3-60. COOLING SYSTEM SERVICING

This task covers:

a. Depressurizing b. Draining System

INITIAL SETUP:

<u>Tools</u>

General mechanic's tool kit: automotive (Appendix B, Item 1)

Test Equipment

Radiator tester (Appendix B, Item 66)

Materials/Parts

Antifreeze (Appendix C, Item 12)

d. Fillng System

c. Preventive Cleaning

Manual References

TM 9-2320-280-10 TM 9-2320-280-24P TM 750-254 TB 750-651

Equipment Condition

Hood raised and secured (TM 9-2320-280-10).

General Safety Instructions

Do not remove surge tank filler cap before releasing internal pressure.

a. Depressurizing

WARNING

Do not remove surge tank filler cap before depressurizing system when engine temperature is above 190°F (88°C). Steam or hot coolant under pressure will cause severe burns.

- 1. If engine is hot, remove surge tank filler cap (1) by placing a thick cloth over cap (l). Press down and turn counterclockwise to its first stop to release internal pressure.
- 2. After pressure has escaped, press down and turn cap (1) counterclockwise again and remove.

b. Draining System

1. If engine is hot, repressurize system (see a. of this task).

ΝΟΤΕ

Have drainage container ready to catch coolant.

- 2. Open draincock (4) and allow system to drain.
- 3. Close draincock (4).

c. Preventive Cleaning

- 1. For preventive cleaning, refer to TB 750-651.
- 2. Test surge tank filler cap (1), refer to TM 750-254.

d. Filling System

NOTE

The cooling system for the vehicles covered in this manual has a 26 qt (25 l) capacity. Continue filling and allow air to escape. Ensure surge tank coolant level is 3/4 full before securing filler cap.

- 1. Ensure radiator draincock (4) is closed and heater control valve (3) is open (pull "TEMP" knob on dash to "MAX" position).
- 2. Fill system with proper antifreeze solution. See table 3-1 for preparation of antifreeze solutions.

3-60. COOLING SYSTEM SERVICING (Cont'd)

- 3. Secure filler cap (1) to surge tank (2).
- 4. Run engine at fast idle (approximately 1500 rpm) until engine temperature reaches 190°F (88°C), opening thermostat to circulate coolant.
- 5. Depressurize system (see a. of this task).
- 6. Fill with proper antifreeze solution until surge tank (2) is 3/4 full. See table 3-1 for preparation of antifreeze solutions.
- 7. Secure filler cap (1) to surge tank (2).
- 8. Run engine at fast idle (approximately 1500 rpm) until temperature reaches 190°F (88°C), opening thermostat, and stop engine.
- 9. Depressurize system (see task a. of this paragraph). Use tester to ensure proper coolant protection is provided.
- 10. Secure filler cap (1) to surge tank (2).



Table 3-1. Guide for Preparation of Antifreeze Solutions.

ETHYLENE-GLYCOL INHIBITED MIL-A-46153				
LOWEST EXPECTED AMBIENT TEMPERATURE		PINTS PER GAUON OF COOLANT CAPACITY	ARCTIC GRADE ANTIFREEZE -90°F (-67.7°C) MIL-A-11755	
°F	°C			
+20	-6.7	1-1/2		
+10	-12.2	2	CAUTION	
0	-17.7	2-3/4		
-10	-23.3	3-1/4	Freezing point of -90°F (-67.7°C).	
-20	-28.8	3-1/2	Issued ready for use and must	
-30	-34.4	4	liquid	
-40	-40.0	4-1/4	iiquiu.	
-50	-45.5	4-1/2		
-55	-48.3	4-3/4		
Below -60	Below -51.1	Use arctic grade antifreeze -90°F (-67.7°C)		

FOLLOW-ON TASKS: • Start engine (TM 9-2320-280-10) and check cooling system for leaks. • Lower and secure hood (TM 9-2320-280-10).

3-61. RADIATOR AND FAN SHROUD ASSEMBLY MAINTENANCE

This task covers:

- a. Removal
- b. Cleaning and Inspection

INITIAL SETUP:

Tools

General mechanic's tool kit: automotive (Appendix B, Item 1)

Materials/Parts

Locknut (Appendix G, Item 99) Six locknuts (Appendix G, Item 128) Eight lockwashers (Appendix G, Item 135) Rivet (Appendix G, Item 254) (optional) Repair kit (Appendix C, Item 37) (optional)

Personnel Required

One mechanic One assistant

c. Installation

Manual References

TM 9-2320-280-10 TM 9-2320-280-24P

Equipment Condition

- Hood removed (para. 10-5).
- Cooling system drained (para. 3-60).
- Oil cooler removed (para. 3-8).

General Safety Instructions

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa).

CAUTION

Do not bend transmission oil cooler fins. Damaged fins reduce cooling efficiency, which may damage engine.

a. Removal

NOTE

The radiator and fan shroud are removed as a unit.

- 1. Loosen clamp (2) and disconnect radiator inlet hose (1) from radiator (3).
- 2. Loosen clamp (6) and disconnect surge tank-to-radiator vent hose (5) from adapter (7).
- 3. Loosen clamp (16) and disconnect control valve hose (15) from shroud bulkhead adapter (17)

NOTE

M1123 and "A2" vehicles have a quick-disconnect on fan drive hose.

- 4. Disconnect fan drive hose (18) from fan drive (19).
- 5. Loosen clamp (10) and disconnect lower radiator front hose (11) from radiator (3).

NOTE

Perform step 6 only if shroud has to be removed from radiator.

- 6. Remove rivet (3.1) (if installed) and strap (4) securing fan shroud (33) to radiator (3).
- 7. Remove locknut (24), washer (25), capscrew (29), large washer (28), washer (25), and lower mount (26) from radiator (3) and frame bracket (27). Discard locknut (24).
- 8. Remove four locknuts (14), washers (13), and capscrews (12) from two rear support brackets (9) and airlift brackets (8). Discard locknuts (14).
- 9. Lift radiator (3) up and remove from vehicle.
- 10. Remove eight capscrews (30), lockwashers, (31), two retaining strips (32) and fan shroud (33) from radiator (3). Discard lockwashers (31).
- 11. Remove two locknuts (20), washers (21), large washers (22), insulators (23), and brackets (9) from radiator (3). Discard locknuts (20).

3-61. RADIATOR AND FAN SHROUD ASSEMBLY MAINTENANCE (6nt'd)







3-61. RADIATOR AND FAN SHROUD ASSEMBLY MAINTENANCE (6nt'd)

b. Cleaning and Inspection

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc).

CAUTION

Using high water pressure when cleaning engine and transmission oil cooler and radiator can cause damage. High water pressure should not be directed at cooler or radiator.

- 1. Remove dirt, trash, and insects embedded in radiator fins, using water and compressed air.
- 2. Inspect radiator adapter (19) for damage. Replace adapter (19) if damaged.
- 3. Inspect radiator (6) for breaks, punctures, cracks, and splits. Replace radiator (6) if broken, punctured, cracked, or split.
- 4. Inspect shroud bulkhead adapter (20) for damage. Replace bulkhead adapter (20) if damaged.

NOTE

For on vehicle fan shroud repair only, use repair kit listed in Appendix C.

- 5. Inspect fan shroud (16) for cracks, splits, and breaks. Repair fan shroud (16) if cracked, split, or broken. Replace fan shroud if damaged beyond repair.
- 6. Inspect fan drive hose (21) for cracks or damage. Replace if defective.

c. Installation

CAUTION

To ensure proper cooling of engine, upper edge of shroud must align with radiator top tank seam or damage to equipment may result.

- 1. Install fan shroud (16) to radiator (6) so fan shroud edge (17) aligns with tank seam (18) and secure with two retaining strips (15), eight washers (14), and capscrews (13). Tighten capscrews (13) to 6 lb-ft (8 N•m).
- 2. Install two support brackets (4) and insulators (5) to radiator (6) with two large washers (3), washers (2), and locknuts (1). Tighten locknuts (1) to 20 lb-ft (27 N•m).
- 3. Align radiator (6) to frame bracket (10), and align rear support brackets (4) to airlift brackets (22).
- 4. Install rear support brackets (4) to airlift brackets (22) with four capscrews (25), washers (24), and locknuts (23). Do not tighten locknuts (23).
- 5. Install radiator (6) and mount (9) on frame bracket (10) with large washer (11), washer (8), capscrew (12), washer (8), and locknut (7). Do not tighten capscrew (12).



3-61. RADIATOR AND FAN SHROUD ASSEMBLY MAINTENANCE (6nt'd)

NOTE

- Fan shroud should be aligned so the following dimensions are maintained. Adjustments may be made by sliding the radiator/ shroud assembly. Distance "A" from the edge of shroud ring and rear edge of fan must be $1-1/2 \pm 1/8$ in. (38.1 \pm 3 mm). Measure distance "A" at the 2, 4, 8, and 10 o'clock positions.
- Fan blade to fan shroud clearance, the distance between the top of the fan blade and fan shroud, must not be less than 1/4 in. (6 mm) at any position.
- 6. Tighten locknuts (12) to 26 lb-ft (35 N·m). Tighten capscrew (9) to 30 lb-ft (41N·m).

NOTE

- To secure strap to shroud, use of rivet is optional.
- Perform steps 7.1 and 7.2 if retaining strap was not connected to radiator shroud with rivet.
- 7. Secure radiator (3) to shroud (13) with strap (5). Secure strap (5) to shroud (13) with rivet (4).
- 7.1. Locate, mark, and drill 0.129-in. (3 mm) diameter hole (using #30 drill bit) in strap (5) and fan shroud (13). Remove burrs and sharp edges.
- 7.2. Secure radiator (3) to fan shroud (13) with rivet (4).
 - 8. Connect lower radiator front hose (11) to radiator (3) with clamp (10).

NOTE

- M1123 and "A2" vehicles have a quick-disconnect on fan drive hose.
- The fan drive hose may be modified to add the quick-disconnect. Refer to appendix D, Fig. D-94 for installation.
- 9. Connect fan drive hose (17) to fan drive (18).
- 10. Connect control valve hose (14) to bulkhead adapter (16) with clamp (15).

NOTE

For vehicles equipped with a 200 amp alternator, it is recommended that the inlet hose be installed with the hose twisted counterclockwise, and upward until a kink in the hose starts to form.

- 11. Connect radiator inlet hose (1) to radiator (3) with clamp (2).
- 12. Connect surge tank-to-radiator vent hose (6) to adapter (8) with clamp (7).





FOLLOW-ON TASKS: • Fill cooling system (para. 3-60).

- Install oil cooler (para. 3-8).
- Start engine (TM 9-2320-280-10) and check cooling system for leaks.
- Install hood (para. 10-5).
- Bleed power steering system (para. 8-29).

3-62. AIRLIFT TO SHROUD SHIELD ASSEMBLY REPLACEMENT

This task covers:

a. Removal	b. Installation
INITIAL SETUP:	
Tools	Manual References
General mechanic's tool kit: automotive (Appendix B. Item 1)	TM 9-2320-280-24P
	Eagipment Condition
	Radiator and fan shroud removed (para. 3-61).

a. Removal

Remove three screws (3) and shield assembly (2) from airlift bracket (1).

b. Installation

Install shield assembly (2) on airlift bracket (1) with three screws (3).



FOLLOW-ON TASK: Install radiator and fan shroud (para. 3-61).

3-63. RADIATOR SUPPORT REPLACEMENT

This task covers:

a.	Removal
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INITIAL SETUP:

Tools

General mechanic's tool kit: automotive (Appendix B, Item 1)

Materials/Parts

Three locknuts (Appendix G, Item 128)

a. Removal

1. Remove locknut (1), washer (2), large washer (3), radiator support (4), and insulator (5) from radiator (6). Discard locknut (1).

b. Installation

Manual References

TM 9-2320-280-24P

• Left splash shield removed (para. 10-17).

• Right splash shield removed (para. 10-20).

Equipment Condition

2. Remove two locknuts (10), washers (8), capscrews (7), and support (4) from airlift bracket (9). Discard locknuts (10).

b. Installation

- 1. Install support (4) on airlift bracket (9) with two capscrews (7), washers (8), and locknuts (10).
- 2. Install insulator (5) and support (4) on radiator (6) with large washer (3), washer (2), and locknut (1). Tighten locknut (1) to 26 lb-ft (35 N·m).
- 3. Tighten locknuts (10) to 26 lb-ft (35 $N \cdot m$).





FOLLOW-ON TASKS: • Install left splash shield (para. 10-17). • Install right splash shield (para. 10-20).

3-64. SURGE TANK REPLACEMENT

This task covers:

a. Removal

INITIAL SETUP:

<u>Tools</u>

General mechanic's tool kit: automotive (Appendix B, Item 1) **b.** Installation

Manual References TM 9-2320-280-24P

Equipment Condition Cooling system drained as required (para. 3-60).

NOTE

- Tag hoses prior to disconnection.
- When current stocks of the four-quart surge tank (12340062) are exhausted, the four and one-half quart surge tank (12340061) will be provided in ita place. When replacing the four-quart surge tank (12340062) with the four and one-half quart surge tank (12340061), the existing surge-tank-to-lower-radiator tube hose (12339163) can be used by cutting approximately four inches from surge tank end of hose.

a. Removal

- 1. Loosen clamp (3) and disconnect surge tank-to-radiator vent hose (6) from surge tank (2).
- 2. Loosen clamp (4) and disconnect surge tank-to-water crossover vent hose (5) from surge tank (2).
- 3. Loosen clamp (9) and disconnect surge tank-to-lower radiator hose (8) from surge tank (2).
- 4. Open two clamps (1) on surge tank (2) and bracket (10).
- 5. Disconnect surge tank overflow hose (7) and remove surge tank (2).

b. Installation

- 1. Install surge tank (2) on bracket (10) with two clamps (1).
- 2. Connect surge tank-to-lower radiator hose (8) to surge tank (2) with clamp (9).
- 3. Connect surge tank-to-water crossover vent hose (5) to surge tank (2) with clamp (4). Tighten clamp (4) to 10-20 lb-in. (1-2 **N**•**m**)
- 4. Connect surge tank-to-radiator vent hose (6) to surge tank (2) with clamp (3). Tighten clamp (3) to 10-20 lb-in. (1-2 **N**•**m**).
- 5. Connect surge tank overflow hose (7) to surge tank (2).



FOLLOW-ON TASK Fill cooling system (para. 3-60).

3-65. SURGE TANK-TO-RADIATOR VENT HOSE REPLACEMENT

This task covers:

a. Removal

INITIAL SETUP:

Tools

General mechanic's tool kit: automotive (Appendix B, Item 1)

Manual References TM 9-2320-280-24P

a. Removal

- 1. Loosen two clamps (2) and remove vent hose (3) from radiator (4) and surge tank (1).
- 2. Remove two clamps (2) from vent hose (3).

b. Installation

- 1. Install two clamps (2) on vent hose (3).
- 2. Install vent hose (3) on surge tank (1)and radiator (4) with two clamps (2). Tighten clamps to 10-20 lb-in. (1-2 N•m).

b. Installation

Equipment Condition

Cooling system depressurized (para. 3-60).



FOLLOW-ON TASK: Tighten coolant filler cap (para. 3-60).

3-66. SURGE TANK-TO-WATER CROSSOVER VENT HOSE REPLACEMENT

This task covers:

a. Removal

Initial setup:

Tools

General mechanic's tool kit: automotive (Appendix B, Item 1)

Manual References

TM 9-2320-280-24P

a. Removal

- 1. Loosen two clamps (2) and remove vent hose (3) from water crossover (4) and surge tank (1).
- 2. Remove two clamps (2) from vent hose (3).

b. Installation

- 1. Install two clamps (2) to vent hose (3).
- 2. Install vent hose (3) on surge tank (1) and water crossover (4) with two clamps (2). Tighten clamps to 10-20 lb in. (1-2 $N \cdot m$).



FOLLOW-ON TASK: Tighten coolant filler cap (para. 3-60).

b. Installation

Equipment Condition Cooling system depressurized (para. 3-60).

3-67. THERMOSTAT BYPASS HOSE REPLACEMENT

This task covers:

a. Removal

INITIAL SETUP:

<u>Tools</u>

General mechanic's tool kit: automotive (Appendix B, Item 1)

Manual References

TM 9-2320-280-24P

a. Removal

b. Installation

Equipment Condition

Cooling system drained as required (para. 3-60).

1. Loosen two clamps (2) and remove hose (3) from water pump (4) and water crossover (1).

2. Remove two clamps (2) from hose (3).

b. Installation

1. Install two clamps (2) on hose (3).

2. Install hose (3) on water pump (4) and water crossover (1) with two clamps (2).



FOLLOW-ON TASK: Fill cooling system (para. 3-60).

3-68. FAN DRIVE HOSE AND QUICK-DISCONNECT REPLACEMENT

This task covers:

a. Removal

INITIAL SETUP:

Applicable Models

M997A2, M1025A2, M1035A2, M1043A2, M1045A2, M1097A2

<u>Tools</u>

General mechanic's tool kit: automotive (Appendix B, Item 1)

Material/Parts

b. Installation

Personnel Required One mechanic One assistant

Manual References TM 9-2320-280-24P

Equipment Condition Hood raised and secured (TM 9-2320-280-10).

Sealing compound (Appendix C, Item 44)

a. Removal

ΝΟΤΕ

Have container ready to catch fluid.

- 1. Loosen clamp (10) and remove control valve hose (9) from bulkhead adapter (5).
- 2. Remove bulkhead adapter (5) from bulkhead adapter bushing (8).
- 3. Remove nut (6), washer (7), bulkhead adapter bushing (8) and bulkhead adapter (11) from shroud (4).
- 4. Release fan drive hose quick-disconnect (2) and remove hose (1) from fan drive (3).
- 5. Remove bulkhead adapter bushing (8) from bulkhead adapter (11).
- 6. Remove bulkhead adapter (11) from fan drive hose (1).
- 7. Remove female end of quick-disconnect (2) from fan drive hose (1).
- 8. Remove male end of quick-disconnect (12) from fan drive (3).

b. Installation

ΝΟΤΕ

- Apply sealing compound to all pipe threads during installation.
- 1. Install male end of quick-disconnect (12) on fan drive (3).
- 2. Install female end of quick-disconnect (2) on fan drive hose (1).
- 3. Install bulkhead adapter (11) on fan drive hose (1)
- 4. Install bulkhead adapter bushing (8) on bulkhead adapter (11).
- 5. Install bulkhead adapter (11) and bulkhead adapter bushing (8) on shroud (4) with washer (7) and nut (6).
- 6. Install hose (1) and fan drive hose quick-disconnect (2) on fan drive (3).
- 7. Install bulkhead adapter (5) on bulkhead adapter bushing (8).
- 8. Install control valve hose (9) on bulkhead adapter (5) with clamp (10).

3-68. FAN DRIVE HOSE AND QUICK-DISCONNECT REPLACEMENT (Cont'd)



FOLLOW-ON TASK: Lower and secure hood (TM 9-2320-280-10).

3-69. RADIATOR INLET HOSE REPLACEMENT

This task covers:

a. Removalb. InstallationINITIAL SETUP:Equipment Condition
Cooling system depressurized (para. 3-60).General mechanic's tool kit:
automotive (Appendix B, Item 1Cooling system depressurized (para. 3-60).Manual References
TM 9-2320-280-24PTM 9-2320-280-24P

a. Removal

1. Loosen two clamps (2) and remove hose (3) from radiator (1) and water crossover (4).

2. Remove two clamps (2) from hose (3).

b. Installation

1. Install two clamps (2) to hose (3).

NOTE

For vehicles equipped with a 200 amp alternator, it is recommended that the inlet hose be installed with the hose twisted counterclockwise and upward until a kink in the hose starts to form.

2. Install hose (3) on water crossover (4) and radiator (1) with two clamps (2).



FOLLOW-ON TASK: Tighten coolant filler cap (para. 3-60).

3-70. RADIATOR LOWER TUBE ASSEMBLY REPLACEMENT

This task covers:

a. Removal

INITIAL SETUP:

Tools

General mechanic's tool kit: automotive (Appendix B, Item 1)

Materials/Parts

Two locknuts (Appendix G, Item 72) Tape (Appendix C, Item 50) b. Installation

Manual References TM 9-2320-280-24P

Equipment Condition Cooling system drained (para. 3-60).

a. Removal

- 1. Remove draincock (11) from radiator lower tube assembly (10).
- 2. Remove two locknuts (5), washers (3), capscrews (2), and washers (3) from radiator lower tube assembly (10) and frame bracket (4). Discard locknuts (5).
- 3. Loosen clamp (7) and disconnect water pump inlet hose (6) from radiator lower tube assembly (10).
- 4. Loosen clamp (8) and disconnect surge tank to lower radiator hose (9) from radiator lower tube assembly (10).
- 5. Loosen clamp (12) and disconnect lower radiator hose (1) from radiator lower tube assembly (10).
- 6. Remove radiator lower tube assembly (10).

b. Installation

- 1. Install radiator lower tube assembly (10) on frame bracket (4) with two washers (3), capscrews (2), washers (3), and locknuts (5). Tighten locknuts (5) to 6 lb-ft (8 N·m).
- 2. Connect lower radiator hose (6) to radiator lower tube assembly (10) with clamp (7).
- 3. Connect surge tank to lower radiator hose (9) to radiator lower tube assembly (10) with clamp (8).
- 4. Connect water pump inlet hose (1) to radiator lower tube assembly (10) with clamp (12).
- 5. Apply sealant type tape to threads of draincock (11) and install draincock (11) on radiator lower tube assembly (10).



FOLLOW-ON TASK: Fill cooling system (para. 3-60).