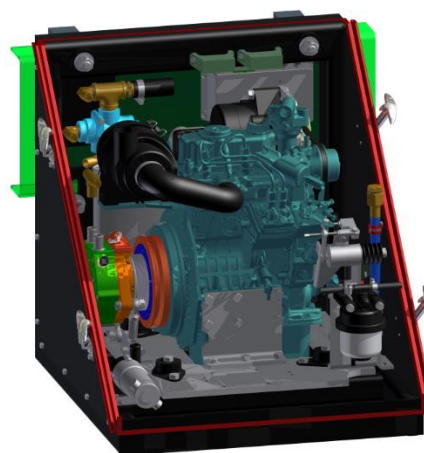
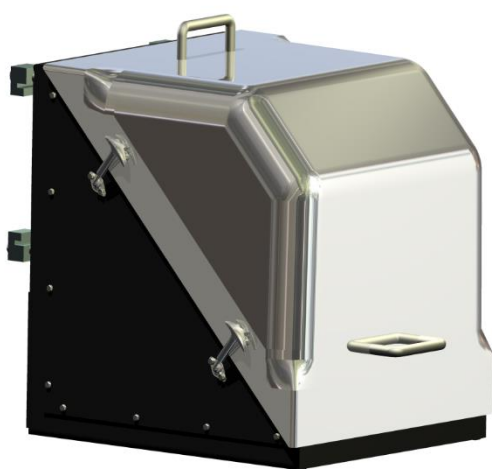


- **Owner's Manual**
- **Installation Guide**
- **Troubleshooting Guide**



| PAEC PN # | Description |
|--------------------|--|
| AHG1000-12V-US-RM | 12V AHG1000 – Base Model, Rail-mount - US Spec |
| AHG1000-24V-US-RM | 24V AHG1000 – Base Model, Rail-mount - US Spec |
| Option PN # | Option Description |
| Option #1 995-0075 | Heated Oil Pan, 80W, 1-1/2" x 8" |
| Option #2 995-0076 | Extreme Arctic Package 80,000 BTU's/hr |
| Option #3 995-0077 | Closed Loop Heating 80,000 BTU's/hr |
| Option #4 995-0078 | DC to AC Inverter, 2000W |
| Option #5 995-0079 | 110VAC 3kW Generator Package |
| Option #6 995-0080 | Air Compressor Package, 4 CFM, 90-120 PSI Switch |
| Option #7 995-0081 | Positive Air Shut-off Valve |
| Option #8 995-0082 | Fuel Consumption Logger |
| Option #9 995-0074 | 140 AMP Hi Output Alternator |
| TBD | Air Conditioning Package |

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2 Foreword

The installation and service of Ventech products requires special expertise and training. Installations and servicing of Ventech products by untrained, unauthorized personnel and end-users voids all warranties and releases Ventech and Ventech authorized distributors, dealers and their personnel from responsibility for damage to Ventech products, any resulting collateral property damage and personal injury.

Any use, operation, installation, modification or application of the product not described in Ventech manuals, or subjecting the product to extreme or unusual conditions beyond the limits of specified performance characteristics is misuse of the product.

Failure to comply with all installation instructions is a misuse of Ventech products. The same applies for all repairs without using genuine Ventech service parts. This will void the products warranty coverage.

2.1.1 Scope and Purpose

These installation instructions are intended to support Ventech trained and authorized distributors and dealers in the installation of the AHG1000 Arctic Heat Generator (AHG). These instructions are not intended for use by untrained or unauthorized personnel.

Location of Arctic Heat Generator (AHG), installation of coolant lines, wiring and control devices are important for proper operation. Failure to comply with the installation instructions provided may result in poor operation or damage to AHG and vehicle/equipment components.

2.1.2 About this Manual

This document is an Owner’s Manual / Installation Manual for Ventech’s AHG1000 Arctic Heat Generator for installation on severe cold-climate vehicles and industrial equipment.

- There are multiple models of the AHG1000 available from Ventech. The table below identified each version of the AHG available:

Table 1

| PAEC PN # | Description |
|--------------------|--|
| AHG1000-12V-US-RM | 12V AHG1000 – Base Model, Rail-mount - US Spec |
| AHG1000-24V-US-RM | 24V AHG1000 - Base Model, Rail-mount - US Spec |
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| Option #7 995-0081 | Positive Air Shut-off Valve |
| Option #8 995-0082 | Fuel Consumption Logger |
| Option #9 995-0074 | 140 AMP Hi Output Alternator |
| TBD | Air Conditioning Package |

2.1.3 California Proposition 65 Warning

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

2.1.4 Ventech AHG1000 Registration Form

Please ensure that you complete the AHG1000 Owner Registration Form provided in the back of this Manual. Completion and return of this form will help facilitate technical support and Warranty matters, should they arise.

2.1.5 Warranty

Ventech Arctic Equipment Company, (“Ventech”) provides the following warranty which defines the extent of protection and assurance to the owner of a Model AHG1000 and AHG2000 Arctic Heat Generator (“AHG”).

THIS WARRANTY HAS BEEN DELIVERED TO THE FIRST OWNER OF THE AHG AT THE TIME OF INSTALLATION. IF THERE ARE ANY TERMS, PROVISIONS OR CONDITIONS OF THIS WARRANTY WHICH ARE NOT CLEARLY UNDERSTOOD AT SUCH TIME BY THE FIRST OWNER, THEN THE FIRST OWNER SHOULD OBTAIN SATISFACTORY WRITTEN CLARIFICATION OF THE WARRANTY SIGNED BY AN AUTHORIZED REPRESENTATIVE OF Ventech PRIOR TO PLACING THE AHG IN SERVICE.

COVERAGE

BASIC COVERAGE:

Ventech warrants (subject to all terms, provisions, conditions, and limitations of this Warranty) that each AHG will be free from defects in material and workmanship under normal use and service for a period of one year from the date of installation for first use, or 1,000 hours of operation, whichever comes first, with a possible longer period of Warranty for specified components of the AHG as set forth below.

VENTECH’S WARRANTY OBLIGATION:

Ventech’s sole obligation under this Warranty shall be to repair or replace, at Ventech’s option, any defective component or material (“Defect”) constituting a part of the AHG. Upon determination by Ventech of the existence of a Defect, such repair and replacement shall be without cost to the first owner of the AHG (“First Owner”) when performed by Ventech at Ventech’s location or at a qualified, authorized repair facility.

ENGINE, LHG AND ALTERNATOR:

Ventech will assign the benefit of any assignable warranties provided by the manufacturers of components of the AHG. Copies of all written warranties on the components are attached as an exhibit to this Warranty and each should be read and complied with fully in order to obtain the maximum benefit from any such warranty. Ventech makes no warranties or representations concerning the extent or enforceability of any warranty from a manufacturer of components or about any requirements imposed by the manufacturers of components of the AHG.

INSTALLATION AND MAINTENANCE:

At the time of installation of the AHG, its operation shall be inspected and adjusted. Such inspections and adjustments include but are not limited to checking engine performance, performance of fuel system, coolant pump function, performance of controls, and electrical system integrity and performance. Proper use of the AHG requires that all such inspections and adjustments shall be properly maintained at all times according to the schedules of recommended maintenance outlined in the instruction manual of the AHG. As a condition of claiming benefits under this Warranty, Ventech reserves the right to require written proof, satisfactory to Ventech, in the form of receipts for maintenance on the AHG and other service records to establish that all such maintenance and service has been performed as required by this Warranty and as recommended in the instruction manual of the AHG.

TERMINATION OR VOIDING OF WARRANTY:

Repair or replacement, other than routine maintenance using approved parts and supplies, or modification of the AHG by anyone other than Ventech representatives or employees of a qualified, authorized repair facility using authorized parts and materials shall void this Warranty. This Warranty also shall be void if the Defect or necessity

for replacement or repair, in Ventech's opinion, is due in whole or in part to improper installation of the AHG by some entity other than Ventech, improper maintenance or service of the AHG, modification or alteration of the AHG after installation, damage due to accident and/or any other misuse or abuse of the AHG. Following expiration of the warranty period, Ventech's obligation hereunder shall terminate. Repair and replacement of components of an AHG under this Warranty shall not extend the warranty period for the AHG or for any component, material or part thereof except as noted in assigned warranties from manufacturers of components of the AHG.

EXCLUSIONS FROM WARRANTY

THIS WARRANTY DOES NOT INCLUDE THESE ITEMS:

To better understand our warranty, the following is a description of some conditions which are not covered by this warranty.

NORMAL MAINTENANCE AND REPLACEMENT SERVICES:

Ventech is not responsible for the cost of tune up of the AHG engine or other maintenance, adjustment and inspection services which may be required including repair or replacement of valves, injectors, fuel system, filters (fuel, air, oil, and water), hoses, and tightening of clamps and fasteners which may loosen in service due to vibration, expansion and contraction due to heating and cooling, and road shocks.

INCIDENTAL AND CONSEQUENTIAL DAMAGES AND COSTS:

Ventech specifically denies and disclaims any liability or responsibility under this Warranty or otherwise for injuries to persons or property, traveling expenses, road calls, towing charges, accident repairs, loss of revenue, loss of perishable loads, profits and/or anticipated profits, and loss of truck use. Ventech shall not, under any circumstances, be liable for special, incidental or consequential damages.

MAXIMUM LIABILITY:

Ventech's liability on any and all claims under this Warranty and under any and all theories of liability for any loss or damage arising out of, concerning, resulting, arising from or related to the contract of sale, delivery, service, repair or use of an AHG manufactured by Ventech shall not in the aggregate exceed the original installed price of the AHG.

DISCLAIMER OF OTHER WARRANTY CLAIMS:

This written Warranty is exclusive and in lieu of all other warranties, whether written, oral, or implied. Ventech makes no other warranty except as expressly stated herein. There are no other express warranties, implied warranties, warranties of merchantability, or warranty of fitness for particular purpose with respect to the AHG unless they are specifically stated herein.

WARRANTY PROCEDURES

NOTICES:

Any notice given by the Owner of an AHG to Ventech shall be in writing, signed by the Owner and shall be personally delivered to Ventech or sent by U. S. Mail, postage prepaid, certified, Return Receipt Requested, to Ventech at its business office or transmitted in facsimile to Ventech at its business office at Unit J2, 28389 Beck Rd, Wixom, MI 48393. Fax: (248) 668-1115.

Such notice shall be effective (a) immediately upon personal delivery to a representative of Ventech at Ventech office, (b) three days after being deposited in the mail as to notices which are mailed, or (c) two days after delivery of the notice by facsimile.

WARRANTY CLAIM PROCEDURE:

In order to claim benefits under this Warranty, Ventech must be notified in writing within the applicable Warranty period of the failure of the AHG to comply with this Warranty. Any claim under this Warranty must be promptly followed, at expense of the Owner, by delivery to Ventech or its qualified, authorized service facility, of the AHG (or of the component or material from the AHG which is claimed to be defective). Ventech reserves the right to inspect for defects of workmanship, parts and materials and its decision with respect to such matters shall be final.

TRANSFER OF WARRANTY:

Ventech extends this Warranty solely to the First Owner. Any unused Warranty time of the First Owner may be transferred to a subsequent owner of the AHG only after approval by Ventech of a written request for the transfer. Any written request for transfer of this Warranty shall disclose the name and address of the intended subsequent owner and shall verify the date of installation of the AHG for first use, the total hours of operation of the AHG, the condition of the AHG and that all recommended maintenance has been performed by qualified, authorized service facilities using only approved parts and materials (excepting only those items of routine maintenance performed by others in accordance with the instruction manual of the AHG).

GOVERNING LAW AND RESOLUTION OF DISPUTES:

This Warranty is extended under the laws of the State of Michigan, the state in which Ventech is incorporated, has its primary place of business and has manufactured the AHG. All questions concerning the interpretation or enforcement of this Warranty shall be governed and construed according to the laws of the State of Michigan. By acceptance of this Warranty, the Owner of each AHG agrees that any litigation and the resolution of any dispute between Ventech and the owner of an AHG shall be conducted solely and exclusively in the state or federal courts of the State of Michigan. Any action of any kind in any other forum or jurisdiction shall be subject to dismissal or to removal, at the discretion of Ventech, and the party filing such action shall pay all costs including reimbursement of Ventech's attorneys' fees in obtaining such dismissal or removal.

2.1.6 Engine Warranty (Kubota)

OUR WARRANTY TO YOU

We warrant to you, the original purchaser, that all parts (except those referred to below) of your new Kubota industrial engine and replacement parts purchased from an Authorized Kubota Industrial Engine Distributor or OEM Distributor in the United States will be free from defects in materials or workmanship during the following periods. (Refer to Service Policy for further details)

1. Industrial Engines for 2 years or 2,000 hours, whichever occurs first.
2. Industrial Engines Major Component Warranty (MCW), 3 years or 3000 hours, whichever occurs first, parts only.

MCW covers cylinder block, cylinder head, crankshaft, camshaft, gears, pistons, rods, flywheel, flywheel housing, oil pump, pulleys, governor, intake manifold, oil pan, ignition distributor.

MCW does not cover rings, bearings, water pump, any electrical component, valve train components, accessory parts, seals, gaskets, carburetors, exhaust manifold, hoses, all fuel system components, muffler, any filters, radiator, fan, belts, thermostat, spark plugs, fuel transfer pumps.

3. Replacement parts for 1 year.

WHAT WE WILL DO

We will, at our option, repair or replace any part covered by this warranty which becomes defective, malfunctions or otherwise fails to conform with this warranty under normal use and service during the term of the warranty at no charge for parts or labor. (Parts only for MCW)

WHAT YOU MUST DO TO OBTAIN WARRANTY SERVICE

In order to obtain warranty repairs, you must deliver the product, together with proof of purchase, to an Authorized Kubota Industrial Engine Distributor or Dealer at your expense. The names and addresses of such Authorized Kubota Industrial Engine Distributors can be found on the internet at www.kubotaengine.com, by calling 1-800-532-9808, via email at EEWRI@kubotaengine.com or by contacting:

Kubota Engine America Corporation 505 Schelster Road
Lincolnshire, IL 60069

WHAT THE WARRANTY DOES NOT COVER

This warranty **does not** cover:

1. Damage, malfunctions or failures resulting from accidents, abuse, misuse, modifications, alteration, improper servicing, or lack of performance of required maintenance service.
2. Normal maintenance services or replacement of maintenance items such as light bulbs, preheater plugs, indicator and resistant coils, filter elements, lubricants, oils, spark plugs, coolant, or belts.
3. Installation of replacement parts, unless originally installed by an Authorized Kubota Industrial Engine Distributor or Dealer.
4. Non-genuine Kubota parts.
5. Any engines damaged by use of ether or any starting aid, or greater than a 50/50% solution of antifreeze and water.
6. Injection nozzle wear or any engine damage caused by injection nozzle wear or sticking.
7. Damage caused by water entering the engine due to any cause.
8. Used Products.
9. Any damage caused by overheating that is not a direct result of a defect in materials or workmanship.
10. Any Engine not application reviewed.

APPLICATION REVIEW PROCESS: The Kubota Engine America (KEA) application review process is intended to assist the OEM with engine installation to optimize functionality/performance within the OEM's equipment in order to maintain durability, customer satisfaction, and reduce warranty failures and expenses. Kubota cannot anticipate all potential failures and issues that may occur with the engine or product in the field during an application review. Therefore, machine durability testing by the OEM either in a test facility and/or in the field is critical to further reduce the potential for field failures.

The amount of time spent by KEA on an application review is significantly less than the amount of time spent by the OEM's design engineers on the application. Because of this, the KEA application review is intended to identify issues that are within the scope of the application review testing performed and in some cases recommend possible solutions. The KEA application review should never take the place of proper design and testing of the finished product by the OEM.

The KEA application review does not in any way express or imply any additional warranty coverage other than what is stated in Kubota's Limited Warranty Agreement. Kubota and its subsidiary companies are not responsible for (including, but not limited to): failures resulting from any components that are not manufactured by Kubota, misrepresented or incorrect information provided from an OEM, any changes made without KEA's knowledge,

any decision by the OEM not to follow KEA's recommendations, or any application related problems or deficiencies that may arise that were not found by KEA's limited application review or the OEM's durability testing.

THIS IS THE ONLY EXPRESS WARRANTY ON OUR PRODUCTS

We neither assume nor authorize anyone to assume for us any other express warranty. The Kubota Distributor/ Dealer has no authority to make any representation or promise on behalf of Kubota Engine America Corporation or to modify the terms or limitations of this warranty in any way.

LIMITATIONS ON OUR RESPONSIBILITY WITH RESPECT TO PRODUCTS PURCHASED AND USED FOR PERSONAL, FAMILY OR HOUSEHOLD USE.

Our responsibility is to repair or replace defective parts as stated above. We will not be responsible for any other expenses, losses or inconvenience which you may sustain as a result of the purchase, use, malfunction or defective condition of our products. ANY IMPLIED WARRANTIES INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE SHALL BE LIMITED IN DURATION TO THE PERIOD SET FORTH ABOVE AND IN NO EVENT WILL WE BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER. Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

LIMITATIONS ON OUR RESPONSIBILITY WITH RESPECT TO PRODUCTS USED FOR RENTAL OR FOR COMMERCIAL, INDUSTRIAL OR AGRICULTURAL PURPOSES.

This warranty is in lieu of all other warranties, express or implied, and of any other obligations or liability on our part. IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED. Our responsibility for any and all losses and damages resulting from any cause whatsoever, including our negligence, alleged damage or defective goods, whether such defects are discoverable or latent, shall be limited to the repair or replacement of defective parts as stated above. IN NO EVENT WILL WE BE LIABLE FOR LOSS OF USE, LOSS OF PROFITS, LOSS OF OR DAMAGE TO OTHER PROPERTY, INCONVENIENCE, COMMERCIAL LOSS, OR OTHER SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER.

2.1.7 Safety

Congratulations on your Ventech AHG purchase. Please, read this manual completely. Contact Ventech or your dealer if you have questions.

Failure to follow the procedures in this manual could void your warranty. Improper installation and usage can cause serious injury to personnel and/or damage to the AHG or the equipment on which it is installed.

If after reading the information contained herein, you still have questions, please contact Ventech or your dealer promptly.

Safety is everybody's business and everybody's responsibility. Each AHG installation is different depending on whether it is installed on a truck or other industrial equipment, so assess all safety concerns peculiar to your situation. Be attentive. Watch for hazards and correct them immediately. Use preventative measures. Exercise common sense.

Many of the safety guidelines set forth are applicable to general plant and equipment safety practices. However, this document is specific to Ventech products. This information is not a comprehensive shop or equipment safety standard. Ventech is not responsible for any accidents that may occur simply because a specific warning has not been made here.

Qualified shops and certified mechanics are familiar with the hazards of working around heavy equipment and diesel engines. Ventech recommends that only qualified mechanics install and conduct maintenance and repairs on the AHG family of products.

- Before operating the AHG1000, read and understand all manuals, including enclosures and insertions for other manufacturer's equipment.
- Always dress for safety. Secure long hair, loose clothing, and jewelry to keep it clear of operating equipment. Have eye protection routinely available and use it when directed or when common sense dictates.
- Disable and discard unsafe components and items that have been removed or replaced during maintenance and repair.
- Follow your company's safety procedures and guidelines at all times.
- Stay clear of the belts on the AHG1000, even when it is not moving.
- Frequently inspect wires. They must be secured away from moving parts and protected by conduit where possible.
- Frequently inspect the hoses and connections. Look for spots where they may be rubbing. Use cushions and tie straps to protect hoses as needed from abrasion.
- Do not operate the AHG1000 with the cover off, except as needed by qualified maintenance personnel. During such maintenance, all other personnel should stand clear of the unit.
- Do not insert objects, fingers, or tools into the unit. Take extra care to retrieve all tools after working on the unit. Tools and objects left in or on the equipment may seriously damage the AHG1000 and create a safety hazard for persons working in the area.
- Altering the AHG1000 RPM will void the warranty.
- Modifications are not permitted.
- Avoid skin and eye contact with the air filter cleaning solution.
- Never stand on the AHG1000 or use it as a step.

3 About the AHG1000

3.1 Overview

The Ventech Arctic Heat Generator Model AHG 1000 is a robust, weather tight, truck-mounted auxiliary power and heating system, specifically designed for unattended operation in the extreme cold weather conditions experienced on the oil fields of Alaska. The AHG1000 provides circulating heated coolant and electrical power to keep the truck's utilities fully operational 24/7, while operating independent of the truck's engine, enabling the main engine to be shut down, significantly reducing main engine idling, fuel costs and tailpipe emissions.

The AHG1000 provides 12VDC 95AMP electrical power to keep the truck's batteries charged and supply the required electrical demands, and an almost instantaneous flow of heated coolant to the truck's main engine, and other onboard services. The AHG 1000 produces up to 80,000 BTU's (~24kW) of heated coolant without flame or electrical power; more heat energy than any other APU on the market. The base AHG1000 is rated to 55,000 Btu/hr.

The AHG 1000 has compact packaging with field serviceability in mind, built using premium quality materials and components rated for Arctic temperatures. The AHG1000 has been successfully factory tested exceeding its intended specification.

3.2 Key Features

Arctic Packaging – weather tight enclosure, heated oil pan, materials rated for the -40°F to -65°F temperatures.

High Quality - powder coated heavy duty aluminum enclosure, stainless steel fixtures, premium quality, performance rated components to withstand operational conditions.

Quick Install – Optional stainless steel, self-sealing quick-disconnect couplings for coolant and fuel, a battery disconnect plug and bayonet style electrical plugs.

Reliable Performance - Kubota 2cyl, 14.5HP (10.8kW) 3200RPM, industrial diesel engine with Glow Plugs and heavy duty 1.2kW starter for cold crank starts, provides reliability and performance.

Heated Coolant - Ventech LHG700 Liquid Heat Generator delivers an almost instantaneous flow of heated coolant up to the main engine and auxiliary heating circuits without flame, fuel lines or emissions. The LHG700 provides up to 55,000 BTU's of heated coolant while running at reduced preset engine speed of only 2700RPM. Higher output is available at higher engine speeds.

Electrical Power – a heavy duty alternator provides 12V 95A or of electrical power for battery charging and electrical demands.

Micro-Processor Control – the AHG1000 is controlled by a proprietary PAEC microprocessor ECU within the APU (silver enclosure on inside rear panel of APU), and a second microcontroller within the handheld Pendant. These microcontrollers handle total management of the APU include engine start, LHG operations, shutdown, alarms, and warnings.

In-Cab Control Panel - provides remote start and operational status indicators for the AHG1000 systems.

Choice of DC Voltages – The AHG1000 is currently only available as a 12V model. Contact Ventech for information about 24V applications.

3.3 Key Benefits

Robust & Compact Packaging

- Premium Quality Components
- Designed and built for operation in Arctic weather conditions.
- Removable cover provides all-round access for AHG service and maintenance.

Premium Quality Materials

- Heavy duty treated steel and fiberglass enclosure.
- Stainless steel fasteners, clips and screws.
- Materials and components rated for Arctic temperatures -40°F to -65°F.

Unparalleled Heat Output

The Kubota engine coupled to a Ventech LHG 700 provides up to 80,000BTU (55,000 BTU base machine) heated coolant almost instantaneously for vehicle system use.

Rapid Heat Generator (Ventech LHG700)

- Specifically modified for Arctic operation.
- Innovative State-of-the-Art Flameless Heat Technology.
- Equipped with Stainless Steel internals for prolonged durability.

Electrical Power

- 12V 95A electrical power for battery charging and electrical demands.

Cost Savings

- Reduced main engine idle time.
- Fast coolant warm-up.
- Reduced fuel consumption.
- Reduced equipment wear & tear.

Environmental Responsibility

- Reduced exhaust emissions.
- Optional Service Bulkhead with self-sealing (no spill) quick -disconnect fluid couplings.
- Full containment AHG Drain Pan.
- AHG 1000 Arctic Enclosure.

3.4 General Arrangement of AHG Main Components

3.4.1 AHG Isometric View (Diagram)

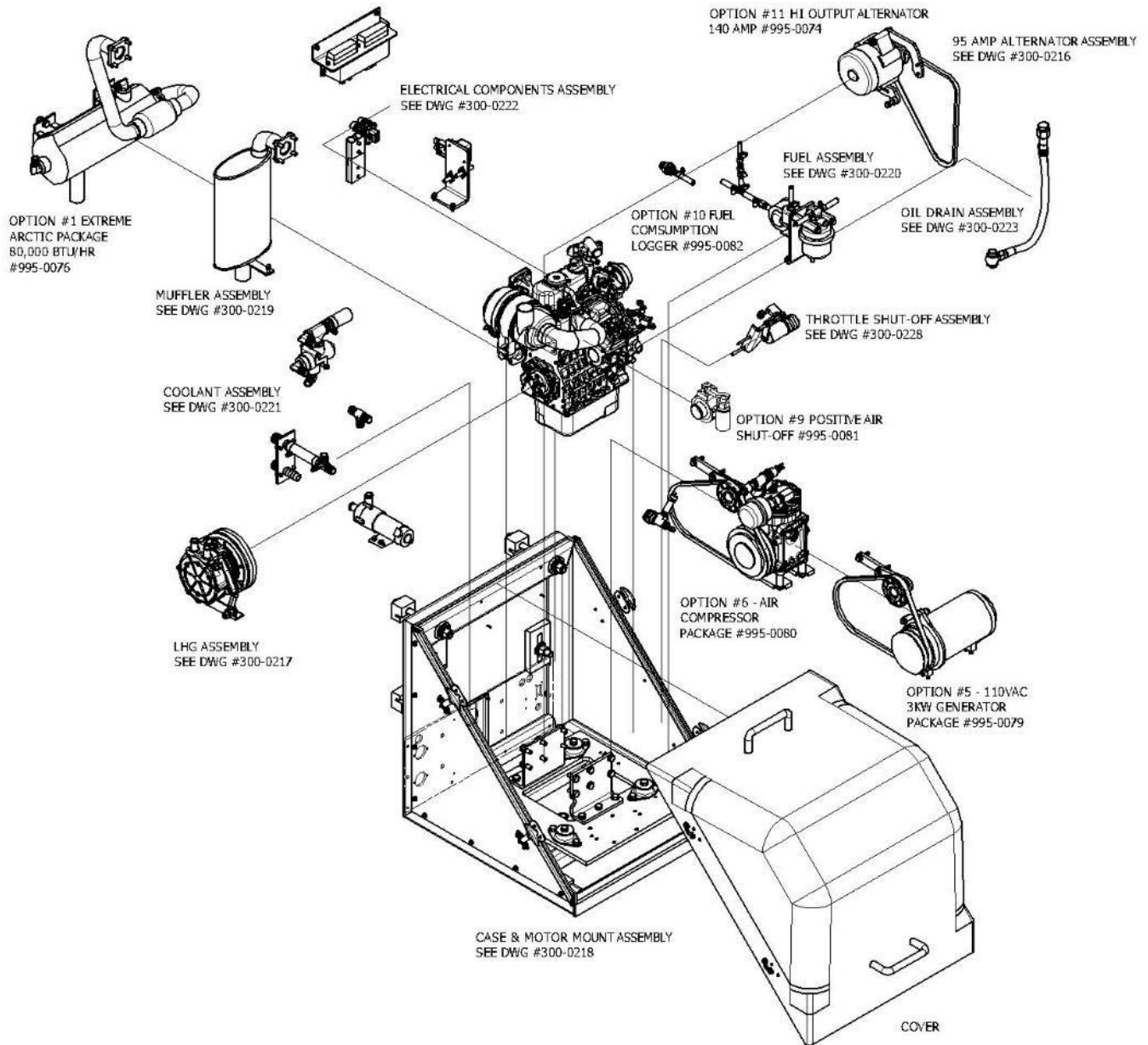


Figure 1 – AHG1000 Isometric View – General Arrangement

3.4.2 AHG Front View (Diagram)

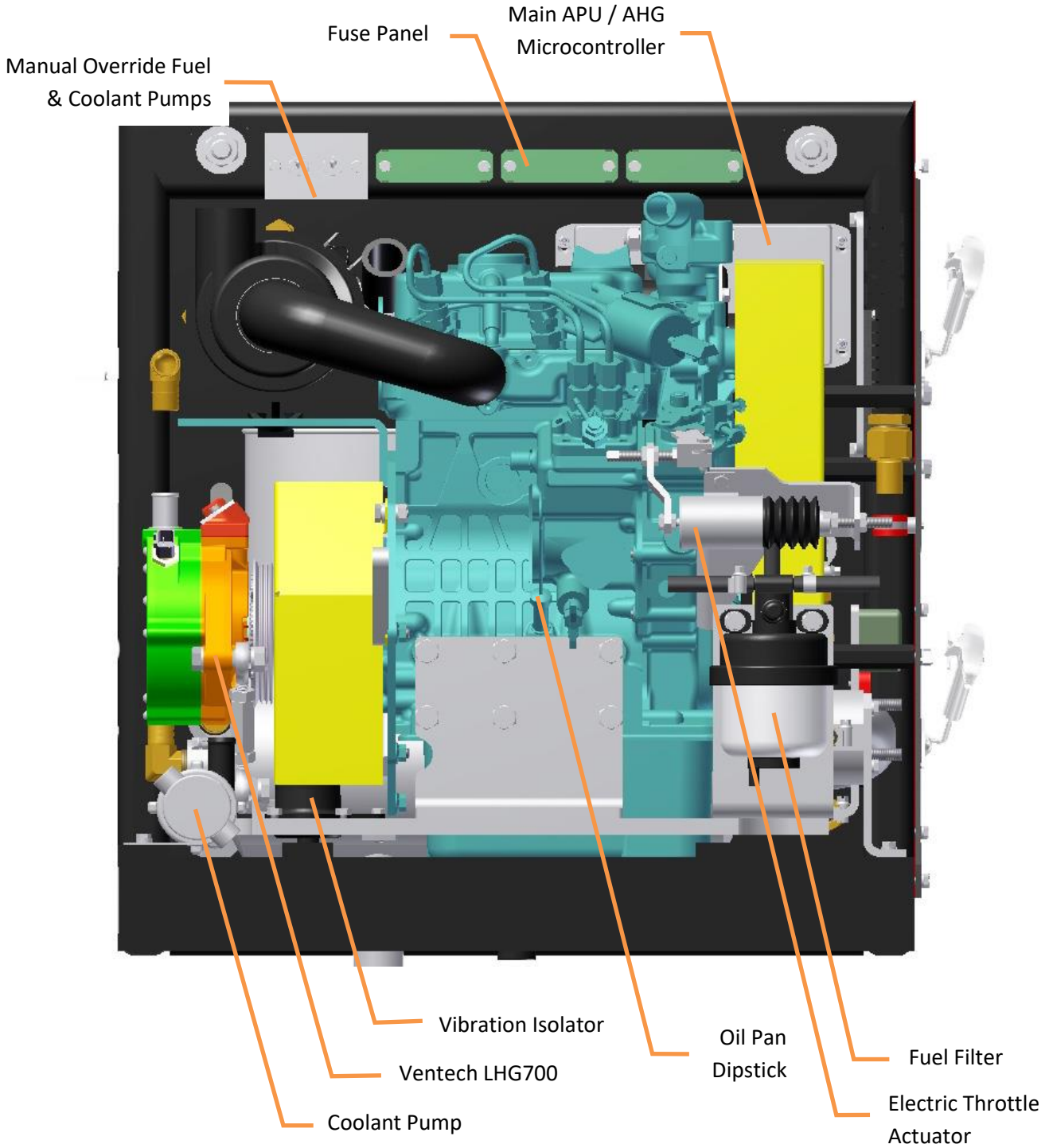


Figure 2 - AHG Front View (Photograph)

3.4.3 AHG Right Side View (Diagram)

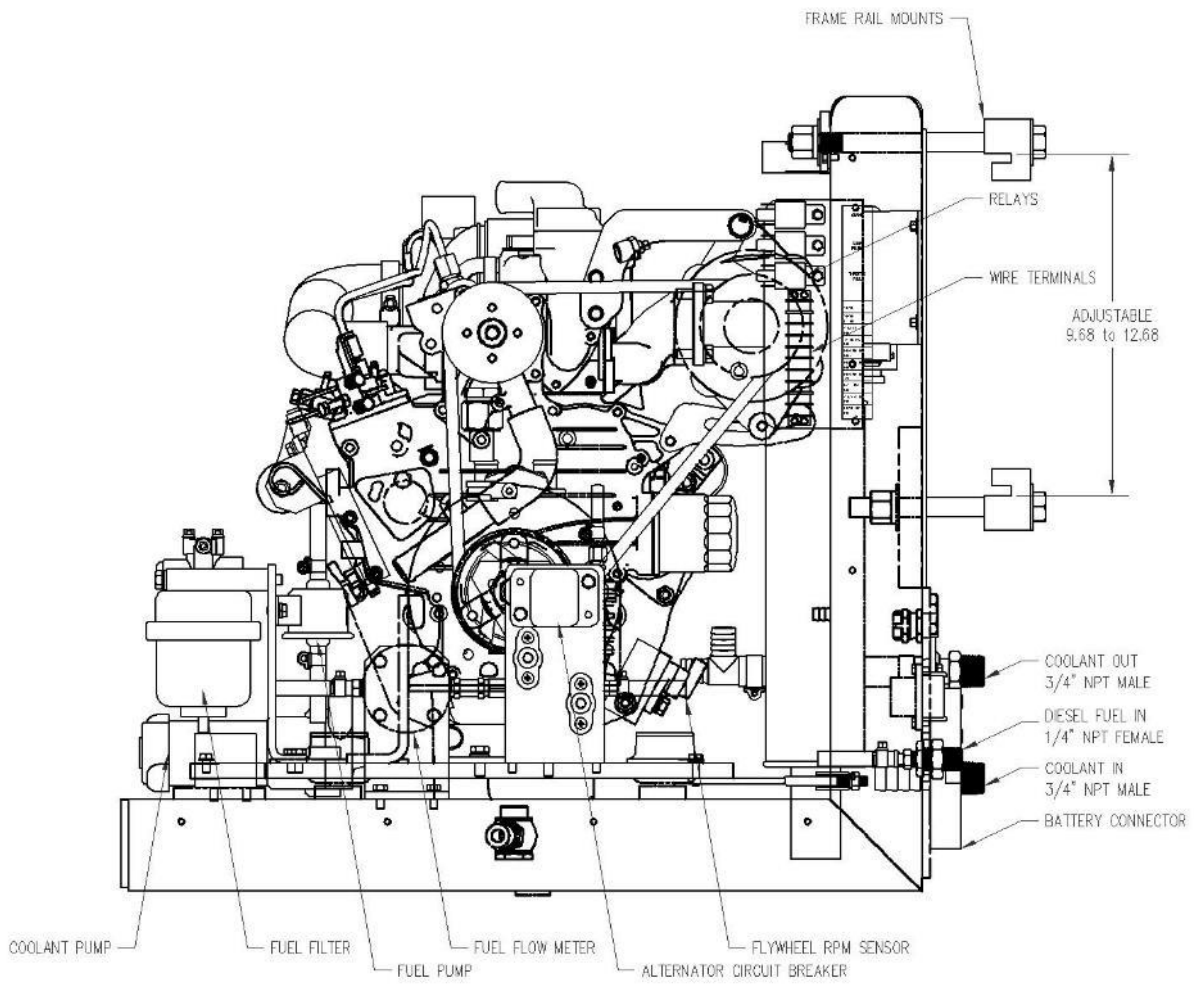


Figure 3 – AHG1000 Right Side View General Arrangement

3.4.4 AHG Left Side View (Diagram)

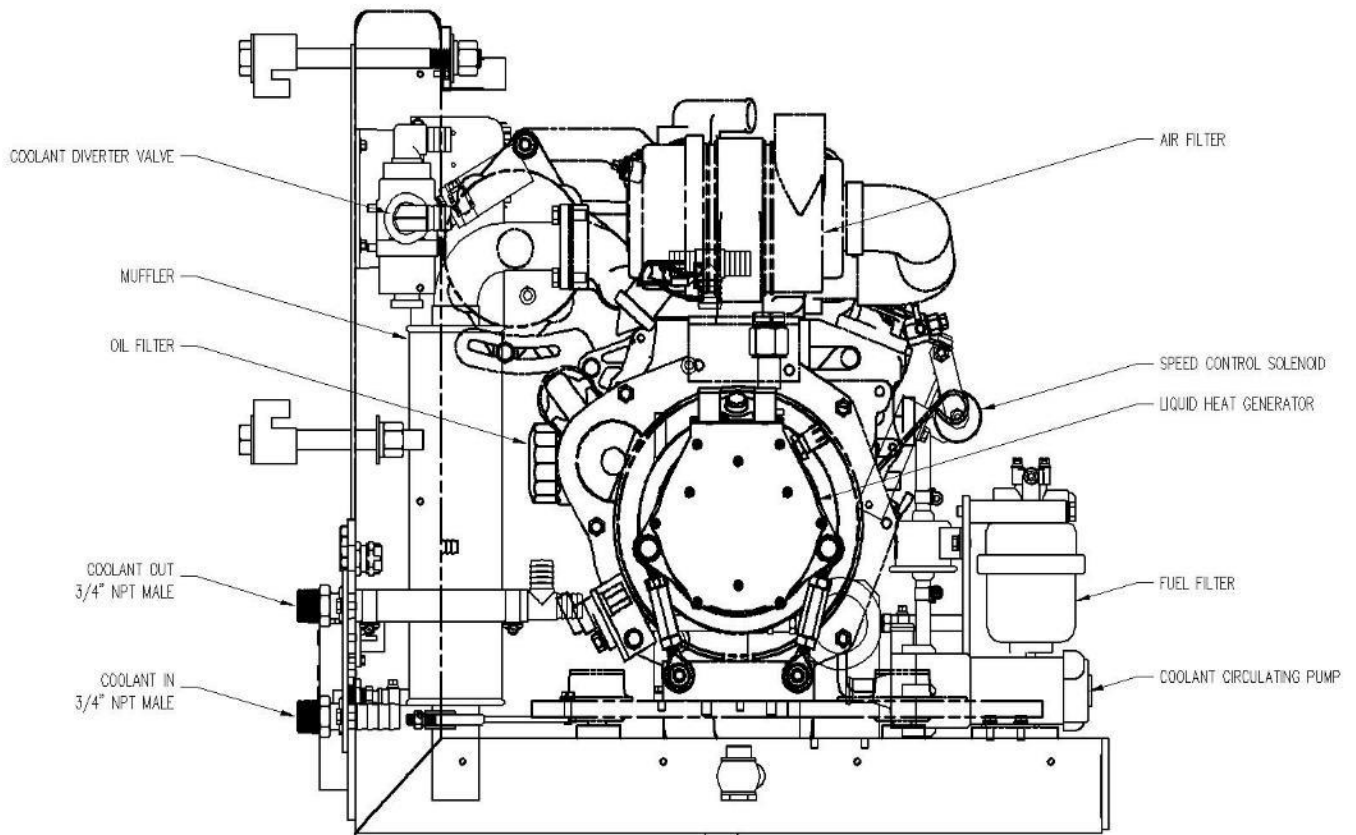


Figure 4 – AHG1000 Left Side View General Arrangement

3.4.5 AHG Rear View General Arrangement

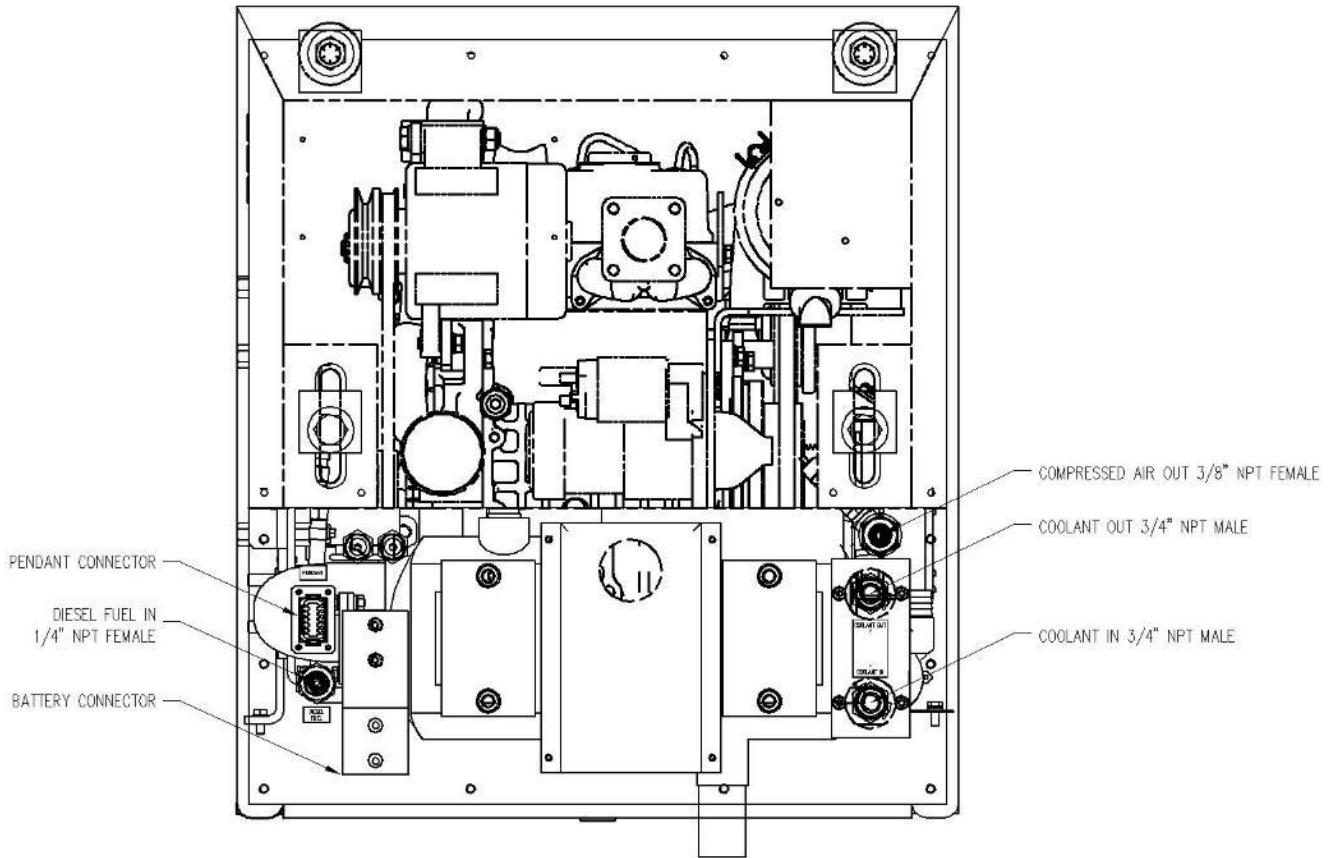


Figure 5 – AHG1000 Rear View General Arrangement

3.5 AHG1000 Technical Description

The Arctic Heat Generator (AHG) Enclosure comprises a heavy-duty chassis and mounting frame assembly housed in a weather tight removable fiberglass cover. All non-stainless-steel surfaces are powder coat finished for weather protection.

The AHG has overall dimensions of 26.56" Wide x 28.82" Tall x 26.75" Deep. These dimensions exclude the removable handles located on the top and front face of the AHG. Each handle is 2.62" tall.

The one-piece removable cover provides all-round access to the systems and components for service and maintenance.

The Exhaust Muffler is fitted to the rear of the AHG Enclosure (within the enclosure footprint), thereby catering for installing the AHG on either side of the truck.

3.5.1 Service Bulkhead

The Service Bulkhead is located at the rear of the AHG Enclosure. It includes couplings for fluid services and bayonet type electrical connectors for fast AHG install/uninstall. The Service Bulkhead includes:

Coolant Service:

- One (1) 3/4" NPT male fitting for Coolant Supply
- One (1) 3/4" NPT male fitting for Coolant Return

Fuel Service:

- One (1) 1/4" NPT female fitting for AHG Fuel Supply.

Battery Power Service:

- One (1) 12V 175A "Battery Power" (2-wire) disconnect plug

In-Cab Control Pendant:

- One (1) Deutsch HD30 Series bayonet connector for "In-Cab AHG Control" panel interconnections.

3.5.2 AHG Sub-System Assemblies

3.5.2.1 Chassis and Fixtures

The main chassis and bolted fixtures for the engine, FEAD sub-systems and components are all machined from substantial steel materials, with powder coat finish to protect against rust and in-service deterioration. The engine assembly is bolted to the chassis/enclosure through vibration isolation pads.

The lower chassis under the engine assembly, is designed as a containment area to capture leaks. The containment area is sized to hold the fluid volume of fluids within AHG 1000 system only.

3.5.2.2 Engine - Kubota Z602-E4B 2 Cylinder Diesel Engine

The AHG 1000 engine selected for this application is a Kubota “Super Mini Series” 2-cylinder diesel engine. A compact, powerful industrial engine, certified T4 emissions compliant, offers the benefits of long operational engine life and proven reliability. The Kubota Model Z602–E4B, with 16.8HP/12.5kW at 3600RPM max continuous output, produces ample power to drive the on-board sub-systems that provide DC electrical power and the power required for heat generation via the Ventech Liquid Heat Generator.

The Kubota Z602-E4B assembly includes the following standard Kubota parts:

- Fuel Pump 12V
- Fuel Filter & Water Separator (replaceable filter element)
- Stop Solenoid (energized to run) 12V
- Throttle Control Solenoid (12V)
- Glow Plugs (2) 12V
- Canister type Air Filter Kit (replaceable filter element)
- Cartridge style Oil Filter (replaceable filter element)
- High power 12V Starter
- Custom (non-Kubota) Exhaust Muffler and gaskets

3.6 Engine Speed

The Kubota Z602-E4B selected for this application has a max continuous speed of 3600 RPM. The AHG1000 is equipped with a two-position electric throttle control system.



The throttle system is designed to transition from a low RPM speed during low heat/low charging situations, and automatically increasing to a higher engine RPM when full heat or elevated charging amps are demanded from the AHG1000.

During Idle (Low Heat/Low Charge Amps), the throttle is preset to 1600 RPM. This preset is adjusted using the engine idle adjustment screw when the throttle actuator is in its rest (non-energized) position.

The AHG1000 control system automatically detects when increased heat and/or increased charging amps are required. The Control System will automatically energize the throttle actuator, elevating the engine to 2,600 RPM.

Figure 6 - Throttle Control Actuator Location

During operation, frequent cycling of the auxiliary heater (automatic clutch engagement and disengagement) identifies that the AHG1000 is producing excess heat and it may be appropriate to reduce the operating RPM thus reducing the thermal output. Running the AHG1000 at lower RPM's will reduce fuel consumption and wear on the engine, the LHG700, Alternator, belts etc. Contact Ventech for information on lowering operating RPM for lower heat requirement applications.

3.6.1 Adjusting throttle Preset Positions

To set the low RPM and high RPM throttle positions, the high RPM throttle position must be adjusted **BEFORE** the low RPM position.

Start the APU. Allow it to complete the warmup sequence and return to low RPM. You must wait until the charging voltage exceeds 13.5 V before the throttle actuator will return to the Low RPM position.

Adjust the Throttle lever mechanism as follows:

- Step 1. Loosen the throttle lever lock nuts that secure the throttle lever to the engine injector pump throttle arm.
- Step 2. Manually extend the throttle actuator to the end of its travel, elevating the engine RPM.
- Step 3. While holding the actuator in a fully-extended position, adjust the engine to 2600 RPM by positioning the lock nuts as necessary. Tighten Lock nuts.

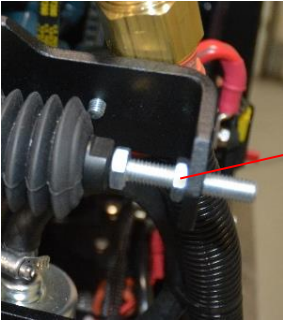


Step 1. Loosen lock nuts

Step 2. Extend the throttle actuator (to the end of its travel). Engine RPM will elevate.

Step 3. While holding the actuator in a fully-extended position, adjust the engine to **2600** RPM by positioning the lock nuts as necessary. Tighten Lock nuts. Release Actuator.

- Step 4. After the engine has returned to Low RPM, set the Low engine speed to 1600 RPM by adjusting the low RPM bolt and lock nut.



Step 4. After the engine has returned to Low RPM, set the Low engine speed to **1600** RPM by adjusting the low RPM bolt and lock nut.

3.7 Fuel System

The fuel system is a simple supply/no return system.

Diesel fuel flows from the truck's tank to the AHG 1000 Service Bulkhead fitting. The onboard electric fuel feed pump pushes fuel to the onboard Fuel Filter/Water Separator and on to the Kubota fuel injection pump. Overflow fuel returns through a one-way check valve and back into the fuel delivery.

A Kubota electric Stop Solenoid (energize to run) is mechanically coupled to the engine injector pump shut-off lever. The Stop Solenoid is controlled by the Ignition and engine safety circuits to ensure a positive engine shut-off.

Fuel Bleed screw is located at the Fuel Filter/Water Separator unit.

3.8 Hoses and Clamps

Fuel Hose – 1 ply polyester reinforced hose meets or exceeds SAE J30R7 with a temperature range of -40°F to 257°F.

Hose Clamps - stainless steel mini clamps with a 1/4" hex stainless-steel screw are used.

3.9 Lubrication System

The Kubota Z602 engine has a standard oil lubrication system including a mechanical pump and cartridge filter with replacement paper element.

A Low Oil Pressure sensor/safety switch is fitted to shut the engine down in the event of low oil.

The crankcase drain plug is replaced by a banjo fitting and custom hose with coupling to accept the user supplied dry break coupler for quick service oil changes.

3.10 FEAD Drive Assembly (Front Engine Accessory Drive)

The AHG1000 is equipped with a V-pulley integrated into the engine flywheel to drive various optional features such as an AC Generator, Air Compressor, and Air Conditioning Compressor.

A separate V belt maintains power transfer from the crankshaft take-off to drive the engine's internal water pump, cooling fan, and alternator.

3.11 Coolant System

Truck coolant supply and return are connected to the AHG Service Bulkhead by two (2) 3/4" NPT (male) ports.

Coolant is circulated by an onboard electric centrifugal pump that pushes coolant to support Kubota engine cooling and the LHG700 Liquid Heat Generator.

An Engine coolant bleeder is located at the engine thermostat housing.

3.12 Liquid Heat Generator - Ventech Model LHG700

The Ventech LHG700 produces an almost immediate supply of heated coolant. The LHG700 is a sophisticated liquid heat generator directly driven by the engine flywheel and operates at engine speed. The Kubota Z602 engine as fitted has a max speed of 3600 RPM. Running at a preset 2600 RPM engine speed the LHG 700/engine combination produces ~55,000 BTU's of heated coolant.

The patented LHG700 is controlled by the AHG main microcontroller mounted within the AHG Enclosure. The controller provides accurate control of the LHG heating performance using an array of embedded sensors, with software configured to optimize the LHG heating performance at all times. The LHG's rotating parts are precision machined from stainless steel providing durability and high performance.

3.13 Controlled Coolant Flow

A three port Thermostatic Diverter Valve (TDV) in the LHG coolant circuit directs heated coolant.

On start-up the AHG coolant circulation pump pushes coolant through the open (smaller) port of the TDV to serve the Kubota engine cooling system and the LHG700. When heated coolant is required for the main engine services a switch on the LHG clutch activates the LHG (Liquid Heat Generator). Coolant temperature rises rapidly and the TDV thermostat pushes the piston to its fully stroked condition opening a second port directing full coolant flow to the main engine and service locations. Engine coolant flow is maintained through the reduced orifice port.

3.14 Electrical System

The truck 12V battery system supplies the AHG1000 with electrical power. Battery power enters the AHG1000 via a two-pole plug mounted at the Service Bulkhead. There is no internal battery switch inside the AHG1000. The battery supply lead should always be disconnected (unplugged) during routine maintenance or repair of the AHG1000.

The incoming battery supply and alternator output is wired in 2AWG wire. A circuit 150AMP breaker protects the motor starter during cranking phase. Other sub-circuits including Glow Plugs are protected by replaceable automotive type fuses.

All electrical wiring is rated for -59°F to 257°F. Wiring harnesses are run in polyester sheath (temp rated for -75°F) for protection and a tidy installation.

3.15 Oil Pan Heater

The AHG1000 is fitted with a 12V automatic Oil Pan heating element that will operate whenever the air temperature surrounding the engine is below 32°F.

Note that the heater element will operate at ambient temperatures below 32°F even when the AHG (or vehicle) is not in operation, eventually causing the vehicle battery to discharge. To prevent battery discharge when not in use, disconnect main 12V supply from the APU.

3.16 AHG Control

The AHG1000 is controlled by the same dedicated microcontroller mounted on the inside/rear panel of the AHG enclosure. The controller handles all AHG systems initiated from the remote In-Cab Control Panel, including engine start sequence, shutdown, and LHG (heat) operation.

The AHG Controller circuits including microcontrollers, relays and sub-circuit fuses that are all PCB mounted, housed in a sealed enclosure. Electrical wiring harnesses from the chassis locations enters the controller via multi-pin Deutsch and Molex connectors.

3.16.1 AHG Maintenance Due Counter

The AHG1000 Pendant includes a re-settable service interval hour counter and a non-resettable engine hours meter. For instructions, see section XXXX for Pendant Operation. In-Cab Control Panel

3.16.2 In-Cab Control Pendant



Figure 7 - In-Cab Control Pendant

The In-Cab Control Pendant for wall or dashboard mounting provides the Operator with a backlit LCD Touchscreen for operation and monitoring of the AHG1000. The In-Cab Control Pendant is connected to the AHG 1000 via a 30ft long multi-conductor umbilical cord.

The control panel includes:

- Main Power ON/OFF - Push Switch with green LED mounted on top/side of Pendant housing
- 3.2" (240 x 320) LCD touchscreen (TFT screen with Integrated 4-wire resistive touch panel).
- Cabin Air Temperature Sensor - mounted on top/side of Pendant.
- 30ft connection cable with bayonet-style receptacle.

The In-Cab Control Pendant connects to the AHG 1000 Service Bulkhead via an electrical harness. The wiring harness is fitted with a mating multi-pin bayonet connector. The wiring harness uses flexible wire rated temp for -59°F to 257°F running in a polyester sheath temp rated for -75°F.

4 Operating Instructions

This document explains how to start and operate the Ventech AHG1000 Arctic Heat Generator. A properly installed AHG is designed to operate independent of the ignition switch of the truck.



Figure 8 - In Cab Control Pendant

The AHG1000 is equipped with an In-Cab Control Pendant used to operate the AHG1000. The pendant is supplied with a 30ft harness and quick-release connector. The AHG cannot be operated if the pendant is not plugged into the AHG bulkhead receptacle located on the rear of the AHG.

4.1 Operating the AHG1000

4.1.1 Safe operation of the AHG1000

- Before operating the AHG, read and understand all manuals, including enclosures and insertions for other manufacturer's equipment.
- Always dress for safety. Secure long hair, loose clothing, and jewelry to keep it clear of operating equipment. Have eye protection routinely available and use it when directed or when common sense dictates.
- Disable and discard unsafe components and items that have been removed or replaced during maintenance and repair.
- Follow your company's safety procedures and guidelines at all times.
- Stay clear of the belts on the AHG, even when it is not moving.
- Frequently inspect wires. They must be secured away from moving parts and protected by conduit where possible.
- Frequently inspect the hoses and connections. Look for spots where they may be rubbing. Use cushions and tie straps to protect hoses as needed from abrasion.
- Do not operate the AHG with the cover off, except as needed by qualified maintenance personnel. During such maintenance, all other personnel should stand clear of the unit.
- Do not insert objects, fingers, or tools into the unit. Take extra care to retrieve all tools after working on the unit. Tools and objects left in or on the equipment may seriously damage the AHG2000 and create a safety hazard for persons working in the area.
- Altering the AHG RPM will void the warranty.
- Modifications are not permitted.
- Read and understand this entire manual before attempting to install the AHG. Call Ventech regarding any questions or concerns.
- Read and understand the entire Kubota engine manual before attempting to install and operate the AHG.
- Use proper lifting procedures. When using a hoist, only lift the unit by the loops on the Kubota engine. Take special care to prevent the chain from interfering with components near the lifting loops.
- Some procedures may require operating the unit with the cover off. Never remove or install the cover while the unit is running.
- Be aware that under operation and afterwards, coolant is hot and under pressure. Do not remove hoses or the radiator cap until the truck engine and AHG1000 have had time to cool.
- Avoid skin and eye contact with the air filter cleaning solution.
- Always disconnect the battery or the truck's alternator before installing or removing the AHG1000. Failure to do so may damage the AHG1000 and /or truck electrical components.
- Stay clear of electrical components during installation. Know which wires are hot and avoid damage to electrical components.
- Secure loose wires out of the way of moving parts. Install cushions wherever wires may rub.
- Secure hoses out of the way of moving parts. Install cushions wherever hoses may rub.

- Never stand on the AHG1000 or use it as a step.

4.1.2 Kubota Engine Manual

The central AHG1000 component is a Kubota two-cylinder diesel engine. Ventech includes the *Kubota Diesel Engine Operator's Manual* with every AHG sold. The same manual covers three Kubota engine models. The AHG1000 uses the Z602-E4.

The Kubota manual makes references to the engine as if it were used on a tractor or similar application. Consequently, some references in the Kubota manual may not apply directly to the AHG1000. The drawings and photographs do identify key engine parts. The Operation, Maintenance, and Troubleshooting information is applicable. Be sure to read and understand the comprehensive safety section at the beginning of the Kubota manual.

WARNING

Note: If the installation included the use of Isolation or Shut Off Valves between the truck cooling system and the AHG1000 (Coolant IN and Coolant OUT), these valves must be open before operation of the AHG1000.

Starvation of coolant flow during operation will likely result in catastrophic failure of the AHG1000 engine (engine over temperature).

Even though the engine is equipped with a coolant temperature sensor, closed valves may cause low coolant levels in the engine coolant cavities, diminishing the effectiveness of the engine coolant temperature sensor and automatic shutdown sequence.

4.1.3 Start Up Procedure

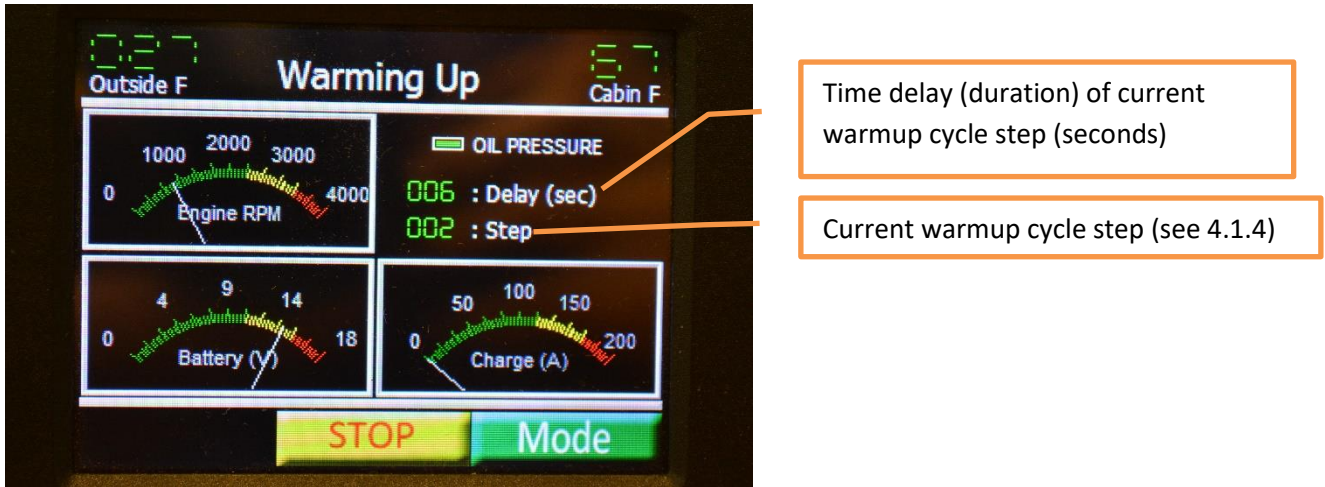
- Ensure that the AHG1000 is connected to either a 12 source via the rear 12V Battery connector.
- Ensure that the AHG1000 is supplied with Fuel (feed).
- Ensure that the AHG1000 is connected to a coolant circuit (see Installation section of this manual).
- Depress the Green Power Button on the side of the Pendant housing. The green LED will illuminate and the AHG Startup Screen will appear on the display as shown below:



- Press the START button once and release. The "Starting AHG1000" Screen will display momentarily:



- Assuming the engine started, the Warming Up screen will appear:



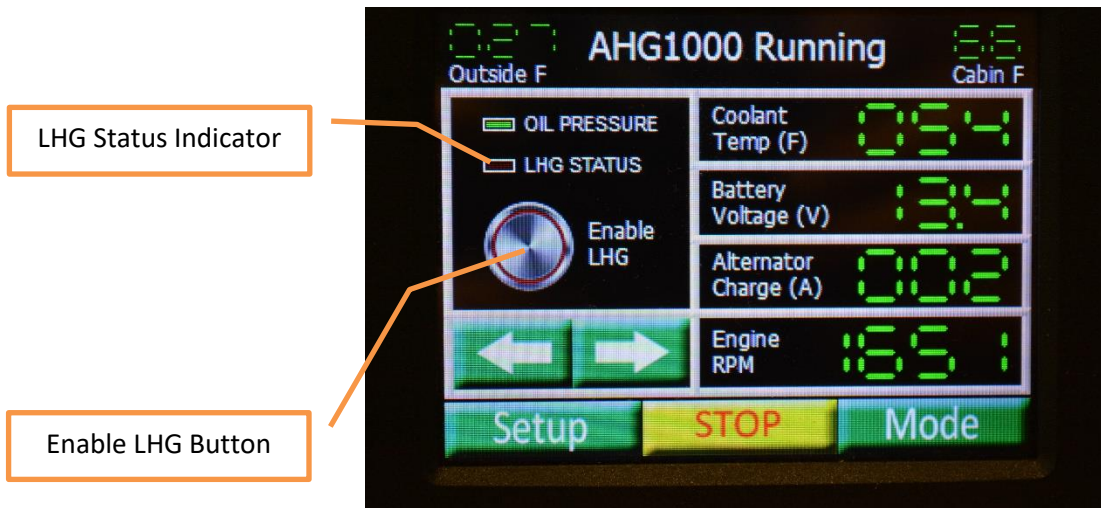
- The AHG1000 will now complete a defined Warm Up period BEFORE the operator can energize the heat generator (LHG) feature of the APU. This Warm Up period includes confirming oil pressure, adequate battery voltage and charging amps. The Warmup period comprised of 8 steps “Step” (0 thru 7), each with different time lengths “Delay (sec)”. The status of the Warm Up period (step by step) is displayed in the top-right quadrant of the warmup screen.

4.1.4 Important - Understanding the Warm Up Procedure

- After START is depressed:
 - Step “0”: Glow Plugs energized for on for **8 seconds**. Then automatically crank.
 - Step “1”: CRANK for up to **8 seconds** (must see above **550** RPM to be considered as “started”. This value is hard-coded.
 - Step “2”: Run No Load, No Alternator for **10 seconds**.
 - Step “3”: Engage Alternator and Idle for **10 seconds**.
 - Step “4”: ATU - Automatic Throttle Up (solenoid) (alternator still engaged)
 - Step “5”: Wait 3 seconds for Engine to stabilize at elevated rpm (not changeable)
 - Step “6”: Not Used (Ignore).
 - Step “7”: Return to Idle if Charge Volts are above **13.5V**. Change to Engine Running screen.
- Pendent Display changes to “AHG1000 Running” Screen and shows the **LHG Enable Button**.

Note: Values in **Red** can be changed with a PAEC Diagnostic PC and AHG1000 GUI installed. Values in **Blue** are hard-coded and cannot be changed in the field.

- Upon completion of the Warm Up period, the main “AHG Running” screen will appear:



- At this stage, the AHG is running stable but the Ventech LHG (supplemental heat generator) is not engaged. To engage the LHG, press “Enable LHG” as shown above.

4.1.5 Conditions for the LHG to engage (LHG Status indicator)

- When the “Enable LHG” button is depressed, the LHG feature will be active but will only engage under the following circumstances:
 - Charge Volts are above 13.5V, and
 - Outside Air Temperature is below 50°F (Default is LHG operational at any ambient temp), and
 - LHG Coolant Temperature below 131°F
- If any one of the above conditions are not met, the LHG Status Indicator on the Pendant will Flash.

4.1.6 Conditions for the LHG to Disengage (LHG Status Indicator)

- While the LHG is Active, the LHG will disengage upon any one of the following circumstances:
 - Charge Volts are below 13.5V, or
 - Outside Air Temperature is above 50°F (Default is LHG operational at any ambient temp), or
 - LHG Coolant Temperature above 185°F
- If any one of the above conditions occur, the LHG Status Indicator on the Pendant will Flash.

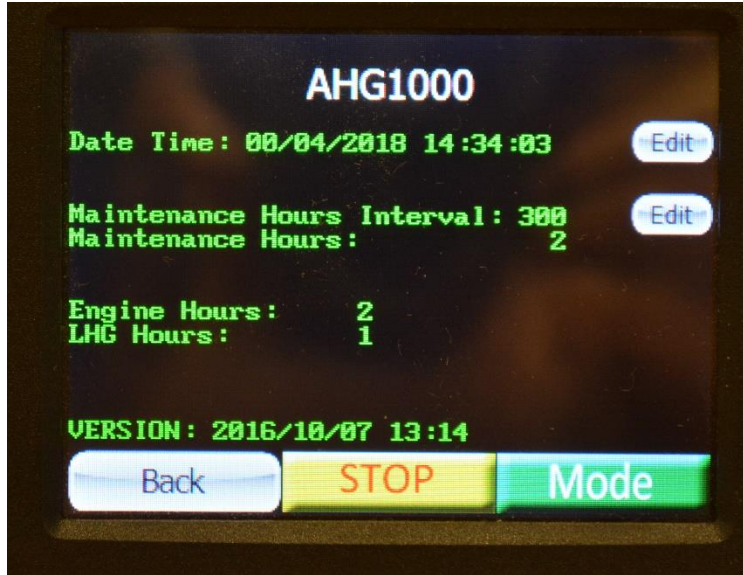
4.1.7 Shutdown Procedure

- Press the **STOP** button on the AHG1000 Pendant.
- Disconnect the 12V supply to the AHG1000 during long term inactivity (leaving the 12V connected, even with Ignition off, may cause battery drain during cold ambient temperatures due to the automated Oil Pan heater).

4.1.8 Setting the Date and Time on the Pendant

- If the APU is running, stop the engine by pressing the **STOP** button on the Pendant.

- Press the Setup button. The following screen will appear:



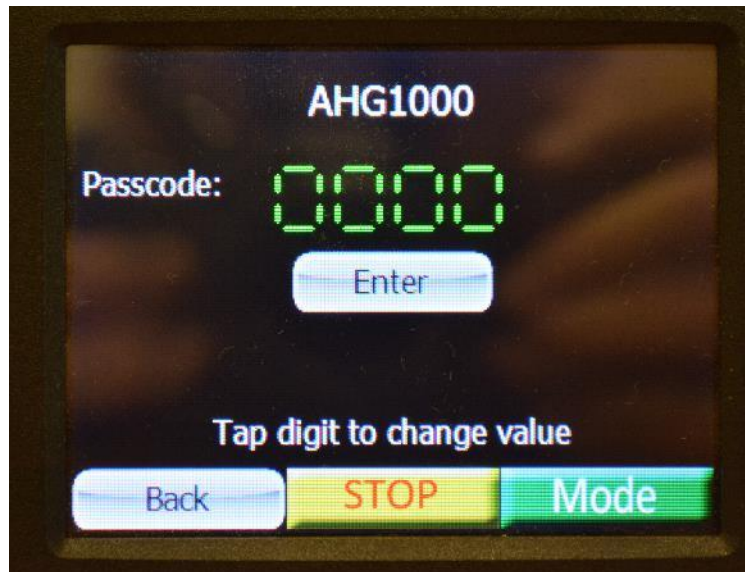
- Using the tip of a pen or pencil, press the Edit button adjacent to the Date Time display. The following screen will appear:



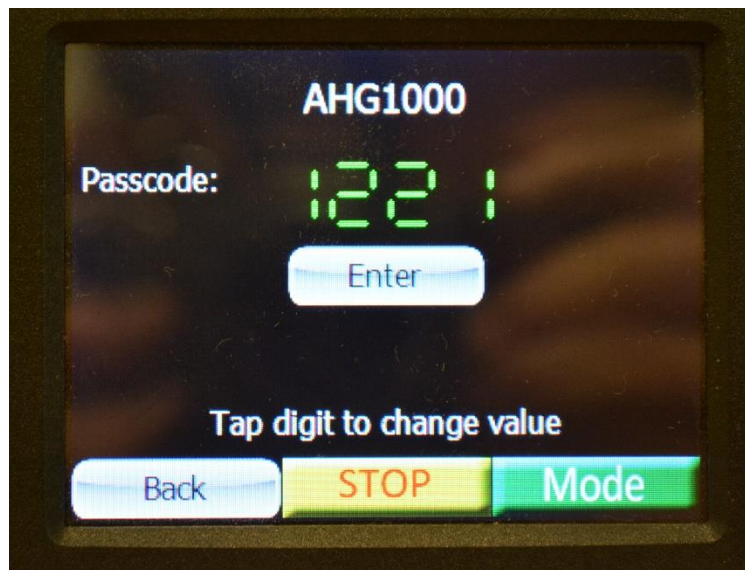
- To change any digit in the Time or Date string, simply tap the digit to change the value. Each tap of the digit will increment the value by one unit of measure. Tap repeatedly until the desired value is reached. When finished, press the **Back** button to return to the main menu.

4.1.9 Resetting & Changing the Maintenance Hours Interval.

- Press **Setup**. Press **Edit** adjacent to the Maintenance Hours display. The following screen will appear:



- Enter the passcode. The factory default passcode is 1221. Enter the passcode by tapping on each digit.



- Press Enter. The following screen will appear:



4.2 AHG1000 Thermal Performance

The AHG1000 has two modes of heater output.

When the AHG is running, but without the LHG700 turned on "AUX HEATER (LHG)", the AHG1000 delivers approximately 20,000 Btu's/hr.

When the AHG is running, and the AUX HEATER (LHG) is switched on, the AHG1000 delivers approximately 55,000 Btu's/hr. of coolant heat to the APU / Vehicle cooling system.

During initial setup, the best RPM/heat output combination should be determined based on the application. Seasonal Throttle Position adjustments can be made as necessary.

Once the AHG is running, an internal timer prevents the alternator and LHG700 from loading the engine, giving the engine sufficient time to stabilize. This timer is set to 60 seconds. Therefore, the AUX HEATER (LHG) switch can be activated after the AHG1000 has been started but the actual auxiliary heat source will not activate (LHG Clutch engagement) until 60 seconds after start (assuming the AUX HEATER switch is depressed).

5 Maintenance

5.1 Recommended Service Schedule

| Interval | Item |
|--|---|
| Every 50 hours | Check of fuel pipes and clamp bands |
| See NOTE | Change of engine oil (depending on the oil pan) |
| Every 100 hours | Cleaning of air cleaner element |
| | Cleaning of fuel filter |
| | Check of fan belt tightness |
| Every 200 hours | Replacement of oil filter cartridge (depending on the oil pan) |
| | Check of intake air line |
| Every 200 hours of operation | Check all hoses and clamp bands |
| Every 400 hours | Replacement of fuel filter element |
| Every 500 hours | Replace all belts |
| Every year or every 6 cleanings of air cleaner element | Replacement of air cleaner element |
| Every 800 hours | Check of valve clearance – Refer to Kubota Operators Manual |
| Every 1500 hours | Check of fuel injection nozzle injection pressure– Refer to Kubota Operators Manual |
| Every 3000 hours | Check of injection pump – Refer to Kubota Operators Manual |
| Every two years | Replacement of radiator hoses and clamp bands |
| | Replacement of fuel pipes and clamps |
| | Flush Cooling System |
| | Replacement of intake air line – Refer to Kubota Operators Manual |

Table 2 - Recommended Service Schedule

Properly maintain the Arctic Heat Generator for peak, trouble-free performance. Follow all safety guidelines. If you are unsure about any maintenance procedure, contact Ventech or consult a qualified mechanic. Failure to conduct scheduled maintenance may void the AHG warranty. Approved filters and belts are listed within this manual.

5.2 Changing the Oil

Note: The oil drains more completely when hot. Avoid touching hot engine surfaces while changing the oil and filter. Use gloves, a rag, or a wrench to remove the oil filter.

Note: Kubota engine break-in period is approximately 500 hours. During this period, you may experience some oil consumption. Change the engine oil and filter after the first 50 hours of use and every 150 hours thereafter.

5.3 Changing interval of Engine oil and oil filter cartridge.

| Engine Oil and Filter Replacement Schedule | | |
|--|----------------------|-------------------|
| Z602-E4B | Engine oil | 50 Hrs. (Initial) |
| | | 100 Hrs. |
| | Oil filter cartridge | 200 Hrs. |

Table 3 - Oil / Filter Change Interval

Due to the compactness of the AHG, direct access to the Kubota oil drain plug is not possible. Therefore the AHG1000 is fitted with an oil pan suction hose to facilitate an oil change. To completely drain the oil pan, an oil suction gun will be required, readily available from most auto parts stores. An example of an oil suction gun is shown below:



Figure 10- Oil Suction Gun



Figure 9 - Oil Pan Suction Hose

Figure 11 - Oil Filter Location

To drain the engine oil, locate the suction hose on the left side of the AHG (view from front) and remove the brass cap.

Using the suction gun, draw out the old oil and dispose.

Replace the engine oil filter (item 1):

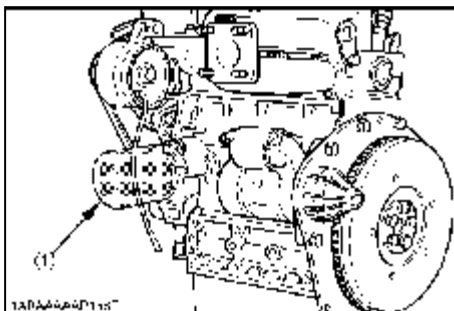


Figure 12 - Oil Filter Location

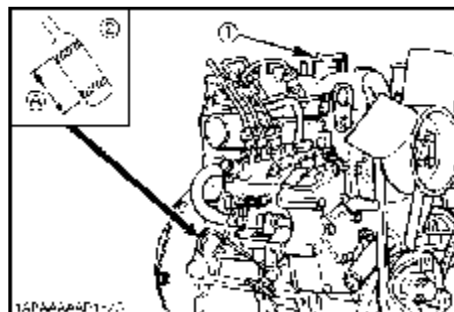


Figure 13 - Oil Dipstick Location

Add Oil. The capacity is 3.7 liters. Check the oil level using the dipstick. 96 fl.oz of oil will raise the oil level to the minimum marker. Adding another quart will raise the oil level to the upper market. Total capacity is 128 fl.oz.

- Oil used in the engine should have API classification and Proper SAE Engine Oil according to the ambient temperatures as shown below:

| | |
|---------------------------|----------------------------|
| Above 25°C (77°F) | SAE30, SAE10W-30 or 15W-40 |
| -10 to 25°C (14° to 77°F) | SAE10W-30 or 15W-40 |
| Below -10°C (14°F) | SAE10W-30 |

Table 4 - Engine Oil Selection

5.4 Air Filter Cleaning or Replacement

The element of the air cleaner employed on this engine is a dry type. Never apply oil to it.

- Open the evacuator valve once a week under ordinary conditions-or daily when used in a dusty place-to get rid of large particles of dust and dirt.
- Wipe the inside air cleaner clean with cloth or the like if it is dirty or wet.
- Avoid touching the element except when cleaning.
- When dry dust adheres to the element, blow compressed air from the inside turning the element. Pressure of compressed air must be under 205 kPa (2.1 kgf/cm , 30 psi).
- Replace the element every year or every six cleanings.

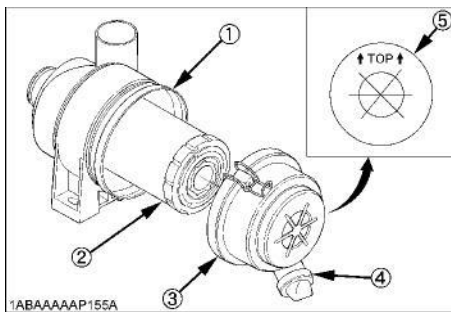


Figure 14 - Engine Air Filter Components

- (1) Air cleaner body
- (2) Element
- (3) Cover
- (4) Evacuator valve
- (5) "TOP" mark

Make sure the snap clips that secure the filter cover are tight. If loose, dust and dirt may enter the filter causing engine damage that may result in poor power output.

5.5 Fuel Filter

The AHG1000 is fitted with a Stanadyne Fuel Manager FM10, Fuel Filter/Separator, Part No. STA36691. The replacement element is Part No. 36682 (2.8" 5-Micron element).

6 Installation

6.1 RECEIVING

Ventech ships the AHG either in a crate or on a small pallet. A complete AHG1000 includes the items listed below. The smaller items, fittings etc. are bundled together in a box.

6.2 What comes with the AHG1000 (Packing List)

| Item | Part Description | Qty |
|------|--|-------|
| 1 | Arctic Heat Generator | 1 |
| 2 | In-Cab Control Pendant | 1 |
| 3 | Battery Plug with (2) 2AWG Wire Lugs | 1 |
| 4 | Cover Handles with Hardware (loose and removed for shipping) | 2 |
| 5 | Kubota Z602 Engine Operators Manual | 1 |
| 6 | AHG1000 Operators Manual | 1 |
| 7 | Installation Drawings | 1 set |

Table 5 - AHG2000 Packing List

6.3 INSTALLATION PREPARATION

A well-equipped shop should be able to install their first unit in about 12-20 hours. More experienced shops can do it quicker, in about 6- 12 hours.

A frame drill and portable engine hoist are needed in addition to common mechanic's tools.

Additional parts which may need to be purchased include:

- 3/4" insulated (pre-insulated preferred) coolant hoses
- 5/16" fuel lines and fittings to tap into the fuel distribution tee.
- 2 gauge battery cable for the main power wire. We supply the terminals.
- Brass plumbing fittings as needed to suit application. Shut-off valves are recommended.

6.4 DISCLAIMER

It is very important that the truck's coolant and fuel systems be free of leaks and contamination before installing an AHG1000. Ventech is not responsible for damage to any truck systems due to faulty equipment, contamination, fuel, or coolant leaks, coolant starvation, or AHG installation not in accordance with this manual.

6.5 Mounting the AHG1000

Depending on the application, there are many ways and configurations to mount the AHG1000 on a truck or other piece of industrial equipment. Each installation is different. Common mounting schemes are discussed here. Locate the unit so fresh cool air can pass around the housing of the AHG. The muffler protrudes from the bottom of the AHG. Exhaust gases must be able to freely escape and dissipate.

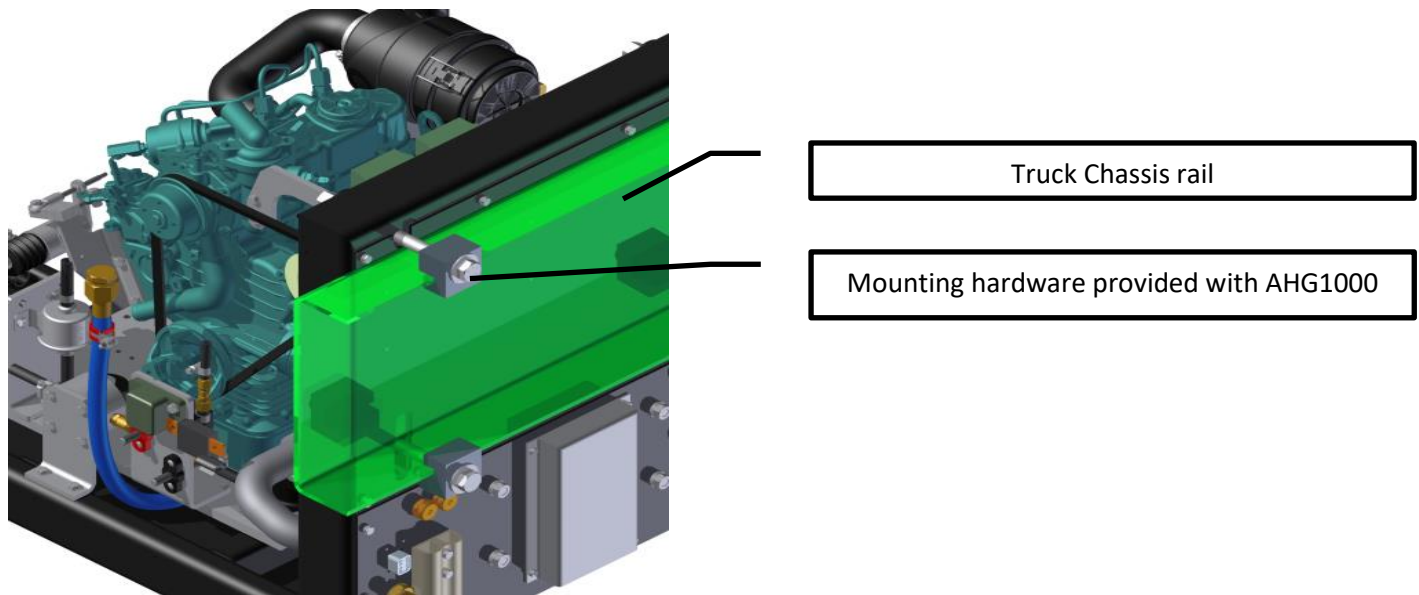
Note: Depending on the mounted location of the AHG, the muffler will likely be facing downward, with the exhaust gases directed to the ground. Be aware that the hot exhaust gases may have a tendency of melting any snow or packed ice beneath the location of the AHG when the vehicle is parked for an extended period of time. Fitting an optional 90 degree elbow to the downward muffler is recommended.

Make sure the AHG is accessible from the front and the cover is easy to remove.

Two coolant hoses, one fuel line, the Control Pendant umbilical cord, and the 12V battery feed all exit the rear of the unit and integrate with the various systems on the truck. Look for good routing locations (away from moving parts, hot exhaust pipes, etc.) for all these lines when choosing a mounting location.

We recommend leaving a clearance on either side of the AHG of at least 4 inches. The overall dimensions of the AHG are shown in the drawings supplied with the AHG1000 shipment.

The AHG1000 is supplied with chassis rail mounting hardware (clamps and fasteners). Simply position the AHG against the chassis rail in the preferred location and secure against the rail using the supplied clamps and fasteners.



6.6 Fuel Connection

The AHG1000 gets its fuel from the truck tank(s). A single ¼" fuel line must be installed from the truck fuel system to the rear of the AHG1000.

The installer must identify a suitable location to draw fuel from the tank.

6.7 Coolant Plumbing

Integrating the AHG1000 with the trucks coolant system involves two tasks:

Installing the SUPPLY hose (coolant flowing from the truck engine to the AHG1000)

Installing the RETURN hose (coolant flowing from the AHG1000 to the truck engine).

6.8 SHUT-OFF VALVES

Ventech strongly recommends installing shutoff valves where the SUPPLY and RETURN hoses exit the truck engine. This makes it easy to isolate the AHG for maintenance or repair purposes.

WARNING

Note: If the installation included the use of Isolation or Shut Off Valves between the truck cooling system and the AHG1000 (Coolant IN and Coolant OUT), these valves must be open before operation of the AHG1000. Starvation of coolant flow during operation will likely result in catastrophic failure of the AHG1000 engine (engine over temperature). Even though the engine is equipped with a coolant temperature sensor, closed valves may cause low coolant levels in the engine coolant cavities, diminishing the effectiveness of the engine coolant temperature sensor and automatic shutdown sequence.

6.9 HOSE PROTECTION

Ventech recommends installing thermal hose protection along the entire length of the hose. Insulate hoses to and from AHG with 1 3/8" I.D. with 1" wall. We recommend KFlex Insultube 6RX100138.

6.10 Coolant Plumbing - Simple

Installation of the AHG1000 ***should not affect*** the cabin heater performance when the ***AHG1000 is not being operated***. However, due to hose lengths and the location of the AHG1000 with respect to the engine and cabin heaters, heat losses can occur when relying solely on main engine heat (AHG off).

The following schematic shows the recommended plumbing arrangement for severe cold-climate applications, arranged to eliminate heat losses when the AHG is not being operated. The recommended installation will require the assembly and installation of a simple manifold using readily-available brass fittings and two flapper-type check valves:

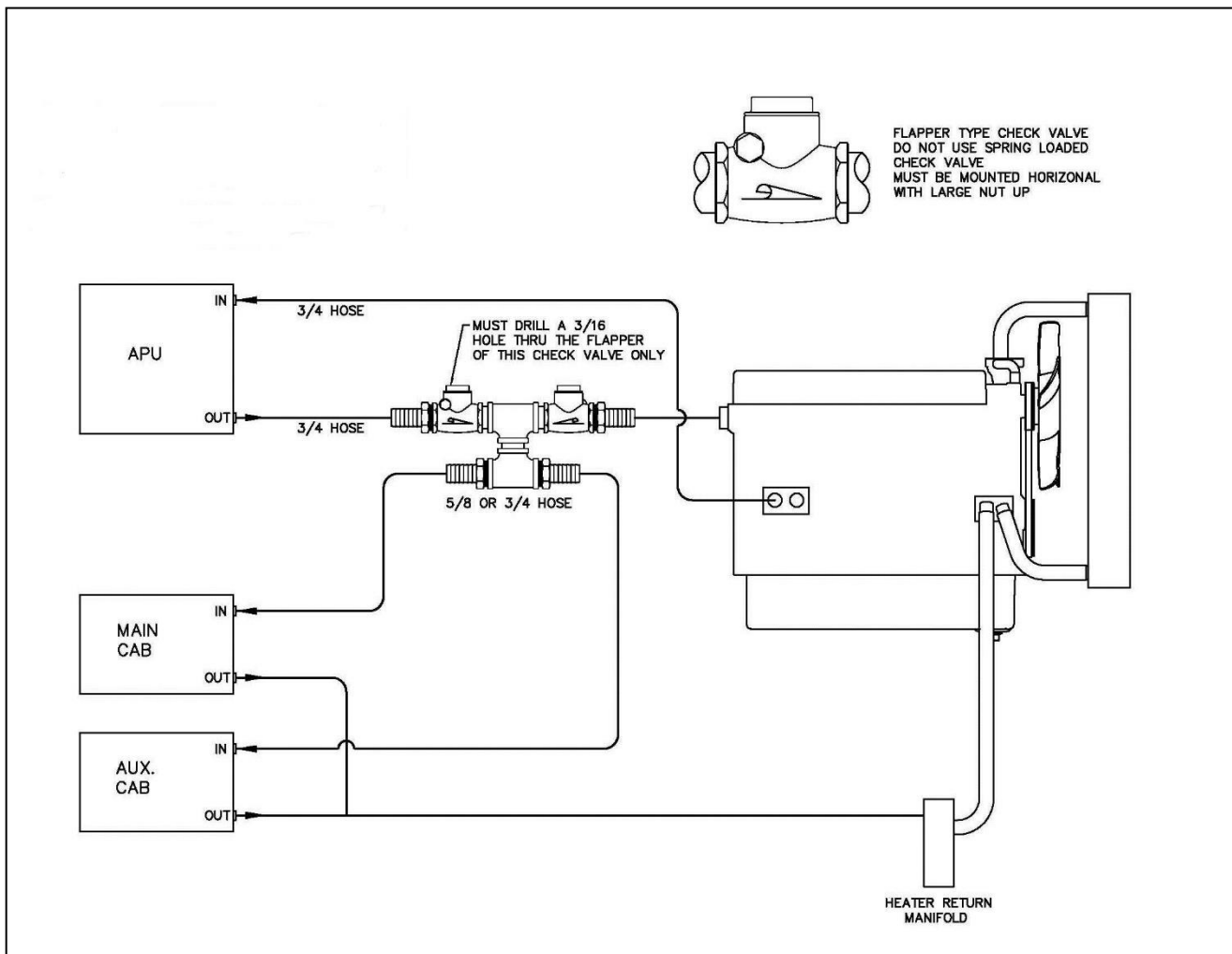


Figure 15 - Chasis Manifold Schematic (Simple)



Locate the manifold as close to the vehicle engine as possible. In this photograph, an example of the assembled manifold is shown before mounting to the truck bulkhead. Note that only flapper-type check valves should be used (not spring-type valves). **Flapper-type check valves must be mounted horizontally, as shown.**

Figure 16 - Example of simple Chassis Manifold

If the AHG1000 is being installed on a vehicle or application where additional heat supplies are required, such as a Urea tank or trailer-mounted 'dog house', a slightly modified plumbing arrangement is recommended, shown below:

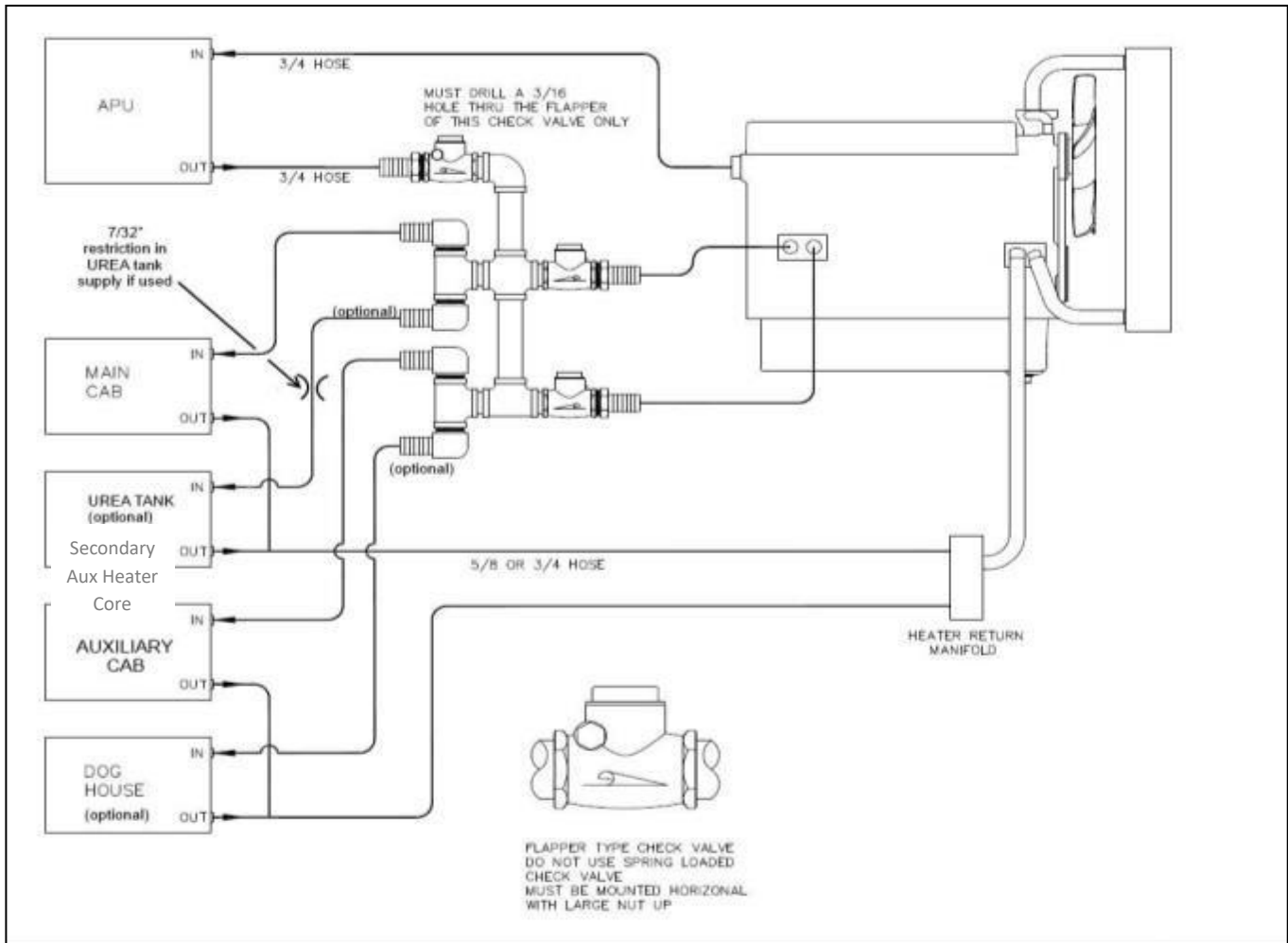


Figure 17 - Chassis Manifold Schematic (Advanced)

Note that an additional check valve is required and the coolant to the Urea tank should be restricted to prevent overheating of the Urea.

6.12 Electrical Installation

The AHG1000 integrates electrically with the truck or industrial equipment via the rear bulkhead of the AHG1000. Operation of the AHG1000 is via an Operator's Control Pendant. The control pendant is pre-wired and equipped with a 30' umbilical cord that plugs directly into the rear of the AHG1000 via a twist-style receptacle. The following electrical tasks are required to complete the electrical installation:

- Choose a location for the control pendant.
- Mount the Control Pendant.
- Route the Control Pendant umbilical cord to the rear of the AHG1000
- Connect the Control Pendant to the AHG1000
- Install the AHG 12V power lead (mating plug included with AHG).
- Test the AHG1000.

The same **Control Pendant** is used for all vehicle and equipment applications.

Different vehicles and/or industrial equipment will require different hydraulic plumbing arrangements, depending on the heating priorities of the vehicle/equipment and the number of heat exchangers incorporated in the coolant / heater system design.

Plumbing modifications to the existing vehicle/ industrial equipment may be required. This Manual provides recommendations of plumbing configurations, but it should be noted that some experimenting of plumbing configurations may be necessary to optimize auxiliary heater performance.

The Installer will be required to supply various plumbing fittings to complete this installation. This may include brass T-fittings, nipples, barbed fittings, and flapper-type check valves. Specific details of hardware requirements are provided later in this Manual. Note that most, if not all components can be purchased from a local hardware store such as Home Depot or Lowes.

WARNING: Never turn on the AHG power without the coolant circuit hooked up and full of coolant. Whenever the AHG Ignition is ON, the internal electric coolant recirculation pump is powered and operational. Running the pump without coolant present will quickly cause the pump to fail.

7 Starting the AHG for the First Time (New Installation)

7.1 Final Inspection

Inspect installation for:

- Loose fasteners.
- Loose heater hose clamps.
- Pinched heater hoses
- Ensure heater hoses are properly routed and protected against chafing and related damage.
- Loose wiring connections and battery connections.
- Ensure wiring harness is routed properly and protected against chafing and related damage.

7.2 Initial Startup

- Remove cover.
- Top off cooling system with coolant per engine/ vehicle manufacturers recommendations.
- Ensure that any coolant valves are open, allowing flow to and from AHG.
- Connect battery to AHG.

7.3 Initial Priming (Bleeding) of the Fuel and Coolant systems.



Figure 18 - Priming Switches Panel

The AHG1000 is equipped with two fluid Priming Switches provided specifically for the purpose of initial bleeding of the fuel and coolant systems. These switches are totally independent of the APU computer controller and will override the Pendant and Controller. Therefore, these switches must be returned to the OFF position after the priming tasks have been completed.

The Priming Switches are located inside the AHG housing on the rear-top cross-member of the AHG spaceframe.

- There are two steps to bleeding the coolant of an installed AHG on a truck. All coolant bleeding should be performed with the Coolant Prime switch turned on.
 - Step #1 is to bleed the truck engine and associated vehicle cooling/heating system. Follow the truck or engine manufacturer's guidelines to bleed the vehicle coolant system.
 - Step #2 is to bleed the Kubota Engine by opening the bleed screw located on the thermostat housing (top of engine). Allow all air to purge.



Bleed screw on Kubota engine

Figure 19 - Engine Coolant Bleed Screw Location

Bleed the Fuel first by opening the bleed screw on the fuel filter assembly and allow all air to purge. Close the screw once a constant flow of diesel coming from the bleeder.



Fuel Filter housing bleed screw

Figure 20 - Fuel Filter Bleed Screw Location

- Bleed the Kubota Injector Pump by opening the bleed fitting and allowing all air to purge.



Injector Pump Bleed fitting

Figure 21 - Engine Injector Pump Bleed Fitting Location

- Retighten all bleed screws.
- Turn both Priming Switches to the OFF position.
- Inspect for any fluid leaks, loose hose clamps, fasteners and fittings.
- Confirm the engine has been filled with oil as described in section [5.2](#) of this Manual.
- Start the AHG1000 per the instructions [4.1.3](#) of this Manual

8 Troubleshooting

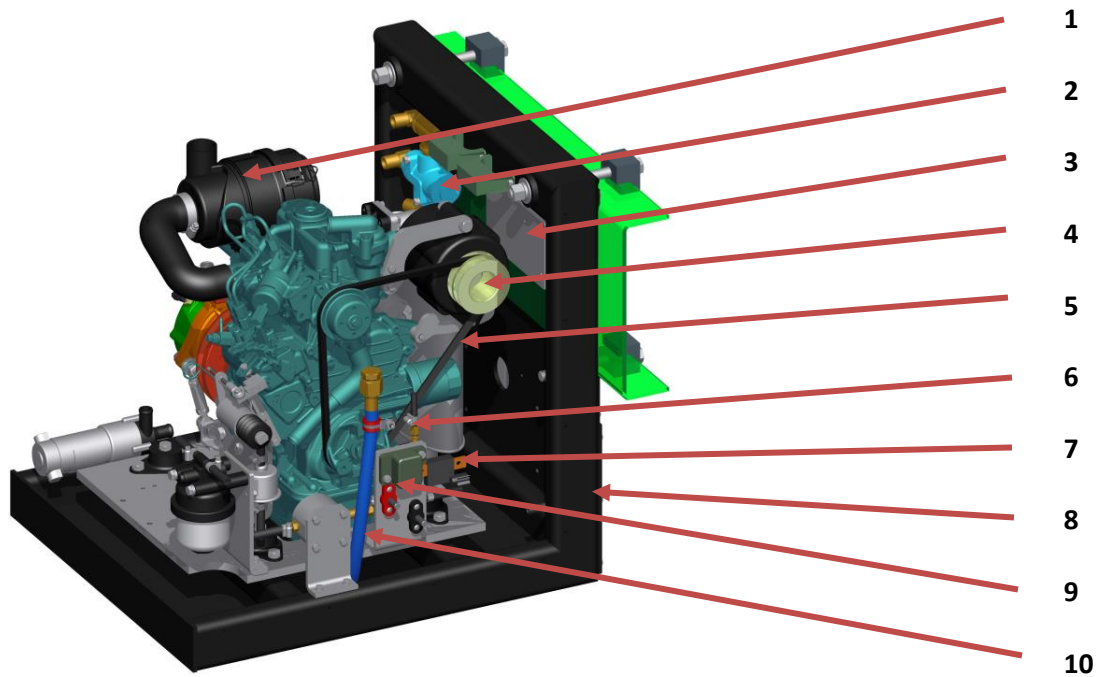
8.1 7.1 Recommended Spare Parts List

| DESCRIPTION | VENTECH PART NUMBER |
|---|---------------------|
| Fiberglass Cover | 30-4523-A0 |
| Cover Handles (Set of 2) | 995-0094 |
| Chassis | 30-4521-A1 |
| Cover Draw Latches | 995-0095 |
| APU Pendant | 995-0110 |
| Fuel Pump 12V | 995-0004 |
| Temp Sensor – Engine Coolant | 995-0005 |
| Pressure Switch – Engine Oil | 995-0055 |
| Fuel Return Brass Check Valve | 995-0106 |
| Coolant Circulation Pump 12V | 995-0007 |
| Thermostat - coolant valve | 995-0008 |
| Exhaust Assembly (Muffler, Pipe, welded flange) | 995-0112 |
| Heavy Duty Fluid Reservoir Heater | 995-0010 |
| Oil Pan Heater Thermostat | 995-0011 |
| Circuit Breaker, 150 amp | 995-0012 |
| Automotive Relay 70A 12V | 995-0016 |
| Heavy Duty Alternator - 95AMP/12V | 995-0096 |
| Kubota Vee Belt | 995-0098 |
| Air Filter | 995-0001 |
| Fuel Filter / Separator Element | 995-0003 |
| APU / AHG Controller | 995-0109 |
| Battery Plug 12V with (2) 2AWG Wire Lugs | 995-0031 |
| LHG 700 HEATER (ONLY) – 3/4” fittings – “Reduced Power” | 100-0013-34-N RP |
| Speed Sensor, rear differential | 995-0101 |
| Vibration Isolator | 995-0088 |
| Engine RH Motor Mount | 30-4529-A0 |
| Engine LH Motor Mount | 30-4530-A1 |
| Front Alternator Guard | 30-4569-A3 |
| Flywheel Guard | 30-4576-A0 |
| Engine Starter (Kubota) 12V | 995-0113 |

| | |
|-------------------------------|----------|
| Fuel Return Brass Check Valve | 995-0006 |
| Coolant Air Bleed Screw | 995-0039 |
| Drip Pan Banjo Fitting Assy | 995-0037 |
| Drip Pan Oil Drain Hose Assy | 995-0038 |
| Current Measurement Module | 995-0025 |
| | |

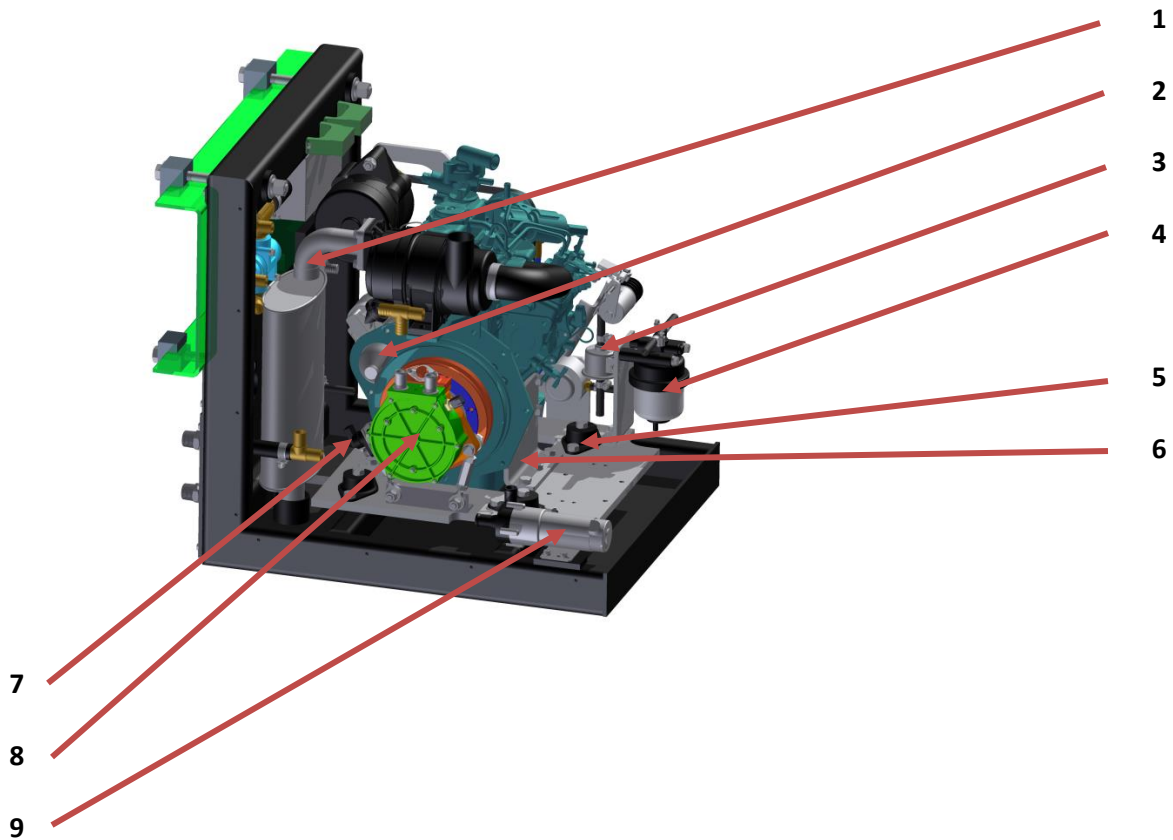
8.2 Part Identification

8.2.1 AHG1000 Right Side View – Part Identification



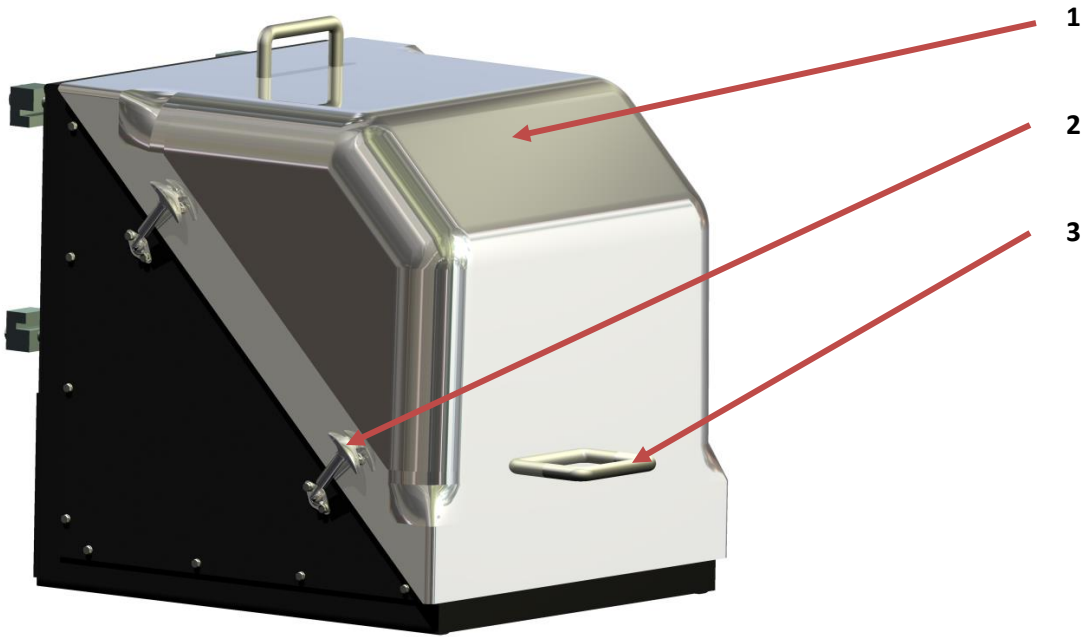
| Picture Location | VENTECH PART NUMBER | DESCRIPTION |
|------------------|---------------------|----------------------------------|
| 1 | 995-0001 | Air Filter |
| 2 | 995-0008 | Thermostat - Coolant Valve |
| 3 | 995-0109 | AHG 1000 Controller |
| 4 | 995-0096 | Heavy Duty Alternator 95Amp- 12V |
| 5 | 995-0098 | Kubota Vee belt |
| 6 | 995-0106 | Fuel Return Brass Check Valve |
| 7 | 995-0025 | Current Measurement Module |
| 8 | 30-4533-A0 | Chassis |
| 9 | 995-0012 | Circuit Breaker – 150 Amp |
| 10 | 995-0038 | Oil Drain Hose Assy |
| | | |

8.2.2 AHG1000 Left Side View – Part Identification



| Picture Location | VENTECH PART NUMBER | DESCRIPTION |
|------------------|--------------------------|--|
| 1 | 995-0112 | Exhaust Assembly (Muffler, Pipe, Welded Flange) |
| 2 | 995-0113 | Engine Starter – Kubota 12V |
| 3 | 995-0004 | Fuel Pump – 12V |
| 4 | 995-0003 | Fuel Filter / Separator Element |
| 5 | 995-0088 | Vibration Isolators – set of (4) |
| 6 | 30-4529-A0 30-4530-A1 | Engine RH Motor Mount Engine LH Motor Mount |
| 7 | 995-0101 | Speed Sensor, Rear Differential |
| 8 | 100-0013-34-N RP | LHG 700 Heater Only – 3/4 fittings – “Reduced Power” |
| 9 | 995-0007 | Coolant Circulation Pump 12V |

8.2.3 AHG1000 Cover and Handles – Part Identification



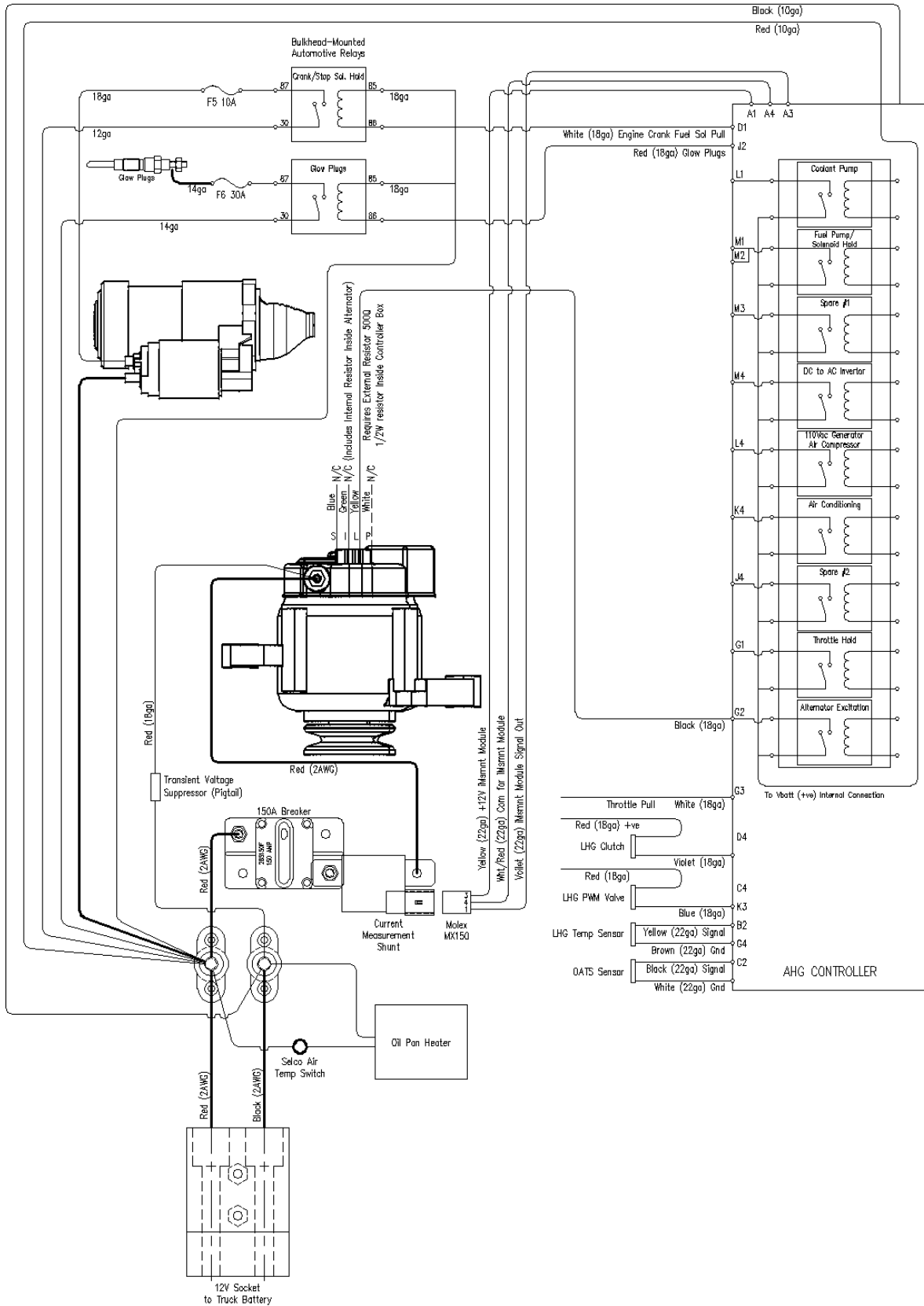
| Picture Location | VENTECH PART NUMBER | DESCRIPTION |
|------------------|---------------------|-------------------------------|
| 1 | 30-4533-A0 | Fiberglass Cover |
| 2 | 995-0094 | Cover Draw Latches (Set of 4) |
| 3 | 995-0094 | Cover Handles (set of 2) |

8.3 Understanding how the AHG1000 functions.

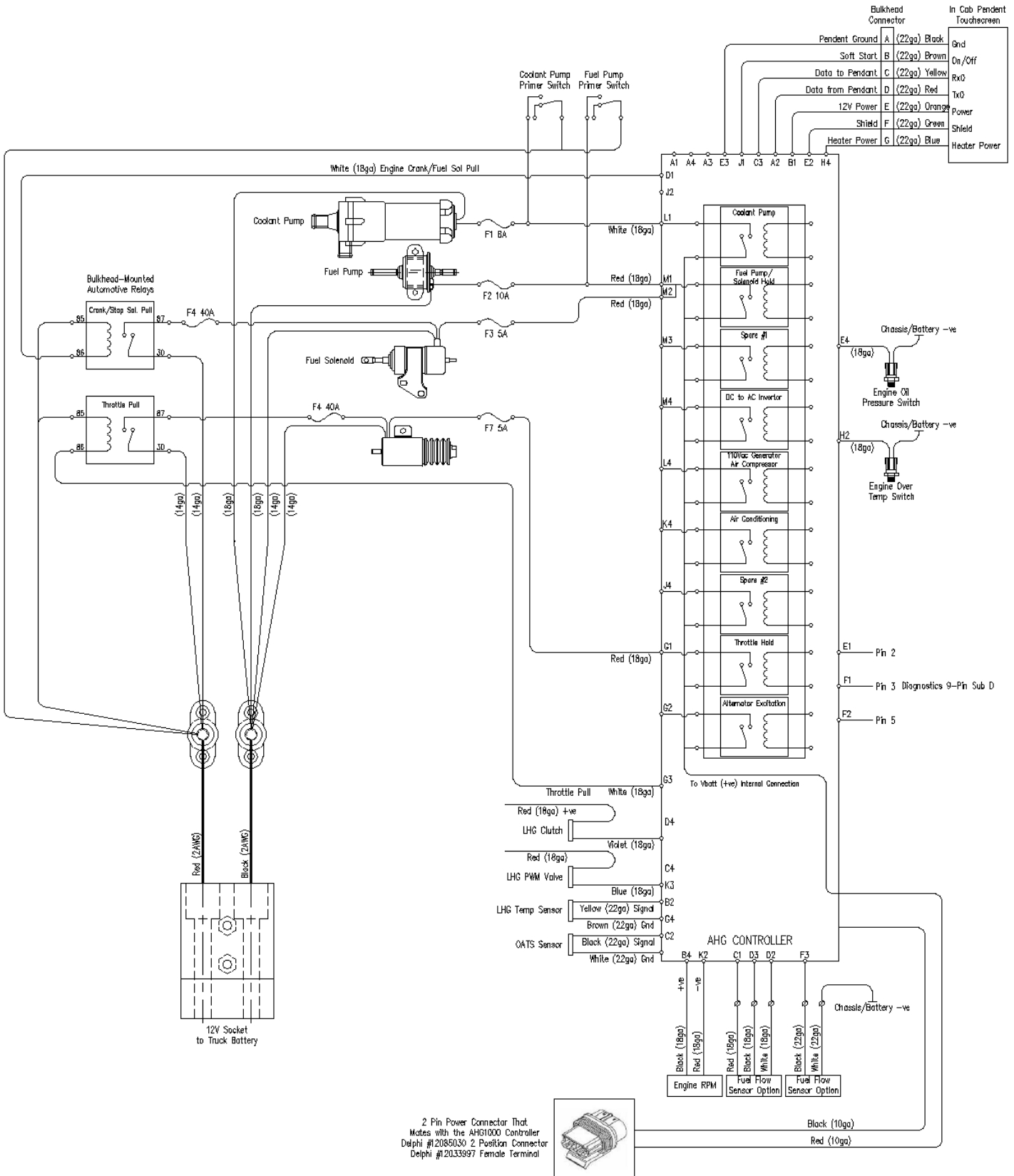
There are six main sections of the AHG1000. Once the functions of each section are explained, the overall system is better understood.

1. 12V High Current Wiring (Crank / Preheat / Charging)
2. Main Controller (Signal & Control) Wiring
3. Pendant
4. Internal Coolant System
5. Fuel System
6. Auxiliary Heater (LHG700)

8.3.1 12V High Current Wiring (Crank / Preheat / Charging)



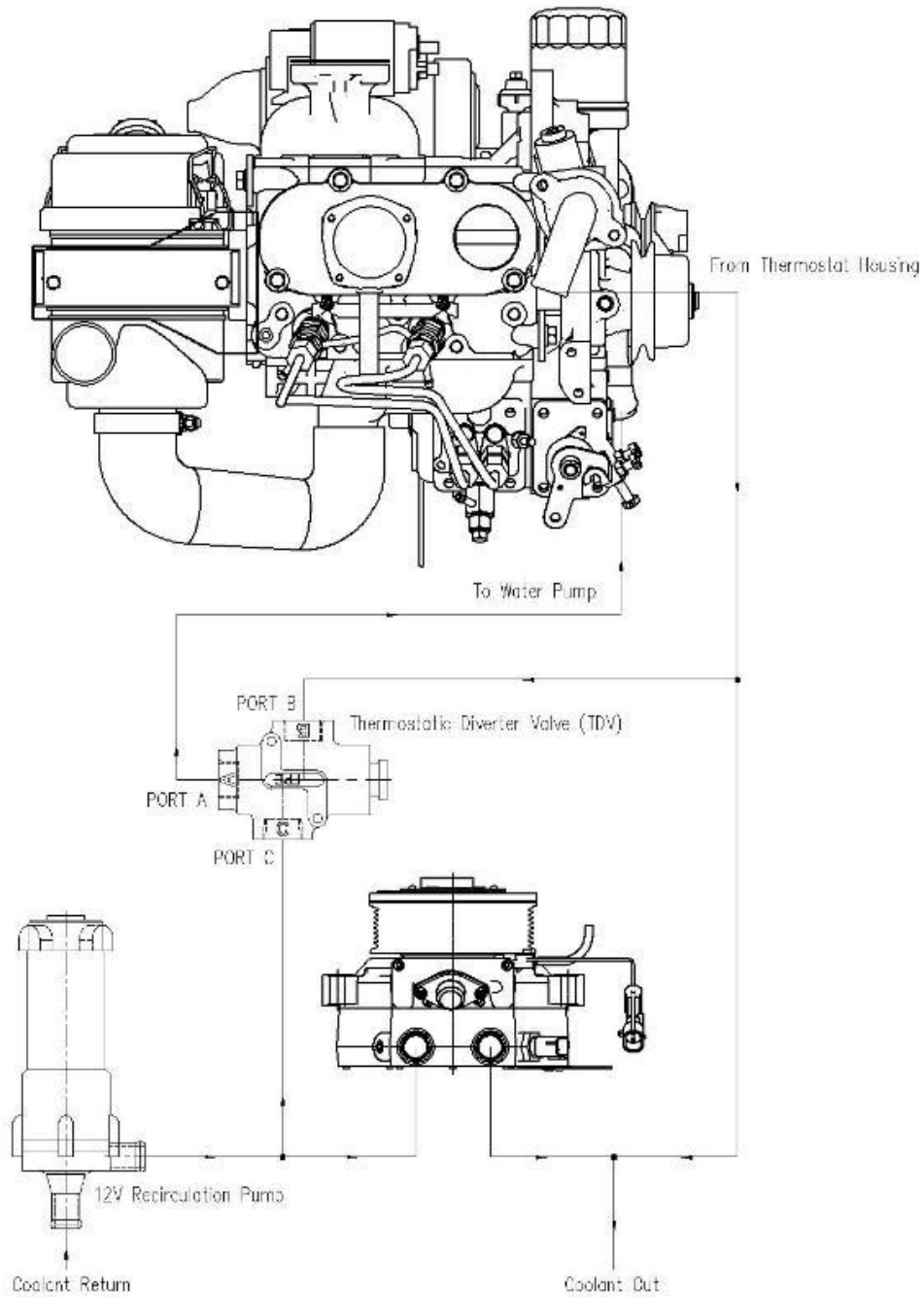
8.3.2 Main Controller (Signal & Control) Wiring & Pendant



8.3.3 Internal Coolant System

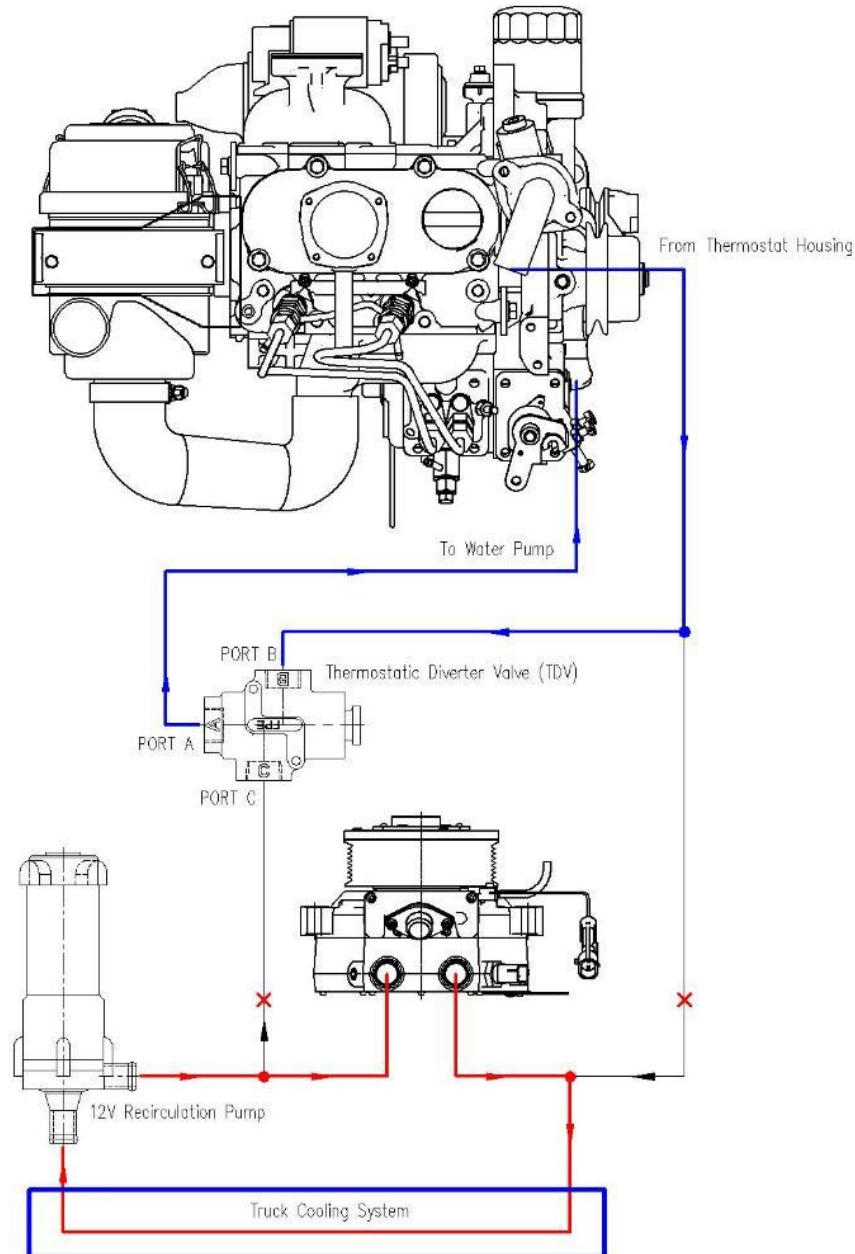
A schematic of the internal coolant system is shown below, followed by a detailed assembly schematic showing all fittings, clamps and hose sizes/lengths.

Note: The Kubota Engine Thermostat is Removed from the Thermostat Housing



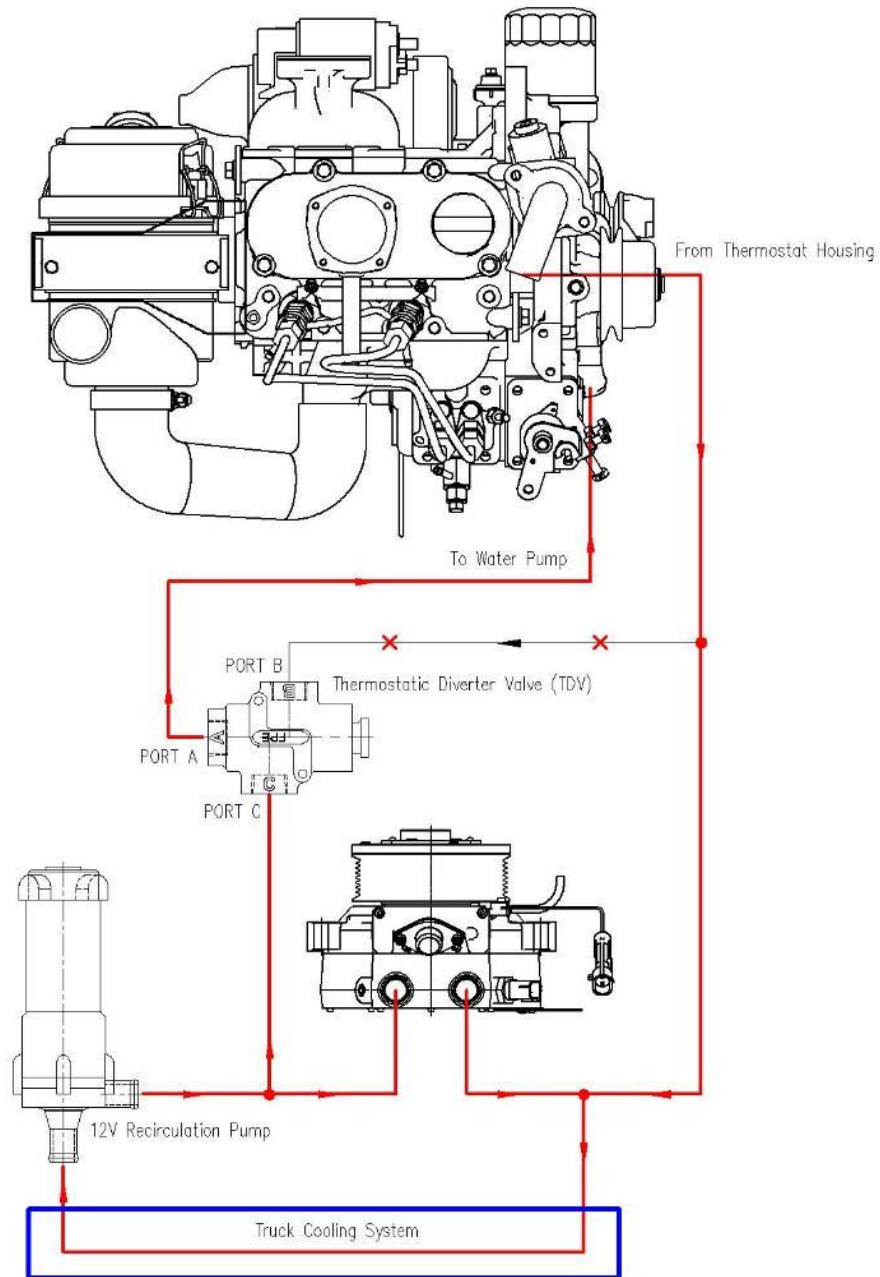
8.3.3.1 Theory of Operation (Internal Coolant System) COLD

At Cold Start, until Kubota reached operating temperature and the TDV Opens, coolant enters the AHG (from Truck cooling system). Port C of the Thermostatic Diverter Valve is closed until such time that the Kubota has reached optimum operating temperature. Coolant flow from the Recirculation Pump can only pass through the LHG (internal) heat exchanger, returning (Coolant OUT) back to the truck. While the Kubota is below normal operating temperature, the Engine Coolant Pump circulates coolant through the engine jackets, into Port B of the TDV, out of Port A of the TDV, and back in to the throat of the Kubota Engine Coolant Pump.

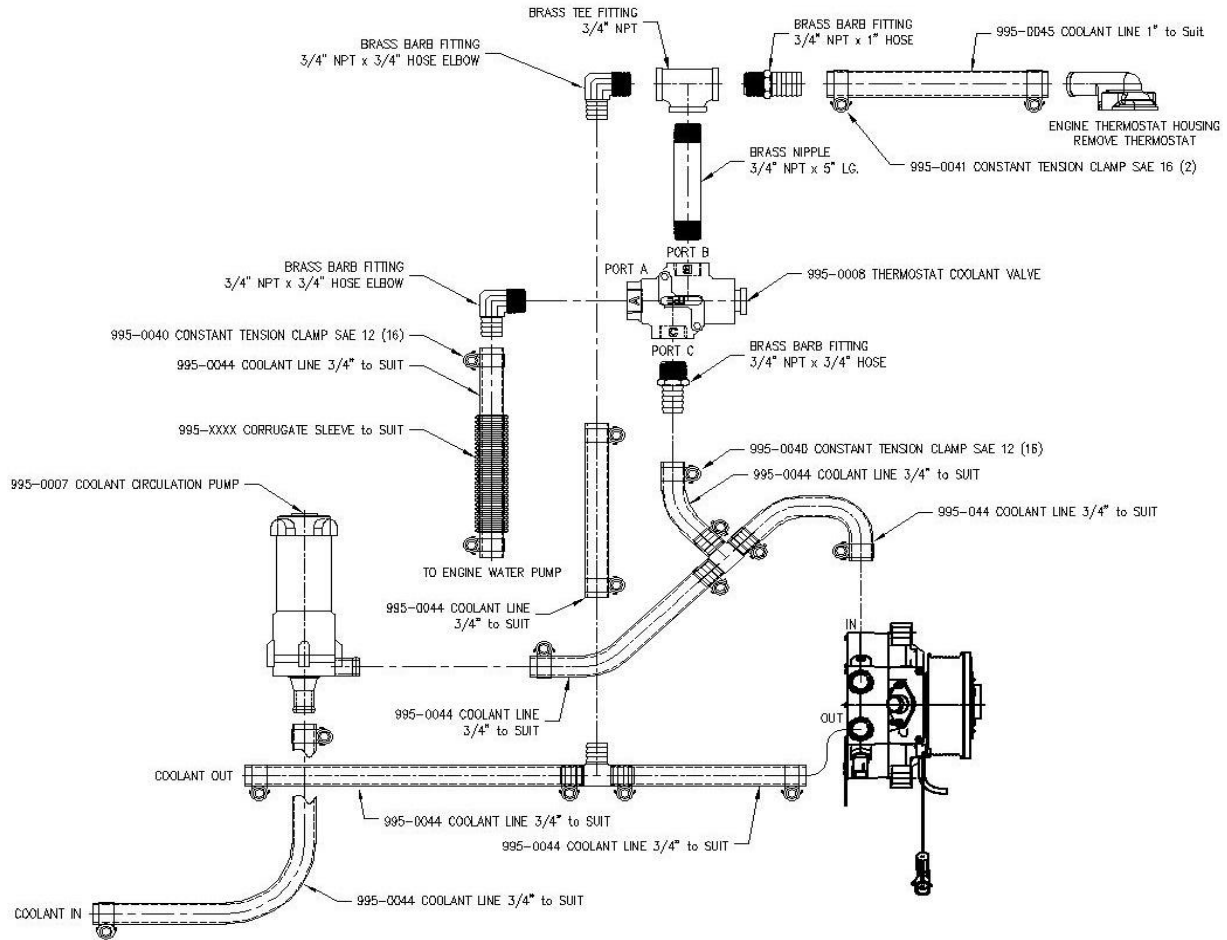


8.3.3.2 Theory of Operation (Coolant System) HOT

Once the Kubota coolant circuit has reached normal operating temperature, the Thermostatic Diverter Valve changes mode, opening flow between Ports A & C, while closing flow between Ports A & B. Surplus heat from the Kubota cooling circuit blends with heat generated by the LHG, as shown below:

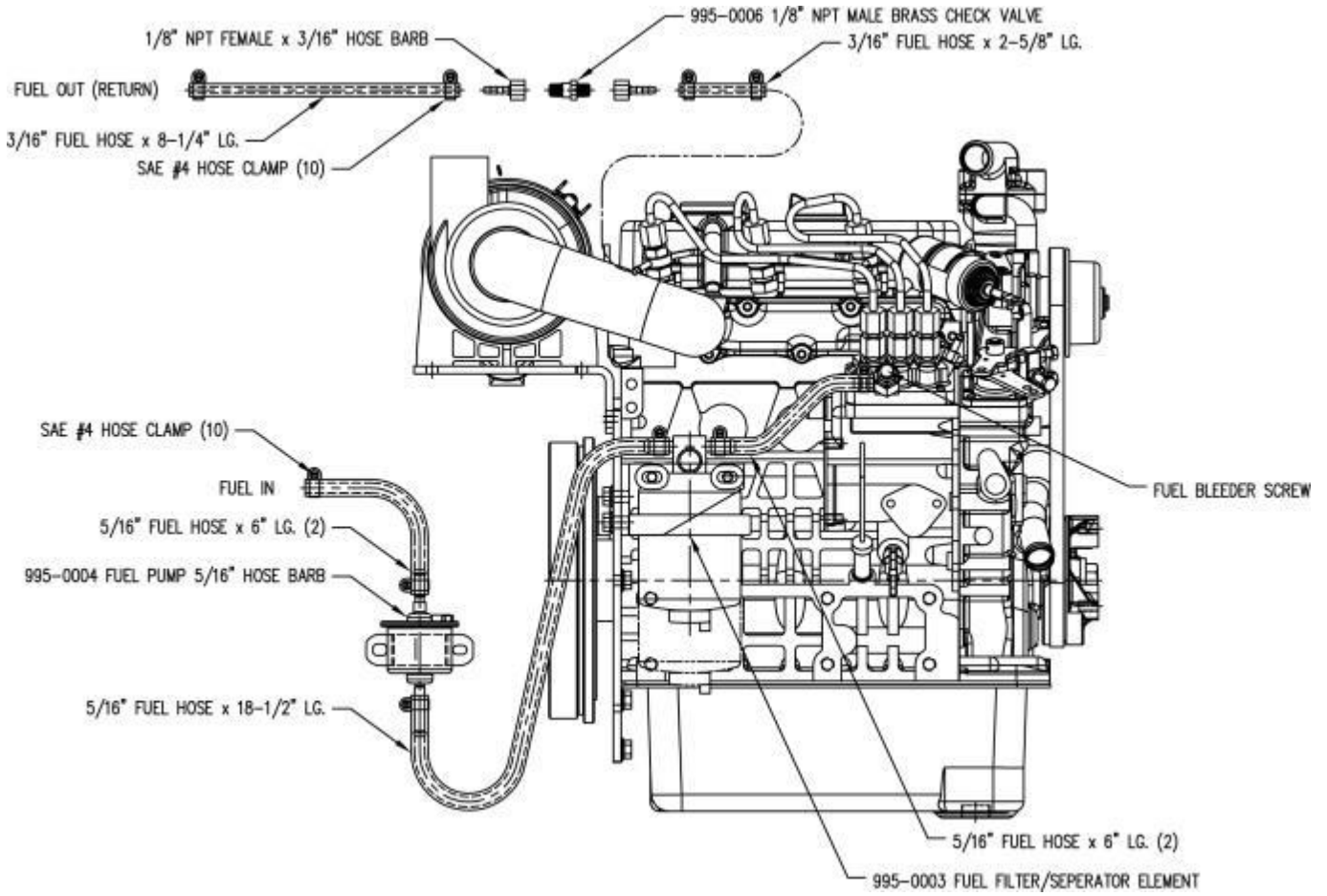


8.3.3.3 Detailed Assembly Schematic of AHG Coolant arrangement



8.3.4 Fuel System

8.3.4.1 Detailed Assembly Schematic of AHG Fuel System arrangement



8.3.4.2 Fuel System – Theory of Operation (electrical)

Electrical control of fuel delivery is derived from a fuel pump and an engine-mounted fuel shutoff solenoid (energize to run).

Turning on the AHG1000 ignition will immediately turn on the fuel pump via the FUEL relay / LED7 illuminated.

An explanation about the Fuel Shutoff Solenoid (FSS).

The FSS is a three wire device. The connections are Ground, “Pull”, and “Hold”.

The HOLD wire is on whenever the Fuel Pump is energized via the FUEL relay #7 and protected by Fuse #5.

Even though the FSS is initially fed with power to the HOLD wire, it will not stroke (pull) until a high current 12V feed is applied to the PULL wire momentarily. The FSS is ‘pulled’ via the slave Crank/Pull Sol Relay mounted on the back wall of the AHG enclosure. This relay is controlled by Relay #4 (CRANK) within the AHG1000 Microcontroller enclosure, protected by Fuse #2.

Electrical power to the pump and solenoid are only interrupted by the following conditions:

- Ignition Switch deactivated
- E-Stop Loop broken (open circuit)
- Low Oil Pressure (engine shutdown sequence)
- Engine Over-Temperature (engine shutdown sequence)