WORKSHOP MANUAL

COMMON RAIL INJECTOR *(DFI1)* - REPAIR PROCEDURE

DDNX299(EN)

2006

(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 líquido, especialmente inyectores, tuberías 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 à 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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1.1 INTRODUCTION

In order to correctly repair a Common Rail injector in terms of quality and cleanness, you must follow the recommendations and methods described in the relevant documentation and must use the tools described in the appendix of this manual.

Equipment required:

- A wash station.
- A metal-coated bench, used solely for work on the injectors.
- A vice with soft metal jaws.
- Lint-free cloths.
- Careclean cleaning product.
- A Hydraclamp multi-directional pump holder.
- Plastic tray with numerous compartments to store the injector's internal components.
- Dismantling and re-assembly tools. **YDT440**
- A set of master injectors.
- Powderless latex gloves.

Caution! These master injectors must be tested regularly (at least once per week) to detect any possible deviation from the test bench.

Parts for repair:

To ensure the correct operation of the repaired injector, you must replace the faulty components with **original parts**; the references for these are noted in the parts lists.

Repair notice:

A "repair notice" must be completed for every injector repaired to include the following information:

- Injector reference.
- Serial number.
- Vehicle's mileage.
- Fault codes or symptoms noted during the diagnostic.
- Parts replaced during the repair.
- Summary of test results on the test bench *(before and after repair)*.

1.2 IMPORTANT RECOMMENDATIONS

When working on the injector you must observe the cleanness and safety conditions stipulated in the "GENERIC" DDNX126 Common Rail manual.

A full diagnostic of the injector must be carried out before dismantling internal or external parts. You are strongly recommended to check the injector on the test bench to determine the cause of the fault.

Injector components must be reassembled under extremely stringent cleanness conditions *(residual dirt can cause damage to the injectors after reassembly)*.

- Reused parts must be washed and dried in advance. Before reassembly, such parts must be lubricated with ISO 4113 fluid.
- During assembly, parts must be stored in a clean area free from metallic, fibrous or other forms of dirt.
- All parts that are to be reused must be visually inspected in terms of their general condition.

You must only use dismantling and re-assembly tools recommended by Delphi.

Seals must be replaced systematically each time these parts are dismantled.

Any parts showing signs of deterioration, corrosion, wear, cracking or deformation must be replaced.

1.3 INJECTOR IDENTIFICATION

The CR injector is identified by:

- Its reference: Starting with the letters EJBR or EJDR.
- Its serial number.
  - The first 4 digits represent the order number for the injector body for the day.
  - 1 letter represents the month of production: A for January, M for December. The letter I is not used.
  - 1 letter represents the year of production: U for 2001, V for 2002, etc.
  - 2 letters represent the day of production.
  - 1 letter represents the production site: W for La Rochelle and F for Blois.
  - 1 or 2 digits represents the number of the test line.

2.1 VEHICLE SYMPTOMS AND RAPID DIAGNOSTICS

Symptoms/faults

During the initial diagnostics, you can use the following table to ascertain which function is faulty.

Symptoms observed on the vehicle	Possible cause
Loss of performance, instability, noise, smoke	Dirt in the valve
	Corrosion of the valve
	Needle stuck due to dirt, corrosion
	Dirt in the internal holes
	Edge filter plugged by external dirt
	Coil fault, open circuit
	Electrical connector fault
	Injector spring broken
	Valve spring broken
	Intermittent fault: short circuit/open circuit
Engine overrevving	Valve stem broken
	Valve stuck open
	Valve spring broken or damaged *(corrosion)*
	Needle stuck open *corrosion, debris, paint)*
Smoke, uneven idle	Internal holes partially blocked *(debris)*
	Leaks at the pressure faces
	Wear on the needle/spacer contact
Uneven idle *(due to an irregular end of injection)*	Uneven electromagnetic force *(intermittent fault on the internal electrical connection)*
	Spring fault *(corrosion, fatigue)*
Loss of power, poor start, risk of stalling	Injection holes blocked *(debris)*
	Carbon deposit
	Corrosion
	Paint
Poor start	Needle spring broken *(corrosion, excessive stress)*
	Needle spring loose *(fatigue due to excessive temperatures or speeds)*
	Excessive temperature of the nozzle

Symptoms observed on the vehicle	Possible cause
Engine overrevving *(due to a fuel leak via the injector tip between two consecutive injections)*	Injector stuck open
	Debris under the needle seat
	Valve stuck open *(debris under the valve seat)*
	Paint
Loss of power, instability, noise due to a poor start of injection	Edge filter blocked by debris
	Coil: open circuit
Engine stop	Coil: short circuit

This first stage must be completed using the tests described below.

Before dismantling the injector:

1. Before working on the injector, the diagnostics procedure should start with an external inspection.
   a. Check the condition of the injector:
      - Excess carbon deposits.
      - Tip damaged.
      - Sealing washer present.
      - Condition of the backleak connection.
      - Condition of the M14 thread.
   b. Locate possible leaks:
      - Around the nut thread/injector body.
      - Around the backleak connection.
   c. Liquid level noted:
      - Extremely low *(or vapours).*
      - Contacts and external parts completely wet.
   d. Fluid type:
      - Diesel fuel.
      - Oil.
      - Other.
2. External cleaning.
   a. Cap the nozzle, the backleak connection and the M14 thread on the nozzle holder body.
   b. Using a screwdriver, decarbonise the slot between the nozzle cap and the nozzle. Clean the slot.
   c. Spray the nut and the injector tip using a degreaser aerosol. Warning, these products can cause damage to the hands and eyes. The action takes more or less time depending on the cleaning product chosen.
   d. Remove the cap from the nozzle and clean to remove carbon deposits around the injection holes. Delphi recommend using ultrasonic cleaning to ensure sufficient cleanness before moving to the test bench. The nozzle must not be brushed as this can hamper its operation.
   e. Clean the entire injector using a washing product concentrating on the most at risk areas.
   f. Dry the injector.

Caution! *It is essential that the nozzle is decarbonised, as the flowmeter is extremely sensitive to dirt.*

3. Electrical tests.

   This test is carried out in two stages:

   a. Checking the condition of the coil.

      Install the injector on the bench and measure the resistance of the coil.

      At 20°C the resistance of the coil must be between 0.155 Ohm and 0.185 Ohm.

      Insulation resistance must be greater than 10 megaohm.

   b. Checking the movement of the valve.

      Start the valve test. This is an automatic test that carries out a predetermined number of valve stroke cycles.

   If the coil resistance lies within the tolerances and movements of the valve are audible, the electrical part of the injector is operational.

   Caution! *The electrical test assumes that the connections, insulation and electrical continuities in the bench control circuit are correct.*

   If the diagnostics show a fault on the coil, reject the injector.

   Caution! *For all bench tests, you must first ensure that the ISO 4113 test fluid and the hydraulic circuits (all HP hoses and the rail) are completely clean. We strongly recommend cleaning the circuits to ensure that all dirt is removed (metallic, organic or other). In particular, ensure that the 2 µm filter is replaced regularly. Failure to observe these recommendations can damage the injectors tested.*

   Similarly, before fitting an injector on the test bench, it must first be decarbonised in an ultrasonic bath.

4. Leakage test.

   Refer to section 2.2.

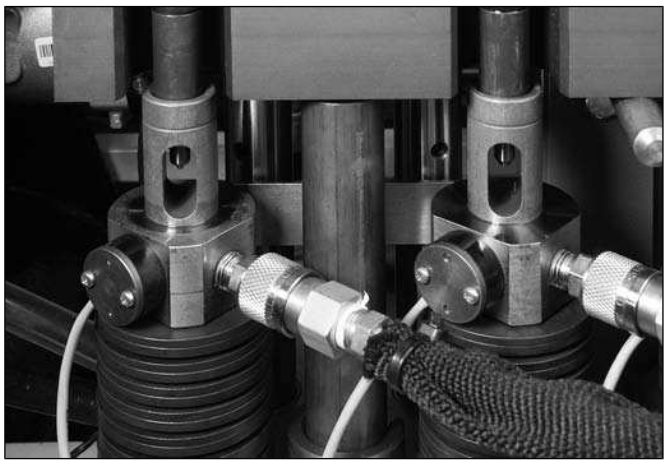
5. Functional test on the test bench.

   Refer to section 2.2.

2.2 BENCH DIAGNOSTICS

2.2.1 Static leakage test

At this stage you must ensure that the injector does not leak in static mode:



1. Assemble the support spacer for the injector on the bench. This part helps detect and recover leaks from the nozzle. *9378*
2. Install the injector on the test bench once all cleanness precautions have been taken.
3. Tighten the HP pipe to a torque of 25 N m on the rail side, following by the injector side.
4. Connect the injector pipe to the return flowmeter.

Caution! *Do not connect the injector electrics.*

5. Start the static leakage test via OCRES.
6. Check for static leaks from the nozzle *(injected flow)* and from the slot between the nut and the nozzle holder body.
7. Measure the static leak flow *(backleak)*.
   - Static backleak above the maximum limit *(fixed in OCRES)* or appearance of leaks around the nozzle or around the nut/nozzle holder body slot, the injector is leaking. The unit must be dismantled to diagnose a fault on internal parts.
   - Static backleak below the maximum limit *(fixed in OCRES)* or no leaks around the nozzle or around the slot, the injector is leak-free. In this instance, perform a dynamic leakage test.

2.2.2 Dynamic leakage test

The dynamic leakage test consists of measuring the backleak from the injector under specific operating conditions. The unit will be controlled so as to reproduce pre-calibrated injections in OCRES. To ensure this, remove the previously used spacer and replace it with a spacer without a lateral hole. Before starting the flow measurements, the following conditions must be met:

- Generate a minimum temperature of 40°C for the test fluid *(ISO 4113)*.
- Cleaning and temperature adjustment of the injector.
- Start the dynamic leakage test via OCRES.

Measure the average backleak, if the flow exceeds the maximum limit *(fixed in the OCRES test schedule)*, the injector is faulty *(valve wear)*.

2.2.3 Fuel deliveries and opening delays

If the injector tested is leak-free, measure the injected flows and opening delays for the five pressures mentioned below.

Caution! *To ensure precise measurements, you must only test ONE injector at a time. Activation of the delivery measuring unit can affect the opening delay measurements. Consequently, you must deactivate this unit when measuring the opening delay.*

During this stage, simply launch the "Diagnostics" program on OCRES. The fuel delivery will be measured for each pressure in the rail [230, 400, 800, 1200, 1600 bar] and for different pulse lengths between 0 and 1600 µs *(mm3/stroke)*. The opening delay is measured at 800, 1200 and 1600 bar. The results obtained are compared to the reference data for the injector in question.

If the curves for flow and opening delay lie within the tolerances, remove and cap the injector. You must observe the cleanness regulations recommended by Delphi throughout the entire operation.

If the characteristics measured for this injector lie outside of the tolerances, remove the injector from the test bench, then dismantle the injector and replace the faulty parts; be sure to observe the relevant cleanness and safety guidelines.

DISMANTLING

3 DISMANTLING

3.1 INTRODUCTION

3.1.1 Repairing the injector - Use scenarios

Repairs do not apply in the following cases:

- The vehicle's mileage is less than 80,000 km.
- The injector is under warranty.

3.1.2 Faults and replacing parts

The table below summarises the most common faults detected on the test bench and the parts to replace in each case.

	Parts to replace							
Fault type	Nut	Needle/ body assembly	Injector spring	Spacer	Valve/seat assembly	Valve spring	Calibration pin	Nozzle holder body/ coil/tube
Resistance:	Reject the injector							
No vibration of the valve	If the resistance is ok, see below:							
	x				x	x	x	
Static leak (backleak)	X				X			
Static leak (nozzle)	X	X	X					
Dynamic leak	X	X	X		X	X	X	
Pilot fuel	X	X	X		X	X	X	
Main fuel	X	X	X		X	X	X	
Opening delay	X	X	X					

This table is given solely for reference purposes, as it is simply impossible to replicate all of the part replacement options according to the different types of injector faults. In fact:

- Wear on a part can result in different fault modes on the injector.
- A given fault on the injector can be caused by a combination of several faulty parts.

To increase the reliability of the repair, all of the wearing parts should be replaced each time the injector is dismantled *(valve, valve seat, nozzle assembly, springs)*.

3.1.3 Description of parts

Refer to appendix I of this document.

DISMANTLING

3.2 PREPARING FOR DISMANTLING

The injector must not be dismantled in the same area as that reserved for assembly.

You must wear powderless disposable latex gloves when working on the injector.

At this stage, the injector is assumed to be clean externally *(decarbonisation and cleaning).*

- Remove the sealing washer using a pair of universal pliers. *9335*
- Citroën injector: Remove the external snap ring using the snap-ring pliers supplied with the kit. **YDT440**

3.3 ASSEMBLING THE INJECTOR ON ITS HOLDER

Install the injector on the main holder and hold it in position. *9336*

To prevent damage to the nozzle, you must fit the socket to the cap nut to allow the injector to be rotated in the fixture.

DISMANTLING

3.4 ID LABEL

Use tool **YDT441** to remove the label from the injector. See figure opposite. *9368*

Caution! *After removing the label, you must clean the application area. You remove all traces of adhesive or other material. The quality of the surface determines the effectiveness of the adhesive on the new label.*

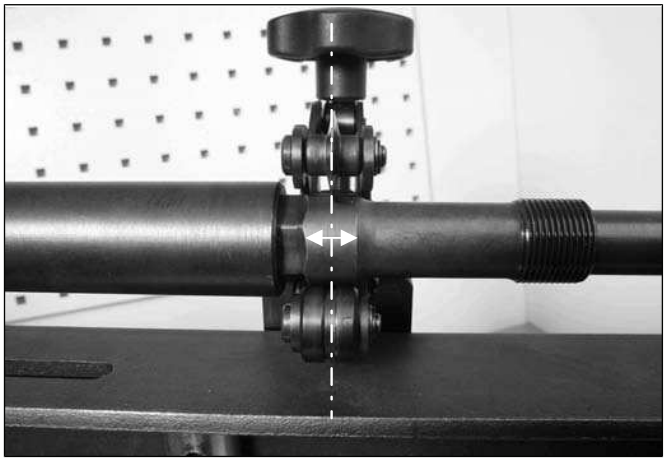
3.5 EXTERNAL PARTS

3.5.1 External gland - Ford Puma

To dismantle this injector, you must first dismantle the external nut *(gland nut)*. To do this, assemble the two bushes to the main fixture **YDT437**. Insert the injector and fasten the tube cutter on the main fixture so that the knurl is positioned as shown in the figure opposite *(in the middle of the indicated area). 9338*

Slowly cut the nut: for two turns of the crank, rotate the tightening knurl on the tube cutter a quarter turn.

Caution! *Failure to observe these recommendations can damage the knurl and the rollers.*



Remove the nut and the internal snap ring.

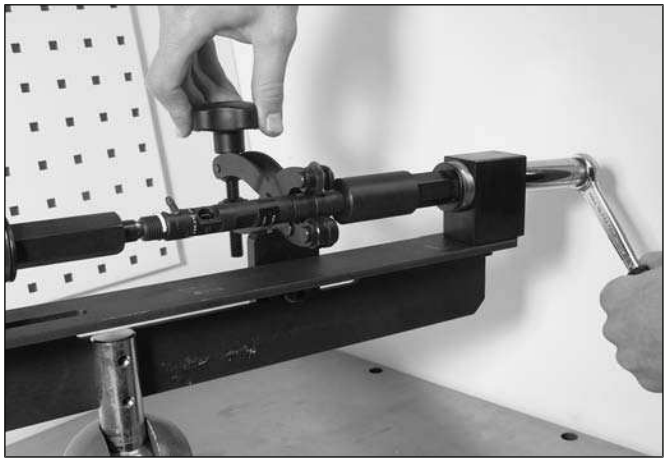
DISMANTLING

3.5.2 Nozzle cap

Before unscrewing the nozzle cap, you must first release the nut/nozzle holder body stresses to prevent the internal pins shearing. To do this, make a **groove** in the nut using the tube cutter. The groove must be positioned **30 mm** from the edge of the nut and the depth must be less than **0.5 mm**. *9351*

Caution! *Do not cut the nut as this can hamper dismantling.*

- Partially unscrew the nozzle cap.
- Remove the injector from the main fixture. *9349*



3.6 INTERNAL PARTS

- Fully unscrew the nut by hand.

Caution! *Take care not to drop any internal parts (needle, springs, spacer, valve, etc.)*

As soon as the injector is dismantled, separate the internal parts in a dismantling tray. *9357*

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- Remove the calibration pin located in the base of the nozzle holder body housing. *9360*

- Insert the nozzle holder body in the cleaning support **YDT439**. *9361*

Caution! *You must plug the HP holes before starting the brushing operation. Any dirt penetrating these channels can damage the injector.*

- Brush the threads of the nozzle holder body using a wheel fitted with a metal brush.

  If required, finish cleaning the threads by spraying with a degreaser *(Décapjoint LOCTITE 7200)*.

Caution! *This product can cause damage to the hands and eyes. Take care during use.*

- Clean the threads using a blow gun.

  Cleaning should remove all traces of metallic dirt, grease or resin from the threads.

RE-ASSEMBLY

4 RE-ASSEMBLY

4.1 PRELIMINARY WORK

Repairs on the injector consist of replacing the faulty parts with original parts. Effective repairs depend on the quality of the diagnostics previously carried out and on observance of the method used to reassemble the new parts.

Once removed, visually inspect the condition of the following internal parts in order to check the source of the fault:

- Needle.
- Nozzle body.
- Needle spring.
- Valve and valve body.
- Adaptor plate.
- Nozzle holder body.
- Valve spring.
- Calibration pin.

Note: *At this stage, the electrical part is assumed to be fully functioning. The coil must not be dismantled.*

Check for possible pollution from organic or metallic sources to locate the cause of the fault.

Wash and dry reusable internal mechanical parts. Next, check for traces of scratches, pitting, burring, dents, deformation and corrosion.

Any part showing traces of damage must be replaced with a new part.

Caution! *We recommend moving parts carefully to prevent scratching or deformation.*

Any part that is dropped must be automatically rejected.

RE-ASSEMBLY

4.2 REPLACING PARTS

4.2.1 Fault table

The table below provides details of faults that you should check for on the parts.

Assembly	Part	Faults
Nozzle assembly	Needle	Particles in the feed slots
		Dents and/or burring on the feed slots
		Scratches
		Damage to the needle cone
		Burring and/or deformation of the needle base, spacer side
		Traces of corrosion
		Traces of seizing
	Nozzle body	Dents
		Traces of leaks
		Scratches on the pressure faces
		Corrosion on the pressure faces
		Cracks around the HP hole
		Presence of particles and/or chips
		Scratches on the bore
		Injection holes blocked
	Needle spring	Presence of particles in the coils
		Spring broken
Valve	Valve body	Pressure faces: Traces of leaks and scratches on the 'body' face, corrosion on the 'adaptor plate' face.
		Seat: Traces of leaks, scratches, corrosion
		Pollution of the HP channel
	Valve stem	Particles on the stem
		Support cone: scratches, dents, traces of leaks
Adaptor plate		Pressure faces: Traces of leaks and scratches on the 'nozzle' face, corrosion on the 'valve' face.
		Pollution of the HP channel

RE-ASSEMBLY

Assembly	Part	Faults
Nozzle holder body	Body	Pressure face: Traces of leaks, deposits, corrosion, scratches.
		Dents
		Pollution of the HP and/or of the backleak channel
	Spring	Presence of particles in the coils
		Spring broken

4.2.2 Replacement procedure

Refer to paragraph 3.1.2 for internal parts.

Reminder: *As the dismantling procedure damages the nozzle cap, it must be automatically replaced.*

Similarly, you must replace the sealing washer and the snap ring *(according to injector)* with new parts.

4.2.3 Warning before assembly

The following cleanness guidelines must be observed before and during assembly of the injector:

Cleaning

All reusable parts must be washed in advance. Mechanical parts automatically pass to the wash station. Particular attention must be paid to removing remnants of adhesive from the threads *(use a degreaser on the bench grinder after brushing, if necessary, and check the condition of the threads at the end of the operation)*. The nozzle holder body threads must be completely clean.

Drying

You must dry all of the washed parts to prevent any residual dirt. A blow gun can be used to remove any remnants of dirt.

Caution! *Take care not to push dirt into the parts or into the HP channels.*

Storage

The injector parts must be moved and stored in a clean overpressurised environment whilst awaiting assembly.

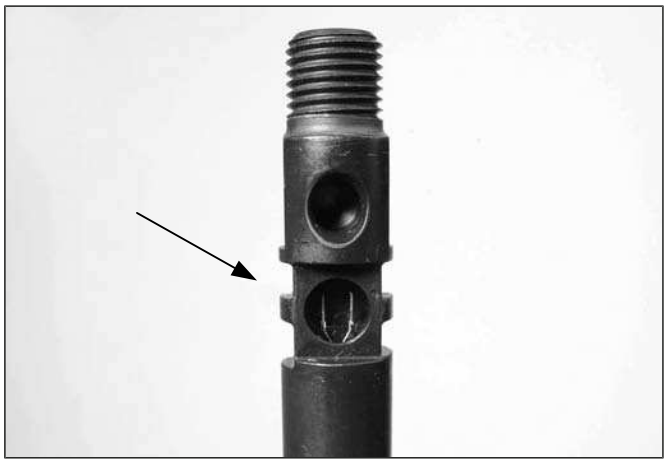
RE-ASSEMBLY

4.3 INJECTOR ASSEMBLY

- The cleanness conditions mentioned above must be observed during assembly.
- Moveable parts must be lubricated before assembly.

At this stage, the injector undergoing repair is presumed to have no electrical faults.

Before starting assembly, check the position of the coil. *9373*



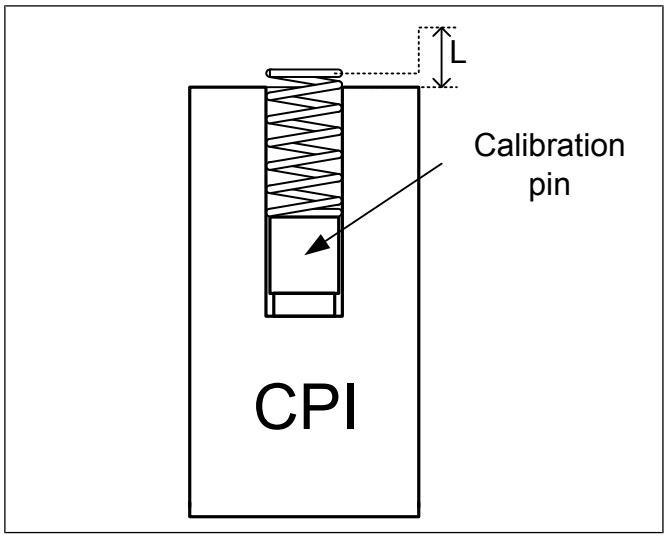
4.3.1 Spring and calibration pin

The spring and pin in the nozzle holder body for repair are matched to ensure precise calibration. They must not be separated. *4312*

You must reassemble the same matched parts to observe the calibration of 18 +/-0.7 N or 22 +/-1 N depending on the injectors where L = 40 µm. If this criterion is not met, correct operation of the injector cannot be guaranteed.

If dismantled in advance, insert the calibration pin into the nozzle holder body housing provided. If the pin is stepped, the big bore must be positioned outwards *(spring side)*.

Caution! *There are 19 classes of pin. These are not interchangeable.*



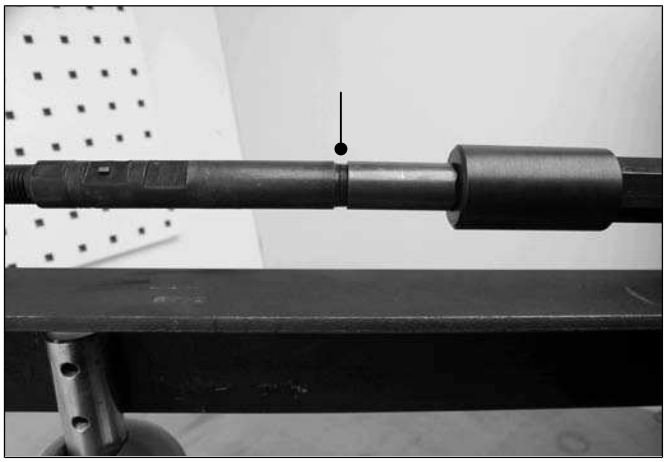
The spring *(washed, dried and free of all dirt)* must be inserted into the housing in front of the pin.

Caution! *There are also several classes of spring. These are not interchangeable.*

RE-ASSEMBLY

4.3.2 Other internal components

- Deposit at least 15 mg of Mobilith 220SHC grease spread evenly across one of the bearing faces of the cap/nozzle contact.
- Stack the internal parts and manually tighten the nut to ensure that these stay in position.
- Mount the assembly on the main fixture. The contact points are:
  => nut M14,
  => the conical area of the nozzle.
- Tighten the screw on the main holder to 40 N m to compress the internal parts against each other.
  This serves to prevent any dirt penetrating these components.
- Manually loosen the nozzle cap.
- In the area between 2.5 and 5 mm from the face of the nozzle holder body window, insert two drops of LOCTITE 222 adhesive on the body threads at 180°. *9343*



The polymerisation time for the adhesive is 10 minutes.

Caution! *The nut and body threads must be free of all grease and other dirt.*

- Next, tighten according to the guidelines opposite.

Vehicle	Pre-tightening torque (N m)	Tightening angle (°)	Maximum inspection torque (N m)
Renault	20 +/- 0,2	45 +/- 3	60
Ford Lynx	20 +/- 0,2	45 +/- 3	60
Ford Puma	20 +/- 0,2	35 +/- 3	55
Kia	20 +/- 0,2	45 +/- 3	60
Citroën	20 +/- 0,2	41 +/- 3	55
Ssang Yong	20 +/- 0,2	45 +/- 3	60

RE-ASSEMBLY

4.3.3 External components

Spherical washer and snap ring

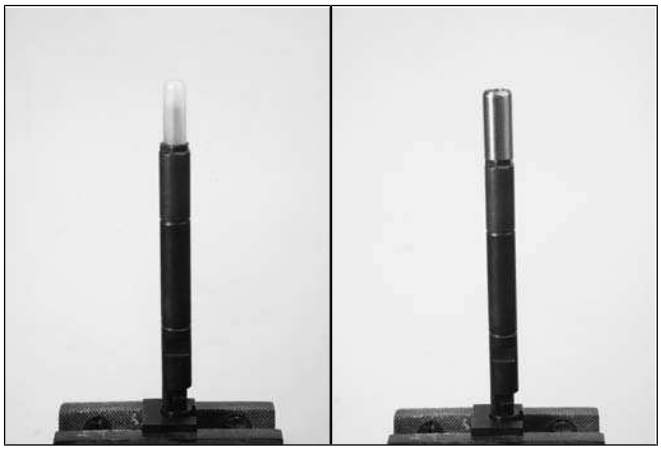
Use pliers **YDT443** supplied with the toolkit to assemble the snap ring. *9367*

Nozzle holder body gland assembly

This nut is assembled on the injector via the nozzle end of the injector:

- Check that the external gland is fitted with its snap ring. If this is not the case, use sleeve **YDT444** for the assembly. Manually insert the snap ring into nut *9363* then finish by pushing it into its housing with sleeve **YDT444**. *9365*

- Protect the injector using the appropriate plastic plugs. *9369*
- Position the tool **YDT447** on a vice.
- Position the injector on tool **YDT447** and protect the injector tip with the metallic cap *9370* **YDT445**.



RE-ASSEMBLY

- Place the external gland fitted with its snap ring into position. *9371-1*

  Using a tool **YDT446** and a mallet, insert the nut into the injector.

4.4 CHECKS AFTER REPAIRS

Strict tests must be carried out on every injector repaired. The component must meet the following functional requirements:

- Coil resistance within the tolerances.
- External sealing.
- Internal sealing.
- Fuel deliveries within the tolerances.

When checking these criteria, you must follow the instructions below:

Coil resistance

At = 20°C 0.155 Ohm < R < 0.185 Ohm

Insulation resistance > 10 M Ohm

External and internal leakage test

Refer to section 2.2

Fuel delivery and injector calibration

No correction code should be entered in the control system for the following operations. The injector must first be characterised without any correction.

- Install the injector on the bench whilst observing the necessary cleanness and tightening guidelines.
- Select the type of injector to be tested.
- Start the tests for each pressure level.
- Measure the following parameters:
  => Opening delay. Refer to section 2.2
  => Fuel delivery. Refer to section 2.2
- Generate the correction code.

The hexadecimal code is generated by comparing the results for the injector tested and the reference curves.

The reference curves are generated on the test bench using **new injectors** with the same reference as the injector repaired.

This operation is carried out prior to calibrating the repaired injector.

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4.5 VALIDATING THE REPAIR

Once the injector corrections have been generated, repeat a full test after entering this new code in OCRES. The flow values obtained during this final test must match those for the reference injector within the predefined tolerances.

If the operating criteria above are met, pack and store the component in a clean environment whilst awaiting assembly on the vehicle. If this is not the case, repeat the diagnostics and repair procedure.

Once the injector is repaired, assemble the corresponding flame arrester washer. Refer to the parts list for the washer references.

4.6 TRACEABILITY

Print the new correction code.

Use the printer and label type recommended by Delphi.

The ID label contains the following information:

- Injector reference.
- Injector serial number.
- Correction code calculated in testing.
- ID of the Delphi distributor who performed the repair.
- Repair date.

For certain applications it may be necessary to print two different labels: One containing only the correction code and one containing the remaining information.

In all cases, we strongly recommend separating out the information: The correction codes generated during testing must also be recorded in the repair notices submitted to the client and kept in the vehicle. Each code must be linked to a serial number for the injector concerned and to the number of the cylinder to which it is fitted.

4.7 EQUIPMENT REQUIRED

- Ultrasonic wash station: External cleaning of the faulty injector and washing of the reusable internal parts.
- Clean overpressurised enclosure for the manipulation of clean internal parts.
- Test bench with test equipment for the CR injector and OCRES test software **DDRX101**.
- Magnification system *(30 times)* to detect possible dirt.
- Dismantling/re-assembly kit for the Common Rail injector **YDT440**.
- Label printer and its software: **DYMO** LabelManager PC.
- Consumables:

  Mobilith 220SHC grease.

  LOCTITE 222 adhesive.

  Ultrasonic wash fluid.

  Label reel.

> ***Caution!*** *It is important that you use a label reel adapted to the engine environment and compatible with the DYMO printer above. Recommended products: Reel D1 in white* ***permanent polyester*** *with a width of 12 mm (Reference DYMO: 16959) and a width of 19 mm (Reference DYMO: 16960).*

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4.8 MAINTAINING MEASURING DEVICES

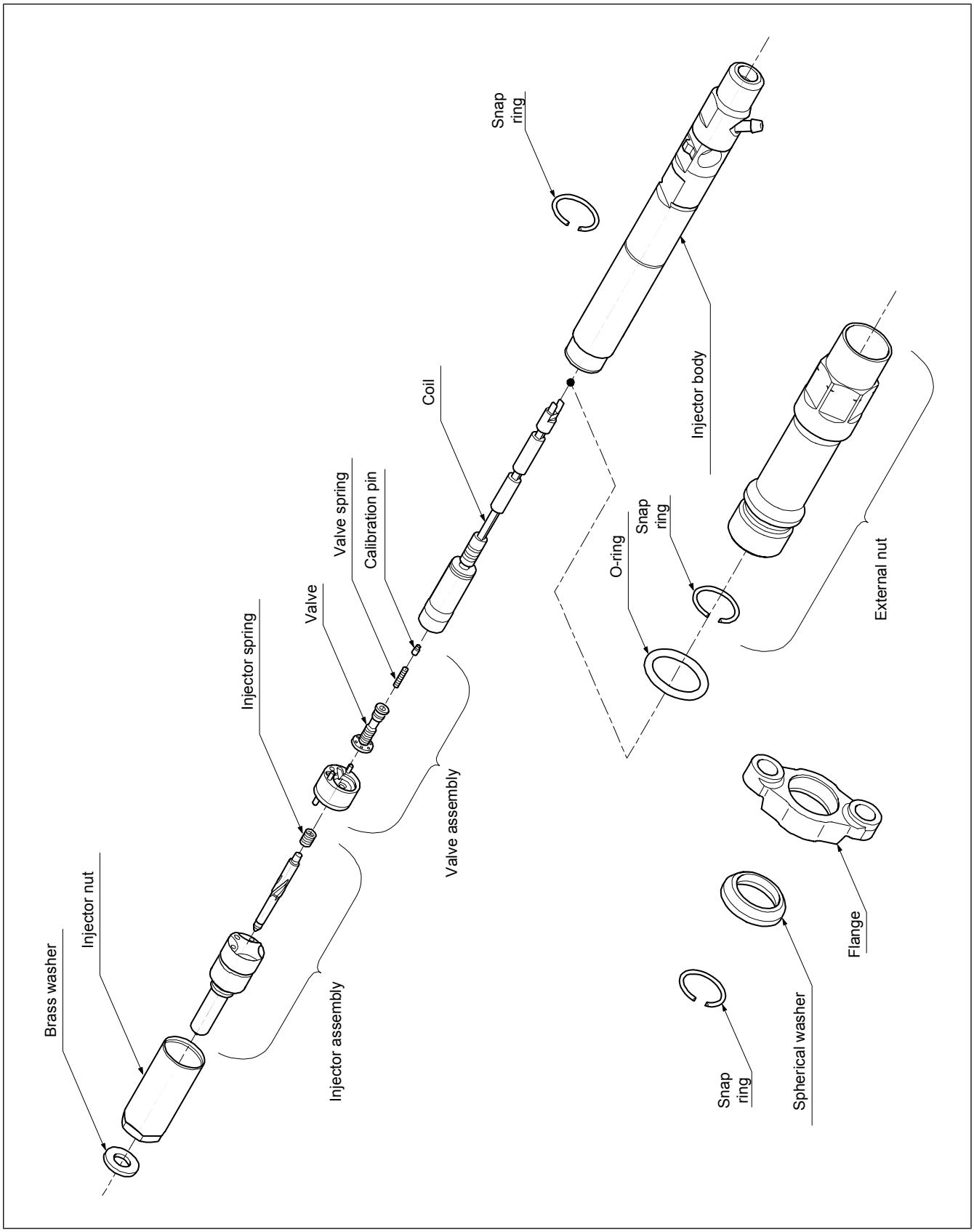
The accuracy of the measurements carried out on the test bench depend on numerous factors:

- The configuration of the test bench. Any modification during assembly or the addition of a component must be validated by Delphi.
- The test temperatures. You must observe the test fluid cooling recommendations to prevent any deviation associated with the temperature.
- The quality of the test fluid. High temperature and high pressure commands can damage the quality of this fluid. You must therefore monitor this parameter carefully and replace this fluid regularly. You are reminded that this fluid must meet standard ISO 4113 and have a viscosity of between **2.45 and 2.75 cSt at 40°C**.

  Moreover, the replacement interval of the 2 µm filter must be observed to prevent dirt penetrating the injectors during the test.

  You are reminded that the reliability of measurements depends on observing the test conditions and on the condition of the test equipment. **It is therefore essential that you check that the bench does not deviate**. To do this, test the master injectors. *(measure the flows and opening delays)* at least once per week.

5.1 Appendix I "Exploded view of the injector"



5.2 Appendix II "Summary of the repair procedure"

No.	Steps	Rejected parts	New parts and consumables
1	Dismantle the flame arrester washer	Washer	
2	External visual inspection *(scratches, dents, leaks)*	Complete injector if dent on M14, on the tube or the nozzle holder body.	
3	External washing		
4	Bench diagnostics *(electric and hydraulic)*		
5	PI Ford Puma: Remove the external gland	External gland	
6	Remove the label C2I/C3I	Label C2I/C3I	
7	Dismantle the cap	Nut	
8	Dismantle the injector	Depending on the repair type: - Valve assembly - Nozzle assembly - pin, valve spring - Nozzle spring	
9	Visual inspection of non-rejected parts		
10	Brush the nozzle holder body threads		
11	Wash all reusable parts		
12	Check the pressure face of the nozzle holder body		
13	Check the position of the coil		
14	Insert the calibration pin *(if replaced)* and the valve spring		Pin and spring *(if replaced)*
15	Lubricate the nut		Grease
16	Assemble the internal parts *(injector assembly, valve, spacer, springs)*		Internal parts changed
17	Compress the stack of internal parts		
18	Deposit adhesive on the threads		Adhesive
19	Screw the nut and and tighten to the torque and angle recommended		
20	Assemble the external gland *(PI Puma)* or snap ring *(PI Citroën)*		External nut and snap ring
21	Bench tests: electrical, static and dynamic leakage		
22	Properties of the injector		
23	Generate the correction code		
24	Assemble the flame arrester washer		Flame arrester washer
25	Print and apply the label		Label

No.	Steps	Rejected parts	New parts and consumables
26	Cap and pack		Protective caps, bag and packaging.