
TECHNICAL BULLETIN INSTALLATION INSTRUCTIONS

FOR SYSTEMS

SINGLE CHANNEL GROUND AND AIRBORNE RADIO SYSTEM (SINGARS)

AN/VRC-88F, AN/VRC-89F, AN/VRC-90F, AN/VRC-91F, AN/VRC-92F

PRECISION LIGHTWEIGHT GPS RECEIVER (PLGR)

AN/PSN-11

MOVEMENT TRACKING SYSTEM (MTS)

AN/UYQ-90 (V)2, AN/UYQ-90 (V)3

DRIVER'S VISION ENHANCER (DVE)

AN/VAS-5A

FOR VEHICLES

TRUCK, UTILITY, 2/4-DOOR: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4,
M998 (2320-01-107-7155) (EIC: BBD); M998A1 (2320-01-371-9577) (EIC: BBN);

TRUCK, UTILITY, 2/4-DOOR: CARGO/TROOP CARRIER, 1-1/4 TON, 4X4,
M1038 (2320-01-107-7156) (EIC: BBE);

TRUCK, UTILITY, 2/4-DOOR: HEAVY VARIANT, 1-1/4 TON, 4X4,
M1097 (2320-01-346-9317) (EIC: BBM); M1097A1 (2320-01-371-9583) (EIC: BBU);
M1097A2 (2320-01-380-8604) (EIC: BB6);

TRUCK, UTILITY, 2/4-DOOR: S250 SHELTER CARRIER, 1-1/4 TON, 4X4,
M1113 (2330-01-412-0143) (EIC: BB6).

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CHAPTER 1

INTRODUCTION

Section I. SCOPE

- 1-1. This technical bulletin provides installation instructions for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) equipment. The C4ISR equipment shall be installed in the following vehicles:
 - a. Truck, Utility: Cargo/Troop Carrier, 1-1/4 Ton, 4x4, M998, M998A1
 - b. Truck, Utility: Cargo/Troop Carrier, 1-1/4 Ton, 4x4, M1038
 - c. Truck, Utility: Heavy Variant, 1-1/4 Ton, 4x4, M1097, M1097A1, M1097A2
 - d. Truck, Utility: S250 Shelter Carrier, 1-1/4 Ton, 4x4, M1113
- 1-2. The information contained in this technical bulletin is the official authorization to perform the installation of the C4ISR equipment at the direct support maintenance level through contract maintenance teams.

Section II. NOTES

- 2-1. This technical bulletin is not an authorization for requisition or turn-in of vehicles.
- 2-2. This technical bulletin does not establish quantity or types of vehicles assigned to using units.

Section III. GENERAL INFORMATION

- 3-1. Included in the C4ISR equipment are:
 - a. Single Channel Ground and Airborne Radio System (SINCGARS), AN/VRC-92F.
 - b. Force XXI Battle Command, Brigade-and Below (FBCB2), AN/UYK-128 (V)4.
 - c. Precision Lightweight Global Positioning System Receiver (PLGR), AN/PSN-11
 - d. Enhance Position Location Reporting System (EPLRS) AN/UYQ-2 (V).
 - e. Near Term Digital Radio (NTDR) RT-1812
 - f. Quick-Erect Antenna Mount (QEAM) AB-1386/U
 - g. Supplementary Batteries
 - h. Additional terminal boards
- 3-2. The C4ISR equipment becomes operable when all the components are installed in the vehicle and correct power is supplied.

Section IV. MAINTENANCE FORMS, RECORDS, AND REPORTS

Use the following to report any discrepancies:

- a. Reports of Maintenance and Unsatisfactory Equipment. See chapter 4, sections VI through VIII for information.
- b. Report of Packaging and Handling Deficiencies. See chapter 4, sections VI through VIII for information.

Section V. CONSOLIDATED INDEX OF ARMY PUBLICATIONS

Refer to the latest issue of DA PAM 25-30 to determine whether there are new changes or additional publications pertaining to the C4ISR equipment.

CHAPTER 2

PURPOSE OF INSTALLATION

The purpose of installing the C4ISR equipment is to provide the primary means of integrating command and control capability.

CHAPTER 3

COMPLETION TIME FOR INSTALLATION

A total of 20 man hours are required for two personnel to install the C4ISR equipment. Typical vehicle downtime is 12 hours.

CHAPTER 4 PREPARATION FOR INSTALLATION

Section I. PREPARATION OF VEHICLE

Ensure that the site includes adequate lighting and a power source when drilling is required. Inspect the vehicle for damage that could affect installation. Have any such damage repaired before installing the C4ISR equipment.

SECTION II. ITEMS TO BE REMOVED

- 2-1. Remove batteries. (Refer to TM 9-2320-280-20-2 or TM 9-2320-387-24.)
- 2-2. Remove right-hand rear fixed door, as applicable. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 2-3. Remove right-hand rear cab enclosure panel. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 2-4. Remove center tunnel insulation, as applicable. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 2-5. Remove cargo bulkhead. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

Section III. LIST OF ITEMS TO BE RETAINED

- 3-1. Batteries
- 3-2. Right-hand rear cab enclosure panel (if applicable).
- 3-3. Right-hand rear fixed door (if applicable).

Section IV. PREPARATION OF C4ISR EQUIPMENT

Unpack, inspect, and check inventory.

Section V. PRECAUTIONS DURING HANDLING

Observe the following precautions to prevent equipment damage.

- a. Keep dust covers in place on connectors.
- b. Do not disassemble or modify parts in the C4ISR equipment unless authorized to do so.
- c. Keep mounting hardware covered and protected until needed.

Section VI. UNPACK AND INSPECT EQUIPMENT

- 6-1. Unpack and inspect packaging for evidence of damage.
- 6-2. Report any shipping damage on SF 364 Report of Discrepancy (ROD), as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73A/AFR 400-64/MCO 4430.F.

Section VII. INVENTORY C4ISR EQUIPMENT

If any item is missing, fill out and forward Transportation Discrepancy Report (TDR) (SF 361), as described in AR 55-38/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 450015.

Section VIII. EXAMINE EACH ITEM FOR DAMAGE

If any item is damaged, fill out and forward SF 364 Report of Discrepancy (ROD) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73A/AFR 400-64/MCO 4430.F. All damages should be reported as prescribed by DA PAM 738-750, as contained in the Maintenance Management Update.

Section IX. C4ISR EQUIPMENT, DISTRIBUTION, AND CONSUMABLES

- 9-1. Use table 4-1 to identify and inventory C4ISR equipment installation parts supplied in kits.
- 9-2. Use table 4-2 to identify and inventory C4ISR equipment installation parts not supplied in kits.

Section X. DISTRIBUTION AND ISSUE INSTRUCTIONS

- 10-1. U.S. Forces: Do not requisition C4ISR equipment. They will be shipped automatically.
- 10-2. U.S. Army Depots: Requisition C4ISR equipment through supply channels.
- 10-3. Multiservice: Instructions shall be included for multiservice modifications.
- 10-4. MAP/MAS countries: Instructions shall be provided for MAP/MAS countries.

Section XI. PARTS LIST

KITS REQUIRED FOR THIS INSTALLATION:

NOTE

- Not all material in kits is required for this installation. Material not used during installation will be returned to stock for disposition in accordance with AR 725-50.
- If maintenance is to be performed on a vehicle with an existing kit, do not order entire kit for necessary reinstallation.

SINGARS:

- (A): MK-2327 (dual)
- (B): MK-????

PLGR:

- (C): 57K4400

EPLRS:

- (D): MK-2520/VSQ-1

FBCB2:

- (E): No kits available

NTDR:

- (F): No kits available

QEAM:

- (G): No kits available

SUPPLEMENTAL BATTERIES:

- (H): No kits available

MATERIAL REQUIRED FROM KITS:*Table 4-1. Kit Parts List for Installation of C4ISR Equipment.*

ITEM NO.	NOMENCLATURE	PART NUMBER	NSN	KIT	QTY.
1.	Antenna	A3005031	5820-01-183-9462	(C)	2
2.	Bracket, Antenna	A3014546-1	5340-01-391-2742	(A)	2
3.	Bracket, Double-Angle	A3046237	5340-01-262-9566	(D)	2
4.	Bracket, PLGR Mount	12480578	N/A	(B)	1
5.	Bracket, Radio Rack Mounting	A3046235	5340-01-262-9563	(D)	2
6.	Bracket, User Readout (URO)	A3006206-2	5340-01-386-7841	(C)	3
7.	Cable Assembly, Antenna	A3014031-17	5995-01-225-1660	(A)	1
8.	Cable Assembly, Antenna, EPLRS	SM-C-911480	5995-01-167-1269	(C)	3
9.	Cable Assembly, Power, EPLRS	A3004939	5995-01-198-0538	(C),(D)	3
10.	Cable Assembly, Radio Frequency	A3014031-8	5995-01-219-7035	(A)	1
11.	Clamp, Loop	MS21333-71	5340-00-057-2904	(A)	2
12.	Clamp, Loop	MS21333-75	5340-00-050-2740	(A)	2
13.	Clamp, Loop	MS21333-96	5340-00-088-1255	(B)	3
14.	Grommet, Nonmetallic	MS21266-4N	5325-00-923-9512	(A)	2
15.	Grommet, Nonmetallic	MS35489-143	5325-00-292-7558	(B)	2
16.	Insert	12446871-2	5310-01-411-3422	(B)	3
17.	Loudspeaker	A3014065-1	5965-01-222-1420	(A)	2
18.	Mounting Base, Electrical Equipment	A3013367-1	5975-01-188-8873	(A), (D)	1
19.	Nut	271169	5310-00-124-9265	(B)	2
20.	Nut	9419143	5310-01-148-0240	(B)	2
21.	Nut	MS35650-302	5310-00-934-9751	(A),(C),(D)	7
22.	Nut	MS51967-2	5310-00-761-6882	(A),(C)	6
23.	Nut	MS51968-5	5310-00-880-7746	(A), (D)	6
24.	Screw, Cap	B1821BH025C100N	5305-00-225-3843	(B)	3
25.	Screw, Cap	B1821BH025C125N	5305-00-068-0509	(B)	2
26.	Screw, Cap	MS35307-365	5305-00-847-1159	(A), (D)	8
27.	Screw, Cap	MS90725-8	5305-00-225-3839	(A), (D)	2
28.	Screw, Cap	MS90726-36	5305-00-225-9091	(A)	2
29.	Screw, Externally Relieved	A3018701-2	5965-01-222-1420	(A)	4
30.	Screw, Machine	MS35206-217	5305-00-889-2999	(C)	3
31.	Screw, Machine, Flat-Head	MS35206-263	5305-00-984-6210	(B)	4
32.	Screw, Self-Tapping	9421073	5305-01-162-8512	(B)	6
33.	Strap, Tiedown	MS3367-1-0	5975-00-984-6582	(B)	2
34.	Terminal Lug	7728777	5940-00-983-4067	(B)	1
35.	Terminal Lug	7728780	5940-01-035-4212	(B)	2
36.	Washer	2436161	5310-01-102-3270	(B)	6
37.	Washer	MS27183-10	5310-00-809-4058	(A)	18

MATERIAL REQUIRED FROM KITS (Contd):

Table 4-1. Kit Parts List for Installation of C4ISR Equipment (Contd).

ITEM NO.	NOMENCLATURE	PART NUMBER	NSN	KIT	QTY.
38.	Washer, Lock	MS35338-43	5310-00-045-3296	(A),(C)	5
39.	Washer, Lock	MS35338-44	5310-00-582-5965	(A)	20
40.	Washer, Lock	MS35338-46	5310-00-637-9541	(A),(C),(D)	7
41.	Washer, Lock	MS35338-48	5310-00-584-5272	(A)	2
42.	Washer, Lock	MS45904-68	5310-00-889-2528	(A)	12
43.	Washer, Lock	MS45904-72	5310-00-889-2527	(A),(C),(D)	89
44.	Washer, Lock	MS45904-76	5310-00-061-1258	(A), (D)	6
45.	Wellnut	12339397-3	5310-01-231-7455	(B)	1
46.	Wellnut	12339397-6	5310-01-388-6205	(B)	1

MATERIAL REQUIRED BUT NOT INCLUDED IN KITS:*Table 4-2. Non-Kit Parts List for Installation of CAISR Equipment.*

ITEM NO.	NOMENCLATURE	PART NUMBER	NSN	QTY.
1.	Angle, Steel	p/o PKMM 000-016	N/A	1
2.	Antenna AS-3900/VRC	A3017899-2	5985-01-308-8988	2
3.	Antenna, Element (lower)	A3018230-1	5985-01-201-1498	2
4.	Antenna, Element (upper)	A3017901-2	5985-01-306-4622	2
5.	Antenna Support	A3103782	5985-01-312-3028	2
6.	Antenna, NTDR	8173964-1	N/A	1
7.	Antenna, PLGR	AT575-030	5985-01-375-4660	1
8.	Assembly, Display Lock	872843-01	N/A	1
9.	Bracket, C-Mount	A3046202	5340-01-237-8102	1
10.	Backing Plate	p/o PKMM 000-006	N/A	2
11.	Backing Plate	A3046222	5975-01-264-1720	2
12.	Bar, Aluminum Flat	p/o PKMM 000-017	N/A	1
13.	Battery, Deep Cycle	PKMM 000-010	N/A	2
14.	Bolt	MS35751-18	5306-00-108-9988	4
15.	Bracket, PLGR	986-0645-001	5975-01-375-1302	1
16.	Cable (battery to battery)	RCSK 19639	N/A	1
17.	Cable (shunt to rear battery)	RCSK 19643	N/A	1
18.	Cable (solenoid to rear battery)	RCSK 19644	N/A	1
19.	Cable Assembly, Antenna, NTDR	8174921-7	5995-01-512-7547	1
20.	Cable Assembly, Antenna, PLGR	426-0141-050	6150-01-375-8662	1
21.	Cable Assembly, Ground	12480567-1	N/A	1
22.	Cable Assembly, Power	12480567-2	N/A	1
23.	Cable Assembly, Power	8174912-2	N/A	1
24.	Cable Assembly, Power	A3014039-2	5995-01-219-1843	2
25.	Cable Assembly, Power	A3014039-7	5995-01-336-6933	1
26.	Cable Assembly, INC-EPUU	A3279383-3	5995-01-453-9171	3
27.	Cable Assembly, Power	PKMM-0004	N/A	2
28.	Cable Assembly, Power, Electrical	A3154857-1	5995-01-438-7822	1
29.	Cable Assembly, Power, PLGR	9728558-10	6150-01-375-8661	1
30.	Cable Assembly, Radio Frequency	A3014032-3	5995-01-219-7025	1
31.	Cable Assembly, Special Purpose	A3210672-1	5995-01-444-7933	1
32.	Cable Assembly, UHF	8174914-7	5995-01-512-7526	1
33.	Cable (shunt)	RCSK-19638	N/A	1
34.	Cable (solenoid)	RCSK-19637	N/A	1
35.	Cable, Control Box (GREEN)	N/A	N/A	1
36.	Cable, Control Box (ORANGE)	N/A	N/A	1
37.	Cable, Control Box (RED)	N/A	N/A	1
38.	Cable, Speaker	A3014038-3	5995-01-219-4704	2
39.	Charge Control Box	PKMM 000-002	N/A	1
40.	Clamp, Loop	A3209994	5340-01-424-1516	4

MATERIAL REQUIRED BUT NOT INCLUDED IN KITS (Contd):*Table 4-2. Non-Kit Parts List for Installation of C4ISR Equipment (Contd).*

ITEM NO.	NOMENCLATURE	PART NUMBER	NSN	QTY.
41.	Clamp, Loop	MS21333-65	5340-00-905-0790	12
42.	Clamp, Loop	MS21333-69	5340-00-764-7051	7
43.	Clamp, Loop	MS21333-71	5340-00-057-2904	4
44.	Clamp, Loop	MS21333-77	5340-00-922-6300	9
45.	CPU (Central Processing Unit)	881292-1	7021-01-474-3793	1
46.	Decal	12339060	7690-01-265-1135	1
47.	Decal	861868-2	N/A	1
48.	Display	881293-1	7025-01-475-0229	1
49.	Folding Step	p/o PKMM 000-006	N/A	2
50.	Frame	A3210675-1	N/A	1
51.	Gasket	A3013655-1	5330-01-205-2864	5
52.	Grommet, Nonmetallic	2400	5325-01-289-7859	1
53.	Grommet, Nonmetallic	12338098	5325-01-308-5424	2
54.	Grommet, Nonmetallic	MS21266-4N	5325-00-923-9512	A/R
55.	Grommet, Nonmetallic	MS21266-6N	5325-00-783-4753	A/R
56.	Grommet, Nonmetallic	12341628	N/A	A/R
57.	Grommet, Nonmetallic	MS35489-7	5325-00-174-5315	2
58.	Guard, Amp	872842-1	5935-01-487-2172	1
59.	Insert	12446871-2	5310-01-411-3422	9
60.	Isolation Kit, CPU	872826-2	5340-01-481-5741	1
61.	Isolation Kit, Display	872870-1	5340-01-481-5757	1
62.	Lanyard	8925T5-7X19	4010-01-497-2675	1
63.	Mount, Ramball	RAM-D-111U	5975-01-485-3615	1
64.	Mount, Resilient	MT-6146/VSQ-1	5340-01-167-8297	3
65.	Mounting Base, Electrical Equipment	A3014053-1	5975-01-235-1962	1
66.	Mounting Tray	8174934G1	N/A	1
67.	Nut	p/o PKMM 000-016	N/A	2
68.	Nut	9418892	5310-01-157-9819	14
69.	Nut	13218E0320-293	5310-00-913-8881	8
70.	Nut	MS35649-2252	5310-00-997-1888	3
71.	Nut	MS35649-2382	5310-00-056-3395	2
72.	Nut	MS35649-63	5310-00-804-3859	5
73.	Nut	MS51967-9	5310-00-761-0654	1
74.	Nut	271169	5310-00-124-9265	3
75.	Nut	9419143	5310-01-148-0240	7
76.	Nut	9422771	5310-01-211-0691	1
77.	Nut	MS51967-5	5310-00-880-7744	18
78.	Nut	MS35690-610	5310-00-655-6457	29
79.	Nut	MS51967-6	5310-00-931-8167	4
80.	Nut	9417954	5310-00-931-8167	4

MATERIAL REQUIRED BUT NOT INCLUDED IN KITS (Contd):*Table 4-2. Non-Kit Parts List for Installation of C4ISR Equipment (Contd).*

ITEM NO.	NOMENCLATURE	PART NUMBER	NSN	QTY.
81.	Nut, Lock	271175	5310-01-333-5245	4
82.	Nut, Self-Locking	p/o PKMM 000-016	N/A	2
83.	Nut, Self-Locking	MS17829-5C	5310-00-245-3424	4
84.	Nut, Self-Locking	MS17829-4C	5310-00-483-8792	6
85.	Nut, Self-Locking	MS21044-NO4	5310-00-088-0551	3
86.	Nut, Self-Locking	MS21044-NO8	5310-00-811-3494	2
87.	Nut Strip	A3014064-1	N/A	1
88.	Panel, Enclosure	12447141	2510-01-413-5993	1
89.	Plate	A3103784	N/A	2
90.	Plate, Angled	A3103740	5340-01-302-0068	2
91.	Plate, Mounting	A3014550-1	N/A	2
92.	Rack, Integrated	A3276903	N/A	1
93.	Rack, QEAM	PKMM 000-006	N/A	1
94.	Rivet, Blind	12339355-1	5320-01-271-6357	2
95.	Rivet, Blind	M24243/1A403	5320-00-083-5009	4
96.	RTV	12346193	6850-01-159-4844	A/R
97.	Screw	N/A	N/A	2
98.	Screw	MS35224-65	5305-00-543-5743	1
99.	Screw	MS90725-30	5306-00-225-8495	8
100.	Screw, Cap	8599267-531	5305-00-847-1159	4
101.	Screw, Cap	B1821AH038C225N	5305-01-434-2947	2
102.	Screw, Cap	B1821BH025C075N	5305-00-068-0508	8
103.	Screw, Cap	B1821BH025C150N	5305-00-071-2509	6
104.	Screw, Cap	B1821BH031C125N	2306-00-226-4829	4
105.	Screw, Cap	B1821BH031F075N	5306-00-050-1238	2
106.	Screw, Cap	B1821BH031F100N	5305-00-051-4076	2
107.	Screw, Cap	B1821BH031F125N	5305-00-051-4078	22
108.	Screw, Cap	B1821BH038F100N	5305-00-269-3236	6
109.	Screw, Cap	B1821BH050C400N	5305-00-071-2079	3
110.	Screw, Cap	B1821BH050C450N	5305-00-071-2081	2
111.	Screw, Cap	B1821BH025C100N	5305-00-225-3843	14
112.	Screw, Cap	B1821BH025C125N	5305-00-068-0509	7
113.	Screw, Cap	MS35307-365	5305-00-847-1159	8
112.	Screw, Cap	MS90726-36	5305-00-225-9091	16
114.	Screw, Cap	MS90725-64	5305-01-325-8387	21
115.	Screw, Cap	MS90725-62	5305-00-269-3213	8
116.	Screw, Cap	B1821BH031C300N	5306-00-226-4837	4
117.	Screw, Machine	160035	5305-00-016-0035	1
118.	Screw, Machine	MS35206-230	5305-00-889-3000	5
119.	Screw, Machine	MS35206-247	5305-00-984-6195	2

MATERIAL REQUIRED BUT NOT INCLUDED IN KITS (Contd):*Table 4-2. Non-Kit Parts List for Installation of C4ISR Equipment (Contd).*

ITEM NO.	NOMENCLATURE	PART NUMBER	NSN	QTY.
120.	Screw, Machine	MS35206-265	5305-00-984-6212	1
121.	Screw, Machine	MS35207-265	5305-00-993-1848	4
122.	Screw, Machine	MS35207-263	5305-00-989-7434	2
123.	Screw, Machine, Flat-Head	MS35190-291	5305-00-958-5247	2
124.	Screw, Self-Tapping	9421073	5305-01-162-8512	27
125.	Screw, Self-Tapping	9426634	N/A	8
126.	Screw, Self-Tapping	9426241	5305-01-206-7219	1
127.	Screw, Self-Tapping	12342499-2	5305-01-264-5809	7
128.	Shelf, Electrical Equipment	A3046236	5975-01-262-9575	2
129.	Shunt	PKMM 000-013	N/A	1
130.	Solenoid	586-905	5945-01-411-7621	1
131.	Spacer	92510A318	N/A	12
132.	Spacer	10705AL315C	5365-01-487-3145	4
133.	Strap, Tiedown	MS3367-1-0	5975-00-984-6582	A/R
134.	Terminal Block	MS27212-1-23	N/A	1
135.	Terminal Board	105A	5940-01-208-4713	1
136.	Terminal Board	MS27212-3-8	5940-00-950-7782	1
137.	Terminal Board Cover	12480569-1	N/A	1
138.	Terminal Board Cover	12480569-2	N/A	1
139.	Terminal Board Cover	MS18029-3S-2	5940-01-280-9304	1
140.	Terminal Cover	MS18029-1L-16	N/A	1
141.	Terminal Link	MS25226-6N-2	6150-01-167-9267	1
142.	Terminal Lug	7728777	5940-00-983-4067	1
143.	Terminal Lug	MS20659-129	5940-00-114-1314	2
144.	Terminal Lug	MS20659-141	5940-00-113-9825	4
145.	Tubing, Shrink	MS23053/4-302-0	5970-01-161-6796	A/R
146.	Washer, Fender	p/o PKMM 000-016	N/A	2
147.	Washer	2436163	5310-01-412-4013	18
148.	Washer	9414920	5310-01-476-8589	2
149.	Washer	9417373	5310-01-361-1163	1
150.	Washer	11500256	5310-00-080-6004	1
151.	Washer	MS27183-14	5310-00-080-6004	4
152.	Washer	MS27183-4	5310-00-950-1310	3
153.	Washer	MS27183-41	5310-00-765-3197	2
154.	Washer	MS51412-23	5310-01-333-0060	2
155.	Washer	2436161	5310-01-102-3270	25
156.	Washer	MS27183-12	5310-00-081-4219	14
157.	Washer	120393	5310-00-012-0393	8
158.	Washer	MS15795-814	5310-00-773-7618	52

MATERIAL REQUIRED BUT NOT INCLUDED IN KITS (Contd):*Table 4-2. Non-Kit Parts List for Installation of C4ISR Equipment (Contd).*

ITEM NO.	NOMENCLATURE	PART NUMBER	NSN	QTY.
159.	Washer, Lock	120380	5310-00-543-2705	5
160.	Washer	p/o PKMM 000-016	N/A	2
161.	Washer, Lock	MS45904-84	5310-00-935-8984	5
162.	Washer, Lock	MS35338-48	5310-00-584-5272	1
163.	Washer, Lock	MS45904-72	5310-00-889-2527	37
164.	Washer, Lock	MS35338-41	5310-00-045-4007	5
165.	Washer, Lock	MS35338-141	5310-01-422-3906	26
166.	Wingnut	MS35425-75	5310-01-078-5996	1
167.	Wingnut	MS51553-420	5310-01-384-2546	4
168.	Wire Assembly, Fuse (12V)	12480568-2	N/A	1
169.	Wire Assembly, Fuse (24V)	12480568-1	N/A	3
170.	Wire, Braided	AA59569F30T0375	6145-00-191-8402	A/R
171.	Wire, Lock	MS20995C32	9505-00-293-4208	A/R

CHAPTER 5 INSTALLATION PROCEDURES

Section I. SCOPE

This chapter provides instructions for installation of the following C4ISR equipment:

- Single Channel Ground and Airborne Radio System (SINCGARS)
- Precision Lightweight Global Positioning System Receiver (PLGR)
- Movement Tracking System (MTS)
- Driver's Vision Enhancer (DVE)
- Additional terminal boards in the vehicle

When installing C4ISR equipment, be sure to read and follow instructions and illustrations carefully.

Section II. INSTALLATION OF TERMINAL BOARDS

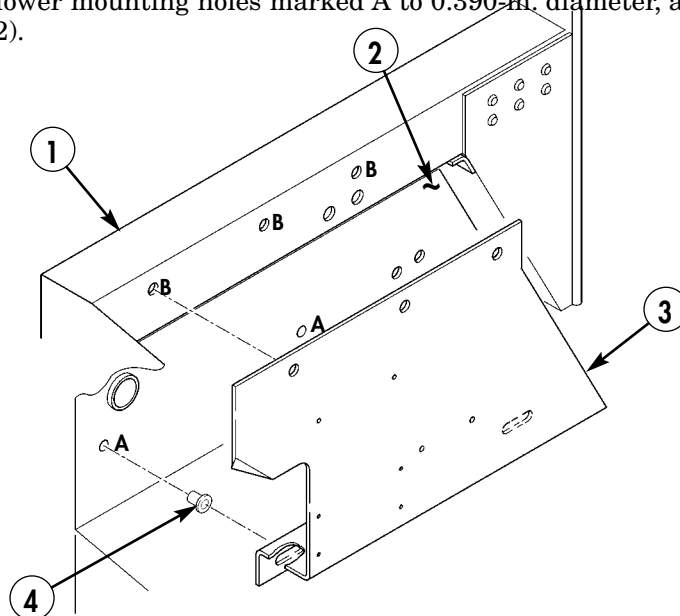
Use the following procedure to install additional terminal boards to provide adequate power connections. Vehicles must have dual-voltage alternators installed in order to have both 12V and 24V terminal boards installed.

Section III. CAB ENCLOSURE PANEL, TERMINAL BOARD, AND COVER MODIFICATION

NOTE

- For vehicles without cab enclosure panel, begin with step 3-1 and use cab enclosure panel NSN 2510-01-413-5993.
- For vehicles with cab enclosure panel, begin with step 3-3.
- All dimensions are in inches.

- 3-1.** Place enclosure panel (3) in position. Locate, mark, and drill five 0.159-in. diameter holes marked A and B in B-beam (1) and battery box (2).
- 3-2.** Enlarge two lower mounting holes marked A to 0.390-in. diameter, and install two inserts (4) in battery box (2).



- 3. ENCLOSURE PANEL – 12447141 – QTY. 1**
4. INSERT – 12446871-2 – QTY. 2

Figure 5-1.

NOTE

- Do not install cab enclosure panel.
- Use figures 5-2 and 5-3 to identify cab enclosure panel that is being modified.

- 3-3.** Locate, mark, and drill three 0.156-in. diameter holes marked A in cab enclosure panel (3) as shown in figures 5-2 or 5-3.
- 3-4.** Locate, mark, and drill two 0.156-in. diameter holes marked C in cab enclosure panel (3) as shown in figures 5-2 or 5-3.

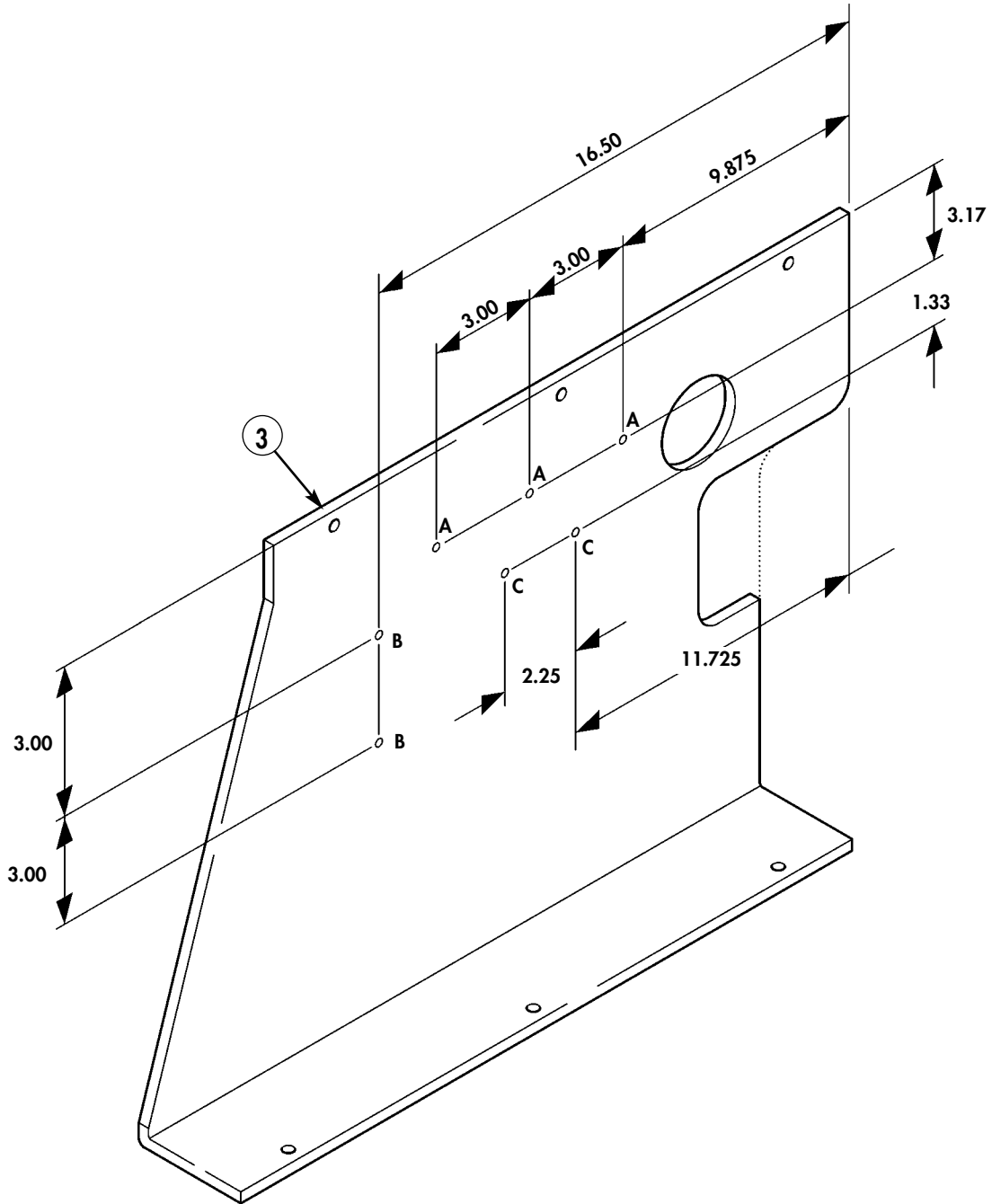


Figure 5-2.

- 3-5.** Locate, mark, and drill two 0.196-in. diameter holes marked B in cab enclosure panel (3) as shown in figures 5-2 or 5-3.

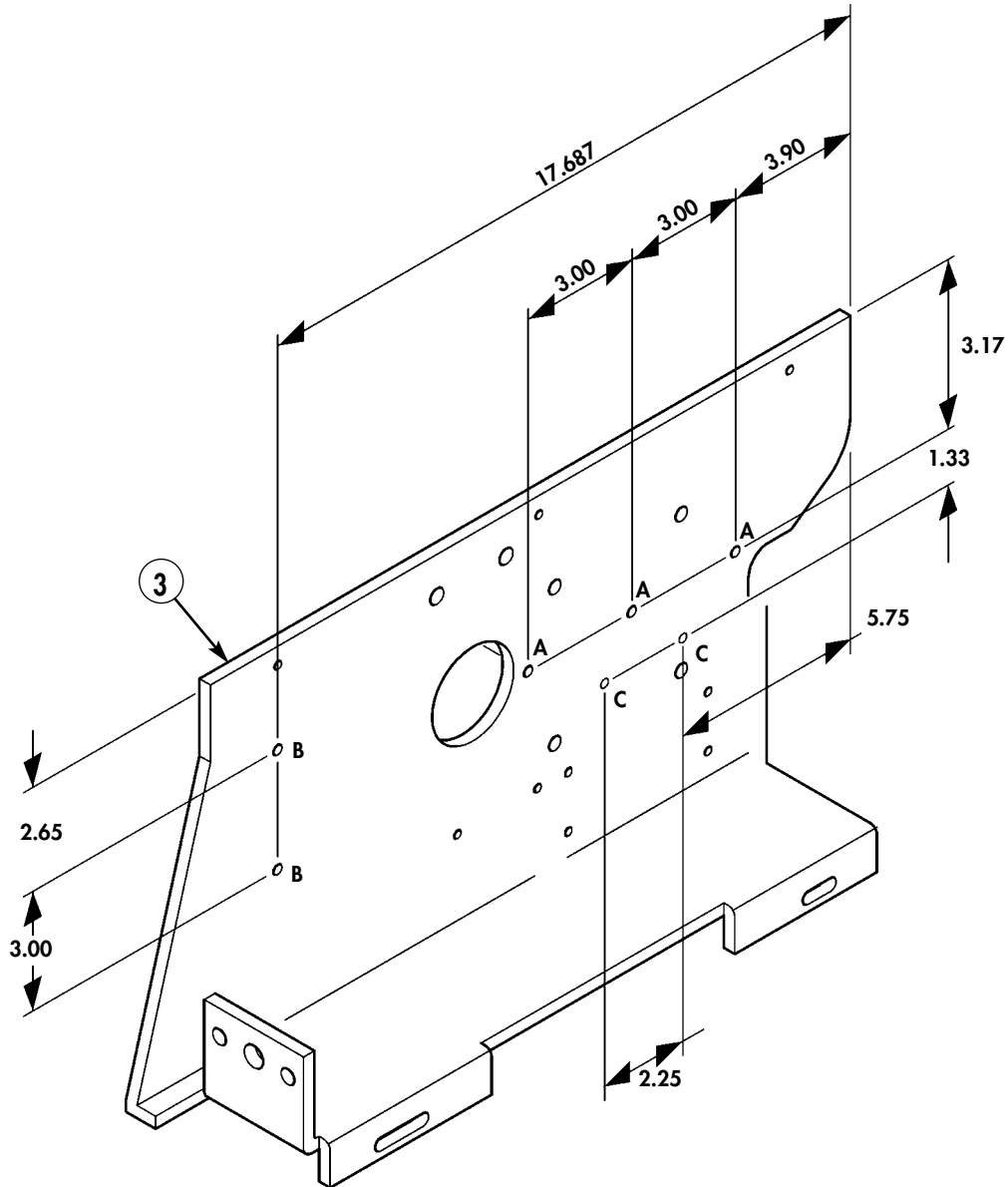


Figure 5-3.

CAUTION

Do not cut raised sections of terminal board. Terminal board is not usable if cut on raised section.

- 3-6. Measure and cut terminal board (5) in two places (6). Remove burrs and sharp edges.
- 3-7. Install five nut sleeves (9) in terminal board covers (7), (8), and (10), and secure with five snaprings (11).

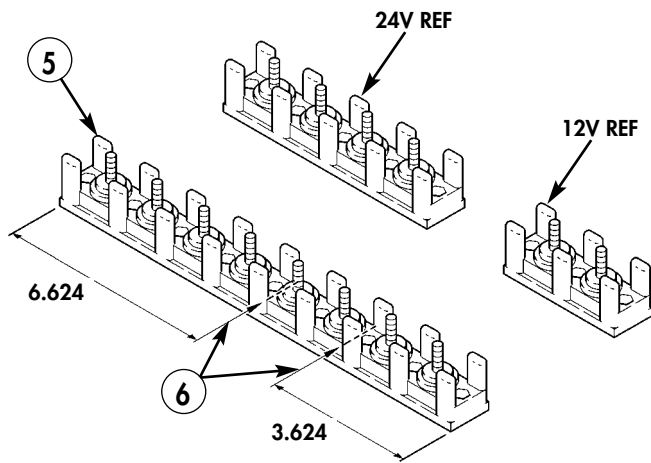


Figure 5-4.

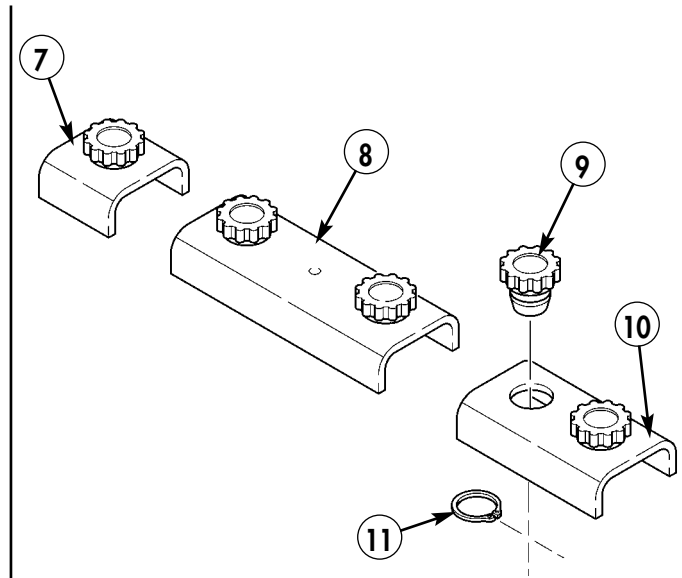


Figure 5-5.

- 5. TERMINAL BOARD – MS27212-3-8 – QTY. 1
- 7. TERMINAL BOARD COVER – 12480569-1 – QTY. 1
- 8. TERMINAL BOARD COVER – 12480569-2 – QTY. 1
- 10. TERMINAL BOARD COVER – MS18029-3S-2 – QTY. 1

Section IV. B-BEAM PREPARATION

- 4-1. Locate, mark, and drill four 0.159-in. diameter holes (2) in B-beam (1).

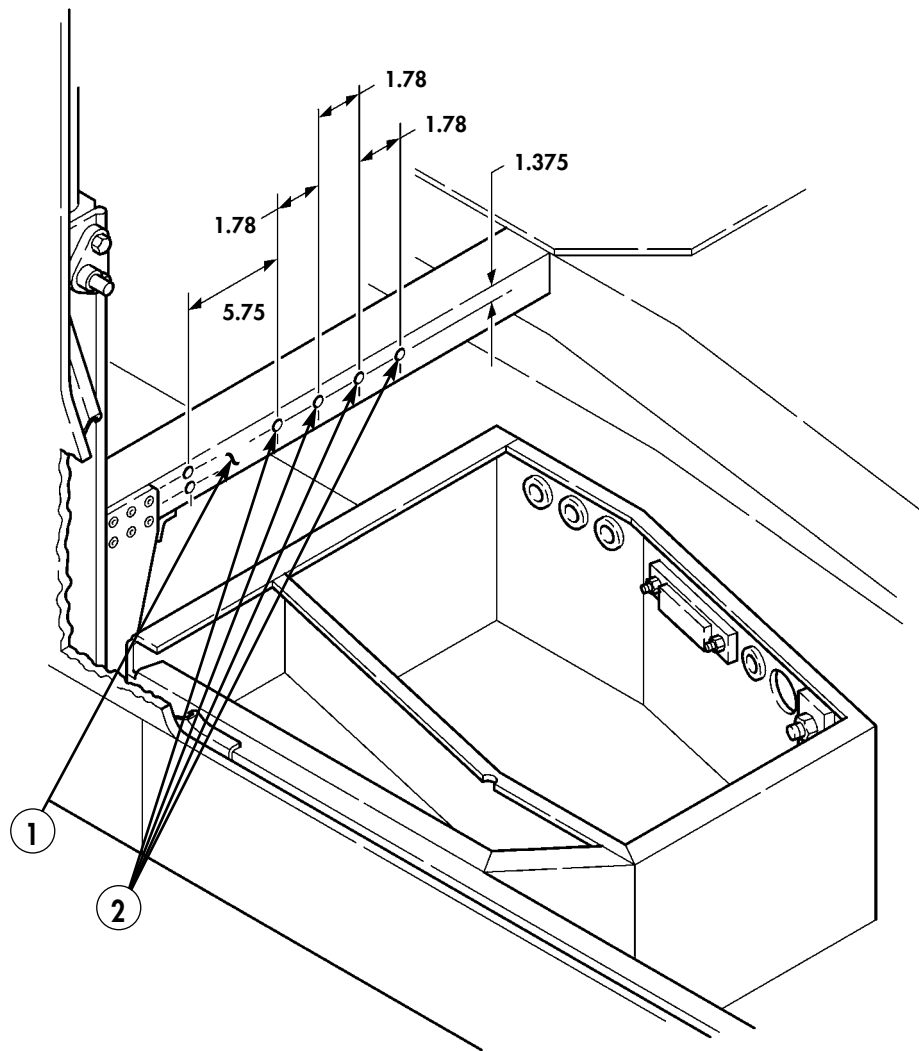
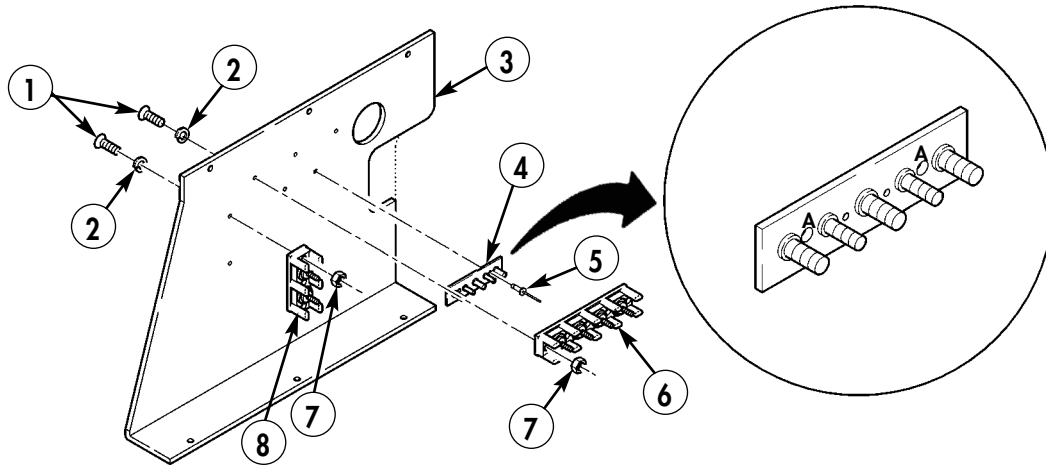


Figure 5-6.

Section V. ASSEMBLY OF CAB ENCLOSURE PANEL

- 5-1. Install 12V terminal board (8) on cab enclosure panel (3) with two machine screws (1), lockwashers (2), and nuts (7).
- 5-2. Install 24V terminal board (6) on cab enclosure panel (3) with three machine screws (1), lockwashers (2), and nuts (7).
- 5-3. Enlarge two holes marked A in terminal board (4) to 0.196 in., and secure terminal board (4) to cab enclosure panel (3) with two rivets (5).



- 1. SCREW, MACHINE – MS35206-230 – QTY. 5
- 2. LOCKWASHER – MS35338-41 – QTY. 5
- 4. TERMINAL BOARD – 12480570 – QTY. 1
- 5. BLIND RIVET – 12339355-1 – QTY. 2
- 7. NUT – MS35649-63 – QTY. 5

Figure 5-7.

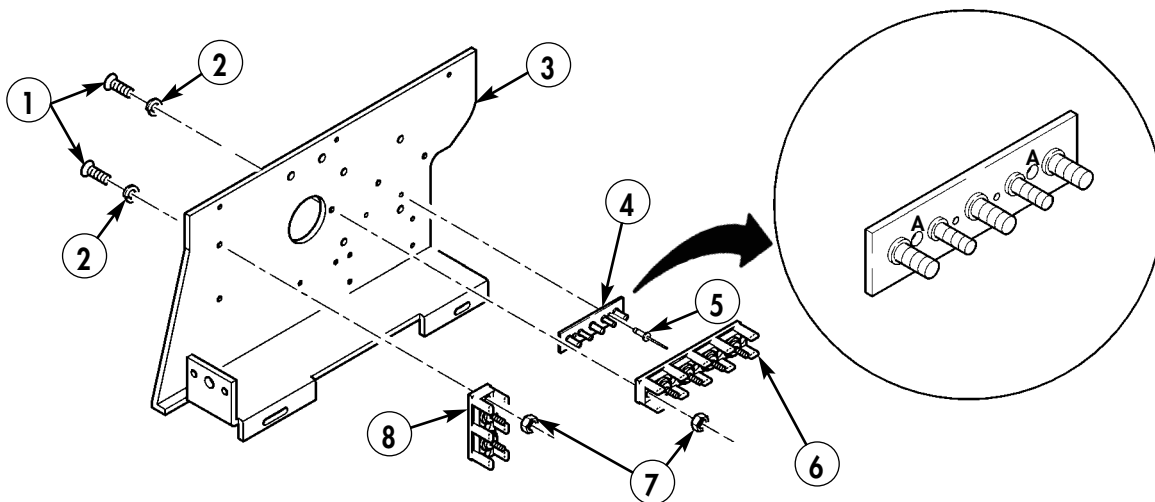


Figure 5-8.

Section VI. FINAL ASSEMBLY, TERMINAL BOARD WIRING, AND TERMINAL LINK

NOTE

- Refer to figure 5-9 for wiring overview.
- Perform steps 6-1 and 6-2 if hole and grommet do not exist in battery box.

- 6-1.** Locate, mark, and drill 2.00-in. diameter hole (6) in upper right corner of rear wall of battery box.
- 6-2.** Install grommet (7) in hole (6).
- 6-3.** Secure terminal link (2) and fuse wire (3) to 12V terminal board (1) with two locknuts (4), and install cover (5).
- 6-4.** Route wire (8) through battery box hole (6).

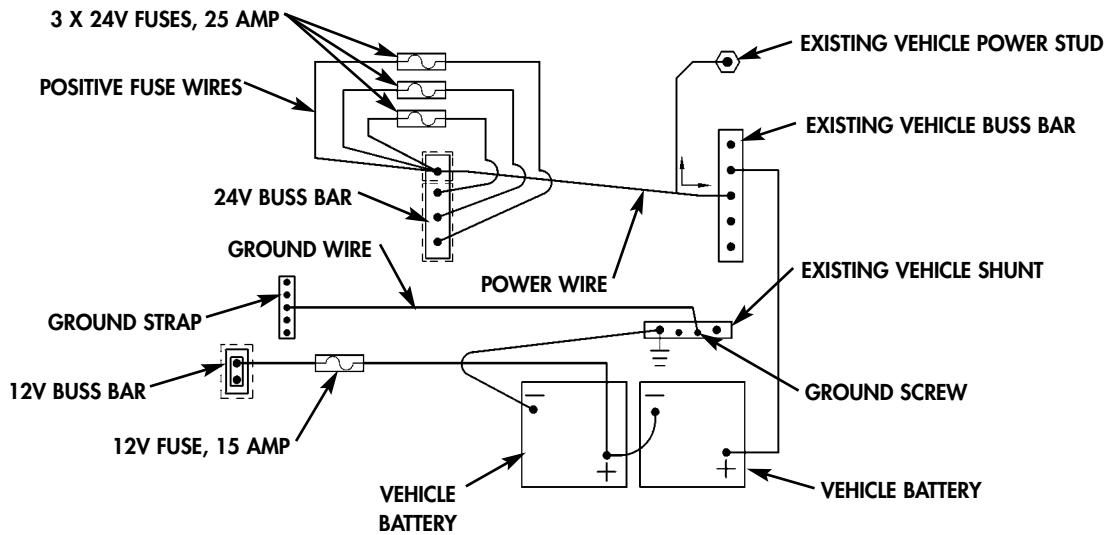
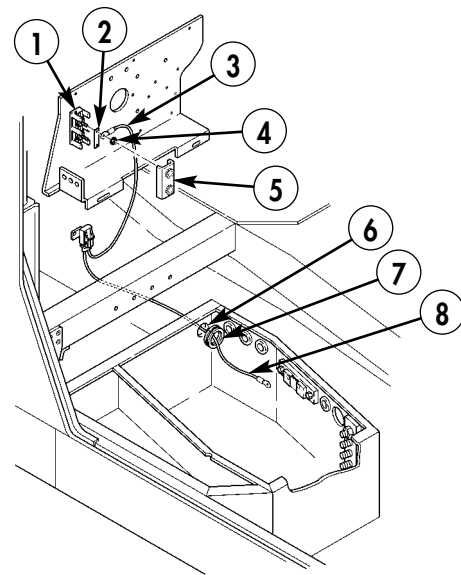


Figure 5-9.



- 2. TERMINAL LINK – MS25226-6N-2 – QTY. 1**
- 3. FUSE WIRE ASSEMBLY (12V) – 12480568-2 – QTY. 1**
- 4. LOCKNUT – 271175 – QTY. 2**
- 5. TERMINAL BOARD COVER – MS18029-3S-2 – QTY. 1**
- 7. GROMMET – 2400 – QTY. 1**

Figure 5-10.

- 6-5. Connect wire (8) to existing positive 12V battery terminal end (10) with existing screw (9) and nut (11).

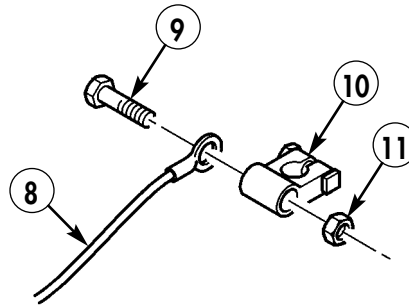
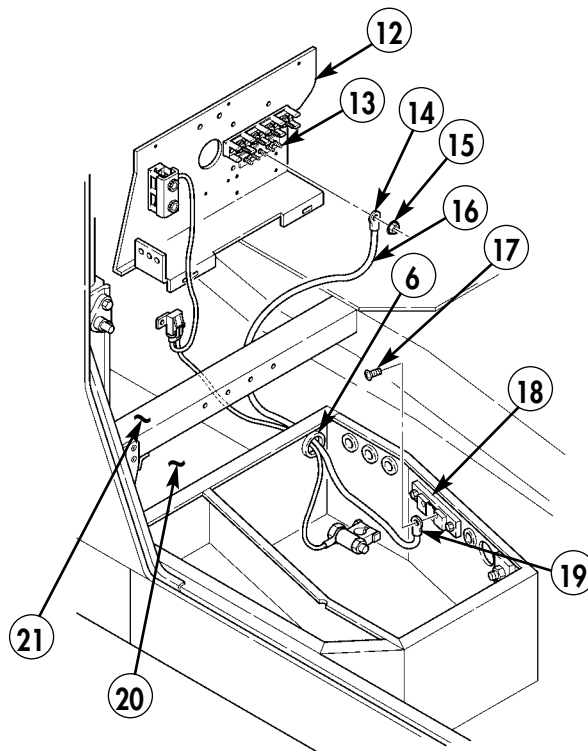


Figure 5-11.

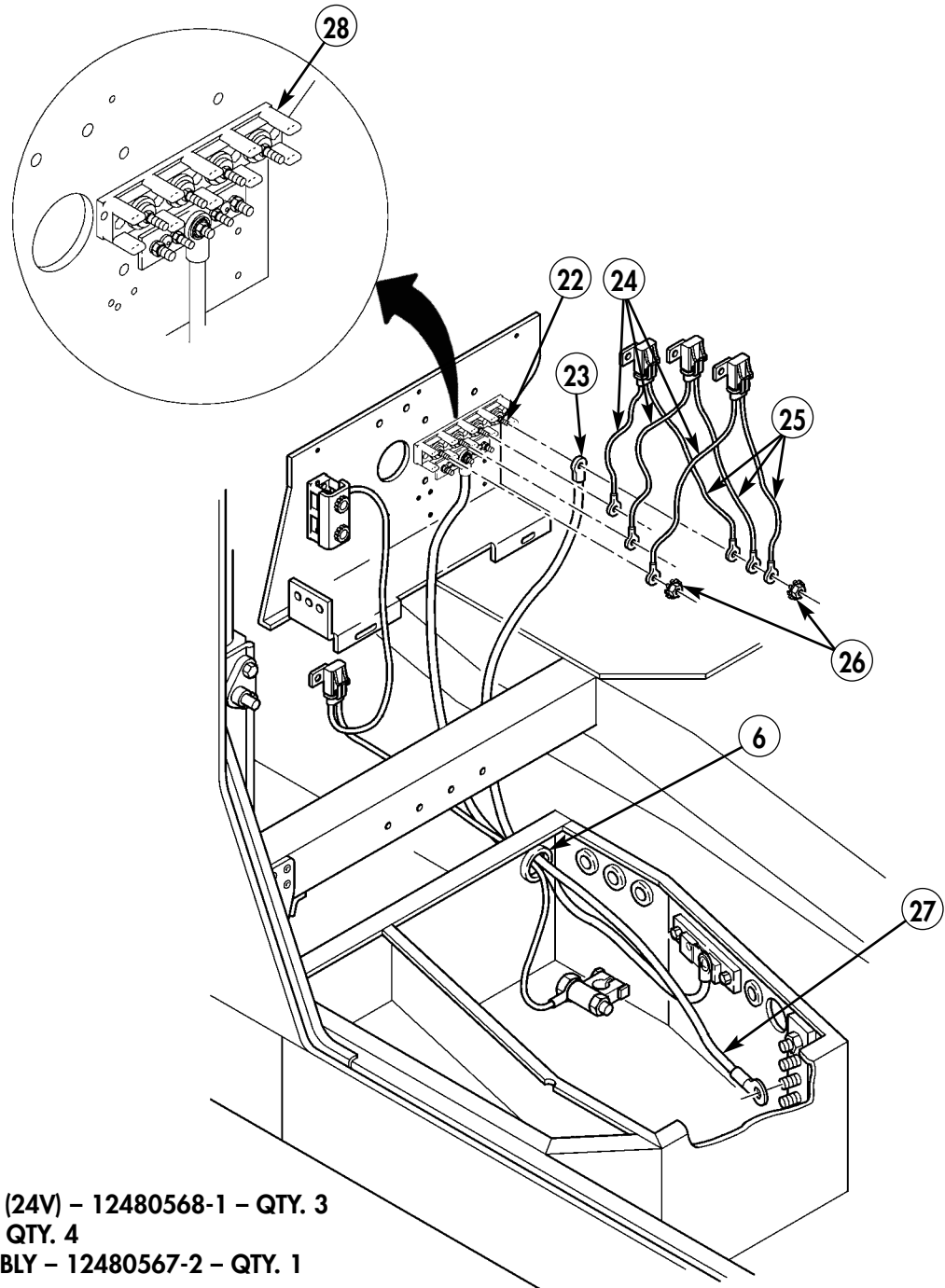
- 6-6. Position cab enclosure panel (12) in rear floor pan (20) and rear of B-beam (21). Do not secure cab enclosure panel (12) at this time.
- 6-7. Route ground cable (16) through battery box hole (6).
- 6-8. Secure terminal lug (14) on center terminal of terminal board (13) with nut (15), and secure terminal lug (19) on shunt (18) with existing screw (17).
- 6-9. Install four additional nuts (15) on terminal board (13).



15. PLAIN-ASSEMBLED NUT – 271169 – QTY. 5
16. GROUND CABLE ASSEMBLY – 12480567-1 – QTY. 1

Figure 5-12.

- 6-10.** Route 24V power cable (27) through hole (6), and install 24V power cable terminal lug (23) on inboard stud (22) of terminal board (28). Do not secure 24V power cable terminal lug (23) at this time.
- 6-11.** Secure three fuse wires (25) and 24V power cable terminal lug (23) to inboard terminal board stud (22) with locknut (26).
- 6-12.** Secure three remaining fuse wires (24) to corresponding studs on 24V terminal board (28) with three locknuts (26).



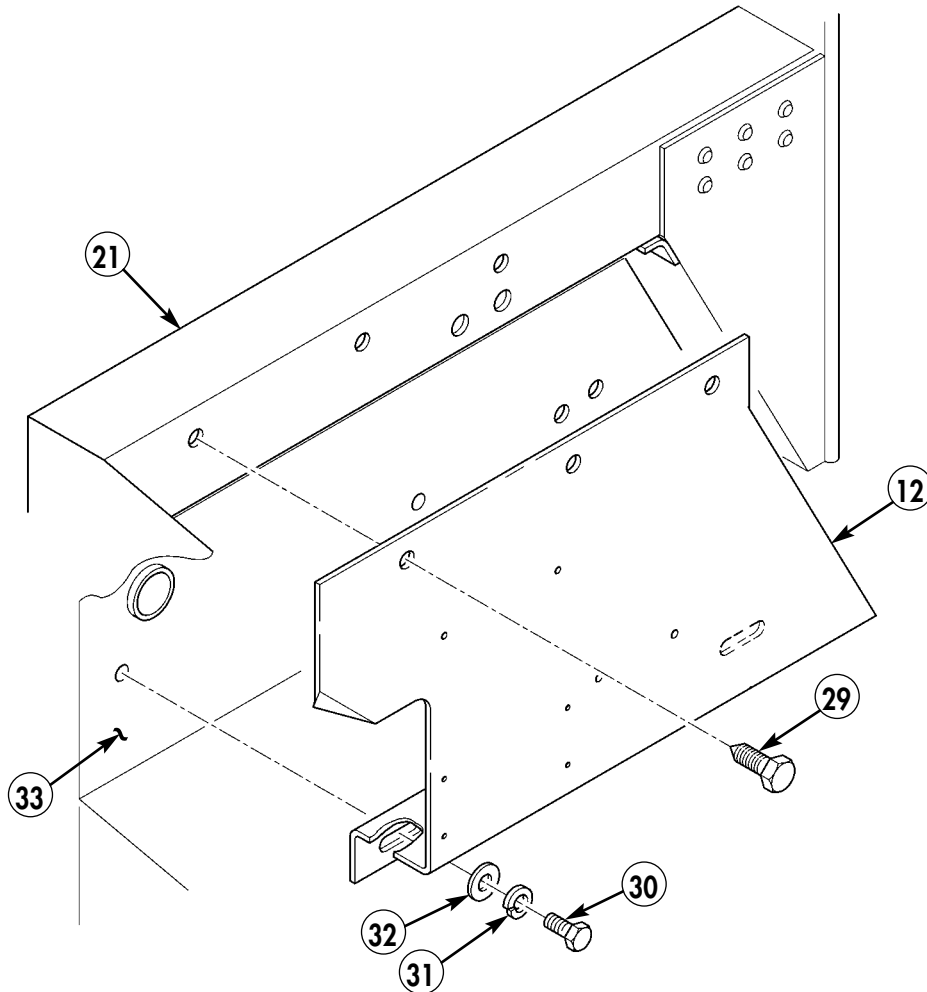
- 24. FUSE WIRE ASSEMBLY (24V) – 12480568-1 – QTY. 3**
26. LOCKNUT – 271175 – QTY. 4
27. POWER CABLE ASSEMBLY – 12480567-2 – QTY. 1

Figure 5-13.

NOTE

For vehicles with new cab enclosure panel, begin with step 6-14.

- 6-13.** Install cab enclosure panel (12). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 6-14.** Secure cab enclosure panel (12) to B-beam (21) with three self-tapping screws (29).
- 6-15.** Secure cab enclosure panel (12) to battery box (33) with two capscrews (30), lockwashers (31), and washers (32).



- 29. SELF-TAPPING SCREW – 12342499-2 – QTY. 3**
- 30. CAPSCREW – B1821BH025C075N – QTY. 2**
- 31. LOCKWASHER – MS35338-48 – QTY. 2**
- 32. FLAT WASHER – MS51412-23 – QTY. 2**

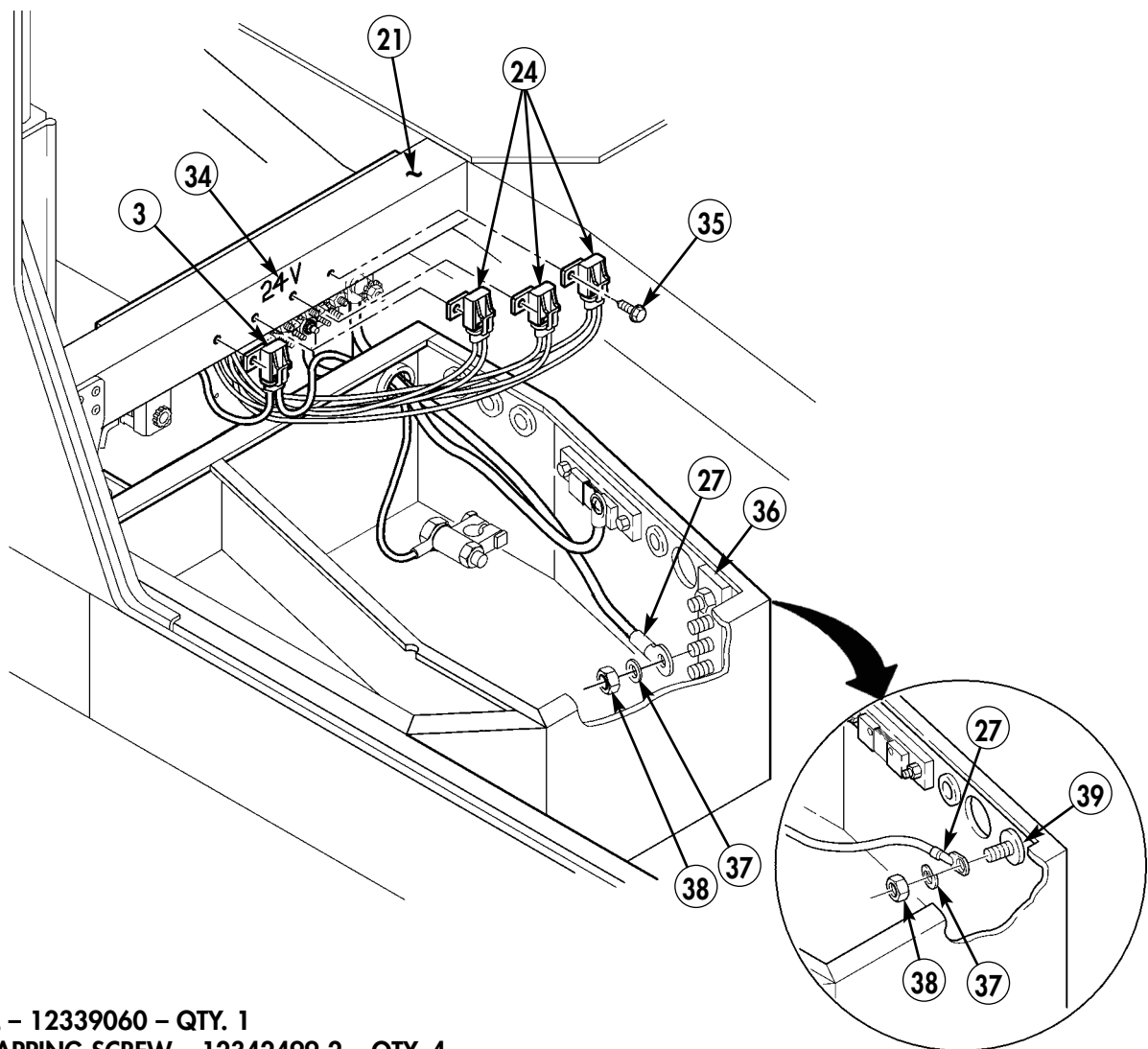
Figure 5-14.

- 6-16.** Secure three 24V fusewire assemblies (24) and one 12V fusewire assembly (3) to B-beam (21) with four self-tapping screws (35).

NOTE

For models equipped with power stud, perform step 6-17.
Otherwise, proceed to step 6-18.

- 6-17.** Secure 24V terminal board power wire terminal lug (27) to power stud (39) with lockwasher (37) and existing nut (38).
- 6-18.** Secure 24V terminal board power wire terminal lug (27) to terminal board (36) with lockwasher (37) and existing nut (38).
- 6-19.** Install decal (34) on B-beam (21).
- 6-20.** If previously removed, install right-hand rear fixed door. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 6-21.** Install batteries. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

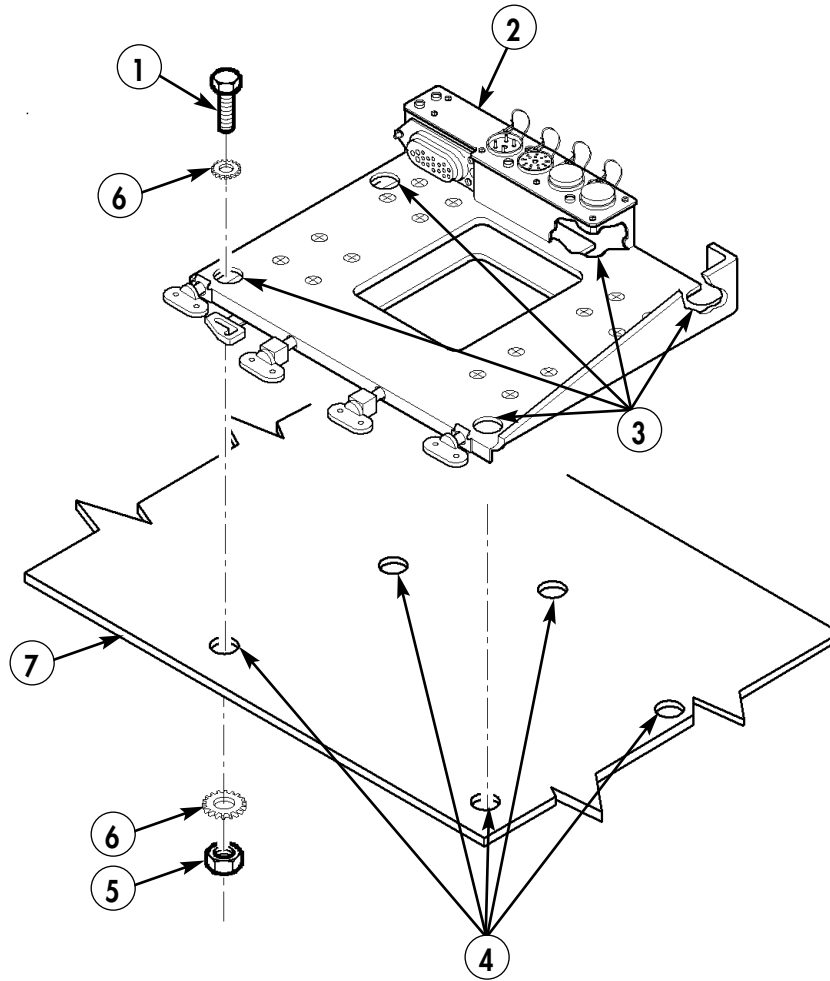


- 34.** DECAL – 12339060 – QTY. 1
35. SELF-TAPPING SCREW – 12342499-2 – QTY. 4
37. LOCKWASHER – MS35338-48 – QTY. 1

Figure 5-15.

Section VII. SINGARS MOUNTING TRAY INSTALLATION

- 7-1. Install standard radio rack and lower equipment shelf. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 7-2. Remove paint from five mounting holes (4) on standard rack (7) and five mounting holes (3) on bottom of mounting base (2).
- 7-3. Apply antiseize compound to five mounting holes (4) and four mounting holes (3).
- 7-4. Install mounting base (2) on standard rack (7) with five capscrews (1), ten lockwashers (6), and five nuts (5).



- 1. CAPSCREW – B1821BH031F100N – QTY. 5
- 2. MOUNTING BASE MT-6352/VRC – A3013367-1 – QTY. 1
- 5. NUT – 9418892 – QTY. 5
- 6. LOCKWASHER – MS45904-72 – QTY. 10

Figure 5-16.

Section VIII. POWER AMPLIFIER INSTALLATION

NOTE

Perform this procedure only if SINCGARS model AN/VRC-92F is to be installed.

- 8-1. Remove paint from four mounting areas (2) on MT-6353/VRC mounting base (1).
- 8-2. Remove paint from four mounting holes (4) on standard rack (3).
- 8-3. Apply antiseize compound to mounting areas (2) on MT-6353/VRC mounting base (1) and to mounting holes (4) on standard rack (3).

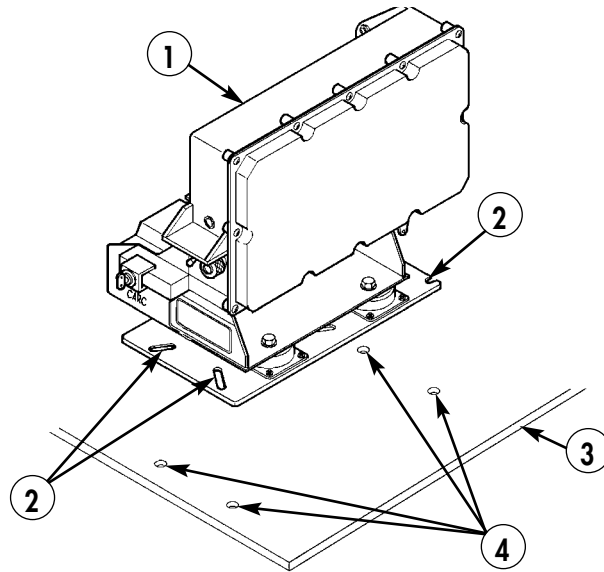
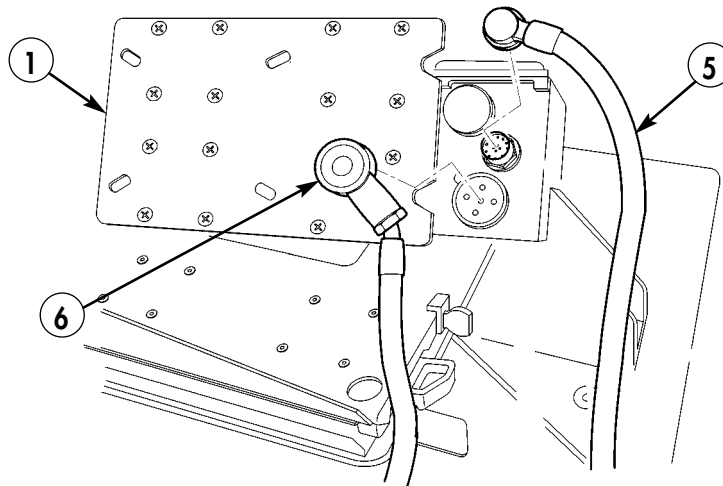


Figure 5-17.

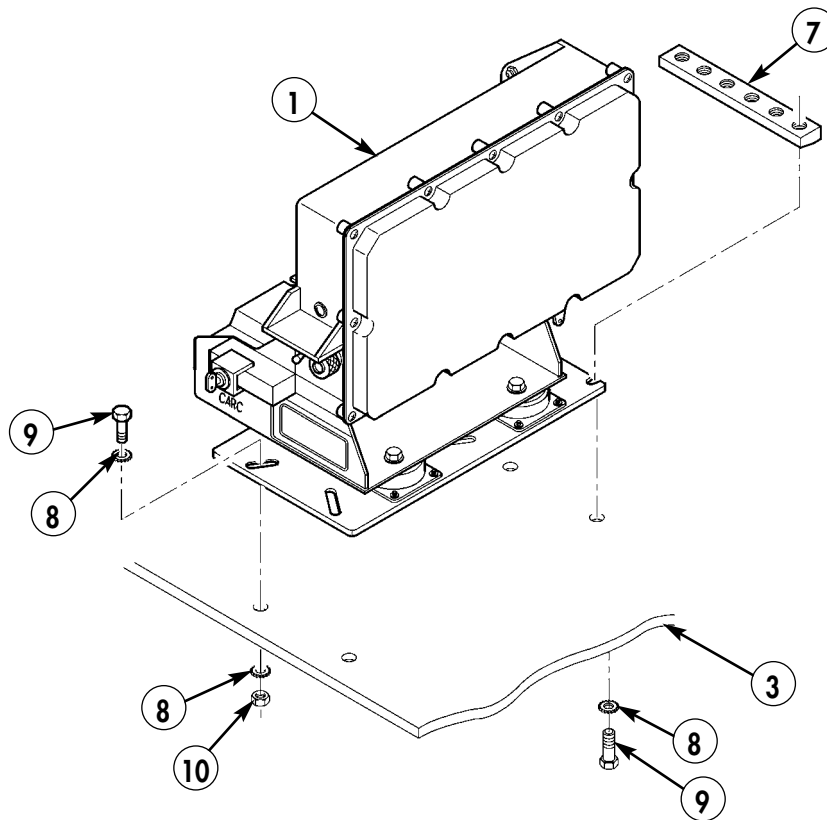
- 8-4. Attach control cable (5) to MT-6353/VRC mounting base (1).
- 8-5. Attach power cable (6) to MT-6353/VRC mounting base (1).



- 1. MOUNTING BASE MT-6353/VRC - A3014053-1 - QTY. 1
- 5. CONTROL CABLE - A3210672-1 - QTY. 1
- 6. POWER CABLE - A3154857-1 - QTY. 1

Figure 5-18.

- 8-6. Install MT-6353/VRC mounting base (1) on standard rack (3) with four capscrews (9), six lockwashers (8), two nuts (10), and nut strip (7).

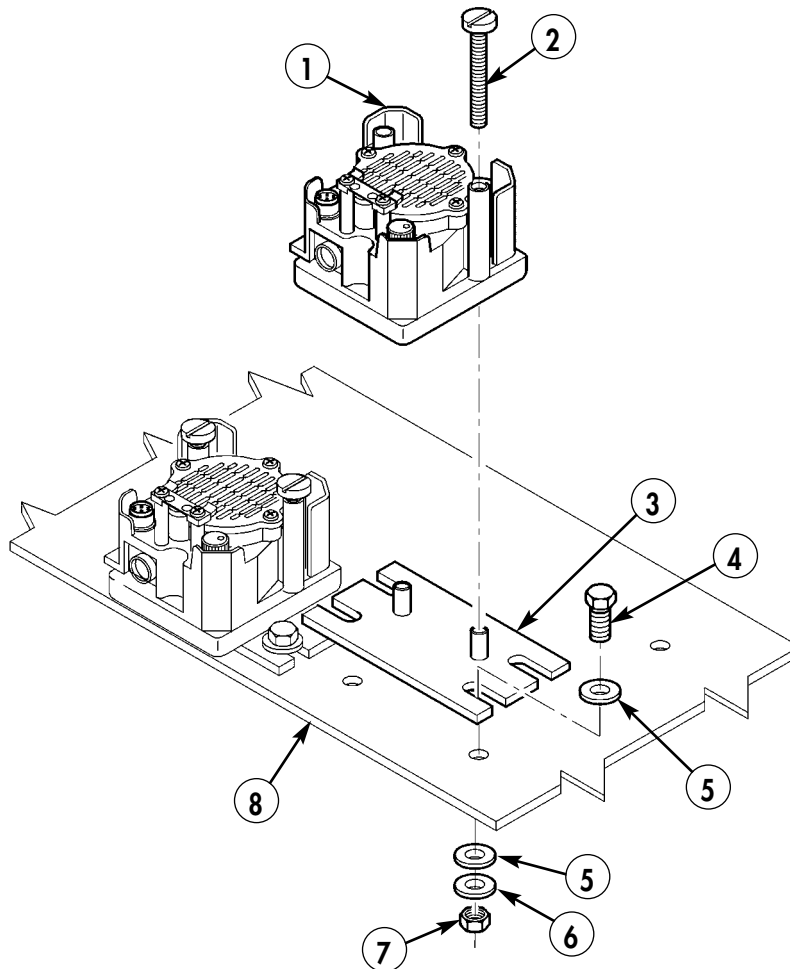


- 7. NUT STRIP - A3014064-1 - QTY. 1
- 8. LOCKWASHER - MS45904-72 - QTY. 6
- 9. CAPSCREW - B1821BH031F075N - QTY. 4
- 10. NUT - 9418892 - QTY. 2

Figure 5-19.

Section IX. LOUDSPEAKER INSTALLATION

- 9-1.** Install mounting plate (3) on lower equipment shelf (8) with two capscrews (4), washers (5), lockwashers (6), washers (5), and nuts (7).
- 9-2.** Install loudspeaker (1) on mounting plate (3) with two existing externally-relieved body screws (2).
- 9-3.** Repeat steps 9-1 and 9-2 for remaining speaker, if applicable.



- 1.** LOUDSPEAKER – A3014065-1 – QTY. 2
- 3.** MOUNTING PLATE – A3014550-1 – QTY. 2
- 4.** CAPSCREW – B1821BH031F100N – QTY. 4
- 5.** WASHER – 2436162 – QTY. 8
- 6.** LOCKWASHER – MS45904-72 – QTY. 4
- 7.** NUT – 9418892 – QTY. 4

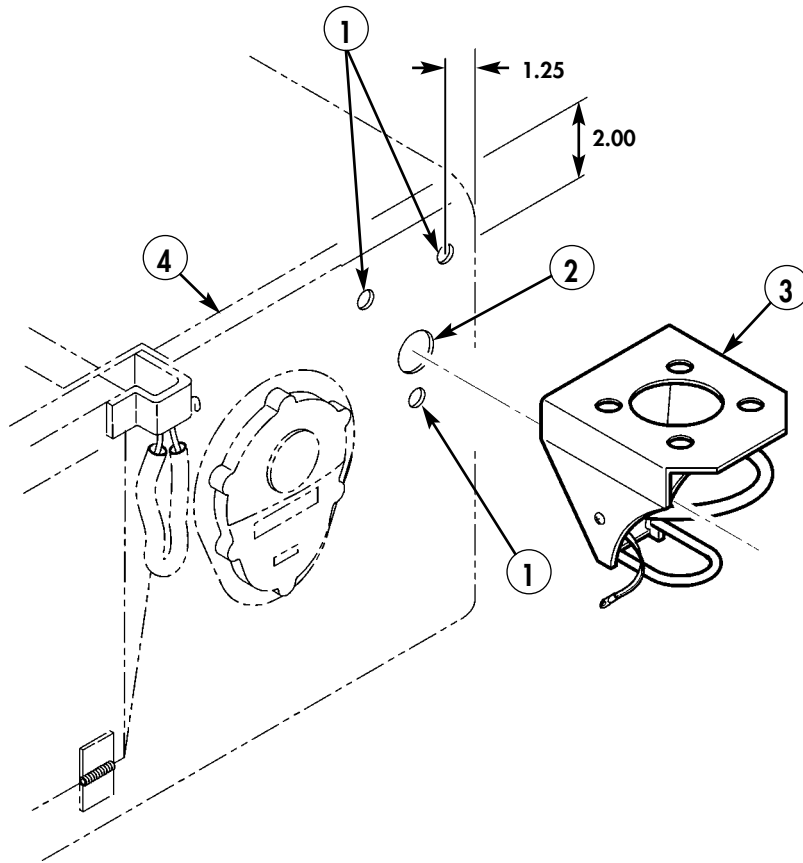
Figure 5-20.

Section X. ANTENNA INSTALLATION

NOTE

This procedure applies to vehicles without existing antennas, and to either left or right side of vehicle.

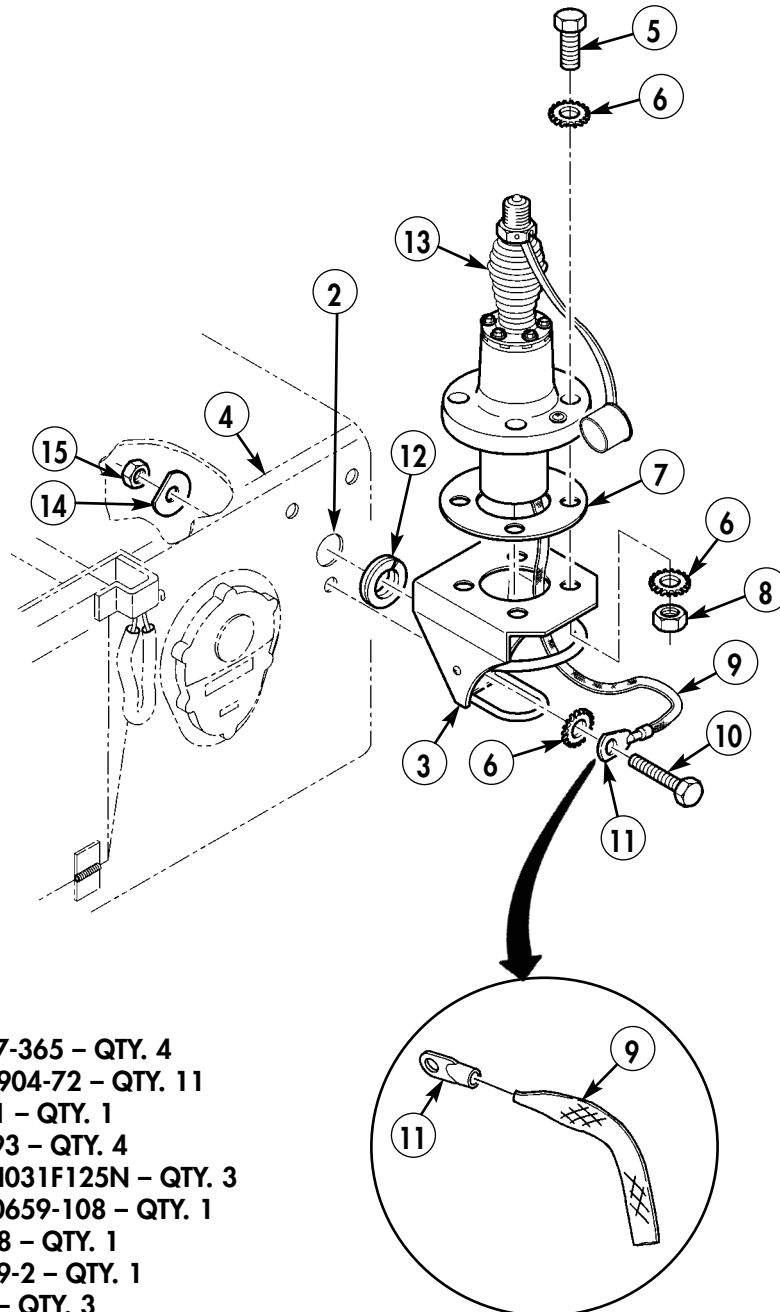
- 10-1. Using antenna bracket (3) as template, locate, mark, and drill 1.375-in. diameter hole (2) in rear wall (4).
- 10-2. Locate, mark, and drill three 0.343-in. diameter holes (1) in rear wall (4).
- 10-3. Remove paint from vicinity of three holes (1) and three holes in antenna bracket (3).



3. ANTENNA BRACKET – A3014546-1 – QTY. 1

Figure 5-21.

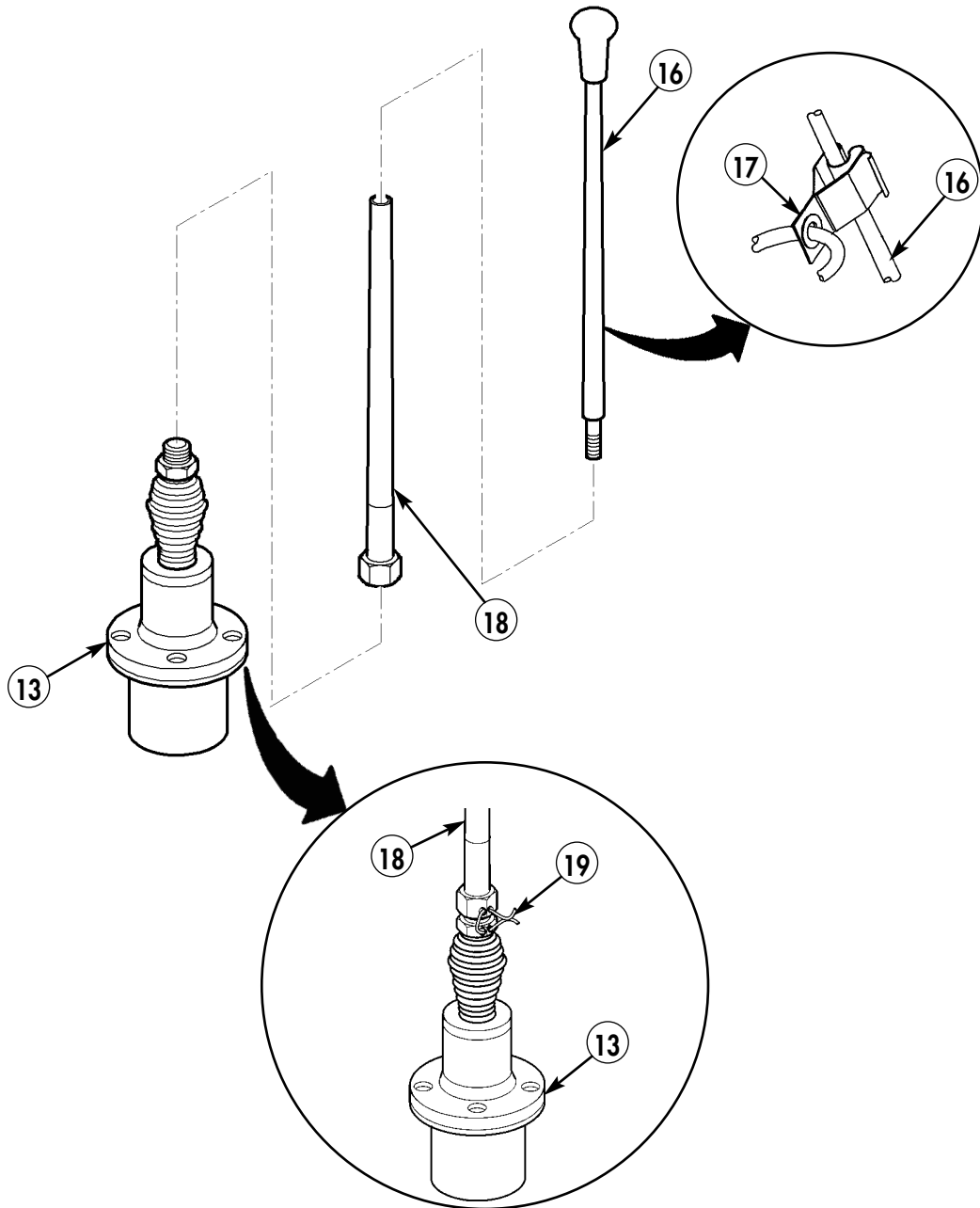
- 10-5. Install grommet (12) in hole (2) of rear wall (4).
- 10-6. Position antenna (13) and gasket (7) on antenna bracket (3) and route existing ground strap (9) through antenna bracket (3).
- 10-7. Install antenna (13) on antenna bracket (3) with four capscrews (5), eight lockwashers (6), and four nuts (8).
- 10-8. Install antenna bracket (3) on rear wall (4) with two capscrews (10), lockwashers (6), washers (14), and nuts (15).
- 10-9. Remove old terminal lug and install new terminal lug (11) on ground strap (9). Install ground strap (9) on antenna bracket (3) and rear wall (4) with capscrew (10), lockwasher (6), washer (14), and nut (15).



5. CAPSCREW - MS35307-365 - QTY. 4
6. LOCKWASHER - MS45904-72 - QTY. 11
7. GASKET - A3013655-1 - QTY. 1
8. NUT - 13218E0320-293 - QTY. 4
10. CAPSCREW - B1821BH031F125N - QTY. 3
11. TERMINAL LUG - MS20659-108 - QTY. 1
12. GROMMET - 12338098 - QTY. 1
13. ANTENNA - A3017899-2 - QTY. 1
14. WASHER - 12338095 - QTY. 3
15. NUT - 9418892 - QTY. 3

Figure 5-22.

- 10-10. Attach upper antenna element (16) to lower antenna element (18).
- 10-11. Install antenna assembly on antenna base (13).
- 10-12. Attach fiber rope assembly (17) to upper antenna element (16).
- 10-13. Secure lower antenna element (18) to antenna base (13) with lock wire (19).
- 10-14. Repeat steps 10-1 through 10-13 for other side of vehicle, if applicable.

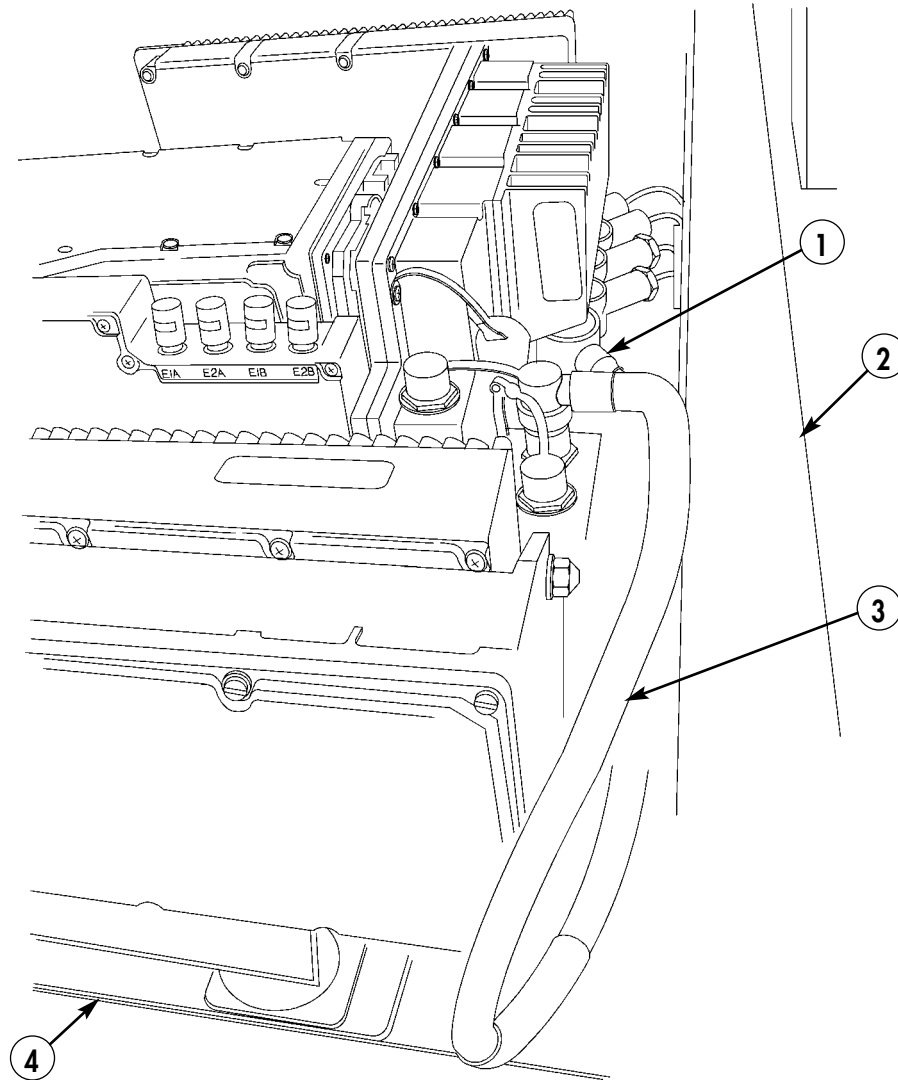


- 16. UPPER ANTENNA ELEMENT – A3017901-2 – QTY. 2
- 18. LOWER ANTENNA ELEMENT – A3018230-1 – QTY. 2
- 19. LOCK WIRE – MS20995C32 – QTY. A/R

Figure 5-23.

Section XI. CABLES INSTALLATION

- 11-1.** Route power cable (1) and control cable (3) between front dash (2) and standard radio rack (4).
11-2. Connect power cable (1) and control cable (3) to MT-6352/VRC mounting base.



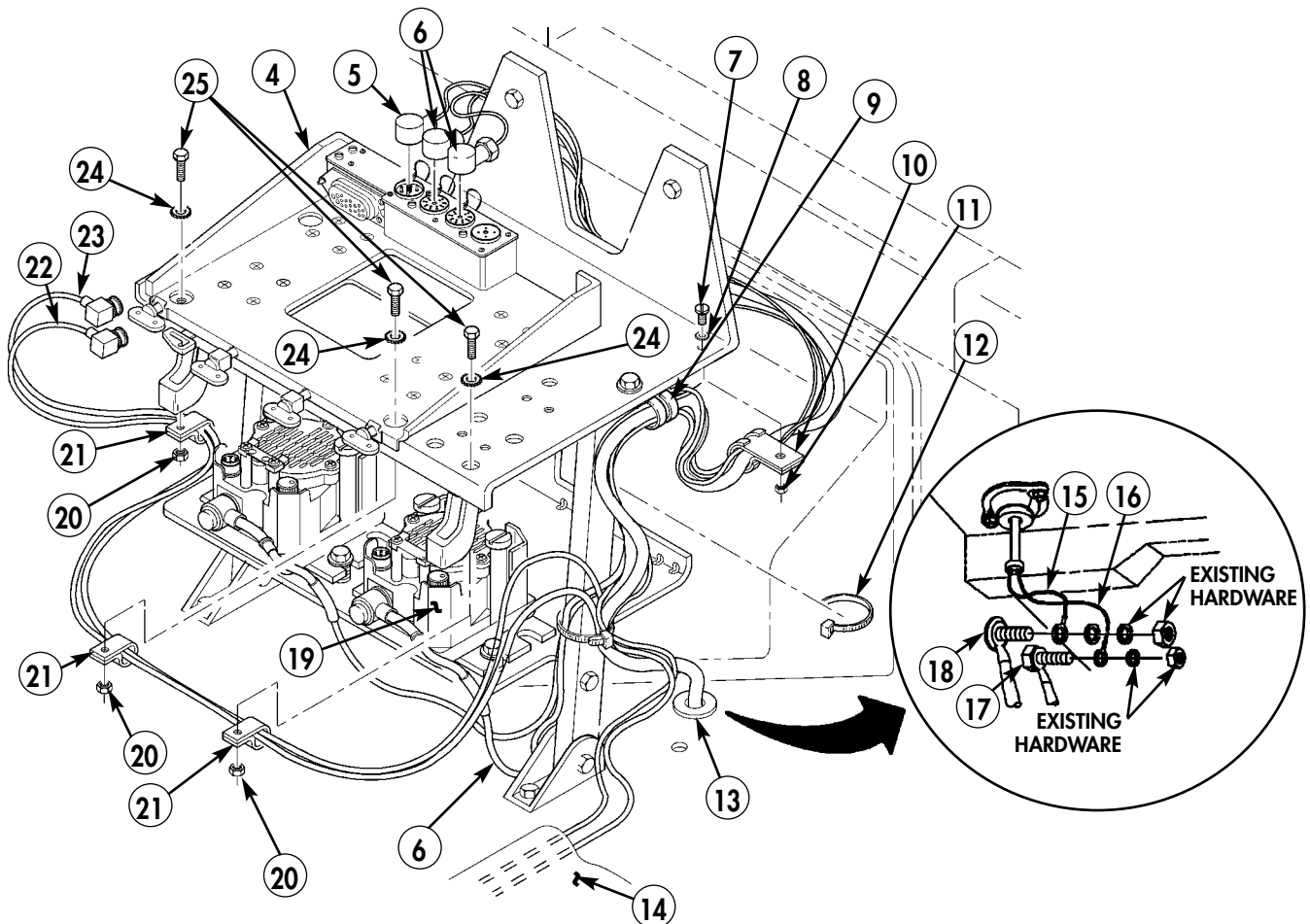
- 1. POWER CABLE – A3154857-1 – QTY. 1**
3. CONTROL CABLE – A3210672-1 – QTY. 1

Figure 5-24.

NOTE

Perform steps 11-3 through 11-11 for AN/VRC-88F, 89F, 90F, or 91F only.

- 11-3. Route antenna cables (22) and (23) through three clamps (21).
- 11-4. Install three clamps (21) on underside of standard rack (4) with three existing lockwashers (24), screws (25), and nuts (20).
- 11-5. Attach power cable (5) and two speaker cables (6) to MT-6352/VRC mounting base connectors.
- 11-6. Route power cable (5) and speaker cables (6) under standard rack (4), and secure using clamps (9) and (10), lockwasher (8), screw (7), nut (11), and existing lockwasher and screw.
- 11-7. Secure power cable (5) and speaker cables (6) to standard rack (4) support with tiedown strap (12).
- 11-8. Route power cable (5) through grommet (13) under tunnel insulation (14). Attach negative lead (16) to negative power stud (17), and positive lead (15) to positive power stud (18), using existing mounting hardware.
- 11-9. Attach speaker cables (6) to loudspeaker (19).
- 11-10. Coil extra speaker cables (6) under lower equipment shelf and secure with tiedown strap (12).
- 11-11. Route antenna cables (22) and (23) beneath tunnel insulation (14) to B-beam.



- 5. POWER CABLE – A3154857-1 – QTY. 1
- 6. SPEAKER CABLE – A3014038-3 – QTY. 2
- 7. SCREW – MS35191-273 – QTY. 2
- 8. LOCKWASHER – MS35338-43 – QTY. 1
- 9. LOOP CLAMP – MS21333-76 – QTY. 1
- 10. LOOP CLAMP – MS21333-115 – QTY. 1

- 11. NUT – MS35650-302 – QTY. 2
- 12. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R
- 21. LOOP CLAMP – MS21333-112 – QTY. 3
- 22. ANTENNA CABLE – A3014031-8 – QTY. 1
- 23. ANTENNA CABLE – A3014031-17 – QTY. 1

Figure 5-25.

NOTE

Perform steps 11-12 through 11-21 for AN/VRC-92F only.

- 11-12. Route antenna cables (22) and (23) through three clamps (21).
- 11-13. Install two clamps (21) on underside of standard rack (4) with two existing lockwashers (24), screws (25), and nuts (20).
- 11-14. Install clamp (21) on underside of standard rack (4) with existing lockwasher (24), screw (25), and nut (20).
- 11-15. Attach power cable (5) and two speaker cables (6) to MT-6352/VRC mounting base connectors.
- 11-16. Route power cable (5) and speaker cables (6) under standard rack (4), and secure using clamp (10), lockwasher (8), screw (7), nut (11), clamp (9), and existing lockwasher and screw.
- 11-17. Secure power cable (5) and speaker cables (6) to standard rack (4) support with tiedown strap (12).
- 11-18. Route power cable (5) through grommet (13) under tunnel insulation (14). Attach negative lead (16) to negative power stud (17), and positive lead (15) to positive power stud (18), using existing mounting hardware.
- 11-19. Install speaker cables (6) on loudspeakers (19).
- 11-20. Coil extra speaker cables (6) under lower equipment shelf and secure with tiedown strap (12).
- 11-21. Route antenna cables (22) and (23) beneath tunnel insulation (14) to B-beam.

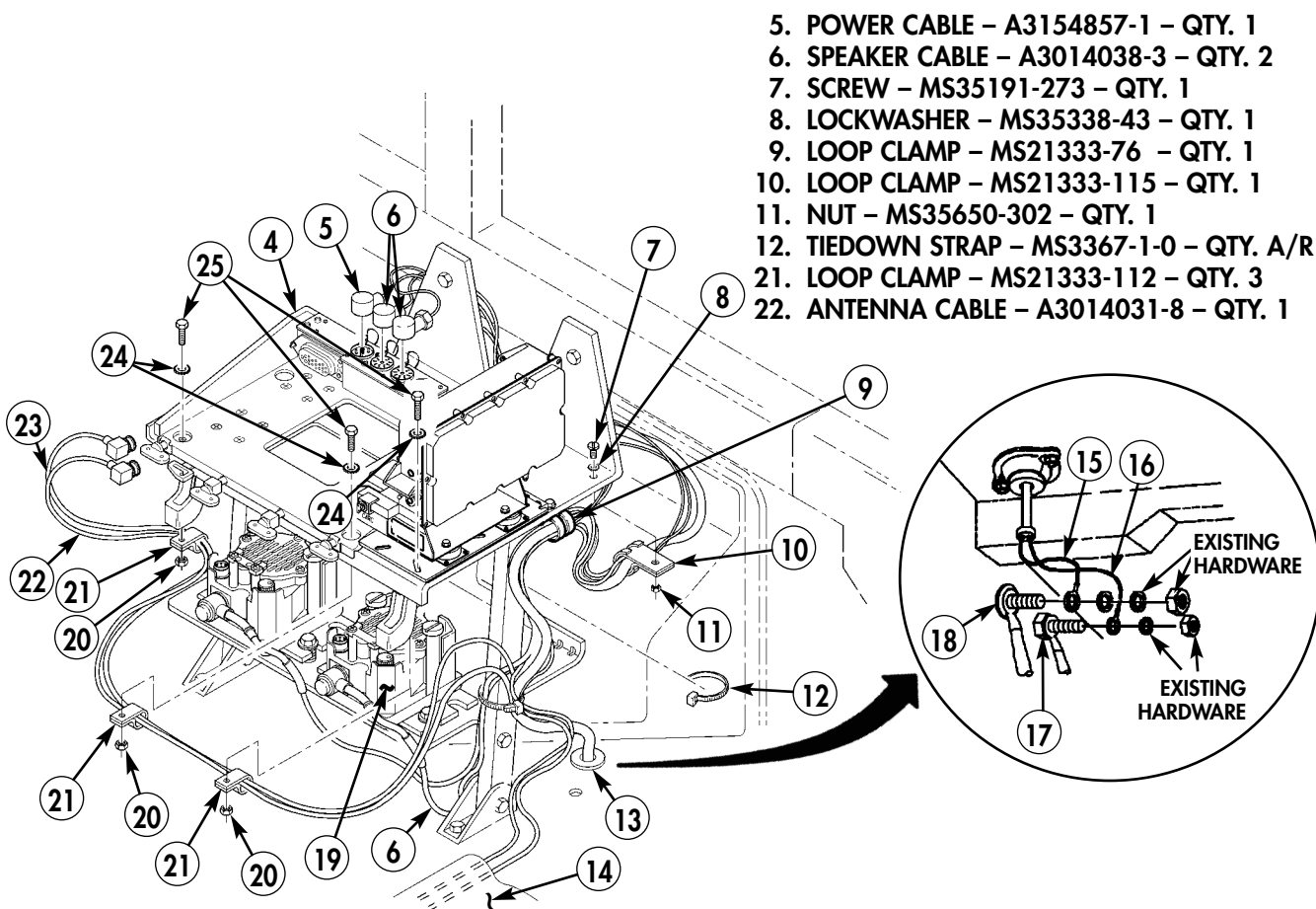
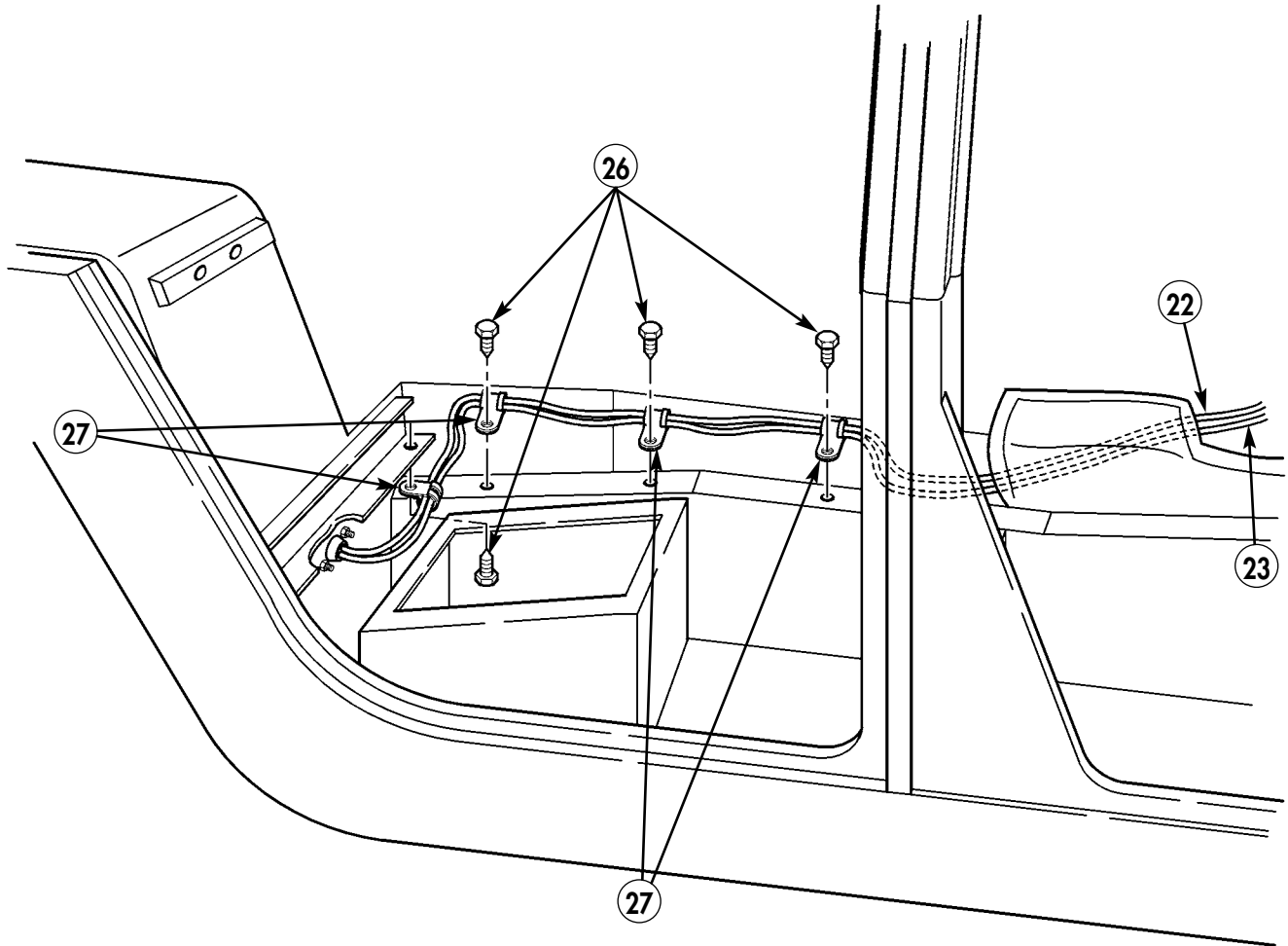


Figure 5-26.

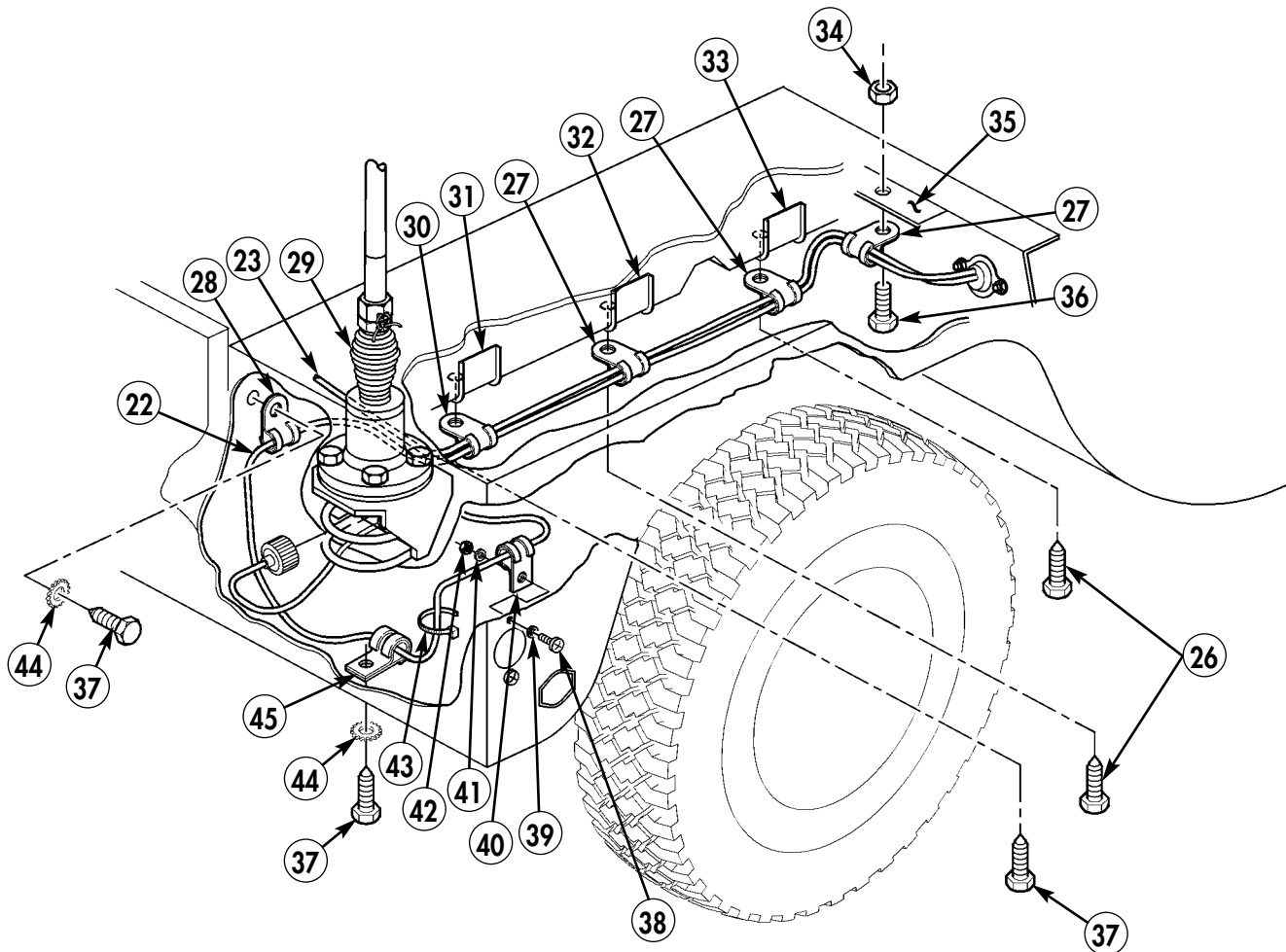
- 11-22. Route two antenna cables (22) and (23) along right rear seat/utility area with four self-tapping screws (26) and loop clamps (27).
- 11-23. Route two antenna cables (22) and (23) through right wheelwell/utility area with existing grommet, retainer, screws, and nut and lockwasher assemblies. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)



- 26. SELF-TAPPING SCREW - 9421073 - QTY. 4
- 27. LOOP CLAMP - MS21333-69 - QTY. 4

Figure 5-27.

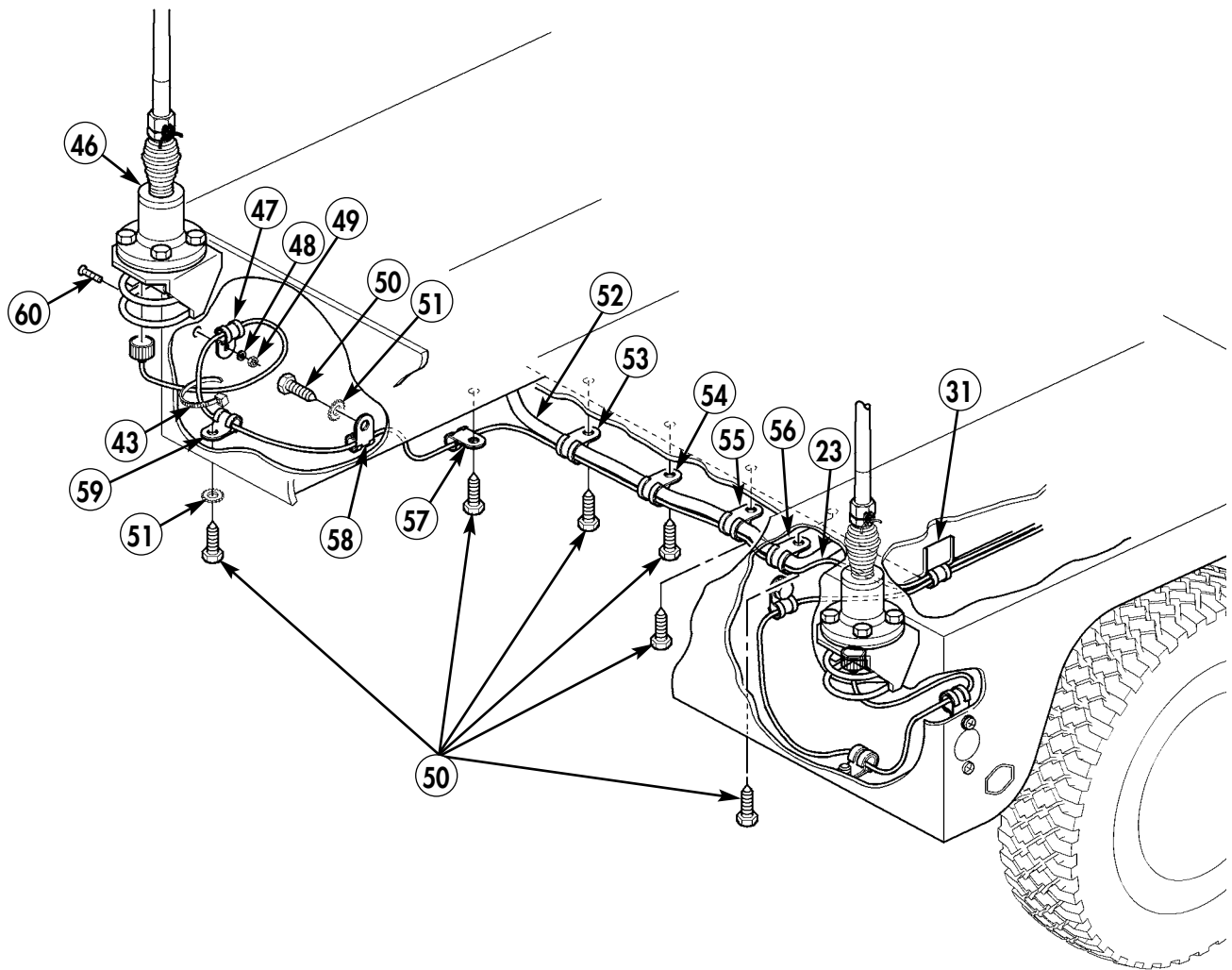
- 11-24.** Route two antenna cables (22) and (23) along front wheel well seam (35) and along front (33), intermediate (32), and rear (31) cargo bed supports. Secure with two self-tapping screws (26), loop clamps (27), screw (36), clamp (27), nut (34), and existing self-tapping screw (37) and clamp (30).
- 11-25.** Route antenna cable (22) along taillight wiring harness with two existing loop clamps (28) and (45), self-tapping screws (37), and lockwashers (44).
- 11-26.** Route antenna cable (22) to antenna base (29) with existing loop clamp (40), nut (42), lockwasher (41), washer (39), and screw (38).
- 11-27.** Install antenna cable (22) on antenna base (29).
- 11-28.** Coil excess antenna cable (22) and secure to inside of taillight closeout cover with tiedown strap (43).



- 26.** SELF-TAPPING SCREW – 9421073 – QTY. 2
27. LOOP CLAMP – MS21333-69 – QTY. 3
34. NUT – MS35650-302 – QTY. 1
36. SCREW – MS35224-65 – QTY. 1
43. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R

Figure 5-28.

- 11-29. Route antenna cable (23) along existing taillight wiring harness (52) on rear cargo bed support (31) and secure with four existing loop clamps (53), (54), (55), (56) and existing self-tapping screws (50).
- 11-30. Route antenna cable (23) along existing taillight wiring harness on left-side frame rail with three existing loop clamps (57), (58), (59), and existing self-tapping screws (50) and lockwashers (51).
- 11-31. Route antenna cable (23) to antenna base (46) with existing loop clamp (47), screw (60), lockwasher (48), and nut (49).
- 11-32. Install antenna cable (23) on antenna base (46).
- 11-33. Coil excess antenna cable (23) and secure to inside of taillight closeout cover with tiedown strap (43).



43. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R

Figure 5-29.

Section XII. PLGR BRACKET INSTALLATION

NOTE

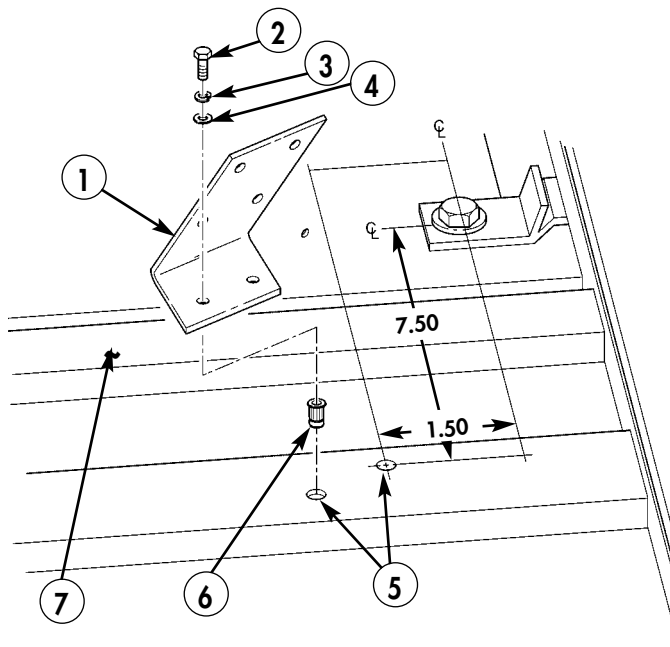
- Perform steps 12-1 through 12-4 for AN/VRC-92F only.
- Tiedown anchors may not be installed. If tiedown anchors are not installed, use existing hole for measurements in step 12-1.
- Ensure mounting holes for PLGR bracket are completely on flat surface of cargo floor raised rib.

12-1. Using PLGR mount (1) as template, mark and drill two 0.390-in. diameter holes (5) in cargo floor (7).

12-2. Install two inserts (6) in holes (5) in cargo floor (7).

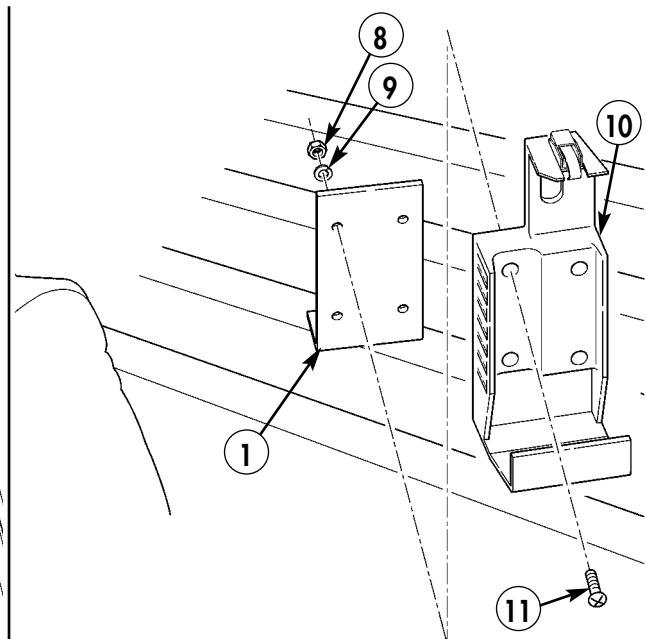
12-3. Attach PLGR mount (1) to cargo floor (7) with two capscrews (2), lockwashers (3), and washers (4).

12-4. Install PLGR bracket (10) on mount (1) with four screws (11), lockwashers (9), and plain-assembled nuts (8).



1. PLGR MOUNT – 12480576 – QTY. 1
2. CAPSCREW – B1821BH025C100N – QTY. 2
3. LOCKWASHER – MS35338-44 – QTY. 2
4. WASHER – 2436161 – QTY. 2
6. INSERT – 12446871-2 – QTY. 2

Figure 5-30.



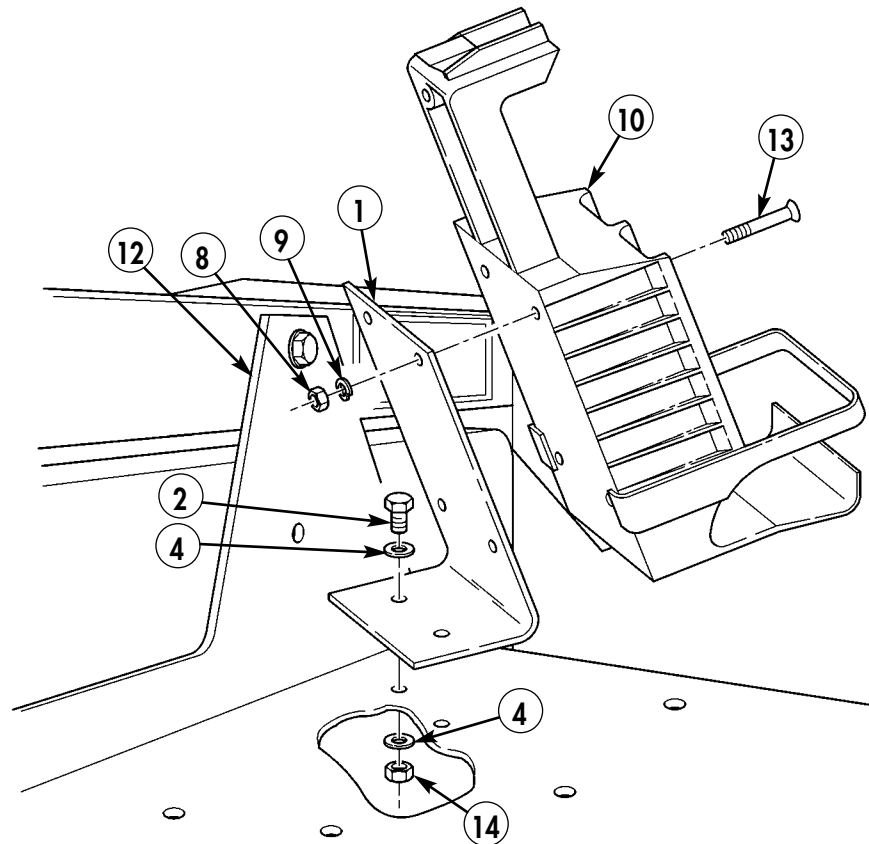
8. PLAIN-ASSEMBLED NUT – 9422771 – QTY. 4
9. LOCKWASHER – MS35338-43 – QTY. 4
10. PLGR BRACKET – 986-0645-001 – QTY. 1
11. SCREW – MS35206-264 – QTY. 4

Figure 5-31.

NOTE

Perform steps 12-5 and 12-6 for AN/VRC-88F, 89F, 90F, or 91F only.

- 12-5. Install PLGR mount (1) on standard rack (12) with two capscrews (2), four washers (4), and nuts (14).
- 12-6. Install PLGR bracket (10) on PLGR mount (1) with four screws (13), lockwashers (9), and nuts (8).



- 1. PLGR MOUNT - 12480576 - QTY. 1
- 2. CAPSCREW - B1821BH025C100N - QTY. 2
- 4. WASHER - 2436161 - QTY. 4
- 8. PLAIN-ASSEMBLED NUT - 9422771 - QTY. 4
- 9. LOCKWASHER - MS35338-43 - QTY. 4
- 10. PLGR BRACKET - 986-0645-001 - QTY. 1
- 13. SCREW - MS35206-263 - QTY. 4
- 14. NUT - 9419143 - QTY. 2

Figure 5-32.

Section XIII. PLGR ANTENNA AND CABLES INSTALLATION

- 13-1. Remove two plugs (1) from outer right side windshield frame (3).

NOTE

Drilled holes on inside and outside of windshield frame should be in alignment with each other to allow routing of PLGR cable through windshield frame.

- 13-2. Locate, mark, and drill 0.375-in. diameter hole (2) in outer right side windshield frame (3).

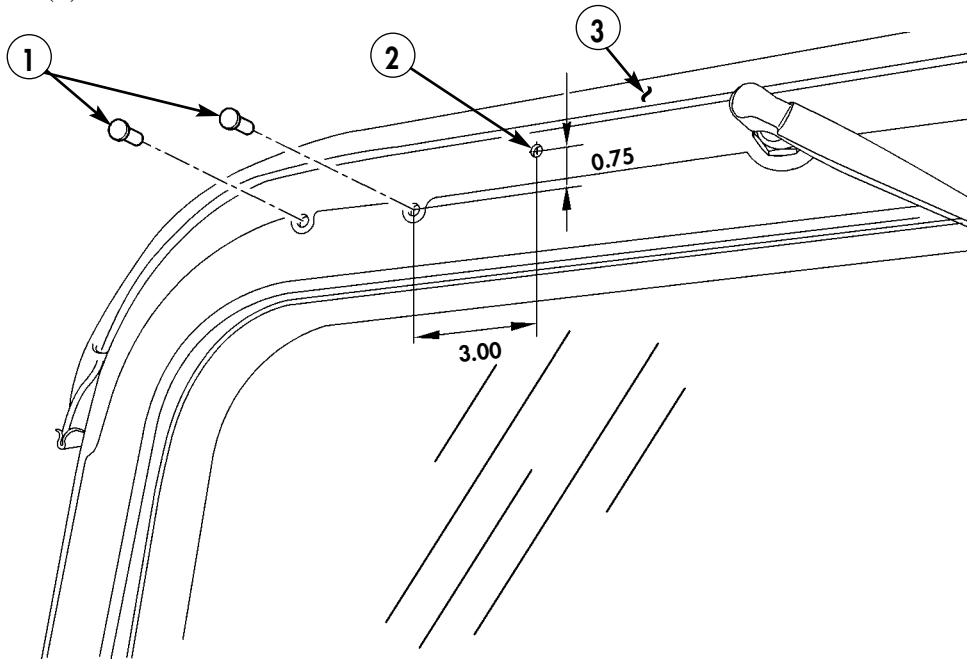


Figure 5-33.

- 13-3. Locate, mark, and drill 0.375-in. diameter hole (4) in inner right side windshield frame (5).

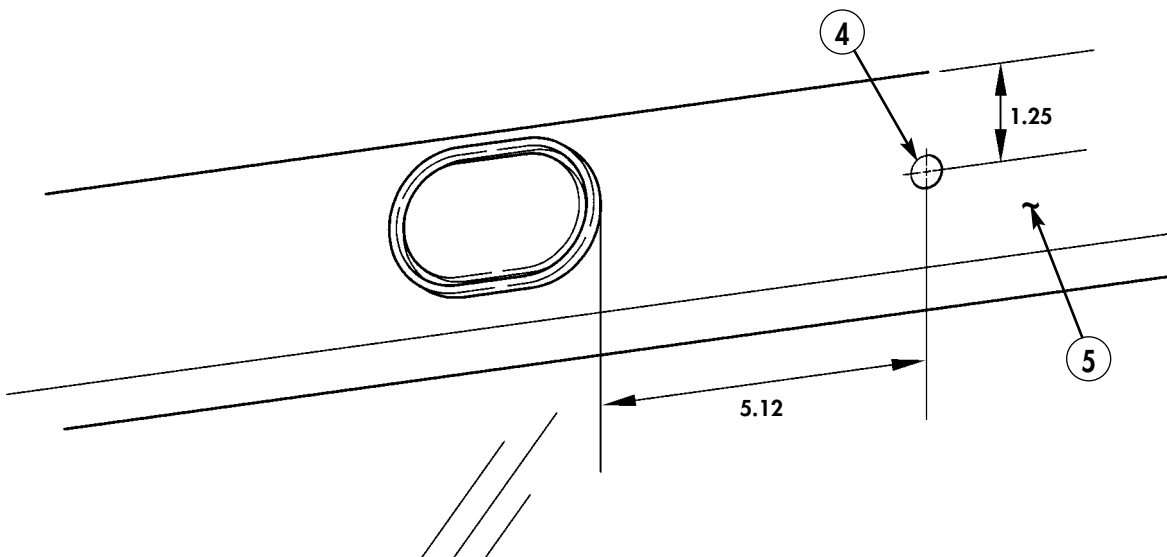
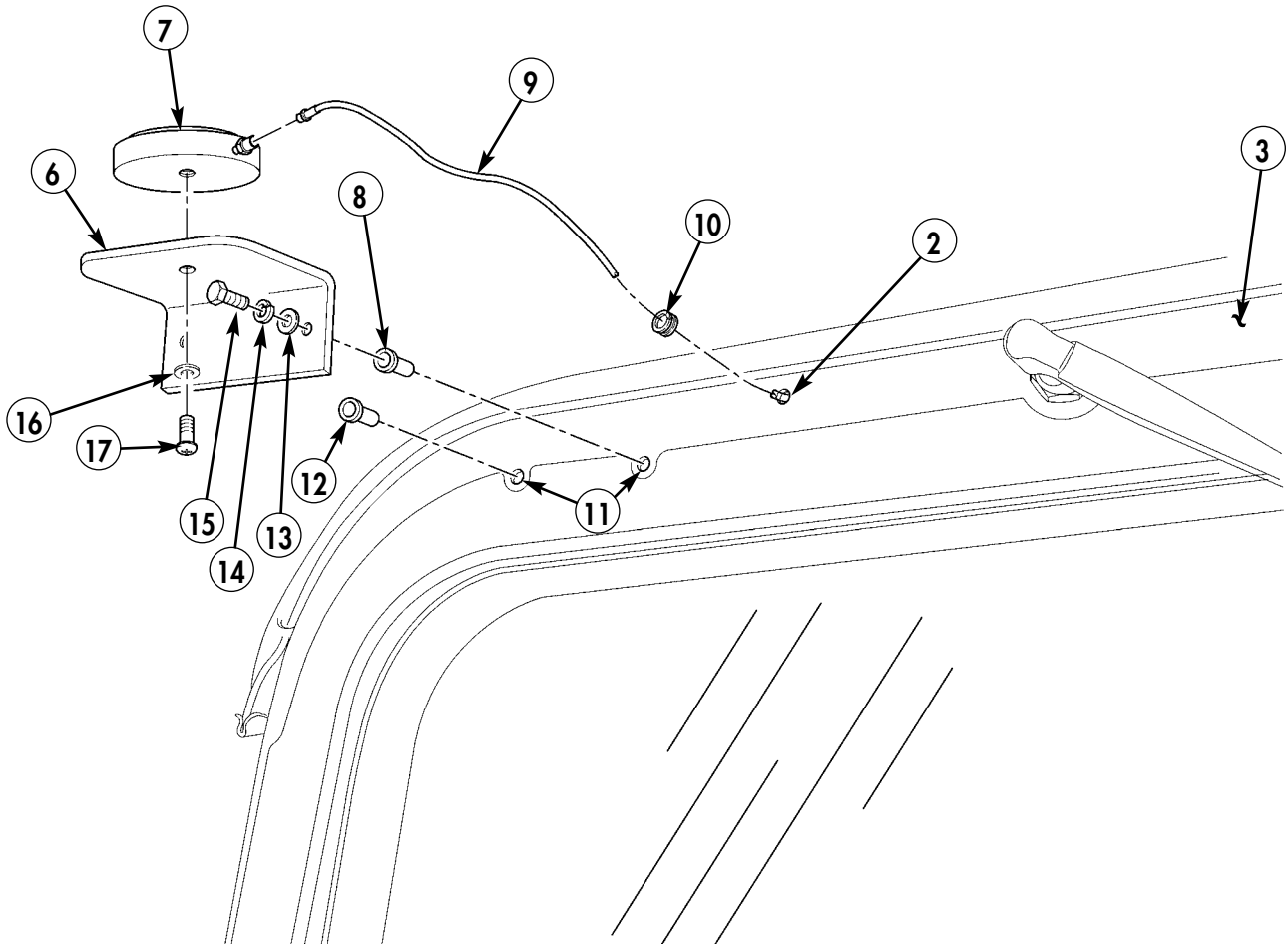


Figure 5-34.

- 13-4. Pull PLGR antenna cable (9) through hole (2) in outer right side windshield frame (3).
- 13-5. Split one side of grommet (10), place on PLGR antenna cable (9), and insert grommet (10) in hole (2) in outer right side windshield frame (3).
- 13-6. Install wellnuts (8) and (12) in holes (11).
- 13-7. Install PLGR antenna mount bracket (6) on outer right side windshield frame (3) with two lockwashers (13), washers (14), and capscrews (15).
- 13-8. Install PLGR antenna (7) on PLGR antenna mount bracket (6) with washer (16) and screw (17).
- 13-9. Install PLGR antenna cable (9) on PLGR antenna (7).



- 6. PLGR ANTENNA MOUNT BRACKET – 12480578 – QTY. 1
- 7. PLGR ANTENNA – AT575-030 – QTY. 1
- 8. WELLNUT – 12339397-6 – QTY. 1
- 9. PLGR ANTENNA CABLE – 426-0141-050 – QTY. 1
- 10. GROMMET – MS35489-143 – QTY. 1
- 12. WELLNUT – 12339397-3 – QTY. 1
- 13. LOCKWASHER – MS35338-44 – QTY. 2
- 14. WASHER – 9414920 – QTY. 2
- 15. CAPSCREW – B1821BH025C125N – QTY. 2
- 16. WASHER – 9417373 – QTY. 1
- 17. SCREW – 160035 – QTY. 1

Figure 5-35.

- 13-10.** Split one side of grommet (10) and place on PLGR antenna cable (9).
13-11. Insert PLGR antenna cable (9) and grommet (10) in hole (4) in inner right windshield frame (5).

NOTE

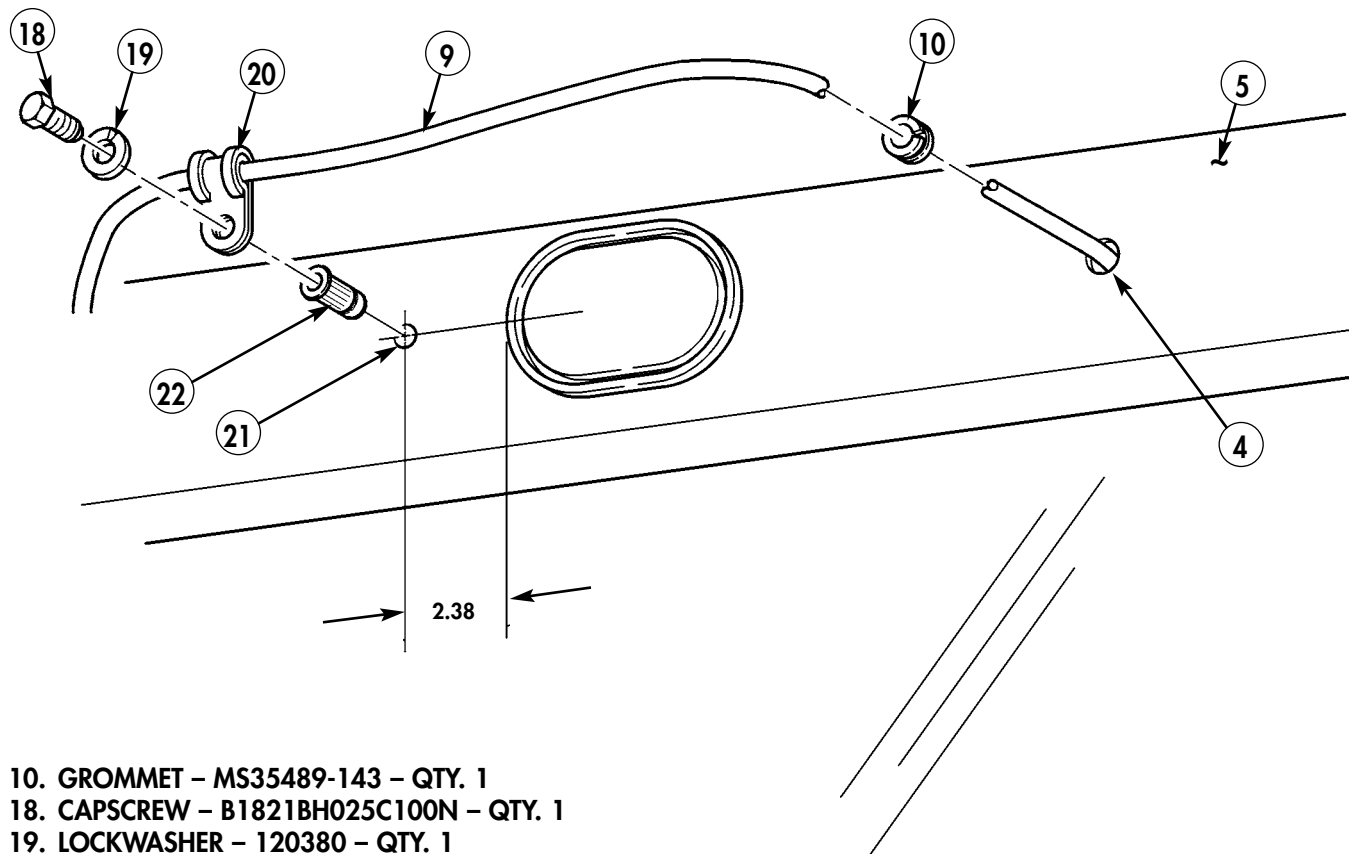
Perform steps 13-12 and 13-13 only if sun visor kit has not been installed.

- 13-12.** Locate, mark, and drill 0.390-in. diameter hole (21) in windshield frame (5).
13-13. Install insert (22) in hole (21).

NOTE

Perform step 13-14 only if sun visor kit has been installed.

- 13-14.** Remove capscrew (18) and lockwasher (19).
13-15. Route PLGR antenna cable (9) along inner right windshield frame (5) and secure with loop clamp (20), lockwasher (19), and capscrew (18).

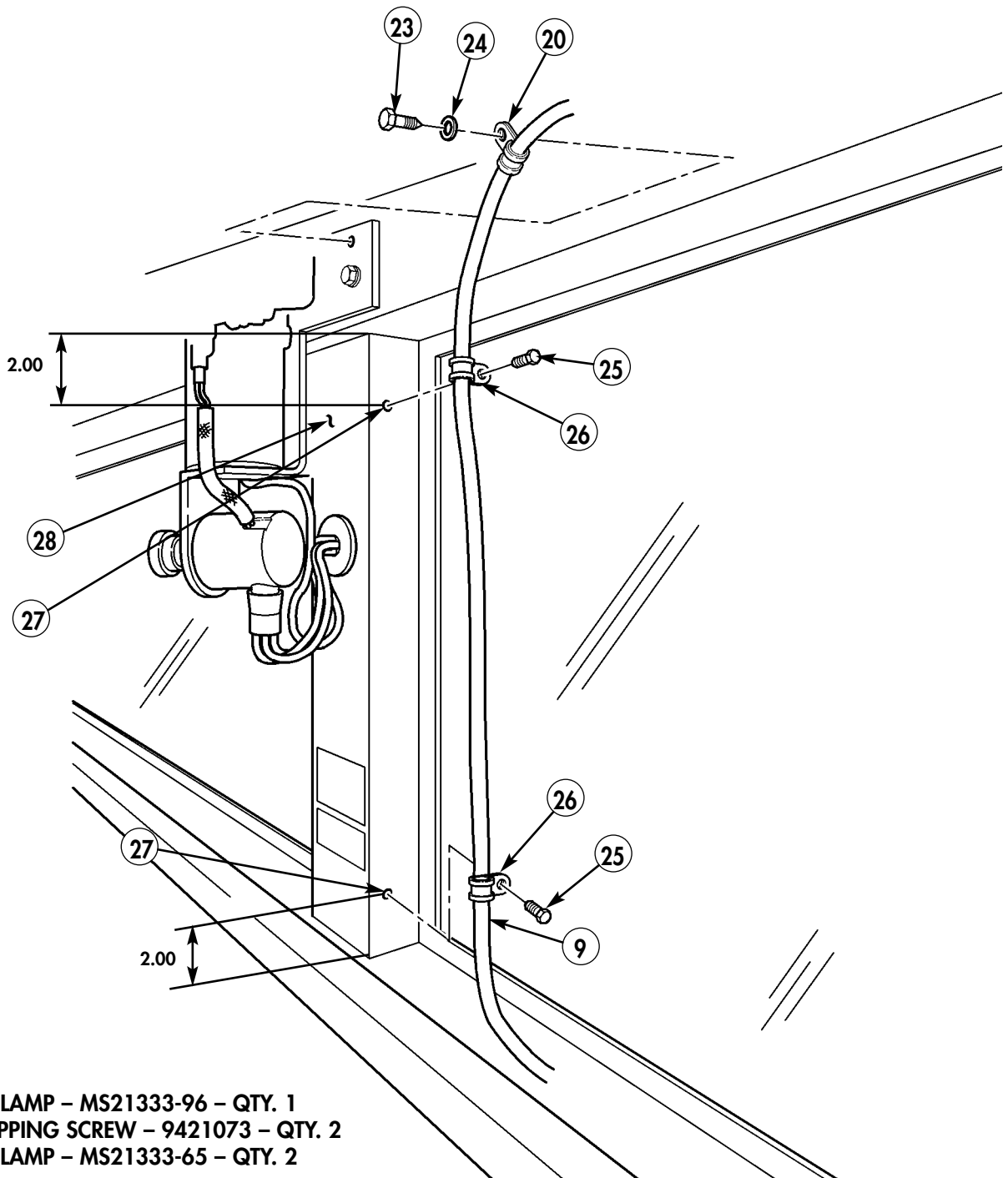


- 10. GROMMET - MS35489-143 - QTY. 1**
18. CAPSCREW - B1821BH025C100N - QTY. 1
19. LOCKWASHER - 120380 - QTY. 1
20. LOOP CLAMP - MS21333-96 - QTY. 1
22. INSERT - 12446871-2 - QTY. 1

Figure 5-36.

13-16. Locate, mark, and drill two 0.147-in. diameter holes (27) in windshield center frame (28).

13-17. Route PLGR antenna cable (9) along windshield center frame (28) and secure with two self-tapping screws (25), loop clamps (26) and (20), existing screw (23), and washer (24).



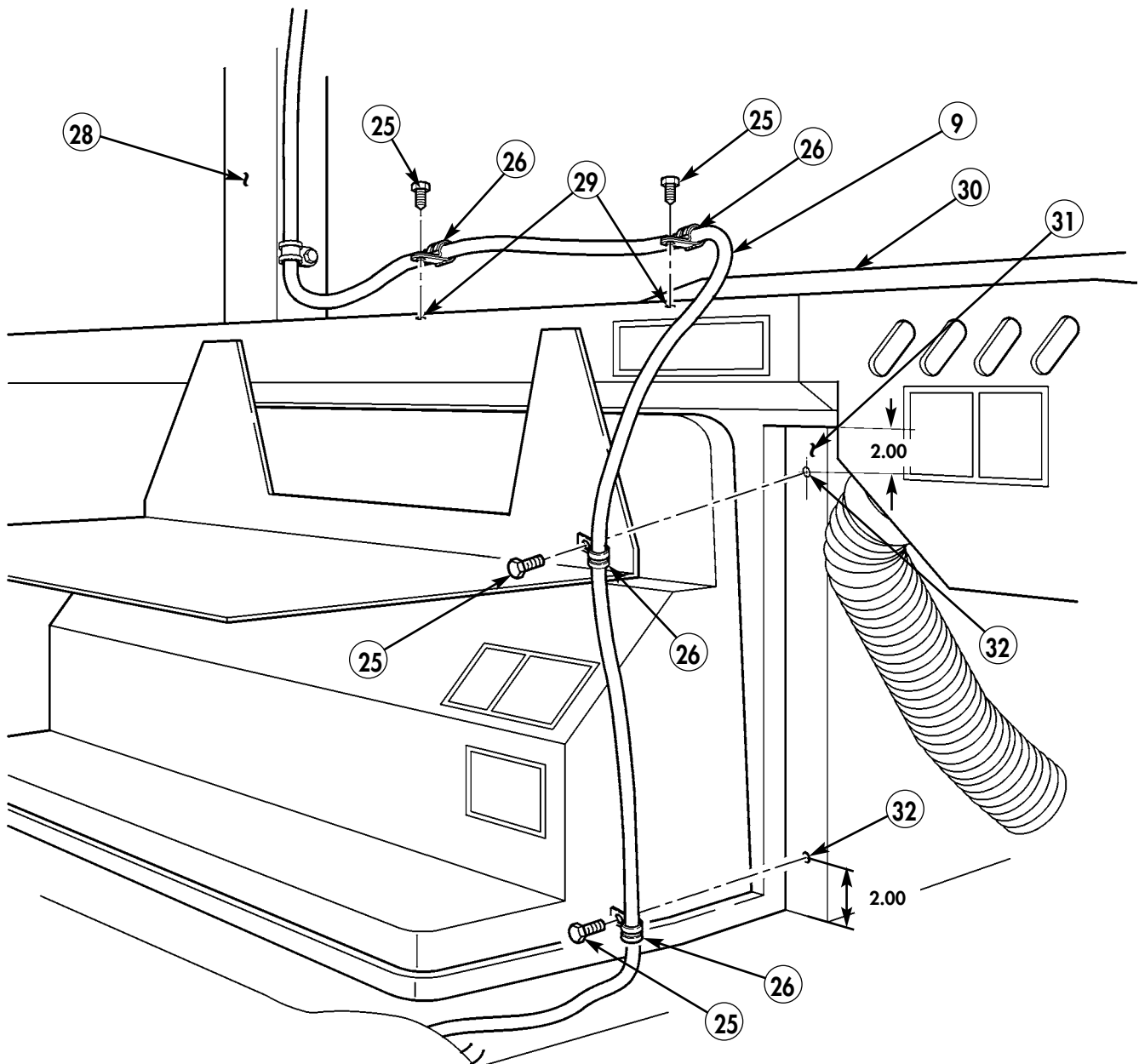
- 20. LOOP CLAMP - MS21333-96 - QTY. 1
- 25. SELF-TAPPING SCREW - 9421073 - QTY. 2
- 26. LOOP CLAMP - MS21333-65 - QTY. 2

Figure 5-37.

NOTE

Perform steps 13-18 through 13-23 for AN/VRC-92F only.

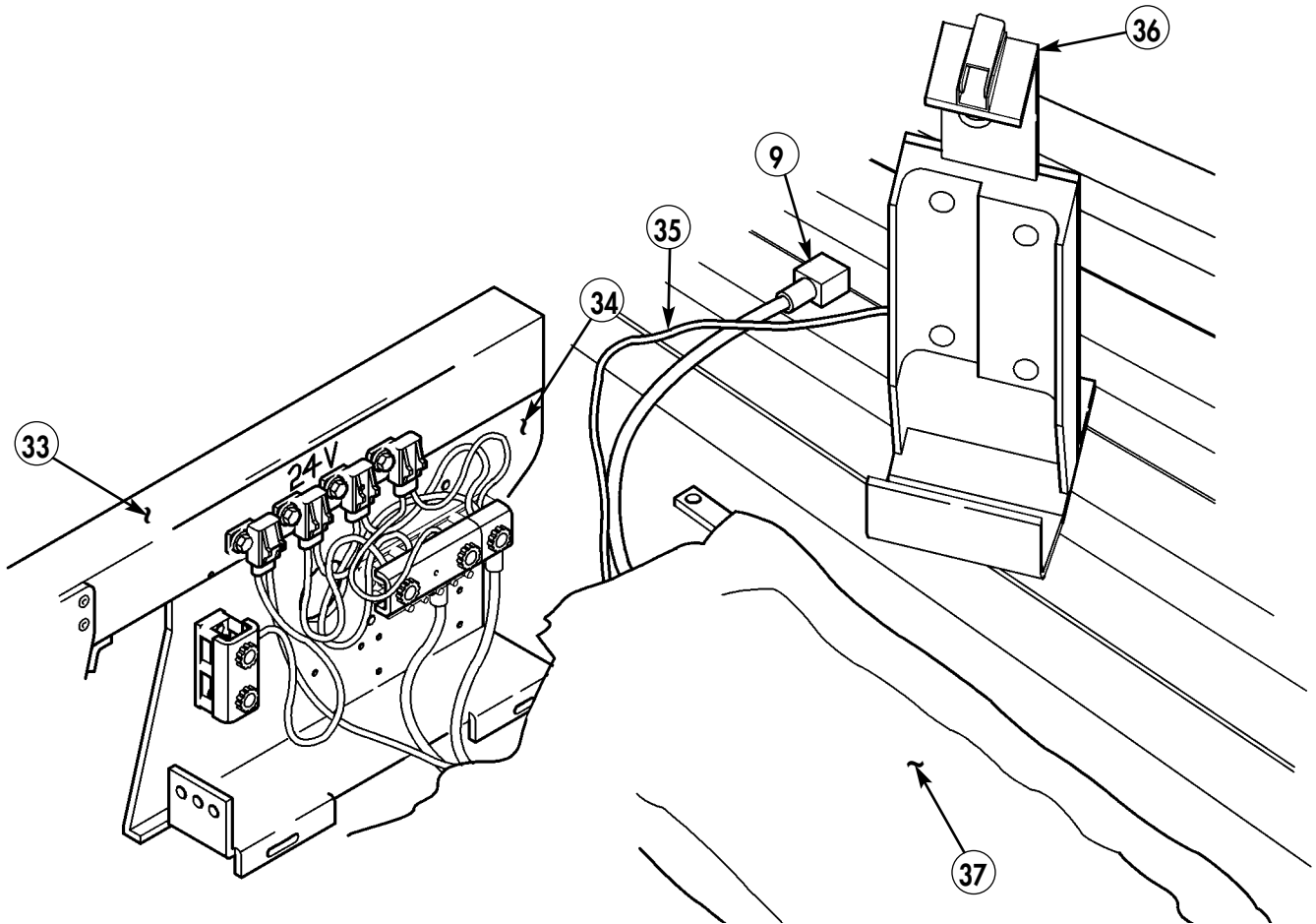
- 13-18.** Locate, mark, and drill two 0.147-in. evenly spaced holes (29) on top of front dash (30).
13-19. Locate, mark, and drill two 0.147-in. holes (32) in support (31).
13-20. Route antenna cable (9) from windshield center frame (28) along top of front dash (30), down along front dash support (31), and secure with four self-tapping screws (25) and loop clamps (26).



- 25. SELF-TAPPING SCREW - 9421073 - QTY. 4**
26. LOOP CLAMP - MS21333-65 - QTY. 4

Figure 5-38.

- 13-21. Loosen right side tunnel insulation (37). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 13-22. Route antenna cable (9) rearward under right side tunnel insulation (37) and towards PLGR bracket assembly (36).
- 13-23. Route PLGR power cable (35) from PLGR bracket assembly (36) under right side tunnel insulation (37) towards B-beam (33) and cab enclosure panel (34).



35. PLGR POWER CABLE – 9728558-10 – QTY. 1

Figure 5-39.

NOTE

Perform steps 13-24 through 13-30 for AN/VRC-88F, 89F, 90F, or 91F only.

- 13-24. Locate, mark, and drill 0.147-in. hole (39) in top of dash (30).
- 13-25. Route antenna cable (9) from windshield center post (28) to PLGR bracket assembly (36) and secure to front dash (30) with self-tapping screw (25) and loop clamp (26).
- 13-26. Route PLGR power cable (35) along side of standard rack (38) and secure with existing clamp and hardware.
- 13-27. Route PLGR power cable (35) down standard rack support (41) and secure with tiedown strap (40).
- 13-28. Loosen right side tunnel insulation (37). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 13-29. Route PLGR power cable (35) from standard rack support (41) rearward under right side tunnel insulation (37) towards B-beam and cab enclosure panel.
- 13-30. Coil excess antenna cable and store under standard rack (38) using tiedown strap (40) as necessary.

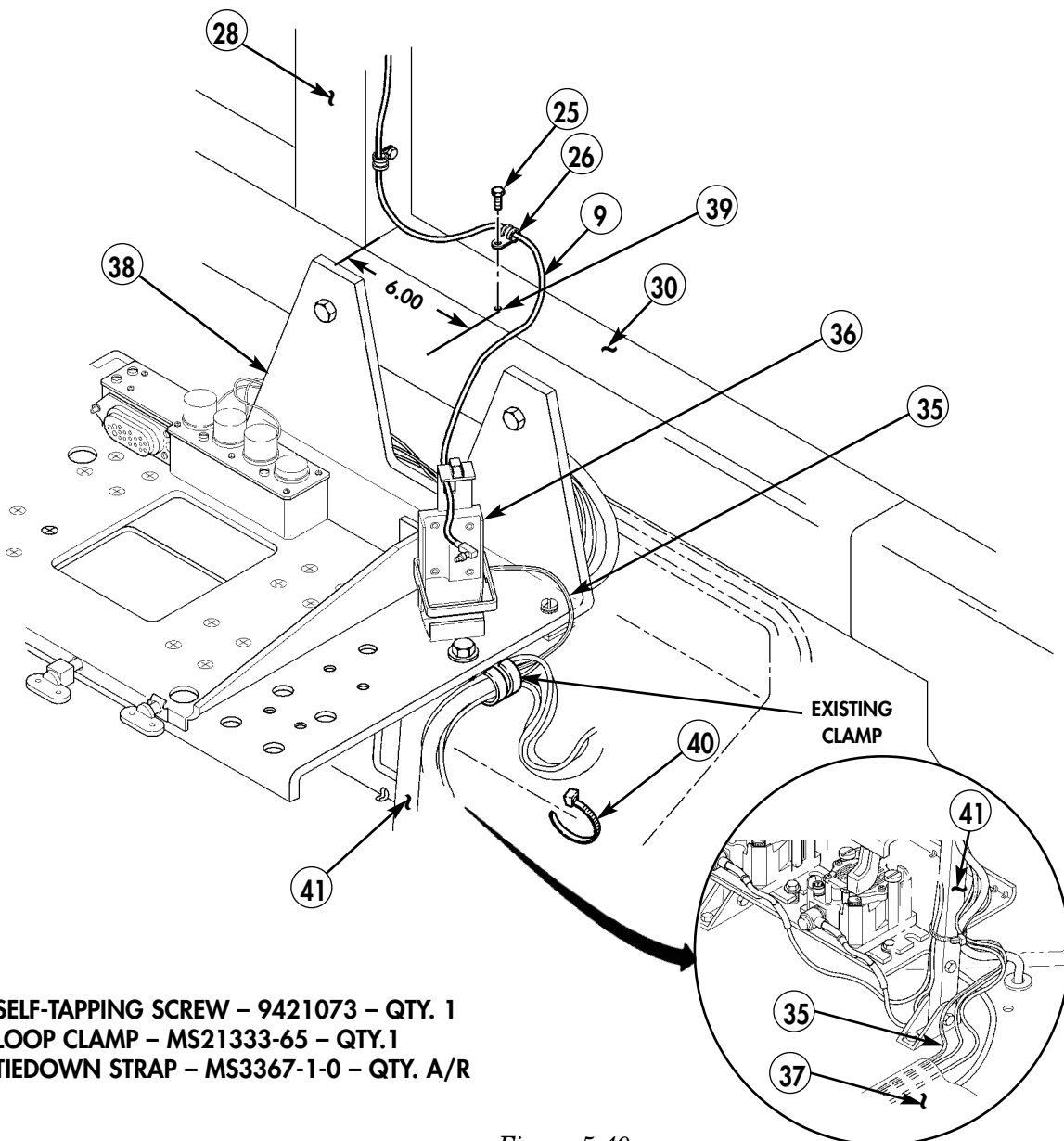
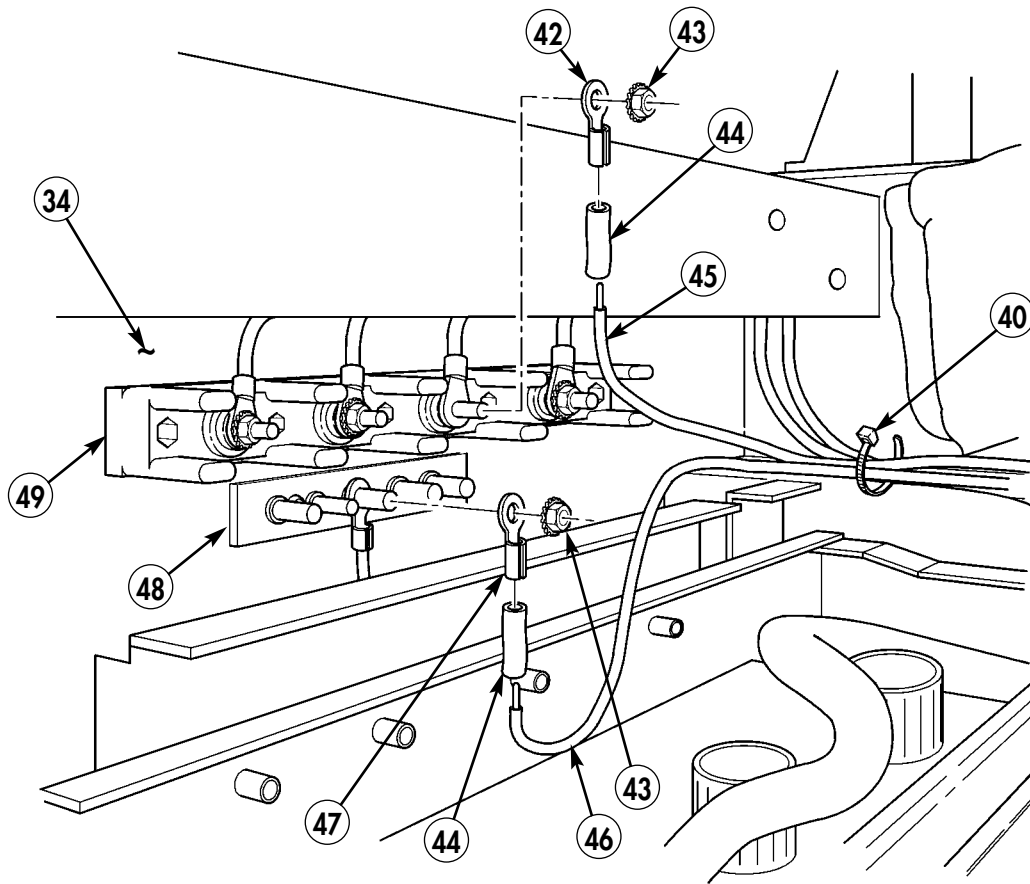


Figure 5-40.

NOTE

PLGR power cable positive lead insulation is ribbed.

- 13-31. Attach shrink tubing (44) and terminal lugs (47) and (42) to PLGR power cable negative lead (46) and PLGR power cable positive lead (45). (Refer to TM9-2320-280-20 or TM 9-2320-387-24 for terminal connector repair.)
- 13-32. Attach PLGR power cable positive lead (45) to 24-volt terminal board (49), located on cab enclosure panel (34), with existing nut (43).
- 13-33. Attach PLGR power cable negative lead (46) to ground strap (48), located on cab enclosure panel (34), with existing nut (43).
- 13-34. Coil excess positive and negative power leads (45) and (46), place beneath ground strap (48), and secure with tiedown strap (40).



- 40. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R
- 42. TERMINAL LUG – 7728780 – QTY. 1
- 44. SHRINK TUBING – MS23053/4-302-0 – QTY. A/R

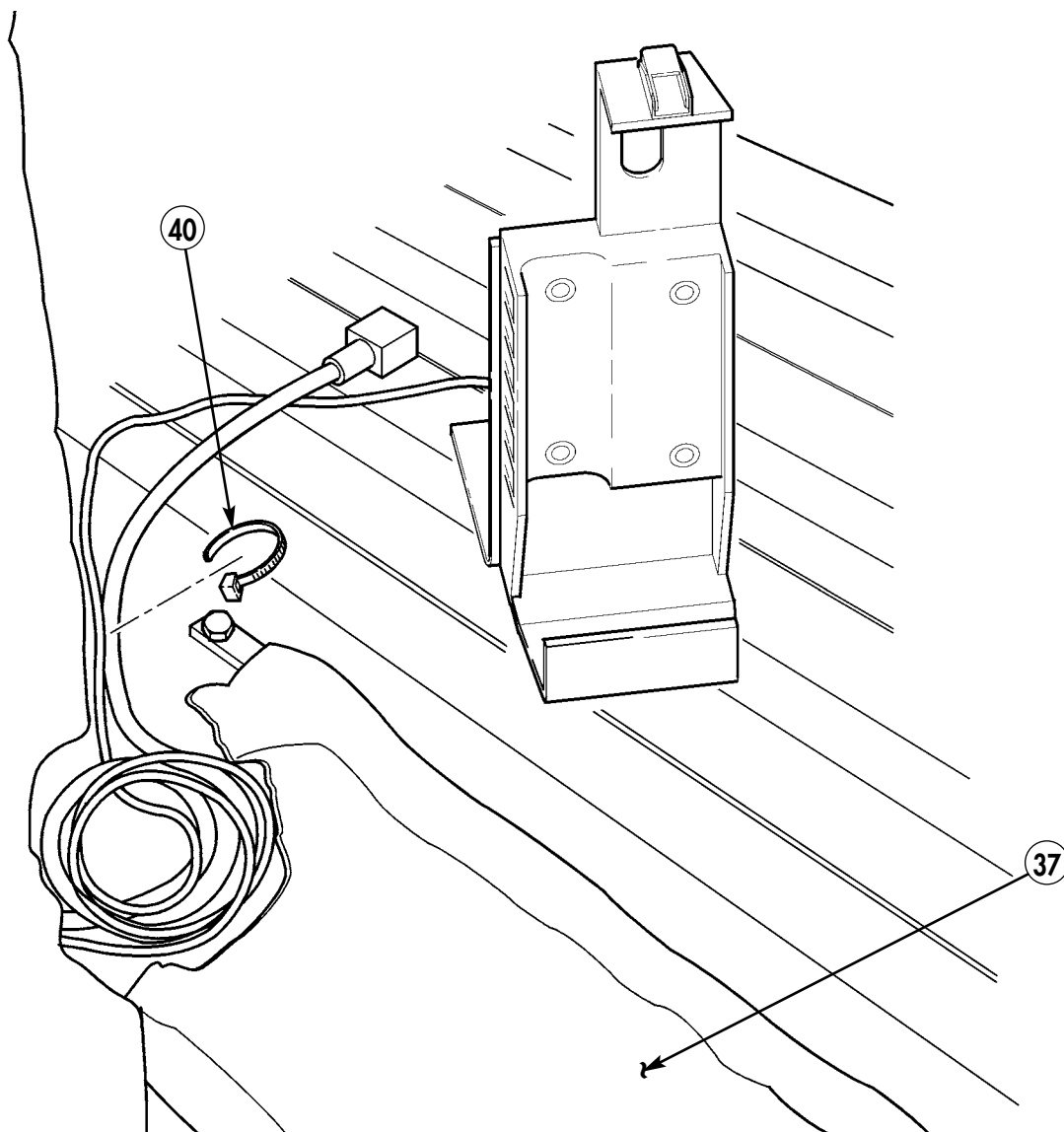
Figure 5-41.

NOTE

- Perform step 13-35 for AN/VRC-92F only.
- Ensure all excess cable is inside cab of vehicle.

13-35. Coil all excess cable, secure with tiedown strap (40) and place under right side tunnel insulation (37).

13-36. Install right side tunnel insulation (37). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)



40. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R

Figure 5-42.

Section XIV. MTS MOUNT AND PLGR BRACKET INSTALLATION

NOTE

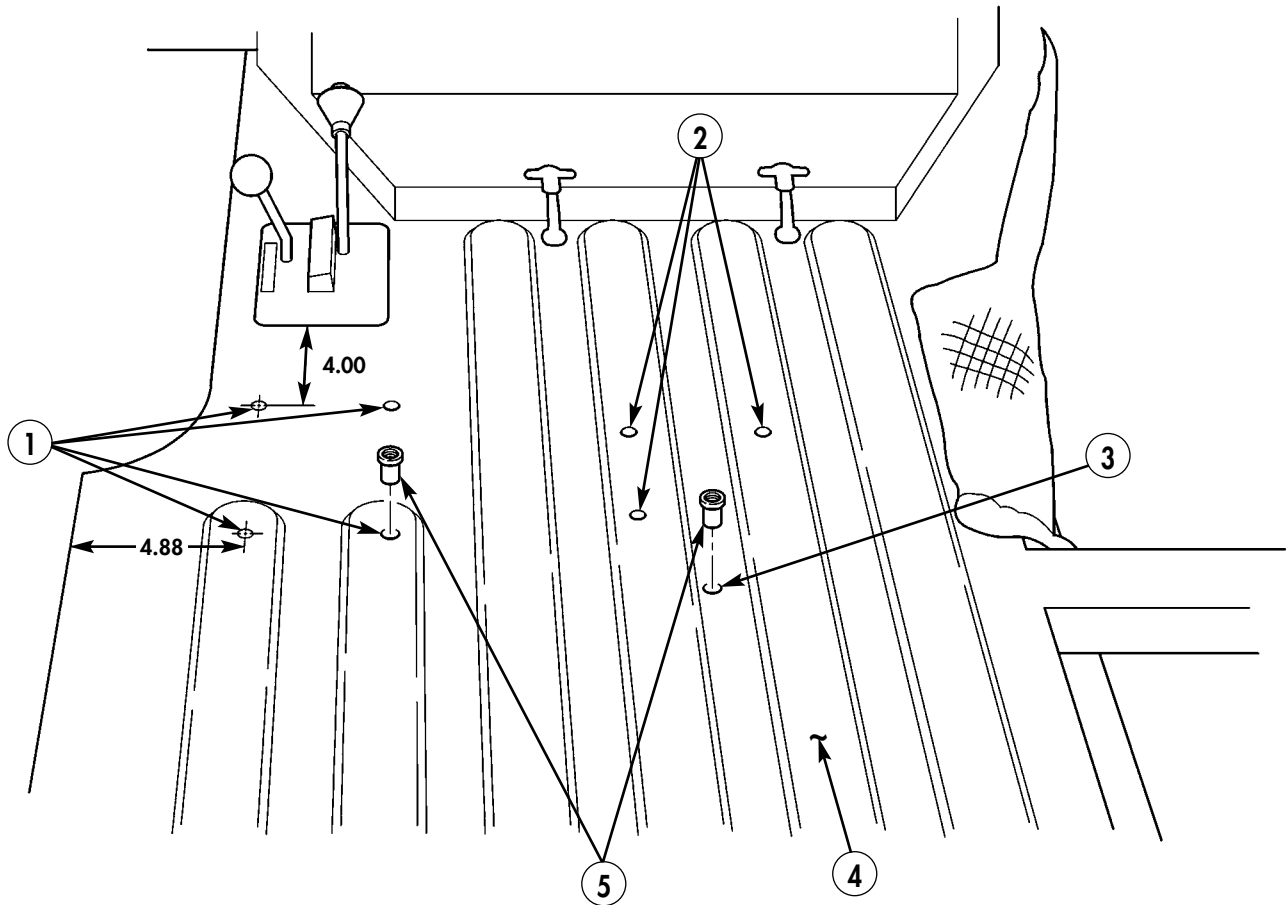
Before performing step 14-1, remove left side tunnel insulation.
(Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

- 14-1. Drill out rivet from floor (4), enlarge hole (3) to 0.390-in. diameter, and install screw thread insert (5) in floor (4).

NOTE

Ensure all holes are located on flat surface of tunnel ribs.

- 14-2. Using MTS mounting base bracket as template, locate, mark, and drill three 0.390-in. diameter holes (2) in floor (4).
- 14-3. Using control box as template, locate, mark, and drill four 0.390-in. diameter holes (1) in floor (4).
- 14-4. Install seven screw thread inserts (5) in floor (4).
- 14-5. Install left side tunnel insulation. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)



5. INSERT - 12446871-2 - QTY. 8

Figure 5-43.

NOTE

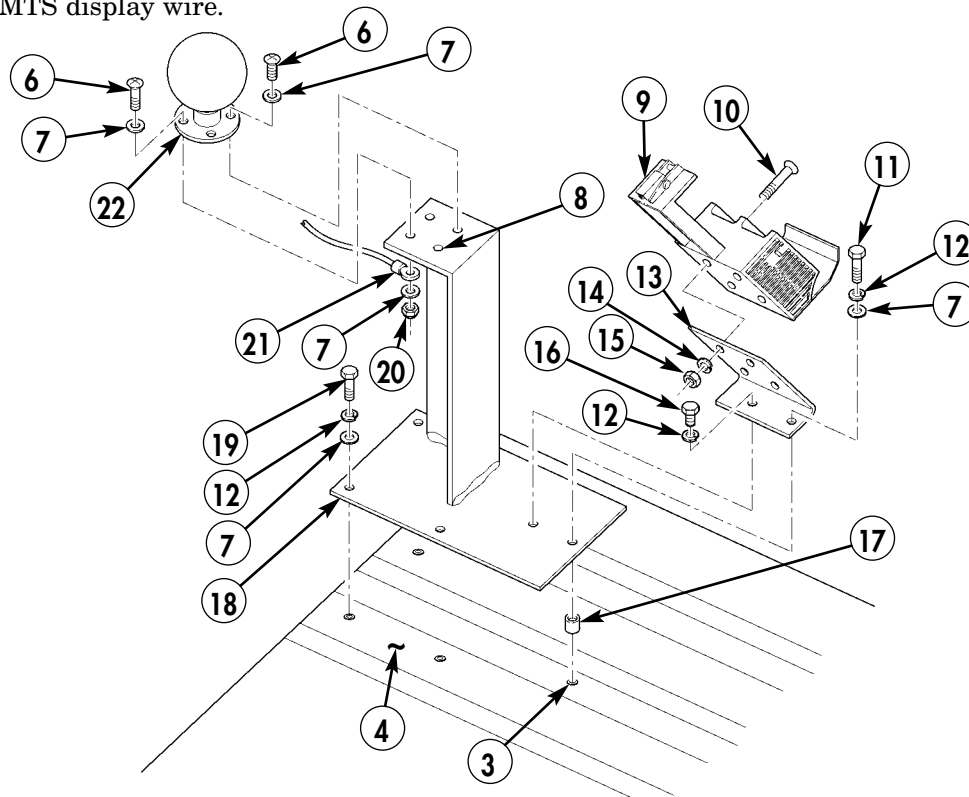
When attaching lower ball to MTS mounting bracket, leave left rear hole open to accommodate future loop clamp and MTS display wire.

- 14-6.** Place spacer (17) in position between insert (3) and MTS mounting base bracket (18). Install MTS mounting base bracket (18) on floor (4) with three lockwashers (12), washers (7), and capscrews (19).
- 14-7.** Install PLGR mount (13) on MTS mounting base bracket (18) with lockwasher (12), capscrew (16), washer (7), lockwasher (12), and capscrew (11).
- 14-8.** Install PLGR bracket (9) on PLGR mount (13) with four screws (10), lockwashers (14), and plain-assembled nuts (15).
- 14-9.** Fabricate ground strap (21) from 6-in. length of braided wire and two terminal lugs.

NOTE

Ground strap will be installed on lower ball mount only at this time. Other end of ground strap will be installed with MTS display cables. (Refer to chapter 5, section XX.)

- 14-10.** Install ground strap (21) and lower ball mount (22) on MTS mounting base bracket (18) with three capscrews (6), six washers (7), and three locknuts (20). Leave hole (8) open for future loop clamps and MTS display wire.



- | | |
|--|---|
| 6. CAPSCREW – B1821BH025C113N – QTY. 3 | 17. SPACER – 12340849 – QTY. 1 |
| 7. WASHER – 2436161 – QTY. 12 | 18. MTS MOUNTING BASE BRACKET – RCSK 19648 – QTY. 1 |
| 9. PLGR BRACKET – 986-0645-001 – QTY. 1 | 19. CAPSCREW – B1821BH025C125N – QTY. 3 |
| 10. SCREW – MS35206-263 QTY. 4 | 20. LOCKNUT – MS51943-31 – QTY. 3 |
| 11. CAPSCREW – B1821BH025C150N – QTY. 1 | 21. GROUND STRAP |
| 12. LOCKWASHER – MS35338-44 – QTY. 5 | • BRAIDED WIRE – AA59569F30T0375 – QTY. A/R |
| 13. PLGR MOUNT – 12480576 – QTY. 1 | • TERMINAL LUG – MS20659-107 – QTY. 1 |
| 14. LOCKWASHER – MS35338-43 – QTY. 4 | • TERMINAL LUG – MS20659-141 – QTY. 1 |
| 15. PLAIN-ASSEMBLED NUT – 9422771 – QTY. 4 | 22. LOWER BALL MOUNT – D254 – QTY. 1 |
| 16. CAPSCREW – B1821BH025C075N – QTY. 1 | |

Figure 5-44.

Section XV. MTS CONTROL BOX INSTALLATION

NOTE

Ensure all holes have been drilled and inserts installed. (Refer to chapter 5, section XIV.)

- 15-1. Using MTS control box as template, locate, mark, and cut two 0.750-in. holes (2) in left-side tunnel insulation (1).

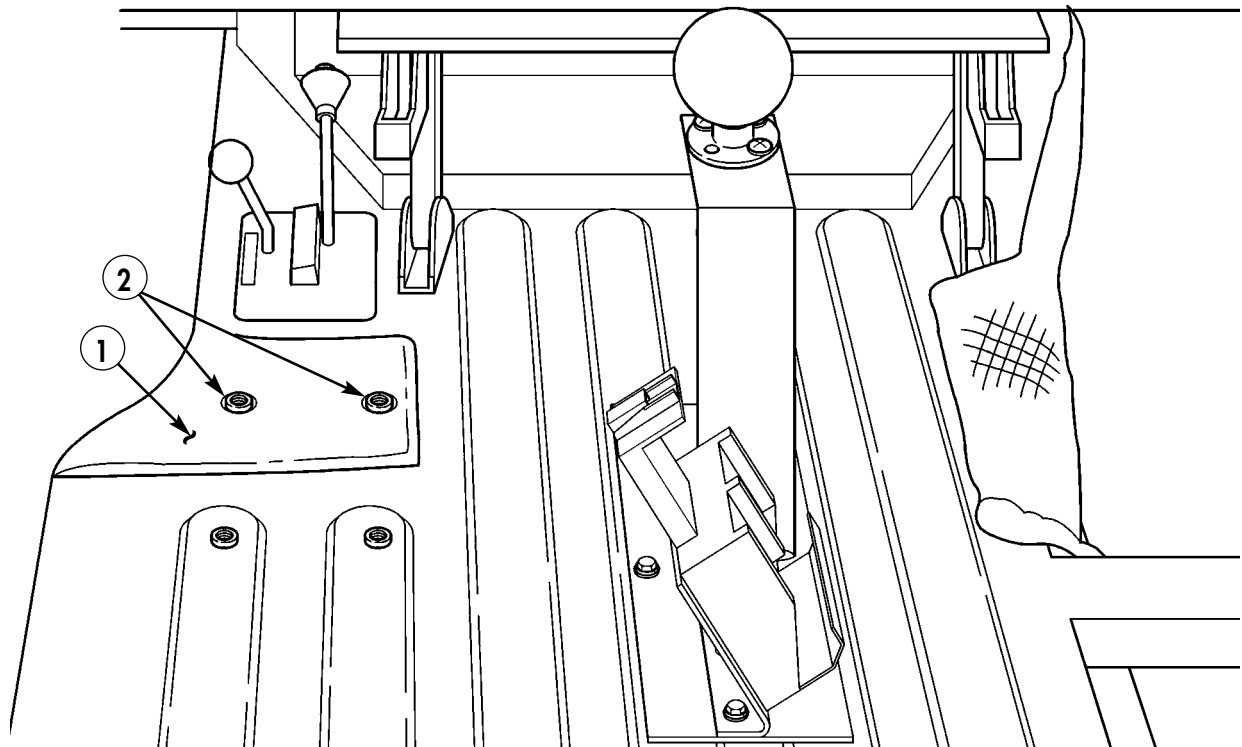


Figure 5-45.

NOTE

- Spacers are installed between control box and tunnel floor and only on front two mounting holes of control box, where tunnel insulation has been cut.
- Install spacer between right front mounting holes first.
- Do not tighten screws until all hardware has been installed.

- 15-2.** Install MTS control unit (3) on tunnel floor (10) with spacer (5), three lockwashers (12), washers (11), and capscrews (13).
- 15-3.** Locate, mark and drill 0.147-in. diameter hole (9) in tunnel floor (10).
- 15-4.** Remove paint from vicinity of hole (9) in tunnel floor (10) and from corner (4) of control box (3). Apply antiseize compound as required.
- 15-5.** Fabricate ground strap (8) from 4-in. length of braided wire and two terminal lugs.
- 15-6.** Install ground strap (8) on tunnel floor (10) with lockwasher (7) and self-tapping screw (6).
- 15-7.** Install ground strap (8) on MTS control box (3) with lockwasher (12), washer (11), and capscrew (13). Then mount control box (3) to tunnel floor (10) with spacer (5).
- 15-8.** Tighten all screws (6) and (13).

3. MTS CONTROL UNIT - 7110-0315 - QTY. 1

5. SPACER - 12340849 - QTY. 2

6. SELF-TAPPING SCREW - 9418944 - QTY. 1

7. LOCKWASHER - 120391 - QTY. 1

8. GROUND STRAP

• BRAIDED WIRE - AA59569F30T0375 - QTY. A/R

• TERMINAL LUG - MS20659-141 - QTY. 1

• TERMINAL LUG - MS20659-107 - QTY. 1

11. WASHER - 2436161 - QTY. 4

12. LOCKWASHER - MS35338-44 - QTY. 4

13. CAPSCREW - B1821BH025C113N - QTY. 4

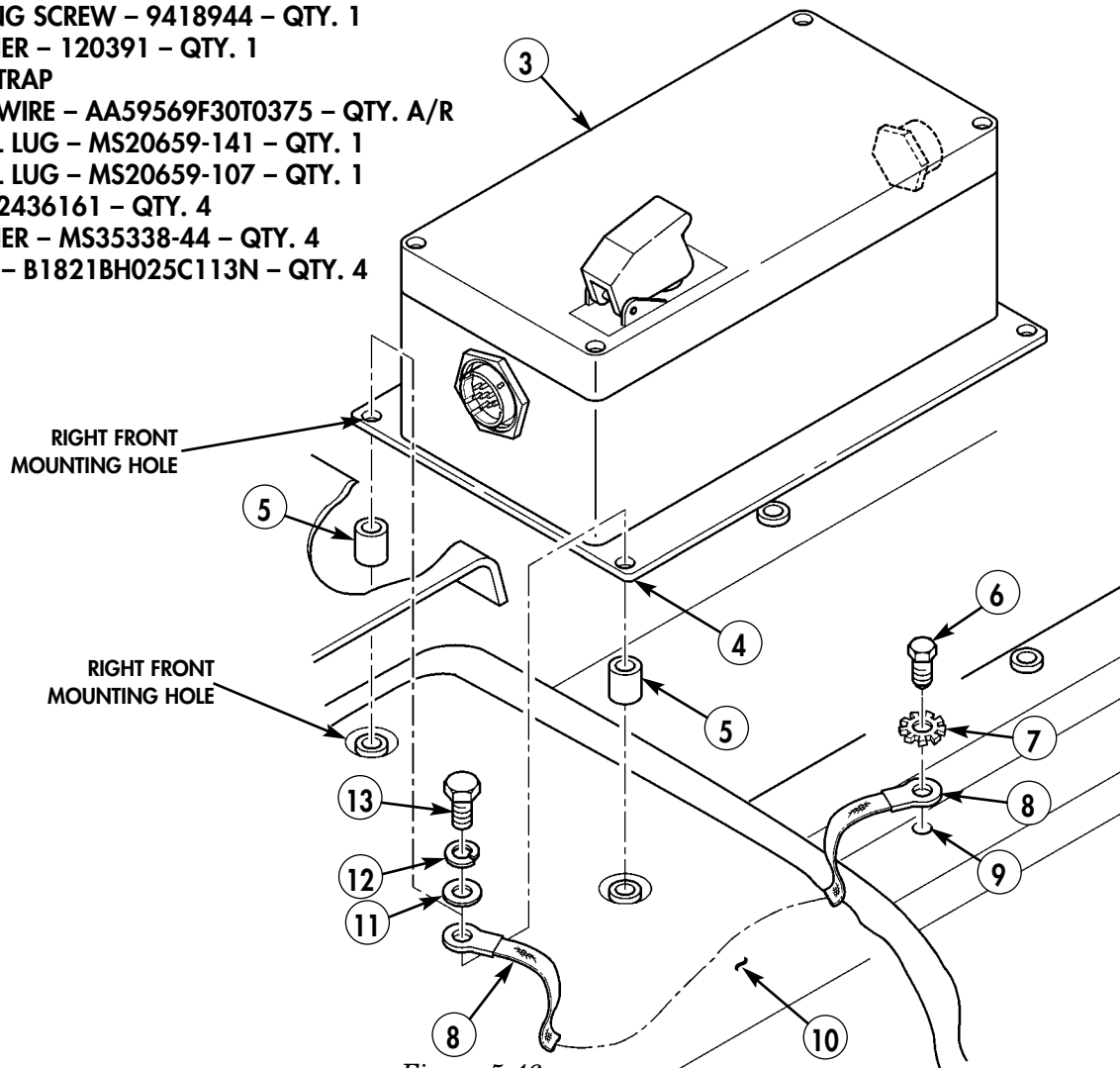


Figure 5-46.

Section XVI. MTS ANTENNA INSTALLATION

16-1. If applicable, remove two bumpers (1) from windshield frame (2).

16-2. Remove four screws (3) from windshield frame (2).

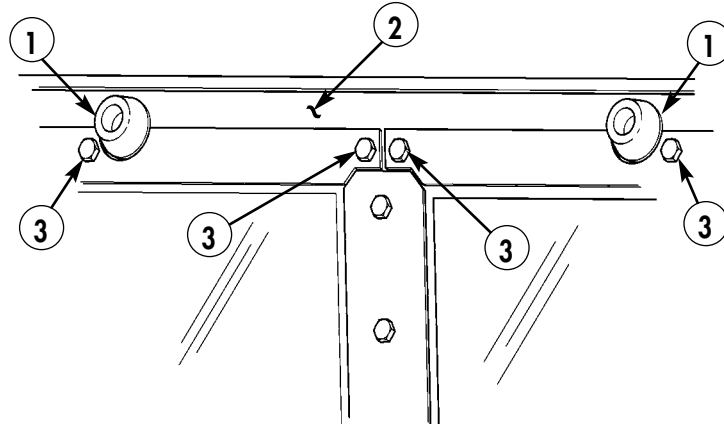
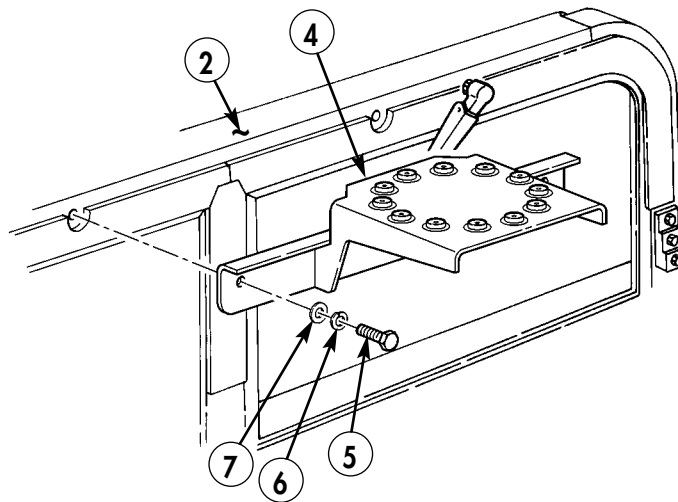


Figure 5-47.

16-3. Mount antenna mounting bracket (4) to windshield frame (2) with two lockwashers (6), washers (7), and capscrews (5).

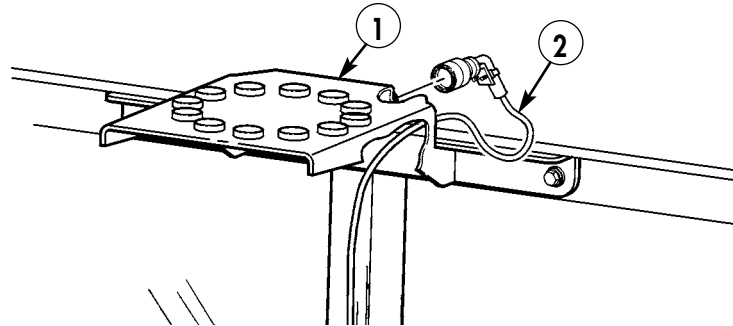


- 4. MTS ANTENNA MOUNTING BRACKET - 7110-0302 - QTY. 1
- 5. CAPSCREW - B1821BH025C125N - QTY. 2
- 6. LOCKWASHER - MS35338-44 - QTY. 2
- 7. WASHER - 2436161 - QTY. 2

Figure 5-48.

Section XVII. MTS ANTENNA CABLE INSTALLATION

- 17-1. Connect antenna cable (2) to connector on antenna bracket (1).
 17-2. Route antenna cable (2) under antenna bracket (1).



2. ANTENNA CABLE – 506B338-01 – QTY. 1

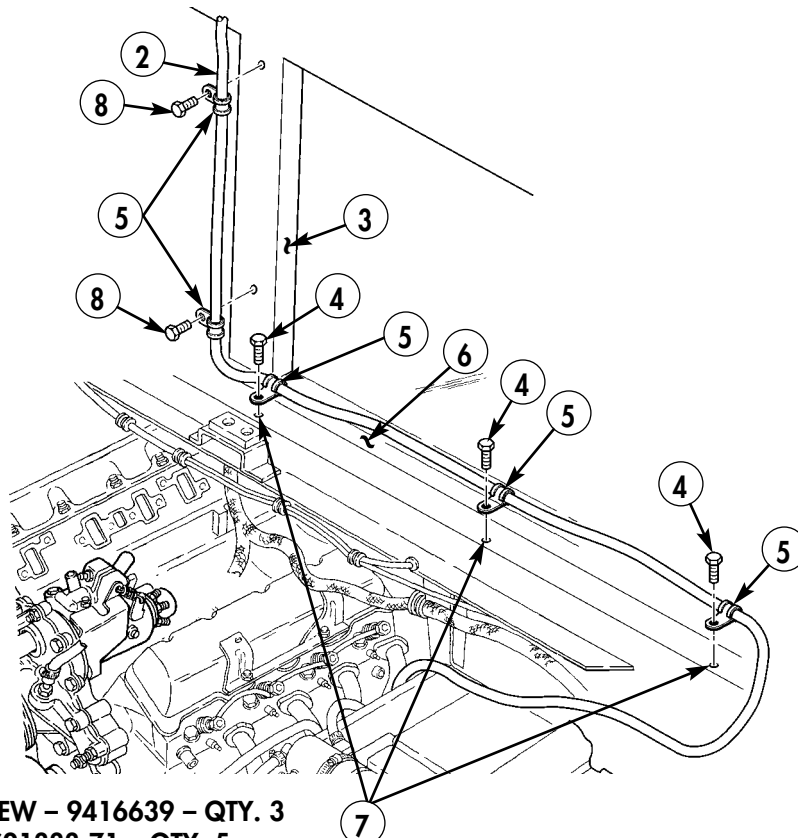
Figure 5-49.

- 17-3. Route antenna cable (2) down windshield center post (3), securing with two loop clamps (5) and existing screws (8).

NOTE

Perform steps 17-4 and 17-5 for vehicles without windshield retainers.

- 17-4. Locate, mark, and drill three 0.147-in. diameter holes (7) on driver's side front cowl (6).
 17-5. Route antenna cable (2) along driver's side front cowl (6) to engine compartment and secure with three loop clamps (5) and self-tapping screws (4).



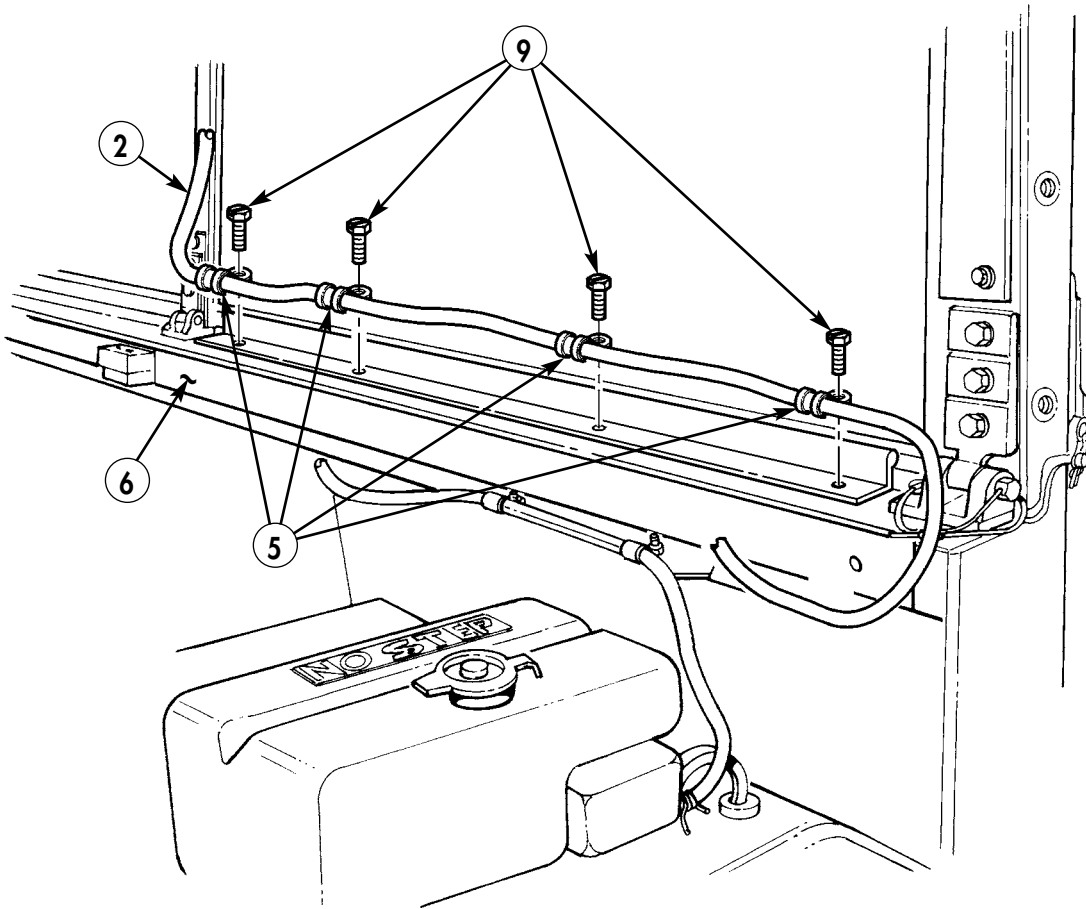
4. SELF-TAPPING SCREW – 9416639 – QTY. 3
 5. LOOP CLAMP – MS21333-71 – QTY. 5

Figure 5-50.

NOTE

Perform step 17-6 for vehicles with windshield retainers.

- 17-6.** Route antenna cable (2) along driver's side front cowl (6) to engine compartment and secure with four loop clamps (5) and existing screws (9).



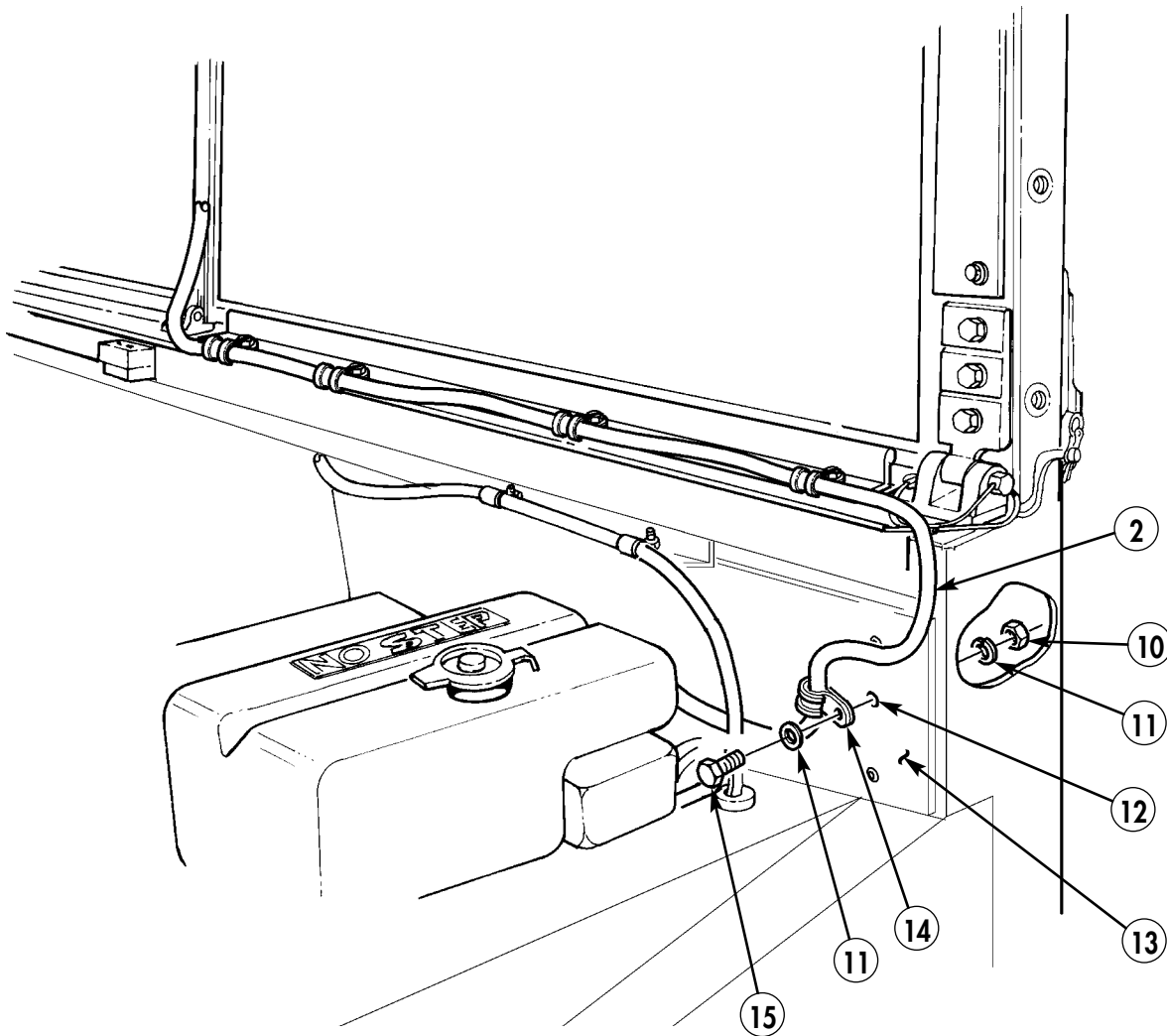
- 5. LOOP CLAMP – MS21333-71 – QTY. 4**

Figure 5-51.

NOTE

Perform steps 17-7 and 17-8 for vehicles with old-style mirror bracket removed/not installed.

- 17-7.** Drill out rivet (12) with 0.281-inch drill bit on engine compartment wall (13).
- 17-8.** Route antenna cable (2) along engine compartment wall (13) and secure with capscrew (15), washer (11), loop clamp (14), washer (11), and nut (10).



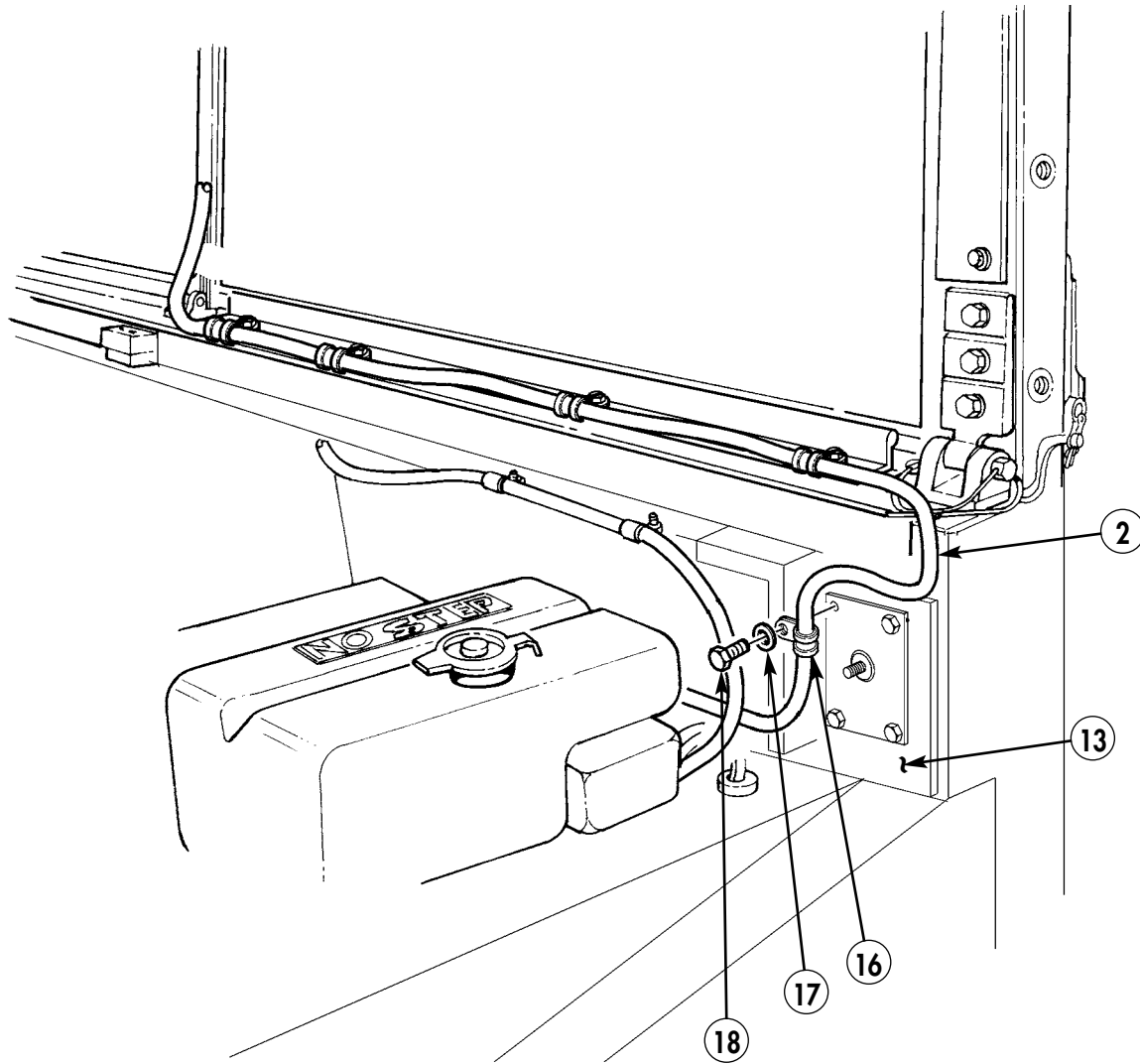
10. NUT - 9419143 - QTY. 1
 11. WASHER - 2436161 - QTY. 2
 14. LOOP CLAMP - MS21333-102 - QTY. 1
 15. CAPSCREW - B1821BH025C075N - QTY. 1

Figure 5-52.

NOTE

Perform step 17-9 for vehicles with old-style mirror bracket installed.

- 17-9.** Route antenna cable (2) along engine compartment wall (13) and secure with loop clamp (16) and existing washer (17) and screw (18).



- 16. LOOP CLAMP – MS21333-112 – QTY. 1**

Figure 5-53.

- 17-10. Remove three existing plugs (19) on driver's side of engine compartment wall (13).
- 17-11. Enlarge largest hole (20) to 1.25 in. diameter.

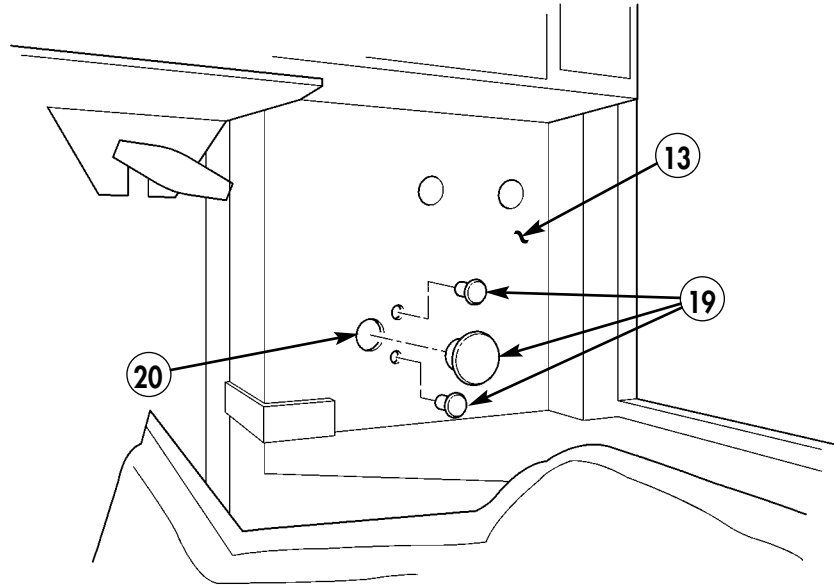


Figure 5-54.

- 17-12. Route antenna cable (2) through engine compartment wall (13) and through hole (20) to interior of vehicle.

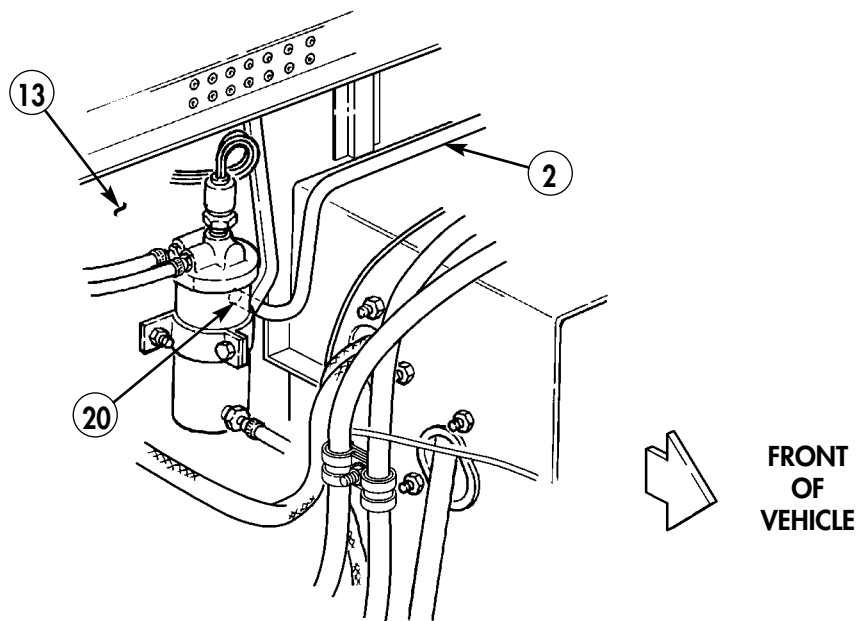


Figure 5-55.

17-13. Attach connector (23) to plate (22) with four screws (24) and nuts (21).

17-14. Connect antenna cable (2) to back of connector (23).

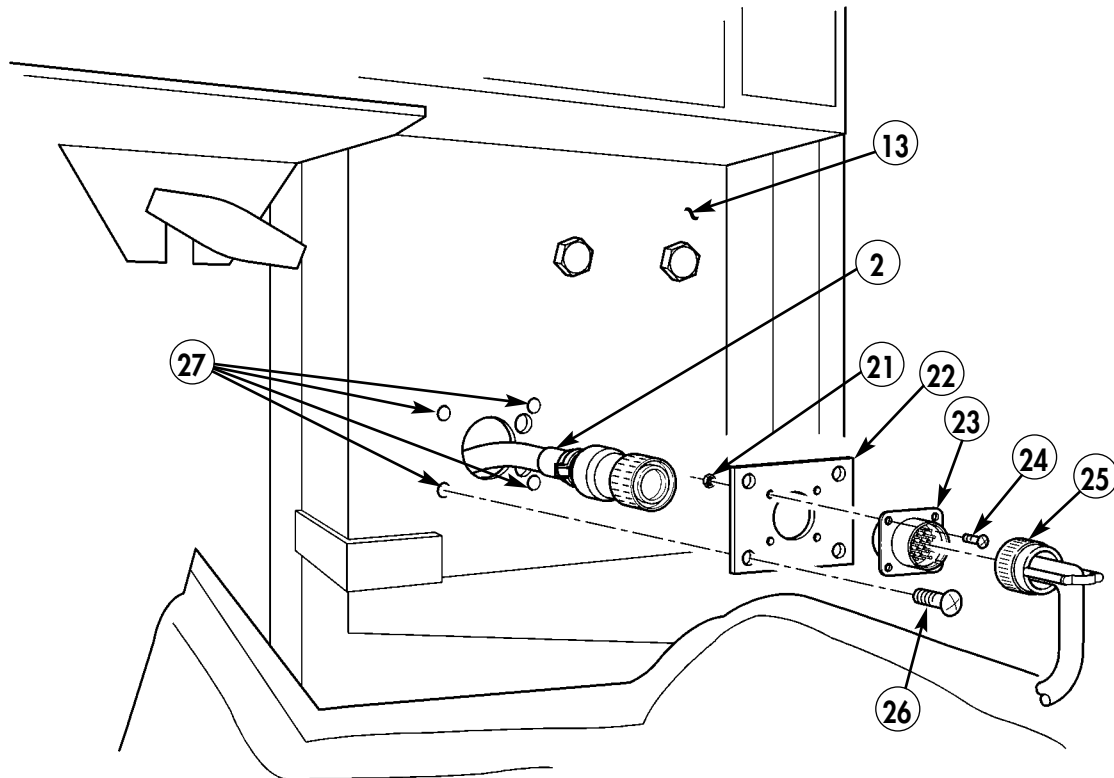
NOTE

Ensure large key is at bottom of connector.

17-15. Using plate (22) as template, locate, mark, and drill four 0.147-in. diameter holes (27) in engine compartment wall (13).

17-16. Attach plate (22) to engine compartment wall (13) with four self-tapping screws (26).

17-17. Connect antenna cable (25) to connector (23).



- 21. NUT - 116002 - QTY. 4
- 23. CONNECTOR - MS3119E14-19 - QTY. 1
- 24. SCREW - 9417875 - QTY. 4
- 25. ANTENNA CABLE - 506B339-01 - QTY. 1
- 26. SELF-TAPPING SCREW - 9416639 - QTY. 4

Figure 5-56.

NOTE

Loosen left side tunnel insulation before performing step 17-18.
(Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

17-18. Route MTS antenna cable (25) under left-side tunnel insulation (28).

17-19. Connect MTS antenna cable (25) to MTS control unit J6 connector (29).

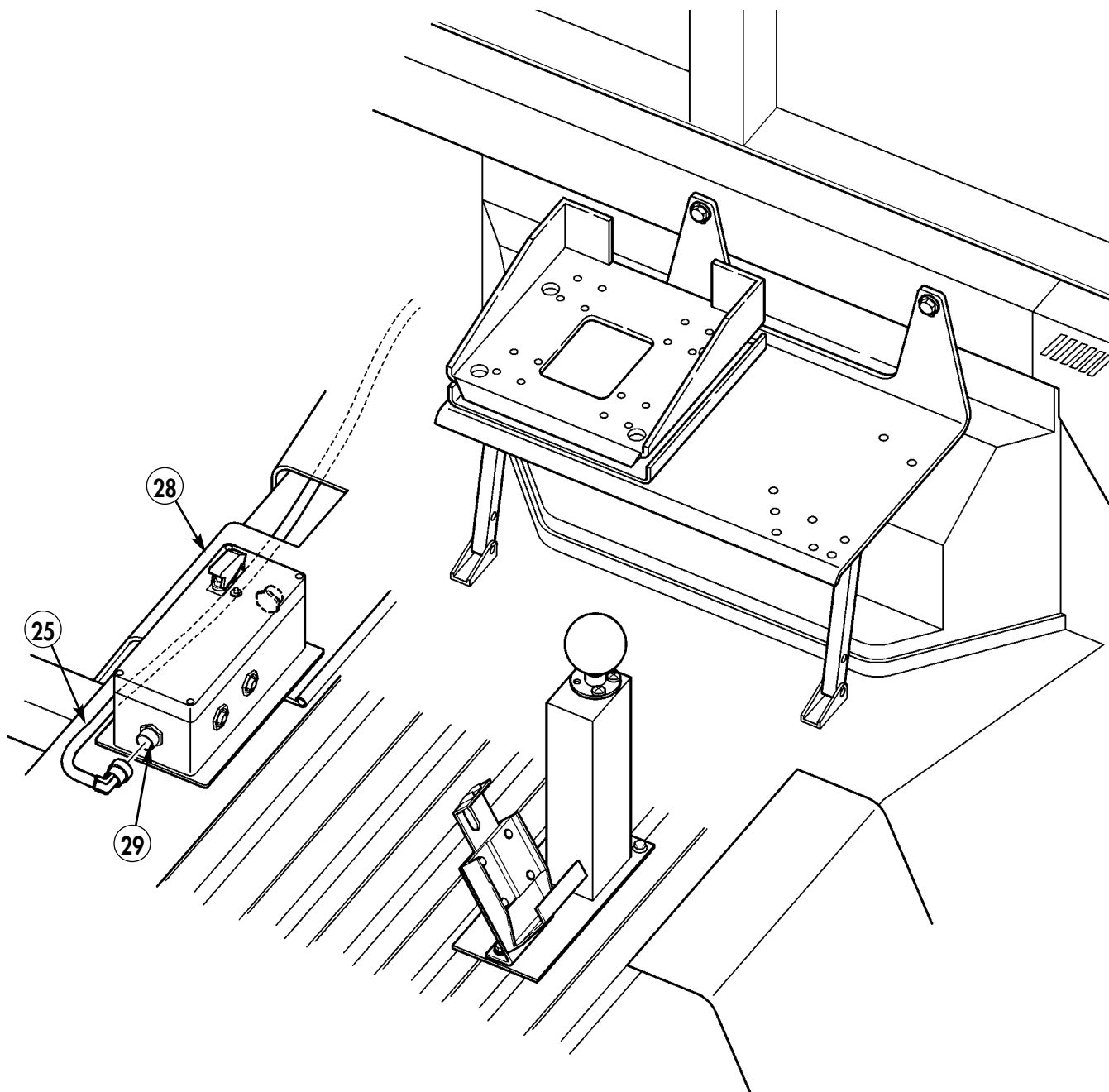


Figure 5-57.

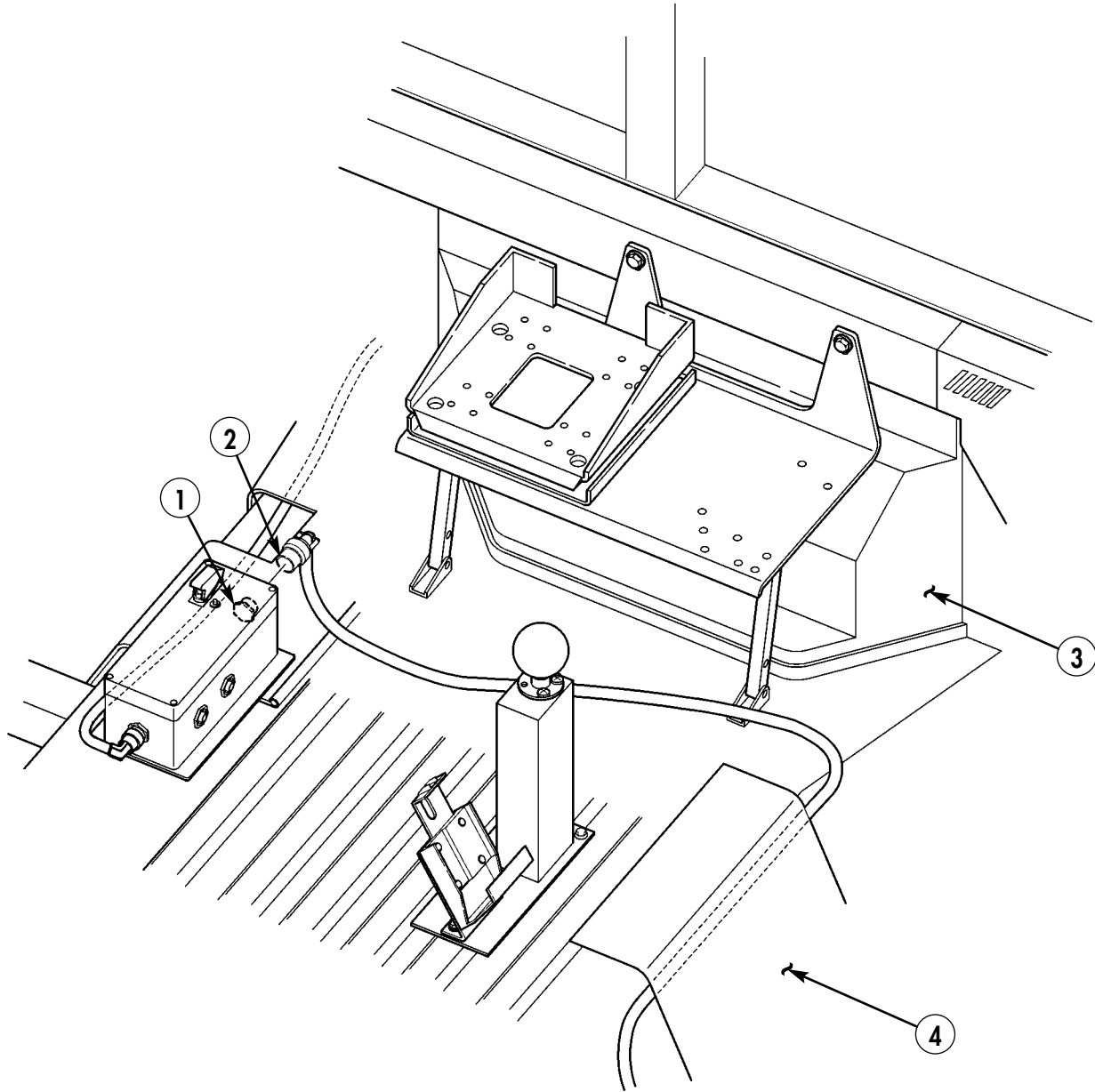
Section XVIII. MTS POWER CABLE INSTALLATION

- 18-1. Connect MTS power cable (2) to MTS control unit J9 connector (1).

NOTE

Loosen right side tunnel insulation before performing step 18-2.
(Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

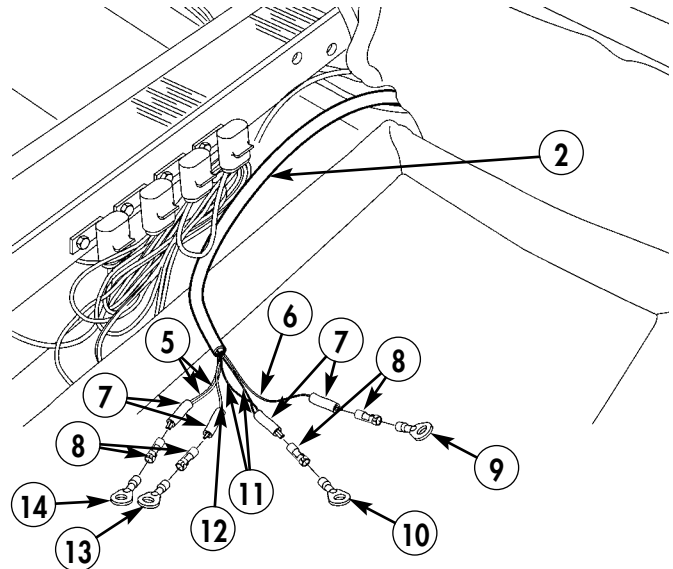
- 18-2. Route MTS power cable (2) under integrated rack (3) and under right side tunnel insulation (4) to B-beam.



2. MTS POWER CABLE – 506B340-01 – QTY. 1

Figure 5-58.

- 18-3. Attach shrink tubing (7), four terminal lugs (9), (10), (13), and (14), and splices (8) to two black leads (11), white lead (6), green lead (12), and two red leads (5) on MTS power cable (2). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24 for terminal connector repair.)



- 7. SHRINK TUBING – MS23053/4-302-0 – QTY. A/R
- 8. SPLICE – NAS1387-4 – QTY. 4
- 9. TERMINAL LUG – MS25036-103 – QTY. 1
- 10. TERMINAL LUG – MS25036-108 – QTY. 1
- 13. TERMINAL LUG – MS25036-150 – QTY. 1
- 14. TERMINAL LUG – MS25036-154 – QTY. 1
- 17. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R

Figure 5-59.

- 18-4. Install negative leads (6) and (11) on outboard ground strap (18) with existing nut (16).
- 18-5. Install positive leads (5) and (12) on outboard 24V terminal board (15) with existing nut (16).
- 18-6. Secure all leads together with tiedown strap (17).
- 18-7. Tighten right side tunnel insulation (4). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 18-8. Coil all excess cable and store under standard rack.

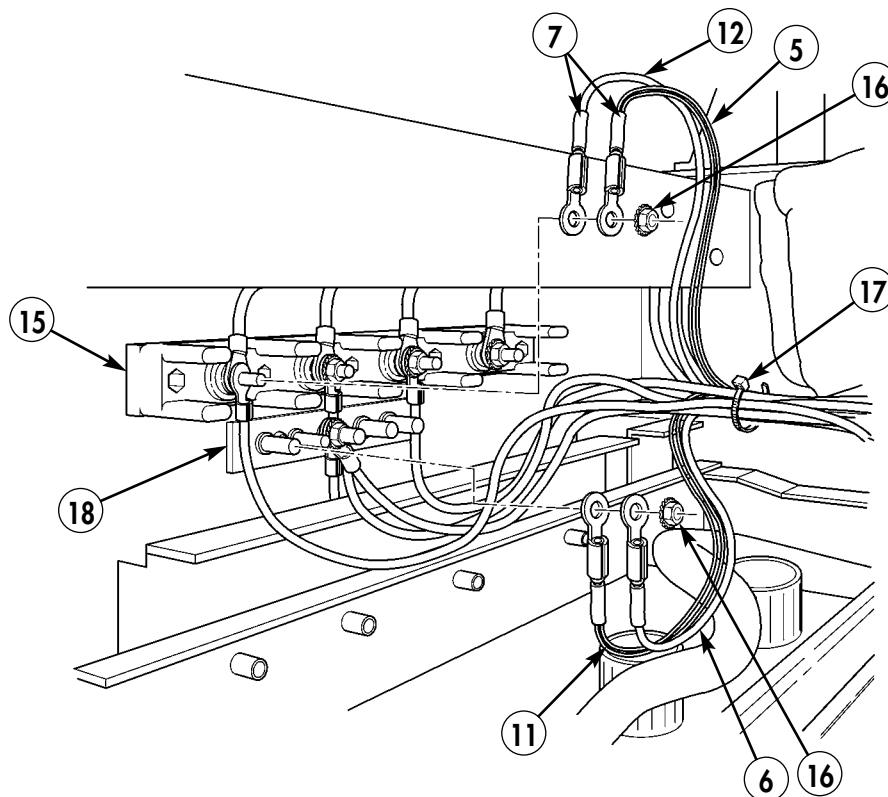
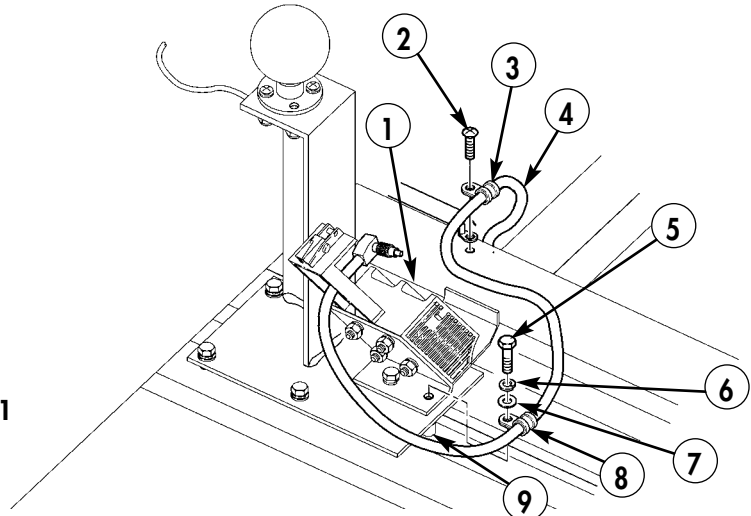


Figure 5-60.

Section XIX. MTS PLGR POWER CABLE INSTALLATION

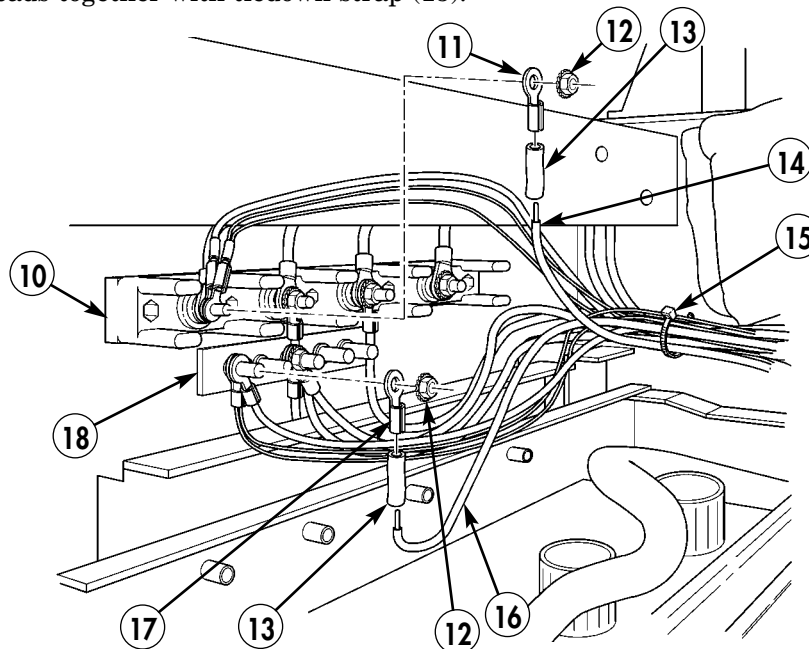
- 19-1. Position PLGR power cable (4) on PLGR bracket assembly (1).
- 19-2. Route PLGR power cable (4) to battery box with loop clamp (8) and existing screw (5), lockwasher (6), washer (7), spacer (9), loop clamp (3), and existing screw (2).



- 3. LOOP CLAMP – MS21333-67 – QTY. 1
- 4. PLGR POWER CABLE – 9728558-10 – QTY. 1
- 8. LOOP CLAMP – MS21333-98 – QTY. 1

Figure 5-61.

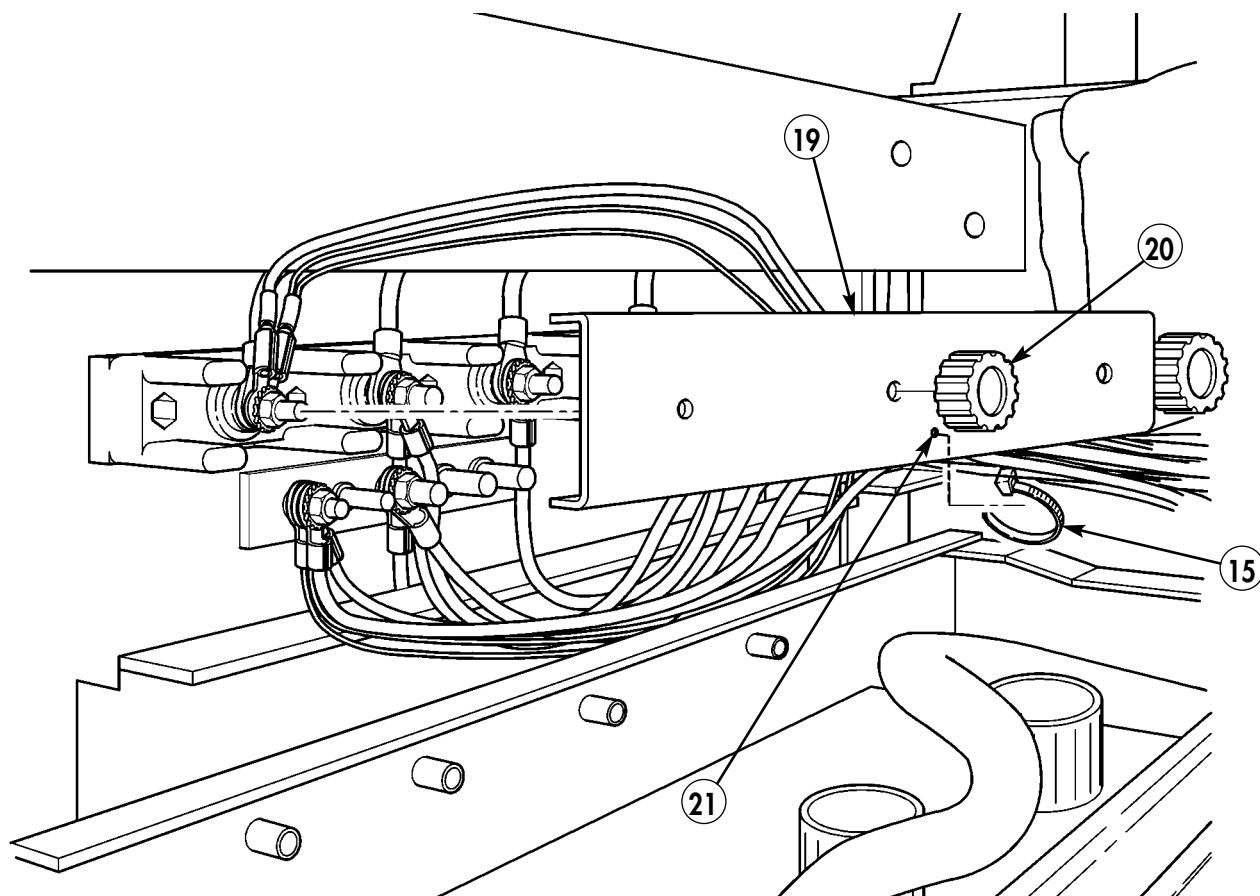
- 19-3. Attach shrink tubing (13) and two terminal lugs (11) and (17) to PLGR power cable negative lead (16) and PLGR power cable positive lead (14). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24 for terminal connector repair.)
- 19-4. Attach PLGR power cable positive lead (14) to 24V terminal board (10) with existing nut (12).
- 19-5. Attach PLGR power cable negative lead (16) to ground strap (18) with existing nut (12).
- 19-6. Secure all leads together with tiedown strap (15).



- 11. TERMINAL LUG – 7728780 – QTY. 1
- 13. SHRINK TUBING – MS23053/4-302-0 – QTY. A/R
- 15. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R
- 17. TERMINAL LUG – 7728777 – QTY. 1

Figure 5-62.

- 19-7.** Locate, mark, and drill 0.25-in. diameter hole (21) in terminal board cover (19).
19-8. Insert tiedown strap (15) in hole (21).
19-9. Install 24V terminal board cover (19) with three existing nuts (20) and tiedown strap (15).

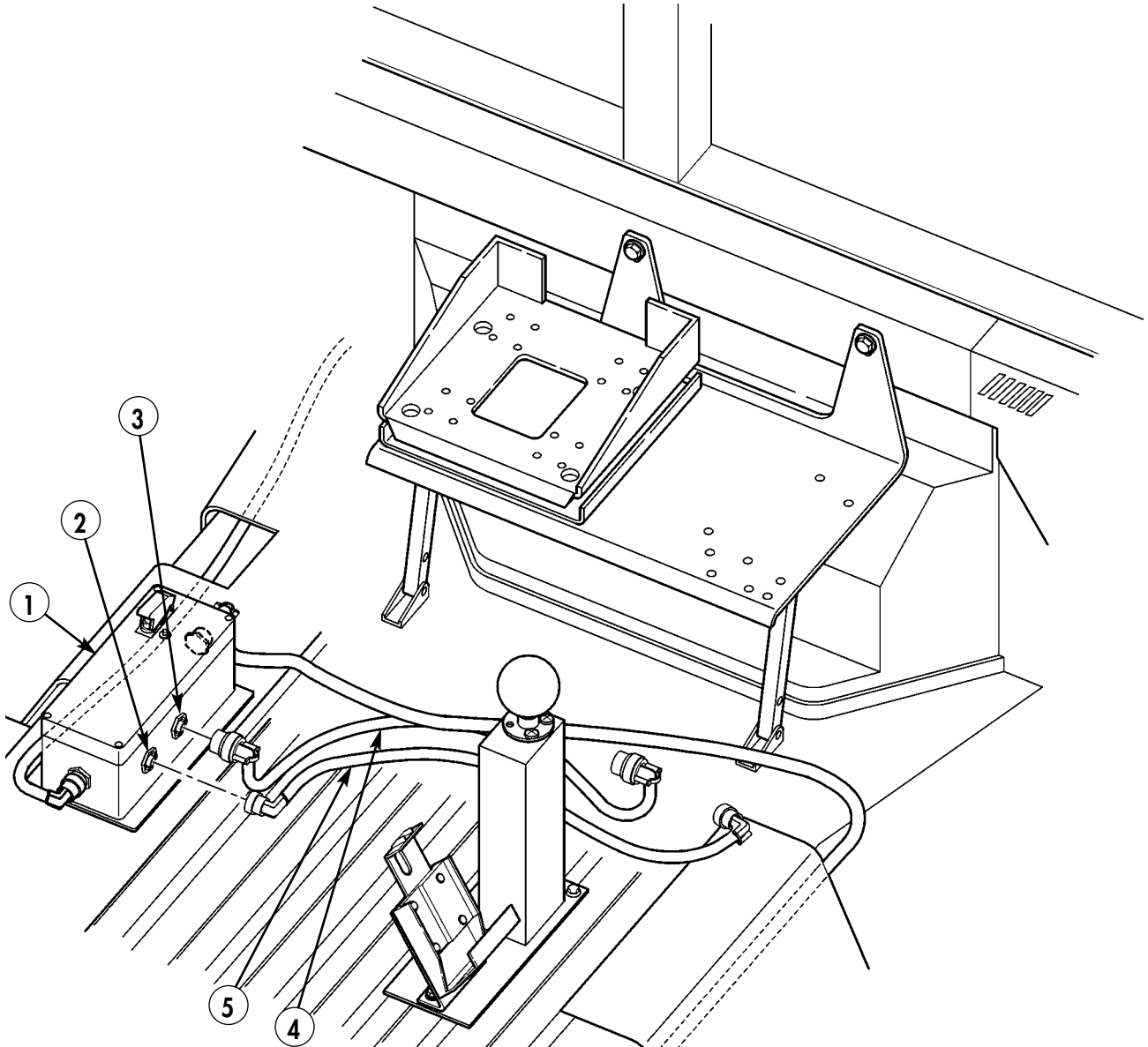


- 15. TIEDOWN STRAP – MS3367-1-0 – QTY. A/R**
19. TERMINAL BOARD COVER – 12480569-2 – QTY. 1

Figure 5-63.

Section XX. MTS DISPLAY CABLES INSTALLATION

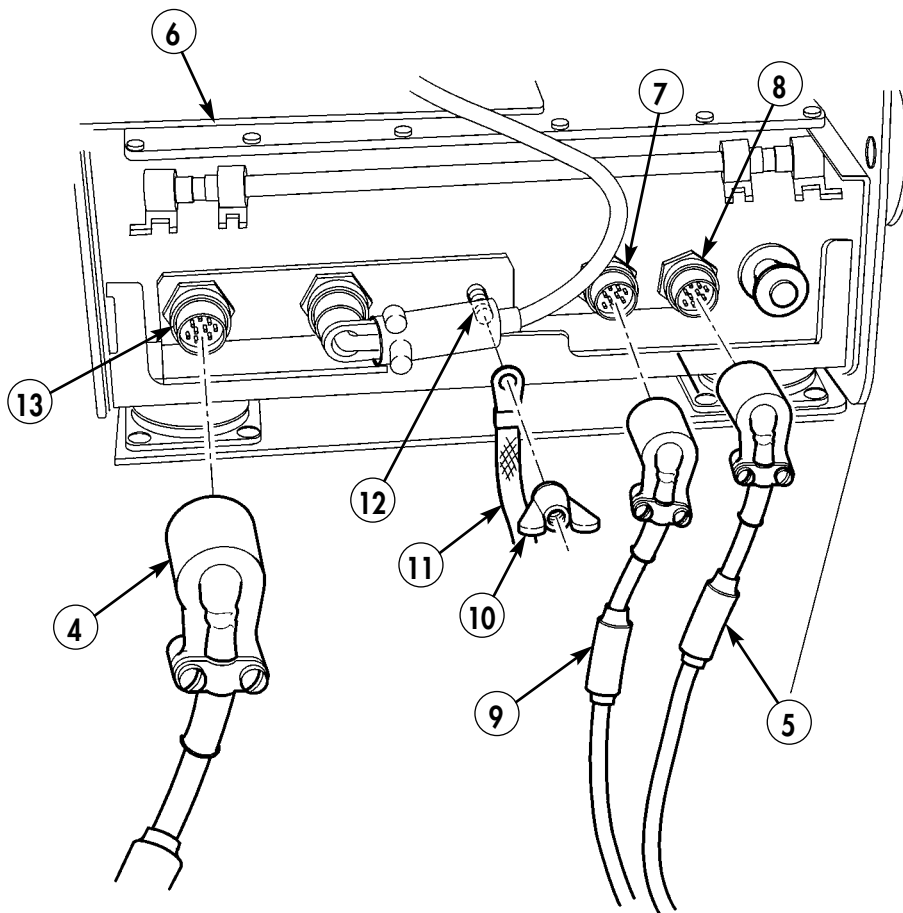
- 20-1. Connect MTS display power cable (4) to J8 connector (3) on MTS control box (1).
- 20-2. Connect MTS data cable (5) to J7 connector (2) on control box (1).



- 4. MTS DISPLAY POWER CABLE – 506B407-04 – QTY. 1
- 5. MTS DATA CABLE – 506B408-04 – QTY. 1

Figure 5-64.

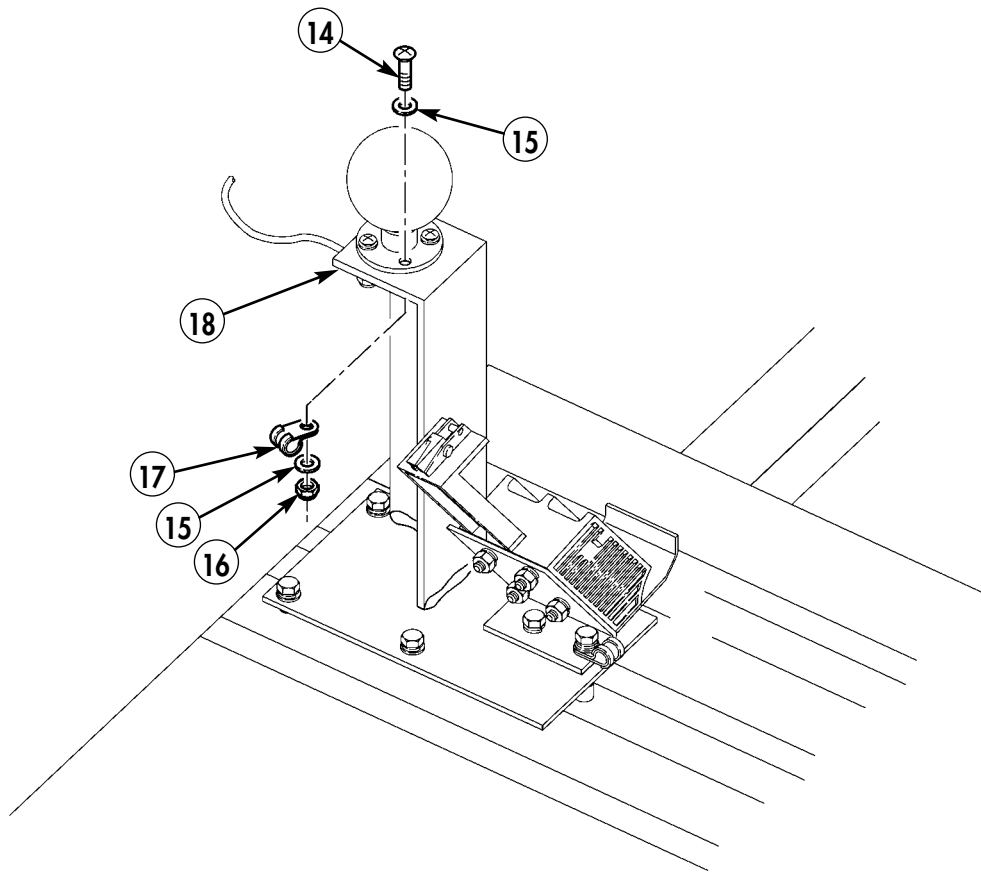
- 20-3. Connect MTS display power cable (4) to power connector (13) on display unit (6).
- 20-4. Connect MTS data cable (5) to connector COM 2 (8) on display unit (6).
- 20-5. Connect PLGR data cable (9) to connector COM 1 (7) on display unit (6).
- 20-6. Install ground strap (11) on display unit stud (12) with wingnut (10).



- 9. PLGR DATA CABLE – 506B409-04 – QTY. 1
- 10. WINGNUT – MS51553-102 – QTY. 1

Figure 5-65.

20-7. Coil excess cable and attach to MTS mount (18) with loop clamp (17), washer (15), capscrew (14), washer (15), and locknut (16).



- 14. CAPSCREW – B1821BH025C113N – QTY. 1
- 15. WASHER – 2436161 – QTY. 2
- 16. LOCKNUT – MS51943-31 – QTY. 1
- 17. LOOP CLAMP – MS21333-107 – QTY. 1

Figure 5-66.

Section XXI. PLGR ANTENNA AND CABLE INSTALLATION WITH MTS

NOTE

- Perform this procedure only when installing additional PLGR antenna when MTS is installed.
- Drilled holes on inside and outside of windshield frame should be in alignment with each other to allow routing of PLGR cable through windshield frame.
- Relocate all caution labels as necessary.

21-1. Using PLGR antenna mount bracket as template, locate, mark, and drill two 0.50-in. holes (3) in outer windshield frame (1).

21-2. Locate, mark, and drill 0.375-in. diameter hole (2) in outer windshield frame (1).

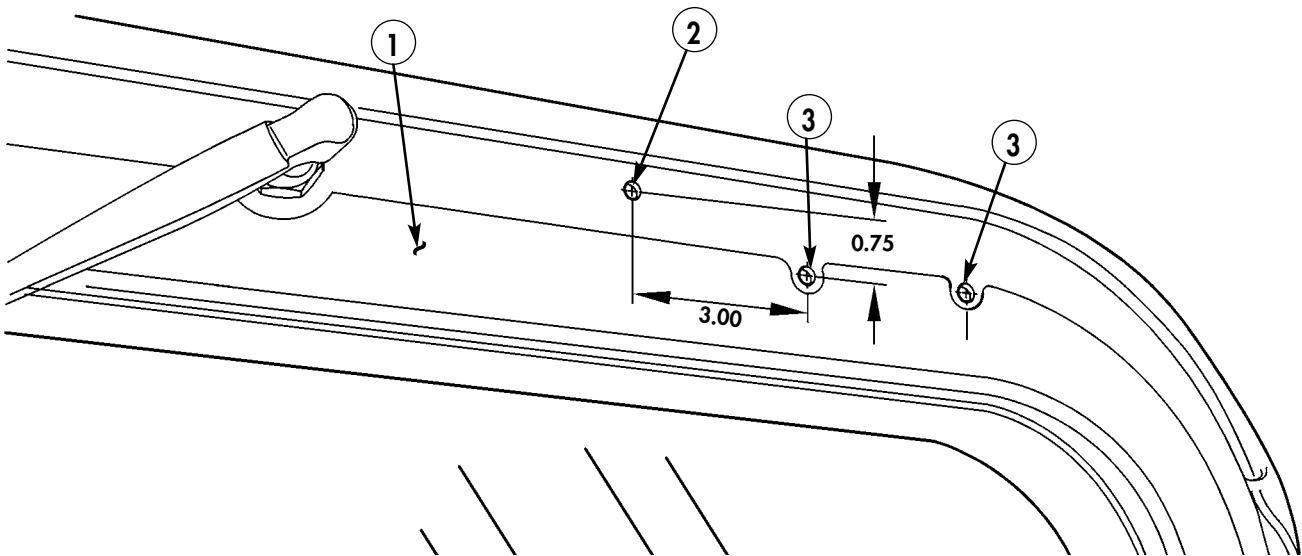


Figure 5-67.

21-3. Locate, mark, and drill 0.375-in. diameter hole (4) in left side inner windshield frame (5).

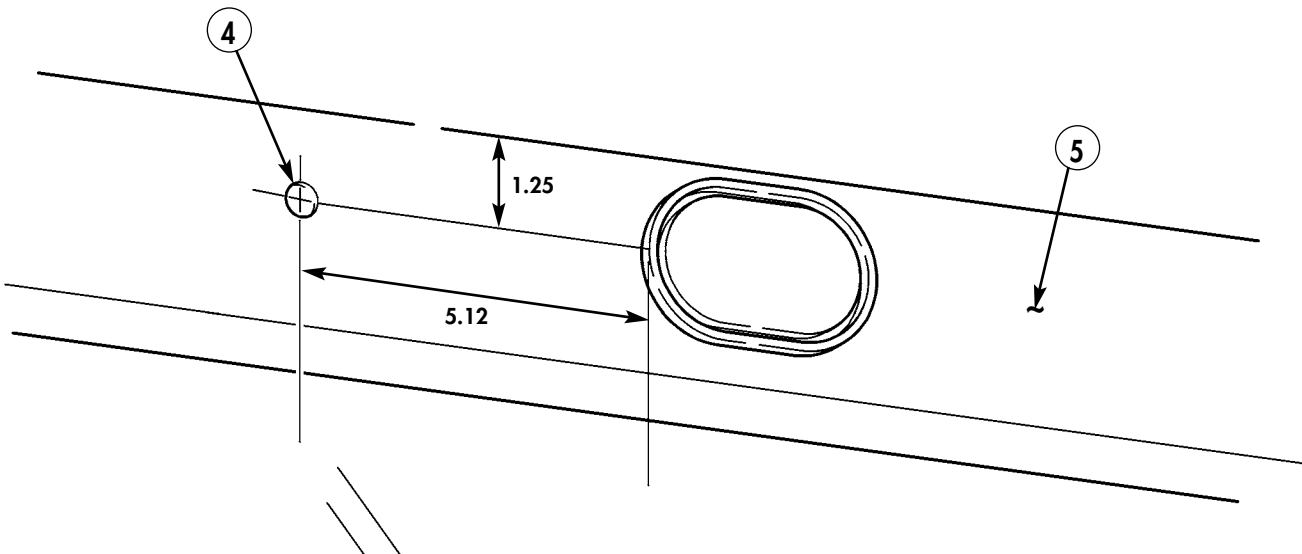
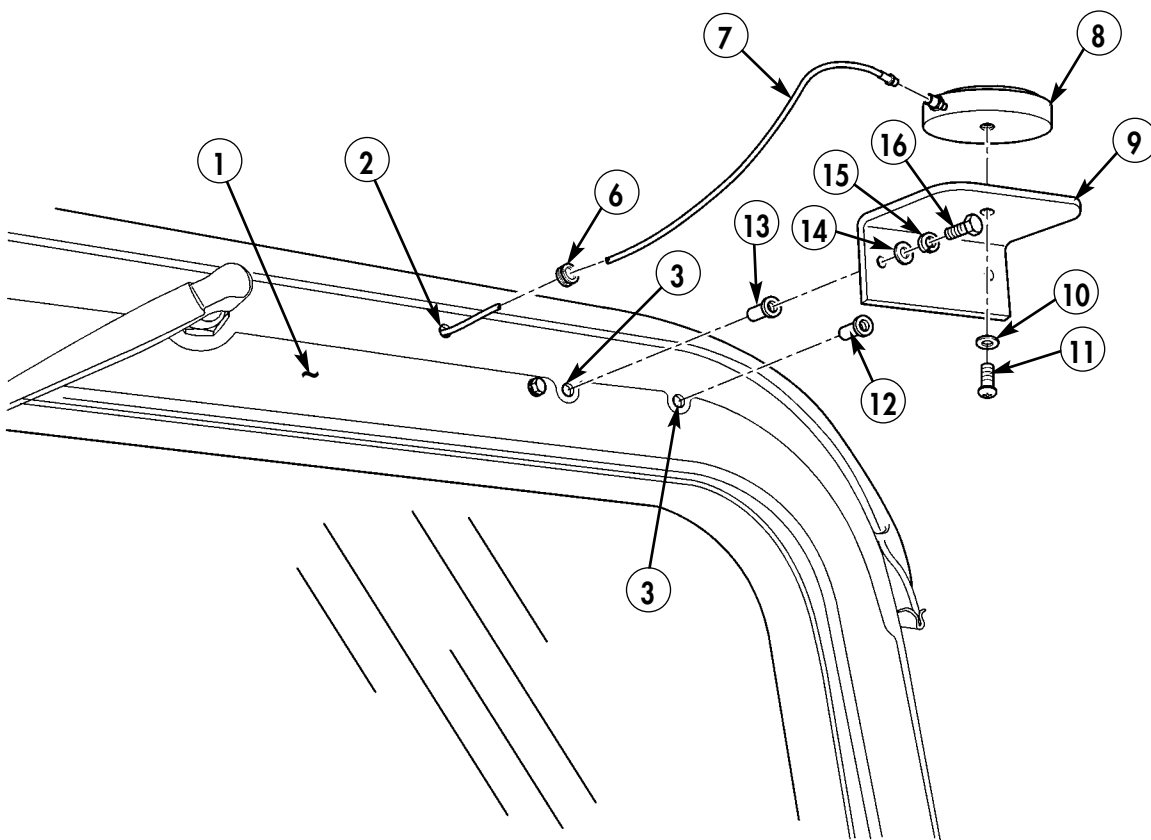


Figure 5-68.

- 21-4. Pull PLGR antenna cable (7) through hole (2) in left side outer windshield frame (1). Split one side of grommet (6), place grommet (6) on cable (7), and insert grommet (6) in hole (2) in left side outer windshield frame (1).
- 21-5. Install wellnuts (12) and (13) in holes (3).
- 21-6. Install PLGR antenna mount bracket (9) on left side outer windshield frame (1) with two lockwashers (15), washers (14), and capscrews (16).
- 21-7. Install PLGR antenna (8) on PLGR antenna mount bracket (9) with washer (10) and screw (11).
- 21-8. Pull PLGR antenna cable (7) through hole (2) in left side outer windshield frame (1) and grommet (6).
- 21-9. Install PLGR antenna cable (7) on PLGR antenna (8).



- 6. GROMMET - MS35489-143 - QTY. 1
- 7. PLGR ANTENNA CABLE - 426-0141-050 - QTY. 1
- 8. PLGR ANTENNA - AT575-030 - QTY. 1
- 9. PLGR ANTENNA MOUNT BRACKET - 12480578 - QTY. 1
- 10. WASHER - 9417373 - QTY. 1
- 11. SCREW - 160035 - QTY. 1
- 12. WELLNUT - 12339397-3 - QTY. 1
- 13. WELLNUT - 12339397-6 - QTY. 1
- 14. WASHER - 9414920 - QTY. 2
- 15. LOCKWASHER - MS35338-44 - QTY. 2
- 16. CAPSCREW - B1821BH025C125N - QTY. 2

Figure 5-69.

NOTE

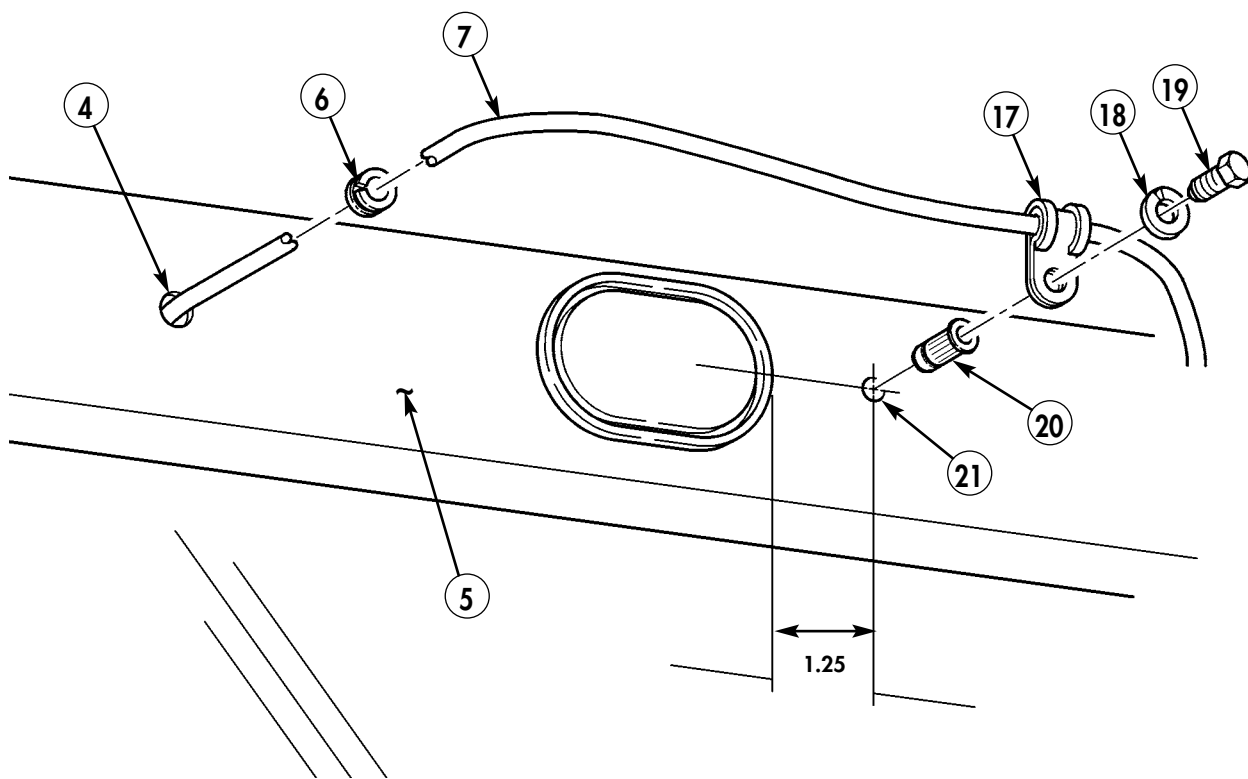
Perform steps 21-10 and 21-11 for vehicles without sun visor kit installed.

- 21-10.** Locate, mark, and drill 0.390-in. hole (21) in left side windshield frame (5). Install insert (20) in hole (21).
- 21-11.** Route cable (7) along left side windshield frame (5) and secure with loop clamp (17), capscrew (19), and lockwasher (18).

NOTE

- Perform step 21-12 for vehicles with sun visor kit installed.
- Antenna cable is secured with topmost sun visor bracket screw.

- 21-12.** Route cable (7) along left side windshield frame (5) and secure with loop clamp (17), existing capscrew (19), and lockwasher (18).



6. GROMMET - MS35489-143 - QTY. 1
 17. LOOP CLAMP - MS21333-96 - QTY. 1
 18. LOCKWASHER - MS35338-44 - QTY. 1
 19. CAPSCREW - B1821BH025C100N - QTY. 1
 20. INSERT - 12446871-2 - QTY. 1

Figure 5-70.

NOTE

Perform steps 21-13 and 21-14 for AN/VRC-88F, 89F, 90F, or 91F only.

- 21-13.** Route cable (7) down along windshield center post (26) and on top of dash (25), and secure with existing loop clamps (24), screws (22), and washer (23).

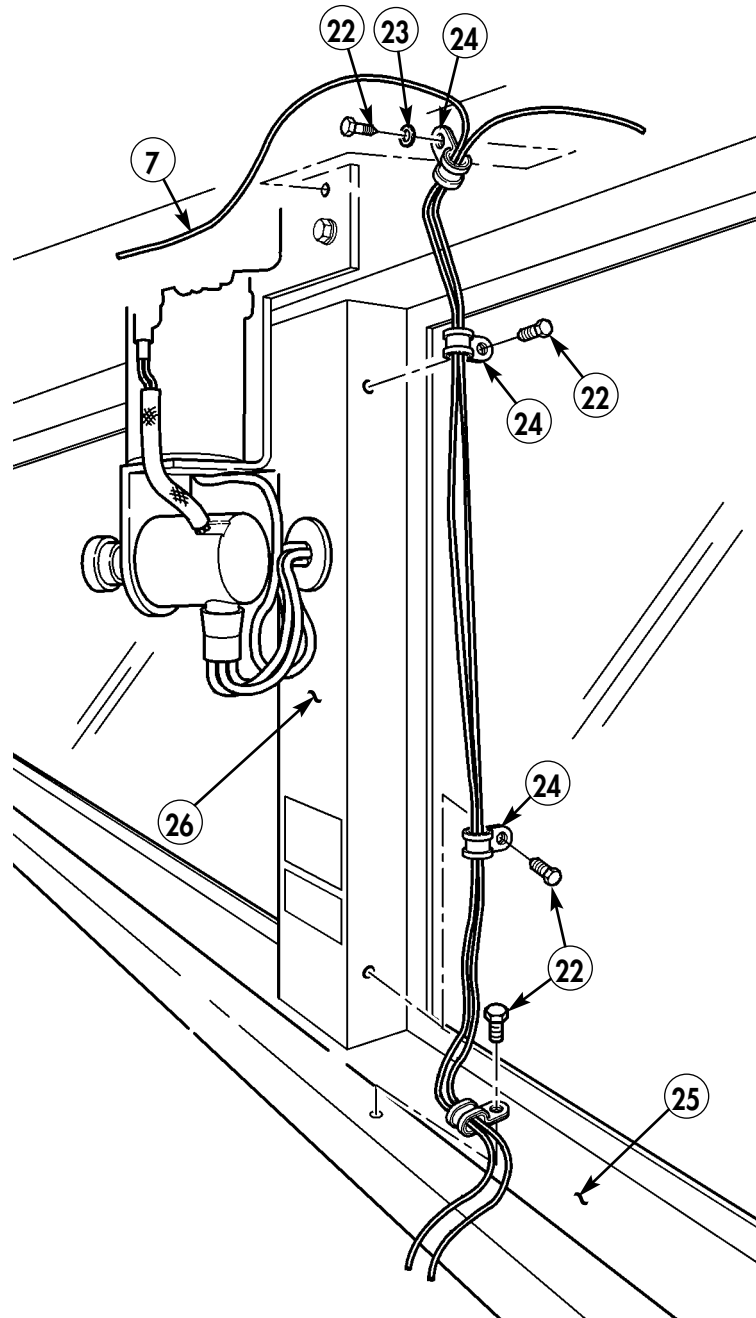


Figure 5-71.

NOTE

Before performing step 21-14, loosen standard rack top mounting bolts to allow cable underneath rack. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

- 21-14.** Route cable (7) from dash (25) under standard rack (27).

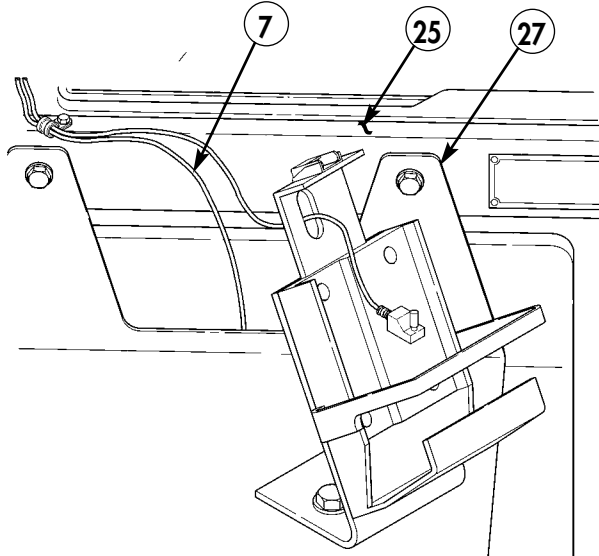


Figure 5-72.

NOTE

Perform steps 21-15 and 21-16 for AN/VRC-92F only.

- 21-15.** Route cable (7) down along windshield center post (26) and on top of dash (25), and secure with existing loop clamps (24), screws (22), and washer (23).

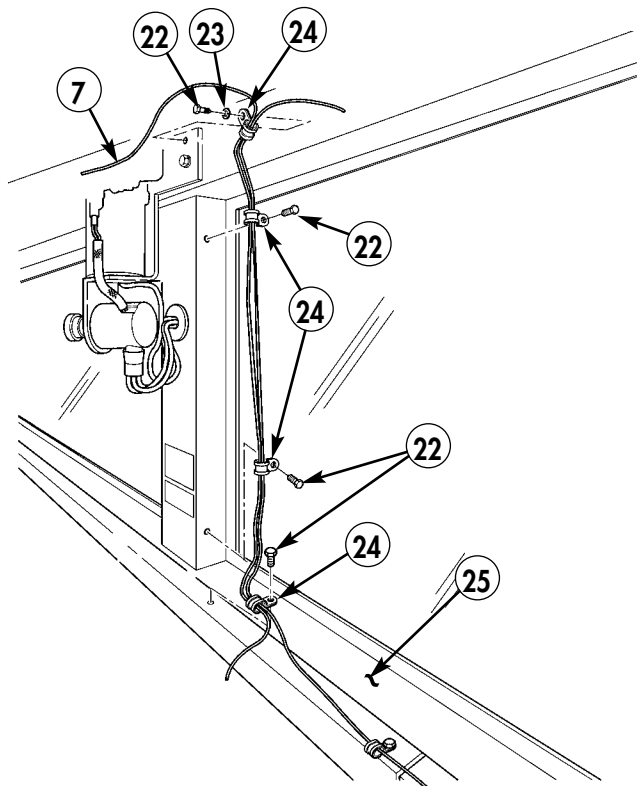


Figure 5-73.

NOTE

Before performing step 21-16, loosen standard rack top mounting bolts to allow cable underneath rack. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

- 21-16. Route cable (7) from dash (25) under standard rack (27).

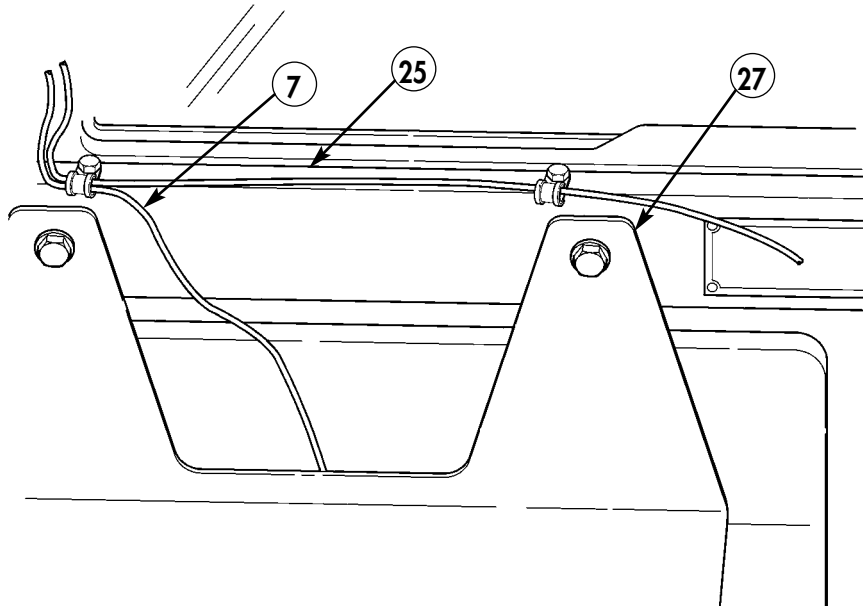


Figure 5-74.

NOTE

Before performing step 21-17, tighten top mounting bolts on standard rack, if necessary. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)

- 21-17. Route cable (7) from underneath standard rack (27) rearward along tunnel floor (29) and place on PLGR bracket assembly (28).
- 21-18. Coil excess cable (7) and store under standard rack (27), using tiedown strap as necessary.

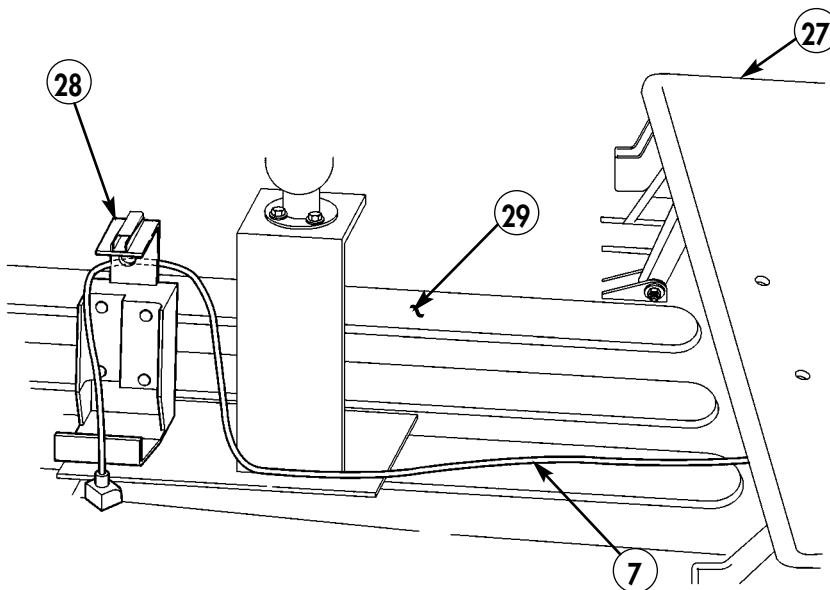


Figure 5-75.

Section XXII. DVE HOOD CABLE GUIDE INSTALLATION

NOTE

- Cover engine compartment prior to performing DVE installation to keep metal and fiberglass filings out of engine compartment.
- Once DVE installation is complete, Pan and Tilt Module (PTM) mount may require adjustment to obtain optimum DVE elevation-viewing angle. This adjustment is made by adding or removing washers from PTM mounting bolt between HMMWV windshields.

- 22-1.** Remove six bolts (3), twelve washers (4), six nuts (7), and two hood brackets (6) from hood (1).
22-2. Remove bracket (9) from top side of hood (1).
22-3. Drill out five rivets (8) from hood (1), rubber hood seal (5), and retaining strip (2).
22-4. Remove retaining strip (2) from hood (1).
22-5. Cut retaining strip (2). Discard cut portion of retaining strip (2).
22-6. Cut rubber hood seal (5). Discard cut portion of rubber hood seal (5).

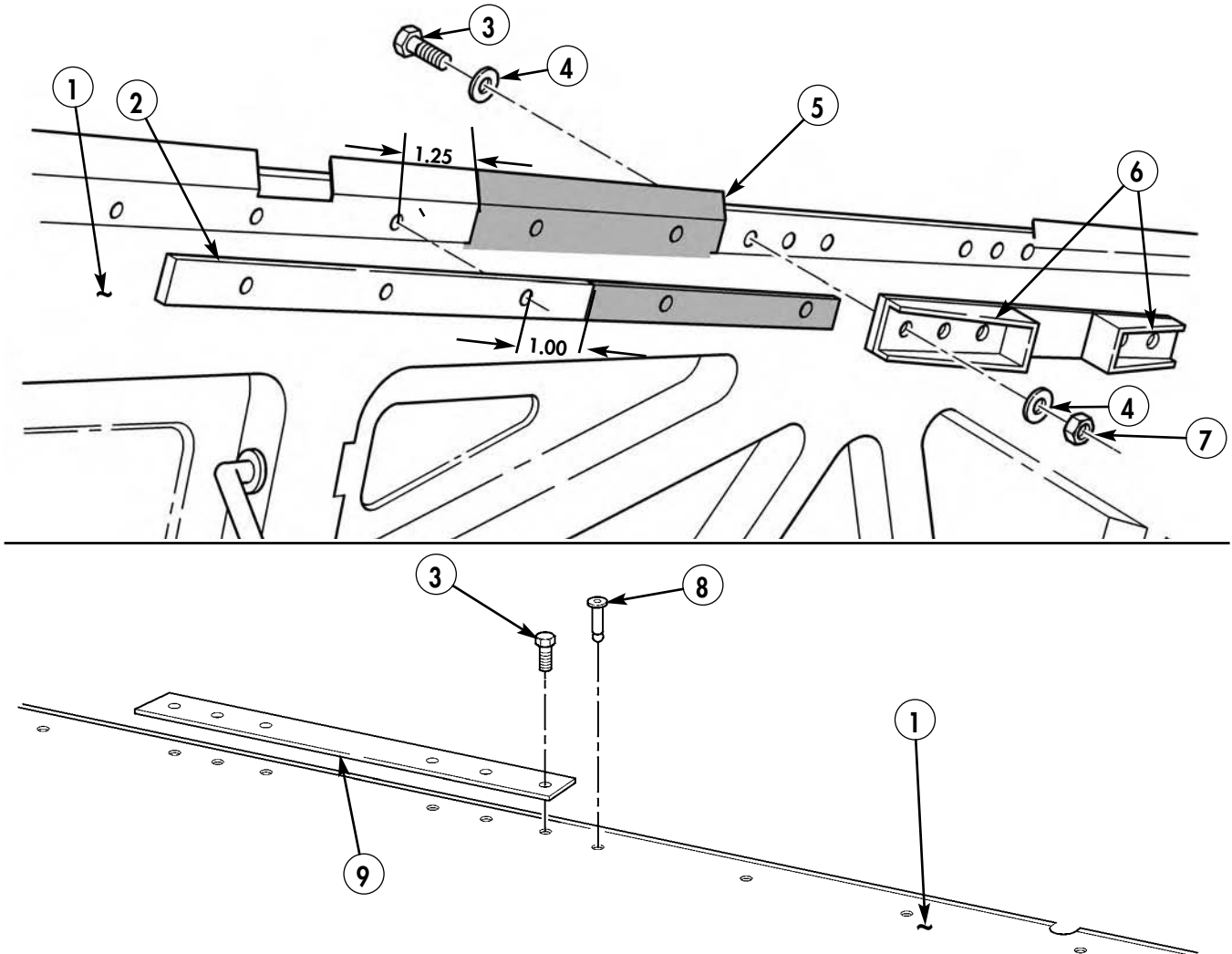


Figure 5-76.

CAUTION

- Use caution to avoid cutting notch in hood too large. If cutout notch is too large, the hood cable guide cannot be correctly installed.
- Remove and retain plug for reinstallation if cutting of hood will damage plug.

NOTE

Use scrap pieces of 2x4 boards to prop open hood.

- 22-7. Locate, mark, and cut area (10) on hood (1).
- 22-8. Reinstall two hood brackets (6), and bracket (9) on top side of hood (1) with six bolts (3), twelve washers (4), and six nuts (7).
- 22-9. Reinstall retaining strip (2) with three rivets (8).

NOTE

File hood and hood cable guide as required to ensure a snug fit.

- 22-10. Ensure hood cable guide (11) fits securely in cutout area (10). Remove cable guide (11).

NOTE

Heat lamp or heat gun may be used to speed curing time for adhesive.

- 22-11. Apply thin coat of adhesive to hood cable guide (11) and matching area on hood (1), and install cable guide (11) on hood (1).

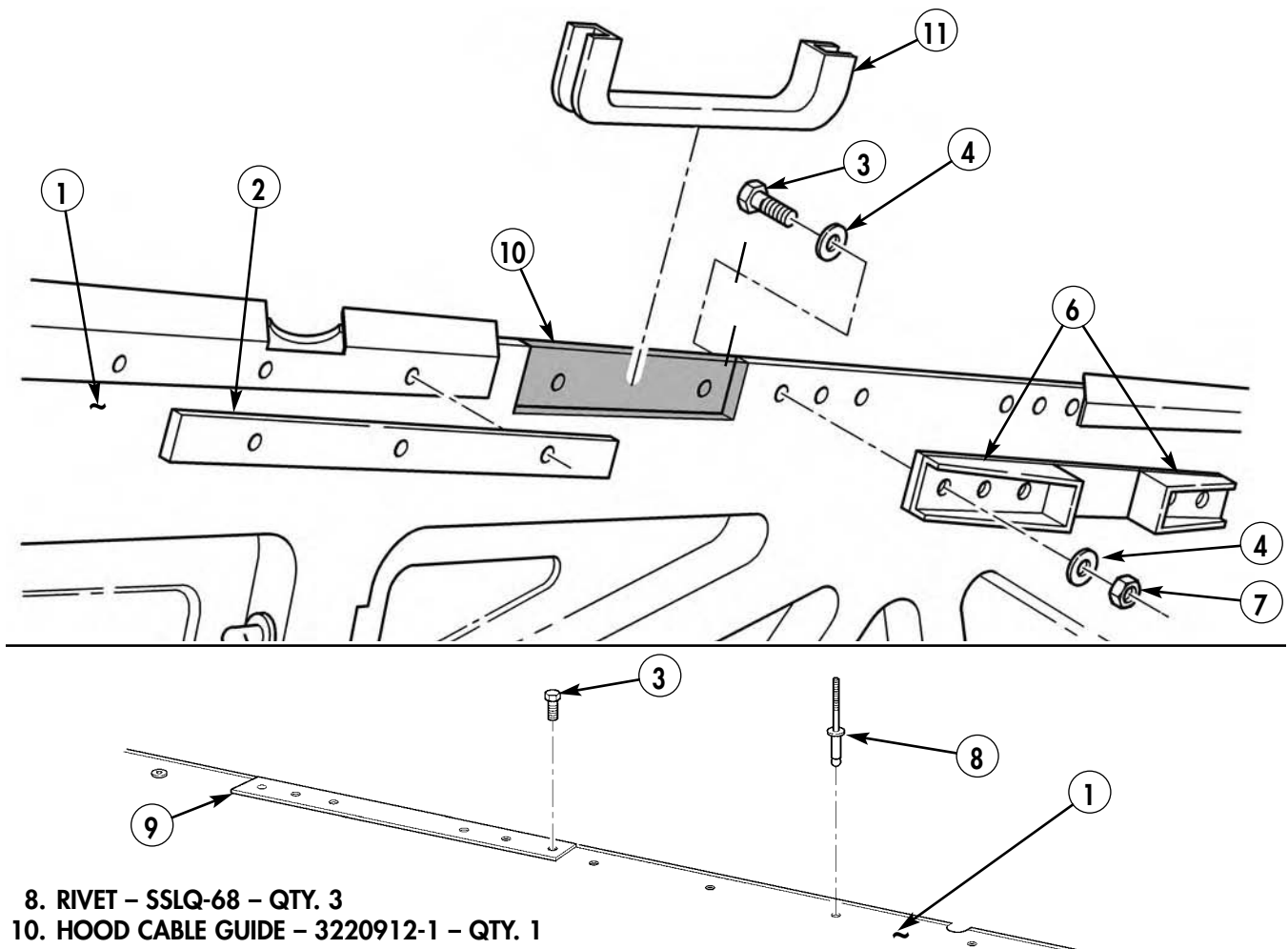
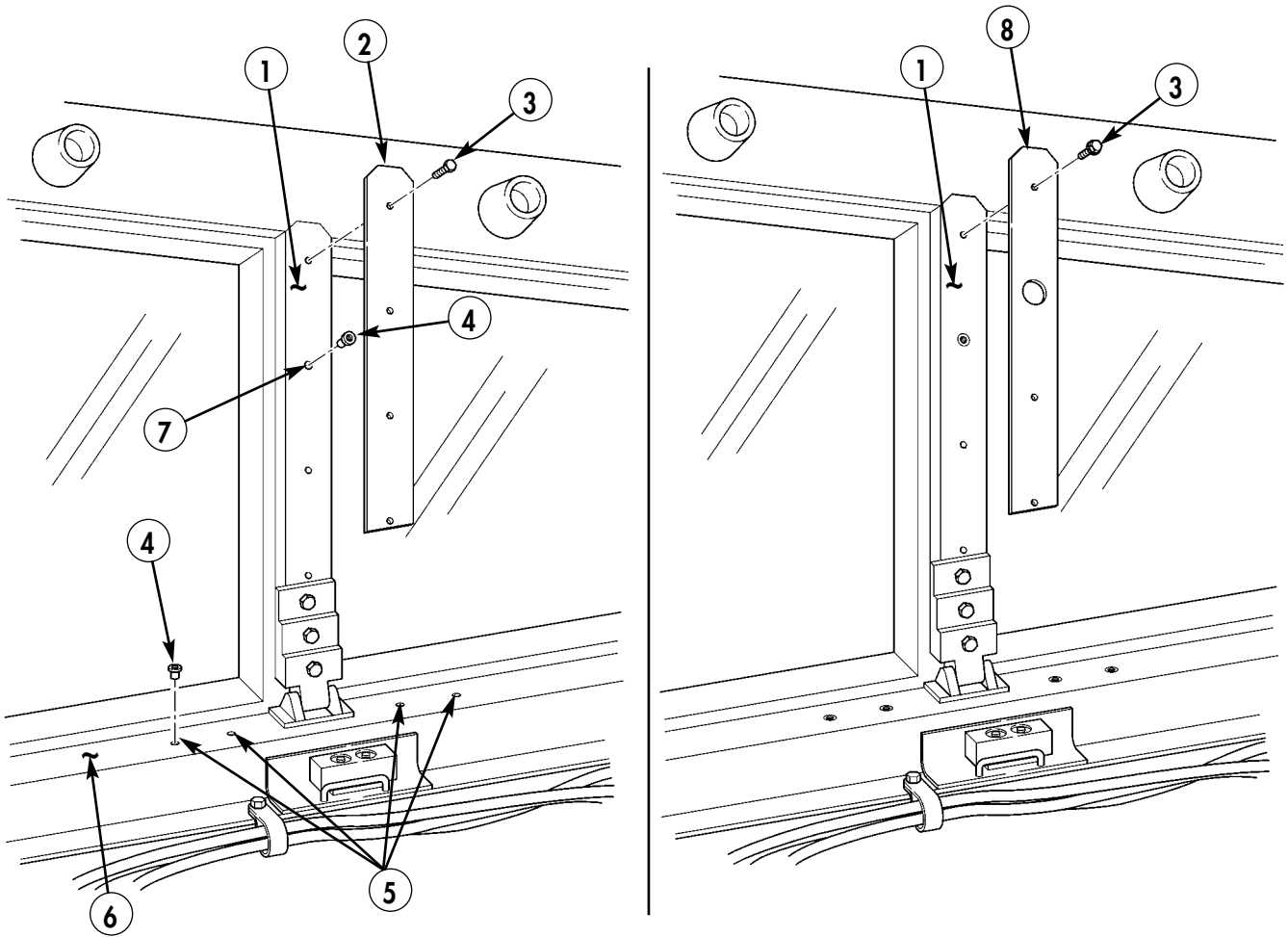


Figure 5-77.

Section XXIII. DVE PAN AND TILT MODULE (PTM) MOUNT ASSEMBLY PREPARATION AND PILLAR MOUNT INSTALLATION

- 23-1.** Remove four existing screws (3) and existing center windshield retainer (2) from center windshield frame (1). Retain three screws (3).
- 23-2.** Using PTM mount assembly as template, locate, mark, and drill four 0.391-in. holes (5) on A-frame pillar flange (6).
- 23-3.** Enlarge hole (7) to 0.391-in. on center windshield frame (1).
- 23-4.** Install one rivet nut (4) on center windshield frame (1) and four rivet nuts (4) on A-frame pillar flange (6).
- 23-5.** Install PTM A-pillar mount (8) on center windshield frame (1) with three existing screws (3).



- 4. RIVET NUT - 3221003-14 - QTY. 5**
- 8. PTM A-PILLAR MOUNT- 3221002-1 - QTY. 1**

Figure 5-78.

Section XXIV. DVE A-FRAME CABLE GUIDE AND PAN AND TILT MODULE (PTM) MOUNT ASSEMBLY INSTALLATION

- 24-1. Remove two screws (2), nuts (4), and clamps (1) from A-frame pillar flange (5). Retain hardware.
- 24-2. Locate and mark cutout area (3) on A-frame pillar flange (5).
- 24-3. Cut out area (3) of A-frame pillar flange (5). Use fine mill file or crocus cloth to remove all burrs and sharp edges.

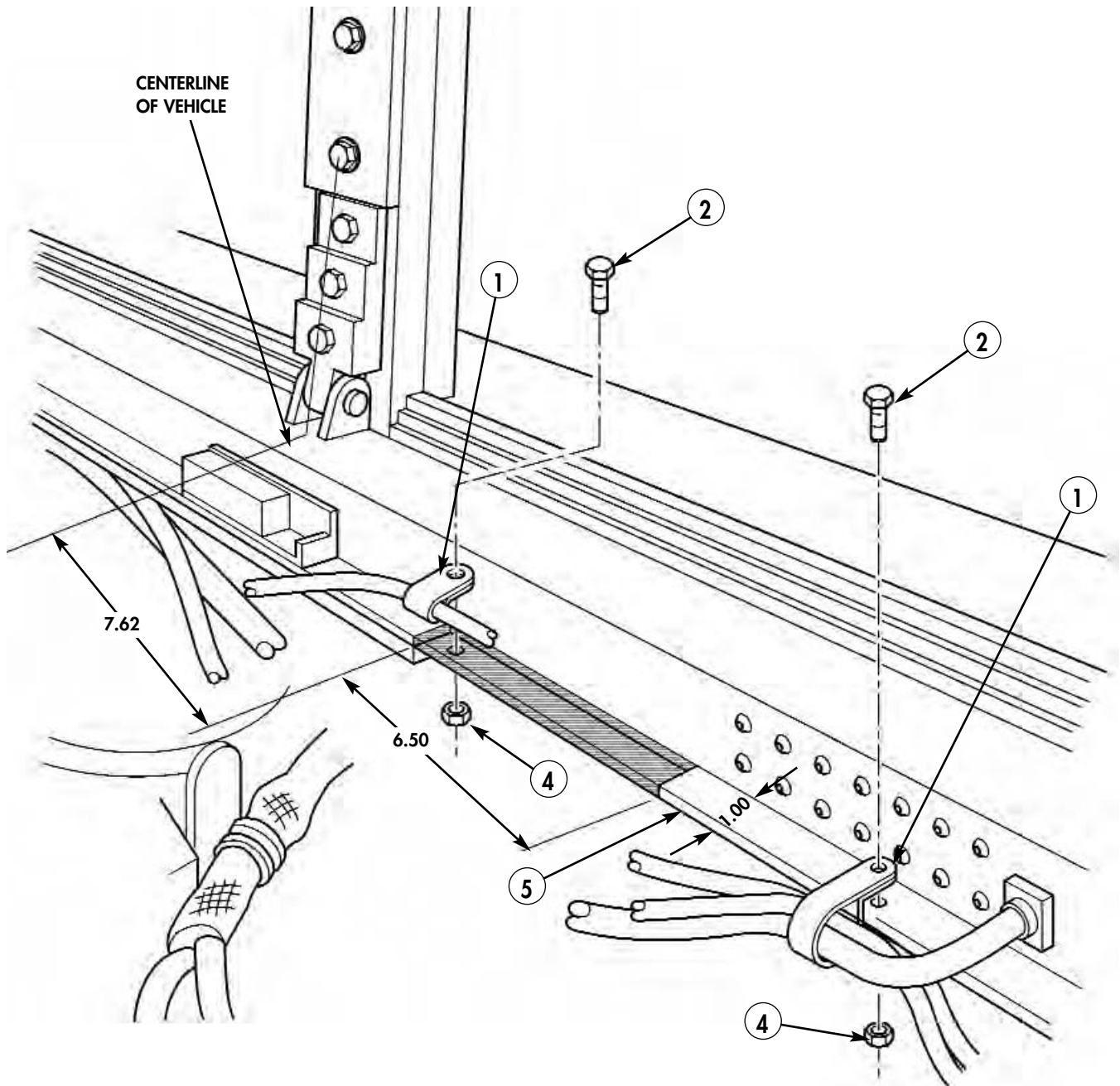


Figure 5-79.

- 24-4. Using A-frame cable guide (13) as template, mark four mounting hole locations (11), (8), and (6).
- 24-5. Drill two 0.391-in. holes (8) on vertical wall (7).
- 24-6. Drill two 0.277-in. holes (6) and (11) on A-frame pillar flange (5).
- 24-7. Install two rivet nuts (12) on vertical wall (7).
- 24-8. Apply thin coat of adhesive to A-frame cable guide (13) and matching areas on A-frame pillar flange (5) and vertical wall (7).
- 24-9. Install A-frame cable guide (13) on A-frame pillar flange (5) and vertical wall (7) with four capscrews (9), six washers (10), and two locknuts (14).
- 24-10. Locate, mark, and drill 0.221-in. hole (15) on center of A-frame pillar flange (5).
- 24-11. Reinstall two cable clamps (1) on A-frame pillar flange (5) with existing screws (2) and nuts (4).

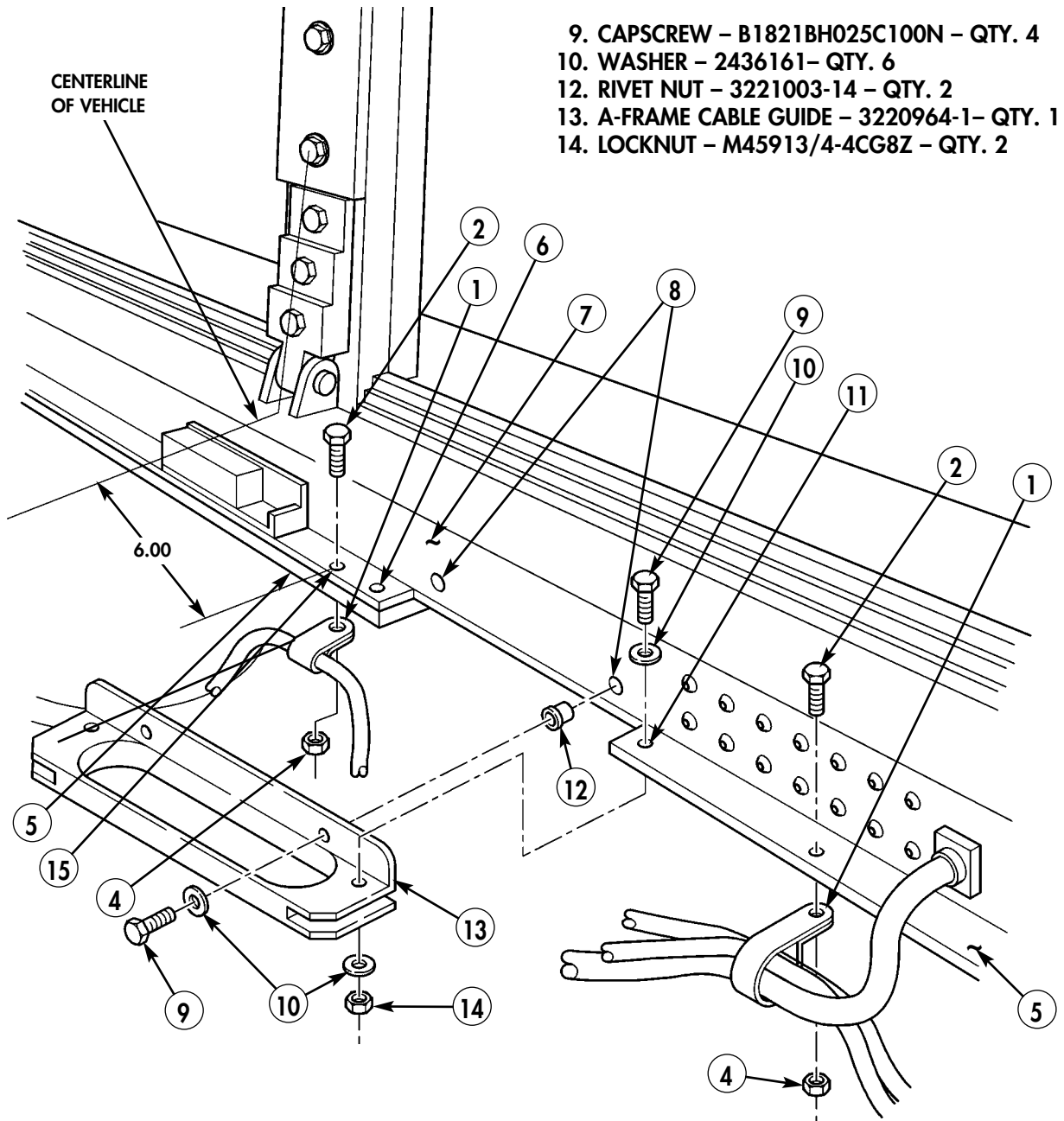
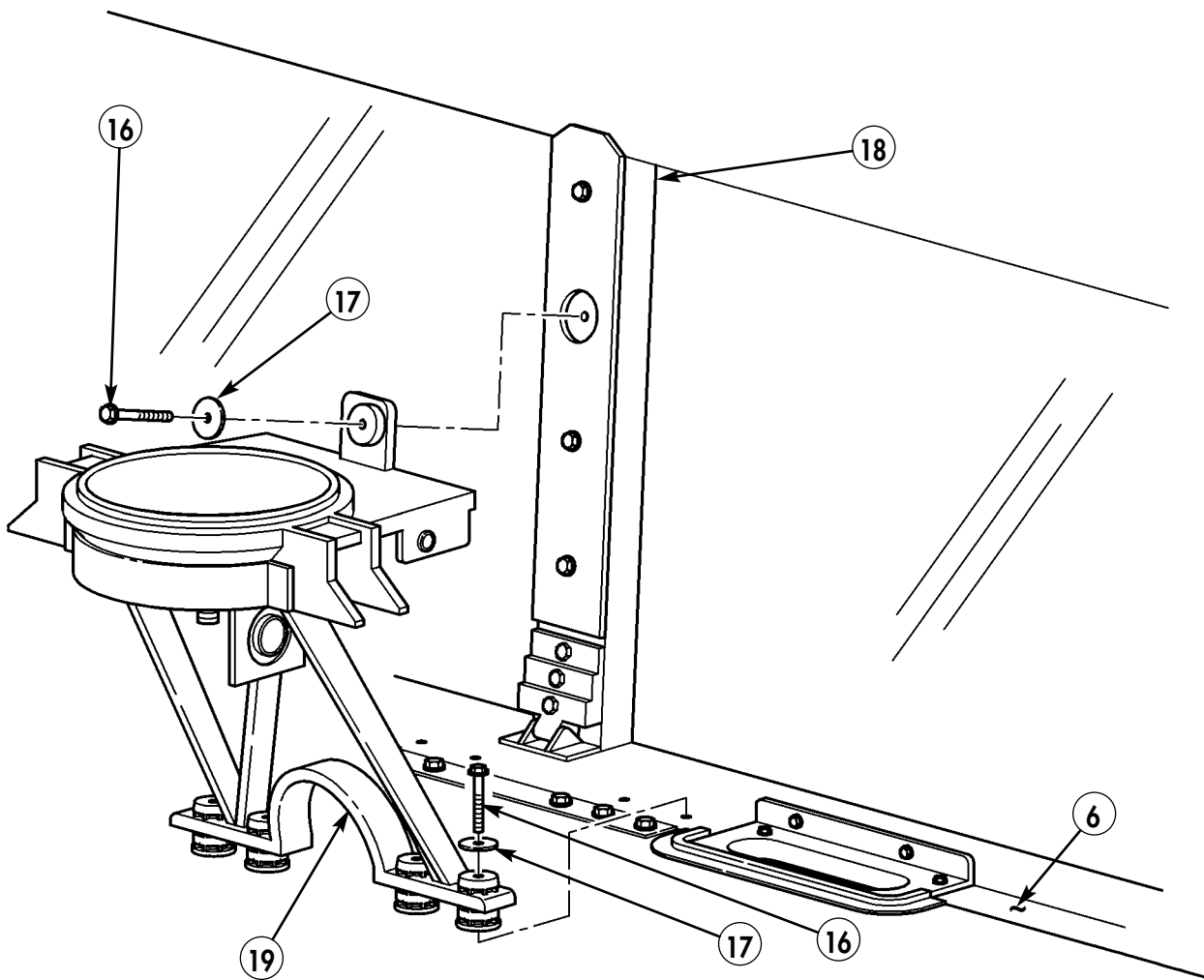


Figure 5-80.

24-12. Install PTM mount assembly (19) on A-frame pillar flange (6) with four capscrews (16) and washers (17), and on center windshield frame (18) with capscrew (16) and washer (17).

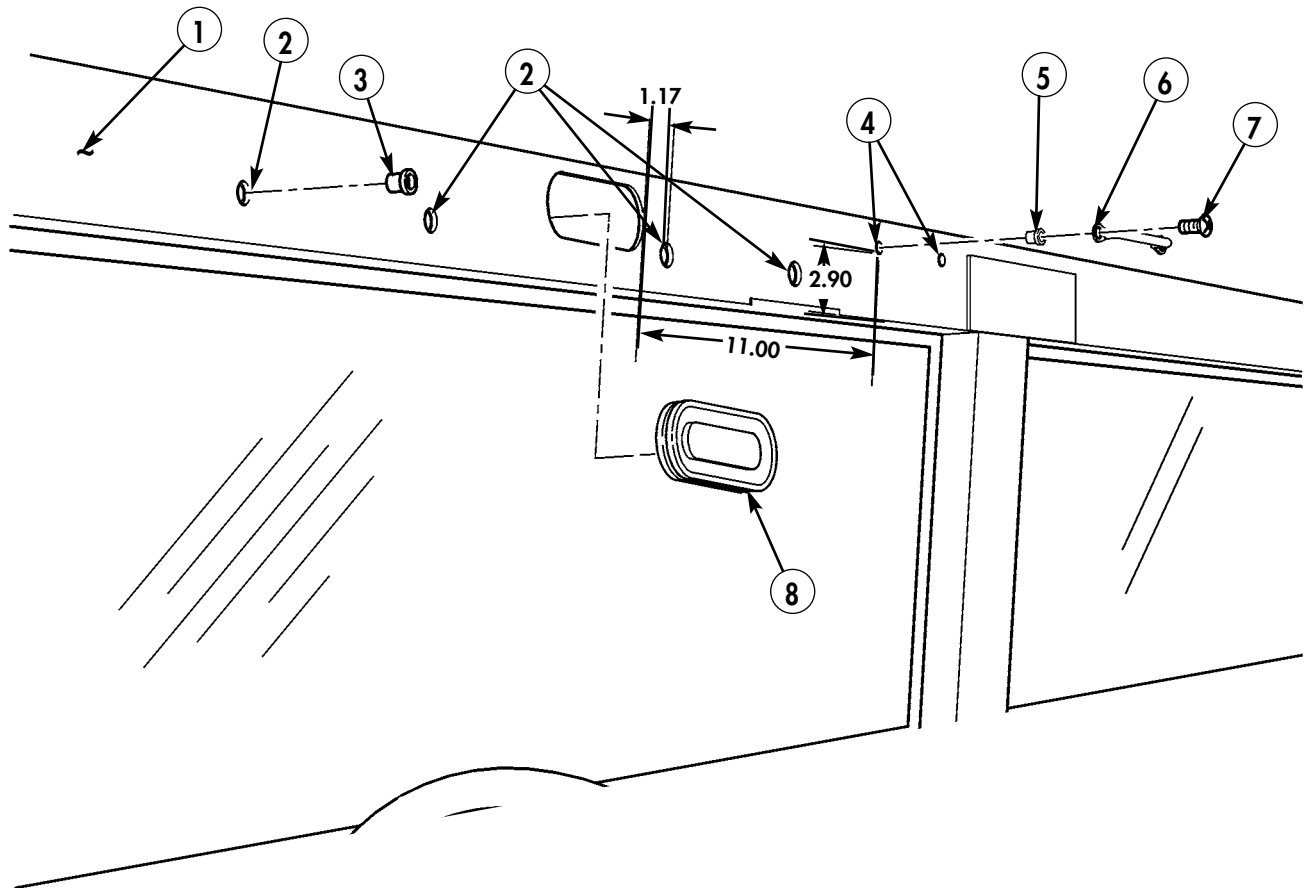


- 16. CAPSCREW - B1821BH025C300N - QTY. 5
- 17. WASHER - 3221003-9 - QTY. 5
- 19. PTM MOUNT ASSEMBLY - 3220952-1 - QTY. 1

Figure 5-81.

Section XXV. DVE DISPLAY CONTROL MODULE (DCM) ROOF MOUNT INSTALLATION

- 25-1.** Remove driver's sun visor, if installed. (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.)
- 25-2.** Remove access cover (8).
- 25-3.** Remove left side footman loop (6) from original location on left side of windshield frame (1). (Refer to TM 9-2320-280-20 or TM 9-2320-387-24.) Retain screws (7).
- 25-4.** Using footman loop (6) as template, locate, mark, and drill two 0.296-in. holes (4) in left side of windshield frame (1).
- 25-5.** Install two rivet nuts (5) in windshield frame (1).
- 25-6.** Reinstall footman loop (6) in new location in windshield frame (1) with existing screws (7).
- 25-7.** Using DCM roof mount assembly as template, locate, mark, and drill four 0.391-in. holes (2) in windshield frame (1).
- 25-8.** Install four rivet nuts (3) in windshield frame (1).
- 25-9.** Install access cover (8).



- 3. RIVET NUT - 3221003-14 - QTY. 4**
- 5. RIVET NUT - 3221003-20 - QTY. 2**

Figure 5-82.

NOTE

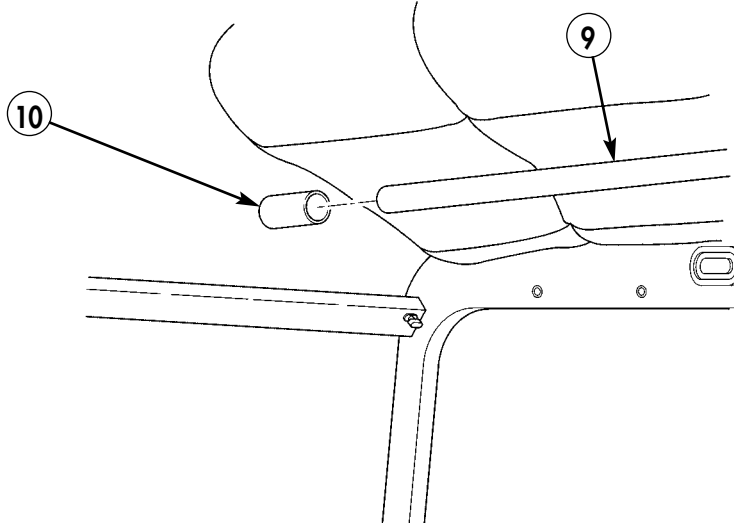
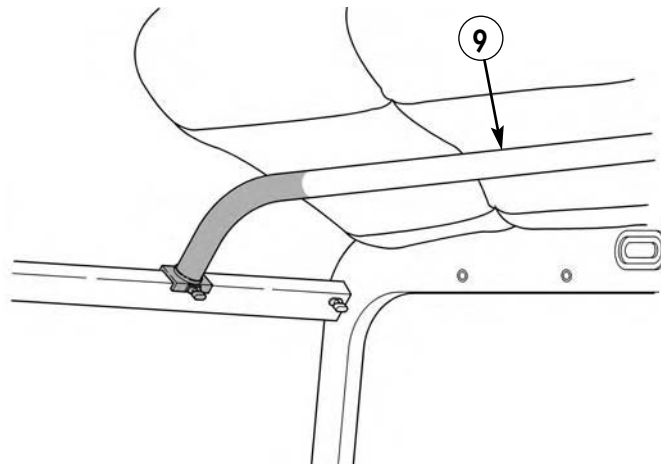
Loosen soft top fasteners to allow soft top to be folded back on the left side for access to support bow and top of DCM mount.

- 25-10.** Remove two screws securing left side of soft top support bow (9). (Refer to TM 9-2320-280-10 or TM 9-2320-387-10.)

NOTE

Cut where support bow begins to bend down.

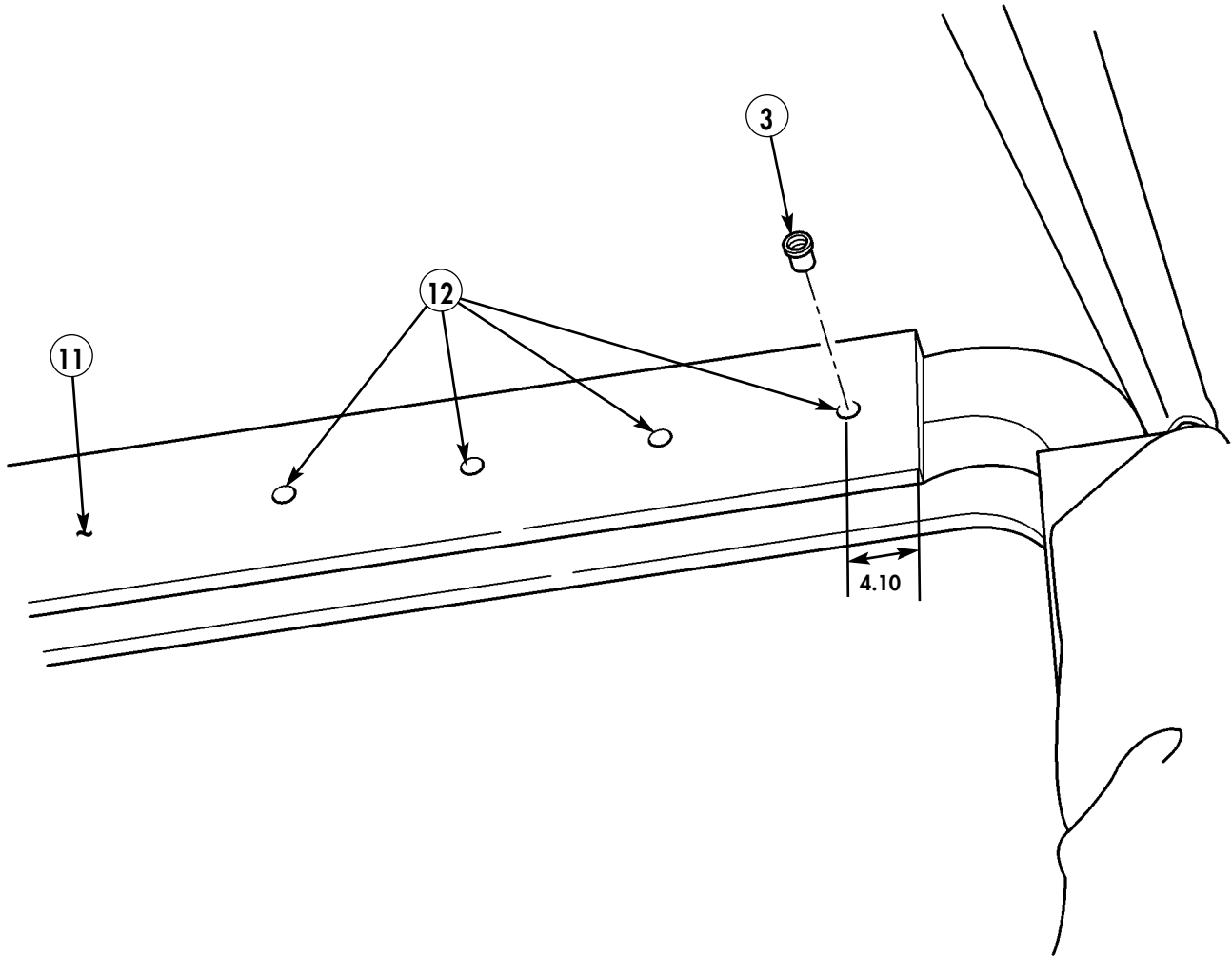
- 25-11.** Cut soft top support bow (9) as shown, and discard.
25-12. Slide bow closeout tube (10) onto end of soft top support bow (9).



10. CLOSEOUT TUBE – 3236685-1 – QTY. 1

Figure 5-83.

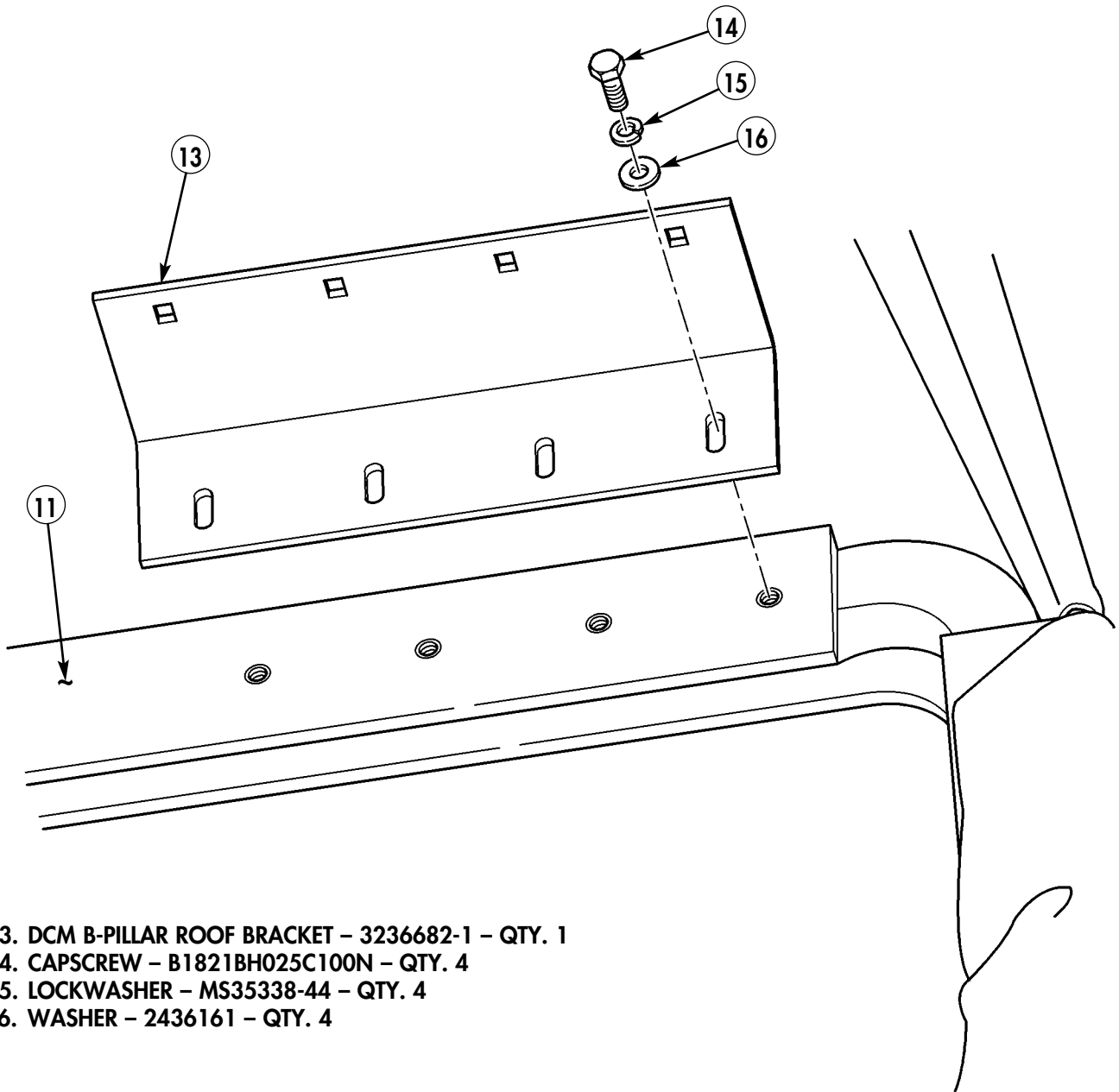
- 25-13. Using DCM B-pillar roof bracket as template, locate, mark, and drill four 0.391-in. holes (12) on B-pillar (11).
- 25-14. Install four rivet nuts (3) in B-pillar (11).



3. RIVET NUT - 3221003-14 - QTY. 4

Figure 5-84.

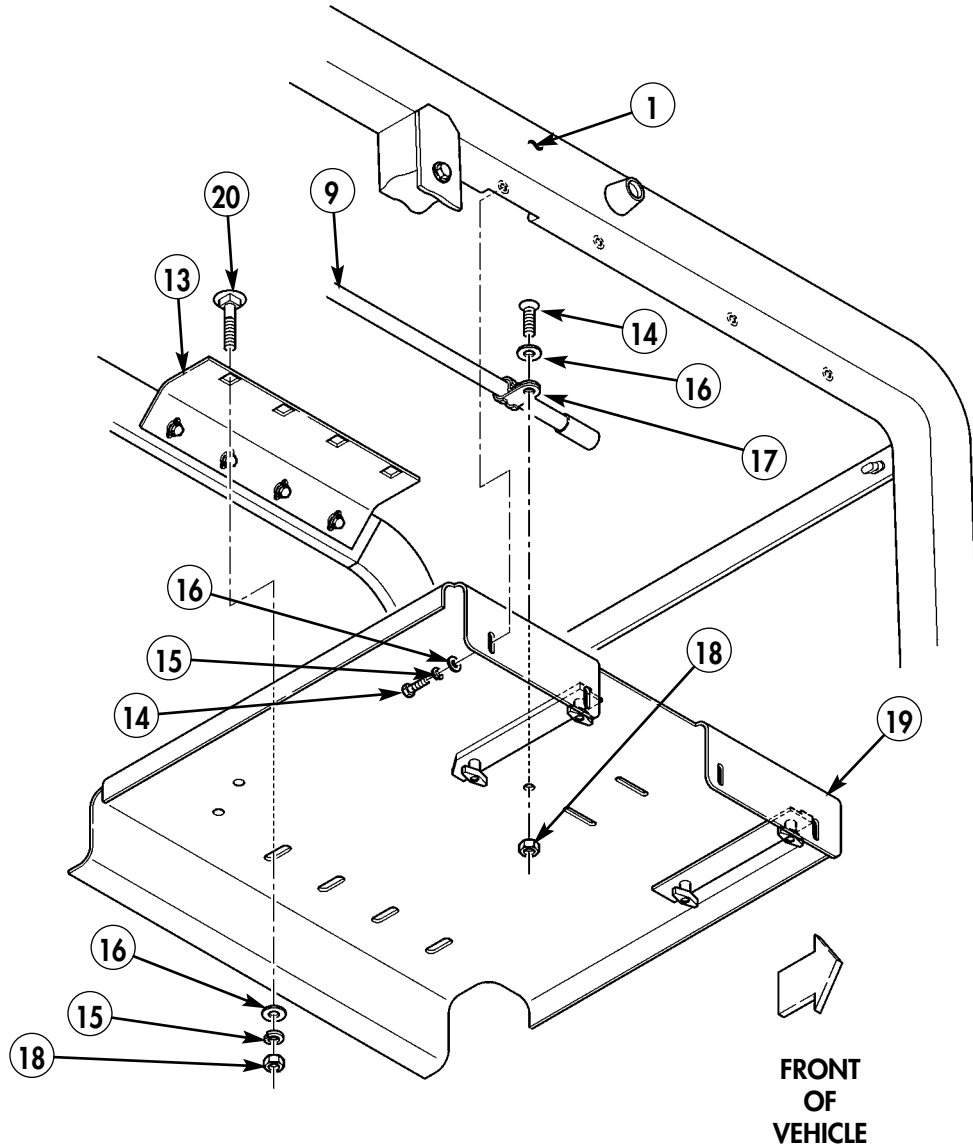
25-15. Install DCM B-pillar roof bracket (13) on B-pillar (11) with four capscrows (14), lockwashers (15), and washers (16). Do not tighten capscrows (14).



- 13. DCM B-PILLAR ROOF BRACKET - 3236682-1 - QTY. 1
- 14. CAPSCREW - B1821BH025C100N - QTY. 4
- 15. LOCKWASHER - MS35338-44 - QTY. 4
- 16. WASHER - 2436161 - QTY. 4

Figure 5-85.

- 25-16.** Install DCM roof mount bracket (19) on inside of windshield frame (1) with four capscrews (14), lockwashers (15), and washers (16), and on B-pillar roof bracket (13) with four carriage bolts (20), washers (16), lockwashers (15), and locknuts (18).
- 25-17.** Install loop clamp (17) on soft top support bow (9) and DCM roof mount (19) with capscrew (14), washer (16), and locknut (18). Tighten all capscrews (14).

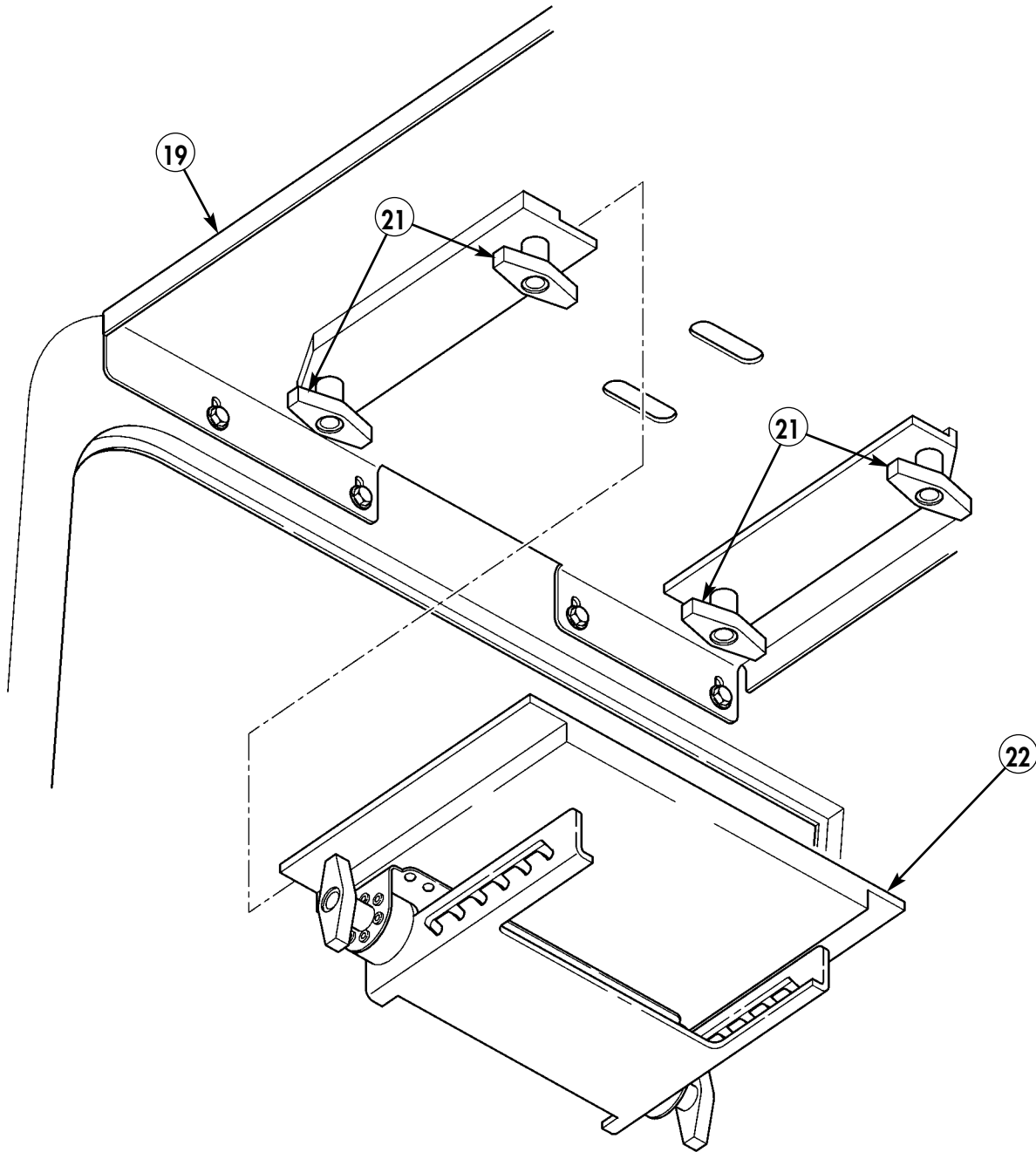


14. CAPSCREW - B1821BH025C100N - QTY. 5
 15. LOCKWASHER - MS35338-44 - QTY. 8
 16. WASHER - 2436161 - QTY. 9
 17. LOOP CLAMP - MS21333-123 - QTY. 1
 18. LOCKNUT - M45913/4-4CG8Z - QTY. 5
 19. DCM ROOF MOUNT BRACKET - 3245782-1 - QTY. 1
 20. CARRIAGE BOLT - 90185A540 - QTY. 4

Figure 5-86.

25-18. Loosen four hand knobs (21) on DCM roof mount (19). Slide DCM mount (22) onto DCM roof mount bracket (19). Tighten four hand knobs (21).

25-19. Install vehicle soft top. (Refer to TM 9-2320-280-10 or TM 9-2320-387-10.)



22. DCM MOUNT - 3221839-1 - QTY. 1

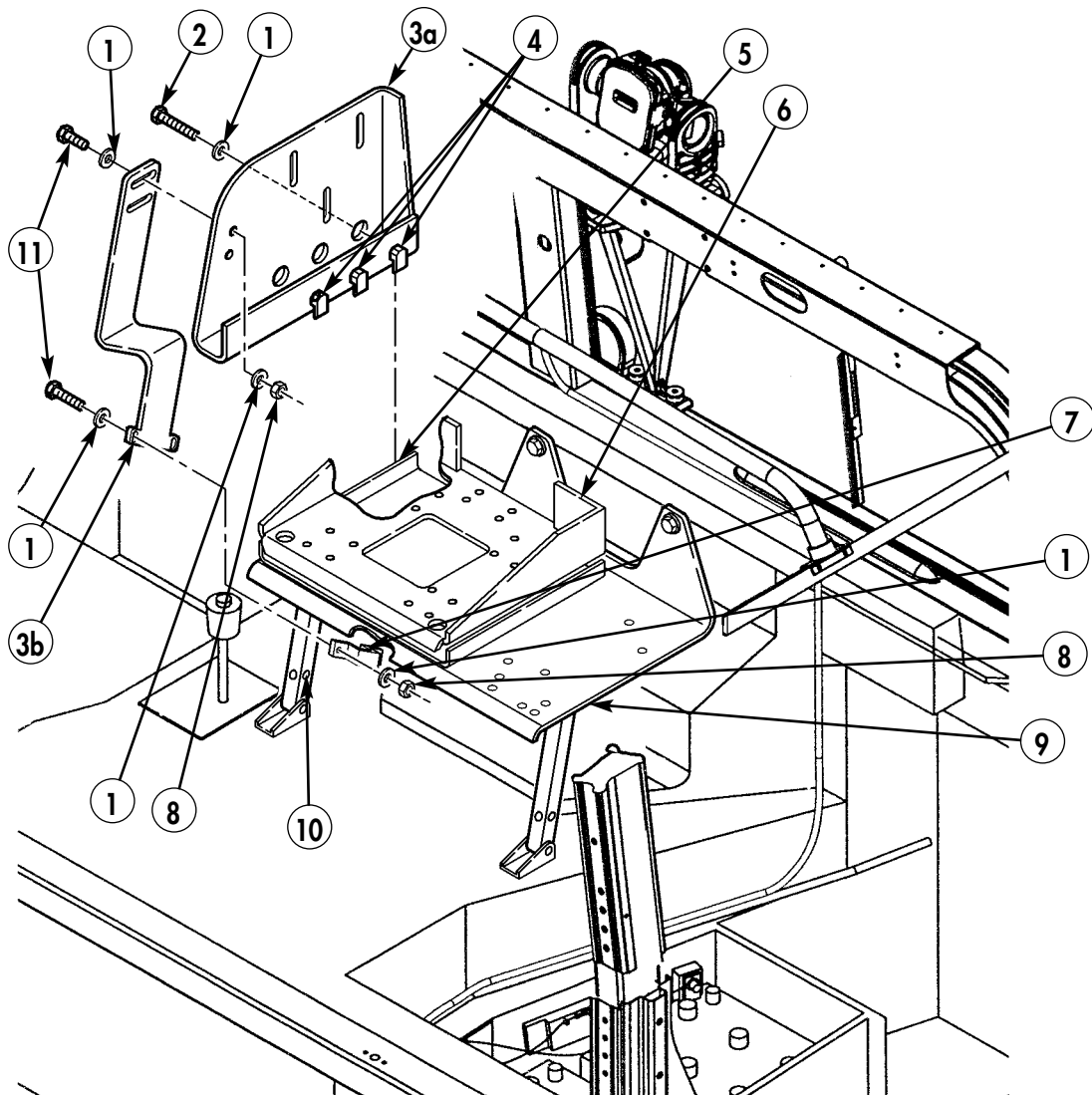
Figure 5-87.

Section XXVI. PAN AND TILT MODULE (PTM) CONTROL MOUNTING BRACKET INSTALLATION

NOTE

Ensure SINCGARS mounting tray is installed. (Refer to chapter 5, section VIII.)

- 26-1. Install PTM upper control mount plate (3a) on SINCGARS mounting tray (6), ensuring clamps (4) on upper portion of PTM control mount plate (3a) engage lower lip (5) of SINCGARS mounting tray (5).
- 26-2. Secure upper portion of PTM control mount plate (3a) to SINCGARS mounting tray (6) with three screws (2) and washers (1). Do not tighten screws (2).
- 26-3. Install lower portion of PTM control mount plate (3b) to left leg (10) of radio rack (9) with clamp (7), two screws (11), four washers (1), and two locknuts (8).
- 26-4. Secure PTM upper control mount plate (3a) to PTM lower control mount plate (3b) with two screws (11), four washers (1), and two locknuts (8).
- 26-5. Tighten all locknuts (8) and screws (2).



3. PTM CONTROL MOUNTING ASSY. - 3220919-1 - QTY. 1

Figure 5-88.

Section XXVII. PAN AND TILT MODULE (PTM) CONTROL ASSEMBLY, CONTROL CABLE ASSEMBLY, AND DCM/PTM INTERCONNECT CABLE INSTALLATION

- 27-1. Locate, mark, and drill 1.375-in. hole (1) for control cable seal assembly (2) on tunnel (3).
- 27-2. Position control cable seal assembly (2) and mark two hole locations (5).
- 27-3. Drill two 0.391-in. holes in marked locations (5).
- 27-4. Insert two rivet nuts (4) into tunnel (3).
- 27-5. Insert DCM connector end of DCM/PTM interconnect cable (6) from transmission compartment through hole (1) in tunnel (3), through control cable seal assembly (2) and into driver's compartment. Insert DCM/PTM interconnect cable (6) from under tunnel (3) into driver's compartment.
- 27-6. For vehicles equipped with FBCB2, route PTM control cable assembly (8) through PTM control mounting bracket (7).

NOTE

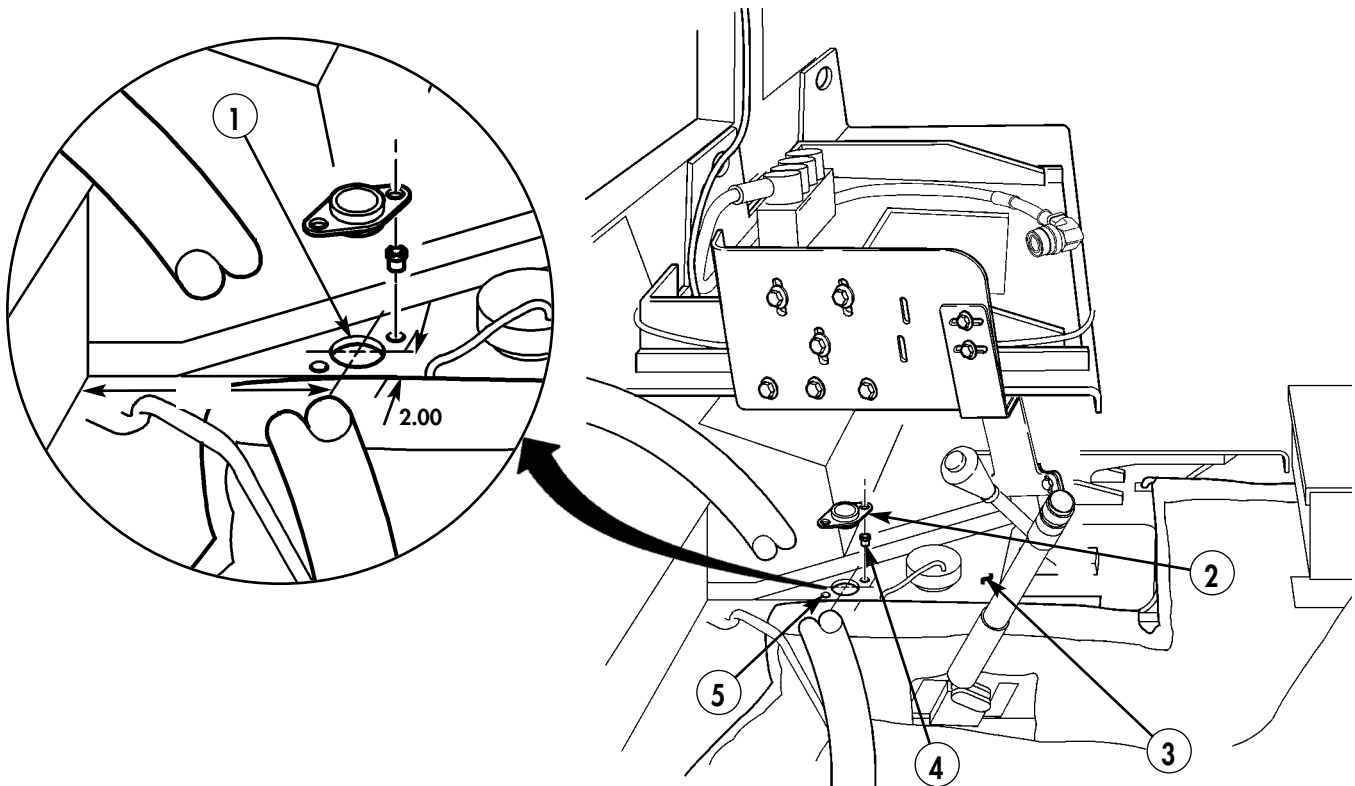
It may be necessary to remove azimuth lock cable adjusting nut to route cabling.

- 27-7. Insert two cables (8) and (9) from PTM control mounting bracket (7) through control cable seal assembly (2).

NOTE

Holes in grommet must be enlarged to allow cables to fit.

- 27-8. Cut sides of four holes on grommet of control cable seal assembly (2).
- 27-9. Insert three cables (6), (8), and (9) from PTM control mounting bracket (7) into tunnel hole (1).
- 27-10. Route three cables (6), (8), and (9) along exhaust pipe (10), body mount (12), and oil filter (11). Continue routing cables (6), (8), and (9) through engine compartment to A-frame cable guide (14) on A-frame pillar flange (13) to PTM mount assembly (15).



- 2. CONTROL CABLE SEAL ASSEMBLY – 3220908 – QTY. 1
- 4. RIVET NUT – 3221004-14 – QTY. 2

Figure 5-89.

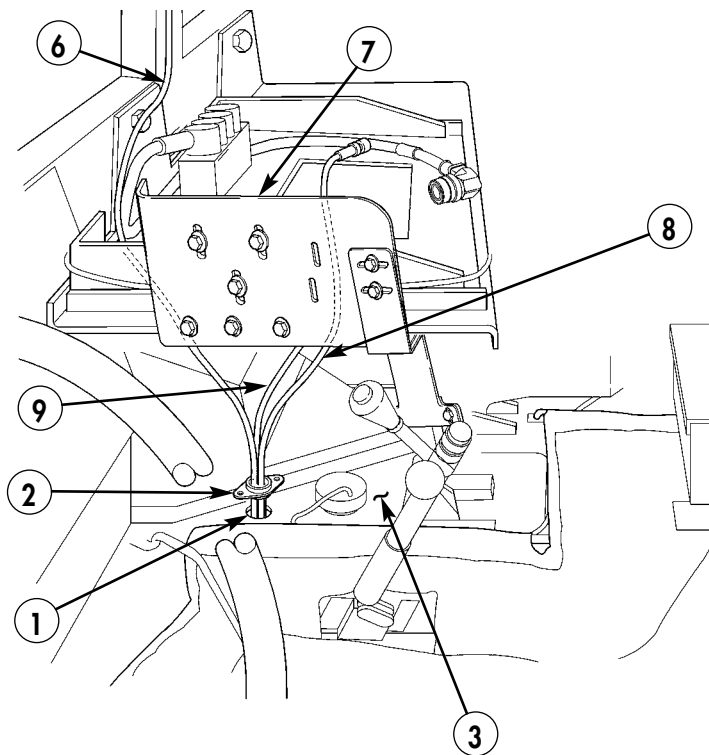


Figure 5-90.

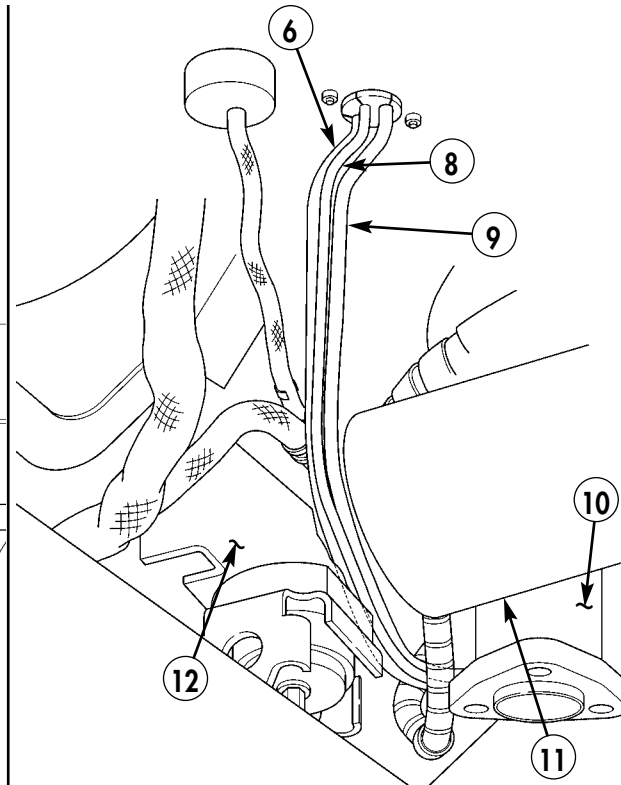
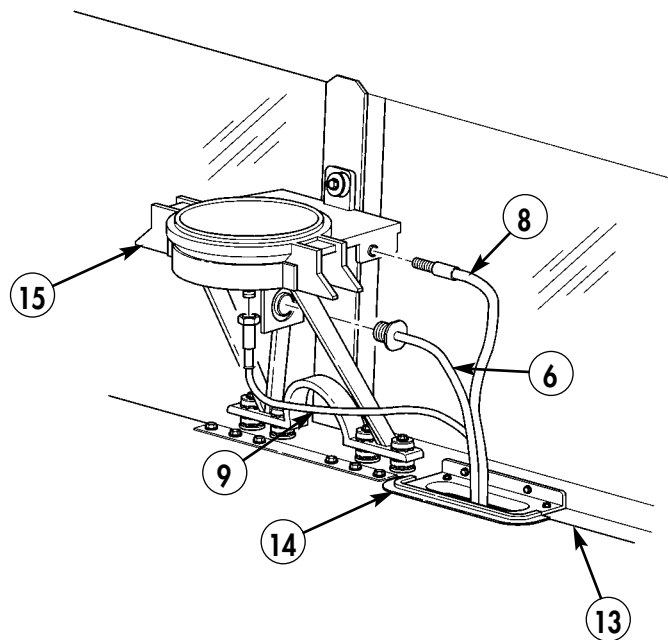


Figure 5-91.



- 6. DCM/PTM INTERCONNECT CABLE - 3220915-1 - QTY. 1
- 8. PTM CONTROL CABLE ASSEMBLY - 3220905-1 - QTY. 1
- 9. AZIMUTH LOCK CABLE - 3221015-1 - QTY. 1

Figure 5-92.

CAUTION

Do not overtighten DCM/PTM interconnect cable. The DCM/PTM interconnect cable is made of plastic and will break when overtightened.

- 27-11.** Secure PTM connector end (17) of DCM/PTM interconnect cable (6) to PTM mount assembly (15) with nut (18).

NOTE

Apply anti-seize compound as required.

- 27-12.** Mount PTM control assembly (31) on PTM control mount bracket assembly (35) with three screws (36), six washers (32), and three nuts (33). Ensure PTM control assembly handle (30) has sufficient room to clear steering wheel and standard radio rack (34).

NOTE

Installation of PTM azimuth control cable may take several attempts before all adjustments are correct.

- 27-13.** Remove bolt (27) and washer (26) from PTM mount assembly (15) and azimuth sector gear assembly (25).

NOTE

To determine which cable is the azimuth control cable, move PTM control handle left, right, fore, and aft to see which cable moves.

- 27-14.** Insert azimuth control cable (8) into side of PTM mount assembly (15).
27-15. Install azimuth control cable rubber boot (19) on azimuth control cable (8).
27-16. Install azimuth control cable (8) into clevis (21) of azimuth sector gear (25) until approximately one thread of shaft (16) is exposed through clevis (21). This is the starting position for aligning azimuth sector gear assembly (25).
27-17. Tighten azimuth control cable locking nut (20).
27-18. Position azimuth sector gear assembly (25) onto PTM mount assembly (15).
27-19. Insert azimuth control cable (8) into PTM mount assembly cable lock (37).

NOTE

PTM control assembly must be in the center position.

- 27-20.** Ensure that azimuth locking pin hole (22) in azimuth sector gear assembly (25) is aligned with azimuth lock cable (9) in PTM mount assembly (15). If aligned, proceed to next step. If not aligned, repeat steps 36-15 through 36-19, adjusting the azimuth sector gear assembly (25) position on the azimuth control cable (8) until alignment is achieved.
27-21. Secure azimuth sector gear assembly (25) to PTM mount assembly (15) with bolt (27) and washer (26).
27-22. Insert azimuth lock cable (9) through hole (29) into PTM mount assembly (15).
27-23. Install azimuth lock cable rubber boot (23) on azimuth lock cable (9).
27-24. Adjust top and bottom locking/adjuster nuts (24) until locking pin (28) clears azimuth sector gear assembly (35) by 1/16 in. when PTM control azimuth locking trigger is pulled.
27-25. Ensure azimuth control cable (8), azimuth lock cable (9), and rubber boots (19) and (23) are installed correctly.

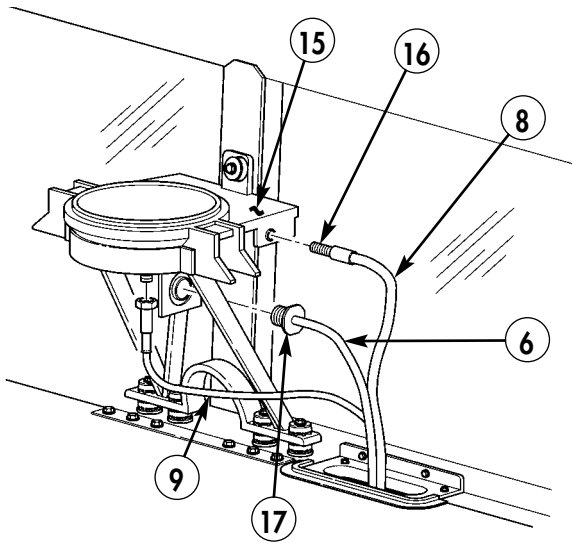


Figure 5-93.

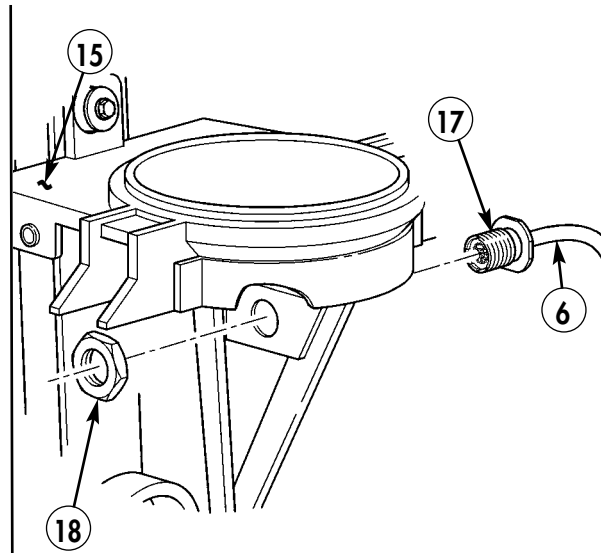
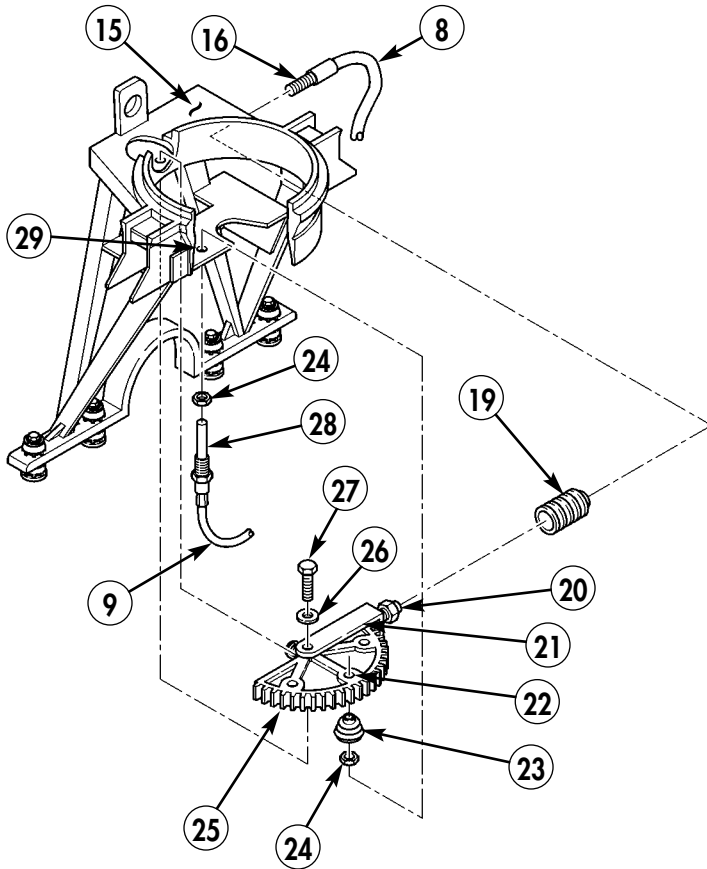


Figure 5-94.



- 15. PTM MOUNT ASSEMBLY - 3220952-1 - QTY. 1
- 23. PTM CONTROL ASSEMBLY - 3220905-1 - QTY. 1
- 24. WASHER - MS27183-12 - QTY. 6
- 25. NUT - M45913/3-5CG8Z - QTY. 3
- 27. SCREW - N/A - QTY. 3

Figure 5-95.

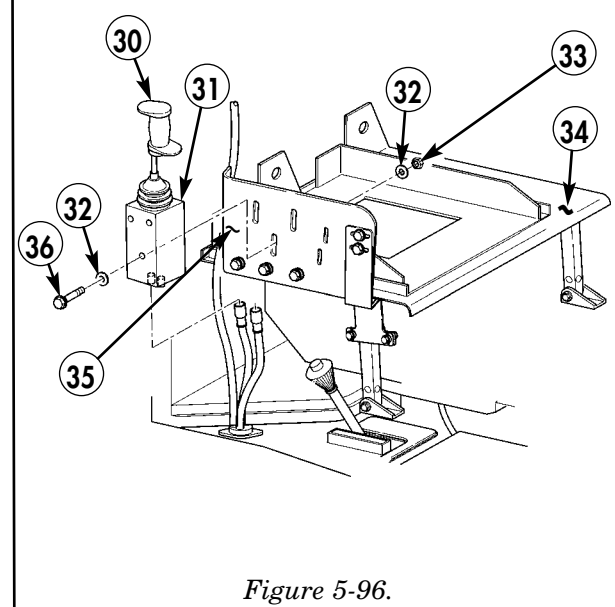


Figure 5-96.

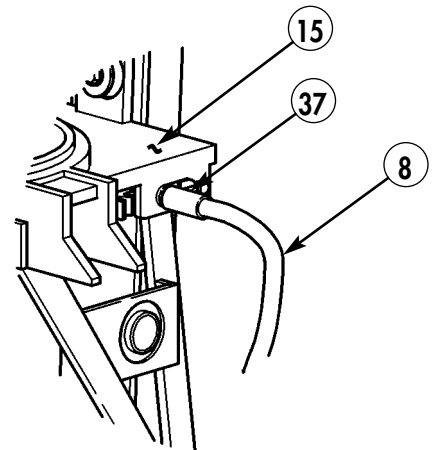
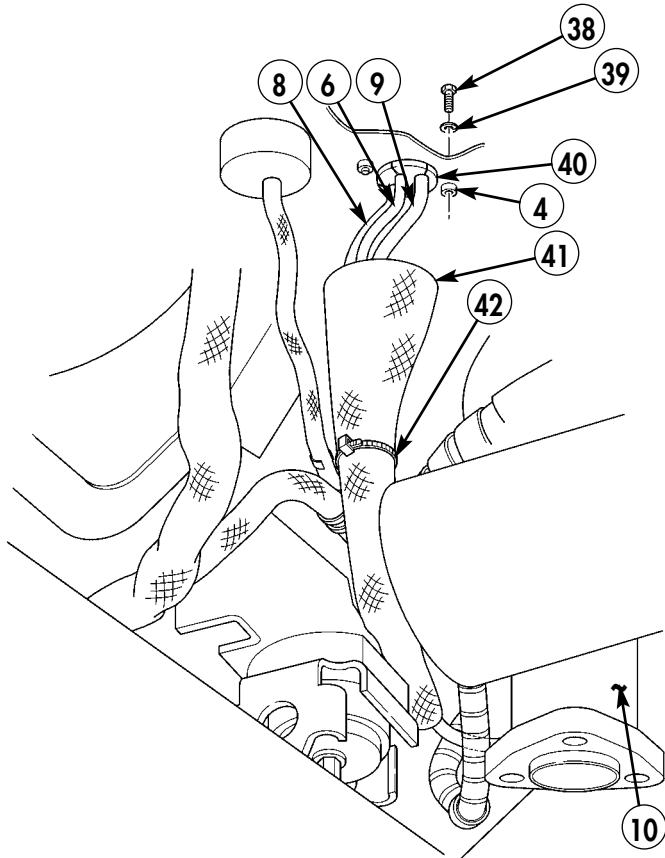


Figure 5-97.

- 27-26. Install control cable seal assembly rubber grommet (40) on PTM control cables (8) and (9) and DCM/PTM interconnect cable (6). Secure control cable seal assembly rubber grommet (40) on tunnel rivet nuts (4) with two capscrews (38) and washers (39).
- 27-27. Cover DVE/PTM control cables (8) and (9) that run along vehicle exhaust pipe (10) with heat shield sleeve (41). Secure heat shield sleeve (41) and PTM control cables (8) and (9) with cable ties (42).
- 27-28. Route DCM/PTM interconnect cable (6) behind radio rack to DCM mounting assembly (43).



- 38. CAPSCREW – B1821BH025C075N – QTY. 2
- 39. WASHER – MS27183-10 – QTY. 2
- 41. HEAT SHIELD SLEEVE – N/A – QTY. 1
- 42. STAINLESS STEEL CABLE TIE – 69855K72 – QTY. A/R

Figure 5-98.

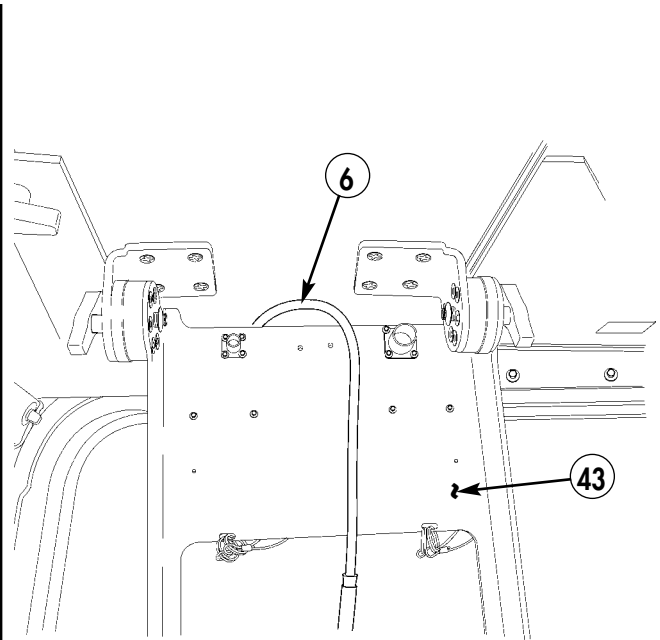


Figure 5-99.

Section XXVIII. LCD PROTECTIVE ASSEMBLY INSTALLATION

NOTE

Installation of the LCD protective assembly is optional. Perform the following operations only if desired.

- 28-1.** Install LCD protective assembly on DCM.

NOTE

LCD protective assembly is stored in stowage pouch 3256879-1.

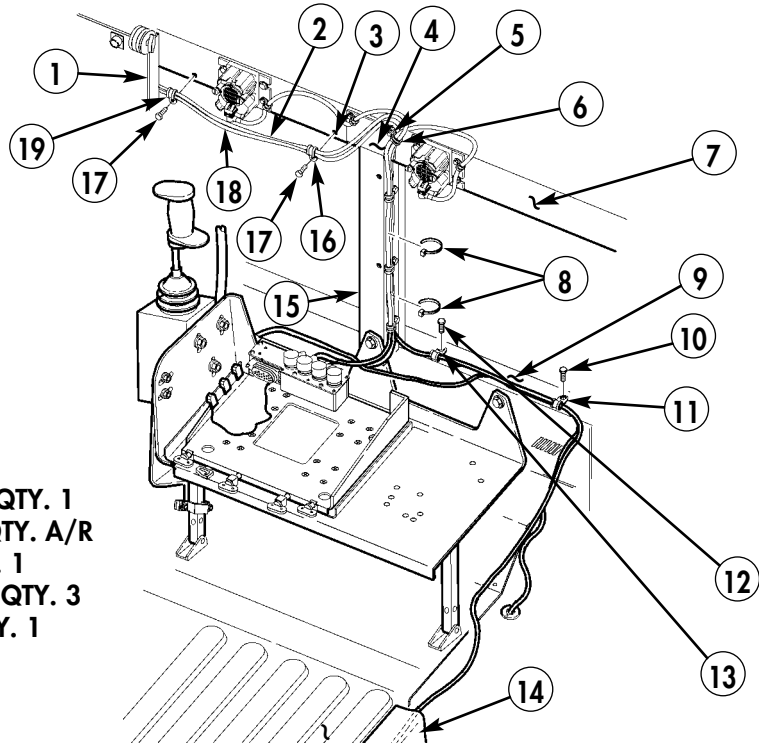
- 28-2.** Place stowage pouch in rear seat storage.

Section XXIX. DVE POWER CABLE INSTALLATION

NOTE

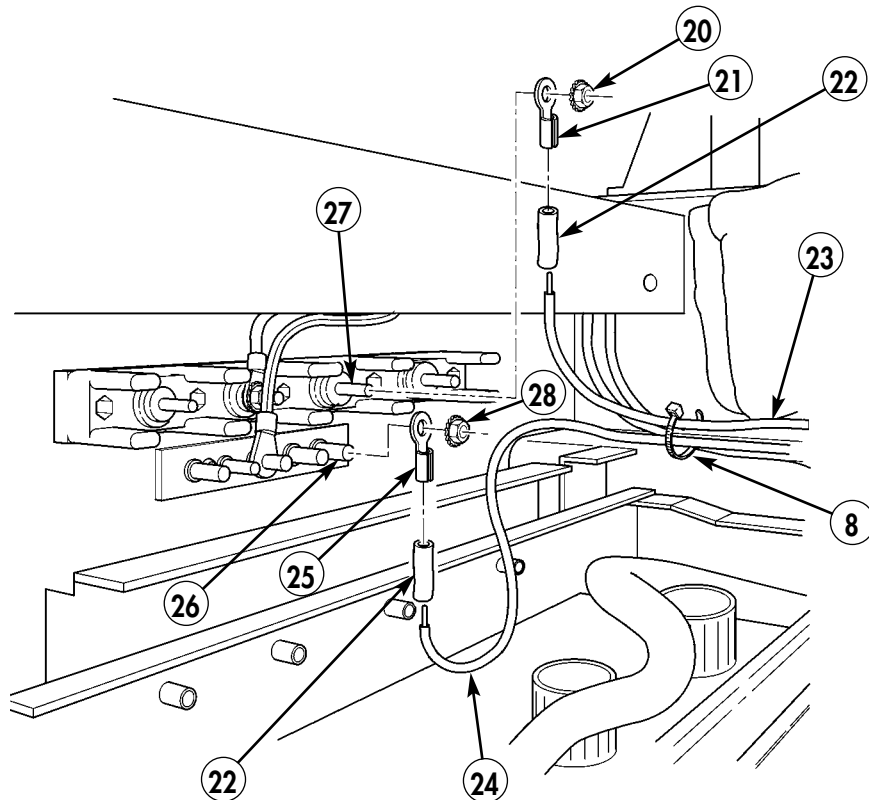
Previously routed cables have been removed for clarity.

- 29-1.** Route DVE power cable (2) from DCM mount (1) to center of windshield center support (15), along plenum (9), and under tunnel insulation (14) to rear of battery box.
- 29-2.** Attach shrink tubing (22) and two terminal lugs (21) and (25) to DVE power cable negative lead (24) and DVE power cable positive lead (23). (Refer to TM 9-2320-280-20 for terminal connector repair.)
- 29-3.** Attach DVE power cable positive lead (23) to 24V terminal board (27) with existing nut (20).
- 29-4.** Attach DVE power cable negative lead (24) to ground strap (26) with existing nut (28).
- 29-5.** Secure all leads together with tiedown strap (8).
- 29-6.** Remove two existing screws, lockwasher, and washers from DCM mount (1) and windshield frame (7).
- 29-7.** Secure two cables (2) and (18) to windshield frame (7) with clamp (19) and screw (17).
- 29-8.** Secure DCM mount (1) to windshield frame (7) with existing washers, lockwashers, and nuts.
- 29-9.** If required, locate, mark, and drill 0.147-in. diameter hole (3) in windshield frame (7).
- 29-10.** Secure two cables (2) and (18) to windshield frame (7) with clamp (16) and screw (17).
- 29-11.** Remove screw (5) and clamp (6) from windshield wiper bracket (4).
- 29-12.** Secure two cables (2) and (18) to windshield wiper bracket (4) with existing clamp (6) and existing screw (5).
- 29-13.** Secure two cables (2) and (18) to existing cables with tiedown straps (8).
- 29-14.** Secure cabling to plenum (9) with clamps (11) and self-tapping screws (12).
- 29-15.** Install right side tunnel insulation. (Refer to TM 9-2320-280-20.)
- 29-16.** Install batteries. (Refer to TM 9-2320-280-20.)



- 2. DVE POWER CABLE - 3256881-1 - QTY. 1
- 8. TIEDOWN STRAP - MS3367-1-0 - QTY. A/R
- 16. LOOP CLAMP - MS21333-76 - QTY. 1
- 17. SELF-TAPPING SCREW - 9421073 - QTY. 3
- 19. LOOP CLAMP - MS21333-104 - QTY. 1

Figure 5-100.



- 21. TERMINAL LUG - MS25036-150 - QTY. 1
- 22. SHRINK TUBING - MS23053/4-302-0 - QTY. A/R
- 25. TERMINAL LUG - MS25036-108 - QTY. 1

Figure 5-101.

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:



SANDRA R. RILEY
Administrative Assistant to the
Secretary of the Army
0520903

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PUBLICATION/FORM NUMBER <p style="text-align: center;">TB 9-2320-280-35-1</p>	DATE <p style="text-align: center;">17 SEP 2005</p>	TITLE <p style="text-align: center;">TECHNICAL BULLETIN INSTALLATION INSTRUCTIONS</p>
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ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible)
1	5-15			5-20		<p>Capscrew part number should be B1821BH031F100N (callout #4)</p>

SAMPLE

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE, OR TITLE <p style="text-align: center;">Pat Smith</p>	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION <p style="text-align: center;">AV272-4162</p>	SIGNATURE <p style="text-align: center;"><i>Pat Smith</i></p>
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PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION
<h1>SAMPLE</h1>								

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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PUBLICATION/FORM NUMBER TB 9-2320-280-35-1	DATE 17 SEP 2005	TITLE TECHNICAL BULLETIN INSTALLATION INSTRUCTIONS
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PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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TO: <i>(Forward direct to addressee listed in publication)</i> AMSTA-LC-LMIT/Tech Pubs, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630	FROM: <i>(Activity and location) (include ZIP code)</i>	DATE:
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PART II - REPAIR PARTS AND SPECIAL TOOLS LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION/FORM NUMBER TB 9-2320-280-35-1	DATE 17 SEP 2005	TITLE TECHNICAL BULLETIN INSTALLATION INSTRUCTIONS
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PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

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