WORKSHOP MANUAL

DP210 FUEL INJECTION PUMP **DDNX184(EN)**

2003

(D) Kommen Sie nicht mit dem Hochdruckstrahl in Verbindung! Besonders nicht, wenn Druckrohrleitung oder Dichtung geprüft werden! Hochdruckflüssigkeiten können tödliche Verletzungen verursachen! Im Falle einer Berührung mit der Haut, kontaktieren Sie sofort einen Arzt. Bitte beachten Sie die Gesundheits-/und Sicherheitsunterlagen.

(E) Mantenga las manos y el cuerpo lejos del rociado del liquido, especialmente inyectores, tuberias y juntas de alta presión con fugas. La inyección de alta presión puede perforar la piel humana y producir una lesión fatal. En caso de que la inyección atraviese la piel, consiga atención médica inmediatamente. Vea la hoja de Datos de Sanidad y Seguridad.

(EN) Do not put your skin into the fuel jets under pressure, especially those due to pressure pipe or seal leaks. High pressure liquids can cause deadly injuries. In case of an injection under the skin, contact a doctor immediately. Please refer to the health and security fuel documents.

(F) Ne pas approcher les mains ni le corps des jets de liquides, particulièrement ceux provenant des fuites de tuyaux et des joint soumis a la haute pression. Le liquide sous haute pression injecté sous la peau peut causer des blessures mortelles. En cas d'injection sous la peau, consulter immédiatement un médecin. Se reporter a la fiche de santé et de sécurité du gazole.

(IT) Non esporre le mani o altre parti del corpo a getti di gasolio ad alta pressione, specialmente a quelli provenienti da tubi o paraolii. I getti di liquidi ad alta pressione possono causare ferite anche mortali. In caso di iniezione sotto pelle contattare immediatamente un medico. Fare riferimento alle schede di sicurezza del gasolio.

(NL) Zorg dat uw handen of andere lichaamsdelen niet in contact komen met vloeistofstralen onder hoge druk, met name bij een lek aan een leiding of dichting. Als de vloeistof onder hoge druk onder de huid terechtkomt, kan dit zelfs tot dodelijke verwondingen leiden. Als de vloeistof onder de huid terechtkomt, onmiddellijk een arts raadplegen. Lees de gezondheids- en veiligheidsfiche met betrekking tot de brandstof.

(P) Não exponha a pele a jactos de combustível sob pressão, especialmente os devidos a fugas de tubos de pressão ou vedantes. Líquidos a alta pressão podem causar ferimentos mortais. No caso de injecção subcutânea, consulte imediatamente um médico. Consulte por favor a documentação respeitante a saúde e segurança de combustíveis.

(D) Schutzbrille/Gesichtsschutz tragen.

(E) Úsese protección para los ojos/la cara.

(EN) Wear eye/face protection.

(F) Porter un appareil de protection des yeux / du visage.

(IT) Proteggersi gli occhi/la faccia.

(NL) Veiligheidsbril/-masker gebruiken.

(P) Use protecção da face/olhos.

(D) Von Zündquellen fernhalten - Nicht rauchen.

(E) Conservar alejado de toda llama o fuente de chispas -No fumar.

(EN) Keep away from sources of ignition - No smoking.

(F) Conserver à l'écart de toute flamme ou source d'étincelles - Ne pas fumer.

(IT) Conservare lontano da fiamme e scintille - Non fumare.

(NL) Ver van open vuur en ontstekingsbronnen houden – Niet roken.

(P) Mantenha afastado de fontes de ignição – Proibido fumar.

(D) Geeignete Schutzhandschuhe tragen.

(E) Usen guantes adecuados.

(EN) Wear suitable gloves.

(F) Porter des gants appropriés.

(IT) Usare guanti adatti.

(NL) Aangepaste veiligheidshandschoenen dragen.

(P) Use luvas apropriadas.

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NOTATIONAL CONVENTIONS AND ABBREVIATIONS

BC	-	Boost Control
CA	-	Cold Advance
CP	-	Zero Backlash Drive
CPS	-	Carriage Position Sensor
DCU	-	Diesel Control Unit
ESOS	-	Electric Shut-Off Solenoid
EVD	-	Exploded View Diagram
FIE	-	Fuel injection Equipment
HP	-	High Pressure
LLA	-	Light Load Advance
OEM	-	Original Equipment Manufacturer
SIN	-	Service Instruction Note
TP	-	Transfer Pressure

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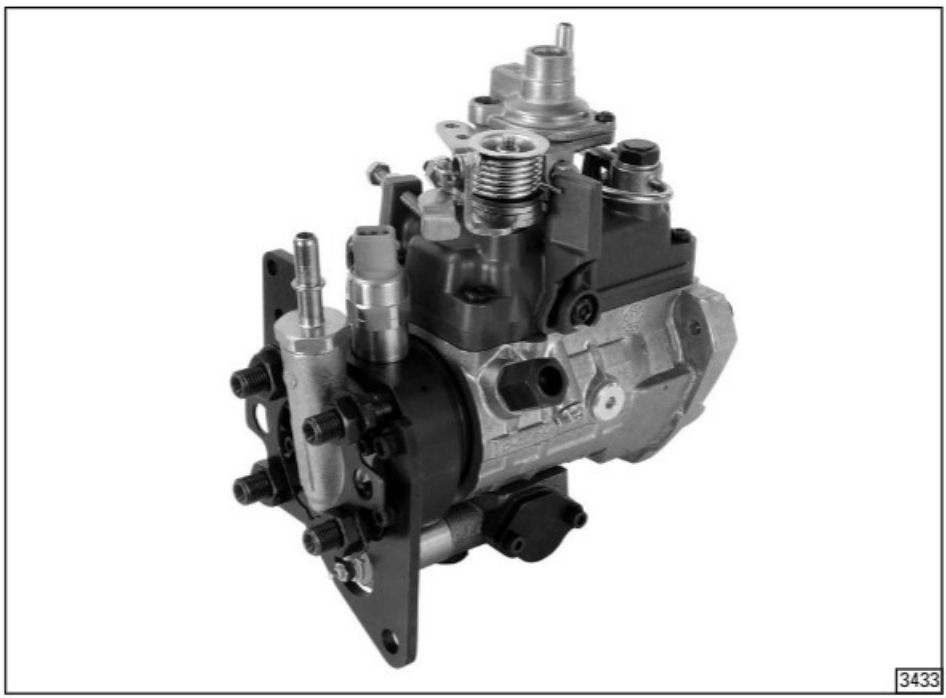


1.1 THE PUMP

The DP210 distributor-type fuel injection pump is a compact, self-contained unit that is suitable for direct injection engines of up to 33 BHP per cylinder and with three, four or six cylinders with either clockwise or anticlockwise gear drives. It is primarily intended for diesel engines which have to meet the Tier 2 off-highway exhaust emissions legislation for the industrial and agricultural markets in Europe and USA.

All internal working parts are lubricated by fuel oil and the pump housing is maintained at an internal pressure that prevents the ingress of external dirt or other foreign matter.

Standard features include improved shaft locked orientation timing, servo controlled light load advance and speed advance with solenoid switched cold advance, torque trimmer control of maximum fuel delivery including excess fuel for starting, transfer pressure curve slope adjustment with viscosity compensation.

It can also be fitted with a range of options to suit particular customer and engine rating requirements, including boost-pressure control for turbocharged engines, high strength camrings, quick fit low pressure connections and throttle levers with combined break-back and throttle return spring features.

Due to the complexity of this product, the need for highly trained personnel, and a high level of investment in equipment and workshop resources, together with the need for up-to-date Technical Information, it can only be tested or serviced by a Delphi authorised distributor.

It has been developed from the well-known range of DPA, DPS and DP200 injection pumps and is the result of the Delphi policy of continued improvement of products to meet the demands of new legislation and operational requirements.

1.2 GENERAL

Fuel pumps may require off-engine workshop attention for two main reasons:

(a) Investigation of a specific fault in engine performance, which may only require partial dismantling.

(b) A complete overhaul e.g. at the same time as a major engine overhaul.

A full performance test is recommended, both before and after any level of attention, as many aspects of pump performance are interrelated.

1.3 THIS MANUAL

The Dismantling, Reassembly and Testing Sections are laid out on a "step-by-step" basis, with each action accompanied by an illustration showing the component(s) involved and where applicable, its/their positions on the pump. The Manual is not based on any one specification, but covers pump features which have been included up to the time of publication. For the purposes of illustration, more than one pump specification has been used.

The pumps illustrated are for clockwise rotation (when viewed from the drive end). Any component used for anticlockwise pumps that is different, is individually described.

1.4 EQUIPMENT

Any tools, both standard and special-purpose, used for the servicing or repair of fuel injection equipment (FIE) must be reserved solely for use on FIE. Worn or damaged tools can cause damage to critical components, as well as being a safety hazard.

The working area must be scrupulously clean and should be in a room separated from any other activity; the ingress of dust and dirt, airborne or otherwise, must be prevented.

The minimum facilities required are:

1. A bench covered in non-rusting metal or industrial-grade linoleum and fitted with an engineer's vice with a jaw size of 100 mm (4 in). The vice jaws must be faced with either soft metal or fibre pads.
2. An adjustable pump-mounting device such as the "Hydraclamp", fitted with an appropriate adaptor plate.
3. Easily cleaned compartmented trays for separate storage of dismantled pumps are available from Delphi Aftermarket Operations, Service Operations Department.
4. All the necessary tools are listed in Section 6 of this manual.
5. A low-pressure washing facility using a suitable, approved, cleaning fluid (not water or water-based) to clean pumps externally prior to dismantling. Cleaning must be carried out in a place separated from the "clean area".
6. A tank large enough to accommodate a complete pump and filled with clean test oil, near to a source of clean, dry, variable pressure compressed air for carrying out leakage tests.
7. Supplies of clean, lint-free (non-fluffy) cloths for cleaning and drying components. Cotton waste must never be used.
8. A pump test machine that conforms to ISO 4008.
9. Adequate storage facilities for pumps, tools and test equipment, with separate areas for pumps before and after repair.

Note: All cleaning tanks, workshop and test facilities and fluids must conform to any Fire Prevention or Health and Safety Regulations in force at the time of use.

1.5 REPLACEMENT OF PARTS

All gaskets and seals must be replaced during reassembly. However, in the event of partial dismantling, only those seals that have been disturbed need replacement, unless leaks from elsewhere are detected during testing prior to dismantling.

If any part of a "mated" assembly is worn or damaged, the whole assembly must be replaced. Any component showing signs of corrosion or water ingress, cracks or distortion must be replaced.

Only service parts supplied by Delphi Aftermarket Operations may be used as replacements. Parts supplied from alternative sources may appear to be externally similar and may carry the same part numbers as the genuine item but may be inferior in material specification or finish and lead to malfunction or premature failure.

1.6 PUMP NAME PLATE

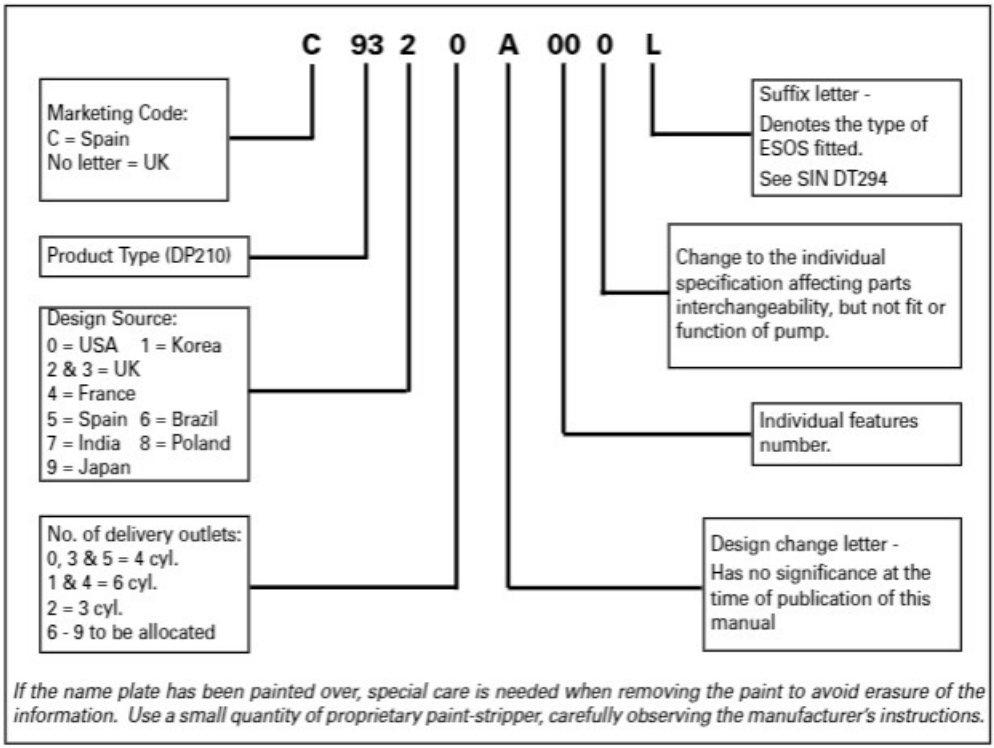
The number stamped on the type-plate attached to the pump housing identifies the type and model of the pump. Pumps with identical build but with different settings, dependent upon engine application, are further identified by the setting code stamped beneath the serial number.

A typical Despatch Number could be as shown in Fig. 1.

Note 1: The pumps shown in the illustrations do not necessarily represent any one specification, but are used to show particular features.

Note 2: As components are removed, inspect them and put those considered unfit for further service to one side for replacement; place those which are fit for further service into a clean compartmented tray. (Trays available through Delphi Diesel Systems Aftermarket Operations, Service Operations Department.) A guide to areas of possible wear or damage appears in Section 3 (Component Inspection & Renewal).

Fig. 1 Explanation of Despatch Number



If the name plate has been painted over, special care is needed when removing the paint to avoid erasure of the information. Use a small quantity of proprietary paint-stripper, carefully observing the manufacturer's instructions.

2.1 PREPRATION

A list of all tools required to dismantle the pump is given in Section 6.

2.1.1 Cleaning and draining

Externally clean the pump. Remove the drain plug (1) and drain any fuel oil remaining in the housing.

If the pump is suspected to be faulty, or is subject to a warranty assessment, a preliminary test on the test machine may be required. In this case, externally clean the pump as above but drain the fuel oil into a clean container for possible subsequent analysis.

If the pump has not seized and it is to be tested prior to dismantling, examination will first be necessary to determine if dirt or water ingress has occurred, so as to avoid contamination of the test fuel and possible damage to the test equipment.

If it is not possible to see through the drain plug hole, remove the spring end cover plate of the advance device (see Section 2.11) and closely examine the components for signs of corrosion or metal particles.

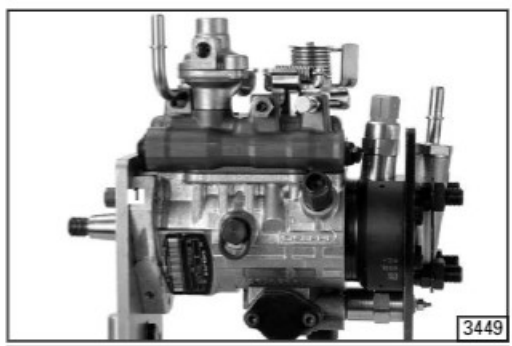
*Note: Do **NOT** remove the advance device as removal of the HLF will destroy the knife edge sealing of the plug.*

If there is no contamination, refit the end cover plate, using a new O-ring. Tighten the two screws to the respective torque and proceed with the test.

2.1.2 Mounting the pump

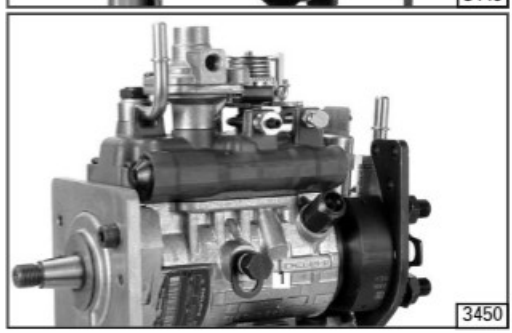
Mount the pump on a Hydraclamp using a mounting plate (1) with a suitable adaptor ring.

Align the pump with its axis horizontal and the governor cover uppermost.



2.1.3 Sealing caps and drive shaft lock bolt

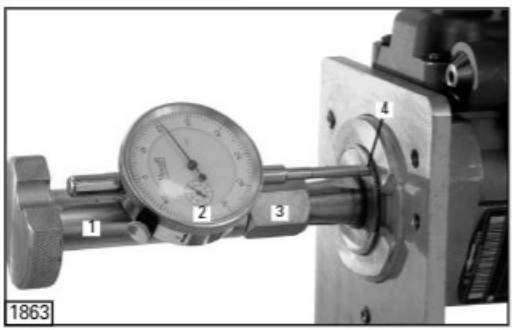
Remove any shrink sleeving or tamperproof caps from adjustment screws. Remove the drive shaft lock screw and washer (1) and discard the O-ring. Remove the plug that enables accsess to the cam ring for the advance readings (not shown).



2.1.4 Drive hub (if fitted)

Restrain the drive hub with the special tool. Slacken the drive hub nut and spring washer just sufficiently to allow release of the hub.

Use a suitable extractor to release the hub from the drive shaft taper. Remove the woodruff key (if fitted).

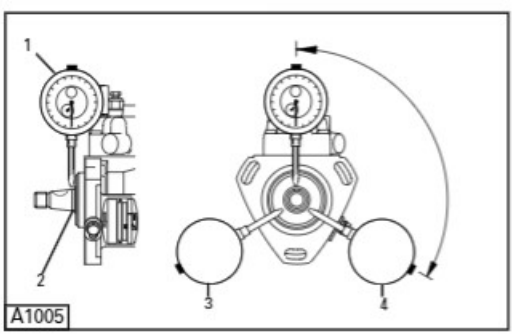


2.1.5 Measuring drive shaft end float

Note: To assess the condition of components subjected to end-thrust, end-float must be measured prior to dismantling. The pump and gauge must be clamped to an assembly plate mounted in a vice or on a Hydraclamp.

Fit the appropriate adaptor (3) to the drive shaft thread. Screw in the dial gauge holder (1), and fit the gauge (2). Adjust the gauge pin to contact the thrust washer (4). Push the drive shaft inwards and set the dial gauge to zero. Pull the drive shaft outwards and note the maximum gauge reading, ensuring the thrust washer (4) remains against the pump housing.

End-float should be 0.05mm to 0.2mm. If the maximum is exceeded, examine the housing thrust-faces during dismantling. If no significant wear or damage is apparent, requiring replacement of the pump housing, correct the end-float by the use of alternative shims during reassembly.



2.1.6 Measuring drive shaft radial play

Note: In order to assess the condition of the bearing and drive shaft, radial play must be measured prior to dismantling.

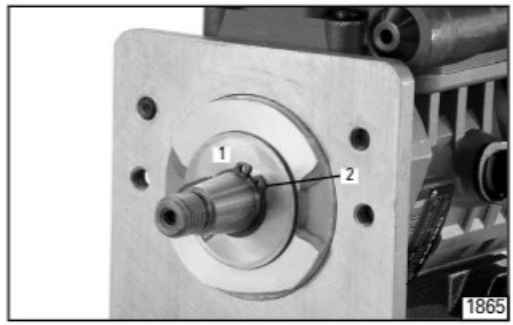
With the pump and gauge (1) mounted rigidly relative to each other, adjust the gauge pin to bear (at right angles) against the parallel section (2) of the drive shaft.

Note that this section is very short, therefore a fine tip will be required on the gauge pin. Push the shaft radially towards the gauge and set the gauge to zero.

Pull the shaft radially to the opposite extreme and record the gauge movement. Repeat the readings with the gauge repositioned as shown at (3) and (4). Do not rotate the drive shaft. Reject the housing if the maximum play is 0.27mm or the difference between the measurements exceeds 0.2mm.

2.2 DRIVE SHAFT

Remove the circlip (2) and thrust washer (1).



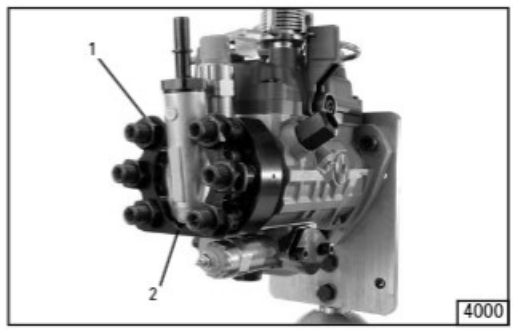
2.3 HIGH PRESSURE OUTLETS AND END PLATE ASSEMBLY

2.3.1 High pressure outlets

Turn the pump vertical so that the endplate is uppermost.

Remove all the nuts (1) securing the clamping plate (2) to the outlet connections, and remove the plate.

If fitted, remove the four support plate screws and the pump-to-engine support bracket (not shown).

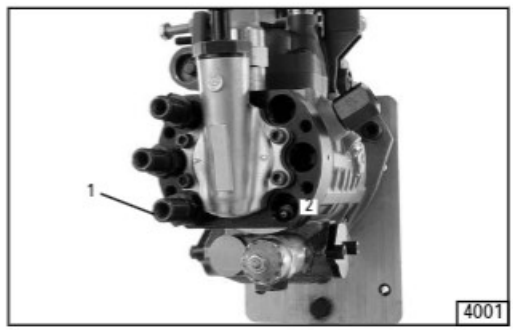


The outlets contain delivery valves that must be retained in their matched seat / valve pairs.

Unscrew and remove each high pressure outlet (1), using a long-reach socket, and then remove the delivery valves (2), delivery valve springs and pegs.

Delivery valve holders must be discarded.

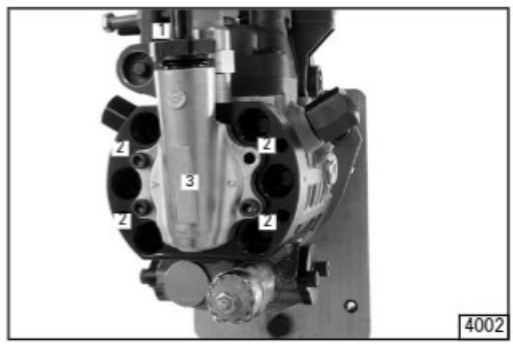
Remove and discard the seating washer from the bottom of each outlet bore.

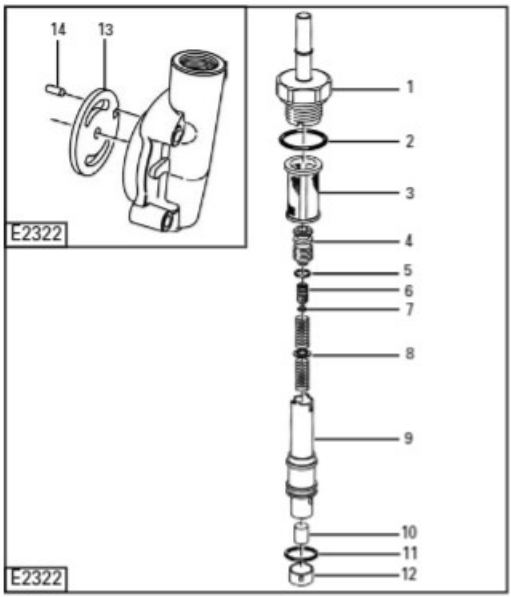


2.3.2 Endplate assembly

2.3.2.1 Removing the endplate assembly

Slacken, but do not remove, the fuel inlet connection (1). Slacken and remove the four endplate screws (2) and remove the endplate assembly (3) complete.





2.3.2.2 Internal components

Remove the fuel inlet connection (1) and discard the O-ring (2). Tip out the filter (3) together with the end plate sleeve assembly and remove the piston retainer (12), the piston (10) and the regulating springs with spring peg (8). From the opposite end of the regulating sleeve unscrew the double adjuster (4) using a 4.5mm hex key. Remove the O-ring (5) and discard. With a 2mm hex key remove, clockwise, the inner adjuster (6), remove the O-ring (7) and discard. From the regulating sleeve remove and discard the O-ring (11).

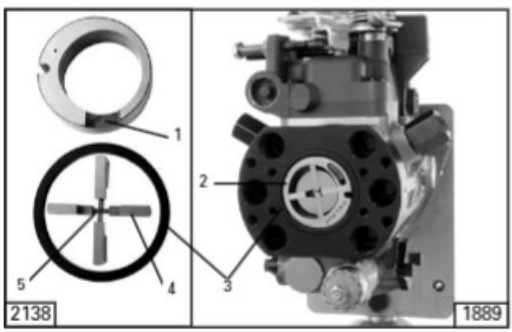
Note: The piston, sleeve and adjusters are matched and are not interchangeable.

Remove the sandwich plate (13).

Note: If damaged carefully remove the sandwich plate locating pin (14) from the end plate using a pair of long nose pliers. Note the particular hole in the endplate to which it is fitted. Incorrect fitting when reassembling will affect transfer pump operation.

2.4 ELECTRIC SHUT-OFF SOLENOID (ESOS)

Remove any detachable electrical connections, nut and washer, depending upon the type of ESOS fitted; slacken and remove the ESOS body. Remove and discard the O-ring.



2.5 TRANSFER PUMP

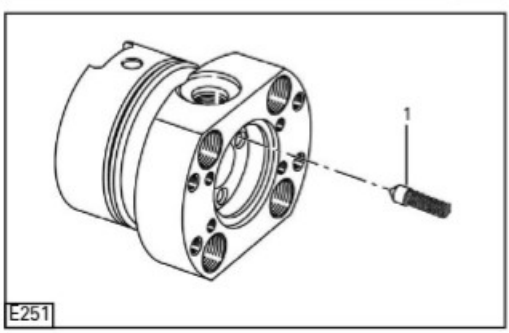
Note: Make a note of the orientation of the transfer pump liner (2) before dismantling, particularly the position of the recess (1) in one face, to aid correct reassembly.

Remove the transfer pump sealing ring (3). Carefully lift out the liner together with the two pairs of transfer pump blades (4) and their separating springs (5).

CAUTION: The springs are very small and could be easily mislaid.

Note: Care must be taken to avoid damage to the blade faces during storage or assembly.

If internal recirculation is fitted, remove the spring and poppet valve assembly (1) which is retained within the barrel by the liner.



2.6 GOVERNOR COVER EXTERNAL COMPONENTS

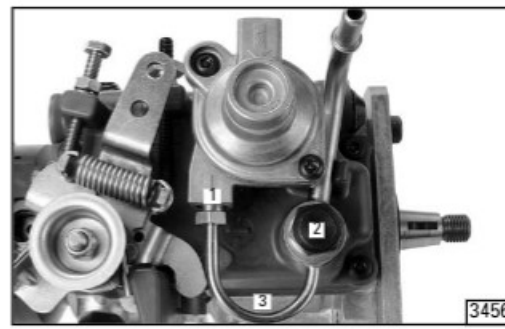
2.6.1 Fuel return connections

Note: Fuel return arrangements will vary, dependent upon the pump specification.

Align the pump with its axis horizontal and the governor cover uppermost.

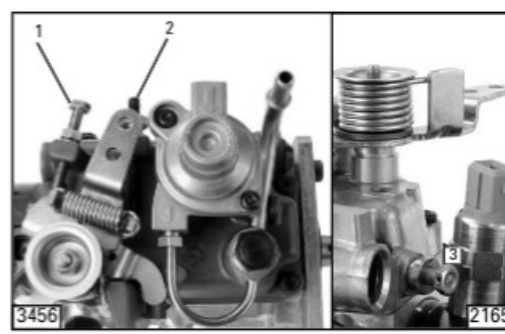
Unscrew the tube nut (1), the banjo bolt (2) and remove the drain pipe (3). Discard the two sealing washers from the banjo bolt.

If any backleak connections are fitted unscrew and remove them. Discard any washers.

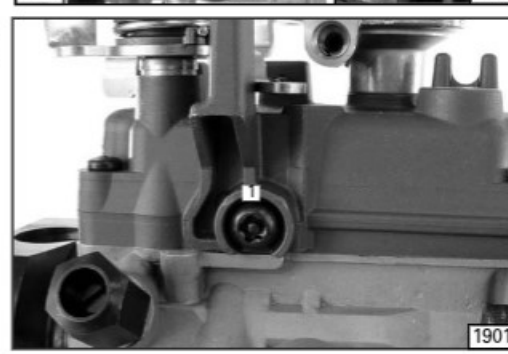


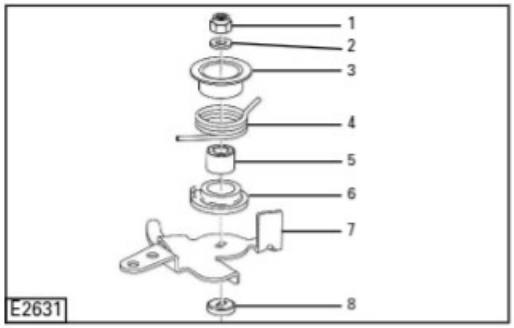
2.6.2 Throttle lever stop screws, maximum fuel adjuster blanking plug and torque control screw

Loosen the lock nuts on the idling stop screw (1), and torque screw (3), and remove the screws and washers. Using a pair of "molegrips" grip and undo the conical tamperproof nut of the maximum speed screw (2). Remove and discard the nut and screw. Discard any rubber sealing washers.



Using the special tool, slacken and remove the blanking plug (1) on the side of the governor cover. Discard any sealing washer.

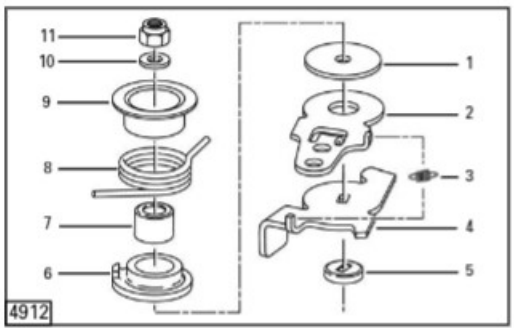




2.6.3 Throttle lever

2.6.3.1 Rigid type

Remove and discard the self-locking nut (1); remove washer (2), upper spring retainer (3), spring (4), spring retainer (6), spacer (5), throttle lever (7), and dust cap (8).



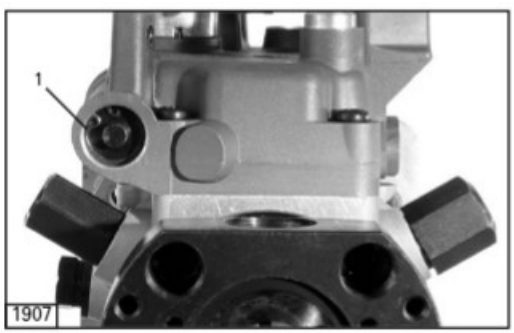
2.6.3.2 Break-back type

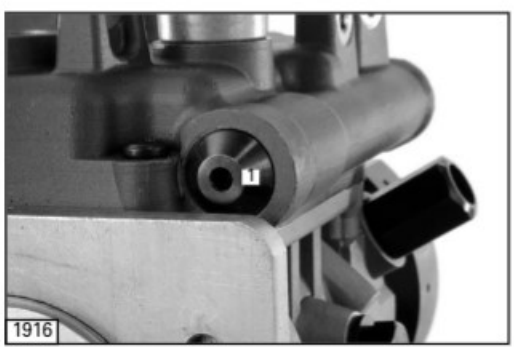
Remove and discard the self-locking nut (11); remove washer (10), upper spring retainer (9), spring (8), spacer (7), lower spring retainer (6) and washer (1). Remove break-back lever (2) and throttle lever (4) together with spring (3). Remove dust cover (5).

2.7 GOVERNOR COVER

2.7.1 Governor cover with Torque Control only

Remove the pressure end plug circlip (1).





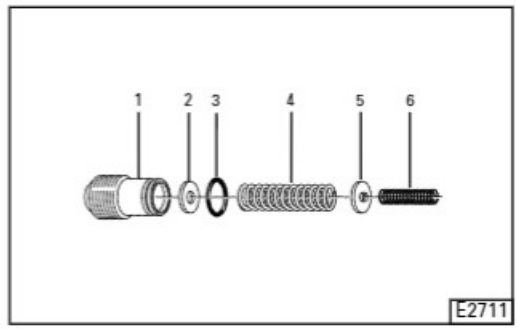
2.7.1.1 Spring end components

Note: It may be necessary to re-position the pump on the Hydraclamp mounting plate to gain access to the preload plug.

Unscrew and remove the plug (1) and discard the O-ring.

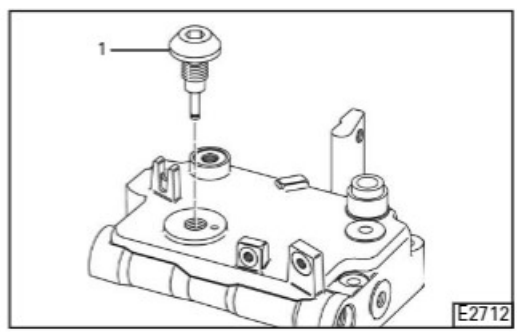
Remove the large spring (4), the spring plate (5) (if fitted), and the small spring (6) (if fitted).

Remove shim(s) (2) from inside preload plug (1); remove and discard the O-ring (3).



2.7.1.2 The pivot plug

If no boost control is fitted, the cam follower will be pivoted on a spindle, which is formed as part of a pivot plug (1) screwed into the governor control cover. If the pivot plug is to be removed, slacken it by no more than one turn before removal of the governor control cover (to avoid the risk of damage to internal components).



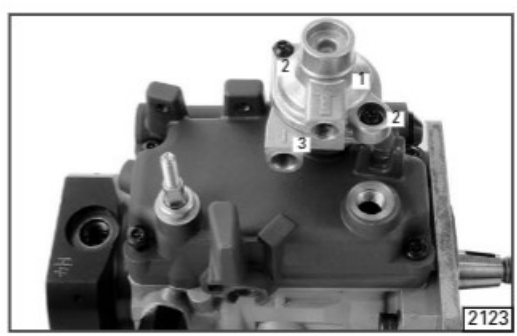
2.7.2 Governor cover fitted with Boost Control

Note the position of the air inlet connection (3) on the boost control cover.

2.7.2.1 Boost control cover and diaphragm

Slacken and remove the cover fixing screws (2).

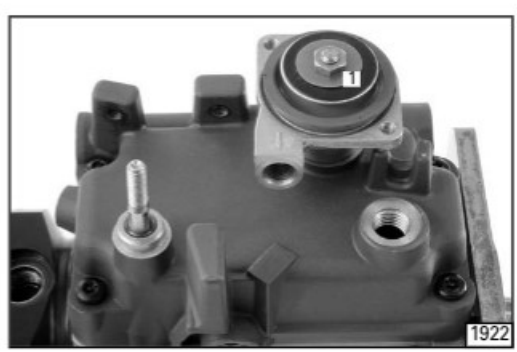
Caution: The cover (1) will be lifted up under the action of the diaphragm return spring as the screws are loosened.

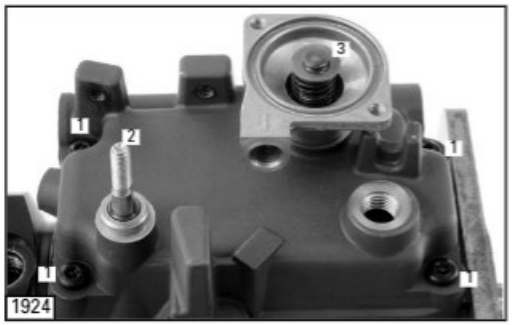


Remove the cover and the diaphragm assembly (1).

If fitted, remove the shim from within the "cup" in the lower face of the diaphragm assembly.

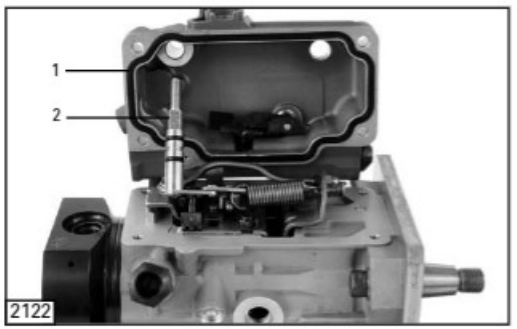
Note 1: Do not dismantle the diaphragm assembly as this is a factory-assembled item. If any part of it is worn or damaged, the whole assembly must be replaced.





Note 2: The spring, spring seat and spindle (3), cannot be lifted out at this stage, as they are retained by the cam follower and a circlip within the governor cover.

Push the throttle shaft (2) down into the cover. Remove the Torx screws (1) securing the governor cover.

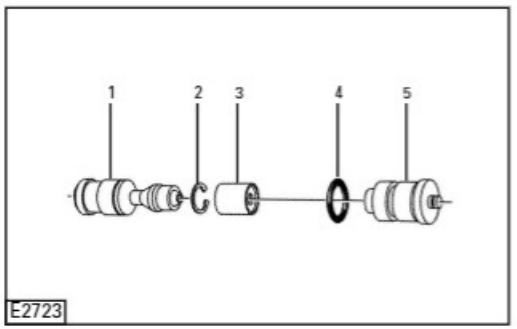


2.7.2.2 Removing the governor cover

Lift and rotate the cover off towards the torque trimmer side, and push the throttle shaft (2) out of its bore. Remove and discard the "trapped" O-ring (1) from the sealing face of the cover.

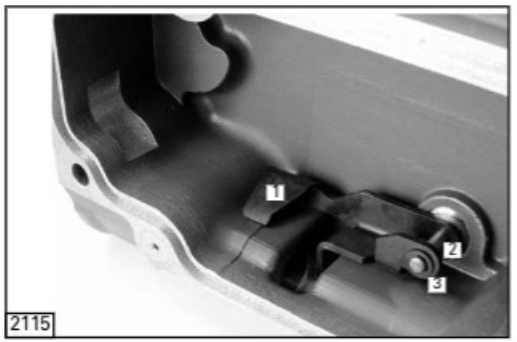
Remove the O-ring from the transfer port and discard.

Note: If the control cover is lifted too far, the carriage angle plate may become distorted; if resistance is felt, lower it and move it further away, then lift it again.



2.7.2.3 Removing the piston and the pressure end plug

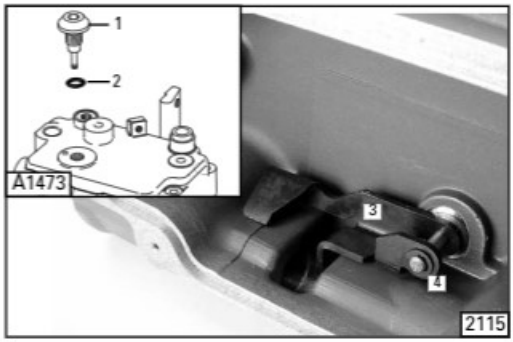
Tip out the torque trimmer cam (1); remove and discard circlip (2) (if fitted). Tip out piston (3). Use a suitable piece of soft metal or plastic rod to push the plug (5) out of the cover; remove and discard the O-ring (4).



2.7.2.4 Removing the cam follower and its pivot

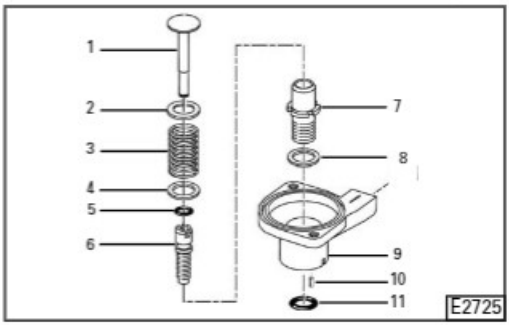
Remove the small circlip (3) and the cam follower (1) from the spindle (2). The washer behind the cam follower (not visible) may be difficult to extract and can be left until the spindle is removed.

If no boost control is fitted to the governor cover remove the small circlip (4) and the cam follower (3). Unscrew and remove the pivot plug (1); at which point the washer (not visible) can be removed from the spindle. Remove and discard the O-ring (2).



2.7.2.5 Boost housing

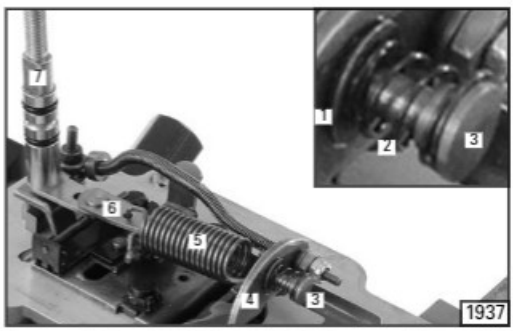
Remove the spindle (1), spring seat washer (2), spring (3) and shim (4). Remove the stroke adjuster (6) from the body (7) and discard the O-ring (5). Using the special tool slacken and remove the stroke adjustment screw body (7), the shim (8) and the housing (9). Remove the dowel pin (10) if damaged. Remove and discard O-ring (11).



2.8 ALL-SPEED GOVERNOR

Detach the governor main spring (5) from the idling spring peg (3). Remove the peg, idling spring (2) and pivot ball washer (1) from the governor arm (4). Remove the main spring from the throttle shaft link (6).

Remove and discard the O-rings from the throttle shaft (7).



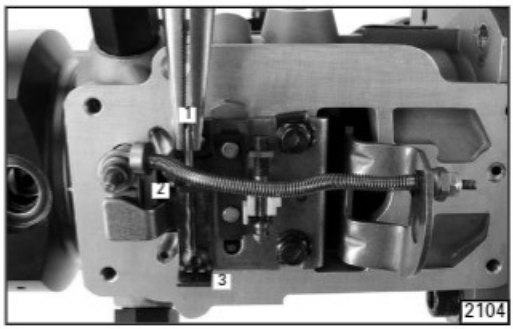
2.9 GOVERNOR CONTROL BRACKET AND ARM ASSEMBLY

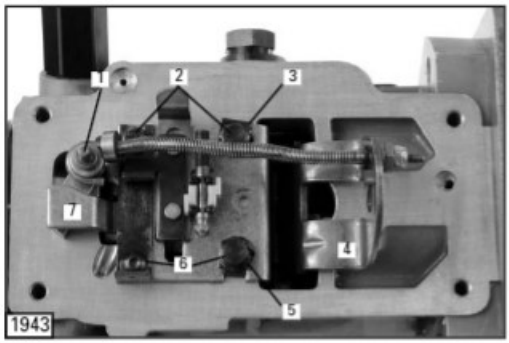
2.9.1 Scroll link plate return spring

Push the scroll link plate (3), to compress the spring and expose the end of the spring pin (1); grip the end of the pin, release the scroll link plate and pull the pin away from the spring stop (2). Tip the "shouldered" end of the pin upwards to clear the spring stop and carefully release and remove the pin and spring.

Warning

Cover the pin and spring with a non-fluffy cloth in case it is released prematurely, allowing it to be ejected at speed.



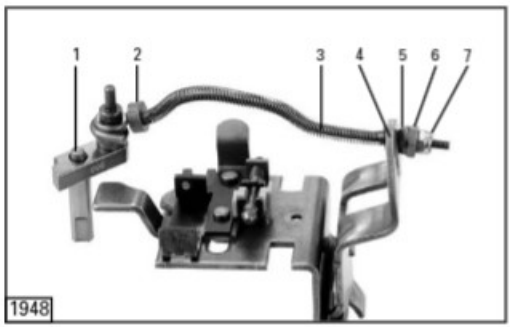


2.9.2 Governor control bracket assembly

Straighten the "ears" of the two tab washers (3) and (5). Slacken and remove the control plate screws (2) and (6) and discard tab washers.

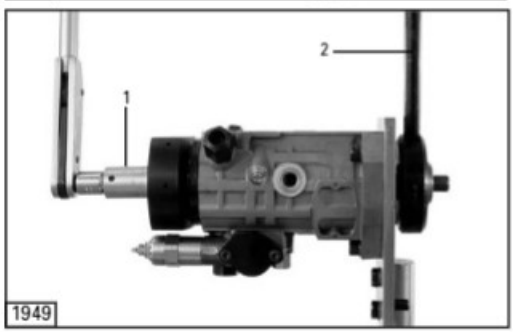
Note: Screws are of a different length and head shape so a note must be made of their respective positions.

Lift out the bracket and anchor plate (7) together with the control arm assembly (4) and the metering valve (1), from the pump housing.



2.9.3 Governor control arm assembly

Unscrew and remove the linkage lock nut (7) and adjusting nut (6). Remove the pivot ball washer (5). Withdraw the linkage hook with the washer and spring (3) from the governor control arm (4); remove the spring retainer (2), and metering valve assembly (1) from the linkage hook.

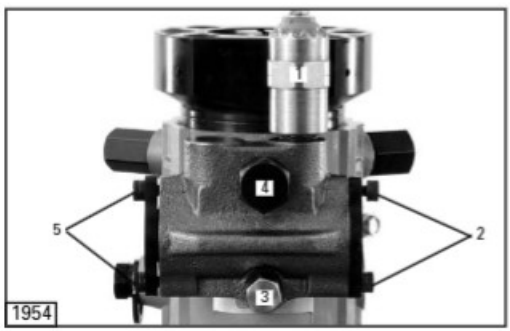


2.10 SLACKENING THE TRANSFER PUMP ROTOR

Temporarily refit a drive hub and key to the shaft and push the hub fully onto the shaft taper; hold the hub with the special tool (2). Hold the transfer pump rotor with the special tool (1). Slacken but do not remove the TP rotor; the direction in which it is to be slackened can be determined by examination of the end face of the TP rotor.

TP rotors marked with an arrow indicate a clockwise (left handed thread) direction in which to turn the rotor to remove it.

Remove the tools; drive hub and key, leaving the TP rotor just finger-tight.



2.11 ADVANCE DEVICE

Align the pump vertically with the transfer pump uppermost.

Slacken but do not remove the cold start solenoid (1) and the four end plate bolts (2) and (5).

Slacken and remove the cap nut (3). Slacken and undo the head locating fitting (4) no more than two turns.

Push the advance assembly back onto the pump housing enabling the head locating fitting to be released and it to be fully removed. Remove the O-rings and discard, noting their relevant positions.

Remove the HLF plug (2) in the end by inserting a suitable bar (1) in to the centre of the sleeve to allow it to be gripped, without collapsing, with a pair of side cutters to assist its removal. The sleeve will collapse if no bar is inserted.

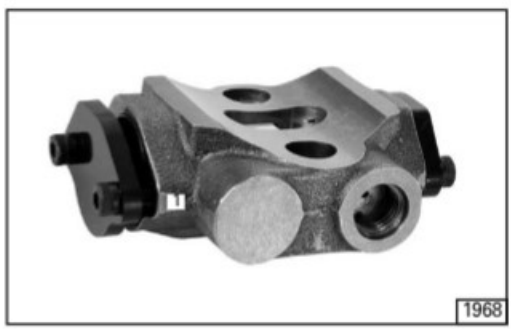
Note: DO NOT push the sleeve any further in to the head locating fitting otherwise it will be unable to be removed and a new head locating fitting will have to be used.

Remove the advance device. Remove and discard the advance housing gasket and the cap nut washer. Remove the solenoid and discard the O-ring.

Remove the two screws and plate from the spring end (1), opposite end to the cold start solenoid.

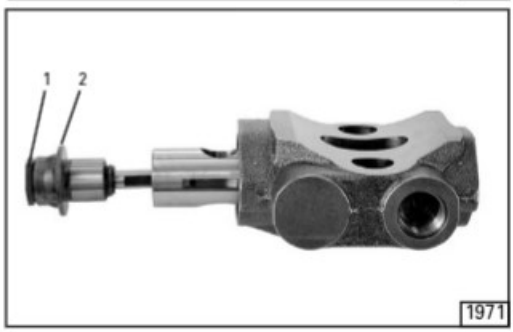
Remove the control spring and shim, remove and discard the O-ring.

From the pressure end remove the two screws and plate. Remove and discard the O-ring.

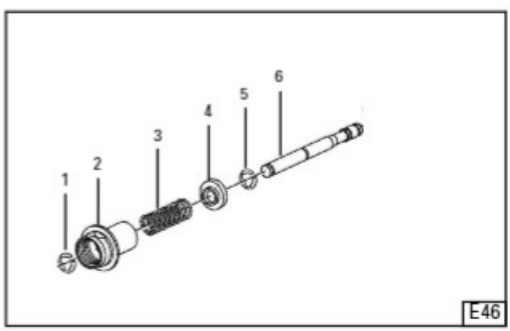


Slide out the advance piston and servo valve assembly.

Remove the servo valve assembly from the advance piston. Using suitable spanners grip and remove the light load screw (1) from the light load piston (2).



Lightly grip in a rubber jawed vice whilst pushing down on the light load piston (2), compress the spring (3) sufficiently to expose the retaining E-clip (1). Remove the E-clip from the servo shaft (6), gently release the spring pressure, lift off the light load piston with the spring and bottom spring plate (4). Only remove the bottom E-clip (5) if damaged.

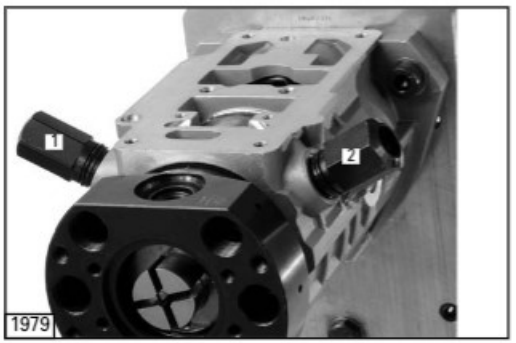



1972

2.11.1 Cam screw

Using a suitable socket and wrench, slacken but do not remove the cam screw.

If the cam ring has become stuck, remove the wrench and socket from the cam advance screw and tap the screw sideways with a soft-faced mallet until the cam has been released. Remove the cam screw from the cam ring.



1979

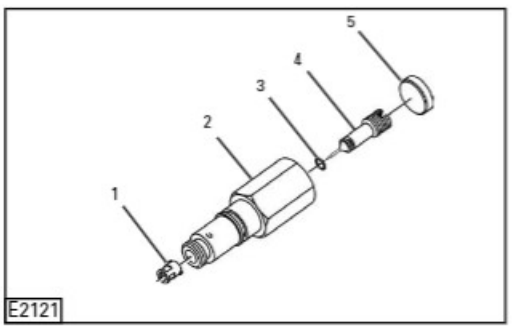
2.12 HEAD LOCATING FITTINGS AND HYDRAULIC HEAD

2.12.1 Head locking screws

Align the pump horizontally with the top of the pump uppermost.

Note: Before removing the head locating fittings make a note of their relative positions.

Slacken and remove the two head locking screws (1) and (2); remove and discard the O-rings and the filters (if fitted) in the inner ends of the screws.

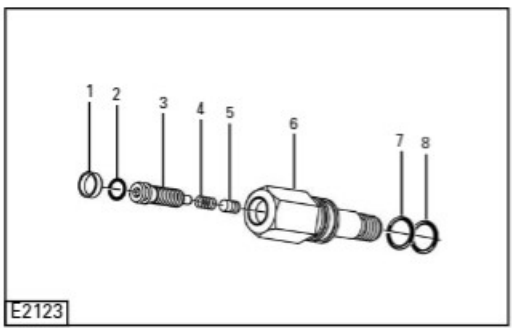


E2121

2.12.2 Light Load Advance (LLA)

Remove the tamper resistant plug (5) from the valve body (2). Unscrew and remove the adjusting screw and tapered valve pin (4) from the body. Remove and discard the O-ring (3).

Note: It is advisable to retain the filter (1) within the body of the valve and to clean and clear any foreign matter with the use of dry compressed air. The process of removing the filter will damage the valve body and will require a new LLA valve to be fitted.



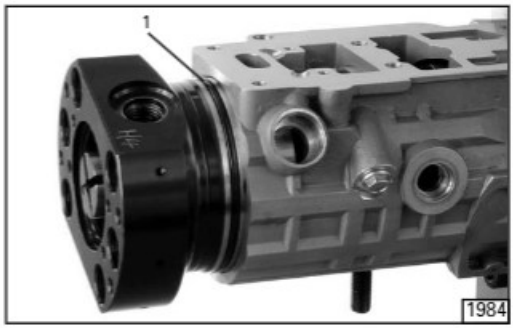
E2123

2.12.3 Latch valve

Remove the tamper resistant plug (1). Unscrew and remove the adjuster (3) from the body (6) and tip out the spring (4) and piston (5). Remove and discard the O-rings (7) and (8).

2.12.4 Releasing the hydraulic head

To release the hydraulic head twist and pull until the large O-ring (1) is just exposed.



Align the pump with its axis vertical and with a twisting action lift the head out of the pump housing; carefully hold the plungers within the rotor and invert the hydraulic head.

Note: The rear scroll plate may adhere to the face of the hydraulic head, if it does, remove it.

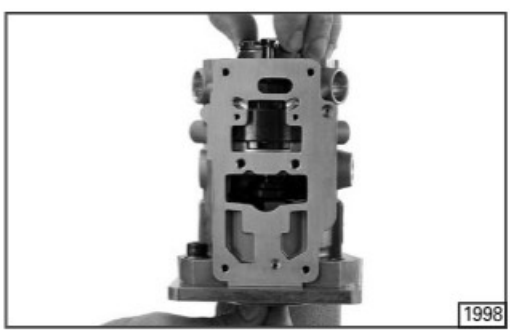
Place a plunger retaining cap (2) over the rotor; remove and discard the large O-ring (1).

Keep the hydraulic head either in a bath of clean test oil, ensuring that the exposed part of the rotor is covered or in a clean plastic bag until it is required for reassembly.

2.12.5 Drive assembly

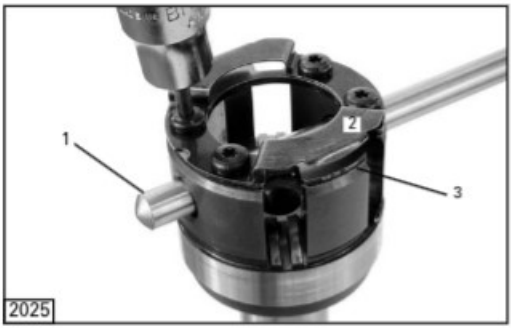
2.12.5.1 Drive shaft

Twist and push the drive shaft carefully up through the front bearing and remove it from the pump, holding the rollers and shoes in position as the shaft is lifted above the cam ring.



2.12.5.2 Rollers and shoes

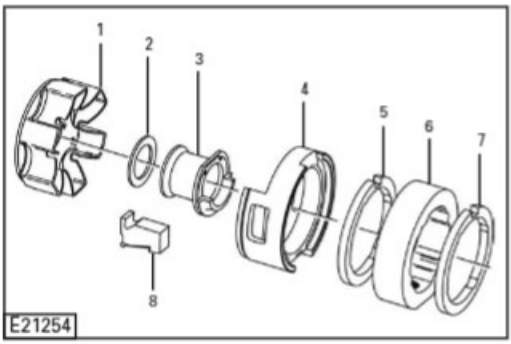
Remove the rollers and shoes, keeping them in their matched pairs.



2.12.5.3 Catch and support plates

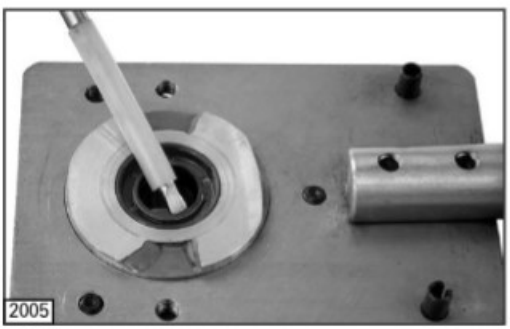
If the roller cage is to be removed, place a suitable "tommy" bar (1) through the transverse hole in the drive shaft; support the drive shaft in a vice fitted with soft jaws, without gripping it and use the "tommy" bar to resist the slackening torque.

Use a "Torx" screw bit and adaptor to remove the four catch plate screws. Remove the catch plate (2) and shoe plate (3).



2.12.5.4 Cam and scroll rings and bearing

Remove the rear scroll plate (7) (if still within the housing), cam ring (6), front scroll plate (5), inner bearing (4), and the governor weight cage assembly complete with the weights, thrust sleeve and thrust washer. Remove the weights (8), thrust sleeve (3) and thrust washer (2) from the weight cage (1).



2.13 DRIVE SHAFT SEAL(S)

Reposition the hydraclamp so that the drive shaft seals are uppermost.

Using the special seal removal tool, carefully lever out the seal noting the way round the seal is fitted into the housing.

If two seals are fitted, remove the circlip spacer and using the special seal removal tool, carefully lever out the seal noting the way round the seal is fitted into the housing.

3.1 CLEANING

If water contamination is suspected, carry out an initial examination of all internal components before attempting any further cleaning. Clean out all passageways in the head and rotor by flushing out with clean test oil.

Also inspect for unusual markings, deposits, odour or seal swelling in the housing, in which case degraded RME fuels may be a factor.

3.2 GENERAL

3.2.1 Mated and matched assemblies

The hydraulic head and rotor should be separated and examined; they should be re-mated immediately after examination and immersed in a covered bath of clean test oil until required for reassembly into the pump.

Note: If light load advance is specified, the metering valve will be matched to the hydraulic head.

The following groups are matched and must be kept assembled in their sets:

Rollers and shoes
Advance housing, piston and servo piston
Delivery Valve Assemblies
Cam ring and scroll plates
Regulating sleeve, piston and adjusting screw assembly
Governor cover and torque control piston

If any part of a matched set is considered to be unfit for further service, the whole set must be replaced.

Note: The pump housing drive shaft bush is not a service repair item; if the bearing is worn, the housing must be replaced.

3.2.2 Examination and replacement

All components must be checked for corrosion, wear or damage. Under service workshop conditions it is not feasible to test individual parts or sub-assemblies to determine their suitability for further service. Close examination of the areas vulnerable to damage, and interpretation of the results of tests prior to dismantling, should indicate the condition of parts.

3.2.2.1 Corrosion

Check for signs of corrosion or water ingress (rust or staining) and damage to machined surfaces. These include the pump housing, drive shaft, hydraulic head bore, metering valve and bore, cam ring, scroll plates, end plate and auto-advance device mounting face.

3.2.2.2 Wear

Inspect the drive shaft tang and associated parts for wear or damage. If excessive end-float or radial play was detected prior to pump strip-down examine the drive shaft thrust washer and housing bearing thrust face, governor backplate and thrust face of the drive shaft for wear.

3.2.2.3 Damage

Inspect all parts for damage or bending due to abuse, especially external levers and controls.

3.2.3 Seals

Replace the advance device gasket and all O-ring seals, including the "trapped" O-ring in the governor cover face.

When fitting new O-rings and oil seals, care must be taken to use protection caps to avoid damage to the seals. O-rings must be dipped in clean test oil prior to being assembled. External seals must be lightly coated with the specified grease. Where possible, inspect seals for small cuts after assembly.

3.3 DETAILS

3.3.1 Hydraulic head rotor

Withdraw the rotor from the hydraulic head. Examine the running surface very closely for signs of erosion, particularly the area around the delivery port. If significant erosion is evident, the head and rotor assembly must be replaced. Also check the condition of the drive tang.

3.3.2 Hydraulic head plungers

If damage to the plungers is suspected, carefully separate them from the rotor, one at a time, and inspect them for scoring or other damage. Replace the hydraulic head if the plungers show severe scratching. Clean each plunger with test oil and immediately replace it very carefully in its original bore, the same way round.

The recommended plastic retainer, or short lengths of clean nitrile rubber tubing, should be used to retain the plungers in their bores.

Note 1: The two pairs of plungers are of different lengths; the two longer plungers are fitted in line with the axis of the rotor delivery port.

Note 2: DP200 pumps specified with light-load advance will be fitted with "graded" metering valves. Refer to the appropriate parts list for details.

3.3.3 Cam ring and scroll plates

Inspect the running surface of the cam ring and scroll plates for signs of breakdown of the leading face or apex of the profile. If there are significant signs of pitting or "smearing" they must be replaced as a set. Smearing is the result of failure of the surface due to abrasion or overloading, which may be due to excessive hydraulic pressure (possibly caused by nozzle blockage).

3.3.4 Rollers and shoes

Inspect rollers and shoes for damage. Pay particular attention to the condition of the contact surfaces and check that the rollers rotate freely in their shoes. If the cam ring has failed, the rollers and shoes may also have been severely damaged. If satisfactory, rollers must be replaced in their original shoes.

3.3.5 Transfer pump

Check the blades for chips, scores or breakage's. Examine the blade springs for distortion.

Blades must be replaced in sets and must be of the same type as the originals. Examine the rotor for wear or damage.

Examine the liner for corrosion or scoring and replace it if there are any signs of damage.

3.3.6 Endplate

Examine the inner face of the end plate for wear. Replace it if there is any significant scoring. If the sandwich plate is scored or worn, it must be replaced and not reversed.

3.3.7 Control valves

Check all control valves for wear or scoring. Examine the metering valve for "stepping" of the control slot edges and at the point where it enters the bore in the hydraulic head. Check that the valve and the governor link pin are securely fixed in the bar and that the roller is free to rotate on the pin and is not worn. Check the regulating sleeve and piston and differential valve for damage, corrosion or blockage of orifices.

3.3.8 Delivery valves and cambox pressurising valves

Check for erosion or other damage to delivery valve assemblies. Replace them (as matched pairs) if necessary.

If movement of the cambox pressurising valve can be detected when shaken, the spring may have collapsed, in which case the whole assembly must be replaced, as it is a factory-sealed item.

3.3.9 Springs

Look for distorted or fractured springs. Very carefully examine the areas of contact with adjoining components (spring pegs, throttle shaft links etc).

Check that all springs specified in the Parts List for the pump are present.

3.3.10 Fittings and threads

Check all screws and nuts for damage.

Check all threads for damage, especially on the transfer and distributor rotors, hydraulic head, cam advance screw hole, studs, fuel inlet and return and high pressure outlet connections.

3.3.11 Linkages

Inspect all mechanical governor linkages, shafts, pivot pins and arms for wear, cracks or scoring of their mating surfaces.

3.3.12 Throttle shaft

Examine the throttle shaft and its associated bore in the governor cover for distortion, wear and looseness of joints or elongation of spring anchor hole.

3.3.13 Drive shafts and associated components

Inspect the shaft for wear or damage, especially where the oil seal contacts the shaft. Check the tang slot on CP drive pumps.

Examine the thrust surfaces on the inner face of the pump housing and the weight cage for damage or scoring.

Examine the governor weight cage and weights for wear, cracks or damage. Ensure that the correct number and type of governor weights are fitted.

3.3.14 Advance device

Examine the components for corrosion. If water has been present in the fuel it will tend to settle in the advance housing. Check that the piston and servo piston moves freely.

3.3.15 External controls

Examine all levers for cracks and for excessive wear at contact points.

3.3.16 Pump housing

Examine the housing for damage, especially to sealing surfaces. If the bearing is unfit for further service, the housing must be replaced. If the advance device stud is damaged replace the housing.

3.3.17 Governor control cover

Check the control shaft bore, stop screw threads, and adjusting screw seal spotfaces. Check the boost control locating dowel pin. Check the torque trimmer piston bore.

3.3.18 Orifices

Examine all orifices for blockage and carefully clear any obstruction with dry compressed air.

3.3.19 Electric shut-off solenoid

Ensure that all the solenoid electrical parts are clean, especially the connection(s). Check that the flexible valve seat is in good condition, with no pitting or other damage. Check the coil for electrical continuity by measuring its resistance. Ensure that the solenoid is completely dry and check insulation resistance between each terminal and the solenoid body (insulated return solenoids only).

Note 1: A few solenoids are specified to be operated only when there is a requirement to stop the engine.

Note 2: If any fault is apparent in the stop solenoid assembly, the whole unit must be replaced.

3.4 STORAGE

3.4.1 New pumps

New pumps must be stored in their "as received" condition, with their original packaging intact.

3.4.2 Overhauled pumps

Run the pump at full load and half maximum speed for 5 minutes on ISO 4113 test oil. Drain the oil; fit the drain plug and tighten it to the specified torque.

Fit protection caps to the inlet and outlet connections and seal the pump, together with some rust-preventing material, in damp-proof packaging.

3.4.3 Storage conditions

Pumps must be stored in a dry, dust-free area, away from direct sunlight or contact with any artificial heat source.

The temperature limits of the storage area must be between minus 30° C and plus 60° C. Humidity must be between 0% and 80%.

Pumps must be stored with the axis horizontal; unboxed pumps must not be stored one on top of another.

A stock-rotation system must be observed to minimise storage time of any individual pump. If a pump has been stored for one year, it should be subjected to a full test according to the relevant Test Plan and the storage procedure repeated.

4.1 PREPARATION

Before using thread-locking compound, if specified, ensure that the mating surfaces are completely oil-free and dry.

When reassembling pumps, it is important to use the correct overhaul kits. The relevant kit numbers can be found in the Service Parts List.

Lightly lubricate all flexible seals and O-rings with clean test oil before fitment to their respective components. Always use the correct protection cap when fitting new O-rings. Apply the specified grease to the drive shaft seal and the throttle shaft before assembly in their respective positions. Dip all internal components in clean test oil before assembly.

Refer to the relevant Test Plan for details of special build items and any initial setting instructions.

Refer to Section 6 for all special tools and torque values.

The direction of rotation of the pump, as shown on the nameplate, is as viewed from the drive end.

4.1.1 HYDRAULIC HEAD

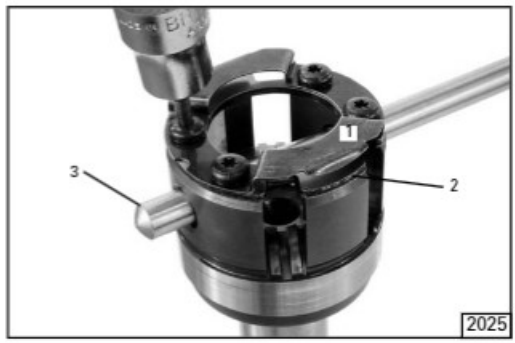
The plungers in four-plunger rotors must be fitted with the longer plungers opposite to each other and in line with the distributor port in the rotor.

4.2 DRIVE SHAFT

4.2.1 Catch and support plates

Fit a suitable "tommy" bar (3) through the transverse hole in the drive shaft; support the drive shaft in a vice fitted with soft jaws without gripping it and use the "tommy" bar to resist the tightening torque.

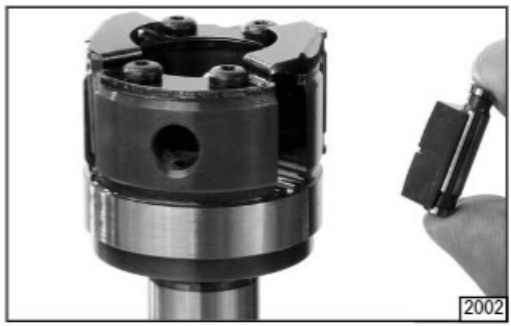
Fit the shoe plate (2) and the catch plate (1) and secure them with the four Torx screws tightened to the specified torque.

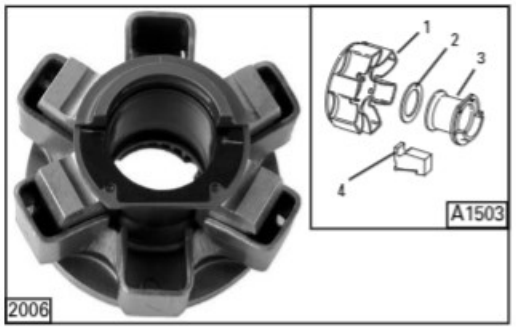


4.2.2 Rollers and shoes

Fit the rollers and shoes to the drive shaft; keeping them in their respective pairs.

Remove the drive shaft from the vice and place on the workbench with the tapered end uppermost.





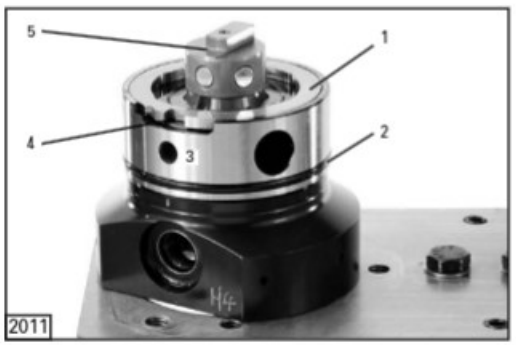
4.2.3 Governor weight cage

Fit the governor weights to the weight cage (1). Arrange them so that, if there are less than six weights (i.e. 4 or 3) they are symmetrically positioned. If there are only three, place one in every alternate "pocket"; if there are four, place them as shown in the illustration.

Place the governor thrust washer (2) on (not under) the "toes" (4) of the weights, followed by the thrust sleeve (3).

4.2.4 Fitting the governor weight assembly to the drive shaft

Hold the weight cage and the governor thrust sleeve assembly and invert it. Place the assembly over the drive shaft and lower it, rotating it a little if necessary to engage the splines on the drive shaft.

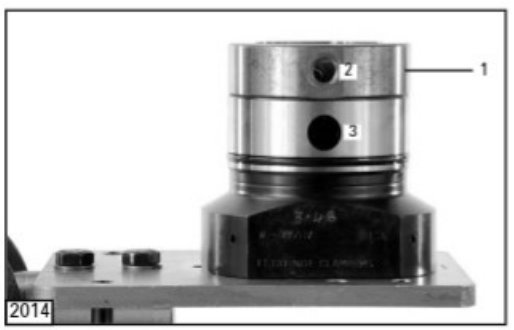


4.2.5 O-ring and rear scroll plate

Place the assembled hydraulic head on the workbench with the pumping plungers uppermost, ensuring they stay in position by use of the plunger retaining cap (not shown). Align the cutaway part of the drive tang (5) with the metering valve bore (3).

Fit a new O-ring into the groove (2) in the hydraulic head.

Place one of the scroll plates (1) in the recess in the hydraulic head (the "rear" scroll plate position). Ensure that its arrow is facing in the correct direction of rotation (as indicated on the pump nameplate) and the slot (4) is centralised in the gap in the hydraulic head, as shown.



4.2.6 Cam ring, front scroll plate and inner bearing

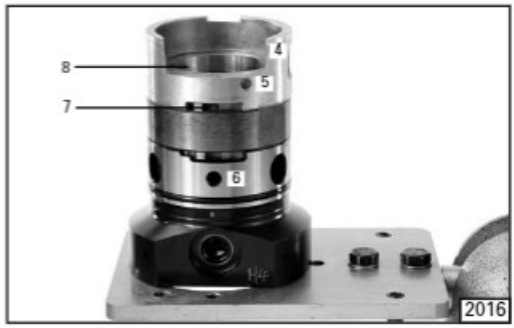
Place the cam ring (1) on the hydraulic head, with its arrow facing in the direction of pump rotation, and with the cam advance screw hole (2) aligned with the head locating fitting hole (3).

Place the front scroll plate on the cam with its arrow pointing in the direction of rotation and with the slot (8) aligned with the metering valve bore (6).

Place the inner bearing (4) over the front scroll plate, with its shallow recess facing downwards and the wide slot (7) centralised in line with the metering valve bore.

Ensure that both scroll plate slots are aligned with each other and with the metering valve bore.

Note: The small blind hole (5) accommodates the extended shank of one of the governor plate securing screws to prevent rotation of the inner bearing.



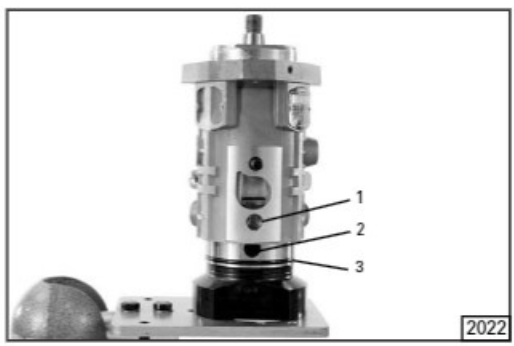
4.2.7 Drive shaft assembly

Hold the drive shaft assembly together and place it into the assembled components on the hydraulic head, rotating the shaft as necessary to align the slot with the hydraulic head rotor "tang" and the drive shaft keyway (1) in line with the metering valve bore (3).

Rotate the shaft so that a gap (2) between any two adjacent weight "pockets" is aligned with the metering valve bore (3) to ensure that the head of the advance housing stud will pass between the two opposite "pockets" when the pump housing is fitted.

4.2.8 Fitting the pump housing

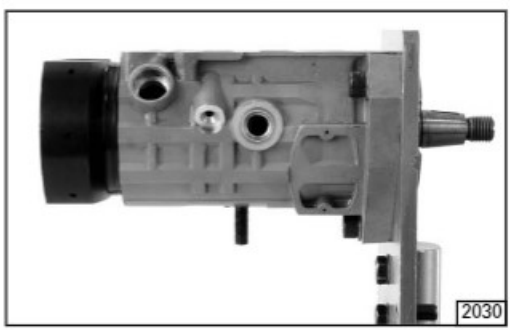
Align the head locating fitting hole (1) in the pump housing with the matching hole (2) in the hydraulic head and lower the housing onto the inner components until it just touches the hydraulic head O-ring (3).

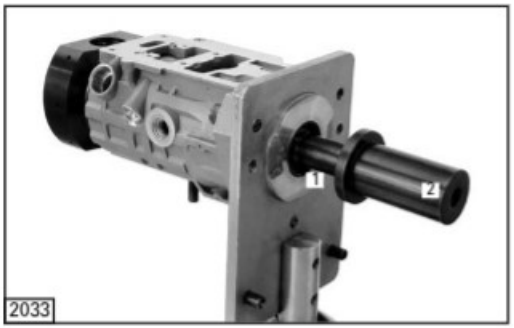


4.3 DRIVE SHAFT SEALS, END FLOAT AND RADIAL PLAY

Fit the pump to the Hydraclamp and align horizontally with the top of the pump uppermost.

Grip the hydraulic head and, using a twisting and pushing action, slide the head fully into the pump housing.





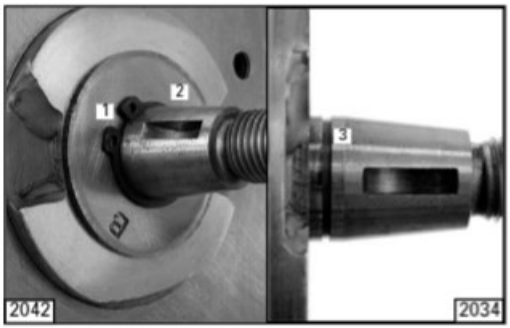
4.3.1 Drive shaft seals

Fit the protection sleeve (1) over the tapered end of the drive shaft. The sleeve must cover the circlip groove in the drive shaft. Failure to do so will cause the lip of the seal to be cut and create a fuel oil leak.

Fit a new seal into the pump housing. Ensure that the seal is the correct way round as noted during dismantling. Use the special punch tool (2) and a soft-headed mallet to drive the seal fully into the recess in the pump housing.

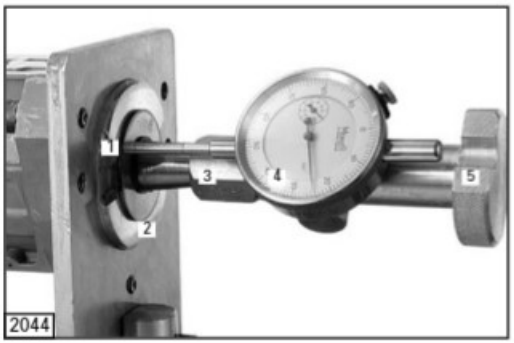
If a second drive shaft seal is required fit the circlip, if specified, into the groove in the pump housing seal recess. The circlip must be positioned within the groove so that the ears are either side of the telltale hole in the pump housing.

Repeat the process for fitting the first seal.



4.3.2 Securing the drive shaft

Fit the thrust washer (2) over the drive shaft and fit the circlip (1) correctly into the shaft groove (3).



4.3.3 Measuring drive shaft end float

Note: If this dimension was found to be correct when measured prior to dismantling, and no components which could affect end-float have been replaced, it should not be necessary to repeat this measurement.

Fit the appropriate adaptor (3) to the drive shaft thread. Screw in the dial gauge holder (5), and fit the dial gauge (4). Adjust the gauge pin to contact the thrust washer (1).

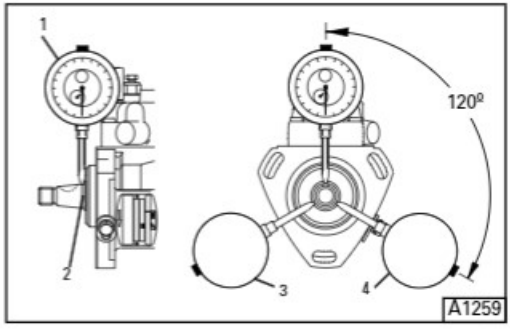
Push the drive shaft inwards and set the dial gauge to zero. Pull the drive shaft outwards and note the maximum gauge reading ensuring the thrust washer (1) remains against the pump housing. End-float should be between 0,05mm and 0,2mm. If it is outside that tolerance, correct it by the use of an alternative thrust washer (1).

4.3.4 Measuring drive shaft radial play

Note: If the original housing and shaft are to be used and radial play at the bearing was found to be within the limits stated below, it should not be necessary to measure radial play at this stage. If either item has been replaced, radial play must be measured.

With the pump and dial gauge (1) mounted rigidly relative to each other (e.g. on a plate fitted to the Hydraclamp), adjust the gauge pin to bear against the parallel section (2) of the drive shaft. Push the shaft radially towards the gauge and set the gauge to zero. Pull the shaft radially to the opposite extreme and record the gauge movement.

Repeat the readings with the gauge repositioned as shown at (3) and (4). Do not rotate the drive shaft. Reject the housing if the maximum play is 0.27mm or the difference between the measurements exceeds 0.2mm.

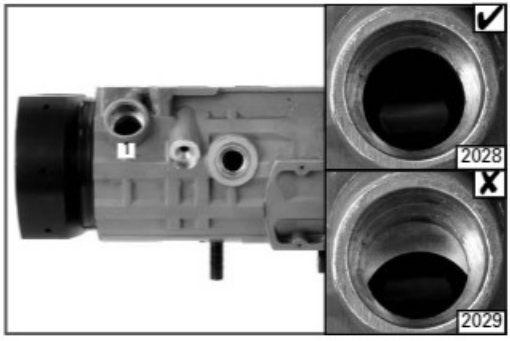


4.4 HYDRAULIC HEAD, CAM SCREW AND HEAD LOCATING FITTINGS

4.4.1 Aligning the hydraulic head

Re-align the Hydraclamp so the pump is horizontal with the top of the pump uppermost.

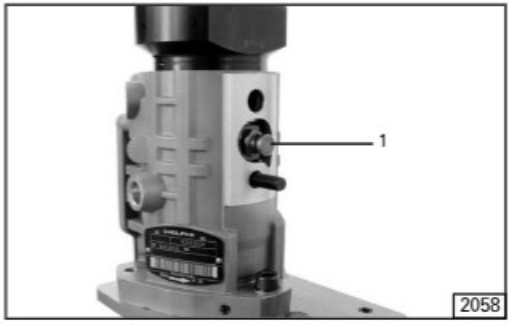
Grip the hydraulic head and, using a twisting action ensure the holes in the housing (1) and the hydraulic head are aligned with each other.

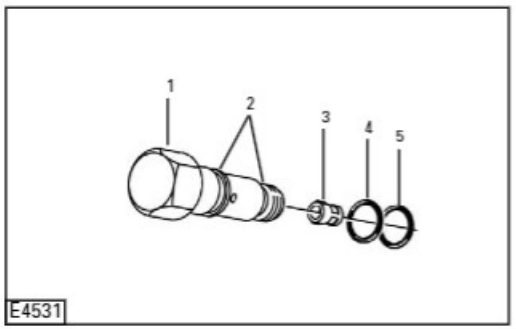


4.4.2 Cam advance screw

Align the Hydraclamp to place the pump with its axis vertical. Fit the cam advance screw (1) to the cam ring and using a suitable socket fitted to a torque wrench tighten the screw to the specified torque.

Note: During this operation, the cam ring usually becomes "jammed" in the housing. Using a rubber or hide mallet, lightly tap the cam screw axially to free the cam ring.





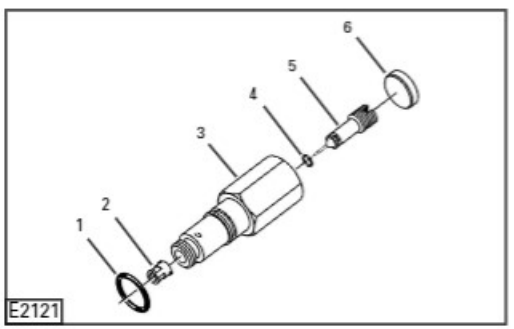
4.4.3 Head locating fittings

Note: To assist in the alignment of the Head and Rotor the head locating fittings should first be inserted without the O-rings fittted.

4.4.3.1 Head locking screws

Fit a new filter (3), if specified, into the open end of the body (1). Fit new O-rings (4) and (5) into the groove's (2) of the screw body.

Fit the locking screw, finger tight, into the hydraulic head-locating hole as noted during dismantling.



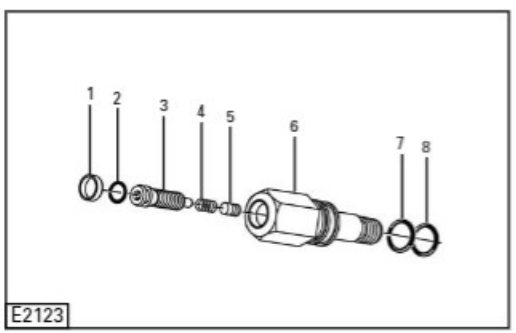
4.4.3.2 Light load advance valve (LLA)

Fit a new O-ring (1) to the valve body (3). Fit a new O-ring (4) to the adjusting screw and valve (5) and fit in to the valve body (3).

If filter (2) was removed during dismantling a new filter should be fitted to the valve body.

Fit the assembly, finger tight, into the hydraulic head-locating hole as noted during dismantling.

The tamper resistant plug (6) is to be left out until the valve has been successfully set on the test bench.



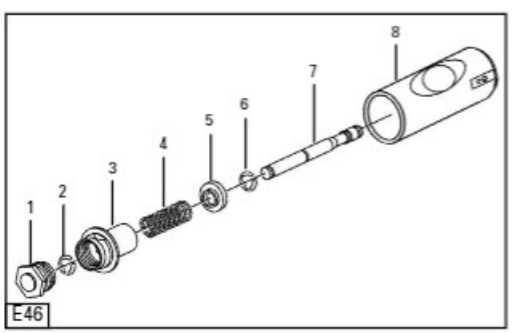
4.4.3.3 Latch valve

Fit new O-rings (7) and (8) to the valve body (6). Fit the piston (5) into the body followed by the spring (4).

Fit a new O-ring (2) onto the adjuster (3) and screw it into the valve body.

Fit the assembly, finger tight, into the hydraulic head-locating hole as noted during dismantling.

The tamper resistant plug (1) is to be left out until the valve has been successfully set on the test bench.



4.5 ADVANCE DEVICE

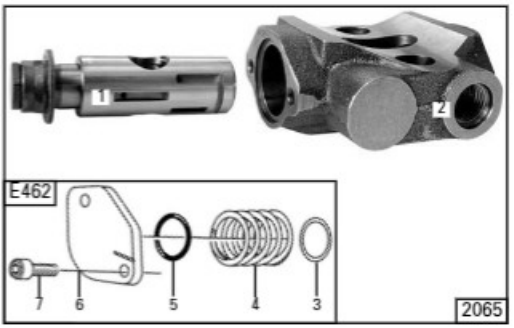
Refit the bottom E-clip (6) to the servo valve shaft (7) if removed during dismantling. Fit the bottom spring plate (5), spring (4) and light load piston (3). Compress the assembly sufficiently to enable fitment of the E-clip (2) to the servo shaft (7).

Fit the light load screw (1) to the piston (3).

Use a spanner to hold the light load piston and tighten the light load screw to the specified torque. Lubricate the servo valve assembly (7) and fit to the advance piston (8).

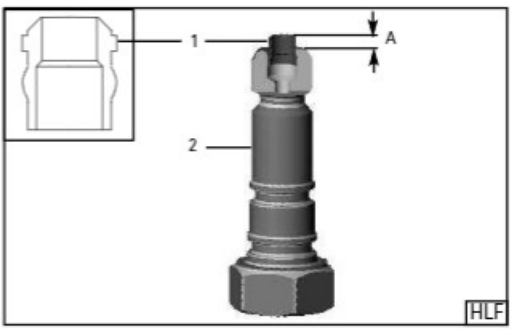
Lubricate and slide the advance piston assembly in to the advance housing from the spring end (which is the opposite end to the cold start solenoid) ensuring that the port and slots (1) are inline with the cold start solenoid hole (2).

Fit shim(s) (3), control spring (4) and a new O-ring (5). Fit the end plate (6) and the two securing bolts (7) finger tight.



Fit the plug (1) in to the head locating fitting (2) and leave it protruding 4.1 ±0.2mm (A).

Note: Its final position will be set when the HLF is tightened to the correct torque value.



4.5.1 Fitting the advance device assembly to the pump housing

Fit new O-rings (2) and (3), as noted during dismantling, to the grooves in the HLF (4).

Push the head locating fitting up through the larger of the two holes in the advance housing. Place a new gasket (1) onto the advance housing, with the straight edge (7) adjacent to the pump housing stud hole. Ensure that the shoulder of the head locating fitting will not cut the gasket when the fitting is tightened.

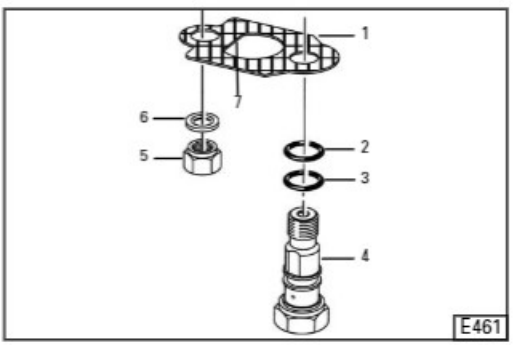
Place the advance housing over the stud and the cam advance screw, and onto the pump housing, ensuring that the gasket is correctly located over the housing stud shoulder.

Note: The position of the piston may need to be adjusted to enable the cam advance screw to be located.

Engage the fitting with the thread in the hydraulic head and screw it fully in finger tight. If necessary adjust the position of the hydraulic head.

Centralisation of the hydraulic head is necessary to avoid damage to the O-rings as the head fixings are screwed in.

Fit a new sealing washer (6) to the stud, followed by



the cap nut (5).

4.5.2 Tightening the head fittings and advance end plates

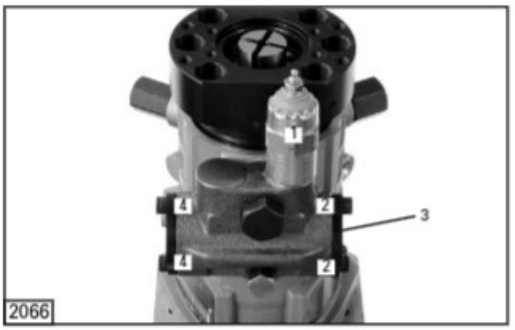
Progressively tighten in the following order, LLA valve, head locating fitting, head locking bolt or latch valve to their specified torques.

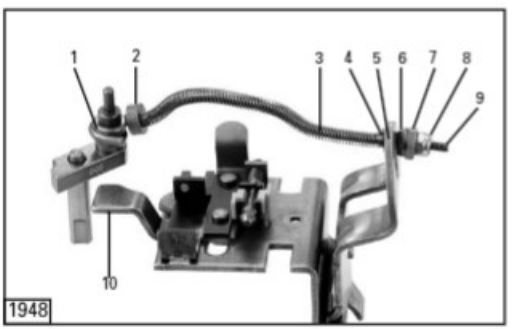
Note: When all screws are tightened, check that the advance piston moves freely within the advance housing.

Warning: If the HLF is slackened once tightened, the plug MUST be replaced.

On the pressure end fit the O-ring in to the advance housing and then fit the end plate (3) and secure with the two bolts (2). Tighten these and the spring end bolts (4) to the correct torque.

Fit a new O-ring to the cold start solenoid (1) and fit the solenoid to the advance housing and tighten to the correct torque.





4.6 GOVERNOR CONTROL BRACKET AND ARM ASSEMBLY

4.6.1 Governor control arm assembly

On to the linkage hook (9) place the spring retainer (2), long spring (3), and washer (4). Feed the linkage hook through the smaller of the two holes in the upper part of the governor arm (5) and then fit the pivot ball washer (6) with its dome towards the governor arm, plain adjusting nut (7), and self-locking nut (8). Leave the nuts at the outer end of the thread. Their final position will be established when the link-length is set.

Engage the hook of the link with the roller (1) of the metering valve; with the open end of the linkage hook facing the metering valve lift stop (10).

Assemble the control arm to the support bracket as shown.

4.6.2 Fitting the governor control bracket assembly

Align the pump horizontally with the top of the pump uppermost.

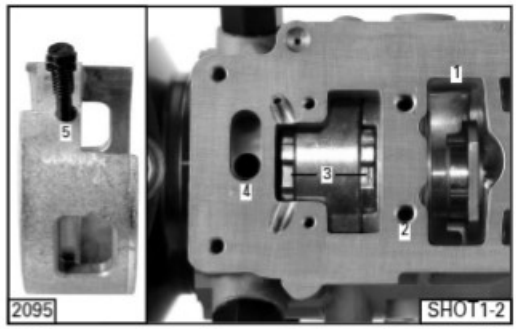
Position the governor thrust sleeve so that the "flats" are horizontal and visible through the access hole (1). Ensure that the locating hole in the bearing (5) is aligned with the governor control plate fixing screw hole (2). Align the scroll plate slots (3) with the metering valve bore (4).

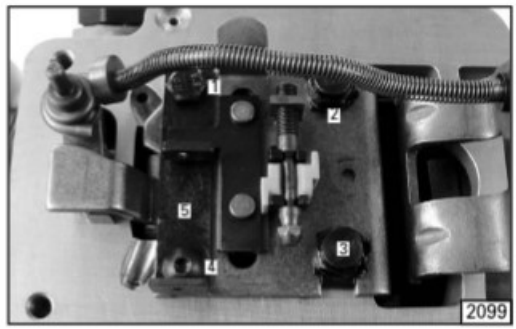
Fit the assembled control arm and control bracket, together with the metering valve, into the pump to rest the control arm forks on the flats on the thrust sleeve and the metering valve in to its bore. Fit the arms of the scroll link plate into the scroll plate slots.

Fit a new tab washer, so that its lip will face downwards, to the fixing screw with the longest shank. Fit the screw at position (3), ensuring that it enters the hole in the internal bearing.

Fit a new tab washer to screw (2), with its lip positioned along the edge of the bracket.

Fit the plate (5) and hold in place with two screws (1) and (4), as noted during dismantling. Check that the scroll link plate is free, check that the governor assembly is in the correct position, and then tighten all control bracket screws to their specified torque and bend up the locking tabs.

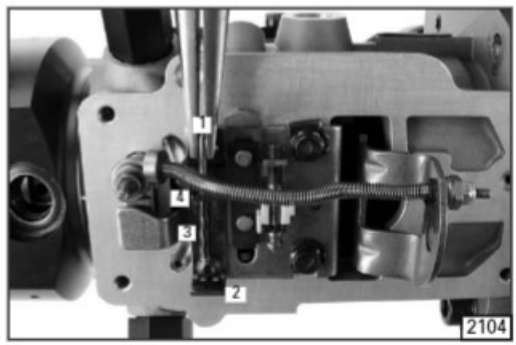




4.6.3 Scroll link plate return spring

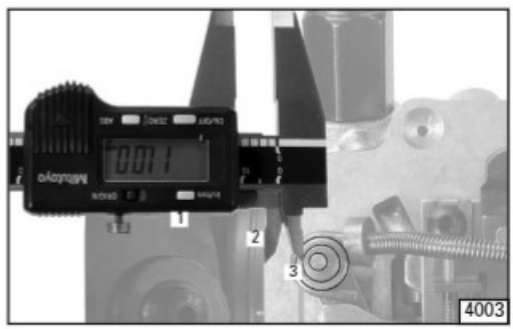
Fit the spring over the spring pin (3) up to the pin shoulder. Fully compress the spring; carefully grip the pin and the spring and insert the exposed end of the pin into the hole in the scroll link plate (4). Transfer grip to the exposed end of the pin (1), push the scroll link plate towards the pump centreline and fit the spigot of the pin into the hole (2) in the spring stop.

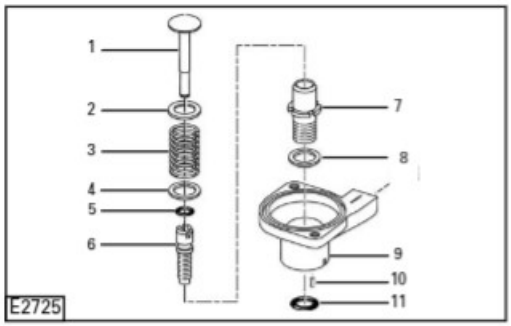
Caution: There is a risk of the spring and pin being ejected at high speed if grip is relaxed before the pin is securely fitted into the spring stop.



4.6.4 Setting the governor link-length

Set a vernier caliper (1) to the link-length specified in the Test Pan. Move and hold the governor control bracket to open the metering valve, i.e. towards the head and rotor. Place one leg of the vernier gauge against the smaller diameter of the metering valve roller (3). Ensure that the gauge leg does not slip into the link hook groove. With the use of a straight edge guide against the end of the pump housing (2) insert the other leg of the vernier gauge. Adjust and lock the lock-nut on the end of the spring link to obtain the test plan specified value.





4.7 GOVERNOR COVER

4.7.1 Governor covers fitted with boost control

Note: The diaphragm assembly is a factory-assembled item.

Fit a new O-ring (11) in the recess in the governor control cover. Fit a new pin (10), if removed, into the governor cover. Locate the boost control housing (9) over the dowel pin (10) and secure it in position using a new adjustment screw body (7) (and shim (8) if fitted). Use the special tool to tighten the body to the specified torque.

Fit a new O-ring (5) to the adjusting screw (6). Fit the screw into the stroke adjustment screw body and screw it into the body until the O-ring is just concealed, or to a position specified in the relevant Test Plan.

Place the shim (4) into the recess in the boost control housing, followed by the spring (3). Fit the spring plate (2) to the spindle (1) and place the spindle assembly through the spring and the adjustment screw (6).

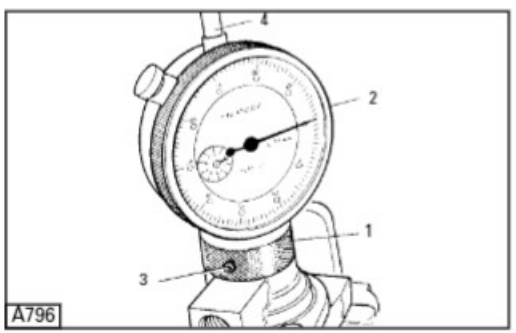
Do not yet fit the cam follower to the spindle.

4.7.1.1 Setting the boost stroke

a) Fit the diaphragm assembly to the boost control housing.

Fit a dummy cover (see tool list) to the housing and secure it with the two screws.

Note: At this stage, the position of the boost pressure inlet is not important.



b) Fitting the gauge

Fit the special tool (1) and dial gauge (2) to the cover, locking the gauge in position with the grub screw (3). Set the gauge to zero then fully depress the gauge pin (4) against the diaphragm spring and note the reading. This "boost stroke" will be specified in the test plan.

c) Adjusting the stroke

If adjustment is required, remove the cover and dial gauge and the inner components. Rotate the adjustment screw to increase or decrease the stroke.

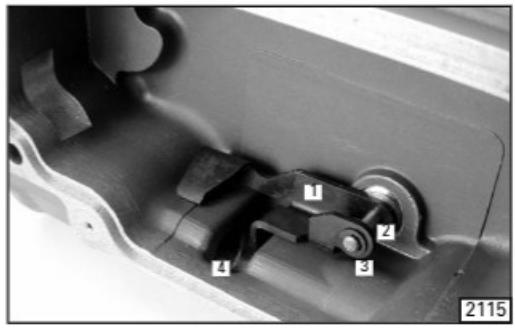
Note: Clockwise rotation of the stroke adjustment screw will increase stroke.

Replace the inner components, cover, gauge and tool to check the stroke.

When the stroke has been set, remove the gauge tool, temporary cover and diaphragm.

4.7.1.2 Fitting the cam follower

Place the washer (not shown) and the cam follower (1) over the spindle (2) with the "shaped" section of the follower facing into the "window" (4) in the torque control bore. Fit a new circlip (3) into the groove in the spindle.



4.7.1.3 Boost control cover and diaphragm

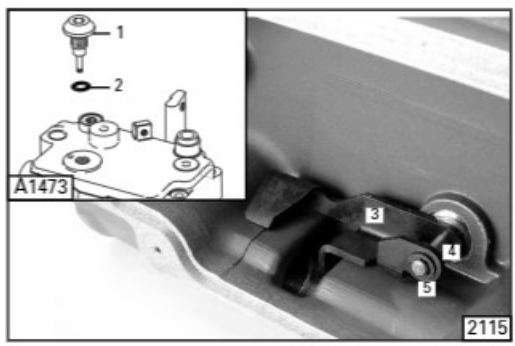
Invert the governor control cover again and place it on the bench. If specified, fit the shim to the "cup" in the lower face of the diaphragm assembly (1) and fit the assembly to the boost control housing.

Place the boost control cover (2) over the diaphragm with the air inlet connection (4) facing in the correct direction (as noted during dismantling) and secure it in position with the two screws (3), tightened to the specified torque.

4.7.2 Governor cover with torque control only

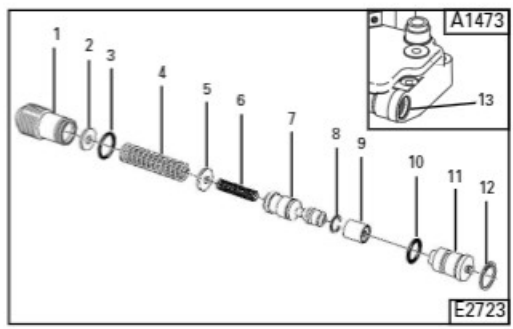
Fitting the pivot-plug.

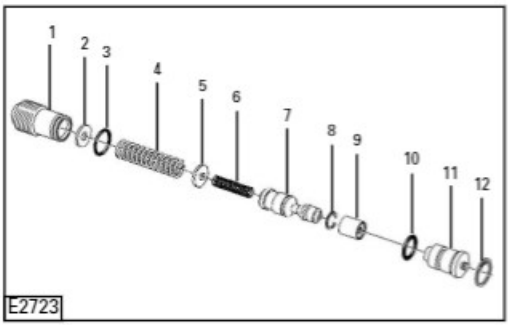
If the cam follower and pivot-plug were removed during dismantling, fit a new O-ring (2) to the pivot-plug (1). Fit the pivot-plug to the governor control cover and screw it in finger-tight. Fit washer (not shown) to the pivot plug spindle (4) then the cam follower (3) retained by a new circlip (5) as shown.



4.7.3 Assembling the torque trimmer

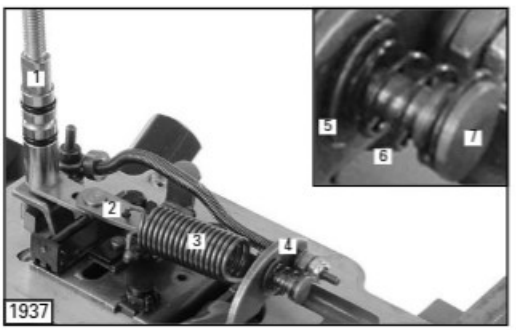
Fit circlip (8), if fitted, to the torque trimmer piston (9). Fit the torque trimmer piston and circlip, with the conical recess in the piston facing inwards (i.e. towards the "spring" end), into the plain bore in the governor control cover (13). Fit a new O-ring (10) to the plain plug (11). Fit the plain plug and O-ring into the governor control cover (13), pushing it far enough to reveal the circlip groove. Fit a new circlip (12) into the groove. From the opposite end of the torque trimmer bore, use a suitable bar to push the plug back against the circlip.





Fit the torque trimmer cam (7), with the small conical end facing the piston. Fit the small spring (6) (if specified) into the hollow end of the cam, followed by the spring plate (5) and the large spring (4).

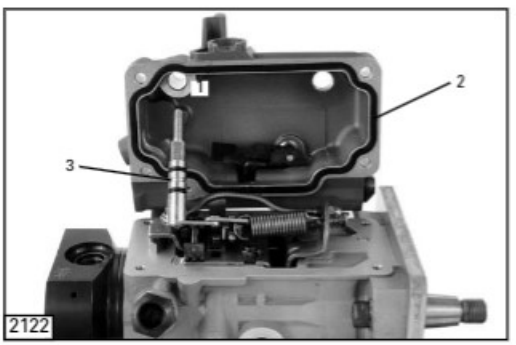
Fit a new O-ring (3) to the threaded pre-load plug (1). Fit the shim (2) in to the preload plug and fit the plug to the governor control cover and screw it in to the position specified in the relevant Test Plan. If no position is specified, leave the plug protruding from the cover by approximately 4 mm. The final position of the plug will be set during Testing.



4.7.4 Throttle shaft and governor main spring

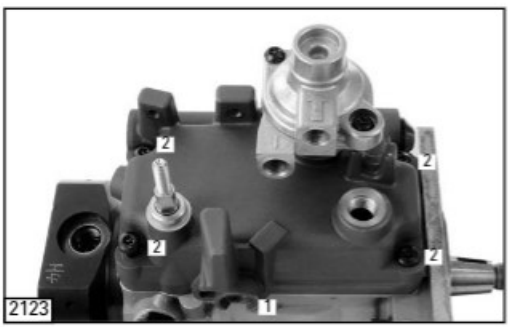
Fit two new O-rings onto the throttle shaft (1).

Fit the idling spring (6) and the pivot ball washer (5) (with its spherical face towards the governor arm) to the spring guide (7). Fit the guide through the large hole in the governor arm (4). Hook one end of the governor main spring (3) through the hole in the end of the guide and the other end through the hole in the throttle shaft link (2).



4.7.5 Fitting the governor cover

Fit the pre-shaped trapped O-ring (2) to the governor cover and a new O-ring in to the transfer port recess (not shown). Fill the throttle shaft grease groove (3) with the specified grease. Moisten the shaft with clean test oil and push it up through the hole (1) in the governor cover. Press the shaft firmly into place.



Place the cover assembly onto the pump, and use a small hook tool through the maximum fuel adjusting screw hole (1) in the cover to pull the carriage link plate away from the torque trimmer cam. Once the cover is lowered remove the hook tool and secure the governor cover with the four Torx screws (2), tightened to their specified torque.

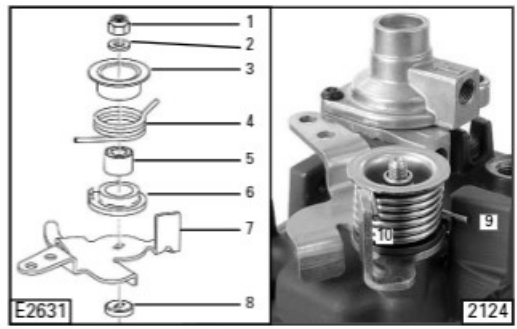
4.8 GOVERNOR COVER EXTERNAL COMPONENTS

4.8.1 Throttle levers

Rotate the throttle shaft fully anticlockwise

4.8.1.1 Rigid type

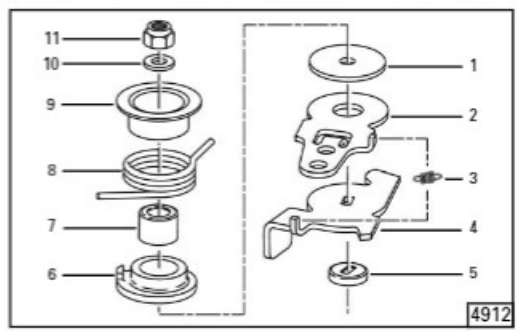
Fit the dust cap (8) to the throttle shaft boss. Fit the lever (7), (ensuring that the flats in the hole of the lever engage with the flats on the shaft), bush (5), spring guide (6), and spring (4). Fit the spring into the grooves in the spring guide and place the lower (shorter) leg of the spring against the maximum speed stop lug (9) and the upper (longer) leg against the lever "upstand" (10). Fit the upper spring retainer (3), small washer (2) and self-locking nut (1), tightened to its specified torque.



4.8.1.2. Break-back type

Fit the following components to the throttle shaft; dust cap (5), throttle lever (4), break-back lever (2). Fit spring (3) to the lugs of both levers and then locate the lever over the flats of the shaft. Then fit large washer (1), spring seat (6), spacer (7), spring (8) (engaging the legs of the spring with both levers). Spring retainer (9), washer (10), and self-locking throttle shaft nut (11). Tighten the nut to the specified torque.

Hold the throttle lever securely with one hand. With the other hand move the throttle lever against the spring; the throttle shaft should rotate. If it does not, check that the flats in the break-back lever are correctly located with those of the throttle shaft.



4.8.2 Throttle lever stop screws, maximum fuel screw and torque control screw

Note 1: The nuts of any stop screws which pass through the governor control cover must be fitted with new rubber seals.

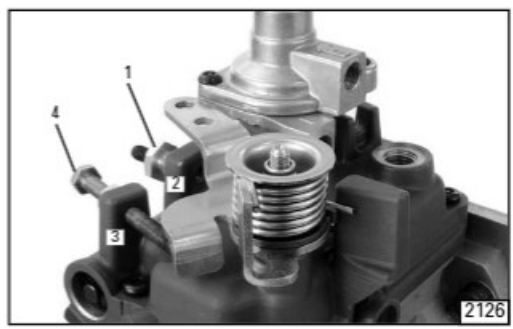
Note 2: The final positions of all stop screws will be established during testing.

4.8.2.1 Maximum speed screw

Fit the shearnut (1) to the screw, with the hex end of the nut facing the hex end of the screw and fit the screw through the pillar (2) so that the hex end is accessible. The Test Plan will specify the initial setting position for the screw.

4.8.2.2 Idling screw

Fit the lock-nut to the screw (4) and fit the screw through the lug (3). The Test Plan will specify the initial setting position for the screw.



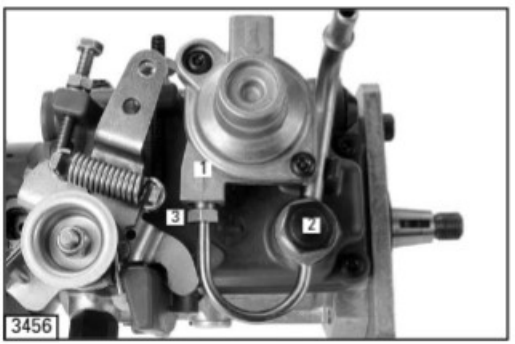
4.8.2.3 Torque screw

Fit the lock nut (1) with its circular end facing the governor control cover, together with a new flexible sealing washer (not shown) to the screw (2) and fit the screw to the cover. Rotate the screw four turns, unless the Test Plan specifies otherwise, and tighten the lock nut to the specified torque.

If no torque screw is specified, the housing will be drilled and tapped and a blanking plug and seal will replace the screw and lock nut.

4.8.2.4 Maximum fuel adjuster blanking plug

Fit a new O-ring to the plug (1); fit the plug to the cover and tighten to its specified torque.

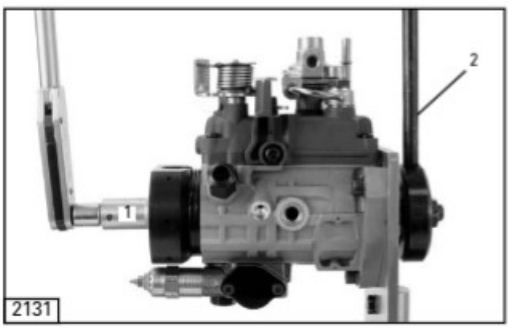


4.8.3 Fuel return connections

Note: Fuel return arrangements will vary, dependent upon the pump specification.

Locate the tube nut (3) in the boost housing (1) and fit the banjo bolt (2), using new washers, and tighten both parts to the specified torques.

If any backleak connection(s) are specified use new O-rings and tighten to their specified torque.



4.9 DRIVE HUB, TRANSFER PUMP AND ENDPLATE ASSEMBLY

4.9.1 Drive hub

Fit a new Woodruff key to the keyway in the drive shaft and fit a "slave" drive hub and nut finger tight. Fit the special tool (2).

4.9.2 Transfer pump rotor

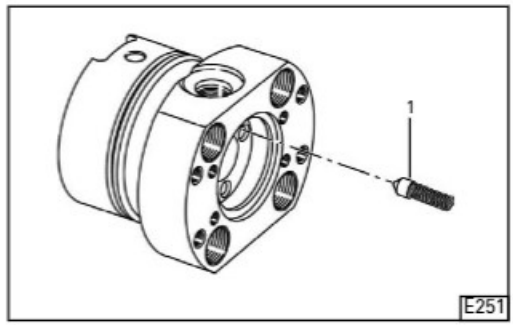
Fit the special tool (1) to the pump rotor and tighten the rotor against the normal direction of pump rotation, to the specified torque.

Remove the drive shaft nut and "slave" hub.

4.9.3 Internal recirculation (if fitted)

Align the pump vertically with the transfer pump uppermost.

Fit the retaining spring and poppet valve assembly (1) into the recess in the hydraulic head barrel valve first.

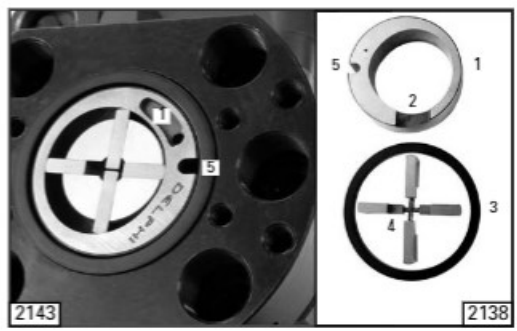


4.9.4 Assembling the transfer pump

Fit the transfer pump liner (1) into the head. The cut-out (2) in one end face of the liner must be positioned at the lowest point in the liner cavity i.e. approximately the 6 o'clock position.

The locating groove (5) in the liner must be positioned so that it will align with the spring dowel pin in the face of the end plate. The position of that pin is determined by the direction of rotation of the pump.

Lubricate a new transfer pump sealing ring (3) with clean test oil and fit it into its groove in the head. Fit the split steel transfer pump blades and springs (4).



4.9.5 Endplate assembly

4.9.5.1 Internal components

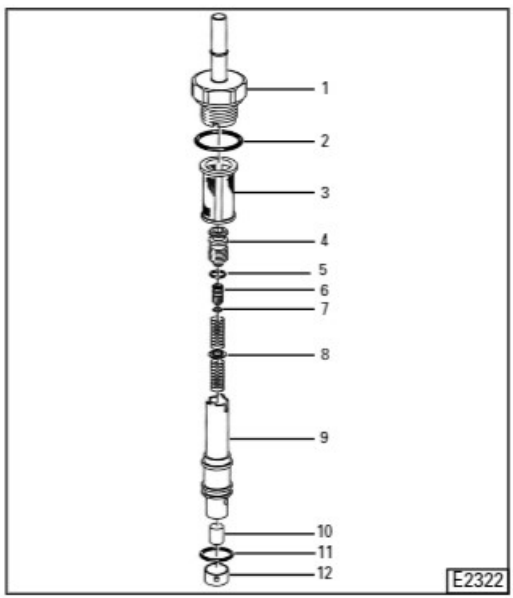
Fit new O-rings (7) and (5) to the regulating sleeve small adjuster (6) and large adjuster (4).

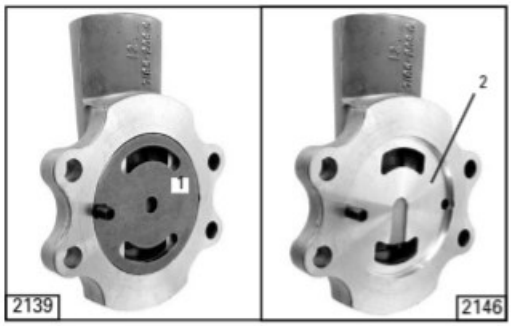
Place a small amount of grease (Alvania R2) on to the small adjuster O-ring and using a 2mm Allen key insert the small adjuster (from the bottom end) in to the large adjuster. Using a 4.5mm Allen key insert the assembly in to the regulating sleeve (9).

Insert the regulating springs with spring peg (8).

Insert the piston (10) and piston retainer (12) in to the regulating sleeve and then fit a new filter (3) to the outside of the sleeve.

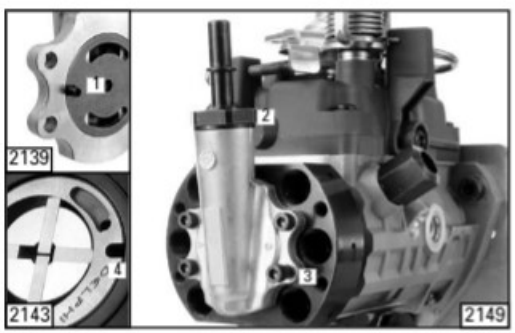
Insert the assembly in to the end plate. Fit a new O-ring (2) on to the fuel inlet adapter (1) and fit to the end plate assembly finger tight.





4.9.5.2 Sandwich plate

Fit the sandwich plate (1) into the recess in the endplate (2), with either face outwards if new, but with the same face towards the transfer rotor if the original plate is to be used again. The spring dowel pin will control the position of the groove in the edge of the plate.

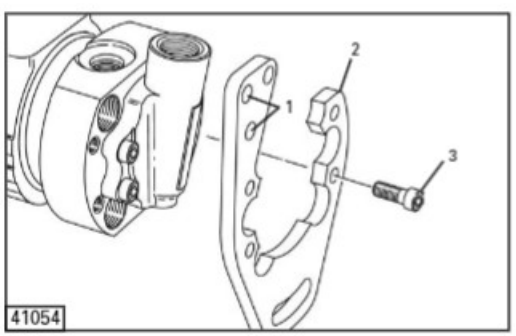


4.9.5.3 Endplate assembly

Fit the endplate in position, matching the spring pin (1) to the slot in the liner (4). Fasten the endplate with the four Allen screws (3) tightened progressively and diagonally to the specified torque.

Tighten the fuel inlet connection (2) to the specified torque.

Check that the drive shaft rotates freely.



4.9.5.4 Support bracket

If specified, fit the pump-to-engine support bracket (2) in the position noted during dismantling and tighten the screws (3) progressively and diagonally, to their specified torque.

If the position of the plate was not noted during dismantling, its orientation may be determined by reference to the position of the engine manufacturer's adaptor plate for anchorage of control cables (if fitted). The adaptor plate will be retained by fixings through the holes (1). The cable holes should align with the free end of the throttle lever.

4.10 ESOS AND HIGH PRESSURE OUTLETS

4.10.1 ESOS

Note: It is essential that the specified solenoid is fitted as there are versions available which operate in the reverse sense to all others, or require additional wiring and resistors. Refer to the Despatch Number and SIN DT294 for correct details.

Fit a new O-ring to the solenoid body (1). Screw the solenoid into the hydraulic head and leave it finger tight. The solenoid will be removed for fitment of a pressure gauge during testing.

If detachable electrical connections are specified for the solenoid fit the terminal blade to the solenoid, retained by the washer and nut.

4.10.2 High pressure outlets and clamp plate

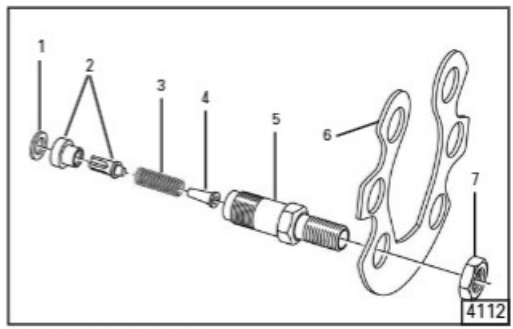
Into each high pressure outlet of the hydraulic head fit a new sealing washer (1), delivery valve and body (2). Fit the spring (3) on to the delivery valve and fit the spring peg (4) in to the spring. Carefully fit the holder (5) over the spring and peg and leave it finger-tight.

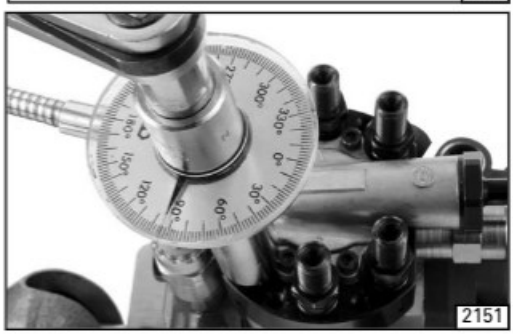
Note 1: The delivery valve holders must not be lubricated before fitment to the hydraulic head.

Note 2: Delivery valve holders which have been fitted to a pump and tightened to the correct torque must not be used again. They must be replaced.

When all of the delivery valve holders have been fitted, tighten them progressively to their initial specified torque then rotate each holder through the specified additional angle (see Section 6).

Fit the high pressure outlet clamp plate (6), followed by a nut (7) on each outlet; tighten the nuts progressively to their specified torque.





4.11 DRIVE SHAFT LOCK BOLT, DRAIN PLUG AND CAM ADVANCE READING SCREW

4.11.1 Drive shaft lock bolt

Fit a new O-ring to the shaft locking screw (1). Fit the lockshaft spacing washer to the screw and fit the screw to the pump housing. Position the washer (2) with its smaller end under the screw head so that the screw does not restrain the shaft. Lightly tighten the screw. It will be tightened to the correct torque after the shaft has been placed in the correct timing position.

4.11.2 Drain plug

Fit the drain plug (1) with a new seal.

Screw the drain plug into the pump housing and tighten it to the specified torque.

4.11.3 Cam advance reading screw

Fit a new O-ring to the plug (2) and screw into the pump body finger tight.

4.12 LEAK TESTING

All pumps must be pressure tested before and after machine testing.

Drain test oil from the pump. Connect a supply of clean, dry, variable pressure compressed air to the pump fuel inlet and return connections. Immerse the pump in a tank of clean test oil.

Raise the pressure to 1.4 bar (20 lbf/in^2). Leave the pump immersed for ten minutes and then look for leaks.

If leaks are detected remove and rectify. Some or the entire Test Plan may need to be repeated, depending upon the rectification necessary.

If no leaks are detected, reduce the pressure to 0.14 bar (2 lbf/in^2) for 30 seconds. If no leaks appear, return the pressure to 1.4 bar (20 lbf/in^2) and wait for 30 seconds. If there is still no air leak, the pump may be passed as leak-free. The setting devices must be sealed with wire and lead seals (embossed with an authorised stamp) or other methods as specified.

TEST PROCEDURE

The testing section of the manual is based on the Service Test Plan format, which consists of five basic sections.

'Pump Specification'

'Test Conditions'

'Pre-Test Notes'

'Test Procedure'

'Overcheck Procedure'

The following notes will examine each section in turn. Statements within a section will assist the operator to pre-set the pump during assembly, prepare the test bench and select the correct testing tools ready for testing.

Each range of pump numbers are all covered by one test plan. e.g. 9320A000G to 9320A009G.

It will also cover any variants of the ESOS, as designated by the last letter of the despatch number.

The Original Manufacture will also be quoted together with the engine type to which the pump has been homologated, but not the application.

All test plans are released at issue 1. As a specification evolves, a change in the settings may be necessary. If this happens, the changes are included in an up-issue of the test plan which can be successfully applied to any pump released prior to the up-date.

5.1 PUMP SPECIFICATION

This section is designed to give a basic description of the features and pump build dimensions specific to the pump despatch number.

They are grouped in a sequence relevant to the order encountered during build and test.

5.1.1 Rotation

Rotation refers to the pump drive shaft and always relates to the direction it turns when looking at the drive end of the pump.

Knowing the drive rotation enables the removal and re-fitting of the 'handed' components, e.g.

Transfer pressure pump.

Advance device.

Cam and scroll plates.

Type plate label.

Rotating the pump against its designed direction on a test bench will prevent fuel delivery and if continued, components will be damaged.

5.1.2 Gov. Link Length

This measurement sets the correct distance between the governor control arm and the metering valve. The precise points to measure between are shown in the workshop manual (section 4.6.4).

Failure to set the correct length will result in either the governor not being able to shut fuel off and therefore control the speed, or under full load acceleration the metering valve will not fully open.

5.1.3 Plunger diameter

States the quantity and diameter of the pumping plungers.

5.1.4 Drive type

The pump drive shaft is of the supported type and the drive from the engine is unsupported, e.g. an engine gear driven design. Therefore the test bench drive must also be unsupported.

Incorrect test bench drive selection will result in shear or seizure of the drive shaft or head and rotor.

5.1.5 Pump features

The pump may contain any of the following features;

Transfer pressure slope adjuster

Viscosity compensating device in end plate

Cambox pressure

Servo Advance with:

- Light load advance
- Cold advance
- Speed advance

Scroll plate max. fuel delivery adjustment

Torque trimmer cam

Torque screw

Boost Control

Latch valve

5.1.6 OEM Code:

e.g. 2644K901PH Setting Code: ...../1/2350

The OEM Customer part number or setting code reference.

5.2 TEST CONDITIONS

In order for the pump to be set or checked accurately there are a number of conditions that the test equipment has to meet.

These conditions are mostly related to ISO standards. However, a number of deviations from the standards are encountered, but are fully contained within agreed parameters laid down during development and final homoligation of the product.

Test conditions for Service are directly related to Production conditions.

Pump performance can be influenced by test machine design. To minimise performance variations, Delphi Aftermarket Operations recommend that the bench must adhere to ISO standards. The Hartridge test machines conform to the design requirement contained in the relevant International Standard on FIE testing (ISO 4008 Parts I and II).

These are:

HA3000, HA2500, HA700, AVM, AVM2 & PGM.

Hartridge test machines have the ability to test the whole foreseeable range of DP210 pumps. If a Hartridge test machine is not available, the use of a Hartridge Universal Calibrator HF580 is recommended, in conjunction with a test machine having a drive motor of at least 5 kW (7.5 hp) power output and conforming to ISO 4008 (Part 1 - Drive Systems Requirements).

The test bench must also adhere to certain drive requirements. The details of pump mounting will depend upon the type of test machine available; however, the machine must incorporate the following features:

a) An anti-backlash coupling of sufficient torsional stiffness for the particular pump under test.

b) A drive unit, suitable for distributor pumps, which can accommodate pumps with either supported or unsupported drive shafts.

5.2.1 Test fluid

The test plan requires the test fluid to be of an ISO specification (ISO 4113). The pump must be tested within the fuel temperature range of 40° ± 2° C. Once set, variation must be held to within ± 0.5° C.

Too high or too low fluid temperatures affect the volume of fuel being delivered by the pump due to the change in viscosity. Too high a temperature, the volume decreases, too low and the volume increases.

Fluctuations outside of the ± 0.5° C range will affect the settings of valves and orifices that are viscosity sensitive. In turn, the variations will affect the timing and light load settings upon which engine emissions are dependent.

5.2.2 Inlet feed pressure

A standard supply pressure is quoted for the pump during test.

The pressure is quoted in psi and a variation during test of ± 0.2 psi must be adhered to.

Pressure variations of more than ± 0.2 psi affect the timing, full load and light load fuel settings upon which engine emissions are dependent.

5.2.3 Nozzles

The range of nozzles available for testing pumps are;

Part No.	***Type No.***
YDB286	BDL0S6844
YDB287	BDL0S6889
YDB445	BDL110S6133/2

Some nozzles are to a recognised ISO standard, others to an agreed authenticated standard, and are available to test different models of pumps.

Failure to use the nozzles as stated on the test plan will affect the overall delivery capabilities and the final delivery volumes from the pump to the engine.

Nozzles should be serviced weekly or every 40 pumps when the opening pressure must be checked and reset.

If the seat leakage or backleakage is incorrect replace where appropriate.

After 400 pumps replace the nozzles.

5.2.4 Nozzle Opening Pressure

A nozzle opening pressure is stated with a tolerance.

Failure to adhere to the stated value on the test plan will affect the overall delivery capabilities and the final delivery volumes from the pump to the engine.

5.2.5 Nozzle Holder

The type of nozzle holder is specified as part number YDB289, which complies with ISO standard 7440. In addition an agreed authenticated size of inlet filter, part number YDB288, is included.

Failure to adhere to the stated parts on the test plan will affect the overall delivery capabilities and the final delivery volumes from the pump to the engine.

5.2.6 H. P. Pipes

Outside diameter, bore and length of injector pipes are quoted, some to a recognised ISO standard, others to an agreed authenticated standard.

The range of HP pipes used is:

6.0 mm x 1.8 mm x 450 mm

6.0 mm x 1.5 mm x 710 mm

6.0 mm x 1.6 mm x 365 mm

6.0 mm x 2.0 mm x 600 mm (ISO 4093.1)

6.0 mm x 2.0 mm x 845 mm (ISO 4093.2)

A number of service checks must be carried out on the condition of the pipes. Failure to do so will affect fuel delivery pressures and volumes.

The nipples at each end of the pipe must be in a condition to permit a leak free seal to be formed when tightened squarely into the seating cone by the pipe gland nut.

The bore of the pipe must not be allowed to close. This will occur more so at the ends of the pipe and if the radius of a bend is less than 50 mm.

5.3 PRE-TEST NOTES

5.3.1 Introduction

The following notes are standard instructions that must be applied to all pumps when being prepared for testing. They will not be stated on any test plan, as they will be recognised as the basic standard to adhere to. However, if there is an exception to any of these basic instructions a relevant note countermanding the instruction will be stated on the test plan.

5.3.2 Leak testing

All pumps must be leak-tested both before and after bench testing and any leaks must be rectified.

During the test procedure, there should be no fuel leaks from the pump.

5.3.3 Test Machine Drive

Caution: Before carrying out any activity on the test machine drive arrangement ensure that the electrical supply to the machine is switched off.

The details of pump mounting will depend upon the type of test machine available (see section: 5.2 Test Conditions).

The test plan includes information necessary for the correct mounting of the pump on to the test machine.

Fit a suitable test drive adaptor to the pump drive shaft. For a dynamically timed pump use the coupling in kit YDT261 or YDT 262. Ensure that the adaptor is fully tightened (see section 6.1 for details of drive adaptors).

Fit a suitable bore adaptor ring to the pump mounting plate, if required.

Ensure that the test machine drive rotation is compatible with the pump rotation.

Warning

Incorrect rotation will result in serious damage to the pump.

Ensure that no end loading is applied to the pump when it is fitted to the drive adaptor.

Rotate the drive by hand in the direction of normal rotation to check that the pump is free to rotate.

Before starting the machine, check the following:

the pump is firmly secured to the mounting.

the mounting is secured to the machine bed.

the drive adaptor is securely clamped.

5.3.4 Pre-Set Notes

These notes give instructions on initial settings and adjustments for the individual features built into a pump specification.

These notes will be listed in the order with which they will be encountered during the test setting procedure.

The instructions can be referred to during:

The build of a pump to determine the initial set position of a feature.

The pre-set position of a feature before testing commences.

Guidance as to how much adjustment is allowed to meet a particular test parameter.

5.3.4.1 Throttle lever: To be fully open unless otherwise stated.

5.3.4.2 Solenoids: To be energised unless otherwise stated.

5.3.4.3 Transfer Pressure:

Position of the transfer pressure adjusters before testing commences.

Transfer pressure adjuster tool to be retracted whilst test readings are being taken.

Transfer and cambox pressures can be taken at more than one speed.

When taking a transfer pressure reading where the test plan calls for the cambox pressure to be included, the test bench transfer pressure gauge must equal the sum of the transfer pressure and cambox pressure shown in the test plan.

E.g. If the test plan states:

Test (11) Transfer Press.(C) 1200 Press at test (8) + 72 to 84 psi. (where test (8) is the cambox pressure.)

If cambox pressure at test (8) was 12 psi then the transfer pressure gauge should read between 84 (72+12) to 96 psi. (84+12).

5.3.4.4 Advance:

The location from where the advance readings are to be taken.

The initial amount of advance shimming that must be present.

The amount of additional advance shimming permitted to meet test values.

5.3.4.5 Torque Trimmer:

The initial position of the torque trimmer cam adjusting screw.

The initial position of the torque screw.

5.3.4.6 Boost Control Unit:

The amount of boost control shimming permissible.

The boost stroke travel that must be obtained to meet test parameters.

5.3.4.7 Light Load and Latch Valve:

The initial position of light load and latch valve adjusters before setting.

5.4 TEST PROCEDURE

5.4.1 Introduction

This is the working part of the test plan and is in two parts, a 'Setting' section and an 'Overcheck' section.

The 'Setting' section is a series of sequential setting and checking instructions for new and repaired pumps. This will enable the pump to be set to values that will re-create the original homologated performance curves of the engine to which the pump is to be fitted.

The tests will enable the operator to determine:

- If the correct parts have been fitted.
- Determine the degree of wear that has occurred during its service life.
- Identify failed components.

All test plans follow the same setting procedure. Each feature or function is set, then checked for correct performance. Once set and confirmed as correctly built, the next feature or function is dealt with. Performed in the correct order, the inter-action of each feature or function is ensured.

The order of setting is:

- Warm-up and running pre-sets
- Transfer pressure
- Cambox pressure
- Advance
- Maximum fuel
- Governor

Interspersed with these settings are the settings for Light Load, the control valves, solenoids and lever positions.

Note: As most aspects of pump performance are inter-related, if a specified figure for a test cannot be achieved then the fault must be rectified before proceeding to the next test. (However, continuation of the test sequence may assist in identifying the cause, but the earlier tests must be repeated after the fault is corrected).

Errors in test results, which cannot be corrected by change of settings, should be rectified by change of component.

The following notes give a guide to the procedures to adopt.

5.4.2 Warm-up and stabilisation

Switch on the test oil supply, set the pressure to that specified in the Test Plan and energise the stop solenoid (if fitted).

Confirm that the test machine is set to rotate in the correct direction, switch on the drive and set the speed to that specified in the Test Plan for priming.

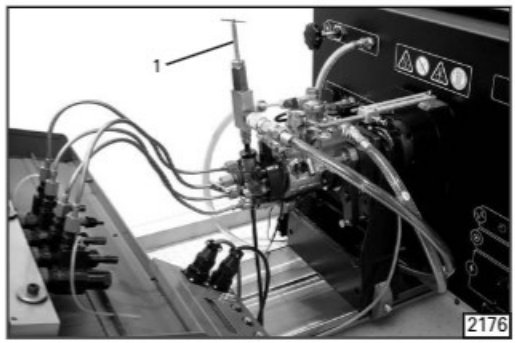
Run the pump at that speed until delivery is obtained from all injectors and the flow of fuel from the backleak connections is clear of air.

Backleakage is usually checked at about the mid-point in the working speed range. Excessive backleakage may be due to an internal leak e.g. worn advance device or damaged or missing seals.

Low backleakage could be attributed to poor fuel supply to the transfer pressure pump or restriction of fuel flow from the H & R into the pump cambox via advance assembly or restriction orifice.

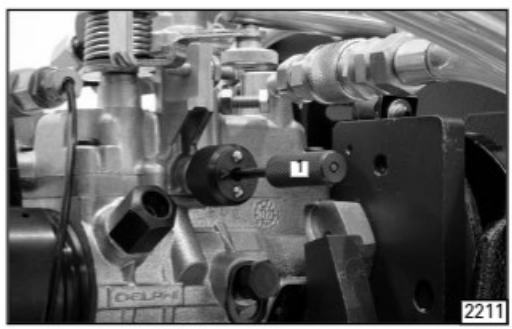
5.4.3 Initial settings

Use the 4.5mm hex adjusting tool (1) to set the upper transfer pressure as stated in the test plan. Ensure that the tool is fully retracted after each adjustment.



Fit the maximum fuel adjuster tool, part no. 6408-80A, and set the maximum fuel delivery by adjusting screw (1).

Run the pump at the specified speed and time quoted at the end of which the fuel temperature should be at the values quoted.



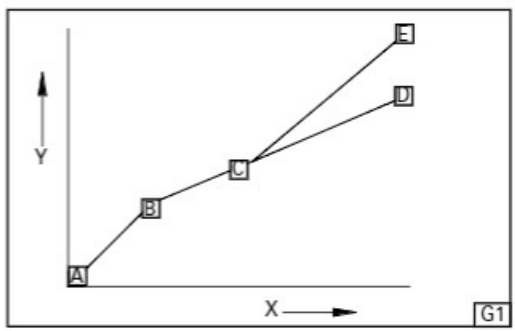
5.4.4 Transfer pressure

5.4.4.1 Operation

The natural transfer pressure curve of both springs operating together is depicted as line A,B,C,D.

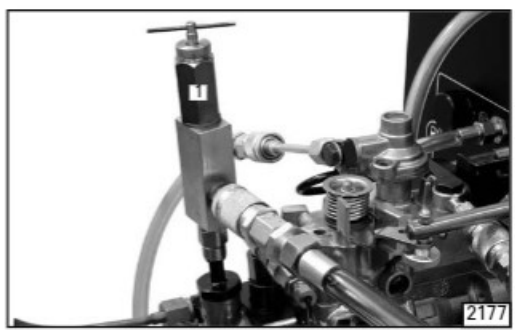
After setting the transfer pressure the curve will follow the line A,B,C,E. Where between (A) and (C) both springs are controlling transfer pressure and at a speed just after point C only the single regulating spring is in control to point (E).

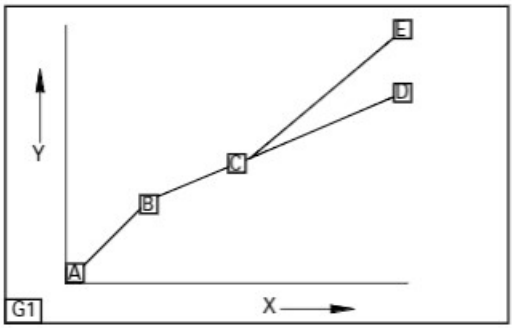
Note: *Y = Transfer pressure*
X = rpm



5.4.4.2 Setting

The method of setting is to initially retract the slope adjuster, using the TP adjusting tool (1) fitted with the 4.5mm 'T' bar, so that it is within the pre-load adjuster and has no influence on the fuel flow; and therefore the true pressure reading.





G1

At the rpm point (C) the pre-load adjuster is screwed in to reach a required pressure.

At the rpm point (D), the slope (inner) adjuster is screwed down into the pre-load (outer) adjuster to achieve a specific transfer pressure rise point (E), above point (D) using the 2.0mm 'T' bar.

Note: Do not rotate more than 4 turns.

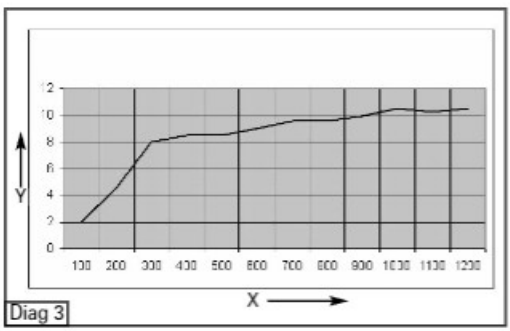
The lighter of the two springs (adjuster spring) is initially compressed until the bottom edge of the slope adjuster contacts the top of the spring connector. Further adjustment pre-loads the regulator spring and controls the rise of transfer pressure (C, E).

The rpm point (C) is re-checked for any change in value brought about by setting point (E). If so, the outer adjuster has been moved in error and the procedure must be repeated from the start.

Note1: Failure to retract the adjuster after each adjustment will influence the pressure gauge reading and also, if left in place too long, a rapid rise in pressure will occur and result in possible damage to the pressure gauge itself.

Note 2: *Y = Transfer pressure*

X = rpm



Diag 3

5.4.5 Cambox pressure

This feature is not adjustable but must be confirmed as being within specified limits at the checkpoints indicated.

If the cambox pressure is significantly above the specified level, it may indicate either an excessive backleak rate or severe restriction at the cambox pressurising valve.

If cambox pressure is too low the cambox pressurising valve, a seal within the pump, or the transfer pump may be faulty.

The Test Plan may specify that pressure be checked at low speed or high speed.

Note: Diag 3 shows a typical cambox pressure curve.

Y = psi

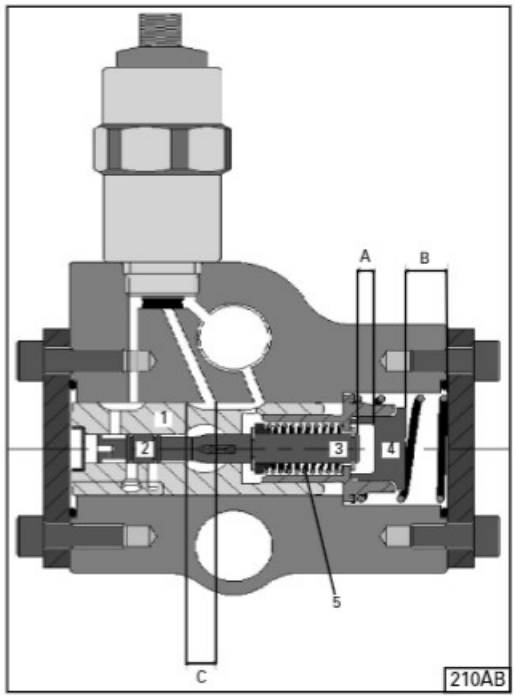
X = rpm

5.4.6 Speed advance

5.4.6.1 Operation

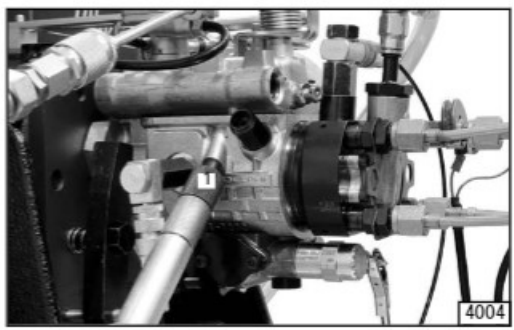
Full load speed advance is dependent on the transfer pressure being fed through to the pressure end of the advance piston (1) via the servo valve (2). Fuel under transfer pressure is fed to a slot in the side of the Advance piston and into the centre where the servo valve controls the flow under an intermediate or reaction pressure to act on the pressure end face of the Advance piston. The Advance piston moves in an advance direction as the pressure acting on its end increases with speed until the servo piston rod (3) contacts the inner face of the Light Load screw (4) at which point total advance travel will be obtained. The rate of movement is controlled by the speed advance spring (5) and the point of lift by the shimming.

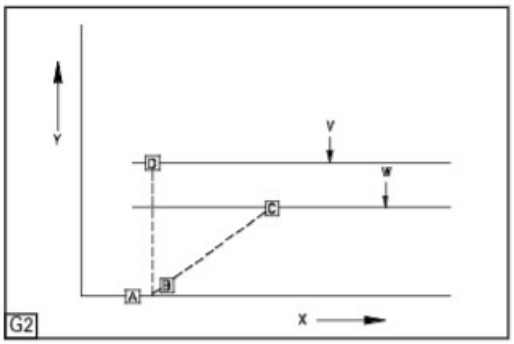
Note: *A = Speed advance*
B = Light load advance
C = Cold advance



5.4.6.2 Setting

Remove the plug in the side of the pump housing and insert the probe of the electronic advance sensor (1) through the hole so that it makes contact with the notch in the rim of the cam ring.



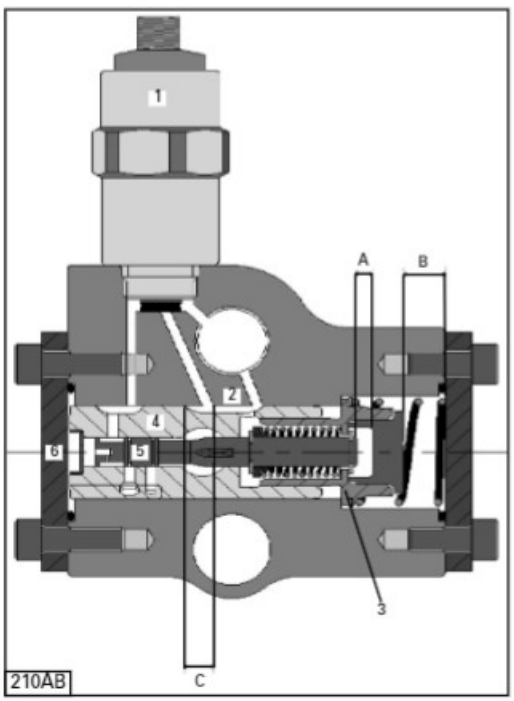


Set the test bench advance gauge reading to suit values stated in the test plan (see manufacturer's test bench instructions) and at the specified speed stated datum the gauge to read zero, point (A).

Points (B) and (C) are then checked to determine that the advance piston has traveled its total distance point (C) and at a pre-determined point in this travel, which relates to speed, the advance position is at point (B).

If point (B) can not be obtained, but point (C) can, then the speed advance spring is either of the incorrect rate, requires shimming or there is a problem with the transfer pressure. If point (C) cannot be obtained, even at a higher speed than that specified in the test plan or exceeds the value stated, then there is a mechanical fault in the advance assembly that controls the total limit of advance travel. Incorrect parts fitted or assembled are the most probable cause.

Note: *Y = degrees of advance*
X = rpm
V = total cold advance
W = total speed advance
(throttle lever open)



5.4.7 Cold advance

5.4.7.1 Operation

Cold advance is dependent on the operation of the solenoid (1). If the solenoid is energised, the plunger lifts and transfer pressure flows to the slot (2) in the side of the advance piston and into the centre of the Light Load piston (3), moving it in an advance direction. The movement of the Light Load piston carries with it the servo valve (5) which allows transfer / reaction pressure to act on the pressure end of the Advance piston (4) and lift it off of the cover plate (6) and into an advanced state. This action will continue until the slot in the side of the advance piston becomes throttled. A balance is then maintained and no further transfer pressure can be fed to it from the solenoid.

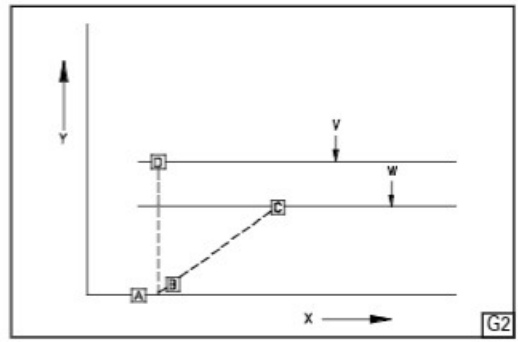
Note: *A = Speed advance*
B = Light load advance
C = Cold advance

5.4.7.2 Setting

At the appropriate point stated in the test plan the cold advance solenoid is energised. Using the same electronic sensor and test bench gauge that monitors speed advance off the can ring, the total movement of the advance piston is measured at point (D).

If point (D) is not obtainable and there is little or no advance movement then dirt, stickiness or the solenoid must be suspected. If the value at point (A) is greater or less than that stated, then incorrect components have been fitted.

Note: *Y = degrees of advance*
X = rpm
V = total cold advance
W = total speed advance (throttle lever open)

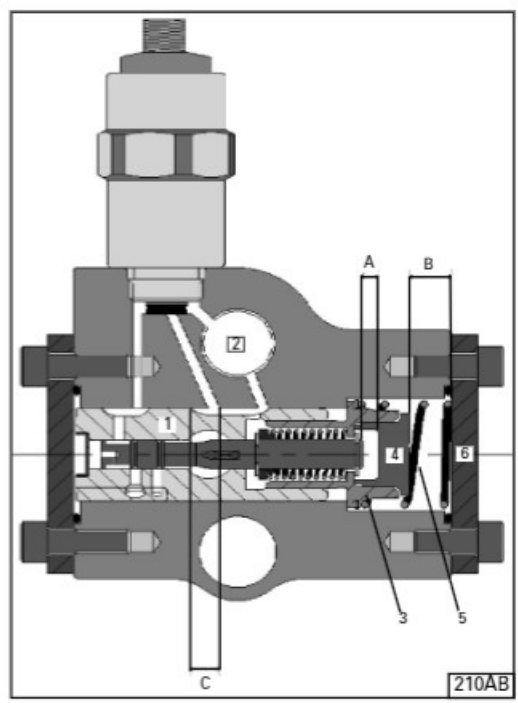


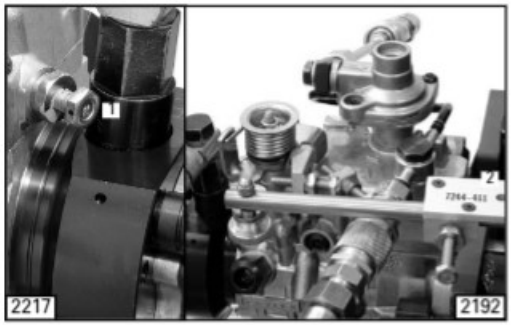
5.4.8 Light-load advance

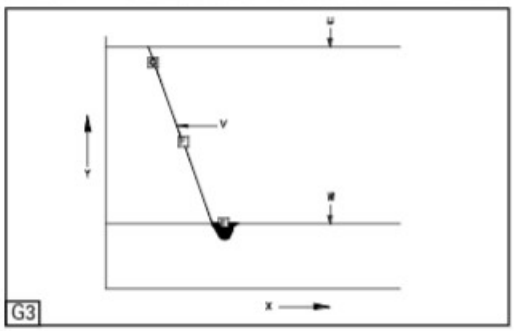
5.4.8.1 Operation

Light load advance is controlled by the position of the metering valve and light load valve. As the metering valve is rotated to reduce fuel, an increase in signal pressure is fed to the light load piston (3). The signal pressure is further controlled by the light load valve which 'bleeds off' some of the flow, thus pressure, to the cambox. The resultant 'finely' controlled signal pressure flows from the Head Locating Fitting (2) into the centre of the Advance piston (1) and acts on the Light Load piston. An increase in signal pressure moves the Light Load piston into an advance position under the control of the Light Load spring (5) until the Light Load screw (4) contacts the end cover (6).

Note: *A = Speed advance*
B = Light load advance
C = Cold advance







5.4.8.2 Setting

The same electronic sensor and test bench gauge that monitors speed and cold advance off the cam ring is used to set and check light load travel. If a torque screw is not fitted as standard, remove the plug and temporarily fit a torque screw, lock nut and seal (1). At the test plan stated speed hold the throttle lever open using tool 7244-411 (2) and adjust the torque screw (1) to a set given advance piston travel which results in a light load fuel delivery, point (F). Point (G) checks the setting, which can be 'finely' set by adjusting transfer pressure.

To ensure the advance position does not become retarded as the throttle lever and fuel delivery return to full load, a further check at point (E) ensures there is no danger of an 'engine' misfire. If LLA at (F) is low, remove a shim, if high, add a shim.

Note: *Y = advance and delivery*
X = rpm
U = maximum LLA (throttle closed)
V = LLA transition
W = no LLA (throttle open)

Providing the correct advance, transfer pressure and metering valve components have been fitted, failure to obtain the values required can be attributed to the control mechanisms that determine light load advance.

Having previously confirmed that transfer pressure is correct then the light load spring or its shimming must be suspect. The setting of the light load valve with resultant flow of 'bled' fuel into the cambox and the seating of the HLF and its plug against the head and rotor must also be suspect.

5.4.9 Maximum fuel

Maximum fuel delivery is controlled by the scroll plates, which limit the outward travel of pumping plungers.

The position of the scroll plates is set by adjusting the position of the carriage link plate, which is in turn dependent on the position of the torque trimmer cam operated by transfer pressure.

Some applications have the addition of a boost capsule.

The diaphragm operated boost capsule, senses engine boost pressure and changes the position of the carriage link and scroll plates at the same time, but independently to that set by the torque trimmer cam.

5.4.10 Torque trimmer

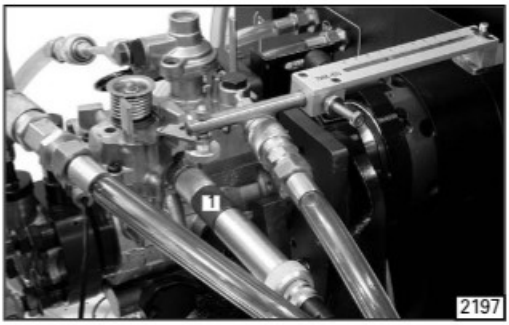
5.4.10.1 Operation

It is necessary to adjust the position of the scroll plates to achieve a specified delivery for a given torque trimmer cam travel.

This is achieved by firstly setting the position and travel of the carriage link plate relative to the torque trimmer cam.

Transfer pressure acts directly on the torque trimmer piston, which bears on the cam. Being directly related to pump speed it will position the carriage link plate for that speed.

An electronic sensor tool (1), introduced through the access hole in the governor cover, contacts the carriage link plate and registers that position.

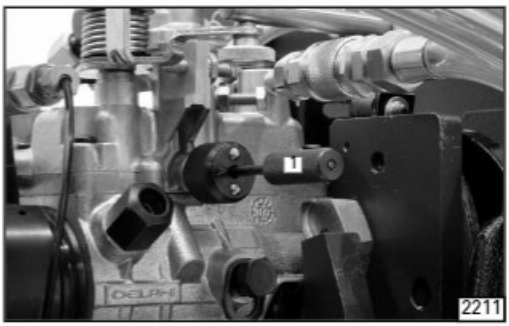


An initial reading is used as a datum point and a second position reading taken at a different speed when the torque trimmer cam should have travelled a set distance.

This is known as 'Carriage Position Sensing' (CPS).

Once the travel is confirmed as correct, but before the scroll plates are adjusted relative to this position to give a specified fuel delivery the latch valve and, if fitted, the boost control, is set using the CPS.

Once the latch valve and the optional boost control has been set the electronic sensor is removed and the maximum fuel adjusting tool (1) is fitted in its place.



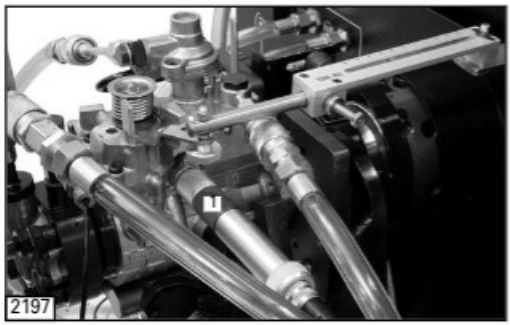
The tool adjusts the scroll plate position in relation to the carriage link plate which enables torque trimmer cam and maximum fuel delivery relationship to be accurately set.

5.4.10.2 Setting

Note: If the pump to be tested has both features of torque trimmer and boost, the boost capsule must be supplied with a compressed air pressure only when stated on the test plan and then only to the value stated. Failure to do so may cause bending and damage to the cam follower.

To set and check the position and travel of the carriage link plate, the advance probe sensor, (AE3/1) has to be converted using kit YDT264.

Note: It will not be a requirement of the test procedure to measure the pump advance travel at the same time as the carriage position travel. Therefore the same sensor tool can be used for setting both features.

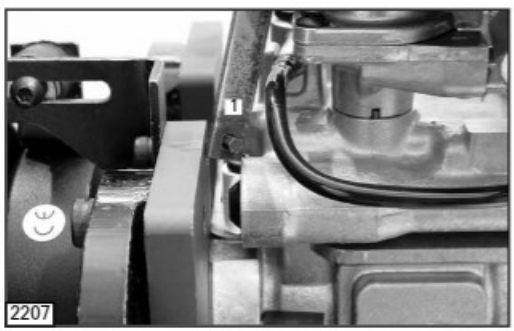


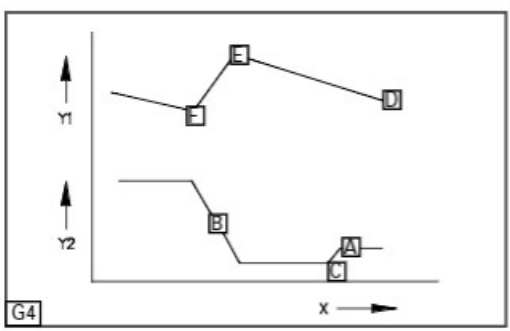
The CPS kit contains a probe pin with a magnetic tip to maintain contact with the maximum fuel adjusting screw, an adaptor to enable the sensor to be screwed into the governor cover and a return spring. (The standard spring used in AE3/1 for measuring advance movement is of a too strong a rate and, if used, will affect the sensitivity of the torque trimmer cam and result in incorrect settings).

The sensor (1), once converted, is fitted carefully through the hole in the governor cover that is used for maximum fuel adjustment.

Note: If fitted carelessly, the probe can be located alongside the maximum fuel adjustment screw. In this position it will not be possible to set the CPS and the probe pin may become bent.

Refer to the Pre-Test notes to confirm that the initial setting of the torque trimmer cam is correct. Adjust if necessary using the special tool (1).





Select the test bench 'advance mm' option and at the speed specified in the test plan zero the CPS sensor, point (A).

Reduce the pump speed to that specified in the test plan and adjust the torque trimmer cam adjuster until the CPS reading is obtained, point (B). Further checks are made to confirm the accuracy of the settings, points (A),(B),(C).

Note: All CPS settings are carried out under decreasing test bench speed conditions. The hysterisis of the system will give inaccurate results if the bench speed is allowed to go below the adjusting speed and then brought back 'up' to the speed.

Note: *Y1 = delivery (mm3/st)*
Y2 = CPS travel (mm)
X = rpm

5.4.11 Boost control

5.4.11.1 Operation

A boost control device can, in addition to the torque trimmer cam, also control the maximum fuel delivery.

The setting of these combined features is carried out in two stages. The torque trimmer cam position is carried out first followed by the boost control.

The boost control device senses the engine turbo boost pressure through the medium of a diaphragm. Diaphragm movement is transmitted through a linkage pin and moves the carriage link plate independently to any changes brought about by torque trimmer cam movement.

5.4.11.2 Setting

Connect the boost capsule inlet (1) to a source of dry, clean compressed air.

Note: The stroke of the boost control diaphragm should have already been set (see section 4.7.1.1).

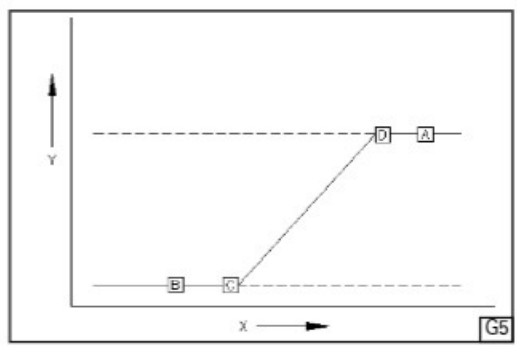
At the specified test plan speed the CPS reading (A) under the full boost pressure is set to zero.

A second CPS reading is taken at the same or different speed (B), but at zero boost pressure. The two readings confirm that the boost stroke is correct.

Further readings taken at other points, speeds and pressures (C) & (D) will confirm that the boost control spring is of the correct rate.

Note: *Y = boost*

X = rpm



Failure to obtain the values at point (C) indicates that the travel of the boost stroke is incorrect. The procedure for setting the stroke must be re-checked (see section 4.7.1.1).

Failure to obtain the values at point (B) indicates that the boost control spring rate or shimming is incorrect.

Note: If the torque trimmer and maximum fuel settings have been inaccurately set, then the boost settings will also be incorrect.

5.4.12 Latch valve

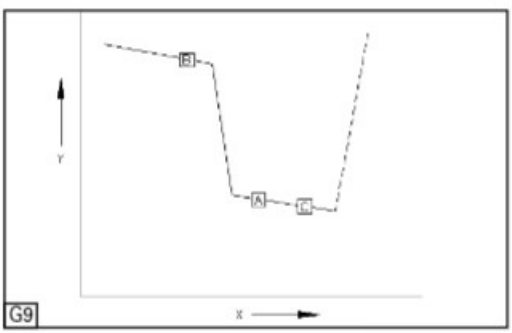
5.4.12.1 Operation

Transfer pressure operates the latch valve and is used primarily to cut excess fuel by movement of the torque trimmer. The latch valve is also used to control advance. This results in there being no speed, light load or cold advance before the valve opens.

5.4.12.2 Setting

At the test plan stated speed, adjust the latch valve (1) at point (A) to obtain the CPS reading specified. Further speed checks at points (B) & (C) will confirm the correct operation of the valve.

Remove the Sensor from the pump and convert it back ready to measure advance.

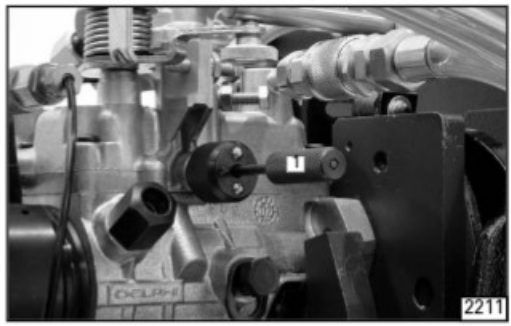


Note: *Y = CPS*
X = rpm

Providing transfer and cambox pressures are being controlled accurately, failure to obtain the settings could be attributed to either a weak or incorrect control spring or debris restricting fuel flow or causing 'stickiness' of the valve operation.

5.4.13 Maximum fuel adjustment

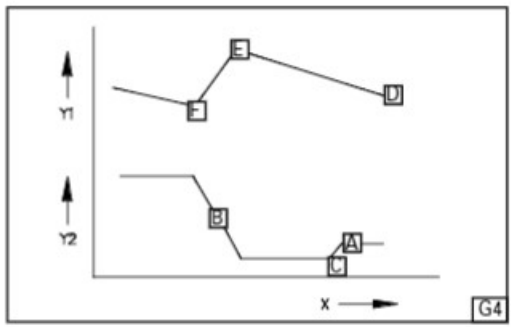
Fit the maximum fuel adjuster tool (1).



Adjust the fuel delivery at the speed and delivery quoted in the test plan, point (D).

The fuel delivery once set at point (D), is checked at points, (E) and (F), which confirm torque trimmer fuel control is correct.

Note: *Y1 = delivery (mm3/st)*
Y2 = CPS travel (mm)
X = rpm



Failure to obtain the CPS readings can be attributed to:

- Incorrect fitting or sticking of the tool.
- Incorrect transfer pressure that fails to position the torque trimmer cam relevant to the speed required.
- The cam follower is contacting the trimmer cam on the wrong side.

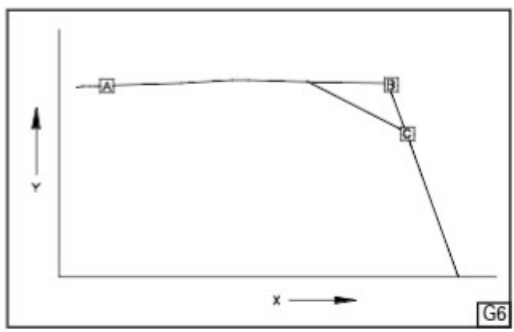
If the CPS readings are correct, but the fuel delivery is outside the limits specified, then a problem is indicated with the components that set and control the outward movement of the pumping plungers. That is; the carriage link assembly, scroll plates, cam ring and Head and Rotor assembly.

5.4.14 Torque screw

5.4.14.1 Operation

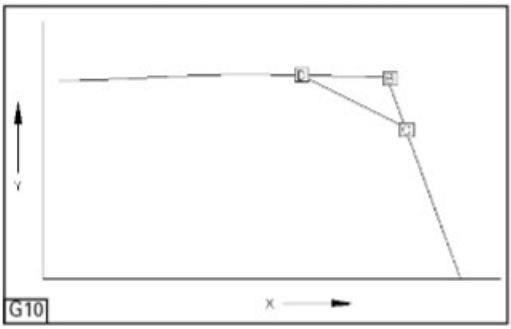
The natural fuel delivery curve (A), (B) can be influenced by the position of the metering valve so that at high speed, a pressure time fill situation occurs. When, on decreasing engine speed, the metering valve position is adjusted, the full load delivery curve is altered, (C), (A).

Note: *Y = delivery*
X = rpm



5.4.14.2 Setting

The torque screw (1) inserted through the side of the governor cover contacts the side of the metering valve. If the screw point (C) is turned in, the metering valve is rotated within its bore and reduces the degree that the slot in the metering valve stem registers with the metering port.

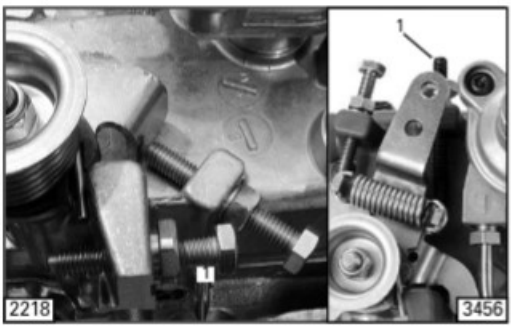


The reduction in metering port area will restrict the flow of fuel that can pass through it for a set period of time, point (C).

As pump / engine speed reduces, (C) to (D), more time is available for the fuel to pass through the metering port with the result that the fuel to the distributor rotor increases. This increase continues with the reduction in speed until the fuel delivery reaches the natural delivery curve at point (D).

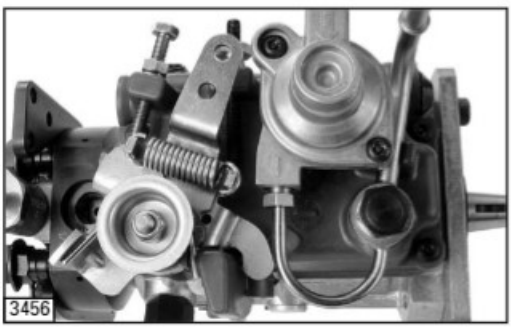
Note: *Y = delivery*

X = rpm



The maximum speed screw (1) must be screwed out. If the governor is allowed to influence the setting of the torque screw at point (C), it will be impossible to obtain the delivery required at point (D).

Some applications may also be phasing sensitive and an incorrect advance position can also affect fuel delivery and the degree of torque back-up.



5.4.15 Governor

5.4.15.1 Operation

Rotating the metering valve to a non-fuel delivery position limits the maximum speed of an engine. The metering valve change of position from fully open to fully closed occurs over a set pump/engine speed range. This is known as 'droop' or 'run-out'.

It is achieved by controlling the outward movement of the governor flyweights under centrifugal force, by the opposing load exerted by the governor control spring.

5.4.15.2 Setting

With the throttle lever held in the open position, using tool (1), the governor control spring holds the flyweights closed and a fuel delivery reading is taken (A).

The pump speed is increased to a pre-determined value and by adjusting the throttle lever stop screw (2) the governor spring load is reduced. This reduction allows the flyweights to start moving outwards under centrifugal force. The metering valve closes and reduces fuel delivery (B).

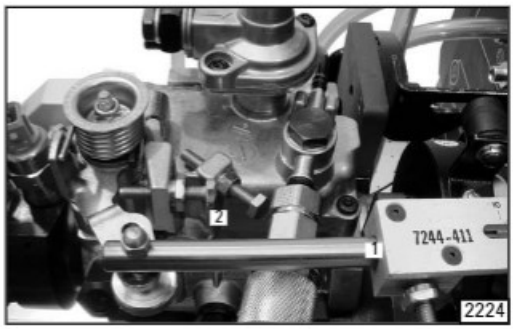
Pump speed is further increased and the fuel delivery should be reduced to the value indicated on the test plan (C).

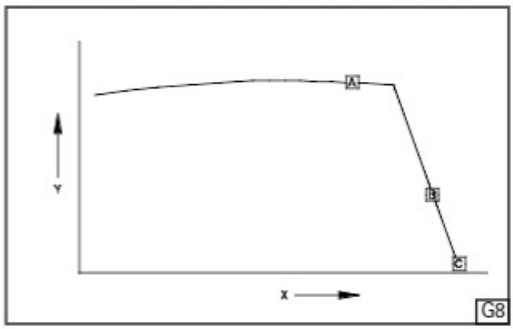
Pump speed is then again re-set to a value that will return delivery to a full load condition.

Note: *Y = delivery*

X = rpm

Failure to meet the points shown on the diagram could be attributed to a 'stiffness' in the governor mechanism, incorrect link length setting, or a wrong or weak governor spring. If the pump has seen an excessive service life then a build up of wear on all the mechanical parts, from drive shaft through to metering valve and throttle lever, is to be suspected.





5.4.16 Light load valve

5.4.16.1 Operation

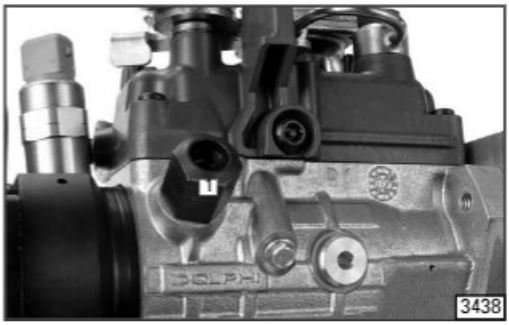
The Light Load Valve (1), in conjunction with the metering valve, controls the signal pressure to the light load piston in the advance device. This enables the position of the advance piston to be set for a compatible position for the amount of fuel required for light load.

5.4.16.2 Setting

The test plan will specify a speed at which to adjust the opening of the valve to give a pre-determined fuel value for a given throttle opening.

If there is difficulty in obtaining the light load fuel deliveries to correspond to the light load advance readings, then the accuracy of the operation of the light load valve must be considered.

Providing metering valve and advance operation is correct, failure to obtain the settings could be attributed to either a weak or incorrect control spring or debris restricting fuel flow.

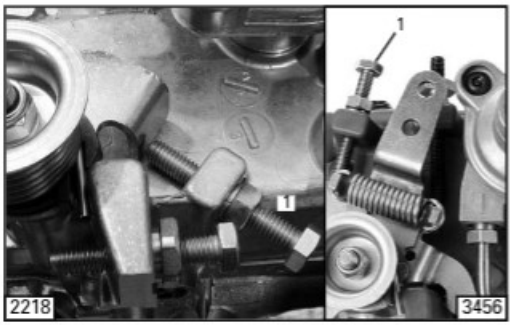


5.4.17 Idle setting

5.4.17.1 Operation

As well as controlling the engine at its highest speed, the governor must also control it at its lowest speed, idle. Without adequate control, engine stall or surge will occur. At high speed when the throttle lever is released, the governor flyweights open, as the governor control spring no longer exerts a load keeping the weights closed. In this position the metering valve rotates to a closed position and the engine speed falls due to lack of fuel.

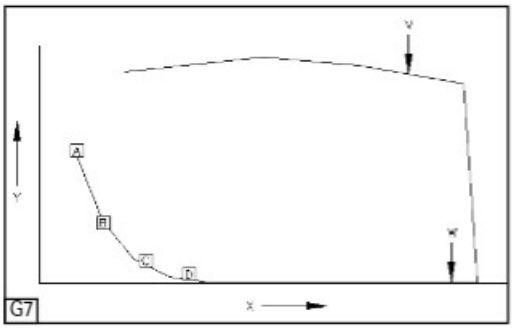
As the engine speed approaches the idling range, the load exerted by the light idle spring hooked around the main governor control spring peg slowly closes the flyweights. A fine balance then occurs between this spring and the centrifugal force produced by the flyweights.



5.4.17.2 Setting

The idle fuel delivery must be set to a nominal setting to ensure sufficient fuel is delivered, with the throttle closed, to sustain idling when the pump is first fitted to an engine.

With the test machine running at the specified speed, adjust the idle screw (1) to achieve the delivery (B) as quoted in the test plan. The test machine speed is then checked at a higher speed to ensure that the delivery reduces by the required amount (C). This will confirm that the governor mechanism is capable of controlling the engine speed at idle and prevent stalling (A),(B),(C),(D).



Note: *Y = delivery*
X = rpm
V = maximum fuel (throttle open)
W = zero delivery (throttle closed)

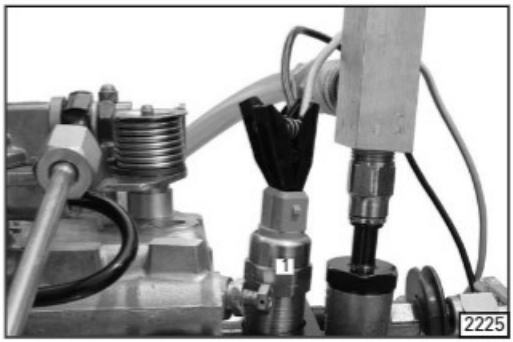
If the readings cannot be achieved, re-check the link length before dismantling the governor mechanism to investigate incorrect build, stiffness or wear problems.

5.4.18 ESOS

Checking of the ESOS, (1) is carried out at a set speed with the solenoid de-energised and the fuel delivery measured. A delivery in excess to that specified indicates a faulty seat.

If there is no change in the delivery quantity, a complete operating failure or in the case of an energised to stop ESOS an open electrical circuit of the ESOS must be suspected. The ESOS is non-repairable and a complete new unit must be fitted in its place.

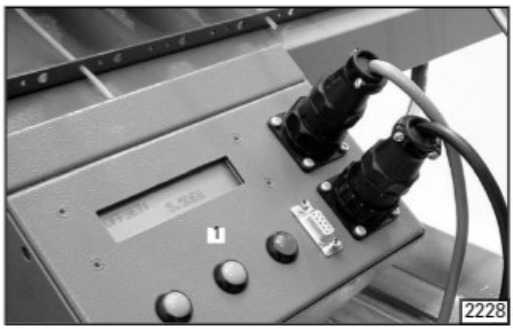
After checking, the test bench must be stopped to allow any pressure above the solenoid plunger to disperse. Failure to do so, will prevent the plunger rising when re-energised to permit delivery to commence.



5.4.19 Timing

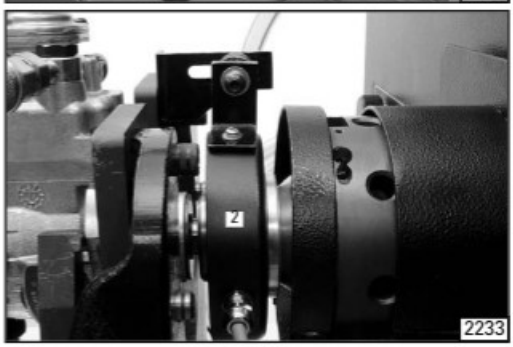
5.4.19.1 Operation

Timing is set dynamically. To do this, an electronic pulse generated at a precise point in drive shaft rotation is compared to a pulse generated by the pumping action of the plungers delivering fuel.



5.4.19.2 Setting

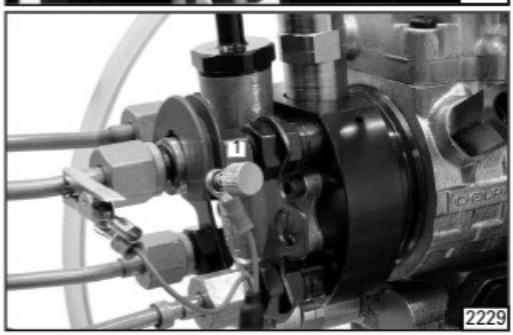
The Dynamic Timing kit (1), part nos. YDT261 or YDT262 (depending on the type of test bench) contains a special encoder coupling (2) keyed to the pump drive shaft.



A piezo transducer (1) which is fitted into the HP outlet (as specified on the test plan).

All parts must be connected according to the fitting instruction contained within the kit.

The setting of the timing is then a process controlled by the timing kit along with the instructions contained within the test plan.



5.5 OVERCHECK PROCEDURE

5.5.1 Introduction

This facility enables the operator to quickly assess the ability of a pump to control an engine within the performance parameters it has been designed for and agreed with, the Original Equipment Manufacturer (OEM).

The pump control curves are compared at set points with pre-determined engine performance curves that are known to produce the required engine performance.

It is an ideal 'tool' to confirm if the pump is the cause of engine malfunction or poor performance and the section is designed to 'stand alone' from the setting plan.

It is also part of the warranty return procedure and any guarantees pertaining to the product are based on the results of the Overcheck plan.

Note: Pumps that are timed dynamically should be received with the drive shaft locked in the timed position. This permits comprehensive diagnostics and validation if subject to Warranty.

Providing all the values specified are achieved, the pump will be able to maintain the original homologated engine performance for which it is designed. Failure to attain any one of the values will indicate that there is a pump setting or function failure that will require further investigation. The setting plan can be used for this purpose.

This section is not designed as a fault diagnostic tool, but as confirmation that the pump is, or is not the cause of an engine fault or performance problem.

The following notes are standard instructions that must be applied to all pumps when being prepared for testing. They will not be stated on any test plan as they will be recognised as the basic standard to adhere to. It is important that the pump is fitted to the test bench without disturbing any of the settings.

However, on some applications settings may have to be disturbed. In these cases, instructions during the checking procedure will indicate when to do so. This will be after the setting to be disturbed has been checked and recorded.

5.5.2 Pump preperation

The pump must be drained and the fuel retained in case of contamination.

The pump should then be leak tested.

During the test procedure, there should be no fuel leaks from the pump.

5.5.3 Test machine drive

Caution: Before carrying out any activity on the test machine drive arrangement ensure that the electrical supply to the machine is switched off.

The details of pump mounting will depend upon the type of test machine available (see section: 5.2 Test Conditions).

The test plan includes information necessary for the correct mounting of the pump on to the test machine.

Fit a suitable test drive adapter for the pump drive shaft, for dynamically timed pumps use the coupling in kit YDT261 or YDT262 Ensure that the adaptor is fully tightened (see section 6.1 for details of drive adaptors).

Ensure that the test machine drive rotation is compatible with the pump rotation.

Warning

Incorrect rotation will result in serious damage to the pump.

Ensure that no end loading is applied to the pump when it is fitted to the drive adaptor.

Rotate the drive by hand in the direction of normal rotation to check that the pump is free to rotate.

Before starting the machine, check the following:

the pump is firmly secured to the mounting

the mounting is secured to the machine bed

the drive adaptor is securely clamped

5.5.4 Overcheck pre-set notes

5.5.4.1 Throttle lever

To be fully open unless otherwise stated.

5.5.4.2 Solenoids

To be energised unless otherwise stated.

5.5.4.3 Transfer Pressure

When taking a transfer pressure reading where the test plan calls for the cambox pressure to be included, the test bench transfer pressure gauge must equal the sum of the transfer pressure and cambox pressure shown in the test plan.

E.g. If the test plan states:

Test (11) Transfer Press. (C) 1200 Press. at test (8) + 72 to 84 psi (where test (8) is the cambox pressure).

If cambox pressure at test (8) was 12 psi then the transfer pressure gauge should read between 84 (72+12) to 96 psi (84+12).

5.5.4.4 Advance

The location from where the advance readings are to be taken.

5.5.5 Overcheck test procedure

Pump preparation, operation and validation of results are fully described in the appropriate SIN's (refer to Direct2Web CD-ROM for a full list of notes.

Note: The drive shaft for those pumps that are dynamically timed must be received and kept locked in the timed position. This will enable the accuracy of the pump to engine bolt-up position to be clarified. Unlocking the drive shaft out of the test plan sequence will result in loosing any "as received" data and make it impossible to determine the root cause of a bolt-up misalignment.

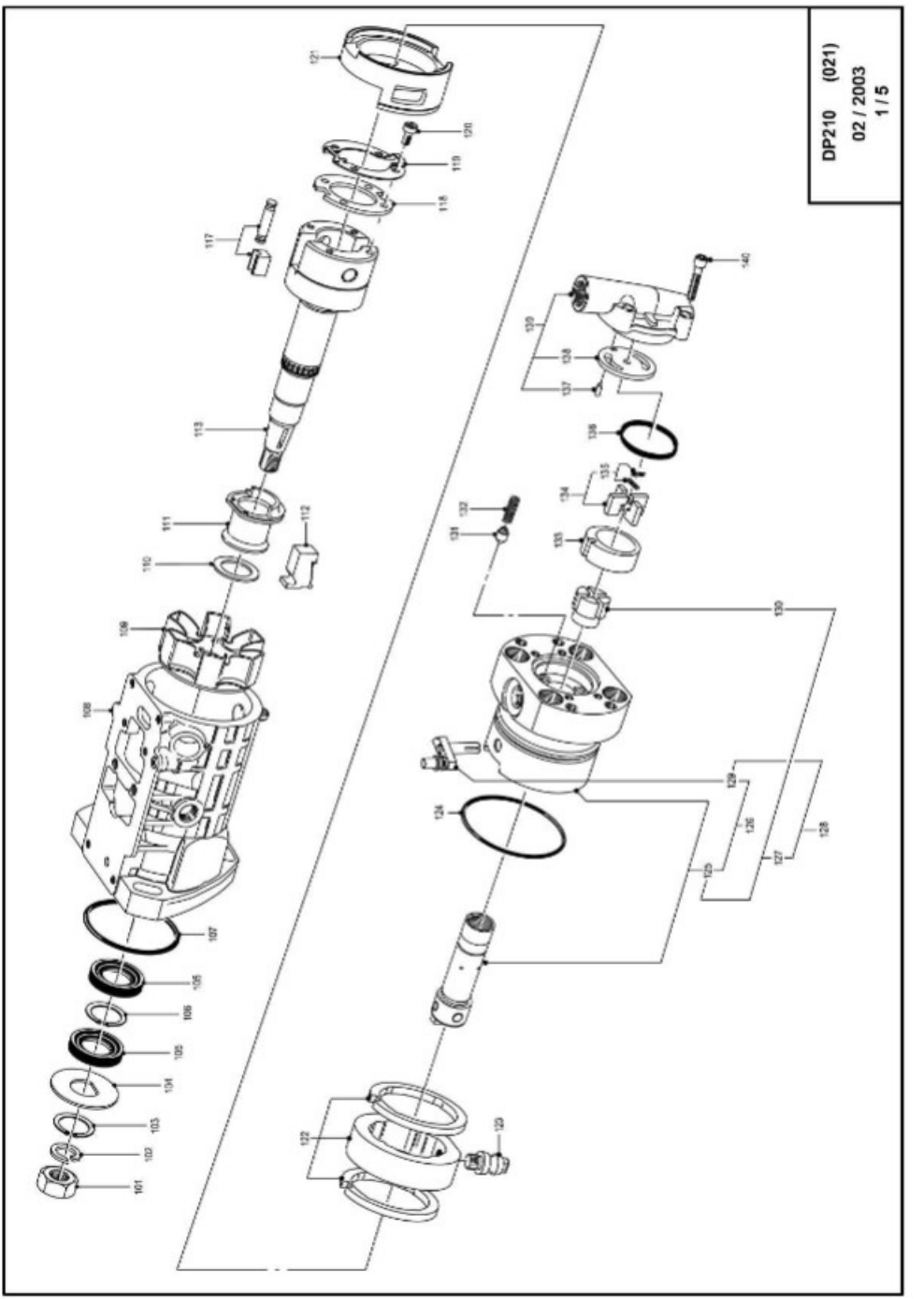
6.1 TOOLING

Part Number	Description
7244-581	Adaptor for Boost Pressure Setting (13 mm dia)
YDT140	Adaptor for Transfer Pressure & Backleak
AE3/1	Advance Probe - Requires AE7 & AE3/2
HB343	Advance Probe Adaptor Kit for use with AE3/1
AE7	Advance Probe Box - Requires AE3/1 & AE3/2
AE3/2	Advance Probe Cable - Requires AE7 & AE3/1
7244-584	Body Screw Tool for Boost Stroke Adjustment
YDB328	Boost Control Tester
HB246	Boost Pressure Control Unit for Setting Boost Pressure
YDT146	Cam Car Torx Kit
YDT264	CPS Tool
7244-582	Dial Gauge Adaptor for Boost Control
YDT136	Dial Indicator Gauge
YDB314	Digital Advance Gauge Kit
APB94	Drive Adaptor Plate (3 Hole)
APB195	Drive Adaptor Plate (68 mm)
APB194	Drive Adaptor Ring (50mm)
7244-633	Drive Shaft Seal Guide for Double Seal Fitment
YDT263	Dual Transfer Pressure Adjuster
YDT262	Dynamic Timing Kit (Stand Alone)
YDT261	Dynamic Timing Kit for AVM2 Test Bench
YDB288	Edge Filter
5936-95Q	Edge Filter Washer
7244-231	Extractor for Drive Hub
7244-604	Extractor for Regulating Sleeve
AHP134	High Pressure Pipe (6 x 1.5 x 710 mm)
AHP133	High Pressure Pipe (6 x 1.8 x 450 mm)
YDB372	Hydra-clamp
AI51	Injector for AVM & PGM Test Bench - Fitted with YDB286 Nozzle
AI53	Injector for AVM & PGM Test Bench - Fitted with YDB287 Nozzle
AI52	Injector for HA2500 & HA700 Test Bench - Fitted with YDB286 Nozzle
AI54	Injector for HA2500 & HA700 Test Bench - Fitted with YDB287 Nozzle
6408-80A	Max. Fuel Adjuster
YDB286	Nozzle BDL0S6844 CFE
YDB287	Nozzle BDL0S6889 CFE
YDB289	Nozzle Holder
7244-275A	Pressure Gauge for Cam Box
7244-625	Protection Cap for Boost Control Pivot Plug

Part Number	Description
7244-627	Protection Cap for Boost Control Plug
7244-626	Protection Cap for Boost Control Screw Body
1804-429	Protection Cap for Housing Drain Screw / TP Advance Screw / Timing Cover Plate Plug
7244-621	Protection Cap for Latch Valve Body
7244-621A	Protection Cap for Latch Valve Body
7144-458C	Protection Cap for Latch Valve Body / Throttle & Exhaust Shafts
7244-623	Protection Cap for LLA Body
7244-623A	Protection Cap for LLA Body
6408-68	Protection Cap for Regulating Sleeve
7044-897	Protection Cap for Solenoid & Head Locating Fitting
7244-628	Protection Cap for Torque Trimmer Piston End Cap
7244-629	Protection Cap for Torque Trimmer Spring End Cap
1804-411	Pump Mounting Plate
ALP307	Quick Fit Pipe Connection
6408-59	Retainer for Rotor Plungers
7174-62	Retaining Clip for Hydraulic Head Plungers
ALP308	Screw Fit Pipe Connection
7244-275/3	Screw for Cambox Pressure Gauge
7044-889	Socket for TP Rotor
7244-24	Spanner for Holding Drive Hub
7244-411	Throttle Lever Movement Gauge
7244-405	Throttle Spring Assy Tool
6408-78	Torque Trimmer Adjuster
7244-439A	Torx Bit T10 for Timing Plate Screw
7244-439	Torx Bit T15 for Timing Plate Screw
7244-437	Torx Bit T20 for Catch Plate Screw
7244-438	Torx Bit T25 for Governor Control Cover Screw
YDT146	Tamper-resist Torx bit kit
60620197	Dismantling tray available through Delphi Diesel Systems, Aftermarket Operations, Service Operations Department

6.2 TORQUE VALUES

LSN	Description	Part Number	NM		LBF.IN		Head Type	Comments
			from	to	from	to		
101	Drive Shaft Nut	7185-758	90.00	90.00	796	796	22mm AF	
120	Catch Plate Screw	7174-350A	4.00	4.00	35	35	T15	
123	Cam Ring Screw	7189-086	57.00	57.00	500	500	14mm AF	
130	Transfer Pump Rotor	7182-245	7.40	7.40	65	65	Special	
140	Endplate Screw	7185-015	5.10	5.10	45	45	4mm Allen	
203	Latch Valve Assy	7185-884A	34.00	34.00	300	300	17mm AF	for tightening sequence refer to manual
210	Blanking Plug	9101-335	5.50	5.50	48	48	5mm Allen	
214	LLA Valve Body	7189-008	34.00	34.00	300	300	22mm AF	
221	Stop Solenoid	7185-900H	15.00	15.00	130	130	24mm AF	
224	Inlet Connection	7189-066	34.00	34.00	300	300	24mm AF	
237	Clamping Plate Nut	7185-852A	30.40	30.40	270	270	18mm AF	
238	Bracket Screw	7167-667A	14.00	14.00	120	120	5mm Allen	
239	Delivery Valve Holder	7185-130D	8.00	12.00	70	103	16mm AF	turn 65° ±5° (max 45.5Nm ±17.0 Nm)
245	Housing Plug Bolt	7167-299	2.30	2.30	20	20	5/16" AF	
247	Drive Shaft Lock Screw	7189-003	17.00	17.00	150	150	10mm AF	drive shaft locked position
			12.00	12.00	106	106	10mm AF	drive shaft unlocked position - engine run
301	CA Housing Screw	7185-304A	9.50	9.50	85	85	4mm Allen	
305	Light Load Screw	7189-096DQ	9.00	9.00	80	80	14mm AF	
316	Nut	7185-854B	2.30	2.30	20	20	8mm AF	
319	Solenoid	7185-900K	15.00	15.00	130	130	24mm AF	
324	Head Locating Fitting	7189-010	40.00	40.00	350	350	3/4" AF	for tightening sequence refer to manual
325	Housing Stud Cap Nut	5330-362C	28.00	28.00	240	240	1/2" AF	
401	Control Bracket Screw	7174-798	2.30	2.30	20	20	2.5mm Allen	
402	Control Bracket Screw	7174-798	2.30	2.30	20	20	2.5mm Allen	
403	Control Bracket Screw	7182-023A	5.10	5.10	45	45	8mm AF	
411	Control Bracket Bolt	7182-023	5.10	5.10	45	45	8mm AF	
415	Backleak Adaptor	7189-142A	25.00	25.00	220	220	17mm AF	
417	Governor Cover Screw	7174-895C	4.00	4.00	35	35	T25	
503	Pivot Plug	7185-316	16.65	20.35	146	176	6mm Allen	
504	Boost Cover Bolt	7185-645	2.30	2.30	20	20	Torx	special
511	Adjusting Screw Body	7185-954	29.50	29.50	260	260	Special	
519	Banjo and Pipe	7189-148	6.80	6.80	60	60	12mm AF	
521	Gov Cover Plug Screw	7185-641	6.30	7.70	56	68	Torx	special
522	Self Lock Nut	7174-637	5.70	5.70	50	50	10mm AF	
537	Gov Cover Plug Screw	7182-569A	5.10	5.10	45	45	10mm AF	
542	Idle Screw Lock Nut	7185-854E	5.70	5.70	50	50	10mm AF	
547	Tamper Proof Nut	7189-040	6.20	6.20	55	55	13mm AF	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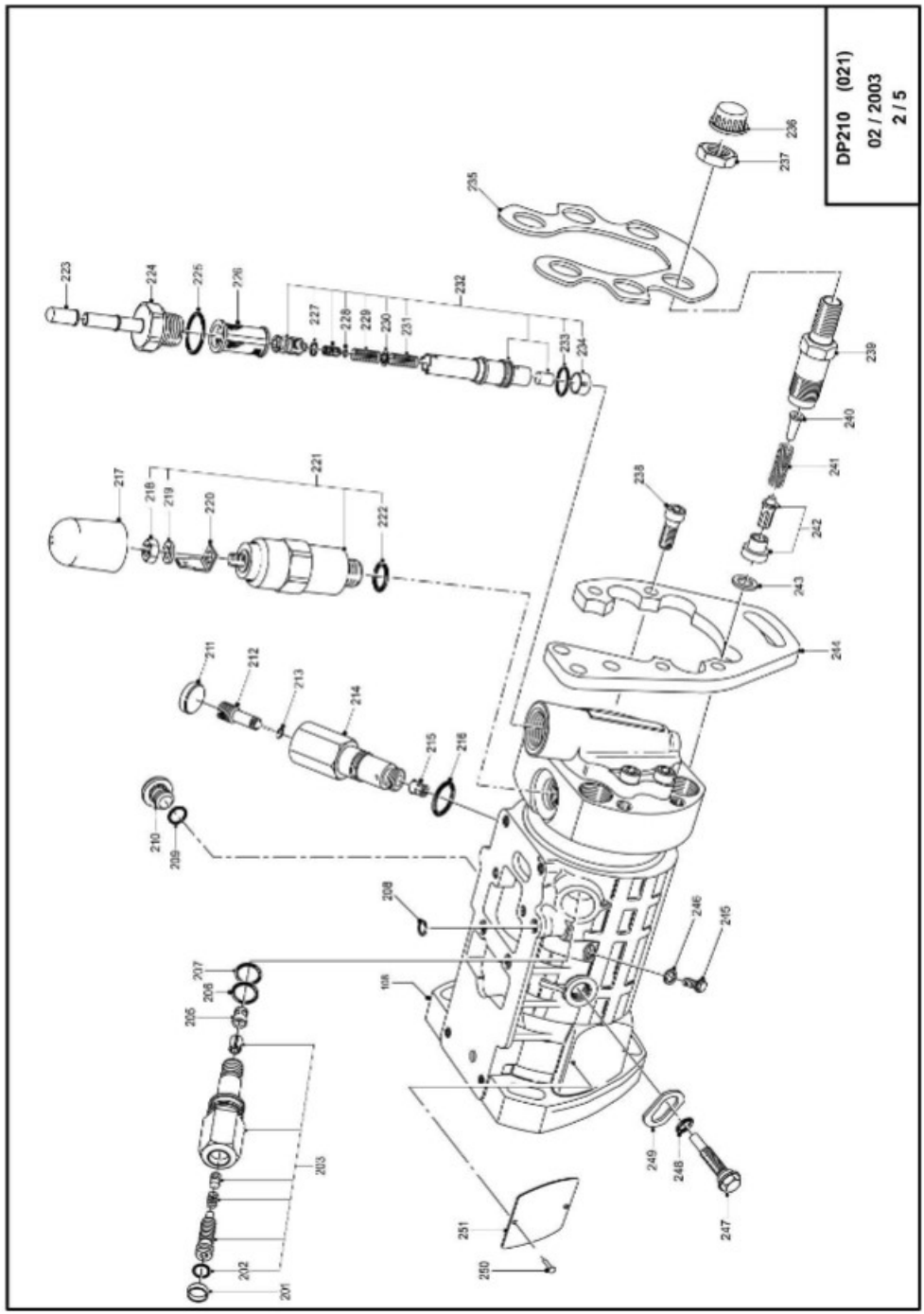
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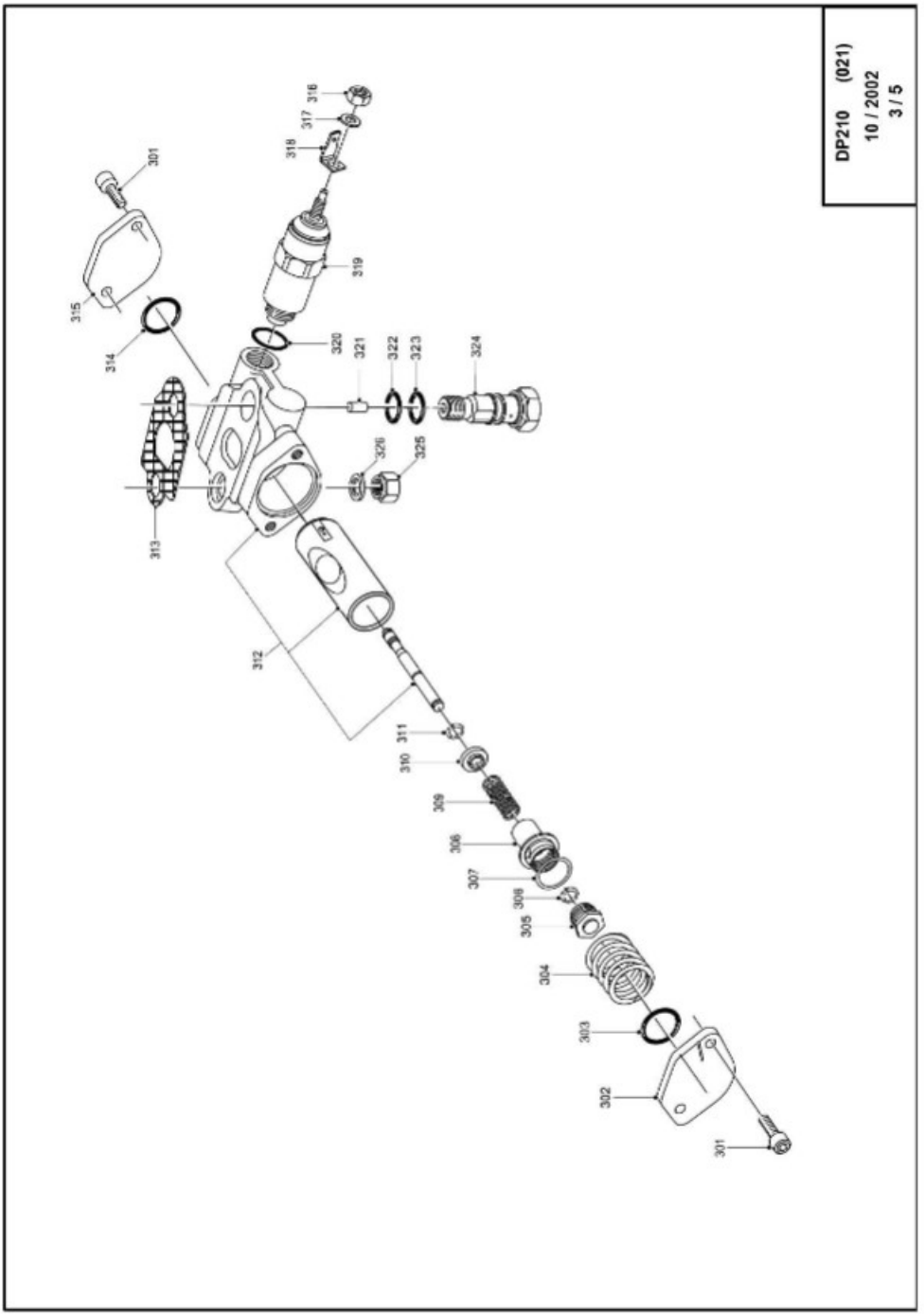
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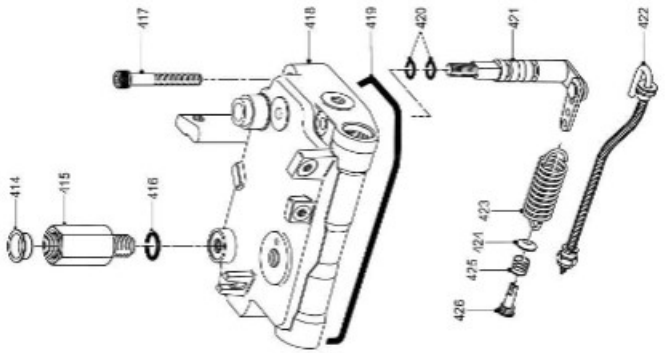

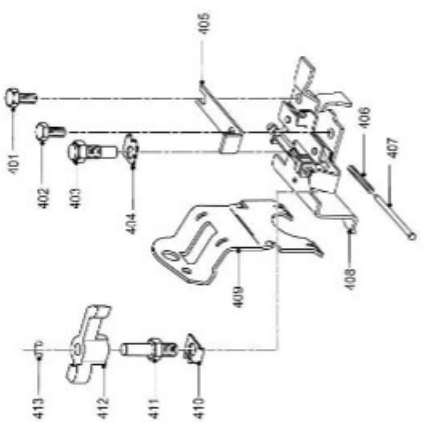

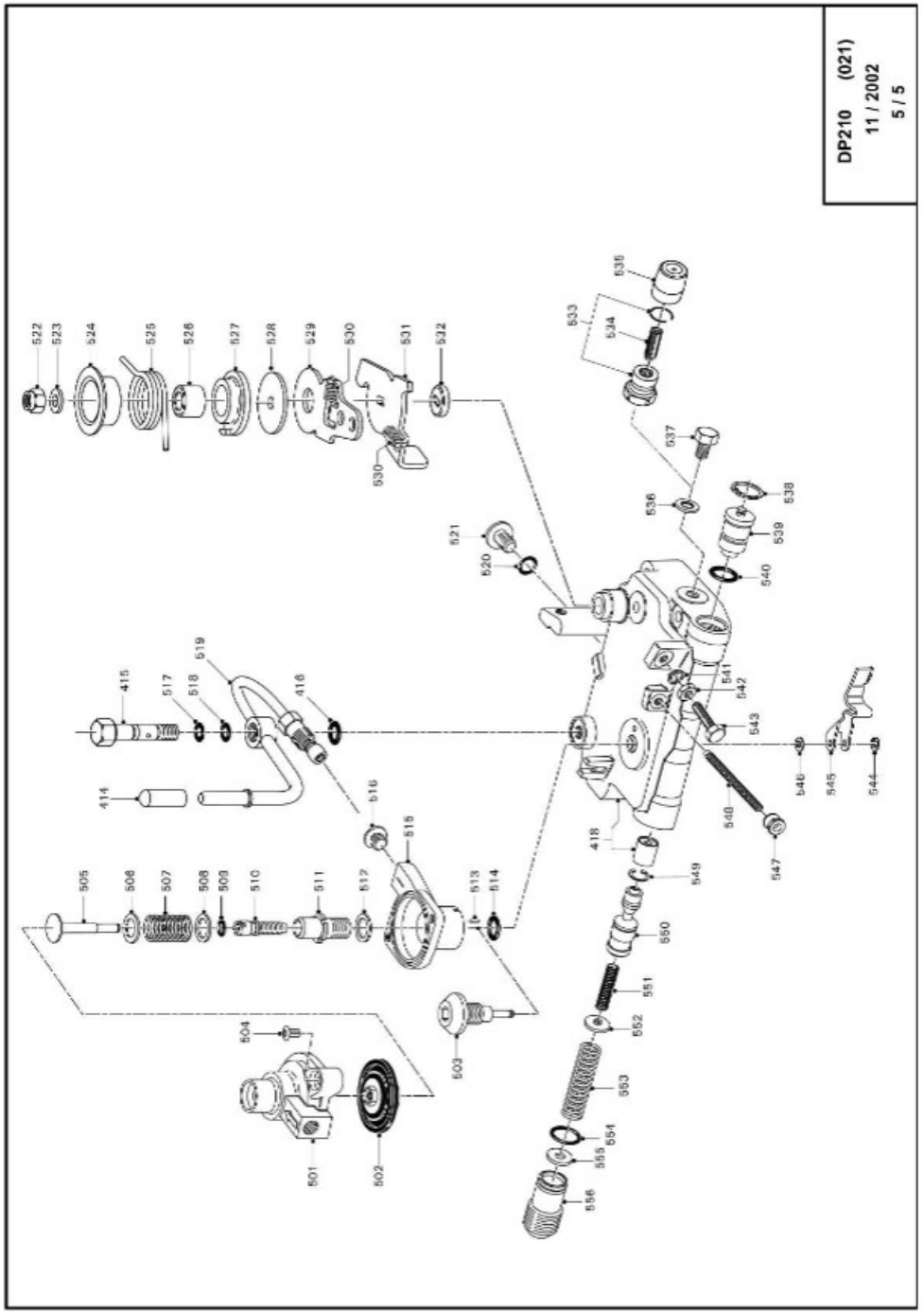
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