WOODWARD

Product Manual 35013
(Revision New, 9/2015)
Original Instructions

Unit Injector
Type G50011293

HiMSEN H17/21V Series Engines

Installation and Operation Manual

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

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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

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Contents

Illustrations and Tables

Warnings and Notices

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.

Chapter 1.
General Information

Manual Objective and Layout

This manual has been prepared to cover the operation, servicing, and overhaul of the Woodward Mechanical Unit Injectors Type G50011293 as fitted to HiMSEN H17/21V series engines.

It is primarily intended for use by Central Distributors (CD), Authorized Independent Service Facilities (AISF), and Agents, but the information may also be of assistance to the Operator and the Engine Manufacturer.

IMPORTANT

Woodward Diesel Systems recommend that the Injector Nozzles covered by this manual be operated to a "Condition" lifting policy. On removal, check the "condition" of the nozzle. If it is in good condition, reuse, otherwise replace. The actual number of hours achieved in service before replacement will vary considerably between different applications and running environments and will normally be controlled by progressive life sampling.

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**
- **Minimize component spares holding**
- **Minimum engine down time**
- **Eliminate need to train maintenance personnel on nozzle repair techniques**
- **Ensure the economic turnaround of injectors to "as new" condition**

The Nozzle rework information provided within this Workshop Manual is intended for use by Distributors in an emergency where spare complete Nozzle Assemblies are not available.

Although great care has been taken in ensuring the maximum accuracy of the information provided, minor variations may occur over the production phase of the equipment. No liability can be accepted by Woodward Diesel Systems for damage, loss, or injury caused by any errors or omissions within this manual.

In general this manual is presented and laid out so that the information provided is readily accessible. Every effort has been made to make the manual self-contained and references to other documents are kept to a minimum.

⚠WARNING

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

Application

The type G50011293 Unit Injector combines the pumping element and nozzle in one unit. See Figure 1-1.

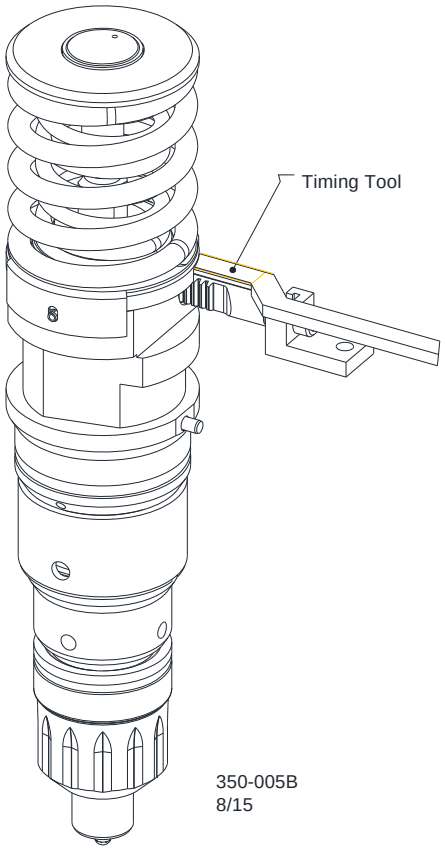

Figure 1-1. G50011293 Unit Injector

Installation and Timing

Follow the instructions contained within the HiMSEN H17/V21 Engine Manual for instructions on:

- How to install the unit
- How to adjust the injector rack link
- How to time the unit (set the plunger height)

Removal

Follow the instructions in the HiMSEN H17/21V manual. Ensure correct use of the extraction feature on the injector body. DO NOT apply load to the control rod while removing the injector, this can cause irreparable damage to the control rod.

Periodic Maintenance

Consult the HiMSEN H17/21V Engine Manual for details of scheduled maintenance or change-out of units.

Torque Requirements

	N·m	lb-ft
Nozzle Nut	224	165
Control Rod Location Screw	4.5	3.3

Glossary of Terms and Abbreviations

A/F	across flats
cSt	centistokes
HP	high pressure
lb-ft	pound-feet (torque)
LSP	lower spring plate
NOP	nozzle opening pressure
psi	pounds per square inch
LP	low pressure

Consumables

Thread Lubricant	D. A. Stuart Oils anti-seize compound, Lubriplate 107 or approved equivalent
Component Lubrication	Grade 15/W40 engine oil or approved equivalent
Test Fluid	Specification: ISO 4113 (viscosity 2.45 to 2.75 cSt at 40 °C) Castrol calibrating oil 4113 Viscor calibrating fluid 1487 (SAE J967)
Water Displacing Fluid	Castrol DWX21
Carbon Softening Fluid	Metasoak SV3952
Luboil	SAE 30
Rust Inhibiting Oil	Castrol Rustilo 647
O-ring Assembly Lubricant	Commercial Vaseline 1A (petroleum jelly)
Thread Locking Ardrox Lubriplate Locquic Primer	Loctite 243 551 107 Activator ‘T’

WARNING **Ensure that the above fluids are used in strict accordance with the manufacturer’s recommendations.**

Chapter 2.
Description of Operation

Construction

Figure 2-1 shows the construction of the G50011293 Unit Injector.

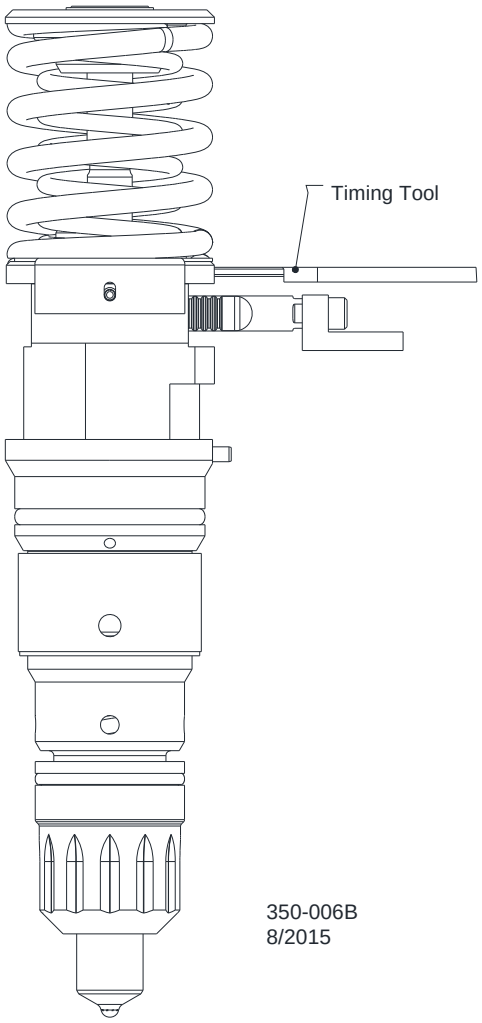

Figure 2-1. G50011293 Unit Injector

The G50011293 Type Unit Pump Injector comprises a pumping plunger in a blind-bore barrel, cam-operated from the engine fuel camshaft via an engine tappet, pushrod, and rocker mechanism. The plunger is spring-returned via twin, nested springs at the top of the injector, operating via keepers on the plunger and the upper spring plate. Load is transferred from the rocker to the plunger foot via a hardened thrust pad at the top of the injector.

Fuel quantity is controlled via a helix on the plunger and rotation of the plunger via a control sleeve/ control rod mechanism, fixed to the engine governor linkage in the cylinder head.

Fuel timing is set by using the rocker adjuster after fixing the position of the plunger by means of the timing groove on the plunger (see Chapter 7, “Top End Components”).

The fuel nozzle is clamped to the lower end of the injector by a nozzle nut. The fuel holes are aligned with the use of dowels. Opening pressure is preset by the manufacturing tolerances of the needle, lift stop, barrel, and injector spring.

Nozzle back-leakage returns to the fuel gallery via drillings in the unit. A hardened spill baffle is fitted adjacent the ports and is retained by a circlip.

Principal of Operation

The Woodward G50011293 unit injector combines the pumping element and nozzle in one unit.

The injector is clamped directly into the engine cylinder head, and is actuated by a pushrod operated rocker arm.

The fuel gallery is formed by the clearance between the injector barrel and the cylinder head injector tube, and is contained by an O-ring seal at the top end of the injector barrel, and the lower section is sealed by an O-ring on the nozzle nut and the interaction of the nozzle nut being forced down onto a sealing washer at the bottom of the injector tube.

Plunger back leakage is via a barrier groove and a drilling in the barrel to return fuel to the gallery.

Nozzle back leakage is via the injector spring chamber and drillings into the fuel gallery area.

The hardened spill baffle is fitted adjacent to the ports and is retained by a circlip.

Nozzle opening pressure is set at the factory, and is non-adjustable.

There are no adjustments possible with the injector, other than timing setting which is achieved only with the injector installed in the engine.

Chapter 3.
Fault Diagnosis

Overview

The injectors will normally have a long working life before requiring overhaul and replacement of parts, provided that the fuel oil has not been contaminated by dirt or water.

Failure to meet these requirements can result in premature wear, corrosion, and leakage or component failure.

IMPORTANT **Information is included in Chapter 6, Examination and Servicing, for guidance in assessing component condition and performing fault diagnosis.**

General Notes

The need to remove injectors for overhaul or adjustment will be indicated by the engine manufacturer's recommended servicing schedules, backed up by operating experience and will vary according to the engine rating, operating environment, and type of duty. It is thus only possible to give general advice within the scope of these instructions.

Injectors will wear with time, but such wear is usually uniform throughout an engine set, so that balance between injectors will remain acceptable for normal operating requirements.

The degree of wear, particularly of the plungers, may be judged by comparing the control rod settings at full load with those recorded on the original engine test sheets.

As a general guide, injectors should be removed for examination when the control rod setting has increased by 10%.

The requirement to increase settings to maintain full load normally indicates an extending injection period, which will be accompanied by rising fuel consumption and exhaust temperature.

Individual injectors which behave differently from the remainder of the engine set should be examined at the earliest opportunity.

Injectors requiring a high control rod setting to balance exhaust temperature may have a worn plunger or leaking nozzle. Running hot can result from leakage from the high pressure joint. Possible causes can include restriction in the high pressure line—blocked spray holes, inadequate nozzle needle lift or blocked high pressure drilling.

Intermittent delivery, or no delivery, may be due to a sticking or seized plunger, particularly if the control rod is stiff to move or jammed.

Leakage of fuel oil rising from the control sleeve area will be due to plunger wear, which may have its origin in water in the fuel oil.
Notes are included in the section on examination of components for guidance in assessing component condition and fault diagnosis.

Before disassembling, we recommend that the injector be examined externally and evaluated on a Hartridge Pop Test Unit, as described in the next section, for nozzle opening pressure and test behavior.

This can provide useful information on its condition, suitability for further service, and the nature and extent of work required.

In particular, low nozzle opening pressure can detract from engine performance and lead to blow back, causing rapid deterioration of the nozzle and requiring its premature replacement.

If the nozzle opening pressure has dropped by more than 20% (new 462 ±24 bar, Maximum of 486 bar), look for the following possible causes at the appropriate stage of disassembly:

- Broken, collapsed, or corroded injector springs
- Worn spring end faces
- Wide seat or incorrect seat contact position on nozzle needle, or seat erosion
- Worn or broken nozzle needle thrust pin

IMPORTANT **As a general guide, injectors should be removed for examination if the control rod/sleeve setting increases by the amount stipulated in the HiMSEN H17/21V Series Engine manual.**

Performance Checking Between Overhaul Periods (Suspect Injectors)

IMPORTANT **The following information is given to provide Engine Operators, Woodward Agents, and Distributors with additional information regarding the action to be taken in the event of injector malfunction between scheduled engine overhaul periods.**

Overcheck Procedure

In general, the engine operator should not be required to remove unit injectors from the engine prior to the normal 'top end' overhaul period.

If abnormal circumstances (such as dirt or water in the fuel) have occurred, and a unit injector(s) appears to be working incorrectly, the suspect unit should initially be exchanged for a new or reconditioned unit, after clearing the fuel system fully. This should restore performance if the original injector was faulty.

The faulty injector should be returned to an authorized Woodward Service Agent for overhaul or, at most, the unit can be split apart at the barrel/spring plate-lower face by prying the retaining clip slightly and the two halves parted carefully.

IMPORTANT **This must only be done in clean surroundings by qualified personnel.**

If the unit is to be checked, this can only be done on the nozzle opening/ performance characteristics and even this demands the use of a special tool to seal the barrel bore and pressurize the nozzle, using a Poptest/Testmaster unit.

NOTICE

If there is any doubt over workshop conditions, tooling, or capability, this work should be left to an authorized Woodward Agent.

Testing—Nozzle Opening Pressure

IMPORTANT

To NOP test the unit, the lower assembly (nozzle assembly, nozzle nut, injector spring, lift stop, housing and control rod) must be removed from the upper assembly. This is easily achieved by lifting the LSP retainer from its location pin. The entire upper assembly can then be removed completely from the housing. After NOP testing has taken place, fit the upper assembly into the lower assembly, ensuring that the control rod notch is central and that the control sleeve dot aligns with it. Ensure the lower spring plate retainer is correctly fitted over the location pin. The unit, if satisfactory, is then ready for reuse.

Place the clamp plate (part of the Nozzle Opening Pressure Adaptor Tool, Woodward part no. 1-B-22890) onto the plunger end of the injector housing, ensuring that the clamp plate engages fully with the 42 mm A/F of the injector housing.

Insert the nozzle opening pressure adaptor through the bore of the clamp plate and into the injector housing bore, rotating slightly to avoid damage to the O-ring seal.

Tighten the knurled clamp screw finger-tight. Connect the threaded end of the adaptor (M12 x 1.5) to a Hartridge Pop Test Unit, Hartridge part no. HH560, using a suitable High Pressure Pipe, Woodward part no. 33-B-38.

Open the pressure gauge isolating valve and operate the hand pump until oil is discharged from the nozzle free from air.

Continue pumping and check the nozzle opening pressure. This should be at least 389 bar for reuse in service.

Check the other performance characteristics per Chapter 8, Testing.

If this is not within the specified limits or the injector performance is otherwise suspect, then the unit will have to be disassembled and components replaced, or the unit returned to an authorized Woodward Agent.

⚠WARNING

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.

⚠WARNING

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

Use goggles or similar eye protection if the spray is exposed.

Chapter 4.
Disassembly

Preparation

⚠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 (former Cheltenham number 308), *Safe Handling and Use of Woodward Diesel Systems Equipment*.

⚠WARNING

Viton O-rings are used in all Woodward pumps and injectors. If subjected to high temperatures (>315 °C), these rings produce extremely corrosive acid. Avoid contact with any rings which look suspect, or from equipment which may have been close to an engine fire. Dispose of seals immediately after removal.

Workshop cleanliness, when disassembling fuel injection equipment, is essential to ensure subsequent trouble-free operation. The workbench 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 paper during cleaning processes. Never use paraffin or kerosene, and never use woven cloths or wipers.

During disassembly operations, the components from each individual injector should be kept separate. It is essential that plungers be refitted only to the injector housings to which they were originally mated. Similarly, the nozzle needle valve should only be reassembled to its original nozzle body.

When overhauling unit injectors, the plungers, injector housings, nozzle bodies, nozzle needle valves, transfer blocks, and control sleeves and rods should never be touched with a file or other hard tool. If any of these parts are damaged, they should be sent to a Woodward Service Agent for attention.

NOTICE

The use of kerosene (paraffin) is not recommended for washing parts as it may contain water, which can cause corrosion.

NOTICE

During the disassembly operation, the components of each individual unit should be kept entirely separate from other parts.

Refer to Chapter 5 for cleaning procedure.

Disposables

The following components must be scrapped after disassembly and replaced with new items:

- O-rings
- Joint washers

Procedure

See Figures 4-1 and 4-2. In the following steps, the numbers in parenthesis, for example "Upper Spring Plate Insert (18)," refer to the callout numbers in Figure 4-2.

IMPORTANT

Prior to the nozzle nut being removed, we recommend that if the nozzle and nut being removed are coated with carbon they be immersed in a Carbon Softening Fluid for 24 hours. This will ease removal of the nozzle nut and prevent undue strain being placed on the internal components.

NOTICE

If any trace of magnetism exists prior to cleaning, all parts should be demagnetized. This will ensure removal of all metal particles during the cleaning process. Wash all parts in clean test oil.

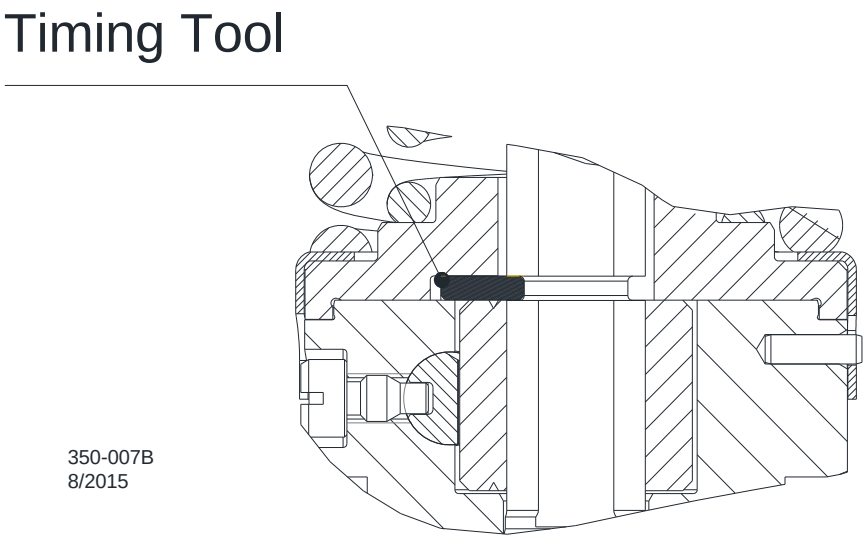

Figure 4-1. Use of Gauge Tool to Fix Plunger Position

1. It may be necessary to compress the plunger slightly in the Assembly Fixture (Woodward Part No. 1-B-22885) to facilitate movement of the control rod. This is achieved by placing the injector in the assembly tool and screwing down the compressor screw to relieve the pressure on the control sleeve.

2. Unscrew the compressor screw and place the Timing gauge tool into the LSP slot below the Plunger Springs (11 and 12). Ensuring that the cut out in the compressor screw end cap is facing the operator, screw down the compressor screw to compress the plunger springs. Allow the gauge to center and continue to compress the spring until the gauge fits into the Timing Groove (see Figure 4-1). The Upper Spring Plate Insert (18) and O-ring (17) will be forced out of their seat.

3. Discard the O-ring seal. The plunger springs should then be compressed sufficiently to facilitate the removal of the Plunger/Spring Plate Keepers (2). Once these are removed, the pressure on the spring plate and plunger springs can be released by unscrewing the compressor screw. Pull out the timing tool.

4. Remove the injector from the assembly tool and remove the Upper Spring Plate (19) and the Plunger Springs from the injector.

5. Remove the Lower Spring Plate (20) by lifting the LSP Retainer (13) off its Location Pin (A).

6. Pull the Plunger (C) and Control Sleeve (1) out of the Barrel (B) and place all the components into a clean bath of oil.

7. The control rod is removed by unscrewing the Retaining Screw (16) and pulling it out of the barrel.

8. Place the injector barrel in the assembly fixture with the Nozzle Assembly (10) uppermost.

9. Remove the O-rings (7 and 8) from the barrel and Nozzle Nut, and discard.

10. Remove the Spill Baffle Circlip (6) from the injector barrel with the aid of a small screwdriver and circlip pliers. Slide the Spill Baffle (3) from the injector housing.

11. Slacken off and remove the Nozzle Nut (22) using an 1.375" A/F ring or bi-hex socket spanner. Apply a steady force to the wrench, do not snatch or hammer it, or grip the nozzle stem to prevent it turning.

IMPORTANT

If a 1.375" A/F bi-hex socket is used to remove the nozzle nut, it must have a depth of at least 55 mm from the hexagon end to the drive square to clear the nozzle tip.

12. Remove the Nozzle Nut (22), Nozzle Assembly (10) and Dowels (4) from the injector barrel.

13. Remove the injector barrel from the assembly fixture, and carefully invert it to remove the Injector Spring (5) and Lift Stop (D)

NOTICE

If the nozzle body is coated with carbon, it should be soaked in fuel oil or proprietary carbon displacing fluid to soften the carbon before removal from the injector housing and nozzle nut. However, it may be necessary to press the nozzle body from the nozzle nut—this can be done with a simple tool made from a piece of pipe, with sufficient internal diameter to avoid contact with the nozzle tip.

⚠WARNING

Do not attempt to remove the nozzle by striking or driving on the tip, as this may start cracks which can lead to the tip breaking off during engine running. A detached nozzle tip can cause serious damage to the engine valves or turbocharger.

ITEM No.	PART No.	DESCRIPTION	QTY
1	20/285	SLEEVE CONTROL	1
2	20/293	KEEPER	2
3	20/295	BAFFLE SPILL	1
4	20/296	PARALLEL DOWEL	2
5	20/297	INJECTOR SPRING	1
6	124/75	SPILL BAFFLE CIRCLIP	1
7	372/61	SEAL O RING	1
8	372/96	O-RING	1
9	G50011286	R.H. CONTROL ROD	1
10	G50010742	NOZZLE ASSEMBLY	1
11	G50010475	PLUNGER (OUTER) SPRING	1
12	G50010476	PLUNGER (INNER) SPRING	1
13	20/289	LOWER SPRING PLATE RETAINER	1
14	G50010884A	SETTING - 1,5mm 10x5 DIN988 SHIM	1
15	G50010885	TIMING BRACKET	1
16	123/9	BARREL LOCATING SCREW	1
17	372/89	O-RING SEAL	1
18	G50010478	UPPER SPRING PLATE INSERT	1
19	G50011250	UPPER SPRING PLATE	1
20	G50011294	LOWER - TIGHT TIMING SPRING PLATE	1
21	G940201201	DIN 912 (ISO4762) M5x12 8.8 SCREW	1
22	G50011206	NOZZLE - HHI NUT	1
23	G50011292	ELEMENT - LOCATING ASSEMBLY	1

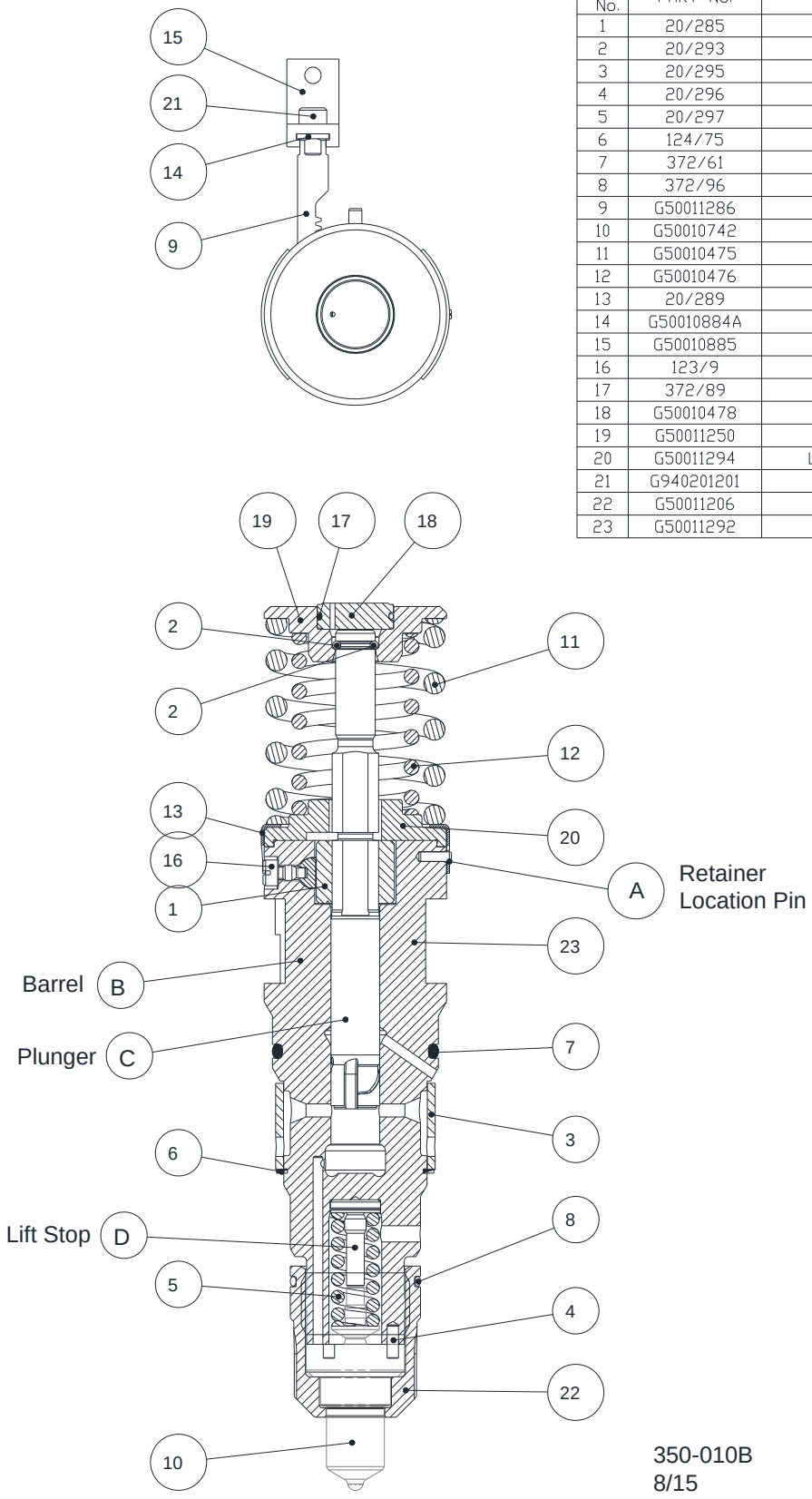

Figure 4-2. Type G50011293 Unit Injector

Chapter 5.
Cleaning

Carbon

Remove carbon deposits by carefully brushing them with a brass wire brush in a bath of water-displacing fluid. After removing carbon, thoroughly wash components in clean test oil.

Prior to removing the nozzle nut, we recommend that if the nozzle and nut being removed are coated with carbon they be immersed in a Carbon Softening Fluid for 24 hours. This will ease removal of the nozzle nut and prevent undue strain being placed on internal components.

Component Parts

IMPORTANT

All parts should be demagnetized prior to cleaning if this process is available. This will ensure the removal of all metallic particles during the cleaning process. Wash all parts in clean test oil.

Components may be washed in clean, light fuel oil or test oil. If components are congealed with hard fuel deposits, this may be cleaned off using the Carbon Softening Fluid listed in Chapter 1 under Consumables.

Traces of dried, friable fuel deposits will probably be left on some components. These can be removed by probe and/or wire brushing in non-critical areas.

Ensure all oilways and fuel bores are cleaned thoroughly. Probe with a rod or undersize drill, if necessary, to remove solidified fuel remains and ensure clear passages.

Wash all components in suitable washing facilities.

⚠ CAUTION

Ensure that all fluids are used in strict accordance with the manufacturer's recommendations.

Chapter 6.
Examination and Servicing

Introduction

Prior to examination, the Unit Injector must be thoroughly cleaned in accordance with Chapter 5.

NOTICE

If any trace of magnetism exists prior to cleaning, all parts should be demagnetized. This will ensure removal of all metal particles during the cleaning process. Wash all parts in clean test oil.

The injectors will normally have a long working life before requiring overhaul and replacement of parts, provided that the fuel oil has not been contaminated by dirt or water.

Failure to meet these requirements can result in premature wear, corrosion, leakage, or component failure.

The need to remove injectors for overhaul or adjustment will be indicated by the engine manufacturer's recommended servicing schedules, backed up by operating experience, and will vary according to the engine rating, operating environment, and type of duty. It is thus only possible to give general advice within the scope of these instructions.

Injectors will wear with time, but such wear is usually uniform throughout an engine set, so that balance between injectors will remain acceptable for normal operating requirements.

The degree of wear, particularly of the plungers, may be judged by comparing the control rod/sleeve settings at full load with those recorded on the original engine test sheets.

IMPORTANT

As a general guide, injectors should be removed for examination if the control rod/sleeve setting increased by 10%.

The requirement to increase settings to maintain full load normally indicates an extending injection period, which will be accompanied by rising fuel consumption and exhaust temperature.

Individual injectors which behave differently from the remainder of the engine set should be examined at the earliest opportunity.

Injectors requiring a high control rod setting to balance exhaust temperature may have a worn plunger or leaking nozzle; running hot can result from leakage from the high-pressure joint; possible causes include restriction in the high pressure line (blocked spray holes, inadequate nozzle needle lift, or blocked high pressure drilling).

Intermittent delivery, or no delivery, may be due to a sticking or seized plunger, particularly if the control rod is stiff to move or jammed.

Leakage of fuel oil rising from the control sleeve area will be due to plunger wear, which may have its origin in water in the fuel oil.

Notes are included in the section on examination of components for guidance in assessing component condition and fault diagnosis.

Before disassembly, we recommend that the injector be examined externally and evaluated on a Hartridge Pop Test Unit, as described later, for nozzle opening pressure and test behavior.

This can provide useful information on its condition, suitability for further service, and the nature and extent of work required.

In particular, low nozzle opening pressure can detract from engine performance and lead to blow-back, causing rapid deterioration of the nozzle and requiring its premature replacement.

If the nozzle opening pressure has dropped by more than 10%, look for the following possible causes at the appropriate stage of disassembly:

- Broken, collapsed or corroded injector springs
- Worn spring end faces
- Wide seat or incorrect seat contact position on nozzle needle
- Worn or broken nozzle needle thrust pin

WARNING

If any parts are worn or damaged, they must only be replaced with genuine Woodward spare parts, obtainable through Woodward Service Agents.

Joint Faces

These must be clean, free from damage, and have a fine lapped finish.

Apart from removing indentation, these faces will normally only require light lapping by hand to remove staining and contact marks.

Dowels

These should be a push or light tap fit in the barrel, and can normally be removed with pliers to allow examination and lapping of faces.

Renew any mutilated or part-sheared dowels, using only genuine Woodward replacements, which are made from special material to resist damage.

If the dowels were difficult to remove, check the injector barrel or nozzle body for cracks.

Dowels must not be a drive fit, as this can crack the injector barrel or nozzle body, thus necessitating replacement, or produce slivers of metal which will damage the nozzle assembly or, if trapped between faces, will cause leakage.

Springs

Replace any springs showing signs of corrosion, pitting, collapse, or distortion.

Nozzle Nut

Clean off all carbon from the exterior and interior, paying particular attention to the smaller bore which locates the nozzle body.

Check that threads are complete and not chipped, also that the end joint face and internal clamping shoulder are clean, flat, and free from damage.

Place the nozzle body in the nozzle nut, check that it seats against the clamping shoulder, can be rotated freely, and has no tendency to jam when removed.

Lift Stop

The lift stop is not usually excessively worn. If wear is severe, the plunger/barrel/ stop assembly must be replaced (mated part).

O-ring Seals

These must be renewed during injector overhaul.

Lower Circlip

This must be renewed during injector overhaul.

Spill Baffle

Evidence of erosion will appear on the inner face. This will have the appearance of a shadow running around the inner circumference.

If erosion has progressed to any significant extent, the spill baffle should be replaced.

Spring Plate—Upper and Lower

Spring plates will rarely require replacement. Replace them, however, if signs of wear are apparent. Replacement should be based on mechanical wear, especially where the keepers sit in the upper spring plate.

Upper Spring Plate Keepers

Examine the keepers for signs of excessive abrasion or cracks. If there is any sign of wear or damage, the keepers should be replaced.

Spring Plate Insert

There should be a bright contact mark on each face, made by the plunger foot and engine rocker.

Any insert which is cracked in this area, or on which the indentation exceeds 0.1 mm (0.004 inch) on either side should be replaced, as continued running can cause rapid further wear, resulting in retarded ignition timing, with eventual breakage and other consequential damage.

Control Sleeve

Check the teeth of the control sleeve for signs of wear and cracking. Although slight polishing of teeth is inevitable, where the teeth mesh with the control rod, the control sleeve should be replaced if any evidence of severe wear is visible.

Place the control sleeve onto the plunger. Holding the plunger securely, check that the radial movement on the end of the control sleeve does not exceed 0.2 mm (0.008 inch).

Control Rod

Check the teeth of the control rod for signs of excessive wear, replace if the teeth show signs of severe abrasion.

Nozzle Assembly

NOTICE

The nozzle body and needle valve are a mated assembly. If either of these parts is defective beyond repair, a new nozzle assembly must be used.

IMPORTANT

Fitting a new nozzle, especially after the stipulated period for injector overhaul in this application, will normally be more cost-effective than nozzle refurbishing.

Pull out the needle and wash both body and needle in clean fuel oil. The needle guide diameter should be bright and free from scratches, and both the guide diameter and seating cone should be free from discoloration.

Blackening of either indicates blow-back of combustion gases, possibly due to low nozzle opening pressure, excessive needle lift, or the presence of water in the fuel.

Clean the exterior of the nozzle body using a brass wire brush. Do not use a steel wire brush, particularly on the tip—this can damage the outer ends of the spray holes which need to retain a sharp corner. It is permissible to polish the exterior of the tip after brushing, using fine polishing cloth.

Check the nozzle tip for damage or lack of material, which is likely to result from cold corrosion. Both of these weaken the nozzle, requiring its replacement. Using a brass scraper, clean the fuel sac and the fuel gallery of the nozzle.
Clean the fuel feed hole using a suitable brass rod.

Clean out spray holes using a wire approximately 0.02–0.04 mm (0.001–0.002 inch) below the size shown in the typecode.

IMPORTANT

All of the above mentioned tools (brass brush, brass sac scraper, fuel gallery scraper, and spray hole cleaning wires) are available in the nozzle cleaning kit, Hartridge Part No 7144-917R.

Inspect the needle seat and, using a Probe Light, Hartridge Part No 99-860, inspect the body seat cone, which should be clean, free from ridges, and showing a bright, continuous seating line at the largest diameter.

Seating lines wider than 1 mm (0.040 inch) or towards the middle of the cone, indicate incorrect seat angle or form on the needle or in the nozzle body.

If the needle and nozzle are in a satisfactory condition, wash them in clean test oil and assemble together.

Check the Needle Lift Dimension as follows (see Figure 6-1). Measure the depth of the Lift Stop face from the barrel lower lapped face.

- Dimension 'B'—Measure the standout of the nozzle needle tip from the body lapped face.
- Dimension 'A'—The needle lift is the difference between these dimensions. This dimension should be 0.5 + 0.1 mm (0.020 + 0.004 inch).

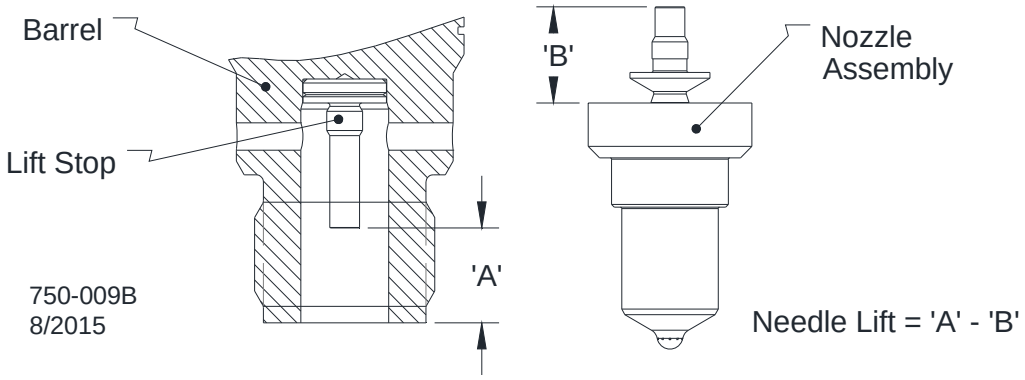

Figure 6-1. Needle Lift Dimension

If it is found that the resulting dimension is greater than this, the lift stop, nozzle assembly, and injector spring should be renewed.

IMPORTANT

The nozzle body is best cleaned by using a Hartridge Nozzle Multi-clean Machine, Part No. HH013. This machine ensures that all traces of carbon, dirt, and lapping compound are flushed from the internal channels and spray holes.

Barrel and Lift Stop Assembly

The most usual reason for Plunger/Barrel Assembly replacement is wear, or occasionally erosion damage, of the end of the plunger in the area swept by the ports.

This reduces pumping efficiency, resulting in the need to increase the control rod/sleeve setting, as mentioned in the introductory notes. Wear is indicated by axial scratching or scoring between the top face and helix.

When such scratching has obliterated the original finish of the plunger, or presents scores which can be seen, or felt with a finger nail, it is no longer suitable for future service.

With clean fuel, Plunger/Barrel Assemblies may be expected to give 10,000 to 20,000 hours of service, and a requirement for earlier replacement will indicate the need to improve fuel filtration.

Erosion damage is recognizable as a matt grey shading on the otherwise fine-ground or lapped surface of the plunger.

It will be in the area swept by the ports and the first sign will be a small crescent-shaped mark in the position of the upper edge of the port at the point of spill.

Gradually the mark will extend to form an imprint of the entire port on engines running at substantially constant load—eventually the imprint will reach the helix.

On engines running under constantly varying load, the crescent-shaped marks will form a continuous line inclined at the same angle as the helix.

Such erosion is not directly detrimental to injector performance until it has reached within 1 mm of the helix or top face of the plunger, at which point the injector should be replaced with a new or service exchange unit.

Erosion damage progresses at a reasonably uniform rate, thus an estimate of the remaining service life can be made if the hours run to date are known.

If erosion damage is noted only on individual injectors, it may be due to a restriction in the high-pressure line causing excessive pressure. Check that the nozzle needle lift is correct, and that the spray holes are not blocked.

Another cause of plunger/barrel deterioration is the presence of water in the fuel, which is indicated by gradual blackening of the mated surfaces of the barrel and plunger by the formation of black iron oxide. This causes a breakdown of finish, resulting in rapid wear. Consequently, the grade of fuel oil and the filtering system should be investigated.

Check the injector barrel for cracks, particularly around the ports and nozzle nut thread. Ensure that the high-pressure and leak-off drillings are free from obstruction and clean. If necessary, probe with a brass rod and blow out using compressed air.

The plunger, injector barrel, and lift stop are a mated assembly. If any of these parts are defective beyond repair, a new or service exchange injector must be fitted.

Chapter 7.
Assembly

Preparation

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 (former Cheltenham number 308), *Safe Handling and Use of Woodward Diesel Systems Equipment*.**

When preparing to assemble fuel injection equipment, the bench on which the work is to be done should be thoroughly cleaned, particular care being taken that all iron filings, dirt, grit, and any other foreign material have been removed. The bench should be securely anchored to the floor. It is also necessary to have a thoroughly cleaned container available holding a supply of fresh, clean fuel oil for washing the components.

NOTICE **The use of kerosene (paraffin) is not recommended for washing parts as it may contain water, which can cause corrosion!**

- Refer to Chapter 5 for cleaning procedure.

IMPORTANT **Wash all parts in clean light fuel or test oil as they are assembled. Assembly generally follows the reverse sequence of the instructions for disassembly.**

NOTICE **It is essential to use a correct torque wrench and socket. Not to do so may result in overtorquing of the components.**

NOTICE **During the assembly operation, the components of each individual injector should be kept entirely separate from other injector parts.**

Bottom End Components

1. Place the Barrel (B) in the assembly fixture with the threaded end uppermost.
2. Insert the Lift Stop (D) (large diameter first), and ensure that it is seated squarely at the bottom of the spring chamber. Place the Injector Spring (5) in position.
3. Place the two Dowels (4) in their respective holes in the barrel.
4. Place the Nozzle Assembly (10) on top of the injector barrel and ensure that the dowels register correctly, and enter the location holes in the nozzle body.
5. Secure by fitting the Nozzle Nut (22) and screwing down.

IMPORTANT

The nozzle nut threads should be brushed sparingly with a suitably thick Molybdenum Disulphide based paste (or a similar non-friction compound) prior to assembly. Do not use Copperslip or any other compound that contains metallic particles.

IMPORTANT

A 1.375 inch A/F bi-hex socket should be used to tighten the nozzle nut to 224 N·m (165 lb-ft.).

6. Fit the Spill Baffle (3) to the injector barrel with the small circumferential holes nearest the nozzle assembly. Secure by fitting the Circlip (6).
7. Remove the injector barrel from the fixture.

IMPORTANT

NOP testing can now be undertaken (as described in Chapter 8, Nozzle Opening Pressure) before the rest of the assembly is built.

Top End Components

1. Place the Control Sleeve (1) onto the shaft of the Plunger (C), ensuring that the flats on the shaft mate with the flats on the control sleeve, and that the alignment notch of the control sleeve, which should be uppermost, is directly above the alignment notch of the plunger.

2. Assemble the Control Rod (9) into the barrel with the rack teeth nearest the axis of the barrel. Ensure that the teeth are upright and the alignment notch facing upwards.

3. Place the plunger and the control sleeve into the barrel, and with the three alignment notches in the same position, engage the teeth of the control sleeve with the control rod rack.

4. Screw in the Retaining Screw (16), and torque to 4.5 N·m (3.3 lb-ft).

5. Fit the Lower Spring Plate (20) to the injector and secure by fitting the LSP retainer (13), ensuring that it clips firmly over the location pin (A).

6. Place the control rod in its mid position and lift the plunger outwards from the barrel to its full extent. Place the timing gauge tool into the timing slot beneath the lower spring plate and push it gently into the groove on the plunger.

7. Lower the plunger into the bore and wait for the timing tool to engage into the timing groove on the plunger.

8. Hold the timing tool in position, fit the Inner (12) and Outer Springs (11) and Upper Spring Plate (19). Place the loose assembly into the assembly tool.

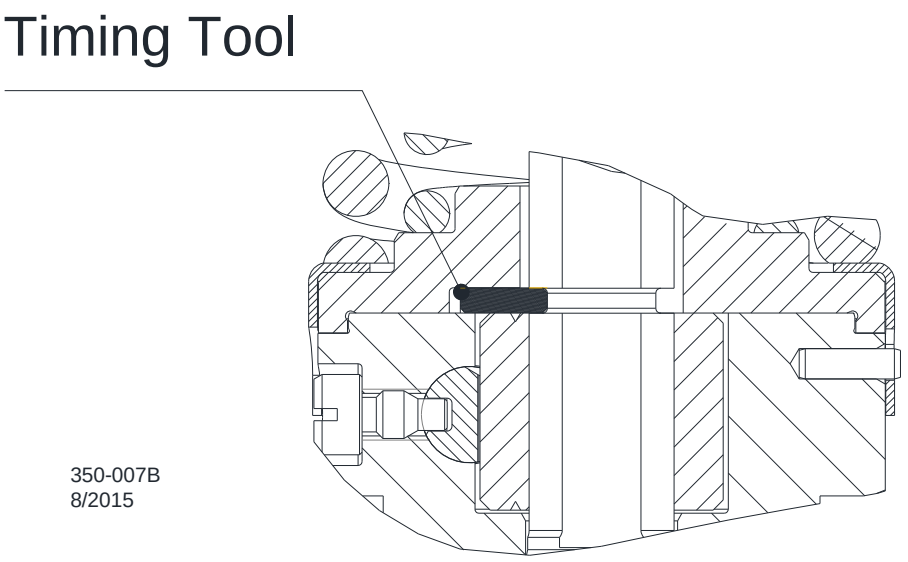

Figure 7-1. Use of Timing Tool to Locate Plunger

9. Keeping constant load on the timing tool (to hold it in position), and ensuring that the slot in the end cap of the compressor screw is facing the operator, screw down the compressor until there is sufficient space to fit the two keepers into the location groove near the top of the plunger.

10. Ensuring that the Keepers (2) remain in the location groove, unscrew the compressor spring until most of the spring load is relieved. Check that the control rod is free to move.

11. Pull out the timing tool, and check to see that both keepers are holding the assembly together. Remove the remaining load from the compressor and remove the injector from the assembly tool.

12. Smear the upper spring plate insert O-ring (17) with petroleum jelly and fit to the Insert (18). Fill the plunger end cavity with petroleum jelly.

13. Fit the insert into the upper spring plate.

14. Smear petroleum jelly on the injector barrel and nozzle nut O-rings (7 and 8) and fit them to the barrel and nozzle nut. The injector assembly is now fully assembled and ready for calibration.

IMPORTANT

The control rod will probably be stiff from the preload exerted by the nested plunger springs. This is quite normal. When fitted to the engine and the engine rocker is adjusted to depress the lower spring plate/springs, the rod will become free.

ITEM No.	PART No.	DESCRIPTION	QTY
1	20/285	SLEEVE CONTROL	1
2	20/293	KEEPER	2
3	20/295	BAFFLE SPILL	1
4	20/296	PARALLEL DOWEL	2
5	20/297	INJECTOR SPRING	1
6	124/75	SPILL BAFFLE CIRCLIP	1
7	372/61	SEAL O RING	1
8	372/96	O-RING	1
9	G50011286	R.H. CONTROL ROD	1
10	G50010742	NOZZLE ASSEMBLY	1
11	G50010475	PLUNGER (OUTER) SPRING	1
12	G50010476	PLUNGER (INNER) SPRING	1
13	20/289	LOWER SPRING PLATE RETAINER	1
14	G50010884A	SETTING - 1,5mm 10x5 DIN988 SHIM	1
15	G50010885	TIMING BRACKET	1
16	123/9	BARREL LOCATING SCREW	1
17	372/89	O-RING SEAL	1
18	G50010478	UPPER SPRING PLATE INSERT	1
19	G50011250	UPPER SPRING PLATE	1
20	G50011294	LOWER - TIGHT TIMING SPRING PLATE	1
21	G940201201	DIN 912 (ISO4762) M5x12 8.8 SCREW	1
22	G50011206	NOZZLE - HHI NUT	1
23	G50011292	ELEMENT - LOCATING ASSEMBLY	1

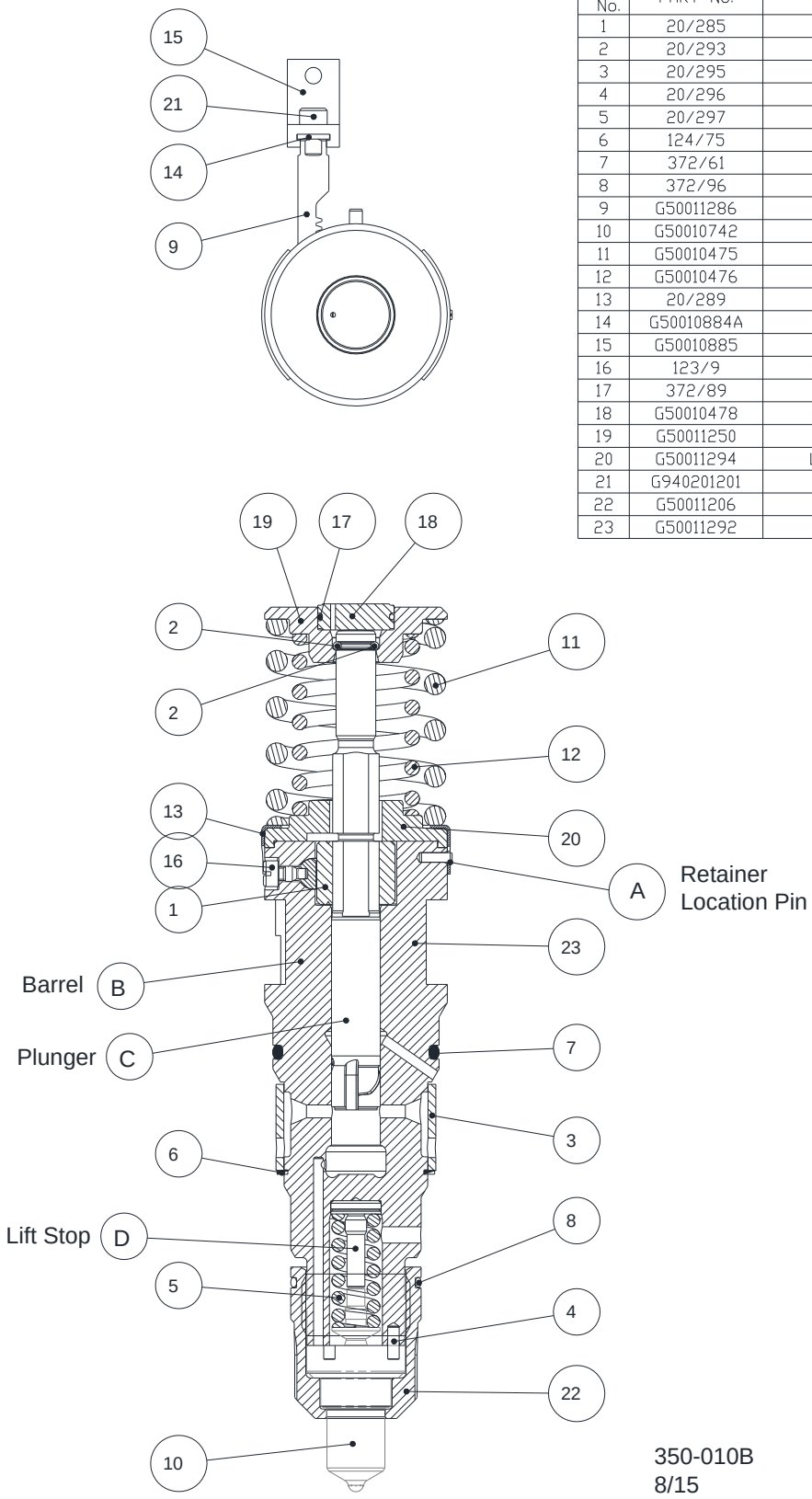

Figure 7-2. Type G50011293 Unit Injector

Chapter 8.
Testing

Introduction

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 (former Cheltenham number 308), *Safe Handling and Use of Woodward Diesel Systems Equipment*.

Refer to Chapter 1 for details of the test fluid to be used for pump testing.

The test oil temperature during testing must be 104 ±2 °F (40 ±1 °C).

The Calibration Test Equipment required is listed below:

- Test Rig Hartridge 1600 Plant No. 8711
- Cambox Part No. 1-B-22878
- Cam Part No. 1-B-22879
- Camshaft Rotation CW viewed from the cambox free end
- Cam 'A' Dimension 109.00 +0.05 mm
- Cambox Fixture Part No. 1-B-22880

The test equipment should be checked at least once a week for the following (includes assembly equipment):

- Accuracy of the pressure gauge with a master gauge
- Freedom from leaks
- Cleanliness of the oil filtration system
- Freedom from damaged high pressure pipe ends (such as closed ends or damaged nipples)
- Pressure transducer to be checked every 3 months (verification to be undertaken by the Quality Department)

WARNING

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.

WARNING

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

Use goggles or similar eye protection if the spray is exposed.

Nozzle Opening Pressure

IMPORTANT

To NOP test the unit, the lower assembly (nozzle assembly, nozzle nut, injector spring, lift stop, housing and control rod) must be removed from the upper assembly. This is easily achieved by lifting the LSP retainer from its location pin. The entire upper assembly can then be removed complete from the housing. After NOP testing has taken place, fit the upper assembly into the lower assembly, ensuring that the control rod notch is central and that the control sleeve dot aligns with it. Ensure the lower spring plate retainer is correctly fitted over the location pin. The unit, if satisfactory, is then ready for reuse.

Place the Clamp Plate (part of the Nozzle Opening Pressure Adaptor Tool, Woodward Part No. 1- B-22890) onto the plunger end of the barrel ensuring that the clamp plate engages fully with the 42 mm A/F of the injector barrel.

Insert the nozzle opening pressure adaptor through the bore of the clamp plate and into the injector barrel bore, rotating slightly to avoid damage to the O-ring seal.

Tighten the knurled clamp screw finger tight. Connect the threaded end of the adaptor (M12 x 1.5) to a Hartridge Pop Test Unit, Hartridge Part No. HH560, using a suitable High Pressure Pipe Woodward Part No. 33-B- 38.

Open the pressure gauge isolating valve and operate the hand pump until oil is discharged from the nozzle free from air.

Continue pumping and check the nozzle opening pressure. The required value is 462 ±24 bar (6700 ±400 psi).

If the figure is not within the specified limits and the injector is chattering correctly (see chatter test), the unit will have to be disassembled and the injector spring replaced.

Seat Leakage Test

Discharge the nozzle and dry the tip. Raise the pressure to approximately 10 bar (150 psi) below the opening pressure and maintain for ten seconds.

After this time, any leakage at the nozzle tip must not be sufficient to form a blob of fuel.

Chatter Test

Close the gauge-isolating valve. Operate the pump handle at the rate of one stroke in two seconds. The nozzle should discharge with a crisp chattering action, without dribbling or squirting jets of non-atomized oil.

The spray from each spray hole must be well atomized, of regular form, and free from ragged edges. All sprays must be of similar form and correctly spaced.

Back Leakage

It is not possible to make accurate or repeatable measurements of back leakage without very close control of the numerous variables involved.

Among these variables are test oil viscosity, pressure, system volume, nozzle nut clamping torque, and factors affecting nozzle body bore distortion and the shape of the leak path.

There are two criteria:
A. The nozzle needle must be free to reciprocate. This is shown by the chatter test.
B. It must not be such a slack fit that excessive leakage occurs during discharge, so that the injection period is extended.

To check the volume of the hand test pump without the injector and its connecting pipe, the system is to be adjusted to a value of 45 ±1.5 Hartridge Units for a pressure change from 150 to 100 bar (2175 to 1450 psi).

Equipment required is a Hartridge Volume Micrometer, Part No. HJ018, and Connecting Pipe, Part No. NTA118.

With the system adjusted to this volume, reconnect test pipe and injector, expel all air and open the pressure gauge isolating valve. Raise pressure to 200 bar (2900 psi).

Measure the time taken for the pressure to drop from 150 bar (2175 psi) to 100 bar (1450 psi). This should be 3–12 seconds at an oil temperature of 21 °C (70 °F).

If there is no other leakage from the injector and the back leak time is persistently less than three seconds, or significantly lower than other injectors in the engine set, it is likely that the nozzle needle valve is too slack a fit and a new nozzle assembly should be used.

IMPORTANT

The back leakage will be emitted from a drilling through the wall of the injector barrel and into the cylinder head fuel gallery. During testing, oil will run from this hole and down the outside of the injector barrel as back leakage from the nozzle rises in the spring chamber. Such leakage is normal and should not be confused with leakage from the joint faces.

Service Test Specification

Test Equipment

Test Rig	Hartridge 1600 or equivalent; minimum inertia 10 kgm² (50 lb-ft²); speed range 150–950 rpm
Cambox	Hartridge AC 57; roller housing - Hartridge AC62/1-B-22878
Cam	18 mm lift to Woodward drawing AC59
Injector	As Woodward drawing Part No. 1-B-22880 Fixture

Test Fluids

Test Oil	ISO 4113: feed 8 ±1 L/min at 40 ± 1 °C
Luboil	SAE 30 grade at 2 bar nominal to cambox and injector lower end (injector is mounted nozzle uppermost).

IMPORTANT

While the unit injector is on the test rig and running, check the control rod load carefully in both directions, using a force gauge. The maximum allowed force is 5 N. Do not move the control rod beyond the nominal full load position!

Chapter 9.
Packaging and Storage

Packaging

IMPORTANT **It is important to comply with the following requirements when packaging Fuel Injection Equipment for transit:**

- Always cap, plug or tape fuel feed/return HP outlet and back-leakage holes to prevent ingress of dirt or water.
- Always protect vulnerable parts of the equipment, such as exposed threads, nozzle tips, long fuel control rods, etc.
- If necessary, spray exposed, vulnerable parts, such as tappet rollers, with a protective oil, and wrap, if possible.
- Always include as many details of the returned equipment as possible—hours run, application, symptoms of failure prior to removal, etc.
- If special packaging has been used to ship the original equipment, use the same packaging to return it. If this is not available, every effort should be made to protect the equipment during return.

IMPORTANT **Failure to follow these recommendations may invalidate any Warranty Claim.**

Storage

Once the injector has been serviced, always fit a brass or plastic cap over any threads, the exposed nozzle tip, and the two back-leak holes. This will prevent the ingress of dirt and also provide protection.

All equipment should be kept in dry, clean conditions and adequately covered to prevent the accumulation of dust and dirt.

Only test oil which contains a corrosive inhibitor should be used. Fuel oil or paraffin must not be used.

The nozzle tip should be protected in storage by a suitable plastic or cardboard cap.

The external barrel diameter of the G50011293 unit is the fuel inlet section. This must be stored in a clean situation, ideally bagged to prevent dirt/dust ingress to the feed holes.

Nozzles should be kept in their individual wrapping and plastic container until required for use. If an unused nozzle is stored for more than two years, it is necessary to replenish the oil film between the needle and nozzle body. This should be repeated at intervals of TWO YEARS until the nozzle is put into service. To do this, unpack the nozzle, remove the needle and carefully flush and clean the nozzle body and needle in clean injector test oil; refit the needle, and repack the nozzle.

Chapter 10.
Illustrated Parts Catalogue

ITEM No.	PART No.	DESCRIPTION	QTY
1	20/285	SLEEVE CONTROL	1
2	20/293	KEEPER	2
3	20/295	BAFFLE SPILL	1
4	20/296	PARALLEL DOWEL	2
5	20/297	INJECTOR SPRING	1
6	124/75	SPILL BAFFLE CIRCLIP	1
7	372/61	SEAL O RING	1
8	372/96	O-RING	1
9	G50011286	R.H. CONTROL ROD	1
10	G50010742	NOZZLE ASSEMBLY	1
11	G50010475	PLUNGER (OUTER) SPRING	1
12	G50010476	PLUNGER (INNER) SPRING	1
13	20/289	LOWER SPRING PLATE RETAINER	1
14	G50010884A	SETTING - 1,5mm 10x5 DIN988 SHIM	1
15	G50010885	TIMING BRACKET	1
16	123/9	BARREL LOCATING SCREW	1
17	372/89	O-RING SEAL	1
18	G50010478	UPPER SPRING PLATE INSERT	1
19	G50011250	UPPER SPRING PLATE	1
20	G50011294	LOWER - TIGHT TIMING SPRING PLATE	1
21	G940201201	DIN 912 (ISO4762) M5x12 8.8 SCREW	1
22	G50011206	NOZZLE - HHI NUT	1
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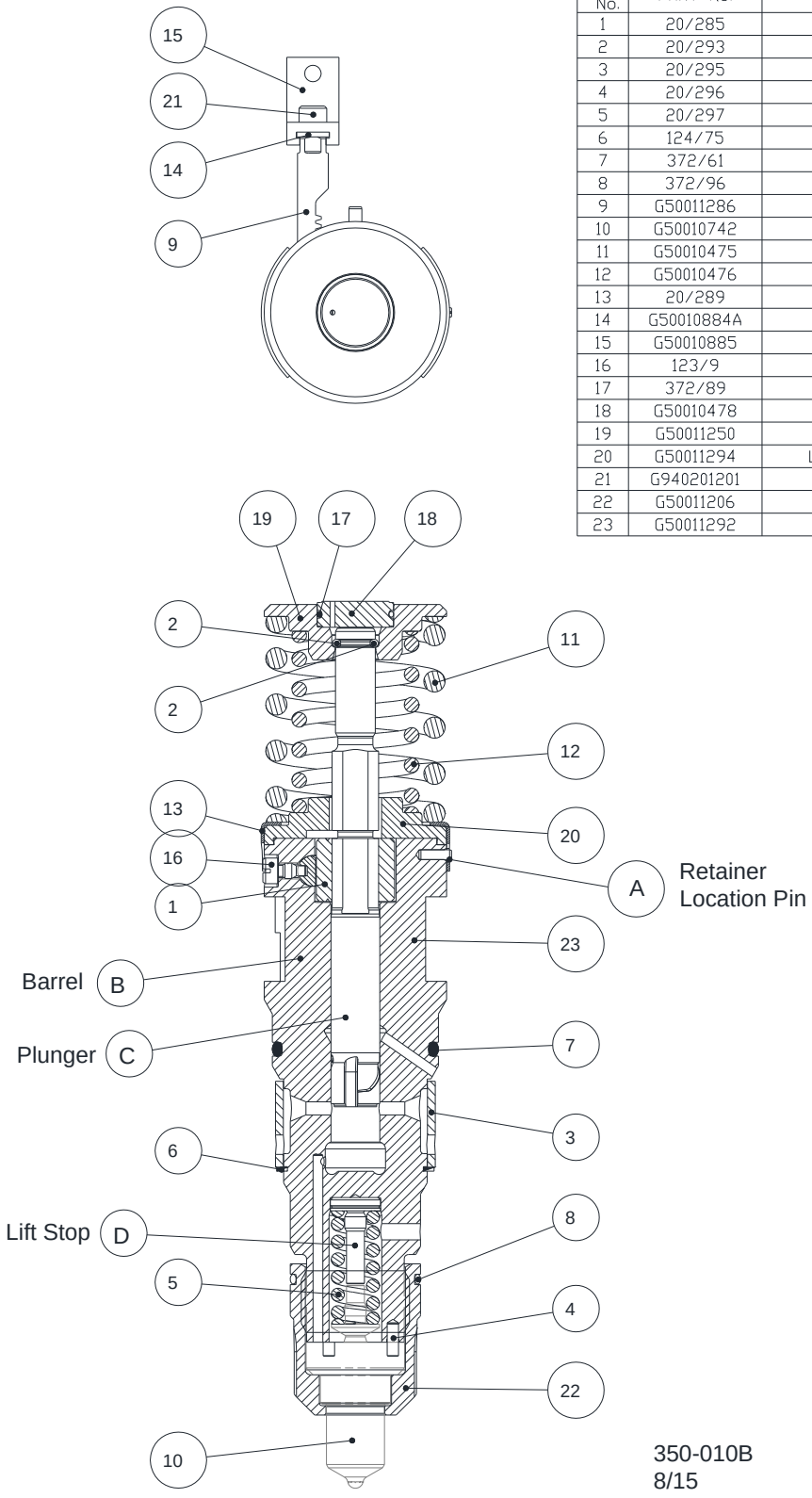

Figure 10-1. Injector G50011293 for HiMSEN H17/21V

Chapter 11.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-

new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in “like-new” condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing and Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

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*.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is laser marked on the injector;
- the unit serial number, which is also marked there.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.
- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Technical Specifications

HHI Unit Injector Type G50011293:

Drawing ‘A’-Dimension	250,315 +0,035/-1,25 mm
S.T.P.C.	3,465 ±0,085 mm
Plunger Diameter	15 mm
Minimum Bump Clearance	
At 3,38 mm S.T.P.C. and	
-18mm Stroke	1,58 mm
- 18,4 mm Stroke	1,18 mm
Nozzle Opening Pressure (Max)	486 bar
Operating Pressure	1500 bar

Declarations

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 35013NEW.

B 3 5 0 1 3 : N E W

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1000 East Drake Road, Fort Collins CO 80525, USA
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Email and Website—www.woodward.com

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as well as authorized distributors and other authorized service and sales facilities throughout the world.**

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