Ingersoll-Rand®
Utility Equipment

Operation & Maintenance Manual

4IRQ2N & 4IRS2N DIESEL ENGINE

This manual contains important safety information.
Do not destroy this manual.
This manual must be available to the personnel who operate and maintain this machine.

[redacted]

Ingersoll-Rand
Utility Equipment
P.O. Box 868 - 501 Sanford Ave
Mocksville, N.C. 27028
Revised (10-12)

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.

Introduction

Forward

READ THIS MANUAL carefully to learn how to operate and service your engine correctly. Failure to do so could result in personal injury or equipment damage.

THIS MANUAL SHOULD BE CONSIDERED a permanent part of your engine and should remain with the engine when you sell it.

MEASUREMENTS IN THIS MANUAL are given in both metric and customary U.S. unit equivalents. Use only correct replacement parts and fasteners. Metric and inch fasteners may require a specific metric or inch wrench.

RIGHT-HAND AND LEFT-HAND sides are determined by standing at the drive or flywheel end (rear) of the engine and facing toward the front of the engine.

WRITE ENGINE SERIAL NUMBERS and option codes in the spaces indicated in the Record Keeping Section. Accurately record all the numbers. Your dealer also needs these numbers when you order parts. File the identification numbers in a secure place off the engine.

SETTING FUEL DELIVERY beyond published factory specifications or otherwise overpowering will result in loss of warranty protection for this engine.

CERTAIN ENGINE ACCESSORIES such as radiator, air cleaner, and instruments are optional equipment on Ingersoll-Rand supplied engines. These accessories may be provided by the equipment manufacturer instead of Ingersoll-Rand. This operator's manual applies only to the engine and those options available through the Ingersoll-Rand distribution network.

Engine Owner

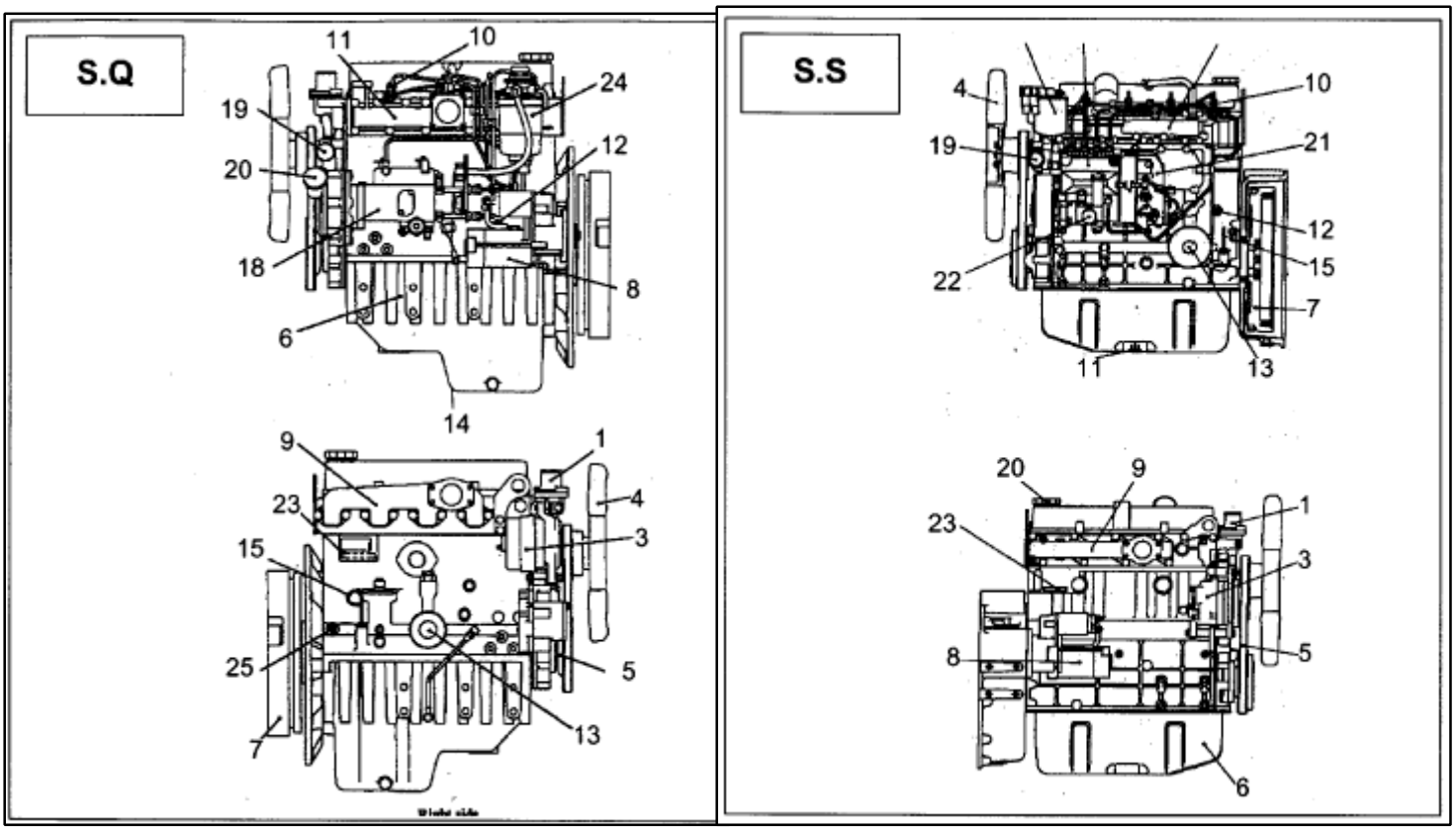
Ingersoll-Rand Equipment Engine Owner:

Don't wait until you need warranty or other service to meet your local Ingersoll-Rand Distributor or Service Dealer.

Learn who he is and where he is. At your first convenience, go meet him. He'll want to get to know you and to learn what your needs might be.

Engine Details

S4Q2 **S4S**

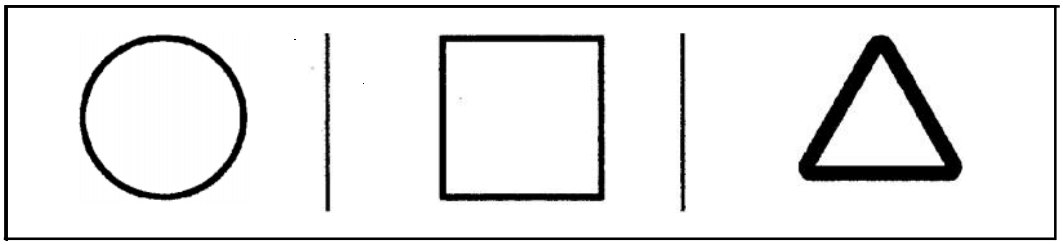


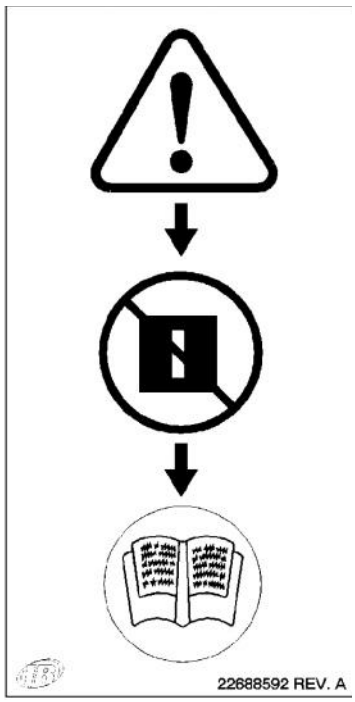
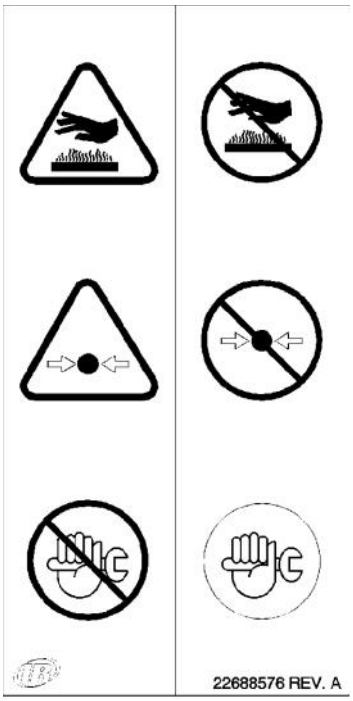
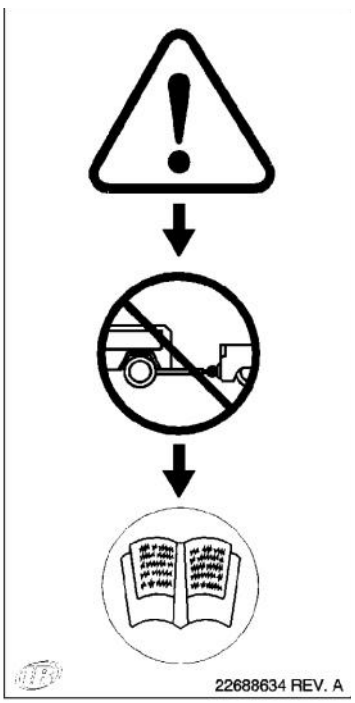
1	Water Thermostat	14	Oil Drain Plug
2	Lifting Eye	15	Dipstick
3	Charge Alternator	16	Crankcase Pulley
4	Fan	17	Oil Filler Neck
5	V-belt	18	Fuel Pump
6	Oil sump	19	Water Pump
7	Flywheel	20	Oil Filler Neck
8	Starter Motor	21	Governor
9	Exhaust manifold	22	Fuel Feed Pump
10	Injector	23	Engine Serial Number
11	Air Inlet Housing	24	Fuel Filter
12	Water Drain Plug	25	Oil Pressure Plug
13	Oil Filter		

Table of Contents

Safety Symbols

Symbols below point out potential safety hazards and provide important information about this machine. Read and understand. Heed warnings and follow instructions. If you do not understand, inform your supervisor.



Prohibition/ Mandatory	Information/Instructions	WARNING
		
WARNING - Read the operator's manual before operating this machine.	WARNING - Do not open radiator until radiator is cool and pressure is relieved.	WARNING - Read the operator's manual before towing machine.

		
WARNING - Diesel fuel is flammable. No open flames or sparks.	WARNING - Battery contains acid. Gases are flammable. No open flames or sparks.	WARNING - Do not perform maintenance until all electrical power has been disconnected.
		
WARNING - Rotating fan	65 MPH maximum towing speed.	

Safety Symbols

Look for these signs on machines manufactured in North America, which point out potential hazards to the safety of you and others. Read and understand thoroughly. Heed warnings and follow instructions. If you do not understand, inform your supervisor.

(Red Background)

Indicates the presence of a hazard which WILL cause serious injury, death or property damage, if ignored.

(Orange Background)

Indicates the presence of a hazard which CAN cause serious injury, death or property damage, if ignored.

(Yellow Background)

Indicates the presence of a hazard which WILL or can cause injury or property damage, if ignored.

(Blue Background)

Indicates important set-up, operating or maintenance information.

Safety Decals area available free of charge.
Safety decals are identified by the decal heading:
DANGER, WARNING or CAUTION
Decal part numbers are on the bottom of each decal and are listed in the parts manual. Help promote product safety! Assure that decals are present on the machines. Replace decals that are not legible.


WARNING
Improper grounding.
Can cause serious injury or death.
Comply with local electrical codes and Operator's Manual shipped with this unit.
54604996 REV. B


WARNING
Combustible gas.
Can cause serious burns, blindness or death.
Keep sparks and open flames away from batteries.
54568753 REV. B


WARNING
Hot pressurized fluid.
Can cause serious burns.
Do not open radiator while hot.
54568761 REV. B


WARNING
Improper operation of this equipment.
Can cause serious injury or death.
Read Operator's Manual supplied with this machine before operation or servicing.
Modification or alteration of this machine.
Can cause serious injury or death.
Do not alter or modify this machine without the express written consent of the manufacturer.
54568787 REV. B


WARNING
Risk of electric shock.
Hazardous voltage.
Can cause serious injury or death.
Disconnect power before servicing.
Lockout / tagout machine.
54605027 REV. C


105
km/h
WARNING
Collapsing jackstand.
Can cause serious injury.
Insert locking pin completely.
Excessive towing speed.
Can cause serious injury or death.
Do NOT exceed 65 mph (105 km/hr.)
54568803 REV. B


WARNING
Rotating fan blade.
Can cause serious injury.
Do not operate without guard in place.
54568779 REV. B


WARNING
Machine can START AUTOMATICALLY.
Can cause serious injury or death.
Read Operating Manual AUTOMATIC START/STOP Section supplied with this equipment before operating or servicing.
Ingersoll-Rand
54687777 REV. A

Safety

This machine is not designed for operating life-sustaining equipment. It is equipped with a safety shutdown system that will cause the machine to stop operating whenever a shutdown condition is present.

Never operate the engine of this machine inside a building without adequate ventilation. Avoid breathing exhaust fumes when working on near the machine.

A battery contains sulfuric acid and can give off gases, which are corrosive and potentially explosive. Avoid contact with skin, eyes, and clothing. In case of contact, flush area immediately with water.

Improper operation of this equipment can cause severe injury or death.

Read Operator's Manual supplied with this machine before operation or service.

Modification or alteration of this machine CAN result in severe injury or death. Do not alter or modify this machine without the express written consent of the manufacturer.

Exercise extreme caution when using booster battery. To jump battery, connect ends of one booster cable to the positive (+) terminal of each battery. Connect one end of other cable to the negative (-) terminal of the booster battery and other end to a ground connection away from dead battery (to avoid a spark occurring near any explosive gases that may be present). After starting unit, always disconnect cables in reverse order.

Never inspect or service unit without first disconnecting battery cable(s) to prevent accidental starting.

Wear eye protection while cleaning unit with compressed air, to prevent debris from injuring eyes.

HOT PRESSURIZED FLUID - Remove cap slowly to relieve PRESSURE from HOT radiator. Protect skin and eyes. HOT water or steam and chemical additives can cause serious personal injury.

Flammable Fuels - Do not fill tank when engine is running.

Do not smoke or use an open flame in the vicinity of the generator set or fuel tank.

Do not permit smoking, open flame, or sparks to occur near the battery, fuel, cleaning solvents or other flammable substances and explosive gases.

Do not operate Genset if fuel has been spilled inside or near the unit.

Disable Start Control - Before performing any service or maintenance operation, always disconnect battery cables to prevent accidental start- ups.

Use extreme care to avoid contacting hot surfaces (engine exhaust manifold and piping).

HAZARDOUS SUBSTANCE PRECAUTION

Ensure that adequate ventilation of the cooling system and exhaust gases is maintained at all times.

The following substances are used in the manufacture of this machine and may be hazardous
to health if used incorrectly.

Avoid ingestion, skin contact and breathing fumes for the following substances: Antifreeze, Engine Lubricating Oil, Preservative Grease, Rust Preventative, Diesel Fuel and Battery Electrolyte.

The following substances may be produced during the operation of this machine and may be hazardous to health:

- Avoid build-up of engine exhaust fumes in confined spaces.
- Avoid breathing exhaust fumes.
- Avoid breathing brake lining dust during maintenance.
- Always operate in a well ventilated area.
- Dispose of waste in a sealed container.
- Use water to damp down dust.
- Avoid inhalation of dust particles.

Safety data sheets for engine lubricants should be obtained from the lubricant supplier.

Fuels, Lubricants, and Coolant

Fuel specifications

When set to factory standards, these engines operate properly with a diesel fuel complying with one of the following specifications:

- BS 2869: 1988, class A2
- BS EN590: 1995 class 1
- ASTM D-975-77: quality 2D
- Use commercially available diesel fuel with a sulphur content lower than 0.5%.
- Gaseous emissions, measured during standard checks, always refer to a standard diesel fuel recommended by the authorities in charge of these standards

The fuel must be a distillate, and a residual oil or a blend. The user is warned that, although engines can operate with fuels not complying with specifications mentioned above, this could lead to excessive wear and damage.

⚠CAUTION

Fuel injection equipment is manufactured in accordance with very precise limits and the smallest foreign body will affect efficiency.

It is essential to use fuel free from water and other impurities.

Note: To operate the engine at temperatures below 0ºC (32ºF), use an anti-prafining additive or use a fuel preheater.

Example: ACCEL additive for cold weather.

Recommended mixture ratio: 1 liter for 1000 liters of diesel fuel. Average operation of diesel engines guaranteed down to -18ºC.

Recommended oil Specifications

Quality

The oil must be suitable for oil changes as specified in the general maintenance schedule. The temperatures mentioned in the Oil Viscosity Table below are ambient temperatures during engine start-up. However, if operating ambient temperatures are much higher than the starting temperatures, a compromise must be found and high viscosity oil must be used providing the engine starts satisfactorily. Multi-grade oils can solve this problem provided that they have an appropriate specification. These diesel engines must be used with heavy duty lubricating oil in compliance with the requirements of the standards API CC, DEF2101D, MIL-I-2104C or MIL-L-46152A/B for L.E. + S.L + S.Q engines and API CD FOR S.S engines. Straight minerals oils are not suitable, neither are oils of less detergency than specified.

In new or reconditioned engines, 3rd series API CD or MIL-L2104C/D oils can inhibit the running-in process and are not suitable for engines used in light service cycles. These oils can be recommended for engines operating with a high load factor, particularly with high ambient temperatures after the last oil change. Note, they must be used when the fuel sulphur content exceeds 0.5%

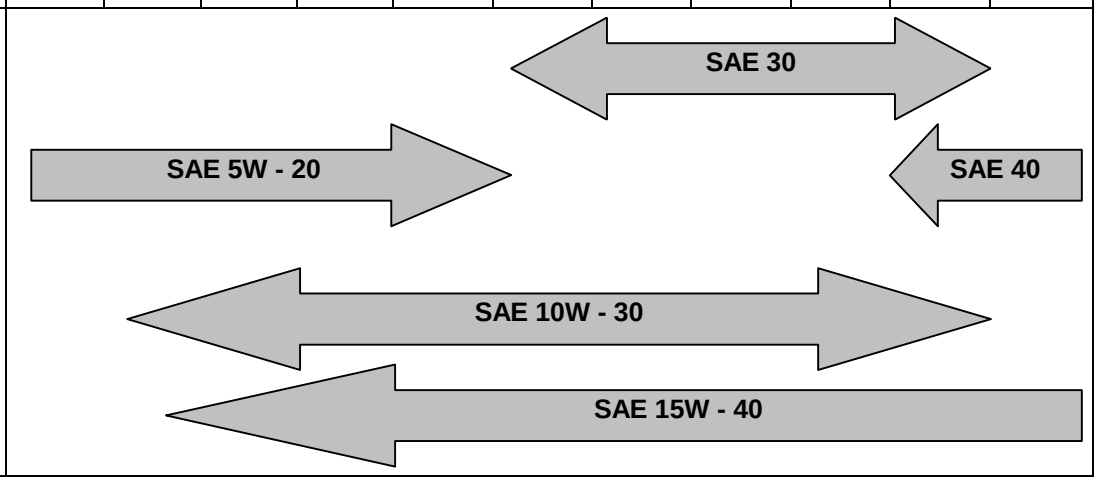
Viscosity

The following chart shows the correct oil viscosities for various ambient temperature s from cold start to maximum operating levels.

⚠CAUTION

Avoid mixing oils of different brands. In most cases, the various oil brands are not compatible with each other, and when mixed, can seize parts such as piston rings, cylinders, etc. or abnormally wear moving parts. It is preferable to stick with one and the same brand of oil at successive service intervals.

Recommended Oil Viscosities

Starting Temperature ºC (ºF)	**-30 (-22)**	**-25 (-13)**	**-20 (-4)**	**-15 (5)**	**-10 (14)**	**-5 (23)**	**0 (32)**	**10 (50)**	**20 (68)**	**30 (86)**	**40 (104)**
Oil Viscosities											

Type SAE 10W – 30 is the recommended oil for general use.

Limiting Requirements For Engine Oils

If a used oil analysis program is conducted in order to determine the condition of the oil, consult the char below. Change the oil if any of these requirements is not met.

Note:

- Oil change intervals depend to a great extent on fuel properties. Be sure to use only recommended fuels.
- The limit of total base number is half of that of a new oil incase of a perchloricacid analysis method.

Property		Test Method	LImit
Viscosity	cSt @ 100ºC (212ºF)	JIS K 2283	+30%, -15% of new oil
Total Base Number (Hcl)	MgKOH/g	JIS K 2501	2.0 minimum
Total Acid Number	MgKOH/g		+3.0% maximum of new oil
Water Content	Vol%	JIS K 2275	0.2 maximum
Flash Point (coc)	ºC (ºF)	JIS K 2265	180 (356) minimum
Pentane Insolubles	Wt%	ASTM D893	0.5 maximum
Pentane Insolubles Coagulated	Wt%		3.0 maximum

Coolant Specifications

The coolant quality has a significant effect on the efficiency and life of the cooling system. The recommendations below will help users to keep their cooling system in good condition with protection against frost and /or corrosion.

Coolant Quality

To contact the quality of your coolant, contact you local Ingersoll-Rand dealer.

Coolant Specifications

Note: Basically, harmful chemical properties and substances contained water (as coolant) must not exceed the limits specified by the manufacturer; however they are tolerable up to the limits shown in the table below.

Item	Chemical Symbol	Unit	Limit Recommended	Main malign effect	
				Corrosion & Rust	Scale formation
pH, 25ºC (77ºF)	-	-	6.5 à 8.5 (6.5 à 8.0)	0	0
Electrical conductivity, 25ºC (77ºF)	-	uΩ/cm	< 400(< 250)	0	0
Total Hardness	Ca CO_3	PPM	< 100 (< 95)	-	0
M alkalinity		PPM	< 150 (, 79)	-	0
Chlorine	Cl^-	PPM	< 100 (< 100)	-	-
Sulphuric acid ion	SO^{2-4}	PPM	< 100 (< 50)	0	-
Total Iron	Fe	PPM	< 1.0 (< 1.0)	-	0
Silica	SiO_2	PPM	< 50 (-)	-	0
Residue from evaporation	-	PPM	< 400 (<250)	-	0

The values indicated ( ) are the limits set by the manufacturer. In addition to the items specified above, turbidity is specified to be above < 15 degrees.

Recommended Types of Long Life Coolants (LLC)

For these engines, all-season, non-amine LLC or equivalent is recommended.

Features of Recommended Brands

- None of amines (methyl amines, ethyl amines, n-propyl amines, etc., all being derivatives of ammonia, NH3) are contained.
- Silicate and borate are not contained.
- Close to neutral on the pH scale, and hence, slightly basic (alkaline).
- Balanced additive ingredients, some being substitutes for amines.
- Long life. (The coolant with 20% concentration, for example, retains its efficacy for long, not less than 2 years).

⚠WARNING

LLC is toxic and can cause personal injury if in contact with the skin or eyes. If LLC enters the eyes, immediately and thoroughly rinse with water and seek medical attention at once.

How to use non-amine type LLC

1. Engine coolant containing any of the recommended additives should be changed every two years.

   Note: If any other LLC is used, refer to the coolant mixture chart displayed on the container.

2. Proper concentration of LLC is from 20% to 60% year-round. Aim at a temperature level lower by 5ºC (9ºF) than the expected lowest temperature. An LLC with a concentration below 30% does not provide sufficient corrosion protection. However, concentrations above 60% affect freeze protection and heat transfer rates. When adding coolant, use LLC of the same concentration.

RECOMMENDED LLC CONCENTRATIONS (REFERENCE)

Ambient temperature ºC (ºF)	-10 (14)	-20 (-4)	-30 (-22)	-45 (-49)
LLC concentration, %	30	40	50	60

Disposing of Coolant

Improperly disposing of engine coolant can threaten the environment and ecology.

Use leak proof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your Ingersoll-Rand distributor or servicing dealer.

Capacity of Cooling and Lubricating Systems

Engine	S4Q	S4S
Water	7.71 L	8.91 L
Oil	8.1 L	10.1 L

Engine Operating Guidelines

⚠CAUTION

Follow the instructions below in order to avoid problems during the first operation of the unit. Any failure to comply with these instructions could lead to injury or serious damage.

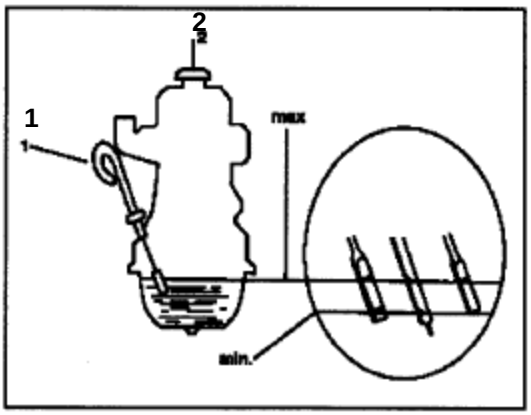
The various capacities of the systems that contain fluids are listed above.

Engine

Oil

Check the oil level in the engine sump and top off or fill as necessary.

Use approved oil (listed above) with a SAE grade suitable to the ambient temperature conditions.



1. Dipstick
2. Filler hole

Coolant

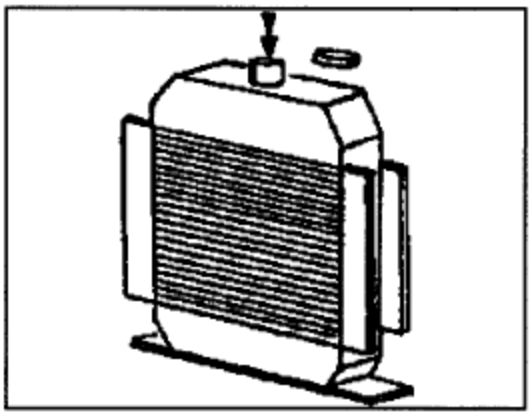
Check the coolant level and top off with water or fill with the specified coolant (listed above) if necessary.

Check hoses and pipes for leaks.

IMPORTANT: Filling the cooling system

Particular care should be taken during this operation. Note, during filling, the escaping air trapped in the system can indicate that the system is full. Therefore filling should be done in stages. After the 1st stage, continue to top off until the level stays visible through the filling hole even after a few minutes of observation.

Operate the engine for 2 to 3 minutes and let it rest for 30 minutes, then check the level again and top off if necessary.



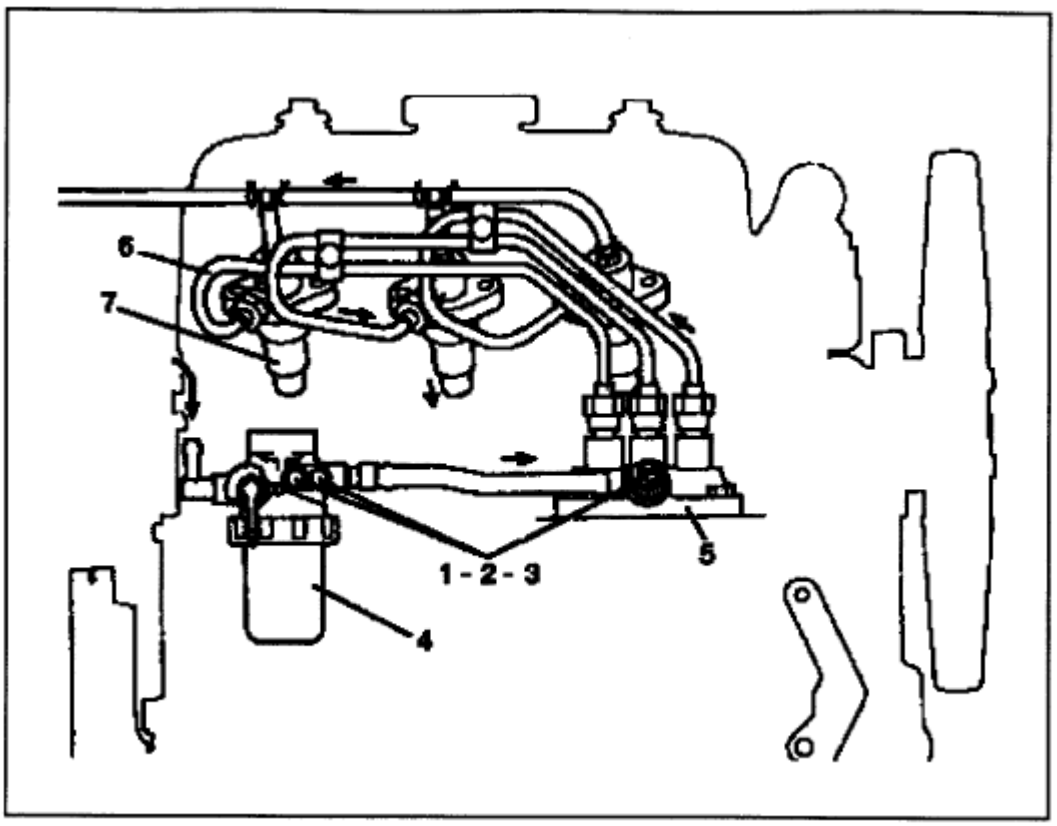
Fuel

Use only clean and filtered fuel complying the specifications listed above.
Fill tanks and check lines and fittings for leaks.
Crank the engine using the starter motor.

⚠CAUTION

Do not crank the engine using the start motor for more than 30 seconds.

Bleed the fuel pump by disconnecting the outlet fuel line until air free fuel flows out.
Bleed the fuel filter (4) by loosening the bleed screw (1) until air free fuel flows out then retighten the bleed screw.



Repeat the same operation with bleed screw (2).
Bleed the injection pump (5) by loosening bleed screw (3) then retighten the bleed screw.
Start the engine to remove the air contained in the injector pipes (6) and injectors (7).
The operation is complete.

Starting The Engine

CAUTION: Before starting engine in a confined building, install proper outlet exhaust ventilation equipment. Always use safety approved fuel storage and piping.

NOTE: If temperature is below 0° C (32° F), it may be necessary to use cold weather starting aids. (See COLD WEATHER OPERATION, later in this section).

1. Perform all prestarting checks outlined in Lubrication & Maintenance/Daily Section later in this manual.

2. Refer to the applicable G25 or G40 Operation and Maintenance Manual for starting the generator set.

3. Warm-up engine for at least 5 minutes before applying a load.

Cold Weather Starting

When outside temperatures fall below 0°C (32° F) it may be necessary to consider using cold weather starting aids. Engines are equipped with standard glow plugs.

CAUTION: NEVER USE ETHER as a starting aid with these glow plug-equipped engines as it could cause an explosion and possible personnel injury.

Additionally, your Engine may be fitted with a block heater, and increased capacity battery and/or lower viscosity oil may also be used. See your local Ingersoll-Rand distributor or servicing dealer for recommendations.

1. Perform all prestarting checks outlined in Lubrication & Maintenance/Daily Section later in this manual.

2. Refer to the G60 Operation and Maintenance Manual for starting and utilize the glow plug position on the start switch by holding at that position for 15 seconds to activate the glow plugs to warm the combustion chamber.

3. Warm-up engine for at least 5 minutes before applying a load.

Stopping the Engine

1. Refer to the applicable G25 or G40 Operation and Maintenance Manual for stopping the generator set.

IMPORTANT: Make sure that exhaust stack cap (rain cap) is in place when engine is not running. This will prevent water and dirt from entering engine.

2. Fill fuel tank to minimize possible water condensation problems. Filling tanks at end of day drives out moisture-laden air

Using a Booster Battery or Charger

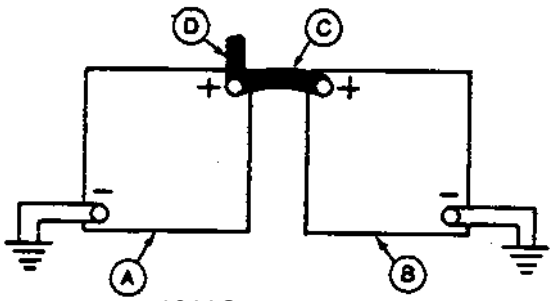
A 12-volt booster battery can be connected in parallel with battery (ies) on the unit to aid in cold weather starting. ALWAYS use heavy-duty jumper cables.

CAUTION: Gas given off by battery is explosive. Keep sparks and flames away from battery. Before connecting or disconnecting a battery charger, turn charger off. Make last connection and first disconnection at a point away from battery. Always connect NEGATIVE (–) cable last and disconnect this cable first.

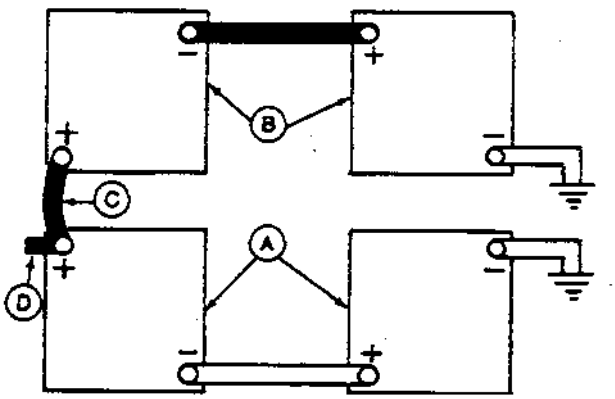
Exploding Battery

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

IMPORTANT: Be sure polarity is correct before making connections. Reversed polarity will damage electrical system. Always connect positive-to-positive **and negative to ground. Always use 12-volt booster battery for 12-volt electrical systems and 24-volt booster battery (ies) for 24-volt electrical systems.**



12 V System



24 V System

1. Connect booster battery or batteries to produce the required system voltage for your engine application.

NOTE: To avoid sparks, DO NOT allow the free ends of jumper cables to touch the engine.

2. Connect one end of jumper cable to the POSITIVE (+) post of the booster battery.

3. Connect the other end of the jumper cable to the POSITIVE (+) post of battery connected to starter.

4. Connect one end of the other jumper cable to the NEGATIVE (–) post of the booster battery.

5. ALWAYS complete the hookup by making the last connection of the NEGATIVE (–) cable to a good ground on the engine frame and away from the battery (ies).

6. Start the engine. Disconnect jumper cables immediately after engine starts. Disconnect NEGATIVE (–) cable first.

A – 12-Volt Machine Battery (ies)
B – 12-Volt Booster Battery (ies)
C – Booster Cable
D – Cable to Starting Motor

Checks, Adjustments and Maintenance Procedures To Be Carried Out After The First 50 Running Hours

NOTE: This the first compulsory maintenance call (other than daily and monthly inspections) to be carried out by your Ingersoll-Rand dealer.

Before performing any operation on the generating set, ensure that cannot be started. To avoid an unwanted start, disconnect the battery cables.

Engine

Cold Engine

- Check and adjust the valve clearance.
- Check the water level and top off if necessary.
- Check the tightness of bolts and screws and particularly the air and exhaust manifolds and engine support.
- Replace the fuel filter cartridge.

Warm Engine

- Start the engine, bring it to its normal running temperature, and then stop it.
- Drain the oil.
- Replace the oil filter cartridge and fill up with new, clean and approved oil to the top mark of the dipstick.
- Restart the engine and ensure that there is no oil, fuel, exhaust gas or combustion air leaks.
- Stop the engine and after a few minutes check the oil level.
- Top off the oil level if necessary.

Preventive Maintnenace

General Maintenance Instructions

Maintenance Schedule

Although specific regular maintenance operations have been given in the maintenance schedule, you are reminded that it is the environment in which the engine operates which defines the maintenance schedule. You must therefore realize that, if the engine operates under extreme conditions, intervals between operations should be shortened. Use the following schedule to establish your own schedule and adapt it to your particular operating conditions. If you are unsure of the need to shorten the recommended maintenance periods, contact your local Ingersoll-Rand dealer.

Before any maintenance operations occur on the engine, disconnect the battery to prevent inadvertent starting.

Daily Maintenance Checks

These checks must be carried out every day or before every start-up (except repeat starts on the same day)

- Check the oil level in the engine oil sump and top off if necessary.
- Check the fuel level and fill up if necessary.
- Check the coolant level and top off if necessary.
- Check the pipe work for leaks and deterioration.
- Check for unrestricted airflow on the parts to be ventilated.

After the engine has been started:

- Check the color of the exhaust gases (the emission of black gas indicates that the engine is malfunctioning)
- Check for oil, fuel, or coolant leaks.
- Check for unusual noises and vibration.

General Maintenance Schedule

The operations indicated below must be carried out at the earliest service period reached, in hours or in months.

MAINTENANCE TO BE PERFORMED	To be performed every						
	50 Hrs	100 Hrs	250 Hrs	500 Hrs	1000 Hrs	2 Yrs	As Required
Engine							
Check the degree of clogging of the air filter	●						
Replace Oil and Oil Filter			●				
Lubricate all couplings			●				
Check the tightness of electrical connections			●				
Replace the fuel filter				●			
Adjust the valve clearance				#			
Clean and check the injectors				#			
Check the condition of the and the tension of the V-belt				●			
Check the Preheating Glow Plugs				#			
Clean or change the air filter				●			
Check the starter and charge alternator					#		
Clean the radiator (depending on clogging)					●		
Lubricate the water pump					●		
Retighten nuts and bolts					●		
Drain the Cooling System						●	
Battery							
Check the electrolyte level and top off			●				
Check the state of charge and recharge if necessary			●				
Clean the terminal lugs and grease with silicone grease			●				
Tighten the terminals			●				
Exhaust Muffler							
Check the pipes for leaks			●				
Retighten mountings			●				

#These operations require specialist knowledge and must be carried out by a factory trained Ingersoll-Rand technician with special tools.

Maintenance Record

This summary will help you keep a record of the maintenance performed on you engine. It must be filled in by the individual undertaking the service work in accordance with general maintenance guide.

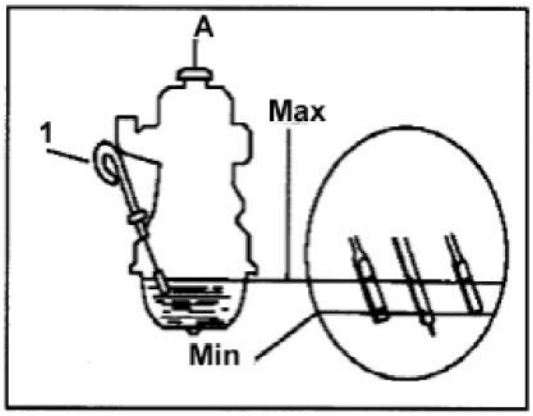
Running Hours	Date	Maintenance Performed	Technician	Running Hours	Date	Maintenance Performed	Technician
100				200			
300				400			
500				600			
700				800			
900				1000			
1100				1200			
1300				1400			
1500				1600			
1700				1800			
1900				2000			
2100				2200			
2300				2400			
2500				2600			
2700				2800			
2900				3000			
3100				3200			
3300				3400			
3500				3600			
3700				3800			
3900				4000			
4100				4200			
4300				4400			
4500				4600			
4700				4800			
4900				5000			
5100				5200			
5300				5400			
5500				5600			
5700				5800			
5900				6000			
6100				6200			
6300				6400			
6500				6600			
6700				6800			
6900				7000			
7100				7200			
7300				7400			
7500				Start a new table at 7600 running hours			

Spare Parts Changed (except Maintenance Parts)

Running Hours	Parts	Running Hours	Parts

Engine Maintenance

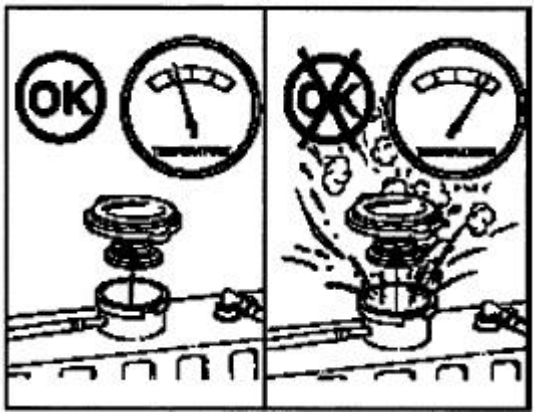
Checking the Oil Level



- Remove the engine oil sump dipstick (1), and then wipe it with a clean cloth.
- Fully reinsert the dipstick and then remove it to visually check the oil level.
- The correct oil level is situated between the max and min marks on the dipstick.
- If the oil level is incorrect, top off with oil through the filler neck (A) until a correct level is reached.

(See ENGINE OIL and ENGINE COOLANT SPECIFICATIONS in Fuels, Lubricants, and Coolant section.)

Checking the Coolant level



- Unscrew the radiator filler cap and visually check the coolant level (correct level is at the lower edge of the filler neck).
- If the level is insufficient, pour clean water into the radiator up to the lower edge of the filler tube and reinstall the filler cap.
- Air is bleed through the relief valve on the filler cap.

⚠CAUTION

Never drain or check the coolant level when the engine is hot, under pressure or running.

(See ENGINE OIL and ENGINE COOLANT SPECIFICATIONS in Fuels, Lubricants, and Coolant section.)

Replacing the Lube Oil and Oil Filter

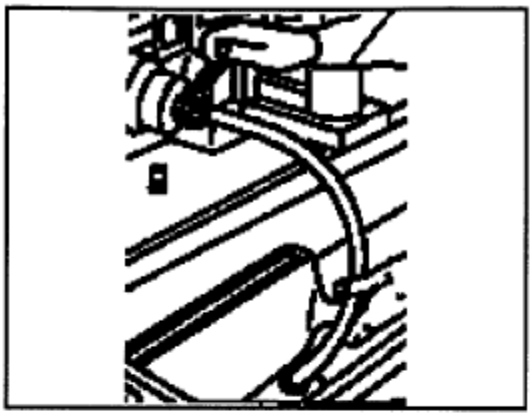
Start and run the engine to operating temperature.

Remove the oil filler cap.

Two drain methods are available:

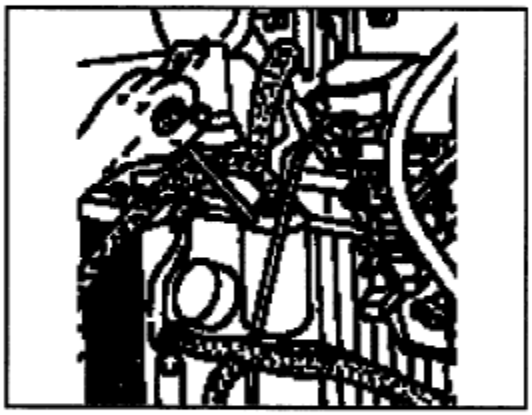
Drain tap:

- Place the fee end of the flexible pipe into a drain pan with a capacity equivalent to the oil sup, and make secure.
- Open the drain tap and let the used oil drain out completely.



Sump hand pump:

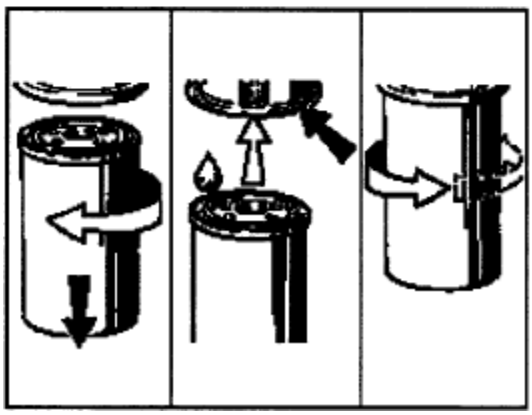
- Place the free end of the flexible pipe into a drain pan with a capacity equivalent to the oil sump, and make secure.
- Open the drain tap if necessary then pump the used oil out with the hand pump until the engine oil sump is completely empty.



⚠CAUTION

Caution! Great care must be taken when draining hot oil: risk of scalding. Collect the used oil and avoid spillage. Used oil must be disposed in accordance with pollution recommendations.

- Loosen the oil filter cartridge and unscrew it.
- Collect any leaking oil.
- Clean the seal surface of the filter holder.
- Lightly coat the rubber seal of the new lubricating oil filter cartridge with clean oil.
- Retighten the cartridge by hand until the seal is in place.
- Tighten the oil filter cartridge and extra 1 turn.
- Refill with oil (See ENGINE OIL and ENGINE COOLANT SPECIFICATIONS in Fuels, Lubricants, and Coolant section.)
- Start the engine and check again the oil level.
- Top off with oil if necessary.



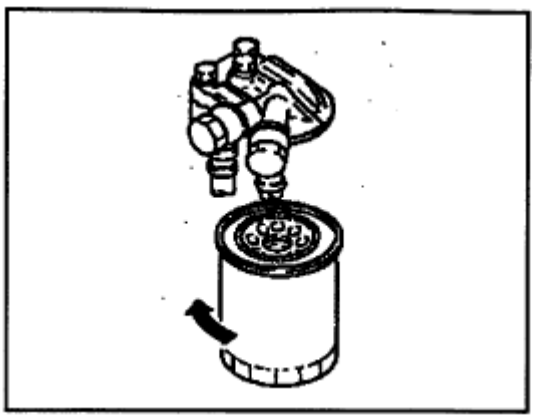
⚠CAUTION

Caution! A drain plug can be fitted on the generating set instead of the drain tap.

The oil filter in the main circuit is a screw-on cartridge placed on the engine crankcase door. Use original filters as they have high temperature seals, a filter paper with suitable specifications and a rigid housing. Although other filters can have the same dimensions and thread as original filters, they can malfunction during service.

Do not fill the sump to quickly. When the engine is fitted with a filler cap on the cylinder head, pour oil into the neck at a speed that allows it to seep into the crankcase.

Replacing the Fuel Filter



- Remove the cartridge with a filter wrench.
- Apply a small amount of fuel to the o-ring of the new cartridge.
- Install the new cartridge by hand

⚠CAUTION

Do not add fuel to the new cartridge.

- After replacing, prime the fuel system.

Adjusting the Valve Clearnance

This operation requires special knowledge and use of special tools, contact your local Ingersoll-Rand dealer for this service.

Checking and Cleaning the Injectors

A faulty injector will be indicated by engine misfire.

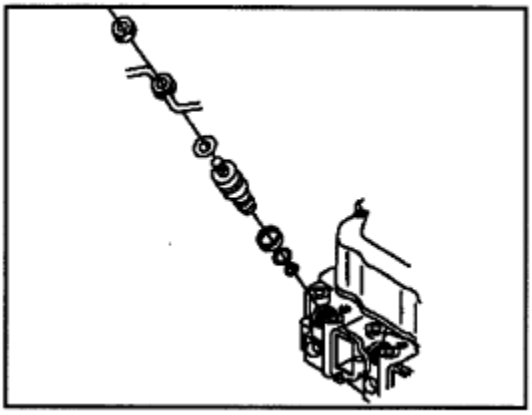
To check the operation of an injector or to locate a faulty injector, run the engine at fast idle speed:

- Slacken the retighten in turn the high pressure pipe fitting on each injector.
- When the nut connecting the faulty injector is slackened, there will be no or little effect on engine speed.

⚠CAUTION

Keep away from fuel sprays.

How to Replace an Injector



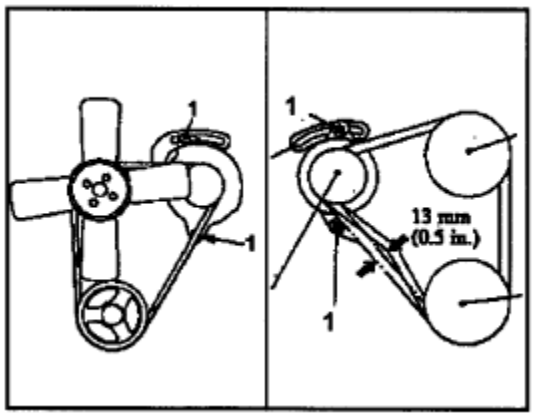
- Remove the fuel leak off pipe.
- Remove the nuts connecting the high pressure pipe from the injector to the injector pump then remove the pipe. If necessary, remove the pipe clamps.
- Remove the injector assembly.
- Install a new injector assembly taking care not to the block the injector.
- Reinstall the fuel leak off pipe and clamps if necessary.
- Operate the engine and check for combustion air and fuel leaks.

Checking the Condition and the Tension of the V-belt, Replacing the V-Belt

WARNING

To check, retighten or replace V-belts, then engine must not be running.

Visually check the V-belt along its entire surface looking for cracks and wear and change it if it is excessively worn or damaged



In the case of new belts, check the tension after 15 running minutes and 50 running hours.

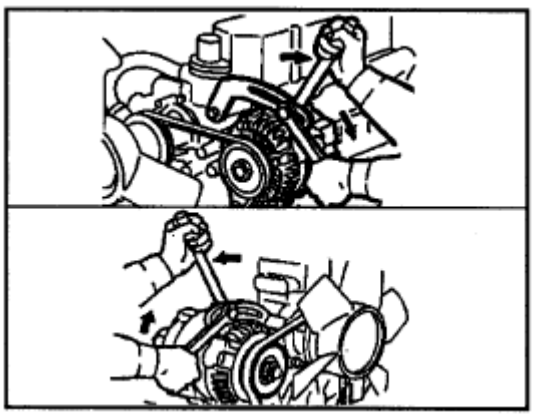
To check the tension, remove the fan and belt guards.

Measure the distortion obtained by pressing your finger on the longest straight part of the belt when stationary.

Belt Tension: 13 mm / 0.5 inches

If necessary, readjust the tension of the belt and measure again.

To retighten or tighten belt:



- Remove the fan and belt guards
- Undo the charge alternator screws (1).
- Pull on the alternator until the correct belt tension is achieved.
- Retighten the alternator screws.
- Reinstall the fan and belt guards.

To replace the belt:

- Remove the fan and belt guards.
- Undo the charge alternator screws (1).
- Push on the alternator and remove the worn belt.
- Install a new belt and pull on the alternator until the correct tension is achieved.
- Retighten the alternator screws and check the belt tension.
- Reinstall the fan and belt guards.

⚠CAUTION

If the fan belt is too tight, the fan bearings and the belt are subject to excessive strain which can shorten the life of these two components. If however the belt is too loose, it will flap against the pulleys leading to unnecessary wear of the belt. It can also slip leading to an overheated engine.

Keep oil and grease away from the belt.

Checking the Preheating Glow Plugs

This operation requires special knowledge and tools, please consult your local Ingersoll-Rand Dealer.

Cleaning the Air Filter

IMPORTANT: ALWAYS REPLACE primary air cleaner element when air restriction indicator shows a vacuum of 625 mm (25 in.) H_2O, is torn, or visibly dirty.

NOTE: Refer to manufacturers' instructions for servicing air cleaners not supplied by Ingersoll-Rand. If engine is NOT equipped with an air restriction indicator, replace air filter element every 500 hours of operation or every 12 months, whichever occurs first.

1. Unlatch and remove dust cup/cover (A) of air cleaner

2. Move end of filter (B) back and forth gently to break seal.

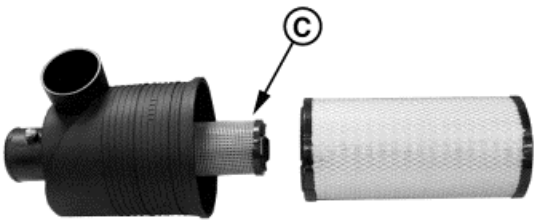
3. Pull filter (B) off outlet tube and out of housing.

4. Thoroughly clean all dirt from inside housing and from outlet bore.

IMPORTANT: Remove secondary (safety) element (C) ONLY for replacement. DO NOT attempt to clean, wash, or reuse secondary element. Replacement of secondary element is usually necessary ONLY when primary element has a hole in it.

5. To replace secondary element (C), pull filter element out gently. Immediately replace secondary element with new element to prevent dust from entering air intake system.

6. Install new primary filter element. Apply pressure by hand at outer rim of filter.



IMPORTANT: Do NOT use latches on cover to force filter into air cleaner. Using cover to force filter will damage cleaner housing.

7. Close housing with dust unloader valve aimed down and latch latches.

IMPORTANT: Whenever the air cleaner has been serviced or cover has been removed, ALWAYS fully depress the air restriction indicator reset button (if equipped) to assure accurate readings.

8. If equipped, fully depress air restriction indicator reset button and release to reset indicator.

Cleaning the Radiator and the Fan Blades

Radiator:

Clogging of the cooling system depends on engine operating conditions. Risk of clogging will increase due to oil and fuel residues, which can settle on the engine. Therefore, in very dusty environments, make sure that the engine is free from oil leaks. Heavy clogging can happen when working conditions on sites are particularly dusty.

Cleaning:

Put a container under the radiator to collect dirt and debris.

Cleaning with compressed air:

- Clean the radiator with compressed air taking particular care with the cooling fins.
- Rinse with water to remove the remaining dirt.

Cleaning with a cleaner/grease remover:

- Spray the radiator with a cold water high pressure cleaner, then wait about tem minutes for the cleaner to impregnate.
- Clean with a strong water jet without directing the jet to the engine's sensitive components such as the alternator, cabling, electronic components etc.
- Use compressed air when cleaning the engine.
- Warm up the engine to evaporate the remaining water.

Fan Blades

- Remove the fan guard.
- Clean the fan blades with a clean cloth. Change the fan if the axial and radial play is excessive or if the blades are cracked.

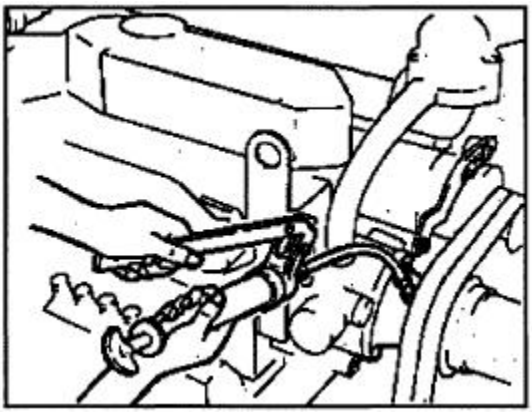
Refit the fan guard.

Checking the injectors

This operation requires special knowledge and use of special tools, contact your local Ingersoll-Rand dealer for this service.

Lubricating the water pump

Lubricate with 20 grams (0.7 oz) of grease.



Retightening Fasteners

Check for loose fasteners and retighten as necessary.

Draining the Cooling System

WARNING

The cooling system is pressurized and great care must be taken when removing the radiator cap on a hot engine.

Draining:

- Remove the radiator filler cap and place a container under the radiator drain plug.
- Remove the radiator drain plug and the engine bleed plug, then let the system drain out into the container of a sufficient capacity.
- Put the container under the flexible pipe below the radiator and slacken the hose clamps.
- Remove the radiator hoses and let the remaining coolant drain off.

Allow enough time for the system to drain completely.

- Remove and empty the container into a suitable receptacle complying with pollution regulations.

Rinsing the cooling system:

- With the lower radiator hose removed, rinse the radiator by flushing clean fresh water through the filler, preferably using a flexible hose, until clean water comes out.
- With the lower and upper radiator hoses removed, rinse the radiator by flushing clean fresh water through the upper radiator hose, until clean water comes out.
- Reinstall all flexible pipes.

Rinsing Agent:

- Reinstall the lower radiator hose, its drain plug and the engine bleed plug.

- Fill the cooling system with a cleaning solution that does not chemically attack rubber and metal surfaces. Operate the engine for 15 minutes, then stop it and drain the cleaning solution.

- Fill the system with clean water and rinse with water.

Filling the cooling system:

⚠CAUTION

In some cases, an air bubble can form during filling of the system, giving a wrong indication of the level.

- Ensure that the upper and lower radiator hoses have been reinstalled.

- Fill the system with clean fresh water and some coolant concentrate.

- The radiator must be filled to 13.0 – 25. mm (0.5 – 1.0 inch) below its filler neck.

- Run the engine for a short time and check the coolant level.

  IMPORTANT! Filling the cooling system. Particular care must be taken during this operation. During filling, escaping air trapped in the system can indicate that the system is full; therefore filling must be carried out in two stages.

  After the 1st stage, keep on topping off until the level stays visible through the filling neck after a few moments of observation, operate the engine for 2 to 3 minutes and let it rest for 30 minutes. Then check the level and top off if necessary.

Exhaust Muffler

Check that there are no gas leaks or deterioration of the pipe work.

Check and retighten if necessary all mountings (engine exhaust outlet, exhaust mounting, connections, etc.)

Troubleshooting

Engine

Fault	Cause	Action
Engine will not start	Blown Fuse	Replace
	Start switch faulty	Repair or replace
	Starting speed too slow	Recharge battery. Check and replace starter motor
	Oil of incorrect viscosity	Change oil to correct grade
	Mobile parts seized	Repair
	Air in the fuel delivery system	Prime
	Fuel tank empty	Fill the tank
	Fuel of incorrect quality	Change the fuel
	Fuel filter clogged	Change the fuel filter
	Fuel injection pump faulty	Repair or replace
	Ignition control unit faulty	Replace
	Air filter element clogged	Clean or replace
Not enough power	Oil of incorrect viscosity	Change the oil
	Air filter element clogged	Clean or replace
	Fuel filter clogged	Clean or replace
	Fuel injection pump clogged	Clean or replace
	Fuel injectors faulty	Clean or replace
	Wrong injection timing	Adjust
	Fuel of incorrect quality	Change the fuel
	Overheat	Rinse the cooling and replace parts as needed
	Valve clearance incorrect	Adjust
	Poor compression (cylinders, piston rings, etc, worn)	Repair or replace
Overheating	Not enough coolant	Add coolant
	Leaks in the cooling system	Retighten or repair
	Loose fan belt	Adjust
	Air flow obstructed in the radiator	Remove obstruction / clean
	Water pump faulty	Replace
	Fan Faulty	Replace
	Thermostat faulty	Replace
	High concentration of LLC	Adjust the LLC concentration
Too much white or blue smoke	Too much oil in the engine	Adjust oil level to proper level
	Oil viscosity too low	Change the oil
	Thermostat faulty (coolant temperature too low)	Replace
	Fuel injector faulty	Repair or replace
	Wrong injection timing	Adjust
	Wrong fuel cetane number	Change the fuel
	Poor compression (cylinders, piston rings, etc, worn)	Repair or replace
Too much black or gray smoke	Fuel of incorrect quality	Change the fuel
	Fuel injection pump faulty	Repair or replace
	Fuel injectors faulty	Repair or replace
	Wrong injection timing	Adjust

Fault	Cause	Action
Too much black or gray smoke	Air filter element clogged	Clean or replace
	Valve clearance incorrect	Adjust
	Engine overloaded	Reduce load
	Poor compression (cylinders, piston rings, etc, worn)	Repair or replace
Fuel consumption too high	Fuel of incorrect quality	Change the fuel
	Fuel injection pump faulty	Repair or replace
	Fuel injectors faulty	Repair or replace
	Wrong injection timing	Adjust
	Air filter element clogged	Clean or replace
	Poor compression (cylinders, piston rings, etc, worn)	Repair or replace
Oil consumption too high	Too much oil in engine	Adjust oil level to proper level
	Oil viscosity too low	Change the oil
	Leaks in the lubrication system	Repair or replace
	Cylinders and piston rings worn, valve stem seals worn	Repair or replace
Oil pressure too low	Not enough oil in the engine	Add more oil
	Oil viscosity too low	Change to correct grade of oil
	Oil filter clogged	Replace
	Oil pump faulty	Repair or replace
	Relief valve faulty	Repair or replace
	Pressure switch faulty	Replace

Specifications

General Engine Specifications—S4Q2

Bore x Stroke		88 X 103 mm
Number of Cylinders		4
Displacement		2.505 L
Combustion System		Swirl Chamber – IDI
Dry Weight kg / lbs.		195 / 430
Start System		Electric start with cell starter
Fuel Oil		Diesel fuel oil (ASTM No. 2-D)
Continuous Power Rating Output kWm (HP)	1500 rpm	20.2 (27.0)
	1800 rpm	24.6 (33.0)
	2000 rpm	27.6 (37.0)
	2200 rpm	30.2 (40.5)
	2500 rpm	33.1 (44.5)
One-hour Power Rating Output kWm (HP)	1500 rpm	21.7 (29.0)
	1800 rpm	26.1 (35.0)
	2000 rpm	29.1 (39.0)
	2200 rpm	32.0 (43.0)
	2500 rpm	35.3 (47.5)
Prime Power kWm (HP)	50 hz / 1500 rpm	19.9 (26.5)
	60 Hz / 1800 rpm	23.9 (32.0)
Stand-By kWm (HP)	50 hz / 1500 rpm	21.7 (29.0)
	60 Hz / 1800 rpm	26.1 (35.0)

General Engine Specifications—S4S

Bore x Stroke		94 x 120
Number of Cylinders		4
Displacement		3.331 L
Combustion System		Swirl Chamber – IDI
Dry Weight kg / lbs.		245 / 540
Start System		Electric start with cell starter
Fuel Oil		Diesel fuel oil (ASTM No. 2-D)
Continuous Power Rating Output kWm (HP)	1500 rpm	29.4 (39.5)
	1800 rpm	34.9 (47.0)
	2000 rpm	38.2 (51.0)
	2200 rpm	41.2 (55.5)
	2500 rpm	44.9 (60.0)
One-hour Power Rating Output kWm (HP)	1500 rpm	30.9 (41.5)
	1800 rpm	36.8 (49.5)
	2000 rpm	40.5 (54.0)
	2200 rpm	43.4 (58.0)
	2500 rpm	47.1 (63.0)
Prime Power kWm (HP)	50 hz / 1500 rpm	28.0 (37.5)
	60 Hz / 1800 rpm	33.5 (45.0)
Stand-By kWm (HP)	50 hz / 1500 rpm	30.9 (41.5)
	60 Hz / 1800 rpm	36.8 (49.5)

ABBREVIATIONS USED IN THIS Manual

API	American Petroleum Institute
ASTM	American Society of Testing and Materials
ºC	Celsius
DP	Depression
ºF	Fahrenheit
ft-lb	Foot – Pound
H_2O	Water
Kg	Kilograms
KW	Kilowatts
L/h	Liter per hour
L/s	Liter per second
M	Meter
mm	Millimeter
m^3/s	Cubic Meter per second
mm H_2O	Millimeters of water
N.m	Newton-meter
Psi	Pound per square inch
P	Power
S.A.E	Society of Automotive Engineers
t/mn	Revolutions per minute
Tº	Temperature
%	x/100
LLC	Long life coolant