MODEL KM 4-40 C1M1

ORIGINAL INSTRUCTIONS

THE CHOICE OF ASPHALT PROFESSIONALS WORLDWIDE

KM INTERNATIONAL
6561 Bernie Kohler Drive, North Branch, Michigan
Tel 1-810-688-1234 Toll Free (USA) 1-800-492-1757 Fax 1-810-688-8765
www.kminternational.com

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INTRODUCTION

The KM International Team would like to take this opportunity to THANK YOU for your purchase of the KM 4-40 Infrared Asphalt Recycler (KM 4-40 IR). We at KMI are confident that your newest Infrared asphalt surface heater will offer years of safe, reliable and cost effective “IN PLACE ASPHALT RECYCLE and REPAIR.” KM International, Inc. has acquired and developed a number of strengths that has fostered KMI’s worldwide reputation as the “INFRARED PROCESS EXPERTS”. We have designed, developed and set the “Gold” and “Green” standards for Infrared use. We are the preeminent authority on the “Infrared Process” of in place “asphalt surface heating” and “recycle and repair.” We have fostered an ongoing industry standard of quality and excellence that continually exceeds our customers’ expectations in all of our product offerings including our “Infrared” line of equipment, crack maintenance and repair equipment, Hot Box Asphalt Reclaimers and Asphalt Recyclers.

Our commitment to the design and manufacture of the highest quality asphalt surface maintenance and repair equipment on the market is not just a “quote on the wall” but rather the driving force for the entire KMI team. Our 26 years in the Infrared and asphalt maintenance industries has provided KM INTERNATIONAL the necessary experience and knowledge of “IN PLACE ASPHALT RECYCLE and REPAIR” to give our customers the “peace of mind” that only experience and knowledge can provide; experience and knowledge that our customers have come to rely on. The Management Team at KM INTERNATIONAL is confident that YOUR purchase of the KM 4-40 IR will be the basis for a long standing and mutually profitable relationship. The Goal at KM INTERNATIONAL has and will always be to manufacture infrared heaters that provide our customers cost savings, purchase justification and profitability.

The KM 4-40 Infrared Asphalt Recyclers are designed to give years of dependable high performance service. Their solid welded construction stands up well to commercial use. The simple, straight forward design has little to go wrong and can be maintained easily. Its patented fold up design makes the 4-40 IR easy to use, transport and store.

The KM 4-40 Infrared Asphalt Recycler provides two (2) 2 foot x 4 foot (.6m x 1.2m) and two (2) 3 foot x 4 foot (.9m x 1.2m) independently controlled infrared zones for a total coverage of 8 foot x 5 (2.4 m x 1.5 m) foot (3.6 sq. meters), as the name indicates four (4) zones for 40 sq. feet (3.6 sq m) hence the name KM 4-40 IR. It is designed to be used to heat and repair asphalt of varying sizes and shapes making it the most versatile and efficient Infrared Asphalt Recycler on the market.

The serial number for this machine is located on a serial tag on the front of the machine. Please be sure to retain this manual. It is a convenient information source that should be consulted regularly.
SAFETY

⚠️ **NOTICE:** This unit is not ATEX Certified. Do Not use in any explosive environment.

⚠️ **NOTICE:** Only properly trained personnel should operate this equipment.

⚠️ **WARNING:** Always wear protective clothing, safety glasses, ear protection, leather protective gloves, and leather protective work boots when operating this or any other equipment. This equipment uses an open flame and requires the proper protection to avoid operator injury.

⚠️ **READ and UNDERSTAND** these operating instructions carefully **PRIOR TO ATTEMPTING TO OPERATE** the KM 4-40 Infrared Asphalt Recycler. **FAILURE TO FOLLOW** these instructions and the safety warnings on the KM 4-40 IR may result in a possible **FIRE HAZARD** and will void the warranty. Any safety screen or guard removed for servicing must be replaced before operating the KM 4-40 Infrared Asphalt Recycler.

⚠️ **WARNING:** **DO NOT USE** the KM 4-40 Infrared Asphalt Recycler if any part(s) has been damaged or placed under water.

⚠️ **NOTICE:** **DO NOT OPERATE** if the ceramic refractory blanket is wet or damaged.

⚠️ **NOTICE:** **DO NOT OPERATE** if the side safety panels have been removed.
If the 4-40 IR is not working or has been damaged in any way **IMMEDIATELY CALL** a qualified service technician to inspect the infrared heater and/or to replace any part of the control system and any gas control, which has been damaged.

⚠️ **THIS UNIT REQUIRES PROPANE GAS.** Maintenance must be **PERFORMED** by a qualified service person. The KM 4-40 Infrared Asphalt Recycler system should be **INSPECTED** before initial use and every use thereafter only by a qualified service technician.

⚠️ **WARNING:** It is imperative that the unit’s control compartment, burners, and circulating air passageways are kept clean to provide for adequate combustion and ventilation air. Always keep the KM 4-40 IR clear and free from combustible materials, gasoline, and other flammable vapors and liquids.

**NEVER OBSTRUCT** the flow of combustion and ventilation air. Keep the front of the KM 4-40 IR CLEAR of all obstacles and materials for servicing and proper operation. Children and adults should be **ALERTED** to the hazards of high surface temperature and should **STAY AWAY** to avoid burns or clothing ignition.

⚠️ **NOTICE:** The KM 4-40 IR is intended for **OUTDOOR USE ONLY.**
SAFETY

⚠️ NOTICE: Safety is a serious concern when working with any fuel combustion system and the KM 4-40 propane system is no exception. Gas leaks present a danger and should be tested for daily. Use a strong soap solution around fittings, bottles and hoses, watching for bubbles. NEVER use a flame to locate a suspected leak.

⚠️ The KM 4-40 Infrared Asphalt Recycler is designed to heat asphalt to a working temperature in excess of three hundred 300 degrees Fahrenheit (149 Celsius). The desired surface temperature can be a hazard and requires all necessary caution. The heat can and will get DANGEROUSLY HOT very quickly; care and caution must be observed at all times.

⚠️ WARNING: Explosions can occur if gas is present!

⚠️ NOTICE: Be aware of your surroundings. Use caution around buildings, utility wires, combustibles, excess seal coat, flammable gasses from manhole covers, landscaping material, dry weeds and grasses, or buried utilities, etc. to prevent damage from heat or fire.

⚠️ Whenever heating on or around manholes and other underground utilities, always check with the local utility company for presence of gas or combustibles. Use a gas sniffer or detector to determine flammable hazards. Do not ever use an open flame to check for flammable gases.

⚠️ CAUTION: When heating asphalt where rubber crack fill exists, take extreme care as the rubber may catch fire. It may be necessary to manually cycle the heating sequence in order to heat the surface more slowly. A slower heating process minimizes the potential to flash ignite the rubber. The same procedure may also be necessary while heating over fresh or excessive sealcoat.

⚠️ WARNING: Inspect all fuel lines and connections daily before using the KM 4-40 Infrared. DO NOT use if damaged in any way. DO NOT allow the fuel line to lie against the bottom of the machine or on any hot surface during use. DO NOT expose the hose in any way to heat or physical abuse during operation.

⚠️ NOTICE: Whenever heating on or around manholes and other underground utilities, always check with the local utility company for presence of gas or combustibles. Use a gas sniffer or detector to determine flammable hazards. Do not ever use an open flame to check for flammable gases.

⚠️ IT IS HIGHLY RECOMMENDED THAT YOU HAVE A FIRE EXTINGUISHER ON YOUR JOB SITE AT ALL TIMES.
THE KM 4-40 IS A TRAILER UNIT

Reporting Safety Defects

If you believe that your vehicle has a defect that could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying KM International Inc.

If the NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, the NHTSA cannot become involved in individual problems between you, your dealer, or KM International, Inc.

To contact the NHTSA, you may call the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153), go to http://www.safercar.gov; or write to: NHTSA, US Department of Transportation, 1200 New Jersey Ave SE, Washington, DC 20590. You can also obtain other information about motor vehicle safety from http://www.safercar.gov.

⚠️ NOTICE: It is necessary to learn and know all applicable Department of Transportation regulations prior to towing this vehicle.

<table>
<thead>
<tr>
<th>AXLE RATING:</th>
<th>2,000 Lbs. (900 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GVWR:</td>
<td>1,180 Lbs. (531 kg)</td>
</tr>
<tr>
<td>TIRES:</td>
<td>590 Lbs. (268 kg) capacity each (load range B)</td>
</tr>
<tr>
<td>TIRE PRESSURE:</td>
<td>60 PSI (410 kpa) cold inflation</td>
</tr>
<tr>
<td>BRAKES:</td>
<td>N/A</td>
</tr>
</tbody>
</table>

⚠️ WARNING: Use of a tow vehicle with a towing capacity less than the load rating of the trailer can result in loss of control, and may lead to death or serious injury. Ensure your hitch and tow vehicle are rated for the Gross Vehicle Weight Rating identified on the VIN tag of your trailer.

⚠️ WARNING: Be sure that the tow hitch load rating meets or exceeds the GVWR of the trailer. Inspect the tow hitch for wear. Replace if worn, cracked, or corrosion exists. Inspect and ensure that all connecting hardware is tightened and serviceable.

⚠️ NOTICE: When connecting the tow vehicle to the trailer ensure to match the tow hitch and trailer hitch size. Inspect that the hitch is securely coupled and safety chains are properly attached before travel.

⚠️ WARNING: Inspect and test the safety chains and safety breakaway system before travel. The safety breakaway cable must connect to the vehicle, never connect to the hitch.
THE KM 4-40 IS A TRAILER UNIT

LIGHTS & BRAKES

⚠️ **NOTICE**: Inspect all trailer lighting prior to travel. Inspect rear running tail lights, marker lights, turn signals and brake lights. Ensure that trailer light plug is properly connected to the tow vehicle.

⚠️ **WARNING**: For electric brakes it is necessary for the tow vehicle to signal the trailer electric brakes. Inspect the trailer brakes for operation before travel. Failed trailer brakes can result in a hazardous accident causing injury, or death.

⚠️ **WARNING**: For hydraulic actuated brake systems it is necessary to inspect the hitch actuator, hydraulic tube lines and connections. Inspect for leaks. Inspect the hydraulic fluid level in the brake actuator. Inspect the trailer brakes for operation before travel. Failed trailer brakes can result in a hazardous accident causing injury, or death.

⚠️ **NOTICE**: A qualified mechanic should inspect the breaks and breaking system for proper service and wear.

WHEELS & TIRES

⚠️ **WARNING**: Improper tire pressure can result in loss of control which can lead to death or serious injury. Ensure tires are inflated to the pressure indicated on the side wall of the tire before towing the trailer.

⚠️ **WARNING**: Be sure lug nuts are tight before each trip. Lug nuts can loosen after initial installation. Check lug nuts for tightness after new tire installation at intervals of the first 10, 25 and 50 miles of travel.

⚠️ **NOTICE**: Tighten the lug nuts to 100 ft/lbs. torque. Over tightening will result in breaking the lugs or cause permanent damage resulting in possible wheel failure. Use a calibrated torque wrench to tighten the lug nuts.

HOW the HEATING SYSTEM WORKS

The blower constantly forces air through the micro-spaces in the ceramic refractory fiber blanket. When the control valves are opened, propane gas is mixed with this air. The pilot light then ignites as shown in Figure 2. This results in the combustible mixture, at the lower surface of the blanket, to ignite on the surface of the ceramic blanket as shown in Figure 1. Flame is never present behind the blanket. The flame spreads evenly across this lower surface and quickly turns red-orange hot. The long wave radiant energy or Infrared that is developed then penetrates the asphalt surface.

The KMI Infrared heating process is the only one of its kind in the industry. The heater utilizes automatically timed cycles that turn the heater on and off during use. The process was specifically designed by the KMI Team to allow for deeper penetration of the asphalt without burning or scorching the surface. The KM International Infrared Process allows the heated asphalt to be reused and provides a better longer lasting seamless repair.

⚠️ WARNING: Heat escaping from under the KM 4-40 Infrared causes the bottom sides of the unit to get very hot. Be sure that the blower has gone through its final cooling cycle. Depending on ambient conditions, the heaters may still be hot enough to cause serious injury. SHOW CARE & CAUTION when loading and transporting.

⚠️ WARNING: Always wear protective clothing, safety glasses, ear protection, leather protective gloves, and leather protective work boots when operating this or any other equipment. This equipment uses an open flame and requires the proper protection to avoid operator injury.

⚠️ CAUTION: When heating asphalt where rubber crack fill exists, take extreme care as the rubber may catch fire. It may be necessary to manually cycle the heating sequence in order to heat the surface more slowly. A slower heating process minimizes the potential to flash ignite the rubber. The same procedure may also be necessary while heating over fresh or excessive sealcoat.
SET UP / UNFOLDING THE 4-40 FOR WORK

The KM 4-40 Infrared must be removed from the transporting vehicle and put into the “unfolded” open position to be operated. The KM 4-40 Infrared Asphalt Recycler was designed for easy use and transport. Its unique folding design accomplishes that goal.

FOLDING (CLOSING) AND UNFOLDING (OPENING) the INFRARED ASPHALT RECYCLER

1. Remove the corresponding removable lift pipe handle bars located in their respective holders directly adjacent to the propane bottles. Place one of the lift pipe handle bars in the slot located on the trailer tongue for easy lift and maneuvering. (Figure 4.)

2. Remove the unit from the trailer hitch of the transporting vehicle. The trailer hitch ball lock lever MUST be lowered to the down position to avoid damage to the surface of the KM 4-40.

3. Place the lift pipe handle bars into the fold/unfold slots under the front edge of the Infrared Recycler, (as shown in Figure 6.)
SET UP / UNFOLDING THE 4-40 FOR WORK

4. While holding onto the lift pipe handle bars slowly walk the front edge backwards toward the rear of the KM 4-40. Please NOTE: the rear casters must be in the rear facing position and locked into position using the caster locking “U” pin (Figure 12), (not side maneuvering position) to prevent the bottom of the 4-40 from directly touching the surface, (as shown in Figures 7 & 8.)

![Figure 7](image1)

![Figure 8](image2)

5. The 4-40 should then be slowly lowered until resting entirely on the deck surface. (As shown in Figures 9 & 10)

![Figure 9](image3)

![Figure 10](image4)

6. When the KM 4-40 is completely unfolded the lift pipe handles should be placed in the axle side corner holsters for easy maneuvering of the infrared machine. (Figure 11) The casters may then be placed in the side maneuvering position to avoid heating surfaces depending upon the application or repair configuration.

![Figure 11](image5)

![Figure 12](image6)
SET UP / UNFOLDING THE 4-40 FOR WORK

7. **TO FOLD/CLOSE**: Remove the corresponding removable lift pipe handle bars located in their respective holders and place the lift pipe handle bars back into the fold/unfold slots under the front edge of the Infrared Recycler, (as shown in Figure 13.)

8. **PRIOR TO FOLDING** the rear casters must be placed back into the rear facing and locked position (Figure 12.). The KM 4-40 Infrared can then be returned to the closed position.

9. Two Crew members will then slowly lift the unit straight up avoiding back or strain injury, (Figure 13.)

10. The unit should then be lifted to the maximum height (approximately 4’) and immediately walked backwards slowly in a single motion until the unit is closed and resting on the tow tires in the fully closed “towing” position. (See Figures 14, 15 and 6.)
## OPERATING THE KM 4-40-C1

### Once unfolded the KM infrared heater can be moved to the area for repair by pushing on the removable lift pipe handles inserted at the axle side of the unit as well as the handle bar across the control panel side of the unit.

Helpful hint: Consider wind direction, caster location, and repair size when positioning the unit.

### Remove the U-pin on zone casters #1 and #2 when positioning the unit over an area for repair.

**WARNING:** Always wear protective clothing, safety glasses, ear protection, leather protective gloves, and leather protective work boots when operating this or any other equipment. This equipment uses an open flame and requires the proper protection to avoid operator injury.

### All four independent casters can be positioned to allow the operator to straddle most repairs with the casters. Remove the hitch pin from the S-arm pin on the bracket, reposition the caster and re-install the hitch pin.

### To begin heating a repair area:

1. **Slowly open all propane cylinders.**

   **NOTE:** Opening a propane cylinder valve too quickly will activate the safety flow control valve which minimizes the amount of propane allowed to leave the bottle.

2. **Gently twist and pull the Emergency Stop button up.**

   **NOTICE:** Push the E-stop button at any time to stop the KM infrared heater. The blower will continue to operate for one minute after stopping the unit. This allows for all combustible mixture to be purged from the blanket.

3. **Turn the keyed switch On. The blower will operate.**

   The Volt gauge will indicate voltage. The optimum operating range is 12 Volts. A fully charged battery might indicate higher at the beginning of operations. As a work time continues the battery voltage will drop and show approximately 11.5 Volts, this is normal. Once the battery voltage drops below 11 Volts, the unit's electronic controls will begin to malfunction and the blower will turn slower causing inefficient heating. Do not depend on solar panel for charging, solar panel is only capable of being a maintainable.
## OPERATING THE KM 4-40-C1

<table>
<thead>
<tr>
<th>4. Push the Green Start button to begin the automatic heat cycling.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The light will indicate that the unit is operating. The infrared heater will cycle automatically for ten minutes then stop. It is necessary to re-start the next heating cycle.</td>
</tr>
<tr>
<td>Push the Red Stop button to stop automatic heat cycling when desired. This will reset the 10 minute time cycle.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The Low Pressure Gauge will indicate fuel supply during On cycles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: The High Pressure Gauge indicates vapor pressure from the fuel cylinders. Vapor pressure is dependent on temperature. Warmer temperatures will offer higher pressures from the fuel cylinders. It may be necessary to replace fuel cylinders often when working in cold temperatures due to propane bottle freeze up and a drop in fuel pressure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Select the Zones desired for heating.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ball valves 1 -4 correspond with the quadrants of the unit 1-4. All four zones have been selected in this picture. The entire 5' x 8' (1.5 m x 2.4 m) of the unit is heating.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>By selecting only Zone 3 and Zone 4 the operator can heat half of the unit.</th>
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<tbody>
<tr>
<td>In this picture the bottom half of the unit is heating equaling 5' x 4' (1.5 m x 1.2m) of repair area.</td>
</tr>
</tbody>
</table>

| NOTE: Other configurations can be used. An experienced operator will find the optimum heating configurations per jobsite application. |

<table>
<thead>
<tr>
<th>6. Reposition the machine for the next repair.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The operator will determine when the asphalt is softened to the desired depth for repair. Push the red stop button and then re-start to begin a full heat cycle.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. Close the propane cylinders to begin shut down of the unit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow the unit to consume all fuel within the combustion system. Both pressure gauges will indicate Zero psi (kpa).</td>
</tr>
</tbody>
</table>
8. Turn the keyed switch off.

The blower will continue to operate for 90 seconds. Allow the unit to complete this delay cycle before proceeding to the "fold-up" sequence.

9. Reposition and install the U-pin locks on Casters #1 and #2.

Follow the Set up, folding and unfolding, procedures to return the unit to travel position.

Casters #1 and #2 (corresponding with Zone #1 and Zone #2) will be in the rear position of the unit and locked.

Casters #3 and #4 (corresponding with Zone #3 and Zone #4 will be at the side position of the unit for folding and unfolding the machine.
ADJUSTING THE HEATING ZONES

⚠️ CAUTION: VIEW FROM AT LEAST 8 FEET (2.5 METERS) AWAY!

From time to time it may be necessary to re-adjust the gas/air ratio of a zone. Adjustment of the improperly heating zone is best done in dim light. The KM 4-40 should be raised up off of the ground and level with a hoist, or lifted onto nonflammable blocks so that the underside may be viewed during adjustment.

There are five (5) mixture adjustment valves located under the control panel. Four are connected to their corresponding control valves above. The fifth is located toward the middle and is the mixture adjustment valve for the pilot light. The mixture adjustment valves have round handles, which should move stiffly when turned by hand. If any handles move loosely, gently tighten the packing nut that is on the shaft beneath the handle.

Clockwise rotation closes the adjustment valve, leaning the mixture to that zone. Counterclockwise richens it. Turn slowly because a small adjustment can make a big difference. If a blue flame layer is visible a distance below the blanket, the mixture is too rich. A patchy blue dancing flame close to blanket means the mixture is too lean. Try several positions as you zero in on the optimum adjustment. Compare the zone to the ones around it.

The ideal heating zone adjustment turns the blanket red/orange hot.
### BASIC MAINTENANCE - Quick Reference

**THIS UNIT REQUIRES PROPANE GAS.** Maintenance must be **PERFORMED** by a qualified service person. The KM 4-40 Infrared Asphalt Recycler system should be **INSPECTED** before initial use and every use thereafter only by a qualified service technician.

**WARNING:** Inspect all fuel lines and connections daily before using the KM 4-40 Infrared. **DO NOT** use if damaged in any way. **DO NOT** allow the fuel line to lie against the bottom of the machine or on any hot surface during use. **DO NOT** expose the hose in any way to heat or physical abuse during operation.

<table>
<thead>
<tr>
<th>DAILY</th>
<th>WEEKLY</th>
<th>MONTHLY, SEASONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge battery. Solar panel only provides 125mA of charge, this is for a maintainer and should not be relied on for charging.</td>
<td>Inspect pilot flame. Adjust if necessary. Consult Maintenance Adjusting the Zones section in Manual.</td>
<td>Inspect blanket thoroughly.</td>
</tr>
<tr>
<td>Grease all casters.</td>
<td>Inspect heating zones. Observe from a safe distance - minimum 8' (2.4 m).</td>
<td>Inspect interior of blanket.</td>
</tr>
<tr>
<td>Inspect tires and wheels.</td>
<td>Example: Block machine with cement block.</td>
<td>Inspect interior of blanket.</td>
</tr>
<tr>
<td>Inspect propane cylinders. Secure before travel.</td>
<td>Adjust heating zones if necessary. Consult Maintenance Adjusting the Zones section in Manual.</td>
<td>Inspect air distribution</td>
</tr>
<tr>
<td>Clean spark plug.</td>
<td></td>
<td>Adjust heating zones after</td>
</tr>
</tbody>
</table>
HELPFUL HINTS

SELECTING HEATING ZONES

CHOOSING HEATING ZONES

When you have positioned the unit over the area you would like to heat, you must then choose which zones to use. You have the choice of any of the four zones independently or in any combination. It does not hurt to heat a margin of asphalt larger than the actual repair area. For example, a pothole that measures 22 inches (56 cm) across would best be done with Zone #3 - 3’ x 4’ (.9 m x 1.2 m). A 2’ x 4’ - (.6m x 1.2m) Zone 4 zone would suffice, but would probably not give the best results.

HEATING SEQUENCE

If the repair area is larger than the infrared’s area, you will have to decide the sequence of areas to heat. Long narrow repairs are easy to figure. Heating an adjoining series of areas with the appropriate zones you can do 2, 3, 6, and 8-foot (.6 m, .9 m, 1.8 m, 2.4 m) width strips. Move with the wind so that the smoke blows away from the work area. Helpful Hint: use a chalk line as a guide on long repairs to make attractive straight edges.

Wider and oddly shaped areas may require more planning. The general guidelines to follow are:

1. Heat the widest strips possible to maximize hot to hot adjoining edges.
2. Never start a repair in the middle, always work from an edge.
3. Step back periodically and look across the repair from a viewpoint close to the ground, this helps you to make a level repair.

CHANGING the BOTTLES

During the course of a day propane bottle pressure may drop below acceptable operating pressure. They may have run out of propane or on cold days with extensive use they may “freeze up,” leaving some amount of cold liquid propane in them. It is necessary to replace these bottles with full ones. Simply turn off all the propane valves, turn off the toggle switch and remove the POL fittings (left-hand threads) from the bottles. Loosen the chains and replace the bottles. Frozen bottles may be useable when they warm up, if they are not too empty.
**WARNING:** ENSURE ALL SAFETY STANDARDS ARE FOLLOWED WHEN PROpane BOTTLES ARE UNDER PRESSURE. BURNS MAY OCCUR.

**HELPFUL HINTS**

**REGULATOR OPERATION**

Your regulator is equipped with a vent which allows the diaphragm to “breathe”. The diaphragm of the regulator moves down and draws air into the bonnet or adjustment spring housing. When the diaphragm moves up, air is expelled through the vent. In the event that excess pressure builds up in the lower housing or body of the regulator, a relief mechanism vents it to the atmosphere. It is imperative to check the vent frequently to be sure it is clean and free of water, corrosion or obstruction, as clogging is a potential cause of regulator malfunction.

Great care has been taken in the manufacture of your regulator and it has been thoroughly tested and UL listed. However, even a small piece of dirt, corrosion, pipe dope or other foreign material which finds its way into the regulator can result in higher than normal pressure (high lockup) and/or loss of fuel.

If the vent does become clogged it can easily be cleaned with a toothbrush. In addition, your regulator should be checked periodically by a competent LP serviceman to be sure it is property adjusted and in safe working condition. By following these simple precautions your regulator should give you years of trouble-free service.

![Figure 10](image)

**WHAT IS REGULATOR FREEZE UP?**

A regulator will not freeze, nor will LP gas under normal atmospheric conditions. However, as the gas passes through the regulator it expands, cools and moisture in the gas or in the regulator may turn to ice. This ice can build up and block the orifice and thus partially or totally block the fuel supply. There are a number of things you can do to prevent this type of freeze up:

1. Be sure your LP cylinder is **totally free of moisture** before it is filled.

2. Be sure your cylinder is **not over filled**. This is particularly important if you have a permanently mounted ASME tank.

3. Keep the **valves on empty cylinders closed**.
4. Have your LP gas dealer **inject methyl alcohol in your cylinder**.

**HELPFUL HINTS**

**WIND SKIRT USE**

Every KM International Infrared is delivered with “wind skirts”. The wind skirts provide protection to the burner and blanket in windy conditions that would otherwise hamper the Infrared’s effective operation and use. The wind skirts are placed on two adjacent sides on the windward side of the Infrared to partially block out the wind and to allow the heat to better directly penetrate the asphalt.

⚠️ **WARNING:** Gloves MUST be worn when adjusting or removing wind skirts. The skirts are made of aluminum and quickly become **very** hot during operation. Handling without proper safety gloves may cause injury.
HELPFUL HINTS

ASPHALT REPAIR USING THE KM INFRARED ASPHALT RECYCER

Once the bituminous surface has been softened the process of repairing, decorating, adhering thermoplastics, or otherwise manipulating the pavement in a quality manner is considered craftsmanship. It is imperative that the operator and/or service crew be properly trained in the fundamentals of in-place reheating asphalt and asphalt repair. Much like a quality asphalt paving operator gains knowledge by experience, a quality asphalt repair technician improves craftsmanship with experience. Hands-on operation in a variety of settings will best train personnel in the craft.

Following is a "basic" step by step fundamental process for in-place asphalt repair using an Infrared Asphalt Recycler and Asphalt Hotbox Reclaimer.

1. Clean the area to be repaired. Remove all dirt, foreign debris, standing water and loose aggregate.
2. Position the infrared unit over the area to be repaired. Maintain a minimum 3" (75 mm) perimeter larger than the actual repair.
3. Allow the infrared heating unit to properly soften the pavement to a depth of 1.5" - 2.5" (37 - 62 mm). (Approx time 8-10 mins.)
4. Move the heating unit off of the repair area. Reposition for the next repair when necessary.
5. Scarify (rake) the entire minimum heated depth of the repair area. Note: Frame edges first for an attractive repair.
6. Optional: Remove material if necessary (high spots). Remove contaminated material.
7. Rejuvenate with a maltenes rejuvenator the heated and raked asphalt. Also, rejuvenate the heated and un-scarified edges. Application rates are approximately .12 gal/sq yd. (.54 liter /sq meter).
8. Add new asphalt as required per job conditions.
9. Lute the repair area level. Typical practice leaves the repair area 1/4" (6 mm) above surrounding grade before compaction.
10. Compact the repair.
11. Apply maltenes rejuvenator, .12 gal/sq yd,(.54 liter /sq meter) over the entire repair area. Apply stone dust and compact or broom into the area.
12. Clean up the repair area and surrounding area.
13. Open repair to straight drive over traffic. Allow sufficient cool down where vehicle stopping or turning is present.

Every repair requires on site evaluation and proper techniques. The infrared asphalt recycler is a tool that provides the means to service asphalt in a variety of settings including:

<table>
<thead>
<tr>
<th>Pothole repair</th>
<th>Water drainage</th>
<th>Trip hazard repair</th>
</tr>
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<tr>
<td>Paving seam corrections</td>
<td>Speed-bump installation</td>
<td>Pavement imprinting</td>
</tr>
<tr>
<td>Oil spot removal</td>
<td>Thermo-plastic installation</td>
<td>Utility joint maintenance</td>
</tr>
</tbody>
</table>
BLANKET REPLACEMENT

⚠️ WARNING: The 4-40 is equipped with a refractory ceramic blanket. Please pay attention to the warning label enclosed with the blanket and take the necessary precaution to avoid any hazards.

The ceramic refractory fiber (ceramic blanket) takes a great deal of thermal stress and in time will need replacement. Inspect the blanket on a regular basis for signs of physical damage or punctures. If damage is evident, replace immediately to prevent a “blown blanket”. Properly installed blankets that are not subjected to physical damage can last for years.

⚠️ NOTICE: The KM 4-40 & 4-48 are designed to make blanket replacement quick and easy. There is NO ASBESTOS in the ceramic blanket; however, the same respiratory protection is necessary with this product as when handling fiberglass insulation. Work in a well ventilated area and wear a mask and protective gloves.

KM International recommends that blanket replacements be part of the ongoing maintenance and service provided by the manufacturer. These services are available at our factory in North Branch Michigan. Please contact a sales staff person at 1-800-492-1757 to get information on pricing and availability.

PRODUCT SAFETY INFORMATION

WARNING

- Fiber released during normal handling can cause skin, eye and respiratory irritation.
- Based on studies of laboratory animals, refractory ceramic fiber is classified as a possible cause of cancer.
- Removal of this product after use at temperatures above 1000°C (1832°F) can result in exposure to crystalline silica. Crystalline silica may cause lung damage (silicosis) and is classified as a possible cause of cancer.

WORK PRACTICES

- Avoid breathing dust and contact with skin and eyes.
- Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Use an approved respirator as specified in the MSDS.
- Sawing, installation and tear out may generate fiber/dust concentrations and may require additional respiratory protection. See MSDS for recommendations.

FIRST AID

- Inhalation – Move to fresh air source, drink water to clear throat, and blow nose to evacuate dust.
- Eye Contact – Flush eyes with water to remove dust. If symptoms persist, seek medical attention.
- Skin Contact – Wash exposed areas with soap and water after handling.
BLANKET REPLACEMENT STEPS

**NOTICE:** It is highly recommended by KMI that the replacement of the heating element, Ceramic Refractory Blanket and all component parts be done by a KM International certified technician.

1. Remove the propane bottles and battery.

2. Open the front cover by scissoring the machine open slightly on its casters, remove the two cable loops holding the cover in place and then lay the front cover on the trailer tongue.

3. With the unit in the trailer position, set the tongue on the ground.

4. Open the top half (zones 1 & 2) of the machine so that the ceramic blanket faces up. The bottom half (zone 3 & 4) blankets are now also accessible, (as shown in Figures 22 and 23.)

5. Determine the problem area. It is usually only necessary to replace the blanket that has become damaged, even though two separate blankets make up the heating area of zones 1 and 3.

6. Put a small amount of penetrating oil on the stainless steel nuts within and surrounding the blown section, while observing how many threads stick above the nuts. This will help during reassembly.
BLANKET REPLACEMENT STEPS

7. Loosen and remove the nuts, washers, frame and old blanket.

8. Inspect the flame arresters. (A fine mesh screen placed in the air/gas inlet.) If it is badly burned and warped from heat it should be replaced. If it shows signs on being clogged, remove it and clear it with compressed air.

9. Inspect the area being repaired. Vacuum any debris out of the area. Check the silicone seal around the channels and under the bar that the frames rest on. If there are any holes or deterioration of the silicone it should be re-sealed. Standard 100% silicone caulk (temp. rating 475 degrees F) available at hardware stores is recommended.

10. Take the new 2’ x 4’ blanket out of the box and roll it out on a flat surface. Measure the opening for the new blanket to the edges of the existing material. Leave the blanket long so that it will meet the opposite blanket where the two halves of the KM 4-40 hinge together. Lay a straight edge on the blanket at your measurements and cut using long light strokes of a knife.

IT IS RECOMMENDED THAT THE CERAMIC BLANKET BE ORDERED PRE-CUT BY THE FACTORY
BLANKET REPLACEMENT STEPS

11. Carefully place the new blanket over the retainer bolts trying not to drag it and potentially tear or damage the new blanket. *NOTE: Insert the blanket with the “INSIDE” facing down. The “INSIDE” is that portion of the Ceramic Blanket that is on the inside or inner part of the roll. If the Blanket is pre-cut by KMI/Factory the “INSIDE” will be pre-marked for easier installation. The new blanket edges should meet the existing blanket edges and the outside perimeter blanket edges. There should not be space between blankets.

12. Inspect the frame and washers for heat distortion, if excessive; attempt to straighten them with a hammer on a flat surface.

13. Install the frame, washers and nuts. Tighten the nuts around the frame down to approximately where they were before disassembly. (One – two threads should show above the nuts around the frame.)

14. Using your palm, gently press the blanket where the central retainer bolts hold the blanket. Install the washers so that the smooth side faces the blanket (the washers have a sharp or rigid side and a more rounded smooth side when inspected closely). Tighten nuts until one thread shows. **DO NOT OVER TIGHTEN.**

15. Where the two halves of the 4-40 come together blanket should extend past the frame to act as a gasket.

- Perimeter nuts & washers. Tighten to two threads showing.
- Outside on frames. Tighten snug to bushing.
- Center frames. Tighten snug - two threads showing.
- Interior blanket nuts & washers. Tighten flush to one thread showing.
- Blanket will extend past the center frame work 1/4".
## TROUBLESHOOTING 4-40-C1

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing happens when unit is powered ON (Key is ON).</td>
<td>Safety Switch not depressed. Ensure that the tongue presence momentary switch is full depressed. If yes, and the unit still does not operate, then use a short jumper wire to connect the switch terminals. If the unit then operates, replace the switch. E-stop button not engaged. Slowly turn and pull the button into the ON position. Dead battery. Check voltage. Charge if necessary. Blown fuse. Inspect 10 A fuse at battery power supply. Replace if failed. Inspect battery connections. Red = Positive (+). Black = Ground (-). Bad switch. Connect switch contact terminals using a short jumper wire. Replace switch if failed. Loose wire. Inspect wire connections. Secure any loose wires or terminals.</td>
</tr>
<tr>
<td>Voltmeter registers 12V but blower does not run.</td>
<td>Bad Blower Relay - Disconnect the four (4) prong blower delay relay. On the female half of the connector, use a short piece of wire to connect the brown wire and yellow wire contacts together. If the blower begins to run, replace the Blower Delay Box. Loose wire. Inspect wire connections at key switch. Secure any loose wires or terminals. Key Switch Failed. Use a multi-meter to inspect input and output current at key switch. Bad blower. Confirm wire connections including ground are satisfactory. Replace blower.</td>
</tr>
<tr>
<td>Blower runs, but the unit will not cycle ON. (No heat &amp; no Low Pressure Gauge indicating fuel into system.) Test Air Pressure Switch.</td>
<td>Air Pressure Switch Failure - Remove the Air Pressure Switch cover exposing the terminal connections. <strong>NOTICE:</strong> Close propane cylinders. With the unit in the working position and all FUEL cylinders OFF, turn on the toggle switch. Using a short jumper wire, connect the two terminals with wires attached (marked <em>Normally Open</em> and <em>Common</em>). With the toggle switched ON the solenoid should activate and cycle. If the solenoid cycles at this point, then it is necessary to replace the pressure switch.</td>
</tr>
<tr>
<td>Blower runs, but the unit will not cycle ON. (No heat &amp; no Low Pressure Gauge indicating fuel into system.) Test Cycling Box</td>
<td>Cycling Circuit Box failure - If in the previous test the solenoid valve does not click on, then locate the Cycling Circuit Box (black box, three wired: yellow, brown, &amp; white). With the unit in the working position and all FUEL cylinders OFF, turn on the toggle switch. Disconnect the three (3) prong plug of the Cycling Box. Using a short jumper wire, connect the <em>yellow &amp; brown</em> wires on the <em>female</em> side of the plug. If the unit cycles ON (you will hear the click of the solenoid valve), then replace the Cycling Circuit Box.</td>
</tr>
</tbody>
</table>
## TROUBLESHOOTING

<table>
<thead>
<tr>
<th>Issue</th>
<th>Description</th>
</tr>
</thead>
</table>
| Blower runs, but the unit will not cycle ON. (No heat & no Low Pressure Gauge indicating fuel into system.) | **Test One Shot 10 Minute Timer**  
NOTE: The light on the Start/Stop button will indicate output current from the One Shot Timer. If the light is on, then it is very likely that the timer is operating properly. Inspect for loose wire connections and confirm previous tests.  
One Shot 10 Minute Timer failure. If in the previous test the solenoid valve does not click on, then locate the One Shot Timer located on the interior rear side of the control panel. Use a multi-meter to test input and output current at the timer.  
If a multi-meter is unavailable, then remove the terminal connecting the Yellow wire (this is the output signal to the Cycling Circuit box). Use a short jumper wire to provide power from the Voltmeter Positive terminal to the Yellow wire which signals the Cycling Circuit Box. If the unit cycles ON, then replace the One Shot Timer. |
| Blower runs, but the unit will not cycle ON. (No heat & no Low Pressure Gauge indicating fuel into system.) | **Test Solenoid**  
Solenoid Valve failure – If in the previous test the solenoid gas valve still will not click on, all or part of it must be replaced. It is rare to replace this component; before doing so it is recommended to check all ground wires (especially one connected directly from the solenoid valve) and repeat the above test procedures in order to verify the necessity to replace the solenoid valve.  
Solenoid valve cycles ON but pilot will not light.  
Fouled Spark Igniter - Check for excess carbon buildup on the spark electrode. Clean with a small wire brush or with carburetor spray cleaner, be careful not to get any on the blanket or damage the blanket with the brush.  
Adjust Pilot Flame Setting - See Maintenance: Adjustment Procedures. |
| Solenoid valve cycles ON but pilot will not light. | **Test 12 V Igniter**  
12 V Igniter failure. Locate the 12 V Igniter located at the bottom of the front interior control panel. Use a multi-meter to inspect current input and output. If no output current is available, inspect all wire connections including the ground connection. Replace the 12 V igniter if necessary.  
If the Igniter indicates output current, then inspect the Spark Plug under the unit for excess carbon buildup on the electrode. Clean with a small wire brush.  
Propane Pressure - Check the Low Pressure (0-15 psi) gauge. With all valves Off, the pressure reading should indicate 7 - 8 psi. Lower pressure indicates out of fuel. Higher pressure indicates regulator failure. Replace the regulator.  
Propane Pressure - Check the High Pressure (0 - 300 psi) gauge. It should indicate a minimum of 30 psi during normal operating temperatures. If no propane is present, close the propane valve and slowly re-open the supply. Fill empty propane cylinders. |

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## TROUBLESHOOTING

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Cycles ON. Pilot is on but one or more zones is not heating properly.</td>
<td>Propane Pressure - Check the Low Pressure (0-15 psi) gauge. With all valves Off, the pressure reading should indicate 7 - 8 psi. Lower pressure indicates out of fuel. Higher pressure indicates regulator failure. Replace the regulator.</td>
</tr>
<tr>
<td></td>
<td>Propane Pressure - Check the High Pressure (0 - 300 psi) gauge. It should indicate a minimum of 30 psi during normal operating temperatures. If no propane is present, close the propane valve and slowly re-open the supply. Fill empty propane cylinders.</td>
</tr>
<tr>
<td></td>
<td>Adjust Zone(s) - See Maintenance: Adjustment Procedures.</td>
</tr>
<tr>
<td>Battery not charging when plugged in.</td>
<td>Blown fuse. Inspect the 15 A fuse wired between the battery and the charger. Replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Loose wire. Inspect wire connections. Secure any loose wires or terminals. Replace charger.</td>
</tr>
</tbody>
</table>

4-40 C1 Wire Schematic
TRAINING POLICY

The optimal and efficient operation of the KM 4-40 INFRARED requires instruction on the operation and maintenance of the equipment. We at KMI are very much aware that time is a precious commodity and will take all the steps necessary to ensure that equipment training is done in a professional and expedient manner. We are in the process of developing a library of instructional videos that will be available shortly. We encourage our customers to take advantage of our extremely knowledgeable staff as needed for trouble shooting or to answer equipment operation questions. We are available during normal business hours, 8:30 a.m. to 4:30 p.m. EST, Monday through Friday by phone – (810) 688-1234 or by e-mail at kmi@kminb.com. We encourage you to contact our sales staff to schedule a convenient training session for your staff prior to operation.

If you are using the KMI infrared equipment for applying thermo-plastic or similar product, our technicians are unable to answer specific questions on those application processes. We would encourage the user to contact the applications manufacturer.

Additionally, we encourage our customers to take advantage of our hands on training classes made available to all purchasers and their staff as requested and/or necessary. We have incorporated a small fee associated with on sight training in an effort to encourage education without making the process cost prohibitive or too time consuming for our staff. This small charge will help to keep KMI equipment price competitive and user friendly. KM International will train FREE OF CHARGE any customer or customer employees that travel to the KMI manufacturing facility within the first 90 days of purchase. We would be happy to schedule an appointment for a free ½ day of training on every aspect of equipment maintenance and operation. The customer would be responsible for travel and expenses to the KMI location. Our technical staff is available to schedule an instructional full day of training at the customers site if that is preferred but would require the following:

1. All travel and expense to and from the customer requested location as required, including Hotel and Airfare as necessary. KMI reserves the sole right to determine appropriate and reasonable accommodations and travel.

2. A per-diem food allowance of Fifty U.S. Dollars ($50.00) per technician, or as agreed.

3. A Five Hundred U.S. Dollar ($500.00) per diem off-site man charge per technician, or as agreed, to be paid in advance.

RECOMMENDED KM 4-40 INFRARED HEATER BASIC MAINTENANCE AND REPAIR PACKAGES

KM International recommends all of our customers purchase a basic maintenance and repair kit to ensure that they are never left without basic parts at critical times. It is our opinion that while our machines are robust, long lasting and easy to operate there may be parts failures in the field that are never expected but that can result in preventable down time. Please call the sales department to help you determine an appropriate maintenance and recommended repair parts package.
LIMITED WARRANTY

KM INTERNATIONAL, INC. (hereinafter called KMI) warrants all equipment manufactured by KMI to be free from defects in material and workmanship on the date of sale to the original end user. With the exception of any special, extended, or limited warranty published by KMI, KMI will, for a period of twelve months from the date of sale, repair or replace any part of the equipment determined by KMI to be defective. This warranty applies only when the equipment is used for its intended purpose and properly maintained.

This warranty does not cover and KMI will not be liable for general wear and tear, or any malfunction, damage or wear caused by misapplication, abrasion, corrosion, inadequate or improper maintenance, negligence, accident, tampering, or substitution of non-KMI component parts.

This warranty is conditioned upon the prepaid return of the equipment claimed to be defective to an authorized KMI distributor or the factory direct, for verification of the claimed defect. If the claimed defect is verified, KMI will repair or replace free of charge any defective parts. Electrical components shall be returned in total. The equipment will be returned to the original purchaser transportation prepaid. If inspection of the equipment does not disclose any defect in material or workmanship, repairs will be made at a reasonable charge, which charges may include the costs of parts, labor, and transportation. THIS WARRANTY IS EXCLUSIVE, AND IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. KMI’s sole obligation and buyer’s sole remedy for any breach of warranty shall be set forth above. The buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available. Any action for breach of warranty must be brought within one (1) Year of date of sale.

Items sold, but not manufactured by KMI (such as electric motors, electric switch boards, switches, hose, etc) are subject to the warranty, if any, of their manufacturer. KMI will provide purchaser with reasonable assistance in making any claim for breach of these warranties or at KMI’s sole discretion shall accept the return in conjunction with and/or despite the original manufacturer’s warranty.

In no event will KMI be liable for indirect, incidental, special or consequential damages resulting from KMI supplying equipment hereunder, or the furnishing performance, or use of any products or other goods sold hereto, whether due to a breach of contract, breach of warranty, the negligence of KMI or otherwise.
CERTIFICATE & DECLARATION OF CONFORMITY FOR CE MARKING

Company contact details:
Keizer-Morris International, Inc.
(aka – KM International)
6561 Bernie Kohler Drive, North Branch, Michigan 48461, USA
Phone: 810-688-1234  Fax: 810-688-8765  Website: www.kminb.com

Keizer-Morris International, Inc. declares that there:
Infrared Asphalt Recyclers
Models:
KM 2-18X C1 M1
KM 4-40 C1
KM 4-48 C1
LB 2-16

comply with the Essential Requirements of the following EU Directives:
Machinery Directive 2006/42/EC
Low Voltage Directive 2006/95/EC

And further conform with the following EU Harmonized Standards:
EN ISO 12100:2010
EN ISO 13849-1:2008
EN 61000-6-2:2005
EN 61000-6-4:2007 + A1:2011

Dated: 10 October 2013
Position of signatory: Vice President of Production
Name of signatory: Bryan Burke
Signed below:
On behalf of Keizer-Morris International, Inc.

Bryan Burke
EQUIPMENT INFORMATION & NOTES

<table>
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<tr>
<th>MODEL</th>
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<tbody>
<tr>
<td>SERIAL NUMBER</td>
<td></td>
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<tr>
<td>PURCHASER</td>
<td></td>
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<tr>
<td>DATE OF PURCHASE</td>
<td></td>
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<tr>
<td>NOTES:</td>
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</tbody>
</table>

Thank you again for your purchase of the KM Infrared Asphalt Recycler. We are happy to have you as a customer and are confident that you will have years of efficient operation by following the above parameters and guidelines. We encourage an open dialogue with our customers and prize any feedback. Our commitment to our customers is second to none and our desire to improve our equipment is an integral part of our ongoing growth strategy.

Sincerely,
The KM International Management Team.

KM International, Inc.
6561 Bernie Kohler Drive
North Branch, Michigan 48461
(810) 688-1234 * www.kminb.com

Please call the Team at KM International anytime for questions, comments or to just talk “Infrared.”

THE “INFRARED PROCESS” WORLDWIDE EXPERTS

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1. **TIRE SAFETY INFORMATION**

This portion of the User’s Manual contains tire safety information as required by 49 CFR 575.6. Section 1.1 contains “Steps for Determining Correct Load Limit - Trailer”.

Section 1.2 contains “Steps for Determining Correct Load Limit – Tow Vehicle”.

Section 1.3 contains a Glossary of Tire Terminology, including “cold inflation pressure”, “maximum inflation pressure”, “recommended inflation pressure”, and other non-technical terms.

Section 1.4 contains information from the NHTSA brochure entitled “Tire Safety – Everything Rides On It”. This brochure, as well as the preceding subsections, describes the following items:
- Tire labeling, including a description and explanation of each marking on the tires, and information about the DOT Tire Identification Number (TIN).
- Recommended tire inflation pressure, including a description and explanation of:
  A. Cold inflation pressure.
  B. Vehicle Placard and location on the vehicle.
  C. Adverse safety consequences of under inflation (including tire failure).
  D. Measuring and adjusting air pressure for proper inflation.
- Tire Care, including maintenance and safety practices.
- Vehicle load limits, including a description and explanation of the following items:
  A. Locating and understanding the load limit information, total load capacity, and cargo capacity.
  B. Calculating total and cargo capacities with varying seating configurations including quantitative examples showing / illustrating how the vehicles cargo and luggage capacity decreases as combined number and size of occupants’ increases. This item is also discussed in Section 3.
  C. Determining compatibility of tire and vehicle load capabilities.
  D. Adverse safety consequences of overloading on handling and stopping on tires.

### 1.1. STEPS FOR DETERMINING CORRECT LOAD LIMIT – TRAILER

Determining the load limits of a trailer includes more than understanding the load limits of the tires alone. On all trailers there is a Federal certification/VIN label that is located on the forward half of the left (road) side of the unit. This certification/VIN label will indicate the trailer’s Gross Vehicle Weight Rating (GVWR). This is the most weight the fully loaded trailer can weigh. It will also provide the Gross Axle Weight Rating (GAWR). This is the most a particular axle can weigh. If there are multiple axles, the GAWR of each axle will be provided.

If your trailer has a GVWR of 10,000 pounds or less, there is a vehicle placard located in the same location as the certification label described above. This placard provides tire and loading information. In addition, this placard will show a statement regarding maximum cargo capacity. Cargo can be added to the trailer, up to the maximum weight specified on the placard. The combined weight of the cargo is provided as a single number. In any case, remember: the total weight of a fully loaded trailer cannot exceed the stated GVWR.
For trailers with living quarters installed, the weight of water and propane also need to be considered. The weight of fully filled propane containers is considered part of the weight of the trailer before it is loaded with cargo, and is not considered part of the disposable cargo load. Water however, is a disposable cargo weight and is treated as such. If there is a fresh water storage tank of 100 gallons, this tank when filled would weigh about 800 pounds. If more cargo is being transported, water can be off-loaded to keep the total amount of cargo added to the vehicle within the limits of the GVWR so as not to overload the vehicle. Understanding this flexibility will allow you, the owner, to make choices that fit your travel needs.

When loading your cargo, be sure it is distributed evenly to prevent overloading front to back and side to side. Heavy items should be placed low and as close to the axle positions as reasonable. Too many items on one side may overload a tire. The best way to know the actual weight of the vehicle is to weigh it at a public scale. Talk to your dealer to discuss the weighing methods needed to capture the various weights related to the trailer. This would include the weight empty or unloaded, weights per axle, wheel, hitch or king-pin, and total weight.

Excessive loads and/or under inflation cause tire overloading and, as a result, abnormal tire flexing occurs. This situation can generate an excessive amount of heat within the tire. Excessive heat may lead to tire failure. It is the air pressure that enables a tire to support the load, so proper inflation is critical. The proper air pressure may be found on the certification/VIN label and/or on the Tire Placard. This value should never exceed the maximum cold inflation pressure stamped on the tire.

1.1.1. TRAILERS 10,000 POUNDS GVWR OR LESS

1. Locate the statement, “The weight of cargo should never exceed XXX kg or XXX lbs.,” on your vehicle’s placard. See figure 1-1.
2. This figure equals the available amount of cargo and luggage load capacity.
3. Determine the combined weight of luggage and cargo being loaded on the vehicle. That weight may not safely exceed the available cargo and luggage load capacity.

The trailer’s placard refers to the Tire Information Placard attached adjacent to or near the trailer’s VIN (Certification) label at the left front of the trailer.
1.1.2. TRAILERS OVER 10,000 POUNDS GVWR (NOTE: THESE TRAILERS ARE NOT REQUIRED TO HAVE A TIRE INFORMATION PLACARD ON THE VEHICLE)

1. Determine the empty weight of your trailer by weighing the trailer using a public scale or other means. This step does not have to be repeated.
2. Locate the GVWR (Gross Vehicle Weight Rating) of the trailer on your trailer’s VIN (Certification) label.
3. Subtract the empty weight of your trailer from the GVWR stated on the VIN label. That weight is the maximum available cargo capacity of the trailer and may not be safely exceeded.

1.2. STEPS FOR DETERMINING CORRECT LOAD LIMIT – TOW VEHICLE

1. Locate the statement, “The combined weight of occupants and cargo should never exceed XXX lbs.,” on your vehicle’s placard.
2. Determine the combined weight of the driver and passengers who will be riding in your vehicle.
3. Subtract the combined weight of the driver and passengers from XXX kilograms or XXX pounds.
4. The resulting figure equals the available amount of cargo and luggage capacity. For example, if the “XXX” amount equals 1400 lbs. and there will be five 150 lb. passengers in your vehicle, the amount of available cargo and luggage capacity is 650 lbs. (1400-750 (5 x 150) = 650 lbs.).
5. Determine the combined weight of luggage and cargo being loaded on the vehicle. That weight may not safely exceed the available cargo and luggage capacity calculated in Step # 4.
6. If your vehicle will be towing a trailer, load from your trailer will be transferred to your vehicle. Consult the tow vehicle’s manual to determine how this weight transfer reduces the available cargo and luggage capacity of your vehicle.

1.3. GLOSSARY OF TIRE TERMINOLOGY

Accessory weight
The combined weight (in excess of those standard items which may be replaced) of automatic transmission, power steering, power brakes, power windows, power seats, radio and heater, to the extent that these items are available as factory-installed equipment (whether installed or not).

Bead
The part of the tire that is made of steel wires, wrapped or reinforced by ply cords and that is shaped to fit the rim.

Bead separation
This is the breakdown of the bond between components in the bead.

Bias ply tire
A pneumatic tire in which the ply cords that extend to the beads are laid at alternate angles substantially less than 90 degrees to the centerline of the tread.

Carcass
The tire structure, except tread and sidewall rubber which, when inflated, bears the load.

Chunking
The breaking away of pieces of the tread or sidewall.

Cold inflation pressure
The pressure in the tire before you drive.
Cord
The strands forming the plies in the tire.

Cord separation
The parting of cords from adjacent rubber compounds.

Cracking
Any parting within the tread, sidewall, or inner liner of the tire extending to cord material.

CT
A pneumatic tire with an inverted flange tire and rim system in which the rim is designed with rim flanges pointed radially inward and the tire is designed to fit on the underside of the rim in a manner that encloses the rim flanges inside the air cavity of the tire.

Curb weight
The weight of a motor vehicle with standard equipment including the maximum capacity of fuel, oil, and coolant, and, if so equipped, air conditioning and additional weight optional engine.

Extra load tire
A tire designed to operate at higher loads and at higher inflation pressures than the corresponding standard tire.

Groove
The space between two adjacent tread ribs.

Gross Axle Weight Rating
The maximum weight that any axle can support, as published on the Certification / VIN label on the front left side of the trailer. Actual weight determined by weighing each axle on a public scale, with the trailer attached to the towing vehicle.

Gross Vehicle Weight Rating
The maximum weight of the fully loaded trailer, as published on the Certification / VIN label. Actual weight determined by weighing trailer on a public scale, without being attached to the towing vehicle.

Hitch Weight
The downward force exerted on the hitch ball by the trailer coupler.

Innerliner
The layer(s) forming the inside surface of a tubeless tire that contains the inflating medium within the tire.

Innerliner separation
The parting of the innerliner from cord material in the carcass.

Intended outboard sidewall
The sidewall that contains a white-wall, bears white lettering or bears manufacturer, brand, and/or model name molding that is higher or deeper than the same molding on the other sidewall of the tire or the outward facing sidewall of an asymmetrical tire that has a particular side that must always face outward when mounted on a vehicle.

Light truck (LT) tire
A tire designated by its manufacturer as primarily intended for use on lightweight trucks or multipurpose passenger vehicles.
Load rating
The maximum load that a tire is rated to carry for a given inflation pressure.

Maximum load rating
The load rating for a tire at the maximum permissible inflation pressure for that tire.

Maximum permissible inflation pressure
The maximum cold inflation pressure to which a tire may be inflated.

Maximum loaded vehicle weight
The sum of curb weight, accessory weight, vehicle capacity weight, and production options weight.

Measuring rim
The rim on which a tire is fitted for physical dimension requirements.

Pin Weight
The downward force applied to the fifth wheel or gooseneck ball, by the trailer kingpin or gooseneck coupler.

Non-pneumatic rim
A mechanical device which, when a non-pneumatic tire assembly incorporates a wheel, supports the tire, and attaches, either integrally or separably, to the wheel center member and upon which the tire is attached.

Non-pneumatic spare tire assembly
A non-pneumatic tire assembly intended for temporary use in place of one of the pneumatic tires and rims that are fitted to a passenger car in compliance with the requirements of this standard.

Non-pneumatic tire
A mechanical device which transmits, either directly or through a wheel or wheel center member, the vertical load and tractive forces from the roadway to the vehicle, generates the tractive forces that provide the directional control of the vehicle and does not rely on the containment of any gas or fluid for providing those functions.

Non-pneumatic tire assembly
A non-pneumatic tire, alone or in combination with a wheel or wheel center member, which can be mounted on a vehicle.

Normal occupant weight
This means 68 kilograms (150 lbs.) times the number of occupants specified in the second column of Table I of 49 CFR 571.110.

Occupant distribution
The distribution of occupants in a vehicle as specified in the third column of Table I of 49 CFR 571.110.

Open splice
Any parting at any junction of tread, sidewall, or innerliner that extends to cord material.

Outer diameter
The overall diameter of an inflated new tire.
Overall width
The linear distance between the exteriors of the sidewalls of an inflated tire, including elevations due to labeling, decorations, or protective bands or ribs.

Ply
A layer of rubber-coated parallel cords.

Ply separation
A parting of rubber compound between adjacent plies.

Pneumatic tire
A mechanical device made of rubber, chemicals, fabric and steel or other materials, that, when mounted on an automotive wheel, provides the traction and contains the gas or fluid that sustains the load.

Production options weight
The combined weight of those installed regular production options weighing over 2.3 kilograms (5 lbs.) in excess of those standard items which they replace, not previously considered in curb weight or accessory weight, including heavy duty brakes, ride levelers, roof rack, heavy duty battery, and special trim.

Radial ply tire
A pneumatic tire in which the ply cords that extend to the beads are laid at substantially 90 degrees to the centerline of the tread.

Recommended inflation pressure
This is the inflation pressure provided by the vehicle manufacturer on the Tire Information label and on the Certification / VIN tag.

Reinforced tire
A tire designed to operate at higher loads and at higher inflation pressures than the corresponding standard tire.

Rim
A metal support for a tire or a tire and tube assembly upon which the tire beads are seated.

Rim diameter
This means the nominal diameter of the bead seat.

Rim size designation
This means the rim diameter and width.

Rim type designation
This means the industry of manufacturer’s designation for a rim by style or code.

Rim width
This means the nominal distance between rim flanges.

Section width
The linear distance between the exteriors of the sidewalls of an inflated tire, excluding elevations due to labeling, decoration, or protective bands.

Sidewall
That portion of a tire between the tread and bead.
Sidewall separation
The parting of the rubber compound from the cord material in the sidewall.

Special Trailer (ST) tire
The “ST” is an indication the tire is for trailer use only.

Test rim
The rim on which a tire is fitted for testing, and may be any rim listed as appropriate for use with that tire.

Tread
That portion of a tire which comes in contact with a road.

Tread rib
A tread section running circumferentially around a tire.

Tread separation
Pulling away of the tread from the tire carcass.

Tread wear indicators (TWI)
The projections within the principal grooves designed to give a visual indication of the degrees of wear of the tread.

Vehicle capacity weight
The rated cargo and luggage load plus 68 kilograms (150 lbs.) times the vehicle’s designated seating capacity.

Vehicle maximum load on the tire
The load on an individual tire that is determined by distributing to each axle its share of the maximum loaded vehicle weight and dividing by two.

Vehicle normal load on the tire
The load on an individual tire that is determined by distributing to each axle its share of the curb weight, accessory weight, and normal occupant weight (distributed in accordance with Table I of CRF 49 571.110) and dividing by 2.

Weather side
The surface area of the rim not covered by the inflated tire.

Wheel center member
In the case of a non-pneumatic tire assembly incorporating a wheel, a mechanical device which attaches, either integrally or separably, to the non-pneumatic rim and provides the connection between the non-pneumatic rim and the vehicle; or, in the case of a non-pneumatic tire assembly not incorporating a wheel, a mechanical device which attaches, either integrally or separably, to the non-pneumatic tire and provides the connection between tire and the vehicle.

Wheel-holding fixture
The fixture used to hold the wheel and tire assembly securely during testing.
1.4. TIRE SAFETY - EVERYTHING RIDES ON IT

The National Traffic Safety Administration (NHTSA) has published a brochure (DOT HS 809 361) that discusses all aspects of Tire Safety, as required by CFR 575.6. This brochure is reproduced in part below. It can be obtained and downloaded from NHTSA, free of charge, from the following web site:


Studies of tire safety show that maintaining proper tire pressure, observing tire and vehicle load limits (not carrying more weight in your vehicle than your tires or vehicle can safely handle), avoiding road hazards, and inspecting tires for cuts, slashes, and other irregularities are the most important things you can do to avoid tire failure, such as tread separation or blowout and flat tires. These actions, along with other care and maintenance activities, can also:

- Improve vehicle handling
- Help protect you and others from avoidable breakdowns and accidents
- Improve fuel economy
- Increase the life of your tires.

This booklet presents a comprehensive overview of tire safety, including information on the following topics:

- Basic tire maintenance
- Uniform Tire Quality Grading System
- Fundamental characteristics of tires
- Tire safety tips.

Use this information to make tire safety a regular part of your vehicle maintenance routine. Recognize that the time you spend is minimal compared with the inconvenience and safety consequences of a flat tire or other tire failure.

1.5. SAFETY FIRST--BASIC TIRE MAINTENANCE

Properly maintained tires improve the steering, stopping, traction, and load-carrying capability of your vehicle. Underinflated tires and overloaded vehicles are a major cause of tire failure. Therefore, as mentioned above, to avoid flat tires and other types of tire failure, you should maintain proper tire pressure, observe tire and vehicle load limits, avoid road hazards, and regularly inspect your tires.

1.5.1. FINDING YOUR VEHICLE’S RECOMMENDED TIRE PRESSURE AND LOAD LIMITS

Tire information placards and vehicle certification labels contain information on tires and load limits. These labels indicate the vehicle manufacturer’s information including:

- Recommended tire size
- Recommended tire inflation pressure
- Vehicle capacity weight (VCW—the maximum occupant and cargo weight a vehicle is designed to carry)
- Front and rear gross axle weight ratings (GAWR— the maximum weight the axle systems are designed to carry).

Both placards and certification labels are permanently attached to the trailer near the left front.
1.5.2. **Understanding Tire Pressure and Load Limits**

Tire inflation pressure is the level of air in the tire that provides it with load-carrying capacity and affects the overall performance of the vehicle. The tire inflation pressure is a number that indicates the amount of air pressure—measured in pounds per square inch (psi)—a tire requires to be properly inflated. (You will also find this number on the vehicle information placard expressed in kilopascals (kpa), which is the metric measure used internationally.)

Manufacturers of passenger vehicles and light trucks determine this number based on the vehicle’s design load limit, that is, the greatest amount of weight a vehicle can safely carry and the vehicle's tire size. The proper tire pressure for your vehicle is referred to as the "recommended cold inflation pressure." (As you will read below, it is difficult to obtain the recommended tire pressure if your tires are not cold.) Because tires are designed to be used on more than one type of vehicle, tire manufacturers list the "maximum permissible inflation pressure" on the tire sidewall. This number is the greatest amount of air pressure that should ever be put in the tire under normal driving conditions.

1.5.3. **Checking Tire Pressure**

It is important to check your vehicle's tire pressure at least once a month for the following reasons:

- Most tires may naturally lose air over time.
- Tires can lose air suddenly if you drive over a pothole or other object or if you strike the curb when parking.
- With radial tires, it is usually not possible to determine under inflation by visual inspection.

For convenience, purchase a tire pressure gauge to keep in your vehicle. Gauges can be purchased at tire dealerships, auto supply stores, and other retail outlets. The recommended tire inflation pressure that vehicle manufacturers provide reflects the proper psi when a tire is cold. The term cold does not relate to the outside temperature. Rather, a cold tire is one that has not been driven on for at least three hours. When you drive, your tires get warmer, causing the air pressure within them to increase. Therefore, to get an accurate tire pressure reading, you must measure tire pressure when the tires are cold or compensate for the extra pressure in warm tires.

1.5.4. **Steps for Maintaining Proper Tire Pressure**

- **Step 1:** Locate the recommended tire pressure on the vehicle's tire information placard, certification label, or in the owner's manual.
- **Step 2:** Record the tire pressure of all tires.
- **Step 3:** If the tire pressure is too high in any of the tires, slowly release air by gently pressing on the tire valve stem with the edge of your tire gauge until you get to the correct pressure.
- **Step 4:** If the tire pressure is too low, note the difference between the measured tire pressure and the correct tire pressure. These "missing" pounds of pressure are what you will need to add.
- **Step 5:** At a service station, add the missing pounds of air pressure to each tire that is underinflated.
- **Step 6:** Check all the tires to make sure they have the same air pressure (except in cases in which the front and rear tires are supposed to have different amounts of pressure).

If you have been driving your vehicle and think that a tire is underinflated, fill it to the recommended cold inflation pressure indicated on your vehicle's tire information placard or certification label. While your tire may still be slightly underinflated due to the extra pounds of pressure in the warm tire, it is safer to drive with air pressure that is slightly lower than the vehicle manufacturer's recommended cold inflation pressure than to drive with a significantly underinflated tire. Since this is a temporary fix, don't forget to recheck and adjust the tire's pressure when you can obtain a cold reading.
1.5.5. **Tire Size**

To maintain tire safety, purchase new tires that are the same size as the vehicle's original tires or another size recommended by the manufacturer. Look at the tire information placard, the owner's manual, or the sidewall of the tire you are replacing to find this information. If you have any doubt about the correct size to choose, consult with the tire dealer.

1.5.6. **Tire Tread**

The tire tread provides the gripping action and traction that prevent your vehicle from slipping or sliding, especially when the road is wet or icy. In general, tires are not safe and should be replaced when the tread is worn down to 1/16 of an inch. Tires have built-in treadwear indicators that let you know when it is time to replace your tires. These indicators are raised sections spaced intermittently in the bottom of the tread grooves. When they appear "even" with the outside of the tread, it is time to replace your tires. Another method for checking tread depth is to place a penny in the tread with Lincoln's head upside down and facing you. If you can see the top of Lincoln's head, you are ready for new tires.

1.5.7. **Tire Balance and Wheel Alignment**

To avoid vibration or shaking of the vehicle when a tire rotates, the tire must be properly balanced. This balance is achieved by positioning weights on the wheel to counterbalance heavy spots on the wheel-and-tire assembly. A wheel alignment adjusts the angles of the wheels so that they are positioned correctly relative to the vehicle's frame. This adjustment maximizes the life of your tires. These adjustments require special equipment and should be performed by a qualified technician.

1.5.8. **Tire Repair**

The proper repair of a punctured tire requires a plug for the hole and a patch for the area inside the tire that surrounds the puncture hole. Punctures through the tread can be repaired if they are not too large, but punctures to the sidewall should not be repaired. Tires must be removed from the rim to be properly inspected before being plugged and patched.

1.5.9. **Tire Fundamentals**

Federal law requires tire manufacturers to place standardized information on the sidewall of all tires. This information identifies and describes the fundamental characteristics of the tire and also provides a tire identification number for safety standard certification and in case of a recall.
1.5.9.1. Information on Passenger Vehicle Tires

Please refer to the diagram below.

**P**
The "P" indicates the tire is for passenger vehicles.

**Next number** This three-digit number gives the width in millimeters of the tire from sidewall edge to sidewall edge. In general, the larger the number, the wider the tire.

**Next number** This two-digit number, known as the aspect ratio, gives the tire's ratio of height to width. Numbers of 70 or lower indicate a short sidewall for improved steering response and better overall handling on dry pavement.

**R** The "R" stands for radial. Radial ply construction of tires has been the industry standard for the past 20 years.

**Next number** This two-digit number is the wheel or rim diameter in inches. If you change your wheel size, you will have to purchase new tires to match the new wheel diameter.

**Next number** This two- or three-digit number is the tire's load index. It is a measurement of how much weight each tire can support. You may find this information in your owner's manual. If not, contact a local tire dealer. Note: You may not find this information on all tires because it is not required by law.

**M+S** The "M+S" or "M/S" indicates that the tire has some mud and snow capability. Most radial tires have these markings; hence, they have some mud and snow capability.

**Speed Rating** The speed rating denotes the speed at which a tire is designed to be driven for extended periods of time. The ratings range from 99 miles per hour (mph) to 186 mph. These ratings are listed below. Note: You may not find this information on all tires because it is not required by law.
Tire Safety Information

<table>
<thead>
<tr>
<th>Letter Rating</th>
<th>Speed Rating</th>
</tr>
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<tbody>
<tr>
<td>Q</td>
<td>99 mph</td>
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<tr>
<td>R</td>
<td>106 mph</td>
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<tr>
<td>S</td>
<td>112 mph</td>
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<td>W</td>
<td>168* mph</td>
</tr>
<tr>
<td>Y</td>
<td>186* mph</td>
</tr>
</tbody>
</table>

* For tires with a maximum speed capability over 149 mph, tire manufacturers sometimes use the letters ZR. For those with a maximum speed capability over 186 mph, tire manufacturers always use the letters ZR.

**U.S. DOT Tire Identification Number** This begins with the letters "DOT" and indicates that the tire meets all federal standards. The next two numbers or letters are the plant code where it was manufactured, and the last four numbers represent the week and year the tire was built. For example, the numbers 3197 means the 31st week of 1997. The other numbers are marketing codes used at the manufacturer's discretion. This information is used to contact consumers if a tire defect requires a recall.

**Tire Ply Composition and Materials Used** The number of plies indicates the number of layers of rubber-coated fabric in the tire. In general, the greater the number of plies, the more weight a tire can support. Tire manufacturers also must indicate the materials in the tire, which include steel, nylon, polyester, and others.

**Maximum Load Rating** This number indicates the maximum load in kilograms and pounds that can be carried by the tire.

**Maximum Permissible Inflation Pressure** This number is the greatest amount of air pressure that should ever be put in the tire under normal driving conditions.

1.5.9.2. **UTQGS Information**

**Treadwear Number** This number indicates the tire's wear rate. The higher the treadwear number is, the longer it should take for the tread to wear down. For example, a tire graded 400 should last twice as long as a tire graded 200.

**Traction Letter** This letter indicates a tire's ability to stop on wet pavement. A higher graded tire should allow you to stop your car on wet roads in a shorter distance than a tire with a lower grade. Traction is graded from highest to lowest as "AA", "A", "B", and "C".

**Temperature Letter** This letter indicates a tire's resistance to heat. The temperature grade is for a tire that is inflated properly and not overloaded. Excessive speed, underinflation or excessive loading, either separately or in combination, can cause heat build-up and possible tire failure. From highest to lowest, a tire's resistance to heat is graded as "A", "B", or "C".
1.5.9.3. Additional Information on Light Truck Tires

Please refer to the following diagram.

Tires for light trucks have other markings besides those found on the sidewalls of passenger tires.

**LT** The "LT" indicates the tire is for light trucks or trailers.

**ST** An "ST" is an indication the tire is for trailer use only.

**Max. Load Dual kg (lbs) at kPa (psi) Cold** This information indicates the maximum load and tire pressure when the tire is used as a dual, that is, when four tires are put on each rear axle (a total of six or more tires on the vehicle).

**Max. Load Single kg (lbs) at kPa (psi) Cold** This information indicates the maximum load and tire pressure when the tire is used as a single.

**Load Range** This information identifies the tire's load-carrying capabilities and its inflation limits.

1.6. TIRE SAFETY TIPS

**Preventing Tire Damage**
Slow down if you have to go over a pothole or other object in the road.
Do not run over curbs or other foreign objects in the roadway, and try not to strike the curb when parking.

**Tire Safety Checklist**
- Check tire pressure regularly (at least once a month), including the spare.
- Inspect tires for uneven wear patterns on the tread, cracks, foreign objects, or other signs of wear or trauma.
- Remove bits of glass and foreign objects wedged in the tread.
- Make sure your tire valves have valve caps.
- Check tire pressure before going on a long trip.
- Do not overload your vehicle. Check the Tire Information and Loading Placard or User’s Manual for the maximum recommended load for the vehicle.