TM 9-2350-292-20-1

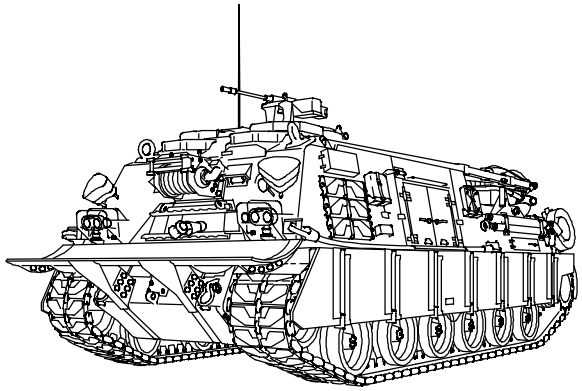
MARINE CORPS TM 07769B-20/2-1

TECHNICAL MANUAL
VOLUME 1 OF 2

UNIT MAINTENANCE MANUAL

FOR

RECOVERY VEHICLE, HEAVY, FULL-TRACKED: M88A2 (NSN 2350-01-390-4683) (EIC: ACQ)



This manual supercedes TM 9-2350-292-20-1 dated 1 October 2000.
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TM 9-2350-292-20-1
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WASHINGTON, D.C. 01 JANUARY 2002

TECHNICAL MANUAL

UNIT MAINTENANCE MANUAL

RECOVERY VEHICLE, HEAVY, FULL-TRACKED:M88A2
NSN 2350-01-390-4683 (EIC: ACQ)

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HOW TO USE THIS MANUAL

This manual was designed to provide you with the information you will need to maintain the M88A2 recovery vehicle.

The information contained in this manual is presented in chapters and work packages. Each chapter is divided into work packages to cover the subject for vehicle system(s) or components. Where references are made to tables, figures, and work packages, refer to those portions of the text.

To find information relating to a specific component or system:

Determine the specific name or function of the component/system.
Find the name or function in the Index Listing, located in the back of this manual.
Refer to appropriate work package(s) called out in the Index Listing.

To find information pertaining to a broader range of information (such as vehicle troubleshooting, preventive maitenance component repair, and component descriptions):

Identify the desired topic.
Find the general topic in the Table of Contents, located in the front of this manual.
Refer to appropriate work package(s) called out in the Table of Contents.

MAINTENANCE

Throughout this manual you will frequently see “notify direct support maintenance”. When you are instructed to notify direct support maintenance, do exactly that; they have the tools and training to efficiently and correctly perform the next level of maintenance.

Maintenance procedures are to be performed in the sequence shown in the text and illustrations. Step 1 must be performed before step 2 and so on.

Equipment illustrations use numbers to identify parts of the system/components.

Throughout this manual the words WARNING, CAUTION, and NOTE will appear. There is a reason for every one of them.

WARNING

A warning is used to alert the user to hazardous operating and maintenance procedures, practices, conditions, statements, etc. that may result in injury to or DEATH or personnel if not strictly observed.

CAUTION

A caution is used to alert the user of hazardous operating and maintenance procedures, practices, conditions, statement, etc. that may result in damage to or destruction of equipment or of mission effectiveness if not observed.

NOTE

A note is used to inform the user of essential information which is of speical interest or importance or will aid the user in performing a job.

END OF TASK

GENERAL INFORMATION 0001 00

THIS WORK PACKAGE COVERS:
General information

SCOPE

Type of manual: Unit Maintenance.

Model number and equipment name: M88A2, Recovery Vehicle, Heavy.

Purpose of equipment: To provide for battlefield recovery (hoist/winch/tow) of vehicles up to and including the M1 series tank.

MAINTENANCE FORMS, RECORDS AND REPORTS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738–750, The Army Maintenance Management System (TAMMS) as contained in the Maintenance Management Update.

Accidents involving injury to personnel or damage to materiel will be reported on DA Form 285 (Accident Reporting) in accordance with AR 385–40.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS

If your M88A2 HRV needs improvement, let us know. Send us an Equipment Improvement Recommendation (EIR). You, the user, are the only one who can tell us what you don't like about our equipment. Let us know why you don't like the design or performance. Put it on a SF 368 (Product Quality Deficiency Report). Mail it to the address specified in DA PAM 738–750.

HAND RECEIPT (HR) MANUALS

This manual has a companion document with a TM number followed by "–HR" (which stands for Hand Receipt). TM 9–2350–292–10–HR consists of preprinted hand receipts that list end item related equipment (i.e., COEI, BII, and AAL) that must be accounted for. As an aid to property accountability, additional HR manuals may be requisitioned through normal publication channels.

CORROSION PREVENTION AND CONTROL

Corrosion Prevention and Control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problem with the HRV be reported so that improvements can be made to prevent the problem in the future. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using SF 368, (Product Quality Deficiency Report). Use of keywords such as "corrosion," "rust," "deterioration," or "cracking" will ensure that the information is identified as a CPC problem. SF 368 should be submitted to the address specified in DA PAM 738–750.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Refer to TM 750–244–6 for procedures on how to destroy the M88A2 HRV.

Below are some general guidelines to follow in destruction of equipment to prevent enemy use.

Destruction of the vehicle and equipment, when subject to capture or abandonment in a combat zone, will be undertaken only when such action is necessary in accordance with orders of, or policy established by, the Army commander.

In general, destruction of essential parts, followed by burning, will usually be sufficient to render the vehicle and equipment useless. Time is usually critical.

GENERAL INFORMATION - CONTINUED 0001 00

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE - CONTINUED

Materiel must be damaged so that it cannot be restored to usable condition by either repair or cannibalization. If lack of time or personnel prevents destruction of all parts, give priority to destruction of parts hardest to replace. It is important that the same parts be destroyed on all vehicles to prevent construction of one complete vehicle from several damaged ones.

The procedure outlined below requires the use of demolition materials and explosives which normally may not be authorized items of issue to the using organization. The issue of these and related materials and conditions under which destruction will be effected, are command decisions in each case, according to the tactical situation.

Varying degrees of damage to the armament and other equipment may be expected during destruction of the vehicle as outlined below:

1. Remove and empty portable fire extinguishers and discharge the fixed fire extinguisher system.

2. Smash all vital elements such as auxiliary power unit, batteries, switches, instruments, hydraulic valves, coupling devices, mechanical transmission, hydraulic pumps and all accessible engine and transmission components. Slash hydraulic lines, electrical cables and harnesses.

3. Drain fuel and hydraulic oil tanks or puncture them as near the bottom as possible.

4. For the engine compartment, transmission, tracks, winches and boom, prepare eleven, 2-pound demolition charges. Use 1-pound TNT blocks or equivalent together with the necessary detonating cord to make up the required charges. Place the required charges as follows:

   - Set the first charge on the accessory drive housing at the forward end of the engine.
   - Set the second and third charges on the engine, one on the left side and one on the right side.
   - Set the fourth charge between the engine and transmission.
   - Set the fifth and sixth charges on the track drive sprockets, one on the left side and one on the right side.
   - Set the seventh charge on the main winch motor.
   - Set the eighth and ninth charges on the hoisting boom at the boom crankarms, one on the left side and one on the right side.
   - Set the tenth and eleventh charges on the hoisting boom stayline crankarms, one on the left side and one on the right side.

   Connect all eleven charges for simultaneous detonation with detonating cord.

5. Provide for dual priming to minimize the possibility of a misfire. For complete details on the use of demolition materials and methods of priming and detonating demolition charges, refer to FM 5-250. Training and careful planning are essential. The danger area is estimated to be 500 yards; elapsed time is approximately 10 minutes.

PREPARATION FOR STORAGE OR SHIPMENT

Refer to WP 0712 00 for the requirements for Administrative Storage and requirements for vehicle shipment.

GENERAL INFORMATION - CONTINUED 0001 00

WARRANTY INFORMATION

Refer to TB 9-2350-292-15 for warranty information pertaining to the M88A2 HRV.

NOMENCLATURE CROSS-REFERENCE LIST

Nomenclature in this manual was chosen in accordance with the terms used for provisioning as they appear in the Repair Parts and Special Tools List (RPSTL) and Maintenance Allocation Chart (MAC) for unit maintenance.

A few tools and components are, however, referred to by names more common than those in the RPSTL. In many cases the more common name is a shorter name for the same component.

OFFICIAL PROVISIONING NOMENCLATURE	MORE COMMON NAME
Cable assembly	Wiring harness or lead assembly
Gauge rod	Dipstick, bayonet gauge, saber gauge
Safety wire	Lockwire
Socket head screw key	Hex key
Solid rubber wheel	Roadwheel
Wire rope	Cable
Engine analyzer set	STE-ICE-R
Vehicle cargo tie-down	Track binder
Key, woodruff key, machine key	Key

LIST OF ABBREVIATIONS

AAL	Additional Authorized List
AOAP	Army Oil Analysis Program
ATE	Automatic Test Equipment
BDAR	Battlefield Damage Assessment and Repair
BII	Basic Issue Item
_C	Degree Centigrade
CAGEC	Contract and Government Entity Code
CAM	Chemical Agent Monitor
CAR	Corrective Action Report
CARC	Chemical Agent Resistant Coating
CCW	Counterclockwise
CM	Centimeters
COEI	Component Of End Item
CPC	Corrosion Prevention and Control
CTA	Common Table of Allowances
CW	Clockwise
DC	Direct Current
DCA	Diagnostic Connector Assembly
DMWR	Depot Maintenance Work Order
DOD	Department of Defense
DS	Direct Support
EIR	Equipment Improvement Recommendation
_F	Degree Fahrenheit
FMC	Fully Mission Capable
FOV	Family of Vehicles
FRH	Fire Resistant, Rust Inhibited Hydraulic Fluid
FWD	Forward
GND	Ground
GS	General Support
HRV	Heavy Recovery Vehicle
KG	Kilogram
KPH	Kilometer Per Hour

GENERAL INFORMATION - CONTINUED 0001 00

LIST OF ABBREVIATIONS - CONTINUED

L	Liter
LRU	Line Replaceable Unit
M	Meter
MM	Milimeter
MAC	Maintenance Allocation Chart
MAX	Maximum
MIN	Minimum
MOS	Military Occupational Specialties
MPH	Miles Per Hour
MTOE	Modified Table of Organization and Equipment
N	Neutral
NBC	Nuclear, Biological, Chemical
NSN	National Stock Number
PMCS	Preventative Maintenance Checks and Services
PSI	Pounds Per Square Inch
PWR	Power
QA	Quality Assurance
QDR	Quality Deficiency Report
R	Reverse
RPM	Revolutions Per Minute
RPSTL	Repair Parts and Special Tools List
SPORT	Soldier's Portable On-system Repair Tool
STE	Special Test Equipment
STE/ICE-R	Simplified Test Equipment for Internal Combustion Engines Reprogrammable
TB	Technical Bulletin
TM	Technical Manual
TAMMS	The Army Maintenance Management System
TMDE	Test, Measurement, Diagnostic Equipment
TOE	Tables of Equipment
VIS	Vehicle Intercommunications System
WP	Work Package

QUALITY ASSURANCE (QA)

No particular quality assurance manual pertains specifically to the M88A2 HRV.

Defective material received through the supply system should be reported on Quality Deficiency Report (QDR) SF 368. Instructions for preparing QDR's are provided in AR 702-7, Reporting of Quality Deficiency Data. QDR's should be mailed directly to:

Commander
U.S. Army Tank-automotive and Armaments Command
ATTN: AMSTA-QRT
Warren, MI 48397-5000

A reply will be furnished directly to you.

GENERAL INFORMATION - CONTINUED 0001 00

COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE), CTA 50-970; or CTA 8-100, as applicable to your unit.

The tool kit (box) assigned to the mechanic (on a 1-per-mechanic-by MOS basis) shall be identified in the individual maintenance paragraphs by nomenclature, item number and work package. No tool in the kit shall be further identified. Other tools required for performance of tall tasks for the maintenance levels covered in the manual shall be identified in the setup and shall be referenced to the Tool identification List, WP 0717 00. "Other tools" includes tools which are part of the components of shop sets authorized to section/teams; tools authorized by RPSTL and CTA 50-970; special and fabricated tools; and items of TMDE.

SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

Special tools and equipment necessary to perform the maintenance described in this manual are listed in WP 0715 00 for information only. Special tools and equipment are listed in TM 9-2350-292-24P, which is the authority for requisitioning replacements. Fabricated tools are identified in the initial setup; manufacturing instructions for fabricated tools are found in WP 0719 00

TOOLS, TMDE, AND SUPPORT EQUIPMENT

Refer to Maintenance Allocation Chart (MAC), WP 0715 00 and Repair Parts and Special Tools List (RPSTL) TM 9-2350-292-24P for tools. Fabricated tools are located in WP 0719 00.

REPAIR PARTS

Repair parts are listed and illustrated in the repair parts and special tools list covering unit maintenance (TM 9-2350-292-24P). All mandatory replacement parts identified in the initial setup are listed in WP 0718 00 of this manual.

Gaskets, packings, preformed packings, seals, lockwashers, locknuts, self-locking nuts, cotter pins and spring pins must be replaced. Bushings must be replaced only if removed.

Springs must be replaced if broken, kinked, cracked or do not conform to standards specified in the repair data.

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END OF TASK

CHAPTER 1

DESCRIPTION AND THEORY OF OPERATION

THEORY OF OPERATION 0005 00

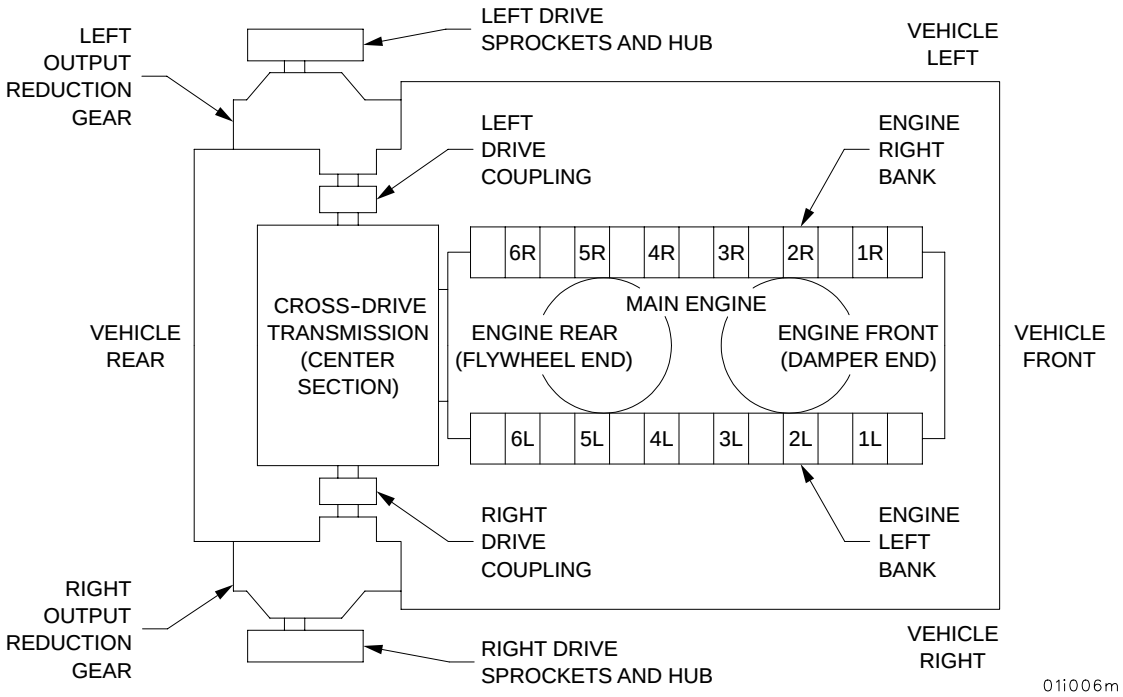
THIS WORK PACKAGE COVERS:

Powerpack, Tracks and Suspension, Fixed Fire Extinguisher System, Hydraulic System, Winch and Spade Assemblies, Auxiliary Power Unit, Gas/Particulate Filter Unit (GPFU), M2A2 Air Purifier with M3 Heaters, Smoke Grenade Launcher System, M239, Exhaust Smoke Generating System, Deep Water Fording Kit, and Electrical System

POWERPACK

Consists of the engine, cross-drive transmission and right and left output reduction gear drive. The powerpack is removed from the vehicle as one complete unit.

The front of the engine is referred to as the damper-end or front, the rear of the engine is referred to as the flywheel-end or rear. As viewed from the front or damper-end toward the rear or flywheel-end, the side to the right is called the right-side and the side to the left is called the left-side. Viewing the engine from the front, the right bank of cylinders is numbered 1R through 6R and the left bank of cylinders is numbered 1L through 6L.



ENGINE

The Teledyne Vehicle Systems model AVDS-1790-8CR engine is a 12-cylinder, 90-degree, V-type, 4-cycle, air-cooled, turbosupercharged diesel engine. The cylinder assemblies are individually replaceable units with overhead valves and valve rocker assemblies in the head. The cylinders are arranged in two banks of six cylinders each. Each bank of cylinders has an overhead camshaft arrangement to actuate the valves of each cylinder.

The engine's fuel injection system utilizes a fuel metering pump which supplies metered fuel to individual cylinders through fuel injector nozzles. The engine fuel pump assembly, located at the front of the engine, delivers fuel to the metering pump. A turbosupercharger is located on each side of the engine at the rear. The exhaust-gas driven turbosupercharger increases the air flow pressure entering the air intake manifolds.

THEORY OF OPERATION - CONTINUED 0005 00

ENGINE - CONTINUED

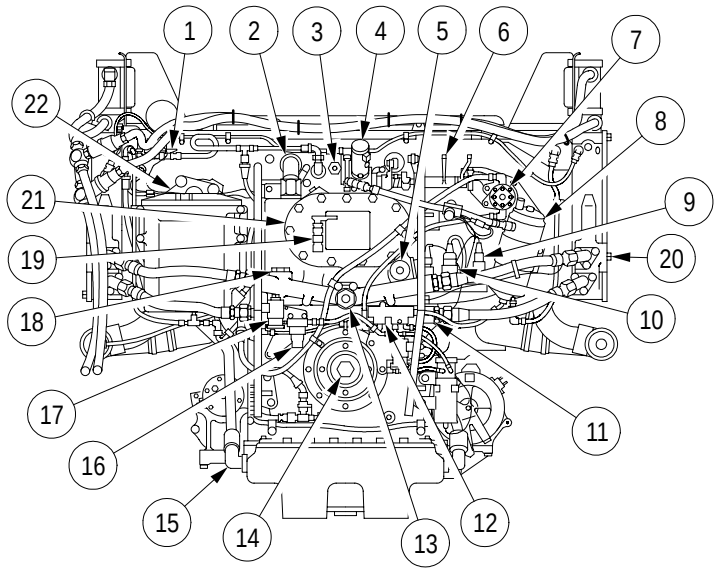
The engine's fuel system primary and fuel/water separator-type secondary fuel filters have top-mounted bleeder valves to assist in the removal of air from the fuel system. Water is removed automatically by a constant bleed orifice in the primary fuel filter and an automatic water drain in the fuel/water separator filter.

The forced-feed engine lubrication system consists of three circuits: the scavenge circuit, the main or pressure circuit and the piston cooling circuit. Each circuit is operated independently by one oil pump which consists of four separate pump sections.

The engine crankcase is vented by the crankcase breather system which exhausts through the crankcase breather tube at the left turbosupercharger exhaust outlet.

The engine is equipped with two intake manifold heaters which are installed in the air intake system between the intake manifold elbows and the turbosuperchargers. The heaters, when operated, preheat the air entering the cylinders to facilitate cold-weather starting and cold-weather idle operation.

The engine is equipped with a 650-amp, 28-V dc generator and a 24 V dc solenoid-operated starter.

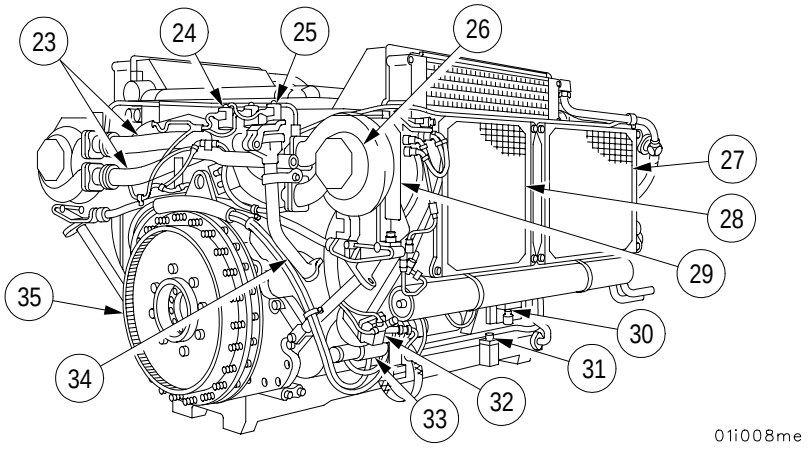


01i007me

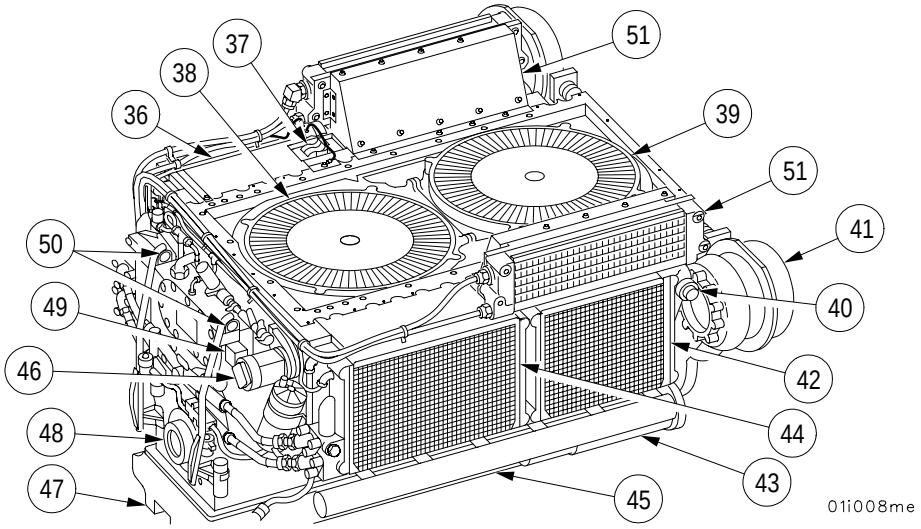
1 Smoke generator manual fuel shutoff valve
2 Front crankcase breather tube
3 Fire extinguisher tube
4 Speed governing solenoid
5 Oil filter bypass valve
6 Manual fuel shutoff
7 Fuel pump assembly
8 Primary fuel filter
9 Oil pressure warning switch
10 Oil pressure gage transmitter
11 Oil pressure regulator valve
12 Fuel check valve (Fuel backflow valve)
13 Damper housing oil drain valve
14 Power takeoff coupling
15 Cylinder head oil drain tube
16 Manifold heater fuel filter
17 Manifold heater fuel solenoid valve
18 Oil cooler bypass valve
19 Oil sampling valve cock
20 Engine oil cooler thermostatic bypass valve
21 Oil filter
22 Fuel/water separator

THEORY OF OPERATION - CONTINUED 0005 00

ENGINE - CONTINUED



23 Exhaust manifold pipe
24 Manifold heater fuel return solenoid
25 Smoke generator fuel solenoid
26 Left bank turbosupercharger
27 Engine oil cooler
28 Transmission oil cooler
29 Air intake manifold
30 Fuel/water automatic drain control
31 Starter low voltage module
32 Manifold heater
33 Engine starter
34 Oil filler tube
35 Flywheel



36 Smoke generator system fuel supply tube
37 Engine oil level check
38 Front engine cooling fan
39 Rear engine cooling fan
40 Transmission oil cooler thermostatic bypass valve
41 Right bank turbosupercharger
42 Transmission oil cooler
43 Engine generator
44 Engine oil cooler
45 Air intake manifold
46 Tachometer drive adapter
47 Oil pan
48 Crankcase
49 Time totalizing meter
50 Front lifting eyes
51 Hydraulic oil coolers

THEORY OF OPERATION - CONTINUED 0005 00

FUEL SYSTEM

Three fuel tanks supply fuel to the engine, auxiliary power unit and the refuel system. Two tanks are adjacent to the engine, one on either side and one forward of the bulkhead in the hydraulic compartment.

A system of four manually operated control valves (1) maintains fuel flow through the check valve (2) and directs fuel to the engine and refueling systems. These valves are also used to drain the fuel tanks.

The fuel from the vehicle fuel tanks is supplied at a minimum pressure of 5 psi to the primary fuel filter (3), which is mounted on the engine right front. Fuel flows through the main fuel check valve (fuel backflow valve) (4) to the engine fuel pump (5) mounted on the front center of the engine. This is an engine-driven, gear-type pump; it boosts fuel pressure to the fuel metering pump (6). A relief valve is incorporated in the pump as a pressure limiting safety valve.

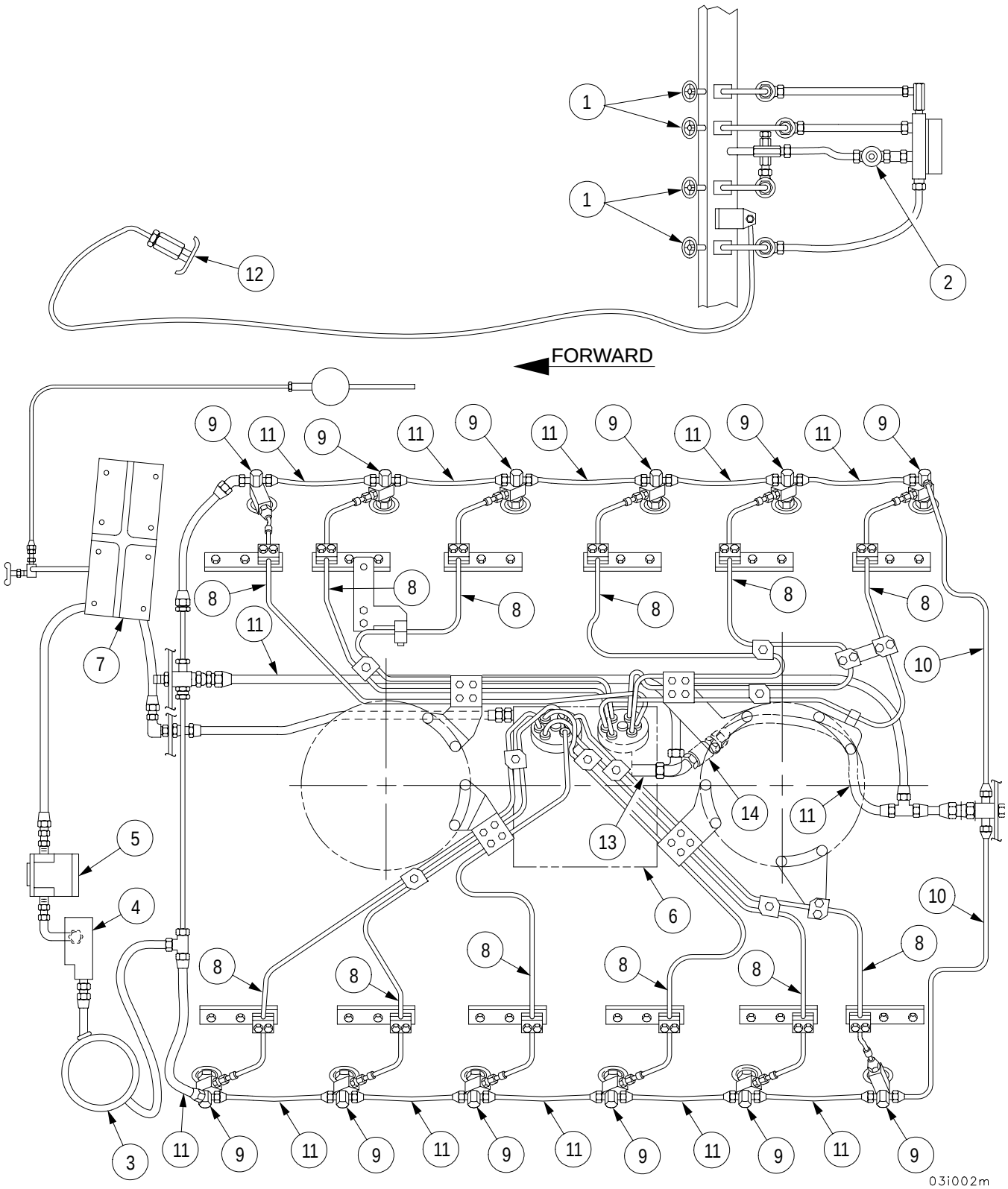
Fuel from the engine fuel pump (5) is filtered through the fuel/water separator filter (7) and passes into the fuel metering pump (6), located in the engine V between the cooling fans. The metering pump (6) delivers metered quantities of fuel under high pressure to each cylinder. An integral governor, of the mechanical-centrifugal type, is used to control fuel delivery as a function of engine speed. Engine shutoff is accomplished by a normally open solenoid control unit in the metering pump (6).

Twelve stainless steel fuel lines (8) carry fuel under high pressure from the fuel metering pump (6) to the twelve fuel injector nozzles (9) on the left and right banks of the engine. The nozzles (9) inject a fine spray of metered fuel under pressure into each cylinder. Excess fuel is carried from the nozzles (9) through return tubes (10) and hoses (11) on each cylinder bank to the fuel return system.

The engine fuel shutoff switch on the master control panel actuates the circuit to close the solenoid in the fuel injector pump (6). Closing the solenoid cuts off fuel from the metering pump (6) and stops the engine. The engine is equipped with a manual fuel shutoff control (12) to stop the engine if the electric fuel shutoff should fail. A bleeder pressure-relief valve (13) in the pump outlet maintains a constant fuel pressure by allowing any accumulated air and excess fuel to return to the fuel tanks through the engine and fuel tank return tubes (10), check valve (14), return hoses (11) and control valves (1). Excess fuel is used to lubricate and cool the fuel metering pump (6). The check valve (14) prevents a back flow of fuel into the metering pump (6) from the fuel return tubes (10) and hoses (11) and prevents continued engine operation after the fuel shutoff valve is closed.

THEORY OF OPERATION - CONTINUED 0005 00

FUEL SYSTEM - CONTINUED



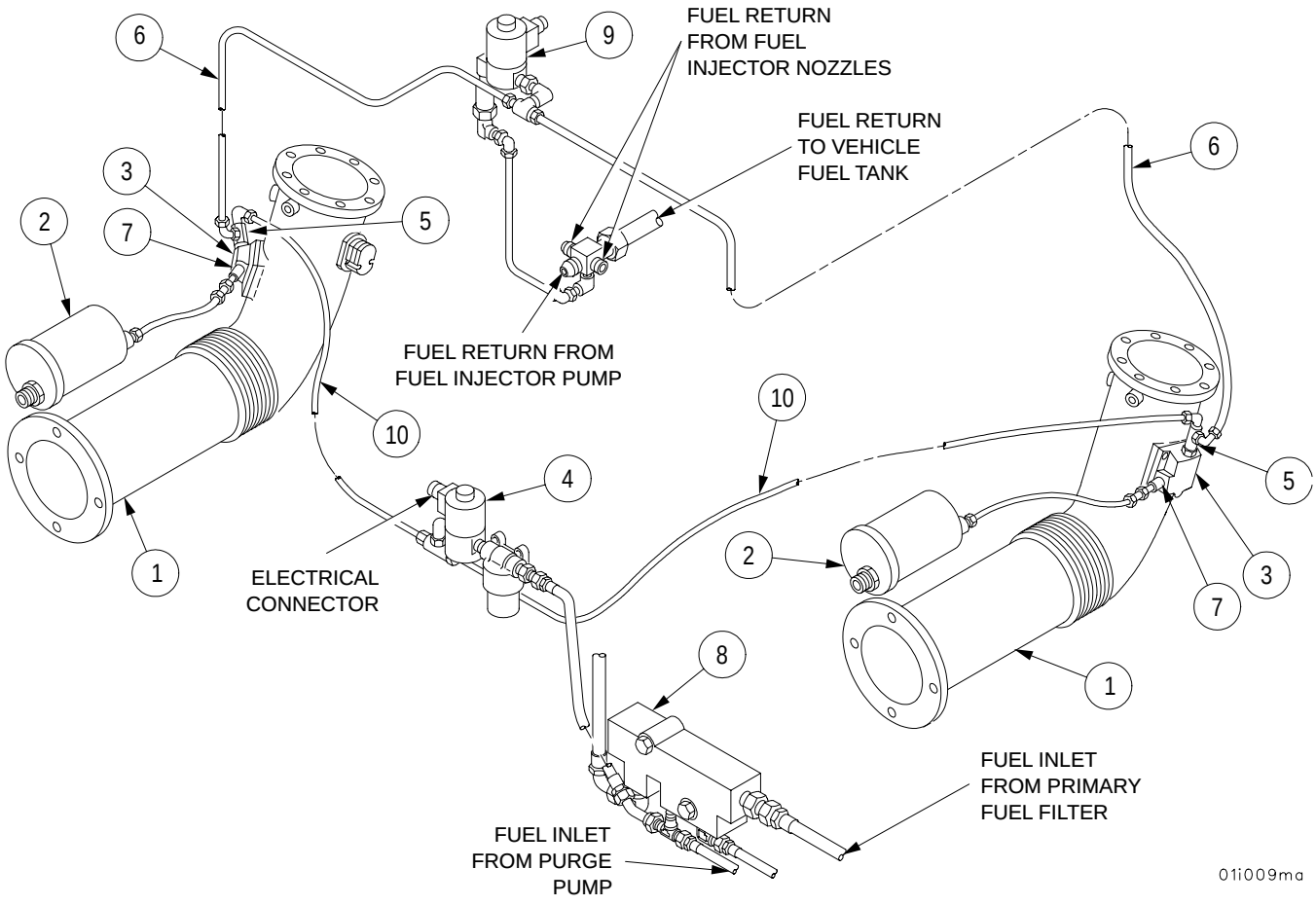
THEORY OF OPERATION - CONTINUED 0005 00

MANIFOLD AIR INDUCTION HEATER SYSTEM

The intake manifold tubes (1) equipped with electrical intake manifold heater ignition units (2) distribute heated supercharged air into each bank of cylinders. These air heaters (3) assist engine starting during cold weather.

Operation of the heater switch energizes the manifold heater fuel inlet solenoid valve (4) to allow fuel flow to the heater nozzles (5). The heater switch also energizes the ignition units (2) to create an electrical spark in the manifold tubes (1), thereby igniting the sprayed fuel.

A leakoff line (6) prevents nozzle fouling and is routed into the fuel injector fuel return line. The fuel is burned in the intake manifold tubes (1) by the ignition of the heater spark plugs (7) which flame heats the incoming air. This flame-heated air and the products of combustion flow directly into the cylinders.

The check valve (fuel backflow valve) (8) ensures the necessary fuel pressure to operate the flame heater nozzles (5). An inlet solenoid valve (4) and fuel return solenoid valve (9) close the flame heater fuel lines (10) when the flame heater switch is off.

The manifold heater fuel return solenoid valve (9) is located at the rear of the engine. When the valves (4 and 9) become energized, the ignition units (2) and heater spark plugs (7) act as a check valve to prevent fuel returning from the injector pump and nozzles from entering the air induction heater system.