

6SE50 MARCH 2004

SERIES 50®

# Service Manual

## Detroit Diesel® Series 50 Diesel and Natural Gas-Fueled Engines

**DETROIT DIESEL**  
CORPORATION



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**CALIFORNIA  
Proposition 65 Warning**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

## ENGINE EXHAUST

Consider the following before servicing engines:



### CAUTION:

**Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.**

- Always start and operate an engine in a well ventilated area.**
- If operating an engine in an enclosed area, vent the exhaust to the outside.**
- Do not modify or tamper with the exhaust system or emission control system.**

## ABSTRACT

This manual provides instruction for servicing on-highway, construction and industrial, generator set, and marine applications of the Detroit Diesel Series 50 Diesel and Natural Gas-Fueled Engines.

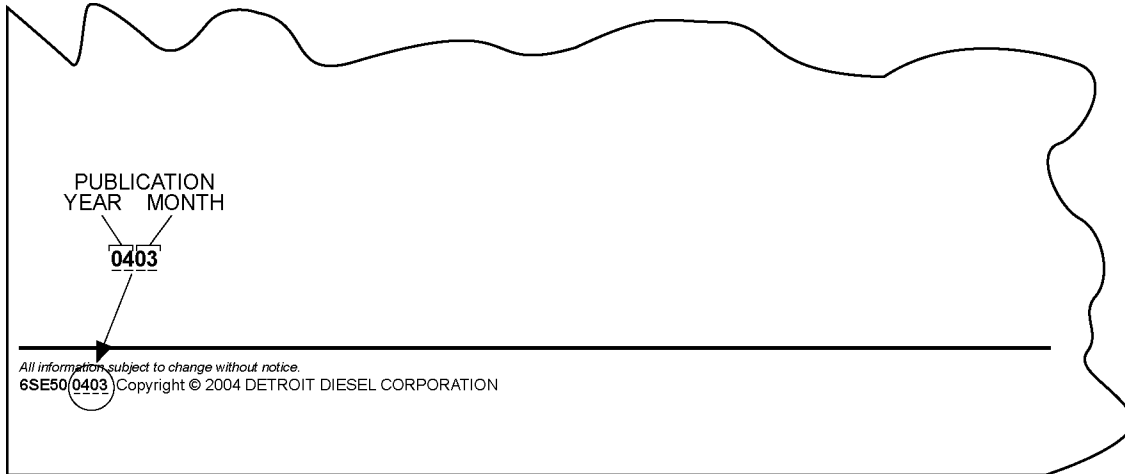
Specifically a basic overview of each major component and system along with recommendations for removal, cleaning, inspection, criteria for replacement, repair and installation and mechanical troubleshooting are contained in this manual.

DDEC III/IV troubleshooting concerns are contained in the *DDEC III/IV Single ECM Troubleshooting Guide*, 6SE497.

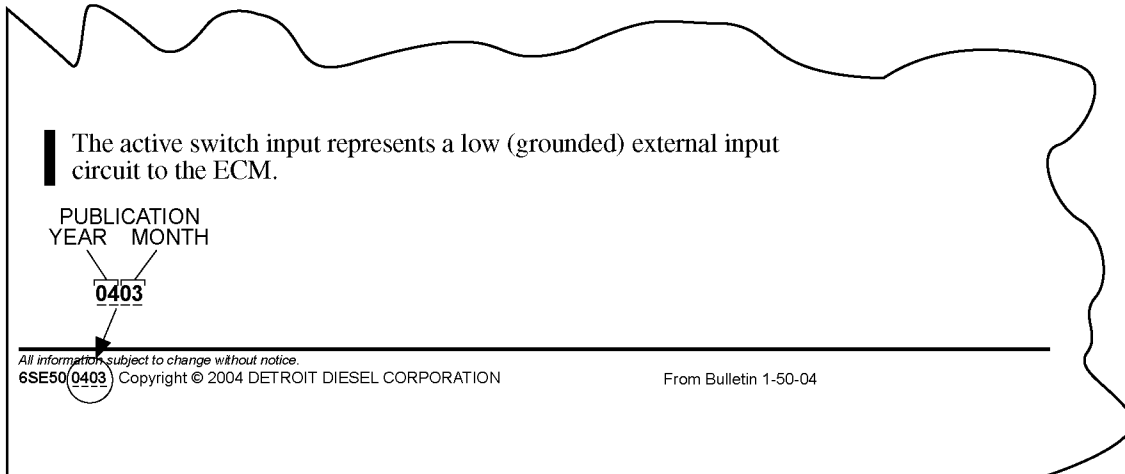
## REVISION NOTIFICATION

Modifications to this manual are announced in the form of Service Information Bulletins. The bulletins include attachment pages and are posted on the World Wide Web ([www.detroitdiesel.com/svc/sibindex.htm](http://www.detroitdiesel.com/svc/sibindex.htm)).

Revisions to this manual will be sent marked with a revision bar (see Example 2). Sections containing revisions will have a third line in the page footer (compare Examples 1 and 2).



Example 1 - Unchanged Pages



Example 2 - Changed Pages

# TABLE OF CONTENTS

<b>GENERAL INFORMATION .....</b>	<b>1</b>
SCOPE AND USE OF THIS MANUAL .....	3
SERVICE PARTS AVAILABILITY .....	3
CLEARANCE OF NEW PARTS AND WEAR LIMITS .....	3
THE FOUR-CYCLE PRINCIPLE .....	4
GENERAL DESCRIPTION .....	5
GENERAL SPECIFICATIONS .....	10
GENERAL SPECIFICATIONS FOR THE SERIES 50G ENGINE .....	11
ENGINE MODEL, SERIAL NUMBER AND OPTION LABEL .....	12
ENGINE MODEL, SERIAL NUMBER AND OPTION LABEL (SERIES 50G) .....	13
REPLACING AND REPAIRING .....	14
DISASSEMBLY .....	15
CLEANING .....	15
INSPECTION .....	20
SAFETY PRECAUTIONS .....	20
FLUOROELASTOMER (VITON) CAUTION .....	30
ENGINE VIEWS AND ELECTRONIC CONTROL MODULE MOUNTING .....	31
ENGLISH TO METRIC CONVERSION .....	33
DECIMAL AND METRIC EQUIVALENTS .....	36
SPECIFICATIONS .....	36
<b>1 ENGINE</b>	
1.1 CYLINDER BLOCK AND CYLINDER LINER .....	1-3
1.2 CYLINDER HEAD .....	1-28
1.3 VALVE AND INJECTOR OPERATING MECHANISM .....	1-60
1.4 VALVES, SPRINGS, GUIDES, INSERTS, SEALS AND ROTATORS .....	1-81
1.5 ENGINE LIFTER BRACKETS .....	1-114
1.6 ROCKER COVER .....	1-118
1.7 CRANKSHAFT .....	1-136
1.8 CRANKSHAFT OIL SEALS .....	1-153
1.9 CRANKSHAFT MAIN BEARINGS .....	1-172
1.10 GEAR CASE COVER .....	1-184
1.11 GEAR CASE .....	1-206
1.12 CRANKSHAFT VIBRATION DAMPER .....	1-233
1.13 CRANKSHAFT PULLEY .....	1-240
1.14 FLYWHEEL .....	1-256
1.15 RING GEAR .....	1-265
1.16 FLYWHEEL HOUSING .....	1-267
1.17 PISTON AND PISTON RING .....	1-275
1.18 PISTON AND CONNECTING ROD ASSEMBLY .....	1-293

1.19	CONNECTING ROD .....	1-309
1.20	CYLINDER LINER .....	1-317
1.21	GEAR TRAIN AND ENGINE TIMING .....	1-331
1.22	CAMSHAFT AND CAMSHAFT BEARING .....	1-356
1.23	THRUST PLATE PERIMETER SEAL .....	1-392
1.24	CAMSHAFT DRIVE GEAR .....	1-405
1.25	ADJUSTABLE IDLER GEAR ASSEMBLY .....	1-419
1.26	BULL GEAR AND CAMSHAFT IDLER GEAR ASSEMBLY .....	1-430
1.27	CRANKSHAFT TIMING GEAR AND TIMING WHEEL .....	1-442
1.28	BALANCE SHAFT AND OIL PUMP MECHANISM .....	1-462
1.29	ACCESSORY DRIVE .....	1-480
1.30	JAKE BRAKE .....	1-511
1.A	ADDITIONAL INFORMATION .....	1-547
<b>2</b>	<b>FUEL SYSTEM</b>	
2.1	FUEL SYSTEM OVERVIEW .....	2-5
2.2	VEHICLE SAFETY FOR THE NATURAL GAS ENGINE .....	2-7
2.3	ELECTRONIC UNIT INJECTOR .....	2-11
2.4	FUEL INJECTOR TUBE AND O-RING .....	2-28
2.5	FUEL PUMP .....	2-42
2.6	FUEL PUMP DRIVE .....	2-64
2.7	FUEL FILTERS (SPIN-ON) .....	2-68
2.8	FUEL FILTER AND WATER SEPARATOR ASSEMBLY .....	2-72
2.9	FUEL PRO <sup>®</sup> 380/380E FUEL FILTER SYSTEM .....	2-79
2.10	ELECTRONIC ENGINE CONTROL .....	2-83
2.11	DDEC III .....	2-84
2.12	DDEC II ECM .....	2-97
2.13	ELECTRONIC FOOT PEDAL ASSEMBLY .....	2-104
2.14	TURBO BOOST PRESSURE SENSOR .....	2-105
2.15	TURBO BOOST PRESSURE SENSOR FOR THE SERIES 50G ENGINES .....	2-107
2.16	MANIFOLD ABSOLUTE PRESSURE SENSOR .....	2-109
2.17	AIR INTAKE PRESSURE SENSOR .....	2-111
2.18	OIL PRESSURE SENSOR .....	2-113
2.19	OIL TEMPERATURE SENSOR .....	2-115
2.20	SYNCHRONOUS REFERENCE SENSOR .....	2-117
2.21	TIMING REFERENCE SENSOR .....	2-120
2.22	COOLANT LEVEL SENSOR .....	2-122
2.23	FUEL PRESSURE SENSOR .....	2-125
2.24	FUEL TEMPERATURE SENSOR .....	2-128
2.25	EXHAUST GAS OXYGEN SENSOR FOR SERIES 50G ENGINES .....	2-132
2.26	EXHAUST TEMPERATURE SENSOR FOR THE SERIES 50G ENGINES .....	2-136
2.27	KNOCK SENSOR AND SIGNAL TO NOISE ENHANCEMENT FILTER (S.N.E.F.) MODULE FOR THE SERIES 50G AUTOMOTIVE ENGINES .	2-137
2.28	OVERVIEW OF THE HIGH PRESSURE FUEL SYSTEM FOR THE SERIES 50G AUTOMOTIVE ENGINE (PRE 1998) .....	2-139

2.29	OVERVIEW OF HIGH PRESSURE FUEL SYSTEM FOR 1998 AND LATER SERIES 50G AUTOMOTIVE ENGINES .....	2-142
2.30	BAROMETRIC PRESSURE SENSOR FOR THE SERIES 50G ENGINE WITH HIGH PRESSURE FUEL SYSTEM 1998 AND LATER .....	2-147
2.31	HIGH PRESSURE FUEL REGULATOR FOR THE SERIES 50G ENGINE .....	2-149
2.32	HIGH PRESSURE FUEL REGULATOR FOR THE SERIES 50G ENGINE PRIOR TO 1998 .....	2-151
2.33	FUEL MIXER FOR THE SERIES 50G HIGH PRESSURE SYSTEM 1998 AND LATER .....	2-155
2.34	FUEL SHUTOFF VALVE FOR 1998 AND LATER SERIES 50G ENGINE WITH HIGH PRESSURE FUEL SYSTEM .....	2-158
2.35	FUEL PRESSURE GAGES FOR THE SERIES 50G ENGINE WITH A HIGH PRESSURE FUEL SYSTEM .....	2-160
2.36	VENTING AND LEAK CHECKING PROCEDURES FOR A NATURAL GAS ENGINE (HIGH PRESSURE SYSTEM) .....	2-162
2.37	FUEL MIXER FOR THE SERIES 50G ENGINE WITH HIGH PRESSURE FUEL SYSTEM (PRIOR TO 1998) .....	2-166
2.38	PULSE WIDTH MODULATED STEPPER MOTOR VALVE (PSV) FOR 1998 AND LATER SERIES 50G AUTOMOTIVE ENGINES .....	2-170
2.39	OVERVIEW OF THE LOW PRESSURE FUEL SYSTEM FOR THE SERIES 50G GENERATOR SET ENGINE (1998 AND LATER) .....	2-173
2.40	IMPCO LOW PRESSURE FUEL REGULATOR FOR THE SERIES 50G ENGINE .....	2-180
2.41	LOW PRESSURE FUEL REGULATOR FOR THE SERIES 50G ENGINE .....	2-184
2.42	FUEL MIXER FOR THE SERIES 50G LOW PRESSURE SYSTEM .....	2-187
2.43	VENTING AND LEAK CHECKING PROCEDURES FOR A NATURAL GAS ENGINE (LOW PRESSURE SYSTEM) .....	2-191
2.44	COMPUVALVE FOR THE SERIES 50G ENGINE .....	2-195
2.45	FUEL SHUTOFF VALVES FOR THE SERIES 50G ENGINE PRIOR TO 1998 .....	2-199
2.46	HOSE, FITTING, AND FILTER FOR THE SERIES 50G ENGINE .....	2-202
2.47	FUEL FILTER TYPE FOR THE SERIES 50G ENGINE .....	2-206
2.A	ADDITIONAL INFORMATION .....	2-215
<b>3</b>	<b>LUBRICATION SYSTEM</b>	
3.1	OVERVIEW OF LUBRICATING SYSTEM .....	3-3
3.2	OIL PUMP .....	3-8
3.3	OIL PRESSURE REGULATOR VALVE .....	3-20
3.4	OIL PRESSURE RELIEF VALVE .....	3-27
3.5	OIL FILTER .....	3-31
3.6	OIL FILTER ADAPTOR .....	3-33
3.7	OIL COOLER .....	3-38
3.8	OIL LEVEL DIPSTICK ASSEMBLY .....	3-46
3.9	OIL PAN .....	3-50
3.10	VENTILATING SYSTEM .....	3-55

<b>4</b>	<b>COOLING SYSTEM</b>	
4.1	COOLING SYSTEM OVERVIEW .....	4-3
4.2	WATER PUMP .....	4-8
4.3	THERMOSTAT .....	4-38
4.4	COOLANT PRESSURE CONTROL CAP .....	4-48
4.5	ENGINE COOLING FAN .....	4-50
4.6	COOLANT FILTER AND CONDITIONER .....	4-60
4.7	RADIATOR .....	4-62
4.A	ADDITIONAL INFORMATION .....	4-63
<b>5</b>	<b>FUEL, LUBRICATING OIL, AND COOLANT</b>	
5.1	FUEL .....	5-3
5.2	LUBRICATING OIL .....	5-10
5.3	LUBRICATING OIL FOR THE SERIES 50G ENGINE .....	5-15
5.4	COOLANT .....	5-17
<b>6</b>	<b>AIR INTAKE SYSTEM</b>	
6.1	AIR INTAKE SYSTEM OVERVIEW .....	6-3
6.2	AIR CLEANER .....	6-8
6.3	INTAKE MANIFOLD .....	6-10
6.4	CLOSED CRANKCASE BREATHER FOR S50G AUTOMOTIVE ENGINES (1998 AND LATER) .....	6-20
6.5	TURBOCHARGER SERIES 50 DIESEL .....	6-22
6.6	TURBOCHARGER SERIES 50 GAS .....	6-61
6.7	CHARGE AIR COOLER .....	6-82
6.8	THROTTLE ACTUATOR FOR THE SERIES 50G ENGINE .....	6-86
6.9	AIR DRYER .....	6-89
6.A	ADDITIONAL INFORMATION .....	6-91
<b>7</b>	<b>EXHAUST SYSTEM</b>	
7.1	OVERVIEW OF EXHAUST SYSTEM .....	7-3
7.2	EXHAUST MANIFOLD .....	7-4
<b>8</b>	<b>ELECTRICAL EQUIPMENT</b>	
8.1	OVERVIEW OF ELECTRICAL SYSTEM .....	8-3
8.2	OVERVIEW OF ELECTRICAL SYSTEM FOR SERIES 50G ENGINE ....	8-4
8.3	BATTERY CHARGING ALTERNATOR .....	8-5
8.4	STORAGE BATTERY .....	8-26
8.5	CRANKING MOTOR .....	8-29
8.6	DDEC III WIRING HARNESS .....	8-35
8.7	METRI-PACK™ 150 SERIES CONNECTORS .....	8-44
8.8	MICRO-PACK™ SERIES CONNECTORS .....	8-50
8.9	WEATHER PACK™ AND METRI-PACK 280 SERIES CONNECTORS ...	8-52
8.10	CONNECTOR TOOLS .....	8-56
8.11	SPLICING GUIDELINES .....	8-57
8.A	ADDITIONAL INFORMATION .....	8-63
<b>9</b>	<b>POWER TAKE-OFF</b>	
9.1	REAR ENGINE POWER TAKE-OFF (REPTO) ASSEMBLY .....	9-3



9.2	FRONT MOUNTED POWER TAKE-OFF .....	9-25
<b>10</b>	<b>SPECIAL EQUIPMENT</b>	
10.1	AIR COMPRESSOR .....	10-3
10.2	AIR COMPRESSOR DRIVE HUB .....	10-9
10.3	AIR COMPRESSOR DRIVE ASSEMBLY .....	10-14
10.A	ADDITIONAL INFORMATION .....	10-31
<b>11</b>	<b>OPERATION AND VERIFICATION</b>	
11.1	PREPARATION FOR A FIRST TIME START .....	11-3
11.2	STARTING .....	11-7
11.3	RUNNING .....	11-8
11.4	STOPPING .....	11-10
11.5	OPERATING CONDITIONS .....	11-11
11.6	SERIES 50G OPERATING CONDITIONS .....	11-13
11.7	MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP SENSOR) FOR THE SERIES 50G ENGINE .....	11-15
11.8	ENGINE RUN-IN INSTRUCTIONS .....	11-20
<b>12</b>	<b>ENGINE TUNE-UP</b>	
12.1	ENGINE TUNE-UP PROCEDURES .....	12-3
12.2	VALVE LASH, INJECTOR HEIGHT (TIMING) AND JAKE BRAKE <sup>®</sup> LASH ADJUSTMENTS .....	12-6
12.3	ENGINE TUNE-UP PROCEDURES FOR THE SERIES 50G ENGINE ...	12-14
12.4	VALVE LASH FOR THE SERIES 50G ENGINE .....	12-16
<b>13</b>	<b>PREVENTIVE MAINTENANCE</b>	
13.1	MAINTENANCE OVERVIEW .....	13-3
13.2	DAILY MAINTENANCE - ALL APPLICATIONS .....	13-4
13.3	MAINTENANCE OF VEHICLE ENGINES .....	13-5
13.4	MAINTENANCE OF ENGINES USED IN STATIONARY AND INDUSTRIAL APPLICATIONS .....	13-18
13.5	DESCRIPTION OF MAINTENANCE ITEMS .....	13-23
13.6	PREVENTIVE MAINTENANCE FOR THE SERIES 50G ENGINE (CITY TRANSIT COACH) .....	13-53
13.7	MAINTENANCE OF SERIES 50G ENGINES .....	13-55
13.8	MAINTENANCE OF SERIES 50G ENGINES FOR GENERATOR SET ..	13-61
13.9	LUBRICATING OIL AND FILTER CHANGE INTERVALS FOR GENSET	13-63
13.10	LUBRICATING OIL AND FILTER CHANGE INTERVALS FOR GENSET (WITH HIGH SULFUR FUELS) .....	13-64
13.11	DETECTING INTERNAL FUEL LEAKS .....	13-65
13.12	CLEANING CONTAMINATED LUBRICATION OIL SYSTEM .....	13-73
<b>14</b>	<b>ENGINE STORAGE</b>	
14.1	PREPARING ENGINE FOR STORAGE .....	14-3
14.2	RESTORING AN EXTENDED STORAGE ENGINE .....	14-8
<b>15</b>	<b>IGNITION SYSTEM</b>	
15.1	OVERVIEW OF IGNITION SYSTEM .....	15-3
15.2	REMOTE MOUNT IGNITION COILS .....	15-4

15.3	IGNITION WIRE HARNESS .....	15-9
15.4	WASTE WIRE HARNESS .....	15-11
15.5	IGNITION BOOT .....	15-13
15.6	IGNITION WIRE AND WASTE WIRE ROUTING .....	15-16
15.7	IGNITION WIRE BRACKETS .....	15-18
15.8	IGNITION BOOT RETAINERS .....	15-20
15.9	IGNITION COIL HARNESS .....	15-21
15.10	SPARK PLUGS .....	15-24
15.11	COIL OVER PLUG IGNITION SYSTEM .....	15-26
15.12	IGNITION BOOT ASSEMBLY .....	15-30
15.13	IGNITER MODULE .....	15-31
15.14	IGNITER MODULE BRACKET .....	15-32
15.15	IGNITION COIL HARNESS .....	15-33
15.16	SPARK PLUGS .....	15-36
<b>16</b>	<b>MISFIRING CYLINDER</b>	
16.1	POOR VEHICLE GROUND .....	16-3
16.2	AERATED FUEL .....	16-6
16.3	IMPROPER INJECTOR CALIBRATION SETTING (DDEC III ENGINES ONLY) .....	16-8
16.4	IMPROPER VALVE CLEARANCE OR INJECTOR HEIGHT, WORN OR DAMAGED CAMSHAFT LOBES AND ROLLERS .....	16-12
16.5	FAULTY FUEL INJECTOR .....	16-22
16.6	FAULTY ELECTRONIC CONTROL MODULE .....	16-24
16.7	WORN OR DAMAGED VALVE OR CYLINDER KIT .....	16-26
<b>17</b>	<b>STARTING DIFFICULTY (ENGINE ROTATES)</b>	
17.1	EMPTY FUEL TANK .....	17-3
17.2	ELECTRONIC CONTROL MODULE WIRING HARNESS .....	17-4
17.3	LOW BATTERY VOLTAGE .....	17-7
17.4	CORRODED OR DAMAGED BATTERY TERMINALS .....	17-9
17.5	DEFECTIVE MAGNETIC SWITCH .....	17-10
17.6	DEFECTIVE STARTER .....	17-13
17.7	LOW CRANKING SPEED .....	17-15
17.8	FUEL SUPPLY VALVE .....	17-17
17.9	PLUGGED FUEL FILTER(S) .....	17-18
17.10	FUEL PUMP .....	17-20
17.11	AERATED FUEL .....	17-22
17.12	RESTRICTIVE AIR FILTER .....	17-24
17.13	LOW COMPRESSION .....	17-26
<b>18</b>	<b>NO START (ENGINE WILL NOT ROTATE)</b>	
18.1	DISCHARGED BATTERY .....	18-3
18.2	DEFECTIVE MAGNETIC SWITCH .....	18-5
18.3	DEFECTIVE STARTER .....	18-8
18.4	INTERNAL ENGINE DAMAGE .....	18-10
<b>19</b>	<b>EXCESSIVE OIL CONSUMPTION</b>	
19.1	MISCALIBRATED DIPSTICK .....	19-3

19.2	EXTERNAL OIL LEAKS .....	19-4
19.3	LEAKING OIL COOLER CORE .....	19-6
19.4	DEFECTIVE AIR COMPRESSOR .....	19-8
19.5	DEFECTIVE TURBOCHARGER .....	19-10
19.6	WORN OR DAMAGED VALVE OR CYLINDER KIT .....	19-11
<b>20</b>	<b>EXCESSIVE CRANKCASE PRESSURE</b>	
20.1	OBSTRUCTION OR DAMAGE TO ROCKER COVER BREATHER .....	20-3
20.2	DEFECTIVE AIR COMPRESSOR .....	20-5
20.3	DEFECTIVE TURBOCHARGER .....	20-7
20.4	WORN OR DAMAGED VALVE OR CYLINDER KIT .....	20-8
<b>21</b>	<b>EXCESSIVE EXHAUST SMOKE (BLACK OR GRAY)</b>	
21.1	IMPROPER GRADE OF FUEL OIL .....	21-3
21.2	RESTRICTED AIR CLEANER ELEMENT .....	21-5
21.3	RESTRICTED OR CRACKED CHARGE AIR COOLER .....	21-7
21.4	FAULTY EXHAUST SYSTEM .....	21-10
21.5	FAULTY FUEL INJECTOR .....	21-12
21.6	DEFECTIVE TURBOCHARGER .....	21-14
<b>22</b>	<b>EXCESSIVE BLUE SMOKE</b>	
22.1	DEFECTIVE TURBOCHARGER .....	22-3
22.2	WORN OR DAMAGED VALVE OR CYLINDER KIT .....	22-6
<b>23</b>	<b>EXCESSIVE WHITE SMOKE</b>	
23.1	IMPROPER GRADE OF FUEL .....	23-3
23.2	DEFECTIVE FUEL PUMP .....	23-5
23.3	AERATED FUEL .....	23-7
23.4	IMPROPER INJECTOR CALIBRATION SETTING (DDEC III ENGINES ONLY) .....	23-10
23.5	IMPROPER VALVE CLEARANCE OR INJECTOR HEIGHT, WORN OR DAMAGED CAMSHAFT LOBES AND ROLLERS .....	23-12
23.6	FAULTY FUEL INJECTOR .....	23-14
23.7	FAULTY ELECTRONIC CONTROL MODULE .....	23-16
<b>24</b>	<b>ROUGH RUNNING OR STALLING</b>	
24.1	LOW BATTERY VOLTAGE .....	24-3
24.2	AERATED FUEL OIL .....	24-5
24.3	INSUFFICIENT FUEL OIL FLOW .....	24-6
24.4	HIGH FUEL OIL TEMPERATURE RETURN .....	24-8
24.5	IMPROPER INJECTOR CALIBRATION SETTING (DDEC III ENGINES ONLY) .....	24-11
24.6	LOW COMPRESSION PRESSURE .....	24-13
<b>25</b>	<b>LACK OF POWER</b>	
25.1	AERATED FUEL .....	25-3
25.2	HIGH FUEL PRESSURE .....	25-5
25.3	HIGH FUEL OIL TEMPERATURE RETURN .....	25-9
25.4	RESTRICTED AIR CLEANER ELEMENT .....	25-11

25.5	RESTRICTED OR CRACKED CHARGE AIR COOLER OR LEAKING INTAKE MANIFOLD .....	25-13
25.6	FAULTY EXHAUST SYSTEM .....	25-15
25.7	HIGH INLET AIR TEMPERATURE .....	25-17
25.8	HIGH ALTITUDE OPERATION .....	25-19
25.9	INCORRECT CAMSHAFT TIMING .....	25-21
<b>26</b>	<b>LOW OIL PRESSURE</b>	
26.1	IMPROPER ENGINE OIL LEVEL .....	26-3
26.2	IMPROPER LUBRICATING OIL VISCOSITY .....	26-5
26.3	LUBRICATING OIL DILUTED WITH FUEL OIL OR ENGINE COOLANT	26-7
26.4	FAULTY OIL PRESSURE GAGE SENSOR .....	26-9
26.5	OIL PRESSURE GAGE LINE OBSTRUCTED .....	26-11
26.6	ROCKER ARM SHAFT PLUGS MISSING (NEW OR REBUILT ENGINES ONLY) .....	26-13
26.7	RESTRICTED OIL COOLER .....	26-15
26.8	NONFUNCTIONAL OR STICKING OIL PRESSURE REGULATOR VALVE .....	26-17
26.9	DEFECTIVE BYPASS VALVE .....	26-19
26.10	DEFECTIVE PRESSURE RELIEF VALVE .....	26-21
26.11	DEFECTIVE PICKUP SCREEN TUBE AND SCREEN ASSEMBLY .....	26-23
26.12	DEFECTIVE CRANKSHAFT MAIN BEARING SHELLS .....	26-25
26.13	DEFECTIVE OIL PUMP ASSEMBLY .....	26-27
<b>27</b>	<b>HIGH ENGINE COOLANT TEMPERATURE</b>	
27.1	IMPROPER ENGINE COOLANT LEVEL .....	27-3
27.2	INSUFFICIENT RADIATOR AIR CIRCULATION .....	27-5
27.3	FAULTY PRESSURE CONTROL CAP .....	27-7
27.4	DEFECTIVE COOLANT HOSES .....	27-9
27.5	FAN BELTS ARE INCORRECTLY ADJUSTED .....	27-11
27.6	INOPERATIVE THERMO-MODULATED FAN .....	27-13
27.7	FAULTY THERMOSTATS .....	27-15
27.8	FAULTY WATER PUMP .....	27-17
27.9	COMBUSTION GASES IN COOLANT .....	27-19
27.10	ABNORMAL RADIATOR COOLANT FLOW .....	27-21
<b>28</b>	<b>LOW COOLANT TEMPERATURE</b>	
28.1	FAULTY THERMOSTATS .....	28-3
28.2	INSUFFICIENT RADIATOR AIR CIRCULATION .....	28-5
<b>29</b>	<b>COMMON TESTS</b>	
29.1	PROPER USE OF MANOMETER .....	29-3
29.2	CYLINDER COMPRESSION TEST .....	29-5
29.3	CRANKCASE PRESSURE TEST (GOVERNED SPEED NO LOAD) .....	29-11
29.4	CRANKCASE PRESSURE TEST (DYNAMIC) .....	29-12
29.5	LUBE OIL CONSUMPTION REPORT .....	29-14
29.6	DIESEL FUEL QUALITY AND SELECTION .....	29-15
29.7	FUEL OIL FLOW TEST .....	29-16
29.8	LUBRICATING OIL CRITERIA .....	29-18

**30 COMMON REPAIRS**

30.1 LEAD REPAIR ..... 30-3  
**INDEX ..... Index-1**



---

## GENERAL INFORMATION

Section	Page
SCOPE AND USE OF THIS MANUAL .....	3
SERVICE PARTS AVAILABILITY .....	3
CLEARANCE OF NEW PARTS AND WEAR LIMITS .....	3
THE FOUR-CYCLE PRINCIPLE .....	4
GENERAL DESCRIPTION .....	5
GENERAL SPECIFICATIONS .....	10
GENERAL SPECIFICATIONS FOR THE SERIES 50G ENGINE .....	11
ENGINE MODEL, SERIAL NUMBER AND OPTION LABEL .....	12
ENGINE MODEL, SERIAL NUMBER AND OPTION LABEL (SERIES 50G) .....	13
REPLACING AND REPAIRING .....	14
DISASSEMBLY .....	15
CLEANING .....	15
INSPECTION .....	20
SAFETY PRECAUTIONS .....	20
FLUOROELASTOMER (VITON) CAUTION .....	30
ENGINE VIEWS AND ELECTRONIC CONTROL MODULE MOUNTING .	31
ENGLISH TO METRIC CONVERSION .....	33
DECIMAL AND METRIC EQUIVALENTS .....	36
SPECIFICATIONS .....	36

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## SCOPE AND USE OF THIS MANUAL

This manual contains complete instructions on operation, adjustment (tune-up), preventive maintenance, and repair (including complete overhaul) for the basic Series 50 Inline Diesel Engines. This manual was written primarily for persons servicing and overhauling the engine. In addition, this manual contains all of the instructions essential to the operators and users. Basic maintenance and overhaul procedures are common to all Series 50 Engines, and apply to all engine models.

This manual is divided into numbered sections. The first section covers the engine (less major assemblies). The following sections cover a complete system such as the fuel system, lubrication system, or air system. Each section is divided into subsections which contain complete maintenance and operating instructions for a specific engine subassembly. Each section begins with a table of contents. Pages and illustrations are numbered consecutively within each section.

Information can be located by using the table of contents at the front of the manual or the table of contents at the beginning of each section. Information on specific sub-assemblies or accessories within the major section is listed immediately following the section title.

## SERVICE PARTS AVAILABILITY

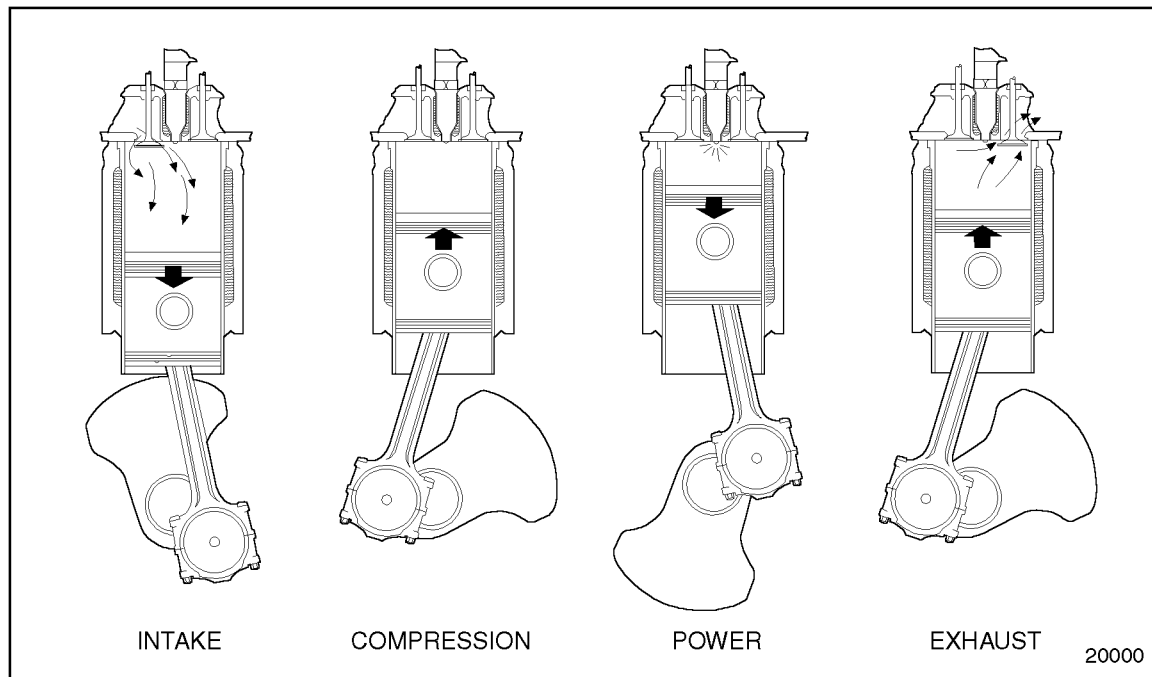
Service parts are available throughout the world. A complete list of all Detroit Diesel Corporation (DDC) distributors and dealers is available in the *Detroit Diesel Corporation World Wide Parts and Service Directory*, 6SE280. This publication can be ordered from any authorized DDC distributor. The dealer must have the engine identification and model number (located on the engine block directly beneath the intake manifold) to fill a parts order.

## CLEARANCE OF NEW PARTS AND WEAR LIMITS

New parts clearances apply only when all new parts are used at the point where the various specifications apply. This also applies to references within the text of the manual. The column entitled Limits must be qualified by the judgement of personnel responsible for installing new parts. For additional information, refer to the section entitled "Inspection" within this section. Refer to Section ADDITIONAL INFORMATION, "Specifications, New Clearances, and Wear Limits" under "Specifications", for a listing of clearances of new parts and wear limits on used parts.

## THE FOUR-CYCLE PRINCIPLE

The diesel engine is an internal combustion engine, in which the energy of burning fuel is converted into work in the cylinder of the engine. In the diesel engine, air alone is compressed in the cylinder, raising its temperature significantly. After the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition is accomplished by the heat of compression. The four piston strokes of the cycle occur in the following order: intake, compression, power and exhaust. See Figure 1.



**Figure 1      The Four Stroke Cycle**

### Intake Stroke

During the intake stroke, the piston travels downward, the intake valves are open, and the exhaust valves are closed. The downstroke of the piston facilitates air from the intake manifold to enter the cylinder through the open intake valves. The turbocharger, by increasing the air pressure in the engine intake manifold, assures a full charge of air is available for the cylinder.

The intake charge consists of air only with no fuel mixture.

### Compression Stroke

At the end of the intake stroke, the intake valves close and the piston starts upward on the compression stroke. The exhaust valves remain closed.

At the end of the compression stroke, the air in the combustion chamber has been compressed by the piston to occupy a space about one-fifteenth as great in volume as it occupied at the beginning of the stroke. Thus, the compression ratio is 15:1.

Compressing the air into a small space causes the temperature of that air to rise. Near the end of the compression stroke, the pressure of the air above the piston is approximately 3445 to 4134 kPa (500 to 600 lb/in.<sup>2</sup>) and the temperature of that air is approximately 538°C (1000°F). During the last part of the compression stroke and the early part of the power stroke, a small metered charge of fuel is injected into the combustion chamber.

Almost immediately after the fuel charge is injected into the combustion chamber, the fuel is ignited by the hot air and starts to burn, beginning the power stroke.

## **Power Stroke**

During the power stroke, the piston travels downward and all intake and exhaust valves are closed.

As the fuel is added and burns, the gases get hotter, the pressure increases, pushing the piston downward and adding to crankshaft rotation.

## **Exhaust Stroke**

During the exhaust stroke, the intake valves are closed; the exhaust valves are open, and the piston is on its upstroke.

The burned gases are forced out of the combustion chamber through the open exhaust valve port by the upward travel of the piston.

From the preceding description, it is apparent that the proper operation of the engine depends upon the two separate functions: first, compression for ignition, and second, that fuel be measured and injected into the compressed air in the cylinder in the proper quantity and at the proper time.

## **GENERAL DESCRIPTION**

The Series 50<sup>®</sup> Diesel Engine described in this manual is a four-stroke cycle, high speed, diesel engine.

It uses an inline cast iron block and has a cast iron cylinder head that contains a single overhead camshaft. The camshaft actuates all the valves (two intake, two exhaust per cylinder), and operates the fuel injectors. The vertically aligned gear train, located at the front end of the engine in a gear case, contains drive gears for the lubricating oil pump, crankshaft, camshaft, air compressor drive, fuel pump drive, water pump and alternator accessory drives.

Each current engine is equipped with dual full flow oil filters, a bypass oil filter, an oil cooler, two fuel oil filters, a turbocharger and an electronic engine control system.

Full pressure lubrication is supplied to all main, connecting and camshaft bearings, and to other moving parts. A gear-type pump draws oil from the oil pan through a screen and delivers it to the oil filters. From the filter, a small portion of the oil is delivered directly to the turbocharger by an external oil line. The remainder of the oil flows to the oil cooler, or bypasses the cooler, and then enters a longitudinal oil gallery in the cylinder block where the supply divides. Part of the oil goes to the cylinder head where it feeds the camshaft bearings and rocker assemblies; part of the oil goes to the main bearings and connecting rod bearings via the drilled oil passages in the crankshaft. The remainder of the oil feeds the balance support where it lubricates the balance shaft bearings and is regulated. Drilled passages in the connecting rod feed oil to the piston pin and the inner surface of the piston crown.

Coolant is circulated through the engine by a centrifugal-type water pump. The cooling system, including the radiator, is a closed system. Heat is removed from the coolant by the radiator. Control of the engine temperature is accomplished by thermostats that regulate the flow of the coolant within the cooling system.

Fuel is drawn from the supply tank through the primary fuel filter by a gear-type fuel pump. From there, the fuel is forced through the secondary fuel filter and into the fuel inlet in the cylinder head and to the injectors. Excess fuel is returned, through a restricted fitting, to the supply tank through the outlet connecting line. Since the fuel is constantly circulating through the injectors, it serves to cool the injectors and to carry off any air in the fuel system.

Air is supplied by the turbocharger to the intake manifold and into the engine cylinders after passing through an air-to-air charge air cooler mounted ahead of the cooling system radiator. The charge air cooler cools the pressurized intake air charge coming from the turbocharger before it enters the intake manifold.

Engine starting may be provided by an electric or air starting motor energized by a storage battery or air pressure storage system. A battery charging alternator, with a suitable voltage regulator, serves to keep the battery charged.

The Series 50 Diesel Engine was designed to be electronically controlled. The Detroit Diesel Electronic Control (DDEC) system has evolved with the product.