

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



PAEC PN #	Description
AHG2000-12V-US-RM	12V AHG2000 - Rail-mount - US Spec
AHG2000-24V-US-RM	24V AHG2000 - Rail-mount - US Spec
AHG2000-12V-US-SO	12V AHG2000 - Slide-out mount - US spec
AHG2000-24V-US-SO	24V AHG2000 - Slide-out mount - US spec
AHG2000-12V-CND-RM	12V AHG2000 - Rail-mount - Canadian Spec
AHG2000-24V-CND-RM	24V AHG2000 - Rail-mount - Canadian Spec
AHG2000-12V-CND-SO	12V AHG2000 - Slide-out mount - Canadian spec
AHG2000-24V-CND-SO	24V AHG2000 - Slide-out mount - Canadian spec

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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 AHG2000 Artic 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 AHG2000 Artic Heat Generator for installation on severe cold-climate vehicles and industrial equipment.

- There are multiple models of the AHG2000 available from Ventech. The table below identified each version of the AHG available:

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Table 1

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 AHG2000 Registration Form

Please ensure that you complete the AHG2000 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, (“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 29769 Anthony Drive, 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 Schelter 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 AHG2000, 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 AHG2000, 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 AHG2000 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 AHG2000 RPM will void the warranty.
- Modifications are not permitted.
- Avoid skin and eye contact with the air filter cleaning solution.
- Never stand on the AHG2000 or use it as a step.

3 About the AHG2000

3.1 Overview

The Ventech Arctic Heat Generator Model AHG 2000 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 AHG2000 provides circulating heated coolant and electrical power to keep the truck's utilities fully operational 24/7, whilst 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 AHG2000 provides 12VDC 140AMP or 24V 100AMP 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 2000 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 AHG 2000 has compact packaging with field serviceability in mind, built using premium quality materials and components rated for Arctic temperatures. The AHG2000 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 3cyl, 24.8HP (18.5kW) 3600RPM, industrial diesel engine with Glow Plugs and heavy duty 1.4kW starter for cold crank starts, provides reliability and performance.

Heated Coolant - Ventech LHG600 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 LHG600 provides up to 80,000 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 140A or 24V 100A of electrical power for battery charging and electrical demands.

Micro-Processor Control – the AHG2000 is controlled by Ventech microprocessor ECU. A Ventech micro-controller provides closed loop servo control functions for the LHG600.

In-Cab Control Panel - provides remote start and operational status indicators for the AHG2000 systems.

Choice of DC Voltages - 12V and 24V versions of the AHG2000 available.

Canadian Model – A Canadian model of the AHG2000 is available that is equipped with a compliant and automatic Emergency Air Shut-Off Valve system.

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 aluminum 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 600 provides up to 80,000BTU heated coolant almost instantaneously for vehicle system use.

Rapid Heat Generator (Ventech LHG600)

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

Electrical Power 12V 140A or 24V 100A 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
Service Bulkhead with self-sealing (no spill) quick -disconnect fluid couplings.
Full containment AHG Drain Pan
AGH 2000 Arctic Enclosure

3.4 General Arrangement of AHG Main Components

3.4.1 AHG Front View (Diagram)

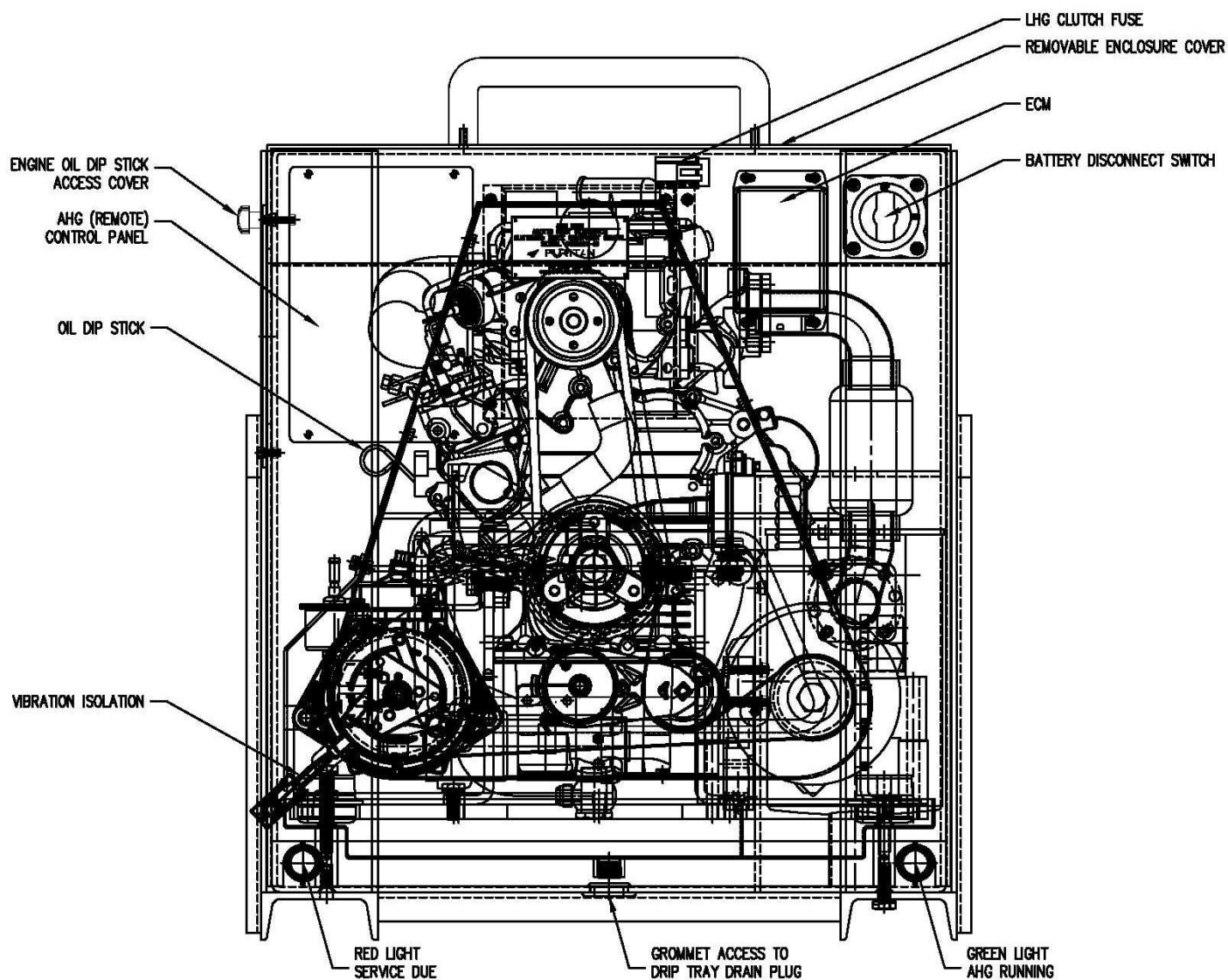


Figure 1 – AHG2000 Front View – General Arrangement

3.4.2 AHG Front View (Photograph)

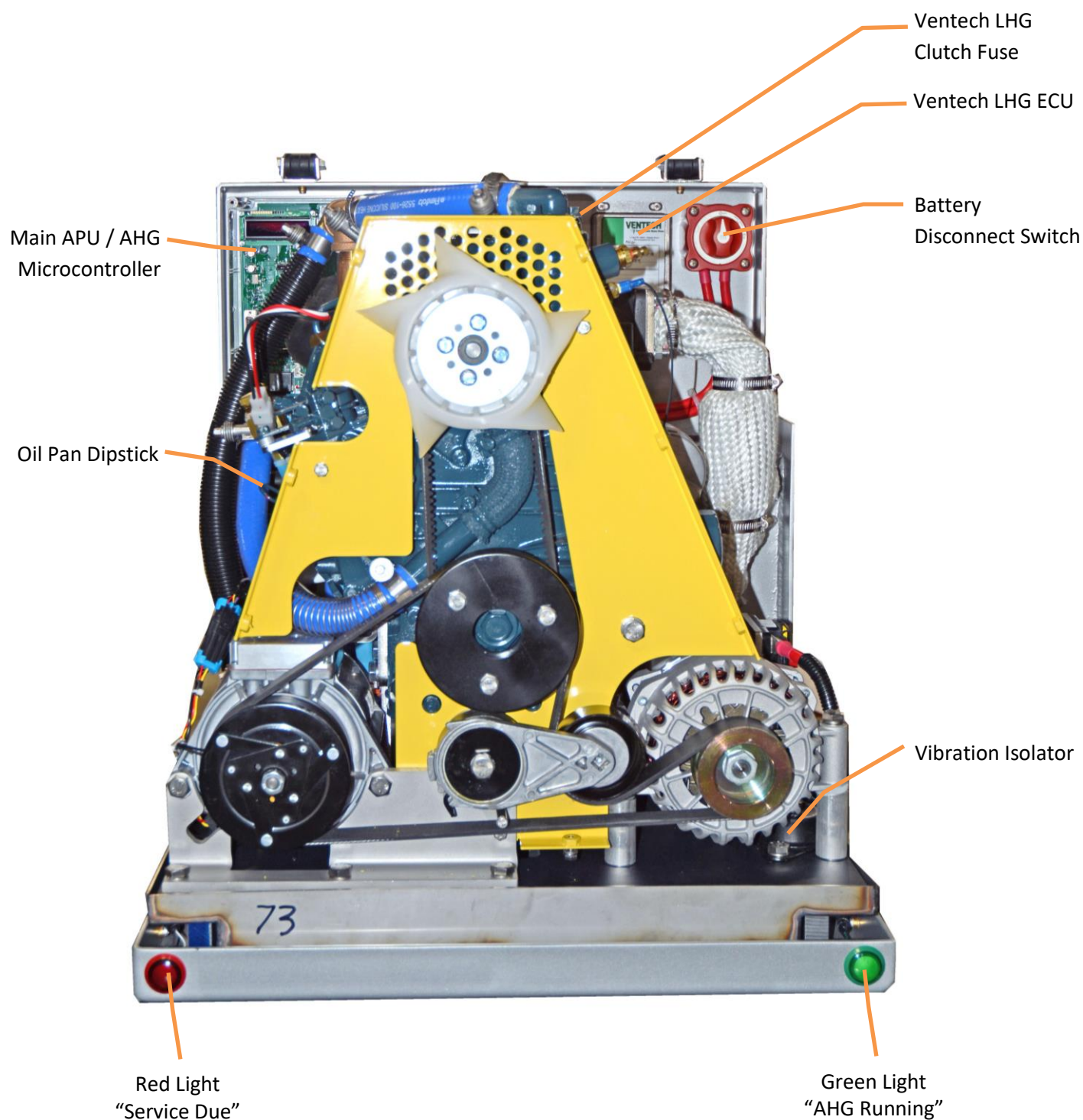


Figure 2 - AHG Front View (Photograph)

3.4.3 AHG Right Side View (Diagram)

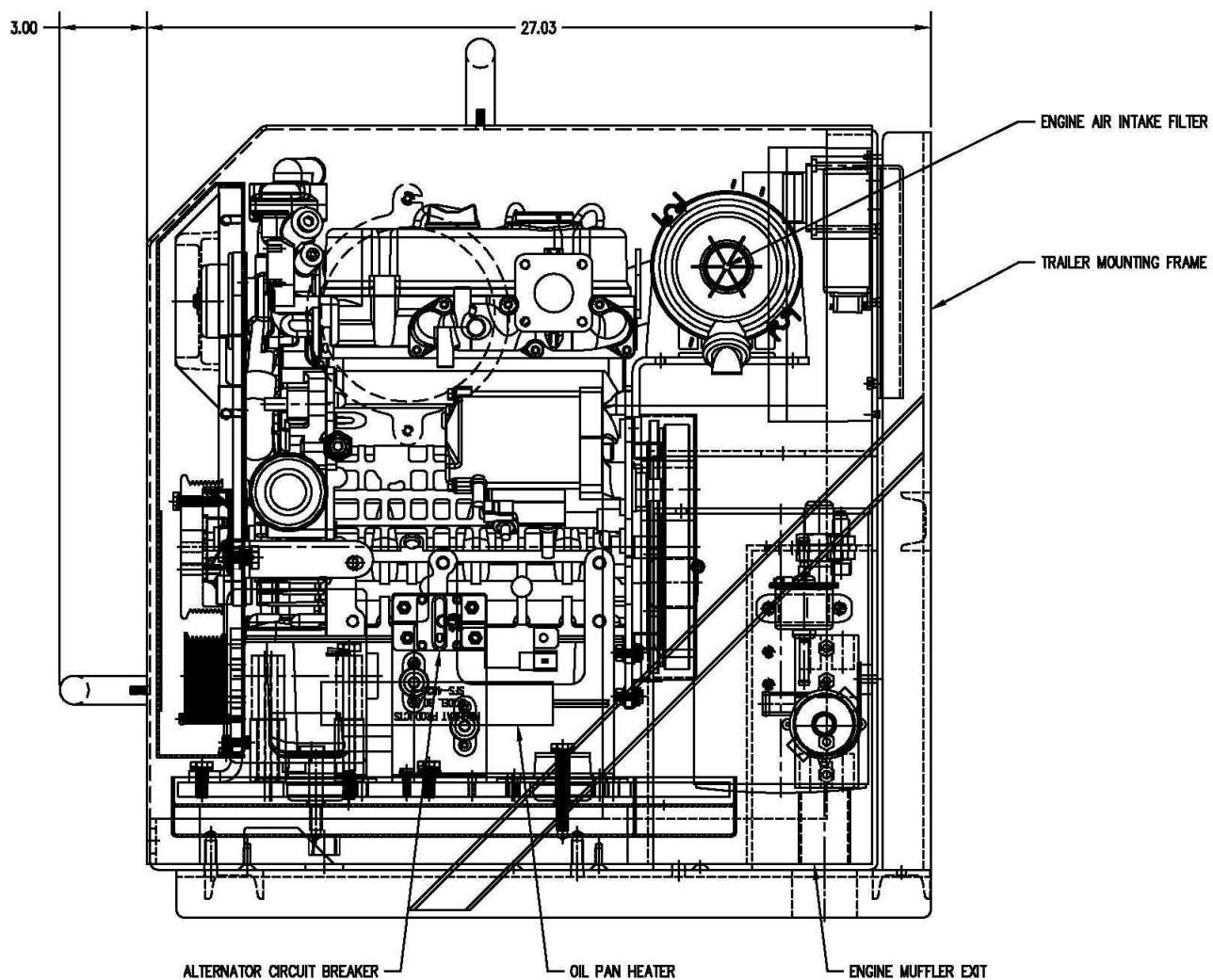


Figure 3 – AHG2000 Right Side View General Arrangement

3.4.4 AHG Right Side View (Photograph)

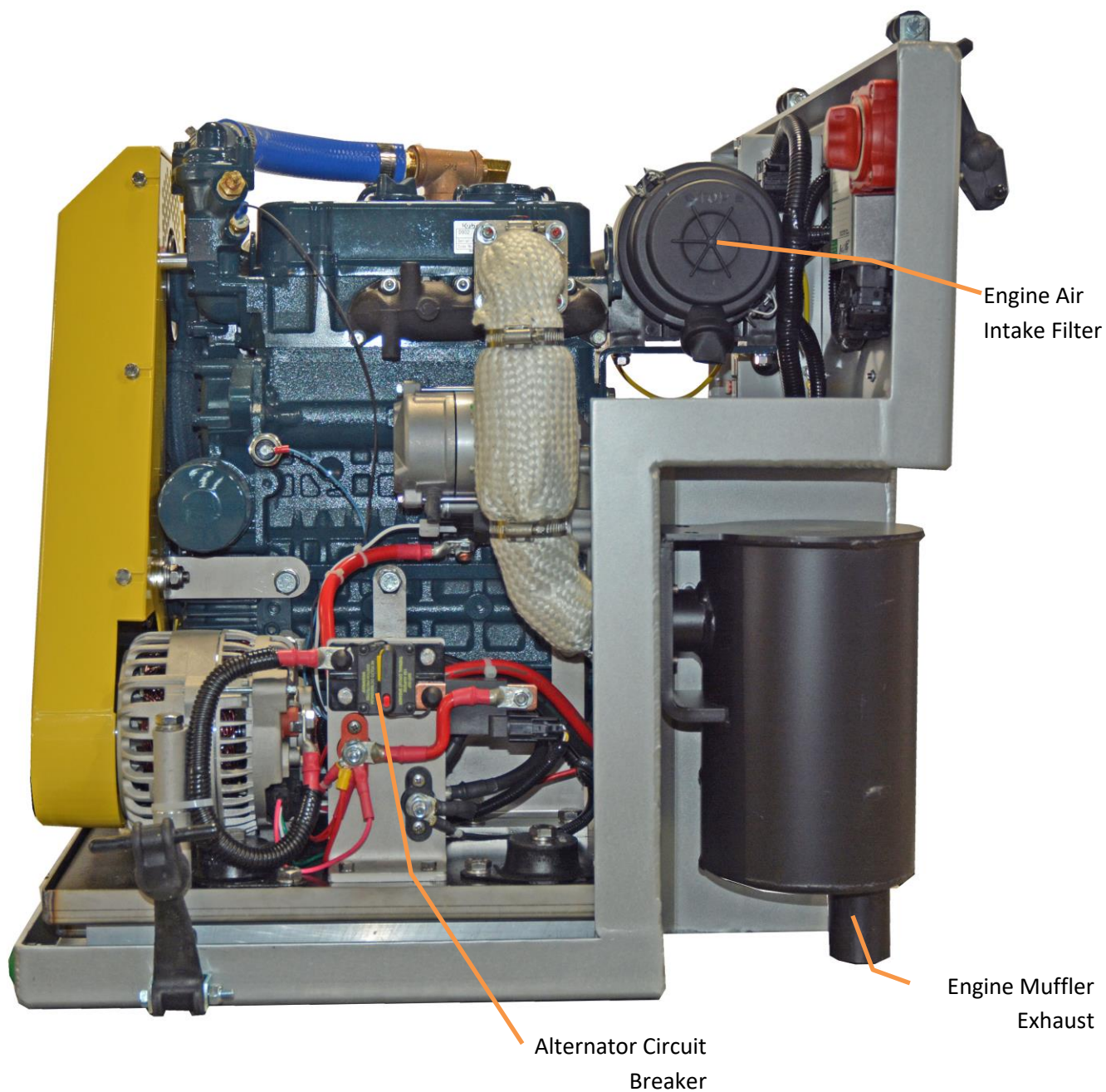


Figure 4 – AHG2000 Right Side Photographic View

3.4.5 AHG Left Side View (Diagram)

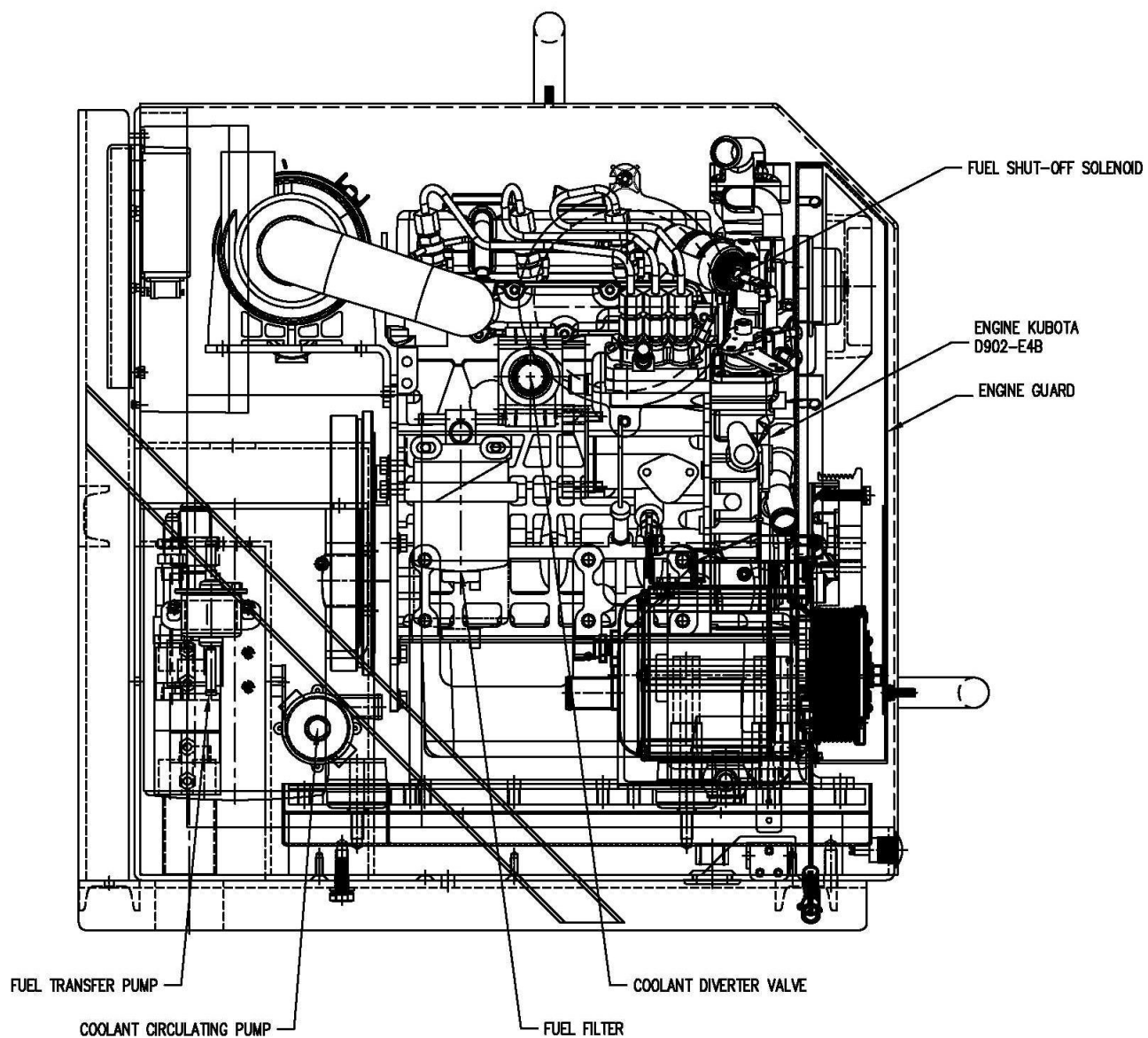


Figure 5 – AHG2000 Left Side View General Arrangement

3.4.6 AHG Left Side View (Photograph)

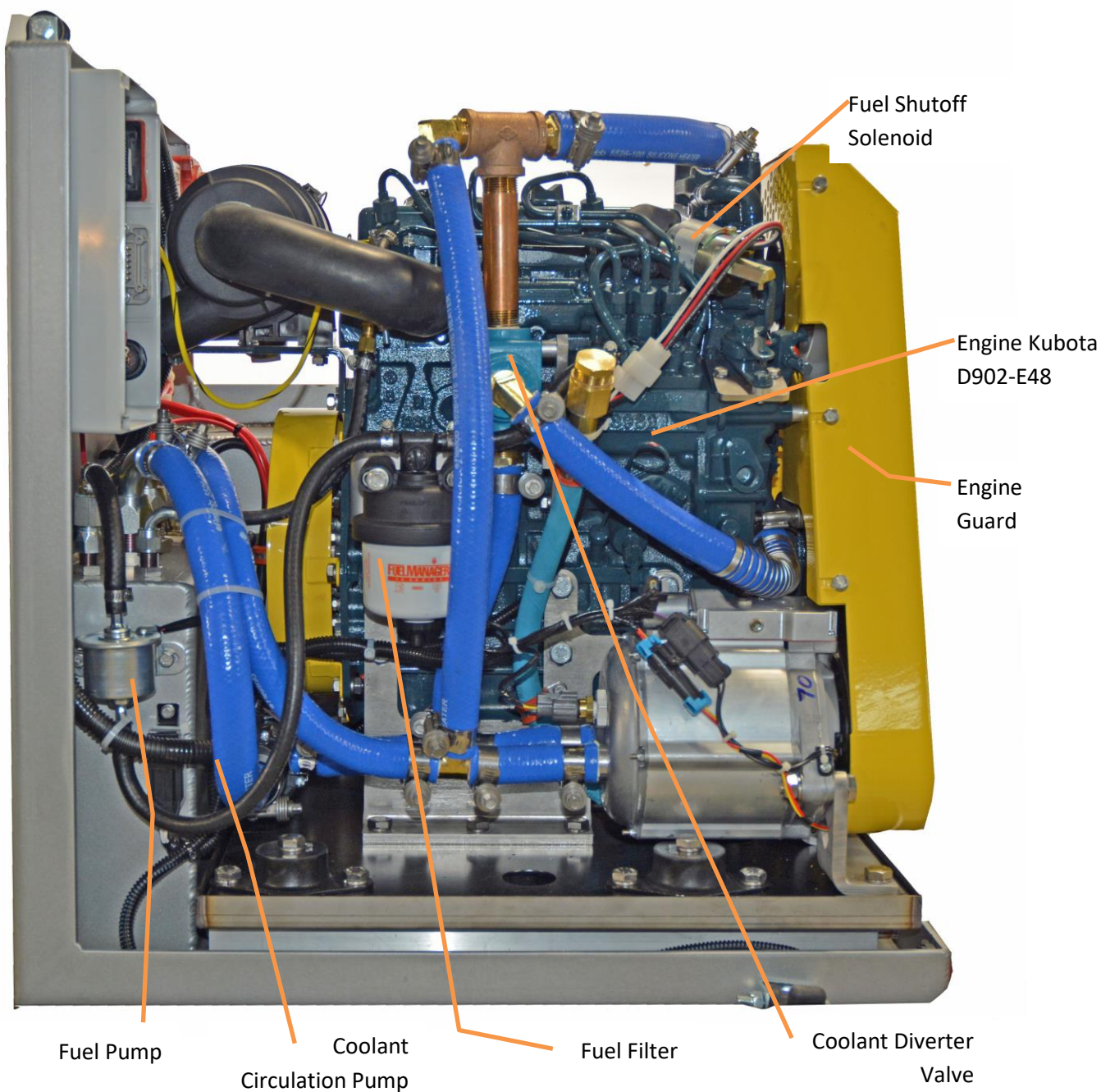


Figure 6 – AHG2000 Left Side Photographic View

3.4.7 AHG Rear View General Arrangement

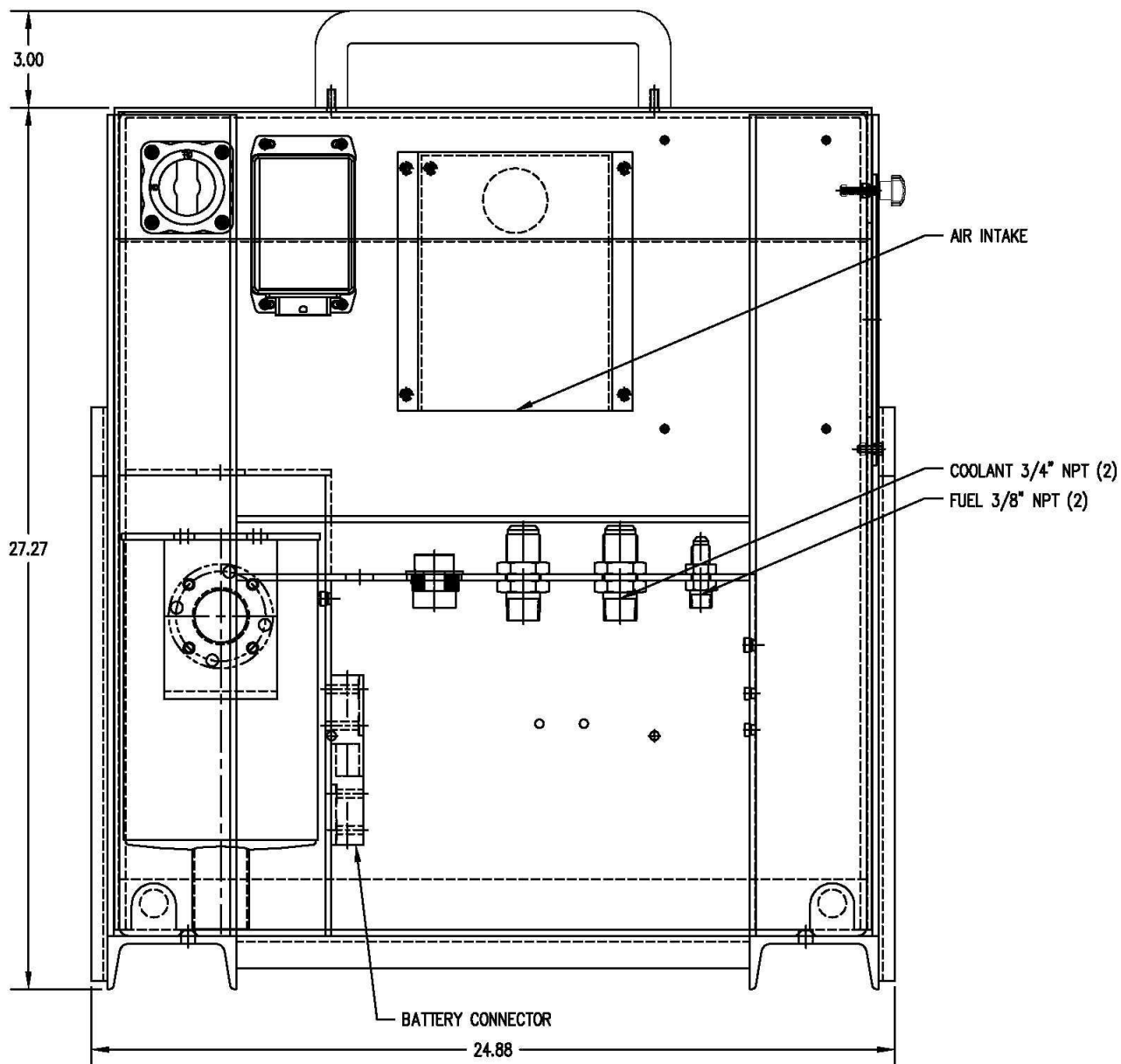


Figure 7 – AHG2000 Rear View General Arrangement

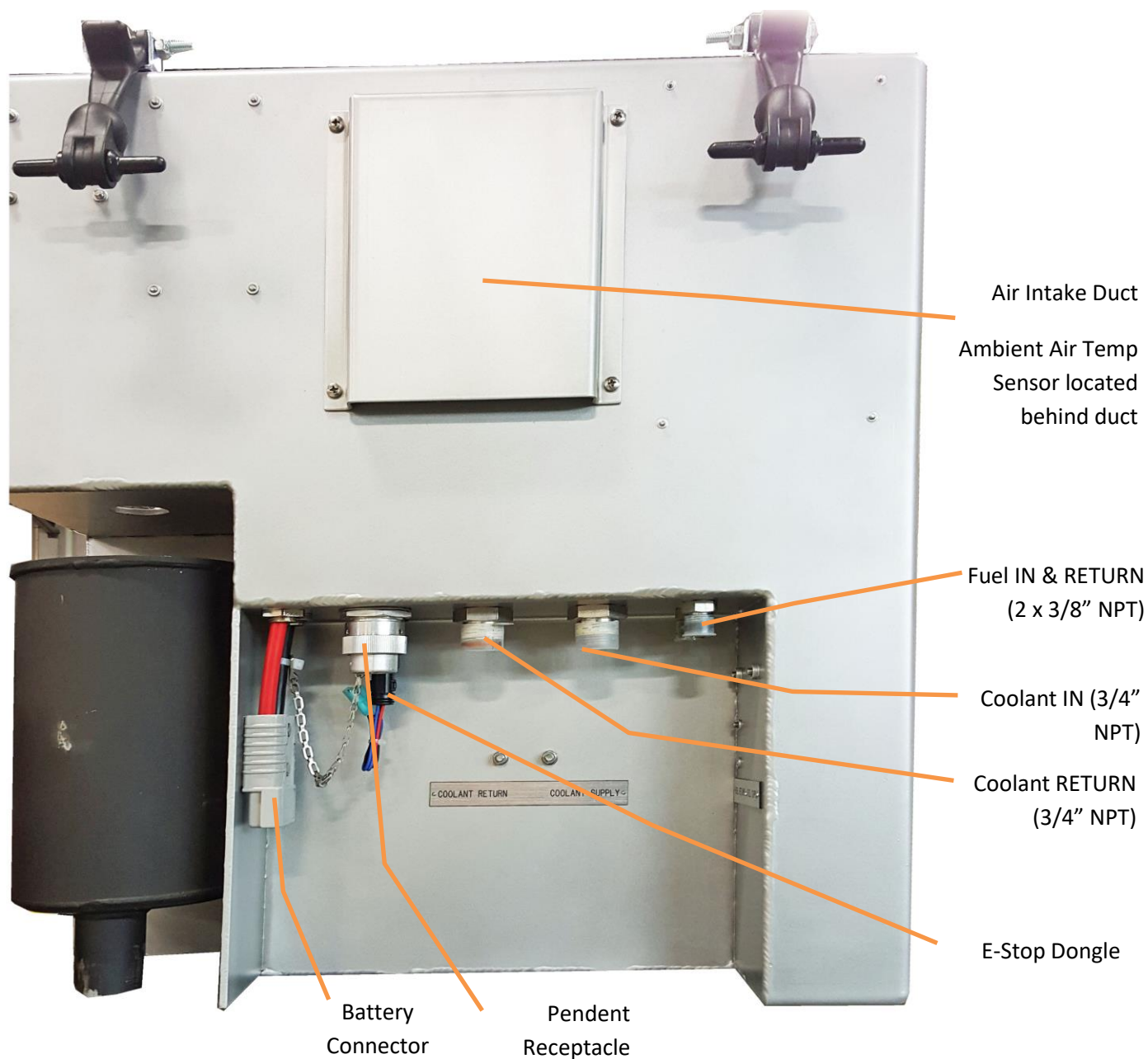


Figure 8 – AHG2000 Rear View (photographic)

3.5 AHG2000 Technical Description

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

The AHG has overall dimensions of 24.88" Wide x 27.27" Tall x 27.03" Deep. These dimensions exclude the removable handles located on the top and front face of the AHG. Each handle is 3" tall.

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

Access for dipstick removal is provided without removing the cover and it is sized for access by the Oiler while wearing arctic gloves.

LED indicators fitted to the front face of the Enclosure provide drive-by indication of "AHG Running" (Green) and an AHG Service Interval Timer "Service Due" (Red).

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) ¾" ID NPT fitting for Coolant Supply (optional stainless steel self-sealing, quick connect couplings are available).
- One (1) ¾" ID NPT fitting for Coolant Return (optional stainless steel self-sealing, quick connect couplings are available).

Fuel Service:

- One (1) 3/8" ID NPT fitting for AHG Fuel Supply. (Optional stainless steel self-sealing, quick connect couplings are available).
- One (1) 3/8" ID NPT fitting for AHG Fuel Return. (Optional stainless steel self-sealing, quick connect couplings are available).

Battery Power Service:

- Model AHG2000-12V-US-**: One 12V 175A "Battery Power" (2-wire) disconnect plug

In-Cab Control Pendant:

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

12V Auxiliary Circuit for Client Assignment:

- One Deutsch DT Series-4 connector for one switched 12VDC 15A Auxiliary Service.

Note: Mating Deutsch DT Series electrical connectors are supplied.

3.5.2 AHG Mounting Frame

A fabricated steel Mounting Frame is supplied to bolt to the truck frame and the AHG, providing a rigid on-truck installation.

3.5.3 AHG Sub-System Assemblies

3.5.3.1 Chassis and Fixtures

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

A stainless steel Drain Pan is positioned under the chassis/engine assembly, sized to capture leaks. The drip Pan is sized to hold the fluid volume of fluids within AHG 2000 system only.

3.5.3.2 Engine - Kubota D902-E4B (3) Cylinder Diesel Engine

The AHG 2000 engine selected for this application is a Kubota “Super Mini Series” 3 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 D902–E4B, with 24.8HP/18.5kW at 3600RPM max continuous output, produces ample power to drive the on-board sub-systems that provide DC electrical power and deliver up to 80,000BTU’s of liquid heat.

The Kubota D902-E4B assembly includes the following standard Kubota parts:

- Fuel Pump 12V or 24V
- Fuel Filter & Water Separator (replaceable filter element)
- Stop Solenoid (energized to run) 12V or 24V
- Glow Plugs (3) 12V or 24V
- Canister type Air Filter Kit (replaceable filter element)
- Cartridge style Oil Filter (replaceable filter element)
- High power 12V or 24V 1.4kW Starter
- Kubota Exhaust Muffler and gaskets

3.5.3.3 Engine Speed

The Kubota D902-E4B selected for this application has a max continuous speed of 3600 RPM. The AHG2000 is equipped with an adjustable Throttle Plate with six preset RPM/Power settings.



The throttle position values are as follows:

Preset	Approx. RPM Aux Heater OFF	Approx. RPM Aux Heater ON
1	850	800
2	1650	1350
3	2300	2000
4	2700	2400
5	3000	2700
6	3700	3500

Figure 9 - Throttle Plate Preset PRM's

Figure 10 - Throttle Plate Location

The AHG2000 is factory set at Preset #4; producing approximately 65,000-70,000 BTU's of heat output.

During operation, frequent cycling of the auxiliary heater (automatic clutch engagement and disengagement) identified that the AHG2000 is producing excess heat and it may be appropriate to reduce the operating RPM thus reducing the thermal output. Running the AHG2000 at lower RPM's will reduce fuel consumption and wear on the engine, the LHG 6000, Alternator, belts etc.

3.5.3.4 Fuel System

The fuel system is a simple supply and return system.

Diesel fuel flows from the truck's tank to the AHG 2000 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 the Service Bullhead fitting back to the truck's tank.

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 is located at the Fuel Filter/Water Separator unit.

3.5.3.5 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 ¼ hex stainless steel screw are used.

3.5.3.6 Lubrication System

The Kubota D902 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.

3.5.3.7 FEAD Drive Assembly (Front Engine Accessory Drive)

The LHG600 Liquid Heat Generator and Alternator are chassis-mounted and driven by the engine crankshaft power take-off through a serpentine PolyVee belt. An engine mounted belt tensioner maintains constant power transfer. A separate V belt maintains power transfer from the crankshaft take-off to drive the engine's internal water pump and cooling fan.

3.5.3.8 Coolant System

Truck coolant supply and return are connected to the AHG Service Bulkhead by two ¾" NPT (female) ports. Optional No-Spill / Quick Disconnect couplings are available.

Coolant is circulated by an onboard electric centrifugal pump that pushes coolant to support Kubota engine cooling and the LHG600 Liquid Heat Generator.

Engine coolant bleeders are located at the engine thermostat housing (bleed screw) and the LHG600 housing.

3.5.3.9 Liquid Heat Generator - Ventech Model LHG600

The Ventech LHG600 produces an almost immediate supply of heated coolant. The LHG600 is a sophisticated liquid heat generator belt driven via the FEAD assembly at engine speed. The Kubota D902 engine as fitted has a max speed of 3600 RPM. Running at a preset 2400 RPM engine speed the LHG 600 / engine combination produces ~70,000 BTU's of heated coolant.

The patented LHG600 is controlled by a dedicated microcontroller (ECU#1) mounted within the AHG Enclosure. The Ventech controller provides accurate closed loop servo control 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.

3.5.3.10 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 LHG600. 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.

3.5.3.11 Electrical System

The truck's 12V or 24V battery system supplies the AHG2000 with electrical power. Battery power enters the AHG2000 via a two pole plug mounted at the Service Bulkhead. A Battery Switch mounted inside the AHG Enclosure isolates the 12V or 24V battery power during maintenance.

3.5.3.12 AHG Control

The AHG2000 is controlled by a second dedicated microcontroller (ECU#2) mounted inside the AHG enclosure. This controller handles all AHG systems initiated from the remote In-Cab Control Panel, including engine systems, auxiliary 12V power, LHG600 liquid heating and safety circuits.

The AHG Controller circuits including ECU, relays and sub-circuit fuses 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.

3.5.3.13 Auxiliary Electrical Power Output

A 12 or 24V heavy duty alternator is belt driven by the Kubota engine, supplying up to 140 Amps (at 12V) or 100 Amps (at 24V) of electrical power to maintain charge of the main engine batteries and support the demands of the engine/chassis systems when the main engine is shut down.

Alternator load is automatically removed from the engine during cold start crank for easier starting in cold temperatures. Alternator Output is made available when the engine is running.

3.5.3.14 AHG Maintenance Due Counter

A re-settable hour's LED display is mounted inside the AHG Electrical Enclosure that monitors run time of the Kubota engine. At preset able intervals, the counter signals LED indicators at the In-Cab Control Panel and the AHG front panel (visible by drive by) that the AHG / Kubota engine maintenance /oil change is due. A second hour meter monitors LHG600 run time.

3.5.3.15 Wiring

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.

Stainless Steel insulated clamps secure the wiring harnesses to guard against vibration and movement which could result in leaks, breakages and unnecessary down-time.

3.5.3.16 Rear E-Stop Dongle

The AHG2000 is equipped with the provision to add an external (remote) emergency stop pushbutton via a 4 pin connector mounted on the rear bulkhead of the AHG2000.

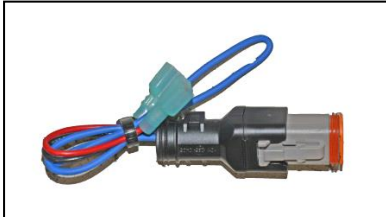


Figure 11 - Dongle

Pin #	Color	Function
1	14ga Black	Dry (relay) contacts for remote switching of aux Cabin Fan. Contacts rated to 10A@12VDC
2	14ga Red	
3	22ga Blue	Emergency Stop Loop. Continuous loop circuit required for AHG Operation. Use for remote E-Stop trailer pushbutton
4	22ga Blue	

Figure 12 – Dongle wiring color code



Figure 13 – E-Stop / Aux 1 Dongle Location

3.5.3.17 In-Cab Control Panel



Figure 14 - In-Cab Control Pendant

The In-Cab Control Pendant for wall or dashboard mounting provides the Operator with switches and status /warning indicators for the AHG2000. The In-Cab Control Pendant is connected to the AHG 2000 via a 30ft long multi-conductor umbilical cord.

The control panel includes:

Control Switches:

- Ignition ON/OFF - Rocker Switch with green LED
- Glow Plug Timer - Rocker Switch (momentary ON)
- Crank - Rocker Switch (Momentary ON)
- Aux Heater (LHG) ON/OFF - Rocker Switch with green LED
- Auxiliary 12V – ON/OFF Rocker Switch with green LED

Status Lamps:

- AHG Running - Green LED
- LHG Active - Green LED
- Glow Plugs – Green LED

Warning Lamps:

- High Engine Temp - Red LED
- Low Oil Pressure – Red LED
- Charge (no charge) – Red LED
- Service Due – Yellow LED

Digital “Hobbs-style” Meter:

- Total (engine) Run Time in hours

The In-Cab Control Pendant connects to the AHG 2000 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 AHG2000 Arctic Heat Generator. A properly installed AHG is designed to operate independent of the ignition switch of the truck.



Figure 15 - In Cab Control Pendant

The AHG2000 is equipped with an In-Cab Control Pendant used to operate the AHG2000. 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 AHG2000

4.1.1 SAFE OPERATION of the AHG2000

- 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 AHG2000 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 AHG2000. Failure to do so may damage the AHG2000 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 AHG2000 or use it as a step.

4.1.2 KUBOTA ENGINE MANUAL

The central AHG2000 component is a Kubota three-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 AHG2000 uses the D902-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 AHG2000. 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 AHG2000 (Coolant IN and Coolant OUT), these valves must be open before operation of the AHG2000.

Starvation of coolant flow during operation will likely result in catastrophic failure of the AHG2000 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 AHG2000 is connected to either a 12 or 24V source via the rear 12V/24V Battery connector.
- Ensure that the E-Stop Dongle is plugged into the rear bulkhead of the AHG2000 and that the E-Stop Loop is connected and a closed circuit.
- Ensure that the AHG2000 is supplied with Fuel (feed and return).
- Ensure that the AHG2000 is connected to a coolant circuit (see Installation section of this manual).
- Ensure that the VDC Service Disconnect, located inside the AHG housing, is in the "ON" position
- Turn on the IGNITION of the AHG2000. The rocker switch will illuminate green. The "Low Oil Press" lamp will illuminate (Red).
- Depress and release the GLOW PLUGS momentary rocker switch. The Glow Plumps lamp (green) will illuminate for 20 seconds while the glow plugs are automatically cycled.
- Press the CRANK rocker switch until the AHG engine starts.

- Once the engine starts, the “AHG Running” lamp will illuminate (Green). The “Low Oil Press” lamp will turn off.

4.1.4 Shutdown Procedure

- Turn off the IGNITION of the AHG2000.
- Turn off the 12V Disconnect during long term inactivity (leaving the 12V disconnect ON, even with Ignition off, may cause battery drain during cold ambient temperatures due to the automated Oil Pan heater.

4.2 General Operation

The AHG2000 has two modes of heater output.

When the AHG is running, but without the LHG600 turned on “AUX HEATER (LHG)”, the AHG2000 delivers approximately 20,000 Btu’s/hr.

When the AHG is running, and the AUX HEATER (LHG) is switched on, the AHG2000 delivers approximately 70,000 Btu’s/hr. of coolant heat when operated with the adjustable Throttle in Position #4. See (3.5.3.3).

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.

Aux Heater OFF (Disengaged) – Approximate performance			
Throttle Position	RPM	Btu’s/Hr.	kW output
1	850	RPM too low for Aux Heater Operation	
2	1650	9,000	2.6 kW
3	2300	12,000	3.5 kW
4	2700	17,000	5.0 kW
5	3000	18,000	5.3 kW
6	3700	26,000	7.7 kW
Aux Heater ON (Engaged) – Approximate performance			
Throttle Position	RPM	Btu’s/Hr.	kW output
1	800	RPM too low for Aux Heater Operation	
2	1350		
3	2000	37,000	11 kW
4	2400	50,000	15 kW
5	2700	65,000	19 kW
6	3500	80,000	23.5 kW

Once the AHG is running, an internal timer prevents the alternator and LHG600 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 AHG2000 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).

4.2.1 Setting the Service Interval (Countdown) Timer (Maintenance Hours)

The AHG2000 is equipped with an LED Service Interval Timer that triggers a visual indicator, prompting to perform routine maintenance. The visual indicator is the Red Lamp on the front of the AHG2000 housing, as well as the Orange lamp on the in-cab Pendant.

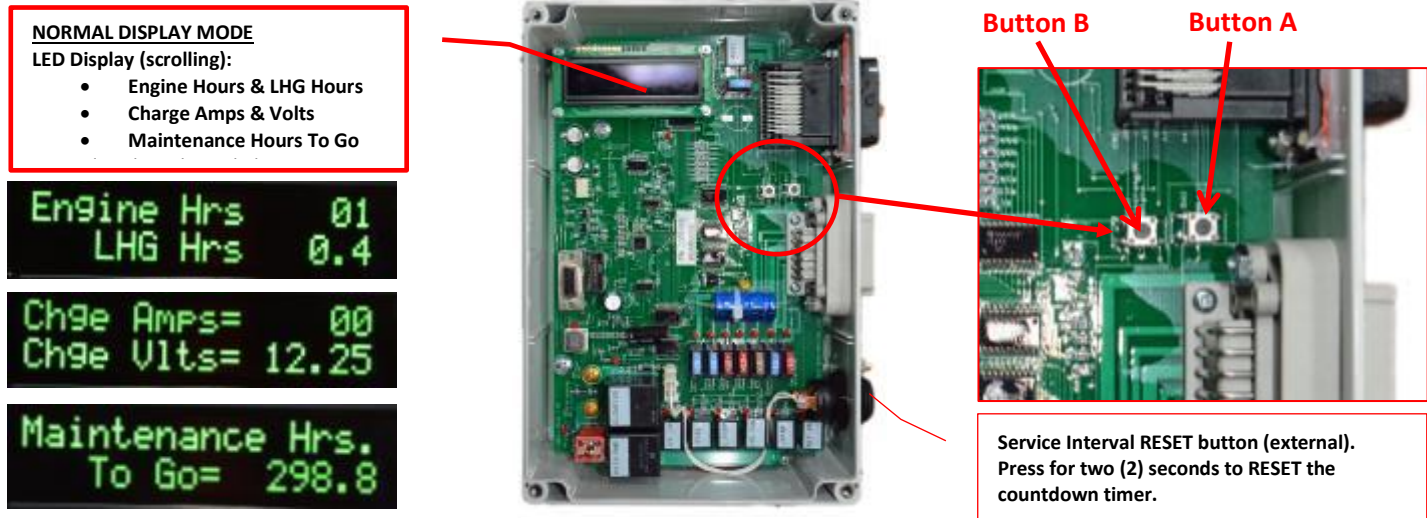


Figure 17 - LED Display during Normal Operating Mode

Figure 16 - Location of Service Interval Programming Pushbuttons

The factory default setting for the Service Interval Timer (Maintenance Hours) is 300 hours when supplied installed in an AHG. Loose controllers are shipped with the Service Interval Timer set to 0.1 hours and will need to be programmed upon installation.

To set the **Service Interval Period**, perform the following steps:

- Remove the clear cover from the AHG Control Box.
- Turn on the AHG Ignition (do not start the engine)
- Observe that the LED display is active and the various parameters are scrolling (example values shown above).
- Enter the **Programming Mode** by pressing **Button A** once and release
- Observe that the display changes to “Set Maint. Hrs. XXXX.X.” similar to below:

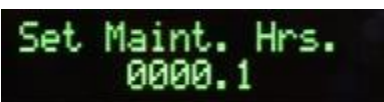


Figure 18 - Programming Mode display

- The left hand digit will be flashing, indicating that this is the digit that you wish to change. Each time **Button A** is pressed and released, the digit to be changed (flashing) will move to the next. By repeatedly pressing **Button A**, you can scroll between thousands, hundreds, tens, single, and tenths of an hour.
- Pulse **Button A** until the desired digit to be changed is flashing.
- Press (slow pulses) **Button B** to increment the value of the chosen digit.
- Press **Button A** to move onto the next digit

- Once all the digits have been set, simply wait ten seconds until the display reverts to the **Normal Display Mode**.
- Once the **Normal Display Mode** appears, turn off the AHG ignition
- Replace the clear cover on the AHG Control Box.

Note that after ten seconds of no button activity, the display will revert to the Normal Display Mode, exiting the Programming Mode.

During normal operation, the **Service Interval Timer** will count down the **Service Interval Period** set per the previous instructions. After the service interval period has elapsed, the Service Indicators will illuminate on the front of the AHG enclosure and Pendant. To reset the **Service Interval Period** (and extinguish the lamps), depress the RESET button on the right side of the Control Box for two seconds.



To reset the **Service Interval Period** (and extinguish the lamps), depress the RESET button on the right side of the Control Box for two seconds.

4.2.2 Emergency use of the ENGINE STOP LEVER

The engine stop lever may be used to stop the engine at the unit in an emergency or when the control panel is not readily accessible.

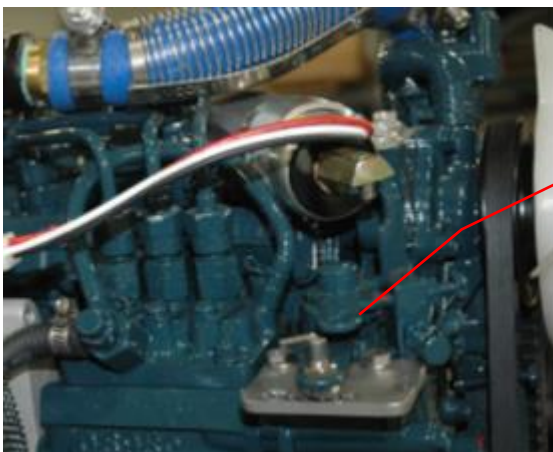


Figure 19 - Emergency Engine Stop Lever

Engine Stop Lever. In case of an emergency, move lever to left to stop engine.

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.

5.2.1 Changing interval of Engine oil and oil filter cartridge.

Engine Oil and Filter Replacement Schedule		
D902-E3	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 AHG2000 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 21- Oil Suction Gun

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 20 - Oil Pan Suction Hose

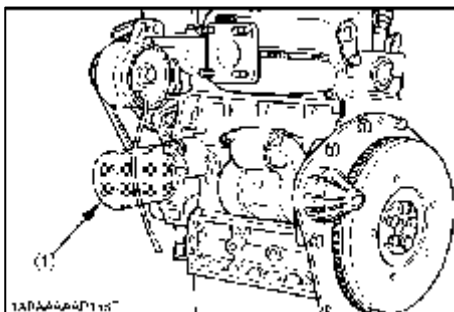


Figure 22 - Oil Filter Location

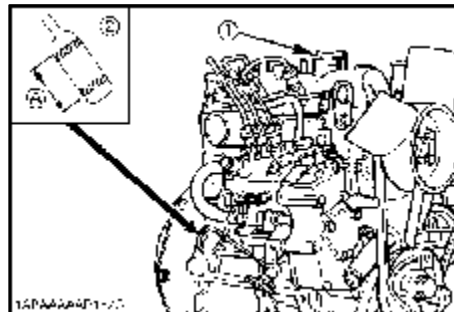


Figure 23 - Oil Dipstick Location

Add Oil. The capacity is 3.7 liters. Check the oil level using the dipstick. 96 fl.oz of oil with 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

5.3 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.

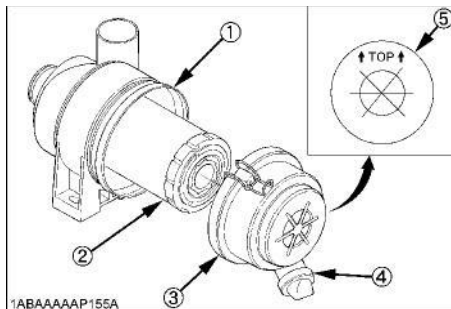


Figure 24 - Engine Air Filter Components

- (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.

5.4 Fuel Filter

The AHG2000 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 designed to fit the AHG frame. A complete AHG2000 includes the items listed below. The smaller items, fittings etc. are bundled together in a box.

6.1.1 What comes with the AHG2000 (Packing List)

Item	Part Number	Part Description	Qty
1		Mounting Frame	1
2	AHG2000	Arctic Heat Generator	1
3		In-Cab Control Pendant	1
4		Battery Plug with (2) 2AWG Wire Lugs	1
5		Aux 1 / E-Stop Pigtail "Dongle"	1
6		LHG Bleeder Wrench	1
7		Cover Handles with Hardware (loose and removed for shipping)	2
8		Kubota D902 Engine Operators Manual	1
9		AHG2000 Operators Manual	1
		Installation Drawings	1 set

Table 5 - AHG2000 Packing List

6.2 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:

- 1/2" or 5/8" Grade 8 bolts for mounting the AHG2000 frame to the truck or equipment frame.
- 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. We supply commonly used brass fittings. Shut-off valves are recommended.

6.3 DISCLAIMER

It is very important that the truck's coolant and fuel systems be free of leaks and contamination before installing an AHG2000. 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.

6.4 Mounting Frame Installation

Depending on the application, there are many ways and configurations to mount the AHG2000 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, two fuel lines (feed and return), 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.

6.4.1 REMOVE AHG Mounting Frame from the AHG2000

The AHG2000 is shipped, attached to the truck/trailer/equipment mounting frame ("mounting frame"). The AHG2000 must first be removed from the frame. The AHG2000 is secured to the mounting frame using 4 bolts that are accessible from the underside of the AHG.

- Remove the AHG2000 cover.
- Identify the two lifting eyes attached to the top of the Kubota engine.
- Use a hoist to lift the AHG2000 (still attached to the mounting frame) off the floor.
- Carefully remove the four bolts that secure the mounting frame to the underside of the AHG.

Warning: The AHG mounting frame is heavy. Use two additional people to support the mounting frame as the bolts are removed. Do not let the frame drop.

With the mounting frame removed, it is now ready for installation on the truck/trailer frame rail or other industrial equipment.



Install the mounting frame to the truck frame with four 1/2" or 5/8" bolts (Grade 8 or equivalent). Occasionally, existing cross member or bracket holes in the truck frame may be used to attach one leg of the unit frame. Replace the existing bolts with bolts that are one inch longer.

We recommend leaving a clearance on either side of the AHG of at least 4 inches. The overall dimensions of the AHG mounting frame are shown in the drawings supplied with the AHG2000 shipment.

Figure 25 - Mounting Frame

When using existing bolt holes, it may be impossible to perfectly center the holes side to side on the AHG mounting frame uprights. The bolt-hole centerline may be a maximum of one inch away from the frame centerline.



The photo shown below is an installation performed on a Kenworth T800 truck. The vertical supports of the AHG mounting frame aligned with existing bolt locations on the truck chassis (as shown).

Figure 26 - Typical Truck Chassis Location



The installed mounting frame on a Kenworth T800 chassis.

Figure 27 - Installed Mounting Frame



Once the mounting framed is secure, lift the AHG2000 onto the frame using chains attached to the Kubota lifting eyes.

Align the AHG assembly mounting holes (underside) with the hole locations on the horizontal rails of the mounting frame.

Secure the AHG to the mounting frame using the bolts provided.

Figure 28 - AHG2000 located on Mounting Frame

6.5 Fuel Connection

The AHG2000 gets its fuel from the truck tank(s). A pair of $\frac{1}{4}$ " fuel lines must be installed to and from the truck fuel system to the rear of the AHG2000.

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

If only a single $\frac{1}{2}$ " NPT port is available on the tank then a simple 'combination' suction / return tube assembly can be made using brass fittings and a standard Kenworth (or similar) suction pipe. The suction pipe used in these photographs is Kenworth PN# V8810033.

Remove the $\frac{1}{2}$ " NPT tank plug and install a $\frac{1}{2}$ " NPT brass street tee (sideways). Insert the suction pipe into the vertical side of the Tee and down into the tank (this is now the AHG Fuel Supply Line connection). The remaining port now connects to the AHG fuel return line.

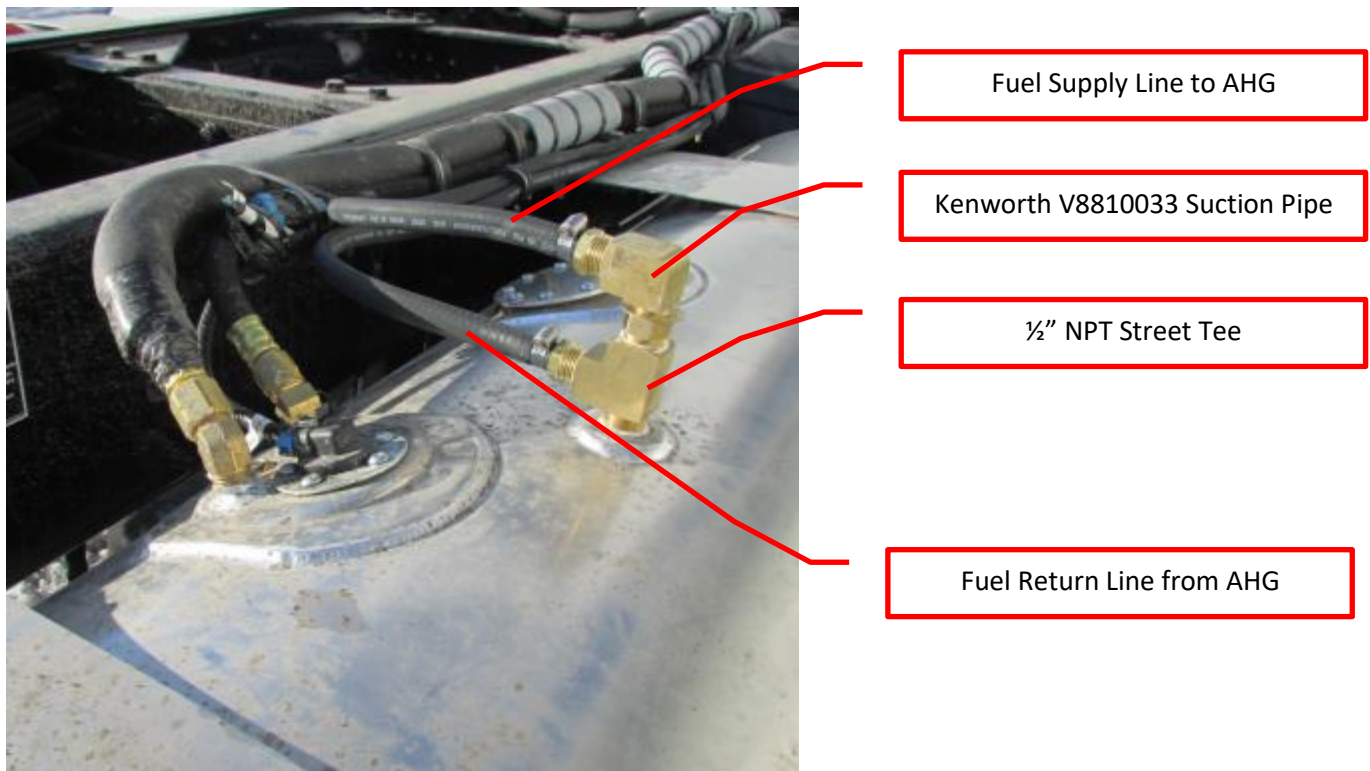


Figure 29 - Fuel Tank Connections

6.6 Coolant Plumbing

Integrating the AHG2000 with the trucks coolant system involves two tasks:

Installing the SUPPLY hose (coolant flowing from the truck engine to the AHG2000)

Installing the RETURN hose (coolant flowing from the AHG2000 to the truck engine).

6.6.1 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 AHG2000 (Coolant IN and Coolant OUT), these valves must be open before operation of the AHG2000. Starvation of coolant flow during operation will likely result in catastrophic failure of the AHG2000 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.

6.6.2 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.

6.7 Coolant Plumbing - Simple

Installation of the AHG2000 **should not affect** the cabin heater performance when the ***AHG2000 is not being operated***. However, due to hose lengths and the location of the AHG2000 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:

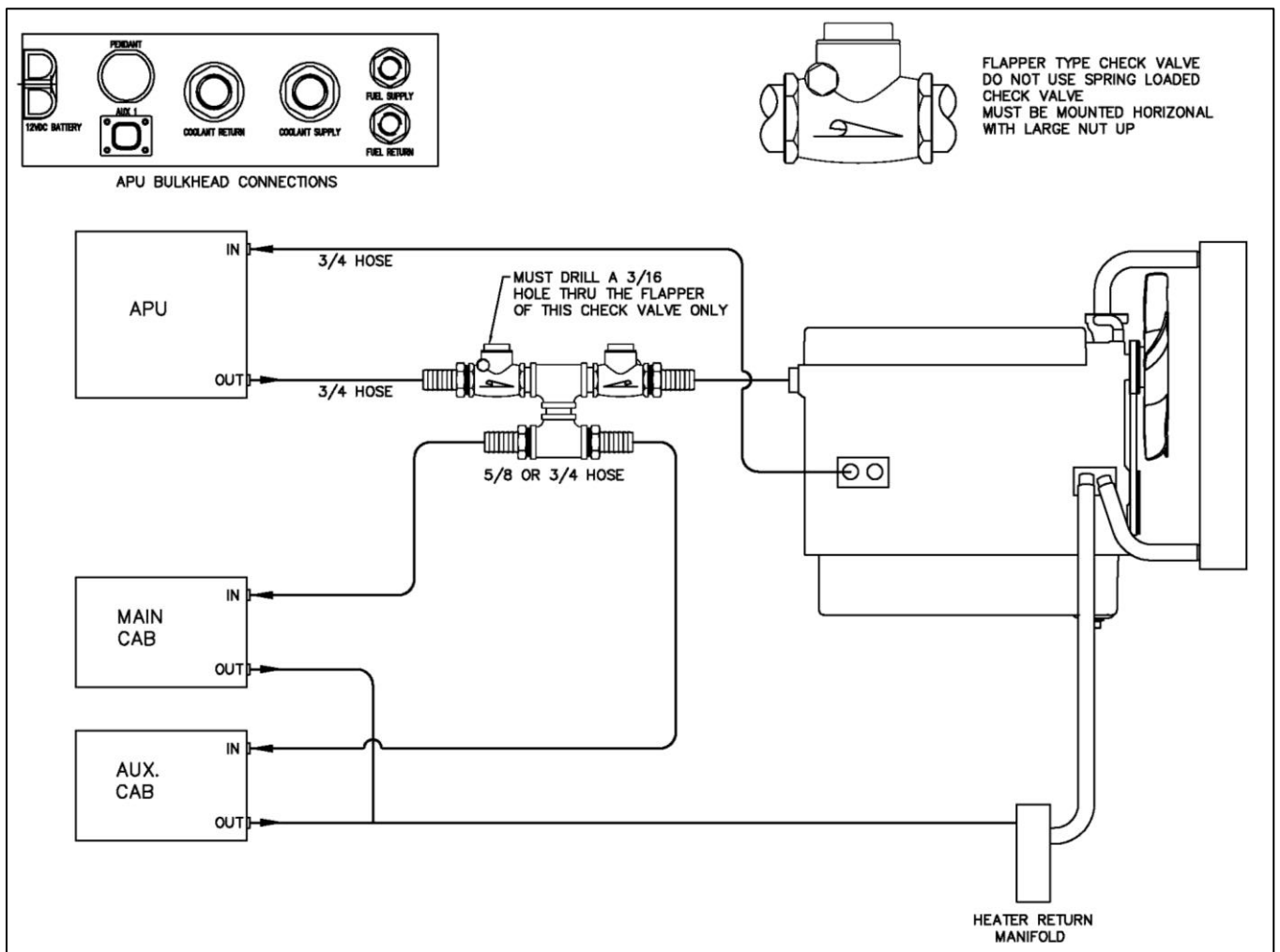


Figure 30 - Chassis Manifold Schematic (Simple)



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 31 - Example of simple Chassis Manifold

6.8 Coolant Plumbing – advanced

If the AHG2000 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:

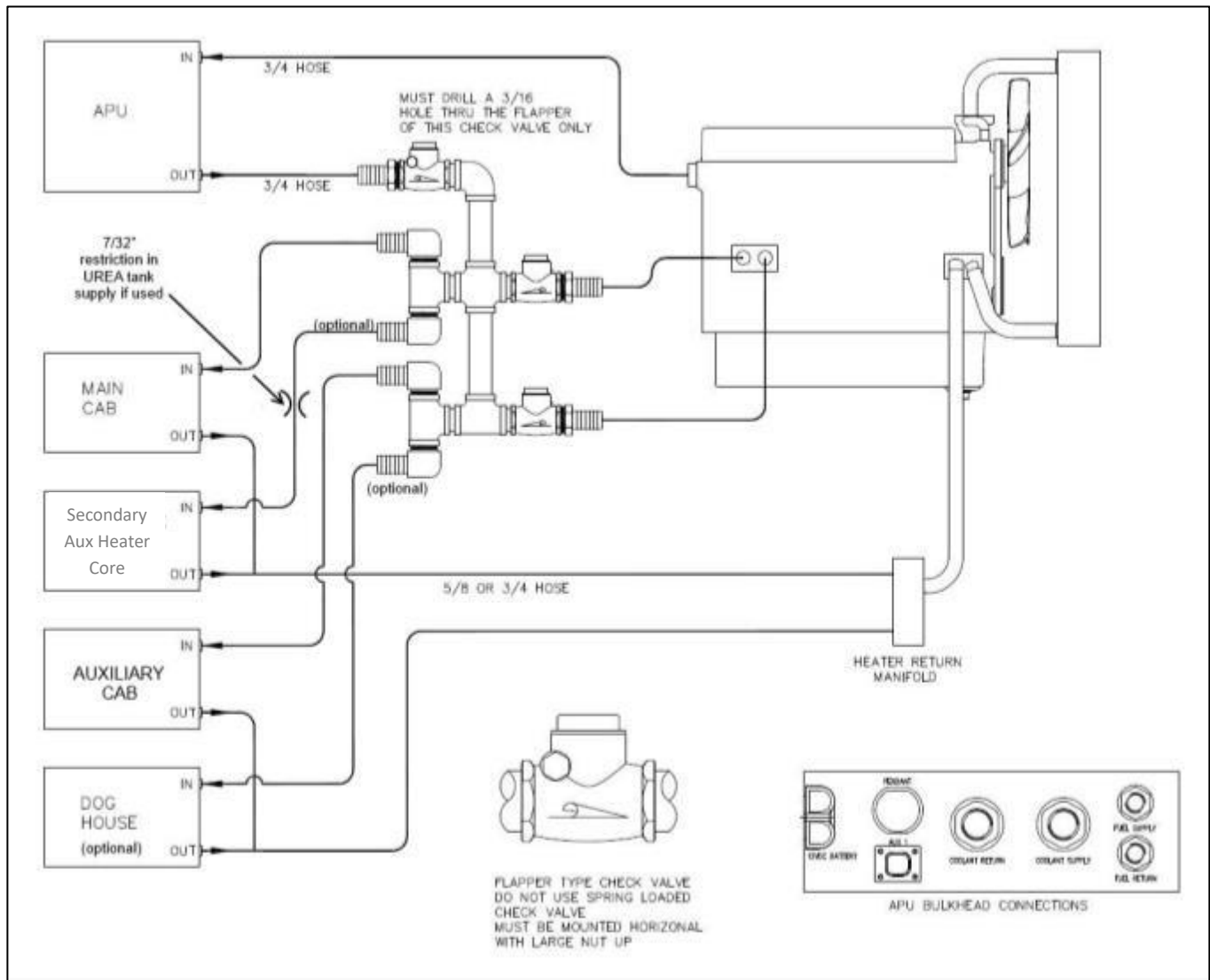


Figure 32 - Chassis Manifold Schematic (Advanced)

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

6.9 Electrical Installation

The AHG2000 integrates electrically with the truck or industrial equipment via the rear bulkhead of the AHG2000. Operation of the AHG2000 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 AHG2000 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 AHG2000
- Connect the Control Pendant to the AHG2000
- Install the AHG 12V power lead (mating plug included with AHG).
- Test the AHG2000.

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

It should be noted that the 24V version of the AHG2000 is manufactured using a 24V alternator that provides a 24V charge output to the host equipment or truck.

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.
- Turn on Main Battery Disconnect (red switch)



Figure 33 - 12V or 24V Main Battery Disconnect

- Confirm that the Pilot indicator is illuminated on the ignition switch of the Pendent. The Pilot Light is illuminated when the AHG is connected to 12V, the Main Disconnect (inside the AHG) is in the ON position, and the Ignition Switch is OFF.



- Turn on IGNITION switch on Control Panel (1st switch). The internal coolant pump and fuel pump should start running. Leave running for several minutes to allow air to purge through the cooling system.

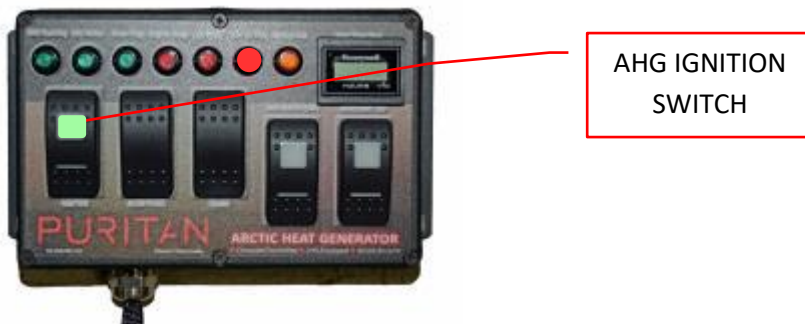


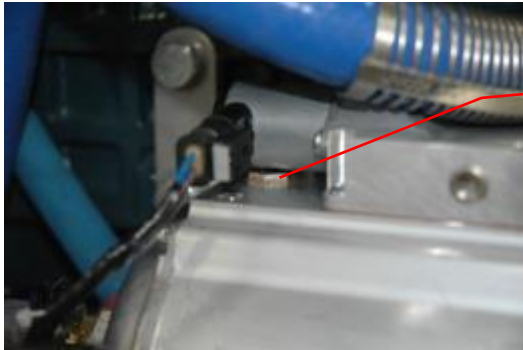
Figure 34 - AHG Ignition Switch ON

- There are three steps to bleeding the coolant of an installed AHG on a truck.
 - 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.



Figure 35 - Engine Coolant Bleed Screw Location

- Step #3 is to bleed the Ventech LHG. Using the wrench provided, open the bleed screw located underneath the control valve mounted on top of the main LHG assembly. Allow all air to purge.



Bleed screw on
LHG600

Figure 36 - LHG 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 37 - 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 38 - Engine Injector Pump Bleed Fitting Location

- Press and release the GLOW PLUGS momentary switch. The Glow Plugs lamp will illuminate for 10 seconds.



Figure 39 - Activating Glow Plugs from the Pendant

When the Glow Plugs light extinguishes, Press CRANK until AHG engine starts. The Low Oil Press lamp will extinguish and the AHG Running lamp will illuminate.

Note: If the engine fails to start, a timer will prevent a re-crank until 3 seconds has passed. After three seconds, attempt to restart the AHG.



Figure 40 - AHG Running Indicator (Pendant) shown

- Once the AHG starts, allow the AHG to run for several minutes, and then repeat the coolant air purge steps previously described.
- While the AHG is running, start the vehicle engine and run on fast idle for 5 minutes to purge any remaining air from the Liquid Heat Generator and coolant system.

Note: Once the AHG is running, it **will not** immediately energize the alternator. The AHG control system includes a timer that prevents alternator charging, as well as the operation of the Aux Heater (Ventech LHG600 – 4th switch from left). This timer is implemented to allow the engine to stabilize before being subject to the loads of the alternator and LHG600. The timer (delay) is set to 60 seconds.

- Turn ON the Aux Heater (Ventech LHG600) by pressing the Aux Heater switch



Figure 41 - Aux Heater (LHG) Activation Switch shown on Pendant

Note: By depressing the Aux Heater ON switch, the LHG600 is 'armed' but not necessarily 'active' (clutch engaged and producing auxiliary heat). Internal software determines when to engage the LHG600 and produce heat and how much heat to produce, depending on various parameters such as RPM and current coolant temperatures.

- If the Auxiliary 12V output has been used, it can be energized via the AUXILLIARY 12V rocker switch.

8 Troubleshooting

8.1 7.1 Recommended Spare Parts List

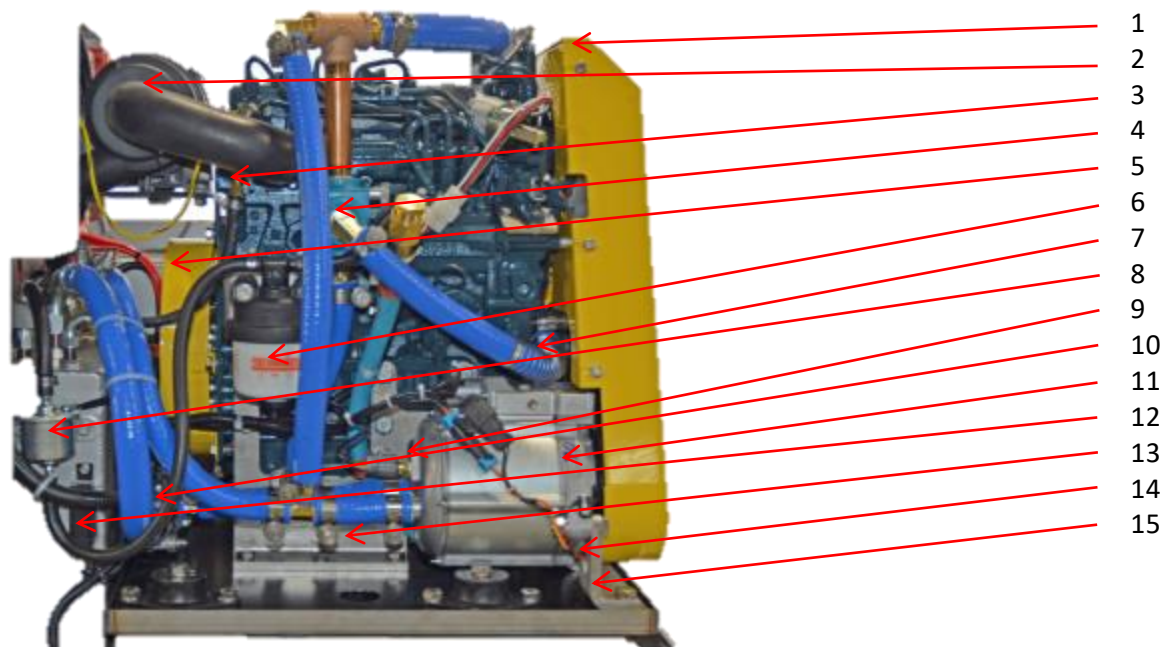
DESCRIPTION	VENTECH PART NUMBER
Cover - New style	30-4237-A4
Cover Original	30-4237-A0
Handles (Set of 2)	995-0027
Mounting Frame	30-4229-A3
Decal Set	995-0029
Retaining rubber straps (Set of 4)	995-0028
APU Pendant (with Hour Meter)	995-0023
AHG Slide-Out Mount	30-4265-A0
Fuel Pump 12V	995-0004
Fuel Pump 24V	995-0053
Temp Sensor – Engine Coolant	995-0005
Pressure Switch – Engine Oil	995-0055
Fuel Return Brass Check Valve	995-0006
Coolant Circulation Pump 12V	995-0007
Coolant Circulation Pump 24V	995-0054
Thermostat - coolant valve	995-0008
Exhaust Assembly (Muffler, Pipe, Heat Sleeve, Clamps)	995-0009
Heavy Duty Fluid Reservoir Heater	995-0010
Oil Pan Heater Thermostat	995-0011
Circuit Breaker, 150 amp	995-0012
Indicator Light Green LED 12V	995-0013
Indicator Light Red LED 12V	995-0014
Battery Switch	995-0015
Automotive Relay 70A 12V	995-0016

Heavy Duty Alternator - 140 amp / 12V	995-0017
Heavy Duty Alternator - 100 amp / 24V	995-0052
Belt Tensioner, CW, 6 groove pulley	995-0018
Pulley, Flat Steel, 70mm dia. x 17mm bore x 27mm wide	995-0019
Belt, 8 groove, effective length 48.5 long (1230 mm)	995-0020
Kubota Vee Belt	995-0021
Air Filter	995-0001
Fuel Filter / Separator Element	995-0003
AHG Current Measurement Module	995-0025
APU / AHG Controller	995-0026
Battery Plug 12V with (2) 2AWG Wire Lugs	995-0031
Battery Plug 24V with (3) 2AWG Wire Lugs	995-0032
Aux 1 - E Stop Loop -12V w/ Deutsch 4 Pin Dongle	995-0033
SHOCKER POSITIVE INTAKE AIR BREAK SYSTEM (OEM)	995-0030
LHG 600 HEATER (ONLY)	LHG600
LHG600 MICROCONTROLLER	135-0007-A0
RPM Sensor	940-0001-A0
LHG Temp Sensor	940-0007-A0
LHG Bleeder Wrench	14-0016-A0
AHG Complete Harness (excludes high current 12V cables)	995-0022
Constant Tension Clamps (bag of 10) SAE 12 11/16" – 1 1/4"	995-0040
Constant Tension Clamps (bag of 10) SAE 16 13/16" – 1 1/2"	995-0041
Fuel Line (6ft) 3/16" dia.	995-0042
Fuel Line (6ft) 3/16" dia.	995-0043
Coolant Lines (10ft) 3/4" dia	995-0044
Coolant Lines (10ft) 1" dia	995-0045
Hose Coil 3/4"	995-0046
Engine Nylon Fan	30-4246-A0
Front Guard Base	30-4238-A4
Front Guard Cover	30-4238-A3
Flywheel Guard	30-4243-A0

Pan Drain Access Plug	995-0035
Engine Mount LH	30-4211-A2
Engine Mount RH	30-4212-A2
Tensioner / LHG Mounting Bracket	30-4216-A9
Alternator Mounting Post (Set of 3)	30-4215-A1
LHG Support Bracket	30-4218-A1
LHG Side Shield	30-4220-A1
Engine Starter (non-Kubota) 12V	995-0050
Engine Starter (non-Kubota) 24V	955-0051
Engine Starter (Kubota) 12V	995-0036
Engine Starter (Kubota) 24V	995-0049
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
LHG Clutch Fuse – 15A	96-0006-A0

8.2 7.2 Part Identification

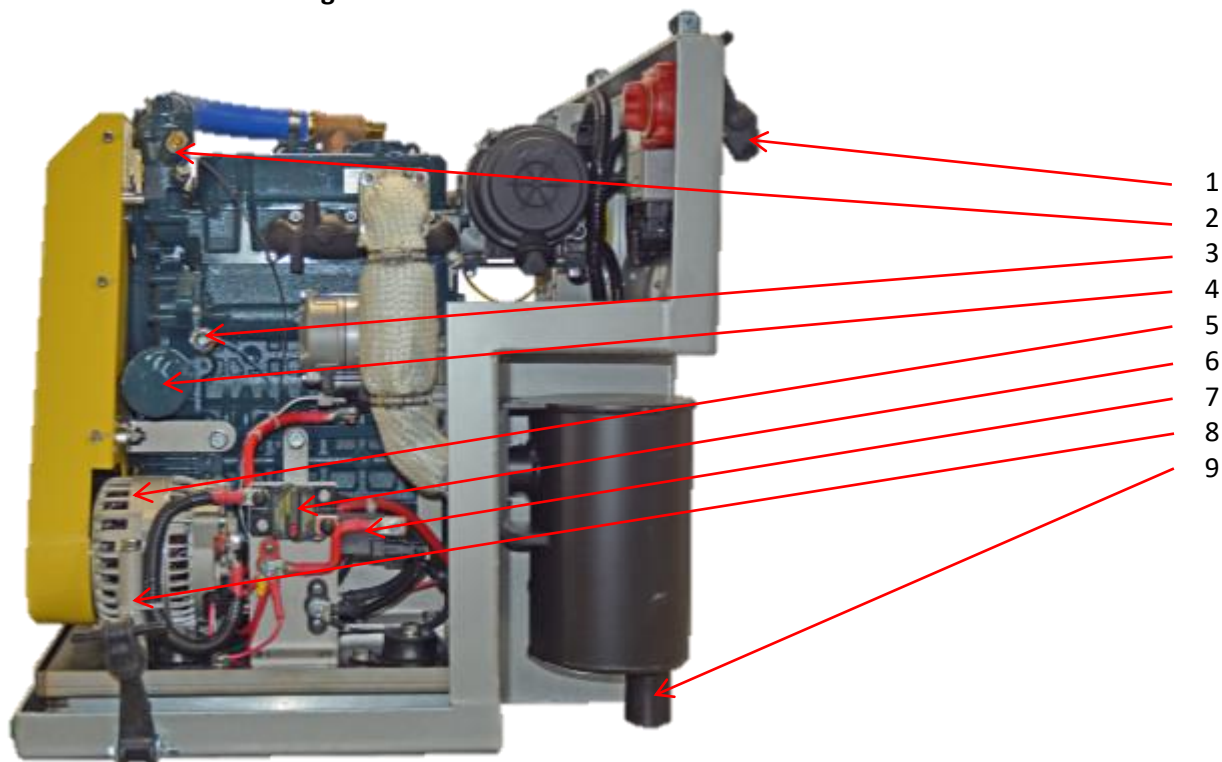
8.3 AHG2000 Left Side View – Part Identification



Picture Location	VENTECH PART NUMBER	DESCRIPTION
1	30-4238-A4 30-4239-A3	Front Guard assembly
2	995-0001	Air Filter
3	995-0006	Fuel Return Check Valve
4	995-0008	Thermostatic - coolant diverter valve
5	30-4243-A0	Rear Guard assembly
6	995-0003	Fuel Filter / Separator Element
7	995-0046	Hose coil 3/4"
8	995-0004	Fuel Pump
9	940-0007-A0	LHG Temp Sensor
10	995-0007	Coolant Circulation Pump
11	LHG600	LHG 600 HEATER (ONLY)
12	995-0016	Automotive Relay 70A 12V

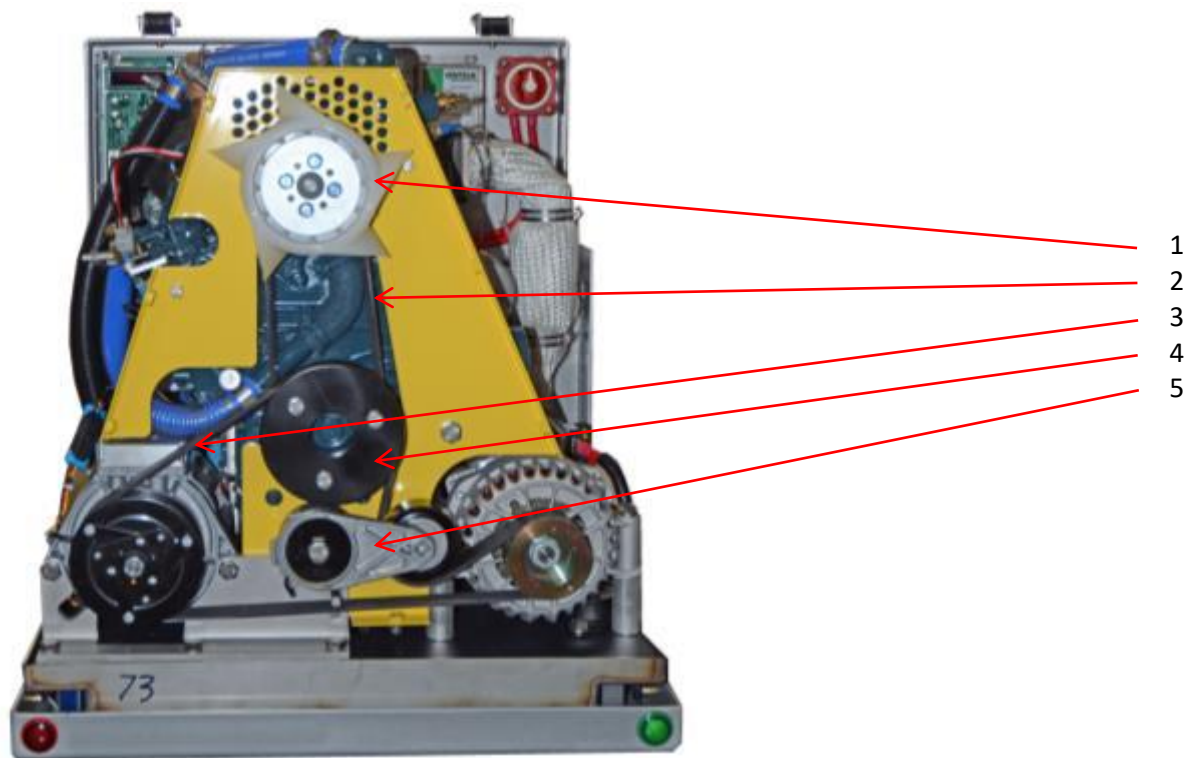
13	30-4211-A2 30-4212-A2	Engine Mount (set)
14	940-0001-A0	RPM Sensor
15	30-4216-A9	LHG Mounting Bracket

8.3.1 AHG2000 Right Side View – Part Identification



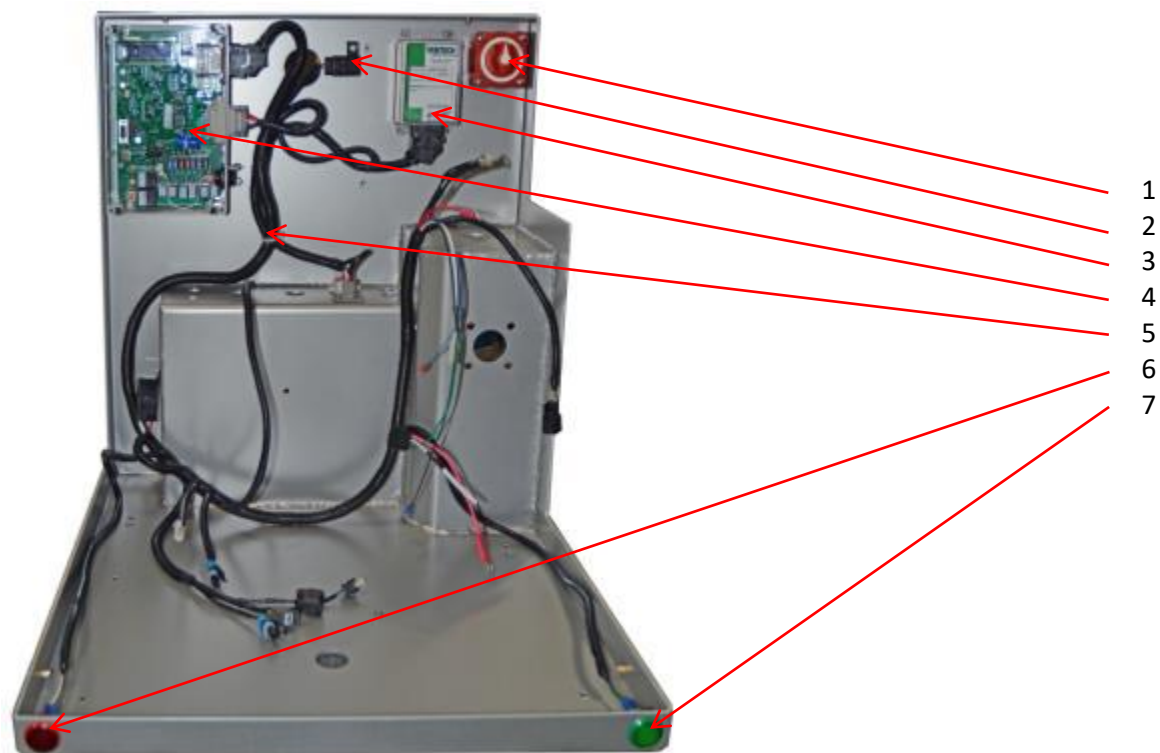
Picture Location	VENTECH PART NUMBER	DESCRIPTION
1	995-0028	Retaining rubber straps (Set of 4)
2	995-0005	Temperature Sensor – Engine Coolant
3	995-0055	Pressure Sensor – Engine Oil
4	995-0056	Engine Oil Filter
5	995-0017	Heavy Duty Alternator - 140 amp
6	995-0012	Circuit Breaker, 150 amp
7	995-0025	AHG Current Measurement Module
8	30-4215-A1	Alternator Mounting Post (Set of 3)
9	995-0009	Muffler plus 2 gaskets

8.3.2 AHG2000 Front View FEAD – Part Identification



Picture Location	VENTECH PART NUMBER	DESCRIPTION
1	30-4246-A0	Custom Nylon Cooling Fan
2	995-0021	Kubota Vee Belt
3	995-0020	Belt, 8 groove, effective length 48.5 long (1230 mm)
4	995-0019	Pulley, Flat Steel, 70mm dia. x 17mm bore x 27mm wide
5	995-0018	Belt Tensioner, CW, 6 groove pulley

8.3.3 AHG2000 Front View Chassis Electrical – Part Identification



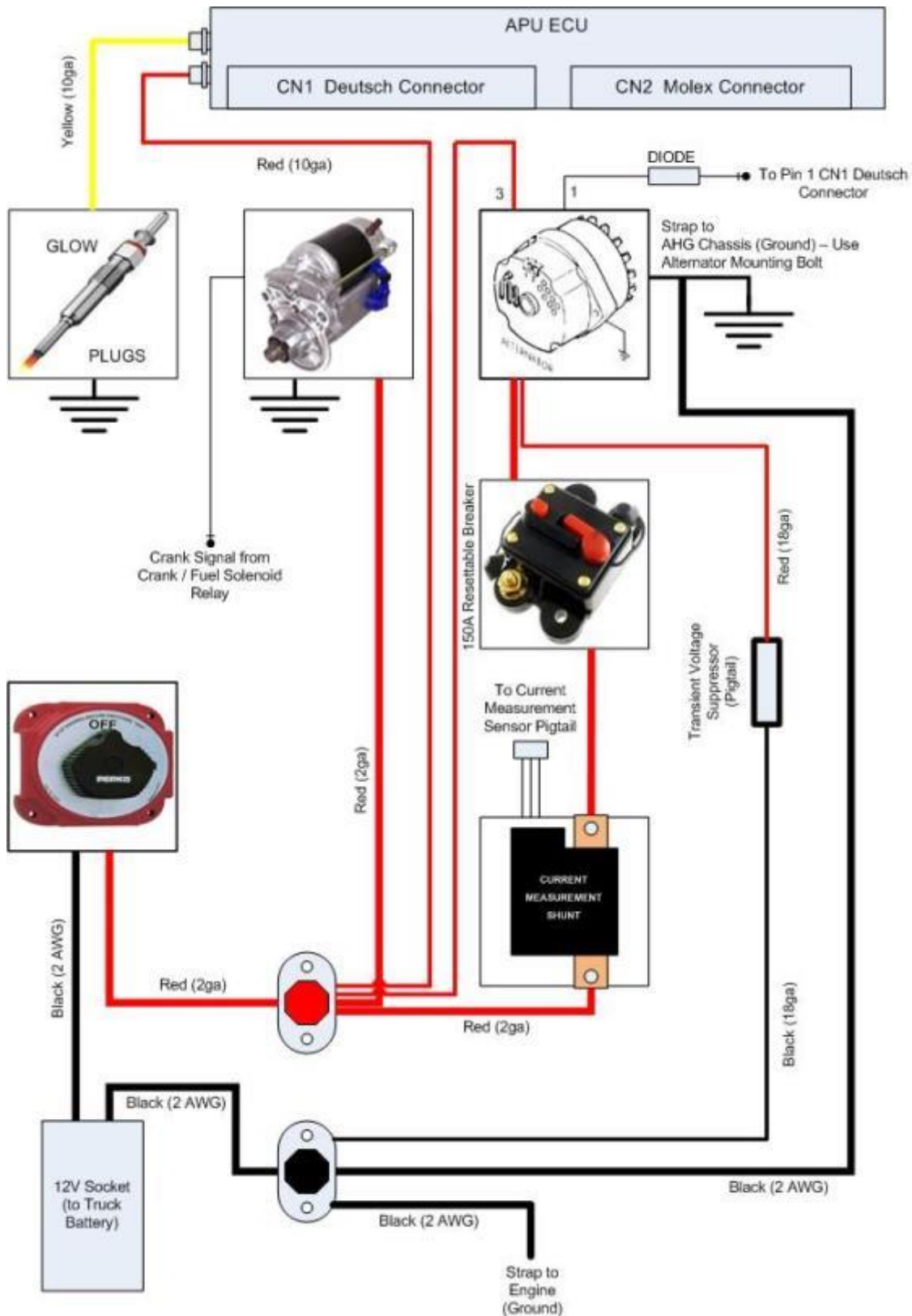
Picture Location	VENTECH PART NUMBER	DESCRIPTION
1	995-0015	Battery Switch
2	96-0006-A0	LHG Clutch 15A Fuse (only) – Shown in fuse holder
3	135-0007-A0	LHG600 MICROCONTROLLER
4	995-0026	APU / AHG Controller
5	995-0022	AHG Complete Harness (excludes high current 12V cables)
6	995-0014	Indicator Light Red LED 12V
7	995-0013	Indicator Light Green LED 12V

8.4 Understanding how the AHG2000 functions.

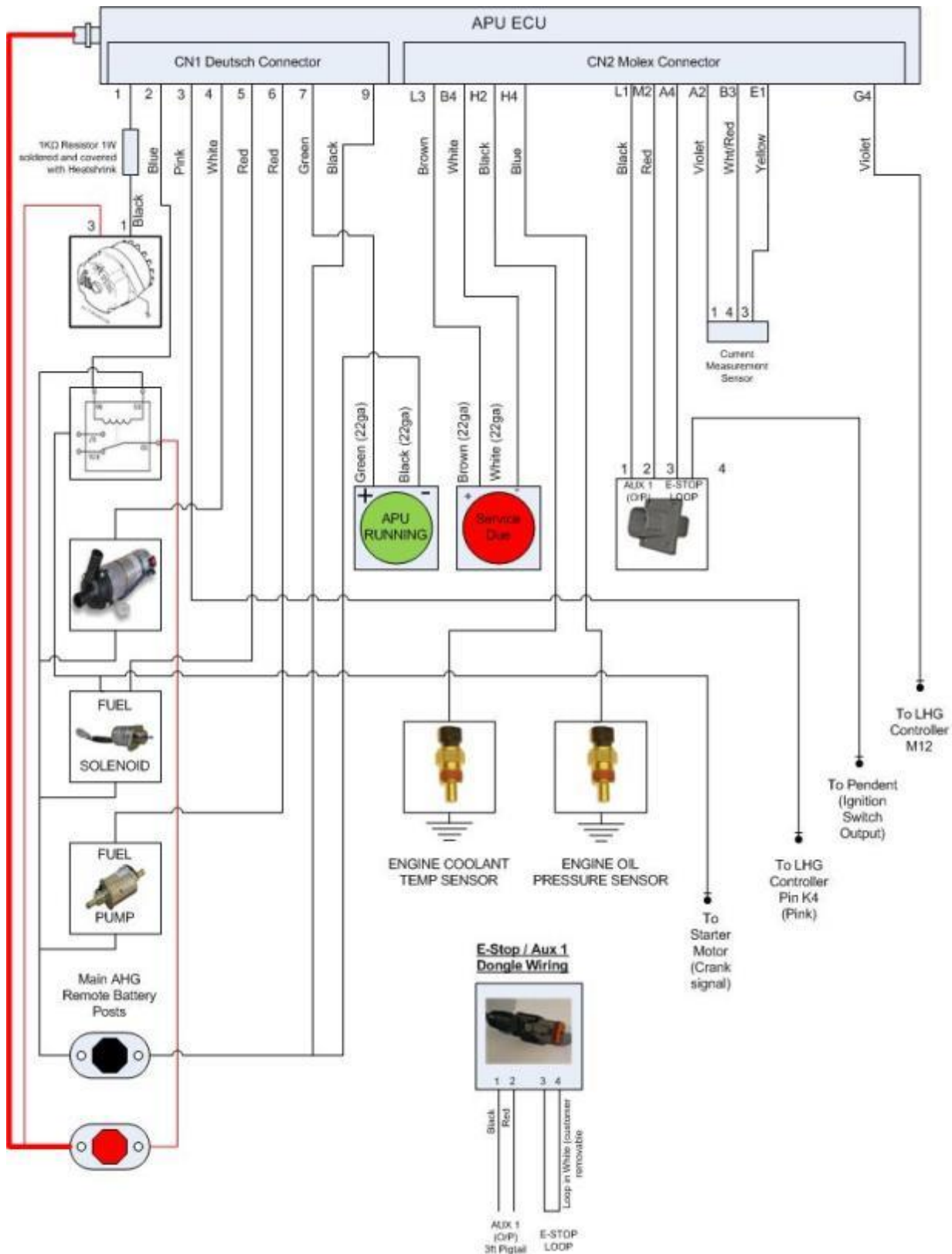
There are six main sections of the AHG2000. Once the functions of each section are explained, the overall system is better understood.

1. 12V High Current Wiring (Crank / Preheat / Charging)
2. Main Controller (Signal & Control) Wiring
3. Pendant Wiring
4. Internal Coolant System
5. Fuel System
6. Auxiliary Heater (LHG600)

8.4.1 12V High Current Wiring (Crank / Preheat / Charging)



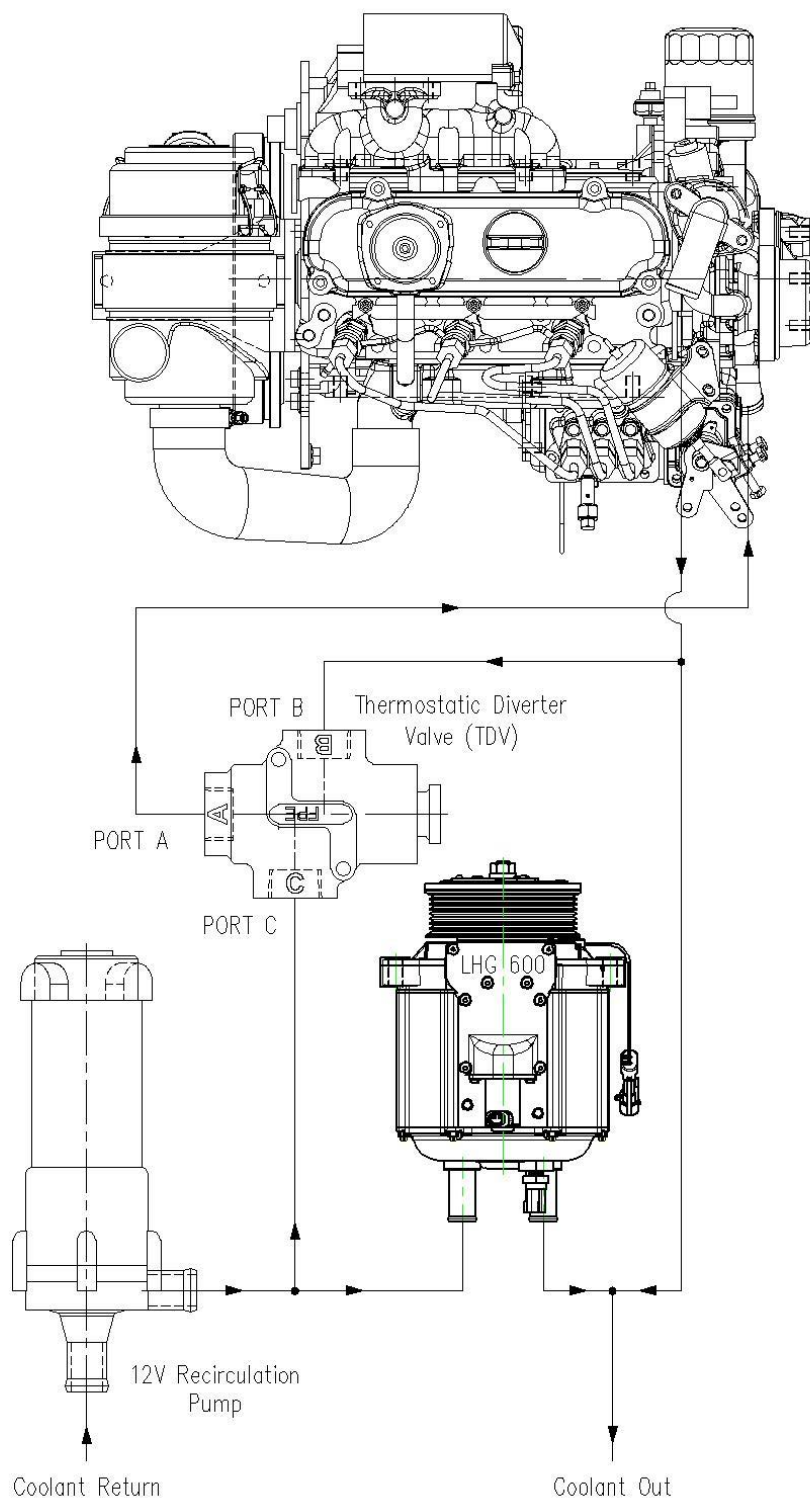
8.4.2 Main Controller (Signal & Control) Wiring



8.4.4 Internal Coolant System

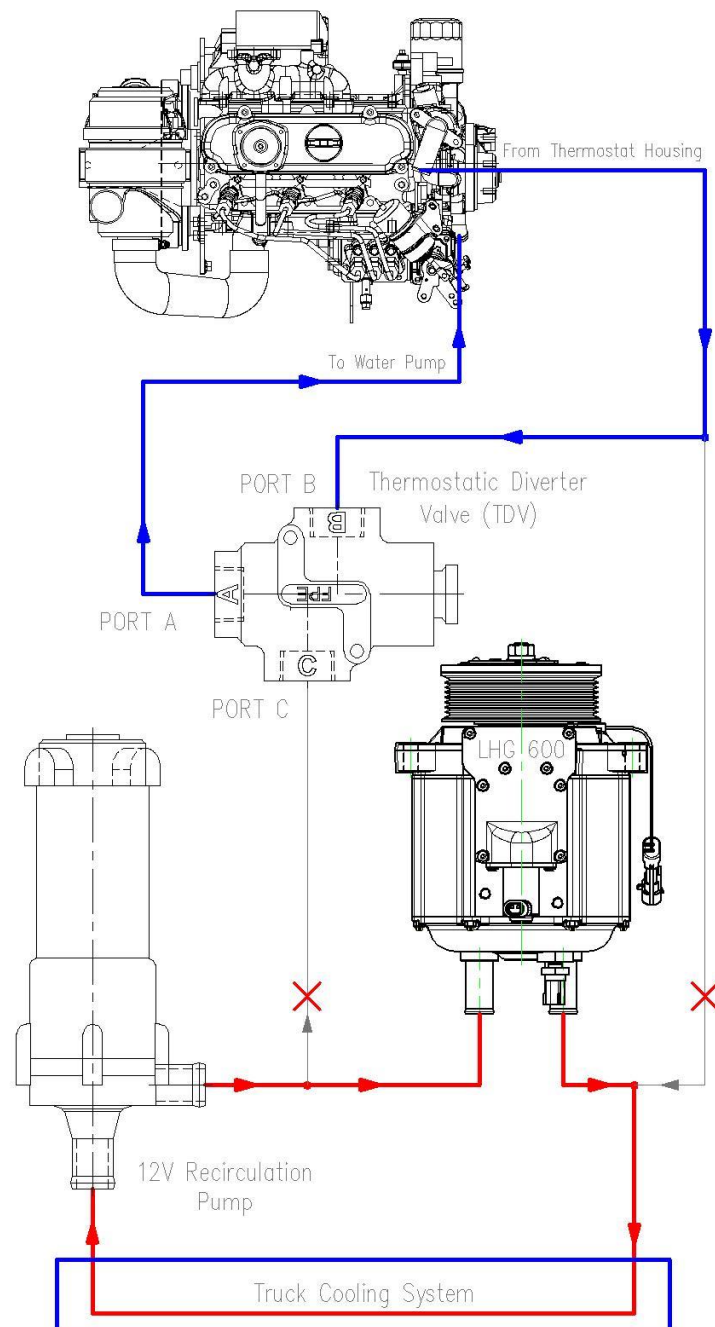
A schematic of the internal coolant system is shown below, followed by a detailed assembly schematic showing all fittings, clamps and hose sizes/lengths.

Note: The Kubota engine thermostat is removed from the thermostat housing.



8.4.4.1 Theory of Operation (Internal Coolant System) COLD

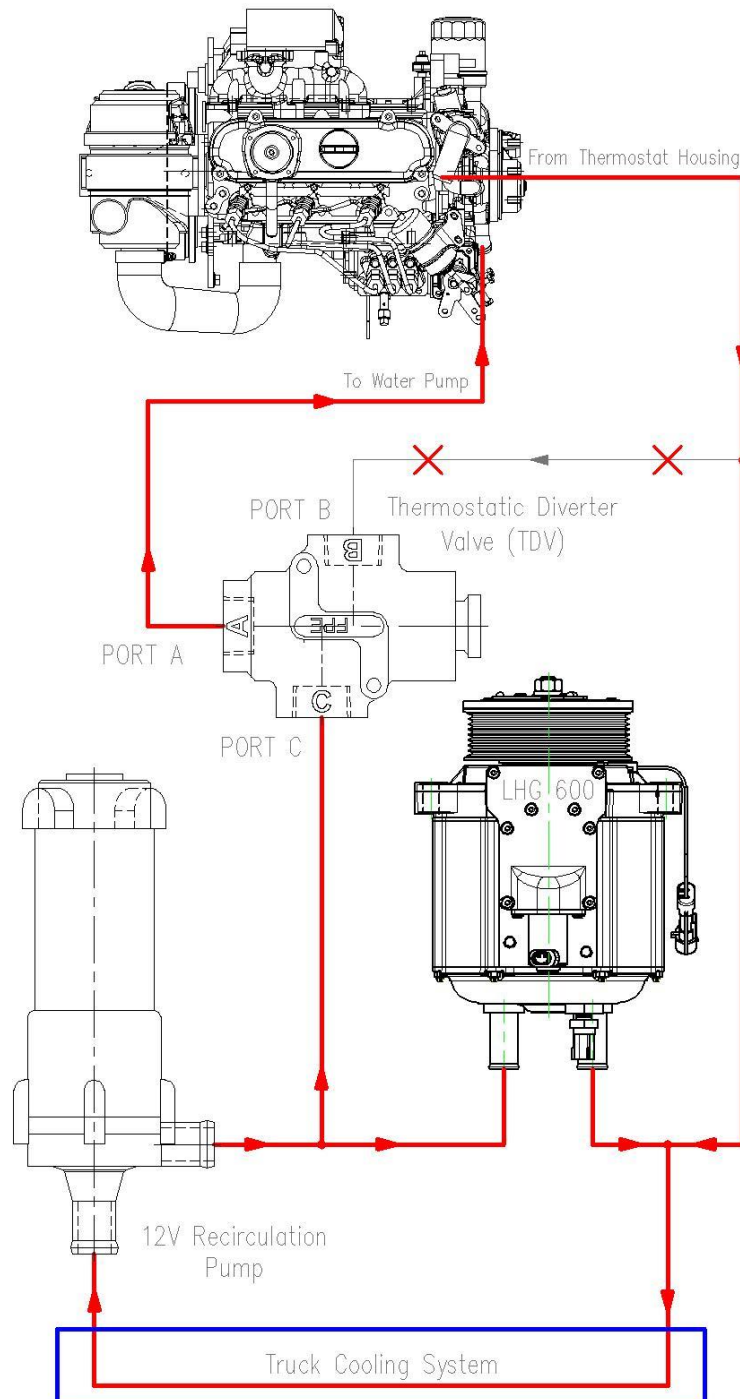
At Cold Start, until Kubota reached operating temperature and the TDV Opens, coolant enters the AHG (from Truck cooling system). Port C of the Thermostatic Diverter Valve is closed until such time that the Kubota has reached optimum operating temperature. Coolant flow from the Recirculation Pump can 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 into the throat of the Kubota Engine Coolant Pump.



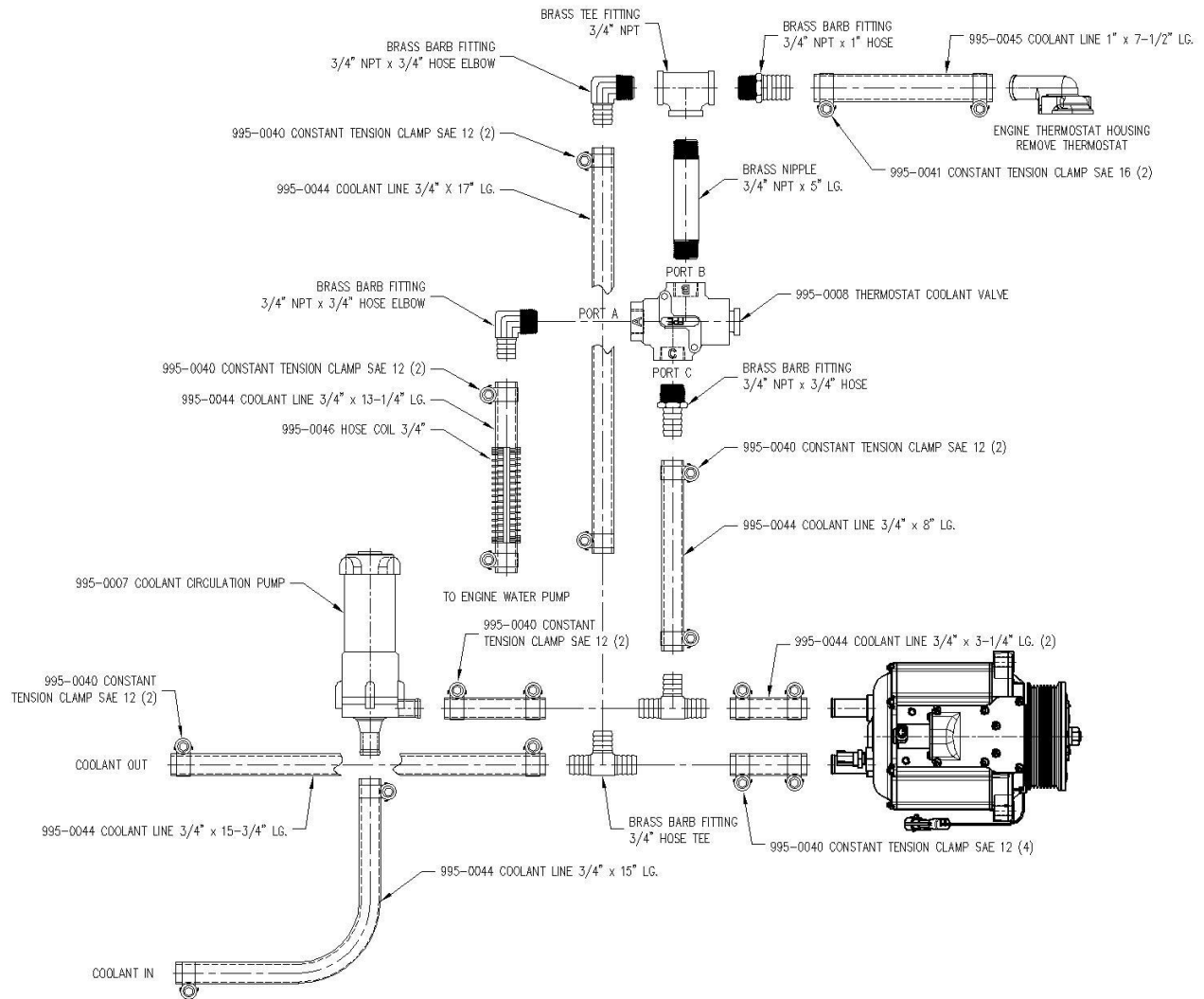
8.4.4.2 Theory of Operation (Coolant System) HOT

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:

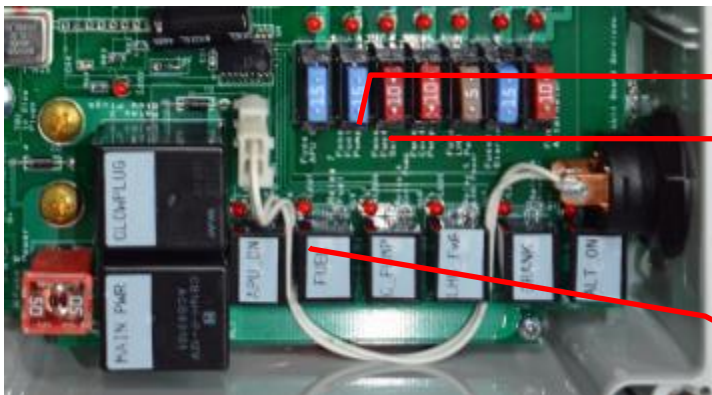
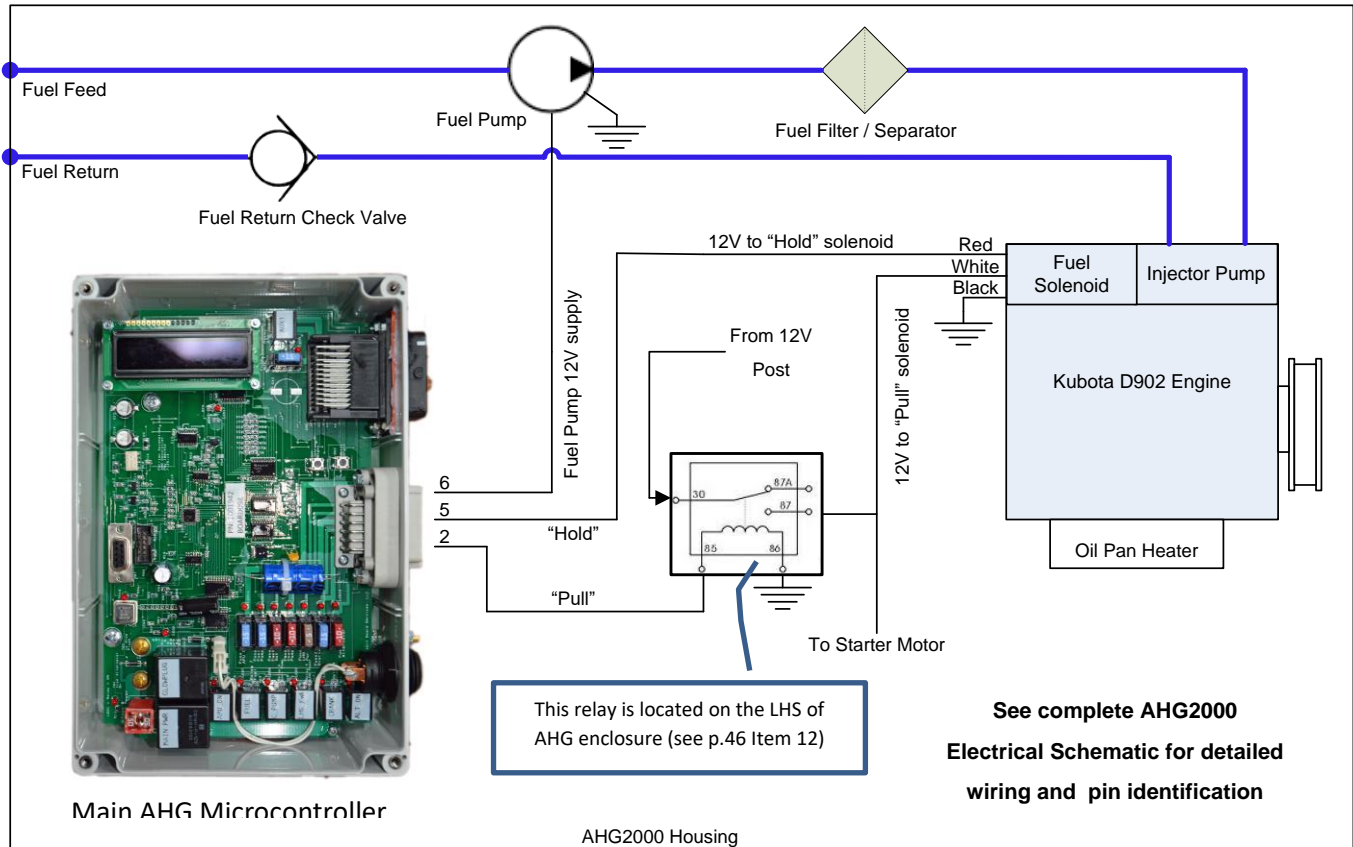


8.4.4.3 Detailed Assembly Schematic of AHG Coolant arrangement



8.4.5 Fuel System

8.4.5.1 Internal Fuel System – Electrical



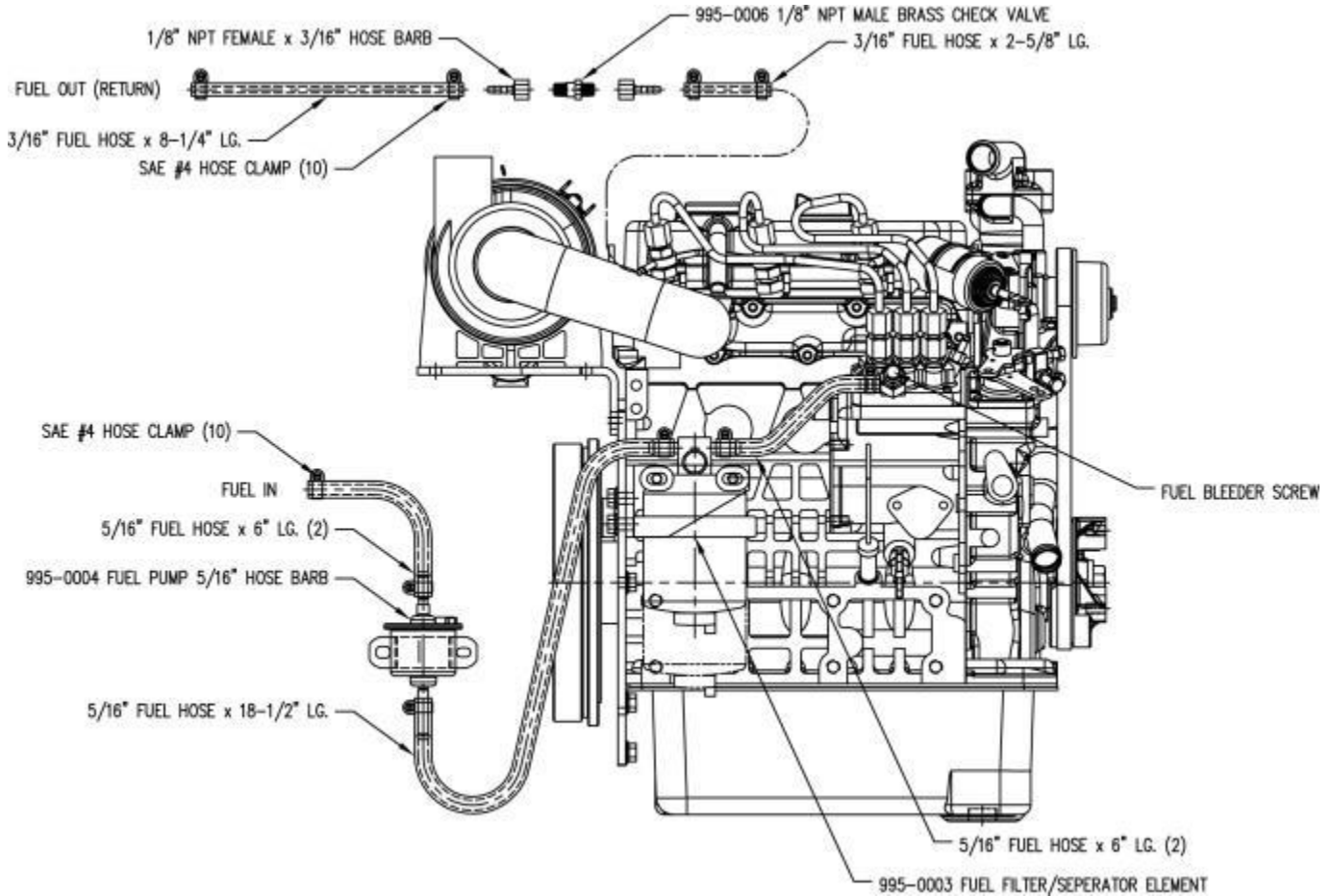
Fuse status lamps (illuminated = blown fuse)

Fuel Pump Fuse (15A)

Fuel Solenoid Fuse (10A)

Fuel Pump indicator (command from microcontroller)

8.4.5.2 Detailed Assembly Schematic of AHG Fuel System arrangement



8.4.5.3 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 AHG2000 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 AHG2000 Microcontroller enclosure, protected by Fuse #2.

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

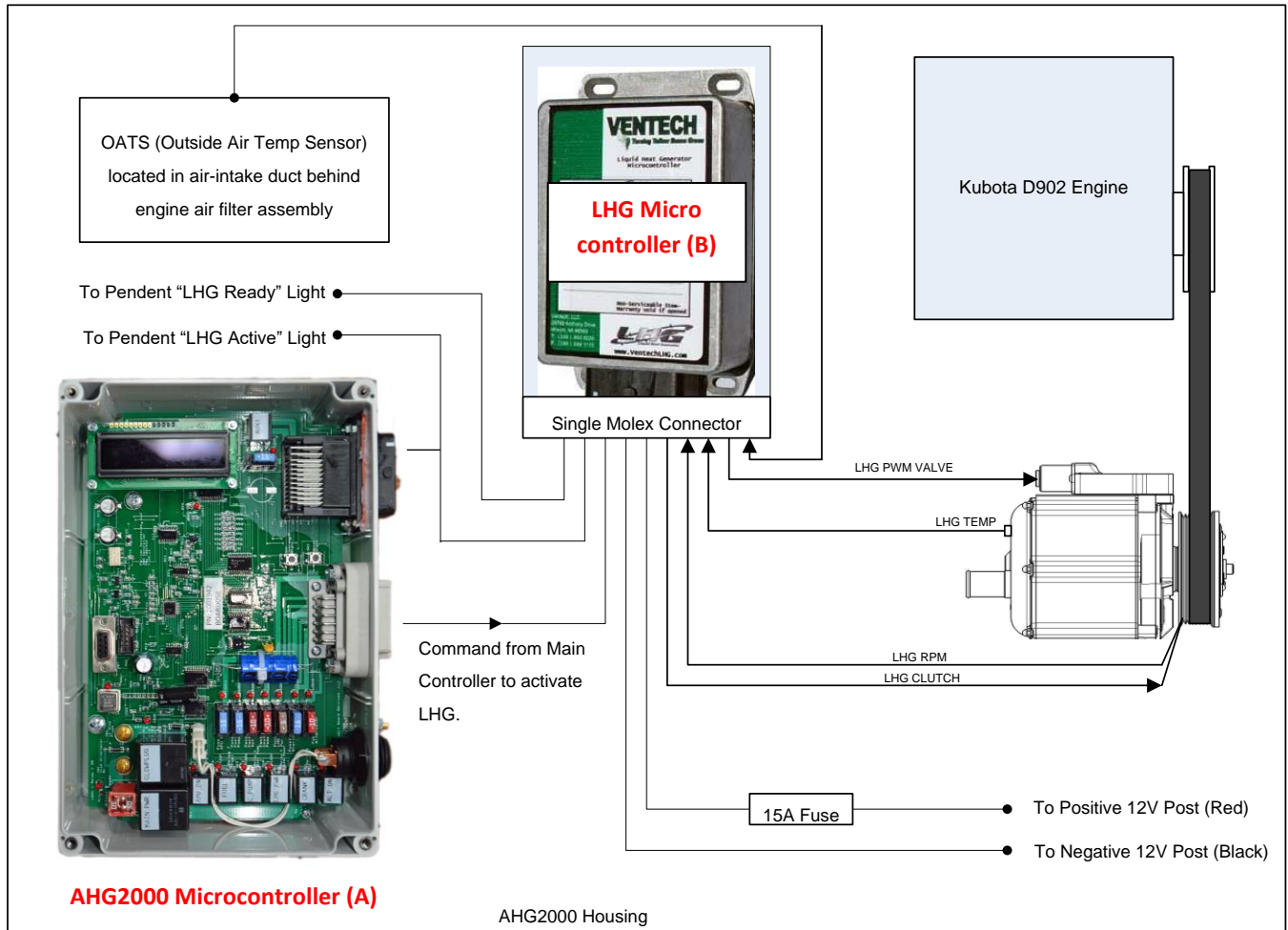
- Ignition Switch deactivated
- E-Stop Loop broken (open circuit)
- Low Oil Pressure (engine shutdown sequence)
- Engine Over-Temperature (engine shutdown sequence)

The fuel system fuses, control relays, and blown-fuse indicators are located in the Main AHG2000 Microcontroller enclosure, identified as follow:

Device	Active LED	Fuse	Rating	Control Relay	Blown-Fuse Indicator
Fuel Pump	LED7	#6	15A	#7	LED15
Fuel Solenoid	LED7	#5	10A	#7	LED14

8.4.6 Auxiliary Heater (LHG600)

8.4.6.1 Auxiliary Heater electrical



See complete AHG2000 Electrical Schematic for detailed wiring and pin identification

Figure 42 - Simplified Auxiliary Heater Electrical Schematic

8.4.6.2 Auxiliary Heater (LHG600) Theory of Operation

The AHG Microcontroller (A) performs the engine start procedure, based on commands received from the AHG Pendant.

Once the engine is running, two timers count down before the alternator and LHG function:

- Alternator Timer 60 seconds after engine START Alternator starts charging
- LHG Timer 150 seconds after engine START LHG available for operation

When the Aux Heater switch is activated, a 12v command is sent from the AHG2000 Microcontroller (A) to the LHG Microcontroller (B). The presence of this command can be identified by LED5 (illuminated) adjacent to the

LHG_PWR relay. Assuming that the LHG timer has timed out, the LHG is dependent on the following conditions to engage (produce heat) and disengage:

LHG ON The LHG will **engage** when **ALL** of the conditions below are TRUE:

- The AHG engine is running (RPM greater than 255)
- Pendant switch #4 is ON (illuminated).
- The ambient (outside) Air Temperature is below 50°F (10°C).
- The LHG Coolant Temperature is below 131°F (55°C).
- The LHG is running below 3500 RPM

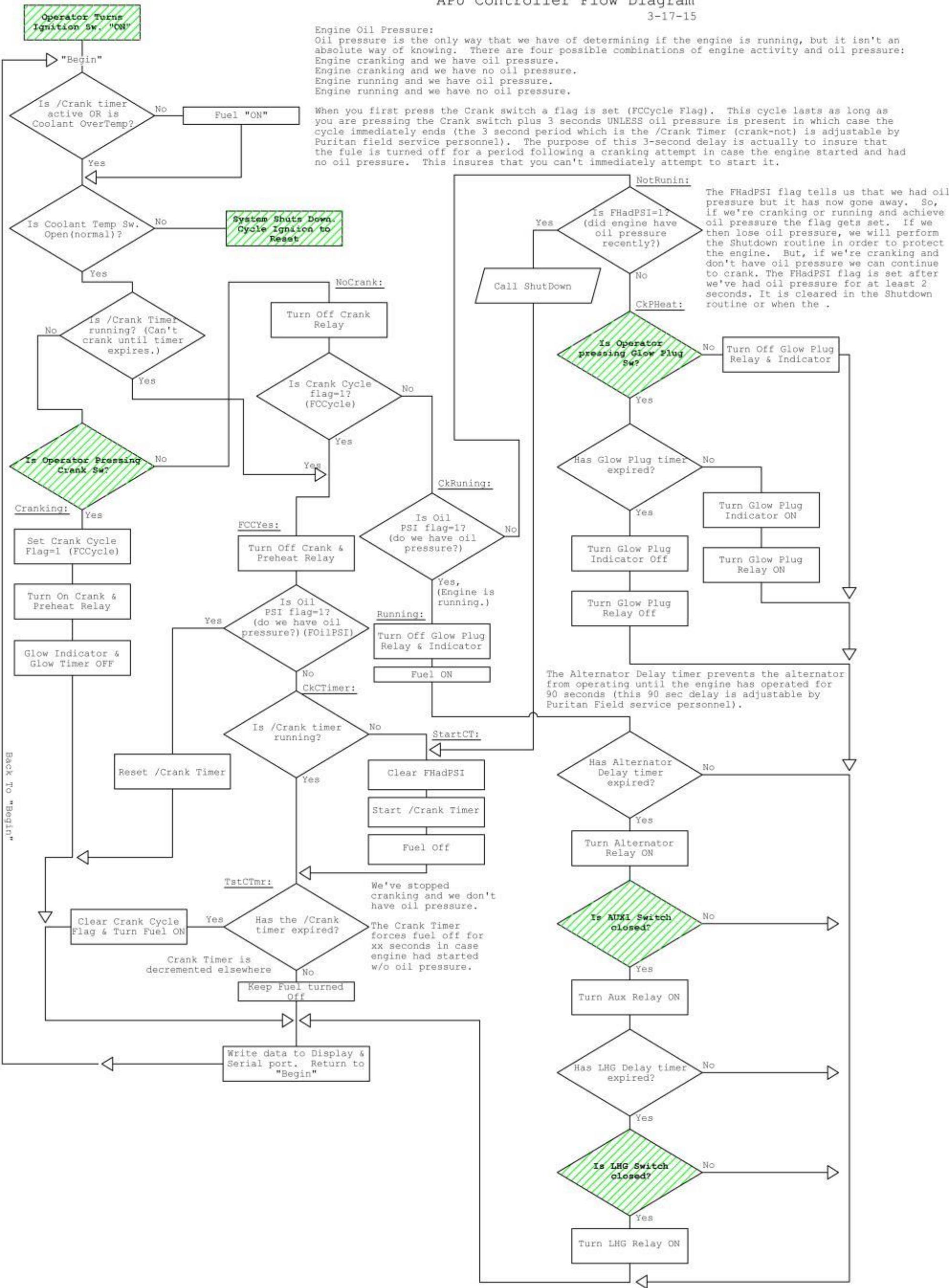
LHG OFF The LHG will **disengage** when **ANY** of the conditions below are TRUE:

- The AHG engine is not running (RPM less than 255)
- Pendant switch #4 is OFF (not illuminated).
- The ambient (Outside) Air Temperature is above 50°F (10°C).
- The LHG Coolant Temperature exceeds 176°F (80°C).
- The LHG is running above 4000 RPM.

The LHG system fuses, control relay, and blown-fuse indicator is located in the Main AHG2000 Microcontroller enclosure. The Clutch fuse is mounted on the rear wall of the AHG enclosure:

Device	Active LED	Fuse	Rating	Control Relay	Blown-Fuse Indicator
LHG Clutch Fuse	None	Bulkhead	15A	LHG micro	None
LHG Power	LED5	#3	5A	#5	LED12

Puritan Automation
APU Controller Flow Diagram
3-17-15



Troubleshooting Matrix

Problem	Possible Causes	Solution
Ignition Switch does not activate	No battery connected	Check presence of battery voltage (12v or 24v) at remote battery lugs near the rear of onboard alternator
	Main battery Disconnect in OFF position	Remove cover of AHG. Turn ON Disconnect
	Dongle not installed in rear of AHG bulkhead	Inspect for presence of Dongle. Confirm correct installation
	Dongle E-Stop loop not closed (open circuit)	Confirm that Pins 3 & 4 of Dongle plug are looped (closed circuit) or wired to a (closed) E-Stop Button.
	Fuse Blown	Check Fuse #8 (Red 50A – Main Power) inside APU ECU Module
AHG does not Crank	Crank / Fuel Solenoid Relay faulty or unplugged	Check terminals are correctly installed on Crank/Fuel Solenoid relay mounted at the rear left side (inside) wall of AHG.
	Blown Fuse	Check Fuse #2 - inside APU ECU Module
Glow Plugs Do not Activate	Blown Fuse	Check Fuse #8 (Red 50A – Main Power) inside APU ECU
Engine Cranks but does not start – Fuel Starvation	Check availability of Fuel	Is there Fuel in the vehicle tank?
	Check Fuel pump is running (Blown fuse)	Check Fuse #6 – 15A inside APU ECU
	Bleed Fuel System	Follow bleeding instructions on page 46 of this Manual
	Check that the Fuel Shutoff Solenoid retracts (mounted above engine injector assembly)	Check terminals are correctly installed on Crank/Fuel Solenoid relay mounted at the rear left side (inside) wall of AHG.
	Blown Fuse	Check Fuse #5 – 10A – inside APU ECU

9 Ventech Diagnostic Equipment

The following Diagnostic Equipment is available from Ventech to support the repair and diagnosis of the AHG2000 and LHG600 products:

9.1 LHG/AHG Diagnostic Test Set Bill of Materials

LHG/AHG2000 Diagnostic Test Set Bill of Materials		
QTY	Puritan P/N	Parts List of Test Equipment Box
1	PC-D630	Dell Latitude D630 (Remanufactured) installed with Windows XP and GUI Software
1	D630-AC	110VAC Adapter for Dell PC
1	T1005 Kit	Small LHG Programming Tool: Includes Programmer & Harness assy, Wall Plug Power Adapter, DC Battery Cable (excludes eLoader Module)
included:	1005-PGMR	Programmer & Harness assembly
included:	1005-DC	12VDC Battery Power Cable
included:	1005-AC	110VAC Wall Plug AC Adapter
1	T1007	LHG RPM Sensor Tester (Yellow Handheld)
1	T1008 Kit	Break Out Box and LHG Programmer: Includes Break Out Box (BOB), Equipment Interface Cable, RS232 to BOB PC Interface Cable, Wall Plug Power Adapter
included:	T1008	Break Out Box
included:	1008-AC	Wall Plug AC Power Adapter
included:	1008-HRNS	Equipment Interface Harness
included:	1008-RS232	RS232 to BOB Interface Harness
included:	TTLSHIFTER	3.3V to RS232 Level Shifter ("TTL Converter")
1	T1012 Kit	AHG Pendent Tester: Includes Pendent Tester and Wall Plug AC Power Adapter
Included:	T1012	Pendent Tester
Included:	1012-AC	Wall Plug AC Power Adapter
1	TCASE-01	Pelican 1560LFC Case. 22" x 18" x 10.5"

9.2 The LHG/AHG Diagnostic Test Set



Figure 43 - LHG/AHG Diagnostic Test Set – View of Protective Travel Case

9.3 LHG/AHG Diagnostic Test Set – Part Identification



9.5 Operating Instructions - T1005 LHG Programming Tool



The T1005 LHG Programming Tool is a single-purpose tool designed to program the LHG Controller that is supplied as part of the Ventech AHG product.

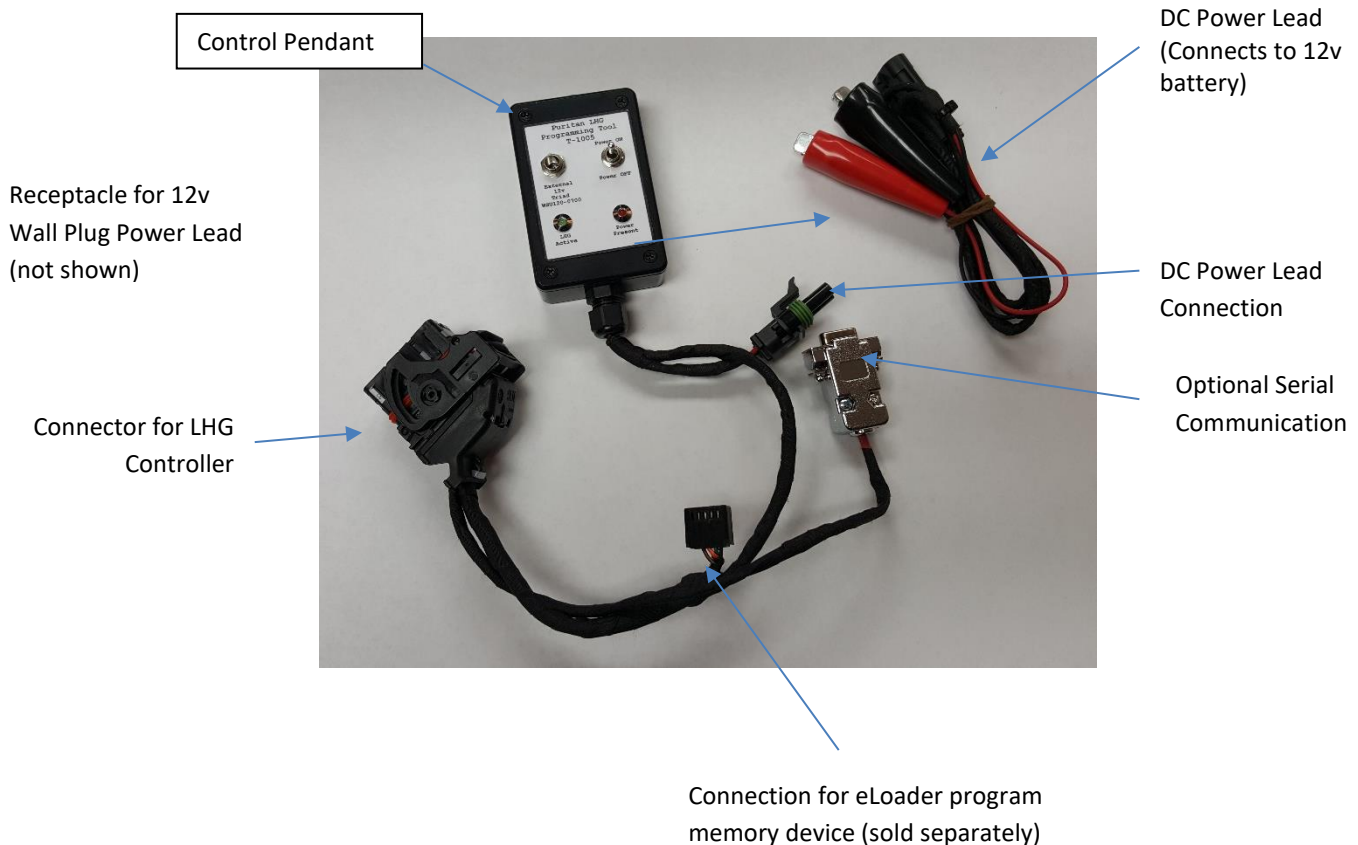
The T1005 LHG Programming Tool is powered by an external 12v, 500ma wall plug adapter that is supplied with the product. However, it DOES NOT include the actual special programming memory device, herein referred to as the eLoader device that is necessary in order to complete the programming process.

The eLoader device must be pre-loaded with the application specific software for the LHG controller, and as such will need to be ordered from Ventech on an as-needed basis.



eLoader Program Memory Device

9.5.1 T1005 Components and Interface Connectors



9.5.2 How to Use the T1005 AHG Pendant Test Tool

- 1) The T1005 can be powered by either its own 12v, 500ma wall power supply or from a 12v battery such as the AHG's battery. So, choose the power source that is most convenient for you.
 - a. If powering from the 12v wall plug power source (supplied with the tool), plug the wall plug device into a 110v wall receptacle, and then plug the 12v wall plug's male power plug into the receptacle located in the upper-left corner of the Control Pendant.
 - b. If powering from a separate 12v battery or from the AHG's system battery, connect the DC Power lead red clip to the battery + terminal, and the power lead's black clip to the battery – terminal. Then connect the DC Power Lead's 2-pin black plastic connector to the mating connector on that is part of the T1005 tool.

The red Power Present indicator on the Control Pendant's front panel should illuminate to indicate that power is available for programming. **DO NOT actuate the power switch on the control panel at this time!**

- 2) Locate the LHG controller that is to be re-programmed and remove the large black 48-position connector. This connector has a locking tab on its top-most surface that must be depressed in order to allow the lever actuator to be rotated, which releases the connector. Remove the connector.
- 3) Plug the T1005 48-position connector into the LHG controller.

- 4) Plug the eLoader device that contains the correct software for performing the update to the LHG controller. Pay close attention to the keying tabs on the eLoader device. Plug the eLoader device onto the 10-pin connector that is part of the T1005, noting that one keying tab is located directly in the center on one side of the connector, the other keying tab located on the other side of the connector is offset from center.
- 5) With all connections made, initiate the programming by moving the toggle switch on the control panel to the 'Power ON' position momentarily. A relay inside of the T1005 will latch the power on.
- 6) The eLoader program memory device both a red and a green LED indicator located at the end opposite of its connector. These LEDs will blink to indicate the status of the programming.

Status	Description
Green LED is blinking and Red LED OFF	Program or verification task in progress
Green LED OFF and Red LED is blinking	Program or verification task failure.
Sequential Green-Red LEDs are blinking	Program and verification is complete.

- 7) After a few seconds, the eLoader LEDs should be blinking alternately red-green (red-green-red-green-etc.) to indicate that programming was successful.
- 8) You should also observe that soon after initiating the programming activity (step 5 above) that the green LED on the Control Pendant front panel should blink 6 times and then remain illuminated.
- 9) To conclude the programming activity, move the Control Pendant toggle switch to the 'Power OFF' position.
- 10) You may now disconnect the T1005 to conclude the programming exercise, or, you may repeat steps 5-9 if you want to observe more closely the various LED activities.

9.6 Operating Instructions - T1007 LHG Speed Sensor Test Tool



The T1007 LHG Speed Sensor Test Tool is a single-purpose tool designed to test the hall-effect speed sensor that is used on the Ventech LHG (liquid heat generator) device. The speed sensor is a two-wire series Hall Effect sensor that includes both a hall sensor and a magnet. The sensor responds to a change in the presence of a ferrous material.

With an excitation voltage applied across the sensor, a normal current is present through the sensor. When a ferrous material comes into close proximity to the sensor, the current through the sensor decreases. When the ferrous material then moves away from the sensor, the current increases.

The T1007 LHG Speed Sensor Test Tool provides both the excitation voltage and the current sensing capability to allow a testing of the speed sensor.

Speed Sensors can be tested either while installed in place on the LHG device or while loose on the work bench.

The T1007 Test Tool is powered by an internal 9v battery.

9.6.1 How to Use the T1007 Tool

- 11) Connect the T1007 to the speed sensor that is to be tested. The 2-pin plastic connector is keyed.
- 12) Depress and hold the front panel “**Power ON**” button. Green LED should illuminate indicating that the tester is powered up.
- 13) If the speed sensor mounted in place on an LHG, simply rotate the clutch pulley to provide stimulus to the speed sensor. If the speed sensor is loose in your hand or on the bench, move a metallic object such as a screwdriver or wrench into very close proximity to the speed sensor repeatedly. The red Sensor LED should blink indicating that the sensor is working.

9.7 Operators Manual - T-1008 Break-Out-Box



Figure 45 – T1008 Break out Box Front View

9.7.1 T-1008 LHG Break Out Box Overview

The T-1008 Break Out Box is an in-circuit testing tool designed specifically to assist in testing and troubleshooting the Ventech LHG (Liquid Heat Generator) system.

The Ventech LHG is an auxiliary heater designed to function as an accessory for internal combustion engines. It provides an almost instantaneous flow of heated coolant up to the main engine and auxiliary heating circuits without flame, fuel lines or emissions.

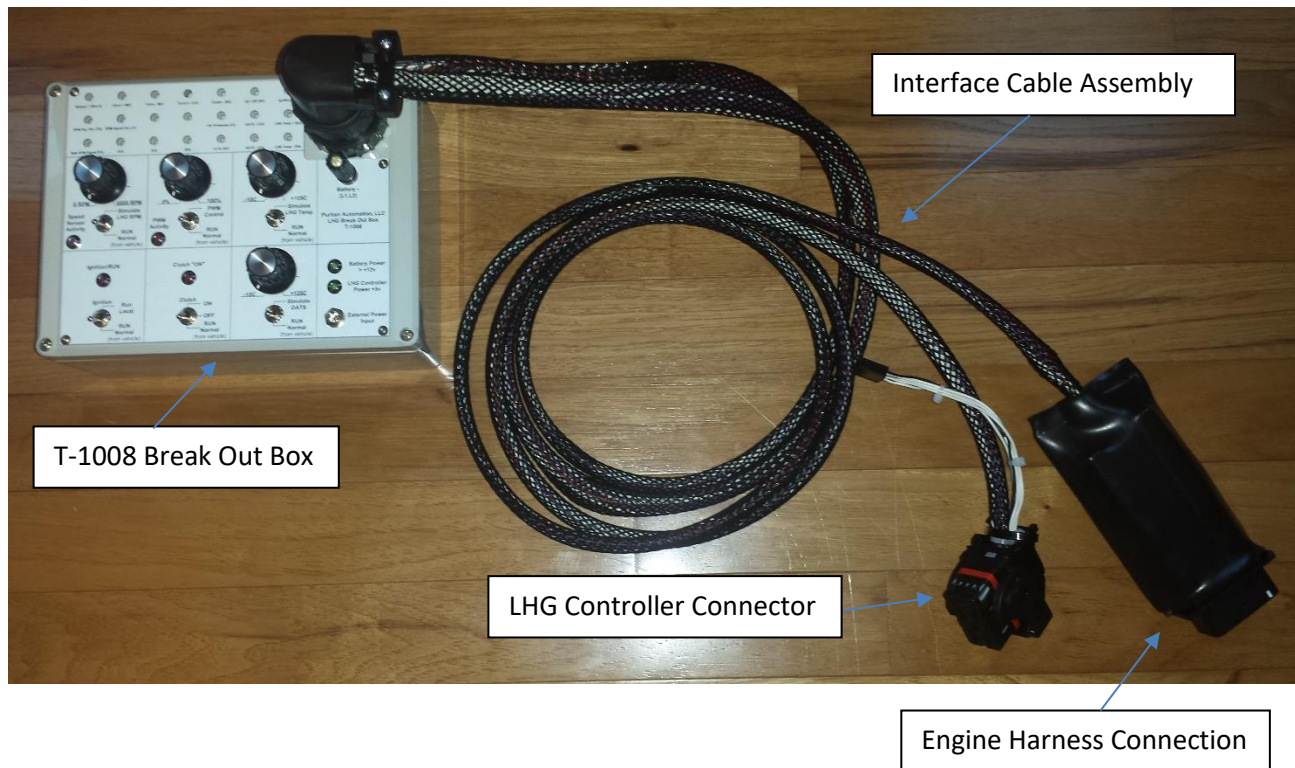
The LHG Auxiliary Heater is controlled by electronics housed in an aluminum enclosure. The electronics includes an embedded controller (a small computer) that measures ambient temperature, coolant temperature, LHG rotational speed (RPM), and switch status. A custom computer algorithm makes decisions based on these measurements to control the LHG clutch and control valve position. It also communicates full duplex digital information through an RS232 data communication port.

The BOB (T-1008 Break Out Box) consists of a box of custom electronics with user controls and a serial communications access port for use with an optional laptop computer that has been configured with custom LHG communications software. The BOB also includes a 6' interface cable for connecting in series between the LHG Control Module its mating engine harness.

9.7.2 Installation

To install the BOB:

- 1) Locate the LHG Controller
- 2) Disconnect the vehicle harness from the controller by depressing the small locking tab located directly in the middle of the connector, and then rotate the latch 90 degrees to release the connector.
- 3) Plug this connector into the BOB's engine harness
- 4) Install the BOB's 48-position connector into the LHG controller



9.7.3 T-1008 Break Out Box Testing Philosophy

The BOB is a passive test tool. It provides access to each of the various system circuits including the ability to over-ride the system sensors and control logic, but it does not perform any measurements or diagnostics. Any diagnostic work must be done by the operator. The BOB also allows access to the LHG controller's internal serial communications if a Windows XP based computer with the proper communications software is connected to the BOB's serial communications port.

9.7.4 Break Out Box Features

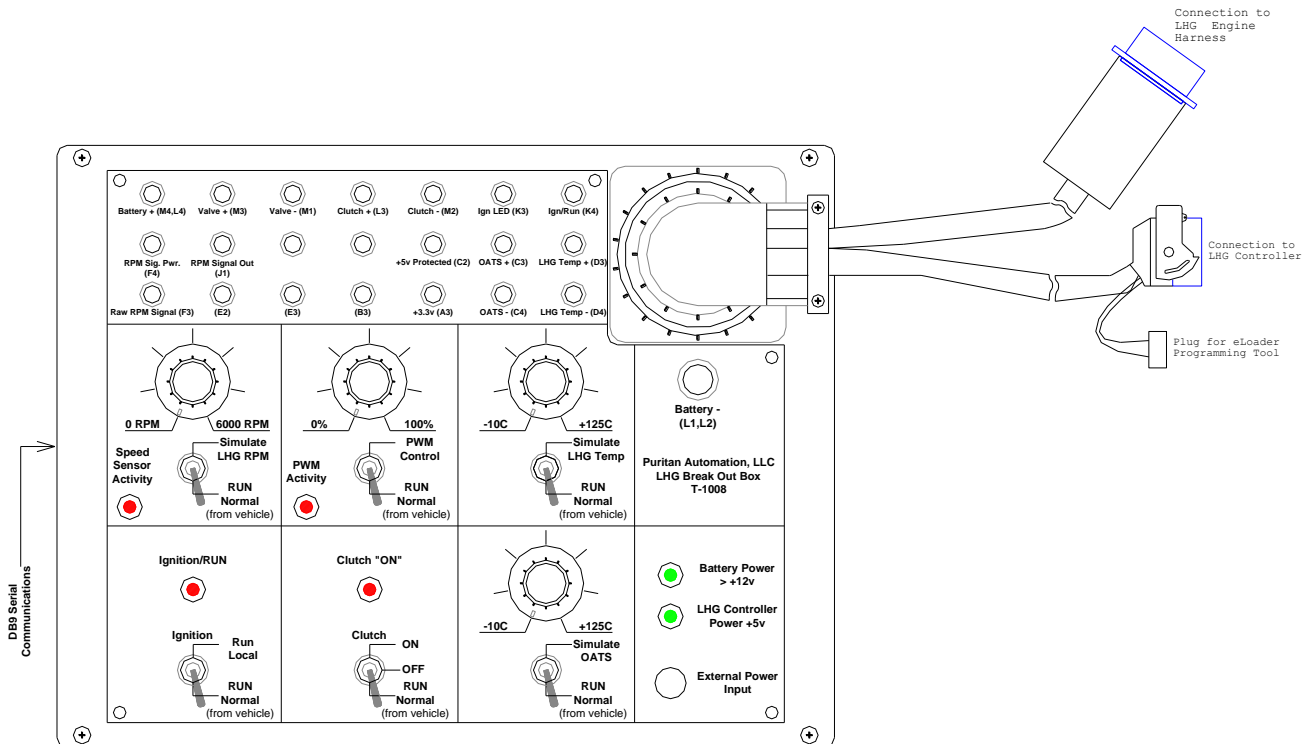


Figure 46 - Break out Box General Arrangement Drawing

Front Panel Features

Interface Harness Connector – In the upper-right corner is the 37-position connector for attaching the interface harness. The harness connects the BOB in series between the LHG controller and the engine harness.

Battery Negative Lug – Just below the Interface Harness Connector is a large test point that is labeled Battery -. When the Interface harness is connected into the LHG Controller and the engine harness, this Battery- Lug is connected to the system ground; the engine's battery negative terminal. This lug will be frequently used as the reference point when making measurements of the various test points discussed below.

Test Points – The upper left-to-middle portion of the front panel consists of 21 test points that provide measurement access to various points in the control system. These test points can be useful for verifying the presence of voltages, for confirming the status of the clutch and the control valve, and for measuring the condition of the temperature sensors in the system.

LHG Speed Simulation and RPM Sensor Detection – In the middle-left of the front panel are a toggle switch, a red LED indicator, and a rotary knob that sweeps from 0 RPM to 6,000 RPM. When the toggle switch is in the down position (as shown above) which is labeled “Run Normal (from vehicle)” the LHG controller operates normally getting a speed signal from the speed sensor that is located on the front of the LHG. The red LED indicator is flashed once each time the LHG speed sensor sends signal to the LHG. So, when the engine is running, this LED indicator will glow red since the speed sensor signals are coming so fast. The LED indicator is actually being flashed by a signal that is sent back from the LHG controller; the LHG controller receives a signal from the LHG speed sensor, processes it, and then sends it signal back to flash the LED indicator.

When the toggle switch is moved to the UP position which is labeled “Simulate LHG RPM” an internal speed signal generator replaces the LHG speed sensor sending a signal to the LHG controller, the speed of which is determined by the rotary knob. The LED indicator will again flash in response to the speed signal that is being sent back from the LHG controller.

Ignition/RUN and Ignition – In the lower-left of the front panel is a toggle switch and LED indicator labeled as Ignition/Run. Again, when the toggle switch is in the down position (as shown above) which is labeled “Run Normal (from vehicle)” the LHG controller operates normally. This means that in the case of installation on a Ventech AHG that the AHG controller will power up the LHG system after all of the time-out intervals have been completed, which can be several minutes.

When the toggle switch is placed in the up position, labeled Run Local, the LHG controller is immediately powered up, bypassing any external power control system.

The LED indicator is connected to the LHG controller. When the controller is powered up, the LED flashes six times and then remains illuminated.

PWM Control and PWM Activity LED – In the middle-left of the front panel is an LED indicator labeled “PWM Activity”, a toggle switch, and a rotary knob that sweeps from 0 % to 100%. This group of controls and indicator are for monitoring or over-riding the LHG controller’s control valves activities. The LHG control valve regulates the amount of energy being produced by the LHG. This regulation is accomplished by turning the valve on/off with a varying duty cycle at a rate of less than 100 Hz.

The LED indicator illuminates in relation to the duty cycle of the control valve; when the valve is off the LED indicator remains dark. When the valve is being turned on only 10% of the time the indicator illuminates brighter. At 100% duty cycle (continuously ON) the indicator is full brightness.

When the toggle switch is in the down position (as shown above) which is labeled “Run Normal (from vehicle)” the LHG controller operates normally, varying the valve’s duty cycle in accordance with the rules programmed into the LHG controller. When the toggle switch is placed in the up position, labeled PWM Control, the control of

the valve is taken away from the LHG controller and is placed under the control of a PWM (pulse-width-modulated) generator inside of the BOB. The duty cycle of the internal PWM generator is varied according to the rotary knob from a low of 0% to a maximum of 100%.

Please note that the LHG controller is programmed with a set of rules for modulating the control valve that are designed to insure that the LHG is not operated in a way where damage to the clutch, shaft, or belt will occur. So when using this feature of the BOB **you must do so only with approval of Ventech personnel.**

Clutch Control – In the middle-lower of the front panel is an LED indicator labeled “Clutch ON” and a three-position toggle switch. The LED indicator provides a visual indication of the status of the LHG clutch; illuminated when the clutch is ON, and dark when the clutch is OFF.

The three position toggle switch provides the ability to take control of the clutch away from the LHG controller and force the LHG clutch to be either ON or OFF.

When the toggle switch is in the down position (as shown above) which is labeled “Run Normal (from vehicle)” the LHG controller operates normally, turning the clutch ON or OFF according to the rules that are programmed into the controller.

When the toggle switch is placed into the middle position, labeled as OFF, the LHG clutch is forced OFF.

When the toggle switch is placed in the up position, labeled as ON, the LHG clutch is forced ON. **Please note** that the LHG controller is programmed with a set of rules for engaging and disengaging the LHG clutch. These rules insure that the LHG is not operated in a way where damage to the clutch or shaft will occur. So when using this feature of the BOB **you must do so only with approval of Ventech personnel.**

LHG Temperature – In middle-right of the front panel is a toggle switch and a rotary knob that sweeps from -10C to 125C. When the toggle switch is in the down position (as shown above) which is labeled “Run Normal (from vehicle)” the LHG controller operates normally using the LHG’s coolant temperature sensor to make operational decisions.

When the toggle switch is placed in the UP position, labeled “Simulate LHG Temp”, the rotary knob can be used to simulate coolant temperatures ranging from -10C to +125C.

Please note that the LHG controller is programmed with a set of rules for controlling the LHG clutch and valve, and for preventing an over-heat condition. When you use this feature where you can trick the LHG controller into thinking that the coolant temperature is lower than it actually is, you run the risk of damaging the LHG. So when using this feature of the BOB **you must do so only with approval of Ventech personnel.**

OATS (outside air temperature) – In lower-right of the front panel is a toggle switch and a rotary knob that sweeps from -10C to 125C. When the toggle switch is in the down position (as shown above) which is labeled “Run Normal (from vehicle)” the LHG controller operates normally using ambient temperature sensor to make LHG ON/OFF decisions.

When the toggle switch is placed in the UP position, labeled “Simulate OATS”, the rotary knob can be used to simulate ambient temperatures ranging from -10C to +125C.

Battery Power LED Indicator – On the lower-far-right of the BOB front panel is a green LED indicator labeled “Battery Power > +12v”. This indicator is illuminated when power is present to the BOB, which power will usually come from the engine harness connection (the engine/vehicle 12v battery) but can also come from the External Power Input (discussed below).

LHG Controller Power LED Indicator – On the lower-far-right of the BOB front panel is a green LED indicator labeled “LHG Controller Power +5v”. This indicator is illuminated by the LHG controller’s internal 5v power supply.

External Power Input – On the lower-far-right of the BOB front panel is a connector labeled “External Power Input”. The primary use for this connector is for training in a classroom or on the bench. A 12v, 700ma wall power adapter is connected to this input to power the LHG controller and the BOB. But, this connector cannot supply enough power to actually power the LHG itself.

Interface Harness – The interface harness includes both a male and a female connector that allows it to be connected in series with the engine/vehicle harness at the LHG controller. Installation is as simple as unplugging the vehicle harness from the LHG controller and then plugging the vehicle harness into the mating connector that is part of the BOB interface harness. Then complete the installation by plugging the remaining BOB connector into the LHG controller.

Interface Harness eLoader Connector – The BOB Interface harness also includes a small, ten-pin plug that is referred to above as the plug for “eLoader Programming Tool”. This plug is used on those rare occasions when the software inside of the LHG controller needs to be revised or changed. This plug is not required for normal diagnostic or repair work.

DB9 Serial Communications – On the left end of the BOB enclosure is a 9-pin Serial Communications connector. This connector allows connection of a Windows XP based PC that has been loaded with Ventech proprietary communications software. This software allows display and measurement of all of the information and measurements that are taking place inside of the LHG controller’s computer.

9.7.5 T-1008 LHG Break Out Box System Wiring Diagram

The diagram above shows how the BOB internal and external wiring. All of the toggle switches are shown in their down position, which means that the LHG and its Controller are operating as if the BOB were not in the circuit.

The diagram is arranged so that the LHG and the vehicle or engine is on the left, and the LHG Controller is on the right.

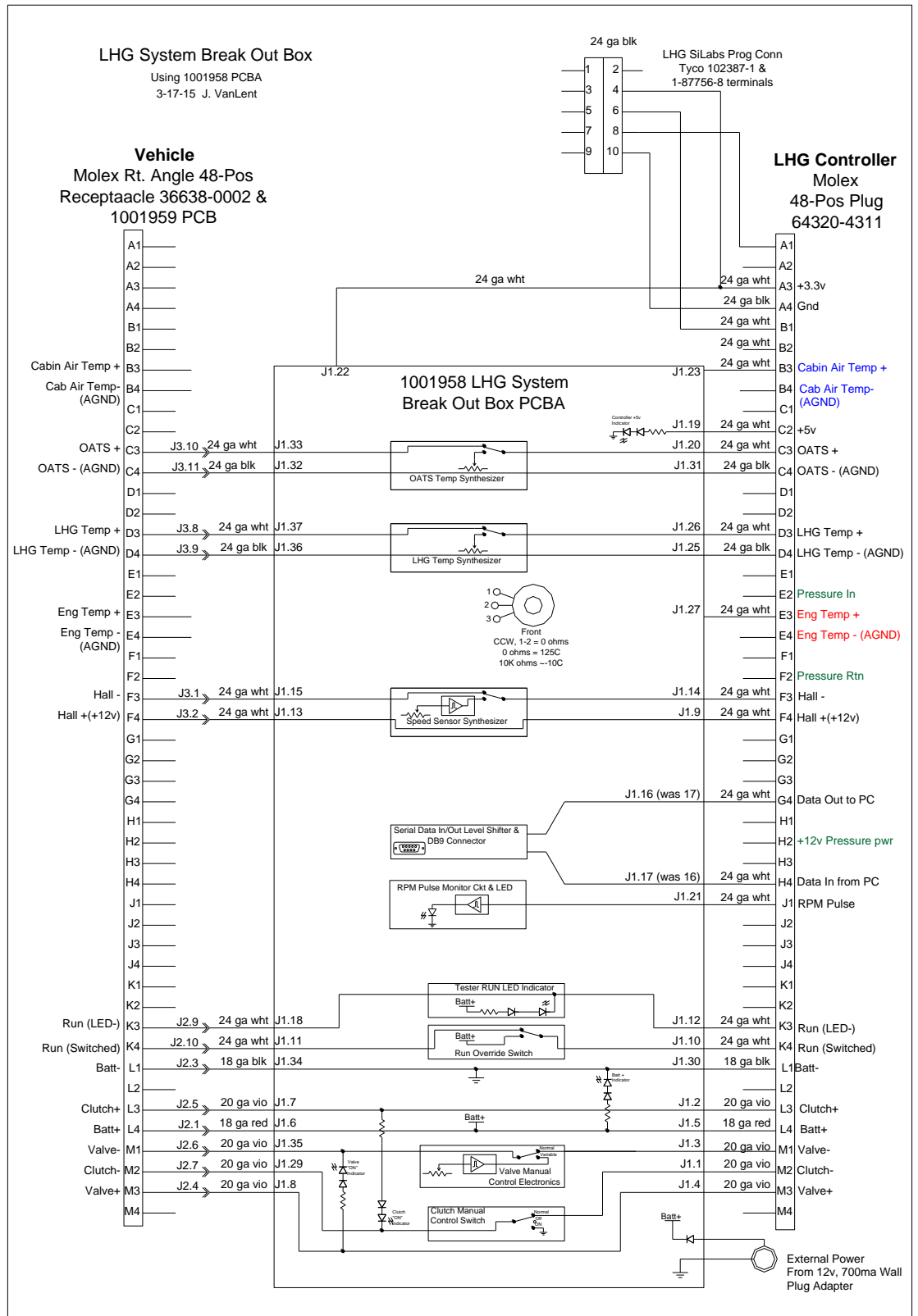


Figure 47 - Break out Box Schematic

9.8 Operating Instructions - T1012 AHG Pendant Test Tool



Figure 48 - AHG2000 Pendant Tester Front View

The T1012 AHG Pendant Test Tool is a single-purpose tool designed to test Pendant assembly that is supplied with the Ventech AHG product.

The T1007 Test Tool is powered by an external 12v, 500ma wall plug adapter that is supplied with the product.

9.8.1 How to Use the T1012 AHG Pendant Test Tool

- Connect the pendant to be tested to the T1012 tool by connecting the pendant's round aluminum 21 pin connector to the complimentary 21-pin receptacle on the pendant tester.
- Connect the +12v wall plug power supply adapter to the T1012 tester.
- Plug the +12v power adapter into a 110vAC power outlet. The green LED indicator in the upper-right corner of the T1012 front panel should illuminate, indicating that power is present.
- Place all of the Pendant rocker switches in their 'OFF' position.
- The red LED indicator located inside of the Ignition switch should glow red. All other indicators should be dark.

9.8.1.1 Test the Pendant Switches

- Depress the Ignition switch into the ON position.
 - The red indicator should go dark and the green indicator in the switch should now be illuminated. Again, all other indicators on the pendant should be dark.
 - The red LED IGNITION indicator on the T1012 tester should be illuminated
 - Note: You must leave the pendant Ignition switch in the ON position for all other Pendant testing.
- Continue by depressing each of the remaining four Pendant switches one-at-a-time. Their respective red LED indicators on the T1012 front panel should illuminate.
- Pendant switch testing complete

9.8.1.2 Test the Pendant Indicators & Hour Meter

- Across the bottom of the T1012 Pendant tester is a row of 9 momentary pushbutton switches. Depress and hold the first button, labeled AHG Running. The AHG Running indicator on the pendant should illuminate, AND the hour meter should power up allowing you to read the hours display.
- Release the AHG Running push button.
- Continuing on, one-at-a-time depress each of the remaining T1012 switches. A corresponding indicator on the pendant's front panel will illuminate.
- Note that the final two momentary pushbuttons, AUX1 Sw Indicator and LHG Sw Indicator, will illuminate the green LED indicators that are inside of the pendant's LHG and AUX1 rocker switches.
- Pendant Indicator and Hour Meter testing complete.