KBi® DIESELMATIC® NVT™

INSTRUCTION MANUAL

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ATA VMRS - T44 KLDBN

SAFETY AWARENESS

WARNING

Do not smoke when installing, maintaining, testing or troubleshooting a DIESELMATIC System. Make sure you are in a well-ventilated area away from heat, open flames or sparks. Wear goggles when testing to avoid eye injury. **Make sure that openings in the valve, tube, or nozzle (nozzle opening indicated by red dot), are pointed away from yourself while testing.**

The engine starting fluid used in DIESELMATIC Systems contains ethyl ether and is extremely flammable and toxic. It can be harmful or fatal if swallowed. Avoid contact with skin or eyes or breathing fumes. If swallowed, DO NOT INDUCE VOMITING. Call a physician immediately.

If fluid enters the eyes or if fumes irritate the eyes, they should be washed with large quantities of clean water for 15 minutes. A physician, preferably an eye specialist, should be contacted.

Contents of cylinder are under pressure. Store in a cool dry area. Do not incinerate, puncture or attempt to remove cores from cylinder.

SAFETY AWARENESS

SAFETY AWARENESS SYMBOLS are inserted in this manual to alert you to possible SAFETY HAZARDS. Whenever you see these symbols:

WARNING or CAUTION heed their instructions!

SAFETY AWARENESS SYMBOLS AND MEANINGS:

WARNING

THIS WARNING SYMBOL IDENTIFIES SPECIAL INSTRUCTIONS OR PROCEDURES WHICH, IF NOT CORRECTLY FOLLOWED, COULD RESULT IN PERSONAL INJURY.

CAUTION

THIS CAUTION SYMBOL IDENTIFIES SPECIAL INSTRUCTIONS OR PROCEDURES WHICH, IF NOT STRICTLY OBSERVED, COULD RESULT IN DAMAGE TO, OR DESTRUCTION OF EQUIPMENT.

TABLE OF CONTENTS

NOTES:

INTRODUCTION

STOP!

Before proceeding in Section 1 - determine that you will be installing the DIESELMATIC NVT to be controlled by your engines' electronic control module (ECM). If you will not be using your engines' ECM to control the DIESELMATIC NVT, skip Section 1 of this manual and proceed to Section 2.

CAUTION

Disconnect glow plugs. Indirect Injection Diesel Engines using glow plugs should have the glow plugs disconnected when using a KBi DIESELMATIC NVT System.

CAUTION

Only use KBi Brand Starting Fluid Cylinders in order for your DIESELMATIC NVT to function properly. KBi Starting Fluid Cylinders have a special "O" Ring seal that is not offered on other competitive cylinders. This special "O" Ring is not available commercially.

KBi's DIESELMATIC NVT System is a fully-automatic Engine Starting Fluid System designed to spray a controlled amount of starting fluid into the air intake system of an engine during and immediately after the cranking cycle. When needed, the solenoid valve is activated automatically during engine cranking; then starting fluid is released from the pressurized cylinder, flows through the valve, through a flow metering orifice fitting at the bottom of the valve, through the nylon tubing, and out of an injector nozzle located in the engine's air intake system.

KBi's DIESELMATIC NVT can be activated during the starting procedure by an engines' ECM. Based upon vital engine information such as engine speed and temperature, the ECM can send an activation signal to KBi's DIESELMATIC NVT. By allowing the ECM to control the activation of the starting fluid into the engine, a more precise delivery of starting fluid can be achieved. Additionally, this automatic feature prevents operator error or abuse.

With the DIESELMATIC NVT properly installed, you will have all of the features and benefits of the original KBi DIESELMATIC and much more.

Exclusive Features of the DIESELMATIC NVT:

- Controllable by ECM Engines
  - Direct Interface
  - Low Current Draw
    - 1.3 amps @ 12 volts
    - 0.6 amps @ 24 volts
  - Voltage Transient Suppression
- Engineered for Reliability
  - Sealed from Environment
  - O-Ring Cylinder Seal
  - Encapsulated Coil
  - Non-corroding Brass Connections
  - Field-Serviceable Metering Orifice/Filter

- Designed for Superior Performance
  - Automatically Activated by the ECM
  - Injects Starting Fluid Precisely

NOTE: WHENEVER THE ENGINE DOES NOT START WITHIN A NORMAL PERIOD OF CRANKING, THE DIESELMATIC NVT FLUID CYLINDER MAY BE EMPTY - REFER TO "SERVICING AND TROUBLESHOOTING".

KBi's DIESELMATIC NVT UNIT SPECIFICATIONS:

Input Power	12 VDC	24 VDC
Operating Voltage Range	6 - 18	12 - 36
Current Draw - Maximum	1.9	1
Current Draw - Nominal	1.3	0.6
Spike Protection	Yes	Yes

Before installing, familiarize yourself with the parts contained in your kit. Note that you have the following items in DIESELMATIC NVT Systems:

A. DIESELMATIC NVT Valve Assembly
B. Starting Fluid Cylinder
C. Valve Fitting
D. Wiring Harness
E. Nylon Tubing
F. Injector Nozzle
G. Mounting Hardware
H. Fuse Harness
I. Cylinder Clamp
J. Nylon Tubing Protective Sheathing

The DIESELMATIC NVT is also available in a compact size, KOMPAC DIESELMATIC NVT, to allow installations in smaller engine compartments or where space is restricted. If a KOMPAC DIESELMATIC NVT Kit is purchased, you will have all of the same components listed above. However, the valve assembly, cylinder, and cylinder clamp will be reduced in size to those referenced in Figure 1.

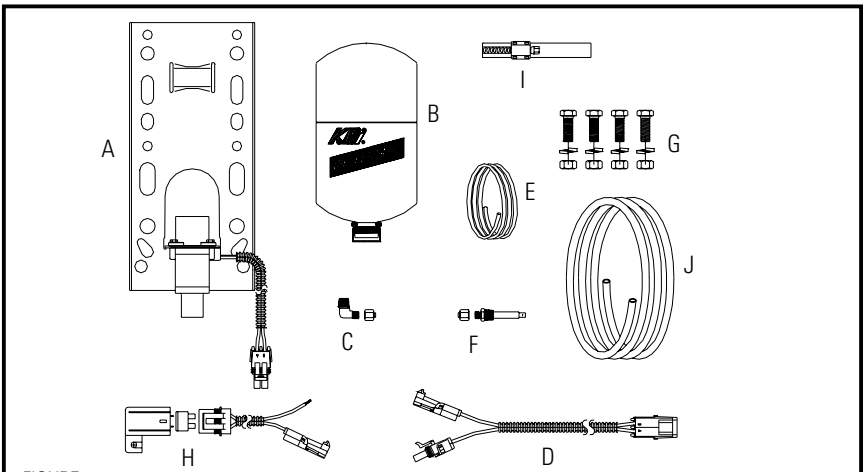

FIGURE 1
Parts in DIESELMATIC NVT kit for installation for use on ECM Engines with "Ether Injection Enabled"

NOZZLE INSTALLATION

Installing the injector nozzle in a proper location is essential if the DIESELMATIC NVT System is to work properly on your engine. It is preferred to choose an installation point for the nozzle that will assure even distribution of starting fluid to all cylinders. On turbocharged engines the nozzle should be on the pressure side of the turbocharger.

The straight brass fitting "nozzle injector" supplied with your system should be used. The nozzle itself fits most engines; but, for some engines it may be necessary, or desirable, to also use the 1/4" NPT Reducer Bushing with the nozzle. An elbow fitting substituted in place of the straight fitting will interfere with proper vaporization of starting fluid. If an elbow fitting installation is necessary, use KBi Special Injector Nozzle; for engines 12 liters and over P/N 220424 (end orifice), or P/N 220475 (side orifice). For engines under 12 liters, use KBi P/N 220401 (end orifice), or P/N 220375 (side orifice).

DRAWING NOTES:

The following drawing notes should be used in conjunction with the engine diagrams in Appendix A, that indicates your air intake system.

NOTE: Some engine manufacturers' pre-tapped nozzle locations are not desirable to use because they will result in the uneven distribution of starting fluid to all of the cylinders of the engine. Uneven distribution, or favoring only one or two cylinders of an engine, can cause engine lock-up during cranking. The solution for this type of problem is to change the location of the injector nozzle or use a Special Injector Nozzle, which will direct the starting fluid into the main air flow when orientated correctly. To correctly orientate the nozzle, unless instructed otherwise upon installation, orientate the nozzle to spray against oncoming air stream. The punch mark on the fitting supplied with KBi's Special Injector Nozzles indicates spray direction.

1. The usual engine manufacturers' tapped nozzle location is indicated by  . If more than one nozzle location is shown on your engine drawing and one is a preferred location, it is indicated by  ; a non-preferred location is indicated by  .

2. **On engines that do not have a pre-tapped hole,** or the tapped hole(s) are not in the recommended location, the crossover tube between the intake manifold and turbocharger (or between the intake manifold and air cleaner), should be removed. An "R" size, or 21/64" diameter hole, can be drilled near where the tube connects to the intake manifold and tapped with a 1/8"-27 NPT tap. If the walls of the tubing are too thin to be tapped, a 17/32" hole may be drilled and the 1/4" to 1/8" reducer bushing can be inserted and brazed to provide a mounting place for the nozzle.

   NOTE: Be sure all chips are cleaned out of the inside of the tube before it is reinstalled on the engine.

3. If the engine is equipped with a plug in the intake manifold, the plug can be removed and drilled with an "R" size or 21/64" bit, and tapped with a 1/8"-27 NPT tap to provide an installation place for the nozzle.

VALVE AND CYLINDER ASSEMBLY INSTALLATION

CAUTION

Valve may be polarity sensitive! If the valve is polarity sensitive, it will be indicated on the valve's wire lead assembly.

WARNING

Cylinder Assembly should be mounted in an accessible location away from extreme heat - the exhaust system - and protected from road dirt, ice, and snow. If protected, it can be mounted in the engine compartment on the fire wall, radiator frame, or any other convenient location. DO NOT mount the unit on the engine or drive train because excessive vibration can cause premature failure. The assembly does not have to be mounted in a direct upright position, but some usable fluid will not be dispensed if the assembly is tipped too far from vertical. See chart below.

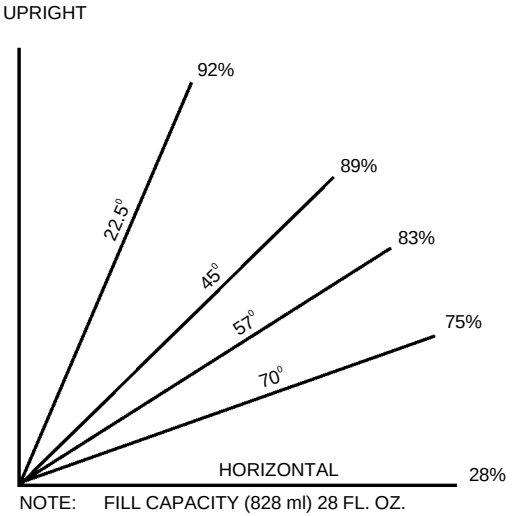

FIGURE 2
Loss of usable fluid in cylinder when not mounted vertically

1. When selecting a location, hold the Assembly in place to determine if it will clear the hood and other movable parts, and that the distance from the assembly's bottom to the nozzle location does not exceed the length of tubing provided. Be sure there is adequate clearance to change the fluid cylinder after installation.

2. The mounting plate may be used as a template. If the mounting plate is used and the cylinder is removed from the valve, the top of **the valve should be protected from debris by installing the red valve cap.**
   NOTE: Four (4) point mounting is recommended for maximum resistance to vibration. Mounting point locations should be spaced symmetrically about the center of mass, above and below the "X" axis.

3. Four bolts, lock washers (or jam nuts), and nuts are provided for mounting the valve and cylinder assembly. Preferably four bolt assemblies must be used; otherwise, warranty conditions may not apply. Space the mounting bolts as widely apart as possible to eliminate any unnecessary vibration of the unit during the equipment's operation.

4. Center punch and drill the holes for mounting. Bolt the assembly into place.

5. If the mounting plate was used as a template, the starting fluid cylinder should be properly installed back onto the valve by turning the cylinder in direction of the arrow ◄— (clockwise) until the cylinder bottoms out. DO NOT OVERTIGHTEN!

   REMEMBER: When handling cylinder, OBSERVE WARNING NOTE ON PAGE 1 of this manual.

CAUTION

Only use KBi Brand Starting Fluid Cylinders in order for your DIESELMATIC NVT to function properly. KBi Starting Fluid Cylinders have a special "O" Ring seal that is not offered on other competitive cylinders and is not available commercially.

6. Make sure that the cylinder clamp is tightened.

NOTE:

1. Do not neglect to occasionally check tightness of the cylinder clamp to make sure it has not loosened.

2. KBi offers an optional Low Cylinder Indicator (LCI), which is used to determine when the contents of the cylinder are nearing an empty level. Contact KBi's sales office (800-527-8278), for more information.

3. KBi offers a Cylinder Return Program for used Starting Fluid Cylinders. This program applies only to DOT39NRC Starting Fluid Cylinders. No other high pressure cylinders, other than Starting Fluid (ether), Cylinders will be accepted by KBi for recycling. Call KBi's sales office (800-527-8278), for a Return Authorization Number and more information.

WIRING

1. First determine whether the ECM output is "sourcing" or "sinking". This will determine where the fuse assembly will be wired. Wire the fuse assembly as close to the power source as possible.

2. Properly configure the ECM output to the ether injection function according to your engine manufactueres procedure. Many engine manufacturers require a "service tool" for your engine to access the ECM functions.

CAUTION Failure to properly configure the ECM output, may result in component damage.

REMEMBER: DANGER, GOOD VENTILATION, GOGGLES.

3. The vavle assembly should be checked for proper operation before the ECM connection is made. With the starting fluid cylinder installed, apply battery power directly to the valve leads. Starting fluid should spray from the valve.

WARNING WHEN PERFORMING THIS OPERATION BE SURE TO SPRAY STARTING FLUID INTO AN APPROPRIATE CONTAINER.

4. After this check is made and proper valve operation is verified, make the ECM connections. Be sure all wires are routed away from heat, moving parts, sharp edges, etc. If possible, route wiring with existing harnesses. Reconnect the battery.

5. Fasten the wires and tubing down with wire ties.

6. Check all connections.

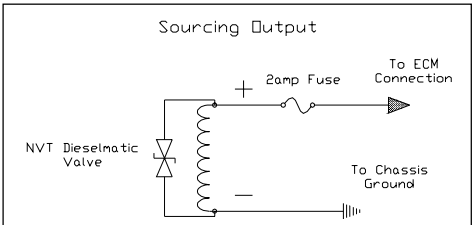

FIGURE 3
Sourcing Output Wiring Diagram

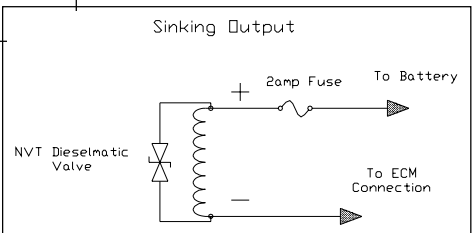

FIGURE 4
Sinking Output Wiring Diagram

INSTALLING TUBING AND VALVE FITTING

Nylon tubing length must not be shorter than two feet to assure the proper vaporization of the starting fluid as it is propelled from the metering orifice to the injector nozzle.

The DIESELMATIC NVT System's "metered flow" feature is controlled by the special internal orifice filter assembly which has been installed into the bottom of the valve.

1. A length of protective sheathing for the nylon tubing, to protect the nylon tubing from chafing, has been supplied in your kit. Be sure to insert the nylon tubing into the sheathing prior to connecting the tubing to the valve fitting and to the nozzle.

2. Route nylon tubing from the valve fitting to the nozzle installed in the intake manifold in such a way that it **does not come in contact** with the exhaust system. Be careful the tubing will not be damaged by vibration or by the engine enclosure, throttle linkage, etc. Avoid contact with all objects that may cut or wear the tubing. If tubing is cut to a shorter length, be sure to cut it squarely. A bias cut may cause leaks or it may become disconnected since the nut sleeve will not seal properly.

3. When connecting the tubing to the valve fitting and to the nozzle, keep the tubing fully seated while tightening the nut. Avoid over tightening since the sleeve can become distorted or collapsed, restricting fluid flow through the tubing. The nut should be tightened **approximately one (1) turn after it is finger tight.**

4. Check all fittings and tubing connections for leaks and make sure they are secure.

SYSTEM INSTALLATION IS NOW COMPLETED.

SERVICING AND TROUBLESHOOTING

REMEMBER: DANGER, GOOD VENTILATION, GOGGLES.

If a diesel engine is not injecting its **primary fuel** into its cylinders, the KBi DIESELMATIC NVT will not start the engine even though it is functioning. The many possible **primary fuel** system failures are waxed fuel filter, water in fuel filter, injector pump has lost prime, fuel solenoid valve has failed, fuel tank is empty, fuel line is frozen, or injector pump not supplying sufficient fuel at cranking RPM.

Many other equipment components or lubricants can affect cold starting. Review Appendix C, "Tips on Cold-Weather Starting".

The following guide is limited to troubleshooting of the DIESELMATIC NVT System. Its' most common problems are an empty fluid cylinder (step 1), or a clogged metering orifice inside the valve assembly (step 3).

1. Check the fluid cylinder contents.

   REMEMBER: When handling cylinder, OBSERVE WARNING NOTE ON PAGE 1 of this manual.

   a. Clean all dirt from neck of cylinder and top of valve before removing the fluid cylinder. Protect the top of valve from dirt when cylinder is removed by installing the red valve cap.
   b. An empty net weight 21 oz. fluid cylinder weighs 16 oz. (454 gr.); a full fluid cylinder weighs 37 oz. (1049 gr.).
   c. An empty net weight 18 oz. fluid cylinder weighs 15 oz. (425 gr.); a full fluid cylinder weighs 33 oz. (935 gr.).
   d. An empty net weight 8 oz. fluid cylinder weighs 10 oz. (283 gr.); a full fluid cylinder weighs 18 oz. (510 gr.).
   e. To determine the amount of fluid remaining in the cylinder, it should be weighed: subtract the empty net weight, convert the difference into liquid volume of fluid remaining using 39 ml. per oz. weight (1.4 ml. per g.).
   f. Check that fluid cylinder has pressure. Minimum of 120 PSI at 68°F (20°C).
   g. All KBi replacement cylinders will have a New KBi "O"Ring Cylinder Seal.
   h. Coat the new cylinder's threads with clean oil and install your engine starting fluid cylinder by turning cylinder in direction of arrow (clockwise) ← until the cylinder bottoms out. DO NOT OVERTIGHTEN CYLINDER! Be sure to retighten cylinder clamp.

   NOTE: KBi offers a Cylinder Return Program for used Starting Fluid Cylinders. This program applies only to DOT39NRC Starting Fluid Cylinders. No other high pressure cylinders, other than Starting Fluid (ether), Cylinders will be accepted by KBi for recycling. Call KBi's sales office (800-527-8278), for a Return Authorization Number and more information.

Most times the fluid cylinder is shelf stored in a position opposite of its use when installed on a valve; therefore, when it is first installed onto a valve, its contents are agitated due to the turning over. Because of flux residue remaining from the manufacturing and brazing of the raw cylinder, the contents of the cylinder should be allowed to settle back down before a System is functioned. This takes approximately 15 to 20 minutes. Failure to allow this settling often causes premature clogging of the System and

necessitates cleaning or replacement of the valve metering orifice filter. When installing our System, we recommend allowing time for this settling to take place before testing the System to see if it is functioning correctly. The design of the cylinder is such that the 1" 20 screw fitting also functions as a small standpipe; therefore, once the flux residue settles it will not enter the valve and cause clogging.

2. Check of electrical system.
   a. Check to see if the fuse is blown.
   b. Check all wiring for loose connections, shorts, and broken wires.
   c. Check that the DIESELMATIC NVT System is wired in accordance with Figure 3 or 4 depending upon the wiring diagram that was required for your particular installation.
   d. Test valve by removing fluid cylinder.
   e. Disconnect valve leads.
   f. Momentarily touch leads directly across battery terminals. The valve plunger should move up and remain up until the leads are disconnected. If the valve does not activate when connected across the battery, it is faulty and should be replaced.
   g. Check ECM output. Refer to your engine manufacturers procedure for testing the ECM output for proper operation and/or enabling.

3. Check for clogged metering orifice inside the valve assembly.

REMEMBER: DANGER, GOOD VENTILATION, GOGGLES.

The DIESELMATIC NVT's fluid flow rate is controlled by a threaded, **serviceable filtered** metering orifice inside the bottom of the valve assemlby (see Figure D1 and Figure 5); therefore, the following procedure is recommended:

a. Remove the System's injector nozzle from engine.

WARNING

During the following procedures, some pressurized fluid may be trapped in the system. Loosen all connections slowly.

b. Activate the system, if starting fluid does not spray from the injector nozzle when the system is activated, disconnect tubing from the valve's fitting. Activate the system, **If starting fluid sprays** from the valve fitting when the System is activated, reconnect tubing to the valve fitting, remove injector nozzle, and activate system. If fluid sprays from the tubing end, replace injector nozzle. If fluid does not spray from the tubing end, check tubing for kinks, burns, cuts, or clogs.

WARNING

WHEN PERFORMING THESE OPERATIONS, BE SURE TO SPRAY FLUID INTO AN APPROPRIATE CONTAINER.

FIGURE 5
Metering Orifice

c. **If starting fluid does not spray** from the valve fitting, remove the metering orifice from the valve. Remove the metering orifice by unscrewing it counterclockwise. To clean the metering orifice, rinse it with cleaning solvent. Then using low air pressure, blow thru the slotted end of the metering orifice. Reinstall metering orifice in valve screwing in clockwise until it is seated firmly. **If starting fluid still does not spray** from the valve fitting, replace the metering orifce with a new KBi metering orifice. After removal of the metering orifice from the valve, look at the etching on the end for a single alpha identification to determine your metering orifice size. Metering orifice identification of KBi part numbers as they correspond to the alpha idetification are as follows:

Alpha ID	KBi Part Number
F	100515F
H	100515H
J	100515J

Identification of which metering orifice was installed at the factory is also indicated by the 6th character of the valve part number on the label. The 100515H is the ONLY metering orifice that may not have a letter etched on it.

d. It is suggested before the cleaned or new valve fitting assembly is reinserted into valve, that the system be flushed by activating the valve.

WARNING

WHEN PERFORMING THIS OPERATION, BE SURE TO SPRAY FLUID INTO AN APPROPRIATE CONTAINER.

e. Check all fitting and tubing connections for leaks.

INTRODUCTION

STOP!

Before proceeding in Section 2 - determine that you do not want the DIESELMATIC NVT to be controlled by your engines' electronic control module (ECM). If you will be using your engines' ECM to control the DIESELMATIC NVT, go back to Section 1 of this manual and do not use Section 2.

CAUTION

Disconnect glow plugs. Indirect Injection Diesel Engines using glow plugs should have the glow plugs disconnected when using a KBi DIESELMATIC NVT System.

CAUTION

Only use KBi Brand Starting Fluid Cylinders in order for your DIESELMATIC NVT to function properly. KBi Starting Fluid Cylinders have a special "O" Ring seal that is not offered on other competitive cylinders. This special "O" Ring is not available commercially.

KBi's DIESELMATIC NVT System is a fully-automatic Engine Starting Fluid System designed to spray a controlled amount of starting fluid into the air intake system of an engine during the cranking cycle.

The System's Engine Temperature Sensor (ETS) switch determines when the DIESELMATIC NVT System should function. When needed, the solenoid valve is activated automatically during engine cranking; then starting fluid is released from the pressurized cylinder, flows through the valve, through a flow metering orifice fitting at the bottom of the valve, through the nylon tubing, and out of an injector nozzle located in the engine's air intake system.

Some diesel engine injection systems are equipped with mechanisms to advance timing or inject extra fuel for cold-weather starting. Check your engine manual to determine the proper procedure and throttle setting for cold starting of your engine.

At very cold temperatures, additional cranking cycles may be necessary because the engine will start and then die after running a short period of time. To eliminate the need for this type of additional cranking cycle, an accessory - KBi Arctic™ Kit assembly - may be purchased or installed.

With the DIESELMATIC NVT properly installed, you will have all of the features and benefits of the original KBi DIESELMATIC and much more.

Exclusive Features of the DIESELMATIC NVT:

- Low Current Draw (with Voltage Transient Suppression)
  1.3 amps @ 12 volts
  0.6 amps @ 24 volts
- Engineered for Reliability
  - Sealed from Environment
  - O-Ring Cylinder Seal
  - Encapsulated Coil
  - Non-corroding Brass Connections
  - Field-Serviceable Metering Orifice/Filter

- Designed for Superior Performance
  - Injects Starting Fluid Precisely

NOTE: WHENEVER THE ENGINE DOES NOT START WITHIN A NORMAL PERIOD OF CRANKING, THE DIESELMATIC NVT FLUID CYLINDER MAY BE EMPTY - REFER TO "SERVICING AND TROUBLESHOOTING".

KBi's DIESELMATIC NVT UNIT SPECIFICATIONS:

Input Power	12 VDC	24 VDC
Operating Voltage Range	6 - 18	12 - 36
Current Draw - Maximum	1.9	1
Current Draw - Nominal	1.3	0.6
Spike Protection	Yes	Yes

Before installing, familiarize yourself with the parts contained in your kit. Note that you have the following items in DIESELMATIC NVT Systems:

A. DIESELMATIC NVT Valve Assembly
B. Starting Fluid Cylinder
C. Valve Fitting
D. Wiring Harness
E. Nylon Tubing
F. Injector Nozzle
G. Mounting Hardware
H. Fuse Harness
I. Cylinder Clamp
J. Nylon Tubing Protective Sheathing
K. ETS Switch

The DIESELMATIC NVT is also available in a compact size, KOMPAC DIESELMATIC NVT, to allow installations in smaller engine compartments or where space is restricted. If a KOMPAC DIESELMATIC NVT Kit is purchased, you will have all of the same components listed above. However, the valve assembly, cylinder, and cylinder clamp will be reduced in size to those referenced in Figure 4.

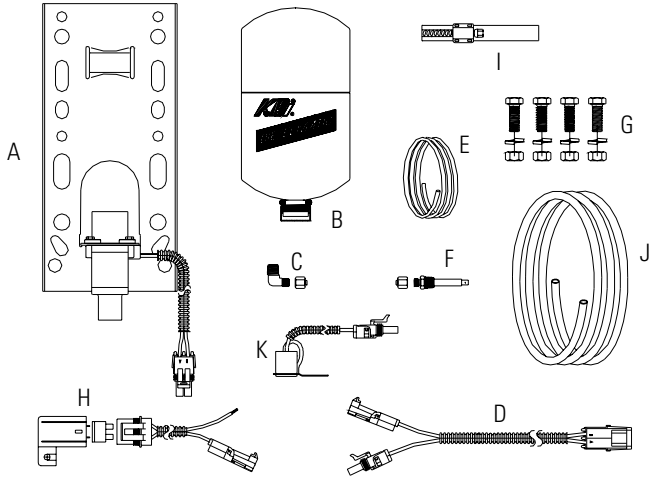

FIGURE 6
Parts in DIESELMATIC NVT kit for installation for Standard DIESELMATIC Applications

NOZZLE INSTALLATION

Installing the injector nozzle in a proper location is essential if the DIESELMATIC NVT System is to work properly on your engine. It is preferred to choose an installation point for the nozzle that will assure even distribution of starting fluid to all cylinders. On turbocharged engines the nozzle should be on the pressure side of the turbocharger.

The straight brass fitting "nozzle injector" supplied with your system should be used. The nozzle itself fits most engines; but, for some engines it may be necessary, or desirable, to also use the 1/4" NPT Reducer Bushing with the nozzle. An elbow fitting substituted in place of the straight fitting will interfere with proper vaporization of starting fluid. If an elbow fitting installation is necessary, use KBi Special Injector Nozzle; for engines 12 liters and over P/N 220424 (end orifice), or P/N 220475 (side orifice). For engines under 12 liters, use KBi P/N 220401 (end orifice), or P/N 220375 (side orifice).

DRAWING NOTES:

The following drawing notes should be used in conjunction with the engine diagrams in Appendix A, that indicates your air intake system.

NOTE: Some engine manufacturers' pre-tapped nozzle locations are not desirable to use because they will result in the uneven distribution of starting fluid to all of the cylinders of the engine. Uneven distribution, or favoring only one or two cylinders of an engine, can cause engine lock-up during cranking. The solution for this type of problem is to change the location of the injector nozzle or use a Special Injector Nozzle, which will direct the starting fluid into the main air flow when orientated correctly. To correctly orientate the nozzle, unless instructed otherwise upon installation, orientate the nozzle to spray against oncoming air stream. The punch mark on the fitting supplied with KBi's Special Injector Nozzles indicates spray direction.

1. The usual engine manufacturers' tapped nozzle location is indicated by  . If more than one nozzle location is shown on your engine drawing and one is a preferred location, it is indicated by 

; a non-preferred location is indicated by 

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2. **On engines that do not have a pre-tapped hole,** or the tapped hole(s) are not in the recommended location, the crossover tube between the intake manifold and turbocharger (or between the intake manifold and air cleaner), should be removed. An "R" size, or 21/64" diameter hole, can be drilled near where the tube connects to the intake manifold and tapped with a 1/8"-27 NPT tap. If the walls of the tubing are too thin to be tapped, a 17/32" hole may be drilled and the 1/4" to 1/8" reducer bushing can be inserted and brazed to provide a mounting place for the nozzle.

   NOTE: Be sure all chips are cleaned out of the inside of the tube before it is reinstalled on the engine.

3. If the engine is equipped with a plug in the intake manifold, the plug can be removed and drilled with an "R" size or 21/64" bit, and tapped with a 1/8"-27 NPT tap to provide an installation place for the nozzle.

VALVE AND CYLINDER ASSEMBLY INSTALLATION

CAUTION

Valve may be polarity sensitive! If the valve is polarity sensitive, it will be indicated on the valve's wire lead assembly.

WARNING

Cylinder Assembly should be mounted in an accessible location away from extreme heat - the exhaust system - and protected from road dirt, ice, and snow. If protected, it can be mounted in the engine compartment on the fire wall, radiator frame, or any other convenient location. DO NOT mount the unit on the engine or drive train because excessive vibration can cause premature failure. The assembly does not have to be mounted in a direct upright position, but some usable fluid will not be dispensed if the assembly is tipped too far from vertical. See chart below.

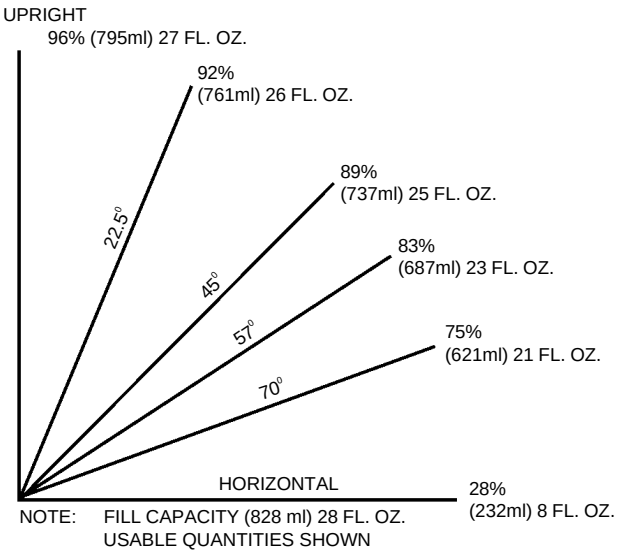

FIGURE 7
Loss of usable fluid in cylinder when not mounted vertically

1. When selecting a location, hold the Assembly in place to determine if it will clear the hood and other movable parts, and that the distance from the assembly's bottom to the nozzle location does not exceed the length of tubing provided. Be sure there is adequate clearance to change the fluid cylinder after installation.

2. The mounting plate may be used as a template. If the mounting plate is used and the cylinder is removed from the valve, the top of **the valve should be protected from debris by installing the red valve cap.**

   NOTE: Four (4) point mounting is recommended for maximum resistance to vibration. Mounting point locations should be spaced symmetrically about the center of mass, above and below the "X" axis.

3. Four bolts, lock washers (or jam nuts), and nuts are provided for mounting the valve and cylinder assembly. Preferably four bolt assemblies must be used; otherwise, warranty conditions may not apply. Space the mounting bolts as widely apart as possible to eliminate any unnecessary vibration of the unit during the equipment's operation.

4. Center punch and drill the holes for mounting. Bolt the assembly into place.

5. If the mounting plate was used as a template, the starting fluid cylinder should be properly installed back onto the valve by turning the cylinder in direction of the arrow ◄— (clockwise) until the cylinder bottoms out. DO NOT OVERTIGHTEN!

   REMEMBER: When handling cylinder, OBSERVE WARNING NOTE ON PAGE 1 of this manual.

Only use KBi Brand Starting Fluid Cylinders in order for your DIESELMATIC NVT to function properly. KBi Starting Fluid Cylinders have a special "O" Ring seal that is not offered on other competitive cylinders and is not available commercially.

6. Make sure that the cylinder clamp is tightened.

NOTE:

1. Do not neglect to occasionally check tightness of the cylinder clamp to make sure it has not loosened.

2. KBi offers an optional Low Cylinder Indicator (LCI), which is used to determine when the contents of the cylinder are nearing an empty level. Contact KBi's sales office (800-527-8278), for more information.

3. KBi offers a Cylinder Return Program for used Starting Fluid Cylinders. This program applies only to DOT39NRC Starting Fluid Cylinders. No other high pressure cylinders, other than Starting Fluid (ether), Cylinders will be accepted by KBi for recycling. Call KBi's sales office (800-527-8278), for a Return Authorization Number and more information.

ENGINE TEMPERATURE SENSOR (ETS), SWITCH LOCATION

1. THE SURFACE TYPE should be mounted where it can most easily sense the engine temperature, such as against the engine block.

   WARNING

   It should never be mounted against the exhaust manifold since temperatures are too high and will destroy the unit. Make sure that there is no air gap between the metal face of the unit and the engine.

2. THE SCREW-IN TYPE should be located in the engine water jacket. Usually the best location is found by removing a water drain plug. The plug size is 1/2" - 14 NPT which is a standard.

3. Special care should be taken when installing the ETS on an engine that is equipped with an engine block heater. The ETS's location should be in an area where heat from the engine's block heater will not affect the ETS. On such installations, an area such as the engine's oil pan flange, etc., would be a preferred location.

4. Make sure good electrical continuity exists between the engine block and the ground lead of the ETS. It may be necessary to remove any paint from the engine block at the grounding point to insure continuity. Wire one lead to the ground lead of the valve. The second lead of the ETS should be grounded. The surface type can be grounded by putting the lead under the mounting bolt; the screw-in type can be grounded to any convenient place on the engine.

5. The NORMAL ETS Switch included in DIESELMATIC NVT units allows the system to function at an operating threshold temperature of 40°F (4°C); i.e. 40°F (4°C) and lower. If your particular equipment requires a different temperature device, please contact your dealer.

NOTE: All ETS's are identified by either a stamp on the bottom of the ETS or by a sleeve on the lead wire. The numbers in these locations refer to the operating threshold temperatures.

WIRING

For Electric Starter Systems

1. The valve assembly should be checked for proper operation before the ETS Switch is wired into the circuit. To do this, disconnect the battery and complete the wiring circuit as shown in Figure 8 (if series parallel wiring is required, see Figure 9). ***However, connect the colored valve lead directly to a good ground.*** Reconnect the battery.

   REMEMBER: DANGER, GOOD VENTILATION, GOGGLES.

2. **With the fluid cylinder installed on the valve,** activate the cranking motor for a brief period of time. Starting fluid should spray from the valve **only for the time the cranking motor is activated.** WHEN PERFORMING THIS OPERATION BE SURE TO SPRAY STARTING FLUID INTO AN APPROPRIATE CONTAINER.

3. After this check is made and proper valve operation is verified, disconnect the battery and complete the wiring circuit for the ETS Switch as shown in Figure 8 (if series parallel was required Figure 9). Be sure all wires are routed away from heat, moving parts, sharp edges, etc. If possible, route wiring with existing harnesses. Reconnect the battery.

4. Fasten the wires and tubing down with wire ties.

5. Check all connections for proper crimping and insulation.

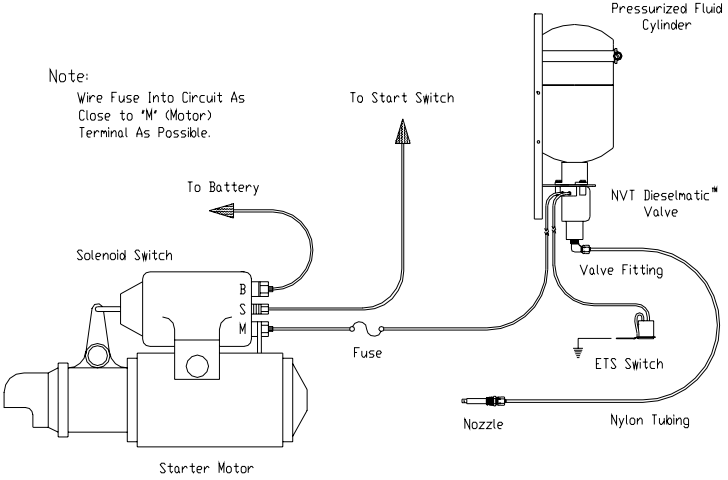

FIGURE 8
Wiring diagram for electric starter systems

For Air Starter Systems

The air switch (KBi Part Number 301125), should be installed before wiring.

1. Ensure that the air reservoir tank is empty (0 lbs. pressure).

2. Find the relay valve located at the opposite end of the large air line and on one of the smaller air lines from the starter.

3. Remove the smaller starter air line from the relay valve and install a tee fitting in its' place.

4. Re-install the air line and fitting into the tee.

5. Install the air switch into the tee.

6. The valve assembly should be checked for proper operation before the ETS Switch is wired into the circuit. To do this, disconnect the battery and complete the wiring circuit as shown in Figure 10. **However, connect the colored lead directly to a good ground.** Reconnect the battery.

   REMEMBER: DANGER, GOOD VENTILATION, GOGGLES

7. **With the fluid cylinder installed on the valve**, activate the cranking motor for a brief period of time. Starting fluid should spray from the valve **only for the time the cranking motor is activated.** WHEN PERFORMING THIS OPERATION BE SURE TO SPRAY STARTING FLUID INTO AN APPROPRIATE CONTAINER.

8. After this check is made and proper valve operation is verified, disconnect the battery and complete the wiring circuit for the ETS Switch as shown in Figure 10. Be sure all wires are routed away from heat, moving parts, sharp edges, etc. If possible, route wiring with existing harnesses. Reconnect the battery.

9. Fasten the wires and tubing down with wire ties.

9. Check all connections for proper crimping and insulation.

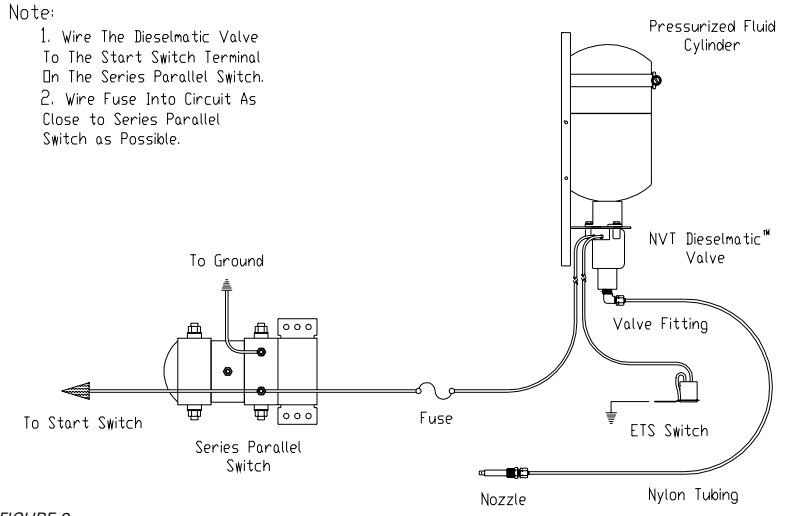

FIGURE 9
Wiring diagram for series parallel installation

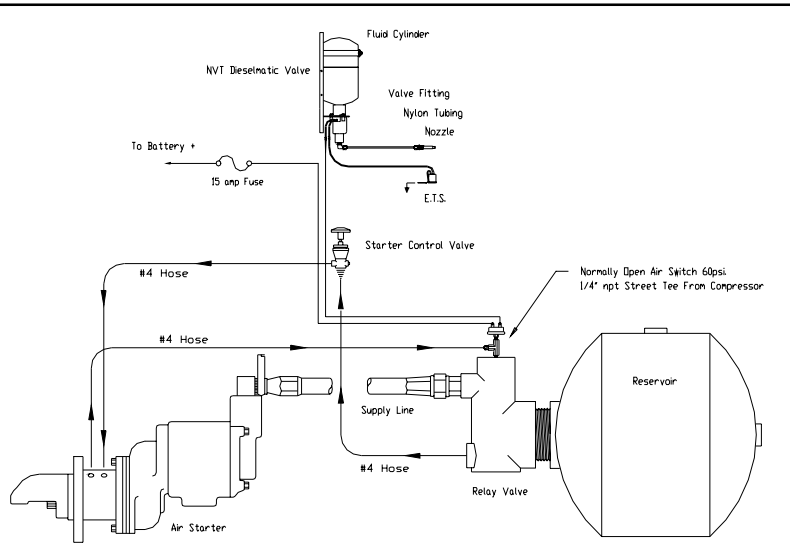

FIGURE 10
Wiring diagram for air starter systems

INSTALLING TUBING AND VALVE FITTING

CAUTION

Nylon tubing length must not be shorter than two feet to assure the proper vaporization of the starting fluid as it is propelled from the metering orifice to the injector nozzle.

The DIESELMATIC NVT System's "metered flow" feature is controlled by the special internal orifice filter assembly which has been installed into the bottom of the valve.

1. A length of protective sheathing for the nylon tubing, to protect the nylon tubing from chafing, has been supplied in your kit. Be sure to insert the nylon tubing into the sheathing prior to connecting the tubing to the valve fitting and to the nozzle.

2. Route nylon tubing from the valve fitting, to the nozzle installed in the intake manifold in such a way that it **does not come in contact** with the exhaust system. Be careful the tubing will not be damaged by vibration or by the engine enclosure, throttle linkage, etc. Avoid contact with all objects that may cut or wear the tubing. If tubing is cut to a shorter length, be sure to cut it squarely. A bias cut may cause leaks or it may become disconnected since the nut sleeve will not seal properly.

3. When connecting the tubing to the valve fitting and to the nozzle, keep the tubing fully seated while tightening the nut. Avoid over tightening since the sleeve can become distorted or collapsed, restricting fluid flow through the tubing. The nut should be tightened **approximately one (1) turn after it is finger tight.**

4. Check all fittings and tubing connections for leaks and make sure they are secure.

SYSTEM INSTALLATION IS NOW COMPLETED.

SERVICING AND TROUBLESHOOTING

REMEMBER: DANGER, GOOD VENTILATION, GOGGLES.

If a diesel engine is not injecting its **primary fuel** into its cylinders, the KBi DIESELMATIC NVT will not start the engine even though it is functioning. The many possible **primary fuel** system failures are waxed fuel filter, water in fuel filter, injector pump has lost prime, fuel solenoid valve has failed, fuel tank is empty, fuel line is frozen, or injector pump not supplying sufficient fuel at cranking RPM.

Many other equipment components or lubricants can affect cold starting. Review Appendix C, "Tips on Cold-Weather Starting".

The following guide is limited to troubleshooting of the DIESELMATIC NVT System. Its' most common problems are an empty fluid cylinder (step 1), or a clogged metering orifice inside the valve assembly (step 3).

1. Check the fluid cylinder contents.

   REMEMBER: When handling cylinder, OBSERVE WARNING NOTE ON PAGE 1 of this manual.

   a. Clean all dirt from neck of cylinder and top of valve before removing the fluid cylinder. Protect the top of valve from dirt when cylinder is removed by installing the red valve cap.
   b. An empty net weight 21 oz. fluid cylinder weighs 16 oz. (454 gr.); a full fluid cylinder weighs 37 oz. (1049 gr.).
   c. An empty net weight 18 oz. fluid cylinder weighs 15 oz. (425 gr.); a full fluid cylinder weighs 33 oz. (935 gr.).
   d. An empty net weight 8 oz. fluid cylinder weighs 10 oz. (283 gr.); a full fluid cylinder weighs 18 oz. (510 gr.).
   e. To determine the amount of fluid remaining in the cylinder, it should be weighed: subtract the empty net weight, convert the difference into liquid volume of fluid remaining using 39 ml. per oz. weight (1.4 ml. per g.).
   f. Check that fluid cylinder has pressure. Minimum of 120 PSI at 68°F (20°C).
   g. All KBi replacement cylinders will have a New KBi "O"Ring Cylinder Seal.
   h. Coat the new cylinder's threads with clean oil and install your engine starting fluid cylinder by turning cylinder in direction of arrow (clockwise) ← until the cylinder bottoms out. DO NOT OVERTIGHTEN CYLINDER! Be sure to retighten cylinder clamp.

   NOTE: KBi offers a Cylinder Return Program for used Starting Fluid Cylinders. This program applies only to DOT39NRC Starting Fluid Cylinders. No other high pressure cylinders, other than Starting Fluid (ether), Cylinders will be accepted by KBi for recycling. Call KBi's sales office (800-527-8278), for a Return Authorization Number and more information.

Most times the fluid cylinder is shelf stored in a position opposite of its use when installed on a valve; therefore, when it is first installed onto a valve, its contents are agitated due to the turning over. Because of flux residue remaining from the manufacturing and brazing of the raw cylinder, the contents of the cylinder should be allowed to settle back down before a System is functioned. This takes approximately 15 to 20 minutes. Failure to allow this settling often causes premature clogging of the System and

necessitates cleaning or replacement of the valve metering orifice filter. When installing our System, we recommend allowing time for this settling to take place before testing the System to see if it is functioning correctly. The design of the cylinder is such that the 1" 20 screw fitting also functions as a small standpipe; therefore, once the flux residue settles it will not enter the valve and cause clogging.

2. Check of electrical system.
   a. Check to see if the fuse is blown.
   b. Check all wiring for loose connections, shorts, and broken wires.
   c. Check that the DIESELMATIC NVT System is wired in accordance with Figure 8, 9, or 10 depending upon the wiring diagram that was required for your particular installation.
      NOTE: **To check system** for proper operation, the NORMAL Engine Temperature Sensor (ETS) must be below 40°F (4°C), or be bypassed by connecting the valve's colored lead directly to a good ground. After checking, be sure to reconnect the colored lead in accordance with Figure 10, 11, or 12.
   d. Test valve by removing fluid cylinder and momentarily engaging cranking motor. The valve plunger should move up and remain up while the cranking motor is engaged. If valve operates, proceed to (2)f.
   e. If valve plunger did not function, check valve by disconnecting leads from cranking motor and ground. Momentarily touch leads directly across battery terminals. The valve plunger should move up and remain up until the leads are disconnected. If the valve does not activate when connected across the battery, it is faulty and should be replaced.
   f. Check ETS Switch performance by **thoroughly** chilling to sub-freezing temperatures for 10 minutes or more, the NORMAL ETS Switch should be closed (i.e., show continuity when checked with a DC power test light or ohmmeter). When thoroughly warmed to temperatures above 65°F (18°C), the NORMAL ETS Switch should be open (i.e., not show continuity). If your ETS Switch is not a NORMAL ETS (see page 10), adjust the above stated temperatures accordingly for the proper closing and opening temperatures.
      If either continuity test fails, the ETS Switch should be replaced.
      NOTE: The ETS Switch may require 10 to 15 minutes to react to temperature change. At room temperatures, a properly functioning switch may be either open or closed, depending upon which ETS is used in your system.

CAUTION

Do not attempt to check ETS Switch by shorting it across battery terminals. EXCESS CURRENT WILL BURN OUT THE SWITCH AND IT WILL HAVE TO BE REPLACED.

3. Check for clogged metering orifice inside the valve assembly.

REMEMBER: DANGER, GOOD VENTILATION, GOGGLES.

The DIESELMATIC NVT's fluid flow rate is controlled by a threaded, **serviceable filtered** metering orifice inside the bottom of the valve assemlby (see Figure D1 and Figure 11); therefore, the following procedure is recommended:

a. Remove the System's injector nozzle from engine.

WARNING

During the following procedures, some pressurized fluid may be trapped in the system. Loosen all connections slowly.

b. Activate the system, if starting fluid does not spray from the injector nozzle when the system is activated, disconnect tubing from the valve's fitting. Activate the system, **If starting fluid sprays** from the valve fitting when the System is activated, reconnect tubing to the valve fitting, remove injector nozzle, and activate system. If fluid sprays from the tubing end, replace injector nozzle. If fluid does not spray from the tubing end, check tubing for kinks, burns, cuts, or clogs.

WARNING

WHEN PERFORMING THESE OPERATIONS, BE SURE TO SPRAY FLUID INTO AN APPROPRIATE CONTAINER.

c. **If starting fluid does not spray** from the valve fitting, remove the metering orifice from the valve. Remove the metering orifice by unscrewing it counterclockwise. To clean the metering orifice, rinse it with cleaning solvent. Then using low air pressure, blow thru the slotted end of the metering orifice. Reinstall metering orifice in valve screwing in clockwise until it is seated firmly. **If starting fluid still does not spray** from the valve fitting, replace the metering orifce with a new KBi metering orifice. After removal of the metering orifice from the valve, look at the etching on the end for a single alpha identification to determine your metering orifice size. Metering orifice identification of KBi part numbers as they correspond to the alpha idetification are as follows:

Alpha ID	KBi Part Number
F	100515F
H	100515H
J	100515J

Identification of which metering orifice was installed at the factory is also indicated by the 6th character of the valve part number on the label. The 100515H is the ONLY metering orifice that may not have a letter etched on it.

d. It is suggested before the cleaned or new valve fitting assembly is reinserted into valve, that the system be flushed by activating the valve.

WARNING

WHEN PERFORMING THIS OPERATION, BE SURE TO SPRAY FLUID INTO AN APPROPRIATE CONTAINER.

e. Check all fitting and tubing connections for leaks.

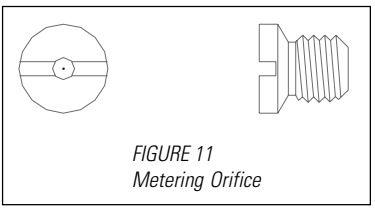

FIGURE 11
Metering Orifice

ENGINE DIAGRAMS

Reference Nozzle Installation for more information on how to use these engine diagrams.

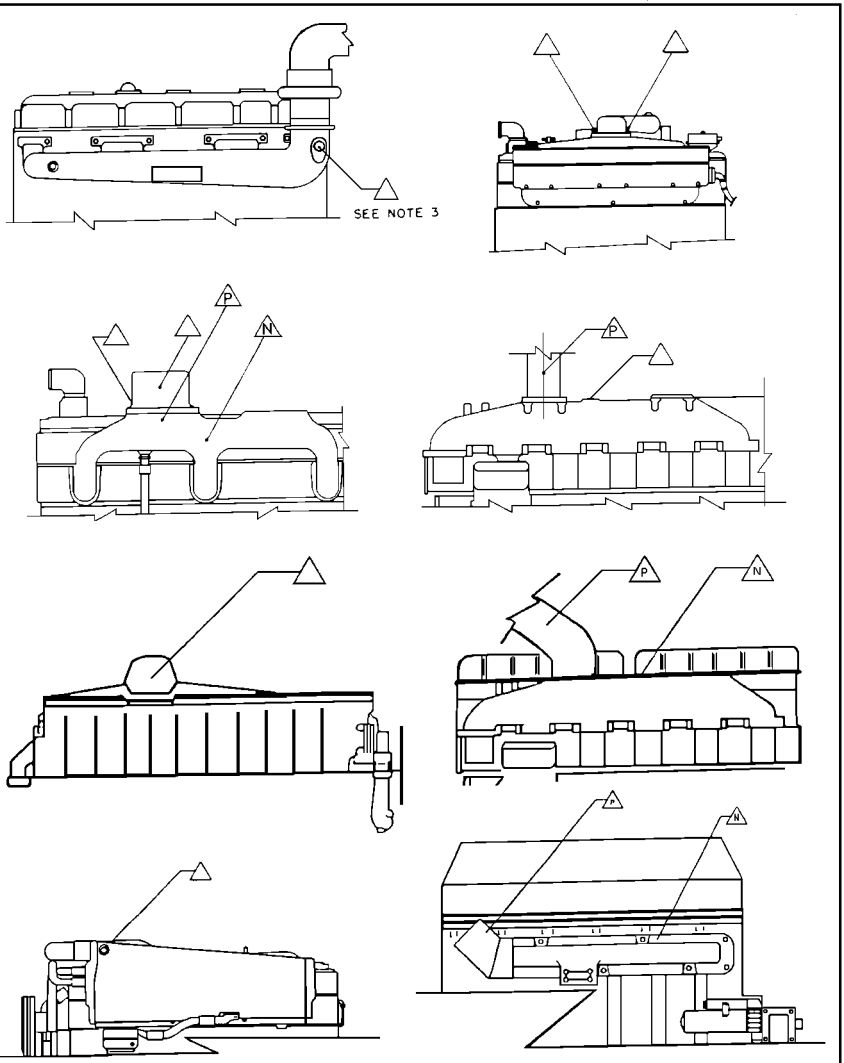

FIGURE A-1
Typical six (6) cylinder

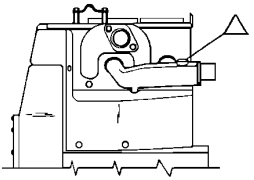

FIGURE A-2
Typical two (2) cylinder

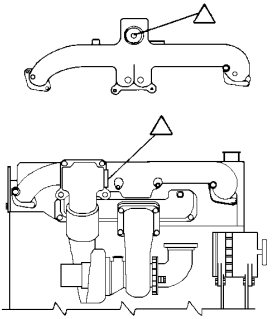

FIGURE A-3
Typical four (4) Cylinder

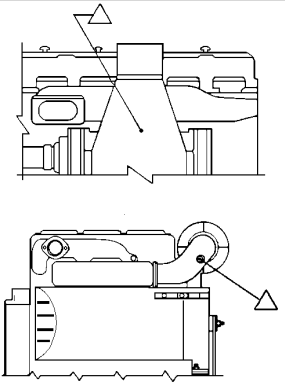

FIGURE A-4
Typical three (3) cylinder

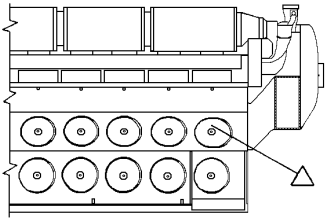

FIGURE A-5
Locomotive type engine

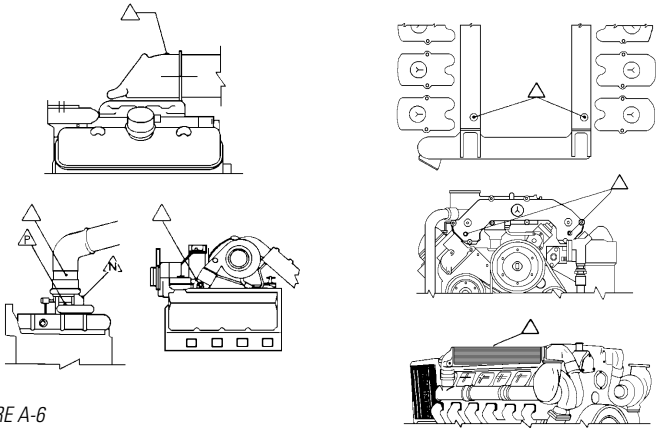

FIGURE A-6
Typical "V" Engine

NOTE: *Some Dual Manifold Engines require a two-nozzle Adapter Kit. The kit contains one Tubing-Tee Fitting, three Nut and Sleeve sets, two 24" Lengths of Nylon Nozzle Tubing, and two Nozzles.*

MAINTENANCE SCHEDULE

NOTE:
1. See "SERVICING AND TROUBLESHOOTING" for detailed procedures.
2. KBi offers a Cylinder Return Program for used Starting Fluid Cylinders. Call KBi's sales office (800-527-8278), for a Return Authorization Number and more information.

R = Replace
I = Inspect (After inspection, clean, adjust, repair, or replace if necessary.)

	Prior to the Winter Season	Every Month or 15,000 Miles During the Winter Season
Fluid Cylinder	R	
Fluid Cylinder Contents		I
Orifice Filter Assembly	I	
Valve Assembly	I	I
Tubing and Nozzle	I	I
System Wiring	I	I
Test ETS*	I	
Bypass ETS* and Check System Operation	I	I

* ETS (Engine Temperature Sensor) is only applicable if your DIESELMATIC NVT unit was installed as per the instructions in Section 2 of this manual.

TIPS ON COLD-WEATHER STARTING

1. **Battery and Cables** - To start in cold weather, a diesel engine must crank at a fairly high speed. Worn out batteries, partially discharged batteries, and poor or loose cable connections will reduce the cranking speed. Batteries, cables and connections should be cleaned and tightened regularly.

2. **Fuel** - For an engine to start and keep running, fuel must flow through the injection system. Unblended #2 diesel fuel "clouds", forming filter-clogging wax at temperatures around 15°F (-10°C), making starting and running impossible. Most engine manufacturers recommend that fuel have a cloud point at least 10°F (-12°C), below the coldest anticipated temperature. If straight #2 fuel is to be used at temperatures lower than 25°F (-4°C), a fuel additive or a fuel heater may be necessary. A blend of 9 parts #2 fuel to 1 part kerosene, (in Europe - paraffin), would lower the "cloud" temperature to approximately 5°F (-15°C). A blend of 3:1 would lower the "cloud" temperature to approximately -4°F (-20°C); 1:1 for -22°F (-30°C).

3. **Lube Oil -** Engine lubricating oil gets thicker at lower temperatures. Many oils that flow freely at 70°F (21°C) are extremely thick at 0°F (-18°C). Follow your engine manufacturer's recommendations regarding oil viscosity for the coldest temperatures you expect your engine to encounter.

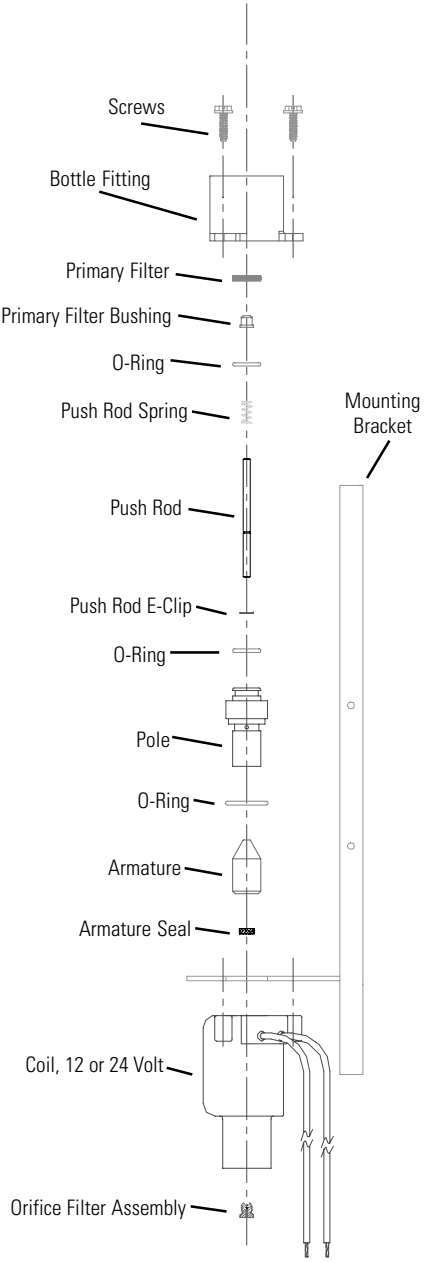

Figure D1
Exploded view of the DIESELMATIC NVT Valve Assembly

LIMITED WARRANTY

All products are guaranteed against defects in material and workmanship for one year from date of purchase. The Valve and Engine Temperature Sensor (ETS), Switch are sealed units. If these components do not operate properly, they must be returned to the factory, prepaid, for replacement. If factory inspection determines the product to be defective under the terms of this warranty, it will be replaced without charge.

Failure due to accident, abuse, neglect, improper installation or maintenance, mishandling, and repairs or attempted repairs which have been made by others, are not covered under the terms of this warranty.

Kold-Ban International Ltd., shall not be liable for loss of use of the System or other incidental or consequential costs, expenses or damages incurred by the purchaser or user.

This warranty does not include labor for repair or replacement, nor does it apply to used fluid cylinders or BLOCKOR Fittings, injector nozzles, and atomizers clogged by dirt.

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