GENERAC® | MAC

MAC 950F

Flameless Air Heater

Owner's Manual

MODEL NUMBER: _____

SERIAL NUMBER: _____

DATE PURCHASED:_____

Register your Generac Mobile Products at:
WWW.GENERACMOBILE.COM
1-800-926-9768

SAVE THIS MANUAL FOR FUTURE REFERENCE

⚠WARNING

California Proposition 65. Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

(000004)

⚠WARNING

California Proposition 65. This product contains or emits chemicals known to the state of California to cause cancer, birth defects, and other reproductive harm.

(000005)

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Section 1 Introduction and Safety

Introduction

Thank you for purchasing a Generac Mobile Product. This unit has been designed to provide high-performance, efficient operation, and years of quality use when maintained properly.

The MAC 950F flameless air heater is designed and built for sustained, reliable heat production in industrial operating conditions and environments. The MAC 950F is built to withstand frequent handling under these conditions.

The unit is mounted on a trailer that has forklift access and chain attach points on both sides. The fully enclosed design protects the operating components, allowing all-weather storage and operations.

⚠WARNING

Consult Manual. Read and understand manual completely before using product. Failure to completely understand manual and product could result in death or serious injury.

(000100a)

If any section of the manual is not understood, contact your nearest Independent Authorized Service Dealer (IASD), or contact Generac Mobile Products at

800-926-9768, or *www.generacmobile.com* with any questions or concerns.

The owner is responsible for proper maintenance and safe use of the equipment.

SAVE THESE INSTRUCTIONS for future reference. This manual contains important instructions for the heater that should be followed during installation, operation and maintenance of the heater and batteries. ALWAYS supply this manual to any individual that will use this machine.

THE INFORMATION CONTAINED HEREIN WAS BASED ON MACHINES IN PRODUCTION AT THE TIME OF PUBLICATION. GENERAC RESERVES THE RIGHT TO MODIFY THIS MANUAL AT ANY TIME.

Safety Rules

The manufacturer cannot anticipate every possible circumstance that might involve a hazard. The warnings in this manual, and on tags and decals affixed to the unit are, therefore, not all inclusive. If using a procedure, work method or operating technique that the manufacturer does not specifically recommend, verify that it is safe for others. Also make sure the procedure, work method or operating technique utilized does not render the equipment unsafe.

Throughout this publication, and on tags and decals affixed to the unit, DANGER, WARNING, CAUTION and NOTE blocks are used to alert personnel to special instructions about a particular operation that may be hazardous if performed incorrectly or carelessly. Observe them carefully. Their definitions are as follows:

⚠DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

(000001)

⚠WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

(000002)

⚠CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

(000003)

NOTE: Notes contain additional information important to a procedure and will be found within the regular text of this manual.

These safety warnings cannot eliminate the hazards that they indicate. Common sense and strict compliance with the special instructions while performing the action or service are essential to preventing accidents.

General Hazards

⚠DANGER

Asphyxiation. Running engines produce carbon monoxide, a colorless, odorless, poisonous gas. Carbon monoxide, if not avoided, will result in death or serious injury. (000103)

⚠DANGER

Hydraulic Fluid Injection. High-pressure, high-temperature hydraulic fluid can pierce skin and cause severe burns. Do not check for leaks with hands. Seek immediate medical attention in case of accident. Failure to protect body accordingly will result in death or serious injury. (000239)

⚠WARNING

Do not operate this unit while transporting. Doing so could result in death or serious injury. (000231)

⚠WARNING

Hearing Loss. Hearing protection is recommended when using this machine. Failure to wear hearing protection could result in permanant hearing loss. (000107)

⚠WARNING

Moving Parts. Keep clothing, hair, and appendages away from moving parts. Failure to do so could result in death or serious injury. (000111)

⚠WARNING

Hot Surfaces. When operating machine, do not touch hot surfaces. Keep machine away from combustibles during use. Hot surfaces could result in severe burns or fire. (000108)

⚠CAUTION

Equipment or property damage. Do not block air intake or restrict proper air flow. Doing so could result in unsafe operation or damage to unit. (000229)

⚠CAUTION

Unit damage. Do not stop engine before heating unit is cooled. Doing so could result in unit damage. (000240a)

⚠CAUTION

Equipment Damage. The emergency stop switch is not to be used to power down the unit under normal operating circumstances. Doing so will result in equipment damage. (000246)

Explosion and Fire Hazards

⚠DANGER

Explosion and Fire. Fuel and vapors are extremely flammable and explosive. Add fuel in a well ventilated area. Keep fire and spark away. Failure to do so will result in death or serious injury. (000105)

⚠WARNING

Risk of Fire. Unit must be positioned in a manner that prevents combustible material accumulation underneath. Failure to do so could result in death or serious injury. (000147)

Trailer Hazards

⚠WARNING

Trailer must be securely coupled to the hitch and chains correctly attached. Uncoupled or unchained towing could result in death or serious injury. (000233)

⚠WARNING

Verify unit is properly secured with wheel chocks and on level ground. Failure to do so could result in death or serious injury. (000234)

⚠WARNING

Property or Equipment Damage. Tighten wheel lug nuts after first 50 miles to factory specifications. Failure to do so could result in death, serious injury, propery or equipment damage. (000235)

Battery Hazards

⚠WARNING

Explosion. Batteries emit explosive gases while charging. Keep fire and spark away. Wear protective gear when working with batteries. Failure to do so could result in death or serious injury.

(000137a)

⚠WARNING

Explosion. Do not dispose of batteries in a fire. Batteries are explosive. Electrolyte solution can cause burns and blindness. If electrolyte contacts skin or eyes, flush with water and seek immediate medical attention.

(000162)

⚠WARNING

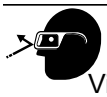
Risk of burn. Do not open or mutilate batteries. Batteries contain electrolyte solution which can cause burns and blindness. If electrolyte contacts skin or eyes, flush with water and seek immediate medical attention.

(000163a)

⚠WARNING

Accidental Start-up. Disconnect the negative battery cable, then the positive battery cable when working on unit. Failure to do so could result in death or serious injury.

(000130)



⚠WARNING

Vision Loss. Eye protection is required to avoid spray from spark plug hole when cranking engine. Failure to do so could result in vision loss.

(000181)

⚠WARNING

Environmental Hazard. Always recycle batteries at an official recycling center in accordance with all local laws and regulations. Failure to do so could result in environmental damage, death or serious injury.

(000228)

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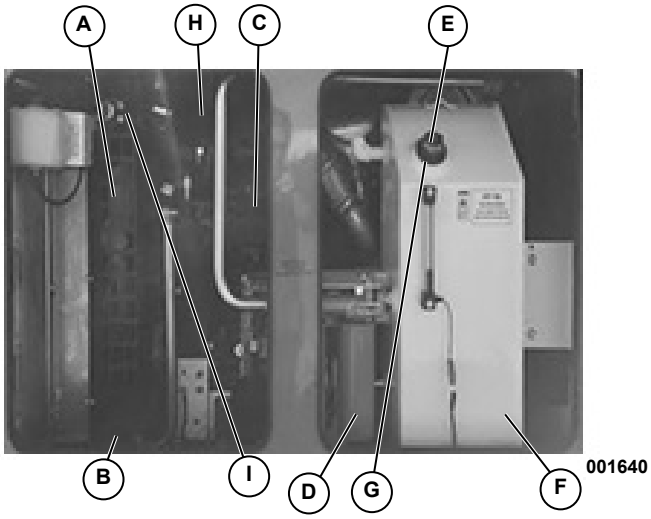
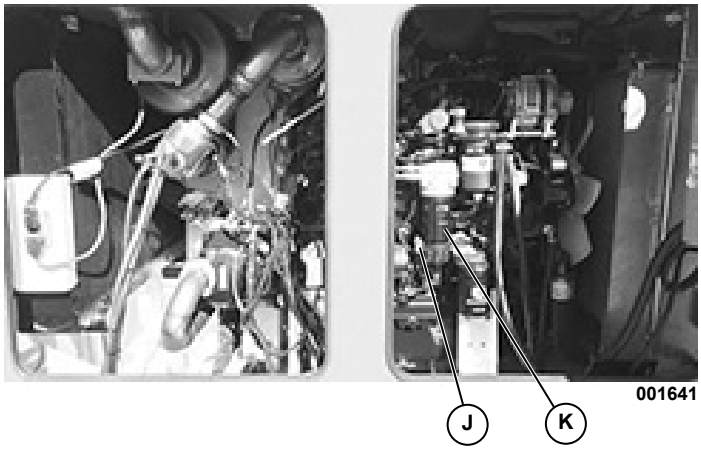
Section 2 General Information

Component Locations



Left Side



Right Side

Table 1 - Heater Components

A	Engine radiator	J	Engine oil dipstick
B	Breakaway battery for trailer brakes	K	Engine fuel filters
C	Diesel engine		
D	Hydraulic fluid filter		
E	Hydraulic fluid fill		
F	Hydraulic fluid reservoir tank		
G	Hydraulic fluid breather/separator		
H	Air intake for engine		
I	Positive air shutdown location		

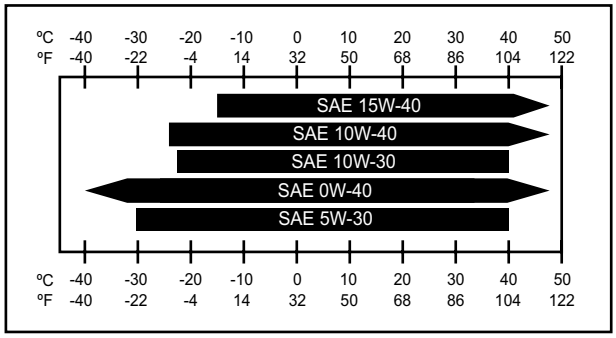
Engine Oil Recommendations

Change oil and oil filter at least once every 12 months even if the hours of operation are fewer than the otherwise recommended service interval. See the applicable engine manual for recommended oil types.

To avoid engine damage:

- Reduce oil and filter service intervals by 50% when using BioDiesel blends greater than B20. Oil analysis may allow longer service interval.
- Use only approved oil types.

Engine oil capacity is 21.66 qt (20.5 L).



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For more information, see the engine manual.

Coolant Recommendation

⚠DANGER

Risk of poisoning. Do not use mouth to siphon coolant. Doing so will result in death or serious injury.

(000149)

Use of improper coolants can damage the engine cooling system. Use demineralized water or distilled water for best results. Hard water causes scale deposits, which reduces cooling efficiency and raises internal temperatures, possibly leading to engine damage.
See the engine manual for recommended coolants.

Never exceed a 60/40 antifreeze/water mix. Do not use a coolant-water mixture greater than 60% ethylene glycol or 60% propylene glycol.
Ethylene glycol or propylene glycol base coolants may be used if they meet the following specifications:

- Pre-mix coolant meeting ASTM D6210 requirements
- Coolant concentrate meeting ASTM D6210 requirements in a 40-60% mixture of concentrate with quality water

Coolant capacity is 36.7 qt (34.73 L).
For more information, see the engine manual.

Fuel System

⚠DANGER

Explosion and Fire. Fuel and vapors are extremely flammable and explosive. Keep fire and spark away. Failure to do so will result in death or serious injury.

(000168)

⚠DANGER

Explosion and Fire. Do not overfill fuel tank. Overfilling may cause fuel to leak and ignite or explode, resulting in death or serious injury.

(000204)

The heater is designed to operate with diesel fuel.
Fuel tank capacity is 160 gal (605.67 L).

IMPORTANT NOTE: Comply with all laws regulating the storage and handling of fuels.

Follow these guidelines:

- Use only ultra-low-sulfur diesel fuel
- When temperatures are at or below freezing, use No. 1D diesel fuel.
- When temperatures are above freezing, use No. 2D diesel fuel.
- In some areas of the country, Climatized Fuel—a mixture of 1D and 2D, may also be used.

Hydraulic Oil

⚠DANGER

Hydraulic Fluid Injection. High-pressure, high-temperature hydraulic fluid can pierce skin and cause severe burns. Do not check for leaks with hands. Seek immediate medical attention in case of accident. Failure to protect body accordingly will result in death or serious injury.

(000239)

Type: Exxon Mobile DTE-10 ISO VG 68 hydraulic oil
System capacity: 28.75 gal (130.7 L)

Trailer Towing Guidelines

⚠WARNING

Trailer must be securely coupled to the hitch and chains correctly attached. Uncoupled or unchained towing could result in death or serious injury.

(000233)

⚠WARNING

Property or Equipment Damage. Tighten wheel lug nuts after first 50 miles to factory specifications. Failure to do so could result in death, serious injury, propery or equipment damage.

(000235)

Driving a vehicle with a trailer in tow is vastly different than driving the same vehicle without a trailer in tow. Consider the following:

- It takes longer to get up to speed.
- More room is need to turn and pass.
- More distance is needed to stop.
- The driver is responsible for keeping the vehicle and trailer in control, and for all damage caused if control is lost.

Before towing, verify the following:

1. The coupling, safety chains, safety brake, tires, wheels and lights are in working order.
2. The breakaway battery is fully charged.
3. Wheel lug nuts are tightened to 85-95 ft-lbs (115-129 Nm).
4. Brake controller engages the trailer brakes before the tow vehicle brakes.

While towing, make regular stops to verify the following:

1. Coupler is secured to the hitch and locked.
2. Electrical connections are made.
3. Appropriate slack in the safety chains.
4. Appropriate slack in the breakaway switch pull-pin cable.
5. Tires are inflated to proper air pressure and no damage or unusual wear to tread or sidewalls.
6. Trailer and doors are secured and latched.

Wheel Chock Guidelines

⚠WARNING

Verify unit is properly secured with wheel chocks and on level ground. Failure to do so could result in death or serious injury.

(000234)

- Select wheel chock according to equipment type and size
- Always use in pairs and on firm surfaces
- Chock in direction of grade
- Chock both sides of wheel if direction of grade is unknown
- Use wheel chock only after parking brake is applied and tested
- Center chocks squarely against tread of each wheel
- Do not drive over wheel chocks

Information Decals

Location	Decal Description
On back of right-side door	• Decal shows tire and loading information • Manufacturer's decal shows VIN #, model #, date of manufacture, GVWR, vehicle class, and tire and rim size
Inside unit, right side, riveted to partition	• Blue and silver metal tag shows serial #, Model #, VIN, and MAC phone #
Front of trailer, near jack	• Tire and loading information • Decal shows VIN #, model #, date of manufacture, GVWR, and tire and rim size

Controller

For troubleshooting, see ***Digital Controller Status Messages***.

Figure 2-1. Controller

Button Position	Manual Mode	Auto Mode
A	Increase heat	Increase temperature setting
B	Increase fan	Decrease temperature setting
C	Overview/Analog gauge screen	
D	Main menu	
E	Heater on/off	
F	Next screen	
G	Popup "Softkeys"	

Monitoring, Diagnostic, and Protective Features

The unit mechanical and electrical systems are connected to various sensors that monitor unit status. If conditions occur outside of predetermined manufacturing parameters, the controller will automatically stop the machine and display fault information. The controller can also display a variety of critical alerts, diagnostics, and recommendations. The controller provides a variety of real-time current operating condition data on outlet temperature, engine RPMs, and fuel level. For more information, refer to the controller wiring diagrams.

Positive Air Shutdown (PAS)

⚠CAUTION

Equipment Damage. The emergency stop switch is not to be used to power down the unit under normal operating circumstances. Doing so will result in equipment damage. (000246)

This unit is equipped with a manual PAS (Positive Air Shutdown) device to stop the engine in an emergency.

Section 3 Operation

Before Starting Engine

Pre-start Checklist

⚠WARNING

Hot Surfaces. When operating machine, do not touch hot surfaces. Keep machine away from combustibles during use. Hot surfaces could result in severe burns or fire. (000108)

- Remove all flammable materials and fire hazards within 5 feet of heater
- Keep heater a minimum of 5 feet from structures or barricades
- Verify the unit is not leaking fluids: check inside and outside the unit for leaking fuel, engine oil, HTF/hydraulic oil, and engine coolant
- Verify the following are clear of debris and obstructions:
  - Engine air intake
  - Engine exhaust stack
  - Outlets and fan intakes
- Verify air duct hose is securely fastened to outlet duct assembly
- Check fuel, engine oil, and engine coolant levels
- Verify unit is properly secure with jacks deployed, if applicable, wheels chocked and level
- Check the alternator drive belt for tension and abnormalities

Engine Oil Check

⚠CAUTION

Engine damage. Verify proper type and quantity of engine oil prior to starting engine. Failure to do so could result in engine damage. (000135)

1. Remove dipstick from crankcase and wipe it clean.
2. Insert dipstick fully and remove slowly.
3. Oil level must be between the FULL and ADD marks on the dipstick.

Hydraulic Oil Check

On the hydraulic fluid reservoir tank is a gauge showing hydraulic oil level. Verify level is between MIN and MAX.

Engine Coolant Check

⚠WARNING

Risk of burns. Do not open coolant system until engine has completely cooled. Doing so could result in serious injury. (000154)

1. Remove radiator fill cap.
2. Check coolant level and degrees of fouling. Level should be approximately 1 cm (10 mm) below the radiator core top.
3. Install radiator cap securely.

Battery Check

⚠WARNING

Electrical shock. Disconnect battery ground terminal before working on battery or battery wires. Failure to do so could result in death or serious injury. (000164)

⚠WARNING

Risk of burn. Do not open or mutilate batteries. Batteries contain electrolyte solution which can cause burns and blindness. If electrolyte contacts skin or eyes, flush with water and seek immediate medical attention. (000163a)

⚠WARNING

Explosion. Batteries emit explosive gases while charging. Keep fire and spark away. Wear protective gear when working with batteries. Failure to do so could result in death or serious injury. (000137a)

⚠CAUTION

Do not make battery connections in reverse. Doing so will result in equipment damage. (000167)

1. Verify battery cable connections are not loose or corroded.
2. Verify battery electrolyte level is sufficient. If necessary, replenish with a commercially available electrolyte, such as distilled water

Engine and Heater Startup

1. Close all doors that access the unit's interior.

IMPORTANT NOTE: All doors on the unit must be closed when operating.

2. Turn ignition key to ON. The screen displays "Engine Preheat" (***Figure 3-1***).

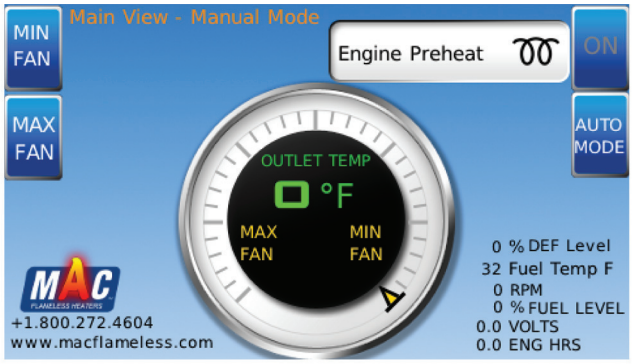

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Figure 3-1. Engine Preheat

3. When screen displays "Start Engine" (***Figure 3-2***), turn ignition key to START.

⚠CAUTION

Equipment Damage. Do not continuously crank engine for more than ten seconds. Doing so will lead to overdischarge of batteries and starter seizure. (000230)

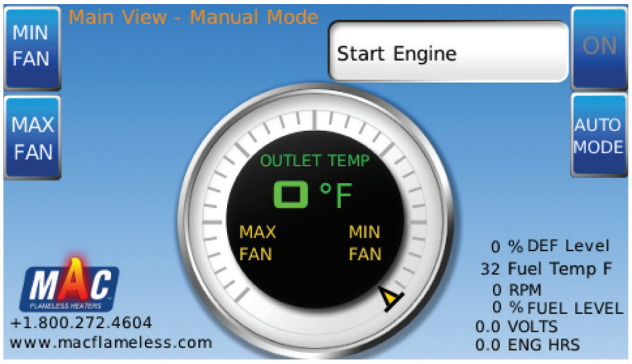

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Figure 3-2. Start Engine

4. The screen displays "Engine Warming" (***Figure 3-3***).

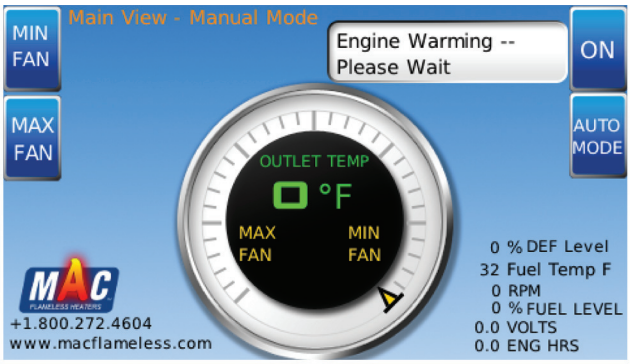

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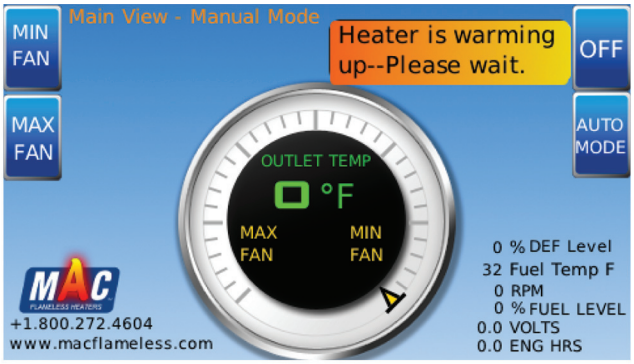
Figure 3-3. Engine Warming

5. When the coolant temperature reaches 100°F (38°C), engine warming is complete and the heater automatically begins warming up. The screen displays "Heater is warming up--Please wait" (***Figure 3-4***).



001636

Figure 3-4. Heater Warming

6. When the heater is warm, heat begins blowing from ducts, green strobe light on top of unit activates and screen displays "Heater on--Press Off to stop the heater" (***Figure 3-5***).

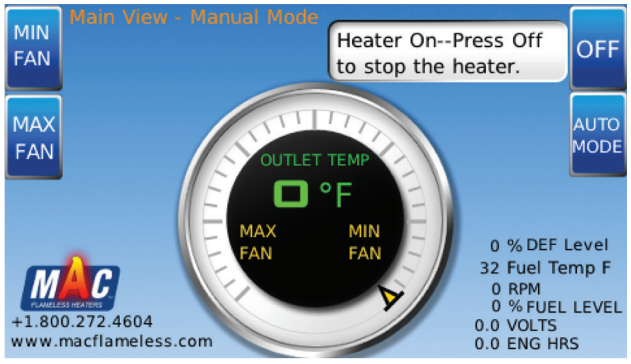


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Figure 3-5. Heater On

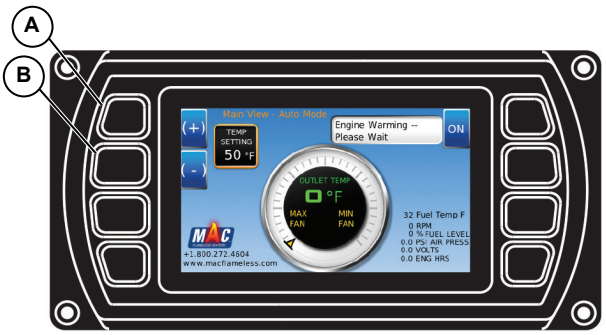
Adjusting Heater Output

The heater has two modes, AUTO and MANUAL. The current mode displays at the top of the controller screen.

AUTO Mode

In AUTO mode, output temperature is manually set, as follows:

- To increase output temperature, press (+) (***Figure 3-6***, item A)
- To decrease output temperature, press (-) (***Figure 3-6***, item B)



001578

Figure 3-6. AUTO mode

MANUAL Mode

In MANUAL mode, heater output can be set to minimum fan or maximum fan, as follows:

- For minimum fan, press MIN FAN (***Figure 3-7***, item A). Minimum fan produces the highest temperature at the lowest air flow.
- For maximum fan, press MAX FAN (***Figure 3-7***, item B). Maximum fan produces a lower temperature at a higher air flow.

001579

Figure 3-7. MANUAL mode

Heater and Engine Shutdown

⚠CAUTION

Equipment Damage. The emergency stop switch is not to be used to power down the unit under normal operating circumstances. Doing so will result in equipment damage. (000246)

1. Press OFF to stop the heater (***Figure 3-7***, item C). Heater automatically turns off and the engine begins cooling down (***Figure 3-8***).

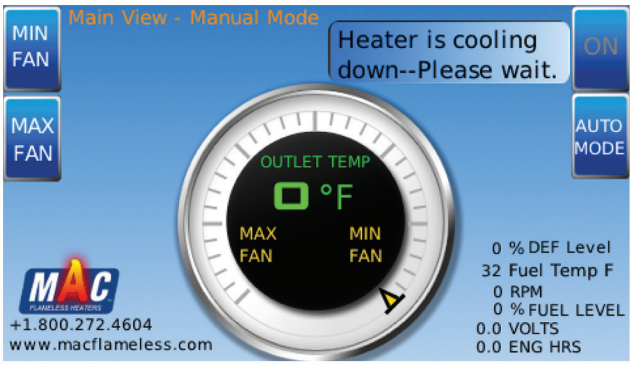


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Figure 3-8. Heater Cooling

NOTE: During cool down, the ON button is disabled.

When cool down is complete, the screen displays as shown in ***Figure 3-9***.

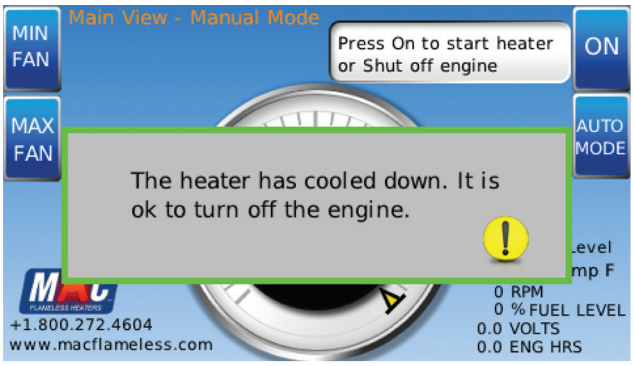

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Figure 3-9. Cool-down Complete

⚠CAUTION

Unit damage. Do not stop engine before heating unit is cooled. Doing so could result in unit damage.

(000240a)

2. When the control screen indicates it is safe to turn off the engine, turn the ignition key to OFF.

Resetting the Positive Air Shutdown (PAS)

⚠CAUTION

Equipment Damage. The emergency stop switch is not to be used to power down the unit under normal operating circumstances. Doing so will result in equipment damage. (000246)

The emergency PAS system must be reset after each use according to the steps below:

1. Locate the PAS valve located inside the cabinet of the unit.
2. See Pull T-handle (A) on PAS valve back.
3. Turn reset knob (B) counter-clockwise 90 degrees.
4. Release T-handle.
5. Repeat steps in ***Engine and Heater Startup*** to start unit.

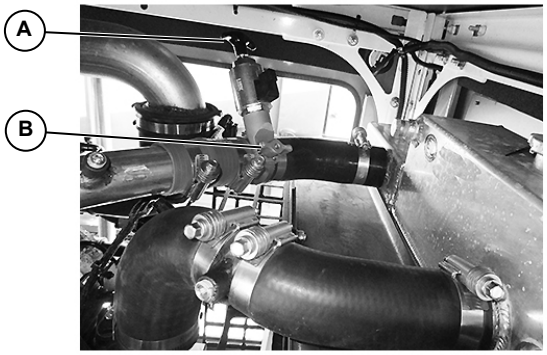


Figure 3-10. T-Handle and Reset Knob

Section 4 Maintenance

Emissions Information

For emissions information, see the OEM engine manual.

Maintenance Tasks

Daily checks must be performed when unit is operated continuously for extended periods of time. Daily checks and routine monthly checks can be performed by an authorized operator.

NOTE: Normal maintenance service and replacement of parts is the responsibility of the owner and, as such, are not considered defects in materials or workmanship within the terms of the warranty. It is strongly recommended that equipment be periodically checked by an IASD.

Daily Walk Around Inspection

Look for conditions that could hinder performance or safety, such as (but not limited to) oil, coolant, fuel leakage, blocked vents, loose or missing hardware and electrical connections. Check for foreign matter blocking the vents and on top of unit.

- Visually inspect outer cover for significant damage beyond scuffs and small nicks.
- Visually inspect for wire abrasion.
- Visually inspect the fan belt for cracks, fraying and stretching. Verify the belt is properly seated in the pulley grooves. Every 750 hours, it is recommended that the belt be removed and checked for wear. While the belt is removed, inspect pulleys and bearing. Rotate and feel for hard turning or unusual sounds.
- Coolant should be checked daily.
- Check electrical connectors, battery and ground points. Look for loose or missing hardware.
- Check all flexible rubber hoses for deterioration.
- Check hydraulic hoses for signs of wear.
- Verify hoses are not crushed, kinked or twisted.
- Verify there are no cracks or corrosion.

Check Engine Oil Level

⚠CAUTION

Engine damage. Verify proper type and quantity of engine oil prior to starting engine. Failure to do so could result in engine damage.

(000135)

NOTE: If engine was running, wait at least ten minutes before proceeding.

1. Remove dipstick and wipe it dry with a clean, lint free cloth.
2. Slowly insert the clean dipstick into the tube. Verify the dipstick is fully seated in the dipstick tube.
3. After ten seconds, remove the dipstick and look at the oil level on both sides. The lower of the two readings will be the correct oil level measurement.
4. Add oil (if necessary) to adjust the level. After adding or changing the oil, the engine should run for one minute before checking the oil level. Wait ten minutes to allow the engine to cool and oil to fully drain into the oil pan.

Typical causes of inaccurate oil level readings:

- Reading the high level of the dipstick.
- Reading the dipstick before the oil fully drains into the oil pan.
- Inserting and removing the dipstick too quickly.
- The dipstick is not fully seated in the dipstick tube.

Drain the Oil

⚠WARNING

Risk of burns. Allow engine to cool before draining oil or coolant. Failure to do so could result in death or serious injury.

(000139)

⚠WARNING

Potential of cancer. Prolonged or repeated contact with used motor oil has been shown to cause cancer in laboratory animals. Thoroughly wash exposed areas with soap and water.

(000127a)

1. Place container under drain port, or connect hose or piping to drain port leading to container.
2. Remove plug from oil drain.
3. Open drain valve.
4. See engine manual for oil filter information.
5. Close drain valve.
6. Remove hose or piping if applicable.
7. Replace plug in drain port on sub base.

Adding Coolant

⚠DANGER

Risk of poisoning. Do not use mouth to siphon coolant. Doing so will result in death or serious injury.

(000149)

⚠WARNING

Risk of burns. Do not open coolant system until engine has completely cooled. Doing so could result in serious injury.

(000154)

⚠CAUTION

Do not use any chromate base rust inhibitor with propylene glycol base antifreeze, boosters or additives. Doing so will cause overheating.

(000165)

Coolant must be changed every six months. Check coolant level and degrees of fouling according to the steps below. Correct coolant level is approximately 1 cm (10 mm) below the radiator core top.

1. Verify engine is stopped and cooled.
2. Remove radiator cap.
3. Fill radiator slowly with coolant until it comes up to the filler neck.
4. Replace radiator cap.
5. Operate engine approximately five minutes at a low idle speed to bleed the air in the coolant circuit.

NOTE: Coolant level will drop.

6. Stop the engine and, once cooled, replenish with coolant.

Maintenance Schedule

The following is the manufacturer's recommended maintenance schedule. The maintenance items will need to be performed more frequently if the heater is used in severe applications (such as very high or very low ambient conditions or extremely dirty/dusty environments). Use the heater hour meter or calendar time, whichever occurs first, from the previous maintenance interval to determine the next required maintenance interval. Note that some checks are based on hours of operation.

Follow all applicable safety alerts found in this manual or engine service manual before performing any maintenance checks or service.

This maintenance schedule reflects the minimum tasks that need to be accomplished to verify the heater remains operational. Some of the tasks can be performed by an authorized operator and others must be performed by an IASD.

NOTE: An authorized operator is one who has been trained by a IASD in proper operation and inspection of this unit.

Engine Maintenance Schedule

Daily	• Check engine oil level • Check engine coolant level • Drain water from fuel filters • Check air cleaner, dust unloader valve and indicator • Perform visual walk around inspection
Every 500 Hours	• Service fire extinguisher • Service battery • Change engine oil and replace oil filter [1] [2] • Visually inspect coolant pump • Check open crankcase vent (OCV) system • Remove and replace fuel filter elements • Check belt wear • Check belt tensioner • Check cooling system • Pressure test cooling system • Check and adjust engine speeds • Check engine mounts • Check engine ground connection
Every 1000 Hours	• Change hydraulic oil • Change hydraulic pump filters
Every 1500 Hours	• Change open crankcase ventilation (OCV) filter
Every 3000 Hours	• Check crankshaft vibration damper • Adjust valve clearance • Test glow plugs for continuity
Every 4500 Hours	• Change diesel exhaust fluid (DEF) dosing unit filter
Every 6000 Hours	• Flush and refill cooling system • Test thermostat opening temperature
As Required	• Drain water from fuel filters • Add coolant • Clean diesel exhaust fluid (DEF) tank • Replace air filter element • Check primary air filter element • Clean exhaust filter • Replace fan belt • Check fuses • Check electrical wiring and connections • Bleed fuel system • Check air compressors (if equipped)

[1] During the initial operation of a new or rebuilt engine with Break-In Plus, change the oil and filter between a minimum of 100 hours and a maximum of up to 500 hours.

[2] Service intervals depend on sulfur content of the diesel fuel, oil pan capacity, and the oil and filter used.

NOTE: For more information, see the engine manual.

Battery Inspection

⚠WARNING

Explosion. Batteries emit explosive gases while charging. Keep fire and spark away. Wear protective gear when working with batteries. Failure to do so could result in death or serious injury.

(000137a)

⚠WARNING

Explosion. Do not dispose of batteries in a fire. Batteries are explosive. Electrolyte solution can cause burns and blindness. If electrolyte contacts skin or eyes, flush with water and seek immediate medical attention.

(000162)

⚠WARNING

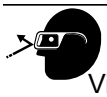
Risk of burn. Do not open or mutilate batteries. Batteries contain electrolyte solution which can cause burns and blindness. If electrolyte contacts skin or eyes, flush with water and seek immediate medical attention.

(000163a)

⚠WARNING

Accidental Start-up. Disconnect the negative battery cable, then the positive battery cable when working on unit. Failure to do so could result in death or serious injury.

(000130)



⚠WARNING

Vision Loss. Eye protection is required to avoid spray from spark plug hole when cranking engine. Failure to do so could result in vision loss.

(000181)

⚠WARNING

Environmental Hazard. Always recycle batteries at an official recycling center in accordance with all local laws and regulations. Failure to do so could result in environmental damage, death or serious injury.

(000228)

NOTE: Remove five amp controller fuse from control panel.

An authorized operator should inspect the engine battery monthly. At this time, the battery fluid level should be checked using a load tester and distilled water added if needed. Battery cables and connections should also be inspected for cleanliness and corrosion.

Once every six months, an IASD should inspect the battery system. At this time, the battery condition and state of charge should be checked using a load test battery. The battery should be recharged or replaced as required.

Battery service is to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away.

Observe the following precautions when working on batteries:

- Remove watches, rings, or other metal objects.
- Use tools with insulated handles.
- Wear rubber gloves and boots.
- Do not lay tools or metal parts on top of battery.
- Disconnect charging source prior to connecting or disconnecting battery terminals.

NOTE: Spilled electrolyte is to be washed down with an acid neutralizing agent. A common practice is to use a solution of one pound (454 grams) bicarbonate of soda (baking soda) to one gallon (3.8 liters) of water. The bicarbonate of soda solution is to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water.

NOTE: Discharge static electricity before touching battery by first touching a grounded metal surface.

Battery Installation and Replacement

When required, the battery must be replaced with one of equivalent size, voltage, and CCA (cold crank amp capacity). Minimum CCA for this unit is 2200 (2 pairs of 2 1100 CCA 12 volt batteries in series to give 1100 Amps at 24 volts. connected in parallel to provide 2200 CCA at 24 volts). Contact the local IASD for correct battery size. A new battery must be filled with the proper electrolyte and be fully charged before install.

Battery cables are connected to the unit at the factory. Connect cables to battery posts as follows.

⚠CAUTION

Do not make battery connections in reverse. Doing so will result in equipment damage.

(000167)

1. Connect battery cable from starter contactor to positive (POS or +) battery post.
2. Connect black battery cable to negative (NEG or -) battery post.
3. Refer to ***Engine and Heater Startup***.

Other Maintenance Checks

The following inspections should be performed by an authorized service technician, or a properly trained authorized operator. These maintenance items require a high level of experience and skill to evaluate and correct.

- Inspect engine accessory drive belts
- Inspect hoses and connections
- Inspect fuel supply system
- Inspect exhaust system
- Inspect exhaust pipe sleeve

Section 5 Troubleshooting

General Troubleshooting Guide

Problem	Cause	Solution
Engine Will Not Crank	Low battery output voltage or discharged battery	Charge or replace batteries
	Loose or corroded connections	Clean and tighten connections
	Faulty start circuit relay	Contact an IASD
	Blown fuse	Replace fuse
	Defective main switch or start safety switch	Repair switch as required
	Starter solenoid defective	Replace solenoid
	Starter defective	Replace starter
Starter Cranks Slowly	Low battery output voltage or discharged battery	Charge or replace batteries
	Too high viscosity crankcase oil	Drain crankcase oil and replace with correct viscosity oil
	Loose or corroded connections	Clean and tighten connections
Hard to Start or Will Not Start	Engine starting under load	Disengage PTO
	Improper starting procedure	Review starting procedure
	Exhaust restricted	Check and correct exhaust restriction
	No fuel	Check fuel tank
	Air in fuel line	Bleed fuel lines
	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition
	Water, dirt, or air in fuel system	Drain, flush, fill, and bleed fuel system
	Fuel filter restricted or full of water	Replace fuel filter or drain water from fuel filter
	Dirty or faulty fuel injectors	Contact an IASD
	Electronic fuel system problem	
	Cold weather	Use cold weather starting aids (see engine manual)
	Too high viscosity crankcase oil	Drain crankcase oil and replace with correct viscosity oil
	Electronic Control System Problem or Basic Engine Problem	Contact an IASD

Problem	Cause	Solution
Engine Misfiring or Runs Irregularly	Poor fuel quality Incorrect fuel/dirty fuel	Test fuel, drain water from fuel bowl
	Restricted fuel filter	Replace fuel filter element
	Water, dirt, or air in fuel system	Drain, flush, fill, and bleed fuel system
	Low coolant temperature	Remove and check thermostat
	Dirty or faulty fuel injectors	Contact an IASD
	Electronic fuel system problem	
	Electronic Control System problem or basic engine problem	
Lack of Engine Power	Intake air restriction	Service air cleaner
	Exhaust restricted	Check and correct exhaust restriction
	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition
	Restricted fuel filter	Replace fuel filter elements
	Engine overloaded	Reduce engine load
	Improper crankcase oil	Drain crankcase oil and replace with correct viscosity oil
	Low coolant temperature	Remove and check thermostat
	Improper valve clearance	Adjust valve clearance or contact an IASD
	Dirty or faulty fuel injectors	Contact an IASD
	Turbocharger not functioning properly	
	Air leak in engine intake or exhaust manifold	Check intake and exhaust manifold gaskets and manifolds; repair as required or contact an IASD
	Engine is in derate due to DTC	Contact an IASD
	Electronic Control System problem or basic engine problem	
Engine Idles Poorly	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition
	Electronic control system problem or basic engine problem	Contact an IASD

Problem	Cause	Solution
Excessive Fuel Consumption	Engine overloaded	Reduce engine load
	Air cleaner restricted or dirty	Replace air cleaner element as required
	Compression too low	Determine cause of low compression and repair as required
	Leaks in fuel supply system	Locate source of leak and repair as required
	Improper type of fuel	Drain fuel and replace with proper grade and quality of fuel for operating condition
	Poor fuel quality	Drain fuel and replace with proper grade and quality of fuel for operating condition
	Improper valve clearance	Adjust valve clearance or contact an IASD
	Dirty or faulty fuel injectors	Contact an IASD
	Electronic fuel system problem	
	Electronic Control System problem or basic engine problem	
	Turbocharger not functioning properly	
	Low engine temperature	Remove and check thermostat
Fuel in Oil	Restricted fuel return line	Check and fix fuel return lines
	Engine load too light	Increase engine load
	Leaking fuel injectors	Contact an IASD
Low-Pressure Fuel System — Fuel Pressure Low	Restricted fuel filter	Replace fuel filter
	Restricted fuel line	Locate restriction, repair as required
	Faulty transfer pump	Contact an IASD
	Faulty high-pressure fuel pump	Remove fuel pump, repair/replace pump as required

Problem	Cause	Solution
Abnormal Engine Noise	Worn main or connecting rod bearings	Contact an IASD
	Excessive crankshaft end play	
	Loose main bearing caps	
	Worn connecting rod bushings and piston pins	
	Scored pistons	
	Worn timing gears or excess backlash	
	Excessive valve clearance	
	Worn camshaft lobes	
	Worn rocker arm shaft(s)	
	Worn valve guides	
	Damaged valve retainers	
	Loose or worn rocker arms	
	Bent pushrods	
	Broken valve springs	
	Bent connecting rods	
	Worn flywheel	
	Loose flywheel	
	Excessive piston to liner clearance	
	Excessive thrust bearing clearance	
	High oil viscosity	
Turbocharger “Screams”	Leak in intake air system	
Turbocharger Noise or Vibration	Bearings not lubricated (insufficient oil pressure)	Determine cause of lack of lubrication; repair as required or contact Contact an IASD
	Air leak in engine intake or exhaust manifold	Check intake and exhaust manifold gaskets and manifolds; repair as required or contact an IASD
	Improper clearance between turbine wheel and turbine housing	Inspect turbocharger; repair/ replace as required or contact an IASD
	Broken blades (or other wheel failures)	Inspect turbocharger; repair/ replace as required or contact an IASD

Problem	Cause	Solution
Engine Emits White Smoke	Engine compression too low	Determine cause of low compression and repair as required or contact an IASD
	Defective thermostat(s) (does not close)	Test thermostats; replace thermostats as required
	Coolant entering combustion chamber (failed cylinder head gasket or cracked cylinder head)	Repair or replace as required, or contact an IASD
	Electronic Control System problem or basic engine problem	Contact an IASD
	Improper type of fuel	Drain fuel and replace with proper grade and quality of fuel for operating condition
	Poor fuel quality	
	Low engine temperature	Warm up engine to normal operating temperature
	Defective thermostat	Remove and check thermostat
	Defective fuel injectors	Contact an IASD
Engine Emits Black, Gray or Blue Smoke	Air cleaner restricted or dirty	Replace air cleaner element as required
	Improper type of fuel	Use proper fuel
	Engine burning oil	Contact an IASD
	Electronic control system problem or basic engine problem	
	Exhaust filter is cracked or damaged	
	Fuel injectors dirty	
	Turbocharger not functioning properly	
Engine Overheats	Air cleaner restricted or dirty	Replace air cleaner element as required
	Lack of coolant in cooling system	Fill cooling system to proper level. Check radiator and hoses for loose connections or leaks
	Low engine oil level	Check oil level. Add oil as required
	Radiator core dirty	Clean cooling system as required
	Cooling system needs flushing	Flush coolant system
	Engine overloaded	Reduce engine load
	Loose or defective fan belt	Check automatic belt tensioner and belts. Replace as required
	Defective or wrong type of thermostats	Test thermostat opening temperature, replace thermostats as required
	Defective radiator cap	Replace radiator cap as required
	Defective temperature gauge or sender	Check coolant temperature with thermometer and replace, if necessary
	Incorrect grade of fuel	Use correct grade of fuel
	Damaged cylinder head gasket	Contact an IASD
	Leak at cylinder head gasket	
	Defective coolant pump	

Problem	Cause	Solution
Coolant Temperature Below Normal	Defective thermostat(s)	Test and replace thermostats as required
	Defective temperature gauge or temperature sender	Check gauge, sender, and connections
Coolant in Crankcase	Cylinder head gasket defective	Contact an IASD
	Cylinder head or block cracked	
	Cylinder liner seals leaking	
	Pitted cylinder liners	
	Leaking oil cooler	
	Defective oil cooler O-rings	
	EGR cooler system leaking	
	Faulty coolant pump seal; weep hole plugged; coolant leaking through bearing	
Excessive Oil Consumption	Too low viscosity crankcase oil	Drain crankcase and refill with correct viscosity oil
	Crankcase oil level too high	Drain oil until oil level is correct
	External oil leak(s)	Determine source of oil leak(s) and repair as required
	Restricted crankcase vent tube	Clean vent tube, verify that crankcase oil level is not too high
	Excessive oil pressure	Contact an IASD
	Oil control rings not seated	
	Oil control rings worn or broken	
	Scored cylinder liners or pistons	
	Worn valve guides or stems	
	Defective turbocharger	
	Front and/or rear crankshaft oil seal faulty	
	Piston ring gaps not staggered	
	Insufficient piston ring tension	
	Piston rings sticking in ring grooves	
	Piston ring grooves excessively worn	
Batteries Will Not Charge	Loose or corroded connections	Clean and tighten connections
	Sulfated or worn-out batteries	Replace batteries
	Stretched belt or defective belt tensioner	Adjust belt tension or replace belts
Entire Electrical System Does Not Function	Faulty battery connection	Clean and tighten connections
	Sulfated or worn-out batteries	Replace batteries
	Blown fuse	Replace fuse

Digital Controller Status Messages

Message	Cause
Engine Warming – Please Wait	Engine coolant temperature < 100°
Engine Preheat	Wait approximately ten seconds after heater power up
Engine is not ready – Check RPMs, Fuel Level or Wait to Start	Engine RPMs < 500
	Fuel level < 10%
	Wait to Start signal
Low Fuel Warning	Fuel level < 20% • Fuel level notification appears on screen Fuel level <= 16% • Fuel level notification appears on screen • Heat/fan load reduced to 50% Fuel level <= 12% • Fuel level notification appears on screen • Open heat circuit and close scroll fan circuit • Engine drops to idle Fuel level <= 8% • Fuel level notification appears on screen • Engine shuts down
Check heater settings or connections, then Reset on the Machine Overview	IFM controller detected a short or break in a sender
Heater is cooling down – Please wait	IFM controller detects heater is in cool down. ON button disabled.
Engine is going to shutdown	Fuel level <=8%
Engine Fault Shutdown	Low engine oil pressure
	High engine coolant temperature
	Engine overspeed
Heater Shutdown due to temperature, pressure or level out of range	High hydraulic temperature
	Low hydraulic pressure
	Low hydraulic level

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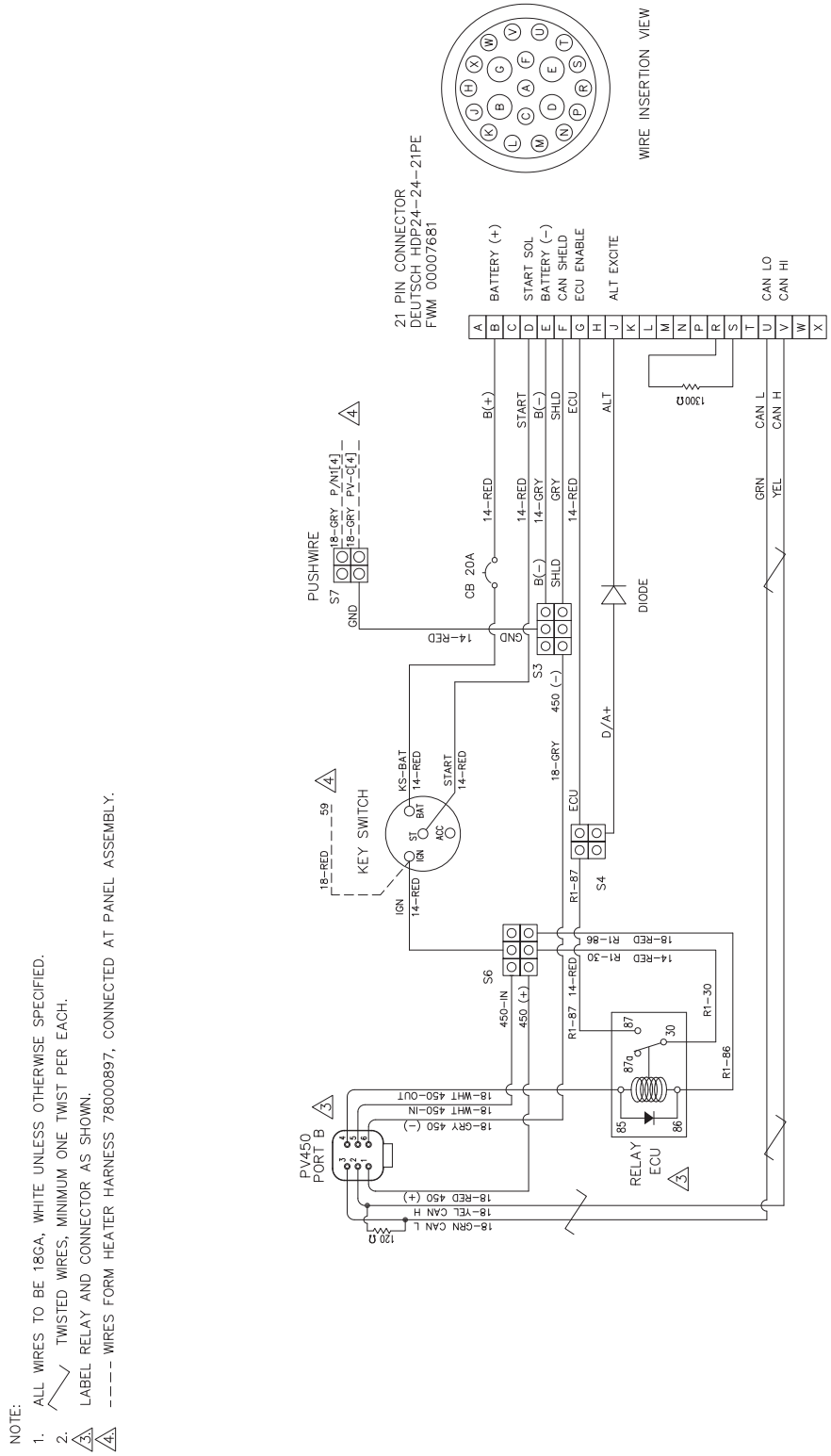
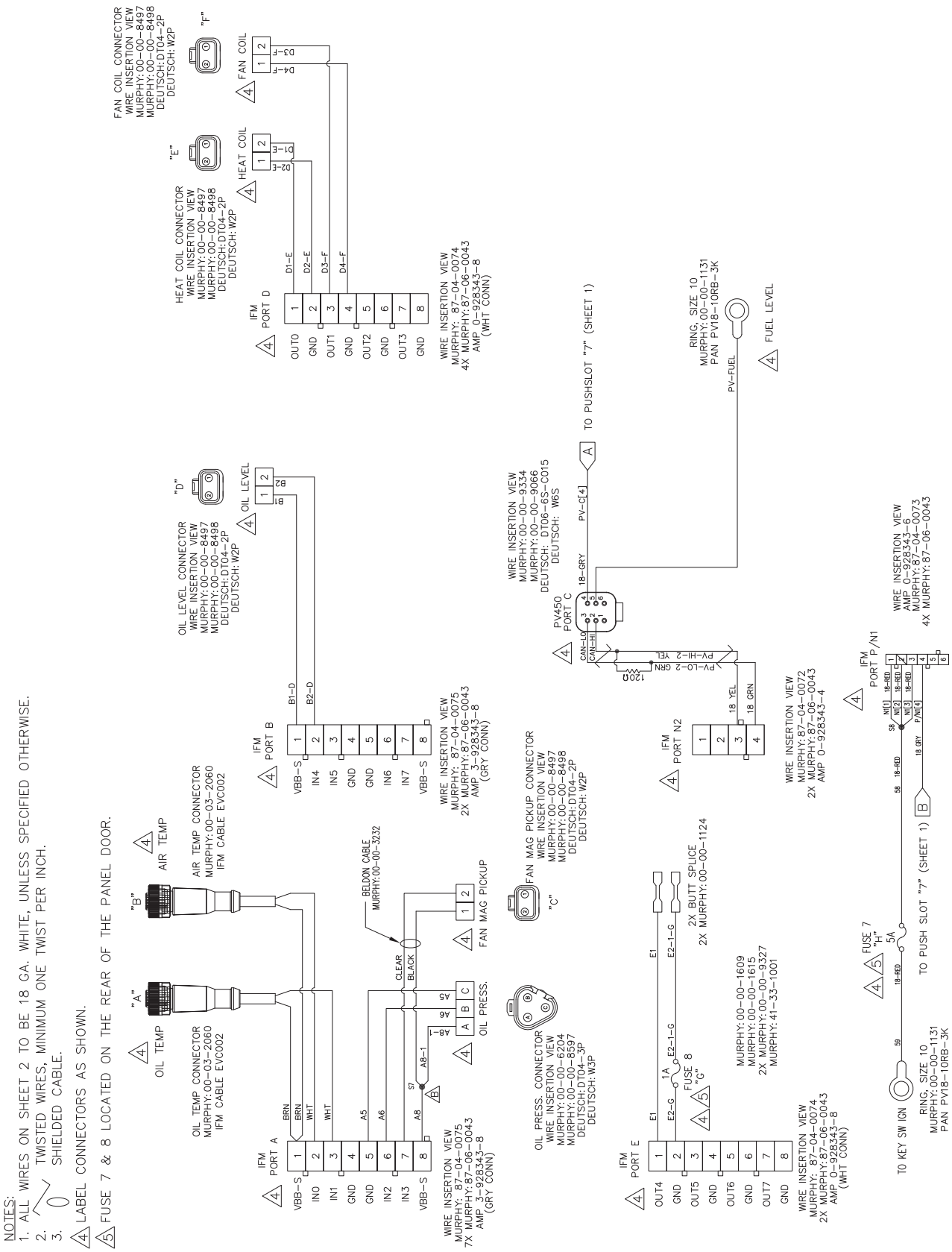
Section 6 Installation Diagrams and Service Log

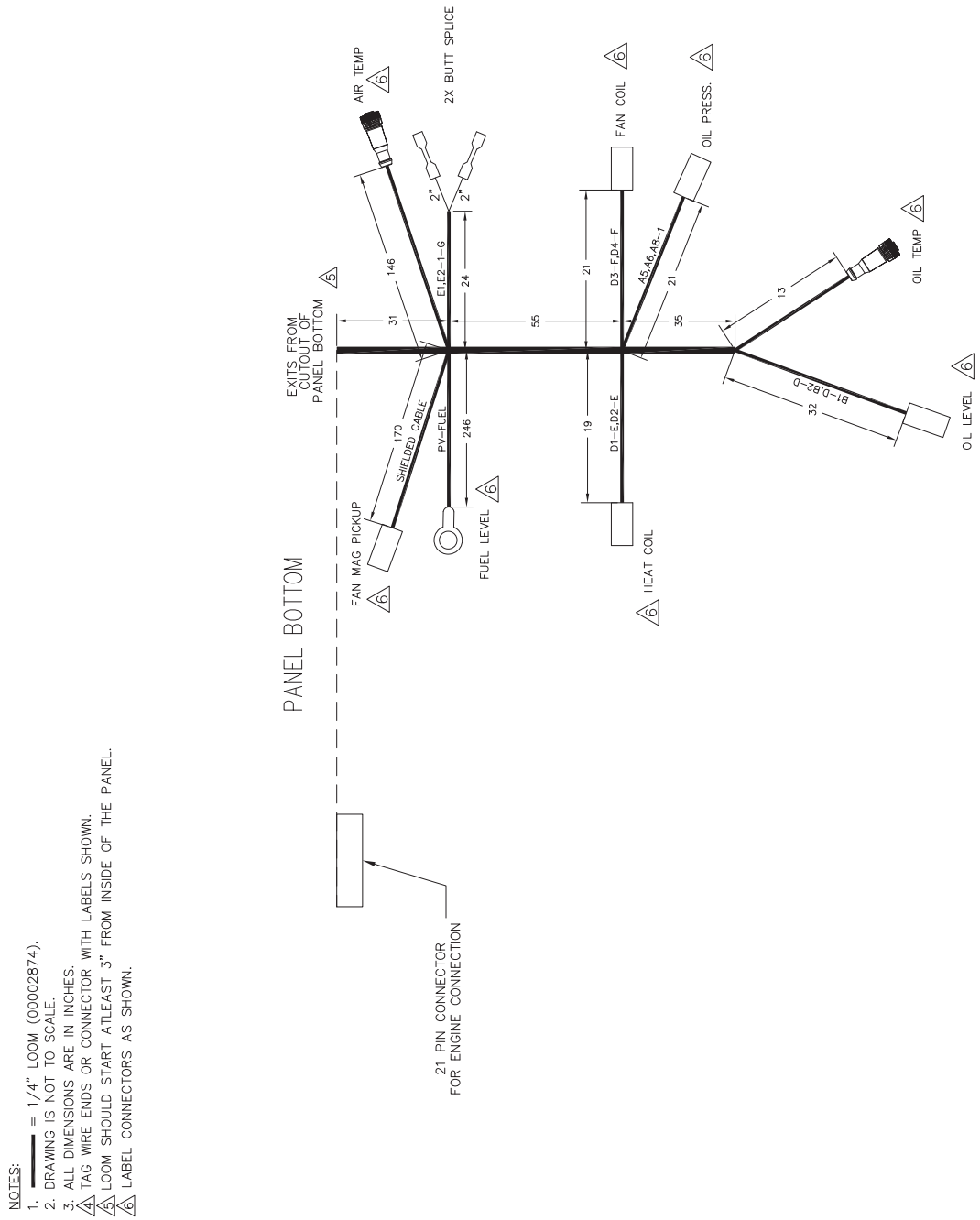
Engine Harness (1 of 3)



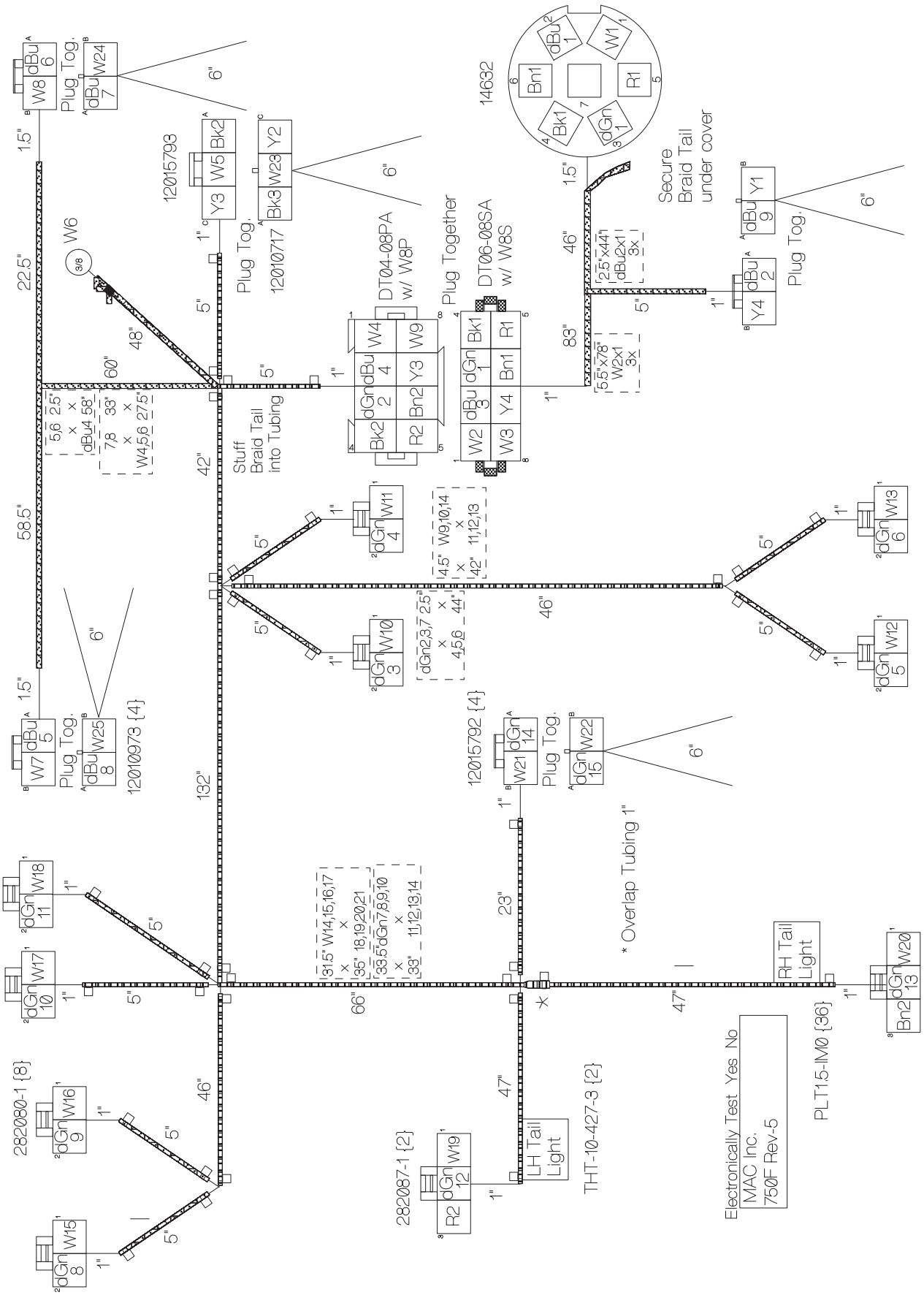
Engine Harness (2 of 3)



Engine Harness (3 of 3)



Trailer Wiring Harness



Service Log

OIL GRADE: _____ BRAND: _____

COOLANT MIXTURE: _____ BRAND: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Date	Hours to Service	Oil Level	Coolant Level

Date	Hours to Service	Oil Level	Coolant Level

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