

OPERATION MANUAL



MQ POWER
MODEL SG1400C3
3-POSITION SWITCH/PARALLELING
1400 AMP STUDIO GENERATOR
(CUMMINS QSB7-G5 DIESEL ENGINE)

Revision #0 (10/05/11)

To find the latest revision of this
publication, visit our website at:
www.mqpower.com



THIS MANUAL MUST ACCOMPANY THE EQUIPMENT AT ALL TIMES.

EE55916



CALIFORNIA — Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

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 Multiquip at 1-800-421-1244.

If 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, NHTSA cannot become involved in individual problems between you, your dealer, or Multiquip.

To contact NHTSA, you may either call the Vehicle Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153), go to <http://www.nhtsa.dot.gov>; or write to:

Administrator
NHTSA
1200 New Jersey Avenue S.E.
Washington, DC 20590

You can also obtain information about motor vehicle safety from <http://www.safercar.gov>.

SG1400C3 Studio Generator

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NOTICE

Specifications are subject to change without notice.

PARTS ORDERING PROCEDURES

Ordering parts has never been easier! Choose from three easy options:

Effective:
January 1st, 2006

www.multiquip.com



Order via Internet (Dealers Only):

Order parts on-line using Multiquip's SmartEquip website!

- View Parts Diagrams
- Order Parts
- Print Specification Information



If you have an MQ Account, to obtain a Username and Password, E-mail us at: parts@multiquip.com.

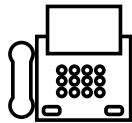
To obtain an MQ Account, contact your District Sales Manager for more information.

Goto www.multiquip.com and click on

Order Parts to log in and save!

Use the **internet** and qualify for a **5% Discount** on *Standard orders* for all orders which include complete part numbers.*

Note: Discounts Are Subject To Change



Order via Fax (Dealers Only):

All customers are welcome to order parts via Fax.

Domestic (US) Customers dial:
1-800-6-PARTS-7 (800-672-7877)

Fax your order in and qualify for a **2% Discount** on *Standard orders* for all orders which include complete part numbers.*

Note: Discounts Are Subject To Change



Order via Phone: Domestic (US) Dealers Call:
1-800-427-1244

Non-Dealer Customers:

Contact your local Multiquip Dealer for parts or call 800-427-1244 for help in locating a dealer near you.



International Customers should contact their local Multiquip Representatives for Parts Ordering information.

When ordering parts, please supply:

- | | |
|---|--|
| <input type="checkbox"/> Dealer Account Number | <input type="checkbox"/> Specify Preferred Method of Shipment: |
| <input type="checkbox"/> Dealer Name and Address | <input checked="" type="checkbox"/> UPS/Fed Ex <input checked="" type="checkbox"/> DHL |
| <input type="checkbox"/> Shipping Address (if different than billing address) | <input type="checkbox"/> Priority One <input checked="" type="checkbox"/> Truck |
| <input type="checkbox"/> Return Fax Number | <input type="checkbox"/> Ground |
| <input type="checkbox"/> Applicable Model Number | <input type="checkbox"/> Next Day |
| <input type="checkbox"/> Quantity, Part Number and Description of Each Part | <input type="checkbox"/> Second/Third Day |

NOTICE

All orders are treated as *Standard Orders* and will ship the same day if received prior to 3PM PST.

WE ACCEPT ALL MAJOR CREDIT CARDS!




SAFETY INFORMATION

Do not operate or service the equipment before reading the entire manual. Safety precautions should be followed at all times when operating this equipment. Failure to read and understand the safety messages and operating instructions could result in injury to yourself and others.


SAFETY MESSAGES

The four safety messages shown below will inform you about potential hazards that could injure you or others. The safety messages specifically address the level of exposure to the operator and are preceded by one of four words: **DANGER**, **WARNING**, **CAUTION** or **NOTICE**.


SAFETY SYMBOLS

 **DANGER**

Indicates a hazardous situation which, if not avoided, **WILL** result in **DEATH** or **SERIOUS INJURY**.

 **WARNING**

Indicates a hazardous situation which, if not avoided, **COULD** result in **DEATH** or **SERIOUS INJURY**.








 **CAUTION**

Indicates a hazardous situation which, if not avoided, **COULD** result in **MINOR** or **MODERATE INJURY**.

NOTICE

Addresses practices not related to personal injury.

Potential hazards associated with the operation of this equipment will be referenced with hazard symbols which may appear throughout this manual in conjunction with safety messages.

Symbol	Safety Hazard
	Lethal exhaust gas hazards
	Explosive fuel hazards
	Burn hazards
	Overspeed hazards
	Rotating parts hazards
	Pressurized fluid hazards
	Electric shock hazards


SAFETY INFORMATION

GENERAL SAFETY

CAUTION

- **NEVER** operate this equipment without proper protective clothing, shatterproof glasses, respiratory protection, hearing protection, steel-toed boots and other protective devices required by the job or city and state regulations.



- **NEVER** operate this equipment when not feeling well due to fatigue, illness or when under medication. 
- **NEVER** operate this equipment under the influence of drugs or alcohol.



- **ALWAYS** check the equipment for loosened threads or bolts before starting.
- **DO NOT** use the equipment for any purpose other than its intended purposes or applications.

NOTICE

- This equipment should only be operated by trained and qualified personnel 18 years of age and older.
- Whenever necessary, replace nameplate, operation and safety decals when they become difficult read.
- Manufacturer does not assume responsibility for any accident due to equipment modifications. Unauthorized equipment modification will void all warranties.

- **NEVER** use accessories or attachments that are not recommended by MQ Power for this equipment. Damage to the equipment and/or injury to user may result.

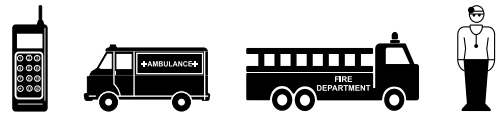
- **ALWAYS** know the location of the nearest **fire extinguisher**.



- **ALWAYS** know the location of the nearest **first aid kit**.



- **ALWAYS** know the location of the nearest phone or **keep a phone on the job site**. Also, know the phone numbers of the nearest **ambulance, doctor and fire department**. This information will be invaluable in the case of an emergency.



GENERATOR SAFETY

DANGER

- **NEVER** operate the equipment in an explosive atmosphere or near combustible materials. An explosion or fire could result causing severe **bodily harm or even death**.



WARNING

- **NEVER** disconnect any **emergency or safety devices**. These devices are intended for operator safety. Disconnection of these devices can cause severe injury, bodily harm or even death. Disconnection of any of these devices will void all warranties.

CAUTION

- **NEVER** lubricate components or attempt service on a running machine.

NOTICE

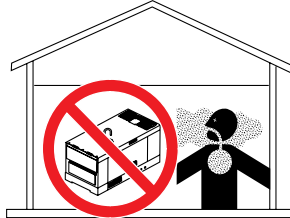
- **ALWAYS** ensure generator is on level ground before use.
- **ALWAYS** keep the machine in proper running condition.
- Fix damage to machine and replace any broken parts immediately.
- **ALWAYS** store equipment properly when it is not being used. Equipment should be stored in a clean, dry location out of the reach of children and unauthorized personnel

SAFETY INFORMATION

ENGINE SAFETY

DANGER

- The engine fuel exhaust gases contain poisonous carbon monoxide. This gas is colorless and odorless, and can cause death if inhaled.
- The engine of this equipment requires an adequate free flow of cooling air. **NEVER** operate this equipment in any enclosed or narrow area where free flow of the air is restricted. If the air flow is restricted it will cause injury to people and property and serious damage to the equipment or engine.



WARNING

- **DO NOT** place hands or fingers inside engine compartment when engine is running.
- **NEVER** operate the engine with heat shields or guards removed.
- Keep fingers, hands hair and clothing away from all moving parts to prevent injury.
- **DO NOT** remove the radiator cap while the engine is hot. High pressure boiling water will gush out of the radiator and severely scald any persons in the general area of the generator.
- **DO NOT** remove the coolant drain plug while the engine is hot. Hot coolant will gush out of the coolant tank and severely scald any persons in the general area of the generator.
- **DO NOT** remove the engine oil drain plug while the engine is hot. Hot oil will gush out of the oil tank and severely scald any persons in the general area of the generator.



CAUTION

- **NEVER** touch the hot exhaust manifold, muffler or cylinder. Allow these parts to cool before servicing equipment.



NOTICE

- **NEVER** run engine without an air filter or with a dirty air filter. Severe engine damage may occur. Service air filter frequently to prevent engine malfunction.
- **NEVER** tamper with the factory settings of the engine or engine governor. Damage to the engine or equipment can result if operating in speed ranges above the maximum allowable.
- Wet stacking is a common problem with diesel engines which are operated for extended periods with light or no load applied. When a diesel engine operates without sufficient load (less than 40% of the rated output), it will not operate at its optimum temperature. This will allow unburned fuel to accumulate in the exhaust system, which can foul the fuel injectors, engine valves and exhaust system, including turbochargers, and reduce the operating performance.



In order for a diesel engine to operate at peak efficiency, it must be able to provide fuel and air in the proper ratio and at a high enough engine temperature for the engine to completely burn all of the fuel.

Wet stacking does not usually cause any permanent damage and can be alleviated if additional load is applied to relieve the condition. It can reduce the system performance and increase maintenance. Applying an increasing load over a period of time until the excess fuel is burned off and the system capacity is reached usually can repair the condition. This can take several hours to burn off the accumulated unburned fuel.

- State Health Safety Codes and Public Resources Codes specify that in certain locations, spark arresters must be used on internal combustion engines that use hydrocarbon fuels. A spark arrester is a device designed to prevent accidental discharge of sparks or flames from the engine exhaust. Spark arresters are qualified and rated by the United States Forest Service for this purpose. In order to comply with local laws regarding spark arresters, consult the engine distributor or the local Health and Safety Administrator.

SAFETY INFORMATION

FUEL SAFETY

DANGER

- **DO NOT** start the engine near spilled fuel or combustible fluids. Diesel fuel is extremely flammable and its vapors can cause an explosion if ignited.
- **ALWAYS** refuel in a well-ventilated area, away from sparks and open flames.
- **ALWAYS** use extreme caution when working with **flammable** liquids.
- **DO NOT** fill the fuel tank while the engine is running or hot.
- **DO NOT** overfill tank, since spilled fuel could ignite if it comes into contact with hot engine parts or sparks from the ignition system.
- Store fuel in appropriate containers, in well-ventilated areas and away from sparks and flames.
- **NEVER** use fuel as a cleaning agent.
- **DO NOT** smoke around or near the equipment. Fire or explosion could result from fuel vapors or if fuel is spilled on a hot engine.



TOWING SAFETY

CAUTION

- Check with your local county or state safety towing regulations, in addition to meeting **Department of Transportation (DOT) Safety Towing Regulations**, before towing your generator.
- Refer to MQ Power trailer manual for additional safety information.
- In order to reduce the possibility of an accident while transporting the generator on public roads, **ALWAYS** make sure the trailer that supports the generator and the towing vehicle are mechanically sound and in good operating condition.
- **ALWAYS** shutdown engine before transporting



- Make sure the hitch and coupling of the towing vehicle are rated equal to, or greater than the trailer “gross vehicle weight rating.”
- **ALWAYS** inspect the hitch and coupling for wear. **NEVER** tow a trailer with defective hitches, couplings, chains, etc.
- Check the tire air pressure on both towing vehicle and trailer. **Trailer tires should be inflated to 50 psi cold.** Also check the tire tread wear on both vehicles.
- **ALWAYS** make sure the trailer is equipped with a **safety chain**.
- **ALWAYS** properly attach trailer’s safety chains to towing vehicle.
- **ALWAYS** make sure the vehicle and trailer directional, backup, brake and trailer lights are connected and working properly.
- DOT Requirements include the following:
 - Connect and test electric brake operation.
 - Secure portable power cables in cable tray with tie wraps.
- The maximum speed for highway towing is **55 MPH** unless posted otherwise. Recommended off-road towing is not to exceed **15 MPH** or less depending on type of terrain.
- Avoid sudden stops and starts. This can cause skidding, or jack-knifing. Smooth, gradual starts and stops will improve towing.
- Avoid sharp turns to prevent rolling.
- Trailer should be adjusted to a level position at all times when towing.
- Raise and lock trailer wheel stand in up position when towing.
- Place **chock blocks** underneath wheel to prevent **rolling** while parked.
- Place **support blocks** underneath the trailer’s bumper to prevent **tipping** while parked.
- Use the trailer’s swivel jack to adjust the trailer height to a level position while parked.

SAFETY INFORMATION

ELECTRICAL SAFETY

DANGER

- **DO NOT** touch output terminals during operation. Contact with output terminals during operation can cause **electrocution, electrical shock or burn.**



- The electrical voltage required to operate the generator can cause severe injury or even death through physical contact with live circuits. Turn generator and all circuit breakers **OFF** before performing maintenance on the generator or making contact with output terminals.

- **NEVER** insert any objects into the output receptacles during operation. This is extremely dangerous. The possibility exists of **electrical shock, electrocution or death.**



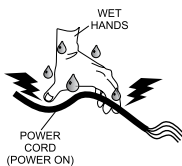
- Backfeed to a utility system can cause **electrocution** and/or property damage. **NEVER** connect the generator to a building's electrical system without a transfer switch or other approved device. All installations should be performed by a **licensed electrician** in accordance with all applicable laws and electrical codes. Failure to do so could result in electrical shock or burn, causing **serious injury or even death.**



Power Cord/Cable Safety

DANGER

- **NEVER** let power cords or cables **lay in water.**
- **NEVER stand in water** while AC power from the generator is being transferred to a load.
- **NEVER** use **damaged** or **worn** cables or cords when connecting equipment to generator. Inspect for cuts in the insulation.
- **NEVER** grab or touch a live power cord or cable with wet hands. The possibility exists of **electrical shock, electrocution or death.**



- Make sure power cables are securely connected to the generator's output receptacles. Incorrect connections may cause electrical shock and damage to the generator.

NOTICE

- **ALWAYS** make certain that proper power or extension cord has been selected for the job. See Cable Selection Chart in this manual.

Grounding Safety

DANGER

- **ALWAYS** make sure that electrical circuits are properly grounded to a suitable earth ground (ground rod) per the National Electrical Code (NEC) and local codes before operating generator. **Severe injury or death by electrocution** can result from operating an ungrounded generator.
- **NEVER** use gas piping as an electrical ground.

SAFETY INFORMATION

BATTERY SAFETY

DANGER

- **DO NOT** drop the battery. There is a possibility that the battery will explode.
- **DO NOT** expose the battery to open flames, sparks, cigarettes, etc. The battery contains combustible gases and liquids. If these gases and liquids come into contact with a flame or spark, an explosion could occur.



WARNING

- **ALWAYS** wear safety glasses when handling the battery to avoid eye irritation. The battery contains acids that can cause injury to the eyes and skin.
- Use well-insulated gloves when picking up the battery.
- **ALWAYS** keep the battery charged. If the battery is not charged, combustible gas will build up.
- **ALWAYS** recharge the battery in a well-ventilated environment to avoid the risk of a dangerous concentration of combustible gasses.
- If the battery liquid (dilute sulfuric acid) comes into contact with **clothing or skin**, rinse skin or clothing immediately with plenty of water.
- If the battery liquid (dilute sulfuric acid) comes into contact with **eyes**, rinse eyes immediately with plenty of water and contact the nearest doctor or hospital to seek medical attention.



CAUTION

- **ALWAYS** disconnect the **NEGATIVE battery terminal** before performing service on the generator.
- **ALWAYS** keep battery cables in good working condition. Repair or replace all worn cables.

ENVIRONMENTAL SAFETY

NOTICE

- Dispose of hazardous waste properly. Examples of potentially hazardous waste are used motor oil, fuel and fuel filters.
- **DO NOT** use food or plastic containers to dispose of hazardous waste.
- **DO NOT** pour waste, oil or fuel directly onto the ground, down a drain or into any water source.



SPECIFICATIONS

Table 1. Generator Specifications		
Model	SG1400C3	
Type	Revolving field, self ventilated, open protected type synchronous generator	
Armature Connection	12-Lead WYE	
No of Poles	4	
Prime Output	200 kVA	
1Ø Voltage	120/240 V	
3Ø Voltages	120/208 V and 277/480 V	
Frequency	60 Hz	
Voltage Regulation (no load to full load)	±1%	
Frequency Regulation (steady state load)	±0.25%	
Speed	1800 rpm	
Power Factor	0.8	
Aux. AC Voltage	120/240V, 60 Hz	
Weight (Generator Only)	5,900 lbs. (2,994 kg)	
Weight (Trailer Only)	2,640 lbs. (1,170 kg)	
Dimensions (LxWxH)	100 x 48 x 110 in (254 x 122 x 279 cm)	
Table 2. Engine Specifications		
Model	Cummins QSB7-G5	
Emissions	Tier 3	
Type	4 cycle, direct injection, turbocharged, charge air cooled	
No. of Cylinders	6 cylinders	
Bore x Stroke in (mm)	4.21 x 4.88 (107 x 124)	
Displacement	408 cu. in. (6,690 cc)	
Rated Output	279 HP/1800 RPM	
Starting	Electric	
Coolant Capacity	7.8 gal. (29 liters)	
Lube Oil Capacity	5.0 gal. (19.0 liters)	
Fuel Type	#2 Diesel Fuel	
Fuel Tank Capacity	150 gal. (567 liters)	
Fuel Consumption	13.3 gal. (64 L)/hr at full load	10.6 gal. (40 L)/hr at 3/4 load
	7.8 gal. (30 L)/hr at 1/2 load	4.0 gal. (15 L)/hr at 1/4 load
Table 3. Battery Specifications		
Battery (Top Post)	12V 750 CCA x 2 (24 VDC System) Group 27	
Dimensions HxWxL in. (cm)	8 x 12 x 6.6 (20.3 x 30.5 x 16.8)	

DIMENSIONS

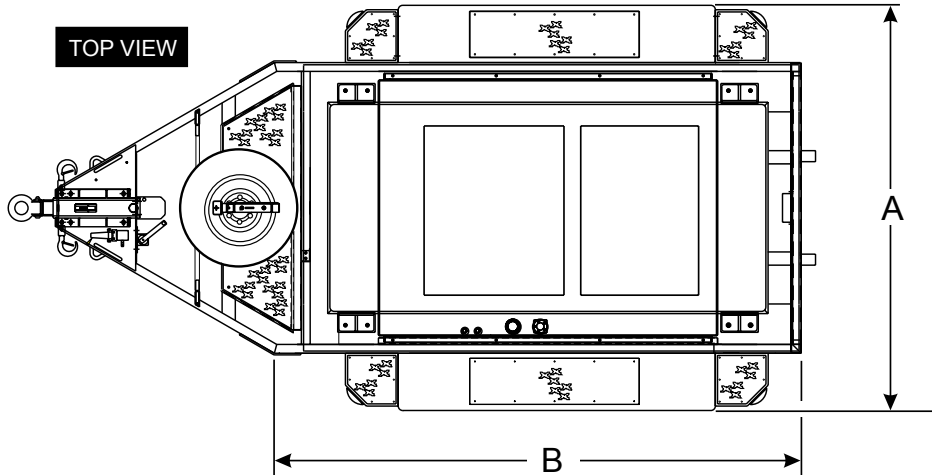


Figure 1. Dimensions

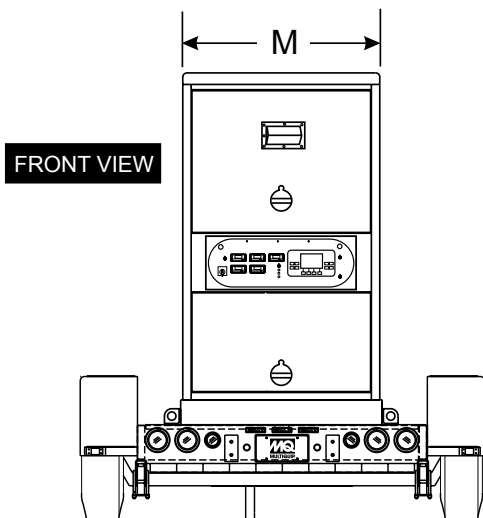
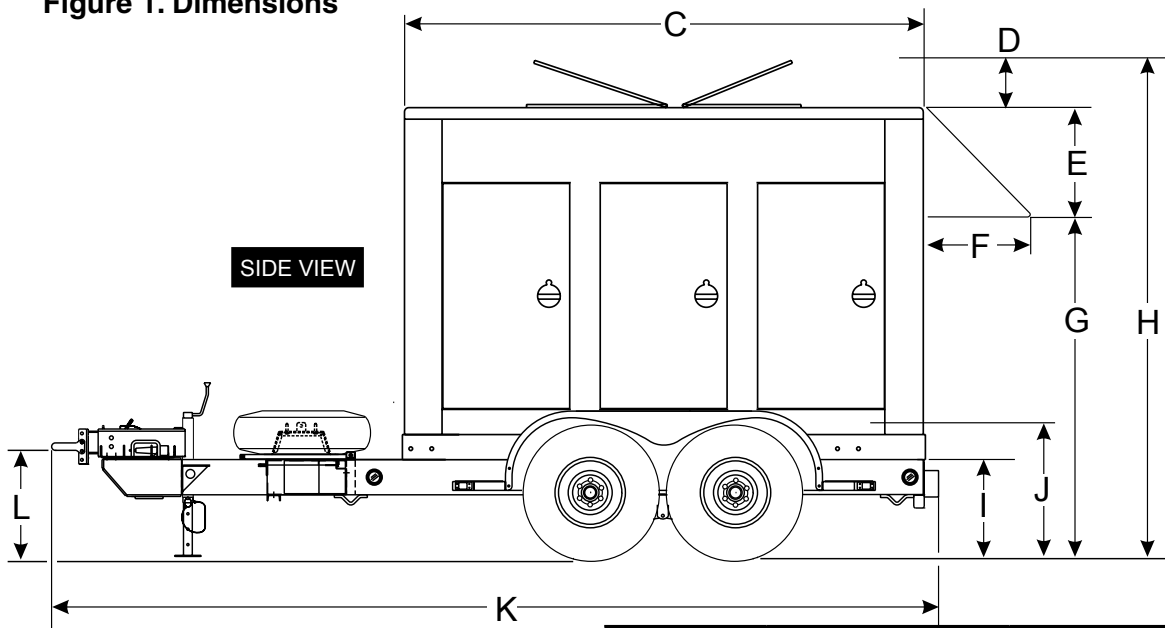


Table 4. Dimensions

Reference Letter	Dimensions in. (mm)	Reference Letter	Dimensions in. (mm)
A	90 (2,286)	H	130 (3,302)
B	115 (2,921)	I	22.5 (571)
C	96 (2,438)	J	23 (584) Chrome Wheels
D	27 (686)	J	24 (610) Aluminum Wheels
E	24 (610)	K	180 (4,572)
F	24 (610)	L	24.5 (622)
G	79 (2,007)	M	47 (1,194)

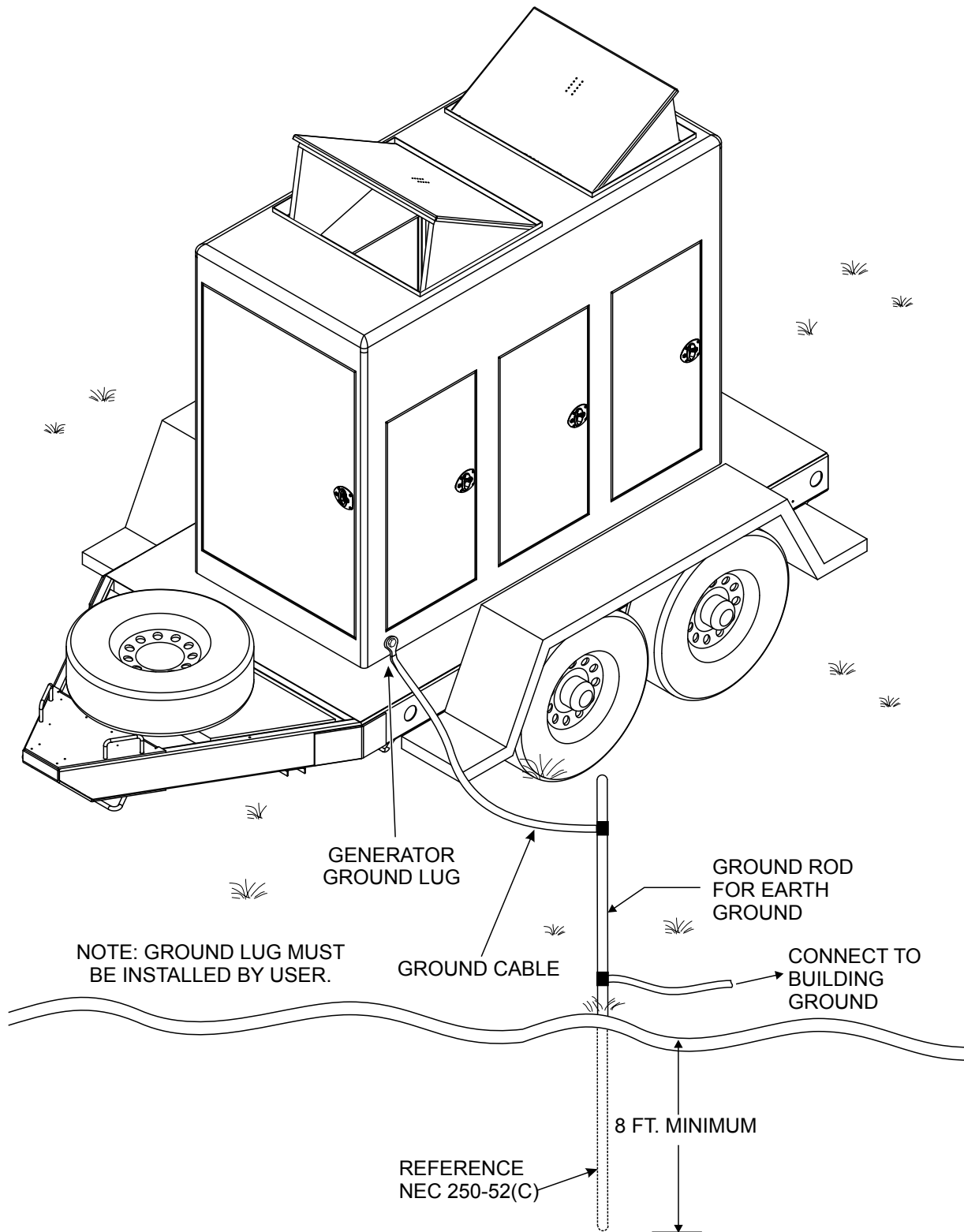


Figure 2. Typical Generator Grounding Application

OUTDOOR INSTALLATION

Install the generator in a area that is free of debris, bystanders, and overhead obstructions. Make sure the generator is on secure level ground so that it cannot slide or shift around. Also install the generator in a manner so that the exhaust will not be discharged in the direction of nearby homes.

The installation site must be relatively free from moisture and dust. All electrical equipment should be protected from excessive moisture. Failure to do will result in deterioration of the insulation and will result in short circuits and grounding.

Foreign materials such as dust, sand, lint and abrasive materials have a tendency to cause excessive wear to engine and alternator parts.

CAUTION

Pay close attention to ventilation when operating the generator inside tunnels and caves. The engine exhaust contains noxious elements. Engine exhaust must be routed to a ventilated area.

INDOOR INSTALLATION

Exhaust gases from diesel engines are extremely poisonous. Whenever an engine is installed indoors the exhaust fumes must be vented to the outside. The engine should be installed at least two feet from any outside wall. Using an exhaust pipe which is too long or too small can cause excessive back pressure which will cause the engine to heat excessively and possibly burn the valves.

GENERATOR GROUNDING

To guard against electrical shock and possible damage to the equipment, it is important to provide a good **EARTH** ground.

Article 250 (Grounding) of the National Electrical Code (NEC) provides guidelines for proper grounding and specifies that the cable ground shall be connected to the grounding system of the building as close to the point of cable entry as practical.

NEC articles 250-64(b) and 250-66 set the following grounding requirements:

1. Use one of the following wire types to connect the generator to earth ground.
 - a. Copper - 10 AWG (5.3 mm²)
 - b. Aluminum - 8 AWG (8.4 mm²)
2. When grounding the generator (Figure 2) connect the ground cable between the lock washer and the nut on the generator and tighten the nut fully. Connect the other end of the ground cable to earth ground.
3. NEC article 250-52(c) specifies that the earth ground rod should be buried a minimum of 8 ft. into the ground.

NOTICE

When connecting the generator to any buildings electrical system **ALWAYS** consult with a licensed electrician.

NOTICE

If connection of the ground rod is not feasible, please check city, local or state electrical requirements on generator grounding requirements.

GENERAL INFORMATION

Generator

The MQ Power Model SG1400C3 is a 200kVA studio generator that is designed as a high quality power source for entertainment and studio applications.

In keeping with Multiquip's policy of constantly improving its products, the specifications quoted herein are subject to change without prior notice.

Permanent Magnet Generator Excitation System

The SG1400C3 generator is equipped with a PMG (Permanent Magnet Generator) generator end. The excitation system provides a minimum short circuit support current of 300% of the standby rating for 10 seconds at 60 Hz, and approximately 275% at 50 Hz.

Both the PMG and the exciter are mounted outboard of the bearing for ease of maintenance. The rotating brushless exciter features hermetically sealed diodes for three-phase full-wave rectification. The three-phase bridge is protected against abnormal transient conditions by a multiplate selenium surge protector.

Engine

This generator is powered by a six-cylinder, 4-cycle direct injection, turbocharged, air-cooled Cummins QSB7-G5 diesel engine. Engine speed is set at the factory at 1800 RPM. This engine is designed to meet every performance requirement for the generator. Refer to Table 2 for engine specifications.

Principle Of Operation

This generator is a brushless, self-excited, externally voltage regulated, synchronous AC generator. The generator is made up of six major components: main stator (armature), main rotor (field), exciter stator (field), exciter rotor (armature), rectifier assembly, and voltage regulator.

The generator's exciter consists of a stationary field and a rotating armature. The stationary field (exciter stator) is designed to be the primary source of the generator's residual magnetism. This residual magnetism allows the exciter rotor (armature) to produce AC voltage even when the exciter stator (field) is not powered. This AC voltage is rectified to DC by the rotating rectifier assembly and fed directly to the main rotor (field). As the generator

shaft continues to rotate, the main rotor (field) induces a voltage into the generator's main stator (armature). At rated speed, the main stator's voltage produced by the residual magnetism of the exciter allows the automatic voltage regulator to function.

The regulator provides voltage to the exciter resulting in a build-up of generator terminal voltage. This system of using residual magnetism eliminates the need for a special field flashing circuit in the regulator. After the generator has established the initial residual voltage, the regulator provides a controlled DC field voltage to the exciter stator resulting in a controlled generator terminal voltage.

Voltage Regulation

In the standard configuration (shunt excited), the automatic voltage regulator receives both its input power and voltage sensing from the generator's output terminals. The regulator automatically monitors the generator's output voltage against an internal reference set point and provides the necessary DC output voltage to the exciter field required to maintain constant generator terminal voltage. The generator's terminal voltage is changed by adjusting the regulator's reference set point.

Electronic Governor System

The electronic governor system controls the RPMs of the engine. When the engine demand increases or decreases, the governor system regulates the frequency variation to $\pm 0.25\%$.

Battery

The battery system is located in the engine compartment on the sub-base. The battery's primary purpose is to provide starting power for the diesel engine starter motor. The battery system is comprised of two 12 VDC, sealed lead acid batteries wired in series to provide 24 VDC to the starting motor. The battery is charged by the charging alternator while the engine is engaged.

Exhaust System

The exhaust system is located above the diesel engine. The exhaust system is comprised of rigid and flexible tubing, a silencer, and a roof-mounted exhaust riser with a rain cap.

GENERAL INFORMATION

Fuel Tank

This generator can be equipped with a 150 gallon (567 liters) fuel tank located beneath the trailer deck. The tank is made of steel (baffled). The tank can be filled from an external fill port located on the side of the trailer. The fill port has a 2-inch (51 mm) fill neck with vented cap.

When refueling, it is recommended to use ASTM-D975/No. 2 diesel fuel. A drain port is provided on the end of the tank.

Fuel Priming Pump

The generator set is equipped with an electric (24 VDC) fuel priming pump to assist in priming the system for maintenance purposes. The priming pump, bypass valves, and priming switch are located on the side of the diesel engine in the engine compartment.

Fuel Water Separator

A 30-micron Racor 900 fuel water separator is part of the fuel system assembly and is located on the side of the engine in within the enclosure compartment.

The supply line between the engine fuel pump and tank passes through an in-line fuel/water separator filter. The filter element is rated to filter elements down to 10 microns.

Intake Ventilation Door

The intake air ventilation door is located on the roof of the generator set enclosure near the control panel. The door is hydraulically actuated. Upon startup of the diesel engine, pressure fills the cylinder and opens the door. Intake air passes through the opening, and across the engine's radiator to cool the engine.

During rainy conditions the roof ventilation door will close when the front ventilation door is opened.

Interior Lighting

The interior lighting system is distributed throughout the interior. There are three separate lighting fixtures. Two lights are in the engine compartment, and one light is in the generator compartment. The lighting system operates from the 24 VDC battery system.

The light fixtures are sealed incandescent bulbs which are activated by a 0-15 minute timer switch located on the side control panel box. The DC lighting system can be used to perform off-line maintenance or assist in setup prior to AC power connection.

Trailer (Optional)

If equipped, the generator set can be mounted on a tandem axle trailer. Standard trailer is available with 8-lug chrome wheels and electric or hydraulic brakes. Options may include electric jack stands, adjustable hitch, ground rod holder and rear stabilizing jacks.

OPTIONS

- **Battery Charger** — 24 VDC/3 AMP, 120 V Input
- **Battery Disconnect Switch** — 400 Amps
- **Optima Red Top Batteries** — Replaces standard batteries
- **Block Heater** —120 V, 1500 Watt
- **CSA Package** — Includes 400 Amp and 200 Amp Circuit Breakers
- **Exterior Lights**
- **Fire Extinguisher and Box** — Mounted on Door
- **Forklift Base**
- **GPS and Remote Monitoring Module**
- **Lift-off Doors**
- **Low Oil Murphy Swichgage®**
- **Oil Level Sight Glass**
- **30-Micron Racor 1000 Fuel/Water Separator** — Replaces Racor 900

InteliVision 5™ Digital Controller

The InteliVision 5 Digital Controller provides monitoring and fault detection capability of all engine and generator operating parameters. A list of operating parameters is shown below:

■ AC Metering Display

- Voltage/Amperage / Frequency
- Generator Phase Voltage / Current
- Generator Frequency

■ Engine Information Display

- Engine Temperature / Oil Pressure (psi)
- Battery Voltage (DC) / Tachometer
- Hourmeter

■ Minor Fault Warning Display

- Switch Not In Auto
- Low Fuel Level
- Low Oil Pressure Alarm
- Low Engine Temperature
- High Engine Temperature Alarm
- Low Battery Voltage
- High Battery Voltage
- Weak Battery Condition
- Battery Charger Input Fail
- Undervoltage
- Over / Underfrequency
- Overcurrent

■ Major Fault Shutdown Display

- Overvoltage
- Emergency Stop
- Loss Of Speed
- Overcrank
- Overspeed
- Low Oil Pressure
- High Engine Temperature
- Low Coolant Level
- Spare Programmable Digital Faults

■ Switches And Operating Controls

- Run / Off / Auto / Load Test Buttons
- Decrement / Increment / Previous (Exit) /Next (Enter) Program Buttons
- Emergency Stop Button
- Audible Alarm Horn
- Alarm Horn Silence Button
- Lamp Test Button
- Fault Reset Function
- RS-485 Remote Communications, External Expansion Module Ports

■ Timer Countdown Display

- Engine Start Delay
- Oil Bypass
- Overcrank
- Cycle Crank
- Starter Re-engage Delay
- Bypass Delay

■ Control LED Indicators

- Switch Position (Run, Off, Auto, Test)
- Common Alarm (Minor Fault)
- Common Shutdown (Major Fault)
- Generator Ready (When in Auto)
- Speed Signal
- Emergency Stop

■ Diagnostic LED Indicators:

- Run Output Energized
- Crank Output Energized
- Remote Start Signal Initiated
- Common Fail Output Energized
- Watchdog - CPU Running
- Programmable Output Contacts

GENERATOR MAJOR COMPONENTS

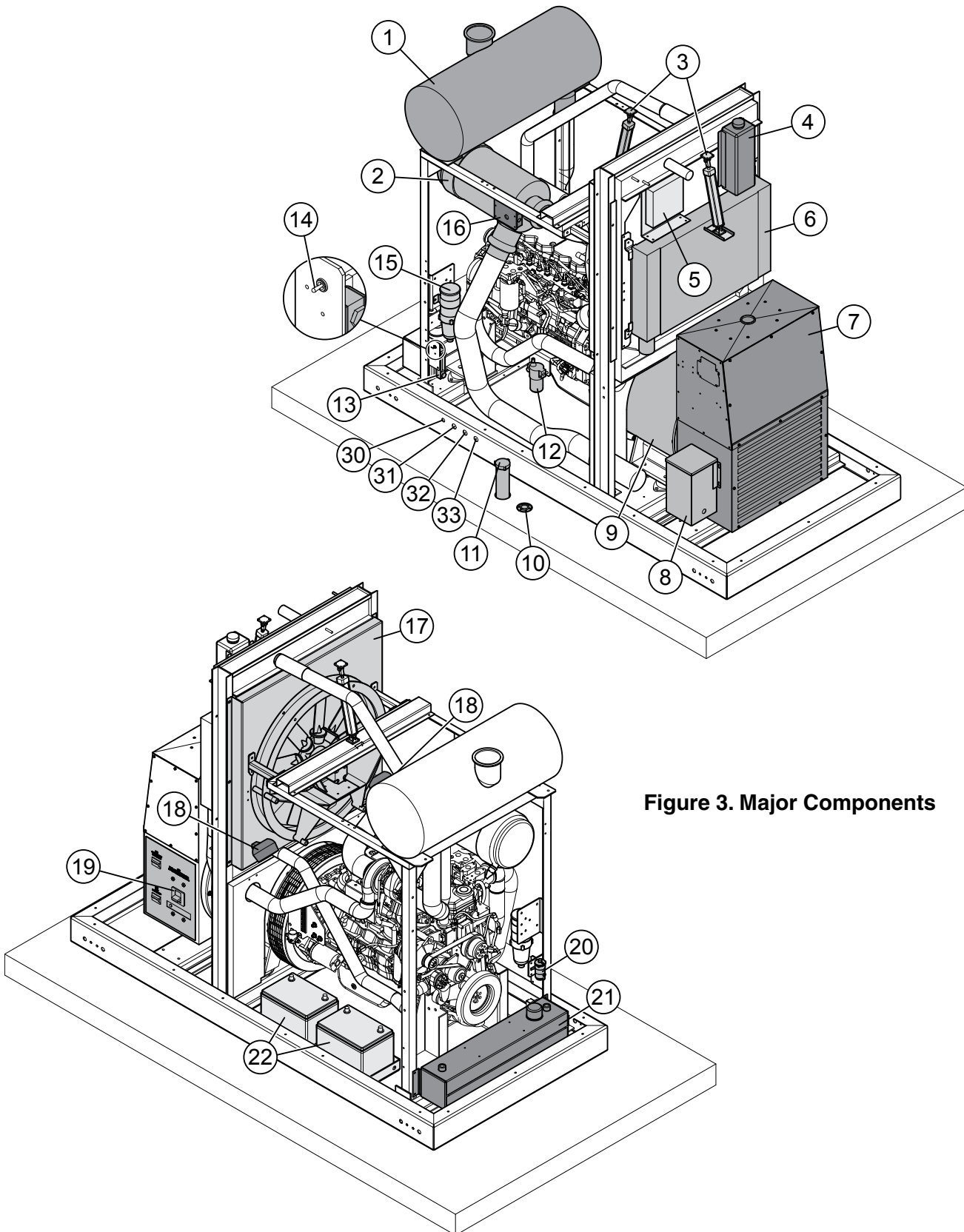


Figure 3. Major Components

GENERATOR MAJOR COMPONENTS

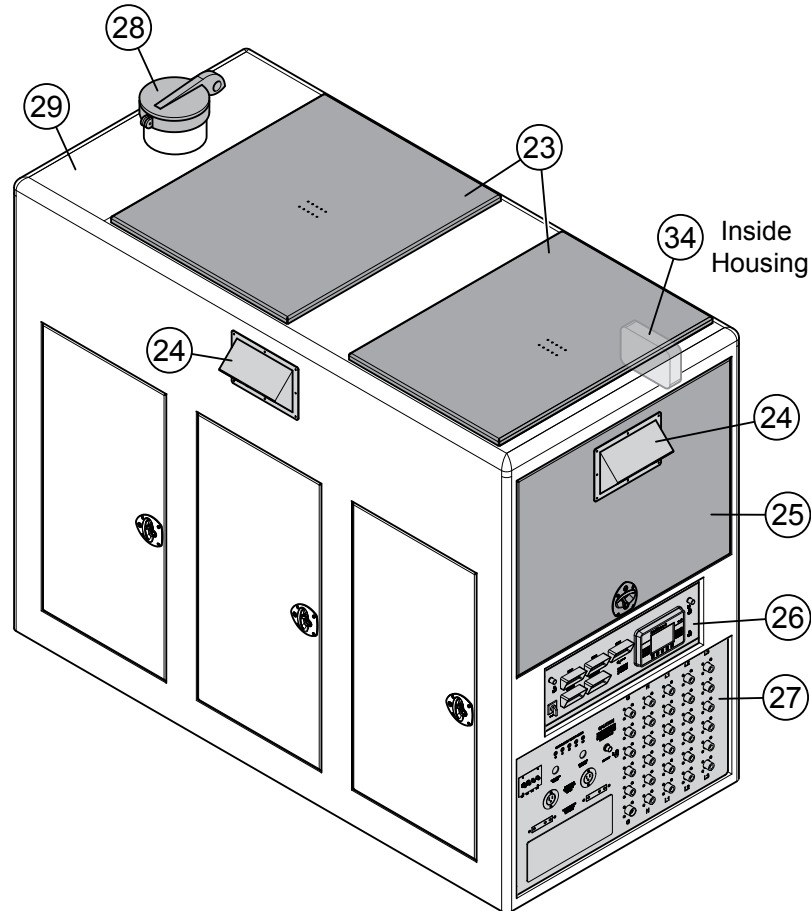


Figure 3. Major Components

Table 5. Generator Major Components

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	Muffler	13	Hydraulic Oil Sight Gauge	25	Rain Door Intake Vent
2	Air Filter	14	Fuel Priming Pump Switch	26	Control Box
3	Hydraulic Cylinders	15	Fuel-Water Separator	27	Camlok Panel
4	Coolant Overflow Bottle	16	Hydraulic Actuator Manifold	28	Rain Cap
5	Charge Oil Cooler (Hydraulic)	17	Radiator	29	Housing Assembly
6	Charge Air Cooler	18	Interior Lights	30	Water Drain
7	Saddlebox	19	Circuit Breaker Panel	31	Oil Drain
8	3 kVA Transformer	20	Coolant Filter	32	Fuel In
9	Generator	21	Hydraulic Oil Tank	33	Fuel Out
10	Fuel Gauge	22	Batteries	34	GPS Module (Option)
11	Fuel Cap, Vented	23	Roof Intake/Exhaust Vents		
12	Hydraulic Oil Filter	24	Exterior Lights (Option)		

BASIC ENGINE COMPONENTS

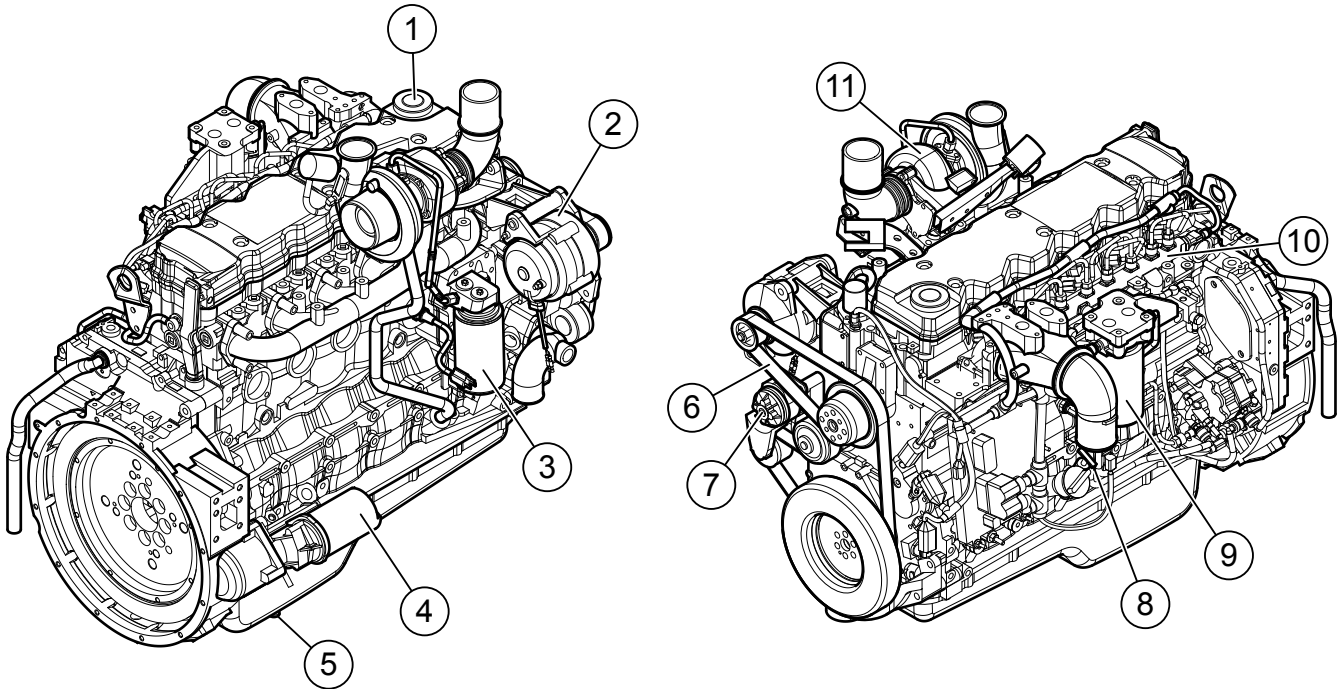


Figure 4. Basic Engine Components

Table 6. Basic Engine Components	
ITEM NO.	DESCRIPTION
1	Oil Filler Cap
2	Alternator
3	Oil Filter
4	Starter
5	Oil Drain Plug
6	Belt
7	Water Pump
8	Oil Dipstick
9	Fuel Filter
10	Fuel Rail
11	Turbocharger

BASIC TRAILER COMPONENTS

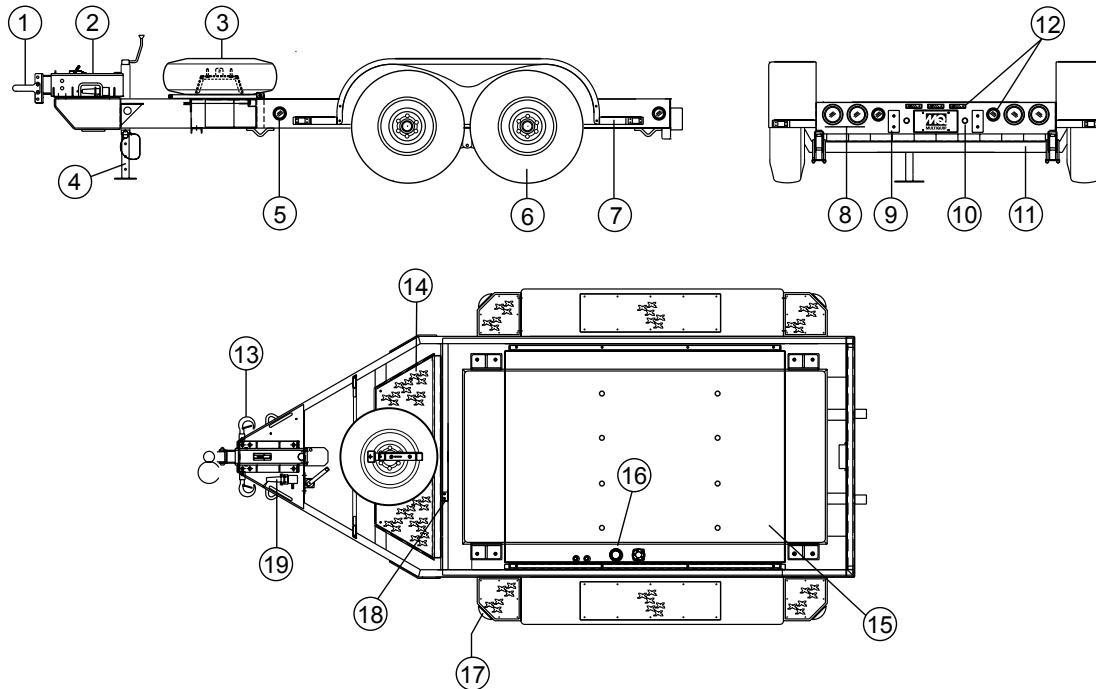


Figure 5. Basic Trailer Components

The definitions below describe the controls and functions of the Trailer (Figure 6).

1. **Pintle Eye Coupler** — Adjustable 3-inch eye coupler rated at 20,000 lbs. (9,072 kg).
2. **Hydraulic Brake Actuator** — Replaceable bolt-on actuator, assists in the stopping of the trailer. Rated at 12,000 lbs. (5,443 kg)
3. **Spare Tire** — Tongue mounted spare tire with anti-theft wheel lock and locking mount.
4. **Jackstand** — Tongue mounted swivel jack with flat disc foot, rated 5000 lbs. (2,268 kg) lift.
5. **Reflectors** — Side mounted reflectors are mounted on both sides of the trailer to provide high visibility when towing in dark areas.
6. **Tires** — Recommended tire size is LT235/85R16 LR E. Tire load rating is 3,500 lbs/tire.
7. **Reflective Tape** — Provides high visibility when towing in dark areas.
8. **Brake/Turn Lights** — DOT approved tail, stop, and turn signal lamps.
9. **Bumper Guard** — Protects trailer frame when coming in contact with stationary objects.
10. **License Plate Lights** — Illuminates license plate.
11. **Axle** — Tandem axle, Gross Axle Weight Rating (GAWR) 6,000 lbs. (2,722 kg) Gross Vehicle Weight Rating is 10,000 lbs. (4,536 kg).
12. **Rear Bumper Reflectors** — Provides high visibility when towing in dark areas.
13. **Safety Chains** — Connect to towing vehicle. Reference towing section in this manual.
14. **Tool Box** — Tongue mounted tool box, lift spare tire to gain access to this compartment
15. **Fuel Tank** — Holds 150 gallons (568 liters) of No. 2 diesel fuel.
16. **Fuel Tank Filler Port** — Fuel filler port, 2-inch (51 mm) neck.
17. **Side Running Lamps** — Provides high visibility when towing in dark areas.
18. **Tool Box Locking Latch** — Release this latch to gain access to tool box. Pull spare tire upward and back.
19. **Plug Holder** — Holds trailer harness (lights) cable plug.

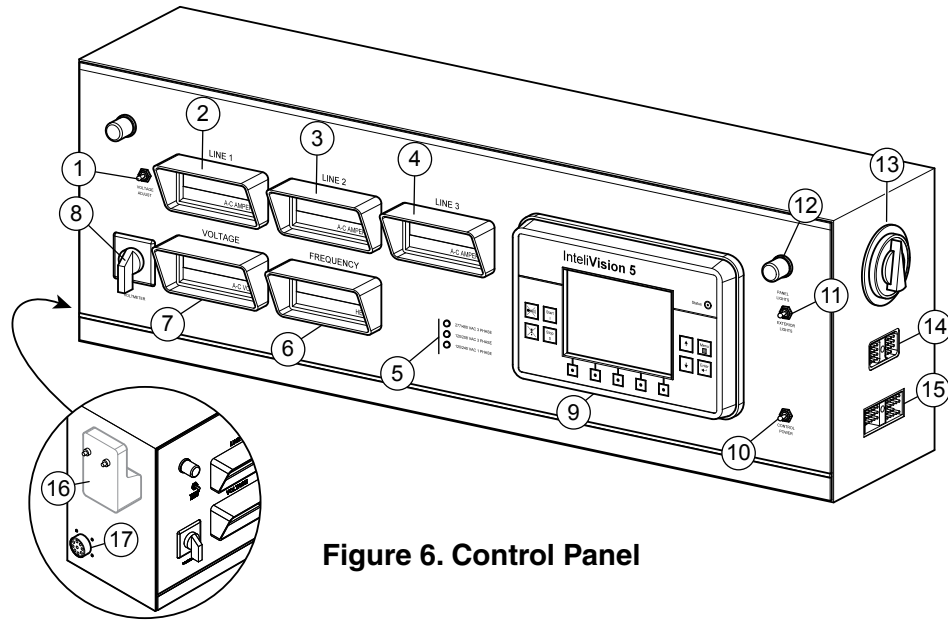


Figure 6. Control Panel

The definitions below describe the controls and functions of the Control Panel (Figure 6).

1. **Voltage Adjust Switch** — To increase the output voltage, pull upward and hold the switch until the desired voltage is achieved by monitoring the AC voltage display (item 8). To decrease the voltage, pull downward.
2. **Line 1 AC Amps Display** — Indicates the amount of current the load is drawing from line 1 of the generator.
3. **Line 2 AC Amps Display** — Indicates the amount of current the load is drawing from line 2 of the generator.
4. **Line 3 AC Amps Display** — Indicates the amount of current the load is drawing from line 3 of the generator.
5. **Voltage Status LEDs** — During operation these status LED's will indicate the phase/voltage of the generator, 3Ø-277/480, 3Ø-120/208 or 1Ø-120/240.
6. **Frequency Display** — Indicates the frequency of the generator in Hertz.
7. **AC Voltmeter Display** — Indicates the output voltage present at the camlok terminals. This display is used in conjunction with the voltmeter select switch (item 8).
8. **Voltmeter Selector Switch** — Place switch in desired position to read line-line or line-neutral voltage. Switch is used in conjunction with AC voltmeter display (item 7).
9. **Digital Controller** — Starts and stops the generator and monitors various engine operating parameters.
10. **Controller Power Switch** — Provides power to engine controller.
11. **Light Switch** — In the up position, turns on exterior lights. In the down position, turns on panel lighting. In the center position, turns off all lights.
12. **Panel Lights** — Located on each side of the digital control panel is a panel light. Lights are activated by light switch.
13. **Light Timer Control** — The interior lights are controlled by an electronic turn dial timer that allows the operator to turn on the lights inside the generator for up to 15 minutes. The lights will automatically shut off when the timer reaches zero.
14. **AC Output Connector** — Provides AC power to various electronic assemblies.
15. **DC Output Connector** — Provides DC power to engine interface.
16. **Fan Control Module** — Provides necessary control electronics to operate fan.
17. **Engine Com Connector** — 9-pin connector for communication to engine via a PC with engine software.

CAMLOK/VOLTAGE OUTPUT PANEL

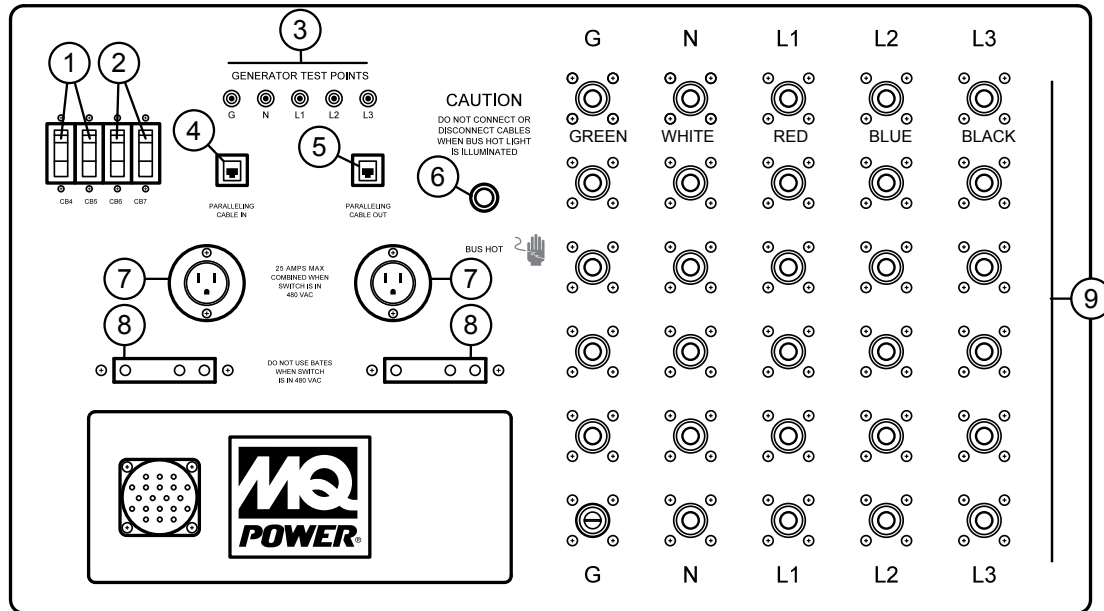


Figure 7. Camlok/Voltage Output Panel

The definitions below describe the controls and functions of the Camlok/Voltage Output Panel (Figure 7).

- CB4/CB5 Circuit Breakers** — These circuit breakers protect the 120 VAC auxiliary output receptacles from overload.
- CB6/CB7 Circuit Breakers** — These circuit breakers protect the bates output receptacles from overload.
- Generator Voltage Test Points** — To determine if the generator's output voltage is present and correct, connect a test meter to these test points during troubleshooting and maintenance.
- Paralleling Cable In** — This Ethernet input connection point is used when multiple generators are going to be connected.
- Paralleling Cable Out** — This Ethernet output connection point is used when multiple generators are going to be connected.
- BUS Hot Indicator Lamp** — When lit, this indicator lamp informs that the voltage bus is active (high voltage). **NEVER** connect or disconnect cables from the camlok or auxiliary receptacles when this indicator is **ON**. The possibility exists of electrocution, shock or even death if cables are connected or unplugged when this indicator is lamp lit.
- 120 VAC Output Receptacles** — These 15-amp receptacles provide 120 VAC output. The maximum allowable combined amps (both receptacles) is 25 amps when the voltage selector switch in the 3Ø 277/480 VAC position.
- Bates 120VAC Output Receptacles** — These receptacles provide AC voltage output. Each receptacle is protect by a 100 amp breaker. These receptacles cannot be used when the voltage selector switch is in the 3Ø 277/480 VAC position.
- Camlok Receptacles** — These output voltage connection points (6 pairs) are used for load connection. **ALWAYS** pay close attention when connecting and disconnecting power cables from these camlok receptacles. The possibility exists of electrocution, shock or even death if cables are connected or unplugged when the bus hot indicator lamp is lit.

CIRCUIT BREAKER PANEL

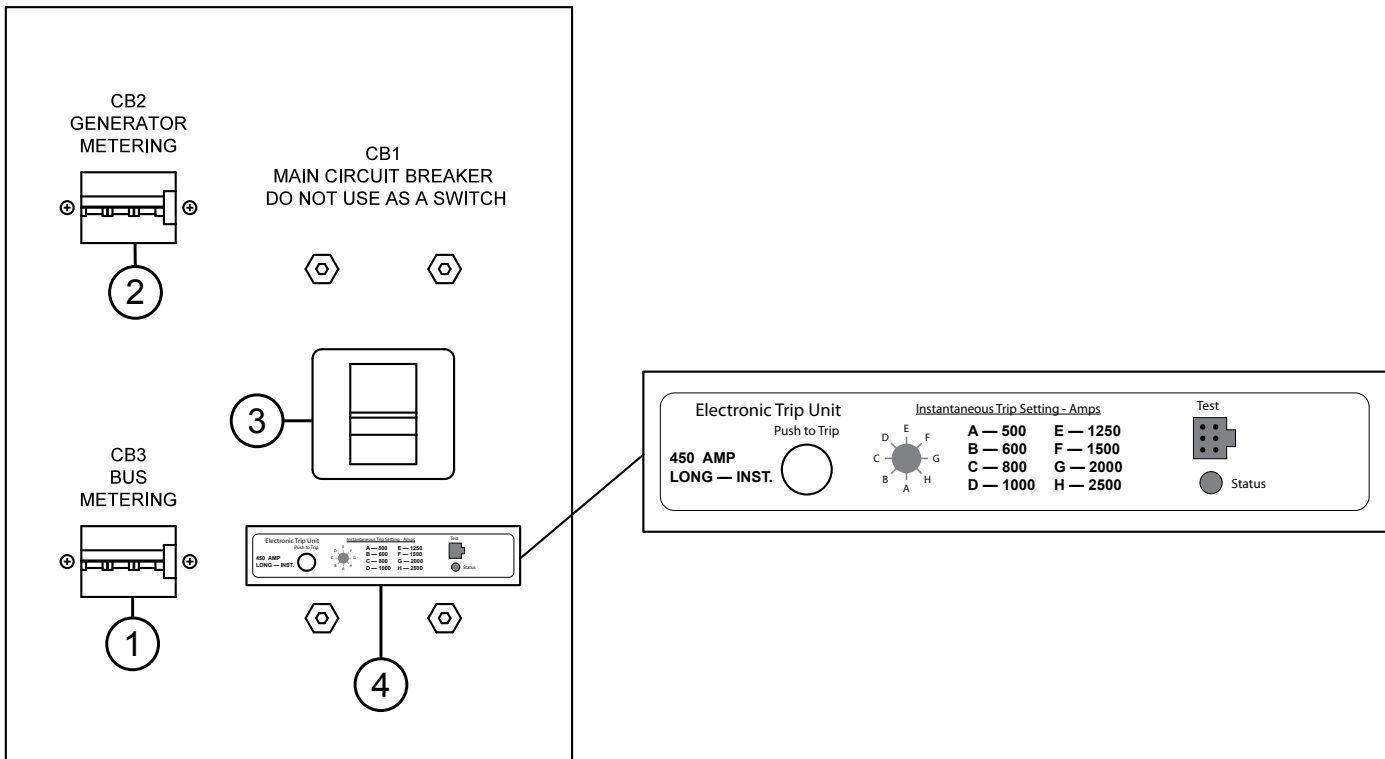


Figure 8. Main Breaker Panel

The definitions below describe the controls and functions of the Main Breaker Panel (Figure 8).

1. **CB2 Circuit Breaker** — This breaker monitors, senses the generator voltage bus. If breaker trips, signal is sent to controller.
2. **CB3 Circuit Breaker** — This breaker monitors, senses the voltage bus. If breaker trips, signal is sent to controller.
3. **Main Circuit Breaker** — This 600 amp breaker protects the camlok receptacles (load) from overload.
4. **Electronic Trip Unit** — This unit protects the generator from in-rush current (load spikes).

NOTICE

When setting the trip point on the electric trip unit, be careful not to set the trip point too high. Setting the trip point too high may cause the main breaker not to trip. This condition could cause serious damage to the equipment, and serious bodily harm even death to operating personnel.

Always be conservative when setting the trip point. The trip setting for this generator is position B 600 amps.

DO NOT adjust the trip point setting when the equipment is in operation.

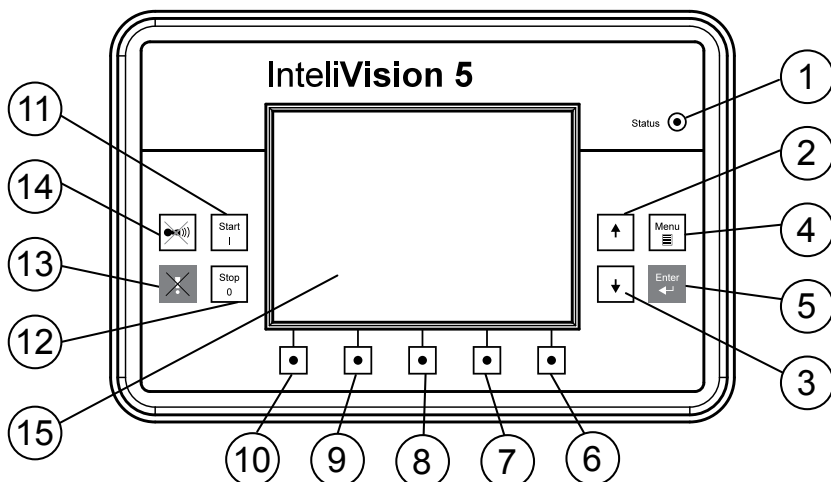


Figure 9. Digital Controller

Refer to Figure 9 for location of controls and indicators.

1. **STATUS LED** — Indicates status of the controller. Lights green when the controller is running.

NAVIGATIONS BUTTONS

2. **ARROW UP Button** — Press button to scroll up through the status menus or programming prompts.
3. **ARROW DOWN Button** — Press button to scroll down through the status menus or programming prompts.
4. **MENU Button** — Press button to jump to menu/sub-menu page or escape from any dialog window.
5. **ENTER Button** — Press button to confirm a value or open a value adjustment within setting dialogs.

CONTEXT BUTTONS

6. **MODE Button** — Press button to jump to the controller mode window.
7. **HISTORY Button** — Press button to jump to history screen.
8. **ALARM Button** — Press button to jump to alarm list
9. **GCB (Generator Circuit Breaker) CONTROL Button** — Press button to close/open GCB.
10. **MCB CONTROL Button** — Not functional in this application.

CONTROL BUTTONS

11. **START Button** — Press button to go idle mode (about an hour) then generator starts. A second press will bypass idle mode and generator goes to full speed immediately.
12. **STOP Button** — Press button to cool the generator for about 5 minutes then the generator will stop. A second press will bypass cool down and will stop the generator immediately.

NOTICE

START and **STOP** buttons work in MAN (manual) or SEM (semi-manual) mode only.

13. **FAULT RESET Button** — Press button to acknowledge faults and alarms (active only in Alarm screen).
14. **HORN RESET Button** — Press button to deactivate the horn (audible alarm).
15. **DISPLAY** — Shows menu, measurements, setpoints, alarm list, history, and help/others screens.

NOTICE

For more detailed operating and programming information on the digital controller, refer to the IntelliVision 5™ Controller User's Guide.

LOAD APPLICATION/GENERATOR OUTPUT

SINGLE PHASE LOAD

Always be sure to check the nameplate on the generator and equipment to insure the wattage, amperage, frequency, and voltage requirements are satisfactorily supplied by the generator for operating the equipment.

Generally, the wattage listed on the nameplate of the equipment is its rated output. Equipment may require 130—150% more wattage than the rating on the nameplate, as the wattage is influenced by the efficiency, power factor and starting system of the equipment.

NOTICE

If wattage is not given on the equipment's name plate, approximate wattage may be determined by multiplying nameplate voltage by the nameplate amperage.

$$\text{WATTS} = \text{VOLTAGE} \times \text{AMPERAGE}$$

The power factor of this generator is 1.0. See Table 7 below when connecting loads.

Table 7. Power Factor By Load

Type of Load	Power Factor
Single-phase induction motors	0.4-0.75
Electric heaters, incandescent lamps	1.0
Fluorescent lamps, mercury lamps	0.4-0.9
Electronic devices, communication equipment	1.0
Common power tools	0.8

Table 8. Cable Selection (60 Hz, Single Phase Operation)

Current in Amperes	Load in Watts		Maximum Allowable Cable Length			
	At 100 Volts	At 200 Volts	#10 Wire	#12 Wire	#14 Wire	#16 Wire
2.5	300	600	1000 ft.	600 ft.	375 ft.	250 ft.
5	600	1200	500 ft.	300 ft.	200 ft.	125 ft.
7.5	900	1800	350 ft.	200 ft.	125 ft.	100 ft.
10	1200	2400	250 ft.	150 ft.	100 ft.	
15	1800	3600	150 ft.	100 ft.	65 ft.	
20	2400	4800	125 ft.	75 ft.	50 ft.	

CAUTION: Equipment damage can result from low voltage

THREE PHASE LOAD

When calculating the power requirements for 3-phase power use the following equation.

$$\text{KVA} = \frac{\text{VOLTAGE} \times \text{AMPERAGE} \times 1.732}{1000}$$

NOTICE

If 3Ø load (kVA) is not given on the equipment nameplate, approximate 3Ø load may be determined by multiplying voltage by amperage by 1.732.

NOTICE

Motors and motor-driven equipment draw much greater current for starting than during operation.

An inadequate size connecting cable which cannot carry the required load can cause a voltage drop which can burn out the appliance or tool and overheat the cable. Refer to Table 8 to select the correct cable size.

- When connecting a resistance load such as an incandescent lamp or electric heater, a capacity of up to the generator's rated output (kW) can be used.
- When connecting a fluorescent or mercury lamp, a capacity of up to the generator's rated output (kW) multiplied by 0.6 can be used.
- When connecting an electric drill or other power tools, pay close attention to the required starting current capacity.

When connecting ordinary power tools, a capacity of up to the generator's rated output (kW) multiplied by 0.8 can be used.

DANGER

Before connecting this generator to any building's electrical system, a **licensed electrician** must install a **transfer switch**. Serious damage to the building's electrical system may occur without this transfer switch.

GENERATOR OUTPUTS

GENERATOR OUTPUT VOLTAGES

A wide range of voltages are available to supply voltage for many different applications. Voltages are selected by using the **voltage selector** switch (Figure 10). To obtain some of the voltages as listed in Table 9 (see below) will require a fine adjustment using the **voltage adjust toggle switch** located on the digital control panel.

Voltage Selector Switch

The voltage selector switch (Figure 10) is located on the back side of the Saddle Box Assembly. It has been provided for ease of voltage selection.

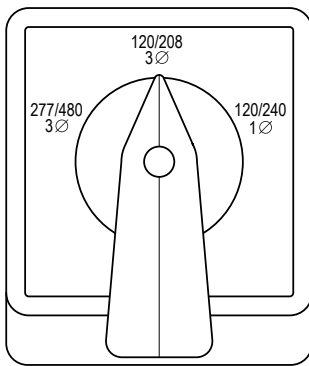


Figure 10. Voltage Selector Switch

Generator Amperage

Table 10 shows the **maximum** amps the generator can provide. **DO NOT** exceed the maximum amps as listed.

Table 10. Generator Maximum Amps		
Rated Voltage	Line Amps	Total Amps
1Ø 240 Volt	538 amps	1076 amps
3Ø 208 Volt	466 amps	1400 amps
3Ø 480 Volt	202 amps	606 amps

CAUTION

NEVER change the position of the **voltage selector switch** while the engine is running. **ALWAYS** place main circuit breaker in the **OFF** position before selecting voltage and activate voltage change mode switch.

Table 9. Voltages Available

L1 L2 L3 Output Terminal Lugs	Voltage Selector Switch 3-Phase 120/208V Position			Voltage Selector Switch 3-Phase 480/277V Position		
	3Ø Line-Line	208V	220V	240V	416V	440V
1Ø Line-Neutral	120V	127V	139V	240V	254V	277V
Voltage Selector Switch Single-Phase 240/120V Position						
1Ø Line-Neutral/Line-Line	120V Line-Neutral	N/A	N/A	240V Line-Line	N/A	N/A

NOTICE

Controller has over/under-voltage protection based on 208 V nominal/480 V nominal/240 V nominal voltage.

MAIN CIRCUIT BREAKER

The generator is equipped with a 3-pole, 600-amp circuit breaker to protect the camlok receptacles from overload. Make sure that the main circuit breaker is in the **OFF** position prior to starting the engine.

LUBRICATION OIL

Fill the engine crankcase with lubricating oil through the filler hole, but **DO NOT** overfill. Make sure the generator is level and verify that the oil level is maintained between the two notches (Figure 11) on the dipstick. See Table 11 for proper selection of engine oil.

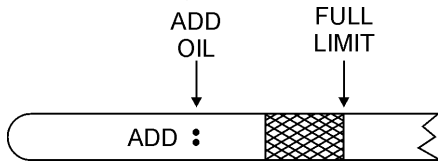


Figure 11. Engine Oil Dipstick

When checking the engine oil, be sure to check if the oil is clean. If the oil is not clean, drain the oil by removing the oil drain plug, and refill with the specified amount of oil as outlined in the **Cummins Engine Owner's Manual**. Oil should be warm before draining.

Other types of motor oils may be substituted if they meet the following requirements:

- API Service Classification CC/SC
- API Service Classification CC/SD
- API Service Classification CC/SE
- API Service Classification CC/SF

Table 11. Recommended Motor Oil	
OIL: SAE	
°F	°C
122	50
104	40
86	30
68	20
50	10
32	0
-14	-10
-4	-20
-22	-30
-40	-40

FUEL CHECK

! DANGER



Fuel spillage on a **hot** engine can cause a **fire** or **explosion**. If fuel spillage occurs, wipe up the spilled fuel completely to prevent fire hazards. **NEVER** smoke around or near the generator.

Refilling the Fuel System

! CAUTION

ONLY properly trained personnel who have read and understood this section should refill the fuel tank system.

This generator has a fuel tank located in the sub base assembly frame. **ALWAYS** fill the fuel tank with clean fresh **#2 diesel fuel**. **DO NOT** fill the fuel tank beyond its capacity.

Pay attention to the fuel tank capacity when replenishing fuel. The fuel tank cap must be closed tightly after filling. Handle fuel in a safe container. If the container does not have a spout, use a funnel. Wipe up any spilled fuel immediately.

Refueling Procedure:

! WARNING



Diesel fuel and its vapors are dangerous to your health and the surrounding environment. Avoid skin contact and/or inhaling fumes.

! CAUTION

ALWAYS make sure generator is on firm level ground before refueling to prevent spilling and maximize the amount of fuel that can be pumped into the tank.

INSPECTION/SETUP

1. Place the generator level with the ground. Failure to do so will cause fuel to spill from the tank before reaching full capacity (Figure 12).

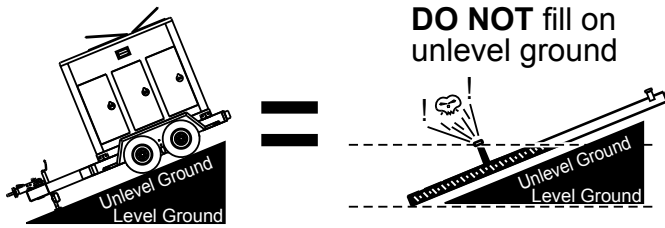


Figure 12. Only Fill on Level Ground

NOTICE

ONLY use #2 diesel fuel when refueling.

2. Remove fuel cap and fill tank (Figure 13).

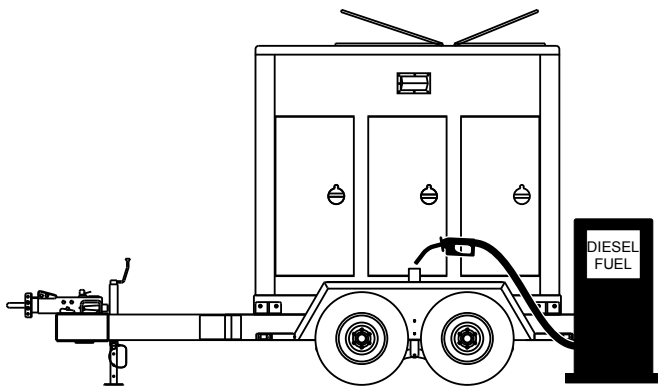


Figure 13. Fueling the Generator

3. Monitor the fuel gauge while filling fuel tank. Stop filling when the fuel gauge indicates full (Figure 14). **DO NOT** wait for fuel to rise in filler neck.

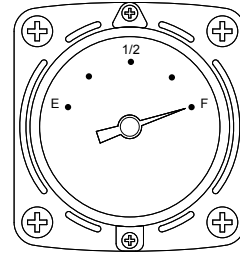


Figure 14. Full Fuel Tank

CAUTION

DO NOT OVERFILL fuel system. Leave room for fuel expansion. Fuel expands when heated (Figure 15).

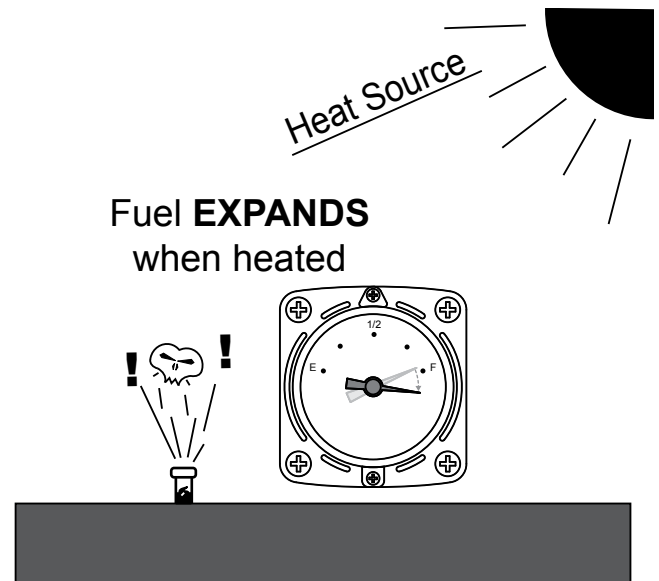



Figure 15. Fuel Expansion

COOLANT (ANTIFREEZE/SUMMER COOLANT)

Cummins recommends antifreeze/summer coolant, for use in their engines, which can be purchased in concentrate (and mixed with 50% demineralized water) or pre-diluted. See the **Cummins Engine Owner's Manual** for further details.

WARNING



If adding coolant/antifreeze mix to the radiator, **do not** remove the radiator cap until the unit has completely cooled. The possibility of **hot** coolant exists which can cause severe burns.

Day-to-day addition of coolant is done from the recovery tank. When adding coolant to the radiator, **DO NOT** remove the radiator cap until the unit has completely cooled. See Table 12 for engine, radiator, and recovery tank coolant capacities. Make sure the coolant level in the recovery tank is always between the "H" and the "L" markings.

Table 12. Coolant Capacity	
Engine and Radiator	7.8 gal (29.5 liters)
Reserve Tank	6 quarts (6.6 liters)

OPERATION IN FREEZING WEATHER

When operating in freezing weather, be certain the proper amount of antifreeze (Table 13) has been added.

Table 13. Anti-Freeze Operating Temperatures				
Vol % Anti-Freeze	Freezing Point		Boiling Point	
	°C	°F	°C	°F
50	-37	-34	108	226

NOTICE

When the antifreeze is mixed with water, the antifreeze mixing ratio **must be** less than 50%.

CLEANING THE RADIATOR

The engine may overheat if the radiator fins become overloaded with dust or debris. Periodically clean the radiator fins with compressed air. Cleaning inside the machine is dangerous, so clean only with the engine turned off and the **negative** battery terminal disconnected.

AIR CLEANER

Periodic cleaning/replacement is necessary. Inspect it in accordance with the **Cummins Engine Owner's Manual**.

FAN BELT TENSION

A slack drive belt may contribute to overheating, or to insufficient charging of the battery, adjust drive belt in accordance with the **Cummins Engine Owner's Manual**.

DRIVE BELT INSPECTION

Inspect the drive belt for damage and wear. Horizontal (across the belt) cracks are acceptable. See Figure 16 below. Vertical (direction of belt ribs) cracks that intersect with horizontal cracks are not acceptable.

If the drive belt is frayed, punctured, or material is missing do not use drive belt.

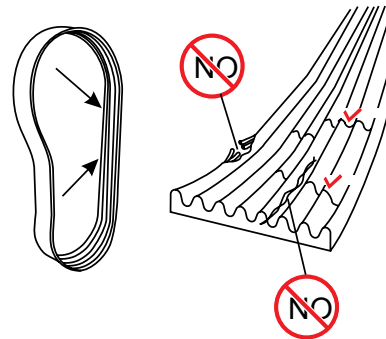



Figure 16. Drive Belt Inspection

CAUTION



NEVER place hands near the belts or fan while the generator is running.

BATTERY

This unit is of negative ground. **DO NOT** connect in reverse. Always maintain battery fluid level between the specified marks. **DO NOT** over fill. Battery life will be shortened if the fluid level is not properly maintained. Add only distilled water when replenishment is necessary.

Check to see whether the battery cables are loose. Poor contact may result in poor starting or malfunction. **Always** keep the terminals firmly tightened. Coat the terminals with an approved battery terminal treatment compound. Replace battery with only recommended type battery.

The battery is sufficiently charged if the specific gravity of the battery fluid is 1.28 (at 68° F). If the specific gravity should fall to 1.245 or lower, the battery is dead and needs to be recharged or replaced.

Before charging the battery with an external electric source, be sure to disconnect the battery cables.

Battery Cable Installation

ALWAYS make sure that the battery cables (Figure 17) are properly connected to the battery terminals as shown below.

CAUTION

ALWAYS disconnect the negative terminal **FIRST** and reconnect negative terminal **LAST**.

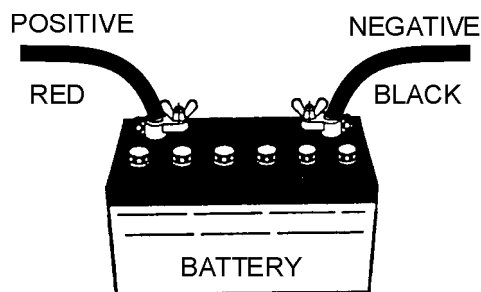


Figure 17. Battery Connections

When connecting the battery do the following:

1. Place a small amount of battery terminal treatment compound around both battery terminals. This will ensure a good connection and will help prevent corrosion around the battery terminals.
2. Connect the **red cable** to the positive terminal of the battery and the **black cable** to the negative terminal of the battery.

NOTICE

If the battery cable is connected incorrectly, electrical damage to the generator will occur. Pay close attention to the polarity when connecting the battery.

CAUTION

Inadequate battery connections may cause poor starting of the generator, and create other malfunctions.

ALTERNATOR

The polarity of the alternator is negative grounding type. When an inverted circuit connection takes place, the circuit will short instantaneously resulting in alternator failure.

DO NOT put water directly on the alternator. Water in the alternator can cause corrosion and damage.

WIRING

Inspect the generator for bad, worn electrical wiring or connections. If any wiring or connections are exposed (insulation missing), replace wiring immediately.

PIPING AND HOSE CONNECTION

Inspect all piping, oil hose, and fuel hose connections for fatigue, wear and tightness. Tighten all hose clamps and check hoses for leaks.

If any hose (**fuel or oil**) lines are defective, replace them immediately.

BEFORE STARTING

CAUTION

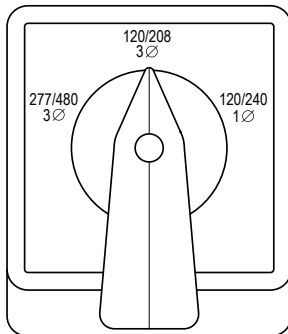
The engine's exhaust contains harmful emissions. **ALWAYS** have adequate ventilation when operating.

1. Place the Control Power switch (Figure 18) on the digital control panel in the up position (ON).



Figure 18. Control Power Switch (ON)

2. Place the voltage selector switch (Figure 19) in the desired voltage setting position. The corresponding Voltage Status LED on the control panel will light to indicate the selected voltage (Figure 20).



**Figure 19. Voltage Selector Switch
120/208 3Ø Position**

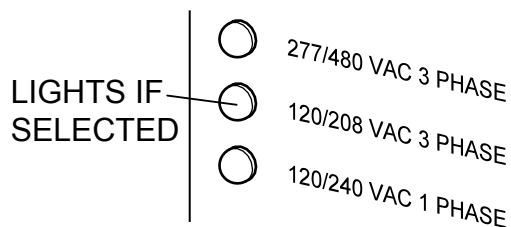


Figure 20. Voltage Status LEDs

3. If it is necessary to prime engine before starting (such as after changing fuel filter or running out of fuel), place the fuel valves in the prime position (Figure 21). Place the fuel priming switch (Figure 22) in the up position.

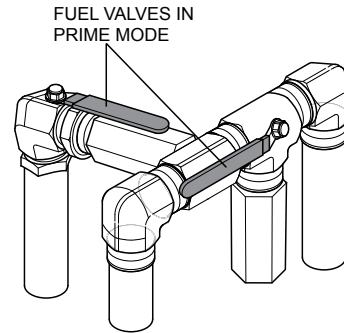


Figure 21. Fuel Valves (Prime Mode)



Figure 22. Fuel Priming Switch (ON)

4. After priming is complete, release the fuel priming switch. Place the fuel valves in the run mode (Figure 23).

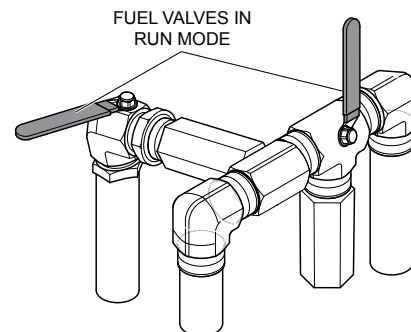


Figure 23. Fuel Valves (Run Mode)

5. Verify that all three circuit breakers (Figure 24) are in the ON position prior to starting the engine.

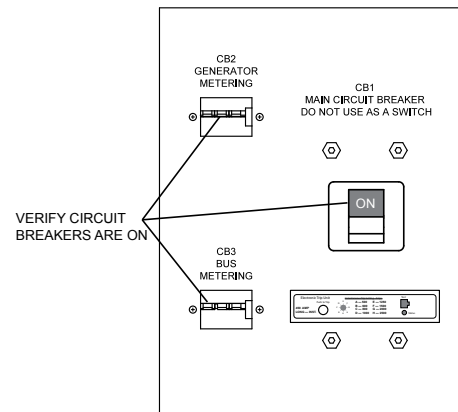
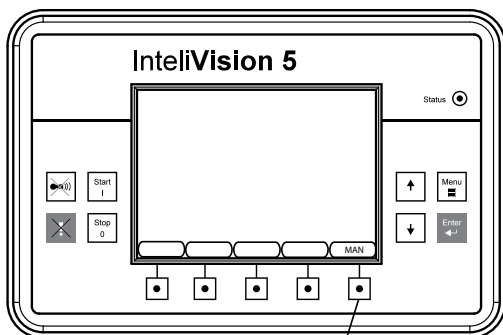


Figure 24. Circuit Breakers (ON)

- If unit is to be used in parallel with another unit, interconnect the units. Interconnect the output buses with suitable power cables to carry full load capacity. Special male-to-male Camlok cables will be needed. For 480 V mode, it is recommended that one 4/0 cable per phase, neutral and ground be used. For 208V mode, use two 4/0 cables per phase and neutral and one 4/0 cable for ground. Also connect the parallel communication cables.
- Connect the load to the receptacles on the Camlok/Voltage Output Panel. When the camlocks are inserted into the outlet connector, rotate clockwise until they are locked in place. Make sure the camlocks are connected securely.
- Press the MODE button (Figure 25) on the Digital Controller Display and select manual mode (MAN) with the arrow keys. Press Enter key when MAN is highlighted on the screen.



PRESS MODE BUTTON

Figure 25. Mode Button (Manual)

STARTING (MANUAL)

- Press the **START** button (Figure 26) on the controller to start the engine.

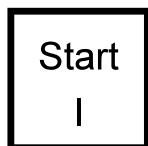


Figure 26. START Button

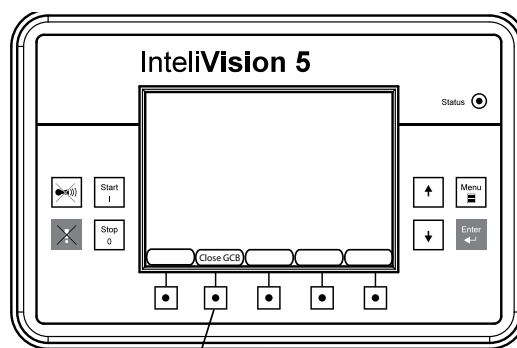
- The engine will go to idle mode.
- Listen for any abnormal noises. If any abnormalities exist, shut down the engine and correct the problem.

- To bypass idle mode, press the **START** button again. The generator should go to full speed.

NOTICE

If **START** button is not pressed again, the engine will remain in idle mode for about an hour then will go to full speed.

- Verify that the no-load frequency reading on the control panel frequency display is approximately 60 Hz (1800 rpm).
- Verify that the voltage reading on the control panel AC voltmeter display matches the voltage selector switch position that was selected prior to startup.
- Press the GCB control button on the controller (Figure 27) to close circuit breaker.



PRESS GCB CONTROL BUTTON

Figure 27. Generator Circuit Breaker (Closed)

- Verify that the BUS HOT light on the Camlok/Voltage Output Panel is on. Voltage is now available at the receptacles.

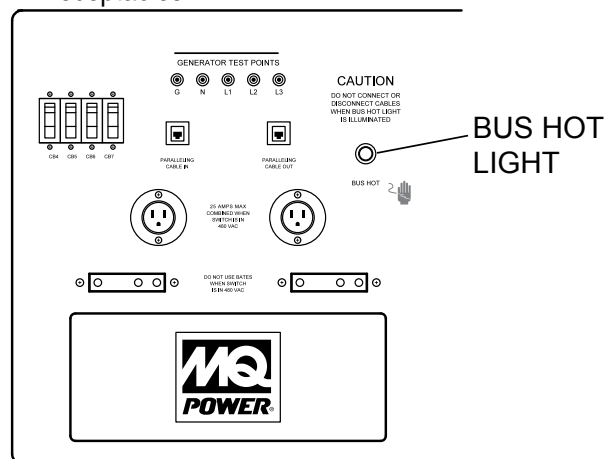


Figure 28. Bus Hot Light

9. If paralleling to another unit and the bus was already energized from another unit (BUS HOT light already on), pressing to close GCB button once would initiate a synchronizing mode. The light above the button will begin flashing, bring the generator into phase and automatically close the breaker. Once the breaker closes, the light above the button would then become solid and the generators would now be in parallel. As load is applied, units will share the load proportionally.

CLOSING THE ENCLOSURE DOORS

1. Close the enclosure doors once the generator has started (Figure 29). Top vents stay open for proper ventilation.

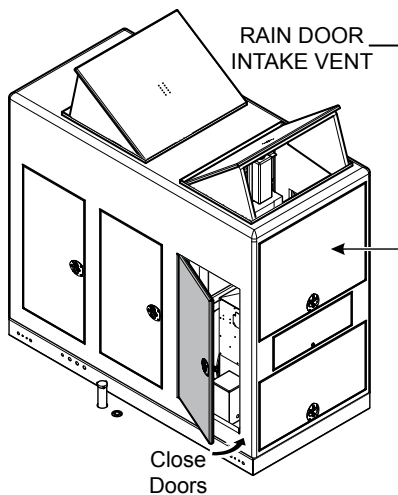


Figure 29. Engine Enclosure Doors

2. If access to the controls or other components is necessary while the engine is running, make sure the doors are not left open for an extended period of time.
3. To protect the unit from rain, the top intake vent can be closed by opening the upper front vent door on the generator enclosure. The front vent will automatically close the upper roof intake vent. The upper exhaust vent will remain open.

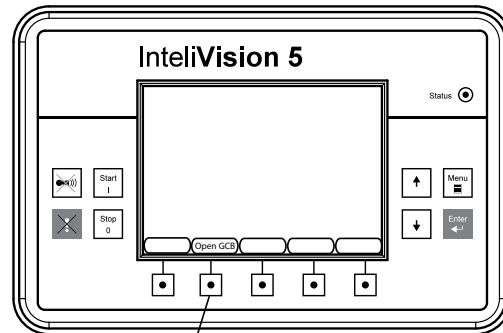
NORMAL SHUTDOWN PROCEDURE

To shutdown the generator, use the following procedure:

WARNING

NEVER stop the engine suddenly except in an emergency.

1. Press the GCB control button on the controller (Figure 30) to open circuit breaker.



PRESS BUTTON

Figure 30. Generator Circuit Breaker (Open)

2. Let the engine cool by running it at full speed for 3-5 minutes with no load applied.
3. Press the **STOP** button (Figure 31) on the controller. The engine will go to idle mode.

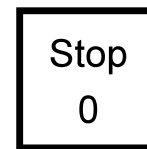


Figure 31. STOP Button

4. Press the **STOP** button again to shut down the engine.

NOTICE

If **STOP** button is not pressed again, the engine will remain in idle mode for about an hour then will shut down.

5. Place the Control Power switch (Figure 32) on the control panel to the OFF position.



Figure 32. Control Power Switch (OFF)

EMERGENCY SHUTDOWN PROCEDURE

1. Press the **STOP** button twice (Figure 31) on the controller to shut down the engine.
2. Place the main circuit breaker (Figure 30) in the **OFF** position.

PROTECTIVE DEVICES

Protection devices and emergency stop devices are designed as standard components for protection of the generator against trouble during operation. The LCD on the Digital Controller will inform the user when a fault has occurred.

When a major fault is detected, such as low oil pressure, high water temperature, and overspeed, the engine automatically shuts down. Check the display for the fault and correct the problem.

For minor faults, the engine will continue working. Stop the engine and remedy the cause of the problem. The Digital Controller will display the cause of the fault.

Before inspecting or troubleshooting the generator, press the **OFF** button on the Digital Controller. Place the main circuit breaker in the **OFF** position and allow sufficient time for adequate cooling.

After automatic shutdown, always inspect the generator and eliminate any problems that might have caused the shutdown before attempting to restart the generator.

When ready to restart, check and make sure that no alarms are shown in the Alarm List on the Digital Controller. Restart the generator as outlined in the Startup section of this manual.

Refer to the IntelliVision 5™ Controller User's Guide for detailed information of faults and display information.

CAUTION

To prevent damage to the equipment and severe bodily harm, even death, please follow all lock-out safety procedures when performing maintenance.

MAINTENANCE

Use Table 14 as a general maintenance guideline when servicing your engine. For more detail engine maintenance information, refer to the engine owner's manual supplied with your engine.

Table 14. Engine Maintenance Schedule

DESCRIPTION	OPERATION	INTERVAL					
		DAILY ³	250 HOURS OR 3 MONTHS ³	500 HOURS OR 6 MONTHS ^{1,2,3}	1000 HOURS OR 1 YEAR ³	2000 HOURS OR 2 YEARS ^{2,3}	5000 HOURS OR 4 YEARS ³
Air Intake Piping	Check	X					
Engine Lubricating Oil Level	Check	X					
Air Tank and Reservoirs	Drain	X					
Crankcase and Breather Tube	Inspect	X					
Engine Coolant Level	Check	X					
Fuel -Water Separator	Drain	X					
Air Cleaner Restriction	Check		X				
Air Compressor Mounting Hardware	Check		X				
Charge-Air Cooler	Check		X				
Charge-Air Piping	Check		X				
Radiator Hoses	Check		X				
Air Intake Piping	Inspect		X				
Fan, Cooling	Check		X				
Coolant Level	Check		X				
Drive Belts	Check		X				
Engine Coolant - Antifreeze	Check			X			
Fuel Filter (Spin-On Type)	Replace			X			
Lubricating Oil and Filters	Change			X			
Radiator Pressure Cap	Check			X			
Cooling Fan Belt Tensioner	Check				X		
Fan Hub, Belt-Driven	Check				X		
Air Compressor Discharge Line	Check					X	
Cooling System	Drain					X	
Vibration Damper, Rubber	Check					X	
Vibration Damper, Viscous	Check					X	
Overhead Set	Adjust						X

1. The lubricating oil and lubricating oil filter interval can be adjusted based on application, fuel consumption, gross vehicle weight, and idle time.
2. Antifreeze check interval is every oil change or 500 hours or 6 months, whichever occurs first. The operator must use heavy-duty, year-round antifreeze that meets the chemical composition of ASTM D6210. The antifreeze change interval is 2 years or 2000 hours whichever occurs first. Antifreeze is essential for freeze, overheating, and corrosion protection.
3. Follow the manufacturer's recommended maintenance procedures for the starter, alternator, generator, batteries, electrical components, exhaust brake, charge air cooler, radiator, air compressor, air cleaner, refrigerant compressor, and fan clutch.

GENERAL INSPECTION

Prior to each use, the generator should be cleaned and inspected for deficiencies. Check for loose, missing or damaged nuts, bolts, and other fasteners. Also check for fuel, oil, and coolant leaks. Use Table 14 as a general maintenance guideline. For engine maintenance, refer to the engine maintenance manual.

AIR FILTER

Every 250 hours: Remove air filter element (Figure 33) and clean the filter element with low pressure compressed air. Air pressure must not exceed 30 psi (207 kPa). The filter can be cleaned and reused for up to six times if properly cleaned. Replace air filter if rips or tears are detected while cleaning.

Air Filter Dust Indicator

The air filter indicator (Figure 33) is attached to the air filter. When the air filter element is clogged, air intake restriction becomes greater and the air filter indicator signal shows **RED**. When indicator is red, replace filter immediately. After changing the air filter, press the air filter indicator button to reset.

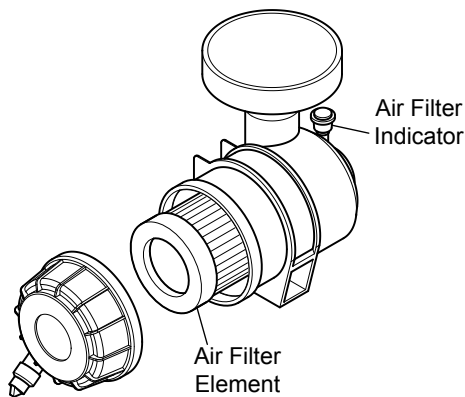


Figure 33. Air Filter/Indicator

NOTICE

The air filter should be changed more frequently in dusty operating conditions.

If the engine is operating in very dusty or dry grass conditions, a clogged air cleaner will result. This can lead to a loss of power, excessive carbon buildup in the combustion chamber and high fuel consumption. Change air cleaner more frequently if these conditions exist.

FUEL ADDITION

Add diesel fuel (the grade may vary according to season and locations).

Removing Water from the Fuel Tank

After prolonged use, water and other impurities accumulate in the bottom of the tank. Occasionally inspect the fuel tank for water contamination and drain the contents if necessary.

During cold weather, the more empty volume inside the tank, the easier it is for water to condense. This can be reduced by keeping the tank full with diesel fuel.

Cleaning Inside the Fuel Tank

If necessary, drain the fuel inside the fuel tank completely. Using a spray washer (Figure 34) wash out any deposits or debris that have accumulated inside the fuel tank.

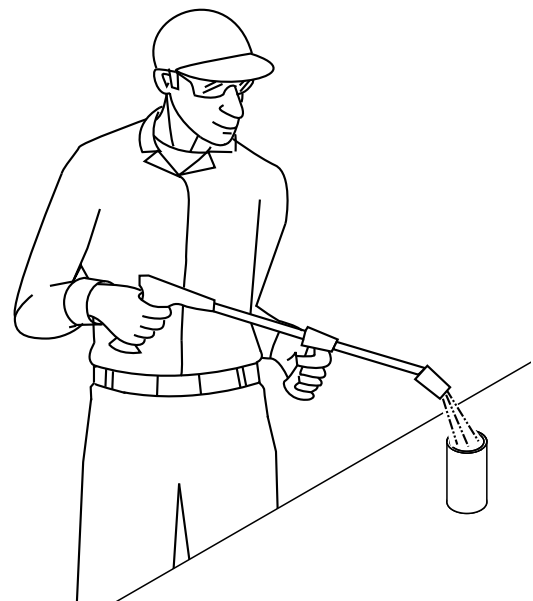


Figure 34. Fuel Tank Cleaning

FUEL TANK INSPECTION

In addition to cleaning the fuel tank, the following components should be inspected for wear:

- **Rubber Suspension** — look for signs of wear or deformity due to contact with oil. Replace the rubber suspension if necessary.
- **Fuel Hoses** — inspect nylon and rubber hoses for signs of wear, deterioration, and hardening.
- **Fuel Tank Lining** — inspect the fuel tank lining for signs of excessive amounts of oil and other foreign matter.

Replacing Fuel Filter

- Replace the fuel filter cartridge with a new one every 500 hours.
- Loosen the drain plug at the lower top of the fuel filter. Drain the fuel in the fuel body together with the mixed water. **DO NOT** spill the fuel during disassembly.
- Vent any air.

AIR REMOVAL

If air enters the fuel injection system of a diesel engine, starting becomes impossible. After running out of fuel, or after disassembling the fuel system, bleed the system. Refer to the Cummins engine manual for details.

CHECK OIL LEVEL

Check the crankcase oil level prior to each use, or when the fuel tank is filled. Insufficient oil may cause severe damage to the engine. The oil level must be between the two notches on the dipstick.

Replacing Oil Filter

1. Remove the old oil filter.
2. Apply a film of oil to the gasket on the new oil filter.
3. Install the new oil filter.
4. After the oil filter has been replaced, the engine oil will drop slightly. Run the engine for a while and check for leaks before adding more oil if needed. Clean excessive oil from engine.

FLUSHING OUT RADIATOR AND REPLACING COOLANT

WARNING



Allow engine to **cool** before flushing out radiator. Flushing the radiator while hot could cause serious burns from water or steam.

1. Remove radiator cap. Remove coolant drain plug located on side of generator. Place coolant drain lever in the open position to drain coolant.
2. Flush the radiator by running clean tap water through radiator until signs of rust and dirt are removed. Do not clean radiator core with any objects, such as a screwdriver.
3. Check hoses for softening and kinks. Check clamps for signs of leakage.
4. Move lever to the closed position and reinstall coolant drain plug.
5. Replace with coolant as recommended by the engine manufacturer.
6. Close radiator cap tightly.

GENERATOR STORAGE

For long term storage of the generator the following is recommended:

1. Drain the fuel tank completely. Treat with a fuel stabilizer if necessary.
2. Completely drain the oil from the crankcase and refill, if necessary, with fresh oil.
3. Clean the entire generator, inside and outside.
4. Disconnect the battery.
5. Make sure engine coolant is at proper level.
6. Cover the generator and store in a clean, and dry place.

The following trailer maintenance guidelines are intended to assist the operator in preventive maintenance.

TRAILER BRAKES

Properly functioning brake shoes and drums are essential to ensure safety. The brakes should be inspected the first 200 miles of operation. This will allow the brake shoes and drums to seat properly. After the first 200 mile interval, inspect the brakes every 3,000 miles. If driving over rough terrain, inspect the brakes more frequently.

HYDRAULIC BRAKES

If your trailer has hydraulic brakes, they function the same way the surge brakes do on your tow vehicle. The hydraulic braking system must be inspected at least as often as the brakes on the tow vehicle, but no less than once per year. This inspection includes an assessment of the condition and proper operation of the wheel cylinders, brake shoes, brake drums and hubs.

MANUALLY ADJUSTING THE BRAKES

Most axles are fitted with a brake mechanism that will adjust the brakes during a hard stop. However, some braking systems are not automatically adjusted by hard stopping. These brakes require manual adjustment. The following steps apply to adjust most manually adjustable brakes.

1. Jack up the trailer and secure it on adequate capacity jackstands.
2. Be sure the wheel and brake drum rotate freely.
3. Remove the adjusting-hole cover from the adjusting slot on the bottom of the brake backing plate.
4. With a screwdriver or standard adjusting tool, rotate the starwheel of the adjuster assembly to expand the brake shoes. Adjust the brake shoes out until the pressure of the linings against the drum makes the wheel very difficult to turn. Note: Your trailer maybe equipped with drop spindle axles. See axle manual for your axle type. You will need a modified adjusting tool for adjusting the brakes in these axles. With drop spindle axles, a modified adjusting tool with about an 80 degree angle should be used.
5. Rotate the starwheel in the opposite direction until the wheel turns freely with a slight drag.

6. Replace the adjusting-hole cover.
7. Repeat the above procedure on all brakes.
8. Lower the trailer to the ground.

Check the fluid level in the master cylinder reservoir at least every three months. If you tow your trailer an average of 1,000 miles per month in a hot and dry environment, you must check the brake fluid level once a month. The brake fluid reservoir is located on the tongue of the trailer. Always fill with clean, uncontaminated DOT 4 brake fluid.

Figure 35 below displays the major hydraulic brake components that will require inspection and maintenance. Please inspect these components as required using steps 1 through 6 as referenced in the “Manually Adjusting The Brakes” section on this page. See Hydraulic Brake Troubleshooting table in maintenance section.

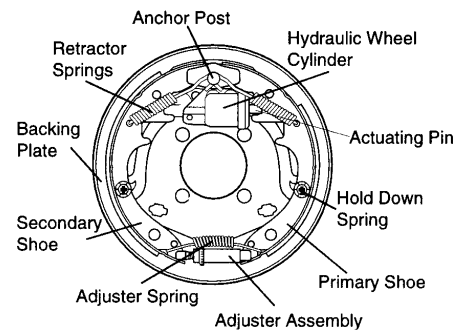


Figure 35. Hydraulic Brake Components

HYDRAULIC BRAKE ACTUATOR

The hydraulic brake actuator (Figure 36) is the mechanism that activates the trailer's brake system. This actuator changes fluid power into mechanical power. Therefore, the fluid level must be checked frequently to assure that the brakes function properly.

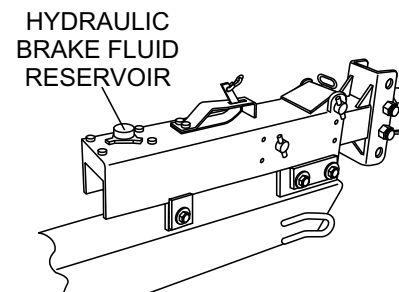


Figure 36. Hydraulic Brake Actuator

WARNING

Failure to maintain proper fluid level in the actuator may result in loss of braking action which could cause severe property damage, injury or death.

Periodically check the actuator mounting fasteners for damage or loosening. Inspect the actuator for worn or damaged parts. As you are towing your trailer, be aware of any changes in braking quality. This could be an early warning of brake or actuator malfunction and requires immediate attention. Consult a certified brake specialist to make necessary adjustment or repairs.

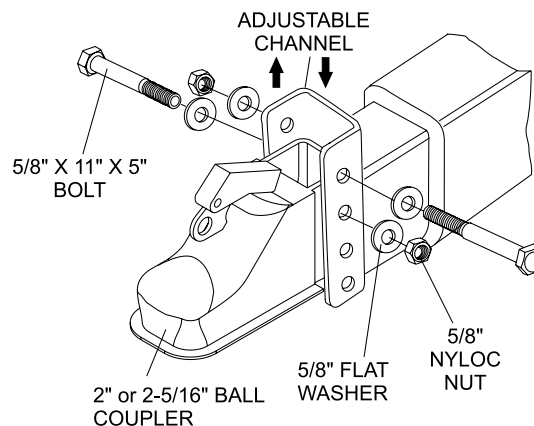


Figure 37. Adjustable Channel

Table 15. Hydraulic Brake Troubleshooting		
Symptom	Possible Cause	Solution
No Brakes	Brake line broken or kinked?	Repair or replace.
Weak Brakes or Brakes Pull to One Side	Brake lining glazed?	Reburnish or replace.
	Trailer overloaded?	Correct weight.
	Brake drums scored or grooved?	Machine or replace.
	Tire pressure correct?	Inflate all tires equally.
	Tires unmatched on the same axle?	Match tires.
Locking Brakes	Brake components loose, bent or broken?	Replace components.
	Brake drums out-of-round?	Replace.
Noisy Brakes	System lubricated?	Lubricate.
	Brake components correct?	Replace and correct.
Dragging Brakes	Brake lining thickness incorrect or not adjusted correctly?	Install new shoes and linings.
	Enough brake fluid or correct fluid?	Replace rubber parts fill with dot 4 fluid.

WHEEL BEARINGS

Wheel bearings (Figure 38) must be inspected and lubricated once a year or 12,000 miles to insure safe operation of your trailer.

If trailer wheel bearings are immersed in water, they must be replaced.

DANGER

If trailer wheels are under water for a long period of time, wheel bearings may fail. If this is the case, service wheel bearings immediately.

The possibility exists of the wheels falling off causing equipment damage and severe bodily harm even death!

If the trailer has not been used for an extended amount of time, have the bearings inspected and packed more frequently, at least every six months and prior to use.

Follow the steps below to disassemble the wheel hub and service the wheel bearings. See Figure 38.

ADJUSTABLE CHANNEL

Your trailer may be equipped with an adjustable channel (Figure 3) that allows the coupler to be raised or lowered to a desired height. Periodically check the channel bolts for damage or loosening.

NOTICE

When replacing channel mounting hardware (nuts, bolts and washers), **NEVER** substitute substandard hardware. Pay close attention to **bolt length** and **grade**. **ALWAYS** use manufacturer's recommended parts when replacing channel mounting hardware.

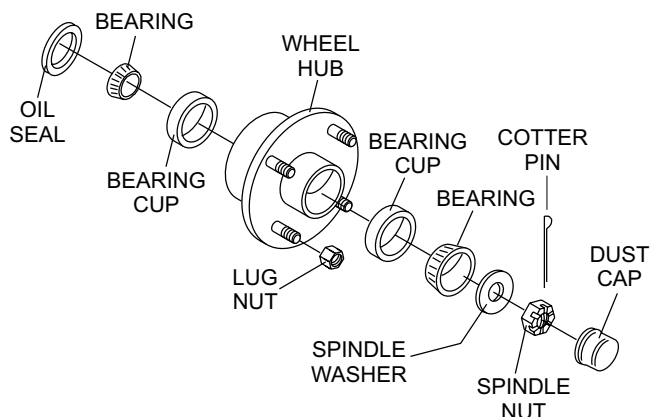


Figure 38. Wheel Hub Components

- After removing the dust cap, cotter pin, spindle nut and spindle washer, remove the hub to inspect the bearings for wear and damage.
- Replace bearings that have flat spots on rollers, broken roller cages, rust or pitting. Always replace bearings and cups in sets. The inner and outer bearings are to be replaced at the same time.
- Replace seals that have nicks, tears or wear.
- Lubricate the bearings with a high quality EP-2 automotive wheel bearing grease.

WHEEL HUB ADJUSTMENT

Every time the wheel hub is removed and the bearings are reassembled, follow the steps below to check the wheel bearings for free running and adjust.

- Turn the hub slowly, by hand, while tightening the spindle nut until you can no longer turn the hub by hand.
- Loosen the spindle nut just until you are able to turn it (the spindle nut) by hand. Do not turn the hub while the spindle nut is loose.
- Install a new cotter pin through the spindle nut and axle.
- Check the adjustments. Both the hub and the spindle nut should be able to move freely (the spindle nut motion will be limited by the cotter pin).

! DANGER

NEVER crawl under the trailer unless it is on firm and level ground and resting on properly placed and secured jackstands.

The possibility exists of the trailer falling thus causing equipment damage and severe bodily harm even death!

! DANGER

When performing trailer inspection and maintenance activities, you must jack up the trailer using jacks and jackstands.

When jacking and using jackstands, place them so as to clear wiring, brake lines, and suspension parts (i.e., springs, torsion bars). Place jacks and jackstands inside of the perimeter strip on the supporting structure to which the axles are attached.

! DANGER

Improper weld repair will lead to early failure of the trailer structure and can cause serious injury or death.

DO NOT repair cracked or broken welds unless you have a certified welder perform the repair. If not, have the welds repaired by your dealer.

! WARNING

If the trailer is involved in an accident, have it inspected immediately by qualified personnel. In addition, the trailer should be inspected annually for signs of wear or deformations.

LEAF SUSPENSION

The leaf suspension springs and associated components (Figure 39) should be visually inspected every 6,000 miles for signs of excessive wear, elongation of bolt holes, and loosening of fasteners. Replace all damaged parts (suspension) immediately.

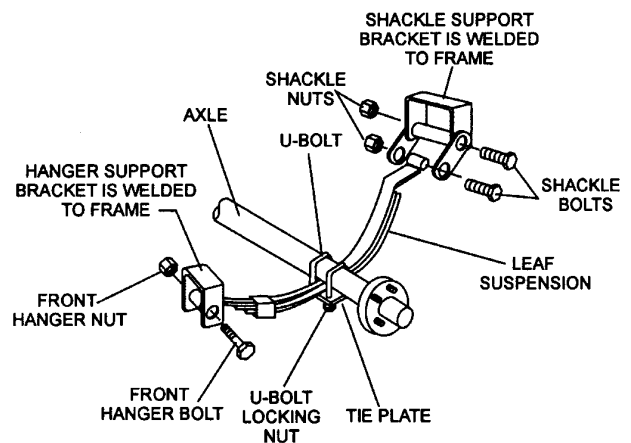


Figure 39. Leaf Suspension Components

! DANGER

Worn or broken suspension parts can cause loss of control, damage to equipment and severe bodily injury, even death!

Check suspension regularly.

TROUBLESHOOTING (GENERATOR)

Troubleshooting (Generator)		
Symptom	Possible Problem	Solution
No Voltage Output	AC Voltmeter defective?	Check output voltage using a voltmeter.
	Is wiring connection loose?	Check wiring and repair.
	Is voltage regulator defective?	Replace if necessary.
	Defective Rotating Rectifier?	Check and replace.
	Defective Exciter Field?	Check and replace.
Low Voltage Output	Is engine speed correct?	Turn engine throttle lever to "High".
	Is wiring connections loose?	Check wiring and repair.
	Defective AVR?	Replace if necessary.
High Voltage Output	Is wiring connections loose?	Check wiring and repair.
	Defective AVR?	Replace if necessary.
Circuit Breaker Tripped	Short Circuit in load?	Check load and repair.
	Over current?	Confirm load requirements and reduce.
	Defective circuit breaker?	Check and replace.
	Over current Relay actuated?	Confirm load requirement and replace.

TROUBLESHOOTING (ENGINE)

Troubleshooting (Engine)		
Symptom	Possible Problem	Solution
Engine will not start or start is delayed, although engine can be turned over.	No Fuel reaching injection pump?	Add fuel. Check entire fuel system.
	Defective fuel pump?	Replace fuel pump.
	Fuel filter clogged?	Replace fuel filter and clean tank.
	Faulty fuel supply line?	Replace or repair fuel line.
	Compression too low?	Check piston, cylinder and valves. Adjust or repair per engine repair manual.
	Fuel pump not working correctly?	Repair or replace fuel pump.
	Oil pressure too low?	Check engine oil pressure.
	Low starting temperature limit exceeded?	Comply with cold starting instructions and proper oil viscosity.
	Defective battery?	Charge or replace battery.
	Air or water mixed in fuel system?	Check carefully for loosened fuel line coupling, loose cap nut, etc.
At low temperatures engine will not start.	Engine oil too thick?	Refill engine crankcase with correct type of oil for winter environment.
	Defective battery?	Replace battery.
Engine fires but stops soon as starter is switched off.	Fuel filter blocked?	Replace fuel filter.
	Fuel supply blocked?	Check the entire fuel system.
	Defective fuel pump?	Replace fuel pump.
Engine stops by itself during normal operation.	Fuel tank empty?	Add fuel.
	Fuel filter blocked?	Replace fuel filter.
	Defective fuel pump?	Replace fuel pump.
	Mechanical oil pressure shutdown sensor stops the engine due to low oil?	Add oil. Replace low oil shutdown sensor if necessary.
Low engine power, output and speed.	Fuel tank empty?	Replace fuel filter.
	Fuel filter clogged?	Replace fuel filter.
	Fuel tank venting is inadequate?	Ensure that tank is adequately vented.
	Leaks at pipe unions?	Check threaded pipe unions tape and tighten unions as required.
	Speed control lever does not remain in selected position?	See engine manual for corrective action.
	Engine oil level too full?	Correct engine oil level.
	Injection pump wear?	Use No. 2-D diesel fuel only. Check the fuel injection pump element and delivery valve assembly and replace as necessary.

TROUBLESHOOTING (CONTROLLER)

Troubleshooting (InteliVision 5 Controller)		
Symptom	Possible Problem	Solution
Wrong Display HW	SW and HW mismatch?	Correct firmware has to be programmed.
Invalidate configuration table Error	Configuration table is invalid?	Controller configuration has to be reprogrammed or upgraded.
Unsupported controller Error	Controller is not supported?	Controller upgrade necessary.
Unsupported cfg. table format Error	Controller configuration table is not supported?	InteliVision 5 firmware upgrade is necessary.
Mismatch parameters length Error	Controller parameters mismatch?	Controller configuration upgrade is necessary.
Mismatch const values length Error	Controller constants mismatch?	Controller configuration upgrade is necessary.
Mismatch values length Error	Controller values mismatch?	Controller configuration upgrade is necessary.
Mismatch val states length Error	Controller values states mismatch?	Controller configuration upgrade is necessary.
Controller was not detected Error	Controller is not connected or communication via RS485 is interrupted?	Communication is lost or RS485 line A and B are swapped.
Communication Error	Controller is detected; RS485 communication level is not defined correctly?	RS485 line is not terminated properly, environment disturbance is present or RS485 line is too long.
Screen template missing Error	Unsupported controller firmware, missing InteliVision 5 support?	Upgrade controller firmware.
Screen template version Error	Unsupported controller screen?	InteliVision 5 firmware has to be updated.
Font not valid Error	Corrupted display font?	Display firmware/font programming is necessary.
	Font programming was not done properly?	Display firmware/font programming is necessary.
Font format not supported Error	Unsupported font?	InteliVision 5 font or firmware is necessary.
Bitmaps not valid Error	Unsupported format?	Firmware upgrade is necessary.
Bitmaps format not supported Error	Unsupported bitmaps format?	Firmware upgrade is necessary.
Default lang. not supported Error	Default/Defined language error/not supported?	Language change or code page change is necessary.

TRAILER GUIDELINES

The following guidelines are intended to assist the operator in the operation and handling of a trailer.

Safety precautions should be followed at all times when operating a trailer. Failure to read, understand and follow the safety guidelines could result in injury to yourself and others. Loss of control of the trailer or tow vehicle can result in death or serious injury.

COMMON CAUSES FOR LOSS OF TRAILER

- Driving too fast for the conditions (maximum speed when towing a trailer is 55 mph).
- Overloading the trailer or loading the trailer unevenly.
- Trailer improperly coupled to the hitch.
- No braking on trailer.
- Not maintaining proper tire pressure.
- Not keeping lug nuts tight.
- Not properly maintaining the trailer structure.
- Ensure machine is towed level to tow vehicle.

TRAILER TOWING GUIDELINES

- Recheck the load tiedowns to make sure the load will not shift during towing.
- Before towing, check coupling, safety chain, safety brake, tires, wheels and lights.
- Check the lug nuts or bolts for tightness.
- Check coupler tightness after towing 50 miles.
- Use your mirrors to verify that you have room to change lanes or pull into traffic.
- Use your turn signals well in advance. Allow plenty of stopping space for your trailer and tow vehicle.
- Allow plenty of stopping space for your trailer and tow vehicle.
- **DO NOT** drive so fast that the trailer begins to sway due to speed.
- Allow plenty of room for passing. A rule of thumb is that the passing distance with a trailer is 4 times the passing distance without the trailer.

- Shift your automatic transmission into a lower gear for city driving.
- **ALWAYS** use lower gears for climbing and descending grades.
- **DO NOT** ride the brakes while descending grades, they may get so hot that they stop working. Then you will potentially have a runaway tow vehicle and trailer.
- To conserve fuel, don't use full throttle to climb a hill. Instead, build speed on the approach.
- Slow down for bumps in the road. Take your foot off the brake when crossing the bump.
- **DO NOT** brake while in a curve unless absolutely necessary. Instead, slow down before you enter the curve and power through the curve. This way, the towing vehicle remains in charge.
- **DO NOT** apply the brakes to correct extreme trailer swaying. Continued pulling of the trailer, and even slight acceleration, will provide a stabilizing force.
- Anticipate the trailer "swaying." Swaying is the trailer reaction to the air pressure wave caused by passing trucks and buses. Continued pulling of the trailer provides a stabilizing force to correct swaying. **DO NOT** apply the brakes to correct trailer swaying.
- Use lower gear when driving down steep or long grades. Use the engine and transmission as a brake. Do not ride the brakes, as they can overheat and become ineffective.
- Be aware of your trailer height, especially when approaching roofed areas and around trees.
- Make regular stops, about once each hour. Confirm that:
 - Coupler is secure to the hitch and is locked.
 - Electrical connectors are secure.
 - There is appropriate slack in the safety chains.
 - There is appropriate slack in the breakaway switch pullpin cable.
 - Tires are not visibly low on pressure.

TRAILER GUIDELINES

DRIVING CONDITIONS

When towing a trailer, you will have decreased acceleration, increased stopping distance, and increased turning radius (which means you must make wider turns to keep from hitting curbs, vehicles, and anything else that is on the inside corner). In addition, you will need a longer distance to pass, due to slower acceleration and increased length.

- Be alert for slippery conditions. You are more likely to be affected by slippery road surfaces when driving a tow vehicle with a trailer, than driving a tow vehicle without a trailer.
- Check rearview mirrors frequently to observe the trailer and traffic.
- **NEVER** drive faster than what is safe.

WARNING

Driving too fast for severe road conditions can result in loss of control and cause death or serious injury.

Decrease your speed as road, weather, and lighting conditions deteriorate.

Always check for local trailer tow speed limits in your area.

WARNING

Do not transport people on the trailer. The transport of people puts their lives at risk and may be illegal.

COUPLING TO THE TOW VEHICLE

Follow all of the safety precautions and instructions in this manual to ensure safety of persons, equipment, and satisfactory life of the trailer. Always use an adequate tow vehicle and hitch. If the vehicle or hitch is not properly selected and matched to the Gross Vehicle Weight Rating (GVWR) of your trailer, you can cause an accident that could lead to death or serious injury.

If you already have a tow vehicle, know your vehicle tow rating and make certain the trailer's rated capacity is less than or equal to the tow vehicle's rated towing capacity. If you already have (or plan to buy) a trailer, make certain that the tow rating of the tow vehicle is equal to or greater than that of the trailer.

The trailer VIN tag contains the critical safety information

for the use of your trailer. Again, be sure your hitch and tow vehicle are rated for the Gross Vehicle Weight Rating of your trailer.

WARNING

Proper selection and condition of the coupler and hitch are essential to safely towing your trailer. A loss of coupling may result in death or serious injury.

- Be sure the hitch load rating is equal to or greater than the load rating of the coupler.
- Be sure the hitch size matches the coupler size.
- Observe the hitch for wear, corrosion and cracks before coupling. Replace worn, corroded or cracked hitch components before coupling the trailer to the tow vehicle.
- Be sure the hitch components are tight before coupling the trailer to the tow vehicle.

WARNING

An improperly coupled trailer can result in death or serious injury.

DO NOT move the trailer until:

- The coupler is secured and locked to hitch.
- The safety chains are secured to the tow vehicle.
- The trailer jack(s) are fully retracted.

DO NOT tow the trailer on the road until:

- Tires and wheels are checked.
- The trailer brakes are checked.
- The breakaway switch is connected to the tow vehicle.
- The load is secured to the trailer.
- The trailer lights are connected and checked.

WARNING

Use of a hitch with a load rating less than the load rating of the trailer can result in loss of control and may lead to death or serious injury.

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.

Be sure your hitch and tow vehicle are rated for the Gross Vehicle Weight Rating of your trailer.

INOPERABLE BRAKES, LIGHTS OR MIRRORS

Be sure that the brakes and all of the lights on your trailer are functioning properly before towing your trailer. Check the trailer taillights by turning on your tow vehicle headlights. Check the trailer brake lights by having someone step on the tow vehicle brake pedal while you look at trailer lights. Do the same thing to check the turn signal lights. See Trailer Wiring Diagram section in this manual.

Standard mirrors usually do not provide adequate visibility for viewing traffic to the sides and rear of a towed trailer. You must provide mirrors that allow you to safely observe approaching traffic.

WARNING

Improper electrical connection between the tow vehicle and the trailer will result in inoperable lights and can lead to collision.

Before each tow, check that the tail lights, brake lights and turn signals work.

TRAILER TOWING TIPS

Driving a vehicle with a trailer in tow is vastly different from driving the same vehicle without a trailer in tow. Acceleration, maneuverability and braking are all diminished with a trailer in tow.

It takes longer to get up to speed, you need more room to turn and pass, and more distance to stop when towing a trailer. You will need to spend time adjusting to the different feel and maneuverability of the tow vehicle with a loaded trailer.

Because of the significant differences in all aspects of maneuverability when towing a trailer, the hazards and risks of injury are also much greater than when driving without a trailer. You are responsible for keeping your vehicle and trailer in control, and for all the damage that is caused if you lose control of your vehicle and trailer.

As you did when learning to drive an automobile, find an open area with little or no traffic for your first practice trailering. Of course, before you start towing the trailer, you must follow all of the instructions for inspection, testing, loading and coupling. Also, before you start towing, adjust the mirrors so you can see the trailer as well as the area to the rear of it.

Drive slowly at first, 5 mph or so, and turn the wheel to get the feel of how the tow vehicle and trailer combination responds. Next, make some right and left hand turns. Watch in your side mirrors to see how the trailer follows the tow vehicle. Turning with a trailer attached requires more room.

Stop the rig a few times from speeds no greater than 10 mph. If your trailer is equipped with brakes, try using different combinations of trailer brake and tow vehicle brake. Note the effect that the trailer brakes have when they are the only brakes used. When properly adjusted, the trailer brakes will come on just before the tow vehicle brakes.

It will take practice to learn how to back up a tow vehicle with a trailer attached. Take it slow. Before backing up, get out of the tow vehicle and look behind the trailer to make sure that there are no obstacles.

Some drivers place their hands at the bottom of the steering wheel, and while the tow vehicle is in reverse, “think” of the hands as being on the top of the wheel. When the hands move to the right (counterclockwise, as you would do to turn the tow vehicle to the left when moving forward), the rear of the trailer moves to the right. Conversely, rotating the steering wheel clockwise with your hands at the bottom of the wheel will move the rear of the trailer to the left while backing up.

If you are towing a bumper hitch rig, be careful not to allow the trailer to turn too much because it will hit the rear of the tow vehicle. To straighten the rig, either pull forward or turn the steering wheel in the opposite direction.

TRAILER VIN TAG

Figure A below is a sample of the Vehicle Identification Number (VIN) Tag which is typically located on the left front of the trailer. See Figure B for location.

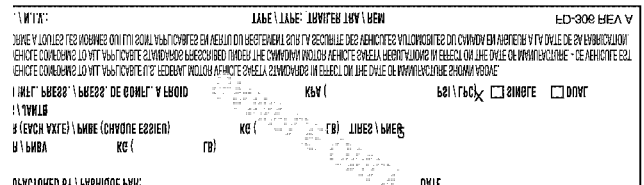


Figure A. Vehicle VIN Tag

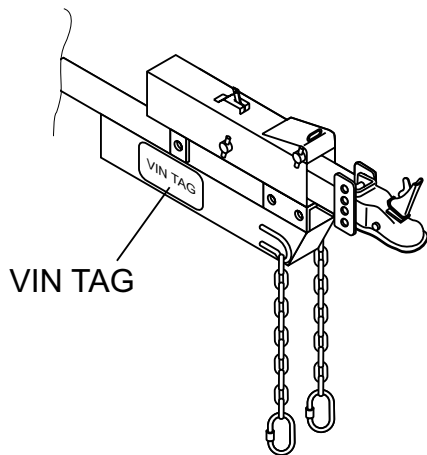


Figure B. VIN Tag Location

The trailer VIN Tag contains the following critical safety information for the use of your trailer.

GAWR: The maximum gross weight that an axle can support. It is the lowest of axle, wheel, or tire rating.

Usually, the tire or wheel rating is lower than the axle rating, and determines GAWR.

GVWR: The maximum allowable gross weight of the trailer and its contents. The gross weight of the trailer includes the weight of the trailer and all of the items within it. GVWR is sometimes referred to as GTWR (Gross Trailer Weight Rating), or MGTW (Maximum Gross Trailer Weight). GVWR, GTWR and MGTW are all the same rating.

The sum total of the GAWR for all trailer axles may be less than the GVWR for the trailer, because some of the trailer load is to be carried by the tow vehicle, rather than by the trailer axle(s). The total weight of the cargo and trailer must not exceed the GVWR, and the load on an axle must not exceed its GAWR.

PSIC: The tire pressure (psi) measured when cold.

VIN: The Vehicle Identification Number.

EMPTY WEIGHT: Some information that comes with the trailer (such as the Manufacturer's Statement of Origin) is not a reliable source for "empty" or "net" weight. The shipping documents list average or standard weights and your trailer may be equipped with options.

To determine the "empty" or "net" weight of your trailer, weigh it on an axle scale. To find the weight of the trailer using an axle scale, you must know the axle weights of your tow vehicle without the trailer coupled. Some of the trailer weight will be transferred from the trailer to the tow vehicle axles, and an axle scale weighs all axles, including the tow vehicle axles.

TOW VEHICLE

The towing hitch attached to your tow vehicle must have a capacity equal to or greater than the load rating of the trailer you intend to tow. The hitch capacity must also be matched to the tow vehicle capacity. Your vehicle dealer can provide and install the proper hitch on your tow vehicle.

SUSPENSION SYSTEM

Sway bars, shock absorbers, heavy duty springs, heavy duty tires and other suspension components may be required to sufficiently tow the trailer and pump.

BRAKE CONTROLLER

For trailers equipped with electric brakes, the electric brake controller is part of the tow vehicle and is essential in the operation of the electric brakes on the trailer. The brake controller is not the same as the safety breakaway brake system that may be equipped on the trailer.

SIDE VIEW MIRRORS

The size of the trailer that is being towed and your state law regulations determine the size of the mirrors. However, some states prohibit extended mirrors on a tow vehicle, except while a trailer is actually being towed. In this situation, detachable extended mirrors are necessary. Check with your dealer or the appropriate state agency for mirror requirements.

HEAVY DUTY FLASHER

A Heavy Duty Flasher is an electrical component that may be required when your trailer turn signal lights are attached to the tow vehicle flasher circuit.

ELECTRICAL CONNECTOR

An Electrical Connector connects the light and brake systems on the trailer to the light and brake controls on the towing vehicle.

EMERGENCY FLARES AND TRIANGLE REFLECTORS

It is wise to carry these warning devices even if you are not towing a trailer. It is particularly important to have these when towing a trailer because the hazard flashers of your towing vehicle will not operate for as long a period of time when the battery is running both the trailer lights and tow vehicle lights.

SAFETY CHAINS

If the coupler connection comes loose, the safety chains can keep the trailer attached to the tow vehicle. With properly rigged safety chains, it is possible to keep the tongue of the trailer from digging into the road pavement, even if the coupler-to-hitch connection comes apart.

TRAILER LIGHTING AND BRAKING CONNECTOR

A device that connects electrical power from the tow vehicle to the trailer. Electricity is used to turn on brake lights, running lights, and turn signals as required. In addition, if your trailer has a separate braking system, the electrical connector will also supply power to the brakes from the tow vehicle.

BREAKAWAY SYSTEM

If the trailer coupler connection comes loose, the breakaway system can actuate emergency hydraulic brakes depending on the type of actuator on the trailer. The breakaway cable must be rigged to the tow vehicle with appropriate slack that will activate the system if the coupler connection comes loose.

JACKSTAND

A device on the trailer that is used to raise and lower the coupler. The jack is sometimes called the “landing gear” or the “tongue jack”.

COUPLER TYPES

Two types of coupler used with the trailer are discussed below.

- Ball Hitch Coupler
- Pintel Eye Coupler

BALL HITCH COUPLER

A ball hitch coupler (Figure C) connects to a ball that is located on or under the rear bumper of tow vehicle. This system of coupling a trailer to a tow vehicle is sometimes referred to as “bumper pull.”

A ball hitch trailer may be fitted with a tongue jack that can raise and lower the coupler. The tongue jack is mounted to the A-frame (front or tongue) part of the trailer. By rotating the jack handle clockwise, the jack will extend and raise the tongue of the trailer.

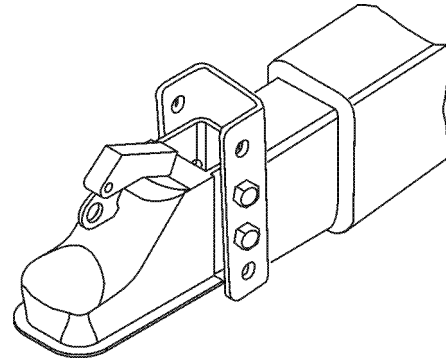


Figure C. Ball Hitch Coupler

Before each tow, coat the ball with a thin layer of automotive bearing grease to reduce wear and ensure proper operation. Check the locking device that secures the coupler to the ball for proper operation.

If you see or feel evidence of wear, such as flat spots, deformations, pitting or corrosion, on the ball or coupler, immediately have your dealer inspect them to determine the proper action to prevent possible failure of the ball and coupler system. All bent or broken coupler parts must be replaced before towing the trailer.

The coupler handle lever must be able to rotate freely and automatically snap into the latched position. Oil the pivot points, sliding surfaces, and spring ends with SAE 30W motor oil. Keep the ball socket and latch mechanism clean. Dirt or contamination can prevent proper operation of the latching mechanism.

The load rating of the coupler and the necessary ball size are listed on the trailer tongue. You must provide a hitch and ball for your tow vehicle where the load rating of the hitch and ball is equal to or greater than that of your trailer.

Also, the ball size must be the same as the coupler size. If the hitch ball is too small, too large, is underrated, is loose

TRAILER GUIDELINES

or is worn, the trailer can come loose from the tow vehicle and may cause death or serious injury.

THE TOW VEHICLE, HITCH AND BALL MUST HAVE A RATED TOWING CAPACITY EQUAL TO OR GREATER THAN THE TRAILER **Gross Vehicle Weight Rating (GVWR)**. IT IS ESSENTIAL THAT THE HITCH BALL BE OF THE SAME SIZE AS THE COUPLER.

The ball size and load rating (capacity) are marked on the ball. Hitch capacity is marked on the hitch.

⚠ WARNING

Coupler-to-hitch mismatch can result in uncoupling, leading to death or serious injury.

Be sure the **LOAD RATING** of the hitch ball is equal or greater than the load rating of the coupler.

Be sure the **SIZE** of the hitch ball matches the size of the ball coupler.

⚠ WARNING

A worn, cracked or corroded hitch ball can fail while towing and may result in death or serious injury.

Before coupling trailer, inspect the hitch ball for wear, corrosion and cracks.

Replace worn or damaged hitch ball.

⚠ WARNING

A loose hitchball nut can result in uncoupling, leading to death or serious injury.

Be sure the hitch ball is tight to the hitch before coupling the trailer.

- Rock the ball to make sure it is tightened to the hitch, and visually check that the hitch ball nut is solid against the lock washer and hitch frame.
- Wipe the inside and outside of the coupler. Clean and visually inspect it for cracks and deformations. Feel the inside of the coupler for worn spots and pits.
- Be sure the coupler is secured tightly to the tongue of the trailer. All coupler fasteners must be visibly solid against the trailer frame.
- The bottom surface of the coupler must be above the top of the hitch ball. Use the tongue jackstand to support

the trailer tongue. Wood or concrete blocks may also be used.

Coupling the Trailer to the Tow Vehicle (Ball Coupler)

- Lubricate the hitch ball and the inside of the coupler with a thin layer of automotive bearing grease.
- Slowly back up the tow vehicle so that the hitch ball is near or aligned under the coupler.
- Using the jackstand at the front of trailer (tongue), turn the jackstand crank handle to raise the trailer. If the ball coupler does not line up with the hitch ball, adjust the position of the tow vehicle.
- Open the coupler locking mechanism. Ball couplers have a locking mechanism with an internal moving piece and an outside handle. In the open position, the coupler is able to drop fully onto the hitch ball.
- Lower the trailer (Figure D) until the coupler fully engages the hitch ball.

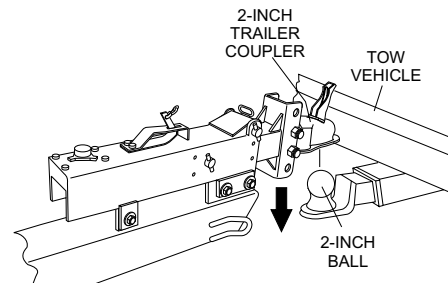


Figure D. Ball Hitch Coupling Mechanism

- Engage the coupler locking mechanism. In the engaged position, the locking mechanism securely holds the coupler to the hitch ball.
- Insert a pin or lock through the hole in the locking mechanism.
- Be sure the coupler is all the way on the hitch ball and the locking mechanism is engaged. A properly engaged locking mechanism will allow the coupler to raise the rear of the tow vehicle. Using the trailer jackstand, verify that you can raise the rear of the tow vehicle by 1 inch after the coupler is locked to the hitch.
- Lower the trailer so that its entire tongue weight is held by the hitch.
- Raise the jackstand to a height where it will not interfere with the road.

TRAILER GUIDELINES

NOTICE

Overloading can damage the tongue jack. **DO NOT** use the tongue jack to raise the tow vehicle more than one inch.

If the coupler cannot be secured to the hitch ball, do not tow the trailer. Call your dealer for assistance. Lower the trailer so that its entire tongue weight is held by the hitch and continue retracting the jack to its fully retracted position.

Attaching Safety Chain

Visually inspect the safety chains and hooks for wear or damage. Replace worn or damaged safety chains and hooks before towing.

Attach the safety chains so that they:

- Cross underneath the coupler. See Figure E.

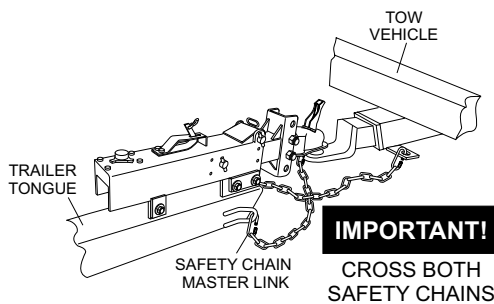


Figure E. Attaching Safety Chain (Ball Hitch)

- Loop around a frame member of the tow vehicle or holes provided in the hitch system (DO NOT attach them to an interchangeable part of the hitch assembly).
- Have enough slack to permit tight turns, but not be close to the road surface, so if the trailer uncouples, the safety chains can hold the tongue up above the road

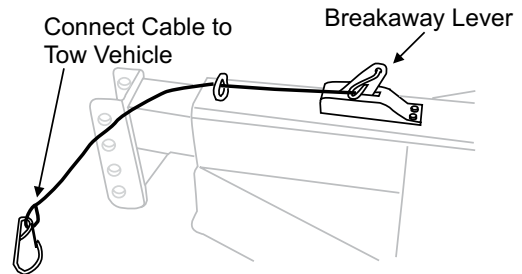
WARNING

Improper rigging of the safety chains can result in loss of control of the trailer and tow vehicle, leading to death or serious injury, if the trailer uncouples from the tow vehicle.

- Fasten chains to frame of tow vehicle. DO NOT fasten chains to any part of the hitch unless the hitch has holes or loops specifically for that purpose.
- Cross chains underneath hitch and coupler with enough slack to permit turning and to hold tongue up, if the trailer comes loose.

Breakaway Brake System

If the coupler or hitch fails, a properly connected and working breakaway brake system (Figure F) will apply the hydraulic brakes on the trailer. The safety chains will keep the tow vehicle attached and as the brakes are applied at the trailer's axles, the trailer/tow vehicle combination will come to a controlled stop.



Hydraulic Actuator

Figure F. Breakaway Brake System

Breakaway Cable Surge Brake System

The breakaway brake system includes a brake cable connected to the tow vehicle on one end and to the emergency brake lever located on the hydraulic actuator on the other end.

WARNING

- An ineffective breakaway brake system can result in a runaway trailer, leading to death or serious injury, if the coupler or ball hitch fails.
- Connect the breakaway cable to the tow vehicle and NOT to the hitch, ball or support.
- Before towing the trailer, test the function of the breakaway brake system. If the breakaway brake system is not working, DO NOT tow the trailer. Have it serviced or repaired.

NOTICE

DO NOT tow the trailer with the breakaway brake system ON because the brakes will overheat which can result in permanent brake failure.

NOTICE

Replace the breakaway brake battery (if equipped) at intervals specified by manufacturer.

TRAILER GUIDELINES

Connecting Trailer Lights

Connect the trailer lights to the tow vehicle's electrical system using the electric connectors at the front of the trailer (tongue). Refer to the wiring diagram shown in the trailer wiring diagram section of this manual. Before towing the trailer check for the following:

- Running lights (turn on tow vehicle headlights).
- Brake Lights (step on tow vehicle brake pedal).
- Backup Lights (place tow vehicle gear shift in reverse).
- Turn Signals (activate tow vehicle directional signal lever).

WARNING

Improper electrical connection between the tow vehicle and the trailer will result in inoperable lights and electric brakes, and can lead to collision.

Before each tow:

- Check that the taillights, brake lights and turn signals work.
- Check that the electric brakes work by operating the brake controller inside the tow vehicle.

Uncoupling the Ball Hitch

Follow these steps to uncouple ball hitch from tow vehicle:

- Block trailer tires to prevent the trailer from rolling, before jacking the trailer up.
- Disconnect the electrical connector.
- Disconnect the breakaway brake switch cable. Promptly replace the pullpin in the switchbox.
- Before extending jackstand, make certain the ground surface below the jackstand foot will support the tongue load.
- Rotate the jackstand handle (or crank) clockwise. This will slowly extend the jack and transfer the weight of the trailer tongue to the jack.

PINTLE HITCH COUPLER

A pintle eye coupler (Figure G) connects to a pintle-hook hitch that is located on or under the rear bumper of the tow vehicle. This system of coupling a trailer to a tow vehicle is sometimes referred to as a "lunette eye, tow ring or G.I. hitch."

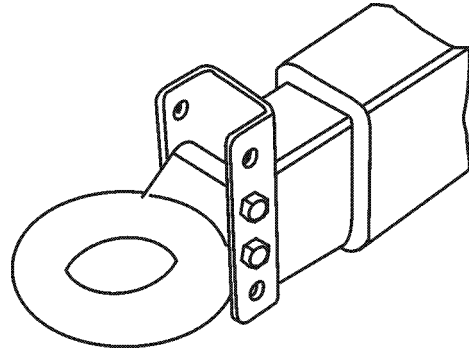


Figure G. Pintle Hitch Coupler

A pintle hitch trailer may be fitted with a tongue jackstand that can raise and lower the coupler. The tongue jack is mounted to the A-frame (front or tongue) part of the trailer. By rotating the jack handle clockwise, the jack will extend and raise the tongue of the trailer.

The load rating of the coupler and the necessary pintle hitch size are listed on the trailer tongue. You must provide a pintle hitch and pintle coupler for your tow vehicle, where the load rating of the pintle hitch and pintle coupler is equal to or greater than that of your trailer.

Also, the pintle hitch size must be the same as the pintle coupler size. If the hitch is too small, too large, underrated, loose or worn, the trailer can come loose from the tow vehicle, and may cause death or serious injury.

Pintle Coupler and Pintle Hook

Before each tow, check the locking device that secures the coupler to the pintle hook assembly.

The pintle hook lever must be able to operate freely and automatically snap into place into the latched position. Lightly oil the pivot points and sliding surfaces with SAE30W motor oil to prevent rust and help ensure proper operation of the latching mechanism.

If you see or feel evidence of wear, such as flat spots, deformations, pitting or corrosion, on the pintle hook or coupler, immediately have your dealer inspect them to determine the proper action to prevent possible failure of

TRAILER GUIDELINES

the ball and coupler system. All bent or broken coupler parts must be replaced before towing the trailer.

THE TOW VEHICLE, PINTLE HITCH AND PINTLE COUPLER MUST HAVE A RATED TOWING CAPACITY EQUAL TO OR GREATER THAN THE TRAILER **Gross Vehicle Weight Rating (GVWR)**.

IT IS ESSENTIAL THAT THE PINTLE HITCH BE OF THE SAME SIZE AS THE PINTLE COUPLER.

The coupler size and load rating (capacity) are marked on the coupler. Hitch capacity is marked on the hitch.

WARNING

Coupler-to-hitch mismatch can result in uncoupling, leading to death or serious injury.

Be sure the **LOAD RATING** of the pintle hitch hook is equal or greater than the load rating of the pintle eye coupler.

Be sure the **SIZE** of the pintle hitch hook matches the size of the pintle eye coupler.

WARNING

A worn, cracked or corroded pintle hitch hook can fail while towing, and may result in death or serious injury.

Before coupling trailer, inspect the pintle hitch hook for wear, corrosion and cracks.

Replace worn or damaged pintle hitch hook.

- Rock the pintle eye coupler to make sure it is secured tightly to the hitch.
- Wipe the inside and outside of the pintle coupler. Clean and inspect it visually for cracks and deformations. Feel the inside of the coupler for worn spots and pits.
- Be sure the coupler is secured tightly to the tongue of the trailer. All coupler fasteners must be visibly solid against the trailer frame.
- Raise the bottom surface of the coupler to be above the top of the pintle hitch hook. Use the tongue jackstand to support the trailer tongue. Wood or concrete blocks may also be used.

WARNING

A defective pintle hitch not properly fastened can result in uncoupling, leading to death or serious injury.

Be sure the pintle hook is securely tightened to the tow vehicle before coupling the trailer.

Coupling Trailer to Tow Vehicle (Pintle Coupler)

- Slowly back up the tow vehicle so that the pintle hitch hook is near or aligned under the pintle eye ring coupler.
- Using the jackstand at the front of trailer (tongue), turn the jackstand crank handle to raise the trailer. If the pintle eye coupler does not line up with the pintle hitch hook, adjust the position of the tow vehicle.
- **OPEN** the pintle hook locking mechanism (Figure H). Place the hook inside the eye coupler. **CLOSE** the pintle hook mechanism.

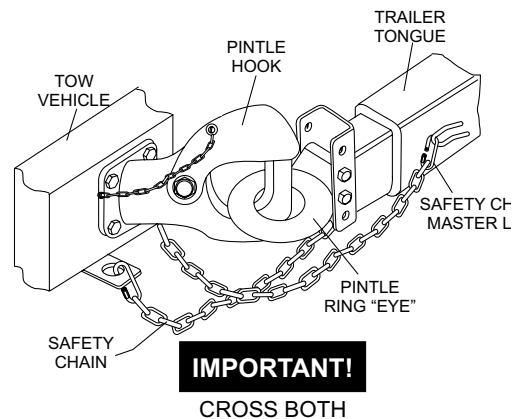


Figure H. Attaching Safety Chain (Pintle Hitch)

- Insert a pin or lock through the hole in the locking mechanism.
- Be sure the pintle hook is inserted completely through the eye ring and the locking mechanism is engaged. A properly engaged locking mechanism will allow the coupler to raise the rear of the tow vehicle. Using the trailer jack, test to see that you can raise the rear of the tow vehicle by 1-inch after the coupler is locked to the hitch.
- Lower the trailer so that its entire tongue weight is held by the hitch.
- Raise the jackstand to a height where it will not interfere with the road.

TRAILER GUIDELINES

TIRE SAFETY

Unsafe Tires, Lug Nuts or Wheels

Trailer tires and wheels are more likely to fail than car tires and wheels because they carry a heavier load. Therefore, it is essential to inspect the trailer tires before each tow.

If a tire has a bald spot, bulge, cuts, is showing any cords, or is cracked, replace the tire before towing. If a tire has uneven tread wear, take the trailer to a dealer service center for diagnosis.

Uneven tread wear can be caused by tire imbalance, axle misalignment or incorrect inflation.

Tires with too little tread will not provide adequate tracking on wet roadways and can result in loss of control, leading to death or serious injury.

Improper tire pressure causes an unstable trailer and can result in a tire blowout and loss of control. Therefore, before each tow you must also check the tire pressure. Tire pressure must be checked when tires are cold.

Allow 3 hours cool-down after driving as much as 1 mile at 40 mph before checking tire pressure. Trailer tires will be inflated to higher pressures than passenger vehicle tires.

Since trailer wheels and lug nuts (or bolts) are subjected to greater side loads than automobile wheels, they are more prone to loosen. Before each tow, check to make sure they are tight.

The proper tightness (torque) for lug nuts is listed in the lug nut tightening section of this manual. Use a torque wrench to tighten the lug nuts. If you do not have a torque wrench, use a lug wrench (from your tow vehicle) and tighten the nuts as much as you can. Then have a service garage or trailer dealer tighten the lug nuts to the proper torque.

WARNING

Metal creep between the wheel rim and lug nuts will cause rim to loosen and could result in a wheel coming off, leading to death or serious injury.

Tighten lug nuts before each tow.

Lug nuts are also prone to loosen after first being assembled. When driving a new trailer (or after wheels have been remounted), check to make sure they are tight after the first 10, 25 and 50 miles of driving and before each tow thereafter.

Failure to perform this check can result in a wheel parting from the trailer and a crash, leading to death or serious injury.

WARNING

Lug nuts are prone to loosen after initial installation, which can lead to death or serious injury.

Check lug nuts for tightness on a new trailer or when wheel(s) have been remounted after the first 10, 25 and 50 miles of driving.

WARNING

Improper lug nut torque can cause a wheel parting from the trailer, leading to death or serious injury.

Be sure lug nuts are tight before each tow.

WARNING

Improper tire pressure can result in a blowout and loss of control, which can lead to death or serious injury.

Be sure tires are inflated to pressure indicated on side wall before towing trailer.

Determining Load Limit of 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 the axle can weigh.

TRAILER GUIDELINES

There is a vehicle placard (Figure I) 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.

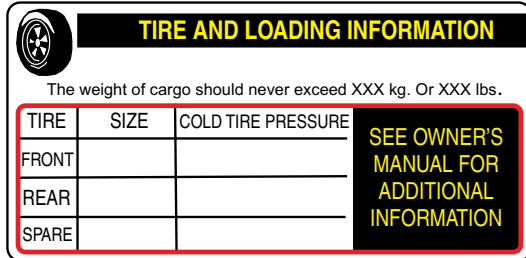


Figure I. Trailer Tire Placard

If additional work items (hoses, tools, clamps etc.) are going to be added to the trailer, be sure they are 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.

Excessive loads and/or underinflation 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 and Loading Information placard. This value should never exceed the maximum cold inflation pressure stamped on the tire.

Perform the following steps to determine the load limit of your trailer.

Step 1.

Locate the statement, “The weight of cargo should never exceed XXX kg or XXX lbs.,” on your vehicle’s Tire and Loading Information placard (Figure I). This value equals the available amount of equipment load capacity.

Step 2.

Determine the weight of the equipment being loaded on the tow vehicle. That weight may not safely exceed the available equipment load capacity. The trailer’s Tire Information Placard is attached adjacent to or near the trailer’s VIN (Certification) label at the left front of the trailer (See Figure I).

Determining Load Limit of Tow Vehicle

Step 1.

Locate the statement, “The combined weight of occupants and cargo should never exceed XXX lbs.,” on your vehicle’s placard.

Step 2.

Determine the combined weight of the driver and passengers who will be riding in your vehicle.

Step 3.

Subtract the combined weight of the driver and passengers from XXX kilograms or XXX pounds.

Step 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.).

Step 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.

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.

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 tire life.

TRAILER GUIDELINES

Use the information contained in this section 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.

TIRE FUNDAMENTALS

Federal law requires tire manufacturers to place standardized information on the sidewall of all tires (Figure J). 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.

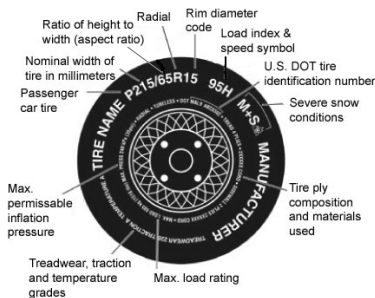


Figure J. Standard Tire Sidewall Information

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.

P: 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 in Table A. *Note:* You may not find this information on all tires because it is not required by law.

Table A. Speed Rating	
Letter Rating	Speed Rating
Q	99 mph
R	106 mph
S	112 mph
T	118 mph
U	124 mph
H	130 mph
V	149 mph
W	168* mph
Y	186* mph

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.

Uniform Tire Quality Grading Standards (UTQGS)

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".

Refer to Figure K for additional tire information for light trucks.

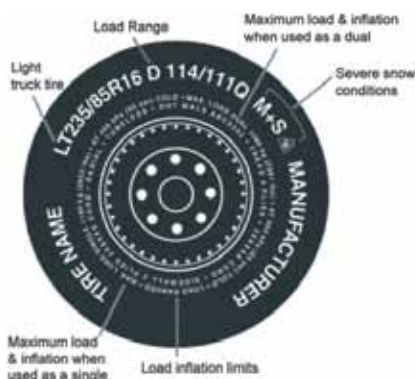


Figure K. UTQGS Tire Information

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.

Tire Safety Tips

- 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.
- Check tire inflation pressure weekly during use to insure the maximum tire life and tread wear.
- DO NOT bleed air from tires when they are hot.
- 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.
- **ALWAYS** check tire pressure on tow vehicle and trailer before towing. Check tire pressure at least once a month.
- **DO NOT** overload tow vehicle. Check the tire information and loading placard for safe allowable tire loading conditions.

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.

Replacing Worn or Damaged Tires


Replace the tire before towing the trailer if the tire treads have less than 1/16 inch depth or the telltale bands are visible. Check inflation pressure weekly during use to insure the maximum tire life and tread wear. A bubble, cut or bulge in a side wall can result in a tire blowout. Inspect both side walls of each tire for any bubble, cut or bulge; and replace a damaged tire before towing the trailer.

TRAILER GUIDELINES

Table B below will help pinpoint the causes and solutions of tire wear problems.

Table B. Tire Wear Troubleshooting		
Wear Pattern	Cause	Solution
	Center Wear	Over inflation. Adjust pressure to particular load per tire manufacturer.
	Edge Wear	Under inflation. Adjust pressure to particular load per tire manufacturer.
	Side Wear	Loss of camber or overloading. Make sure load does not exceed axle rating. Align wheels.
	Toe Wear	Incorrect toe-in. Align wheels.
	Cupping	Out-of-balance. Check bearing adjustment and balance tires.
	Flat Spots	Wheel lockup and tire skidding. Avoid sudden stops when possible and adjust brakes.

WARNING

 ALWAYS wear safety glasses when removing or installing force fitted parts. **DO NOT** attempt to repair or modify a wheel. **DO NOT** install an inner-tube to correct a leak through through the rim. If the rim is cracked, the air pressure in the inner tube may cause pieces of the rim to explode (break off) with great force and cause serious eye or bodily injury.

Wheel Rims

If the trailer has been struck, or impacted, on or near the wheels, or if the trailer has struck a curb, inspect the rims for damage (i.e. being out of round); and replace any damaged wheel. Inspect the wheels for damage every year, even if no obvious impact has occurred.

Wheels, Bearings and Lug Nuts

A loose, worn or damaged wheel bearing is the most common cause of brakes that grab.

To check wheel bearings, jack trailer and check wheels for side-to-side looseness. If the wheels are loose, or spin with a wobble, the bearings must be serviced or replaced. Check inflation pressure weekly during use to insure the maximum tire life and tread wear. Most trailer axles are built with sealed bearings that are not serviceable. Sealed bearings must be replaced as complete units.

NOTICE

NEVER use an pneumatic air gun to tighten wheel lug nuts.

Over-tightening lug nuts will result in breaking the studs or permanently deforming the mounting stud holes in the wheels.

WARNING

Lug nuts are prone to loosen after initial installation, which can lead to death or serious injury. Check all wheel lug nuts periodically.

Lug Nut Torque Requirements

It is extremely important to apply and maintain proper wheel mounting torque on the trailer. Be sure to use only the fasteners matched to the cone angle of the wheel. Proper procedure for attachment of the wheels is as follows:

1. Start all wheel lug nuts by hand.
2. Torque all lug nuts in sequence. See Figure L. **DO NOT** torque the wheel lug nuts all the way down. Tighten each lug nut in 3 separate passes as defined by Table C.
3. Check to see if the lug nuts are tight after the first 10, 25 and 50 miles of driving and before each tow thereafter

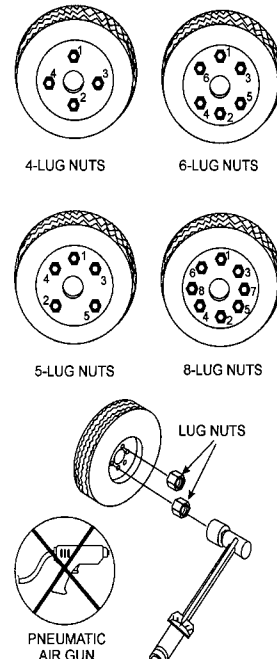


Figure L. Wheel Lug Nuts Tightening Sequence

TRAILER GUIDELINES

Table C. Tire Torque Requirements

Wheel Size	First Pass FT-LBS	Second Pass FT-LBS	Third Pass FT-LBS
12"	20-25	35-40	50-65
13"	20-25	35-40	50-65
14"	20-25	50-60	90-120
15"	20-25	50-60	90-120
16"	20-25	50-60	90-120

Replace any broken or burned-out lamps as necessary. Check the wire harness for cuts, fraying or other damage. If it needs replacing, contact your dealer.

WARNING

Improper operating taillights, stoplights and turn signals can cause collisions.

Check all lights before each tow.

Lights and Signals

Before each tow, check the trailer taillights, stoplights, turn signals and any clearance lights for proper operation.

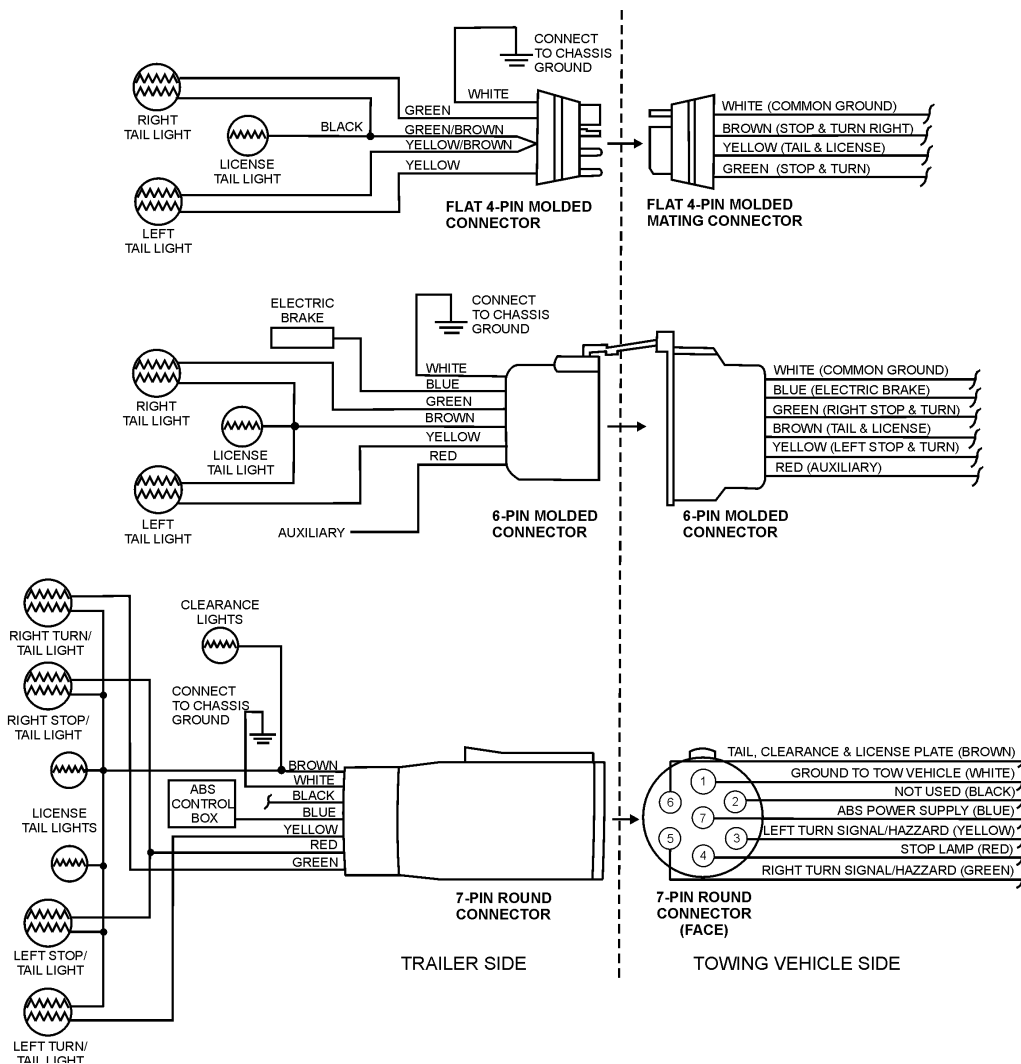


Figure M. Trailer to Tow Vehicle Wiring Diagram

OPERATION MANUAL

HERE'S HOW TO GET HELP

PLEASE HAVE THE MODEL AND SERIAL
NUMBER ON-HAND WHEN CALLING

UNITED STATES

Multiquip Corporate Office

18910 Wilmington Ave.
Carson, CA 90746
Contact: mq@multiquip.com

Tel. (800) 421-1244
Fax (800) 537-3927

Service Department

800-421-1244
310-537-3700

Fax: 310-537-4259

Technical Assistance

800-478-1244

Fax: 310-943-2238

MQ Parts Department

800-427-1244
310-537-3700

Fax: 800-672-7877
Fax: 310-637-3284

Warranty Department

800-421-1244
310-537-3700

Fax: 310-943-2249

MEXICO

MQ Cipsa

Carr. Fed. Mexico-Puebla KM 126.5
Momoxpan, Cholula, Puebla 72760 Mexico
Contact: pmastretta@cipsa.com.mx

Tel: (52) 222-225-9900
Fax: (52) 222-285-0420

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Multiquip

4110 Industriel Boul.
Laval, Quebec, Canada H7L 6V3
Contact: jmartin@multiquip.com

Tel: (450) 625-2244
Tel: (877) 963-4411
Fax: (450) 625-8664

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