

Service procedures Tier 4 CR engines

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YANMAR

Contents

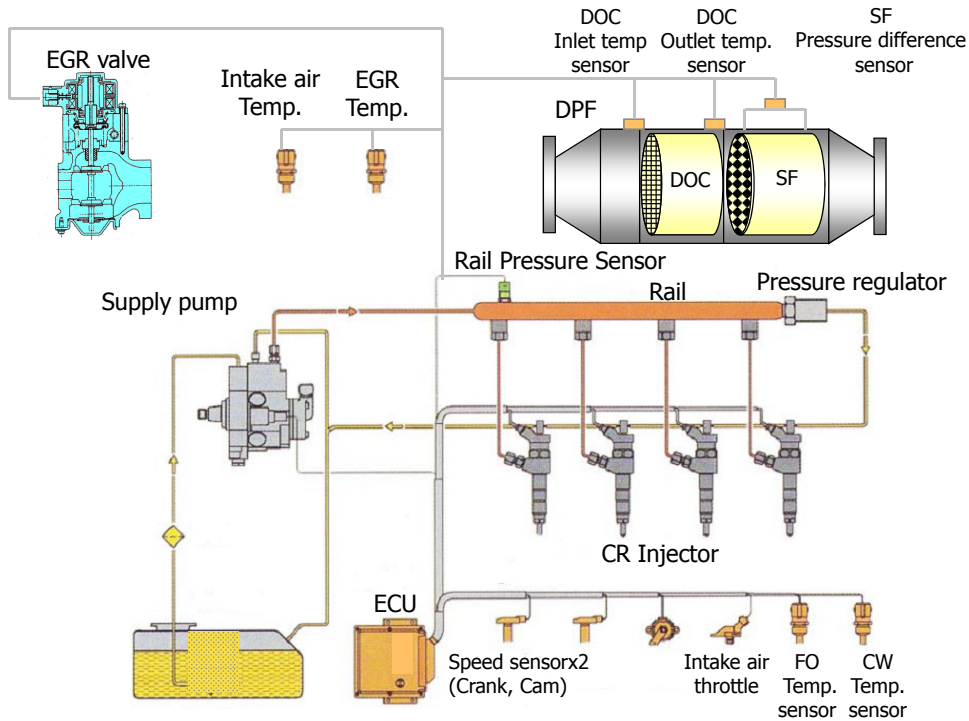
- A. Service for CR system**
- B. Service for DPF**
- C. Service tool (SMARTASSIST-Direct)**

Service for the CR system

Contents of Service for CR system

1. Outline of service for CR system
2. Service procedure
3. Investigation of failed parts

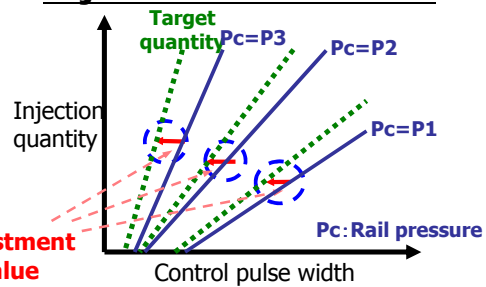
Outline of CR-System



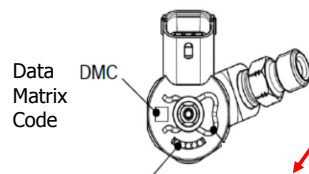
Feature of CR-System (1) : Injector Trim Data

The trim data for guaranteeing predetermined injection quantity for every individual injector is indicated. And these data are registered in the ECU

Injector characteristics

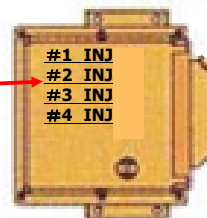


Top of injector (Bosch)



Alpha-num-code

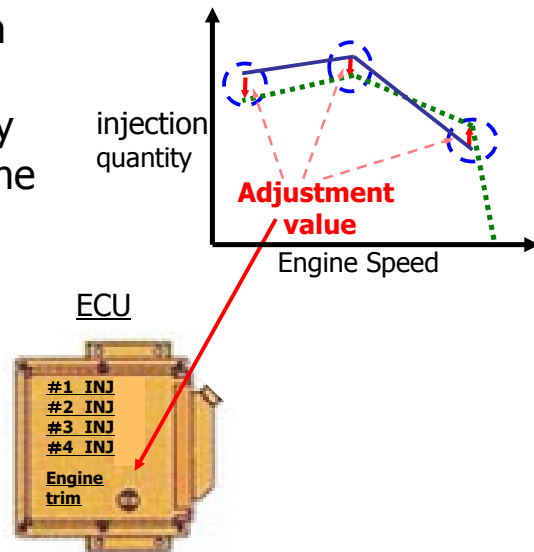
ECU



ECU has an injector Trim data for each cylinder.
At the time of injector exchange, the trim data in ECU needs to be rewritten using a service tool.

Feature of CR-System (2) : Engine Trim Data

In order to apply to emission control regulation, there is the injection quantity trim data corresponding to the performance for each single engine in the ECU.

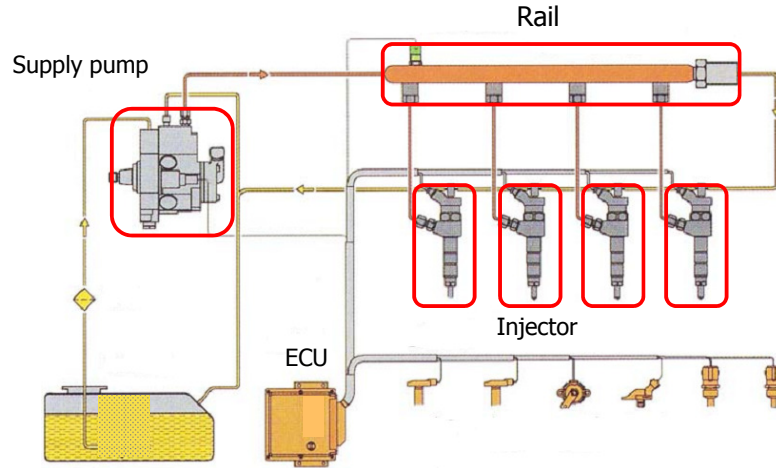


It is necessary to write these trim data in new ECU using a service tool at the time of ECU exchange.

Contents of Service for CR system

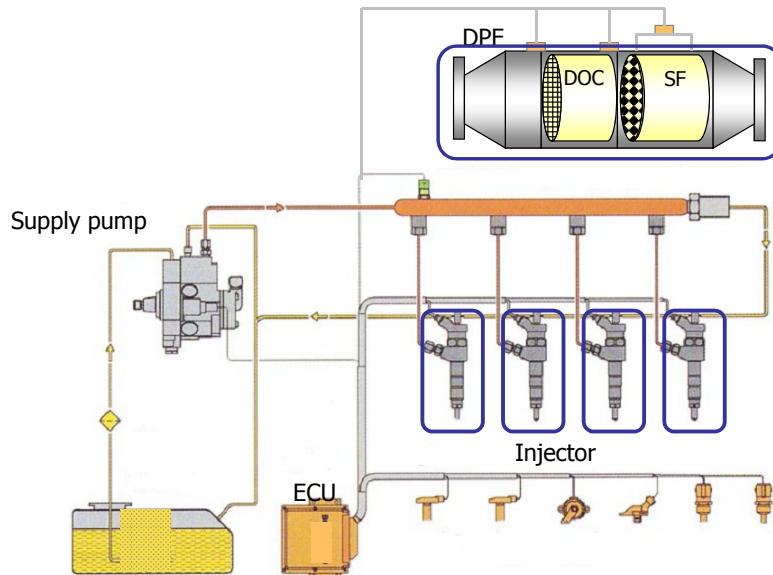
1. Outline of service for CR system
2. **Service procedure**
3. Investigation of failed parts

Feature of CR engine service: → Complete parts replacement



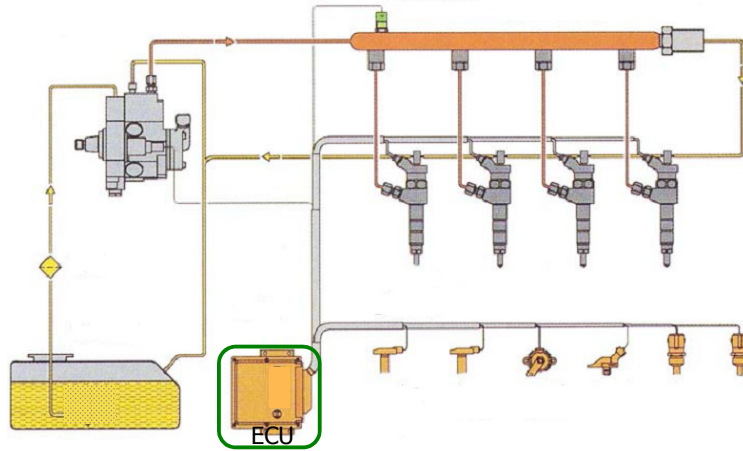
Service Parts in Red color box are prepared as complete parts only.
When service is required, complete part replacement is required.

Feature of CR engine service: → Re-write Trim data in ECU



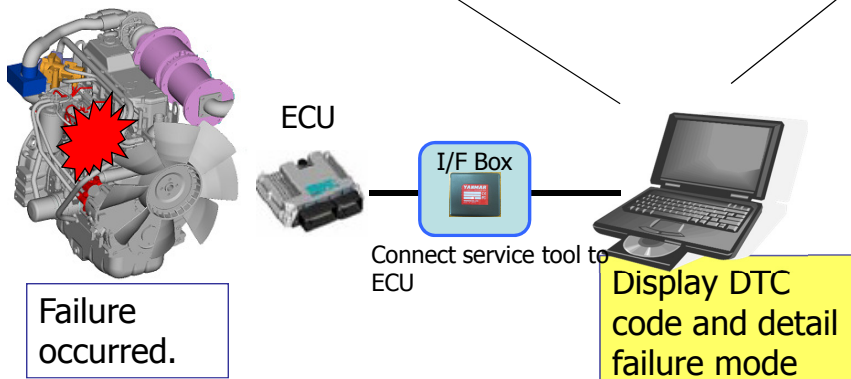
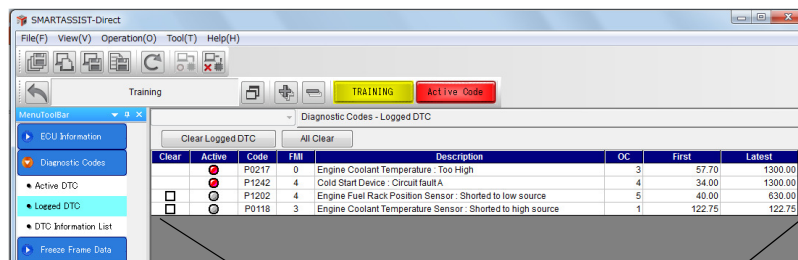
It is necessary to re-write Trim Data in ECU, if replacement of injector are required.
And it is also necessary to reset DPF information in ECU, if replacement or cleaning of DPF is required.

Feature of CR engine service: → Flash the ECU with software and data

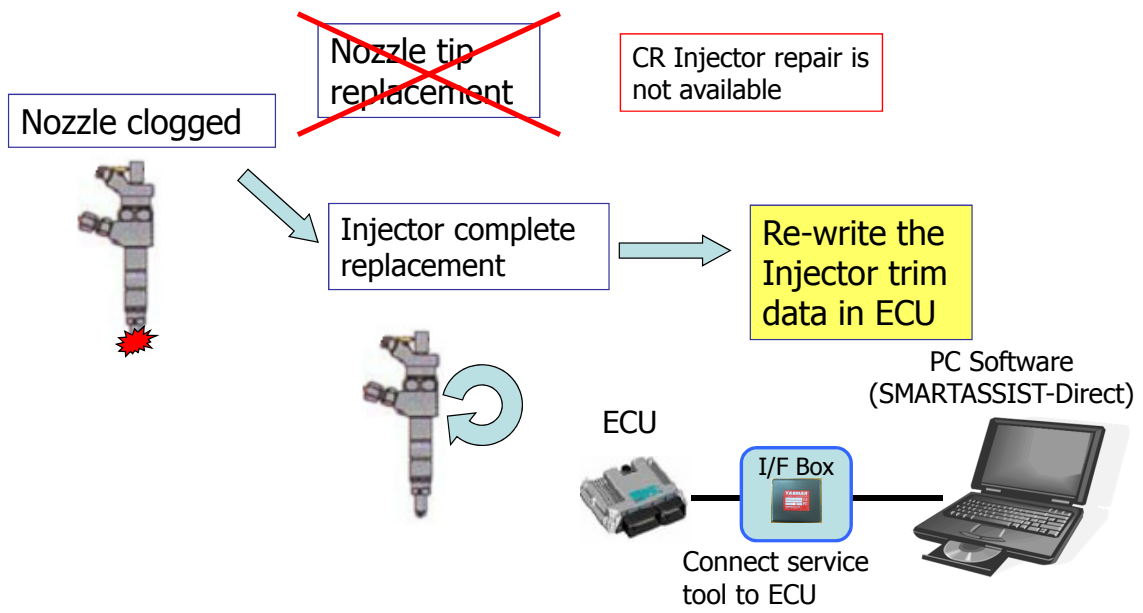


Service ECU, which is prepared to the field service, does not have software or data. ECU software and Engine trim data are able to be downloaded from the data server (SA-C) through the SA-D. Then complete ECU is flashed from Service ECU using SA-D.

CR engine service in the field: (Example 1: Troubleshooting)

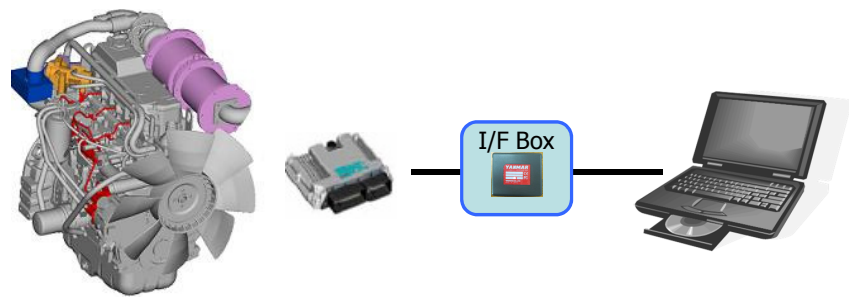


CR engine service in the field: (Example2: Parts replacement)



Feature of CR engine service

The service tool is necessary for Troubleshooting and parts replacement (CR parts and DPF)



General part table related to CR system (1/2) :

		kW<56(Bosch)	remark
Rail assy.		2types (3cyl,4cyl)	Replace as assy.
	Pressure sensor	1type	
	Pressure Regulator	1type	
Fuel Supply Pump		1type	Replace as assy.
	Fuel Oil Temp.	1type	
Fuel Injector		4types	For 3TNV88C & 4TNV88C For 3TNV86CT & 4TNV86CT For 4TNV98C For 4TNV98CT
HPP(High Pressure Pipe)		3types	For 3TNV86CT & 3TNV88C For 4TNV86CT & 4TNV88C For 4TNV98C & 4TNV98CT
Intake Air Throttle Valve (sensor equipped)		1type	
EGR Valve		3types (Valve diameter is varied)	For 3TNV86CT & 3TNV88C For 4TNV86CT & 4TNV88C For 4TNV98C & 4TNV98CT
Service ECU		1type	
DPF	Case	3types (size)	
	Diesel Oxidation Catalyst	5types (size)	
	Soot Filter	3types (size)	

General part table related to CR system (2/2) :

		kW<56(Bosch)	remark
Sensors	CWT (Coolant Water Temp.)	1type	
	IAT (Intake Air Temp)	1type	
	NAT (Intake Air temp., after Intake throttle)	1type	
	EGT (Exhaust Gas Temp.)	3types (Harness length)	
	EGRT (between EGR valve and EGR Cooler)	1type	
	DOC In Temp.	1type or more (Harness length)	Planning
	DOC Out Temp.	1type or more (Harness length)	Planning
	Pressure difference sensor (between Intake and Exhaust.)	1type	
	Pressure difference sensor (between SF in and out)	1type	
	Cam speed	1type	
	Crank speed	1type	

Required condition of Fuel Oil and Lubrication oil

■Fuel Oil

- Cetane number should equal 45 or higher
- Sulfer content of the diesel fuel should be less than **15 ppm**.

■Classification of Lubricating Oil

- API classification **CJ-4**
TBN Value \geq under confirmation(CJ-4)
- ACEA classification **E-6**
TBN Value \geq 7(E-6)
- JASO classification **DH-2**
TBN Value \geq 5.5(DH-2)

*TBN: Total Base Number

■It is unable to guarantee, in case a problem occurs using unsuitable fuel or lubricating oil.

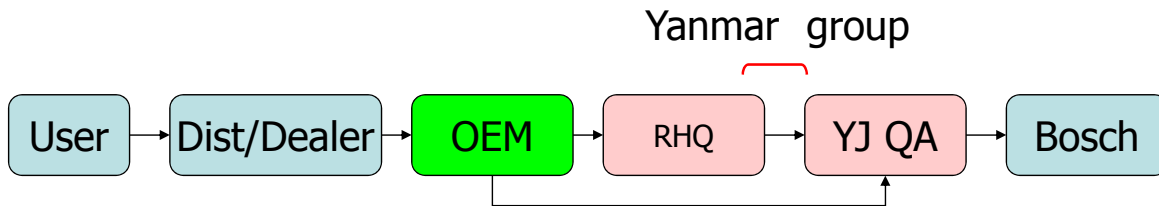
■Tier4 (CR) Engine sales out of a regulated area is not allowed.

Contents of Service for CR system

1. Outline of service for CR system
2. Service procedure
3. **Investigation of failed parts**

Investigation flow for failed CR parts

Since CR-related parts are not able to be disassembly investigated, the failed CR parts will be collected and investigated by the following route.



Service for DPF

Contents of Service for DPF

1. Outline of DPF
2. Service procedure for DPF

Outline of DPF

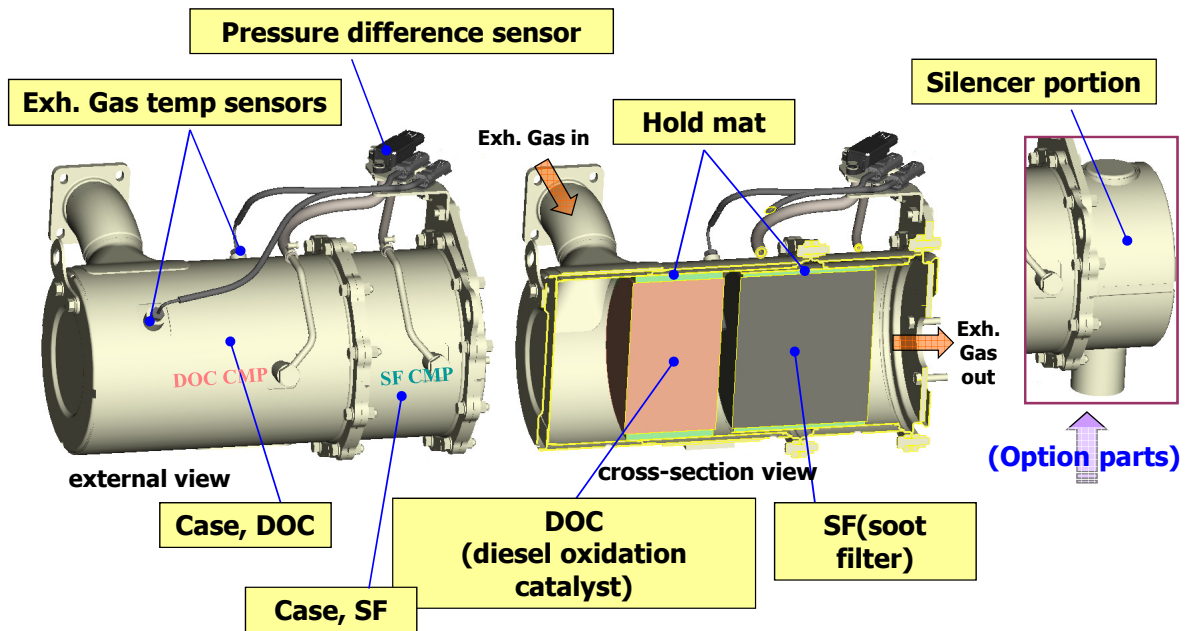
1. Diesel Particulate Filter (DPF)
Diesel Particulate Filter (DPF) is consisting of DOC and SF.

- DOC(Diesel Oxidation Catalyst)
- SF(Soot Filter)

※ It turned out as DPF that it was a registered trademark of Mitsubishi Fuso.
Please use the expression named
“DIESEL PARTICULATE FILTER (DPF) “provisionally.

Outline of Diesel Particulate Filter (DPF)

◆ Diesel Particulate Filter (DPF) Structure



Contents of Service for DPF

1. Outline of DPF
2. Service procedure for DPF

DPF service (Plan)

Service for DPF

DPF can be separated to DOC, SF and the silencer.

The each complete part replacement will be available (Plan)

DPF is registered as emissions-related parts and periodic maintenance of DPF is required.

If SF is replaced, it is necessary to update DPF information in ECU due to the management of the history.

DPF Cleaning

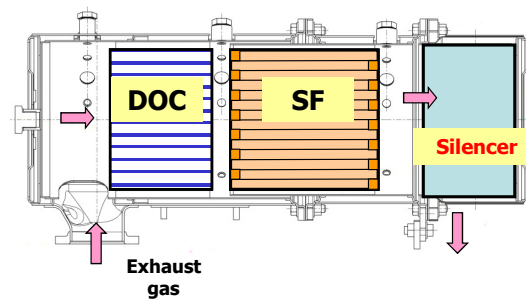
To remove Ash in SF, it is necessary to perform a periodic SF cleaning. DPF cleaning service is scheduled to be performed from the Yanmar service network (Plan).

If SF is cleaned, it is also necessary to update DPF information in ECU due to the management of the history.

DPF service

DOC: maintenance-free parts
Replacement only, every 9000hrs of operation

SF : maintenance is required parts
Perform the cleaning every 3000hrs of operation



Item	Engine Type	Emission warranty (Useful Life)	Periodic Maintenance Interval	
			Replacement	Clean
DOC	19-37kW	5000hrs or 7years, whichever comes first.	Every 9000hrs of operation	Not necessary
	≥37kW	8000hrs or 10years, whichever comes first.		
SF	19-37kW	5000hrs or 7years, whichever comes first.	Every 9000hrs of operation	Every 3000hrs of operation
	≥37kW	8000hrs or 10years, whichever comes first.		

Service tool (SMARTASSIST-Direct)

Contents of Service tool (SMARTASSIST-Direct)

1. **Background**
2. Outline of Service tool (SA-D)
3. Service policy
4. Operations Guidelines of SA-D

Background

To enhance security and user management, Yanmar developed new service tool, **SMARTASSIST-Direct**.

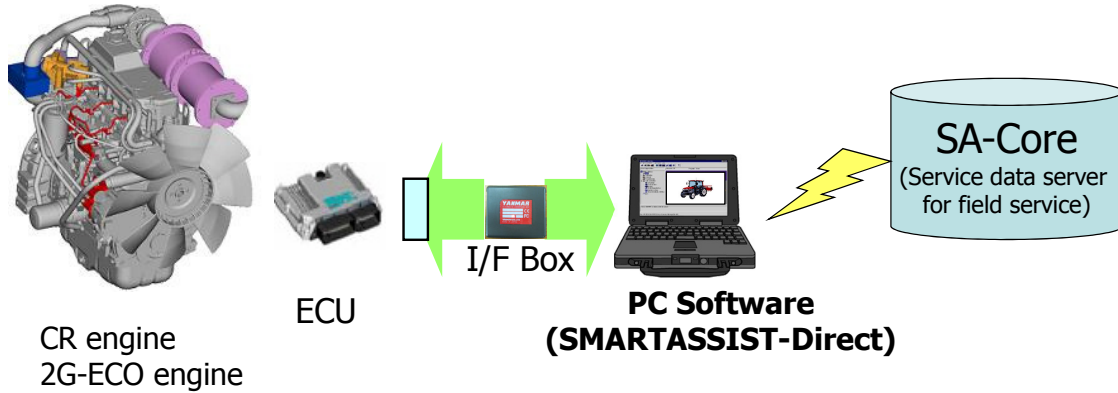
The service tool shifts from YDT to SMARTASSIST-Direct.

With this shift, operation method of user management and fee charge will be changed.

Contents of Service tool (SMARTASSIST-Direct)

- C-1. Background
- C-2. Outline of Service tool (SA-D)**
- C-3. Service policy
- C-4. Operations Guidelines of SA-D

Outline of Yanmar Service tool (SMARTASSIST-Direct)



- Connector (Deutsch-DTM Series)
- Special Signal Converter (USB-CAN)
- Software Provided by CD-ROM initially,
And download to update through Internet

Screen image of Troubleshooting

The screenshot displays the SMARTASSIST-Direct software interface. It is divided into three main sections:

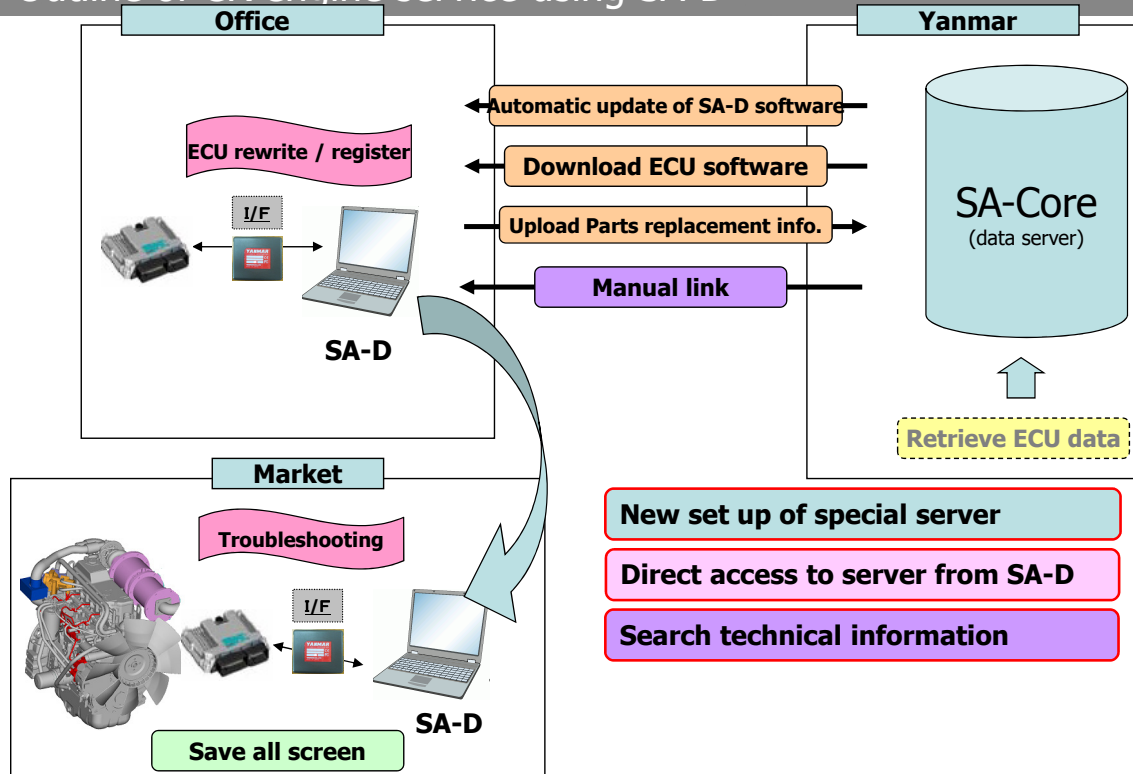
- DTC (Diagnostic Trouble Code):** A table showing active codes and their descriptions.
- Historical data:** A bar chart showing engine load percentage over time, with a corresponding data table.
- System information:** A table providing detailed specifications for the engine, fuel system, and ECU.

Clear	Active	Code	FMI	Description	Action
		P0217	0	Engine High	
		P1242	4	Cold Start	
		P1202	4	Engine	Shorted to low source
		P0118	3	Engine Coolant Temperature Sensor	Shorted to high source

Engine Load(%)	0-99	100-124	125-149	150-174	175-199	200-249	250-100	Total	(%)
0.49	0.50	1.00	1.50	2.00	2.50	3.00	2.00	1.00	13.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.50	1.00	1.50	2.00	2.50	3.00	2.00	1.00		
3.70	7.41	11.11	14.81	18.52	22.22	14.81	7.41		

System Group	Type	Value	Unit
Engine	Type	4TNV98-Z00X	
	Rated RPM	2000.00	r/min
	SNo	54321	
	Manufacturing Test Date	080520	
Fuel System	Type	2GECO_MP_TNV	
	Part No.	729938-5100X-	
ECU	Sno.	080528Z321	
	Part No.	1R1992-0000X**	
	SNo.	0852754321	

Outline of CR engine service using SA-D



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Comparison of YDT and SA-D

		YDT	SA-D
Function	Operativity	-	improved
	Manual link	-	available
	Applicable engine	Tier3	Tier3, Tier4(CR)
License	User management	manage per company	manage per individuals
	Security check	-	Every 3 month through internet
Fee	Initial fee *	charged	charged
	Annual fee	-	charged

* Initial fee is not required if you already have I/F Box.

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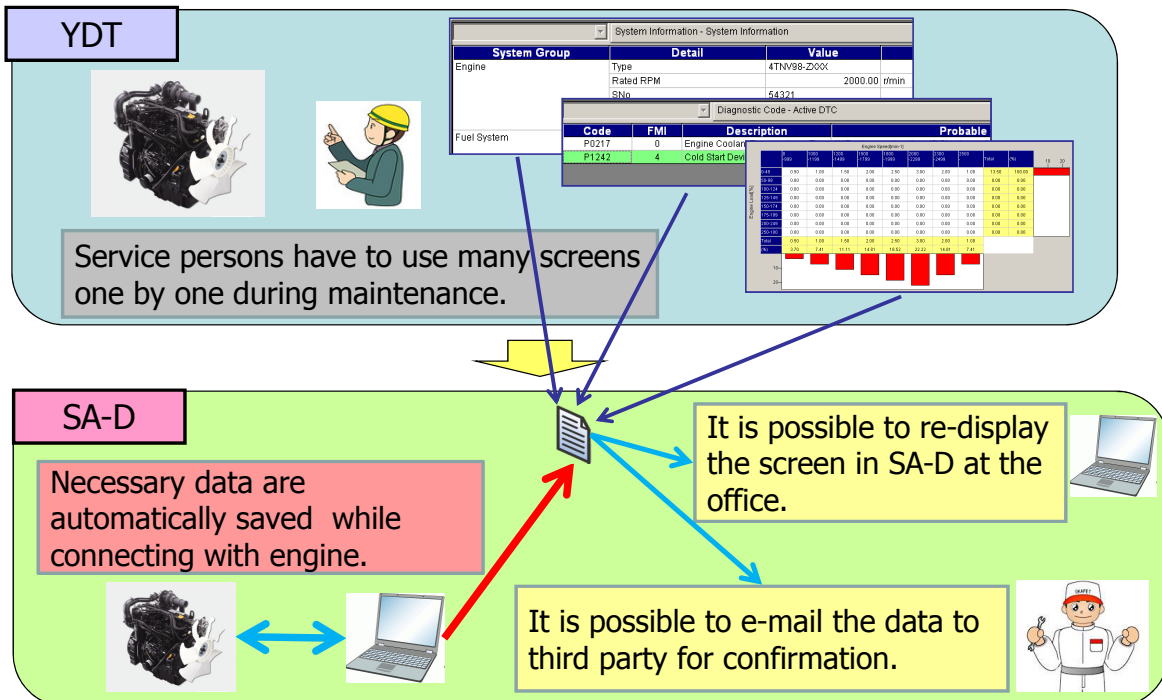
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Necessity of annual fee charge

Annual fee is necessary for the maintenance of SA-D system.
Collected fee is used for following reasons.

- Maintenance of server system
 - new server is established for SA-D system
- User management
 - for security reason, individual user is registered and managed
- Update of SA-D software
 - correspondence to new Windows version
 - development of new function

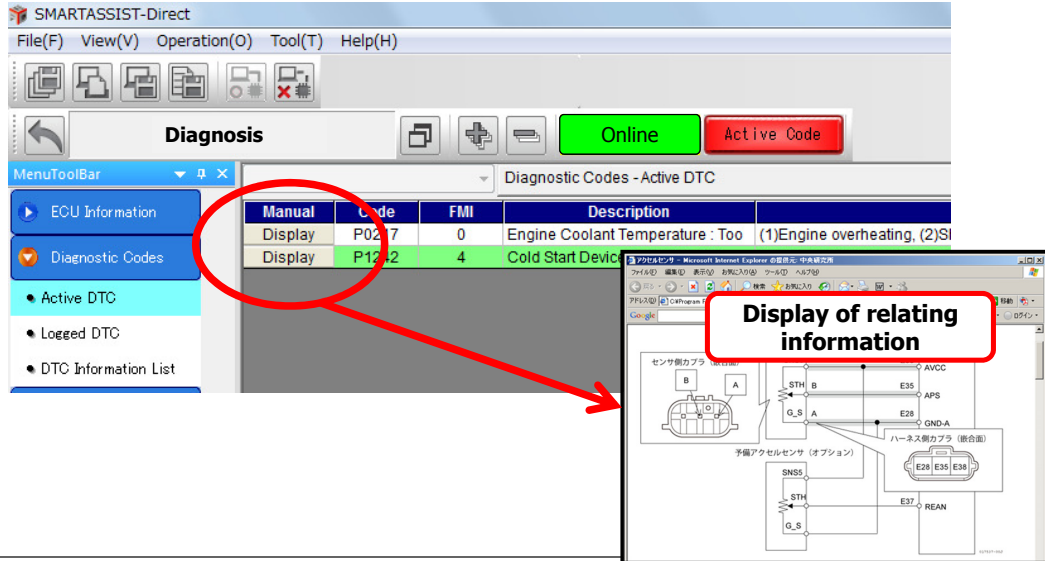
Improvement of data handling



Manual link function

SA-D has function that links to maintenance and service information data in addition to YDT trouble display function. You can use the function by clicking display item.

This function enables immediate trouble-shooting and provides a hands-on solution.



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Main additional function for Tier4

CR Parts replacement (re-write data in ECU)

➤ Injector

➤ Diesel Particulate Filter
(Soot Filter, Diesel Oxidation Catalyst)

Active control

➤ It is possible to control engine run /off operation and fuel cutting of supply pump by SA-D → Compression test is available.

➤ It is possible cylinder cut off test by SA-D → troubleshooting for each cylinder is available.

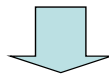
Contents of Service tool (SMARTASSIST-Direct)

1. Background
2. Outline of Service tool (SA-D)
3. **Service policy**
4. Operations Guidelines of SA-D

Background of service policy for CR engine

■ **It will increase the frequency in use service tool in the market (troubleshooting, injector replacement etc.) through CR engine service**

■ **New service tool and data management system are created in order to comply strictly with security for CR service information in between OEMs.**



■ **Data writing/flashing into ECU is possible by OEM**
■ **Proactive engine service support by OEM will be also required in order to prevent the down time from end users.**

Yanmar's proposal of CR engine service

- Service of the CR engine is performed by OEM service network

It is also possible to serve the Yanmar brand engine from the Yanmar network. However, Yanmar cannot support the demand of service excluding the sales specification region

- Service tool (SA-D) is indispensable to the CR engine

Service tool can be provided to OEM with charge.

Contents of Service tool (SMARTASSIST-Direct)

1. Background
2. Outline of Service tool (SA-D)
3. Service policy
4. Operations Guidelines of SA-D

Outline of license mode

SA-D has the following modes according to user's usage pattern.

Mode	Outline
Standard	It is possible to use the function of troubleshooting only .
Advanced	It is possible to use all function like troubleshooting and writing/flashing ECU and so on .

License mode function

Mode		Standard	OEM Advanced
Security check	Security period	90 days	90 days
	Temporary relief of expiration	7 days	7 days
License update		O	O
Usable engine model		All models	OEM model only
Troubleshooting	Basic troubleshooting	O	O
Parts replacement	Rewrite parameter	X	O
	ECU writing	X	O
Logging data save and re-display		X	O
ECU maintenance information upload		O	O
ECU all data save and re-display		O	O
ECU information	ECU data save	O	Δ
Service information	Manual link	X	Δ
O: Possible to use, X: Impossible to use, Δ: Depending on discussion with OEM			

Time chart of annual fee charge (example)

	2013	2014	2015
Case 1			
Case 2			
Annual fee	Free of charge	Charge	Charge

The first year of contract, the annual fee is free of charge.
For example, in both case 1 and 2, the annual fee for 2013 is free of charge.

Application form of SA-D

Application form for SMARTASSIST-Direct
** : Required for new applications, changes or cancellations

SMARTASSIST Direct

Application type ** New Change Cancel
 Application date **
 Company name **
 Department
 Country **
 Delivery address for the interface box, contract and application documents:
 Postal Code **
 Address **
 Telephone **
 Country Code ()
 Country Code ()
 Name **
 E-Mail **

Service (before the change)
 * : Required for changes
 Click on the box and choose the Mode

Service (after the change)
 * : Required for new applications, for changes
 Click on the box and choose the Mode

Number of necessary interface boxes
 Desired date
 * : Required for new applications, for changes
 * The annual service fee depends on the number of interface boxes. Please contact YANMAR for details.

License serial number for cancellation * : Required for cancellation

* To find the license serial number, go to Help (H) of SMARTASSIST Direct, click Version Information, open the Workstation Information screen, and check under License Information.

Use * : Required for new applications for changes Click on the box and choose the condition

No.	Name (local language)	(English) E-mail	Type of change	YDS user ID
Ex	Kyoko Nomura	kyoko.nomura@yanmar.co.jp	Delete	Yes
Ex	Tommy Johnson	thompson@yanmar.co.uk	Add	No
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Memo

Yanmar send Application form for SMARTASSIST-Direct by e-Mail or electronic media.
Fill the form and send back to YANMAR by e-Mail.

Parts exchange

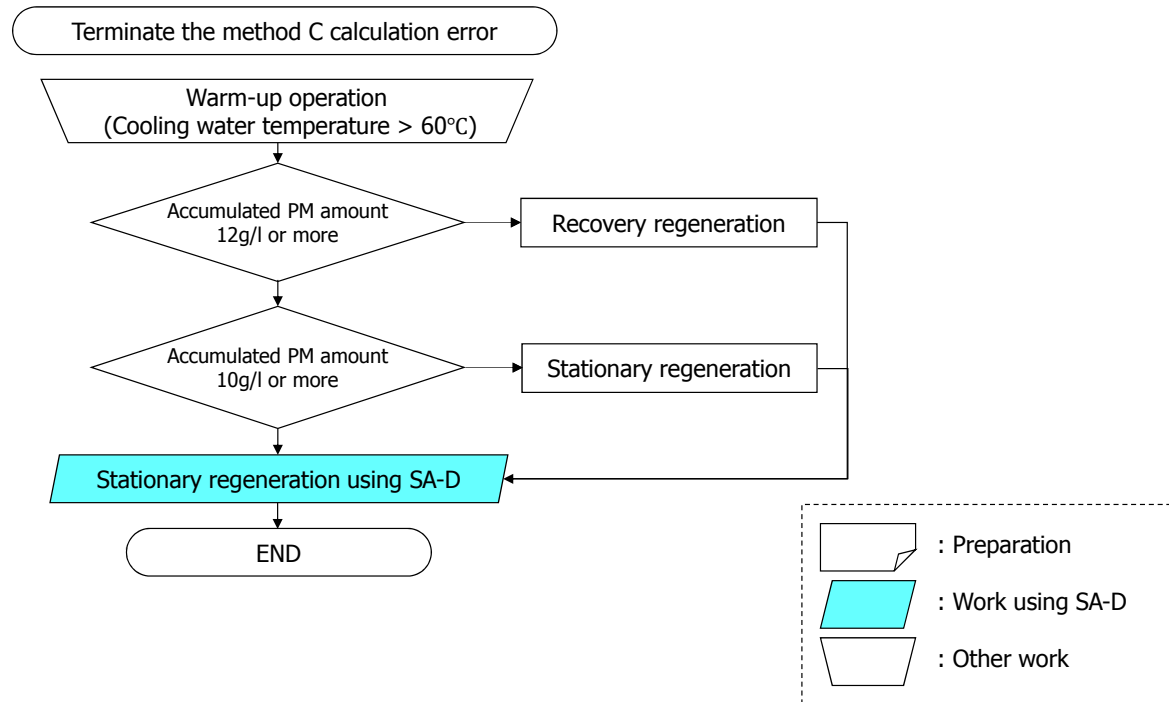
Processing the DPF regeneration after the parts replacement

The following devices are used for the calculation of the accumulated PM amount using the method C, so when there is a fault in these devices, the accumulated PM amount may be miscalculated. Therefore, be sure to process the DPF regeneration in order to eliminate the calculation error of the accumulated PM amount when you replace the parts for these devices.

- | | |
|---------------------------------------|------------------------------------|
| - Injector | - DOC |
| - Supply pump | - Rail |
| - EGR valve | - Intake throttle |
| - DPF differential pressure sensor | - DPF inlet temperature sensor |
| - DPF inside temperature sensor | - ER pressure sensor |
| - Intake manifold temperature sensor | - EGR gas temperature sensor |
| - Exhaust manifold temperature sensor | - Crankshaft speed sensor |
| - Fuel temperature sensor | - Cooling water temperature sensor |

- (1) Start and warm-up the engine until the cooling water temperature is 60°C or higher.
- (2) When the accumulated PM amount is judged by the ECU as 12g/l or more, the recovery regeneration request is displayed. Perform the recovery regeneration.
- (3) When the accumulated PM amount is judged by the ECU as 10g/l or more, the stationary regeneration request is displayed. Perform the stationary regeneration.
- (4) When none of the above regeneration requests are displayed by the ECU, perform the stationary regeneration using SMARTASSIST-Direct.

Flow Chart (Processing the DPF regeneration after the parts replacement)

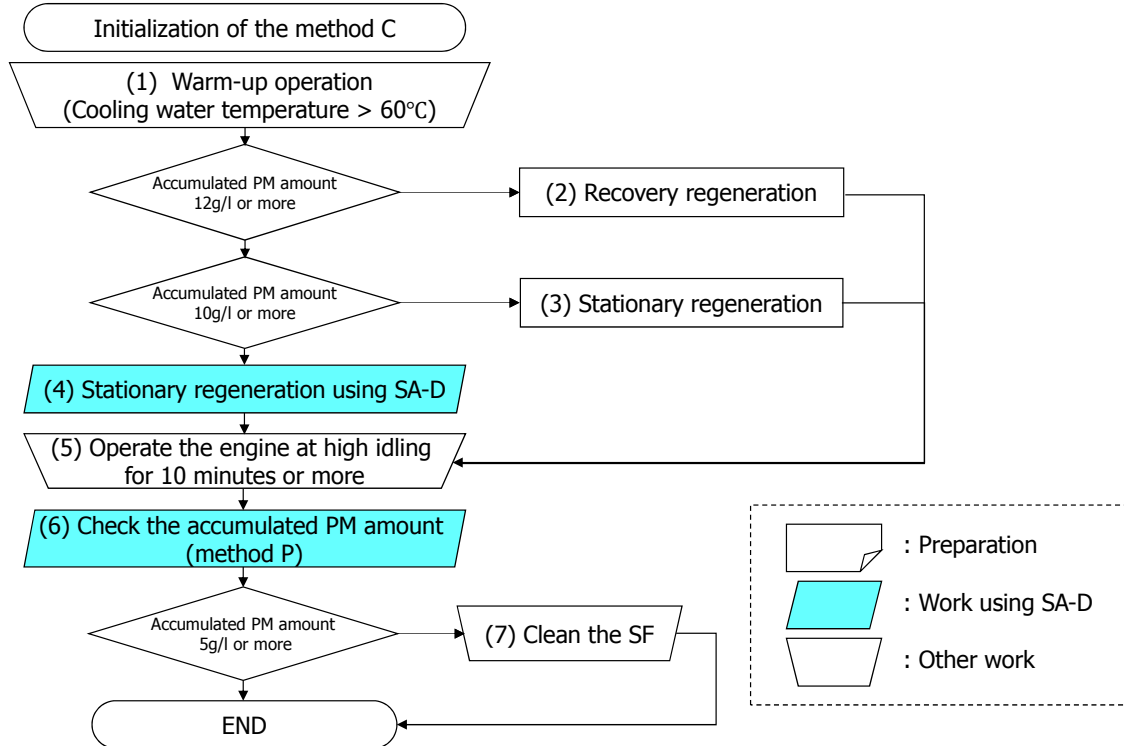


Processing after the ECU replacement (when it is impossible to inherit from the old ECU)

When the history data could not be inherited from the old ECU at the time of replacing the ECU, process the DPF regeneration and check the accumulated ash amount in accordance with the following procedures.

- (1) Start and warm-up the engine until the cooling water temperature is 60°C or higher.
- (2) When the accumulated PM amount is judged by the ECU as 12g/l or more, the recovery regeneration request is displayed. Perform the recovery regeneration.
- (3) When the accumulated PM amount is judged by the ECU as 10g/l or more, the stationary regeneration request is displayed. Perform the stationary regeneration.
- (4) When none of the above regeneration requests are displayed by the ECU, perform the stationary regeneration using SMARTASSIST-Direct.
- (5) After the completion of the above regeneration, operate the engine at high idling for 10 minutes or more until the method P is stabilized.
- (6) Check the accumulated amount of the method P using SMARTASSIST-Direct.
- (7) When the accumulated amount exceeds 5g/l, there is a possibility that ash is overaccumulated in the DPF. Clean the SF.

Flow Chart (Processing after the ECU replacement)
(when it is impossible to inherit from the old ECU)



Required processing at the CR-related parts replacement

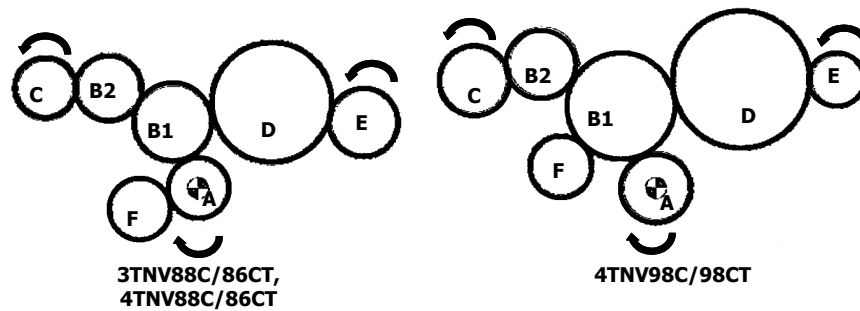
Replacement parts	SA-D operation			
	Bosch		DENSO	
	ECU rewrite	Processing DPF regeneration	ECU rewrite	Processing DPF regeneration
ECU	○	○ *2	○	○ *2
Injector	○	○	○	○
DPF	○	○	○	○
SF	○	○	○	○
DOC	○	○	○	○
Rail	○	○	-	○
Supply Pump	-	○	○	○
Other *1	-	○	-	○

*1 EGR valve, intake throttle, DPF differential pressure sensor, DPF inlet temperature sensor, DPF inside temperature sensor, EGR pressure sensor, intake manifold temperature sensor, EGR gas temperature sensor, exhaust manifold temperature sensor, crankshaft speed sensor, fuel temperature sensor, cooling water temperature sensor.

*2 When the history data could not be inherited from the old ECU, processing the DPF regeneration is required. Furthermore, it is required to clean the SF when the accumulated amount by method P after the DPF regeneration exceeds 5g/l.

Front Gear Drive Train

Front Gear Train *



A – Crank Shaft

B1 – Idler Gear

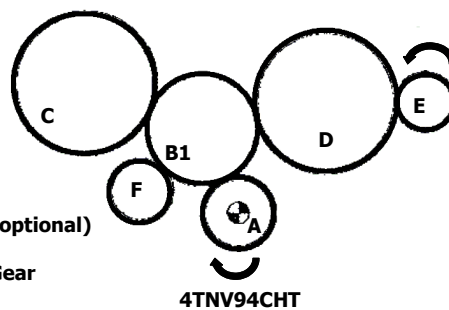
B2 – Idler Gear

C – Fuel Pump Drive Gear

D – Cam Gear

E – Hydraulic Pump Drive Gear (optional)

F – Lubricating Oil Pump Drive Gear



* Viewed from the front gear case

Front Gear Drive Train

Code	Gear Name		Number of teeth		
			3TNV88C/86CT 4TNV88C/CT	4TNV98 C/CT	4TNV98 C/CT 4TNV94CHT
A	Crank Shaft Gear	S	28	32	32
B1	Idler Gear	S	37	42	50
B2	Idler Gear	S	31	31	*
C	Fuel Pump Drive Gear	S	28	32	64
D	Cam Shaft Gear	S	56	64	64
E	Hydraulic Pump Drive Gear	O	31	26	26
F	Lubricating Pump Drive Gear	S	*	29	29

THANK YOU FOR YOUR ATTENTION.

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