



# "EXIMOTOR" SA

Rețea de magazine auto

Anexa nr. 7

la Documentația standard nr. \_\_\_\_\_  
din "\_\_\_\_\_" \_\_\_\_\_ 20\_\_\_\_

## CERERE DE PARTICIPARE

Către Administrația Națională a Penitenciarelor, mun. Chișinău, str. Nicolae Titulescu 35, MD-2032

**Stimați domni,**

Ca urmare a anunțului/invitației de participare/de preselecție apărut în Buletinul achizițiilor publice și/sau Jurnalul Oficial al Uniunii Europene, nr. ocds-b3wdp1-MD-1769772380856 din 23/02/2026, (ziua/luna/anul), privind aplicarea procedurii pentru atribuirea contractului Generatoare de curent, (denumirea contractului de achiziție publică), noi „Eximotor SA” (denumirea/numele ofertantului/candidatului), am luat cunoștință de condițiile și de cerințele expuse în documentația de atribuire și exprimăm prin prezenta interesul de a participa, în calitate de ofertant/candidat, neavând obiecții la documentația de atribuire.

Data completării 23.02.2026

Cu stimă,

Ofertant/candidat

(semnătura autorizată)





# "EXIMOTOR" SA

Rețea de magazine auto

Anexa nr. 8

la Documentația standard nr. \_\_\_\_\_  
din "\_\_\_\_" \_\_\_\_\_ 20\_\_\_\_

## DECLARAȚIE

### privind valabilitatea ofertei

Către Administrația Națională a Penitenciarelor, mun.Chișinău, str.Nicolae Titulescu 35, MD-2032

Stimați domni,

Ne angajăm să menținem oferta valabilă, privind Generatoare de curent, prin procedura de achiziție Licitatie deschisă, pentru o durată de 90 (noua zeci) zile, (durata în litere și cifre), respectiv până la data de 27.05.2026 (ziua/luna/anul), și ea va rămâne obligatorie pentru noi și poate fi acceptată oricând înainte de expirarea perioadei de valabilitate.

Data completării 23.02.2026 Cu stimă,

Ofertant/candidat

(semnătura autorizată)





**BANCA:**

BC „MAIB” S.A.,  
str. 31 august 1989, 127, mun. Chișinău, MD-2012, Republica Moldova  
codul fiscal 1002600003778

**SCRISOARE DE GARANȚIE BANCARĂ**

pentru participare cu ofertă la procedura de atribuire a contractului de achiziție publică  
nr. LD2605000418 din 19 februarie 2026

Către **Administrația Națională a Penitenciarelor**, cu sediul în MD-2032, Republica Moldova, mun. Chișinău, str. Nicolae Titulescu nr. 35, codul fiscal 1006601001012 cu privire la procedura de atribuire a contractului privind achiziționarea Generatoare de curent, licitația publică nr. ocds-b3wdp1-MD-1769772380856 din 23.02.2026.

Subsemnata **BC ”MAIB” S.A.**, cu sediul în mun. Chișinău, MD-2012, str. 31 august 1989, 127, codul fiscal 1002600003778 ne obligăm față de **Administrația Națională a Penitenciarelor**, să plătim suma de **8 400,00 MDL (opt mii patru sute lei 00 bani)**, la prima sa cerere scrisă și fără ca acesta să aibă obligația de a-și motiva cererea respectivă, cu condiția, ca în cererea sa autoritatea contractantă să specifice că suma cerută de ea și datorată ei este din cauza existenței uneia sau mai multora dintre situațiile următoare:

1. Ofertantul **“Eximotor” S.A.** codul fiscal 1002600034712, își retrage sau modifică oferta în perioada de valabilitate a acesteia;  
Prezenta ofertă rămâne valabilă pentru perioada de timp specificată în Anexa nr. 2 Anunțul de Participare, începând cu data-limită pentru depunerea ofertei, în conformitate cu Anexa nr. 2 Anunțul de Participare, și rămâne obligatorie și poate fi acceptată în orice moment până la expirarea acestei perioade;
2. Oferta sa fiind stabilită câștigătoare, ofertantul **“Eximotor” S.A.**, nu a constituit garanția de bună execuție;
3. Oferta sa fiind stabilită câștigătoare, ofertantul **“Eximotor” S.A.** a refuzat să semneze contractul de achiziție publică de bunuri/servicii;
4. nu se execută vreo condiție, specificată în documentația de atribuire înainte de semnarea contractului de achiziție publică de bunuri/servicii.

Orice litigiu apărut pe parcursul realizării prezentei garanții va fi soluționat pe calea negocierilor. În cazul când părțile nu vor soluționa litigiile apărute prin negocieri, acestea vor fi soluționate în conformitate cu legislația Republicii Moldova.

Prezenta garanție intră în vigoare la data de **23 februarie 2026** și este valabilă până la data de **25 mai 2026** inclusiv.

Digitally signed by Cociorva Ion  
Date: 2026.02.19 16:28:13 EET  
Reason: MoldSign Signature  
Location: Moldova

MOLDOVA EUROPEANĂ



**Ion Cociorva**

Director Relații Clienți Corporativi  
BC ”MAIB” S.A.

Emiterea prezentei Garanții poate  
fi verificată pe pagina web a băncii [www.maib.md](http://www.maib.md),  
compartimentul Garanții bancare



**Garantul: B.C."MAIB" S.A.**, str. 31 August 1989, nr.127, MD – 2012, mun. Chișinău, Republica Moldova, codul fiscal 1002600003778.

**Administrația Națională a Penitenciarelor**, MD-2032, Republica Moldova, mun. Chișinău, str. Nicolae Titulescu nr. 35, codul fiscal 1006601001012

**AMENDAMENTUL nr. 1**  
**la Scrisoarea de garanție bancară nr. LD2605000418 din 19 februarie 2026**

**Data: 19 februarie 2026**

**mun. Chișinău**

Prin prezentul,

**B.C."MAIB" S.A.**, cu sediul pe 31 August 1989, nr.127, mun. Chișinău, MD-2012, Republica Moldova, codul fiscal 1002600003778, denumită în continuare „Garant”, în persoana dlui Ion Cociorva, Director relații Clienți Corporativi, care acționează în baza Actelor normative interne ale băncii, la cererea,

**"Eximotor" S.A.**, cu sediul pe str. Aerodromului, 15, ap. 6, mun. Chișinău, Republica Moldova, codul fiscal 1002600034712, denumită în continuare „Ordonator”, în persoana d-nei Socolova Natalia, Administrator al societății, care acționează în baza Statutului societății, eliberează prezentul amendament la Scrisoarea de garanție bancară nr. **LD2605000418** din **19 februarie 2026**, în continuare - „Garanție bancară” pentru a fi prezentată **Administrația Națională a Penitenciarelor**, denumit în continuare "Beneficiar", în următoarele condiții:

1. În textul Garanției bancare sintagma „**8 400,00 MDL (opt mii patru sute lei 00 bani)**” se substituie cu sintagma „**9 200,00 (nouă mii două sute lei 00 bani)**”.
2. Celelalte condiții ale Garanției bancare nu se modifică.
3. Dreptul asupra prezentului amendament la Garanția bancară nu este transmisibil altor persoane în nici un mod.
4. Prezentul amendament intră în vigoare din data semnării.

**Ion Cociorva,**  
Director Relații Clienți Corporativi  
B.C. "MAIB" S.A.

Digitally signed by Cociorva Ion  
Date: 2026.02.19 16:28:20 EET  
Reason: MoldSign Signature  
Location: Moldova

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## Specificații tehnice

Numărul procedurii de achiziție ocds-b3wdp1-MD-1769772380856Obiectul de achiziției: „**Generatoare de curent**”

Denumirea serviciilor	Denumirea modelului bunului/ serviciului	Țara de origine	Producătorul	Specificarea tehnică deplină solicitată de către autoritatea contractantă	Specificarea tehnică deplină propusă de către ofertant
1	2	3	4	5	6
<b>Lotul nr. 1: Generator de curent industrial de tip închis cu carcasă insonorizată, cu puterea minim 240 kW, 300 kVA</b>					
<b>Generator de curent industrial de tip închis cu carcasă insonorizată, cu puterea minim 240 kW, 300 kVA</b>	Generator de curent industrial de tip închis cu carcasă insonorizată LG260C	China	FUAN LONGKAI POWER CO., LTD.	Conform caietului de sarcini	Specificații tehnice: - Dotat cu panou de control cu posibilitatea monitorizării moto-orelor, presiunii, temperaturii lichidului de răcire, nivelului de combustibil, sistem de pornire/oprire automat la comanda panoului AAR (ATS/ABP); - Buton de oprire în caz de avarie; - Tipul motorului – diesel; - Sistem electronic de control al turației (vitezei de rotație a motorului); - Filtre de aer, combustibil și ulei înlocuibile; - Sistem de răcire cu lichid cu radiator; - În complet cu un încălzitor de apă conectat prin furtun la motor, pentru a porni generatorul mai ușor în condiții nefavorabile pe timp de iarnă; - Perne anti vibrații la motor și carcasă din cauciuc și/sau alt material care va diminua vibrațiile când generatorul funcționează; - Puterea nominală: 240 kW, 300 kVA;





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					<ul style="list-style-type: none"><li>- Tensiunea: 380/220 V; 400/230 V; 415/240 V;</li><li>- Frecvența: 50 Hz;</li><li>- Numărul de faze: 3;</li><li>- Reglarea tensiunii <math>\pm 0.25\%</math> – 1 %, pentru o precizie bună necesară în aplicații sensibile cum ar fi echipamente medicale și sisteme IT;</li><li>- Clasa de izolare: H (clasa termică a materialelor izolatoare folosite în înfășurări);</li><li>- În ofertă va fi inclus suplimentar: panoul AAR (ATS/ABP) cu posibilitatea conectării automate la rețea completat corespunzător generatorului propus;</li><li>- Generatorul va fi dotat cu carcasă insonorizată cu protecție la condițiile meteorologice nefavorabile și uși din ambele părți care vor permite accesul pentru deservirea acestuia, cu posibilitatea de a fi încuiate;</li><li>- Adicional va fi necesar de realizat: confecționarea împământării din materiale rezistente la coroziune (cupru sau zinc), care nu va depăși valoarea maximă admisă și va asigura o protecție sigură la scurgerea curenților de defect din generator;</li><li>- Inclusiv va fi efectuat: livrarea generatorului la destinatar, amplasarea pe platforma existentă, conectarea la împământare și la panoul AAR (ATS/ABP) inclus și conectarea la panoul central al instituției (până la 10 m), firele electrice fiind amplasate prin furtun metalic izolat din PVC sau jgheab metalic;</li><li>- Toate testările și pornirile de probă până la darea în exploatare, vor fi efectuate din contul ofertantului;</li></ul> <p>Termenul de garanție extins pentru bunul propus minim 24 luni de la data primirii/predării, însoțit de certificatul de garanție și manualul de utilizare.</p> <ul style="list-style-type: none"><li>- Termenul de livrare: 90 de zile de la data înregistrării contractului la Trezoreria de Stat</li><li>- Locul livrării: Penitenciarul nr.6 – Soroca.</li></ul>
<b>Lotul nr. 2: Generator de curent industrial de tip închis cu carcasă insonorizată, cu puterea minim 200 kW, 250 kVA</b>					
<b>Generator de curent industrial de tip închis cu carcasă insonorizată,</b>	Generator de curent industrial de tip închis cu carcasă insonorizată	China	FUAN LONGKAI POWER CO., LTD.	Conform caietului de sarcini	<ul style="list-style-type: none"><li>- Specificații tehnice:</li><li>- Dotat cu panou de control cu posibilitatea monitorizării moto-orelor, presiunii, temperaturii lichidului de răcire, nivelului de combustibil, sistem de pornire/oprire automat la comanda panoului AAR (ATS/ABP);</li><li>- Buton de oprire în caz de avarie;</li></ul>

Adresa juridică: RM, mun. Chișinău, MD-2024, str. Aerodromului 15/6  
Adresa poștală: RM, mun. Chișinău, MD-2005, str. Albisoara 38A  
tel. 0 22 407-747; fax. 0 22 407-956  
e-mail: director@coleso.md  
www.coleso.md



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TVA 0603690  
BC "ProCredit Bank" SA  
c/d 2251130060160201  
BIC: PRCBMD22



# "EXIMOTOR" SA

Rețea de magazine auto

<b>cu puterea minim 200 kW, 250 kVA</b>	LG250YTO				<ul style="list-style-type: none"><li>- Tipul motorului – diesel;</li><li>- Sistem electronic de control al turației (vitezei de rotație a motorului);</li><li>- Filtre de aer, combustibil și ulei înlocuibile;</li><li>- Sistem de răcire cu lichid cu radiator;</li><li>- În complet un încălzitor de apă conectat prin furtun la motor, pentru a porni generatorul mai ușor în condiții nefavorabile pe timp de iarnă;</li><li>- Perne anti vibrații la motor și carcasă din cauciuc și/sau alt material care va diminua vibrațiile când generatorul funcționează;</li><li>- Puterea nominală: 250 kW / 313 kVA ;</li><li>- Tensiunea: 380/220 – 400/230 – 415/240 V ;</li><li>- Frecvența: 50 Hz;</li><li>- Numărul de faze: 3;</li><li>- Reglarea tensiunii <math>\pm 0.25-1\%</math>, pentru o precizie bună necesară în aplicații sensibile cum ar fi echipamente medicale și sisteme IT;</li><li>- Clasa de izolare: H (clasa termică a materialelor izolatoare folosite în înfășurări);</li><li>- În ofertă va fi inclus suplimentar: panoul AAR (ATS/ABP) cu posibilitatea conectării automate la rețea completat corespunzător generatorului propus;</li><li>- Amplasarea utilajului va fi efectuată în aer liber, în acest fel se solicită a fi dotat cu carcasă insonorizată cu protecție la condițiile meteorologice nefavorabile și uși din ambele părți care vor permite accesul pentru deservirea acestuia cu posibilitatea de a fi încuiate;</li><li>- Adicional va fi necesar de realizat: confecționarea împământării din materiale rezistente la coroziune (cupru sau zinc), care nu va depăși valoarea maximă admisă și va asigura o protecție sigură la scurgerea curenților de defect din generator;</li><li>- Inclusiv va fi efectuat: livrarea generatorului la destinatar, amplasarea pe platforma confecționată, conectarea la împământare, la panoul AAR (ATS/ABP) inclus și conectarea la panoul central al instituției (până la 10 m), firele electrice fiind amplasate prin furtun metalic izolat din PVC sau jgheab metalic;</li><li>- Toate testările și pornirile de probă până la darea în exploatare, vor fi efectuate din contul ofertantului;</li><li>- Termenul de garanție extins pentru bunul propus 24 luni de la data primirii/predării, însoțit de certificatul de garanție și manualul de utilizare.</li></ul>
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Adresa juridică: RM, mun. Chișinău, MD-2024, str. Aerodromului 15/6  
Adresa poștală: RM, mun. Chișinău, MD-2005, str. Albisoara 38A  
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BIC: PRCBMD22



# "EXIMOTOR" SA

Rețea de magazine auto

					- Termenul de livrare: 90 de zile de la data înregistrării contractului la Trezoreria de Stat - Locul livrării: Penitenciarul nr. 18 – Brănești
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Semnat: \_\_\_\_\_ Numele, Prenumele: Socolova Natalia În calitate de: Director  
Ofertantul: „Eximotor SA”, Adresa: mun. Chișinău, str. Albișoara 38A, MD2005



Adresa juridică: RM, mun. Chișinău, MD-2024, str. Aerodromului 15/6  
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# "EXIMOTOR" SA

Rețea de magazine auto

Anexa nr. 23  
la Documentația standard nr. 115 din 15.09.2021

## Specificații de preț

Numărul procedurii de achiziție ocds-b3wdp1-MD-1769772380856										
Obiectul de achiziție: „Generatoare de curent”										
Cod CPV	Denumirea bunurilor/serviciilor	Unitatea de măsură	Cantitatea	Preț unitar (fără TVA)	Preț unitar (cu TVA)	Suma fără TVA	Suma cu TVA	Termenul de livrare/prestare	Clasificație bugetară (IBAN)	Discount %
1	2	3	4	5	6	7	8	9	10	11
<b>Lotul nr. 1: Generator de curent industrial de tip închis cu carcasă insonorizată, cu puterea minim 240 kW, 300 kVA</b>										
31120000-3	Generator de curent industrial de tip închis cu carcasă insonorizată, cu puterea minim 240 kW, 300 kVA	buc.	1	484 000 lei	580 800 lei	484 000 lei	580 800 lei	În termen de 90 de zile de la data înregistrării contractului la Trezoreria de Stat <b>Locul livrării:</b> Penitenciarul nr. 6 – Soroca		
<b>Lotul nr. 2: Generator de curent industrial de tip închis cu carcasă insonorizată, cu puterea minim 200 kW, 250 kVA</b>										
31120000-3	Generator de curent industrial de tip închis cu carcasă insonorizată, cu puterea minim 200 kW, 250 kVA	buc.	1	432 000 lei	518 400 lei	432 000 lei	518 400 lei	În termen de 90 de zile de la data înregistrării contractului la Trezoreria de Stat <b>Locul livrării:</b> Penitenciarul nr. 18 – Brănești		
<b>TOTAL</b>						<b>916 000 lei</b>	<b>1 099 200 lei</b>			

Semnat: \_\_\_\_\_ Numele, Prenumele: Socolova Natalia În calitate de: Director  
Ofertantul: „Eximotor SA”, Adresa: mun. Chișinău, str. Albișoara 38A, MD2005

Adresa juridică: RM, mun. Chișinău, MD-2024, str. Aerodromului 15/6  
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REPUBLICA



MOLDOVA

# CERTIFICAT DE ÎNREGISTRARE

**SOCIETATEA PE ACȚIUNI "EXIMOTOR"**  
ESTE ÎNREGISTRATĂ LA CAMERA ÎNREGISTRĂRII DE STAT

*Numărul de indentificare de stat - codul fiscal*  
**1002600034712**

*Data înregistrării*

**12.06.1995**

*Data eliberării*

**20.01.2005**

**Iovu Galina, registrator de stat**

*Funcția, numele, prenumele persoanei  
care a eliberat certificatul*

*G. Iovu*  
semnătură

**MD 0011311**





I.P. "AGENȚIA SERVICII PUBLICE"  
Departamentul înregistrare a unităților de drept (DÎUD)

Extras  
din Registrul de stat al persoanelor juridice  
nr. 200989 din 03.02.2026



Denumirea completă: **SOCIETATEA PE ACȚIUNI "EXIMOTOR"**

Denumirea prescurtată: **"EXIMOTOR" S.A.**

Forma juridică de organizare: **Societate pe acțiuni.**

Numărul de identificare de stat și codul fiscal: **1002600034712**

Data înregistrării de stat: **12.06.1995**

Sediu: **MD-2024, strada Aerodromului 15, ap. 6, mun. Chișinău, Republica Moldova**

Genurile de activitate:

1. Comerț cu ridicata al deșeurilor și resturilor;
2. Comerț cu ridicata nespecializat;
3. Comerț cu amănuntul în magazine nespecializate, cu vânzare predominantă de produse nealimentare;
4. Repararea mașinilor;
5. Repararea echipamentelor electrice;
6. Repararea și întreținerea altor echipamente de transport;
7. Repararea altor echipamente;
8. Colectarea deșeurilor nepericuloase;
9. Colectarea deșeurilor periculoase;
10. Lucrări de construcții a clădirilor rezidențiale și nerezidențiale;
11. Comerț cu amănuntul al articolelor și aparatelor electrocasnice, în magazine specializate;
12. Comerț cu amănuntul al mobilei, al articolelor de iluminat și al articolelor de uz casnic n.c.a., în magazine specializate;
13. Comerț cu amănuntul al echipamentelor sportive, în magazine specializate;
14. Comerț cu amănuntul al jocurilor și jucăriilor, în magazine specializate;
15. Comerț cu amănuntul al altor bunuri noi, în magazine specializate;
16. Comerț cu amănuntul prin standuri, chioșcuri și piețe al altor produse;
17. Comerț cu amănuntul prin intermediul caselor de comenzi sau prin Internet;
18. Comerț cu amănuntul efectuat în afara magazinelor, standurilor, chioșcurilor și piețelor;
19. Transporturi rutiere de mărfuri;
20. Depozități;
21. Activități de servicii anexe pentru transporturi terestre;
22. Alte activități poștale și de curier;
23. Alte intermediieri financiare n.c.a.;
24. Închirierea și exploatarea bunurilor imobiliare proprii sau închiriate;
25. Activități de consultanță pentru afaceri și management;
26. Activități ale agențiilor de publicitate;
27. Servicii de reprezentare media;
28. Comerț cu autoturisme și autovehicule ușoare (sub 3,5 tone);
29. Comerț cu alte autovehicule;
30. Întreținerea și repararea autovehiculelor;
31. Comerț cu ridicata de piese și accesorii pentru autovehicule;
32. Comerț cu amănuntul de piese și accesorii pentru autovehicule;
33. Comerț cu motociclete, piese și accesorii aferente; întreținerea și repararea motocicletelor;
34. Comerț cu ridicata al aparatelor electrice de uz gospodăresc, al aparatelor de radio și televizoarelor;
35. Comerț cu ridicata al altor bunuri de uz gospodăresc;
36. Comerț cu ridicata al mașinilor agricole, echipamentelor și furniturilor;
37. Comerț cu ridicata al mașinilor-unelte;



**38. Comerț cu ridicata al mașinilor pentru industria minieră și construcții;**  
**39. Comerț cu ridicata al altor mașini și echipamente;**

Capitalul social: **600000 Lei**

Administrator(i): **SOCOLOVA NATALIA**

Beneficiari efectivi: **SOCOLOVA NATALIA**

Prezentul extras este eliberat în temeiul art. 34 al Legii nr.220/2007 privind înregistrarea de stat a persoanelor juridice și a întreprinzătorilor individuali și confirmă datele din Registrul de stat la data de 03.02.2026

Specialist coordonator  
**Diana Nasian-Nicolaev**  
tel. 022-20-7826





# ProCredit Bank

B.C. "ProCredit Bank" S.A., bd. Ștefan cel Mare și Sfânt, 65, of. 901, Chișinău, MD-2001, Republica Moldova

Către: EXIMOTOR SA

№ 13 -252

## CERTIFICAT

Prin prezentul, B.C. ProCredit Bank S.A. confirmă precum că EXIMOTOR SA (c/f 1002600034712), are deschise următoarele conturi bancare:

Cod IBAN	Tipul contului	Denumirea valutei
MD08PR002251130060160201	Cont curent	MDL
MD72PR002224130060160302	Cont curent	USD
MD54PR002224020725001978	Cont curent	EUR
MD34PR002224130060160404	Cont curent	RUB
MD45PR002224020725001946	Cont curent	RON

Expert Servicii Bancare  
Sucursala nr. 2 Chisinau  
B.C. ProCredit Bank S.A.

SINJEREAC CRISTINA

numele, prenumele ESB

*Sinjeriac*

semnătura



Executor: Petrov Nadejda

Tel.080000010

*[Signature]*

B.C. "ProCredit Bank" S.A.  
Forma juridică de organizare Societate pe acțiuni  
Numărul înregistrării de stat 1007600059183  
Sediul bd. Ștefan cel Mare și Sfânt 65, of. 901, Chișinău, MD-2001  
Republica Moldova

Președinte al Comitetului de Conducere Olga Bulat  
Capitalul social 406 550 000 lei  
Telefon 0800 000 10  
office@procreditbank.md  
www.procreditbank.md



# Certificate of Compliance

No. 3N220915.FLPQQ65

Certificate's Holder: FUAN LONGKAI POWER CO., LTD.  
Wei 5 Road, Tiehu Industrial Zone, Fuan, Fujian, China

Certification ECM Mark:



Product: Diesel Generator Set  
Model(s): (see the following annex)

Verification to: Standard:  
EN 12100:2010, EN ISO 8528-13:2016, EN 60204-1:2018,  
EN 61000-6-2:2019, EN 61000-6-4:2019  
related to CE Directive(s):  
2006/42/EC (Machinery)  
2014/30/EU (Electromagnetic Compatibility)

**Remark:** This document is a voluntary third-party EC verification where the manufacturer voluntarily decides to have its documents concerning the above-mentioned product(s) verified. Ente Certificazione Macchine Srl confirms that the documentation provided by the manufacturer and immediately returned to it as containing sensitive data, meets the essential requirements of the above-mentioned directives and the requirements of the ECM certification mark. This document cannot replace the EC Declaration of Conformity. The above conformity mark may be affixed to the documentation in accordance with the ECM Regulation on its issue and use.

Additional information and clarification on marking:

The presence of the EC symbol shown on the left is to demonstrate the type of activity carried out. The manufacturer must carry out the EC marking process before placing the product(s) on the market, and if the product(s) so requires, it must be submitted to a notified body. This document has been issued on the basis of the Voluntary Certificate Issuing Regulation number RCC\_ECM rev. 0 and the Voluntary ECM Marking Regulation for product certification. RG01\_ECM rev.3 both available at [www.entecerma.it](http://www.entecerma.it)



**Issuance date: 15 September 2022**

**Expiry date: 14 September 2027**

For online check:



Approver  
Ente Certificazione Macchine  
Legal Representative  
Luca Redonni





# Annex I

No. 3N220915.FLPQQ65

## Model(s):

LG7, LG8, LG9, LG10, LG12, LG13, LG14, LG15, LG16, LG18, LG19, LG20, LG22, LG24, LG25, LG30, LG32, LG34, LG36, LG38, LG40, LG45, LG48, LG50, LG52, LG55, LG58, LG60, LG64, LG68, LG72, LG75, LG80, LG85, LG90, LG100, LG105, LG108, LG110, LG120, LG128, LG130, LG135, LG140, LG145, LG150, LG160, LG170, LG180, LG200, LG210, LG220, LG240, LG250, LG260, LG270, LG280, LG290, LG300, LG310, LG320, LG330, LG350, LG360, LG370, LG380, LG400, LG410, LG425, LG440, LG450, LG460, LG480, LG500, LG510, LG520, LG550, LG560, LG570, LG580, LG600, LG620, LG640, LG650, LG700, LG720, LG750, LG800, LG850, LG900, LG1000, LG1100, LG1180, LG1200, LG1250, LG1300, LG1350, LG1400, LG1500, LG1600, LG1650, LG1700, LG1800, LG1900, LG2000, LG2200, LG2400, LG2600, LG2800, LG3000,

DG11, DG12, DG14, DG17, DG21, DG22, DG28, DG33, DG36, DG41, DG47, DG50, DG52, DG55, DG62, DG69, DG80, DG83, DG88, DG103, DG124, DG138, DG165, DG206, DG220, DG248, DG275, DG303, DG358, DG385, DG440, DG495

# LONGKAI®

## LG260C

Prime Power:256KW/320KVA  
Standby Power:282KW/352KVA

### 8-4000kVA Diesel Generator Sets



POWERS	PRP		ESP		PRIME
	kW	kVA	kW	kVA	Amps
VOLTAGE(V)	256	320	282	352	486,2
380/220	256	320	282	352	486,2
ALTERNATOR	LONGKAI	STAMFORD		LEROY SOMER	MECCALTE
MODEL	LK444ES	HCI444ES		TAL-A46-G	ECO38 2L4C
		S4L1D-E41/S4L1S-E4		LSA46.3 L10	

POWERS	PRP		ESP		PRIME
	kW	kVA	kW	kVA	Amps
VOLTAGE(V)	256	320	282	352	461,9
400/230	256	320	282	352	461,9
ALTERNATOR	LONGKAI	STAMFORD		LEROY SOMER	MECCALTE
MODEL	LK444ES	HCI444ES		TAL-A46-G	ECO38 2L4C
		S4L1S-E4		LSA46.3 L10	

POWERS	PRP		ESP		PRIME
	kW	kVA	kW	kVA	Amps
VOLTAGE(V)	256	320	282	352	445,2
415/240	256	320	282	352	445,2
ALTERNATOR	LONGKAI	STAMFORD		LEROY SOMER	MECCALTE
MODEL	LK444ES	HCI444ES		TAL-A46-G	ECO38 2L4C
		S4L1S-E4		LSA46.3 L10	

i

### RENTAL RANGE

LONGKAI with quality certification ISO 9001,ISO 14001,ISO 45001

LONGKAI is compliant with EC mark which includes the following directives:

Verification to standard:

BS EN ISO 12100:2010,BS EN ISO 8528-13:2016,  
BS EN 60204-1:2018,BS EN IEC 61000-6-2:2019,  
BS EN IEC 61000-6-4:2019

Related to GBR regulation:

Supply of Machinery (Safety) Regulations 2008  
Electromagnetic Compatibility Regulations 2016

Certification ECM mark:



Verification to standard:

EN ISO 3744:2010

Related to CE directive(s):

2000/14/EC (Noise)

The submitted products have been tested by us with the listed standards and found compliance with the following European Directives:

The EMC Directive 2014/30/EU

EN 55012:2007+A1:2009



THREE PHASES



DIESEL



WATER-COOLED



50 HZ





# LONGKAI®

## Engine-DCEC Cummins

Model	6LTAA9.5-G1
Aspiration	Jacket air Aftercooled
Fuel system	Mechanical fuel pump
No. cylinders	6
Displacement	9.5L
Bore*Stroke	116.5*148mm
Compression ratio	16.6:1
Rated speed	1500r/min
Rated net power(with fan)	290Kw
Governor type	Electronic
Start motor	24V

100% (Prime power)	70L/h
75% (Prime power)	52L/h
50% (Prime power)	35L/h
Oil capacity	32.4L
Maximum Oil Temperature	124°C
Oil pressure (continuous operation)	69-270kPa
Max inlet pressure-dirty element	6.2kPa
Max inlet pressure-clean element	3.7kPa
Intake air flow	281litre/sec
Exhaust gas flow	23kg/min
Exhaust gas temp	580°C
Max back pressure	8kPa
Coolant capacity	11.1L
Thermostat operation range	82-95°C
Max top tank temperature	100°C

- Diesel engine
- Water-cooled
- Electrical system

- Air filter
- Radiator
- Governor

- Hot protection
- Moving parts protection
- Radiator water level sensor (Optional).

## Alternator

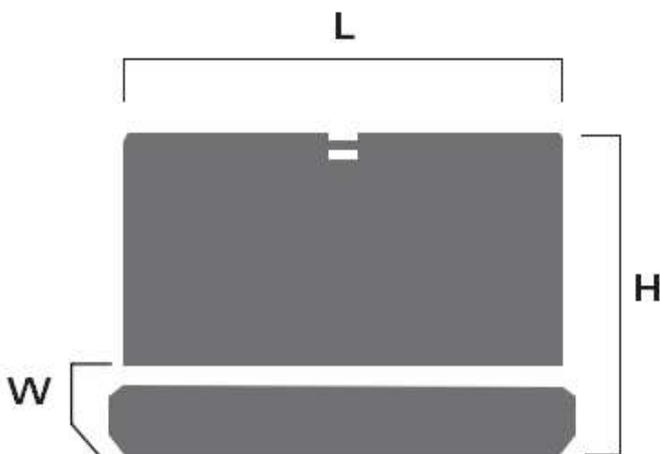
Wiring type	3 Phase 4 Pole, Y type
Bearing	1
Power factor	0,8
Frequency	50Hz
Overspeed	2250

Exciter type	Brushless, self-excitation
Voltage regulation	± (0.25%~1% )
Protection grade	IP 23
Insulation class	H
Altitude(m)	≤1000

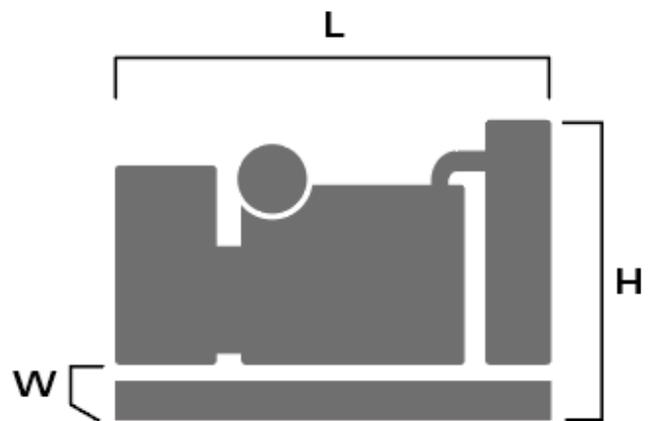


# LONGKAI®

## DIMENSIONS



Silent Type



Open Type

## WEIGHT AND DIMENSIONS

	Length (mm)	Width (mm)	Height (mm)	Weight (kg)	Fuel tank (L)	sound level (dB(@7m))
Open Type	2850	1140	1800	1945	--	≤87
SD Type	4170	1370	2200	--	--	≤75
SDF Type	4170	1370	2200	3310	480	≤75
SA Type	4188	1400	2220	3406	448	≤75
SM Type	--	--	--	--	--	≤75
ST Type	4150	1400	2150	1250	574	≤75
STF TYPE	--	--	--	--	--	≤75
SL Type	4050	1280	2150	--	--	≤75
SH Type	--	--	--	--	--	≤75

TBD = To Be Decided



**LONGKAI**  
POWER SOLUTIONS

# LONGKAI®

## Configuration

<b>Standard Features</b>	Engine(DCEC Cummins)	●
	Radiator 50°C max,fans are driven by belt	●
	Charge alternator	●
	Alternator: single bearing alternator IP23,insulation class H/H	●
	Standard auto control system	●
	One set of air filter, fuel filter, oil filter	●
	MCCB	●
	Fuel tank	●
	Batteries, rack and cable	●
	Exhaust system(Ripple flex exhaust pipe, flange, muffler)	●
	User manual	●
	Water oil separator	●
<b>Options</b>	Battery charge	◎
	Engine heater	◎
	Alternator heater	◎
	PMG	◎
	Daily fuel tank	◎
	Remote control panel	◎
	Automatic transfer switch/ATS	◎
	Switch box	◎

● Standard      ◎ Optional

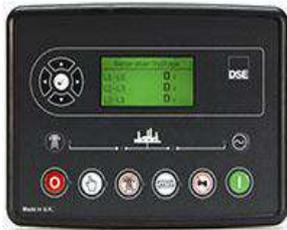
## Protective functions

Cummins Engine  
Generator



**LONGKAI**  
POWER SOLUTIONS

**LONGKAI**<sup>®</sup>



*DEESEA DSE6120*

*LONGKAI LPC7220*

**Protective functions**

- | Low oil pressure
- | High water temperature
- | High/low voltage
- | High Engine Temperature and Overspeed.
- | Voltage regulator frequency regulator
- | Emergency stop
- | Start failure



*Control Module Options*

- Auto generator control module
- Control module with " Three Remote Control " functions
- ATS auto load transfer screen
- Synchronising control modules
- Power output cabinet



**LONGKAI**  
POWER SOLUTIONS

# LONGKAI®

## LG250YTO

Prime Power:250KW/313KVA  
Standby Power:275KW/344KVA

### 8-4000kVA Diesel Generator Sets



POWERS	PRP		ESP		PRIME
	kW	kVA	kW	kVA	Amps
VOLTAGE(V)	250	313	275	344	475,6
380/220	250	313	275	344	475,6
ALTERNATOR	LONGKAI	STAMFORD		LEROY SOMER	MECCALTE
MODEL	LK444ES	HCI444ES		TAL-A46-G	ECO38 2L4C
		S4L1D-E41/S4L1S-E4		LSA46.3 L10	

POWERS	PRP		ESP		PRIME
	kW	kVA	kW	kVA	Amps
VOLTAGE(V)	250	313	275	344	451,8
400/230	250	313	275	344	451,8
ALTERNATOR	LONGKAI	STAMFORD		LEROY SOMER	MECCALTE
MODEL	LK444ES	HCI444ES		TAL-A46-G	ECO38 2L4C
		S4L1S-E4		LSA46.3 L10	

POWERS	PRP		ESP		PRIME
	kW	kVA	kW	kVA	Amps
VOLTAGE(V)	250	313	275	344	435,5
415/240	250	313	275	344	435,5
ALTERNATOR	LONGKAI	STAMFORD		LEROY SOMER	MECCALTE
MODEL	LK444ES	HCI444ES		TAL-A46-G	ECO38 2L4C
		S4L1S-E4		LSA46.3 L10	

i

### RENTAL RANGE

LONGKAI with quality certification ISO 9001,ISO 14001,ISO 45001

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BS EN IEC 61000-6-4:2019

Related to GBR regulation:

Supply of Machinery (Safety) Regulations 2008  
Electromagnetic Compatibility Regulations 2016

Certification ECM mark:



Verification to standard:

EN ISO 3744:2010

Related to CE directive(s):

2000/14/EC (Noise)

The submitted products have been tested by us with the listed standards and found compliance with the following European Directives:

The EMC Directive 2014/30/EU

EN 55012:2007+A1:2009



THREE PHASES



DIESEL



WATER-COOLED



50 HZ





# LONGKAI®

## Engine-YTO

Model	YM6S9L-D
Aspiration	Air to air intercooled
Type of injection system	Direct injection
No. cylinders	6
Displacement	11.596L
Bore*Stroke	126*155mm
Compression ratio	17:1
Rated speed	1500r/min
Rated net power(with fan)	290Kw
Governor type	Electronic
Start motor	24V

100% (Prime power)	69.94L/h
75% (Prime power)	52.46L/h
50% (Prime power)	34.97L/h
Oil capacity	28L
Maximum Oil Temperature	115°C
Oil pressure	98-490kPa
Air inlet Restriction	≤5kPa
Air temperature	25°C
Intake air flow	TBD
Exhaust gas flow	TBD
Exhaust gas temp	TBD
Max back pressure	6kPa
Coolant capacity	55L
Thermostat operation range	71-80°C
Max top tank temperature	99°C

- Diesel engine
- Water-cooled
- Electrical system

- Air filter
- Radiator
- Governor

- Hot protection
- Moving parts protection
- Radiator water level sensor (Optional).

## Alternator

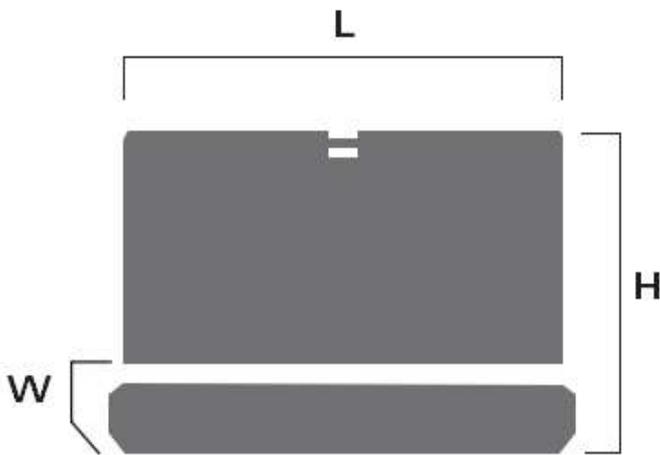
Wiring type	3 Phase 4 Pole, Y type
Bearing	1
Power factor	0,8
Frequency	50Hz
Overspeed	2250

Exciter type	Brushless, self-excitation
Voltage regulation	± (0.25%~1% )
Protection grade	IP 23
Insulation class	H
Altitude(m)	≤1000

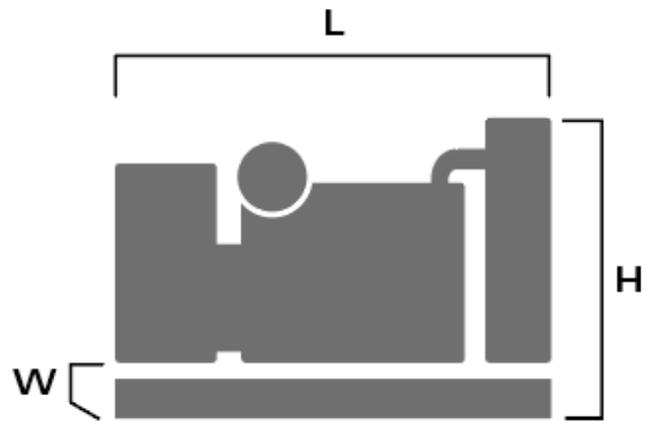


# LONGKAI®

## DIMENSIONS



Silent Type



Open Type

## WEIGHT AND DIMENSIONS

	Length (mm)	Width (mm)	Height (mm)	Weight (kg)	Fuel tank (L)	sound level (dB(@7m))
Open Type	3200	1350	1880	--	--	≤87
SD Type	4520	1620	2350	--	--	≤75
SDF Type	4520	1620	2350	--	780	≤75
SA Type	4588	1600	2500	4190	1015	≤75
SM Type	--	--	--	--	--	≤75
ST Type	4500	1600	2350	1500	733	≤75
STF TYPE	--	--	--	--	--	≤75
SL Type	--	--	--	--	--	≤75
SH Type	--	--	--	--	--	≤75

TBD = To Be Decided



**LONGKAI**  
POWER SOLUTIONS

**LONGKAI**<sup>®</sup>

**Configuration**

<b>Standard Features</b>	Engine(YTO)	●
	Radiator 50°C max,fans are driven by belt	●
	Charge alternator	●
	Alternator: single bearing alternator IP23,insulation class H/H	●
	Standard auto control system	●
	One set of air filter, fuel filter, oil filter	●
	MCCB	●
	Fuel tank	●
	Batteries, rack and cable	●
	Exhaust system(Ripple flex exhaust pipe, flange, muffler)	●
	User manual	●
	Water oil separator	●
<b>Options</b>	Battery charge	◎
	Engine heater	◎
	Alternator heater	◎
	PMG	◎
	Daily fuel tank	◎
	Remote control panel	◎
	Automatic transfer switch/ATS	◎
	Switch box	◎
	● Standard      ◎ Optional	

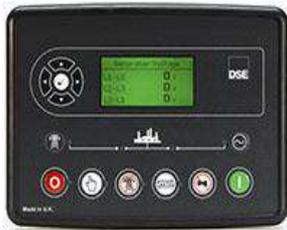
**Protective functions**

YTO Engine  
Generator



**LONGKAI**  
POWER SOLUTIONS

**LONGKAI**<sup>®</sup>



*DEESEA DSE6120*

*LONGKAI LPC7220*

**Protective functions**

- | Low oil pressure
- | High water temperature
- | High/low voltage
- | High Engine Temperature and Overspeed.
- | Voltage regulator frequency regulator
- | Emergency stop
- | Start failure



*Control Module Options*

- Auto generator control module
- Control module with " Three Remote Control " functions
- ATS auto load transfer screen
- Synchronising control modules
- Power output cabinet



**LONGKAI**  
POWER SOLUTIONS

## Certificat de garanție

Prin prezenta, compania Eximotor SA, participând la Licitația de achiziție publică: ocds-b3wdp1-MD-1769772380856 din 23.02.2026, confirmă perioada de garanție a marfii pe un termen de 24 luni.

Eximotor SA,  
Director,  
Socolova Natalia

---

Data: 23.02.2026



## DECLARAȚIE

**privind confirmarea identității beneficiarilor efectivi și neîncadrarea acestora în situația condamnării pentru participarea la activități ale unei organizații sau grupări criminale, pentru corupție, fraudă și/sau spălare de bani.**

Subsemnatul, Socolova Natalia reprezentant împuternicit al „Eximotor SA” (*denumirea operatorului economic*) în calitate de ofertant/ofertant asociat desemnat câștigător în cadrul procedurii de achiziție publică nr. ocds-b3wdp1-MD-1769772380856 din data 23/02/2026, declar pe propria răspundere, sub sancțiunile aplicabile faptei de fals în acte publice, că beneficiarul/beneficiarii efectivi ai operatorului economic în ultimii 5 ani nu au fost condamnați prin hotărâre judecătorească definitivă pentru participarea la activități ale unei organizații sau grupări criminale, pentru corupție, fraudă și/sau spălare de bani.

Numele și prenumele beneficiarului efectiv	IDNP al beneficiarului efectiv
Socolova Natalia	0961303541877

Data completării: 23.02.2026

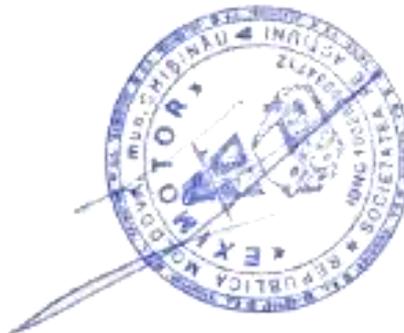
Semnat: \_\_\_\_\_

Nume/prenume: Socolova Natalia

Funcția în cadrul persoanei juridice: director

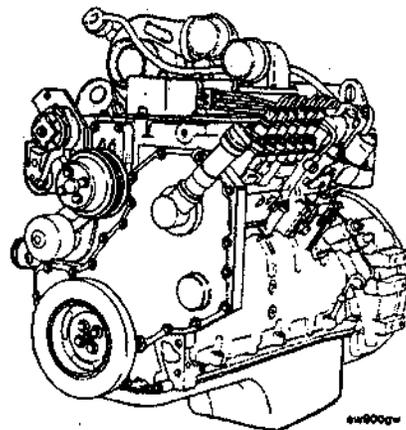
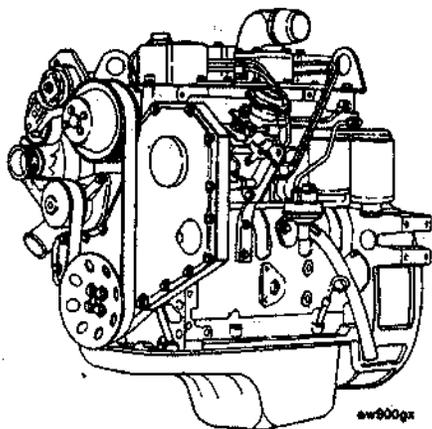
Denumirea persoanei juridice Eximotor SA

IDNO al persoanei juridice 1002600034712





# Operation and Maintenance Manual B Series Engines



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Cummins Engine Company, Inc.  
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## **Foreword**

This manual contains information for the correct operation and maintenance of your Cummins engine. It also includes important safety information, engine and systems specifications, troubleshooting guidelines, and listings of Cummins Authorized Repair Locations and component manufacturers.

Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner.

The information, specification, and recommended maintenance guidelines in this manual are based on information in effect at the time of printing. Diesel Engine plant of DongFeng Automobile Co, Ltd.reserves the right to make changes at any time without obligation. If you find differences between your engine and the information in this manual, contact us.

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine Cummins exchange parts.

# Table of Contents

	Page No.
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Maintenance Guidelines.....	2
Daily Maintenance Procedures.....	3
Maintenance Procedures at 10,000 kilometers [6,000 Miles] 250 Hours or 3 Months.....	4
Maintenance Procedures at 19,000 kilometers [12,000 Miles] 500 Hours or 6 Months.....	5
Maintenance Procedures at 38,000 kilometers [24,000 Miles] 1000 Hours or 12 Months.....	6
Maintenance Procedures at 77,000 kilometers [48,000 Miles] 2000 Hours or 2 Years.....	7
System Diagrams.....	D
Troubleshooting.....	T

**Adjustment, Repair and Replacement.....A**

**Specifications and Torque Values.....V**

## Important Reference Numbers

Fill in the part name and number in the blank spaces provided below. This will give you a reference whenever service or maintenance is required.

Engine Model

---

Engine Serial Number

---

Engine Specification Number

---

Fuel Pump Part Number

---

Filter Part Numbers:

• Air Cleaner Element

---

• Lubricating Oil

---

• Fuel

---

• Fuel Water separator

---

Belt Part Number

---

---

---

---

---

# **Section i-Introduction**

## **Section Contents**

	<b>Page</b>
<b>About the Manual.....</b>	<b>i-3</b>
<b>Definition of Terms.....</b>	<b>i-13</b>
<b>General Safety Instructions.....</b>	<b>i-10</b>
<b>How to Use the Manual.....</b>	<b>i-4</b>
<b>Illustrations.....</b>	<b>i-9</b>
<b>Symbols.....</b>	<b>i-5</b>
<b>To The Owner and Operator.....</b>	<b>i-2</b>

## **To The Owner and Operator**

Preventative maintenance is the easiest and least expensive type of maintenance. Follow the maintenance schedule recommendations Outlined in Maintenance Guidelines (Section 2).

Keep records of regularly scheduled maintenance.

Use the correct fuel, oil and coolant in your engine as specified in Engine Specifications (Section V).

## **About the Manual**

This manual contains information needed to correctly operate and maintain your engine as recommended by Dongfeng Cummins Engine Co., Ltd. Additional service literature (Shop Manual, Troubleshooting and Repair Manual, etc.) can be ordered by filling out and mailing the Literature order Form located in Service Literature.

This manual does not cover vehicle or equipment maintenance procedures. Consult the vehicle or equipment manufacturer for specific maintenance recommendations.

Numerous illustrations and symbols are used to aid in understanding the meaning of the text. Refer to page i-5 for a complete listing of symbols and their definitions.

Each section is preceded by a "Section Contents" to aid in locating information more quickly.

## **How to Use the Manual**

This manual is organized according to intervals at which maintenance on your engine is to be performed. A table which states the required intervals and the checks to be made is located in Section 2. Locate the interval at which you are performing maintenance then follow the steps given in that section for all the procedures to be performed. In addition, all the procedures done under previous maintenance intervals must be performed.

Keep a record of all the checks and inspections made. A record form for recording date, mileage / kilometer or hours, and which maintenance checks were performed is located in Section 2.

Refer to Section T for a guide to troubleshooting your engine. Follow the directions given on page T — 2 to locate and correct engine problems.

Refer to Section V for specifications recommended for your engine. Specifications and torque values for each engine system are given in that section.

## Symbols

The following symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears the meaning defined below:



**WARNING**-Serious personal injury or extensive property damage can result if the warning instructions are not followed.



**CAUTION**-Minor personal injury can result or a part, an assembly, or the engine can be damaged if the caution instructions are not followed.



Indicates a **REMOVAL** or **DISASSEMBLY** step.



Indicates an **INSTALLATION** or **ASSEMBLY** step.



**INSPECTION** is required.



**CLEAN** the part or assembly.



**PERFORM** a mechanical or time **MEASUREMENT**.



**LUBRICATE** the part or assembly.



Indicates that a **WRENCH** or **TOOL SIZE** will be given.



**TIGHTEN** to a specific torque.



**PERFORM** an electrical **MEASUREMENT**.



Refer to another location in this manual or another publication for additional information.



The component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift the component.

## Simbolo

Los simbolos siguientes son usados en este manual para clarificar el proceso de las instrucciones. Cuando aparece uno de estos simbolos, su significado se especifica en la parte inferior.



**ADVERTENCIA**-Serios danos personales o dano a la propiedad puede resultar si las instrucciones de Advertencia no se consideran.



**PRECAUCION**-Danos menores pueden resultar, o de piezas del conjunto o el motor puede averiarse si las instrucciones de Precaucion no se siguen.



Indica un paso de **REMOCLON** o **DESMONTAJE**.



Indica un paso de **INSTALACION** o **MON-TAJE**.



se requiere **INSPECCION**.



**LIMPIESE** la pieaze o el montaje.



**EJECUTESE** una **MEDICION** mecanica o del tiempo.



**LUBRIQUESE** la pieza o el montaje.



Indica que se dara una **LLAVE DE TUERCAS** o el **TAMANO DE HERRAMIENTA**.



**APRIETESE** hasta un par torsor especifico.



**EJECUTESE** una **MESICION** electrica.



Para informacion adicional referase a otro emplazamiento de este manual o a otra publicacion anterior.



El componente pesq 23 kg [50 lb] o mas. Para evitar dano corporal empleen una cabria u obtengan ayuda para elevar el com ponente.

## Symbole

In diesem Handbuch werden die folgenden Symbole verwendet, die wesentliche Funktionen hervorheben. Die Symbole haben folgende Bedeutung:



**WARNUNG**-Wird die Warnung nicht beachtet, dann besteht erhöhte Unfall-und Beschadigungsgefahr.



**VORSICHT**-Werden die Vorsichtsmassnahmen nicht beachtet, dann besteht Unfall-und Beschadigungsgefahr.



**AUSBAU** bzw. **ZERLEGEN**.



**EINBAU** bzw. **ZUSAMMENBAU**.



**INSPEKTION** erforderlich.



Teil oder Baugruppe **REINIGEN**.



**DIMENSION**-oder **ZEITMESSUNG**.



Teil oder Baugruppe **OLEN**.



**WERKZEUGGROSSE** wird angegeben.



**ANZUG** auf vorgeschriebenes Drehmoment erforderlich.



Elektrische **MESSUNG DURCHFUHREN**.



Weitere Informationen an anderer Stelle bzw. in anderen Handbuchern.



Das teil wiegt 23 kg [50 lb] oder mehr Zur Vermeidung von Koerperverletzung winde benutzen oder hilfe beim heben des teils in anspruch nehmen.

## Symboles

Les symboles suivants sont utilisés dans ce manuel pour aider à communiquer le but des instructions. Quand l'un de ces symboles apparaît, il évoque le sens défini ci-dessous:



**AVERTISSEMENT**-De graves lésions corporelles ou des dommages matériels considérables peuvent survenir si les instructions "Avertissement" ne sont pas suivies.



**ATTENTION**-De petites lésions corporelles peuvent survenir, ou bien une pièce, un ensemble ou le moteur peuvent être endommagés si les instructions données sous les rubriques "Attention" ne sont pas suivies.



Indique une opération de **DEPOSE**.



Indique une opération de **MONTAGE**.



**L'INSPECTION** est nécessaire.



**NETTOYER** la pièce ou l'ensemble.



**EFFECTUER** une **MESURE** mécanique ou de temps.



**GRAISSER** la pièce ou l'ensemble.



Indique qu'une **DIMENSION DE CLE** ou **D'OUTIL** sera donnée.



**SERRER** à un couple spécifique.



**EFFECTUER** une **MESURE** électrique.



Se reporter à un autre endroit dans ce manuel ou à une autre publication pour obtenir des informations plus complètes.

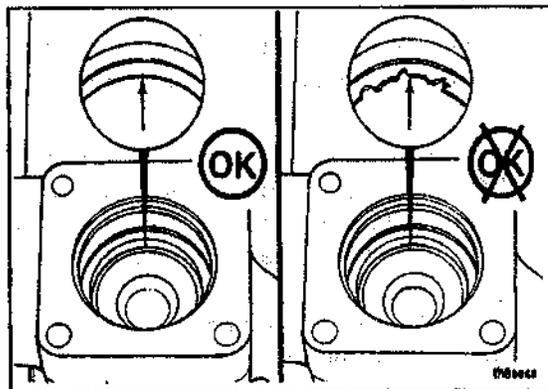


Le composant pèse 23 kg [50 lb] ou davantage. Pour éviter toute blessure, employer un appareil de levage ou demander de l'aide pour le soulever.

## Illustrations

Use the illustrations in this manual as a guide to perform the action or the repair described. Many illustrations are generic and will not look exactly like the engine or the parts used in your application. In order to provide clarity to illustrations, some illustrations show parts removed that are not related to the specific parts given in the text.

Most of the illustrations contain symbols to indicate an action required or to indicate an **acceptable (OK)** or **unacceptable (not OK)** condition.



## General Safety Instructions

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that must be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

**NOTE:** It is not possible for Cummins Engine Company, Inc. to anticipate every possible circumstance that can involve a potential hazard.

-  **Warning: Disconnect the battery and discharge any capacitors before beginning any repair work. Disconnect the air starter, if equipped, to prevent accidental engine starting. Put a "Do Not Operate" tag in the operator's compartment or on the controls.**
-  **Warning: Use ONLY the correct engine barring techniques for manually rotating the engine. Do not attempt to rotate the engine by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade (s), causing premature fan failure.**
-  **Warning: If an engine has been operating and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.**
-  **Warning: Do not work on anything that is supported ONLY by lift jacks or a hoist. Always use blocks or correct stands to support the product before performing any service work.**

-  **Warning:** To avoid burns, be alert for hot component parts just after the engine has been shut off and for hot fluids in lines, tubes, and compartments.
-  **Warning:** Relieve all pressure in the air, the oil, and the cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do not check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
-  **Warning:** To prevent suffocation and frostbite, wear protective clothing and **ONLY** disconnect liquid refrigerant (freon) lines in a well ventilated area. Use a freon capture system to prevent leakage to the atmosphere. If in doubt, contact your state and local environmental authorities or the Environmental Protection Agency (EPA) for guidance as to proper handling of freon.
-  **Warning:** Corrosion inhibitor contains alkali. Do not get the substance in your eyes. Avoid prolonged or repeated contact with skin. Do not swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. **IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.**
-  **Warning:** Always use proper tools that are in good condition. Make sure you understand how to use them before performing any service work.
-  **Warning:** Always use the same fastener part number (or equivalent) when replacing fasteners. Do not use a fastener of lesser quality if replacements are necessary.
-  **Warning:** Never use gasoline or other flammable materials to clean parts. Always use approved cleaning Solvents.



**Warning: Avoid prolonged and repeated skin contact with used engine oils. Such prolonged and repeated contact may cause serious skin disorders or other serious bodily injury,**

- Avoid excessive contact. Wash thoroughly after contact.**
- Keep out of reach of children**

**PROTECT THE ENVIRONMENT: Handling and disposal of used engine oils may be subject to federal, state and local law and regulation. Use authorized waste disposal facilities, including civic amenity sites and garages providing authorized facilities for receipt of used oil. If in doubt, contact your state and local environmental authorities or the Environmental Protection Agency for guidance as to proper handling and disposal of used engine oil.**

**Dispose of antifreeze properly. Handling and disposal of antifreeze can be subject to Federal, State and Local regulation. If in doubt, contact your state and local authorities or the Environmental Protection Agency (EPA) for guidance as to proper handling and disposal of used antifreeze.**

**Definition of Terms**

<b>AFC</b>	Air Fuel Control	<b>H<sub>2</sub>O</b>	Water
<b>API</b>	American Petroleum Institute	<b>in-lb</b>	Inch Pound
<b>ASA</b>	Air Signal Attenuator	<b>kg</b>	Kilograms
<b>ASTM</b>	American Society of Testing and Materials	<b>km</b>	Kilometers
<b>C</b>	Celsius	<b>km/l</b>	Kilometers per Liter
<b>CAC</b>	Charge Air Cooled	<b>kPa</b>	Kilopascal
<b>CARB</b>	California Air Resources Board	<b>KSB</b>	Cold Start Advance
<b>C. I. D.</b>	Cubic Inch Displacement	<b>l</b>	Liter
<b>Cm</b>	Centimeter	<b>LDA</b>	Air-Fuel Control
<b>CPL</b>	Control Parts List	<b>m</b>	Meter
<b>cSt</b>	Centistokes	<b>mm</b>	Millimeter
<b>DCA</b>	Diesel Coolant Additive	<b>MPa</b>	Megapascal
<b>E. C. S.</b>	Emission Control System	<b>MPH</b>	Miles Per Hour
<b>EPA</b>	Environmental Protection Agency	<b>MPQ</b>	Miles Per Quart
<b>F</b>	Fahrenheit	<b>N · m</b>	Newton-meter
<b>ft-lb</b>	Foot Pound	<b>OEM</b>	Original Equipment Manufacturer
<b>GVW</b>	Gross Vehicle Weight	<b>ppm</b>	Parts Per Million
<b>Hg</b>	Mercury	<b>psi</b>	Pounds Per Square Inch
<b>HP</b>	Horsepower	<b>RPM</b>	Revolutions Per Minute
		<b>S. A. E</b>	Society of Automotive Engineers

# **Section E-Engine and Component Identification**

## **Section Contents**

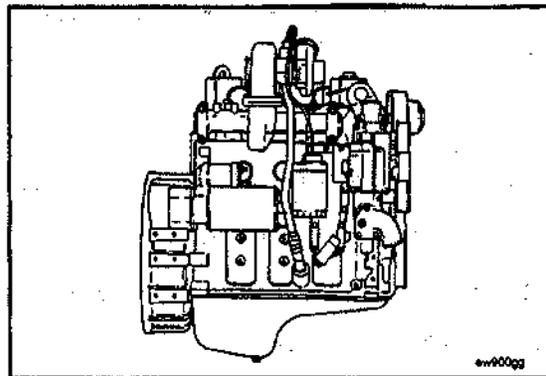
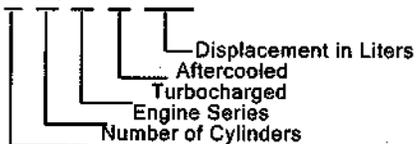
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**Section E-Engine and Component Identification**  
**B Series**

**Industrial Engine Nomenclature**

The model name for Industrial engines provides the following engine data:

**4 B T A 3.9**



## General Specifications (Non-Automotive Engines)

GENERAL ENGINE DATA	4B3.9	4BT3.9	4BTA3.9	6B5.9	6BT5.9	6BTA5.9
Bore-mm [in.].....			102 [4.02]			
Stroke-mm [in.].....			120 [4.72]			
Displacement-liter [in. <sup>3</sup> ]....		3.9 [239]			5.9 [359]	
Engine Weight (Dry) Less Flywheel and Electricskg [lbs.].....	308 [680]	320 [705]	329 [725]	388 [855]	399 [880]	411 [905]
Firing Order.....		1.3.4.2			1.5.3.6.2.4	
Valve Clearances						
-Intake-mm [in.].....			25 [0.010]			
-Exhaust-mm [in.].....			51 [0.020]			
Compression Ratio.....	18.5 : 1	17.5 : 1	16.5 : 1	18.5 : 1	17.5 : 1	16.5 : 1
Rotation, viewed from the Front of the Engine.....						Clockwise
Aspiration	x			x		
-naturally Aspirated.....		x	x		x	x
-Turbocharged.....			x			x
-Aftercooled.....						
-Charge Air Cooled.....						

**NOTE:** See additional pages for Automotive Specifications.

<b>LUBRICATION SYSTEM kPa [psi]</b>	<b>4B3.9</b>	<b>4BT3.9</b>	<b>4BTA3.9*</b>	<b>6B5.9</b>	<b>6BT5.9</b>	<b>6BTA5.9*</b>
Minimum Allowable Oil Pressure@Idle	69 [10]	69 [10]	69 [10]	69 [10]	69 [10]	69 [10]
Minimum Allowable Oil Pressure@Rated	207 [30]	207 [30]	207 [30]	207 [30]	207 [30]	207 [30]
Regulated Pressure	449 [65]	449 [65]	449 [65]	449 [65]	449 [65]	449 [65]
Differential Pressure to Open Filter Bypass	138 [20]	138 [20]	138 [20]	138 [20]	138 [20]	138 [20]
<b>Oil Capacity L [QT]</b>						
Standard Pan Only	9.5 [10]	9.5 [10]	9.5 [10]	14.2 [15]	14.2 [15]	14.2 [15]
Total System (Pan, Filter, Lines)	10.9 [11.5]	11 [11.6]	11 [11.6]	16.3 [17.2]	16.4 [17.3]	16.4 [17.3]
No.QTS From "L" to "H" on Dipstick	[1]	[1]	[1]	[2]	[2]	[2]
<b>COOLING SYSTEM L [QT]</b>						
Engine Coolant Capacity	7.0 [7.4]	7.0 [7.4]	7.9 [8.4]	9.0 [9.5]	9.0 [9.5]	9.9 [10.5]
Thermostat Modulating Range °C [°F]	83-95 [181-230]	83-95 [181-203]	83-95 [181-203]	83-95 [181-203]	83-95 [181-203]	83-95 [181-203]
<b>Pressure Cap kPa [psi]</b>						
104 °C [220 °F]	103 [15]	103 [15]	103 [15]	103 [15]	103 [15]	103 [15]
99 °C [210 °F]	48 [7]	48 [7]	48 [7]	48 [7]	48 [7]	48 [7]

\*Jacket-water aftercooled

**Section E-Engine and Component Identification**  
**B Series**

**General Specifications (Non-Automotive Engines)**  
**Page E-9**

<b>INTAKE AIR, EXHAUST AND FUEL SYSTEM</b>	<b>4B3.9</b>	<b>4BT3.9</b>	<b>4BTA3.9</b>	<b>6B5.9</b>	<b>6BT5.9</b>	<b>6BTA5.9</b>
Maximum Allowable Intake Restriction at Rated Speed and Load with Dirty Speed Filter El- ement-mm H <sub>2</sub> O [in. H <sub>2</sub> O].....	508 [20]	635 [25]	635 [25]	508 [20]	635 [25]	635 [25]
Maximum Allowable Exhaust Restriction at Rated Speed and Load-mm Hg [in. Hg].....	76.2mm [3 in.]					
Maximum Fuel Pressure Drop Across Filters kPa [psi].....	34mm [5]					
Maximum Allowable Return Line Restriction-mm Hg [in. Hg]....	518mm [20.4 in]					
Maximum Inlet Restriction to fuel transfer pump- mm Hg [in. Hg].....	100 [4]					

**General Specifications (Non-Automotive Engines)**  
**Page E-10**

**Section E-Engine and Component Identification**  
**B Series**

<b>ELECTRICAL SYSTEM</b>	<b>4B3.9</b>	<b>4B73.9</b>	<b>4BTA3.9</b>	<b>6B5.9</b>	<b>6B75.9</b>	<b>6BTA5.9</b>
Minimum Recommended Battery Capacity- With Light Accessories*						
-12 V Starter.....	625CCA	625CCA	625CCA	800CCA	800CCA	800CCA
-24 V Starter.....	312CCA	400CCA	400CCA	400CCA	400CCA	400CCA
With Heavy Accessories**						
-12 V Starter.....	800CCA	800CCA	800CCA	950CCA	950CCA	950CCA
-24 V Starter.....	400CCA	400CCA	400CCA	475CCA	475CCA	475CCA
Maximum Allowable Resistance of Starting Circuit						
-With 12 V Starter-Ohms.....	.....			0012	.....	
-With 24 V Starter-Ohms.....	.....			0020	.....	

\*Typical light accessories include alternator, small steering pump, and disengaged clutch.

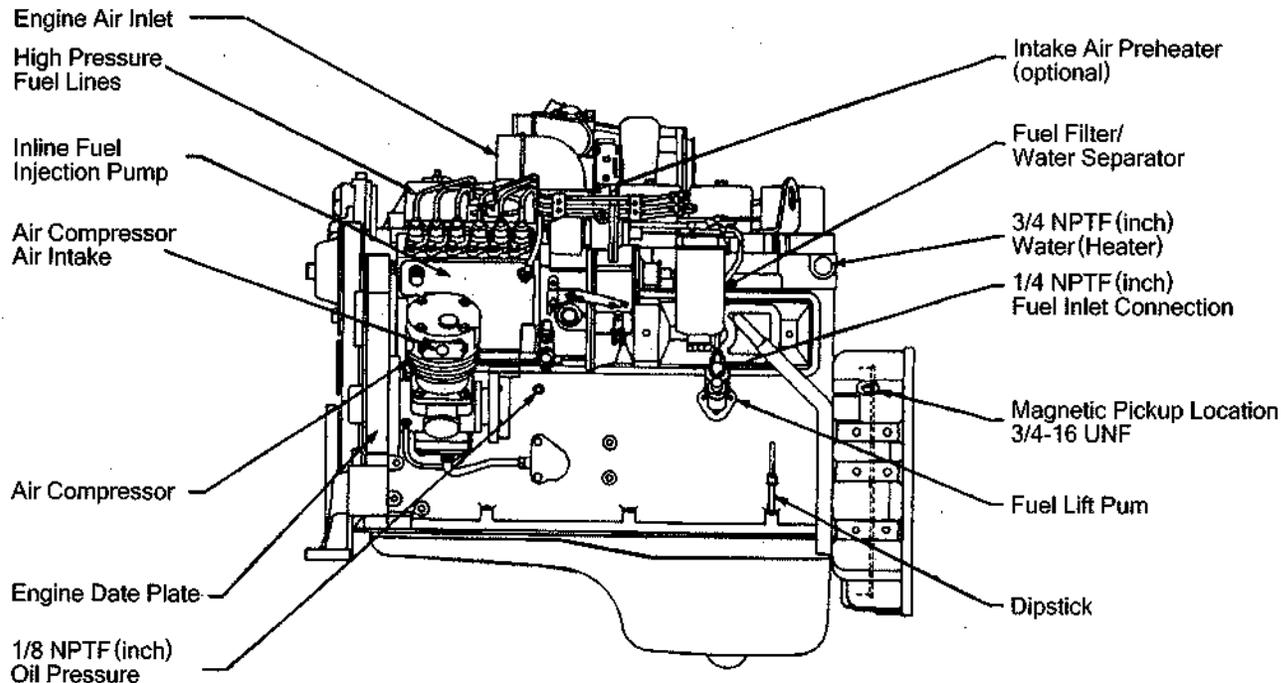
\*\*Typical heavy accessories include hydraulic pump and torque converter.

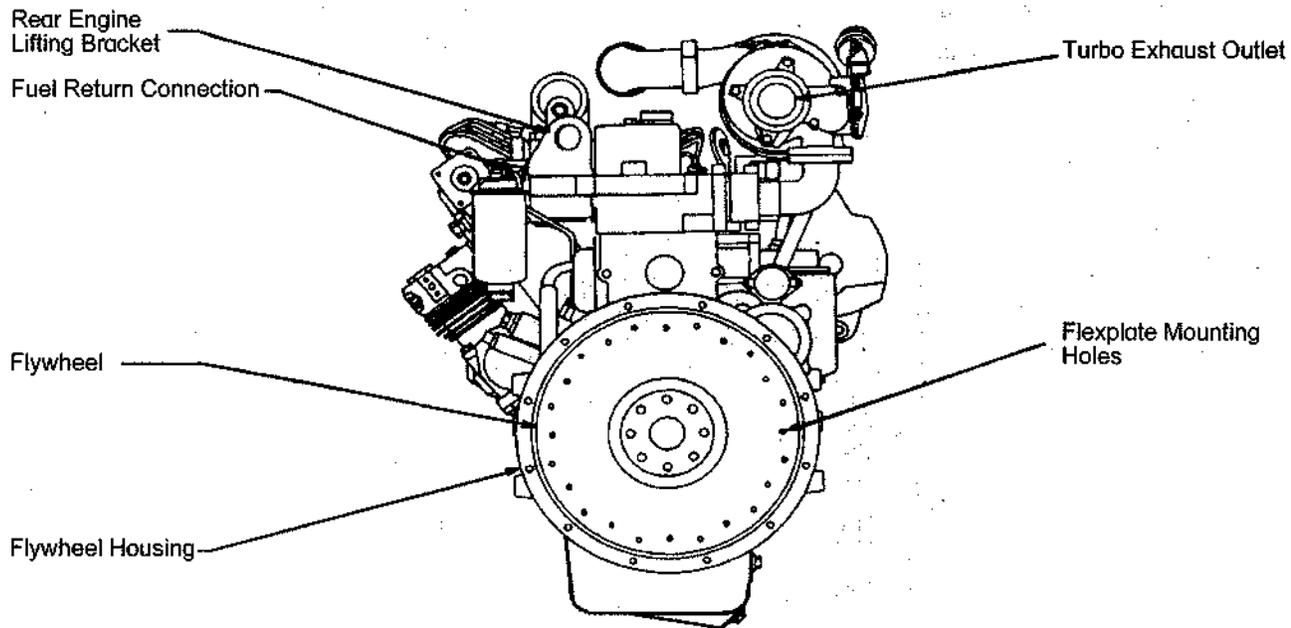
**Batteries (Specific Gravity)**

<b>Specific Gravity at 27°C [80°F]</b>	<b>State of Charge</b>
1.260-1.280	100%
1.230-1.250	75%
1.200-1.220	50%
1.170-1.190	25%
1.110-1.130	Discharged

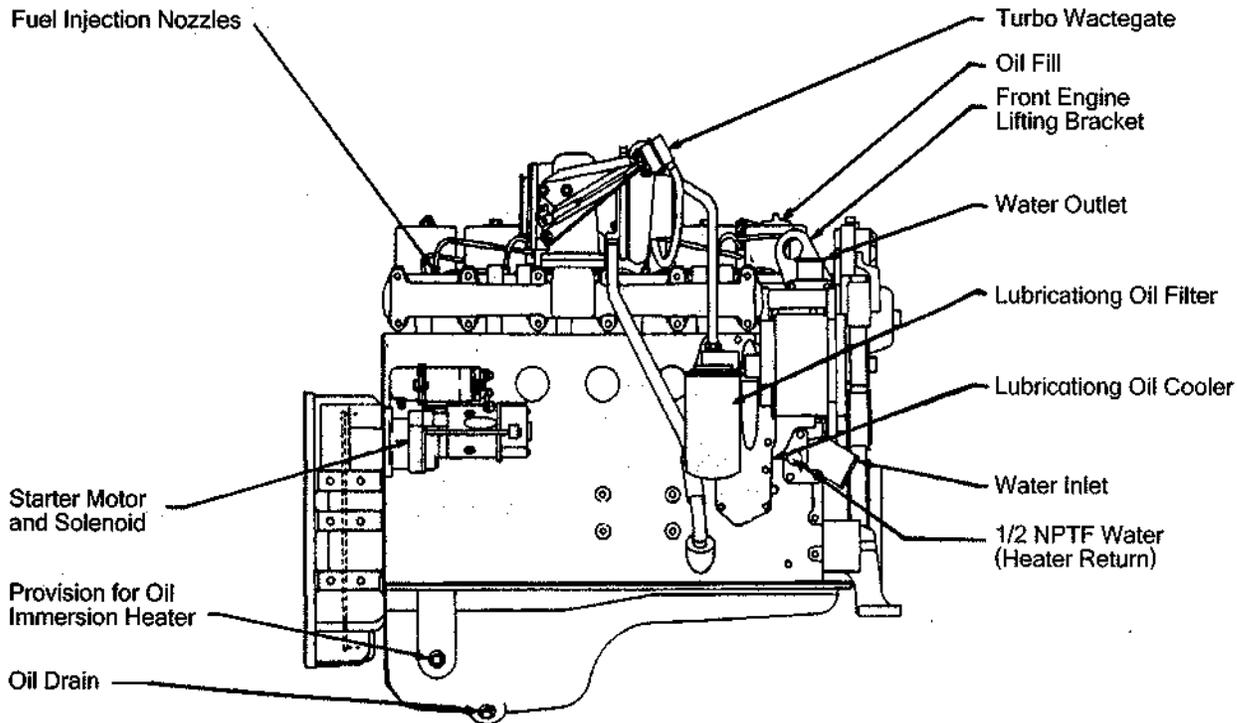
### External Engine Components

The illustrations which follow show the locations of the major external engine components, the filters, and other service and maintenance points. Some external components will be at different locations for different engine models.

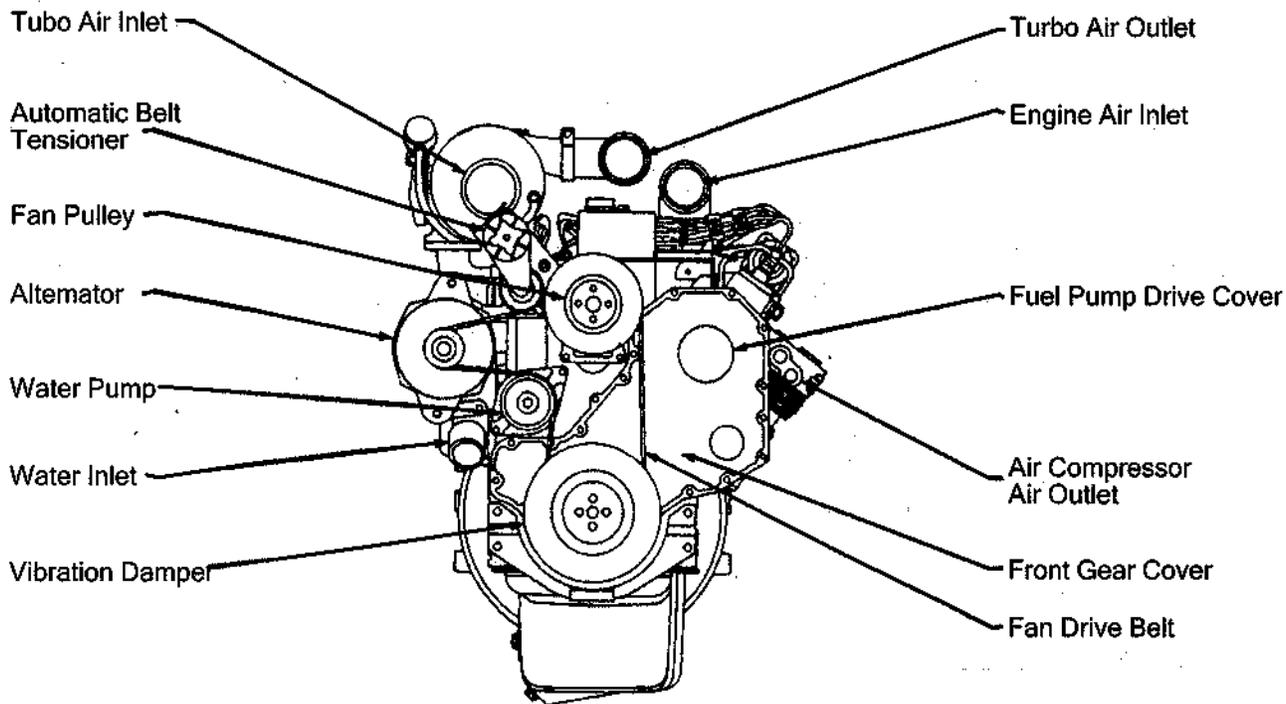




**Rear View**



Turbocharger Side View



**Front View**

# **Section 1-Operating Instructions**

## **Section Contents**

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## General Information

Correct care of your engine will result in longer life, better performance, and more economical operation.

- Follow the daily maintenance checks listed in Maintenance Guidelines, Section 2.
- Check the oil pressure indicators, temperature indicators, warning lights, and other gauges daily to make sure they are operational.



**Warnign: DO NOT OPERATE A DIESEL ENGINE WHERE THERE ARE OR CAN BE COMBUSTIBLE VAPORS.** These vapors can be drawn through the air intake system and cause engine acceleration and over-speeding, which can result in a fire, an explosion and/or extensive property damage. Numerous safety devices are available, such as air intake shut-off devices, to minimize the risk of over-speeding where an engine, due to its application, might operate in a combustible environment, such as due to a fuel spill or gas leak. Remember, Cummins has no way of knowing the use you have for your engine. **THE EQUIPMENT OWNER AND OPERATOR ARE RESPONSIBLE FOR SAFE OPERATION IN A HOSTILE ENVIRONMENT CONSULT YOUR CUMMINS AUTHORIZED REPAIR LOCATION FOR FURTHER INFORMATION.**

### Starting Procedure

**Automotive- (Bosch VE and P-Pumps with RQV-K Governor) above 16 °C [60 °F]**

Foot off throttle. The VE pump has an internal starting circuit to provide starting fuel delivery. The inline pump delivers sufficient fuel to start engine with throttle at idle.

**Automotive- (Bosch VE and P-Pumps with RQV-K Governor) below 16 °C [60 °F]**

Foot at full throttle while cranking. The VE pump has an internal circuit to provide starting fuel delivery, and open throttle helps keep the engine operating, once started. The inline pump requires open throttle to position and hold the rack in the maximum fuel position.

**Industrial/Marine- (Bosch VE, Lucas DPA, Stanadyne DP4, Nippondenso EP-9) above 0 °C [32 °F]**

Foot off throttle. The VE pump has an internal starting circuit to provide starting fuel delivery. The DPA pump has a metering valve which will remain in start position if cranking speed does not approach idle speed. The EP-9 pump has a "Start Spring" which automatically moves the rack to the start fuel position.

**Industrial/Marine**

• **(Bosch VE)below 0 °C [32 °F]**

Foot at full throttle while cranking. The VE pump has an internal circuit to provide starting fuel delivery, and open throttle helps keep the engine operating, once started.

• **(Lucas DPA, Stanadyne DP4 and Nippondenso EP-9)below 0 °C [32 °F]**

Foot off throttle. The DPA pump has a metering valve which will remain in start position if cranking speed does not approach idle speed. The EP-9 has a "start Spring" which automatically moves the rack to the start fuel position.

**Starting Procedure Matrix**

	Idle Throttle	Full Throttle
<b>Automotive</b>		
All pumps-above 16°C [60°F].....	x	
All pumps-below 16°C [60°F].....		x
<b>Industrial/Marine</b>		
All pumps-above 0°C [32°F].....	x	
All except Bosch VE-below 0°C [32°F].....	x	
Bosch VE-below 0°C [32°F].....		x

- Disengage the driven unit, or if equipped, put the transmission in neutral.
- Position the fuel shut-off, electrical switch or mechanism control to the RUN position.



**Caution: To prevent damage to the starter, do not engage the starting motor more than 30 seconds. Wait 2 minutes between each attempt to start (electrical starting motors only).**

- If the engine does not start after three attempts, check the fuel supply system. Absence of blue or white exhaust smoke during cranking indicates no fuel is being delivered.

- Move the throttle position to idle as the engine starts.
- Engine oil pressure must be indicated on the gauge within 15 seconds after starting.
- When starting a cold engine, increase the engine speed (RPM) slowly to make sure adequate lubrication is available to the bearings.



**Caution: Do not idle the engine for excessively long periods. Long periods of idling (more than 10 minutes) can damage an engine because combustion chamber temperatures drop so low the fuel will not burn completely. This will cause carbon to clog the injector spray holes and piston rings, and can cause the valves to stick. If the engine coolant temperature becomes too low (60 °C [140 °F]), raw fuel will wash the lubricating oil off the cylinder walls and dilute the crankcase oil; therefore, all moving parts of the engine will not receive the correct amount of lubrication.**

- Idle the engine 3 to 5 minutes before operating with a load.



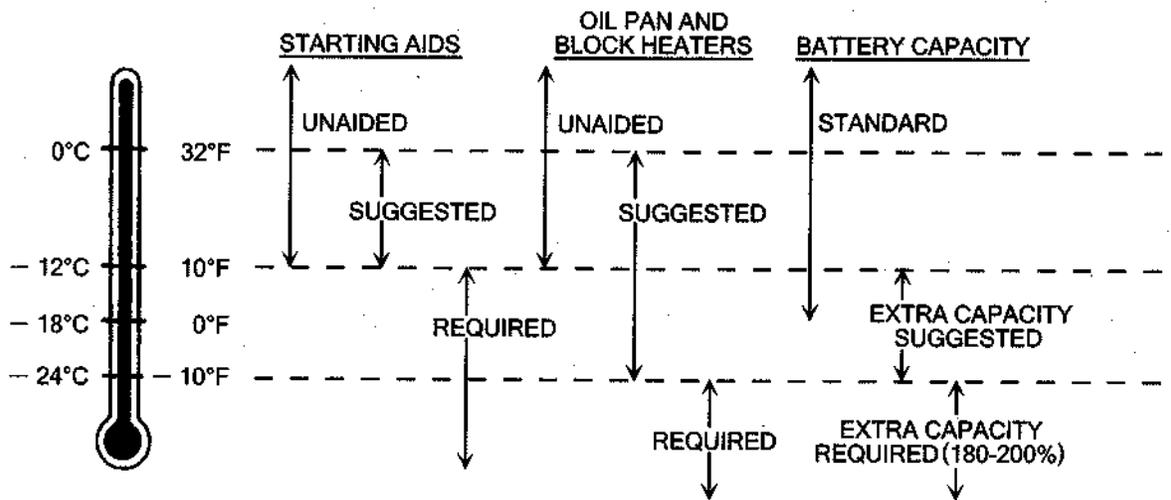
**Caution: When using jumper cables to start the engine, make sure to connect the cables in parallel: positive (+) to positive (+) and negative (-) to negative (-). When using an external electrical source to start the engine, turn the disconnect switch to the "OFF" position. Remove the key before attaching the jumper cables to prevent unintentional starter engagement.**

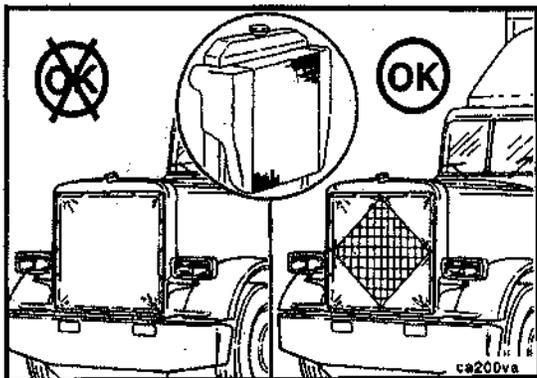
## Cold Weather Operation

### Starting Aid Requirements

Use the following chart as a reference for required cold weather starting aids:

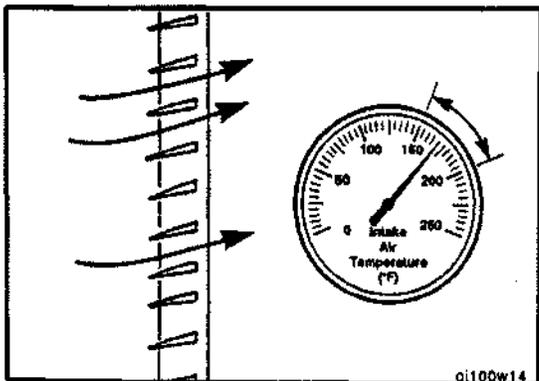
Operation in ambient temperatures below 0°C [32°F] can require special consideration be given to engine starting. At temperatures below 0°C [32°F], operate the engine at moderate speeds for 5 minutes before full loads are applied.





### Winterfronts

Winterfronts can be used on a vehicle equipped with charge air cooling (CAC), but must be designed to partially cover the frontal area of the cooling system. A minimum of 120 square inches (11 in × 11 in) of frontal area must be left open to air flow for the CAC to function correctly.



### Shutters

Installations of CAC engines with shutters also requires an intake manifold air temperature switch to open the shutters to prevent excessive intake manifold temperatures. This prevents engine damage due to high intake manifold temperatures as a result of blocked air flow across the CAC.

## **Cold Weather Starting**

### **Using Starting Fluid With Mechanical or Electrical Metering Equipment**

- Set the throttle at half speed.
- Disengage the driven unit, or if equipped, put the transmission in neutral.
- Activate the switch to open the fuel pump shut-off valve.
- While cranking the engine, inject metered amounts of starting fluid.
- Engine oil pressure must be indicated on the gauge within 30 seconds after starting.

### **Using Starting Fluid Without Metering Equipment**

-  **Warnign:** Never use starting fluid near an open flame, or with a preheater or flame thrower equipment. This combination can cause an explosion.
-  **Warning:** Do not breathe starting fluid fumes. Starting fluid fumes can be harmful to your health.
-  **Caution:** Do not use excessive amounts of starting fluid when starting an engine. The use of too much starting fluid will cause engine damage.
- Spray starting fluid into the air cleaner intake while another person cranks the engine.
-  **Warning:** Do not use volatile cold starting aids in underground mine or tunnel operations due to the potential of an explosion. Check with the local U. S. Bureau of Mines Inspector for instructions.

## **Starting Procedure-After Extended Shutdown or Oil Change**

Complete the following steps after each oil change, or after the engine has been shut off for more than 7 days to make sure the engine receives the correct oil flow through the lubricating oil system:

- Disconnect the electrical wire from the fuel pump solenoid valve.
- Rotate the crankshaft, using the starting motor, until oil pressure appears on the gauge, or the warning light goes out.
- Connect the electrical wire to the fuel pump solenoid valve.
- Start the engine; refer to Normal Starting Procedures in this section.
- Refer to Fuel System-Bleeding, Section 5, for instructions to vent the fuel system.

## **Operating the Engine**

- Do not operate engine at full throttle below peak torque engine speed (1100 to 1600 RPM, dependent on engine rating) for extended periods (more than 1 minute) of time.
- Allow the engine to idle 3 to 5 minutes before shutting it off after a full load operation.
- Monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System or Cooling System, Section v, for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does not meet the specifications.



**Caution: Continuous operation with low coolant temperature (below 60°C [140°F]) or high coolant temperature (above 100°C [212°F]) can damage the engine.**

- If an overheating condition starts to occur, reduce the power output of the engine by releasing the throttle pressure or shifting the transmission to a lower gear, or both, until the temperature returns to normal operating range. If engine temperature does not return to normal, shut off the engine and refer to Troubleshooting, Section T, or contact a Cummins Authorized Repair Location.
- Most failures give an early warning. Look and listen for changes in performance, sound, or engine appearance that can indicate service or engine repair is needed. Some changes to look for are as follows:
  - Engine misfires
  - Excessive smoke
  - Vibration
  - Loss of power
  - Unusual engine noises
  - An increase in oil consumption
  - Fuel, oil, or coolant leaks
  - An increase in fuel consumption
  - Sudden changes in engine operating temperature or oil pressure

## Engine Operating Range

 **Caution:** Cummins engines are designed to operate successfully at full throttle under transient conditions down to peak torque engine speed (RPM). This is consistent with recommended driving practices for good fuel economy. Excessive full throttle operation below peak torque RPM (peak torque RPM varies from 1,100 RPM to 1,600 RPM, depending upon rated engine speed) will shorten engine life to overhaul, can cause serious engine damage, and is considered engine abuse.

 **Caution:** Operation of the engine below peak torque RPM can occur during gear shifting due to the difference of ratios between transmission gears, but engine operation must not be sustained more than 1 minute at full throttle below peak torque RPM.

 **Caution:** Operating the engine beyond high idle speed can cause severe engine damage. When descending a steep grade, use a combination of transmission gears and engine or service brakes to control the vehicle and engine speed.

## Engine Shut-down

- Allow the engine to idle 3 to 5 minutes after a full load operation before shutting it off. This allows the engine to cool gradually and uniformly.
- Turn the ignition key switch to the OFF position.

## **Section 2-Maintenance Guidelines**

### **Section Contents**

	<b>Page</b>
<b>General Information</b> .....	<b>2-2</b>
<b>Maintenance Record Form</b> .....	<b>2-8</b>
<b>Maintenance Schedule</b> .....	<b>2-4</b>
Page References for Maintenance Instructions.....	<b>2-5</b>
<b>Tool Requirements</b> .....	<b>2-3</b>

## **General Information**

Cummins Engine Company, Inc. recommends that the engine be maintained according to the Maintenance Schedule in this section.

If the engine is operating in ambient temperatures consistently below  $-18^{\circ}\text{C}$  [ $0^{\circ}\text{F}$ ] or above  $38^{\circ}\text{C}$  [ $100^{\circ}\text{F}$ ], perform maintenance at shorter intervals. Shorter maintenance intervals are also required if the engine is operated in a dusty environment or if frequent stops are made. See your Cummins Authorized Repair Location for recommended intervals.

Use the chart provided at the end of this section as a convenient way to keep a record of maintenance performed.

## **Tool Requirements**

In the text, a symbol followed by the wrench size or tool description is used to identify the tooling required to perform each step. A list of wrench sizes and descriptions indicate more than one tool is needed.

<b>Sockets</b>	<b>Wrenches</b>	<b>Other Tools</b>
19mm	19mm	Fuel line nuts
17mm	17mm	Filter Wrenches (75-80mm and 90-95mm)
15mm	15mm	Ratchet (1/2 inch drive)
	14mm	Torque Wrench
	13mm	Flat Blade Screwdriver
	10mm	5/16 Allen Wrench
		Feeler Gauges (0.25 mm and 0.51 mm)
		Engine Barring Gear Part NO. 3377371.

**Maintenance Schedule**

Daily or Refueling	Every 10,000 Km [6,000 Mi], 250 Hours or 3 Months	Every 19,000 Km [12,000 Mi], 500 Hours or 6 Months	Every 38,000 Km [24,000 Mi] 1000 Hours or 12 Months	Every 77,000 Km [48,000 Mi], 2000 Hours or 2 Years
Check	----- Change/Replace -----			
<ul style="list-style-type: none"> <li>• Oil Level</li> <li>• Coolant Level</li> <li>• Fan-Inspection</li> <li>• Drive Belt-Inspection</li> <li>• Fuel Water Trap</li> </ul>	<ul style="list-style-type: none"> <li>• Lube Oil<sup>①</sup></li> <li>• Lube Filter</li> </ul>	<ul style="list-style-type: none"> <li>• Lube Oil</li> <li>• Lube Filter</li> <li>• Fuel Filter<sup>②</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Lube Oil</li> <li>• Lube Filter</li> <li>• Fuel Filter</li> </ul>	<ul style="list-style-type: none"> <li>• Lube Oil</li> <li>• Lube Filter</li> <li>• Fuel Filter</li> <li>• Antifreeze<sup>③</sup></li> </ul>
	----- Adjust -----			
			<ul style="list-style-type: none"> <li>• Valve Lash<sup>2</sup> Clearance</li> </ul>	
	----- Check/Inspect -----			
	<ul style="list-style-type: none"> <li>• Air Cleaner</li> <li>• Intake System</li> <li>• Charge Air Cooler</li> </ul>	<ul style="list-style-type: none"> <li>• Air Cleaner</li> <li>• Intake System</li> <li>• Antifreeze<sup>④</sup></li> <li>• Charge Air Cooler</li> </ul>	<ul style="list-style-type: none"> <li>• Air Cleaner</li> <li>• Intake System</li> <li>• Charge Air Cooler</li> <li>• Antifreeze</li> <li>• Fan Hub</li> <li>• Belt Tensioner</li> <li>• Bearing</li> <li>• Belt Tension</li> </ul>	<ul style="list-style-type: none"> <li>• Air Cleaner</li> <li>• Charge Air Cooler<sup>⑤</sup></li> <li>• Intake System</li> <li>• Fan Hub</li> <li>• Belt Tensioner</li> <li>• Bearing</li> <li>• Belt Tension</li> <li>• Damper</li> </ul>

<sup>①</sup> Refer to the Oil Change Interval chart given in Section 4 to find the specific oil change interval for your application.

<sup>②</sup> Initial valve lash clearance adjustment, subsequent adjustments to be performed at 77,000 Km [48,000 mile] or every 4th oil change for automotive engines and, 2000 hour, 2 year intervals.

<sup>③</sup> Must use a heavy duty year around antifreeze that meets the chemical composition of GM6038M. The change interval is 2 years or 320,000 Km [200,000 Mi], whichever occurs first. Antifreeze is essential for freeze, overheat and corrosion protection.

<sup>④</sup> Service interval is 2 years or 320,000 Km [200,000 Mi], whichever occurs first.

<sup>⑤</sup> Service interval is every other oil change or 19,000 Km [12,000 miles], 500 hours or 6 months.

### **Page References for Maintenance Instructions**

For your convenience, listed below are the page numbers which contain specific instructions for performing the maintenance checks listed in the maintenance schedule.

#### **Daily or Refueling**

•Belts-inspect.....	3-5
•Engine oil level-check.....	3-3
•Engine coolant level-check.....	3-4
•Fan-Inspect.....	3-6
•Fuel-water separator-drain.....	3-3

#### **Every 10,000 Kilometers [6,000 Miles], 250 Hours or 3 Months**

•Lubricating oil-change.....	4-5
•Lubricating oil filters-change.....	4-5
•Air intake system check.....	4-11
•Air cleaner restriction-check.....	4-12
•Charge Air Cooler.....	4-11

**Every 19,000 Kilometers [12,000 Miles], 500 Hours or 6 Months**

• Lubricating oil-change.....	4-5
• Lubricating oil filter-change.....	4-5
• Fuel filter-change.....	5-3
• Intake air system-check.....	4-11
• Charge Air Cooler.....	4-11
• Coolant and Antifreeze-check.....	5-9

**Every 38,000 Kilometers [24,000 Miles], 1000 Hours or 12 Months**

• Lubricating oil-change.....	4-5
• Lubricating oil filter-change.....	4-5
• Fuel filter-change.....	5-3
• Intake air system-check.....	4-11
• Charge Air Cooler.....	4-11
• Valve lash clearance-adjust (first time only, thereafter every 64,000 KM).....	6-3
• Fan hub-check.....	6-11
• Belt tensioner bearing-check.....	6-11
• Belt tension-check.....	6-9
• Coolant and antifreeze-check	

**Every 77,000 Kilometers [48,000 Miles], 2,000 Hours or 2 Years**

•Lubricating oil - change.....	4-5
•Lubricating oil filter - change.....	4-5
•Fuel filter - change.....	5-3
•Intake air system - check.....	5-3
•Valve lash clearance - adjust.....	6-3
•Fan hub - check.....	6-11
•Belt tensioner bearing - check.....	6-9
•Belt tension - check.....	6-11
•Vibration damper - inspect.....	7-7
•Coolant and antifreeze - change.....	7-3
•Charge Air Cooler - leak check (320,000 Km/200,000 Mi).....	A-87





## **Section 3-Daily Maintenance Procedures**

### **Section Contents**

	<b>Page</b>
<b>Coolant Level</b> .....	<b>3-4</b>
Check.....	<b>3-4</b>
<b>Cooling Fan</b> .....	<b>3-6</b>
Inspection.....	<b>3-6</b>
<b>Drive Belt</b> .....	<b>3-5</b>
Inspection.....	<b>3-5</b>
<b>Fuel-Water Separator</b> .....	<b>3-3</b>
Draining.....	<b>3-3</b>
<b>General Information</b> .....	<b>3-2</b>
<b>Oil Level</b> .....	<b>3-3</b>
Check.....	<b>3-3</b>

## **General Information**

Preventative maintenance begins with day-to-day awareness of the condition of the engine and its systems.

Before starting the engine, check the oil and coolant levels. Look for:

- Leaks
- Loose or damaged parts
- Worn or damaged belts
- Any change in engine appearance

## **Fuel-Water Separator**

### **Draining**

Draining the water and sediment from the separator daily. Shut off the engine. Use your hand to open the drain valve. Turn the valve **counterclockwise** approximately 1 1/2-to 2 turns until draining occurs. Drain the filter sump of water until clear fuel is visible.

**Caution: Do not overtighten the valve. Overtightening can damage the threads.**

Turn the valve **clockwise** to close the drain valve.

### **Oil Level**

#### **Check**

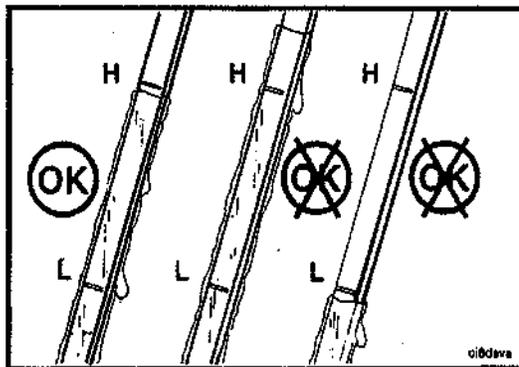
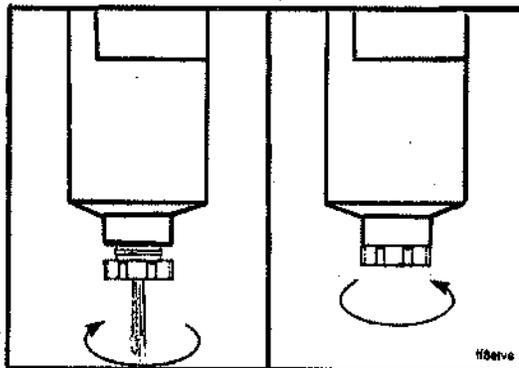
**Never** operate the engine with the oil level below the "L" (Low) mark or above the "H" (High) mark. Wait at least 5 minutes after shutting off the engine to check the oil. This allows time for the oil to drain to the oil pan.

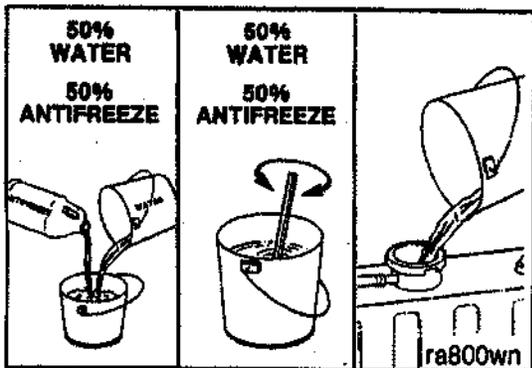
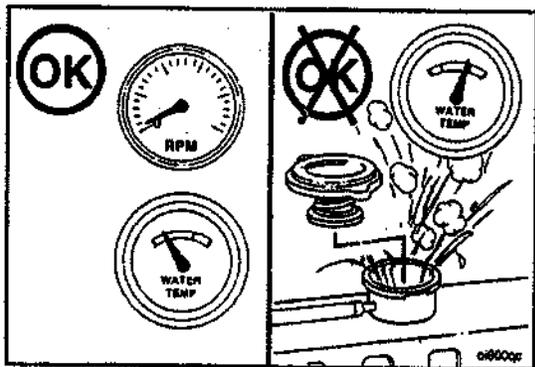
**NOTE:** The engine **must** be level when checking the oil level to make sure the measurement is correct.

#### **Low Mark To High Mark Oil Capacity**

4 Cylinder-0.95 Liter [1.0 U.S. Quart]

6 Cylinder-1.89 Liter [2.0 U.S. Quart]





## Coolant Level

### Check



**Warning:** Do not remove the radiator cap from a hot engine. Wait until the temperature is below 50 °C [120 ° F] Before removing the pressure cap. Failure to do so can result in personal injury from heated coolant spray or steam. Remove the filler cap slowly to relieve coolant system pressure.

**NOTE:** Never use a sealing additive to stop leaks in the coolant system. This can result in coolant system plugging and inadequate coolant flow causing the engine to overheat.



The coolant level **must** be checked daily.



**Caution:** Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50 °C [120 °F] before adding coolant.

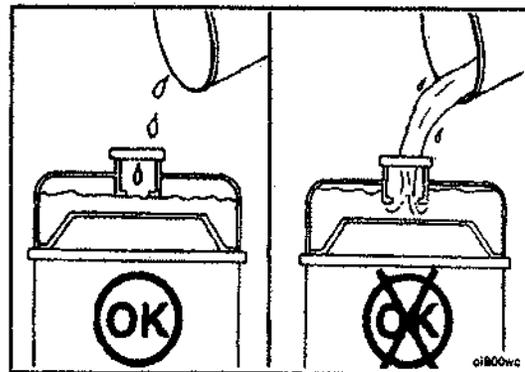
**NOTE:** On applications that use a coolant recovery system, check to make sure the coolant is at the appropriate level on the coolant recovery tank depending on engine temperature.

### Section 3-Daily Maintenance Procedures B Series

Drive Belt  
Page 3-5

Fill the cooling system with coolant to the bottom of the fill neck in the radiator fill or expansion tank.

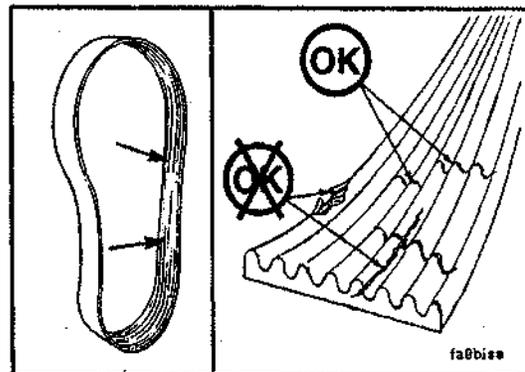
**NOTE:** Some radiators have two fill necks, both of which **must** be filled when the cooling system is drained.

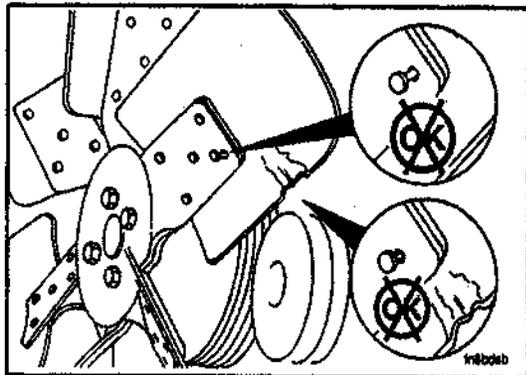


### Drive Belt

#### Inspection

Visually inspect the belt. Check the belt for intersecting cracks. Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are **not** acceptable. Replace the belt if it is frayed or has pieces of material missing. Refer to **Adjustment and Replacement** (Section A).





## Cooling Fan

### Inspection



**Warning:** Personnel Injury can result from a fan blade failure. Never pull or pry on the fan. This can damage the fan blade (s) and cause fan failure.

**NOTE:** Rotate the crankshaft by using the engine barring gear.



A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted. Tighten the capscrews if necessary. Replace any fan that is damaged.

## **Section 4-Maintenance Procedures at 10,000 Kilometers [6,000 Miles], 250 Hours or 3 Months**

### **Section Contents**

	<b>Page</b>
<b>Air Cleaner Restriction</b> .....	<b>4-13</b>
Check.....	<b>4-13</b>
<b>Air Intake System</b> .....	<b>4-10</b>
Charge Air Cooler.....	<b>4-11</b>
Inspection.....	<b>4-10</b>
<b>General Information</b> .....	<b>4-2</b>
<b>Lubricating Oil and Filter</b> .....	<b>4-4</b>
Changing.....	<b>4-4</b>
<b>Lubricating Oil and Filter Change Interval</b> .....	<b>4-2</b>

## General Information

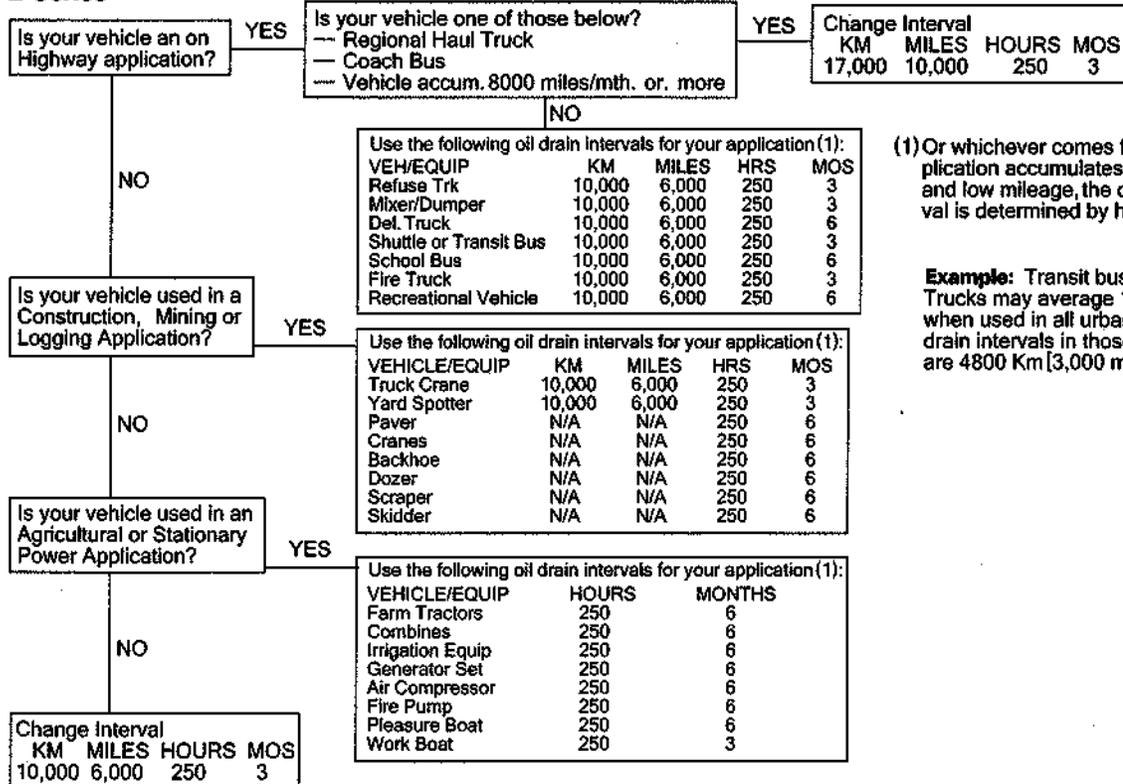
All checks or inspections listed under daily or previous maintenance intervals **must** also be performed at this time in addition to those listed under this maintenance interval.

### Lubricating Oil and Filter Change Interval

Refer to the following flow chart to determine the **maximum** recommended oil and filter change intervals in kilometers, milse, hours or months; whichever comes first.

# Maintenance Procedures at 10,000 Km [6,000 Mi] B Series

# Lubricating Oil and Filter Change Interval Page 4-3



(1) Or whichever comes first. If your application accumulates high hours and low mileage, the change interval is determined by hours.

**Example:** Transit buses and refuse Trucks may average 16 Km [10 MPH] when used in all urban routes. Oil drain intervals in those applications are 4800 Km [3,000 mi], or less.

## Lubricating Oil and Filter

### Changing



**Caution:** Avoid prolonged and repeated skin contact with used engine lubricating oils. Such prolonged and repeated contact may cause skin disorders or other bodily injury.

- Avoid excessive contact-wash thoroughly after contact.
- Keep out of reach of children.

**PROTECT THE ENVIRONMENT:** Handling and disposal of used engine lubricating oil may be subject to federal, state and local law and regulation. Use authorized waste disposal facilities, including civic amenity sites and garages providing authorized facilities for receipt of used lubricating oil. If in doubt, contact your state and local environmental authorities or the Environmental Protection Agency for guidance as to proper handling and disposal of used engine oil.

## Maintenance Procedures at 10,000 Km [6,000 Mi] B Series

**NOTE:** If the engine is service, the oil drain interval of 10,000 Km [6,000 miles] 250 hours or 3 months (or approved extended interval from the Chart on Page 4-3) **must** be observed.

Change the oil and filters to remove the contaminants suspended in the oil.

**NOTE:** Drain the oil only when it is hot and the contaminants are in suspension.

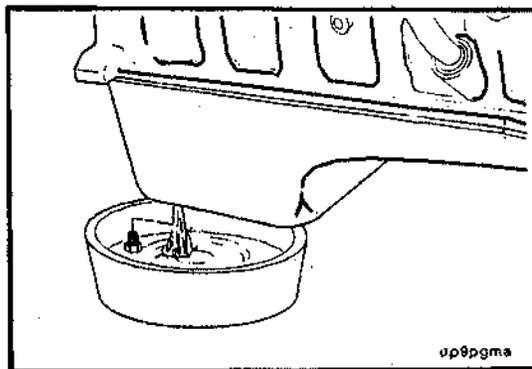
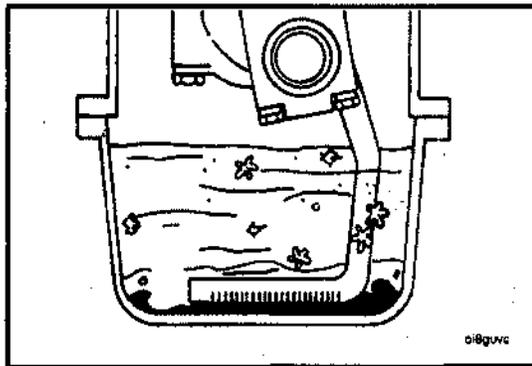
17mm

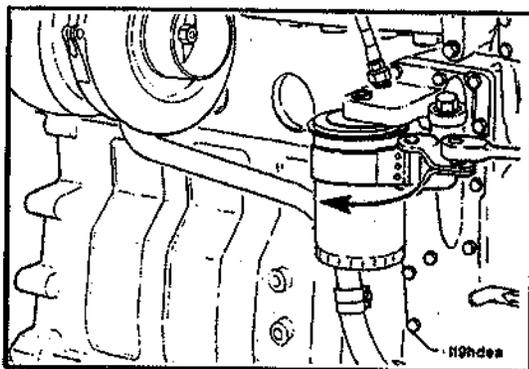
**Caution:** Hot oil can cause personal injury

Operate the engine until the water temperature reaches 60°C [140°F]. Shut the engine off. Remove the oil drain plug.

**NOTE:** Use a container that can hold at least 20 liters [15 U.S. qts.] of oil.

## Lubricating Oil and Filter Page 4-5

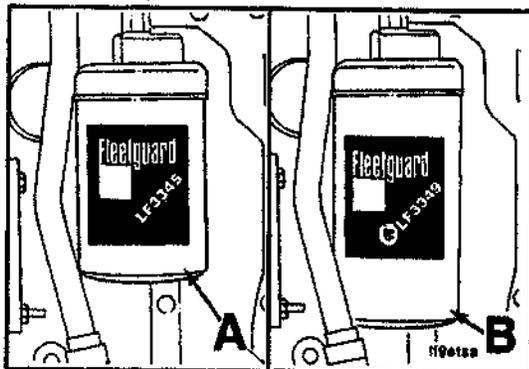




### 90 to 95 mm Filter Wrench

Clean the area around the lubricating oil filter head. Remove the filter. Clean the gasket surface of the filter head.

**NOTE:** The o-ring can stick on the filter head. Make sure it is removed before installing the new filter.



Make sure the correct oil filter is used.

The filter for the six-cylinder engine is longer than the filter for the four-cylinder engine.

A = Standard for four-cylinder applications.

B = Standard for six-cylinder applications.

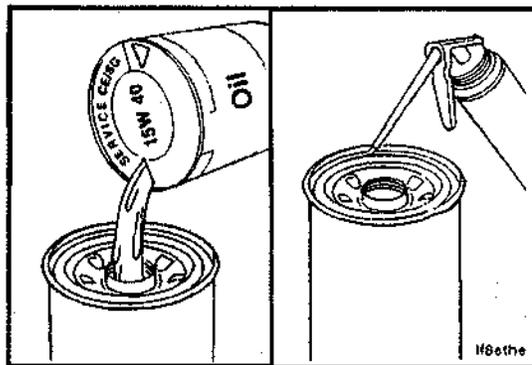
**NOTE:** A 6 cylinder oil filter can be used on a 4 cylinder engine. **Do not** use a 4 cylinder oil filter on a 6 cylinder engine.

## Maintenance Procedures at 10,000 Km [6,000 Mi] B Series

**NOTE:** Fill the filters with clean lubricating oil before installation.

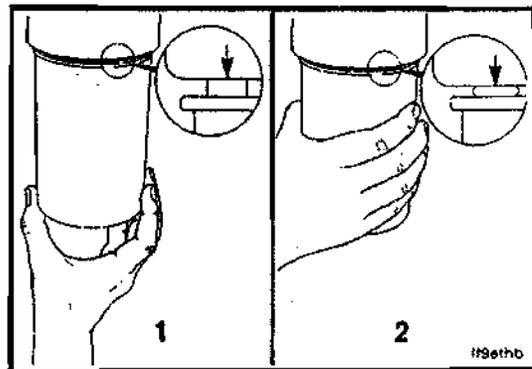
Apply a light film of lubricating oil to the gasket sealing surface before installing the filters.

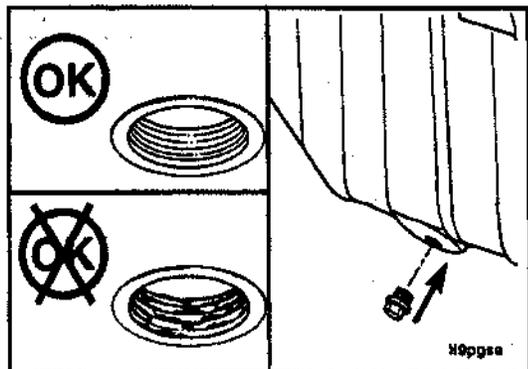
## Lubricating Oil and Filter Page 4-7



**Caution: Mechanical over-tightening can distort the threads or damage the filter element seal.**

Install the filter as specified by the filter manufacturer.





17 mm

Check and clean the oil drain plug threads and sealing surface.

Install the oil drain plug.

**Torque Value:** 80 N•m [60 ft•lb]

**NOTE:** Use high quality multi-grade lubricating oil meeting the American Petroleum Institute (API) classification of CE/SG as outlined in Specifications and Torque Values (Section V).

**NOTE:** CD/SF oil can be used in areas where CE/SG oil is not yet available.

If CD/SF oil is used, change the oil at one-half the recommended intervals.



## Maintenance Procedures at 10,000 Km [6,000 Mi] B Series

Lubricating Oil and Filter  
Page 4-9

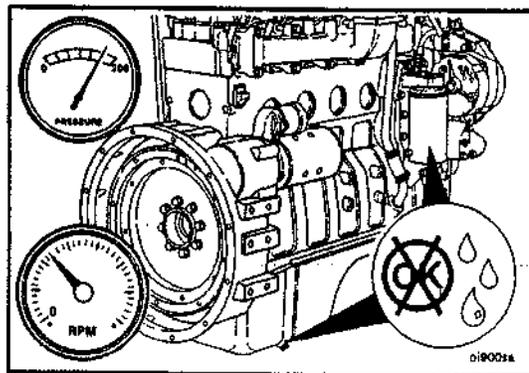
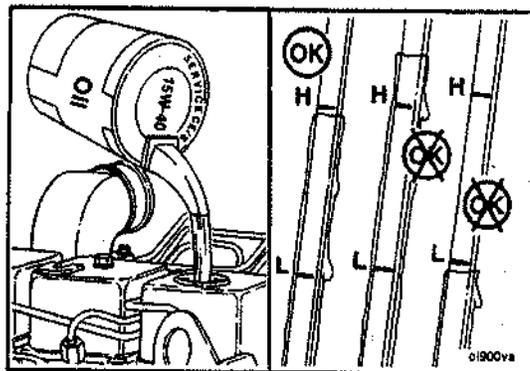
Fill the engine with clean oil to the proper level.

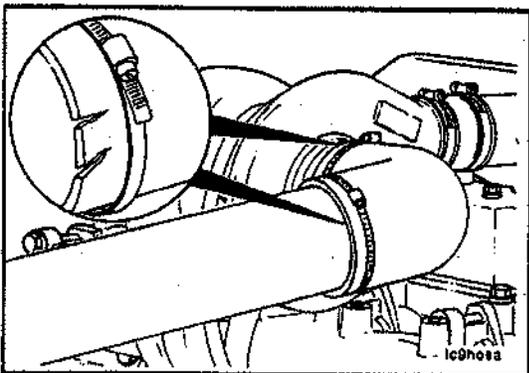
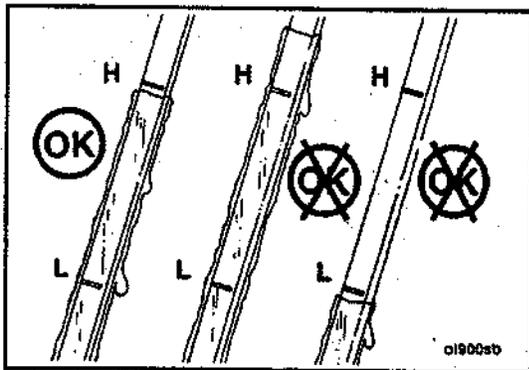
	Four Cylinder	Six Cylinder
Pan Capacity	9.5 Liters [10 U.S. Qts]	14.2 Liters [15 U.S. Qts]
Total System	10.9 Liters	16.3 Liters
Capacity	[11.5 U.S. Qts]	[17.2 U.S. Qts]

**NOTE:** Capacities assume standard pan. Total system assumes standard pan plus filter.

Some 6B applications use a reduced capacity pan 10.4 Liters [11 U.S. Qts] and some have increased capacity of 16 liters [17 U.S. Qts]. Fill quantities **must** be adjusted accordingly.

Operate the engine at idle to inspect for leaks at the filters and the drain plug.





## Maintenance Procedures at 10,000 Km [6,000 Mi] B Series



Stop the engine. Wait approximately 5 minutes to let the oil drain from the upper parts of the engine. Check the oil level again.

Add oil as necessary to bring the oil level to the "H" (High) mark on the dipstick.



### Air Intake System

#### Inspection

Inspect the intake piping for cracked hoses, loose clamps, or punctures which can allow dirt and debris to enter the engine.

Tighten or replace parts as necessary to make sure the air intake system does not leak.

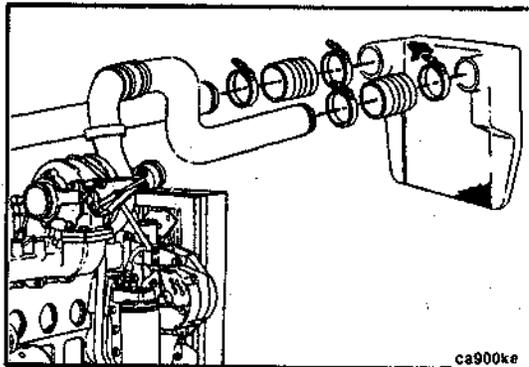
**Maintenance Procedures at 10,000 Km [6,000 Mi]  
B Series**

**Charge Air Cooler**

**Inspection**

If the engine experiences a turbocharger failure or any other occasion where oil or debris is put into the CAC, the CAC must be cleaned.

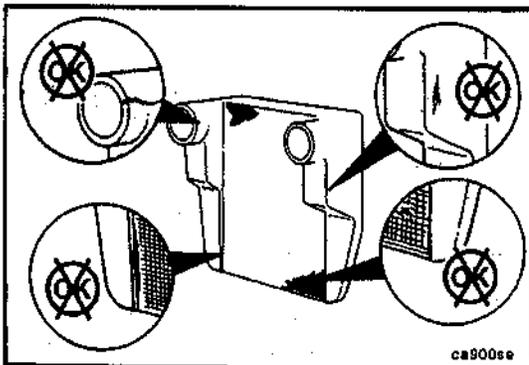
Remove the CAC from the vehicle. Refer to the vehicle manufacturer's instructions.

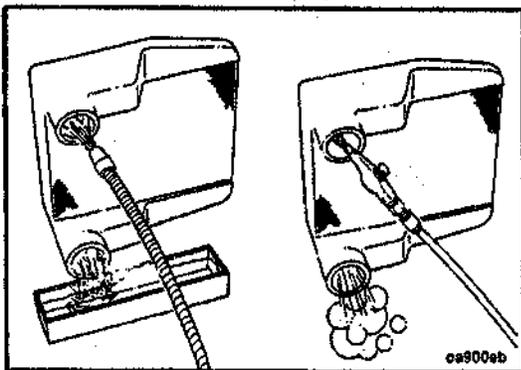
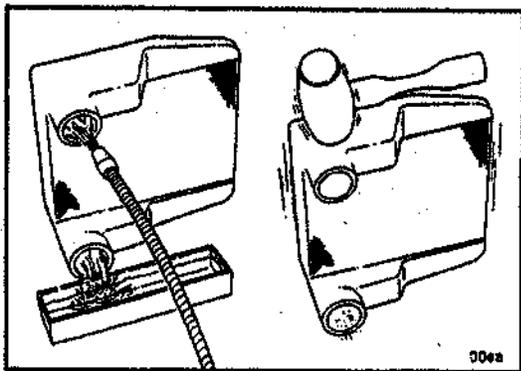


Visually inspect the CAC for cracks, holes or damage.

Inspect the tubes, fins and welds for tears, breaks or other damage.

Refer to Section A to find the leak check procedure.





### Cleaning



Flush the CAC internally with solvent in the opposite direction of normal air flow. Shake the CAC and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris. Continue flushing until all debris or oil is removed.



**Caution: Do not use caustic cleaners to clean the CAC. Damage to the CAC will result.**



After the CAC has been thoroughly cleaned of all oil and debris with solvent, wash the CAC internally with hot soapy water to remove the remaining solvent. Rinse thoroughly with clean water.

Blow compressed air into the CAC in the opposite direction of normal air flow until the CAC is dry internally.



Refer to the vehicle manufacture's instructions for installation procedures.

## Air Cleaner Restriction

### Check

Maximum intake air restriction is 635 mm [25.0 in.] of water for turbocharged engines. Naturally aspirated engines have a maximum restriction of 510 mm [20.0 in.] of water.

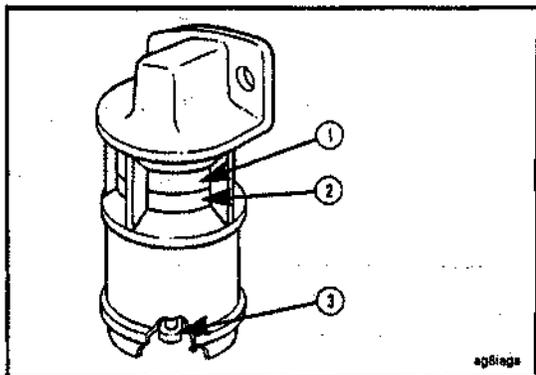
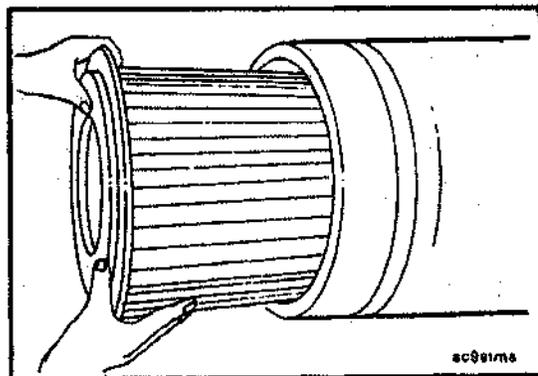
Turbocharged engines must be operated at rated RPM and full load to check maximum intake air restriction. Replace the air cleaner element when the restriction reaches the maximum allowable limit or clean according to the manufacturer's recommendations.

**NOTE:** Follow the manufacturer's instructions when cleaning or replacing the air cleaner element.

Check the air cleaner service indicator, if equipped. Change the filter element when the red indicator flag (2) is at the raised position in the window. (1)

After the air cleaner has been serviced, push the button (3) to reset the service indicator.

**NOTE:** Never operate the engine without an air cleaner. Intake air must be filtered to prevent dirt and debris from entering the engine and causing premature wear.



## Section 5-Maintenance Procedures at 19,000 Kilometers [12,000 Miles], 500 Hours or 6 Months

### Section Contents

	Page
Antifreeze Concentration.....	5-9
Check.....	5-9
Fuel Filter.....	5-3
Replacement.....	5-3
Fuel System.....	5-4
Bleeding.....	5-4
General Information.....	5-2
High Pressure Lines (Rotary and.....	5-8
Re-Tighten Line Fittings.....	5-8
Venting.....	5-8
Injection Pump.....	5-6
Venting.....	5-6
Low Pressure Lines and Fuel filter (s).....	5-5
Venting.....	5-5

**General Information**

All checks or inspections listed under daily or previous maintenance intervals **must** also be performed at this time in addition to those listed under this maintenance interval.

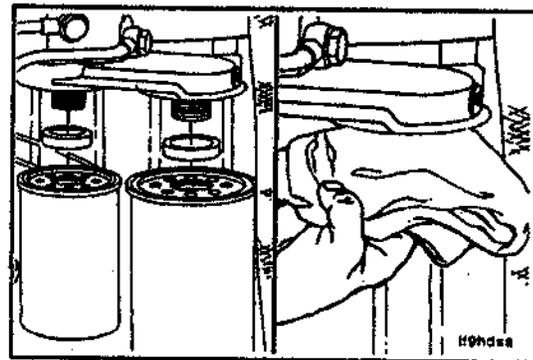
## **Fuel Filter**

### **Replacement**

**75-80 mm and 90-95 mm**

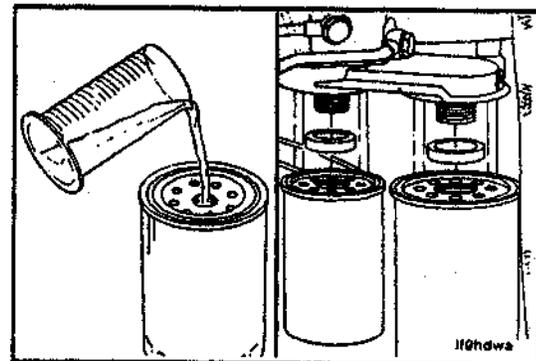
Clean the area around the fuel filter head. Remove the filters. Clean the gasket surface of the filter head.

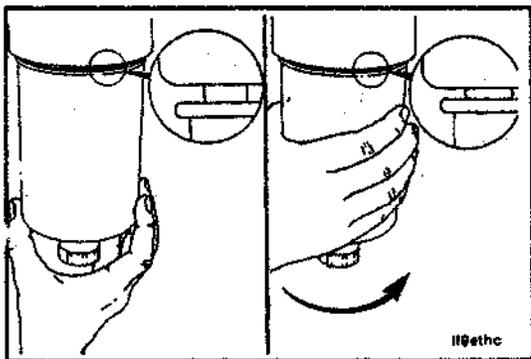
Replace the o-ring.



Fill the new filter (s) with clean fuel and lubricate the o-ring seal with clean lubricating oil.

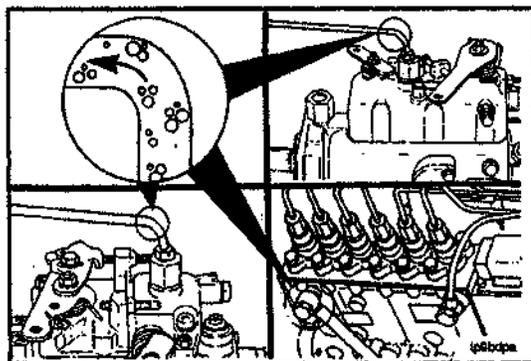
- Standard filter - used as secondary filter in dual filter applications.
- Fuel water separator - used as primary filter in dual filter applications.
- Fuel water separator - used in single filter applications.





**Caution:** Mechanical tightening will distort the threads, filter element seal or filter can.

Install the filter as specified by the filter manufacturer.



## Fuel System

### Bleeding

Controlled venting is provided at the injection pump through the fuel drain manifold. Small amounts of air introduced by changing the filters or injection pump supply line will be vented automatically, if the fuel filter is changed in accordance with the instructions. No manual bleeding of fuel lines is required.

## Maintenance Procedures at 19,000 Km [12,000 Mi] B Series

NOTE: Manual bleeding is required if:

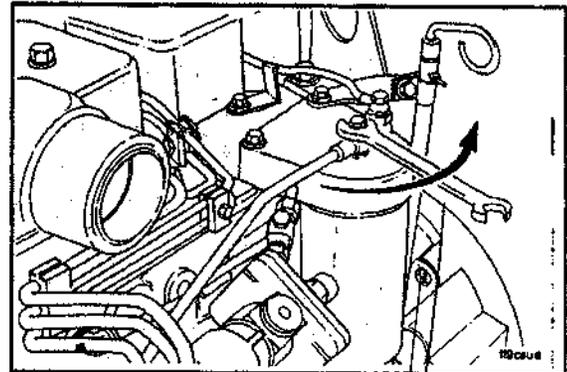
- The fuel filter is not filled prior to installation.
- Injection pump is replaced.
- High pressure fuel line connections are loosened or lines replaced.
- Initial engine start up or start up after an extended period of no engine operation.
- Vehicle fuel tank has run empty.

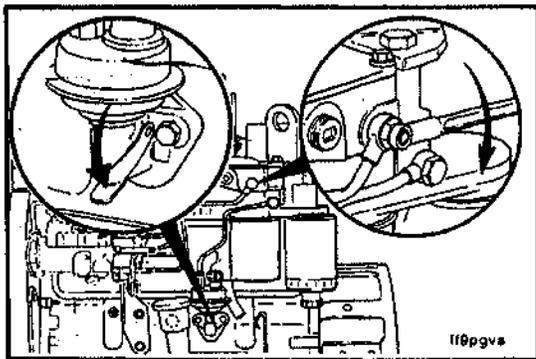
### Low Pressure Lines and Fuel Filter (s)

#### Venting

8 mm

open the vent screw.



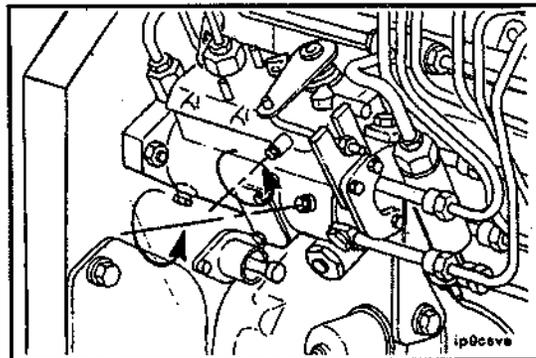


Operate the plunger on the lift pump until the fuel flowing from the fitting is free of air.

Tighten the bleed screw.



**Torque Value:** 9 N•m [7 ft-lb]



### **Injection pump**

#### **Venting**

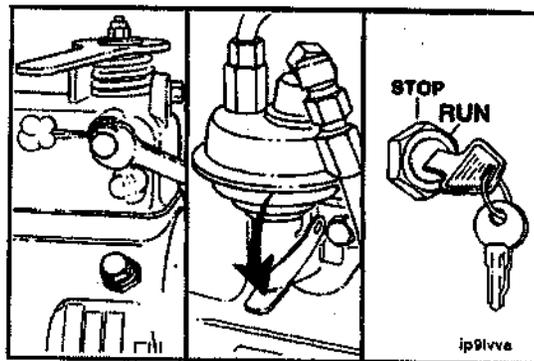
**8 mm**

Bleed the Lucas CAV pump at the location shown in the illustration.

## Maintenance Procedures at 19,000 Km (12,000 Mi) B Series

Air/fuel can be pumped from this location with the hand lever on the lift pump if the fuel solenoid valve is energized.

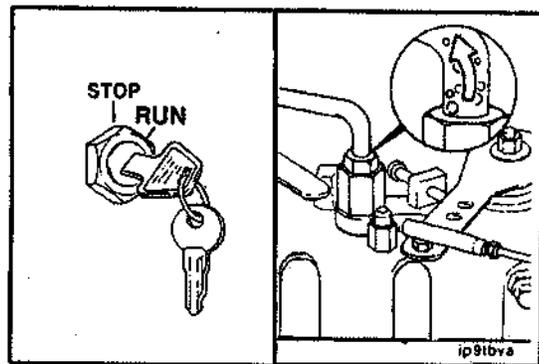
Injection pump  
Page 5-7

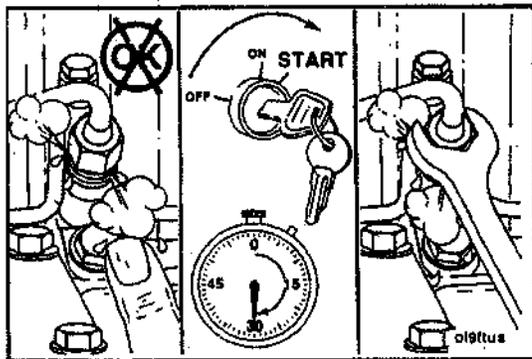


Air can be vented from both pumps through the fuel drain manifold line by operating the starting motor.

**Caution:** When using the starting motor to vent the system, do not engage it for more than 30 seconds at a time: Wait 2 minutes between engagements.

**Warning:** It is necessary to put the engine in the "Run" position. Because the engine may start, be sure to follow all the safety precautions. Use the normal engine starting procedure.





## High Pressure Lines (Rotary and- In-line Pumps)

### Venting

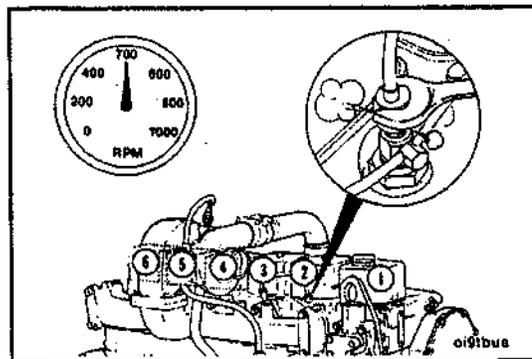


17 mm, 19 mm



**Warning:** The pressure of the fuel in the line is sufficient to penetrate the skin and cause serious bodily harm.

Venting is accomplished by loosening one or more fittings at the injectors and cranking the engine to allow entrapped air to bleed from the lines.



### Re-Tighten Line Fittings



Torque Value: 30 N·m [22 ft·lb]



**Warnig:** Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire.

Start the engine and vent one line at a time until the engine runs smoothly.

## Antifreeze Concentration

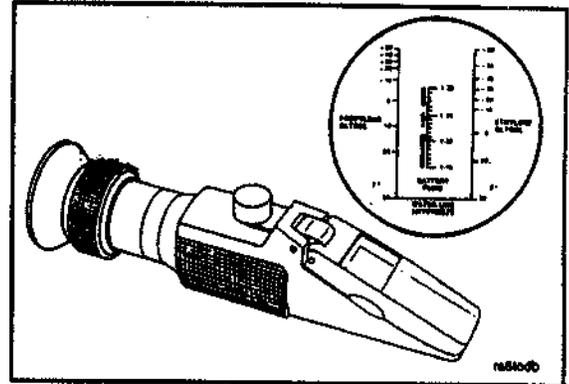
### Check

Check the antifreeze concentration. Use a mixture of 50 percent water and 50 percent ethylene-glycol base antifreeze to protect the engine to  $-37^{\circ}\text{C}$  [ $-34^{\circ}\text{F}$ ] year around.

#### Antifreeze is essential in any climate.

It broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point.

The corrosion inhibitors also protects the cooling system components from corrosion and provides longer component life.





## Section 6-Maintenance Procedures at 38,000 Kilometers [24,000 Mi.], 1000 Hours or 1 Year

### Section Contents

	Page
Drive Belt.....	6-10
Inspection.....	6-10
Drive Belt Tension.....	6-9
Check.....	6-9
General Information.....	6-2
Valves.....	6-3
Adjustment.....	6-3
Four-Cylinder Engine Adjustment.....	6-5
Six-Cylinder Engine Adjustment.....	6-7

**General Information**

All checks or inspections listed under daily or previous maintenance intervals must also be performed at this time in addition to those listed under this maintenance interval.

The procedures given in this section for valve lash adjustment are to be performed at the initial 38,000 km [24,000 mi] adjustment. Subsequent adjustments are to be performed at 77,000 km [48,000 mi] intervals.

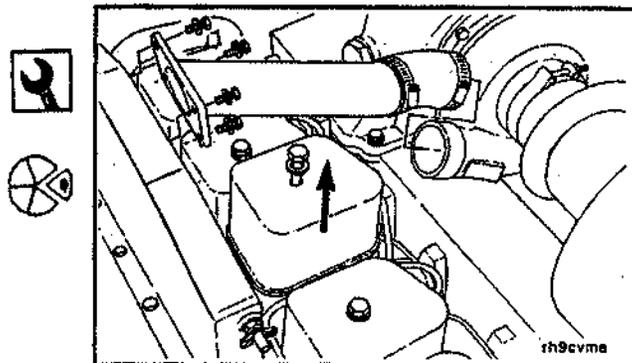
**Maintenance Procedures at 38,000 Km [24,000 Mi.]  
B Series**

**Valves**

**Adjustment**

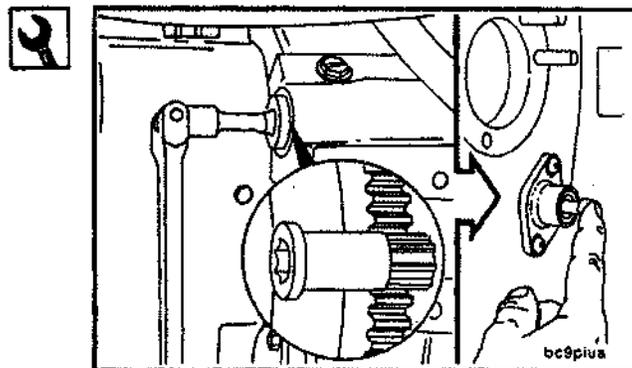
**15 mm**

Remove the valve cover.



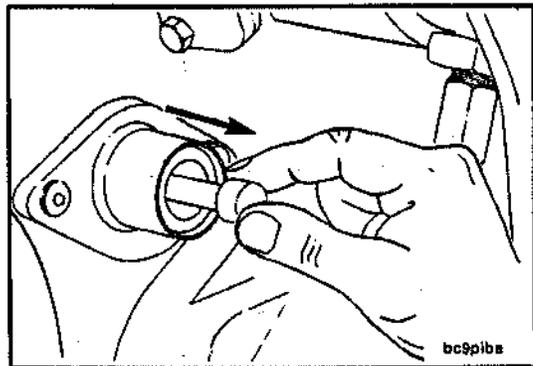
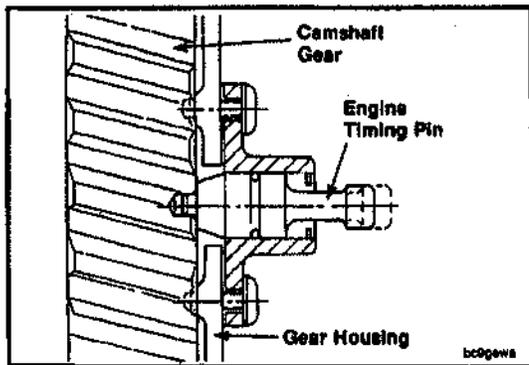
**1/2 Inch Drive, 3377371 Engine Barring Gear**

Locate Top Dead Center (TDC) for Cylinder Number 1 by barring engine slowly while pressing on the engine timing pin.



**Maintenance procedures at 38,000 Km [24,000Mi.]  
B Series**

When the pin engages the hole in the camshaft gear, cylinder Number 1 is at TDC on the compression stroke.



**Caution: To prevent damage to the engine or pin, be sure to disengage the pin after locating TDC.**

## Maintenance Procedures at 38,000 Km [24,000 Mi.] B Series

Valves  
Page 6-5

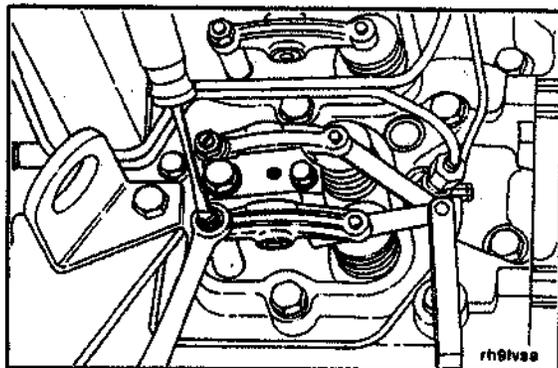
### Feeler Gauge

Intake Clearance: 0.254 mm [0.010 IN]

Exhaust Clearance: 0.508 mm [0.020 IN]

Check/set valves with engine cold-**below** 60°C [140°F].

NOTE: The clearance is correct when some resistance is "felt" when the feeler gauge is slipped between the valve stem and the rocker lever.



### Four Cylinder Engine Adjustment

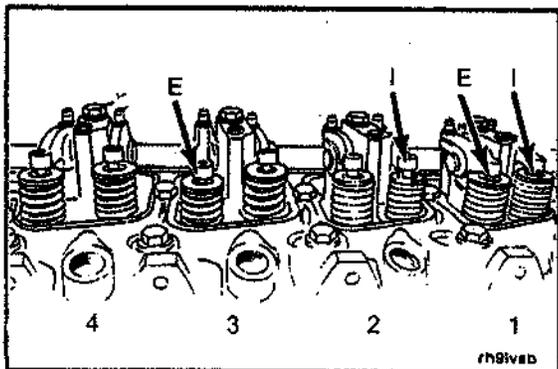
#### 14 mm, Flatblade Screwdriver

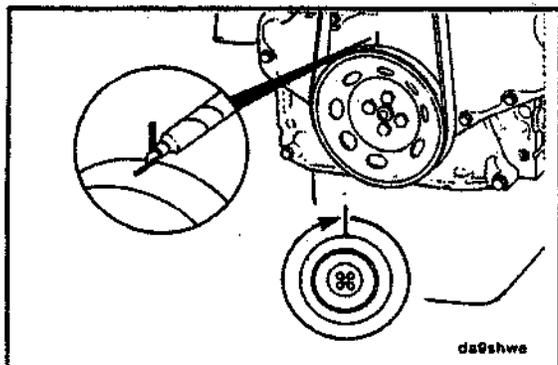
Locate Top Dead Center (TDC) for Cylinder Number 1.

Check / adjust the valves as indicated in the illustration (1 = Intake; E = Exhaust).

Tighten the locknut and measure the valve lash again.

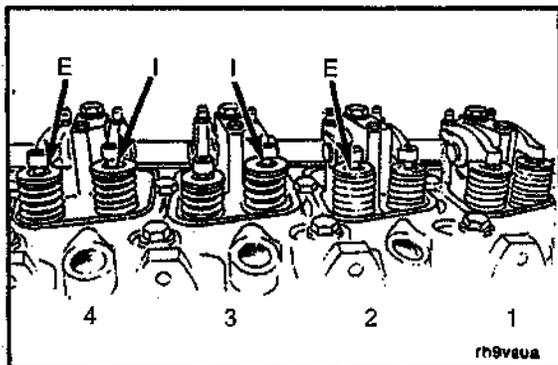
**Torque Value:** 24 N•m [18 ft-lb]





Mark the pulley and rotate the crankshaft 360 degrees.

**Caution:** To prevent engine or pin damage, be sure timing is disengaged.



**14 mm, Flatblade Screwdriver**

Adjust the valves as indicated in the illustration.



Tighten the lock nut and measure the valve lash again.

**Torque Value:** 24 N•m [18 ft-lb]

**Maintenance Procedures at 38,000 Km [24,000 Mi.]  
B Series**

**Six-Cylinder Engine Adjustment**

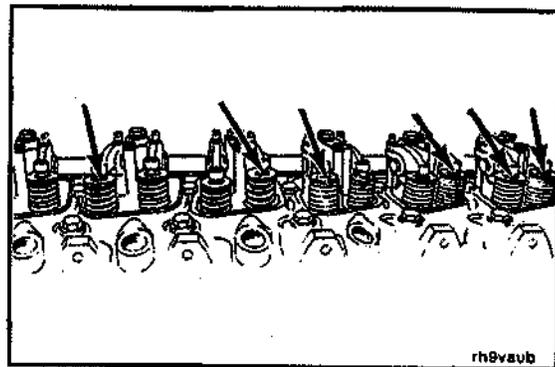
**14 mm, Flatblade Screwdriver**

Locate Top Dead Center (TDC) for Cylinder Number 1.

Check / adjust the valves as indicated in the illustration  
(I = Intake; E = Exhaust).

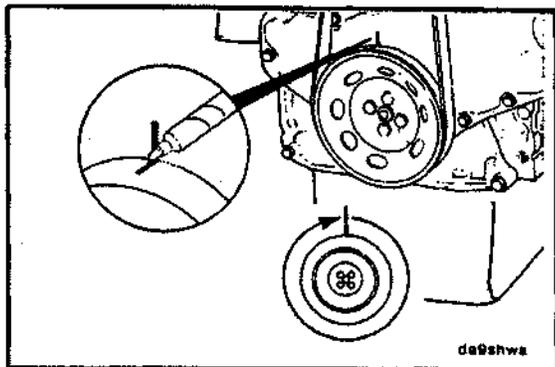
Tighten the locknut and measure the valve lash again.

**Torque Value: 24 N·m [18 ft-lb]**



Mark the pulley / vibration damper and rotate the crankshaft 360 degrees.

**Caution: To prevent engine or pin damage, be sure timing pin is disengaged.**

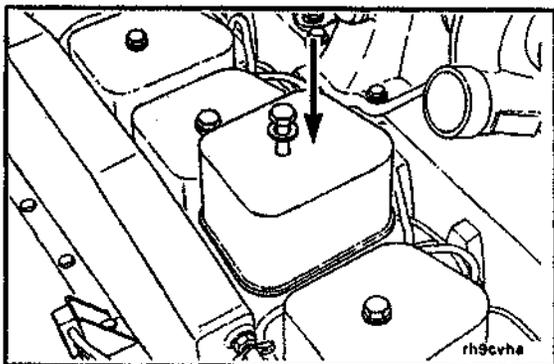
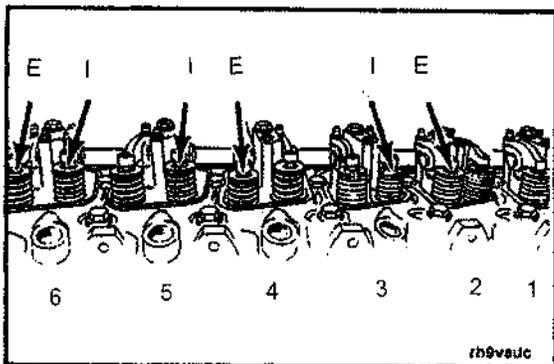


**Valves**  
page 6-8

**Maintenance procedures at 38,000 Km [24,000Mi.]**  
**B Series**

Adjust the valves as indicated in the illustration.  
Tighten the lock nut and measure the valve lash again.

**Torque Value:** 24 N·m [18 ft·lb]



**15 mm**

Install the valve covers and tighten capscrews.

**Torque Value:** 24 N·m [18 ft·lb]

**Maintenance Procedures at 38,000 Km [24,000 Mi.]  
B Series**

**Drive Belt Tension**

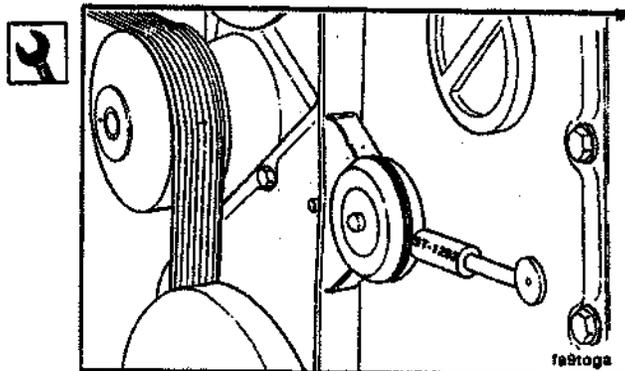
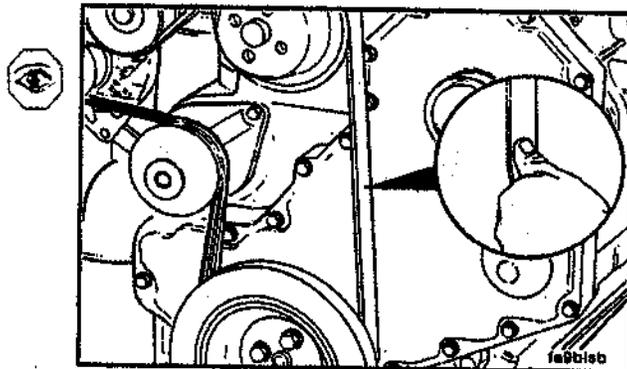
**Check**

Measure the belt deflection at the longest span of the belt.

**Maximum Deflection:** 9.5 to 12.7 mm [3/8 to 1/2 inch]

**NOTE:** The Cummins belt tension gauge, Part No. ST-1293 can be used.

**Gauge Value:** 267 to 578 N [60 to 130 Lbf]



## Drive Belt

### Inspection



3/8 Inch Square Drive, 13 mm



Remove the drive belt.



Lift the tensioner to remove and install the belt.

**NOTE:** After the tensioner has been raised to remove/install the belt, check the torque of the tensioner capscrew.

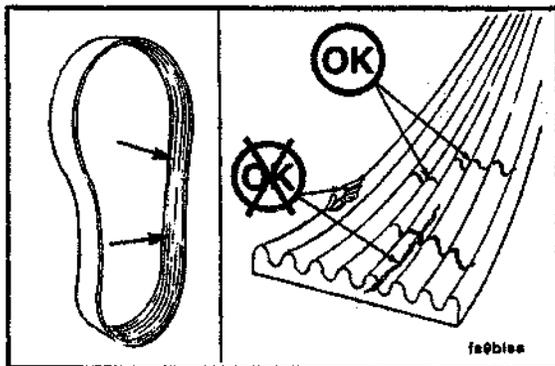
**Torque Value:** 43 N•m [32 ft-lb]



Inspect the belt for damage.

Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with Transverse cracks are **not** acceptable.

Replace the belt if it has unacceptable cracks, if frayed or has pieces of material missing.



# Section 7-Maintenance Procedures at 77,000 Kilometers [48,000 Mi.], 2000 Hours or 2 Year

## Section Contents

	Page
<b>Cooling System Maintenance</b> .....	7-3
Coolant Draining.....	7-3
Coolant System Filling.....	7-7
Coolant System Flushing.....	7-5
<b>General Information</b> .....	7-2
<b>Vibration Damper(Rubber)</b> .....	7-9
Inspection.....	7-9

## **General Information**

All checks or inspections listed under daily or previous maintenance intervals **must** also be performed at this time in addition to those listed under this maintenance interval.

## Cooling System Maintenance

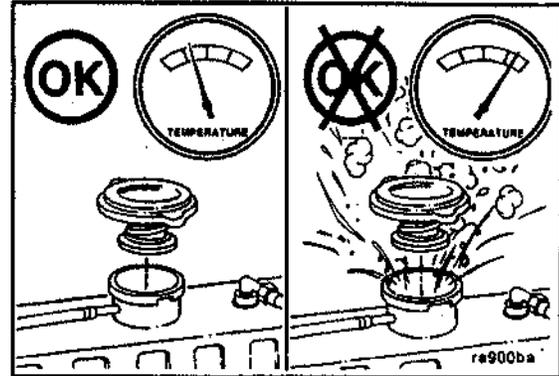
### Coolant draining

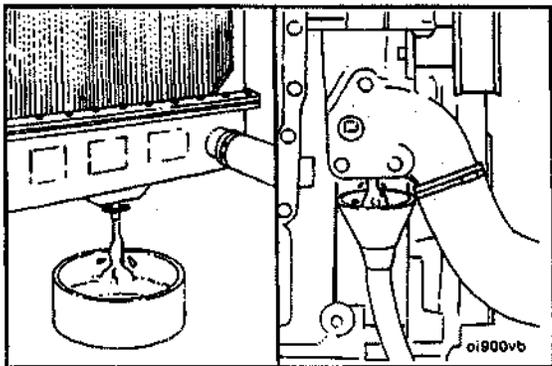
**Caution:** Avoid prolonged and repeated skin contact with used antifreeze. Such prolonged repeated contact can cause skin disorders or other bodily injury.

- Avoid excessive contact-wash thoroughly after contact.
- Keep out of reach of children.

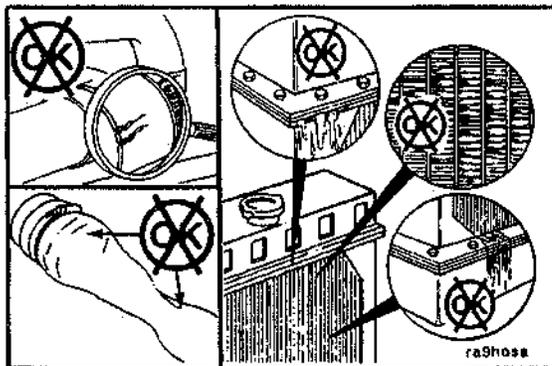
**Protect the environment:** Handling and disposal of used antifreeze can be subject to federal, state, and local law regulation. Use authorized waste disposal facilities, including civic amenity sites and garages providing authorized facilities for the receipt of used antifreeze. If in doubt, contact your local authorities or the EPA for guidance as to proper handling of used antifreeze.

**Caution:** Wait until the temperature is below 50 °C [120 °F] before removing the coolant system pressure cap. Failure to do so can cause personal injury from heated coolant spray.





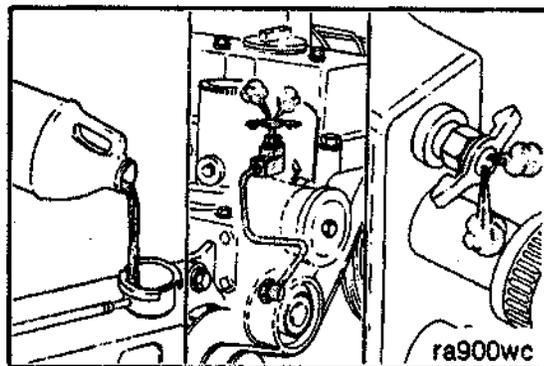
Drain the cooling system by opening the drain valve on the radiator and removing the plug in the bottom of the water inlet. A drain pan with a capacity of 20 liters [5 U.S. gallons] will be adequate in most applications.



Check for damaged hoses and loose or damaged hose clamps. Replace as required. Check the radiator for leaks, damage and build up of dirt. Clean and repair as required.

### Cooling System Flushing

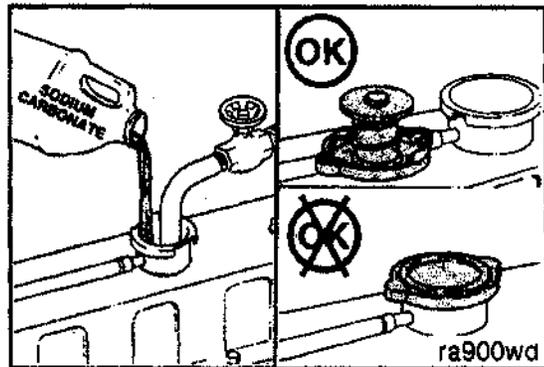
**Caution:** During filling, air must be vented from the engine coolant passages. Open the engine venting petcock and the petcock on the aftercooler for aftercooled engines. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add mixture to bring the level to the top.



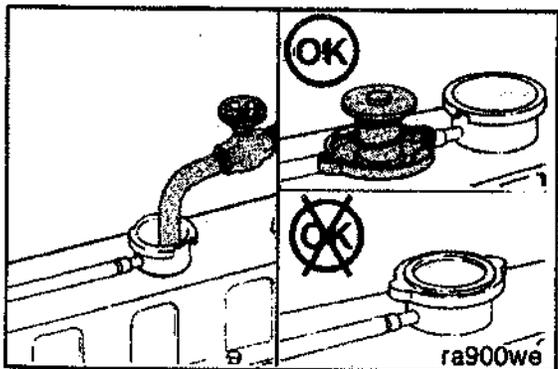
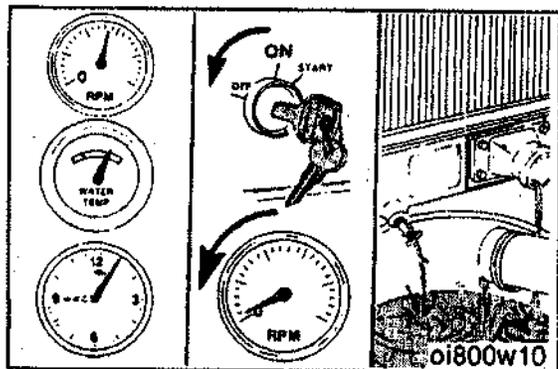
Fill the system with a mixture of sodium carbonate and water (or a commercially available equivalent).

**NOTE:** Use 0.5 kilogram [1.0 pound] of sodium carbonate for every 23 liters [6.0 U.S. gallons] of water.

**Caution:** Do not install the radiator cap. The engine is to be operated without the cap for this process.



**Cooling System Maintenance**  
page 7-6



**Maintenance procedures at 77,000 Km [48,000Mi.]**  
**B Series**

Operate the engine for 5 minutes with the coolant temperature above 80°C [176°F].

Shut the engine off and drain the cooling system.

Fill the cooling system with clean water.

**NOTE:** Be sure to vent the engine and aftercooler for complete filling.

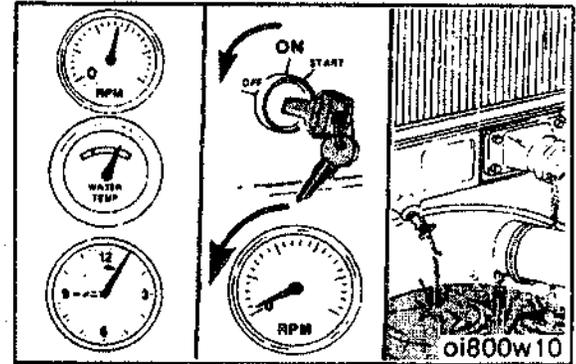
**NOTE:** Do not install the radiator cap or the new coolant filter.

## Maintenance procedures at 77,000 Km [48,000Mi.] B Series

Operate the engine for 5 minutes with the coolant temperature above 80°C [176°F].

Shut the engine off and drain the cooling system.

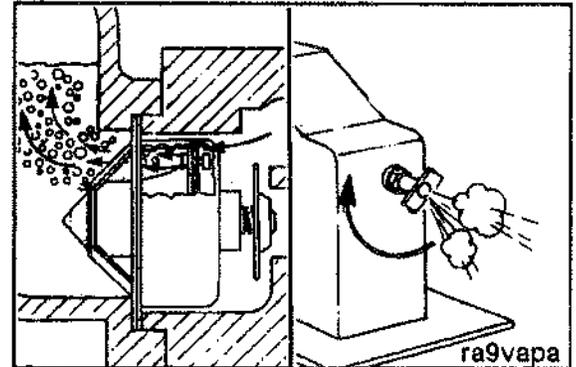
**NOTE:** If the water being drained is still dirty, the system must be flushed again until the water is clean.

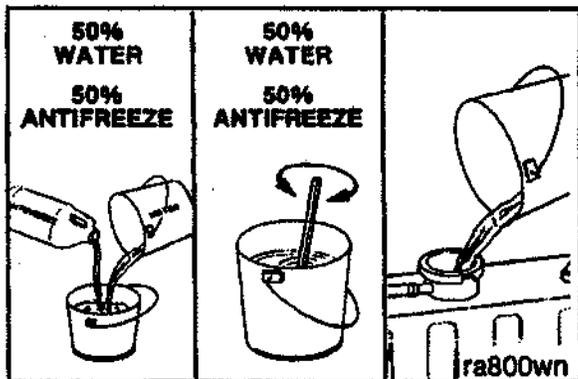


## Coolant System Filling

The system has a maximum fill rate of 14 liters per minute [3.5 U.S. Gallons per minute]. **Do not exceed this fill rate.**

**Caution:** The system must be filled slowly to prevent air locks. During filling, air must be vented from the engine coolant passages. Be sure to open the petcock on the aftercooler for aftercooled engines. Wait 2 to 3 minutes to allow air to be vented, then add mixture to bring the level to the top.





Use a mixture of 50 percent water and 50 percent ethylene glycol antifreeze to fill the cooling system.

Coolant Capacity (Engine Only)		Liter [U.S. Quarts]	
4B3.9		6B5.9	
4BT3.9	4BTA3.9*	6BT5.9	6BTA5.9*
7.0 [7.4]	7.9 [8.4]	9 [9.5]	9.9 [10.5]

\*4BTA and 6BTA engines use a jacket-water aftercooler. If a Charge Air Cooler is used, the coolant capacity is the same as the naturally aspirated or turbocharged only engines.



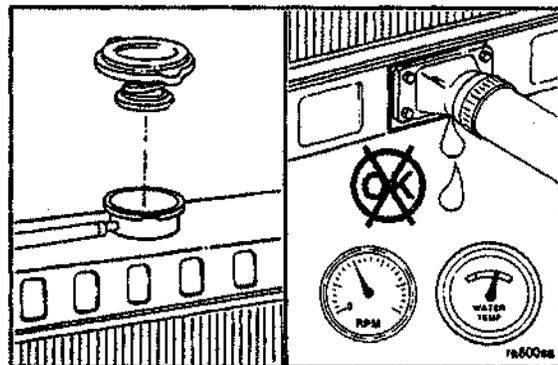
**Caution:** Never use water alone for coolant. Damage from corrosion can be the result of using water alone for coolant.

## Maintenance procedures at 77,000 Km [48,000Mi.] B Series

Install the pressure cap. Operate the engine until it reaches a temperature of 80°C [180°F], and check for coolant leaks.

Check the coolant level again to make sure the system is full of coolant, or that the coolant level has risen to the hot level in the recovery bottle on the system, if so equipped.

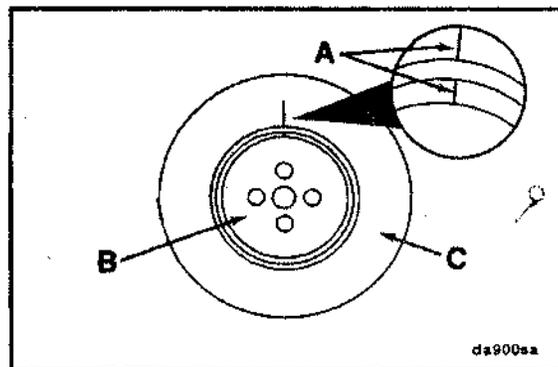
**Warning:** Before removing the pressure cap, wait until the coolant temperature is below 50°C [120°F]. Failure to do so can cause personal injury from heated coolant spray.



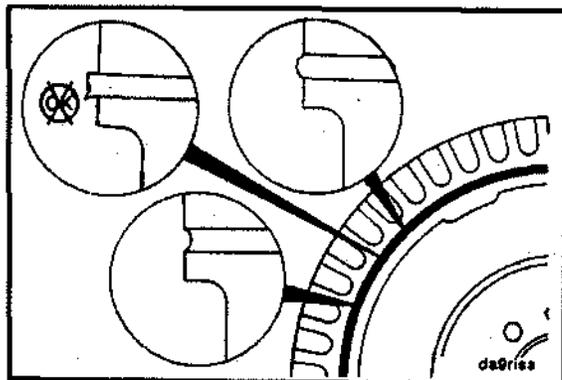
## Vibration Damper (Rubber)

### Inspection

Check the index lines (A) on the damper hub (B) and the inertia member (C). If the lines are more than 1.59 mm [1/16 inch] out of alignment, replace the damper.



**Vibration Damper (Rubber)**  
page 7-10



**Maintenance procedures at 77,000 Km [48,000Mi.]**  
**B Series**



Inspect the rubber member for deterioration. If pieces of rubber are missing or if the elastic member is more than 3.18 mm [1/8 inch] below the metal surface, replace the damper.

**NOTE:** Also look for forward movement of the damper ring on the hub. Replace the damper if any movement is detected.

## **Section D-System Diagrams**

### **Section Contents**

<b>Air System.....</b>	<b>D-10</b>
<b>Air System-Exhaust Air.....</b>	<b>D-12</b>
<b>Air System-Intake Air.....</b>	<b>D-11</b>
<b>Coolant System.....</b>	<b>D-9</b>
<b>Fuel System.....</b>	<b>D-3</b>
<b>General information.....</b>	<b>D-2</b>
<b>Hydraulic Cold Start Injection Advance(Rotary Automotive Pumps Only).....</b>	<b>D-4</b>
<b>Lubricating Oil System.....</b>	<b>D-5</b>
<b>Lubricating for the Overhead.....</b>	<b>D-8</b>
<b>Lubricating for the Power Components.....</b>	<b>D-7</b>
<b>Lubricating for the Turbocharger.....</b>	<b>D-6</b>

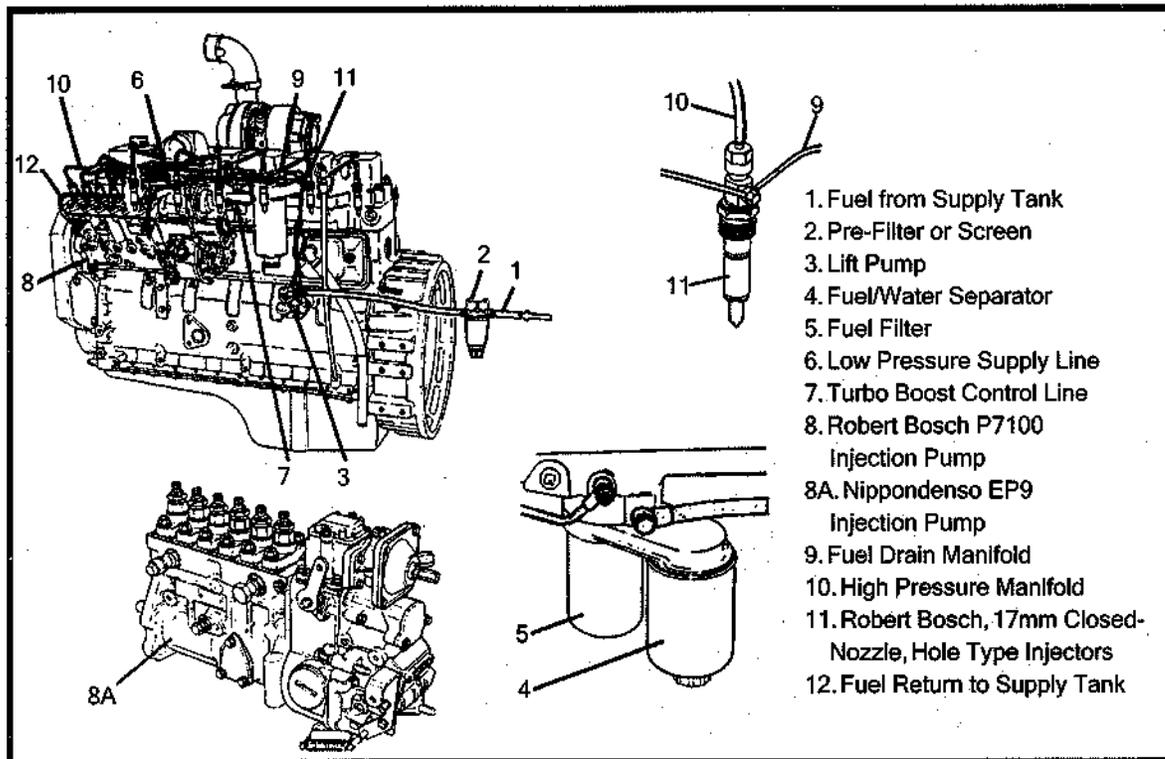
## **General Information**

The following drawings show the flow through the engine systems. Although parts can change between different applications and installation, the flow remains the same. The systems shown are:

- Fuel System
- Lubricating Oil System
- Coolant System
- Intake Air System
- Exhaust System

Knowledge Of the engine systems can help you in troubleshooting, service and general maintenance of your engine.

Fuel System

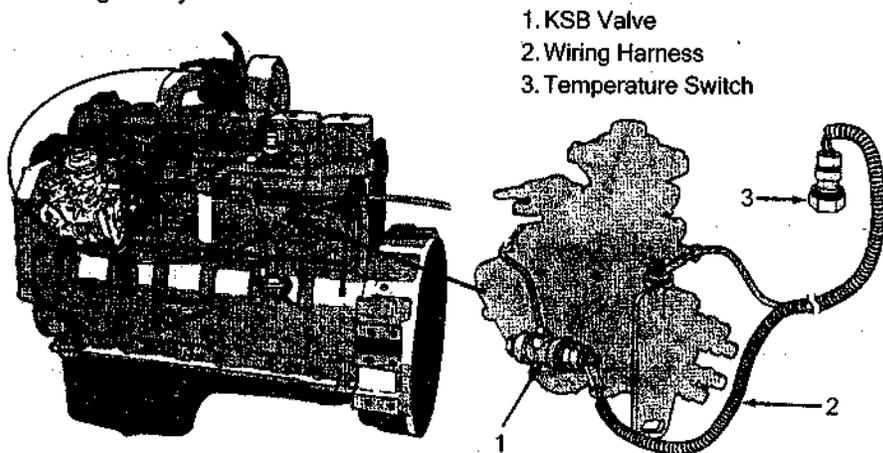


## **Hydraulic Cold Start Injection Advance (Rotary Automotive Pumps Only)**

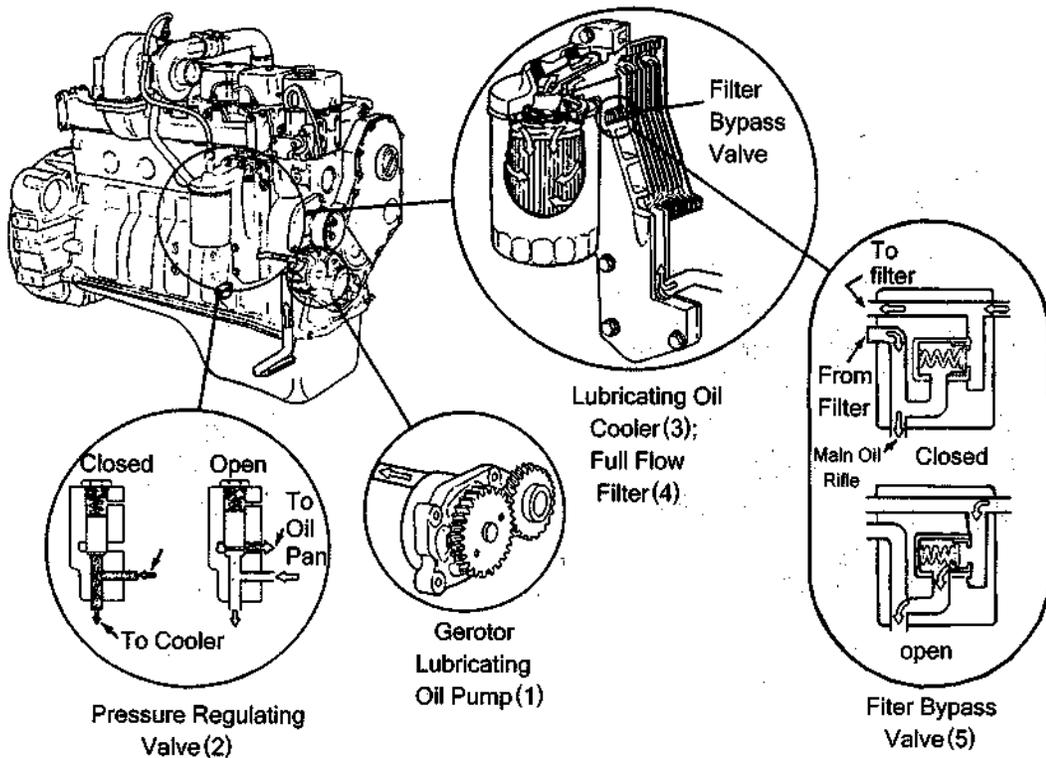
A hydraulic cold start injection advance (KSB) device is used on 1988 and later certified engines for white smoke control during cold starting.

When the engine is cold, the KSB cause the injection timing mechanism to be fully advanced at low speeds. When the engine reaches normal operating temperature, the KSB is deactivated and injection timing is then advanced proportionally to increased engine speed.

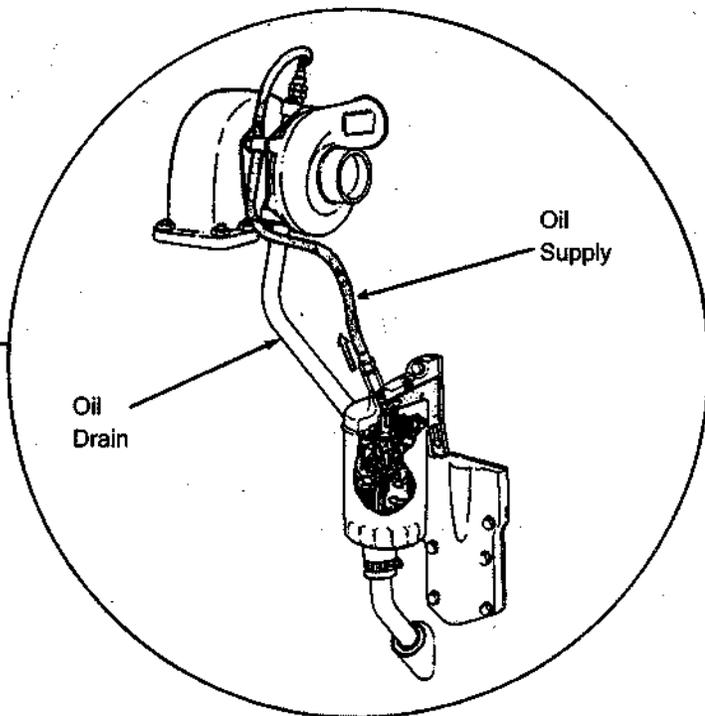
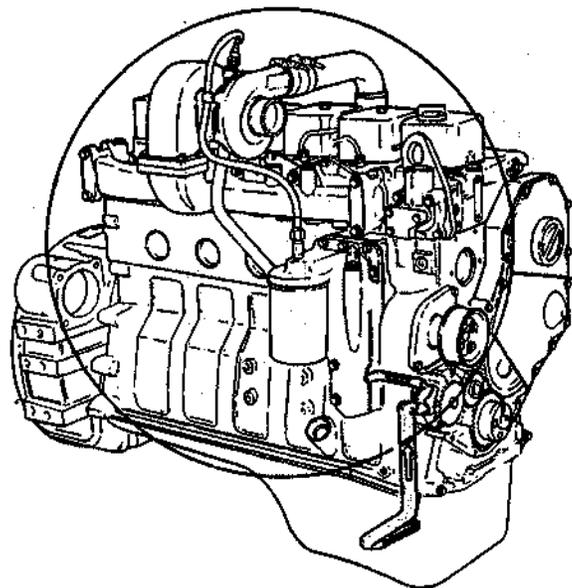
Deactivation of the KSB is controlled by a temperature sensor switch located in the engine air intake manifold. A wiring harness connects the KSB and temperature switch. If the wiring is disconnected, the KSB remains activated and the injection timing is fully advanced.



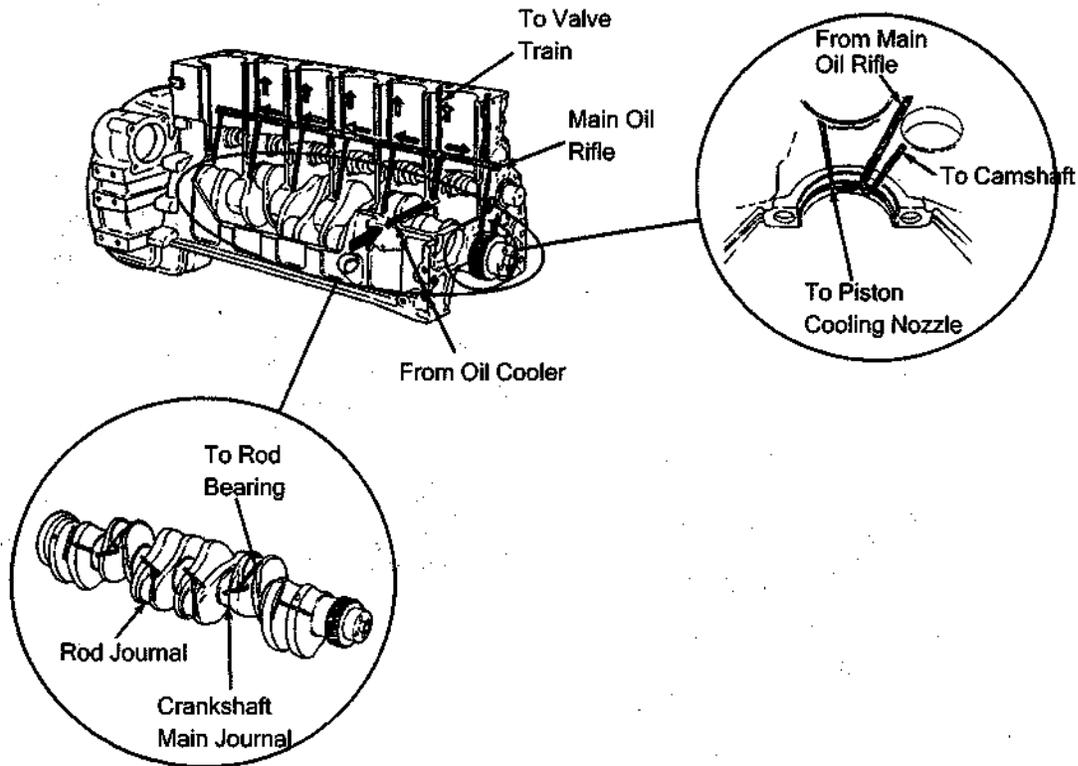
### Lubricating Oil System



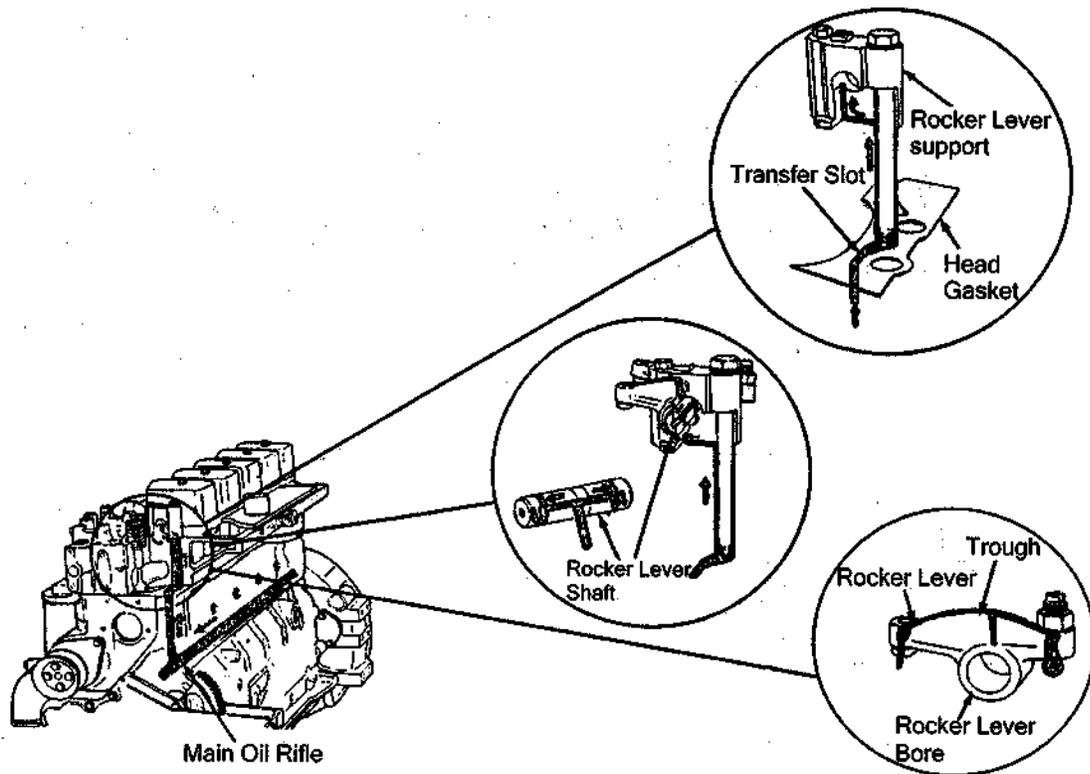
Lubricating for the Turbocharger



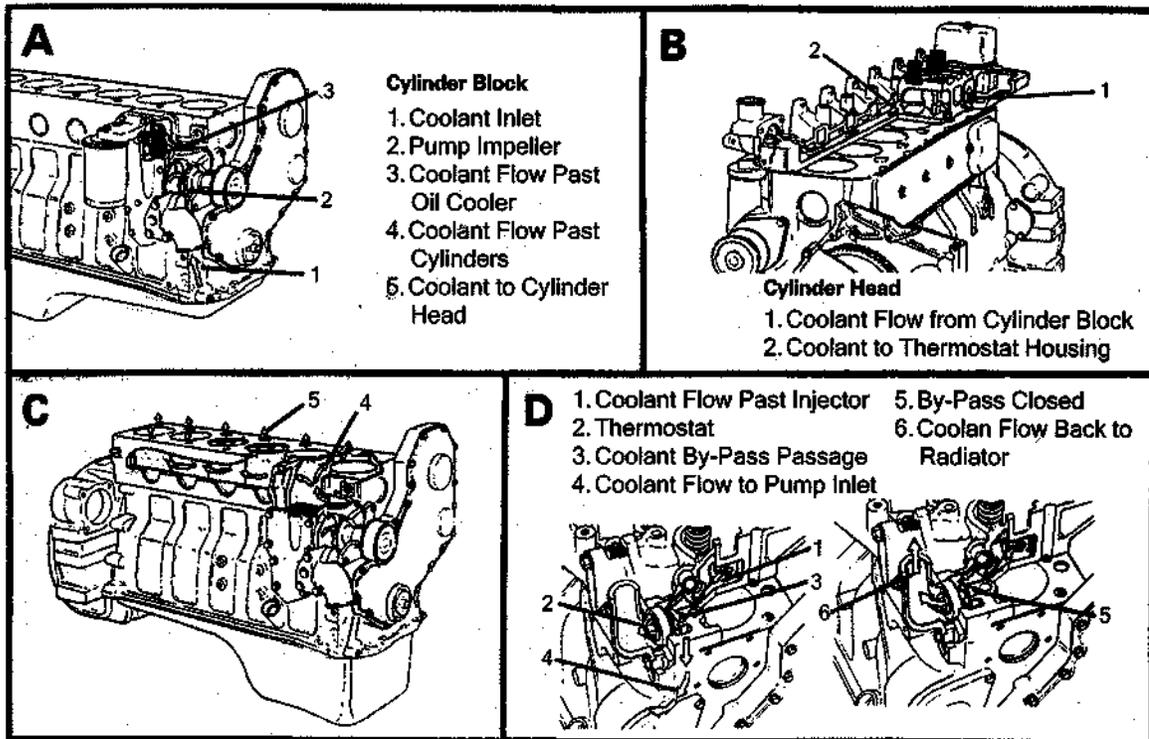
### Lubricating for the Power Components

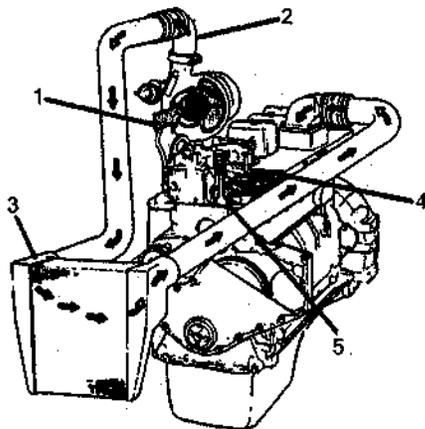


Lubricating for the Overhead



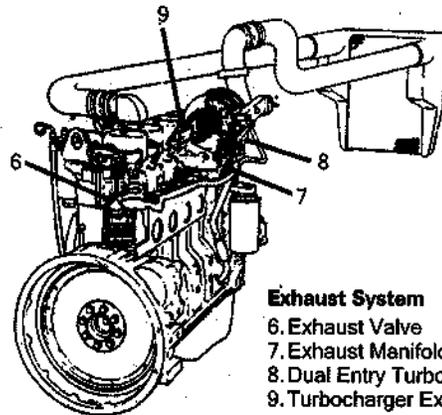
Coolant System





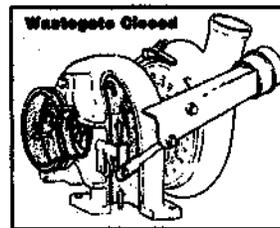
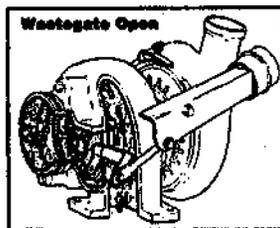
**Intake System**

1. Intake Air Inlet to Turbocharger
2. Turbocharger Air to Charge Air Cooler
3. Charge Air Cooler
4. Intake Manifold  
(Integral part of Cylinder Head)
5. Intake Valve

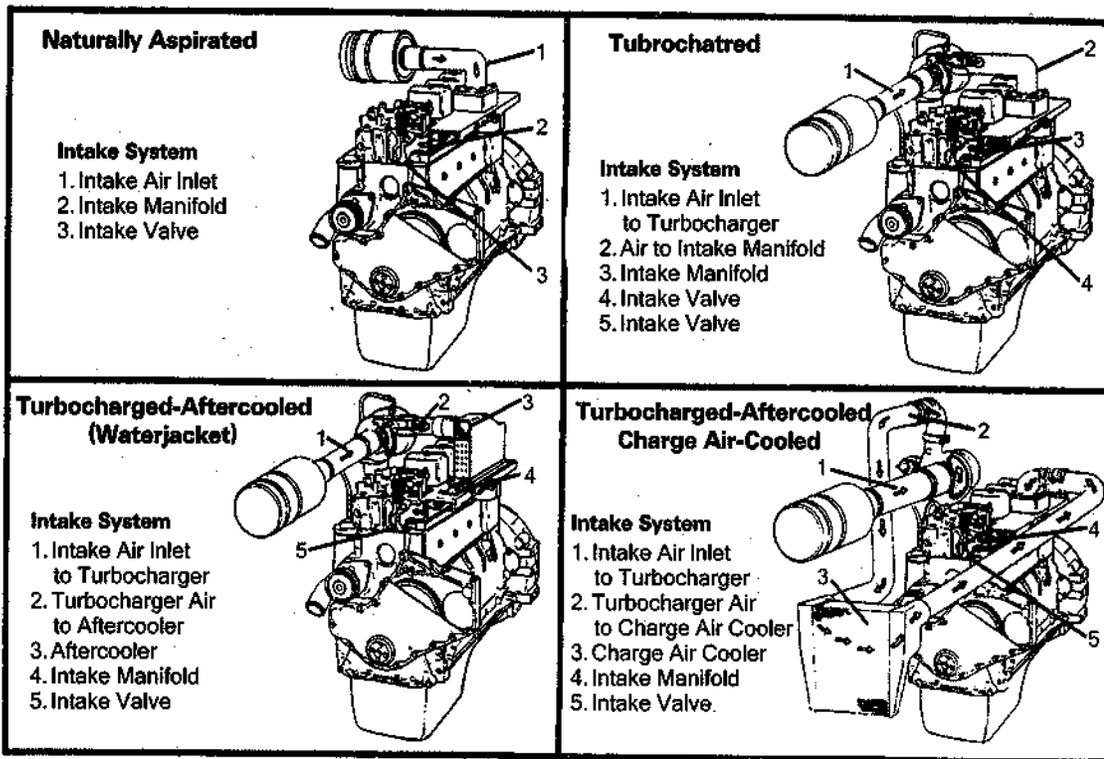


**Exhaust System**

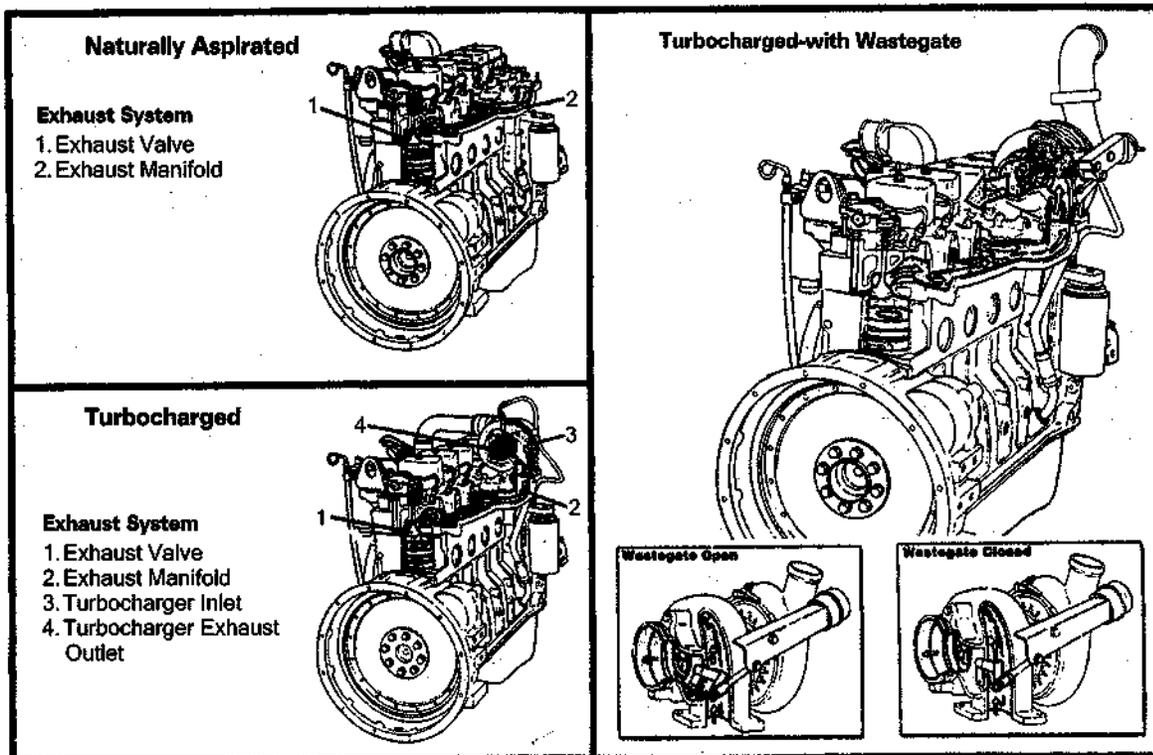
6. Exhaust Valve
7. Exhaust Manifold (Pulse Type)
8. Dual Entry Turbocharger
9. Turbocharger Exhaust Outlet



Air System-Intake Air



**Air System-Exhaust Air**



## Section T-Troubleshooting

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## **Troubleshooting Procedures and Techniques**

This guide describes some typical engine operating problems, their causes, and some acceptable corrections to those problems. Unless noted otherwise, the problems listed are those which an operator can diagnose and repair. See a Cummins Authorized Repair Location for diagnosis and repair of problems **not** listed.

Follow the suggestions below to develop good troubleshooting procedures:

- Study the problem thoroughly before acting.
- Do the easiest and obvious things first.
- Find and correct the basic cause of the problem.

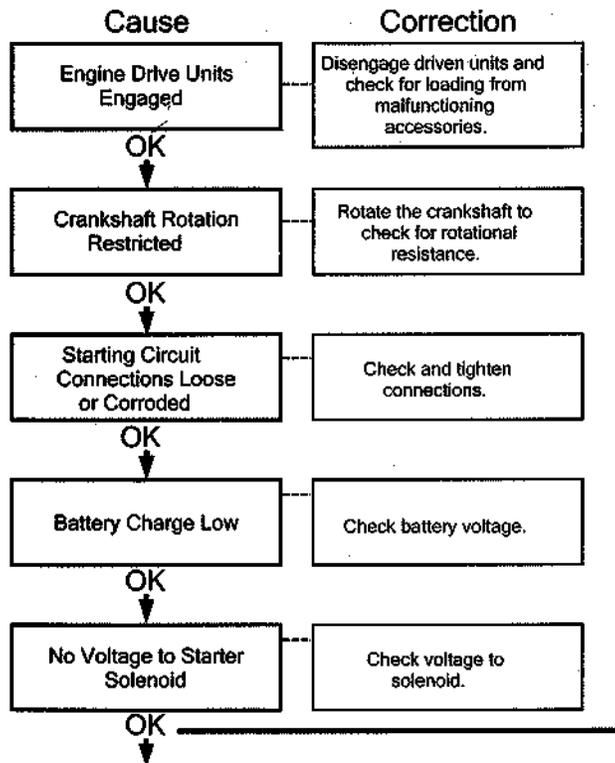
## **Troubleshooting Symptoms**

Use the charts given on the following pages to help find the cause and correction of a malfunction. Read each row of blocks from top to bottom. Follow the arrows through the chart to identify corrective action.

# Troubleshooting Symptoms

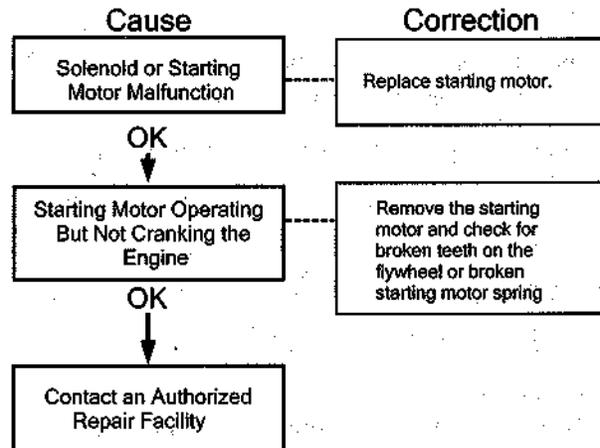
Page T-4

## Engine Will Not Crank or Cranks Slowly

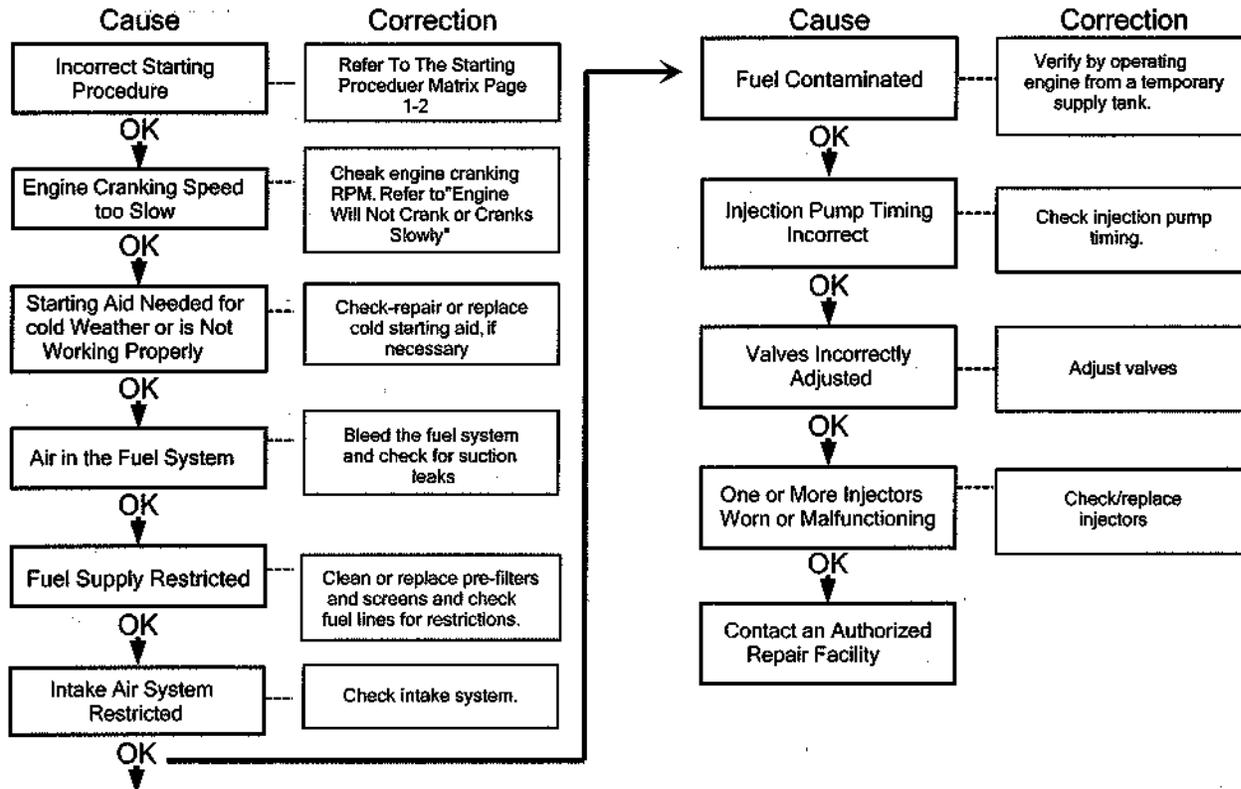


# Troubleshooting

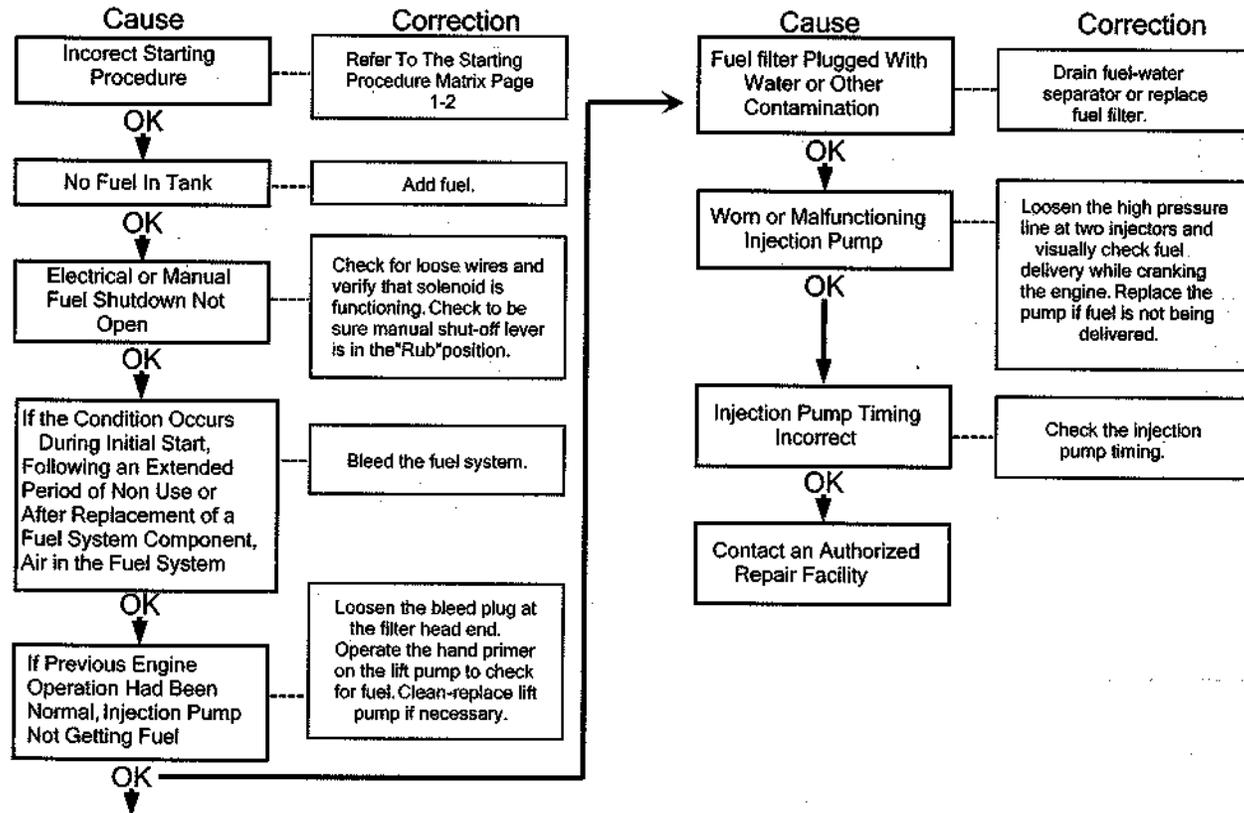
B Series



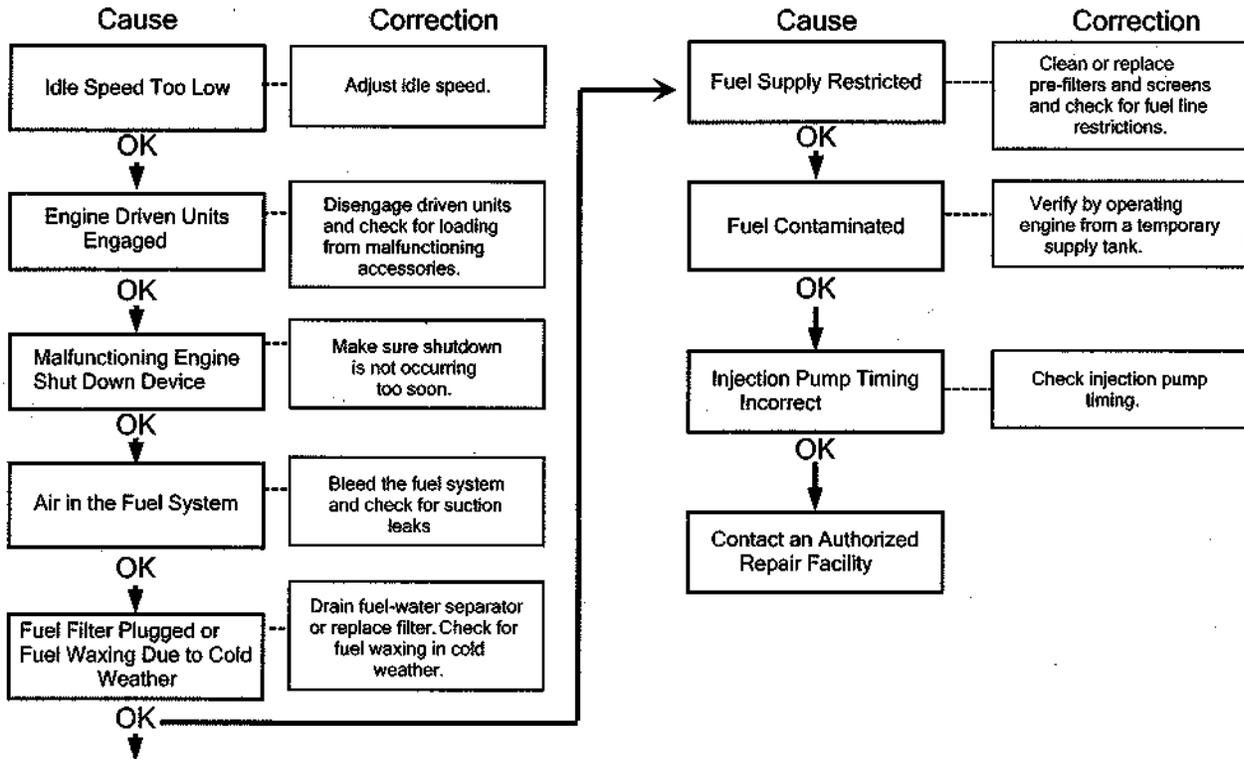
### Engine Hard to Start or Will Not Start (Exhaust Smoke Present)



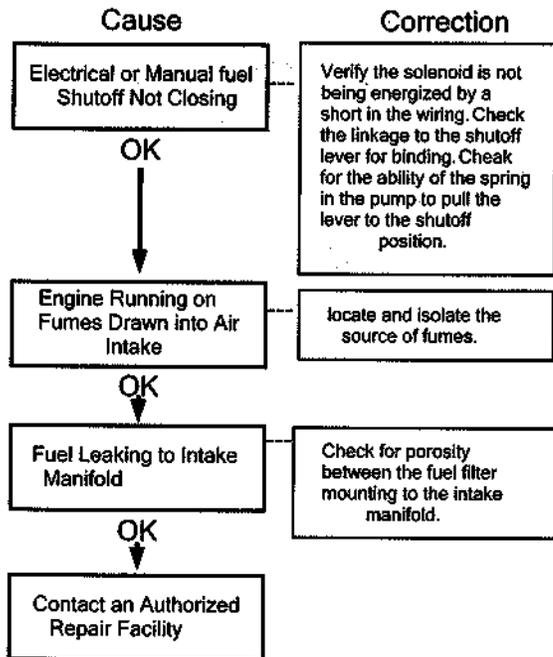
### Engine Cranks But Will Not Start (No Smoke From Exhaust)



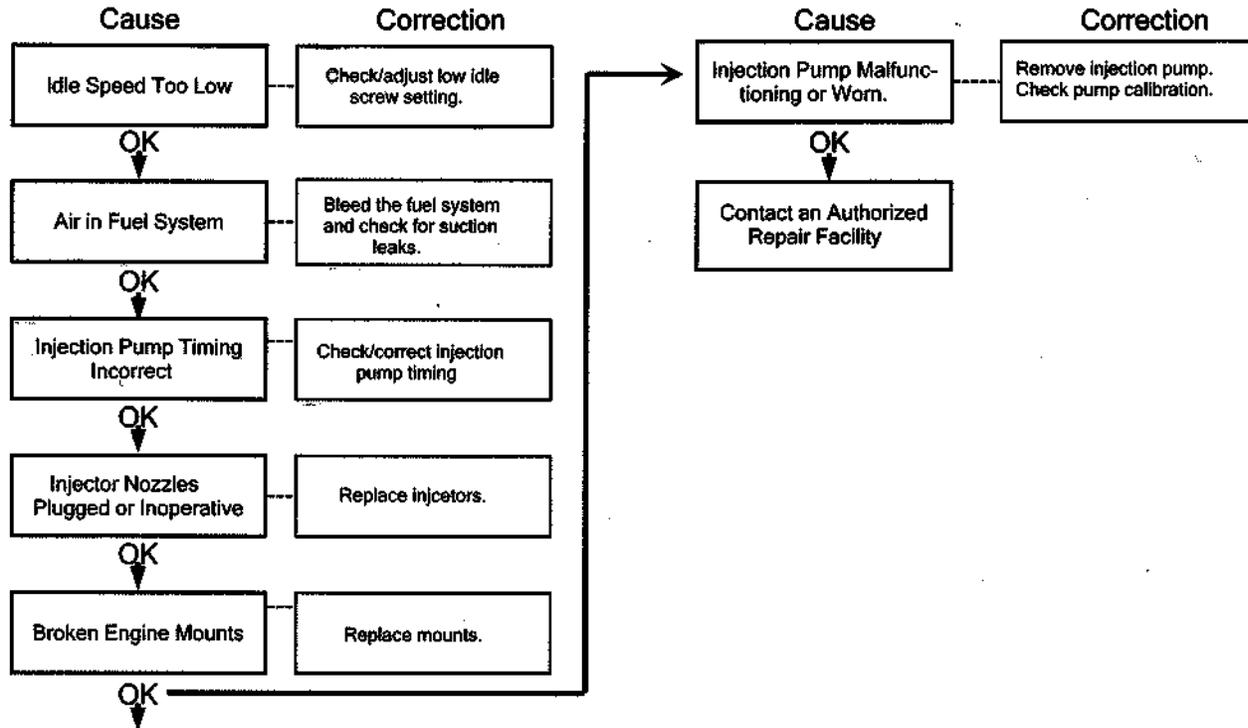
### Engine Starts But will Not Keep Running



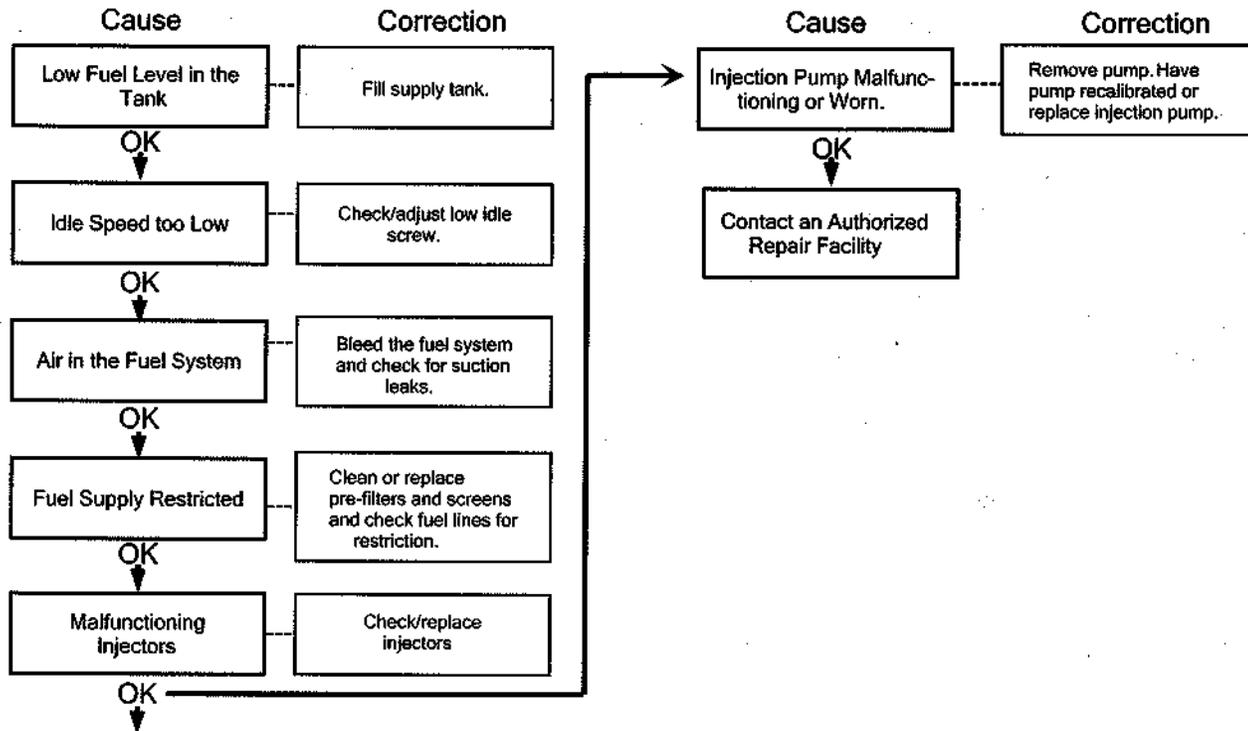
### Engine Will Not Shut Off



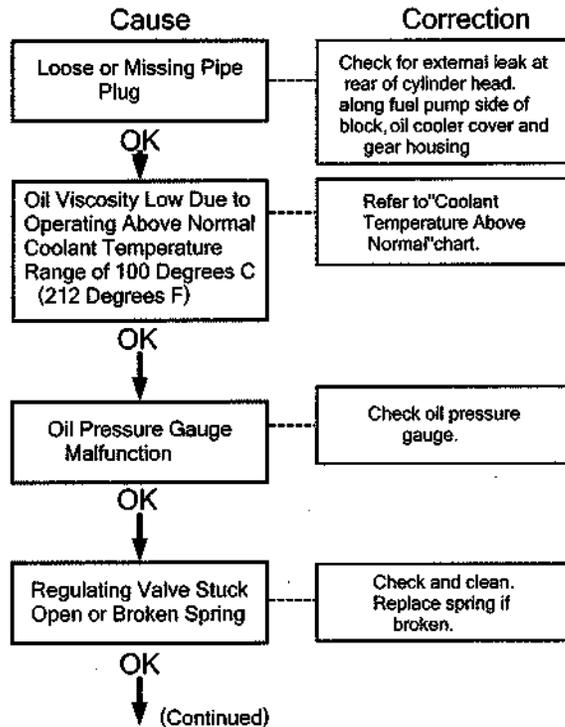
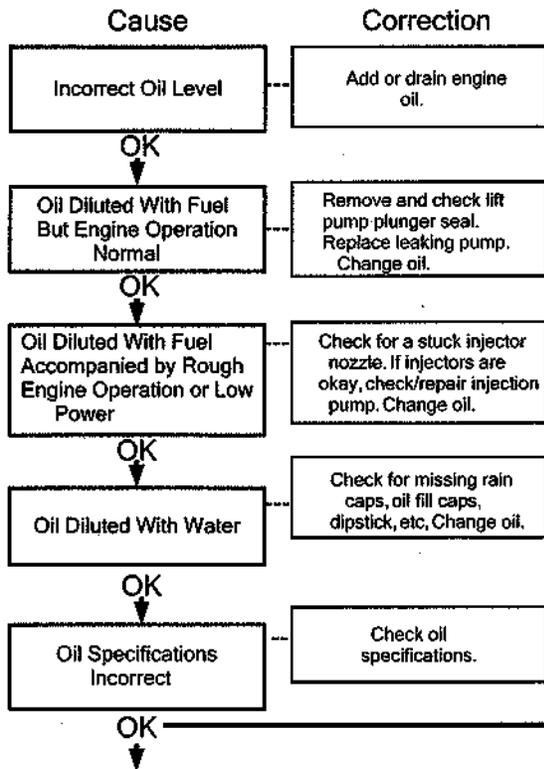
**Rough Idle, Warm Engine**



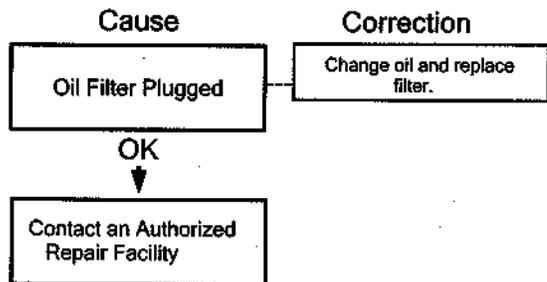
### Engine Surges at Idle



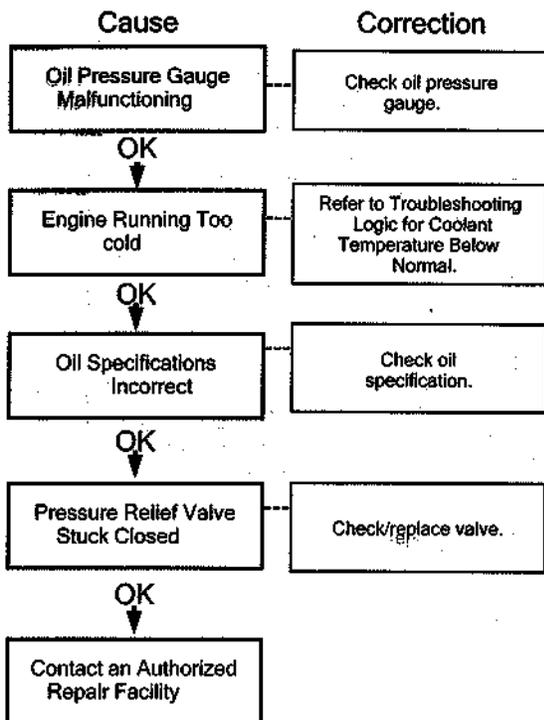
**Lubricating Oil Pressure Low**



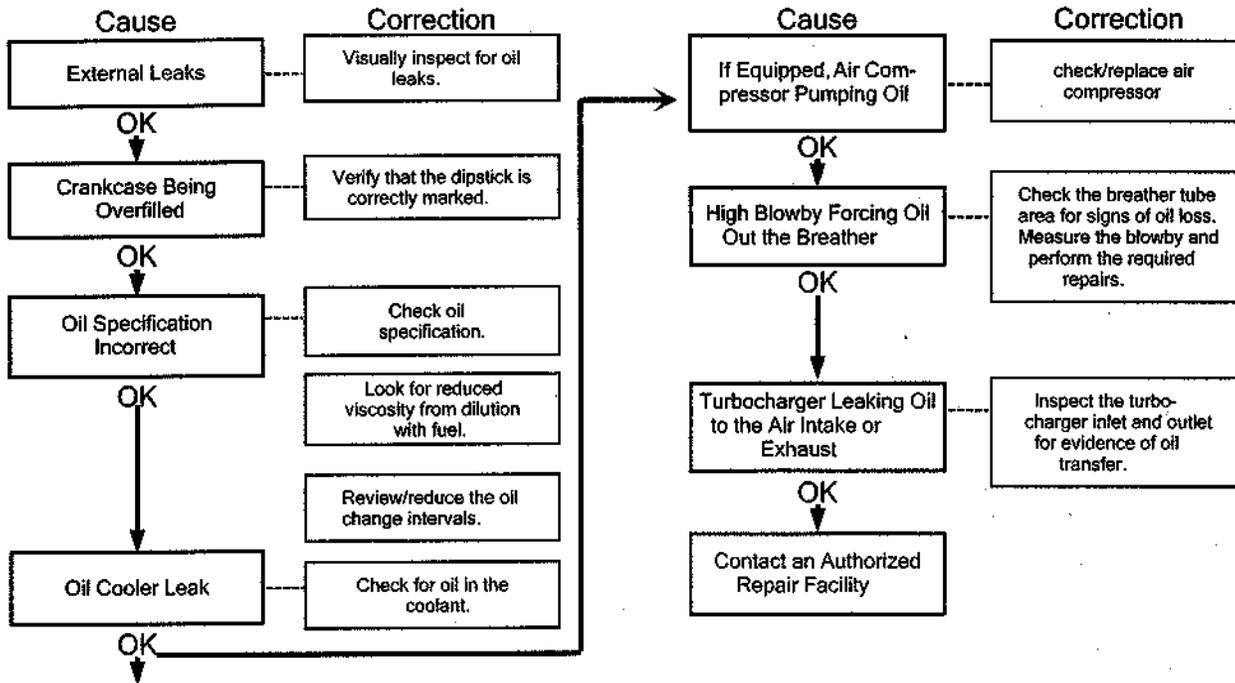
**Lubricating Oil Pressure Low (Continued)**



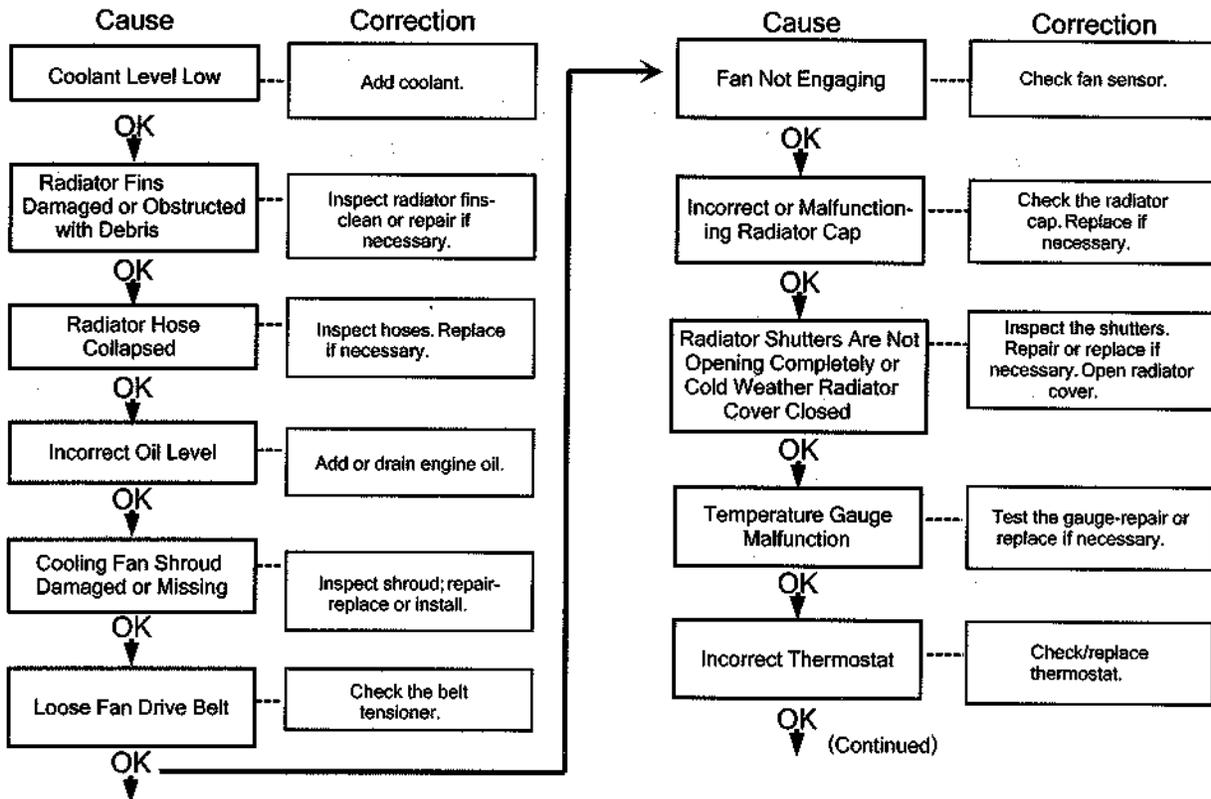
### **Lubricating Oil Pressure Too High**



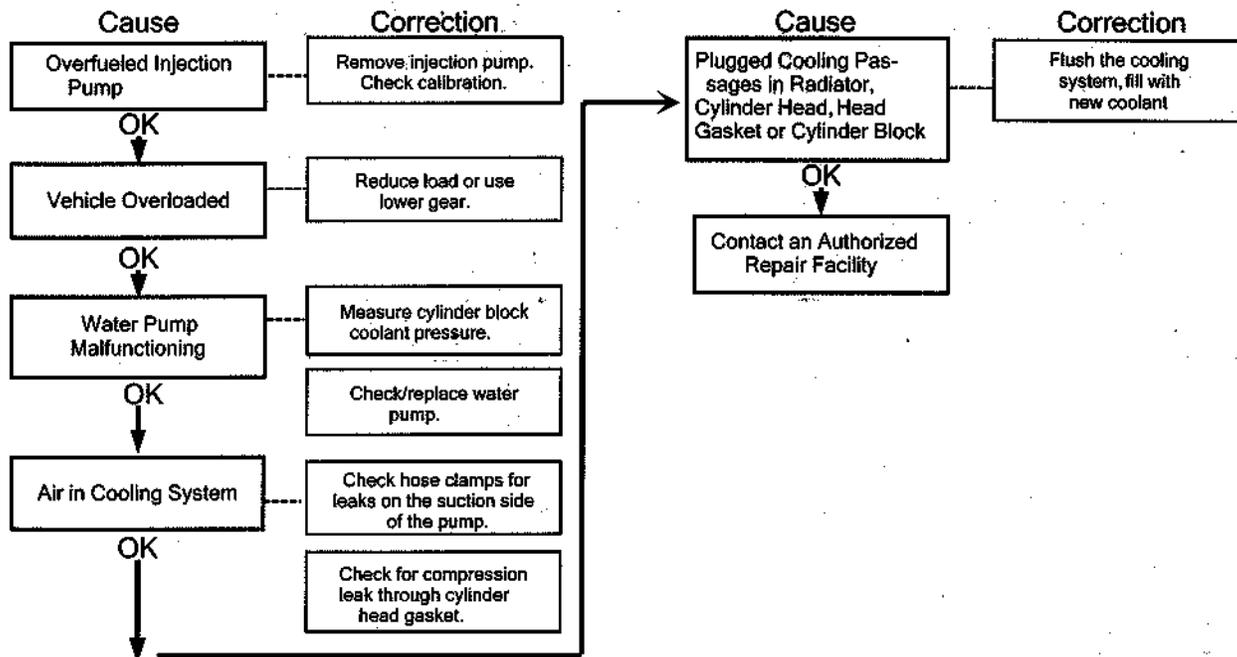
### Lubricating Oil Loss



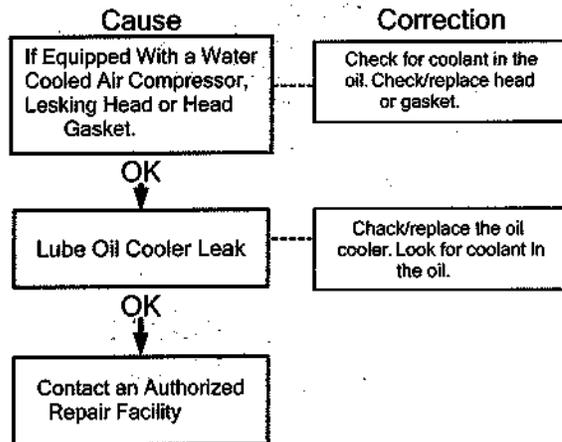
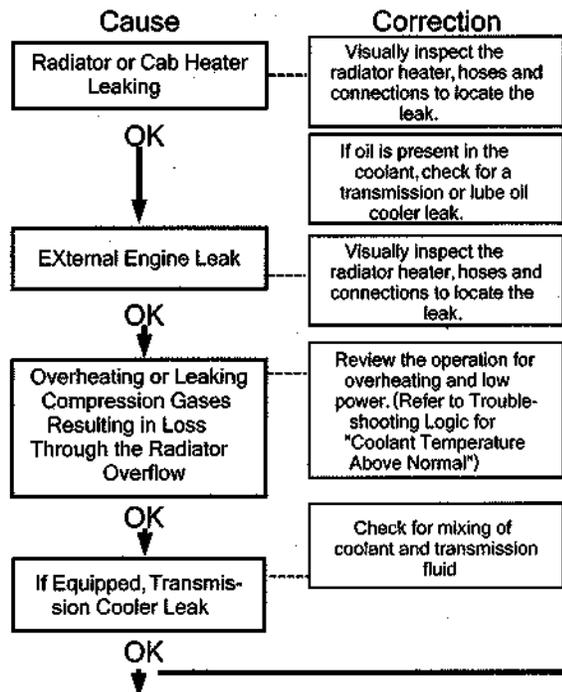
### Coolant Temperature Above Normal



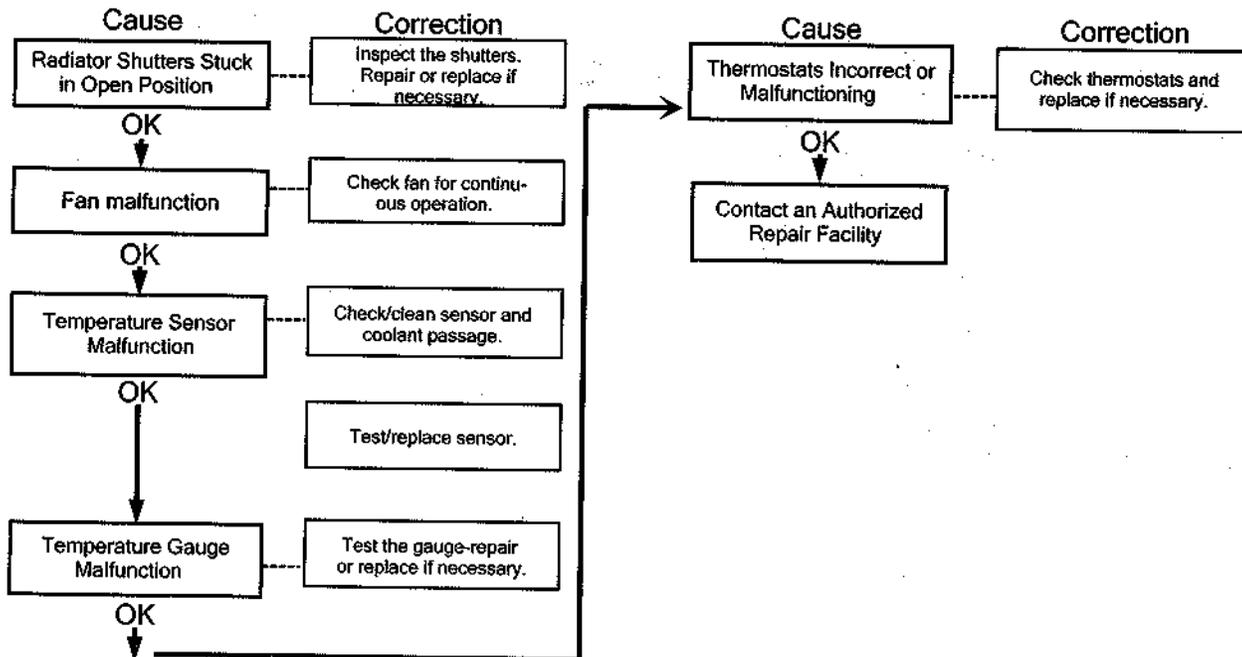
### Coolant Temperature Above Normal (Continued)



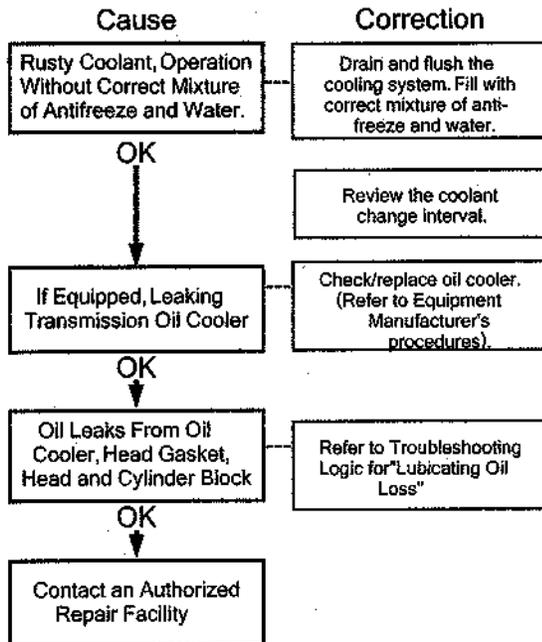
### Coolant Loss



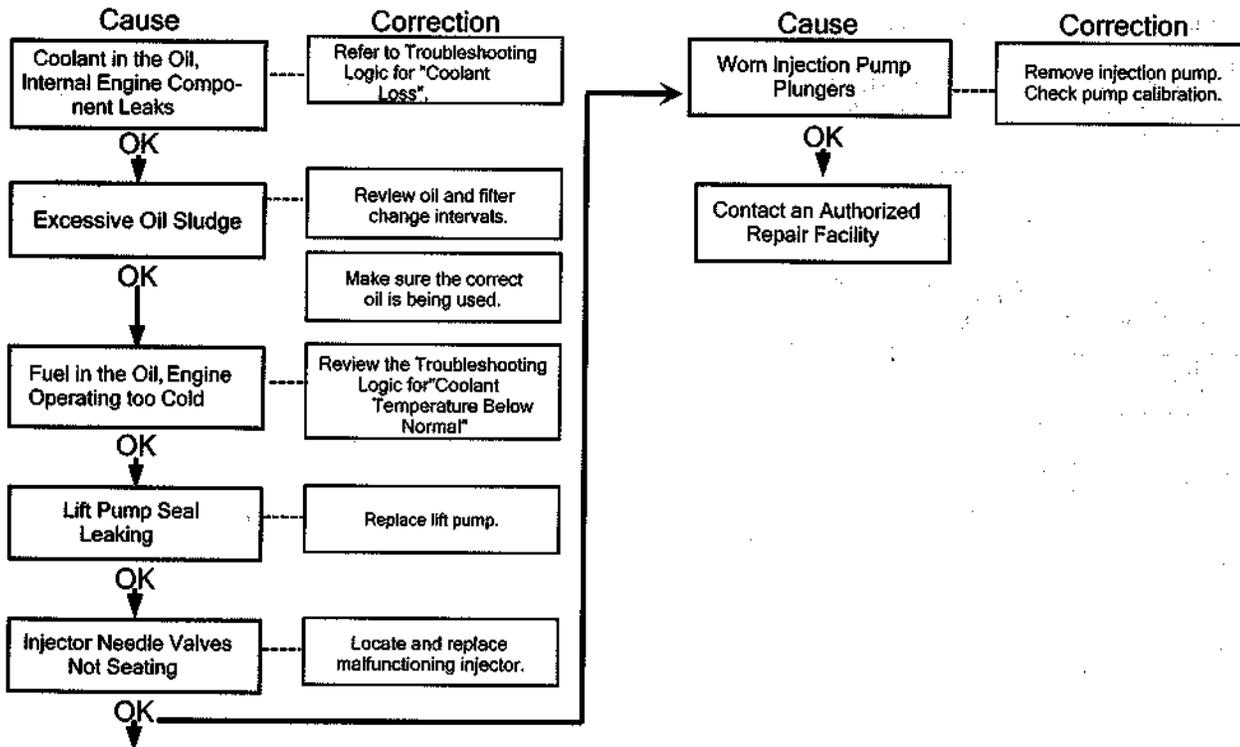
### Coolant Temperature Below Normal



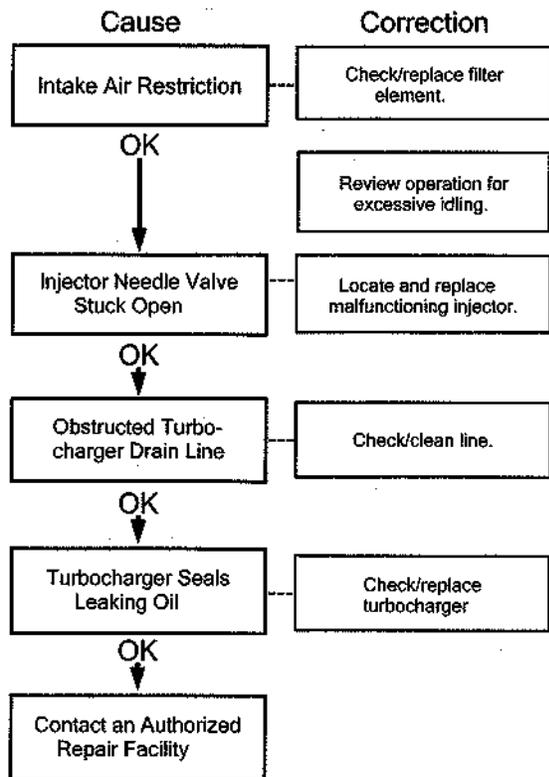
### Coolant Contaminated



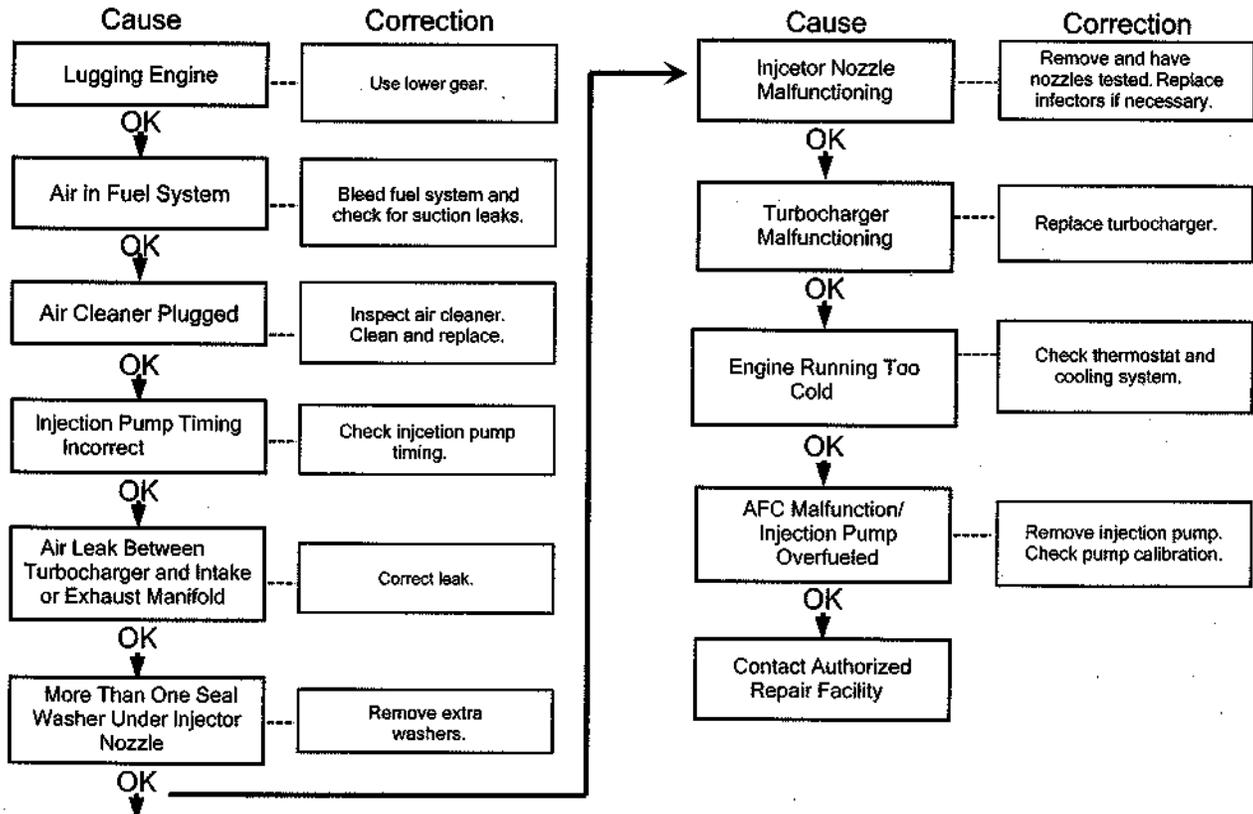
### Lubricating Oil Contaminated



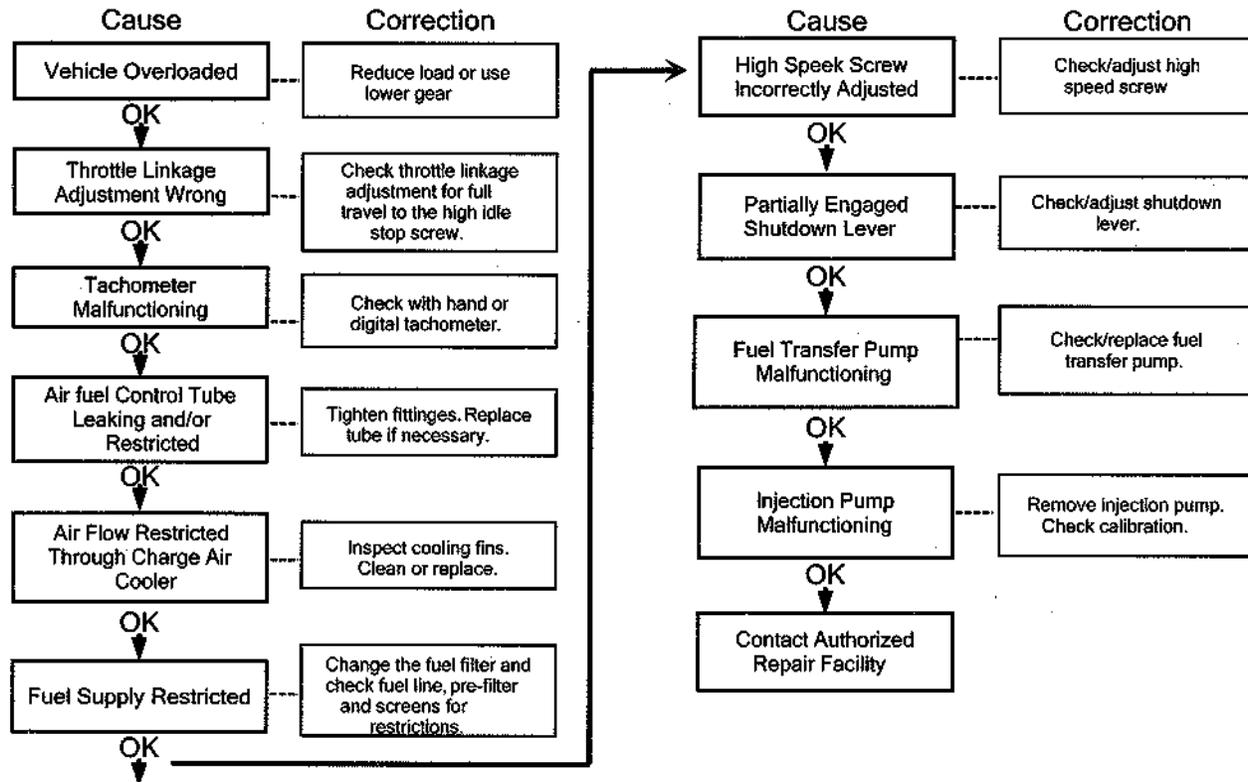
### Fuel or Oil Leaking from Exhaust Manifold



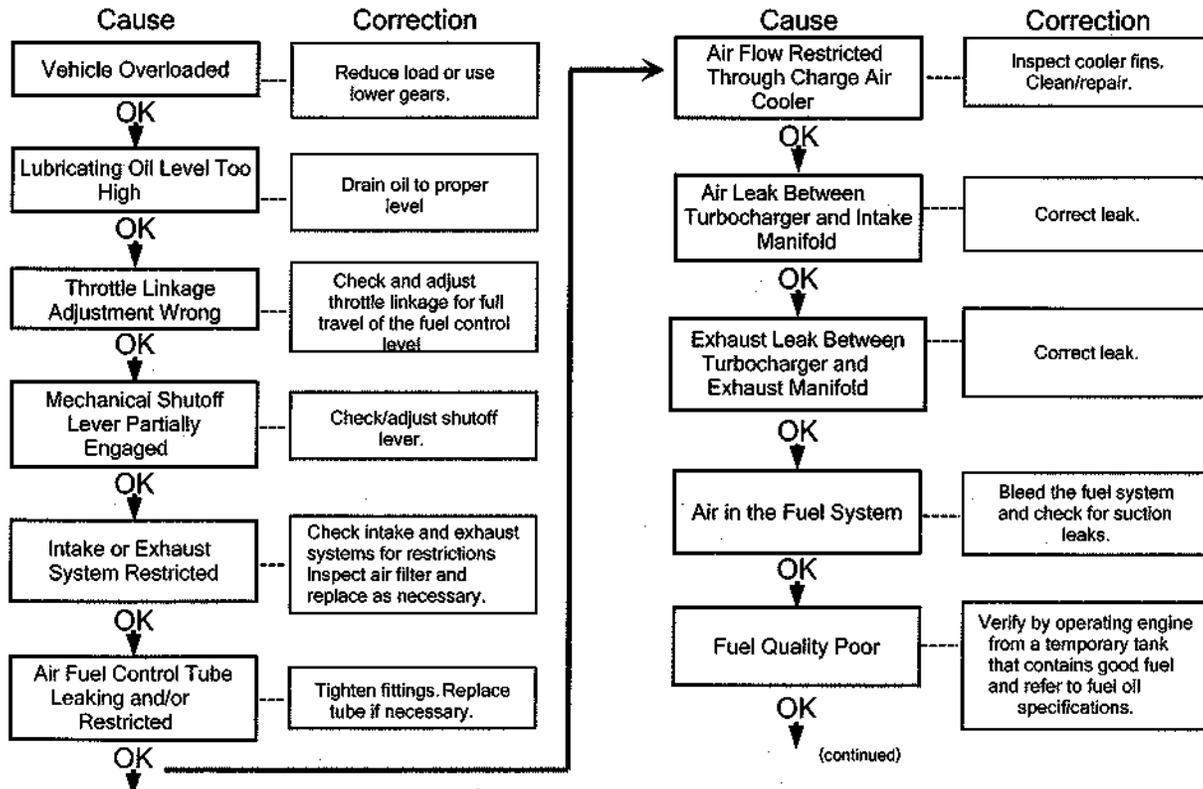
### Exhaust Smoke Excessive Under Load



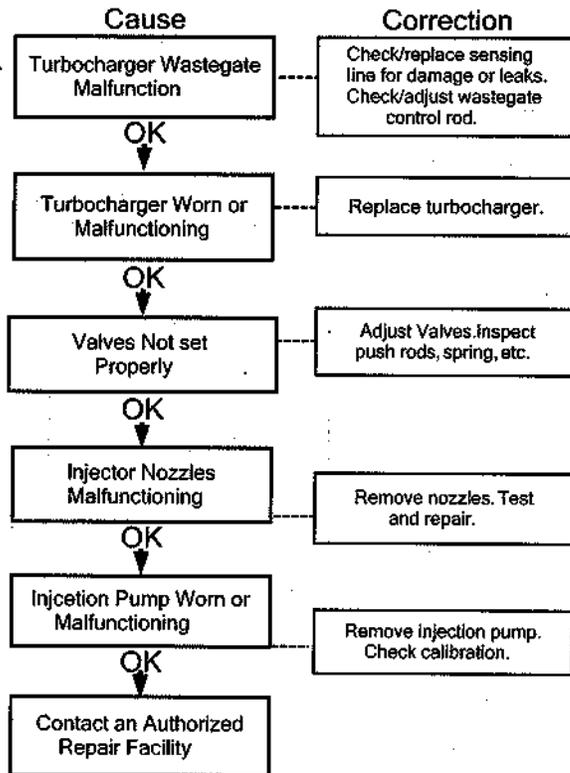
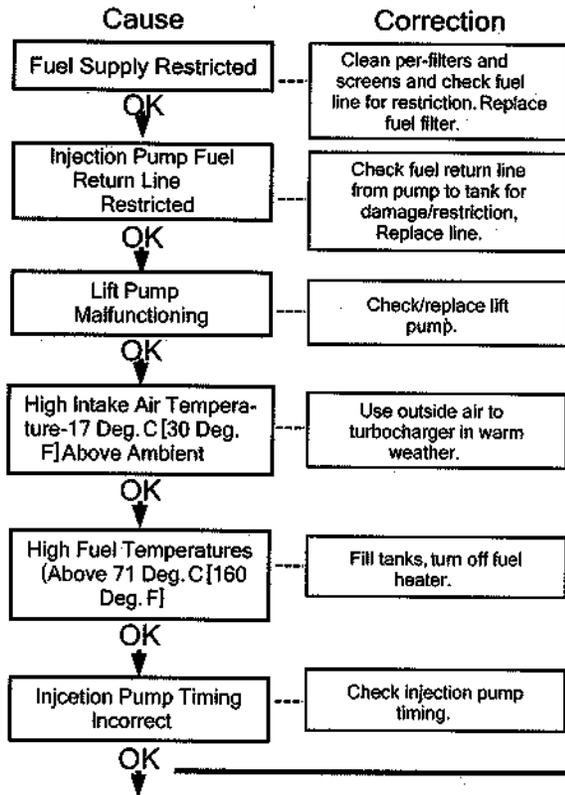
### Engine Will Not Reach Rated Speed When Loaded



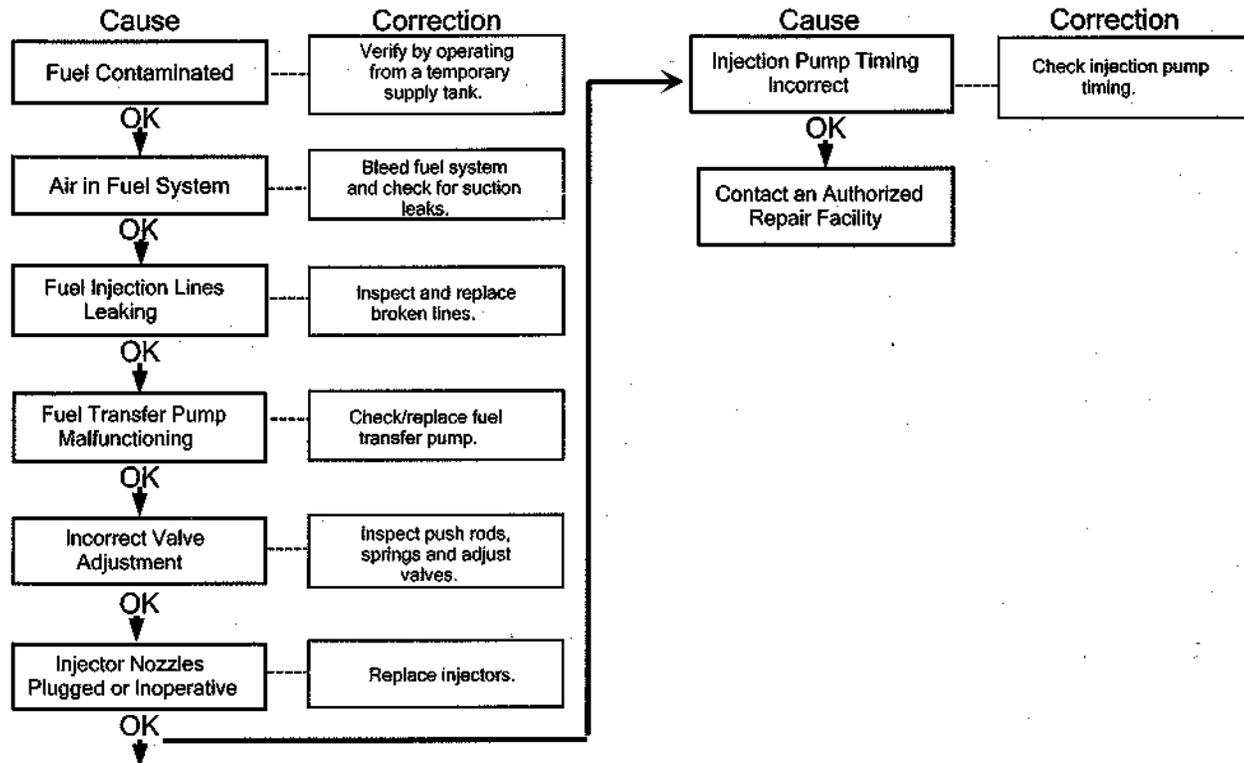
**Power Output Low**



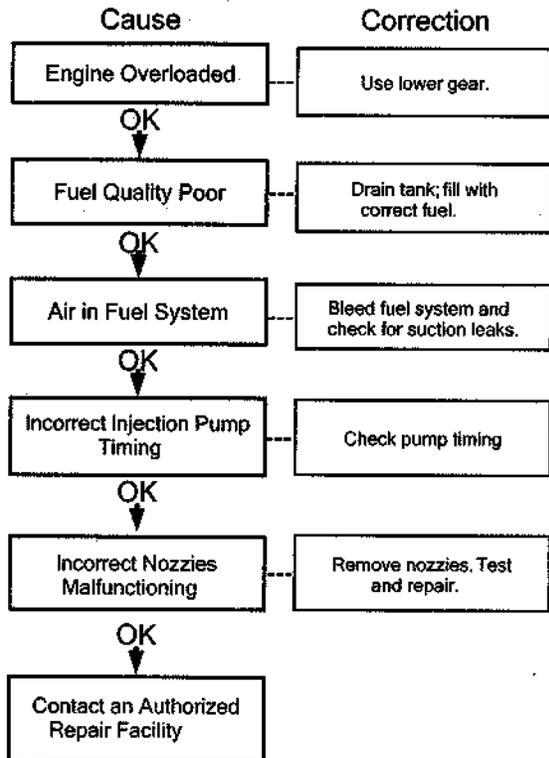
### Power Output Low (Continued)



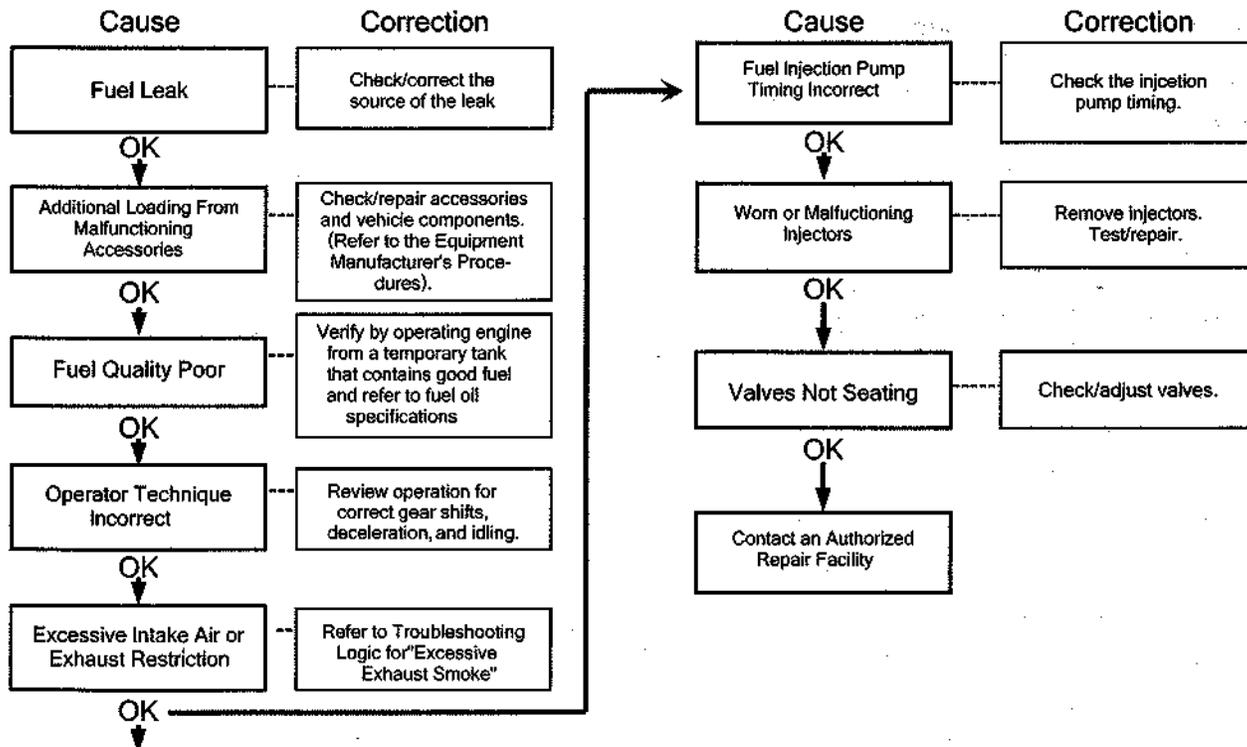
### Engine Misfiring



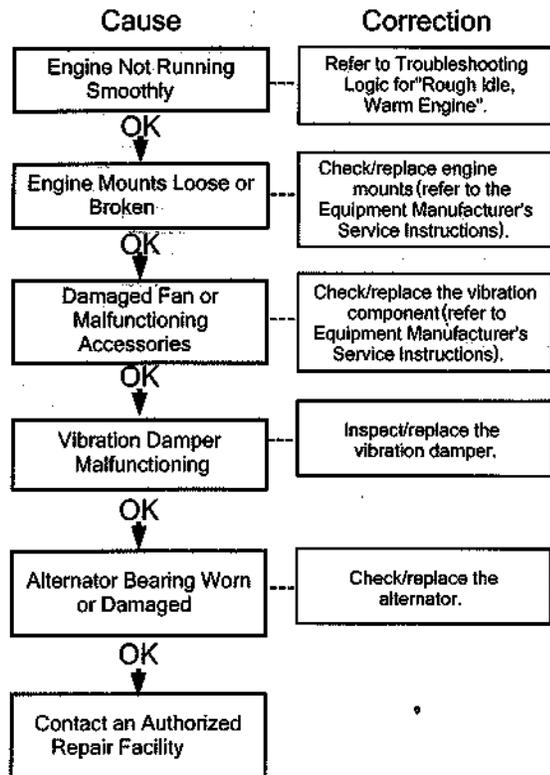
**Fuel Knock**



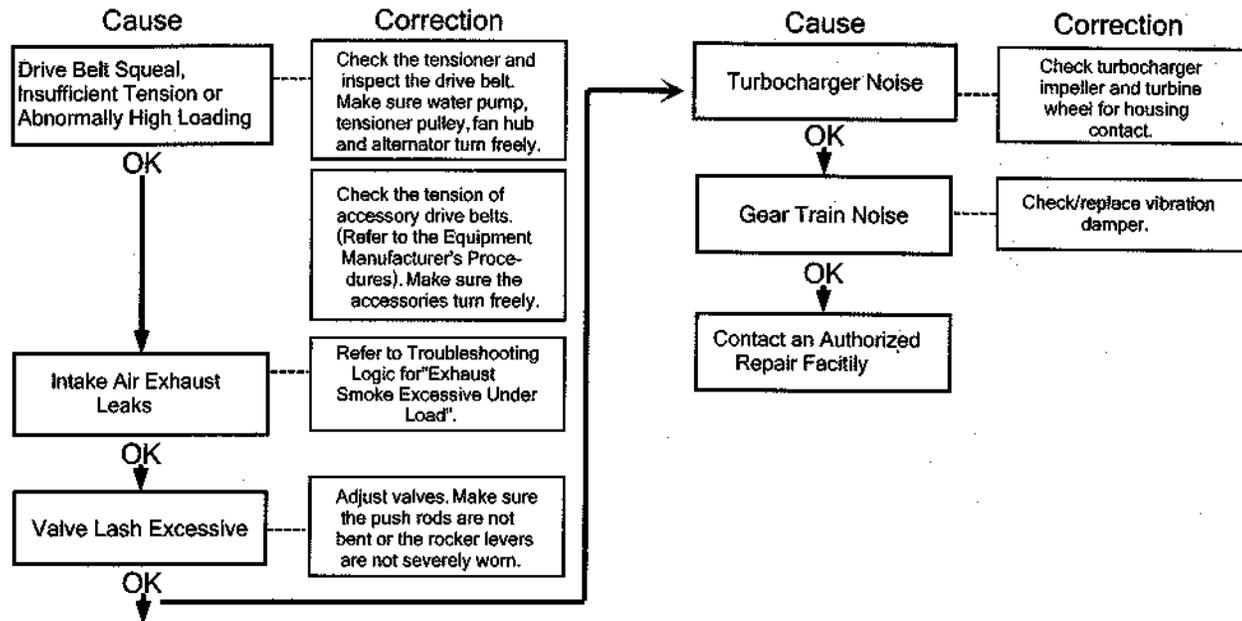
### Fuel Consumption Excessive



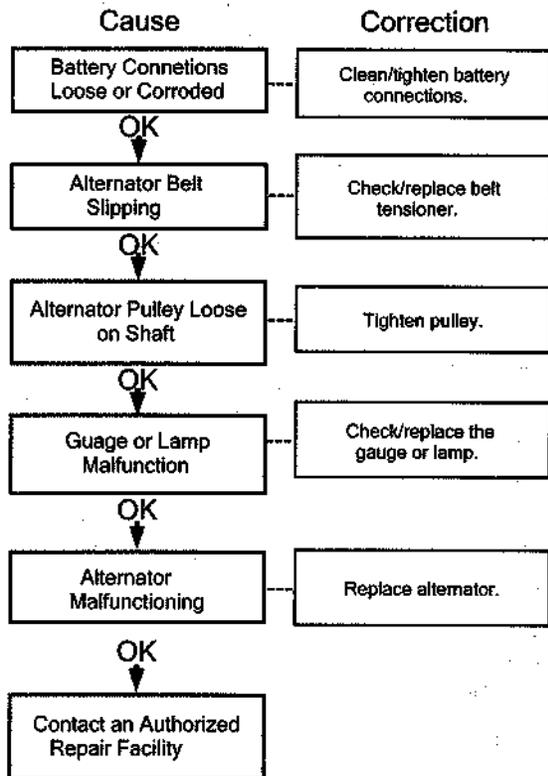
**Vibration Excessive**



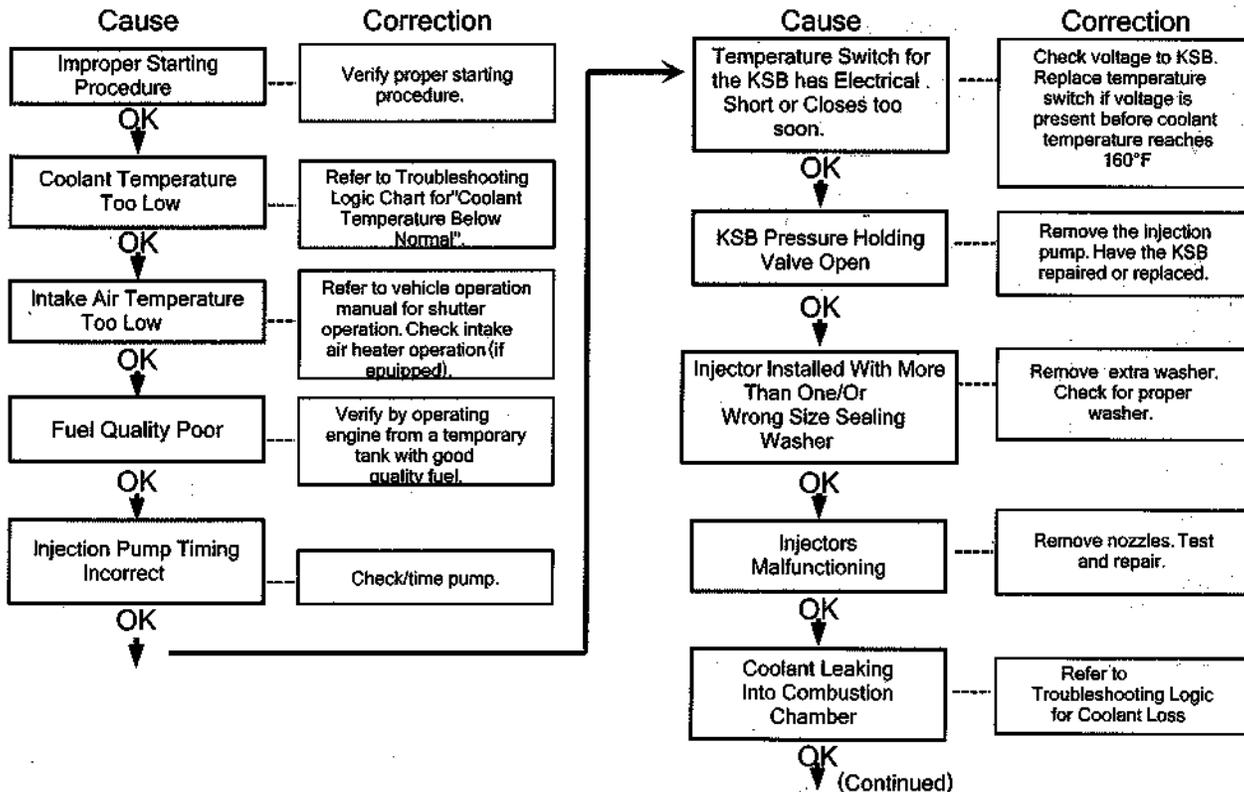
### Engine Noises Excessive



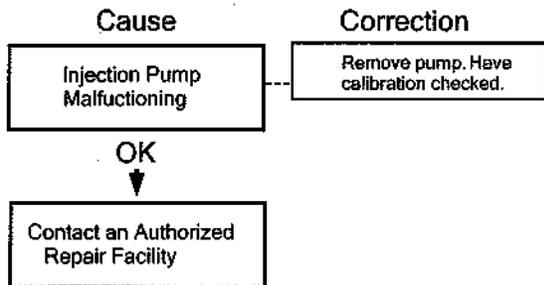
## Alternator Not Charging or Insufficient Charging



### White Smoke Excessive During Cold Start



**White Smoke Excessive During Cold Start (Continued)**





## Section A-Adjustment, Replacement and Repair

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**Page**

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**Repair Tools Required**  
**Page A-4**

**Section A-Adjustment, Replacement and Repair**  
**B Series**

**Repair Tools Required**

**Sockets**

10 mm  
12 mm  
13 mm  
15 mm  
17 mm  
18 mm  
19 mm  
22 mm  
27 mm

**Wrenches**

8 mm  
10 mm  
13 mm  
15 mm  
17 mm (open end)  
19 mm  
22 mm  
24 mm

**Other**

Allen Wrench (8 mm)  
Breaker Bar (1/2 in. Sq. Drive)  
Flat Screwdriver  
Ratchet (3/8 in. Sq. Drive)  
Ratchet (1/2 in. Sq. Drive)  
Filter Wrenches (75-80 mm and 90-95 mm)  
Drill Motor (1/4 inch)  
Drill Bit (3 mm)  
Slide Hammer  
Flat Chisel  
T-Bar Puller (75mm)  
Sheet Metal Screw (#10)  
Torque Wrench  
Pliers  
Engine Barring Gear 3377371

**Cooling System Repair Summary**

<b>Component To Be Replaced</b>	<b>Tools</b>	<b>Preparatory Steps</b>
<b>Drive Belt</b>	<b>Breaker Bar (3/8 inch Square drive)</b>	
<b>Belt Tensioner</b>	<b>Ratchet (3/8 inch drive) 15mm Socket and Torque Wrench 10 mm Socket/Wrench 10 mm Socket/Wrench 10 mm, 18 mm and 19 mm Socket/Wrench</b>	<b>Remove Drive Belt  Remove Drive Belt and Pulley  Drain Coolant and Remove Drive Belt  Drain Coolant, Remove Drive Belt, Loosen Alternator Link, Remove Alternator Mounting Capscrew, Remove Thermostat Housing</b>

## Cooling System Repair

### Drive Belt-Replacement



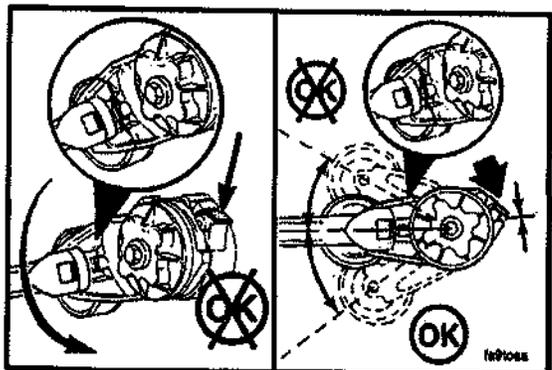
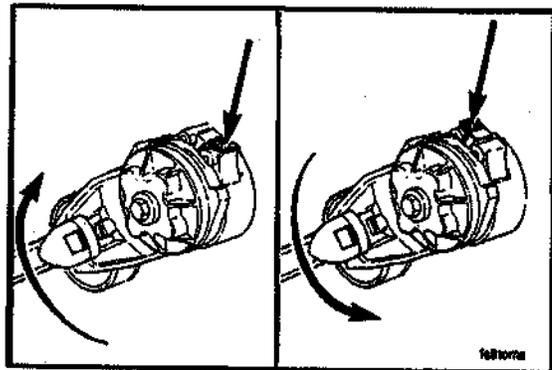
#### 3/8 Inch Square Drive



Lift the tensioner arm and pulley to remove and install the belt.



The belt tensioner winds in the direction that the spring tang is bent over the tensioner body. To loosen the tensioner on the belt, rotate the tensioner to wind the spring tighter.



Applying excessive force in the opposite direction of wind-up or after the tensioner has been wound-up to the positive stop can cause the tensioner arm to break.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

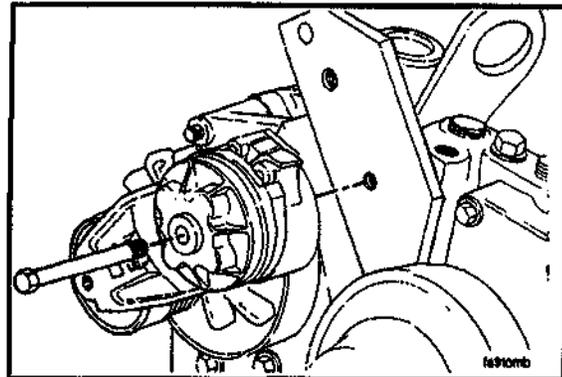
**Belt Tensioner-Replacement**

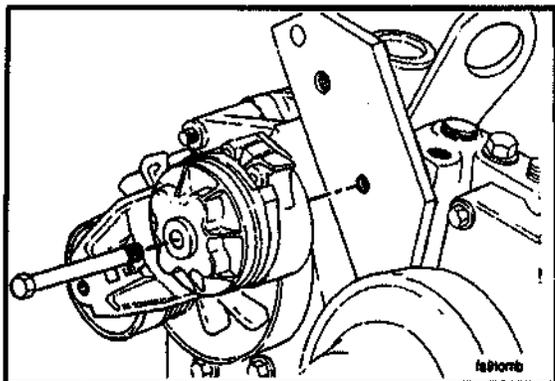
**Preparatory Step:**

- Remove the drive belt.

**13 mm**

Remove the belt tensioner from the bracket.





13 mm

Install the belt tensioner.



**Torque Value:** 43 N•m [32 ft-lb]



### Fan Pulley-Replacement

#### Preparatory Steps:

- Remove the drive belt.

**NOTE:** Loosen the capscrews before removing the belt and torque the capscrews after the belt is installed.

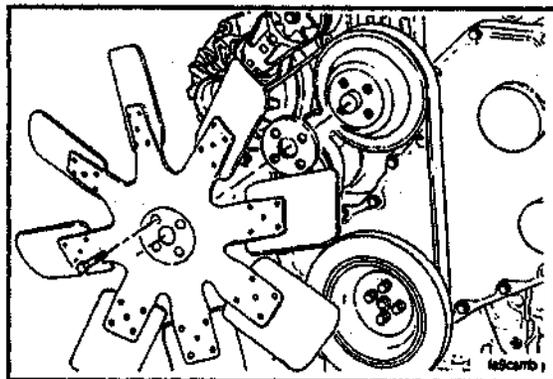
## Section A-Adjustment, Replacement and Repair B Series

### 10 mm and 13 mm

Remove the four capscrews, fan and spacer. Replace the fan pulley.

#### Torque Values:

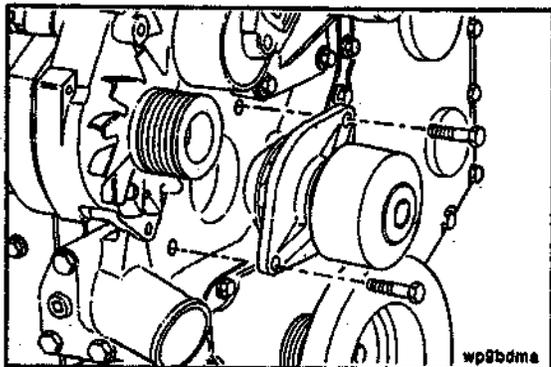
8 mm Capscrews-24 N·m	[18 ft-lb]
10 mm Capscrews-43 N·m	[32 ft-lb]



## Water Pump-Replacement

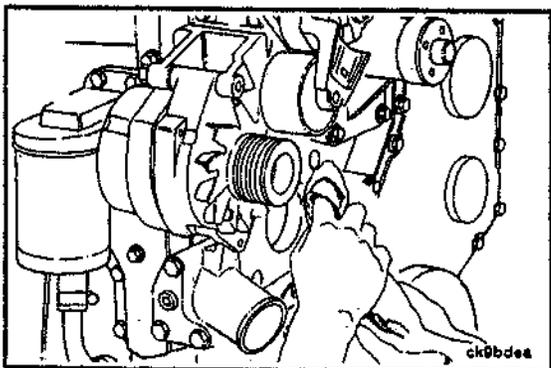
### Preparatory Steps:

- Drain the coolant.
- Remove the drive belt.



10 mm

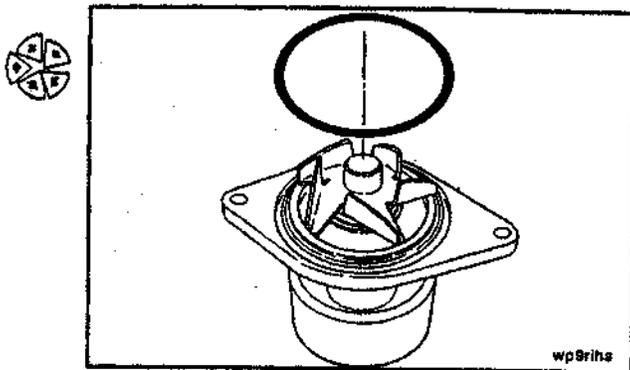
Remove the water pump.



Clean the sealing surface on the cylinder block.

**Section A-Adjustment, Replacement and Repair  
B Series**

Install a new o-ring into the groove in the water pump.

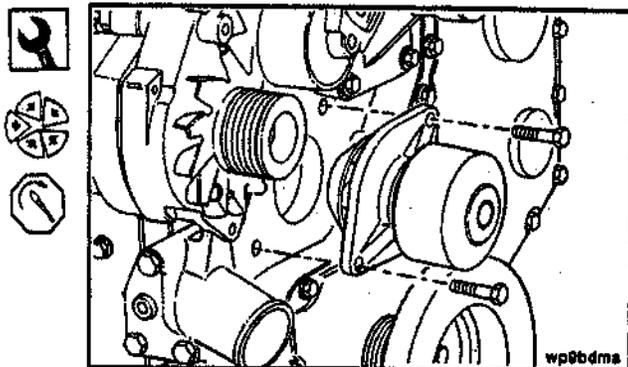


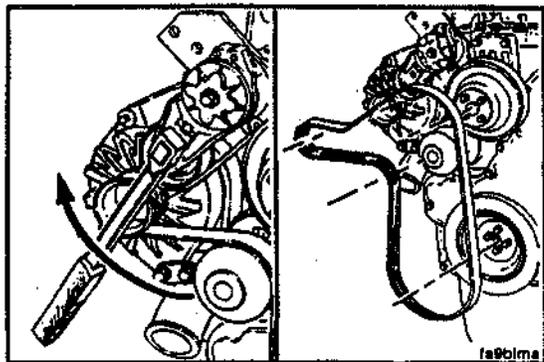
**10 mm**

Install the water pump.

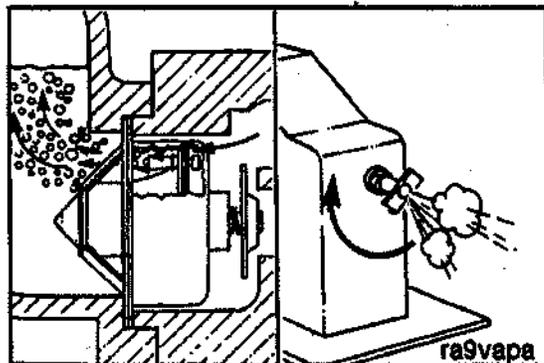
Torque Value: 24 N•m

[18 ft-lb]





Lift the tensioner arm and pulley to install the drive belt.



**Caution:** The system must be filled slowly to prevent air locks. During filling, air must be vented from the engine coolant passages. Be sure to open the petcock on the aftercooler for aftercooled engines.

The system has a maximum fill rate of 14 liters per minute [3.5 U.S. gallons per minute]. Do not exceed this fill rate. Wait 2 to 3 minutes to allow air to be vented. Then add coolant to bring the level to the top.

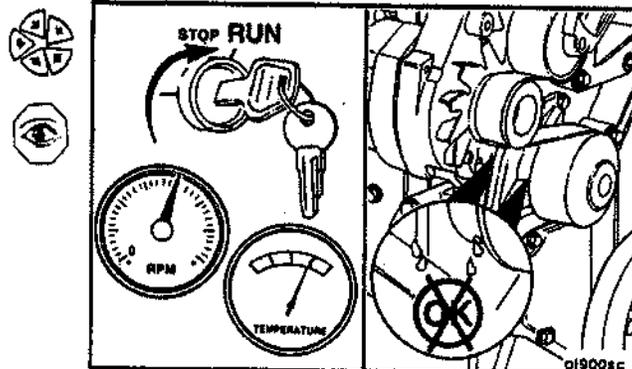
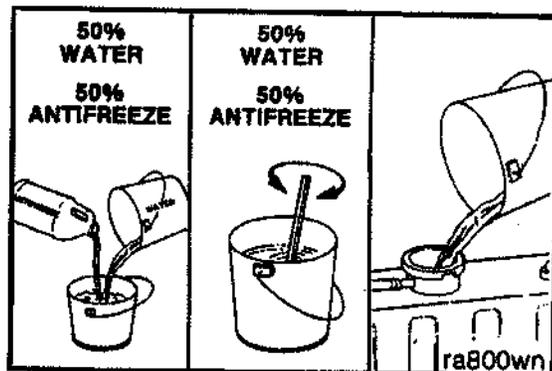
## Section A-Adjustment, Replacement and Repair B Series

Close the drain valves. Fill the cooling system with a mixture of 50% water and 50% ethylene-glycol type antifreeze. This will provide freeze protection to  $-37^{\circ}\text{C}$  [ $-34^{\circ}\text{F}$ ].

Coolant Capacity (Engine Only)		Liters [U.S. Quarts]	
4B3.9	6B5.9		
4BT3.9	4BTA3.9*	6BT5.9	6BTA5.9*
7.0 [7.4]	7.9 [8.4]	9 [9.5]	9.9 [10.5]

\*4BTA and 6BTA engines use a jacket-water aftercoolers. If a charge air aftercooler is used, the coolant capacity is the same as the naturally aspirated or turbocharged only engines.

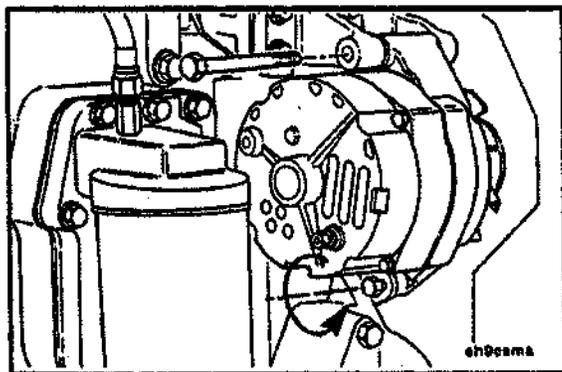
Install the pressure cap. Operate the engine until it reaches a temperature of  $80^{\circ}\text{C}$  [ $180^{\circ}\text{F}$ ], and check for coolant leaks.



## Thermostat-Replacement

### Preparatory Steps:

- Disconnect the negative battery cable.
- Drain 2 liters (2.1 U.S. Quarts) of coolant.
- Remove the radiator hose from the outlet connection.
- Remove the drive belt.

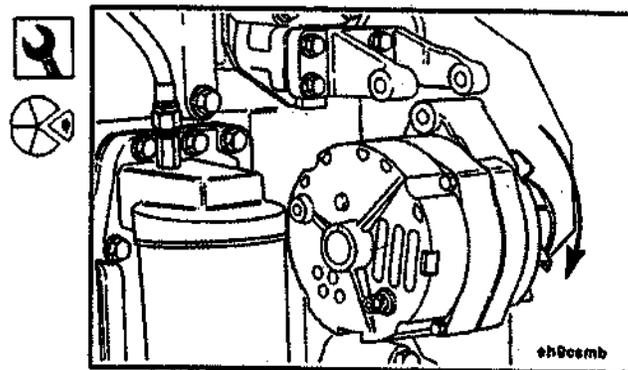


14 mm, 16 mm

- Loosen the lower alternator link capscrew.
- Remove the upper alternator mounting capscrew.

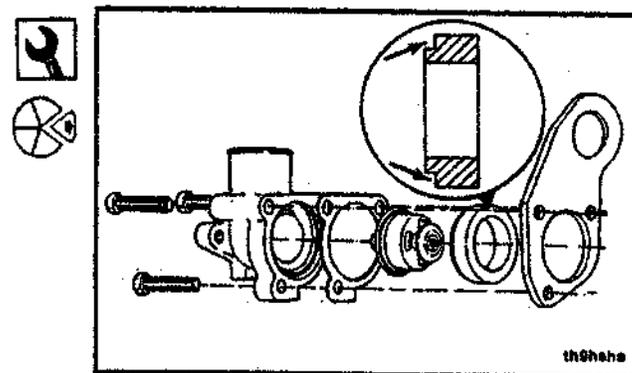
**Section A-Adjustment, Replacement and Repair**  
**B Series**

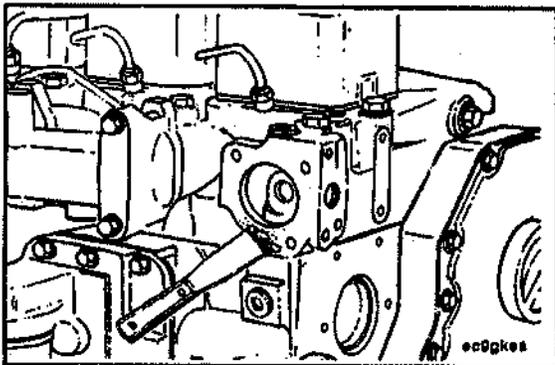
Lower the alternator.



**10 mm**

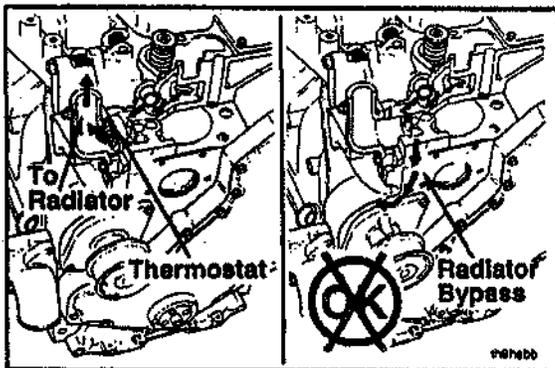
Remove the thermostat housing, lifting bracket, thermostat and thermostat seal.





Clean the gasket surfaces.

**NOTE:** Do not let any debris fall into the thermostat cavity when cleaning gasket surface.



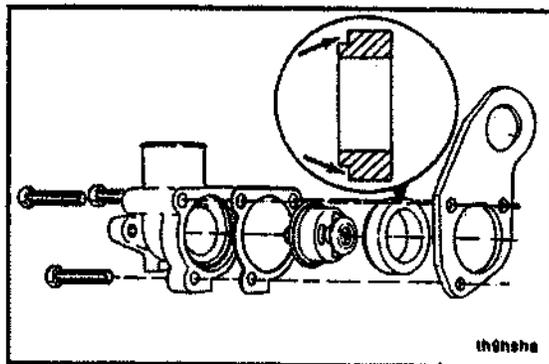
**Caution:** Always use the correct thermostat and never operate the engine without a thermostat. An incorrect thermostat can cause the engine to overheat or run too cold. The engine will overheat if operated without a thermostat because the coolant flows back to the inlet of the water pump instead of through the radiator for cooling.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

Assemble the removed parts in the reverse order of removal.

Make sure the gasket is aligned with the capscrew holes. Install the capscrews and use your fingers to tighten.

The notched end of the rubber thermostat seal points away from the cylinder head.

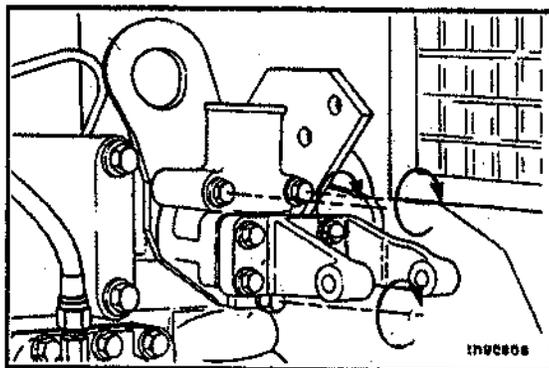


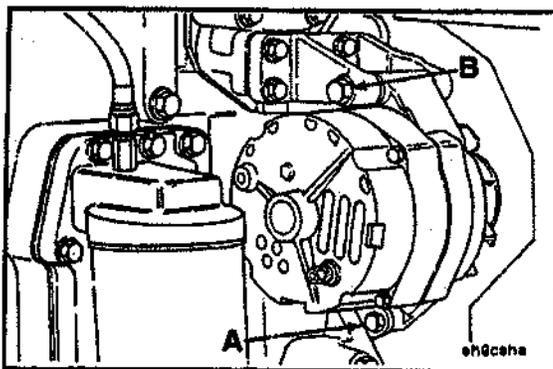
**10 mm**

Tighten all Capscrews.

Torque Value: 24 N•m

[18 ft-lb]





14 mm, 16 mm



Torque Value:

(A) 24 N·m [18 ft-lb]

(B) 43 N·m [32 ft-lb]



13 mm

Install the drive belt.



**NOTE:** After the tensioner has been raised to remove/install the belt, check the torque of the tensioner cap screw.

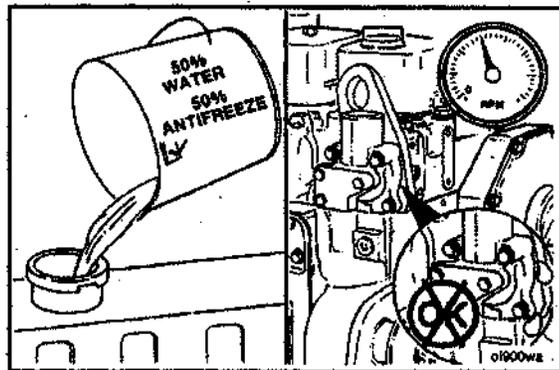


**Torque Value:** 43 N · m [32 ft-lb]

## Section A-Adjustment, Replacement and Repair B Series

Fill the cooling system. Operate the engine and check for leaks.

**Caution:** Be sure to vent the engine and aftercooler during filling, to remove air from the coolant system or over-heating will result.



## Fuel System Repair Summary

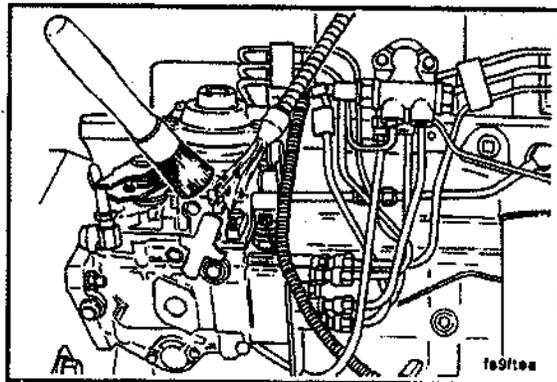
<b>Component To Be Replaced</b>	<b>Tools</b>	<b>Preparatory Steps</b>
Lift Pump	13,14 and 17 mm Wrenches	Clean debris.
High Pressure Lines	13 mm Socket, 14,17, and 19mm Open End Wrenches and a Torque Wrench	Clean debris.
Injector Fuel Drain Manifold	10 mm and 19 mm Open End Wrenches, 10 mm and 13 mm Sockets, and a Torque Wrench	
Injectors	Ratchet, 24 mm Socket (deep well), and a Torque Wrench	Disconnect the high pressure lines and fuel drain manifold.
Injection Pump	Injector bore cleaning brush. 10 mm Wrench, Ratchet, 22 mm Socket, 75 mm T-Bar Puller (w/2 8 mm capscrews) 1/2 in. open end wrench flat Screwdriver 13 mm Socket, 13 mm Wrench, Hammer, flat Chisel and a Torque Wrench.	Remove high pressure lines, supply line and return line. Remove the AFC air line, oil line (s), fuel shutoff solenoid and control linkage.
Fuel Solenoid	Robert Bosch 24 mm Wrench, Lucas CAV 22 mm Wrench	Label and disconnect wiring.
Fuel Filter Head	24 mm, 75-80 mm and 90-95 mm Filter Wrench	Clean debris.

**Section A-Adjustment, Replacement and Repair  
B Series**

**Fuel System Repair-Rotary Pump**

**Fuel System Components-Cleaning**

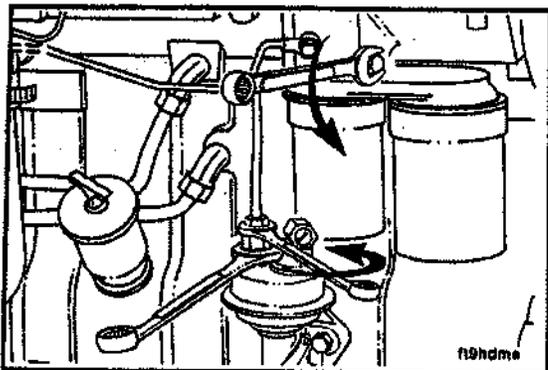
Thoroughly clean all fittings and components before removal. Make sure that the debris, water, steam, or cleaning solution does not reach the inside of the fuel system.



**Low Pressure Fuel Line-Replacement**

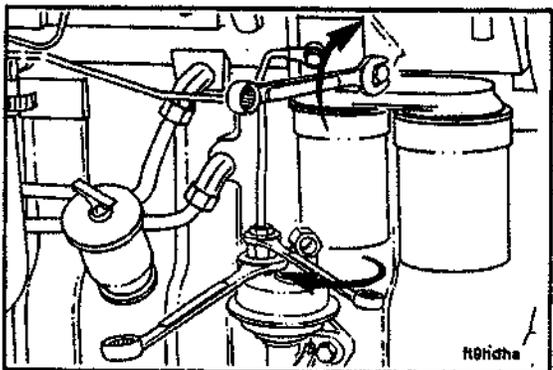
**Preparatory Step:**

- Clean all debris from around the fittings.



14 mm, 17 mm

Disconnect the fuel line from the lift pump and filter head.  
Use two wrenches to disconnect the line from the lift pump.



14,17 mm

Install the fuel line to the lift pump and filter head. Use two wrenches to tighten the connection to the lift pump.



**NOTE:** Do not overtighten the connection. Fuel leaks can result from overtightening.



**Torque Value:** 24 N•m [18 ft-lb]

## **Fuel Filter Head Adapter-Replacement**

### **Preparatory Steps:**

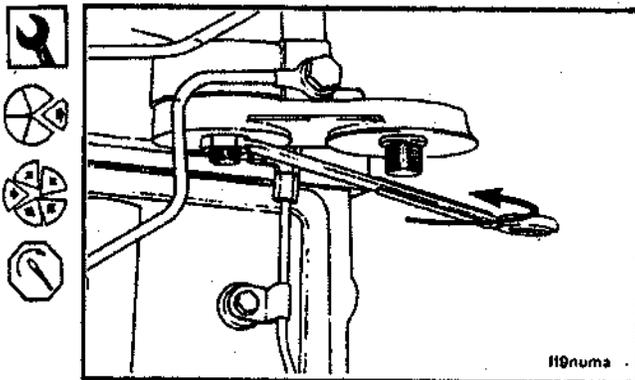
- Clean debris.
- Remove fuel filters.

**24 mm**

Remove the retaining nut, filter head adapter and sealing washers.

Install in the reverse order of removal.

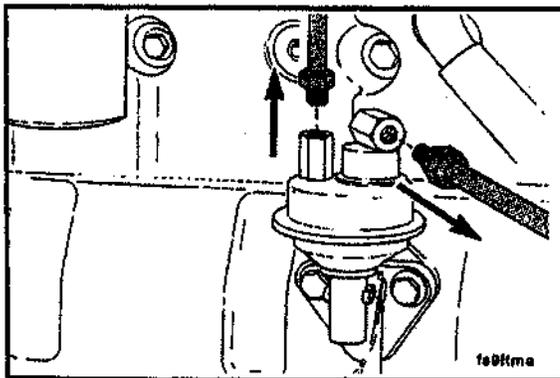
**Torque Value:** 32 N•m [24 ft-lb]



### Lift Pump-Replacement

#### Preparatory Steps:

- Clean debris from around the lift pump.



14 mm, 17 mm

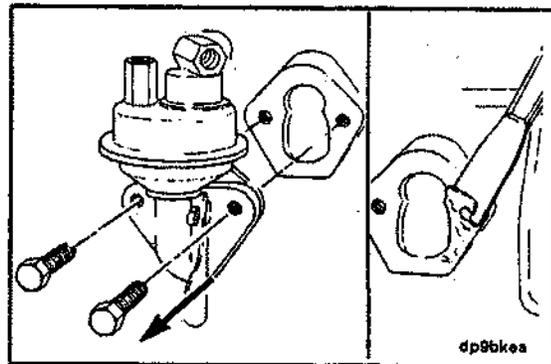


Disconnect the fuel lines.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

**10 mm**

Remove the lift pump and clean the mounting surface on the cylinder block.

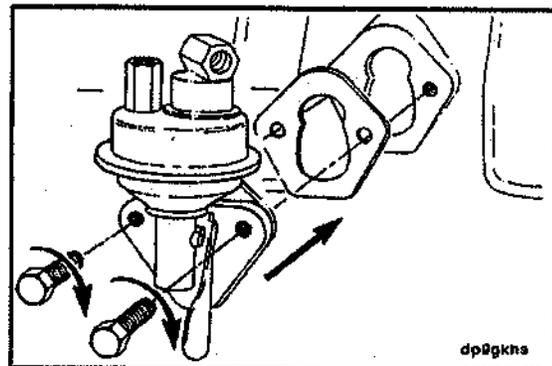


**10 mm**

Install the lift pump and a new gasket.

Connect the fuel lines.

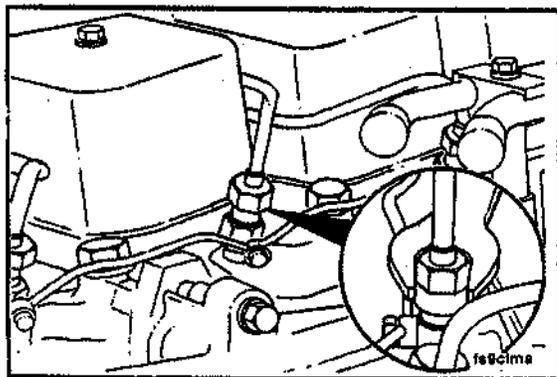
Torque Value: 24 N•m [18 ft-lb]



## High Pressure Fuel Lines-Replacement

### Preparatory Steps:

- Clean all debris from around the fittings.



17 mm



**NOTE:** If individual lines are to be replaced, remove the support clamp from the let of lines containing the line to be replaced.

Disconnect the line (s) from the injectors.

## Section A-Adjustment, Replacement and Repair B Series

17 mm

Disconnect the line (s) from the fuel pump. Install protective covers to the injectors and delivery valves to prevent the entry of dirt into the system.

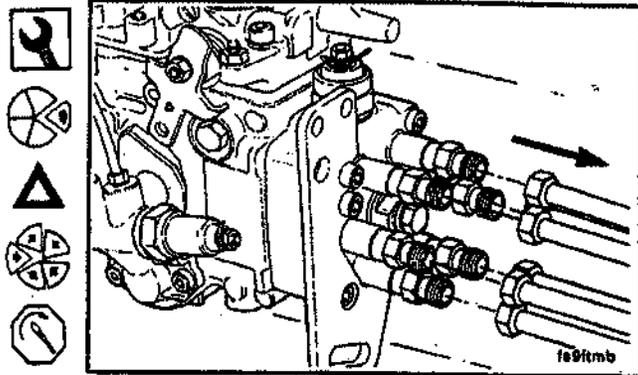
**Caution:** Install the support clamp in original position and , to prevent damage from high frequency vibration, make sure the lines have not been bent or do not contact each other or another component.

**NOTE:** To prevent damage to the fuel lines, they **must** be connected to the injectors and fuel injection pump in a free state without forcing the connecting nuts. The fuel lines are correctly sized for each application and bending the lines is **not** acceptable.

Install the lines in the reverse order of removal.

### Torque Value:

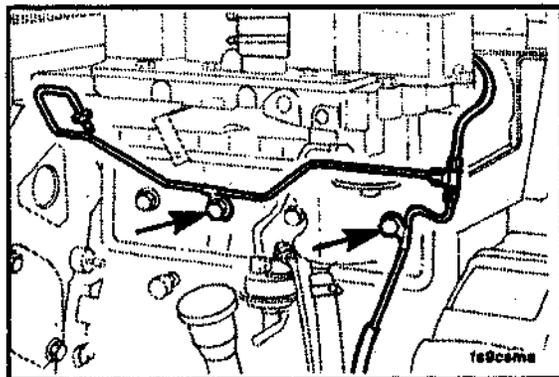
(Line Fittings)	30 N•m	[22 ft-lb]
(Support Clamp)	6 N•m	[4 ft-lb]
(Support Bracket)	24 N•m	[18 ft-lb]



### Fuel Drain Manifold-Replacement

#### Preparatory Steps:

- Clean debris.



10 mm

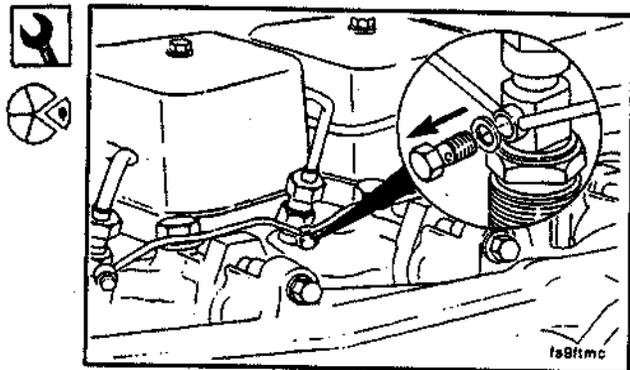


Remove the cap screw from the hold-down clamp.

**Section A-Adjustment, Replacement and Repair  
B Series**

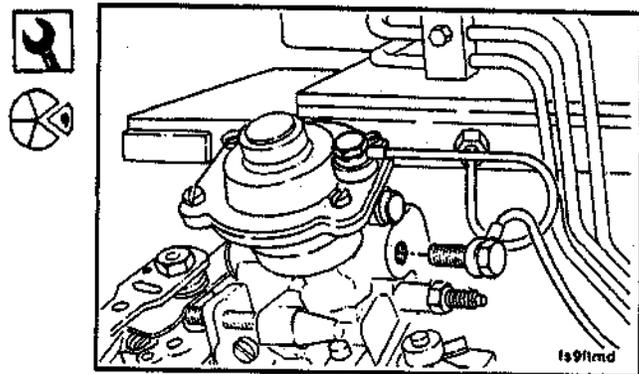
**10 mm**

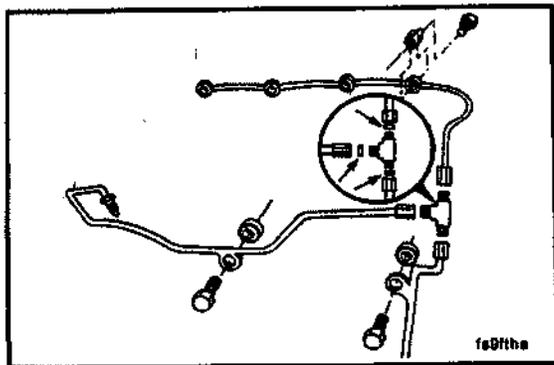
Remove the banjo fitting screws and washers.



**17 mm**

Disconnect the drain line fitting from the injection pump.



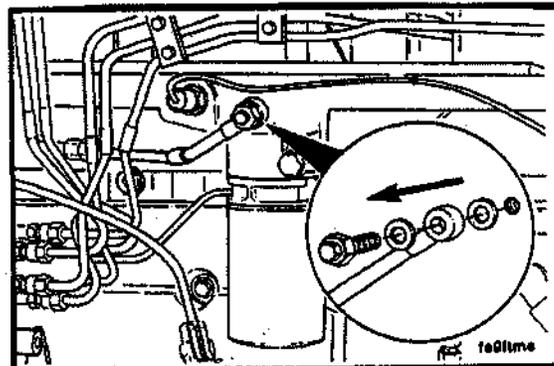


**NOTE:** Use new seals and sealing washers.

Assemble the drain line and fuel drain manifold in the reverse order of removal.

**Torque Value:**

(Banjo fitting screw)	15 N•m	[11 ft-lb]
(Banjo fitting)	9 N•m	[7 ft-lb]
(Clamp screw)	24 N•m	[18 ft-lb]



**Injection Pump Supply Line-Replacement**



17 mm

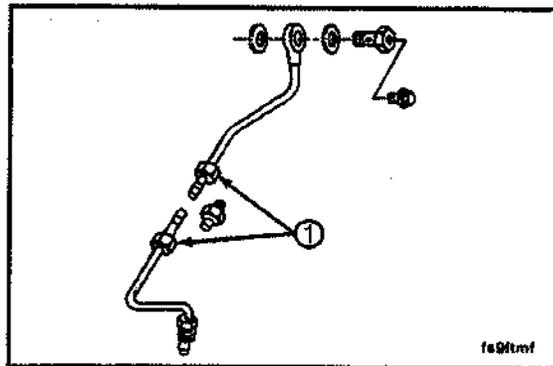
Remove the bleed screw banjo fitting.

**Section A-Adjustment, Replacement and Repair  
B Series**

**14 mm, 16 mm, 17 mm**

Remove the supply line (Bosch Injection Pump).

Replace the seals (1) in the fittings if the line is disassembled.



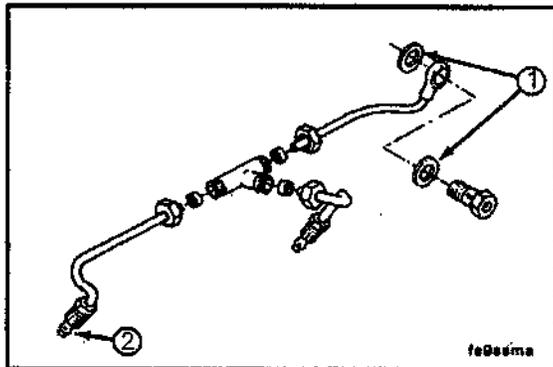
**14,16,19 and 24 mm**

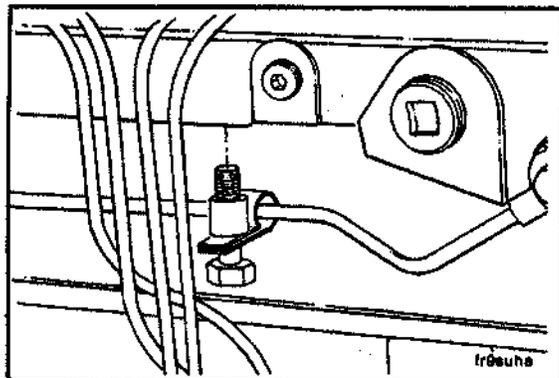
The Lucas CAV pump has two fittings for the supply line.

Replace the seals in the fittings if the line is disassembled.

Replace banjo fitting sealing washers (1) and ferrules (2) each time they are removed.

**Torque Value:** 32 N•m [24 ft-lb]





**17 mm**

Engines rated at 2500 RPM and above require additional fuel line support. Install as illustrated.

Torque Value: 24 N·m [18 ft-lb]

### **Injectors-Replacement**

#### **Preparatory Steps:**

- Thoroughly clean around the injectors.
- Disconnect the high pressure fuel lines.
- Disconnect the fuel drain manifold.

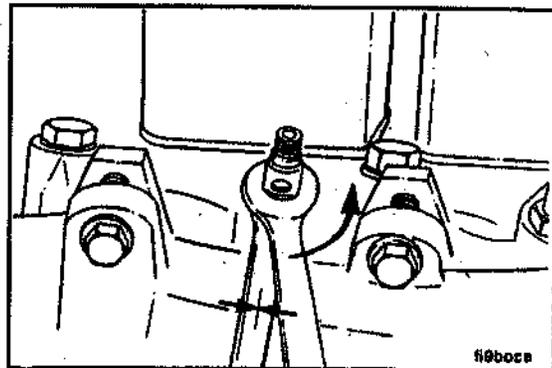
**Section A-Adjustment, Replacement and Repair  
B Series**

**16 mm, 24 mm Box Wrench**

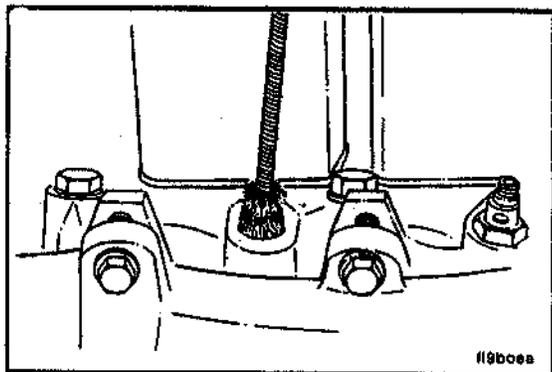
**Caution: The injector must not rotate in the bore of the cylinder head. This will damage the cylinder head.**

Remove the injectors.

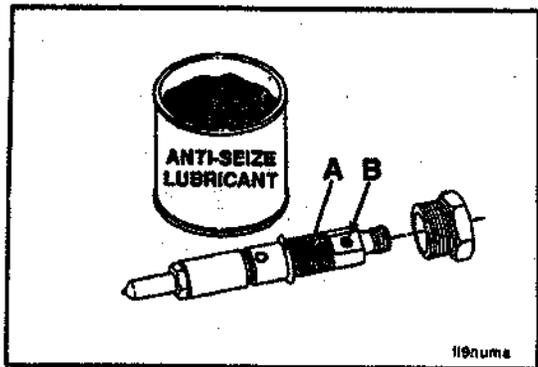
Hold the injector body with the 16 mm wrench while you loosen the hold-down nut with a 24 mm box end wrench.



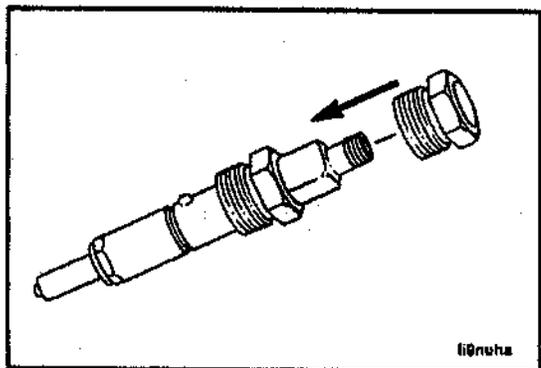
Clean the injector nozzle bore using Service Tool No. 3822509.



Section A-Adjustment, Replacement and Repair  
B Series



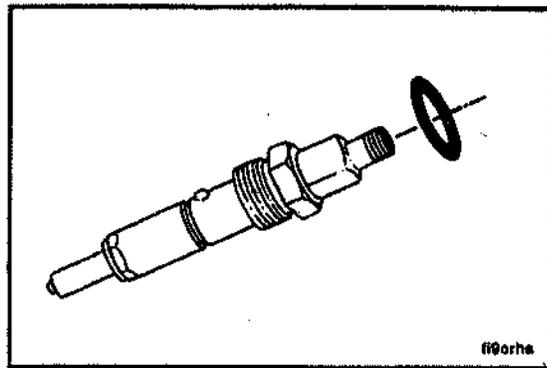
Remove the injector hold-down nut and apply a coat of anti-seize compound to injector surface (A). Avoid getting anti-seize compound in the fuel drain hole (B).



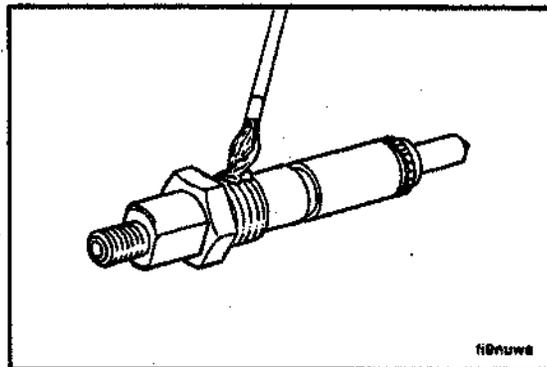
Install the hold-down nut on the injector body.

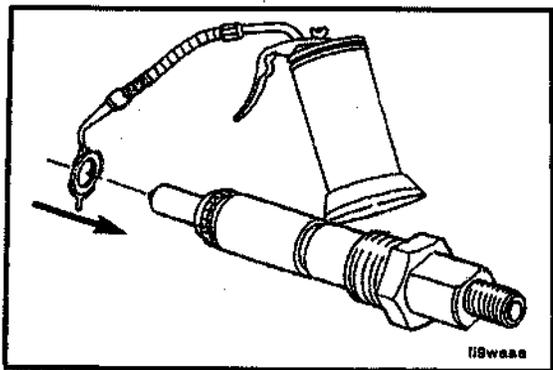
## Section A-Adjustment, Replacement and Repair B Series

Install a new o-ring into the recessed groove on the top of the hold-down nut. Make sure the o-ring is not cut or wisted when installing (BOSCH and Stanadyne). CAV injectors retain the o-ring inside the hold-down nut.



Apply a coat of anti-seize compound to the threads of the injector hold-down nut.



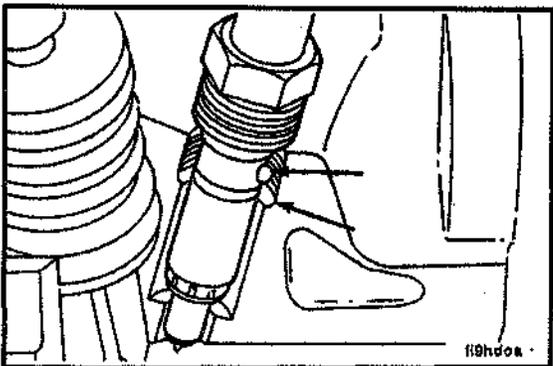


Assemble the injector and new copper washer.

Use only one copper washer.

Service Tip: A light coat of clean 15W40 engine oil between the washer and injector can help to keep the washer from falling during installation.

### 24 mm



### Install the Injectors

The protrusion on the side of the nozzle fits into a notch in the head to orient the injector.



Tighten the injector nozzle nuts.



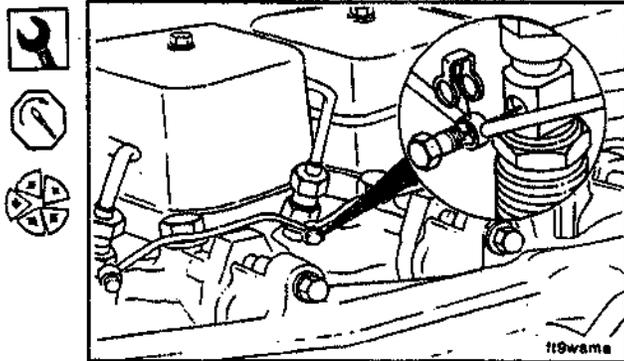
**Torque Value:** 60 N·m [44 ft-lb]

**Section A-Adjustment, Replacement and Repair**  
**B Series**

**10 mm**

Install the fuel drain manifold.

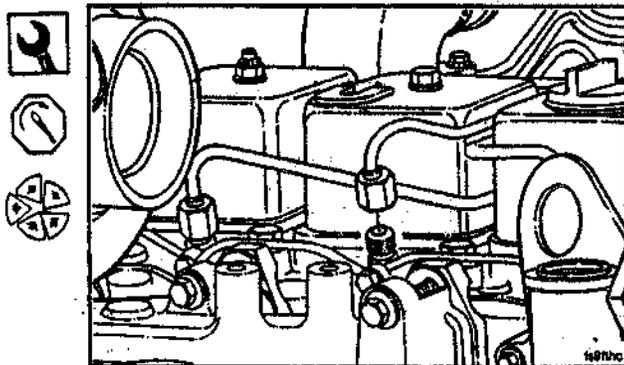
**Torque Value:** 9 N·m [7 ft-lb]



**17 mm**

Install the high pressure fuel lines.

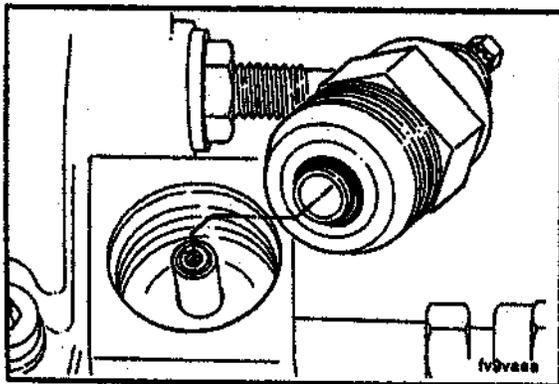
**Torque Value:** 30 N·m [22 ft-lb]



### Fuel Shut Off Solenoid-Replacement

#### Preparatory Steps:

- Label and disconnect the wiring.



**Bosch and CAV**

**22 mm-CAV**



**24 mm-Bosch**

Clean around the valve.



**WHEN REMOVING THE VALVE, BE CAREFUL NOT TO  
DROP THE PISTON AND SPRING.**

Replace the valve and connect the electrical wire.

**Section A-Adjustment, Replacement and Repair  
B Series**

**Stanadyne DB4**

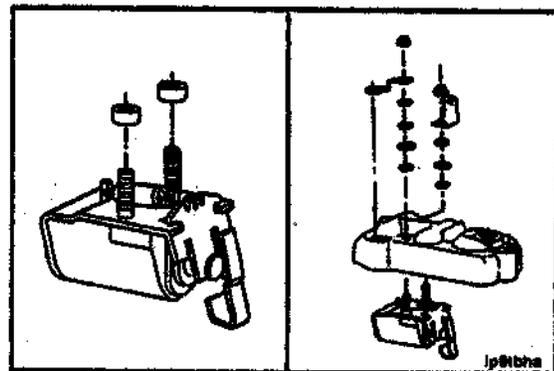
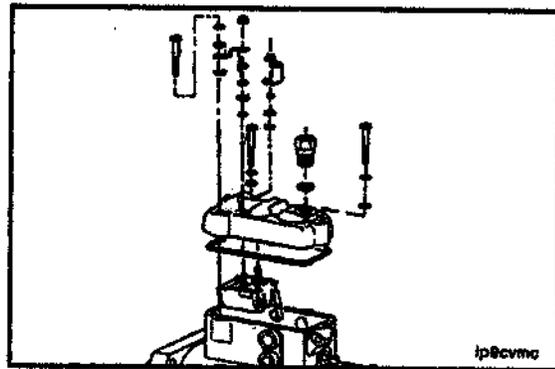
- **Remove the electrical wiring.**
- **Remove the fuel drain line.**
- **Remove the throttle shutoff linkage.**
- **Remove the fuel injection pump top cover.**
- **Disassemble the fuel injection pump top cover.**

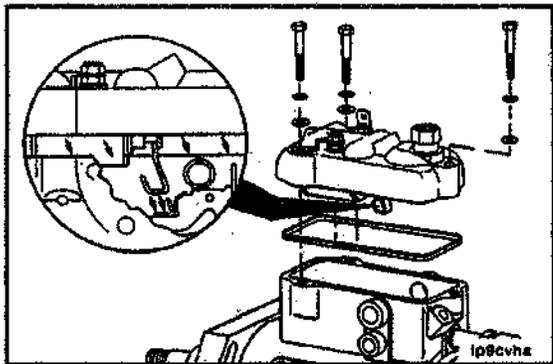
**5/16 Inch**

Install new insulating tubes onto the terminals on the terminal studs of the new solenoid.

Install the valve into the cover.

**Torque Value:** 14 N•m [12 in-lb]





### 5/16 Inch

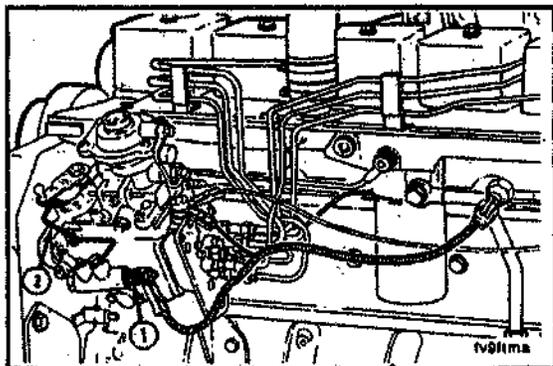
Install the cover and gasket onto the fuel injection pump.

**NOTE:** Extreme care must be taken in assembling the cover to a fuel injection pump to make sure the shutoff arm is in proper with the linkage hook tab.

Install the cover to pump at a downward angle from the drive shaft end of the fuel injection pump, then slide the cover horizontally into position.

**Torque Value:** 4.6 N•m [41 in-lb]

### KSB Replacement



### T30 TORX, 12 mm

Disconnect the wiring harness from the KSB solenoid (1). Disconnect the fuel lines (2). Replace the KSB, fuel lines and wiring harness.



### Torque Value:

Fuel Line Banjo Fittings:	12 N•m	[9 ft-lb]
KSB Mounting Nuts	9 N•m	[7 ft-lb]

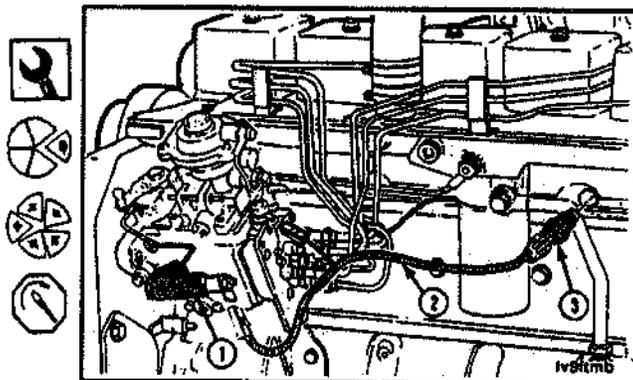
**Section A-Adjustment, Replacement and Repair**  
**B Series**

**KDB Temperature Switch Replacement**

**27 mm**

Disconnect the KSB (1) wiring harness (2) from the switch (3). Replace the temperature switch. Install the wiring harness.

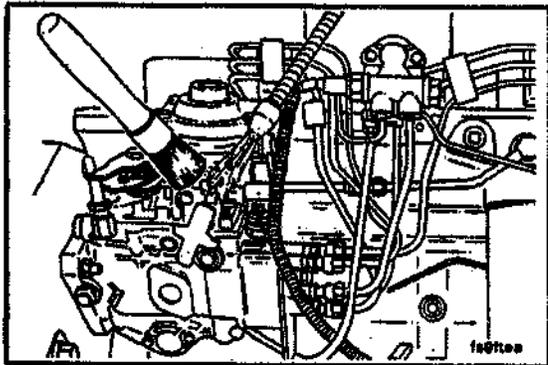
**Torque Value:** 24 N·m [18 ft-lb]



**Fuel Pump-Replacement**

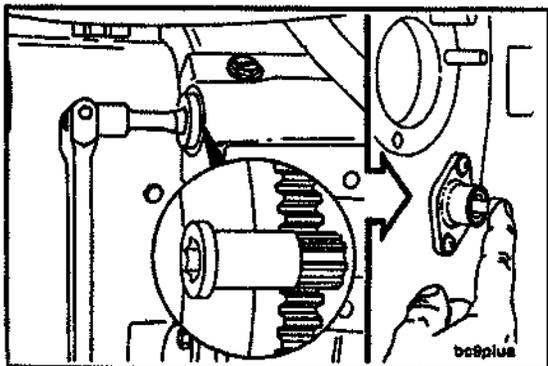
**Preparatory Steps:**

- Remove all fuel lines.
- Remove control linkage.
- Remove fuel shut off solenoid.



**NOTE:** A diesel engine cannot tolerate dirt or water in the fuel system. A tiny piece of dirt or a few drops of water in the injection system may stop your unit.

Clean all external surfaces of the injection pump, including all line connections and fittings that are to be disconnected. Clean the area around the injection pump gear cover to prevent dirt from entering the crankcase.



### Removing the Fuel Pump

Locate TDC for cylinder number 1. Push the TDC pin into the hole in the camshaft gear while slowly barring the engine.

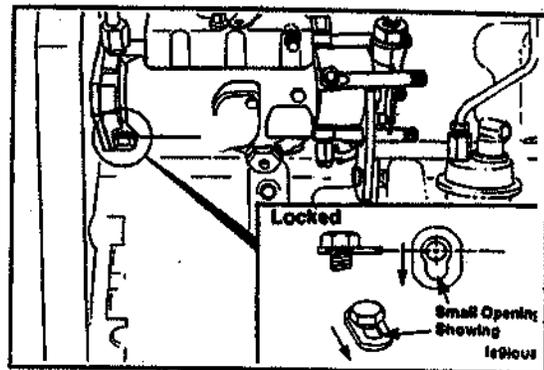
To prevent damage to the timing pin, be sure to disengage the pin after locating TDC.

**Section A-Adjustment, Replacement and Repair  
B Series**

**14 mm**

Loosen the CAV injection pump lockscrew and position the special washer, then tighten the lockscrew against the pump drive shaft.

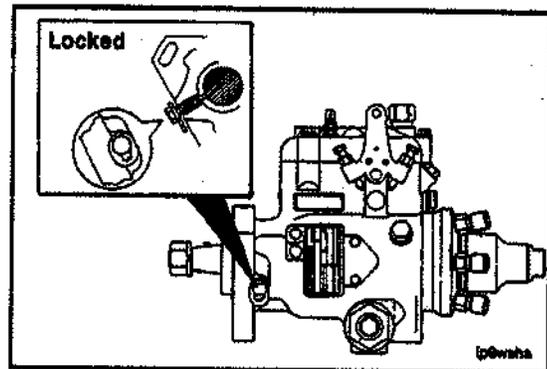
**Torque Value:** 7 N·m [5 ft-lb]

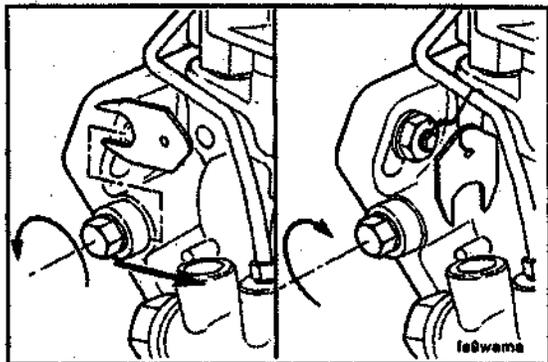


**3/8 Inch**

Loosen the Stanadyne DB4 fuel injection pump lock screw and position the special washer. Tighten the lock screw until contact is made with the fuel injection pump drive shaft.

**Torque Value:** 12 N·m [9 ft-lb]



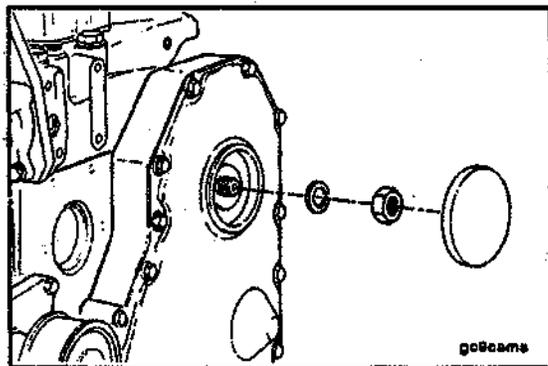


10 mm

The special washer on the Bosch injection pump must be removed so the lockscrew can be tightened against the drive shaft.



**Torque Value:** 30 N·m [22 ft-lb]



22 mm

Remove the gear cover access cap.

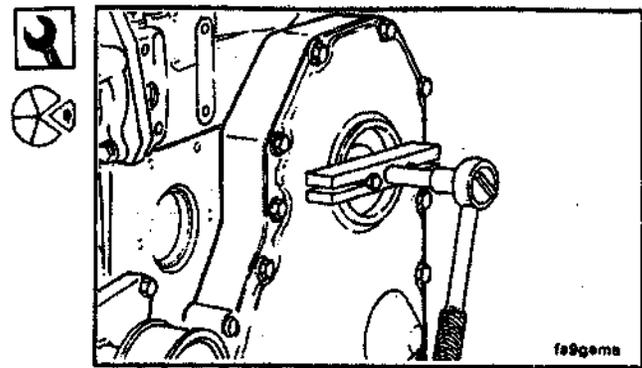


Remove the nut and washer from the fuel pump shaft.

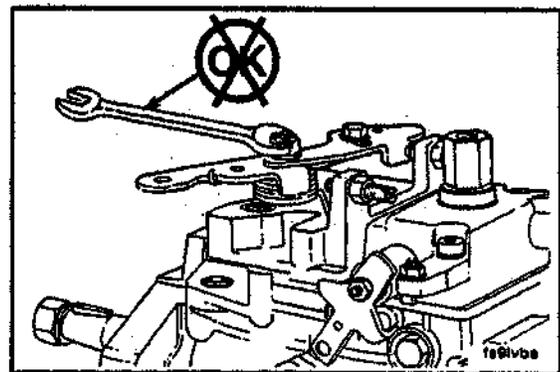
**Section A-Adjustment, Replacement and Repair  
B Series**

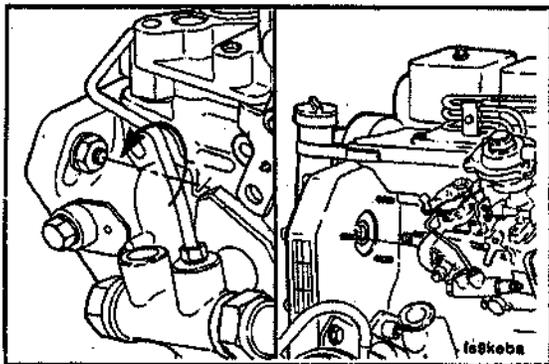
**75 mm T-Bar Puller**

Pull the fuel pump drive gear loose from the shaft.



**Caution: Do not remove the control lever. The lever is indexed to shaft during pump calibration. Removal of the lever will alter the fuel pump calibration and effect engine performance.**



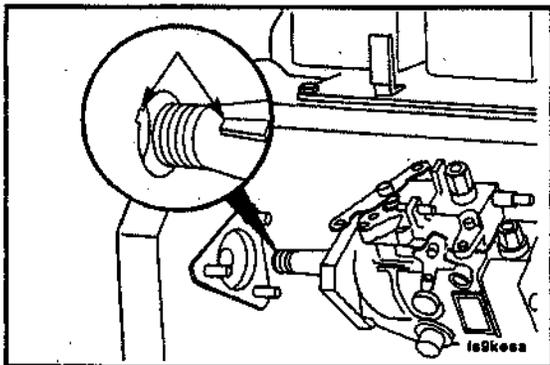


13 mm

**NOTE:** Do not drop drive gear key when removing pump.

Remove the three mounting nuts.

Remove the fuel pump.



### Installing the Fuel Pump

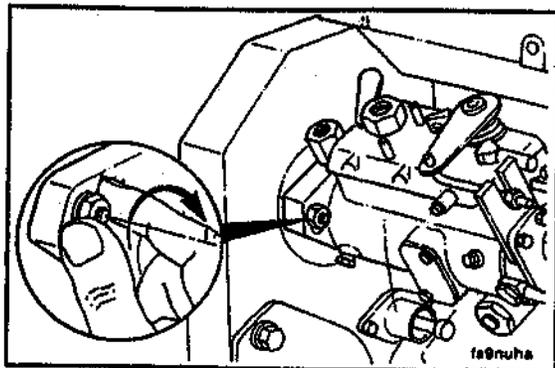
Make sure the engine has cylinder number 1 at TDC.

The keyway in the shaft of new and reconditioned pumps will be locked in a position corresponding to the keyway in the drive gear when cylinder number 1 is at TDC on the compression stroke.

After verifying that Cylinder Number 1 is at TDC, install the pump. Make sure the key does **not** fall into the gear housing.

## Section A-Adjustment, Replacement and Repair B Series

Attach the pump by finger tightening the three mounting nuts. The pump must be free to move in the slots.

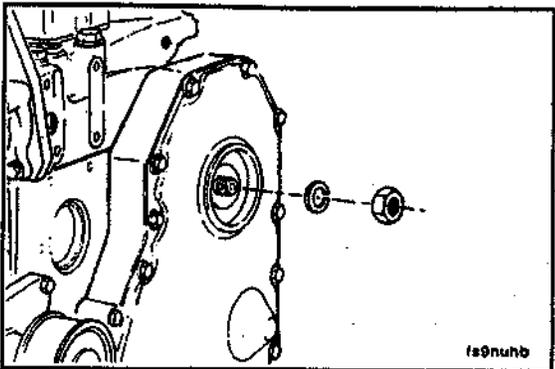


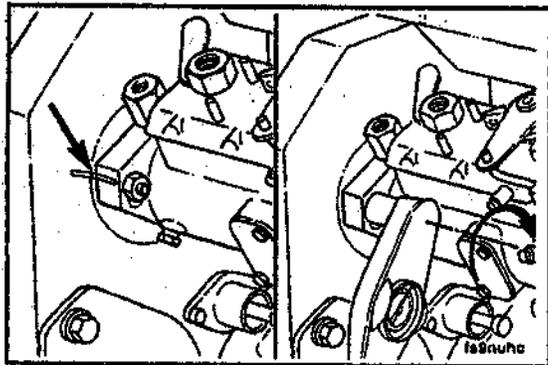
**22 mm (CAV Stanadyne), 24 mm (Bosch)**

Attach the pump drive shaft nut and spring washer. The pump may rotate slightly due to gear helix and clearance. This is acceptable providing the pump is free to move on the flange slots and the crankshaft does not move.

**NOTE:** Do not overtighten. This is not the final torque.

**Torque Value:** 15 to 20 N·m [11 to 15 ft-lb]





13 mm

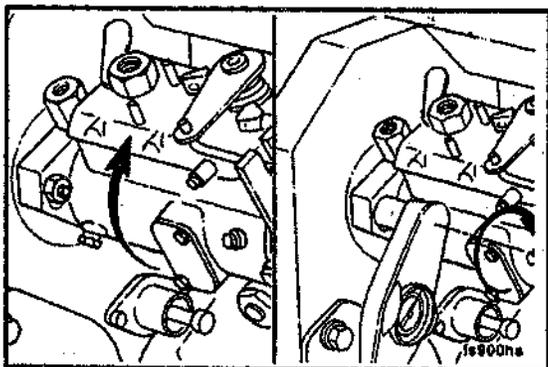
If reinstalling the removed pump, install the pump onto the engine. Rotate the pump to align the scribe marks. Tighten the three mounting nuts.



**Caution:** The pump shaft must be unlocked after installation to prevent pump damage.



**Torque Value:** 24 N·m [18 ft-lb]



13 mm

If installing a new or rebuilt pump without scribe marks, take up gear lash by rotating the pump against the direction of drive rotation.

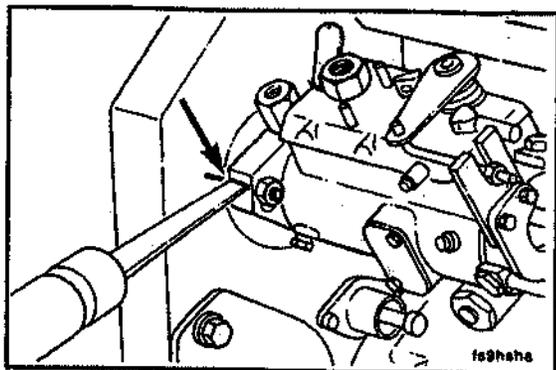


Tighten pump retaining nuts.

**Torque Value:** 24 N·m [18 ft-lb]

## Section A-Adjustment, Replacement and Repair B Series

If a new or rebuilt pump is being installed, permanently mark the injection pump flange to match the mark on the gear housing.

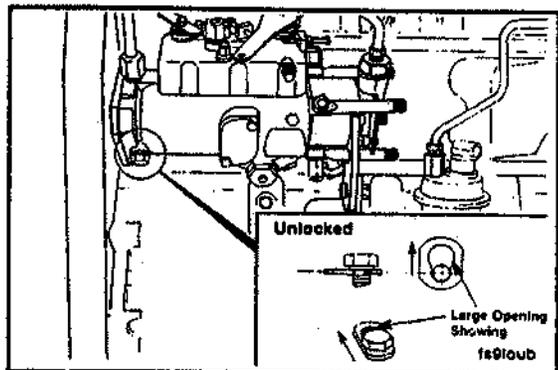


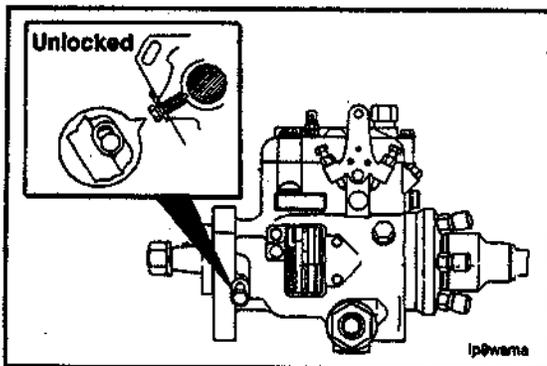
14 mm

Loosen the CAV pump lockscrew and position the special washer behind the lockscrew head.

Tighten the pump lockscrew.

**Torque Value:** 20 N•m [15 ft-lb]



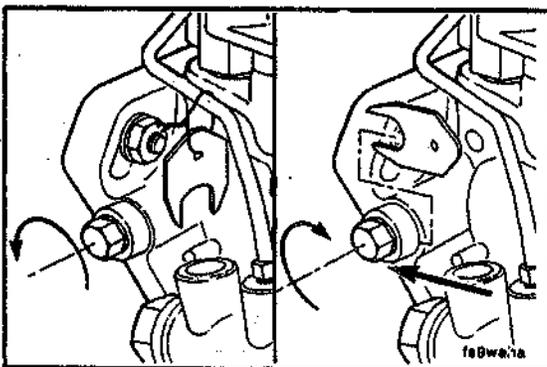


**3/8 Inch**

Loosen the Stanadyne DB4 fuel injection pump lock screw and position the special washer behind the lock screw head.



Tighten the lock screw.



**10 mm**

**NOTE:** On the Bosch pump, the special washer is wired to the pump and must be installed under the lock screw.



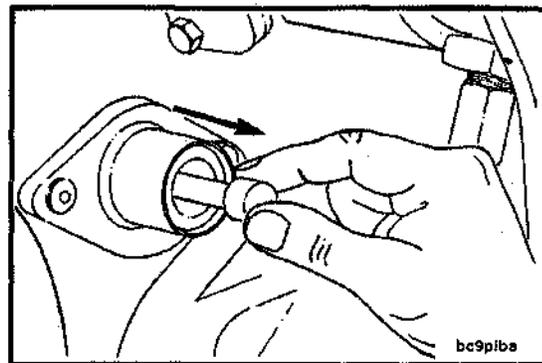
Tighten the pump lock screw.



**Torque value:** 13 N•m [10 ft-lb]

**Section A-Adjustment, Replacement and Repair  
B Series**

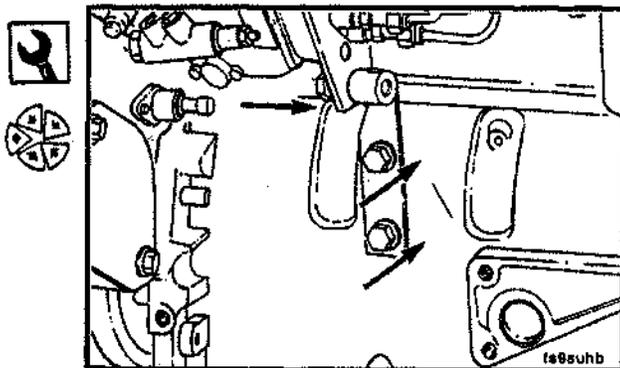
**NOTE:** Be sure to disengage the timing pin.

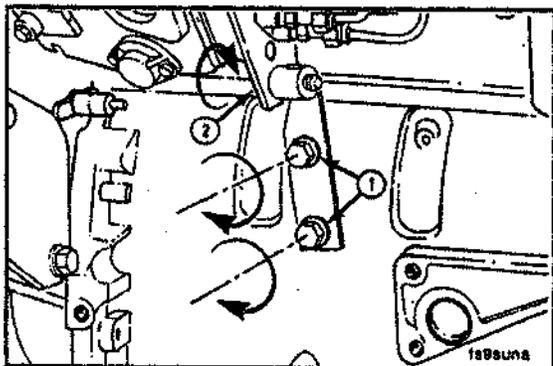


**10 mm**

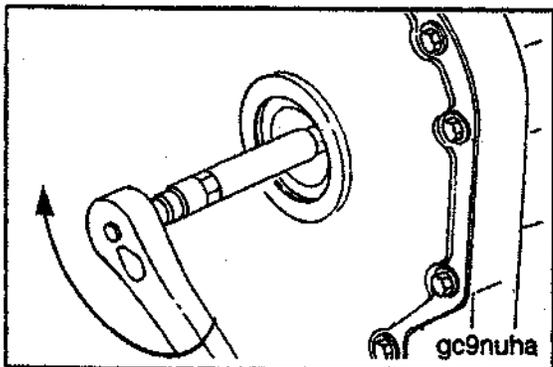
Install the injection pump support bracket. Finger tighten all capscrews before final tightening.

**NOTE:** Tighten the bracket to block mounting capscrew before tightening the bracket to injection pump capscrews.





Torque Value: 24 N·m [18 ft-lb]



22 mm

Tighten the drive gear mounting nut.



Install the access cap.



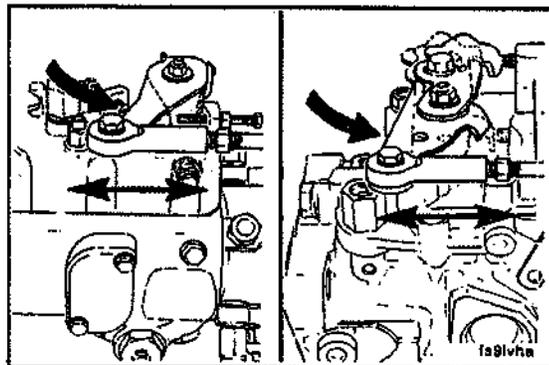
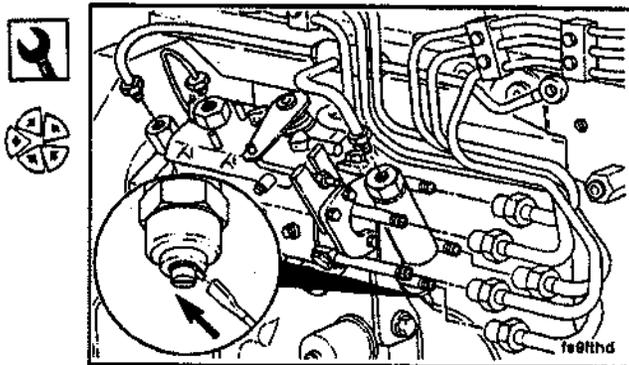
Torque Value: Bosch 60 N·m [48 ft-lb]  
Stanadyne 65 N·m [48 ft-lb]

**Section A-Adjustment, Replacement and Repair  
B Series**

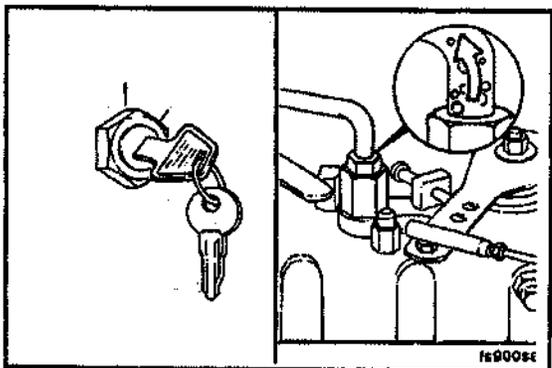
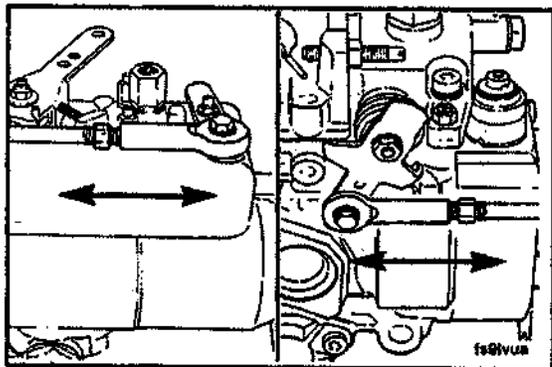
**8 mm**

Install the solenoid wiring and all fuel lines.

**NOTE:** When connecting the cable/rod to the control lever, adjust the length so the lever has stop-to-stop movement.



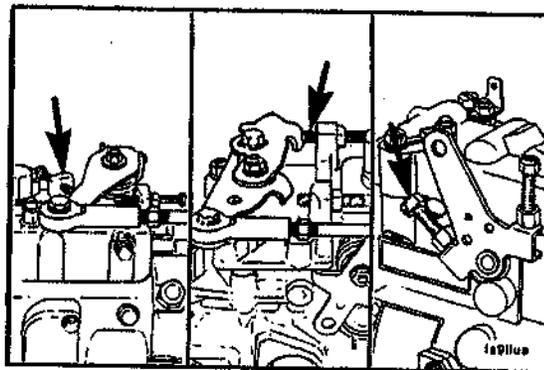
**NOTE:** Similarly adjust the length of the cable/rod to the mechanical shut down lever so there is a stop-to-stop movement.



Bleed all air from the fuel system.

## Section A-Adjustment, Replacement and Repair B Series

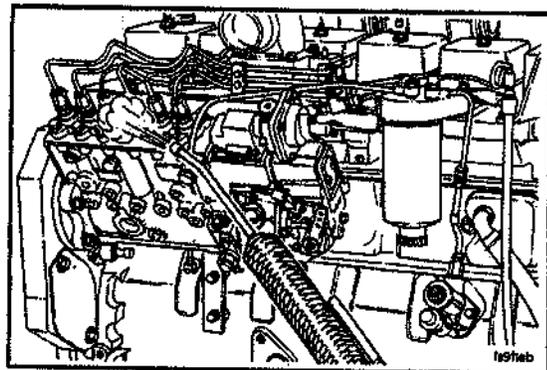
If necessary, adjust the idle speed.



## Fuel System Repair-In-Line Pump

### Fuel system Components-Cleaning

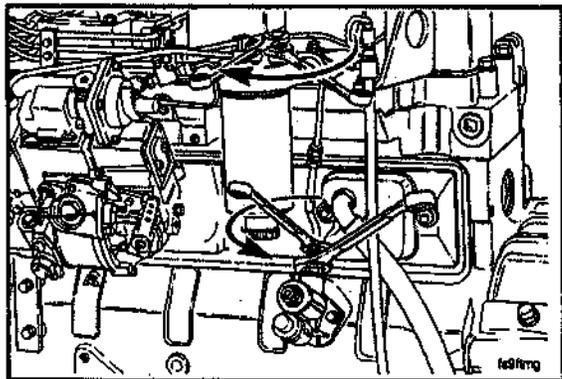
Thoroughly clean all fittings and components before removal. Make sure that the debris, water, steam or cleaning solution does **not** reach the inside of the fuel system.



### Low Pressure Fuel Line-Replacement

#### Preparatory Step:

- Clean debris from fittings



14 mm, 17 mm, 20 mm



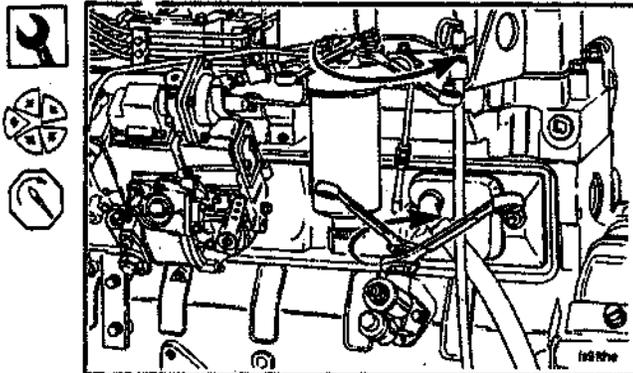
Disconnect the fuel line from the lift pump and filter head.  
Use two wrenches to disconnect the line from the lift pump.

## Section A-Adjustment, Replacement and Repair B Series

14 mm, 17 mm, 20 mm

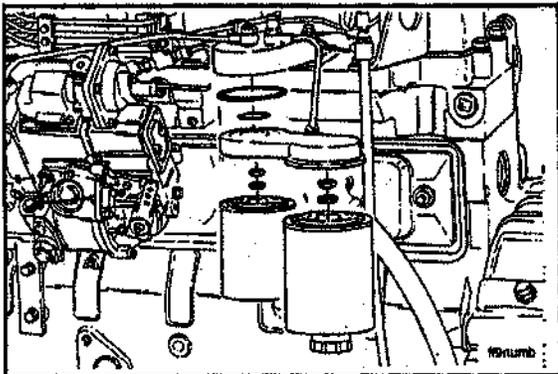
Install the fuel line to the lift pump and filter head. Use two wrenches to tighten the connection to the lift pump.

**Torque Value:** 24 N·m [18 ft-lb]



## Fuel Filter Head Adapter-Replacement Preparatory Steps

- Clean debris.
- Remove fuel filters.



24 mm



Remove the retaining nut, filter head adapter and sealing washers.



Install in the reverse order of removal.



**Torque Value:** 32 N·m [24 ft-lb]



### Lift Pump-Replacement

#### Preparatory Steps:

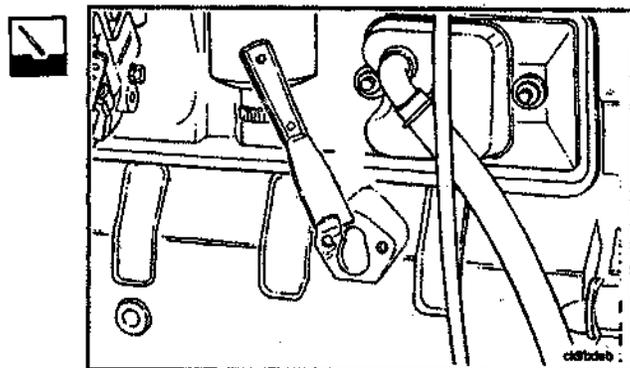
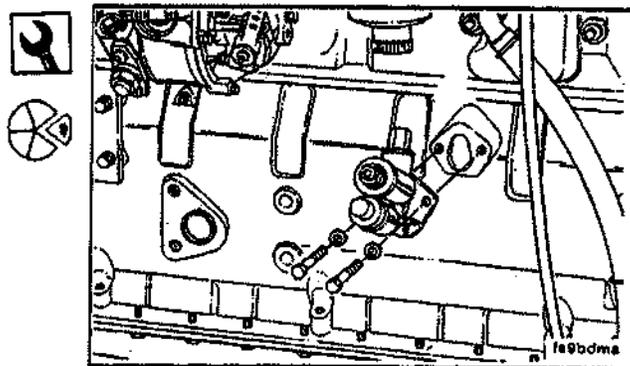
- Clean debris
- Disconnect the fuel lines.

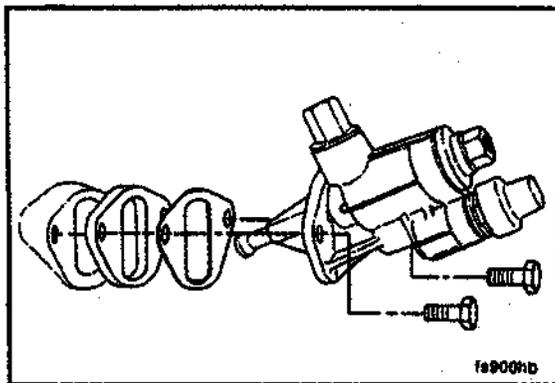
**Section A-Adjustment, Replacement and Repair  
B Series**

**10 mm**

Remove the lift pump.

Clean the mounting surface on the cylinder block.





10 mm



**Caution: Alternately tighten the mounting capscrews. As the capscrews are tightened, the fuel transfer pump plunger is pushed into the pump. Failure to tighten the capscrews in an even manner can result in the plunger being bent or broken.**



Install the pump.

**Torque Value: 24 N·m [18 ft-lb]**

### High Pressure Fuel Lines-Replacement

#### Preparatory Steps:

- Clean debris.

## Section A-Adjustment, Replacement and Repair B Series

8 mm, 17 mm, and 19 mm

**NOTE:** If individual lines are to be replaced, remove the support clamp from the set of lines containing the line to be replaced.

Disconnect the line (s) from the injectors.

19 mm

Disconnect the line (s) from the fuel pump.

**NOTE:** If removed, reinstall the support clamp in the original position and make sure the lines do not contact each other or another component. Install a protective cover on the injectors and fuel delivery valves to prevent the entry of dirt into the system.

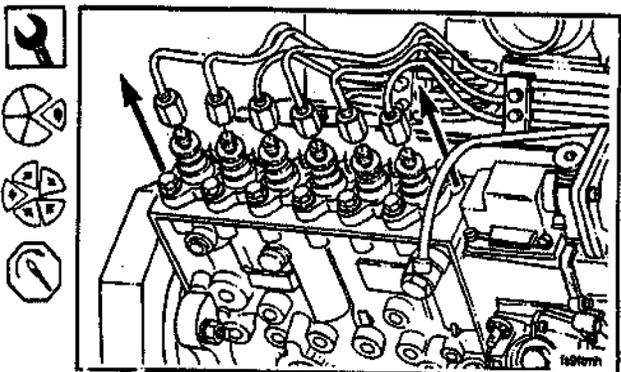
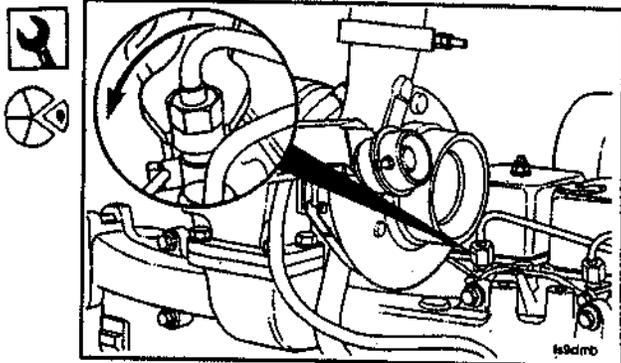
Install the lines in the reverse order of removal.

Torque Value:

(Line Fittings) 30 N•m [22 ft-lb]

(Support Clamp) 6 N•m [4 ft-lb]

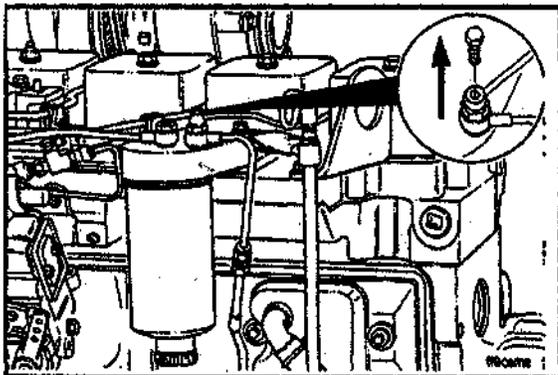
(Support Bracket) 24 N•m [18 ft-lb]



### Fuel Drain Manifold-Replacement

#### Preparatory Steps:

- Clean debris.



10 mm



Remove the drain line banjo cap screw from the fuel filter head. Remove the cap screw from the bracket on the intake cover.

**Section A-Adjustment, Replacement and Repair  
B Series**

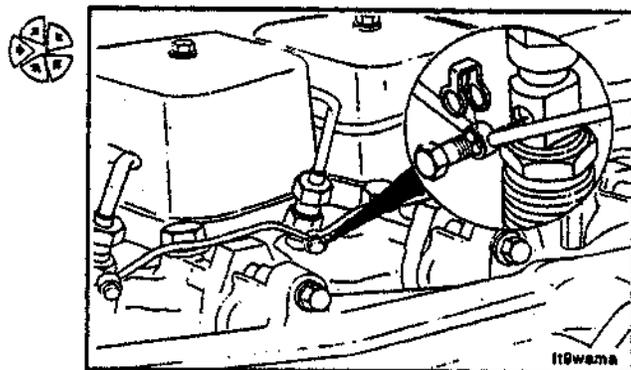
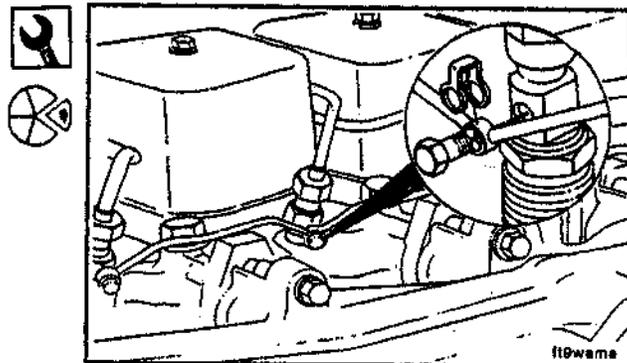
**10 mm**

Remove the banjo capscrews from the injectors.

**NOTE:** Use new seals and sealing washers.  
Assemble the drain line and fuel drain manifold in the reverse order of removal.

**Torque Value:**

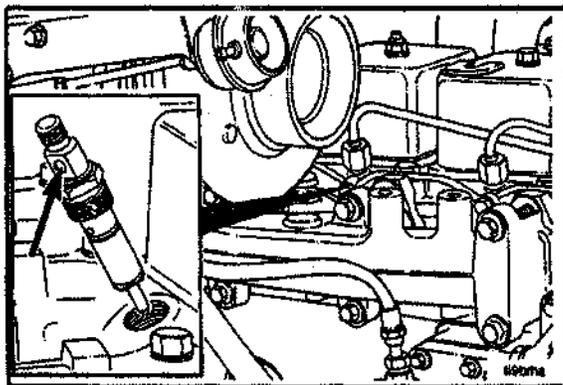
(Banjo fitting screw)	15 N•m	[11 ft-lb]
(Banjo fitting)	9 N•m	[7 ft-lb]
(Bracket Capscrew)	24 N•m	[18 ft-lb]



### Injectors-Replacement

#### Preparatory Steps:

- Thoroughly clean around the injectors.
- Remove the high pressure fuel lines.
- Remove the fuel drain manifold.



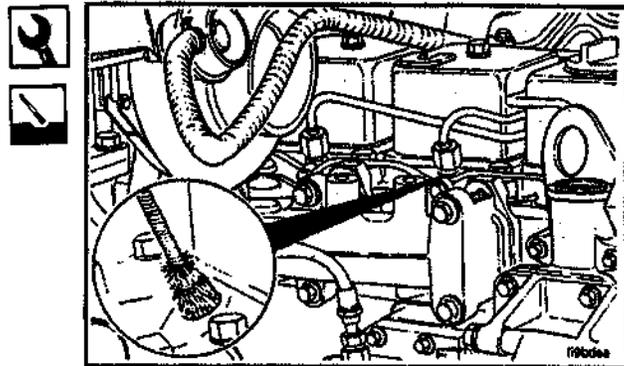
24 mm

Remove the injectors.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

**Injector Bore Brush**

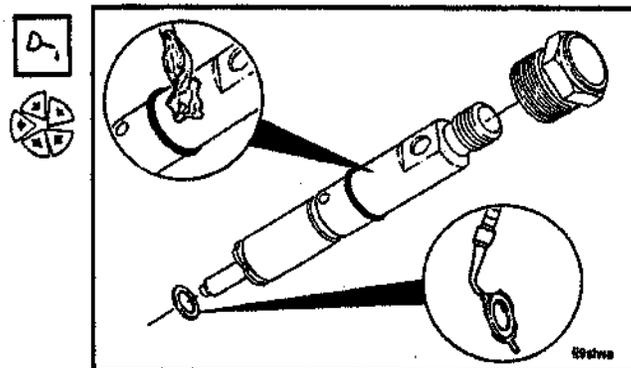
Clean the injector nozzle bore, using Service Tool No. 3822509.

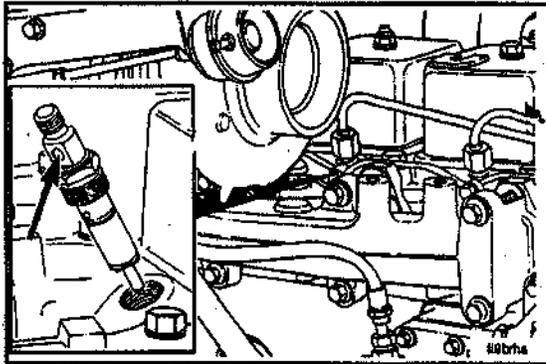


Lubricate the sealing lips of the sleeve with anti-seize compound. Package the injector, sealing sleeve, a new copper sealing washer and the holddown clamp.

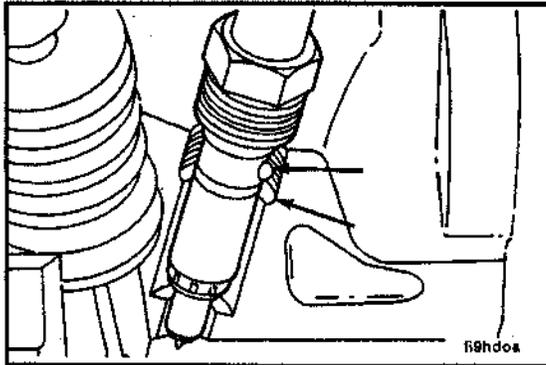
**Use only one washer**

**Service Tip:** A light coat of clean 15W40 engine oil between the washer and injector can help to keep the washer from falling during installation.





Install the injector package into the injector bore. The injector leak off connection **must** be away from the valve cover.



**24 mm**

Tighten the injector nozzle nut. The protrusion on the side of the nozzle fits into a notch in the head to orient the injector.



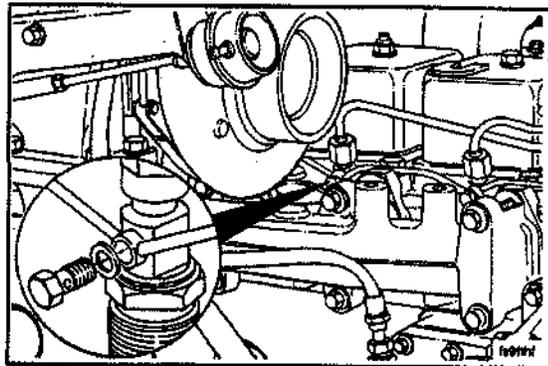
**Torque Value:** 60 N•m [44 ft-lb]

**Section A-Adjustment, Replacement and Repair  
B Series**

**10 mm**

Install the fuel drain manifold.

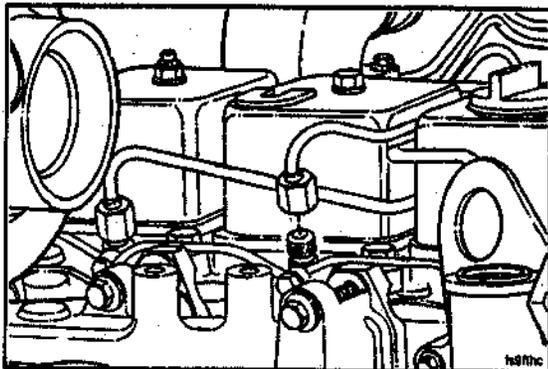
**Torque Value:** 9 N·m [7 ft-lb]



**17 mm, 19mm**

Install the high pressure fuel lines.

**Torque value:** 30 N·m [22 ft-lb]



## Fuel Shutoff Solenoid-Replacement

### Preparatory Steps:

- Label and disconnect the wiring.

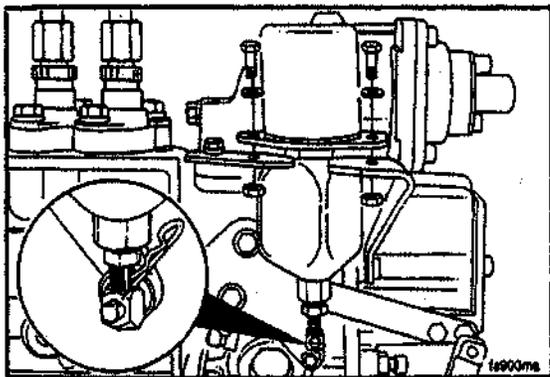
## RQVK Governor Shutoff Solenoid

### 10 mm

Remove the hitch pin clip, mounting capscrews and the fuel shutoff solenoid.

Install the new solenoid in reverse order of removal and connect the wires.

**Torque Value:** 10 N•m [89 in-lb]

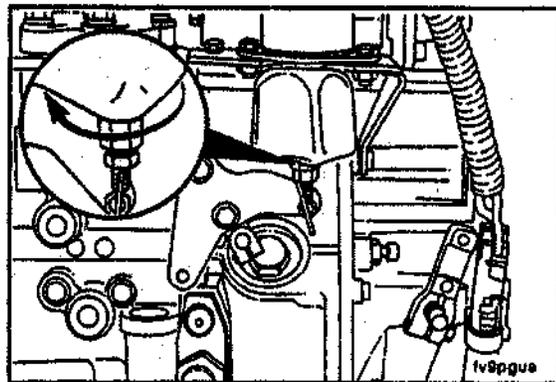


## Section A-Adjustment, Replacement and Repair B Series

10 mm, 16 mm

Adjust the solenoid linkage as necessary so that the plunger is magnetically held in with the shutoff lever in the absolute full run position. Turn the large hex on the end of the plunger to make adjustments.

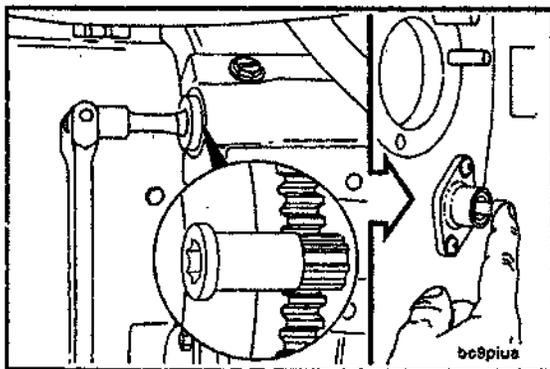
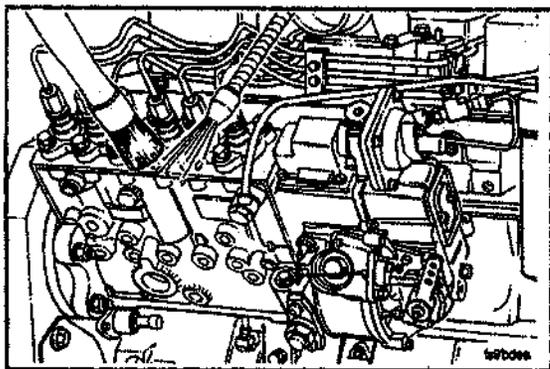
Fuel System Repair-In-Line Pump  
Page A-69



## Injection Pump-Replacement

### Preparatory Steps:

- Clean debris.
- Remove all fuel lines.
- Remove control linkage.
- Remove fuel shutoff solenoid.
- Remove AFC air line
- Remove oil line(s)



## Section A-Adjustment, Replacement and Repair B Series

**NOTE:** A diesel engine can **not** tolerate dirt or water in the fuel system. A tiny piece of dirt or a few drops of water in the injection system may stop your units.



Clean all external surfaces of the injection pump, including all line connections and fittings that are to be disconnected. Clean the area around the injection pump gear cover to prevent dirt from entering the crankcase.

### Injection Pump-Removal



#### 3377371 Engine Barring Gear

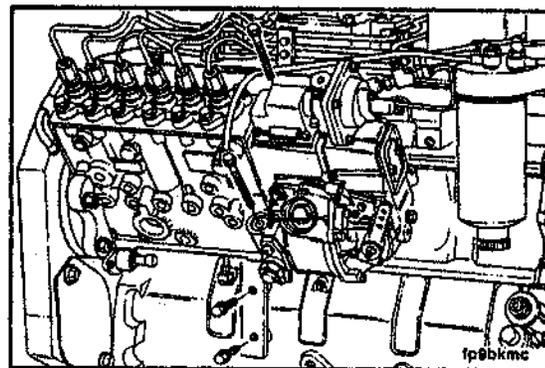
Locate TDC for cylinder No. 1. Push the TDC pin into the hole in the camshaft gear while slowly barring the engine.

**NOTE:** Be sure to disengage the pin after locating TDC.

**Section A-Adjustment, Replacement and Repair  
B Series**

**10 mm**

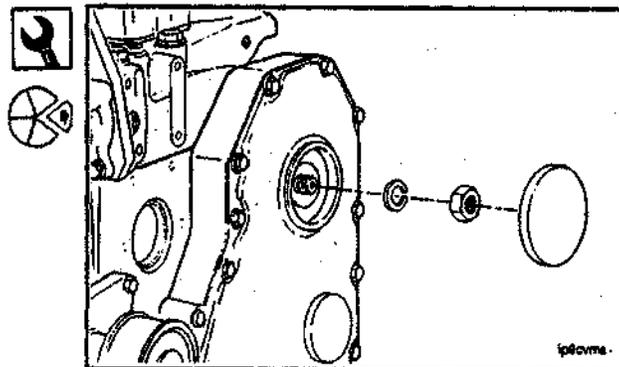
Remove the fuel pump mounting bracket.



**30 mm (P7100 Pump)**

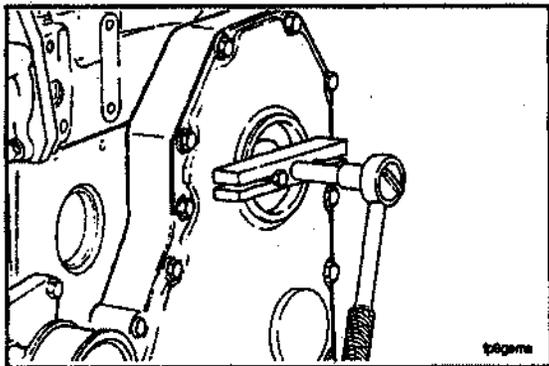
Remove the gear cover access cap.

Remove the nut and washer from the fuel pump shaft.



75 mm T-Bar Puller

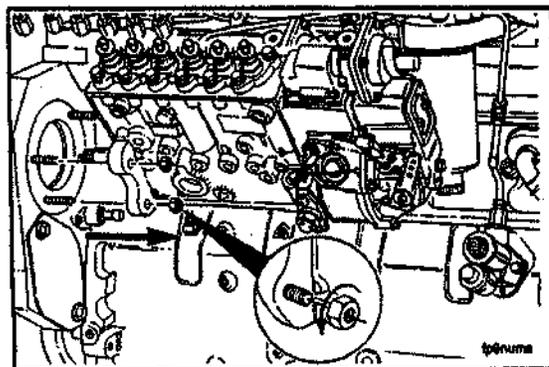
Pull the fuel pump drive gear loose from the shaft.



15 mm

Remove the four mounting nuts.

Remove the fuel pump.

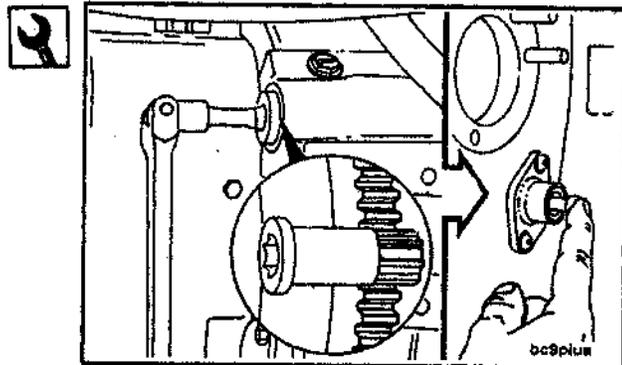


**Section A-Adjustment, Replacement and Repair  
B Series**

**Injection Pump-Installation**

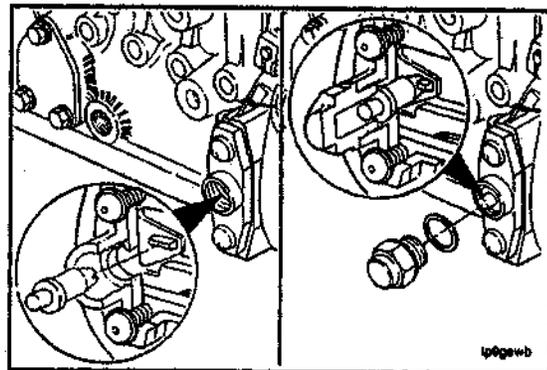
**3377371 Engine Barring Gear**

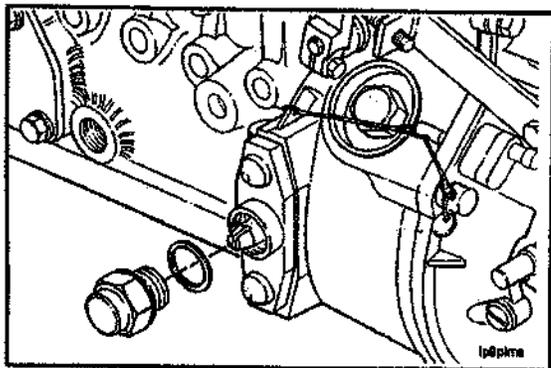
Make sure the engine has cylinder No. 1 at TDC.



**Injection Pump-Timing**

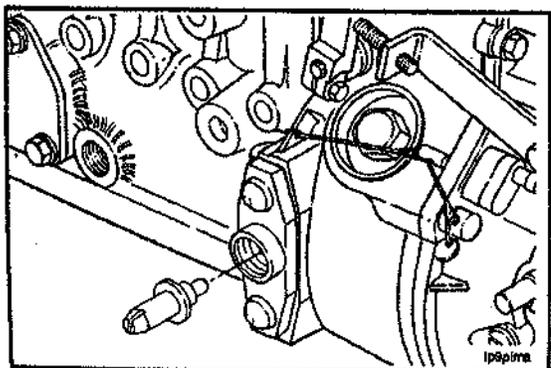
The injection pump also has a timing pin, located in the governor housing, to position the pump shaft to correspond with TDC for cylinder No. 1.





24 mm

Remove the access plug.



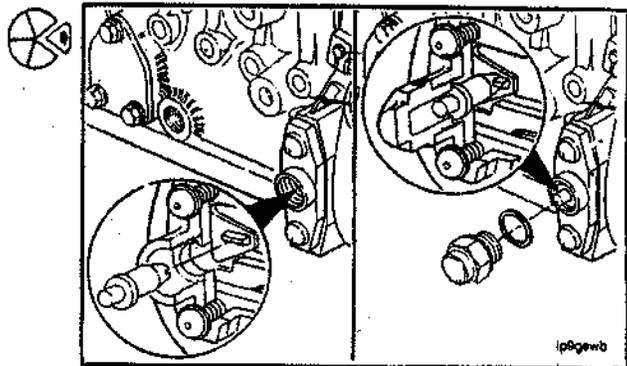
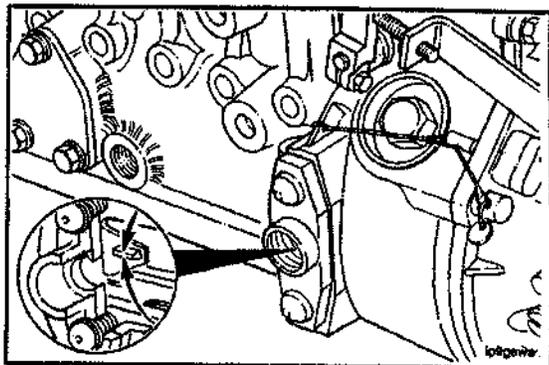
Remove the timing pin.

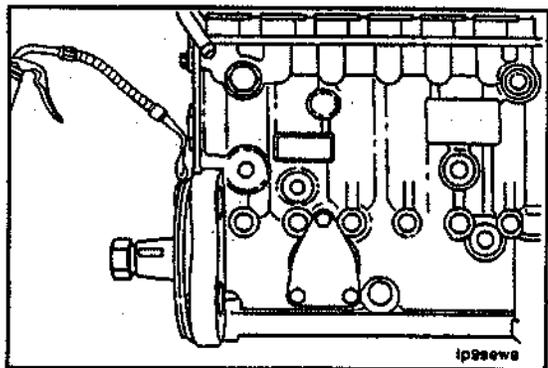
## Section A-Adjustment, Replacement and Repair B Series

If the timing tooth is **not** aligned with the timing pin hole, rotate the pump shaft until the timing tooth aligns.

Reverse the position of the pin so the slot of the pin will fit over the timing tooth in the pump.

Install and secure the pin with the access plug.



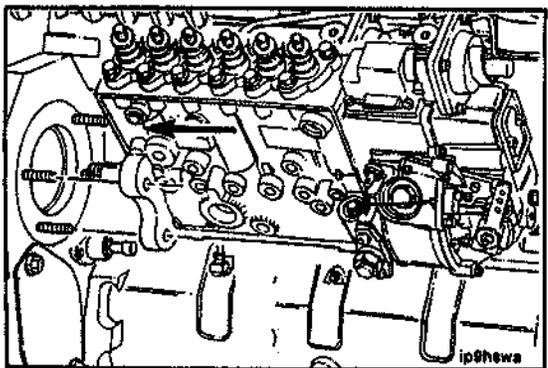


Lubricate the mounting flange of the fuel injection pump with clean engine oil.



**Caution:** The fuel pump drive gear inside diameter and the shaft outside diameter must be clean and dry before installing the shaft into the gear.

**NOTE:** The P7100 fuel injection pump driveshaft has a provision for a Woodruff key, however, it is not required. Timing mark alignment is not required for the P7100 drive gear.



Slide the pump shaft through the drive gear and position the pump flange onto the mounting studs.

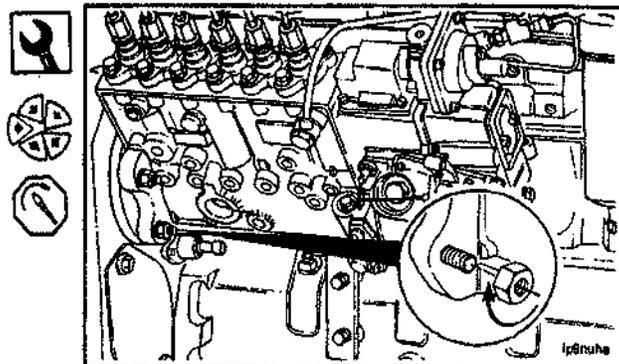
Push the pump forward until the mounting flange and o-ring are properly fitted into the gear housing bore.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

**15 mm**

Install the mounting nuts.

**Torque Value:** 43 N·m [32 ft-lb]

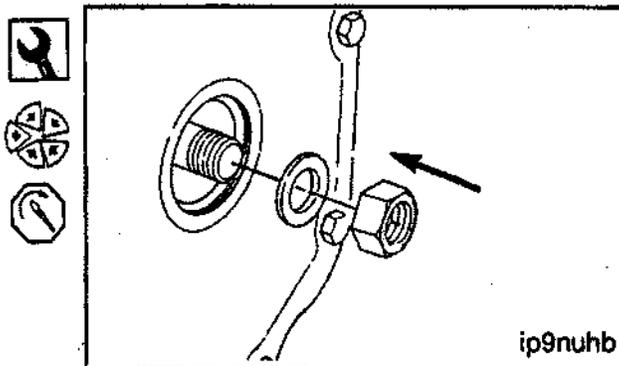


**30 mm (P7100 Pump)**

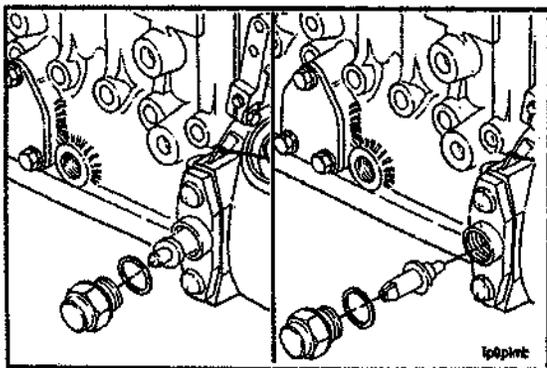
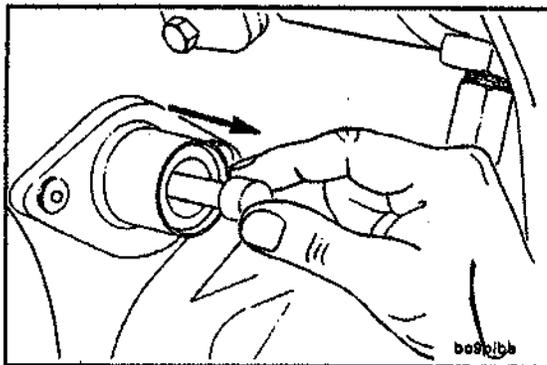
Install the retaining nut and washer.

**Torque Value:** 10 to 15 N·m [7 to 11 ft-lb]

**NOTE:** Do not exceed the torque value given. This is not the final torque value for the retaining nut.



Disengage the engine timing pin.



24 mm



Remove the fuel pump timing pin plug. Reverse the position of the pin and install the pin, plug, and sealing washer.



**Torque Value:** 15 N·m [11 ft-lb]



**Section A-Adjustment, Replacement and Repair  
B Series**

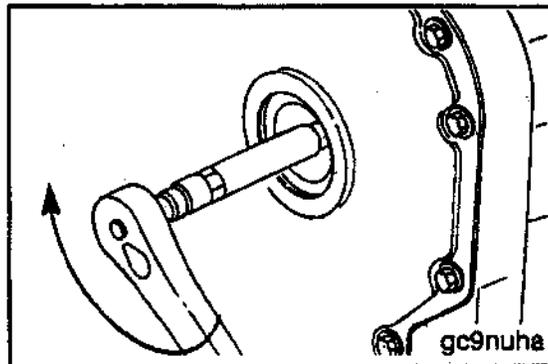
**22 mm or 27 mm**

Tighten the fuel pump drive nut.

**Torque Value:**

**P7100 Pump, 165 N·m [122 ft-lb]**

Install the gear cover access cap hand tight.

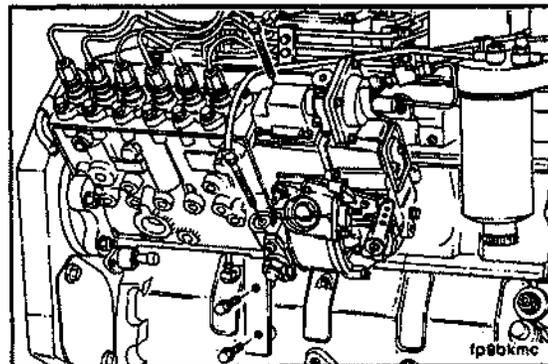


**10 mm**

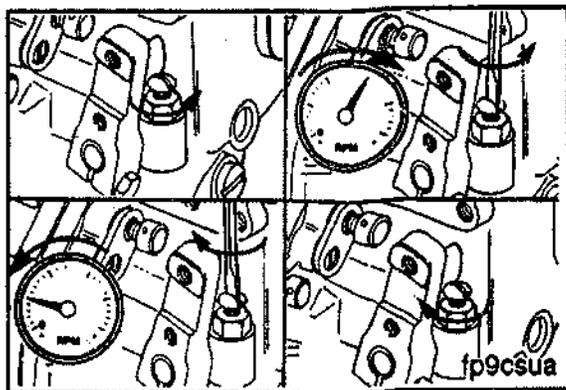
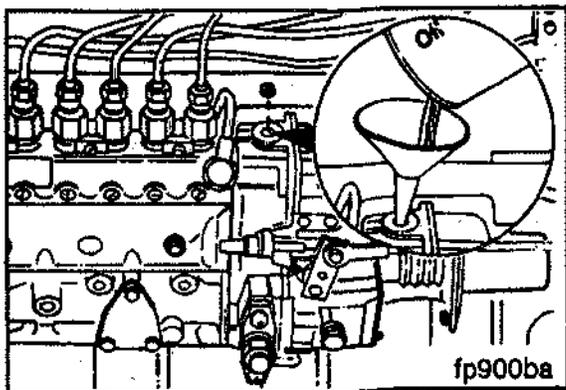
Install the fuel pump mounting bracket capscrews finger tight.

To make sure the alignment is correct, tighten the support mounting capscrews.

**Torque Value: 24 N·m [18 ft-lb]**



## Injection Pump-Idle speed Adjustment Page A-80



## Section A-Adjustment, Replacement and Repair B Series



### 10 mm Hex Drive



**Caution:** If a replacement or repaired pump was installed, be sure to fill the governor housing with engine oil before starting the engine. Failure to do so will result in damage to the governor fly weights.

Remove the access plug.

### Oil Capacity

Oil Capacity	
RQVK Governor	750 ML [0.71 Qt]

Install the access plug.

**Torque Value:** 28 N·m [21 ft-lb]

## Injection Pump-Idle Speed Adjustment

### RQVK Governor



### 10 mm Screwdriver and Tachometer

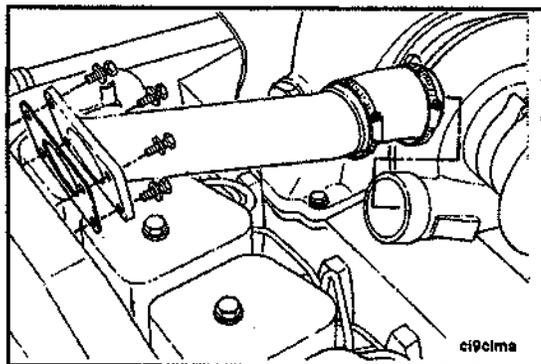
Idle adjustment on automotive pumps requires setting of the stop screw.

Loosen the locknut and turn the screw counterclockwise to raise the RPM; clockwise to decrease the idle speed. Tighten the lock screw.

## **Air System Repair Summary**

<b>Component To Be Replaced</b>	<b>Tools</b>	<b>Preparatory Steps*</b>
Air Crossover Tubing	8 mm and Common Screwdriver and Torque Wrench	
Intake Manifold Cover and Gasket	10 mm Socket	Remove high pressure fuel lines, disconnect cold starting aid, if used, and air crossover tubing.
Aftercooler and Gasket	8 mm, 10 mm Socket	Disconnect Cold Starting aid if used, remove air crossover tube and drain coolant.
Turbocharger and/or Gasket	10 mm, 15 mm, 16 mm, 7/16-Inch Wrenches	Disconnect intake and exhaust piping and remove crossover tubing.
Exhaust Manifold and/or Gasket	15 mm Socket	Disconnect intake and exhaust piping, remove air crossover tube and remove the turbocharger.

\*Removal of some chassis parts may be necessary to gain access to some engine components. Follow the equipment manufacturer's procedures and precautions for removing chassis parts.



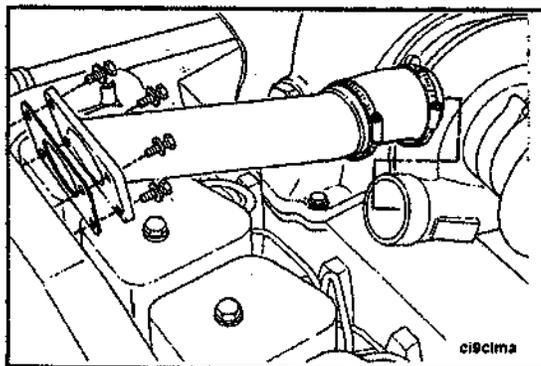
### **Air System Repair**

#### **Air Crossover Tube-Replacement**



**8 mm or Screwdriver**

Loosen the hose clamps and position the hose so the crossover tube can be removed.



**8 mm or Screwdriver**

Use new hose and clamps as required to install the crossover tube.



**Torque Value: 8 N·m [6 ft-lb]**



**Section A-Adjustment, Replacement and Repair  
B Series**

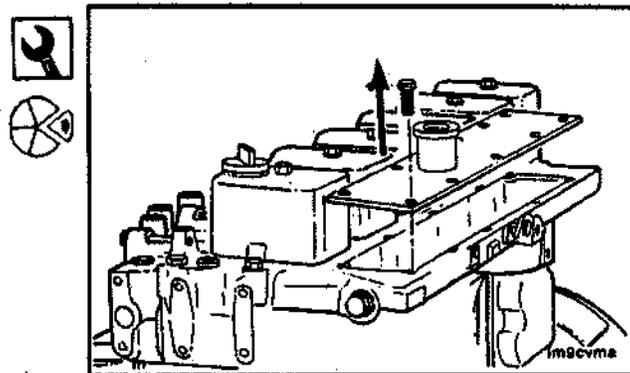
**Intake Manifold Cover and Gasket-Replace-  
ment**

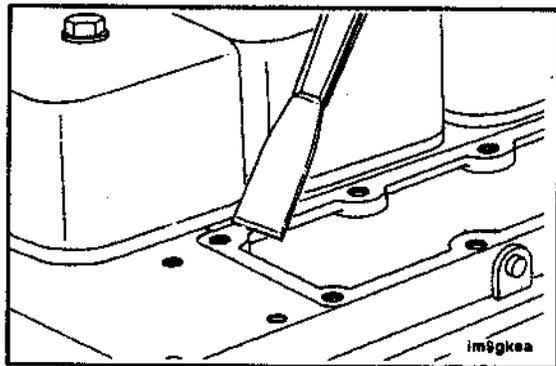
**Preparatory Steps:**

- Remove the high pressure fuel lines.
- Disconnect the cold starting aid,if used.
- Remove the air crossover tube(Industrial).

**10 mm**

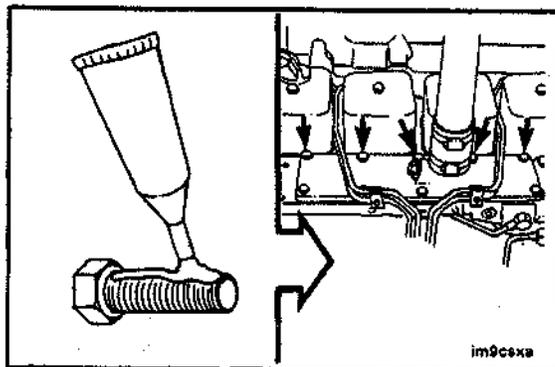
Remove the manifold cover and gasket.





Clean the sealing surface.

**NOTE:** Keep the gasket material and any other material out of the air intake.



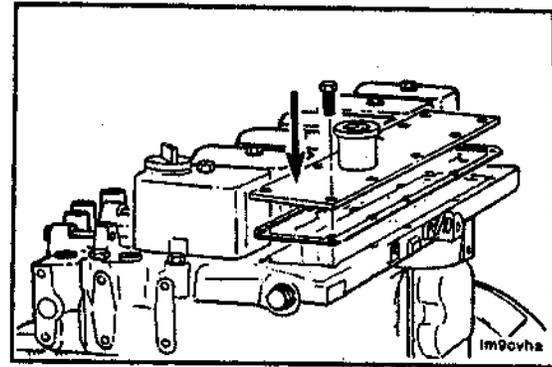
**NOTE:** The holes shown in the illustration are drilled through and must be sealed by applying liquid teflon sealant to the cap screws.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

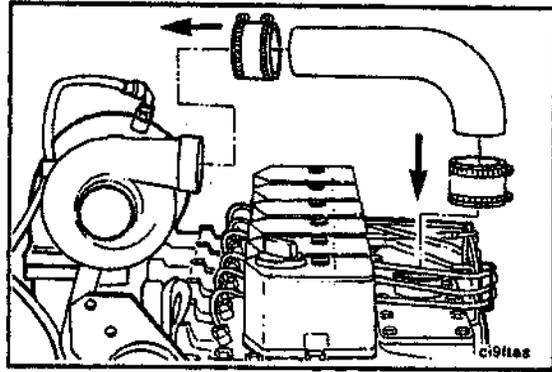
**10 mm**

Install the cover and a new gasket.

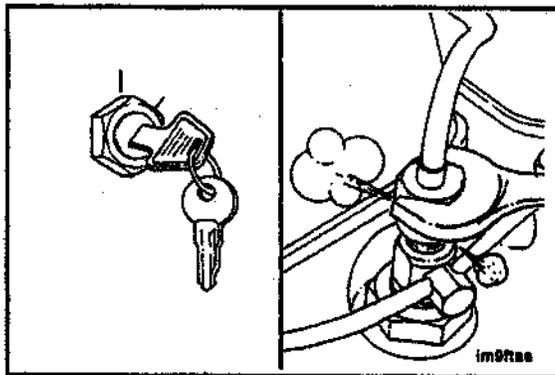
**Torque Value:** 24 N·m [18 ft-lb]



Assemble the intake piping and connect the cold starting aid if used.



Install and bleed the high pressure fuel lines.



### **Jacket-Water Aftercooler and Gasket- Replacemet**

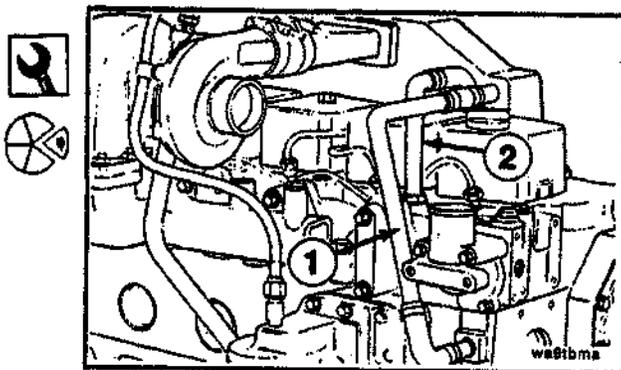
#### **Preparatory Steps:**

- Disconnect the cold starting aid , if used.
- Remove the air crossover tube.
- Remove high pressure fuel lines.
- Drain 2 liters (2.1 U.S. Quarts) of coolant.

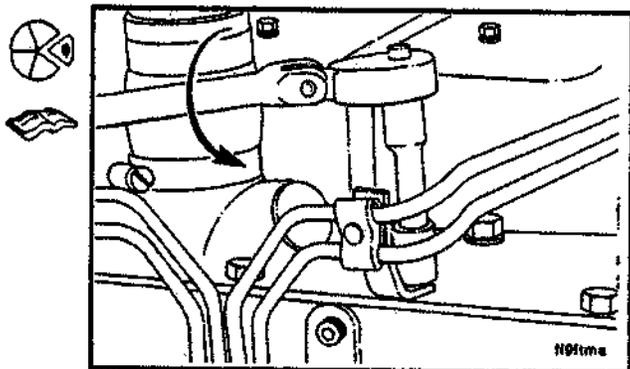
**Section A-Adjustment, Replacement and Repair**  
**B Series**

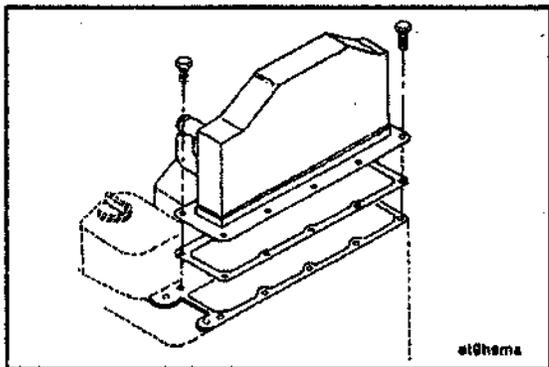
**8 mm**

Remove the coolant supply tube (1) and the coolant return tube (2).



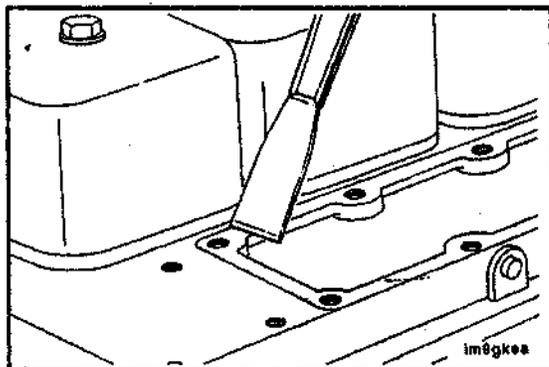
Remove the high pressure fuel lines (reference page 10-25).





10 mm

Remove the aftercooler housing and gasket.



Clean the sealing surface.

**NOTE:** Keep the gasket material and any other material out of the air intake.

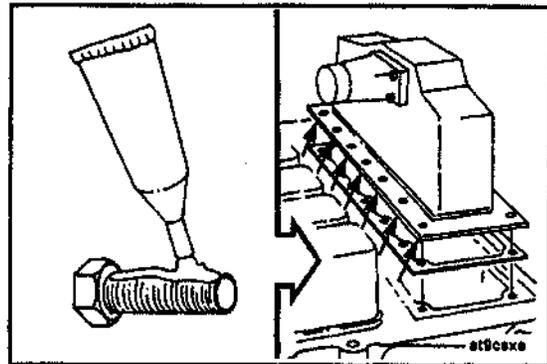
**Section A-Adjustment, Replacement and Repair**  
**B Series**

**10 mm**

**NOTE:** The holes shown in the illustration are drilled through. Apply liquid teflon sealant to the capscrews.

Install the aftercooler housing and a new gasket.

**Torque Value:** 24 N·m [18 ft-lb]

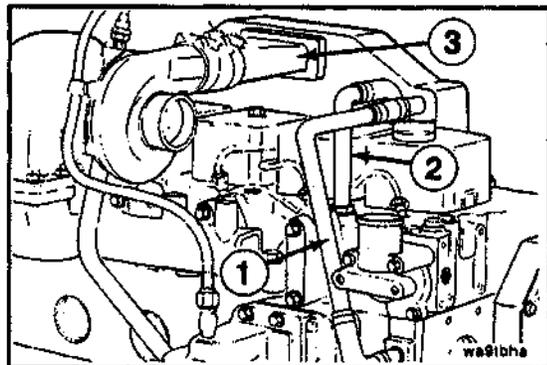


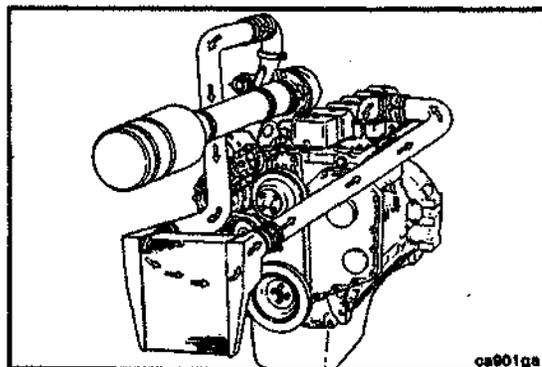
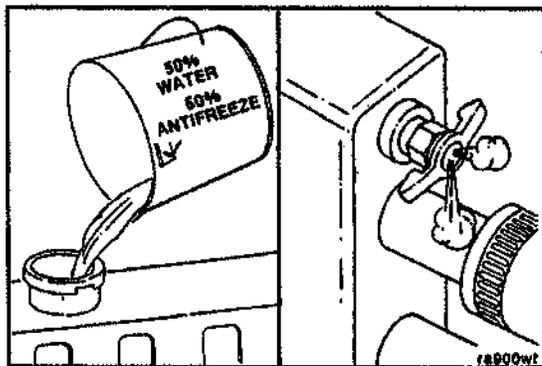
**8 mm**

Install the coolant supply tube (1) and coolant return tube (2). Install the air crossover tube (3).

Reinstall and bleed the high pressure fuel lines.

**Torque Value:** 8 N·m [6 ft-lb]





**Caution:** The system must be filled slowly to prevent air locks. Be sure to open the engine and aftercooler vents to allow air to escape as the system is filled.

Fill the coolant system with a mixture of 50% water and 50% ethylene-glycol type antifreeze.

### **Charge Air Cooler-Leak Check**

**NOTE:** The long term integrity of the charge air cooler system is the responsibility of the vehicle and component manufacturers; however, the following symptoms can be checked by any Cummins Authorized Repair Location:

## Section A-Adjustment, Replacement and Repair B Series

Air System Repair  
Page A-91

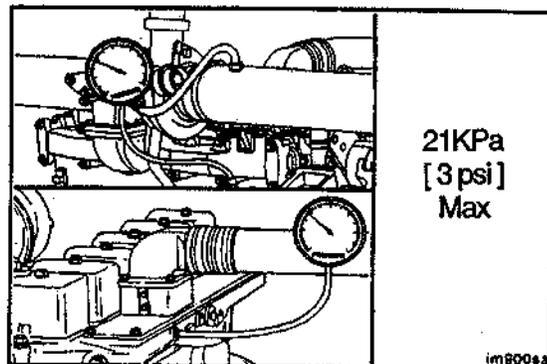
### Intake Manifold Pressure-Check

Install pressure gauge, Part No. ST-1273, to the fitting in the turbocharger outlet.

Install another pressure gauge, Part No. ST-1273, in the intake manifold.

Operate the engine at rated RPM and load. Record the readings on the two gauges.

If the differential pressure is greater than 21 kPa [3 psi], check the charge air cooler for plugging. Clean or replace if necessary.

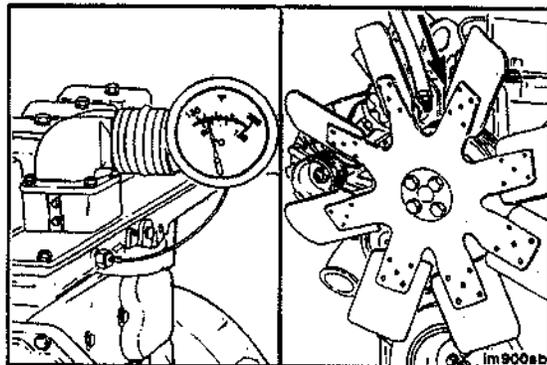


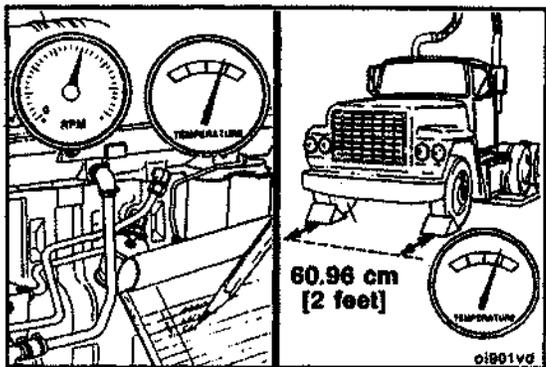
### Intake Manifold Temperature-Check

Install a temperature gauge in the intake manifold.

Lock the fan drive in the ON mode to prevent erratic test results. This can be done by installing a jumper across the temperature switch or supplying shop air to the fan. Refer to the fan drive manufacturer for lock-up procedure.

**NOTE:** Some trucks have a manual switch that will lock on the fan.





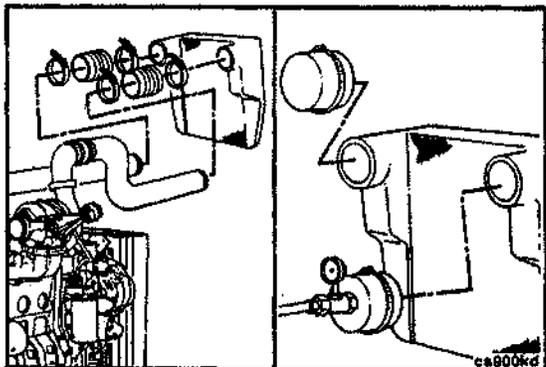
Operate the engine at rated RPM and load. Record the intake manifold temperature.



Measure the ambient temperature at least two feet in front of the vehicle.

The maximum temperature differential **must not** be greater than 25°C [45°F].

If the temperature differential is greater than 25°C [45°F] check the charge air cooler for dirt and debris on the fins, and clean as necessary. If the problem still exists, check the cooler for internal contamination or plugging.



To check the charge air cooler or cracked tubes or header, remove the inlet and outlet hoses from the cooler.

Remove the charge air cooler.

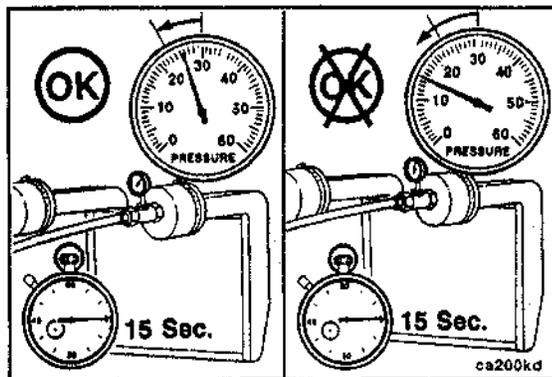
Install a cap over the outlet side of the cooler. Install a pressure gauge and a shop air supply line to the inlet side of the cooler.

## Section A-Adjustment, Replacement and Repair B Series

Apply 276 kPa [40 psi] of air pressure to the cooler. If the pressure drop is 35 kPa [5 psi] or less in 15 seconds, the cooler is okay.

If the pressure drop is greater than 35 kPa [5 psi] in 15 seconds, the charge air cooler **must** be repaired or replaced. Refer to the CAC manufacturer for repair instructions.

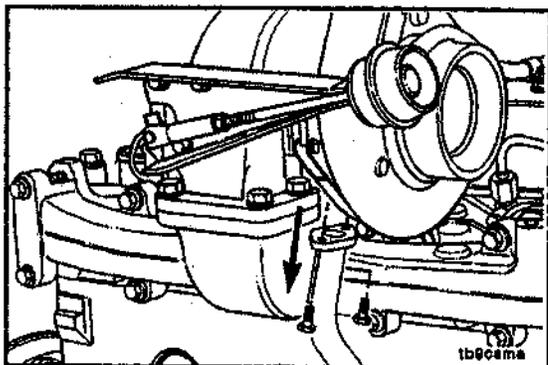
**NOTE:** A leak tank can be used to locate the air leak.



## Turbocharger-Replacement

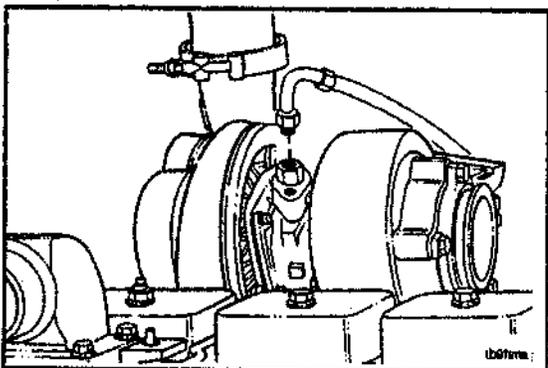
### Preparatory Steps:

- Remove the air crossover tube.
- Disconnect the intake and exhaust piping.



10 mm

Remove the capscrews from the oil drain tube.



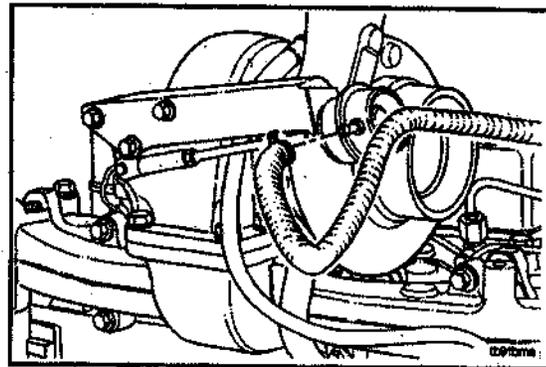
16 mm

Remove the oil supply line.



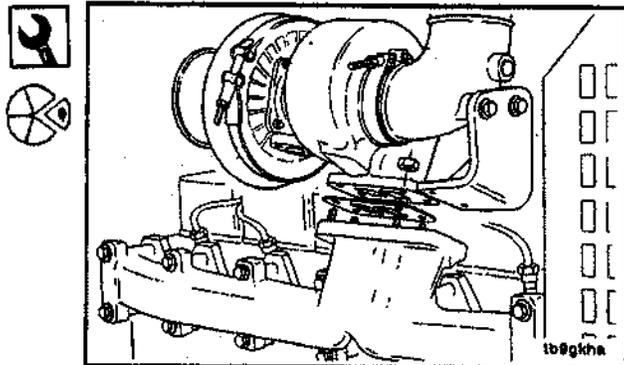
**Section A-Adjustment, Replacement and Repair  
B Series**

If equipped with a wastegate turbocharger, remove the intake manifold pressure supply line from the boost capsule.

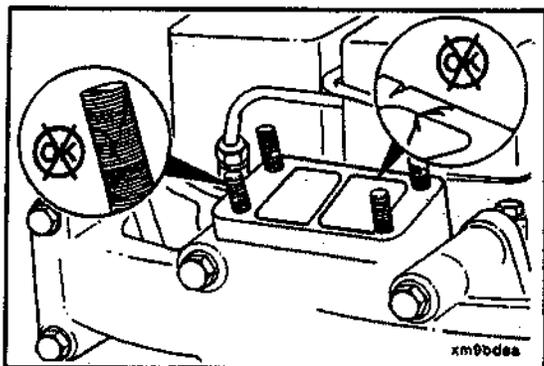


**15 mm and 11 mm**

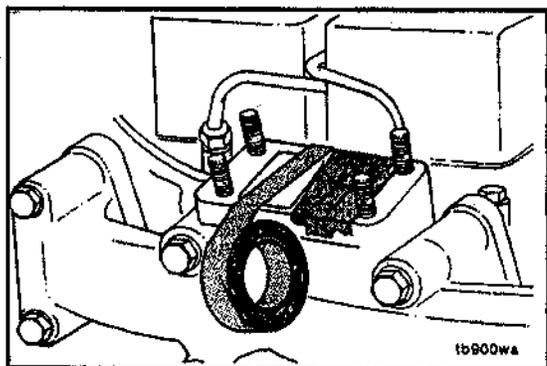
**Remove the exhaust clamp, turbocharger, and gasket.**



Section A-Adjustment, Replacement and Repair  
B Series



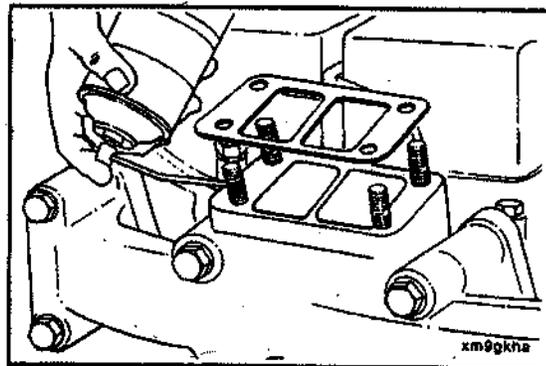
Clean the sealing surface. Inspect the sealing surface and mounting studs for damage.



**NOTE:** If the turbocharger is not be immediately replaced, cover the opening to prevent any material from falling into the manifold.

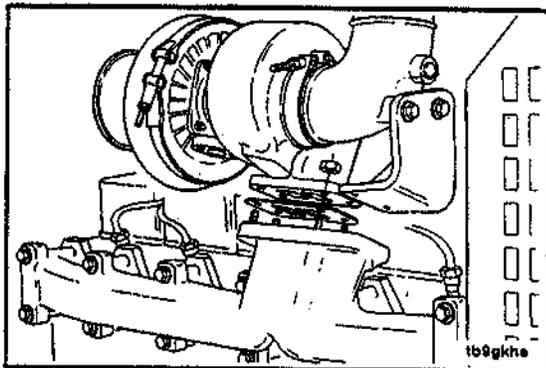
**Section A-Adjustment, Replacement and Repair**  
**B Series**

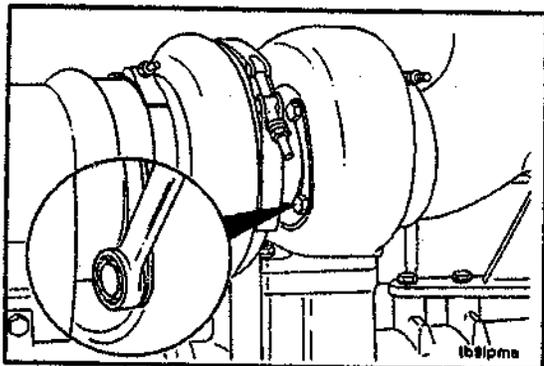
Install a new gasket and apply anti-seize compound to the mounting studs.



**15 mm**

Install the turbocharger and a new gasket.  
**Torque Value:** 32 N·m [24 ft-lb]

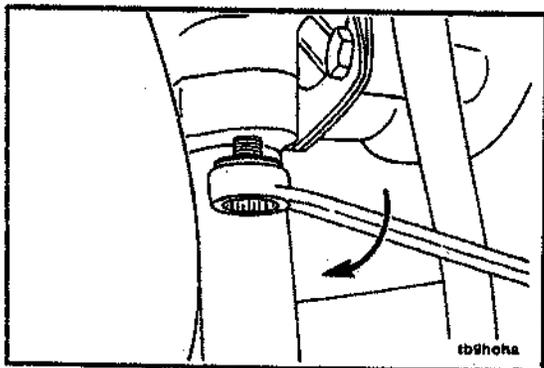




13 mm



If required, bend the lockplates back and loosen the turbine housing capscrow and position the bearing housing to install the turbocharger drain tube.



13 mm



Install the hose and clamps on the turbocharger drain tube loosely. Install the drain tube and gasket on the turbocharger.

**Torque Value:** 24 N•m [18 ft-lb]

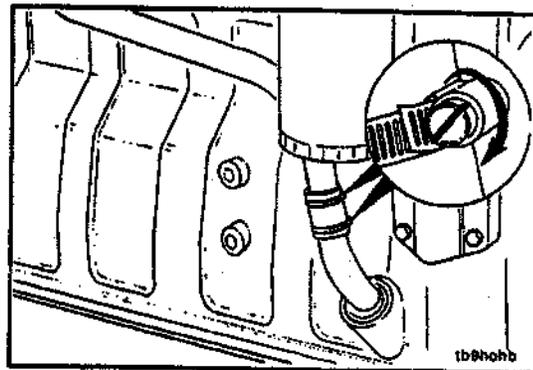


## Section A-Adjustment, Replacement and Repair

### B Series

#### Screwdriver

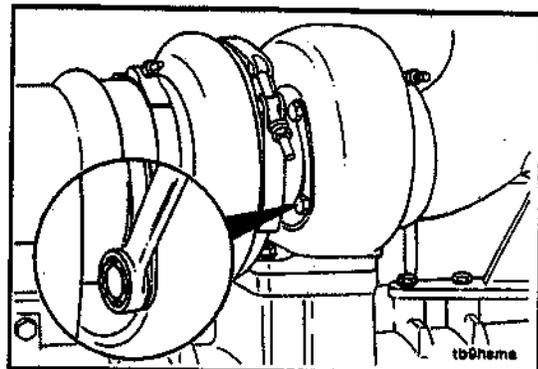
Position the turbocharger drain hose to connect the drain tubes; tighten the clamps.

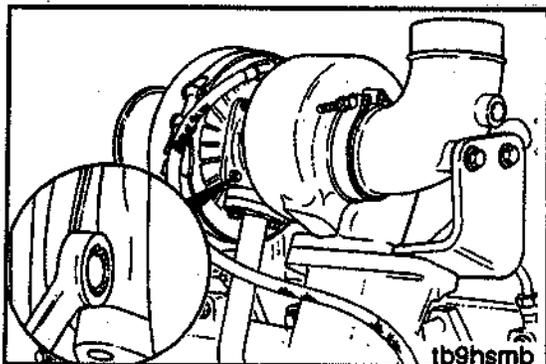


#### 13 mm, Punch, Hammer

If loosened, tighten the turbine housing capscrews. Bend the lockplates onto the flats to prevent loosening.

**Torque Value:** 11.3 N·m [8 ft-lb]



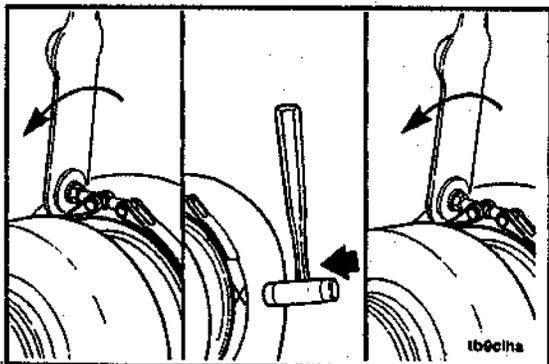


10 mm

If required, loosen the compressor housing and position the housing to align with the crossover tube.



**Torque Value:** 5.7 N•m [50 in-lb]



Tighten the band clamp to 5.7 N•m [50 in-lb]. Tap around the clamp with a plastic hammer and tighten again to 5.7 N•m [50 in-lb].

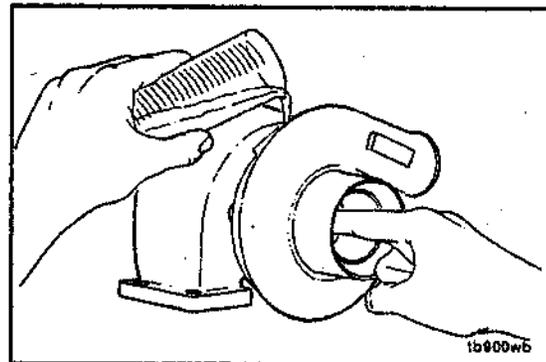


**Section A-Adjustment, Replacement and Repair**  
**B Series**

**Caution:** To prevent bearing damage new turbochargers must be prelubricated before start-up.



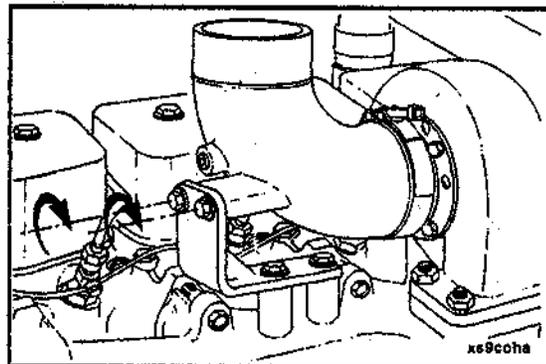
Pour 50 to 60 [2 to 3 ounces] of clean engine oil into the oil supply fitting. Rotate the turbine wheel to allow the oil to enter the bearing housing.

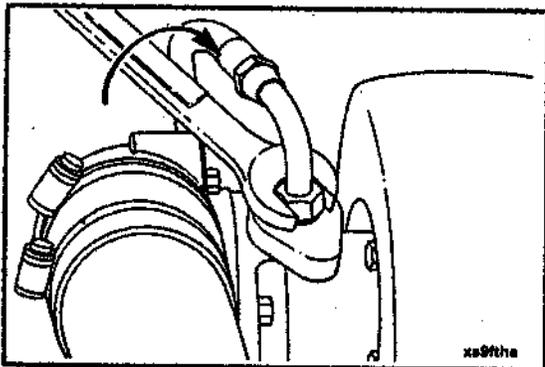


Install the exhaust outlet connection.

Do not tighten the two mounting capscrews until the band clamp has been tightened.

**Torque Value:** Band Clamp-8 N·m [6 ft-lb]  
Capscrews - 43 N·m [32 ft-lb]



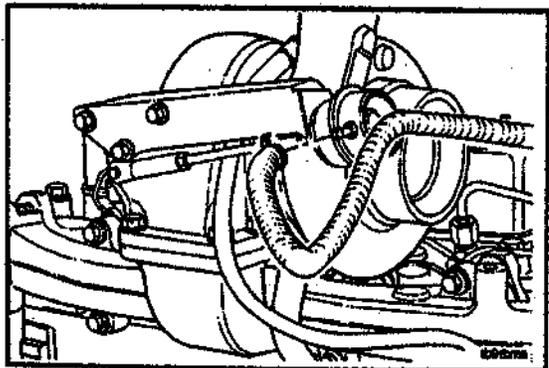


16 mm

Install the oil supply line.

**Torque Value:** 15 N·m

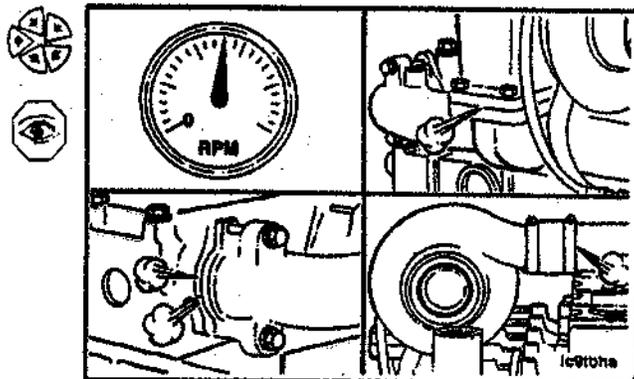
[11 ft·lb]



If equipped with a wastegate turbocharger, install the intake manifold pressure supply line from the boost capsule.

## Section A-Adjustment, Replacement and Repair B Series

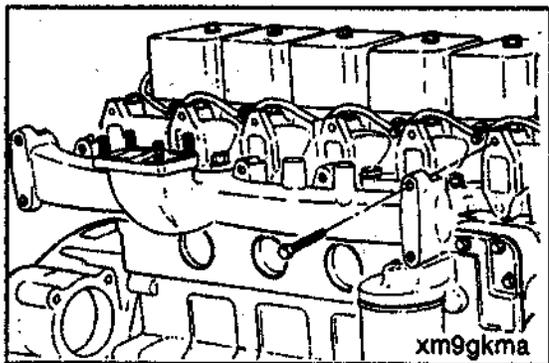
Install the air crossover tube, inlet and exhaust piping.  
Operate the engine and check for leaks.



### Exhaust Manifold and Gaskets -Replacement

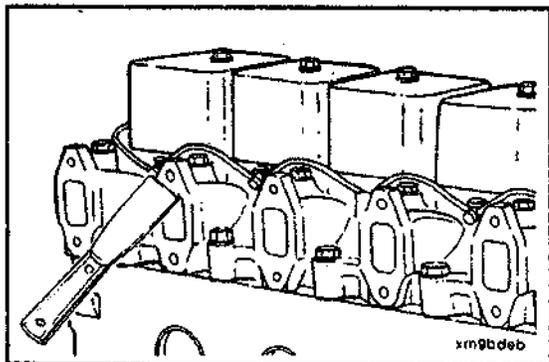
#### Preparatory Steps:

- Remove the air crossover tube.
- Disconnect the air intake and exhaust piping.
- Remove the turbocharger,if used.



15 mm

Remove the exhaust manifold and gaskets.



Clean the sealing surfaces.

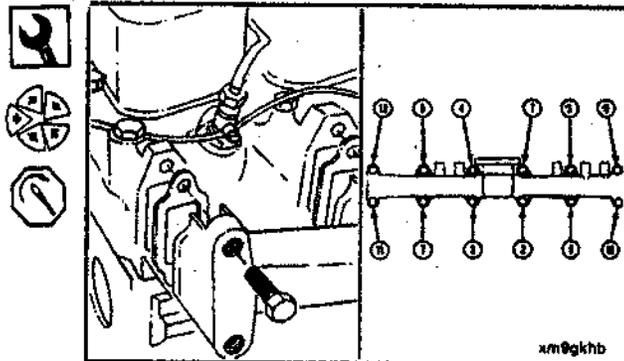
**Section A-Adjustment, Replacement and Repair**  
**B Series**

15 mm

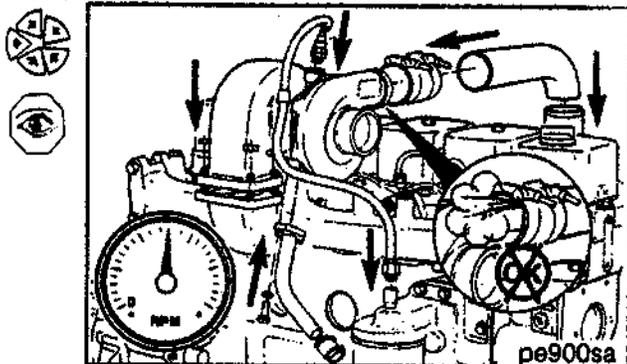
Install the exhaust manifold and new gaskets.

**Torque Value:** 43 N·m [32 ft-lb]

Follow the tightening sequence shown in the illustration. Then, follow the same sequence and tighten the capscrews again to the same torque values.



Install the parts previously removed. Operate the engine and check for leaks.



**Lubricating System Repair Summary**

<b>Component To Be Replaced</b>	<b>Tools</b>	<b>Preparatory Steps</b>
Oil Pressure Regulator Valve and/or Spring	Ratchet, 22 mm Socket and Torque Wrench	Clean debris.
Oil Cooler Element and/or Gaskets	16 mm Wrench, Ratchet, 10 mm Socket and Torque Wrench	Drain Coolant. Remove the oil filter.

## **Lubricating System Repair**

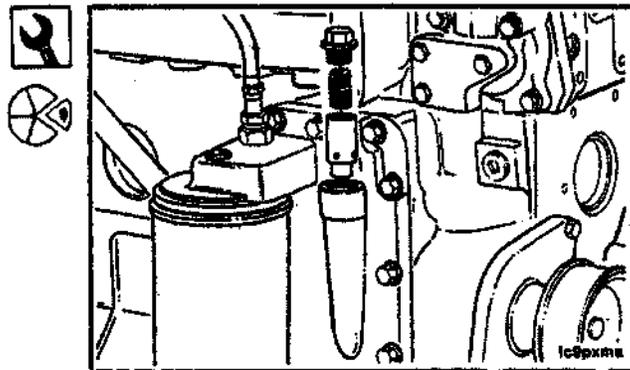
### **Oil Pressure Regulator, Valve and Spring Replacement.**

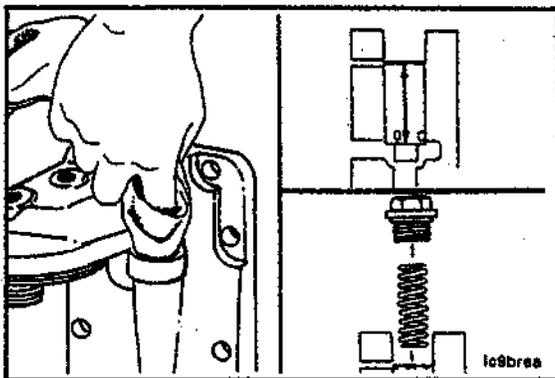
#### **Preparatory Steps:**

- Clean debris.

**22 mm**

Remove the plug and regulator valve.





22 mm



Clean and inspect the bore and regulator valve before assembly.



**Caution:** In order to regulate the oil pressure, the valve must move freely in the bore.

Install the regulator and spring.



**Torque Value:** 80 N·m [60 ft-lb]



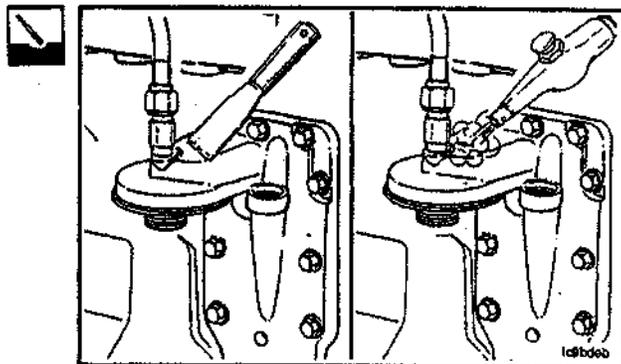
### Oil Cooler Element and Gasket-Replacement

#### Preparatory Steps:

- Drain The coolant.
- Remove the oil filter.

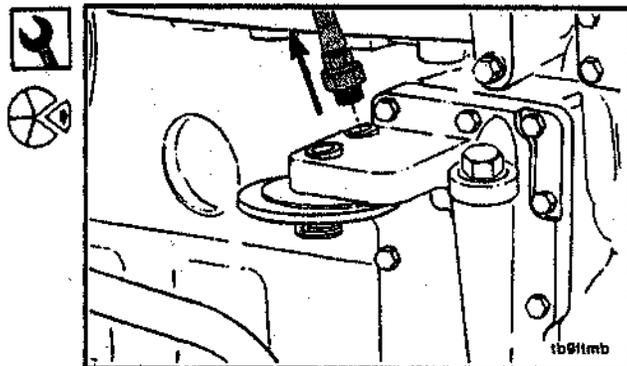
**Section A-Adjustment, Replacement and Repair**  
**B Series**

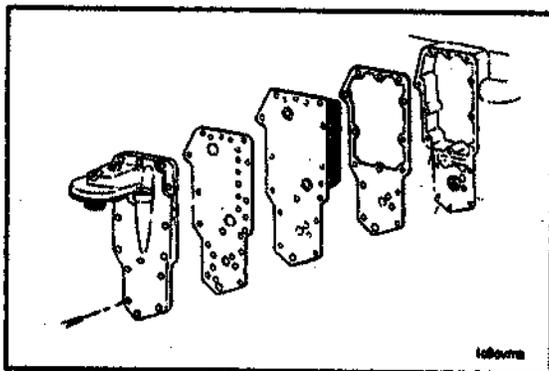
Clean all debris from around the oil cooler.



**16 mm**

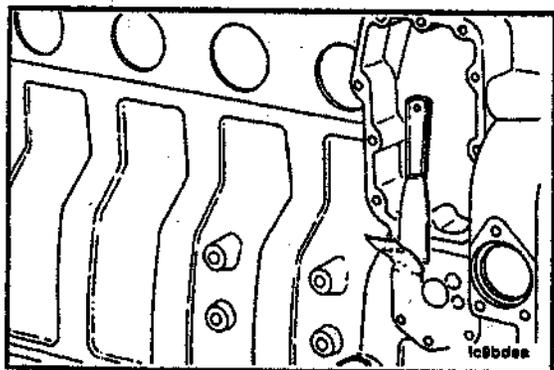
Remove the turbocharger oil supply line from the oil filter head.





10 mm

Remove the oil cooler cover, element and gaskets.

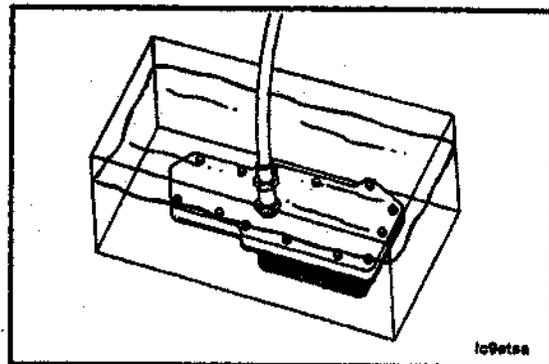


Clean the sealing surfaces.

## Section A-Adjustment, Replacement and Repair

### B Series

Pressurize the element to 690 kPa [100 psi] to check it for leaks.

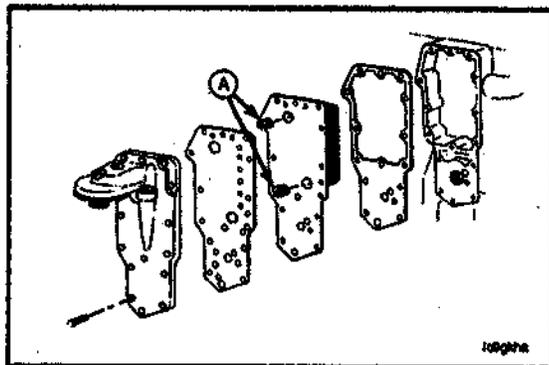


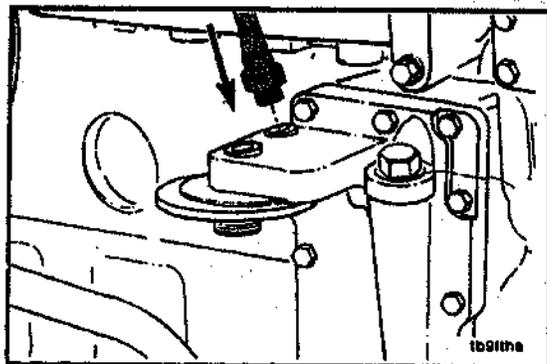
### 10 mm

Assemble the oil cooler gasket, element, cooler cover gasket and cooler cover to the cylinder block.

**NOTE:** Be sure to remove the shipping plugs (A) from the new cooler element.

**Torque Value:** 24 N·m [18 ft·lb]

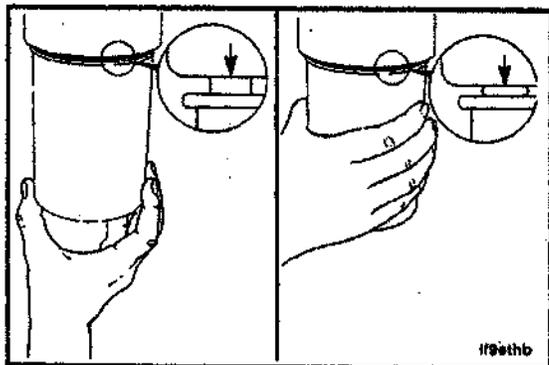




16 mm

Connect the turbocharger oil supply line.

Torque Value: 15 N·m [11 ft·lb]



Install a new oil filter.

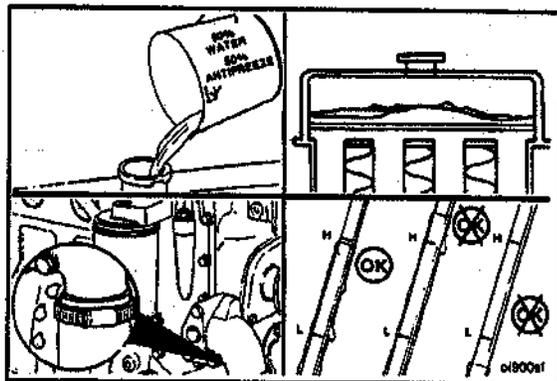
Follow the manufacturer's instructions for tightening.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

**Caution:** The system must be filled slowly to prevent air locks. Be sure to open the aftercooler vents to allow air to escape as the system is filled.

Fill the coolant system and operate the engine to check for leaks.

Stop the engine and check the coolant and oil level.



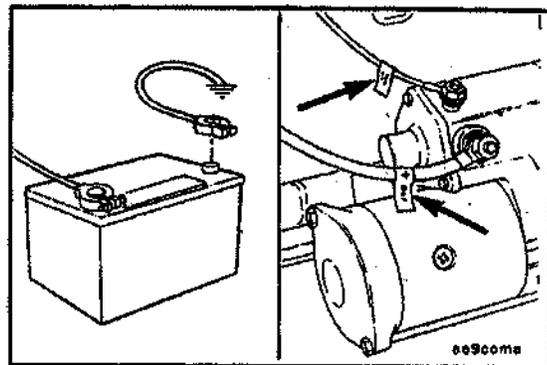
**Electrical System Repair Summary**

<b>Component To Be Replaced</b>	<b>Tools</b>	<b>Preparatory steps</b>
Starting Motor	Ratchet, 17 mm Socket, 14 mm Wrench, and Torque Wrench	Disconnect ground cable to battery.
Alternator	Ratchet, 8 mm, 14 mm and 16 mm Socket and torque Wrench, 1/2 inch Square Drive Breaker Bar	Disconnect ground cable to battery and remove drive belt.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

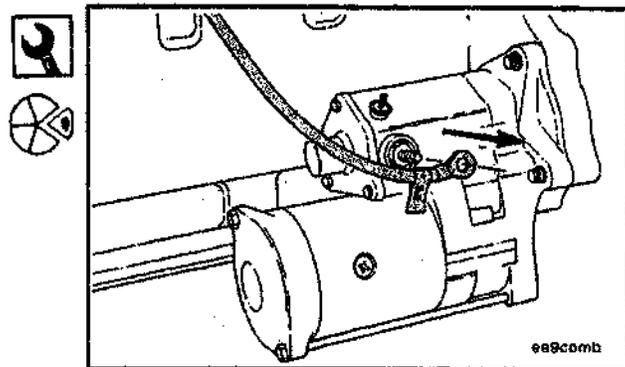
**Electrical System Repair**  
**Starting Motor-Replacement**

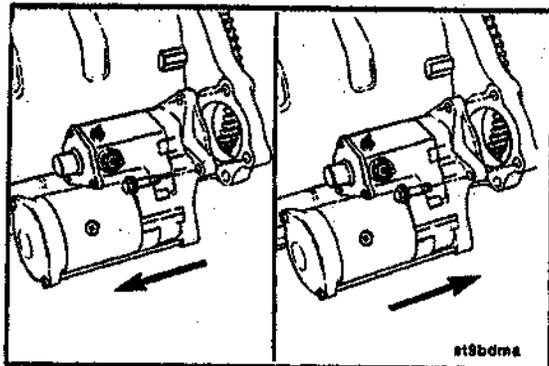
Disconnect the ground cable from the battery.  
Identify each electrical wire with a tag indicating location.



**14 mm**

Remove the battery cable from the solenoid.





10 mm

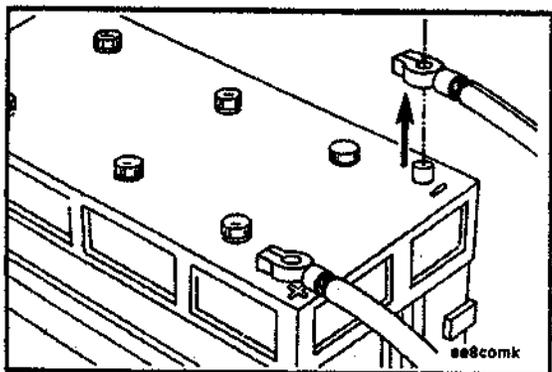
Remove the starting motor.



Install the starting motor in the reverse order of removal.



**Torque Value:** 43 N·m [32 ft·lb]



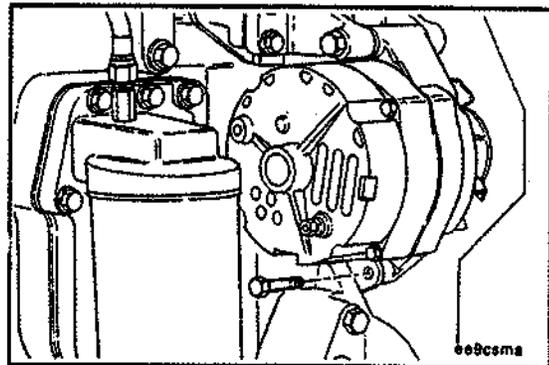
### Alternator-Replacement

Disconnect the ground cable from the battery terminal.  
Identify each electrical wire with a tag indicating location.  
Remove the drive belt.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

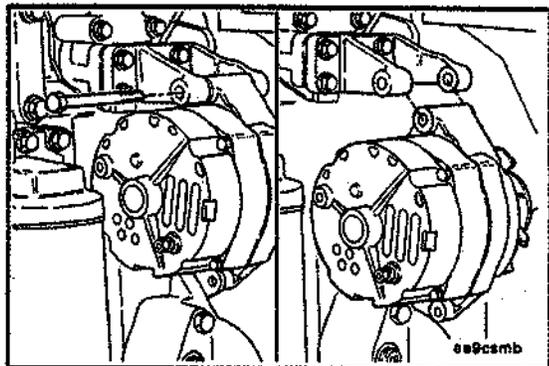
**14 mm**

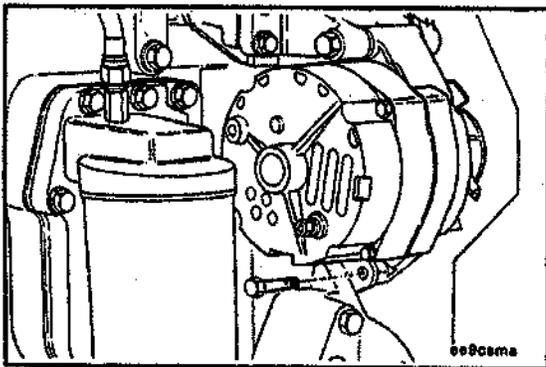
Remove the capscrew from the alternator link.



**16 mm**

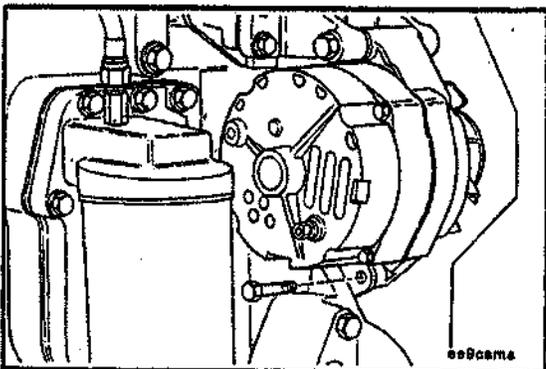
Remove the alternator mounting capscrews.  
Remove the alternator.





Position the alternator on the bracket and secure it with the mounting capscrews.

**Do not tighten at this time.**



Connect the alternator link to the alternator. Finger tighten.

**NOTE:** Make sure the alternator link is properly positioned for correct belt alignment.

**Section A-Adjustment, Replacement and Repair**  
**B Series**

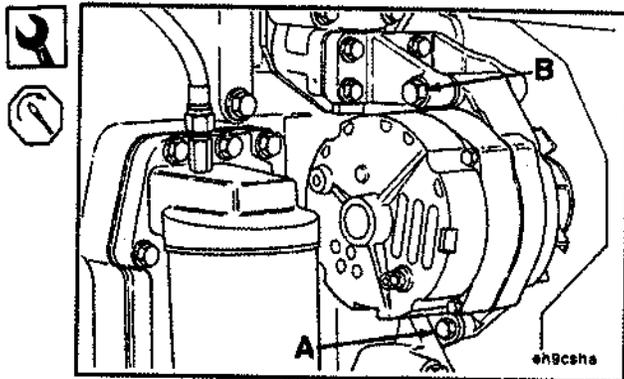
**14,16 mm**

Tighten the alternator mounting capscrew.

**Torque Value:**

A = 24 N·m [18 ft-lb]

A = 43 N·m [32 ft-lb]





## Section V-Specifications and Torque Values

### Section contents

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<b>Arctic Operation</b> .....	V-15
<b>Capscrew Markings and Torque values</b> .....	V-22
Capscrew Markings and Torque Values-Metric.....	V-23
Capscrew Markings and Torque Values-U. S. Customary.....	V-24
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<b>Filter Selection</b> .....	V-17
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Oil Filters.....	V-17
<b>Fuel Recommendations/Specifications</b> .....	V-10
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<b>Lubricating Oil Recommendations/Specifications</b> .....	V-12
New Engine Break-In Oils.....	V-13
Oil Performance Recommendations.....	V-12
Oil Viscosity Recommendations.....	V-12
<b>Sealants</b> .....	V-21

Engine Specifications (Non-Automotive Engines)

GENERAL ENGINE DATA	4B3.9	4BT3.9	4BTA3.9	6B5.9	6BT5.9	6BTA5.9
Bore-mm [in.].....	102 [4.02]					
Stroke-mm [in.].....	120 [4.72]					
Displacement-liter [in. <sup>3</sup> ]	3.9 [239]		5.9 [359]			
Engine Weight (Dry) Less Fly-wheel and Electrics-Kg [lbs.].....	308 [680]	320 [705]	329 [725]	388 [855]	399 [880]	411 [905]
Firing Order.....	1.3.4.2.			1.5.3.6.2.4.		
Valve Clearances						
-Intake-mm [in.].....	0.25 [0.010]					
-Exhaust-mm [in.].....	0.51 [0.020]					
Compression Ratio.....	18.5 : 1	17.5 : 1	16.5 : 1	18.5 : 1	17.5 : 1	16.5 : 1
Rotation viewed from the Front of the Engine.....	Clockwise					
Aspiration						
-Naturally Aspirated.....	x			x		
-Turbocharged.....		x	x		x	x
-Aftercooled.....			x			x
-Charge Air Cooled.....						

**Section V-Specifications and Torque Values**  
**B Series**

**Engine Specifications (Non-Automotive Engines)**  
**Page V-3**

<b>LUBRICATION SYSTEM kPa [psi]</b>	<b>4B3.9</b>	<b>4BT3.9</b>	<b>4BTA3.9*</b>	<b>6B5.9</b>	<b>6BT5.9</b>	<b>6BTA5.9</b>
Minimum Allowable Oil Pressure@ Idle	69 [10]	69 [10]	69 [10]	69 [10]	69 [10]	69 [10]
Minimum Allowable Oil Pressure@ Rated	207 [30]	207 [30]	207 [30]	207 [30]	207 [30]	207 [30]
Regulated Pressure	449 [65]	449 [65]	449 [65]	449 [65]	449 [65]	449 [65]
Differential Pressure to Open Filter Bypass	138 [20]	138 [20]	138 [20]	138 [20]	138 [20]	138 [20]
Oil Capacity L [QT]						
Standard Pan Only	9.5 [10]	9.5 [10]	9.5 [10]	14.2 [15]	14.2 [15]	14.2 [15]
Total System (Pan, Filter, Lines)	10.9[11.5]	11 [11.6]	11 [11.6]	16.3[17.2]	16.4[17.3]	16.4[17.3]
No. QTS From "L" to "H" on Dipstick	[1]	[1]	[1]	[2]	[2]	[2]
<b>COOLING SYSTEM L [QT]</b>						
Engine Coolant Capacity	7.0 [7.4]	7.0 [7.4]	7.9 [8.4]	9.0 [9.5]	9.0 [9.5]	9.9[10.5]
Thermostat Modulating Range°C [°F]	83-95 [181-230]	83-95 [181-203]	83-95 [181-203]	83-95 [181-203]	83-95 [181-203]	83-95 [181-203]
Pressure Cap kPa [psi]						
104°C [220°F]	103 [15]	103 [15]	103 [15]	103 [15]	103 [15]	103 [15]
99°C [210°F]	48 [7]	48 [7]	48 [7]	48 [7]	48 [7]	48 [7]

\*Jacket-water aftercooled

INTAKE AIR, EXHAUST AND FUEL SYSTEM	4B3.9	4BT3.9	4BTA3.9	6B5.9	6BT5.9	6BTA5.9
Maximum Allowable Intake Restriction at Rated Speed and Load with Dirty Air Filter Element - mm H <sub>2</sub> O [in. H <sub>2</sub> O].....	508 [20]	635 [25]	635 [25]	508 [20]	635 [25]	635 [25]
Maximum Allowable Ex- haust Restriction at Rated Speed and Load-mm Hg [in. Hg].....	76.2 mm [3 in.]					
Maximum Allowable Re- striction to Transfer Pump- mm Hg [in. Hg].....	100 mm [4 in.]					
Maximum Allowable Return Line Restriction-mm Hg [in . Hg].....	518 mm [20.4 in.]					
Maximum Fuel Pressure Drop Across Filters kPa [psi].....	34 [5]					

**Section V-Specifications and Torque Values****Engine Specifications (Non-Automotive Engines****B Series****Page V-5**

<b>ELECTRICAL SYSTEM</b>	<b>4B3.9</b>	<b>4BT3.9</b>	<b>4BTA3.9</b>	<b>6B5.9</b>	<b>6BT5.9</b>	<b>6BTA5.9</b>
<b>Minimum Recommended Battery Capacity-With Light Accessories*</b>						
-12V Starter.....	625CCA	625CCA	8CCA	800CCA	800CCA	800CCA
-24 V Starter.....	312CCA	400CCA	400CCA	400CCA	400CCA	400CCA
<b>With Heavy Accessories**</b>						
-12V Starter.....	800CCA	800CCA	800CCA	950CCA	950CCA	950CAA
-24 V Starter.....	400CCA	400CCA	400CCA	475CCA	475CCA	475CCA
<b>Maximum Allowable Resistance of Starting Circuit</b>						
-With 12 V Starter-Ohms.....				0.0012		
-With 24 V Starter-Ohms.....				0.0020		

\*Typical light accessories include alternator, small steering pump, and disengaged clutch.

\*\*Typical heavy accessories include hydraulic pump and torque converter.

**Batteries (Specific Gravity)**

<b>Specific Gravity at 27 °C [80 °F]</b>	<b>State of Charge</b>
1.260-1.280	100%
1.230-1.250	75%
1.200-1.220	50%
1.170-1.190	25%
1.110-1.130	Discharged

## General Specifications (Automotive Engines)

GENERAL ENGINE DATA	B5.9-160	B5.9-175	B5.9-190	B5.9-210	B5.9-230
Bore-mm [in.].....	102 [4.02]	102 [4.02]	102 [4.02]	102 [4.02]	102 [4.02]
Stroke-mm [in.].....	120 [4.72]	120 [4.72]	120 [4.72]	120 [4.72]	120 [4.72]
Displacement-liter [in. <sup>3</sup> ].....	5.9 [359]	5.9 [359]	5.9 [359]	5.9 [359]	5.9 [359]
Engine Weight (Dry) Less Fly-wheel and Electrics-kg [lbs].....	428 [942]	428 [942]	428 [942]	428 [942]	428 [942]
Firing Order.....	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Valve Clearances:					
-Intake-mm [in.].....	0.25 [0.010]	0.25 [0.010]	0.25 [0.010]	0.25 [0.010]	0.25 [0.010]
-Exhaust-mm [in.].....	0.51 [0.020]	0.51 [0.020]	0.51 [0.020]	0.51 [0.020]	0.51 [0.020]
Compression Ratio.....	17.5:1	17.5:1	17.1:1	17.1:1	17.1:1
Rotation, viewed from the Front of the Engine.....	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise
Aspiration:					
-Naturally Aspirated.....					
-Turbocharged.....	×	×	×	×	×
-Aftercooled.....					
-Charge Air Cooled.....	×	×	×	×	×

## General Specifications (Automotive Engines)

<b>Lubricating System kPa [psi]</b>	<b>B5.9-160</b>	<b>B5.9-175</b>	<b>B5.9-190</b>	<b>B5.9-210</b>	<b>B5.9-230</b>
Min. Allowable Press. @ Idle.....	69 [10]	69 [10]	69 [10]	69 [10]	69 [10]
Min. Allowable Press. @ Rated.....	207 [30]	207 [30]	207 [30]	207 [30]	207 [30]
Regulated Pressure.....	449 [65]	449 [65]	449 [65]	449 [65]	449 [65]
Filter Bypass Diff. Pressure Oil Capacity L [QT]:	138 [20]	138 [20]	138 [20]	138 [20]	138 [20]
-Standard Pan Only.....	14.2 [15]	14.2 [15]	14.2 [15]	14.2 [15]	14.2 [15]
-Total System.....	16.4 [17.3]	16.4 [17.3]	16.4 [17.3]	16.4 [17.3]	16.4 [17.3]
QTS From "L" to "H".....	[2]	[2]	[2]	[2]	[2]
<b>COOLING SYSTEM L [QT]</b>	<b>B5.9-160</b>	<b>B5.9-180</b>	<b>B5.9-190</b>	<b>B5.9-210</b>	<b>B5.9-230</b>
Engine Coolant Capacity.....	9.0 [9.5]	9.0 [9.5]	9.0 [9.5]	9.0 [9.5]	9.0 [9.5]
Thermostat Modulating Range:					
C.....	83-95	83-95	83-95	83-95	83-95
[F].....	[181-203]	[181-203]	[181-203]	[181-203]	[181-203]
Pressure Cap kPa [psi]:					
-104°C [220°F].....	103 [15]	103 [15]	103 [15]	103 [15]	103 [15]
-99°C [210°F].....	48 [7]	48 [7]	48 [7]	48 [7]	48 [7]

**General Specifications (Automotive Engines)**

<b>Intake Air, Exhaust, and Fuel System</b>	<b>B5.9-160</b>	<b>B5.9-175</b>	<b>B5.9-190</b>	<b>B5.9-210</b>	<b>B5.9-230</b>
Maximum Allowable Intake Restriction at Rated Speed and Load with Dirty Air Filter Element-mm H <sub>2</sub> O [in. H <sub>2</sub> O].....	635 [25]	635 [25]	635 [25]	635 [25]	635 [25]
Maximum Allowable Exhaust Restriction at Rated Speed and Load-mm Hg [in. Hg].....	152.4 [6]	152.4 [6]	152.4 [6]	152.4 [6]	152.4 [6]
Maximum Allowable Restriction to Fuel Transfer Pump-With Dirty Filter-mm Hg [in. Hg].....	100 [4]	100 [4]	100 [4]	100 [4]	100 [4]
Maximum Allowable Return Line Restriction-mm Hg [in. Hg].....	518 [20.4]	518 [20.4]	518 [20.4]	518 [20.4]	518 [20.4]
Maximum Fuel Pressure Drop Across Filters kPa [psi]	----- 34 [5] -----				

**General Specifications (Automotive Engines)**

<b>Electrical System</b>	<b>B5.9-160</b>	<b>B5.9-175</b>	<b>B5.9-190</b>	<b>B5.9-210</b>	<b>B5.9-230</b>
Minimum Recommended Battery Capacity-With Light Accessories*:					
- 12 V Starter .....	800CCA	800CCA	800CCA	800CCA	800CCA
- 24 V Starter .....	400CCA	400CCA	400CCA	400CCA	400CCA
With heavy Accessories**:					
- 12 V Starter .....	950CCA	950CCA	950CCA	950CCA	950CCA
- 24 V Starter .....	475CCA	475CCA	475CCA	475CCA	475CCA
Maximum Allowable Resistance of Starting Circuit:					
- With 12 V Starter-Ohms	.0012	.0012	.0012	.0012	.0012
- With 24 V Starter-Ohms	.0012	.0012	.0012	.0012	.0012

\*Typical light accessories include alternator, small steering pump, and disengaged clutch.

\*\*Typical heavy accessories include hydraulic pump and torque converter.



## Fuel Recommendations / Specifications



**Warning:** Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.



**Caution:** Due to the precise tolerances of diesel injection systems. It is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.



**Caution:** Do NOT use diesel fuel blended with lube oil in engines equipped with a catalytic convertor (including all model year 1994 and beyond). Damage to legally required emission control may result.

Use ASTM No. 2 D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to prevent misfires and excessive Smoke.

At operating temperatures below 0° C [32° F], use a blend Of No. 1 D and No. 2 D fuels, also known as “winterized”

No. 2 D.

**NOTE:** No. 1 D fuel can be used, however, fuel economy will suffer.

Use low sulfur content fuel having a cloud point that is at least 10 degrees below the lowest expected fuel temperature. Cloud point is the temperature at which crystals begin to form in diesel fuel.

The viscosity of the fuel must be kept above 1.3 centistokes to provide adequate fuel system lubrication at 40° C [104° F].

For a more detailed description of fuel properties. refer to Fuel For Cummins Engines. Bulletin NO. 3379001.

The following chart lists acceptable alternate fuels for MidRange engines.

Acceptable Alternate Fuels-Component Wear/Durability							
Fuel Type	Bosch			Nippondenso	Stanadyne	Lucas CAV	
	A	P7100	VE	Ep-9	DB-4	DPA	DPS
NO. 1-D Diesel	OK	OK	OK	OK	OK	OK	OK
NO. 2 Fuel Oil	OK	OK	OK	OK	OK	OK	OK
NO. 1-K Kerosene	OK	OK		OK	*	*	*
NO. 2-K Kerosene	OK	OK		OK	*	*	*
Jet-A	OK	OK		OK	*	*	*
Jet A-1	OK	OK		OK	*	*	*
JP-5	OK	OK		OK	*	*	*
JP-8	OK	OK		OK	*	*	*
Jet-B	Not ok	Not ok	Not ok	Not ok	Not ok	Not ok	Not ok
JP-4	Not ok	Not ok	Not ok	Not ok	Not ok	Not ok	Not ok
Cite	Not ok	Not ok	Not ok	Not ok	Not ok	Not ok	Not ok

\*OK ONLY if 5% new lube oil is blended with these fuels to increase the lubricity to acceptable level.

**Caution: Do NOT use diesel fuel blended with lube oil in engines equipped with a catalytic convertor (including all model year 1994 and beyond). Damage to legally required emission control may result.**

**NOTE:** Any adjustment to compensate for reduced performance with a fuel system using alternate fuel is not warrantable.

**NOTE:** Wear on any mid-ranged fuel pump component attributed to the lack of lubrication in the fuel is not a warrantable repair.

## Lubricating Oil Recommendations / Specifications

### Oil Performance Recommendations

The use of quality engine lubricating oils combined with appropriate oil drain and filter change intervals are critical factors in maintaining engine performance and durability.

Cummins Engine Company, Inc. recommends the use of a high quality SAE 15W-40 heavy duty engine oil (such as Cummins Premium Blue) which meets the American Petroleum Institute (API) performance classification CE/SG.

**NOTE:** CC / CD or CD / SF engine oils can be used in areas where CE oil is not yet available, but the oil change interval must be reduced to one half the interval given in the maintenance schedule.

A sulfated ash limit of 1.0 mass percent is suggested for optimum valve and piston deposit and oil consumption control. The sulfated ash must not exceed 1.85 mass percent.

### oil Viscosity Recommendations

The use of multi-viscosity lubricating oil has been found to improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures.

While 15W-40 oil is recommended for most climates, refer to the accompanying table for oil viscosity recommendations for extreme climates.

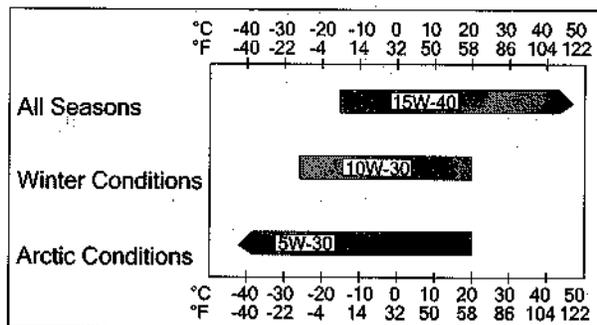
## Section V-Specifications and Torque Values

### B Series

**NOTE:** Limited use of low viscosity oils, such as 10W-30 may be used for easier starting and providing sufficient oil flow at ambient temperatures below -5°C [23°F]. However, continuous use of low viscosity oils can decrease engine life due to wear. Refer to the accompanying chart.

## Lubricating Oil Recommendations / Specifications

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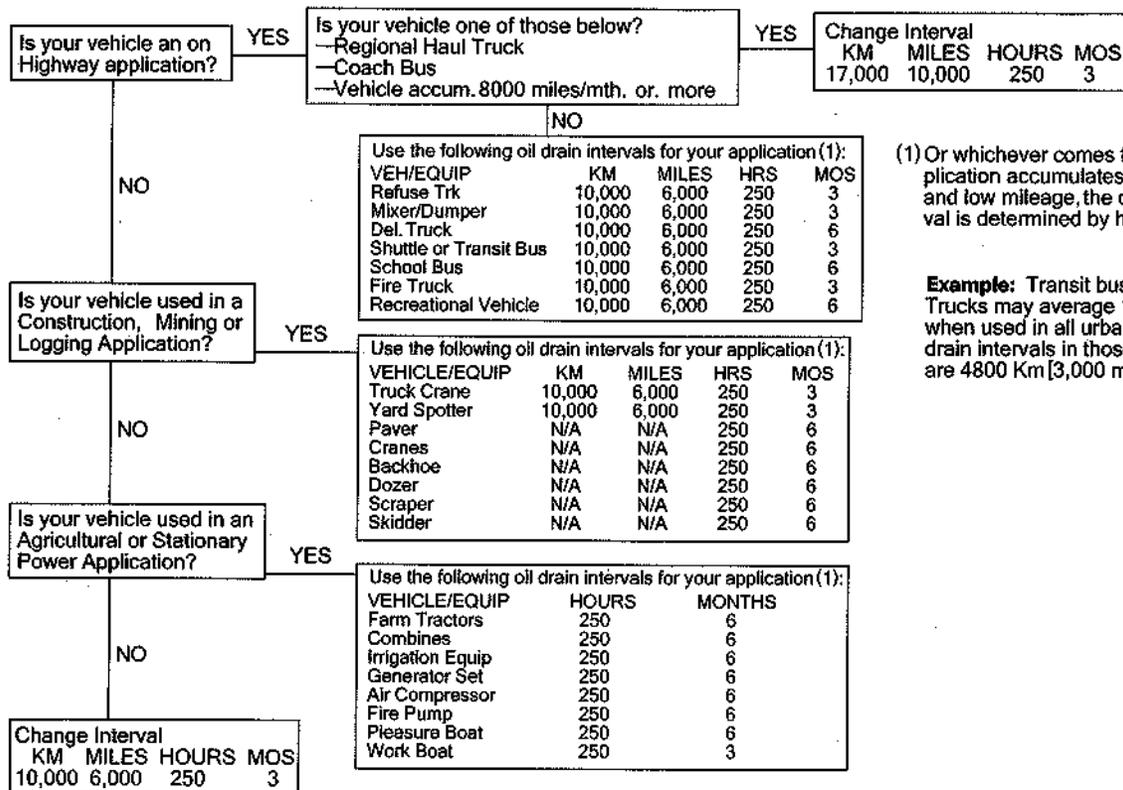


### New Engine Break-In Oils

Do not use special “break-in” lubricating oils for new or rebuilt Cummins engines. Use the same type of oil during the “break-in ” as that which is used in normal operation.

### Recommended Oil Change Intervals

Refer to the following flowchart for the recommended oil change interval based on engine application.



(1) Or whichever comes first. If your application accumulates high hours and low mileage, the change interval is determined by hours.

**Example:** Transit buses and refuse Trucks may average 16 Km [10 MPH] when used in all urban routes. Oil drain intervals in those applications are 4800 Km [3,000 mi], or less.

**Oil Consumption**

In addition to the information that follows, a service publication entitled Technical Overview of Oil Consumption is available, Bulletin 3379214-00.

Cummins defines "Acceptable Oil Usage" as outlined in the following table:

<b>ACCEPTABLE OIL USAGE</b>									
<b>ANY TIME DURING COVERAGE PERIOD</b>									
<b>ENGINE FAMILY</b>	<b>HRS PER QT</b>	<b>HRS PER LITER</b>	<b>HOURS PER IMPERIAL QUART</b>	<b>MILES PER QUART</b>	<b>MILES PER LITER</b>	<b>MILES PER IMPERIAL QUART</b>	<b>KILOM PER QUART</b>	<b>KILOM PER LITER</b>	<b>KILOM PER IMPERIAL QUART</b>
4B	10.0	10.6	12.0	400	425	475	650	675	775
6B	10.0	10.6	12.0	400	425	475	650	675	775
6C	10.0	10.6	12.0	400	425	475	650	675	775

## **Arctic Operation**

If an engine is operated in ambient temperatures consistently below  $-23^{\circ}\text{C}$  [ $-10^{\circ}\text{F}$ ] and there are no provisions to keep the engine warm when it is **not** in operation, use a synthetic CE/SG engine oil with adequate low temperature properties such as; 5W-30.

The oil supplier **must** be responsible for meeting the performance service specifications.



**Caution: The use of a synthetic base oil does not justify extended oil change intervals. Extended oil change intervals can decrease engine life due to factors such as; corrosion, deposits and wear.**

Additional information regarding lubricating oil availability throughout the world is available in the "E. M. A. Lubricating oils Data Book for Heavy Duty Automotive and Industrial Engines." The data book may be ordered from the engine Manufacturers Association, One Illinois Center, 111 East Wacker Drive, Chicago, IL U. S. A. 60601. The telephone number is: (312) 644-6610.

**Coolant Recommendations / Specifications**

Heavy duty diesel engines require a balanced coolant mixture of water and antifreeze. Drain and replace the mixture every 2 years, 320, 000 KM [200,000 miles] or 6, 000 hours of operation (whichever occurs first) to eliminate build up of harmful chemicals.

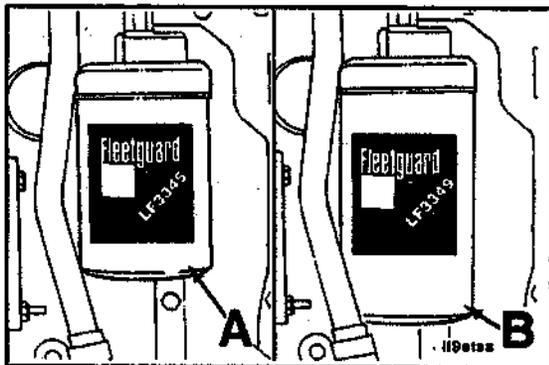
- **Antifreeze is essential in any climate.** It broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point. Do **not** use more than 50 percent antifreeze in the mixture unless additional freeze protection is required. **Never** use more than 68 percent antifreeze under any condition.
- Use soft water in the coolant mixture. Contaminants in hard water neutralize the corrosion inhibitor components. Water must not exceed 300 ppm hardness, or contain more than 100 ppm of either chloride or sulfate.
- **Specifications-Use low silicate antifreeze which meets ASTM4985 test(GM6038M spec.)criteria.**

**Concentration**-Antifreeze must be used in any climate for both freeze and boiling point protection.

**Cummins recommends a 50 percent concentration level(40 percent to 60 percent range)of ethylene glycol or propylene glycol in most climates.** Antifreeze at 68 percent concentration provides the maximum freeze Protection and **must** never be exceeded under any Condition. Antifreeze Protection decreases above 68 percent.

Ethylene Glycol	Propylene Glycol
40% = -23°C [-10°F]	40% = -21°C [-6°F]
50% = -37°C [-34°F]	50% = -33°C [-27°F]
60% = -54°C [-65°F]	60% = -49°C [-56°F]
68% = -71°C [-90°F]	68% = -63°C [-82°F]

**Concentration Testing**-Antifreeze concentration must be checked using a refractometer(such as Fleet-guard Pa rt No.Cc2800).“Floating ball”type density testers or hydrometers are not accurate enough for use with heavy duty diesel cooling systems.

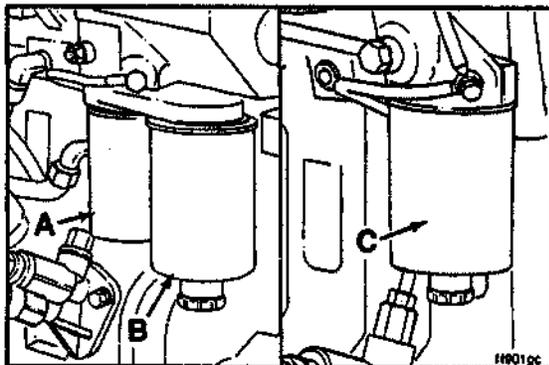


## **Filter Selection**

### **Oil Filters**

A = LF 3345 Standard Four Cylinder Applications

B = LF 3349 Standard Six Cylinder Applications



### **Fuel Filters**

A = Standard Filter used as secondary filter in fuel filter applications.

B = Fuel Water Separator Primary filter for fuel filter applications.

C = Fuel Water Separator used in single filter applications.

## Engine Component Torque Value

Socket or Wrench Size MM(Inch)		Torque N · m	(Ft-lb)
10	Aftercooler Mounting.....	24	[18]
8	Aftercooler Water Hose Clamp.....	5	[4]
13	Alternator Link (Delco 10-15 SI).....	24	[18]
[3/4]	Alternator Link (Delco 20-27 SI).....	43	[32]
15	Alternator Mtg. Bolt 10-15 SI.....	43	[32]
18	Alternator Mtg. Bolt 27 SI.....	77	[57]
10	Alternator Support (Upper).....	24	[18]
Allen 5 mm	Belt Tensioner Flat Bracket.....	24	[18]
15	Belt Tensioner Mounting.....	43	[32]
15	Crankshaft Damper & Pulley.....	137	[101]
[5/16]	Crossover Clamp.....	5	[4]
11	Tee Bolt Type Clamp.....	8	[6]
15	Exhaust Manifold.....	43	[32]
15	Exhaust Outlet Pipe Mtg Bracket.....	43	[32]
(7/16)	Exhaust Outlet Pipe, V Band Clamp.....	8	[6]
10	Fan Bracket Mounting.....	24	[18]
10	Fan Pulley.....	24	[18]
13	Fan Pulley.....	43	[32]
19	Flywheel.....	137	[101]
--	Front Cover Clamp Access Cap.....	-----Hand Tighten-----	
17	Fuel Drain Line Banjo Screw (Rotary Pump).....	15	[11]

**Engine Component Torque Value (Continued)**

Socket or Wrench Size MM(Inch)		Torque N · m	(Pt-lb)
17	Fuel Banjo Screw (in Filter Head).....	24	[18]
10	Fuel Vent Screw (in Banjo).....	9	[7]
10	Fuel Banjo Screw (Injector).....	9	[7]
75-85	Fuel Filter.....	3/4 Turn After Contact	
24	Fuel Filter Adapter Nut.....	32	[24]
17 or 19	Fuel Line Fitting (High Pressure).....	30	[22]
22	Fuel Pump Drive Gear (with Pump Unlocked) Rotary.....	65	[48]
22	Fuel Pump Drive Gear (Pump Unlocked) Nippondenso.....	123	[92]
30	Fuel Pump Drive Gear (Pump Unlocked) Bosch Inline.....	165	[122]
10	Fuel Pump Lock (Bosch) Rotary.....	30	[22]
	Fuel Pump Unlock (Bosch) Rotary.....	13	[10]
14	Fuel Pump Lock (CAV).....	7	[5]
	Fuel Pump Unlock (CAV).....	20	[15]
13	Fuel Pump Mounting Nuts (Bosch Rotary).....	24	[18]
15	Fuel Pump Mounting Nuts (Bosch In-Line, Nippondenso).....	43	[32]
13	Fuel Pump Mounting Nuts (CAV).....	30	[22]
13	Fuel Pump Support Bracket.....	24	[18]
24	Injector Retaining Nut.....	60	[44]
13	Intake Manifold Cover.....	24	[18]
10	Lift Pump/Cover Plate.....	24	[18]
18	Lifting Bracket (Rear).....	77	[57]

## Section V-Specificatons and Torque Values

## Engine Component Torque Value

## B series

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Socket or Wrench Size MM(Inch)		Torque N · m	(Ft-lb)
75-85	Oil Filter.....	3/4 Turn After Contact	
10	Oil Cooler Assembly.....	24	[18]
17	Oil Pan Drain Plug.....	80	[60]
27	Oil Pan Heater Plug.....	80	[60]
19	Oil Pressure Regulator Plug.....	80	[60]
10	Rear Seal Housing.....	9	[7]
14	Rocker Lever Nut.....	24	[18]
10	Starter Mounting.....	43	[32]
10	Tappet Cover/Fuel Drain Line Supports.....	24	[18]
10	Thermostat Housing.....	24	[18]
13	Turbine Housing.....	11	[8]
10	Turbo Compressor Housing Clamp.....	6	[5]
15	Turbo Mounting Nuts.....	32	[24]
13	Turbo Drain Tube.....	24	[18]
16	Turbo Oil Supply (Both Ends).....	24	[18]
15	Water Inlet Connection.....	43	[32]
13	Water Pump Mounting.....	24	[18]
15	Valve Cover.....	24	[18]
--	Valve Cover Oil Fill.....	Hand Tighten	

### **Sealants**

Use the sealants listed below or sealants containing equivalent properties.

<b>Description</b>	<b>Sealing Method</b>
1. Pipe Plugs	Precoated teflon or pipe sealer.
2. Cup Plugs	Loctite 277 or 11,264
3. O-Rings	No sealant required.
4. Rear Camshaft Expansion Plug	Precoated or Loctite 59,241 liquid teflon.
5. Fuel Pump Studs	Loctite 609.
6. Turbo Drain in Block	Loctite 277 or 11,264
7. Front Seal in Gear Cover	Loctite 277 or 11,264
8. Rear Seal in Rear Cover	No sealant.
9. Oil Pan at T-Joint	3-Bond 1207C (P/N 3823494)

## Capscrew Markings and Torque Values

**⚠ Caution:** When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using incorrect capscrews can result in engine damage.

Most of the capscrews used on the B Series engine are metric. Some components, such as the air compressor and fuel pump, are installed using U. S. Customary capscrews.

Metric capscrews and nuts are identified by the grade number stamped on the head of the capscrew, or on the surface of the nuts. U. S. Customary capscrews are identified by radial lines stamped on the head of the capscrew.

The following examples indicate how capscrews are identified:

Metric (M8-1.25×25)		
M8	1.25	25
Major Thread Diameter in	Distance Between Threads in	Length in Millimeters

U. S. Customary (5/16×8×1 1/2)		
5/16	8	1 1/2
Major Thread Diameter in Inches	Number of Threads per Inch	Length in Inches

**Notes:**

1. **Always** use the torque values listed in the following tables when specific torque values are **not** available.
2. Do **not** use the torque values in place of those specified in other sections of this manual.
3. The torque values in the table are based on the use of lubricated threads.

**Capscrew Markings and Torque Values-Metric**

**Commercial Steel Class**

8.8

10.9

12.9

**Capscrew Head Markings**



**Body  
Size**

**Torque**

**Torque**

**Torque**

Diam. mm	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
	N · m	ft-lb	N · m	ft-lb	N · m	ft-lb	N · m	ft-lb	N · m	ft-lb	N · m	ft-lb
6	9	7	7	5	12	9	7	5	12	9	7	5
7	14	10	11	8	18	13	11	8	23	18	11	8
8	25	18	18	13	32	23	18	13	36	27	18	13
10	40	30	30	22	60	45	30	22	70	50	30	22
12	70	22	55	40	105	77	55	40	125	95	55	40
14	115	85	90	66	160	118	90	66	195	145	90	66
16	180	133	140	103	240	177	140	103	290	210	140	103
18	230	170	180	133	320	236	180	133	400	290	180	133

B series

## Capscrew Markings and Torque Values - U.S. Customary

SAE Grade Number

5

8

These are all SAE Grade 5 (3) line

Capscrew Head Markings



Capscrew Torque-Grade 5 Capscrew

Capscrew Torque-Grade 8 Capscrew

Capscrew Body Size

Cast Iron

Aluminum

Cast Iron

Aluminum

N·m

ft-lb

N·m

ft-lb

N·m

ft-lb

N·m

ft-lb

1/4 - 20

9

7

8

6

15

11

12

9

- 28

12

9

9

7

18

13

14

10

5/16 - 18

20

15

16

12

30

22

24

18

- 24

23

17

19

14

33

24

25

19

3/8 - 16

40

30

25

20

55

40

40

30

- 24

40

30

35

25

60

45

45

35

7/16 - 14

60

45

45

35

90

65

65

50

- 20

65

50

55

40

95

70

75

55

1/2 - 13

95

70

75

55

130

95

100

75

- 20

100

75

80

60

150

110

120

90

9/16 - 12

135

100

110

80

190

140

150

110

- 18

150

110

115

85

210

155

170

125

5/8 - 11

180

135

150

110

255

190

205

150

- 18

210

155

160

120

290

215

230

170

3/4 - 10

325

240

255

190

460

340

365

270

- 16

365

270

285

210

515

380

410

300

7/8 - 9

490

360

380

280

745

550

600

440

- 14

530

390

420

310

825

610

660

490

1 - 8

720

530

570

420

1100

820

890

660

- 14

800

590

650

480

1200

890

960

710

YTO LR- R, A, B, M, N, V Series Engines  
**OPERATION & MAINTENANCE**  
**MANUAL**

YTO (LUOYANG) DIESEL ENGINE CO.,LTD.

## Foreword

YTO (Luoyang) Diesel Engine CO. Ltd is a joint venture subsidiary with China YTO Group Corp. based on technology transfer from Ricardo Consulting Engineers, the YTO LR-R, A, B, M, N, V series diesel engines are new, high power engines jointly developed China YTO Group Corp.. It meets the requirements of GB/T 1147.1 General Technical Requirements of Small and Medium Power Internal Combustion Engine.

Based on in-line ,water-cooled, four-stroke ,direct-injection construction, the engine of 4,6 cylinders have natural-aspirated , turbo-charged and turbo-charged with intercooler versions with bore diameter of 100,105,108,110,112 and 115mm and stroke of 120,125 and 135mm.The power ranges from 33 to 200kW at the range from 1500 r/min to 2800r/mim.

Continuing improvement and advancement of product might have caused changes to the engine specification, structure, adapted accessories, etc. in this manual, those will be republished this operation and maintenance manual in next edition. Pay attention to some contents in this manual will be a little different from the engine that you owned.

This manual will not be a quality warranty certificate to the engine, so all the date, illustrated figures and explanations will not be based to the customer claim. All rights are reserved. No part of this manual covered by the copyright hereon may be reproduced or copied without written permission of YTO (Luoyang) Diesel Engine CO. Ltd.

This manual compiling is organized by YTO (Luoyang) Diesel Engine CO. Ltd. The manual involves many contents, and which have some shortcomings, so it is hoped that the readers will kindly point out our errors, these errors will be corrected in new edition manual. At same time, we hope all our users cooperates with us sincerity to give our opinions about the product quality, performance, structure after-sales service and etc. in order to improve the product and perfect level and make greater contributions to society together.

## Dear user:

Acknowledgement for you to trust our brand YTO LR-R, A, B, M, N, V series diesel engines, welcome to use the engine made by YTO (LUOYANG) DIESEL ENGINE CO.,LTD.

The operation and maintenance manual contains product structures, performances, safety, operation, adjustment, maintenance information. For the best use of the engine and your safety, we remind you reading this manual in detail before use the engine.

In order to better understand the main contents in this manual, we set some indicative symbol, which will remind you to notice the information during operating engine.

YTO LR-R, A, B, M, N, V series diesel engines are all introduced in this manual. This manual will not use specific engine model, simple call engines, and give explanation for different structures.



**Tips logo:**Involved, including security, operations and other elements of the important information.



**Warning symbol:** warning information which involves personal injury property loss due to violation operation.



**Fireproof symbol:**warning information which involves property loss due to fire caused by incorrect operation.



**Maintenance symbol:**warning information which involves correct operation and maintenance.

For any question or requirements to the product quality or service please contact our hot line 086-0379-64245033. Thank you.

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# Chapter 1 Brief Introduction

## 1 Products Introduction

YTO (Luoyang) Diesel Engine CO. Ltd is a joint venture subsidiary of China YTO Group Corp. Based on technology transfer from Ricardo Consulting Engineers, the YTO LR-R, A, B, M, N, V series diesel engines manufactured by YTO (Luoyang) Diesel Engine CO., Ltd are new, high speed, middle power, energy-saving engines developed by China YTO Group Corp.

Based on in-line, water-cooled, four-stroke, direct-injection construction, the engines of 4, 6 cylinders have natural-aspirated, turbo-charged and turbo-charged with intercooler versions with bore diameter of 100, 105, 108, 110, 112 and 115mm and stroke of 120, 125 and 135mm. The power ranges from 33 to 182kW at the range from 1500 r/min to 2800r/min.

Based on good low temperature starting performance, the engine could easily be started without any assistance when the temperature is not below  $-10^{\circ}\text{C}$ ; and it could be started easily at  $-40^{\circ}\text{C}$  by using preheating measures. The engine can continuously run at the following conditions: vertical inclination  $20^{\circ}$ , horizontal inclination  $15^{\circ}$ ,  $-40^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  ambient temperature. The engine can install some PTO (power take-off) devices, and can output full or part of the power from front end of the crankshaft so as to meet different requirements.

The altitude type turbo-charged engines have passed construction machine quality certification test for the plateau of 4500 meters above sea level, which have a better regional adaptation. Four valves, turbocharged and turbocharged-middle-cooled, air intake passage optimum simulation, double-shaft balance for four-cylinder diesel engine, electronically controlled fuel injection, and other core patent technologies have been successfully applied, which make the series diesel engines have lower noise, lower vibration, lower oil consumption, lower emission, and so on. Through EGR internal recycle control and water-cooling EGR control technology, all products have been granted China environmental protection certification, Europe e-mark type approval, USA EPA3 certificate.

YTO LR-R, A, B, M, N, V series diesel engines have been widely used as power sources for vehicles, tractors, construction machinery, generator sets, small generating stations and marines.

Golden service is our service brand. About 400 customer service nets, 300 prepare spare parts supply system, and product querying system have been set up all over China, which can provide satisfactory whole course service for our customers.

## 2 Recognizing the Engine

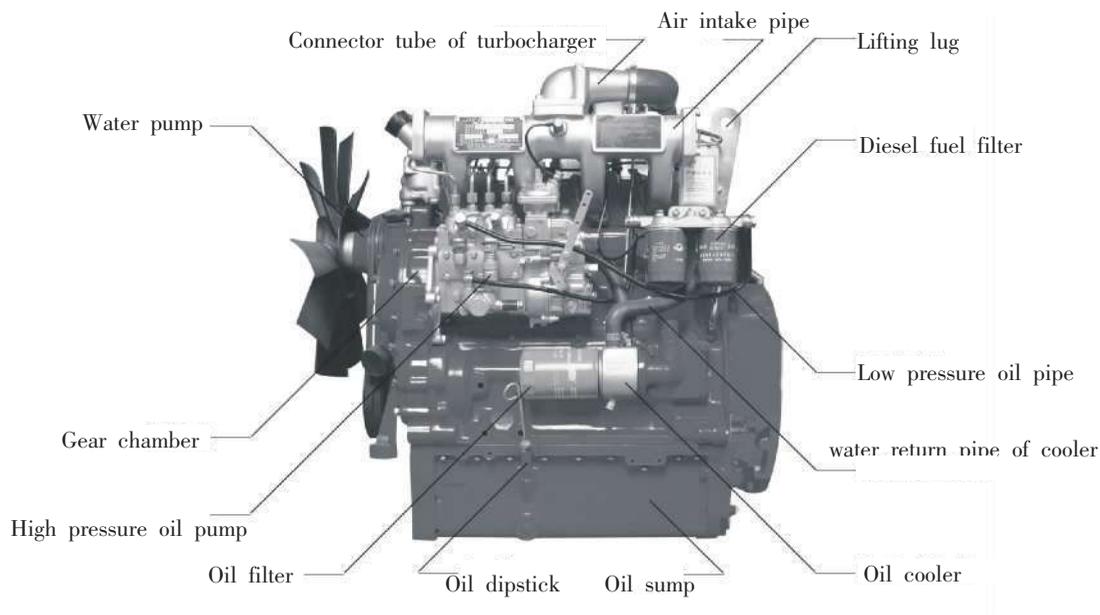


Fig1-1 Left-side view

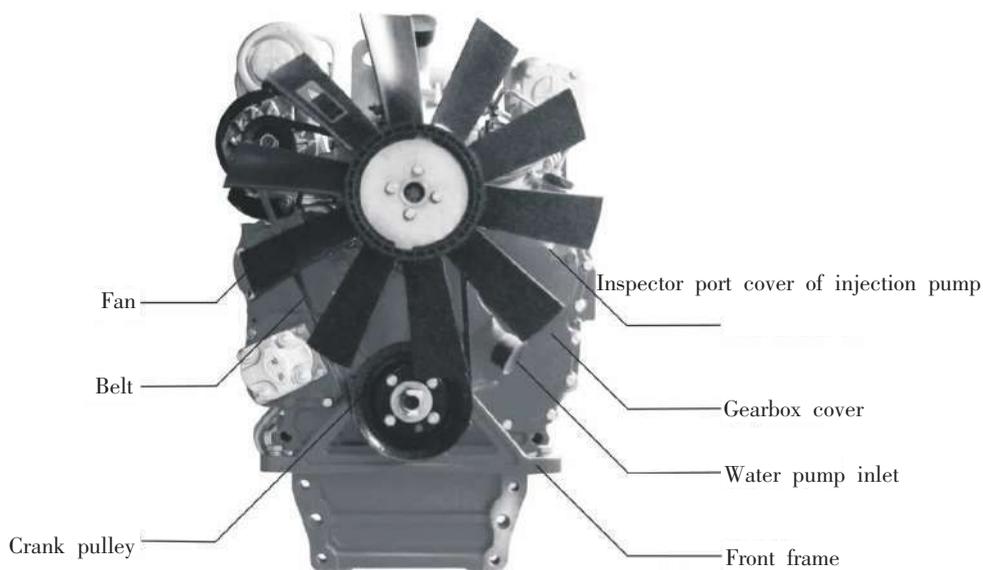


Fig1-2 Front view

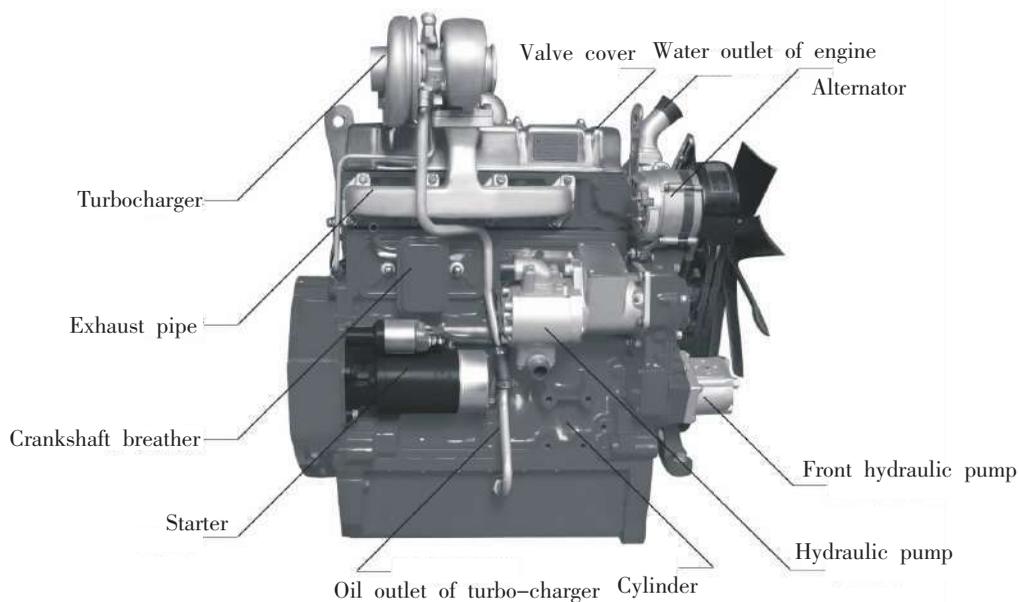


Fig1-3 Right view

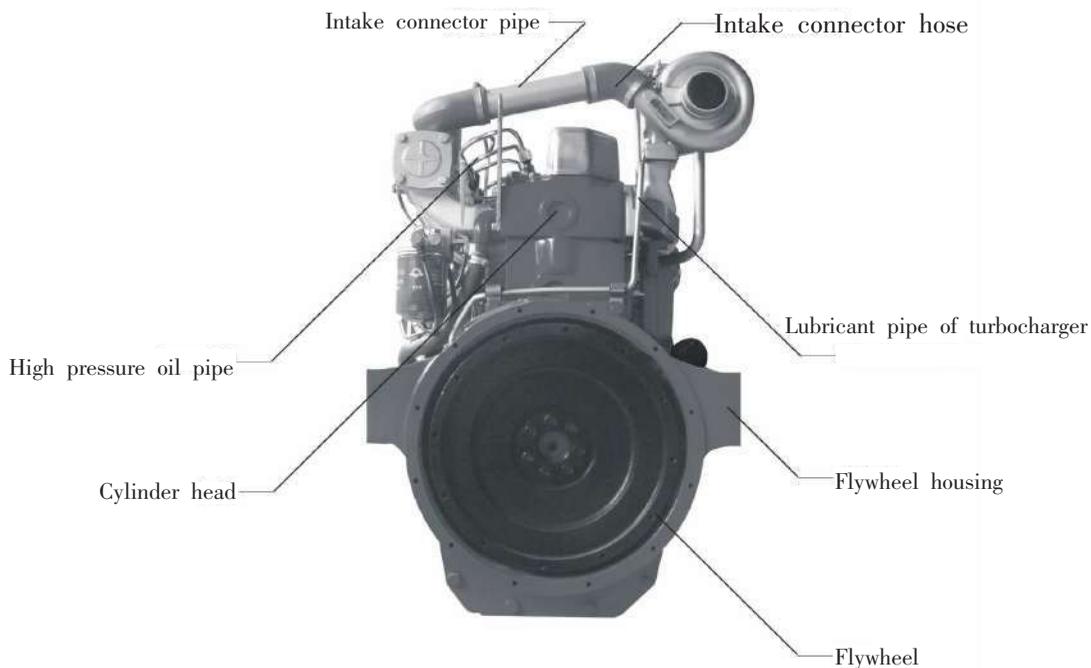


Fig1-4 Rear view

### 3 Important Safety Information

#### 3.1 Before Starting the Engine



The product that you selected conforms to Chinese safety standard. It will be well worth to read this manual from cover to cover prior to putting the engine into operation. It covers important information about engine installation, use and safety instruction. If you do not obey above instructions, when engine have some faults, the manufacturer will not take any responsibility. Follow the instruction of this manual to run in the engine, use the engine and maintain the engine.

#### 3.2 General Safety Rules



Never try to approach the turning parts when the engine is running (see Fig1-5). The protective devices should be installed when turning parts, such as fan, belt and fly wheel are exposed outside during operating engine. Do not try to disassemble, adjust & maintain the engine when engine is running. All the works should be done after stopping the engine.



Fig.1-5 Located on Alternator Hood



Fig.1-6 Located below Exhaust Pipe

3.2.2 When engine is working, the temperature at the turbocharger, exhaust pipe, muffler and radiator is very high, the protective devices should be installed. Pay attention to keep your body away from the engine to avoid hot injure (see Fig1-6).



3.2.3 Do not add the coolant to the engine at hot engine temperature. To avoid hot injure, please wait the coolant temperature lower down after engine is stopped.

3.2.4 Do not operate the engine in room or closed place. Pay attention to have good Ventilation in order to avoid personal injury.



3.2.5 Keep engine away from flame when adding fuel and lubrication to the engine. Meanwhile, Exhaust gas has also very high temperature, please install spark extinguish devices to exhaust pipe or the muffler if the engine is located nearby the flame-able materials.

### 3.3 Use Information



3.3.1 Lubricant Selection: Naturally aspirated diesel engine should use no lower than CD grade engine oil. Turbocharged Diesel Engine should use CF grade or above CF grade engine oil. Do not mix the new oil with the used oil or other grade oil.



3.3.2 Do not operate the engine without air filter. Often check the air inlet pipeline (Including connecting pipe lines between the turbocharger and the inter-cooler) in order to ensure the sealing performance.

3.3.3 Do not try to dismount the turbocharger. For turbochargers with waste gate valve, do not try to dismount or remove the valve controller and its support.

3.3.4 Electric circuit connection should be correct and firmly. Do not dismount connection lines to avoid accidents when alternator is running.

3.3.5 When engine works without oil pressure or low oil pressure, high coolant temperature, abnormal noise in the engine, stop the engine immediately, find out the causes and correct them.



3.3.6 When the engine runs away, cut off the fuel supply pipe or block up the intake pipe immediately.

### 3.4 After Operation



3.4.1 Stopping the engine suddenly is prohibited when coolant is in high temperature. Before stopping the engine, reduce the load and speed, let the engine run stably for 2-3 minutes, and then do not stop the engine until the coolant temperature is below 70°C.



3.4.2 If the engine need to store for a long period at the temperature below 0°C, if the engine does not use antifreeze, drain out the water in the cooling system or add antifreeze as coolant to prevent the engine damaged due to freezing.

### 3.5 Fault Appearance



3.5.1 Without allowance of special service centers of the manufacturer, never overhaul and maintain the engine by customers within the warranty period when the fault happens to the engine.

3.5.2 Do not try to remove and adjust the lead seals on the injection pump.



3.5.3 Please contact our hot line 086-379-64245033.

3.5.4 Please provide the accurate contents on the nameplate for the special service stations when your product needs service.

#### 4 Name Plate and Identification Number



Fig1-7 Name Plate

Number

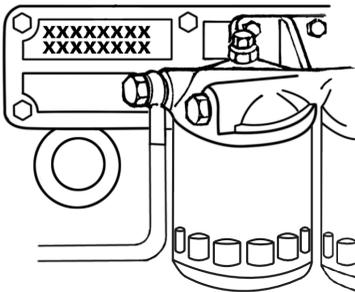


Fig1-8 Engine Serial Number

Nameplate is located on the outside of intake pipes. There are the main data and information for warranty claims and ordering spare parts. The contents on the nameplate for engines are shown on Fig 1-7.

The serial number on the nameplate is the same as the number on the engine block (see Fig 1-8). Please check them carefully as it is required for customer to get after sale service. The serial numbers are located on the different places on the engine block depending on models, most of them are located at the side of fuel injection pump or on the cover board.

Notice: there is not supply symbol on the name plate of some engines.



Without allowance by the manufacturer, changing nameplate or the engine serial number is prohibited. If you do it, this means that you will forwardly give up your rights.

## Chapter 2 Engine Usage

### 1 Fuel/Lubrication/ Coolant Selection

#### 1.1 Fuel Selection

Fuel used is light diesel that must meet China Standard: GB 252 - 2000. For different ambient temperatures, relative grade diesel fuel must be used, see Table 2-1.

Table 2-1 Ambient Temperature and Fuel

Ambient Temperature(°C)	$\geq 4^{\circ}\text{C}$	$\geq -5^{\circ}\text{C}$	$-5\sim-14^{\circ}\text{C}$
Fuel Grade	0	-10	-20

Each performance index of the engine is related to fuel grade, less than required fuel grade can influence the engine performance.

In order to prolong the service life, fill the engine with only clean diesel fuel. Fuel container must be clean and specialized. When filling the fuel into the engine, it's better to adopt sealing method. Do not fill fuel until fuel deposits for three to seven days, and take the fuel from topside of the container or barrel. Pay attention to keep the fuel clean during the transportation, filling and usage to avoid the fuel be contaminated.



When filling or operating the engine, you should stop the engine and keep the engine away from flame or other danger sources.

#### 1.2 Lubricant Selection

1.2.1 Lubricant Selection: Naturally aspirated diesel engine should use no lower than CD grade engine oil; Turbocharged diesel engine should use CF grade or above CF grade engine oil.

1.2.2 Lubricant selection in different ambient temperatures (see Tab 2-2).

Table 2-2 Ambient Temperature and Lubricant

Ambient Temperature(°C)	$>10^{\circ}\text{C}$	$-10^{\circ}\text{C}\sim 30^{\circ}\text{C}$	$-25^{\circ}\text{C}\sim -10^{\circ}\text{C}$
Lubricant Grade	40	15W/40	5W/30



Fig2-1 Oil Filler

#### Usage notice for turbocharged diesel engines

- 1 Choose relative CF grade oil according to different ambient temperatures.
- 2 Clean or replace oil filter after the engine works for more than one week. Before starting engine, add oil into the turbocharger.
- 3 After starting the engine, first of all, let the engine run at the idle speed for 3 minutes, and the engine speed should not be increased until the bearings in turbocharger have a sufficient lubrication.
- 4 Before stopping the engine, let the engine run at the idle speed for 3 minutes in order to reduce the speed of the turbocharger vastly and make the turbocharger operate reliably.

Engine Oil and Operation Prompting(Located on Intake Pipe)

### 1.2.3 Adding the Lubricant:

Add specified lubricant from oil filler, and wait for 5 minutes, check the oil level on the dipstick, make sure the oil level between the upper mark and lower mark (see Fig2-2).

If the engine has a additional oil cooler, for the first time to filling oil into the engine, may add a little bit more, let the engine run for 3 to 5 minutes, then stop the engine for 5 to 10 minutes, recheck the oil level and make sure the keep the oil level correctly.

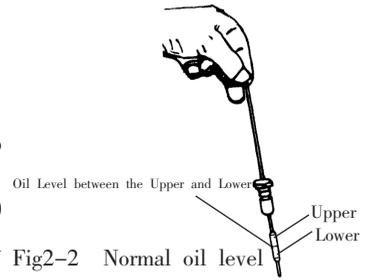


Fig2-3

Oil filler

Upper limit screw

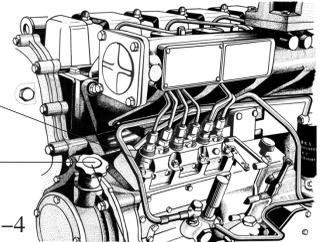


Fig2-4

Oil Fill Cap

1.2.4 For different configurations, the engines adopt various kinds of injection pumps, some of injection pumps adopt lubricating separated from the engine, such as ZHB pump. When adding the oil, loosen upper limit screw and add the lubricant from oil filler (see Fig2-3), do not tighten the limit screw until the oil in limit hole appears (see Fig2-4).

If there are lubricant pipes between injection pump and main oil gallery of the engine, the injection pump does not add the oil.

### 1.2.5 ZHB the use of lubricating oil injection pump

Diesel engine lubricating oil filling should be consistent with the use of lubricants.



Fig2-5 Mark in Oil Basin

### 1.2.6 Add the oil to oil-bath air cleaner

There should be enough oil in oil-bath air cleaner. Never overrun scribed line in oil basin when adding the oil (see Fig 2-5). There should be enough oil in metal screen of oil-bath air cleaner. Install metal screen after it is marinated in oil.



There should be enough and specified lubricant in the engine, injection pump and oil-bath air cleaner.

Faults which are caused by poor quality lubricant, the manufacturer will treat the customers as giving up their rights.



Never use common lubricants, do not mix different grade oil or oil from different refineries together, never mix the new oil with the used one.



Do stop the engine when filling oil, and keep the engine away from flame or other dangers.

### 1.3 Coolant Selection



1.3.1 The cooling water used in engine should be clean soft water, such as river, water, rain water, snow water, or add the engine with purchased antifreeze.

1.3.2 When the ambient temperature is below 0°C, add antifreeze additives as the coolant in order to reduce draining water or prevent the parts from damage.



Never let the engine start and run without coolant.

Never add coolant after opening radiator cap at high temperature, this would make serious personal injury.

## 2 Before First Operation



2.1 Read the operation and maintenance manual carefully before starting, performing on the engine, strictly follow the instruction in the manual for engine running-in, operation and maintenance.

2.2 Before operating the turbocharger, add a little bit oil into the inlet of turbocharger.

2.3 During the operation, never run the engine at idle speed more than 10 minutes.

2.4 If the engine need to store for a long period at the temperature below 5°C, if the engine does not use antifreeze, all the water in the cooling system should be discharged to avoid the engine damaged.



2.5 After the engine is started, do not operate the engine at high speed and load immediately, let engine at middle speed until water temperature over 60°C, and then increase the speed to maximum with full load. Do not run the engine with overload for a long time.

2.6 Continuously operating the engine is prohibited when the oil pressure is lower than 98 kPa or without oil pressure.

2.7 Do not continuously operate the engine with abnormal noise and leakage in intake system. Stop the engine, and look for any failure and correct it.

2.8 Do not use watering from outside to reduce the engine temperature when the coolant temperature is above 95°C. Let the engine run at low speed in order to gradually reduce the engine temperature.

2.9 Do not stop the engine immediately when coolant and lubricant temperature are too hot. Before stopping the engine, reduce the load and speed of engine step by step, let the engine run at low speed for 3-5 minutes. And do not stop the engine until coolant and lubricant temperature is reduced down.

2.10 Do not stomp or deposit heavy things on all exterior parts of the engine.

### 3 Starting the Engine

#### 3.1 Pre-starting Preparation

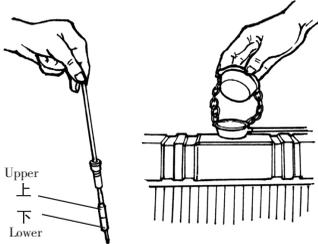


Fig2-6 Check coolant and lubricant level

3.1.1 Check coolant level and add enough cooling water (see Fig 2-6)

3.1.2 Add specified lubrication from oil inlet and wait for 5 minutes, check the oil level on the dipstick, make sure the oil level between the upper mark and lower mark.

3.1.3 make sure that the oil level of the injection pump and oil-bath air cleaner is correct.

3.1.4 Check the tightness of the connection of oil pipes, water pipes and air pipes, and make sure that there is not leakage.

3.1.5 For a new engine, a repaired engine or an engine stored for a long time, use the following procedures to bleed the fuel system before starting: First of all, loosen bleeding screw on the fuel filter. Pump the fuel transfer pump by hand to bleed air in the fuel. Retighten the bleeding screw on the fuel filter.

Loosen bleeding screw on the injection pump. Repeat above procedure (see Fig 2-7, Fig 2-8 and Fig 2-9).

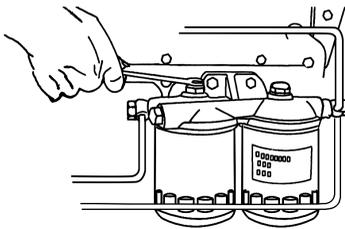


Fig2-7 Bleeding Diesel Filter

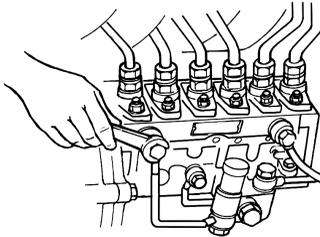


Fig2-8 Bleeding Injection Pump

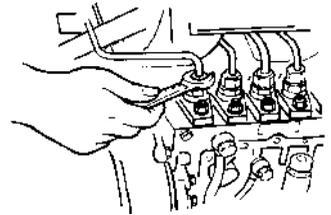


Fig2-9 Bleeding High Pressure Pipe

3.1.6 Check the tension of fan belt, electrical line connection and battery output.



3.1.7 For a new, or repaired turbocharged diesel engine or a turbocharged diesel engine stored for a long time, loosen oil inlet of turbocharger, add a little oil, tighten the screw, and then start the engine (see Fig 2-10).

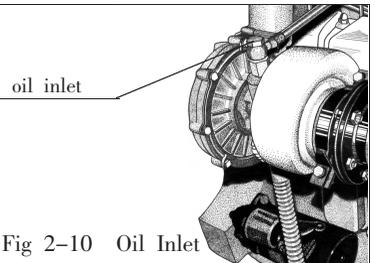


Fig 2-10 Oil Inlet

### 3.2 Starting the Engine



3.2.1 When starting the engine, do not try to approach these parts of engine, such as turning parts, front and back of moving parts, which could make you injury.

Do not start the engine by using short circuit method.

3.2.2 Before starting the engine, move the transmission control to NEUTRAL.

3.2.3 Move the fuel pump rack approaching maximum position and leave the shut off hand lever at fuel supply position.

3.2.4 Turn on the power switch. Push down the start button to start the engine. When the ambient temperature is below  $-10^{\circ}\text{C}$ , for the engine with preheating function, press air preheat button to preheat the engine for about 30 seconds, and then the engine can be started easily.



3.2.5 The time of startup must be restricted in 10 minutes to prevent the starter and battery. The interval of each startup is 1–2 minutes. If the engine can not start over 3 times, find out the causes and correct them before starting the engine.

### 4 Operating the Engine

4.1 After the engine is started, put the fuel pump rack at the position of idle speed. Be sure that the oil pressure is not less than 98kPa.

4.2 After the engine is started, do not operate the engine at full load immediately. Let the engine run at middle speed in order to preheat it. Do not let the engine operate at full load and maximum speed until the coolant temperature is up to  $60^{\circ}\text{C}$ .

4.3 During the engine operation, always check engine oil pressure and coolant temperature regularly. At normal ambient condition, the coolant temperature should be about  $75^{\circ}\text{C}\sim 90^{\circ}\text{C}$  and the oil pressure 294 kPa to 490 kPa . However when oil temperature is  $95^{\circ}\text{C}$  to  $100^{\circ}\text{C}$ , the oil pressure could be a little bit lower than 294 kPa.

4.4 When operating the engine, pay attention to any abnormal noise and look for leakage at the connection of fuel pipes, water pipes and air pipes. If any encountered, remove it immediately.



4.5 When the engine runs away, cut off fuel supply or choke the air intake system in order to stop the engine (see Fig 2-11).

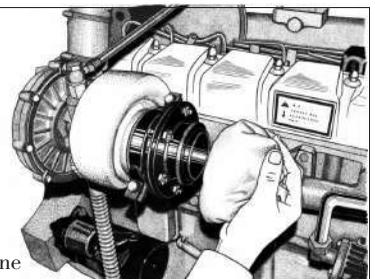


Fig2-11 Stop the Engine



4.6 Do not let the engine run at the idle speed over 10 minutes. This will cause the failure of injection system.

4.7 When the ambient temperature is below  $-10^{\circ}\text{C}$ , do not let the engine run at the high speed immediately after the engine is started.

4.8 Do not run the engine when the oil pressure is less than 98 kPa. If it happens, find out the causes and correct them immediately.

4.9 Do not let the engine run continuously when the coolant temperature is lower than  $60^{\circ}\text{C}$  or above  $100^{\circ}\text{C}$ .

## 5 Stopping the Engine



5.1 After operating under heavy load condition, allow the engine to idle for approximately 3 to 5 minutes prior to stop the engine.

5.2 In order to avoid air entering fuel supply system, do not stop the engine by turning off the fuel tank switch.

5.3 When the ambient temperature is below  $5^{\circ}\text{C}$ , for the engine without antifreeze coolant, drain the cooling water when the cooling water temperature is at  $40^{\circ}\text{C}$  to  $50^{\circ}\text{C}$ . Open one by one the water drain cocks on radiator, cylinder body and oil cooler. And then let all cooling water off.

5.4 Maintain the engine according to the instructions if the engine is to be stored for a long period of time.

## 6 Running in

6.1 For a new engine or repaired engine, Run in the engine gradually to improve working capability of the engine before operating the engine. After running-in the engine, its functional reliability and usage life will be improved obviously.

6.2 With the engine running-in, the following procedures should be complied with.

6.2.1 Warm up the engine at light load and mid-low speed in order to make coolant temperature up to  $60^{\circ}\text{C}$ .

6.2.2 Idling the engine not over 10 minutes.

6.2.3 Often observe coolant temperature and oil pressure, keep them in normal ranges.

6.2.4 Check the levels of coolant and lubrication, keep them in normal ranges.



6.3 The running-in hours of YTO LR-R, A, B, M, N, V series engines is not less than 60 hours. Run-in the engine in proper sequence according following tables (Tab 2-3).

Table 2-3 (1) Engine Running-in Procedure (Three Circles)

Load(%)	Speed(%)	Hours/min	Load(%)	Speed(%)	Hours/min
25	70	60	75	80	150
50	70	120	90	80	30

Table 2-3(2) Engine Running-in Procedure (Five Circles)

Load(%)	Speed(%)	Hours/min	Load(%)	Speed(%)	Hours/min
50	80	60	90	90	150
75	80	120	100	90	30

Table 2-3(3) Engine Running-in Procedure (Two Circles)

Load(%)	Speed(%)	Hours/min	Load(%)	Speed(%)	Hours/min
50	100	60	90	90	150
75	100	120	100	100	30

6.4 When engine matches with automobile vehicles, running-in the engine according to the vehicle running-in procedure. Total running-in mile is not less than 2 500 km.

6.4.1 Not more than 50% load, running is 800 km, running velocity is less than 70% corresponding the engine speed.

6.4.2 Not more than 75% load, running is 1500 km, running velocity is less than 75% corresponding the engine speed.

6.4.3 75% load, running is 1 500 to 25 000 km, running velocity is less than corresponding the engine rated maximum speed.

6.5 After running-in, clean and check the engine according to the following procedure (please read relative contents in the maintenance manual carefully).

6.5.1 Change the oil, replace the oil filter elements, and clean the oil sump.

6.5.2 Change the diesel fuel filter element.

6.5.3 Check and adjust valve clearances and fuel supply advance angles. Tighten all the bolts and nuts (see chapter 5).



Do not operate the engine at full load without running-in. This will shorten the engine useful life.

## Chapter 3 Maintenance

### 1 Technical Maintenance

Considering that the engine is used under normal working conditions, the maintenance intervals stipulated are determined. When working in extremely adverse conditions, it is recommended that the planned maintenance should be executed at shorter intervals.

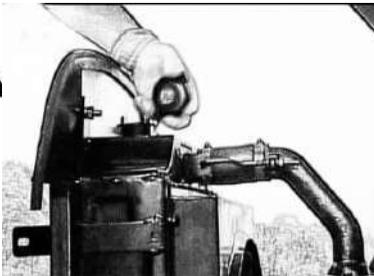
Maintenance intervals stipulated are divided into four maintenance periods.

- 1.1 Daily Maintenance: Every 8 to 10 hours.
- 1.2 Class I Maintenance: Every 50 hours (about 2000 km for vehicles).
- 1.3 Class II Maintenance: Every 150 hours (about 6000 km for vehicles).
- 1.4 Class III Maintenance: Every 900 to 1000 hours (about 35000 km for vehicles)



For the turbo-charged and turbo-charged with intercooler diesel engines, the period should be shortened by 20%

### 2 Daily Maintenance (After 8 to 10 hours)

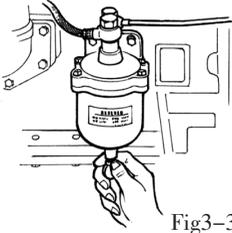


2.1 Before starting the engine every day, check whether the oil level in oil sump and injection pump without pressurized lubrication is correct. Refill the oil if necessary. Pay attention to check whether there is water in oil.

2.2 Check the coolant level in the radiator, refill them if necessary (see Fig3-1).



2.3 Clean sundries and dust on radiator grille. Remove the dust and oil outside the engine. For the engine used for tractors, do clean them at any time (see Fig3-2).



2.4 Drain the water from filter element with drain cock, and sedimentation filter (see Fig 3-3).

Fig3-3 Drain the Water



2.5 Check and retighten all fastening screws. Correct any fuel, water gas leak found (see Fig3-4).

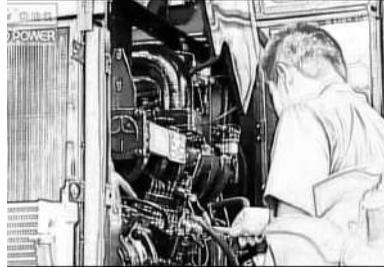
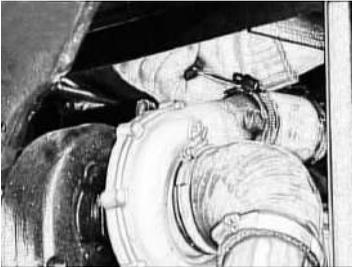
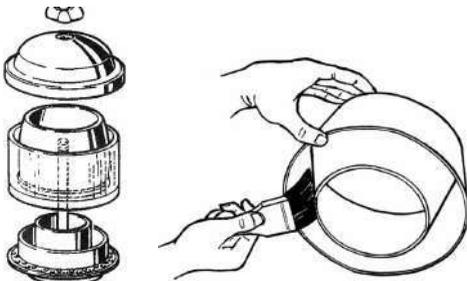


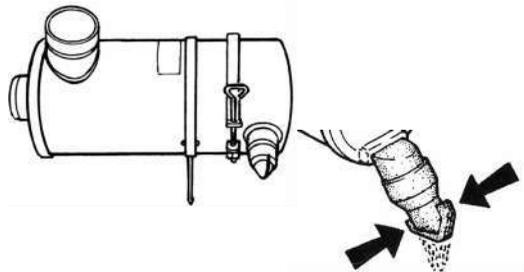
Fig 3-4 Check the Leaks

## 2.6 Air Cleaner

2.6.1 Clean the dust accumulator of oil bath air cleaner.



2.6.2 Clean the drain valve of dry air cleaner.



For the engines under the special conditions, cleaning time should be shortened. Recommended cleaning time is listed in Table 3-4.

Table 3-4 Recommended Cleaning Time

Harvesters	Every 4 hours
Tractors	Every 6 hours
Construction machinery working in mines with more dust	Every 4 hours
Machines working in general condition	Every 8 hours

### 3 Class I Maintenance (after 50 hours)



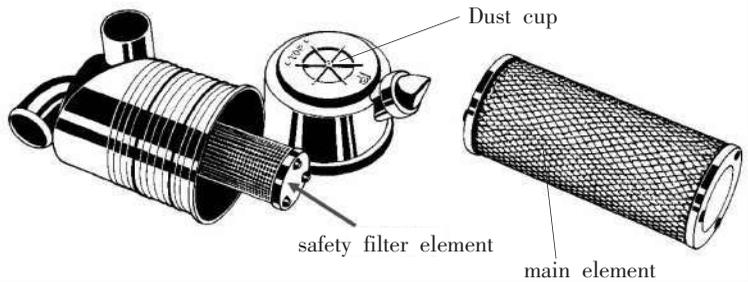
3.1 Perform all the items in Daily Maintenance.



#### 3.2 Clean dry air cleaner

Do not wash the dry paper filter element with water, diesel oil or gasoline. Be careful not to touch the paper filter element, and sealing ring should not forget to be installed in order to avoid air filter damaged. For the air cleaner with safety filter element, do not remove the safety filter element during operation and maintenance so as to avoid excessive wear due to broken main element. Replace the main element immediately when finding it out broken (including safety filter element).

3.2.1 All the junction parts of dry oil filter must be reliable. Do not go on working when any breakage happens.



3.2.2 Clean the dust accumulator of air cleaner (see Fig3-5).

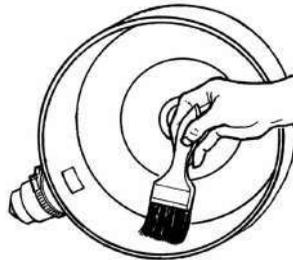


Fig 3-5 Clean Dust Accumulator

3.2.3 The filter element can be cleaned by finger tapping the upper and lower covers. Clean the dust on filter element with brush, or use compressed air along the pleats to blows the dust from inside to outside, and then from outside to inside, and finally from inside to outside (see Fig 3-6).

The filter element installation sees section 4 in chapter 3



Fig 3-6 Clean Air Filter Element

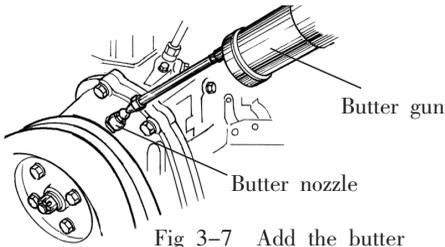


Fig 3-7 Add the butter

3.3 Add the butter of 15g to water pump bearing (see Fig 3-7). For maintenance free water pump, does not add the butter.



Running the engine with failure is prohibited. Pay a special attention to observe and hear abnormal noise and vibration, and watch whether the smoke color is normal. If finding out the failure, correct them immediately.



3.4 Measure the degree of tightness of fan belt. Press the belt between water pump and generator by hand. The deflection should be 10-20mm. Adjust belt tension if necessary by changing the position of the generator (see Fig3-8). Do not use the new and old one or different brands together.

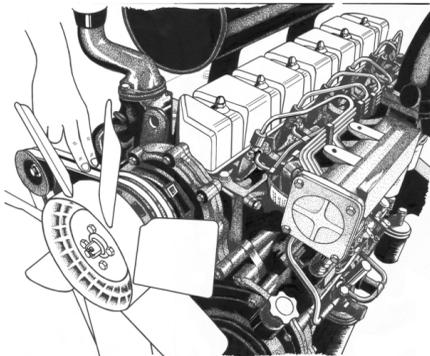


Fig 3-8 Check Belt Tension

Adjust the tension of multi-rib flat belt used for N series engines by tension pulley (see Fig3-9).

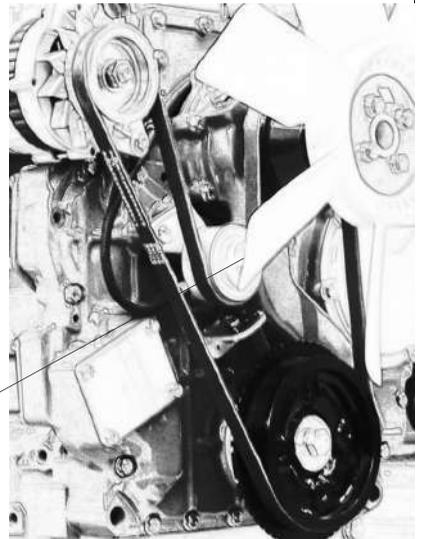


Fig 3-9 Tension Pulley



3.5 For the first Class I Maintenance of a new or overhauled engine, change the lubrication, and clean the oil sump and air filter. Check the torques of main bolts and nuts. Check and adjust valve clearances and fuel supply advance angles. For details, please see section 4 and 5 of chapter 3.

#### 4 Class II Maintenance (after 150 hours)



4.1 Perform all the items in Class I Maintenance.



4.2 Warm up the engine until the oil temperature reaches 50~60°C. Unscrew the oil drain plug to drain the oil (see Fig3-10). Add cleaned diesel oil to clean the oil sump, and then drain them. Refill new oil after tightening the screws.

Fill the new lubrication.

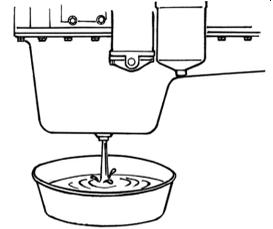


Fig 3-10 Drain the Oil



The used oil should be properly dealt to prevent pollution of the environment.

Pay attention to prevent hot injury by hot oil when adding.



Do not mix the new oil with old oil or different brands oil together.



4.3 Replace diesel fuel filter element: remove single use filter element with special tools (see Fig3-11). Before installing new filter element, daub a thin coat of oil on the sealing ring, then fix with the unloading torque.

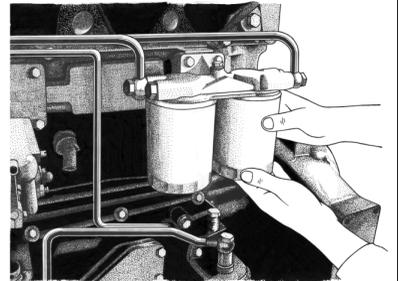


Fig3-11 Replace Diesel Fuel Filter Element



4.4 Replace spin-on oil filter element; remove oil filter with special tools. Daub a thin coat of oil on the sealing ring of new filter, and install new filter until the filter can be firmly connected with the sealing ring (see Fig3-12). For some filters with paper filter element, filter element is only replaced.

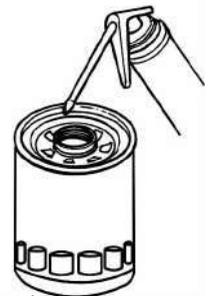


Fig3-12 Replace Oil Filter Element

#### 4.5 Clean air filter

##### 4.5.1 Clean oil bath air cleaner

4.5.1.1 Change the oil in oil bath air cleaner. Add the oil to the specified level.

4.5.1.2 For oil bath air cleaner, wash the filter element assembly with diesel oil or kerosene until it is clean.

4.5.1.3 Marinate the filter element assembly with engine oil. Make the engine oil adhere to the filter element, and then install it.

##### 4.5.2 Replace filter element of dry air cleaner

4.5.2.1 Take out the old filter element. Clean the filter shell and its dust cup with clean wet cloth (see Fig3-13).



Fig3-13 Clean the Shell and Dust Cup

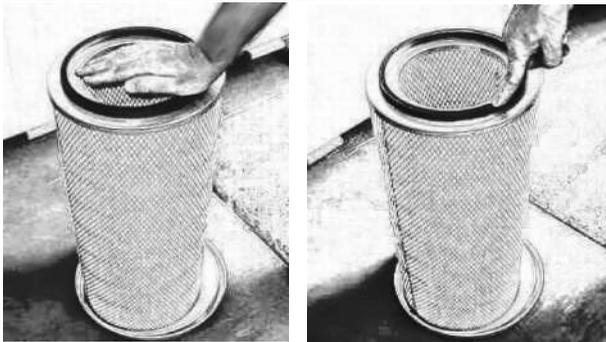
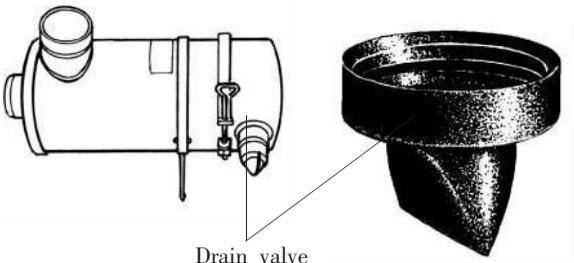


Fig3-14 Rubber Ring Installation

4.5.2.2 For a new filter element, check the elasticity and leak tightness of rubber ring. Press the rubber ring by hand, and make it reliably be connected to filter element (see Fig3-14).



Drain valve  
Fig3-15 Drain Valve

4.5.2.3 After installing the filter element, check the drain valve. If any breakage occurs, replace it immediately (see Fig3-15).



4.6 Check the injection pressure and quality of sprayer (see Fig3-16). The opening pressure of J series fuel injection is 19.6 MPa to 20.8MPa. The opening pressure of P series fuel injection is 25 MPa to 26MPa. Clean the soot and adjust the pressure if necessary.

When nozzle is blocked, it must be replaced. It is suggested that all the jobs are finished by the professionals.

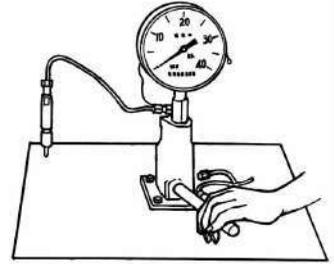


Fig3-16 Check the Injector



4.7 Check and adjust the fuel supply advance angle of the injector. For details, please see section 5 of charter 5.



4.8 Check and adjust the clearances of exhaust valve and intake valve. The clearance of intake valve is 0.3mm to 0.4mm, the clearance of exhaust valve is 0.4mm to 0.5mm. For details, please see section 2 of charter 5.



4.9 Check and tighten all screws and nuts with specified torques. For details, please see section 1 and 2 of charter 5.



4.10 Check the leakage of intake pipe and exhaust pipe of air compressor. Check and clean the dirt on the exhaust valve and intake valve. Check the leakage. Remove the faults. The profile of the air compressor sees Fig 3-17.

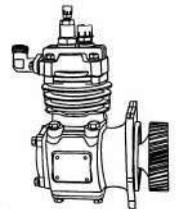


Fig 3-17 Air Compressor

### 5 Class III Maintenance (after 900 hours)



5.1 Perform all the items in Class II Maintenance.

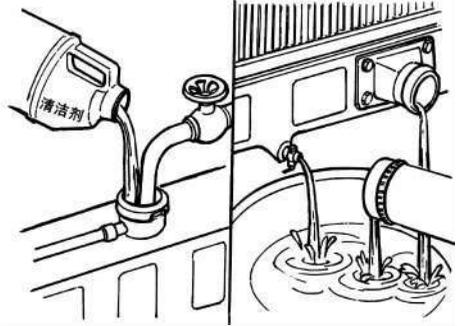
If the users could not independently finish them, it is suggested that the Class III Maintenance jobs are finished by specialized agency.



5.2 Wash and Clean the Cooling System

The scale deposit in the cooling system can cause the cooling failure of diesel engine. Remove it regularly. The general method is that the detergent is poured into the cooling system to wash them. The detergent is mixed with 750g caustic soda and 150g kerosene. Washing the cooling system as fol-

lows: Fill the detergent into engine as coolant. Run the engine at middle speed for 5~10 minutes. Stop the engine. Restart the engine after making the detergent stay at the engine for 10~12 hours. Let off the detergent after running the engine at middle speed 15~20 minutes. let the engine run at middle speed 15~20 minutes after refilling the clean water. Drain the water in the engine.



5.3 Remove the cylinder head. Clean the soot on the valve. Replace the valve oil seal (see Fig3-18).

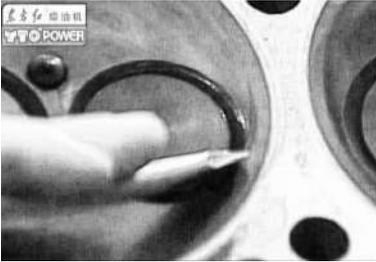


Fig3-18 Clean the Soot



5.4 Check if there is the cinch marks on the liner and piston. Check if the clearance of piston ring is correct (see Fig3-19).

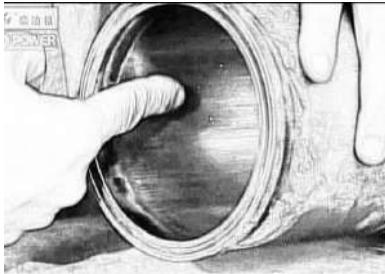


Fig3-19 Check Liner and Piston

5.5 Check crankshaft, main bearing and connecting-rod bearing shell. Replace it if the wear of cinch marks is bigger (see Fig3-20).

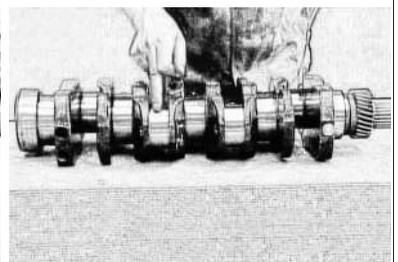
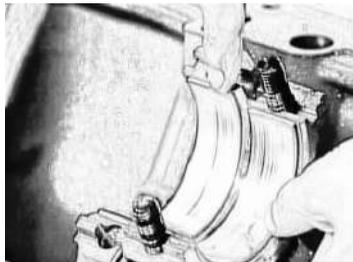


Fig3-20 Check Crankshaft, Main Bearing and Connecting-rod Bearing Shell



When performing the class III maintenance, if any part of the piston, piston ring, liner, main bearing and connecting-rod bearing shell has been replaced, do not operate the engine until rerunning-in the engine is finished completely according to the specified procedure.



5.6 Check water leakage of water pump. Change the water sealing of water pump as necessary (see Fig3-21).

For details, please see section 6 of chapter 5.

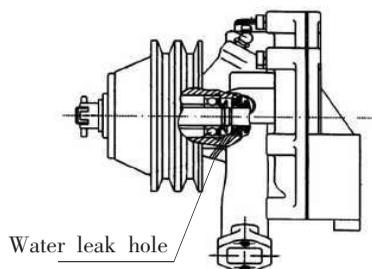


Fig 3-21 Check Water Leakage

## 6. Turbocharger



The turbocharger maintenances should be carried out with the engine maintenance.

### 6.1 Daily Maintenance

Tighten the connection between the turbocharger and the engine. Look for oil seepage and leakage gas, and correct them. Check if the cushion at the connection flange between the turbocharger and exhaust pipe is breakage. Replace it as necessary. Keep outside the turbocharger clean. The structure of the turbocharger sees Fig3-22.

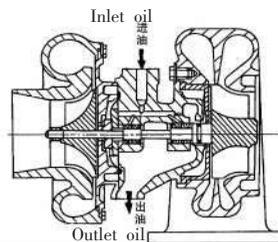


Fig 3-22

### 6.2 Turbocharger Regular Maintenance



The regular Maintenance of the turbocharger is performed when the Class II Maintenance of the engine is carried out.

It is suggested that the maintenance of the turbocharger is carried out by professionals.



Do not dismount and adjust the turbocharger by laypeople.  
Do not allow something to go into the intake system and exhaust system when checking the turbocharger.



6.2.1 Replace filter element of the turbocharger: dismount oil filter with special purpose tools. Daub a little bit oil on sealing ring. And then make the new filter be installed firmly (see Fig3-23).

Turbocharger filter element

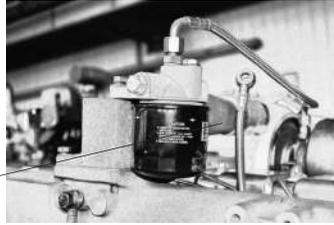


Fig3-23 Turbocharger Filter Element

6.2.2 Wash the intake connector pipes, compressor impeller and compressor shell. Clean the soot in the impeller and turbine casing.

6.2.3 Check the moving parts in the turbocharger. Turn the rotor moving with finger. If the rotor can move some revolutions by inertia force, it is considered moving flexible. If the rotor rotates roughly and knocking noise is heard, find out the cause and correct it.

6.2.4 Check the axial displacement of rotor shaft. If the axial displacement is more than 3mm, which shows that the wear of thrust bearing in the turbocharger is bigger, find out the cause and correct it.

6.2.5 Check the radial displacement between compressor impeller and casing. Press the impeller in radial direction by hand. If the displacement is over 0.1mm, find out the cause and correct it.

6.2.6 When the engine run at the idle speed, unscrew the oil drain connector of the turbocharger. Observe if the lubrication flows through the turbocharger. Check and reinstall it if necessary.

## 7 Maintenance in Winter Season

In winter season (ambient temperature below 5°C), it is difficult to start the engine due to the cooler engine block and stickier oil. The oil in the transmission system and running gears of tractors, vehicles and construction machinery will become stickier due to low temperature. This will cause higher resistance. Therefore, the engine operation and maintenance must be carried out more carefully when the engine runs at the low temperature



When the ambient temperature is below 60°C, do not let the engine run at the full load just after starting.

### 7.1 Cooling System

7.1.1 The engine should use coolant with antifreeze additives in winter season.

7.1.2 Before starting the engine without antifreeze additives, fill the cooling system with 60~70°C hot water ,and then with 90~100°C hot water until the water flowing out at the water drain cock. Fill the radiator with 60~70°C hot water, and then start the engine.

7.1.3 During operation, the coolant temperature should not be below 60°C. If the engine without antifreeze additives is to be stored for a long period of time, drain the cooling system when the coolant temperature reduces at the 50~60°C.

### 7.2 Lubrication System

Use winter lubrication oil in winter season. When the ambient temperature is below  $-10^{\circ}\text{C}$ , turn on the switch to preheat the engine for about 30 seconds before starting.

### 7.3 Fuel Supply System

Use winter fuel in winter season. Keep rain, snow or dirt away from entering fuel system. If the water in the fuel tank is found out, drain the fuel system completely to prevent fuel line choked due to freezing. Refill the fuel tank with new fuel.

## 8 Storage and Maintenance

Use the following procedures to store the engine for over 3 months.

8.1 Turn the crankshaft several revolutions so that the surface of moving parts are equably coated with oil film.

8.2 Drain out the fuel, oil and coolant, including the oil in the injection pump, oil bath air filter.

8.3 Remove the trash, dust and rust outside the engine. Smear anti-rust oil on the unpainted parts and jointed points.

8.4 Plug the air intake, exhaust port and oil filler to prevent something entering the engine.

8.5 Store the engine in dry, clean and good ventilation place. There are no corrosive gases nearby. If the engine is stored outside, cover it with plastic sheep.



For a long period of storage, make a through examination, and run the engine at middle speed and accelerator for 3 to 5 minutes every half a year so as to maintain the moving parts with oil film. Restore the engine with specified requirements.

## Chapter 4 EUP Fuel Injection System Operation Instruction

EUP fuel injection system is a pump-tube-nozzle time controlled fuel injection system, which consist of sensors, harness components, electronic control unit (ECU) electronic unit-pump (EUP) assembly, high-pressure oil tubes and injector. This system can realize flexible control of fuel injection quantity and fuel-injection timing.

### 1 System Constitution (see Fig 4-1)

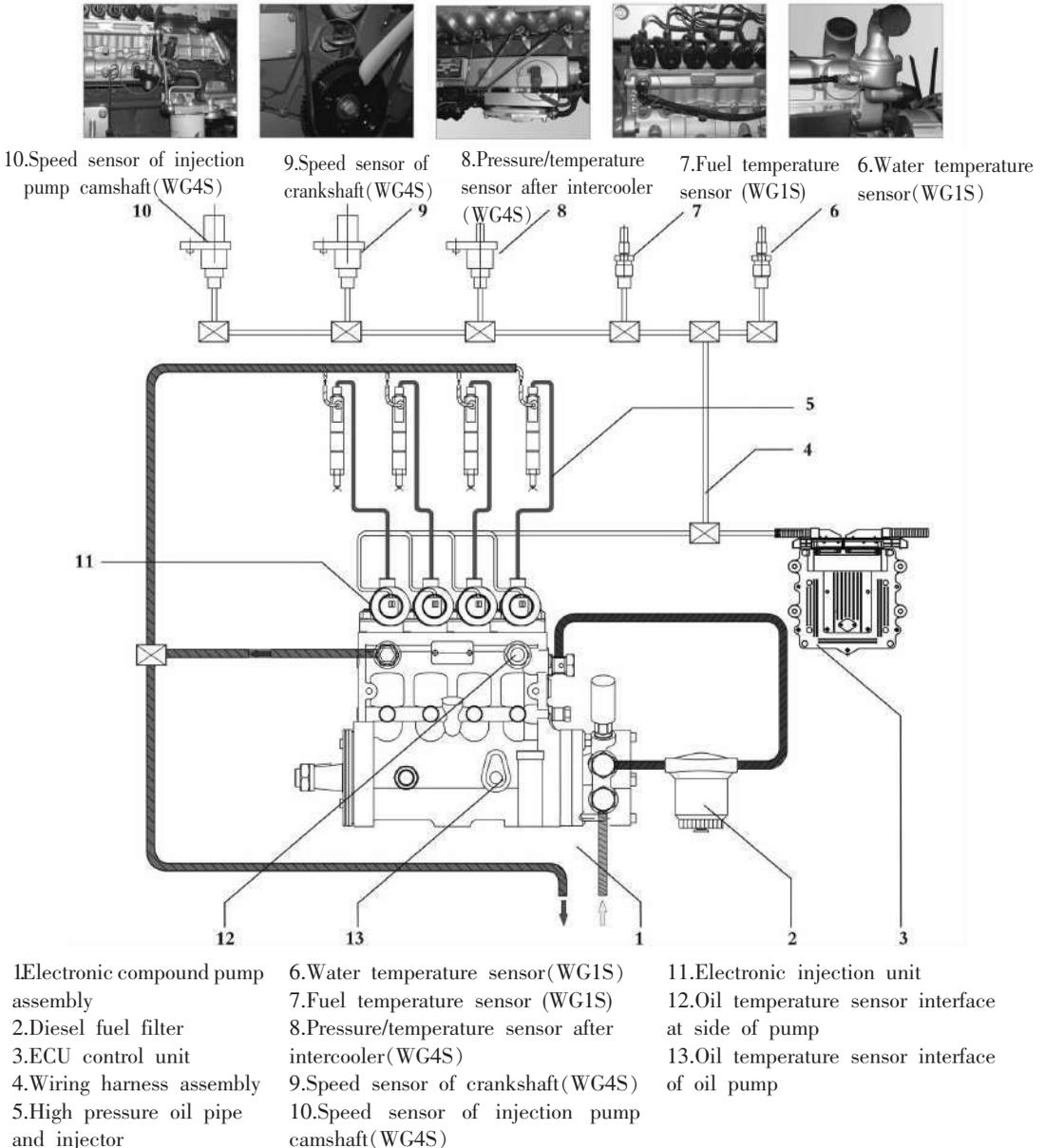


Fig 4-1 Diagram of System Constitution

## 2 Each Part Function and Sensor Installation Position

### 2.1 Diesel engine crankshaft speed sensor

Pulley speed sensor installed on the client side or the flywheel from the ECU to the current diesel engine speed determination (see Fig4-2).



Fig 4-2

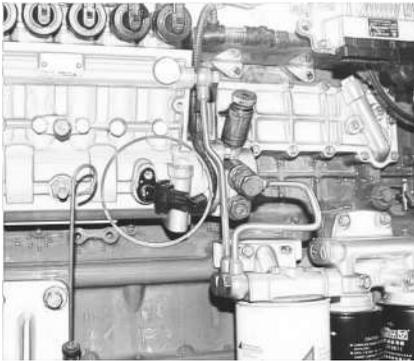


Fig 4-3

2.2 Measure the speed of oil pump cam shaft with ECU. Model number: MG4S (see Fig4-3).

### 2.3 Oil temperature Sensor at the side of Oil Pump

The oil temperature sensor is installed at the side of oil pump. The fuel temperature at the side of oil pump is detected by ECU. Model number: WG1S (see Fig4-4).



Fig 4-4

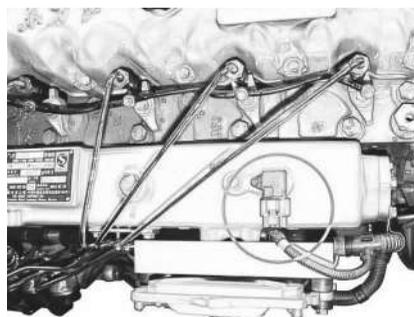


Fig 4-5 Pressure/temperature Sensor after Intercooler

2.4 Pressure/temperature Sensor after Intercooler

The pressure/temperature sensor is installed on the intake pipe. The air temperature and pressure after intercooler are detected by ECU. Model number: YWG1S (see Fig4-5).

### 2.5 Water Temperature Sensor

The coolant temperature sensor is installed on the cooling watercourse or radiator housing, which is used for measuring coolant temperature of the engine. Model number: WG1S (see Fig4-6).

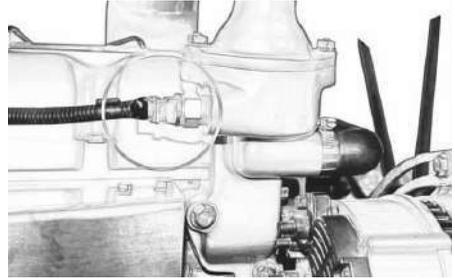


Fig 4-6 Water Temperature Sensor

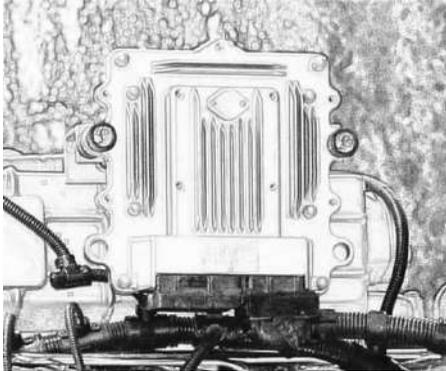


Fig 4-7 ECU Control Unit

every cylinder injection unit of electric pump by using wiring harness (see Fig4-7).

### 2.6 ECU Control Unit

ECU has 121 core standard socket which has error-proof function. 81 core patch plug is connected with the accelerator, detecting Instruments, communication serial port and vehicle power in cab by using wiring harness. 40 core patch plug is connected with sensors of electrical system and every cylinder injection unit of electric pump by using wiring harness (see Fig4-7).

### 2.7 Electronic Unit Pump Assembly

Each cylinder injection unit of electric pump is connected with ECU by using the control wire of wiring harness. For four cylinder engines, wiring harness component consists of 8 control wires, for six cylinder engines, wiring harness component consists of 12 control wires. Each group of two is installed in the plug, which is connected with injection unit of each cylinder electromagnet. The red wire in each group is connected to the control wire of each cylinder solenoid valve, the gray wire in each group is public end (see Fig4-8).

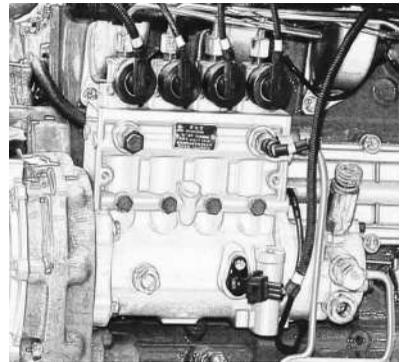


Fig4-8 Electronic Unit Pump Assembly

### 2.8 Wiring Harness Component

The engine control Harness is connected to 40 core standard socket which has error-proof function in ECU through 40 core standard plug, at the same time, which is also connected with the sensors of electric system and electric injection unit of each cylinder (see Fig4-9).

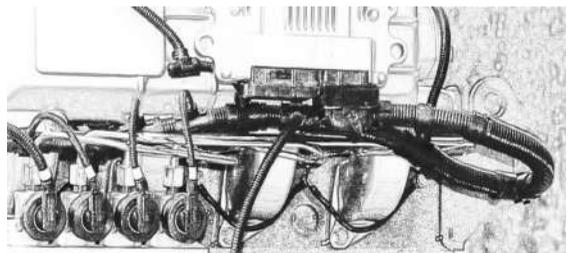


Fig4-9 Wiring Harness Component

### 2.9 Low Pressure Oil Transfer Pipes and Diesel Fuel Filter

2.9.1 Low pressure oil transfer pipes: Low pressure oil transfer pipes use enough strength and performance non-metal pipes to connect oil tank, oil transfer pipes and diesel fuel filter.

2.9.2 Because only high cleaning fuel is used for electronic fuel injection system, so the engine uses filter with high filtration capacity, which can not be replaced by common filter.

### 2.10 High Pressure Oil Pipes and Injector

2.10.1 High pressure oil pipes: high pressure oil pipes used in the system are special purpose parts. The pressure resistance index of high pressure oil pipes is higher than that of general ones because the system is a high pressure injection system. Specified high pressure oil pipes can not be replaced by ordinary ones.

2.10.2 Injector: the injector used in the system is determined by special design and the engine test bed match calibration experiment, and its parameters, such as opening pressure, injection hole numbers, flow and spraying angle must be in conformity with the specified requirements so as to meet the performance and emission of the engine. Therefore, the injector is made from special materials and techniques, although its shape is similar to general injector, but it can not be replaced by ordinary injector. The key parameters of the injector are as follows:

Hole number×angle: 7×155°    Opening pressure : 25 MPa~27MPa

## 3 System Operation

### 3.1 Check-up before Operation

3.1.1 Lubrication: API CF grade or CF above engine oil should be used. Make sure the level at the middle of the dipstick.

3.1.2 Diesel: add the diesel fuel that must meet China Standard: GB-252. For ambient temperatures, relative grade diesel fuel must be used.

3.1.3 Coolant: add the coolant level as specified demand.

3.1.4 Keep the connector tubes of air filter and turbocharged intercooler system without leakage.

### 3.2 Bleeding Low Pressure Pipes and Injection Pump Body.

For a new engine or an engine stored for a long period, use the following procedures to bleed the low pressure pipes and injection pump body before starting: Open the oil tank switch and bleeder screw on the fuel filter. Turn the handle of hand pump anticlockwise to make the handle release. Press the handle to bleed air in low pressure pipes. Close the bleeder screw. Loosen the high pressure pipe connector at the pump one by one. Press the handle until the oil flows out from high pressure pipe. Screw down high pressure pipe. Press the handle back. Tighten it up clockwise.



CF4 grade or above CF4 grade engine oil must be used  
Oil pump should be full with oil before starting to prevent the oil pump from being damaged.

### 3.3 System Inspection

After above items meet the request, start the engine. First of all, turn the power on and turn the ignition key to the first gear and this means the system is switched on. When ECU is switched on, the system is automatically detected by ECU. No matter whether the system is in trouble, the trouble lamp on the instrument panel will forced light up for 4 seconds. If the trouble lamp does not light up after 4 seconds, this means the system is in normal condition. Start the engine.

After 4 seconds, if the trouble lamp goes into blink slowly, this means there are common faults in the system. If the trouble lamp goes into blink fast, this means there are serious faults in the system. Starting the engine is prohibited in above two conditions. Turn the power off, look for the causes and correct them. After the power is turned off, the system is detected until normal condition.

After the power is turned on, the trouble lamp does not light up, this means that trouble lamp has been damaged or the wiring is in trouble. Do not start the engine, and find out the causes and correct them



Do not start the engine when the trouble lamp blinks slowly, fast or is inoperative.



When above faults happen, please contact your local dealer or professional maintenance staff, and correct them.

### 3.4 Normal Operation

3.4.1 During the operation, the trouble lamp on the instrument panel slowly or fast blinks, stop the engine, find out the causes and correct them and then let the engine start and run again.

3.4.2 For other details, please see chapter 2 **Engine usage**.

## 4 Maintenance

4.1 Check the pump assembly and make sure the seal without oil leakage after running-in the engine.

4.2 Combining the engine Daily Maintenance, check the leaks between WP2000 pump assembly and the engine, and bolt tightness.

4.3 Combining the engine Class II Maintenance, check the tightness of set bolts, electromagnet bolts and binding screws in WP2000 pump assembly.

4.4 Connect the solenoid plug well to avoid short circuit. If leakage, crack and short circuit in the electromagnet occur, replace with a new one. The pre-tightening of electromagnet rear cover is 40~45N·m.

4.5 For harness, if these faults occur, such as poor quality electrical connection, scratch in insulating layer and crack caused by excessive curve and extrusion, replace it in time.

4.6 Fuse: 15A fuse, supply 24V power to electromagnet though whole vehicle battery and main relay; 3A fuse, supply power to the ECU Internal circuit.



Changing fuse Specifications is prohibited.



4.7 Before other operation with power-on (such as welding), turn off ECU supply power circuit (disconnect the battery positive electrode), and separate ECU from the engine or vehicle.



4.8 Never swash the ECU and harness directly with high pressure gun when cleaning and maintaining.

4.9 Never dismount or replace the pump assembly or its parts by people who are not from the manufacturer or professionals specified by the manufacturer.

4.10 The waterproofing treatment of ECU controller is done. When fault happens, opening ECU is not prohibited by customers, please send it to the maintenance points specified by the manufacturer.

4.11 Maintenance and operation with charged condition is prohibited. Turn the power off during maintaining.

4.12 For Other maintenances, please see chapter 3 **Maintenance**.

## 5 Fault Diagnosis

During the engine and vehicles operation, the fault may occur to each component in electronic-controlled fuel injection system. When any fault occurs, the engine works abnormally. Some faults can make the engine misfire. ECU not only can write down automatically the faults happened, and but also can indicate the current fault state of diesel engine to driver or maintenance staff through the fault indicator so as to operate and maintain vehicles.

5.1 Fault information is divided into two parts:

5.1.1 General fault level: breakdown is in water temperature sensor, oil temperature sensor, temperature pressure sensor after intercooler. When these faults occur, the engine can work normally through the treatment of control system, but this will influence the power and emission performance of the engine at a certain extent.

5.1.2 Serious fault level: there are the faults in the system which worsen the engine running and even make the engine stop, such as injection faults, abnormal speed signals of crankshaft or camshaft, etc.

### 5.2 Fault Code

5.2.1 Fault codes are encoded by using the SAE International Standards, which is combination of four Arabic numerals, and stands for the specific fault. But the customers can not understand the code, please contact the manufacturer to diagnose and read them by professionals through connecting the display terminal with diagnosis interface. And correct them.

5.2.2 Diagnosis Interface: it is used for the whole vehicle calibration and fault diagnosis. In general condition, the diagnosis interface is connected with the wiring harness of the whole vehicle, and then installed on the instrument panel. The vehicle wiring harness supplies the power to diagnostic interface, and a standard RS-232 communication port. When the computer is monitoring the system or diagnosing the faults, the communication port of harness is connected with the computer , RS-232 port of the fault diagnosis instrument or CAN port, and then the communication is done.



Without allowance, do not modify and adjust the electric control system by customers. When any fault happens, please contact the manufacturer or specialist agencies specified by the manufacturer, find out the causes and correct them. Otherwise, this will bring you a great loss.

For details about electric control system, please refer to the introduction manual supplied by whole vehicle manufacturer or electric control system manufacturer.

## Chapter 5 Main Components Installation and Adjustment



Because YTO LR-A, B, M series engines have many models, therefore, if internal parts of the engine need to repair or replace, please let the model on the nameplate into local dealers or servicers exactly.

For the engine maintenance, please consult the specialized agency and perform by professionals.

### 1 Cylinder Body and Crankshaft Connecting Rod System



Wash all the parts with diesel oil or kerosene, and keep away flame before installation

1.1 For some cylinders with piston cooling nozzle, when installing, the junction surface of the nozzle should be smooth so as to prevent pressure oil leakage. Tighten up the washer and hollow screw (see Fig 5-1).

Cooling nozzle

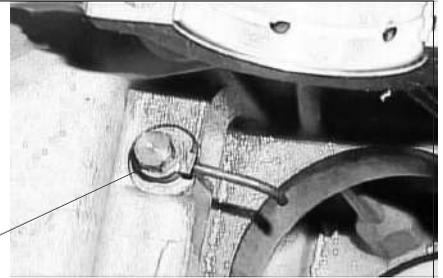


Fig 5-1 Cooling Nozzle

1.2 Opening pressure of the pressure limiting valve of oil pump: 680~700kPa for a four-cylinder diesel engine, 784±19kPa for a six-cylinder diesel engine. Do not adjust it. Lock firmly with iron wire after tightening (see Fig 5-2).

Pressure limiting valve of oil pump



Fig 5-2 Pressure Limiting Valve of Oil Pump

1.3 When installing main bearing, one with hole should be installed on cylinder block, other without hole should be on cover. Counted from rear end of crankshaft, the 2nd bearing bush is trust bearing, it should be installed in right position (see Fig 5-3).

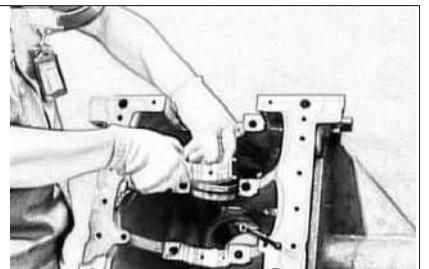


Fig 5-3 Main Bearing Installation

1.4 Before installing crankshaft, check screw plugs and tighten them firmly. Heat crankshaft gear to 100°C, then install it on front of spindle of crankshaft. Coat some oil on main bearings and connecting shafts, then install crankshaft into cylinder block (see Fig 5-4).

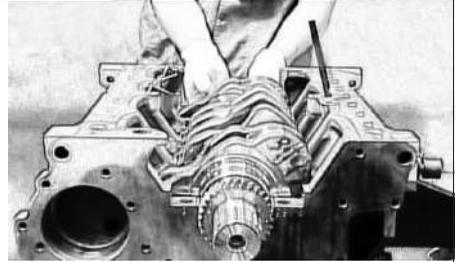


Fig 5-4 Crankshaft Installation

1.5 Pay attention to sequence number on main bearing cover before installation, arrow mark is toward front end of crankshaft, not let them in disorder. Tighten main bearing bolts starting from middle to each ends across two times, tighten torque is 205 Nm (see Fig 5-5).

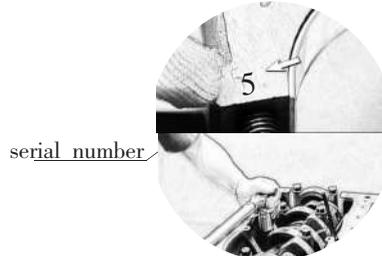


Fig 5-5 Main Bearing Cover Installation

1.6 There are four grooves around outside of wet block sleeves, among them, 1st, 2nd, 4th grooves are used for installing o-rings, 3rd one is leak groove, let this groove align with leak hole on cylinder block while installing sleeves (see Fig 5-6).

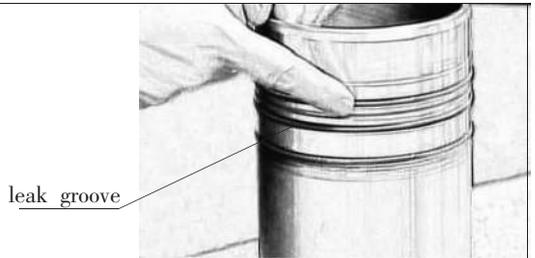


Fig 5-6 Leak Groove

1.7 Coat some oil on O-rings. Push sleeves into cylinder block by hands. If it is too hard, may use woodblock on sleeves, knock woodblock to let sleeves into its position on block. The head face of the sleeves should be 0.05–0.12mm tall above cylinder plane (see Fig 5-7)

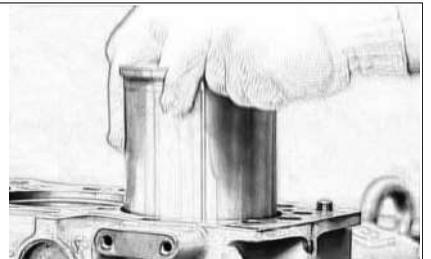


Fig 5-7 Wet Sleeves Installation

1.8 For dry sleeves, coat some oil on outside wall, push it into block, then may use woodblock on sleeves, knock woodblock to let sleeves into it position on block (see Fig 5-8).

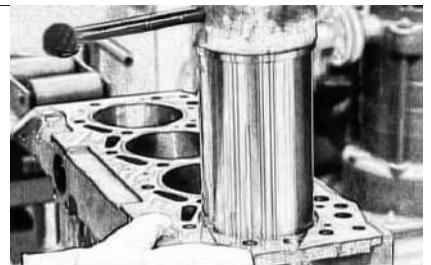


Fig 5-8 Dry Sleeves Installation

1.9 When installing connecting rods with piston, heat the piston to 100°C~120°C. if no heating condition, may put pistons into hot water, and boil it for 5~10 minutes.

1.10 Arrow mark on top of piston should align with forging mark on connecting rod side. Keep block ring into groove after installing piston pin (see Fig 5-9)



Without heating piston or knocking piston pin into piston is forbidden. For the same engine, weight grouping of the piston should bring into correspondence with that of connecting rods.

1.11 Oil ring is the 3rd of piston ring grooves, keep notch of oil ring separated with notch of supporting spring 180 degree. Make mark sides upward, if 1st and 2nd compression rings have a mark, it's doesn't matter for rings without mark. Notch of oil ring should avoid piston pin's, make notches of those three rings separated each other in 120 degree.

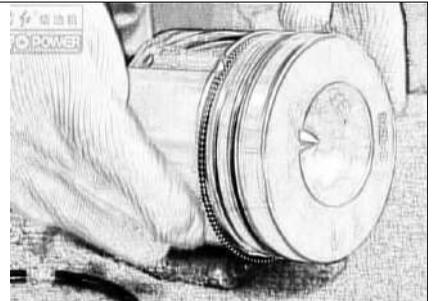


Fig 5-9 Piston and Piston Pin Installation

1.12 Coat some oil on piston and surface of cylinder sleeves before installing pistons, Use special tooling to install piston with connecting road assembly into sleeves, make arrow mark on top of piston faces to front end of crankshaft (see Fig 5-10).

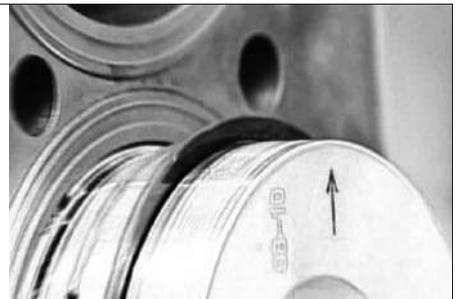


Fig 5-10 Piston Installation

1.13 Before installing connecting rod bearing cover, coat some oil on crankshaft necks. Not mix connecting rod covers, keep group number consistently. Tighten (Tightening) torque of connecting rod bolts is 135 Nm (see Fig 5-11).

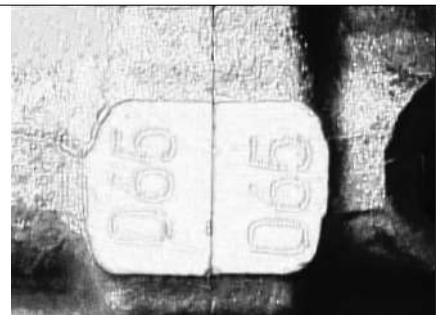


Fig 5-11 Connecting Rod Bearing Cover Installation

1.14 Use fixed pin to fix flywheel with crankshaft, crossly tighten bolts with torque 210 Nm (see Fig 5-12).

lywheel knock-pin

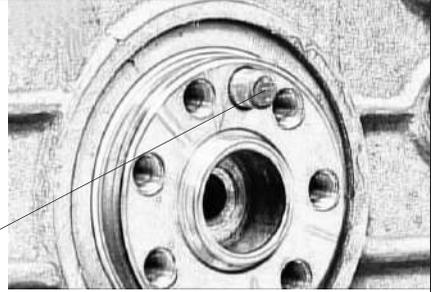


Fig 5-12 Flywheel Knock-pin



YTO-series engine adopted different connecting rods, before maintaining, please consult with local dealer to buy correct spare parts according to name plate on machine.



Group number of connecting rods should not be changed, same as group number of pistons. Connecting rods used on turbo-charger engine is not allowed to use general engine one's.

## 2 Cylinder head and Valve system

2.1 The YTO-series engines use united structure cylinder heads. Froze intake & exhaust valve seats into -180 degree liquid nitrogen, then install them into cylinder head (Fig 5-13).

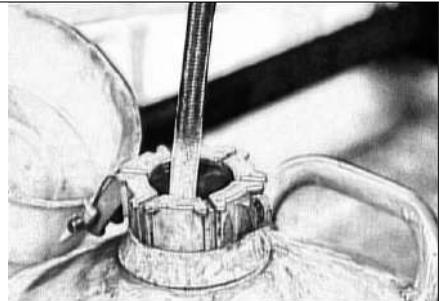


Fig 5-13 Freezing of Intake & Exhaust Valve Seats in Liquid Nitrogen

2.2 There are valve rotators on bottom of exhaust valve spring seat which makes valve rotation, improve valve seal and prolong use life (see Fig 5-14).

Valve-rotator

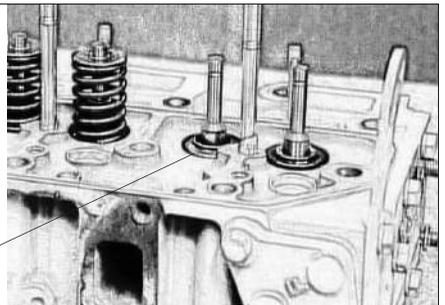


Fig 5-14 Valve Rotator

2.3 There are valve oil seals on valve stem which keep over oil into valve guide pipe. Make valve oil seals go into the correct position (see Fig 5-15).

Valve oil seal

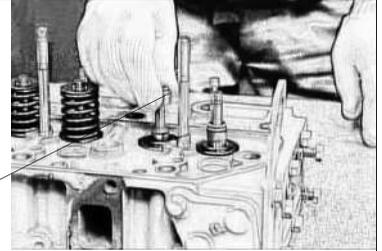


Fig 5-15 Valve Oil Seal



2.4 The cylinder head gaskets (see Fig 5-16) which have non-asbestos one and full metal one are used in YTO series engines according to requirements. When maintaining, please chose and use the same gasket as original engine, and select the torques of cylinder head belts according to the corresponding engine model.

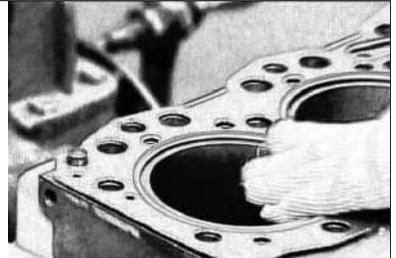


Fig 5-16 Cylinder Head Gasket

2.5 Tighten bolts from inside to outside crossly, first tighten to 80N.m, for the second time, firmly tighten them according to specified torque supplied in the maintenance data table of chapter 7. Sequence for tightening cylinder head belts (see Fig 5-17).

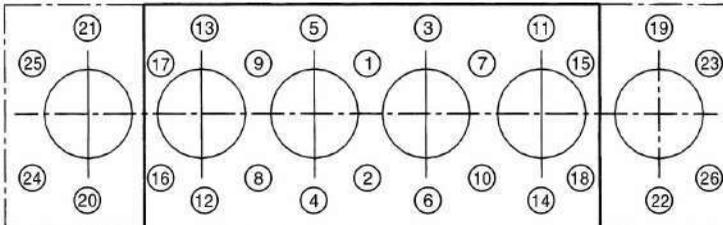


Fig 5-17 Sequence for Tightening Cylinder Head Belts

2.6 Install the valve tappet and valve push rod. Please choose them correctly because valve tappet and valve push rod used in N series engines are different from others.

2.7 When installing rocker assembly, align oil hole on rocker arm seat with oil hole on cylinder head, and tighten bolts (see Fig 5-18).

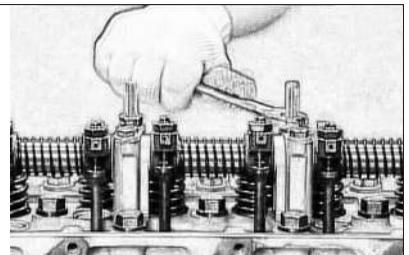


Fig 5-18 Rocker Assembly Installation

2.8 The valve sequence is; counted from front side of the engine, odd number is Intake valve, even number is exhaust valve. Intake valve clearance is 0.3~0.4mm, Exhaust valve clearance is 0.4~0.5mm (see Fig 5-19).

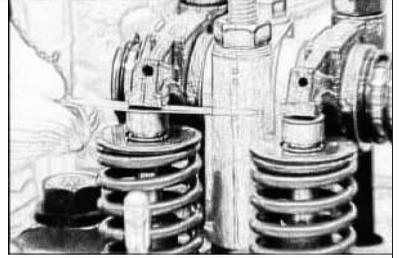


Fig 5-19 Valve Clearance Measured by Proof Stick

2.9 Adjusting method of valve clearance: turn crankshaft, when fuel appears on delivery port of first cylinder pump, stop to turn, at same time, all intake and exhaust valves are all closed (see Fig 5-20). Finger on flywheel ring should align with mark on flywheel housing.

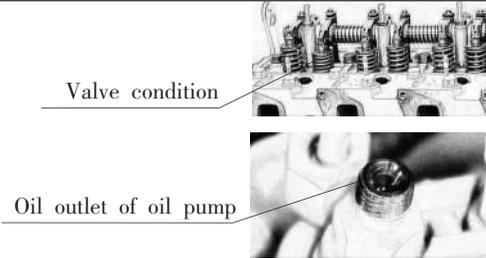


Fig 5-20 Valve Clearances Adjustment

2.10 For four-cylinder engine, counted from front side of the engine, adjust no. 1, 2, 3, 6 four valves (see Fig 5-21).

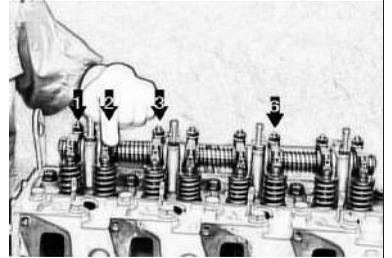


Fig 5-21 Valve Clearances Adjustment for Four-cylinder Engine

2.11 For six-cylinder engine, counted from front side of the engine, adjust no.1, 2, 3, 6, 7, 10 six valves (see Fig 5-22).

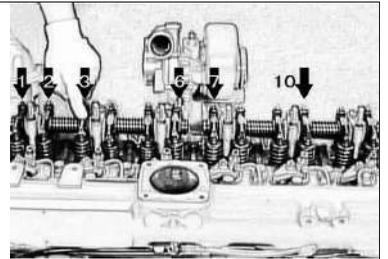


Fig 5-22 Valve Clearances Adjustment for Six-cylinder Engine

2.12 After above adjustment, turn crankshaft one revolution, adjust other valves clearances. After finishing all valves adjustment, recheck valve clearances as same sequence to keep correct valve clearances (see Fig 5-23).

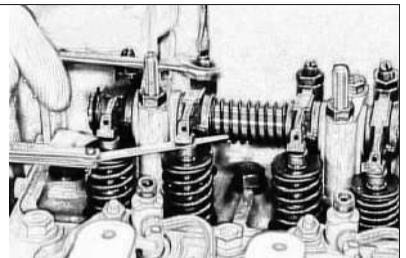


Fig 5-23 Check Valve Clearances

2.13 The lubrication in the gear system adopts pressurized lubrication. When installing lubricating pipes, pay attention to make the hollow screw tighten firmly (see Fig 5-24).

lubricant pipe of gears system



Fig 5-24 Lubricating Pipes Installation

2.14 Before installing the camshaft, coat a little bit oil on the bearing of support hole. Turn the camshaft into cylinder block. The thrust of camshaft depends on front thrust plate, so tighten bolts of thrust plate firmly (see Fig 5-25).

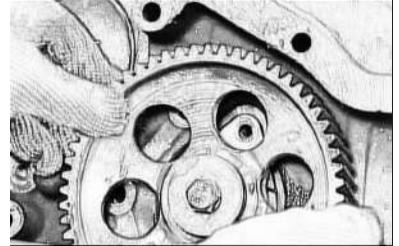


Fig 5-25 Camshaft Installation

2.15 Opening and closing of Intake valves and exhaust valves and fuel supply time are determined by timing gear system. When installing, align the mark on the idle gear with that of camshaft gear, injection pump gear and crankshaft gear, and tighten screws firmly (see Fig 5-26).

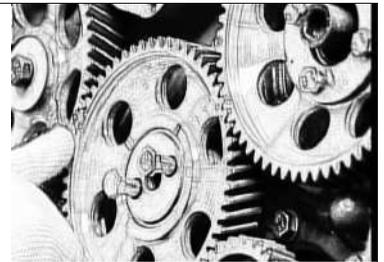


Fig 5-26 Timing Gear System Installation

2.16 In order to reduce vibration and noise, YTO series four cylinder engines adopt double-shaft balance mechanism, and its cylinders are different from general cylinders. The gears on the Left balance shaft are not same as that on the right balance shaft, and install them correctly. Before installing balance shafts, coat right amount oil on every journal of balance shaft, then put balance shafts into cylinder block, and fix locking plate on the cylinder (see Fig 5-27).



Fig 5-27 Double-shaft Balance Mechanism

2.17 Align mark on oil pump gear with idle gear and Left-balance shaft gear. Two dot marks on right-balance idle gear should align with single-dot mark on camshaft gear and mark on right-balance shaft gear.

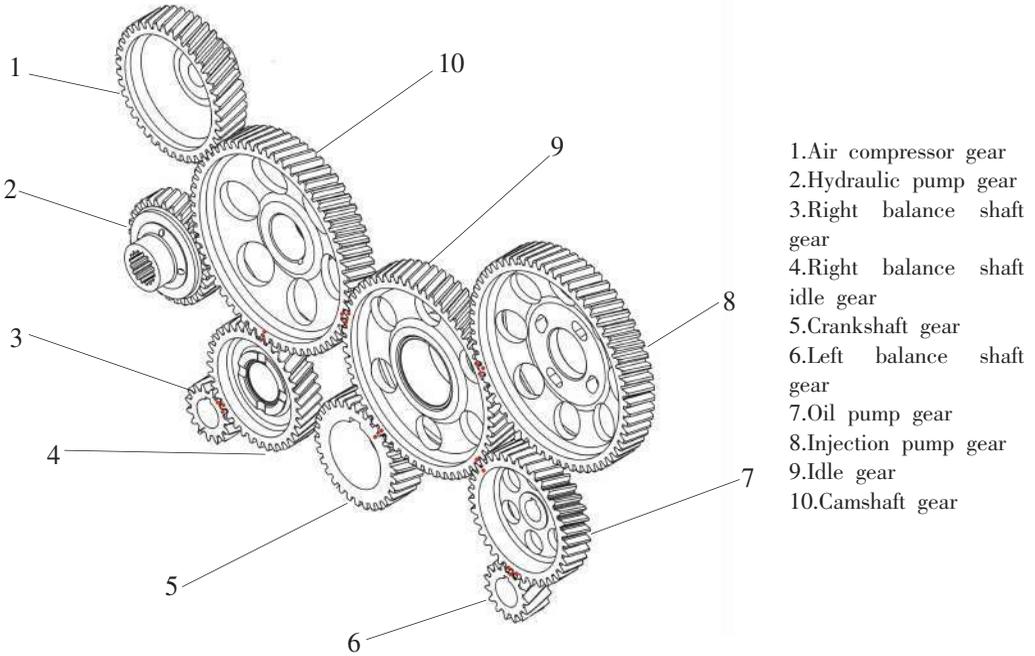


Fig5-28 Gears System with Double-shaft Balance

### 3 Turbo-changer and Intercooler System

3.1 The full floating bearings are used in the turbocharger. The rotor assembly is mounted on the middle housing. The pressurized lubrication flows through the middle housing to lubricate and cool the bearings. When the turbo-changer is working, its skin temperature is above 400°C. Rotate speed of the impeller is up to 80000 ~ 120000r/min. After the air flows through turbocharger, the air is pressurized and the temperature is also increased to 70~140°C. Therefore, turbo-charged system should be lubricated, and its seal should be very reliably; only clean air and lubrication can make the engine work normally.

#### 3.2 Turbocharger

3.2.1 Install turbocharger on exhaust manifold, Put gasket in right place, and tighten bolts (see Fig 5-29).

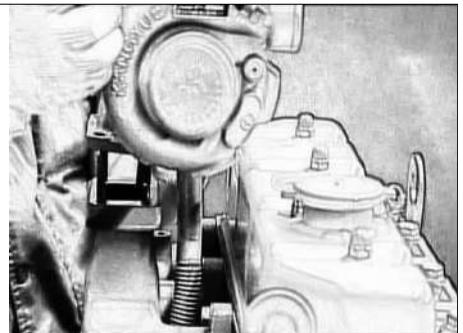


Fig 5-29 Turbocharger Installation

3.2.2 Connect oil return pipe of the turbo-charger well, Makes it thoroughly (see Fig 5-30).

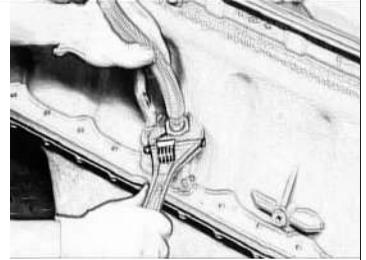


Fig 5-30 Oil Return Pipe of Turbo-charger

3.2.3 When installing oil inlet pipe, add suitable oil into oil inlet of turbo-charger, then tighten oil Inlet pipe (see Fig 5-31).

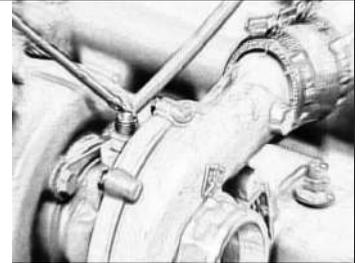


Fig 5-31 Turbo-charger Oil Inlet Pipe Installation

3.2.4 Keep the connecting tube of inlet intake and exhaust pipe well without broken. Tighten up with clip see Fig 5-32).

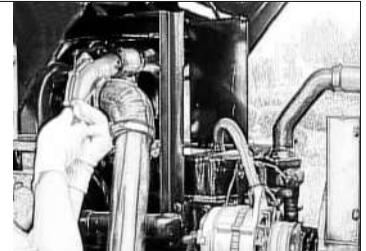


Fig 5-32 Connecting of Intake and Exhaust Pipes



### 3.3 Main usage points for turbocharger

3.3.1 For a new or repaired turbocharger, turn the rotor with hand, move gear freely without block and abnormal noise.

3.3.2 Start the engine alternatively 2~3 times by 3~5 seconds each times in order to make floating bearing of turbocharger fill with oil. After the engine is started, let the engine run at idle speed several minutes. Do not increase the speed until the turbocharger bearings are enough lubricated. Pay attention to this in cold winter.

3.3.3 Do not shut off the engine suddenly when the engine is running. After stopping the engine, let the engine run at middle speed for several minutes. Reduce the speed gradually, and stop it.

3.3.4 API CF grade or CF above engine oil should be used. Replace filter element as specified interval time.

3.3.5 Stop the engine, and find out the causes when oil pressure is less than 0.2 MPa.

3.3.6 Clean the air cleaner in time in order to prevent filter breakage or too big resistance, and make sure the intake system is leakproof.



Continuing to operate the engine is prohibited after air inlet pipes in the turbo-charged system is breakage  
Do not dismantle and adjust the turbocharger by laypeople.

### 3.4 Inter-cooling System

YTO series engines use air-air, water-air intercooler technologies to cool the compressed air from the turbocharger. The air-air intercooler is installed in the front of the radiator and cooled by the air sucked by the radiator fan and wind facing the traveling vehicle (see Fig 5-33). The temperature of intake air from the intercooler is reduced greatly so that the dynamic and economic performances of the engine are all increased and emissions and heat load of the engine are improved.

During operating the engine, observe coolant pipeline if any metal tube sealing-off, damage, cracked hose or loosen band. If any is encountered, retighten the loose parts or replace the damaged parts, eliminate any leaks. Otherwise the engine will not work properly.

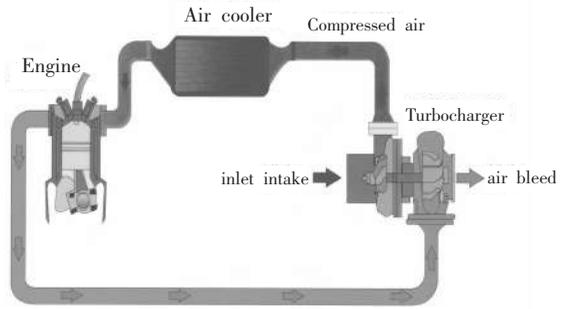


Fig 5-33 Turbocharged-intercooled Way

## 4 Lubrication System

4.1 Pressure-splash lubrication is used for YTO series engines. Lubrication system can make the moving parts get good lubrication so as to reduce friction power loss and parts excessive wear, and carry away heat and scraps caused by friction, and purify the lubrication continuously (see Fig 5-34).

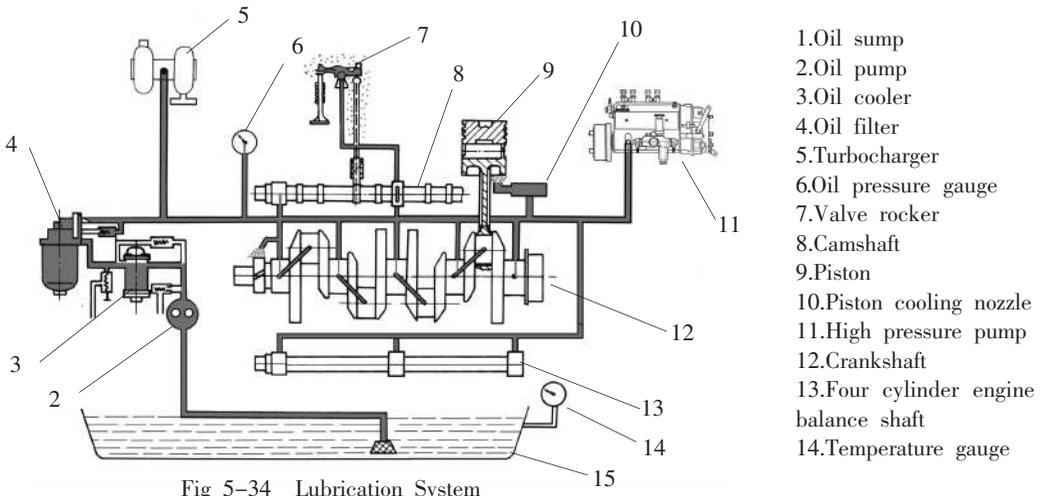


Fig 5-34 Lubrication System

4.2 Insert O-ring before installing oil pump, coat some oil on pump, tighten bolts, move gear freely without block (see Fig 5-35).

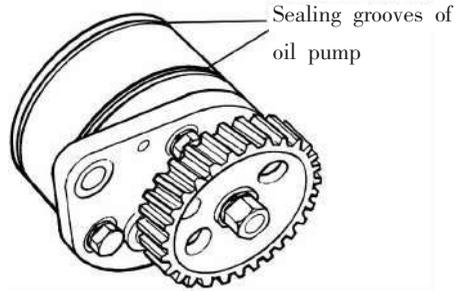


Fig 5-35 Sealing Grooves of Oil Pump

4.3 6N series engines install below type oil pump, put oil pump idle gear with spindle with block ring into 1st bearing cover, tighten fix bolts. Install main bearing cover on cylinder block. Insert O-ring into groove of support, fix support with block.



There are different flows in different series engine models. Purchase the correct oil pump according to the model on the nameplate or consult with your local dealer.

4.4 According to purpose and installation position, choose single stage oil filter with paper element or spin-on oil filter. When installing filter element, pay attention to gasket. Coat some oil on sealing ring, tighten bolts well (see Fig 5-36).

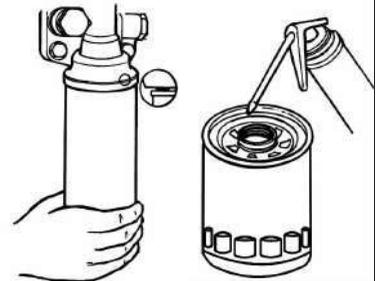


Fig 5-36 Below Type Oil Pump Installation

4.5 When oil pressure is up or blow regulated values, may adjust pressure through regulatory valve in a small range. Turn in clockwise to increase pressure, turn in anti-clockwise to reduce pressure (see Fig 5-37).

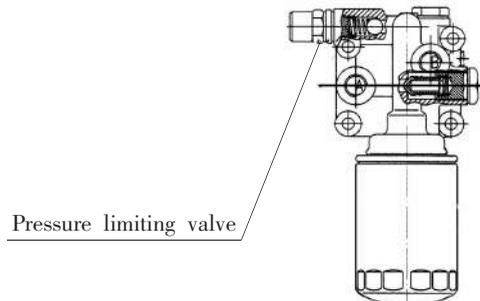
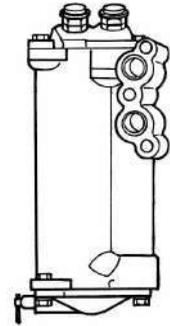


Fig 5-37 Oil Pressure Adjustment



During normal operation, if finding oil pressure lower than regulated limits, not only adjust regulatory valve to increase oil pressure, but also need to find causes and remove faults.

4.6 In order to reduce oil temperature, may install many kinds of oil coolers, install oil cooler firmly with attention to seals or gasket without broken. Make sure the cooling pipes without broken in order to keep out the failure caused by leakage (see Fig 5-38).



4.7 The inner-oil cooler is used in four cylinder diesel engines with double-shaft balance system and 6N series engines. Insert seals into seal grooves of oil coolers. Align two oil orifices of cover board with oil cooler, screw bolts and tighten them, install cover board with gasket on cylinder block. Retighten the belts from middle to each side (see Fig 5-39).

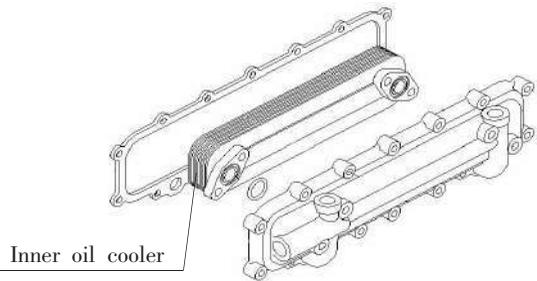


Fig 5-39 Inner-oil Cooler Installation

## 5 Fuel Supply and Injection System



5.1 Injection pump is precision components, repairing and adjustment can only be done by special persons on test bend. The connection between the compensator in some turbocharged engines and intake pipes should be installed firmly.

The Lubrications of some fuel injection pumps use the oil used in general diesel engine. Oil pipes connected main oil gallery should be installed firmly.



5.2 Never disassemble lead sealing on the injection pump by the customers.

5.3 YTO series engines use many kinds of injection pumps, such as ZHB, BP, BB, AD, EP-9 and so on, but basically dismantling and installation methods are same. This manual introduces general methods and adjustment of fuel supply advance

angle. Before dismantling injection pump, open inspection window, use cleaning cloth to scrape oils on the gears, use a mark pen to make marks on injection pump gear witch meshed with idle gear. Do not turn the engine so as to lead to troubled marks (see Fig 5-40).

After calibrating fuel injection pump, re-install pump as referred marks, and tighten bolts, then readjust fuel supply advance angle.



Fig 5-40 Marks in Gear

5.4 Adjusting method: loose 1st high pressure pipe, clear fuel on delivery valve port, put control rod in maximum fuel supply position, press hand primer to let air in pipe out. Turn engine slowly, when fuel appears on delivery port, stop to turn, observe finger on flywheel ring to angle marks on flywheel housing through inspection window, which is advanced angle (see Fig 5-41).

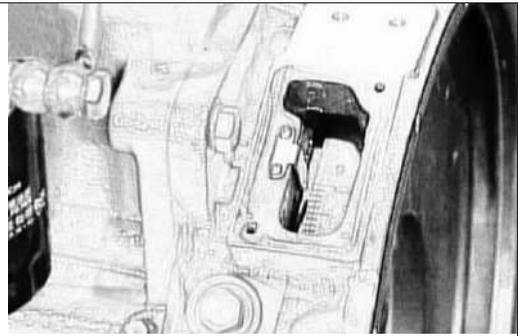
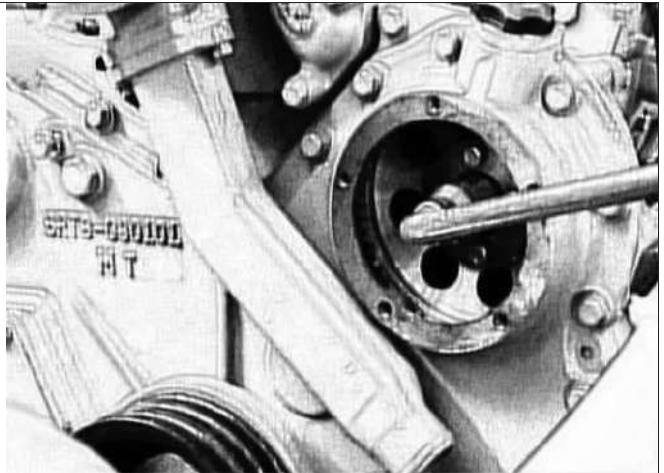


Fig 5-41 Mark on Flywheel Housing and Finger

5.5 If advanced angle is over required ranges, first align finger to required advanced angle mark, loose four pump gear cover plate bolts, turn injection pump with sleeve spanner, increase advanced angle clockwise, decrease angle counter-clockwise. Slowly turn engine to check fuel appear, then stop turning, tighten cover bolts, here advanced angle is correct angle as required.



5.6 Fuel supply advance angles have a significant effect on the engine performance. Adjust them according to relative contents in section 2 of chapter 7.

5.7 YTO series diesel engines use J series and P series injectors (see Fig 5-42). The opening pressure of J series injectors is 19.6~20.8MPa. The opening pressure of P series injectors is 25~26.2MPa. Adjust or replace the matching parts on the test-bed by professionals.

If injectors and its matching parts need to replace, keep original injector model consistently.

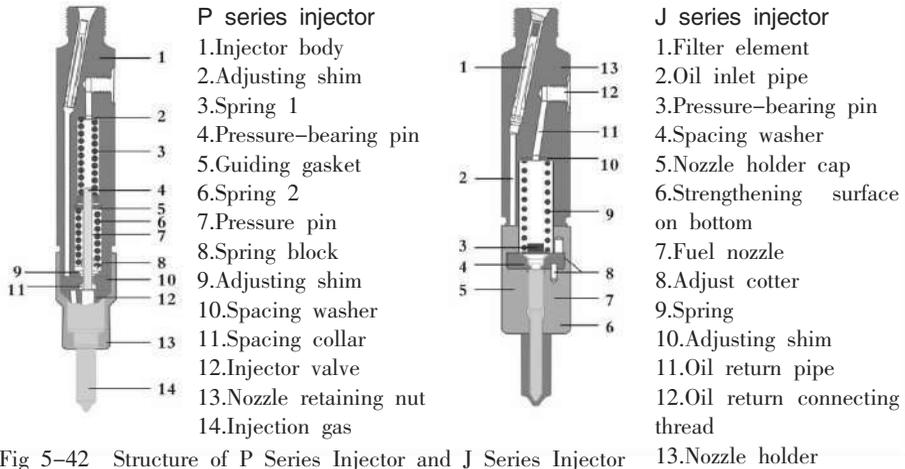


Fig 5-42 Structure of P Series Injector and J Series Injector

5.8 When installing injector, keep the injector hole clean. Install copper seal gasket at front end of injector, and then install the injector into cylinder head carefully. Tighten pressure plate screw firmly (see Fig 5-43).

Make sure the thickness of copper seal gasket is the same if the copper seal gasket needs to replace.

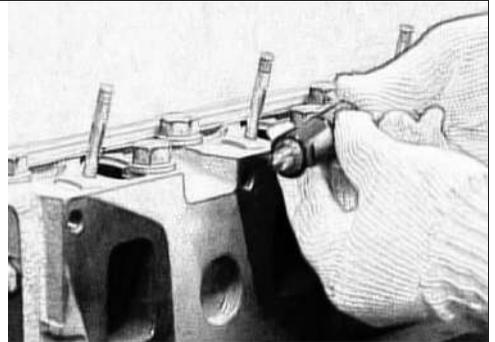


Fig 5-43 Injector Installation

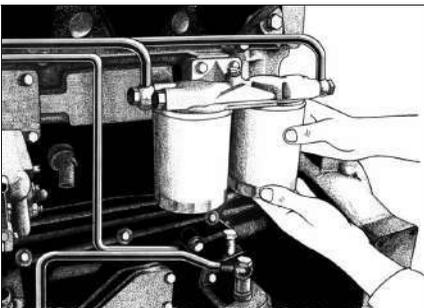


Fig 5-44 Replace Oil Filter Element

5.9 Replace the oil filter element regularly as specified procedures. First of all, close oil supply switch. Clean the oil and dirty outside diesel fuel filter housing. Remove the filter. Check the seal with filling oil after new filter is installed. Do not use the old element to avoid the faults due to injector nozzle pair damaged (see Fig 5-44).

## 6 Cooling System

6.1 Connect water pump with cylinder block by bolts, after installing, move V-belt pulley freely without block (see Fig 5-45).

During the operating, observe if there is water leakage in drain hole below the water pump body. If water leakage is serious, replace water block. The drain hole should not be blocked in order to prevent the bearing worn-out due to the water block going into bearing.

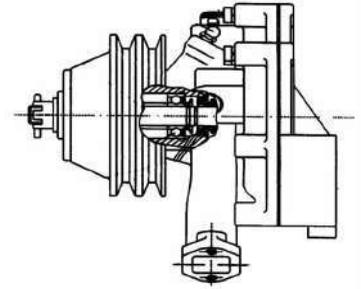


Fig 5-45 Connection between Water Pump and Cylinder Block



Because the machining of the impeller and shell of water pump belongs to the matching process, so water pump assembly must be replaced due to wear.

### 6.2 Fan and Belt

Make sure that cooling fan is installed reliably. Check for cracks on the fan. Replace damaged fan. Inspect the v-belt. When finding out the cracks and scratch, replace them.

Check the degree of the tightness of the V-belts every working 50~60 hours. Too tightening or loose can affect cooling effects and shorten V-belt using life. Press the V-belt between water pump and generator by hand. The deflection should be 10~15mm. Adjust the degree of the tightness of the V-belt by changing the position of the generator pulley (see Fig 5-46).

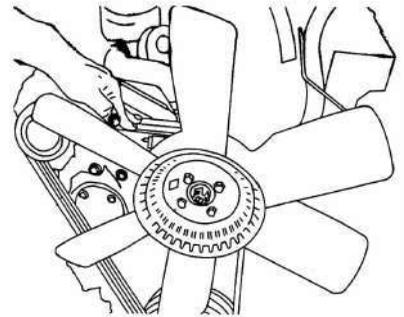


Fig 5-46 Fan and Belt Installation



Replace all the belts when changing. Do not use old and new one or different brands together so as to avoid different elongation and influence the efficiency of the cooling water pump.

### 6.3 Thermostat

The Opening temperature of main valve in thermostat is  $76\pm 2^{\circ}\text{C}$ . The temperature for thermostat full opening is  $86\pm 2^{\circ}\text{C}$ . The valve lift is 8~10mm (see Fig 5-47).

After the engine is started, the coolant flows out from water outlet when the coolant temperature does not reach specified temperature; or after the engine works

for some time, and the coolant temperature is above 78°C, the coolant does not flow out from water outlet, these mean that the thermostat is defective, replace it.

Harvests need not to install the thermostat due to hot temperature in summer, nor does generator sets due to working in closed environment.

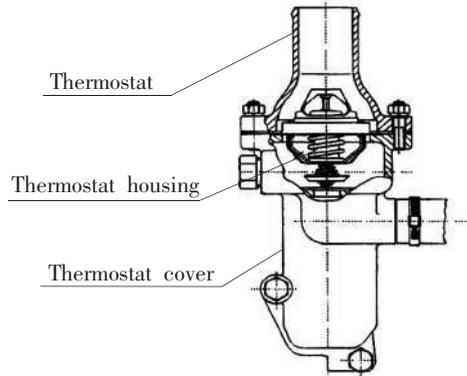


Fig 5-47 Structure of Thermostat



For the diesel engines with thermostat, do not dismount the thermostat during operation, otherwise, it will influence the engine operation and shorten its service life.

## 6.4 Radiator

6.4.1 Check leaks or damage of the radiator and remove any trash or dirty accumulating on the radiator daily. Clean or repair it as necessary (see Fig 5-48).

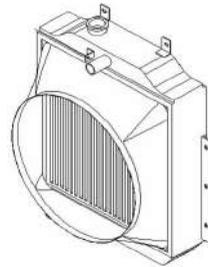


Fig 5-48



For the tractors working in the farmland, remove any trash or dirty accumulating on the radiator at any time.

6.4.2 During operating, the loss of the coolant should be checked and added at any time. Additive coolant should be clean soft water. After adding, let the engine start and run for some time. Check the level of coolant again. Add some coolant when needed (see Fig 5-49).

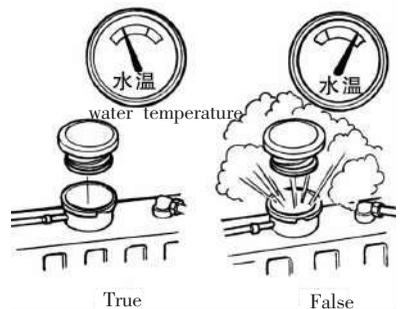


Fig 5-49 Check the Level of Coolant



Check the coolant level after the engine has been stopped. When the temperature is too hot, do not open the radiator filler cap to prevent people from scald.

6.4.3 Although soft water is used, however after some period of time, a little scale can be deposited in the cooling system, which can have negative effect on coolant circulation and heat exchange. Remove the scales regularly (see Fig 5-50).

The contents in detail are listed in section 5 of chapter 3.

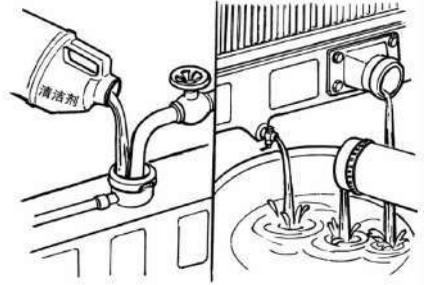


Fig 5-50 Remove Scales



When the ambient temperature is below 5°C and the coolant is without anti-freeze additives, open the water drain cock on the cylinder, radiator and oil cooler to drain the cooling system after the engine has been stopped.

## 7 Electrical System

12 V and 24 V electrical system is available according to engine applications. The engine is equipped with AC alternator and starter at shipping. The generator governor, pre-heater and instrument sensors are optional.

### 7.1 Alternator

The purpose of the alternator is to charge the battery and to supply electrical power to other loads. JFZ series unit alternator (with regulator), JF series alternator, JFW series alternator are available. The basic structure and principle of the three alternators are the same.

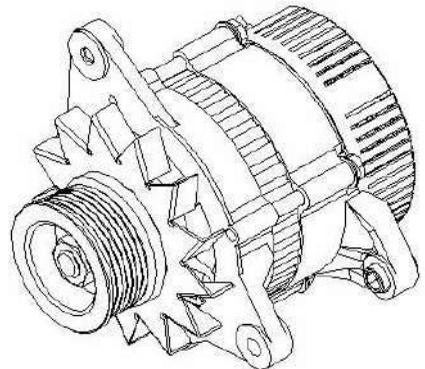


Fig 5-51 Alternator

As a part of electrical system, the wiring between the alternator and other electrical elements refer to the electrical diagram. Fig5-52 and Fig5-53 are principle and wiring diagrams.

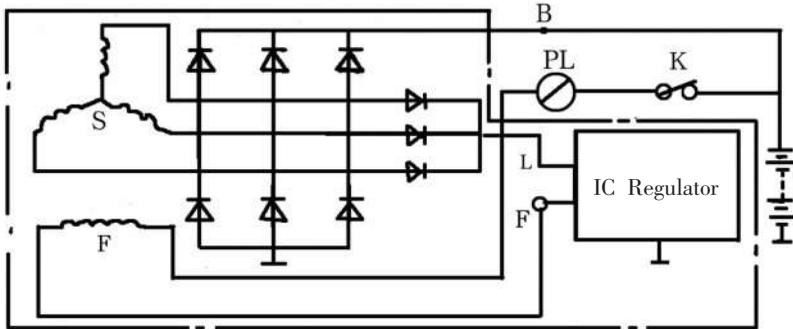
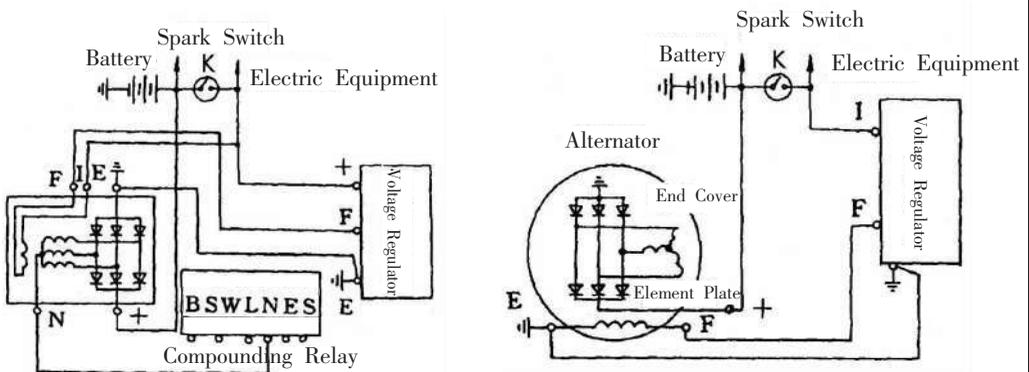


Fig 5-52 wiring diagram of unit alternator



(a) Inner negative

(b) Outer negative

Fig 5-53 Principle and Working Sketch of AC Alternator

## 7.2 Alternator operation and maintenance

7.2.1 Do not use short circuit to check the alternator charging.

7.2.2 Use the negative earth. When using in parallel with batteries, pay attention to the earth connection.

7.2.3 Remove the dirt on the alternator especially on the terminals regularly so as to keep the terminals in proper connection.

7.2.4 Check the tension and wear of V-belt, and adjust it in time.

7.2.5 Maintain the alternator every 900~1000 working hours or every 30000~40000 km of the vehicle. Clean the bearings with gasoline, kerosene is forbidden. Add No.3

complex calcium base grease or No.4 high temperature grease to the bearings. The quantity is about 1/3-1/2 of the bearing chamber.

7.2.6 When the engine is stopped, turn the start switch to "OFF" position to prevent electric current coming from the battery into the magnetic field winding (see K switch in Fig5-53).

### 7.3 Starter

The function of the starter is to start the engine. 12 V and 24 V starters are available. The starter consists of DC motor, magnetic switch and free-wheeling clutch. The starter is connected with main electrical system by the magnetic switch.

The starter is shown in Fig 5-54.

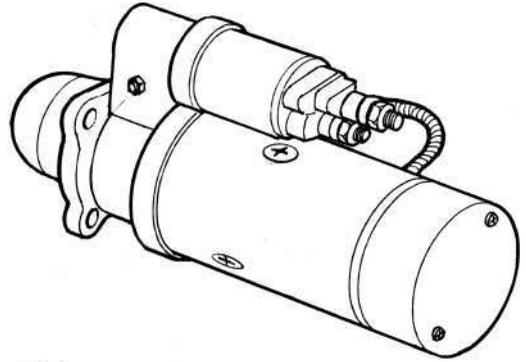


Fig 5-54 Starter

### 7.4 Usage Notice for Starter

7.4.1 The battery should be installed as soon as possible nearby the starter so as to reduce line drop.

7.4.2 The time of startup must be restricted in 10 seconds. If the engine does not start, wait for 2 minutes. Start it again. It is prohibited to start the engine for a long time or start the engine continuously.

7.4.3 If the magnetic switch will not return automatically after the engine is started, which means the key is released from the starting position but the starter continues running, turn off the main electrical power switch to look for the causes.



Do not allow to operate the starter by using short circuit.

## 8 Sensor Interface

8.1 Oil pressure sensor: oil pressure sensor is connected with the detecting instruments, and installed in the main oil gallery on left side of cylinder body.

8.2 Oil pressure alarm: optional device. Oil pressure alarm is connected with the oil pressure alarming system, and installed in the main oil gallery on left side of cylinder body (see Fig 5-55).

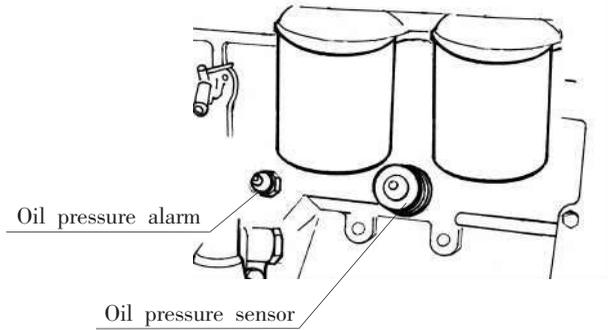


Fig 5-55 Oil Pressure Alarm System

8.3 Water temperature sensor: water temperature sensor is connected with the detecting instruments, and installed on the thermostat housing (see Fig 5-56).

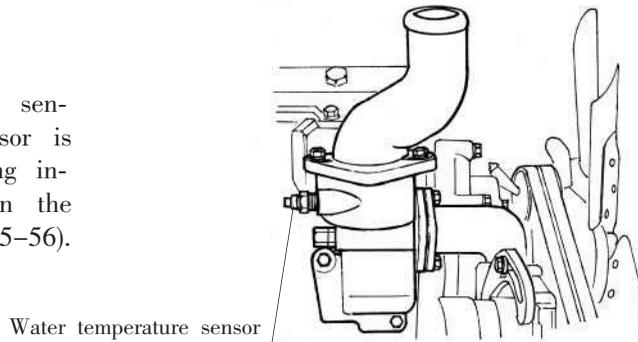


Fig 5-56 Water Temperature Sensor

8.4 Oil temperature sensor: optional equipment. Oil temperature sensor is connected with the detecting instruments, and installed on the oil sump (see Fig 5-57).

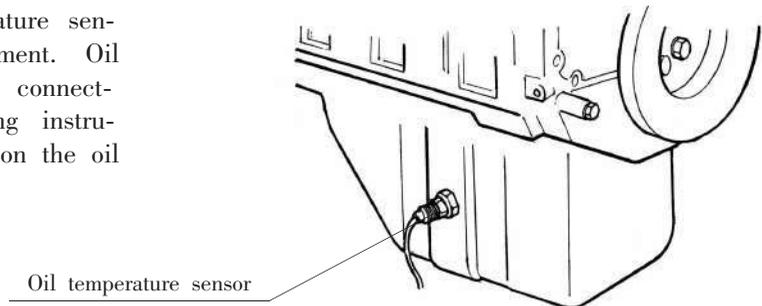


Fig 5-57 Oil Temperature Sensor

## Chapter 6 Troubleshooting



When the engine has some faults, you should remove them. If the engine works with faults, it will not only result in low power, low efficiency, but also in excessive parts abrasion, and even machine damage.

The items marked with "★" in troubleshooting table are the fault which may happen to the electronic injection diesel engine, but for the engine without electronic injection, it doesn't matter.

The common malfunctions are: hard to start, running rough, low power, abnormal running sound, abnormal smoke low oil pressure, over-heated coolant, automatic shut down, running-away and so on.

When the engine has some faults, you should remove them. If the engine works with faults, it will not only result in low power, low efficiency, but also in excessive parts abrasion, and even machine damage.

For removing the faults as soon as possible, the following procedures are suggested:

(1) Before removing the faults, you had better understand the features and details of faults such as the load, ambient temperature and altitude and other conditions.

(2) Analyze the faults carefully.

(3) Consider the relationship between the faults and the relevant engine system and parts.

(4) Review the latest service or repair and make a careful check.

(5) Remove the faults from the most easy ones.

(6) Find out the causes and remove them.

(7) Start the engine, make sure the faults have been eliminated.

Some of the typical faults and their elimination methods are as follows:

### 1 Engine hard to start

Cause	Solution
<b>1.Engine hard to start</b>	
(1)Low battery	→Recharge the battery
(2)Bad electrical contact	→Remove ill contact
(3)Starter gear does not engage with the flywheel ring gear	→Find out the causes and correct them.
<b>2.Malfunction of fuel supply system</b>	
(1)Fuse burnt ★	→Change fuse
(2)Fuel tank without fuel	→Add the fuel
(3)Jams in outlet pipes	→Clean and make it smoothly
(4)Air in the fuel system	→Bleed the system
(5)Jams in the fuel pipes or fuel filter	→Clean the fuel pipes, and change filter
(6)Poor quality fuel injection or low injection pressure	→Clean and repair the injector
(7)Loose connector in electrical equipment ★	→Fasten connectors
(8)Abnormal power supply of ECU controller ★	→Check supply circuit of ECU controller

Cause	Solution
(9)Low engine temperature	→Use winter lubrication and fuel, switch on the electric heater
(10)Incorrect installing gap of cam speed sensor or sensor damaged ★	→Adjust installing gap of cam speed sensor or replace the sensor
(11)Power supply of cam and crankshaft speed sensors or temperature pressure sensor is shorted to ground ★	→Replace cam and crankshaft speed sensors or temperature pressure sensor
(12)Fault diagnosis switch is turned on before starting ★	→Turn off fault diagnosis switch, and resupply power to make it return
(13) ECU controller damaged ★	→Replace ECU controller
(14)Back pressure valve damaged ★	→Replace Back pressure valve
<b>3.Low compression pressure in cylinder</b>	
(1)Piston ring worn out	→Replace piston ring
(2)Valve leakage	→Check and rub valve
<b>4.Low ambient temperature</b>	→Use pre-heater
<b>5.Jam in air cleaner</b>	→Check, clean or change air filter

## 2 Running rough

cause	solution
1.Air or water in fuel system	→Bleed the system and check water content in the diesel fuel
2.Malfunction fuel transfer pump	→Repair or replace fuel transfer pump
3.Valve spring break or improper valve clearance	→Replace valve spring and readjust the valve clearance
4.Gas leakage	→Replace cylinder head gasket

## 3 Lack of engine power

Cause	Solution
<b>1.Turbocharged system</b>	
(1)Leaks in inlet pipe of turbocharger	→Find out leaks in pipes and tubes of turbocharger and intercooler, and correct them
(2)Leaks in exhaust pipe of turbocharger	→Replace gasket. Find out leaks and correct them
(3)Turbocharger works abnormally	→check
<b>2.Fuel supply system</b>	
(1)Fuel pipes and fuel filter throttled	→Clean fuel pipes and filter or replace filter element
(2)Water in fuel	→Drain out the water and change fuel
(3)Injector damaged	→repair or replace
(4)Bad contacts between connector and pressure temperature sensors or sensor damaged★	→Check pressure sensor connector or replace super-charged pressure sensor
(5)Injection pump performance reduction or does not work	→Adjust flow coefficient or replace injection pump
(6)Scrap iron is absorbed by crankshaft speed sensor★	→Remove scrap iron on crankshaft speed sensor

Cause	Solution
(7) Poor contacts in throttle sensor or sensor damaged★	→ Plug in and pull out connector again or replace throttle
(8) Low engine temperature results in throttle without output★	→ Wait for engine warm-up
3. Air cleaner blocked	→ Clean or replace air filter
4. Muffler blocked	→ Clean muffler
5. Low pressure in cylinder	
(1) Valve spring break	→ replace valve spring
(2) Incorrect valve clearance	→ Adjust valve clearance
(3) Valve leakage	→ Rub valve
(4) Piston ring soot or worn-out	→ Clean soot or replace piston ring

#### 4 Abnormal noise

Cause	Solution
1. Excessive clearance between piston and cylinder results in knock sound in the cylinder after engine starts and it will go less with engine warm-up	→ Replace piston or cylinder liner
2. Excessive clearance between piston pin and small end bushing of connecting rod results in clear knock on the top of cylinder at low speed	→ Replace small end bushing of connecting rod
3. Excessive valve clearance results in rhythmical knock at valve cover.	→ Adjust valve clearance
4. Excessive valve clearance of connecting rod bearing shell or main bearing, there are clash noise at low speed	→ Replace main bearing or connecting rod bearing shell
5. Turbocharger noise	→ Look for friction between impellers and the housing of turbocharger or compressor
6. Driver gear noise	→ Replace gears

#### 5 Black smoke

Cause	Solution
1. Engine over-load	→ Reduce engine load
2. Bad fuel spraying	→ Check or replace injector
3. Leakage at the connection of turbocharger and the intake pipe or exhaust pipe	→ Look for the leaks and correct them
4. Turbocharger failure	→ Replace turbocharger
5. Transient state switch without opening★	→ Turn on transient state switch
6. Scrap iron is absorbed on crankshaft speed sensor★	→ Remove scrap iron on crankshaft speed sensor
7. ECU control procedure is not compatible★	→ Replace ECU control procedure or ECU control unit
8. Defective intercooler	→ Clean intercooler or repair fan
9. Air cleaner blocked	→ Check, clean or replace filter element

## 6 White smoke

Cause	Solution
1.Low ambient temperature	→Warm up engine with low load
2.Low coolant temperature or water in cylinder	→Warm up coolant, find out the sources of water in cylinder and correct them
3.Poor fuel spraying or leaks	→Repair or replace injector
4.Scrap iron is absorbed on crankshaft speed sensor★	→Remove scrap iron on crankshaft speed sensor
5.Water in fuel	→Wash fuel tank and filter, change fuel
6.Cylinder score	→Repair or replace piston and cylinder liner

## 7 Blue smoke

Cause	Solution
1.Poor fuel spraying	→Repair or replace injector
2.Piston ring installed upside down	→Reinstall piston ring
3.Piston ring worn-out	→Replace piston ring

## 8 Lack of Oil Pressure



Never operate the engine when engine oil pressure is too low. Whenever when engine oil pressure is too low, stop the engine immediately. Find out the causes and correct them

Cause	Solution
1.Oil pressure gauge or sensor damaged	→Replace gauge or sensor, check connect lines
2.Low level in oil sump	→Add oil to specified level
3.Oil screen, oil filter plugged or filter bypass valve stuck	→Clean Oil screen, adjust or replace bypass valve
4.Main relief valve failure	→Adjust or replace relief valve
5.Leaks in oil inlet or outlet pipe of turbocharger	→Look for the leaks, tighten or replace oil pipe
6.Excessive clearance at connecting -rod bearing, crankshaft bearing and camshaft bearing	→Replace the bearing
7.Damaged or wear-out oil pump	→Find out the causes and correct them
8.Improper engine oil	→Change with correct engine oil and find out the causes

## 9 Coolant is too hot



When the coolant in engine radiator is bolting, do not stop the engine immediately or add cold water in it. To avoid cylinder liner damage, the speed should be reduced, and keep the engine run at low speed until the coolant temperature becomes lower. Then stop the engine to find out the causes.

Cause	Solution
1.Damaged coolant temperature gauge or sensor	→Check and replace coolant temperature gauge or sensor
2.Excess fuel injection quantity	→Check or replace fuel injection pump (or readjust)
3.Overload	→Reduce load
4.Low coolant level, V-belt loose	→Add coolant, adjust V-belt tension
5.Damaged thermostat	→Replace thermostat
6.Serious scale deposit in the water jacket of cylinder head or block	→Scour out the jacket and Clean cooling system
7.Damaged cylinder liner O-ring, leaks in cooling system	→Replace sealing ring or correct leaks
8.Intercooler or radiator is too dirty	→Clean intercooler or radiator
9.Damaged water pump	→Check or replace water pump

## 10 Engine stalls abruptly

Cause	Solution
1.Engine stalls abruptly and crankshaft can be cranked	
(1)Engine overloaded	→Reduce loads and restart engine
(2)Fuel tank without fuel	→Add fuel to fuel tank
(3)Air in fuel supply system	→Bleed the system
(4)clogged fuel supply system	→Clean fuel supply system
(5)Air cleaner clogged	→Clean or replace filter element
(6)Short circuit caused by damaged sensor ★	→Replace sensor
(7)Loose plug of cam speed sensor ★	→Check cam speed sensor plug or replace sensor
(8)Damaged controller ECU ★	→Replace controller ECU
(9)Coolant temperature is too hot	→Check coolant system
(10)Damaged wiring harness ★	→Replace wiring harness
(11)Impurity is absorbed on cam sensor ★	→Clean impurity on sensor
(12)Ground connection is bad ★	→Connect earth line well
2.Engine stalls abruptly and crankshaft cannot be cranked	
(1)Crankshaft and bearing stuck	→Check crankshaft and bearing, repair or replace them
(2)Piston and cylinder liner stuck	→Replace piston and cylinder liner

## 11 Runaway



When runaway happens, try to stop the engine immediately. The general way is as follows: stop the engine and cut off fuel and air supply so as to avoid personal injury or machine damage. When runaway happens on tractors, vehicles and construction machinery except the measures mentioned above, depress the brake pedal to stall the engine. However never depress clutch pedal.

Cause	Solution
1.Controller ECU works abnormally★	→Replace or repair controller ECU
2.Injection pump works abnormally	→Replace or repair Injection pump
3.Throttle line failure(including whole vehicle)★	→Check throttle line
4.Pre-heater failed, much fuel in intake pipe	→Replace pre-heater, clean up fuel in intake pipe
5.Incorrect oil or too much oil in oil bath air filter	→Change with correct oil, set oil level to specified level, and wash intake pipe and intake passage
6.Excessive oil in oil sump	→Drain out excessive oil, and clean air intake pipe

## 12 Lack of power, higher fuel consumption due to excessive wear



The sealing in the air inlet pipeline should be frequently checked. If any leak happens, find out the causes and remove them immediately to avoid lack of power or excessive wear.

Turbocharged engines should use ADI CF grade oil. Common oil is prohibited. When changing oil, do not mix with used oil or other brands oil.

Cause	Solution
1.Parts excessive worn out due to incorrect oil	→Clean oil sump and oil filter, replace element, add specified oil, replace worn components
2.Cylinder liner, piston ring and bearing damaged due to not changing oil for a long time or use incorrect oil	→Same as above
3.Injector pair wear or plugged	→Replace or clean injector pair
4.Parts seriously worn out due to damaged air filter	→Replace element or air cleaner, replace parts as necessary
5.Piston, cylinder liner, piston ring seriously worn out due to leaks or other trouble in air intake system	→Find out causes and correct them, replace parts as necessary

## 13 Low air pressure or oil leaks of air compressor

Cause	Solution
1. Low air pressure	
(1)Soot on intake or exhaust valve or diaphragm broken or too weak	→Replace diaphragm, rub valve seat and remove soot
(2)Loose cylinder head bolts or leaks at valve seat gasket	→Retighten bolts and replace gasket
(3)Safety valve can not close completely	→Clean safety valve, remove dirt at air intake or exhaust port and replace spring
(4)Air filter plugged	→Clean air filter
(5)Leaks or plugged at the pipe connection	→Tighten nuts, remove soot or dirt
2. Too much lubrication oil consumed	
(1)Cylinder liner or piston ring worn out	→Replace cylinder liner or piston ring

Cause	Solution
(2)Oil return orifice plugged, or high oil level	→Clean oil sump and oil return orifice
<b>3. Leaks on joint surface</b>	
(1)Loose fasteners	→Tighten bolts
(2)Damaged gaskets	→Replace gasket

## 14 Alternator faults

Cause	Solution
<b>1.Alternator does not work</b>	
(1)Electrical wire broken, short circuit, improper connection or wire connected incorrectly	→Connect wire tightly and correctly
(2)Loose Claw pole, rotor winding broken, damaged rectifier bridge, bad brush connect	→Repair and replace components as necessary
(3)Low regulator voltage, wire connected incorrectly, contact point burnt or oxidated , relay winding burnt	→Repair and replace components as necessary
<b>2.Undercharge</b>	
(1)Damaged rectifier bridge, bad brush connect, weaken spring, grease on slip ring, loose V-belt	→Repair and replace alternator
(2)Low regulator voltage, connect point burnt	→Repair and replace regulator
(3)Insufficient battery electrolyte, obsolete battery	→Add specified electrolyte or replace battery
<b>3.Unsteady charging</b>	
(1)Loose V-belt, bad brush connect, weaken spring, loose terminal or improper contact	→Tighten V-belt, adjust brush and spring, screw down terminals
(2)Dirty regulator contactor	→Clean regulator contact point
<b>4.Abnormal noise</b>	
(1)Alternator improperly installed	→Re-install alternator as necessary
(2)Damaged bearing, friction between stator and rotor or stator winding short circuit	→Repair or replace alternator
<b>5.Charging current is too high</b>	
(1)High regulator voltage or regulator failed	→Repair regulator
(2)Brush runs into rectifier or short circuit with armature. Current output goes directly to excitation coil which results in uncontrollable voltage	→Repair alternator
<b>6.Alternator damaged</b>	
(1)Rectifier element short circuit or friction between stator and rotator	→Repair alternator, replace it as necessary
(2)Damaged regulator	→Repair regulator, and replace it as necessary

## Chapter 7 Main Data of Maintenance

### 1 Main torque specifications

The torque specifications of YTO LR-R, A, B, M, N, V series engine are listed in the table 7-1.

Table 7-1 Torque Specifications

Name	Torque/ N.m	Name	Torque/ N.m
Cylinder head set bolts (common gasket)	natural-aspirated 196-206	Main bearing bolts	201 <sup>+4.9</sup> <sub>0</sub>
	turbocharged engine 220-230		
Cylinder head set bolts (metal gasket)	natural-aspirated 220-230	Connecting-rod bolts	132 <sup>+4.9</sup> <sub>0</sub>
	turbocharged engine 250-260	Flywheel securing bolts	206 <sup>+4.9</sup> <sub>0</sub>

### 2 Main adjustment specifications

#### 2.1 Valve clearance

The Valve clearances of YTO LR-R, A, B, M, N, V series diesel engine are listed in the table 7-2

Table 7-2 Valve clearances of YTO LR-R, A, B, M, N, V Series Diesel Engines

Valve	Clearance/ mm	Valve	mm
Air intake valve	0.30~0.40	Exhaust valve	0.40~0.50

2.2 Needle-valve opening pressure: P series: 25~26.2 MPa; J series: 19.6~20.8MPa

2.3 Piston-to-head clearance: 1.1±0.1 mm

2.4 Fuel supply advance angle (static state): For tractors and construction machinery: 20°±1°

For vehicles (with auto fuel supply advanced angle adjuster ): 15°±1°

For vehicles (without auto fuel supply advanced angle adjuster): 22°±1°



For some engines with electric control or higher rank configuration, fuel supply advance angles are subject to change, please consult with the host manufacturer in detail.

## Chapter 8 Main Technical Specifications

### 1、Instruction to specifications table

With the continuous advancement of technology, in order to fully meet customer's requirements on engine usage, the original establishment rules of YTO LR-R, A, B, M, N, V series engines model spectrum do not meet the actual application. The specification tables in this manual are organized according to new model spectrum, and some explanation for specific parameter is gave. The illustrative items marks with \*, and which corresponds to the parameters in specification table.

\* 1、Model: for some engines, new and origin model are listed at the same time, for new developed engines, new models are only listed. There are the same meanings among corresponding models in table. The suffix part of the model represents the practical application area, but it is not listed in specification table. In general condition, the letter in the suffix part shows application field of the engine, for example, the letter Q represents the engine is used for vehicles, the letter T represents the engine is used for tractors, the letter G represents the engine is used for construction machinery, the letter D represents the engine is used for generator sets, the letter C represents the engine is used for marines.

\* 2、Power range; minimum power in power ranges means the power when the engine adopts natural-aspirated technology and runs at the speed of 1500r/min, maximum power means the power when the engine adopts turbocharged or turbocharged intercooled air intake technology and runs at the speed of 2400r/min. Of course, for different application conditions, some models may be not adequate for low speed running and turbocharged-intercooled air intake technology.

\* 3、Speed range: the choice of the speed is decided by application areas. In general condition, the speed of the engine used for power generation and marines is less than 2000 r/min, the speed of the engine used for other application areas is 2000 r/min to 2400 r/min. Of course, this also depends on the choice of manufacturer in actual application conditions.

\* 4、Torque reserve ratio: it is not suitable for some engines, such as generator sets and marines.

\* 5、Lowest fuel consumption: lowest fuel consumption is obtained when the engine adopts higher configuration, which is different from that of the engine with lower configuration. Meanwhile lowest fuel consumption is also affected by actual environment.

\* 6、Emission standard: emission data is obtained when the engine adopts higher rank configuration, the engine with lower rank configuration will not meet this index.

\* 7、Infrastructure weight: the natural-aspirated diesel engine is used as a reference. For the engines working in different application areas or with higher configuration, the structure weigh should be accordingly increased. For an example, when your engine installs any exterior component, such as turbocharger, air intercooler, sea-water exchanger, radiator etc., this will make the weight of the engine become bigger.

### 2、Other instruction

2、1 For natural-aspirated engines, the altitude in normal operation is not above 2000m (at the altitude of 2000m, the engine will have a power reduction). When the engine works at more than 2000m above sea level, please choose plateau type turbocharged diesel engines.

2、2 Due to continuous improvements, specifications are subject to change without notice.

## YTO LR-R, A, B, M, N, V Series Engines Random Spare Parts Packing List

No.	Part Name	Quantity.
1	Flood pipe union screw gasket	4
2	Injector gasket	2
3	Aluminum gasket	4
4	Oil filter	1
5	Drive belt	2
6	Oil-filter wrench	1
7	《YTO LR Diesel Engine Operation & Maintenance Manual》	1
8	YTO LR Series Diesel Engine Operation & Maintenance-DVD	1
9	YTO LR Series Diesel Engine Random Spare Parts Packing List	1
10	《YTO LR Series Diesel Engines Warranty Card 》	1

Notice: the model in this list is basic engine model. Random spare parts are different due to different engine models.

## YTO LR-R, A, B, M, N, V Series Diesel Engines Wearing Parts List

No.	Model	Name	Notes
1	Based on specific models	Cylinder head gasket	
2	Based on specific models	Sealing gasket,cylinder head hood	
3	Based on specific models	Push rod cap gasket	
4	Based on specific models	All Metal gasket	
5	Based on specific models	All Non-Metal gasket	
6	Based on specific models	1st compression	
7	Based on specific models	2nd compression	
8	Based on specific models	Inner sustain oil ring	
9	Based on specific models	Piston	
10	Based on specific models	Cylinder liner	
11	Based on specific models	Thrust shell(top), bearing	
12	Based on specific models	Thrust shell(bottom), bearing	
13	Based on specific models	Thrust shell(top),main bearing	
14	Based on specific models	Thrust shell(bottom),main bearing	
15	Based on specific models	Shell,connecting rod	
16	Based on specific models	Injector matching parts	
17	Based on specific models	Injector plunger pair	
18	Based on specific models	Oil seal	
19	Based on specific models	Waterproof ring	Wet Cylinder block
20	Based on specific models	Temperature Sensor	
21	Based on specific models	Speed Sensor	
22	Based on specific models	Pressure Sensor	
23	Based on specific models	Various oil pipe	
24	Based on specific models	drive belt	
25	Based on specific models	Ribbed	The use of specific models
26	Based on specific models	Diesel filter element	Two-stage Fuel filter
27	Based on specific models	Oil filter element	
28	Based on specific models	Oil filter element	
29	Based on specific models	Alternator	
30	Based on specific models	Turbocharger	
31	Based on specific models	Starter	
32	Based on specific models	Air Compressor Installation Assy	
33	Based on specific models	Hydraulic pump	
34	Based on specific models	Harness	

YTO LR-R, A, B, M, N, V series diesel engines

production license No. and license term:

Rotated power  $\leq 266.00\text{kW}$

Production license No: XK06-002-00114

License term: July 6, 2013



**YTO (LUOYANG) DIESEL ENGINE CO.,LTD.**