the actual loaded weight of the motorhome and the weight on each axle is unknown, follow the recommended tire inflation pressure(s) listed on the federal certification label. When loading a motorhome never exceed the motorhome's Gross Vehicle Weight Rating (GVWR) or the GAWR for each axle.

Contact the tire manufacturer for further information concerning proper tire pressure inflation and other tire issues.

## Tire Chart - Goodyear

| TIRE SIZE | MAX Speed Rating (MPH) | Dual (D) Single (S) | INFLATION PRESSURE PSI | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 |
| 8R19.5 | 75 | D | 2350 | 2460 | 2570 | 2680 | 2780 | 2880 | 2980 | 3070 | 3160 | **3375(F)** | | | |
| | | S | 2410 | 2540 | 2680 | 2800 | 2930 | 3060 | 3170 | 3280 | 3400 | **3500(F)** | | | |
| 225/70R19.5 | 75 | D | | 2720 | 2860 | 3000 | 3115 | 3245 | **3415(F)** | | | | | | |
| | | S | | 2895 | 3040 | 3195 | 3315 | 3450 | **3640(F)** | | | | | | |
| 245/70R19.5 | 75 | D | | 3415 | 3515 | 3655 | **3875(F)** | 3940 | 4075 | **4375(G)** | | | | | |
| | | S | | 3640 | 3740 | 3890 | **4080(F)** | 4190 | 4335 | **4545(G)** | | | | | |
| 265/70R19.5 | 75 | D | | | | 3750 | 3930 | 4095 | 4300 | 4405 | 4560 | 4805 | 4860 | **5070(G)** | |
| | | S | | | | 3970 | 4180 | 4355 | 4540 | 4685 | 4850 | 5070 | 5170 | **5355(G)** | |
| 9R22.5 | 65 | D | 3120 | 3270 | 3410 | 3550 | 3690 | 3820 | **3950(F)** | | | | | | |
| | | S | 3190 | 3370 | 3560 | 3730 | 3890 | 4050 | 4210 | 4350 | **4500(F)** | | | | |
| 10R22.5 | 65 | D | 3690 | 3870 | 4040 | 4200 | 4375 | 4520 | 4670 | **4875(F)** | 4970 | 5110 | **5250(G)** | | |
| | | S | 3770 | 4000 | 4210 | 4410 | 4610 | 4790 | 4970 | **5150(F)** | 5320 | 5490 | **5680(G)** | | |
| 11R22.5 | 75 | D | | | | 4760 | 4950 | 5120 | 5300 | 5470 | **5750(G)** | **5800(H)** | | | |
| | | S | | | | 4990 | 5220 | 5430 | 5640 | 5840 | **6175(G)** | 6240 | 6430 | **6610(H)** | |
| 12R22.5 | 65 | D | | | | 5190 | 5390 | 5590 | 5780 | 5960 | 6150 | 6320 | 6500 | **6750(H)** | |
| | | S | | | | 5450 | 5690 | 5920 | 6140 | 6370 | 6590 | 6790 | 7010 | **7390(H)** | |
| 245/75R22.5 | 75 | D | | 3260 | 3425 | 3640 | 3740 | 3890 | 4080 | 4190 | 4335 | **4410(G)** | | | |
| | | S | | 3470 | 3645 | 3860 | 3980 | 4140 | 4300 | 4455 | 4610 | **4675(G)** | | | |
| 255/70R22.5 | 75 | D | | 3585 | 3765 | 3970 | 4110 | 4275 | 4410 | 4455 | 4610 | 4675 | **5070(H)** | | |
| | | S | | 3815 | 4005 | 4190 | 4370 | 4550 | 4675 | 4895 | 5065 | 5205 | **5510(H)** | | |
| 265/75R22.5 | 75 | D | | | 4040 | 4205 | 4370 | 4525 | 4685 | **4805(G)** | | | | | |
| | | S | | | 4070 | 4255 | 4440 | 4620 | 4800 | 4975 | 5150 | **5205(G)** | | | |
| 275/70R22.5 | 75 | D | | | | | 4535 | 4750 | 4960 | 5165 | 5370 | 5575 | 5775 | 5975 | **6175(H)** |
| | | S | | | | | 4885 | 5080 | 5305 | 5530 | 5750 | 5965 | 6185 | 6400 | **6610(H)** |
| 275/80R22.5 | 75 | D | | | | | 4855 | 5080 | 5305 | 5525 | 5745 | 5965 | 6180 | **6395(H)** | |
| | | S | | | | | 5265 | 5515 | 5755 | 6000 | 6235 | 6475 | 6710 | **6940(H)** | |
| 295/75R22.5 | 75 | D | | | 4690 | 4885 | 5070 | 5260 | 5440 | **5675(G)** | 5800 | **6005(H)** | | | |
| | | S | | | 4725 | 4945 | 5155 | 5370 | 5510 | 5780 | 5980 | **6175(G)** | 6370 | **6610(H)** | |
| 295/80R22.5 | 75 | D | | | | 4855 | 5100 | 5335 | 5570 | 5805 | 6035 | 6265 | 6490 | 6720 | **6940(H)** |
| | | S | | | | 5480 | 5750 | 6020 | 6285 | 6550 | 6810 | 7070 | 7320 | 7580 | **7830(H)** |
| 315/80R22.5 | 75 | D | | | | | 5840 | 6070 | 6395 | 6540 | 6770 | 6940 | 7210 | **7610(J)** | 7390 |
| | | S | | | | | 6415 | 6670 | 6940 | 7190 | 7440 | 7610 | 7920 | **8270(J)** | 8820 |
| 285/75R24.5 | 75 | D | | | 4740 | 4930 | 5205 | 5310 | 5495 | **5675(G)** | | | | | |
| | | S | | | 4770 | 4990 | 5210 | 5420 | 5675 | 5835 | 6040 | **6175(G)** | | | |

*The motorhome manufactureris not the author of this chart and makes no representation or warranty concerning the accuracy of the information disclosed by the chart. The motorhome is not responsible for the accuracy of the information disclosed or for any errors within the Tire Inflation Chart.*

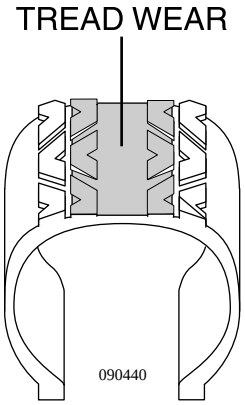
## Inspecting & Pressure

Regularly check the tire pressure. A nail or screw can lodge in a tire and create a slow leak. The object may eventually be spotted on a front tire or an outside rear dual. However, if there is a slow leak on an inside dual, it will probably go unnoticed. If you begin driving unaware that an inside dual tire is low on air pressure or is flat, very quickly (in most cases a few miles) the outside rear tire will heat up due to carrying double the load. This can lead to failure of the outside tire resulting in two flat tires on the same side of the same axle.

Check the tire pressure every two weeks or at least once a month and before any major trip. Check the tire pressure every "drive" morning on both long and short trips (driving a day or less). Check the tire pressure before leaving on a trip and again before starting your trip home. Check the tire pressure before storing the motorhome for any length of time. More importantly, check the tire pressure when removing the motorhome from storage.

Check the tire pressure when the tires are "cold" and have not been driven for more than one mile. The rated load capacity for cold inflation pressure is based on ambient temperature. If you must check the tires when they are warm or hot, allow for a slight increase in air pressure. The pressure should be within a couple of pounds of each other on the same axle. Never let air out of a hot tire.

When checking the inflation pressure, use a high-quality truck tire air gauge. These have an angle dual head. This type of pressure gauge can check the pressure of the inner dual wheel that has the valve stem pointing outward and the outer wheel has the valve stem pointing inward. Nothing should restrict the ability to easily check the tire's air pressure daily when traveling in the motorhome. Use valve stem caps with a positive seal to prevent air escaping from the valve stem. If there are extension hoses on the valve stem, make sure they are good quality reinforced stainless steel braid. Attach hoses securely to the outer wheel.



*Example of Overinflation. More wear in Center*

Optimum tire performance is achieved at proper inflation pressure for the load carried. Do not mix tires of different tread patterns on the same axle. The difference in traction could cause rear end gear fight and mechanical damage to the drive train. Never mix tires of a different size or construction on the same axle.

**Higher than recommended pressure can cause:**

- Hard ride.
- Tire bruising or carcass damage.
- Rapid tread wear in the center of the tire.

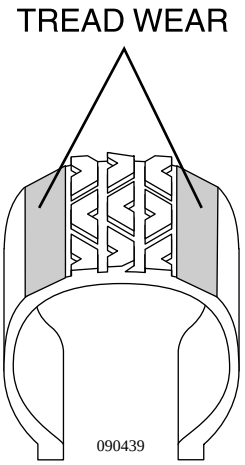
**WARNING: Improperly inflated tires can effect handling or cause sudden tire failure possibly resulting in loss of vehicle control. Always use an accurate tire pressure gauge when checking tire pressure.**

**Lower than recommended pressure can cause:**

- Tire squeal on turns.
- Rapid and uneven wear on the edges of the tread.
- Tire container can bruise or rupture.
- Tire cord breakage.
- Excessive tire temperature.
- Reduced handling quality.
- Separations.
- Circumferential Breaks.
- Higher Risk of Road Hazard.
- Loss of Casing Durability.
- High fuel consumption.

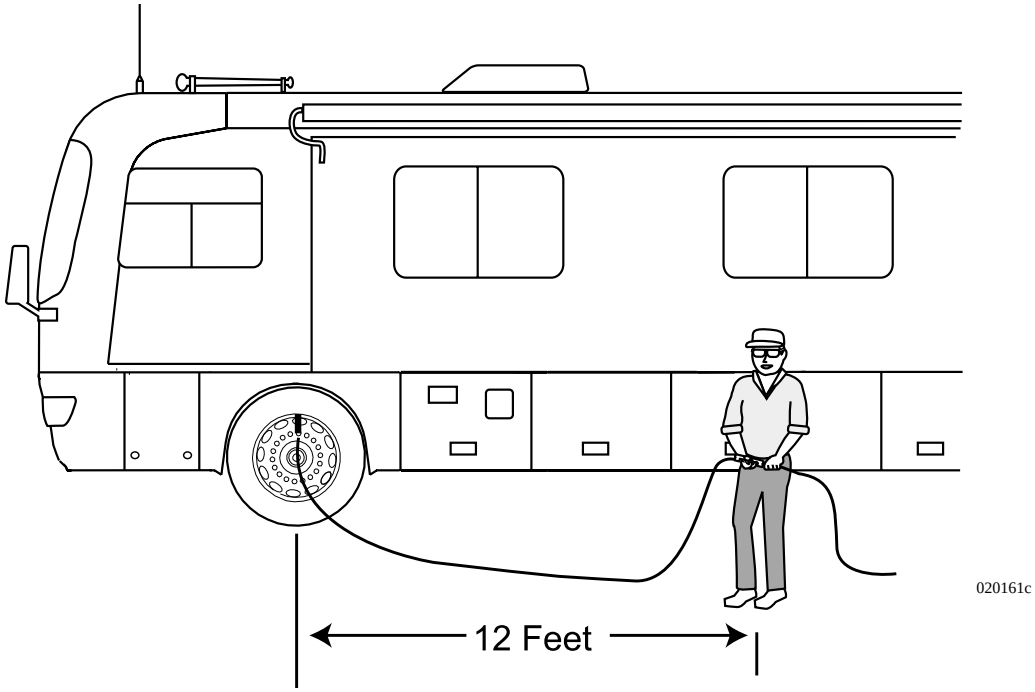
**Unequal tire pressures on same axle can cause:**

- Uneven braking, swerve upon acceleration.
- Steering lead, torque steer.
- Reduced handling quality.




*Example of Underinflation*
*More wear on edges.*

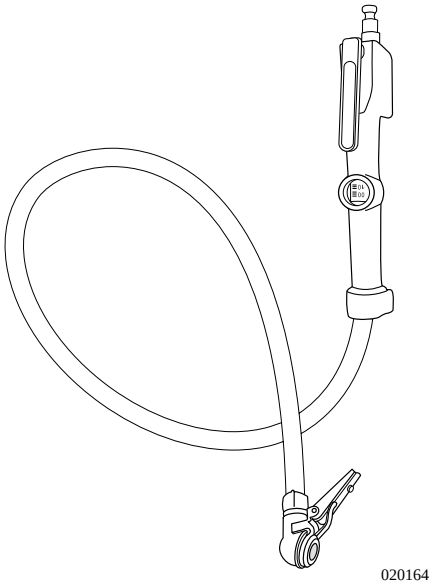
**WARNING: Driving on a tire with low air pressure can exceed the design limits of the tire. Damage to the sidewall of the tire can occur. A damaged sidewall can burst upon inflation causing serious damage, injury or death. Aged tires are also susceptible to sidewall damage. For safety purposes clear the area of people and pets during tire inflation. Inflate tires using a remote inflation device.**



## Air Pressure Checklist

1. When checking the air pressure, make sure the tires are cool - meaning they are not hot from driving, even a mile.

**NOTE: If the motorhome must be driven a distance to get air, check and record the tire pressure first and add the appropriate air pressure when reaching the pump. It is normal for tires to heat up and the air pressure inside to go up as driven. Never "bleed" or reduce air pressure when tires are hot.**



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2. Remove the cap from the valve on one tire.
3. Firmly press a tire gauge onto the valve and record reading.
4. Add air to achieve recommended air pressure.
5. If the tire is over filled, release air by pushing on the metal stem in the center of the valve. Then recheck the pressure with the tire gauge.
6. Replace the valve cap.
7. Repeat with each tire.
8. Visually inspect the tires to insure sure there are no nails, or other objects, embedded that could poke a hole in the tire and cause an air leak.
9. Check the sidewalls to make sure there are no gouges, cuts, bulges, or other irregularities.

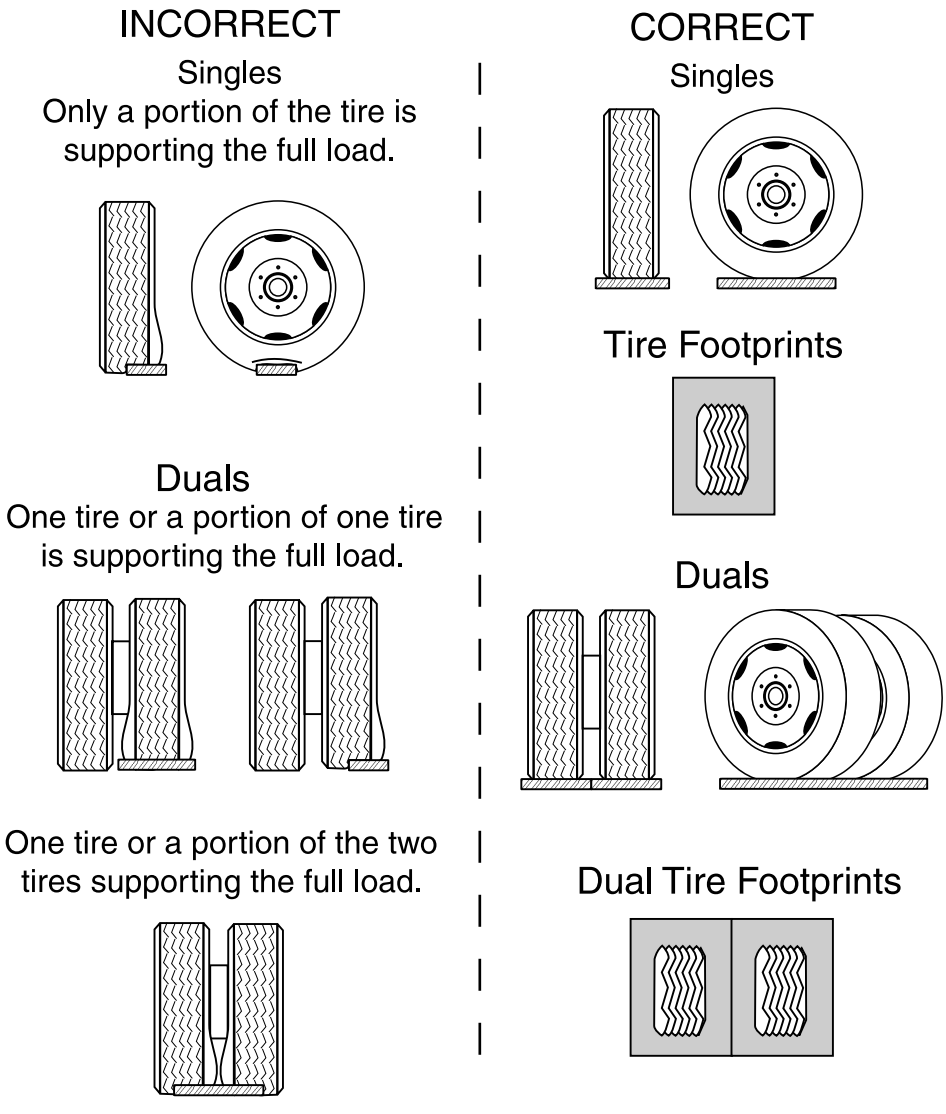
**NOTE: Air pressure in a tire goes up (in warm weather) or down (in cold weather) 1-2 pounds for every 10 degrees of temperature change.**

## Supporting When Leveling

Extreme caution must be taken to ensure that the tires are fully supported when placing blocks under the tires. The load on the tire should be evenly distributed on the support block. In the case of dual tires, distribute the load evenly on blocks for both tires. If not properly supported, the steel cables in the sidewall of the tires may be damaged and could lead to premature fatigue of the sidewall.

**CAUTION: Supporting the tires prevents damage to the sidewall of the tires and does not prevent tire roll.**

# Tire "Support" Methods

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### Tire Vibration

Sudden tire failure or blowout is often preceded by tire vibration. Some other symptoms that can cause tire failure are a bulge in the sidewall or swelling in the tire carcass. Striking an object or large hole in the road surface can damage a tire. Inspect the tires immediately after such an occurrence. Continue to inspect the tires periodically thereafter in case minor damage occurred. Rotation forces can continue to stress damaged areas that can manifest later in a sudden tire failure. If an unusual vibration begins, or a bulge is noticed in a sidewall, have the tires evaluated by a qualified professional as soon as possible.

### Tire Rotation

Tire rotation can increase the useful life of the tires by achieving uniform wear on all of the tires. The first tire rotation is the most important in determining which rotation pattern to use. Have the tire manufacturer determine the tire rotation pattern. Any unusual or unique wear patterns, or indications of uneven wear that may have developed, should be evaluated for possible tire rotation. Misalignment, imbalance or other mechanical problems may exist and will need corrected prior to rotation.

After a tire rotation, check and adjust the inflation pressures for the actual loads of the wheel position accordingly.

Tires are warranted by the tire manufacturer. The motorhome manufacturer is not responsible for warranty coverage or tire wear.

### Tread

Tires must be replaced when the tread is worn down to 4/32 of an inch on the front and 2/32 of an inch on the rear in order to prevent skidding and hydroplaning. If there are questions regarding tread wear consult a tire dealer as soon as possible.

Built in tread wear indicators, or “wear bars,” which look like narrow strips of smooth rubber across the tread will appear on the tire when the tread is worn down to one-sixteenth of an inch. When these “wear bars” are noticed, the tire is worn out and should be replaced.

Visually check the tires for signs of uneven wear. The tire may have irregular tread wear if there are high and low areas or unusually smooth areas. Consult the tire manufacturer as soon as possible.

**WARNING: In many instances the life of the tires on the motorhome is not determined by mileage but by age. Tires are subject to weathering. Weathering cracks run in circumference with the tire. Though the sidewall of the tire may look fine and be structurally sound, weathering can occur inside the well of the tread, therefore replacement may be determined not by mileage but age. Have the tire manufacturer inspect the tires for age weathering.**

## Tire Care

Road oil will cause deterioration of the rubber. Dirt buildup will help hold chemicals in the air next to the tire and will also cause deterioration.

When cleaning any rubber product, proper care and methods in cleaning must be used to obtain the maximum service years out of the tires. Use a soft brush and a mild detergent to clean the tires. If a dressing product is used to "protect" the tires from aging, use extra care and caution. Tire dressings that contain petroleum products or alcohol may cause deterioration or cracking.

In many cases it is not the dressing that causes a problem, but the chemical reaction that subsequently occurs. When these same dressing products are used on a passenger car tire that is replaced every three to four years, it is rare to see a major problem. However, in most cases, motorhome tires may last longer due to limited annual mileage, and exposure.

## In Case of Flat Tire

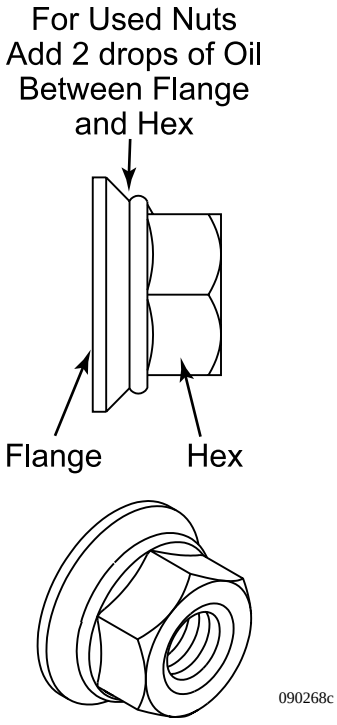
In the event of a flat tire, it is recommended to call for roadside assistance. The size and weight of the motorhome and its tires require the proper equipment to change the tire. A professional service technician will have the equipment and training needed to repair or replace the tire. In the case of sudden tire failure, avoid heavy braking. Hold the steering wheel firmly and gradually decrease speed. Slowly move to a safe off-road place, which should be a firm level spot. Turn the ignition off and turn the hazard flasher system ON. Save the old tire for any warranty coverage.

**INFO: *Goodyear* emergency service number is 877-484-7376.**

**Hub Piloted Mounting:**

- Before using flange nuts that have already been used in service, apply two drops of oil at one point between the flange and hex. This will allow parts to rotate freely and provide the proper clamping force when tightened. Use any common lubricant typically used for fasteners. Examples are motor oil and general purpose lubricating oils. Excessive lubricant is not desirable, this will not improve the nut torquing performance. Excessive lubricant makes the nuts hard to handle, attracts dirt to the nuts and may cause unsightly appearance to the wheel. Only used nuts need to be lubricated.

- Since flange nuts generate higher clamping force always use grade eight studs with hub mount wheels.



- Before installing the wheels, lubricate the hub pilot pads with a drop of oil to prevent galling. Do not lubricate any other wheel or hub surface.

- For a hub with intermittent pilot pads, position a pad at the twelve o'clock position to center the wheel and reduce runout.

**NOTE: Loosen and tighten lug nuts in a star pattern sequence. Sequence tighten to 50 ft. lbs. first, then sequence tighten to 500 lbs. Over-tightening can cause distortion.**

**WARNING: Never use wheels or lug nuts different than the original equipment as this could damage the wheel or the mounting system. Damage to the wheel or mounting system could cause a wheel to come off while the recreational vehicle is in motion.**

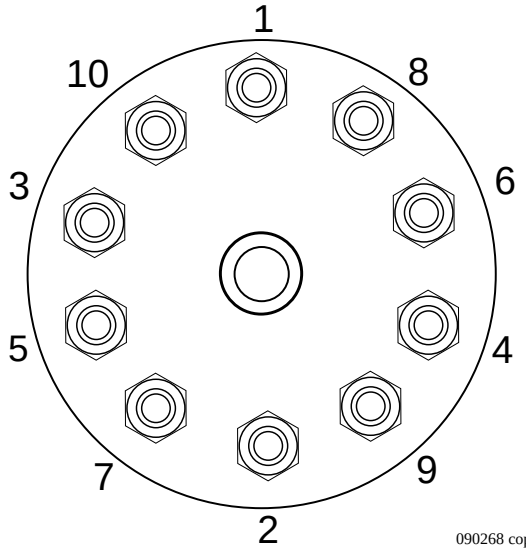
**Front Wheels:**

Slide the front wheel over the studs, being careful not to damage stud threads. Snug the nuts in sequence, do not tighten them fully until all have been seated. Tighten the nuts to 500 ft.lbs in sequence (as shown in the illustration).

**Dual Rear Wheels:**

Slide the inner dual wheel over the studs, being careful not to damage the stud threads. Align the handholds for valve access and slide the outer dual wheel over the studs, again being careful not to damage the stud threads.

Snug the nuts in sequence, do not tighten them fully until all have been seated. Tighten the nuts to 500 ft. lbs. using the sequence (as shown in the illustration). The hub mount wheels use two piece flange cap nuts for both front and rear applications. No inner cap nuts are required.



Nut Tightening Sequence

**Torque the Nuts Properly:**

- Tighten the wheel nuts to the recommended lug nut torque. Do not over tighten
- Maintain the nut torque at the recommended level through planned periodic checks or at 10,000 miles intervals, whichever comes first.
- If air wrenches are used they must be periodically calibrated for the proper torque output. Use a torque wrench to check the air wrench output and adjust the line pressure for the correct torque.

## Storage of Tires - Long Term

The motorhome is designed for recreation, not long-term storage. However, unless you are living in your motorhome full-time you will have a need to store it. Rubber tires age faster when not being used. A cool, dry, sealed garage is the preferred method of storage. Many recreational vehicles are stored outside in the elements. Some storage surfaces may cause tires to age prematurely. Placing a barrier (i.e. cardboard, plastic or plywood) between the tire and the storage floor/ground surface will help to protect the tires.

When the tire is anticipated to be out of service for a period of thirty days or more, the motorhome should be in the long-term storage condition. The ideal conditions include placing the motorhome on "jack stands" to remove all weight from the tires. Then the inflation pressure can be reduced by 15 psi. However, this is not always possible, with a few simple steps the aging effects from long-term storage or a non-use period can be reduced.

**NOTE: If the motorhome is stored with weight on the tires they should be inflated to the maximum inflation pressure as indicated on the Federal Identification Tag.**

- Thoroughly clean the tires.
- Unload the motorhome so there is minimum weight on the tires.
- Ensure the surface is reasonably level, firm, clean and has good drainage.
- Move the motorhome every three months to prevent cracking in bulge areas as well as flat spotting from prolonged sidewall strain and tread deflection.
- Cover the tires to block direct sunlight and ultraviolet rays.
- Store the motorhome out of a high ozone area.

Failure to take these steps can cause early deterioration and shorten the life of your tires. The type of surface the motorhome is parked upon will have an affect on much moisture accumulation occurs on the chassis and flooring. Moisture can eventually seep into the interior. Further, the type of surface can affect the tires.

- Gravel covered parking area still allows moisture to evaporate from the ground, through the gravel and to the underside of the motorhome.
- Sealed concrete pads allow better ventilation under the motorhome.
- Storage buildings with sealed concrete floors or heated storage facilities greatly reduce the amount of moisture accumulation and protect the motorhome from moisture damage.
- Wet, oily, or greasy surfaces should be avoided. Highly reflective surfaces such as sand or snow, should be avoided. Heat absorbent surfaces, such as black asphalt, will cause problems as well.

Before removing the motorhome from long-term storage thoroughly **inspect** each of the tires. This means a close examination of each tire's tread area and air pressure. If the pressure check indicates the tires have lost air during storage, inflate them to the correct pressure for the current load before putting the motorhome into service

## WEIGHING THE MOTORHOME

Proper weight distribution, load management and operating within established limitations will aide in safe and enjoyable travel. The information contained in this publication outlines guidelines and provides worksheets for weighing procedures.

Proper weight distribution and load management is an individual responsibility. Once the process and procedures are understood, weighing the motorhome really isn't complicated. In order to correctly manage load and weight distribution, more than one weight measurement will need to be taken and/or repeated. Each wheel position must be weighed to accurately determine the weight placed on each wheel position for proper weight computations.

The entire process of weigh management begins with the Gross Vehicle Weight Rating as listed on the Federal Certification Label. **This weight cannot be exceeded.**

Next is the Unloaded Vehicle Weight, meaning the weight of the motorhome full of fuel with engine fluid level full. Cargo Carrying Capacity can then be calculated. Once Cargo Carrying Capacity is determined, the motorhome can be loaded. After the motorhome is loaded it will need to be weighed again. These weight measurements will be used to ensure proper weight distribution and tire inflation pressures.

**Weight Terms:**

Numerous Federal, State and local governments mandate weight limits. Understanding the terminology and performing proper weighing procedure will help eliminate confusion. It is important to understand there are two reasons to weigh the motorhome. One to find out the **Cargo Carrying Capacity (CCC)** and the other to ensure no axle is overloaded.

The **Gross Axle Weight Rating (GAWR)** of the axles is listed on the federal certification label attached to the motorhome. This is the maximum allowable loaded weight on a particular axle. This label is generally located to the rear of the driver's seat, on the wall.

When the actual loaded weight of the motorhome, and the weight on each axle is unknown, follow the recommended tire inflation pressure(s) listed on the federal certification label. When loading a motorhome never exceed the motorhome's **Gross Vehicle Weight Rating (GVWR)** or the **GAWR** for each axle.

**NOTE: Contact the tire manufacturer for further information concerning proper tire pressure inflation and other tire issues.**

The **Gross Vehicle Weight Rating (GVWR)** and **Gross Axle Weight Rating (GAWR)** listed on the Federal Certification Label attached to the motorhome will detail the chassis manufacturer's and/or the RV manufacturer's total vehicle maximum weight rating and per axle weight rating.

The **GVWR** is the maximum total weight for which the motorhome is rated - including passengers, fluids and cargo. The **GAWR** is the maximum weight for which a single axle is designed. The tires, wheels, axle, the motorhome frame and/or other components of the motorhome, could limit these per axle and total maximum weight ratings.

The Federal Certification Label is a guide in knowing the maximum loaded axle weight rating **GAWR**, and subsequently the correct tire inflation pressure for that weight. Every recreational vehicle, even of the same make and model, will vary in actual loaded axle weights because of different options and personal loads.

While the actual loaded axle weight should be below the **GAWR**, the motorhome must be weighed in a loaded condition to know its actual weight. Weigh the front axle, the total unit and the rear axle. It is possible for a motorhome to be within the **GVWR** yet overloaded on an axle. It is even possible for one wheel position to be overloaded, even though the **GAWR** has not been exceeded. For this reason it will be necessary to weigh each wheel position of the motorhome to give a clear indication of exactly how the weight of the motorhome is distributed.

Instructions and diagrams are presented on the following pages. When the total weight and the weight on each axle is known, the tire load data chart in this manual will show the correct cold inflation pressure per tire for each axle.

There are two important factors to consider when loading the motorhome: **total weight** and **balance**. When loading heavy objects keep them as low as possible, preferably on the floor or below in storage compartments. Load weight must be distributed as evenly as possible.

The following is an explanation of commonly used weight abbreviations.

- **Gross Vehicle Weight Rating (GVWR):**
  Maximum permissible weight of this motorhome. GVWR is equal to or greater than the sum of UVW plus CCC.

- **Unloaded Vehicle Weight (UVW):**
  Weight of this motorhome as built at factory with full fuel, engine oil and coolants. UVW does not include cargo, fresh water, LP-Gas, occupants or dealer installed accessories.

- **Cargo Carrying Capacity (CCC):**
  Equal to GVWR minus each of the following: UVW, full fresh potable water weight (including water heater), full LP-Gas weight, and SCWR. Tongue weight of towed vehicle and dealer installed equipment will reduce CCC.

- **Gross Combination Weight Rating (GCWR):**
  The maximum allowable loaded weight of this motorhome and any towed trailer or towed vehicle

- **Gross Axle Weight Rating (GAWR):**
  Load-carrying capacity specified by manufacturer of a single axle system, as measured at tire ground interfaces.

- **Sleeping Capacity Weight Rating (SCWR):**
  The manufacturer's designated number of sleeping positions multiplied by 154 pounds.

**Tire Pressure:**

A motorhome may weigh slightly heavier on one side than on the other. Tire inflation pressure of the heavier side tires determine the inflation pressure for all tire(s) on that axle due to the weight transfer that occurs when cornering. The weight load will be transferred on the opposite side from the direction in which the motorhome is cornering.

Improperly inflated tires, or suspension that is incorrectly loaded, can result in poor fuel economy, poor handling and over-stressed chassis components. Vehicle loading will influence tire inflation pressure and the load carried by each axle. This is why each wheel position must be weighed. Motorhome axle configuration and floor plan styles will require different weighing procedures.

**NOTE: When weighing a motorhome, each tire on any axle must be inflated to the same pressure. The wheel position carrying the most weight will determine the tire inflation pressure for each tire of that particular axle.**

**Scales:**

Certified public scales are located in a variety of places such as moving and storage lots, farm suppliers with grain elevators, gravel pits, recycling companies and large commercial truck stops.

If you are not aware of a nearby public scale, check the local area telephone book yellow pages under "scales-public" section or "weighers." A nominal fee will be charged, but this is money wisely spent.

Weight scale types and weighing methods determine the procedure used to calculate proper tire inflation pressure and axle loading. There are several types of scales in use today. A platform scale will allow the entire motorhome to fit on the scale, which will read the **GVW** with only one scale recording required. A segmented platform scale is designed to weigh only one axle at a time, which may require two or three scale readings to determine the **GAW** or **GVW** total. A single axle scale enables one axle at a time. Some scales will read only one wheel position at a time due to physical size. Several scale readings may be required to determine the **GAW** or **GVW** total. Each wheel position will require weighing. This is referred to as a four corner or four point weigh. This type of weighing procedure will accurately determine what the correct tire inflation pressure should be. Depending on the type of scale being used, several different scale readings may be required.

**NOTE: The most accurate method to determine proper tire pressure is a four-corner or four point weigh. Each wheel position must be weighed independently. Weighing the entire axle will not accurately determine the total weight carried by that wheel position. When calculating the drive axle dual tire pressure using a independent corner weigh method, divide the total weight by two to determine the weight carried by each tire. Each wheel position must be weighed and recorded.**

During weighing, the scales as well as the motorhome must be as level as possible to obtain an accurate scale reading. Even though an axle or side is not physically on the scale, a definite lean in the motorhome will produce inaccurate scale readings.

## Weight Label

**MODEL YEAR:** _____ **MAKE:** _____ **MODEL:** _____

**UNIT NO.** _____ **CHASSIS VIN:** _____

| | | LBS. | KGS. |
|---|---|---|---|
| **GVWR** | (Gross Vehicle Weight Rating) is the maximum permissible weight of this fully loaded motorhome ..... | _____ | _____ |
| **UVW** | (Unloaded Vehicle Weight) is the weight of an exemplar Motorhome as manufactured at the factory with full fuel, engine oil and coolants (*1) ..... | _____ | _____ |
| **SCWR** | (Sleeping Capacity Weight Rating) is the manufacturer's designated number of sleeping positions multiplied by 154 pounds (70 kilograms) ..... | _____ | _____ |
| **CCC** | (Cargo Carrying Capacity) is the GVWR minus each of the following: UVW, full fresh (potable) water weight (including water heater), full LP-Gas weight and SCWR (*1)..... | _____ | _____ |
| **GCWR** | (Gross Combination Weight Rating) means the maximum allowable loaded weight of this motorhome and any towed trailer or towed vehicle.(*2)..... | _____ | _____ |
| | FACTORY INSTALLED OPTIONS are options installed at the factory but do not include dealer installed after market equipment... | _____ | _____ |

**CARGO CARRYING CAPACITY (CCC) COMPUTATION**

| | | |
|---|---|---|
| GVWR ..... | _____ | _____ |
| minus UVW ..... | _____ | _____ |
| minus fresh water (*3) weight of ___ gallons @ 8.3 lbs./gal ..... | _____ | _____ |
| minus LP-Gas weight of ___ gallons@ 4.2 lbs./gal ..... | _____ | _____ |
| minus SCWR of ___ persons @ 154 lbs./person..... | _____ | _____ |
| CCC for this motorhome (*4) ..... | _____ | _____ |

**WARNING: CONSULT OWNER MANUAL(S) FOR SPECIFIC WEIGHING INSTRUCTIONS AND TOWING GUIDELINES INCLUDING AUXILIARY BRAKE REQUIREMENTS FOR ANY TOWED TRAILER OR TOWED VEHICLE.**

**Factory installed options do not include dealer installed after market equipment.**

**WARNING:DO NOT EXCEED THE GVWR, GCWR AND/OR GAWR AFTER LOADING YOUR MOTORHOME WITH WATER, FUEL, PASSENGERS AND CARGO. GAWR (Gross Axle Weight Rating) means the maximum permissible load weight a specific axle is designed to carry. See Federal Certification Label for disclosure of The GAWR for each axle.**

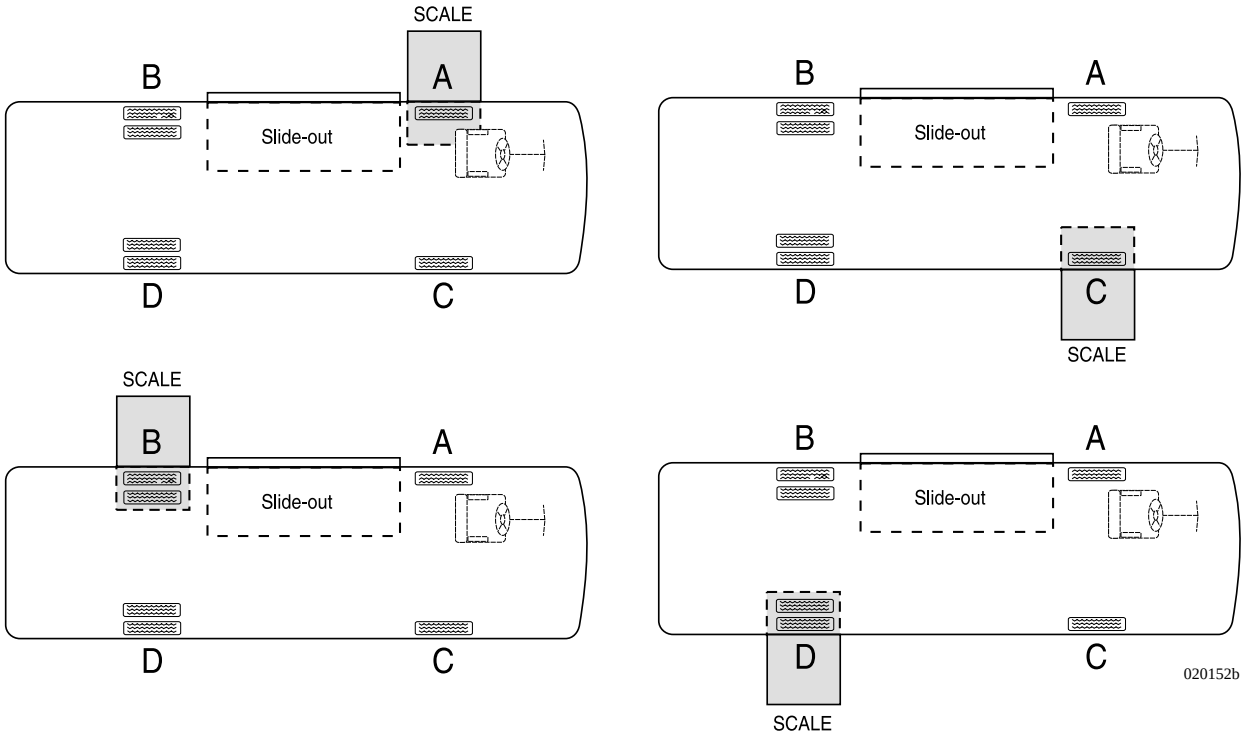
(*1) The UVW and CCC have been determined by weighing an exemplar motorhome with some but not all optional equipment available for each model year, make and model of motorhome. The result of the weighing of the exemplar motorhome is then used in calculating the UVW and CCC of other motorhomes of same model year, make and model. Your actual UVW and CCC may vary based upon options ordered. Please contact the manufacturer for the actual weight of each option.
(*2) Consult your Owner's Manual for towing limitations, restrictions and other guidelines.
(*3) Your motorhome's fresh water tank and water heater taken together determine the gross fresh water capacity. Your usable fresh water capacity, however, may be less.
(*4) Dealer installed equipment and towed vehicle tongue weight will reduce CCC.

**NOTE: Following scale readings and Gross Axle Weight Ratings are fictitious. Actual scale readings and Gross Axle Weight Ratings will vary with model and options.**

## Four Corner Weighing (Example)

The motorhome must be weighed fully loaded to obtain accurate scale readings and to determine the proper tire pressure. All slide rooms must be in retracted position.

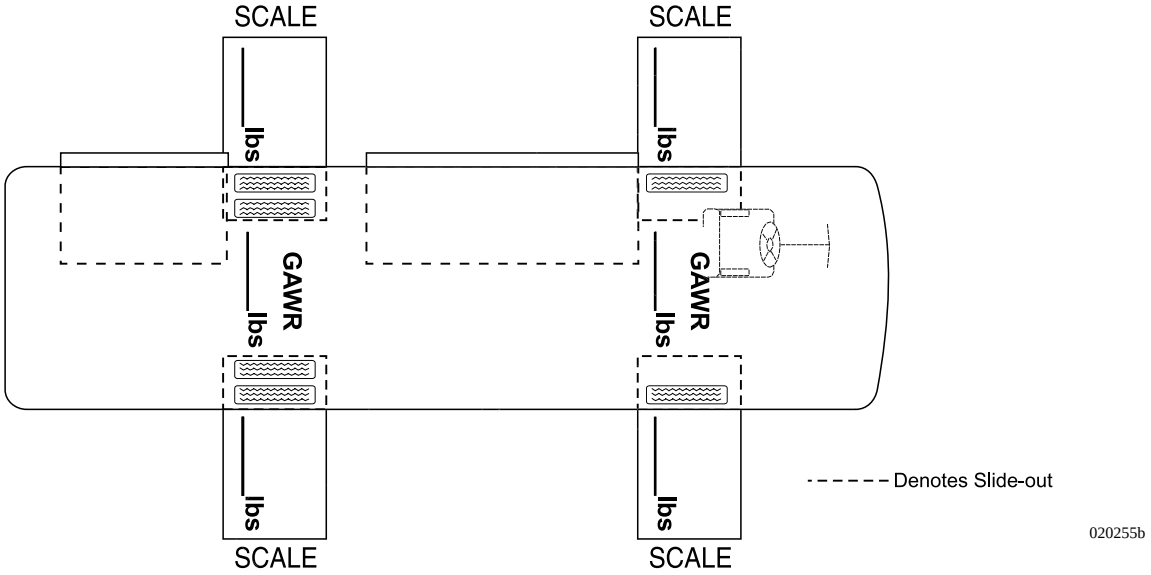
- Take the rear axle **Gross Axle Weight Rating (GAWR)** and divide it by two. Example: Rear axle **GAWR** taken from the motorhome Vehicle Certification Label is 20,000 lbs. Divide the figure by 2, using chart below, record 10,000 lbs. on Scale B and D, line 1.
- Weigh the driver side rear corner (Scale B) and record weight on chart Scale B, line 2. Example: 7,100 lbs.
- Weigh the passenger's side rear corner (Scale D) and record weight on chart Scale D, line 2. Example: 6,900 lbs.
- Add chart Scale B and D, lines 1, for **Gross Axle Weight Rating (GAWR)** and record on chart under Totals. Example: 20,000 lbs.
- Add chart Scale B and D, lines 2, for actual **Gross Axle Weight (GAW)** and record on chart under Totals. Example: 14,000 lbs.
- Actual **Gross Axle Weight (GAW)**. Example: 14,000 lbs., is not to exceed **Gross Axle Weight Rating (GAWR)**. Example: 20,000 lbs.



- Refer to the Tire Chart (Tire size 295/80R22.5). Use the highest actual weight, Scale B or D, line 2. Example 7,100 lbs. Determine the proper tire pressure for each tire using the Load Inflation chart. Example: 115 psi or stamp on the sidewall of the tire.
- Repeat above procedures to determine front axle Scale A and C, tire pressures.

| | ROADSIDE | | CURBSIDE | | TOTAL AXLE WEIGHT | GROSS AXLE WEIGHT RATING GAWR | GAWR Minus Total Axle Weight |
|---|---|---|---|---|---|---|---|
| FRONT AXLE | 1. 6,500 | + | 6,500 | = | 13,000 | | |
| | 2.(A) 5,000 | | (C) 4,000 | | 9,000 | 13,000 | 4,000 |
| DRIVE AXLE | 1. 10,000 | + | 10,000 | = | 20,000 | | |
| | 2.(B) 7,100 | | (D) 6,900 | | + 14,000 | + 20,000 | 6,000 |
| | | | Total Axle Weight | | = 23,000 UVW | = 33,000 GVWR | = 10,000 CCC |

**NOTE: These measurements are with a full fuel tank and nobody in the motorhome.**




**WARNING: Improperly inflated or overloaded tires can cause a blowout. An overloaded axle can cause a component failure of the suspension system. Tire blowout or broken suspension components can lead to loss of vehicle control resulting in property damage, personal injury or death.**

**CAUTION: If actual weight carried by any tire is below the tire chart weight specification minimum tire pressure the minimum inflation pressure must be maintained. Tire pressure below the minimum inflation pressure can overheat and damage the tire casing leading to premature tire failure or blowout.**

**Load and Inflation Tables:**

The load and inflation table helps to determine the correct inflation for the motorhome tire, after properly weighing the motorhome. All pressures are rated at a cold psi. Cold conditions are defined as early in the morning before the day's ambient temperature, sun's radiant heat or the heat generated while driving have caused the tire pressure to temporarily increase. This means that the pressure should be checked early and when the motorhome has not been driven more than one mile. The check interval should be in the morning, before the "drive" trip and every morning on extended trips. A quality truck tire gauge with a multiple angle airhead is needed to ensure access to both dual wheel positions of the drive axle. Ensure the valve cap is replaced on the stem after the inflation is checked. This guarantees the valve core will remain free of dirt and foreign material. Material lodged between the valve core and internal stem can cause slow leaks resulting in tire failure.

**Understanding the Inflation Table**

- Tire Size is on the left margin of the Table.
- Determine the "Single" inflation reading or "Dual" inflation reading. This is denoted with a "D" or "S" on the Table. Single is for the Front axle. Dual is for the Drive axle.
- Find the corresponding psi at the top columns to see the corresponding maximum weight capacity for that psi.

**NOTE: Every load range has a maximum rating as well as a minimum rating. Do not exceed those ratings.**

- Rated load capacities are listed for individual tires in a Dual or Single position.

| TIRE SIZE | MAX Speed Rating (MPH) | Dual (D) Single (S) | INFLATION PRESSURE PSI | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 |
| 8R19.5 | 75 | D | 2350 | 2460 | 2570 | 2680 | 2780 | 2880 | 2980 | 3070 | 3160 | **3375(F)** | | | |
| | | S | 2410 | 2540 | 2680 | 2800 | 2930 | 3060 | 3170 | 3280 | 3400 | **3500(F)** | | | |
| 225/70R19.5 | 75 | D | | 2720 | 2860 | 3000 | 3115 | 3245 | **3415(F)** | | | | | | |
| | | S | | 2895 | 3040 | 3195 | 3315 | 3450 | **3640(F)** | | | | | | |
| 245/70R19.5 | 75 | D | | 3415 | 3515 | 3655 | **3875(F)** | 3940 | 4075 | **4375(G)** | | | | | |
| | | S | | 3640 | 3740 | 3890 | **4080(F)** | 4190 | 4335 | **4545(G)** | | | | | |
| 265/70R19.5 | 75 | D | | | | 3750 | 3930 | 4095 | 4300 | 4405 | 4560 | 4805 | 4860 | **5070(G)** | |
| | | S | | | | 3970 | 4180 | 4355 | 4540 | 4685 | 4850 | 5070 | 5170 | **5355(G)** | |
| 9R22.5 | 65 | D | 3120 | 3270 | 3410 | 3550 | 3690 | 3820 | **3950(F)** | | | | | | |
| | | S | 3190 | 3370 | 3560 | 3730 | 3890 | 4050 | 4210 | 4350 | **4500(F)** | | | | |
| 10R22.5 | 65 | D | 3690 | 3870 | 4040 | 4200 | 4375 | 4520 | 4670 | **4875(F)** | 4970 | 5110 | **5250(G)** | | |
| | | S | 3770 | 4000 | 4210 | 4410 | 4610 | 4790 | 4970 | **5150(F)** | 5320 | 5490 | **5680(G)** | | |
| 11R22.5 | 75 | D | | | | 4760 | 4950 | 5120 | 5300 | 5470 | **5750(G)** | **5800(H)** | | | |
| | | S | | | | 4990 | 5220 | 5430 | 5640 | 5840 | **6175(G)** | 6240 | 6430 | **6610(H)** | |
| 12R22.5 | 65 | D | | | | 5190 | 5390 | 5590 | 5780 | 5960 | 6150 | 6320 | 6500 | **6750(H)** | |
| | | S | | | | 5450 | 5690 | 5920 | 6140 | 6370 | 6590 | 6790 | 7010 | **7390(H)** | |
| 245/75R22.5 | 75 | D | | 3260 | 3425 | 3640 | 3740 | 3890 | 4080 | 4190 | 4335 | **4410(G)** | | | |
| | | S | | 3470 | 3645 | 3860 | 3980 | 4140 | 4300 | 4455 | 4610 | **4675(G)** | | | |
| 255/70R22.5 | 75 | D | | 3585 | 3765 | 3970 | 4110 | 4275 | 4410 | 4455 | 4610 | 4675 | **5070(H)** | | |
| | | S | | 3815 | 4005 | 4190 | 4370 | 4550 | 4675 | 4895 | 5065 | 5205 | **5510(H)** | | |
| 265/75R22.5 | 75 | D | | | 4040 | 4205 | 4370 | 4525 | 4685 | **4805(G)** | | | | | |
| | | S | | | 4070 | 4255 | 4440 | 4620 | 4800 | 4975 | 5150 | **5205(G)** | | | |
| 275/70R22.5 | 75 | D | | | | | 4535 | 4750 | 4960 | 5165 | 5370 | 5575 | 5775 | 5975 | **6175(H)** |
| | | S | | | | | 4885 | 5080 | 5305 | 5530 | 5750 | 5965 | 6185 | 6400 | **6610(H)** |
| 275/80R22.5 | 75 | D | | | | | 4855 | 5080 | 5305 | 5525 | 5745 | 5965 | 6180 | **6395(H)** | |
| | | S | | | | | 5265 | 5515 | 5755 | 6000 | 6235 | 6475 | 6710 | **6940(H)** | |
| 295/75R22.5 | 75 | D | | | 4690 | 4885 | 5070 | 5260 | 5440 | **5675(G)** | 5800 | **6005(H)** | | | |
| | | S | | | 4725 | 4945 | 5155 | 5370 | 5510 | 5780 | 5980 | **6175(G)** | 6370 | **6610(H)** | |
| 295/80R22.5 | 75 | D | | | | 4855 | 5100 | 5335 | 5570 | 5805 | 6035 | 6265 | 6490 | 6720 | **6940(H)** |
| | | S | | | | 5480 | 5750 | 6020 | 6285 | 6550 | 6810 | 7070 | 7320 | 7580 | **7830(H)** |
| 315/80R22.5 | 75 | D | | | | | 5840 | 6070 | 6395 | 6540 | 6770 | 6940 | 7210 | **7610(J)** | 7390 |
| | | S | | | | | 6415 | 6670 | 6940 | 7190 | 7440 | 7610 | 7920 | **8270(J)** | 8820 |
| 285/75R24.5 | 75 | D | | | 4740 | 4930 | 5205 | 5310 | 5495 | **5675(G)** | | | | | |
| | | S | | | 4770 | 4990 | 5210 | 5420 | 5675 | 5835 | 6040 | **6175(G)** | | | |

EXAMPLE

**Cargo Carrying Capacity:**

When weighing the motorhome it is important to understand that each motorhome, even of the same model year, floorplan and length will weigh different due to options and accessories. The **Gross Vehicle Weight Rating (GVWR)**, **Gross Combination Weight Rating (GCWR**) and/or **Gross Axle Weight Rating (GAWR)** must not be exceeded.

**GVWR** of the vehicle limits the weight of the entire load combination, regardless of the mix of water, LP-Gas, passengers, or cargo.

It is important to understand the weighing process is performed in two phases. The first phase is determining the **Cargo Carrying Capacity (CCC)** and the second to ensure the **GVWR** is not exceeded when adjusting tire pressures. The weighing process should start by recording the **GVWR** from the Federal Weight Label, then weighing the motorhome unloaded, without passengers and with a full fuel tank. Engine and transmission fluid levels must be full. This is known as the **Unloaded Vehicle Weight (UVW)**. Once this weight has been recorded it can be subtracted from the **GVWR**.

GVWR 35,000 - UVW 20,000 = A 15,000

Next, begin to calculate the **Cargo Carrying Capacity (CCC)**.

Fresh water weight and LP-Gas weight can now be subtracted from the remaining total line A.

- Water weight is the number of gallons multiplied by 8.3.
- LP-Gas weight is the number of gallons multiplied by 4.2.

A 10-gallon water heater with a 40-gallon fresh tank would total 50 gallons times 8.3, or 415 pounds.

A 30-gallon LP-Gas tank will have 24 gallons of LP-Gas due to the 80% liquid capacity. This would mean 24 gallons multiplied by 4.2, or 100.8 pounds.

A 15,000 - 415 = B 14,585

B 14,585 - 100.8 = C 14,484.2

Next, calculate the **Sleep Capacity Weight Rating (SCWR)**. The manufacturer's designated number of sleeping positions for the motorhome multiplied by 154 pounds.

The 154 pounds (70kg) is the average weight established by the US Federal Government and Transport Canada, and is used to arrive at **Cargo Carrying Capacity (CCC)**. However, actual sleep capacity weight may be greater. The **SCWR** is not intended to limit the sleeping capacity to a specified weight.

Example: If the manufacturer has designated the motorhome sleeping position at 4 (616 pounds) and there are 4 people who weight 200, 200, 178 and 138 pounds, totaling 716 pounds, that doesn't mean the sleeping capacity is reduced to 3 individuals, but rather the **CCC** is reduced by 100 pounds due to the actual passenger weight.

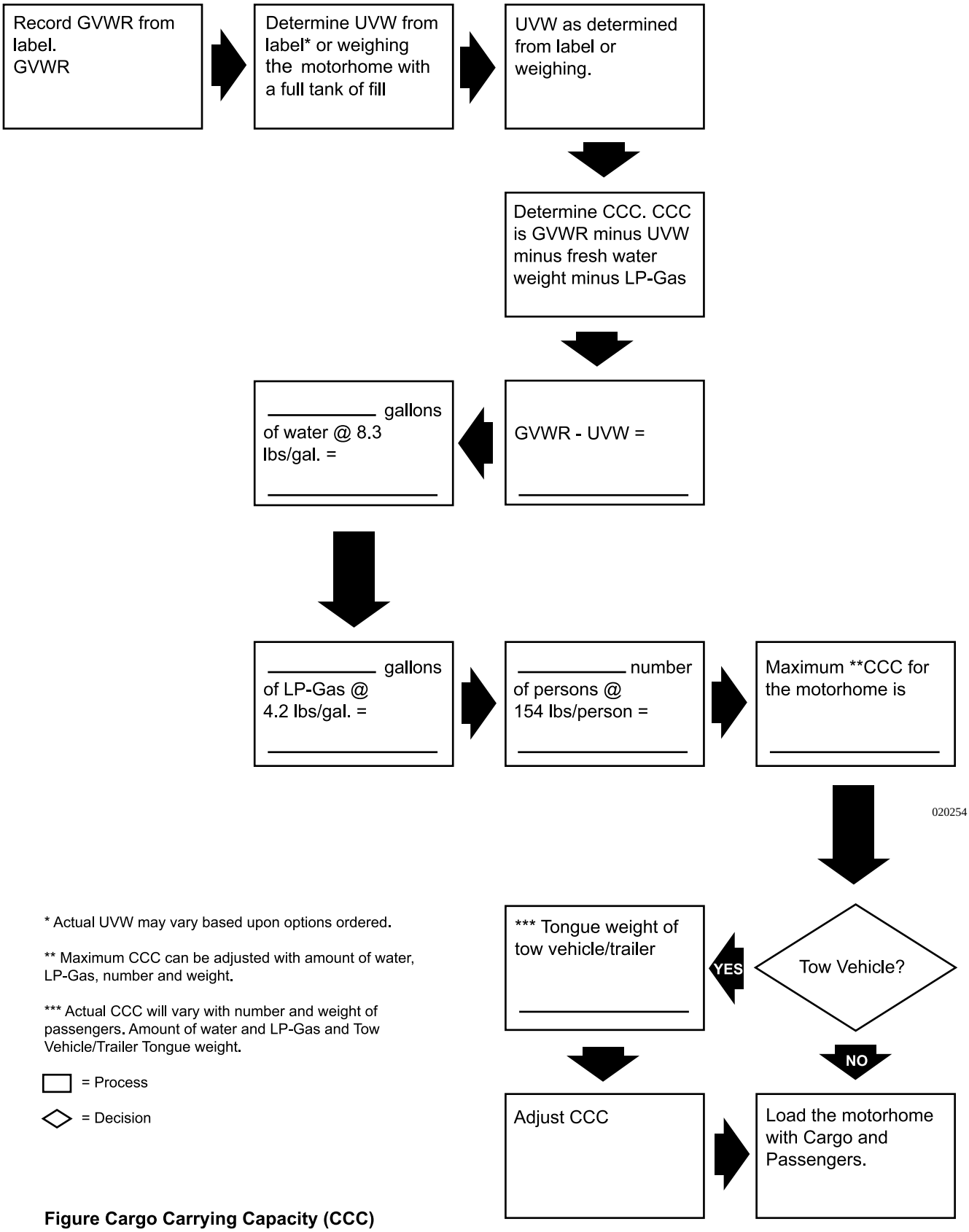
C 14,484.2 - SCWR 716 = CCC 13,768.2

**Cargo Carrying Capacity (CCC)** is how much cargo the motorhome can carry. However, tongue weight of a towed vehicle will further reduce this amount.

Now the motorhome can be fully loaded and weighed to ensure **GVWR** is not exceeded. When weighing the motorhome, all slide rooms must be in the retracted position. The motorhome must remain as level as possible on the scale, even though an axle or side is not physically on the scale. Once the motorhome is fully loaded and weighed to obtain an accurate scale reading, determine the proper tire pressure.

- Each wheel position must be weighed to accurately determine the weight carried at each wheel position.
- Refer to the previous examples on how to weigh each wheel position. Each wheel position weight must be weighed and recorded to determine proper tire inflation.
- Wheel position weights are not to exceed any **Gross Axle Weight Rating (GAWR)** and **Gross Vehicle Weight Rating (GVWR)** as printed on the Motorhome Vehicle Certification Label.
- Compare wheel position weights with weigh ratings on the label. Do not operate if wheel position weights exceed maximum specifications. Items will need to be removed until rating weight is within specification.

**WARNING: Further instructions for towing guideline, including auxiliary brake requirements for any towed trailer or towed vehicle, are found in other areas of this manual.**




* Actual UVW may vary based upon options ordered.

** Maximum CCC can be adjusted with amount of water, LP-Gas, number and weight.

*** Actual CCC will vary with number and weight of passengers. Amount of water and LP-Gas and Tow Vehicle/Trailer Tongue weight.

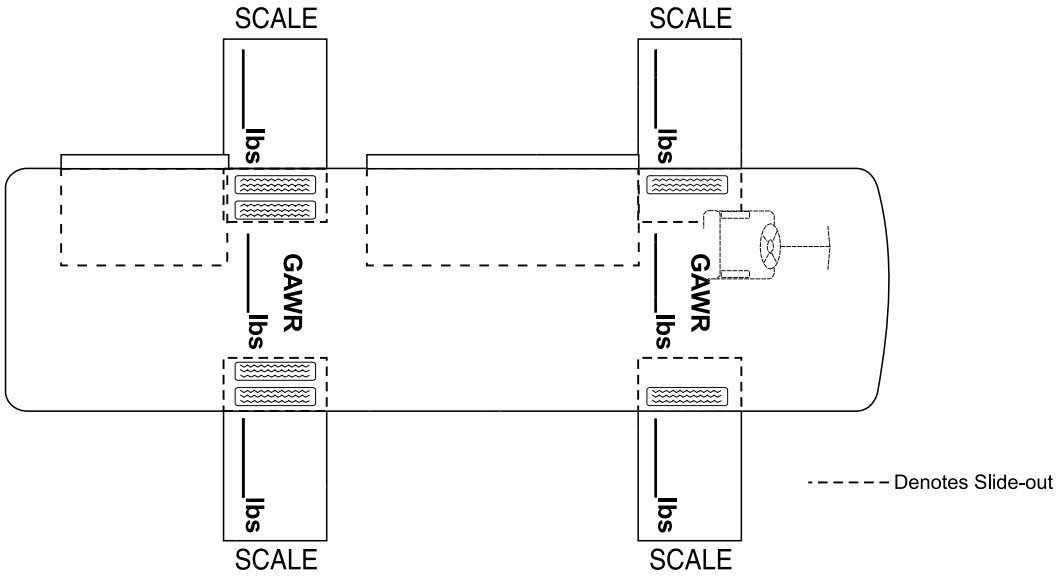
= Process

= Decision

**Figure Cargo Carrying Capacity (CCC)**

| | ROADSIDE | | CURBSIDE | | TOTAL AXLE WEIGHT | GROSS AXLE WEIGHT RATING GAWR | GAWR Minus Total Axle Weight |
|---|---|---|---|---|---|---|---|
| FRONT AXLE | 1. 6,500 | + | 6,500 | = | 13,000 | | |
| | 2.(A) 5,000 | | (C) 4,000 | | 9,000 | 13,000 | 4,000 |
| DRIVE AXLE | 1. 10,000 | + | 10,000 | = | 20,000 | | |
| | 2.(B) 7,100 | | (D) 6,900 | | + 14,000 | + 20,000 | 6,000 |
| | | | Total Axle Weight | | = 23,000 UVW | = 33,000 GVWR | = 10,000 CCC |

**NOTE: These measurements are with a full fuel tank and nobody in the motorhome.**



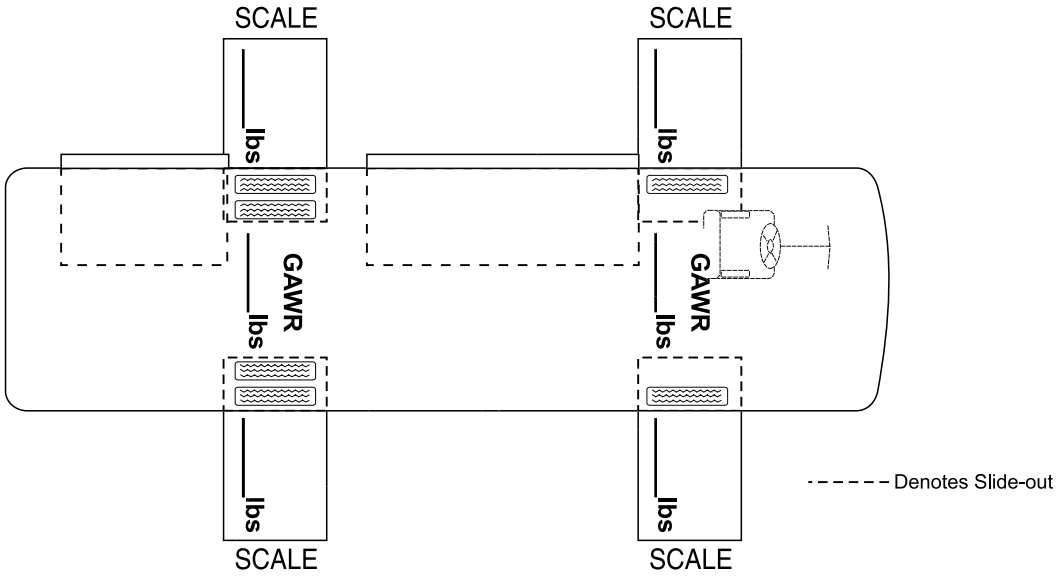

| | FORMULA | UVW 23,000 CAPACITY | | CCC 10,000 |
|---|---|---|---|---|
| FRESH WATER | Subtract Gallon @ 8.3 lbs/gal | 100 X 8.3 = 830 | - | 9,170 |
| WATER HEATER | Subtract Gallon @ 8.3 lbs/gal | 10 X 8.3 = 83 | - | 9,087 |
| LP-GAS | Subtract Gallon @ 4.2 lbs/gal | 40 X 4.2 = 168 | - | 8,919 |
| SLEEP CARRYING WEIGHT RATING | Subtract Persons @ 154 lbs/person | 5 X 154 = 770 | - | 8,149 |
| | | Maximum Cargo Carrying Capacity CCC | | 8,149 |

Maximum Cargo Carrying Capacity will change by varying any of the capacities. Tongue Weight of a towed vehicle will reduce the Cargo Carrying Capacity (CCC).

020255b example

| | ROADSIDE | | CURBSIDE | | TOTAL AXLE WEIGHT | GROSS AXLE WEIGHT RATING GAWR | GAWR Minus Total Axle Weight |
|---|---|---|---|---|---|---|---|
| FRONT AXLE | 1.<br>2.(A) | + | (C) | = | | | |
| DRIVE AXLE | 1.<br>2.(B) | + | (D) | = | + | + | |
| | | | Total Axle Weight | | = UVW | = GVWR | = CCC |

**NOTE: These measurements are with a full fuel tank and nobody in the motorhome.**




| | FORMULA | UVW CAPACITY | | CCC |
|---|---|---|---|---|
| FRESH WATER | Subtract Gallon @ 8.3 lbs/gal | X 8.3 = | - | |
| WATER HEATER | Subtract Gallon @ 8.3 lbs/gal | X 8.3 = | - | |
| LP-GAS | Subtract Gallon @ 4.2 lbs/gal | X 4.2 = | - | |
| SLEEP CARRYING WEIGHT RATING | Subtract Persons @ 154 lbs/person | X 154 = | - | |
| | | Maximum Cargo Carrying Capacity CCC | | |

Maximum Cargo Carrying Capacity will change by varying any of the capacities. Tongue Weight of a towed vehicle will reduce the Cargo Carrying Capacity (CCC).

020255b

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

DATE: _____

PLACE: _____

FRONT: _____ + _____ = _____
LEFT RIGHT TOTAL

REAR: _____ + _____ = _____
LEFT RIGHT TOTAL

= _____
TOTAL GROSS VEHICLE WEIGHT

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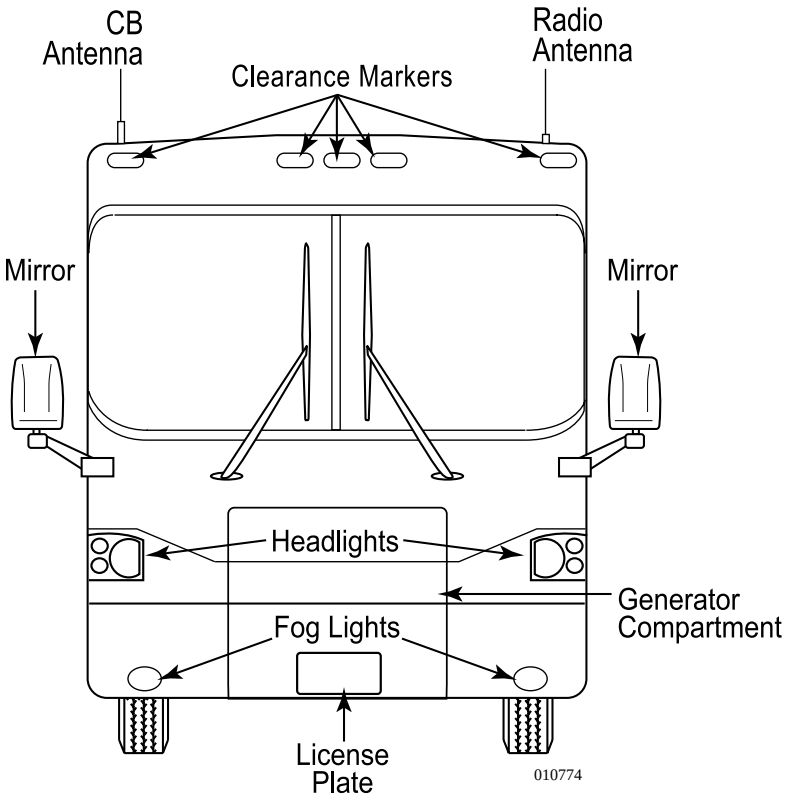
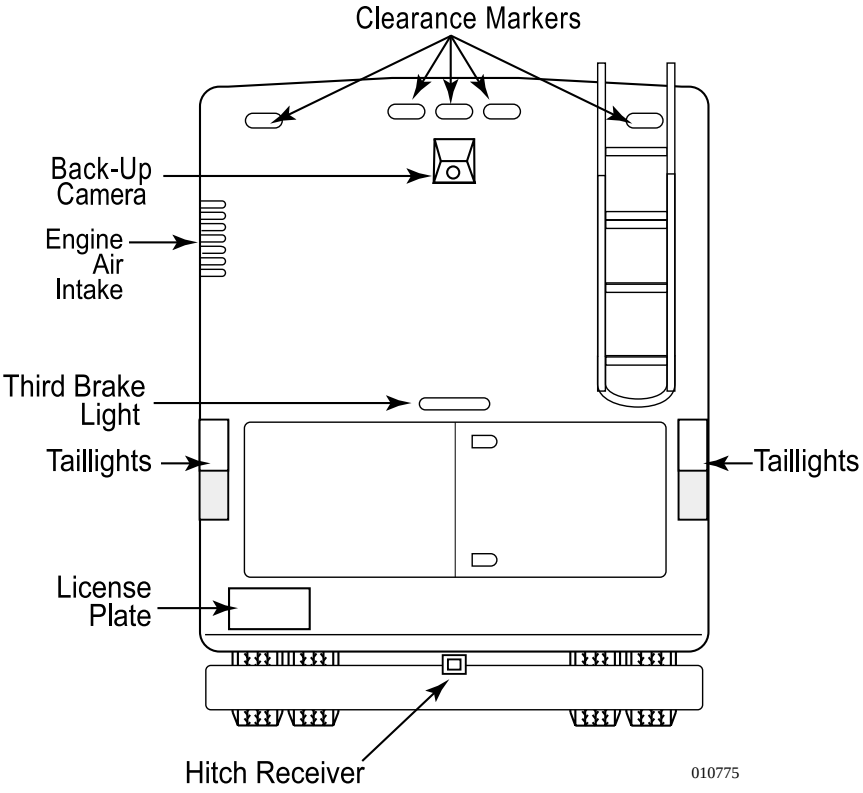
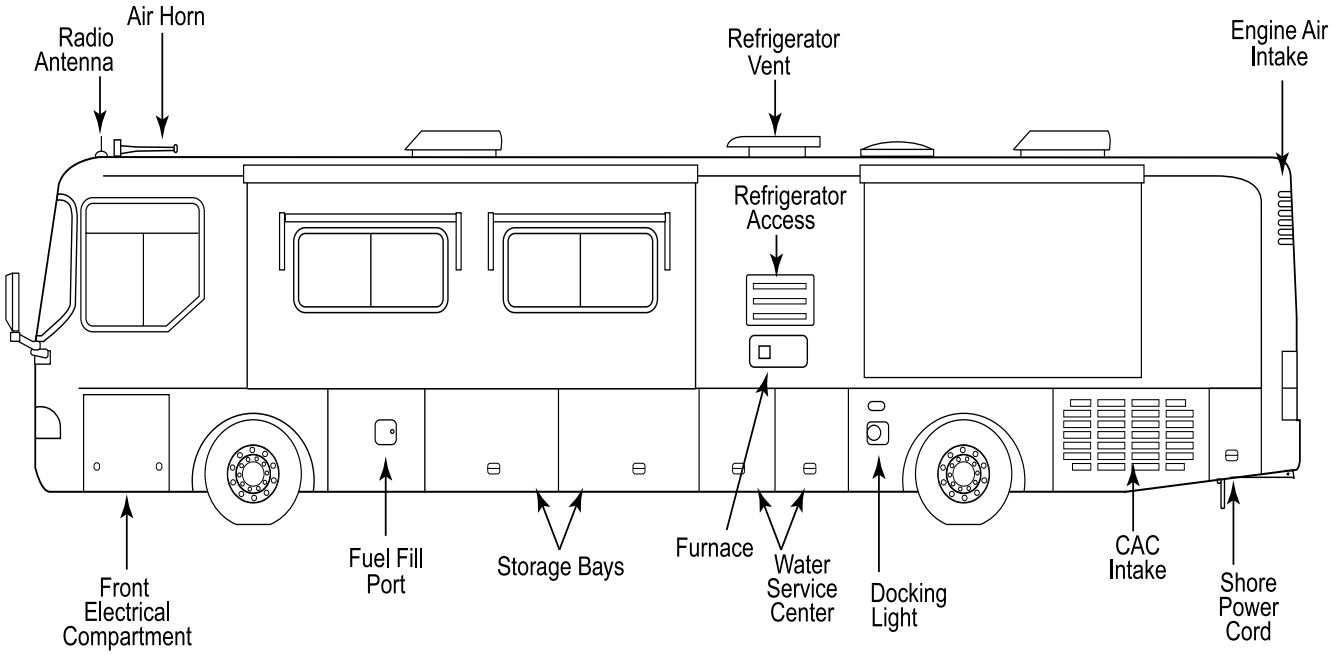
## VIEWS - *Front*



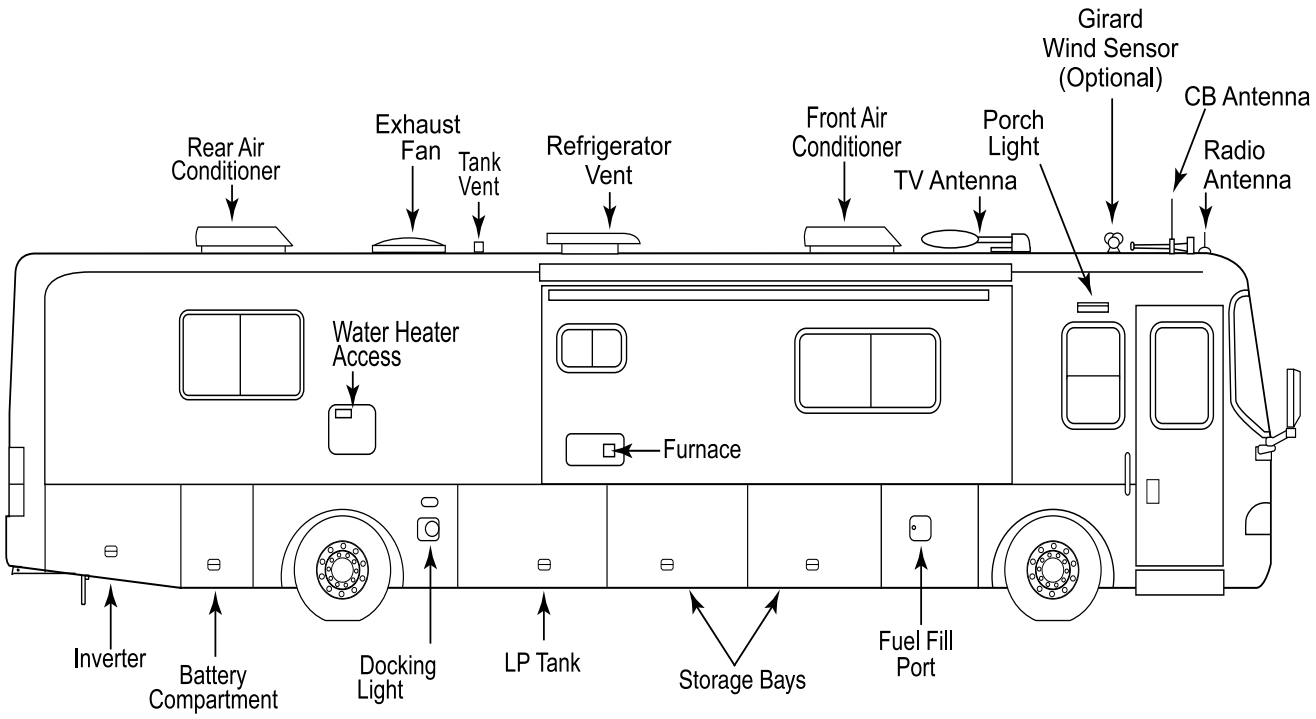

## *Rear*



## Roadside




## Curbside



## SPECIFICATIONS - DIMENSIONS CHART

| 2004 Scepter Specifications | 36PST | 38PBDD | 38PST | 40PBDD | 40PWD | 40PST | 40PDT | 40DST | 40PRT | 40PDQ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Weights** | | | | | | | | | | |
| Gross Vehicle Weight Rating | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. |
| Gross Combined Weight Rating | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. |
| Front Gross Axle Weight Rating | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. |
| Rear Gross Axle Weight Rating | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. |
| **Measurements** | | | | | | | | | | |
| Wheelbase | 216" | 242" | 242" | 256" | 256" | 256" | 256" | 256" | 256" | 256" |
| Overall Length | 36'-6" | 38' 9" | 38' 9" | 39' 11" | 39' 11" | 39' 11" | 39' 11" | 39' 11" | 39' 11" | 39' 11" |
| Overall Height | 12' | 12' | 12' | 12' | 12' | 12' | 12' | 12' | 12' | 12' |
| Interior Height | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" |
| Interior Width | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" |
| Exterior Width | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" |
| **Tank Capacities** | | | | | | | | | | |
| Water Heater (Atwood) | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. |
| Grey Tank (Amerikart) | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL |
| Black Tank (Amerikart) | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL |
| Fresh Tank (Amerikart) | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL |
| Fuel Tank (In House) | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. |
| LP Tank * (Manchester) | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL |

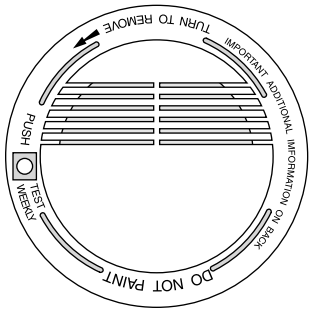
**Actual filled LP capacity is 80% of listing due to safety shut-off required on tank.*

**NOTE: This chart reflects product specifications available at the time of printing. Therefore any floor plans introduced thereafter may not be reflected in the chart. All other information contained throughout the manual will still apply**

**NOTE: All tank capacities are estimated based upon calculation provided by the tank manufacturers and represent approximate capacities. The actual "usuable capacity" may be greater or less then the estimated capacities based upon fabrication and installation of the tanks.**

## SMOKE DETECTOR

Statistics show that most fire casualties are not caused by direct flame, but by less visible smoke (products of combustion). The smoke detector responds to both visible and invisible products of combustion. The smoke detector will automatically return from alarm to normal state when the reason for activation, the presence of smoke, is completely removed. Fires are commonly caused by smoking in bed, leaving children unattended or using flammable cleaning fluids. Please be safety conscious and avoid unnecessary risk.

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**WARNING: There is no way to insure there will be no injury or loss of life in a fire; however, the smoke detector is intended to help reduce the risk of tragedy. Additional smoke detectors may help to reduce the risk. Proper use and care of the smoke detector could save lives.**

### Operation

When a 9 Volt DC battery is correctly connected, the smoke alarm is operating. The LED will flash every minute showing the battery is supplying power. A load alarm will sound when a production of combustion is sensed.

**NOTE: The unit will not operate without a battery. A battery flag will pop up preventing the unit from being installed to the mounting bracket without a battery. Carbon zinc batteries average a service life of one year. Alkaline batteries average a service life of one to two years.**

### Testing

Simply press the test button on the smoke alarm cover for approximately three seconds. The alarm will sound if all electronic circuitry, horn and battery are working properly. The smoke alarm should be tested at least once a week when the motorhome is in use, prior to each trip and when the motorhome has been in storage. When testing the smoke alarm it is advised to stand at arm's length.

**CAUTION: Never use an open flame to test the smoke alarm. You may ignite and set fire to the alarm and to the motorhome.**

### Maintenance

A smoke alarm is designed to be as maintenance free as possible. However, there are some simple steps to perform in order to keep the smoke alarm working properly:

- Test the smoke alarm once a week.
- Keep a supply of 9 Volt DC batteries on hand.
- Vacuum the slots in the cover and sides with a soft brush attachment every month. Test the smoke alarm once the unit has been vacuumed.
- The smoke alarm should be cleaned every six months to help keep the unit working efficiently.
- The smoke alarm will beep once a minute when a low battery condition exists. The battery must be replaced immediately.

### Troubleshooting

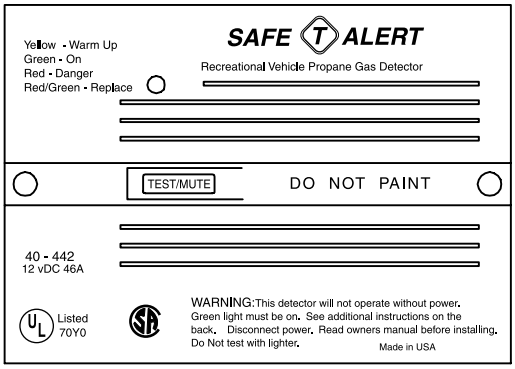
If the alarm does not sound when the test button is pushed, or with a smoke test, try the following:

- Inspect for obvious damage.
- Check for the recommended battery type.
- Check the battery for proper connection or replace the battery if needed.
- Gently vacuum as recommended.

If these procedures do not correct the problem, do not attempt repairs. If the smoke alarm is within the warranty period and the terms indicate the nature of the problem, return the unit to your dealer. Smoke detectors beyond the warranty period cannot be economically repaired.

## LP-GAS DETECTOR

The LP-Gas detector is required safety equipment in RVs. American National Standards Institute (ANSI) A119.2 - Fire & Life Safety 3-4.8 LP Gas Detectors states " An LP Gas detector must be installed in any RV that contains an LP Gas appliance and an electrical system. The LP Gas detector must be listed as suitable for use in recreational vehicles under the requirement of UL 1484 Residential Gas Detectors, and be installed according to the terms of its listing."

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It detects both LP-Gas and methane gas. Liquefied Petroleum (LP) Gas is heavier than air; methane gas is lighter than air. LP-Gas will settle to the lowest point, generally the floor of the motorhome. Methane gas will rise. The gas detector is also sensitive to other fumes such as hair spray, of which most contain butane as the propellant. Butane, like propane, is heavier than air and will settle to the floor level where it will be detected. When this occurs, reset the detector to stop the alert sound.

**About the LP-Gas Detector:**

It is important to be aware of the difference between a gas leak versus gas escaping from an unlit, open burner. Pure propane vapors from a leaking pipe or gas fitting are heavier than air and will build up their heaviest concentration at the leak and float down until they mix with air. Gas from open burners is intentionally mixed with air to induce burning and will dissipate into the air. When mixed with air, the gas becomes only marginally heavier than air and will expand outward. If a gas burner is left on, the area around the burner, range, and adjoining counter space will be combustible and can cause injury and damage if ignited. This condition will exist for an extended time period and eventually the gas will reach the detector's location and be detected.

**NOTE: The LP detector only indicates the presence of propane gas at its sensor. Combustible levels of propane gas may be present in other areas. This detector is intended for the detection of propane gas ONLY.**

It has not been tested to detect any other gas. However, other volatile gases (nuisance gases), most of them flammable in various concentrations, may cause the detector to alarm. Some products that may cause the detector to alarm are alcohol, liquor, kerosene, gasoline, deodorants, colognes, propellants used in spray cans and cleaning solvents. In some cases vapors from the glues and adhesives used in the manufacturing of the motorhome may also cause the detector to alarm for several months after the date of manufacture. If it is determined that the detector has false alarmed because of the above mentioned nuisance gases, reset the detector and air out the vehicle with fresh outside air.

Take precautions to be sure one of these nuisances has not masked an actual gas alarm condition. The detector draws less current than one instrument panel lamp. The detector will operate to detect gas until the battery is drained down to 7.0 Volts. The detector must be supplied with a voltage higher than 7.0 Volts, for it to operate properly. If the power source is disconnected, or if the power is otherwise interrupted, the detector will not operate.

The LP-Gas leak detector has a self-check circuit which runs at all times while the detector is powered. In the event that the circuitry fails, a failure alarm will sound and the operating indicator will cease to light.

**LP-Gas Detector Operation:**

Upon first application of power the LED will flash yellow for three minutes while the detector is stabilizing. At the end of the start cycle the LED will turn Green, indicating full operation. If the detector senses unsafe levels of gas it will immediately sound an alarm. The gas detector operates on 12 Volt DC, with a current draw less than 1/10th of one amp.

**CAUTION: The detector will not alarm during the three minute warm up cycle.**

## *Testing*

Press the **TEST** switch any time during the warm up cycle or while in normal operation. The LED should flash red and the alarm should sound. Release the switch. This is the only way the detector should be tested. The test feature checks full operation of the detector.

**WARNING: Test the operation of this detector after the motorhome has been in storage, before each trip and at least once per week during use.**

## *Alarm*

The **red** LED will flash and the alarm will sound whenever a dangerous level of propane or methane gas is detected. The detector will continue to alarm until the gas clears or the **Test/Mute** switch is pressed.

**Procedures to Take During an Alarm:**

1. Turn off all gas appliances, (stove, heaters, furnace), extinguish all flames and smoking material. Evacuate, leave doors and windows open.
2. Turn off the propane tank valve.
3. Determine and repair the source of the leak. Seek professional help if necessary.

**CAUTION: Do Not re-enter until the problem is corrected.**

**Potential Sources of LP Gas Leaks When Operating the Motorhome:**

- Cooktop Burners
- Oven
- Furnace
- Refrigerator
- Water heater
- Defective Regulator
- Defective LP-Gas Connection
- Portable Propane Powered Equipment

**Alarm Mute:**

Press the **Test-Mute** button when the detector is in alarm.

1. The red LED will continue flash and the alarm will beep every 30 seconds until the gas level has dropped to a safe level.
2. The LED will flash green until the end of the Mute cycle.
3. If dangerous gas levels return before the end of the Mute cycle, the alarm will beep four times and return to phase 1.
4. After two minutes the detector will return to normal operation (solid green) or resound the alarm if dangerous levels of gas remain in the area.

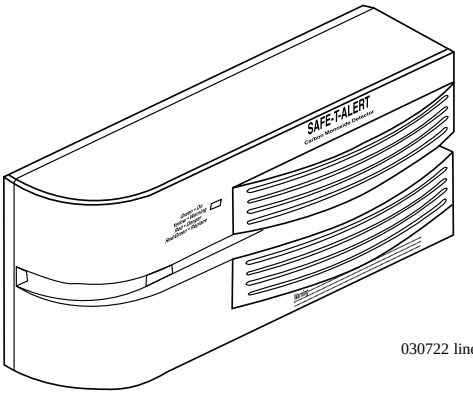
**Fault Alarm:**

Should the microprocessor sense a fault in the gas detector, a fault alarm will sound twice every 15 seconds. The LED will alternately flash **red to green** and the **MUTE** switch will not respond to any command. The gas detector must be repaired or replaced.

## *Maintenance*

1. Vacuum the dust off the detector cover weekly (more frequently in dusty locations) using the soft brush attachment of the vacuum.
2. Do not spray cleaning agents or waxes directly onto the front panel. This action may damage the sensor, cause an alarm or cause a detector malfunction.

## CARBON MONOXIDE DETECTOR

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American National Standards Institute **(ANSI) A119.2 -** Fire & Life Safety 3-4.6 Carbon Monoxide Detectors states *" All RVs equipped with an internal combustion engine or designed with features to accommodate future installation of an internal combustion engine and truck campers shall be equipped with a listed CO detector installed in accordance with its listing."*

The motorhome is equipped with such a carbon monoxide detector. Everyone is at risk with Carbon monoxide poisoning. Carbon monoxide (CO) is a colorless, odorless and tasteless gas that binds with hemoglobin reducing the body's ability to absorb and carrying oxygen to vital organs. Even low levels of CO have been known to cause brain and other vital organ damage in unborn infants, with no effect on the mother.

When removed from exposure, the symptoms dissipate as Carbon Monoxide is expelled through the lungs. Level of contamination in the body reduces at half-life increments at approximately four-hour intervals. Treatment with Oxygen will quicken recovery time.

In cases of mild exposure, the symptoms may include: a slight headache, nausea, vomiting and fatigue. Some consider this a "Flu-like Symptom." Symptoms for medium exposure may include a severe throbbing headache, drowsiness, confusion and fast heart rate. Extreme exposure can result in unconsciousness, convulsions, cardio-respiratory failure and death. Young children and household pets may be the first affected. Other highly sensitive people would include the elderly and people with lung or heart disease or anemia.

The CO detector is designed to detect the toxic CO Gas resulting from incomplete combustion of any fuel. This can be gasoline, propane, natural gas, oil, charcoal or wood. Anything that burns fuel such as engines, generators, furnaces, gas stoves or water heaters, produce CO gas. Consequently, it is uncommon for household smoke from cigarettes or normal cooking to cause the alarm to sound.

**CAUTION: Activation of this device indicates the presence of carbon monoxide (CO), which can be fatal. A concentration of above 100 PPM will cause a warning condition. Individuals with medical problems may consider using detection devices with lower carbon monoxide alarming capabilities. Prolonged exposure to the horn at a close distance may be harmful to hearing.**

The CO detector is wired to both the house and chassis batteries, this allows a reliable and continuous protection by alerting the build up of potentially dangerous levels of CO. Once the unit is powered, it will run through a brief warm-up and self check prior to monitoring for CO gas. There are no switches that can accidentally be turned off. There is a simple test procedure that should be performed to ensure the CO detector is functioning properly.

**WARNING: If there is constant beeping and the red light is flashing, CO gas has been detected. Shut off appliances, coach engine, and water heater. Evacuate the coach and call the fire department. Have any problems corrected before restarting any appliances or the coach.**

## Operation

The detector is equipped with a self-cleaning CO sensor and requires a ten minute initial warm-up period to clean the sensor element and achieve stabilization. During the warm-up period, the **green** power light will flash **ON** and **OFF**. The **green** power light should be lit when the power is on. If the light is not lit, turn off the power and check all wire connections. If the power is on and the connections are correct, but the indicator still does not light, the detector should be returned for service. **Do not attempt to fix the detector.**

The indicator light displays a specific color to monitor along with a matching sound pattern:

**Indicator Lights and Sound Patterns:**

- **ON** or normal condition is indicated by **green**. The CO detector has power and is sensing air for the presence of CO gas. The alarm horn will not sound.
- Flashing **red** indicates low CO Alarm condition along with 4 beeps then **OFF** for 5 seconds. The alarm horn will sound and can be reset by the **TEST/RESET** button. The CO detector has detected the presence of 70 ppm.
- Steady Red indicates a **CO ALARM** condition. The detector has sensed the presence of levels over 100 ppm of carbon monoxide. The alarm horn will sound continuously until the **RESET** switch is reset.
- Alternating red and green indicates a malfunction alarm.

## Alarm

When the alarm sounds have the detector and the motorhome checked by an authorized service technician as soon as possible. Never disconnect a CO detector to silence an annoying alarm. Evacuate the motorhome immediately when the **red** light is lit and the alarm sounds. Do a head count to check that all persons are accounted for. Call the nearest fire department and ask them to determine the source of the carbon monoxide. Do not re-enter the motorhome until it has been aired out and the problem corrected.

**Potential Sources of CO when operating the motorhome:**

- Engine Exhaust
- Portable Space Heaters
- Gas Stoves and Ovens
- Defective Engine Exhaust System
- Other Motorhomes
- Portable Grills
- Camp Fires
- Generator Exhaust
- Portable Generators

## Testing

**Test Procedures:**

Test the carbon monoxide detector operation after the motorhome has been in storage, before each trip and at least once a week during use. Test the alarm by holding the **TEST/RESET** button in until the alarm sounds. The alarm will sound 4 beeps and the indicator lamp goes steady **red**. Six seconds later the alarm will again beep 4 times and the indicator light goes steady **green**.

**Peak Level Memory:**

The CO detector has the capability to remember the level of carbon monoxide that activated the alarm. Press the **TEST/RESET** button for less than one second and observe the visual and audible signals.

- One beep and a green flash indicate memory is clear.
- Two beeps and two red flashes indicate less than 100 ppm.
- Three beeps and three red flashes indicate less than 200 ppm.
- Four beeps and four red flashes indicate greater than 200 ppm.

**NOTE: Memory is erased when power is disconnected for 15 seconds.**

## Cleaning

Use a vacuum cleaner to remove dust or any other buildup on the detector. Do not wash. Wipe the detector with a damp cloth and dry with a towel. Do not open the detector for cleaning. Do not paint the detector. It is recommend that the carbon monoxide detector be replaced every 10 years.

## Troubleshooting

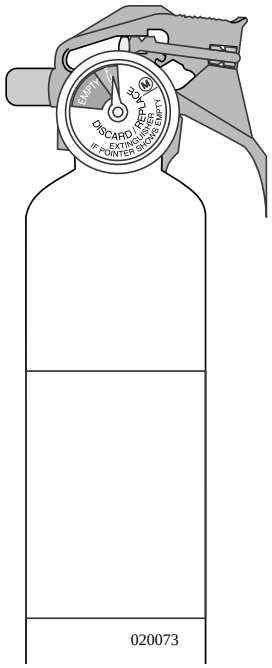
The CO detector has **NO** user service parts. If there is a problem with the detector refer to an authorized service center. **DO NOT REMOVE POWER**.

**NOTE: Check the CO detector weekly and at the beginning and end of each trip.**

## FIRE EXTINGUISHER

The fire extinguisher in the motorhome is located near the main entrance door. Please read the operating instructions that are printed on the fire extinguisher. If there is any doubt on how to operate the fire extinguisher, you and your family should practice using it. Be sure to replace or recharge the extinguisher immediately after use.

**Inspect** the fire extinguisher at least once a month. Do so more frequently if the extinguisher is exposed to weather or possible tampering. Do not test the extinguisher by partially discharging. Internal pressure will escape and the fire extinguisher will need to be replaced.



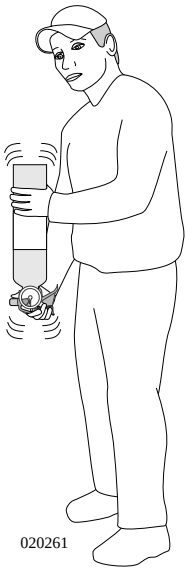

**Use the PASS word!**

**P**ull the pin to unlock the extinguisher.

**A**im at the base (bottom) of the fire and stand 6-10 feet away.

**S**queeze the lever to discharge the agent.

**S**weep the spray from left to right until totally extinguished.

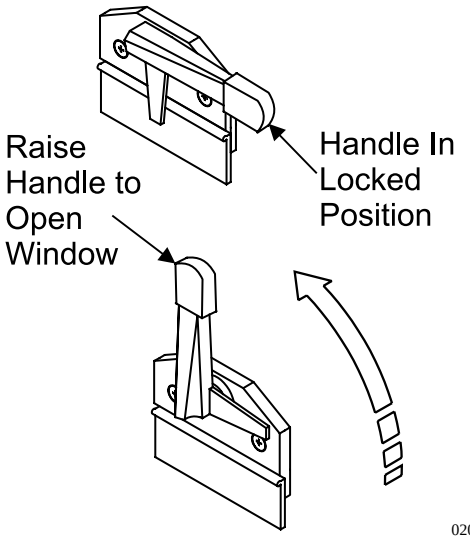



**WARNING: Road vibration will cause extinguisher powder to compact and may cause extinguisher malfunction. Invert and shake extinguisher monthly.**

## EGRESS EXIT WINDOW

An egress window is designated for use as an exit in the case of an emergency. Inside the motorhome the egress window is easily identified by the red locking handle. It is also marked as an "EXIT." The glass slider in the egress window operates the same as all other windows.

- To open the egress window, lift the red handle and push outward on the window.
- To close the egress window, pull the window closed and lower the handles to lock window in place.




Egress Window Handle

**CAUTION: The egress window should be opened twice a year to ensure proper operation. Over time, the rubber seal will tend to stick to the egress window. Occasional operation will help prevent the rubber seal from sticking.**

## ~ NOTES ~

# Exterior & Interior Care

## section 3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## EXTERIOR CARE

### *Corrosion*

The most common cause of corrosion to the motorhome is the accumulation of road salts, grime and dirt. These elements, combined with moisture, may possibly cause early component failure. Salt air and fog from coastal trips can greatly accelerate the corrosion process. Corrosive materials collected from roadways accumulate on the undercarriage, around wheel openings and on the radiator charge air cooler package. These areas need to be cleaned periodically to help prevent component failure due to corrosion. If the motorhome is driven in areas where road salts are used it should be washed at least once a week. Otherwise, it is recommended to hose off the undercarriage area at least once a month to help minimize the corrosion process. High pressure washers or steam cleaners are the most effective way of cleaning off the underside and inside wheel openings. **Avoid directly spraying the painted surface with a high pressure washer.** Remove road debris and mud that has accumulated. Material left behind can intensify the corrosion problem.

**CAUTION: Exercise caution when cleaning the radiator charge air cooler package. Damage to the fins can result when using a high pressure washer or steam cleaner. Nozzle discharge pressure can exceed 1800 psi. Avoid using high pressure steam cleaners on the exterior paint surfaces. Remove all spattered washing debris from the exterior paint surfaces as soon as possible.**

### *Washing*

The life of the exterior paint finish can be extended if properly cared for. Periodic cleaning will help preserve the paint finish. The motorhome is painted with a “base coat, clear coat system.” The clear coat is a polyurethane based material which brings out the shine or luster to the base coat paint. Care should be used when washing the motorhome. Use only mild detergents or preferred specifically designed automotive detergents. Avoid using abrasive cleansers or laundry detergents as they will scratch the clear coat and leave a soap film. The use of specially designed automotive washing utensils, such as soft bristle brushes, are acceptable as long as they do not trap abrasive material and scratch the surface while being used. Before washing the motorhome remove most of the accumulated dirt and “road wash” behind wheel openings, below the windshield and on the rear of the motorhome. If the build up is excessive, run water over a soft brush while gently scrubbing the surface in one direction. This will help float away the “build-up” from the clear coat. Avoid back and forth or circular motions as this may act like sandpaper, scratching the clear coat and leaving a haze or “swirl marks.” After removing the heavy build-up, use the mixed detergent solution to wash the motorhome. Start washing at the top of the motorhome working towards the bottom. If possible, wash the motorhome in a shaded area when the exterior is not hot to the touch. If necessary, turn the motorhome around to keep the area being washed in the shade. Try not to allow the detergent to dry onto the clear coat surface. Use plenty of water when rinsing the surface to remove any detergent residue.

### Drying

Drying chamois cloths come in natural and synthetic materials. Either type is acceptable as long as the surface is clean. Soak the chamois in clean water until all chamois material has absorbed water. Wring excess water from chamois. Start at the top and work towards the bottom. Use a downward "S" pattern to remove water from the surface and wring out the chamois as needed. Using a chamois cloth to remove the rinse water is not necessary, but the effort can be worthwhile.

### Waxing

To wax or not to wax? This is a good question. There are many schools of thought on this issue. The two most common thoughts are:

- The clear coat needs to "breathe." A layer of wax will seal the clear coat not allowing it to breathe, possibly leading to failure of the clear coat.
- If the surface is not waxed, what is protecting the surface from the environment (road salts, acid rain, road tar, ultraviolet light)?

**It is recommended to wax the motorhome twice a year: spring and fall.** Many types of protective barriers are available today that may be applied to the clear coat: glazes, waxes, polishes, rubbing compounds or combinations of these products.

**INFORMATION: When selecting a product for use follow the product manufacturer's recommended application instructions.**

**Types of Products:**

**Glazes:** Glazes are generally used to fill very fine scratches in the clear coat, being applied either by hand or by using a polisher with a special pad.

**Waxes:** Waxes come in many types of chemical make-ups. The popular Carnauba wax is a natural occurring wax from the leaves or fronds of the Carnauba palm tree. Mineral waxes have a paraffin base. There are also other topical application products which contain silicone.

**Polishes:** Polishes usually contain a combination of wax based substances with an abrasive, getting the two for one idea. These products can be too abrasive for clear coats and are not recommended for use.

**Rubbing Compounds:** These types of products are generally applied by using a buffer. The use of rubbing compounds should be left to professionals as undesired results can quickly occur. These types of products are generally used to correct or flatten a surface by removing high spots or small amounts of material.

When selecting a product the container should be marked, “safe for clear coats” or “clear coat safe.” Carefully follow all manufacturer’s application instructions when using a product. Upon first use of a product, try it on a “small test spot” in an inconspicuous area in case an undesired reaction occurs.

Observe the test area from different angles checking for hazing or swirl marks. If an abnormal reaction to the finish occurs, discontinue product use and consult the product’s manufacturer. If the product is a paste, do not allow dried paste to be baked on by the sun. Remove paste shortly after drying. Clean, dry, 100% cotton cloths or cotton baby diapers are best suited for the removal of dried paste. Turn the cloth often. Use a separate clean cloth to buff. The surface should feel “slick” when rubbing the cloth lightly over it. Avoid repeated wax applications which can cause wax to build up. Some very fine scratches or swirl marks may be removed by an application of a glaze. These types of glazes fill the scratches or swirl marks.

The motorhome has a large surface area. Washing and waxing may not be completed in one afternoon. Select sections to wax until the motorhome is complete. If the task seems overwhelming, have an automotive detailer perform the task.

## Tire Care

Road oil will cause deterioration of the rubber. Dirt buildup will help hold chemicals in the air next to the tire and will also cause deterioration.

When cleaning any rubber product, proper care and methods in cleaning must be used to obtain the maximum service years out of the tires. Use a soft brush and a mild detergent to clean the tires. If a dressing product is used to “protect” the tires from aging, use extra care and caution. Tire dressings that contain petroleum products or alcohol may cause deterioration or cracking.

In many cases it is not the dressing that causes a problem but the chemical reaction that subsequently occurs. When these same dressing products are used on a passenger car tire that is replaced every three to four years, it is rare to see a major problem. However, in most cases recreational vehicle tires may last longer due to limited annual mileage and exposure.

## Aluminum Wheels

- Clean frequently with high pressure water from a hose. The use of mild detergent will speed the cleaning process. Do not use harsh alkalis, alcohol or acidic cleansers. A secondary hand washing with a soft cloth may be required to remove some stubborn road films.
- When the tires are removed, **inspect** and clean the entire wheel. Use a wire brush or sandpaper to remove dirt, corrosion or any foreign materials from the tire side of the rim. Do not use a wire brush or other abrasive substances to remove dirt and corrosion on the polished surface of the wheel.

To maintain the original appearance of the aluminum wheels the following procedures are recommended:

1. After installing new wheels (prior to driving the motorhome) use a sponge, cloth or soft fiber brush to wash the exposed wheel surfaces with a mild detergent/warm water solution.
2. Rinse thoroughly with clean water.
3. Wipe dry to avoid water spots.
4. Use a high quality, non-abrasive polish to remove stubborn road tars, insects or hard to remove deposits.
5. To protect the appearance surface, wax the cleaned surface with a high quality car wax.
6. Clean the aluminum wheels as frequently as required to maintain their appearance.

### *Bright Metal*

All chrome, stainless steel and aluminum should be washed and cleaned each time the motorhome is washed. Use only automotive approved non-abrasive cleaners and polishes on exterior bright work. Aluminum wheels should be cleaned regularly with a non-abrasive cleaner recommended for aluminum wheel care. Do not use rubbing compounds. Do not use any abrasive cleaners or compounds to clean the mirrors.

**NOTE: When using chemicals to remove road tars, use only automotive type products that are recommended for use on painted surfaces and fiberglass. Observe the warning recommendations and directions printed on the container of any agent being used.**

## EXTERIOR MAINTENANCE

The motorhome is subject to a great deal of outside conditions. While the coach is parked it is exposed to extreme temperatures, humidity, ultraviolet rays, acid rain and other organic environmental conditions. While in operation the coach is subject to twisting and flexing caused by (for example) going in and out of driveways, bouncing through potholes and driving through winding mountain roads.

**Inspect** the fiberglass exterior. Periodic inspections may reveal minute cracks in the surface commonly called “spider cracks” or “hairline cracks” which are caused by the flexing of the fiberglass exterior. These are normal. If a crack represents a threat to the integrity of the fiberglass it will open up and the weave of the cloth would be visible. If the exterior has been damaged, prevent moisture penetration, especially in freezing climates. Cover the area as quickly as possible. Use plastic sheeting and tape, if necessary, so that moisture will not get into the motorhome and damage the interior.

## Roof Care & Seal Inspections

Periodic resealing of the joints and seams is necessary to prevent the entrance of moisture into the motorhome. Enough emphasis cannot be placed on this issue. Extreme damage from a water leak can occur rapidly. Never leave the vehicle unattended with the slide room extended. If the vehicle is to be stored outside throughout the winter months, a full interior inspection for water leaks should be made bi-monthly.

Extensive sealing has been done at the factory; however, the normal twisting and flexing that occurs while traveling may have compromised a seal or seam.

**INSPECT: All joints and seams should be inspected at least twice a year and recalked as necessary.**

Special attention should be directed toward the roof air conditioning seals, ceiling and plumbing vents, skylights, roof mounted antennas, windows, door molding, clearance lights and the beltline molding.

Specific sealant products should be used in the areas for which they were designed. These items can be obtained from recreational vehicle parts suppliers. Listed below are some of the more common sealants and the areas in which they are used. Approved sealants are available at service centers and authorized dealers.

**WARNING: Some products may contain hazardous materials which require special handling. Read labels carefully. Follow all of the product manufacturer's safety requirements.**

**Sealant Types:**

**Dolphin Sealants (7549):** Used where items are sealed under a painted surface such as the metal corners of the slide-out room. The material is specially formulated to allow paint adhesion.

**Black Urethane:** Used for sealing the windshields, not to fill holes or other imperfections. Black urethane comes in a tube and it applies much the same way as silicone. Clean up using solvents such as paint thinner. Gloves are required as this material is hazardous.

**Silicone Sealant:** Primarily used on the sidewalls where a hole has been made and an item installed. This includes Windows, Doors, Handles, Beltline Molding, Latches and around bases of items surface mounted such as clearance lights. Old peeling sealant should be removed. Avoid using metal utensils which can scratch the painted surface. Use nylon sticks or equivalent. Avoid using lacquer thinners or ketone based solvents as these chemicals can damage the painted surfaces. Be sure the surface is clean and dry before application. Cut the tube at an angle with smallest usable opening. Avoid a heavy bead as a little goes a long way. Use finger at a 45° angle on beaded surface to smooth out product. Do not moisten finger, use a disposable latex glove. Keep rags or paper towels handy for clean up. Use care when applying silicone. Plan ahead before starting a bead, look for obstacles that may impede application.

**Spray Foam:** Used as a sealant where a hole has been made for items such as water lines or wires that are coming through a floor opening.

## INTERIOR CARE - FABRICS

Most fabrics have a designated cleaning code assigned to them. The cleaning code is determined, in most cases, by the content of the fabric. The code represents the cleaning agent and method that is approved by the fabric industry. If the fabric is abused, it can be damaged. Special care needs to be taken when the motorhome is exposed to a very humid climate for an extended period of time. Cover all upholstery and make sure window coverings are down to protect from sun damage.

Protect the fabric from any unnecessary exposure to moisture. Frequently used items will wear accordingly and may require more attention than those items not regularly used.

**Use the following guidelines for cleaning upholstery fabrics.**

- Water-based cleaners are not recommended.
- If a spill does occur, blot the soiled area. Do not rub it.
- Some solvents are not recommended since they may have an adverse reaction on a specific backing of the upholstery fabric.
- To prevent overall soiling, frequent vacuuming or light brushing are recommended to remove dust and grime.
- Clean spots using a mild water-free solvent or dry cleaning product.
- Clean only in a well ventilated area and avoid any product containing carbon tetrachloride or other toxic materials.
- Use a professional furniture cleaning service for overall cleaning.

## *Fabric Cleaning Codes*

The codes listed below refer to cleaning instructions recommended by the fabric manufacturing industry. Since most fabrics are hand-selected it is up to you to obtain the cleaning code for a particular fabric. If a spill occurs blot the moisture as quickly as possible. **Do not** use soap and hot water as this may set a stain. Obtain the cleaning code for the fabric as soon as possible.

**"W" -** Clean this fabric with the foam only of a water-based cleaning agent to remove the overall soil. Many household cleaning solvents are harmful to the color and life of a fabric. Cleaning only by a professional furniture cleaning service is recommended. To prevent overall soil, frequent vacuuming or light brushing to remove dust and grime is recommended.

**"S" -** Clean this fabric with pure solvents (petroleum distillate-based products such as Energine, Carbona, Renuzit, or similar products may be used) in a well ventilated room. Cleaning only by a professional furniture cleaning service is recommended.

**"S/W" -** Clean this fabric with the foam only of a water-based cleaning agent or with a pure solvent in a well ventilated room petroleum distillate-based products such as Energine, Carbona, Renuzit, or similar products may be used). Cleaning only by a professional furniture cleaning service is recommended. To help prevent overall soiling, frequent vacuuming or light brushing to remove dust and grime is suggested.

**CAUTION: Use of water-based or detergent-based solvent cleaners may cause excessive shrinking. Water stains may become permanent and unable to be removed with solvent cleaning agents. Avoid products containing Carbon Tetrachloride as it is highly toxic. To help prevent overall soiling, frequent vacuuming or light brushing to remove dust and grime is recommended.**

**"P" -** The article is resistant against perchlorethene, cleaning benzine (spirit), white spirit, R-11 and R-13.

**"Dry Clean Only" -** Cleaning only by a professional dry cleaner or furniture cleaning service is recommended for this fabric.

**"X" -** Vacuum only. A non-metallic brush may be used.

***Machine Washing for 100% Polyester:**

**"Wash Cycle" -** Use synthetic setting and high water level with mild agitation. A mild soap or detergent in water not to exceed 160º F. No bleach or fabric softener.

**"Drying" -** Use low temperatures, a synthetic setting of 85º F to 90º F maximum should be used. Do not exceed three to five minutes time on the synthetic cycle. If washed at 160º F, the maximum temperature which can be used to dry is 140º F. Hang or fold immediately after drying.

If necessary, press as following:

- Iron on low setting (275° F) with damp cloth or steam iron using a dry press cloth.
- Grid Head press for short intervals with minimum steam. Do not lock the head.
- Flat bed press dampened drapery using cloth covering.
- Avoid prolonged contact with heat.

| IVORYWOOD .951<br>APPLICATION | COLOR/PATTERN | CONTENT | CODE |
|---|---|---|---|
| Sofa | R-Barosa - Platinum col #02000 | 39% Acrylic 44% Rayon 2% Nylon 15% Essera | Dry Clean |
| Bedspread | Dominion Ref 1 | 35% Rayon 40% Polyester 25% Acrylic | S/W |
| Living Room Pillows, Free Standing Dinette, Booth Backs, Living Room Valance | Pacifica Flax Col# 01000 | 76% Acrylic 24% Essera | Dry Clean |
| Bedroom Windows, Living Room Valance | Donegal DY24 Truffle | 52% Cotton 48% Rayon | S-Dry Clean |
| Bedroom Pillow, Bedroom Valance Accent | Hunting Heritage Document Toile 929 Graphite | 89% Cotton 11% Rayon | Dry Clean |
| Living Room & Bedroom Pillow, Living Room & Bedroom Window Accent, Bedspread Accent | Touchy - Chestnut | 100% Polyester | S |
| Trim - Living Room Pillow | Malibu Taupe Loop Fringe | 55% Polyester 13% Cotton Chenill 32% Rayon | S/W |
| Vinyl | Illusion Rush Sand | Vinyl | Vinyl |
| Fringe | Hollywood FR-26896 Color Dill | 30% Polyester 70% Rayon | S/W |

| TRUFFLE .623<br>APPLICATION | COLOR/PATTERN | CONTENT | CODE |
|---|---|---|---|
| Sofa, J-Lounge | Hilton Butternut | 72% Essera 28% Acrylic | Dry Clean |
| Chair, Rec, Living Room Lambrequin, Bedroom Lambrequin, Living Room Pillow, Bedspread Accent | J2015 Tabu 70094031 Col. Verde #912461 | 100% Cotton | W/S |
| Free Standing Dinette, Living Room Pillow, Booth Backs | 18693 col. 8 | 100% Polypropylene | S - Dry Clean |
| Living Room Lambrequin, Bedroom Lambrequin, Living Room Pillow, Bedroom Pillow | Annapolis Col. Chino | 54% Cotton 42% Polye | S - Dry Clean |
| Living Room Lambrequin | J2015 Tabu Color Sable | 100% Cotton | W/S |
| Bedspread, Bedroom Lambrequin, Swags, Bedroom Pillows | Walden co. 7802 Sand | 52% Cotton 48% Viscose | Dry Clean |
| Bedroom Pillow | Parade Truffle | 100% Cotton | S - Dry Clean |
| Vinyl | Illusion Rush Parchment | Vinyl | Vinyl |
| Leather / Vinyl | Tumbleweed Parchment | | |
| Closeoff Rope Tieback | 21815 Tieback | 24% Polyester 23% Rayon 10% Acetate 14% Acrylic 29% Synthetic | S/W |
| Windshield | Pearl 009 Natural | 100% Polyester | W/S |
| Rope - Living Room Pillow | Cassis Coll. 3/8" mixed cord w/ tab color safari | 11% Rayon 29% Polyester 6% Acrylic 54% Olefin | S/W |
| Trim - Living Room Pillow | Mazan Collection Col. Leopard | 100% Cotton | W/S |

| BERMUDA .952<br>APPLICATION | COLOR/PATTERN | CONTENT | CODE |
|---|---|---|---|
| Sofa | Caceres Ref. 71 | 65% Rayon 30% Polyester 5% Acrylic | S/W |
| Bedspread, Bedroom Pillows, Bedroom Valance | Newcomb Mineral | 57% Cotton 43% Polyester | Dry Clean |
| Sofa Pillows / Free Standing Dinette, Booth Backs, Living Room Valance | Serab #80420 color Baltic #02000 | | |
| Living Room Window Boxings, Living Room Pillows | Midtown - Flannel | 37% Polyester 37% Cotton Chenille 26% Viscose | S |
| Bedroom Window Boxings, Bedroom Pillows, Bedspread Accent | Limelight - Cornflower | 100% Polyester | S |
| Trim - Living Room Pillow | La Boheme Mocha Brush Fringe | 80% Polyester 16% Rayon 4% Acrylic | S/W |
| Trim - Bedroom Pillow | Ventura Topaz Loop Fringe | 26% Polyester 18% Rayon Chenille 42% Cotton 14% Acrylic | S/W |
| Vinyl | Illusion Taupe | Vinyl | Vinyl |

| BELLAGIO .953<br>APPLICATION | COLOR/PATTERN | CONTENT | CODE |
|---|---|---|---|
| Sofa | R-Manderley Pewter color #01500 | 71% Acrylic 23% Olefin 6% Essera | Dry Clean |
| Sofa Pillows, Free Standing Dinette, Booth Backs, Living Room Valance | Folio 6133-29 Black / Grey (54" wide) | 24% Cotton 42% Polyester 34% Rayon | S |
| Bedspread, Bedroom Pillow, Bedroom Valance | Cordoba / Paramount Color Mineral | 100% Cotton | W |
| Accent Pillows / Living Room Window Boxings | Armitage Onyx Col #00000 | 71% Olefin 29% Essera | Dry Clean |
| Bedroom Windows / Bedroom Pillow | Tedesco 98J2991 Sterling | 55% Polyester 45% Rayon | S |
| Bedroom Pillow Accent, Bedspread Accent, Bedroom Valance | Nirvana color Ebony | 100% Polyester | S |
| Vinyl | Illusion Quicksilver | Vinyl | Vinyl |
| Fringe | Victoria Color Midnight | 55% Polyester 45% Rayon Chenille | S/W |

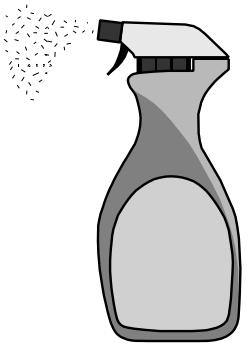
| CAVIAR .572 APPLICATION | COLOR/PATTERN | CONTENT | CODE |
|---|---|---|---|
| Sofa, Living Room Lambriquen | Chenonceau Putty | 70% Acrylic 30% Essera | W/S |
| Living Room Pillow | Giorgione Platinum | 83% Acrylic 17% Essera | W/S |
| Free Standing Dinette, Chair, Living Room Pillow, Dinette Cushion | R Edison Taupe | 16% Acrylic 84% Essera | W/S |
| Living Room Lambriquen, Living Room Pillow | Poneroy 0016 Charcoal | 52% Cotton, 48% Polyester | Dry Clean |
| Living Room Lambrequin, Windshield Drape | Intarsia 0003 Parchment | 64% Cotton, 36% Polyester | Dry Clean |
| Bedspread | Medallion Damsk 003 Natual Linen | 70% Viscose 30% Linen | Dry Clean |
| Bedroom Pillow, Bedroom Accent, Headboard, Bedroom Lambrequin | Remsen 23 Flint | 52% Cotton 48% Polyester | W/S |
| Bedroom Pillow, Bedroom Lambrequin | Acadia Rye | 74% Cotton 26% Polyester | Dry Clean |
| Bedroom Pillow, Bedroom Lambrequin | Fancy Taffeta 0004 Ash | 60% Acetate 40% Cotton | Dry Clean |
| Leather (Furniture behind Pilot Seat) | Tumbleweed RVAA Taupe CAX7947 | Leather | Leather |
| Leather (Pilot & Co-Pilot Seat) | Tumbleweed RVAA Taupe CAX7947 | Leather | Leather |
| Closeoff Rope Tieback | 21815 Tieback | 24% Polyester 23% Rayon 10% Acetate 14% Acrylic 29% Synthetic | S/W |
| Leather / Vinyl | Tumbleweed Taupe | | |
| Leather (Distressed Leather Opt) | Tuscany Putty (Distressed) | Leather | Leather |
| Trim | Ventura 1/2" 4 Ply Cord Dill | 33% Polyester 14% Rayon 22% Olefin 19% Cotton 11%Cotton Chenille | W/S |
| Trim | Malibu Loop Fringe Taupe | 55% Polyester 13% Cotton Chenille 32% Rayon | S/W |

## Optional - Fabric

| 50TH ANNIVERSARY EDITION .674 APPLICATION | COLOR/PATTERN | CONTENT | CODE |
|---|---|---|---|
| Sofa (fabric/leather combo) | Leather Classic Rider Color Fools Gold | Leather | W |
| Sofa (fabric/leather combo), Chair | Armitage Color Taupe 0200 (seat & back cushion) | 71% Olefin 29% Essera | Dry Clean |
| Living Room Lambrequin, Bedroom Lambrequin | Arlington Paisley REC 14313F | 60% Cotton 40% Polyester | W/S |
| Living Room Lambrequin, Bedroom Lambrequin | Arlington Acorn | 52% Cotton, 48% Polyester | Dry Clean |
| Living Room & Bedroom Lambrequin, Jumbo Cord, Band, Skirt | Majesty Silk Color Bark (backing / 302) | 100% Silk | S - Dry Clean |
| Bedspread | Strie Tafetta Col. 0057 Ginger | 60% Rayon 40% Polyester | W/S |
| Free Standing Dinette | Morgan 0398 Espresso | 56% Acrylic 42% Polyester 2% Nylon | W |
| Throw - Bedroom | Fox-11 48043-A2GU Brown | 80% Acrylic 20% Polyester | X |
| Closeoff Rope Tieback | 21815 Tieback | 24% Polyester 23% Rayon 10% Acetate 14% Acrylic 29% Synthetic | S/W |
| Windshield Drape | Pearl Natural | 100% Polyester | W/S |
| Vinyl | Tumbleweed Parchment | Vinyl | Vinyl |
| Rope - Living Room Lambriquen | Victoria Rope 1/2" Color Midnight | 35% Polyester 30% Olefin 35% Rayon Chenille | S/W |
| Loop Fringe | 2" Loop Fringe Victoria - Midnight | 56% Polyester 44% Rayon Chenille | S/W |
| Rope - Bedroom Lambrequin | Mazan Collection 3/8" Multi Col Leopard | 100% Cotton | W/S |
| Brush Fringe | Mazan Collection1 3/4" Brush Fringe Leopard | 100% Cotton | W/S |

Several areas of the motorhome such as the dash, ceiling and items of furniture may be covered in vinyl. The care and cleaning of these areas are outlined in the Morbern Vinyl section below.

**Morbern Vinyl:**
Vinyl requires periodic cleaning to maintain its neat appearance and to prevent the buildup of dirt and contaminants that may permanently stain and/or reduce the life of the vinyl if not removed. The frequency of cleaning depends upon the amount of use and the environmental conditions in which the vinyl is subjected. The procedures used for cleaning are dependent upon the end-use circumstances.


cleaner

**Normal Cleaning:**
Most common stains can be cleaned using warm soapy water and clear water rinse. Moderate scrubbing with a medium bristle brush will help to loosen soil from the depression of embossed surfaces. For stubborn stains use the following commercially available mild detergents in accordance with the manufacturer's instructions: Mr. Clean or Fantastik. Full strength rubbing alcohol or mineral spirits may be tried cautiously as a last resort on very stubborn stains if the above suggestions do not work. Indiscriminate use of any solvent, or solvent containing cleaner, can severely damage or discolor the vinyl. Stains may become permanent if they are not removed immediately. The procedure for removal of the more severe staining agents are outlined below.

**NOTE: Detergents should never be used on a regular or repeated basis for normal cleaning.**

**CAUTION: Powdered cleaners containing abrasives, steel wool and industrial strength cleaners are not recommended for Morbern vinyl.**

**Bird Excreta & Vomit Stains:**
Sponge the area with soapy water containing a diluted bleach until the stain is removed. Rinse thoroughly with clean water.

**Urine Stains:**
Sponge with soapy water containing a small amount of household ammonia. Rinse thoroughly with clean water.

**Surface Mildew:**
Wash with diluted bleach and use a soft brush for stubborn growth. Rinse repeatedly with clear, cold water.

**Ballpoint Ink:**
Permanent Marker Ink spots will stain the vinyl permanently. Wipe the stain immediately with rubbing alcohol in a well ventilated area to remove much of the stain.

**Oil-Base Paint:**
Use turpentine in a well ventilated area to remove any fresh paint. Dried paint must be moistened using a semi-solid, gel-type stripper. The softened paint can be gently scraped away. Rinse with soap and water.

**CAUTION: Lacquer solvent will cause immediate irreparable damage to the vinyl. Do not use wax on any vinyl upholstery as it will cause premature embrittlement and cracking. Dilute chlorine bleach before using. Never use full strength bleach.**

**CAUTION: Paint strippers will remove the print pattern and damage the vinyl if it comes in direct contact.**

**WARNING: If flammable solvents such as alcohol, turpentine or varsol are used for cleaning, use only small quantities while in a well-ventilated area. Exercise proper caution by notifying any persons in the area. Keep away from any ignition source. Always wear protective gloves.**

**Latex Paint:**
Fresh paint can be wiped off with a damp cloth. Hot soapy water will normally remove dried latex.

**Tar or Asphalt:**
Remove immediately. Prolonged contact will result in a permanent stain. Use a cloth lightly dampened with mineral spirits and rub the stain gently, working from the outer edge of the stain toward the center to prevent spreading. Rinse with soap and water.

**Crayon, Mustard or Ketchup:**
Sponge with mild soap and water. For stubborn stains that may have set, use a cloth soaked in diluted mild detergent with gentle rubbing. Any remaining stain should be washed with diluted bleach. Rinse repeatedly with cold water.

**Chewing Gum:**
Scrape off as much gum as possible using a dull knife. Rub the gum with an ice cube to harden and make it easier to remove. In a well ventilated area, use a cloth saturated with mineral spirits and gently rub the remaining gum. Rinse thoroughly with clean water.

**Lipstick, Grease, Oil, Make-Up or Shoe Polish:**
Apply a small amount of mineral spirits with a cloth. Rub gently. Be careful not to spread the stain by smearing it beyond its original source. Remove shoe polish immediately as it contains a dye which will cause permanent staining. Rinse thoroughly with clean water.

**Candy, Ice Cream, Coffee, Tea, Fruit Stains, Liquor, Wine, Tanning Lotion or Soft Drinks:**
Use lukewarm water and sponge repeatedly. Any loose material should be gently scraped with a dull knife. Any soiled area that remains after drying should be gently rubbed with a cloth, dampened with a mild detergent solution. Rinse thoroughly with clean water.

**Blood or Plant Residue:**
Rub out any spots with a clean cloth soaked in cool water. If stubborn spots remain use household ammonia and rinse repeatedly with a clean, wet cloth. Do not use hot water or soap suds as this will set the stain.

**TIP: Vinyl requires periodic cleaning to maintain its appearance and to prevent the buildup of dirt and contaminants that may permanently stain or reduce the life of the vinyl if left untreated. Frequency of cleaning and procedures used depend upon the amount of use and the environmental conditions in which the vinyl is subjected. Tears or holes in the vinyl can be temporarily covered with clear "office" tape to prevent further damage. Repairs should be made by a professional upholstery shop. Commercial repair products may contain lacquers and cause the vinyl to become brittle and more difficult to repair.**

## Ultra-Leather

**Care Instructions:**

- Spot clean with mild soap and water.
- Air dry or dry quickly with warm setting of a hair dryer.
- For stubborn stains, use mild solvent.
- For tougher stains, try *Fantastik*® brand spray cleaner.
- Disinfect with a **5:1 NON-CHLORINATED** (only) bleach solution.
- Dry clean using commercial dry cleaning solvents only.
- Use a mild detergent for:
  - Red Wine, Liquor - Coffee, Tea, Cola - Milk
  - Ketchup, Mustard, Mayonnaise - Steak Sauce, Soy Sauce
  - Butter, Salad Oil - Chocolate - Lipstick, Make-up, Face Cream
  - Suntan Oil - Machine Oil - Urine, Blood

**Removing ballpoint pen stains:**

Wipe the stain off with ethanol (ethyl alcohol). If the stain cannot be removed with ethanol, use the following procedure. Proceed with caution when using toxic chemical.

1. Prepare bleach. Dilute household bleach (sodium hypochloride) with the same amount of water.
2. Place a piece of tissue and apply the solution prepared by step 1 (do not apply too much). Cover it with polyethylene film to prevent the solution from drying.
3. Remove the tissues occasionally to check on the condition of the stain. When the stain is almost gone, remove the tissues completely. Do not leave on for more than one hour.
4. Wash the stain with sufficient amount of water.

**If there is residue of bleach, polyurethane resin and back cloth will deteriorate. Neutralize it by the following method:**

- Place a piece of tissue, as in step 2, and apply hydrogen peroxide solution (15%).
- Leave the solution on for approximately 30 minutes, then remove the tissue.
- Completely remove the residue of hydrogen peroxide on the Ultra-leather with water.

Sodium hypochloride is the only chemical that will remove ballpoint pen stains. However, this chemical may cause polyurethane to yellow or the back cloth to deteriorate. It is recommended to remove ballpoint pen stains as early as possible with ethanol.

**For more information, please call: Ultrafabrics, LLC**
**Customer Service: 1-877-309-6648**

## FLOORS - *Carpet Cleaning*

**Spot Removal Procedures:**

- Act quickly when anything is dropped or spilled. Remove spots before they dry.
- Blot liquids with a clean, white absorbent cloth or paper towel.
- For semi-solids, scoop up with a rounded spoon.
- For solids, break up and vacuum out as much as possible.
- Pretest the spot removal agent in an inconspicuous area to make certain it will not damage the carpet dyes.
- Apply a small amount of the cleaning solution recommended for the particular spot. Do not scrub. Work from the edges of the spot to the center. Blot thoroughly. Repeat until spot is removed.
- Follow steps on the Carpet Spot Removal Guide.
- After each application, absorb as much as possible before proceeding to the next step.
- Absorb remaining moisture with layers of white paper towels, weighted down with a non-staining glass or ceramic object.
- When completely dry, vacuum or brush the pile to restore texture.
- If the spot is not completely removed, contact a professional carpet cleaner.

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| **Use the solution specified in order from 1-8 until stain is removed.** | DRY CLEANING FLUID | NAIL POLISH REMOVER | DETERGENT SOLUTION | WARM WATER | VINEGAR SOLUTION | AMMONIA SOLUTION | SPOT REMOVAL KIT | CALL PROFESSIONAL | PERMANENT CHANGE |
| **SPOTS** | | | | | | | | | |
| Acid | | | | 2 | | 1 | | 3 | * |
| Acne Medication | | 1 | | 2 | 5 | 4 | 3 | 6 | * |
| Alcoholic Beverage | | | 1 | 4 | 3 | 2 | | | * |
| Ammonia | | | | 2 | 1 | | | | * |
| Bleach | | 1 | 2 | | | | | 3 | * |
| Blood | | 1 | 3 | | 2 | 4 | | | |
| Candle Wax | 1 | | | | | 2 | | | |
| Cement & Glue | 2 | 1 | 3 | | 5 | 4 | 6 | | * |
| Chalk | | 1 | 2 | | | | | | |
| Charcoal | | 1 | 2 | | | | | | |
| Chewing Gum | 1 | | | | | | | | |
| Coffee | | | 1 | 3 | 2 | | 4 | 5 | * |
| Cosmetics | | 2 | 1 | 3 | 6 | 5 | 4 | 7 | * |
| Crayon | 1 | | 2 | 3 | | | | | |
| Drain/Toilet Cleaner | | | 2 | 1 | 3 | | | 4 | * |
| Dye | 1 | | 2 | | 4 | 3 | 5 | 6 | * |
| Food | | | 1 | 4 | 3 | 2 | 5 | 6 | * |
| Fungicides, Insecticides, Pesticides | 1 | | 2 | 5 | 4 | 3 | 6 | * | |
| Furniture Polish (Water Based) | | | 1 | 4 | 3 | 2 | 5 | 6 | * |
| Furniture Polish (Solvent Based) | 2 | 1 | 3 | 6 | 5 | 4 | 7 | 8 | * |
| Furniture Stain | 2 | 1 | 3 | 6 | 5 | 4 | 7 | 8 | * |
| Graphite | | 1 | 2 | | | | | | |
| Grease | 1 | 2 | 3 | | | | 4 | 5 | * |
| Ink | 2 | 1 | 3 | 6 | 5 | 4 | 7 | 8 | * |
| Iodine | 1 | | 2 | 5 | 4 | 3 | 6 | 7 | * |
| Lipstick | 2 | 1 | 3 | 6 | 5 | 4 | 7 | 8 | * |
| Medicine | 2 | 1 | 3 | 6 | 5 | 4 | 7 | 8 | * |
| Merthiolate | | | 1 | 4 | 3 | 2 | 5 | 6 | * |
| Nail Polish | 2 | 1 | 3 | | | | 4 | 5 | * |
| Oil | 1 | | 2 | 4 | | 3 | | 5 | * |
| Paint | 2 | 1 | 3 | | | | 4 | 5 | * |
| Plant Food | | | 1 | 4 | 3 | 2 | 5 | 6 | * |
| Rust | | | 2 | 3 | 1 | | 4 | 5 | * |
| Shoe Polish | 2 | 1 | 3 | 5 | | 4 | 6 | 7 | * |
| Soft Drinks | | | 1 | 4 | 3 | 2 | 5 | 6 | * |
| Soot | 1 | | 2 | 3 | | | | 4 | * |
| Tar | 1 | | | | | | 2 | 3 | * |
| Toothpaste | | | 1 | | | | | | |
| Urine | | | 1 | | 2 | | 3 | 4 | * |
| Vomit | | | 1 | 4 | 3 | 2 | 5 | 6 | * |

* While recommended cleaning agents are effective, some stains may become permanent.

**Cleaning Solutions:**

**A. Dry Cleaning Fluid**: A nonflammable spot removal liquid, available in grocery and hardware stores.

**B. Nail Polish Remover:** Any acetate, which often has a banana fragrance. Do not use if it contains acetone.

**C. Detergent Solution:** Mix two cups of cold water and 1/8 teaspoon mild liquid detergent (no lanolin, non-bleach).

**D. Warm Water:** Lukewarm tap water.

**E. Vinegar Solution:** One cup white vinegar to one cup water.

**F. Ammonia Solution:** One tablespoon household ammonia to one cup water.

**G. Kit - Spot Removal:** Available from retail carpet stores or professional cleaners.

**H. Call Professional:** Additional suggestions, special cleaning chemicals or the ability to patch the area might be available.

**I. Permanent Change:** Due to the nature of the stain, there may be color loss. The carpet has been permanently dyed or the carpet yarns have been permanently damaged.

**NOTE: While the recommended cleaning agents have proven to be effective, some stains may become permanent.**

Tile floors vary in porosity and surface irregularities. This can make it difficult to protect and maintain. Regular maintenance is important to keep the tile in the motorhome looking showroom new. Once the slide-out has been extended, keep the tile floor clean to prevent dirt from scratching the tiles prior to retracting the slide-out.

**NOTE: Tile is ceramic and will chip and break easily. Avoid dropping heavy or sharp objects on the tile.**

**Cleaning Tile:**

Use a damp sponge mop or a cloth to clean tile and maintain its luster. If moderate staining occurs, cleaning with a window cleaner such as Windex should do the job. A mild solution of hot water and all-purpose cleaner for tile floors, walls and countertops can also be used. Rinse well with clear water and dry with a soft cloth to prevent streaking. Avoid cleaning tile with soap. Soap forms a film to dull the luster. Soap also promotes the growth of mildew and bacteria. Do not use powdered cleaners on unglazed tile floors. Undissolved powder will dull the surface. Grout sealers are available that protect the porous surfaces. If a sealer is used, follow the sealant manufacturer guideline for application. Never use sealers on unglazed tile. With the exception of terra cotta, which may be oiled or waxed, tile does not need to be polished or buffed maintain its finish.

**Grout:**

The grout used is a two part concrete mix. It is normal for this type of grout to develop surface cracks over time. In motorhome application, due to the constant flexing of the flooring, this process may accelerate. If the grout requires cleaning, scrub with a plastic brush. Do not use steel wool as small particles may remain and produce unsightly stains.

**NOTE: Before using any solution to clean the tile, check the manufacturer's warning label to ensure the safety of the product. If there is any doubt, apply several test patches of the solution in an inconspicuous place to determine the product's suitability.**

## Laminate Floors (Optional)

Laminate flooring used in the motorhome provides style, durability and ease of maintenance. This high-pressure laminated flooring is designed to be incorporated as a floating floor.

Laminate flooring is constructed of three main material components. The surface, similar to many countertops, contains aluminum oxide particles to form an extremely hard, durable outer layer. The carrier, or core layer, is constructed from high density fiberboard. A tongue and groove design provides a tighter bond. The backer or bottom layer is also made of laminate for strength.

**Cleaning and Maintenance:**

For everyday cleaning, vacuum the floor to remove dirt and debris. It is recommended to occasionally mop the floor using a cotton string mop and a minimal amount of water. Use a mixture of soap-free household cleaner (either vinegar or ammonia work well) and water for a more thorough cleaning.

- Wipe away stains with a damp cloth.
- Stains caused by inks or paints may require a cloth moistened with acetone (nail polish remover).
- Stains caused by gum or tar should be allowed to harden completely, then gently scraped away.
- Felt protectors on the bottom of furniture and floor mats can preserve the beauty and appearance of the flooring.

**CAUTION: Abrasive cleaners and scouring pads can scratch and damage the flooring. Never wax, sand or apply lacquer to laminate flooring.**

**NOTE: Any unusual or unique problems concerning the laminate flooring can be addressed by contacting Wilsonart at (800) 433-3222.**

## SHOWER

Showers are susceptible to soap build up. Showers should be cleaned weekly to prevent burdensome clean-up. Using the same solution used to clean tile floors will be sufficient for the shower. However, to control mildew growth spray the shower with household chlorine bleach and allow it to stand for five minutes. Clean the glass shower doors with window cleaner on a weekly basis to maintain the shine. If water spots cannot be removed from the glass, rub lightly with the flat edge of a razor blade to remove deposits.

To prevent excessive moisture and a continual growth of mildew, use the shower only with adequate ventilation. The sealant in a regularly used shower should be replaced once a year. To replace sealant, remove the old sealant using a sharp non-metallic instrument. Apply a new sealant, which can be found at most recreational vehicle supply stores.

## CEILING

The ceiling of the motorhome can be a variety of materials or fabrics, many of which require little or no care or maintenance.

**Vinyl:**

The soft touch padded vinyl ceiling can be cleaned using the procedures discussed in the vinyl article of this section. Generally, a mild soap and water is sufficient for cleaning vinyl.

**NOTE: Use care not to puncture the padded vinyl.**

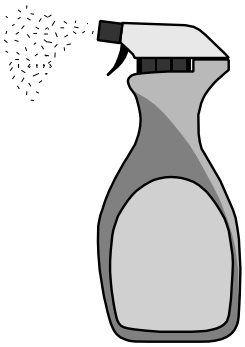
**Hardwood Vinyl and Decorated Paneling:**

Hardwood vinyl and decorated paneling are sensitive and demanding materials. Certain cleaning agents will affect the surface on both printed and unprinted vinyl. Use only a mild, non-abrasive detergent and warm water with a soft cloth or sponge for cleaning to protect the material.

Under no circumstance should bleach, alcohol, oil-based spray cleaners or cleaning agents with solvents, citrus oil or harsh chemicals be used. Other liquid spray cleaners may also cause damage to the material.

## WALL COVERINGS

Time is very important when removing substance from wall coverings that are solvent based or contain color. Do not use abrasive cleaners containing chlorine bleach or solvents. *Fidelity*® and *Jolie*® brands are recommended. Always begin with a mild detergent or soap and warm water. To remove normal dirt clean with a soft sponge. Rinse and wipe dry.



cleaner

**Care for the Tower Wall Covering:**

Remove ordinary stains with mild soap and warm water. Sponge on. Rinse well and dry with a soft cloth. **For special cleaning problems:** To remove ball point pen, blood, lipstick, etc., use a sponge or soft bristle brush and *Formula 409*®, *Fantastik*® or a similar product. Rinse well and dry. Finish cleaning by applying full strength isopropyl alcohol with a sponge or soft brush. Rinse well and dry.

**Care for the Satinesque Wall Covering:**

Stains should be removed as quickly as possible to minimize reaction between the staining agent and wall covering. Time is very important when removing substances that are solvent based or contain color. Examples: nail polish, oil, shampoo, lacquer, enamel, paint, ink and lipstick.

Always begin cleaning with a mild detergent such as soap. If necessary, move to a stronger cleaner such as household bleach, liquid household cleaners or rubbing alcohol. Before using one of the stronger cleaners, test the cleaning agent on a small inconspicuous portion of the wallcovering to make sure that the cleaner does not affect the color or gloss of the wall covering.

**Stain Removal Procedures for Specific Stain Types:**

**Normal Dirt:**

Remove normal dirt using a mild soap or detergent and warm water. Allow it to soak for a few minutes then rub briskly with a cloth or sponge.

**Nail Polish, Shellac or Lacquer:**

Remove liquid using a dry cloth. Use care not to spread the stain. Quickly clean the remaining stain with rubbing alcohol. Rinse with clean water.

**Ink:**

Remove immediately by wiping with a cloth dampened in rubbing alcohol. Rinse with clean water.

**Chewing Gum:**

Rub with an ice cube to cool and harden. Gently pull off the bulk of the gum. Remove any remaining gum with rubbing alcohol.

**Pencil:**
Erase as much of the pencil mark as possible. Wipe any remaining marks with rubbing alcohol.

**Blood, Feces or Urine:**
Remove these staining substances as quickly as possible. Wash the stained area with a strong soap. If the stain does not disappear, rinse the soapy area thoroughly with clean water. Mix a solution of 50% water and 50% household bleach. Clean the stained area with the bleach solution. Rinse with clean water.

## WOOD CARE

Wood should be treated the same as a piece of fine furniture. Care and cleaning of the wood surface is essential in maintaining the natural beauty of wood. Keep in mind that wood finishes can vary widely. Test a new cleaning solution in an inconspicuous area to check for possible damage.

The care and cleaning of the solid wood surfaces and the wood products used in the motorhome depends on individual choices and preferences. Numerous waxes, polishes and finishing products are available for use. Always follow the manufacture label and instructions. The solid wood surfaces should be cleaned weekly. Dust regularly with a soft, lint-free cloth. Dampen the cloth slightly with water. Wipe one small area at a time and dry immediately.

For stubborn stains, use a clean cloth dampened with a solution of mild, non-alkaline soap (like dishwashing liquid) and water. Dry thoroughly using a soft cloth. Buff lightly, following the direction of the grain. Never use abrasive cleaners, scouring pads or powdered cleansers.

Excessive dampness, dryness, heat, or cold can damage solid wood finishes. Sunlight can change the color or age the wood. Never allow moisture or spills to stand, always blot dry immediately. Solvents, alcohol, nail polish and polish removers, as well as harsh cleaners should not be used on finished wood surfaces.

Minor damage to solid wood surfaces can be repaired quickly and effectively with a bit of hard work, some careful attention to details, and most importantly, the right materials. However, any wood repair or finishing job is best left for a professionally trained individual.

**NOTE: It is important to inform the service technician of any products used for the care and cleaning in the event of wood repairs.**

**Sanding and Sandpaper:**

The following table is a general guide to the proper uses, although this may vary from wood type to type.The key to sanding is using the right sandpaper for the repair that is needed. Always sand with the grain.

| GRIT | GRADE | USAGE |
|---|---|---|
| 80-120 | Medium | Smoothing the surface, removing small marks. |
| 150-180 | Fine | Final sanding prior to finishing. |
| 220-240 | Very Fine | Sanding between coats of seal. |
| 280-320 | Extra Fine | Removing dust spots or marks between finish coats. |
| 360-600 | Super Fine | Remove luster of surface blemishes after finish coat. |

**Steel Wool:**

Abrasive material composed of long steel fibers of varying degrees of fineness that are matted together. The coarser grades are used to remove paint and other finishes; the finer grades for polishing or smoothing a finished surface.

**Nail Holes and Small Cracks:**

Fill nail holes and small cracks with wood putty or dough for unstained woods prior to any sanding. Stained finishes require filling holes and cracks after the stain has been applied. Putty should match the stain closely in color.

**NOTE: A little sawdust and wood glue can be used to make putty for end grains.**

**Fixing scratches in stained woodwork:**

"Quick and simple" rarely describes repairs to stained wood finishes. However, a few tricks can be tried. When scratches appear lighter than the surrounding dark-stained woodwork, it usually means either that the scratch goes through the stain into the wood or that the varnish is flaking off.

**Dents:**

Dents are the results of wood fibers being crushed and compressed. Dents can be raised back to original level by steam. To raise a dent, place a damp cloth over the dent and hold a medium-hot iron on it. The steam will cause the wood fibers to swell back into place. It may be necessary to repeat this process until the dented area is level with the surface. Allow the area to dry.

**Restoring the clear finish:**

Check the scratches carefully. If flaking varnish is visible with dark-stained wood underneath, only the clear finish may need to be restored. Rub the loose varnish with fine steel wool or fine synthetic steel wool until you have removed the flaking varnish and slightly roughened a small area of the finish surrounding the scratch. With the tip of rag, a small brush, or even a cotton swab, apply a thin coat of a wipe-on finish. Apply finish to the damaged area only. Several coats may be needed to hide the scratch.

**Re-staining the wood:**

If bare wood is visible at the bottom of the scratch, the wood will need to be re-stained. To remove damaged varnish, lightly roughen a small area around the scratch with sandpaper, steel wool or synthetic steel wool. Find a stain that is a shade lighter than the wood finish. Stain the bare wood with a very small amount of stain on a rag, brush or cotton swab. If the color is too light, apply several coats. Rub away excess stain with a dry rag. If the wood becomes too dark, use a rag moistened in mineral sprits to lighten the wood. Select a lighter color stain and continue.

Several companies have simplified this repair process by putting oil-based wood stain into marker-like containers. Just rub the stain marker on the scratch. Start with a stain color that is lighter than the original finish, because torn and scratched wood fibers will absorb stain and darken quickly. A second coat can always be applied if the color of the first coat is too light. Once the color is blended, patch the clear finish as described above and apply a wipe-on finish.

**Scratches and Nicks:**

Several professional woodworkers use similar procedures and tricks when it comes to scratches and nicks, most of which can be easily repaired. Always test an inconspicuous area of the wood prior to repairs to ensure no damages to the finish.

Light scratches will often disappear when carefully rubbed with furniture polish or paste wax. Deeper scratches can be hidden by carefully rubbing with a piece of oily nutmeat such as Brazil nut, black walnut or pecan. Be careful to rub the nutmeat directly into the scratch to avoid darkening of the surrounding wood. Color the scratch with brown coloring crayon or liquid shoe dye (especially good on walnut).

Staining the scratch with iodine:
Mahogany - Use new iodine.
Brown or Cherry Mahogany - Use iodine that has turned dark brown.
Maple -Dilute one part iodine with one part denatured alcohol.

Commercial scratch removers, or stick wax to match the wood finish, can also be used. After the scratch has been hidden, polish or wax the entire area. Deep scratches should be repaired and finished by a professional.

## COUNTERTOP - Solid Surface

The Solid Surface was created for a lifetime of easy care. Just follow the simple guidelines listed here to the keep countertop surface looking nice.

**Routine Care:**

The motorhome countertops are finished with one type of finish: matte/satin. All solid surface sinks and bowls have a matte/satin finish. Soapy water or ammonia-based cleaners will remove most dirt and stains from all tops and bowls. However, slightly different techniques must be used to remove different stains. Follow the recommendations below.

**Cleaning the Countertops:**

- Most dirt and stains: Use soapy water or ammonia-based cleaner.
- Water marks: Wipe with damp cloth and towel dry.
- Difficult stains: Use soft scrub and a Grey *Scotchbrite* Pad.
- Disinfecting: Occasionally wipe surface with diluted household bleach (one part water and one part bleach).

**Cleaning the Solid Surfaces Sink:**

Occasionally clean by using *Soft Scrub Liquid Cleanser* and a Grey *Scotchbrite* pad. Scrub the sink, rinse and towel dry. Do this as often as necessary.

**Removing Cuts and Scratches:**

Because the beauty of the surface goes all the way through the Solid Surface, countertops are completely renewable. Use the following instructions to remove minor cuts and scratches.

- Sand with 180 grit and then 320 grit sandpaper until the scratch is gone.
- Restore the finish using a Grey *Scotchbrite* pad. Never sand hard in one small area. Feather out lightly to blend restoration.

**Preventing Heat Damage:**

The Solid Surface withstands heat better than ordinary surface materials; however, hot pans and some heat-generating appliances, such as frying pans or crockpots, can damage the surface. To prevent heat damage always use a hot pad or a trivet with rubber feet to protect the surface. In most cases the surface can be repaired if it is accidentally damaged.

**Other Important Tips:**

Avoid using strong chemicals on the Solid Surface such as paint removers or oven cleaners. If these chemicals come in contact with the Solid Surface, quickly wash with water. Avoid contact with nail polish or nail polish remover. If contact is made, quickly wash with water.

**NOTE: Do not cut directly on the solid surface. Always run cold water into the Solid Surface sink when pouring boiling water into the sink.**

### Countertops - Laminate

Clean laminate countertops with a damp cloth or sponge. Use a spray cleaner to remove stubborn stains. Avoid using harsh abrasives, scouring powders, peroxides or bleaches as these products may dull or damage the surface. Avoid contact with dyes, bleaches, and indelible inks on food packages. Do not use laminated countertops as a cutting board. Laminated countertops are resistant to minor heat; however, hot pans, irons, and lighted cigarettes will damage the surface. Use hot pads under pans taken directly from the stovetop.

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## WINDOWS

**Water Spots:**

Any glass will develop water spots if not cleaned properly. A spotting effect is magnified when the glass has a reflective finish. Use a squeegee immediately after washing to reduce water spotting. To remove stubborn water stains from reflective glass we recommend *Cerium Oxide Polishing Compound*, made by C.R. Lawrence, available at most glass shops.

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### Condensation

Condensation is a natural phenomenon. The amount of condensation will vary with climate conditions, particularly in relative humidity. Condensation occurs from water vapor present in the air. Each of us add more vapors by breathing, bathing, cooking, etc. Water vapor collects wherever there is available air space. When the temperature reaches the dew point the water vapor in the air condenses and changes to liquid form.

**Controlling Moisture Condensation:**

Reduce or eliminate interior moisture condensation during cold weather by using the following steps:

- Partially open the roof vents and windows so that outside air can circulate into the interior. Increase the ventilation when large numbers of people are in the motorhome. Even in raining or snowing conditions the air outside will be far drier than the interior air.
- Install a dehumidifier. Continuous use of a dehumidifier is effective in removing excess moisture from the interior air. Using a dehumidifier is not a cure-all, however, it will reduce the amount of outside air needed for ventilation.
- Run the range vent fan when cooking and the bath vent fan (or open the bath vent) when bathing, to reduce water vapor. Avoid excessive boiling or use of hot water as it produces steam.
- Do not heat the motorhome interior with the range or oven. Heating with the range or oven increases the risk of toxic fumes and allows oxygen depletion. Also, open flames add moisture to the interior air increasing condensation.
- In very cold weather leave the cabinet and closet doors partially open. The air flow will warm and ventilate the interior of the storage compartments and the exterior wall surface, reducing or eliminating condensation and preventing the possibility of ice formations.

## WINDOW TREATMENTS *- Mini Blinds*

- **Dusting:**
  Regular dusting maintains the appearance of most blinds. Keep the aluminum blind looking its best by periodically wiping them with a soft cloth or a dusting mitt. By tilting the slats down, but not quite closed, you'll be able to clean most of the top surface of each slat. Blinds may be cleaned while hanging in place using this method.

- **Vacuuming:**
  For deeper cleaning, vacuum gently with brush attachment of any vacuum cleaner.

- **Compressed Air or Hair Dryer (non-heat setting):**
  Blow dust off each slat. Dust will be air-borne using this method so ventilate the motorhome.

- **Spot-Cleaning:**
  Spot-clean shades and blinds using a soft cloth or a moistened sponge with lukewarm water. Add mild detergent, if needed. Blot gently to avoid creasing. In a dusty environment, the blinds may need to be cleaned regularly using a sponge or dampened soft cloth. Use warm (not hot) water and a mild detergent. The mild detergent cannot contain abrasives. Rinse the blinds using a clean cloth and water to prevent water spots. Place a towel directly under the blinds to absorb any water that might drip down.

- **Ultrasonic cleaning:**
  Professional ultrasonic cleaning may be preferred.

- **Tub cleaning:**
  1. Immerse entire shade assembly in lukewarm water with mild detergent. Wash for several minutes by gently moving liquid around with your fingers.
  2. Rinse with clear water.
  3. Close shade before removing from rinse water.
  4. Hold rails and tilt the shade to allow excess water to drain off.
  5. Re-install damp shade into window opening. Place a towel directly under the blinds to absorb any water that might drip down.
  6. Lower shade all the way to allow it to dry completely.

## *Day/Night Shades (Optional)*

The day/night shades are made of polyester blended material. Use the following guidelines to care and maintain the day/night shades:

- Leave Day-Night shades in the **UP** position when not in use to help shades hold their shape.
- String tension for the shades should be equal. The tension can be adjusted if the shades will not remain up.

**Dusting:**
Vacuum with a brush attachment, or use a dusting tool, on a regular basis.

**Cleaning:**
A dry foam cleaner may be used for soil and dirt removal. Follow all directions on the container or a cleaning solution of ¼ ounce clear liquid soap to 8 ounces water.

**NOTE: Do not use colored liquid soap as a stain may appear when fabric dries.**

## MOLD & MILDEW

**What is Mold?**

Mold is a plant belonging to the Fungi group. In short, mold is a type of fungus that occurs naturally in the environment, and is necessary for the natural decomposition of plant and other organic material. Mold spreads by means of microscopic spores borne on the wind, and is found everywhere life can be supported. Due to the fact mold spores are present in all types of environments, motorhome construction is not, and cannot be, designed to exclude mold spores. If the growing conditions are right, mold can grow in the motorhome. Most people are familiar with mold growth in the form of bread mold, and mold that may grow on bathroom tile. Mold spores, as they grow, can leave a musty odor, discolor fabric, and stain surfaces as well as cause considerable damage.

**What Does Mold Need to Grow?**

Being a plant, mold will need a food source in order to grow. Mold can use a variety of organic materials such as fabric, carpet, wallpaper, or even building materials, such as wood and insulation, to name a few. Grease films contain many nutrients for mold spores to grow when moisture and temperatures are right. Soil on dirty items such as fabrics and furniture may supply enough nutrients for mold to grow. Many of the synthetic fabrics such as acetate, polyester, acrylic and nylon are mildew resistant. However, soil on these fabrics may supply the nutrients to start mold growth.

Mold growth requires a temperate climate. The best growth occurs at temperatures between 40º F and 100º F. Finally, mold growth requires moisture. Moisture is a mold growth factor that can be controlled. By minimizing moisture inside the motorhome, mold growth can be reduced or eliminated.

Moisture in a motorhome can have many causes. Spills, leaks, overflows, condensation, and high humidity, to name a few. Good housekeeping and regular maintenance are essential in the effort to prevent or eliminate mold growth. If moisture is allowed to remain on a growth medium, mold can develop within 24 to 48 hours.

**Consequences of Mold:**

All mold is not necessarily harmful, but certain strains of mold have been shown to cause, in susceptible persons, allergic reactions, including skin irritation, watery eyes, runny noise, coughing, sneezing, congestion, sore throat and headache. Individuals with suppressed immune systems may risk infections. Some experts contend that mold causes serious symptoms and disease which may even be life threatening. However, experts disagree about the level of mold exposure that may cause health problems, and about the exact nature and extent of the health problems that may be caused by mold. Moreover, the Center for Disease Control states that a casual link between the presence of toxic mold and serious health conditions has not been proven.

Standards or threshold limit values for concentration of mold or mold spores have not been set. Currently, there are no EPA regulations or standards for airborne mold contaminants. There is simply no practical way to eliminate all mold and mold spores in the indoor environment. For example, studies have shown that ozone cleaners are not effective at killing airborne mold or surface mold contamination.

**Controlling Mold Growth:**

The owner can, and should, reduce or eliminate the occurrence of mold growth in the motorhome; thereby, minimizing any possible adverse effects that may be caused by mold. Taking the following steps can help reduce of eliminate mold growth in the motorhome.

1. Check for signs of mold prior to bringing items in the motorhome. Potted plants (roots and soil), furnishings, or stored clothing and bedding material, as well as many other household goods, may already contain mold growth.
2. Regular vacuuming and cleaning will help reduce mold levels. Mild bleach solutions and most tile cleaners are effective in eliminating or preventing mold growth.
3. Indoor humidity can be reduced by 30-60% when venting clothes dryers to the outdoors. Ventilate the kitchen and bathroom by opening the windows, by using exhaust fans, or a combination of both. Operating the air conditioning will remove excess moisture in the air, and help facilitate evaporation of water from wet surfaces.
4. Promptly clean up spills, condensation and other sources of moisture. Thoroughly dry any wet surfaces or material. Do not let water pool or stand in the motorhome. Promptly replace any materials that cannot be thoroughly dried.
5. **Inspect** for leaks on a regular basis. Look for discolorations or wet spots. Repair leaks promptly. Inspect condensation pans (refrigerators and air conditions) for mold growth. Take notice of musty odors, and any visible signs of mold.
6. Should mold develop, thoroughly clean the affected area with a mild solution of bleach. First, test to see if the affected material or surface is color safe. Should the mold growth be severe, call on the services of a qualified professional cleaner.
7. If materials with mold on them cannot be cleaned, they should be removed and properly disposed.

Whether or not a motorhome owner experiences mold growth depends largely on how the motorhome is managed and maintained. As a manufacturer, our responsibility is limited to things that we can control. As explained in the written warranty, we will repair or replace defects in the construction (defects defined as a failure to comply with reasonable standards of motorhome construction) for the Limited Warranty coverage period provided. **THE MANUFACTURER WILL NOT BE RESPONSIBLE FOR ANY DAMAGES CAUSED BY MOLD THAT MAY BE THE CONSEQUENCE OF OR ASSOCIATED WITH DEFECTS IN THE CONSTRUCTION.**

## PEST CONTROL

Pests can come in all sizes and shapes, from insects to mammal. Regardless of the area one lives in or travels to, it is safe in stating there will be pests waiting. These pests are not only annoying; they can pose health risk and create serious damage to the motorhome. There are a number of host-transmitted diseases that can be carried by a pest.

- Common pests include insects such as ants, cockroaches, termites, flies, pantry pests and wasps as well as wildlife such as rodents, raccoons, bats, birds and snakes. It is important to remember, pests are the same as humans in the fact they need food, water and a place to live. Eliminating any one of those elements will help significantly in controlling the pest.

To control pest infestation, eliminate those factors that attract pests, and take immediate steps to remove a pest as soon as the presence is detected. There are a number of steps that can be taken to help in controlling pests:

- Reduce clutter inside the motorhome and storage bays. All storage items, particularly food (including pet food), should be kept in tightly sealed containers. Seal all cracks and holes, and insure that window, door and vent screens are securely in place.
- Routinely clean the motorhome, including storage bays. Wipe down the water bay. Promptly remove all crumbs from areas where food is regularly prepared and eaten. Garbage should be placed in a sealed container and removed to an outside receptacle daily. Only put out pet food that will be immediately eaten.
- Keep foods such as flour, cereal, spaghetti and pet food in re-sealable containers with tight lids.
- Sweep and vacuum often (especially in eating areas) to help eliminate food sources for some pests.

- Seal cracks, crevices, and other gaps especially around doors and windows. Make sure all windows and doors are screened and fit the screens snugly in the frame.
- Many pests need moisture to successfully live and reproduce. Limit access to water or moisture sources by sealing any cracks and leaks in pipes and faucets. Reduce moisture in the motorhome by controlling condensation, immediately wiping up spills and promptly repairing leaks. Be extra alert around areas that attract rodents and insects, including the sewer hose, fresh water hose, bay doors and items that may be leaning against the outside of the motorhome, such as fishing poles and golf clubs.
- When the motorhome is stored outdoors, clear the surrounding area of all rodent friendly hiding places - shrubs, trees and clutter. Completely seal the underside of the motorhome. Wire mesh will work well to prevent points of entry, but beware of blocking necessary air vents. Prior to operating the motorhome after storage, remove all insect and animal nests that may have developed around vents, engine compartments, and the exhaust pipe and in the wheel wells.

**Rodents:**

Rodents may chew through wires or build nests in components of the motorhome. Signs of rodent infestation include droppings, shredded material or chewed furniture fabrics and vinyl. Rodents like to build nests with wire insulation, and are commonly attracted to the outside coating of 110 wiring more than 12-Volt wiring.

**NOTE: Although the back cap on most motorhomes is well sealed, rodents are capable of chewing through the foam insulation and that area should be routinely inspected.**

If there are signs of rodent infestation around the motorhome, place traps or poisons in suspected areas. Keep the traps and poisons safely away from pets and children. Cheese is not the best bait for a rodent trap. Use peanut butter or chocolate in small amounts. Place the bait on the trigger of the trap to induce the rodent to climb onto the trigger to reach the bait. Rodents do not limit invasion to unused vehicles.

**Insects:**

Eliminate insects the moment a sign of infestation is spotted. If you are unable to identify the type of insect, purchase some sticky traps from the hardware store and place the tape where you have seen the insects. Once caught, seek assistance in identifying the insect and determining what will be required to remove the infestation.

Regularly inspect the exterior of the motorhome for signs of a budding wasp nest, and promptly destroy small nests before they become too large.

Spiders can be in any structure. Since they are predators and feed on living prey, this would indicate other smaller pests may be found. Immediately remove spider webs. Some types of spiders like to nest on top of the diesel tank and around the diesel hoses. Dispense of spiders using a vacuum. Use care to capture the spider and egg sacs. Throw the vacuum bag away in a sealed bag.

Fruit flies invade the motorhome by attaching themselves to fresh fruits and vegetables. Determine what food items are generating the flies and discard that item in an outdoor trash receptacle. Any remaining fruit flies can be eliminated with a homemade trap. Pour a few ounces of vinegar into a cup and cover the cup with plastic wrap. Secure the wrap with tape or a rubber band and poke a ¼" hole in the plastic. Place the trap in the area where fruit flies are present.

Ants live in colonies. Only a fraction of the ant colony will leave to seek food. Spraying pesticides will only kill the ants that are away from the colony. To eliminate all ants, the colony must be destroyed. Keep ants away from the sewer hose by spraying the hose ends with a soap and water solution.

Fleas can be removed by properly treating pets with a veterinarian-approved treatment and a thorough cleaning of the motorhome. Vacuum vinyl areas and tile floors to remove dust, flea larva and flea eggs. Follow by thoroughly washing those areas with soap and water. Carpets must be vacuumed and treated with a residual flea control product labeled safe for indoor carpet and furniture use. Perform the cleaning treatment daily for three days to insure that all fleas have encountered the treatment.

Flying outdoor insects are attracted to bright light. Yellow porch light covers on the motorhome work to discourage insect invasion. During nighttime hours insects will be attracted to docking lights, or other bright exterior lighting.

If the presence of moths is detected inside of the motorhome, usually by holes appearing in material, clean the affected clothing and all other items stored in the same area. Follow by completely cleaning the closet, dresser or storage area. If cracks are detected, seal the cracks and treat the area with a properly labeled indoor pest control product.

Even birds can be considered pests, particularly when the motorhome is parked in the flight path of a flock. Bird droppings are hard to remove and will leave stains. Prevent permanent staining to the motorhome roof by regularly cleaning the surface to remove all bird droppings.

**Damage from Pest:**

On one occasion a motorhome owner, investigating the cause of a failed inverter, discovered that a lizard had crawled in the inverter, shorted out the circuit board and died. Lizards can be captured using glue traps. To remove the lizard from the trap, dissolve the glue with vegetable oil and then release the lizard outside and well away from the motorhome. A scorpion will glow blue-green in UV light. If you suspect the presence of scorpions in the motorhome, investigate with an UV black light during the nighttime hours.

**What are the best sources of information about common household pests?**

The Internet is a great place to find information about common pests, however, the information is not always correct. The National Pest Management Association website can be useful resource about common pest. Another good source for information are colleges and universities with entomology departments (entomology is the study of insects).

Electronic pest control devices can be costly and most likely will not work on all types of rodents and insects. When calling on the services of a professional to combat pest infestation, call a reputable business that is licensed in handling pesticides. Check references. Explain that you are seeking assistance for a motorhome, as treatments may differ from standard household jobs.

If you do suspect a pest problem in the motorhome, consider professional pest control help. The following guidelines can be used for selecting a pest control service.

- A good place to start is to inquire as to who has used pest control services. Inquire about the type of pest problem encountered and how satisfied they were with the service.
- Membership in the national, state or local pest control associations is a good indicator that the company has access to modern technical information and is committed to further education.
- Reach a complete understanding with the company before work starts; find out what the pest is, how the problem will be treated, how long the period of treatment will be, and what results can be expected.
- Be sure to understand what is guaranteed and what is not.

## GENERAL LUBRICATION MAINTENANCE

Performing regular scheduled maintenance ensures reliable operation and optimum service life of the various chassis components. Completed maintenance brings peace of mind knowing the various components have received proper service. Failure to follow maintenance guidelines, or perform scheduled maintenance, results in inefficient operation, premature component wear or component failure resulting in breakdown.

Maintenance schedules are usually performed at certain mile or time intervals. When performing high level procedures, lower level service should also be performed. Maintenance procedures for chassis components are located in the chassis section

**NOTE: Maintenance schedules are based on normal operating conditions and use. Operating under unusual or adverse condition shortens service intervals.**

**NOTE: Engine and transmission service intervals are listed in their respective manuals.**

### *Lubricants*

Many chassis components require lubrication. The types of lubricants used will vary with the application of the component. A component may fail prematurely due to lack of lubrication or from using an incorrect lubricant type. The component manufacturer usually recommends a particular type of lubricant with a minimum approval rating. Most lubricants are tested under strict guidelines set by the ASTM (American Society for Testing and Materials). The NLGI (National Lubricating Grease Institute) helps disperse information to the grease production industry. Grease containers usually have an approval rating by the SAE (Society of Automotive Engineers), Mil Spec (Military Specification), API (American Petroleum Institute) or by other recognized and accepted organizations. The correct lubricant type with an approved specific rating must be used whenever applying, changing or adding any lubricant. When purchasing lubricants for a specific application be sure the label affirms the type of lubricant required with the tested rating by the term "meets or exceeds" in accordance with the manufacturer specifications.

### *Lubricant Classification*

Lubricants are manufactured in many forms for a variety of applications. There are many different oil and grease consistencies each with a designed application. To properly select a particular type of lubricant for a specific application, the component must be evaluated. Component stress loads, ambient temperature, working temperature and environmental exposure are just a few of the variables to consider. Select the proper lubricant for its intended application. As an example: selecting high viscosity grease to lubricate a lock cylinder results in sluggish lock cylinder operation especially in a cool environment. Conversely, using graphite to lubricate a component that is under extreme temperature and load will result in component failure.

Grease ratings and their base compounds are especially important when selecting a lubricant type for an intended application. Some grease compounds are manufactured for multi-use application. These are acceptable if the grease rating is in accordance with the manufacturer's recommended lubricant type and rating.

Lubricating greases are made from different base compounds giving the grease different lubricating consistencies, properties and maximum operating temperatures. Most containers list the base compound and maximum operating temperature usually listed as melting point or drip point. Lubricating components, such as brake component for example, require a high temperature special base compound grease. Lubricating this type of component with other than specified grease type will result in inadequate lubricating qualities resulting in component malfunction or failure.

**Be Observant:**

When performing any scheduled maintenance, **inspect** the area around where you are working. For example, changing the oil, look at the rear differential. **Inspect** for visual signs of fluid leaks. Use your nose to detect early signs of trouble. Most fluids and lubricants have a distinct odor. Generally, odors are most detectable soon after parking. Unusual sounds are another method of detecting a problem early. There are many types of sounds that are normal, such as the cyclic purging of the air dryer. Become familiar with the different sounds. If something sounds odd, smells peculiar or looks unusual investigate the situation.

## *Proper Fluid Disposal*

When performing service maintenance on the engine, transmission or rear axle, waste fluids and filters should be properly disposed of or recycled. Package used oils, antifreeze and other fluids in sealed containers. In many cases used oil is accepted free of charge at county disposal sites. Waste fluids are toxic to pets and other animals. Waste fluids should not be left in open containers. The sweet odor of antifreeze is attractive to pets, but highly toxic.

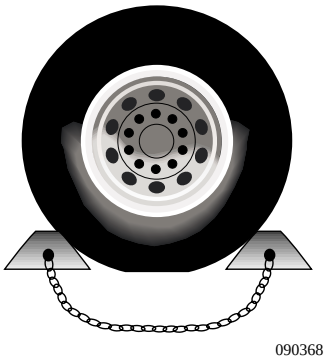
**CAUTION: Properly dispose of used antifreeze and waste oil. Animals like the sweet odor of antifreeze and may ingest it if left in open containers. Wipe up any fluid spills. Pets may lie in puddles of fluid, many of which are irritants and can cause severe chemical burns if not properly washed.**

## Greasing

When preparing to use a high-pressure grease gun, thoroughly clean all Zerk grease fittings before applying new lubricant. Keep paper towels or disposable rags handy when greasing. When lubricating items such as drive shafts and steer axles components, continued grease application is generally required until new grease appears at exit points.

Some items use sealed boots around the component to prevent moisture intrusion. When greasing these types of components care must be given to prevent excess lubricant pressure from rupturing the seal.

**WARNING: Always chock wheels before going underneath the motorhome.**



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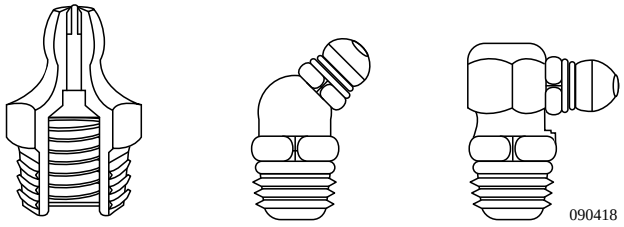
Brake actuating components require lubrication to keep the actuating components operating freely. Avoid contaminating brake linings with lubricant. Particular care and attention to details should be taken when lubricating brake actuating components. Wheel removal may be necessary to gain access the grease fittings.

**To apply grease:**

- Clean the grease fitting. Initially operate grease gun until new lubricant discharges from nozzle then wipe nozzle clean. This avoids introducing contaminants into the component.
- Snap nozzle onto grease fitting.
- Nozzle must remain in line with the grease fitting during the application process. If the nozzle is not in line, lubricant will collect around nozzle and grease fitting, failing to lubricate the component.
- Wrap the nozzle with a paper towel or rag to prevent contamination and accidental soiling of other areas.

If the component does not accept grease the Zerk fitting may be plugged or damaged. Zerk fittings are replaceable and generally available at most auto supply stores. Zerk fittings come in variety of angles depending on the application. Every effort should be made to lubricate the component, as neglect will only result in premature component failure.



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*Typical Zerk Fitting.*

**NOTE: Some grease fittings may not be accessible until the steering wheel is turned or the motorhome is moved slightly.**

## STORAGE - *Short Term*

Short term storage is defined as storing the motorhome for a period of thirty days or less. Properly preparing the motorhome during periods of short term storage will make bringing the motorhome out of storage a much easier process. Winterize the plumbing system if the motorhome is stored in winter months or if stored when temperatures are below 32º F.

**Checklist-Short Term Storage:**

- If applicable, retract the slide room(s). Do not store the motorhome with slide room(s) extended.
- Shut off all appliances. Close the primary LP-Gas valve.
- Remove all articles from refrigerator/freezer and clean thoroughly.
  Prop doors open to prevent mildew.
- Holding tanks should be drained and fresh water system winterized, with potable antifreeze or winterize the plumbing system using air pressure.
- Retract and secure all awnings.
- Turn **OFF** the battery cut-off switch.
- Batteries should be stored fully charged. Batteries stored in a discharged state will readily freeze.
- If possible, park the motorhome so that the batteries are accessible for charging or changing without having to move the motorhome.
- If available, leave the motorhome hooked to shore power. Leave the main battery disconnect switch **ON**.
- Careful placement of a small heat source in the interior will help control moisture. Desiccate filter systems help remove interior moisture.
- If AC power is not available turn the main battery disconnect switches **OFF**.
- If possible, store the motorhome inside a storage building.
- If stored outside, inspect all seams and seals for possible leakage.
- Store the motorhome with a full fuel tank to minimize moisture condensing at top of fuel tank.
- Vents and windows should be closed to prevent wind driven rain entrance.
- Tires should be stored at maximum inflation pressure.
- A full interior inspection for water leaks should be made bi-monthly, inspecting behind all cabinet doors and drawers.
- Start and run the generator at least 1/2 hour per month.

### Long Term

Long term storage of the motorhome can be defined as leaving a motorhome unattended for a period of thirty days or more. A motorhome requires protection from the elements just as a house or a car would. When left out in the environment without proper storage or maintenance, a motorhome, house or car is vulnerable to the moisture and oxidation processes inherent in the environment.

Preventative measures should be taken and preferable situations used when storing a motorhome. Such measures will aid in protecting and preventing a motorhome from the damaging effects caused by an accumulation of moisture.

**NOTE: The natural process of moisture in the air condensing will occur with temperature changes of 30º F or more in one day. Humidity readings of 60% or greater will allow the accumulated moisture to remain for extended periods of time.**

**If the motorhome is stored in a location where AC power is not available:**

- Turn off all the appliances.
- Turn off the battery cut-off switch.
- If possible, situate the motorhome so the batteries remain accessible. This allows a battery to be charged or replaced without moving the motorhome.
- Charge the batteries to a full state of charge.
- Turn the main battery disconnects **OFF**.
- When stored outside, use the available DC Volt meters to make a quick reference check of the batteries while the motorhome is in storage. If the motorhome is stored outside, solar panels may offset the parasitic loads.
- Preventative measures should be used if the voltage readings are low. When using preventative measures, taking the motorhome out of storage or moving the motorhome in case of an emergency is a much easier process.

**NOTE: Batteries in a low state of charge will readily freeze. Freezing will damage the battery.**

**CAUTION: A 20 Amp service using light duty extension cords and the required adapters create serious voltage losses. Line voltage loss and the resistance at each electrical connection is a hazardous combination and should be avoided. Damage to sensitive electronic equipment may result!**

**Type of surface to park and store the motorhome on:**

- The type of surface the motorhome is parked upon will affect how much moisture accumulation occurs on the chassis and flooring. Moisture can eventually seep into the interior.
- Parking the motorhome on a grass surface, with the tires supported by blocks, is a perfect situation for moisture to accumulate.
- A gravel covered parking area still allows moisture to evaporate from the ground, through the gravel and to the underside of the motorhome.
- Concrete pads should be sealed to prevent moisture coming up through the concrete flooring.
- Storage buildings with sealed concrete floors, or heated storage facilities, greatly reduce the amount of moisture accumulation and protects the motorhome from moisture damage.

**If the motorhome is stored outdoors:**

- The interior should be heated to help prevent mold and mildew growth. Moisture removing desiccate filter systems are available from hardware and RV supply stores. Place the filter system inside the motorhome to reduce inside moisture condensation or humidity. These systems help control mold and mildew growth.
- Proper winterization of the fresh water system will prevent potential damage in extreme cold.
- Ultraviolet radiation affects soft goods and rubber products such as privacy curtains, window shades and tires. These items should be protected.
- Cardboard templates can be made for the windows to protect these items from exposure to direct sunlight.
- Tire covers are available to protect the sidewall of the tires from cracking. Make sure the tires contain the correct air pressure. Underinflated tires can be damaged.
- Washing the exterior regularly will help control moss accumulation. The clear coat has UV protective substances. Waxing the motorhome twice a year will augment these substances.

**Inspect the motorhome:**

- Perform a full interior inspection for water leaks every two weeks while the motorhome is in storage. Open all cabinet doors looking for signs of dampness or leaks. Inspect the ceiling areas around roof vents or other roof openings.

- The roof and sidewall seams should be inspected and cleaned at least twice a year. **Inspect** for exterior sealant gaps of all roof seams, vents, skylights, roof air conditioners and windows. If necessary, use the proper sealants and recommended application procedures.

**Fuel:**

A full tank of fuel will help minimize moisture condensing at the top of the tank. Diesel fuel is an organic material which will develop a microbe growth (black slime). Fuel stabilizers may be added to control microbe growth and degrading of the fuel. Consult the Cummins manual or a Cummins distributor for further detailed information on fuel stabilizers and additives.

**Brakes:**

Brakes also suffer from non-use during periods of storage. The bare metal machined surfaces of brake drums or rotors have only a light coating of dust from the brake lining friction material. The brake dust is the only thing protecting the bare metal surfaces from rusting. Only regular brake applications dry the moisture preventing rust on brake drum or rotor surfaces. During periods of non-use, oxygen and moisture oxidize the machined surfaces. Only occasional use keeps these surfaces from oxidizing. Rusty brake drum or rotor surfaces permeate the brake linings upon the first few applications, reducing the friction action of the linings.

**Engine:**

Internal combustion engines need to be “exercised” on a regular basis. This will ensure that an adequate supply of lubricating oil coats the cylinder walls and piston rings. Valve and valve seat surfaces also suffer from non-use. Some valves will remain open depending at which part of the combustion cycle the engine has stopped. The heat and cold of the day allows moisture to accumulate through the exhaust system.

**Electric Motors:**

Electric motors in the motorhome should be operated occasionally to help lubricate and keep surfaces rotating freely. These items include the roof air conditioners, dash fans, dash blower motor, furnace motors and powered roof vents.

## Winter Storage - Checklist

- **Plumbing Lines** - Drain and protect by filling with approved RV antifreeze.
- **Fresh Water Tank** - Drain.
- **Body** - Clean and wax. Oil locks and hinges. Repair roof seams as needed.
- **Countertop and Cabinets** - Wash with mild soap and water.
- **Curtains** - Remove and clean according to care specifications.
- **Windows** - To protect the interior fabric from fading, cover windows by pulling blinds, closing shades or using a separate cover such as a sheet.
- **Holding Tank** - Drain and rinse. Close valves.

**Add a small amount of antifreeze to waste holding tanks to keep valves and gaskets lubricated.**

- **Drain Traps** - Pour RV antifreeze down all drains.
- **Refrigerator** - Clean and leave both doors propped open. Cover the exterior panels and roof vents.
- **Batteries** - Add distilled water and recharge if needed. Disconnect the cables. Remove the batteries and store them in a cool dry place. Check and recharge as needed. Never park the coach where the battery door cannot be opened.
- **Air Conditioner** - Remove the air filters. Clean or replace.
- **Roof** - Keep clear of snow accumulation or damage may occur.
- **Interior/Exterior** - Storing under cover or indoors helps extend interior and exterior life.
- **Fuel Tank** - Diesel fuel tank should be full of fuel.

### Removal from Storage

If the motorhome was properly and carefully prepared for storage, removing it from storage will not be difficult. The following checklist pertains to items or areas which should be checked before operating or moving the motorhome. If the motorhome was not properly winterized, extensive freeze damage or other serious deterioration may have occurred. Consult a dealer or an authorized service center for advice.

- Thoroughly **inspect** the outside of motorhome. Look for animal nests in the wheel wells or in other out of the way places.
- Remove all appliance flue vent covers, ceiling vent covers and air conditioning covers. Be sure the refrigerator openings are free of debris, insect nests, webs, etc.
- Open all doors and compartments. Check for animal or insect intrusion, water damage or other types of damage which may have occurred.
- Check the state of charge of the batteries. If necessary fill the cells with distilled water only and charge as necessary. Inspect the cable ends and terminals. They should be clean and free of corrosion.
- Check all the chassis fluid levels: engine oil, engine coolant, hydraulic fluid reservoir, transmission oil and rear axle oil.
- Start the engine, allowing it to reach operating temperature. Ensure the engine instruments are indicating proper readings.
- While the engine is running check the operation of headlights, taillights, turn signals, back-up lights, license plate light and emergency flasher. Operate the dash air conditioner. If the air conditioner does not work, or the compressor makes unusual noises, have the system checked by a qualified air conditioner technician.

- Shut the engine down. Adjust or add fluids as necessary. **Inspect** the engine for fluid leaks. Look under the motorhome for any other type of fluid leaks.
- Drain, sanitize and flush the fresh water system as outlined in the ***Water Systems - Section 6***. **Inspect** the sewer drain hose and connections for leaks. Replace if necessary.
- Operate all faucets and fixtures in the fresh water system. Run a sufficient amount of fresh water through all the water lines and faucets to thoroughly purge any potable antifreeze from the fresh water system.

**NOTE: Discard at least the first two trays of ice from the icemaker to ensure the ice does not contain traces of antifreeze or other contaminates.**

- Open cabinet doors and drawers. **Inspect** for water leaks at joints or fittings. Repair as necessary.
- Operate all 12 Volt lights and accessories. If something does not work there may be a bad 12 Volt circuit breaker or blown fuse.
- Install new batteries in battery operated safety detectors or devices. Test the carbon monoxide, LP-Gas and smoke detectors for proper operation.
- Check that the monitor panel is functioning properly.
- Inspect the 120 Volt electrical system which includes the power cord, inverter/converter all outlets and exposed wiring.

**NOTE: Prepare the generator for operation following the instructions in the Generator Manual.**

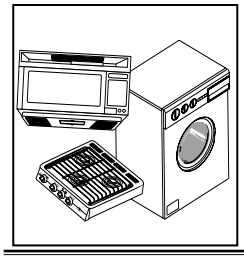
- Start and run the generator.
- Confirm that the batteries are charging. Operate the 120 Volt appliances and air conditioners. If an electrical item or appliance is not functioning properly, contact the dealer or an authorized service center to have it evaluated.

- Have a qualified technician **inspect** the LP-Gas system and perform an LP-Gas leak test. The leak test should also include an LP-Gas regulator adjustment (if needed). The test can also verify if the regulator is faulty and should be replaced. Have the LP-Gas tank inspected.
- Operate each LP-Gas appliance. Observe all burner/pilot flames for proper color and size.

- **Inspect** and clean the interior.
- Check the sealant around all roof and body seams and windows. Reseal if necessary.

- **Lubricate** all the exterior locks, hinges and latches with a graphite lubricant.
- Check the windshield wiper blade condition. Check the wiper/washer operation.
- Wash and wax the exterior. Check the body for scratches or other damage; touch up or repair as necessary. Flush the underside thoroughly.
- Run through the operational checks for steering, brakes, engine and transmission. Operate the motorhome slowly during these checks to allow sufficient circulation of fluids and resetting of the components.
- If desired, have the dealer or repair center double-check preparation to make any necessary adjustments and/or correct defects.

## ~ NOTES ~



# *Appliances*
## *section 4*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## APPLIANCES - INTRODUCTION

This section covers operation and care of various appliances found in the motorhome. The motorhome is equipped with a refrigerator, cooktop range, microwave, furnace, water heater, roof air conditioner and other optional appliances. Many of these appliances operate on AC or DC current, LP-Gas or a combination of all three.

**Detailed information with CAUTION or WARNING instructions for the various appliances, other than what is found in this section, can be found in the manufacturer's manual.**

**WARNING: Before entering any type of refueling station make sure all LP-Gas operated appliances are off. Most LP-Gas appliances used in recreational vehicles are vented to the outside. When parked close to a gasoline pump it is possible for fuel vapors to enter this type of appliance and ignite, resulting in an explosion or fire. Carbon monoxide gas may cause nausea, fainting or death. Operating an LP-Gas appliance with inadequate ventilation or partial blockage of the flue can result in carbon monoxide poisoning. Do not store flammable liquids such as lighter fluid, gasoline or propane in the outside refrigerator compartment.**

## REFRIGERATOR

The refrigerator in the motorhome operates on a different principle than a standard household refrigerator. Knowing these differences should answer questions or solve problems that may arise. A standard household refrigerator uses a compressor to pump refrigerant. This system is efficient as long as 120 Volts AC is available.

The motorhome refrigerator uses a different refrigerant. The refrigerant is heated which causes the refrigerant to circulate and vaporize. Using gravity, the refrigerant returns to the absorber vessel to start the process again. To ensure longevity and proper operation of the refrigerator, follow the specific guidelines in the refrigerator manual. With proper care and maintenance, the refrigerator should provide years of trouble-free service.

**NOTE: Refer to the refrigerator manual for detailed operating and maintenance instructions.**

## Operation Specifics

- The refrigerator operates from LP-Gas or 120 Volts AC electric.
- DC Voltage must be no higher than 15.4 Volts DC or lower than 10.5 Volts DC.
- AC voltage must be no higher than 132 Volts AC or lower than 108 Volts AC.
- It is important to operate the refrigerator only when level. Level the refrigerator (from front view) within 3º side to side and 6º front to back using a torpedo or bulls eye (fence post) level. Place the level on the freezer plate. The level should be within the circle by a half of a bubble. Generally, this is within comfortable living conditions.

**NOTE: Operating the refrigerator "off level" separates the chemicals that crystallize and block the circulation action of the cooling unit. Damage is cumulative and irreversible.**

**WARNING: Do not use the refrigerator if there is an ammonia smell inside or outside of the refrigerator, or if a yellowish substance appears inside or at the outside access compartment. This can be an indication of a refrigerant leak. Contact an authorized repair facility.**

**NOTE: To reduce the possibility of food spoilage, keep the interior box temperature at or below 54º F. The refrigerator will consume more energy to maintain low temperature, especially in hot, humid climates. Lower temperature may also lead to quicker frost build-up.**

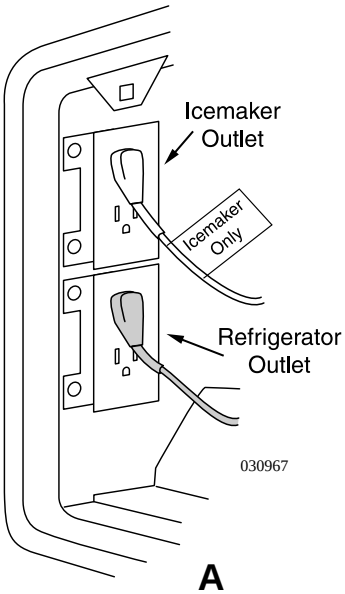
**In order for the refrigerator to operate:**

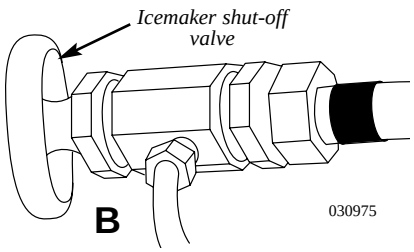
- The house batteries must be charged.
- The primary LP-Gas valve must be on and the electric gas valve must be on.

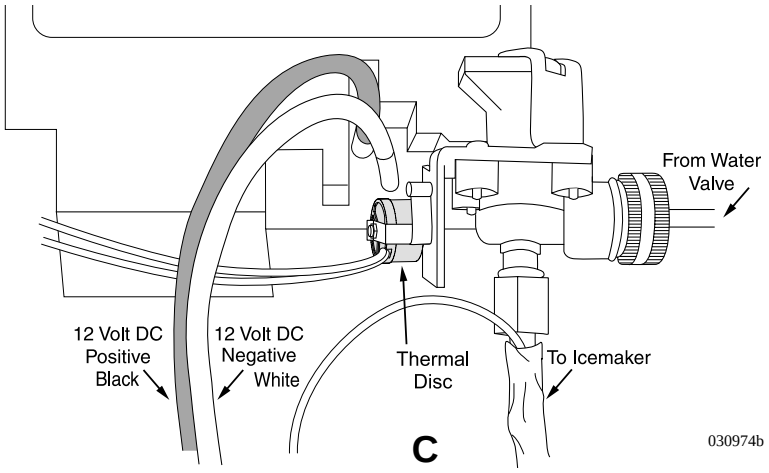
**A.** The refrigerator AC cords must be plugged in (located outside behind refrigerator access door).

**B.** The water valve must be on if the refrigerator is equipped with an icemaker.

**C.** If the controls do not light up check the house batteries charge status or see if the 12 Volt wires are plugged into the refrigerator's circuit board (located outside behind refrigerator access door).



## Inverter Mode Operations

The icemaker requires 120 Volt AC power from shore power, generator or the inverter to operate. The icemaker will not operate on LP-Gas. For example: If dry camping or 120 Volt AC is not available from the generator or from shore power the icemaker can still operate by using the inverter to supply the 120 Volt AC. The refrigerator will not operate on AC Electric when using the inverter and must be running on LP-Gas.

House battery power will be consumed when using the inverter. When possible hook to shore power or start the generator when using the icemaker.

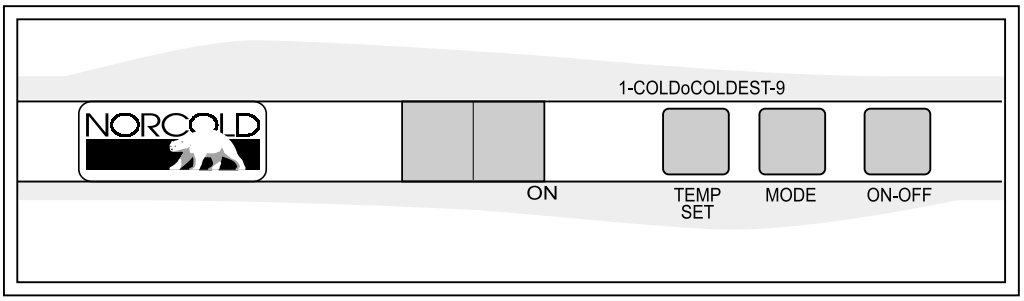
**To Enable this Feature:**

1. Select LP-Gas operation for the refrigerator.
2. Allow the freezer to reach ice freezing temperatures. This may take up to 24 hours from initial refrigerator start up.
3. Tun on water pump or city water.
4. Turn the inverter ON.
5. The icemaker will start automatically when the freezer temperature is satisfied.

**To Disable this Feature:**

1. Turn the inverter **OFF**.
2. Start the generator or plug into shore power if available
3. Select AC operation for the refirgerator.

## Control Panel - Two Door

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- **ON/OFF Button -** Turns the refrigerator on or off.
- Push the **ON/OFF** button to start the refrigerator in **Auto** mode.
- Push and hold the **ON/OFF** button for two seconds to shut it off.

- **TEMP SET Button -** Adjusts the temperature.
- To adjust push and hold the **TEMP SET** button.
- Number "**9**" is the coldest setting.

- **MODE Button -** Controls the operation mode of the refrigerator.
- Push and hold the **MODE** button to select between Automatic AU, AC or LP operation.

**Manual Mode:**

When one of the two manual modes is selected:

**1. AC =** The refrigerator is operating on AC electric.

**2. LP =** The refrigerator is operating on LP-Gas.

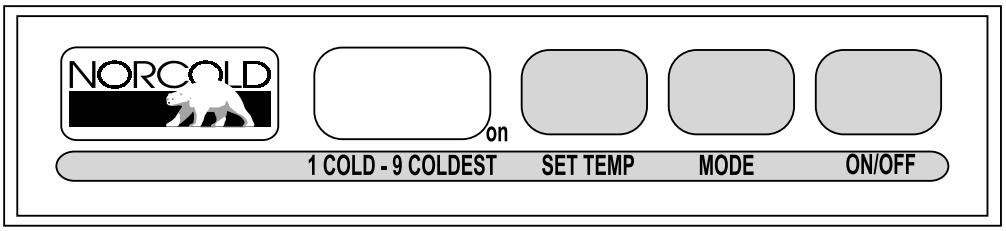
If the LP-Gas does not ignite within 30 seconds, the control changes to a different energy source or the gas safety valve closes and **F** displays. Turn the refrigerator off then back on. If the gas does not ignite after several attempts, consult a dealer or authorized Norcold service center.

**Automatic Mode:**

The refrigerator selects AC power over LP-Gas in **Auto** mode (**AU**). The controls select the energy source in this sequence.

1. When 120 Volts AC is available "**AU AC**" flashes in the display. This indicates the refrigerator is operating on AC electric. After ten seconds, the "**AU AC**" goes off and only a power indicator remains.
2. If 120 Volts AC is not available, "**AU LP**" flashes in the display. This means the refrigerator is operating on LP-Gas.
3. After the refrigerator is operating, press the **TEMP SET** button and set the desired temperature.

## *Control Panel - Four Door (Optional)*




*The Refrigerator Control Panel requires 12 Volt DC to operate.* 030864

• **ON/OFF Button -** Turns the refrigerator on or off.
- Push the **ON/OFF** button to start the refrigerator in Auto mode.
- Push and hold the **ON/OFF** button for two seconds to shut it off.

• **LED Display -** This screen is used for mode, temperature and fault code display.

• **MODE Button -** Controls the operation mode of the refrigerator.
- Push and hold the **MODE** button to select between Automatic AU, AC or LP operation.

• **TEMP SET Button -** Adjusts the temperature.
- To adjust push and hold the **TEMP SET** button.
- Number "**9**" is the coldest setting.

**Manual Mode:**

When one of the two manual modes is selected:

**1. AC =** The refrigerator is operating on AC electric.

**2. LP =** The refrigerator is operating on LP-Gas.

**Automatic Mode:**

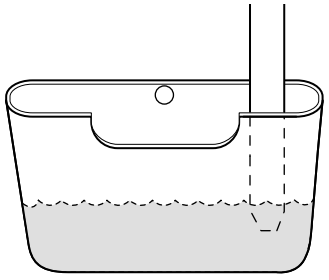
This feature selects AC over LP-Gas operation. If AC discontinues, the alarm sounds and the refrigerator switches to LP-Gas operation. If the refrigerator fails to light, the alarm sounds and a code displays.

- Press and hold the **MODE** button until **AUTO** displays, release the button.
- Press and hold the **TEMP SET** button until the desired temperature displays, release button.
- In **AUTO** mode, AC or LP will remain lit for 10 seconds or when a mode has changed.

If the LP-Gas does not ignite within 30 seconds, the control changes to a different energy source or the gas safety valve closes and **F** displays. Turn the refrigerator off then back on. If the gas does not ignite after several attempts consult a dealer or authorized Norcold service center.

**Tips**

- Cool items first, if possible, before putting them into the refrigerator.
- Keep the doors shut. Know what you want before opening the doors.
- Allow the refrigerator 24 hours of operation before actual use to help get a "head start" with the refrigeration process.
- A box of open baking soda will help absorb food odors.
- Refrigerator icing can be slowed in high humidity if the end of the drain tube is submersed in drip pan.

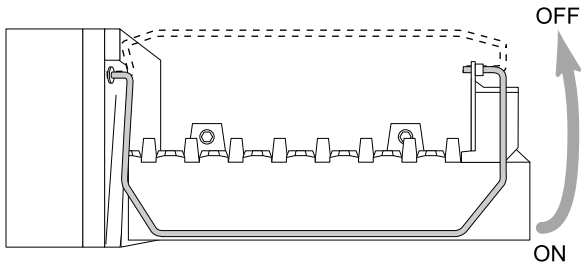


*Located behind the outside access.*

## *Icemaker (Optional)*

The icemaker works from 120 Volts AC only. The icemaker functions only after the freezer temperature is low enough. City water or the water pump must be on and the valve for the water supply line to the icemaker must be on.

- Pull the metal arm (bail) down to turn the icemaker on.
- Push the arm up to turn the icemaker off.

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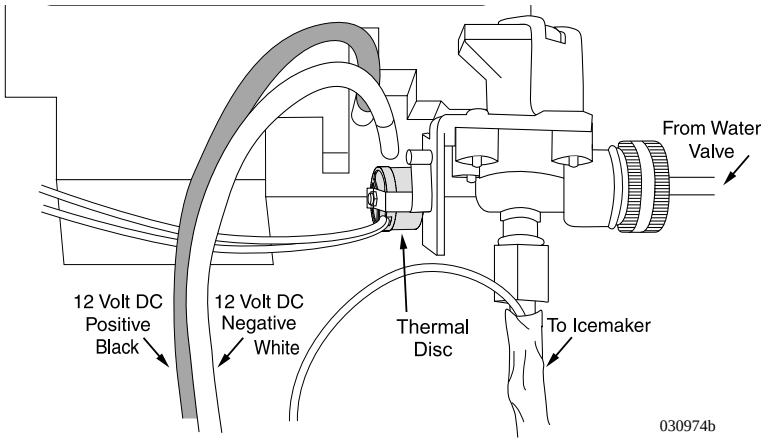
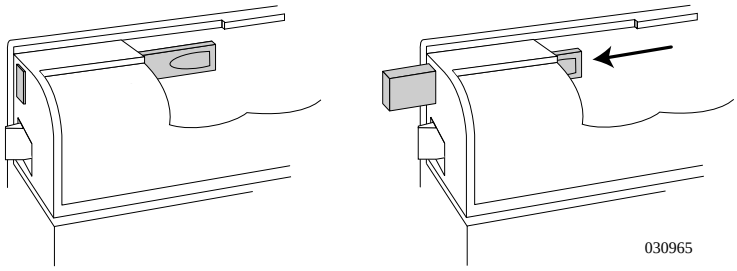



**Water Line Heater:**

A thermal disc supplies voltage to heater tape when ambient temperature is less then 38° F (+/- 4°). It shuts off at temperature greater than 48° F (+/- 5°). The water line heater is only for the line from the solenoid to the icemaker. The line from the shut-off valve to the water valve is not protected.

**NOTE: If the icemaker is in operation while the motorhome is in motion, water may spill out of the ice tray. Raise the icemaker arm to stop ice production while in transit. Do not use the first one or two trays of ice if the refrigerator has been in storage. Ice cubes may have contaminates. Do not operate the icemaker without water pressure supplied to the refrigerator. This can cause damage to the icemaker assembly.**

## *Doors*




The refrigerator doors use a positive latch that secures the door with a "click" to prevent the door from opening while traveling. The doors use a heating element located in the flapper on the left door (four-door model) or in the door (two-door model). The heating element activates when operating the refrigerator in any mode to help prevent moisture accumulation in high humidity conditions.

When storing the motorhome, the refrigerator doors have a storage position that locks the doors partially open. This will help reduce odor from mold and bacteria. A completely sealed refrigerator in storage is a perfect environment for mold and bacteria to grow.

To use the storage feature,partially open doors and slide tab into the cut-out of the strike plate.

### Alarm

The refrigerator uses an audible alarm that will sound for the following reasons:

1. DC or AC voltage is higher or lower than allowed.
2. Refrigerator is set to Auto and 120 Volts AC is discontinued.
3. The refrigerator fails to light on LP-Gas or fails to light after a period of operation.
4. Door is open longer than two minutes.
5. The circuit board detects a failure displaying a code.

**NOTE: If the alarm sounds, note the code in the LED display and turn the refrigerator off to silence the alarm.**

**Refer to the manufacturer's manual for the list of codes and their meanings.**

**WARNING: Make sure all flames are extinguished and the LP-Gas valve is off before refueling. LP-Gas and gasoline are highly flammable which can ignite, resulting in an explosion, fire or death. Many states have passed laws regarding having the LP-Gas valve open while traveling. Know the laws for the particular state in which you are traveling.**

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### Service

The LP-Gas function of the refrigerator and LP-Gas pressure will need servicing yearly, depending on use. Over time, the BTU rating of the flame can change, affecting the refrigerator's performance. Ambient temperature and humidity can also affect performance and function. The BTU rating lowers when operating on LP-Gas at an altitude higher than 5,500 feet. This affects the refrigerator's performance. If possible, switch mode operation to AC while at a higher altitude.

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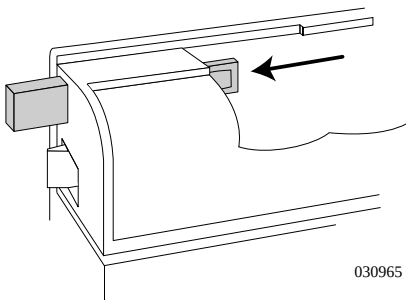
### Cooling Unit Fans (Four Door Models)

The cooling unit is equipped with a pair of cooling fans to help pass air across the cooling unit. These fans start automatically and are audible when in operation.

### *Storage*




- Turn the refrigerator off and remove all items. Leave the drip tray under the cooling fins.
- Shorten defrost time by using trays of warm water. Do not use a heating gun, hair dryer or sharp objects to remove frost as these can damage the interior or cooling unit.
- Wash the interior using mild spray cleansers or a solution of liquid dish detergent and warm water. Do not use scouring pads or abrasive cleansers as these can damage the interior finish.
- Rinse with a solution of baking soda and water. Dry with a clean cloth.
- Lock the doors open.

**CAUTION: When defrosting, do not use a hot air blower. Permanent damage could result to plastic parts. Do not use a knife, ice pick or any other sharp instrument to remove ice from the freezer as they can puncture the system.**

## MICROWAVE / CONVECTION OVEN

The microwave works from 120 Volt AC supplied by shore power, the generator or the inverter. Microwaves heat food using sound waves generated at a very high frequency (2,450 MHz) to agitate water, sugar and fat molecules. The higher the water and fat content, the shorter the cooking time. A turntable rotates inside the microwave when it is operating to heat food evenly. The turntable can be turned off if a baking dish or other large item is used. The microwave is designed to sit over the cooktop. The microwave's two-speed ventilation fan is handy when using the cooktop. The fan draws air in from the bottom of the microwave through a pair of grease filters then discharges the filtered air out through a charcoal filter at the top. If the bottom of the microwave becomes too warm, the ventilation fan activates automatically from heat produced by the cooktop.

The microwave offers many features which may include: varied cooking times with different power settings, automatic sensor cooking, a kitchen timer, a Metric to American conversion chart (which includes temperature and weight), on screen programming help, childproof lockout and auto defrost cycles. The screen can display one of three different languages.

**Microwave Tips:**

- When the microwave is first powered up, the display will blink. Press Stop/Clear.
- Limit microwave use when dry camping. House battery power is quickly consumed.
- Turn the oven off before cleaning.
- Keep the inside of the oven clean. When food spatters or spilled liquids adhere to oven walls, wipe with a damp cloth. Mild detergent may be used if the oven gets dirty. Harsh detergent or abrasive cleaner is not recommended.
- Clean the outside oven surface with soap and water. Wipe away any residue using a damp cloth. Dry with a soft cloth. To prevent damage to the operating parts inside the oven, do not allow water to seep into the ventilation openings.
- If the control panel becomes wet, clean with a soft, dry cloth. Do not use harsh detergents or abrasives on the control panel.
- If steam accumulates inside or around the outside of the oven door, wipe it away with a soft cloth. This may occur when the microwave oven is operated under high humidity conditions and in no way indicates a malfunction of the unit.
- Remove the glass tray for cleaning. Wash the tray in warm sudsy water or in a dishwasher.
- Clean the roller guide and oven cavity floor regularly to avoid excessive noise. Wipe the bottom surface of the oven with mild detergent water or window cleaner and then dry. The roller guide may be washed in mild sudsy water.
- The glass tray and roller guide must always be in place during cooking.
- Place the food in a suitable container.
- Ensure the door is firmly closed before use.

**Microwave Facts:**

One of the most useful documents is the operations manual for the microwave, located in the owner's information file box. Read it carefully and keep it for reference. Another useful item is a microwave cookbook. Many will contain information about cooking principles, techniques, hints and recipes. Ensure food is in the microwave during operation to absorb the microwave energy. The magnetron, cycling on and off, may be heard for power levels less than 100%.

Condensation is a normal occurrence in microwave cooking. The moisture within foods and the room humidity will influence how much moisture condenses in the microwave. Covered foods will not usually produce as much condensation as foods that are not covered.

**NOTE: The microwave is for food preparation only. Do not use the microwave to dry clothes, newspapers, shoes or other items.**

**About Cooking:**

- Food should be arranged with the thickest area towards the outside of the dish.
- Monitor cooking times. Use the shortest amount of time required for cooking and add time as needed. For popcorn, follow product instructions and carefully monitor for the duration of popping time.
- Cover the food while cooking to prevent splatter and reduce condensation.
- Stir the food from the outside of the dish to the center, once or twice, between cooking.
- Turn food over during cooking to speed cooking times. Large food items should be turned at least once during cooking time.
- Use standing times to prevent overcooking. Covered food will continue to cook after it is removed from the microwave oven.
- Check for indications that the food is thoroughly cooked.
  - Food is steaming throughout, not just around the edges.
  - Poultry thigh joints come apart and move easily.
  - Meat or poultry is not pink in color.
  - Fish is opaque and flakes easily with a fork.
  - Center bottom of the dish is very hot to touch.

A meat thermometer is the best way to ensure that the food is cooked. The meat thermometer should be inserted into the thickest part of the meat, away from bone or fat. Most food should range between 160º F to 180º F. Never leave the thermometer in during cooking as it can shatter.

| FOOD | DO | DO NOT |
|---|---|---|
| Eggs, Sausages, Fruits & Vegetables | • Puncture egg yolks before cooking to prevent bursting.<br>• Pierce skins of potatoes, apples, squash, hot dogs & sausages to allow steam to escape. | • Cook eggs in shells.<br>• Reheat whole eggs. |
| Popcorn | • Use specially bagged popcorn for use in the microwave.<br>• Remove popcorn when popping slows to 1 or 2 seconds in between pops. Use the POPCORN setting. | • Pop popcorn in regular brown bags or glass bowls.<br>• Exceed maximum time on popcorn package. |
| Baby Food | • Transfer baby food to small dish & heat carefully. Stir often. Check temperature before serving. | • Heat disposable bottles.<br>• Heat rubber nipple.<br>• Heat baby food in original jar. |
| General | • Cut filled baked goods after heating to release steam.<br>• Stir liquids before and after heating to avoid boiling over.<br>• Use deep bowls for cooking liquids or cereals to avoid boiling out of the container. | • Heat or cook in closed jars or air-tight containers.<br>• Use for Canning. Cooking and heating may not destroy bacteria.<br>• Deep fat fry.<br>• Dry wood, gourds, herbs or wet paper. |

The microwave oven in the motorhome combines the power and convenience of a microwave and a convection oven. The microwave oven is 850 watts microwave oven, with convection temperature range from 100º, 150º and 275º to 450º F, and a 1.2 cubic foot oven capacity. It operates on 110 Volt or 120 Volt AC power sources; such as shore power, the generator, or the inverter. The power cord outlet is located in the cabinet to the side of the microwave.

**NOTE: The microwave is for food preparation only. Do not use the microwave to dry clothes, newspapers, shoes or other items.**

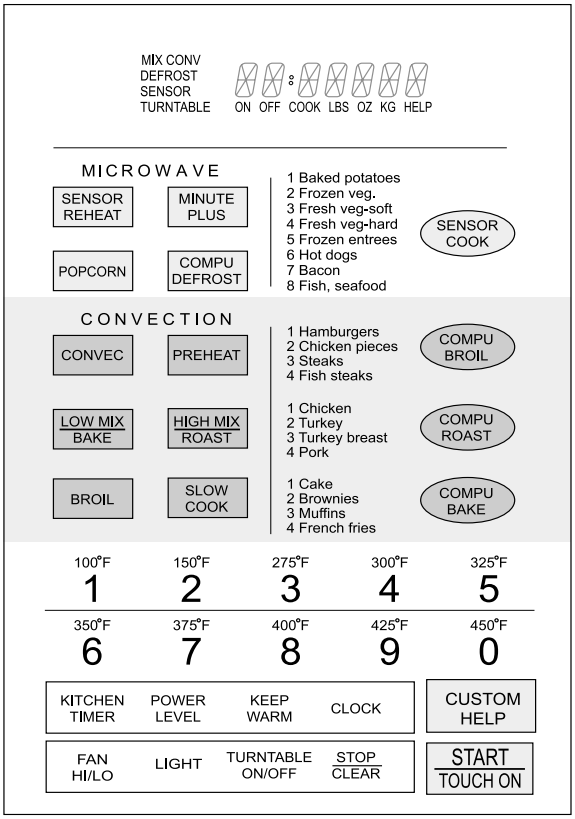
**Child Lock:**

The microwave comes with a child lock feature as part of the **CUSTOM HELP** menu. This feature prevents the oven from operating accidentally.

**To Use this Feature:**

- Press the **CUSTOM HELP** label.
- Press the number one label.
- Press the **START/TOUCH ON** label.
- **LOCK** will appear in the display area.

The oven is now locked. If any button is pressed the word **LOCK** appears on the screen. The fan and hood light is still operational with the Safety Lock feature on. To return the oven to normal operation:




- Press the **CUSTOM HELP** label.
- Press the number one label.
- Press the **STOP/CLEAR** label.

**Setting the Clock:**

- Press the **STOP/CLEAR** label.
- Press the **CLOCK** label.
- The display will prompt to enter time.
- Enter the time of day by touching the numbers in sequence.
- Press the **CLOCK** label.

**NOTE: The clock is a 12 hour clock only.**

### Maintenance

The exterior of the microwave is plastic and metal. The interior is metal. Do not use scouring pads, harsh or abrasive cleanser, chemical cleaners or petroleum based thinners as these can damage the finish. Use mild soap and water with a damp cloth or paper towel to remove most stains or spills. When cleaning the touch pad open the door to prevent accidental operation. Use mild soap and water with a soft cloth. Avoid using excess amounts of water on the touch pad. The turntable plate and oven racks are dishwasher safe.

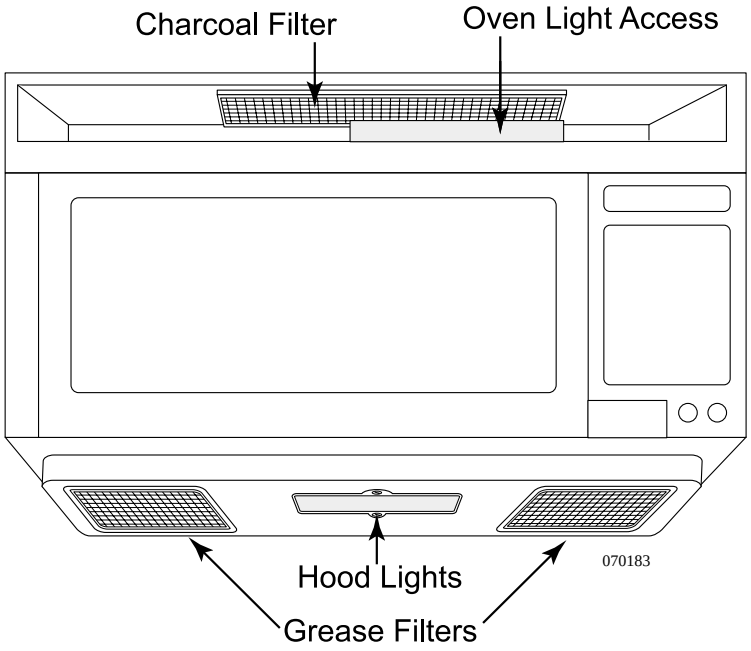
### Fan

The fan automatically starts when heat rises from range surface or when convection settings are used. The fans can not be shut off manually and will remain on until excessive temperatures have decreased.

### Charcoal Filter

Depending on usage the charcoal filter should be replaced every 6 to 12 months. Use the following procedure to remove the louvers to replace the charcoal filter and oven light.

1. Remove power to the microwave.
2. Remove the screws securing the louver.
3. Insert a flat edge screwdriver over each tab pressing downward and moving the louver away from the microwave.
4. Remove the louver from the face of the microwave.
5. Remove and replace the charcoal filter ensuring the filter is positioned on the supporting tabs.
6. Replace louver and mounting screws.



**Oven Light:**

1. Remove the louver as indicated under the charcoal filter.
2. Slide the metal light cover forward and lift upwards.
3. Remove the light bulb and replace only with an equivalent watt bulb.
   **DO NOT EXCEED 30 WATTS.**
4. Replace light cover, louver and mounting screws.

**Hood Light:**

1. Remove power to the microwave.
2. Remove the screw securing the light cover.
3. Remove the light bulb and replace only with an equivalent watt bulb.
   **DO NOT EXCEED 30 WATTS**
4. Close the cover and re-secure with screw from step two.

**CAUTION: Light cover may be hot. Do not touch glass with lamp ON. Never use the light for prolonged periods such as a night light.**

**Grease Filters:**

Do not operate the oven without the grease filters in place. This can damage the microwave. Grease filters should be cleaned at least once a month. To remove the filters, use the pull-tab to slide the filter to the end of the opening and tip down. Soak the filters in the sink or in a dishpan filled with hot water and detergent.

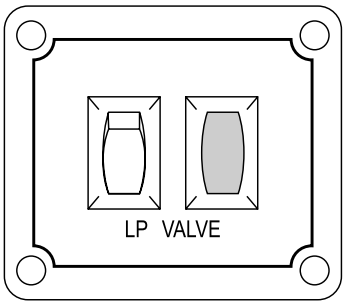
- Do not use ammonia or other alkali-based products that may darken the filter material.
- Agitate the filter. Use a scrub brush to remove caked on grease.
- Rinse the filter thoroughly and shake dry. Place the filter back into the opening, tip upward and slide filter to the end of the opening. Lock in place. Be careful not to kink or warp the filter upon installation.

**Microwave Cooking Safety:**

- Always use pot holder to prevent burns when handling utensils that are in contact with hot food. Enough heat can transfer from food through utensils to cause skin burns.
- Stay near microwave while operating and check frequently to prevent overcooking.
- Never use the cavity as a storage area for cookbooks or other items.
- Avoid steam burns by directing steam away from face and hands.

## COOKTOP

The cooktop utilizes sealed glass cooktop surface burners that spread heat evenly across the bottom of the cookware surface. The cooktop uses an electric ignition system that requires 12 Volt DC to operate. The house disconnect switch must be on to supply power to ignition module. The cooktop should be used for cooking purposes only, not as a heating source. When the burner valve is opened the fuel source flows through the valve into the mixture tube. The fuel passes by a hole or venturi in the mixture tube, which draws air in with the fuel for a proper fuel/air ratio. The flame should have a blue appearance with a lighter blue defined flame at the burner head. A yellow flame or yellow flame tips indicate a rich fuel mixture, which can leave a black color or carbon on the bottom of the cookware. To conserve LP-Gas energy, pre-heat the pans only when recommended and shorten the cooking time by using the least amount of water possible. When cooking, heat the food on a higher heat setting, and then turn the heat down to finish cooking.

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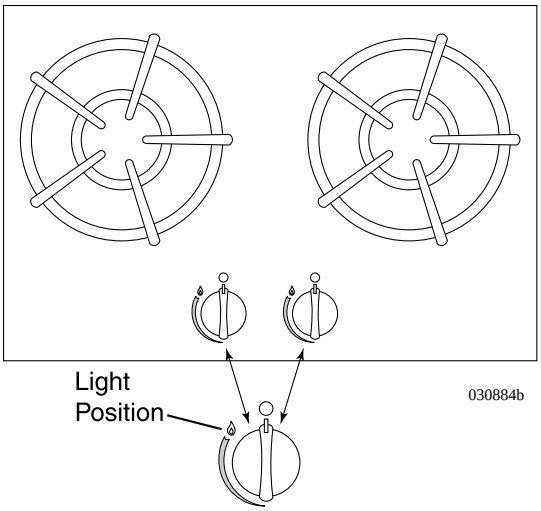
**The cooktop will operate under the following conditions:**

1. The primary LP-Gas valve on the LP tank is open.
2. The battery cut-off switch is ON.
3. The electric switch, located at the remote fill, is ON.

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**Surface Burners:**

The surface burners have an independent heat rating. The ratings for the burners used are 7,000 BTU's and 10,000 BTU's. The smaller rated burner (left burner) should be used for simmering or smaller quantities of food in small cookware. The larger rated burner (right burner) should be used for deep-frying, large quantities of food and large cookware. The amount of heat produced is controlled at the control panel. The flames at the surface burners should have an even appearance at the burner base. Uneven flames may indicate the need to clean the burners.

**WARNING: Do not leave burner valve(s) open while burner(s) are not lit. LP-Gas is heavier than air and will settle on the floor and "hide" in corners. If you smell gas, extinguish all open flames and turn off the main gas supply. Liquid propane is highly volatile, highly explosive and extremely dangerous. Explosion, fire, property damage, injury or death can result. Open all windows and doors. Do not touch any electrical switches. They may cause a spark that can ignite. Evacuate the motorhome and shut off the primary LP valve. Contact a qualified service center to have the problem correctly diagnosed and repaired before operation.**

**Using the Cooktop:**

Place the cookware on the burner grate over the desired surface burner first. Depress control knob slightly and turn counterclockwise to the spark position. Push control knob down firmly until burner stays lit (approximately 5 seconds). Once the burner lights, rotate the knob to the desired cooking setting. In the unlikely event of a power outage or igniter failure, the cooktop can be lit manually.

**WARNING: Do not leave burners unattended during cooking.**

**WARNING: Do not the heat motorhome interior with the cooktop or oven. Gas combustion consumes oxygen inside the motorhome. Carbon Monoxide is an odorless, colorless and highly poisonous gas.**

**Tips:**

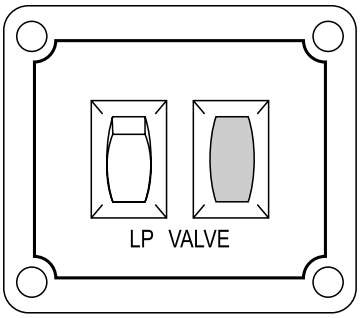
1. A yellow flame is an indicator of incorrect fuel/air ratio. Lowered BTU output and carbon build up can occur.
2. When cooking at an altitude above 5,000 feet, the flame may change appearance and the flame BTU output will be lowered. Allow extra cooking time.
3. Do not allow the tips of the flame to extend beyond pan or pot edge. When this occurs, heat is wasted and possibility of injury increases.
4. Cooking time can be reduced if the least amount of liquid is used. The choice of cookware selected can make a big difference.

**Care and Cleaning:**

Regular cleaning with a soft cloth and a warm detergent solution is generally enough to keep the cooktop clean. Wash, rinse and dry with a soft cloth. Thoroughly clean the cooktop when it is cool. Use a dry cloth or paper towel while the surface is warm to the touch to clean splatters or spills. Cleaning will be more difficult if spills bake on to the surface. Glass cleaner sprayed on a paper towel should be used for the cooktop surface. DO NOT spray glass cleaner directly on the surface. DO NOT use abrasive cleaners or steel wool. Harsh cleanser like bleach, ammonia and oven cleaner should NEVER be used. The surface burner grate and caps should be cleaned using the same guidelines as the cooktop surface.

## COOKTOP RANGE/OVEN (Optional)

The cooktop range/oven uses LP-Gas only as a fuel source. The burners use a piezo type igniter. The cooktop should be used for cooking purposes only and not as a heating source. When the burner valve is opened the fuel source flows through the valve into the mixture tube. The fuel passes by a hole or venturi in the mixture tube, which draws air in with the fuel for a proper fuel/air ratio. The flame should have a blue appearance with a lighter blue defined flame at the burner head. A yellow flame or yellow tips indicate a rich fuel mixture, which can leave a black color or carbon on the bottom of a pot or pan.

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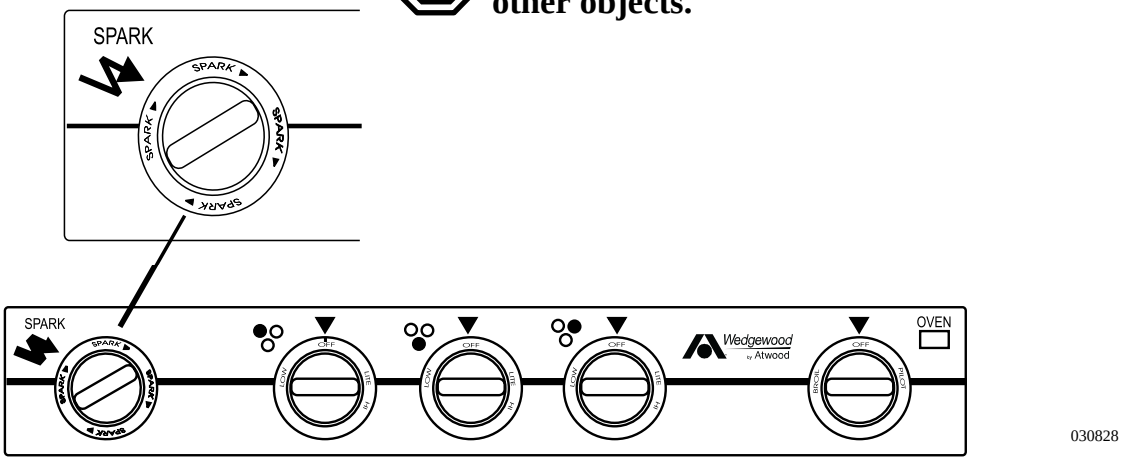
**The cooktop operates under the following conditions:**

1. The primary LP-Gas valve on the LP tank is open.
2. The battery cut-off switch is on.
3. The electric switch, located at the remote fill, is on.

- The oven may be used with the cooktop cover down.
- Push in the oven control knob and rotate counterclockwise to **PILOT ON**.
- Light the oven pilot located near the back of the oven, under the broiler shelf and to the left of the oven burner.
- Set the oven control knob to **PILOT ON** to maintain the pilot flame. The oven and broiler are now ready for operation. The oven pilot has been factory set and requires no further adjustment.
- To extinguish the oven pilot push in the oven control knob and rotate clockwise to **OFF**.

**WARNING: Extinguish all pilots when refueling or traveling. Do not block vents in oven with cookware or other objects.**

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To use the cooktop open the desired burner valve and rotate the igniter knob, clockwise, at the left hand side of the stove.

Before cooking on the range top the cover must be in full upright and folded position. Push the cover toward the outside wall to prevent it from falling onto the range top during cooking.

- Never close the cover while the burners are in use.
- Do not use the cover as a griddle.
- The bi-fold cover must always be closed when the motorhome is in transit.

**WARNING: Do not heat the motorhome interior with the cooktop or oven. Gas combustion consumes oxygen inside the motorhome. Carbon Monoxide is an oderless, colorless and highly poisonous gas.**

## *Cooktop Cover*

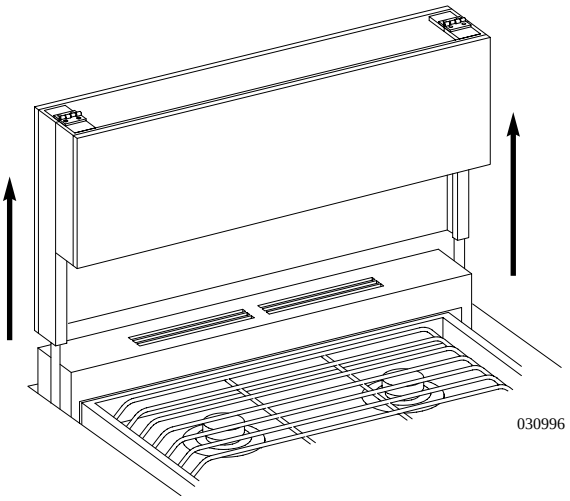
**To Lift Cover:**

- Lift the cover then fold. The cover will lock into the upright position.

**To Close Cover:**

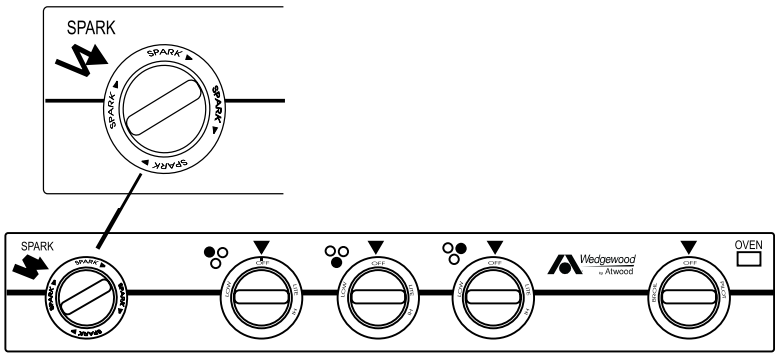
- Allow the cooktop to cool to room temperature before closing cover. Raise cover arms from lock position, lower and unfold cover.

**WARNING:Top cover must be open when the cooking surface is in operation. Do not cover the oven vent openings while the oven is in operation.**




## *Lighting the Burners*

- Turn the appropriate burner knob counterclockwise to **LITE**. Do not attempt to light more than one burner at a time.
- Turn the **SPARK** knob clockwise one click. If the burner fails to light, continue turning the **SPARK** knob clockwise until the burner lights.
- Turn the burner knob clockwise to **OFF**, to turn the burner off.



### Burner Grate

The burner grate is attached to the cooktop cover by two spring clips located on the underside of the cooktop cover. The burner grate can be separated from the cooktop cover for cleaning purposes. Place a towel down onto the countertop next to the cooktop. Lift the cooktop cover up by pushing cover towards rear of cooktop. Lift cover at the front edge. Place the cooktop cover upside down onto the towel. Squeeze both of the grate spring clips to remove the grate from cooktop cover.

**WARNING: If you smell gas, extinguish all open flames and turn off the main gas supply. Liquid propane is highly volatile, highly explosive and extremely dangerous. Explosion, fire, property damage, injury or death can result. Propane is a "heavy" gas and will lay on the floor and "hide" in corners. Open all windows and doors. Do not touch any electrical switches. They may cause a spark which can ignite. Contact a qualified service center to have the problem correctly diagnosed and repaired before resuming operation.**

Operation Tips:

- A yellow flame is an indication of incorrect fuel/air ratio. Lowered BTU output and carbon build up can occur.
- Flame appearance may change and BTU output will lower when operating the cooktop at an altitude above 5,000 feet. Allow extra cooking time.
- Do not allow the tips of the flame to extend beyond pan or pot edge. When this occurs heat is wasted and possibility of injury increases.
- Remove cooktop cover to help keep the underside of the cooktop clean. Place strips of aluminum foil on the cooktop floor pan and under burners. Do not restrict air flow of mixture tubes.
- Pre-heat the oven for 10 minutes prior to use.

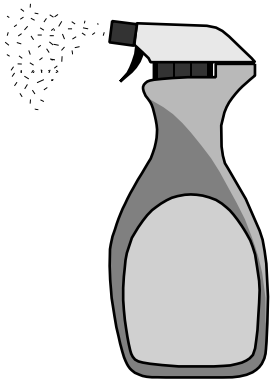
---

### Cleaning

Cleaning Tips:

- Clean all surfaces as soon as possible after boil overs or spillovers.
- Use warm soapy water to clean the burner grates, cooktops, painted surfaces, porcelain surfaces, stainless steel surfaces and plastic items on the range or cooktop. Grit or acid-type cleaners may ruin the surface.
- Use only non-abrasive plastic scrubbing pads.
- Do not allow foods containing acids (such as lemon or tomato juice, or vinegar) to remain on porcelain or painted surfaces. Acids may remove the glossy finish. Wipe up egg spills when cooktop is cool.
- Allow porcelain surfaces to cool before cleaning. Burns from the heated surface may occur or the cooktop porcelain can crack.

Regular cleaning with a soft cloth and a warm detergent solution is generally enough to keep the cooktop clean. Wash, rinse and dry with a soft cloth. Thoroughly clean the cooktop when it is cool. Use a dry cloth or paper towel while the surface is warm to the touch to clean splatters or spills. Cleaning will be more difficult if spills bake on to the surface. Glass cleaner sprayed on a paper towel should be used for the cooktop surface. Do not spray glass cleaner directly on the surface. **DO NOT** use abrasive cleaners or steel wool. Harsh cleansers like bleach, ammonia and oven cleaner should **NEVER** be used. The surface burner grate and caps should be cleaned using the same guidelines as the cooktop surface.



cleaner

*Glass Cleaner should be applied to the cooktop surface using a paper towel. Do not spray cleaner directly on the surface.*

**Porcelain Enamel:**

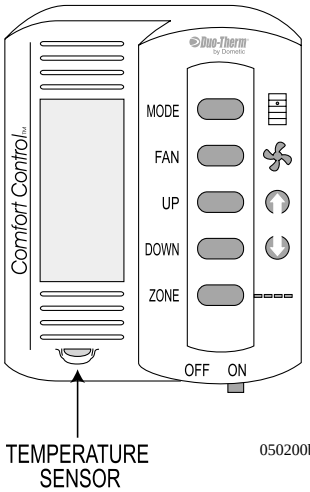
Porcelain enamel, a type of glass fused on steel at a very high temperature, is not extremely delicate but must be treated as glass. Sharp blows, radical surface temperature changes, etc., will cause enamel to chip or crack. Some foods such as vinegar, lemon juice, tomatoes and milk contain acids which can dull the finish of the enamel. To avoid dulling the finish, wipe up the spill before it is baked on. The surface is glass and must be given consideration when cleaning. Steel wool and coarse, gritty cleanser will scratch or mar the surface. Any gentle kitchen cleanser powder or grease cleaner will be suitable. For urther information on care of the porcelain, call "*Hopes Cultured Marble Polish*" at 800-325-4026.

## WALL THERMOSTAT

One comfort control operates the HVAC (Heating, Ventilating and Air Conditioning) system. The comfort control is located in the hallway on the monitor panel. The comfort control will operate roof air conditioner functions and LP-Gas furnace operation. The comfort control uses a liquid crystal display to show the current mode status.

There are five different functions of the HVAC system: OFF, FAN, COOL, HEAT PUMP and FURNACE. These are selected by repeat pressing of the MODE button. The FAN button controls the fan speed of the roof air conditioner. Two speeds are available: Low and High. Fan speed control applies only to the blower speed of the roof air conditioner. Selecting the fan speed Auto adjusts the fan speed automatically, depending on temperature set point and actual temperature in a selected zone.

The motorhome is divided into two operating Zones, the living room and the bedroom. The living room is Zone One. The bedroom is Zone Two. The comfort control must be in Zone 1 for the furnace to operate. Press the Zone button to change zones. The selected zone will flash. The UP or DOWN buttons control the temperature in any mode.

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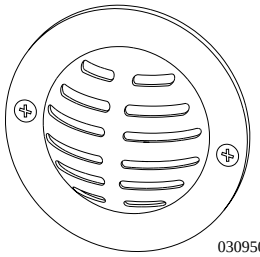

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**NOTE: The Comfort Control must be ON to operate any HVAC function. Do not select conflicting modes of operation. One zone cannot be on COOL while another zone is set to FURNACE.**

**NOTE: The motorhome will not heat or cool faster by selecting a very high or very low temperature setting.**

## AIR CONDITIONER - ROOF

The roof air conditioners operate from 120 Volts AC only, by shore power or the generator. Operations are controlled by the 12 Volt DC comfort control. The electronics in the comfort control use a telephone style patch cord to send low voltage signals to the roof air conditioner's circuit board. The circuit board controls the desired roof air functions and furnace operation. The refrigeration operation principle of the roof air conditioner is the same as the dash air conditioner or a household type refrigerator, functioning as an enclosed system. The compressor pumps refrigerant into a condenser as high-pressure vapor. A condenser expels heat from the vapor into the atmosphere. Vapor condenses to high-pressure liquid. The liquid is forced through a metered capillary tube and then into the evaporator or low side pressure. The refrigerant changes from liquid to vapor as the refrigerant extracts heat. The compressor pumps the vapor to the condenser repeating the cycle. Operating the air conditioner in HEAT PUMP mode reverses the cycle. Reversing the refrigerant flow blows heated air into the interior of the motorhome. There are ambient temperature operating limitations in HEAT PUMP mode.

**NOTE: The air conditioning system freezes moisture in the air. It is recommended to set the blower fan speed to high when operating in high humidity.**

**NOTE: There are ambient air temperature limitations in HEAT PUMP mode. The roof air conditioner will not operate in HEAT PUMP mode with ambient temperatures of 30º F and below.**

**AUX HEAT Mode:**

If the HEAT PUMP mode is selected when ambient temperature is approximately 30° F, or if operating in HEAT PUMP mode and temperature drops to approximately 30º F., the air conditioner will stop Heat Pump operation and Aux Heat operation begins. AUX HEAT mode selects the furnace as the auxiliary heat source. AUX HEAT mode initiates automatically due to refrigerant limitations in cold temperature. The furnace remains the primary heat source until ambient temperature rises above 30º F. When operating in HEAT PUMP mode with ambient temperature between 30 to 42º F, a defrosting cycle begins approximately every 40 minutes of compressor operation. During the defrost cycle, the blower motor will stop for five minutes and the display will indicate DEFROST. After the defrost cycle Heat Pump operation will resume.

## Operating Instructions

**Roof air conditioner operates only when following needs are met.**

- 120 Volts AC, from either shore power or the generator, is supplied.
- The battery cut-off switch is in the **ON** position and house batteries are charged.

**Fan Operation:**

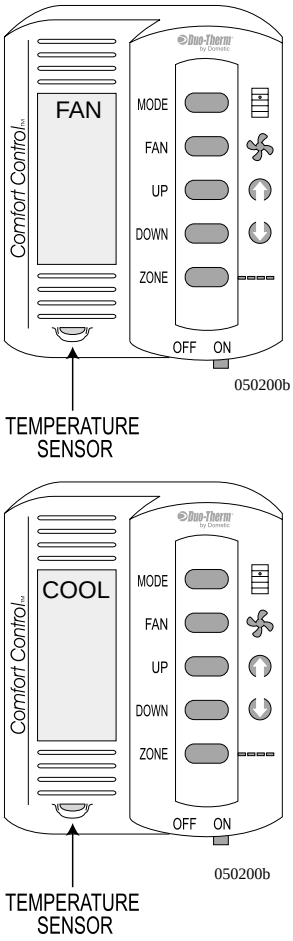
Circulates the interior air by using the roof air conditioner blower. The fan speed controls the roof air conditioner blower speed in the following modes: **FAN**, **COOL** or **HEAT PUMP**.

- Press the **MODE** button repeatedly until **FAN** is displayed.
- Press the **FAN** button to select the desired fan speed.

**Air Conditioner Operation:**

- Press the **ZONE** button to select Zone 1 (front roof A/C) or Zone 2 (rear roof A/C).
- Press the **MODE** button repeatedly until **COOL** is displayed.
- Set desired fan speed by pressing the **FAN** button.
- Set desired cooling temperature by pressing the **UP** or **DOWN** buttons.

**NOTE: The compressor will engage approximately two minutes after blower motor activation. This prevents accidental compressor activation against high pressure.**




## Heat Pump

The Heat Pump mode supplies heat by using the air conditioner. The air conditioning principle is reversed, supplying heated air to the ceiling registers instead of refrigerated air. There are ambient temperature limitations of Heat Pump mode.

**NOTE: The roof air conditioner will not operate in HEAT PUMP mode with ambient temperatures at or below 30º F.**

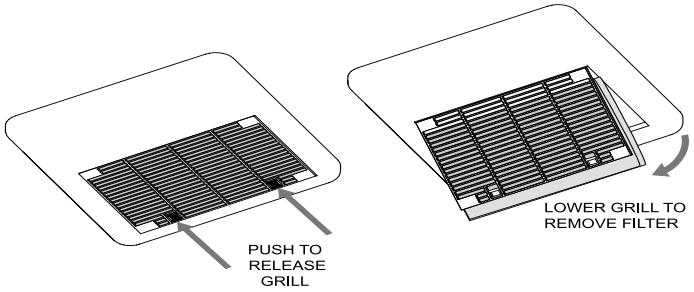
If the Heat Pump mode is selected at or below 30° F., or if operating in Heat Pump mode and temperature drops to 30º F., the air conditioner will stop Heat Pump operation and **AUX HEAT** will be displayed. The furnace will be selected as the auxiliary heat source and will begin operation. The furnace will remain the primary heat source until ambient temperature rises above 42º F. When ambient temperature is between 30 to 42º F., a defrost cycle is initiated approximately every 40 minutes of compressor operation. The blower motor will stop for five minutes and **DEFROST** will be displayed. After the defrost cycle the Heat Pump operation will resume.

**Heat Pump Operation:**

- Battery cut-off switch must be in the **ON** position.
- Slide the **ON/OFF** switch to the **ON** position.
- Press the **MODE** button repeatedly until **HEAT PUMP** is displayed.
- Set desired fan speed by pressing the **FAN** button.
- Press the **UP** or **DOWN** buttons to set desired heating temperature.
- Select Zone 1 or Zone 2, using the **MODE** button.

## *Return Air Filters*

Clean the return air filters frequently. They are located inside the motorhome behind the intake vent covers. Firmly grasp the leading edge and push back on both tabs. Never run the air conditioner without the return air filters in place. Dust and other particles will plug the evaporator core and substantially reduce the performance of the air conditioners.




**To Clean:**

- Wash filters in warm soapy water. Do not use solvents.
- Rinse filters thoroughly with fresh water. Allow them to dry.
- Install filters and secure the covers.

## FURNACE

The furnace and related components are 12 Volt DC operated, using LP-Gas as the fuel source. Electronic circuitry (automatic ignition) is used to ignite the burner. The furnace uses outside air for the burner combustion and exhaust is expelled through the outside vent. Inside air is drawn into the furnace and blown across the internal heat exchanger. Heated air is then discharged through ducted hoses which can be run throughout the motorhome.

**CAUTION: Do not store any items/materials in furnace area. Restricted air flow may hamper furnace operation leading to failure and/or fire hazard.**

**WARNING: IF YOU SMELL GAS extinguish all open flames and turn off the main gas supply. Liquid propane is a highly volatile, extremely dangerous gas. It can explode or ignite, which may result in property damage, injury or death. Propane is "heavy" and can "float" on the floor or "hide" in corners. Open all windows and doors. Do not touch electrical switches. They may spark, which can ignite. Keep all open flames, spark producing devices and smoking material out of the area. Contact a qualified service center to have the problem correctly diagnosed and repaired before resuming operation.**

## Operating Instructions

The furnace operates in the following manner: The wall thermostat sends a signal to the front roof air conditioner circuit board, which closes a relay. Closing a relay sends an electrical signal to the furnace to begin the ignition cycle. There is a small time delay before the blower motor begins. Once the blower motor attains a predetermined speed it will close the sail switch. The sail switch, which is now closed, sends the electrical signal through a high temperature protection switch, then to the automatic ignition circuit board. After the thermostat is satisfied, the gas valve closes and extinguishes the burner. The blower motor stops approximately two or three minutes after cool down.

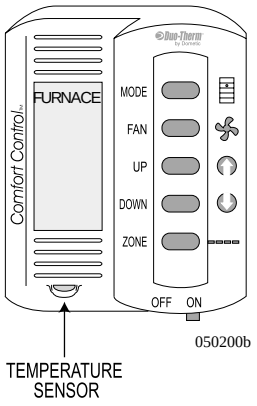
**The furnace will operate when the following conditions have been met.**

1. The LP-Gas primary valve on the LP tank is open and the LP-Gas valve at furnace is on. The LP-Gas switch is on.
2. The house batteries in the motorhome are fully charged.

**NOTE: The automatic ignition circuit board will attempt to light the burner three times before the ignition board will go into "lock-out." If the burner does not light, the furnace blower motor will continue to run and the wall thermostat will have to be cycled off.**

## Using the Furnace

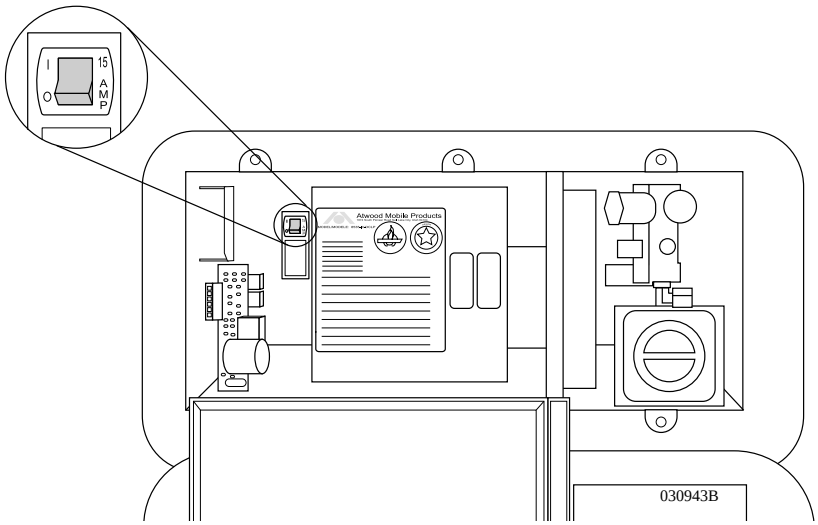
- Slide the ON/OFF switch (on hallway thermostat) to the ON position.
- Press the ZONE button to select Zone 1
- Select the Furnace mode on the Comfort Control using the MODE button.
- Select the desired temperature using the UP and DOWN arrow buttons.




## Tips

- After storage the furnace may produce a musty smell during the first couple of cycles.
- Operating the furnace at an altitude above 5,000 feet reduces the BTU output due to air/fuel ratio.
- The furnace will periodically need to be serviced by a qualified technician. If the furnace exhibits unusual symptoms or noises, or has an unusual odor when operating, have the furnace checked or serviced.

• If the blower fails to operate after verifying the batteries are charged and fuses are good, use a coin or screwdriver to open outside access door. Make sure the power switch is on and circuit breaker is pushed in.




**CAUTION: It is not advisable to use the furnace to heat the inside of the motorhome during transit.**

**NOTE: When washing the exterior of the motorhome, avoid a direct stream of water into the outside furnace vents. This can cause damage to the furnace.**

### *If the Furnace Fails to Light*

If the furnace fails to light make sure the LP-Gas primary supply valves are open and the LP-Gas switch is turned on. The furnace will not light if the blower motor is not spinning to its specified speed. This may be due to a low house battery charge condition.

**To Charge the House Batteries:**

1. Hook-up to shore power.
2. Start the generator.
3. Start the main engine to charge the batteries.

**WARNING: If you smell gas and the blower motor is spinning do not attempt additional furnace operation as this may result in an explosion, fire or personal injury. Contact a qualified technician.**

## WATER HEATER

The water heater uses two different methods to heat water: (**1**) 120 Volt AC, supplied either by shore power or the on board generator (**2**) LP-Gas. The 120 Volt AC uses a heating element similar to the type used in a house water heater. The 120 Volt AC method is efficient if shore power is available. An automatic ignition circuit board, operated by 12 Volt DC, controls the LP-Gas. Two thermostats control water temperature: One for the 120 Volt and the other for the LP-Gas. The thermostat temperatures are preset by the water heater manufacturer and are not adjustable.

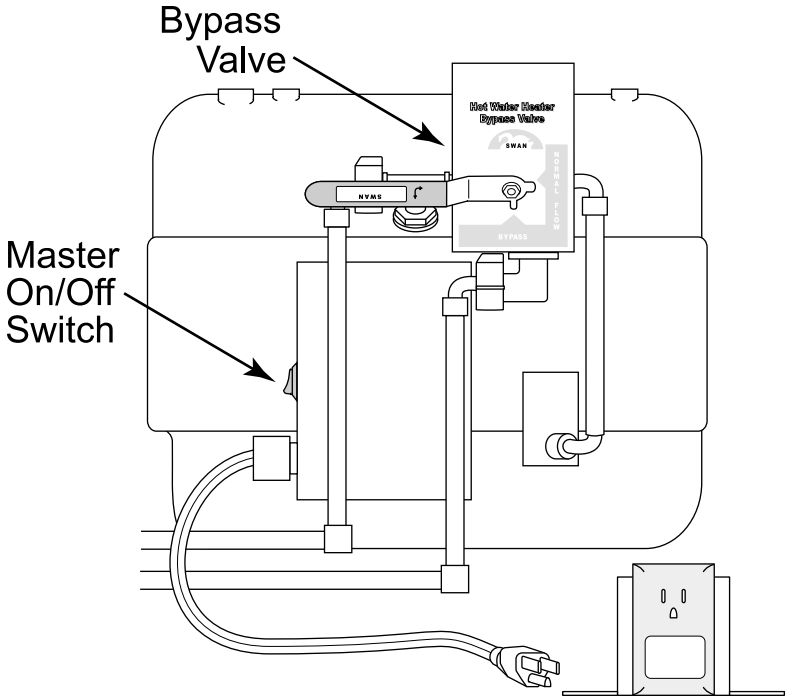
Water is pumped into the bottom of the water heater tank where it is heated and discharged out of the top upon use. For ease of draining the tank during winterization, the water heater is equipped with a pressure-temperature valve, bypass valve and drain plug.

**NOTE: Do not operate the water heater without water in the water heater tank. Damage to the thermostats and electric heating element can occur.**

**NOTE: It is not fuel efficient to use the generator to operate the water heater on 120 Volt AC.**

### *Before Using the Water Heater*

Before using the water heater, purge all trapped air from the water system and water heater.

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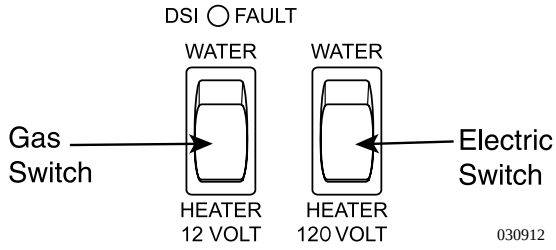
**To Purge the Air and Pressurize the System:**

- Remove the access panel to the back of the water heater.
- Turn the water heater Bypass Valve (located at the back of the water heater) to Normal Flow. If necessary replace drain plug.
- Fill the fresh water tank or hook to city water.
- Turn on the water pump or city water.
- Turn on the hot and cold valves for each faucet, one at a time. Operate each faucet, inside and outside the motorhome, until a steady stream of water with no air bubbles or air pockets are present. Do not operate the water heater until the water system is purged of air.
- After the system pressurizes, inspect the water heater and water system for leaks.

**CAUTION: After purging the water lines and water heater, air may still be present. Use caution upon opening a hot water faucet after the first heat cycle of the water heater.**

**WARNING: IF YOU SMELL GAS extinguish all open flames and turn off the primary LP-Gas valve. Do not touch any electrical switches. They may cause a spark that can ignite. Open all windows and doors. Evacuate the motorhome. Propane is a "heavy" gas and will lay on the floor and "hide" in corners. Liquid propane is highly volatile, explosive and extremely dangerous. Explosion, fire, property damage, injury or death can result. Contact a qualified service center to have the problem correctly diagnosed and repaired before resuming operation.**

## *Operation*




*Switches on Monitor Panel.*

**Water Heater Operation:**

- Turn on the battery cut-off switch at the entry door.
- 120 Volt AC is supplied from shore power or the generator.
- The house batteries are charged.
- The primary LP-Gas valve on the LP tank is open and the electric LP valve is on.
- Turn on the Master On/Off switch located on the back of the water heater.

**Heating Water with 120 Volt AC:**

- Have either shore power (preferable) or the generator supplying AC voltage.
- Turn on the Water Heater 120 V switch.

**Heating Water with LP-Gas:**

- Make sure the primary LP-Gas valve is open and the electric LP valve is on.
- Turn on the water heater 12 V switch. The indicator light on the switch will illuminate briefly then go out when the burner ignites. The burner will make an audible "roar" when lit.
- The automatic ignition circuit board will attempt three ignition cycles to light the burner. If the burner does not light after the third attempt, the circuit board will "lock-out" and the indicator light on the switch will glow steady.
- Check the level of LP-Gas in the tank and make sure the primary LP-Gas valve is on. Cycle the LP switch Off then back On to reset the ignition board.

**NOTE: The LP-Gas and AC electric functions may be on at the same time. This will speed the recovery process of heating water for large volume use.**

**CAUTION: It is recommended not to operate the water heater on LP-Gas while the motorhome is in transit. Be sure the water heater is off before refueling.**

**WARNING: Before beginning any service or work on the water heater make sure the LP-Gas is turned off, the 120 Volt AC source has been disconnected and the 12 Volt DC source has been disconnected. Failure to do so can result in explosion, fire or injury.**

**Indicator Lamp:**

- Illuminates briefly when the LP switch is turned on, ignition occurs and the lamp goes out.
- If the burner does not light within 6 to 9 seconds the ignition board will attempt two more ignition cycles. If the burner does not light after the third attempt, the indicator lamp glows steady.

## *Ignition Module Function*

**The ignition module will perform the following sequence:**

1. The module has a timing circuit, which allows 6 to 9 seconds for ignition to occur.
2. Initially the module supplies current to the gas valve. At the same time, it produces a high-voltage current supply to the electrode to produce a spark at mixture tube.
3. Upon ignition, the electrode senses the presence of flame.
4. If ignition does not occur, the module will wait 20 to 40 seconds before the next ignition cycle.

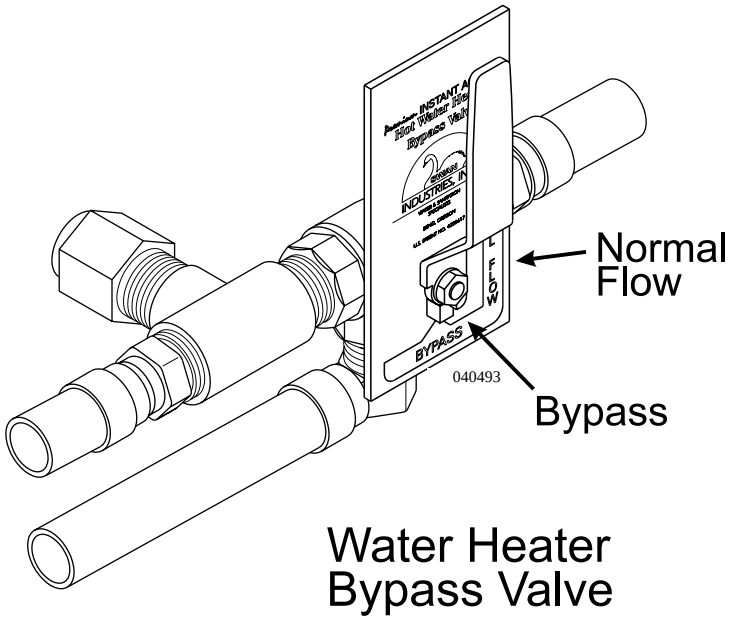
### Thermostats

Separate thermostats are used for LP-Gas and AC electric. The thermostat controls the power to the module board. At 130° F, the thermostat will open, extinguishing the burner. If the thermostat fails, a High Temperature safety limit switch will open. The safety switch will require manual reset.

**CAUTION: If the High Temperature safety limit should open discontinue using the water heater. Have the water heater inspected by a qualified technician to determine the cause of the over temperature condition.**

### Water Heater Bypass

The bypass valve is located at the back of the water heater. Turning the valve to **BYPASS** stops water from entering the cold water inlet of the water heater. Turn the valve to **BYPASS** when winterizing. For normal operation, turn valve so that handle points to **NORMAL FLOW**.




Water Heater
Bypass Valve

## Pressure Temperature Relief Valve

The water heater is equipped with a Pressure-Temperature relief valve. The water heater may discharge from the Pressure-Temperature relief valve during the heating cycle due to thermal expansion of water. The Pressure-Temperature relief valve is designed to open if the water temperature in the tank reaches 210° F (98.8° C), or if internal pressure reaches 150 psi. A small discharge is normal and is not necessarily a faulty valve. The water heater has an internal air pocket to reduce the possibility of dripping or weeping.

Eventually, the expansion of the water will absorb the air pocket. When this occurs, the air pocket will have to be replaced utilizing the following procedure.

**CAUTION: Ensure the water heater tank is cool prior to making any check of the valve.**

**Re-establishing the Air Pocket:**

**Step 1:** Turn OFF the water heater.

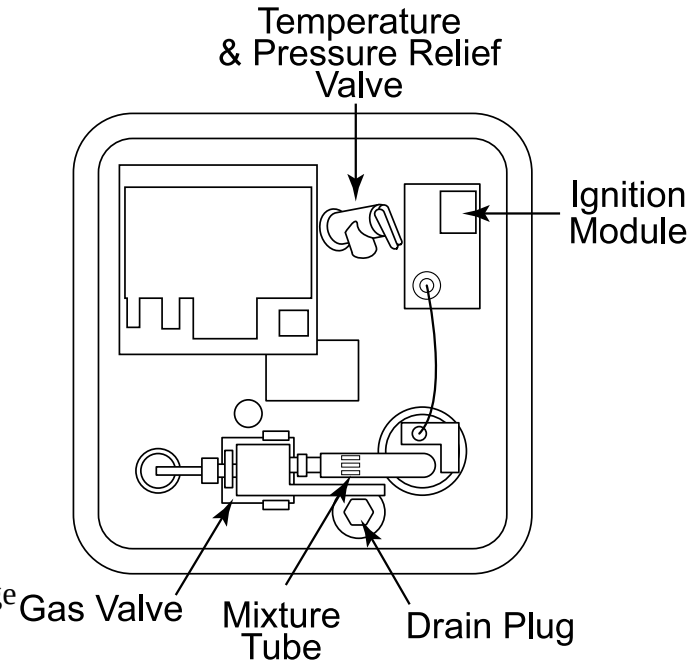
**Step 2:** Shut OFF the incoming water supply.

**Step 3:** Open the hot water faucet closest to the water heater.

**Step 4:** Pull the handle of the relief valve until the flow of water stops.

**Step 5:** Close the relief valve allowing it to snap shut. Close the hot faucet and turn ON the water supply.

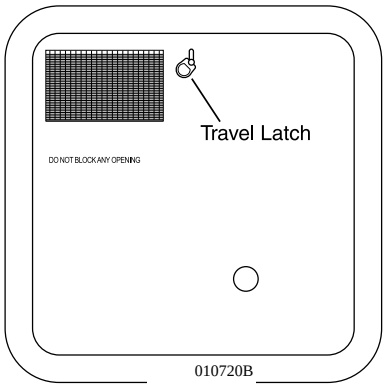
**Step 6:** Turn ON the water heater.




The air pocket is re-established and the process does not need to be repeated until the next discharge of water from the T & P valve. If the discharge does not stop, contact a qualified service center to evaluate the valve and make any required repairs.

## Burner Compartment

Periodically check the outside service compartment and screen (in the door) for foreign material the can accumulate and prevent the flow of combustion and ventilating air.



### Tips

- To conserve LP-Gas, turn off the water heater when not in use.
- When using the shower, conserve energy and hot water by shutting the shower water off when not in use.
- Use caution when hooked to anything less than 50 Amp shore service. When the water heater element is in operation it will use approximately 12 AC Amps. Appliances will need to be operated in sequence to avoid tripping a breaker.
- Water may drip occasionally from the Temperature-Pressure relief valve until the pressure has dropped. Avoid opening the T & P valve manually as collected minerals may cause the valve to leak continually. The valves can be purchased from most hardware stores.
- Operate the water heater using LP-Gas when hooked to 30 Amp shore power. This will reduce the likelihood of tripping the shore power breaker.

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### Draining & Storage

If the motorhome is to be stored during the winter months, drain the water heater to prevent freeze damage.

1. Turn off electrical power to the water heater.
2. Shut off the primary LP-Gas valve.
3. Open low point drains.
4. Open both **HOT** and **COLD** on all faucets.
5. Remove water heater drain plug.
6. Turn the Bypass lever to **BYPASS**.

**NOTE: Be sure to refill the water heater with water before resuming operation.**

**Troubleshooting**

- If water heater fails to light check the mixture tube for obstructions. Spiders may make nests in the burner tube. It is recommended to clean the burner tube with a brush and not compressed air. Compressed air may not fully remove the obstruction.
- If the indicator light on the switch does not light, and the water heater does not light, ensure the house power switch at the entry door is on or check for a blown fuse in the house distribution panel.
- If the water heater fails to operate after checking the fuses, the High Temperature safety limit switch may be tripped. Have a qualified technician inspect the water heater.

## AQUA-HOT (Optional)

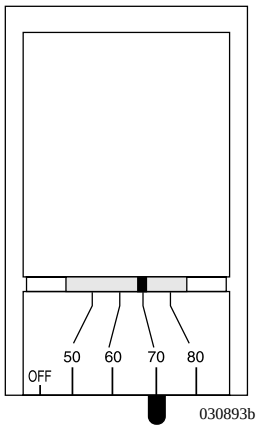
Specially designed for use in motorhomes, the Aqua-Hot is an appliance combining a water heater with a furnace. Aqua-Hot provides an almost endless supply of hot water and heats the interior of the motorhome. A 50,000 BTU diesel fired burner and a 1650 watt AC element heats a 60/40 solution of antifreeze to approximately 200º F. Using three pumps the antifreeze solution circulates through heat exchangers located throughout the motorhome. A fourth pump circulates engine coolant through the Aqua-Hot. Fresh water heats when pumped through a coil tube inside the Aqua-Hot.

**CAUTION: If not properly and thoroughly rinsed, bleach or other concentrated chlorine bearing chemicals can cause failure to the copper tubing inside the Aqua-Hot domestic Water Loop. The rating for the Aqua-Hot copper tubing is for fresh water and winterizing solutions only. Periodic flushing with common household chemicals, including bleach, has little or no effect on the heating system if properly rinsed with fresh water afterwards. Failure of copper tubing, especially soft or flexible copper, can result if materials other than water or winterizing solutions are allowed to reside inside the piping for extended periods as during storage or other periods of non-use. The most common cause for failure is due to an extended exposure to chlorine, solutions containing chlorine (i.e. bleach) or hydrochloric acid.**

**NOTE: The Aqua-Hot must be turned ON before using any heat feature.**

**Thermostat:**

The thermostat controls the temperature at which the heat exchangers cycle. Individual heat exchangers are placed throughout the motorhome. Each thermostat controls the blower(s) in a particular zone. Typically three zones are used: front (living room), middle (hallway, bathroom) and rear (bedroom).

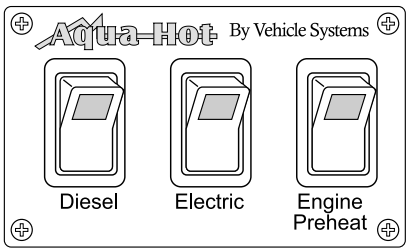



**Using the Thermostat:**

- Select the method of heating, either the diesel burner or the electric element.
- Slide the lever to the desired temperature.

**Diesel Burner:**

The diesel burner will consume approximately ½ gallon of diesel for each hour of continuous burner operation. The diesel burner is rated at 12 Volt/65 watts. Circulating pumps rated at 12 Volt/12 watts each. The diesel-fired burner has a fast recovery rate. To heat the Aqua-Hot from the diesel burner turn the switch to the ON position. The switch will illuminate when the Aqua-Hot is ON. Allow 20 to 30 minutes for the Aqua-Hot to reach operating temperature before operating heat exchangers or using hot water.



**Electric Heat Element:**

The electric element works well if plugged into 50 Amp service. When plugging into less than 50 Amp service, exercise care not to overload the electric service provided. The rate of recovery of the electric element is slower than the diesel burner. Allow two to three hours for the Aqua-Hot to reach operating temperature when operating from the electric element.

**Interior Heat Exchangers:**

The heat exchangers are small 8,000 BTU radiators.

**Engine Preheat:**

The Aqua-Hot system has an engine preheat feature to aid in starting in cold or frigid weather. Inside the Aqua-Hot is an engine coolant loop and an engine coolant pump. The Aqua-Hot will heat the engine coolant and the internal engine pump will circulate the heated coolant through the engine.

To Use the Engine Preheat System:

- Turn the **Aqua-Hot** switch to the **ON** position.
- Turn the **Engine Heat** switch to the **ON** position. This activates the engine pump inside the Aqua-Hot. The time required to preheat the engine varies with ambient temperature. Allow at least three hours of engine pre-heat time.

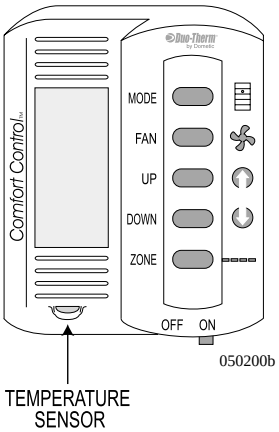
**Engine Heat Exchange System:**

When traveling, the water pump on the engine circulates heated engine coolant through the Aqua-Hot. Through convection, the heat transfers to the Aqua-Hot coolant, providing hot water and interior heating. Use the Comfort Control to operate the heat exchangers.

To Use the Engine Heat Exchange System:

- Turn ON the **Battery Cut-off** switch at the entry door.
- Set the Comfort Controls to **Furnace**.
- Select the desired Zone and Temperature.

**NOTE: All zones must be in the same mode for the HVAC (Heating, Ventilating, Air Conditioning) system to function correctly. DO NOT set Furnace mode in one zone and Cool mode in another zone.**



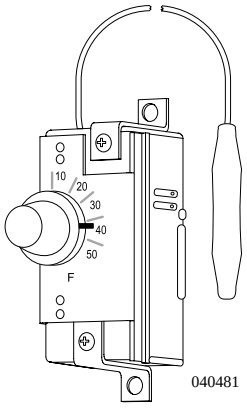
**To Operate the Furnace:**

- Select either diesel burner or electric element operation. Select both functions if desired.
- Turn living room and bedroom comfort controls to **ON**.
- Set the desired zone using the **ZONE** button.
- Press the **MODE** button repeatedly until furnace displays.
- Select desired temperature setting using the **UP** or **DOWN** buttons.

**NOTE: The switch in the private bathroom controls the blower motor of the heat exchanger in the private bathroom. When the switch is on, the bathroom blower motor will cycle on and off when Zone 2 exchanger blower cycles on or off.**

## Bay Thermostat

If the motorhome is used in cold weather conditions the bay thermostat, located next to the Aqua-Hot, will be needed. This thermostat controls the heat exchanger for holding tank bay heat. Adjust the thermostat to 40-50° F. This will help prevent freezing of the water system.

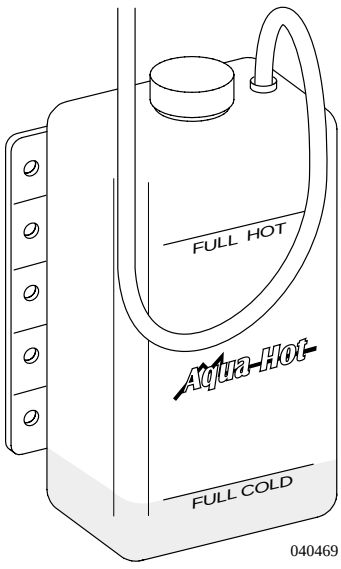



**NOTE: The Aqua-Hot must be turned ON when using the holding tank bay exchanger.**

## Maintenance Schedule

**Monthly:**

Check the Aqua-Hot's 60/40 solution of water and antifreeze to ensure its proper level. Visually inspect the coolant level in Aqua-Hot's expansion tank when the Aqua-Hot is at operating temperature. Adding solution to the expansion tank when the unit is cold will result in a solution overflow when the Aqua-Hot attains normal operating temperature. The expansion tank is located in the battery compartment.




**Annually:**

Be sure to have the Aqua-Hot tuned up early. A tune up consists of a fuel nozzle and fuel filter replacement, as well as a thorough cleaning of the combustion chamber. This simple tune up will keep the Aqua-Hot running smoothly throughout the year, as well as allow service personnel to inspect for additional wear of other components. Signs that the Aqua-Hot may need servicing are continuous white exhaust smoke or poor ignition start up. When in operation, the Aqua-Hot should have a smooth, high-pitched whine. Loud growls or other abnormal noises indicate service or repair is required.

**CAUTION: Before cleaning or servicing disconnect all power supplies.**

**INFORMATION: For more details about the Aqua-Hot system, see the Owner's Information Packet.**

**Aqua-Hot Fuel Filter:**

The filter is located on the wall above the fuel tank unit. Unlatch and securely position door open.

**Draining the Collection Bowl:**

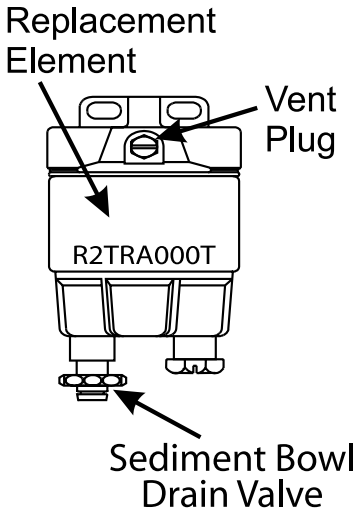
Water is heavier than fuel and will settle to the bottom of a fuel bowl, making it appear different in color. In high humidity environment, check the collection bowl more often. With the engine and the Aqua-Hot off, open the drain to evacuate any contaminants, then close it.

**Element Replacement:**

The contamination levels in the fuel determine the elements replacement frequency. Fuel flow to the Aqua-Hot becomes restricted as the element gradually plugs up with contaminates, resulting in noticeable heating loss and/or hard starting. If this occurs, change the element as soon as possible.

As a guideline, change the element every 500 hours, annually or at first indication of heat loss, whichever occurs first. Always carry an extra replacement element as one tank of contaminated fuel can plug a fuel filter. Replacement filters must have a 10-micron rating.

**Racor filter Aqua-Hot R2TRA000T ten micron.**

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**To Replace the Element:**

- Open the drain valve to drain the filter unit.
- Spin bowl/element from head and remove element.
- Coat new seals with motor oil and install the new element.
- Prime bowl/element with clean fuel.
- Spin bowl/element onto head and tighten firmly by hand.
- Start Aqua-Hot and check fuel filter for leaks.

## WASHER-DRYER PREPARED

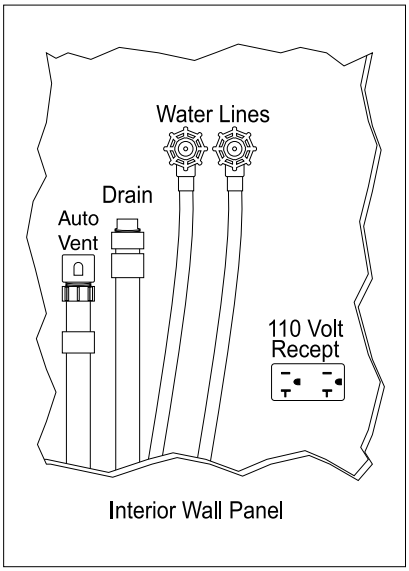
If the motorhome was not ordered with an optional washer-dryer, it will have a washer-dryer preparation package installed from the factory. The washer-dryer "prep" package includes the following items:

1. Color coded water supply lines. A red line for hot; a blue line for cold.
2. An 1½ in. waste water drain line with threaded cap, P-trap, and an automatic vent cap. This will drain the waste water into the grey water holding tank.
3. A 120 Volt receptacle located in the compartment.

**NOTE: Sidewall dryer vents are not part of the prep package. If a sidewall vent is to be installed, properly seal vent to sidewall.**

If a washer-dryer is to be installed at a later date, follow all the manufacturer installation instructions. Listed here are further instructions which should be adhered to for safe and reliable operation:

- Do not connect the clothes dryer exhaust duct to any other duct, vent or chimney.
- Do not terminate the exhaust duct beneath the motorhome.
- Use proper length fastener when attaching exhaust vent to exterior sidewall. Stainless steel fasteners are best suited for this as they will not rust.
- If the cabinet or closet in which a washer-dryer is installed does not have vented louvered doors, the manufacturer's installation instructions may require installation of vented doors or vents to be installed in the doors. This is for sufficient circulation of drying.




Location of specified parts may vary within wall panel depending on floor plan and model.

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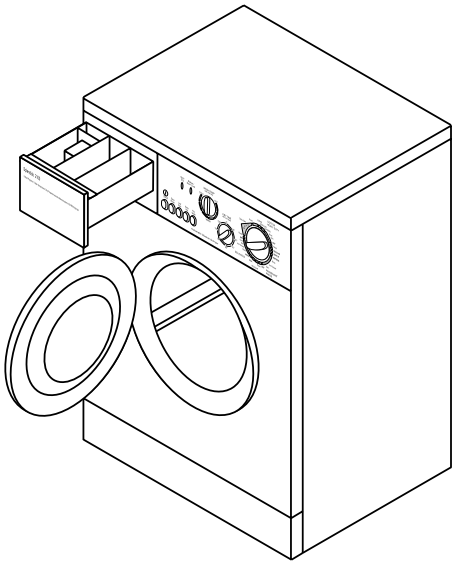
## WASHER - DRYER (OPTIONAL)




The automatic washer-dryer has a capacity of up to 12 lbs. of dry clothing. It is front loading with an extra large door opening for easier access. Several wash and dry programs are available along with variable water temperature settings.

- The washer-dryer operates on 120 Volt AC from shore power or the generator.
- The washer-dryer will use approximately 12 to 20 gallons of water per wash cycle.

**INFO: The washer-dryer has many features. Refer to the manufacturer's manual in the owner's information file for detailed operating instructions.**

**WARNING: Open a window or vent while operating the dryer. The washer-dryer can create negative air pressure inside the motorhome that can accumulate Carbon Monoxide or LP-Gas while operating fuel-burning appliances.**

**CAUTION: Do not use the washer-dryer while traveling. Suspension movement, combined with the weight of the drum while in the wash cycle, can damage the internal components of the washer-dryer.**

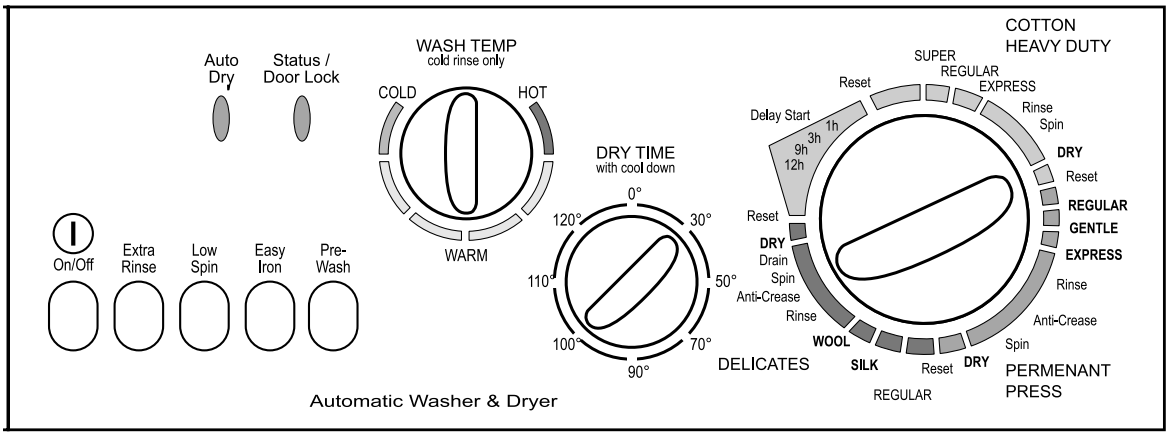
Before using the washer for the first time, after winter storage or a long period of non-use, it is a good idea to conduct this simple test procedure prior to loading the machine for use. This procedure will verify all the hardware and electronic components are functioning properly. Wipe the inside and outside with a damp cloth to remove any travel dust that has accumulated.

**NOTE: Perform this test before putting the washer-dryer in use for the first time or after the winter months. This will clear the water lines and drum of winterization antifreeze.**

### *Test Procedure*

**Test Procedure Requirements:**

- Make sure water lines are secure and any water valves are open.
- Hook to city water or turn on the water pump.
- Hook to shore power or start the generator.

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**To Conduct the Test Procedure:**

1. Set the selector knob to **Reset**.
2. Set the **Dry Timer** knob to 30 minutes. Push the **On/Off** button to **On**. Wait five seconds. The **Auto Dry** light should be on and the **Status** light flashes fast then slow.
3. Set the selector knob to a wash cycle. Set **Wash Temp** knob to **Warm**. Water should be flowing into washer and drum should rotate both directions.
4. Set the selector knob to **Reset**. Wait five seconds.
5. Set the selector knob to **Spin**. Water should drain and drum rotation should speed up.
6. Set the selector knob to **Reset**. Wait five seconds.
7. Set the selector knob to **Dry**. Dryer fan should begin and drum should rotate both directions.
8. Set the selector knob to **Reset**. Wait five seconds.
9. Set the **Dry Time** knob to zero. The **Auto Dry** light should go off.
10. The door will unlock in two minutes or less. The **Status** light flashes fast then slow. The door should now open.
11. Push the **On/Off** button to **Out** (Off) position. The **Status** light should be off.

**WARNING: Do not wash or dry articles that have previously been cleaned, washed, soaked or spotted with gasoline, dry cleaning solvents or other flammable or explosive substances. They give off vapors that could ignite or explode. Do not add gasoline, dry cleaning solvents or other flammable or explosive substances to the wash water. Do not use heat to dry articles containing foam rubber or similar textured, rubber-like materials.**

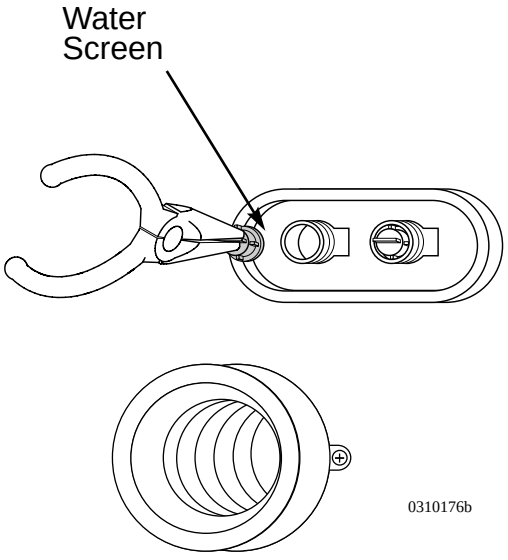
**To begin a wash load:**

- Sort and pre-treat clothes.
- Add the measured amount of detergent suggested by the package directions (maximum two tablespoons).
- Load the clothes loosely into the washer. Close the washer door.
- Turn the Wash Temperature knob to the desired temperature setting.
- Choose the desired washing cycle option using the Selector knob.
- Load wash tray with detergent.
- Turn the power ON.
- After the cycle is complete, wait two minutes for the door lock to release before attempting to open the door.

## *Washer - Dryer Maintenance*

Occasionally wipe the exterior cabinet of the washer-dryer with a damp cloth or sponge. Wipe dry with a soft cloth. Do not use polish on plastic trim. In areas of hard water, detergent can accumulate in the drum. Obtain a packaged water softener. Add quantity as specified by the manufacturer directly to the drum. Run the washer through a complete cycle using hot water. Repeat the process if necessary. Remove hard water deposits using only cleaners labeled as washer safe. Wipe the inside of the washer-dryer door with a soft cloth to remove any moisture. Periodically apply a thin coat of paste wax to the inner door, especially to the area that is immediately next to the door window. This will protect the door finish from laundry spills and discoloration.

If water flow to the washer-dryer is reduced, the Hot and Cold water inlet screens may be clogged. Remove water pressure and undo water lines at the back of the washer-dryer. Use tweezers or pliers to remove screens from fittings. Clean and install screens and water lines. Hook to city water or turn on the water pump. Check for water leaks before using the washer-dryer.




**NOTE: Should the washer-dryer need removal for service, care should be taken as the washer-dryer weighs approximately 170 lbs. Proper accommodations should be made to avoid risk of injury or damage to the cabinetry.**

## Winterizing the Washer-Dryer

**To Winterize the Washer Dryer with Air Pressure:**

1. Hook an airline (regulated to 45 psi or less) to the water inlet of the motorhome.
2. Rotate Selector knob to a wash position with the Wash Temp setting on Warm. Press the power button to On. Air pressure will clear the Hot and Cold water lines.
3. After water lines are clear, rotate Selector knob to Spin. Allow the pump to drain the drum.
4. Set Selector knob to reset and Timer to zero. The door will unlock in two minutes or less. Open door and pour in ¼ gallon of RV antifreeze.
5. Set Selector knob to Spin. The pump will prime with antifreeze. Set selector knob to Reset and turn the power off.

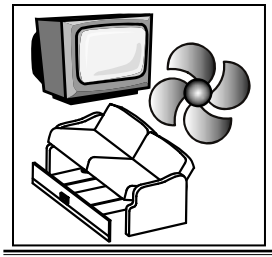
**To Winterize the Washer Dryer Using RV Antifreeze:**

Two methods of introducing antifreeze to the water system can be used. Add antifreeze directly to the water tank or use a separate container of antifreeze with water line hooked to the intake side of the water pump.

1. Turn on the Water Pump. Rotate Selector knob to a wash position with the Wash Temp setting on Warm. Press the power button to On. Allow antifreeze to enter the drum.
2. After water lines are filled with antifreeze, rotate Selector knob to Spin. Allow the pump to drain the drum.
3. Set Selector knob to reset and Timer to zero. The door will unlock in two minutes or less. Turn the power off.
4. Any remaining liquid should contain a sufficient amount of antifreeze to be protected from freezing.

**NOTE: After winter, perform a Test Procedure before washing or drying any laundry to make sure all antifreeze has purged.**

## ~ NOTES ~



# Equipment
## section 5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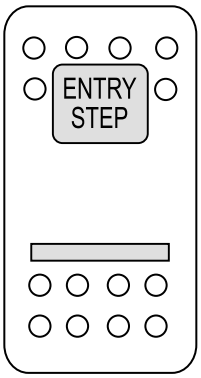
## EQUIPMENT - INTRODUCTION

This section covers the basic operation and care of various types of equipment found in the motorhome, most of which are provided for entertainment and comfort. More detailed information about specific equipment may be found in that particular manufacturer's manual. Optional equipment will also be discussed in this section which may not apply to all motorhomes.

**INFO: Detailed information with CAUTION or WARNING instructions for the various electronics, other than what is provided in this section, can be found in the manufacturer's manual.**

## ENTRY STEP *- Operation*

The entry step features amber lighting under the step, automatic retraction with the ignition key in the **RUN** position and a last out feature. Located just inside the entry door is the step switch. The uppermost step has a **storage compartment** w/removable tray. The area can be utilized to store frequently used items such as, gloves (for refueling), tire pressure gauge, flashlight or outside slippers.

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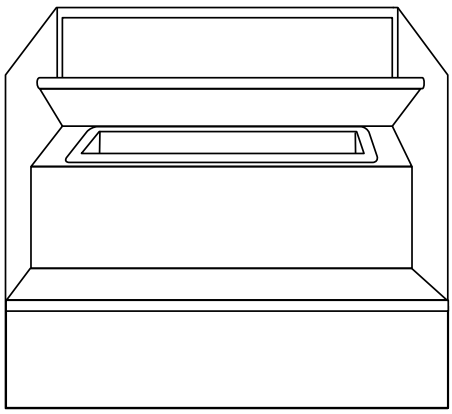
**Operating the Entry Step:**

1. With the entrance door open, turn the step switch **ON**.
2. Close the door. The step should retract and lock in the **UP** position. The step light will remain on.
3. Open the door. The step should extend and lock in the **DOWN** position with the under step light on. The step will retract when the door is closed.
4. The step is equipped with a power switch. When the switch is turned **OFF**, the step should remain in the extended position with the door closed and the light **OFF**. Close the door and turn **ON** the ignition switch. The step will retract for travel.
5. With the power switch off, the step extended, the entrance door closed and the ignition turned on, the ignition override system will go into effect and the step will automatically retract.
6. Turn the ignition **OFF** and open the door. The step will extend and lock in the **DOWN** position. This is the "last out" feature. When the ignition is on the step will always activate with the door movement, regardless of the power switch position.



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**If the step fails to operate:**
- Verify that the step switch is **ON**.
- Check the main power supply for the step, a 25 Amp fuse is located in the front distribution panel.

**WARNING: If the motorhome is driven with the step in the extended position there is the possibility of causing major damage to both the step and the motorhome.**

## STEPWELL COVER

The stepwell cover operates by 12 Volt DC house power.

**To Operate the Stepwell Cover:**
1. Turn **ON** the battery cut-off switch.
2. Press the Step Cover switch to the desired direction. Release the switch to stop movement.

**CAUTION: When operating the stepwell cover, be sure there are no pets, shoes or other obstructions in the stepwell area. Do not operate the stepwell cover while standing in the stepwell area.**

## ENTRY DOOR

The entry door is adjusted at the factory and tested for all operations. The door incorporates three separate seals to eliminate wind noise during travel. The door uses two separate locks for safety and security. One locking system is the door handle and the other is a dead bolt. The door handle incorporates a primary and secondary latching system. This is used to ensure secure and safe latching. There are adjustments which can be made to help maintain entry door performance.

**Adjusting the Entry Door Latch:**
- Determine which bolt needs adjustment.
- Slowly close the entry door observing the latch and strike bolt alignment. Do not attempt to latch if the alignment is off. If the alignment is correct, allow the latch to catch in the first (primary) position only.

- The latch should move to the second position with only slight pressure applied to the entry door. Upper and lower latches should be evenly timed. Press on the entry door to check for further movement of the door.
- The entry handle should operate with little effort to open the entry door. Excessive pressure indicates the bolts are set too far back.
- With a 5/8" inch box wrench or socket, loosen the movable strike bolt. Make all adjustments in small increments. Tighten the bolt firmly after making adjustments. The bolts should have slight up and down movement for vibration control in travel.
- Test the operation of the dead bolt lock to ensure proper functions.

- Apply silicone weekly to the entry door rubber gaskets to prevent squeaking while the motorhome is traveling. Use a one inch sponge paint brush, sprayed with silicone for easy application.

**CAUTION: When operating the entry door ensure the dead bolt latch is fully in the unlock position prior to closing the entry door. Failure to do so can result in damage to the dead bolt and/or entry door.**

## *Screen Door Maintenance*

**Changing Screen Door Glass:**

- The screen slider is Plexiglas, the slider can be bowed for removal and replacement.
- Replace with new Plexiglas and reverse the procedure.

**Adjusting the Screen Door:**

- Loosen the chrome bolts on the hinge side of the screen door; four on the top and four on the bottom.
- The steel hinge has slots to allow up and down movement.
- Four Allen type screws are on the top hinge, and four on the bottom hinge, to adjust the screen door to properly fit to the entry door. The hinge should fit tightly to the trim of the door when the screen door is latched to the door and the door is open.

**Removable Screen:**

- The top half of the screen door is removable. This allows clear viewing through the entry door glass while traveling.
- To remove the top half of the screen door for travel, rotate clips and remove the screen.
- To store the screen for travel, use the clips provided on the bottom half of the screen door.

## SLIDE-OUT OPERATION

The main slide-out room operates by an electric switch which controls an electric motor. Slide-out room operation uses many safety features preventing mechanical damage or physical harm. The slide-out room(s) will not operate until all safety requirements are met.

The design of the slide-out system requires very little maintenance. To ensure long life of the slide-out system, follow these simple guidelines:

- **Inspect** the roof of the slide-out for debris such as pine needles, dirt, leaves, sticks, etc. Any debris left on the top may cause damage to the seals when being retracted. If debris is present wash with soap and water, then rinse.
- When the room is out visually **inspect** the wipe seal. The seal should be clean and free of dirt or other foreign material. **Inspect** the seal for tears.
- In the event the slide-out room leaks, fully retract it. If necessary, tape the exterior opening closed with duct tape until repairs to the motorhome can be completed.
- Open a window or a vent to equalize pressure during slide-out operation.

**NOTE: Do not use any petroleum-based products on the slide-out seal. Petroleum based products can damage the paint and will cause premature aging of the rubber seal.**

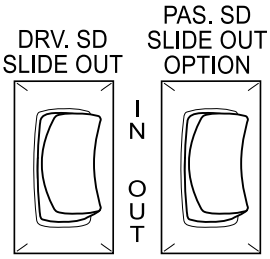
**WARNING: Move the driver's seat forward before activating the slide-out room. Damage to the upholstery can occur. The outside area must be clear of any obstructions restricting slide-out room operation. Ensure there is five or more feet of clear space outside the slide-out room prior to extending or damage can occur. When retracting the slide-out room, ensure there is sufficient clearance inside the motorhome. Never move the motorhome with any slide-out room extended.**

**CAUTION: Continuous operation of the slide-out room can drain the batteries and damage the motor from overheating.**

## Main Room Slide-out

**To Extend the Main Slide-out Room:**

- Move the driver seat forward.
- Confirm that there is at least five feet of clearance outside the motorhome for the slide-out room to extend.
- Ensure the ignition key is in the **OFF** position.
- The park brake must be applied.
- The house batteries are fully charged.
- Be sure all people, pets and objects are clear of slide-out room path.
- Remove the lock bar.
- The control switch for the slide-out room is on the system monitor panel.
- Press and hold the front slide-out room switch in the **OUT** position. The slide-out room will slowly move to the **OUT** position. Release the switch to stop room movement. To continue the room movement, push and hold the switch in.
- Release the slide-out switch when the room is fully extended (a change in motor sound indicates extension). The slide-out drive motor will not stop automatically; the switch must be released.
- If equipped, extend additional slide-out rooms.
- Level the motorhome with the leveling system.

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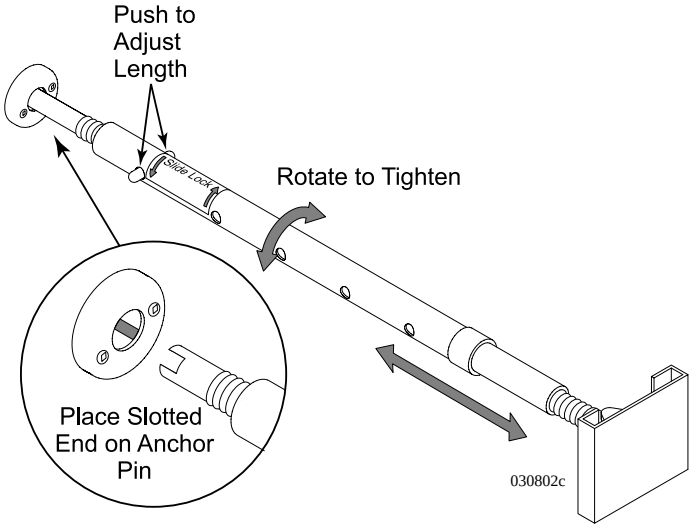
**NOTE: Perform the slide-out room operation with the air suspension system full. Extensive damage could occur to the slide-out room and awning when extending the slide-out room in snow, sleet, ice or freezing rain. In such conditions, if the slide-out room is extended, clear the awning and ensure free movement prior to operating the slide-out room.**

**CAUTION: Dirt and grit trapped under the slide-out room could result in damage to the floor. Continuous operation of the slide-out could cause a drain on the house batteries and damage to the slide-out motor from overheating.**



**To Retract the Main Slide-out Room:**

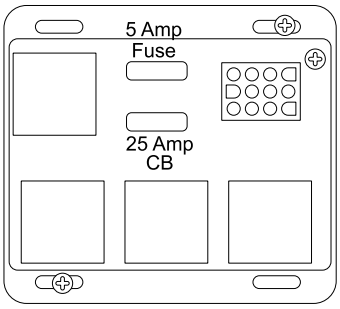
- Check for sufficient clearance inside the motorhome before retracting the slide-out room.
- Clean the floor, if applicable, to ensure there is no dirt or grit that could result in floor damage during operation.
- Move the driver's seat forward.
- Inspect the exterior to ensure there are no sags in the awning material.
- Remove any debris from the top of the slide-out room.
- Prior to retracting the slide-out room, start the motorhome. Allow the air bags to fully inflate to normal travel height.
- Retract the leveling jacks prior to operating the slide-out.
- Turn the ignition switch **OFF**. The slide-out room will not operate with the engine running.
- The house batteries should be fully charged.
- The park brake must be applied.
- Ensure all people, pets and objects are clear of slide-out room path.
- Press and hold the switch in the **IN** position. The slide-out room will move slowly in. To stop the slide-out room, release the switch. To continue the room movement, push and hold the switch in.
- Release the switch.
- Install lock bar for travel.
- Rain water can pool on the slide-out awning. Added weight will cause the awning to sag. Upon retracting the room, the material can catch between the top of the slide room and the opening in the the motorhome. It will be necessary to retract the room in small increments, allowing the water time to run off.

**NOTE: Be sure you have sufficient clearance on the inside of the motorhome (driver's seat, etc.) before you retract the slide-out room. Ensure the floor is clean before you retract the slide-out room. Trapped dirt or grit under the slide-out room can scratch the floor surface. Never move the motorhome with the slide-out room extended.**

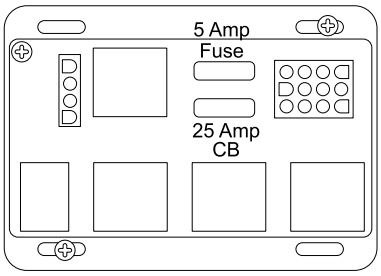
**CAUTION: Rain water can pool on the slide-out awning. The added weight will cause the awning to sag. Upon retracting the room, material can become caught in between the top of slide room and the opening in the motorhome. It will be necessary to retract the room in small increments allowing the water time to run off.**

**If the Slide Room Fails to Operate:**

Check the fuse and auto-reset circuit breaker on the slide-out relay module located adjacent to the inverter. If the fuses and circuit breakers test okay, it will be necessary to call and obtain mechanical assistance to correct the problem.




*Double Slide*

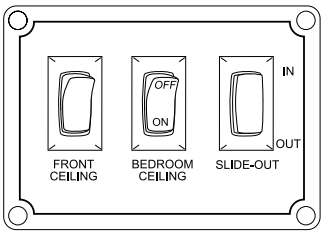



*Triple Slide*

## *Bedroom Slide-out*

**To Extend the Bedroom Slide-out:**

- Confirm that there is at least five feet of clearance outside the motorhome for the slide-out room to extend.
- Ensure the ignition key is in the **OFF** position.
- The house batteries are fully charged.
- The battery cut-off switch must be in the **ON** position. Depending on the floor plan, the switch is either on the monitor panel, or in the bedroom wall.
- Ensure all people, pets and objects are clear of the slide-out room path.
- Press and hold the rear slide-out room switch in the **OUT** position. The slide-out room will slowly move to the **OUT** position. Release the switch to stop room movement. To continue the room movement, push and hold the switch in.
- Release the slide-out switch when the room is fully extended (a change in motor sound indicates extension). The slide-out drive motor will stop automatically.
- Level the motorhome with the leveling system.

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**WARNING: Firmly latch all cabinet doors adjacent to the bedroom slide-out before extending or retracting the room. Damage to doors or fascia can occur.**

**CAUTION: Dirt and grit trapped under the slide could result in damage to the floor. Continuous operation of the slide-out could cause a drain on the house batteries and damage to the motor from overheating.**

**NOTE: Do not leave the slide-out in the extended position during severe weather. Conditions such as high winds or heavy rain may cause damage.**

**NOTE: Perform the slide-out room operation with the air suspension system full. Extensive damage could occur to the slide-out room and awning when extending the slide-out room in snow, sleet, ice or freezing rain conditions. In such conditions, if the slide-out room is extended, clear the awning and ensure free movement prior to operating the slide-out room.**

**To Retract the Bedroom Slide-out:**

- Check for sufficient clearance inside the motorhome before retracting the slide-out room.
- Clean the floor, if applicable, to ensure there is no dirt or grit that could result in floor damage during slide-out retraction.
- Remove any debris from the top of the slide-out room.
- Prior to retracting the slide-out room, start the motorhome. Allow the air bags to fully inflate to normal travel height.
- Retract the leveling system or prepare the air leveling system for travel prior to operating the slide-out.
- Turn the ignition switch **OFF**. **The slide-out room will not operate with the engine running.**
- The house batteries are fully charged.
- The battery cut-off switch must be in the **ON** position.
- Locate the control switch for the slide-out, usually located on the monitor panel, or on the bedroom wall.
- Clear all people, pets and objects from the slide-out room path.
- Press and hold the switch in the **IN** position. The slide-out room will move slowly **IN**. To stop the slide-out room before the room reaches the **IN** position, release the switch. To continue the room movement, push and hold the switch in. The motor will automatically stop when the slide-out room is fully retracted.
- Release the switch.
- Rain water can pool on the slide-out awning. Added weight will cause the awning to sag. Upon retracting the room, the material can catch between the top of the slide room and the opening in the the motorhome. It will be necessary to retract the room in small increments, allowing the water time to run off.

**CAUTION: Continuous operation of the slide-out room can drain the battery and damage the slide-out motor from overheating. Never move the motorhome without having the slide-out room retracted.**

## Manual Override - Bedroom Slide-out

If the slide-out room does not respond from the switch, check that all the safety features are in place.

- The ignition key is **OFF**.
- The battery cut-off switch is **ON**.
- The house batteries are fully charged.

**If the Slide Room Fails to Operate:**

Check the fuse and auto-reset circuit breaker on the slide-out relay module located adjacent to the inverter. If the fuses and circuit breakers test okay, it will be necessary to call and obtain mechanical assistance to correct the problem.

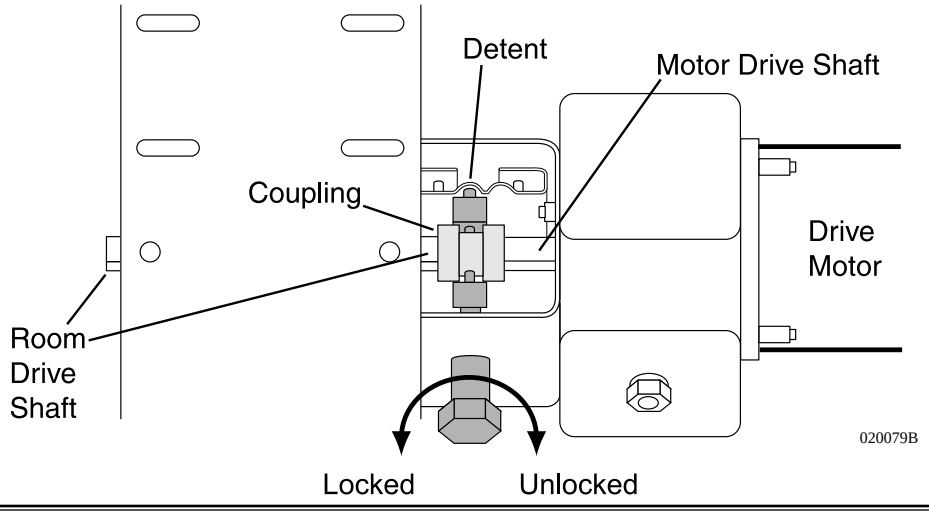
**WARNING: Do not work on the slide-out system unless the battery is disconnected. Make sure the floor is clean before retracting the slide-out room.**

After the previous items have been checked and the room still does not move when the slide-out switch is pressed, follow these simple steps to manually override the slide-out room:

**Manual Override for Bedroom Slide-out:**

1. Lift up the mattress and unscrew baseboard to gain access to the slide-out cover board and mechanism.
2. Remove 12 Volt DC from the motor by disconnecting the plug from the slide-out motor to the power supply.
3. The drive mechanism has a sliding coupling to engage and disengage the drive motor. Turn the large hex nut clockwise to unlock the drive motor.
4. The slide-out then can be pushed back.
5. Once the slide room has been manually retracted, turn the large hex nut counterclockwise to lock the room in place.
6. Take the motorhome to an authorized dealer for service.

**NOTE: The slide out room is heavy and may require several persons to push it into the retracted position.**



## Slide-out Cover

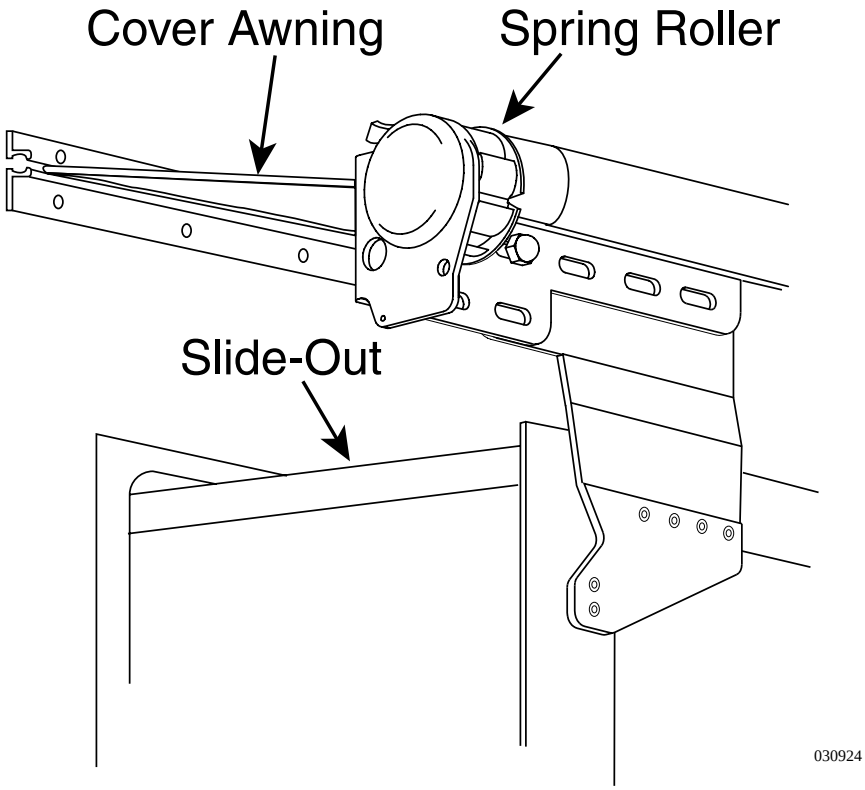
The slide-out cover is automatic. When the slide-out moves in or out, the cover reacts to the slide-out direction. A fixed edge of the slide-out cover is installed into an awning rail, mounted just above the slide-out. A spring-loaded roller with special brackets mounts to the slide-out. In a hard rain, the cover helps prevent water from penetrating the seal of the slide-out.

The slide-out cover will extend automatically attaining full coverage when the slide-out achieves maximum extension.

**NOTE: Water may pool on top of the extended cover. As the slide-out is retracted, the water is removed when the cover retracts. Retract room slowly. Pause three or four times to allow any accumulated water a chance to run off.**

The slide-out cover retracts automatically and rolls up to the travel position when the slide-out is completely closed.

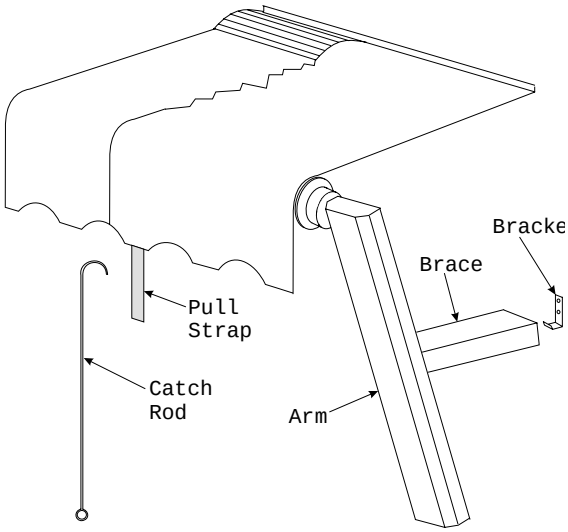
**NOTE: When retracting the slide-out, stop the room approximately halfway. Confirm that the fabric is rolling properly before fully retracting the slide-out.**



## AWNINGS - *Front Door*

**To Extend the Awning:**

- Hook the pull strap loop with awning pull rod.
- Pull strap until awning is at full extension. With free hand, lever out brace arms.
- Mate the slot of inner arm with hook on side of the motorhome. Repeat procedure for other arm.
- Release strap slowly ensuring inner arms are secure. Slide the strap to rear of awning roll tube and tie to rear arm.



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**To Retract the Awning:**

- Untie the pull strap and slide strap to center of awning roll tube.
- Pull down on pull strap with a firm grip until tension is off the brace arms. Fold inner arms and attach them to the velcro.
- Carefully allow material to wind onto awning roll tube while holding strap in a neutral position. This will allow material to roll up evenly.
- Awning end caps should be against the rubber bumpers. If one end cap is off, pull down on awning pull strap while holding strap slightly to opposite side, allowing awning to roll back up into position.

**CAUTION: When the awning is at full extension do not allow the awning to snap back into the retracted position. Personal injury or damage to the awning or motorhome may occur.**

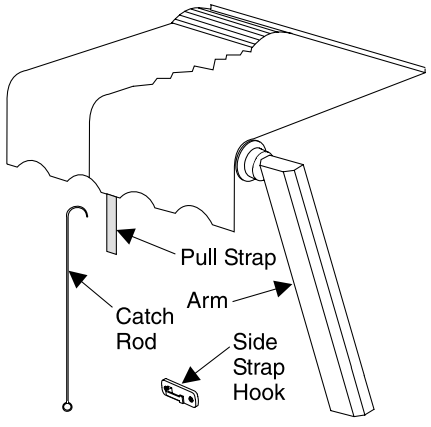
## *Window Awning (Optional)*

**To Extend Awning:**

- Hook loop of pull strap with catch rod and pull awning, reel assembly and side arms to extend fully away from motorhome.
- Hook pull strap on side strap hook, remove catch rod from pull strap and store.

**To Retract Awning:**

- Hook catch rod on pull strap, remove pull strap from side strap hook and slowly allow awning to retract.
- Remove catch rod from pull strap and store.



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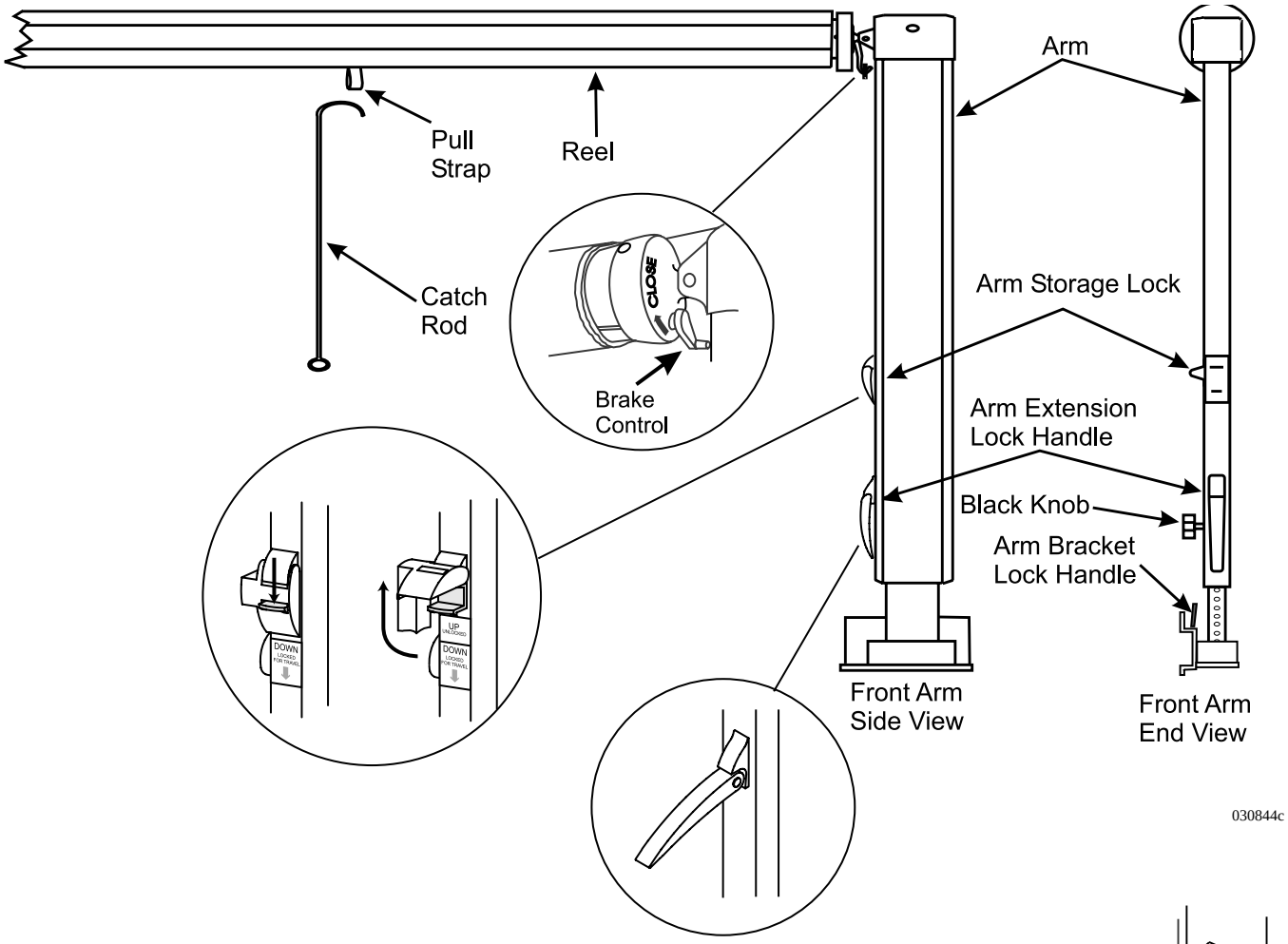
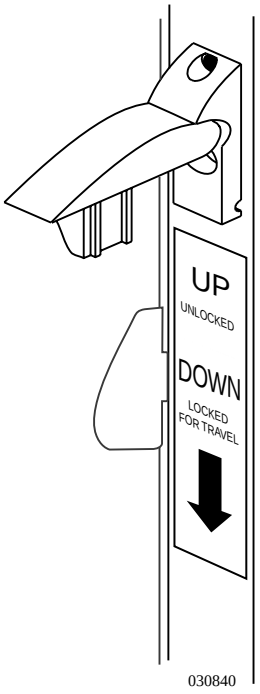
## Awning - Patio




**To Unlock the Awning:**

Start with either awning leg and repeat the following steps for each leg.

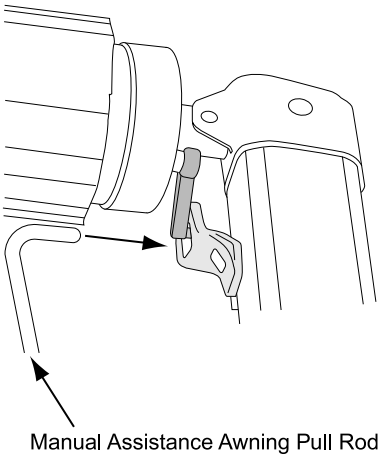
1. Loosen the black locking knob located on the backside of the awning leg (only about six turns are needed). This will allow the support brace to move freely.
2. Unlock the travel lock by using one hand to squeeze inner and outer arm to remove tension from storage lock. Push up on tab and swing lock away.
3. Move the brake control (front leg only) to the up/unlock position.




*Lower Brake Control*

**To Extend the Patio Awning:**

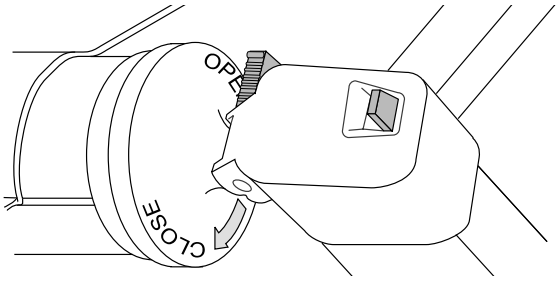
1. Locate the awning pull rod.
2. Locate the loop of the pull strap and hook it with the awning pull rod. Draw the awning away from the motorhome to the desired extension.



Manual Assistance Awning Pull Rod

**WARNING: Always use the pull strap for extending and retracting awning. Never retract awning while holding onto the awning arm. Hands or fingers caught between the awning arm channel and brace channel during awning retraction may result in serious injury.**

3. Slide the inner bracing rafters to the top of each arm ensuring the bracing is locked in place. Tighten the black locking knob.

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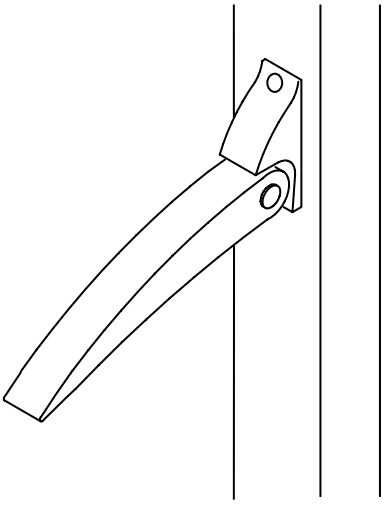
**NOTE: Ensure the locking tab on the support brace is latched through in the hole in the end cap.**

4. If equipped with Canopy Clamps, fasten the clamps at this time.
5. Using the arm extension lock handle, the awning can be hoisted upwards for additional clearance. Grasp upper arm with one hand and lift slightly upward. While lifting upward, push in on the release lever located on the lower portion of the upper arm. Lift front of awning to the desired height. Support the weight of the awning with one hand while relaxing release lever and allow the engaging pin to set into a hole in the lower arm. Go to the other awning arm and do the same. Ensure the awning is straight.
6. Slide the center pull strap to one end of the awning and store it by wrapping the strap around the awning leg.



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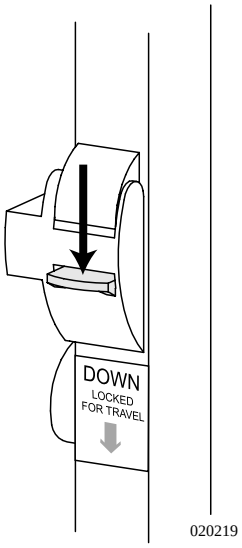



**To Retract the Patio Awning:**

1. Loosen the strap from the awning leg if it has been stored there.
2. Support the weight of the awning with one hand while opening the extension lock handle and lower the awning until the arms rest on the lower stop bolt. Loosen the two black locking knobs enough to allow the support brace to travel freely.
3. If equipped with Canopy Clamps, remove and store the clamps at this time.
4. Release the locking tab on the end cap of the awning leg and slide the inner support brace to down the awning leg to the stop bolt. Repeat for opposite side.
5. While pulling down slightly on the pull strap, slide the brake control down located on the front awning leg.
6. Keeping downward pressure applied, slide the pull strap to the center of the awning while holding on to the strap.
7. Place the hook end of awning rod into pull strap loop to assist in retracting the awning. Make sure pull wand does not slip out of pull strap loop, allow the awning to roll up to the stored position.
8. Store the awning rod until it is needed again.
9. Verify that the brake control is in the locked or closed position. Snap the arm storage locks into the down position and tighten black locking knobs.

**Rain Release Setting:**

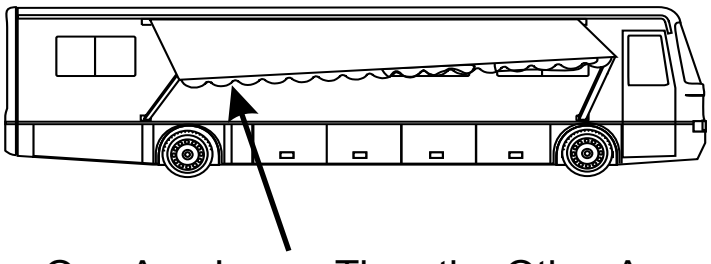
After the awning has been extended, choose the rain release position to prevent water build up on the awning. To position the awning in the rain release setting, lower one arm of the awning and leave the other arm in the normal position. This will create enough of a slope for adequate water run off.

**NOTE: Water weighs 8.33 pounds per gallon. The awning was not made to withstand the 500 to 700 pounds that could accumulate. It is best not to subject the awning and the motorhome to the needless strain.**

**Using the Carport Feature:**

(Not available with Carefree One Touch Awnings.)

Rain Release Setting

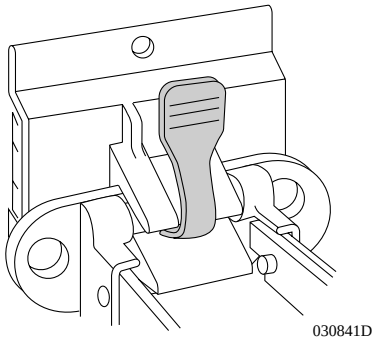


One Arm Lower Than the Other Arm

**Using the Carport Feature:**

(Not available with Carefree One Touch Awnings.)

1. Unlock and extend the awning as described under "To Unlock the Awning" and "To Extend Awning."
2. Unlatch the bottom of the rear arm by pushing in on the lock handle on the arm bracket. Swing the arm away from the motorhome to an upright position.
3. Drive the stakes through the bottom holes in the arm.
4. Raise the rear arm extension lock handle all the way up or to the desired height and lower the lock handle to lock the arms in place.
5. Repeat instructions 2 through 4 for the front arm.



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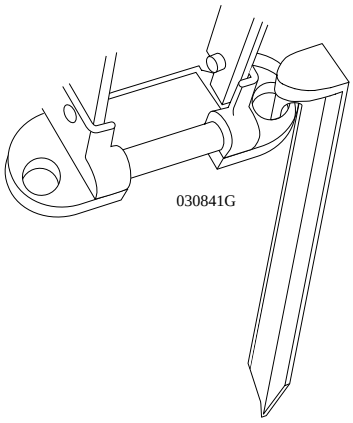

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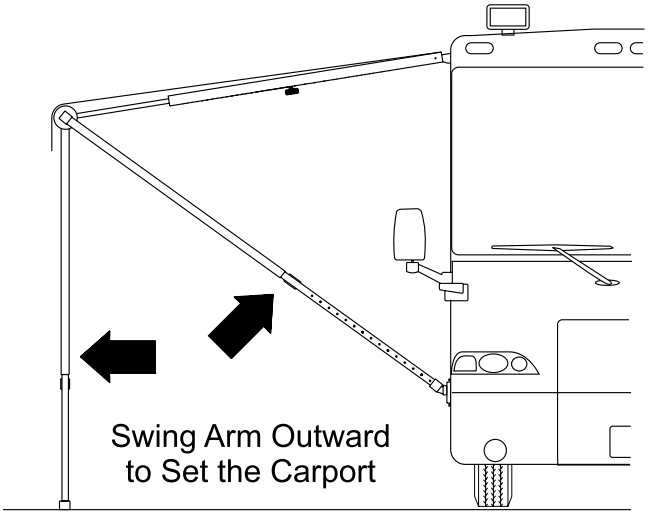
**NOTE: To move the awning out of the carport position reverse the above steps.**

**Securing the Awning for Travel:**

Before traveling, check the following:

1. The awning is fully retracted against the sides of the motorhome.
2. The black locking knobs are tightened.
3. The brake control is in the full down (locked) position, and no red warning is showing.
4. The storage locks are down and in the locked position.
5. The bottom of the front and rear arms is latched properly into the bottom brackets.
6. The awning pull rod is stored away.

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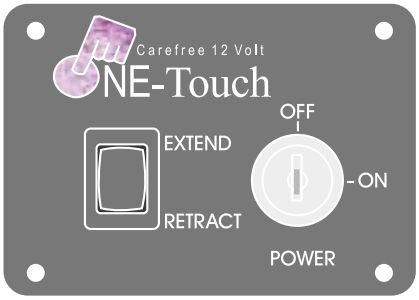
## Awning - Automatic Carefree (Optional)

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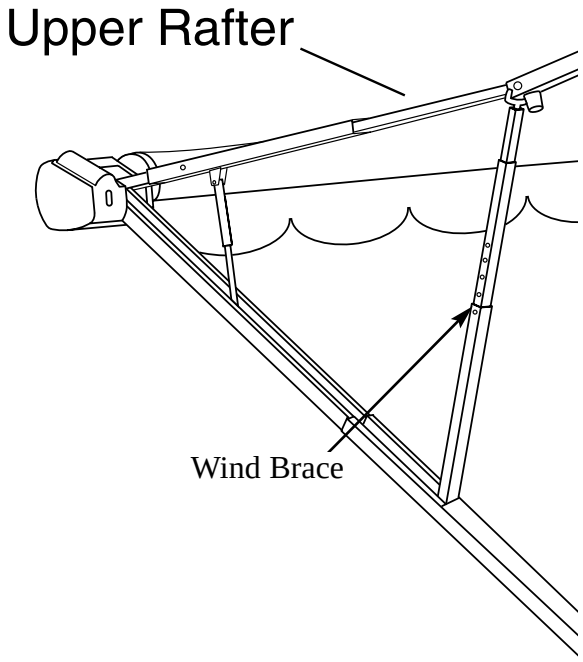
The Carefree One Touch automatic awning requires only "finger tip" operation. A key lock on the One Touch switch pad is provided to prevent accidental deployment of the awning while the motorhome is in motion. The key is removable in the lock or unlock position. Gas filled struts keep the awning fabric tight at any extended position. The 12 Volt DC motor for the One Touch awning uses approximately 15 Amps while in operation.

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**To Extend the Awning:**

- Verify all persons and objects are clear from the extend path of the awning and related hardware.
- Turn the **One Touch** key to the **ON** position.
- Press and hold the momentary switch to **EXTEND**. Motor will automatically stop at full extension.
- Allow 14 seconds for awning to reach full extension.
- Extension distance or fabric tension is adjusted by toggling between **RETRACT** and **EXTEND**.
- Turn the One Touch key to the **OFF** position.
- Install the wind braces (2) between the upper rafter and the main arm. Adjust wind brace so the inner spring is under tension.

**CAUTION: The patio awning requires nine feet of lateral clearance from the side of the motorhome. This distance will allow the awning to reach full extension. The One Touch patio awning was not designed with a carport feature or a rain release setting. The awning should be retracted if the motorhome is left unattended or high wind conditions exist. Otherwise, wind damage to the awning may occur.**

**NOTE: It is not required to have the awning at full extension. Awning may be stopped at any time of extension or retraction by releasing the momentary switch.**

**To Retract the Awning:**

- Remove the wind braces.
- Verify all persons and objects are clear from the retract path of the awning and related hardware.
- Turn the One Touch key to the **ON** position.
- Press and hold the momentary switch to **RETRACT**. The motor will automatically stop at full retraction.
- It takes approximately 14 seconds for the awning to travel from the fully extended position to the fully retracted position.
- Turn the One Touch key to the **OFF** position to avoid accidental deployment of the awning while the vehicle is in motion.

**Tips - If the awning fails to retract or extend:**

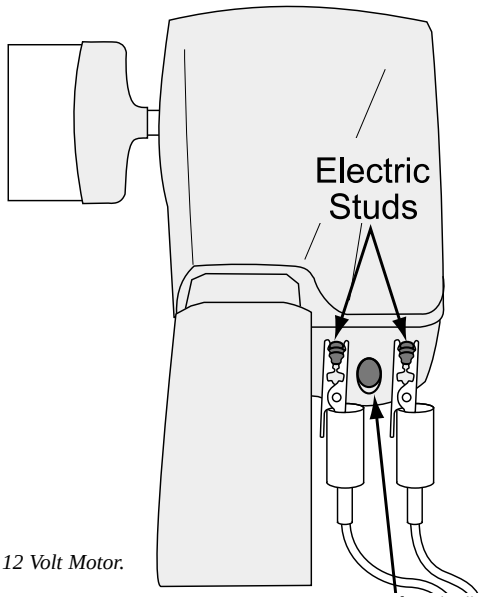
- Verify the One Touch key is in the **ON** position.
- The house battery cut off switch is in the **ON** position.
- The house battery voltage is at 12 Volts or above.
- Verify proper electrical connection from the awning motor to the side of the motorhome.

**Emergency Retract Procedure:**

If the One Touch awning fails to retract and proper DC voltages have been verified, the One Touch awning has two emergency methods of alternately retracting the awning.

1. Two exposed electrical studs are mounted externally at the forward end of the awning at the motor assembly. An alternate 12 Volt DC positive and negative supply may be applied to these connections. If awning fails to move, reverse the polarity of the alternate supply leads.

2. On the motor assembly, mounted externally at the forward end of the awning, is an opening. Insert a 9/64” Allen hex wrench. Using an electric drill, wind the awning to the retract position.




**CAUTION: When using an alternate method to operate the awning, use extreme care to keep appendages, hair or loose clothing away from exposed rotating hardware.**

## Awning Care & Maintenance

Mildew will not form on the awning material itself, but it may form on the dust accumulated on the canopy. A quality vinyl cleaner, such as Carefree Awning Magic, will help keep your awning looking new. Be sure to follow the instructions on the container.

**NOTE: Allow the awning material to thoroughly dry before rolling the awning up. Metal surfaces should be cleaned with soapy water and thoroughly rinsed.**

**Care of Awning Acrylic Fabric:**

The acrylic fabric should be cleaned regularly before substances such as dirt, leaves, etc., are allowed to accumulate on, and become embedded in, the fabric. The fabric can be cleaned without being removed from the awning. Simply brush off any loose dirt, leaves, etc. Hose down and clean with a cloth and mild soap. **Do not use detergents.** Allow to air dry, preferably on a warm sunny day. Should you have to retract the awning when the fabric is wet, it should be extended at the first opportunity to finish air drying.

Avoid leaving the awning partially extended during rainy conditions. The awning is at the strongest setting when the awning is fully extended.

**Cleaning and Maintenance:**

- **Washing:** On a monthly basis, loosen hardened dirt and remove dust from the awning with a dry, medium bristle brush. Thoroughly rinse both the top and bottom with a hose. This process can be made easier with awning maintenance products. Saturate the fabric with the solution and leave it on for 15-20 minutes. Wash both sides of the awning using an awning brush. If necessary, reapply the solution to keep fabric saturated. Rinse the awning thoroughly. Repeat, if necessary, until most of the stains disappear.

- **Water Leaks:** If leaking occurs after washing, it generally results from insufficient rinsing. If water drips through the needle holes in the stitching use a commercial seam sealer which is available in canvas and trailer supply stores. Paraffin wax may also be applied to the top of the seams. As the awning "weathers" these holes will normally seal themselves.

It is normal for slight leakage to occur through the fabric where water is allowed to accumulate or pocket on the fabric. See "**Storm Precautions**" for information on the awning settings for proper water drainage. Sometimes soap or chemical residue, such as from active agents in insect fog or sprays, can "wet" the fabric so that it appears unable to repel water. Rinse the fabric thoroughly and test to see if it is water repellent after it dries. If leakage continues after repeating the washing and thoroughly rinsing, please contact *Carefree Awning Magic* concerning further maintenance.

**Storm Precautions:**

The warranty does not cover damage caused by acts of nature; therefore, steps should be taken to prevent damage from occurring due to wind, rain or storms. If you are leaving or retiring for the night, close the awning. This takes only a few seconds and it gives the best protection for the awning. If unable to close the awning, lower both ends of it as far as you can. This will create a sufficient slope for water run-off. One end may be lowered to sufficiently divert the water, if the awning is being monitored.

Water weighs 8.33 pounds per gallon. The awning was not made to withstand the 500 to 700 pounds that could accumulate. It is best not to subject the awning and the motorhome to the needless strain.

## *Awning - Automatic Girard (Optional)*

The Girard Lateral Arm Awning incorporates the very latest in technology and design. This box awning offers total protection in all weather as it applies the following advanced features:

- Convenient push button operation and an optional remote control for state of the art convenience.
- Retractable arms have twin cables for increased fabric tension and longer life. Angle of arm is adjustable from 5º to 35º for maximum comfort.
- All profiles are made from aluminum, which is then powder coated to give maximum protection for both housing and mechanical parts.
- 100% acrylic fabric is weatherproof, permeable to air and resistant to mildew, rotting and fading.
- Motorized operation, which includes a manual/crank override.
- Wind sensor and/or optional remote control.

**Motorized Operation:**

Motorized operation is simple. The motor (110 Volt) is housed in the roller tube, protected from view and elements. Push the bottom button momentarily to extend the awning all the way. The awning will extend until it reaches the full extend position. Press the top button to retract the awning. The awning can be stopped in either direction.

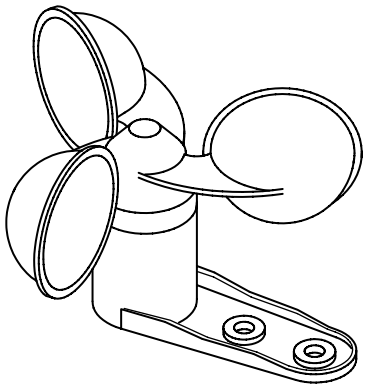
**CAUTION: The motor is not designed for continuous use. In the event that the motor is used to excess, it will automatically shut off and be inoperative until the internal breaker cools down and resets. The run time is four to five minutes per hour. Reset time will be 30 minutes to one hour depending on the outside temperature.**

**NOTE: Ignition must be OFF for the awning to operate.**

The awning will then extend to full projection. To retract the awning, put the switch in the UP position. There is no need to hold the switch once it has been activated. To stop the awning at any point in extension or retraction, move the switch to the center position. The switch should be left in the center position at all times when the awning is stationary. The motor used in the Girard uses 300 watts and draws approximately 3 Amps of power.

**Manual Operation:**

To manually operate the awning, use the telescoping crank handle supplied and follow the instructions in the manufacturer's manual.



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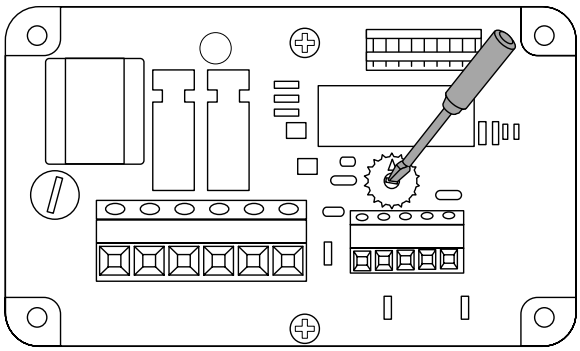
**Wind Sensor:**

To prevent damage, the awning uses a wind sensor that will retract the awning in case of high wind. The wind sensor must have unrestricted access to wind and 110 Volt availability. The wind sensor will override any push button command in case of excess wind. As the sensor rotates, information in the awning control box interprets wind speed. If wind speed is excessive, the awning retracts. Inside the control box is a potentiometer. The potentiometer can vary the wind speed necessary to retract the awning.

Wind speed sensing is adjustable between 18 and 22 mph. The control box is located in the forward cabinet of the curbside living room overhead. The access panel must be removed to adjust the wind speed sensor.



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**To Adjust the Sensor:**

- Unscrew the cover plate screws.
- Adjust the potentiometer clockwise to increase the amount of wind speed needed to retract the awning.
- Adjust the potentiometer counterclockwise to decrease the amount of wind speed needed to retract the awning.

When the wind sensor attains the predetermined speed, the awning will close completely. The awning will not re-open automatically, it must be opened using the extend button. This feature is intended to prevent possible damage to the awning and related components.

**Girard Acrylic Awning Cleaning:**

The Girard acrylic awning should be cleaned regularly, before dirt, leaves, and debris are allowed to accumulate on, and become embedded in, the fabric. The fabric can be cleaned without being removed from the awning. Brush off any loose debris and hose down the awning. Clean the fabric using a cloth and mild soap. A quality acrylic cleaner, such as *FeronCLEAN*, may also be used to help maintain the appearance. Carefully, follow the instructions listed on the container. **Do not use detergents.** Metal surfaces should be cleaned with soapy water and thoroughly rinsed. Allow the awning to air dry while extended, preferably on a warm sunny day.

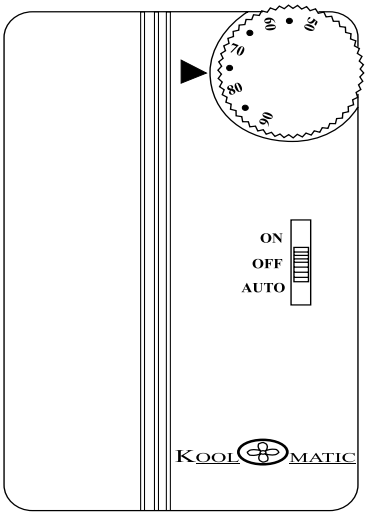
**NOTE: Allow the awning material to thoroughly dry before rolling the awning up. Should the awning need to be retracted while the fabric is wet, it should be extended as soon as possible to allow it to finish drying. Metal surfaces should be cleaned with soapy water and thoroughly rinsed.**

**Girard Care Tips:**

- Avoid leaving the awning partially extended during rainy conditions. The awning is at the strongest setting when fully extended.
- If the wind sensor retracts the awning, it is recommend to leave the awning in until the winds subside.
- The ignition key must be in the **OFF** position for the awning to operate.

## *FANS*
## *Attic Exhaust Fan*

The exhaust fan is a three-speed fan with a "**0**" or **OFF** position on the fan. The exhaust fan requires the presence of 12 Volt DC to operate. The fan will either pull in air or extract air from the motorhome depending on how the **IN/OUT** switch was set. The **IN/OUT** switch controls the direction of the fan rotation. There are three basic controls located on the ceiling vent fan. The knurled knob manually opens and closes the dome cover. The rotary knob selects the operating speed of the fan. When the dome cover opens approximately two inches, the fan motor begins to operate. During normal operations the knurled knob offers manual control of the dome cover for opening and closing.

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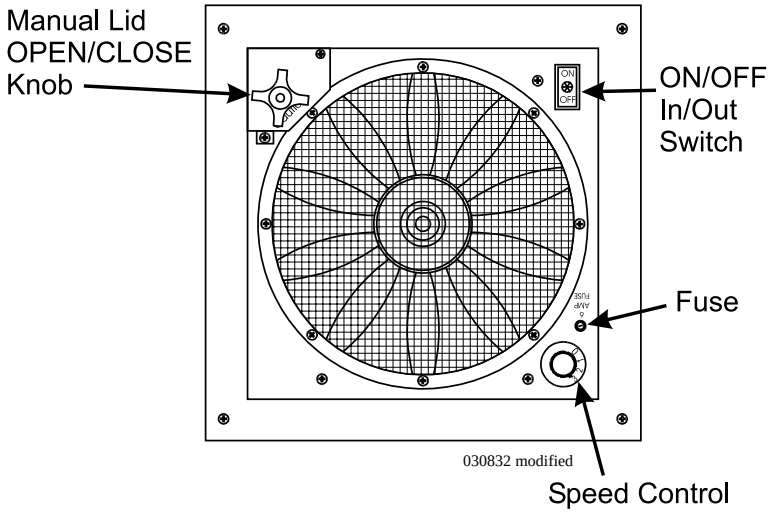



**To Operate the Fan:**

- The Battery cut-off switch needs to be set **ON**.
- The dome manually opens and closes using the knurled knob.
- Select the desired fan direction to **IN/OUT**.
- Select the desired fan speed on the Speed Control dial:

**Zero = OFF.**
**One = LOW.**
**Two = MEDIUM.**
**Three = HIGH.**

**NOTE: Let fan come to a complete stop before changing fan direction.**

**NOTE: If the speed switch is in the "0" position the fan operates only as a vent.**

**Tips:**

- To keep condensation from accumulating open the vent fan lids slightly to help the air circulate. Condensation occurs naturally from fluctuations in interior and exterior temperatures, humidity and dew point changes, steam from cooking, or boiling large amounts of water on the cooktop. Shower usage also produces condensation.
- If the fan fails to operate, check for either a blown fuse in the domestic fuse panel or the 6-amp fuse on the fan.
- To clean the screen, remove the eight screws holding it in place. Wash the screen using a non-abrasive soap and water. Re-install the screen and tighten the screws.
- Keep all the vents closed when using the Fantastic Fan Vent. Direct the airflow by slightly opening the window(s) on the shaded side of the motorhome to obtain the maximum airflow, especially on hot, sunny days. Close all the roof vents. The area between the open window(s) and the Fantastic Vent supplies the maximum airflow and providing the most comfort.

**NOTE: Do not leave the vent cover open while the motorhome is stored or unattended for extended periods. High winds, other unusual conditions or obstructions may prevent closing. The resulting leakage could cause serious damage.**

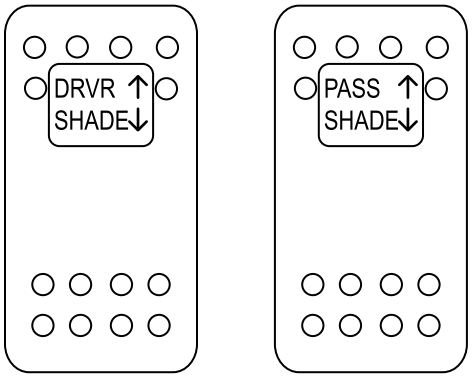
## POWER SUNVISOR (Optional)

The cockpit blinds are 12 Volt DC operating from the house batteries. One blind assembly is used for each window located in the cockpit area.

**To Operate the Blind:**

- The house battery cut-off switch must be on.
- Push the switch down to lower the desired blind.
- Push the switch up to raise the blind.

**NOTE: Do not attempt to move or drive the motorhome with any blind in the lowered position.**

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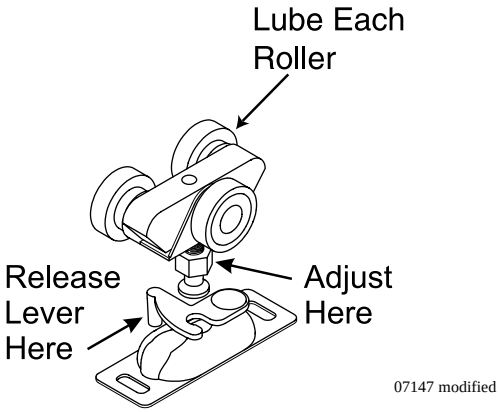
## SLIDING DOOR

The sliding pocket door uses two rollers at the top of each door. During the life of the motorhome the sliding door may need adjusting. The sliding pocket door can be adjusted to close tight against the wall. Locate the small wrench and turn the adjusting screw upward or downward.

If, for any reason, the pocket door needs to be removed, locate the portion that is secured to the top of the pocket door and rotate the small lever outward to release the latches.

**LUBE: The pocket door rollers should be lubed with just a small drop of oil once a year to help increase the life of the rollers and improve the sliding of the door.**

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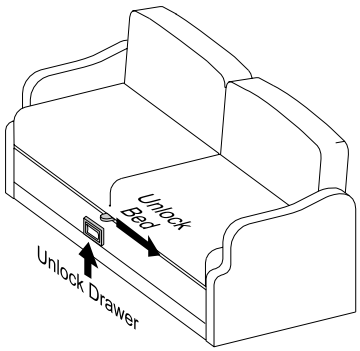
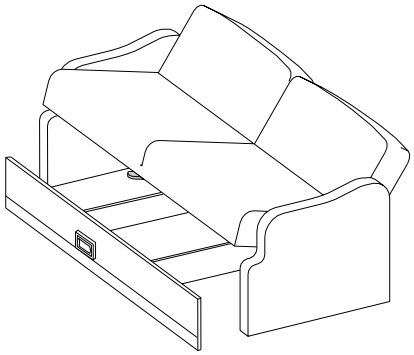
## SOFA
## Easy Bed Sofa (Drawer Optional)

The sofa will convert easily into a bed. The sofa comes equipped with safety belts and these should be used if occupied during travel.




**Sofa to Sleeper:**

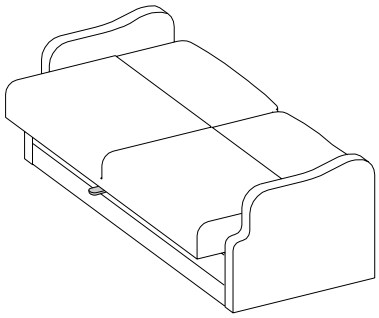
- Slide the lever forward to release the locking mechanism.
- Raise the sofa seat base until seat base and backrest form a “V” shape by lifting up from the center of sofa just below the seat cushions.
- Push down on seat base until the seat base and backrest are flat.
- Fold seat belts out of the way.



**Sleeper to Sofa:**

- Lift the seat base up until seat and back rest are in a “V” shape.
- Push down on seat base.

**WARNING: Do Not use the sofa for transporting infants or children that require safety seats or booster seats.**



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## Hide-A-Bed Conversion (Optional) Not Available 36PST

The sofa hide-a-bed will convert easily into a bed. Clear the area of obstruction and debris. The sofa comes equipped with safety belts to be worn if occupied during travel.

**Sofa to Sleeper:**

- Remove the three seat cushions to access the hide-a-bed. The seat cushions should be stored safely until the bed is converted back to a sofa.
- Release the lock on the right side of metal bar, grasp the front metal bar and lift up pulling out on the bar slightly until the leg of the bed is firmly resting on the floor.
- Fold seat belts out of the way.
- When the legs of the bed are firmly on the floor there will be another lifting bar exposed to complete the conversion process.
- Grasping and opening the lifting bar will open the bed fully. The bed is now ready for linen.

**Sleeper to Sofa:**

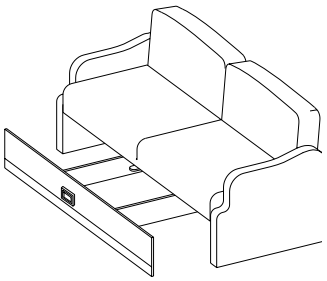
- Remove all bedding from the hide-a-bed.
- Grasp the foot of the hide-a-bed in the center using the metal lifting bar.
- Fold over the bottom portion of the bed that will form the seat.
- Lift the front portion of the lifting bar to raise and lower the hide-a-bed back into the sofa base.
- Position the seat belts for use.
- Replace the seat cushions.

## Magic Bed Conversion (Optional) Not Available 36PST

The sofa will convert easily into a bed. The sofa comes equipped with safety belts and these should be used if occupied during travel.

**Sofa to Sleeper:**

- Remove back rest cushions.
- Raise the sofa seat base until seat base and backrest form a “V” shape by lifting up from the center of sofa just below the seat cushions.
- Pull out and push down on seat base until the seat base is flat.
- Fold seat belts out of the way.
- Flip seat cushions back to form mattress.



**Sleeper to Sofa:**

- Fold mattress in to form the seat cushions.
- Lift the seat base up until seat and back rest are in a “V” shape.
- Push back and down on seat base.
- Replace back cushions.

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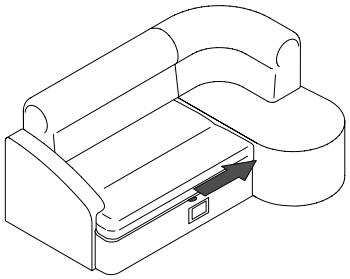
## J-Lounge (Optional) Not Available 38PBDD

The J-Lounge provides comfortable seating with extra storage space for small items. The J-Lounge comes equipped with safety belts and these should be used if occupied during travel.



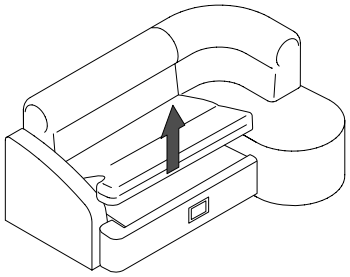
**Storage Compartment**

**Open:**

- Lift the handle latch up, releasing the lock mechanism and pull the storage drawer forward.

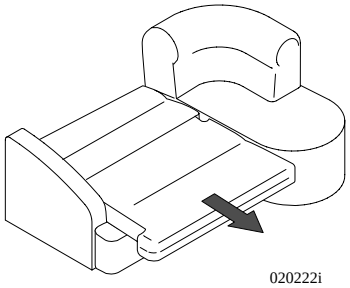
**Close:**

- Push the storage drawer until the lock mechanism catches the latch.



**J-Lounge to Sleeper:**

- Slide the lever to the right to release the locking mechanism.
- While holding the lever in the unlock position, raise the J-Lounge seat base until the seat base and backrest form a “V” shape by lifting up from the center of the J-Lounge just below the seat cushions.
- Pull the seat cushion forward until the seat base and backrest are flat.
- Fold seatbelts out of the way.



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**Sleeper to J-Lounge:**

- Slide the lever to the right to release the locking mechanism.
- While holding the lever in the unlock position, raise the seat base.
- Push the seat base towards the backrest.
- Push the seat base down to latch the locking mechanism.

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## Electric Sofa Bed Conversion (Optional) Not Available 36PST

The sofa will convert easily into a bed. Clear the area of obstruction. The sofa comes equipped with safety belts and these should be used if occupied during travel.

**Sofa to Sleeper:**

- Unlock latch at bottom center of sofa and pull bed extension frame out all the way.
- Lift bed extension cushion up and pull out all the way to lock into extension frame.
- Push switch on sofa arm to position back and bottom cushions flat against the bed extension cushion.

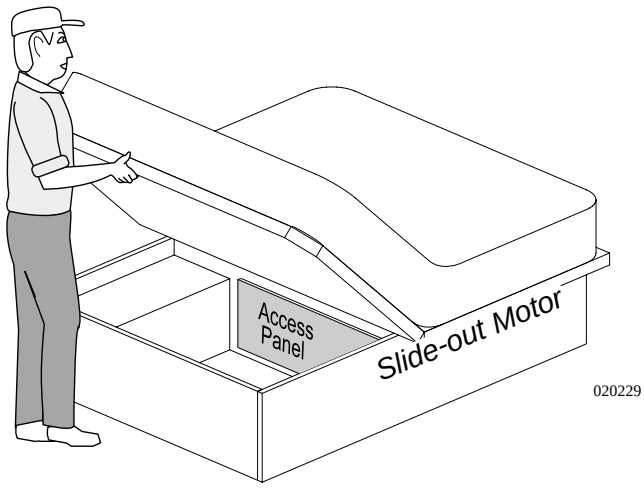
**Sleeper to Sofa:**

- Push switch on sofa arm so that back and bottom cushions are in the sofa position.
- Push in and down on the bed extension cushion to place cushion in stored position on frame.
- Push bed extension frame under sofa into locked position.
- Position seat belts for use.

## STORAGE - UNDER BED

To use the storage compartment located under the bed, locate and unlock the bed deck latches. Lift up the bed by the front edge of the mattress platform. Gas struts hold the mattress and platform open.

**NOTE: Do not over stress gas struts by rapidly opening or closing the bed access cover, as this action can damage the struts or mounts. In extreme cold gas struts may not hold the mattress platform in the open position.**




## STORAGE BAY SLIDE-OUT TRAY

The super slide is an option that is available for use in the storage compartment bays of the motorhome. This allows for the pay-load to slide outward for easier access.

- The motorhome must be level before opening.
- There are two latch releases: lift and hold up to release one, pull outward while pulling on the slide to release the other.
- Maximum weight capacity is 1,000 lbs. Never exceed this amount.

**WARNING: The motorhome must be level when sliding the drawer out of the bay compartment. The drawer can slide out abruptly, if the motorhome is not level, and cause bodily harm.**

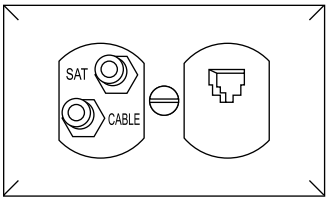
## ENTERTAINMENT SYSTEMS

The components used to make up the entertainment center are carefully selected to provide the highest quality in audio and visual enjoyment. There are several pieces of equipment, which encompass the entertainment center. The following paragraphs will discuss the operations and various components. Use the instructions given in the Video Selector Box section to use these components.

### *Hook-ups - TV Cable, Computer & Telephone*

The motorhome is equipped with cable TV, satellite TV and telephone hook-up, located in the rear roadside shore cord bay. For convenience, there are auxiliary outlets located at the co-pilot seat and on the optional computer desk. This connection is set up for a telephone or laptop computer.

Entertainment connections are provided for convenience in the passenger bay. These include telephone jack, cable TV hook-up, a 12 Volt DC utility outlet and 120 Volt AC electrical outlet.

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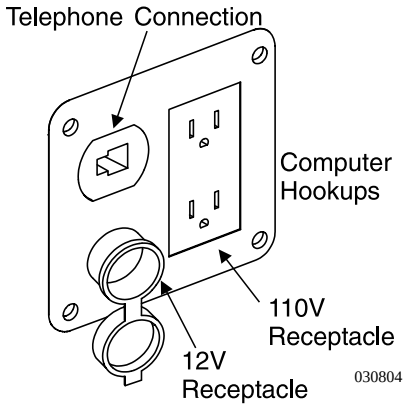


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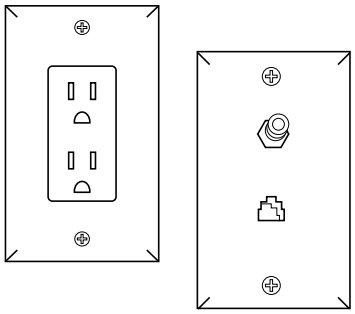

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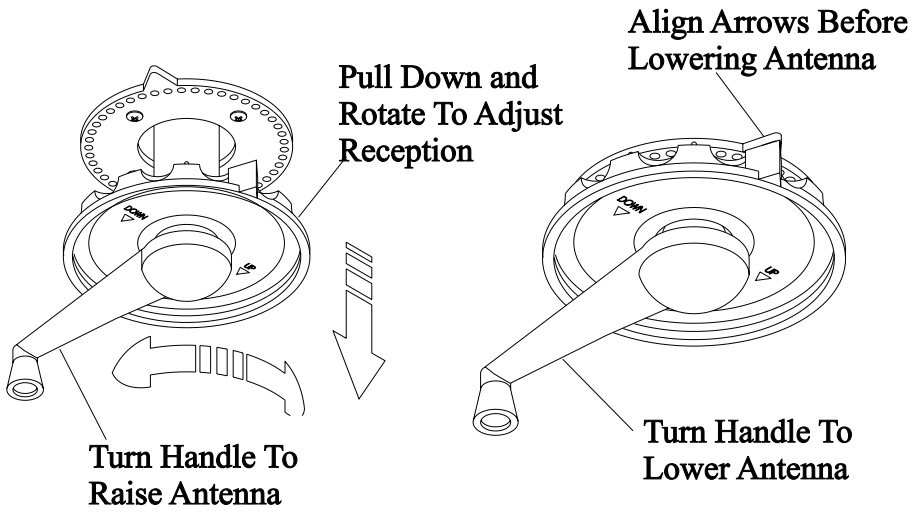
### *Television (Front) w/Lock-out Feature*

The Main TV has lockout circuitry. Simply stated, the ignition switch controls the front TV power outlet. Only with the ignition OFF will the front TV operate. No other television set is affected by the lockout circuitry. The TV operates on 120 Volt AC power only. This power can be provided by shore power, the generator or the inverter. Viewing time of the front TV from the inverter depends on the state of charge of the house batteries and any additional 12 Volt DC circuitry which is being operated.

## Television Antenna

The television antenna is a manual crank up style antenna with built in electronics that use 12 Volts DC to "boost" signal strength. Signals that are weak or fuzzy can be amplified by turning on the TV Ant Power switch on the Video Selector Box. The antenna and booster work together to provide the best possible picture for most situations. Certain conditions occur when no amplification is needed, and in fact may make the picture worse. The television station will send a signal that resembles the waves or rings of water from a rock thrown into a still pond. The radiating television signal can hit an object such as a mountain and come back. The result one sees in the television picture is a double image. The antenna will receive a signal from the initial pass, and then receive an additional signal from the rebound resulting in a split or double image. In this case, the picture may be improved by no amplification or even lowering the antenna.




**NOTE: Do not move the motorhome with antenna in the raised position, it can be damaged by tree limbs or wires.**

**WARNING: Before raising antenna make an outside, visual inspection for any obstructions or overhead electrical wires. Damage to the antenna, severe shock, personal injury or death can occur from inadequate clearance.**

**To Raise the Antenna:**

- Rotate the crank handle clockwise to raise the antenna (it is approximately 14 ½ turns).
- Pull down on the outside directional wheel and rotate the antenna until the best picture is obtained. The directional wheel is spring loaded.

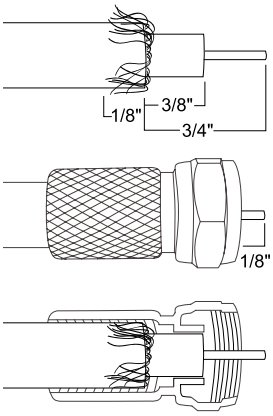
**WARNING: Do not raise a TV antenna near overhead electrical wires as contact may cause serious injury or death. The motorhome must not be driven with the antenna in a raised or partially raised position. Worm gear or worm breakage may result.**

**To Lower the Antenna:**

- Pull down on the directional wheel and align arrows together.
- Rotate the crank handle counterclockwise to lower the antenna fully into the cradle. Make an outside visual inspection to ensure the antenna is properly stowed.

**Troubleshooting the Coax Wire:**

Weak or no picture can indicate a possible shorted or open coax. The coax cable is made of two conductors: A center conductor usually of copper and a ground that is woven of braided aluminum. The "die-electric" insulating material separates the two conductors. The ground and center conductors are to remain electrically separate from one another. When installing a F-connector onto a coax cable, use care so none of the woven ground strands make contact with the center conductor. A continuity tester is required to test a suspected fault in a coax wire. Unscrew both ends of the suspected bad coax run, with the continuity tester check between the center conductor and the outside threaded ring. If continuity is present, the coax is shorted. To test for an open connection of a particular coax run, use one test lead and touch the threaded end of the coax. With the other test lead, touch the threaded ring at the opposite end. Continuity should be present. Perform the same test procedure on the center conductor. Proper electrical coax operation should indicate continuity from the center conductor at one end to center conductor at other end. Continuity should be present between each coax terminal end. There should be no continuity between the terminal end and center conductor. Though damage does not usually occur from a shorted or open coax cable, picture quality is compromised.



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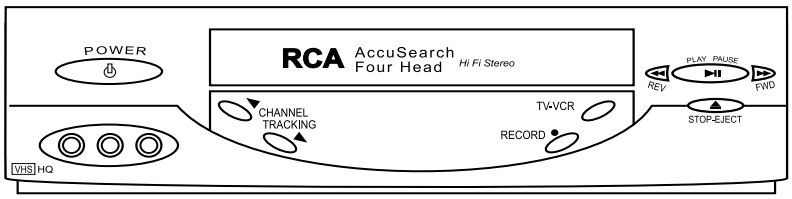
**Television Set:**

Ensure the television set will select channel 3. The TV menu may need programmed. ie: Input Video Signal Type, Channel Programming or Signal Output Levels.

**NOTE: TV channels and the alternate input FRNT may need to be programmed. To program press Menu on the TV remote. Select 4 Channel from the main menu. Select 3 List and Labels. Use cursor to select channel. FRNT is located below channel 2.**

## *Video Cassette Recorder (VCR)*

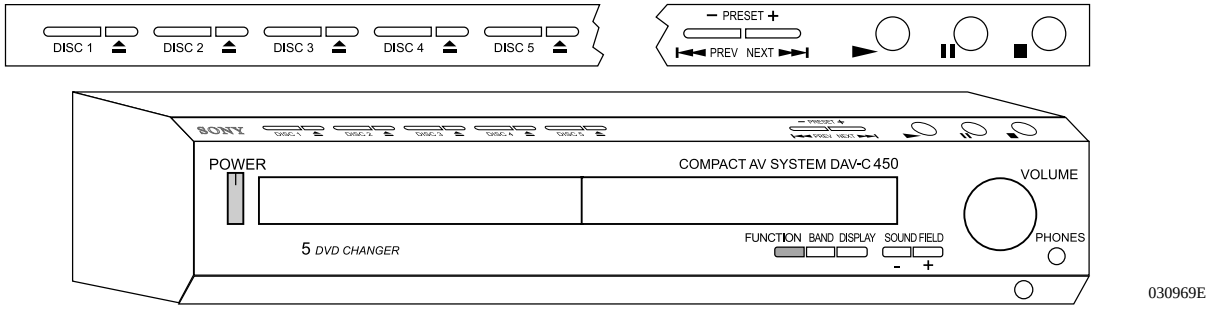
The videocassette recorder is the same one found in most homes. The VHS compatibility allows recording and playing back programs on standard VHS tapes. The Audio/Video Input Jacks in the front allows for quick, easy connections of additional video equipment.



030977

## DVD Player

The DVD player is a multi-function component. It plays Digital Video Discs, built in radio and amplifier. The power button on the DVD player must be pushed on to place the system in Stand-by mode. The DVD player will then respond manually or when using the remote control.

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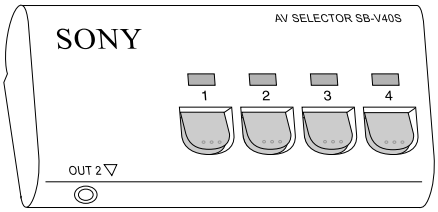
## Sony AV Selector

The Sony AV selector switches the audio and video signals between the VCR, DVD Receiver and Satellite (optional). The selector is also used with the optional Aladdin Monitoring System.



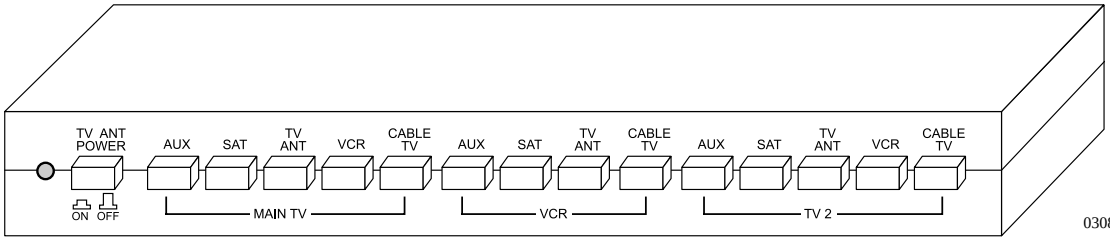

031021

## Video Selector Box

The motorhome is equipped with a video selector box that has five inputs and three outputs. The televisions have many different input signals available. Depending on preference these can vary from a DVD (Digital Video Disc) player, a roof antenna and DSS Satellite just to name a few. The video selector box interfaces these different input signals from the various components to the televisions and VCR.

**Features Include:**

- Five inputs are Satellite Receiver, TV Antenna, VCR, Cable TV and Auxiliary.
- 3 Outputs: Main TV, TV2 (Bedroom TV), VCR.
- Built-in 12 Volt TV antenna amplifier.
- The Video Selector Box allows for independent viewing of signals at different televisions, with a record option from the VCR.



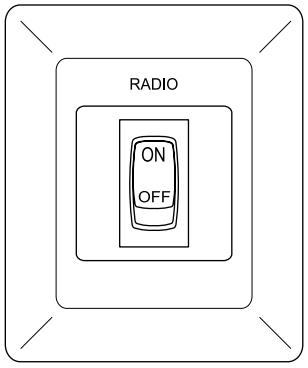

030861b

## Operating the Components

**To Operate any Component:**

Hook to shore power, start the generator or turn on the inverter. The battery cut-off switch must be in the ON position and the house batteries charged. The Radio switch must be in the OFF position for sound to be broadcast through the optional surround sound system.

**NOTE: The RADIO switch, located in the overhead compartment above the driver's seat, must be in the OFF position for any audio from the DVD Receiver to be broadcast through the optional surround sound system.**

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**To View Television using the Antenna or Cable TV:**

- Turn **ON** the TV.
- Raise the Antenna.
- Turn **ON** the Antenna Booster, located on the Video Selector Box, and select TV ANT or CABLE TV for the Front TV.
- Tune TV to the desired channel.

**To View a Video Tape or TV through the VCR:**

- Turn **ON** the TV.
- Raise the Antenna.
- Tune the Front TV to Channel 3.
- Turn **ON** the Antenna Booster located, on the Video Selector Box, and select VCR for the Front TV.
- Select TV ANT or CABLE TV for the VCR on the Video Selector Box.
- Insert videotape or tune to desired channel.

**To Play a DVD:**

- Turn **ON** the Front TV.
- Tune the TV to the VIDEO 1 input by pressing TV/VIDEO button on the TV remote control, or by opening the front access panel on the TV and pressing the TV/VIDEO button. ***VIDEO 1*** will display on the TV.
- Turn **ON** The DVD receiver. Press the FUNCTION button on the DVD remote control, or on the front panel of the DVD Receiver until ***DVD*** is displayed in the display.
- Select position 3 on the Sony AV selector box.
- Open tray and insert DVD into the player. Press PLAY.
- The volume can be adjusted using the DVD remote control or by turning the volume knob on the DVD Receiver.

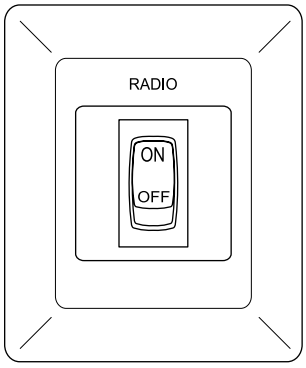
**To View Satellite Programming (Optional):**

- Turn ON the Front TV.
- Tune the TV to the VIDEO 1 input by pressing TV/VIDEO button on the TV remote control, or by opening the front access panel on the TV and pressing the TV/VIDEO button. ***VIDEO 1*** will display on the TV.
- Turn ON The DVD receiver. Press the FUNCTION button on the DVD remote control, or on the front panel of the DVD receiver, until AUDIO 1 is displayed in the DVD display screen.
- Select position 2 on the Sony AV switch.
- Turn **ON** the Satellite Receiver and acquire signal.
- The volume can be adjusted using the DVD remote control or by turning the volume knob on the DVD Receiver.

The sound from the TV and VCR will be broadcast through the speakers on the TV. The TV or VCR sound can be broadcasted through the optional surround sound system. See below for set up instructions.

**To Listen to TV & VCR Through Optional Surround Sound System:**

The cable or antenna signal must be tuned through the VCR to listen to the sound through the surround sound system. Audio from a video tape may also be broadcast through the optional surround sound system using the following procedures:

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**NOTE: The RADIO switch must be in the OFF position for any audio from the DVD Receiver to be broadcast through the optional surround sound system.**

- Turn ON the Front TV.
- Tune the TV to the VIDEO 1 input by pressing TV/VIDEO button on the TV remote control, or by opening the front access panel on the TV and pressing the TV/VIDEO button. VIDEO 1 will display on the TV.
- Turn on the DVD Receiver. Press the FUNCTION button on the DVD remote control or front panel of the DVD receiver until AUDIO 1 is displayed in the DVD display.
- Select position 1 on the Sony AV selector box.
- Turn ON the VCR.
- Insert Video Tape and push PLAY if necessary or tune to the desired TV channel.
- The volume can be adjusted using the DVD remote control or by turning the volume knob on the DVD Receiver.

**To Listen to the DVD Receiver Built-in AM/FM Radio:**

- Turn **ON** the DVD Receiver.
- Press the FUNCTION button on the DVD remote control, or on the front panel of the DVD receiver until ***TUNER*** is displayed in the DVD display screen.
- Using the remote control or the front of the DVD Receiver, tune to the desired stations.
- Volume is adjusted using the DVD remote control or by turning the volume knob on the DVD receiver.

**Optional Surround Sound Radio Switch:**

The Radio switch selects the sound output between the dash radio and the DVD receiver. When the switch is in the ON position, the sound from the dash radio will broadcast through the front surround speakers, the galley ceiling speakers and the bedroom ceiling speakers. When the switch is in the OFF position, the sound from the DVD Receiver will broadcast through the front surround sound speakers, and the galley ceiling speakers.

**NOTE: Sound from the DVD Receiver will not broadcast from the bedroom ceiling speakers.**

**NOTE: Sound from the dash radio will broadcast through the bedroom speakers regardless of the position of the Radio switch.**

**NOTE: The radio is Sirius® satellite compatible. An additional satellite receiver and special antenna are required before the system will receive Sirius® satellite radio services.**

**Tips:**

1. If the radio does not function, check the house power switch to make sure it is on.
2. The LCD display may become difficult to read at temperatures at or below 41° F.

**INFORMATION: For detailed information and operating instructions on the stereo and CD player system, refer to the manufacturer's manual located in the Owner's Information File Box.**

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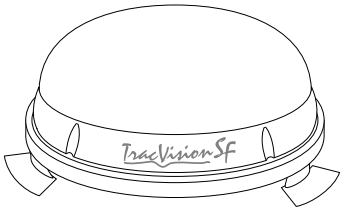
## SATELLITE SYSTEM (OPTIONAL)

The TracVision SF is a self-contained stationary, automatic satellite TV system. The TracVision SF automatically acquires and tracks DirecTV®, DISH Network™ and Bell ExpressVu satellite signals throughout the continental United States when the motorhome is in a stationary position.

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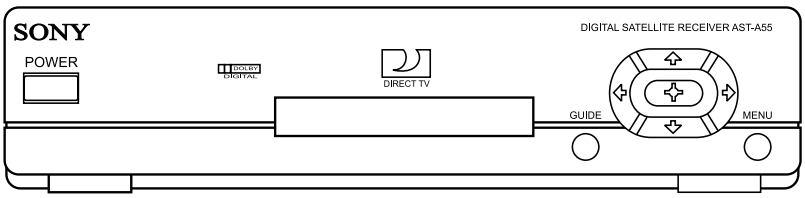
**WARNING: TracVision SF is a self-acquiring satellite TV antenna for use when the motorhome is stationary. The system is not designed to track the TV satellite when the motorhome is in motion.**

**NOTE: For specific satellite coverage areas and providers visit KVH online at www.kvh.com.**

## *Integrated Receiver Decoder*

The IRD receives satellite signals from the antenna unit for signal decoding, processing, and channel selection, and sends the signals to the TV for viewing. The IRD also provides the interface for the user to activate authorization for reception.

**Refer to the IRD User's Manual for complete operating instructions.**

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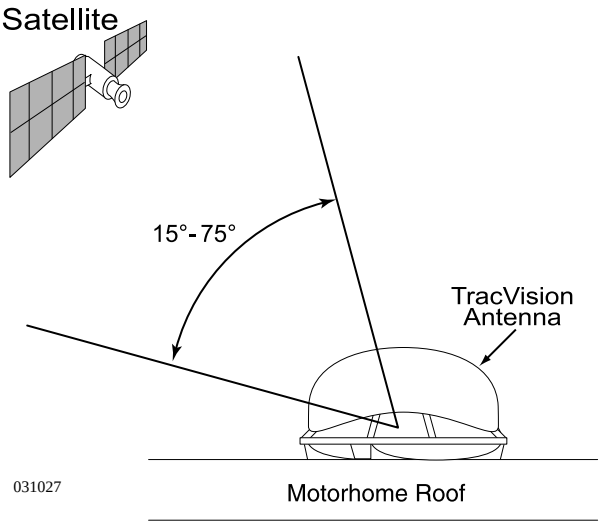
## *Operation*

The TracVision SF satellite system requires a clear view of the southern sky to receive satellite signals, the ideal antenna site has an unobstructed view of 15º - 75º in the Southern horizon.

If the satellite antenna receives intermittent signals or cannot locate the satellite, check around the motorhome for any objects that could be blocking the signal, such as trees, building, etc. The satellite antenna must be located in the selected satellite's coverage area in order to receive a signal.

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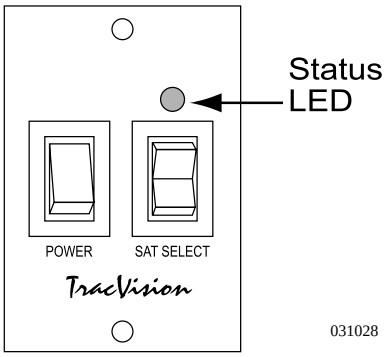


*TracVision Switch Plate*

**To Turn the TracVision SF Satellite System ON:**

1. Park the motorhome.
2. Turn **ON** the Interior House power using the Battery Cut-off Switch.
3. Turn **ON** the IRD.
4. Press the Switch Plate's **POWER** button.
5. Using the Video Selector Box, press the SAT button above the area marked "Main TV." Follow the same procedure for TV2. Turn the TV ON and select channel 3. Use the IRD to select channels.

**NOTE: As part of the startup process, the TracVision SF System will default to channel 200, a program directory. This is the system's means of verifying that is has identified and is tracking the correct satellite. Once channel 200 appears, wait at least another 30 seconds before changing the channel to ensure that the system has completed the startup routine.**

**System Start-up:**

- Upon power-up, the system performs a set of start-up routines.
- Antenna then searches for a TV satellite.
- After locating a satellite, it uses the IRD data connection to determine if the satellite signal can be decoded. If the signal can be decoded by the IRD, the antenna locks onto and tracks the satellite.

**NOTE: Once the startup procedure is complete and the antenna is locked onto the correct satellite, the TracVision SF does not need to be remain on. The TracVision SF unit may be turned off to avoid unnecessary usage of battery power. Because the antenna LNB receives its power from the IRD, the antenna will continue to receive the satellite TV signals and relay them to the IRD.**

**NOTE: If the antenna is unable to locate the desired satellite, refer to Section 4 "Troubleshooting" of the TracVision SF User's Manual for possible causes and their corrective actions.**

**"Instant On" Operation:**

As part of its operation, the TracVision SF routinely saves the satellite position to memory and retains it when the system is turned off. When TracVision SF is powered up, the system looks at the satellite's last saved position. If the vehicle has not changed its location, the antenna will immediately acquire the satellite and receive the signal without initializing the antenna.

If the motorhome moves after the TracVision SF is turned off, the antenna unit will quickly carry out its normal initialization routine to reacquire the satellite.

To turn off the TracVision SF system, simply press the switch plate's **POWER** button

**WARNING: It is highly recommended that the TracVision SF be turned OFF prior to moving the motorhome. TracVision SF will not track a satellite while the vehicle is in motion.**

## *Maintenance*

TracVision SF requires minimal preventive maintenance. The following tasks are sufficient to maintain peak performance.

**Monthly:**

- Wash the exterior of the radome and baseplate assembly with fresh water; a mild detergent may be added to remove grime. DO NOT spray the radome directly with high-pressure water.
- DO NOT apply abrasive cleaners or volatile solvents such as acetone to the ABS dome.

**Annually:**

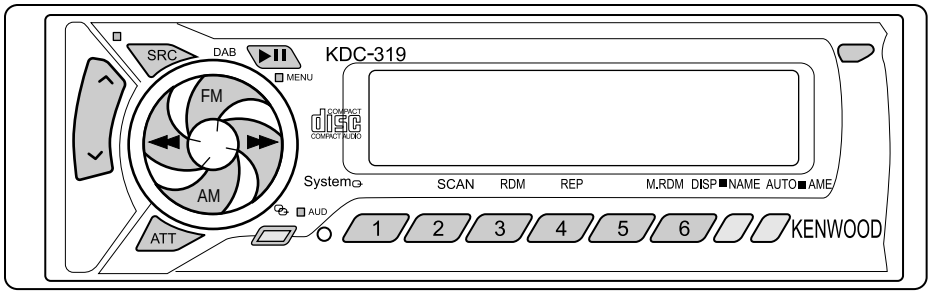
- Have the TracVision SF satellite system inspected by a professional RV Technician or TracVision satellite installer.
- Apply liquid dish detergent to the dome surface. Wipe the full-strength detergent on the dome and allow to dry. This treatment will provide a film that will help moisture bead up and roll off the dome.

**NOTE: If a need arises to paint the radome, ONLY use non-metallic automotive paint to avoid degrading the RF signal strength and the reception quality.**

**For information on KVH warranty, repair, and liability policies, please refer to the complete warranty statement provided with the KVH User's Manual.**

## RADIO - DASH

The dash radio is a tuner and a compact disc player. Holding up to eighteen preset FM stations and six AM stations. Other features are an attenuate mode; loudness control, clock display and auto seek tuning. The compact disc player features are fast forward and reverse, random track play, repeat and pause.

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**Operation:**

- Turn on the house battery cut-off switch, located at entry door.
- Press the SRC button to turn on the radio.
- Press and hold the SRC button to turn off the radio.

**Function of Features:**

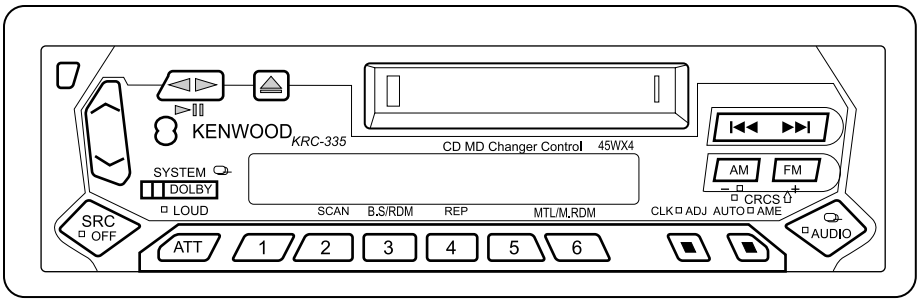
- Volume - Use the Volume Control (up/down arrows) to increase or decrease volume.
- Press the upper right button to open the radio to insert CD (KRC 319) or Cassette (KRC 435).
- Open the radio to detach face. Move face left and tip right side out and away. Reverse procedure to install.

**Clock Set:**

- Clock Set/Adjust - Press and hold the Menu button for three seconds. The main Menu will appear.
- Use the AM or FM button to scroll the menu until CLK ADJ displays.
- Press and hold either the Left or Right arrow button for two seconds until the clock time appears then release the button. Press and hold the Right button to increase time or Left button to decrease time.
- Press the Menu button once to return to the menu or twice to exit the menu.
- Insert a compact disc. Press the SRC button to toggle between tuner and disc.
- Press the ATT button to attenuate the sound. Press and hold the SRC button for "loud" bass control.

## Cassette Deck (Optional)

The optional dash radio is a tuner and a cassette tape player. It holds up to twenty-four preset FM stations and six AM stations. Other features are a system Q sound control, color LCD display with white LED backlight and removable faceplate. The cassette player features auto-reverse tape transport, metal tape selector, and Dolby® B Noise reduction. Other features are offered and can be explained in the manufacturer's owners manual.

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**Operation:**

- Turn on the house battery cut-off switch, located at entry door.
- Press the SRC button to turn on the radio.
- Press and hold the SRC buttton to turn off the radio.

**Function of Features:**

- Volume - Use the Volume Control (up/down arrows) to increase or decrease volume.
- Press the release button to remove the detachable face plate. Pull the left side away from the console. Reverse procedure to install.

**Clock Set:**

- Press the CLK button.
- Press the CLK button for at least two seconds (the clock display blinks).
- Press FM or AM button to adjust the hours.
- Press the previous or next track selection button to adjust the minutes.
- Press CLK button to exit.

**NOTE: Sirius® Satellite Radio is not available with the cassette deck option.**

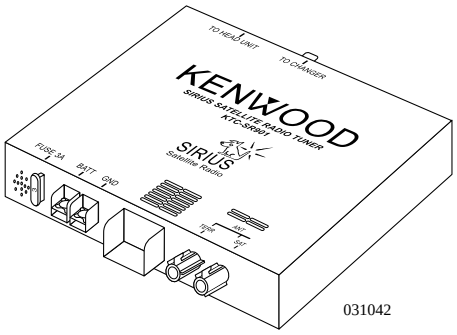
## Satellite Radio (Optional)

The Sirius® Satellite Radio is a digital signal decoder and tuner. Signals are transmitted from Sirius's ground station to one of three Sirius® satellites that are orbiting over the continental Unites States. The satellite then transmits the signal to the exterior surface-mounted antenna located on the roof of the motorhome. The radio receiver decodes the transmission and plays the selected channel within the transmission. Signals are also transmitted to ground repeaters for listeners in urban areas where the satellite signal can be interrupted.

A Sirius® subscription service features 40 channels of news, sports and information channels as well as 60 commercial-free music channels.

**NOTE: For information regarding subscriptions and coverage areas visit Sirius® Radio online at www.siriusradio.com or call 1-888-539-SIRIUS (7474).**

**INFORMATION: For detailed information and operating instructions on the Sirius®-Ready Satellite Radio, refer to the manufacturer's manual located in the Owner's Information File.**



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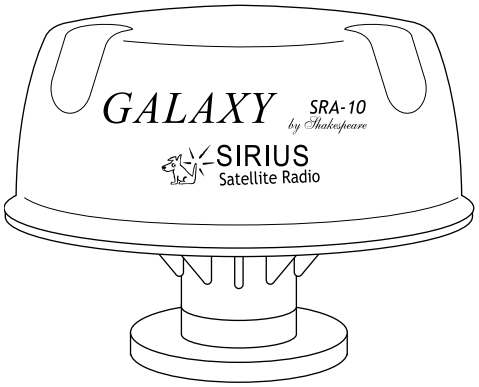

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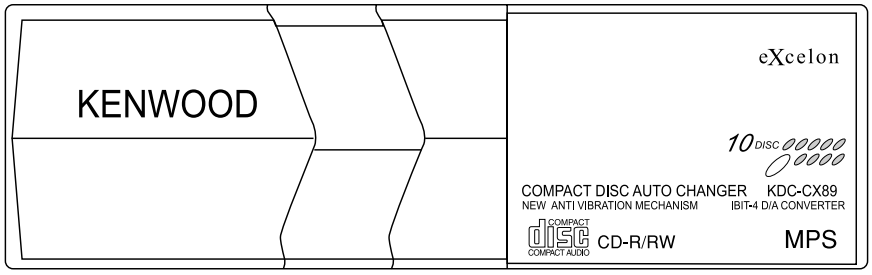
## *10 Disc CD Changer (Optional)*

The 10 disc changer is operated by the dash radio. To load a CD, slide the cover to the right, push the CARTRIDGE RELEASE button and remove the cartridge. Load CD's into the cartridge and reinsert the cartridge into the changer. Close the cover. Consult radio Owner's Manual for procedure to operate the changer.

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## CITIZEN BAND RADIO (OPTIONAL)

A CB (Citizen Band) Radio is installed in the dash board area of the motorhome. The type and manufacturer may vary depending on availability. According to the FCC (Federal Communications Commission) the radio is designed for operation on any of the 40 designated CB channels.

The following will cover the basic controls of most CB units:

- Press to Talk Switch: Switch is located on the microphone and is used to control the reception and transmission. Press the switch to transmit and release switch to receive.
- ON/OFF Volume Control: Turns the unit on and off also controls the speaker volume.
- Squelch Control: Allows the operator to set the receiver sensitivity to a position where the noise is inaudible. Strong signals (above the setting) will be heard.
- Channel Display: Where the selected channel is indicated.
- Channel Selector: This control selects the desired channel for transmission and reception. All channels, except channel 9, may be used for communication, including rendering assistance to motorists.

**For information regarding the specific unit installed in the motorhome please refer to the CB manufacturer's Owner's Manual.**

## ALADDIN SYSTEM

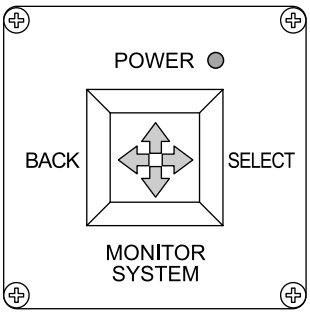
The Aladdin Video Coach Monitor (VCM) system is designed to monitor various chassis and house systems, providing the operator with up to date and accurate information. This allows the operator to make informed decisions regarding operations of the motorhome.

Chassis information comes from the engine and transmission electronics. House information is obtained from a number of sensor modules distributed throughout the motorhome. The type of interface sensor used will determine screen displays.

### *System Components and Features*

**Video Coach Monitor Control Module:**

The brain of the Aladdin system is the Control Module. The control module interconnects with the engine/transmission data, and with the coach sensor data. The control module also has audio and video inputs for: the rear view camera, an auxiliary video source and audio/video outputs for dash monitor and TV. **This black box does not require operator access.**

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**Joystick Module:**

Joystick Module is the operator interface to the VCM system through either the monitor or television display. Multiple joystick modules may be attached to the VCM. Each joystick module allows the operator to control cursor movements. Pushing the joystick to the right typically selects a menu item, pushing the joystick left typically takes the operator back to the previous menu. Likewise, pushing the joystick up or down enables the operator to scroll through or change information. An LED provides system-on power indication. When the joystick is moved, the LED turns off briefly ("blinks") indicating that the joystick command has been transferred to the VCM. During normal operation the LED blinks approximately every four seconds.

**Bus Tap Module:**

The Bus Tap Module is simply a connector module for easily interfacing the various other modules. The bus tap module has five connectors in parallel; any bus cable can be connected to any bus tap module connector.

**Tank Level Interface:**

The Tank Level Interface (TLI) module is one of the numerous sensor modules distributed throughout the motorhome. The TLI connects to the BTM data bus and to sensors that monitor the fluid levels for the fresh, gray and black holding tanks. The TLI data display is in percentage full and gallons. Gallons are based on the operator-specified tank capacity. The tank capacity and sensor calibration information is retained within the TLI module and is not lost if power is removed. However, if the module or sensors are replaced, re-calibration must be performed.

**Temperature Module Interface:**

The Temperature Module Interface (TMI) monitors outside and basement temperatures. The outside temperature sensor is located at the rear of the motorhome (in the shade, but exposed to outside air).

**Direct Current Interface:**

The Direct Current Interface (DCI) monitors both house and chassis batteries and solar panels, providing voltage and current information to the system.

**Alternating Current Interface (Not used on all versions and models):**

The Alternating Current Interface (ACI) monitors Leg 1 and Leg 2 of the motorhome AC power. The ACI provides RMS voltage, current and frequency for each leg.

**Liquid Propane Interface:**

The Liquid Propane Interface (LPI) monitors the sender gauge on the LP tank to provide percentage of full information to the system. This may be a separate module or combined with the TLI.

## *Other Features*

**Compare Alarm -** Allows the operator to specify a number of compares with current chassis and house parameters, to provide the operator with an alarm when the comparison is true. The comparison function and compare value are specified by the operator. The concept is for the VCM to monitor various parameters continuously, so the operator does not have to.

**Real Time Clock -** Providing date, time of day and time alarm functions.

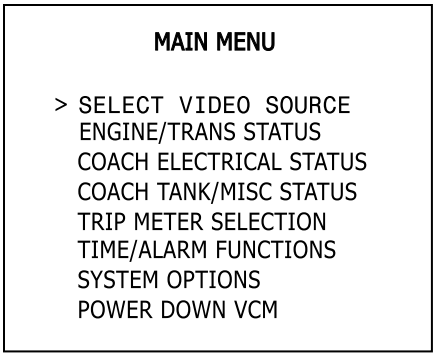
**Trip Meter -** Provides the operator with trip information for 10 different trips, plus dedicated trip leg status and fuel status screens. Trip screens selected by the operator are independent of each other and can be started, paused, resumed, cleared, and provide time and distance information as well as average speed and fuel mileage. Trip leg status gives trip information as well, plus distance-to-go and time-to-go based on trip leg averages. Fuel status provides estimated fuel remaining and range based on current averages.

**Preventive Maintenance Scheduler -** Provides a mileage countdown to three maintenance item schedules. The operator can specify maintenance intervals for engine or transmission.

## Operations

The VCM is turned on either with the motorhome ignition switch or a joystick. Likewise, the VCM will power down when ignition is turned off, unless the operator selects the VCM to remain ON. If the VCM is left on, the operator can power it down manually via joystick control. Any joystick operation or turning ignition back on will activate the VCM.

The main menu appears when the VCM is powered up. The operator can choose any item by pressing the joystick up or down. An arrow indicates the current menu item. Pressing the joystick right will select that menu item.




**NOTE: The Battery Cut-Off switch must be switched ON for the VCM screen to be displayed.**

## Front TV Display

**To View Aladdin Monitor System through front TV.**

- Turn ON the battery cut-off switch.
- Turn ON the inverter.
- Turn ON the Front TV.
- Tune the TV to the VIDEO 1 input by pressing TV/VIDEO button on the TV remote control, or by opening the front access panel on the TV and pressing the TV/VIDEO button. VIDEO 1 will display on the TV.
- Select position 4 on the Sony AV switch.

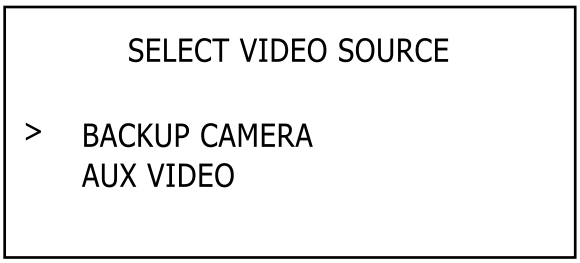
**NOTE: If ignition is in the run position, the front TV can not be turned on.**

## Rear TV Display

**To View Aladdin Monitor System through the rear TV:**

- Turn ON the battery cut-off switch.
- Turn ON the inverter.
- Turn ON the Rear TV.
- Tune the TV to the VIDEO 1 input by pressing TV/VIDEO button on the TV remote control, pressing the TV/VIDEO button on the front of the TV. VIDEO 1 will display on the TV.
- Select position 4 on the Sony AV Switch.

Here the operator can select the video source displayed on the **VCM's** output when not displaying motorhome information. **Backup Camera** selects the backup camera. **Aux Video** selects the VCR or DVD player, depending on how the motorhome is wired.



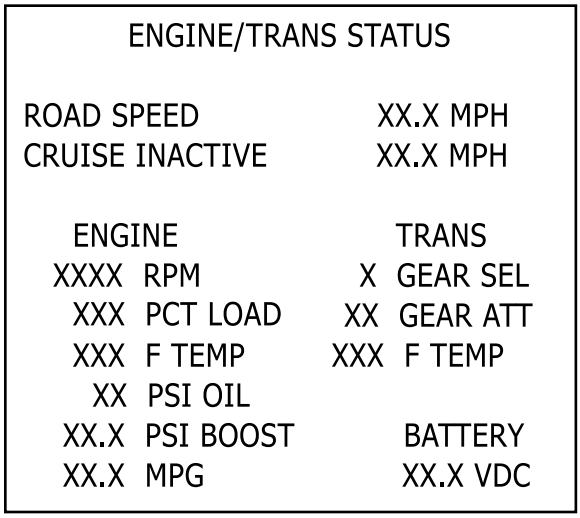

020215

**NOTE: The Backup Camera is automatically selected when the transmission is placed in reverse. The Backup Camera is also selected if the VCM is manually powered down while the ignition is turned on.**

Aux Video is automatically selected when the VCM is manually powered down with ignition off, and when the VCM is powered down by turning the ignition off. **Aux Video cannot be selected if ignition is on.**

## *Engine/Trans Status*

Provides the operator with a single screen display of current available engine and transmission data. The display is updated as the information changes.




020196b

If the operator moves the joystick **Right** in this screen, an enlarged engine and transmission screen is displayed, showing only four parameters at a time, with five screens available. These screens are scanned automatically approximately every six seconds. Moving the joystick up or down will manually scan through the screens and disable automatic scanning. Moving the joystick **Right** resumes automatic scanning, while moving the joystick **Left** will return to the previous all-in-one screen. A **Left/Back** from this original status screen will return the operator to the main menu.

| ENGINE/TRANS STATUS | |
|---|---|
| ENGINE SPEED | XXXXRPM |
| PERCENT LOAD | XXXPCT |
| ENGINE OIL PRESS | XXXPSI |
| TURBO BOOST PRESS | XXXPSI |

020197b

| ENGINE/TRANS STATUS | |
|---|---|
| ROAD SPEED | XXXX MPH |
| CRUISE INACTIVE | XXXX MPH |
| TRANS GEAR SELECTED | X |
| TRANS GEAR ATTAINED | XX |

020197

| ENGINE/TRANS STATUS | |
|---|---|
| PERCENT LOAD | XXXPCT |
| INST FUEL MILEAGE | XXXMPG |
| FUEL RATE | XXXGPM |
| TURBO BOOST PRESS. | XXXXPSI |

020197d

| ENGINE/TRANS STATUS | |
|---|---|
| ENGINE COOLANT TEMP | XXXF |
| TRANS OIL TEMP | XXXF |
| INTAKE MANIFOLD TEMP | XXXF |
| OUTSIDE TEMP | XXXF |

020197c

## *Coach Electrical Status*

The **COACH ELECTRICAL STATUS** screen, depending on configuration, will provided the operator with a display of AC leg 1 and leg 2 volts, amps and frequency, house battery volts and amps, and solar panel voltage and amps. Basement and outside temperatures may also be displayed in lieu of the AC Leg 1 and 2.

**NOTE: AC volts and amps are in the RMS value.**

| COACH ELECTRICAL STATUS | | |
|---|---|---|
| AC LEG 1 | VOLTS | XXXXXXX |
| | AMPS | XXXXXXX |
| | FREQUENCY | XXXXXXX |
| AC LEG 2 | VOLTS | XXXXXXX |
| | AMPS | XXXXXXX |
| | FREQUENCY | XXXXXXX |
| BATTERY | VOLTS | XXXXXXX |
| | AMPS | XXXXXXX |
| SOLAR | VOLTS | XXXXXXX |
| | AMPS | XXXXXXX |

*With AC Interface*

020198

| COACH ELECTRICAL STATUS | | |
|---|---|---|
| BATTERY | VOLTS | XXXXXXX |
| | AMPS | XXXXXXX |
| SOLAR | VOLTS | XXXXXXX |
| | AMPS | XXXXXXX |
| BASEMENT | TEMP F | XXXXXXX |
| OUTSIDE | TEMP F | XXXXXXX |

*Without AC Interface*

020198b

## Coach Tank/Misc Status

The **COACH TANK/MISC STATUS** screen gives fresh, gray and black tank percentage full and corresponding gallons, LP tank percentage full. The basement and outside temperatures may be displayed on this screen in certain configurations.

Fresh, gray and black percentages are determined by tank sensor calibrations, which are preset at the factory. Gallons given is the percentage full applied to the holding tank capacity (see **SYSTEM OPTIONS/SET TANK CAPACITIES**).

**NOTE: If re-calibration of tanks is required, locate the nearest authorized dealer for service.**

| COACH TANK/MISC STATUS | | |
|---|---|---|
| FRESH TANK | PCT | XXXXXXX |
| | GAL | XXXXXXX |
| GRAY TANK | PCT | XXXXXXX |
| | GAL | XXXXXXX |
| BLACK TANK | PCT | XXXXXXX |
| | GAL | XXXXXXX |
| LP TANK | PCT | XXXXXXX |
| BASEMENT TEMP | F | XXXXXXX |
| OUTSIDE TEMP | F | XXXXXXX |

*With AC Interface* 020199

| COACH TANK/MISC STATUS | | |
|---|---|---|
| FRESH TANK | PCT | XXXXXXX |
| | GAL | XXXXXXX |
| GRAY TANK | PCT | XXXXXXX |
| | GAL | XXXXXXX |
| BLACK TANK | PCT | XXXXXXX |
| | GAL | XXXXXXX |
| LP TANK | PCT | XXXXXXX |

*Without AC Interface* 020199b

## Trip Meter Selection

**TRIP METER SELECTION** is a submenu for selecting a numbered trip, trip leg statistics or trip fuel statistics. It also displays engine totals as reported from the ECM, including total engine hours, total miles and total fuel usage.

TRIP METER SELECTION

> NUMBERED TRIP SELECT
TRIP LEG STATISTICS
TRIP FUEL STATISTICS

ENGINE TOTALS

| | |
|---|---|
| TOTAL HOURS | XXXXXX |
| TOTAL MILES | XXXXXX |
| TOTAL FUEL GAL | XXXXXX |

020200

### Numbered Trip Select

This submenu allows viewing the active status of the ten numbered trips, or select one for viewing.

```
          TRIP SELECTION

>   TRIP 1     Active
    TRIP 2     Active
    TRIP 3     Inactive
    TRIP 4     Active
    TRIP 5     Inactive
    TRIP 6     Inactive
    TRIP 7     Inactive
    TRIP 8     Inactive
    TRIP 9     Inactive
    TRIP 10    Inactive
```

020201

### Trip Number

Select one of ten available trips for viewing. Information showing the distance and duration of a selected trip since it was started, amount of fuel used, speed and fuel mileage averages will be displayed. Trip start and stop times are also shown. A trip is labeled "**ACTIVE**" if it the trip has been started using the on-screen menu.

Trip is "**STOPPED**" if the operator selects the **STOP TRIP** option. This suspends or pauses the trip, and can be resumed by selecting **RESUME TRIP.** A stopped trip does not affect trip averages. The data collection is stopped.

**CLEAR TRIP** resets the trip to zero and makes it "**INACTIVE**."

**NOTE: All trip meter screens, DURATION is the time the engine was running, not the clock time since the start of a trip. DURATION is the time value used in calculating average MPH.**

All fuel usage data is only for the engine and applies to fuel used and average MPG. Fuel used by a generator or heater, while using fuel from the same tank, does not affect average MPG. However, the estimated fuel remaining in the tank will be affected.

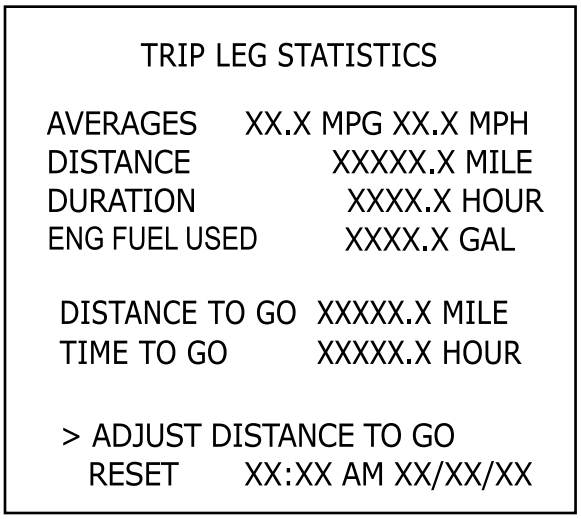
```
          TRIP 1 Active

START          XX:XX AM XX/XX/XX
STOP           XX:XX AM XX/XX/XX
AVERAGES     XX.X MPG XX.X MPH
DISTANCE          XXXXX.X MILE
DURATION           XXXX.X HOUR
ENG FUEL USED      XXXX.X GAL

 > STOP TRIP
   CLEAR TRIP
```

020202

Any or all of the numbered trips may be active simultaneously, although only one can be displayed at any time. They can be used for many purposes, for example to keep track of a vacation's individual trip legs, or a vacation's over-all statistics versus a vacation's on-the-highway statistics (stop a trip while visiting or driving around town). A numbered trip could also be used to keep track of maintenance items, such as how long it has been since the oil was changed.

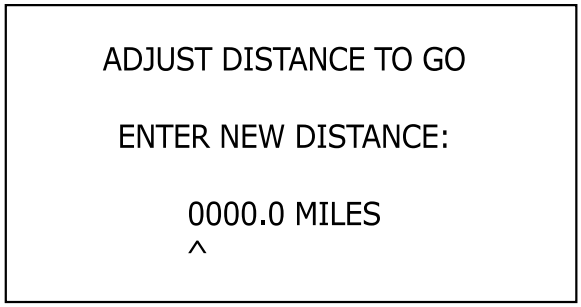
## *Trip Leg Statistics*

The **TRIP LEG STATISTICS** screen shows information similar to the numbered trip screens, but with additional distance to go and time left to go information. A trip leg is "started" by resetting the trip (by selecting **RESET**), then specifying the length of the trip in miles using **ADJUST DISTANCE TO GO**. By default, a trip length of 100 miles is set when **RESET** is selected. The time/date displayed to the right of "**RESET**" is the trip start time and is only changed with **RESET**.




020203b

The **ADJUST DISTANCE TO GO** screen allows the operator to specify a trip distance. Moving the joystick left or right selects the digit in the trip length. Moving the joystick up and down modifies that digit. For example, a trip leg length of 857 miles could be entered at the start of the vacation. Viewing the **TRIP LEG STATISTICS** screen provides distance to go and time to go which answers the classic question, "Are we there yet?"

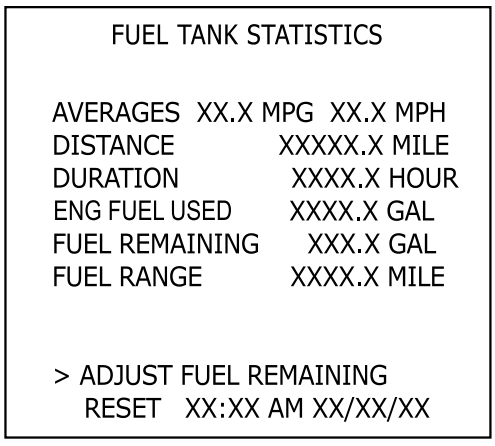



020218b

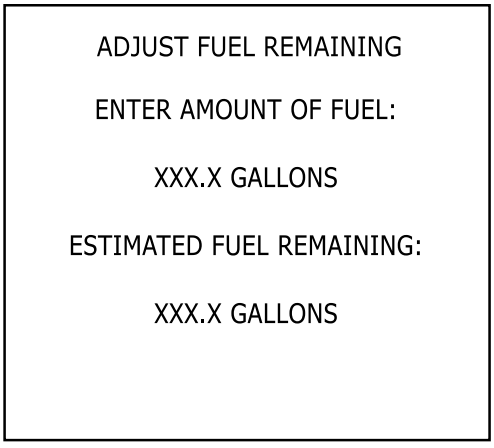
A trip length can be specified up to 9999.9 miles long. The trip length can be adjusted at any time without affecting the data collected since **RESET**.

**TRIP FUEL STATISTICS** provides statistics similar to the other trip screens, but with fuel remaining and fuel range data as well. Two commands are available, **RESET** will return the fuel remaining value to the fuel tank capacity limit and reset the time and date this "trip" started and **ADJUST FUEL REMAININ**G which can be used to set the fuel remaining amount to a specific amount. Since the VCM bases fuel usage on numbers reported by the engine alone, the amount of fuel remaining might be less with a generator or diesel heater sharing the same fuel tank. The **SET FUEL AMOUNT** command could be used to bring estimated fuel remaining back in sync with the dash fuel gauge.

Example, estimated fuel remaining might be 37 gallons on a 100 gallon tank, but generator and heater usage has brought the fuel gauge down to 25% or 25 gallons. **SET FUEL AMOUNT** could be used to reset the fuel remaining to 25 gallons and thus provide a more accurate fuel range calculation.




020205b




020206

**NOTE: ADJUST FUEL REMAINING value cannot be greater than previously set fuel tank capacity; such values will be reset to the tank limit**

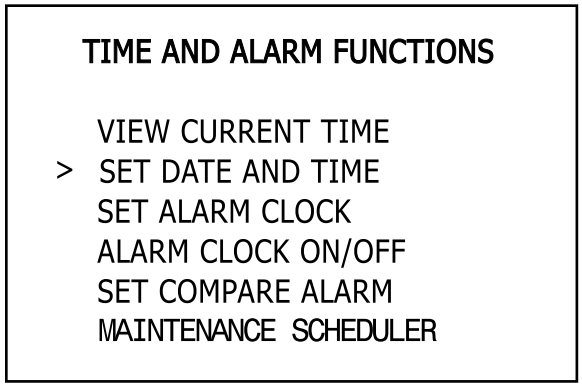
Changes made to any of the Trip Meter selections, with the single exception of clearing a numbered trip, should be done while the ignition is on to enable the VCM to collect necessary information from the engine. If the ignition is off, the last available information from the ECM will be used.

When a change is made to a trip the status screen display may take several minutes before updating values. In the case of **DURATION**, the display will not update for six minutes, because **DURATION** is displayed to the tenth of an hour or six minutes. The VCM requests engine statistics periodically from the engine for use with trip calculations. After such a change the next valid engine data won't be available for approximately one minute. Additionally, the rate of change of data is influenced by motorhome speed, fuel rate, and time.

Data used to make trip statistic calculations is maintained internally to a higher accuracy than displayed. This fact, and the actual method of making the calculations, will account for any difference between displayed averages and what you might calculate using the same displayed numbers, particularly when the values are small. For example, if the **DISTANCE** displayed is 9.2 miles and **DURATION** displayed is 0.3, the average speed might be displayed as 26.2 MPH while the calculations would give 30.66 MPH…but if 0.351 hours is used in the calculations,the same answer will be displayed.

## Time/Alarm Functions

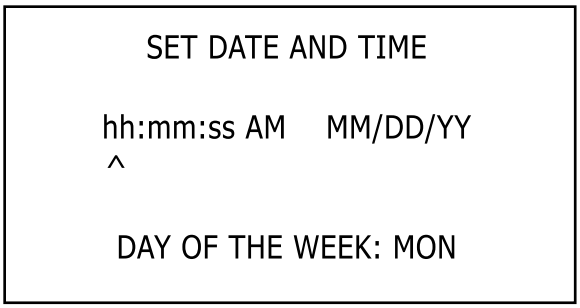
The VCM is designed to provide the operator with a number of alarms. The idea is for the VCM to monitor various parameters continuously, so the operator does not have to. When an alarm condition is detected, the VCM is reset to **MAIN MENU**, and the Alarm Activation window displayed. This blinking display indicates than an alarm was activated, and the source of the activation. Moving a joystick controller in any direction turns off the alarm tone and leaves the alarm screen displayed. A second joystick movement will cause the VCM to return to **MAIN MENU**, allowing the operator to check the parameter that was the source of the alarm.




020208b

**TIME/ALARM FUNCTIONS** is a submenu allowing the operator to view and set the clock, the alarm, and the compare alarms.

**SET DATE AND TIME** screen allows setting the current time and date. Joystick **Left** or **Right** selects the various digits, whereas joystick **Up** and **Down** changes the value.




020209

Example, when first entering this screen, the hour tens digit will be selected; Joystick Right selects the hour ones digit. Move the joystick **Up** changes the digit value, a value of 5 would increase to 6. As the date is modified, the corresponding day of the week is displayed.

Exiting this screen either by going Left from the hour tens digit or going Right from the year's ones digit will cause the time entered to be set into the real time clock.

**NOTE: Should incorrect input be given, for example setting the date to February 30, the incorrect value for the date will be rejected and prompt the operator to correct.**

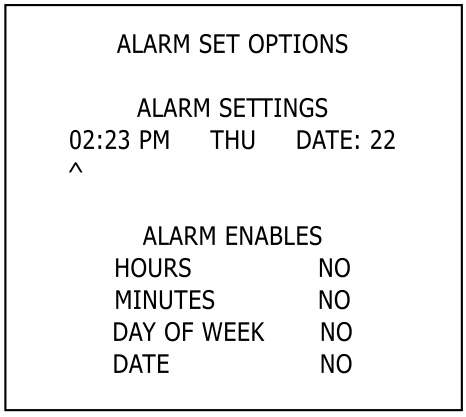
**NOTE: Clock information is lost if power is disconnected for more than four minutes, such as when a battery is replaced, or if power switch is turned off. Compare alarm and trip information are unaffected; simply reset the date and time when power is restored. Powering down the VCM via the joystick or ignition switch will not cause clock information to be lost.**

## *Set Alarm Clock*

The alarm can be set to achieve an alarm condition based on the following real time clock parameters:

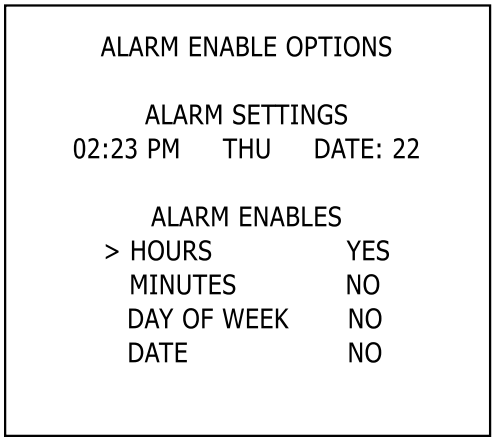
**Hours**
**Minutes**
**Day of the Week**
**Day of the Month**

Each parameter has an individual alarm which will activate when all conditions are met. It is possible to set the alarm to go off every 13 minutes past the hour if only minutes are enabled, 4:15 PM every day if the hours and minutes set are enabled, 5:30 AM Saturday if the hours, minutes and day of week are enabled or 12:00 PM Friday 13th with all values set and enabled.




020210

Move the joystick **Left** or **Right** to select the hours, minutes, AM/PM, day of the week and date. Move the Joystick **Up** or **Down** to change a value. The digit or field currently selected will be highlighted. Moving the Joystick **Left** from the left-most screen position returns to the **TIME/ALARM FUNCTIONS** screen. Moving the Joystick Right from the right-most screen position causes the VCM to change to the **Alarm Enable Options** screen.




020211

In the **Alarm Enable Options** screen the hours, minutes, day of week and date enables are individually selected using the joystick **Up** or **Down** movement. Moving the Joystick Right change the value. Moving the joystick Left from this screen returns to **TIME AND ALARM FUNCTIONS** screen.

**NOTE: When an alarm occurs, an ALARM ACTIVATED screen is displayed and a beeping tone is sounded. The source of the alarm condition is identified by the flashing text. Any joystick action will turn off the alarm tone, while retaining the ALARM ACTIVATED screen. A second joystick action will return the operator to the MAIN MENU.**

**Alarm Clock On/Off:**

The alarm can be enabled or disabled at the **Alarm Enable Options** screen without changing the value of the alarm itself.

## Set Compare Alarm

There are eighteen different parameters that can be specified and individually enabled for an alarm. These parameters are:

1. Road Speed
2. Engine Load
3. Engine Speed
4. Coolant Temperature
5. Transmission Oil Temperature
6. Oil Pressure
7. Chassis Battery Voltage
8. Fuel Remaining in Tank
9. Fresh Tank Percentage Full
10. Gray Tank Percentage Full
11. Black Tank Percentage Full
12. LP Tank Percentage Full
13. House Battery Voltage
14. Basement Temperature
15. Outside Temperature
16. Miles to PM1
17. Miles to PM2
18. Miles to PM3

The operator enters an item to monitor and what comparison is made to sound an alarm. Select one of the following compare options:

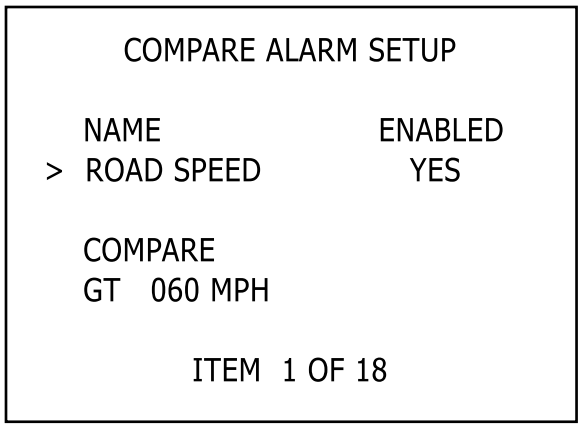
| | |
|---|---|
| GT | Greater Than |
| GE | Greater Than or Equal To |
| EQ | Equal To |
| NEQ | Not Equal To |
| LE | Less Than or Equal To |
| LT | Less Than |

While there are many options for setting an alarm condition, not all possibilities are valid or sensible. An alarm condition of Road Speed Not Equal To 0 MPH would be activated as soon as the motorhome started moving. Additionally, while some options are reasonable, such as compare engine speed EQ 2000 rpm, in reality the alarm may not go off. The data being compared may never equal 2000, and instead may alternate between 1999 and 2001. Setting the compare option GT would likely produce the desired result.

Each enabled alarm is checked frequently as the VCM is operating. Any of the enabled alarms, once the comparison is made, activates the alarm. Once an alarm is activated, any joystick movement will cancel the alarm tone and disable further activation. **It is necessary to re-enable the alarm for it to activate again.**

**NOTE: Any other alarms enabled but not activated are still enabled and will activate when their respective comparison value is reached.**

Example: Selecting an alarm condition of Full Tank Percentage LT 25%, or Gray Tank GE 85%. Upon entering a **Compare Alarm Setup** screen, the first field, parameter **Name** is automatically selected. Various parameters selections are made using the VCM joystick **Up** or **Down** to move through the list of choices.




020213

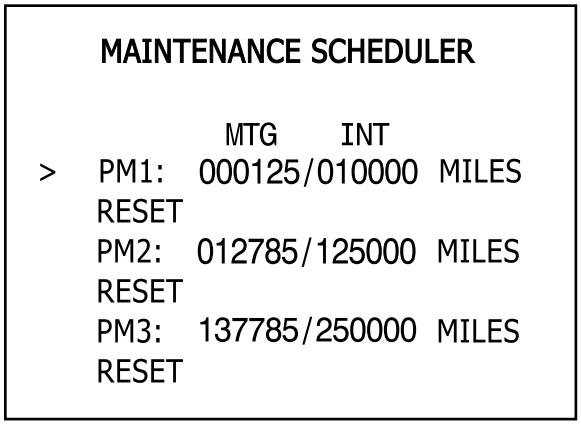
Moving the joystick **Right** from **Name** selects the **Enable** field. Moving the joystick **Up** or **Down** in the **Enable** field scrolls the choices NO disabled, YES enabled or IGN OFF enabled. However, the alarm will not sound while the ignition is turned on, instead waits until the ignition is turned off. From the **Enable** field, moving the joystick **Left** returns to the **Name** field, and moving the joystick **Right** continues to the **Compare** field. In the **Compare** field, moving the joystick **Up** or **Down** sequences through the list of compare options. Moving the joystick **Left** returns to the **Name** field and moving the joystick **Right** continues to the **Value** field. Each digit of the value is adjusted moving the joystick **Up** or **Down**. Each digit selection is made moving the joystick **Left** or **Right**. Another **Right** from the one's value will return to the **Name** field selection.

**NOTE: The PM alarms are designed to notify the operator of pending Preventative Maintenance tasks. These PM tasks are intended to match those specified by the engine OEM recommendations, however the operator can modify them as desired in the MAINTENANCE SCHEDULER screen. The alarm compare is performed against the miles remaining before the PM task is due, and as such the only valid compare selections would be LT (less than), LE (less than or equal) or EQ (equal); furthermore, if the miles remaining before the PM task is due is greater than 999 miles, the compare will not be done. Regardless of the PM alarm status, any PM performed is the responsibility of the operator/owner.**

## Maintenance Scheduler

The **MAINTENANCE SCHEDULER** screen displays statistics for three Preventive Maintenance items: PM1, PM2 and PM3. Each PM item displays two values: the first is the number of miles to go before each PM is scheduled (**MTG**) and the second is the interval in miles for that PM item (**INT**).

Each PM item can be selected (joystick **Right**), and maintenance interval can be modified per the requirement of a particular engine, or as the operator chooses. Immediately below each PM item is an associated **RESET**, which when selected, will reset the PM miles to go back to the maintenance interval.




Example: PM1 has an interval of 10,000 miles, and is performed with 125 miles to go. Selecting RESET will set the miles to go back to 10,000 interval in preparation for the next PM1 service.

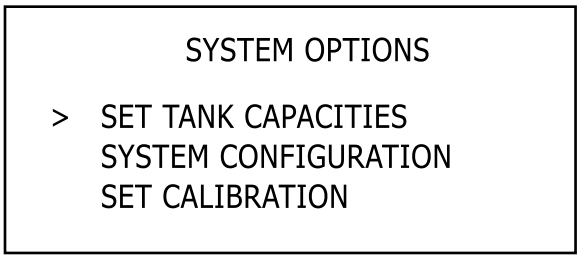
**INFORMATION: Consult the OEM manual for its recommended preventive maintenance schedule.**

**NOTES: A compare alarm can set for the PM miles to go. Modifying the maintenance interval will not automatically update the miles to go value. Miles to go will continue to count down until reaching zero or is reset.**

Modifying maintenance intervals and resetting miles to go should be done with the ignition on so engine information is available for recording.

### System Options

Provides a submenu for various VCM functions that are less frequently used. Only service personnel should use **SET TANK CAPACITIES, SET CALIBRATION** and **SYSTEM CONFIGURATION** to help troubleshoot system problems.

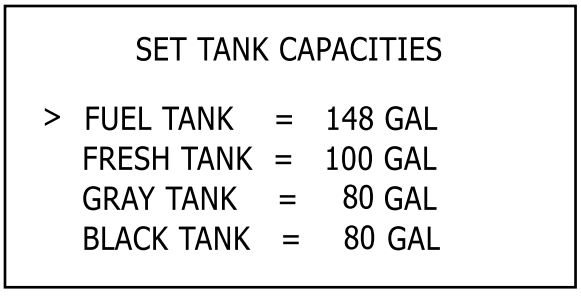



020214b

### Set Tank Capacities

Enables programming the VCM with fuel tank size and to program the Tank Level Interface module with the capacities of the holding tanks. The fuel tank capacity information is used in the fuel remaining calculations. The TLI, once calibrated, provides percentage of full information. Setting the tank capacity allows it to provide an equivalent number of gallons. The tank capacities are preset at the factory. If for any reason the tank capacities need to be changed contact an authorized dealer to reset the tank capacities.

**NOTE: Any change made to a tank capacity, the new value will blink until confirmed by the TLI module.**




020216b

**NOTE: If calibration of tanks is required, located the nearest authorized dealer for service.**

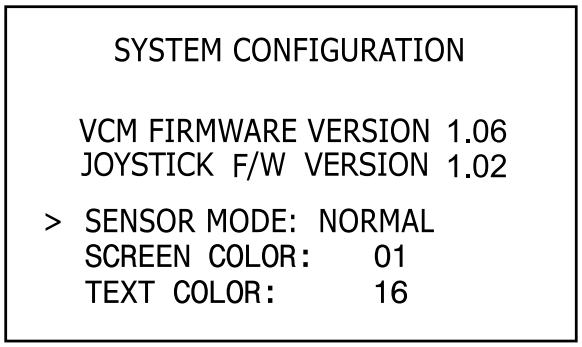
The **SYSTEM CONFIGURATION** sets the data mode used by the sensor modules and enables adjustment in the display appearance by allowing screen and text color selection. The data modes are **NORMAL, RAW** and **VERSION**. The usual operating sensor mode is **NORMAL**.

Selecting **RAW** mode causes the sensor modules to display raw, unmodified/calibrated data from their sensors. **RAW** mode is used to troubleshoot the system.

The **VERSION** mode causes the sensor modules to display their internal software version numbers. Again this information should be used for troubleshooting the system.

**NOTE: The VCM Firmware number is important in the identification of software configuration for the motorhome.**

Screen and text color are selected using joystick Up or Down movements to select the menu item. Using joystick Right movements, step through the seven available colors for personal preference. Color display is immediate and will remain in effect until changed, even when the VCM is powered down.



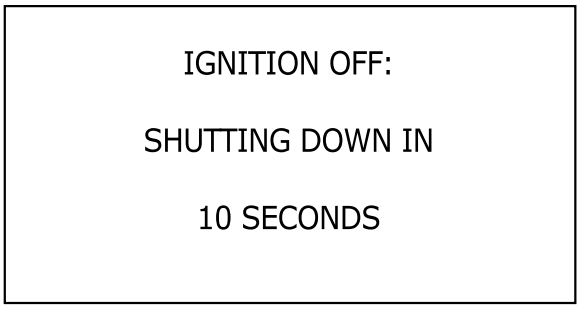

020217b

**NOTE: All sensor module data, regardless of mode, is displayed on the COACH ELECTRICAL STATUS and COACH TANK/MISC STATUS screens; outside temperature is also displayed in ENGINE/TRANS STATUS screen. Joystick version is displayed on the SYSTEM CONFIGURATION screen, but only after VERSION mode has been selected.**

**NOTE: RCA Brand Televisions will display the Aladdin System in black and white only.**

### Power Down VCM

Selecting **POWER DOWN VCM** will cause the VCM and the joystick modules to enter low power mode, and turn off sensor modules. The VCM also enters low power mode when the ignition is turned off. In the power down or "sleep" mode the VCM will "wake up" when any joystick module is touched or if the motorhome ignition is turned on.




020218d

Turning off the ignition will also cause the VCM to power down. However, power down in this case is not immediate: a ten-second countdown is performed prior to power down. Any joystick action aborts this countdown and the VCM will remain on. Thus, if the operator wishes to check trip statistics after arrival, a touch of the joystick will keep the VCM on after turning the ignition off. The VCM can be manually powered down by selecting the **POWER DOWN VCM**. If the joystick is not touched before the countdown completes and the VCM has powered down, the joystick touch will cause the VCM to power back up.

**NOTE: When power is first applied to the VCM using the main power switch or if power is interrupted (e.g., if a battery is changed), the VCM will wake up, display the "Hello" screen and then go to power down sleep mode. This prevents the system from turning on completely and being left on inadvertently. Any joystick operation or turning the ignition on will wake the system back up.**

## KEYLESS ENTRY

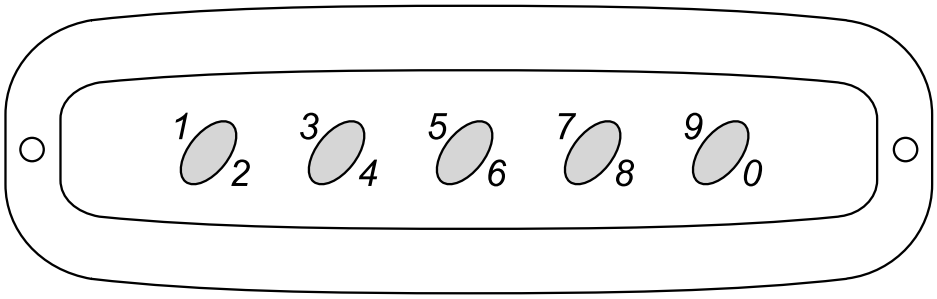
The entry door and bay doors can be locked or unlocked using the touch keypad located adjacent to the entry door. Three lock codes are pre-assigned and not programmable. They cannot be assigned as unlock codes.

- **555 -** Locks entry door and bay doors if connected.
- **557 -** Locks entry door and bay doors if connected.
- **559 -** Locks entry door and bay doors if connected and arms keypad (flashes momentarily once every 15 seconds).

Unlock codes are programmable and should be personalized upon receipt. Unlock codes are in two categories: **Master code** and **Optional codes**. Master code enables motorhome entry and auxiliary control. Deletion, adding or changing of optional codes are performed at the master code level. Optional codes only allow motorhome entry and auxiliary control.

**Consult the system owner's manual for further information.**

- To lock, shut the door, enter one of the three lock codes to lock the entry door and bay doors if bay doors are connected.
- To unlock, enter Factory Default master code or a three to eight digit personalized unlock code, if programmed.

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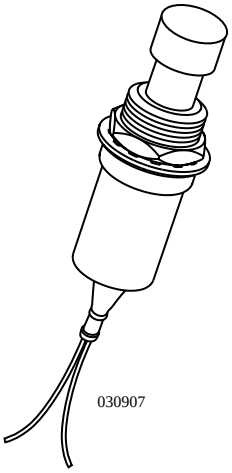
All motorhomes equipped with the keyless entry are shipped from the factory with default settings. It is recommended the unlock code be personalized for security purposes.




**To Program a Personal Number:**

1. Locate the programming switch, which is a small button with two 22-gauge wires connected: **Yellow** is **power** and **black** is **ground**. This switch is located in the curbside arm rest under the cup holder.
2. Press the programming switch until four (4) rapid beeps are audible.
3. Enter **1119** on the keypad; three (3) rapid beeps are audible. **1119** code opens the memory for accepting the master code.
4. Enter the new 3 to 8 digit master unlock code within five seconds.
5. Wait five seconds for two (2) rapid beeps.
6. Test the new Master Unlock code.
7. If the code was not accepted, repeat the procedure.

**WARNING: Ensure possession of entry door keys prior to testing new personal code.**

**NOTE: These instructions are for motorhomes equipped with "keyless entry" only.**

**NOTE: During any service work, it is recommended all key fobs be left with the motorhome for thorough testing and check procedure.**

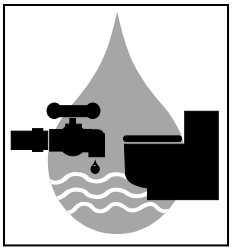
If the remote does not respond, it may need authorization.

- Locate the keyless entry receiver box behind the instrument cluster.
- Unplug the receiver box. Plug receiver box back in.
- Within three seconds, press the lock button on one remote. The entry door should lock.
- Press the lock button on the other remote.

**NOTE: If the motorhome is factory equipped with an optional security system, the security system remote will lock or unlock the entry door and bay doors when the system is armed or disarmed. However, if the entry door is locked and armed with the security key fob, it must be unlocked with the security key fob to disarm the security system. Using the keypad to unlock will not disarm the security system.**

## ~ NOTES ~

## ~ NOTES ~



# Water Systems
## section 6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## WATER SYSTEMS - INTRODUCTION

The Water Systems section contains information and knowledge for the operation and care of the various water system equipment found in the motorhome. The motorhome is equipped with two separate water systems. Optional water equipment will also be discussed, so not all information may be applicable to the motorhome. More detailed information with **CAUTION** or **WARNING** instructions for the various equipment, other than what is found in this section, can be found in the manufacturer's manual in the owner information box.

It is hard to imagine how much water is used by the average person everyday. Newcomers to a self-contained motorhome soon discover water does not last very long unless consumption is drastically reduced. For example, less water can be used for showering if the shower is turned off while soaping down, then turned back on to rinse. This way a good shower uses a couple gallons of water or less. There is plenty of water to meet personal needs once habits are adjusted.

**Fresh Water System:**

The fresh water system consists of a fresh water tank, water pump, water purifier in the kitchen and a fresh water connection.

Be sure to use a water hose that is marked for potable water use only. Care and maintenance of the water hose is a must. After each use, drain and rewind. **Attach the ends together to keep dirt, debris and insects out of the hose.**

**Waste Water System:**

The waste water system consists of two tanks: the waste holding tank and the sewage tank. The waste holding tank (grey tank) holds the sink water, shower waste, and the (optional) washer and dryer. The sewage holding tank (black tank) holds only toilet waste.

## MONITOR PANEL (WATER TANK)

The motorhome is equipped with a monitor panel to aide in managing the storage tanks. The monitor panel will be located in the overhead compartment above the entry door. If the motorhome has the Aladdin System please refer to Section Five, Aladdin System for detailed information regarding tank monitoring. The switch marked **TEST** is a momentary switch that requires being held down while testing the level of the storage tanks. Read the scale for the desired storage tank that is to be monitored. Each scale uses colored lights along with a corresponding scale reading. The lights and scale indications are as follows:

| **LP Tank and Fresh Tank** | **Waste Holding Tanks** |
|---|---|
| Red = Empty | Green = Empty |
| Orange = 1/3 Full | Yellow = 1/3 Full |
| Yellow = 2/3 Full | Orange = 2/3 Full |
| Green = Full | Red = Full |

## Power Water Hose Reel (Optional)

The convenience of the water hose reel eliminates the need to store a potable water hose in the bay. Use the hose reel for city water hook-up or to fill the fresh water tank. The reel is equipped with a 12 Volt motor that will rewind the hose after use. The water reel is located in the roadside bay.

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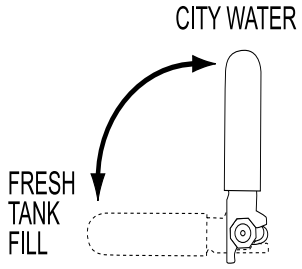
**To Use the Hose Reel:**

- Remove hose plug and install a water pressure regulator to the water hose.
- Connect the water hose to a city water hook-up.
- Located next to the Water Hose Reel is the City Water/Tank Fill valve. Select either City Water or Fresh Tank Fill.
- Turn on the water supply.
- If used for filling the water tank, water will flow out of the overflow underneath the motorhome when the tank is full. Shut the water supply off as soon as possible.

**To Retract the Hose Reel:**

- Disconnect the water hose from the faucet. Do not leave water regulator attached to faucet.
- Press the retract switch while guiding the hose onto the reel.
- Install plug in hose when not in use.

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**Maintenance:**

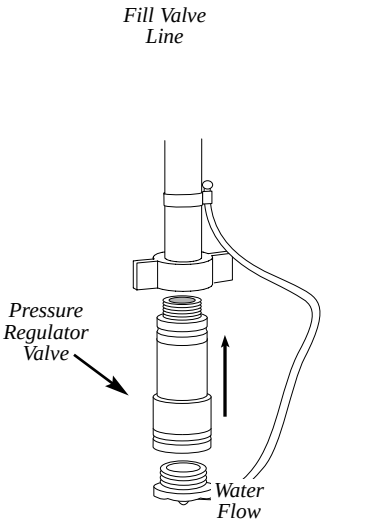
When using the hose, look for kinks. Periodically fully extend the hose. Straighten the hose on the ground. It is important that the water hose remains clean.

**CAUTION: Some outside water sources develop high water pressure, particularly in mountainous regions. High water pressure is anything over 55 psi (pounds per square inch). Excessive water pressure may cause leaks in water lines and/or damage the water heater. A pressure regulator should be connected to the city water faucet to regulate the pressure to the potable water hose. Excess pressure on a hot day can cause the water hose to swell and burst.**

## WATER TANK - FRESH FILL

1. If the motorhome has the optional hose reel, pull hose out. Connect hose to water source and go to step 5. If motorhome does not have the reel, proceed with step 2.
2. Connect the hose labeled for potable water to the water source. Install the provided pressure regulator on the fill valve. Arrow on regulator must be pointed toward valve. On a hot day the hose may expand and burst from water pressure within the water hose.

3. Remove white plug in the end of the pressure regulator.
4. Connect the water hose to the pressure regulator inlet.
5. Check to make sure the fresh water tank drain valve, located on roadside in the service center, is in the closed position.
6. The fill valve should be in the Fresh Water Tank position.
7. Turn on the water at the water source. The water should be audible as the fresh water tank fills.
8. Locate the monitor panel. Locate the switch marked test. The switch is a momentary switch that requires the switch to be held in position while testing the level in the fresh water tank. Read the scale as the fresh water tank is filling. When the 2/3 tank light illuminates it should not take much longer to finish filling the tank. Do not leave coach unattended while filling the fresh water tank. The light marked “F” should start to blink as a warning that the fresh water tank is almost full. Return to the service center. When the fresh water tank is full water will come out an overflow vent above the gravity fill cap.
9. Turn off water supply as quickly as possible.
10. Return fill valve handle to “local supply.”
11. Unhook hose from water source. If applicable, activate hose reel switch to coil hose on the reel.



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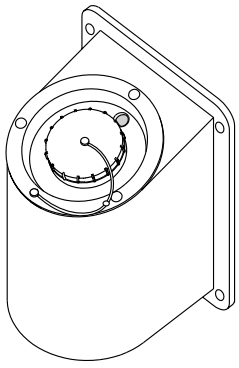
## WATER TANK - FRESH GRAVITY FILL

The gravity fill inlet allows fluids to be introduced directly into the fresh water tank. When dry camping water can be poured directly from a container into the fresh water tank. The gravity fill inlet can be used to pour disinfecting solution into the fresh water tank or when using potable RV antifreeze to winterize the fresh water system. Use only potable water sources, solutions and delivery systems when using the gravity fill inlet.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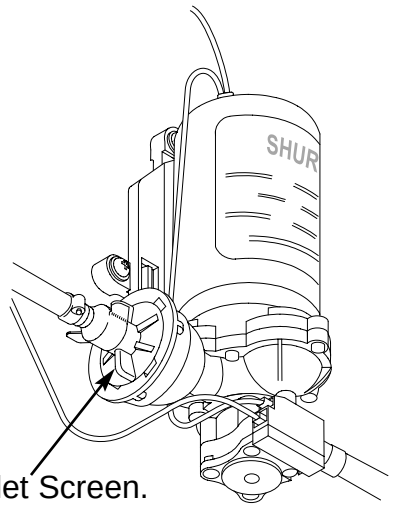
**Filling the Tank:**

1. Unscrew fill cap taking care to keep cap and inlet clean.
2. Insert potable water hose into inlet.
3. Fill tank until water overflows from inlet.

**NOTE: When filling tank do not leave hose unattended.**

## WATER PUMP

The water pump pressurizes the fresh water system when not connected to city water. The water pump is totally automatic and self-priming, operating on demand as water is used. The water pump is located in a storage compartment of the motorhome.




Inlet Screen. Check every 3 months.

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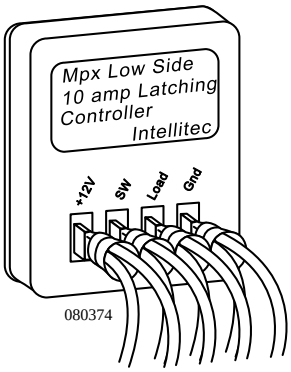
**WARNING: Before leaving the motorhome for extended periods of time (i.e. overnight or longer) be sure that the city water and all water pumps have been turned off. Damage from neglect will be the responsibility of the owner, not the manufacturer.**

**Latching Controller:**

The circuitry of a latching controller allows multiple switch locations to operate the water pump. Pressing one of the water pump switches provides a momentary ground signal to the latching controller, turning the water pump on or off from any location. An indicator lamp at each water pump switch illuminates when the water pump is on.

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**NOTE: The latching controller is located next to the water pump.**

**The water pump can be operated from the following locations:**

• Monitor Panel • Bathroom • Service Center

**To turn the water pump on or off:**

• Momentarily press the water pump switch. The indicator lamp will illuminate when the water pump is turned on.

**CAUTION: Do not continue water pump operation if the fresh water holding tank is empty. Damage to the water pump or electrical supply system may result.**

**Use the following procedure to operate the water pump after unhooking from the city water supply or after storage:**

• Close all drain valves and low point drains.
• Fill the fresh water tank.
• Open the hot and cold water valves of each faucet.
• Turn the water pump on. Wait for the water lines and the hot water tank to fill.
• Close each faucet when it delivers a steady stream of water (cold water faucets first).

## Water Pump Troubleshooting

Vibration induced by road conditions can cause the plumbing or pump hardware to loosen. Check for system components that are loose. Many symptoms can be resolved by tightening the hardware. Check the following items:

**The water pump will not start or blows the fuse:**
- Check the electrical connections, fuse or breaker, main switch and ground connection.
- Check the electrical connections at the latching controller.
- Is voltage present at the pressure switch? Bypass the pressure switch.
- Is the latching controller grounding the water pump?
- Check the charging system for correct voltage and good ground.
- Check for an open or grounded circuit or motor.
- Check for seized or locked diaphragm assembly (water frozen).

**The water pump will not prime/sputters: (No discharge/motor runs):**
- Is the strainer clogged with debris?
- Is there water in the tank or has air collected in the hot water heater?
- Is the inlet tubing/plumbing sucking in air at plumbing connections (vacuum leak)?
- Check for proper voltage with the pump operating.
- Look for debris in the pump inlet/outlet valves or dry/swollen valves.
- Check the pump housing for cracks or loose drive assembly screws.

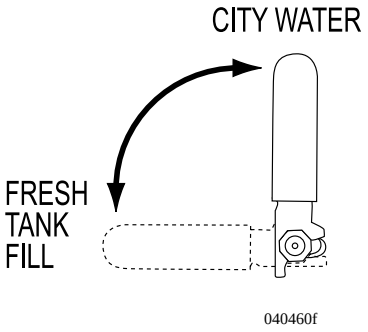
**The water pump will not shut-off or runs when the faucet is closed:**
- Check to see if the fresh water tank fill valve is completely closed.
- Check output side (pressure) plumbing for leaks and **inspect** for a leaky toilet or valves.
- Look for loose drive assembly or pump head screws.
- Are the valves or the internal check valve held open by debris or is the rubber swollen?

**The water pump is noisy or rough in operation:**
- Check for plumbing which may have vibrated loose.
- Does the mounting surface multiply noise (flexible)?
- Check for mounting feet that are loose or compressed too tight.
- Look for loose pump head to motor screws.

**The water pump is rapid cycling:**
- Look for restrictive plumbing/flow restrictors in the faucets or shower heads.

## WATER - CITY HOOK-UP

When connecting the motorhome to fresh water, use a hose manufactured and labeled for potable water to ensure that the hose will not flavor the water.




1. If the motorhome has an optional hose reel, pull house out. Connect hose to water source and go to step 5. If motorhome does not have a reel, proceed with step 2.
2. Connect the hose labeled for potable water to the water source. Install the provided pressure regulator on the fill valve. Arrow on regulator must be pointed toward valve. On a hot day the hose may expand and burst from water pressure within the water hose.
3. Remove white plug from the end of the pressure regulator.
4. Connect the water hose to the pressure regulator.
5. Valve handle should be in the local supply position.
6. Turn on water at water source.
7. The water pump can either be in the OFF position or in the ON position. It will not affect the water pump to leave it on.
8. Open each faucet, one at a time, to rid any trapped air inside the pipes.

**CAUTION: Some water sources develop high water pressure, particularly in mountainous regions. High water pressure is anything over 55 psi (pounds per square inch). Excessive water pressure may cause leaks in water lines and/or damage the water heater.**

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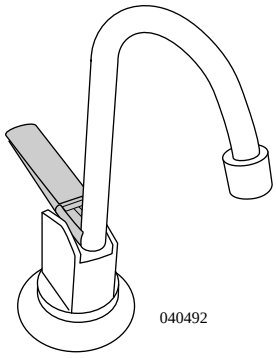
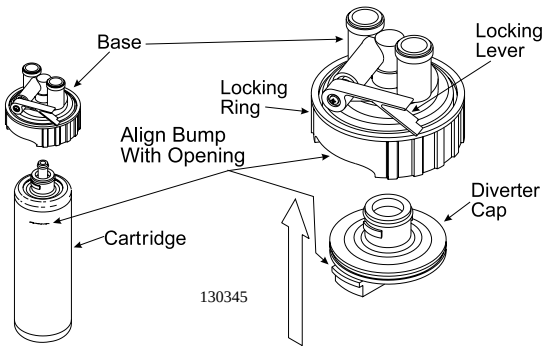
### *Galley Filter*




The water filter is located under the galley sink. For winterization purposes, the filter head may have been installed with the diverter cap in place. In this case remove the diverter cap and store for winterization. Install the cartridge by following the instructions on the cartridge.

The internal filter is designed to remove particles and organisms as small as ½ micron*. As water passes through the water filter, impurities are trapped in the pores of the micro-pure coating restricting the flow of water. When the flow of water is restricted the cartridge should be replaced.

The life of the filter will vary depending on the purity of the incoming water and the quantity used. If the cartridge is not changed, the flow will eventually stop entirely. Even if the flow of water is not reduced, change the cartridge at least once a year for reliable filter performance.




***One micron is one millionth of one meter.**

**NOTE: Change the filter at least once a year.**

## WATER SYSTEM - TROUBLESHOOTING

Water system problems and leaks usually fall into two categories: system problems and problems caused by improper use or lack of attention. These problems result from improper winterizing, poor maintenance, road vibration and campsite water pressure variations. Check all plumbing connections for leaks at least once a year. If the water pump runs when a faucet is not open, check for a water leak. If a water line or fitting is leaking, tighten the fitting. Have the leak repaired before returning the supply line to service. In addition, opening the city water/tank fill valve with the water pump off will remove all water line pressure within the motorhome.

**NOTE: A small water leak can cause severe water damage. Shut off the water supply and have the leak repaired.**

## WATER SYSTEM - DISINFECTING FRESH WATER

Disinfecting the water system with chlorine bleach (superchlorination) protects the drinking water from bacterial or viral contamination that may come from any common water source.

**Disinfect the Water System:**

- If the motorhome is new.
- If the motorhome has not been used in a long time.
- Every three months.

**Use the following procedures to disinfect the water system.**

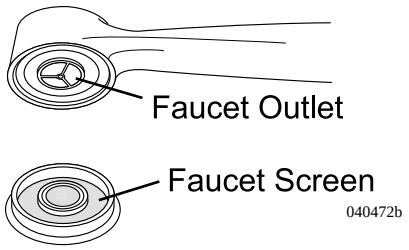
- Remove any water filter elements that may be installed and install divert caps or hoses as needed.
- Prepare a chlorine bleach solution using one gallon water and ¼ cup of chlorine bleach. Use 1 gallon of solution for every 15 gallons of tank capacity. For example: Add 2 2/3 gallons solution to a 40 gallon tank. Add 4 2/3 gallons solution to a 70 gallon tank. Add 6 2/3 gallons to 100 gallon tank. This mixture puts a 50 PPM (parts per million) disinfecting solution in the water system. This concentration will act as a quick-kill dosage for harmful bacteria, viruses and slime-forming organisms. Concentrations higher than 50 PPM may damage the water lines and/or tanks.
- Another method of introducing the chlorine bleach would be to multiply the number of gallons by 0.13. The result would be the amount in ounces of chlorine needed to be introduced into the fresh tank with water.
- Drain the fresh water tank. Close the drain and prepare to introduce the solution into the fresh water tank. Pour solution into the fresh water tank using the gravity fill and funnel.
- Turn on the water pump in the motorhome.
- Open each faucet and run the water until you smell a distinct chlorine bleach odor.
- Turn off all faucets allowing the system to stand for four hours.

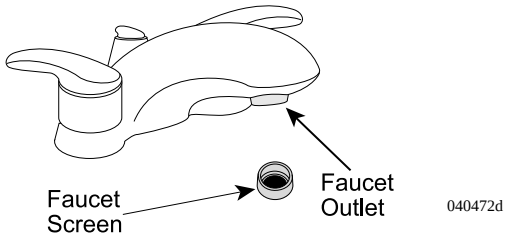
- Drain the fresh water tank of the mixed solution.
- Fill the water tank with fresh water. Flush hot and cold lines thoroughly with fresh water. Repeat this process until the chlorine bleach smell is no longer detectable in the water system.
- Install new water filter.

### *Faucet Screens*

Fresh water sources will vary by location. Build up lime deposits or debris on the faucet screens will restrict or plug the flow of water coming from the faucets. All faucet screens should be checked and cleaned every two weeks of use.

- Faucet screens are normally located on the outlet side of the faucet and held in place with a threaded collar.
- Remove screen from faucet.
- Clean screen using a small soft brush and a de-liming solution.
- Reinstall screen and check water flow.




### WASTE WATER SYSTEMS *- Proper Waste Disposal*

Most State Parks have strict regulations about discharging wastes except into authorized disposal systems. Dumping raw sewage from toilet holding tanks, except at authorized dumping stations, is universally prohibited.

Most National, State and private parks have either a central dump facility or campsite hook-up for sewage. Many of the modern rest areas along the interstate now have dump stations available. You will find a list of dumping stations from coast to coast in Woodall's Campground Directory, Trailer Life's RV Campgrounds and Services Directory, Rand McNally's Campground and Trailer Park Guide, Good Sam Park Director (Good Sam Club), and other similar publications. Some major oil companies offer dump facilities at selected stations. Usually, very few inconveniences are experienced when holding tank waste is properly and legally disposed of.

### What Not to Put in Waste Holding Tanks

- Do not use strong or full strength detergents to deodorize and disinfect. Use odor control chemicals made especially for holding tanks.
- Do not put automotive antifreeze, ammonia, alcohol or acetone in holding tanks. Some chemicals will dissolve plastic.
- Do not put large table scraps in the tanks. They could be stuck in or damage the valve seals.
- Do not flush facial tissues. They are treated chemically to strengthen them and will not dissolve like toilet paper. Special holding tank tissues are available at most RV supply stores.
- Household tissues are thicker, softer and stronger than a rapidly dissolving tissue. White toilet paper dissolves faster than colored papers. To test tissue dissolving ability, immerse one tissue square into a jar of water. Shake the jar five times to determine if the tissue disintegrates into pieces or remains in one piece. Do not use any type of tissue that remains in one piece.

**NOTE: Never dispose of sanitary supplies or other non-dissolving items into the system. Facial tissue, wet strength tissue, paper towels or an excessive amount of toilet tissue can create clogging in the holding tank system.**

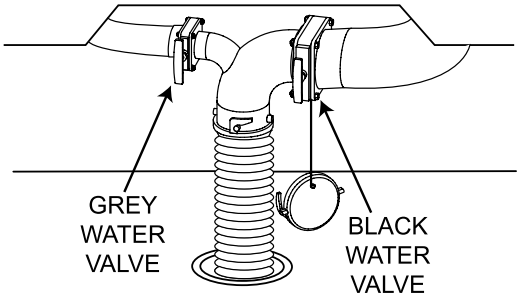
**CAUTION: Do not use any products that contain petroleum distillate or ammonia in place of RV odor controlling chemicals. Petroleum distillate or ammonia will damage the ABS plastic holding tanks and seals.**

## WASTE DRAIN & SEWAGE TANKS

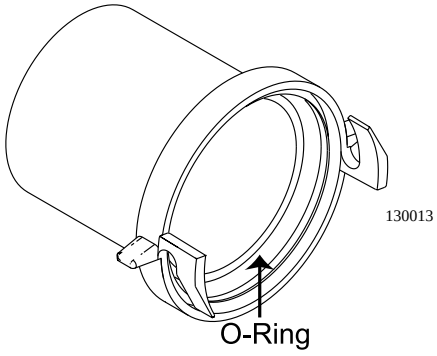
The waste drain system provides adequate and safe storage and/or discharge of waste materials. The drain system uses ABS plastic piping and fittings connected to sinks, shower, toilet and holding tanks draining to an outside termination. The motorhome should be reasonably level for optimum operation of the systems. The wastewater holding system consists of a wastewater holding tank (grey tank). The grey water tank stores the sink, shower and clothes washer drain water. A sewage holding tank (black tank) stores waste from the toilet only.

Drain valves and a tank flush system dispose waste through a common termination. Each holding tank has a separate drain valve dumping the waste water (grey water) and sewage (black water) through a common single discharge outlet. The tank drain valves are located service center on the roadside. Use the water monitor panel to observe tank levels. When ready to drain the tanks, drain the sewage tank first. Next, flush the black tank with the flush system. Close black tank valve after flushing tank. Drain the grey water tank. Using this sequence helps flush solids from the sewer hose. When traveling, it is recommended both holding tanks be empty or less than half full.

### *Waste Drain Hose*




Hose Adapter




A flexible three inch sewer hose attaches between the termination drain and the shore facility. Sewer hoses usually come in 10 or 20 foot lengths. The sewer hose is stored in a tube accessed through a door within the service center compartment. The shore fitting for the sewer hose may be three or four inch pipe, which could be male or female thread. Another possibility may be a four inch pipe, with no threads, covered by a metal plate. There are many configurations. Different style adapters are available to fit most configurations. Hose ladders may also be purchased to support the hose.

It is important that the hose remains secure. Always tighten clamps and restraining devices before use. Lay the hose inline between the termination outlet and the shore fitting. Restrain the hose to prevent movement during use. Wear protective and/or disposable gloves when handling the sewer hose.

**To Attach the Hose:**

1. Remove sewer hose from carrier.
2. Remove termination cap. Align coupler tangs with termination tabs. Twist coupler clockwise 90º locking coupler to termination outlet.
3. Attach the other end of the hose to the drain service. Restrain hose to prevent movement during use.
4. Open the (small) grey water valve.

**LUBE: Lubricate the O-ring on the sewer hose adapter periodically with silicone spray.**

The black water valve remains closed until the tank is full or until time of departure. This will help prevent accumulation of solids. Use the outside faucet or shower attachment for washing or rinsing.

**NOTE: Close the grey water valve 24 hours prior to departing to allow the tank to fill with liquid to help in the dumping process.**

**NOTE: Use care when connecting the sewer hose adapter to the termination outlet in cold weather.**

### What to Put in Holding Tanks - Black Water Tank

Before initially operating the toilet, treat the sewage holding tank with a pre-charge of water and an odor-controlling chemical (available at most RV supply stores). First, add approximately three gallons of water to the holding tank. Next, mix the chemicals, in accordance with the manufacturer instructions, with approximately one gallon of water. Pour mixture through toilet to the holding tank. Be careful not to spill the chemical on your hands, clothing, toilet bowl or carpet as it can permanently stain. Extremely hot weather conditions may require adjusting the amount of chemical used to control odor. Repeat the chemical pre-charge to the holding tank each time the tank is cycled.

**WARNING: Most chemical mixtures for holding tank odor control are poisonous. Follow the product manufacturer's directions and warnings when using any holding tank additive. Do not use any products that contain petroleum distillate or ammonia in place of RV odor controlling chemical. Petroleum distillate or ammonia will damage the ABS plastic holding tanks and seals.**

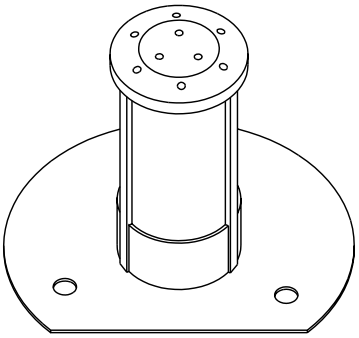
### What to Put in Holding Tanks - Grey Water Tank

The grey water waste tank stores the sink, shower and clothes washer drain water. No chemical is required in this holding tank; however, a waste holding tank can produce odors. A reduced mixture of chemicals can help with odor control.

Ensure that there is enough liquid in the holding tanks prior to dumping the waste holding tanks. This provides a smooth flow through the valve, drain pipe and drain hose. When cycling the tank with sufficient liquid, a swirling action should remove accumulated solid wastes along with the waste liquid. Empty the sewage tank weekly to prevent stagnation and overfilling.

The motorhome comes equipped with a power flush system to aid in cleaning the holding tank. The power flush nozzle, located in the black tank, helps reduce solid build-up. Use the tank flush each drain cycle. Failure to thoroughly rinse the tank each drain cycle may result in solids accumulating and a clogged spray nozzle.

## Black Tank Flush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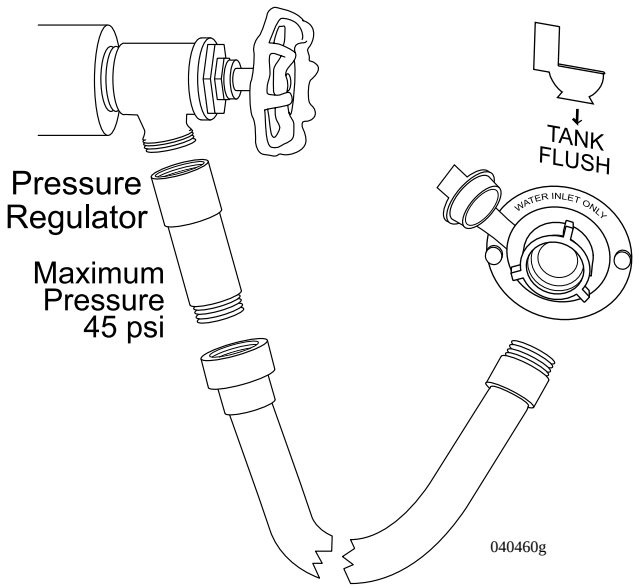
**Dumping the Tanks:**

1. When preparing to dump the black tank, first close the grey water valve.
2. Fill the grey tank to at least 50% by running water in the shower or sinks.
3. Use the monitor panel to observe tank fluid levels. When the grey tank is 50% full stop filling the tank.
4. Open the black water valve. Allow the black tank to drain.
5. Use the tank flush system.
6. Connect a non-potable water hose, with pressure regulator, to the flush system fitting located in the service center. Arrow on regulator must be pointed toward tank flush.
7. Turn on the faucet allowing water to rinse the black tank at least three minutes. Never operate the system unattended. Ensure the water flows freely though the drain hose.
8. When completed turn off the faucet and close the black water valve.
9. Open the grey water valve. The water in the grey tank flushes any remaining solids from the hose. With the grey water valve open, run two gallons of water down any drain to flush the grey tank. The grey valve remains open until the next drain cycle or departure.

**WARNING: Never operate the flush system unattended. Flooding may occur. Use the tank flush system each time the holding tanks are cycled. Failure to routinely use the flush system will result in a clogged spray nozzle. Turn off the water supply when finished flushing the tank.**




**NOTE: Dump the black tank before driving.**

10. If preparing for travel, close both the valves. Undo any restraining devices from the hose. Disconnect the hose from the termination outlet by rotating the fitting counterclockwise 90º.
11. Raise hose and drain using hand over hand method working hose towards shore fitting. Rinse the hose with outside facility and repeat the hose drain process.
12. Remove the hose from shore fitting. Install hose in carrier and lock door. Secure the termination cap (required by law in some states).
13. If desired, add chemicals to the tanks to control odor. Follow the chemical manufacturer's directions.

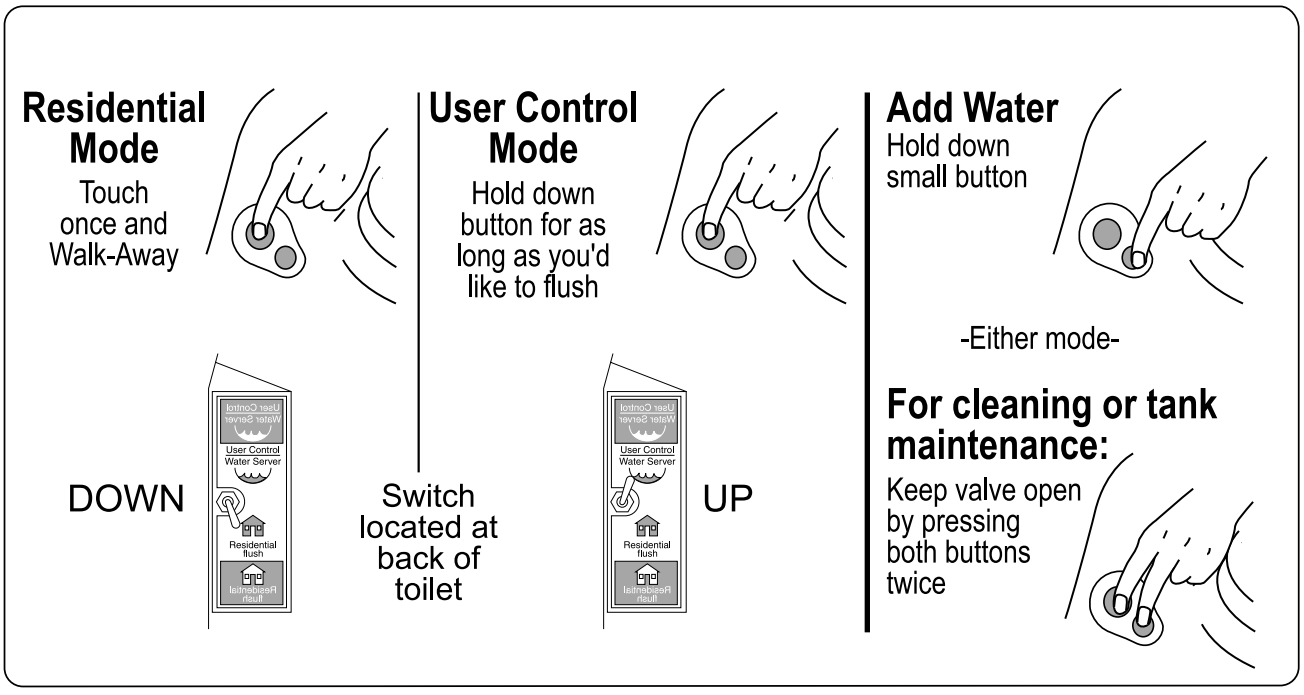
## TOILET - Thetford Operating Instructions

The toilet operates from either the fresh water tank or city water supply. The water pump must be turned on or the city water connected. The toilet flushes directly into a sewage holding tank (black water).

Water consumption is dependent on incoming supply pressure and flow rates. To help conserve water when dry camping or without water hook-ups, two modes to flush the toilet are available and are controlled using a switch located behind the toilet on the right side, as viewed from the front. A mirror may help locate it.

- To flush in Residential mode, move switch to Residential Flush position and push large button once and release.
- To flush toilet in User Control model, move switch to User Control Water Saver position and hold down button for as long as you want to flush and then release. This mode provides water conservation of 50% or more.
- To add water to the toilet, press and hold the small button until the desired water level is reached. Generally, more water is required when flushing solids.
- Pressing both buttons twice simultaneously opens the flush valve to access the holding tank to add chemicals. Pressing the flush button again will close the valve.

In the event the 12 Volt DC is lost at the toilet, the valve can be manually opened using the override knob located in the back of the toilet.

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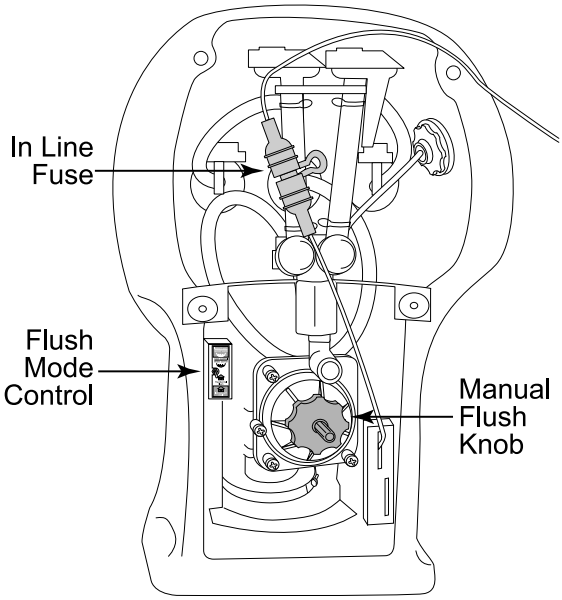
## Troubleshooting




**Wiring:**

- The toilet is wired to a 10 Amp Fuse in the house distribution panel.
- The toilet has a 4 Amp 3 Ag “slow-blow” in-line fuse located in the back of the toilet.

**Leaks:**

- Back of toilet: check water supply line connection.
- Between closet flange and toilet: Check screws for tightness. If leak continues, remove toilet and check flange height. Adjust if necessary to 7/16” above floor. Replace flange seal if damaged.
- Poor flush: A good flush should be obtained within 2 to 3 seconds. If problem persists remove the water supply line and check flow rate. The flow rate should be at least ten quarts (9.5 liters) per minute.
- Bowl will not hold water: Check for foreign material in valve blade groove in the flush drain.

**NOTE: Most chemical mixtures for holding tank odor control are poisonous. Follow the product manufacturer’s directions and warnings when using any holding tank additive.**

## Cleaning

**Cleaning:**

The toilet should be cleaned regularly for maximum sanitation and operational efficiency. Clean the toilet bowl with a mild bathroom cleaner. Do not use chlorine or caustic chemicals, such as drain opening types, as they will damage the seals.

Clean out the system by using the tank flush system. If additional flushing is desired, flush with several gallons of fresh water and one cup of dry laundry detergent. Add odor control deodorant, in the amount specified for your holding tank capacity, after cleaning and every few days during use.

## Maintenance

**Maintenance:**

To find leaks, check behind or under toilet. Take four or five sheets of toilet tissue and wipe all the seams and water line connects. Start at the top of the unit and work downward. When the tissue comes in contact with leaking water it will immediately change texture.

**NOTE: If the motorhome is in storage for six months it is a good idea to spray silicone on the toilet valve and work it back and forth. Perform this maintenance monthly (silicone will evaporate in about 30 days).**

## Hydro-Vac Operating Instructions

The Hydro-Vac toilet operates on a simple principle of accelerating pressured water through a Venturi jet to create a vacuum. City water supply or the water pump and an accumulator tank can be used to supply the pressurized water. The venturi jet water macerates and discharges waste to the black holding tank. The push button on the toilet begins the flushing process.

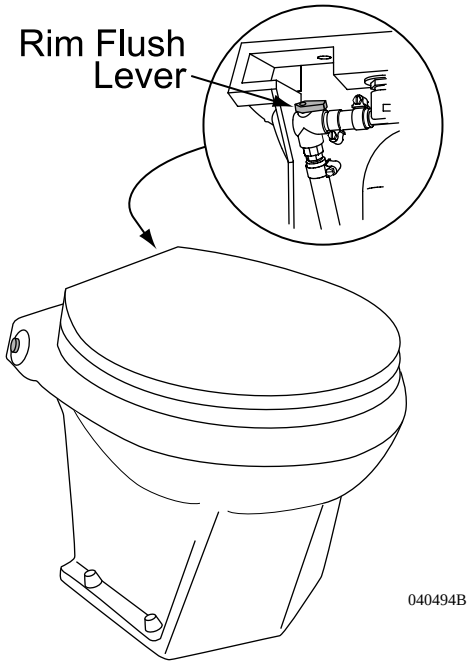
**Prior to Use:**

Make the following checks and adjustments:

- Check all plumbing connections for obvious problems. Make repairs as needed.
- The fresh water supply is available.

**If Using the Fresh Tank Supply:**

- The water pump should be fully primed.
- The pressure pre-charge in the accumulator tank should be adjusted to 4 psi below the pump cut-in pressure of 25 psi.
- Close the rim-feed valve on the back of the bowl.



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**After Initial Checks:**

Make the following initial adjustments:

- Flush the toilet until any air has been purged out of the system.
- Check the entire plumbing for any leaks. Make repairs as needed.
- Check the water pressure system gauge located by the water heater.
- Adjust the rim feed to the desired level by opening the rim-feed valve at the back of the toilet. A higher rim-feed will allow a higher water level in the bowl, but less powerful flushing action. Likewise, a lower water level in the bowl gives a more powerful flushing action.

## Maintenance

**Routine Maintenance:**

The system has been designed for trouble-free operation. No moving parts ever touch the waste stream, so clogging is very unlikely. However, regular checks of the plumbing components should be performed to identify leaks or minor problem.

Using a tire air pressure gauge, one that reads low air pressure, check the accumulator tank pressure bi-monthly. The accumulator tank has a tire valve for checking the air pressure in the tank. In the event air pressure needs to be increased, a manual pump is recommended. Compressed air flow can overcharge the tank too quickly causing the tank to rupture.

## Troubleshooting

| PROBLEM | POSSIBLE CAUSES |
|---|---|
| Toilet will not flush. | • System not pressurized. |
| Toilet flushes continuously. | • Debris stuck in flush valve diaphragm. |
| Bowl fills up while flushing. | • Holding tank is full. |
| Bowl fills up when not flushing. | • Holding tank is not adequately ventilated.<br>• Blockage in discharge plumbing.<br>• Blockage in supply plumbing.<br>• System pressure is too low.<br>• Debris stuck in jet macerator.<br>• Swing Check closed.<br>• Debris stuck on flush valve seat, preventing valve from closing completely. |
| Pump cycles frequently. | • Accumulator tank bladder is ruptured.<br>• Accumulator air pressure is too high. (Adjust it to 4 psi below the pump cut-in pressure).<br>• Water system has a leak. |
| Water will not stay in bowl. | • Vented loop is missing, or is installed too low. |

## Sealand Operating Instructions

The toilet operates from either the fresh water tank or city water supply. The water pump must be turned on or the city water connected. The toilet flushes directly into a sewage holding tank (black water).

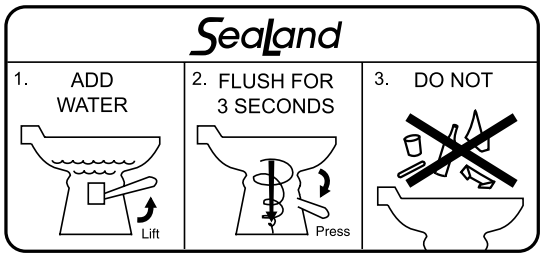
**NOTE: To prevent accumulation of solids below toilet, add several gallons of water to the holding tank before use.**

**CAUTION: Most chemical mixtures for holding tank odor control are poisonous. Follow the product manufacturer's directions and warnings when using any holding tank additive.**

040491

- Using foot, lift up the flush lever to add water to the bowl. Generally, more water is required only when flushing solids.
- To flush the toilet, push the lever all the way down until the sewage leaves the toilet.

Water flow pressures vary at different locations; therefore, holding the flush lever down for several seconds may be required. Release the flush lever by allowing it to snap back, which permits positive sealing around the flush ball. A small amount of water should remain in bowl.



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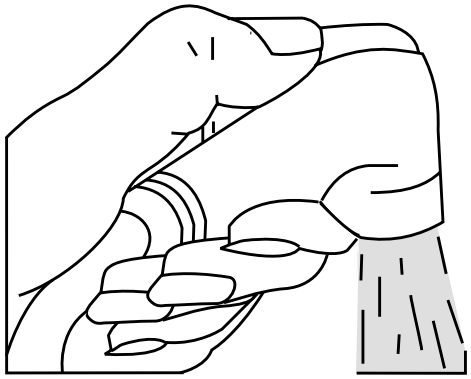
**NOTE: Holding flush lever down longer than necessary results in excessive water usage.**

- To operate the remote mounted hose sprayer, hold the flush lever up or push the flush lever down. Press the handle on the sprayer to wash trim and bowl.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**NOTE: Never dispose of sanitary supplies or other non-dissolving items into the toilet. Facial tissue, wet strengths issue, paper towels or an excessive amount of toilet tissue can clog the tank or termination valve.**

## Cleaning

**Cleaning:**

The toilet should be cleaned regularly for maximum sanitation and operational efficiency. Clean the toilet bowl with a mild bathroom cleaner. Do not use chlorine or caustic chemicals, such as drain opening types, as they will damage the seals.

Clean out the system by using the tank flush system. If additional flushing is desired, flush with several gallons of fresh water and one cup of dry laundry detergent. Add odor control deodorant, in the amount specified for your holding tank capacity, after cleaning and every few days during use.

## Maintenance

**Checking for Leaks:**

- Back of toilet: Check water supply line connection. Toilet tissue works well to find leaks. The tissue changes textures when it contacts moisture.
- Between closet flange and toilet: Check flange screws making sure they are snug. Do not over tighten screws. If leak continues, remove toilet and check flange height. Adjust, if necessary to 7/16" above floor. Replace flange seal if damaged.
- Poor flush: A good flush should be obtained within 2 to 3 seconds. If problem persists, adjust the water level. If it continues, the water pressure may be low or the water flow rate is low. Remove the water supply line and check flow rate. The flow rate should be at least ten quarts (9.5 liters) per minute. Water pressure should not be below 25 psi.
- Bowl will not hold water: Check for foreign material in ball valve.

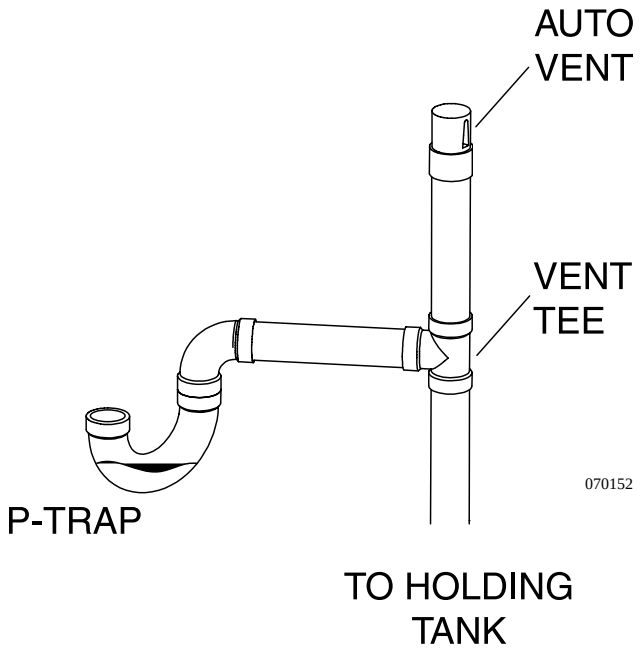
**NOTE: If the motorhome is in storage for six months, it is a good idea to spray silicone on the ball valve. Perform this maintenance monthly (silicone will evaporate in about 30 days).**

### *Drain Traps & Auto Vents*

Sinks, shower and clothes washer drains incorporate a water trap or "P-trap" and auto vents to prevent waste water holding tank odor from entering the motorhome. These P-traps are usually within 54" of a vent tee. These traps must have water in them to block odors.

During storage water can evaporate and allow odor into motorhome. If odor is detected run water into sinks, shower and clothes washer to fill drain traps. The auto vent by design is to assist in the flow of water in the drain lines. They enable a smooth flow of water in the drain without creating a vacuum.

If the auto vent is stuck in the open position, grey odors may enter the motorhome. Auto vents double as "clean-outs" in case the line has to be “snaked” out.



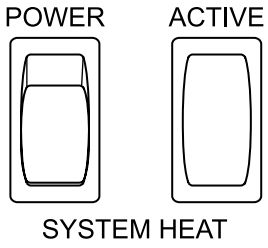

**WARNING: Most chemical mixtures for holding tank odor control are poisonous. Follow the product manufacturer's directions and warnings when using any holding tank additive.**

**NOTE: During cold weather antifreeze must be added to the drain traps.**

## COLD WEATHER CONDITIONS

The motorhome is not designed for extended use in below freezing (32°F/0°C) weather. There are precautionary measures that can be taken for extended cold weather use.

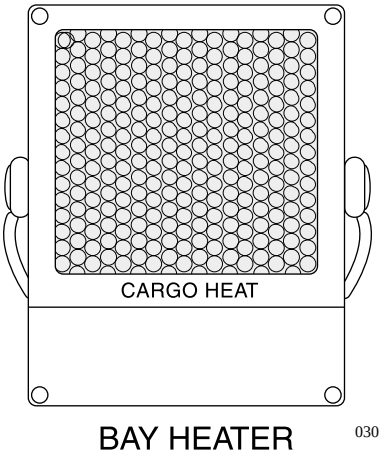
Interior water lines, fixtures, and drains above the floor are normally protected from moderate freezing temperatures as long as the furnace is operating. Cold temperatures can adversely affect water systems below the floor level because the LP-Gas furnace heat does not provide heat to these components. A supplement 12 Volt bay heater and thermal snap disc are located in the water service bay. The System Heat switch on the monitor panel operates the bay heater and should be turned on when ambient temperature approaches 44ºF (+/- 6ºF) and freezing temperatures may occur.




**System Heat Operation:**

1. Turn the Systems Heat switch ON to supply power to the snap disc thermostat.
2. When the bay temperature reaches 40ºF (+/- 6ºF), the snap disc thermostat will close. The bay heater and the systems heat Active light will turn on. The heater will continue to operate until bay temperature reaches 55ºF (+/- 6ºF). The bay heater and Active indicator light will turn OFF.

**NOTE: The bay heater consumes about 20 Amps when operating. House battery power can be quickly consumed. It is recommended to hook to shore power when using Systems Heat.**




**Storing the Motorhome in Cold Weather Conditions:**

If the motorhome is stored where freezing temperatures may occur, drain the domestic fresh water loop completely of water. When draining the domestic fresh water system begin with draining the fresh water tank by opening the point drain lever for the fresh tank and allowing the water to drain.

**NOTE: Icemaker, water filters, water purifies and water heaters all use domestic water and should be drained and stored in accordance with the manufacturer's recommendation for winterization.**

## WINTERIZING

Winterization is an easy process that only takes a few minutes to perform with the proper equipment. There are two methods that may be used, using air pressure to blow the line out or using FLA approved RV antifreeze. Both methods may be combined.

The method chosen to winterize the motorhome and water lines is up to the motorhome owner. Blowing the lines out removes standing water from the lines. The lines can be left empty to dry or the lines can be filled with approved FLA RV antifreeze. Either way, all interior and exterior faucets need to be opened and closed, one at a time, to be checked. All low point drains should be opened and the holding tanks emptied.

The preferred method of winterizing is using air pressure. The use of RV antifreeze is up to the owner. There is no need to introduce RV antifreeze into the fresh water holding tank.

**NOTE: FLA approved RV antifreeze should be used to winterize the motorhome.**

**Winterizing Using Air Pressure:**

To use air pressure to winterize the motorhome you will need access to an air compressor and an adapter to connect the air line to the water system. Adapters can be found at any RV supply store. When hooked to the water lines the pressure should not exceed 40 psi. Higher pressure can damage the lines.

1. Empty and flush the holding tanks.
2. Drain the fresh water tank by opening the drain valve located inside the water service center of the motorhome.
3. Drain the water heater and open all low-point drains in the water service center. Leave low-point valves open until the motorhome is used again. Remove gallery filter and install diverter cap.
4. Let all the water drain.
5. Turn the pump on and allow it to run until all water is cleared out of the pump and lines. Turn the pump off.
6. After water lines are drained, hook an air hose to the water hose reel located in the water control panel in the outside service compartment. Turn tank fill/city water valve to city water. Blow out the water lines until no further water can be seen coming out of the low point drains. Do not exceed 40 psi in the water lines and faucets.
7. Open all faucets, hot and cold valves (including the outside spigot), one at a time while the air is on, to clear water from the faucet supply lines. Do not forget the shower faucet.
8. While the air is on, hold the spray nozzle (located right next to the toilet) open until the water has quit running. Hold the toilet flush pedal or handle up until the water has stopped running.
9. Unhook the air hose.
10. One (1) gallon of RV antifreeze is needed to protect various water drain lines in the motorhome. Pour 1 pint into both the kitchen and bath shower drains. Pour 2 pints into the bath sink drain, with some of the antifreeze going into grey tank to protect the drain valve. Open the ball valve on the toilet. Pour another 3 pints into the toilet, letting the antifreeze run into the black tank to protect the valve located there. Pour one pint of antifreeze into the toilet after you have released the flush pedal. Use a soft cloth to wipe out the sinks and shower (after the antifreeze is poured in) to protect the surfaces from stains. Pour the last pint into the washer/dryer drain.
11. Leave the low-point drains open until the motorhome is used again.

**WARNING: When draining the low water drain lines and the water heater ensure the water is not hot. Hot water from the lines can burn or injure skin.**

**Winterizing with antifreeze:**

Five gallons of FLA approved RV antifreeze will be required to winterize the motorhome.

1. Empty and flush the holding tanks.
2. Remove the water filter element from the galley spigot and reassemble with diverter cap.
3. Remove the drain plug from the front of the water heater. At the back of the water heater, turn the water heater bypass valve to Bypass.
4. Open all faucets. In the water service compartment, open the low point drains and drain valve for the fresh water tank. Operate the water pump to clear water pump of water.
5. Close all faucets, drain valves and low point drains.
6. Pour the antifreeze into the fresh water tank using the fresh water gravity fill.
7. Turn on the water pump and operate each faucet (hot and cold valves) individually until a small amount of antifreeze is present.
8. Close off the faucets.
9. Open the shower faucets and toilet valve to allow a small amount of antifreeze to run into the holding tanks.
10. Use a soft cloth to wipe out the sinks and shower to protect surfaces from antifreeze stains.
11. Open the exterior faucet using the same procedure as the interior faucets.
12. If the motorhome is equipped with an icemaker in the refrigerator, remove the 3/4” fitting and flush antifreeze through the water line.
13. Disconnect the power supply line affecting water pump operation.

To de-winterize, drain and fill the fresh tank with water. Connect the power supply line for the water pump. Install drain plug to water heater and switch bypass valve to Normal Flow. Operate all faucets, one at a time, until clear water is present.

**WARNING: Use only specifically designed non-toxic RV antifreeze for potable water systems. Automotive antifreeze, if ingested, can cause blindness, deafness or death.**

**CAUTION: Discard the first two trays of ice from the icemaker. They may contain contaminants.**

**WARNING: It is recommended that a qualified RV service technician familiar with motorhomes, such as an authorized dealer, do this procedure.**

## TANK CAPACITIES - CHART

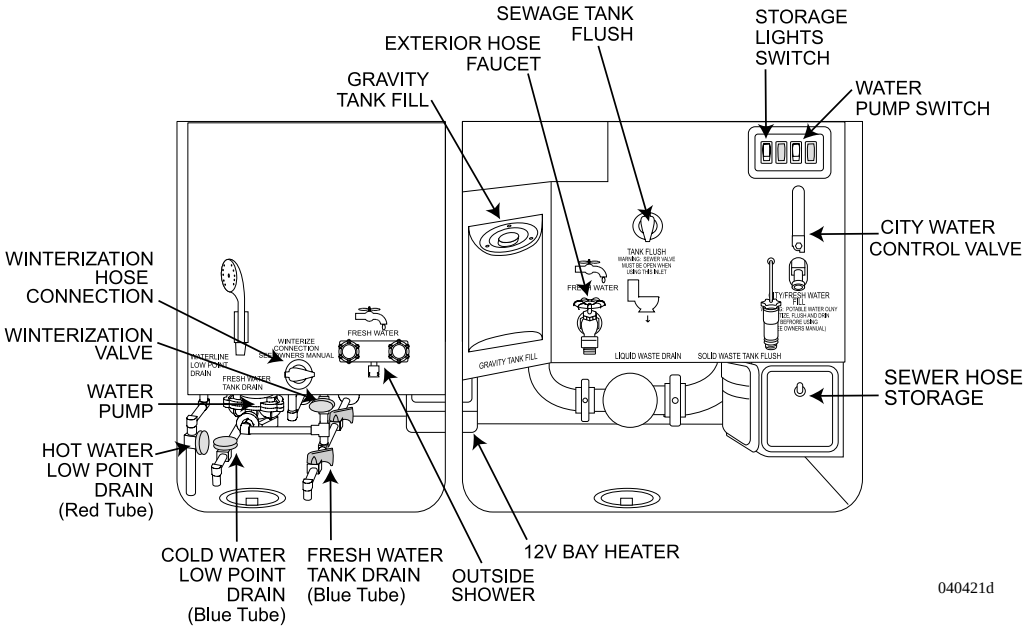
| Tank Capacities | 36PST | 38PBDD | 38PST | 40PBDD | 40PWD | 40PWD | 40PST | 40PDT | 40DST | 40PRT | 40PDQ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Heater (Atwood) | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. |
| Grey Tank (Amerikart) | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL |
| Black Tank (Amerikart) | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL |
| Fresh Tank (Amerikart) | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL |
| Fuel Tank (In House) | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. |
| LP Tank * (Manchester) | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL |

**Actual filled LP capacity is 80% of listing due to safety shut off required on tank.*

**NOTE: This charts reflects product specifications available at the time of printing. Therefore, any floor plans introduced thereafter may not be reflected in the chart. All other information contained throughout the manual will still apply.**

**NOTE: All tank capacities are estimated based upon calculations provided by the tank manufacturers and represent approximate capacities. The actual useable capacity" may be greater or less then the estimated capacities based upon fabrication and installation of the tanks.**

## SERVICE CENTER




**NOTE: Layout of Service Center and location of components may vary with floor plans.**

## ~ NOTES ~

# LP-Gas System

## section 7

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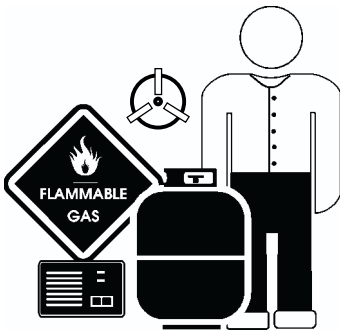
## LP-GAS SYSTEM



LP2

The LP-Gas System section contains information and knowledge for the operation and care of the various Liquefied Petroleum (LP-Gas) system equipment found in the motorhome. The motorhome is equipped with several appliances and various equipment which are capable to operate on LP-Gas. Some items discussed may not be applicable to all motorhomes. More detailed information with **CAUTION** or **WARNING** instructions for the various equipment, other than what is found in this section, can be found in the manufacturer's manual in the owner's information box.

All components for the motorhome LP-Gas systems are approved for use in recreational vehicles by a nationally recognized testing laboratory. When properly handled, LP-Gas is a clean-burning dependable fuel for heat producing components. The LP-Gas tank mounted in the motorhome contains liquid petroleum gas that is under high pressure. As the fuel is used, liquid gas vaporizes and passes through the tank valve to a regulator that automatically reduces pressure. Low-pressure gas is then distributed to components through a pipe manifold system.

Component lighting problems are commonly caused by an improperly adjusted gas regulator. Do not attempt to reset the regulator. Adjustments need to be made by a dealer or an authorized service person.

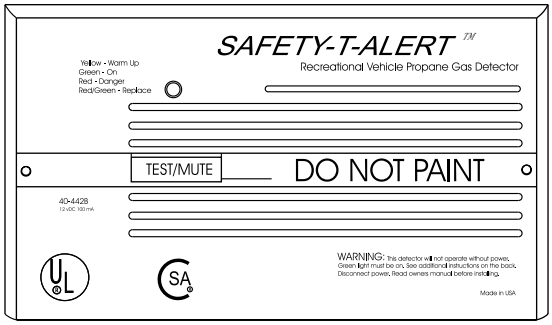
In higher elevations or extreme cold weather (10° F/-21° C or lower) a shortage of LP-Gas may be experienced. Usage can be modified by running only one component at a time. For example, turn off the furnace while using the range. If LP-Gas is going to be used in higher elevations or cold climates for a long period of time, have an authorized service person adjust the LP-Gas regulator for these conditions.

Have the LP-Gas system checked by an authorized dealer at least once a year, and thereafter before every extended trip. Although the manufacturer and the dealer test the system carefully for leakage, travel vibrations can loosen fittings.

Leaks can be easily found by applying a leak detector solution on all connections. Leaks can usually be repaired by tightening the fittings. If not, shut off the main gas valve at the tank. Immediately see an authorized dealer for repairs. Hand tighten the tank valves only. Do not use a wrench or pliers as over tightening may damage valve seats and cause leaks. If a leak is suspected (which can be easily identified by the odor of rotten eggs or sulfur) never light a match, have an open flame or use any spark producing equipment or appliance.

**WARNING: LP-Gas is highly volatile and extremely explosive. DO NOT use matches or a flame to test for leaks. Use only approved LP-Gas leak testing solution for leak detection. Unapproved solutions can damage copper tubing and brass fittings. Never attempt to adjust LP-Gas regulators. Only qualified personnel should perform any maintenance or repair to the LP-Gas system.**

## LP-GAS DETECTOR

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The LP-Gas detector is required safety equipment in RVs. American National Standards Institute (ANSI) A119.2 - Fire & Life Safety 3-4.8 LP Gas Detectors states " An LP Gas detector must be installed in any RV that contains an LP Gas appliance and an electrical system. The LP Gas detector must be listed as suitable for use in recreational vehicles under the requirement of UL 1484 Residential Gas Detectors, and installed according to the terms of its listing."

The dector senses both LP-Gas and methane gas. Liquefied Petroleum (LP) Gas is heavier than air; methane gas is lighter than air. LP-Gas will settle to the lowest point, generally the floor of the motorhome. Methane gas will rise. The gas detector is also sensitive to other fumes such as hair spray, of which most contain butane as the propellant. Butane, like propane, is heavier than air and will settle to the floor level where it will be detected. Sulfated batteries (rotten egg odor) will also sound the alarm. When this occurs, reset the detector to stop the alert sound.

**About the LP-Gas Detector:**

It is important to be aware of the difference between a gas leak versus gas escaping from an unlit, open burner. Pure propane vapors from a leaking pipe or gas fitting are heavier than air and will build up their heaviest concentration at the leak and float down until they mix with air. Gas from open burners is intentionally mixed with air to induce burning and will dissipate into the air. When mixed with air, the gas becomes only marginally heavier than air and will expand outward. If a gas burner is left on, the area around the burner, range, and adjoining counter space will be combustible and can cause injury and damage if ignited. This condition will exist for an extended time period and eventually the gas will reach the detector's location and be detected.

**NOTE: The LP detector only indicates the presence of propane gas at its sensor. Combustible levels of propane gas may be present in other areas. This detector is intended for the detection of propane gas ONLY.**

The LP-Gas detector is not tested to detect other types of gas. However, other volatile gases (nuisance gases), most of them flammable in various concentrations, may cause the detector to alarm. Some products that may cause the detector to alarm are alcohol, liquor, kerosene, gasoline, deodorants, colognes, propellants used in spray cans and cleaning solvents. In some cases vapors from glues and adhesives used in the manufacturing of the motorhome may also cause the detector to alarm for several months after the date of manufacture. If it is determined that the detector has false alarmed because of the above mentioned nuisance gases, reset the detector and air out the motorhome with fresh outside air.

Take precautions to be sure one of these nuisances has not masked an actual gas alarm condition. The detector draws less current than one instrument panel lamp. The detector will operate to detect gas until the battery is drained down to 7.0 Volts. The detector must be supplied with a voltage higher than 7.0 Volts, for it to operate properly. If the power source is disconnected, or if the power is otherwise interrupted, the detector will not operate.

The LP-Gas leak detector has a self-check circuit which runs at all times while the detector is powered. In the event that the circuitry fails, a failure alarm will sound and the operating indicator will cease to light.

**LP-Gas Detector Operation:**

Upon first application of power the LED will flash yellow for three minutes while the detector is stabilizing. At the end of the start cycle the LED will turn Green, indicating full operation. If the detector senses unsafe levels of gas it will immediately sound an alarm. The gas detector operates on 12 Volt DC, with a current draw less than 1/10th of one amp.

**CAUTION: The detector will not alarm during the three minute warm up cycle.**

## *Testing*

Press the **TEST** switch any time during the warm up cycle or while in normal operation. The LED should flash red and the alarm should sound. Release the switch. This is the only way the detector should be tested. The test feature checks full operation of the detector.

**WARNING: Test the operation of this detector after the motorhome has been in storage, before each trip and at least once per week during use.**

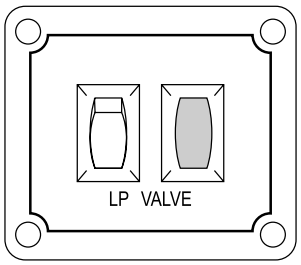
The **red** LED will flash and the alarm will sound whenever a dangerous level of propane or methane gas is detected. The detector will continue to alarm until the gas clears or the **Test/Mute** switch is pressed.

## Alarm

**Procedures to Take During an Alarm:**

1. Turn off all gas appliances, (stove, heaters, furnace), extinguish all flames and smoking material. Evacuate, leave doors and windows open.
2. Turn off the primary valve on the LP tank.
3. Determine and repair the source of the leak. Have a qualified professional determine and repair the source of the leak.

**CAUTION: Do Not re-enter until the problem is corrected.**

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**WARNING: Do not operate the remote LP disconnect switch during an alarm. This may cause a spark that can ignite the fuel. Turn off the primary LP valve on the LP tank.**

**Potential Sources of LP Gas Leaks When Operating the Motorhome:**

- Cooktop Burners
- Oven
- Furnace
- Refrigerator
- Water Heater
- Defective Regulator
- Defective LP-Gas Connection
- Portable Propane Powered Equipment

**Alarm Mute:**

Press the **Test-Mute** button when the detector is in alarm.

1. The **red** LED will continue flash and the alarm will beep every 30 seconds until the gas level has dropped to a safe level.
2. The LED will flash **green** until the end of the **Mute** cycle.
3. If dangerous gas levels return before the end of the **Mute** cycle, the alarm will beep four times and return to phase 1.
4. After two minutes the detector will return to normal operation (solid **green**) or resound the alarm if dangerous levels of gas remain in the area.

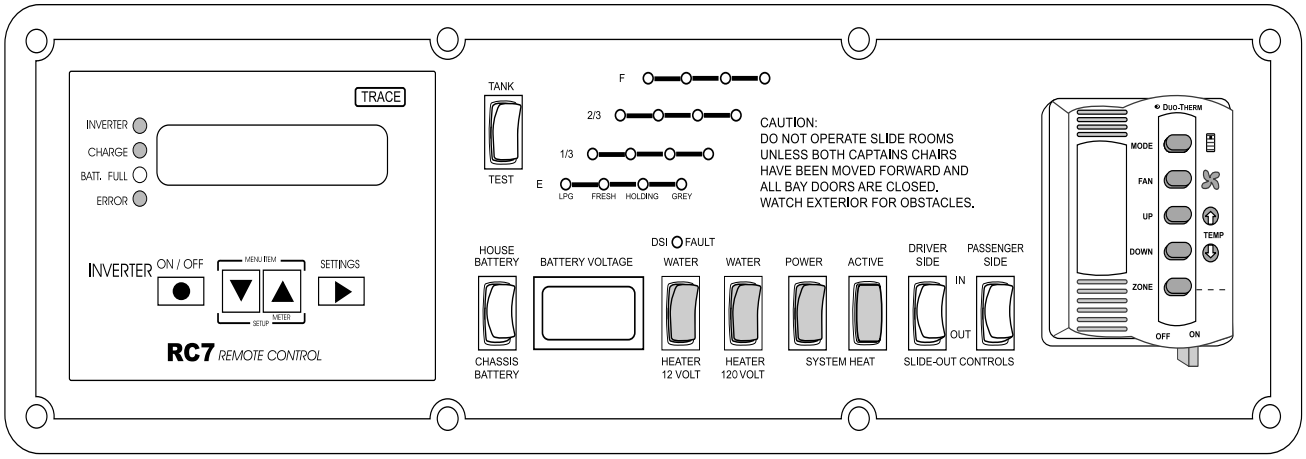
**Fault Alarm:**

Should the microprocessor sense a fault in the gas detector, a fault alarm will sound twice every 15 seconds. The LED will alternately flash **red to green** and the **MUTE** switch will not respond to any command. The gas detector must be repaired or replaced.

## Maintenance

1. Vacuum the dust off the detector cover weekly (more frequently in dusty locations) using the soft brush attachment of the vacuum.
2. Do not spray cleaning agents or waxes directly onto the front panel. This action may damage the sensor, cause an alarm or cause a detector malfunction.

## MONITOR PANEL (LP TANK)
### *- Measurement*

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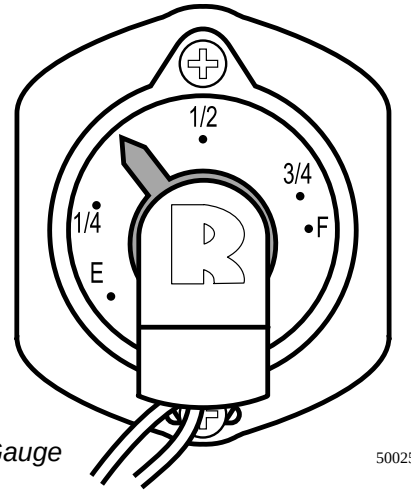
**Tank Measurement:**

To measure level of a tank simply push button on display panel corresponding to tank you wish to measure. Observe the gauge. If the motorhome has the Aladdin System please refer to Section 5, “Aladdin System” for detailed information regarding tank monitoring.

**Calibration:**

The monitor panel comes factory calibrated for accuracy and should not need to be adjusted.

**NOTE: The LP-Gas gauge is not adjustable.**




*LP Tank Gauge*

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## LP-GAS EMERGENCY PROCEDURES - CHECKLIST

If you smell gas (a rotten egg or sulfur smell) at any time, perform the following steps immediately:

- Shut off gas appliances.
- Manually turn off the primary shut-off valve at the LP-Gas tank.
- Do not attempt to operate any electric switch as this can produce a spark and ignite the gas.
- Open windows and doors.
- Evacuate the motorhome. Stay clear of the surrounding area.
- Keep open flames, spark producing devices and smoking material out of the area.
- Contact a qualified service technician to find the source and repair the gas leak.

**WARNING: A fire or explosion from ignited gas or gas fumes can seriously injure person(s) or cause death.**

## LP - GAS TANK

### *Tank Capacity*

| LP GAS TANK CAPACITY* | |
|---|---|
| All Models | 38 Gallons* |

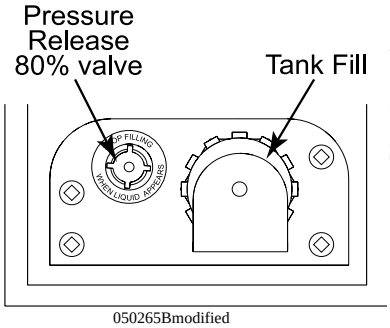
**NOTE: Actual filled LP capacityis 80% of listing due to shut off required on tank.**

### *Tank Filling*

Woodall's Campground and Trailer Guide and other similar publications list refueling stations. Many travel parks sell LP-Gas. Before filling the LP-Gas tank, shut off the electric valve at the LP Tank, pilot lights, appliances and igniters to prevent a fire or explosion. Have a trained service person fill the LP-Gas tank.

The LP-Gas tank fill is located in the LP-Gas tank access outside compartment. Inform the service technician to purge any air from the tank before filling if the tank is new and being filled for the first time. When the tank is filled to the proper level, there is space available for the conversion of liquid into gas. If a tank is over-filled, it may cause the safety valve to release pressure. When this happens, a strong rotten egg odor near the tank and/or a hissing noise may be detected.

LP-Gas exists in both liquid and vapor within the LP-Gas tank. A "Full" tank is approximately 80% liquid. The pressure inside the tank varies with the temperature of the liquid. All tanks are required to be equipped with a safety pressure relief device. The purpose of the safety valve is to release excess pressure. When the tank is full, the gauge on the tank will only read 3/4 full. The monitor panel is adjusted to indicate "FULL" at this point.



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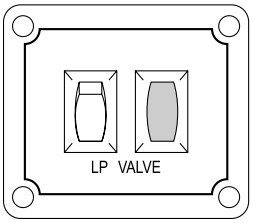
**WARNING: Turn off the electric valve, pilot lights and appliances while filling the LP-Gas tank to prevent a fire or explosion.**

**NOTE: Actual filled liquid capacity is 80% of full tank capacity.**

**WARNING: Extinguish all sources of heat, sparks, flame and smoking materials within a 50-foot radius during the fueling process.**

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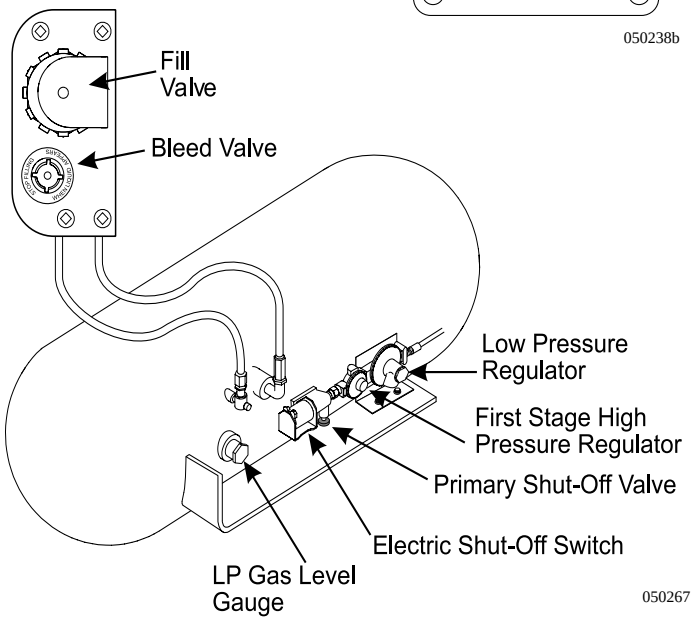
1. Turn off the electric gas valve at the remote tank fill, pilot lights, all appliances and the engine.
2. Remove dust cover to fill valve. Screw fill nozzle to fill valve.
3. Turn on dispensing pump, then open 80% bleed valve.
4. Open valve on fill nozzle dispensing liquid into tank.
5. Close valve on fill nozzle as liquid just begins to expel from 80% bleed valve.
6. Close 80% valve then shut off dispensing pump.
7. Open high-pressure bleed valve on fill nozzle to remove high pressure between dispensing pump and fill nozzle. Remove fill nozzle from fill valve.
8. Install dust cover.

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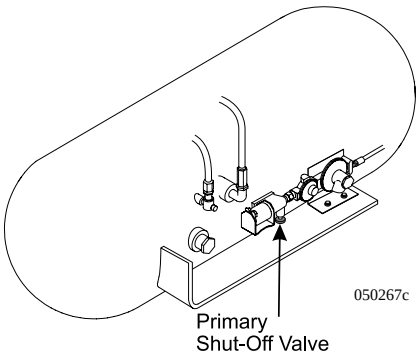
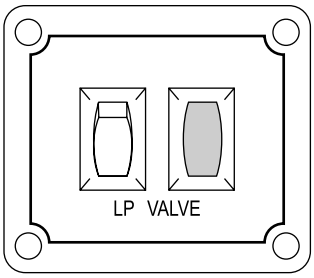
**WARNING: It is common for small amounts of liquid propane to escape and evaporate during the fueling process. Protect bare skin. Instant freezing will occur if exposed to liquid propane.**

**WARNING: When storing portable LP-Gas tanks that are not connected to an LP-Gas system, install an approved plug in the tank outlet holes to prevent leaks. Do not store or transport empty LP-Gas tanks, portable tanks, gasoline or other flammable liquids inside the motorhome. Keep open flame and spark producing materials away from the LP-Gas area. Shut off all appliances and the primary LP-Gas tank valve (located on the LP-Gas tank underneath the motorhome) when the motorhome is in storage. If this warning is ignored, a fire or explosion could result.**

**CAUTION: Pressure inside LP-Gas tanks can reach over 200 psi when exposed to direct sunlight. A high-pressure safety relief valve will purge excess high pressure if necessary. LP-Gas will stop vaporizing as the LP-Gas tank temperature approaches - 40º F. Appliances that consume large amounts of LP-Gas, such as the water heater or furnace, may need to be operated in sequence in extremely cold environments.**

## LP Tank Operation

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- Manually open the primary shut-off valve located on the LP-Gas tank.
- Turn on the electric valve to allow gas to flow to the appliances.
- Turn off the electric valve and primary valve on the LP-Gas tank when the tank is being filled, in between trips and when in storage.
- Hand-tighten the primary valve only. Do not use a wrench or pliers, as this will over-tighten the valve. The primary valve is designed to be closed by hand, over-tightening may permanently damage the valve seat.

## LP-GAS FUNDAMENTALS

| # Capacity | Gallon Capacity | BTU Capacity |
|---|---|---|
| 5 | 1.18 | 107,903 |
| 10 | 2.36 | 215,807 |
| 11 | 2.59 | 237,387 |
| 20 | 4.72 | 431,613 |
| 30 | 7.08 | 647,420 |
| 40 | 9.43 | 863,226 |

**CONVERSIONS**

Gallons to Liters (1 Gallon = 3.785 Liters)
Fahrenheit to Celsius (F° - 32 ÷ 1.8 = C°)
11 in. Water Column = 6 1/4 ozs. per sq. in. pressure.
27.7 in. Water Column = 1 lb. per sq. in. pressure.

**The above capacities allow for 20% vapor space on each cylinder.**

*Data taken from the National Fire Prevention Association (NFPA). Pamphlet #58-1998.*

**LP-Gas Statistics:**

| | |
|---|---|
| Pounds Per Gallon | 4.24 |
| Specific Gravity of Gas | 1.50 |
| Specific Gravity of Liquid | .504 |
| Cubic Feet Gas Per Gallon of Liquid | 36.38 |
| Cubic Feet Gas Per Pound | 8.66 |
| BTU Per Gallon | 91,502 |
| BTU Per Pound | 21,548 |
| Dew Point in Degrees Fahrenheit | - 44° F |
| Vapor Pressure at 0° F | 31 |
| Vapor Pressure at 70° F | 127 |
| Vapor Pressure at 100° F | 196 |
| Vapor Pressure at 110° F | 230 |
| Flash Point | 842° F |

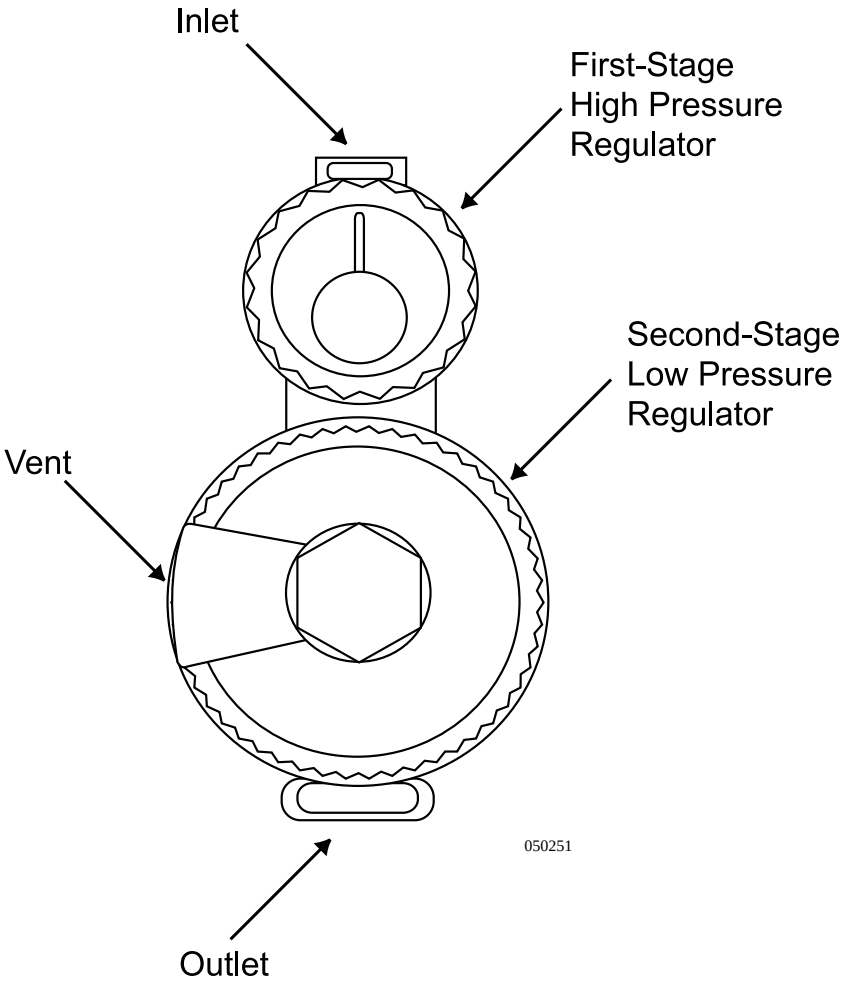
**Basic Facts About LP-Gas:**

- LP-Gas detectors are a federal requirement on all LP-Gas equipped recreation vehicles.
- LP-Gas is a by-product produced by refining oil.
- Odor is added to LP-Gas after the refining process.
- Each liquid gallon of LP-Gas produces 91,502 BTU (British Thermal Units).
- Temperature affects pressure of LP-Gas. Internal tank pressure can exceed 200 psi.
- Tanks or valves contain pressure relief valves. The relief valve opens at 125% above tank rating.
- LP-Gas stops vaporizing at -44º F.
- Standard LP-Gas operating pressure is 11" of Water Column or approximately 6 ¼ ounces per square inch.
- An inch of Water Column is a measurement of applied pressure to one side of a U-Tube ½ filled with water at sea level. The amount of pressure required to raise the water level 11", represents 11” of Water Column.

**NOTE: The above information is not a complete guide for the use of LP-Gas tanks or appliances. In cold climates keep fuel levels above 50% in order to keep vaporization of LP-Gas at the highest level.**

## LP-GAS REGULATOR

LP-Gas is compressed into liquid form in the tank. Only the vapor is used during combustion by an appliance. As vapor is removed from the tank, the remaining liquid will vaporize to maintain pressure that is removed during consumption. This process will continue until there is no liquid remaining in the tank.




Temperature affects action of the liquid to vaporize. If temperature of the liquid is - 44º F. the liquid remains stable with tank pressure, about 0 psi. If liquid temperature is 100º F. the liquid quickly vaporizes with tank pressure, about 200 psi. Vapor pressure must remain relatively consistent regardless of temperature so that appliance heat output remains stable. Vapor pressure regulation is performed by the regulator.

The regulator is the heart of the LP-Gas system. The regulator reduces vapor pressure so that it is safe to use. The regulator on the motorhome is a two-stage regulator. The first stage of the regulator reduces tank pressure to a range of 10 to 13 psig (pounds per square inch gauge). The second stage further reduces pressure to a working pressure of 0.4 psig (11 Inches of Water Column or about 6¼ ounces psi.). The regulator has a vent that allows the internal diaphragm to move with atmospheric pressure change. It is important to keep the vent clean and clear of obstruction or corrosion. If the vent becomes clogged, pressure from LP tank could cause erratic pressure regulation. If there is corrosion, contact a qualified LP-Gas service technician. The regulator is mounted so that the vent faces downward. If the vent becomes clogged clean it with a toothbrush.

Under normal atmospheric conditions an LP regulator will not freeze, nor will the LP-Gas. Vapor passing through the regulator will expand and cool condensing moisture in the gas. The moisture will freeze which can build up and partially or totally block the vent. The possibilities of freeze up are greatly reduced with the two stage regulator.

**To Prevent Freeze Up:**

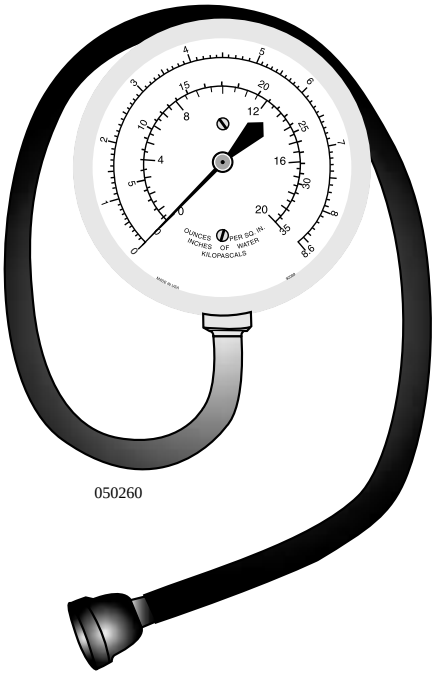
1. Ensure the LP tank is totally free of moisture prior to filling.
2. Ensure the tank is not overfilled.
3. Keep the valve closed when the tank is empty.
4. If a freeze up occurs, have an LP-Gas distributor purge the tank.
5. Have the LP-Gas distributor inject methyl alcohol in the tank.

Damage to the regulator can occur when the tank is overfilled. The regulator is designed to work with vapor only. This is why the tank is filled to only 80% of its liquid capacity. The other 20% allows for vaporization of the liquid. The primary vapor valve is located in the vapor section of the tank. In an overfilled tank, liquefied petroleum can fill the regulator. As the liquid vaporizes, it can freeze the diaphragm. High tank pressure on a frozen diaphragm can cause a rupture resulting in erratic pressure regulation. This is why it is important to have the LP-Gas pressure checked for proper pressure and accurate regulation during appliance operation. Erratic pressure regulation dramatically effects refrigerator operation on LP-Gas.

**Manometers:**

The manometer is the best way to accurately determine LP-Gas pressure. There are two different styles of manometers, a gauge and a U-tube. Gas pressure is measured in Inches of Water Column. This is the amount of pressure applied to one side of a U-shaped tube half filled with water. The amount of pressure needed to raise the column of water **11"** represents **11 Inches of Water Column**.

**WARNING: Do not attempt to adjust the regulator, it is preset at the factory. If adjustments need to be made it requires special equipment. Failure to follow these instructions may result in a fire or explosion and cause severe personal injury or death. Do not operate any LP-Gas appliance until the LP-Gas pressure is checked and a leak down test is performed!**



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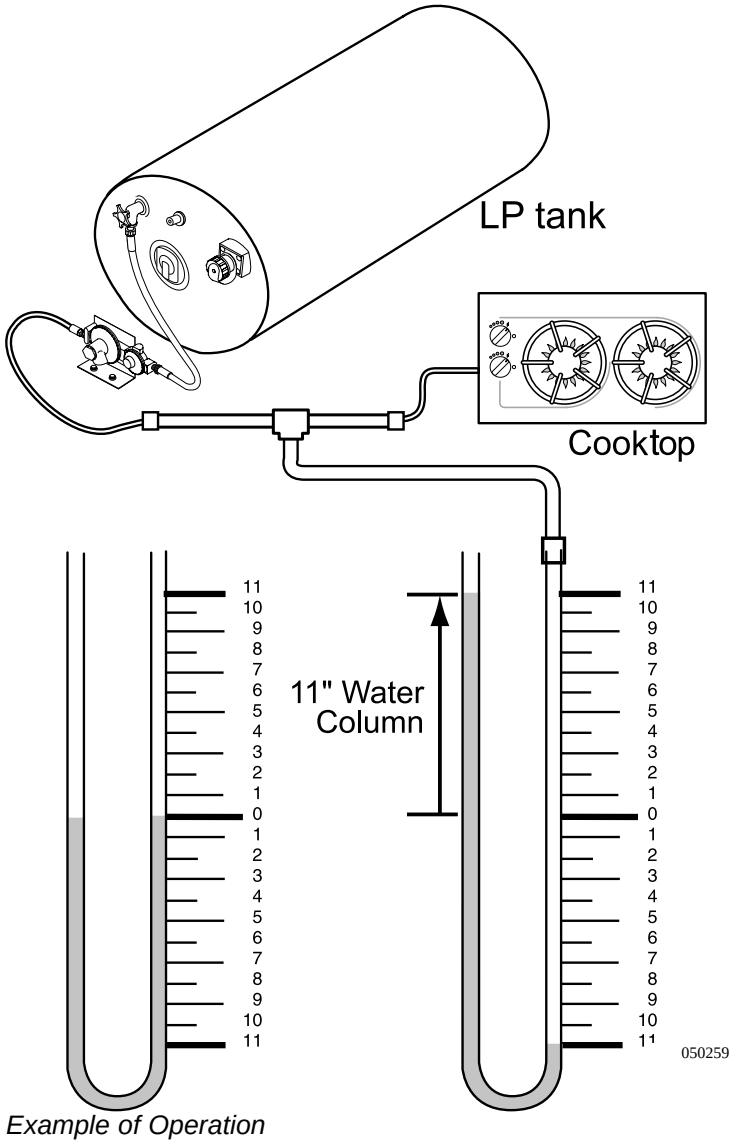



*Example of Operation*

## LP-GAS HOSE INSPECTION

It is suggested by the hose manufacturer that the Liquid Propane Gas (LP-Gas) supply hoses, used on the motorhome, be subject to regular inspection. As a guideline, we suggest that all flexible LP lines connecting the slide-out, appliances, or tanks be inspected in the spring and fall of each year by a qualified RV technician.

According to the manufacturer, the inspections should consist of the following procedures and be performed when the hose is not under pressure:

1.**INSPECTION:** Inspect the outside cover of the hose for blistering, abrasion or cuts and coupling slippage. Cuts in the hose cover, which expose or damage the reinforcement, is cause for replacement. Hose strength is controlled by the plies of the reinforcement and damage in this area cannot be tolerated. Small cuts, nicks, or gouges in the cover that do not go completely through the cover will not be cause for replacement of the hose.

**NOTE: Pricking of the cover in the manufacture of this type of hose is common and necessary for satisfactory hose performance. Consequently, the uniformly pricked cover should not be viewed with alarm.**

2. Damage to the textile reinforcement or wire braid is cause for hose replacement. Wire braid reinforced hose, which has been kinked or flattened so as to permanently deform the wire braid in the unpressurized state, shall be removed from service.
3. Blistering or loose outer cover is cause for hose replacement.
4. Examine couplings for slippage. Slippage is evidenced by the misalignment of the hose and coupling and/or the scored or exposed area where slippage has occurred. Any evidence of slippage is cause for hose replacement.
5. It is important that if a damaged LP-Gas hose is found, the source of the damage be determined and corrected prior to the replacement of the LP-Gas hose.

**NOTE: Only a qualified RV technician should complete replacement of LP-Gas components.**

It is also suggested, that the flexible LP-Gas supply lines on your recreational vehicle be replaced every ten (10) years. The manufacturer of the LP-Gas supply lines recommended this schedule after performing extended testing and have determined that the failure rate may rise after this period of time. The motorhome manufacturer recommends following these guidelines to assure continued safety and the dependable use of the recreation vehicle.

## LP-GAS CONSUMPTION

Each gallon of LP-Gas produces 91,502 BTU's of heat. One 27 gallon tank produces two million BTU's. Total consumption depends on the rate of usage by each appliance and the operating time. The stove and heating systems typically use the most gas. With sub-freezing temperatures and high winds, consumption by the furnace can be very high. Check the tank level often in cold weather.

**Determine Fuel Consumption:**

To determine approximately how many hours an LP-Gas appliance will operate on one gallon of LP use the following formula:

- LP-Gas appliances are rated in Input BTU (British Thermal Units). The rating is usually stamped or printed on tag affixed to the appliance. For example: the Input rating of the appliance is 10,000 BTU's.
- One gallon of LP-Gas produces 91,502 BTU's.
- Divide the amount of BTU's of one gallon of LP-Gas (91,502) by the rating on the appliance in this example 10,000. Net continuous operation time for one gallon of LP-Gas for this appliance would be approximately 9.2 hours.

| Typical Appliance BTU Ratings |
|---|
| **Water Heater (Suburban)**<br>10 gallon - 12,000 BTU |
| **Furnace (Atwood)**<br>40,000 BTU |
| **Cooktop**<br>9,000 BTU - Front<br>6,500 BTU - Rear<br>7,100 BTU - Oven |
| **Refrigerator (Norcold)**<br>2-door 1500 BTU<br>4-door 2200 BTU |

The above formula can be useful when trying to determine the approximate length of time a tank of LP-Gas will last. Generally, LP-Gas appliances do not operate continuously. An example would be the typical cycling of the furnace or water heater.

**Determining how long a tank of LP-Gas will last:**

- Combine the BTU input totals of all appliances and the approximate length of time these appliances operate per day.
- Multiply the number of liquid gallons in the LP tank by 91,502.
- Divide the total of BTU's of the LP tank by the total number of BTU's the appliances consume equals the approximate number of hours of operation before refueling.

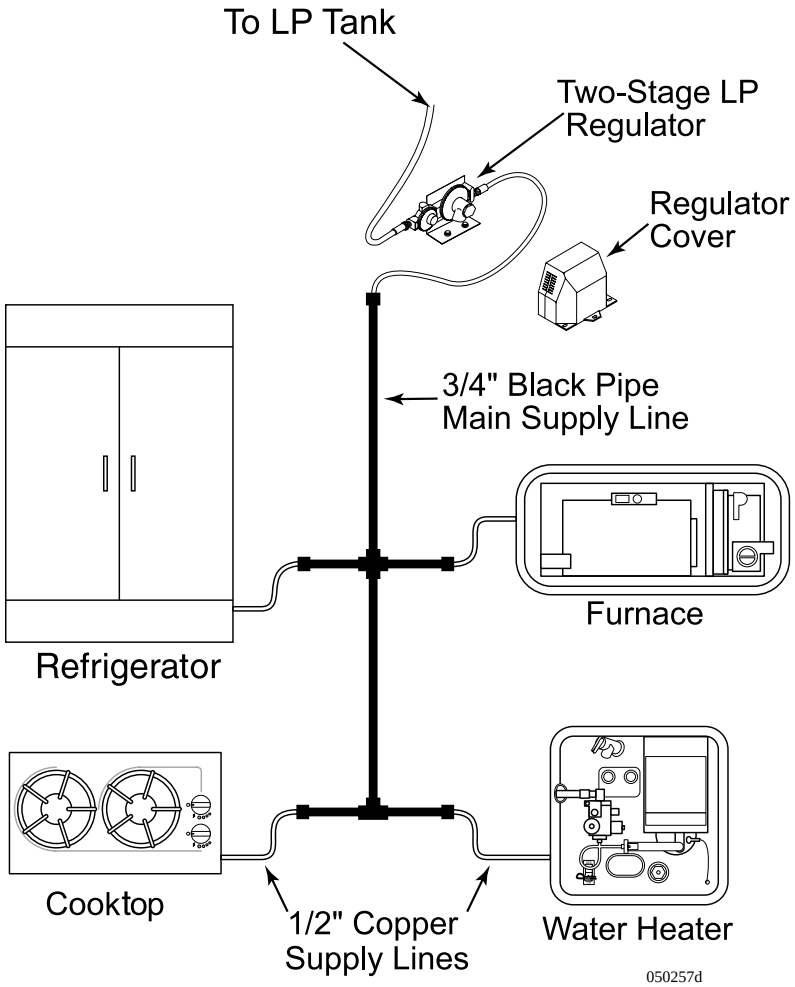
**WARNING: LP-Gas is highly volatile and extremely explosive. Never use matches or open flame to test for leaks. Use only approved LP-Gas leak testing solution to test for leaks. Unapproved solutions can damage copper tubing and brass fittings. Never attempt to adjust LP-Gas regulators without the use of proper equipment. Improper LP-Gas regulator adjustment will affect the performance of LP-Gas operated appliances. Incorrect flame or explosion can occur. Only qualified personnel should perform any maintenance or repair to the LP-Gas system.**

## LP-GAS DISTRIBUTION LINES

A primary manifold black steel pipe running throughout the motorhome distributes LP-Gas to secondary lines. All secondary lines leading to gas appliances are made of copper tubing with flared fittings. If any lines rupture do not attempt to splice them. Always run a new line. We recommend gas distribution work be performed by an authorized dealer or an authorized service technician. When removing or servicing any gas appliance, manually close the main valve located on the side of the LP-Gas tank. This will prevent dangerous gas leakage that could result in an explosion and possible serious injury.

**INSPECTION:** Inspect the rubber flexible lines, twice a year, for abrasions, tears, kinks or other signs of damage.

If a gas leak is suspected, get the system inspected and repaired by a qualified service technician as soon as possible.



## LP-GAS SAFETY TIPS

Liquid Propane gas is one of the safest and most reliable fuels available on the market if it is handled properly. LP-Gas, however, does have a great explosive “potential" if handled improperly. Danger is minimized by becoming familiar with and following a few safety precautions, and by learning how to properly operate LP-Gas appliances. Use of LP-Gas requires the responsibility to enforce extra safety measures.

The motorhome is equipped with many LP-Gas operated appliances because it is a convenient and efficient source of fuel. LP-Gas appliances must be operated and maintained in accordance with the product manufacturer’s instructions.

The National Propane Gas Association (NPGA) has a special service program offered called GAS® (Gas Appliance System) Check. The GAS® Check program is aimed at educating the users in the association about the convenience of propane use with safety and peace of mind. For information on the **NPGA Gas® Check program, call (630) 515-0600 or visit www.npga.org.**

**LP-Gas Tanks and Cylinders:**

Tanks are built to American Society of Mechanical Engineers (AMSE) Code. The cylinders are built to DOT (Department of Transportation) Code. The major difference between cylinders and tanks is in required testing and inspection procedures and in the construction of the containers. Both tanks and cylinders are required to undergo pressure testing and inspections; however, the procedures for how they are tested and inspected differ.

The difference between the two codes are that the valves, fittings and brackets are located only on the ends of the DOT cylinders; however, on the ASME tanks they may be located on ends, as well as the sides. There is also a difference in how the tanks are rated. Required tank ratings are in gallons (ASME ratings) or pounds (DOT) water capacity. The Federal DOT (Department of Transportation) regulations require periodic inspections and re-qualifications of cylinders.

American Society of Mechanical Engineers (AMSE) tanks or bulk containers are generally used in the motorhomes and motorized products. These tanks are permanently mounted on to the unit.

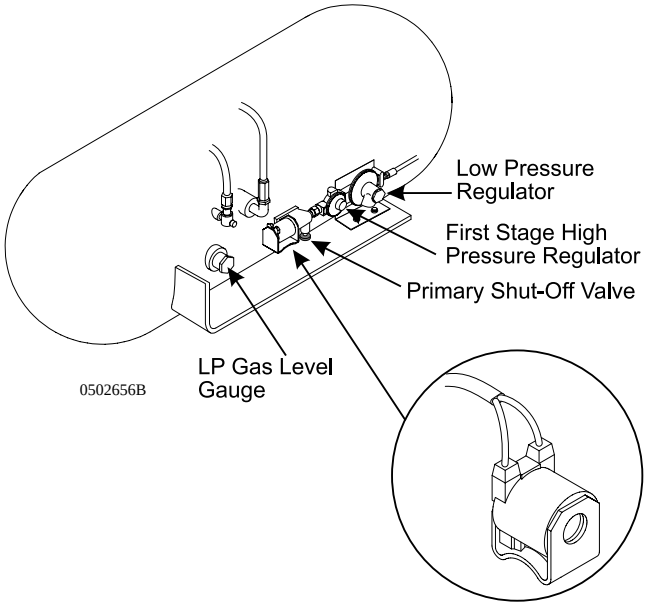
An alloy steel two-piece welded and brazed tank is used on all towable products. The marking on the collar, DOT 4BA240, identifies the DOT specifications and service pressure. Other pertinent information included on the collar is the water capacity (WC) and the tare weight (TW), both which are measured in pounds, and the Manufacture date (one of the most important items). There is a required 12 year re-qualification. The final piece of information is for the Dip Tube (DT) length. This is part of the overfill protection and maximum liquid allowance in the cylinder.

**Maintenance and Safety Tips for the LP-Gas Refrigerator:**

- Have the refrigerator, furnace and venting **inspected** annually by an authorized service center.
- Before firing up the refrigerator, or using the propane gas furnace for the first time each season, have the venting system checked for blockage. Insects may have built nests that will obstruct flow.
- At the first indication of incomplete combustion (yellow flame instead of a blue flame or soot is present) contact a service technician immediately. Improper combustion can cause carbon monoxide buildup, which is potentially fatal!

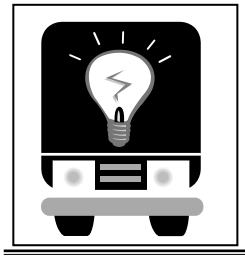
**Maintenance and Safety Tips for the Propane Range:**

- Burner flame should be a blue color, indicating complete combustion. If not, have the unit serviced by a qualified technician.
- Do not cover the oven bottom with foil. Air circulation will be restricted.
- Never use gas ranges or ovens for heating purposes.
- Always have pot handles turned inward.
- Ensure children understand never to turn or play with the knobs on the front of the propane gas range.




*While dry camping this solenoid will draw .66 Amps .66x24 hrs. per day = 15.84 Amps each day.*

## ~ NOTES ~



# Electrical Systems - House

## section 8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## ELECTRICAL HOUSE - INTRODUCTION

The motorhome 120/240 Volt AC system can be operated from three different power sources: shore power, the on-board generator or the inverter/converter. Shore power is the most efficient and should be used whenever possible. The on board generator can be used when shore power is unavailable. The inverter/converter supplies silent AC power using the house batteries of the motorhome. This source has limited AC power output and should be used sparingly.

Two different sources supply the main AC circuit breaker panel with power: the 50 Amp shore power cord or the on board generator. The power source used is selected automatically by an automatic electrical switching device known as a transfer switch. The inverter/converter supplies AC power to the sub-panel.

**WARNING: The electrical system is engineered and tested for complete safety. Circuit breakers and fuses protect the electrical circuits from overloading. If you plan modifications or additions to the electrical system, we strongly recommend consulting your dealer for assistance to ensure continued integrity and safety of the electrical system. Please note that any modifications may void the warranty.**

### *Shore Power*

The motorhome is equipped with a shore power cord. The electrical cord connects the motorhome to outside electrical services. Shore power service is the most efficient source of electrical power. Use this as the primary power source. The plug end of the shore power cord is 50 Amp 220 Volt. Many facilities are equipped with this power service. When this type of power service is not available electrical adapters will be required to allow a proper and safe connection to the electrical service supply.

**NOTE: In instances when 50 Amp shore service is not available, care will have to be used when operating the appliances and using the outlets so the shore power service will not be overloaded.**

### *Generator*

The generator can be selected for use when AC shore power is not available. The generator maximum amount of output power, measured in watts, is calculated at an elevation of 500 feet above sea level. This figure will decrease slightly with a higher altitude. Ambient temperature also effects total maximum output. The amount of AC electrical load applied to the generator determines fuel consumption.

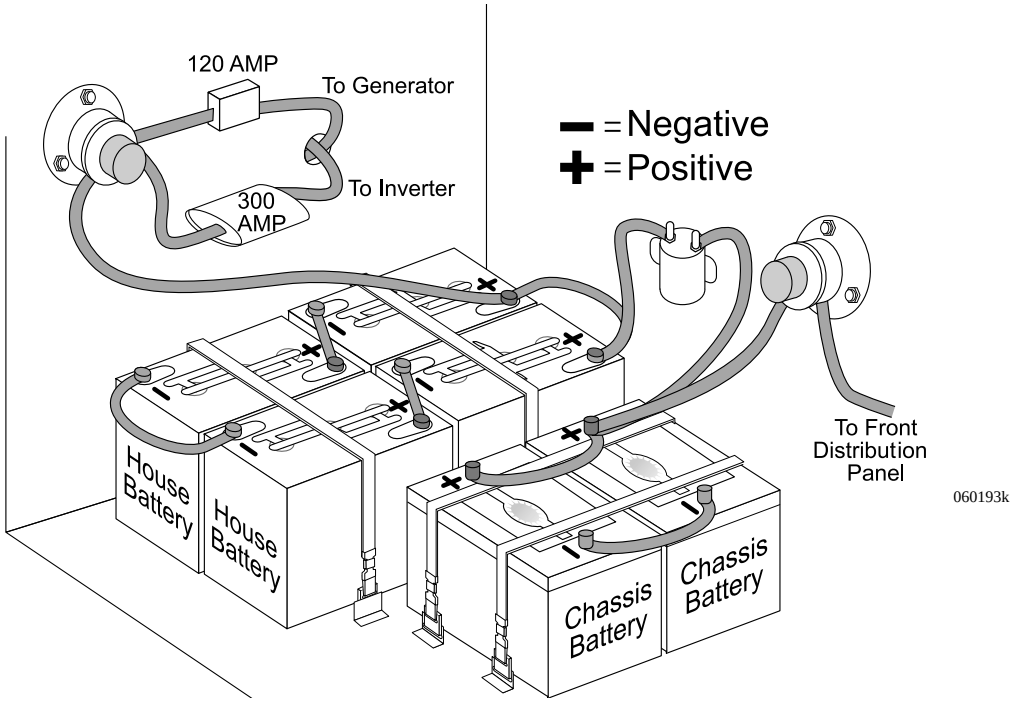
### *Inverter/Converter*

The inverter/converter can be used for silent AC power if shore power is not available, and using the generator is not going to be selected as a secondary power source. This device has limited AC power output, measured in watts. It operates only selected appliances and outlets. The inverter/converter is two components in one. First is as an auxiliary 120 Volt AC power source that uses 12 Volt DC house battery power to invert to 120 Volts AC. The second function of the inverter/converter is to use 120 Volts AC power, supplied from either shore power or the generator, and convert it to 12 Volts DC power to recharge the batteries. When dry camping, the inverter/converter may be used to supply power to selected outlets.

---

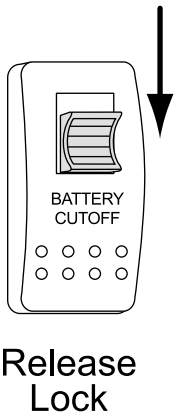
### BATTERY DISCONNECT - HOUSE

The main battery disconnects are located in the rear curbside battery compartment. In the compartment are a pair of battery disconnects: One for the chassis batteries and the other for the house batteries. Turn off the batteries any time the motorhome is going to be stored and not in use. If possible, leave the motorhome plugged into an AC source with the battery disconnects on. This will help prevent the batteries from going dead. Use of the battery cut-off switch at the entry door will not turn off all DC electrical items. There are small “parasitic” loads that are present on both the house and chassis batteries. Some are federal mandate items, such as the LP detector. If the motorhome will not be used, or will be stored for more then 48 hours, it is recommended to turn the batteries off.



## BATTERY CUT-OFF SWITCH

The battery cut-off switch is located inside next to the entry door. This switch controls the 12 Volt DC power to the interior 12 Volt Panel and select front distribution panel. The switch locks into the center position preventing interior DC power from being accidentally turned on or off. When the switch is activated, power is supplied to all interior DC lighting and DC operated appliances. Some appliances will require both DC and AC power to operate, such as the roof air conditioner. This switch is helpful when dry camping and can be used to conserve house battery power. Refrigerator and inverter/converter operation are unaffected by the operation of this switch. When the interior house power is off, there are still parasitic loads on the house batteries and therefore is not a substitute for the main battery disconnect switch.



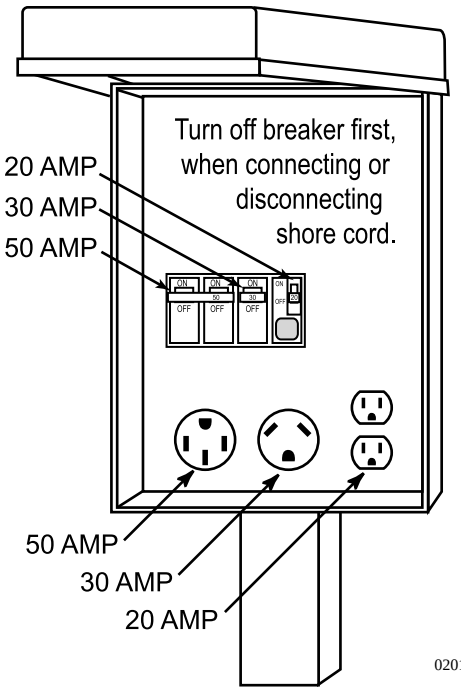

**To Turn the Interior Power On or Off:**

- Simultaneously push the spring-loaded lock down and push the switch.

**CAUTION: To avoid flash damage to electrical contacts, turn off the interior lighting before activating the battery cut-off switch.**

## SHORE POWER HOOK-UP

The power requirement for the motorhome is 50 Amp 120/240 Volt AC single phase. The shore cord is stored in the roadside compartment. If 50 Amp shore power service is available, all that is necessary is connect the supplied shore power cord. If 50 Amp service is not available, electrical adapters will be required.




**CAUTION: Avoid flash damage to the electrical system contacts. Before hooking up to shore power, starting the generator or using the inverter/converter make sure all the appliances are off.**

**WARNING: Keep fingers away from metal contacts of the shore plug end. Avoid standing in water when making electrical connections. Serious electrical shock and personal injury can occur. To avoid the risk of an electrical shock, turn the circuit breaker off for the power supply outlet before making the shore power connection.**

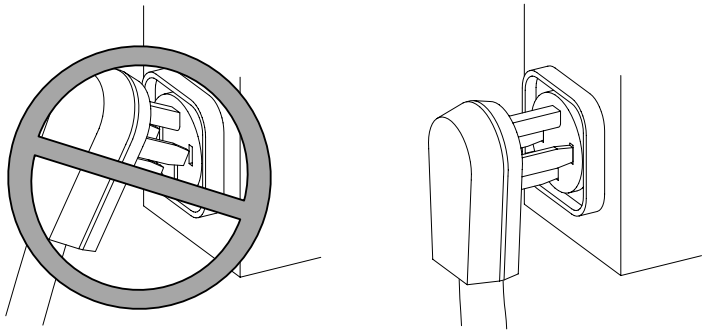
**Power Supply:**

Different amperage supplies vary greatly in the amount of available current.

- The continuous amount of current through a breaker or fuse is only 80% of its rated capacity.
- 50 Amp 220 Volt AC shore power service consists of two power supply conductors, a neutral and a safety ground. The 50 Amp breaker simultaneously limits each power supply conductor to no more than a short-term maximum of 50 Amps for each conductor. The 50 Amp 220 Volt service actually provides 80 continuous amps.
- Use care when hooked to anything less than 50 Amp shore service. Shore power service less than 50 Amps consists of one power supply conductor, a neutral and a safety ground. 30 Amp shore service is limited to 24 continuous amps. 20 Amp shore service is limited to 16 continuous amps.

**Plugging in the Shore Cord Power Supply:**

- Located in the roadside compartment is the shore power cord.
- Manually extend a sufficient amount of cable to reach the power supply. If 50 Amp service is not available, install the proper electrical adapter(s) to the cord.
- Always turn off the shore power breaker to the power supply before connecting or disconnecting the shore cord. This will prevent an accidental shock and flashing of electrical contacts.
- After the connection is made, turn the shore power breaker on. The transfer switch should make an audible click.
- Go inside the motorhome to verify AC power is available. The AC In light on the inverter/converter remote panel should be lit and the microwave display should be lit.

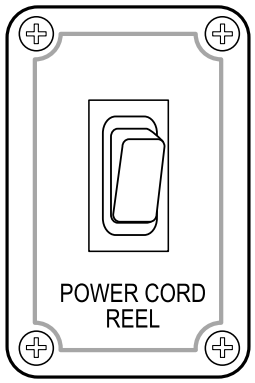


Incorrect Method Correct Method 060212

After connecting the motorhome to shore power, wait approximately one minute for the inverter/converter or converter to "stabilize" charging of the batteries before starting air conditioners or other large AC loads. In the instance 50 Amp service is not available, use caution not to overload the supplied shore service breaker. Operate appliances and outlets in sequence rather than all at the same time.

**Disconnecting the Shore Cord:**

- Turn off all AC appliances. This will prevent accidental shock and flashing of electrical contacts when disconnecting.
- Turn off the shore power breaker.
- Grasp housing of electrical cord. Without touching electrical contacts, work cord out and away from socket.
- Straighten and clean cord. If equipped, press the powercord switch to retract cord. Assist and guide cord as it retracts.

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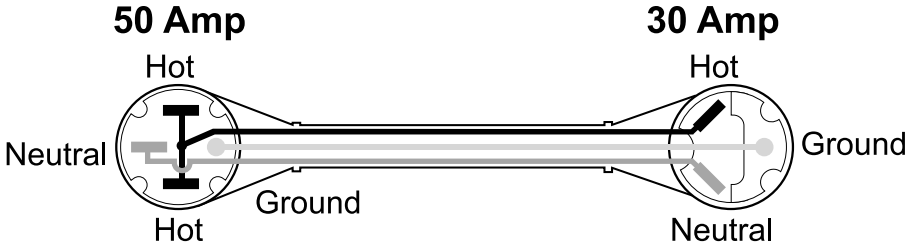
**Electrical Adapters:**

There are many different electrical adapters available to suit a variety of needs. Only UL approved adapters should be used. The most common adapter is a 50-30 Amp adapter. The type of connector adapts the 50 Amp shore cord to a 30 Amp shore power outlet. Always install the adapter to the cord prior to making the connection to the outlet.

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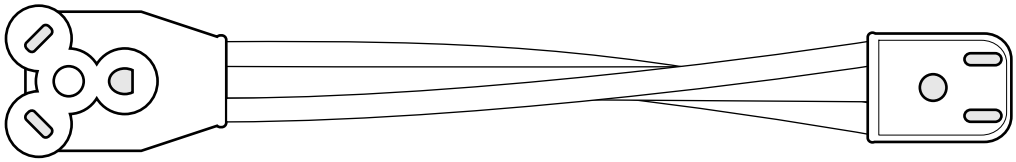
Another common adapter is a 30 to 20 Amp adapter. This type of connector adapts the 30 Amp shore cord to a 20 Amp shore power outlet.



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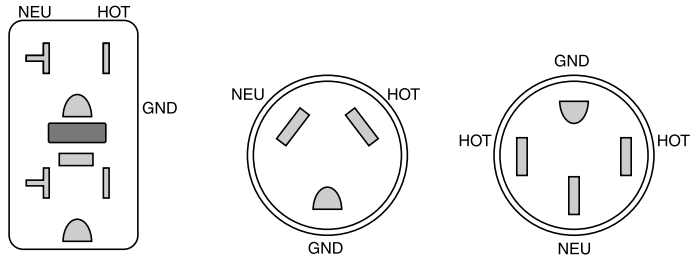
**CAUTION: If shore power service is limited to 15 or 20 Amps, use of light duty extension cords and electrical adapters will create a voltage loss through the cord and at each electrical connection. Line voltage loss and the resistance at each electrical connection can be a hazardous combination. Damage to sensitive electronic equipment may result!**

**CAUTION: Avoid the risk of electrical shock or component damage by disconnecting from shore power during electrical storm activity. Use the inverter/converter or start the generator if AC power is needed.**

**NOTE: Three types of shore power outlets most commonly used are shown in the illustration below.**

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15-20 AMP
120 VOLT

30 AMP
120 VOLT

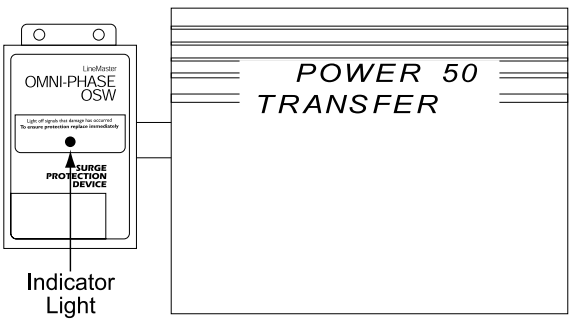
50 AMP
220 VOLT

## TRANSFER SWITCH

The transfer switch uses electronics to monitor voltage input for high or low voltage conditions. If the incoming voltage from the generator or shore power exceeds 138 Volts, or if voltage drops below 105 Volts, the transfer switch automatically disconnects the electrical service. This helps prevent damage to voltage sensitive equipment that can occur.

**Surge Protector:**

A surge protector with line sensor mounts to the transfer switch. The surge protector prevents the motorhome from receiving a sudden "spike" of incoming voltage. This may be from a lightning strike to the electrical utility during storm activity.

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When hooked to shore power or operating from the generator, the indicator on surge protector activates to indicate the surge protector is operating correctly. If the indicator light is not active, this indicates the surge protector is damaged and damage to the electrical system may have occurred.

**To Replace Surge Protector:**

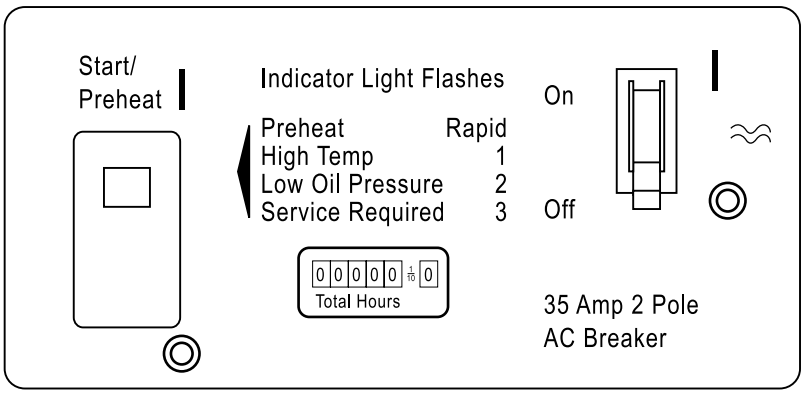
- Disconnect from shore power.
- Stop the generator and **do not** use the inverter/converter.
- Replace the surge protector and have the electrical system inspected by a qualified electrical service technician.

**NOTE: The shore cord is NOT electrically connected to the generator. When the generator is operating, the electrical contacts of the shore cord are note electrically energized.**

# GENERATOR
# 120 AC DIESEL

The generator is located in the front compartment of the motorhome. The generator can be started from the following locations:

- The generator remote switch on the dash.
- The generator control panel located on the generator.

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## *Generator Access*

**Open:**

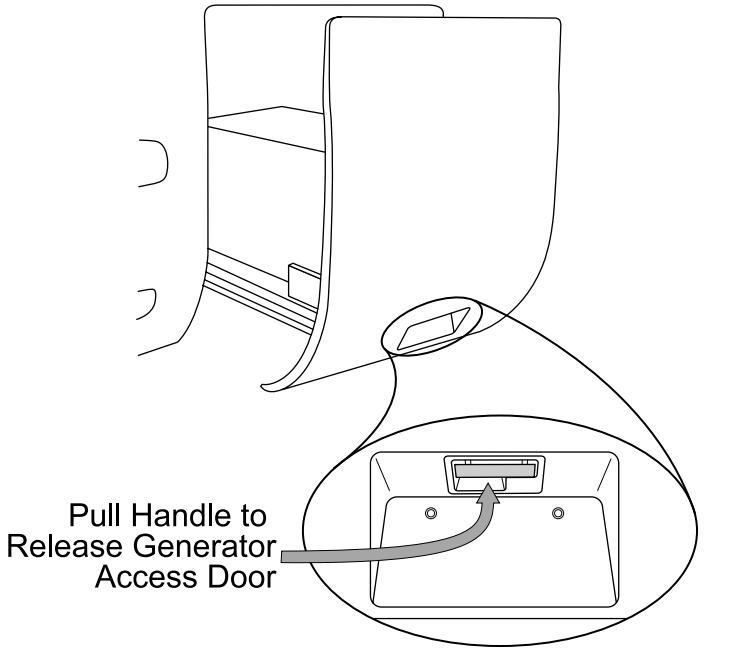
- To release the manual slide locking mechanism, pull the latch handle located within the license plate recess.
- Pull the generator door by the latch handle to extend the generator slide-out tray.

**Close:**

- Push the generator door until the slide locking mechanism latches.

**NOTE: Do not apply excessive force to unsupported fiberglass. The fiberglass can warp or break.**

**CAUTION: When moving the generator slide the generator exhaust pipe, located on the roadside under the first compartment bay, will move with the generator. The exhaust pipe can be hot after generator usage, be sure that the area is clear of debris and other objects before moving the generator slide.**

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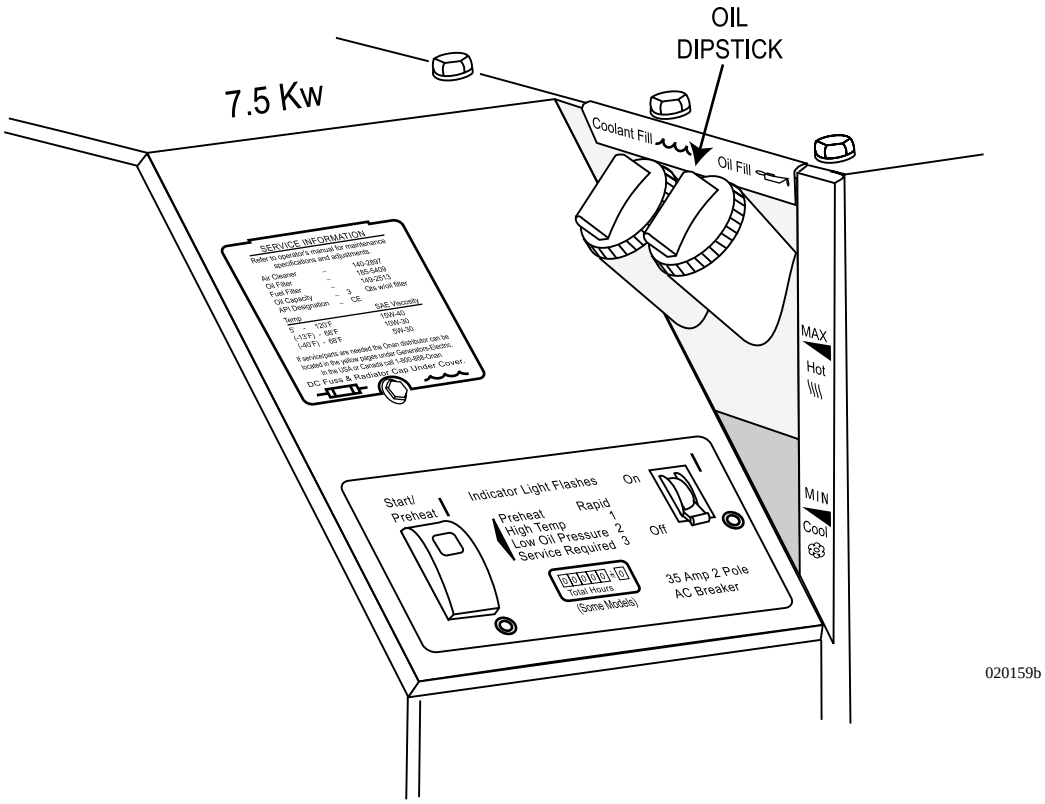
## Pre-Start Checks

Prior to the first start of the day perform a general inspection including oil and coolant levels. Keep a maintenance log on number of hours in operation since the last service. Perform any service or maintenance that may be due.

**Before Starting the Generator:**

- People and animals must be clear of hazards of electrical shock and moving parts.
- All appliances and other large AC electrical loads must be off.



## Starting the Generator

Push and hold control switch in START position until the generator starts. Release switch. On diesel models the control switch may flash up to 15 seconds, indicating engine preheat.

**NOTE: Diesel models may require priming. Hold control switch in the OFF position for one minute. Repeat if necessary. The diesel generator fuel pick-up tube is cut to approximately 1/4 tank so as not to run the main engine out of fuel.**

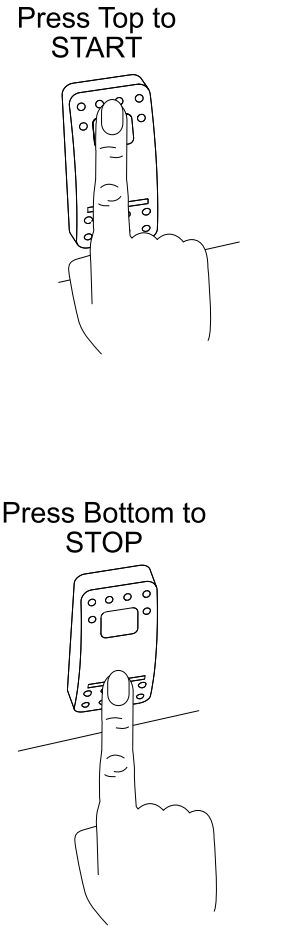
**WARNING: Excessive cranking can overheat and damage the starter motor. Do not crank the engine more than 30 seconds at any one time. Wait at least two minutes before resuming.**

**If the generator fails to start refer to the generator manufacturer's owner's manual.**

**WARNING: When the motorhome is parked, position the dash air conditioner vent control in the OFF position to prevent exhaust gases from entering the motorhome. The engine exhaust contains carbon monoxide, which is an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and/or death. Inspect the exhaust system thoroughly before starting the generator. Do not block the exhaust pipe or situate the motorhome where the exhaust may accumulate either outside, underneath, or inside the motorhome or any nearby vehicles. Operate the generator only when safe dispersion of exhaust can be assured. Monitor the outside conditions to be sure that the exhaust continues to disperse safely.**

**WARNING: When parking near high grass, be sure that the hot exhaust does not come into contact with the grass, it could be a fire hazard. Hot exhaust pipe or hot exhaust gases can ignite the grass.**

**CAUTION: An exhaust extension adds weight and stresses the generator exhaust system. Damage to the exhaust piping or exhaust manifold can result, allowing Carbon Monoxide gases to accumulate under or leak into the motorhome.**




## Stopping the Generator

Turn off the appliances and disconnect other AC loads being used. Allow the generator to run unloaded for at least one minute before shutdown. This will allow the engine to cool. Push and hold the control switch in the STOP position until the generator stops. Release the switch.

**NOTE: Diesel models require only a momentary stop signal.**

## Powering the Equipment

The AC output of the generator powers the motorhome air conditioners, the AC inverter/converter, all appliances and items plugged into the electrical outlets of the motorhome. The number of electrical appliances that can be operated at any given time depends upon how much power is available from the generator. If the generator is "overloaded" or a short circuit causes "over current," the generator will shut down or the circuit breaker will trip. If power consumption, in total, exceeds the generator power output, compensation for temperature and elevation may be necessary. Operate some appliances in sequence rather than all at the same time.

**NOTE: The generator may shut down when it is loaded nearly to full power and an air conditioner (or other large motor load) cycles on. For a brief moment during start up an electric motor can draw up to three times the rated power. For this reason, it may be necessary to operate some appliances in sequence when air conditioners or other large motor loads are on.**

It is important to remember that air density decreases as altitude increases, causing the generator engine power to decrease. Power decreases at approximately 3% of the rated power each 1,000 feet (305M) of increase in elevation above sea level. It may be necessary to operate fewer appliances at the same time when the camping location is at a higher elevation. For example: 7500 watt generator at 5,000 ft. = 6375 watts net. Temperature also affects maximum output power. For example: At 120º F. a 7500 watt generator produces 6000 watts net.

**INFORMATION: The generator may shut down for reasons beside "overloads." A blink code may appear on the control switch. Refer to the manufacturer's manual to obtain an explanation of the codes.**

## Generator Fuel

When refueling there is always a possibility the fuel may be contaminated. Contamination of fuel affects the performance of the generator. Diesel fuel may contain water or a microbe growth (black slime). Propane, due to the refining process, may contain lightweight oil. Any contamination of fuel greatly reduces the total output of the generator and may cause erratic AC output.

| AVERAGE FUEL CONSUMPTION | LP-GAS 6500 WATTS (lbs./hr.)* | DIESEL 7500 WATTS (gal./hr.) |
|---|---|---|
| No Load | 2.6 | 0.13 |
| Half Load | 4.5 | 0.49 |
| Full Load | 7.3 | 0.96 |

*4.2 lbs. = one liquid gallon of LP-Gas.

**NOTE: The motorhome manufacturer does not cover damage to the generator caused by fuel contamination, or to appliances due to erratic AC voltage.**

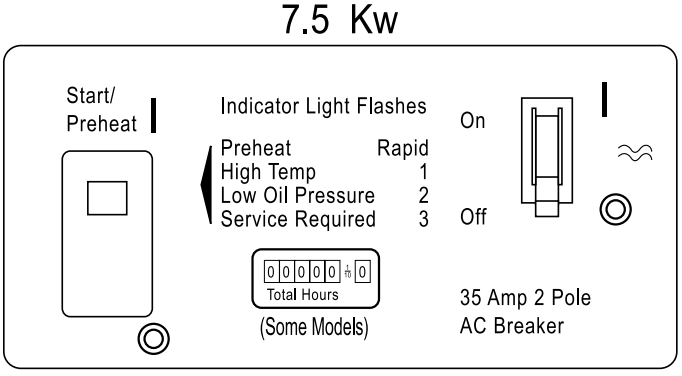
## Resetting the Circuit Breaker

If a circuit breaker trips in the main AC breaker panel, or on the generator control panel, there may be a short circuit or too many loads.

**NOTE: The generator will continue to run after a circuit breaker trips.**

If a circuit breaker trips, disconnect or turn off as many loads as possible. To reset the circuit breaker, switch the circuit breaker to **OFF**; then switch back to **ON** to reconnect the circuit. If the circuit breaker immediately trips, the electrical distribution system has a short or the circuit breaker is faulty. Call a qualified electrician. If the circuit breaker does not trip, reconnect a combination of loads that will not overload the generator or cause the circuit breaker to trip again. Remember to compensate for elevation and temperature changes when reconnecting loads.

**NOTE: An appliance or load may have a short if it causes a circuit breaker to trip after reconnection. DO NOT continue to reset breaker. Have the problem corrected before resuming operation.**

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### Generator Exercise

If use of the generator is infrequent, “exercise” the generator once a month by operating it at approximately half the maximum rated output for two hours. This “exercise” will help promote better starting, more reliable operation and longer engine life. This procedure drives off moisture, relubricates the internal engine parts and replaces the old stale fuel with a fresh supply. It also promotes removing oxides from the electrical switches and contacts.

**NOTE: Avoid short run periods of the generator set. Run the generator set under a load for a minimum of one-half hour.**

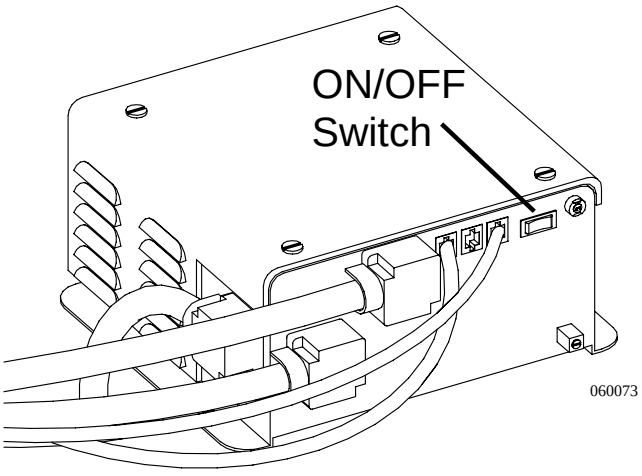
## INVERTER/ CONVERTER

Use the inverter/converter when shore power is not available and the generator is not going to be used as the secondary AC power source option. To turn the inverter/converter on or off, momentarily depress the inverter ON/OFF button on the RC7GS remote. This will supply silent AC power to most receptacles, the television and microwave. It is important to remember that use of the inverter/converter will greatly increase house battery power consumption. Turn off the inverter/converter when not in use to conserve house battery power.

The inverter/converter is programmable with many features. The RC7GS remote control is used to change or add features and set variable parameters. Inverter/converter remote may also be used to start and stop the generator.

**Some of the Features Available Are:**

- Automatic generator start.
- Fully adjustable battery charge rates.
- Adjustable fuel gauge cut-out.
- Adjustable charging curves for different battery types.
- Adjustable power sharing.
- Meters Menu.



### RC7 GS Remote

The remote control liquid crystal display (LCD) and light emitting diode (LED) lights are used for operation status conditions. The LED lights give inverter/converter status, charge status, battery condition and error indications at a glance. The LCD screen displays charging cycle status, various meter readings, automatic generator operation status, programming field and error messages. The inverter/converter ON/OFF button turns the inverter on or off. This button can be used to start or stop the generator. The up or down arrows are used to scroll up or down through the operations field or meters field. The up arrow is used to toggle between operations and meter fields. Pressing the up and down arrows simultaneously accesses the programming field. The settings button is used to set or scroll through a particular programming field.

**NOTE: The main switch on the inverter/converter is to remain ON.**

### Stand-by Operation

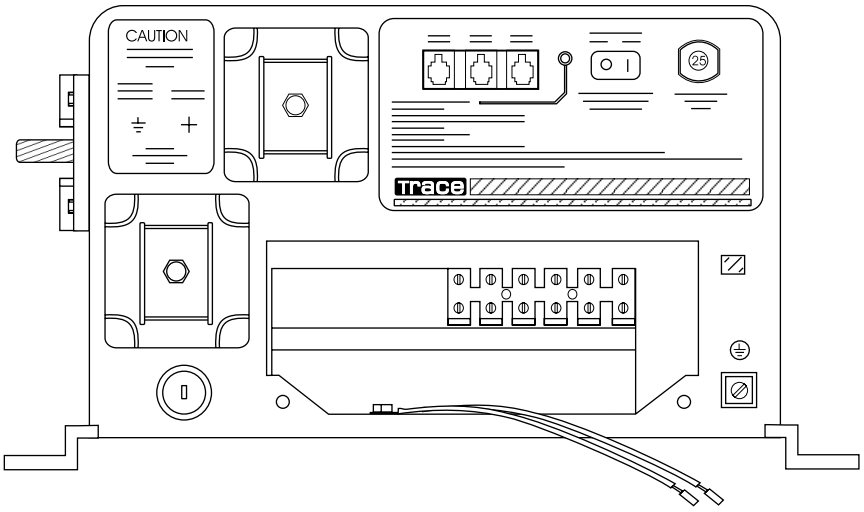
The inverter/converter can be set-up for stand-by power operation. If AC input is discontinued to the motorhome, the inverter will automatically provide AC power. When AC power is resumed, the inverter/converter will automatically return to "STAND-BY" mode. The STAND-BY mode is activated by momentarily pressing the "**ON/OFF**" inverter/converter remote button while the motorhome is plugged into shore power or operating from the generator. Stand-by mode is indicated by the inverter/converter status light blinking. Battery charging is not affected by stand-by operation.

**NOTE: Remember to disable stand-by operation when not in use. House battery power may be accidently consumed and could run down the house batteries.**

## Battery Charging with the Inverter

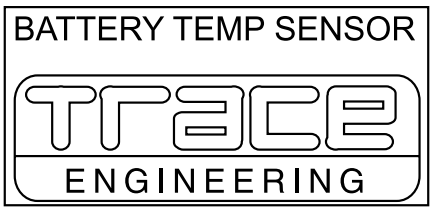
Whether hooked to shore power or operating from the generator, the internal battery charger of the inverter/converter will automatically charge the batteries when AC power is supplied to the input terminals of the inverter/converter. The time it takes to charge the batteries to a full state of charge varies greatly. It can take several hours, or even days, depending on the inverter/converter set-up parameters and actual state of charge of the batteries. The inverter/converter uses a three stage charging cycle. The first stage is “bulk” charge. The bulk charge will bring the DC voltage up high, initially between 14.2-14.6 Volts. Actual bulk charge voltage depends on which battery type has been selected in the programming menu. The bulk charge cycle is controlled by voltage and current. The length of time the inverter/converter is in the bulk charge cycle will vary with the state of charge of the batteries. The second stage is the “absorb” cycle. The battery voltage in the absorb cycle is the same as the bulk charge cycle between 14.2-14.6 Volts. The length of the absorb cycle is a timed event determined by the inverter/converter. The final charging stage is the “float” charge cycle. Approximately 80% of the charging cycle has been completed by this time. The float charge voltage is generally around 13.3-13.7 Volts. The last 20% of the charge cycle typically takes the most amount of time.

**NOTE: The inverter/converter will charge the batteries with AC power applied regardless of remote status.**



## Battery Temperature Sensor

The inverter/converter uses a battery temperature sensor to adjust charge voltage. When the battery temperature rises the BTS will send this information, registering as counts, to the inverter/converter to decrease charge voltage. Voltage compensation with temperature variation is necessary to keep charge voltage at optimum figures. The BTS should be adhered to a house battery. If the BTS is unplugged, the inverter/converter default setting of 77º F/25º C is used as the charge temperature reference point.

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## Pass-Through AC Power

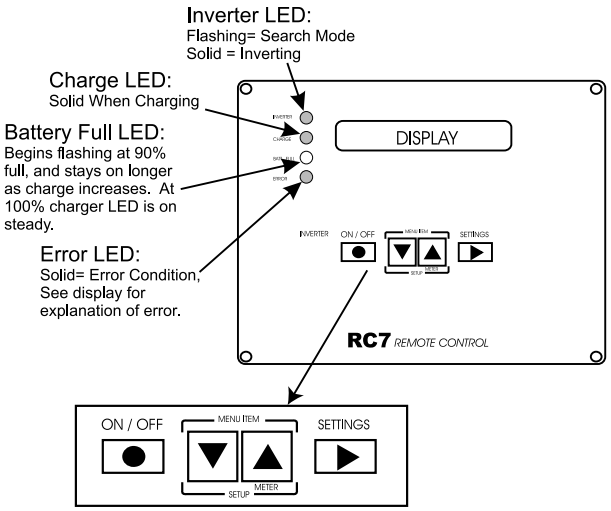
Incorporated in the inverter/converter is a double pole “pass-through” relay which trips when AC power is supplied to the input terminals. This will transfer AC power through the inverter/converter to a sub panel supplying AC power to outlets and appliances. When AC power is supplied to the inverter/converter, the internal battery charger will “ramp up” battery charging voltage. A 20 second time delay allows charge stabilization before pass through AC power is supplied to the sub panel.

## Operating Display

This field is a general overview of system status. This is the primary screen of the RC7 remote.

**Field Areas:**

- **Main Menu Display.**
- **Waiting for AC:** System inactive waiting for AC power to be supplied.
- **Inverting:** Unit is inverting.
- **Charging Cycle Status:** Bulk, Absorb or Float mode.
- **Battery State of Charge:** Based on the Fuel Gauge Cutout setting. It may be displayed in percentages or as a fuel gauge.
- **Time Left To Run:** This evaluates the battery reserve capacity at current operating load. It is based on the Fuel Gauge Cutout and Battery Bank Capacity settings.
- **Time Left To Charge:** Estimated time left to charge batteries to full state of charge. This is based on Fuel Gauge Cutout and Battery Bank Capacity settings with current battery voltage.
- **Generator Start/Stop:** Use inverter/converter on/off button to remotely start the generator or to override automatic generator start feature for manual operation. This feature is available to use without altering automatic generator start programming.



## Meter Menu

This is an alternate field of main system status. To access the various meters available, depress the **UP ARROW** button and hold for five seconds. The RC7 GS remote will beep. Release the button. The Avg Shunt Amps will be displayed.

**Field Areas:**

- **Avg Shunt Amps:** This measures the DC current either charging or discharging. Most of the house DC current usage is monitored by the inverter/converter.
- **Battery Voltage:** This monitors the house battery voltage.
- **Inv/Chg Current:** This measures the AC current usage when the inverter/converter is charging.
- **Inverter/Converter Output VAC:** This monitors the AC output voltage while the unit is inverting.
- **AC Input Amps:** The inverter/converter uses a double pole pass through relay. This measures current consumption through the Hot 1 terminal.
- **Battery Temperature:** This monitors counts of the battery temperature sensor (BTS). Counts are measured impulse which the inverter/converter uses to calculate the battery case temperature. The charging voltage is adjusted to optimum values.
- **Xformer Temp:** This monitors the transformer temperature which is measured in counts. Higher count readings are registering lower temperatures.
- **FET Temp:** This monitors the Field Effect Transistor temperature which is measured in counts.
- **Est Batt Cap:** This estimates the battery bank capacity in amp hours (Ahrs). Charging and discharging on a cyclic basis will give an approximate indication of the battery capacity in amp hours. Observe the reading and multiply by eight to obtain an approximate reserve capacity. This figure is only approximate and will change with cyclic use.

## Programming the RC 7 GS

**To Enter Programming Mode:**

- Press and hold the Set-Up buttons (up and down arrows) for five seconds. The RC7 GS remote will beep.
- Release the buttons. The programming mode has been entered when the Search Sense is displayed.
- Use the Menu buttons (up and down arrows) to scroll though available field settings.
- Use the Settings button (arrow pointing to right) to scroll through available settings for selected field.

**To Exit the Programming Mode:**

- Allow 20 seconds to elapse from the time the last key is pressed. Program changes are then accepted by the inverter/converter in non-volatile memory.
- Momentarily pressing the set-up buttons (up and down arrows) exits the programming menu. Program changes are automatically saved in non-volatile memory.
- The inverter/converter is now ready to use. “Waiting for AC” will be displayed or if any program changes were made with AC applied, one of the three stages of the charge cycle will be displayed.

**NOTE: Non-volatile memory is a permanent programming change accepted by the inverter/converter. Turning the main battery disconnect switch off does not affect programming changes. Only the inverter clock time and automatic generator start/stop programming will be erased.**

## *Adjustable Field Setting*

**Search Sense:**

The inverter/converter searches for an AC load. For example: While inverting, AC loads of various amperage may be applied. These loads may range from a few watts to several amps. Search Sense is the cut-in point which the inverter/converter will exit the “sleep mode” and start inverting at a standard output voltage. The Defeat setting allows the inverter/converter to be at a constant standard output voltage. When changing the Search Sense value, AC loads must be evaluated for proper inverter/converter operation.

**Auto LBCO:**

The Automatic Low Battery Cut-off may be turned on or off. These settings allow the inverter/converter to use available DC voltage to a set value while inverting. Turning the LBCO **ON** stops the inverter/converter when the battery voltage drops to 10.5 Volts DC. Turning the LBCO **OFF** stops the inverter/converter when the battery voltage drops to 8.5 Volts DC. This leaves the batteries discharged, but not completely dead.

**Battery Capacity:**

The battery bank capacity is adjustable in Ahrs (amp hours). These settings change charging curves and the length of time of the charging cycles. The range is from 125 Ahrs to 1,000 Ahrs. Select the closest Amp Hour rating for the house battery bank capacity. The auto setting will "learn" the battery bank size by user characteristics. For example: Discharging and recharging the batteries on a cyclic basis. The inverter/converter takes several charging cycles to "learn" an individual battery bank size. When the main battery disconnects have been tuned off, the "learning" curve is erased.

**Battery Type:**

Many types of batteries with different chemical compositions are available. Different chemical types require different charging characteristics at different voltages. Selection of available battery types are:

• AGM (absorb glass matte) • Gel Cell • Liquid Lead Acid

**Charge Rate:**

Charge rate is adjustable from 10 to 100%. This feature may be used in many different ways. Selecting a lower percentage charge rate lowers the inverter/converter AC battery charger's current consumption. It will take longer to charge batteries but will leave user a few extra AC amps when operating from a limited AC power source.

**Shore Power Amps:**

This is a load shedding feature of the battery charger in the inverter/converter. For example: Shore Power Amps set to 30 amps will decrease the AC current available for the internal battery charger's use, as pass through AC current value approaches 30 amps. Lowering shore power amps will limit the available AC current for the internal battery charger's use. This is adjustable from 5 to 30 amps, in 5 amp increments.

**RC7 GS Setup:**

This option allows the user to select the desired screen display. The Last Key will leave the menu active with the last status viewed on the display. The Rolling Display will continue to scroll through the active menu status display. Power Saver allows the display to "sleep" after viewing the status. Touch any key to "awaken" the RC7GS remote, then press the desired key.

**LCD Contrast:**

This changes the display screen contrast. Six settings are available. Lighter contrast settings may leave the screen difficult to see in a bright atmosphere.

**External Shunt:**

The inverter/converter monitors both AC and DC current values, whether charging or discharging (figures are approximate), by using internal or external shunts. A shunt monitors partial current consumption, allowing the majority of current to pass on heavier conductors. Programming shunt selection affects which shunt the inverter/converter is using to monitor DC current values. Single inverter/converter systems use their internal shunt to monitor system DC current values. When programming single inverter/converter systems select External Shunt None.

**Fuel Gauge Cutout:**

Battery chemistries and types have different static voltage readings at different states of charge. The battery voltage may be used to determine an approximate state of charge for that battery type and chemistry. The Fuel Gauge Cutout voltage is a reference point the inverter/converter uses to determine a battery with no reserve capacity amp hours remaining. Changing the value of the Fuel Gauge Cutout will affect the fuel meter, automatic generator start and stop points if set by SOC (state of charge) and time left to run or charge. The Fuel Gauge will read 0 when and the Fuel Gauge Cutout program voltage reaches the 50% SOC battery voltage.

**NOTE: The remaining field items are used to program the Automatic Generator Start parameters.**

## *Automatic Generator Start*

The house batteries operate most of the interior lighting and most appliances. As the house battery power is consumed the reserve battery capacity diminishes. The inverter/converter can be programmed to automatically start and stop the generator to keep up with the drain on the house batteries. All field reference points are house battery indications or conditions. A wide field of parameters may be chosen for the generator start and stop points. These points may be set in three categories:

1. House battery voltage.
2. State of charge (SOC). (The Fuel Gauge Cut-out affects SOC.)
3. Absorb or Float point of the charge cycle.

**For Example:**

The inverter/converter can be programmed to start the generator when house battery voltage falls to 11.4 Volts. As the battery voltage rises, the inverter/converter can be programmed to stop the generator when the house battery voltage obtains a percentage of state of charge (SOC). When selecting the field reference points make sure that the start and stop points are spread apart.

It is possible to set parameters too close, causing short cycling of the generator. The menu will display the status of the generator while pending generator start. The generator must be operating correctly for proper automatic generator start and stop operation.

**NOTE: If the generator is started manually from any remote switch other than the RC7 GS remote while automatic generator start feature is enabled, the generator will shut down due to field parameter settings.**

To override the automatic generator operation so that the generator may be operated manually, use the RC7 GS remote Inverter/converter button to start or stop the generator. This is done using the **UP** or **DOWN** arrows while in the main menu until Generator Start/Stop: Press (on/off) is displayed. The display will inform the user of the generator's status. The generator will need to be manually stopped.

To enable the automatic generator operation, the programming mode must be entered. Before any field reference points can be established, the clock must first be set. The clock set field is the last item in the programming menu.

**Clock Set:**

The clock is a 24 hour clock. If the display reads 00:01, it is 12:01 a.m. If the clock reads 13:00, it is 1:00 p.m. The hours and minutes will flash, alternating every eight seconds. Use the Settings button to advance hours or minutes. **The clock time and the generator start/stop programming will be erased whenever the main battery disconnects are turned off.**

**Generator Start:**

Selecting a state of charge (SOC) generator start point is affected by the Fuel Gauge Cutout voltage setting. SOC start points are between 40-60 percent, or the generator may be programmed to start at a specified voltage. The manual start disables the automatic start.

**Generator Stop:**

Selecting a state of charge generator stop point is affected by the Fuel Gauge Cutout voltage setting. SOC stop points are between 90-99 percent, or the generator may be programmed to stop at the Absorb or Float point of charge cycle. The manual off disables the automatic stop.

**Begin Generator Quiet Time or End Generator Quiet Time:**

The automatic generator start feature may be programmed to operate only at certain times in the 24 hour clock period. Example: The user wants the automatic generator to start operation at 10:00 a.m. and stop operation at 7:00 p.m.

**End Generator Quiet Time:**

This is the time which the automatic generator operation is to begin. Using the example time above, the 24 hour clock would be set to 10:00 hrs.

**Begin Generator Quiet Time:**

This is the time which the automatic generator operation is set to stop. Using the example time above, as a reference, the 24 clock would be set to 19:00 hrs.

**NOTE: If the generator started from the automatic start program and has not reached the automatic stop set point when quiet time begins, the generator will stop and "Gen Quiet Fault" will be displayed.**

**Select Generator:**

The inverter/converter has the capability to operate more than one generator manufacturer type. The selections are:

- Onan Quiet Diesel (Type used in Holiday Rambler units).
- Power Tech, two and three wire.

**To Disable the Automatic Generator:**

- Set Generator Start and Generator Stop points back to manual **ON/OFF** positions.
- Switch off the house and chassis main battery disconnects to erase the clock time and generator start/stop programming.

## *Equalize Charge*

Batteries can sulfate over time. When this occurs some of the sulfuric acid has adhered to the lead plates of the battery and cannot enter the electrolyte solution though normal battery charging. A battery with a low concentration of acid in the electrolyte will effect the battery's performance. Sulfation can occur when a battery is stored in a discharged condition or when a battery is continually cycled below a 50% state of charge. An indication a battery has sulfated is when the inverter/converter is in float charge and the hydrometer reading has stabilized below a full state of charge (approximately 1260). An equalize charge cycle may promote the acid to leave the lead plate and enter the electrolyte solution. This is done by charging the battery at a slightly higher than normal voltage for a short duration. The equalization cycle will charge the batteries at approximately 15.5 volts for three hours. To maximize the results from an equalize charge initiate the

equalize cycle after the batteries have entered float charge. Only liquid lead acid or absorb glass matte (AGM) type batteries should be equalize charged. Other battery types can be damaged if equalize charged. Monitor the electrolyte solution closely when equalizing a liquid lead acid battery. A batteries "healthy" cell(s) can be damaged if overcharged. High DC charge voltages can also damage voltage sensitive electronic equipment. Several precautions should be used when performing an equalize charge:

- Only equalize charge batteries with the motorhome in a well ventilated area, preferably outdoors. Liquid lead acid batteries produce explosive hydrogen gas when charging. Extinguish all flames and other sources of ignition.
- Secure the battery compartment door in the open position. Extend battery trays to the full open position when equalize charging.
- Remove the liquid lead acid battery caps during the equalize charge cycle. AGM battery caps are not removable and may void the battery's warranty if removed.
- A liquid lead acid battery will consume water at an equalize charge voltage. Fill battery cells with distilled water before beginning an equalize charge cycle. Do not overfill the battery cells. Overfilled battery cells will spatter excess electrolyte.
- Protect all painted surfaces from any electrolyte solution which may spatter during equalize charging. If the electrolyte solution spatters on the exterior painted surface rinse immediately using large quantities of water.
- Turn OFF the battery cut-off switch located at the entry door.
- Remove the fuses from the solar panel charge leads.
- Observing the polarity, disconnect the 12 Volt DC supply from the refrigerator. Access supply leads through the outside refrigerator compartment. Tape the positive lead to prevent a short circuit.
- Mark the specific location then disconnect the wires from the battery maintainer.
- Avoid operating any electrical equipment while in the equalize charge cycle.

**To Equalize Charge:**

- Press and hold the Settings button on the remote (arrow pointing right) for six seconds. Charge light will flash rapidly and "System Status: Equalize" will appear on the screen. The inverter/converter will run the equalize charge cycle for three hours.

**To Exit Equalize Charge:**

- The equalize charge cycle may be discontinued at any time during the charge cycle. Press and hold the settings button for six seconds. The inverter/converter will display "System Status: Absorb" for thirty seconds then switch to float charge.

- Allow the batteries to cool for approximately three hours. Check the electrolyte solution with a hydrometer. Avoid overcharging the battery, this can damage healthy cells.
- Add distilled water if necessary. Install battery caps. Use large quantities of fresh water to rinse the entire battery compartment and surrounding area.
- Install fuses to solar panel charge leads.
- Observing polarity, hook the 12 Volt DC supply leads to the back of the refrigerator. Do not reverse polarity. Damage to the refrigerator circuit board can result.
- Hook up the battery maintainer. Be sure the wires are connected to the correct location.

**CAUTION: Never equalize charge a frozen battery.**

**WARNING: Liquid lead acid batteries produce highly explosive hydrogen gas when being charged. Extinguish all flames and other sources of ignition. Never smoke around batteries. Danger of explosion, fire, property damage, serious personal injury or death can result!**

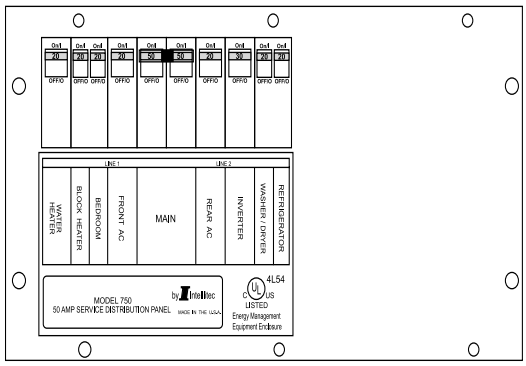
## *Re-Booting the Inverter*

The remote is used to program or turn on or off the inverter/converter. The RC7 GS remote is a display only. All the programming information is retained in the inverter. If the inverter exhibits unusual symptoms or behavior such as not responding to commands or displaying erroneous error conditions, “re-booting” the inverter/converter may alleviate these symptoms.

**To Re-boot the Inverter/converter:**

1. Remove AC power from the inverter/converter by disconnecting shore power and/or shutting the generator off.
2. Turn the main switch on the inverter/converter to the OFF position.
3. Switch house and chassis main battery disconnects to the OFF position.
4. Wait 30 seconds, this allows time for capacitors to discharge.
5. Switch house and chassis main battery disconnects to the ON position.
6. Turn the main switch on the inverter/converter to the ON position.
7. Connect the shore power cord or start the generator.

## DISTRIBUTION PANEL (50 AMP)

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The AC distribution panel is located in the bedroom. The main AC panel 120 Volt circuit breakers receive power from the transfer switch, which is powered by either shore power or the on board generator. Power is introduced into the panel to the 50 Amp MAIN breaker first, followed by power being fed into the individual branch circuit breakers. The panel label describes the breaker layout and the item, outlet or appliance to which they pertain.

**WARNING: This panel contains high voltage which can cause serious injury or death. Before beginning any work or testing procedures involving the electric panels, or any of the branch circuits, be sure the motorhome is unplugged from shore power and the generator is not running. Certain testing procedures can require the AC power to be on. Only qualified personnel or personnel with electrical backgrounds should attempt any testing procedures.**

### *Circuit Breaker*

Branch circuit breakers supply AC power to the different items or “loads.” An electrical load is any item or device that will use current when supplied with an electromotive force. Should a breaker “trip” from over current use, or a short circuit condition, the load to which the breaker is supplying the electromotive force should be reviewed or disconnected to determine the cause of the trip. If no cause is found, or not readily apparent, reset the breaker by toggling the breaker to the OFF position, then back to ON. Should the breaker trip again after the load is reapplied it may indicate a fault with that particular load. Do not continue to reset breaker until the problem has been diagnosed and corrected.

Breaker current ratings are current set points in which the breaker is designed to operate. The internal configuration of the circuit breaker is designed to trip when excess continuous current is drawn through the breaker. The trip action of the circuit breaker can occur within milliseconds due to the speed at which electricity can travel. Breaker ratings are set to operate on a continuous load at 80% of the breaker’s rated capacity and handle loads in excess of their rating for short periods of time. This designed set point is when an inductive load is applied, such as when an electric motor turns on. As the motor starts to spin, current consumption may momentarily exceed the rated capacity of the breaker. As the electric motor comes up to operating speed the electric motor’s current consumption will fall. The AC current load then falls back into the breaker’s rated 80% set point. This electric principle should be kept in mind when using anything other than 50 amp shore service and using appliances with electric motors. When using outlets care should be considered when applying loads such as electric motors, heaters, coffee makers, toasters, hair dryer or other large current consuming loads. If the current rating of a load is not known it is usually stated on most electrical items. The rating will either be in amps or watts.

Current ratings stated on electrical items will change slightly with voltage fluctuations. As voltage increases current consumption decreases. As voltage decreases current consumption increases. This may explain why in some instances items operated at borderline voltage to current tolerances may seem fine in one location but problematic in another.

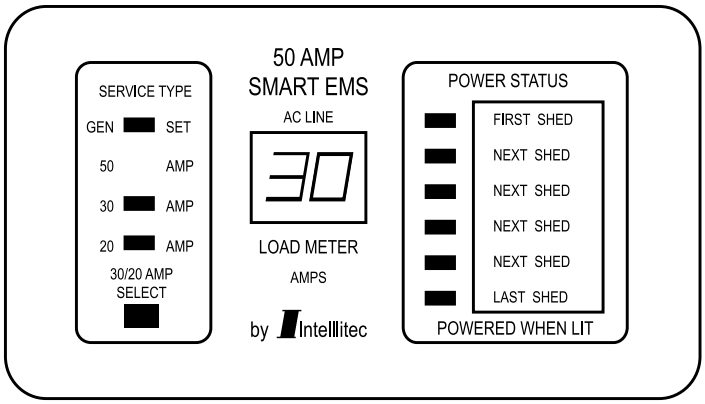
**NOTE: To calculate watts to amps simply divide the watt figure by the voltage of which the item operates from. For example: The electrical item is rated at 1370 watts. Divide that by the operating voltage of 115 volts which equals 11.913 amps. Use this formula to calculate load to current supply ratio.**

## *Energy Management System (Optional)*

The Energy Management System is easily identified by the remote display panel located inside motorhome.

The 50 Amp Smart EMS consists of two elements: the display panel and the bedroom distribution panel. The distribution panel, located in the bedroom, is a completely self-contained 120/240 Volt power distribution and energy management system intended to be used in recreational vehicles. It is housed in a sheet metal enclosure with removable front panel. It provides circuit protection for all the 120 Volt AC loads in the motorhome and a system of energy management to minimize the over-loading and tripping of circuit breakers.

**Circuit Breakers:** The distribution panel offers slots for eight single or dual, standard 120 Volt circuit breakers. Two of these breakers, located in the two center positions, must be a 50 Amp unit that act as a main input protection for each of the lines supplying the remainder of the branch breakers (up to 12).

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**Energy Management:** The 50 Amp Smart EMS automatically senses the

available power to the motorhome, determining whether it is connected to a 120 Volt AC - 30 Amp shore power source, 50 Amp shore power source or generator source. Depending upon available power, the EMS controls the operation of 6 possible loads as indicated on the distribution panel. These may be any type load, but are typically heavier loads; those whose use can be "postponed until a time when current is available for use. If the available power source is 120 Volt AC - 30 Amp shore power, the EMS attempts to keep the total 120 Volt current draw to less than 30 Amps.

**Operation:** If 120 Volt AC is not available at the distribution panel, L1 or L2 outputs, the system shuts itself off. This feature is intended to prevent the system from drawing current from the +12 Volt DC battery supply when not in operation.

When 120 Volt AC power is applied, the system automatically powers up and determines the nature of the power source.

If the generator is running, 120 Volt AC will be present at the distribution panel L1 and L2 inputs. In this mode the energy management feature is disabled and all control relay contacts are closed, energizing all of the controlled loads. The control module sends a signal to the display panel causing the load meter to display actual load current, the GEN SET service indicator to light and all power status indicators to light.

If 120 Volt AC is present at the distribution panel L1 and L2 inputs the system will assume that 120 Volt AC, 30 Amp shore power is available and the energy management feature will be enabled. **If only 20 Amp service is available the user must select the 20 AMP service mode by momentarily pressing the 20/30 Amp select switch on the Control Panel.** Initially, all relay contacts are closed and the total current is monitored. If the total current should exceed the service limit the system will turn off the first load in the shedding table, turning the loads off and calculating the amount of current that was removed, which is the value for that load. This value is placed in memory. If the current remains above the service limit, the system will turn off the next load in shedding table, again calculating the amount of current that was removed and placing this value, which is the value of that load, in memory. The system continues to turn off loads until the total current falls below the service limit or all of the six controlled loads have been shed. Through this process the system has "learned" the amount of current that each particular load draws. This feature compensates for the differences in current draw over a range of line voltage and ambient temperature, by re-learning the load each time it is turned off or "shed."

The 50 Amp Smart EMS now waits until the total current is lower than the service limit and enough current is available (as compared with the amount in memory for the last load shed) before turning that load back on. This assures that there is sufficient current to operate the load.

**NOTE: There is a two minute minimum delay period after a load is shed before the load will be turned on again to prevent air conditioners from turning on with a head pressure.**

**Three Hour Averaging:** The RVIA (Recreational Vehicle Industry Association) in conjunction with the NEC (National Electrical Council) have established rules regarding the rating of electrical systems and the use of energy management systems. One of these rules requires that, if any energy management system is used, the average total load current for the system over a 3 hour period be limited to 80% of the service rating. For that reason the 50 Amp EMS calculates the average running current for the system and, if it exceeds 80% of the service rating, the EMS sheds loads to reduce the average current below that limit.

For example, if a system operating under 120 Volt AC, 30 Amp service has been running at the 30 Amp limit for three hours, the EMS will change its shedding threshold to 24 Amps and turn off loads until the 24 Amp limit is attained. If the user selects the 20 Amp service mode this limit will translate to 16 Amps. Because the EMS calculates a running 3 hour average, if the average load current drops below the limit the system will restore power to loads based on their impact on the limit. If the system is in the averaging mode the decimal point at the lower right corner of the load meter display on the display panel will illuminate.

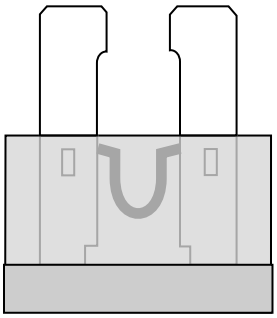
**Display Panel:** The display panel connects to the distribution panel located in the bedroom. Six power status LED's indicate power is applied to those loads. These LED's are on when the power is applied. The load meter has a two digit display to indicate the amount of current actually being drawn by all the appliances in the motorhome.

Four service type LED's indicate the source for 120/240 Volt AC power. Three of these sources are automatically detected and indicated by the EMS, namely: Gen Set Service, 50 Amp Service and 30 Amp Service.

**The 20 Amp service mode is not automatically detected and the operator must manually select the 20 Amp mode when 20 Amp service is available.** The service select button allows the current threshold to be set to either 30 Amps or 20 Amps, to match the incoming service.

## Fuses

| AMPERAGE | COLOR |
|---|---|
| 1 | BLACK |
| 2 | GRAY |
| 3 | VIOLET |
| 4 | PINK |
| 5 | GOLD |
| 7.5 | BROWN |
| 10 | RED |
| 15 | BLUE |
| 20 | YELLOW |
| 25 | CLEAR |
| 30 | GREEN |



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The 12 Volt DC fuses protect the low voltage electrical circuits. These fuses are a standard automotive type. When a fuse is "blown," the wire in middle of the plastic case will be burnt. A broken, bad or "blown" fuse must be replaced with a fuse of the same rating and type. Using a fuse with a different rating or type will defeat the circuit protection provided by that fuse and could result in damage to the motorhome's electrical system.

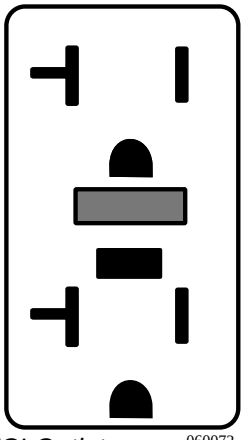
The 12 Volt fuses, located in this distribution panel, service the interior house lighting, ventilation fans, monitor panel, furnace and water heater. Should a fuse blow it will be evident by the broken metal strip located in the center of the fuse. Replacement fuses should be of the same amperage. If a higher rated fuse is installed it can damage the wiring. Blade style fuses are color coded to reflect their amperage rating. See chart for details. Fuse current set points follow much of the same electrical principle as the 120 Volt AC breakers. Using 12 Volt DC as the electromotive force can make it more susceptible to outside influences, such as corrosion from weathering or oxidation.

The large variety of applications this voltage can be used in makes it a diet staple for most of the recreational vehicle and automotive industries. The danger from shocks with this voltage is minimized, but can still occur. A good example is when a magnetic field is generated, then collapses when the power supply is cut. The result is a discharge that can reach tens of thousands of volts for a short time period. Care should be used when working with this voltage as current values can be quite high, like in the case of a battery cables.

Shorting a battery cable to ground with a battery at a reasonable state of charge can result in a fire or serious personal injury from a burn.

## GFCI Breakers & Outlets

A ground fault circuit interrupter "GFCI" can be found in two different types of applications. One type is incorporated in a breaker used in 120 Volt AC breaker panels, the other is incorporated in an outlet. The GFCI, whether it is a breaker or an outlet, offer two types of protection. One type of protection is from over-current or shorts. It also provides protection for persons against hazardous ground fault currents which can result in injury or death. Ground fault currents are currents that flow from the "HOT" or power terminal through a person to the ground. For example, touching a faulty appliance while standing on or making contact with an electrical ground such as a water fixture, bath tub or the earth. If the device has been properly installed it will offer protection against the type of shock that can result from faulty insulation, wet wiring from inside an appliance, or any device or equipment plugged in or wired to that circuit. The "ground fault" portion of the outlet or breaker uses sensitive electronics inside the outlet or breaker to detect a ground fault problem. The electronics monitor the normal current of power, flowing to the "hot" or black wire through the load (eg. a light bulb or appliance) and coming back on the "neutral" or white wire. If just a small amount of the current comes back on the safety ground wire the electronics will "trip" the breaker or outlet, stopping the flow of electricity. The amount of current it takes to trip the device from a ground fault varies slightly from the different outlet or breaker manufacturers (approximately 30 mils or less). Electrical shocks resulting from ground faults can be felt, but such a shock is considerably less than one without ground fault protection. People with heart conditions, or other conditions that make them susceptible to shock, can still be seriously injured. A GFCI outlet or breaker will not protect against shock from a normal current flow. For example, a shock from touching both metal prongs of an electrical cord or appliance while plugging it in.



GFCI Outlet 060072

**WARNING: If a breaker or outlet trips continually DO NOT continue to reset breaker or outlet until the problem has been identified and corrected.**

**NOTE: The ground fault outlet or breaker should be tested once a month to insure it is working properly. Use the "TEST" button on the outlet or breaker. It should trip with an audible "click." The breaker or outlet will not trip if no AC power is present to the device. If power is present and the device will not "trip," replace it before using that circuit.**

**NOTE: One mil is 1/1000 of one amp.**

### Tools of the Trade

One of the most widely used tools for testing a 12 Volt problem is the test light. Test lights come in a host of varieties, such as a light bulb with a probe and ground clip, to the more elaborate electronic ones that measure a wide scale of voltages and perform a variety of functions. A VOM or Volt Ohm Meter is used to perform a multitude of tests. It is generally used when exact values are needed for evaluation. These meters come in an analog or digital format. Either of these two testing tools may be used, depending upon personal preference. If a 12 Volt light is not working, the test light may be better suited for this. In the case of a charging system problem the meter may be the tool of choice. In any situation the testing tool is an invaluable piece of equipment when it comes to determining an electrical problem.

### Know When To Say No

If it is necessary to use testing tools, use precautions and consider three things. First, recognize when the problem is beyond your skill level. Nothing will create more problems than being armed with tools and going in an unknown direction. Good intentions can lead to major problems. The second item to consider is if something will cause more grief by being dealt with now than if it were left alone and repaired by a professional at a more convenient time. Items that seem as if they should only take a few minutes, may end up taking an entire day. The third item to consider is whether or not the current situation may be potentially dangerous if left to be repaired at a more convenient time.

**NOTE: Check all related fuses before assuming you have encountered an electrical problem or situation. Spare fuses should be kept on hand and can be purchased from auto parts stores. A fuse description label is on the distribution panel cover.**

**WARNING: If a fuse blows replace the fuse with same amperage rating and type. Installing higher amperage fuses can damage the wiring or the item the fuse is protecting, or may cause a fire. If the fuse repeatedly blows after replacing it do not continue to replace it. Have the problem diagnosed and corrected by a qualified technician.**

## BATTERY - *How It Works*

Batteries come in different sizes, types, amp hours, voltages and chemistries. There are nearly as many descriptions of battery types and how they should be used as there are people willing to offer advice on them. Although it is not possible to cover batteries in their entirety, there are guidelines that can be followed to ensure that the batteries are well maintained.

The operation of the battery is based on a chemical reaction. The battery is a container of lead plates, insulators and a solution of distilled water and sulfuric acid. The solution, when mixed together, is known as "electrolyte."

The 12 Volt battery is actually six batteries in one case. When charged, each cell has a voltage of 2.1 Volts. When six cells are hooked together this makes a 12.6 Volt battery (fully charged).

Electrons are stored on the negative plates. When a load (eg. a light bulb) is put between the positive and negative terminals, the electrons move from the negative plate to the positive plate through the "load" and then back to the ground terminal. At this time the sulfuric acid leaves the water and adheres onto the plates of the battery. The electrolyte solution keeps the electrons from flowing while the battery is in the "at rest" position.

Charging the battery moves the sulfuric acid back into solution with the distilled water. A battery left in a low or discharged state will cause the acid to "sulfate." In attempting to recharge the battery, the acid has become hardened and no longer will leave the plates and enter into the liquid solution with the distilled water. The lowered acid to water ratio has a direct affect on the battery's ability to release the stored electrons (power output) and the length of time it can perform (reserve capacity). Batteries left in a discharged condition will readily freeze. This can crack the case allowing the solution to spill, it can also warp the plates. The acid acts like an "antifreeze" for the battery. This is why batteries should not be left or stored in a "discharged" condition.

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## *Battery Types*

**Starting Batteries:**

Starting batteries are designed for high output cranking power, but not for deep cycling like the house batteries are designed to do. Starting batteries will not last long in deep cycle application. The way they are rated should give a good indication of their intended use. "Cold Cranking Ampere" is a measurement of amperage output that can be sustained for 30 seconds. Starting batteries use thin plates to maximize the surface area of the battery. This allows a very high starting current but lets the plates warp when the battery is deep cycled (discharged).

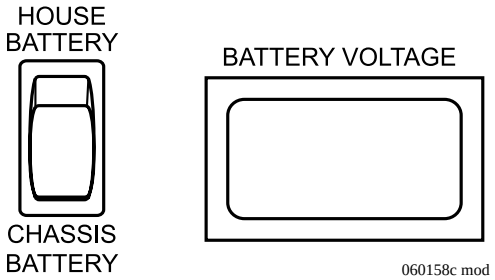
**Deep Cycle Batteries:**

Deep cycle batteries are best suited for use with 12 Volt operated lights, appliances and inverter/converters. Deep cycle batteries are designed to have a majority of their capacity used before being recharged. These are available in many sizes and types. The most common is a non-sealed, liquid electrolyte battery. The non-sealed types have battery caps. The caps should be removed periodically to check the level of electrolyte. When a cell is low, only distilled water should be added. Water consumption will vary depending on many factors: how far the batteries are depleted, how long the voltage is being applied to charge the batteries, how much voltage is used and how often this occurs. Generally, the batteries should be checked every two or three weeks when continuously hooked to shore power.

**NOTE: Tap water contains minerals which can alter battery chemistry and ruin the battery. Use only distilled water when refilling the battery.**

**NOTE: Batteries should not be drained past 50% of capacity, life of batteries may be shortened.**

## *Testing the Battery*

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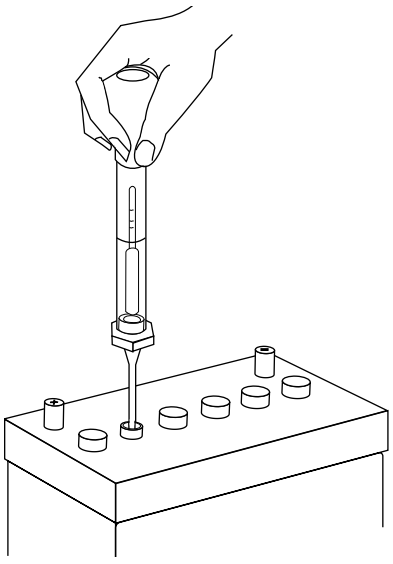
There are several ways that a battery can be tested and monitored. The motorhome uses the Aladdin Monitoring System to show the status of the batteries. Refer to Section Five, Aladdin System for detailed information regarding the batteries.

A more efficient way of testing the batteries is to check the electrolyte solution. The only way to test a battery's electrolyte solution is with a hydrometer. Hydrometers can be purchased from most auto parts stores.

Many styles are available, from types with cylinder graduation (shown here) to types with floating balls. The hydrometer tests the battery's electrolyte solution which is measured in specific gravity. Distilled water has a specific assigned gravity of 1,000. The hydrometer is calibrated to this mark. Pure sulfuric acid has a specific gravity reading of 1,840. The acid is 1.84 times heavier than water. The electrolyte solution is about 64% water to 36% acid (fully charged battery). Hydrometers with cylinder graduation are graphed and the exact state of specific gravity can be determined.



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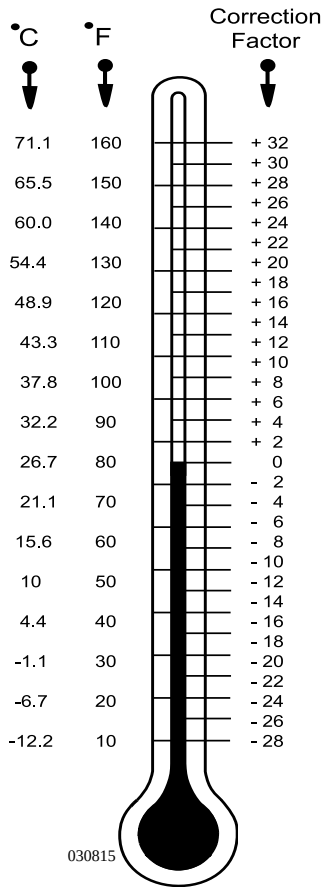
Temperature and recent battery activity (charging or discharging) affect the hydrometer readings. It is best to check the battery when it has been “at rest” for at least three hours, although readings taken at other times will give a “ballpark” figure. When using the hydrometer, draw the electrolyte solution up into the tube. Allow the hydrometer to attain the same temperature as the electrolyte solution. Note the reading for that cell. Complete the same test for the rest of the cells on that battery bank.

The hydrometer is calibrated at 80° F. Temperature affects the hydrometer readings. The higher the electrolyte temperature, the higher the specific gravity reading. The lower the temperature, the lower the specific gravity reading. Add or subtract four points for each 10° variance from the 80° F chart. Readings between cells should not vary more than 50 points.

If one cell in a particular battery bank being tested is at a 50% state of charge while the others are indicating a full charge, charge only that battery to see if the low cell will come up. At the same time, do not over charge the “healthy” cells.

If the low cell does not come up after charging, this battery can damage the rest of the battery bank and should be replaced. An accurate digital volt meter + - .5% will also give an indicator of the battery’s state of charge.

Another test that can be performed is to place a specific load on the battery for a predetermined length of time equal to that particular battery’s rating. This machine is usually an adjustable carbon pile that can vary the load being applied to the battery(s) while monitoring voltage to see if they will perform to their specific rated capacities.

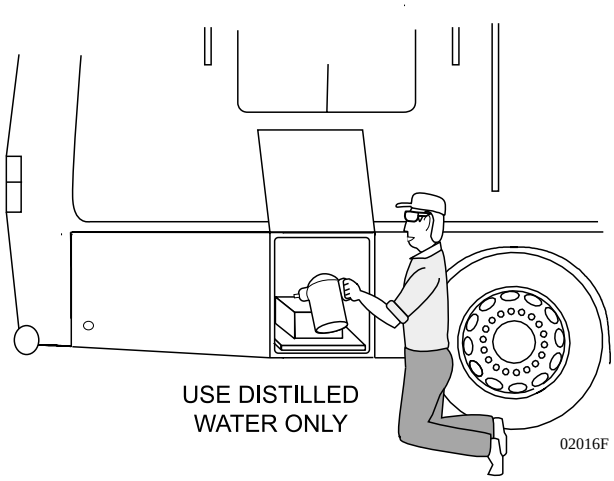



*Temperature Compensation Chart*

**NOTE: See the Temperature Compensation Chart. Liquid levels should be even between the cells of the battery being tested as it will affect the accuracy of the test.**

**WARNING: Sulfuric acid in the batteries can cause severe injury or death. Sulfuric acid can cause permanent damage to eyes, burn skin and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If the battery electrolyte is splashed in the eyes, or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous splattering of electrolyte.**

## Battery Maintenance




*Wear safety glasses when servicing the battery.*

At a minimum, the battery electrolyte level should be checked at least once a month. Check the level sooner if the battery is frequently used. The level should be above the top of the plates, but not overfull. Most batteries have a plastic cup or well. The electrolyte level should be approximately 3/8" below the well to allow room for expansion while the battery is being charged. Over-filling the battery will allow the electrolyte solution to boil or gas out of the battery cap. Remember to use only distilled water to refill the battery. A battery with a low electrolyte level will boil the water out rapidly once the plates have been exposed to air. This process may take only a matter of hours. If this has happened the battery is more than likely damaged.

After checking the battery's electrolyte levels it is also a good idea to check the battery connections for tightness and corrosion. If any corrosion is found disconnect the cables (make sure to mark their locations) and carefully clean them with a mild solution of baking soda and water. There are also aerosol products available that will work. This will neutralize any acid that may be present. Do not allow the solution to enter the battery as this will damage the electrolyte balance. Use water to rinse the top of the battery and surrounding area when done. Carefully hook the cables back to the battery. Coat the terminals with petroleum jelly or an anti-corrosion grease.

The battery cable to battery terminal connections should be metal to metal. Periodically check the batteries for corrosion. Look for cracks and check the vent plugs. Replace them if they are cracked or missing. Keep the top of the batteries clean. The accumulation of electrolyte and dirt may permit small amounts of current to flow between the terminals, which can drain the battery.

**WARNING: Liquid lead acid batteries produce highly explosive hydrogen gas when charging. Do not smoke around batteries. Extinguish all flames in the area. The hydrogen gas may explode resulting in fire, personal injury, property damage or death.**

## Reasons Why Batteries Fail

**1. Physical Condition:**

Active material flakes off the plates and falls to the bottom of the cell. This is normal, but sediment accumulation under the plates can short out a cell. The plate separators fail to insulate positive and negative plates in a cell and the cell becomes shorted, ruining the battery.

**2. Insufficient Electrolyte:**

This allows exposed portions of the plates to sulfate rapidly. This reduces the battery's ability to accept a charge and the battery capacity is reduced. Accelerated erosion of the lower portions of the plates occur from higher than normal acid content due to water loss. Only the water evaporates, not the acid. The battery also has a higher internal resistance when low on water. Add only distilled water. Fill each cell to the bottom of the vent well when the battery is warm. Filling a very cold battery with water to the bottom of the vent well will cause overspill when the battery warms up and the plates expand. A Battery Formula For Failure: the battery has a higher internal resistance when low on water, therefore: *high resistance = more heat = shorter battery life!*

**3. Sulfation:**

When a battery remains discharged for too long the accumulated lead sulfate in the plate material solidifies and cannot reenter the electrolyte. When a battery is left in a discharged state the lead sulfate will crystallize. Charging the battery does not move the crystallized lead sulfate off the battery plate. The battery is damaged.

**4. Overheating:**

The chemical reaction inside of the battery is increased when the battery temperature rises above 125º F. This increases the corrosion of the plates and reduces the battery life. When overheated, the battery plates tend to buckle and destroy the structural integrity of the battery.

**5. Freezing:**

When the electrolyte freezes, ice formed dislodges the active material from the plates. The battery case may crack and the electrolyte will leak out when thawed. It is especially important to keep a battery at full charge in cold weather to prevent freezing. The high specific gravity of a fully charged battery does not freeze as easily. Never attempt to charge a frozen battery. Warm it up first.

**6. Corrosion:**

Corrosion from spilled or splashed electrolyte form deposits that can conduct electricity and can cause battery drain. Clean off all corrosion, especially around the battery terminals and on the top of the battery. Prevent accumulation by coating the terminals and the exposed metal cable connectors with high temperature grease.

**7. Overcharging:**

Overcharging rapidly converts water to gas and decreases the electrolyte's water content as the water evaporates. The electrolyte level drops and becomes more acid in content. This subjects the plates to a higher concentration of sulfuric acid and results in early battery failure.

**NOTE: Any time more than one or two ounces of distilled water is added per-cell per-thousand miles, check the motorhome charging system for overcharging. Prolonged overcharging generates excessive heat inside the battery, which buckles the plates and destroys the battery. It is a fact that over 50% of battery failures are caused by overcharging.**

## *Battery Voltage & Current*

Why does the voltage on a discharged battery measure the same as a fully charged battery until the loads are applied? The simple answer to this might go as follows: A battery creates electrical power by converting energy from a chemical reaction into electrical energy. As this reaction slows down the battery voltage will drop. In a lead acid battery the electrolyte conductivity (how well electrical current can flow through it) changes. The same current may be available but the rate of the reaction decreases, causing a voltage drop.

Another way of looking at this is to use the analogy of a water pump (a battery is an electric pump). The pressure in psi (pounds per square inch) that a pump delivers is like a battery's voltage. The volume of water in GPM (gallons per minute) is like the electrical current. Look at a 12 psi pump with no loads (the pump is running but the outflow valve is turned off). The pump will run and the internal pressure of the pump will build up to some point higher than 12 psi. When the valve is opened, and the water is free to flow into the loads, the pressure will drop to the rated output pressure of 12 psi, but only if the load is not too big. If the pump is designed to maintain 12 psi at 15 GPM, and a load demanding 20 GPM is connected, the pump will not be able to keep up and the pressure will get sucked down to a lower psi. If the load is reduced or removed the pump will catch up and return to its rated 12 psi pressure. If the pump has an infinite source of water, such as a lake or the water utility (this is like the grid, no battery), the pump will never run out of pressure. If the pump never runs out of pressure, and is operated at or below its 15 GPM level, it will hold 12 psi. However, a pump that is connected to a water tank with a finite capacity will start to lose the ability to hold pressure as the level of water in the tank drops. Think of siphoning water from a bucket. As the level of the water drops, the volume of water exiting the siphon slows down.

When the tank is full it is capable of feeding more “pressure” to the pump inlet due to gravity, and the pump always has enough water available to maintain its rated pressure and volume. However, if the water tank gets low the pump will not have enough water volume coming in to maintain 12 psi at 15 GPM. If the loads are removed from the pump by closing the valve on the outflow, even with low pressure in the tank the pump will eventually pressure up to 12 psi. It will just take it longer to get there. When the valve is opened the pump will sustain 12 psi for a brief period, but since the tank is no longer feeding the pump as fast as needed the pressure will eventually drop. This analogy can be restated by replacing the pump with a battery, pressure with voltage, volume with amps, outflow valve with a switch, water with electricity and the water tank with the battery electrolyte.

The level of the tank could be thought of as the rate of the reaction occurring in the electrolyte. When the battery is fully charged the electrolyte has an excess of reactions taking place to feed the battery terminals. This tapers off with time as the electrolyte is spent, so maintaining voltage becomes possible. With no loads, the discharged electrolyte is capable of producing close to the rated voltage, but only after a period of time has elapsed for enough of a reaction to take place to bring the voltage back up. This explains why a battery measured at rest can indicate close to its rated voltage, but will not run a load.

## Battery Charge Time & Consumption Rate

**Calculating Run Times:**

Calculating run time figures when operating 120 Volt AC electrical items with an inverter/converter can be exponential. This is due to battery characteristics. Flow characteristics of electrons vary with different battery types and chemical compositions. Deep cycle batteries are generally designed to slowly release a majority of their charge capacity. Deep cycle batteries are rated in amp hours (Ahrs) with the discharge occurring over an extended period of time before the battery is charged. Engine starting batteries are designed to quickly release large amounts of current for short durations, without depleting battery reserves. Commercial type batteries bridge the gap of deep cycle and engine batteries. Commercial batteries release medium amounts of current over a longer period of time but they are not designed to cycle their charge capacity.

The working range of a deep cycle battery is between 50 and 100% state of charge (SOC). Deep cycle batteries should not be cycled below 50% state of charge. Discharging a deep cycle battery below 50% state of charge shortens the life of the battery. Deep cycle batteries use an amp hour rating which is usually calculated over a 20 hour discharge interval. For example: A deep cycle battery with a rated capacity of 100 Ahrs. is designed to release current at the rate of 5 Amps per hour. Multiply a 5 Amp load over a 20 hour

discharge period equals the rated 100 Ahr. capacity. These discharge figures are calculated with the battery starting at 100% state of charge with the battery at 80º F when the discharge cycle begins. However, increasing the discharge load applied to the battery from five amps to ten amps on a 100 Ahr battery does not yield 10 hours of discharge time. This is due to the internal reactions which occur when a battery is discharging. Actual discharge time for a 10 Amp load may be closer to eight hours of discharge time. Increasing the load applied to the battery to 20 Amps will not yield five hours discharge time but may be less than three hours. It might be understood as a point of diminishing return.

Calculating applied loads to an inverter/converter to approximate run time from the battery amp hours available is not an equal trade up when voltage is inverted and amperage is calculated. When the inverter/converter is used to operate an AC load it uses approximately ten times the DC current needed from the battery when inverting 12 Volts to operate the 120 Volt item. There is also a small efficiency loss of about 10% when inverting. For example: When using the inverter/converter to operate an AC electrical item, which has a current draw rating of 2 Amps, the inverter/converter will use over 20 Amps DC power from the batteries.

**Determining Current Consumption:**

First determine the amount of current used by an AC item. For example: The television is rated at 200 watts at 120 Volts. Calculate watts to amps. Divide 200 watts by the operating voltage of 120, this equals 1.6 Amps. Multiply 1.6 Amps AC current by a factor of ten the inverter/converter will use, this equals 16 Amps DC battery current. Add the revised 10% efficiency loss figure, this calculates to a total of 17.6 Amps DC. If the battery bank capacity is rated at 500 Ahrs., actual elapsed time to the suggested 50% state of charge would net viewing time for the television at approximately 13 hours in ideal conditions.

The run time figure will vary greatly with the actual state of charge of the battery bank when the discharge process begins. Ambient temperature, combined with other working loads, such as lights and parasitic loads applied to batteries, affect run times. Calculating the exact run time is not precise due to all the variables and equations involved; however, an approximate time figure can be obtained. Proper battery maintenance and charge cycles affect battery performance. Observe the battery condition with hydrometer and voltage readings. Use only distilled water when filling batteries. To achieve the highest quality of battery performance and longevity keep batteries in their proper operating range.

## BATTERY SPECIFICATION - HOUSE

| Application | Ah (20hr) | CCA† | RC (25A @ 80° F) minutes |
|---|---|---|---|
| 12 Volt Chassis*<br>Group 31p - LHD (2 each) | | 750 | 180 X 2 = 360 |
| 6 Volt Domestic**<br>U2200 (4 each) | 450 | | 75Amp@<br>80º F. = 230 Min. |

**Batteries connected in parallel. **Battery connections are made in a Series/Parallel connection. †CCA Ratings are at 0º F. These are the minimum requirements.*

| Approximate Hours at Ampere Load* | | | | | |
|---|---|---|---|---|---|
| | 5 AMPS | 10 AMPS | 15 AMPS | 20 AMPS | 25 AMPS |
| **U2200** (4 each) | 55 | 22 | 12.5 | 9.1 | 7 |

** Loads conducted @ 80° F. with battery fully charged to 1260 per cell specific gravity. Voltage to maintain 1.75 Volts per cell (10.5 Volts for 12 Volt battery).*

| Battery State of Charge vs. Voltage / Specific Gravity | | | |
|---|---|---|---|
| Voltage | Specific Gravity | State of Charge | Depth of Charge |
| 12.66 | 1.265 | 100% | 0% |
| 12.45 | 1.225 | 75% | 25% |
| 12.25 | 1.190 | 50% | 50% |
| 12.05 | 1.145 | 25% | 75% |
| 11.90 | 1.100 | 0% | 100% |

*Voltage Reading: Battery fully charged at rest for one hour.*

## SOLAR PANEL

The motorhome is equipped with a solar-powered battery charging system. The system consists of one solar panel with mounts, a Combiner box (this allows additional panels to be wired to the system) and a charge controller that can handle up to five 100 watt solar panels.

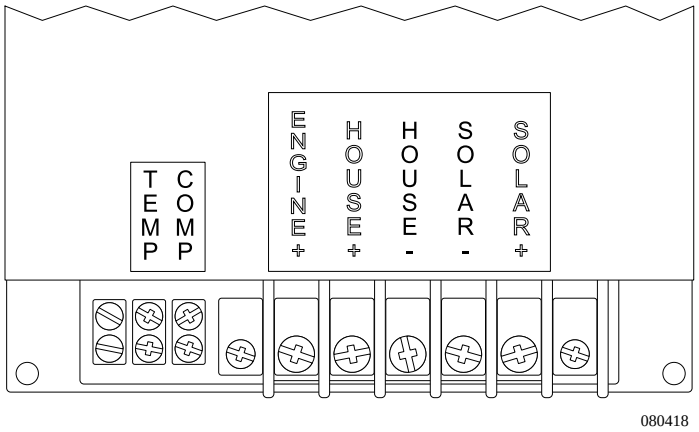
**Solar Panel:**

The solar panel is a laser-grooved, buried-grid panel that is capable of delivering about five amps of charge per hour, per panel, in full sunlight (usually between 9:30 a.m. and 2:30 p.m.). Extensive testing has shown that one 100 watt solar panel delivers enough power to offset the normal day-to-day drain on batteries caused by various parasitic electrical loads. These parasitic loads are usually associated with transmission memories, alarm systems, natural self-discharge of batteries and other like items. This means that the first solar panel is only intended to cover these parasitic loads. Adding a second, third or more solar panels (depending upon needs and electrical consumption) can replace what is drawn out of the batteries from the operation of lights, water pumps, inverters, etc., while dry camping.

**NOTE: The solar panel needs to be cleaned monthly. The solar panel may need to be cleaned more frequently depending on weather conditions.**

**Combiner Box:**

The Combiner Box is located on the side of the refrigerator vent on the roof. It has four standard "knock outs" to allow additional solar panels to be added to meet dry-camping needs.

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**Charge Controller:**

The Charge Controller, built specifically to meet the needs of a motorhome, can be set to accommodate either Flooded Lead-Acid batteries or Absorb Glass Mat (AGM) batteries. The Charge Controller is located behind the washer-dryer.

Status of the charge controller is viewed through the Aladdin System electrical status display. The controller is used as a heat sink for the electronics attached to it. It is normal for the controller to become warm to the touch, especially when processing higher amperage. The charge controller will automatically enter Thermal Shutdown if it gets too warm.

## Charge Controller Features

The RV-45D Charge Controller has many unique features.

1. **Dual Battery Bank Charging -** Parasitic loads affect both the House and Engine batteries. The controller automatically charges both the House and Engine batteries at the same time to deal with this issue.

2. **Pulse Width Modulation -** This charging strategy has been found by the Sandia National Laboratories to maintain the highest state of charge with the least amount of water consumption by the batteries. In effect, it delivers all the available charging amperage until the batteries reach their set point voltage (this stage is called bulk charging) and then it begins to taper off amperage (absorption stage) until it is reduced to all that is needed to simply hold the batteries at their set point voltage (Float Stage).

3. **Temperature Compensation -** The gassing threshold of the batteries is reached at around 14.1 to 14.4 Volts at room temperature (25º C). If the temperature of the batteries is hotter than 25º C, the gassing threshold is reached at a lower voltage. If the temperature of the batteries is colder than 25º C, the gassing threshold is reached at a higher voltage. This feature protects the batteries from excess water loss and/or plate sulfating by automatically compensating for these temperature changes and adjusting the charging voltage accordingly.

4. **Automatic Equalization (Only when set to Flooded Lead-Acid Batteries) -** This feature is activated once per day to extend the life of the batteries by allowing the weaker cells a chance to catch up with the stronger cells. This assures that all cells will be at an equal state of charge. The first time the house batteries reach 14.2 Volts during the day, a delay timer is activated that allows a short duration period (20 to 30 minutes) at a slightly higher voltage (14.5 to 15.0 Volts) and then falls back to the 14.2 Volt setting for the remainder of the day.

5. **Automatic Float (Only when set to Absorbed Glass Mat Batteries) -** Resets the charge parameters to work with AGM batteries and removes the equalization cycle. AGM batteries are sealed and are not designed to withstand the higher voltage reached during equalization. The feature also changes Float setting from 14.2 to 13.4 Volts, which is the AGM battery manufacturer's recommendation.

**CAUTION: The Charge Controller may be warm to the touch. This is a normal function of the Charge Controller.**

## Solar Panel Care

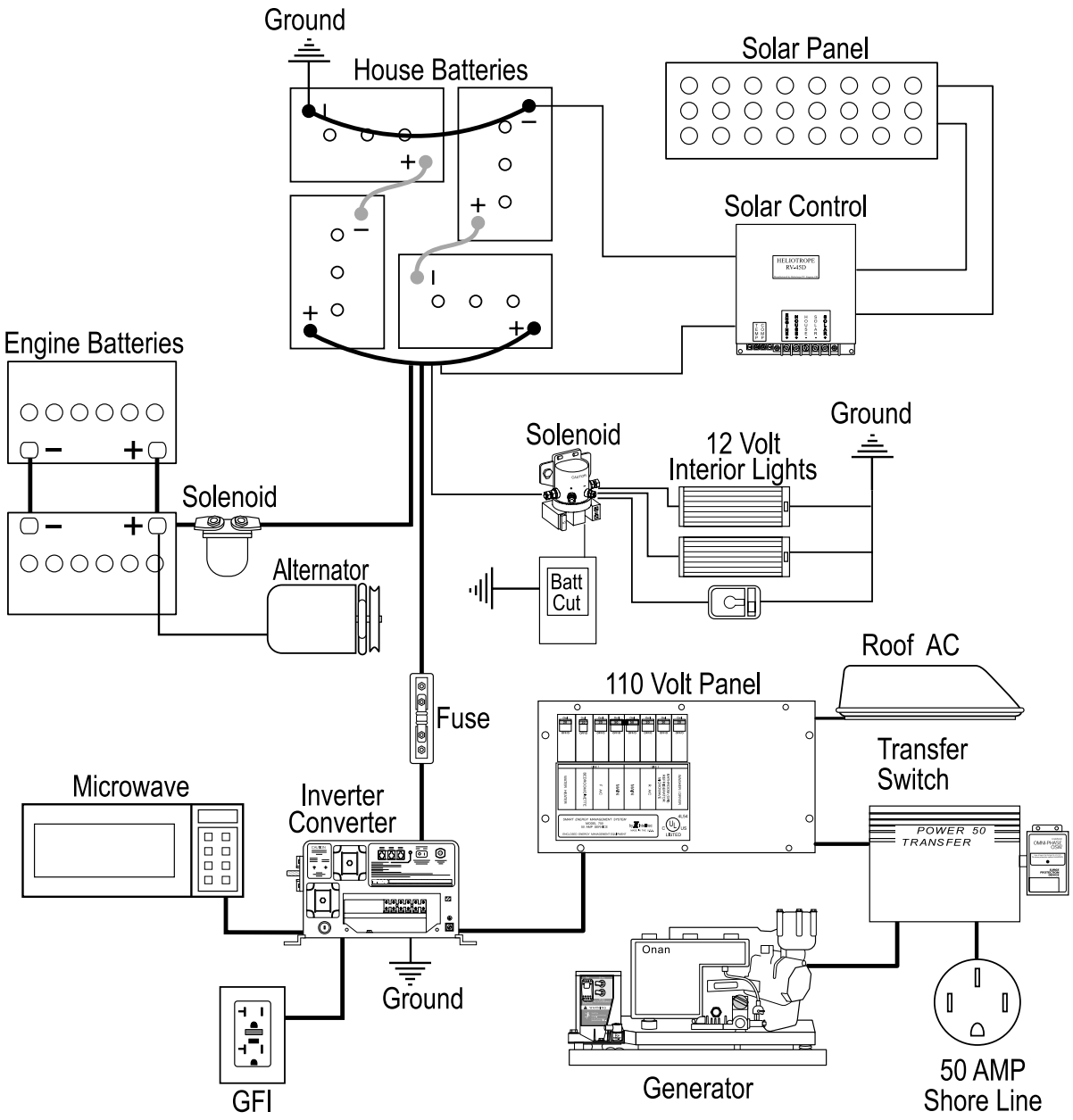
A critical part of maintaining the solar electric battery charging system is to keep the panel clean. The amount of power that a panel will produce is directly related to the intensity of sunlight. A dirty panel will allow less light to reach the panel, resulting in less power produced. A single layer of dust or road grime can reduce the power output by 15 to 25%. Leaves and debris that can cover two or three of the 36 individual cells can reduce output power by 50 to 75%.

Use of the basic maintenance tips, regular inspections and regular cleaning will assure maximum charging from the solar charging system. To clean the panel, use a non-abrasive cleaner and paper towels. The surrounding environment and the amount of road dust encountered will determine how frequently the panel should be cleaned. One to two times a month is preferred.

**Tips to Follow:**

1. The panel should be cleaned if a film or a layer of dust is on the windshield.
2. On a bright sunny day, the charging amps should be 3.5 to 5 Amps per panel.
3. High winds can blow dust and debris around causing dirt build up. Frequently **inspect** the panels and clean as necessary.

**CAUTION: Avoid damage to the solar panel controller. Cover the solar panel with a blanket when replacing the batteries or performing battery cable maintenance.**


Ground
House Batteries
Solar Panel
Solar Control
Engine Batteries
Solenoid
Alternator
Solenoid
12 Volt
Interior Lights
Ground
Batt
Cut
Roof AC
110 Volt Panel
Fuse
Transfer
Switch
Microwave
Inverter
Converter
POWER 50
TRANSFER
Onan
Ground
GFI
Generator
50 AMP
Shore Line

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## ~ NOTES ~

# Electrical Systems - Chassis

## section 9


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## ELECTRICAL CHASSIS - INTRODUCTION

A majority of the lighting and appliances are designed to operate from 12 Volt DC (direct current) power. This is why batteries play such an important role in the function of the motorhome. There are exceptions with appliances such as the microwave or television; however, indirectly they still operate from 12 Volt DC power, as they can be operated from the inverter. The chassis functions (engine, transmission, dash air, etc.) are also 12 Volt DC.

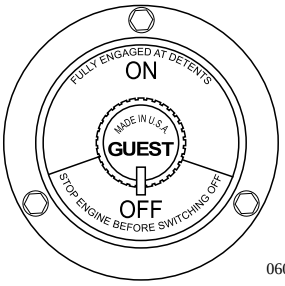
With the all technological advancements taking place in the past several years manufacturers have now incorporated electronics into these systems. It is important to keep the 12 Volt system(s) in good working order. These systems, with their incorporated electronics, are voltage sensitive. Some items can be damaged if the DC voltage is not maintained within the designed specifications.

There are two separate 12 Volt systems. One is the chassis system; the other is the house system. These two systems, for the most part, are separate from one another. The house system does not operate engine functions; as the engine system does not operate house functions. However, within the two systems there are some inner connections. For example: While the motorhome is driven the alternator on the engine will surface charge the house batteries. Each system will supply 12 Volt DC power to the 12 Volt distribution panels.

The two different systems, engine and house, have their own set(s) of battery(s). The engine battery supplies 12 Volt DC power to the front distribution panel located in an outside compartment by the driver's side front wheel. This panel contains mostly engine system fuses and wiring such as headlights, taillight, dashboard functions, gauges, etc. The house battery(s) supplies 12 Volt DC power to the distribution panel located in the bedroom. This panel contains fuses for the house, interior lighting and appliances, such as the furnace and water heater.

## BATTERY DISCONNECT - CHASSIS

The main battery disconnect for the chassis battery turns the DC power on or off to the front electrical bay. Chassis and engine functions are interrupted when the battery disconnect is turned off. Some electronic items require a constant power source for memory retention such as the dash and CB radios. Some electronic components of the engine and transmission require a constant power source. Turn the main battery disconnect switch off when the motorhome is going to be stored, or when performing electrical maintenance.

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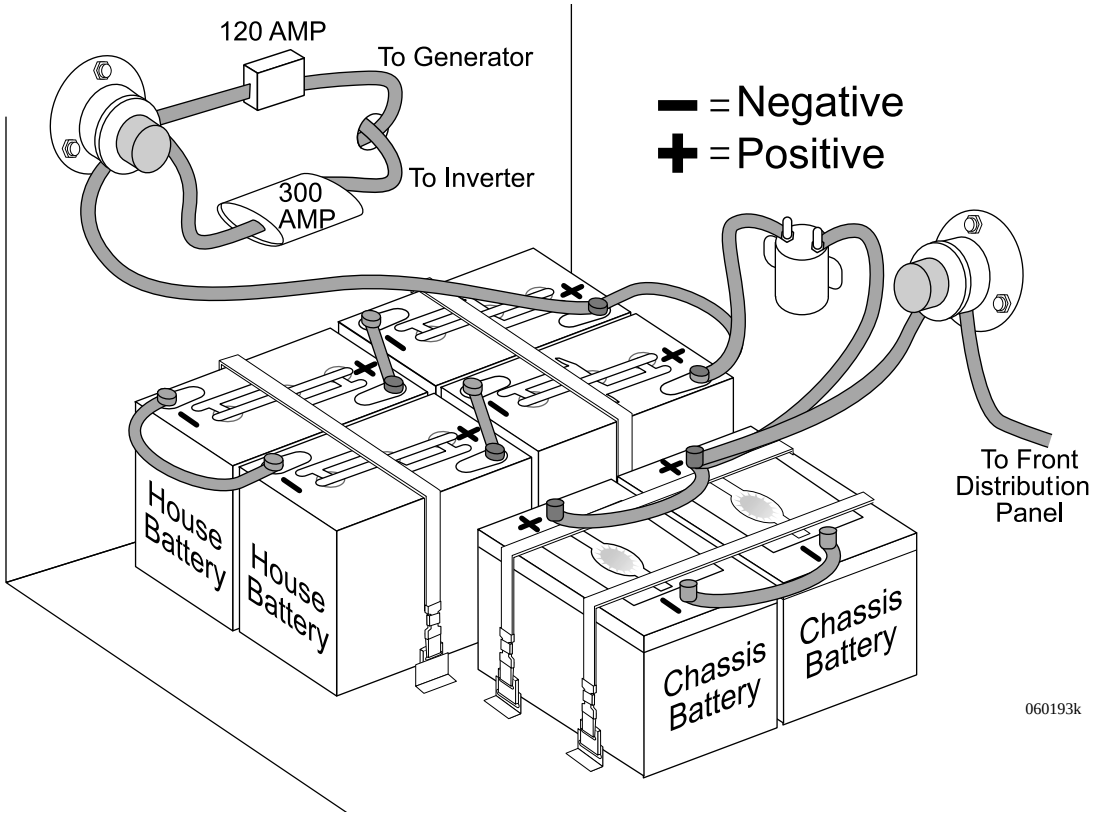
**NOTE: The solar panel (optional) will charge the batteries with the disconnect switches off.**

**WARNING: When the frame or other welding is involved for motorhome repair, or modification, the following precautions are required to protect electronic components in the motorhome chassis:**

1. **Disconnect the (+) positive and (-) negative battery connection and any electronic control ground wires connected to the frame or chassis.**
2. **Cover electronic control components and wiring to protect from hot sparks.**
3. **Disconnect the wiring harness connectors at the transmission electronic control unit. The ECU is located in the front roadside electrical compartment.**
4. **Do not connect welding cables to electronic control components.**
5. **The welding ground cable should be attached no more than two feet from the part to be welded.**



## BATTERY - CHASSIS

The chassis battery operates only chassis and engine functions. The chassis battery is a crank type battery, producing the high amperage needed to start the engine. Engine starters initially require a large amount of current to crank an engine. Initial starter amperage draw exceeds 1200 amps. The type of application in which the engine battery is used differs from the house battery application. The engine battery state of charge remains consistent. Maintenance is still required with an engine battery. Regular electrolyte level checks and hydrometer readings should be performed. High electrolyte consumption, or inconsistent hydrometer cell readings, may indicate a charging system problem. Perform a charging system and current draw check if the battery is exhibiting abnormal hydrometer readings.

**NOTE: Replacement batteries should have the same cold cranking amp (CCA) rating.**

## BATTERY SPECIFICATIONS - CHASSIS

| Application | Ah (20hr) | CCA† | RC (25A @ 80° F) minutes |
|---|---|---|---|
| 12 Volt Chassis*<br>Group 31p - LHD (2 each) | | 750 | 180 X 2 = 360 |
| 6 Volt Domestic**<br>U2200 (4 each) | 450 | | 75Amp@<br>80º F. = 230 Min. |

**Batteries connected in parallel. **Battery connections are made in a Series/Parallel connection.*
*†CCA Ratings are at 0º F. These are the minimum requirements.*

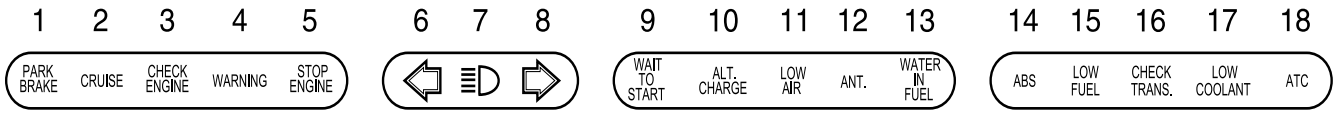
| Battery State of Charge vs. Voltage / Specific Gravity | | | |
|---|---|---|---|
| **Voltage** | **Specific Gravity** | **State of Charge** | **Depth of Charge** |
| 12.66 | 1.265 | 100% | 0% |
| 12.45 | 1.225 | 75% | 25% |
| 12.25 | 1.190 | 50% | 50% |
| 12.05 | 1.145 | 25% | 75% |
| 11.90 | 1.100 | 0% | 100% |

*Voltage Reading: Battery fully charged at rest for one hour.*

| CUMMINS ENGINE COLD CRANKING AMPS REQUIREMENTS | | | |
|---|---|---|---|
| ISC | 1250 | CCA | 12 VOLTS |

*CCA Rating are at 0º F. These are the minimum requirements.*

# DASH
## *Indicator Lamps*

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**1. Park Brake:**
Parking/emergency brake is applied.

**2. Cruise:**
Indicates when cruise control is activated.

**3. Check Engine:**
Problem with the engine.

**4. Warning:**
Out of range condition exists within the engine protection circuits. Stop coach, check all fluid levels.

**5. Stop Engine:**
Alerts driver of severe out of range condition within the engine protection circuits. Pull over and stop as soon as possible. Shut-off engine to avoid engine damage.

**6. Left Arrow - Audible Turn Indicators:**
Indicates left turn indicator circuits active. Audible indicator cancels when the brake is applied.

**7. Headlight Beam:**
High beams when illuminated.

**8. Right Arrow:**
Indicates right turn indicator circuits active. Audible indicator cancels when the brake is applied.

**9. Wait to Start:**
Monitors the air intake heater at engine start up.

**10. Alt Charge:**
Failure within the alternator charging system.

**11. Low Air:**
Air tank pressures are out of operating range. Check air pressure.

**12. Ant:**
Indicates TV antenna is raised. Lower antenna before moving coach.

**13. Water in Fuel:**
Water has been detected in fuel

**14. ABS:**
ABS possible fault in the ABS Brake system. Also indicates fault code for service technicians.

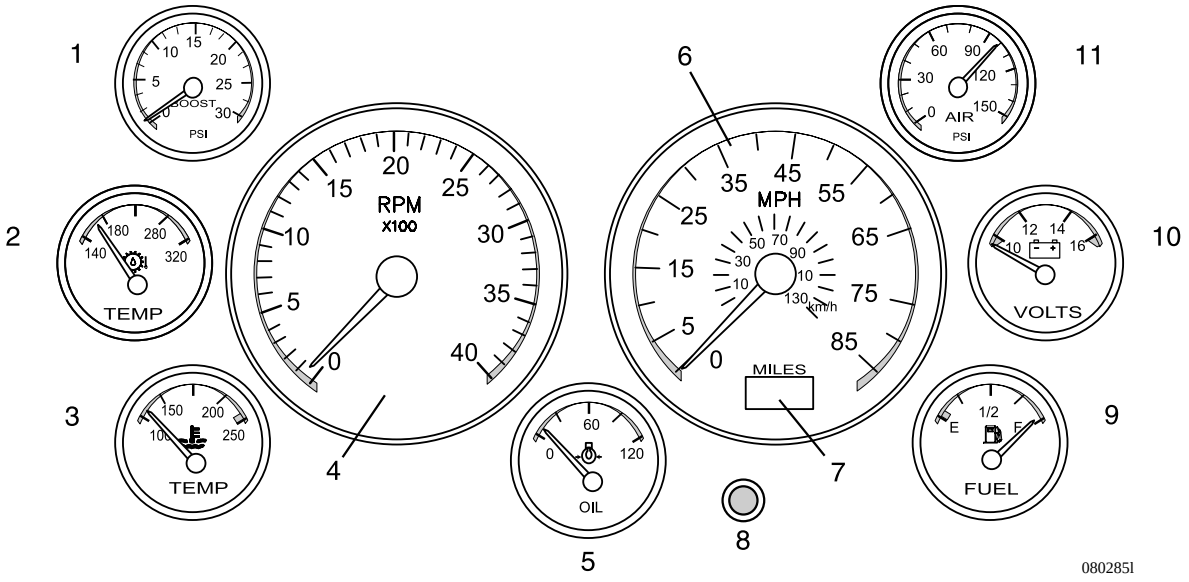
**15. Low Fuel:**
Fuel level is becoming low.

**16. Check Trans:**
Alerts driver of problems related to the Allison Transmission. The light should momentarily illuminate when the ignition is switched ON. When starting the lamp will extinguish indicating the circuits are working properly. If the lamp fails to illuminate or remains on, the transmission needs to be checked immediately. Contact the nearest Allison dealer.

**17. Low Coolant:**
Coolant level in the overflow tank is below acceptable level.

**18. ATC (Automatic Traction Control):**
The ATC indicator light will illuminate steady when the ignition key is turned ON. The light remains illuminated until the first brake application. The indicator flashes slowly when the switch is pressed to indicate the ATC is activated. The indicator light will flash quickly when at ATC event occurs.

## Gauges




**1. Turbo Boost:**
Indicates boost pressure produced by engine turbocharger.

**2. Trans Temp:**
Shows temperature of transmission fluid. Normal transmission operating temperature is 160-250º F. The maximum transmission to cooler oil temperature is 300º F. Do not let the transmission temperature exceed 275º F. If excessive temperature is indicated stop motorhome and shift to neutral. Accelerate engine to 1200-1500 RPM and allow temperature to return to normal.

**3. Coolant Temp:**
Under average conditions the gauge reads between 180º F and 205º F. Monitor this gauge frequently when CLIMBING HILLS, TOWING or in HIGH AMBIENT TEMPERATURES. If the gauge shows that over-heating exists (the needle moving above the 212º F area) IMMEDIATE ACTION should be taken.

**Overheating may be a Result of any of the Following Conditions:**
- Low coolant level.
- Hydraulic fan motor failure.
- Mechanical failure of hoses or belts.
- Blocking of charge air cooler fins.
- Climbing a long hill on a hot day.
- Towing a heavy trailer.
- Idling for long periods of time.

**4. Tachometer:**
Displays engine speed in revolutions per minute (RPM).

**5. Oil Pressure:**

Indicates pressure of oil and not the amount of oil in system. Please refer to manufacturer's instructions for specific pressure recommendations.

**6. Speedometer:**

Indicates the speed of the motorhome. The gauge indicates MPH and KPH.

**7. Odometer/Trip Meter:**

This meter records mileage driven as well as keeps track of mileage on a trip. To operate trip meter push the round black button under the speedometer. This changes odometer mileage reading to the trip mileage reading. The black reset button sets the trip mileage back to zero when held for 2 to 3 seconds. Release the button and momentarily press the button again. This changes the trip mileage reading to the odometer mileage reading.

**8. Mileage/Trip Reset Button:**

Operates the trip meter, changes the odometer mileage reading to the trip mileage reading. Press and hold to reset the trip meter.

**9. Fuel:**

Fuel gauge will register approximate fuel level in the tank when ignition switch is in the run position.

**NOTE: Fuel mileage varies with driving style and road conditions. Always average more than one tankful to obtain a more accurate figure. The diesel Generator uses fuel from main tank and will affect fuel mileage figures. Diesel Generators will not operate below 1/4 tank to ensure there is enough fuel to run main engine.**

**10. Voltmeter:**

This gauge shows the charge condition in the chassis battery. The normal voltage with the ignition switch ON and the engine OFF varies between 12.0 and 13.0 Volts. With the engine operating without a heavy load the battery charging voltage is about 14.0 Volts. Battery readings of less than 10.5, or more than 15.0 Volts, usually indicates a battery or electrical system problem.

**11. Air Pressure Gauge:**

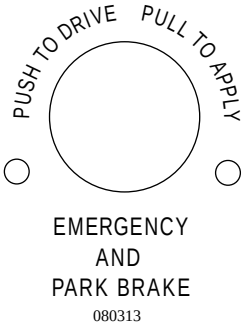
This gauge indicates air system pressures. The normal air system operating pressures are 105 to 120 psi. These air pressures are preset at the factory. If a problem occurs with air system not maintaining normal operating pressure it is an indication of a malfunction in the air system. Use caution and stop the motorhome in a safe area. Contact your dealer immediately.

**NOTE: It is not safe to drive the motorhome with low air pressure. Damage can occur to the suspension and drive line. The operation of the air brake system is also affected.**

**NOTE: Layouts may vary with different models and options.**

## Parking Brake

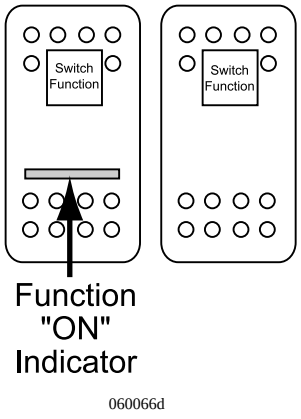
The parking brake system is activated when the push-pull control knob (located on the driver's left console panel) is pulled. When the knob is pushed, the brake is released. Prior to driving, allow time for the air compressor to build up sufficient air to shut off the air warning lamp.




**WARNING: If the air tank is not dumped, there is the possibility of an accidental release of the parking brake. Traveling with small children and/or pets may require a small block to be fabricated to prevent accidental release. The block should be placed under the knob and rested on the dash panel. A wooden clothes pin clasped at the base of the shaft will work.**

## Driver Side Switches

There are two types of switches used, both switches are lighted, but one utilizes a funtion "ON" indicator. Each switch has the function it controls printed on the switch. Press the top of the switch to start the function and press the bottom to stop the function. Following is a list of switches used and their functions.




**FAN:**
Controls the front windshield fans.

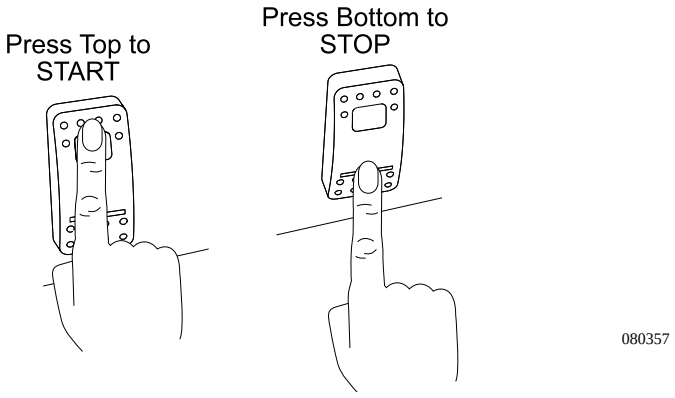
**SIDE DOCK:**
Operates the side docking lights to increase visibility when parking.

**BATT BOOST:**
In the event the motorhome chassis battery has been drained and cannot start the engine, this switch momentarily "jumps" the domestic battery to the motorhome chassis battery to assist in starting the engine.

**GEN START:**
The generator automatically initiates a preheat cycle when the switch is pressed to START. The preheat cycle cycle is indicated by the light on the switch flashing rapidly. Depending on ambient temperature thereheat cycle may last up to 15 seconds.

**To Start the Generator:**
Press and hold the switch to START. The light will flash rapidly indicating the preheat cycle. At the end of the preheat cycle the engine will crank and start. Release the switch after the generator has started and is operating smoothly.

**To Stop the Generator:**
Momentarily press the switch to STOP. It is not necessary to hold the switch until the generator has stopped.




**FOG LIGHTS:**
Turns fog lights ON and OFF for better visibility. The fog lights will operate with the Low Beam of the headlights.

**ATC:**
The ATC system improves traction on slippery or unstable surfaces by preventing excessive wheel slip (see Section 10 for detailed information).

**EXHAUST BRAKE (EXHST BRAKE):**
Auxiliary braking device for slowing down the motorhome. For flat dry road conditions apply the exhaust brake until speed is reduced. The exhaust brake is effective for speed control in town and on local routes. Use the exhaust brake to slow down when preparing to exit onto an off-ramp, when approaching traffic lights or when approaching slowed or stopped traffic. The exhaust brake is not a substitute for the service brakes. Do not neglect service brake maintenance.

**NOTE: Some municipalities have ordinances banning the use of the exhaust brake. Check for road signs in densley populated areas.**

**STEP COVER:**
Extends and retracts the step cover.

**PEDAL IN/OUT:**
After sitting in the driver's seat and making adjustments to the mirrors and steering wheel, use the Pedal In/Out switch to adjust the brake and throttle pedals to be either closer or farther away. Switch moves the pedals inward or outward approximately three inches. If you need to move the pedals inward, just push the switch. When the pedals reach the end of their traveling distance, the pedals will automatically stop. Release the switch.

**LH SHADE:**
Operates the power sun visor located on driver's side.

**RH SHADE:**
Operates the power sun visor located on passenger side.

**AIR DUMP:**
Will manually dump air from the air bags. May be an aid in leveling the motorhome. Releasing the air from air bags will give the leveler more range of travel for leveling. Ignition must be in accessory or run position.

**NOTE: Never drive the motorhome with the air bags deflated. This may damage the motorhome.**

**MIRROR HEAT:**
The switch turns on the heaters in outside rearview mirrors. The mirror heaters should be used when defogging or deicing as needed. To use the mirror heat, press the switch to the ON position.

**NOTE: Mirror heat should not be left ON unless continuous fogging conditions occur.**

**RADIO:**
Applies power to the dash radio. This will allow the radio to be turned ON and OFF, independent of the main radio switch.

**INC/DEC:**
Will increase and decrease the engine idle in 25 rpm increments.
There are limits to the idle speed, about 700 to 875 rpm.

**ENG DIA:**
Checks engine functions.

**CEILING LIGHTS:**
Illuminates the front ceiling light from the Entry and Bedroom Areas.

**PORCH LIGHT:**
Turns ON and OFF the outside Porch Light.

**STORAGE LIGHT:**
Operates the lights within the compartment bays.

**ENTRY STEP:**
Provides power to operate the Entry Step.

**BATTERY CUTOFF:**
Controls the 12Volt DC power to the domestic fuse panels.

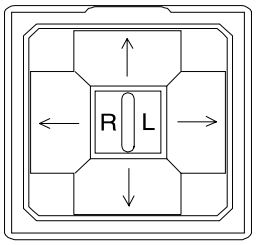
**STEP LIGHT:**
Provides power to the exterior amber step light.

**PASS SHADE:**
Operates the power sun visor located on the passenger side.

**STEP COVER:**
Extends and retracts the step cover.

**MAP LIGHT:**
Provides power to the adjustable map light.

## Controls

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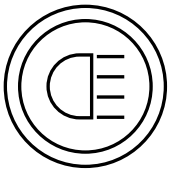
**MIRROR ADJUST:**
To adjust the rear view mirror the small selector in the middle of the switch must be placed in the desired side. The middle position is to prevent accidental bumping of the switch and changing the mirror position. The outside mirrors have been placed so that they can be easily adjusted with the Allen wrench. After taking delivery of the new motorhome it will be necessary to sit in the driver's seat and adjust the mirrors to driver's needs. Both the driver and the passenger mirrors should be adjusted.



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*Headlight Control*

**HEADLIGHT:**
Pull one click to operate the parking lights. Pull two clicks to operate the headlights. Rotating the headlight switch clockwise will dim the dash lights. Counterclockwise rotation will illuminate the map light in the overhead compartment.

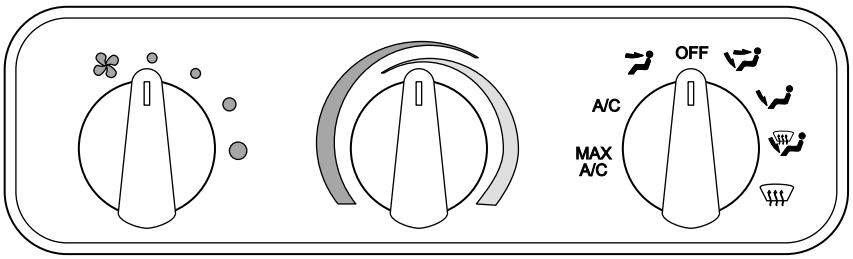
**BACKUP MONITOR:**
Used with the back up camera and will display the rear view of the motorhome when the Aladdin System is activated.

The system is designed to only provide heating, cooling and defrost for the pilot and co-pilot area. The system is not capable of heating or cooling the entire motorhome.

**Blower Control Switch:**
This switch controls the four speeds of the blower motor. This is one of the best and most effective ways of controlling temperature. The blower will not activate until the Mode Control Switch is set to any position other than Off.

**Temperature Control Switch:** Setting the switch to the Red zone controls an electric water valve regulating the amount of engine coolant passing through the heating coils in the system. Rotating to the blue zone sets the cut-in/cut-out temperature of the air conditioning compressor on the engine.

**Mode Control Switch:** This switch directs air flow by opening or closing damper doors. Use the Mode Control Switch to direct airflow where it is needed to maximize comfort in the cockpit area.

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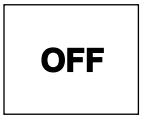
*Blower Speed Control* *Temperature Control* *Mode Control Switch*

**MAX A/C -** Recirculated air is drawn from the passenger area and discharged through the dash louvers.

**A/C -** Fresh Air is drawn from outside into the system and discharged through the dash louvers.

**VENT -** Fresh air is drawn in and discharged throughout the dash louvers.

**OFF -** The blower motor does not operate. The fresh air inlet door will close, minimizing outside air infiltration into the motorhome.




**BI-LEVEL -** Fresh air is drawn in and discharged through the dash and the floor louvers.

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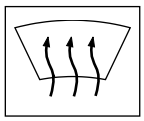
**FLOOR -** Fresh air is drawn in and discharged through the floor louvers. A small amount of air discharges through the defrost vents.

**MIX -** Fresh air is drawn in and discharged through the floor and defrost louvers. The A/C system operates to dehumidify the discharged air.



**DEFROST -** Fresh air is drawn in and discharged through the defrost louvers. The A/C compressor operates to dehumidify the discharged air.

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**Heat and Defrost Operation:**

The air conditioning compressor operates in all modes except **VENT**, **FLOOR** and **OFF** to dehumidify the air. Rotate the temperature control switch to set discharge air temperature.

- Set the Mode Control Switch to the desired position.
- Set the Temperature Control Switch to the red zone.

**A/C Operation:**

The air conditioning compressor operates in all modes, except vent, floor and off, to dehumidify the air. Rotate the temperature control switch to set discharge air temperature.

- Setting the Mode Control Switch to **A/C** will allow outside air into the system.
- Setting the Mode Control Switch to **MAX A/C** will recirculate inside air. When maximum cold air is desired, select this position.
- Set the Temperature Control Switch to the blue zone.

**NOTE: The temperature control switch must be set to the blue zone for cool air.**

**NOTE: Activate the A/C system monthly to keep internal components of the compressor lubricated.**

**Winter Use:**

- De-ice the windshield using the DEFROST mode.
- The system will heat up faster with a slower blower speed until normal engine operating temperature is obtained.

**Summer Use:**

- Close all windows and vents preventing hot and humid outside air from entering the motorhome.
- MAX A/C and HI blower will provide quick cool down.
- Using a lower blower speed will produce cooler air.

**Operating Tips and Hints:**

- Air intake and discharge temperatures are greatly effected by ambient temperature and relative humidity.
- A large amount of cooling capacity is used to dehumidify air as well as cool it. After three to five minutes of A/C compressor operation, the discharged air temperature should be approximately 30º F cooler than the fresh or recirculated air entering the A/C system.
- The air system on the motorhome must have adequate pressure to operate the vacuum generator or damper doors will not function.
- At the beginning of the day, activate the compressor with the engine at idle. This will avoid sudden high speed activation resulting in damage from lack of internal compressor lubrication.
- The dash A/C and heater system should be used monthly to keep the compressor lubricated.

**Trouble Shooting:**

The dash A/C/Heat system uses a combination of compressed air (developed by the chassis system), vacuum air (developed by the vacuum generator) and electric relays and vacuum switches. Therefore, any repair can be classified in one of five categories:

• **Electrical** • **Vacuum** • **Air Conditioner** • **Heater** • **Defroster**

The following information is provided to assist in troubleshooting common operational problems which may occur.

**No Heating:**

1. A/C switch is turned off.
2. Blower switch is turned off.
3. Verify the proper engine coolant level.
4. Verify that the engine is reaching operating temperature.
5. Verify engine coolant is reaching water valve attached to unit.
6. Verify operation of water valve to permit engine coolant to pass through valve to heater core.
7. Check unit fuses.
8. Check power supply to water valve and grounding.
9. Check wiring.
10. Engine thermostat faulty.

**No Cooling:**

1. Check blower is operating, A/C switch is in **A/C** or **Max** position, temperature control is turned to Max cooling (blue area).
2. System fuses are not blown.
3. Condenser fan is operating.
4. Check power supply to unit and grounding of system.
5. Check wiring.
6. Coolant valve is leaking.
7. Drive belt is loose or broken.
8. Compressor Clutch is inoperative, will not engage.
9. Expansion Valve is faulty or frozen.
10. Thermostat control is faulty.
11. Mode control switch is faulty.
12. Compressor is faulty.
13. Loss of refrigerant.

**Reduced Cooling:**

1. Coolant valve not operating correctly.
2. Air passages are obstructed.
3. Loose or worn drive belt.
4. Check blower and select switch.
5. Thermostat control valve is faulty.
6. Expansion valve is faulty.
7. Compressor is faulty.
8. Low refrigerant charge.

**Blower Does Not Operate or Runs Slow:**

1. Check fuses.
2. Check for loose or corroded connection.
3. Check wiring.
4. Check to ensure ignition switch is “ON.”
5. Check blower and select switch.
6. Motor shaft has seized.
7. Blower wheel is out of alignment.

**Damper Doors Do Not Operate:**

1. Does the motorhome air tank have pressure?
2. Is the vacuum generator being powered and producing a vacuum?
3. Check the vacuum line entering the unit for vacuum.
4. Check that the vacuum solenoid mounted on unit is receiving power from the mode switch. If operating properly, the vacuum solenoid will feel hot if current is engaging the solenoid.
5. Check the mode switch.
6. Check wiring.
7. Check for a pinch in the vacuum line leading to the vacuum motor that operates the damper door in question.

**Air Conditioner Refrigeration Components:**

**Compressor -** The compressor is belt driven from the engine through the compressor and electronic clutch pulley. The compressor will pump freon from a low pressure gas into a high pressure, high temperature gas. This is the start of the refrigeration process.

**Condenser -** The condenser in front of the radiator is made of coils and fins which provide rapid transfer of heat from the refrigerant as external air passes over the coils. The high pressure gas is changed to a high pressure liquid.

**Condenser Fan -** A steady flow of cooling air is maintained across the condenser during system operations. The fan is part of the hydraulic system.

**Receiver-Drier -** Freon leaves the condenser, enters the dehydrator and is stored until needed. The drier filters out moisture in the system. It only takes one drop of moisture to cause a malfunction in the cooling unit.

**Expansion Valve** - The expansion valve suppresses the refrigerant into the evaporator according to the cooling requirements. The pressure is reduced in the restrictive effort of the expansion valve. A part of the valve is the capillary tube assembly. The capillary tube is the sensing bulb at the outlet of the evaporator.

**Evaporator** - A tube core and fins are used in the evaporator similar to the condenser. Air is blown through the fins to allow the evaporator to cool and reduce the pressure.

**Blower and Motor** - Just as the condenser has a fan, the evaporator has a fan called the blower. The blower will draw air from the cab area and force the air over the evaporator coils and fins. This forced air will ensure continuous vaporizing of the R134a.

**Relays and Switches -** Both electronic and vacuum switches are used in the control and operations of the system.

## About Refrigerants

**Chemical Stability:**

The air conditioning system life and efficient operations depends upon the chemical stability of the refrigeration system. The refrigeration system is made of Refrigerant-R134a and Polyakylene Gycol (PAG) synthetic lubricant. It is very important that all materials contained within the refrigerant system be chemically compatible.

The only suitable compound for use with R134a is PAG. The total amount of PAG within the refrigerant system is approximately 18% of the total refrigerant in the system.

How much refrigerant is in the system? How much should be used when charging? You will need 1 oz. of PAG for each 7 feet of hose after the first 15 feet of hose. Roughly, a 40 foot motorhome will use 92 feet of refrigerant hose. Take 15 feet off the measurement and the result would be 77 feet. This 77 feet is then divided by 7 for total of 11. This represents the number of ounces of PAG oil needed for the A/C system (11 oz.).

Carrying the formula one step further, the 11 oz. equal approximately 18% of the entire system. The total will equate to approximately 61 oz. or 3.8 lbs. of R134a.

High pressure readings are another way to determine the amount of charge. The ambient temperature reading is measured one inch away from the condenser. The ambient temperature reading, plus 40° F, will equate to a value from the pressure table.

**EXAMPLE:**

**90° F. 1 inch from condenser + 40° F = 130° F ----- 198.90 PSIG -**

On fully charged system the expected pressure that should be seen on the HIGH-SIDE gauge will be around 200 PSIG.

**NOTE: All systems are charged at the factory with 4.0 lbs of R134A.**

| TEMPERATURE | PSI GAUGE | TEMPERATURE | PSI GAUGE | TEMPERATURE | PSI GAUGE |
|---|---|---|---|---|---|
| 16° F | 15.69 | 60° F | 57.47 | 112° F | 151.30 |
| 18° F | 17.04 | 65° F | 64.10 | 114° F | 156.10 |
| 20° F | 18.43 | 70° F | 71.19 | 116° F | 161.10 |
| 22° F | 19.73 | 75° F | 78.75 | 118° F | 166.10 |
| 24° F | 21.35 | 80° F | 86.80 | 120° F | 171.30 |
| 26° F | 22.88 | 85° F | 95.40 | 122° F | 176.60 |
| 28° F | 24.47 | 90° F | 104.40 | 124° F | 182.00 |
| 30° F | 26.10 | 91° F | 106.30 | 126° F | 187.50 |
| 32° F | 27.79 | 92° F | 108.20 | 128° F | 193.10 |
| 34° F | 29.52 | 93° F | 110.20 | 130° F | 198.90 |
| 36° F | 31.32 | 94° F | 112.10 | 135° F | 213.70 |
| 38° F | 33.17 | 95° F | 114.10 | 140° F | 229.40 |
| 40° F | 35.07 | 100° F | 124.30 | 145° F | 245.80 |
| 42° F | 37.03 | 102° F | 128.50 | 150° F | 263.00 |
| 44° F | 39.05 | 104° F | 132.90 | 155° F | 281.00 |
| 45° F | 40.09 | 106° F | 137.30 | 160° F | 300.10 |
| 50° F | 45.48 | 108° F | 141.90 | 165° F | 320.00 |
| 55° F | 51.27 | 110° F | 146.50 | 170° F | 340.80 |

psi gauge_temp

**R-134a Refrigerant:**

R-134a is classified non-explosive, non-flammable and non-corrosive.

There is hardly any odor and it is much heavier than air. R134a is ozone friendly; however, it is not technician friendly. Proper care in handling and adequate ventilation must be observed. Under normal atmospheric pressures and temperatures R134a will evaporate so quickly it will freeze anything it comes in contact with. The open container boiling point for R134a is minus 21.7º F. This low boiling point makes for an ideal refrigerant. The tremendous amount heat transfer which occurs when a liquid boils, or vapors condense, forms the basic principles of all A/C systems. The amount of heat required to raise or lower the temperature of one pound of water by 1º F equals one British Thermal Unit (BTU). The BTU is the standard measurement of an air conditioner system.

**Safety and Handling of 134A and Pag Oil:**

- When working with any refrigerant system wear eye protection and hand protection.
- Pag Oil irritates the skin. Flush with water immediately if in contact with any body part.
- Ensure any service work performed on the A/C system is in a well ventilated work area.
- Keep open flame away from service area. The discharge of a refrigerant gas near an open flame can produce a very poisonous gas.

**NOTE: O-rings used in a 134A system are Hydrogenated Nitrile Butadiene Rubber (HNBR). These are green in color and required for the 134A system.**

**A/C Heater:**

The A/C system will also produce heat to warm the air in the dash area. Much like the refrigeration side of the system, a liquid will be used in the process. This liquid is the engine coolant. The coolant is passed from the radiator to an electronic water valve. The water valve, when open, will allow the coolant to flow through the heater core. The heater core is tubing and fins. Air is drawn into the system by a blower motor through the outside recirculation door opening. Air is blown through the A/C evaporator core and then through the heater core. When the temperature control is in the **WARM** position coolant flows through the heater core. When the temperature is in the **COOL** position coolant flow bypasses the heater core. In either position the air flow is felt at the discharge vents.

**Diagnosis of Electric Water Valve:**

Theory of Operation: The thermostat is a potentiometer. The water valve, which controls the water flow to the heater core, is opened and closed by a stepper motor mounted on the water valve. A control module compares the output voltage from the potentiometer to the feedback for the stepper motor of the water valve. The control module then drives the motor to within one-half volt of the control potentiometer voltage.

**Functional Test:**

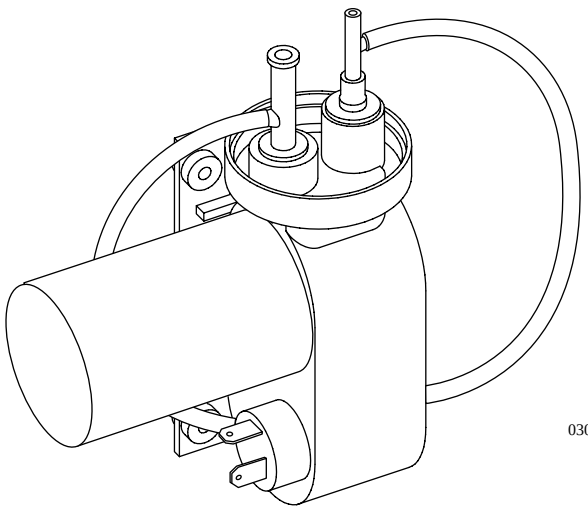
- Start and operate the engine until the water reaches normal operating temperature.
- Set the HVAC temperature control to the full hot position.
- The discharge air outlets should have hot air.
- Rotate the temperature control to full cold position.
- Allow 10 minutes for the temperature to stabilize.
- The discharge air outlets should have cold air.

**No Heat:**

- Check the blower and air mode operations. Repair prior to proceeding.
- Verify the engine is reaching normal operating temperature. (Check with engine manufacturer for proper procedure.)
- Check the inlet hose at the water valve. The hose has hot water at the valve inlet. The inlet water temperature should be the same as the engine water temp.
- With the temp control on full hot position, check the outlet hose of the water valve. The hose should be at engine water temperature.

**Vacuum Generator:**

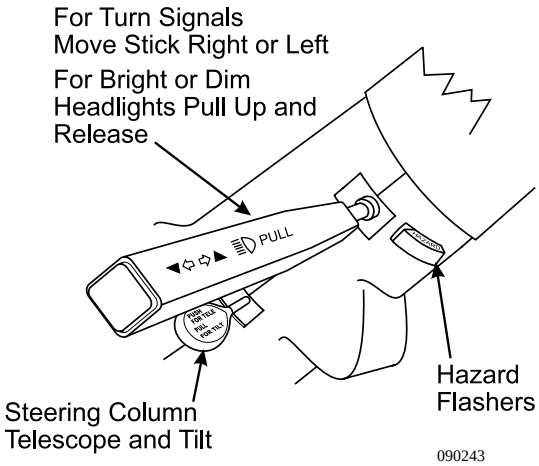
The vacuum generator is important to the operation of the dash heating and A/C systems. This provides the vacuum to open and close the vacuum switches. When the vacuum generator is operating it creates 15 inches of vacuum and is passed to a reservoir ball. Most dash heater and A/C systems will only require 10 inches of vacuum to operate the switches. The output from the reservoir is sent to the vent control knob. The control knob will then direct the vacuum operation to the appropriate vacuum switch to open or close vents and switches. The vacuum generator uses the air from the front air storage tank through a 1/4 inch red air line. Whenever the ignition is ON, and the A/C is operating, the vacuum generator will operate.



## STEERING COLUMN
### *Tilt & Telescope*

**Tilt and Telescope Steering Wheel Control Lever: Located on the Steering Column.**

- To tilt the steering wheel pull the lever up. Tilt the steering wheel where desired. Releasing the lever will lock the steering wheel in the new position.
- To telescope the steering wheel push and hold the lever down. Push down or pull up on the steering wheel until the wheel is in place. Release the lever and the steering wheel will lock in the new position.




**Turn Indicator and Headlight High/Low Dimmer Control Lever: Located on the Steering Column.**

- Pushing the lever forward will activate the right turn indicator circuits when the ignition is on.
- Pulling the lever down will activate the left turn indicator circuits when the ignition is on.
- Pulling the lever up will select high/low beam circuits when the headlights are ON.

**Hazard Flasher Button: Located on the Steering Column.**

- Pull out on flasher button to turn four way flasher on.
- Push button inward to shut off flasher.

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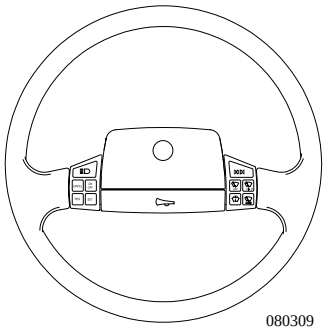
### *Smart Wheel Operation*

**City Horn:** Horn bar on the steering wheel sends the appropriate signal to cause the electric horn output to activate when the switch is pressed. It is recommended for city driving.

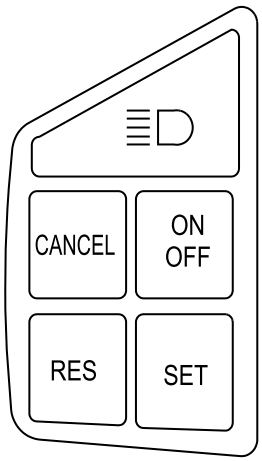



**Headlamp Flash:** If the headlamps are on, pressing the switch will cause them to go off while the switch is pressed. In a like manner, if the headlamps are off, pressing the switch will cause them to go on while the switch is pressed.

**Marker Lamp Flash:** If the marker lamps are turned on, pressing the switch will cause them to go off while the switch is pressed. If marker lamps are off, pressing this switch will cause them to temporarily illuminate.

**Cruise Functions:**

- **Cruise ON/OFF -** Cycles the Cruise system ON and OFF.
- **Cruise Set -** Actuates the Cruise Set function of the engine controller.
- **Cruise Res -** Actuates the Cruise Resume function of the engine controller.
- **Cruise Cancel -** Signals the cruise system to disengage without losing the current speed memory setting.



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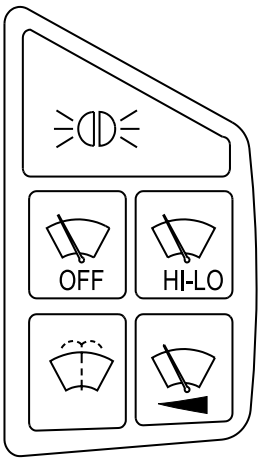
**WARNING: Do not use cruise control in heavy traffic or on roads that are winding, slippery or unpaved. Do not shift the transmission into "N" (Neutral) with the cruise control on. High engine RPM will occur until the system is turned off.**

**NOTE: Cruise Control can not be used if exhause brake switch is in the on position**

**Wiper Wash:** Activates the wash pump relay when the switch is pressed. In addition, if none of the latching wiper functions (Wiper Lo/Hi or Variable) had been previously selected, the Low Speed Wiper will be activated for a period of approximately three wiper cycles after the switch is released. If any of the latching wiper functions (Wiper Lo/Hi or Variable) had been previously selected, the wipers will continue to run in the selected mode after the wash switch is released. Washer reservoir is located in the front generator compartment.



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**Wiper LO/HI:** Causes the Low Speed Wiper functions to activate. If the switch is pressed again the High-Speed Wiper will be activated. Subsequent presses of this switch will cause alternate operation of the wipers in the low or high-speed mode.

**Wiper Variable:** The operation of this switch initially causes the Low Speed Wiper function to activate for one wipe. If the switch is pressed again within approximately 30 seconds, the Low Speed Wiper function will be activated again and will repeat at an interval determined by the time between the last two operations of the switch. Additional switch operations will shorten the cycle. Activation of any wiper mode cancels the variable mode. For example: In light rain or mist conditions the driver presses the switch once when windshield first needs clearing. When the windshield again requires clearing, the driver presses button again which will set the time period between subsequent wipes to that required by the current conditions.

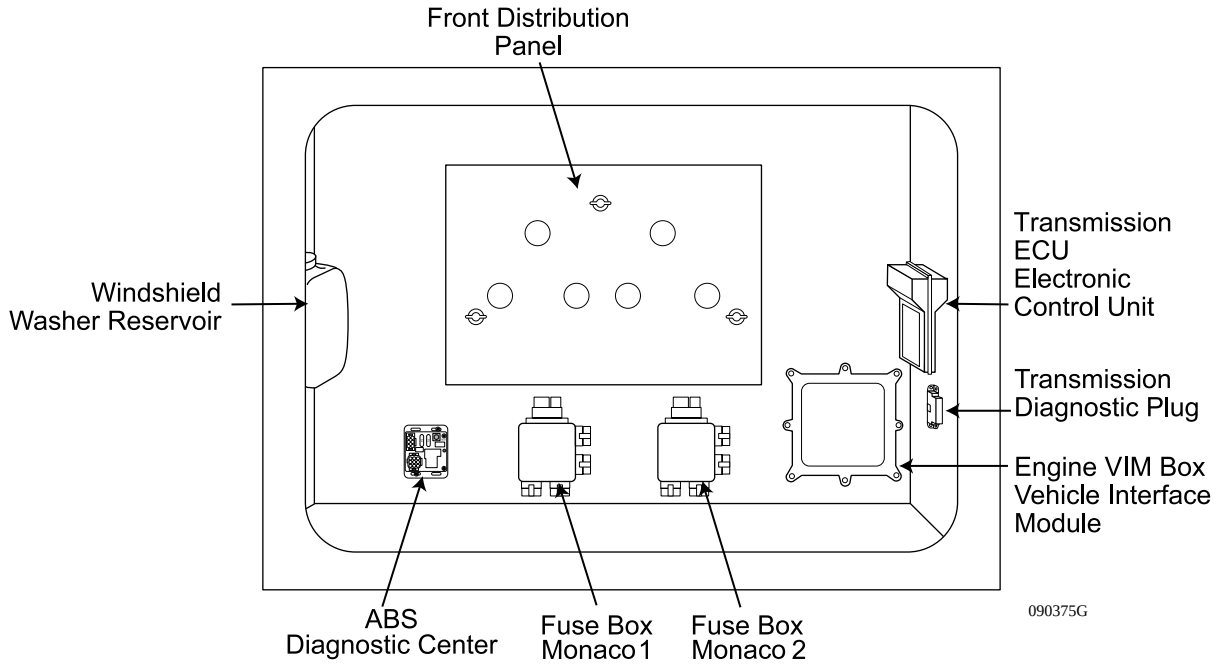
**Wiper OFF:** Causes all operation of wipers to be canceled. Turning off the ignition also resets this mode. Pull headlight switch to **ON** then back to **OFF** to cancel automatic headlight operation.

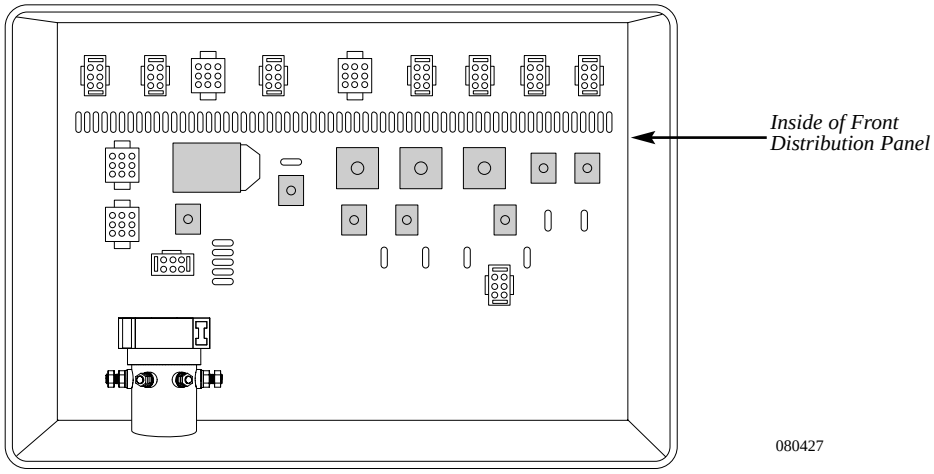
**NOTE: Headlights will come on when any wiper mode is selected.**

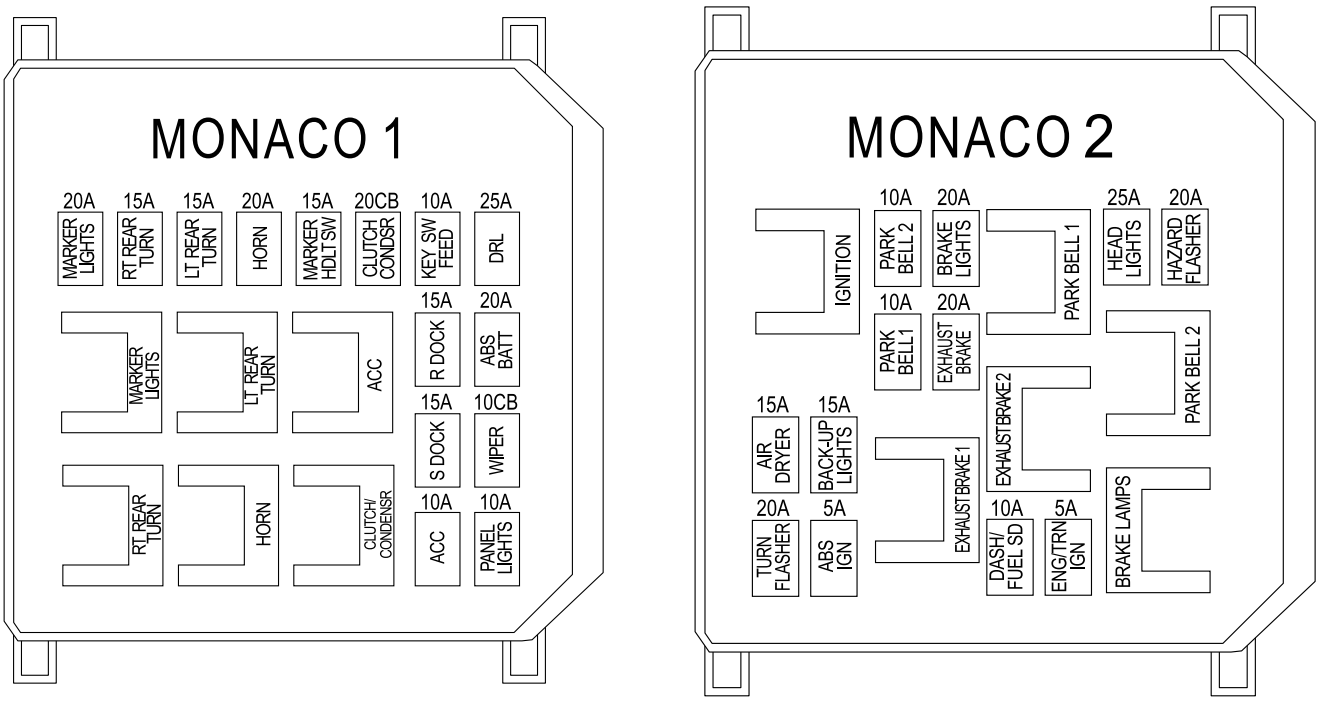
## FUSE & CIRCUITS *- Front Distribution Panel*

The front electrical panel is located in the outside roadside front compartment and contains the fuses, self resetting and manual reset supply circuit breakers, solenoid and relays.

The automotive fuses are located in the front electrical panel. The fuses are the standard plug-in type (ATM). When a fuse “BLOWS,” the wire in middle of the plastic case will be broken. A bad or blown fuse must be replaced with a fuse of the same rating and type. Using a fuse of a different type rating will defeat the circuit protection provided by the fuse, which could result in damage to the motorhome’s electrical system. If a fuse has been replaced and it “BLOWS” repeatedly, that may be an indication that a fault exists or an electronic component has failed. It is recommended that the motorhome be taken to a qualified RV technician before any future use to diagnose and repair the problem. Circuits are identified on the fuse label located on the inside of the electrical door. Remove 3 wing nuts, turn cover over to view.






P/N 03212843

| FUSE NO. | | DESCRIPTION | MAX FUSE SIZE |
|---|---|---|---|
| | | **CHASSIS** | |
| C401 (F) | 1 | STEP MOTOR | 25 |
| | 2 | STEP SWITCH | 7.5 |
| | 3 | AIR LEVELING | 15 |
| | 4 | CHASSIS READ OUT | 3 |
| | 5 | SPARE | 15 |
| | 6 | SPARE | 15 |
| C402 (D) | 7 | AIR HORNS | 15 |
| | 8 | STEP COVER | 15 |
| | 9 | SUNVISOR | 5 |
| | 10 | CB RADIO | 15 |
| | 11 | SPARE | 15 |
| | 12 | SPARE | 15 |
| | | **IGN #2** | |
| C403 (D) | 13 | DASH A/C | 20 |
| | 14 | JACK/ANT WARNING | 5 |
| | 15 | TV/LEVEL LOCK OUT | 7.5 |
| | 16 | MIRROR HEAT | 15 |
| | 17 | MIRROR MOTORS | 15 |
| | 18 | FOG/DRIV/DOCK LTS | 15 |
| | | **RELAY FUSE** | |
| C411 (F) | 59 | IGN LOC OUT | 10 |
| | 60 | IGN LOCK OUT | 10 |
| | 61 | SIDE DOCKING | 15 |
| | 62 | REAR DOCKING | 15 |
| | 63 | DO NOT USE RSVD | 5 |
| | 64 | DO NOT USE RSVD | 15 |
| | 65 | MARKER LIGHTS | 10 |

| FUSE NO. | | DESCRIPTION | MAX FUSE SIZE |
|---|---|---|---|
| | | **IGN #1** | |
| C404 (F) | 19 | STEP/ISO SENSE | 7.5 |
| | 20 | LEVELING JACKS | 15 |
| | 21 | SPARE | * |
| | 22 | SLIDE-OUT RELAY | 15 |
| | 23 | SPARE | 15 |
| | 24 | SPARE | 15 |
| | | **ACC #1** | |
| C405 (D) | 25 | REAR VISION | 5 |
| | 26 | OPEN | * |
| | 27 | ADJUSTABLE PEDALS | 10 |
| | 28 | SPOT LIGHT | 15 |
| | 29 | ACCESSORY | 15 |
| | 30 | AIR DUMP | 15 |
| | 31 | SPARE | 15 |
| | 32 | FOG LAMPS | 15 |
| | | **NON SWITCHED HOUSE 12 VOLT** | |
| C410 (F) | 66 | RADIO MEMORY | 10 |
| | 67 | REFER | * |
| | 68 | SPARE | 15 |
| | 69 | SPARE | 15 |
| | 70 | SNAP DISC | 5 |
| | 71 | HOUSE READ OUT | 3 |
| | | **CIRCUIT BREAKERS** | |
| | | INTERIOR FUSE PANEL | 50 |

| FUSE NO. | | DESCRIPTION | MAX FUSE SIZE |
|---|---|---|---|
| | | **SWITCHED HOUSE 12 VOLT** | |
| C406 (F) | 33 | POWER SEAT | 15A c.b. |
| | 34 | POWER SEAT | 15A c.b. |
| | 35 | STORAGE LIGHTS | 15 |
| | 36 | SERVICE LIGHT / LP SOL | 7.5 |
| | 37 | POWER CORD REEL (OPT) | 15 |
| | 38 | WATER HOSE REEL (OPT) | 15 |
| C407 (F) | 39 | SPARE | 20 |
| | 40 | BAY 12 V RECEPT | 15 |
| | 41 | DOOR BELL | 5 |
| | 42 | RESERVE SVC LIGHTS | 15 |
| | 43 | RANGE | 15 |
| | 44 | AWNING | 15 |
| | 45 | STEP WELL LIGHTS | 15 |
| | 46 | SPARE | 15 |
| C408 (F) | 47 | LP/CO DETECTOR | 3 |
| | 48 | FREEZER | 15 |
| | 49 | SPARE | 15 |
| | 50 | SPARE | 15 |
| | 51 | SPARE | 15 |
| | 52 | SPARE | 15 |
| C409 (D) | 53 | MAP LIGHT | 7.5 |
| | 54 | 12VOLT COMP RECEPT | 15 |
| | 55 | AUX START | 5 |
| | 56 | DASH FANS | 15 |
| | 57 | ALADDIN SYSTEM | 15 |
| | 58 | SERV LT / AUS 12 V PWR | 15 |

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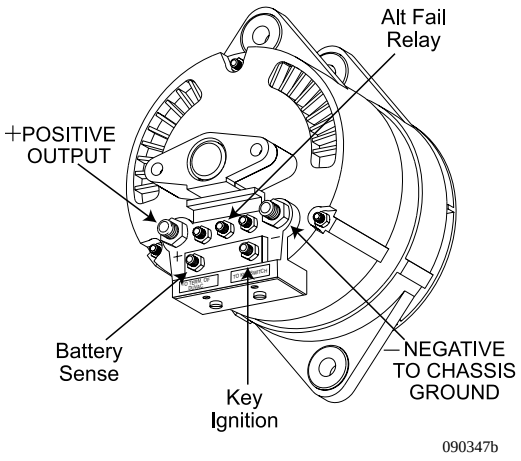
*Fuse label chart inside cover of distribution panel.*

## ALTERNATOR




The Leece-Neville alternator with integral rectifier, regulator and remote voltage sensor is designed for reliable output throughout the engine operating range. When traveling, keep an eye on the voltmeter in the dash area. Normal readings should be between 13 to 14.5 Volts. Voltage indications higher or lower indicate a problem with the charging system. If the alternator output drops below an acceptable level, a charge indicator warning lamp will illuminate.

The alternator charges or maintains the chassis battery used to start the engine. The amount of charge to the batteries is dependent on the amount of time the engine is operated. Repeatedly starting the engine and driving the motorhome for a short distance, or short periods, may not be enough operating time to adequately recharge the batteries hours necessary to start the engine.

### *Check Out Procedure*

The alternator also maintains a charge to the house batteries. The function of the alternator is an electrical system voltage maintainer, not a battery charger. When traveling, the alternator maintains electrical system voltage relative to any loads, such as headlights and windshield wipers. When a heavy load is placed on the alternator, such as trying to charge dead batteries, the operating temperature of the alternator increases dramatically. Excess operating temperature of the alternator for extended periods of operation can lead to premature failure of the alternator.

If the house batteries are in a low state of charge, or dead, before traveling it is recommended to charge the house batteries with the inverter/converter or an auxiliary battery charger.

**NOTE: Excessive loads applied to the inverter/converter could actually drain both chassis and house batteries during operation**

**Specifications:**

- 160 Amp standard
- The integral rectifier system utilizes 12:50 Amp diodes mounted in multiple aluminum heat sinks for efficient heat dissipation during high-output operation.
- Aluminum housings
- Bi-directional fan
- Front bearing: 305 cartridge type
- Enclosed brush system
- Operation Ambient Temperature Range (-40º to 200º F.)
- Negative Ground Configuration
- Regulator Adjustment Range 13.6 to 15.4 Volts
- Batteries may start to gas at 14.3 Volts
- Max. Operating RPM 8000

**Alternator Testing Procedure:**

- Check all wiring for burnt or loose electrical connections. Repair as needed.
- Check all grounds and electrical connections to be sure they are clean and tight.
    a. Alternator ground to chassis frame.
    b. Motor block ground to chassis frame.
    c. Chassis battery ground to chassis frame.

**Inspect the alternator for damage. A broken fan blade can damage an alternator or make it out of balance.**

- Check belt, pulley and fan for wear. Replace as needed.
- Never attempt to disconnect the battery or battery wire from the alternator with the engine running. This can cause damage to the alternator or the regulator.
- The pulley for the alternator should be torqued to 80 foot pounds.
- Chassis battery voltage, with the engine OFF, should range from 12.2 to 12.7 Volts DC.
- Chassis battery voltage with the engine at idle, should range 13.5 to 14.2 Volts DC.
- The output of the alternator range is 13.6 to 15.4 Volts DC. Connect a voltmeter to the (B+) terminal of the alternator and chassis ground. Idle the engine up to 1200 RPM.
- Connect a clamp-on amp-meter, if available, to the positive battery cable to verify the battery state/rate of charge.

**NOTE: Remember the alternator is not a battery charger, but designed to maintain proper electrical system voltage. A battery with a low state of charge, or a dead battery, may overheat and damage the alternator.**

## ~ NOTES ~

# Chassis Information

## section 10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## CHASSIS - INTRODUCTION

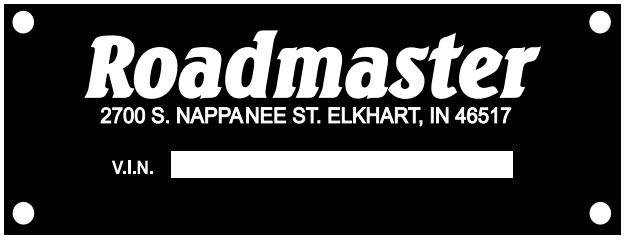
This section contains knowledge and information on various components of the motorhome chassis. Following the guidelines and procedures will help you to understand and operate your motorhome. Complete instructions for engine and transmission are located in their respective operators manual included in the Owner's Information File box.

**WARNING: When frame or other welding is involved for motorhome repair or modification, the following precautions are required to protect electrical components in the motorhome chassis.**

1. **Disconnect the (+) positive and (-) negative battery connection, and any electronic control ground wires connected to the frame or chassis.**
2. **Cover electronic control components and wiring to protect from hot sparks.**
3. **Disconnect the wiring harness connectors at the transmission electronic control unit.**
4. **Do not connect welding cables to electronic control components.**
5. **Attach the welding ground cable no more than 2 feet from the part to be welded.**

The Roadmaster chassis design provides exceptional balance, handling and braking characteristics. The Roadmaster chassis is an engine and frame unit featuring an all steel frame design, providing greater structural integrity and uniform stress distribution. Incorporated in the Roadmaster chassis is the air suspension system using eight air bags and Monroe gas shock absorbers. The design and set up is intended to provide the smoothest ride, best handling and trouble free service while delivering excellent drivability. The chassis has a three-point hydraulic leveling system. The Roadmaster chassis design offers unsurpassed ease of maintenance and service.

The towing system rating incorporated in the construction of the frame is 10,000 lbs. towing and 1,000 lbs. tongue weight.

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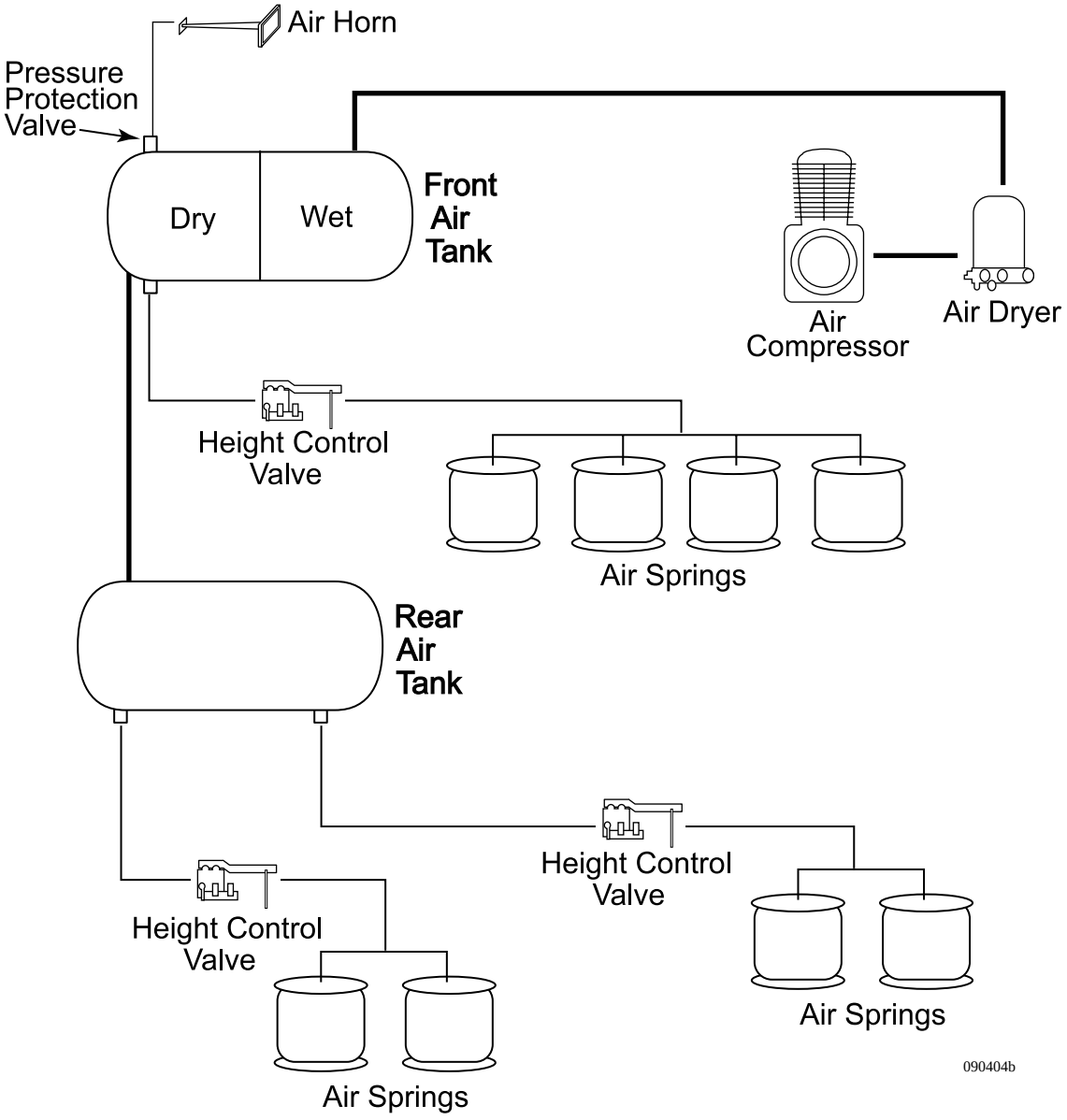
The Roadmaster's exclusive stacked-rail chassis with air suspension consists of front and rear axles, with trailing links. A panhard bar on each axle controls side motion. Each axle mounts to the trailing links that are connected to the chassis. The stacked-rail design of main chassis offers increased bay storage space. The suspension control arms attach to the frame through bushings, which require no lubrication. The preset suspension ride height automatically maintains proper suspension height throughout the load range.

## AIR SUPPLY SYSTEM

The air compressing system on the motorhome is comprised of several items: an air compressor, air governor, air dryer, a front air tank and a rear air tank. The compressed air system operates several items, some of which include brakes, suspension, air horns, air gauge. The air system is charged by a gear driven air compressor mounted on the engine. As engine speed increases, compressed air output increases. When the air is compressed, heat is generated. Heat dissipates as the air is discharged from the compressor. Moisture condenses in the compressed air as it cools. The moisture laden air then enters an air dryer where the air is filtered. The filtered air charges the front air tank. The front air tank is divided in two halves: a wet side and a dry side. The compressed air enters the wet side before entering the dry side. A discharge line from the dry side of the front air tank charges the rear air tank. Discharge lines use inline check valves to prevent back flow of compressed air.

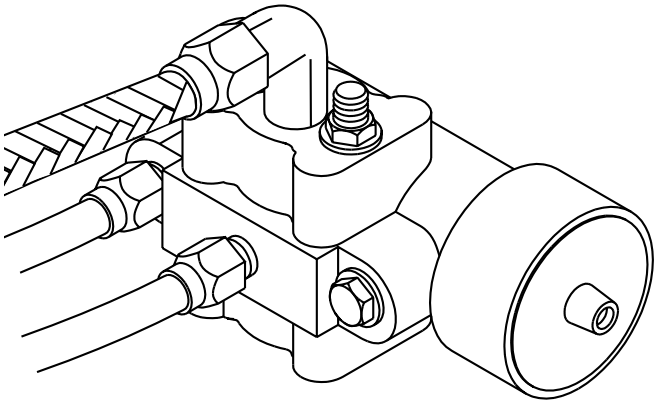


The pneumatically operated items are divided into two categories: brakes and accessory air. Brakes have full use of supplied air pressure. Accessory air items, such as air horns, receive air through pressure protection valves (PPV). The PPV will not allow compressed air flow until approximately 60 psi. In the event of an air system problem, the pressure protection valve will leave a reserve air charge for braking. Pressure protection valves are installed for safety.

## Air Govenor

The air governor, located in the engine compartment, regulates the air compressor to cut-in and cut-out, keeping the air system in the specified operating range of 105 to 120 psi, then sends an air "purge" signal to the Air Dryer.

Cut-in pressure of approximately 105 psi is factory preset from the governor manufacturer and is not adjustable. Cut-out pressure is calibrated to 120 psi. When cut-out pressure is reached, the governor will send an air purge signal to the Air Dryer. This opens the purge port of the Air Dryer, expelling moisture. The purge action of the Air Dryer is identified by the short release of air at the rear of the motorhome.



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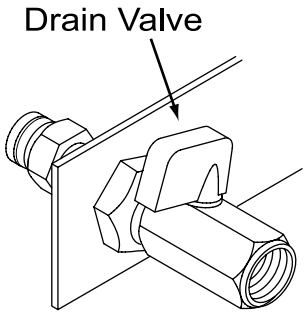
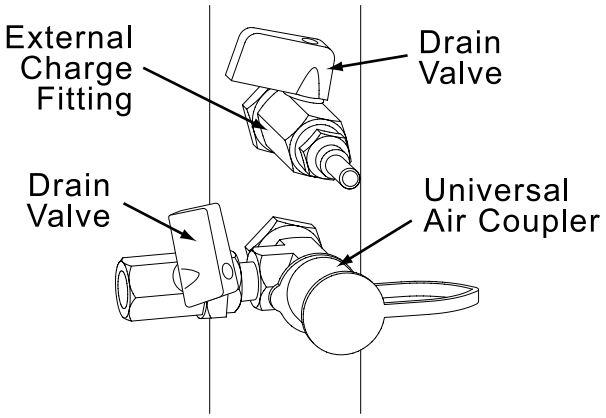
## Air Storage Tanks

The front and rear air tanks should be manually drained once a month, or more, depending on operating conditions where humidity is high. Open the drain valves until all air is purged from the tanks, allowing five extra minutes for moisture to be expelled. Remember to close the tank drain valves.




*Rear Tank Drain* 090435c




*Front Tank Drains*

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**Air Drains:**

Air system tank drains are located in the generator compartment and in the rear engine compartment. The air tanks should be drained at least once a month or more often in areas of high humidity and where temperature fluctuates 40º F. or more daily.

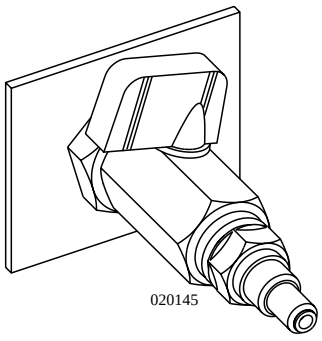
**To Drain the Tanks:**

- Slowly open the drain valves as moisture will be expelled under pressure. After all moisture and air is purged from the tanks, the valves should remain open an additional five minutes to allow any moisture remaining a chance to drain.
- Close valves and start engine. Check valves for leaks.

**WARNING: Wear safety glasses to prevent eye injury from expelled moisture. Open drain valves slowly as moisture will be expelled under high-pressure.**

**NOTE: Both air tanks have a pressure relief valve which are set to release at approximately 130 psi.**

## AIR SYSTEM CHARGING (EXTERNAL)




The air system on the motorhome can be charged from an external air supply source. Located in the front generator compartment is a type C automotive male fitting. Caution should be used when charging the air system from this fitting. The air supplied from an external source may contain moisture. Compressed air introduced into the air system from this fitting is not filtered by the air dryer. The auxiliary air charge fitting will charge the front and rear air tanks. A shut-off valve is installed to prevent air from escaping.

**CAUTION: The external air supply source should be regulated to charge the air system on the motorhome no higher than 120 psi. Damage to the air system or pneumatically operated items may occur.**

## Air Coupler

Provided for convenience is a remote air supply coupler located in the generator compartment. This female fitting will accept type C automotive. This auxiliary air fitting may be used to inflate tires, air mattresses or other pneumatic items. This fitting is not designed to charge the air system on the motorhome. The air supply for the auxiliary air fitting is charged from the front air tank through a pressure protection valve.

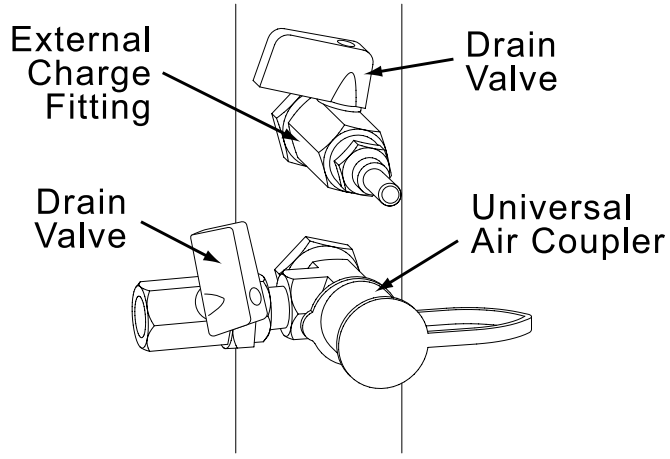
**To use this feature:**

- Slide the locking collar back. Using a firm grip, fully insert the air fitting into the auxiliary air supply. Release the locking collar to retain the air fitting after the fitting is properly inserted.

**To remove fitting:**

- Firmly grip the air hose near the fitting to prevent recoil.
- Slide the locking collar back to release fitting.

**NOTE: There are small air pressure restrictions in the pressure protection valve and tire stem valve. Due to this restriction, the maximum amount of tire pressure achieved when the system is used to fill a tire is approximately 95-105 psi with air system on the motorhome charged to 120 psi. Maximum outlet air pressure is achieved when the air system completes the fill cycle indicated by the purge cycle of the air dryer.**

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## BRAKE SYSTEMS - *Air Brakes*

The motorhome is equipped with air brakes using the same efficient system as over the road trucks. Proper maintenance and lubrication is the key to keeping the brake system in proper working order. The brake system on the motorhome is designed to accommodate the weight of the vehicle and towing loads. This system differs from a conventional automotive hydraulic braking system and should be treated differently.

When operating a vehicle equipped with air brakes consideration needs to be given to stopping distances and air system pressures. The heavier the vehicle, the greater the kinetic energy. The motorhome requires longer stopping distances. Each brake application uses air from the air system. Give attention to the air gauge as well as the surroundings. Engine speed is directly proportional to how fast the air system is replenished. Prepare for downhill grades. Grades are generally posted in percentages. It may be necessary to select a lower gear. Make use of the engine exhaust brake. When making brake applications use individual short applications down long hills rather than “riding” the brakes. This will extend the life of the brake lining. Avoid overheating the brakes. Hot brakes have less stopping power. When maneuvering the motorhome around in small areas, or backing into spaces, several individual brake applications might be made. Watch the air gauge. Plan ahead when parking to make it easier on yourself. When preparing to back into a space swing the motorhome so it is aligned with the parking slot before backing up.

The air braking system on the motorhome is equipped with several safety features unlike that of automotive hydraulic braking systems. One safety feature is a low air pressure warning system. Should a low air condition arise while the vehicle is under operation a warning buzzer will sound and a dash warning light will illuminate alerting the operator of the situation. This warning occurs at approximately 60 to 65 psi (pounds per square inch).

A simple mechanical explanation of what occurs when a brake application is made as follows: The air system supplies air to the foot brake, this is called a treadle valve. Pushing down on the treadle valve supplies an air charge signal to a brake chamber. This sealed chamber consists of a spring and air bladder. The air charge signal pushes on the bladder which extends a threaded rod connected to the automatic slack adjuster. The slack adjuster rotates the S-cam expanding the shoes against the drum. Air disc brakes follow much the same principle, with the exception of the S-cams.

## Park & Emergency Brake Systems

The park and emergency brake systems are combined and apply to the rear drive axle only. These are called spring brakes. When the park brake is applied, air is released from the rear brake chambers, allowing the large spring in each rear brake chamber to manually push the brake shoes against the drum. The air system must be charged above 35 psi so the park brake will remain released. Pushing down on the park brake handle charges the rear brake chambers with air pressure, overriding the emergency brake springs and releasing the brakes. In the event of air loss, while the vehicle is under operation, the park brake will automatically apply (this occurs at approximately 30 psi) acting as an automatic emergency brake system.

When preparing to depart, allow the air system to achieve full air pressure. This is indicated by the air gauge needles. Listen for the air dryer to purge, indicating full air pressure has been obtained and the air dryer is functioning. Look and listen for abnormalities. Abnormal air pressure readings by either needle of the air gauge should alert the operator. Have the air system checked to avoid an untimely failure.

Should a failure occur in the air system, preventing the air pressure from building, it may become necessary to "cage" the spring brakes. This is an emergency procedure only. Caging the rear air brake chambers manually overrides the spring brakes and allows the vehicle to move. This procedure does not affect normal service braking. (See Section 2 for details.)

**NOTE: When the park brake is released the Park illumination lamp will remain lit until air system pressure is above 65 psi.**

**WARNING: When parked, if the air tank is not depleted there is the possibility of an accidental release of the parking brake. Traveling with small children and/or pets may require a small block to be fabricated to prevent accidental release. The block should be placed under the knob on the dash panel. A wooden clothes pin, clasped at the base of the shaft, will work.**

### Brake Adjustment /Slack Adjuster

The motorhome is equipped with automatic slack adjusters. As brake lining wears, the slack adjusters will automatically ratchet on the return stroke as needed. This ratchet action will keep the brake lining at proper adjustment. Brake adjustment should not be necessary. Indications of a vehicle needing possible brake adjustment may be noticed by the park brake not holding on a hill, or gradual loss of braking power. Automatic slack adjusters and the connecting S-camshaft require periodic lubrication.

**NOTE: Replacement parts should be of the same original equipment size and type. Mixing brake components may result in unequal braking action. Brake adjustments are part of normal maintenance of the motorhome. Brake adjustments are not covered by the manufacturer.**

**WARNING: Brake lining may contain asbestos material and should only be serviced by qualified service technicians who are trained in the appropriate precautionary procedures. If any loss of braking effectiveness, or abnormal braking indications, are noticed the brakes and slack adjusters should be inspected by a qualified brake technician.**

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### Brake Systems - Back-up

The motorhome air braking system is equipped with several back-up safety systems and warning alarms in case of an air system failure. Refinements to air braking systems have been instituted with safety as top priority. For example: should the air compressor fail to charge the air system and the low air gauge readings go undetected, a low air pressure warning buzzer will sound and a low air pressure dash warning indicator lamp will illuminate. These warning indicators occur at approximately 65 psi. This will alert the operator of an impending situation. If the motorhome is allowed continued operation, the pneumatic emergency spring brake relay valve installed in the air system senses the low air pressure condition. The emergency spring brake relay valve will release the air charge from the spring brake air chambers on the rear drive axle. In this case, the park brakes will automatically apply at approximately 30 psi. This safety back-up system acts as an automatic emergency brake system.

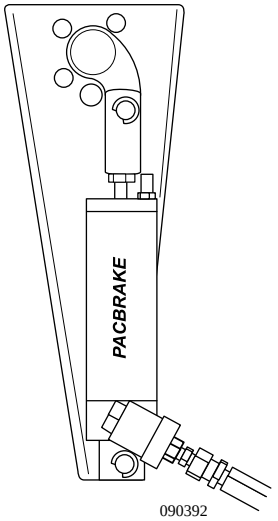
Another back up safety is the air system separation of the front and rear brakes, implemented by using two air tanks. One tank is located in the front and the other is located in the rear. This separation allows the front air tank to operate the front brakes; the rear tank operates the rear drive axle brakes. This tank division gives reassurance in case one tank experiences a failure of an accessory air item allowing the compressed air to escape.

Accessory air items are other pneumatically operated items such as the air horn, vacuum generator, etc. The accessory air items operate only when air tank pressures exceed 65 psi. This is done with pressure protection valves. Should an accessory air item fail, the pressure protection valve (PPV) reserves the remaining air pressure of 65 psi for braking. This will leave the motorhome with one air tank fully charged for safety back up.

In another situation, whereby all compressed air has escaped from the rear air tank, a pneumatic back-up safety valve is installed. This is the safety inversion valve. The inversion valve senses the absence of rear air tank pressure. In this case the inversion valve will allow the operator to make a modulated spring brake application, made in conjunction with the emergency spring brake relay valve. The inversion valve allows the front air tank pressure to recharge the rear brake chambers after the modulated spring brake application has been made. This back-up system implements use of all the brakes, allowing the operator to bring the vehicle to a safe stop. In case of all compressed air charge escaping from the front air tank, the operator will still have full use of the rear brakes.

## EXHAUST BRAKE

The Pac Brake exhaust retard system is an auxiliary braking device that is attached directly to the engine turbocharger. The exhaust brake operates by using a dash switch. The dash mounted switch will operate the exhaust brake when dash switch is "**ON**" and throttle is "**RELEASED**."



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When the exhaust brake is activated, a flapper inside the exhaust brake moves and restricts the flow of exhaust gases. This causes an increase of exhaust pressure within the engine. Increased exhaust back pressure quickly slows the engine speed resulting in powerful engine braking action. When the exhaust brake is activated, the amount of engine braking power developed is related to engine speed (RPM). When an exhaust brake application is made, the engine braking affect increases with higher engine RPM. The exhaust brake is wired to the electronically controlled transmission. When the exhaust brake is activated going down a hill, it will help control road speed or sufficiently slow the road speed until the Allison Transmission can automatically downshift to the next lower gear. Downshifting automatically occurs from high gear down to second gear. Certain road conditions and engine speeds may require the transmission be manually shifted down in order to generate adequate engine RPM and increase the engine brake effect.

**NOTE: The brake lights will illuminate while the PAC Brake is applied.**

**NOTE: Cruise Control will not engage with the exhaust brake switch in the ON position.**

## Maintenance

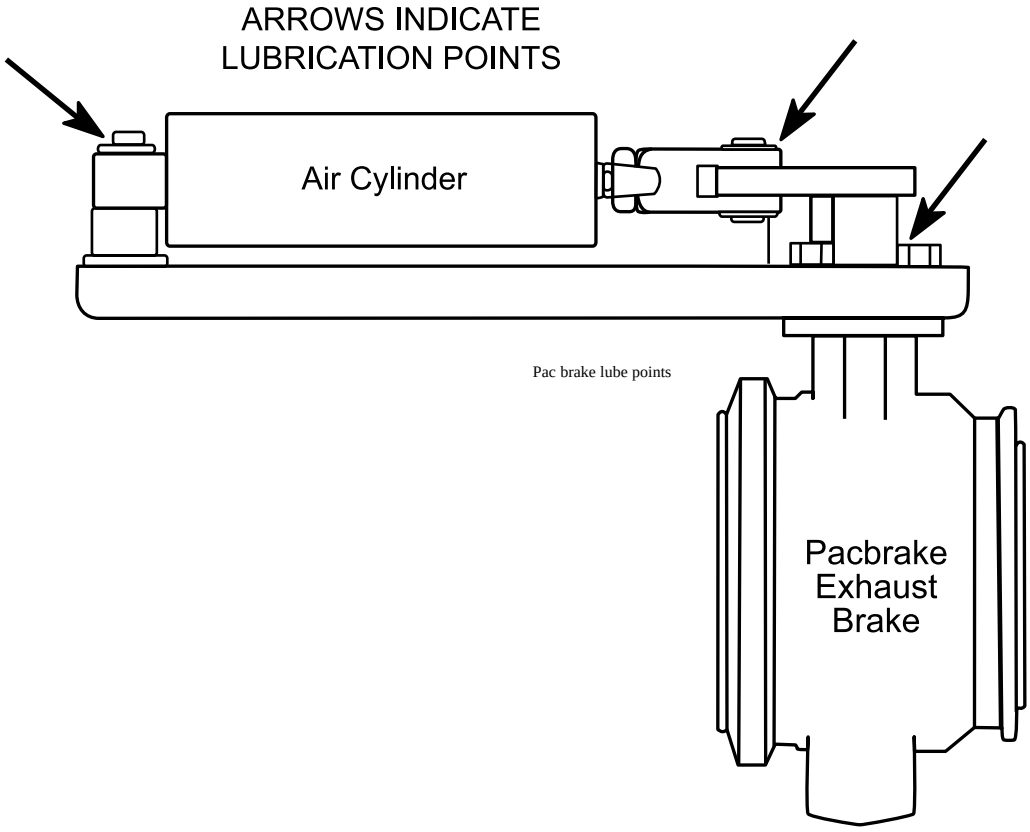
The exhaust brake system, used routinely at normal exhaust operating temperatures, is virtually maintenance free. There are contributing causes which can result in failures with the exhaust brake, including moisture, dirt, carbon, and improper usage.

Starting the engine and idling for short periods of time is not recommended. Moisture is created within the engine and the exhaust system during cold startups. When normal operating temperatures are not obtained, moisture may get trapped in the valve housing resulting in rust and leading to insufficient operation of the exhaust brake.

To help prevent exhaust brake freeze-up, caused by periods of non-use, it is recommended to use silicone spray at the points shown. Apply liberal amounts of silicone spray to the moving joints whenever the motorhome is parked for storage. Use a pair of pliers to manually operate the valve several times to work the lubricant into moving parts.

**NOTE: Do not use petroleum-based lubricants as these will burn off and possibly create a fire hazard.**

Some problems that may be encountered with the exhaust brake include, but are not limited to, will not activate or deactivate, intermittent on/off operations or actuates with the switch off. These are commonly related to electrical symptoms. Other problems such as slow operations, delays in operations, and limited performance are mechanical symptoms. Refer these problems to the dealer for diagnosis.



## AIR DRYER

The air dryer is located underneath the motorhome next to the transmission. The air dryer removes moisture from the compressed air system. This is important because if air contains moisture it can freeze and prevent operation of brakes or other pneumatic operated items.

The air dryer has three functions: cooling, filtering and drying the air going through the motorhome's air system. If an excessive amount of water is present when performing the monthly air tank drain service, it may be an indication that the filter for the air dryer needs to be changed.

**Operation:**

During system pressure build-up, compressed air passes into the air dryer where the filter system removes contaminants and passes the air into the drying stage. When the compressor unloads, the water is expelled and the dry air flows back through the dryer, drying the desiccant for the next cycle. Initially, moisture condenses in the base of the dryer. Moisture-laden air passes through the desiccant bed in the air dryer cartridge and is dried.

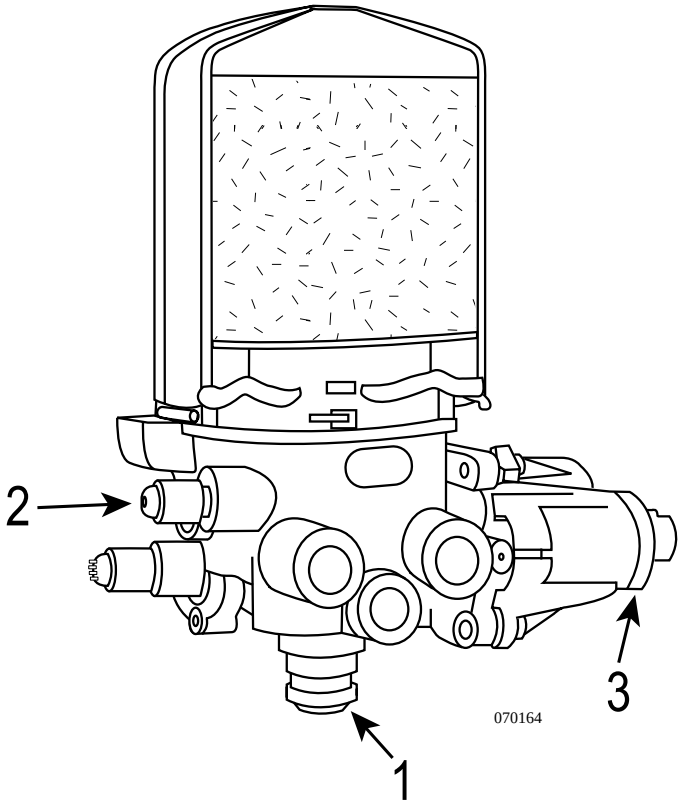
- The compressor intakes water vapor with the air. The water vapor condenses as it cools.
- The air dryer prevents water accumulation in air lines that could damage seals and valves and wash away lubricants.
- The air dryer also prevents water in the air lines that can freeze and damage air system components.

**Air Dryer Components**:

1. **Purge Valve:** A valve located on the bottom of the air dryer base that remains open during a compressor unload cycle. The purge valve allows collected moisture, condensation and contamination to be expelled from the air dryer during the purge cycle.

2. **Pressure Relief Valve:** Protects the air dryer from over-pressurization.

3. **Regeneration Valve:** Controls regeneration of the desiccant. The regeneration valve allows air from the supply and secondary tanks to bypass the outlet check valve. The air expands and back flushes moisture off the desiccant through the dryer's purge valve.




In extreme cold, verify that the air dryer heater is in good working order. The heater in the air dryer is a 100-watt heater controlled by ignition power and turned off when the ignition is switched off. The heater turns on below 45° F and off when the air dryer temperature is above 86° F. The fuse is located in the front electric bay, roadside.

**WARNING: Remove all pressure from the air system before disconnecting any component, including the desiccant cartridge. Pressurized air can cause serious personal injury.**

## Desiccant Cartridge

1. The replacement kit contains one cartridge and one O-ring.
2. Place wheel chocks firmly against wheel before removing cartridge.
3. Remove all air pressure from the air system.
4. Loosen and remove the old cartridge. Use a strap wrench, if necessary.
5. Remove and discard the O-ring from the dryer base.
6. Inspect and clean the seal seat. Repair any minor damage.

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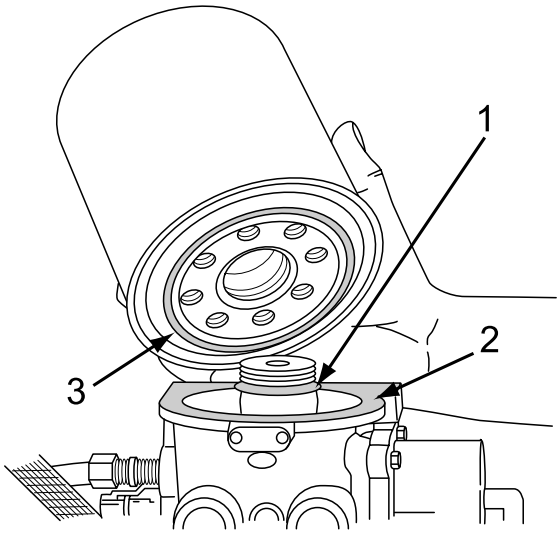
**NOTE: If the seats are damaged so badly that a tight seal cannot be maintained, replace the air dryer.**

7. Lubricate the O-Ring on the stem with a thin layer of grease.
8. Lubricate the cartridge seal with a thin layer of grease.
9. Thread the replacement cartridge onto the base until the seal touches the base. Tighten the cartridge ONE additional turn. **DO NOT OVERTIGHTEN.**




1. O-Ring
2. Seal Seat
3. Seal

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| REPLACEMENT REQUIREMENTS | | |
|---|---|---|
| **Components** | **When to replace** | **Why** |
| Desiccant Cartridge | Every two to three years. When compressor is replaced. Water in supply tank. | Preventive maintenance. Contaminated cartridge. Saturated or contaminated cartridge, high duty cycle (wrong application of air dryer). |

### Desiccant-Type Air Dryer

1. Warm, humid air from the compressor condenses into either water or water vapor before entering the air dryer.
2. A desiccant-type air dryer protects the motorhome air brake system by drying moisture-laden air before it passes through the air reservoirs and into the brake system.
3. Water collects in the base of the dryer when warm air condenses the water before it enters the dryer, or inside of the dryer before the water reaches the desiccant.
4. The desiccant material then removes additional water vapor, further drying the air.
5. During regeneration phase, the regeneration valve and pressure-controlled check valve remove water from the desiccant bed with a backflow of dried, expanded system air.

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### Air Dryer Cycle

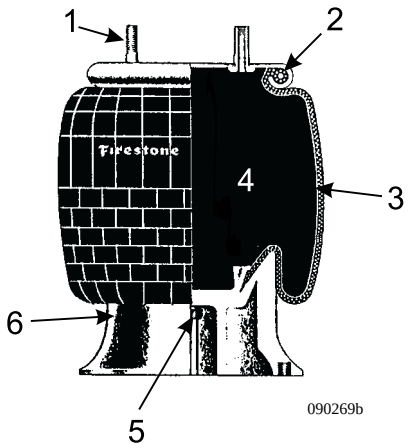
The governor turns the compressor on when the supply tank pressure drops below cut-in pressure. Compressed air passes into the air dryer at the inlet port:

1. Moisture-laden air and contaminants pass through the desiccant.
2. Moisture is retained by the desiccant. Moisture also collects in the base of the dryer.
3. When the compressor unloads the purge valve opens. The governor turns the compressor off when the system reaches cutout pressure (approximately 120 psi).
4. The dryer purges and expels water collected in the dryer base.
5. When the regeneration valve opens, the dry system air flows back through the dryer. A small charge of air from the front tank back flows through the filter. The backflow dries the desiccant, preparing it for the next cycle.

## AIR SPRINGS

Air ride springs are available in single, double and triple convolution types plus reversible sleeve models for virtually every conceivable heavy-duty vehicle suspension application.

1. **STUD:** Manufactured as a permanent part of bead plate assembly for maximum strength and durability. Used to attach spring to the vehicle's suspension.
2. **BEAD PLATE:** Crimped onto bellows at the factory for a durable design and maximum quality control. Allows 100% leak proof testing prior to shipment.
3. **BELLOWS:** "Air bag" includes four plies of material: an inner layer, two plies of cord-reinforced fabric and an outer cover. Natural rubber construction provides functional properties up to - 65º F.
4. **BUMPERS:** A solid rubber or engineered plastic device designed to prevent significant damage to the vehicle or its suspension in event of a sudden loss of air pressure in spring.
5. **PISTON:** Provides a lower mounting arrangement for air spring. Controls characteristics of spring under changing pressure loads.
6. **PISTON BOLT:** Attaches piston to bellows. Sometimes extended as a means of attaching spring to vehicle suspension.



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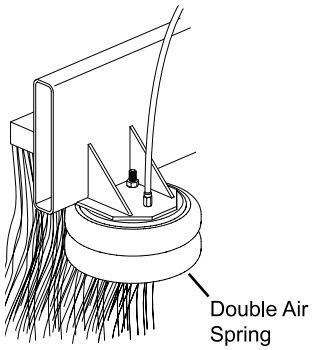
## *Air Bag Inspections - Checklist*

Listed below are items that can be checked when the motorhome is in for periodic maintenance.

**NOTE: Never attempt to service the air suspension on a motorhome with the air bags inflated.**

- **Inspect** the OD of the air springs. Check for signs of irregular wear or heat cracking.
- **Inspect** the air lines to make sure contact does not exist between the air line and the OD of the air springs. Air lines can rub a hole in an air spring very quickly.
- Check to see that there is sufficient clearance around the complete circumference of the air spring while at its maximum diameter.
- **Inspect** the OD of piston for buildup of foreign materials. (On a reversible sleeve style air spring, the piston is the bottom component of the air spring.)
- The correct ride height should be maintained. All motorhomes with air springs have a specified ride height established by the manufacturer. This height should be maintained within ¼ in. This dimension can be checked with the vehicle loaded or empty.



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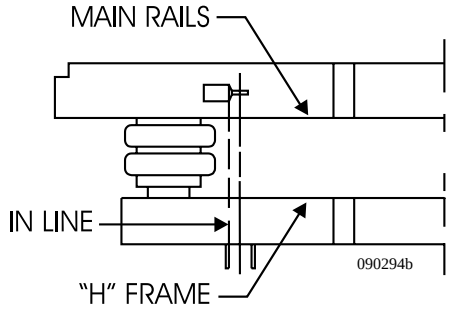
- The leveling valves (or height control valves) play a large part in ensuring that the total air spring system works as required. Clean, **inspect** and replace if necessary.
- Make sure to check shock absorbers for leaking hydraulic oil and worn or broken end connectors. If a broken shock is found, replace it immediately. The shock absorber will normally limit the rebound of an air spring and keep it from over extending.
- Check the tightness of all mounting hardware (nuts and bolts). If loose, tighten. Do not over-tighten.

**Cleaning:**

The approved cleaning method is to use soap and water, methyl alcohol, ethyl alcohol and isopropyl alcohol. Unapproved cleaning methods include all organic solvents, open flames, abrasives and direct pressurized steam cleaning.

## RIDE HEIGHT VALVES




**NOTE: Ride height measurements:**
**Front - 8 ¼”**
**Rear - 8 ¾”**

Three height control valves (HCV) inflate or deflate the air springs maintaining the proper suspension height throughout the load range. Two valves are used at the drive axle. These valves control rear suspension height and left or right tilt of the motorhome. One valve controls the front suspension height. The height control valves mount to the main frame of the motorhome above the axles with a linkage rod connecting the valve to the axle.

The actuating components inside the valves are oil dampened to reduce valve reaction to momentary suspension bounce and rebound. When a constant suspension change occurs, such as a load change or weight transfer through a sustained corner, the valve reacts adding or purging air from the air springs as needed.

The air springs mount between the main frame rails and the trailing links. The air spring must maintain a specified distance between the mounting plates. Other than specified distance between the plates not only compromises ride quality and handling, it adversely affects shock absorber travel, drive shaft angle and various other running gear components.

Should it become necessary to check the suspension ride height, start with the motorhome on a flat level surface. The air system must be fully charged with the suspension normalized at ride height. Specified distances may vary plus or minus ¼". Small offset adjustments to the rear valves may be necessary to compensate for slight tilt. Example: Adjusting the curbside rear height control valve up will pivot the roadside front corner down.

**NOTE: Drive shaft angle is affected by the suspension ride height. Improper drive shaft angle can damage suspension or shorten the life of universal joints. Shock absorbers and air springs are in travel centers at proper ride height.**

## *Adjusting*

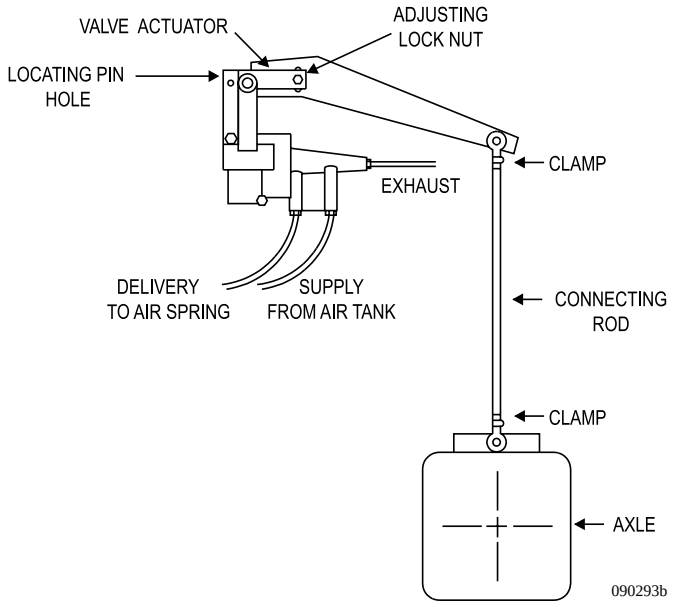
**To adjust the suspension ride height begin with:**

- The motorhome on flat level surface.
- Air system fully charged.
- Suspension at normal ride height.

**Start by checking the distance in the front.**

1. Measure the distance between the lower air bag mounting plate and the upper air bag mounting plate of the air springs.
2. If the measurement is off, loosen the adjusting lock nut at the eccentric slot on the valve.
3. Move the plastic arm up to raise suspension height, this will inflate the front air springs. Move the plastic arm down to lower suspension height, this will deflate the air springs. Make adjustments in small increments.
4. After obtaining the specified distance, insert a 1/8" or 7/64" inch twist drill bit into the plastic arm and valve body. This will center the travel of internal piston. Tighten adjusting lock nut between 60-80 in/lbs.
5. Check adjustments made by using the Air Dump switch to deflate air springs. Start the engine and allow the air system to become fully charged. Allow the suspension to reach a neutral setting.
6. Re-check the suspension height measurement. Follow the same procedure for each rear control valve.
7. Re-check the front suspension height after adjusting the rear height control valves.

**NOTE: Do not modify length of the linkage rods. Make any necessary adjustments using eccentric slot on the ride height control valve.**



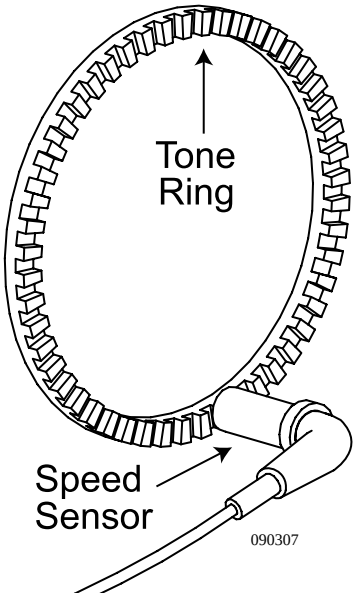
## ABS/ATC SYSTEM *(Anti-lock Brakes)*

The motorhome is equipped with an anti-lock braking system (ABS) and automatic traction control system (ATC). The ABS system monitors wheel rotation speeds by using a 100-tooth magnetic tone ring mounted to the hub. Revolving with the wheel, the magnetic tone ring is polarized giving positive and negative pulsations. A stationary sensor is mounted adjacent to the tone ring monitoring the magnetic pulses. The pulses are monitored by the ABS electronic control unit (ECU).

The ECU monitors all available wheel sensors at the rate of 100 times per second. The ECU controls Pressure Modulator Valves. Pressure Modulator Valves have two electric over air solenoids, a hold solenoid and a release solenoid. The modulator valves are open under normal braking, allowing a straight through air signal from the treadle valve to the brake chamber. Should a wheel lose traction under a braking application, the ECU will energize the hold solenoid of the Pressure Modulator Valve to interrupt the air signal from the treadle valve to the brake chamber. The release solenoid vents the existing air signal, at the brake chamber to the atmosphere, allowing the skidding tire to regain traction. Skidding tires have less tractive efficiency. It is possible, under certain conditions, to have the wheel(s) skid with a normal functioning ABS system.

The ABS itself does not apply additional braking power. The purpose of the ABS is limiting brake torque to prevent wheel locking that results in the loss of lateral stability, and increased stopping distances. Cautious driving practices and maintaining adequate safe distances when following vehicles is the key to safe vehicle operation.

**WARNING: The ABS/ATC system is designed to increase tire to road surface traction. The system cannot overcome naturally occurring laws of physics. The ABS/ATC system combined with safe driving practices reduce the possibility of wheel skid and loss of lateral stability.**




**ABS Component Function:**

- Speed sensors and tone rings on each wheel monitor wheel rotation.
- Each speed sensor communicates wheel rotation pulses to the Electronic Control Unit.
- ECU receives the speed sensor inputs, interprets the signal pulses, calculates speed and acceleration rates of each wheel.
- Based on the speed sensor input, the ECU detects impending wheel lock and operates the ABS Modulator Valves required for proper control. The Modulator Valves can be operated in the air, release or hold modes to regulate air pressure to the brake chambers.
- The braking force is applied at a level which minimizes the stopping distances while maintaining as much lateral stability as possible.

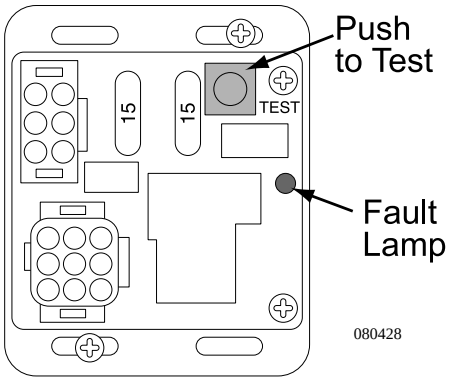
**ABS Warning Lights:**

The ABS will perform a dash indicator lamp check and self-diagnostic test each time the ignition is switched to the on position.

- When the ignition is turned on, the ABS indicator illuminates momentarily (2.2 seconds), verifying the self-diagnostic test. If the ABS light illuminates while the motorhome is being operated, there is a fault in the anti-lock brake system on the drive axle or steer axle. This fault will not affect normal service braking. The motorhome will need to go to a service center to repair the problem.

**ABS Diagnostic Button:**

By properly actuating the test button on the ABS diagnostic center, system configuration codes and fault codes can be retrieved as blinked sequences on the fault lamp. System configuration codes are sequences of four blinked digits while fault codes are sequences of two blinked digits. Refer to an authorized Eaton/Roadranger for a list of blink code sequences. If the test button is not pressed correctly for a specific readout, stop and start over at the beginning of the procedure. All blink codes are displayed by the ABS warning light only. The ATC light does not display blink codes.

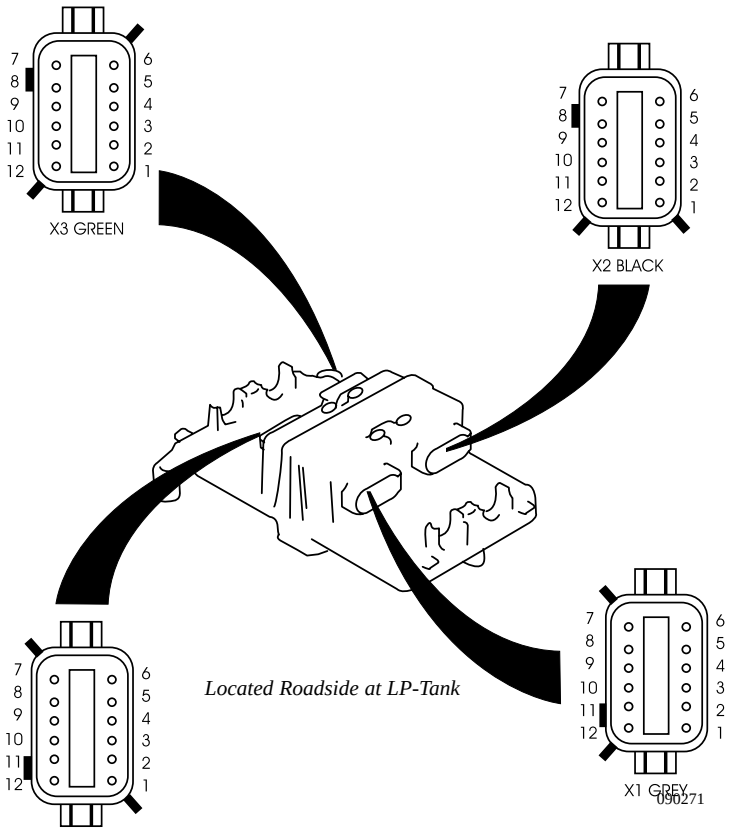



*Located in the Front Electrical Panel.*

**NOTE: All blink codes are displayed by the ABS warning light only. The ATC light does not display blink codes.**

**NOTE: Contact a certified Eaton service repair center at (800-826-4357) for more information.**

1. Write down system configuration codes and fault codes.
2. If the system configuration is correct, clear the fault codes. The process for clearing the fault codes and reconfiguring the ECU is the same when using the diagnostic button.
3. After clearing fault codes, retrieve the fault codes once again to make sure inactive fault codes were cleared. Only active codes will now be displayed.




*Located Roadside at LP-Tank*

**Reading Configuration Codes:**

1. Turn the ignition key to ON.
2. Apply and release brakes once before proceeding.
3. Press and hold the diagnostic button for two seconds and release, immediately press the diagnostic button a second time for two seconds and release.
4. The four-digit configuration code is retrieved and displayed. It should read 1-2 pause 4-5.

**Retrieving Fault Codes:**

1. Turn the ignition key to ON.
2. Apply and release brakes once before proceeding.
3. Press and hold the diagnostic button for two seconds and release.
4. Two-number blink codes are retrieved and displayed. A two-digit display of 1-1 indicates no faults; the ABS system is functioning properly.

**Clearing Fault Codes and/or System Configuration:**

1. With the ignition OFF, press and hold the diagnostic button.
2. Turn the ignition key to ON while pressing the diagnostic button.
3. Wait two seconds and release the diagnostic button.
4. Press and release the brake pedal.
5. The ECU is reconfigured to match connected components and fault codes are cleared.
6. Repeat the "Retrieving Fault Codes" procedure to verify that fault codes are cleared.

**Disabling ATC for Dynomometer Testing:**

1. Turn the ignition key to **ON**.
2. Press and hold the diagnostic button for at least 3 seconds and release.
3. The ATC light turns **ON** and the fault lamp blinks **17-8**, indicating the ATC system is disabled. All subsequent flashes are active ABS fault codes.
4. The ATC system will be enabled when the ignition is switched off then back to on.

## Automatic Traction Control System

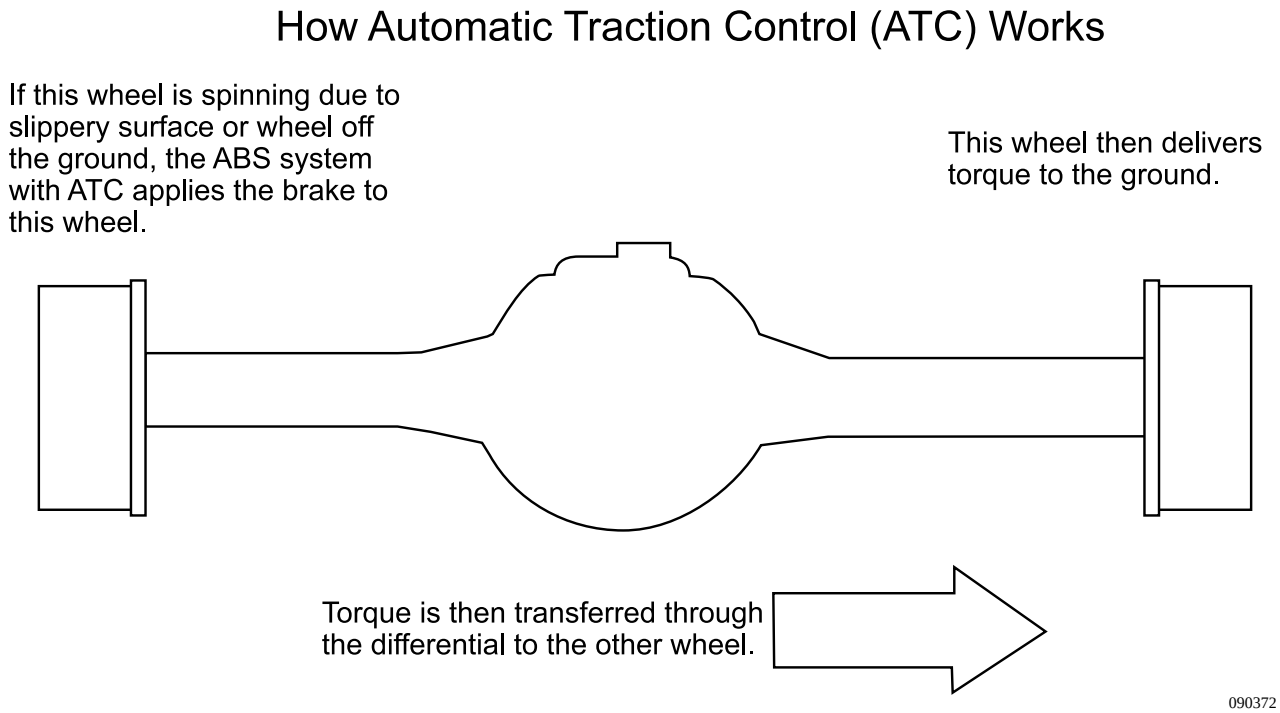
The ATC system improves traction on slippery or unstable road surfaces by limiting excessive drive wheel slip. This is accomplished by limiting engine torque to the drive wheel or engaging a brake to the spinning drive wheel. During normal operation engine torque is not affected. The ATC system works in conjunction with the ABS Electronic Control Unit. The ECU monitors tone ring speed of the drive wheel in relation to the other wheels. If a speed differential occurs in the drive wheel, the ECU enters Automatic Traction Control mode.

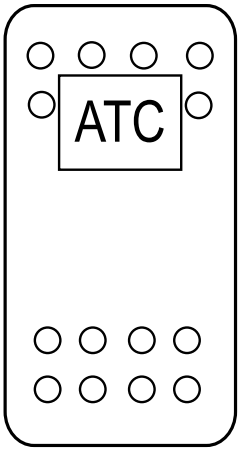
During an ATC event, the ECU will automatically react to optimize traction and safety if the motorhome encounters a slippery road surface. Engine torque is normally reduced to limit drive wheel slip.

**NOTE: The ATC system is always active.**

**ATC reacts to drive wheel slip by:**

- Reducing engine torque to the drive wheel if road speed is above 25 mph.
- Reducing engine torque and activating drive axle brake controls if road speed is below 25 mph. If the brake control activates, it remains active regardless of road speed.






080331

**ATC Switch:**

Activating the ATC switch reduces ECU control over engine torque. Momentarily pressing the ATC switch allows the ECU to increase the amount of engine torque applied to the drive wheel in an ATC event. The amount of engine torque applied to the drive wheel will vary with the amount of drive wheel slip versus road speed. In an ATC event, the ECU remains active regardless of road speed or switch position. The indicator light flashes slowly when the ATC switch is activated.

**ATC Indicator Light:**

During normal operation, the ATC indicator light will illuminate steady when the ignition key is turned ON. The light remains illuminated until the first brake application. If an ATC event occurs, the indicator light will flash quickly. The indicator light will flash slowly if the ATC switch is activated.

**CAUTION: Normally the switch should remain inactive. During an ATC event (drive wheel slip) the ECU will automatically optimize drive wheel traction in most situations. Activating the switch during periods of wheel slip can increase torque to the spinning drive wheel. Drive train damage can occur if the spinning drive wheel should suddenly regain traction. If the motorhome is stuck it is advised to call a professional towing company to limit the possibility of body and drive train damage.**

## FRONT AXLE *- Steering System*

The motorhome is equipped with power steering. Power steering uses hydraulic pressure to assist rotating the output shaft of the steering gear. Located at the end of the input shaft of the steering gear is poppet valve and worm drive. The poppet valve directs the hydraulic fluid pressure to a type of spool. The worm drive threads into the center of the spool. When in the center position, pressurized hydraulic fluid bypasses the spool. When a turn is made, the poppet valve shifts to one direction or the other, directing the hydraulic pressure to one side of the spool depending on turning direction. The hydraulic fluid is then cooled before returning to the reservoir.

**INSPECT: For signs of leakage when performing fluid level checks.**

When the operator turns the steering wheel the steering shaft causes hydraulic power from the pump to move the sector shaft of the steering gear. This movement of the sector shaft is then transferred to the front axle and tires through the steering linkages.

While driving the motorhome, be aware of any changes in the feel of steering and have the system checked if there are any apparent differences. It is normal to hear some hydraulic noise from the steering, especially when the steering is at maximum or while turning the wheel when the motorhome isn't moving. Investigate any unusual or loud noises that occur. Begin by checking the level of the hydraulic fluid level. Traveling at slow speeds over rough surfaces may cause a "clunking" noise to emanate from the steering column, but if noise is heard on smooth surfaces while turning back and forth sharply, the noise should be inspected and a cause determined.

Shimmy and looseness should be checked and corrected as soon as possible. If any looseness is felt in the steering, the steering linkages can be observed while someone turns the steering wheel left and right. Watch the linkages for any evident play or uneven interaction between components to help pinpoint a problem. Have the steering system checked for damage after a severe impact, such as striking large potholes or curbs, and front-end collisions. Observe the alignment of the steering wheel spokes; a change in the alignment may indicate damage to the steering components or suspension.

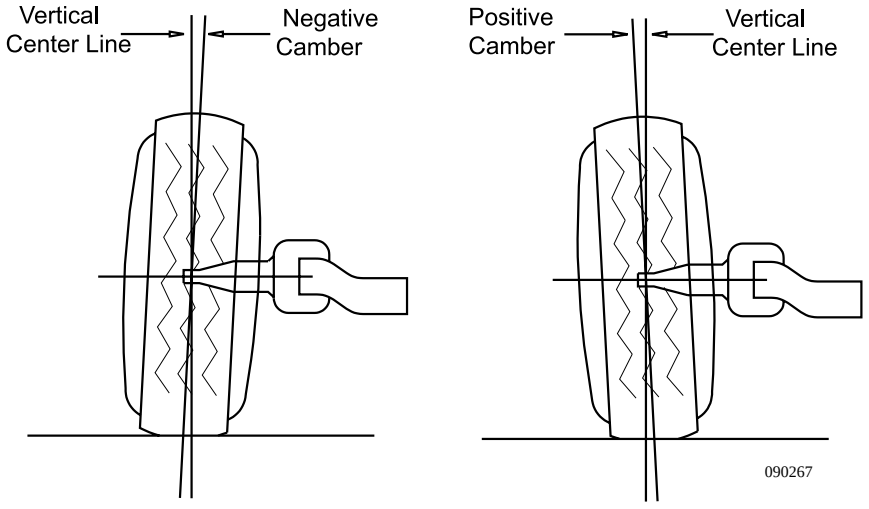
Maintenance for the system entails adequate lubrication of the system. Use only a hand operated grease gun on the fittings. Grease fittings for the steering system are found on the both ends of the drag link (the bar connecting the steering gear to the axle), and on the steering drive shaft located between the steering wheel and steering gear. The correct wheel alignment promotes longer tire wear and ease of handling while minimizing the strain on the steering system and the axle components. Use NLGI #2 Lithium soap base lubricant for all steering linkage and brake components.

## *Alignment Specifications*

**Camber:**

Camber, as shown, is vertical tilt of wheel as viewed from the front of the vehicle. This is machined into the axle when manufactured and is not adjustable.

- “Positive” camber is an outward tilt of the wheel at the top.
- “Negative” camber is an inward tilt of the wheel at the top.



**Toe Setting:**

The toe setting represents different distances between the front and rear of the tires (measured at the vertical center line of the tires).

**Toe-in**:

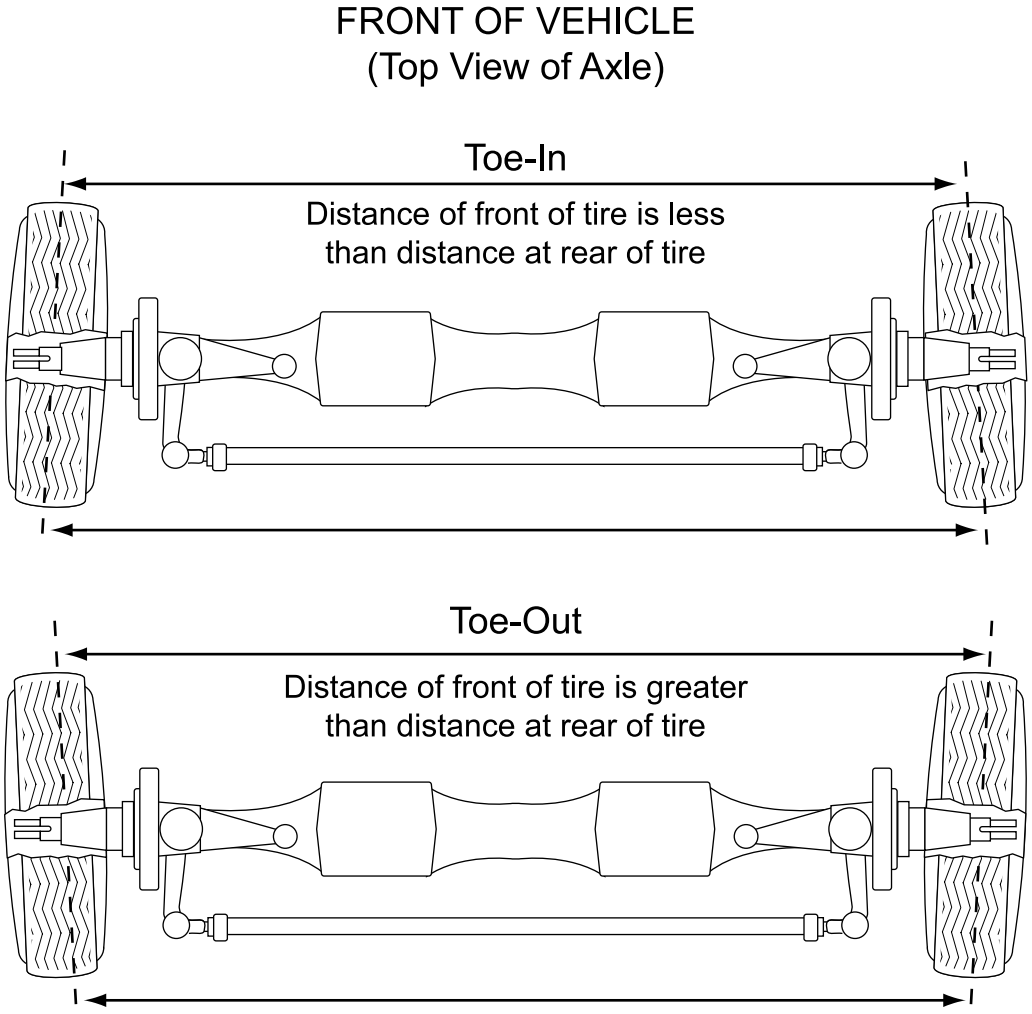
Occurs when the tire front distance is less than the tire rear distance.

**Toe-out:**

Occurs when the tire front distance is greater than the tire rear distance.

Wheels are generally set with initial toe-in. As the vehicle operates tires tend toward a toe-out condition. By starting with an initial toe-in setting, a desirable “near zero toe-in” can be achieved when the vehicle is in motion.

Incorrect toe settings, where toed-in or toed-out, can have a significant affect on tire wear. The toe setting is adjusted by lengthening or shortening the cross tube.



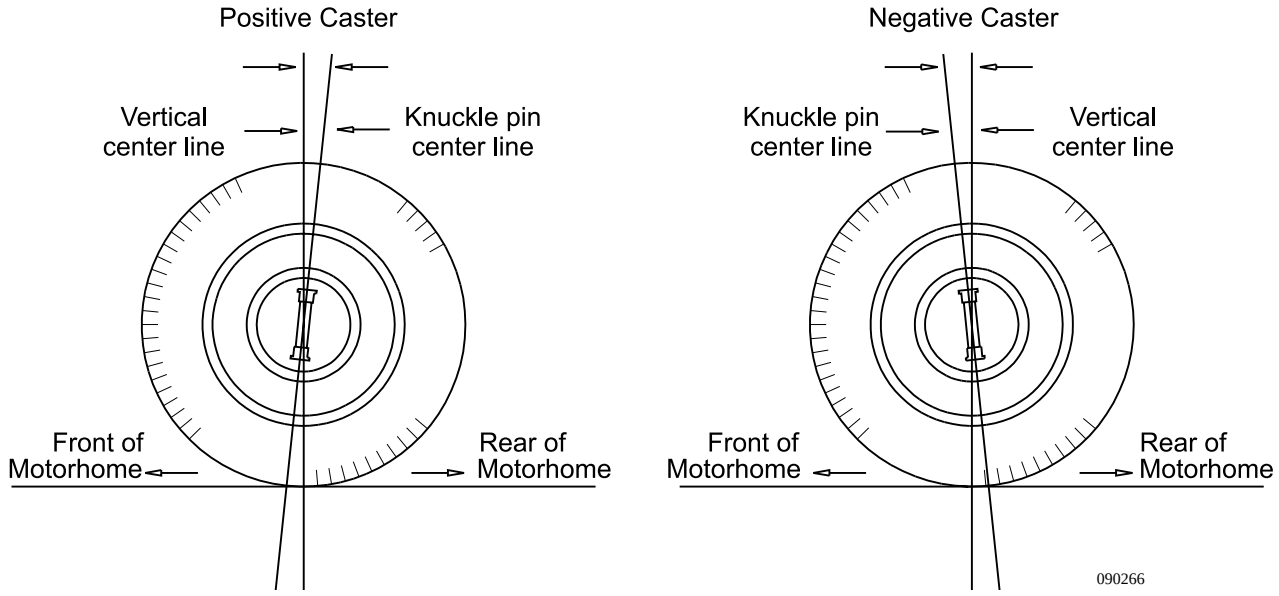
**Caster Adjustments:**

Caster is the fore and aft tilt (toward the front or rear of the motorhome) of the steering kingpin as viewed from the side of the motorhome.

"**Positive**" caster is the tilt of the top end of the kingpin toward the rear of the motorhome.

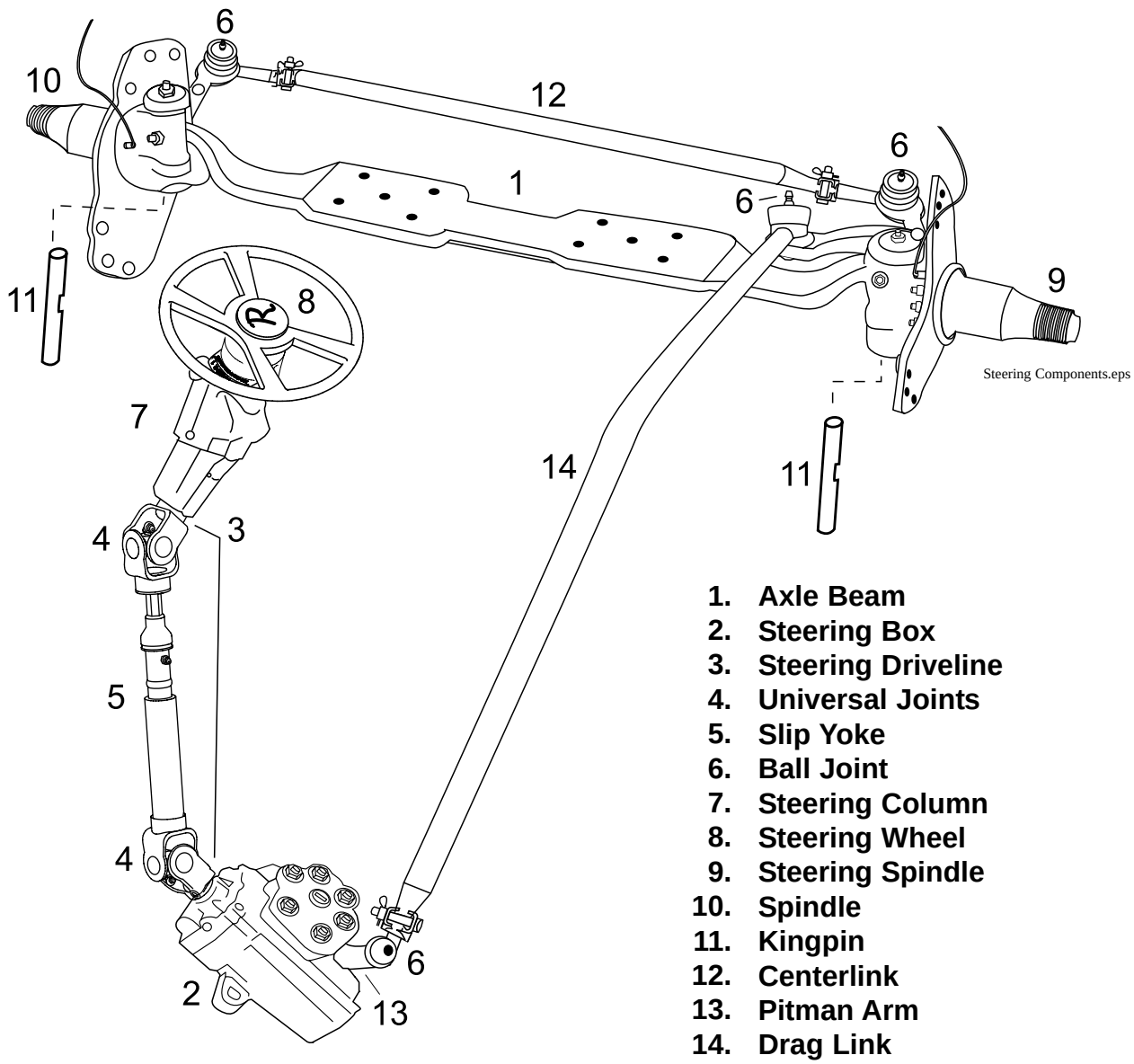
"**Negative**" caster is the tilt of the top end of the kingpin toward the front of the motorhome.

Setting the caster angle more positive than specified may result in excess steering effort and/or shimmy. Decreasing the angle may result in vehicle wander or poor steering return to center. The caster angle is determined by the installed position of the steer axle.




| | | SPEC | TOL |
|---|---|---|---|
| LEFT FRONT | *CAMBER* | 0.00° | 0.40° |
| | *CASTER* | 6.00° | 0.50° |
| | *TOE* | 0.03° | 0.12° |
| RIGHT FRONT | *CAMBER* | -0.25° | 0.40° |
| | *CASTER* | 6.00° | 0.50° |
| | *TOE* | 0.03° | 0.12° |

## Steering Components




TYPICAL

1. **Axle Beam**
2. **Steering Box**
3. **Steering Driveline**
4. **Universal Joints**
5. **Slip Yoke**
6. **Ball Joint**
7. **Steering Column**
8. **Steering Wheel**
9. **Steering Spindle**
10. **Spindle**
11. **Kingpin**
12. **Centerlink**
13. **Pitman Arm**
14. **Drag Link**

## Steering Column

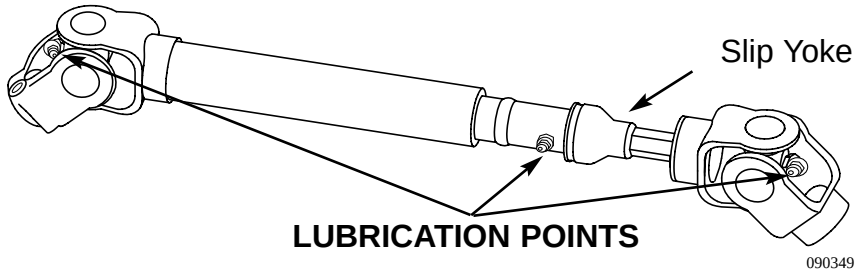
The steering wheel connects to the steering box using a driveline. Service the steering drive shaft universal joints and slip yoke every 30,000 miles or annually. Remove the steering column cover to access the upper universal joint and slip yoke. The lower universal joint is accessed from underneath in the generator compartment behind the front electrical box.

**Greasing the Drive Shaft Universal Joints:**

**1.** Check the drive shaft for looseness. If loose or worn, repair the drive shaft as necessary.
**2.** Apply the specified grease at the grease fitting on the universal joint. Apply new grease until the new grease purges from all the seals.
**3.** If the new grease does not purge from the seals, disassemble and clean the joint or replace the universal joint. Do not lose any of the needle bearings.

**Greasing the Drive Shaft Slip Yoke and Splines:**

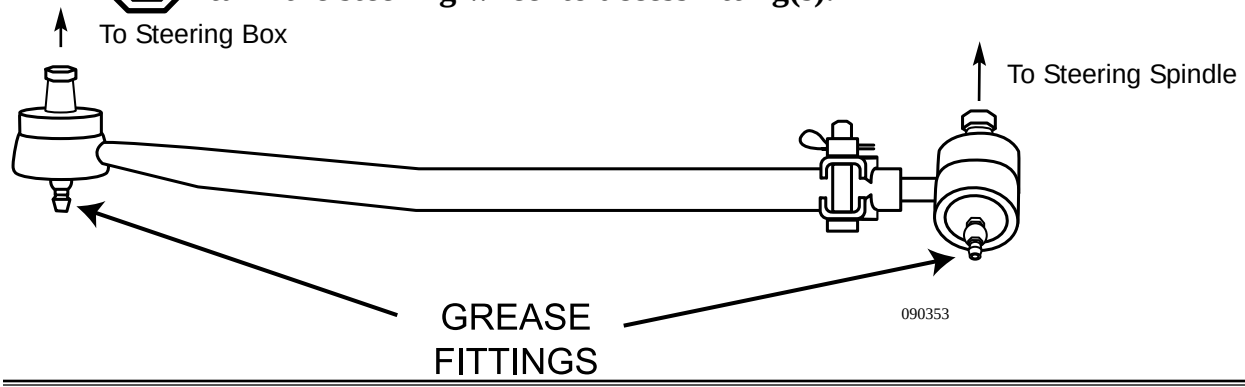
**1.** Check the drive shaft for looseness. If loose or worn, repair the drive shaft as necessary.
**2.** With finger, cover the rear air hole so grease flows to the front seal. Apply the specified grease at the grease fitting on the slip yoke. Apply grease until new grease purges and forces finger away from the air hole in the end of the slip yoke. Greasing interval is yearly or every 30,000 miles.




## Drag Link

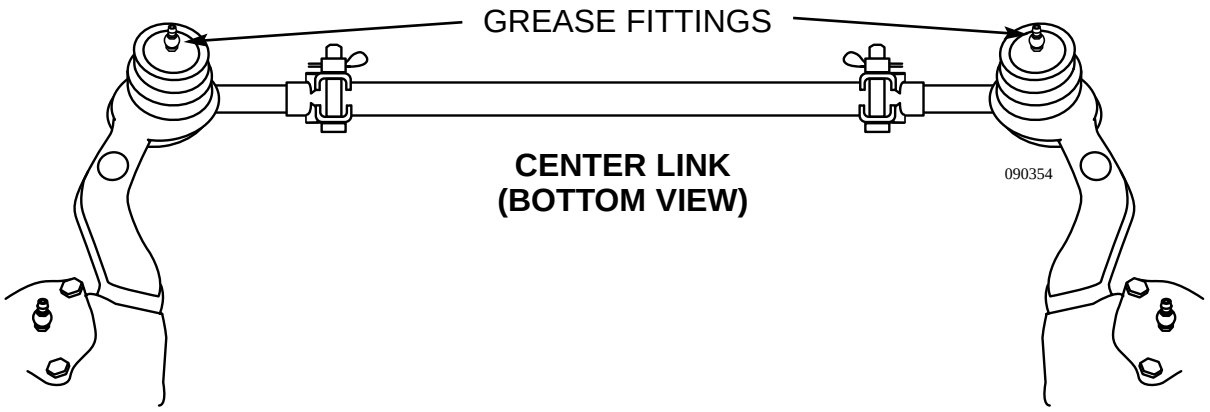
The drag link connects the steering box pitman arm to the steer axle. The movable joint (ball joint) uses sealed boots to prevent water intrusion. Do not rupture the boot when applying grease. Grease interval is six months or every 5,000 miles.

**NOTE: It will be necessary to start the motorhome and turn the steering wheel to access fitting(s).**

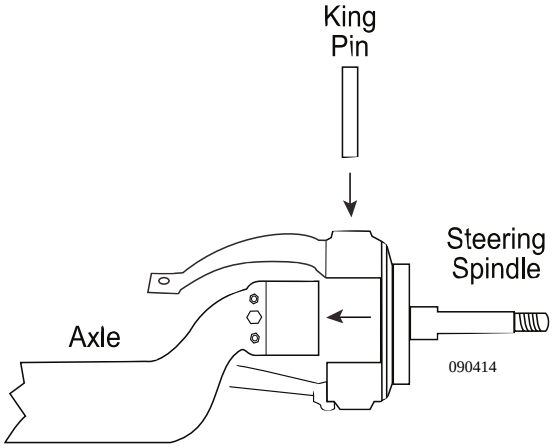


### Center Link

The center link is located on the backside of the steer axle. The center link attaches the two wheels together causing the right front to track with the left front. Greasing interval is every six months or 5,000 miles.




### Steering Spindles



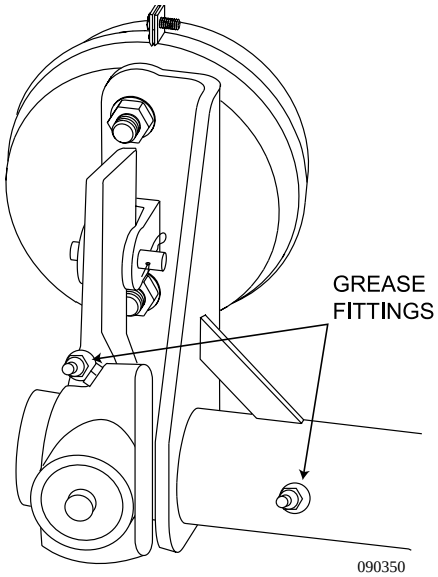

The steering spindles attach to the front axle and pivot on the kingpin. The wheel end assembly and brake system attach to the spindle. There are upper and lower lubrication points for the kingpin. The drag link attaches to the roadside spindle. After initially lubricating the roadside and curbside kingpins, rotate the steering assembly lock to lock (full left to right) then move assembly back to center. This purges any remaining air pockets. Continue lubricating the kingpins until new grease purges with no air pockets. Greasing interval is every six months or 5,000 miles.

### Control Arm Bushings

Control arms align the axles perpendicular with the frame. The panhard bar controls side to side motion of the axles in the frame. Control arm bushings and panhard bar bushings do not require lubrication.

## Front Brakes

The slack adjuster and camshaft need to be lubed periodically to ensure proper brake operation. Lubricate every 10,000 miles or annually.



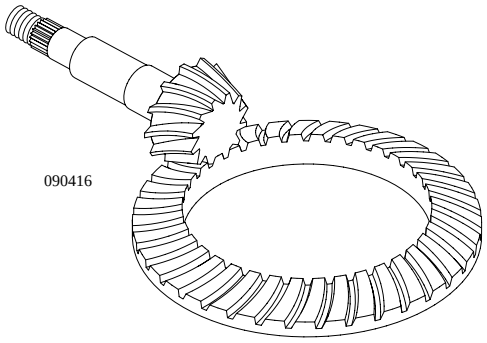

***Typical Air Drum Brakes*** *-*
*Lubricate until new grease appears at exit points.*

## DRIVE AXLE & DRIVE SHAFT

**Drive Axle:**

The chassis drive axle is a single reduction axle, with a gear ratio of 4.30:1. The differential gears consist of a hypoid pinion and ring gear set and bevel differential gears. The differential carrier can be removed from the axle housing as a unit in order to perform repairs.

All power from the engine to the rear tires is transferred through the rear axle. For this reason, it is important that maintenance be performed on the axle as required to avoid premature wear of the gears and bearings in the axle.




**Drive Axle Lubricant:**

The rear axle is filled with synthetic gear oil meeting MIL-L-2105D specifications. Change interval is every 250,000 miles, or 36 months, whichever occurs first.

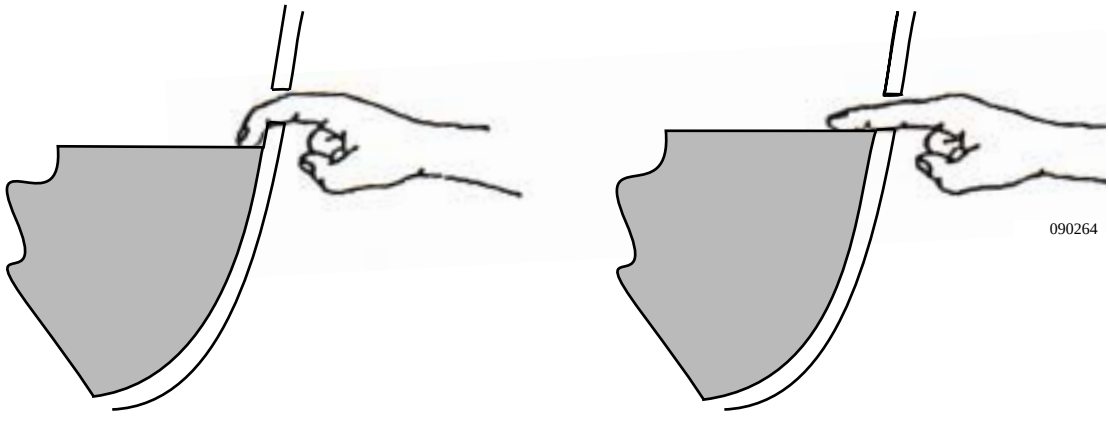
During lubricant change, fine metal particles will be observed clinging to the magnetic fill and drain plugs of the axle. These particles are normal wear particles from the axle components, but will cause faster than normal wear of the axle components if allowed to circulate through the lubricant. It is recommended that the magnetic plugs be tested, if not replaced, at each lubricant change when petroleum-based lubricants are used, or every 100,000 miles when synthetic lubricant is used. These plugs should have sufficient magnetic strength to pick up a 1.5-pound weight of low carbon steel. Never replace a magnetic plug with a non-magnetic "pipe plug" as they will not keep the lubricant clear of metal particles or seal properly.

The level of lubricant in the rear axle should be checked every 30,000 miles or annually, whichever comes first. This will ensure adequate lubricant in the axle for proper operation.

**Proper Drive Axle Lubricant Level:**

- Regular inspection of the drive axle lube levels is an essential maintenance procedure.
- Clean the area around the fill plug, which is located approximately halfway up the axle housing bowl.
- Remove the fill plug and observe the lubricant level.
- The lubricant should be level with bottom of the hole.
- Important: The lube level close enough to the hole to be seen or touched is not sufficient. The lube must be level with the hole.
- Correct the level as necessary.
- Re-install the fill plug and tighten to 35-50 ft-lbs.

**NOTE: When checking the lube level also check the housing breathers. Clean the breathers if dirty or replace them if damaged.**




Incorrect Oil Level

Correct Oil Level

**To Drain and Replace Lubricant:**

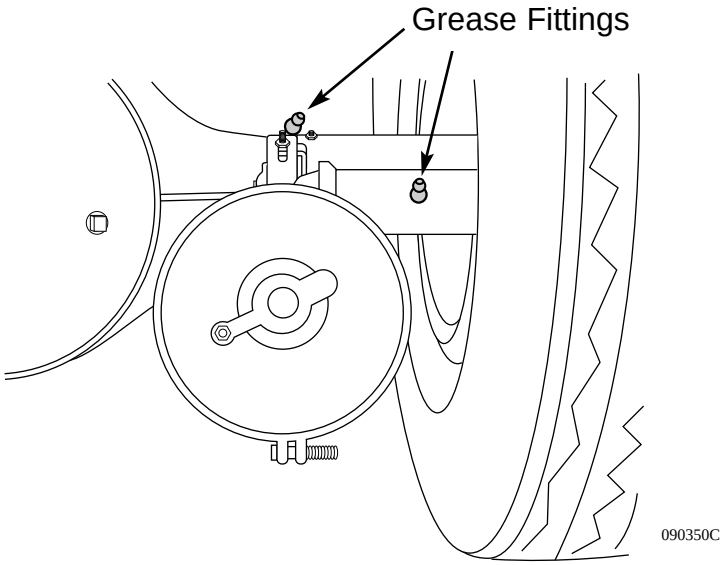
With vehicle parked on a level surface and rear axle warm, place a large container under axle.

1. Remove drain plug and allow axle to drain completely.
2. Dispose of oil properly.
3. Clean the drain plug and test (replace the drain plug if needed).
4. Install and tighten drain plug to 35-50 ft-lbs.
5. Clean the area around the fill plug from the axle-housing bowl.
6. Fill the axle with approved lubricant until the level is even with the bottom of the fill plug hole.

**WARNING: When checking or changing the lubricant, always ensure that the axle is not "hot." Oil temperature 90º or hotter can easily cause severe burns.**

## *Lubrication Maintenance*

The slack adjuster and camshaft need to be lubed periodically to ensure proper brake operation. Lubricate every 10,000 miles or annually.




***Rear Drum Brake*** *-*
*Lubricate until new grease appears at exit points.*
*Use NCCI #2 Lithium Soap base grease.*

**Drive Shaft:**

The drive shaft transfers the power produced by the engine to the drive axle. A worn or out of balance driveline causes chassis vibration that generally increases in intensity with road speed.

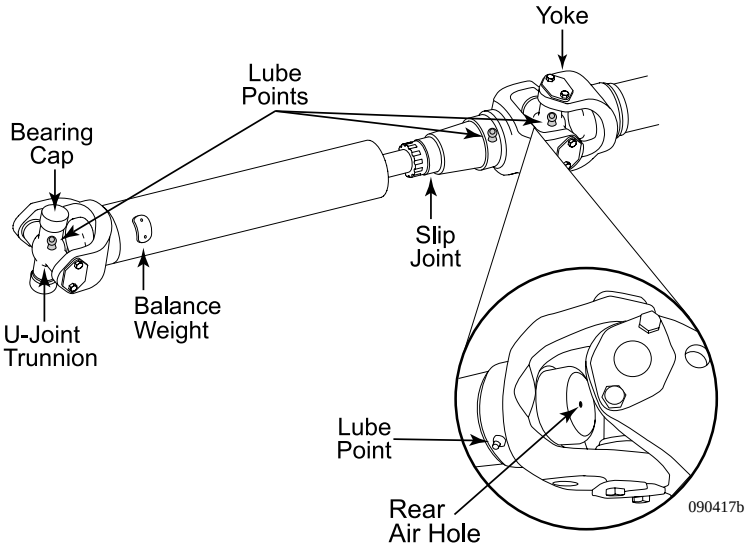
**NOTE: It will be necessary to move the motorhome forward or backward to access all fittings on the drive shaft.**

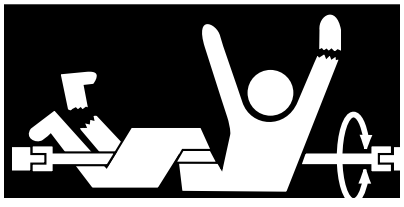
**Greasing the Drive Shaft Universal Joints:**

1. Check the drive shaft for looseness. If loose or worn, repair the drive shaft as necessary.
2. Apply the specified grease at the grease fitting on the universal joint. Apply new grease until new grease purges from all the seals.
3. If new grease does not purge at the seals, loosen the bearing cap bolts and re-grease until all four caps purge. If new grease still does not purge, disassemble and clean or replace the universal joint.

**Greasing the Drive Shaft Slip Yoke and Splines:**

1. Check the drive shaft for looseness. If loose or worn, repair the drive shaft as necessary.
2. With finger, cover the rear air hole so grease flows to the front seal. Apply the specified grease at the grease fitting on the slip yoke. Apply grease until new grease purges and forces finger away from the air hole in the end of the slip yoke. Greasing interval is 10,000 miles or annually.



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**Warning: Rotating shafts can be dangerous. Rotating shafts can snag clothes, skin, hair, hands, etc. causing serious injury or death. Do not work on or near a shaft "with or without a guard" when the engine is running.**

## U-Joint Angles Phasing & Driveline Balance

Correct U-joint working angles U-joint phasing, and driveline balance is vital to maintaining a quiet-running drivetrain and long life of drivetrain components (including driveline components).

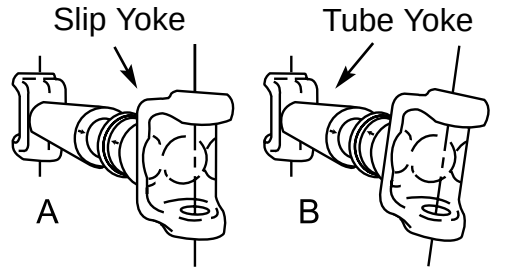
When in phase, the slip yoke lugs (ears) and tube yoke lugs (ears) are in line. Normally this is the ideal condition and gives the smoothest running shaft. There may be an alignment arrow stamped on the slip yoke and on the tube shaft to assure proper phasing when assembling these components. If there are no alignment marks, they should be added before disassembly of the shaft to assure proper reassembly.

Phasing is relatively simple on a two-joint set, be sure that the slip yoke lugs and the tube yoke lugs are in line.

The U-Joint working angle is the angle formed by the intersection of the driveshaft centerline and the extended centerline of the shaft of any component to which the U-joint connects. Because the double oscillating motion of a U-joint that connects angled shafts causes a fluctuating speed difference between the shafts, the effect created by the U-joint at one end of the shaft must cancel the effect created by the U-joint at the other end. This is done by making U-joint working angles at both ends of the driveshaft approximately equal, with the U-joints in phase. If the yoke lugs at both ends of the shaft are lying in the same plane (a plane which bisects the shaft lengthwise), the U-joints will be in phase.

Any condition which allows excessive movement of a driveshaft will cause driveline imbalance: loose end yoke nuts, loose U-joint bearing cap retaining capscrews, worn U-joint trunnions, bearings and worn slip-joint splines.

Among the most common causes of U-joint and slip joint damage is lack of lubrication. To keep the motorhome operating smoothly and economically, the driveline must be carefully checked and lubricated at regular intervals.




A. In Phase B. Out of Phase

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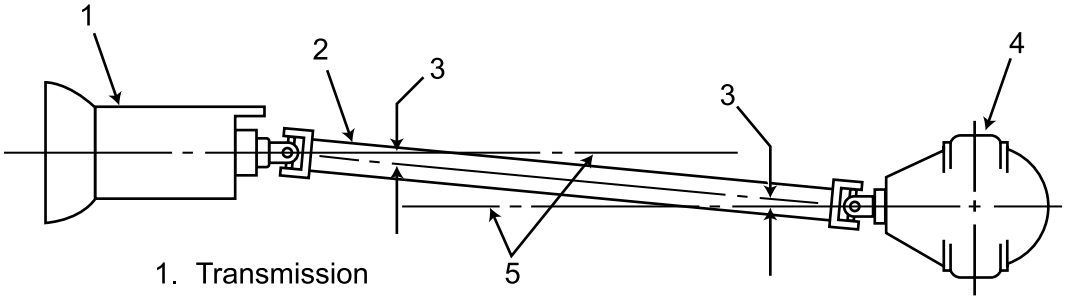


1. Transmission
2. Driveshaft
3. U-Joint Working Angles
4. Rear Axle
5. Extended Centerlines

090336

## SHOCK ABSORBER

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The shock absorber by definition is a hydraulic device used to dampen suspension/body movement. Road surface irregularities are compensated for by the shock absorber. The roadmaster chassis incorporates the "Monroe" shock in the design of the exclusive air glide suspension system. This shock absorber is a telescopic, mono tube unit filled with nitrogen gas and hydraulic oil. The result of the mixture is uninterrupted damping for the smallest of wheel deflection.

By design, a self lubricating seal is used which will allow approximately 10% of the total oil capacity to pass onto the piston rod. The gradual process of oil loss does not affect the performance of the shock absorber during the service life. This process will be evident after a long period of service by an oil film on the body of the shock absorber. The appearance of a coating or film on the body or rod is completely normal, it is an indication the shock is functioning normally.

Road holding, handling, balance and braking characteristics all can be contributed to the shock absorber. The operating conditions for which the shock absorber must endure will determine the life span. However, since the only moving part is the piston rod, there are no springs, hinges or pins to wear out, get weak or deteriorate.

## LEVELING SYSTEM
### *Hydraulic Leveling RVA*

The three point leveling system features a multiple warning system with flashing lights and a bong alarm to alert you of the jack position. The system also features a remote control location from the driver seat. Some units will have an optional air/hydraulic leveling system. Do not use both leveling systems at the same time. Retract all jacks and turn system off before using the air leveling system.

The model 22.5A J-II leveling system pump is located in the roadside compartment behind the rear wheel. The valve assembly manifold is mounted on the pump motor, providing easy access to the manual retract valves. The system is designed to be self bleeding in the event any component of the hydraulics has been removed or repaired. Fully extend and retract each jack twice. The remote rocker switches will operate with a minimum of 7.5 Volt DC. Optimum requirements for operating the system are voltages above 9.6 Volt DC.

**CAUTION: Before leveling the motorhome survey the area around and under the motorhome for obstructions which can damage the motorhome or undercarriage components when the air bags are deflated.**

**CAUTION: Hot asphalt may not support the weight the is place on the hydraulic jack pads. Place thick plywood under the jack pads to help disperse the weight. Never use the leveling system to support the entire weight of the motorhome. Damage from excessive torsional twists can result.**

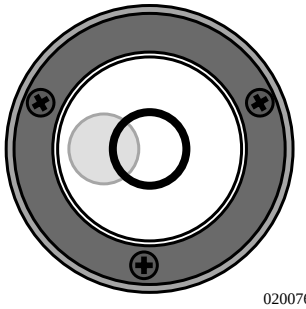
**CAUTION: If blocking up a rear jack pad to gain added clearance while the motorhome is on a slope, place a chock at the opposite set of rear wheels to prevent the motorhome from rolling.**

**WARNING: Using an improper leveling process can result in applying excess torsional stress to the chassis and body resulting in damage to the windshield or entry door malfunction. The leveling system jacks are not designed for changing tires. This can cause problems with the suspension system, frame alignment and damage to the windshields. Never use the jacks to elevate any wheel position off the ground.**

## *Manual Leveling System*

When manually operating the leveling system, always lower the front jack first. The front jack acts as a pivot point for the chassis and reduces torsion stress on the body of the motorhome.

**NOTE: In the event the front of the motorhome is high and does not require elevating, it will be necessary to raise front of motorhome a minimum of ½ inch to allow jacks to act as a pivot point.**



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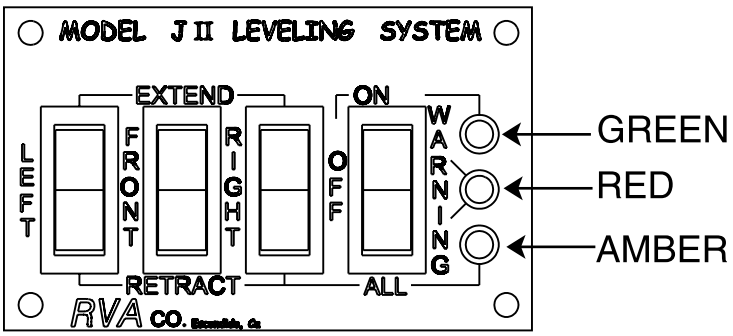
The leveling system was designed to reduce site selection problems. If possible, park the motorhome with the front facing downhill. If the ground is soft, place a wooden 2 x 8 board under the foot of each jack pad to prevent sinking.

The front jack will be the pivot point for the chassis and is always lowered first. This reduces the torsion stress on the body of the motorhome. The Bong alarm will activate when any jack is extended more than 2” to 6” from fully retracted position and will indicate low fluid level for the pump motor. The Bong alarm may momentarily activate when driving over rough roads, or negotiating curves and corners. Usually this indicates low fluid level.

**NOTE: Air will not automatically dump from air bags when leveling cycle begins. To expedite the air dumping, a manual air bag release switch is located on the dash panel.**

- Place the gear selector in PARK.
- Apply the parking brake.
- Turn the ignition switch to the **ON** position.
- Switch the main jack control power switch **ON**.
- To extend a particular jack, push the appropriate rocker switch to extend position and hold it until the desired extension is reached.
- To retract a particular jack, simply push the rocker switch to the retract position and hold until the desired retraction is reached.
- Turn **OFF** the switch labeled POWER on the jack control panel.
- Turn **OFF** the ignition switch.

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### Retracting Leveling Jacks RVA

- Ensure the gear selector is in **PARK**.
- Ensure the parking brake is applied.
- Turn the ignition switch to the **ON** position.
- For manual control of the system, switch the control panel power switch **ON**.
- To retract a particular jack, simply push the rocker switch to the retract.
- All jacks may be retracted by selecting the **ALL** position on the power switch.

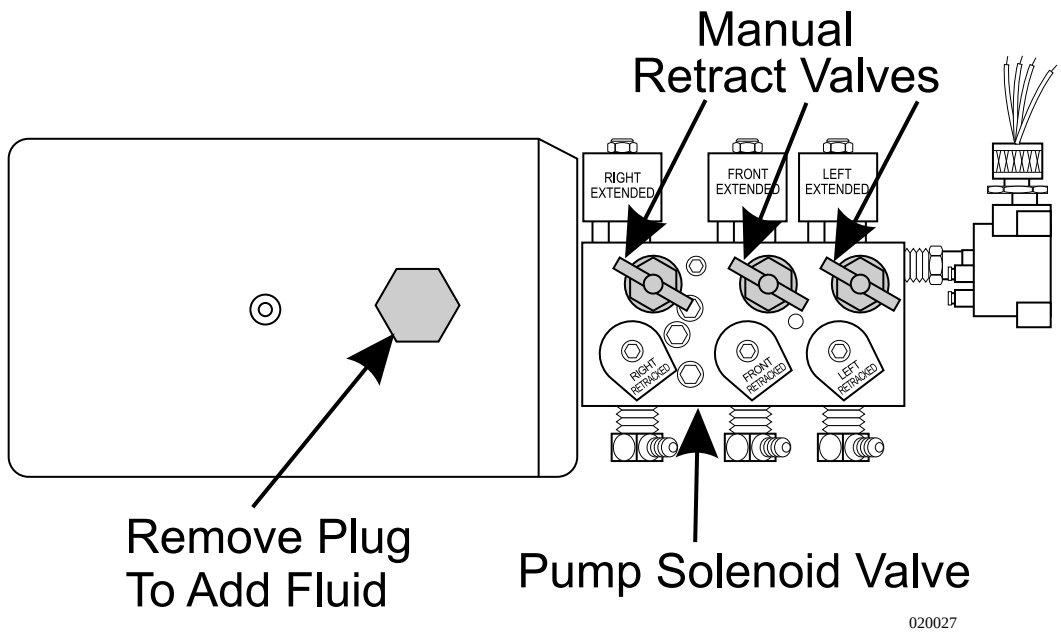
**CAUTION: Damage to the mud flap may occur if the mud flap is located over a raised area when the suspension is lowered.**

**NOTE: Do not move the motorhome until the jacks are fully retracted. A visual check of the jacks is recommended to ensure full retraction. Do not rely solely on the lights and alarms.**

## Manual Retract Valves

In the event of mechanical or electrical failure that would prevent the leveling jacks from being automatically retracted, the motorhome is equipped with manual emergency retract valves. These valves are located inside the roadside compartment behind the rear wheel. The manual system will release fluid under pressure in each jack and allow fluid to return to the reservoir. The jacks will then retract.

To operate the manual system, turn all three valves counterclockwise until they stop. Once the jacks are fully retracted, rotate all the valves fully clockwise. In the event one of the jacks is not holding pressure, check to make sure all valves are fully closed.



### RVA Maintenance

Occasionally, while the jacks are fully extended, wipe dirt from the jack rod. This will help lengthen the life of the jacks. This can vary from the amount and type of usage of the jacks. Dexron III will serve as a solvent as well as a lubricant. Occasional oil or grease on the extended jack ram is normal and aids in the lubrication of the ram. It helps to learn the sound of the normal pumping and gurgling sounds of the pump when it is low on fluid.

**Adding Fluid:**

1. Use Dexron III automatic transmission fluid.
2. Extend any jack six inches from the full retracted position. All other jacks should be fully retracted.
3. Unscrew the reservoir cap from the top of the pump.
4. Turn the ignition switch to the ON position. Turn the rocker switch to ON. Open the window so the bong alarm is audible from outside the motorhome. Slowly fill the reservoir with fluid until the bong alarm stops sounding.
5. Replace the reservoir cap.
6. Turn the ignition switch and the remote panel OFF.

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### Hydraulic Leveling Power Gear (Optional)

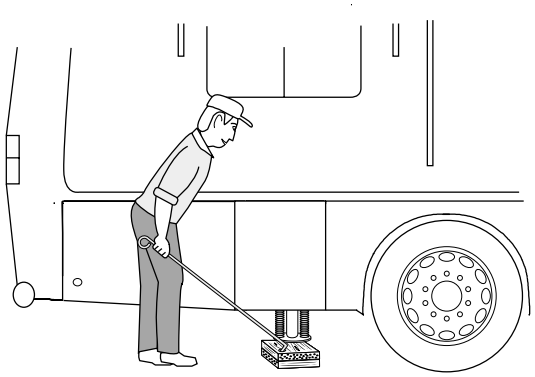
The hydraulic leveling system is designed as a leveling system only. The leveling system should not be used to support the motorhome for changing tires. A tire change should always be performed by trained personnel. Attempts to change tires using the leveling jack to support the motorhome could result in damage to the motorhome and risk causing serious personal injury. Some units will have an optional air/hydraulic leveling system. Do not use both systems at the same time. Retract all jacks and turn system off before using the air leveling system.

The leveling system uses four hydraulic cylinders to level the motorhome, two cylinders located in the rear and two located in the front. The leveling system was designed to reduce site selection problems. A remote control panel located next to the driver seat operates the system. There are some essential steps to follow when operating the leveling system:

## Leveling Tips

Tips:

- Select a level site if possible. If the site is not level, park the motorhome with the front facing downhill or move the motorhome to another location.
- Before operating the system, lower the air suspension by making several brake applications, then push the Air Dump switch.
- If a jack reaches full extension and additional height is needed this can be attained by cutting two ¾" pieces of plywood to 1'x 1' then staple the plywood together to equal 1½" thick. Drill a hole in one end, and use the awning hook to slide the block under the jack pad.



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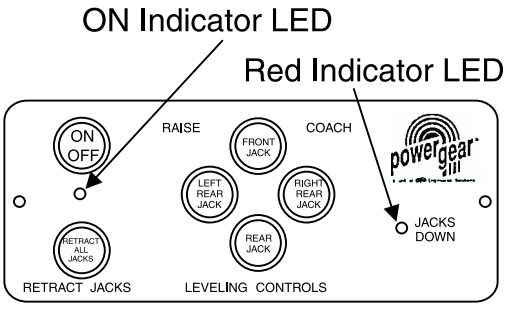
## Before Operating Leveling Jacks

**Operate the Leveling System ONLY Under the Following Conditions:**

- The motorhome is parked on a reasonable level surface.
- The **PARKING BRAKE** must be engaged.
- The transmission must be be in the **NEUTRAL** or **PARK** position.
- The ignition switch is placed in the **ON** position.

Clear the potential jack contact points of obstructions or depressions before operation. Keep all people clear of the motorhome during the leveling system operations. Never expose hands or other parts of the body near hydraulic leaks. Hydraulic lines are under high pressure, oil leaks may cut and penetrate the skin causing serious injury.

### Leveling the Motorhome

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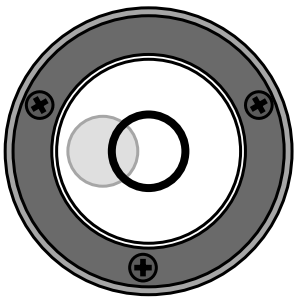
- Ensure all conditions have been met to operate the leveling system.
- Press the ON/OFF label on the control panel. The ON/OFF label illuminates, indicating the system is now operational.
- If the ON/OFF label does not illuminate, verify that all conditions have been met.
- Press the FRONT JACK label until the jack contacts with ground. This will be felt in the motorhome.
- The FRONT JACK and REAR JACK labels will be used to achieve a center in the level vial which is pointed front to rear of the motorhome. The air bubble will indicate the high side of the motorhome. Press the button that is opposite the air bubble in level vial. (i.e. If bubble is towards front of coach press the REAR JACK label.) Keep button pressed until the air bubble is centered front to back.
- The air bubble in the level indicator indicates the high side of the motorhome. Push the button opposite of the bubble, either LEFT or RIGHT REAR JACK, to level the motorhome. (i.e. If the bubble is towards left of the coach push RIGHT REAR JACK.) Keep the label depressed until the bubble is centered in the vial.



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**NOTE: Right and left rear jacks are used to level the motorhome side to side. Pushing the "LEFT REAR JACK" label on the control panel will extend the left rear jack. Pushing the "RIGHT REAR JACK" button on the control panel will extend the right rear jack. There is no individual control for right or left front jack.**

Park the motorhome on a reasonable solid surface, the jacks may sink into ground on extremely soft surfaces. A load distribution pad or block may be placed under each jack. The system is not designed to lift the wheels off the ground, doing so may create an unstable condition.

## Retracting Leveling Jacks Power Gear

- Place the ignition switch in the ON position.
- Push the **ON/OFF** button. See first step of leveling.
- Push the **RETRACT ALL JACKS** label. All jacks will start to retract and return to full retract position. When all jacks return to full retract position the **JACKS DOWN** light will go out.

**NOTE:To stop the jacks from retracting, turn the system OFF and back ON. The motorhome can be leveled by following the steps under "Leveling the Motorhome."**

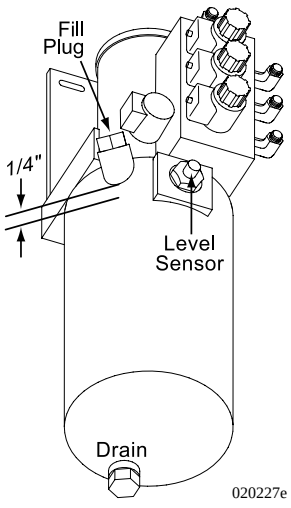
- When the **JACKS DOWN** lights goes out, push the **ON/OFF** label on control panel to de-energize the system. Perform a brief visual inspection around the motorhome to verify that all jacks are fully retracted. Proceed to travel.

## Drive Away Protection System

When the ignition switch is set to the **RUN** position, with the jacks extended, if the transmission is taken out of neutral or park or when the park brake is released, the **JACKS DOWN** indicator lights and the alarm beeper activates. The system will then automatically retract all jacks. The system will continue to retract the jacks until they are fully retracted or the park brake is reset and the transmission is shifted back into **PARK** or **NEUTRAL**.

## Power Gear Maintenance

- Change the fluid every 36 months.
- Check the fluid level every month. The fluid level should be within 1/4 inch of fill port lip and checked when all the jacks retracted.
- Inspect and clean all hydraulic pump electrical connections every 12 months.
- Remove dirt and road debris from the jacks as needed.
- If the jacks are down for extended periods it is recommended to spray exposed chrome with *WD 40* every seven days for protection.




In most applications the Type A automatic transmission fluid is adequate. If operating in cold temperature (less than -10 F°) the jacks may extend and retract at a slower rate.

**WARNING: Never rely solely upon warning lights or a warning buzzer to determine position of leveling jacks. Make a visual check to ensure all jacks are fully retracted prior to moving the motorhome.**

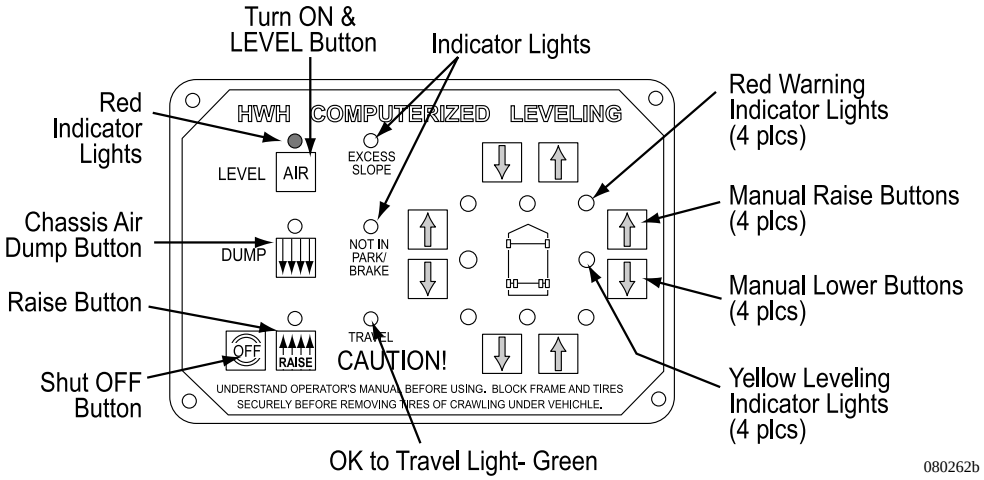
Fluids specially formulated for low temperatures may be desirable for cold weather operation. Consult factory for recommended cold weather fluid.

- Useable Reservoir Capacity = 1.2 gal.
- 4-Jack System Capacity = 2.4 gal. (approx.)

## AIR LEVELING (OPTIONAL)

A touch panel, computer controlled air leveling system uses the air springs to level the motorhome. The system is fully automatic or it may be operated manually. Some units will have an optional air/hydraulic leveling system. Do not use both leveling systems at the same time. Turn control panel off and wait until system turns off before using hydraulic leveling system.

**CAUTION: The ignition must be ON for the air suspension to operate. This is critical to note in the event the motorhome requires emergency towing.**




**Automatic Leveling**

When set to auto-level, the system will attempt to level to the lowest point first. Example: if the right rear is the low, the system will dump air from the front and left rear air springs until the motorhome is level. If the air springs fully deflate before the motorhome is level, the system will raise the entire motorhome and go through another leveling process. It is critical there is no movement in the motorhome while the system is attempting to auto-level.

**To Level:**

- Start the engine. The leveling system will operate faster if engine is running.
- Set the parking brake.
- The transmission must be in neutral. (Important: Please no movement in the motorhome while the system is leveling.)
- Press the **AIR** button once to enter air mode. The Air indicator light and four yellow warning lights will glow steady.
- Press **AIR** button a second time. The Air indicator light will start flashing and automatic leveling will begin.
- When all four yellow lights are out, the leveling process is complete. The Air indicator light will stop flashing and glow steady. The engine may now be turned off.

**NOTE: The control panel remains on until time of departure or storage.**

The control panel remains on and the processor enters Sleep Mode. The processor will continue to monitor the level sensors. When there is movement in the motorhome, the yellow lights will blink, indicating an off-level condition. If one or more yellow lights glow steady for more than one minute, the processor will "awaken" and make any necessary adjustments to return the motorhome to level. After any adjustments are made, the processor will go back to Sleep. This will continue until the system is turned OFF, or the transmission is placed in gear and the parking brake released.

**NOTE: If the control panel is turned off, the Processor will not make any adjustments and an off level condition may occur over time.**

**Excess Slope:**

If the system was unable to level motorhome, one or two yellow Level indicator lights will remain on and the Excess Slope light luminates. The System will remain on but will not go into Sleep Mode.

**System Air Compressor:**

A small air compressor provides pressure if air in the leveling system drops below specifications. The compressor will activate only when pressure drops below specifications.

**Manual Air Leveling Operation:**

- Air leveling will operate faster with the engine running.
- Set the parking brake.
- The transmission must be in neutral.
- Press the AIR button once. The Air indicator light will glow steady.
- Pressing the individual Raise or Lower buttons (**UP** or **DOWN** arrows) will raise or lower the position indicated on the control panel.
- A yellow light indicates a side, end or corner of the motorhome is low. Lower the opposite side or end of motorhome to achieve level. If a level position cannot be achieved by dumping air, raise the motorhome according to light yellow lights.
- Turn the ignition and control panel off.

**NOTE: Always give preference to any side light before leveling motorhome front to rear.**

**Dump Button:**

With the engine running, press and hold the Dump button. The system will release air from the air springs lowering the suspension. When the button is released the suspension will slowly return to normal ride height.

With the engine off, press and hold the Dump button to release all air from the air springs lowering the suspension. Only air in the air springs is released. The air system will remain charged.

**Raise Button:**

With the engine running and the system at full air pressure, press and hold the **Raise** button. The system will add air to the springs raising the suspension. When the button is released the suspension will slowly return to normal ride height.

**Preparing for Travel:**

Start the engine and allow the air system to fully pressurize for travel. Turn the control panel off, or place the transmission in gear and release the parking brake. The leveling system will turn off automatically. Before travel, all red indicator lights must be **OFF** and the Travel indicator must be lit before moving the motorhome. Ensure that the motorhome is at the proper ride height before moving. **DO NOT** solely rely upon the warning lights.

**CAUTION: Do not rely solely upon warning lights. It is the operator's responsibility to check that the motorhome is at the proper ride height before moving the motorhome.**

The diesel engine operates differently from the conventional gasoline engine. Gasoline engines control engine speed using a butterfly throttle plate controlling air/fuel mixture inlet flow. As the throttle plate opens, vacuum created by the piston velocity draws the metered fuel/air charge into the combustion chamber, then ignites from a controlled electric ignition source. Closing the throttle plate limits the fuel/air supply, slowing engine speed, increasing intake manifold vacuum.

The diesel engine in the motorhome controls engine speed by varying fuel supply only. No throttle plates are used. An exhaust driven turbine system (turbocharger) compresses the fresh air supply into the engine. The fuel is injected under pressure into the combustion chamber. Ignition of fuel/air charge occurs from heat generated by rapid high compression. The turbo boost gauge registers amount of intake manifold pressure measured in lbs./in$^2$. Therefore, no intake manifold vacuum exists.

Diesel engine RPM (revolutions per minute) operating speeds are generally much lower than that of the gasoline engine. Peak torque and horsepower output values occur at much lower engine speeds. Idle speeds between the two engine types are similar, however maximum engine speeds are quite different. The gasoline engine generally is not regulated to a maximum engine speed. The maximum engine speed on a diesel engine is controlled by an engine speed governor set by the engine manufacturer.

**WARNING: Do not operate a diesel engine where there are or can be combustible vapors. Vapors can be drawn through the air intake system and cause engine acceleration and over-speeding, resulting in fire, explosion and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize risk of an engine over-speeding where an engine (due to its application) might operate in a combustible environment, such as fuel spills or gas leaks. The equipment owner and operator is responsible for safe operation of engine. Consult your engine authorized repair location for further information.**

The Cummins diesel engine is a 6-cylinder in-line engine, utilizing an electronic fuel control system to supply fuel to the cylinders for precise fuel delivery, as well as built-in diagnostics to monitor engine operation.

Engine electronics also enable the use of programmable monitoring features that may cause limited engine power/vehicle speed when certain conditions arise. These features limit the operation of the engine when conditions that may damage the engine are encountered. These conditions may include such events as low oil pressure and high coolant temperature. When the engine electronics encounter such a condition, it limits the amount of power produced by the engine to help prevent or limit damage. It is possible however, for the engine to be damaged if corrective action is not taken immediately when such a condition exists. Operation of the vehicle while in the limited operation mode may result in serious engine damage. If a sudden loss of power is noticed in conjunction with the engine warning light illuminating **STOP ENGINE**, pull to the side of the road as soon as it is safely possible. Evaluate the situation.

Refer to the engine manufactures OEM for additional information concerning the operation, description, maintenance, and warranty information for the engine.

**Diagnostic Fault Codes:**

The engine ECM will record three types of fault codes; Electronic Control System Faults, Protection System Faults and Maintenance Indicators. All faults recorded will be **ACTIVE** or **INACTIVE**. Not all faults will light an indicator when they are **ACTIVE**.

**Three Lamps that Can Illuminate Are:**

**Engine Warning -** Indicates a need to repair the fault at the first opportunity.

**Stop Engine -** Indicates a need to shut down and remain shut down until the fault can be repaired.

**Maint Reminder -** Indicates a maintenance function needs to be performed.

**Eng Diagnostic:**

Uses the Engine Warning and Stop Engine dash warning lamps to emit engine diagnostic codes.

**NOTE: To retrieve engine diagnostic codes requires an Insight Diagnostic Display or a Shorting Plug hooked to the engine diagnostic harness.**

**To Retrieve Active Fault Codes:**

1. Turn the ignition key **OFF**.
2. Hook up an Insight diagnostic display or Shorting Plug to the engine diagnostic harness.
3. Turn the ignition key **ON**; observe **Engine Warning** and **Stop Engine** lamps.
   a. If no active codes are recorded, both lamps will remain illuminated.
   b. If an active code is recorded, both the **Engine Warning** and **Stop Engine** dash warning lamps will illuminate briefly then go out followed by the **Engine Warning** lamp illuminating briefly. This is an indication one or more fault codes will be displayed by the **Stop Engine** lamp. A three-digit code group will display as a series of blinks-pause-blinks-pause-blinks-pause. Record the code(s) as a three-digit number. Codes are separated or ended by the **Engine Warning** lamp flashing once.
   c. Use the **Fast Idle** switch to scroll through all ACTIVE faults.
   d. When codes are retrieved, turn **OFF** the **Engine Diagnostic** switch.
   e. Contact ***Cummins*** help line, **1-800-DIESELS**, or an authorized distributor.

## STARTING PROCEDURE - *Normal Starting*

The engine is equipped with an intake manifold grid heater. The grid heater helps engine starting in cold weather. Intake manifold air temperature is monitored by the Electronic Control Module (ECM) on the engine. If intake manifold temperature is below specified level (approximately 40º F) manifold grid heater will be activated. Grid heater activation is indicated by the **WAIT TO START** indicator lamp.

**WARNING: Use of ether starting fluids may cause an explosion upon grid heater activation.**

With the throttle at idle position, turn the ignition key to the **ON** position allowing the **WAIT TO START** lamp to extinguish. Turn the key to the **START** position. When the engine is started, the grid heater will again energize for a time period determined by the intake air temperature and fuel temperature. Allow the engine to idle with no load for three to five minutes. The engine coolant temperature should be up to normal operating range (140°F/60ºC to 212°F/100°C) before operating the engine under full throttle.

## *Cold Weather Starting*

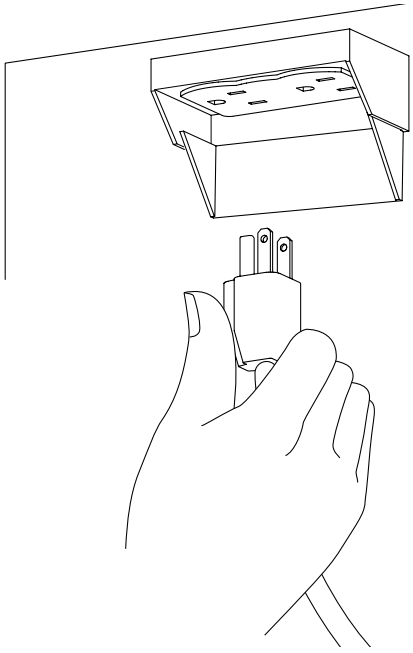
Starting and operating the motorhome during cold weather requires extra care and consideration. Use the following guidelines and refer to the *OEM Engine Manual* to help ensure safe, trouble-free operation of the motorhome:

The Block Heater requires 120 Volt AC to operate. Hook to shore power, as this is more efficient. The generator may be difficult to start and the time required to pre-heat the engine may be lengthy. The block heater receptacle is located inside the rear engine access doors along the left side. The block heater is rated at 1000 watts.

An extension cord may be used, however, the power cord should be rated at 15 Amps and the outlet used is GFCI protected rated at 20 Amps. The engine may require several hours of pre-heating prior to starting. It is recommended to start pre-heating the engine the night before departure. Remember to unplug the block heater before departure.

**To Use the Block Heater:**

- Hook to a shore power receptacle and plug in the block heater cord.



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**WARNING: All extension cords require a UL rating. Use only a 15 Amp, 120 Volt AC extension cord.**

**NOTE: The inverter should never be used for the power source. Rapid battery drain and inverter shut down will occur.**

**Engine Heat with Aqua-Hot (Optional):**

The diesel burner inside the Aqua-Hot heats an internal engine coolant loop. When the Engine Heat switch is turned on, an engine coolant pump inside the Aqua-Hot circulates heated coolant through the engine. The time it takes for the Aqua-Hot to pre-heat the engine depends on ambient temperature. Allow at least three hours of pre-heating before attempting to start the engine.

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**To Use the Aqua-Hot System:**

Turn the Aqua-Hot switch to the ON position.
Turn the Engine Heat Switch to the ON position.
This activates the engine pump inside the Aqua-Hot.

1. When operating below 32º F, an engine block heater or other means to warm the engine can enhance engine starting. This will ease cranking and help prevent engine misfiring and white smoke during starting.
2. Always follow the recommended oil, fuel, and coolant specifications as outlined in the OEM Engine Manual. Proper oil viscosity and coolant concentration eases engine starting and helps to avoid engine damage.
3. Allow the engine to idle until it warms sufficiently for operation. Utilize the fast idle feature to quicken the process. Wait to operate the vehicle for at least three minutes or until the coolant temperature begins to move.
4. Check the air inlet and filter daily, or as necessary, when driving in snow conditions.
5. The demand on batteries increase during winter; check and service the batteries frequently to help ensure trouble-free starts.
6. Start out slowly with the motorhome to allow the transmission and axle lubricants time to circulate and warm before putting them under full load.

**WARNING: Do not use ether cold starting aids to start the engine as damage may occur.**

## OIL RECOMMENDATIONS

Following the maintenance guidelines in the engine manufacturer OEM Manual recommendations for the engine will help to extend engine life and improve performance, resulting in cost efficient operations. A good maintenance schedule begins with a daily awareness of the engine and its various systems.

A high grade 15W-40 multiviscosity heavy duty lubricating oil meeting Cummins Engineering Specification CES 20071 or CES 20076, American Petroleum Institute (API) specification CH-4 which can be used as an alternative to CES 20071 is recommended. Lubricating oils meeting API CG-4 specifications may be used at a reduced drain interval. The engine uses Pennzoil 15W-40 heavy duty engine lubricating oil that meets Cummins specifications. A critical factor in maintaining engine performance and durability is the use of high grade multigrade lubricating oil and strict adherence to the maintenance service intervals.

A straight weight or monograde lubricating oil is not recommended. Shortened drain intervals may be required as determined by a close monitoring of the lubricating oil condition by means of an oil-sampling program. The use of oil analysis to extend drain interval is not recommended. There are numerous variables, which is the basis of the recommendation.

Synthetic oils API category III specifications are recommended for extreme cold temperatures only.

Low viscosity oils, used for winter operations, will aid in starting. Synthetic oils, or oil with adequate low temperature properties used for Arctic operations where the engine cannot be kept warm when shut down, will aid in starting.

The use of synthetic oils should not be used to extend drain intervals. Extended oil change intervals can decrease engine life and possibly affect the engine warranty.

Oil additives should not be used unless the oil supplier or oil manufacturer has been consulted and provided positive evidence or data establishing satisfactory performance in the engine.

**NOTE: The engine does not require a "break-in" procedure.**

**Function of Engine Oil:**

If a lubricating oil is to work in an engine it must be capable of performing various functions. Lubrication of the moving parts is the primary function. The lubricating oil should be able to form a film between metal surfaces preventing metal to metal contact and reducing friction. When there is a metal to metal contact, friction heat is generated. Welding of the part can occur and metal transfer will result in scuffing or seizing. The film of oil contacting the surfaces will provide cushioning and shock dampening as well.

Cleaning is another function. The oil should perform as a cleaner in the engine by flushing contaminates from critical components. These contaminates should be removed in the filtration system or during the course of an oil change. Oil will provide a protective barrier to prevent corrosion of non-like metals.

Internal components of the engine require cooling. The primary coolant system cannot provide this cooling. Oil will transfer heat by contacting the various components then transferring to the primary cooling system at the oil cooler. The uneven surfaces in the combustion chamber are filled to act as a combustion seal within the cylinder liner and other internal components.

**Synthetic Engine Oil:**

In extreme environments, where ambient temperatures can be as low as 45º C (-50º F), a petroleum-based oil will not perform satisfactorily in diesel engines. Synthetic oils were developed for these type applications. These synthetic oils are blend from ether and/or hydrocarbon based oils. Chemically reacting lower molecular weight materials to manufacture lubricants of desired properties produce these base oils. All synthetic based oils must meet the API category III classifications and SAE viscosity grades.

**NOTE: Synthetic oils and petroleum based oils should never be mixed.**

**Viscosity:**

Viscosity is simply a measure of resistance of molecule layers moving relative to an adjacent layer. All fluid viscosity is affected by temperature. A multigrade lubricating oil tends to be less sensitive to temperature changes due to formulation. Lubricating oils are generally selected for use with viscosities appropriate for the expected operating temperature. The correct selection of a lubricating oil of correct viscosity is critical for optimum performance. Some effects of incorrect viscosity when the oil is too thick range from difficulty in starting, to increasing fuel consumption and reduced power output. When the oil is too thin, oil consumption is increased as well as wear from the metal to metal contact. This will also increase engine noise.

Low temperature viscosity specifications are identified by a "W" (winter). High temperature viscosity that meets the 100º C (212º F) requirements has no suffix. When lubricating oil meets both high and low temperature requirements they are classified as multi-viscosity or multigrade.

## *Routine Oil Maintenance*

1. Check oil level daily.
2. Replace oil filter at every oil drain interval.
3. Cummins Engine Company, Inc. recommends the use of high quality, API (American Petroleum Institute) licensed CH-4 or CES20071, 15W-40, multiviscosity oil or premium oil.
4. The recommended oil drain interval is defined by the API oil performance classification and the engine duty cycle. Refer to the *Cummins Operation & Maintenance* Manual for complete details.

To change oil start with the motorhome at normal operating temperature. Park on a level surface and stop the engine. Remove the two crankcase drains plugs from both the deep and shallow portions of the oil pan to allow the oil to drain. Install the drain plugs back into the oil pan and tighten to 40 to 60 ft-lbs. Remove the oil filter.

**NOTE: It is recommended that the used oil filter be opened and the element examined for excessive wear particles; see the OEM Engine Manual for information on this procedure.**

Wipe the filter base sealing surface and ensure that the old gasket is removed. Apply clean engine oil to the gasket of the new filter and install the filter until the gasket contacts the filter base. Tighten the filter an additional ¾ turn. Do not over-tighten. Remove the oil filler cap located at the rear of the engine. Fill the crankcase with the amount of oil determined by dipstick readings (about 20 quarts).

Allow time for the oil to drain into the sump and start the engine. Observe the engine for proper oil pressure. Run the engine at low idle for three minutes while observing engine and filter for leaks. Stop the engine and allow the oil to settle for five minutes. Check the level of the engine oil with the dipstick. Correct the level as necessary.

- The recommended oil drain interval is defined by the API oil performance classification and the engine duty cycle. Refer to the OEM Engine Manual for complete details.

### *Cold Weather - Oil*

It is possible to operate diesel engines in extremely cold environments. The engine should be properly prepared and maintained. The correct lubricants, fuels and coolant MUST be used for the cold weather range for which the motorhome is being operated. Cold weather operation can be defined in two categories: Winter and Arctic.

**WINTER (32º to -25º F) (0º to -32º C):** Use a 50% antifreeze to 50% water coolant mixture, use multi-viscosity oil meeting Cummins specifications and fuel to have maximum cloud pour points 10º F (6º C) lower than the ambient temperature in which the motorhome operates.

**ARCTIC (-25º to -65º F) (-32º to -52º C):** Use a 60% antifreeze to 40% water coolant mixture. Use oil meeting Cummins specifications and fuel to have maximum cloud pour points 10º F (6º C) lower than the ambient temperature in which the motorhome operates.

**Refer to the Operations & Maintenance Manual for more detailed information.**

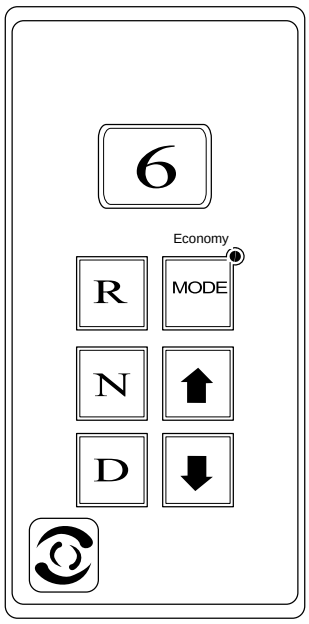
## ENGINE SHUTDOWN

General guidelines for shutting the engine down are fairly simplistic. Allow the engine to idle three to five minutes after a full load operation. This allows adequate cool down of pistons, cylinders, bearings and turbocharger components. Under normal driving conditions, exiting the highway is generally lighter engine operation and the need for the three to five minutes is not necessary. It is recommended to fill the fuel tank at the end of the day to help prevent condensation and drive out moist air. Do not fill the fuel tank to the top, as fuel will expand when warm and may overflow.

### *Extended Engine Shutdown*

When the motorhome has been sitting for extended periods, 30 days or more, verify all the fluid levels are correct. Follow the normal starting procedures. If the oil pressure gauge does not register within 15 seconds, shut off the engine immediately to avoid damage. Consult the OEM Engine Manual for guidelines on troubleshooting low oil pressure, or contact a qualified service technician. If oil pressure is normal, allow the engine to idle for three to five minutes before operating under a load.

## TRANSMISSION
### *Shift Selector*




trans shifter w mode light.eps

The Allison World transmission incorporates the World Transmission Electronic Control (WTEC) system. The system is compromised of five major components connected by a wiring harness: the electronic control unit (ECU), engine throttle position sensor, three speed sensors, remote shift selector (keypad) and the control module. The ECU processes information received from the throttle position sensor, speed sensor, pressure switch and shift selector to activate solenoids on the control module in the transmission. The solenoids control oncoming and off going clutch pressure to provide closed loop shift control. This is accomplished by matching transmission and engine RPM during a shift to establish a desired shift profile within the ECU.

The system is monitored for the first 30 seconds of each engine start. This is referred to as “autodetect.” Autodetect searches for presence of data inputs of transmission components. Autodetect enables the ECU functions and diagnostics to respond to items that are detected.

Another feature of the transmission is the ability to “learn” or “adapt.” The electronic control system optimizes shift quality by using “Adaptive Shifting.” A wide variety of varied shift conditions is required before optimizing shift quality. Generally, five typical shifts of a consistent shift type is needed to optimize shift quality.

The range selection is accomplished via the remote push button selector. The controls are **R**, **N**, **D**, arrow **UP**, arrow **DOWN**, **MODE** button and a digital display window. Under normal operation press the **D** button and the digital display shows the highest forward range attainable for shift selection in use. The digital display window will also indicate codes for abnormal conditions, and can even be a useful troubleshooting aid. When the ignition is turned **ON**, the display should be visible. This display indicates the presence of neutral start command. If the display indication is not visible, there is no power to the selector and the transmission will not allow the engine to start. This is an indicator of electrical problems with the engine batteries, ECU on shift selector keypad.

The window displays gear selection, various transmission modes, oil level and transmission fault codes.

**Keypad Functions:**

- Select the **REVERSE** gear by pressing **R**.
- Select **NEUTRAL** by pressing **N**. The area around the **N** button has a raised ridge so the driver can orient his hand to the push buttons by touch, without looking at the display.
- Select **DRIVE** range by pressing **D**. The highest forward gear appears in the display and the transmission will shift to first gear though 6 is displayed.
- The **UPSHIFT** and **DOWNSHIFT** arrow buttons are used to select a higher (if not in "**D**") or lower (if not in "**1**") forward range. These buttons are not functional in **NEUTRAL** or **REVERSE**. One press changes the gear range selected by one. If the button is held continuously, the selected range will continue to change up or down until the button is released or until the highest/lowest possible range of gears is selected.
- The **MODE** button enables a secondary shift point to be selected. This is commonly referred to as "Economy." It is further used by the service technician to access diagnostic codes when troubleshooting. The diagnostic circuitry must be enabled to display.
- When the Auxiliary Braking device (Jacob or Exhaust brake) is used, the display changes to a default reading of **2**, **3** or **4**. This default is pre-selected at the factory and can only be reprogrammed by an authorized Allison Service Center. The transmission is not in second, third or fourth gear. This is only a reference for the transmission downshift points to optimize the engine braking effect.
- Engine temperature may rise when ascending long grades using full throttle. Towing a load will increase the demand on the engine. If this occurs manually shift the transmission down to the next lower gear and use less throttle. The engine will use less fuel and RPM should increase.

**NOTE: The transmission will not accept a manually selected gear change to occur if the gear selected is out of the specified operating range.**

**NOTE: The transmission will not shift into gear if the engine RPM is at or above 900. The display will flash "6" indicating the engine RPM is excessive. Select "N" and lower the engine RPM.**

### Transmission Check Light

The electronic control system of the transmission is programmed to inform the operator of a problem with the transmission system and reacts automatically to protect the operator, motorhome and transmission. When the Electronic Control Unit (ECU) detects a **DO NOT SHIFT** (DNS) condition the ECU restricts shifting, turns on the **CHECK TRANS** light in the instrument panel and registers a fault code.

**NOTE: For some problems, fault codes may be registered without the ECU activating the CHECK TRANS light. An Allison Transmission authorized service outlet should be consulted whenever there is a transmission related concern. They have the equipment to check diagnostic codes and correct problems which may arise.**

Each time the engine is started the **CHECK TRANS** icon will light, then turn off after a few seconds. This momentary lighting is to indicate that the status light circuit is working properly. If the **CHECK TRANS** light does not illuminate during start up, or if the light remains on after start up, the transmission system should be checked immediately.

Continued illumination of the **CHECK TRANS** light during vehicle operation (other than start up) indicates that the ECU has signaled a diagnostic code. Illumination of the **CHECK TRANS** light is accompanied by a flashing display from the shift selector. The shift selector display will show actual range attained and the transmission will not respond to shift selector requests.

Indications from the shift selector are provided to inform the operator that the transmission is not performing as designed and is operating at reduced capabilities. Before turning the ignition off, the transmission may be operated for a short time in the selected range in order to “limp home” for service assistance. Service should be performed immediately in order to minimize potential damage to the transmission.

When the **CHECK TRANS** icon illuminates the keypad will not respond to command and the transmission generally will downshift to 4th gear. The torque converter will not "lock-up" and engine speed is automatically reduced. Direction changes (i.e. forward to reverse) will not be allowed. Locate a safe secure place to park the motorhome. If the engine is shut off, then engaged after a **CHECK TRANS** indication, the transmission remains in Neutral until the fault causing the **CHECK TRANS** light has been corrected.

**Diagnostic Codes:**

The diagnostic codes are numerical representations of malfunctions in the transmission operations. Each code is a two digit main code and a two digit sub code. The codes, when detected, are logged in the ECU memory. These codes will fall in two classes: active and inactive. Active codes are codes currently effecting the ECU process. Inactive codes are retained but may not effect the ECU process. The diagnostic mode must be entered. A maximum of five codes, **D1** to **D5**, may be listed at one time. The highest priority code will be listed in **D1**. The **MODE** button will enable selection of sequential codes.

**To Enable Diagnostic Code Selection Display:**

- Stop the motorhome at a safe location.
- Apply the parking brake.
- Simultaneously press the **UP** and **DOWN** arrows twice to enter the stored codes. The first time the arrows are pressed will indicate the oil level display. Press the **UP** and **DOWN** arrows again.
- The codes will display one digit at a time.
- The mode button is pressed to scroll through the codes.
- Any code obtained should be noted and reported to an Allison Service Center for evaluation and possible repair.
- Inactive codes can be cleared by holding the **MODE** button for approximately three seconds. Some codes are self clearing while others will require service or ignition on/off cycles to clear.

## *Periodic Inspections*

The Allison MH Series requires minimum maintenance. Careful attention to fluid level and connections for the electronic and hydraulic circuits is very important.

For easier inspection the transmission should be kept clean. Make periodic checks for loose bolts and leaking fluid lines. Check the condition of the electrical harnesses regularly. Check the engine cooling system occasionally for evidence of transmission fluid which would indicate a faulty oil cooler. Report any abnormal condition to an Allison dealer.

**Prevent Major Problems:**

Help the WTEC III control system oversee the operation of the transmission. Minor problems can be kept from becoming major problems if an Allison Transmission distributor or dealer is notified when one of these conditions occur:

1. The shifting feels odd.
2. The transmission leaks fluid.
3. There are unusual transmission-related sounds (changes in sound caused by normal engine thermostatic fan cycling, while climbing a long grade with a heavy load, have been mistaken for transmission-related sounds).
4. The **CHECK TRANS** light comes on frequently.

**The Importance of Proper Fluid Levels:**

Transmission fluid cools, lubricates and transmits hydraulic power. Proper fluid levels must be maintained at all times. If fluid level is too low, the converter and clutches do not receive an adequate supply of fluid. If fluid level is too high, the fluid can aerate. Aerated fluid can cause the transmission to shift erratically or overheat.

The MH Series oil level sensor (OLS) allows the operator to check the transmission fluid level from the keypad shift selector. Frequently check for the presence of oil level diagnostics in the transmission. If the OLS has not been detected, troubleshooting of the OLS circuit is required. This will have to be performed by an Allison Service Center. After the OLS circuit is repaired, ensure that reset of the “autodetect” or manual selection of the OLS function is enabled by using a Pro-Link transmission diagnostic center.

**Fluid Level Check with the Keypad:**

To Enter Oil Level Sense Mode:

- Park the motorhome on a level surface. Place the transmission in "**N**" and set parking brake.
- The transmission temperature must be at least 140º F./60º C, otherwise an error code will appear.
- The motorhome must be stationary and in **Neutral** for approximately two minutes to allow the fluid to settle in the sump.
- The engine must be idling lower than 800 RPM.
- Simultaneously press the **Up** and **Down** buttons once.

The transmission is now in **Oil Level Sense** mode. The display will indicate one character at a time. An "**o**" followed by "**L**" represents **oil level check** mode. One of the following will be indicated.

**Common Oil Level Fault Codes:**

| Display | Cause of Code |
|---|---|
| o,L - O,X | Setting time too short |
| o,L - 5,0 | Engine speed (RPM) too low |
| o,L - 5,9 | Engine speed (RPM) too high |
| o,L - 6,5 | Neutral must be selected |
| o,L - 7,0 | Sump fluid temperature too low |
| o,L - 7,9 | Sump fluid temperature too high |
| o,L - 8,9 | Output shaft rotation |
| o,L - 9,5 | Sensor failure |

- "**o K**" represents the level is okay.
- "**Lo**" represents a low fluid level followed by a numeric indication of the number of quarts needed fill the sump.
- "**HI**" represents an overfull condition followed by a numeric indication of the number of quarts the sump is overfull.
- A countdown of flashing numbers indicate the fluid is still settling. When the fluid has stabilized in the sump the true level will be indicated.
- If an "**o**" "**L**" "**-**" followed by a number displays, the oil level sensor could not read the level due to one of conditions listed in the chart.

**To Exit Oil Level Sense Mode:**

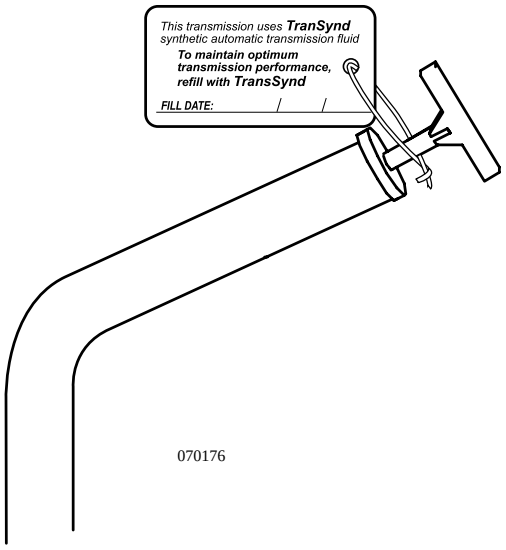
• Press **Neutral**, **Reverse** or **Drive**.

**NOTE: Reading between the Oil Level Sensor and the dipstick may not agree because the OLS compensates for fluid temperatures.**

**NOTE: To correctly check the transmission fluid level using the dipstick, the transmission fluid must be at operating temperature. The oil level sensor method of checking the fluid level compensates for transmission fluid temperature between 60º C - 104º C (140º F - 220º F). Any temperature below 60º C (140º F), or above 104º C (220º F), will result in an error code.**

## TRANSMISSION LUBRICATING FLUID

Transmission performance, reliability and durability are dependent on the type of lubricating fluids used. From the factory, the transmission has been filled with TranSynd™ synthetic transmission fluid. TranSynd™ synthetic transmission fluid extends the service intervals. A small tag has been attached to the dipstick identifying that the transmission is filled with TranSynd™ synthetic transmission fluid. The dipstick/oil fill is located in the rear curbside engine service compartment.




**Fluid and Internal Filters Change Interval:**

Fluid and internal filters may require changing earlier depending on the severity of operating conditions. Fluid must also be changed whenever there is evidence of dirt or high temperature operation as indicated by discoloration, strong odor or fluid analysis. Local conditions, severity of operation or duty cycle will dictate more or less frequent service intervals.

**NOTE: Refer to the Allison transmission owner's manual or contact an authorized Allison service center for change intervals.**

## Fluid Levels - Cold Check

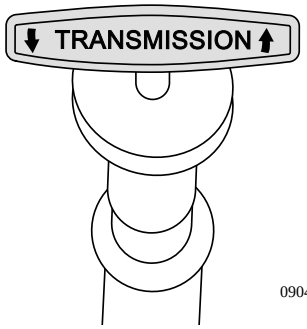
**Cold Check - Manual Check Procedures:**

The concept of a cold check is to determine adequate fluid level for safe operating until hot check can be performed.

**To Check the Fluid When Cold:**

- Park the motorhome on a level surface. Set the parking brake.
- With the engine operated at a low idle, put the transmission in **N** (Neutral).
- Chock the wheels to prevent the motorhome from moving.
- Allow the engine to run at idle (500-800 RPM) for one minute.
- Apply service brakes and shift to **D** (Drive), then to **N** (Neutral) and next to **R** (Reverse) to fill the system. Finally shift to **N** (Neutral) and release service brakes. Allow the engine to continue to run at idle (500 - 800 RPM).
- Remove the dipstick and wipe clean. Reinsert the dipstick fully into the tube and remove to check fluid level. Repeat this to verify reading if needed.
- Safe operating level is anywhere within the **COLD CHECK** band on the dipstick. The fluid level is sufficient enough to operate until a **HOT CHECK** can be performed.
- If the level is not within this band, add or drain the fluid as necessary to put the level to the middle of the **COLD CHECK** band.
- Perform the **HOT CHECK** at the first opportunity after reaching normal operating temperatures (160º - 200º F/71º - 93º C).

**CAUTION: Low or high fluid level can cause overheating and irregular shift patterns. These conditions can damage the transmission if not corrected.**



### Fluid Levels - Hot Checks

- Fluid level rises as temperature increases. Fluid must be hot to ensure an accurate check.
- Be sure fluid has reached normal operating temperature (160º - 200º F /71º - 93º C). If a transmission temperature gauge is not present, check the fluid level when the engine water temperature gauge has stabilized and the transmission has been operated under the load for at least one hour.
- Park the motorhome on a level surface and shift to **N** (Neutral). Apply the parking brake and allow the engine to idle (500 - 800 RPM).
- After wiping the dipstick clean, check the fluid level. Safe operating level is anywhere within the **HOT RUN** band on the dipstick.
- The width of the **HOT RUN** band is approximately one quart of fluid at normal temperature range.
- If the level is not within this band, add or drain the fluid as necessary to put the level within the **HOT RUN** band.
- Be sure that the fluid level checks are consistent. Check the level more than once. If the readings are not consistent, ensure that the transmission breather is clean and not clogged. If the readings are still not consistent, contact the nearest Allison distributor or dealer.

## COOLANT SYSTEM

The cooling system consists of a radiator mounted on the roadside of the motorhome, a hydraulic powered fan, an in-line transmission cooler, as well as an external hydraulic cooler and charge air cooler that are mounted to the radiator. Steel tubes and radiator hoses allow engine coolant to flow between the radiator and the engine. The hydraulic fan draws air from the outside of the motorhome, through the radiator and into the engine compartment. These components working together ensure that all the chassis systems maintain proper operating temperatures as they are inner-related. A problem with one component may cause problems with an entirely different system.

After the engine reaches proper temperature, the water regulator (thermostat) on the engine opens and allows coolant to flow from the engine, through the upper radiator hose and into the radiator. The coolant is cooled in the radiator and flows back to the engine through the lower radiator tube. A by-pass tube installed between the thermostat housing and lower radiator tube functions to supply coolant to the transmission cooler under certain conditions to ensure proper cooling.

The charge air cooler, which is mounted on the outboard side of the radiator, cools the intake air for the engine after it has passed through the turbocharger. This is necessary due to the heat generated as the intake air is pressurized, and subsequently heated, as it passes through the turbocharger.

With all the components working together to maintain the engine, transmission, and hydraulics operating at the proper temperatures proper maintenance of the cooling system is very important. One neglected component could result in cooling problems. Maintenance of the cooling system includes maintaining a proper coolant level with the correct mixture of coolant and additives, inspection of cooling system components, flushing the engine coolant system with approved cleaners, and ensuring that the exterior of the radiator and other external coolers are kept clean and free of debris.

Understand that adding straight water or antifreeze to the system creates an imbalance of the coolant mixture. While adding small amounts occasionally may not affect the mixture greatly, large amounts (1/2 gallon) or frequent "top-offs" will.

Three components necessary for the proper coolant mixture are clean water, glycol antifreeze (ethylene or propylene), and Supplemental Coolant Additives (SCA). The water in the coolant system serves as the "base." It is critical to use as pure of water as possible. Salts and other minerals in the water can solidify in the cooling system causing scaling and "clogging" of the radiator. Distilled or de-ionized water is recommended for use in the cooling system in order to avoid these problems.

Glycol antifreeze, usually in the form of ethylene glycol or propylene glycol, provides an increased boiling point of the coolant mixture, increased freeze protection, and helps prevent water pump cavitation (air bubbles in the coolant mixture that can result in wear of the engine). While the ratio of water and glycol can be adjusted to meet differing anti-boil and freeze protection, it is recommended that a mixture of 50% water and 50% glycol be used. This 50/50 mixture provides freeze protection to -34º Fahrenheit.

A minimum mixture of 30% glycol and 70% water is required in order to minimize water pump cavitation and corrosion protection.

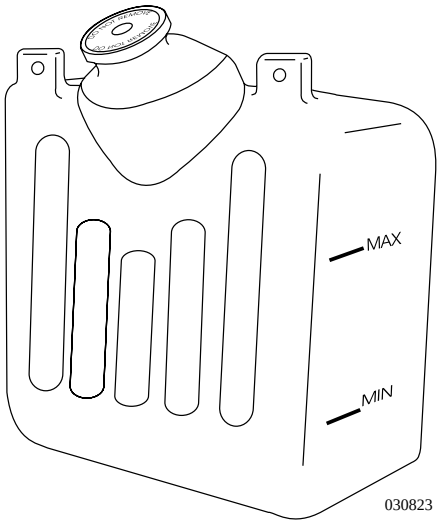
## Coolant

Fully formulated antifreeze or coolant containing a precharge of Supplemental Coolant Additives (SCA) is recommended. The use of either will significantly simplify coolant system maintenance. The difference between a fully formatted antifreeze and a fully formatted coolant is the percentage of water. Both contain balance amounts of antifreeze, SCA, buffering compounds and a percentage of good clean quality water. The antifreeze of coolant must meet ethylene glycol or propylene glycol recommendations. A good clean quality water in a 50/50 ratio (40 to 60% working range) mixed with fully formatted antifreeze will provide protection from -34º F to 228º F. The 50/50 mix ratio must be premixed prior to being put in the system. Placing antifreeze and water in the cooling system is not recommended. Consult the *Cummins Operation & Maintenance Manual* for more details.

**NOTE: An over concentration of antifreeze, or the use of high silicate antifreeze, can cause damage to the coolant system and engine. Antifreeze is essential in every climate.**

**WARNING: Do not continue engine operation when engine temperature rises above 220º F. At 220º an engine warning light will illuminate and the engine will begin to de-rate in power output. Continued operation will result in engine damage.**

The coolant level and fluid freeze point should be checked with every oil change interval, at 15,000 miles, 500 hours or six months, whichever comes first. Also change the coolant filter (not on all engines) at the same interval unless SCA concentration is over three units. The coolant should be drained and flushed at 6,000 hours or two years of service, whichever comes first.




*Located in the rear engine compartment.*

**Engine Coolant Reservoir:**

A "see-through" plastic reservoir, similar to the familiar windshield washer jar, is connected to the radiator by a hose. As the motorhome is driven, coolant is heated and expands. A portion of fluid displaced by this expansion flows from the radiator into the reservoir tank. When the engine is stopped, the coolant cools and contracts. Displaced coolant is drawn back in the radiator by a vacuum. Thus, the radiator is kept filled with coolant to the desired level at all times resulting in increased cooling efficiency. The coolant level should be at or slightly above the appropriate mark on the reservoir tank when the system is cold.

**CAUTION: To avoid scalding hot steam or coolant from being released from the engine cooling system, never remove the reservoir cap while the engine is running or hot. Failure to follow this warning may result in damage to the engine's cooling system and possibly cause severe personal injury.**

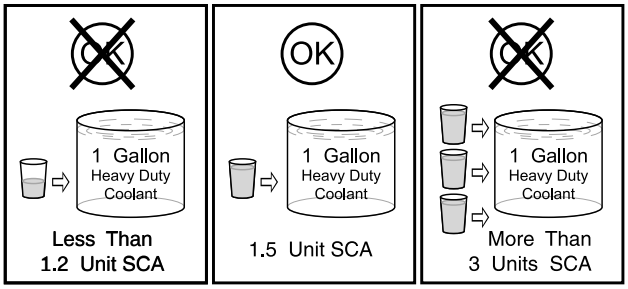
- Check the coolant level daily or when refueling.
- Drain and flush the coolant system every 60,000 miles or two years, and refill with a heavy-duty coolant (50/50 mix of water and antifreeze).
- If the coolant is below the **MIN** mark, the low coolant alarm will sound and the low coolant light will appear on the dash.
- The coolant level remains between the **MAX** and **MIN** level in the reservoir.

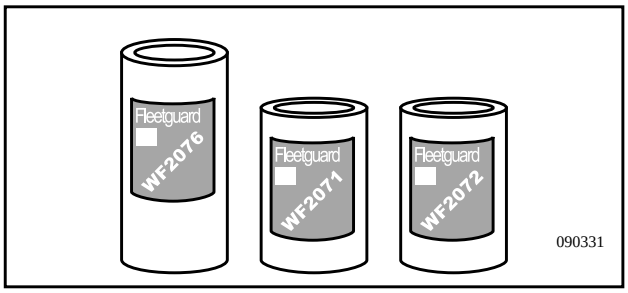
**INSPECT: Stop the motorhome and inspect the coolant level before continued operation.**

## Coolant Additive (SCA)

Fully formulated products contain SCA and are required to protect the cooling system from fouling, solder blooming and general corrosion. The cooling filter is required to protect the coolant system from abrasive materials, debris and precipitated coolant additives.

Supplement coolant additives, or equivalent, are used to prevent cylinder liner pitting, corrosion and scale deposits in the cooling system. Use the correct Fleetguard coolant filter to maintain the recommended SCA concentration in the system by changing the service filter at each oil drain interval.




**NOTE: The correct filter is determined by the total cooling system capacity and oil drain interval. Refer to the Coolant Capacity Specifications in this section.**

**CAUTION: Insufficient concentration of the coolant additives will result in cylinder liner pitting and engine failure. The SCA concentration must not fall below 1.2 units or exceed 3 units per gallon of cooling system capacity.**

**For more information refer to the Cummins manual.**

**Routine Maintenance Recommendations:**

1. Check the SCA concentration level every 15,000 miles/6 months.
2. Change the coolant filter every 15,000 miles/6 months.
3. Drain and flush the system every 240,000 miles/2 years, and refill with a heavy-duty coolant (50/50 mix of water and antifreeze).
4. Always use antifreeze. In addition to freeze protection, antifreeze is essential for overheat and corrosion protection.
5. The supplemental coolant additive (SCA) is required.
6. Freeze point should be measured every 15,000 miles/6 months.

**Maintenance Procedures**

When performing maintenance, it is also necessary to **inspect** other components of the cooling system.

Have an **inspection** performed of the surge tank cap seal and have the cap pressure tested, and also replace the thermostat, gasket and seal. The charge air cooler and radiator also requires an **inspection** for cracks, broken welds, secure mounting, and general cleanliness.

It may be necessary to clean the radiator and external coolers more often under certain conditions. Leaves, twigs, road debris and other contaminants can block the radiator and cooler fins resulting in reduced cooling system performance. Blockage can vary depending on road conditions, climate, and regional conditions. Check the radiator and external coolers weekly for any blockage and clean as required. To clean the radiator and external coolers, compressed air is recommended. In the event that road grime, oil, or inadequate cleaning with compressed air is encountered, a high pressure washer and degreaser may be used with caution, as excessive pressure can bend the radiator fins.

Please refer to the Cummins OEM Manual for detailed information regarding the 24 month/60,000 mile maintenance interval. This service includes draining the engine coolant, flushing/cleaning the cooling system, **inspecting** the water pump standpipe, replacing the thermostat, gasket and seal, and replacing the coolant and SCA element.

To replace the SCA element (located on the passenger side of the motorhome), park the motorhome and stop the engine. Close both the inlet and outlet valves at the element mounting base. Remove the element from the base and discard properly. Clean the element base and ensure that the old gasket is removed.

Apply a thin film of clean engine oil to the new element gasket and install it onto the element head until the gasket contacts the base. Tighten the element an additional 3/4 turn. Open the inlet and outlet valves. Remove the surge tank cap and run the engine until the coolant level stabilizes. Add premixed coolant/water to the system if necessary to bring the coolant to the proper level. **Inspect** the fill cap gasket and replace if damaged. Install the fill cap.

**Coolant Hoses:**

Rotten, swollen and worn hoses, as well as loose connections, are frequent causes of coolant system problems. Overheating can be caused by a collapsed hose or a clog caused by rubber shedding from a rotton hose. Replace any hose found to be cracked, swollen or damaged. Connections should be inspected periodically and hose clamps tightened.

**Every 12 months - Inspect** all hoses, clamps, and fittings for leaks due to cracking, softness, and loose clamps/fittings. Look for signs of fluid leaks, damaged end fittings, ballooning, chafed, kinked, or crushed hoses, and loose clamps and fittings. Correct any deficiencies found.

**Coolant Overheated:**

If the engine is overheated, never pour cold coolant into a hot engine. The sudden change in temperature may crack the cylinder head or block. If the engine is hot, fill slowly to prevent rapid cooling and distortion of engine castings.

**Coolant Changing:**

**24 months/60,000 miles - Inspect** and clean the cooling system and charge air systems to promote system cleanliness and to enhance engine cooling. Stop the engine and allow it to cool. Remove the cap from the surge tank and place a large container beneath the drain valve on the radiator. Open the drain valve and allow the cooling system to drain. With the drain valve open, flush the cooling system with clean water to remove debris. Dispose of the old coolant mixture appropriately. Close the drain valve and fill the cooling system with a mixture of clean water and sodium carbonate. One pound of sodium carbonate is needed for every six gallons of water. Operate the engine for five minutes at temperature above 176 º F. Stop the engine and allow the system to cool. Open the radiator drain valve to allow the system to drain. Fill the system with high quality water. Again, operate the engine for five minutes at temperature above 176 º F. Flush the system with clean water until the draining water is clear. Allow draining completely. **Inspect** the water pump standpipe for blockage.

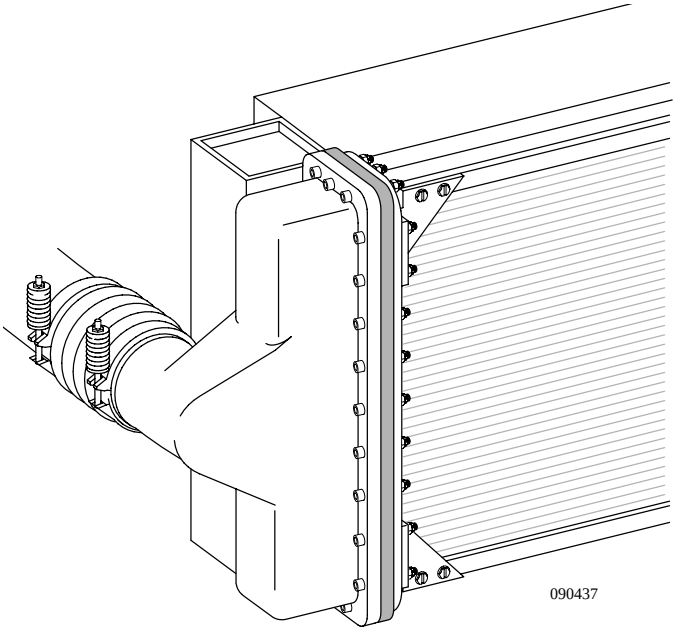
Replace the thermostat. Loosen the hose clamps and remove the hose assembly from the radiator to thermostat housing assembly. Remove the thermostat housing assembly from the cylinder head. Remove the thermostat and gasket from the housing, along with the seal in the housing. Install the new thermostat, seal and gasket into the housing. Re-install the thermostat housing and connect the hose assembly. Tighten the hose clamps. Ensure that the drain valve for the radiator is closed. Fill the cooling system with the recommended coolant / water / coolant additive mixture. Start the engine with the surge tank cap removed and allow the coolant to warm and the thermostat to open. Add coolant mixture until the coolant level in the surge tank is between MIN and MAX. Replace the surge tank cap. Allow the engine to warm to operating temperature while observing for coolant leaks. Stop the engine.

**Inspect** the radiator core and CAC for dirt and debris build-up. Wash any accumulations using high-pressure water, being careful not to damage the fins from excessive pressure. Any grease or oil build-up should first be treated with a non-caustic degreaser to ensure a thorough cleaning.

**Coolant System - Thawing:**

If the coolant system becomes frozen solid, place the motorhome in a warm area until completely thawed. At this point the motorhome must be towed. If the engine is operated when the cooling system is frozen it will result in engine overheating due to insufficient coolant circulation. Once thawed, check engine, radiator and related components for damage caused by expansion of frozen coolant.

## CHARGE AIR COOLER




The diesel engine uses compression to ignite the fuel/air charge. To increase compression inside the combustion chamber (resulting in increased power output) a turbocharger is added to the engine. The turbocharger is a paired housing assembly with impellers inside each housing connected by a common shaft. One impeller is propelled by the engine exhaust, which drives the other impeller. The function of the other impeller is to increase compression inside the combustion chamber by forcing air into the intake manifold. The intake air charge is heated two different ways: through convection by the exhaust gases driving the turbocharger, and any time air is compressed heat is produced. This has a negative effect inside the combustion chamber resulting in lost power potential. Therefore, a Charge Air Cooler (CAC) is installed to cool the intake air before it enters the engine. The CAC may be mounted to either the top or side of the radiator.

The CAC performs the same function as a radiator, cooling air instead of liquid. Ambient air passing through the CAC will cool the engine's intake air charge.

After leaving the turbocharger, intake air is compressed and heated to approximately 300º to 375º F., depending on the engine load and throttle position. Before the air enters the intake manifold, the CAC cools the intake air temperature to the engine manufacturer's specifications. Lower intake air temperatures reduce exhaust emissions, improve fuel economy and increase horsepower. The CAC will continually expand and contract up to ¼" as throttle increases and decreases.

Visually **inspect** the charge air cooler, every six months, for dirt and debris that may be blocking the fins. If the motorhome develops an oil leak, there is a possibility that the oil will coat the fins of the CAC. Dust will adhere to the oil film and eventually clog the fins greatly reducing cooling efficiency. When the oil leak is repaired, the CAC must be thoroughly cleaned.

Spraying degreaser on the charge air cooler, as well as using a steam cleaner, will not damage the CAC. However, pressure washer and steam cleaner nozzles placed too close to the CAC can bend the fins. The recommended cleaning procedure for the CAC, and the radiator, is to use a bucket of mild soap and water. Carefully wash with a bristle brush then rinse using a garden hose, with minimum water pressure, standing back a distance to avoid bending the fins.

The fuel tank, fuel lines, fuel/water separator, secondary fuel filter, fuel transfer pump, and fuel injectors are primary components of the fuel system. When the fuel transfer pump is operating, fuel is drawn from the fuel tank through the fuel supply hose to the primary water/separator. Most contaminants that may be present in the fuel are removed at this point. The fuel then flows to the secondary filter that removes any remaining contamination in the fuel down to five microns. From the filter, the fuel flows to the injectors, where the ECM controls injection timing and the amount of fuel delivered to the cylinder through the use of an electric solenoid on the injector. Fuel that is not used is returned to the fuel tank.

The fuel passes through the fuel transfer pump, which is a fixed clearance gear transfer pump, and through passages in the electronic control module (ECM) in order to provide cooling for the electronics.

Prevention of problems associated with the fuel system and performance of the vehicle begins with the quality and cleanliness of the fuel used. Fuel contaminated with water, dirt, and even algae can quickly clog fuel filters and cause problems with the fuel system.

Try to obtain fuel from large fueling stations, such as truck stops, that do a large amount of business and the supply of fuel is replenished often.

Always keep the fuel tank full whenever possible, this helps prevent water condensation from forming inside the fuel tank. Condensation can cause problems in the fuel system not only with the filters, but can also eventually cause corrosion of the fuel tank. Always store the motorhome with a full tank of fuel.

**Fuel Requirements:**

Low sulphur #2 diesel fuel or #1 and #2 commercial winter blend diesel fuels are the most common commercially available and recommended for use. These fuels should have a minimum cetane number of 40 and be of a low sulfur content (less than 0.05%) in order to reduce engine wear and emissions. The engine manufacturer recommends the use ASTM #2D fuel. The use of #2D diesel fuel will result in optimum engine performance.

During cold weather operation, #1 grades or a blended fuel should be used. #1 grade fuel has a lower pour point and cloud point than #2D fuel, enabling them to flow through the fuel system easier at lower temperatures.

**WARNING: Do not mix gasohol with diesel fuel. This mixture can cause an explosion.**

**NOTE: Due to the precise tolerances of diesel injection systems, it is extremely important that fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the fuel pump and the fuel injector. Fuel additives for lubricity are not recommended. There are numerous diesel fuel additives to help remove moisture from fuel, prevent microbe growth and to prevent freeze-up during cold weather. Always consult your fuel supplier or engine manufacturer service center for information on fuel additives should they be necessary.**

Any fuel additives product should show supporting data for performance and benefits. Engine failures caused by incorrect fuel are not covered under warranty.

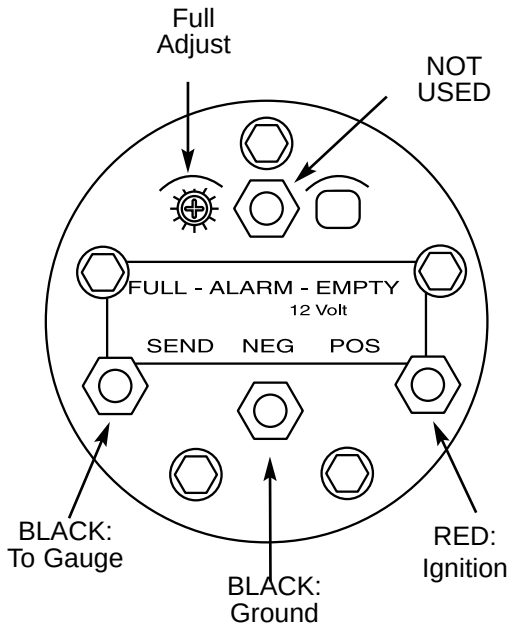
Maintenance of the fuel system is important, as it supplies the energy with which the engine requires to run efficiently. Poor maintenance of the fuel system can result in poor performance, premature failure of components, and unexpected breakdowns. **Inspect** the entire fuel system at oil change intervals for leaks, secure mounting, corrosion, and other problems.

**Fuel Tank:**

The diesel fuel tank is made of 13-gauge steel. The total capacity is 100 gallons. The engine pick-up tube is cut at a 45-degree angle to allow optimum flow to the engine.

**NOTE: If the motorhome has been stored for any length of time, check the vent for blockage. It is not uncommon for insects to plug the vent tube. If the tank appears to be pressurized the vent tube may be blocked. To inspect the vent tube check on the curbside of the fuel tank, near the bottom. Always store the motorhome with a full fuel tank.**

## *Fuel Sender*




*Fuel Sending Unit.* 090318

The "Centroid" fuel sender has no moving parts and works by measuring capacitance (electrical property) between its inner and outer tubes in the tank. The more fuel between the tubes, the higher the reading. Electronics in the "hockey-puck" head of the sender convert the capacitance to current to drive the fuel gauge.

**The "Centroid" sender has four connections:**

- **Positive (POS) and Negative (NEG):** Battery voltage to run the electronics in the sender head.
- **SEND:** Connects to the SEND terminal of the gauge on the dash.
- **ALARM:** Makes a connection internally to the negative (NEG) terminal when the low fuel alarm level is reached (when the fuel gauge is reading about 1/8 tank). This turns on the low fuel indicator light on the dash and is not adjustable.

**Adjustments:**

**The "Centroid" sender has two adjustments:**

- **EMPTY:** Adjusts for length of sender. It has been set at the factory, covered with a sealant and should not be changed.

- **Full Adjustment (FULL):** The full adjustment can be used to correct for slight differences between fuel meters. During installation, it has been calibrated for the meter and should not need readjustment.

The correct adjustment technique, with a full tank of fuel, is to start with the full adjustment screw completely clockwise. This should cause the reading to be above full. Adjust slowly, rotate counterclockwise, until the full mark on the gauge is reached. The intent is to always adjust downscale rather than upscale.

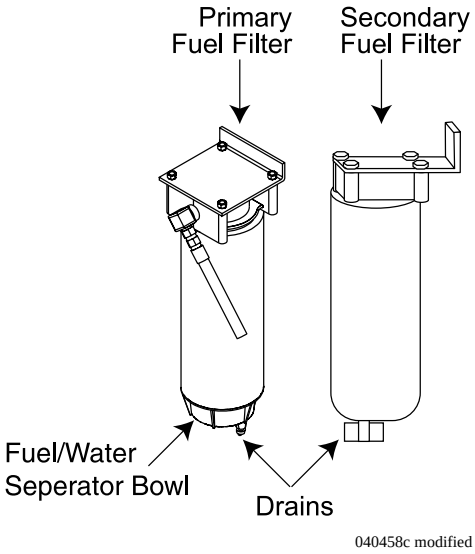
**Troubleshooting:**

**A. Electronic Output:** The sender has a transistorized output to prevent an ohmmeter from getting a correct reading of its output resistance.

**B. Fuel Only:** The sender will not work correctly in conducting fluids such as water (it will read above full all the time in water). One possibility is that when there is a constant above-full reading there may be water in the bottom of the fuel tank.

**C. Contact Centroid:** Probably 90% of the return Centroid tests work okay on the bench. If you have incorrect readings contact **Centroid** (**telephone: 800-423-3574,** or preferably, **fax: 386-423-3709**) with the symptoms. A short,"fill in the blanks" troubleshooting test is provided to test the sender. It is easier to find the problem that way than after the sender has been removed from the system, since the problem is not necessarily with the sender.

## Fuel Filters




The fuel filters are located in the rear engine compartment. The primary and secondary fuel filters have drains located at the bottom of the filters. The primary filter has a clear sediment bowl located at the bottom of the filter. Water (by weight) is heavier than fuel and will collect in the sediment bowl. Water can accumulate in the fuel from condensation in the fuel tank or contamination upon refueling.

The appearance of water in the sediment bowl is easily identified by the inability of water to mix with the fuel forming small pools. The water should be drained at the first opportunity. If water passes through the filters it can cause engine misfire and damage fuel injectors.

**NOTE: Replace both primary and secondary filters every six months or 15,000 miles.**

**To Drain the Filters:**

- Shut off the engine.
- Drain the secondary filter first and then the primary filter.
- Turn the valves counterclockwise approximately 1½ to 2 turns until draining occurs.
- Drain the filters of water and sediment until clear fuel is visible.
- Turn the valve clockwise to close the drain valves.
- Depending on the amount of contamination it may be necessary to replace the filters at the first opportunity.

In the event the engine runs out of fuel, the lift pump on the fuel pump will run for approximately one minute with the ignition on. The ignition may need to be turned on and off several times before attempting a start. If unable to restart, contact the nearest **Cummins Center** or phone **1-800-343-7357** for Cummins Customer Assistance Center.

### Fuel Line & Hoses

Make a visual check for fuel leaks at all engine-mounted fuel lines and connections and at the fuel tank pick-up and return lines. Leaks in this area may best be detected by checking for accumulation of fuel under the tank. Engine performance and auxiliary equipment is dependent upon the ability of flexible hoses to transfer lubricating oil, air, coolant and fuel oil. Diligent maintenance of hoses is an important step in ensuring efficient, economical and safe operation of engine and related equipment.

**INSPECT: Check hoses daily as part of the pre-start-up inspection. Examine hoses for leaks. Check all fittings, clamps and ties carefully. Make sure that the hoses are not touching shafts, couplings and heated surfaces, including exhaust manifolds, sharp edges or other obvious hazardous areas. Since all machinery vibrates and moves to a certain extent, clamps and ties can fatigue with age. To ensure continued proper support, inspect fasteners frequently and tighten or replace them as necessary.**

Engine oil levels above the dipstick full mark, or a decrease in lube oil consumption, may indicate internal fuel leaks into the crankcase. Check oil level frequently for fuel contamination.

## HYDRAULIC SYSTEM

The motorhome uses an engine driven hydraulic pump to operate both the power steering system and the engine hydraulic cooling fan system. The hydraulic pump is a dual stage pump that uses one half of the pump to supply pressurized hydraulic fluid to the power steering. The other half of the pump supplies the engine cooling fan motors. The hydraulic system uses the same fluid for both systems, sharing one common reservoir. The hydraulic fluid used is an automatic transmission fluid (*Dexron III*®) which has a wide ambient temperature operating range.

**CAUTION: If ambient temperatures approach 0º F, Pennzoil Arctic Blue hydraulic fluid, or equivalent hydraulic fluid, should be used. Using incorrect hydraulic system fluid weights in cold or arctic temperatures will raise the hydraulic system operating pressure and may damage the hydraulic cooler.**

Hydraulic fluid passing through the system also goes through an air-to-fluid cooler mounted on the outside of the charge air cooler, as well as a filter. Maintenance requirements for this system include fluid level checks, filter and fluid replacement, and inspection.

### Hydraulic Pump

The hydraulic pump creates pressure by meshing sets of gears together inside a close tolerance housing. A filtered supply of hydraulic fluid from the hydraulic reservoir enters the intake side of the pump. The meshing gear assembly "squeezes" oil through the pump to the output side, delivering the pressurized fluid to the power steering gear and the switching valve of the engine cooling system. Each half of the pump is equipped with an internal by-pass pressure relief spring. If the hydraulic pressure should exceed the specified pressure limit, the internal by-pass relief valve will be forced open to keep the hydraulic fluid at operating pressure. The hydraulic pressure generally is not rated in psi but is rated in the term Bar. One bar is equivalent to approximately 14.5 psi. Hydraulic system pressures with a system at no load may be as low as eight bars on the output side of the pump. This is due to the hydraulic fluid flow of the pump. When a load is placed on the hydraulic pump, such as turning the steering wheel, hydraulic fluid flow slows from hydraulic fluid restriction and pressure increases.

This may be understood as a faucet with a garden hose attached. Crimping the hose with the faucet on will create pressure from the restriction. This principle applies to the hydraulic system. The hydraulic pump is the supply, the load is the power steering gear or the hydraulic fan motors. Hydraulic system pressure at full load can exceed 130 bar or 2000 psi. Hydraulic system pressure falls dramatically after the load. The return line pressure may be as low as six to eight bars. The fluid enters the hydraulic cooler where the heat is dissipated.

### Hydraulic Cooler

The hydraulic cooler is an important part in the hydraulic system. This helps keep the hydraulic fluid from overheating. When a load is placed on the hydraulic system, heat is created in the fluid. The hydraulic pump builds pressure that creates heat in the fluid. Restriction from the loads applied also create heat. This heat must be dissipated to keep the hydraulic fluid from overheating and breaking down. After cooling, the fluid is filtered before returning to the reservoir.

Care must be used when starting an engine in very cold or arctic climates. As with any oil, lower temperatures thicken the oil. Hydraulic system pressure increases due to the viscosity of the fluid. Although the hydraulic pump is equipped with pressure relief valves, the thick oil on the return line can exceed the operating pressure of the hydraulic cooler.

### Hydraulic Fan System

The hydraulic fan drive system cools the radiator, charge air cooler, hydraulic fluid cooler and transmission cooler. The components of the hydraulic fan system are: hydraulic reservoir, filter, pump, one hydraulic fan motor, hydraulic switching valve and thermovalve. Cooling fan speed is proportional to engine speed and radiator temperature. When radiator temperature rises above 185º F, the wax thermovalve, located in the upper radiator tube, slowly closes off the bypassing hydraulic fluid from the switching valve. As radiator temperature rises, a spool valve begins to move in the switching valve. The spool valve directs the pressurized hydraulic fluid to the fan motors. The higher the radiator temperature, the further the spool valve is moved in the switching valve, providing a higher volume of pressurized hydraulic fluid to the fan motors. Fan motor speed is increased to meet the demand for cooling. The action of the thermovalve is designed to move the spool in the switching valve to ramp up fan motor speed. This design saves horsepower and increases fuel mileage by precise control of hydraulic fan motor speed. The fan motors will increase in speed when the motorhome is ascending long hills or operating in high ambient temperatures. It is normal for the fans to "roar" when they are operating. Fan motor speed and engine RPM are approximately the same with the switching valve at full engagement.

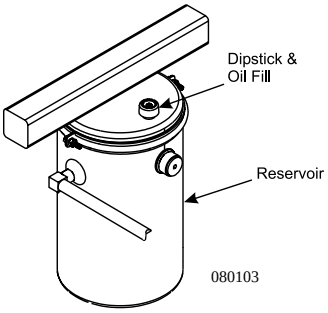
### Thermovalve

The wax filled thermovalve is mounted at the top of the radiator sensing coolant temperature. The thermovalve controls the action of the switching valve. When the radiator is cool, the hydraulic fluid is allowed to flow through the inlet and outlet ports of the thermovalve and return to the hydraulic reservoir. As the coolant temperature inside the radiator rises to approximately 185º F, the wax inside the thermovalve begins to melt and expand. This begins to restrict hydraulic fluid flow through the thermovalve. The restricted hydraulic fluid pressure then begins to move the internal spool valve of the switching valve. This process will continue until coolant temperature inside the radiator reaches approximately 199º F. At this temperature hydraulic fluid flow through the thermovalve is stopped, moving the spool valve to full open position.

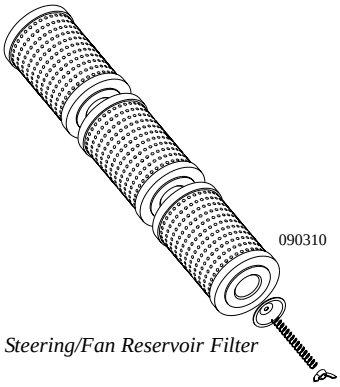
### Switching Valve

The switching valve is mounted to the fan motor. This valve controls direction of high pressure hydraulic fluid flow. High pressure hydraulic fluid comes from the hydraulic pump to the switching valve before returning to the reservoir. The thermovalve directs the fluid to the spool in the switching valve. When the radiator is cool, pressurized hydraulic fluid will bypass the fan motors and return to the fluid reservoir. As radiator temperature rises, the thermovalve signal is slowed or stopped to the switching valve. High pressure fluid is then directed to the fan motors, cooling the radiator.

## Hydraulic Reservoir




*Steering/Fan Reservoir*

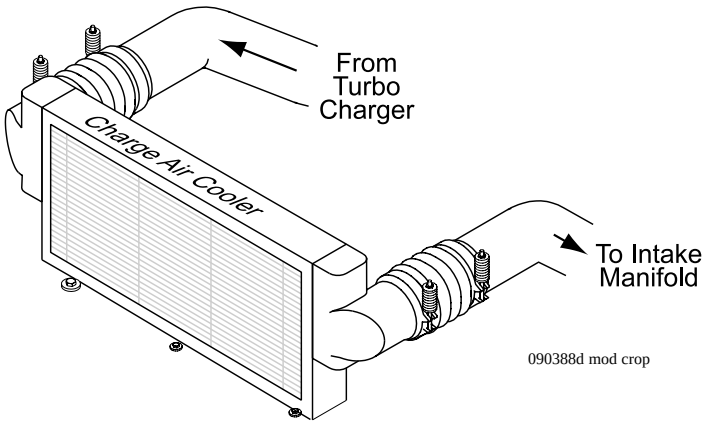



*Steering/Fan Reservoir Filter*

The Nelson hydraulic reservoir with internal filter system is located in the engine compartment. It is the reservoir for both the hydraulic fan drive system and power steering system. The hydraulic filter assembly is located inside the reservoir. The 25 micron* filter system is designed to protect the precision tolerance hydraulic system components. Check the oil level in the reservoir when the oil is at operating temperature. This should be done every 6000 miles or three months. The oil dipstick/oil fill is located on top of the reservoir. The oil level should be done every 6000 miles or three months. The oil dipstick/oil fill is located on top of the reservoir. The oil level should be kept between the full and add marks on the dipstick. Change the hydraulic oil filters every 15,500 miles or once a year. When performing fluid level checks, inspect fittings and hoses for signs of leakage. Avoid untimely and costly failures by having leaks repaired. To change the filter system a five gallon drain bucket will be needed. Loosen the band clamp at the top of the reservoir and remove the lid. Place the drain bucket under the reservoir and loosen one of the bottom fittings to drain the reservoir. Drain only enough fluid from the reservoir to expose bottom filter, then tighten fitting. Remove the wing nut, filter spring and filter washer. Remove the three drop in filters and install the new ones. Install the filter washer and filter spring. Tighten the wing nut until wing nut reaches end of threaded rod. It is recommended to install new hydraulic fluid. Old fluid may contaminate the hydraulic system. Fill the reservoir with approximately three to four gallons to the full mark. Install top and band clamp. Run engine to purge trapped air. Check fluid level after fifteen minutes of operation. Total system capacity is approximately 44 quarts.

## AIR INTAKE & CHARGE AIR SYSTEM

The air intake and charge air system supply the engine with clean air for proper combustion and performance. The air entering the engine must be clean as possible, as contaminated air can cause destruction of major engine components. Even small amounts of contaminants can do major damage to an engine. Air entering the system is cleaned through a replaceable filter element and monitored with an air filter restriction indicator.

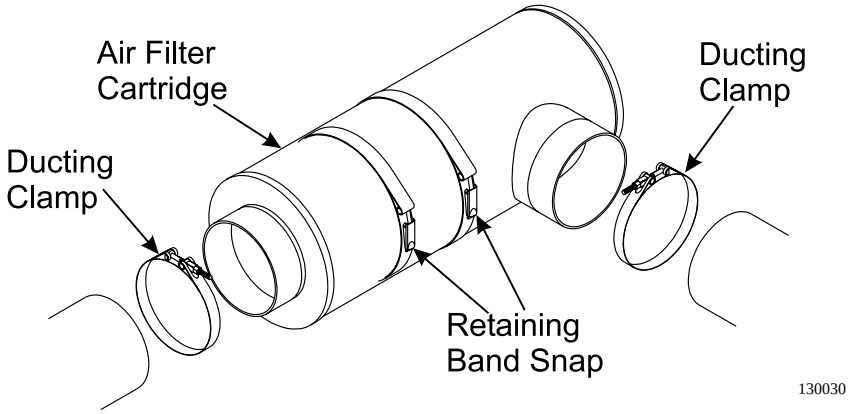



The airflow through the air filter is passed through the engine turbocharger, which pressurizes and heats the air. The heated pressurized air then passes through the charge air cooler, where the air is cooled before entering the engine intake manifold.

**INSPECT: The air intake system on a weekly basis, looking for damage, clogged fins, loose connections, and wear to the air ducting, clamps, and filter housing. Check to ensure that the ducting is not rubbing or wearing on other components and that all components are securely in place. Have any problems investigated and corrected as soon as possible in order to prevent engine damage.**

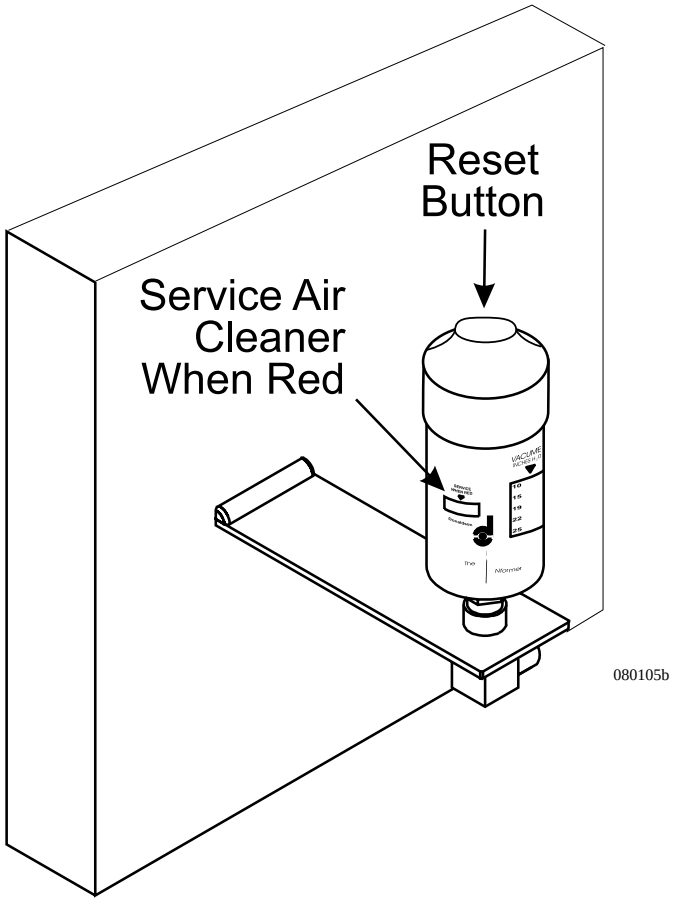
### *Air Filter*

Proper air filter servicing will result in maximum engine protection. The service interval is based upon the amount of air restriction through the air cleaning system. The air filter located in the rear engine compartment is a disposable container. When the air filter needs to be changed, the entire air filter cartridge is discarded and replaced by loosening the inlet and outlet ducting clamps and releasing the retaining band snaps.

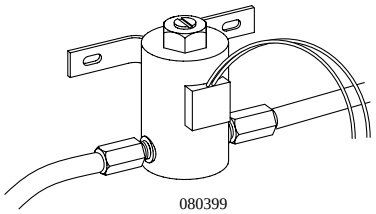


### Air Filter Minder

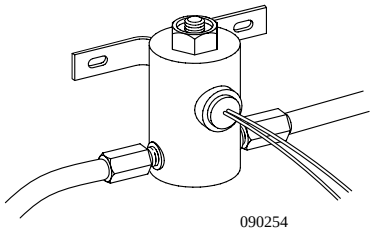
The air filter restriction indicator relays the amount of restriction present in the air intake system and should be inspected before each trip. If the **yellow** indicator approaches the **red** (top) area of the air restriction indicator, it is signaling that the air filter is beginning to become excessively dirty.



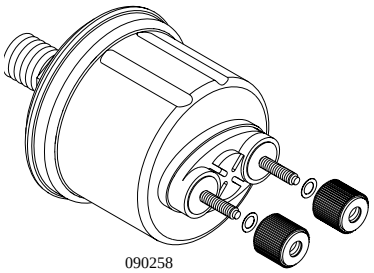
**Rear Bag Dump Solenoids:**
- Only used for the hydraulic leveling.
- Dumps air in the rear bags.
- Two air bag solenoids, one for each side.
- Location - Open rear the engine compartment door, the solenoids are located on the curbside next to the radiator.


080399

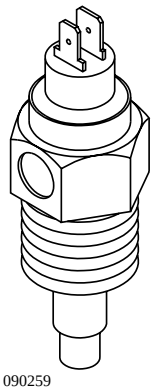
**Front Bag Dump Solenoid:**
- Only used on hydraulic leveling.
- Dumps the air in the front air bags.
- Location - Open the generator door and the solenoid is located on the center front firewall.

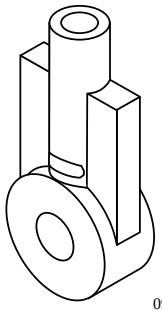

090254

**Oil Pressure/Low Oil Pressure Warning Dual Post Sending Unit:**
- One post oil pressure. One post warning light.


090258

**Water Temperature/High Water Temp Dual Post Sending Unit:**
- One post water temperature gauge. One post warning light.

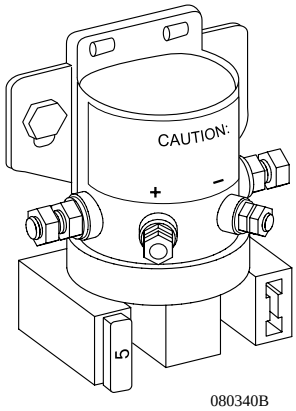

090259



090333D

**Link Assembly:**

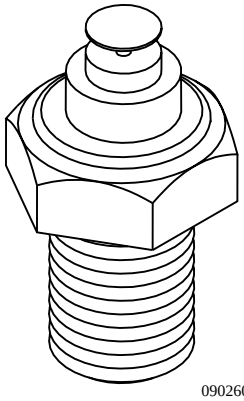
- Located on ends of connecting rod between axles and ride height valve.
- Secures connecting rod with hose clamp.
- Type Hadley Products HPB450-3.
- MP# 2057.




080340B

**House Disconnect Solenoid:**

- 110 Amp solenoid controlled log switch at entry door.
- Solenoid interrupts house battery power to interior 12 Volt fuse panel.
- Four post isolated coil latching solenoid.
- MP #1665055.

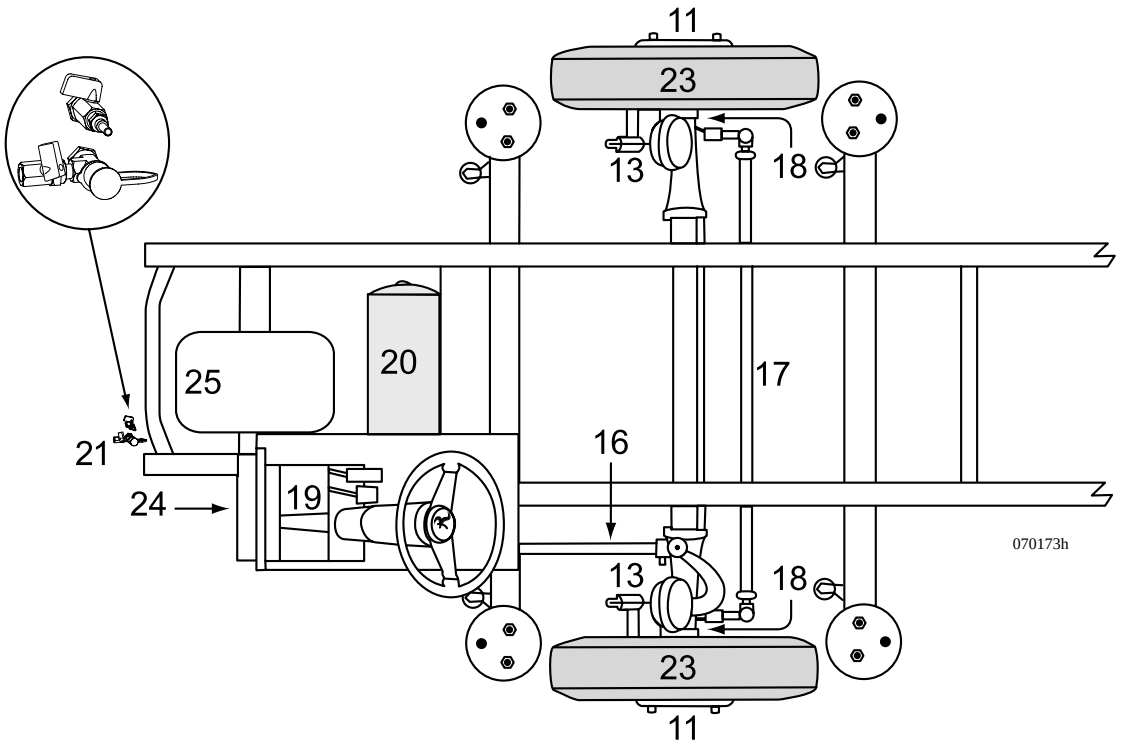


090260

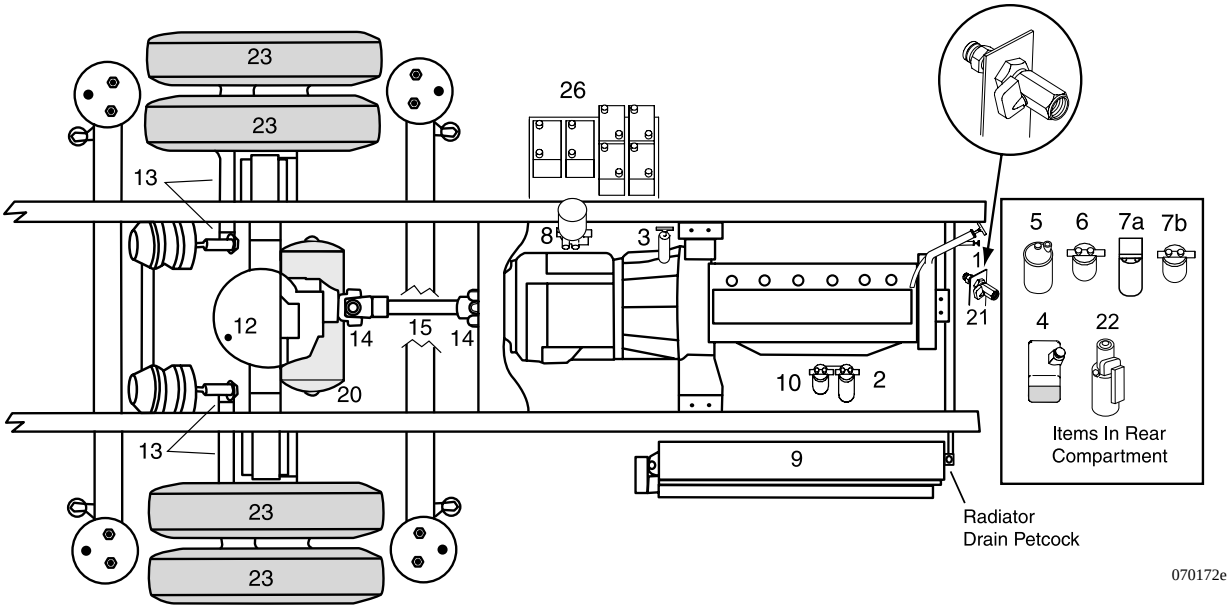
**Transmission Sending Unit:**

- Located on the bottom of the tailshaft housing, between hoses.
- Type - VDO 323 0868

# LUBRICATION CHARTS




| | COMPONENT | ACTION | WHEN | CODE - REFER TO CHART |
|---|---|---|---|---|
| 1 | Engine Oil Fill/Dip Stick | Keep To Full Mark | Before Each Trip | EO |
| 2 | Engine Oil Filter | Replace | Refer to OEM | OEM |
| 3 | Transmission Oil Check | Keep To Full Mark | Before Each Trip | TF or TS |
| 4 | Engine Coolant Level | Keep To Full Mark | Before Each Trip | AF |
| 5 | Hydraulic Fluid Reservoir | Keep To Full Mark | 6,000 or 3 Months | TF |
| 6 | Hydraulic Fluid Filter | Replace | 15,000 or Annually | TF |
| 7a | Filter Fuel Water Separator (Primary) | Replace | 15,000 or 6 Months | FF |
| 7b | Filter Fuel Water Separator (Secondary) | Replace | Refer to OEM | OEM |
| 8 | Air Dryer Filter | Replace | 2 - 3 Years | - |
| 9 | Radiator/Charge Air Cooler | Inspect | Weekly | - |
| 10 | Coolant Filter (not on all units) | Replace | Refer to OEM | OEM |
| 11 | Wheel Bearings | Re-pack | 30,000 or Annually | HT |
| 12 | Rear Differential | To Filler Plug | 250,000 or Every 3 Years | MP |
| 13 | Slack Adjuster/Cam Shaft | Grease - 3 Fittings | 10,000 or Quarterly | CBL |
| 14 | Driveline Universal Joints | Grease - 2 Fittings | 10,000 or Annually | CL |
| 15 | Driveline Slip Yoke | Grease - 1 Fitting | 10,000 or Annually | CL |
| 16 | Drag Link | Grease - 2 Fittings | 5,000 or 6 Months | CL |
| 17 | Center Link | Grease - 2 Fittings | 5,000 or 6 Months | CL |
| 18 | Spindles/Kingpins | Grease - 2 Fittings ea. | 5,000 or 6 Months | CL |
| 19 | Steering Driveline | Grease - 3 Fittings | 30,000 or Annually | CL-4 |
| 20 | Air Tanks | Remote Drains | Monthly | - |
| 21 | Air Tank Drains | Drain | Monthly | - |
| 22 | HWH Reservoir (location may vary) | Keep To Full Mark | 6,000 or 3 Months | TF |
| 23 | Tire Pressures | Check | Before Each Trip | - |
| 24 | Steering Box | Grease - 1 Fitting | Twice a Year | CL |
| 25 | Generator | Refer to Service Manual | Refer to OEM | OEM |
| 26 | Batteries | Inspect | Monthly | DW |
| | Battery Terminals | Apply Coating | Quarterly | P |




| LUBRICATION CODE CHART | |
|---|---|
| CL-4 | U-Joints located inside the coach under the steering cover |
| EO | Engine oil as recommended by engine manufacturer |
| OEM | Refer to Equipment Manufacturers Manual |
| MP | API GL-5 or MT-1 type gear lubricant - Penzoil Gear Plus SUPER-ew 75w-90, Synthetic |
| GO | EP-SAE 90 Gear Oil |
| CL | Chassis lubricant should be high quality non-corrosive multipurpose lithium soap pressure gun lubricant that is water resistant and designed to withstand extremely high operating temperature |
| P | Petroleum jelly, or commercial battery terminal corrosion inhibitor |
| AF | Consult Cummins Owners Manual for antifreeze type |
| TF | Transmission fluid. Use *Dexron III*® transmission fluid only. |
| FF | Fuel Filter |
| BF | Dot-3 Brake Fluid |
| TS | TranSynd™ synthetic transmission fluid (identified by tag on dipstick) |
| CBL | Clay-based Lubricant |
| DW | Distilled Water |
| HT | High Temperature Bearing Grease |

Service must be perfomed every twelve (12) months, regardless of acutal mileage, to protect seals, bearings and gaskets from drying out and failing. The motorhome must be started and driven for at least 20 miles bi-monthly.

**NOTE: It is important to remember the generator lubrication interval is based on hours of usage. Consult the OEM for the generator service interval.**

## SPECIFICATIONS DIMENSIONS CHART

| 2004 Scepter Specifications | 36PST | 38PBDD | 38PST | 40PBDD | 40PWD | 40PST | 40PDT | 40DST | 40PRT | 40PDQ |
|---|---|---|---|---|---|---|---|---|---|---|
| **Weights** | | | | | | | | | | |
| Gross Vehicle Weight Rating | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. | 33,000 lbs. |
| Gross Combined Weight Rating | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. | 43,000 lbs. |
| Front Gross Axle Weight Rating | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. | 13,000 lbs. |
| Rear Gross Axle Weight Rating | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. | 20,000 lbs. |
| **Measurements** | | | | | | | | | | |
| Wheelbase | 216" | 242" | 242" | 256" | 256" | 256" | 256" | 256" | 256" | 256" |
| Overall Length | 36'-6" | 38' 9" | 38' 9" | 39' 11" | 39' 11" | 39' 11" | 39' 11" | 39' 11" | 39' 11" | 39' 11" |
| Overall Height | 12' | 12' | 12' | 12' | 12' | 12' | 12' | 12' | 12' | 12' |
| Interior Height | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" | 6' 6" |
| Interior Width | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" | 94.5" |
| Exterior Width | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" | 100.5" |
| **Tank Capacities** | | | | | | | | | | |
| Water Heater (Atwood) | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. | 10 GAL. |
| Grey Tank (Amerikart) | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL | 60 GAL |
| Black Tank (Amerikart) | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL | 39 GAL |
| Fresh Tank (Amerikart) | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL | 95 GAL |
| Fuel Tank (In House) | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. | 100 GAL. |
| LP Tank * (Manchester) | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL | 38 GAL |

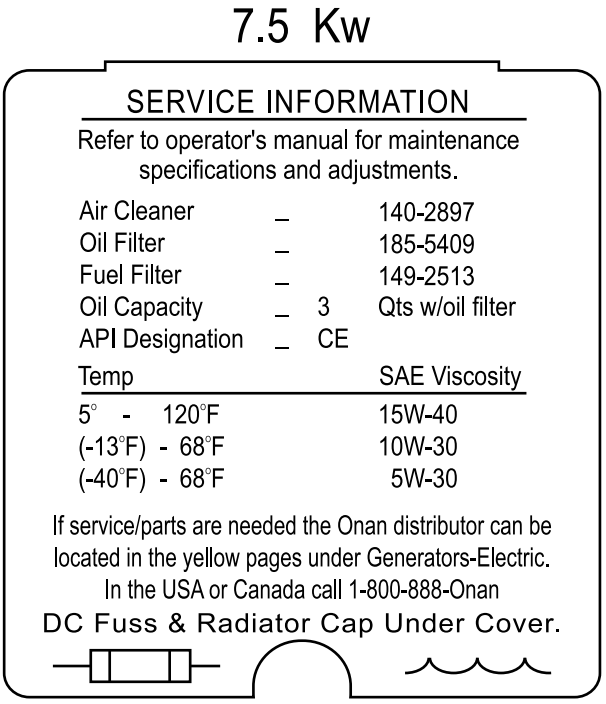
** Actual filled LP capacity is 80% of listing due to safety shut off required on tank.*

*This Chart reflects product specification available at the time of printing. Therefore any floor plans thereafter may not be reflected in the chart. All other information contained throughout the manual will still apply.*

**CHASSIS LIQUID CAPACITIES** **ISC 330**

| | QUARTS | GALLONS |
|---|---|---|
| Engine Oil | 24 quarts | 6.0 gallons |
| Transmission (initial fill) | 22 quarts | 5.5 gallons |
| Transmission (service fill) | 19 quarts | 4.75 gallons |
| Coolant | 39 quarts | 9.75 gallons |
| Rear Differential | 16 quarts (approximately) | 4.0 gallons (approximately) |
| A/C Refrigerant | 4 pounds of R134 | 4 pound of R134 |
| Front Axle (filled in pints) | 2 pints | 2 pints |

| ENGINE SPECIFICATIONS - CUMMINS ENGINE ISC 350 | |
|---|---|
| | |
| Engine Size / Cummins | 8.3 Liter |
| Allison Transmission | MH 3000 |
| Torque (lbs - ft. Max. Net at 1,400 RPM | 1050 |
| Cubic Inch Displacement - 300 HP | 504.5 |
| Alternator / Leece Neville | 160 amp |
| Rear Axle Ratio | 4.30:1 |
| Tire Size / Goodyear | 275 / 70R / 22.5 G169 |




*Diesel Generator Label* 020159c

## CHART FILTERS & BELTS

| ISC FILTERS AND BELTS | MANUFACTURER | NUMBER |
|---|---|---|
| A/C Belt | Dayco | 15465 |
| Air Filter | Donaldson | P537448 |
| Alternator Belt | Dayco | 3911581 |
| Fuel Filter Primary | Fleetguard | FS1242 |
| Fuel Filter Secondary | Fleetguard | FS1022 |
| Oil Filter | Fleetguard | LF3000 |
| Coolant Filter | Fleetguard | WF2074 |
| Transmission Filter | Allison | Internal Filters |

**NOTE: Filter and belt numbers were correct at the time of printing. Verify the numbers at time of removal. The manufacturer will not be responsible for incorrect filter or belt usage. Please refer to the engine manufacturer's operating instructions for specific maintenance information.**

# METRIC/U.S. CONVERSION CHART

| U.S. Customary to Metric | | | Metric to U.S. Customary | |
|---|---|---|---|---|
| Measurement | Multiplied By | Equals/Measurement | Multiplied By | Equals |
| **Length** | | | | |
| inches (in) | 25.4 | millimeters (mm) | 0.03937 | inches (in) |
| inches (in) | 2.54 | centimeters (cm) | 0.3937 | inches (in) |
| feet (ft) | 0.3048 | meters (m) | 3.281 | feet (ft) |
| yards (yd) | 0.9144 | meters (m) | 1.094 | yards (yd) |
| miles (mi) | 1.609 | kilometers (km) | 0.6215 | miles (mi) |
| **Area** | | | | |
| square inches ($in^2$) | 645.16 | square millimeters ($m^2$) | 0.00155 | square inches ($in^2$) |
| square inches ($in^2$) | 6.452 | square centimeters ($cm^2$) | 0.15 | square inches ($in^2$) |
| square feet ($ft^2$) | 0.0929 | square meters ($m^2$) | 10.764 | square feet ($ft^2$) |
| **Volume** | | | | |
| cubic inches ($in^3$) | 16387.0 | cubic millimeters ($mm^3$) | 0.000061 | cubic inches ($in^3$) |
| cubic inches ($in^3$) | 16.387 | cubic centimeters ($cm^3$) | 0.06102 | cubic inches ($in^3$) |
| cubic inches ($in^3$) | 0.01639 | liters (L) | 61.024 | cubic inches ($in^3$) |
| fluid ounces (fl oz) | 29.54 | milliliters (mL) | 0.03381 | fluid ounces (fl oz) |
| pints (pt) | 0.47318 | liters (L) | 2.1134 | pints (pt) |
| quarts (qt) | 0.94635 | liters (L) | 1.0567 | quarts (qt) |
| gallons (gal) | 3.7854 | liters (L) | 0.2642 | gallons (gal) |
| cubic feet ($ft^3$) | 28.317 | liters (L) | 0.03531 | cubic feet ($ft^3$) |
| cubic feet ($ft^3$) | 0.02832 | cubic meters ($m^3$) | 35.315 | cubic feet ($ft^3$) |
| **Weight/Force** | | | | |
| ounces (av) (oz) | 28.35 | grams (g) | 0.03527 | ounces (av) (oz) |
| pounds (av) (lb) | 0.454 | kilograms (kg) | 2.205 | pounds (av) (lb) |
| U.S. tons (t) | 907.18 | kilograms (kg) | 0.001102 | U.S. tons (t) |
| U.S. tons (t) | 0.90718 | metric tons (t) | 1.1023 | U.S. tons (t) |
| **Torque/Work Force** | | | | |
| inch-pounds (lbf.in) | 11.298 | Newton-centimeters (N.cm) | 0.08851 | inch-pounds (lbf.in) |
| foot-pounds (lbf.ft) | 1.3558 | Newton-meters (N.m) | 0.7376 | foot-pounds (lbf.ft) |
| **Pressure/Vacuum** | | | | |
| inches of mercury (inHg) | 3.37685 | kiloPascals (kPa) | 0.29613 | inches of mercury (inHg) |
| pounds per square inch (psi) | 6.895 | kiloPascals (kPa) | 0.14503 | pounds per square inch (psi) |

| Measurement | Subtract | Divide By | Equals/Measurement | Multiply By | Add | Equals |
|---|---|---|---|---|---|---|
| **Temperature** | | | | | | |
| degrees Fahrenheit (ºF) | 32 | 1.8 | degrees Celsius (ºC) | 1.8 | 32 | degrees Fahrenheit (ºF) |

## MAINTENANCE RECORD

After scheduled services are performed, record the date, odometer reading and who performed the service in the boxes provided after the maintenance interval. Any additional information from "Owner Checks and Services" or "Periodic Maintenance" can be added on the following record pages. In addition, retain all maintenance receipts. The owner information portfolio is a convenient place to store them.

### LUBRICATION SERVICE RECORD

KEY TO SERVICES

A – Lubrication & Inspection
A1 – Motor Oil & Filter Change
A2 – Transmission Oil Change
A3 – Drive Axle Oil Change
A4 – Wheel Bearing Service
B – Prescribed Service
C – Prescribed Service
D – Prescribed Service
E – Prescribed Service

| MILEAGE | SERVICES | | | | | | | | | JOB PERFORMED | | MILEAGE | SERVICES | | | | | | | | | JOB PERFORMED | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | A1 | A2 | A3 | A4 | B | C | D | E | DATE | BY | | A | A1 | A2 | A3 | A4 | B | C | D | E | DATE | BY |
| 1 | | | | | | | | | | | | 31 | | | | | | | | | | | |
| 2 | | | | | | | | | | | | 32 | | | | | | | | | | | |
| 3 | | | | | | | | | | | | 33 | | | | | | | | | | | |
| 4 | | | | | | | | | | | | 34 | | | | | | | | | | | |
| 5 | | | | | | | | | | | | 35 | | | | | | | | | | | |
| 6 | | | | | | | | | | | | 36 | | | | | | | | | | | |
| 7 | | | | | | | | | | | | 37 | | | | | | | | | | | |
| 8 | | | | | | | | | | | | 38 | | | | | | | | | | | |
| 9 | | | | | | | | | | | | 39 | | | | | | | | | | | |
| 10 | | | | | | | | | | | | 40 | | | | | | | | | | | |
| 11 | | | | | | | | | | | | 41 | | | | | | | | | | | |
| 12 | | | | | | | | | | | | 42 | | | | | | | | | | | |
| 13 | | | | | | | | | | | | 43 | | | | | | | | | | | |
| 14 | | | | | | | | | | | | 44 | | | | | | | | | | | |
| 15 | | | | | | | | | | | | 45 | | | | | | | | | | | |
| 16 | | | | | | | | | | | | 46 | | | | | | | | | | | |
| 17 | | | | | | | | | | | | 47 | | | | | | | | | | | |
| 18 | | | | | | | | | | | | 48 | | | | | | | | | | | |
| 19 | | | | | | | | | | | | 49 | | | | | | | | | | | |
| 20 | | | | | | | | | | | | 50 | | | | | | | | | | | |
| 21 | | | | | | | | | | | | 51 | | | | | | | | | | | |
| 22 | | | | | | | | | | | | 52 | | | | | | | | | | | |
| 23 | | | | | | | | | | | | 53 | | | | | | | | | | | |
| 24 | | | | | | | | | | | | 54 | | | | | | | | | | | |
| 25 | | | | | | | | | | | | 55 | | | | | | | | | | | |
| 26 | | | | | | | | | | | | 56 | | | | | | | | | | | |
| 27 | | | | | | | | | | | | 57 | | | | | | | | | | | |
| 28 | | | | | | | | | | | | 58 | | | | | | | | | | | |
| 29 | | | | | | | | | | | | 59 | | | | | | | | | | | |
| 30 | | | | | | | | | | | | 60 | | | | | | | | | | | |

Lube Serv Rec Shortened

# LUBRICATION SERVICE RECORD

KEY TO SERVICES

A -- Lubrication & Inspection
A1 – Motor Oil & Filter Change
A2 – Transmission Oil Change
A3 -- Drive Axle Oil Change
A4 -- Wheel Bearing Service
B -- Prescribed Service
C -- Prescribed Service
D -- Prescribed Service
E – Prescribed Service

| MILEAGE | SERVICES | | | | | | | | | JOB PERFORMED | | MILEAGE | SERVICES | | | | | | | | | JOB PERFORMED | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | A1 | A2 | A3 | A4 | B | C | D | E | DATE | BY | | A | A1 | A2 | A3 | A4 | B | C | D | E | DATE | BY |
| 1 | | | | | | | | | | | | 51 | | | | | | | | | | | |
| 2 | | | | | | | | | | | | 52 | | | | | | | | | | | |
| 3 | | | | | | | | | | | | 53 | | | | | | | | | | | |
| 4 | | | | | | | | | | | | 54 | | | | | | | | | | | |
| 5 | | | | | | | | | | | | 55 | | | | | | | | | | | |
| 6 | | | | | | | | | | | | 56 | | | | | | | | | | | |
| 7 | | | | | | | | | | | | 57 | | | | | | | | | | | |
| 8 | | | | | | | | | | | | 58 | | | | | | | | | | | |
| 9 | | | | | | | | | | | | 59 | | | | | | | | | | | |
| 10 | | | | | | | | | | | | 60 | | | | | | | | | | | |
| 11 | | | | | | | | | | | | 61 | | | | | | | | | | | |
| 12 | | | | | | | | | | | | 62 | | | | | | | | | | | |
| 13 | | | | | | | | | | | | 63 | | | | | | | | | | | |
| 14 | | | | | | | | | | | | 64 | | | | | | | | | | | |
| 15 | | | | | | | | | | | | 65 | | | | | | | | | | | |
| 16 | | | | | | | | | | | | 66 | | | | | | | | | | | |
| 17 | | | | | | | | | | | | 67 | | | | | | | | | | | |
| 18 | | | | | | | | | | | | 68 | | | | | | | | | | | |
| 19 | | | | | | | | | | | | 69 | | | | | | | | | | | |
| 20 | | | | | | | | | | | | 70 | | | | | | | | | | | |
| 21 | | | | | | | | | | | | 71 | | | | | | | | | | | |
| 22 | | | | | | | | | | | | 72 | | | | | | | | | | | |
| 23 | | | | | | | | | | | | 73 | | | | | | | | | | | |
| 24 | | | | | | | | | | | | 74 | | | | | | | | | | | |
| 25 | | | | | | | | | | | | 75 | | | | | | | | | | | |
| 26 | | | | | | | | | | | | 76 | | | | | | | | | | | |
| 27 | | | | | | | | | | | | 77 | | | | | | | | | | | |
| 28 | | | | | | | | | | | | 78 | | | | | | | | | | | |
| 29 | | | | | | | | | | | | 79 | | | | | | | | | | | |
| 30 | | | | | | | | | | | | 80 | | | | | | | | | | | |
| 31 | | | | | | | | | | | | 81 | | | | | | | | | | | |
| 32 | | | | | | | | | | | | 82 | | | | | | | | | | | |
| 33 | | | | | | | | | | | | 83 | | | | | | | | | | | |
| 34 | | | | | | | | | | | | 84 | | | | | | | | | | | |
| 35 | | | | | | | | | | | | 85 | | | | | | | | | | | |
| 36 | | | | | | | | | | | | 86 | | | | | | | | | | | |
| 37 | | | | | | | | | | | | 87 | | | | | | | | | | | |
| 38 | | | | | | | | | | | | 88 | | | | | | | | | | | |
| 39 | | | | | | | | | | | | 89 | | | | | | | | | | | |
| 40 | | | | | | | | | | | | 90 | | | | | | | | | | | |
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Lubrication Service Record

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