WOODWARD

Manual 55151
(Revision NEW, 1998)
Original Instructions

Fuel Injection Equipment Introductory Manual

Service Instruction

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Manual 55151

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Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Chapter 1.
General Information

WARNING

It is mandatory that before carrying out any work on the equipment covered by this manual, the customer or user satisfactorily complete a Woodward-recognized training course. Training courses can be made available by Woodward or some of its Distributors if required.

WARNING

Important health and safety considerations apply when working on Woodward fuel injection equipment. All work carried out must be compliant with service bulletin 01539 (old number 308), *Safe Handling and Use of Woodward Diesel Systems Equipment*.

Workshop cleanliness, when disassembling (dismantling) and assembling fuel injection equipment, is essential to ensure subsequent trouble-free operation.

The work-bench must be thoroughly cleaned before commencing work, and all dirt, grit, iron filings, and other foreign materials removed. Clean containers should be provided in which to place components.

A thoroughly cleaned vessel holding a supply of fresh, clean, water-free, light fuel oil or injector test oil should be available for washing disassembled parts. Components should be assembled wet. It is permissible to use lint-free (non-fluffing) paper during cleaning processes. Never use paraffin or kerosene, and never use woven cloths or wipers.

The components of each individual pump or injector should be kept together during disassembly. It is especially important that pump plungers be fitted only to barrels with which they were originally mated and that the delivery valve be re-assembled with its mated seat.

A brass wire brush will be found useful for cleaning all non-mating surfaces and, although a scraper is suitable for clearing small carbon deposits on the nozzle nut clamping shoulder of the injector, no hard tool should be used on highly finished surfaces such as those on the pump plunger or barrel.

Only genuine Woodward spare parts should be used when replacement of damaged or worn components becomes necessary.

WARNING

To guarantee the safety, performance, and reliability of the equipment, only genuine Woodward spares must be used during rework.

Chapter 2.
Fuel Injection Pumps

Construction and Operation

Woodward fuel injection pumps, incorporating a constant-stroke spring-returned plunger, are usually flange-mounted and operated from the engine camshaft, roller tappet, and pushrod onto the tappet in the fuel pump, or directly onto the roller tappet in the fuel pump. A typical single-cylinder pump is illustrated in Figure 2-1.

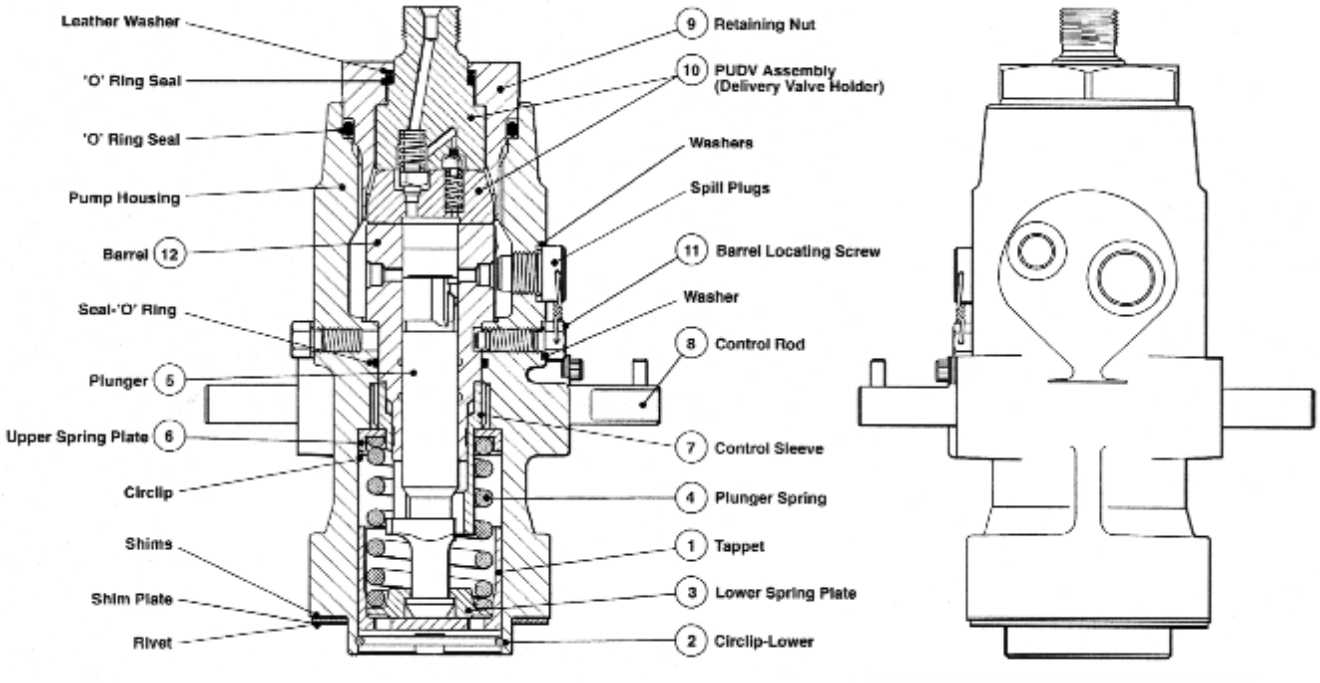


Figure 2-1. Typical Fuel Injection Pump

Pump Element

The pump element controls the metering of high-pressure fuel oil to the injector in precisely measured quantities and to specific timing. The operation of the element is illustrated Figure 2-2, showing the plunger in various stages of travel from the bottom to the top of its stroke. The vertical gash in the plunger remains in communication with the barrel port during the no-delivery stroke. Fuel flows down the vertical gash and out through the spill port throughout the stroke, and no fuel passes to the injector. This is known as the ‘dead rack position’ and is used to stop the engine.

The four lower drawings show the plunger rotated so that the plunger helix becomes operative. The plunger commences to pump fuel during its upward stroke when the plunger top edge closes the port (point of port closure), and will continue to deliver fuel while the triangular portion above the helix covers the port. The plunger can be rotated by the control rod to alter the effective length of the triangular portion of the plunger in line with the barrel port, thus controlling the quantity of fuel delivered.

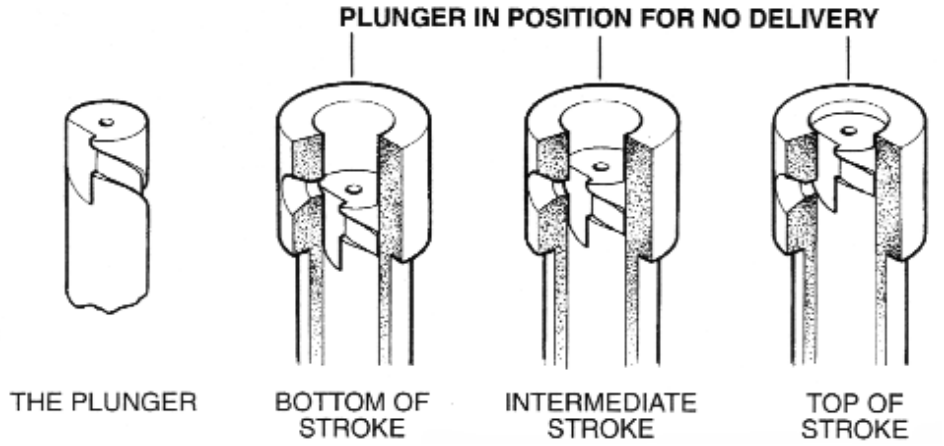
The delivery of fuel terminates when the edge of the helix in the pump plunger uncovers the barrel port (point of spill). Further plunger movement towards the top of stroke after injection displaces fuel through the vertical gash and helix back to the pump fuel feed gallery via the spill port.

Delivery Valve

The delivery valve has two important functions:

1. It acts as a non-return valve between the pumping element and the injector to facilitate efficient filling of the high-pressure system particularly at starting.
2. The piston action of the delivery valve collar in the valve seat bore retracts a predetermined amount of fuel from the high-pressure pipe after injection to reduce undesirable pressure waves which could result in unsatisfactory nozzle performance.

Some types of delivery valve control the pressure contained in the pumping line between injections. These may have a similar valve collar unloading feature or may comprise simpler ball or poppet type valves.



IMPORTANT **Vertical gash remains in communication with port throughout stroke.**

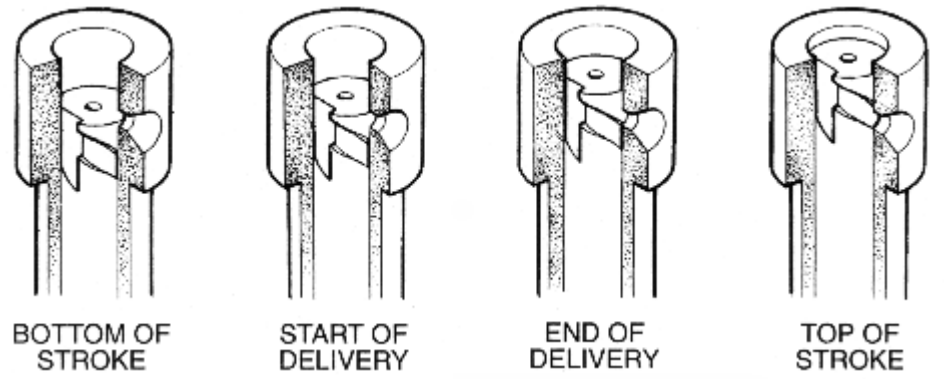


Figure 2-2. Plunger in Position for Normal Delivery

Disassembly

These notes are provided as a simple explanation of disassembly (dismantling), inspection, and reassembly/test requirements in general. Woodward Diesel Systems provides either workshop manuals or service instructions for all significant types of pumps and injectors, and these should be consulted for detailed information.

Invert the pump and grip the flats of the delivery valve holder (if fitted) in a plain jaw vise (pump inverted)(see Figure 2-1). Depress the tappet (1) until a service pin can be inserted through the hole provided in the spigot of the pump flange. Remove the lower circlip (2). Free the service pin and withdraw the tappet, lower spring plate (3), spring (4), plunger (5), upper spring plate (6), and the control sleeve (7).

The pump body may now be reversed and held in a vise or suitable fixture. The control rod (8) should be removed. Unscrew the delivery valve holder (if fitted) or retaining nut (9) and remove the separate spring peg (if fitted), delivery valve spring, and delivery valve. The PUDV assembly (10) or valve seat (if fitted) and any high-pressure seal can now be removed. Unscrew the barrel-locating screw (11) (if fitted) and remove the barrel (12), taking care not to damage any lapped sealing faces.

Examination

Element Assembly

Carefully check the mated surface of the plunger. The sealing face of the barrel should be inspected for evidence of possible leakage which will show as fine, irregular radial tracks on the surface. If these tracks are not too deep, they may be removed by re-lapping the sealing face on a lapping plate. Faults on mating plunger surfaces can seldom be rectified and, in such cases, the element assembly should be replaced.

Inspect the plunger foot, lower spring plate, and tappet for wear. Absence of longitudinal clearance between the plunger foot and the tappet can result in stiff control rod operation, and this should be rectified by fitting a replacement spring plate or tappet as required.

Sealing Rings and Washers

Damaged or flattened sealing rings should be renewed. Sealing washers and O-ring seals removed in disassembly should be discarded and new components fitted.

Barrel Locating Screw

This screw, which is fitted with the pump housing, should be carefully inspected and replaced if damaged. Dowels are fitted on some pump types.

Delivery Valve Group

Check the delivery valve and seat for any signs of wear or damage. The sealing face of the seat should be inspected for evidence of leakage which will be indicated by fine, irregular tracks on the surface. If not too deep, these tracks may be removed by re-lapping the sealing face on a lapping plate. Damaged components should be replaced. Springs should be checked for corrosion, erosion, or excessive wear, and replaced as necessary.

Pump Assembly

Prior to assembly, all parts must have been thoroughly cleaned and oiled. The plunger and barrel should be assembled while completely coated with clean injector test oil.

The tappet surfaces should be lightly oiled prior to assembly, with engine grade lube oil, and the remaining parts in the lower half of the pump oiled with injector test oil, clean lubricating oil, or non-drying, rust-inhibiting preservative oil.

Again referring to Figure 2-1, proceed to assemble the components in reverse sequence of operations given for disassembly. Pay particular attention to the following points:

- That the slot in the barrel is opposite the locating screw.
- After fitting the delivery valve/seat assembly, high-pressure seal, spring and spring peg (if specified), tighten the delivery valve holder to the torque and sequence laid down in current Woodward Diesel Systems technical service information.
- The control sleeve must mesh with the control rod in the position where the punch-marked tooth falls between the similarly marked tooth gap on the control rod.
- Before fitting the tappet, ensure that the plunger is positioned so that the locating pin, or marked lug at its lower end, registers with the marked slot in the control sleeve. Push in the tappet until the plunger locating pin has correctly located in the control sleeve slot. Retain the tappet by means of a service pin passed through the hole in the flange spigot or tappet depressor, fit the lower circlip and remove the service pin and depressor.
- When critical components (elements, control rod, etc) have been renewed, the pump should be re-calibrated, which requires special equipment. The current Woodward service test specification should be followed.
- On the completion of assembly operations, fit clean blanking plugs to pump inlet and outlet connections to prevent the ingress of foreign material. The caps should not be removed until the pump is installed on the engine.

Engine Fuel System Venting

If the fuel system has been disconnected at any time, or if the fuel tank has been allowed to run dry, it is essential that all air be removed from the system before starting the engine.

This operation is usually carried out by progressively opening the air venting screws generally fitted to filter and pump, allowing fuel to flow until it is free from air bubbles.

When no pump air venting screw is provided, set the control rod in the ’stop’ position and then slacken back the pump inlet feed connection until fuel flows freely without air bubbles being present.

Re-tighten the inlet connection to the required torque.

After connecting the high-pressure pipe between pump and injector, follow the starting instructions in the Engine Manufacturers manual until the high-pressure pipes are full, the injectors are heard to operate, and the engine starts.

Fuel Storage and Filtration

Fuel oil should preferably be purchased in large quantities and stored in covered twin tanks connected in such a way that one serves as a settling tank. (Galvanized containers should never be used.) The fuel oil can then be drawn through large-capacity filters to the engine supply tank. The engine tank should be adequately filled at all times to reduce moisture condensation: it should not be completely emptied (other than for periodic cleaning) as the dregs usually contain harmful impurities.

Chapter 3.
Fuel Injectors

Construction and Operation

The injector, located in the engine cylinder head, comprises two main assemblies: a nozzle holder and a nozzle. A typical injector is illustrated in Figure 3-1.

Fuel is pumped, under pressure, through the fuel inlet and down through the nozzle holder body (1) to the nozzle (2): The pressure of the fuel lifts the needle valve in the nozzle, and fuel flows across the seat and through the spray holes in the nozzle. The opening pressure of the needle valve is controlled by the injector spring (3), which can be adjusted by shims (4) in the spring housing or by the separate adjusting screw, if fitted.

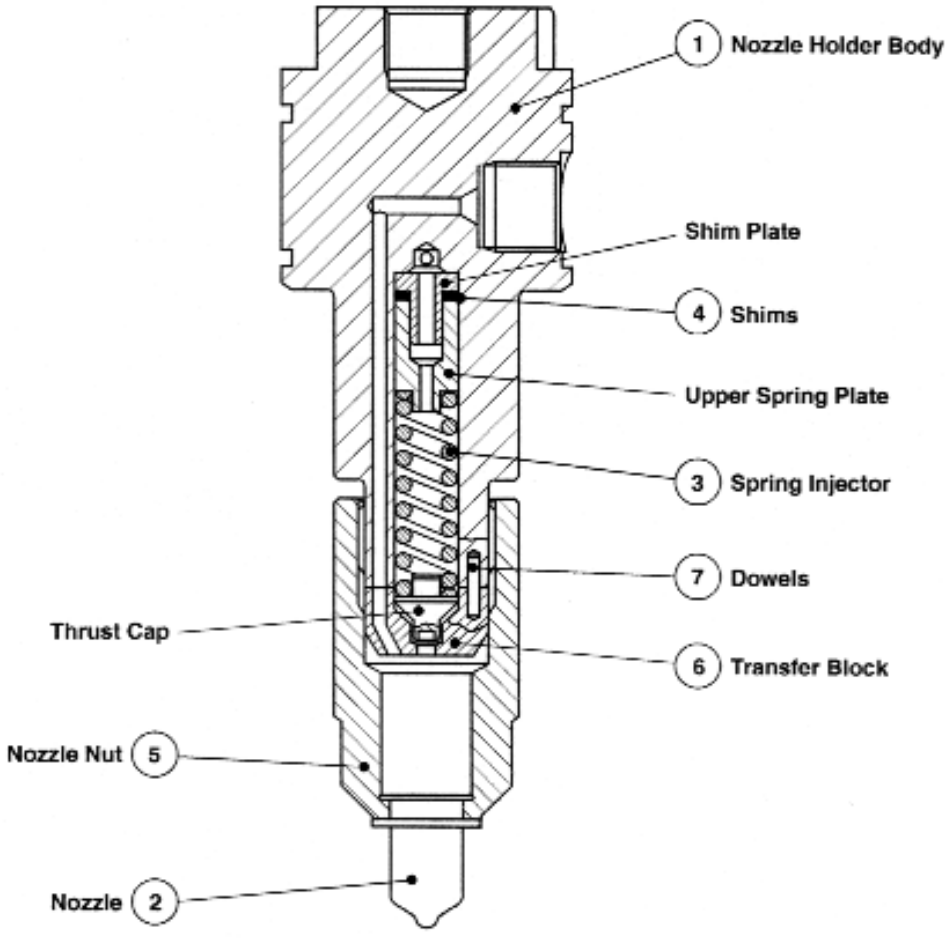


Figure 3-1. Typical Injector

Disassembly

Clean the injector and remove carbon deposits from the nozzle, taking care not to damage the nozzle tip or end face. Steel wire brushes should never be used in the spray-hole area as these will damage the spray-hole outer edges.

Low Inertia (Low Spring) Injectors

Place the holder in a vise or bench plate (see Figure 3-2). Remove the nozzle nut. The nozzle will invariably be captive in the nozzle nut owing to carbon build-up between the two. Take care not to allow the nozzle needle to drop out. Remove the transfer block and any loose dowels. Remove the lower spring plate or thrust cap, injector (NOP) spring, and any upper spring plate, shims, and shim carriers. Remove any screwed inlet connector and discard seal washers/O-ring seals. It may be necessary to push the nozzle out of the nut by means of a copper or brass tubular drift (see Figure 3-3). The nozzle must not be driven out by striking the nozzle end face or tip.

High Spring Injectors

Remove the nozzle nut, nozzle assembly, transfer block, and dowels (if fitted). Remove the top cap, lock nut, and discard the copper seals, if damaged. Remove the thrust spindle and spring.

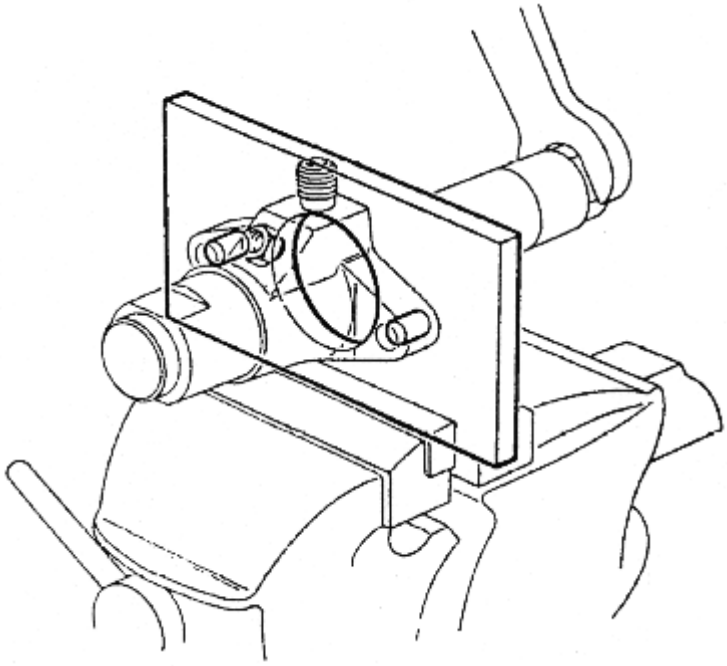


Figure 3-2. Bench Plate

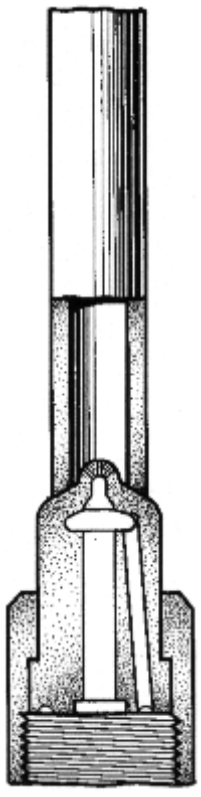


Figure 3-3. Nozzle Drift

Examination

The sealing faces between the nozzle holder, transfer block, and nozzle body must be perfectly clean, flat, and smooth.

Immerse the nozzle body and needle valve in clean fuel oil. The needle valve stem and seat should be lightly brushed with a brass wire brush. (Note that nozzle bodies and needle valves are mated pairs and must not be interchanged). It is preferable to deal with one nozzle assembly at a time.

The guide surface of the needle valve should be clean with an even, mirror-like finish, and there should be no scratched or dull patches, very bright spots, or any discoloration on or above the needle seat.

'T' Size Nozzles

IMPORTANT

Woodward Diesel Systems recommends that with respect to 'T' size injectors the injector nozzles be operated to an "On Condition" lifing policy. The actual number of hours achieved in service before removal will vary considerably between different applications and running environments and will normally be controlled by progressive life sampling.

The nozzle assembly should provide two years of continuous service without malfunction if the fuel system is kept clean and free of water.

Woodward does not recommend that 'T' size nozzles be reworked in service. All nozzles which are removed from the engine on a scheduled basis or because of unsatisfactory performance should be replaced by a new genuine Woodward spare.

This policy reflects the inability to rework nozzles to an "as new" standard and will ensure the following:

- **Optimum emission control**
- **Reduced fuel consumption**
- **Minimum engine down time**
- **Eliminate need to train maintenance personnel on nozzle repair techniques**
- **Economic turnaround of injectors to "as new" condition**

Inspect the nozzle body joint face and ensure that it is not scratched or damaged. Clean the fuel feed holes by pushing a suitable wire probe down into the fuel chamber. Take care not to damage the joint face.

Any lacquer deposits which may be present in the fuel chamber can be removed by the special fuel chamber scraper provided in the Woodward nozzle cleaning kit. A seat cleaning tool is also provided for cleaning the nozzle body seat.

The seat should be closely examined under a strong light to make sure that all traces of foreign matter have been removed.

Nozzle spray holes should be cleaned by the special probing tool and cleaning wire included in the kit. (When ordering cleaning wires, the type of nozzle or the size of hole should be quoted.)

If, after examination, there are found to be defects in nozzle components which cannot easily be rectified, the complete nozzle assembly should be replaced. It may be necessary to flow-test nozzles from certain applications to determine spray-hole wear and suitability for reuse. The relevant Woodward workshop manual, service instruction, or engine manual should be consulted.

Injector Assembly

Ensure that all components are free from unacceptable wear and damage and that the sealing faces between the nozzle assembly and holder body are in good condition. Wash all parts in clean injector test oil or light fuel oil as they are assembled.

Assembly follows the reverse sequence of disassembly operations. On screw-set injectors, ensure that there is no nozzle spring pressure tending to hold the assembly away from the holder sealing face before attempting to fit the nozzle assembly to the holder.

The nozzle nut should be tightened to the torque specified in current Woodward workshop manuals or service instructions.

Functional Tests

A Proprietary Nozzle Function Test Unit will be necessary to carry out the following tests.

Connect the assembled Injector to the unit by a length of high-pressure pipe.

Test oil recommended: ISO 4113 International Standard should be used.

⚠WARNING

Use goggles or similar eye protection if the spray is exposed. Do not permit an injector on test to direct its spray towards a heat source or naked flame. Oil in spray form is highly flammable. Ensure that the room or space where injectors are tested is well ventilated and that an efficient extractor is used to remove oil spray.

⚠CAUTION

When testing injectors, ensure that the fuel spray is directed away from the person. Keep hands away from the spray, which can penetrate the skin and cause injury. If oil penetrates the skin, prompt medical attention will be required to drain the oil, to remove any foreign body, and to prevent infection.

(1) Seat Leakage

Operate the pump of the pop-test equipment until oil is discharged from the injector. Tighten the nozzle holder vent screw if one is fitted. Continue pumping and adjust the nozzle opening pressure to that required for the particular application (see engine instruction manual or Woodward service test specification) with the pop-test gauge-cock open. Discharge the nozzle and wipe dry. Raise the pressure to approximately 10 bar (150 psi) below opening pressure and maintain for ten seconds. After this period, the leakage on the nozzle body must not be sufficient to form a drop of oil on the nozzle bulbous tip.

(2) Chatter Test

At the nozzle opening pressure, and with the gauge-cock closed, the pump lever should be operated at a slow rate approximately 6 pumping strokes per 10 seconds. Under these conditions, the nozzle should generally discharge with a sharp and crisp chattering action. (It should be noted that a few types of nozzle—due to specific design considerations—do not chatter under all hand test conditions, but will operate satisfactorily when applied to the engine.) It is always advisable to check nozzle performance against that of a new assembly, which should be retained for reference or emergency.

(3) Spray Form

The spray from each nozzle hole must be atomized, of regular form, and free from ragged edges. All sprays must be equal, correctly spaced, and properly related to the nozzle design characteristics.

(4) Back Leakage

Consult the current service instruction and workshop manuals for relevant back-leak test figures.

(5) Nozzle Opening Pressure

Set correct nozzle pressure (refer to engine manual or Woodward workshop manual or service instruction) and then tighten the nozzle nut or adjusting screw locknut. Operate the pump a few times with the gauge-cock closed to ensure that all components have settled, and then, finally, re-check the pressure.

Installation

Before replacing the nozzle holder in the cylinder head, it is advisable to fit a new joint washer below the nozzle nut. (There are cases where no washers or similar components are used. Reference should be made to the engine manual). The metal seating on the cylinder head, the joint washer, and the nozzle nut must be perfectly clean to ensure a leak-proof seal.

The injector must be pulled down evenly when being fitted to the engine, and the holding-down nuts tightened to the appropriate torque quoted in the engine manual.

Appendix.
Conversion Values

Here are conversion values for units typically used in fuel injection equipment, between the SI metric system and common non-SI units. Conversions are approximate unless otherwise stated.

SI is the “Système international d’unités” (International System of Units), the official “metric” system used around the world. Units such as “bar” are older, non-SI metric units still commonly used, and units such as “pound” are non-metric units used primarily in the United States.

Decimal Marker and Thousands Separator

Some countries use a period (full stop) as the decimal marker (12.5), and use a comma to separate thousands in large numbers (10,000). Other countries do exactly the opposite, using a comma as the decimal marker (12,5) and a period/full stop as the thousands separator (10.000). To avoid confusion, it is common international practice to separate thousands with a space (or half space) for numbers of more than four digits (10 000) and not to use a separator for numbers of four or fewer digits (1000). Woodward publications in English generally use the period/full stop as the decimal marker.

Length

1 inch = 25.4 mm (exact)	1 m = 39.37 inches
1 foot = 304.8 mm (exact)	1 m = 3.28 feet

abbreviation: inch = in or “; foot = ft or ‘

Liquid Measure

1 US quart = 0.9464 L	1 L = 1.06 US quarts
1 US gallon = 3.785 L	1 L = 0.26 US gallon
1 imperial gallon = 4.542 L	1 L = 0.22 imperial gallon

abbreviation: quart = qt, gallon = gal

Mass (Weight)

1 ounce = 28.35 g	1 g = 0.0353 ounce
1 pound = 0.4536 kg	1 kg = 2.2 pounds

abbreviation: ounce = oz, pound = lb (from Latin *libra*)

Temperature

°C = (°F–32)/1.8 (exact)	°F = (1.8)(°C) + 32

0 °C = 32 °F and 100 °C = 212 °F

abbreviation: F = Fahrenheit (°C is the SI symbol for degree Celsius)

Power/Energy

1 hp = 746 W	1 kW = 1.34 hp
1 calorie = 4.185 J	1 J = 0.239 calories
1 kWh = 3.6 MJ	1 MJ = 0.28 kWh

abbreviation: hp = horsepower, kWh = kilowatt-hour

Work/Torque

1 ft-lb = 1.356 J 1 J = 0.737 ft-lb
1 in-lb = 0.113 J
1 lb-ft = 1.356 N•m 1 N•m = 0.737 lb-ft
1 lb-in = 0.113 N•m
(work is linear, torque is angular)
abbreviation: ft-lb = foot-pound, in-lb = inch-pound, lb-ft = pound-foot, lb-in = pound-inch)

Speed

1 ft/s = 0.3048 m/s (exact) 1 m/s = 3.28 ft/s
1 mph = 1.609 km/h 1 km/h = 0.62 mph
abbreviation: ft/s = feet/second, mph = miles per hour

Force

1 pound force = 4.448 N 1 N = 0.22 lbf
1 kg force = 9.807 N
abbreviation: pound force = lbf

Pressure

1 psi = 6.895 kPa = 0.06895 bar 1 kPa = 0.145 psi
1” Hg = 3.386 kPa = 0.03386 bar
1 atm = 101.325 kPa = 1.013 bar 100 kPa = 0.987 atm
1 bar = 100 kPa (exact)
abbreviation: psi = pounds(force)/inch² (also sometimes lbf/in²), “ Hg = inches of Mercury, atm = atmosphere (also sometimes ats)

Angle

Although SI uses radians (1 rad = 180°/π), angular degrees are allowed in SI. Decimal degrees are preferred over degrees/minutes/seconds.
1° = 60 angular minutes = 3600 angular seconds
1 minute = 60 angular seconds
1 rpm = 360°/min
abbreviation: angular degree = °, angular minute = ‘, angular second = “, rpm = revolution per minute

Oil Viscosity (Kinematic Viscosity)

Oil viscosity is measured in Saybolt Universal Seconds (SUS, also SSU) in the US, and often in centistokes (cSt) elsewhere, although the SI standard is cm²/s (1 cSt = 0.01 cm²/s or 1 St = 1 cm²/s). Since viscosity is dependent on temperature, conversion between units is not straightforward (SUS is measured at standard temperatures of 100 °F or 210 °F, while cSt is measured at standard temperatures of 40 °C or 100 °C).

Many countries now use the ISO Viscosity Classification System, which is simply the centistokes value at 40 °C (that is, an oil with a viscosity of 100 cSt at 40 °C would be ISO grade 100).

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 55151.

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