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Recreation Vehicle Industry Association

Recreation Vehicle Introduction to RV Service

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Chapter

1-1 History and Uses of Recreation Vehicles

- Detail the history and uses of recreation vehicles.

1-1.1 Introduction to RV Service

The widespread use of recreation vehicles came about in the early 1960s. However, many trailers were built by individuals well back into the 1920s. Little did these people understand the future impact of their inventions. Today more than 8.3 million recreation vehicles are used by American families in the quest of travel and leisure time activities. The future job security and advancement of an RV service technician is virtually guaranteed by this growth in RV manufacturing. It is important that this introductory course provide an overview of the industry and future work.

An RV service technician will come across many types of recreation vehicles and their components. RVs have come a long way since the first ones were built in the 1920s. The progression to today's functional, attractive units is interesting and essential for the RV service technician to understand.

1-1.2 History of Recreation Vehicles

It could be said that the true start of recreation vehicles was around the turn of the 20th century. Thinking back to the definition of an RV, it is a vehicle that combines transportation and temporary living quarters for travel. Well, how about the prairie schooners, gypsy caravans, and maybe even the mobile Red Cross units used in 1914 during WWI? Any of these could be considered the first RVs.

In 1915, a peddler in New York City developed a fifth wheel hitch for his Model T Ford so that he could pull a covered wagon to protect his goods from the weather. During the same year, a minister traveled from Kansas to California with a trailer that provided him with space to eat and sleep. Most early trailers were privately built or built to order, since there was no factory production.

The first factory-assembled RVs were made in New York by the Chenango Camp Trailer Company (folding tent trailers). Glen Curtis, an aircraft designer, transferred aerodynamic principles to RVs and produced the first solid-body trailer in the mid 1920s. In the later 1920s, the following manufacturers began production:

Arehart Brothers - Flint, Michigan
Covered Wagon Co. - Detroit, Michigan
Sportsman Trailer Co. - Elkhart, Indiana
Traveleze - Los Angeles, California
Airfloat - Los Angeles, California
Airstream - Los Angeles, California

These first trailers were small (16–18 ft), but by the late 1940s, their sizes grew to 30 ft. In the early 1950s, manufacturers reverted back to smaller sizes for easier towing. They usually produced two models: the "standard," which had few conveniences, and the "deluxe," which had iceboxes or even refrigerators and toilets (without tanks). In the late 1950s, holding tanks, gas appliances, and running water became frequently requested amenities.

The widespread use of RVs did not really occur until the early 1960s. Airstream, however, had its first caravan event back in 1955. By the early 1960s, the value of RV sales and related vehicles was approximately $100 million per year. Into the 1970s, cumulative sales increased from $1.6 billion to $2.5 billion to over $9 billion by 1990. Recent growth in the industry has been exceptional. According to a 2011 University of Michigan study the number of RV-owning households have grown to a new peak of 8.9 million as of the end of 2011, up from 7.9 million in 2005.

Elkhart, Indiana, is a small town of just over 53,000 people and is probably best known as the "RV Capital of the World." Nearly 40 companies are based in this town and the surrounding four counties. Along with these offices, there are about two dozen manufacturing plants that produce RVs and their accessories. The 1930s marked the beginning of the industry being based in Elkhart, and since then it has grown significantly. Today, over 60 percent of all the RVs in the nation are made in Elkhart and then shipped around the country. A full quarter of the population of the town and the surrounding counties are somehow tied to RVs through manufacturing, office work, and other associated jobs. The outstanding transportation options in the area (rail, highway, and waterway) allowed the industry to flourish. Milo Miller's Sportsmen Trailer Company began in 1932, and in just ten years there were more than 100 companies in the area.

What had been a spring and summer business has blossomed into a year-round, full-time, multibillion dollar industry. Offshoots of the RV industry have been the formation of many RV clubs and organizations. Groups of neighbors gathering on weekends have evolved into national membership clubs such as Good Sam (www.goodsamclub.com), Family Motor Coach Association (www.fmca.com), and manufacturer travel clubs, among others. These clubs organize trips, give discounts on parts and supplies, and project a positive and healthy attitude to RVing.

1-1.3 What Is a Recreation Vehicle or RV?

An RV is a vehicle designed as temporary living quarters for recreation, camping, travel, or seasonal use. RVs may have their own motor power (as in the case of Class A, B, and C motorhomes), may be mounted on another vehicle (as are truck campers), or may be towed by another vehicle (travel trailers, fifth wheels, and folding camping trailers). All-terrain vehicles (ATV, snowmobiles, and so forth) are not included in the RV definition.

The basic types of RVs are motorhomes, folding camping trailers, travel trailers, fifth wheel trailers, and truck campers.

1-1.3.1 What Is the Recreation Vehicle Industry Association (RVIA)?

RVIA is the national trade association representing manufacturers and component suppliers producing approximately 98 percent of all RVs and conversion vehicles manufactured in the United States. The mission of the RVIA is to protect and promote the interests of its members and the well-being of the industry. The major activities of RVIA that pertain directly to the RV service technician are as follows:

A. Maintains an inspection program to periodically audit RV manufacturers' compliance with the American National Standards Institute *NFPA 1192 Standard for Recreational Vehicles* and *ANSI/RVIA 12V Standard for Low Voltage Systems in Conversion and Recreational Vehicles.*

B. Develops and participates in industry service technician training programs to build a strong base of trained RV service technicians.

C. National efforts include:

1. Conducting annual RV service technician Trouble Shooter Clinics
2. Developing and publishing RV service technician textbooks
3. Developing and maintaining the RVDA/RVIA Certification Tests as part of the joint RVDA/RVIA Certification Program
4. Developing and publishing study guides for the RVDA/RVIA Certification Tests
5. Developing on-line training programs for technical service training

1-1.3.2 What Is the Recreation Vehicle Dealers Association (RVDA)?

RVDA is the international association dedicated to advancing the RV retailer's best interests through education, member services, industry leadership, and market expansion programs that promote the increased sale and use of RVs and that enhance the positive image of the RV experience. RVDA is involved with dealer-manufacturer issues, state and federal legislation affecting the dealer's business, the national Go RVing advertising campaign, and educational programs.

1-1.3.3 What Is the National Association of RV Parks and Campgrounds (ARVC)?

The National Association of RV Parks and Campgrounds was founded as the National Campground Owners Association (NCOA) in 1966 by commercial campground owners seeking to gain the advantages of group purchasing power and national advocacy for the industry. With offices in Falls Church, Virginia, ARVC is the only national association exclusively representing the interest of all commercial RV parks and campgrounds in the United States. Membership has grown to more than 4,000, with members including destination RV parks, cabin and lodge resorts, industry suppliers, and associations. ARVC offers its members government affairs representation, continuing education opportunities through a certification program, national promotion through the www.GoCampingAmerica.com website, and discounts on services.

1-1.3.4 Uses of Recreation Vehicles

Over the years, with advanced manufacturing procedures and designs, RVs have evolved to the point that they now can fulfill almost every conceivable situation. From the lone hunter or fisherman who just needs a place to lie down comfortably and keep warm, to the family who wants luxury and comfort while traveling for extended periods or full time. The different styles, models, floor plans, and price ranges can enable everyone to enjoy the recreation activity of camping. It is definitely their home away from home. Families plan extended vacations or weekend getaways around the usefulness of recreation vehicles. Salesmen with goods to sell over a large area use them as traveling showcases. Doctors, lawyers, and veterinarians utilize modified RVs as mobile offices. The movie industry has used them for years as on-location dressing rooms. Some RVs have been designed and built as complete shelters for utilizing RVs year round. Many aftermarket items, such as awnings and screen enclosures, make RV living comfortable and enjoyable on any trip from weekends to year-round, full-time living. RV uses are just about unlimited.

A University of Michigan study shows there are approximately 30 million RV enthusiasts. In addition, rentals of RVs are booming.

1-1.3.5 Who is the RV Owner?

The following information was extracted from a 2005 survey of RV owners conducted by the University of Michigan.

- 7.9 million households own a RV.
- 8.0 percent of all households owning a vehicle also own an RV.
- There are more RVs in use today that at any time before.
- The typical RV owner is 49 years old.
- The average income of RV owners is $68,000.
- 79 percent of RV owners are married.

- More RVs are owned by those age 35 to 54 than any other age group, according to research from the University of Michigan. The same study shows that the fastest-growing segment for RV ownership is people under the age of 35.
- Two-thirds of current RV owners plan to purchase another RV to replace their current unit.
- Overall ownership of RVs can be expected to grow by more than 110,000 per year.

1-1.3.6 Where Do RVers Travel?

With more than 16,000 public and privately owned campgrounds located nationwide, RVers are free to roam America's highways and back roads for a weekend or weeks on end.

Public lands are popular for hiking, fishing, white-water rafting, and many other outdoor sports. They also are popular for families seeking educational opportunities for their school-age children. Facilities at public campgrounds tend to be simple but offer great scenic beauty for a very low fee.

Commercial campgrounds are common around popular destinations, along major tourist routes, and even in city environments. These campgrounds appeal to traveling families by offering a variety of activities to keep children busy. Swimming pools, game rooms, playgrounds, and snack bars are practically standard.

RV travelers seeking a resort atmosphere with facilities such as tennis courts, golf courses, and health spas flock to the new breed of luxury RV resorts.

1-1.3.7 How Does RV Travel Impact Tourism?

RVer's spending for services and attractions on the road is an increasingly significant source of income for travel and tourism-related businesses such as service stations, amusement parks and other attractions, grocery stores, restaurants, souvenir retailers, sporting goods stores, and tour operations.

A survey of RVers who use *Woodall's Campground Directories* found that, in the mid 1990s, the average RVer spent more than $61 a day on related goods and services ranging from meals and accommodations to souvenirs and attractions. This makes RV travelers extremely desirable visitors to any community.

According to the University of Michigan, in the mid 1990s, RV owners annually travelled more than 4500 miles and spent more than 26 days on the road. Another 12 million households intend to buy or rent in the near future. Recreation Vehicles Dealers Association (RVDA) calculations show that RVers travel 60 billion miles or more annually. Including the RV rental market, RVDA reports that RVs are a $16 billion a year industry.

1-1 Review

1. Where was the first RV factory located?
2. In what decade did RVing begin widespread usage?
3. What were the total RV sales worth for 2000–2005?
4. How many RVs are on the road today?

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Chapter

1-2 Classifications of Recreation Vehicles

- Identify the different classifications.
- Identify terminology related to classifications.

1-2.1 Recreation Vehicles

The RV industry is growing and prospering today in spite of having endured two significant economic hurdles. The first was the "energy crisis" of the early 1970s, and the other was the high interest rates and inflation in the early 1980s. The industry also has representatives on an international scale, with plants in Canada, Mexico, Australia, and various European countries. In addition to the new models being produced, there are millions of RVs already in the marketplace. All these RVs need quality maintenance and attention. As of May 2010, the Bureau of Labor Statistics lists 9,540 RV technicians in the United States. With our 8.3 million RVs on the road, this means there is one technician for every 870 RVs.

1-2.1.1 State RV Production

According to the 2010 RVIA Industry Profile, the top RV-producing states are as follows:

Indiana
Oregon
California
Iowa
Idaho
Michigan
Pennsylvania
Alabama

1-2.1.2 RV Categories

RVs fall into two general categories: motorized RVs (three categories of motorhomes) and towable RVs (five categories of towables).

1-2.1.2.1 Motorhomes

A motorhome is defined as a vehicular unit designed to provide temporary quarters for recreational, camping, or travel use, built on or permanently attached to a self-propelled motor vehicle chassis or on a chassis cab or van that is an integral part of the completed vehicle. A motorhome can provide a complete and modern kitchen, sleeping, bathroom, and living and dining facilities, all conveniently accessible to the driver's cab from inside the motorhome. There are three types of motorhomes as shown in *Figures 1-1, 1-2* and *1-3*: conventional motorhomes (Type A) which, depending on size, can sleep up to ten people; van campers (Type B) that can sleep from two to six people; and mini-motorhomes which include low profile and compact motorhomes (Type C), that can sleep two to eight people.

Figure 1-1 Conventional Motorhome (Type A)

Figure 1-2 Mini-Motorhome (Type C)

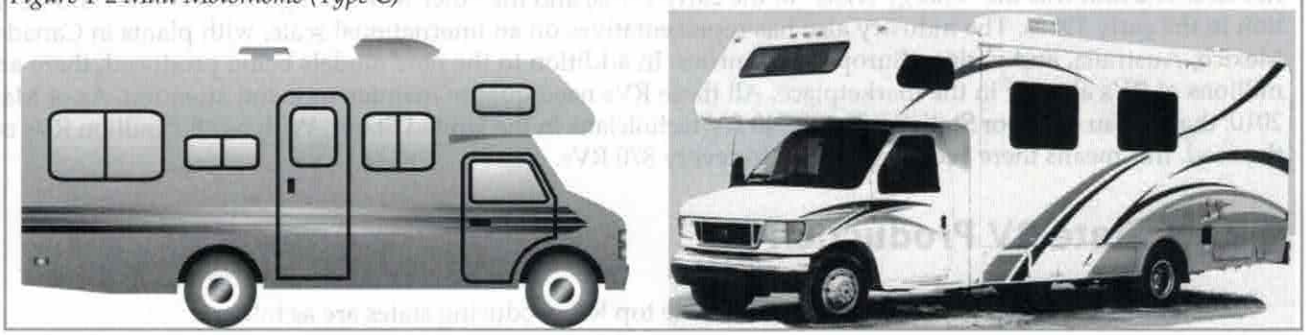


Figure 1-3 Van Camper Motorhome (Type B)

1-2.1.2.2 Travel Trailer

A travel trailer is defined as a vehicular unit, mounted on wheels, designed to provide temporary quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permits when towed by a motorized vehicle, and a gross trailer area less than 400 ft^2. A travel trailer, as shown in *Figure 1-4*, can provide comforts such as full kitchen, toilet, dining and living facilities, electric and water systems and modern appliances. An advantage of travel trailers is the flexibility. At a campsite, they can be unhitched from the tow vehicle, which can then be used for side trips. Travel trailers are limited in size to not exceed 400 ft^2, measured on the exterior of the unit, in the setup mode. Travel trailers can sleep four to eight people.

Figure 1-4 Travel Trailer

1-2.1.2.3 Fifth Wheel Trailer

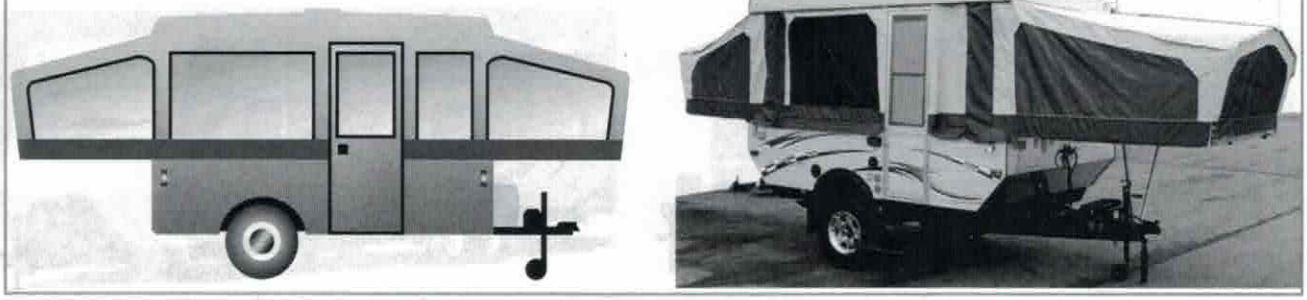
A fifth wheel trailer is defined as a vehicular unit, mounted on wheels, designed to provide temporary quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permit(s), of gross trailer area not to exceed 430 ft^2 in the setup mode, and designed to be towed by a motorized vehicle that contains a towing mechanism that is mounted above and forward of the tow vehicle's rear axle. A fifth wheel trailer, as shown in *Figure 1-5*, is similar to the travel trailer in every way except for the way it is towed. Where a travel trailer typically uses a ball and coupler for attachment to the tow vehicle, the fifth wheel trailer uses a "fifth wheel" hitch, similar to a tractor trailer arrangement. The fifth wheel hitch uses a kingpin, generally mounted on the trailer, and a pin box, mounted on the bed of a pickup truck, for connection between the trailer and the tow vehicle. The towing mechanism is mounted above or forward of the tow vehicle's rear axle. Fifth wheel trailers are limited in size to not exceed 430 ft^2, measured on the exterior of the unit, in the setup mode. These units are designed to sleep four to eight people.

Figure 1-5 Fifth Wheel Trailer

1-2.1.2.4 Folding Camping Trailer

A folding camping trailer, as shown in *Figure 1-6*, is defined as a vehicular portable unit mounted on wheels and constructed with collapsible partial sidewalls that fold for towing by another vehicle and unfold at the campsite to provide temporary living quarters for recreational, camping, or travel use. A folding camping trailer's collapsible sides can be soft fabric or hard and are lightweight. Because they are lightweight, some can be towed by small compact cars. Like all trailers, they have the advantage of being unhitched and left set up at the campsite. They can have water and electrical hookups, downsized modern appliances, and kitchen and dining facilities, and bathroom and shower facilities, and they can sleep up to eight people.

Figure 1-6 Folding Camping Trailer



1-2.1.2.5 Truck Camper

A truck camper, as shown in *Figure 1-7*, is defined as a portable unit constructed to provide temporary living quarters for recreational, travel, or camping use, consisting of a roof, floor, and sides, designed to be loaded onto and unloaded from the bed of a pickup truck. Some may have kitchen and bathroom facilities. They can sleep two to six people.

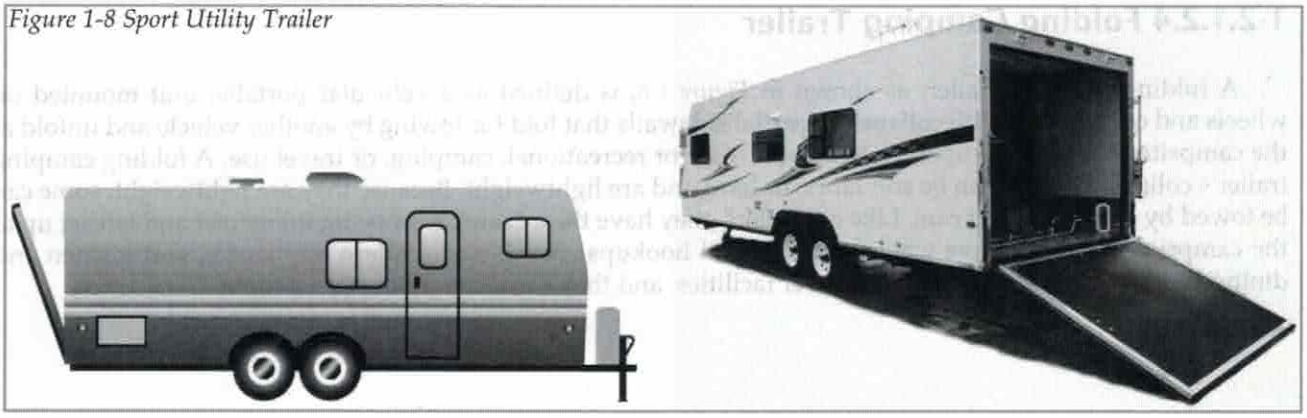
Truck campers and folding camping trailers are both popular choices of first-time RVers because they are generally the most lightweight and inexpensive types of RVs.

Figure 1-7 Truck Camper

1-2.1.2.6 Hybrids/Sport Utility Trailers

A sport utility RV has a built-in "garage" for hauling cycles, ATVs, and other sports equipment.

Figure 1-8 Sport Utility Trailer



1-2.2 Structure

Competition among RV manufacturers has created a large selection of RV floor plans. Many of the floor plans are identified by what they offer the consumer. As a result, the RV service technician must be familiar with terms like *rear bath, center bath, island bed, sliding gaucho,* and *convertible dinette,* among others. Differences in style and decor, blended with the availability of different appliance configurations, can make choosing a floor plan that suits the needs and demands of an RV family really fun. Some floor plans provide separate sleeping quarters with a private bath and tub, plus complete entertainment centers with satellite television, a wet bar, and sound systems. At the other end of the spectrum are those floor plans designed only for two people. An RV technician must become familiar with all these floor plans and their benefits. The plumbing, while installed in accordance with the *NFPA 1192 Standard for Recreational Vehicles,* may be routed differently from model to model. *Figure 1-9* shows an example of a floor plan for a Type A motorhome. *Figures 1-10* through *1-15* show examples of other types of floor plans.

Figure 1-9 Type A Motorhome Floor Plan Example

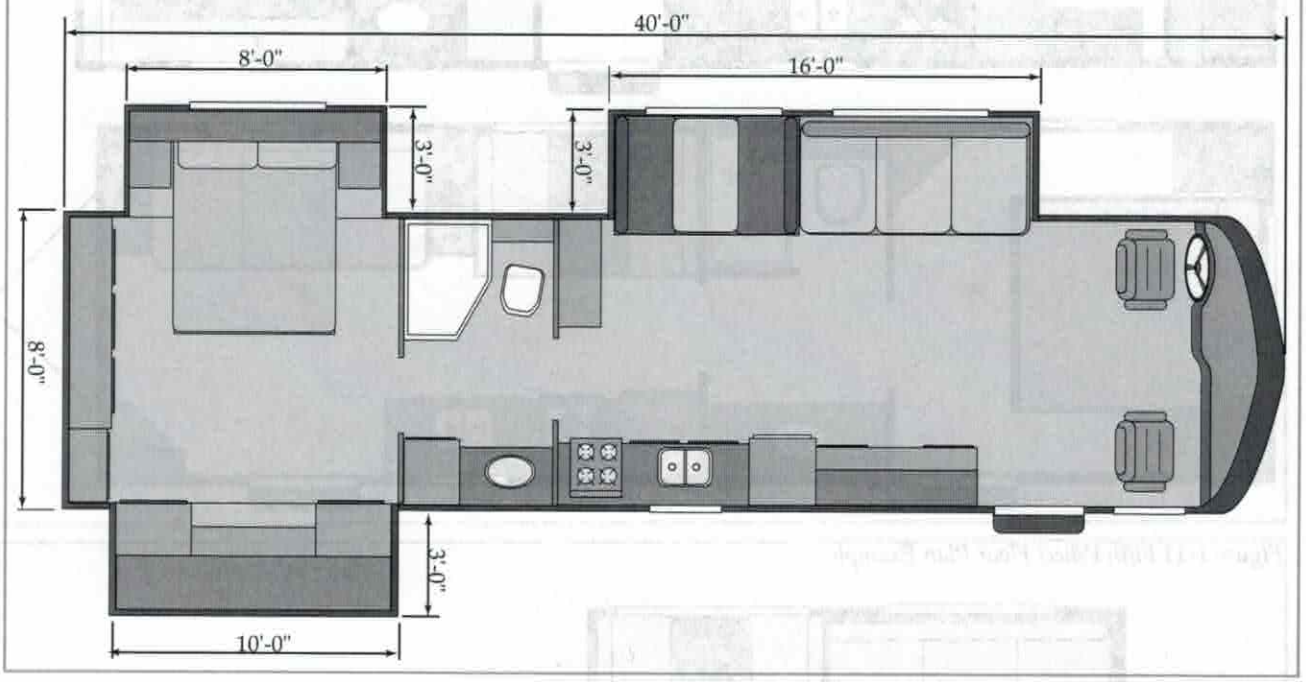


Figure 1-10 Travel Trailer Floor Plan Examples

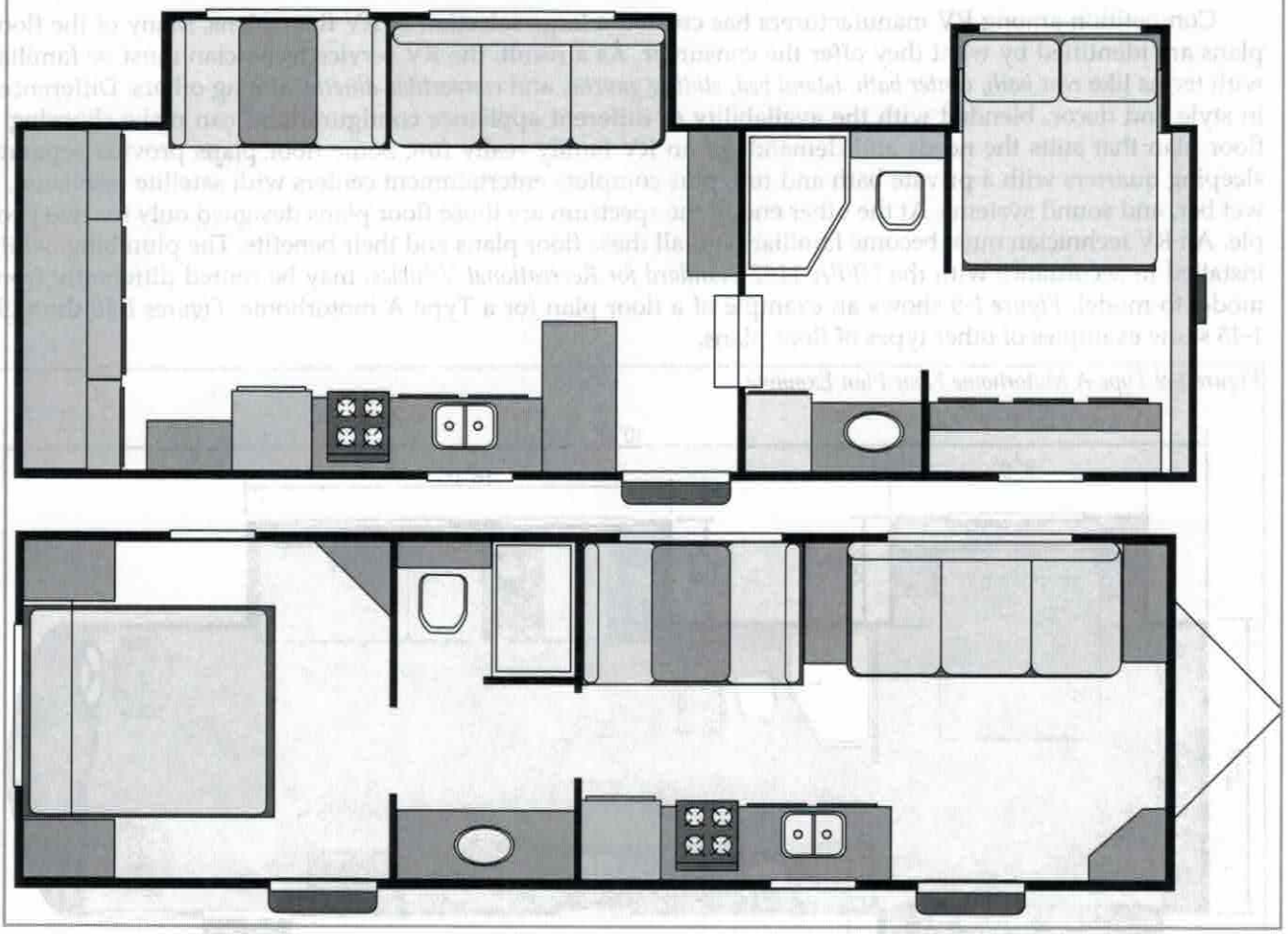


Figure 1-11 Fifth Wheel Floor Plan Example

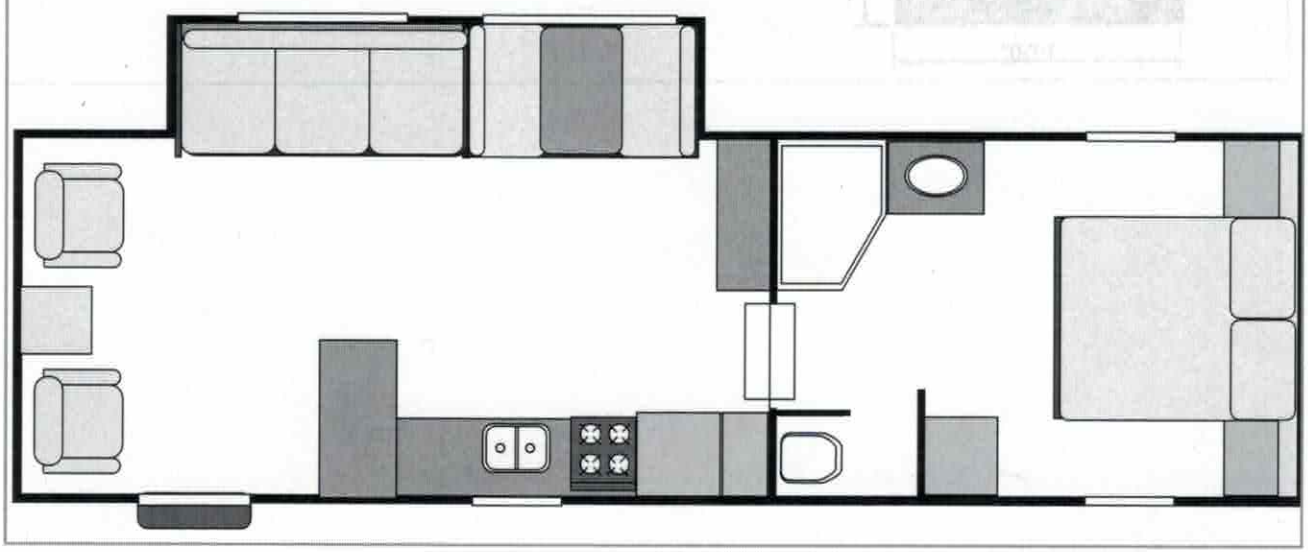


Figure 1-12 Folding Camping Trailer Floor Plan Example

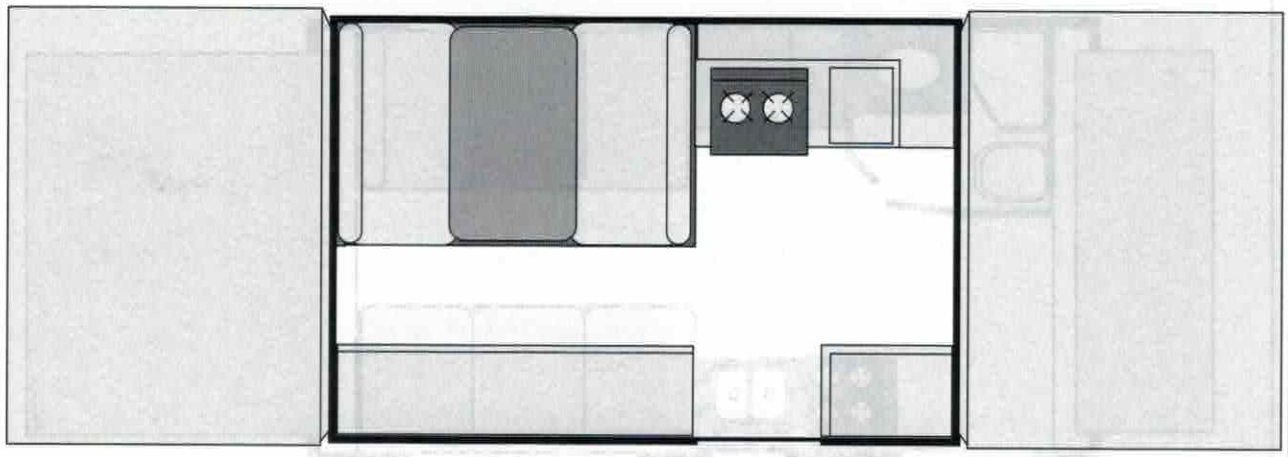


Figure 1-13 Truck Camper Floor Plan Example

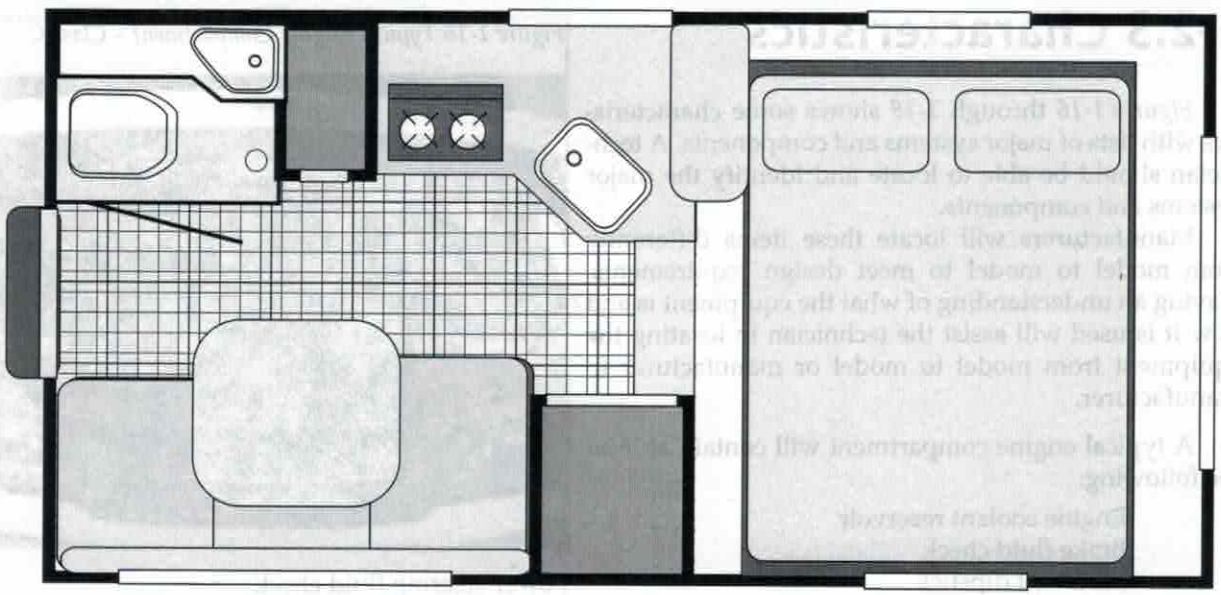


Figure 1-14 Sport Utility Trailer Floor Plan Example

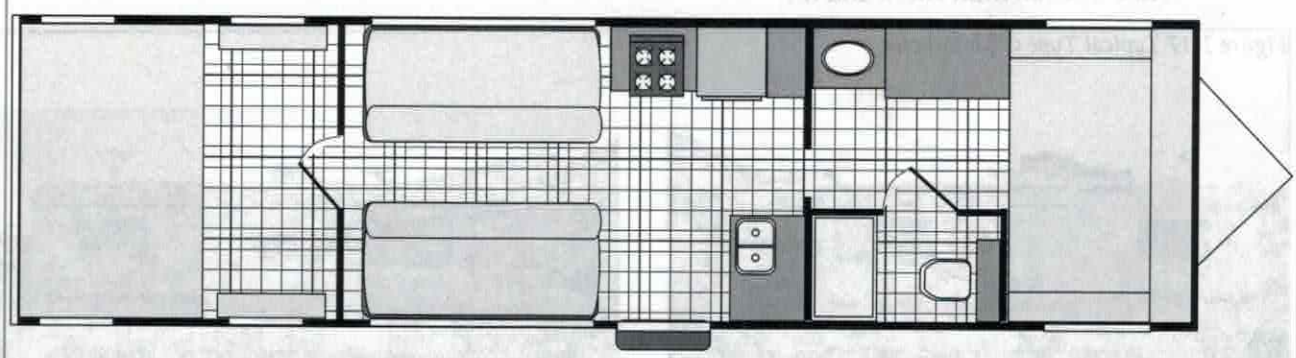
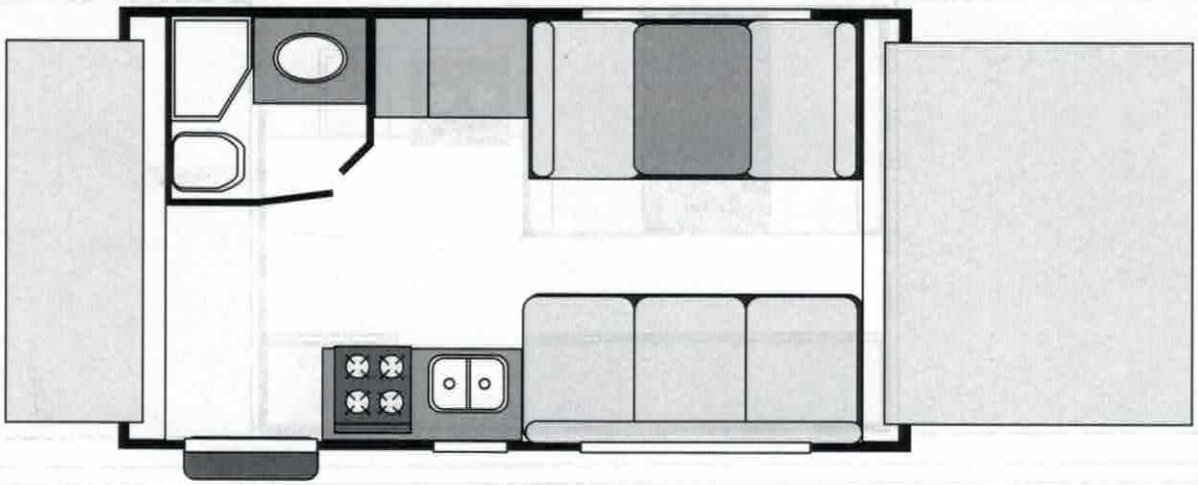


Figure 1-15 Hybrid Trailer Floor Plan Example



1-2.3 Characteristics

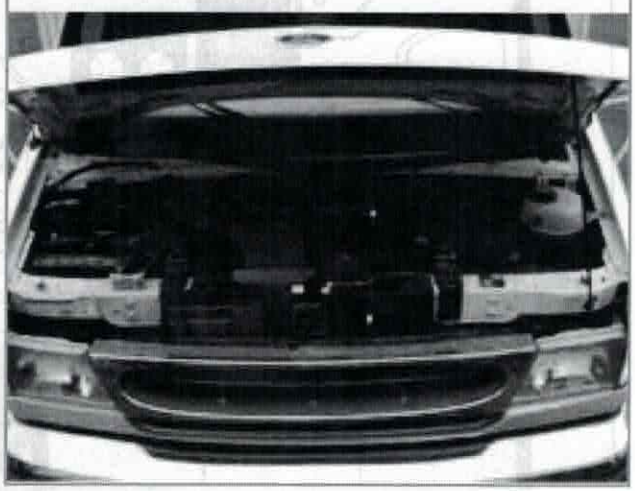
Figures 1-16 through *1-18* shows some characteristics with lists of major systems and components. A technician should be able to locate and identify the major systems and components.

Manufacturers will locate these items differently from model to model to meet design requirements. Having an understanding of what the equipment is and how it is used will assist the technician in locating the equipment from model to model or manufacturer to manufacturer.

A typical engine compartment will contain at least the following:

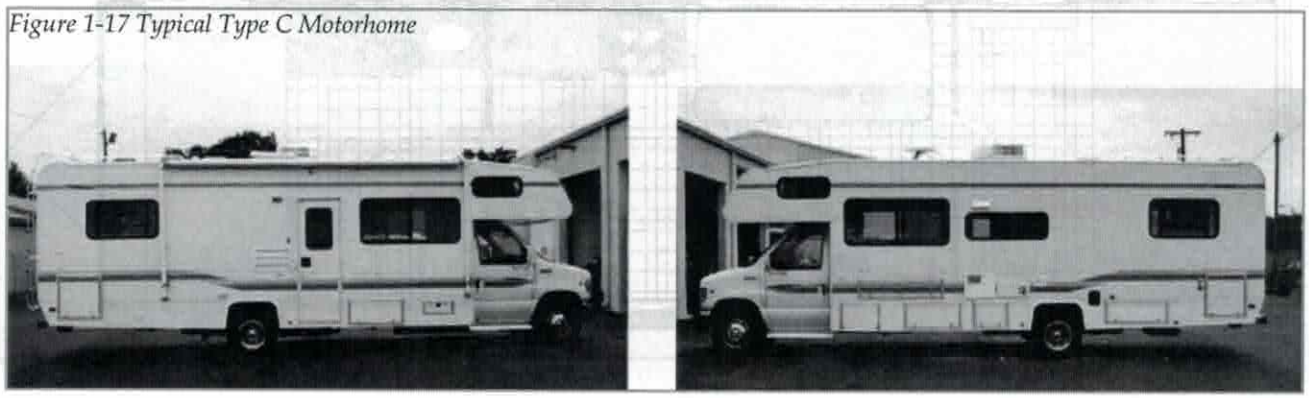
Engine coolant reservoir
Brake fluid check
Motor oil dipstick
Motor oil fill
Engine battery
Transmission fluid check and fill

Figure 1-16 Typical Engine Compartment – Class C



Power steering fluid check
Hood release latch
Windshield washer reservoir

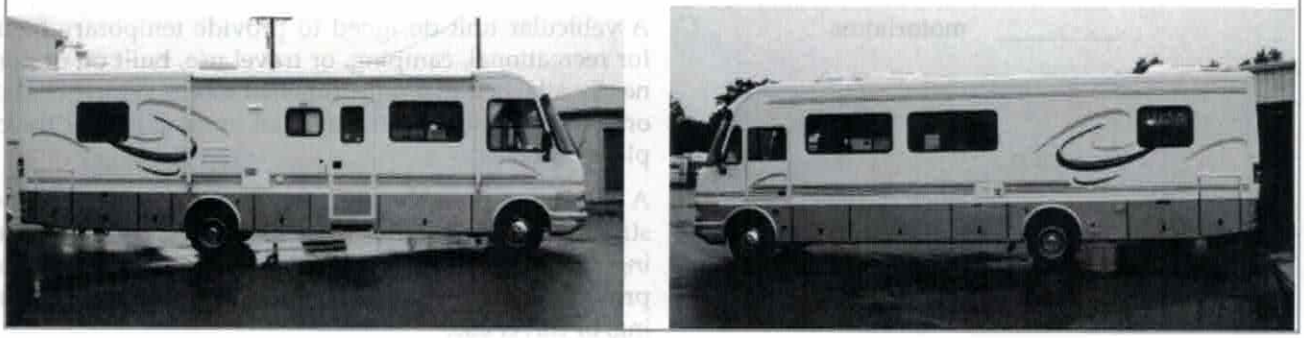
Figure 1-17 Typical Type C Motorhome



A typical motorhome will contain at least the following:

- Generator compartment
- Propane compartment
- Water heater door
- Refrigerator service door
- Water tank fill
- City/campground water connection
- Dump hose storage
- Storage compartment
- 120 VAC receptacle
- Furnace exhaust vent
- Sewage/wastewater drain connection
- Auxiliary battery compartment
- Roof vent
- Roof air conditioner
- Entry step
- Refrigerator roof vent
- 120 VAC electric power cord (shore line)
- Water tank drain valve
- Spare tire

Figure 1-18 Typical Type A Motorhome



1-2 Review

1. Match the RV type to the definition.

_____	travel trailer	A. A portable unit constructed to provide temporary living quarters for recreational, travel, or camping use, consisting of a roof, floor, and sides, designed to be loaded onto and unloaded from the bed of a pickup truck.
_____	camping trailer	B. A vehicular unit, mounted on wheels, designed to provide temporary quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permit(s), of gross trailer area not to exceed 430 ft^2 in the setup mode, and designed to be towed by a motorized vehicle that contains a towing mechanism that is mounted above and forward of the tow vehicle's rear axle.
_____	motorhome	C. A vehicular unit designed to provide temporary quarters for recreational, camping, or travel use, built on or permanently attached to a self-propelled motor vehicle chassis or on a chassis cab or van that is an integral part of the completed vehicle.
_____	truck camper	D. A vehicular portable unit mounted on wheels and constructed with collapsible partial sidewalls that fold for towing by another vehicle and unfold at the campsite to provide temporary living quarters for recreational, camping, or travel use.
_____	fifth wheel	E. A vehicular unit, mounted on wheels, designed to provide temporary quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permits when towed by a motorized vehicle, and a gross trailer area less than 400 ft^2.
_____	sport utility trailer	F. A trailer with a built-in "garage" for hauling cycles, ATVs, and other sports equipment.

2. An advantage of the travel trailer is that it provides its own self-propelled vehicle chassis.

   True False

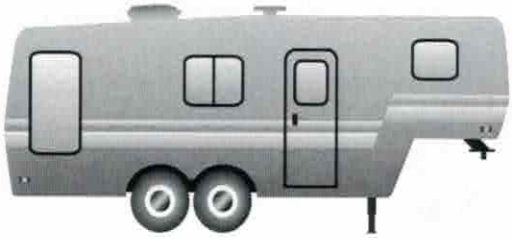
3. Which type of trailer has a kingpin and pin box to connect the trailer to the tow vehicle?
4. Name two states responsible for the high production of RVs.
5. Identify the following classification of units by name in the space provided.

A. _____

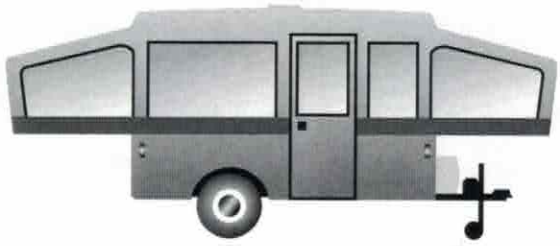
B. _____

C. _____

D. _____



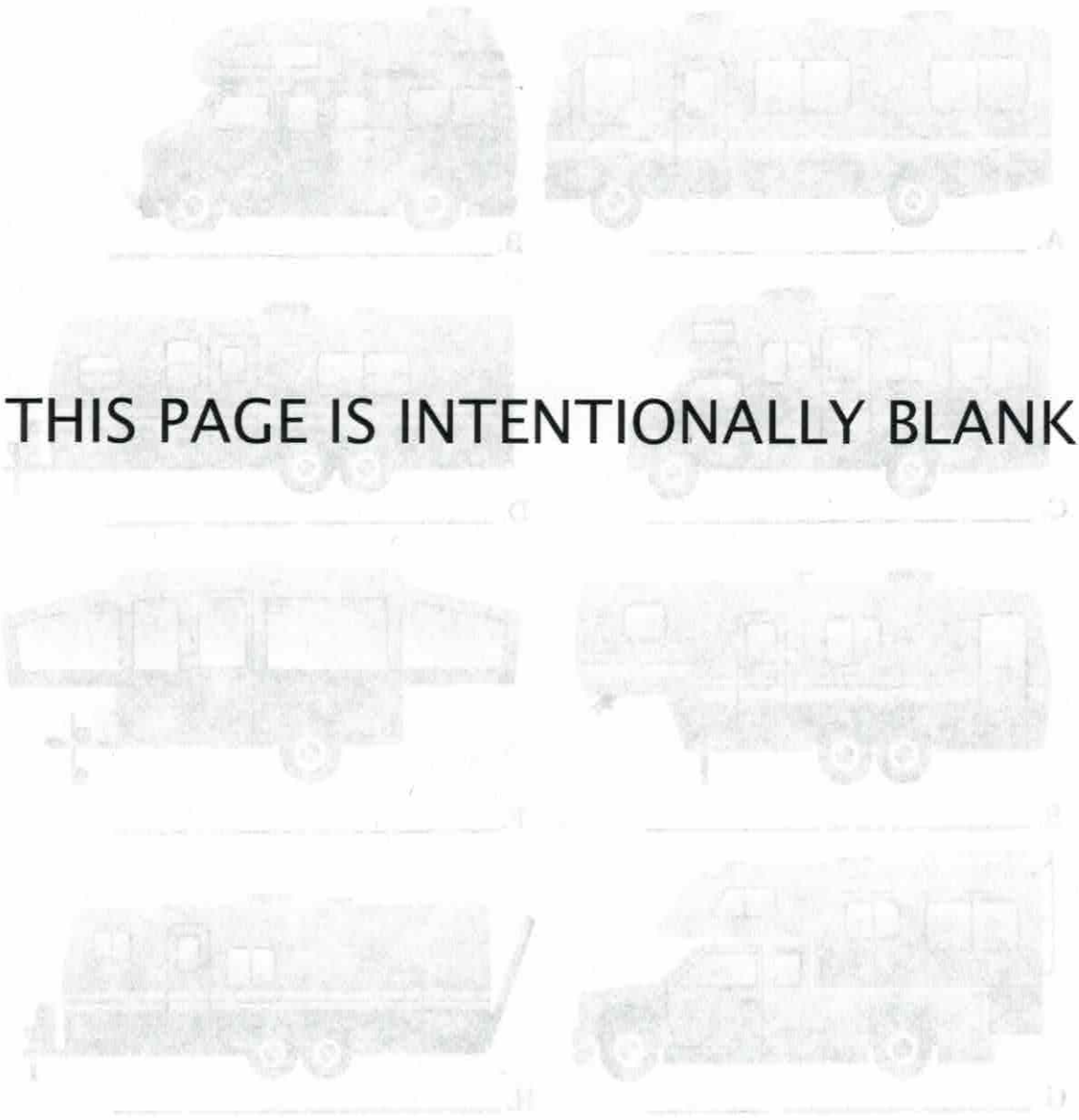
E. _____



F. _____

G. _____

H. _____



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Chapter

1-3 Tools and Equipment

- Identify hand tools and shop equipment.
- Describe the safe use of tools.
- Identify and select the right tool for a job.
- Identify the proper care of tools.
- Identify specialized tools for RV service technicians.
- Identify test equipment.

Any service or repair to a recreation vehicle requires the use of a wide variety of tools and equipment. Technicians are almost always required to provide their own tools and equipment on the job. The technician is solely responsible for tool selection, use, and maintenance. As technicians become more skilled and begin to perform more complex repairs, they usually add more specialized tools and testing equipment so that they can complete their work more easily and quickly.

This chapter introduces the basic tools and equipment RV technicians purchase as they begin their professional training. There are recommendations for the selection and storage of the technician's tools. Selection of the right tool for the job, and how to use that tool effectively and safely, will be covered. In addition, how to make necessary repairs to hand tools will be covered.

All RV tools and equipment are designed to aid the technician in making fast, effective repairs in a safe manner. Some tools used by the RV technician today have remained unchanged for years, while others have been specifically designed for use in the technologically advanced systems of today's RVs.

RV technicians have found through experience that in the purchase, care, and use of tools, three simple rules apply:

1. It is critical to buy good-quality tools. Quality tools purchased from reputable companies should have an excellent tool replacement policy, because quality tools are designed and built to last a lifetime. Low-quality tools may cost less up front but require frequent replacement, costing more over a period of time. Quality tools are the best bargain.
2. Use the right tool for the job. Using the right tool will save time and avoid damaging RV parts and/or the tools. Personal injury is also less likely when the right tool is properly used. Most technicians beginning their studies will purchase the "basic" tools and add to their toolboxes as they gain experience and skill in more complex RV repairs.
3. Keep the tools maintained. If this is done, the tools will be in excellent condition and ready to use at a moment's notice. Tool maintenance saves time, ensures a safer work environment, and saves replacement costs. Tool maintenance includes keeping the tools clean and storing them in a metal cabinet (preferably on wheels so they can be moved from unit to unit as necessary), where they can be easily located and protected from loss and damage.

1-3.1 Recreation Vehicle Service Technician Tool List

The following is a list of individual tools and equipment that an RV service technician may need to perform the job and should be able to use. Some jobs will require special tools as discussed below. Other specialty tools for special jobs will be discussed in other textbooks, as appropriate.

Flat-tip screwdriver set
Phillips screwdriver set
Robertson screwdriver set (Scrulox®)

Combination wrench set, 3/8 to 1 in. std. and 6 to 19 mm metric
Pipe wrench, 10 in.

Torx screwdriver set
Nut driver or tips set, 3/16 to 1/2 in. and metric
Clutch head screwdriver set

Adjustable wrenches, 8 and 10 in. Crescent®
Tubing wrenches (flare nut), 3/8 to 7/8 in. std.

Standard socket sets 1/4, 3/8, 1/2 in. (standard and metric)	Air impact driver 1/2 in.
Hex key/Allen wrench set (standard and metric)	Deep socket sets 1/4, 3/8, 1/2 in. (standard and metric)
	Torque wrench 1/2 in., 0–150 ft/lb
Claw hammer, 16 oz	Rubber mallet
Ball-peen hammer	Wonder bar
Channellocks®	Vise-Grips®
Slip joint pliers	Diagonal cutters
Needlenose pliers	Crimping tool
Hose clamp pliers	Wire strippers
Battery terminal spreader/reamer	Battery terminal puller
Battery post cleaner	Hydrometer
Battery pliers	
Keyhole saw	Utility knife
Hacksaw with replacement blades	10 in. single and double cut files
Aviation snip set (left, right, straight)	chisel set (1/2 in. wood and 3/4 in. metal)
	Punch set
Putty knives, 1, 2, and 3 in.	Scratch awl
Tape measure, 1 in. × 25 ft	Levels, 6 and 18 in.
Chalk line	Combination square
Tubing cutter	Flaring tool kit
Manometer	120 VAC circuit tester (polarity/GFCI)
Ammeter (clamp-on AC/DC)	12 VAC test light
Multimeter (VOM)(digital)	
Handheld or cordless screwdriver/drill w/bits	Air blow gun
	Tire pressure gauge
Flashlight	Earplugs
Safety glasses	Toolbox/bag/bucket

The following information will help the technician to become familiar with the various hand tools and how they are designed to be used.

1-3.1.1 Screwdrivers

Screwdrivers are designed in many different shapes and sizes to remove the many screws fastening components together. The screwdriver is often the most abused tool in the tool kit; there is no such thing as an all-purpose screwdriver. Use screwdrivers only to remove the type and size of screw for which they were designed. The tip of the screwdriver should fit snugly into the screwhead. If the tip fits loosely into the screwhead, the screwhead, screwdriver tip, and surrounding area may be damaged. Tips of all types of screwdrivers have a numbering system according to size. The tip size of the screwdriver to be used is determined by the diameter of the screw. Screwdrivers should be kept clean and oil free, and they are not designed to be used with a hammer or as a pry bar.

1-3.1.1.1 Flat-Tip Screwdrivers

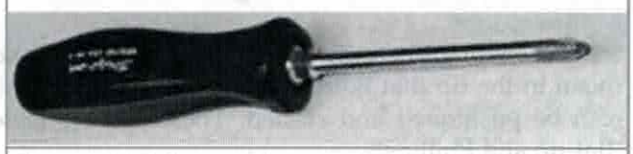
Flat-tip screwdrivers drive screws with a straight groove slot in the head of the screw. The length of the screwdriver is measured either from the shank to the tip or its entire length.

Figure 1-19 Flat-Tip Screwdriver

1-3.1.1.2 Phillips Screwdrivers

Phillips screwdrivers have a pointed tip with four grooves.

Figure 1-20 Phillips Screwdriver



1-3.1.1.3 Robertson Screwdriver Set (Scrulox®)

Robertson screwdrivers have a square tapered tip.

Figure 1-21 Robertson Bit

1-3.1.1.4 Torx® Bit

Torx® bits are a recent innovation in fastener head/screwdriver design. Their six-sided fastener heads are easy to grip and tighten.

Figure 1-22 Torx® Bit

1-3.1.1.5 Nut Drivers

Nut drivers are six-sided sockets with handles permanently attached, usually in sizes 3/16 through 5/8 in.

Figure 1-23 Nut Driver

1-3.1.1.6 Clutch Head Bits

Clutch head bits have a figure-eight-shaped tip. These screws are generally found on older RVs.

Figure 1-24 Clutch Head Bit

1-3.1.2 Other Screwdrivers

The following screwdriver types are not on the recommended list but may be encountered in different applications.

1-3.1.2.1 Offset Screwdrivers

Figure 1-25 Offset Screwdrivers

Offset screwdrivers have tips at each end that are set at a 90° angle to each other. These are available in a variety of tips including flat-tip, Phillips®, and Robertson.

1-3.1.2.2 Screw-Holding Screwdrivers

Figure 1-26 Screw-holding Screwdriver

Screw-holding screwdrivers have a locking mechanism in the tip that holds the screw in position until it can be positioned and started. These are available in flat-tip and Phillips®.

1-3.1.2.3 Pozidriv® Bits

Figure 1-27 Pozidriv® Bits

The tip of this bit is similar to a Phillips®, but they CANNOT be interchanged without damaging the recess of the fastener's head. Pozidriv® bits are used more frequently in newer applications.

1-3.1.3 Wrenches

Wrenches are designed to tighten and loosen the many nuts and bolts used to fasten RV components together. They are made in many different shapes and sizes to assist the technician in performing a wide variety of RV servicing jobs. The size of any wrench to be used is determined by the nut/bolt head size and type.

Wrenches should be kept clean and oil free. If used on RV parts for which they were NOT designed, the jaws can become damaged, which will, in turn, damage parts. They should be stored where they will not damage or be damaged by other tools and equipment.

Good quality wrenches will result in quality work. The quality wrench will fit better and last longer. A wrench that is not of high quality will slip and wear out quickly. Loose-fitting wrenches can round a nut's corners, making tightening and removal difficult, leading to the need to repurchase another wrench set.

1-3.1.3.1 Combination Wrenches

Figure 1-28 Combination Wrench

A combination wrench has one open-end and one box-end head, usually of the same size. These wrenches are popular with technicians because they are such a multipurpose wrench. Combination wrenches are typically used for RV applications in sizes from 1/4 to 1 in. or 6 to 19 mm.

1-3.1.3.2 Tubing Wrenches (Flare Nut)

Figure 1-29 Tubing Wrench

Tubing wrenches are used on copper and brass tubing fittings to avoid rounding of fitting corners. By grabbing the fitting on five sides, they are less likely to damage the fitting.

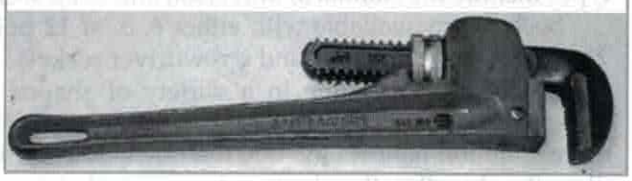
1-3.1.3.3 Adjustable Wrenches (Crescent®)

Figure 1-30 Adjustable Wrench

Adjustable wrenches will adjust to fit any nut or bolt within their adjustment range. If used incorrectly, the jaws of the adjustable wrenches can be damaged as well as the nut or bolt that the technician is attempting to remove. The adjustable wrench should always be pulled away from the fixed jaw. Do not use an adjustable wrench on brass fittings.

1-3.1.3.4 Pipe Wrench

Figure 1-31 Pipe Wrench



Pipe wrenches are intended for use on pipes and never on nuts and bolts. When using a pipe wrench, make sure the jaw is properly tightened. The pipe wrench should always be pulled away from the fixed jaw.

1-3.1.4 Other Wrenches

The following wrenches are not on the recommended list but may be encountered in different applications.

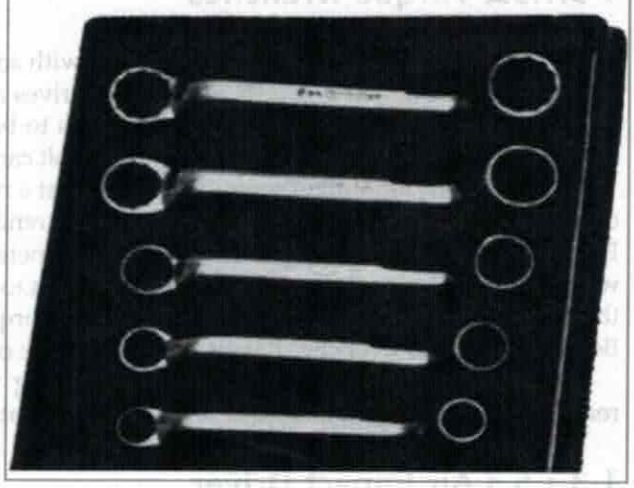
1-3.1.4.1 Open-End Wrenches

Figure 1-32 Open-End Wrenches

As the name describes, these wrenches have an opening at the end that is placed around the nut or bolt. The opening is set at a 15° angle for easy use in tight spaces.

Other angles of the opening include 22-1/2°, 30°, 60°, and 90°. Open-end wrenches have two different sized openings at the ends. In a standard wrench set, sizes range from 3/16 to 1-1/4 in., in 1/16 in. increments. Wrench sets in the metric system range from 6 to 32 mm.

Figure 1-33 Box Wrenches



1-3.1.4.2 Box Wrenches

Box wrenches are designed to reduce the slipping of the wrench off the nut. The closed-box end of the wrench has points that engage the nut.

These wrench heads are set straight or at a 15° angle for ease of use in tight spaces. The most common type has 12 points, but they are also available with 6 and 8 points.

There are also box wrenches that have ratcheting heads. The interior part of the box wrench holds the bolt or nut and will ratchet. These are very convenient to use.

1-3.1.5 Socket Wrenches

Socket wrenches have completely closed ends, as do the box wrenches, which prevents slipping of the wrench from the nut. Their major advantage over other types of wrenches is the time saved when removing nuts. Socket drive sets are available in both English and metric measurement systems. Sets consist of a 1/4, 3/8, 1/2, and 3/4 in. drive.

Sockets are available in a variety of designs to assist the technician in making efficient repairs. Common types include the standard, universal, and deep socket.

Sockets are available with either 6, 8, or 12 points. There are also Allen head and screwdriver sockets.

Socket handles come in a variety of shapes and sizes to access specific RV components. Some of the more common handles include the ratchets, T-bar handles, flex handles (breaker), spinners, and the speed handles.

Some other available options include universal joints and universal sockets as well as extensions for longer reach.

Figure 1-34 Deep and Standard Socket Sets

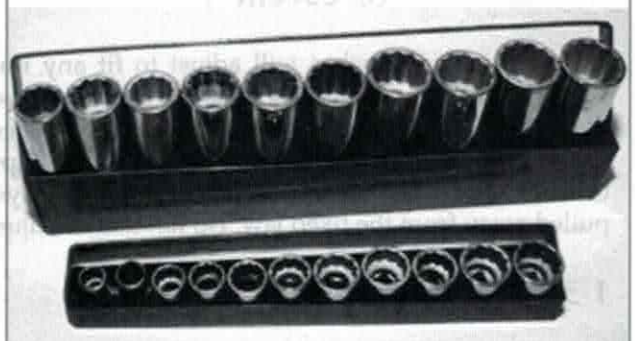


Figure 1-35 Torque Wrench

Figure 1-36 Air Impact Driver

1-3.1.5.1 Socket Sets

Sets commonly used in RV applications are 1/4, 3/8, and 1/2 in. drives. These come with 6 and 12 points for standard hexagon fasteners and 8 points for square fasteners. They are available in standard and deep depths and in standard and metric sizes. Sets usually come with drivers such as ratchets, T-bar handles, flex handles (breaker), spinners, and the speed handles.

1-3.1.5.2 Torque Wrenches

Torque wrenches are designed to be used with sockets and are available in 1/4, 3/8, and 1/2 in. drives and different torque ranges. When the nut or bolt is to be tightened to the manufacturer's specification, the torque wrench is used. Too loose or too tight a nut or bolt can result in poor performance and fastener failure.

Torque is the amount of force exerted to twist a nut or bolt. Torque is calculated by multiplying force times distance ($F \times D = T$) (i.e., 1 lb pull on a 1 ft wrench equals 1 ft/lb). Inch-pounds and foot-pounds are the English measurement value of force, while centimeter-kilogram and meter-kilogram are the metric terms used when referring to force. The technician must use a torque wrench in the same system as the RV part or convert the torque using a torque conversion chart. Torque wrenches are available in a variety of drive sizes. Beam-type torque wrenches have a dial on the face of the wrench.

The signal type also has a surface dial along with an audible click when the preset torque has been reached. Other signal-type torque wrenches have ratchet drive heads with an adjustable handle and scale.

1-3.1.5.3 Air Impact Driver

Impact drivers are designed to be used with impact sockets that are a made of a heavier construction than standard sockets. Do not use standard sockets with an impact driver. Impact drivers are available in

1/4, 3/8, and 1/2 in. drives. They provide a faster method of tightening and loosening nuts and bolts. A number of designs and sizes are available.

1-3.1.5.4 Allen Wrenches

Allen wrenches, sometimes called "setscrew" wrenches or hex keys, are L-shaped or T-handled steel bars used to loosen or tighten recessed hexagonal screw heads. They come in standards size sets of 1/16 to 3/8 in. or in metric sizes sets 1-1/2 to 8 mm. Allen wrenches are also available as socket sets.

Figure 1-37 Allen Wrenches

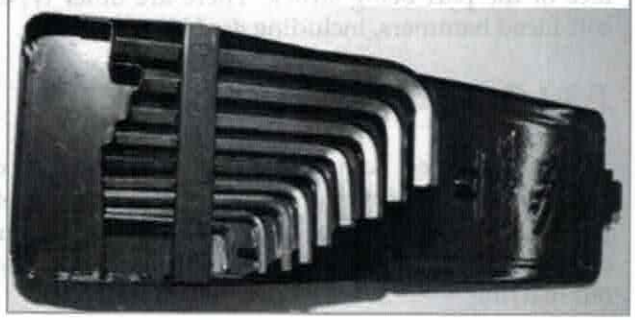
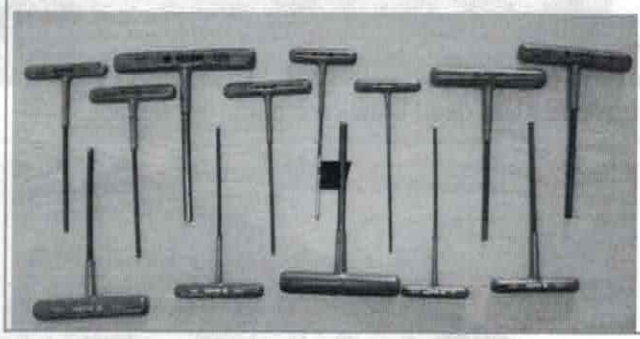


Figure 1-38 T-handled Allen Wrenches



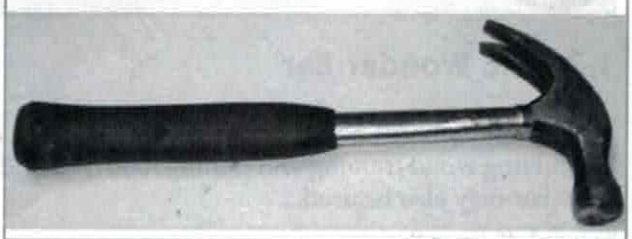
1-3.1.6 Hammers

Hammers are used in many RV servicing jobs. Care must be taken not to damage the part being hammered. NEVER use a hammer with a loose handle. Many types of hammers are available. Always use the correct hammer for the job.

1-3.1.6.1 Claw Hammers

This is the most commonly owned hammer and is designed primarily for carpentry work. Its purpose is for driving and removing nails. They are not designed to be struck against another hardened metal surface, due to the danger of chipping the hammer or metal surface. Claw hammers are available in a wide variety of weights. Sixteen ounces is the recommended size.

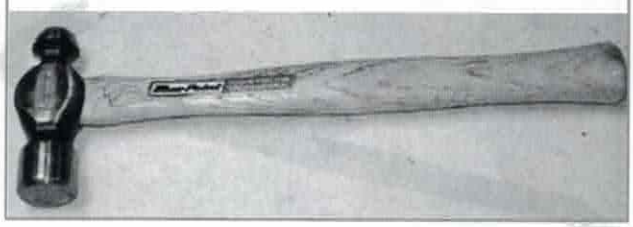
Figure 1-39 Claw Hammer



1-3.1.6.2 Ball-Peen Hammers

The ball-peen hammer has two striking surfaces; one is flat, and the other is a bell-shaped peen. They are the most often used hammer by the technician and are classified according to the weight of the head (without the handle). A ball-peen is available in weights ranging from 2 to 48 oz.

Figure 1-40 Ball-Peen Hammer



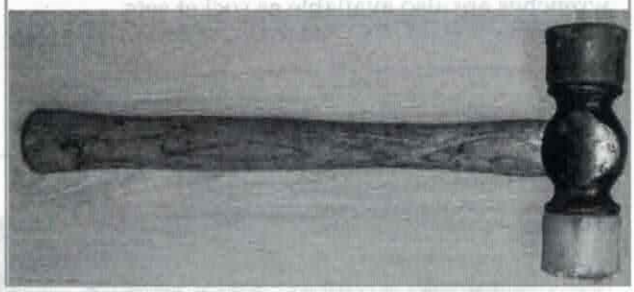
1-3.1.6.3 Rubber Mallet

Figure 1-41 Rubber Mallet

Rubber mallets are soft rubber-faced hammers and are used if there is any possibility of damaging the surface of the part being struck. There are other types of soft-faced hammers, including *dead blow* hammers.

1-3.1.6.4 Plastic-Tip Hammer

Figure 1-42 Plastic Tip Hammer



Plastic-tipped hammers are to be used when concerned about marring a surface. They can have different plastic heads with soft of hard plastic. These hammers can be used on wood, plastic, stone, and concrete without marring.

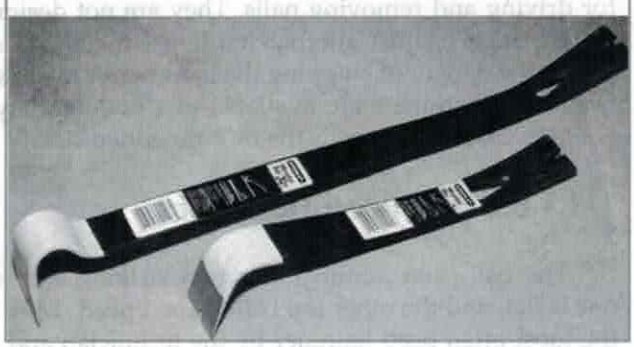
1-3.1.6.5 Dead Blow Hammer

A dead blow hammer is another good hammer to use when concerned about marring a surface. The dead blow is designed to reduce and eliminate bouncing on contact. Most dead blows are made of plastic.

Figure 1-43 Dead Blow Hammer

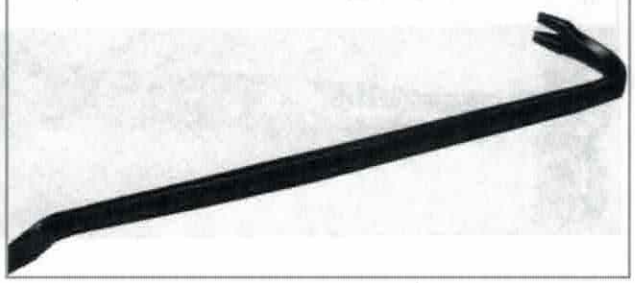
1-3.1.6.6 Wonder Bar

Figure 1-44 Wonder Bar



A wonder bar is a type of flat pry bar used for disassembling wood framing and pulling nails. A standard crow bar may also be used.

Figure 1-45 Crow Bar



1-3.1.7 Pliers

Figure 1-46 Channel-Lock Pliers

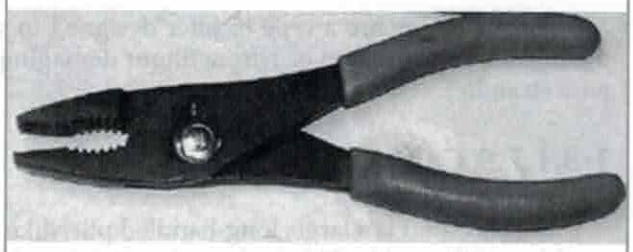
Pliers are used for gripping things that cannot be gripped by wrenches and for cutting wire. They are manufactured in many different sizes and grouped according to length. Pliers SHOULD NOT be used to loosen or tighten nuts, as they damage their heads.

1-3.1.7.1 Channellock® Pliers

Channellock® (interlocking channel) pliers get their name from channels that allow the jaws to be set and clamped at many differently sized openings. They are used for gripping odd-sized parts. They are available in many different sizes.

1-3.1.7.2 Slip-Joint Pliers

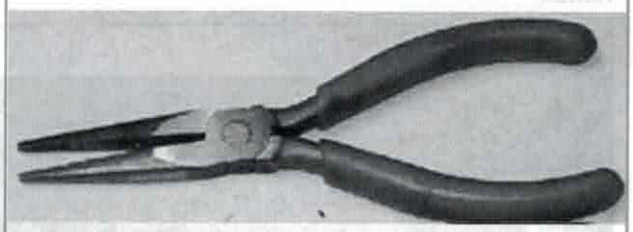
Figure 1-47 Slip-Joint Pliers



These pliers have a slip joint where the two jaws meet, which allows the jaws two settings—one for holding large objects and one for small objects. This is a multipurpose plier available in many sizes.

1-3.1.7.3 Needle-Nose Pliers

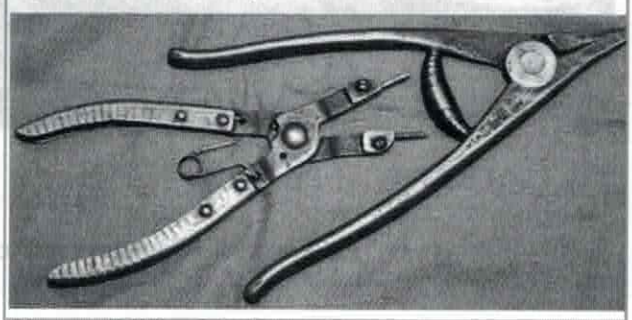
Figure 1-48 Needle-Nose Pliers



These are used to grip small, irregular-shaped items in hard-to-access areas. Some are designed with bent jaws for reaching around objects. They are available in many sizes and shapes.

1-3.1.7.4 Hose Clamp Pliers

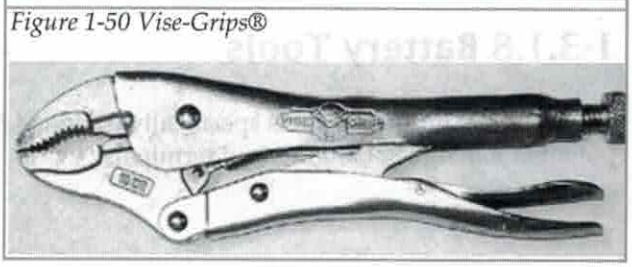
Figure 1-49 Hose Clamp Pliers



Hose clamp pliers have special ends to grip clamp rings for removal and installation.

1-3.1.7.5 Vise-Grips®

Figure 1-50 Vise-Grips®



Vise-Grips® are pliers that lock into position. By turning the screw in the handle, the jaw opening is adjusted. They are one of the most versatile tools in the technician's kit, as they will firmly grip even a tiny area when the jaws are locked on the desired surface. Caution must be used when using them with soft materials. They are available in various jaw configurations and sizes.

1-3.1.7.6 Diagonal Cutting Pliers

Diagonal cutting pliers have diagonally set jaws designed to cut wire cotter pins and so forth. They are available in different sizes. They are also called *side cutters* and *dykes* (short for *diagonal*).

Figure 1-51 Cutting Pliers

1-3.1.7.7 Crimping Tool

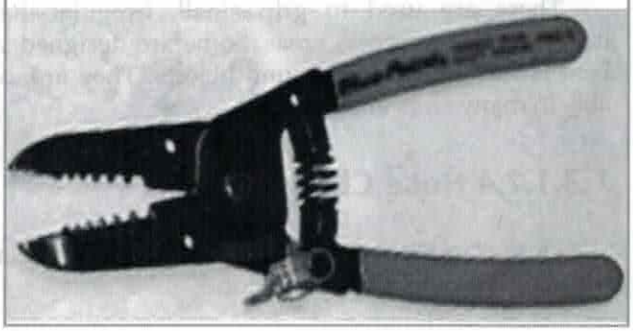
A crimping tool is a type of plier designed to apply maximum pressure at the proper point to crimp electrical fasteners. They are also available as combination wire crimpers/strippers.

Figure 1-52 Crimping Tool

1-3.1.7.8 Wire Strippers

Wire strippers are a type of plier designed to strip the insulation of the end of wire without damaging the wire strand(s).

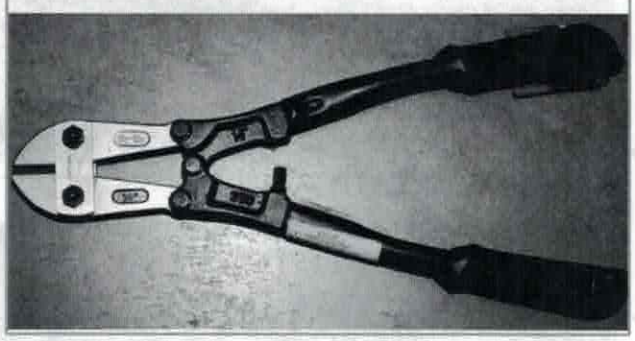
Figure 1-53 Wire Strippers



1-3.1.7.9 Cable Cutters

A cable cutter is a large, long-handled plier-like tool used for cutting cable. This tool requires the use of both hands.

Figure 1-54 Cable Cutters



1-3.1.7.10 Special-Purpose Pliers

Many pliers are designed to access and service specific components, such as snap-ring pliers used to remove/replace lock rings.

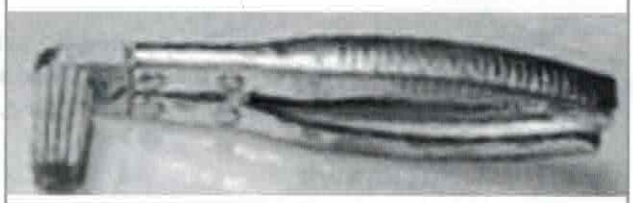
1-3.1.8 Battery Tools

There are numerous tools specifically designed for servicing batteries. The use of these tools will minimize potential damage to batteries and terminals.

1-3.1.8.1 Battery Terminal Spreader/Reamer

This is a plier-type tool used to spread and clean the battery cable clamp.

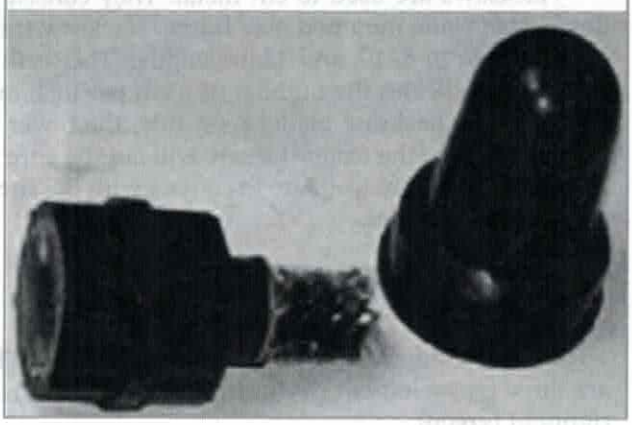
Figure 1-55 Battery Terminal Spreader/Reamer



1-3.1.8.2 Battery Post Cleaner

This is a two-part wire brush. One part is designed to brush and clean the battery post, while the second part is designed to brush and clean the battery cable clamp.

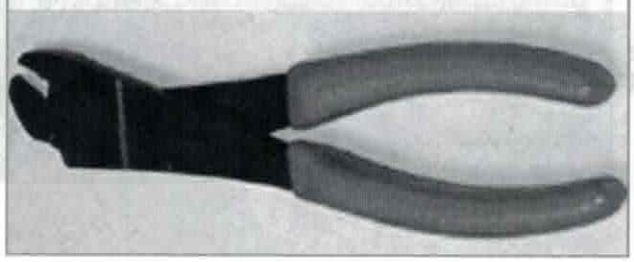
Figure 1-56 Battery Post Cleaner



1-3.1.8.3 Battery Pliers

Battery pliers are designed to grip the terminal nuts on the battery connections.

Figure 1-57 Battery Pliers



1-3.1.8.4 Battery Terminal Puller

This is a puller designed to remove the battery cable clamp from the battery post. It minimizes the possibility of damaging the battery.

Figure 1-58 Battery Terminal Puller

1-3.1.8.5 Battery Hydrometer

This is a float-type instrument used to determine the state of charge of a battery by measuring the specific gravity of the electrolyte in each individual cell.

Figure 1-59 Battery Hydrometer

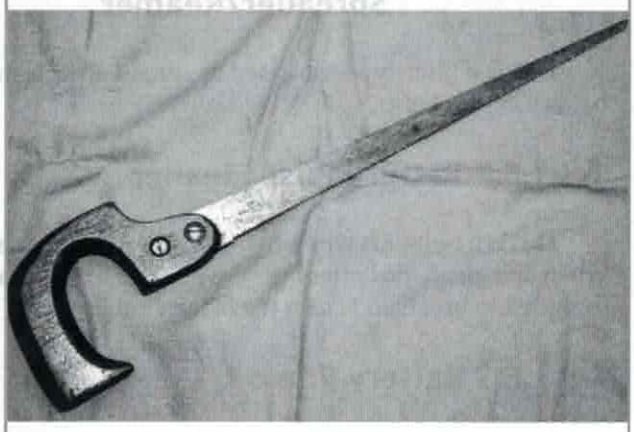
1-3.1.9 Cutting Tools

Many RV repair jobs require tools that will cut, shape, and/or smooth metal, wood, or fiberglass parts. These tools include chisels, files, hacksaws, knives, and so on.

1-3.1.9.1 Key Hole Saw

This is a small hand saw with a pointed tip, which allows starting a cut with a very small hole. These saws can be used in tight quarters to cut wood, fiberglass, etc.

Figure 1-60 Key Hole Saw



1-3.1.9.2 Hacksaws

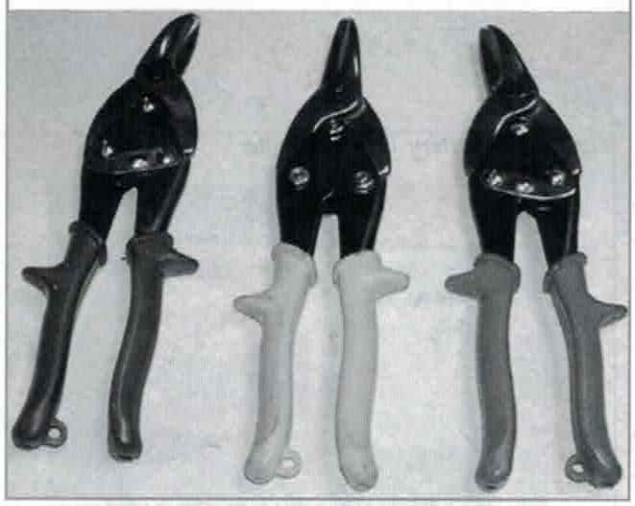
Hacksaws are used to cut metal. They consist of a detachable blade mounted on a frame. Hacksaw frames are available in 8, 10, and 12 in. lengths. The teeth per inch (TPI) indicates the number of teeth per inch in the length of the hacksaw blade. As a rule, the fewer and larger the teeth, the faster the saw will cut. Be sure that at least two or more teeth are in contact with the surface being cut at all times.

Figure 1-61 Hand Hacksaw

1-3.1.9.3 Aviation Snip Set

Aviation snips are sheet metal cutting snips. There are three types: left-cut (red), straight-cut (yellow), and right-cut (green).

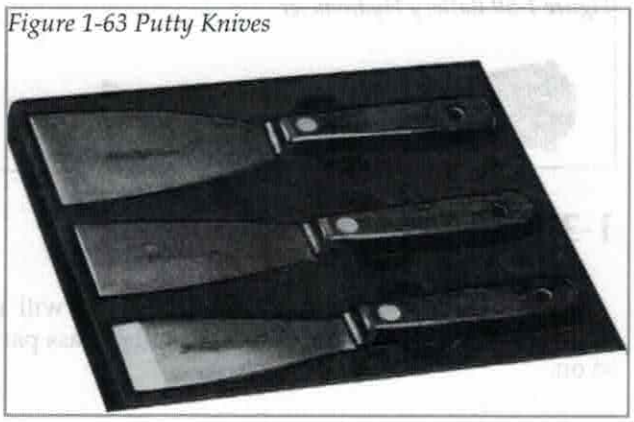
Figure 1-62 Aviation Snips



1-3.1.9.4 Putty Knives

Putty knives are flat bladed instruments, available in various blade widths and thicknesses with a variety of uses such as scraping, spreading, and so on.

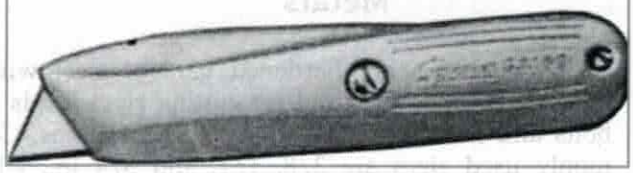
Figure 1-63 Putty Knives



1-3.1.9.5 Utility Knives

These are retractable blade knives used for a wide variety of cutting applications. The blade is extremely sharp and easily replaceable.

Figure 1-64 Utility Knife



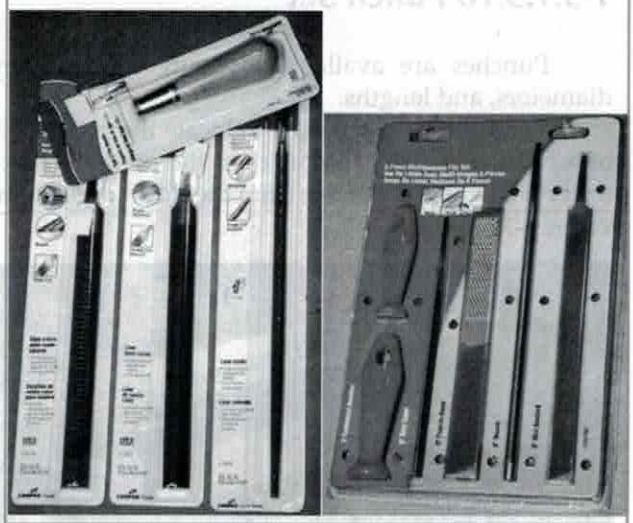
1-3.1.9.6 Files

Files are used to remove material when polishing, smoothing, or shaping components. They are made of hardened steel and have diagonal rows of parallel teeth forming the cutting edge across the face of the file. Files come in lengths of 3 to 18 in. with either a single row of teeth, called a *single-cut,* or with one row of teeth crossing the other diagonally, which is called *double-cut.*

Metal filings clogging the file teeth during use are removed by tapping the file handle on a flat surface or by brushing with a file card.

Files are classified as to the coarseness or fineness of their cutting edge. These grades, from fine to coarse, are *smooth, second-cut, bastard,* and *coarse.* Files are designed in many different shapes.

Figure 1-65 Files for Metal Working



1-3.1.9.7 Rasps

A rasp is a file-like tool used for filing or shaping wood.

Figure 1-66 Rasp

1-3.1.9.8 Wood Chisels

Wood chisels are utilized for shaping wood and have a sharper cutting edge. They should not be used on metal. They are available in a variety of widths from 1/4 to 1-1/2 in.

Figure 1-67 Wood Chisels

1-3.1.9.9 Metal Cold Chisels for Cutting Metals

Cold chisels are hardened bars of steel with a ground cutting edge used for cutting rivet heads and bolts and for various other metal applications. Commonly used sizes are 3/8, 1/2, and 3/4 in., which denote the width of the cutting edge.

Figure 1-68 Metal Chisels

1-3.1.9.10 Punch Set

Punches are available in many different types, diameters, and lengths.

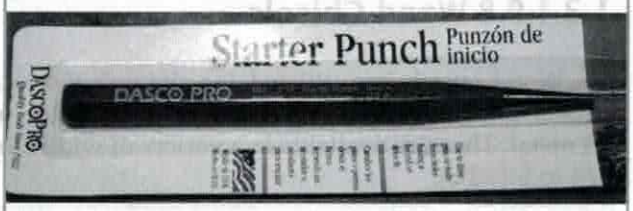
Center punches are used to locate the start position of a twist drill. Their points dent the metal so that the drill twist will not wander from the desired position.

Figure 1-69 Punch Set

Figure 1-70 Center Punch

The starter punch is used to begin the removal of a rivet after the rivet head has been removed with a chisel.

Figure 1-71 Starter Punch



The pin punch is used to finish removing the rivet after it has been started with the starting punch.

An aligning punch is long and tapered and is used to align parts.

Figure 1-72 Pin Punch

1-3.1.9.11 Scratch Awl

A scratch awl is a very sharp metal tool with a screwdriver-type handle. It can be used for scratching marks onto metal surfaces, punching and aligning holes in light materials, and so forth.

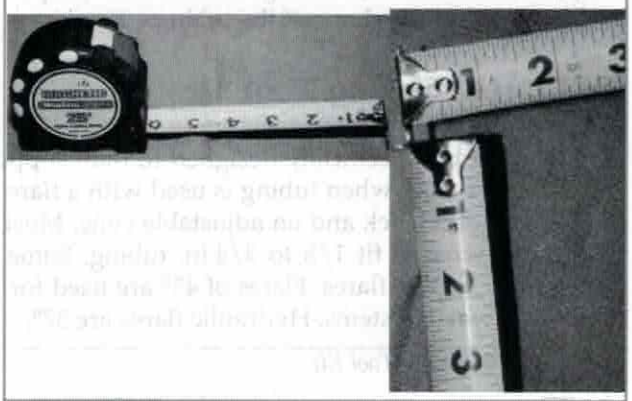
Figure 1-73 Scratch Awl Set

1-3.1.10 Additional Tools and Test Equipment

1-3.1.10.1 Tape Measure

A measuring device with a retractable blade (tape). These are available in lengths from 6 to 30 ft and in both standard and metric increments. A tape measure 1 in. wide and 25 ft minimum length is recommended.

Figure 1-74 Tape Measure



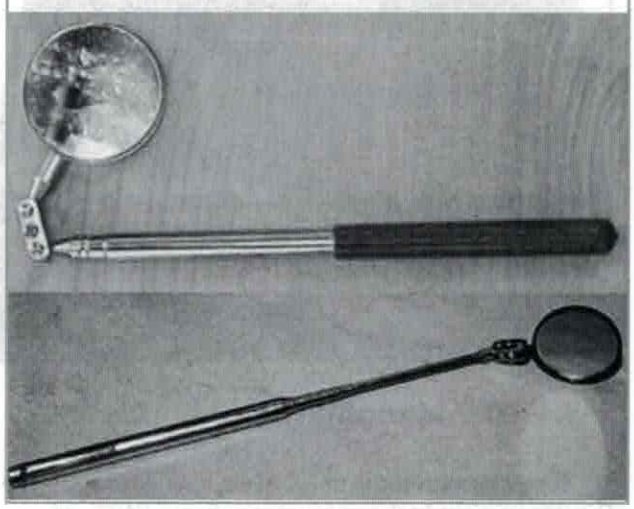
1-3.1.10.2 Chalk Line

This is a string or line used for marking straight lines. The string is rolled into a case that is filled with chalk. When the line is extended, stretched taut, and snapped, it will leave a chalk line on the surface.

1-3.1.10.3 Flexible Mirror

A flexible mirror is a small mirror on the end of a flexible rod used to look at otherwise concealed areas.

Figure 1-75 Flexible Mirrors



1-3.1.10.4 Levels

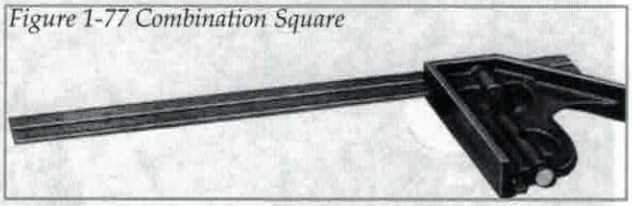
A level is a straight edge with a liquid-filled indicator. The liquid-filled indicator uses an air bubble to show when the straight edge is level. They will have a horizontal, vertical, and sometime 45° level indicators.

Figure 1-76 Level

1-3.1.10.5 Combination Square

This is a 12 in. ruled straight edge with a movable 45° and 90° angle head. They are available in standard and metric increments.

Figure 1-77 Combination Square



1-3.1.10.6 Tubing Cutter

A tubing cutter is a tool specifically designed to cut copper or aluminum tubing. When used properly, it will not distort the shape of the tubing.

Figure 1-78 Tubing Cutters

1-3.1.10.7 Flaring Tool Kit

This tool is specifically designed to flare copper or aluminum tubing when tubing is used with a flare nut. It consists of a block and an adjustable cone. Most sets will have sizes to fit 1/8 to 3/4 in. tubing. Some sets will create double flares. Flares of 45° are used for propane and water systems. Hydraulic flares are 37°.

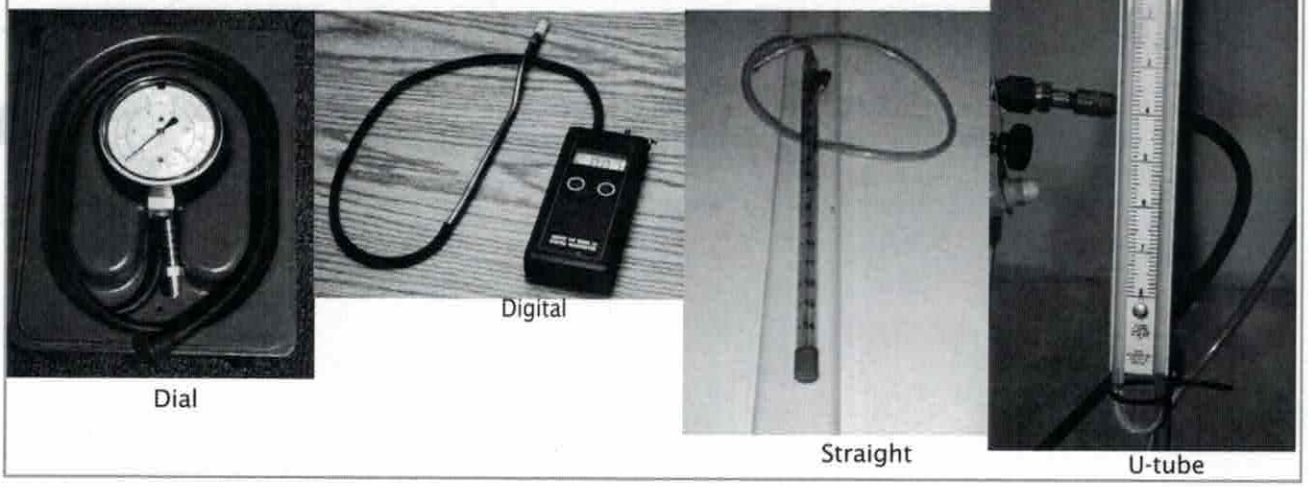
Figure 1-79 Flaring Tool Kit

1-3.1.10.8 Manometer

The manometer is used when checking propane pressure in a recreation vehicle. The manometer measures the pressure in inches of water column (WC). Three types of manometers are generally available: the dial type, loop type, and the digital type. Use of the manometer is covered in the other appropriate textbooks, such as *Propane Systems* and *Pre-delivery Inspection*.

Dial manometers should be calibrated on a monthly basis.

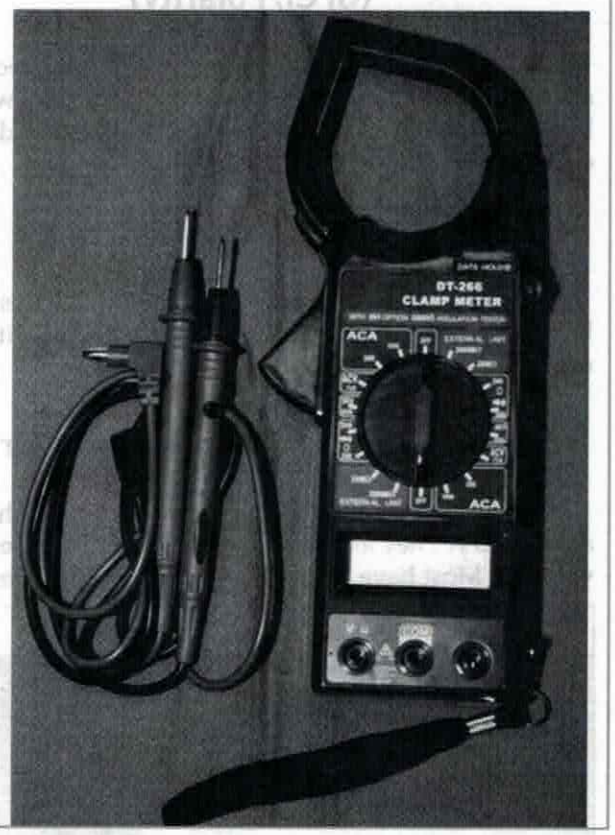
Figure 1-80 Manometer Examples



1-3.1.10.9 DC and AC Inductive Ammeter

This instrument is used to measure the current flow in amps. They are available for both AC and DC circuits and provide analog or digital readouts.

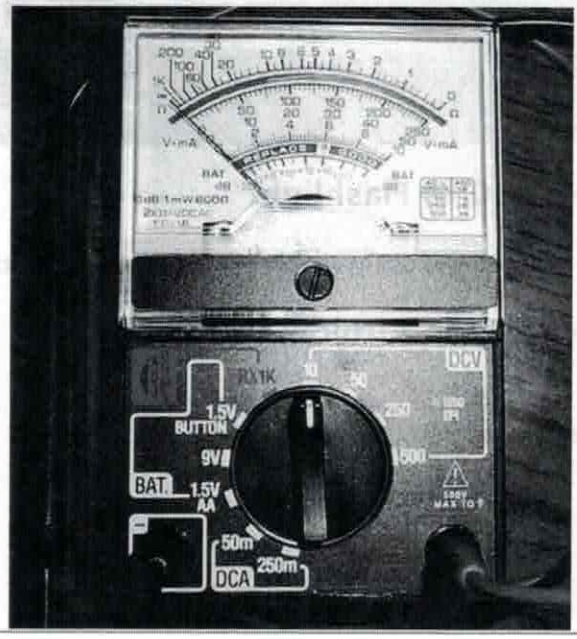
Figure 1-81 Inductive Ammeters



1-3.1.10.10 VOM

Volt-ohm meters (VOMs) are electrical meters capable of taking voltage, resistance, and small amperage readings. They are available for both AC and DC circuits and analog or digital readouts. They are sometimes referred to as *multimeters*.

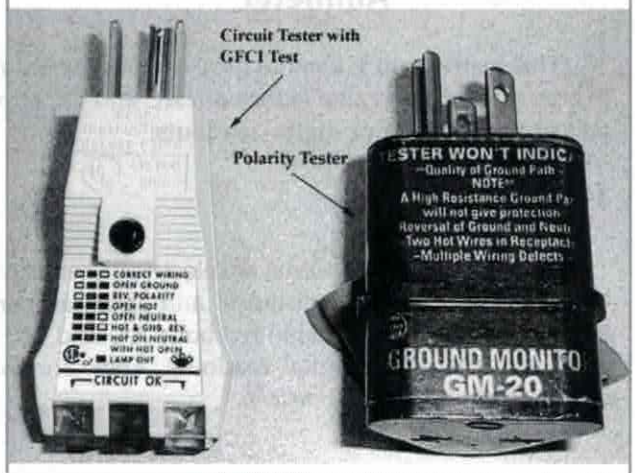
Figure 1-82 VOMs



1-3.1.10.11 120 VAC Circuit Tester (GFCI/Polarity)

A circuit tester is a device that plugs into a receptacle to analyze its polarity. Some are provided with a button that will create a fault for testing of ground fault circuit interrupter (GFCI) receptacles or circuits.

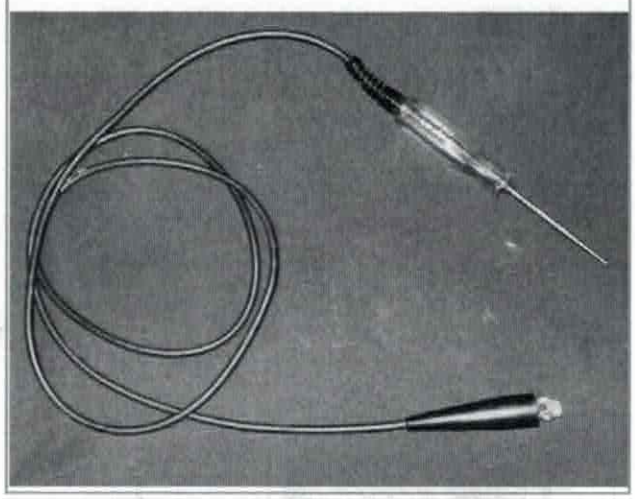
Figure 1-83 GFCI/ Polarity Tester



1-3.1.10.12 12 VDC Test Light

This is a circuit tester designed for 12 VDC systems. It indicates the presence of voltage in a circuit with the use of a light bulb.

Figure 1-84 12 VDC Test Light



1-3.1.10.13 Cordless Screwdriver/Drill

A screwdriver/drill motor powered by a rechargeable battery. They are available in a variety of sizes and voltages. Most have variable speeds and are reversible.

Figure 1-85 Cordless Drill

1-3.1.10.14 Flashlight

Flashlights are available in many sizes and battery types.

1-3.1.10.15 Airblow Gun

This device uses compressed air for blowing dust, debris, and other foreign material.

Figure 1-86 Airblow Gun

1-3.1.10.16 Tire Pressure Gauge

This is a device for measuring air pressure in a tire or any other pneumatic system. They are available in standard and metric calibration. They should be of high quality and capable of being calibrated. Pressure gauges used in the RV service field should be capable of measuring up to 160 psi.

Figure 1-87 Tire Pressure Gauge Examples

1-3.1.10.17 Safety Glasses

Eye protection should be worn at all times. Safety glasses should consist of side shields and meet *OSHA* and *CSA* standards.

1-3.1.10.18 Hearing Protection

A variety of hearing protection devices are available. Ear plugs should be used for hearing protection when working in a noisy environment.

1-3.1.10.19 Toolbox

This device is used to store, protect, and organize tools and equipment. The toolbox should be mobile and capable of holding existing and additional tools obtained in the future.

1-3.1.11 RV Specialty Tools and Equipment

As a new RV service technician will learn, every job to be done requires the use of tools. Tools are a major investment, reflecting the technicians' dedication to this career choice. As technicians become more skilled and begin to perform more complex repairs, they add more specialized tools to their tool kits.

1-3 Review

1. What tools are used to remove nuts and bolts?
2. Which pliers are designed to cut wires?
3. Name the wrench specifically designed to prevent slipping when removing nuts.
4. When a nut is to be tightened to a manufacturer-specified amount, what wrench is used?
5. Why is it dangerous to hammer a surface as hard or harder than the hammer used?
6. Which wrench greatly cuts down on the time it takes to remove nuts from RV automotive parts?
7. What is the name of the screwdriver that has four grooves on the tip?
8. Name the screwdriver with tips at each end, set at 90° angles to the handle?
9. Which type of pliers has two jaw settings?
10. Which hammer is used if there is any chance of damaging the RV parts?
11. Read the descriptions of the tools below. Write the name of the tool described in the blanks provided.

    A. Each one has both an open-end and a box-end head of the same size. _____

    B. Used to set nuts and bolts to a specified tightness. _____

    C. Screwdriver with tips at each end at 90° angles to the handle. _____

    D. Hammer used to strike parts that MAY be damaged. _____

    E. Pliers with long, thin jaws used to grasp hard-to-access parts. _____

    F. Wrench that saves the most time when removing screws and/or bolts. _____

    G. Pliers with two jaw settings. _____

Chapter

1-4 Shop Safety

- Identify appropriate dress and safety gear.
- Identify the safe storage of hazardous materials.
- Identify safe work habits when servicing RVs.
- Find and use material safety data sheets (MSDSs).

Sometimes RV service technicians are unnecessarily injured while repairing or servicing recreation vehicles and their systems. Accidents can be avoided if the technician pays attention to safety and ensures a safe working environment.

A career in recreation vehicle servicing and repair offers a variety of different servicing jobs and procedures. This diversity, however, calls for an increased awareness of the safety precautions that must be taken when performing each of these varied repair jobs. Injuries are most often caused by ignorance of the hazards involved or personal carelessness. Safety is everyone's responsibility.

Accidents can be prevented if the individuals are aware of the hazards present in the shop and think of their own personal safety as well as the safety of those around them. Safety also includes avoiding damage to vehicles and shop tools and equipment.

This chapter provides an introduction to safe working practices in the RV shop, hazards found in the shop, and the effective use of the different types of fire extinguishers.

1-4.1 Safety Test

Answer each question by placing a check mark in the yes or no column.

YES	NO	
____	____	Is help utilized in lifting heavy objects?
____	____	Are leather shoes or boots worn, not soft top shoes or sandals, when working?
____	____	Is there a well stocked first aid kit available in the bay or work area at all times?
____	____	Is there an eye wash station?
____	____	Has training in first aid treatment and/or CPR been received?
____	____	Are safety glasses or goggles worn for any work such as grinding, filing, sanding, drilling, or working with liquid chemicals?
____	____	Are safety glasses or goggles worn for any work performed underneath a vehicle?
____	____	Is wearing of long ties, sleeves, rings, or watches avoided when making RV repairs?
____	____	Are gloves worn or a rag used to avoid cuts when replacing headlights, light bulbs, or glass?
____	____	Is there a list of emergency phone numbers located by all phones?
____	____	Is the checking of overheated radiators avoided until the pressure in the system is relieved?
____	____	Are all the floors in the work area are kept free from grease, oil, and water?
____	____	Is the rule of never dumping oil into the sewer or septic system followed?
____	____	Is there an awareness of the danger in attempting to start an engine by pouring gasoline into the carburetor while the engine is being turned over?
____	____	Is a fuse puller used for removing cartridge-type fuses?

YES	NO	
____	____	Are all electrical power tools properly grounded?
____	____	Are chemicals and solvents properly stored?
____	____	Is there adequate ventilation when working on running engines?
____	____	Are heavy objects lifted using chain hoists or other mechanical equipment when handling vehicle components or cargo/loads?
____	____	Are specialized shop tools maintained in good condition?
____	____	Are all hand tools kept clean and oil free?
____	____	Are all worn or broken extension cords and plug-in attachments replaced immediately?
____	____	Are all hammer heads securely fastened to the handles?
____	____	Are protective guards used on all equipment with moving parts?
____	____	Are the wheels blocked with chocks to prevent the vehicle from rolling?
____	____	Are all flammable liquids kept away from all electrical equipment?
____	____	Are all flammable vapors well ventilated?
____	____	Are all flammable liquids properly stored and labeled?
____	____	Are solvent-soaked and greasy, oily rags kept in a metal container with a lid?
____	____	Is the battery ground cable disconnected first before removing a battery and reconnected it last when installing a battery?
____	____	Is the "no smoking" rule observed near batteries and flammable liquids regardless of whether they are in or out of the RV?
____	____	Is eye protection worn when doing any welding?
____	____	Are all batteries disconnected when welding on the RV?
____	____	Is the shop equipped with sufficient approved extinguishers for fires from lacquers, thinners, gasoline, or grease?
____	____	Are the fire extinguishers are fully charged and in good working condition?
____	____	Is there a safety blanket handy to roll a person in to smother a fire?
____	____	Are all exits clearly marked and lighted with alternative power sources?
____	____	Are jack stands always used when working on a jacked-up unit?

The correct answer for all these questions should be "yes."

The first safety concern covered in the next section is what to wear and not to wear in the RV service bay or work area, so as to minimize the possibility of personal injury.

1-4.2 Shop Safety

A safe working environment begins by thinking safety. If there is doubt about how safe a course of action is, ask the RV service manager BEFORE continuing. Always be alert to the possibility of an emergency situation. Know the layout of the shop: location of fire extinguishers, telephones, first aid equipment, and exits.

Creating a safe workplace also takes an understanding of what the potential dangers are and how to protect against them. Begin by identifying ways to protect against these dangers. These lists are designed for entry-level technicians; as experience is gained, many of the items will not require the approval of service manager, supervisor, or mentor.

1-4.2.1 Safety in the RV Workplace

1-4.2.1.1 Safe Dress for Repair Work

What to wear when repairing RVs is totally within the individual's control for the prevention of personal injury. The following safety guidelines for dress are recommended by safety experts.

1. WEAR WELL FITTING CLOTHING. Loose-fitting shirts (or shirts not tucked in), as well as any unbuttoned long sleeve, can get caught in moving RV parts or power tools.
2. WEAR PROTECTIVE SHOES. Wear shoes that will protect the feet; steel-toed work boots or shoes with nonskid soles and heels will protect against falling parts, electrical shocks, and falls. Sandals and sneakers should not be worn.
3. REMOVE JEWELRY. Do not wear rings, bracelets, wrist watches, necklaces, chains, or earrings in the RV shop. They can become caught in moving parts and cause severe—even fatal—injuries. Jewelry can also cause electrical shorts, resulting in severe burns.
4. CONFINE HAIR. A cap should be worn over long hair. Again, it can become caught in moving RV parts or power tools with the result being a serious or fatal injury.
5. WEAR PROTECTIVE CLOTHING. Know what protective clothing to wear for the job (i.e., when welding, wear protective leather gloves; wear rubber gloves and an apron when working with batteries).
6. WEAR EYE PROTECTION. Wear eye protection whenever there is even the slightest risk of eye injury. Face shields, safety goggles, and safety glasses protect against injury resulting from splashed acids, solvents, or flying metal fragments. Eye protection should always be worn in shop areas to avoid injury. Eye injuries can occur from hazards created by other employees.

1-4.2.1.2 General Shop Safety Rules

These safety rules apply to everyone in the RV workplace, no matter what repairs they may be making or what equipment they may be using. Follow these rules AT ALL TIMES in the RV service bay or work area.

1. Use RV shop equipment ONLY when the service manager or other personnel are present and ONLY when necessary. Working alone (e.g., after hours or on the weekend) is dangerous, because there is no one to assist if there is a serious accident.
2. DO NOT attempt to use any piece of equipment when full instruction on how to operate has not been received. If these directions are not understood, DON'T use it.
3. NEVER smoke when around or servicing an RV.
4. Report ALL injuries and accidents to the service manager immediately—no matter how minor they may appear.
5. NEVER become involved in practical jokes, pranks, or horseplay in the shop. It could lead to injuries.
6. Wipe up all spills IMMEDIATELY to reduce the possibility of slips and falls.
7. Lift and carry things properly; lift with the legs, NOT with the back. Use lifting equipment to reposition heavy items.
8. Do not work under heavy equipment unless two forms of fall protection are provided.

9. Avoid lying with the individual's legs in the aisle when working under a vehicle. People may trip over the legs or run over them with a vehicle.
10. Store portable equipment in designated areas (e.g., creepers in an upright position away from traffic areas in the shop).
11. Keep the work area clean and aisles clear at all times. Return tools to their proper storage space: tool cabinet, tool rack, etc., when finished using them. NEVER leave anything laying around that may be run into, tripped over, or knocked off a vehicle or bench.
12. A running RV must be connected to an exhaust disposal system to remove carbon monoxide, which is colorless, odorless, and DEADLY.
13. The battery MUST BE DISCONNECTED before the engine is "cranked" with the pulley or flywheel.
14. Procedures that indicate that a system is disabled for repair (lockout/tagout) should be utilized when working on propane, 12 VDC, 120–240 VAC, or hydraulics, and when working under live units.

1-4.2.1.3 Handling Combustible Toxic Liquids

Many flammable or combustible liquids are found in the RV service bay or work area. Each technician must be aware of the location of safety equipment in the case of emergency as well as the precautions to be taken to prevent fires.

1. Communicate any potential safety hazards to the service manager immediately.
2. Keep flammable and combustible liquids away from any sparks (i.e., electrical equipment), flames, and heat.
3. Use combustible or flammable liquids ONLY in well ventilated areas AND avoid inhaling the fumes.
4. Store all flammable or combustible liquids in approved, sealed safety containers.
5. Return all flammable or combustible liquids to approved, sealed safety containers immediately when finished.
6. NEVER use gasoline as a cleaning agent. Gasoline is only a fuel for gasoline engines.
7. Be careful not to splash gasoline or other toxic liquids on any individual, including self. This can result in skin irritations, chemical burns, and severe eye injuries.
8. If a toxic liquid does splash on skin, wash it off IMMEDIATELY. If spilled on clothing, rinse them out immediately or change clothes as soon as possible.
9. Place used, greasy rags in approved, covered metal containers. Oily rags can burn by spontaneous combustion (from the heat produced by being exposed to the air).

These are SOME of the safety rules to be observed in the RV service bay or work area. Next the introduction to safety rules that apply to the use of certain tools and equipment when making specific RV repairs will be covered.

1-4.2.2 Using Hand Tools

Accidents in the RV service bay or work area are often the result of the misuse or abuse of ordinary hand tools. This section will cover the identification and application of safety rules for the use of hand tools.

1. Keep hand tools clean. Wash hands if greasy or oily to prevent tools and RV parts from slipping and causing injury. Hand tools should also be wiped clean before, during, and after use for the same reason.

2. Use a vise to secure small parts, or clamp them to a bench when using metal cutting tools (i.e., saws, chisels, files).
3. Use the tool designed for the job and the correct tool size to avoid damaging components.
4. DO NOT use any tool that is damaged or broken. Report or replace any damaged, broken, or improperly working tools/equipment immediately. Replace personal tools immediately if they become broken. Many tools come with a lifetime guarantee.
5. DO NOT carry tools in pockets. The tool can damage the RV's upholstery if work is being done in the passenger compartment. Carrying tools in pockets could also cause injury to the technician.
6. Hold tools by their handles. When handing a tool to someone, hold it so they can take it by the handle.
7. DO NOT lay tools or parts anywhere where they might fall on people (i.e., ladders, fenders, ledges).
8. ALWAYS wear eye protection, especially when chipping, grinding, or cutting.
9. NEVER use a finger to test if a tool is sharp.
10. Make sure that all tool handles are tight and secure.
11. ALWAYS keep hands, arms, and body out of the path of cutting tools.
12. Use only GROUNDED or double-insulated tools.
13. Use the correct size box or open-end wrenches when possible. They are much less likely to slip than adjustable wrenches.
14. If using an adjustable wrench, hold it so the force is applied on the solid side of the wrench, NOT the adjustable side.
15. When pulling on a wrench, hold the wrench with hand closed. When pushing it, leave the hand open.
16. NEVER use a torque wrench to loosen fasteners OR to check the torque on fasteners that are already seated. They are used ONLY to set the torque of a fastener.
17. Check and make sure that the socket is secure and firmly seated in the socket wrench before any force is applied.
18. DO NOT use ratchet handles for seating fasteners. They are used for light work (i.e., removing fasteners that have been loosened using a socket or box wrench).
19. NEVER use a file without a handle.
20. NEVER brush away metal filing, chips, and so on from work with bare hands. Use a brush, a clean shop rag, or a file card.
21. Ball-peen hammers have tempered, hardened surfaces. NEVER hit another tempered, hardened surface with a ball-peen hammer; the surfaces may chip.
22. Soft-face hammers and mallets can rebound (bounce) and strike the individual. Keep body out of line of a possible rebound.
23. When using a screwdriver, start the fastener by hand and then keep hands away from the blade.
24. When using a chisel, strike it with a hammer that has a face TWICE the size of the chisel head. Keep eyes on the cut, NOT on the chisel head.
25. Never cut toward yourself or another person.

1-4.2.3 Using Power Tools

Tools driven by electricity, hydraulic fluid, or compressed air are called *power tools*. These tools save the technician a great deal of time and energy in making RV repairs.

The safety rules listed below apply to the use of both hydraulic and electrical tools, with compressed air-powered tools being discussed in the next section. Due to the properties of electricity, special precautions must be taken when using these tools.

1. ALWAYS wear a face shield when using power tools.
2. The power switch must be "off" when plugging the cord into the socket.
3. DO NOT use electrical equipment around batteries or gas welding equipment. Sparks from the power tool can cause batteries or other components to explode.
4. Look around the work area before using electric tools. DO NOT use electrical tools if there are flammable solvents or gasoline nearby.
5. Keep all machine safety guards in position.
6. Once a power tool is started, NEVER LEAVE IT until the power has been turned off and completely stopped.
7. NEVER attempt to put down, oil, adjust, or clean a power tool until it has been turned off, it has come to a dead stop, AND the power cord has been disconnected.
8. Hands and the floor MUST BE DRY to operate electrical tools safely.
9. Electrical power tools must be grounded or double insulated to protect people from electrical shock. If the power tool is not grounded or double insulated, DO NOT USE IT.
10. DO NOT use a power tool that is TOO BIG (will damage the part) or TOO SMALL (will overload the tool) for the job.
11. Place work within reach. NEVER create a situation where overextending can cause loss of balance.
12. When disconnecting a power tool, always pull the plug. Never yank the cord to remove it from the power outlet.
13. Check the cord to make sure it is in good condition. DO NOT use the tool if the cord insulation is damaged in any way. Also check the plug and the source outlet to make sure they are in good condition.
14. Keep the power cord out of the way so no one trips over it.
15. If a tool is damaged or not working properly, DO NOT USE IT. Report the malfunction to the service manager.
16. If a power tool is oily or greasy, thoroughly clean it before using it.
17. ALWAYS hold the power tool firmly. Some power tools may surge when the power switch is turned to the "on" position.
18. Stay clear of other people using power tools.

1-4.2.4 Using Compressed Air

Compressed air is used in the RV service bay or work area to power tools, inflate tires, and to spray parts. Compressed air-driven tools can be extremely dangerous if they are misused. By following these safety rules, accidents and injury can be prevented.

1. NEVER use an air-driven tool in which training on safe and correct use has not been provided.

2. ALWAYS wear eye protection when using compressed air (i.e., full face shield when cleaning parts, and goggles when inflating tires).
3. BEFORE using an air-driven tool, have the service manager check the regulator adjustment to ensure that it is at the correct pressure for the attachment in use.
4. ALWAYS wear an air filter or particle mask if the compressed air is blowing dust or particles in the work areas.
5. NEVER use an air hose to clean brake assemblies unless it is in a closed container with a special vacuum attached and operating. Old brake linings may contain asbestos, which is a known carcinogen (cancer-causing agent) AND MUST NEVER BE INHALED!
6. Use the correct size tool for the job.
7. Keep air hoses clean and free from oil and grease.
8. Handle air hose attachments carefully, as they are easily damaged; damaged equipment could cause injuries.
9. Before connecting an air tool, make sure the throttle is in the "off" position.
10. If the tool was designed with a guard, make sure the guard is in place and that it is working properly.
11. Be sure all couplings are secure and correctly attached before connecting the air.
12. If the air tool has a torque adjustment, make sure it is adjusted for the work being done.
13. Use the right tool for the job (i.e., all final seating of fasteners to specifications are done with a torque wrench, etc.).
14. DO NOT inflate tires beyond their rated pressure. Use a tire gauge to check inflation. Overinflated tires can explode!
15. NEVER point an air hose at ANYONE, including yourself (i.e., to dust off clothing).
16. Hold onto an air hose when disconnecting it and until all the pressure is released so that it does not "whip" around.
17. Use short bursts of power when operating air-driven power tools.
18. Several types of quick-disconnect couplings are used to attach air hoses to tools. They are fastened to the air hose, NOT the tool, and MUST be the same type.
19. Keep air hoses away from traffic areas where they may be tripped over or run over by an RV.
20. If working on a small component, secure it in a vise or clamp it down securely.
21. Never use compressed air to spin dry bearings.

1-4.2.5 Using Jacks and Hoists

In order to service the underbody systems of an RV, it must be lifted by a jack or raised on a hoist. Because most RVs weight more than 3,000 lb, an RV falling from a jack or hoist could injure the technician severely or cause death. Thus, the following should be followed to promote the safe use of jacks and hoists.

1-4.2.5.1 Using Jacks

1. Before using a jack, inspect it briefly to ensure that it is in good working condition.
2. ALWAYS wear eye protection when working under a vehicle.

3. Place chocks on **both sides** of the wheels that are to remain on the floor. This will prevent the vehicle from moving. Use chocks large enough to extend beyond the width of the tires.
4. The jack MUST have a rated lifting capacity to accommodate the RV needing to be raised.

NOTE: The RV leveling system is never to be used as support while working under the vehicle.

5. Remember, RV emergency jacks are used ONLY for on-the-road emergency tire changes.
6. Know the locations of the lifting points under the model of RV being raised. Failure to identify the correct locations can result in severe damage to the RV and/or the technician.
7. Jack stands are used to HOLD the vehicles in the raised position (jacks are used ONLY TO RAISE them). Jack stands, also called *axle stands,* must be rated to support the weight of the portion of the vehicle being lifted.
8. Double-check the chocks, jack stands, and jack location before lifting the RV.
9. Only raise the RV the MINIMUM height necessary to complete the servicing.
10. The RV MUST be level (side to side) when it is lowered onto the jack stands (which means the stands must also be adjusted evenly in relation to each other).
11. When moving jack stands, be careful! Move the stands by their base only; do not move jack stands by their extenders. When adjusting jack stands, do not grab the extender. Place fingers lightly under the saddle.
12. SLOWLY lower the vehicle onto the jack stands.
13. Once the RV is resting securely on the jack stands, store the jack with the handle raised.
14. To lower an RV, raise it with the jack just enough to clear the jack stands. Then remove the stands by grasping the stands' base, and then lower the vehicle SLOWLY.
15. When the RV tires are resting fully on the floor, remove and store the chocks, jacks, and jack stands in their designated storage areas.

1-4.2.5.2 Using Hoists

1. Know the capacity and operations of any hoist before using it.
2. ALWAYS wear eye protection when working under an RV.
3. The RV must be centered from side to side and front to rear so the vehicle's weight is evenly distributed along the length of the hoist. To help accomplish this, always have someone guiding and directing as the RV is driven onto the hoist.
4. BEFORE raising a vehicle, make sure that the hoist is rated to lift the heavier vehicles AND that there is enough room above the hoist to accommodate their height.
5. NEVER allow the person who is guiding to stand directly in front of the vehicle. They must stand to the side.
6. The saddles (also called *lifting chucks*) must be positioned directly under the recommended lifting points of the vehicle on the hoist. DO NOT allow the underbody system of the vehicle to be blocked by the saddles.
7. Double-check the placement of the saddles BEFORE attempting to raise the vehicle. If unsure of the lift points on a particular unit, check with the service manager before engaging the hoist.
8. Vehicles are hoisted with their gears in NEUTRAL and the hand brake OFF, with all doors, trunks, and hoods CLOSED.
9. DO NOT raise a vehicle with someone in it.

10. Alert everyone nearby when a vehicle is being raised on the hoist.
11. Raise the vehicle only a few inches, STOP the hoist, and ROCK the vehicle to ensure that it is positioned correctly (balanced) on the hoist.
12. If there is a safety catch on the hoist, SECURE it.
13. DO NOT use the hoist as a shelf to place servicing tools and equipment.
14. Wipe up all spills around the hoist IMMEDIATELY.
15. Before lowering the hoist, make sure NOTHING is under it.
16. Alert everyone around that the hoist is going to be lowered.
17. Saddles must be moved COMPLETELY OUT OF THE WAY before driving the vehicle off the hoist.
18. Drive the vehicle STRAIGHT off of the hoist slowly until it is past the hoist beams.

1-4.2.6 Servicing Batteries

RV and automotive batteries that are not a sealed-unit type require special safety precautions. When charging, they not only emit hydrogen gas, which is explosive, but contain sulfuric acid.

1. NEVER allow a lighted match, electric tools, welding flame, or any spark-producing item near a battery.
2. NEVER lay tools on a battery. They may cause a short, which could produce sparks resulting in an explosion.
3. NEVER use compressed air to dry a battery, because it could pick up battery acid and spray it in the direction of the air stream. Use only paper towels to dry batteries.
4. NEVER wear jewelry when servicing batteries.
5. AVOID splashing the battery "electrolyte" (sulfuric acid and water) solution on anything. It can dissolve concrete, paint, clothing, and HUMAN SKIN!
6. If electrolyte gets on any individual or clothing, wash it off IMMEDIATELY. Water and baking soda will neutralize it.
7. ALWAYS wear eye protection when working with batteries. If electrolyte comes in contact with eyes, flush them for a minimum of 10 minutes and see the doctor.
8. ALWAYS add sulfuric acid to water, NOT water to acid when mixing an electrolyte solution.
9. REMOVE any corrosion around battery terminals/posts by brushing a baking soda/water paste on them. Be sure the top of the battery is clean.
10. When disconnecting a battery ALWAYS disconnect the ground/negative terminal FIRST. The negative (-) terminal is typically colored black and is the smaller of the battery's two posts.
11. When reconnecting a battery, ALWAYS connect the ground/negative terminal LAST.
12. Connect the correct charger cable to each post; black to the negative and red to the positive (larger) post.
13. Battery chargers are not to be turned on until the battery cables are removed and the charger cables are correctly connected to the battery posts.
14. DO NOT use a voltmeter to test a battery being charged or discharged. The prongs will create a spark when they touch the battery at a time when the battery is producing potentially dangerous gases.
15. ALWAYS use a battery lift strap or case-type carrier when lifting/moving a battery.

16. NEVER use jumper cables until proper instruction has been received on their use from the supervisor or instructor.
17. Jumper cables and booster batteries (charged batteries outside of unit) are used only in emergency situations.
18. NEVER allow vehicles to touch when one is being used to start the other.
19. DO NOT use jumper cables if there is any chance that the car battery is frozen.
20. DO NOT lean over the battery when connecting jumper cables.
21. ALWAYS FOLLOW this procedure when using jumper cables:
    A. Turn off all accessories AND then turn off the ignition switches of both vehicles.
    B. Connect the positive (red or orange) jumper cable to the positive (+) battery post of the booster battery, THEN to the positive (+) post of the weakened battery.

NOTE: Do not allow positive jumper cables to touch any part of the RV frames or the cables to each other.

    C. Connect the black cable to the ground/negative (-) post of the booster battery, THEN to the weakened battery or vehicle frame.
    D. Start the engine of the vehicle with the good battery and let it run several minutes.
    E. Attempt to start the vehicle with the weakened battery.
    F. If the RV does not start after several tries, STOP trying.
22. To disconnect jumper cables, turn off the engine with the good battery and REVERSE this process.

1-4.2.7 Extinguishing Fires and Identifying Safety Color Codes

Because of the many flammable materials found in the RV service bay or work area, there are constant fire hazards.

Three elements must be present to have a fire: oxygen, heat, and fuel. By removing any ONE of these elements, a fire will not burn. Fire extinguishers are typically designed to remove either the oxygen or the heat. Fire extinguishers are classified according to the types of fuel-burning materials they can extinguish:

Class A: Combustible materials such as paper, wood, or cloth.
Extinguishing agents: water or water-based extinguisher fluid or foam.

Class B: Flammable liquids such as oil, gasoline, solvents, or paint.
Extinguishing agents: dry chemical, carbon dioxide, or foam extinguisher.

NOTE: Do not use water on Class B fires, it will help spread the fire!

Class C: Electrical fires involving, wiring, switches, or motors.
Extinguishing agents: dry powder extinguisher.

NOTE: Never use liquid; water or foam extinguisher unless all electricity has been cut off, due to the risk of electrical shock.

Class D: Fires involving metals and chemicals such as magnesium, titanium, and powdered steel.
Extinguishing agents: a special extinguisher powder or, if the fire is small, sand may be used to smother it.

NOTE: Never use water on a class D fire!

Fire extinguishers are mandatory in most RVs under the safety standards for RVs, *NFPA 1192*. The most common sizes of fire extinguishers are 5B:C and 2A:10B:C. The number designates the pounds of material in the extinguisher, and the letter designates the type of fire the extinguisher is designed to used against.

1-4.2.7.1 PASS Method

The word *pass* is an acronym for generally accepted methods for using a fire extinguisher.

P = pull the pin

A = aim the nozzle at the base of the fire

S = squeeze the activating mechanism

S = sweep back and forth across the base of the fire

The federal government has established universal color-coded areas for all U.S. industries to follow. Thus, a certain color will be used to paint an area of flooring, or colored banners or similar devices could be used to indicate the storage of specified materials in any RV shop, factory, or institution. The federal safety color codes are as follows:

RED identifies:

A. Fire protection equipment (i.e., extinguisher and fire hoses)

B. Portable containers of flammable liquids (i.e., gas cans)

C. Emergency stop switches (i.e., machinery)

YELLOW designates caution:

A. Physical hazards (i.e., hoists)

B. Waste containers for combustible materials (i.e., oils)

C. Power source of machinery

ORANGE identifies:

A. Dangerous machine parts

B. Safety starter buttons

C. Equipment parts that may produce shocks if touched

D. Unshielded moving parts of machinery

PURPLE designates:

A. Radiation hazards

GREEN identifies:

A. Safe areas

B. Location of first aid equipment

BLACK AND WHITE together or separately note:

A. Traffic flow

B. Storage areas

C. General housekeeping purposes

1-4 Review

Please fill in the blanks with words from the following list. Also include the corresponding letter to the left of each item.

A. ACCIDENTS
B. CAP/HAT
C. CLEAN
D. CLEAR
E. COMBUSTIBLE
F. EYE PROTECTION
G. FIRE EXTINGUISHERS
H. GASOLINE
I. HORSEPLAY
J. IMMEDIATELY
K. INJURIES
L. SAFETY PROCEDURES
M. JEWELRY
N. METAL CONTAINERS
O. OPERATION
P. PROTECTIVE
Q. SMOKE
R. STORAGE
S. VENTILATED
T. WASH

1. Tuck long hair neatly under a _____ when working in the RV service bay or work area.
2. No _____ should be worn in the RV service bay or work area.
3. _____ is never used as a cleaning solvent.
4. Use shop equipment only after instruction on its proper operation and _____.
5. _____ shoes or boots with nonskid soles and heels should be worn in the shop.
6. Oily rags are stored in approved, air-tight _____.
7. Following safety rules prevents many needless _____.
8. Wipe up all spills in the service bay or work area/shop _____.
9. Keep hands _____ when making RV repairs.
10. Never be part of _____ in the RV service bay or work area.
11. Never _____ when working on recreation vehicles.
12. Wearing protective clothing prevents many personal _____.
13. Never use a piece of equipment in the service bay or work area until receiving instructions on its proper _____.
14. Always wear _____, even if there is only the slightest risk of injury.
15. Use flammable, combustible liquids only in well _____ areas.
16. Return tools and equipment to their proper _____ area when finished using them.
17. Know where the _____ are located and how to operate them.
18. If skin comes in contact with toxic substances, _____ it immediately.
19. Keep all flammable and _____ materials away from sparks and flames.
20. Keep work area and aisles _____ so people will not trip over things.

Please fill in the blanks with words from the following list. Also include the corresponding letter to the left of each item.

A. OUT OF PATH
B. CLEAN
C. DESIGNED
D. LEDGE
E. EYE PROTECTION
F. GROUNDED
G. HANDLES
H. INSULATED
I. LIGHT
J. LOOSE
K. POCKETS
L. REBOUNDS
M. RETURN
N. SAFER
O. SECURED
P. SHARPNESS
Q. TIGHTENED

21. Use _____ tools when working with RV electrical systems.
22. Small parts may be _____ in a vise to prevent them from slipping while being worked on.
23. Wear _____ whenever there is even a slight risk of an eye injury.
24. Use only _____ or double-insulated tools.
25. Never lay tools or parts on the _____ of the work bench where they may be knocked off.
26. Always clean tools and _____ them to their assigned storage area when finished using them.
27. Always keep hands, arms, and body _____ the cutting edge of a tool.
28. Carry tools in hands, not in _____.
29. Carry tools by their _____.
30. Do not use a tool with a _____ handle.
31. Always use a tool for the purpose it was _____.
32. Never use fingers to test the _____ of a cutting edge.
33. Tools should be kept _____ and in good condition.
34. Never use files without _____.
35. Box wrenches are _____ to use than adjustable wrenches.
36. Ratchets are used for _____ work, not for setting fasteners.
37. When using a soft-face hammer or mallet, take precautions in case it _____.

Please fill in the blanks with words from the following list. Also include the corresponding letter to the left of each item.

A. BALANCE
B. BATTERIES
C. CAP/HAT
D. DEFECTIVE
E. DISCONNECTED
F. DRY
G. EXPLOSIVE
H. EYE PROTECTION
I. FIRMLY
J. GROUNDED
K. GUARDS
L. SUPERVISOR
M. JEWELRY
N. LOOSE
O. OVERLOAD
P. PLUG IN
Q. PRESENT
R. TIGHT
S. GAS WELDING

38. When using power tools, always wear _____.
39. Always keep the safety _____ of the power tool in position.
40. Do not wear _____ clothing in the RV service bay or work area.
41. Remove all _____ before doing any work in the service bay or work area.
42. Do not use _____ power tools or equipment.
43. The floor and hands must be _____ when using electric power tools,
44. Do not _____ a power tool by using it for a job bigger than it was designed to handle.
45. Power tools must be held _____ at all times for control.
46. Do not use electrical tools around _____ or _____ equipment.
47. Electrical tools must not be used around flammable or _____ liquids.
48. All power tools must be _____ for protection.
49. Power tools must be _____ before making any adjustments.
50. Do not overextend when using a power tool to maintain _____.
51. Check that the power switch is on the "off" position before _____ a power tool.

Fill in the blank. Write the missing word(s) that completes each statement in the blank provided.

52. Always wear _____ when using air-driven power tools.
53. Air hoses are never used in the open shop to clean brake assemblies because brake linings contain _____.
54. Tires must not be inflated beyond the manufacturers' rated _____.
55. Do not use any air-driven power tools until the correct, safe use of them has been _____ by the service manager.
56. Store air hoses where no one will _____ over them or drive over them.
57. Never _____ an air hose at anyone.
58. Use the right _____ of tool for the job.
59. Quick-disconnect couplings should be attached to the _____, not the tool.
60. To protect lungs when using an air hose, wear _____.
61. Tires can _____ if overinflated.

62. Wear a full _____ when using an air hose to clean parts.
63. The tool used to tighten fasteners according to manufacturers' specifications is the _____.
64. If an air-driven power tool has a guard, make sure it is in _____ and working properly.
65. Before connecting an air hose, be sure the couplings are _____ correctly.
66. Before _____ a tool to the air hose, make sure the throttle is in the "off" position.
67. Damaged nozzles and attachments can cause _____.
68. Operate air driven power tools with _____ bursts of power.
69. Keep air hoses _____ and free of oil and grease.

Select the best response and place the appropriate letter in the blank.

70. An RV can be lifted with _____. (Mark all correct answers.)
    A. floor jacks
    B. fork lifts
    C. hoists
    D. all of the above
71. When using jacks and hoists, always wear _____.
    A. jewelry
    B. sandals
    C. eye protection
    D. all of the above
72. Chocks are placed in front of and behind the wheels that remain on the ground when a vehicle is raised with a _____.
    A. jack
    B. hoist
    C. all of the above
    D. none of the above
73. In order to align an RV on a hoist, _____.
    A. center the length of the RV with the length of the hoist
    B. center the RV from side to side of the hoist ramp
    C. someone must guide the technician onto the hoist
    D. all of the above
74. Before raising an RV onto a hoist, make sure _____.
    A. the hoist is rated to lift heavier vehicles
    B. the vehicle is not wider than the hoist ramp
    C. someone stands in front of the hoist to guide
    D. all of the above

75. Recreation vehicles being hoisted must have _____.
    A. gears engaged in PARK or DRIVE
    B. doors, trunk, hood closed
    C. parking braking on
    D. all of the above

Please fill in the blanks with words from the following list. Also include the corresponding letter to the left of each item.

A. SULFURIC ACID	L. LAST
B. BAKING POWDER	M. LIFT STRAP
C. BAKING SODA	N. NEGATIVE
D. CONTACT	O. OFF
E. ELECTROLYTE	P. ON
F. EXPLOSIVE	Q. PAPER TOWELS
G. EYE PROTECTION	R. POSITIVE
H. FIRST	S. SPARKS
I. FROZEN	T. STOP
J. IMMEDIATELY	U. TOOLS
K. JEWELRY	V. WATER

76. Battery solution is a combination of sulfuric acid and water, which is called _____.
77. Batteries produce hydrogen gas, which is very _____.
78. Always wear _____, a rubber apron, and gloves when working around batteries.
79. Keep all _____ away from batteries.
80. Use a solution of _____ and water to remove corrosion on batteries.
81. Never wear _____ when working with batteries.
82. When mixing an electrolyte solution, always add the _____ to the _____.
83. Use only _____ to dry batteries.
84. The _____ terminal is typically the smaller of the two battery posts.
85. If electrolyte solution is spilled on anyone, wash it off _____.
86. If _____ are placed on batteries, they can cause a short, which may produce a spark.
87. Use a _____ or case-type battery carrier to move a battery.
88. The battery charger power switch must be in the _____ position when connecting it to a battery.
89. When disconnecting a battery, the ground/negative is disconnected _____.
90. The ground/negative terminal is connected _____ when connecting a battery.
91. The red battery cable on the battery charger is connected to the _____ post of the battery.
92. Do not use jumper cables on a battery that may be _____.
93. If the engine of the RV with the weakened battery does not start after several attempts, _____ trying to jump start it.

94. There can be no _____ between two vehicles being "jumped" or the jumper cables themselves.

95. Below are the steps in the proper connection and use of jumper cables. Number each step in the proper order in which it is performed.

_____ Start the engine of the RV with the good battery and let it run several minutes.

_____ Connect the black jumper cable to the negative/ground post of the weakened battery.

_____ Connect the red jumper cable to the positive post of the weakened battery.

_____ Connect the red jumper cable to the positive post of the booster battery.

_____ Turn off the ignition and all accessories on both cars.

_____ Connect the black jumper cable to the negative/ground post or good ground source away from the booster battery.

_____ Start the car with the weakened battery.

Please fill in the blanks with words or letters from the following list. Where appropriate, include both the corresponding letter to the left of each word.

A. A	F. GREEN	K. RED
B. B	G. HEAT	L. WHITE
C. C	H. ORANGE	M. YELLOW
D. D	I. OXYGEN	N. BLACK
E. FUEL	J. PURPLE	

96. The three elements necessary for a fire are _____, _____, and _____.

97. Class _____ fires involve flammable liquids.

98. Class _____ fires involve paper, cloth, and wood.

99. Class _____ fires involve combustible metals and chemicals.

100. Class _____ fires involve electricity.

101. _____ is the Federal Safety Color that designates radiation hazards.

102. _____ is the Federal Safety Color that denotes or identifies the location of fire protection equipment and emergency stop switches.

103. _____ is the Federal Safety Color that designates the location of first aid equipment.

104. _____ and _____ are the Federal Safety Colors that together or separately designates traffic flows.

105. _____ is the Federal Safety Color that designates dangerous parts of machinery and parts of equipment that may shock.

106. _____ is the Federal Safety Color used to identify waste containers for combustible materials.

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Chapter

1-5 Codes and Standards

- Identify applicable RV codes and standards (NEC, 1192, DOT, and state).
- Find and use federal standards applicable to RV service procedures.

1-5.1 Industry Codes and Standards

Industry codes and standards have been developed to ensure safety and to reduce liability. The major source of RV standards are the National Fire Protection Association's *NFPA 1192* and the Canadian Standards Association's *CSA Z240*. These standards outline requirements for plumbing, heating (propane system), fire and life safety, and electrical.

The RVIA (Recreation Vehicle Industry Association) requires that member manufacturers agree to in-plant visits by the RVIA inspectors. If members refuse or fail to comply, they can be expelled and, therefore, lose the right to bear the association's seal of membership.

To help everyone better understand the requirements of the standard, an industry handbook is maintained by RVIA. Industry stakeholders work with RVIA to document the enforcement positions, which explain the standards in detail. Although standards are primarily designed for RV manufacturers, it is important from a liability standpoint that RV service technicians should strive to follow these standards where possible when modifying, servicing, or installing RV systems or their components.

Agencies, state and private, involved with RV safety training use and follow the *NFPA* and *CSA* Standards for Recreational Vehicles. This *NFPA* standard is revised every three years, with dates being 2002, 2005, 2008, 2011, and so on. Industry always begins using the new edition of the *NFPA* requirements on or near May 1 of the revision year, and manufacturers must comply with requirements by September 1 of the new code edition year.

1-5.2 Code Summary

Table 1-1 through *Table 1-7* provide summaries of the current RV standard that pertains to the normal duties of the RV service technician. This summary is provided as a quick reference, NOT AS A SUBSTITUTE FOR THE ACTUAL STANDARDS. Once the reference in these tables has been found, go to the referenced standard for the exact wording and use the handbook for the detailed explanation.

The *NFPA 1192 Standard for Recreational Vehicles*, RVIA's *NFPA 1192 Handbook, A Guide to NFPA 1192* and *ANSI/RVIA 12V Standard for Low Voltage Systems in Conversion and Recreational Vehicles* are available at www.rvia.org. The *National Electrical Code* is available from *NFPA* at www.nfpa.org/catalog/ or by calling 1-800-334-3555.

Information on CSA standards can be obtained by going to their website at www.shopcsa.ca.

Table 1-1 Propane—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirements
Inspect, Adjust, Replace Propane Regulator	7.1.1	5.2.15.4	Vent openings for regulators must be positioned within 45° of vertical downward.
	7.1.3	5.2.15.8	Above floor regulator(s) must be equipped with a durable cover to protect the regulator vent opening from the elements.
	8.2.2.4	5.3.6.1	Single- or double-flare tubing joints of 45° are required by this standard.
		5.3.6.3	Restricts the use of sealants on flare joints.
		5.3.7.2	Thread sealants may be used, but only on the male threads.
	8.1.2	5.3.6.1	Compression-type fittings must be listed as vibration resistant to be acceptable for use.
Inspect, Repair, Replace Propane Piping System	9.12	5.3.2.2	Any defective gas tubing or piping must be replaced, not repaired.
	8.2	5.3.2.5	Gas pipe shall be steel or wrought iron pipe complying with ANSI B36.10M. Also, copper tubing shall be type K or L and conform to ASTM B88.
	9.5	5.3.8.2	Where tubing passes through walls, floors, partition, etc., it shall be protected by snugly fitting weather-resistant grommets.
	9.3	5.3.9.1	Pipe or tubing joints are restricted from being located in any wall, floor, partition, or concealed construction.
	9.6	5.3.9.2	Propane tubing located in storage areas must be protected.
	5.14.1 Electrical	551.56(E)	Gas supply systems are to be electrically bonded to the chassis by approved (listed) means.
Testing the propane system with appliances connected	11.1.2 Propane	5.3.20 5.3.20.1	Requirements for this test are as follows: • All appliances shall be installed and connected to gas system prior to performing this test. • The system requires a minimum test setting of 8 to 14 in. of WC be maintained. • Systems that monitor the test pressure by connecting the gauge to a range spud need to have the test pressure reduced to 8 in. of WC.

Table 1-1 Propane—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirements
	11.1.2 Propane	5.3.20.2	• Temperature of the air and piping shall be approximately the same at the beginning of the test and remain the same throughout the test period. • The entire piping system shall be pressurized at 10–14 in. of WC (or 6–8 oz.). • The appliance shut-off valves shall be closed. • The source of pressure shall be disconnected or turned off. • This requirement does not allow any drop in pressure during the 3 minute test period. • If a regulator is used downstream of the test pressure source, the system must be bled off to release any high pressure that may be trapped between the pressure source and regulator. This may be accomplished by opening a range burner until the manometer drops. • Test the appliance connections with soapy water or bubble solution. Products that contain ammonia or chlorine shall not be used. • An alternate test allows a dial gauge or u-tube manometer to be used to perform the test. The gauge or manometer used must be capable of measuring in inches of WC or 1/2-oz increments.
		5.3.20.6(1)(a)	
		5.3.20.6(1)(d)	
		5.3.20.6(3)	
Selecting Propane Fuel Lines	9.12	5.3.2.1	Materials used in gas piping system free from defects (dents, kinks, or other damage).
	9.12	5.3.2.1	Gas tubing shall not be flattened beyond allowable tolerance.
	8.1.1.1 8.2.1.1	5.3.2.5	Gas pipe shall be steel, iron, copper, or brass.
	8.1.1.1	5.3.2.5	Iron pipe and fittings used on high-pressure side of regulator shall be schedule 80.
	8.2.2.4	5.3.2.5	Fittings for gas piping shall be iron, steel, or brass.
	8.2.2.2	5.3.2.5	Brass flare nuts shall be of the stress-relieved or forged type. Provide evidence that milled flare nuts are stress relieved.
	8.2.1.2	5.3.2.5	Copper tubing shall be marked type K or L on the tubing or be identified as ASTM B280 tubing on the package or tubing.
		5.3.2.5	Steel tubing flare connections shall be double flared.

Table 1-1 Propane—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirements
	7.2.2 10.2.1	5.3.2.5(11)	Flexible nonmetallic tubing or hose shall be assembled using listed hose and fittings or be part of a listed assembly.
		5.3.3	Gas piping systems shall be designed for propane gas.
Propane Fittings Installation/Assembly	8.2.2.4(a)	5.3.6.1	Tubing joints shall be made with single or double flares.
		5.3.6.1	Flares shall be free from defects.
		5.3.6.3	Sealants shall not be used on flared tubing joints.
	8.1.5	5.3.7.1	Provide evidence of listing for use with propane for sealants used on pipe threads.
		5.3.7.2	Pipe joint sealant shall be applied to male threads only.
Propane Fuel Line Installation and Routing	9.3	5.3.8.1	Tubing or hose shall not be run inside walls/floors/partitions/roof.
	9.5	5.3.8.2	Tubing or hose shall be protected where it passes through walls/floors/partition/roof.
	9.5	5.3.8.2	Grommets to protect tubing or hose shall be secured in place.
		5.3.8.3	Tubing or hose shall be protected against physical damage, sharp edges, and moving parts.
		5.3.8.3	Tubing or hose must not be routed in direct contact with any metal edge.
		5.3.8.3	Tubing or hose must be routed above approach/departure angle of RV.
	9.6	5.3.9.1	Pipe or tubing joints shall not be located in concealed construction space.
	9.6	5.3.9.1	Gas piping joints shall not be installed inside the underbelly.
	9.6	5.3.9.1	Gas piping joints shall be accessible.
	9.6	5.3.9.2	Pipe joints located in storage area shall be located within 2 in. of the compartments ceiling or shall be substantially protected.

Table 1-1 Propane—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirements
	9.6	5.3.9.2	Tubing joints located in storage area shall be protected and located within 2 in. of the compartments ceiling.
	9.6	5.3.9.2	Appliance connection joints shall not be located in storage area unless within 2 in. of the compartment ceiling.
	9.6	5.3.9.4	Tubing in storage area shall be protected by routing and additional protection.
	7.2	5.3.10.1	Supply connection shall be located at the container location.
	10.1.1	5.3.13.1	Flexible hose connector shall pass through floor, wall, ceiling, or partition as directly as possible, and entire hose must be capable of inspection.
Propane Fuel Lines	7.2.1	5.3.12.2	Propane supply connectors shall be listed to UL 569.
	7.2.2	5.3.12.3	Listed high-pressure flexible connector shall be used if propane cylinders are removable, or if regulator is mounted on a cylinder support bracket.
	7.2.1	5.3.12.4	Flexible hose connector used in low-pressure propane connections shall be listed.
	7.2.2	5.3.12.4	Listed flexible hose connector must be used from regulator to propane piping system if the regulator is mounted on a cylinder support bracket.
	10.1.1	5.3.13.1	Flexible gas hose shall not be concealed.
Propane Inspect and Repair		5.3.17	Gas piping shall not be used for a grounding electrode.
	9.11	5.3.18.1	Gas piping or hose shall be adequately supported at intervals of not more than 4 ft.
	9.11	5.3.18.2	Pipe, tubing, or hose supply connections shall be rigidly anchored within 6 in. of supply connections with metal clamp or equivalent.
	9.11	5.3.18.2	Pipe, tubing, or hose supply connection shall be rigidly anchored (no movement by hand).
	9.11	5.3.18.3	All piping shall be anchored within 6 in. of tubing or hose connections at end of run.

Table 1-1 Propane—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirements
		5.3.18.3	All piping shall be anchored within 12 in. of tubing or hose connections within run.
	9.15	5.3.18.3	Iron pipe requiring anchoring within 6 or 12 in. shall allow no more than 1/8 in. of movement.
Select and Install/ Replace Gasoline and Diesel Fuel Lines	5.11.2.1 General Req	5.10.8.3	Valves, filters, strainers, and similar components shall be accessible for maintenance.
	5.10.1 General Req	5.10.8.4	All fuel distribution equipment shall be protected from road damage.
	5.10.3 General Req	5.10.8.5	Tubing must be prime aluminized steel or identified for use with fuel.
	5.10.4 General Req	5.10.8.6	Provide evidence hose used conforms to J30R7 or better.
	5.10.5 General Req	5.10.8.7	Provide evidence hose to tube joints shall remain leak-free when subject to 20 b axial pull test for 1 minute.
	510.6 General Req	5.10.8.8	Fuel line shall be supported to protect from chaffing.
	5.10.6 General Req	5.10.8.10	Maintain 4-1/2 in. between fuel distribution system and unshielded exhaust system.
	5.10.7 General Req	5.10.8.11	Fuel system shall not be in contact with electrical wiring.
	5.10.8 General Req	5.10.8.12	Fuel system shall be designed so leakage from tanks or joints will not contact electric or exhaust system.

Table 1-2 DC Electrical—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	ANSI 12V 2011	Summary of Requirement
Service/Maintain/Replace Batteries	5.13.1 to 5.13.3	2-3	This paragraph has the following requirements: • Battery compartments shall have a minimum of 1.7 in^2 of venting at the top and bottom of the compartments. • Batteries shall be secured to the vehicle. • Battery compartments shall not contain spark- or flame-producing equipment. • Battery compartments shall be vapor tight to the interior of the unit.

Table 1-2 DC Electrical—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	ANSI 12V 2011	Summary of Requirement
Service Converters	5.10	2-5	Converters shall be listed for RV use. The formula for converter ratings is as follows: • First 20 A of load at 100%; plus. • Second 20 A of load at 50%; plus. • All load above 40 A at 25%.
	5.14	2-5.1	Converters shall be bonded to chassis with a minimum 8-ga copper conductor.
Service DC Wiring/ Distribution System	5.12.11	3-2	DC circuits must be protected by overcurrent protective devices rated not in excess of the ampacity of conductor.
		3-3	Metal-capped mini breakers shall be wired correctly; the "BAT" leg of a breaker is for the load; the "AUX" leg is for the protected circuits.
	5.12.13	3-3	Fuseholders and circuit breakers shall be protected against shorting and physical damage.
	5.12.12	3-3	Replacement size for fuses must be identified.
	5.13.3	3-3	Open-bottom blade fuses are considered spark producers and shall not be installed in battery compartments.
	5.12.1	4-2	Low-voltage conductors shall conform to SAE J1127 or J1128 or have insulation in accordance with NEC table 310.13 or equal.
	5.12.1	4-4	Conductors shall be surface marked at maximum 4 ft intervals with temperature rating, type, and size or as required by the listing agency.
	5.12.1	5-1	Conductors shall be protected against physical damage and be secured.
	5.12.1	5-1	Conductors shall be routed away from sharp edges, moving parts, and heat sources (including potable hot water lines).
	5.12.7	6-1.3	Terminals used must be identified for the proper wire size used.
	5.12.7	6-1.8	All splices, joints, and free ends of conductors shall be wrapped a minimum of three times with listed electrical tape.
		7-2.1	Switches require a DC rating not less than connected load.

Table 1-2 DC Electrical—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	ANSI 12V 2011	Summary of Requirement
	5.12.13	3-5	Overcurrent protection shall be accessible and located within 18 in. of where the power supply connects to vehicle circuits.
	5.12.10	5-2	DC and AC circuits shall be separated by a minimum of 1/2 in.
	5.14.6	6-1.14	No more than four terminal shall be secured to one terminal stud.
	5.14.1	6-2.5	Ground terminals shall be accessible and made mechanically secure to a clean surface using a self-tapping screw or internal-external star washer or other approved means.
Service DC Devices	5.1.2	7-3.1	Interior light fixtures shall be listed (exception: fixtures with bulbs rated 4 W or less).

Table 1-3 AC Electrical—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA NEC	Summary of Requirement
120/240 VAC Test		551.60	**NOTE**: The dielectric test for the low-voltage system was removed beginning with the 1999 NEC. This test information is included, as this test could be determined to be of value to some technicians. The requirement of the NEC is to provide an operational test of the low-voltage system to be sure all circuits and equipment are in working order.
Service A/C Distribution Panel	5.3.1 Table 1	551.42(C) 5 Max unless EMS	RVs have limitations on the number of branch circuits provided.
	5.4.2	551.45(B)	Readily accessible and a minimum of 24 × 30 in. of working clearance directly in front of the distribution panel.
	5.4.1	551.45(C)	Any distribution panelboard with three or more branch circuits shall have a main circuit breaker provided.
	5.14.8	551.56(B)	Any distribution panelboard shall be bonded to the chassis with a minimum 8-ga conductor.

Table 1-3 AC Electrical—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA NEC	Summary of Requirement
120 VAC Service Power Supply Cord	5.1	551.40(B)	All components of the 120 VAC electrical system shall be listed.
	5.3.3.1 Table 1	551.46(C)	Power cord plugs shall have the proper plug configurations.
Replacing Power Cord		551.43(A)	If the power cord terminates in a j-box, the conductor from the j-box to the distribution panelboard shall be sized according to the main disconnect breaker.
	5.3.2.3	551.46	Permanently attached power cords shall have strain relief so that the cord is not pulling directly on the first point of connection.
	5.3.2.7	551.46(A) (1)	Male motor-base attachment plugs shall be in a listed enclosure.
	5.3.2.2	551.46(B)	When the point of entrance for a power cord is on the side of unit, a minimum of 25 ft of exposed cord is needed. When the point of entrance is on rear of unit, a minimum of 30 ft is needed.
Service 120 VAC Wiring/Distribution System	5.1.3	551.40(B)/551.50	All terminals shall be installed according to their listing.
	5.1.3 5.6.1	551.43(A)	Circuit breakers shall be sized not more than the circuit conductors (50 A, 6 ga; 30 A, 10 ga; 20 A, 12 ga, 15 A, 14 ga).
	5.1.3	551.47(F)	Sheathing of Romex® or cable shall enter enclosures a minimum of 1/4 in.
	5.5.1.14	551.47(G)	Romex® shall be protected when passing within 1-1/4 in of the inside or outside of studs or framing.
	5.5.1.13	551.47(K)	Where subject to physical damage, conductors shall be protected.
	5.1.3	551.47(N)	Conductors routed outside the vehicle envelope and subject to the elements shall be in a listed direct burial-type conduit.
	5.5.2.1	551.47(P)	The slideout room flexible 120 VAC cord shall be listed for hard use, and the cord must be routed to prevent chaffing during movement and protected from physical damage.
	5.1.3	551.48	All boxes in the 120 VAC system shall be sized according to this paragraph's calculation method.

Table 1-3 AC Electrical—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA NEC	Summary of Requirement
	5.1.3 5.5.1	551.51(A)	Switches shall not be rated less than the connected load.
	5.14.1	551.55(A)	All exposed metal parts (J-boxes, frames, fixture canopies, etc.) shall be effectively grounded (listed ground screw or clip).
	5.1.3	551.55(E)	Grounding connections between multiple conductors shall be made in a manner that disconnection or removal of a device will not interrupt grounding continuity.
	5.14.6	551.56(B)	Ground terminals must be accessible. Also, the grounding conductor for the distribution panelboard must be permanent and continuous (no splices).
Service 120 VAC Receptacles	5.8.1	551.52	All receptacles shall be of the grounding type.
	5.8.3	551.41(C)(2)	GFI protection is required for all receptacles within 6 ft of any sink.
	5.8.5	551.41(C)(4)	Exterior receptacles shall be GFI protected.
120 VAC System Testing	7.3.1	551.60(A)	The requirements of this dielectric strength test are as follows: • Minimum test settings are 900-volt for 1 minute or 1080-volt for 1 second. • Maximum test setting is 1250-volt. • Switches shall be in the "ON" position. • Fixtures and permanently installed appliances shall be disconnected. • Generator/inverter circuit shall be tested. • Circuits downstream of transfer switches shall be tested. • Conduct continuity and polarity tests. • Test equipment shall be in proper working condition and recalibrated a maximum of 12 months. • Test equipment must be used according to its written instructions.

Table 1-4 Generator—Applicable to RV Service Technicians

Service Technician's Task	2008 CSA Z240	2011 NFPA NEC/1192	Summary of Requirement
Service Test/ Generator	5.11.2(a)	551.30(A)	The neutral of the generator shall be bonded to chassis.
	5.11.4.1 (a)	551.30(B)	Current carrying conductors from the generator and an outside source cannot be capable of being connected to a vehicle circuit at the same time. Transfer, three-way, and double-pole double-throw switches used to separate shore and generator supply conductors shall be wired so that neutrals are simultaneously switched.
	5.11.3	551.30(E)	The first termination location for the generator circuit shall be in a panelboard, J-box with a blank cover, J-box with receptacle, transfer switch or receptacle assembly listed in conjunction with generator. Distribution panelboards or J-boxes with receptacles shall not be installed inside generator compartments. Overcurrent protection for generator prep setups shall be located within 18 in. of where the supply conductors enter the vehicle.
	7.3.1	551.60	Generator circuits installed by the RV manufacturer are subject to a dielectric strength test.
		6.4.3.1	Generator and primary mover engine exhausts shall terminate beyond the periphery of the vehicle (including bumpers, step wells, slideouts, etc.).
	5.11.2(c)	6.4.5.2	Generator compartments shall be sealed vapor-resistant to the interior of unit.

Table 1-5 Plumbing—Applicable to RV Service Technicians

Service Technicians Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirement
Inspect/ Repair Water Tanks	4.7.2	7.3.7	Freshwater holding tanks shall not be subject to road damage. Also, nonpressure or gravity tanks shall be vented at the top of the tank.
Replace City Water Fill	6.2.5	7.3.9	City water fills shall be equipped with a backflow preventer or check valve.

Table 1-5 Plumbing—Applicable to RV Service Technicians

Service Technicians Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirement
Inspect/ Repair Water Distribution System	5.2	7.1.2.1	Materials, devices, fixtures, fittings, equipment, and appliances of the water system shall be listed.
Inspect/ Repair Showers	4.1.7	7.2.4.3	Seal shower enclosures to a minimum height of 70 in. (1778 mm). Doors, tubs, and enclosures, if glazed, shall meet the requirements of *ANSI Z97.1.*
	4.1.7	7.3.9	Exterior showers shall have internal vacuum breakers.
Inspect/ Repair/ Replace Waste Storage Tanks	7.6.3	7.5.1	Waste holding tanks shall be accessible for replacement and repair without removal of permanent structural members.
	7.6.3	7.5.4	No connection shall be made between liquid and body waste holding tanks upstream from fullway valves.
	7.3	7.5.2.3	The drain opening for the liquid tank shall be a minimum of 1-1/2 in. dia and located at the lowest point of the tank.
	7.6.2.3	7.5.2.5	The liquid holding tanks shall be vented through the roof with a minimum 1-1/4 in. pipe dia.
	7.6.3.2	7.5.3.4	Body waste tanks shall have a minimum 3 in. drain opening located at the lowest point of tank. A fullway valve is required within 36 in. (914.4 mm) of the holding tank.
	7.6.3.3	7.5.3.6	Body waste tanks shall be vented through the roof with a minimum 1/4 in. pipe dia.
Inspect/ Repair/ Replace Drainage Piping System	7.4.1	7.4.3.3	Horizontal-to-horizontal and vertical-to-horizontal drain connections require long turn-type fittings.
	4.4.2.1	7.4.8.2	Cleanout openings shall be located such that a cleanout tool not be required to pass through more than 360° of turns.
	4.4.2.2	7.4.8.3	6 ft (152.4 mm) clearance is required in front of cleanout openings.
	7.5	7.4.2.4	1/8 in. (3.175 mm) per foot (30.48 cm) of slope is required for drains.
	8.1	7.6.1.1	All traps are required to be vented.

Table 1-5 Plumbing—Applicable to RV Service Technicians

Service Technicians Task	2008 CSA Z240	2011 NFPA 1192	Summary of Requirement
Inspect/ Repair/ Replace Drainage Piping System	7.4	7.6.5.1	Other than wet vents, horizontal vents shall be a minimum of one vent pipe diameter above the flood level of lowest fixture on that drainage system.
	4.1.5	7.6.6	Anti-siphon trap vent devices shall be accessible for replacement and repair.
	8.11.1	7.6.8.1	Waste holding tank vent terminations shall be a minimum of 3 ft (91.44 cm) from motor-driven air intakes.

Table 1-6 Appliances—Applicable to RV Service Technicians

Service Technicians Task	2008 CSA Z240	2011 1192	Summary of Requirement
Inspect/ Repair/ Replace Air Conditioner	5.1.1 Electric	551.40(B)	Any 120 VAC appliance must be listed and installed according to the installation instructions. The air conditioner shall be on its own circuit if required by the listing.
Inspect/ Repair/ Replace Water Heater	5.7.1.1(b) Electric	551.43(A)(1)	Check rating of water heater vs. size and load of overcurrent protection.
	5.1.3 Propane	5.4.5.1 5.4.5.2	Any propane water heater must be listed for RV use and installed according to the installation instructions. The installation of some water heaters on combustible materials is not acceptable.
	6.3.3 Plumbing	7.3.12.1	Relief valves for water heaters shall terminate to the outside of unit.
	6.3.3 Plumbing	7.3.12.1	Relief valve pipe away shall not diminish in size or be threaded so that it could be capped.

Table 1-6 Appliances—Applicable to RV Service Technicians

Service Technicians Task	2008 CSA Z240	2011 1192	Summary of Requirement
Inspect/ Repair/ Replace Furnace	5.1.2 5.2 Propane	5.4.5.1	Any propane furnace must be listed for RV use and installed according to the installation instructions. The following are common deviations from this requirement: • Furnaces shall not be installed on carpet or combustible material. • Minimum ducting; BTU rating, top or bottom discharge. • Minimum required return air. • Screen factor for return air openings. • Maintaining listed clearances to combustible materials.
	5.4.1 Propane	5.4.9	Separation of furnace and oven is required (panel in between).
	12.1.1 Propane	5.7.1.1	Materials used for ducting shall meet the minimum requirements of this standard.
	12.1.1 Propane	5.7.2.1	Duct materials shall not be crushed.
Inspect/ Repair/ Replace Refrigerator	5.1.5 Propane	5.6.2.1	Any propane refrigerator must be listed for RV use and installed according to the installation instructions. The following are common deviations from this requirement: • Refrigerator compartments shall be vapor-resistant to the interior of the unit. • Minimum vent openings at top of compartment (per instructions). • Baffle may be required at top of refrigerator.
Inspect/Repair/Replace Ranges & Cooktops	11.2 Propane	5.3.20.4	Products containing ammonia or chlorine shall not be used to test propane appliance connections.
	5.1.1 Propane	5.4.1	Propane ranges/ovens shall be listed for RV use.
	5.7.1.1 Propane	5.5.4.8	Range vent duct shall be designed so as not to trap products of combustion. Range hood components cannot be modified
	5.5 Propane	5.6.4	Window treatments and shower curtains must be secured so they cannot swing into range clearance.
	5.4.2 Propane	5.6.6.5	Vertical clearances for ranges shall be maintained, also center the range hood above the cooktop.
	5.3 Propane	5.6.3.1	Appliance shall be accessible for replacement or repair without removing permanent construction.

Table 1-7 Accessories—Applicable to RV Service Technicians

Service Technicians Task	2008 CSA Z240	2011 1192	Summary of Requirement
Other Safety Requirements	5.4.1 General Req	6.3.1.1	At least one integral battery-operated smoke detector shall be installed in each fifth wheel, travel trailer, or motor home.
	5.4.1 General Req	6.3.2	Smoke detectors shall be listed to *UL217* and marked on the device as being suitable for installation in RVs.
	5.3 General Req	6.4.1.2	A minimum of 5B:C fire extinguisher is required.
	5.3 General Req	6.4.1.1	Motorized RVs will require a minimum of 10B:C extinguisher.
	5.6 General Req	6.4.6	CO detectors shall be listed and be installed in accordance with their listing and are required in all RVs.
	5.7.4 General Req	6.4.7.4	Toy haulers need a minimum 10B:C extinguisher
	5.5 General Req	6.4.8	Propane detectors are required if a propane system is present.

NOTE: There is no review for this chapter.

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Chapter

1-6 Job Classifications

- Identify various RV occupations.
- Describe RV service technician job classifications.

Having decided to pursue a career in recreation vehicle service, it is important to understand the different jobs available in the RV industry and the classifications of RV service technicians.

1-6.1 Jobs Relative to the RV Training Program

The following table lists some of the specific jobs that an RV service technician may be called upon to do, individually or in some multiple combination. Some of these job titles will be found in dealerships and repair facilities, and some will be found in RV manufacturing facilities. A few will be found in the insurance and repair estimate area. Some facilities may not use the titles found here and have developed their own. Some of these jobs are entry-level positions, and some will require extensive training and years of experience. The job title itself is no indication of a salary range offered for the position. What all these titles have in common is they apply to the RV industry, and the basic knowledge of being an RV service technician is required for all of them. This basic knowledge will allow the technician to chose where they want to go in this very diverse RV field.

1-6.1.1 Entry-Level Positions

RV Service Technician Helper
Sales Lot Technician
RV Retail Store Clerk
Parts Counterperson
Parts Runner
Detail Technician

1-6.1.2 Intermediate Level Positions

RV Service Technician
Retail Store Assistant Manager
Assistant Service Manager
Service Advisor (Writer)
Pre-delivery Inspection Technician
Mobile Repair Mechanic
RV Insurance Claims Adjuster
RV Custom Construction
Van Conversion Technician
Bus Conversion Technician
Parts Department Assistant Manager
Body Shop Assistant Manager
Body and Skin Technician
RV Retail Salesperson
Rental Maintenance Technician
Repair Estimator
RV Purchasing Agent
Warranty Clerk
Warranty Troubleshooter

1-6.1.3 Advanced-Level Positions

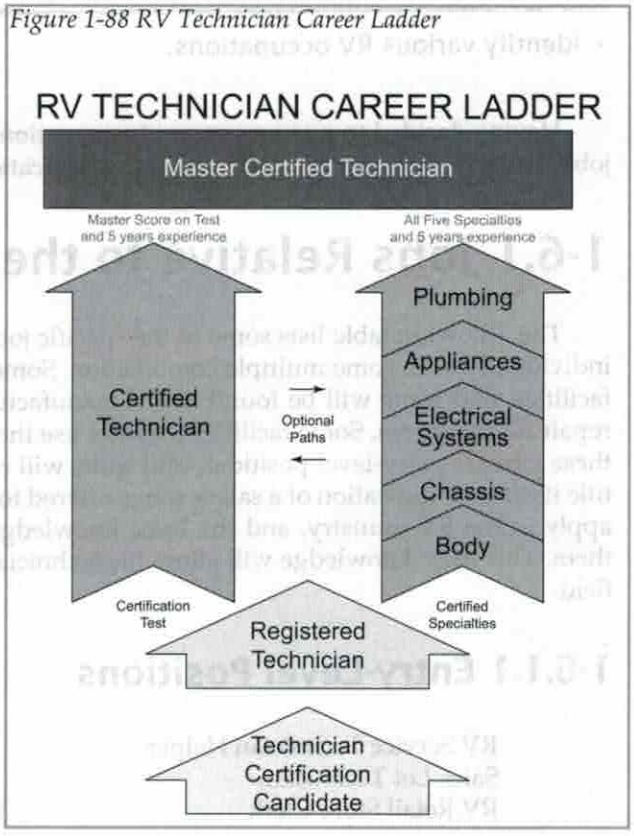
Service Manager
RV Instructor
RV Quality Control Inspector
Production Inspector at Factory
Body Shop Manager
Group Leader
Parts Department Manager
Retail Store Manager
RV Insurance Investigator
RV Quality Control Technician
Shop Foreman

1-6.2 RV Technician Career Ladder

The RV industry does not have an industry-wide apprenticeship program or similar training and experience requirements to become an RV service technician at this time. There is such a program in Canada, and the state of Pennsylvania has started an apprenticeship program. However, in the rest of the U.S.A., as soon as a technician starts working at a dealership or repair facility, they become an RV service technician, if that is the title assigned. Some dealerships and repair facilities may have local policies requiring minimum experience or skills to be classified as a service technician.

The RV industry has developed and implemented a career ladder for the RV service technician. These classifications were developed to identify levels of excellence within the technician workforce and give recognition to the many different levels of RV service technicians. Technicians with these classifications may be found in almost all the jobs identified above. The only way to achieve these formal classifications is to take and pass the corresponding industry-developed tests. These tests are jointly sponsored by the Recreation Vehicle Dealers Association (RVDA) and the Recreation Vehicle Industry Association (RVIA). The tests are written test consisting of multiple choice questions covering all facets of the required skills of the RV service technician. Technicians desiring to prepare for these tests may obtain complimentary study guides by visiting www.rvtechnician.com or by calling RVDA at (703) 591-7130, extension 102.

Figure 1-88 RV Technician Career Ladder



1-6.2.1 Technician Certification Candidate

The Technician Certification Candidate is the first rung on the RV Service Technician Career Ladder. This is a mandatory step for all technicians wishing to pursue certification. The training and testing for this entry-level classification is free to everyone and can be found at www.rvst.org/Candidate/.

1-6.2.2 Registered Technician

The Registered Technician is the second rung on the RV Service Technician Career Ladder. This is also a mandatory step for all technicians wishing to pursue certification. Successfully passing the test, at the published minimum score, for this classification grants the individual the "Registered Technician" designation for a period of five years. At the end of the five-year period, the test must either be retaken OR the individual must choose a path and move up the career ladder to another designation. The application to take this test is located at www.rvtechnician.com.

1-6.2.3 Certified RV Service Technician

To become a Certified RV Service Technician, the certification test must be taken and the published minimum score achieved. There are no minimum experience requirements for Certified RV Service Technicians. The application to take this test is located at www.rvtechnician.com.

1-6.2.4 Certified Specialist

Individuals who wish to specialize in given areas, or who find it easier to focus their training into smaller segments, have the option of taking smaller Certified Specialist tests. Certified Specialist tests are available in the following classifications.

- Body
- Chassis
- Electrical Systems
- Appliances
- Plumbing

The application to take these tests is located at www.rvtechnician.com.

1-6.2.5 Master Certified RV Service Technician

Individuals wishing to achieve the Master Certified RV Service Technician designation have two options. Option 1 (left-hand path on the career ladder) is to take the Certified RV Service Technician test and achieve the published minimum score (higher than a certified technician) and have a minimum of five years' experience as an RV service technician. Option 2 (right-hand path on the career ladder) is to be a current certified specialist in ALL five classifications have a minimum of five years' experience as an RV service technician.

Graduates of the National Recreation Vehicle Technical Institute (NRVTI) or a Provincially approved Apprenticeship Program in Canada can reduce the five years of experience to just two years of experience.

In the event a passing score or better is achieved, but the required experience level has not been met, a technician will be classified as a Certified RV Service Technician or Certified Specialist until the five years' experience is achieved. At that time, the technician will be automatically upgraded to Master Certified RV Service Technician, without any need to retest.

1-6.2.6 Recertification

Recertification for Certified RV Service Technicians, Certified Specialists, and Master Certified RV Service Technicians is required every five years. Procedures and requirements for recertification are contained in study guides at www.rvtechnician.com or can be obtained by contacting the RVDA at (703) 591-7130, extension 102.

1-6.3 Pay Scales

How a service technician is paid can also be reflective of the job classification or the level of certification. As an example, a lot porter will make less than a certified RV service technician. And a master certified technician will typically make more than a certified technician. The level of pay is almost always based on what the individual knows and their value to the dealership or repair shop in terms of the amount of money they can generate as a service technician.

RV service technicians in a management-type position are often paid on a salary basis. The salaried technician can expect the same amount of money in each paycheck, regardless of the hours worked. This arrangement can have its advantages and disadvantages. In busy times, a salaried employee may have to work several hours of overtime but receives no direct additional income for the effort. In other times, the work load may be reduced because of the season or weather, and the number of hours worked will be less than normal. In either case, the amount of the pay remains the same.

The two most common methods of being paid as an RV service technician are hourly and flat rate.

1-6.3.1 Hourly Wages

Hourly, or *straight time,* is typically where a specific dollar amount is paid to the technician for every hour worked. The typical day is 8 hr long, and the typical week is 40 hr long. Therefore, a technician would receive the established hourly rate for 40 hr worked in a typical work week. If the workload calls for extra hours to be worked, the technician agreeing to the extra work would usually be paid "overtime," or at a rate of time and a half.

This pay structure allows the technician to earn a reliable income, because the amount of money earned is based on the hours worked at the shop. In slow periods, such as during the winter, when the amount of available service work can decline, the technician can still earn the same level of pay if the dealer or shop manager continues to provide work, even if the work is not directly related to RV service.

1-6.3.2 Flat-Rate Pay

A flat-rate pay structure is based on the amount of time a specific task is suppose to take an average RV service technician to complete the task. The length of time to complete a task is outlined in a "flat-rate manual." If the RV service technician is given a job or task that is listed in the flat-rate manual as taking six hours to complete, this is the amount of money the technician will be paid, regardless of the time it actually takes to complete the job. In this example, if the RV service technician takes eight hours to do the job, the technician still gets paid only for the six hours stated in the flat-rate manual. Conversely, if the task only takes five hours to complete, the technician will still be paid for six hours. This is a great method for paying the technician if the technician is proficient, the correct tools and parts are readily available, and the amount of work available is constant. However, if the technician is new and is not comfortable in all aspects of RV service, or the amount of repair work available is limited, the technician may not be able to earn enough.

It is important for RV service technicians to know their own abilities and determine which rate of pay programs works best for them when determining where they choose to work. As in any other career field, some are better and faster than others. It is a good idea to know where they fit in so they can take the best advantage of the situation, especially if given a choice of how to be paid.

1-6 Review

1. How often do ALL certified technicians need to recertify?
2. List the requirements of the two options for becoming a Master Certified RV Service Technician.

   A.

   B.
3. Who sponsors the RV Service Technician certification tests?
4. List the two forms of pay structure routinely found in the RV Industry.

   A.

   B.

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Chapter

1-7 Service Manuals, Documentation, and Resources

- Identify and utilize various service manuals.
- Identify and utilize service bulletins.
- Locate RV specifications in specified service manuals
- Describe flat-rate manuals

Today's RVs are machines made up of many parts forming complex systems. Each part or component in each system requires specific methods of assembly/disassembly and adjustments. The information on service procedures is found in service manuals, which provide very specific information for the RV service technician.

1-7.1 Using Service Manuals

There are several different types of service manuals designed to provide specific information for the technician. Most manuals are still in book form, but some of the servicing information necessary for technicians to be successful in RV repairs is now available on digital storage media or on the internet. Use of training videos is also on the rise. Information on the Internet is becoming commonplace.

Several types of references are available to aid today's technician in making effective RV repairs. These references include owner's manuals, manufacturers' service manuals, repair manuals, maintenance manuals, service bulletins, and flat-rate manuals. Each has a special use and purpose, and it would be of great benefit to acquire samples and study their contents.

1-7.1.1 Owner's Manuals

Owner's manuals are designed by manufacturers for the RV owner. Owner's manuals provide information on how to operate the unit and its accessories. Most include a recommended schedule for periodic servicing.

1-7.1.2 Repair Manuals

Repair manuals are written for technicians and are based on information provided in the manufacturer's shop manual. Repair manuals provide step-by-step procedures for common repairs and may cover more than one model and/or year of RV. Since these manuals are not as extensive in the coverage of a specific model as manufacturers' service manuals, it is assumed that the technician is experienced and familiar with the technical data and the names of parts.

1-7.1.3 Manufacturers' Service Manuals

Some manufacturers write a service manual for each model of RV they produce, for use by the technician in their local dealerships. These manuals are more detailed than repair manuals. Because of the great detail and technical data presented, one model might be presented in several volumes. Because RV manufacturers want their customers to be satisfied with their units, they offer their shop manuals for sale to any interested party at prices lower than repair manuals. If an independent repair shop specializes in certain models, it usually maintains a library of manufacturer's service manuals for its technicians to use. RV owners, if they wish, can purchase manufacturers service manuals so as to be aware of the parts used and procedures followed in the repair of their RVs.

1-7.1.4 Service Bulletins

Service bulletins are sent by RV manufacturers and component part manufacturers to their dealerships, alerting technicians to changes in serving procedures and/or a servicing problem encountered during the model year. These bulletins are usually only a few pages in length and are kept on file for reference by the technicians.

1-7.1.5 Flat-Rate Manuals

Flat-rate manuals are printed by RV manufacturers, associations, and independent publishers. These indicate the average time/amount of labor and parts it takes to perform a given repair job. Different flat-rate manuals may not be consistent in the times listed. Flat-rate manuals are used by the technician if responsible for providing the customer with a written cost estimate for a particular servicing job BEFORE starting the repair. Technicians are usually paid either a portion of the flat-rate manual labor charge per job or an hourly or weekly salary, regardless of the repairs they make. With the right tools, experienced technicians can sometimes "beat" the flat rate, making the repairs in less time than indicated. They can, therefore, make more repairs (and money) in eight hours than indicated by a flat-rate manual. A good example is to review the *"RV Service Management Guide"* published by the Recreation Vehicle Dealers Association.

1-7.1.6 Maintenance Manuals

These manuals are specifically designed to explain preventive maintenance along with required inspections and sealants to be used when doing repairs and resealing.

1-7.1.7 Installation Instructions

Installation instructions are written by component manufacturers. Installation instructions provide information on how to install the component and its accessories, emphasizing requirements such as clearances, wiring gauges, ventilation, fastening, and so on. These instructions should adhere to the appropriate standards as required. Failure to follow installation instructions can, in some cases, invalidate warranties.

1-7 Review

Match the letter of the appropriate document with the description below.

A. OWNER'S MANUAL
B. MANUFACTURERS' SERVICE MANUALS
C. REPAIR MANUALS
D. SERVICE BULLETINS
E. FLAT-RATE MANUALS

1. List the time it takes an average technician to complete a repair. _____
2. Explains how to operate vehicle controls. _____
3. More detailed than repair manuals. _____
4. May cover many models/years in one volume. _____
5. One model may be presented in several volumes. _____
6. Explains how to operate RV accessories. _____
7. Gives information about a service change/problem on a specific model._____

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Chapter

1-8 Customer Service Relations

- Identify who the customer is and the common needs/behaviors of the customer.
- Be able to identify and explain the service triangle concept and define organizational roles and responsibilities to the customer service.
- Identify components of effective customer service.
- Demonstrate good listening skills.
- Demonstrate techniques for effective customer service.
- Demonstrate effective communication skills when:
  - Dealing with an angry customer
  - Providing customer information
  - Conducting a customer follow-up
- Demonstrate the "cause and effect" relationship between customer service and company productivity.
- Define customer relations/service.

The most important group of people for the RV service technician is the "customer group" for whom the technician is doing the work. Without the customer, the RV service technician would not have a job. This chapter is designed to introduce the technician to the art of dealing with and satisfying the customer.

1-8.1 Customer Service Relations

Customer service relations simply refers to an accumulation of opinions and perceptions that exist between an organization and the people it serves. The two perceptions of how we see ourselves and how our customers see us are the key ingredients—the ingredients we must strive to manage.

As customers, it is easy to recognize the symptoms of poor customer service in others. In dealing with our own companies, however, it is never quite so simple.

A reputation for quality customer service takes months and even years to cultivate. Customers' high opinions are the culmination of considerable effort on the part of sales personnel, advertising staff, marketing specialists, and customer service representatives. But the odds, however, aren't in our favor when it comes to influencing customers' opinions of us. In fact, research shows that customers remember negative experiences twice as often as positive ones. It only takes a few negative experiences to wipe out all the months and years that have gone into creating a good reputation.

When poor customer treatment and service are allowed to exist unchecked in the work environment, a series of unfavorable reactions that have lasting impact are unleashed. At the company level, the cost of poor customer service includes increased managerial burdens for supervisors, damaged public image, loss of perceived quality in products and services, and, ultimately, a loss of business and profits. Dissatisfied customers can ruin a company faster than inflation or trade competition. Customers also suffer as the result of poor service. Even small faults can become major issues in their perception. It doesn't take long for negative impressions to turn into negative publicity. Finally, as a customer contact employee, the technician can also stand to lose as a result of service that is not top quality. Performance ratings, career growth, and even personal job security are put in jeopardy.

Satisfied customers, on the other hand, are the company's best asset. They can boost sales, generate repeat business, serve as public relations spokespersons, and, in short, ensure growth and prosperity. The decision to make a difference in the quality of customer service the company provides can begin with the technician.

1-8.2 Customer Relations

As stated earlier, customer relations are nothing more than an accumulation of opinions and perceptions that exist between an organization and the people it serves. It forms two sides of a coin—how we see ourselves and how our customers see us. These two perceptions, however, can be as different as night and day. Nonetheless, it is what the customer thinks that is most important. We may know our intentions are good; it is just that the customer may not always recognize this! Right or wrong, "the customer is always right" (if only by the virtue that they "think" they are right). It is the customer's perception that ultimately influences the customer relations picture, not our own.

Customer — One who purchases a commodity or service.

Service — Contribution to the welfare of others; useful labor that does not produce a tangible commodity.

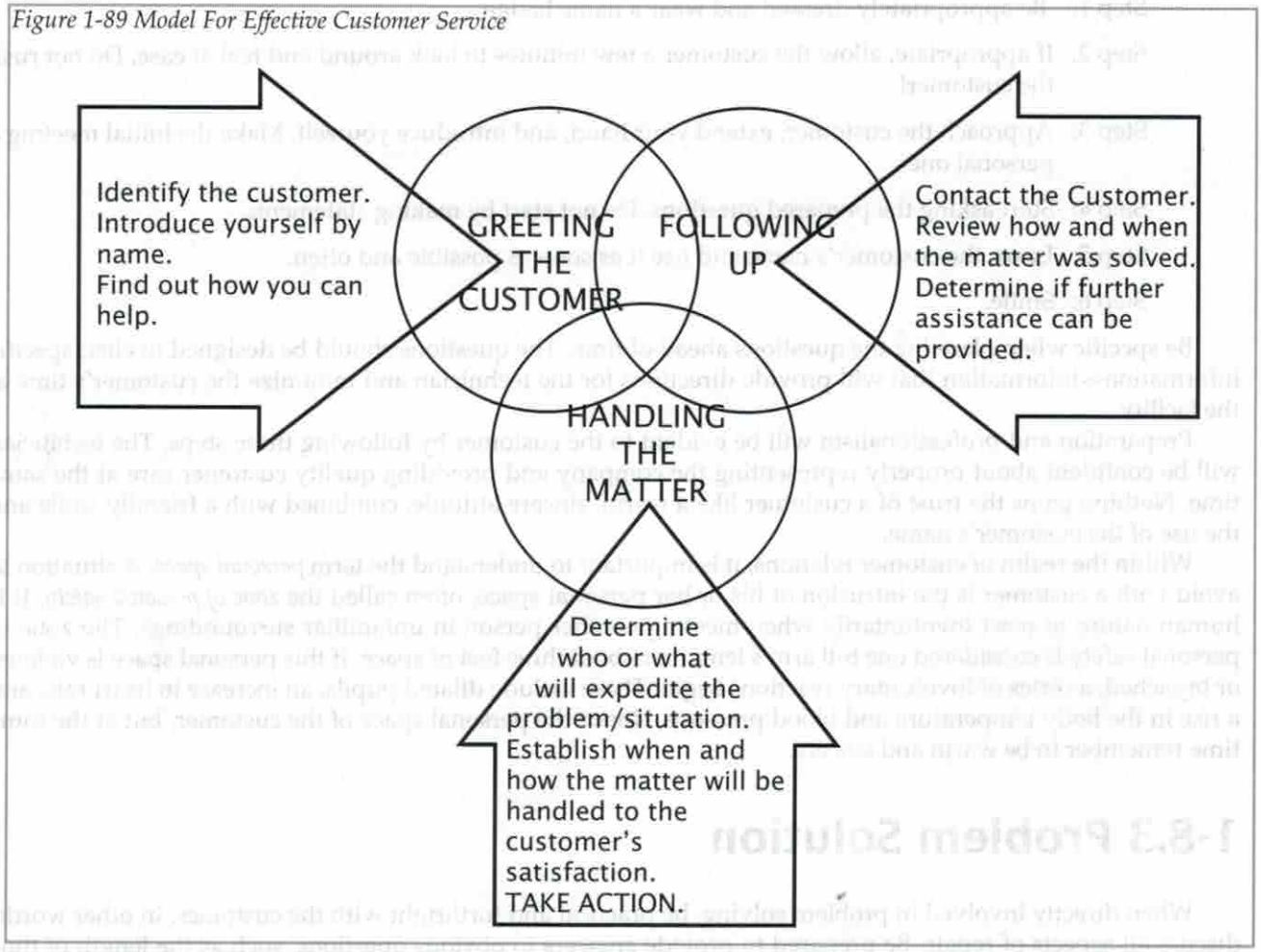
These are two simple words, easily defined individually by Webster yet seemingly difficult to apply in a positive way when coupled into a single phrase. Ironically, it is more readily recognizable when performed poorly than when applied correctly. Such are the sometimes confusing results of simply doing it right. The same maxim is true in the recreation vehicle industry. Our RV customers are more likely to perceive poor customer service than excellent customer care. Customer service, good or bad, exists in every entity within the RV industry, regardless of the task or job title. As soon as the "shingle" is hung, customer service becomes a part of our business. Every individual in the organization assumes responsibility for positive customer service. To succeed, it is our job to become skilled at the higher levels of excellence in this arena.

Although the responsibility for sound customer care begins as soon as the doors open for business, it literally takes years of deep commitment and continuous focus to build and maintain a good reputation. Conversely, it may only take a few disgruntled customers a very short time to scuttle the concerted effort of an entire organization. This is reason enough to realize that positive customer service is the responsibility of everyone in the facility. Every sector of our industry—manufacturing, sales, marketing, service, and the aftermarket—must understand the importance of correct customer care.

Let's expand on the phrase *customer service relations*. Within our world of RV service, there are three basic elements that can combine for a positive experience when a customer pulls into the service drive or the retail store. The elements of effective customer service consist of:

The greeting
Handling the transaction
Proper follow-up

Figure 1-89 Model For Effective Customer Service



Effective customer service depends on three distinct but interrelated parts. In order to provide quality service, the technician must (1) greet the customer, (2) handle the problem/situation/transaction, and (3) follow up with the customer to ensure that the matter was handled to the customer's satisfaction.

REMEMBER: QUALITY SERVICE IS ONLY QUALITY SERVICE WHEN THE CUSTOMER FEELS IT IS! THE CUSTOMER'S OPINION IS THE ONLY ONE THAT COUNTS.

When greeting a walk-up customer, the first concern is to quickly identify the needs of the customer. Since RV facilities have many departments, a logical approach would be to direct the customer to the right department or the right person. A few quick, friendly questions will help determine if the customer is looking for the accessory store, the service department, the sales office, and so forth. The last thing the customer needs is to be caught in a loop—being passed from department to department. The astute employee will be able to quickly determine just who this customer truly needs to see.

Remember, regardless of the situation, always be ready to present yourself and the company in the best light possible. This is crucial whenever there is customer contact. The first greeting with the customer may set the tone for the entire visit as well as all subsequent visits. Just how we greet him or her is vital to customer relations. **There is never a second chance to make a first impression**.

Within the first few seconds of the initial meeting between an employee and a customer, a pecking order is established. Only one person can assume the dominant role. This is the point where the relationship starts. Unfortunately, it is all too common to hear an employee simply ask, "May I help you?" Not only can the customer quickly reply, "No, thanks, just looking," but in essence, control of the conversation has been relinquished. This could be a fatal mistake in a retail sales environment, although less damaging if the customer is just seeking the service department. It is always best to plan opening remarks ahead of time. According to consultant and motivational speaker John Wyckoff, there are six steps in planning the actions of the initial contact:

Step 1: Be appropriately dressed and wear a name badge.

Step 2: If appropriate, allow the customer a few minutes to look around and feel at ease. Do not rush the customer!

Step 3: Approach the customer, extend your hand, and introduce yourself. Make the initial meeting a personal one.

Step 4: Start asking the prepared questions. Do not start by making statements.

Step 5: Learn the customer's name and use it as soon as possible and often.

Step 6: Smile.

Be specific when planning the questions ahead of time. The questions should be designed to elicit specific information—information that will provide directions for the technician and minimize the customer's time at the facility.

Preparation and professionalism will be evident to the customer by following these steps. The technician will be confident about properly representing the company and providing quality customer care at the same time. Nothing gains the trust of a customer like a warm, sincere attitude, combined with a friendly smile and the use of the customer's name.

Within the realm of customer relations, it is important to understand the term *personal space*. A situation to avoid with a customer is the intrusion of his or her personal space, often called the *zone of personal safety*. It is human nature to react involuntarily when meeting another person in unfamiliar surroundings. The zone of personal safety is considered one full arm's length or about three feet of space. If this personal space is violated or broached, a series of involuntary reactions begin. These include dilated pupils, an increase in heart rate, and a rise in the body temperature and blood pressure. Honor the personal space of the customer, but at the same time remember to be warm and sincere.

1-8.3 Problem Solution

When directly involved in problem solving, be practical and forthright with the customer. In other words, discuss all aspects of repair. Be prepared to provide answers to obvious questions, such as the length of time the repair will take, how much will the repair cost, and exactly what will be done to complete the repair. Be sure to advise the customer about warranty coverages, parts availability issues, and the sublet of repairs, if any. Obtain authorization before beginning any repair. If a revised estimate is necessary, always obtain the customer's authorization prior to continuing the repair. Any work performed by the technician or the company not included on the repair order and performed without proper customer authorization is simply nothing more than a gift from the company to the customer. The customer is not required to pay for any work performed without their knowledge and prior authorization. Record any recommendations for future repair or maintenance.

1-8.3.1 Follow-Up

Proper follow-up is crucial for positive customer service. The follow-up should be considered one of the many moments of truth discussed later. It allows the customer's degree of satisfaction with the work to be gauged. Listen to the responses and use them to change habits or procedures in the company. Nothing can be worse than having the top of the pyramid (see *Figure 1-100*) make valid suggestions and then ignore the advice.

If possible, talk with the customer before the RV leaves the facility. Show the customer what was done to make the repair and ask if they are satisfied with not only the method of the repair but the quality of the repair as well. Telephone the customers from time to time. Find out the status of the repair a week or two after the fact. This is especially beneficial when additional repairs were also suggested on the repair order. Explain concern for the welfare of the RV and be available to answer any further questions concerning the most recent repair. A genuine show of concern will build further trust into the relationship. A stronger bond of trust will

keep the customer coming back. This is often done by an outside company that is professionally trained with a program called the Customer Satisfaction Index (CSI).

1-8.3.2 Why Is Customer Service So Important?

Customer service is so important because satisfied customers are the company's best asset. They result is increased sales, repeat business, growth, and prosperity.

The decision to make a difference in the quality of customer service in the company is the technician's. It cannot be overemphasized that the cornerstone of a successful service facility results primarily with those individuals who have direct customer contact. This is where the organizational image is built, not in the office of the CEO or president. Image is not built and displayed on a plaque in the customer waiting lounge, but earned in the trenches of the service drive, the service bays, and the retail store.

Figure 1-90 Importance of Satisfied Customer

Importance of Satisfied Customers

1. Increased Sales
2. Repeat Business
3. 1 + 2 = Growth
4. 1 + 2 + 3 = Prosperity

All customers have an impact on the success of the company. The choice is the technician's as to whether that impact is positive or negative.

The worst-case scenario is one where a customer decides not to come back. Remember this: satisfied customers expand our growth potential and seldom quit us. Additional research in the field of customer service is shown in *Figure 1-91*.

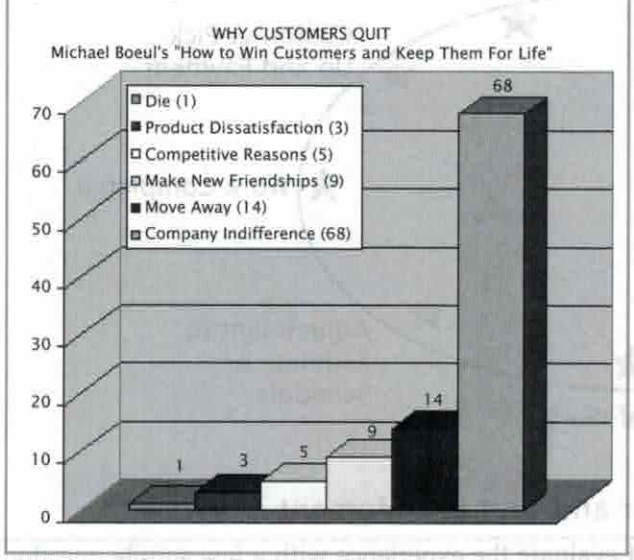
Figure 1-91 TARP Findings Statistics Chart

TARP* Findings

- The average business never hears from 95% of its unhappy customers.
  - For every complaint received, the average company actually has 26 customers with problems.
  - If there are 50 unhappy customers, 96% will never tell you they are unhappy. 45 of them will just go away.
- 54 - 70% will do business again if problem is solved.
- 90% will do business again if problem is solved quickly.
- Customers talk!
  - An average customer with a problem will tell 9 to 10 other people about the problem.
  - Some customers (13%) with a problem will tell 20 or more people.
  - Customers who have their problem resolved quickly only tell an average of 5 people.
- Don't create problems. If you do - solve them quick.

*Technical Assistance Research Institute Programs, Inc.

Figure 1-92 Why Customers Quit



The reality of these numbers is that the technician and everyone at the RV facility can make a difference and directly influence the largest percentage of unhappy customers. The challenge is there.

During every encounter with a customer, at any level within the RV service facility or dealership, there exists a moment of truth. A moment of truth is an episode during which a customer comes into any contact with a representative of the organization as shown in *Figure 1-92*.

It's at a moment of truth that the customer forms an impression, not only of an individual but of the whole company. Recognizing these moments of truth as opportunities to apply quality customer care will result in the ultimate win/win situation. The customer's needs are met, and the company contact gets the sale. The customer also comes away with a positive image of the company and will probably be back. Company employees should consider their attitude and actions during these relational activities. These relational activities, sometimes called "The Cycle of Service," are shown in *Figure 1-93*.

Figure 1-93 Moments of Truth

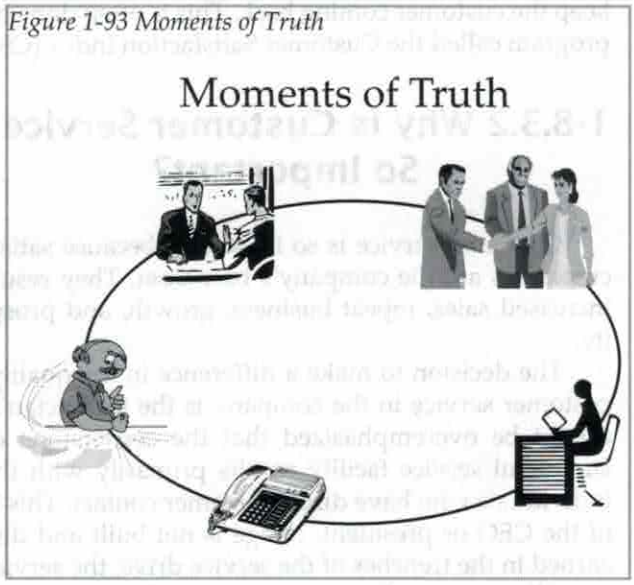
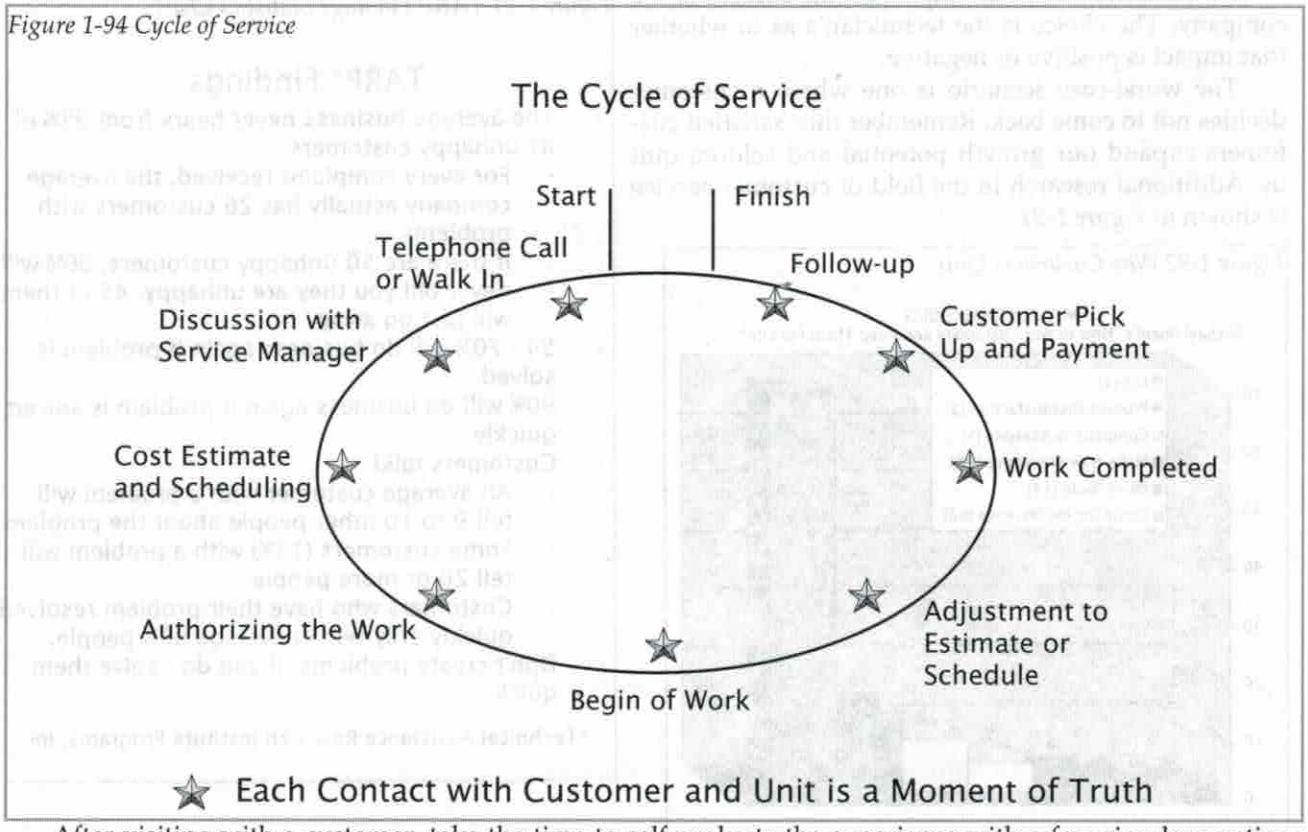


Figure 1-94 Cycle of Service



After visiting with a customer, take the time to self evaluate the experience with a few simple questions about the encounter. This is the first step in self-managing and evaluating consumer care policies. For example, ask whether the customer believed they received proper respect and attention. Did the customer perceive their contact as being genuinely interested in helping them? Did the customer walk away knowing all questions were answered and the transaction fully completed? If the questions can be honestly answered "yes," a good job was done. If not, perhaps further evaluation is necessary. Ask how the encounter could have been improved. Continually strive for improvement in the area of customer relations.

1-8.3.3 Three Keys to Making the Repair

Figure 1-95 Three Keys to Making Repairs

Three Keys to Making Repairs

- Make Them Quickly
  - Don't make customer wait if you can avoid it.
  - Complete them within the time frame stated.
  - Tell the customer if the time frame has to be adjusted.
- Make Them Correctly
  - Don't make the customer come back.
  - Troubleshoot - don't "replace components until it works."
- Do a Clean Job
  - Remember perceptions! A clean job will be perceived as a good job.

Fully understanding that satisfied customers do return, RV service facilities must apply certain strategies when making repairs or performing their services. Such strategies, as shown in *Figure 1-94*, should include these three characteristics: quick, correct, and clean.

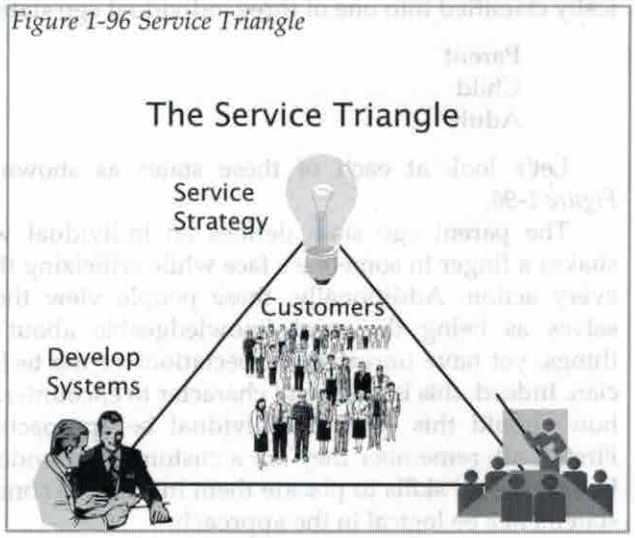
Quick is defined as both a state of mind and an element of time. Two days can be a quick repair time for a major repair, especially if all downtime has been minimized. If repairs will take longer than promised or estimated, tell the customer immediately. A common mistake is waiting for the customer to initiate an inquiring telephone call. Always take the proactive role and keep the customers informed. When delays are inevitable, fully explain the details to the customer. Express concern for the welfare of their RV, especially if the repair or service is safety related. End the conversation with a revised estimated completion time.

Correctly means a combination of applied technical expertise and thoroughness. Technical knowledge provides the means of completing the task. Thoroughness ensures that the job is done properly. Simply replacing parts may complete the job, but that alone does not constitute a correct repair. Thoroughness is performing an propane leak test after working on any component in the propane system. Thoroughness is a prompt to find out why a fuse blows, not just to simply replace it. Correcting the cause of a failure and knowing why a component failed is as important as the apparent symptom discovered by the customer.

Cleanliness is simply having respect and displaying courtesy to the customer. Remember, the RV just may be a full-time home. Minimally, it is the customer's current home. Treat it with the same respect as anyone's house. Obvious methods include protecting the carpeting, vacuuming wood or metal shavings, and wiping down appliances and cabinets. Also, never smoke in or around a customer's RV—first, out of respect for the customer's personal belongings and, second, because of the safety factor. Liquid propane and an open flame are two of the three ingredients that can lead to potential disaster. (The third ingredient is carelessness.) Smoke only in those designated areas assigned by the company/employer. Fully inspect all the areas encountered and verify their cleanliness prior to returning the RV to the customer. Remember, forgetting to clean a soiled steering wheel is a failed moment of truth!

Examples of how to promote a clean image to the customer is the use of plastic seat covers, carpet covers, and steering wheel covers and booties.

Figure 1-96 Service Triangle



Positive customer relations are the responsibility of everyone and should be thoughtfully planned by the whole organizational team. One method of implementing this approach is with the service triangle as shown in *Figure 1-95*.

Notice the customer is positioned at the center, while the remaining elements interconnect with the customer and each other. Although the service strategies, systems, and employees all work together, the focus is on the customer. The customer's opinion is the only one that truly counts. Let's explore another view of the customer.

All nonemployees of at the facility should be considered potential customers. Every time a new contact is made, assume that person is a customer; they just may be. Treat all new contacts accordingly. Each will form

an immediate opinion of us (which we've learned has a direct impact on the organization). Often, their impressions are based on the attitude of the first person with whom they come into contact.

Treat each person as a unique, valued individual rather then just another repair order number, a nonentity. People receive enough of that kind of treatment in other areas of their lives. Sincerity and genuineness is our approach, while language and posture build an element of trust and self-worth in our customers. During the entire encounter with that person, acknowledge their individuality with a pleasant attitude, attentiveness, and appreciation for who they are—the customer.

1-8.3.4 The Influence of Women

Today, women play a large role in the RV industry. Many women own dealerships and repair shops. Some are managers, and more and more are becoming service technicians. Additionally, they are, or at least have the potential to be, 50 percent of the consumer market. Many RV clubs consist entirely of female RV owners. One can find many singles clubs that schedule rallies throughout the country. In many families, the wife has control of the purse strings, or at least an equal voice in spending habits. The RV facility that realizes the importance of the female consumer has the potential to increase sales and service profits. The only questions is, how?

One of the obvious ways is to hire smart, intelligent, and technically oriented women and place them in the sales and service departments. As always, technical training may require an investment, but the returns will be beneficial. Placed in positions of authority within the sales and service departments, female employees can service the customer with an air of confidence and knowledge.

However, no company should ever cater to the female consumer only. The workforce will consist of both men and women serving male and female customers. Each will still interact with the women customers, though the male employees may need some occasional sensitivity training. Male employees should be knowledgeable concerning female attitudes and make concerted efforts to avoid confrontational attitudes that disturb or threaten the female consumer. Some men already have this understanding; others may need training.

The bottom line is that female consumers are significant to the company and can have a major impact on future growth. The company, firm in its understanding of this, is in a position to greatly increase profits. Satisfied customers come back.

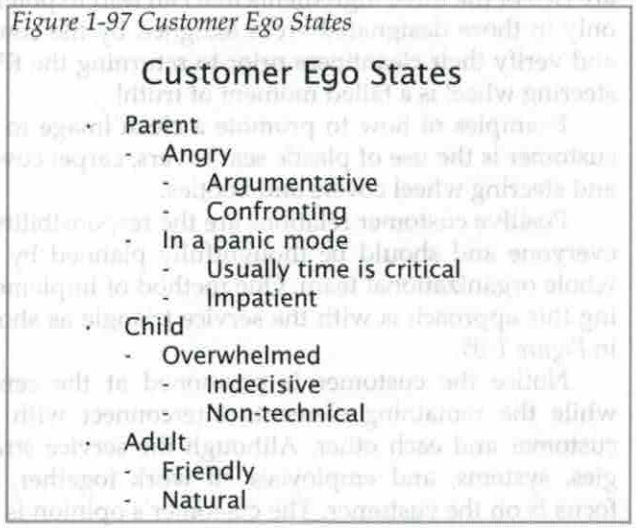
1-8.3.5 Ego States

It has been said that nearly everyone can be theoretically classified into one of three individual ego states:

Parent
Child
Adult

Let's look at each of these states as shown in *Figure 1-96.*

Figure 1-97 Customer Ego States



The parent ego state defines an individual who shakes a finger in someone's face while criticizing their every action. Additionally, these people view themselves as being the most knowledgeable about all things, yet have unrealistic expectations of the technician. Indeed, this is a difficult character to encounter. So how should this type of individual be approached? First of all, remember they are a customer. Be understanding and even sympathetic towards the individual. Use relational skills to placate them in order to conduct business with them. Use suggestions instead of hard statements; be logical in the approach.

The child ego state is best described as a crybaby. The viewpoint professes that nothing is ever right, and it is highly unlikely to be able to help at all. Approaching this individual must be done assertively yet positively.

To be successful, provide an overabundance of detail as to how the complaints about the RV will be rectified. Always reinforce the explanation with opportunities for them to agree to the repair methods. Ask if they indeed understand exactly how their expectations are going to be met.

The third ego state, that of the adult, is a welcomed sight as a customer, though seldom encountered. The individual is actually open, rational, and calm. This individual's demeanor is basically friendly, and they understand their is a job to do and generally allows it to be done. The approach should simply be friendly, confident, and professional.

It's quite easy to spot insincerity and an uncaring attitude. They appear to want to be somewhere else, they are fidgety and unfocused, their eyes wander, and they constantly ask, "What did you say?" Special training is not necessary to interpret such an encounter. Just remember, your customers are as equally adept as you. Genuine interest must be cultivated. Most people respond positively when called by name. So will the customers. Seemingly unacceptable answers are more readily accepted when customers are shown honesty, respect, and genuine courtesy.

1-8.3.6 Establishing a Relationship with the Customer

The most successful way to communicate with a customer is to rapidly establish a working relationship. This is sometimes called *establishing a rapport* with the customer. This can be done quickly and quietly by correctly reading the mood of the customer and responding accordingly. This is done by responding correctly with the proper tone of voice and with the proper mannerisms. However, care must be taken to prevent the establishment of a routine response to all customers. Customers are individual persons with unique (at least in their own mind) problems that they expect the technician to solve. Responses should be tailored to that perceived uniqueness. It may take some practice to develop this ability and mistakes may be made. Mistakes are correctable and are part of the learning process, so don't be afraid of them. Eventually, the mistakes will become fewer and the process more natural.

The easiest way to respond correctly is to avoid certain answers that will almost always send a customer "into orbit." The safest, but not foolproof, approach is to be positive and caring. Don't be too positive. This can sometimes be interpreted as being cocky or uncaring. *Table 1-8* below identifies some phrases to avoid, with some possible alternatives.

Table 1-8 Phrases to Avoid and Alternatives

Don't Use Negative Phrases	Possible Alternative Positive Phrases
That's not my job.	John Doe can help you with that, let me get him for you.
I don't know.	Let me look up the answer to that question.
You will have to bring it back.	If you can leave it with us, we will have our expert check it out for you.
The boss can't see you now.	The boss will be with you as soon as he/she gets off the telephone, etc.
We can't do that.	1. We are not equipped to do that, but we can send it to facility XX that is. 2. What you want done would constitute a danger to your safety and/or is prohibited by warranty requirements and/or safety standards.

To read the customer's mood, listen to the tone of voice and observe facial expressions and body language (physical body movements indicate the mood and state of mind of an individual), then respond accordingly. Some typical customer moods and possible responses involve listening, which is discussed below. These moods can be equated to our earlier discussion of customer states. The "parent state" equates to the angry and panicky customers. The "child state" most frequently can be identified with the overwhelmed customer. The "adult state" is the welcomed, friendly, natural customer.

1-8.3.7 Listening

Listening is probably the single most important aspect of establishing a good working relationship with a customer. Listening is an art that many management and customer relations experts claim is disappearing. Listening is the ability to hear and understand what is being said, when it is being said, without making immediate interpretations. All too often, the first thing that someone says is all that is heard and disagreed with; the next five minutes is spent developing our rebuttal. In the meantime, the customer is still talking, and there is little idea what was said during that ensuing five minutes; but the rebuttal is ready. Except for unusual circumstances, rebuttals are not important. Understanding the customer's problem and solving it are. Where the emphasis should be put is obvious.

1-8.3.7.1 Active Listening

ACTIVE LISTENING = CAREFUL ATTENTION TO BOTH CONTENT AND FEELING
CONTENT = WHAT THE WORDS MEAN
FEELING = HOW THE PERSON REALLY FEELS:

*angry	*pleased	*joyful
*frustrated	*afraid	*sad

1-8.3.8 Attitudes

Technicians need to develop positive attitudes toward customers. These attitudes need to become second nature.

1. Care about customers. Be concerned with how they feel (e.g., don't ever refer to a customer's RV as "an old piece of junk!").
2. Assume other people have value and something to offer.
3. Assume that everyone is unique, and accept them.
4. Empathize. Understand how they feel (which doesn't mean sympathize and feel the same thing).

1-8.3.9 Rules

Try to follow the two rules below whenever dealing with a customer:

1. Try to anticipate what the customer is getting at. On the basis of what has already been said, ask yourself, "What is the speaker trying to get at? What point is he or she going to make?"
2. Do not form conclusions or begin to construct replies until understanding the customer's position.

1-8.3.10 The Angry Customer

The angry customer is frequently insulting, intimidating, confrontational, and argumentative. What is sometimes lost is that the angry customer can be righteously angry. In other words, the customer may have

cause to be angry. The clues that a customer is angry are easily recognizable. The customer will sometimes use profane language, make "You...." statements, threaten, pound fists, speak loudly and fast, try to stare you down, and frequently maintain close proximity to the person being talked to, even if that person attempts to move away. The angry customer will often repeat pertinent points of the discussion and will almost always demand proof of any statement made to him/her. The response to the angry customer is to let the customer express the emotion without challenge. Make notes of pertinent information, but above all else, listen and let the customer know they are being listened to. After the emotion has been spent, calmly go back and verify the details of the problem. Admit where the dealership or repair facility was wrong, if it was wrong. Let the customer know it is OK to be angry, that you care, and that everything possible will be done to resolve the problem. *Table 1-9* outlines the basic approach to handling anger.

Table 1-9 Handling Anger

1. Assess the anger	• Level • Cause
2. Assess your reaction	• Value yourself. • Cope, don't defend. • Be assertive.
3. Calm the anger	• Attend and listen actively (do not tell customer to calm down). • Vent or sector. • Reflect. • Ask and answer questions. • Disagree diplomatically.
4. Solve the problem	• Use the basic complaint formula. • Generate alternatives. • See things from their point of view. • Dovetail.

1-8.3.11 The Panicky Customer

The panicky customer is borderline angry. This customer is frequently on vacation, has a problem that is disrupting the vacation, and sees the entire vacation being ruined. If not actually on vacation yet, this customer may be getting the RV ready for vacation and anticipating that it will not be ready on time. This customer becomes assertive, demanding, impatient, and extremely insistent. There will be a lot of finger pointing and use of either long, repetitive sentences or very clipped, partial sentences. The customer will frequently speak very quickly and make a number of suggestions (good and bad) on how to expedite solving the problem. As with the angry customer, the customer must be listened to so as to let the emotion be spent. Once the emotion is spent, verify the problem and do everything possible to meet the needs of the customer. Remember that time is probably critical to this customer. "We can get to it in two or three days" is not a recommended response. Some dealers have made friends of panicky customers by recommending a competitor or specialist shop that may be able to meet their time needs. Do everything that is appropriate to get this customer satisfied in a timely manner.

1-8.3.12 The Overwhelmed Customer

The overwhelmed customer is most frequently characterized as being indecisive. This customer knows there is a problem but isn't sure what to do about it. This customer will seldom, if ever, be technically oriented and would describe himself/herself as a user, not a fixer. This customer will act puzzled, be hesitant and

apprehensive, and frequently avoid making eye contact. This customer may demonstrate tenseness and uncertainty. He/she will frequently hesitate in answering questions and will often consult with another family member or friend before providing an answer. Speech will usually be slow and interjected with frequent "ah" and "I don't know." With this customer, a tone of helpfulness must clearly established. Work with them to clarify all issues and reassure them that someone will stay with them until the problem is identified and their needs are met. Avoid technical language if possible; use "plain English." Define technical terms, if they have to be used.

1-8.3.13 The Friendly or Natural Customer

The friendly or natural customer is obviously relaxed. This customer will smile, be pleasant, chat about the weather or latest basketball game, and be cooperative. The customer will be polite, frequently thanking you for your time and help. This customer will listen as carefully as they were listened to. This customer is valuable to the technician and the company. Let the customer know that they are valued and do everything possible to solve the problem quickly and correctly. Take the extra step and **exceed the customer's expectations** of the service provided. This customer will tell others how good their service was, and personal recommendations from satisfied customers is the best publicity any business can get.

Figure 1-97 is presented as a brief review of the above customer moods along with some possible strategies the technician can use to respond to them.

Figure 1-98 Customer Moods and Recommended Responses

Responses to Customer States and Moods

- Angry
  - Express concern and interest
  - Hear them out before responding
- Panic
  - Express urgency
  - Express understanding
- Overwhelmed
  - Express "Can Do" attitude
  - Simplify explanation of solutions
- Friendly
  - Respond in kind
  - Cultivate
- Natural
  - Respond in kind

1-8.3.14 Putting Common Sense into Customer Relations

Most tasks performed in the repair shop are simply a compilation of common sense and common courtesy. Generous helpings of both characteristics applied through technical expertise will indeed promote positive customer relations. *Figure 1-98* shows a few more examples of common sense and common courtesy.

Figure 1-99 Common Sense Approach

Common Sense Approach

- Don't give the customer an excuse
  - Protect all seat covers and carpeting
  - Advise customer to remove valuables
    - Inventory if not possible
  - Keep customer informed of progress during lengthy repairs
  - Notify customer immediately if estimate need to be adjusted
  - Do no alter radio or television station settings
  - Do no smoke in the cutomers unit
- NEVER LIE TO THE CUSTOMER
- EXCEED CUSTOMER EXPECTATIONS
  - Just a little can be enough

1-8.3.14.1 Customer Relations of the Organization

The focus to this point has been directed at individual behavior. A larger perspective of the whole organization is also important when discussing customer services. Traditionally, most organization are composed of a president or CEO positioned at the top of the organizational chart. All department heads, managers, and other subordinates would be under this principal authority figure. *Figure 1-99* shows how a diagram of the pyramid of authority would look.

However, the progressive company that exercises positive customer service relations will have an organizational pyramid that resembles the diagram shown in *Figure 1-100*.

Here the customer is positioned at the top with all the employees below. This approach suggests total organization understanding for those contact employees at the front lines. Managers and department heads are poised to offer support for those who come in contact daily with the customers. To which organizational principle does your facility adhere? If the former, perhaps approach management with the details of the customer first mind-set.

Figure 1-100 Traditional Pyramid of Authority

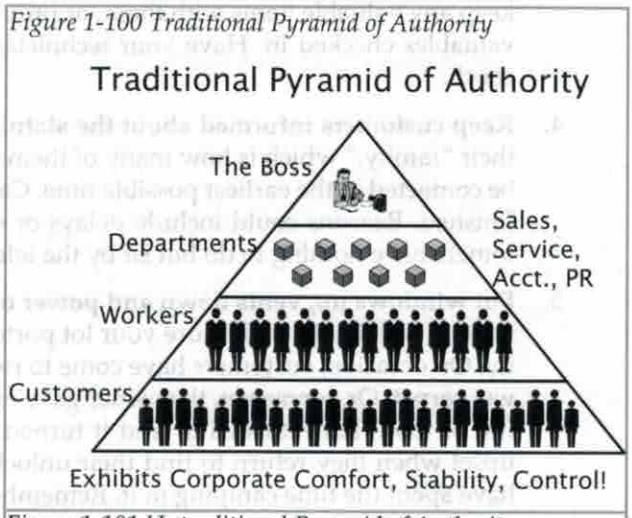
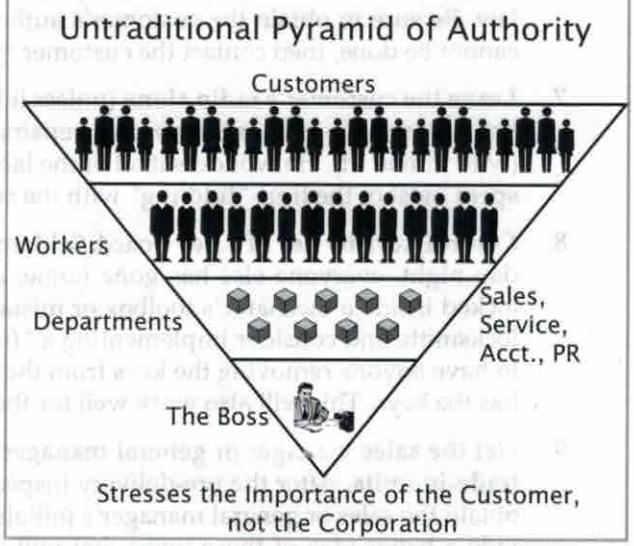


Figure 1-101 Untraditional Pyramid of Authority



1-8.3.14.2 10 Helpful Suggestions by Michael Packard

"If someone had given me a primer with the title '10 Items to Remember in the RV Business' when I first started (more than 25 years ago), I could have avoided making some mistakes. Since then, I have compiled a list from experience." Read and analyze each suggestion; keep in mind that other helpful hints certainly could be added to the list.

1. **Keep a professional distance between the customers and yourself.** Many people in RV service wish that they had practiced this suggestion. For example, a disgruntled customer called to report that one dealership was not giving him enough attention. The customer now felt that his coach repairs were being "put on the back burner." This client said, "Yeah, I used to slip Frank a $20 bill, and then I got all the attention!" They will always come back to collect. I feel that Frank had long forgotten the $20, but the customer hadn't. Similarly, a new sales representative related to me that a customer had offered him reserved seats for his favorite NFL team. I cautioned him (even pleaded) to thank the customer but respectfully decline the tickets. The sale rep enjoyed the game. When he tried to repay the customer's generosity by offering him discounted service parts and labor prices, he was reprimanded by upper management.

2. **Protect the customers' seats, carpet, countertops, and so forth.** It should go without saying that you have to respect a customer's coach. All too often, the repairs are made and the customer is ready to go but, upon his inspection, dirt and grease are found smeared on the fabrics and carpet. Not only is this embarrassing, but it seems to be what the customer will remember most about the service he receives from your dealership. Using carpet runners, protective seat covers, and other preventive measures will help save you money in the long run. Having a professional cleaning service dispatched to your dealership can create delays, as well as accentuate the customer's anger, while being more expensive than prevention.

3. **Advise customers to secure valuables such as money, jewelry, firearms, CD players, and other valuables before you work on their units.** If customers are going to leave their unit with you, have them remove valuables. If they decide to stay at the dealership while repairs are made, advise customers to

keep any valuable items with them, or provide a safe for storage. If providing a safe, issue a receipt for valuables checked in. Have your technicians notify a supervisor if they see any valuable left in the coach.

4. **Keep customers informed about the status of repairs on their coach.** Customers worry about one of their "family," which is how many of them treat their RVs. If there is delay in repairs, customers must be contacted at the earliest possible time. Call or write them and explain the reason that repairs are not finished. Reasons could include delays or scheduling, among others. Remember, many of your customers have nothing to do but sit by the telephone, waiting for it to ring!
5. **Put windows up, vents down and power off, and leave door locked.** (However, the refrigerator may need to be left on!) Make sure your lot porter, technician, or someone else is responsible for this activity. On occasion, customers have come to receive their coach and were welcomed by soaked seats and wet carpet. Or, worse yet, the owner gave explicit instructions to leave the refrigerator on (since it was full of food) but returned to find it turned off with all of the food spoiled! Customers also get very upset when they return to find their unlocked unit on your lot, causing them to wonder who might have spent the time camping in it. Remember, as in suggestion no. 2, respect the customer's property.
6. **Advise a customer when you think your estimate is going to be exceeded.** In many states, this is the law. Be sure to obtain the customer's authorization to continue repairs, in writing if possible. If this cannot be done, then contact the customer by phone and document the date and time of the call.
7. **Leave the customer's radio alone** (unless it is to be repaired). More than a few times, when a customer has received his unit and inspected repairs, the "boom-box city" has erupted in the customer's unit (with him in it!). He wonders if all of the labor time he was charged was legitimate or if the technician spent most of the time "fiddling" with the stereo.
8. **Control keys by use of a key board.** Seldom has anything been more frustrating than, at 8 p.m. on Friday night, everyone else has gone home, and you must locate lost keys. Or, occasionally keys are locked inside a mechanic's toolbox or mistakenly taken home in someone's pocket. Find a good local locksmith, and consider implementing a "fine" for lost keys. A system that has worked well for me is to have anyone removing the keys from the key board put a flag or chip on the board identifying who has the keys. This will also work well for the sales staff.
9. **Get the sales manager or general manager's approval for repairs made to (preowned) sales unit or trade-in units.** After the pre-delivery inspection, review the list of items requiring further repair and obtain the sales or general manager's initials on the items that your department is to fix. This will provide a better idea of those items that will be adding cost to the unit, affecting the selling price and profit.
10. **Never lie to a customer.** If you cannot answer a question, tell the customer so and find out the truth. Misleading him will come back to haunt you and could cost you a customer and your job."

1-8.4 Summary

A solid reputation for positive customer service takes months, if not years, to cultivate. This is the opportunity to make that difference with the organization. If no formal customer service policy is in effect, either suggest that one be set up or implement change. There are benefits of having such a program. Begin to make a difference today.

1-8 Review

1. Who or what fills the center position in the service triangle?
   A. Systems
   B. People
   C. Customer
   D. Service strategy
2. What percentage of unhappy customers will the average company never hear from? _____
   A. 50%
   B. 65%
   C. 76%
   D. 95%
3. How many customers with problems does the average company have for every complaint received?
   A. 19
   B. 21
   C. 26
   D. 38
4. What percent of customers will do business with an organization again if a complaint is resolved quickly?
   A. 65%
   B. 75%
   C. 85%
   D. 90%
5. Which of the following is not one of the three keys to making the repair?
   A. Economics
   B. Quickness
   C. Correctness
   D. Cleanliness
6. Which of the following best describes the parent ego?
   A. Helpful and understanding
   B. Critical and unrealistic
   C. Old and retired
   D. Overwhelmed and unsure
7. Which of the following best describes the child ego?
   A. Easily controlled
   B. Impossible to control
   C. Depends on mood
   D. Overwhelmed and unsure

8. Any encounter with a customer is called _____.
   A. The introduction
   B. TARP
   C. A moment of truth
   D. None of the above
9. When planning opening remarks to a customer, which of the following is not one of the six steps in planning this process?
   A. Be appropriately dressed and wear a name badge.
   B. Learn the customer's name as soon as possible.
   C. Allow the customer a few minutes to look around.
   D. Wait for the customer to approach.
10. The zone of personal safety is considered _____ from the customer.
   A. 1 ft
   B. 2 ft
   C. 3 ft
   D. 4 ft
11. What ego state would best be described as critical, most knowledgeable, finger in someone's face?
   A. Child
   B. Parent
   C. Adult
   D. Juvenile
12. Which of the following sequence of activities is the best approach for handling anger?
   A. Assess the anger, assess your reaction, calm the anger, solve the problem.
   B. Assess the anger, calm the anger, assess your reaction, solve the problem.
   C. Assess your reaction, assess the anger, calm the anger, solve the problem.
   D. Assess your reaction, calm the anger, solve the problem, assess the anger.
13. According to the TARP findings, customers who have their problems resolved tell an average of how many people?
   A. 5
   B. 10
   C. 15
   D. 20

Chapter

1-9 Record-Keeping

- Complete service documentation.
- Record and report defects (PDI).
- Accurately complete warranty registration forms.
- Identify and explain information on a Pre-delivery Inspections sheet (PDI).
- Identify and explain information on a Customer Acceptance Sheet (CAS).
- Identify and explain information on a Dealer Acceptance Sheet.
- Record and sign test results of propane and electrical systems (PDI or separate sheet).
- Accurately complete maintenance and repair orders/parts orders.
- Explain methods of maintaining and storing records.

1-9.1 Purposes of Maintenance and Repair Records

To a technically oriented person, many jobs are more interesting than doing paperwork, or in this case, maintaining records of service performed for customers. At the same time, few jobs are as important to a business than maintaining current and accurate records. The best example for showing the need for accurate records is having to provide these records in a court of law because of a lawsuit initiated by a customer. The best-case scenario is that there are records, they are accurate, they are explicit in the work that was performed, they identify when the work was performed, they show to what established standards the work was accomplished, and they show that the customer authorized the work. Hopefully, this need for records is an exception that will never need to be faced.

Under normal conditions, good records serve the following three purposes:

1. They document the service provided on a unit or appliance. They are a record of all service that has been performed. This information is beneficial to the customer in having a historical record of the service performed on the RV, to the dealer or repair facility as a referral document if the RV is returned for service, and as a reminder when contractual maintenance requirements are approaching.
2. They become a record of the hours that a technician worked on performing the service. This becomes the basis of salary and—possibly—promotion for the technician and helps the service manager evaluate technicians and service department efficiency.
3. They can meet the legal need described above as well as other legal requirements, such as tax audits.

Each of these situations is discussed in more detail below.

1-9.1.1 Document Service Provided

1. Customer information. Many customers want (some demand) a complete history of all services and repairs performed on their RV. In some cases, this is a personal preference for the customer, but in more and more cases, as full-time RVing grows, it is important for the customer to be able to relate, for instance, to a dealer in California the services that were provided in Indiana last spring. This need is routinely met by providing the customer with a hard (paper) copy of all repair orders, PDI forms, warranty registrations, and customer acceptance forms.

NOTE: Some original equipment manufacturers (OEMs) may combine the warranty registration and customer acceptance into the same form. For the purpose of this text, the term *warranty registration* will imply the use of a combination form.

In some cases, the customer is provided a reproduced copy of the forms. In other cases, commercially obtained forms will have multiple copies, one of which is usually marked "Customer Copy." Frequently, the customer will receive their copy from the cashier's office after payment and processing rather than from the

technician or service department. This is really dictated by the standard operating procedures for the dealership or repair facility. How the copy is provided is not as important as making sure that a copy is, in fact, provided and that it is accurate.

2. Dealer/repair facility referral. Dealerships and repair facilities will use the records maintained on service performed for several purposes.
   A. If an RV returns quickly because of the same problem, a review of the previous service records could save significant time in eliminating potential causes. Remember, customers want it fixed right the first time.
   B. If the repair site maintains large spare part inventories, a copy of the records may be used to track parts usage and determine when to order new inventory.
   C. If maintenance agreements have been sold, the dealer copy may be used to establish a suspense file for notifying customers of the next scheduled service and what should be performed as part of that service.
   D. The cashier's office or accounting department will usually maintain a copy of all records to facilitate billing and payment activities and the development of accounting records and tax preparation.
3. Legal requirement. There is a legal requirement that service records be maintained for a specific period of time. This time element may vary from state to state and from purpose to purpose, so it should be checked out carefully. In all cases, there will be a minimum requirement for each purpose (tax audit, litigation, warranty, and so on). If the dealership or repair facility is a busy operation, this will probably necessitate some sort of off-site storage for the oldest records. If this is done, some form of accurate inventory system must be in effect to facilitate retrieval when necessary.

1-9.1.2 Document Technician Hours

Documentation of technician hours is important for several reasons.

1. Technicians want to be paid. The record of what they have worked on and how long it took them can accurately come from the service records maintained within the shop. These documents are especially important to the technician working flat rate versus hourly rate.
2. Service managers can evaluate technician performance by comparing times to complete a job from one occasion to the next. The technician who is improving and becoming more technically proficient will usually show a reduction in hours spent on the same job performed previously.
3. The service manager can also evaluate which technicians are better (this can sometimes equate to faster, but not always) on what type of jobs. By assigning jobs to technicians who are better able to handle them, the efficiency of the entire shop can be improved.
4. The technician can also benefit from these records. The technician who routinely performs four-hour jobs in two or three hours might consider the advantages and disadvantages of flat rate versus an hourly rate.

NOTE: A flat rate manual is available from the Recreation Vehicle Dealers Association, 3930 University Drive, Fairfax, VA 22030-2515, (703) 591-7130.

1-9.2 Warranty Requirements

RV manufacturers (OEMs) and suppliers all have requirements that must be met to have service covered under warranty. These requirements generally include all the information needed to validate that the service was performed, when it was performed, by whom, where, and on what unit or item by identification number.

Most warranties are governed either by a time frame or a mileage/usage factor. The initial warranty registration is the basis for computing these limitations. Inaccuracies or failure to properly register warranties can invalidate a warranty and lead to major problems between the dealer and customer, the OEM and dealer, the supplier and dealer, the supplier and OEM, and perhaps several lawyers thrown in for good measure. As an example, if the sale date for an air conditioner is notated as 1 July instead of 1 June, the warranty covers six months, and the customer brings the unit in for repair in August, the supplier may refuse warranty coverage because the time limit has expired according to the inaccurate documentation. If the records are accurately completed and registered properly, all of these possibilities become extremely remote. In all of record-keeping the adage "do it right and do it on time" is most importantly applied to both warranty records and safety checks.

1-9.3 Types of Maintenance and Repair Records

A. Pre-delivery Inspection (PDI) Form. Pre-delivery inspection record forms are usually provided by the OEM. This form lists all of the safety and operational checks as well as the physical condition inspections that should be made on a new RV before the customer walk-through is accomplished. In its simplest terms, it is a bumper-to-bumper check to ensure that everything is working properly and in condition to be turned over to the new owner. Anything that is found to be inoperable or substandard should be repaired prior to customer walk-through and acceptance. A separate textbook is available that covers the actual conduct of a pre-delivery inspection.

B. Warranty Registration Forms. Warranty registration (and customer acceptance) forms are also usually provided by the OEM and supplier. These can usually be found as a packet of material inside a new unit. The OEM form will normally be completed for the unit, while the suppliers may provide individual forms to cover the appliances and equipment provided in the unit. These records should be prepared in advance and signed during the customer walk-through inspection after the operation of the unit or warranty item has been thoroughly explained and demonstrated. Many forms will have space for the signature of both the demonstrator and the customer, as well as other data identified below. Warranty registrations are also completed anytime an appliance or item is originally installed (after market add-on) or replaced in the RV. The warranty registration records are critical to the customer, because they are used as the authorization for repair or replacement of an item wherever the customer may be. Warranty records and the procedures recommended for the walk through are also discussed in the *Pre-delivery Inspection* textbook.

C. Maintenance/Installation Repair Orders. Repair orders should be filled out for all services performed on an RV. This includes all corrective action taken during a PDI, installation of new items, and repair and replacement actions conducted both under warranty and out of warranty. The repair order forms used are generally created and printed locally by the dealership or repair facility or commercially purchased.

1-9.4 Methods of Storage and Retrieval of Maintenance and Repair Records

A. Hard Copy (service folder). Most dealers will maintain some form of hard copy record of all documentation concerning services provided to a customer. This documentation is probably maintained in a file folder and stored in a file cabinet in the service department area. The forms placed into this file folder can be locally-created, printed forms tailored to meet the facility's specific needs, forms provided by the OEMs and suppliers to meet their needs, commercially obtained "generic" forms, or some combination of the above. There are advantages and disadvantages to hard copy record-keeping.

1. Advantages:
   a. Readily available. They are as close to the service personnel as the filing cabinet.
   b. Multiple user. All service personnel have access to any file anytime they need it. The need for two service personnel to have the same file simultaneously would be extremely remote.
   c. Notations. Service personnel can make notes on hard copy records immediately. Notations could include telephone conversations, date and time, and so forth.
   d. Reproducible. The hard copy records are easily reproducible if a copy machine is available.
2. Disadvantages:
   a. Bulky. Hard copy records require significant storage space, especially over time. Off-site storage of old but required records can add to the cost of doing business for the dealership or repair facility.
   b. Not easily backed up. Some management experts suggest that it is a sound business practice to have duplicate copies of all important records. This is recommended to offset the possible harm caused by a catastrophic fire, flood, or other event that could destroy records essential to the business. Duplicates of hard copy records normally increase the cost of off-site storage.

B. Microfiche. Microfiche are small sheets of microfilm containing reproductions of printed or graphic material. One small sheet of microfiche 3 × 5 in. may hold as many as 20 pages of hard copy material. Microfiche is seldom the only record-keeping system used. It is usually used in combination with a hard copy system. The hard copy is used for current records, and microfiche is used for older records and/or off-site storage records. The reasons for this are clear after a discussion of the advantages and disadvantages. The use of microfiche was popular at one time, but its use is rapidly diminishing in the business world and will probably totally disappear in the near future.

1. Advantages:
   a. Requires small storage capability. An entire file drawer of hard copy records can be stored in a small envelope-size container.
   b. Reproducible. Paper copies of microfiche records can be made with the availability of proper equipment.
2. Disadvantages:
   a. Requires a special machine to read records. A microfiche reader is required to enlarge the records to a readable size.
   b. Limited access. The number of service personnel who can review records at the same time is limited to the number of microfiche readers available, usually one.
   c. Costly to create. Microfiche is made by taking pictures of the hard copy records, creating the negative image on the microfilm. This takes special equipment and usually requires the records to be sent out to a company specializing in this process.
   d. Not easily reproducible. Copies can be made of microfiche records, but it requires a reader/printer machine or separate printer. If one is not available, the records would have to be sent out again for this process.

C. Electronic Copy. Computers are rapidly changing how business is done, even at the small-business level. Some dealers will use a combination of hard copy and computer copy record-keeping, but more and more are converting to all computer systems. The forms used in electronic storage/retrieval can be the OEM provided hard copy form, scanned into the computer or special software programs containing the appropriate business forms. The advantages of using computers is obvious, but a few are worth identifying individually.

1. Advantages:
    a. Multiple access. The relative inexpensive cost of personal computers and the ability to network them provide an immediate multiple access capability.
    b. Reproducibility. The wide range of quality printers available on the market makes original quality reproduction of computer copies possible.
    c. Storage capability. The storage capability of computers, computer discs, and CDs is almost limitless when even average computers today are capable of megabyte and gigabyte storage of information.
    d. Duplicate copy capability. Computer records are easily copied and stored off-site for protection from catastrophic disaster. An entire business's records could be reproduced on relatively few discs and stored in the owner's house with no inconvenience. These duplicate copies can routinely be brought back to the business and quickly updated to ensure a minimum loss of information if the original records are lost. This update can even be done remotely with compatible computers at both sites through the use of modems or networks and supporting software.
    e. Transportability. Computers can transmit records to anywhere in the world to compatible equipment at astonishing speed.
2. Disadvantages
    a. Cost. A business has to make an investment in equipment and software to establish computer capability.
    b. Training. Personnel must be trained to use the computer system. While more people than ever are familiar with computers, training on the specific software being used is frequently required.

1-9.5 Disposition of Maintenance and Repair Records

Disposition of maintenance and repair records is generally spelled out by OEM and supplier requirements and by the dealership or repair facility standard operating procedures. Technicians should make themselves familiar with the requirements of the workplace as soon as possible to avoid mistakes and possible costly corrective actions.

Some general guidelines can be developed as to who should get copies of all records.

A. PDI Records. The customer should always get a copy of the Pre-delivery Inspection form. A copy will typically be sent to the OEM, and two or more copies may be maintained by the dealership or repair facility—one in the service department and one in the accounting department or cashier's office. Eventually, one or more of the dealership records will be "retired" to storage for a specifically required period of time. Backup copies, either hard copy or electronic, may be maintained off-site.

B. Warranty Registration Records. The customer should receive a copy of all warranty registration records. Some OEMs may require a copy of all supplier-provided warranty records. Other OEMs may not require copies if they have established a record of all items that were shipped with the unit. The supplier will receive at least one copy, and the dealership or repair facility should maintain at least one copy in the service department. As warranties are generally dictated by a specific time frame or usage factor (miles, operating hours, and so forth), warranty records are considered active and are seldom if ever "retired" to storage. Backup copies, either hard copy or electronic, may be maintained off-site.

C. Repair Order Records. The customer receives one copy of all repair order records, usually after processing through the cashier's office, with payment method and date notated. Some OEMs and suppliers may require copies of all repair orders that document service under warranty. The dealer will

normally maintain two or more copies, one in the accounting department or cashier's office and one in the service department. Backup copies, either hard copy or electronic, may be maintained off-site. Eventually, one or more of the dealership records will be "retired" to storage for a specifically required period of time.

1-9.6 Typical Information Recorded

This section is designed to acquaint the technician with recommended procedures that should be followed or adapted to complete the pre-delivery inspection that should be conducted for all new and used RVs. These procedures have been compiled from a variety of original equipment manufacturer (OEM) guidelines, checklists, and industry standards. The technician should adapt these procedures to the type of RV being inspected, the requirements of the OEM, and local operating procedures. The pre-delivery inspection should be conducted and all deficiencies corrected prior to the customer walk-through and issuance of the keys to the new owner.

Pre-delivery inspection constitutes a vital facet of the retail sale of a recreation vehicle. A thorough pre-delivery inspection can assure owner satisfaction by precluding or minimizing problems, thus enhancing the reputation of the dealer and manufacturer. Because of in-transit conditions, prolonged storage, and other unforeseen factors, it is impractical for any manufacturer to completely condition a new vehicle before it is delivered to the dealer. Used RVs should be thoroughly inspected and repaired prior to resale for both safety and customer satisfaction reasons.

Detailed information on pre-delivery inspections can be found in the *Pre-delivery Inspection* textbook. The textbook has been prepared to facilitate and improve pre-delivery inspection procedures. The textbook describes the tests and inspections that should be performed and, in some cases, explains how to perform them. In other cases, the required steps to perform the test or procedure will be contained in OEM guidance, service, and installation manuals, and training documentation.

Who conducts the pre-delivery inspection is a matter decided by the individual dealership. Some dealers have a competent, well trained technician perform the pre-delivery tests, inspections, and adjustments necessary for an accurate and complete inspection. The Pre-delivery Inspection Checklist is included in every new vehicle received by the dealership. The checklist should be completed by the technician during the conduct of the pre-delivery inspection of the unit. Most OEMs require a Pre-delivery Checklist to be completed and returned to the manufacturer for each new vehicle sold.

It is recommended that a locally produced pre-delivery inspection form be developed for all used units. In cases where the Pre-delivery Inspection Checklist does not provide sufficient space, the technician should use standard repair order forms or other appropriate record-keeping forms to record the information to be recorded. A copy of those forms should then be attached to the Pre-delivery Inspection Checklist. Ensure that all forms contain the serial numbers and other technical data itemized on the primary checklist form in case the forms are inadvertently separated. It is also recommended that the dealership retain a complete copy of all documentation pertaining to the conduct of the pre-delivery inspection and actions taken as a result of the inspection. This pertains to both new and used RVs.

Some dealerships also have the technician fill out the warranty forms during the pre-delivery inspection, since model numbers, serial numbers, and similar data are being recorded as part of the pre-delivery inspection.

1-9.6.1 Pre-delivery Inspection Checklists

The following is a detailed form that can be used or adapted for completing the pre-delivery inspection. See *Figure 1-101* and *Figure 1-102*. This form contains information for a variety of the types of RVs being manufactured today. It is recommended that categories that do not pertain to a specific RV be notated with "NA" (for *not applicable*). This eliminates any possible misinterpretation that a step or test was unintentionally omitted from the inspection.

1. Type or print the unit's serial number.

2. Type or print the model name.
3. Type or print the model year.
4. Type or print the unit's length.
5. If predelivering a motorized unit, type or print the name of the chassis manufacturer.
6. If predelivering a motorized unit, type or print the unit's chassis serial number.
7. The technician should initial and date each test or step as it is completed.
8. Record the component specifications clearly as requested.
9. When pre-delivery is finished, the technician who performed the tests and inspections should sign and date the checklist.
10. At the time of owner delivery, the dealer or dealer representative should sign and date the checklist.

NOTE: See the *Pre-delivery Inspection* textbook for information on recommended specifics for what information should be recorded during the inspection.

NOTE: Some Pre-delivery Inspection Checklists do not provide sufficient space to record all PDI results. In this case, use a Repair Order Form or locally produced form to record results and attach it to the PDI Inspection Checklist.

Figure 1-102 Pre-delivery Inspection Checklist Page 1 Example

PRE-DELIVERY INSPECTION CHECKLIST

MANUFACTURER _____ DATE OF MANUFACTURE _____

VEHICLE SERIAL NUMBER _____ CHASSIS NUMBER _____

BRAND/MODEL/COLOR _____ YEAR _____ LENGTH _____

CUSTOMER NAME (LAST, FIRST, MIDDLE) _____ RETAIL DELIVERY DATE/MILEAGE _____

ADDRESS _____ CITY, STATE, ZIP _____ TELEPHONE _____

PROPANE SYSTEM

___ CONTAINER(S) PURGED AND FILLED
___ UN1075 DECAL APPLIED
___ CYLINDER DATE(S) _____ _____
___ CONTAINER(S) CONDITION OK
___ CONTAINER(S) SECURED AND VENTED
___ HOSE CONDITION OK
___ PIPING AND TUBING OK
___ SIGHT GAUGE OK
___ REGULATOR
___ SECURELY MOUNTED & COVERED
___ PROPER VENT POSITION
___ OPERATING PRESSURE TEST ___" W.C.
___ LOCK-UP PRESSURE TEST ___" W.C.
START TIME ___:___ STOP TIME ___:___
___ TIMED PRESSURE DROP TEST ___" W.C.
START TIME ___:___ STOP TIME ___:___

120 VAC ELECTRICAL

___ SHORE CABLE CONDITION OK
___ HOT SKIN TEST OK
___ CIRCUIT BREAKERS OPERATIONAL
___ INTERIOR RECEPTACLE(S) POLARITY OK
___ EXTERIOR RECEPTACLE(S) POLARITY OK
___ GFCI RECEPTACLE(S)/CIRCUIT(S) OK
___ INTERIOR LIGHTS/FANS
___ CONVERTER OPERATION OK
___ REFRIGERATOR (120 VAC OPERATION)
___ MICROWAVE OPERATES
___ FRONT TELEVISION OPERATION OK
___ REAR TELEVISION OPERATION OK
___ STEREO/HOME THEATER OPERATION OK
OTHER ELECTRICAL APPLIANCES
_____ OK
_____ OK
_____ OK

FRESH WATER SYSTEM

___ GRAVITY/CITY FILL OK
___ FULL WATER TANK OK
___ WATER PUMP FUNCTIONS OK
___ CITY WATER CONNECTION OK
___ SYSTEM FUNCTIONS ON PUMP AND CITY HOOK-UP
___ TOILET FUNCTIONS OK
___ ALL FAUCETS FUNCTION OK
___ OUTSIDE SHOWER FUNCTIONS OK
___ COMPLETE WATER SYSTEM LEAK TEST OK
___ WATER FILTER OK
___ ACCUMULATOR TANK OK
___ ICEMAKER LINES & VALVES OK
___ WASHING MACHINE LINES OK
___ ALL LOW POINT DRAINS OK
___ WINTERIZED (WHERE APPLICABLE)

WASTE WATER SYSTEM

___ FLOOD TEST ALL FIXTURES
___ FLOW TEST ALL FIXTURES
___ ALL DRAINS FUNCTION OK
___ ALL ACCESSIBLE FITTINGS OK
___ FLOOD TEST BLACK TANK
___ FLOOD TEST GRAY TANK
___ HOLDING TANKS CHECKED
___ TERMINATION VALVES FUNCTION OK

12 VDC ELECTRICAL

___ BATTERY
___ SECURED AND VENTED
___ ELECTROLYTE LEVEL OK
___ TEMP. COMPENSATED HYDROMETER
___ READING(S) OK - ALL BATTERIES
___ TERMINAL CONNECTIONS OK
CONVERTER OUTPUT
___ UNLOADED FUSE OUTPUT ___ VDC
___ LOADED FUSE OUTPUT ___ VDC
___ BATTERY CHARGE OUTPUT ___ VDC
___ SOLAR PANEL CHARGE OK
___ INTERIOR LIGHTS OK
___ RUNNING/MARKER LIGHTS OK
___ STOP LIGHTS OK
___ RIGHT/LEFT TURN SIGNALS OK
___ BACKUP LIGHTS OK
___ PORCH/SECURITY LIGHTS OK
___ RANGE HOOD FAN & LIGHT OK
___ VENT FANS (ALL FUNCTIONS) OK
___ REFRIGERATOR (12 VDC OPERATION)
MONITOR PANEL
___ BLACK WATER TANK(S) OK
___ GRAY WATER TANK(S) OK
___ FRESH WATER TANK OK
___ PROPANE OK
___ BATTERY CONDITION OK
OTHER OPTIONS
_____ OK
_____ OK
___ INVERTER OUTPUT VOLTAGE
___ UNLOADED ___VAC LOADED ___VAC

FURNACE(S)

___ FURNACE - 1
___ MAKE & MODEL
___ SERIAL
___ FURNACE CYCLE OK
___ DUCTING AIR FLOW OK
___ RETURN AIR FLOW OK
___ EXHAUST/INTAKE VENT OK
___ FURNACE - 2
___ MAKE & MODEL
___ SERIAL
___ FURNACE CYCLE OK
___ DUCTING AIR FLOW OK
___ RETURN AIR FLOW OK
___ EXHAUST/INTAKE VENT OK

FIRE, LIFE & SAFETY

___ FIRE EXTINGUISHER(S) OK
___ DATE CODE OK
___ CO DETECTOR OK
___ PROPANE DETECTOR OK
___ SMOKE DETECTOR(S) OK
___ DATE CODE OK
___ EXIT WINDOWS/HATCHES/PANEL(S) OK
___ SEAT BELTS OK
___ APPLICABLE MARKINGS./LABELS
___ APPLICABLE GOVERNMENTAL INSPECTIONS

WATER HEATER

___ MAKE & MODEL _____
___ SERIAL _____
___ WATER HEATER PROPANE CYCLE OK
___ WATER HEATER 120 VAC CYCLE OK
___ VERIFY COMBUSTION PAN SEALS OK
___ T&P VALVE OK
___ TEMP. AT CLOSEST FAUCET
___ PROPANE ___DEG. 120VAC ___DEG.
___ MOTOR-AID CONNECTIONS OK

OVEN/RANGE

___ MAKE & MODEL _____
___ SERIAL _____
___ OVEN CYCLE OK
___ OVEN THERMOSTAT/TEMPERATURE OK
___ OVEN DOOR GASKET OK
___ ALL TOP BURNERS LIGHT
___ IGNITION SYSTEM OK
___ PORTABLE COOKTOPS/BBQ GRILLS OK
___ QUICK DISCONNECTS OK

REFRIGERATORS

___ MAKE & MODEL _____
___ SERIAL _____
___ PROPANE CYCLE OK TEMP.___
___ 120 VAC CYCLE OK TEMP.___
___ 12 VDC HEATING FUNCTION OK
___ DOOR(S) GASKET(S) OK
___ COMPARTMENT SEALED TO INTERIOR
___ VERIFY PROPER VENTING
___ ICEMAKER MAKES ICE

AIR CONDITIONER(S)

___ AIR CONDITIONER - FRONT
___ MAKE & MODEL _____
___ SERIAL _____
___ VERIFY INSTALLATION CORRECT
___ THERMOSTAT OPERATION OK
___ HEAT MODE OK
___ TEMPERATURE IN ___ OUT___
___ AIR CONDITIONER - REAR
___ MAKE & MODEL _____
___ SERIAL _____
___ VERIFY INSTALLATION CORRECT
___ THERMOSTAT OPERATION OK
___ HEAT MODE OK
___ TEMPERATURE IN ___ OUT___

INTERIOR

___ ALL OWNERS MANUALS/WARRANTY/SERVICE & MAINTENANCE INFORMATION
___ FLOOR COVERING OK
___ TABLES/COUNTER TOPS/SINK LIDS OK
___ CURTAINS/DRAPES/BLINDS OK
___ ALL DOORS/DRAWERS OK
___ ALL WINDOWS/SCREENS OK
___ EXIT WINDOWS/HATCHES OK
___ ALL VENTS OK
___ LOUNGES/BEDS/DINETTES/CHAIRS
___ UPHOLSTERY OK
___ OPERATION OK
___ WALL/CEILING PANELS & TRIM OK
___ TUB/SHOWER SURROUNDS OK
___ GENERAL APPEARANCE/CLEANLINESS OK

Page 1 of 2

ORIGINAL - RETURN TO MANUFACTURER
YELLOW - DEALER COPY
PINK - CUSTOMER COPY

Figure 1-103 Pre-delivery Inspection Checklist Page 2 Example

PRE-DELIVERY INSPECTION CHECKLIST CONTINUED

MANUFACTURER BRAND/MODEL/COLOR

VEHICLE SERIAL NUMBER

CUSTOMER NAME (LAST, FIRST, MIDDLE)

EXPANDABLE ROOM(S)/SLIDE-OUT(S)

___ MECHANICAL OPERATION OK
___ ALIGNMENT FRONT TO REAR OK
___ ALIGNMENT TOP TO BOTTOM OK
___ SWITCH OPERATION OK
___ EXTENDED SEAL(S)/SWEEPS OK
___ RETRACTED SEAL(S)/SWEEPS OK
___ EXPANDABLE ROOM AWNING(S) OK
___ 120 VAC WIRING/CONNECTIONS OK
___ 12 VDC WIRING/CONNECTIONS OK
___ PROPANE PIPING OK
___ FRESH WATER PLUMBING OK
___ WASTE WATER PLUMBING OK
___ WINDOWS OK
___ OVERALL EXTERIOR APPEARANCE OK
___ OVERALL INTERIOR APPEARANCE OK
___ ROOF INSPECTION OK
___ TRAVEL BAR/LOCKS OK

GENERATORS

___ MAKE & MODEL _____
___ SERIAL _____
___ MECHANICAL OPERATION OK
___ OIL OK
___ COOLANT OK
___ OIL/AIR/FUEL FILTERS OK
___ OUTPUT
___ ___ VAC ___ HERTZ - NO LOAD
___ ___ VAC ___ HERTZ - ___ LOAD
___ REMOTE START/GAUGES OK
___ INSTALLATION
___ SEALED COMPARTMENT
___ CLEARANCES
___ ELECTRICAL CONNECTIONS/ROUTING
___ FUEL CONNECTIONS
___ AIR INTAKE/DISCHARGE (VENTING)
___ EXHAUST CONDITION/TERMINATION

EXTERIOR

___ KEYS FOR ALL LOCKS
___ ALL EXTERIOR COMPARTMENT DOORS & LOCKS OK
___ ENTRY DOOR/SCREEN & LOCKS OK
___ ENTRY STEP(S) OK
___ ROOF INSPECTION OK
___ RACK AND LADDERS/STORAGE PODS OK
___ TRIM SEAL OK
___ WINDOWS SEAL OK
___ OVERALL EXTERIOR APPEARANCE OK
___ AWNING(S)/WINDOW AWNING(S) OK
___ ROCKGUARD AWNING(S) OK
___ TV ANTENNA/SATELLITE OK
___ 12 VDC OPERATION OK
___ DEALER DECALS/TIRE COVER OK
___ APPLICABLE STANDARD(S) DECALS OK

TOWABLES

___ HITCH AND COUPLER/PIN BOX OK
___ BOLTS TIGHT
___ SAFETY CHAIN(S) OK
___ TONGUE JACK/LANDING GEAR OK
___ STABILIZING JACKS OK
___ HUB BEARING(S) LUBRICATED
___ BRAKES ADJUSTED
___ WHEEL SPIN LOCKUP
___ BRAKE FUNCTION OK
___ % SHOES REMAINING
___ BRAKE AMPERAGE
___ BREAK-AWAY SWITCH OK
___ HYDRAULIC BRAKE ACTUATOR OK
___ TIRE CONDITION OK
___ TIRE AIR PRESSURE OK
___ TIRE DATE CODE OK
___ LUG NUTS TORQUED ___ FT/LB
___ SPARE TIRE OK
___ SPRING SUSPENSION OK
___ SHACKLES/BOLTS/BUSHINGS OK
___ U-BOLTS
___ SPRINGS
___ SHOCKS
___ OTHER SUSPENSION OK
___ SKID PLATE/WHEELS OK
___ UNDERSIDE VISUAL INSPECTION OK

FOLDING CAMPING TRAILERS

___ LIFT MECHANISMS OK
___ LIFT SUPPORT MECHANISMS OK
___ BED SLIDE MECHANISMS OK
___ BED SUPPORT MECHANISMS OK
___ CANVASS/VINYL
___ ZIPPERS OK
___ WINDOW FLAPS OK
___ WINDOW EXIT PANEL(S) OK
___ DOOR ATTACHMENT OK
___ CEILING POWER SAFETY SWITCH OK
___ FOLDING SCREEN DOOR/LATCH(S) OK
___ ROOF TRAVEL LATCHES OK
___ ROOF/BODY SEAL OK

TRUCK CAMPERS

___ JACK MECHANISMS OK
___ TRUCK/CAMPER PLUG OK
___ TIE DOWN HARDWARE OK
___ WEIGHT CAPACITY OK

OPTIONAL EQUIPMENT

___ _____ OK
___ _____ OK
___ _____ OK
___ _____ OK
___ _____ OK
___ _____ OK

MOTOR HOMES

___ DRIVER CONTROLS
___ INSTRUMENTS & GAUGES OK
___ FUEL LEVEL(S) ___ ___
___ HORN OK
___ RADIO/STEREO OK
___ POWER/SPEAKER SELECTION OK
___ WASHER/WIPERS OK
___ PARKING BRAKE OK
___ SEAT ADJUSTMENTS OK
___ DASH A/C OK
___ DASH HEATER/DEFROST OK
___ BACKUP MONITOR OK
___ BACKUP ALARM OK
___ REAR/SIDE VIEW MIRRORS OK
___ SUNVISORS OK
___ DOCKING/FOG LIGHTS OK
___ SPOT LIGHTS OK
___ TIRE CONDITION OK
___ TIRE AIR PRESSURE OK
___ LUG NUTS TORQUED ___ FT/LB
___ SPARE TIRE OK
___ HEADLIGHTS ADJUSTED
___ ENGINE COMPARTMENT
___ ENGINE OIL OK
___ COOLANT FLUID OK
___ ___ DEG. ANTIFREEZE
___ WINDSHIELD WASHER FLUID OK
___ POWER STEERING FLUID OK
___ BRAKE FLUID OK
___ TRANSMISSION FLUID OK
___ DRIVE BELTS OK
___ CHASSIS BATTERY
___ SECURED AND VENTED
___ ELECTROLYTE LEVEL OK
___ TEMP. COMPENSATED HYDROMETER READING(S) OK - ALL BATTERIES
___ TERMINAL CONNECTIONS OK
___ ALTERNATOR OUTPUT ___ VDC
___ BATTERY ISOLATOR/SOLENOID OK
___ ___VDC TO HOUSE BATTERY
___ EXHAUST
___ CONDITION OK
___ TERMINATION OK
___ LEVELING SYSTEM(S)
___ FLUID LEVEL OK
___ OPERATION OK
___ LEVEL SENSOR ACCURATE
___ CHECK FOR HYDRAULIC LEAK
___ AIR SUSPENSION OK
___ ROAD TEST
___ CRUISE CONTROL OK
___ STEERING/BRAKES OK
___ INTERIOR COMPONENTS SECURE
___ INSTRUMENTS & GAUGES OK
___ TRANSMISSION FLUID (WARM) OK

Page 2 of 2

ORIGINAL - RETURN TO MANUFACTURER
YELLOW - DEALER COPY
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1-9.6.2 Warranty Registration

Figure 1-103 is a sample of an OEM unit warranty registration form. *Figure 1-104* is a sample appliance warranty registration form. OEM and local standard operating procedures may call for one or all of these forms.

Figure 1-104 Sample OEM Unit Warranty Registration

COMPANY NAME

WARRANTY REGISTRATION

DATE OF PURCHASE | SERIAL NUMBER | MODEL | YEAR | LENGTH

MOTORIZED: CHASSIS SERIAL NUMBER | CHASSIS MANUFACTURER | MILEAGE

THIS PRODUCT WILL BE WARRANTED IN THE NAME OF:

OWNER	DEALER
OWNER'S NAME (LAST, FIRST, MIDDLE)	SELLING DEALER DEALER NUMBER
REGULAR MAILING ADDRESS - STREET OR PO BOX	REGULAR MAILING ADDRESS - STREET OR PO BOX
CITY YEAR ZIP	CITY YEAR ZIP
COUNTRY TELEPHONE (AREA CODE)	TELEPHONE (AREA CODE)

TYPE OR PRINT ALL ENTRIES

At the time of retail delivery, the selling dealer representative will perform the following inspections with the new owner and complete this pre-delivery and acceptance declaration. This form must be received within 30 calendar days from the date of purchase.

- ○ EXTERIOR INSPECTION
- ○ SHORELINE FUNCTION AND OPERATION
- ○ GENERATOR FUNCTION AND OPERATION
- ○ FRESH WATER SYSTEM: CITY AND GRAVITY WATER FILLS, WATER TANK, DRAINING
- ○ WASTE WATER SYSTEM: HOLDING TANKS, DRAINING
- ○ PROPANE SAFETY EXPLAINED
- ○ PROPANE CONTAINER(S) FILLED
- ○ WATER HEATER OPERATION
- ○ INTERIOR INSPECTION: FLOOR CARE, EMERGENCY EXITS, ROOF VENTS
- ○ CONVERTER FUNCTION AND OPERATION
- ○ RV BATTERY FUNCTION AND OPERATION
- ○ RV BATTERY FULLY CHARGED
- ○ GROUND FAULT INTERRUPTER
- ○ CIRCUIT BREAKERS
- ○ INTERIOR LIGHT, SWITCHES, AND RECEPTACLES
- ○ REFRIGERATOR OPERATION
- ○ RANGE OR RANGE/OVEN OPERATION
- ○ OPERATION OF OTHER APPLIANCES: ROOF AIR CONDITIONER(S), MICROWAVE OVEN, FOOD CONTROL CENTER
- ○ MONITORING PANEL FUNCTION AND OPERATION
- ○ FURNACE OPERATION
- ○ WATER PUMP OPERATION
- ○ BED SETUP AND STORAGE
- ○ TABLE SETUP AND STORAGE
- ○ CARE OF WINDOWS, CURTAINS, TABLES AND COUNTERTOPS
- ○ LAVATORY OPERATION AND CARE
- ○ MOTORIZED ROAD TEST: MAINTENANCE, LOADING, BACKING, OPERATION OF DASH COMPONENTS
- ○ NON-MOTORIZED ROAD TEST: MAINTENANCE, COUPLING/UNCOUPLING, PIGTAIL CONNECTION, LOADING, BACKING, BREAKAWAY SWITCH, BRAKE CONTROLLER
- ○ EXPLANATION OF WARRANTY
- ○ EXPLANATION OF CHASSIS WARRANTY
- ○ CHASSIS WARRANTY APPLIED FOR
- ○ EXPLANATION OF OTHER WARRANTIES
- ○ UNIT WAS CLEAN

DEALER

I certify that the unit described above was delivered to _____ (owner's name) on this date _____. The tests and inspections listed on a Pre-Delivery Checklist, a copy of which is on file at the dealership, were performed as described in the Pre-Delivery Manual. The Propane system was tested and is free of leaks. I also certify that all applicable items listed here were explained and/or demonstrated to the owner's satisfaction. I certify that all warranties were clearly explained to the owner and that the owner was offered to be taken on a road test of the unit described above.

Road Test was ☐ accepted ☐ declined

_____ _____

DEALER SIGNATURE DATE

OWNER

I certify that the unit described above was delivered to me on this date _____, and that the dealer (or an authorized representative) explained and/or demonstrated all applicable items listed here to my satisfaction. I certify that all warranties were clearly explained and that I was offered to be taken on a road test of this unit. I further certify that I have inspected this unit with the dealer or his authorized representative and that I accept the unit with complete satisfaction. Also, I have been provided with an Owner's Manual.

_____ _____

OWNER SIGNATURE DATE

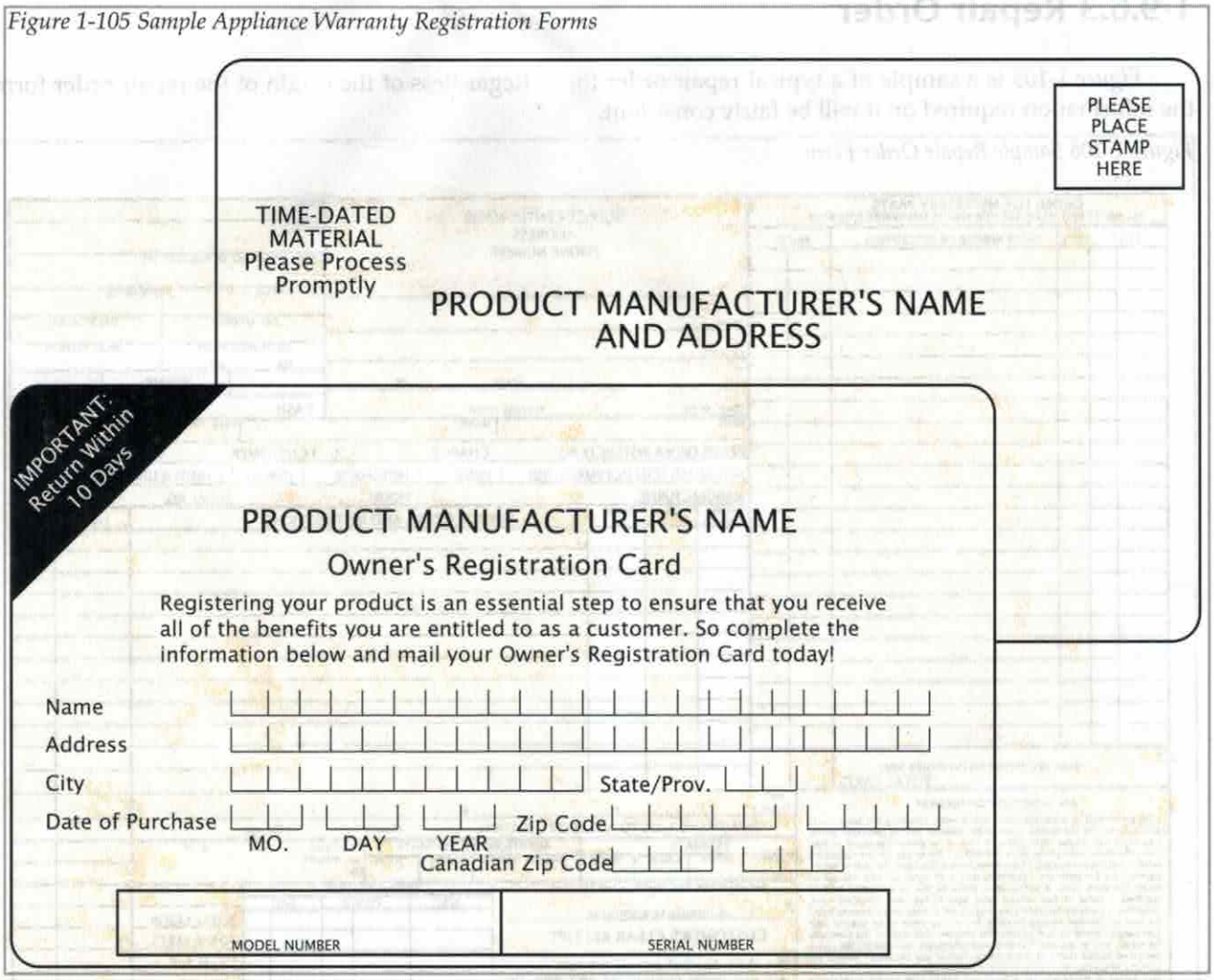
(Attach a copy of the Pre-delivery Checklist to this form.)

MANUFACTURER COPY

RETAIL COPY

DEALER COPY

Figure 1-105 Sample Appliance Warranty Registration Forms

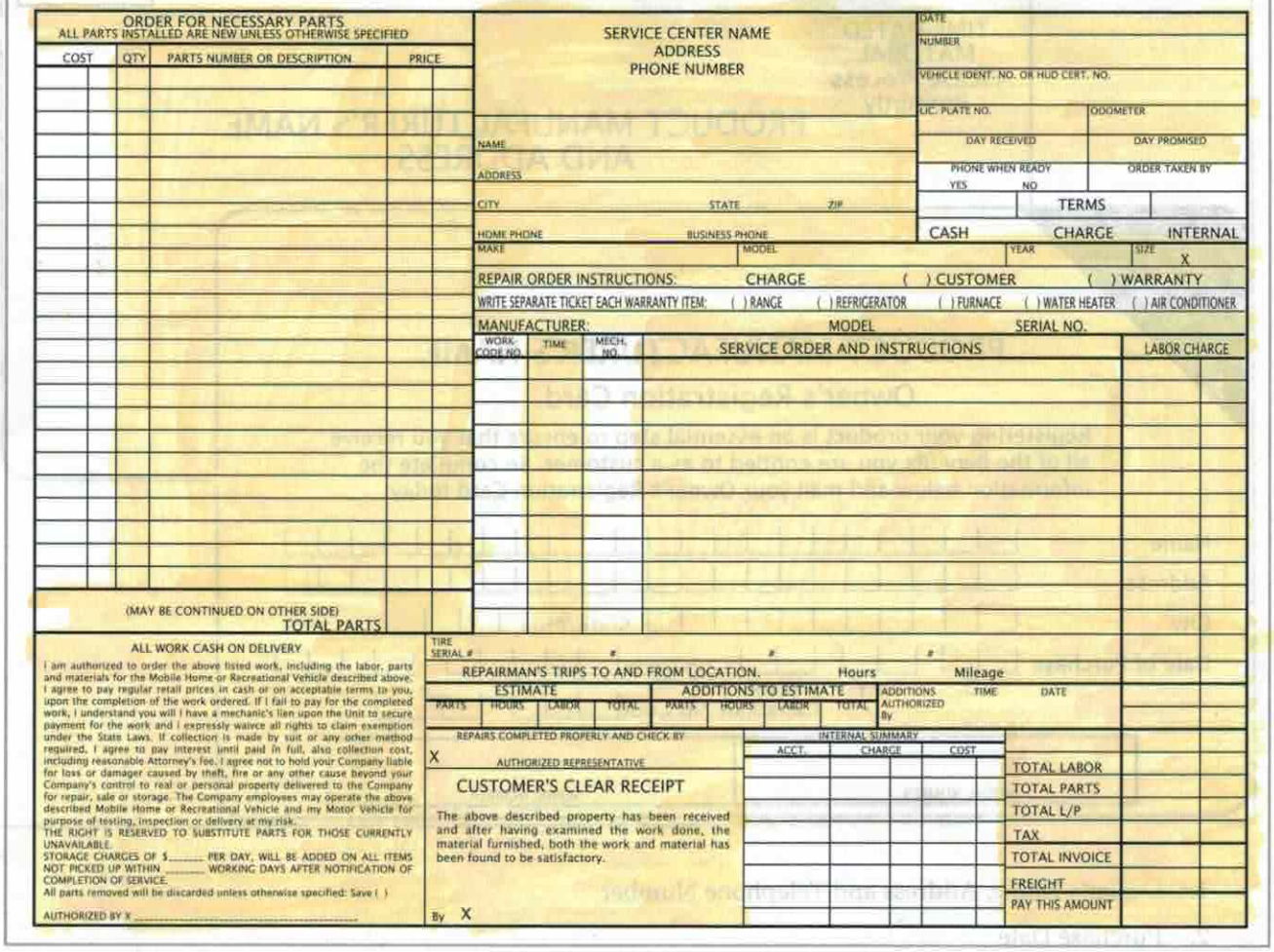


1. Dealer's Name, Address and Telephone Number
2. Purchase Date
3. Customer's Name, Address and Telephone Number
4. Technician's Name and Signature
5. Date of Walk-Through
6. Unit/Item Name, Model and ID/Serial Number
7. Chassis Serial Number if Motorized
8. Unit Length
9. Model Year
10. Customer's Acknowledgment (Initials) of Demonstration or Explanation
11. Dealer's Authorized Representative and Signature
12. Customer's Acceptance Signature

1-9.6.3 Repair Order

Figure 1-105 is a sample of a typical repair order form. Regardless of the origin of the repair order form, the information required on it will be fairly consistent.

Figure 1-106 Sample Repair Order Form



ORDER FOR NECESSARY PARTS
ALL PARTS INSTALLED ARE NEW UNLESS OTHERWISE SPECIFIED

COST | QTY | PARTS NUMBER OR DESCRIPTION | PRICE

(MAY BE CONTINUED ON OTHER SIDE) TOTAL PARTS

ALL WORK CASH ON DELIVERY

I am authorized to order the above listed work, including the labor, parts and materials for the Mobile Home or Recreational Vehicle described above. I agree to pay regular retail prices in cash or on acceptable terms to you, upon the completion of the work ordered. If I fail to pay for the completed work, I understand you will I have a mechanic's lien upon the Unit to secure payment for the work and I expressly waive all rights to claim exemption under the State Laws. If collection is made by suit or any other method required, I agree to pay interest until paid in full, also collection cost, including reasonable Attorney's fee. I agree not to hold your Company liable for loss or damager caused by theft, fire or any other cause beyond your Company's control to real or personal property delivered to the Company for repair, sale or storage. The Company employees may operate the above described Mobile Home or Recreational Vehicle and my Motor Vehicle for purpose of testing, inspection or delivery at my risk.
THE RIGHT IS RESERVED TO SUBSTITUTE PARTS FOR THOSE CURRENTLY UNAVAILABLE.
STORAGE CHARGES OF $_____ PER DAY, WILL BE ADDED ON ALL ITEMS NOT PICKED UP WITHIN _____ WORKING DAYS AFTER NOTIFICATION OF COMPLETION OF SERVICE.
All parts removed will be discarded unless otherwise specified: Save ( )

AUTHORIZED BY X _____

SERVICE CENTER NAME
ADDRESS
PHONE NUMBER

DATE
NUMBER
VEHICLE IDENT. NO. OR HUD CERT. NO.
LIC. PLATE NO. | ODOMETER
DAY RECEIVED | DAY PROMISED
PHONE WHEN READY YES NO | ORDER TAKEN BY
TERMS
CASH CHARGE INTERNAL

NAME
ADDRESS
CITY STATE ZIP
HOME PHONE BUSINESS PHONE

MAKE | MODEL | YEAR | SIZE X

REPAIR ORDER INSTRUCTIONS: CHARGE ( ) CUSTOMER ( ) WARRANTY
WRITE SEPARATE TICKET EACH WARRANTY ITEM: ( ) RANGE ( ) REFRIGERATOR ( ) FURNACE ( ) WATER HEATER ( ) AIR CONDITIONER
MANUFACTURER: MODEL SERIAL NO.

WORK CODE NO. | TIME | MECH. NO. | SERVICE ORDER AND INSTRUCTIONS | LABOR CHARGE

TIRE SERIAL # # # #

REPAIRMAN'S TRIPS TO AND FROM LOCATION. Hours Mileage

ESTIMATE: PARTS | HOURS | LABOR | TOTAL
ADDITIONS TO ESTIMATE: PARTS | HOURS | LABOR | TOTAL
ADDITIONS AUTHORIZED By | TIME | DATE

REPAIRS COMPLETED PROPERLY AND CHECK BY
X AUTHORIZED REPRESENTATIVE

CUSTOMER'S CLEAR RECEIPT

The above described property has been received and after having examined the work done, the material furnished, both the work and material has been found to be satisfactory.

By X

INTERNAL SUMMARY
ACCT. | CHARGE | COST

TOTAL LABOR
TOTAL PARTS
TOTAL L/P
TAX
TOTAL INVOICE
FREIGHT
PAY THIS AMOUNT

1. Customer's Name, Address and Telephone Number
2. Customer's Authorization of Work (not required if used to record PDI inspections and checks)
3. Technician's Name and Signature
4. Dealer's Authorized Representative and Signature
5. Date of Repair Order
6. Date Work Accomplished
7. Unit/Item Name, Model, and ID/Serial Number
8. If Motorized, Chassis Manufacturer
9. If Motorized, Chassis Serial Number
10. Unit Model Year
11. Reported Problem
12. Required Action (if new installation, etc.)

13. Action Taken
    A. Tests conducted and standards used
        1. *NFPA 1192*
        2. *National Electric Code,* Article 551 RV
        3. Item Service Manual and/or Bulletin
        4. Owner's Manual

NOTE: RV standards often require specific tests to be conducted whenever any work is accomplished on a system or system component. Standards, subject matter textbooks, and service manuals will identify what is required. For example, the propane system requires a leak test and a timed pressure drop test, recording times and pressures, anytime the system is "broken" (or opened as in removing or loosening a fitting) or a component is removed/replaced. In addition, if conducting a Hot Skin Test, the results must be recorded.

    B. Fluids replaced/checked
        1. Quantity
        2. Type
        3. Level reading
    C. Parts replaced/repaired
        1. Parts ID/serial numbers
        2. Remember the warranty registration form for replaced items having warranty coverage.
    D. Hours expended. The service manager or accounting department will normally compute the cost for the labor hours performed. Local standard operating procedures will dictate how hours are to be recorded. Some dealers may use a flat rate manual to determine hours to be charged for a specific task. Other dealers may use actual hours expended or may round hours, such as to the nearest quarter or half hour. Be aware of the company's policy.

1-9 Review

1. Which of the following is NOT a normally accepted reason for maintaining maintenance records?
   A. To document service performed
   B. To justify overhead rates
   C. To document technician hours
   D. To validate warranty requirements
2. Which of the following are types of maintenance records kept by a dealer or repair facility?
   A. Pre-delivery inspection forms
   B. Warranty registration forms
   C. Maintenance/repair order forms
   D. All of the above
3. List three methods of storing and retrieving maintenance records.
   A.
   B.
   C.
4. Customers should receive a copy of all maintenance and repair records.
   True False
5. When a pre-delivery inspection form does not have space to notate actions taken, the technician does not need to record them elsewhere.
   True False
6. Repair orders should be completed for all services performed on an RV.
   True False
7. When a customer moves away from the area, the dealership should destroy the maintenance records.
   True False
8. Dealerships and repair facilities may only use OEM/supplier-provided forms.
   True False
9. Completion and distribution of warranty registration forms is the responsibility of the customer.
   True False
10. Some OEMs may combine warranty registration and customer acceptance into the same form.
    True False

1 Answer Keys

Chapter 1-1

1. New York *(page 1-1)*
2. 1960s *(page 1-1)*
3. Over $70 billion *(page 1-1)*
4. 8.9 million *(page 1-1)*

Chapter 1-2

1. E. travel trailer *(page 1-8)*
   D. camping trailer *(page 1-9)*
   C. motorhome *(page 1-7)*
   A. truck camper *(page 1-10)*
   B. fifth wheel *(page 1-9)*
   F. sport utility trailer *(page 1-10)*
2. False—a travel trailer requires a tow vehicle *(page 1-8)*
3. Fifth wheel trailer *(page 1-9)*
4. Any of the following: *(page 1-7)*

   Indiana
   Oregon
   Michigan
   California
   Idaho
   Pennsylvania
   Iowa
   Alabama

5. A. conventional motorhome (Type A) *(page 1-8)*
   B. van camper (Type B) *(page 1-8)*
   C. mini motorhome (Type C) *(page 1-8)*
   D. travel trailer *(page 1-9)*
   E. fifth wheel trailer *(page 1-9)*
   F. folding camping trailer (pop-up) *(page 1-10)*
   G. truck camper *(page 1-10)*
   H. sport utility trailer *(page 1-10)*

Chapter 1-3

1. Wrenches and sockets *(page 1-22)*
2. Diagonal cutting pliers *(page 1-28)*
3. Box-end wrench *(page 1-23)*
4. Torque wrench *(page 1-24)*
5. Causes metal chips to fly *(page 1-25)*
6. Socket wrench *(page 1-24)*
7. Phillips *(page 1-21)*
8. Offset *(page 1-22)*
9. Slip-joint *(page 1-27)*
10. Plastic tip *(page 1-26)*
11. A. Combination wrench *(page 1-22)*
    B. Torque wrench *(page 1-24)*
    C. Offset *(page 1-22)*
    D. Plastic tip *(page 1-26)*
    E. Needlenose *(page 1-27)*
    F. Socket *(page 1-24)*
    G. Slip-joint *(page 1-27)*

Chapter 1-4

1. B (CAP/HAT) *(page 1-41)*
2. M (JEWELRY) *(page 1-41)*
3. H (GASOLINE) *(page 1-42)*
4. L (SAFETY PROCEDURES) *(page 1-41)*
5. P (PROTECTIVE) *(page 1-41)*
6. N (METAL CONTAINERS) *(page 1-42)*
7. A (ACCIDENTS) or K (INJURIES) *(page 1-39)*
8. J (IMMEDIATELY) *(page 1-41)*
9. C (CLEAN) *(page 1-42)*
10. I (HORSEPLAY)*(page 1-41)*
11. Q (SMOKE) *(page 1-41)*
12. K (INJURIES) *(page 1-41)*
13. O (OPERATION) *(page 1-41)*
14. F (EYE PROTECTION) *(page 1-41)*
15. S (VENTILATED) *(page 1-42)*
16. R (STORAGE) *(page 1-42)*
17. G (FIRE EXTINGUISHER) *(page 1-40)*
18. T (WASH) *(page 1-42)*
19. E (COMBUSTIBLE) *(page 1-42)*
20. D (CLEAR) *(page 1-42)*
21. H (INSULATED) or F (GROUNDED) *(page 1-44)*
22. O (SECURED) *(page 1-43)*

23. E (EYE PROTECTION) *(page 1-43)*
24. F (GROUNDED) *(page 1-43)*
25. D (LEDGE) *(page 1-43)*
26. M (RETURN) *(page 1-42)*
27. A (OUT OF THE PATH) *(page 1-43)*
28. K (POCKETS) *(page 1-43)*
29. G (HANDLES) *(page 1-43)*
30. J (LOOSE) *(page 1-43)*
31. C (DESIGNED) *(page 1-43)*
32. P (SHARPNESS) *(page 1-43)*
33. B (CLEAN) *(page 1-42)*
34. G (HANDLES) *(page 1-43)*
35. N (SAFER) *(page 1-43)*
36. I (LIGHT) *(page 1-43)*
37. L (REBOUNDS) *(page 1-43)*
38. H (EYE PROTECTION) *(page 1-44)*
39. K (GUARDS) *(page 1-44)*
40. N (LOOSE) *(page 1-41)*
41. M (JEWELRY) *(page 1-41)*
42. D (DEFECTIVE) *(page 1-44)*
43. F (DRY) *(page 1-44)*
44. O (OVERLOAD) *(page 1-44)*
45. I (FIRMLY) *(page 1-44)*
46. B (BATTERIES); S (GAS WELDING) *(page 1-44)*
47. G (EXPLOSIVE) *(page 1-44)*
48. J (GROUNDED or DOUBLE INSULATED) *(page 1-44)*
49. E (DISCONNECTED) *(page 1-44)*
50. A (BALANCE) *(page 1-44)*
51. P (PLUG IN) *(page 1-44)*
52. EYE PROTECTION *(page 1-45)*
53. ASBESTOS *(page 1-45)*
54. PRESSURE *(page 1-45)*
55. DEMONSTRATED *(page 1-44)*
56. TRIP *(page 1-45)*
57. POINT *(page 1-45)*
58. SIZE *(page 1-45)*
59. AIR HOSE *(page 1-45)*
60. AIR FILTER OR PARTICLE MASK *(page 1-45)*
61. EXPLODE *(page 1-45)*
62. FACE SHIELD *(page 1-45)*
63. TORQUE WRENCH *(page 1-45)*
64. PLACE *(page 1-45)*
65. ATTACHED *(page 1-45)*
66. CONNECT *(page 1-45)*
67. INJURY *(page 1-45)*
68. SHORT *(page 1-45)*
69. CLEAN *(page 1-45)*
70. A & C *(page 1-45)*
71. C (eye protection) *(page 1-45)*
72. A (jack) *(page 1-46)*
73. D (all of the above) *(page 1-46)*
74. A (the hoist is rated to lift heavier vehicles) *(page 1-46)*
75. B (doors, trunk, hood closed) *(page 1-46)*
76. E (ELECTROLYTE) *(page 1-47)*
77. F (EXPLOSIVE) *(page 1-47)*
78. G (EYE PROTECTION) *(page 1-47)*
79. S (SPARKS) *(page 1-47)*
80. C (BAKING SODA) *(page 1-47)*
81. K (JEWELRY) *(page 1-47)*
82. A (ACID); V (WATER) *(page 1-47)*
83. Q (PAPER TOWELS) *(page 1-47)*
84. N (NEGATIVE) *(page 1-47)*
85. J (IMMEDIATELY) *(page 1-47)*
86. U (TOOLS) *(page 1-47)*
87. M (LIFT STRAP) *(page 1-47)*
88. O (OFF) *(page 1-47)*
89. H (FIRST) *(page 1-47)*
90. L (LAST) *(page 1-47)*
91. R (POSITIVE) *(page 1-47)*
92. I (FROZEN) *(page 1-48)*

93. T (STOP) *(page 1-48)*
94. D (CONTACT) *(page 1-48)*
95. 6, 5, 3, 2, 1, 4, 7 *(page 1-48)*
96. I (OXYGEN); G (HEAT); E (FUEL) *(page 1-48)*
97. B (B) *(page 1-48)*
98. A (A) *(page 1-48)*
99. D (D) *(page 1-48)*
100. C (C) *(page 1-48)*
101. J (PURPLE) *(page 1-49)*
102. K (RED) *(page 1-49)*
103. F (GREEN) *(page 1-49)*
104. L (WHITE); N (BLACK) *(page 1-49)*
105. H (ORANGE) *(page 1-49)*
106. M (YELLOW) *(page 1-49)*

Chapter 1-5

There is no review for this chapter.

Chapter 1-6

1. Every five years *(page 1-75)*
2. A. minimum published score (higher than certified). *(page 1-75)* and five years' experience
   B. all five certified specialties and five years' experience *(page 1-75)*
3. It is jointly sponsored by the RV Dealers Association (RVDA) and the RV Industry Association (RVIA). *(page 1-74)*
4. A. hourly wage *(page 1-75)*
   B. flat rate *(page 1-75)*

Chapter 1-7

1. E (Flat-Rate Manuals) *(page 1-80)*
2. A (Owner's Manual) *(page 1-79)*
3. B (Manufacturers' Service Manuals) *(page 1-79)*
4. C (Repair Manuals) *(page 1-79)*
5. B (Manufacturers' Service Manuals) *(page 1-79)*
6. A (Owner's Manual) *(page 1-79)*
7. D (Service Bulletins) *(page 1-80)*

Chapter 1-8

1. C *(page 1-89)*
2. D *(page 1-87)*
3. C *(page 1-87)*
4. D *(page 1-87)*
5. A *(page 1-89)*
6. B *(page 1-90)*
7. D *(page 1-90)*
8. C *(page 1-88)*
9. D *(page 1-85)*
10. C *(page 1-86)*
11. B *(page 1-90)*
12. A *(page 1-93)*
13. A *(page 1-87)*

Chapter 1-9

1. B *(page 1-99)*
2. D *(page 1-101)*
3. A. hard copy *(page 1-101)*
   B. microfiche copy *(page 1-102)*
   C. electronic copy *(page 1-102)*
4. True *(page 1-103)*
5. False—An installation/repair order should be used to record actions taken. *(page 1-104)*
6. True *(page 1-101)*
7. False—Records need to be maintained for a specific period of time to meet legal and/or OEM and supplier requirements. *(page 1-100)*
8. False—OEM and supplier forms are used where required but dealers and repair facilities may develop their own additional forms to meet their own needs. *(page 1-99)*
9. False—Warranty registration forms should be completed by the technician and given to the customer during the customer's acceptance walk through after the safe operation and use has been explained. *(page 1-101)*
10. True *(page 1-99)*

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1 Glossary of Introduction to RV Service Terms

Air Conditioning Often thought to mean only the cooling of air, but also includes heating, humidifying, cleaning, and distribution of air.

Alternating Current (AC) Electricity A flow of electricity that rises from zero to some maximum value in one direction, falls off to zero, then reverses and reaches a maximum value in the other direction, then again falls off to zero. This cycle is repeated continuously at a fixed frequency, measured in hertz (Hz). In the U.S.A. and Canada, the frequency is 60 Hz.

Ambient Temperature or pressure in the immediate area being discussed.

American Gas Association (AGA) An agency involved in testing and listing gas fired appliances, controls, and accessories. The "Blue Star" AGA label states that the design of a labeled appliance "complies with national safety standards."

American National Standards Institute (ANSI) The American National Standards Institute is the central body responsible for the voluntary establishment of a single, consistent set of standards known as the American National Standards. ANSI approval of standards is intended to verify that the principles of openness and due process have been followed in the approval procedure and that a consensus of those directly and materially affected by the standards has been achieved.

Ampere A unit of flow of electrical current (flow of electrons). One ampere represents the flow of 6.25×10^8 electrons per second past a given point in the circuit. One volt (potential difference) across a resistance of one ohm will cause one ampere of current to flow.

Camping Trailer A vehicular portable unit mounted on wheels and constructed with collapsible partial side walls that fold for towing by another vehicle and unfold at the campsite to provide temporary living quarters for recreational, camping, or travel use.

Carbon Dioxide (CO_2) Colorless, odorless gas formed by the combustion of a fuel.

Carbon Monoxide (CO) By-product of poor combustion of fuel. Colorless, odorless, highly poisonous if breathed.

Celsius (C) Scale used in temperature measurement; 0° water freezes, 100° water boils (at mean sea level). Also known as Centigrade scale.

Centigrade See Celsius.

Circuit An arrangement of conductors and devices connected together for the purpose of carrying an electrical current.

Circuit Breaker A device designed to open and close a circuit by (non)automatic means, and to open the circuit automatically on a predetermined overload of current, without injury to itself when properly applied within its rating.

Code Collection of rules, regulations, and laws enforced by federal, state, and local agencies, usually as a protection for consumers. Example: an appliance will be installed "to code," or a house will be built "to code."

Conversion Vehicle A vehicle that contains the permanent addition to or modification of any item or system from its original state as supplied by the original equipment manufacturer (OEM). This includes the additional or separate, fully independent systems that were not present in the vehicle as supplied by the OEM.

Current The movement of electrons through a conductor, similar to the flow of water in a plumbing system. Current is measured in amperes, milliamperes, and micro-amperes. Expressed by the letter "I."

Customer One who purchases a commodity or service.

Direct Current (DC) Electrical current that flows in only one direction (polarity does not reverse as does alternating current).

Fahrenheit (F) The common scale of temperature measurement in the English system of units. It is based on the freezing point of water being 32°F and the boiling point of water being 212°F at mean sea level.

Federal Motor Vehicle Safety Standards (FMVSS) The safety standards established for motor vehicles and motor vehicle equipment as a result of Section 103 of the National Traffic and Motor Vehicle Safety Act of 1966 (80 Stat. 718).

Fifth Wheel A vehicular unit, mounted on wheels, designed to provide temporary quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permit(s), of gross trailer area not to exceed 430 ft^2 in the set-up mode, and designed to be towed by a motorized vehicle that contains a towing mechanism that is mounted above and forward of the tow vehicle's rear axle.

Folding Camping Trailers A vehicular portable unit mounted on wheels and constructed with collapsible partial side walls that fold for towing by another vehicle and unfold at the campsite to provide temporary living quarters for recreational, camping, or travel use.

Gas Appliance Manufacturers Association (GAMA) An association of manufacturers of appliances and equipment for utilization, distribution, and control of gas.

Generator (Electrical) Any device that produces electrical energy. Commonly used to describe a rotating machine that converts mechanical energy into electrical energy.

Genset (Power plant) An on-board engine-driven alternator (or generator) used to produce AC power independent of utility power.

Hydraulic Mechanical means of operation using fluid under pressure. An automobile brake system uses this principle.

Inches of Water Column (IN WC) Units used to measure pressure and vacuum in air or gas. Normal regulated gas pressure is usually 11 in. WC nominal. 1 in. WC = 0.0361 psi or 0.58 oz/in^2. See *Manometer*.

Junction Point at which two or more wires are connected.

Listed Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

Listening The ability to hear and understand what is being said, when it is being said, without making immediate interpretations.

Manometer Instrument used to measure air and gas pressure or vacuum. Unit measurement for a U-tube-type manometer is inches of water column (in. WC). A dial manometer may also provide readings in ounces per square inch and kilopascals.

Moment of Truth An episode during which a customer comes into any contact with a representative of the organization.

Motor A device that produces mechanical motion from electric energy.

Motorhome A vehicular unit designed to provide temporary quarters for recreational, camping, or travel use, built on or permanently attached to a self-propelled motor vehicle chassis or on a chassis cab or van that is an integral part of the completed vehicle.

National Electrical Code (NEC) Regulations governing electrical installations in the U.S.A.

National Electric Manufacturing Association (NEMA) Sets standards used by Underwriters Laboratories and industry.

Overcurrent Protection Device A switch operated by heat and placed on motor windings to open the motor circuit in case of excessive heat in the motor.

Personal Space One full arm's length or about three feet of space.

Propane A liquefied petroleum gas. Specific gravity is heavier than air. Sometimes called *bottled gas*. Used mostly in areas where natural gas is not piped.

Rapport Harmonious relation.

Recreation Vehicle A vehicular-type unit primarily designed as temporary living quarters for recreational, camping, travel, or seasonal use that either has its own motive power or is mounted on, or towed by, another vehicle.

Recreation Vehicle Industry Association The Recreation Vehicle Industry Association (RVIA) is the national trade association representing recreation vehicle manufacturers and their component part suppliers who together build more than 98 percent of all RVs produced in the United States.

Regulator (Gas pressure regulator) A device for controlling and maintaining uniform gas pressure.

Service Contribution to the welfare to others; useful labor that does not produce a tangible commodity.

Travel Trailer A vehicular unit, mounted on wheels, designed to provide temporary quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permits when towed by a motorized vehicle, and a gross trailer area less than 400 ft^2.

Truck Campers A portable unit constructed to provide temporary living quarters for recreational, travel, or camping use, consisting of a roof, floor, and sides, designed to be loaded onto and unloaded from the bed of a pickup truck.

Underwriters Laboratories (UL) Approval and testing agency principally concerned with electrical devices.

Volt The unit of voltage (potential difference, EMF). One volt will produce a flow of one ampere through a one ohm resistance.

Voltage The relative amount of electric charge at one point in an electric circuit compared with that at another point in the circuit, which causes a current flow through a continuous path between the two points. Also referred to as *electromotive force* and *potential difference*.

Voltmeter An instrument for measuring voltage.

Water Column Abbreviated as WC. A unit used for expressing pressure.

Watt Unit of measurement of electrical power. Rate at which one volt can push one amp through an electrical system.

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Proposal (include proposed new or revised wording, or identification of wording to be deleted): (Note: proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (deleted wording). Use reverse side of this or a blank sheet if necessary. Please provide sketches of required illustrations.

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