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LMSC-916670A

**UTILITY  
TECHNICAL MANUAL**

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**GROUND HANDLING AND SERVICING EQUIPMENT**

FSSD CODE SS 5.0

**AGENA B MODEL NO.  
5205 THROUGH 16205**

**OPERATION AND SERVICE MANUAL**

**CONTRACT NO. AF8M EXHIBIT**  
S/L AF 04(647)-392 NASA/AGENA B PROGRAM,  
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**SECTION I  
INTRODUCTION**

**1-1. INTRODUCTION.**

1-2. This manual contains the description and operation instructions for the ground handling equipment provided by Lockheed Missiles and Space Company (LMSC) for ground support of Agena B vehicles. This equipment is listed and described in section II. A typical vehicle handling sequence is included in section III.

1-3. For convenience, the ground handling equipment is divided into the following four categories: Vehicle Handling Yokes, Vehicle Hoisting Equipment, Mobile Equipment, and Fixed Stands and Special Equipment. The operation instructions for each of these four categories of equipment are covered in separate sections.

**1-4. PURPOSE OF EQUIPMENT.**

1-5. The ground handling equipment covered in this manual is used for handling and supporting Agena B vehicles while they are being assembled, disassembled, transported, transferred, stored, lifted, tested, aligned, and mated with their companion booster adapter and booster on the launch pad. Other equipment covered in this manual is used for handling and supporting the booster adapter.

**1-6. REFERENCE PUBLICATIONS.**

1-7. Operation instructions and supplemental data for some of the equipment covered in this manual can be found in related LMSC or vendor manuals. Missing vendor manuals should be obtained from the equipment design organization. Operation instructions for the ground handling equipment used in handling and supporting the various payloads can be found in separate LMSC manuals for each payload. These reference publications are listed in table 1-1.

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Section I

Table 1-1. Reference Publications

TITLE	PUBLICATION NO. OR VENDOR
Auxiliary Hydraulic Cart Operation and Service Instructions Manual	LMSD-6278
Center of Gravity and Moment of Inertia Equipment Operation and Service Manual	LMSD-445923
Vehicle Transporter Operation and Service Manual	LMSD-446256
Vehicle Checkout Stand Operation and Service Manual	LMSD-446385
Vehicle Pitch and Roll Stand Operation and Service Manual	LMSD-447039
Agena Handling Equipment Maintenance Instructions Manual	LMSD-918000A
Installation and Removal Trailer Model 4100B, Operation, Service and Repair Instructions	Air Logistics Corp. Pasadena, Calif.
Auxiliary Power Pack, Model 2410, Installation and Operation Instructions	Air Logistics Corp. Pasadena, Calif.
NASA Ground Handling Equipment Operation Instructions, Agena Model No. 10205	LMSD-917154A
Advent Payload Ground Handling Equipment Operation Manual, Agena Model No. 8205	LMSC-919445
Payload Ground Handling and Service Equipment Operation Manual, Agena Model No. 5205	LMSC-918496
MIDAS Payload Ground Handling Equipment Operation Manual, Agena Model No. 7205	LMSC-920008
Digital and Analog Payload Ground Handling Equipment Operation Manual, Agena Model No. 11205 and 16205	LMSC-920035

**SECTION II**  
**EQUIPMENT SUMMARY AND DESCRIPTION**

**2-1. GENERAL**

2-2. The ground handling equipment required for supporting Agena B vehicles and the vehicle model or models for which each equipment item is required are listed in table 2-1. Subsequent paragraphs contain the functional and physical descriptions of this equipment.

Table 2-1. Ground Handling Equipment Summary

ITEM	NAME	PART NO.	MODEL NO.	FIG. NO.	VEHICLE MODEL USAGE*
	<b>VEHICLE HANDLING YOKES:</b>				
1	Vehicle Handling Yoke	1507316	205-47	2-1	C
2	Vehicle Handling Yoke	1408712	205-459	2-1	C
3	Vehicle Handling Yoke	1509201	205-492	2-1	C
4	Vehicle Handling Yoke	1509202	205-493	2-1	C
5	Vehicle Handling Yoke	1510568-501	205-500	2-1	B, D, G, J
6	Vehicle Handling Yoke	1510568-503	205-500	2-1	B, D, G, J, L
7	Vehicle Handling Yoke	1585908	205-534	2-1	F, H, I, K
8	Vehicle Handling Yoke	1583502	205-910	2-1	E
	<b>VEHICLE HOISTING EQUIPMENT:</b>				
9	Vehicle Tilt Sling	1503703	205-443	2-2	A
10	Adapter-Hoisting Tilt Sling Fitting	1508955	205-490	2-2	A
11	2X-Tank-Hoisting Tilt Sling Fittings	1508956	205-491	2-2	A

Table 2-1. Ground Handling Equipment Summary (Continued)

ITEM	NAME	PART NO.	MODEL NO.	FIG. NO.	VEHICLE MODEL USAGE*
12	Vehicle Tilt Sling Adapter	1507611	205-476	None	C
13	Vehicle Tilt Sling Cable Assembly	1510065	205-478	None	J
14	Yoke Beam Assembly	1511157	205-505	2-2	B, D, G
15	Yoke Beam Assembly	1586113	205-430	2-2	E, F, H, I, K
16	Yoke Beam Assembly	1583878	205-912	2-2	B, D, G, J, L
17	Vehicle Horizontal Hoisting Sling	1506811	205-477	None	C
18	Vehicle Horizontal Hoisting Sling	1512162	205-520	2-3	A
19	Vehicle Vertical Hoisting Sling	1082125	205-3	2-6	C
20	Horizontal Yoke Removal Sling	1506525	205-430	2-4	C
21	Horizontal Yoke Removal Sling	1585926	205-430	2-4	B, D thru L
22	Yoke Removal Sling	1592233	205-909	2-4	G, L
23	Vertical Yoke Removal Sling	1506526	205-430	2-4	A
24	Adapter Hoisting Plate	1511486	205-430	None	C
25	Engine Hoisting Sling	1082276	205-14	2-5	A
26	Forward Midbody Sling	1087918	205-62	2-6	C
27	Vehicle Tension Hoist Strap	1507743	205-488	None	C
28	Vehicle Tension Hoist Strap	1592600	205-762	None	L
29	Vehicle Tension Hoist Strap	1599792	205-1108	None	G
	<b>MOBILE EQUIPMENT:</b>				
30	Forward Midbody Stand	1087917	205-61	2-6	C
31	Vehicle Handling Dolly	1503447	205-428	2-7	A
32	Vehicle Handling Dolly Tow Bar	1506532	205-486	None	A
33	Vehicle Transporter	1503448	205-429	2-8	A

Table 2-1. Ground Handling Equipment Summary (Continued)

ITEM	NAME	PART NO.	MODEL NO.	FIG. NO.	VEHICLE MODEL USAGE*
34	Vehicle Transporter Conversion Equipment	1591271	205-906	None	B
35	Vehicle Transporter Tank Pressurization Hose	1593207	205-914	None	A
36	Adapter Handling Dolly	1508169	205-485	2-9	A
37	Vehicle Mating Dolly	1087102-503	205-43	2-10	C, G, H, I, K, L
38	Vehicle Horizontal Mating Fixture	1591165	205-795	2-11	C, G, H, I, K, L
39	Vehicle Mating Dolly	1508690	205-495	2-12	C
40	Vehicle Checkout Stand	1508697	205-16	2-13	C
41	Auxiliary Hydraulic Cart	1500481	205-34	2-13	C, J
42	Vehicle Holding Dolly	1585127	205-531	2-14	C
43	NASA Facility Checkout Vehicle Holding Dolly	1589531	205-719	None	0205-0005, F, H, I, K
44	Engine Removal Dolly	1586389	205-65	2-15	A
45	Engine Maintenance Stand **	8001-800-005(LMSC-1062204)	205-10	2-16	A
FIXED STANDS AND SPECIAL EQUIPMENT:					
46	Vehicle Pitch and Roll Stand	1503443	205-425	2-17	A
47	Vertical Workstand	1503450	205-431	2-18	A
48	Vertical Assembly Fixture	1506501	205-59	2-19	A
49	Center of Gravity and Moment of Inertia Equipment	1506710	205-15	2-20	A

Table 2-1. Ground Handling Equipment Summary (Continued)

ITEM	NAME	PART NO.	MODEL NO.	FIG. NO.	VEHICLE MODEL USAGE *
50	Vehicle Weighing and Center of Gravity Determination Fitting	1589507	205-712	None	B, D, E, F, G
51	Vehicle Tilt and Roll Equipment	1510878	205-504	2-21	A
52	Vehicle Alinement Equipment	1586073	205-725	None	E, F, H, I, K
53	Horizontal Vehicle Checkout Work Platform	1592341	205-913	2-22	A
54	Horizontal Mating Work Platform	1597518	205-961	2-23	G, L
55	Vehicle Shelter	1062737	205-532	2-24	A

\*VEHICLE MODEL CODE:

A	5205 thru 16205 (All)	D	7205	G	11205	J	14205
B	5205	E	8205	H	12205	K	15205
C	6205	F	10205	I	13205	L	16205

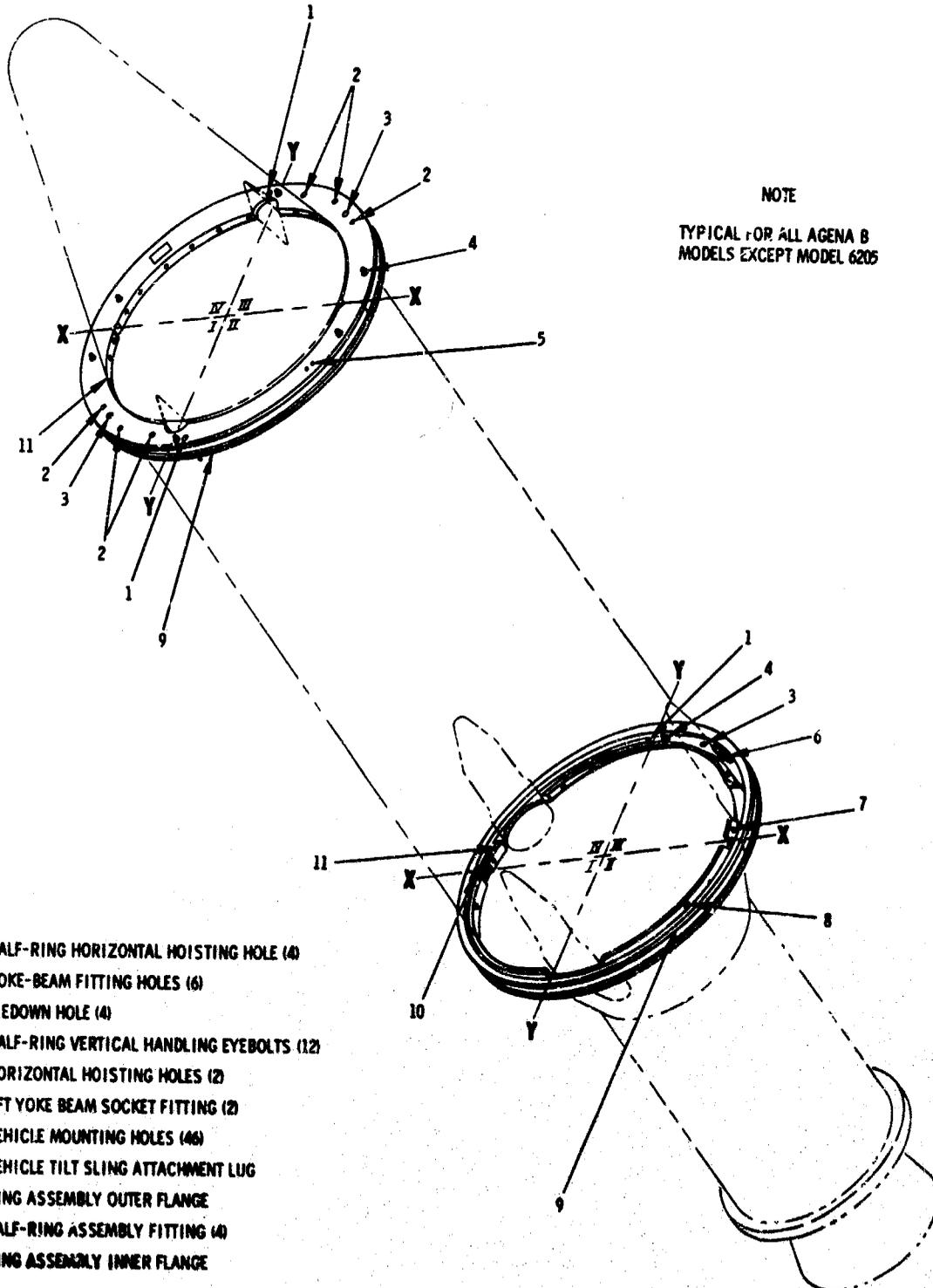
\*\* Manufactured by Bell Aircraft Corporation

2-3. VEHICLE HANDLING YOKES. (See figure 2-1.)

2-4. FUNCTION. The vehicle handling yokes provide a means of attaching and supporting the vehicle on equipment used during vehicle handling, lifting, storing, checkout, and mating procedures.

2-5. DESCRIPTION. Each yoke consists of two circular aluminum or steel ring assemblies, a forward ring assembly and an aft ring assembly, which are mounted around the periphery of the vehicles. The weight of each aluminum ring assembly is approximately 150 pounds; each steel ring assembly weighs approximately 300 pounds. The inner diameter of each ring assembly is 60.00 inches; the outer diameter of each ring assembly at the bearing surface is 71.00 inches. Each ring assembly has an I-beam cross section. The inner flange is shaped to fit the vehicle. It has cutouts for the vehicle fairings and is covered with a protective rubber strip. Installation

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**Section II**

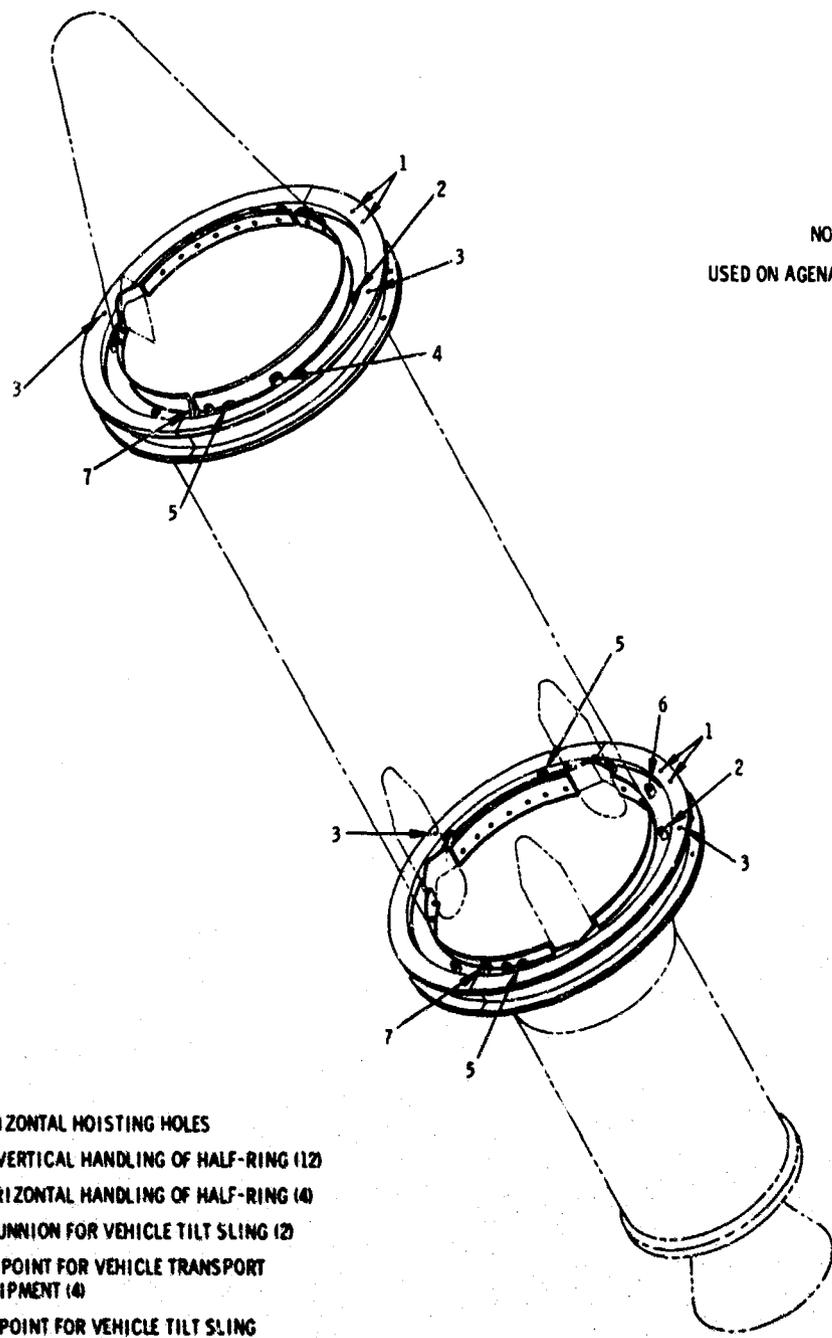


NOTE  
 TYPICAL FOR ALL AGENA 8  
 MODELS EXCEPT MODEL 6205

- 1. HALF-RING HORIZONTAL HOISTING HOLE (4)
- 2. YOKE-BEAM FITTING HOLES (6)
- 3. TIEDOWN HOLE (4)
- 4. HALF-RING VERTICAL HANDLING EYEBOLTS (12)
- 5. HORIZONTAL HOISTING HOLES (2)
- 6. AFT YOKE BEAM SOCKET FITTING (2)
- 7. VEHICLE MOUNTING HOLES (46)
- 8. VEHICLE TILT SLING ATTACHMENT LUG
- 9. RING ASSEMBLY OUTER FLANGE
- 10. HALF-RING ASSEMBLY FITTING (4)
- 11. RING ASSEMBLY INNER FLANGE

**Figure 2-1. Vehicle Handling Yokes (Sheet 1 of 2)**

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**Section II**



NOTE  
USED ON AGENA B MODEL 6205

1. VEHICLE HORIZONTAL HOISTING HOLES
2. FITTING FOR VERTICAL HANDLING OF HALF-RING (12)
3. HOLE FOR HORIZONTAL HANDLING OF HALF-RING (4)
4. HOISTING TRUNNION FOR VEHICLE TILT SLING (2)
5. ATTACHMENT POINT FOR VEHICLE TRANSPORT TIEDOWN EQUIPMENT (4)
6. ATTACHMENT POINT FOR VEHICLE TILT SLING
7. HALF-RING ASSEMBLY FITTING (4)

**Figure 2-1. Vehicle Handling Yokes (Sheet 2 of 2)**

boltholes are provided on the inner flange. Each ring divides into two equal halves and has two half-ring assembly fittings. Three eyebolts or fittings on the forward face of each half-ring assembly facilitate vertical handling and removal of the rings. A single hole is provided on each half-ring for horizontal handling. Installation or removal of the ring assemblies is accomplished with the use of the applicable horizontal yoke removal sling, or vertical yoke removal sling (items 20 through 23, table 2-1). Two tiedown holes on each ring assembly are provided for attachment of vehicle transporter tiedown equipment. The applicable vehicle hoisting equipment (items 9, 14, 15, 16, 17, or 18, table 2-1) must be attached to the vehicle handling yoke during all vehicle handling and hoisting operations. Table 2-2 lists the forward and aft ring assemblies for each vehicle handling yoke assembly.

Table 2-2. Vehicle Handling Yoke Ring Assemblies

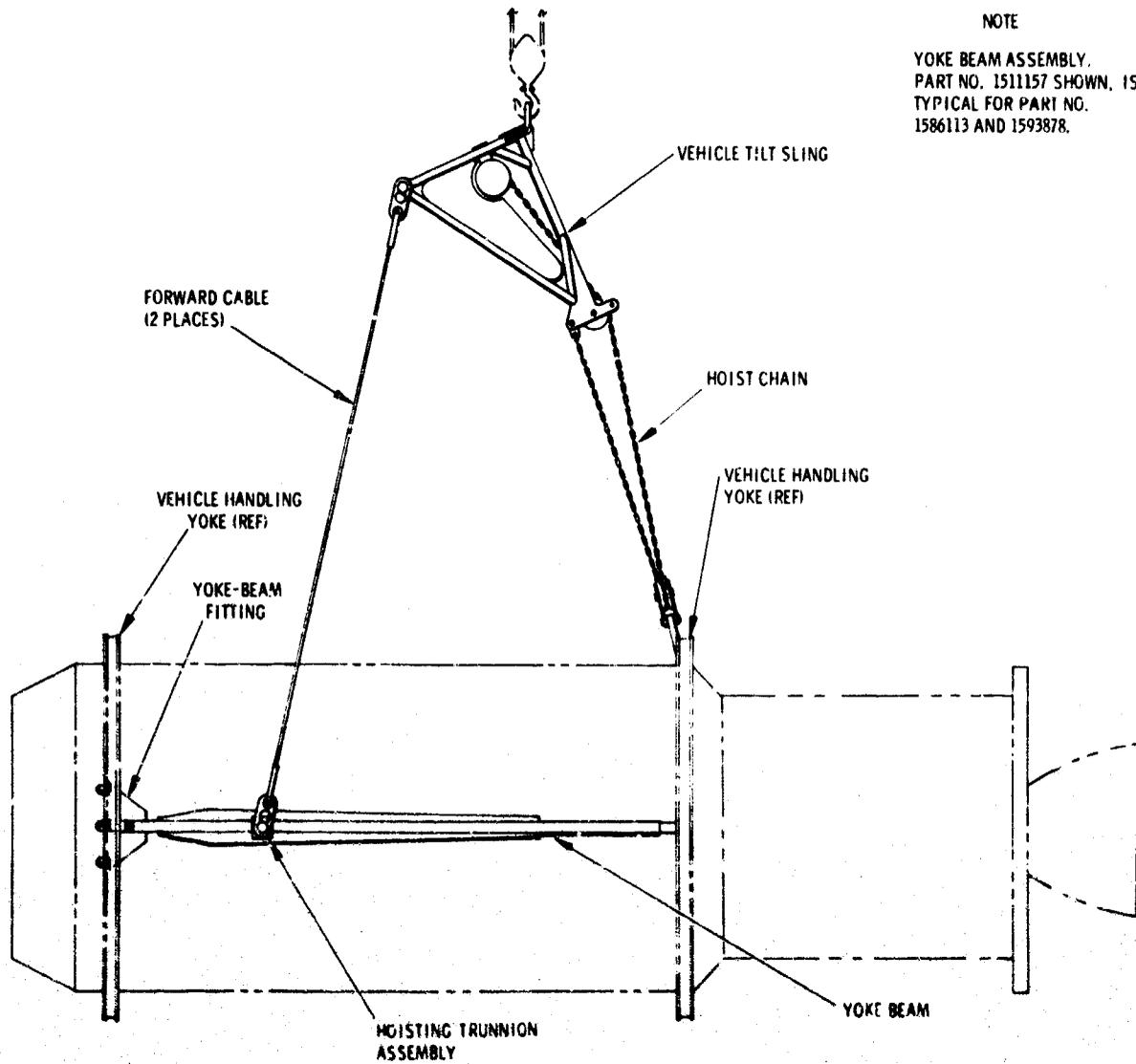
ASSEMBLY PART NO.	FORWARD RING ASSEMBLY PART NO.	AFT RING ASSEMBLY PART NO.
1507316	1506807-501	1506807-503
1508712	1508713-503	1508713-501
1509201	1508713-503	1509203-501
1509202	1508713-503	1509203-503
1510568-501	1510567-503	1510567-501
1510568-503	1510567-507	1510567-501
1585903	1585582-501	1510567-505
1593502	1585582-503	1510567-505

2-6. **VEHICLE TILT SLING AND AUXILIARY EQUIPMENT.** (See figure 2-2.)

2-7. **FUNCTION.** The vehicle tilt sling is used with applicable auxiliary equipment for hoisting the vehicle in a horizontal or vertical attitude and for rotating the vehicle from a horizontal to a vertical attitude, or vice versa, as required. The sling is also used in conjunction with applicable auxiliary equipment for hoisting the vehicle adapter and 2X tank.

2-8. **DESCRIPTION.** The vehicle tilt sling consists of a triangular, tubular steel frame supporting an adjustable hoist chain and two 110-inch or two 74-inch forward cables. The hoist chain can be retracted or extended by an air hoist mounted in the center of the tubular frame and controllable by means of a 28-foot-long pushbutton pendant. During operation, the retracted portion of the hoist chain is automatically stowed in a metal container

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**Figure 2-2. Vehicle Tilt Sling and Auxiliary Equipment (Sheet 1 of 2)**

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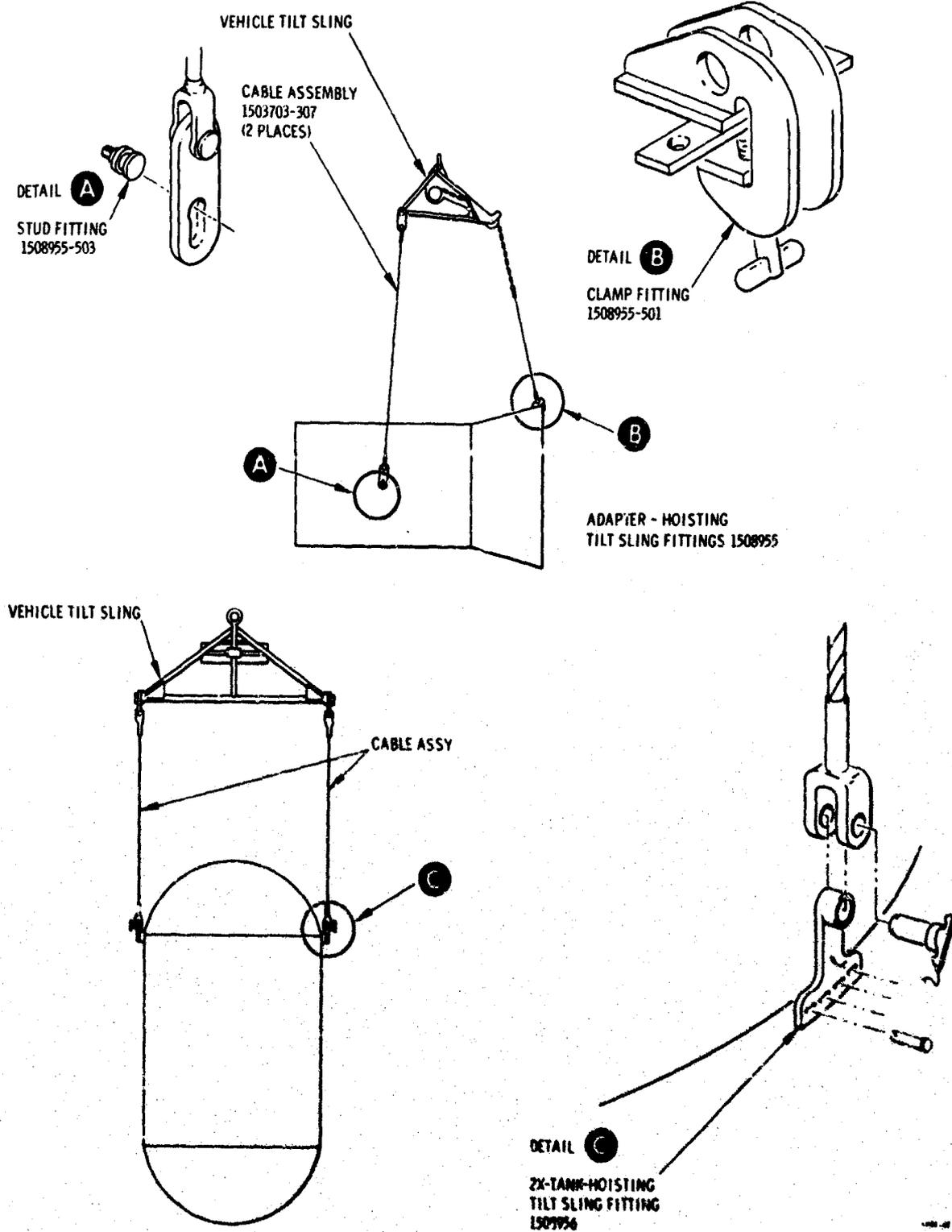


Figure 2-2. Vehicle Tilt Sling and Auxiliary Equipment (Sheet 2 of 2)

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**Section II**

located adjacent to the air hoist. Air pressure required for operating the hoist is supplied from an external source that is connected to a fitting on the end of the air hose attached to the pendant. The vehicle can be tilted through a 90-degree arc by powering the axial-piston air motor to shorten or lengthen the hoist chain. The air hoist automatically shuts off when the hoist chain is extended to its limit. The auxiliary equipment used in conjunction with the tilt sling for accomplishing various hoisting operations is described in the following paragraphs.

**2-9. ADAPTER-HOISTING TILT SLING FITTINGS.** (See figure 2-2.) The adapter-hoisting tilt sling fittings are the means by which the tilt sling can raise and tilt the vehicle adapter. There are two stud fittings and one clamp fitting. The stud fittings are trunnions which screw into each side of the adapter just forward of the midpoint and leave a channeled stud extended outside for attachment of the forward cables of the tilt sling. The clamp fitting fits over the fairing of the adapter and provides a connecting point for the tilt sling hoist chain.

**2-10. 2X-TANK-HOISTING TILT SLING FITTINGS.** (See figure 2-2.) The 2X-tank-hoisting tilt sling fittings provide a place on each side of the 2X tank for connecting the tilt sling forward cables. The fittings are T-shaped steel flanges curved to fit the tank to which they are bolted. A short length of tubular steel is welded to and projects from the upper end of each flange at a right angle to the flange face. This tube connects to one of the tilt sling forward cable assembly clevises and is secured with a quick-release pin that is attached to the fitting with a lanyard.

**2-11. VEHICLE TILT SLING ADAPTER.** (See item 12, table 2-1.) The vehicle tilt sling adapter replaces each of the two forward cables of the vehicle tilt sling when the Agena vehicle, Model 6205, is hoisted or rotated. The adapter is a 70-inch cable with a connector at each end. The connector which is attached to the vehicle has a cable adapter consisting of a flat steel plate to which a rubber pad is cemented.

**2-12. VEHICLE TILT SLING CABLE ASSEMBLY.** (See item 13, table 2-1.) The vehicle tilt sling cable assembly replaces each of the two forward cables of the vehicle tilt sling for hoisting or rotating the Agena vehicle, Model 14205, when the nose cone is not installed. The cable assembly is a 54-inch cable with a connector at each end.

**2-13. YOKE BEAM ASSEMBLY.** (See figure 2-2.)

2-14. **FUNCTION.** The yoke beam assembly is fastened between the forward and aft handling yokes installed on the vehicle. An identical assembly is fastened between the handling yokes on the opposite side of the vehicle. The two yoke beam assemblies are required for providing adequate stiffness and for distributing the loading experienced during hoisting operations with the vehicle tilt sling. They also provide the attachment points for the two forward cables of the tilt sling.

2-15. **DESCRIPTION.** Each assembly consists of a yoke beam fitting and a yoke beam. The yoke beam fitting is a reinforced bar with two tack-welded bolts and a stud, which provide the means of attaching the yoke beam to the web of the forward vehicle handling yoke ring. A single bolt, tack-welded to the yoke beam fitting, attaches this fitting to the yoke beam. The yoke beam is a reinforced 3-1/4-inch steel tube fitted with end adapters that mate with the yoke beam fitting at its forward end and with a socket fitting provided on the aft vehicle handling yoke ring at its opposite end. A hoisting trunnion assembly is fitted to the forward part of the yoke beam and is attached to the top and bottom reinforcing bars with two bolts and nuts. These bolts are tack-welded to the trunnion assembly. Four sets of holes in the reinforcing bars of the yoke beam provide four positions for attaching the trunnion assembly to accommodate varying center of gravity conditions. On yoke beam assembly (item 15, table 2-1), the hoisting trunnion assembly attaches to the outer periphery of the forward vehicle handling yoke ring.

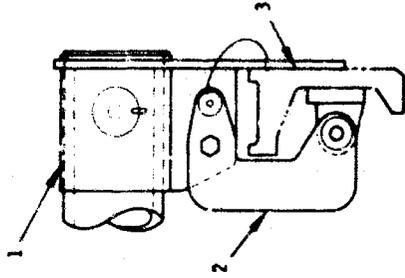
2-16. **VEHICLE HORIZONTAL HOISTING SLING.** (See figure 2-3.)

2-17. **FUNCTION.** The vehicle horizontal hoisting sling is used in conjunction with the vehicle handling yokes for hoisting the vehicle in the horizontal attitude.

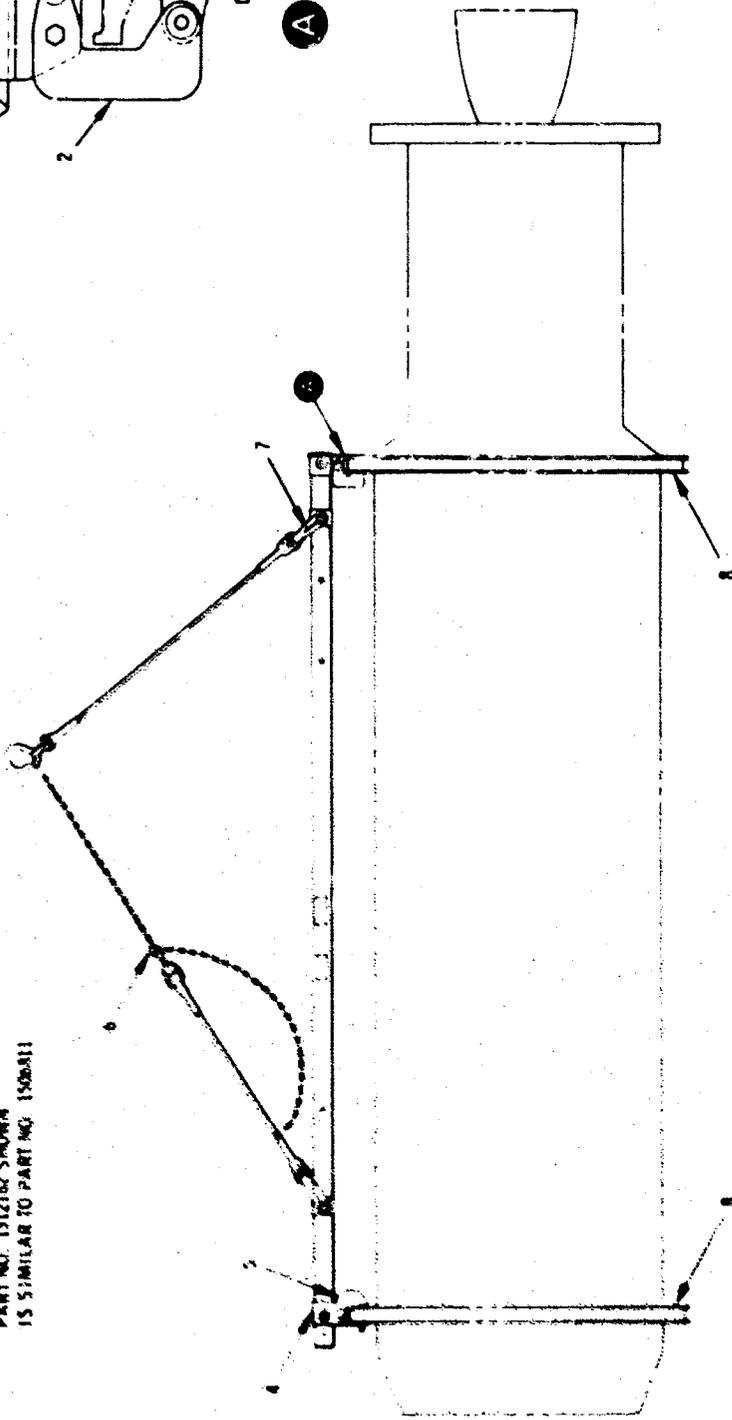
2-18. **DESCRIPTION.** The hoisting sling is a 3-3/4-inch tubular steel beam, 164 inches long for sling (item 18, table 2-1) and 117 inches long for sling (item 17, table 2-1), with a fixed steel cable and an adjustable chain with a grab hook which are attached to a hoist ring. Adjustable hoist fittings are attached to support sleeves located at each end of the beam. These fittings are fastened to the vehicle handling yokes. The beam has eight holes, to which the support sleeves and hoisting clevis sleeves are mated as required by vehicle configuration. Instructions for properly locating fittings for hoisting specific vehicle models are affixed to the beam.

2-19. **VEHICLE VERTICAL HOISTING SLING.** (See item 19, table 2-1.)

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**A**



**NOTE**  
 PART NO. 15121A2 SHOWN  
 IS SIMILAR TO PART NO. 1505A11

- |                        |                                 |
|------------------------|---------------------------------|
| 1. AFT SUPPORT SLEEVE  | 5. FWD HOIST FITTING            |
| 2. AFT HOIST FITTING   | 6. GRAB HOOK                    |
| 3. AFT YOKE RING (REF) | 7. CLEVIS AND SLEEVE (2 PLACES) |
| 4. FWD SUPPORT SLEEVE  | 8. VEHICLE HANDLING YOKE (REF)  |

**Figure 2-3. Vehicle Horizontal Hoisting Sling**

2-20. **FUNCTION.** The vehicle vertical hoisting sling is used in conjunction with the forward midbody sling for hoisting the forward midbody in a vertical attitude during installation on or removal from the vehicle on the vertical workstand or the vertical assembly fixture.

2-21. **DESCRIPTION.** The hoisting sling is a welded-steel triangular spreader bar with a hoist ring and three stainless steel cables. The cables are attached to the ends of the spreader bar and to the three eyebolts on the forward midbody sling by means of steel shackles.

2-22. **HORIZONTAL YOKE REMOVAL SLING.** (See figure 2-4.)

2-23. **FUNCTION.** The horizontal yoke removal sling provides a hoisting attachment for removing one half of the vehicle handling yoke ring from the vehicle in the horizontal position.

2-24. **DESCRIPTION.** The sling is a clevis with a removable quick-release pin, which is attached by a lanyard, and a hoisting ring. The clevis fits over the removal hole of the vehicle handling yoke and is secured to the yoke by the quick-release pin.

2-25. **YOKE REMOVAL SLING.** (See figure 2-4.)

2-26. **FUNCTION.** The yoke removal sling is used on the launch pad for removing the vehicle yoke rings after the vehicle is mated to the booster in a horizontal attitude and the separation plane of the yoke rings is vertical.

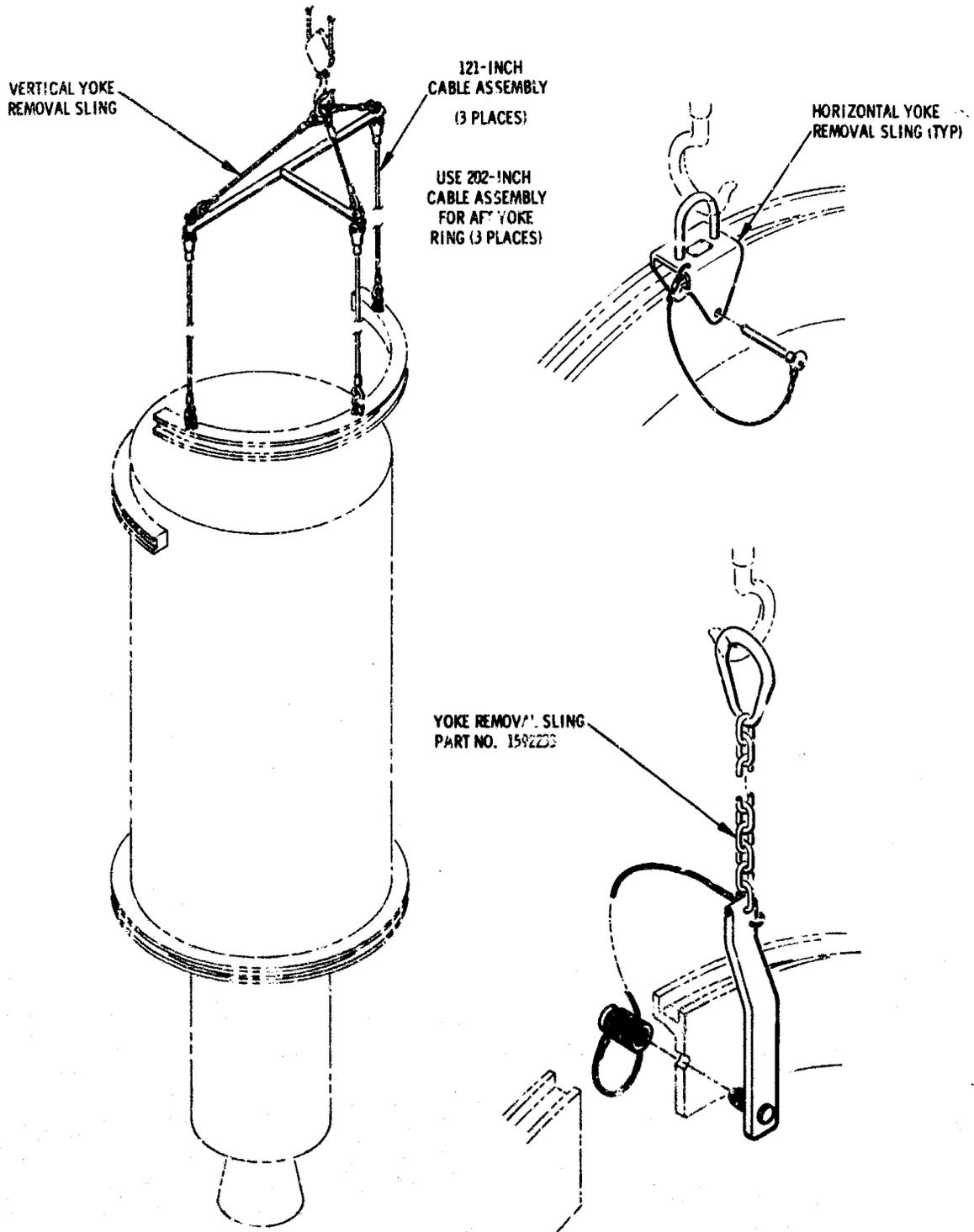
2-27. **DESCRIPTION.** The sling is essentially an angular lifting bar attached to a hoisting ring with a steel chain. The bar is fitted on the flat surface of the yoke ring by inserting the tack-welded bolt on the end of the bar through the removal hole of the ring and securing the bolt with the captive nut attached to the sling with a lanyard.

2-28. **VERTICAL YOKE REMOVAL SLING.** (See figure 2-4.)

2-29. **FUNCTION.** The vertical yoke removal sling is used for removing the vehicle handling yoke half-rings from the vehicle when it is in a vertical attitude.

2-30. **DESCRIPTION.** The sling is a T-shaped tubular steel spreader with cables attached from the ends to a center hoisting ring. Three 12 $\frac{1}{2}$ -inch cables are provided for removing the forward yoke half-rings, and three 20 $\frac{1}{2}$ -inch cables are provided for removing the aft yoke half-rings. The swaged

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**Figure 2-4. Yoke Removal Slings**

clevises on the upper ends of the cables are attached to lugs on the bottom of each spreader end with pins. The shackles attached to the thimbles on the lower ends of the cables connect to respective hoisting fittings provided on each yoke half-ring.

2-31. ADAPTER HOISTING PLATE. (See item 24, table 2-1.)

2-32. FUNCTION. The adapter hoisting plate provides the means of attachment for hoisting the adapter with the vehicle tilt sling. Two hoisting plates are required.

2-33. DESCRIPTION. The hoisting plate is a flat aluminum plate which is fastened to either side of the adapter by means of two thumbscrews which are attached by lanyards to the plate. A floating nut is provided for installing the hoisting stud furnished with the vehicle tilt sling. The forward cables of the vehicle tilt sling are attached to the hoisting studs when the adapter is hoisted.

2-34. ENGINE HOISTING SLING. (See figure 2-5.)

2-35. FUNCTION. The engine hoisting sling provides a means of hoisting the engine in a horizontal attitude.

2-36. DESCRIPTION. The hoisting sling is a tubular steel beam with a lifting bar welded to it and a thrust chamber sling and two forward cables. A hook with a locking device is provided at the end of each forward cable for attachment to the engine mount. The thrust chamber sling fits around the thrust section of the engine thrust chamber. A shackled hoisting ring may be positioned in any one of seven holes on the lifting bar to balance the engine in a horizontal attitude.

2-37. FORWARD MIDBODY SLING. (See figure 2-6.)

2-38. FUNCTION. The forward midbody sling is used for hoisting the forward midbody during installation on or removal from the vehicle on the vertical workstand or the vertical assembly fixture.

2-39. DESCRIPTION. The sling is a steel ring with three symmetrically placed eyebolts providing the means of attachment to the vehicle vertical hoisting sling (paragraph 2-19) with which the forward midbody is hoisted. The sling is bolted to the forward midbody at three existing hole locations in the area of the lower edge of the access doors.

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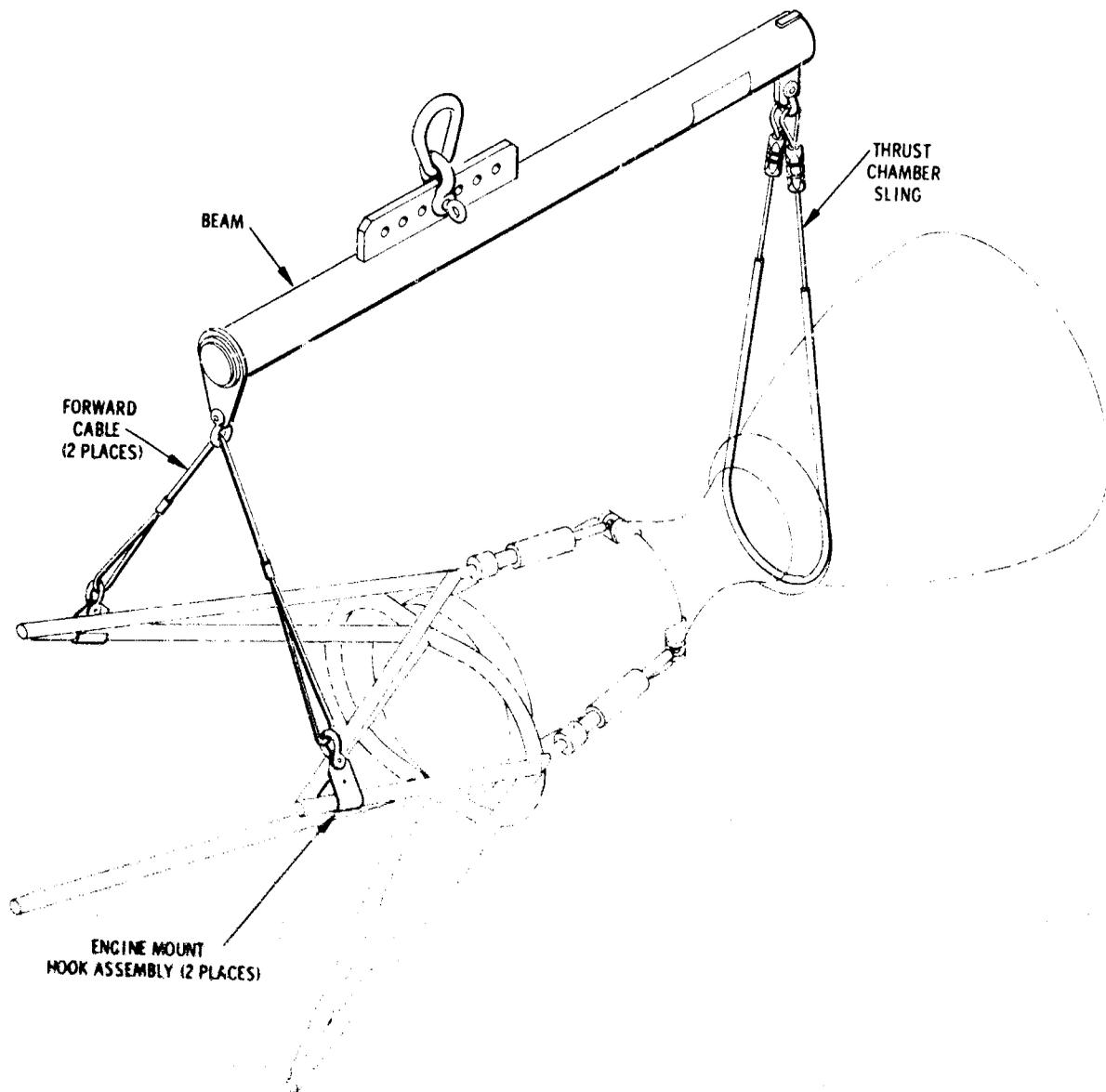


Figure 2-5. Engine Hoisting Sling

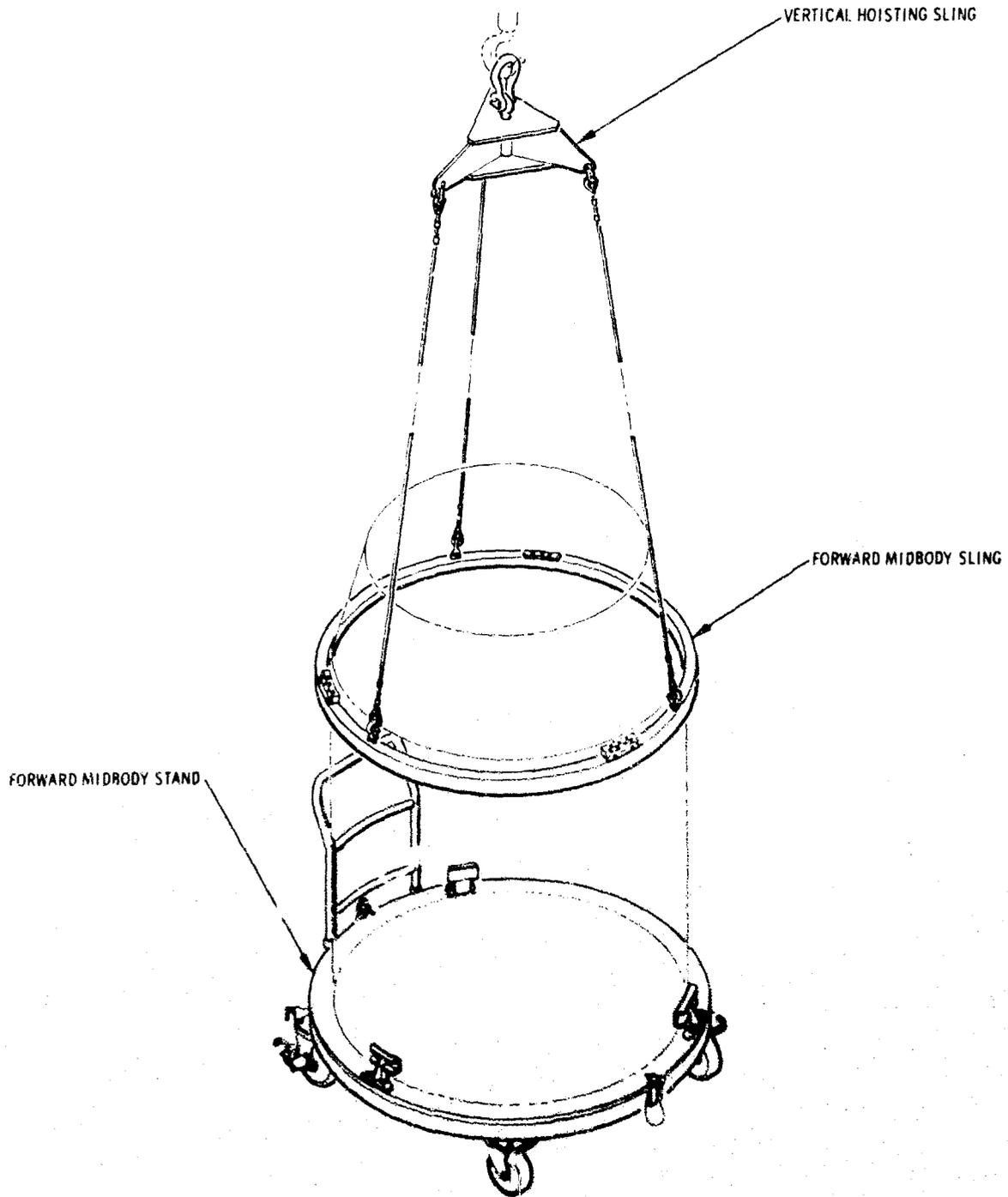


Figure 2-6. Forward Midbody Stand and Hoisting Equipment

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2-40. VEHICLE TENSION HOIST STRAP. (See items 27, 28, and 29, table 2-1.)

2-41. FUNCTION. The vehicle tension hoist strap provides added support at the separation plane of the vehicle and booster adapter during erecting operations at the launch pad.

2-42. DESCRIPTION. The hoist strap is a sheet steel fixture that is contoured and drilled with mounting holes to permit attachment to the vehicle and booster adapter. The strap bolts to matching holes in the vehicle and adapter at station 388.55. A handle is welded to the strap to facilitate handling. A red warning streamer is attached to the handle with wire. The hoist strap and the attaching bolts required are kept in a storage box when they are not in use. Vehicle tension hoist straps (items 27 and 28, table 2-1) are mounted on the vehicle at the centerline of quadrants I and IV with 36 AN4-5 attaching bolts. Vehicle tension hoist strap (item 29, table 2-1) is mounted on the vehicle in quadrant I with 33 AN4-5A attaching bolts. The mounting holes on the forward side of this strap must be drilled at time of installation. (Refer to LMSC Drawing No. 1599792 for drilling instructions.)

2-43. FORWARD MIDBODY STAND. (See figure 2-6.)

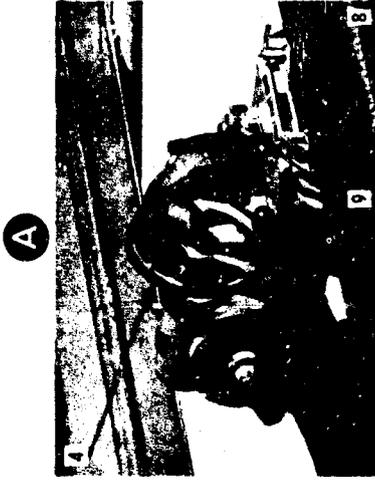
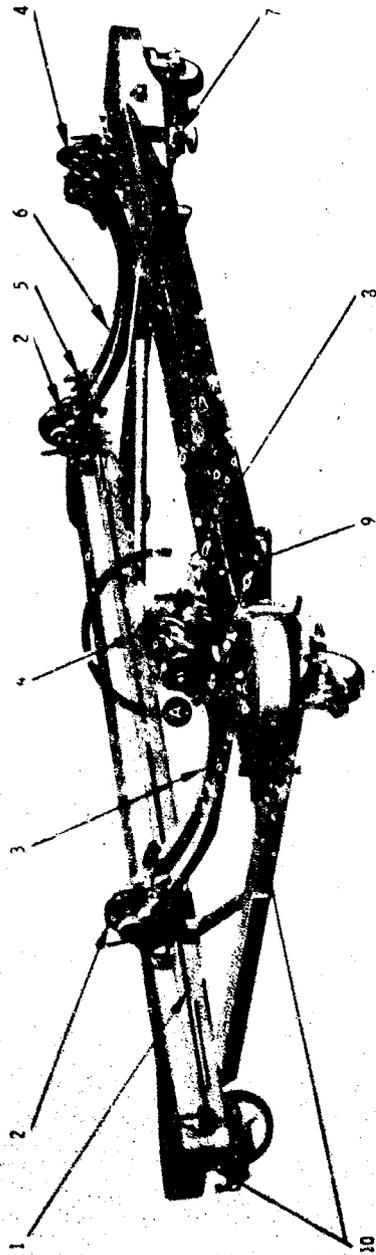
2-44. FUNCTION. The forward midbody stand is used for handling and storing the vehicle forward midbody in a vertical attitude.

2-45. DESCRIPTION. The forward midbody stand consists of a tubular steel ring mounted on four rubber-tired casters equipped with footbrakes. Two casters incorporate swivel locks. A plywood base, having an outer diameter of 66 inches and an inner diameter of 56 inches, is bolted to the upper surface of the ring. Three movable stabilizing brackets mounted on the upper surface of the base secure the vehicle midbody in position. A detachable handle is provided so that the stand can be pushed by hand. The two quick-release pins located on opposite sides of the stand are not used with current Agena vehicles.

2-46. VEHICLE HANDLING DOLLY. (See figure 2-7.)

2-47. FUNCTION. The vehicle handling dolly is a movable workstand that supports the vehicle in a horizontal attitude. It incorporates provisions for leveling the vehicle and for rotating the vehicle 360 degrees about its longitudinal axis. When used with Vehicle Handling Dolly Tow Bar, Part No. 1506532, the dolly provides a means for in-plant transportation of the vehicle.

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- 1. CRADLE TRACK (TYPICAL 2 PLACES)
- 2. ROLLER (TYPICAL 4 PLACES)
- 3. FRONT CRADLE
- 4. VEHICLE ROTATING MECHANISM
- 5. YOKE RETAINING CLAMP (TYPICAL 8 PLACES)
- 6. REAR CRADLE
- 7. LEVELING JACK (TYPICAL 4 PLAC 5)
- 8. CRADLE LOCKING PIN (TYPICAL 8 PLACES)
- 9. TRACK LOCK (TYPICAL 4 PLACES)
- 10. ATTACHING POINTS FOR TOW BAR 150652

Figure 2-7. Vehicle Handling Dolly

2-48. DESCRIPTION. The vehicle handling dolly is a welded steel frame mounted on four rubber-tired swivel casters equipped with footbrakes and swivel locks. Work platforms are incorporated along each side of the dolly. Two cradles are provided to support the vehicle. These cradles ride on tracks on each side of the dolly to provide fore and aft movement. Two rollers on each cradle support the vehicle in the applicable vehicle handling yoke and permit rotation of the vehicle about its longitudinal axis. This is accomplished by turning two handcranks which are connected through a gearbox to one roller on each cradle. The vehicle is leveled by means of four leveling jacks, one at each corner of the dolly. Retaining clamps secure the vehicle handling yoke to the cradles, track locks secure the cradles in position on the tracks, and pins lock the cradles for transportation. Attachment points are provided for the vehicle handling dolly tow bar at both ends of the dolly. The tow bar is constructed of two steel bars, 1.5 inches in diameter and 70 inches long, which are welded to a lunette. The tow bar is attached to the dolly with quick-release pins which are fastened to the dolly by lanyards.

2-49. VEHICLE TRANSPORTER AND AUXILIARY EQUIPMENT. (See figure 2-8.)

2-50. FUNCTION. The vehicle transporter and applicable auxiliary equipment are used to perform the following functions:

- a. Transport the Agena vehicle to the test site, airport, or launch site, when towed by a prime mover.
- b. Anchor, support, and shock-mount the vehicle in a cargo-type aircraft.
- c. Supply the vehicle propellant tanks with pressurized gaseous nitrogen to maintain pressure previously applied from a ground source.
- d. Provide dc power for the vehicle inertial reference package (IRP) heaters during transport.

2-51. DESCRIPTION. The vehicle transporter consists principally of a shock-isolated platform suspended on a chassis with four sets of dual wheels and incorporates a pneumatic system, a nitrogen pressurization system, and an electrical system. The chassis is suspended by leaf springs and airplane-type shock absorbers attached between the axles and frame at each dual-wheel set. The chassis is stabilized by two vertical stabilizing rods that restrict leaning at corners and eight horizontal stabilizing rods that restrict

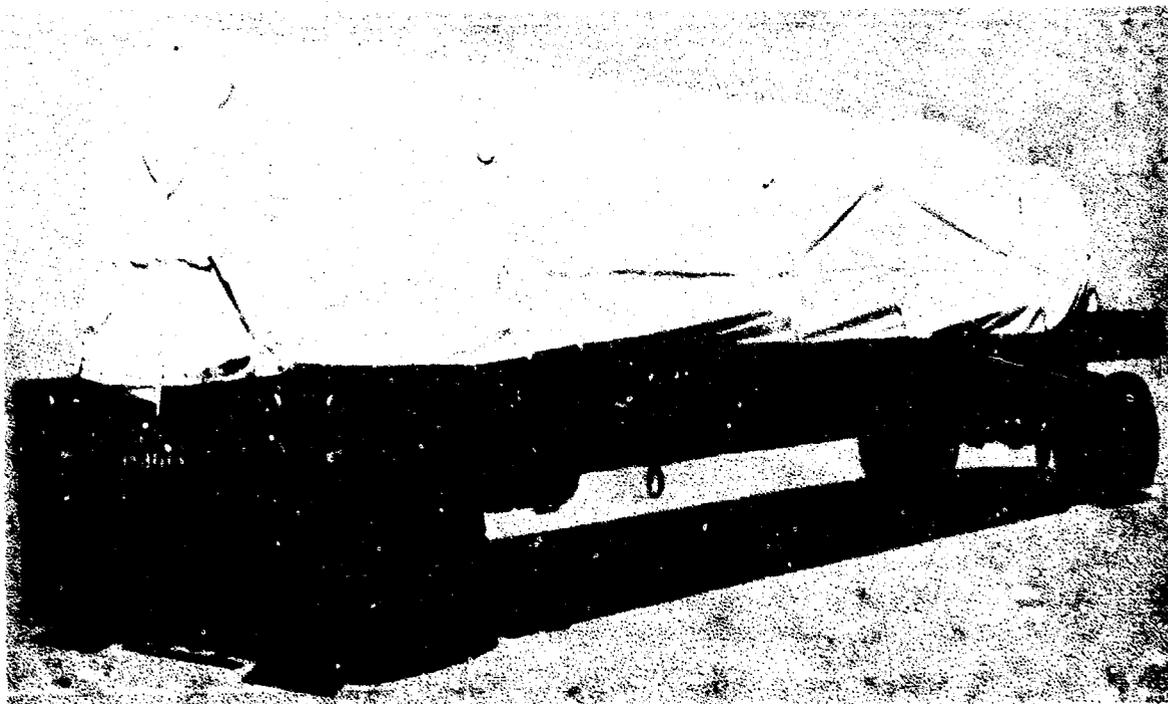
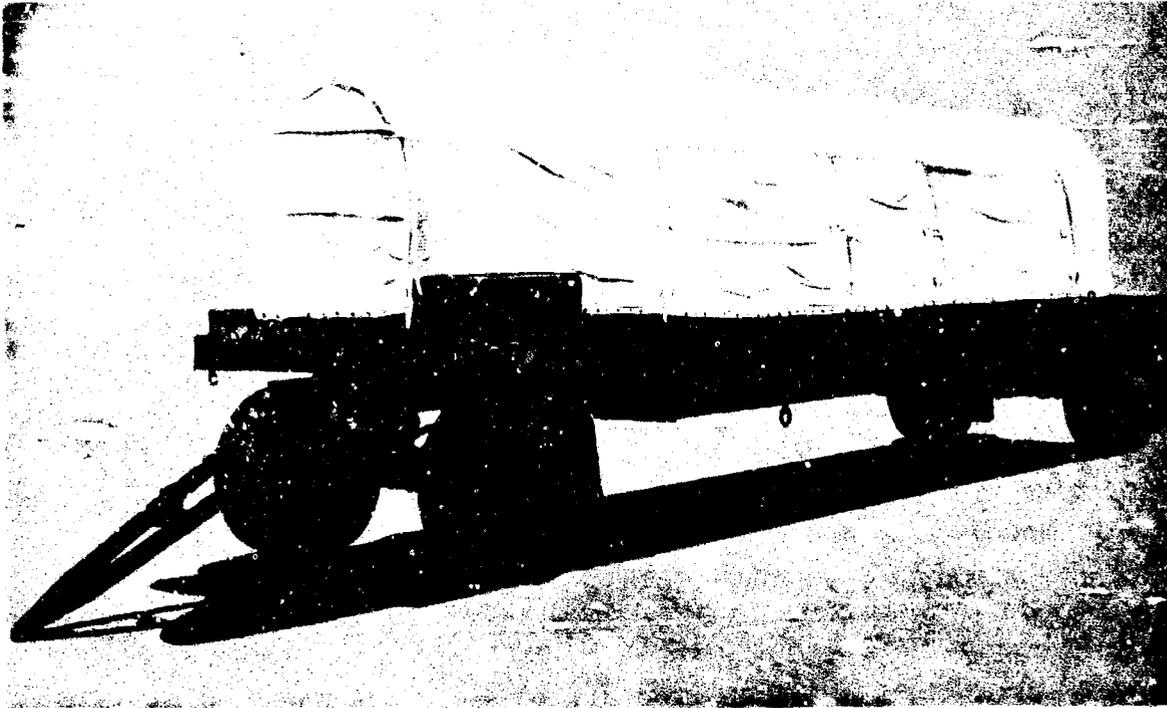


Figure 2-8. Vehicle Transporter

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lateral and longitudinal displacement of the platform. The platform is suspended on four air springs positioned between the platform and main frame. The two front air springs are controlled by air suspension control valve having two outlet ports. The two rear air springs are each controlled by a separate air suspension control valve having a single outlet port. The platform air suspension system and the transporter four-wheel service brakes require a source of 120-psig air pressure supplied from the prime mover through service and emergency airline hoses coupled to the front of the transporter. The integral nitrogen pressurization system is provided to maintain static pressure required in the vehicle propellant tanks when the vehicle is loaded on the transporter. The 12-volt dc electrical system consists of brake, tail, and clearance lights controlled and powered from the prime mover. Environmental protection for the vehicle is provided by a hoop-supported, weatherproof nylon cover. (Refer to Operation and Service Manual, LSMD-446256, for additional details.)

2-52. The vehicle transporter conversion equipment (item 34, table 2-1) consists of necessary hoops, protective cover, and fairing support to provide environmental protection for the Agena vehicle, Model 5205.

2-53. The vehicle transporter tank pressurization hose (item 35, table 2-1) consists of a hose assembly equipped with a filter, socket, and socket plug on one end and a coupling on the opposite end. This hose is used to connect the transporter nitrogen pressurization system to the applicable vehicle propellant tanks.

2-54. ADAPTER HANDLING DOLLY. (See figure 2-9.)

2-55. FUNCTION. The adapter handling dolly is used as an interfacility transporter and mobile storage stand for the vehicle adapter. It must be loaded on a suitable commercial conveyance for transportation over public roads.

2-56. DESCRIPTION. The adapter handling dolly is a spring-mounted unit consisting of a welded aluminum frame mounted on standard, commercial, pneumatic-tired hub-and-axle assemblies. The dolly has a tow bar with automotive-type steering and a hand-operated parking brake system for the rear wheels. The main frame has two padded saddles, which are contoured to receive the adapter, and nylon tiedown straps. The forward saddle is fixed; the rear saddle is adjustable to accommodate adapters of different lengths. A manually operated rear clamp assembly holds the adapter firmly against fixed stops at the forward end of the dolly. A storage box mounted on each side of the dolly frame provides space for storing the tiedown straps and associated fittings and two adapter protective covers. The two protective

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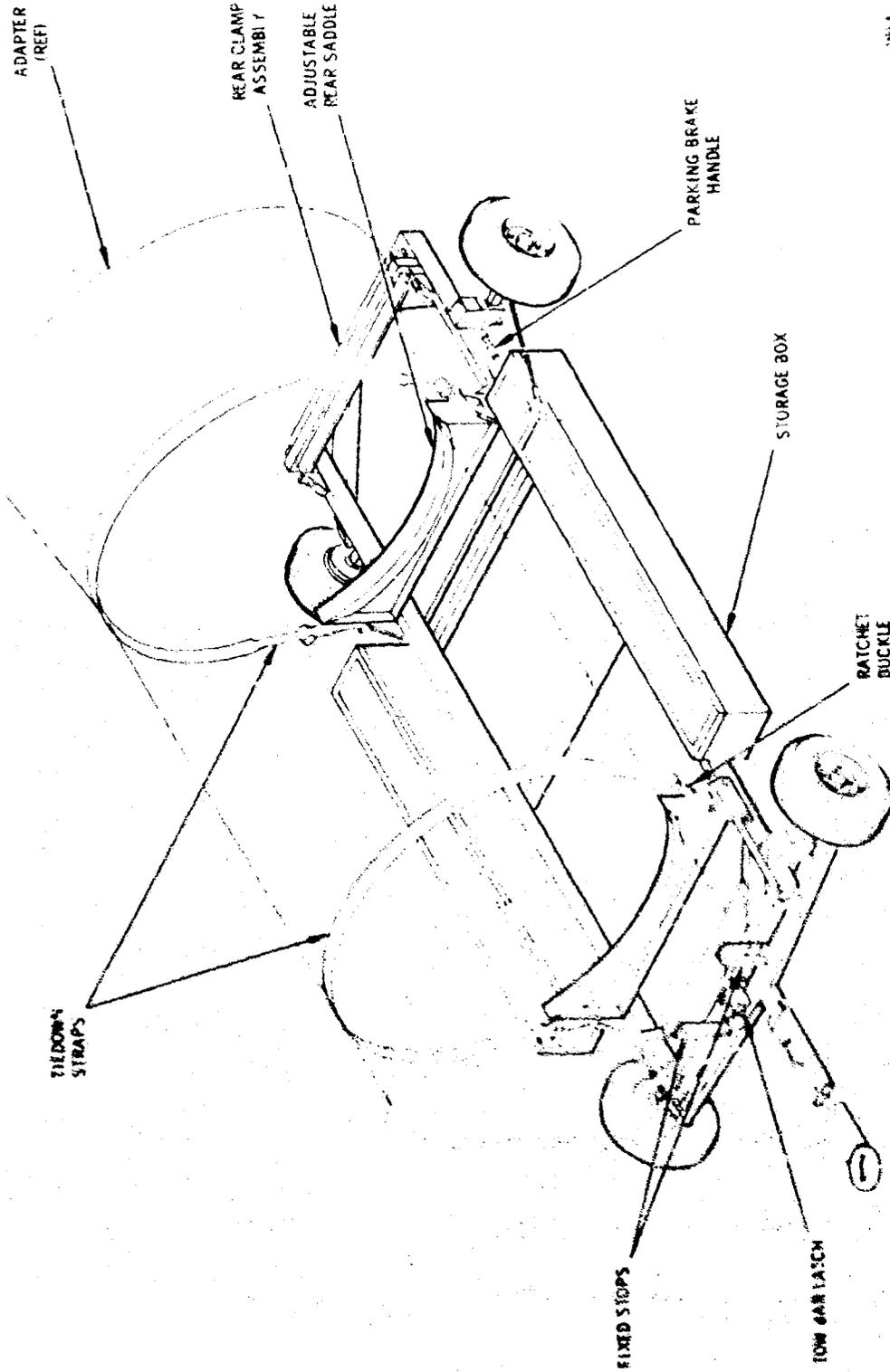


Figure 2-9. Adapter Handling Dolly

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covers are provided for accommodating adapters of different lengths. The protective covers are used with the dolly to protect the adapters from adverse environmental conditions and to serve as security shrouds. Each cover is made of waterproof vinyl-impregnated nylon and is closed by means of a zipper.

2-57. VEHICLE MATING DOLLY, PART NO. 1087102-503. (See item 37, table 2-1.)

2-58. The vehicle mating dolly consists of the Installation and Removal Trailer, Model 4100B (figure 2-10), modified by the addition of an Auxiliary Power Pack, Model 2410, and a toolbox. The function and description of these components are described in the following paragraphs.

2-59. INSTALLATION AND REMOVAL TRAILER, MODEL 4100B. (See figure 2-10.)

2-60. FUNCTION. The installation and removal trailer is used with the applicable mating fixtures for supporting and aligning the vehicle during horizontal mating operations with the booster on the launch pad.

2-61. DESCRIPTION. The trailer is a mobile four-wheel unit with hydraulically actuated lift mechanisms. The trailer wheels, with attaching support arms and wheel cylinder assemblies, are used to raise or lower the entire trailer with respect to the ground. Four sets of lower links are hinged to the main frame of the trailer at the bottom ends and to upper links at their top ends. The upper links are attached to and support the upper frame assembly which, in turn, supports a cradle assembly on top of which is a rail assembly. The upper frame may be raised or lowered with respect to the main frame by means of hydraulic lift cylinders attached to the link mechanism. The forward sets of hydraulic lift cylinders and links supporting the upper frame may be moved independently from the aft sets and vice versa. This allows the upper frame and rail assembly to be pitched up or down at either end. The rail assembly can be shifted laterally and yawed with respect to the upper frame by using the traverse adjustment knobs. The rail assembly can also be rotated about a longitudinal axis by using the rotation adjustment knob.

2-62. The trailer wheels may be turned by tie rod assemblies and locked 90 degrees from their normal positions for moving the trailer at right angles to the normal trailer movement. Footbrakes are provided on the aft wheels. During mating operations, stability is increased by transferring weight from the wheels to four adjustable foot assemblies located at the corners of the main frame. Additional stability is afforded by four outriggers, each

consisting of a jackscrew mounted in a hinged arm attached to the main frame near each corner.

2-63. The wheel cylinder assemblies are equipped with ratchet and pawl mechanisms for protecting the trailer in the event of hydraulic failure. The lift cylinder assemblies attached to the upper frame are protected by a hydraulic lock system. The safety lock release knobs must be pulled before the upper frame can be lowered.

2-64. The upper frame assembly contains a winch assembly which is manually operated by using a winch drive handle. The winch assembly is used for propelling the applicable mating fixture along the rails. The winch drawbar is manually connected to the mating fixture for winching operations.

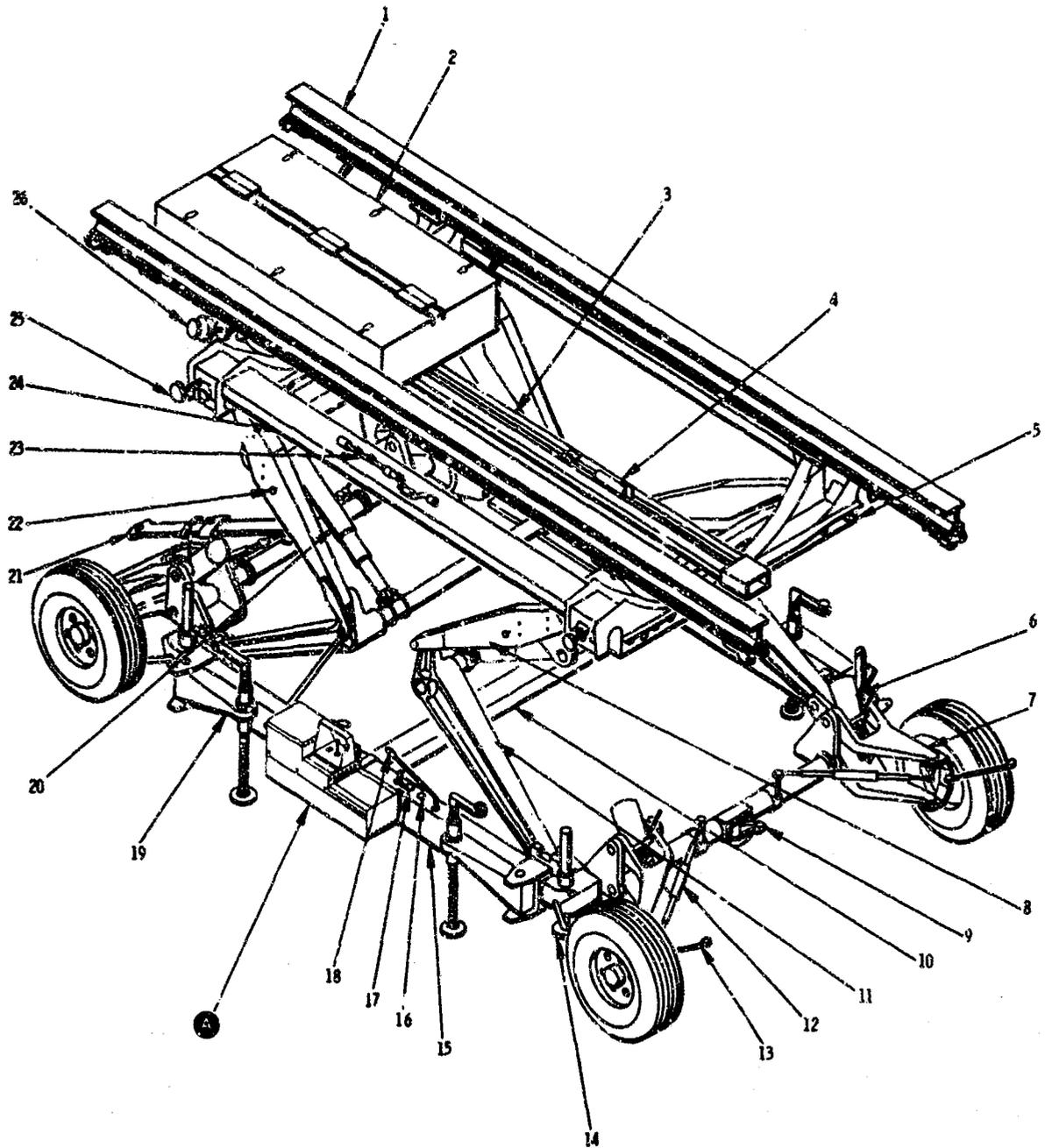
2-65. The reservoir for hydraulic fluid is located in the hollow central crossmember of the main frame. Hydraulic pressure is generated by the hand pumps located on the left-hand side of the main frame. Hydraulic fluid can be pumped into either the lift cylinder assemblies or the wheel cylinder assemblies by positioning the selector valve as required and operating the hand pumps. Movements are reversed by returning oil to the reservoir through the pump bypass valves.

2-66. A tow bar on the forward end of the main frame of the trailer and a pintle hook at the rear provide the means for towing the trailer singly or in train. A toolbox is provided between the rails for storing accessory items as may be required.

2-67. **AUXILIARY POWER PACK, MODEL 2410.** On some installation and removal trailers, the Auxiliary Power Pack, Model 2410, is employed to augment operation of hand pumps for lift operations. The power pack is a portable, detachable unit which is bolted to the left-hand side of the main frame. The power pack consists of a housing containing a 2.5-horsepower electric motor, hydraulic pump, and actuating valves along with attachment fittings and couplings. A power receptacle is provided for connecting the power pack to a facility source of 440-volt, 60-cycle, 3-phase electrical power. The controls, consisting of a motor switch, a valve control for forward trailer rams, and a valve control for aft trailer rams, are located under a shroud on top of the unit. Features for attaching the power pack include an access panel for hydraulic connections, a center support bracket, and two end attachment brackets.

2-68. **VEHICLE HORIZONTAL MATING FIXTURE.** (See figure 2-11.)

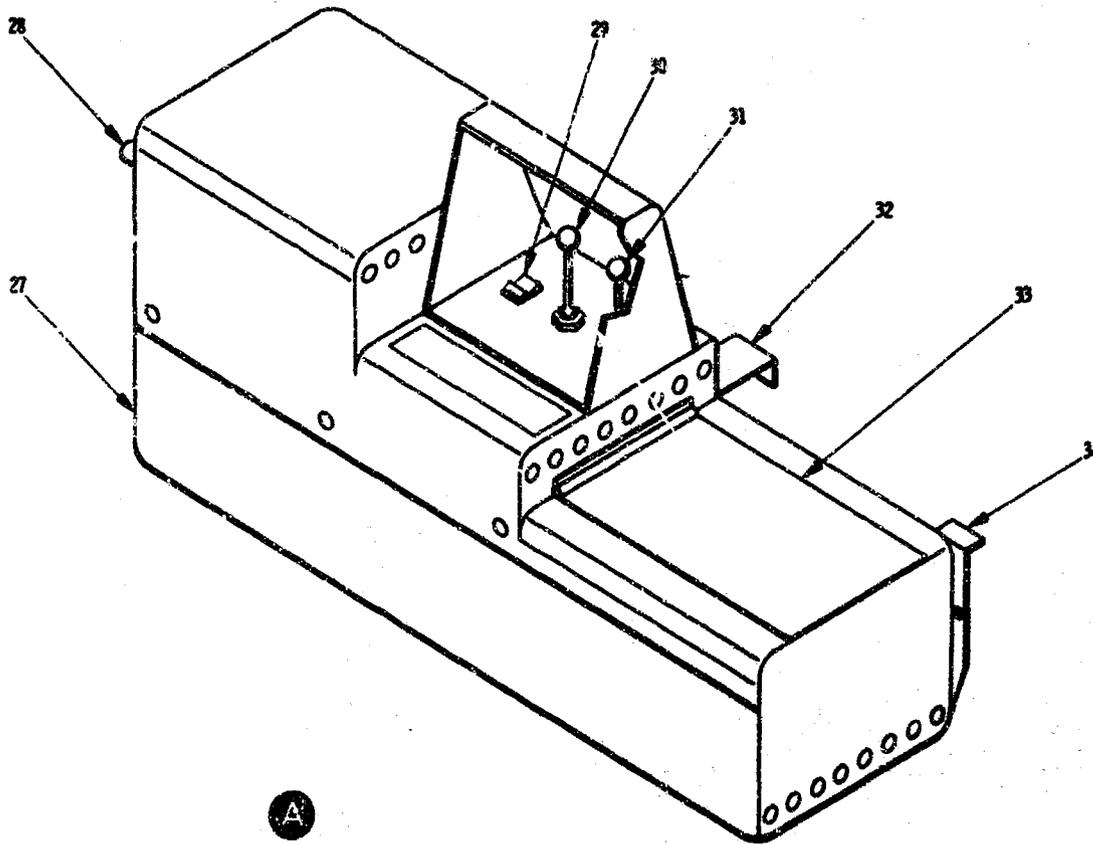
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**Figure 2-10. Installation and Removal Trailer, Model 41003 (Sheet 1 of 2)**

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- |                                       |   |  |
|---------------------------------------|---|--|
| 1. RAIL ASSEMBLY                      | 13. FOOTBRAKE                           | 25. TRAVERSE ADJUSTMENT KNOB               |
| 2. TOOL BOX                           | 14. FOOT ASSEMBLY (4 PLACES)            | 26. ROTATION ADJUSTMENT KNOB               |
| 3. WINCH ASSEMBLY                     | 15. MAIN FRAME                          | 27. AUXILIARY POWER PACK, MODEL 2410       |
| 4. WINCH DRAWBAR                      | 16. PUMP BYPASS VALVE (2 PLACES)        | 28. POWER RECEPTACLE                       |
| 5. CRADLE ASSEMBLY (2 PLACES)         | 17. SELECTOR VALVE                      | 29. MOTOR SWITCH                           |
| 6. WHEEL CYLINDER ASSEMBLY (4 PLACES) | 18. HAND PUMP (2 PLACES)                | 30. VALVE CONTROL FOR FORWARD TRAILER BARS |
| 7. SUPPORT ARM (4 PLACES)             | 19. OUTRIGGER (4 PLACES)                | 31. VALVE CONTROL FOR AFT TRAILER BARS     |
| 8. UPPER LINK (4 PLACES)              | 20. LIFT CYLINDER ASSEMBLY (4 PLACES)   | 32. CENTER SUPPORT BRACKET                 |
| 9. PINTLE HOOK                        | 21. TOWBAR                              | 33. ACCESS PANEL TO HYDRAULIC CONNECTIONS  |
| 10. RESERVOIR                         | 22. SAFETY LOCK RELEASE KNOB (2 PLACES) | 34. END ATTACH BRACKET (2 PLACES)          |
| 11. LOWER LINK (4 PLACES)             | 23. WINCH DRIVE HANDLE (STRAPPED)       |  |
| 12. TIEROD ASSEMBLY (4 PLACES)        | 24. UPPER FRAME ASSEMBLY                |  |

Figure 2-10. Installation and Removal Trailer, Model 4100B (Sheet 2 of 2)

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**2-69. FUNCTION.** The vehicle horizontal mating fixture provides the means for adapting the vehicle to the rails of the vehicle mating dolly (item 37, table 2-1) for mating the vehicle to the booster adapter on the launch pad.

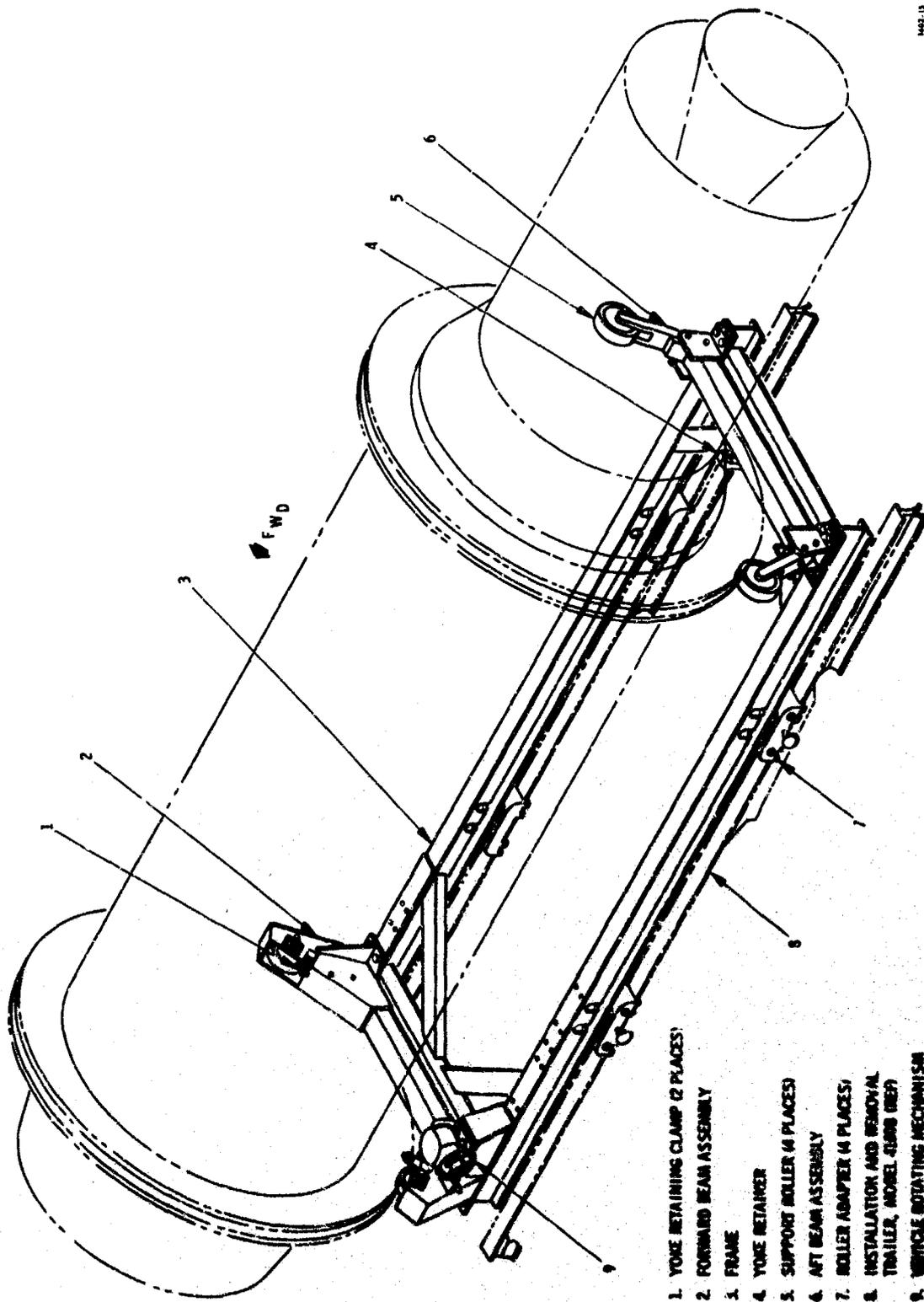
**2-70. DESCRIPTION.** The vehicle horizontal mating fixture consists of a main frame, a forward beam assembly, and an aft beam assembly. Four roller adapters are mounted on the lower side of the main frame for attaching the mating fixture to the rail assembly of the mating dolly (item 37, table 2-1). The forward beam assembly incorporates a vehicle rotating mechanism and two yoke retaining clamps. The aft beam assembly incorporates a yoke retainer and two free-turning support rollers. The vehicle rotating mechanism consists of a handwheel-operated gear reducer that chain-drives both support rollers on the forward beam assembly through a series of sprockets. The two yoke retaining clamps on the forward beam assembly and the yoke retainer on the aft beam assembly are used for securing the vehicle on the mating fixture.

**2-71. VEHICLE MATING DOLLY, PART NO. 1508690.** (See item 39, table 2-1.)

**2-72. FUNCTION.** The vehicle mating dolly provides the means for supporting and positioning the vehicle during horizontal mating operations with the booster on the launch pad.

**2-73. DESCRIPTION.** The mating dolly consists of an Installation and Removal Trailer, Model 4100B (figure 2-10), and a Vehicle Mating Fixture, Part No. 1506809 (figure 2-12). The installation and removal trailer is described in paragraph 2-59. The mating fixture consists of a frame assembly with four roller adapters. The roller adapters are attached to the bottom of the fixture for adapting it to the rail assembly of the mating dolly. Two support rollers are mounted on cradles at each end of the frame assembly. These rollers are positioned to fit the outer flange channels of the vehicle handling yoke. The support rollers on one side of the frame assembly are coupled to the vehicle rotating mechanism. The rotating mechanism consists of a handwheel, a reductor, two drive rods, and four rod couplings. A winch drawbar attachment clevis is located on the lower side of the frame assembly at the aft end. This clevis is used for attaching the winch drawbar located on the installation and removal trailer. Two yoke retaining clamps on each of the cradles are used for securing the vehicle on the mating fixture.

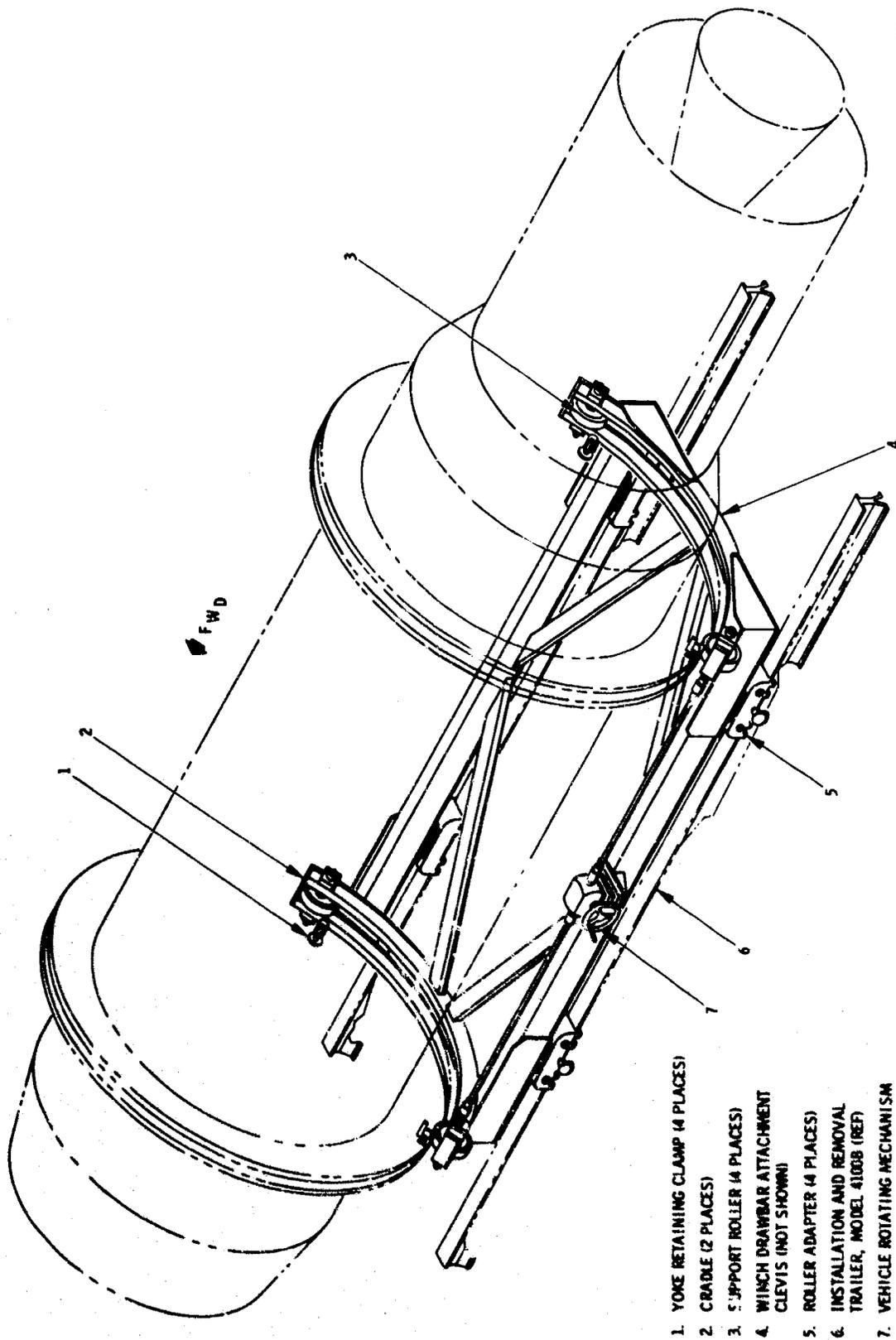
**2-74. VEHICLE CHECKOUT STAND.** (See figure 2-13.)



1. YOKE RETAINING CLAMP (2 PLACES)
2. FORWARD BEAM ASSEMBLY
3. FRAME
4. YOKE RETAINER
5. SUPPORT ROLLER (4 PLACES)
6. AFT BEAM ASSEMBLY
7. ROLLER ADAPTER (4 PLACES)
8. INSTALLATION AND REMOVAL TRAILER, MODEL 4180B (REF)
9. VEHICLE ROTATING MECHANISM

Figure 2-11. Vehicle Horizontal Mating Fixture, Part No. 1591165

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- 1. YOKE RETAINING CLAMP (4 PLACES)
- 2. CRADLE (2 PLACES)
- 3. SUPPORT ROLLER (4 PLACES)
- 4. WINCH DRAWBAR ATTACHMENT CLEVIS (NOT SHOWN)
- 5. ROLLER ADAPTER (4 PLACES)
- 6. INSTALLATION AND REMOVAL TRAILER, MODEL 4100B (REF)
- 7. VEHICLE ROTATING MECHANISM

Figure 2-12. Vehicle Mating Fixture, Part No. 1506809

2-75. **FUNCTION.** The vehicle checkout stand is used to support the vehicle in a horizontal attitude during system testing and checkout. The stand is used in conjunction with the auxiliary hydraulic cart (item 41, table 2-1) to raise and lower one side, or one end, of the vehicle at an even and timed rate to simulate pitch, yaw, and roll conditions.

2-76. **DESCRIPTION.** The vehicle checkout stand consists of a tubular steel frame that is cross braced with channel iron and supported on four rubber-tired swivel casters equipped with swivel locks. Leveling jacks are provided at each corner. Three jacking points (one on the right, two on the left) and three steel pivot pads (two on the right, one on the left) are welded to the bottom of the side frame members for placement of the hydraulic jacks and pivot supports, which are provided with the auxiliary hydraulic cart, during vehicle checkout. Three sets of rollers, each mounted on one of the cross braces, are spaced to accommodate two different vehicle yoke ring spans. A handwheel geared to one roller is provided for rotating the vehicle about its longitudinal axis. Yoke retaining clamps on the cross braces tighten on the yoke rings and secure the vehicle on the stand. A cable assembly equipped with turnbuckles is attached to the stand in line with one set of rollers. This cable assembly provides additional anchoring by tightening into the channel of the yoke ring which is supported on the rollers.

2-77. **AUXILIARY HYDRAULIC CART.** (See figure 2-13.)

2-78. **FUNCTION.** The auxiliary hydraulic cart is used in conjunction with the vehicle checkout stand (item 40, table 2-1) to raise and lower one side of a vehicle at an even and timed rate during checkout and testing operations on the vehicle systems.

2-79. **DESCRIPTION.** The auxiliary hydraulic cart is a mobile hydraulic pressure supply unit that includes hoses, cables, jacks, and the control components needed for operation. The cart is serviced with hydraulic fluid (Military Specification MIL-H-5606). An external 440-volt, 60-cycle, 3-phase power supply is required for cart operation. The cart is a cabinet mounted on four rubber-tired casters with an exposed control panel. A handle is located on one end of the cabinet for moving the cart manually. (For additional information, refer to Operation and Service Instructions Manual, LMSD-6278.)

2-80. **VEHICLE HOLDING DOLLY.** (See figure 2-14.)

2-81. **FUNCTION.** The vehicle holding dolly supports an Agena vehicle, Model 6205, installed in the vehicle handling yokes, during storage.

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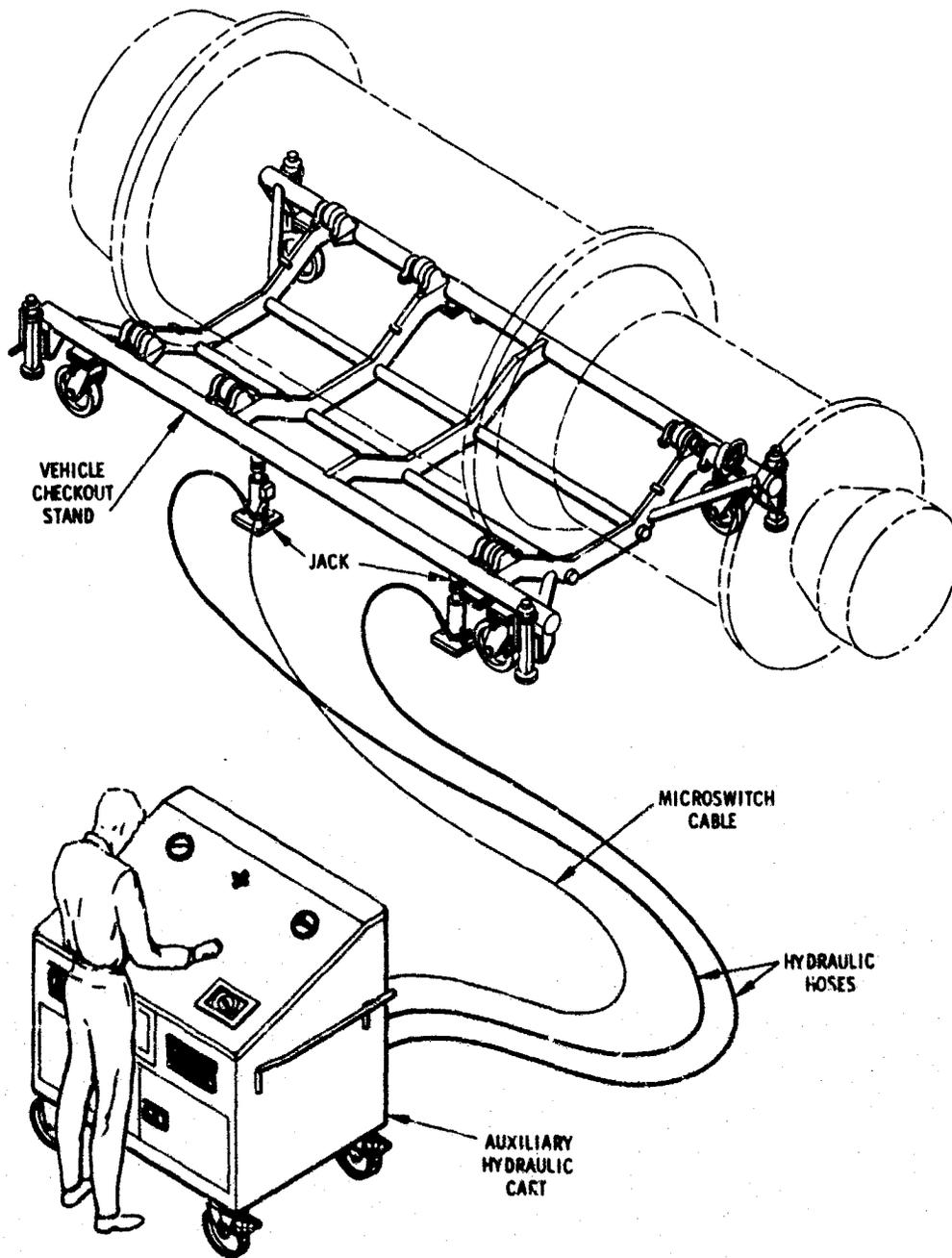


Figure 2-13. Vehicle Checkout Stand and Auxiliary Hydraulic Cart

1482-11

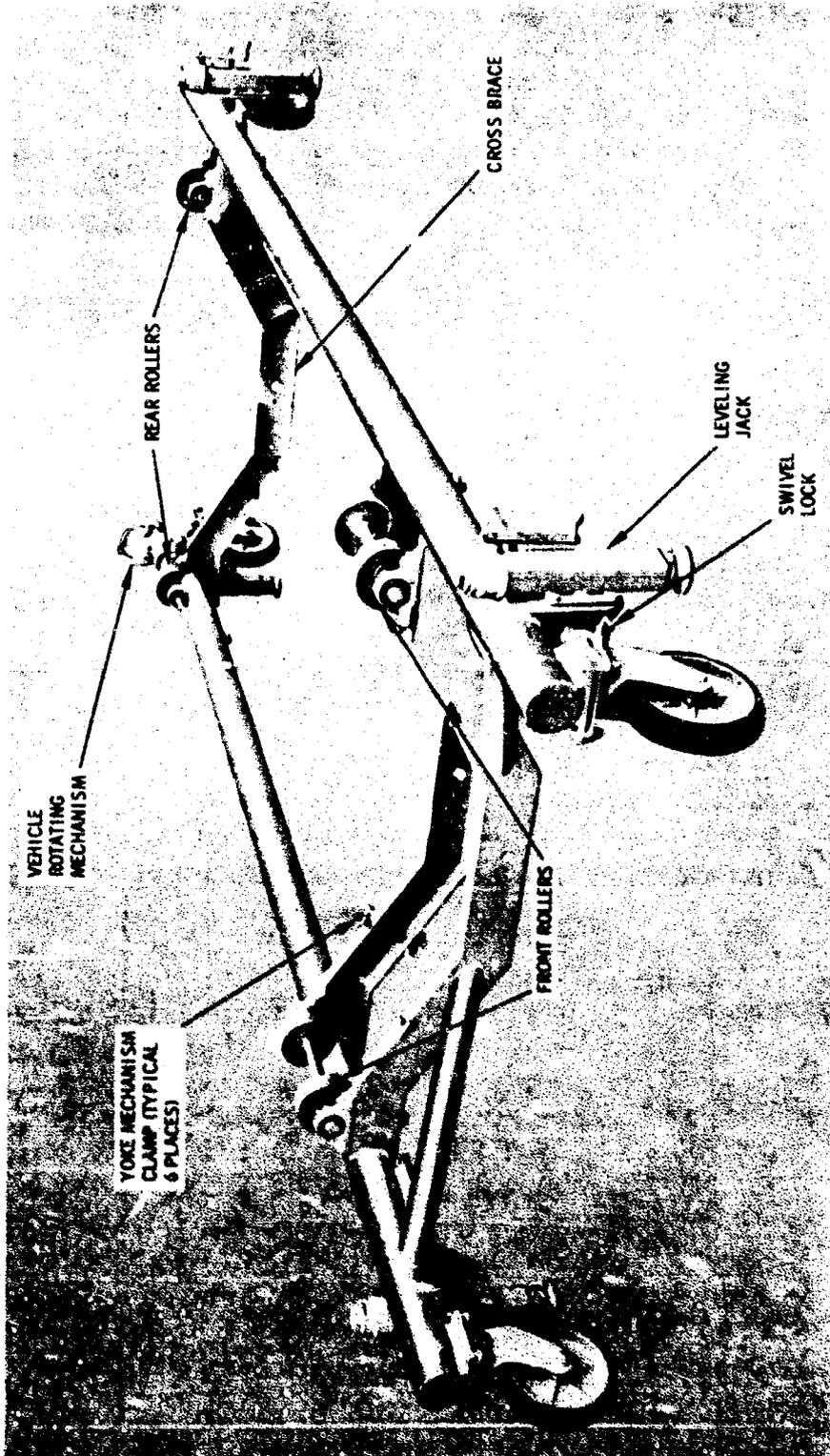


Figure 2-14. Vehicle Holding Dolly

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2-82. DESCRIPTION. The dolly is a caster-mounted steel framework contoured to receive the vehicle, installed in the handling yokes, on rollers. The roller spacing is adjustable by pillow block setscrews for the particular vehicle. Four leveling jacks near the corners of the dolly are used for leveling and supporting it. A vehicle rotating mechanism, connected to one support roller, provides a means of rotating the vehicle about its longitudinal axis. Six yoke retaining clamps are provided for securing the vehicle on the dolly.

2-83. NASA FACILITY CHECKOUT VEHICLE HOLDING DOLLY. (See item 43, table 2-1.)

2-84. FUNCTION. The vehicle holding dolly supports the Facility Checkout Vehicle (FCV), Serial Number 0205-0005, at the Atlantic Missile Range (AMP).

2-85. DESCRIPTION. The holding dolly is similar in appearance to the vehicle checkout stand (figure 2-13) and the vehicle holding dolly (figure 2-14), except that the dolly does not have leveling jacks, swivel locks, a rotating mechanism, or yoke retaining clamps. The dolly incorporates caster footbrakes, a towbar, and tiedown straps.

2-86. ENGINE REMOVAL DOLLY. (See figure 2-15.)

2-87. FUNCTION. The engine removal dolly is used for handling the engine during installation in or removal from the vehicle installed in the vehicle handling dolly.

2-88. DESCRIPTION. The engine removal dolly is a tubular steel framework mounted on four swivel casters equipped with swivel locks. Two foot-operated floor locks permit the dolly to be held securely in position during usage. The dolly consists of two arched members welded to a rectangular base which supports a horizontal cantilevered boom. A winch-operated cable, with a clevis which passes through the boom and over a pulley at each end of the boom, is provided for raising or lowering the engine. The removal or installation of the complete engine is accomplished with the aid of a lift bar assembly attached to the engine in place of one of the hydraulic actuators. The separate removal or installation of only that portion of the engine aft of the gimbals is accomplished by attaching a sling assembly to the engine thrust chamber. This loose equipment is stored in a storage box mounted on the dolly.

2-89. ENGINE MAINTENANCE STAND. (See figure 2-16.)

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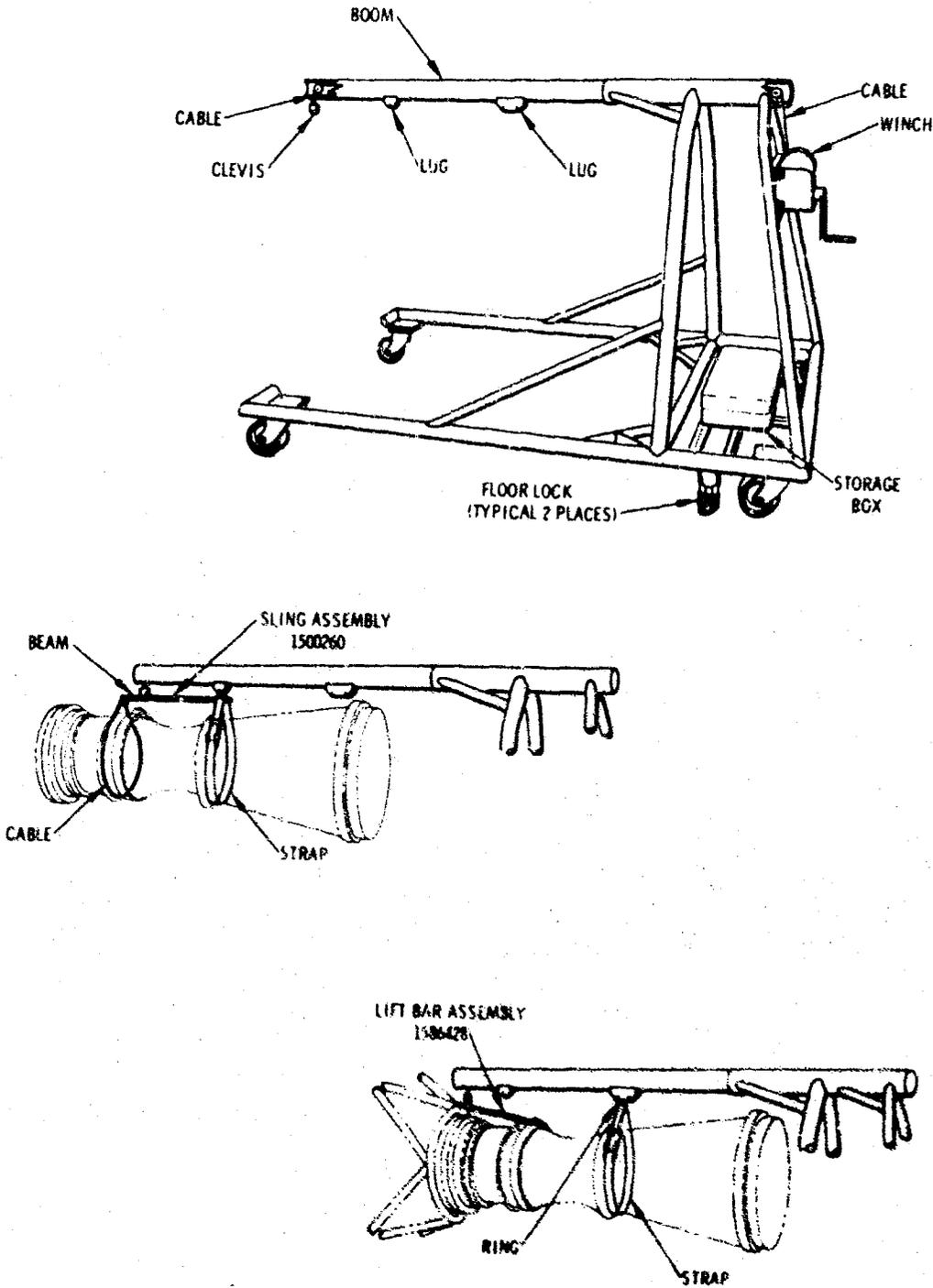


Figure 2-15. Engine Removal Dolly

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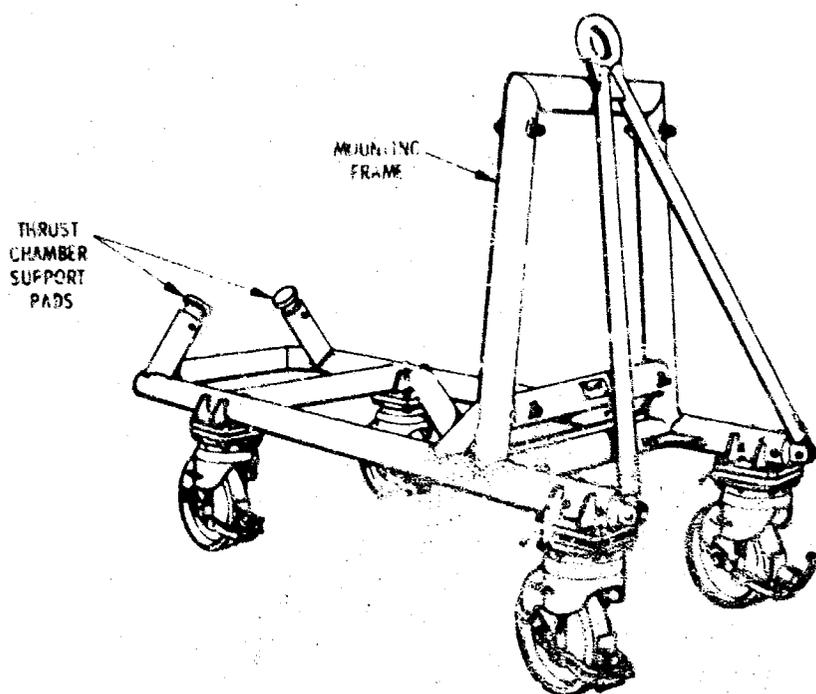


Figure 2-16. Engine Maintenance Stand

2-90. **FUNCTION.** The engine maintenance stand is used for supporting, transporting, and handling the vehicle rocket engine during fabrication and checkout.

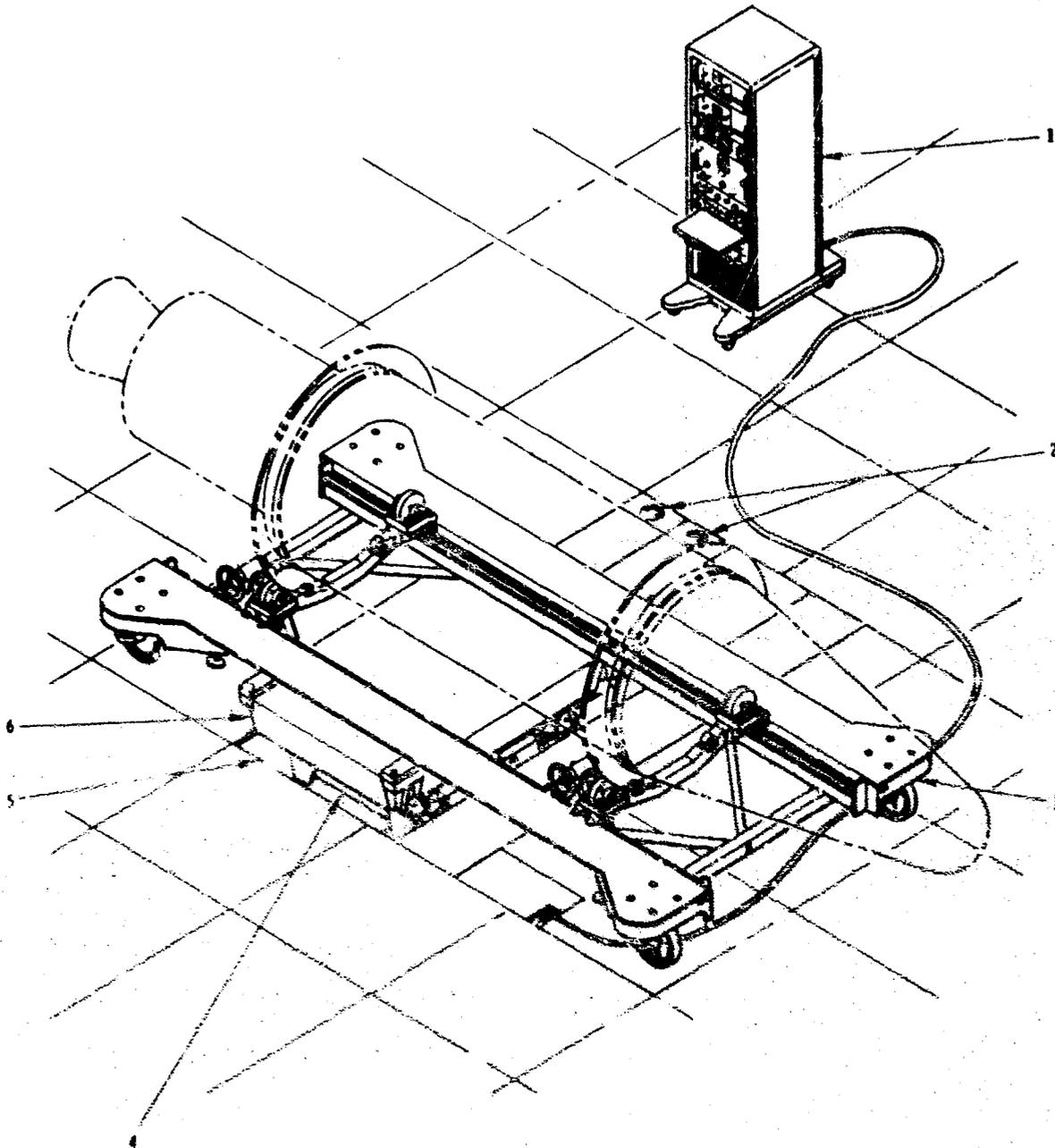
2-91. **DESCRIPTION.** The engine maintenance stand is a caster-mounted tubular frame that supports the rocket engine at the forward mounting points by screws and at the nozzle end on padded rests. Each caster is full-swiveling and incorporates a locking device. The stand is equipped with a tow bar.

2-92. **VEHICLE PITCH AND ROLL STAND.** (See figure 2-17.)

2-93. **FUNCTION.** The vehicle pitch and roll stand is used for subjecting a vehicle to pitch, yaw, and roll motions and testing the vehicle guidance equipment after it has been installed in the vehicle.

2-94. **DESCRIPTION.** The pitch and roll stand is made up of three major assemblies: a frame assembly, a hydraulic supply assembly, and an electrical control rack. The frame assembly is the means by which the vehicle is supported and is subjected to the pitch, yaw, and roll motions imparted

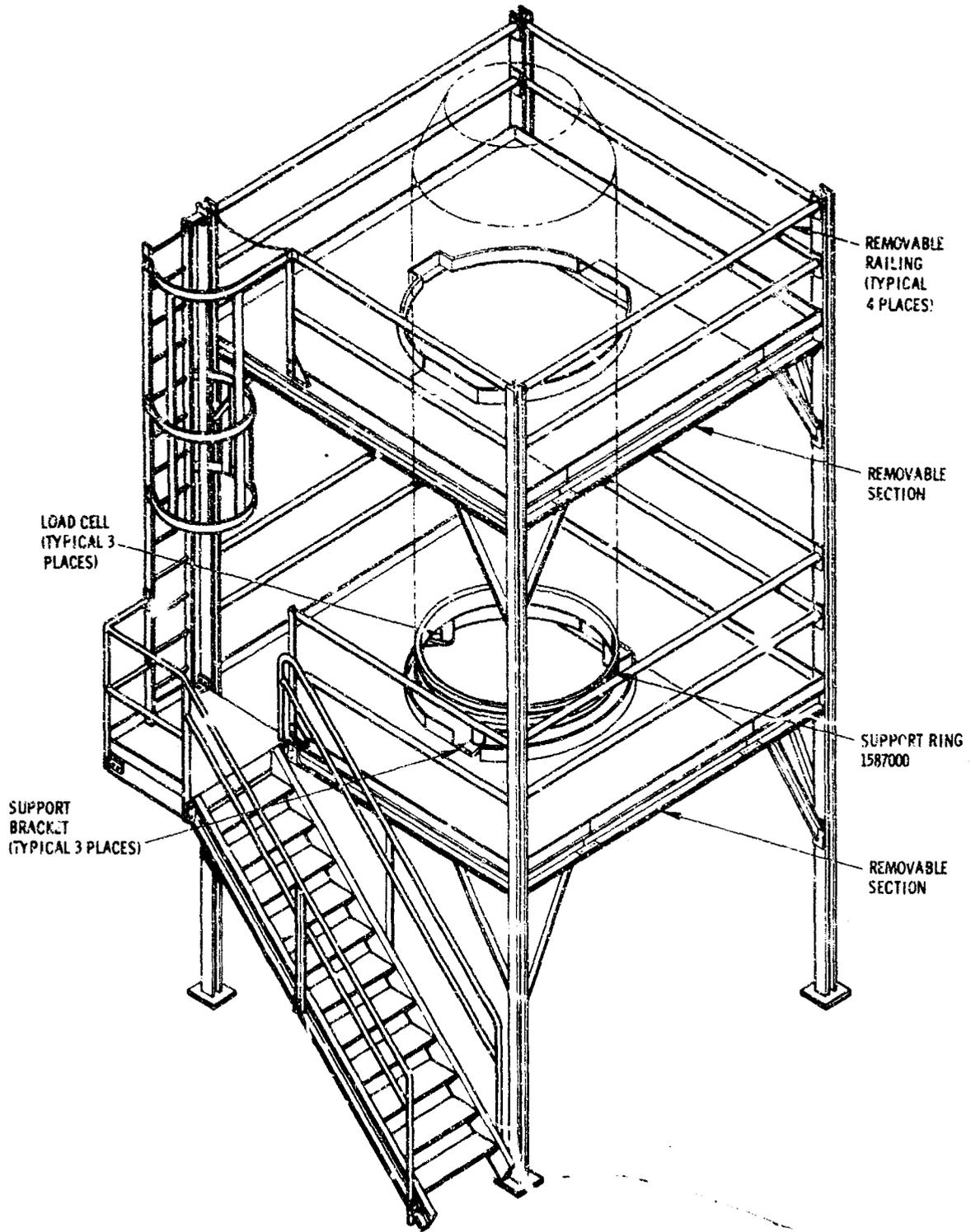
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- |                                      |                         |
|--------------------------------------|-------------------------|
| 1. ELECTRICAL CONTROL CONSOLE        | 4. LOWER FRAME ASSEMBLY |
| 2. ACCESS DOORS TO HYDRAULIC CONSOLE | 5. PIT                  |
| 3. VEHICLE HANDLING DOLLY (INCL.)    | 6. UPPER FRAME ASSEMBLY |

Figure 2-17. Vehicle Pitch and Roll Stand

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**Figure 2-16. Vertical Workstand**

by hydraulic actuators. These actuators are controlled by electrical signals from the control panel on the electrical control rack. The frame assembly has an upper frame and a lower frame. Motions of the frame assembly are indicated, in degrees, on protractors secured to the lower frame. Transducers on the hydraulic actuators transmit frame movements by means of electrical signals to the electrical control rack, where external recording equipment permits a permanent record to be made of the frame pitch, yaw, and roll motions.

2-95. VERTICAL WORKSTAND. (See figure 2-18.)

2-96. FUNCTION. The vertical workstand supports the vehicle in the vertical position for assembly, disassembly, modification, and checkout of the vehicle and is used with load cells for determining the lateral center of gravity and weight of the vehicle.

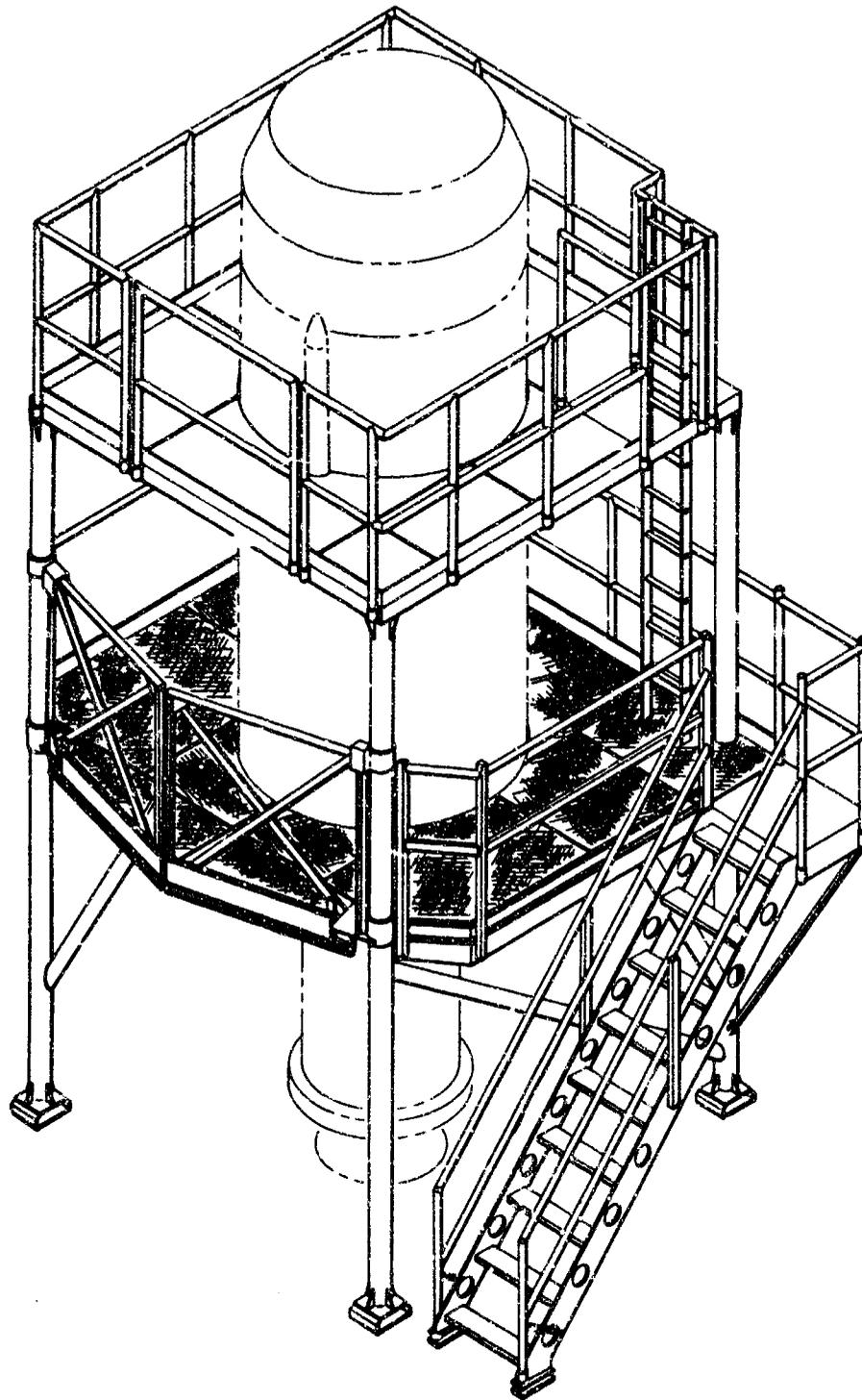
2-97. DESCRIPTION. The vertical workstand is a two-level, structural steel stand that is bolted together and mounted on four pads. A platform at each level, with safety rails and access stairs, provides working area for personnel. First - and second-level floor sections are removed for installation of the vehicle. A support ring, provided with the workstand, is attached to the vehicle at station 388.55 before installation. The vehicle is placed in the workstand, where it is supported on the support ring by three steel brackets, and is leveled by three adjustable studs. Jacks are provided with the workstand to compensate for deflection of structural members during the center of gravity test and to provide additional support for a vehicle when it is loaded with fuel. The workstand sections removed for installation of the vehicle must be replaced and bolted in position for structural rigidity.

2-98. VERTICAL ASSEMBLY FIXTURE. (See figure 2-19.)

2-99. FUNCTION. The vertical assembly fixture provides two levels of work platforms for access to a vertical vehicle during major assembly and disassembly operations. The assembly fixture also provides equipment for determining the weight and lateral center of gravity of the vehicle.

2-100. DESCRIPTION. The vertical assembly fixture is a tubular steel structure with two work platforms which surround the vehicle. A stairway with guardrails provides access to the first-level work platform, and a service ladder extends up to the second level. A section of the lower platform swings aside for installation of the vehicle on a split circular support pad. The upper platform also has a removable section that permits installation of the vehicle. Hoist cables stored in boxes on the second-level

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**Figure 2-19. Vertical Assembly Fixture**

platform are used for handling the removable section. The first- and second-level platforms can be separated and dismantled. The weight of the vehicle can be determined with load cells mounted in the lower platform framework which supports the vehicle. These load cells are used with an electronic weighing kit and an auxiliary attaching ring.

**2-101. CENTER OF GRAVITY AND MOMENT OF INERTIA EQUIPMENT.**  
(See figure 2-20.)

**2-102. FUNCTION.** The center of gravity and moment of inertia equipment is used for determining the following data about the vehicle:

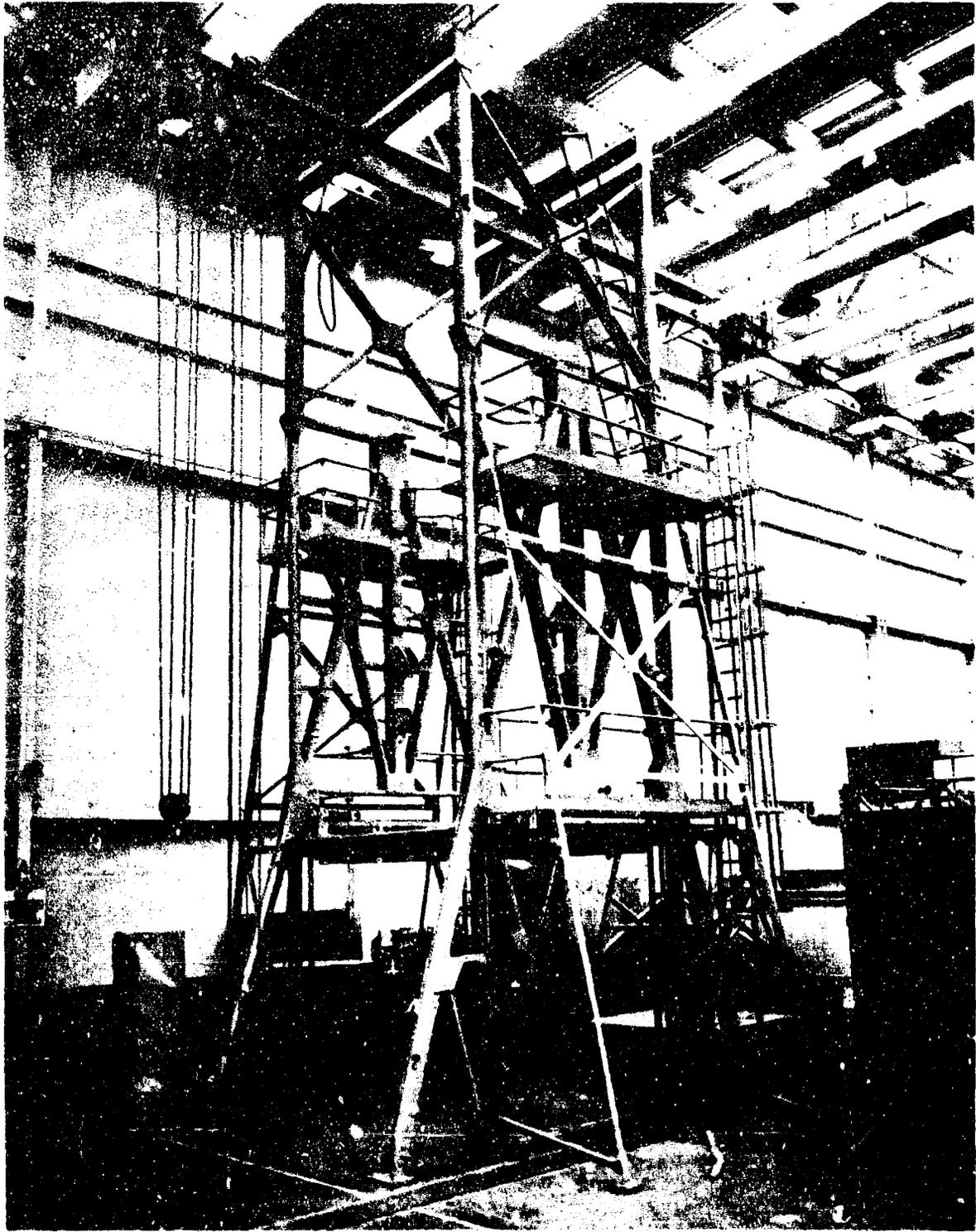
- a. Weight.
- b. Location of the center of gravity.
- c. Moments of inertia.
- d. Locations of the principal axes.

**2-103. DESCRIPTION.** The equipment consists of a structural steel stand 40 feet high with a 5-ton electrical hoist that operates on an overhead mono-rail. A lifting platform, suspended on four screwjacks powered by a 5-horsepower motor, is provided for handling the vehicle. The lifting platform incorporates inner frames for precise horizontal movement in two perpendicular directions, a hydraulically operated tilting frame, and a rotating ring for positioning the vehicle. The stand is equipped with ladders, catwalks, retractable platforms, and handrails for safe access to the vehicle by personnel. A swinging platform is provided with interchangeable support arms so that the vehicle can be swung as a compound pendulum at two different lengths, as a level bifilar pendulum, and as a bifilar pendulum with a 10-degree tilt. A photoelectric transducer, two electronic counters, and a printer are used for measuring and recording the period of oscillation of the swinging platform with an accuracy within  $\pm 0.0001$  second. (Refer to Operation and Service Manual, LMSD-445923, for additional details.)

**2-104. VEHICLE WEIGHING AND CENTER OF GRAVITY DETERMINATION FITTING.** (See item 50, table 2-1.)

**2-105. FUNCTION.** The vehicle weighing and center of gravity determination fitting provides the means for attaching the vehicle to hoisting equipment with load cells for determining the weight and longitudinal center of gravity of the vehicle.

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**Figure 2-20. Center of Gravity and Moment of Inertia Equipment**

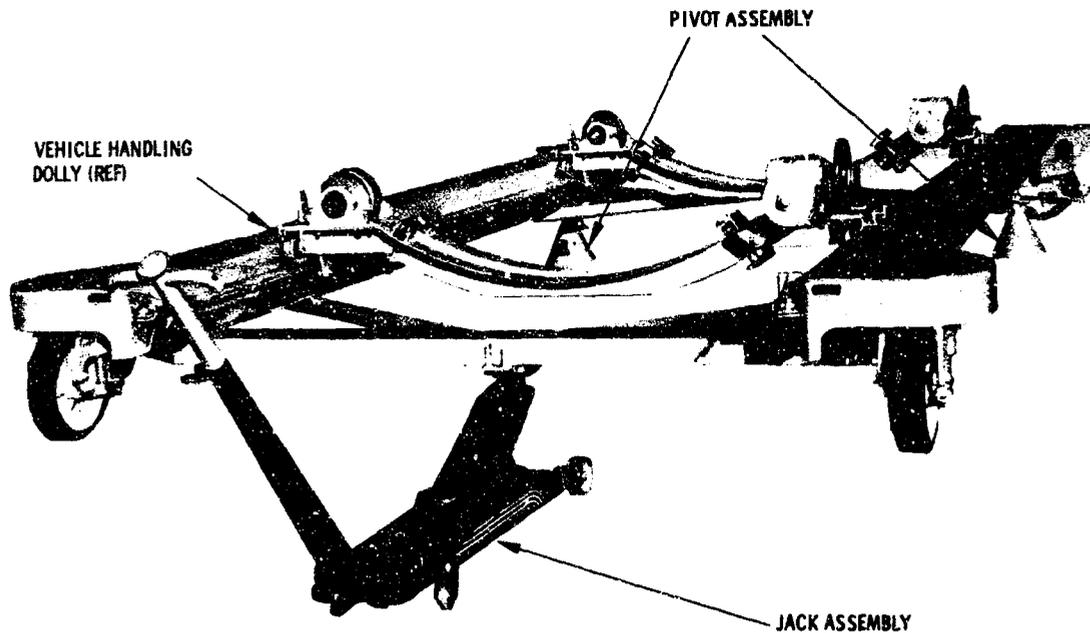


Figure 2-21. Vehicle Tilt and Roll Equipment

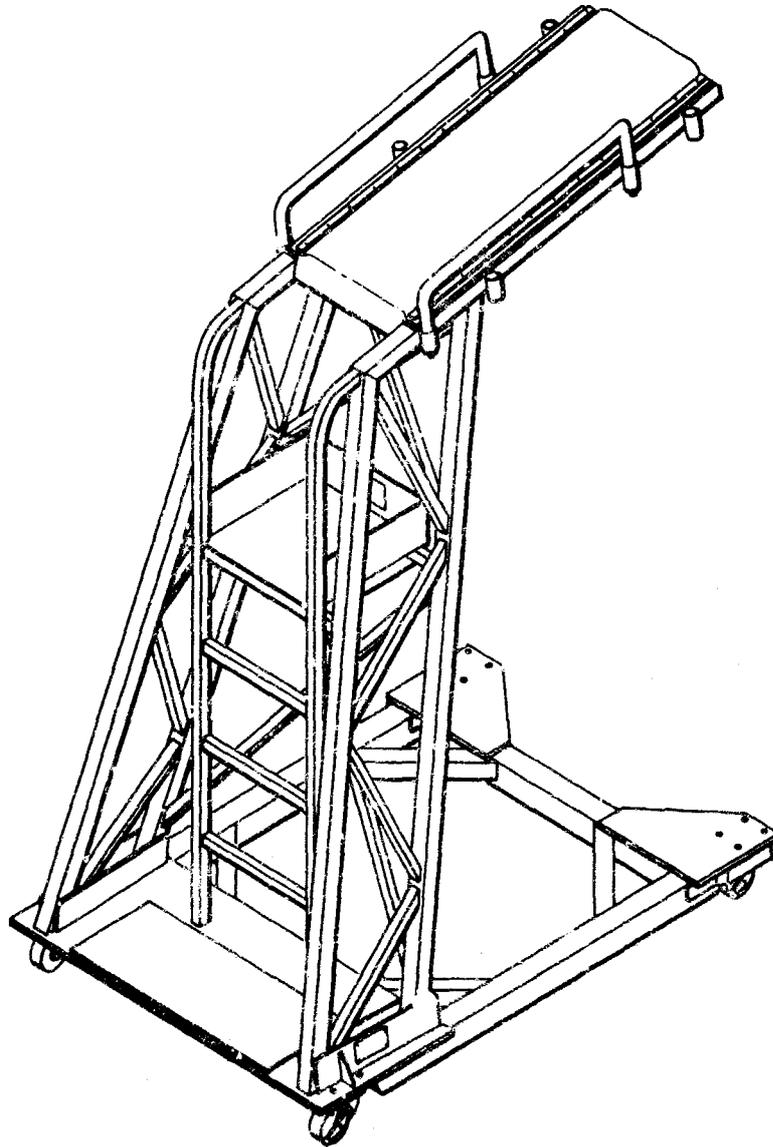
2-106. DESCRIPTION. The fitting consists of a steel tube and hoisting lug welded together. In use, one tube is fitted into the forward and another into the aft support sleeve which, together with the hoist fittings bolted to them, have been previously removed from the vehicle horizontal hoisting sling (item 18, table 2-1). The hoist fittings attach to the vehicle handling yokes, and hoisting equipment with load cells raise the vehicle for weighing by means of the hoisting lugs.

2-107. VEHICLE TILT AND ROLL EQUIPMENT. (See figure 2-21.)

2-108. FUNCTION. The vehicle tilt and roll equipment is used for subjecting a test vehicle to tilt and roll motions when the vehicle is installed in the vehicle handling dolly.

2-109. DESCRIPTION. The vehicle tilt and roll equipment consists of three assemblies: one Jack Assembly, Part No. 1588009, and two Pivot Assemblies, Part No. 1510880. The jack assembly is a hydraulic, automotive-

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**Figure 2-22. Horizontal Vehicle Checkout Work Platform**

type jack with four rollers, a control handle, and a lifting arm with a slotted guide for proper engagement with the dolly frame. The jack assembly is used for raising the vehicle handling dolly at either end for simulating tilt motions or at either side for simulating roll motions. Each pivot assembly consists of a clevis fitting mounted on a conical base. The pivot assemblies have quick-release pins fastened by lanyards for securing the pivot assemblies to the vehicle handling dolly. In use, the pivot assemblies are positioned under the end or side of the dolly opposite the jack assembly.

2-110. **VEHICLE ALINEMENT EQUIPMENT.** (See item 52, table 2-1.)

2-111. **FUNCTION.** The vehicle alinement equipment is used for leveling and alinement operations required during assembly, checkout, and mating of the vehicle and its associated subsystems.

2-112. **DESCRIPTION.** The equipment consists of optical leveling and alinement tools and associated fixtures, stands, adapters, and miscellaneous equipment, which are listed on the summary drawing for the equipment. Detailed descriptions of these items are not required.

2-113. **HORIZONTAL VEHICLE CHECKOUT WORK PLATFORM.** (See figure 2-22.)

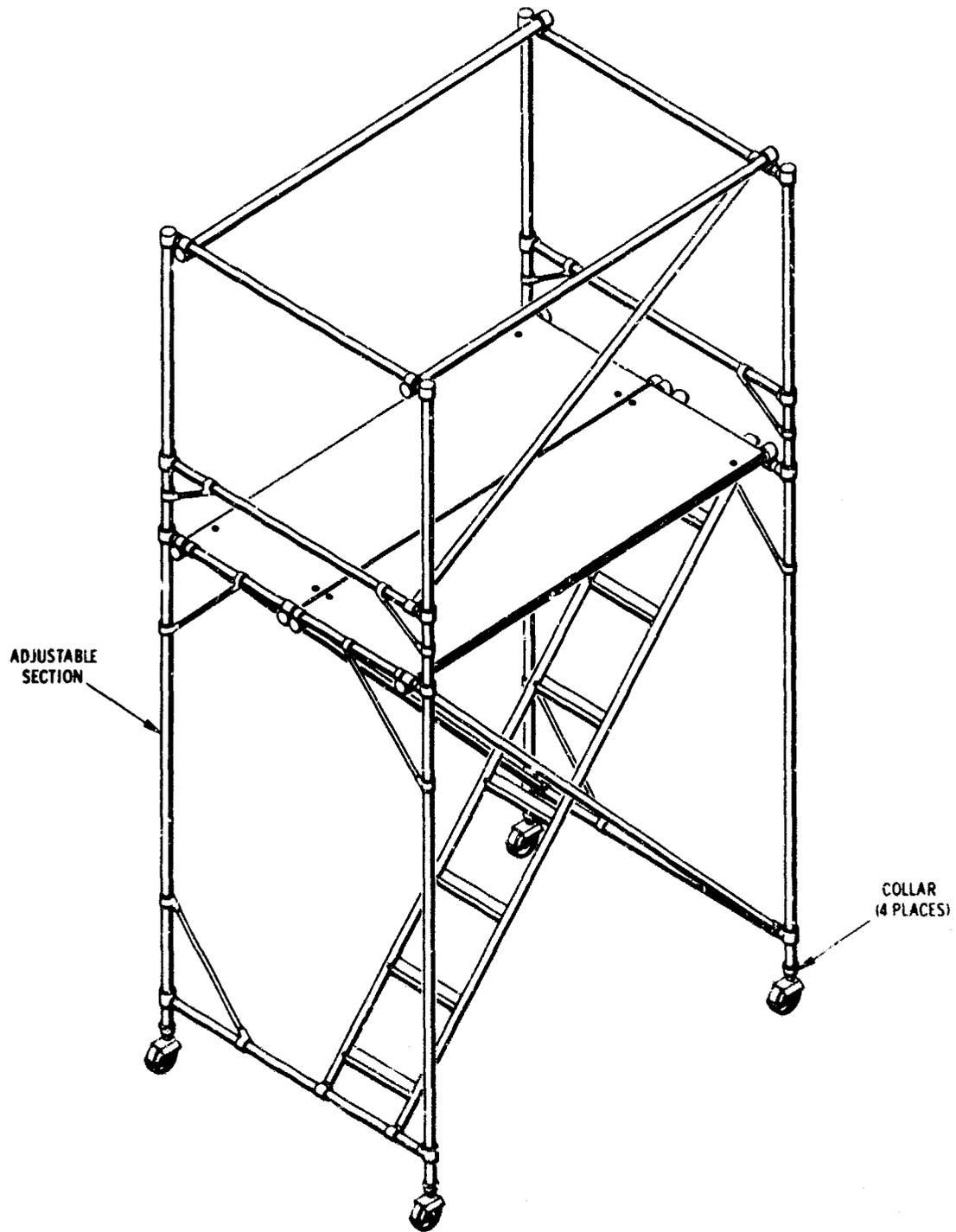
2-114. **FUNCTION.** The horizontal vehicle checkout work platform provides access for personnel to the upper surface of the vehicle as it rests on the vehicle handling dolly (figure 2-7).

2-115. **DESCRIPTION.** The work platform is essentially a horizontal elevated platform that is cantilevered from a superstructure supported on a castered frame. A ladder with handrails provides access to the platform. The platform is padded with nylon-cloth-covered rubber and incorporates guardrails for safety of personnel. The four rubber-tired swivel casters include swivel locks and footbrakes. Maximum towing speed of the platform is 3 miles per hour.

2-116. **HORIZONTAL MATING WORK PLATFORM.** (See figure 2-23.)

2-117. **FUNCTION.** The horizontal mating work platform provides access for personnel to the payload and vehicle during horizontal mating operations on the launch pad.

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**Figure 2-23. Horizontal Mating Work Platform**

2-118. DESCRIPTION. The horizontal mating work platform is a two-level, scaffold-type, tubular aluminum alloy framework supporting two plywood work platforms. The upper-level platform provides a working level at 10-1/2 feet (adjustable to 12-1/2 feet) above ground level. The work platform is mounted on four swivel casters attached to adjustable legs that provide a level surface when the work platform is positioned on an uneven surface. Each caster assembly contains a foot lever that locks the wheel and swivel mechanism with a single depression. Each plywood board is mounted on four dowel pins. The boards can be mounted side by side on the first level to form a solid working platform or a board can be mounted on each level to provide two working platforms. Each adjustable leg has 24 inches of adjustment. The legs of the stand are slotted to allow expansion. A sliding collar on each leg compresses the slotted legs to engage the threaded shaft of the casters. This feature allows rapid large adjustments with capabilities for accurate minor adjustments. A removable ladder provides access to the first working level. The ladder is locked in place by spring-loaded lockpins and forms a major diagonal structural member.

2-119. VEHICLE SHELTER. (See figure 2-24.)

2-120. FUNCTION. The vehicle shelter provides a movable weatherproof work shelter for personnel working on a horizontal vehicle at the launch pad.

2-121. DESCRIPTION. The vehicle shelter consists of three identical sections which are clamped together when in use. The assembled sections are open at each end and are covered by a nylon drop cloth for weather protection. Each section is made up of alternate panels of sheet metal and translucent plastic attached to a floorless metal framework mounted on casters. During towing of the individual sections, a stabilizer bar with an attached tow bar is placed in sockets at each side of the opening. A similar stabilizer bar is placed at the other open end for structural rigidity. A small section of each wall folds up for ground clearance during towing and is lowered for weather protection while the unit is stationary. Each section has regularly spaced lights and convenience receptacles, which are connected to those of the other two sections.

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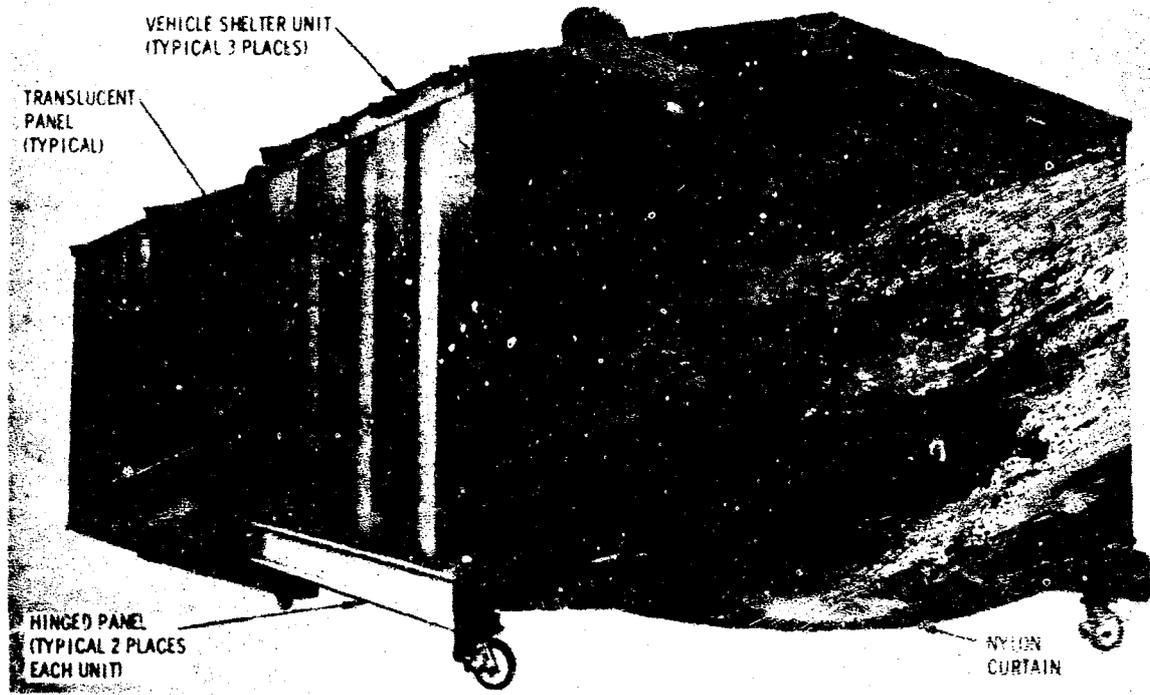


Figure 2-24. Vehicle Shelter

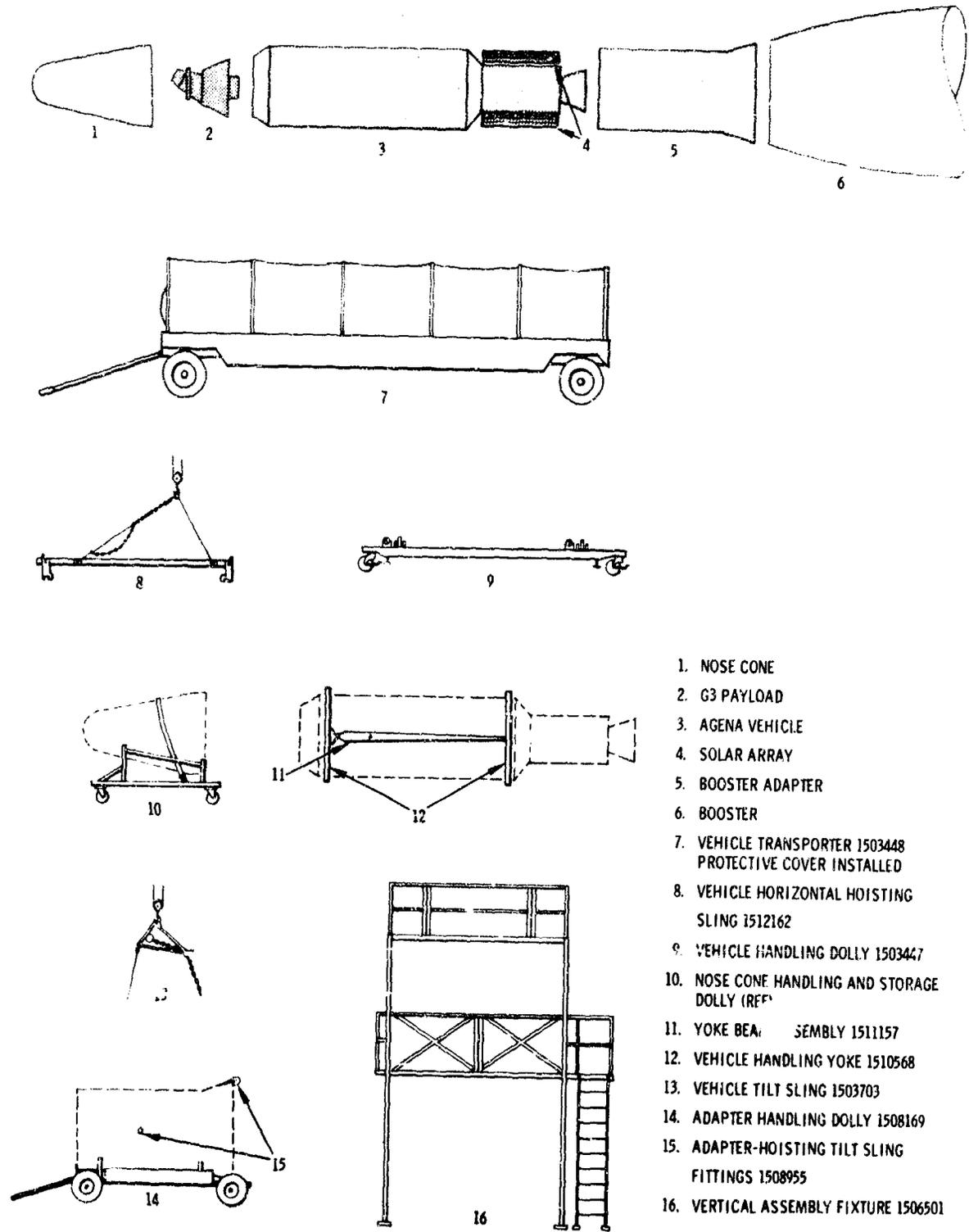
### SECTION III VEHICLE HANDLING SEQUENCE

#### 3-1. GENERAL.

3-2. This section outlines a typical handling sequence for the Agena B vehicle from final assembly at the manufacturer's Sunnyvale facility to final mating with its companion booster on the launch pad. This handling sequence is illustrated and described in figure 3-1.

3-3. The handling sequence shown in figure 3-1 is for an Agena vehicle, Model 7205, which is mated to its companion booster in a vertical attitude on the launch pad. Since handling requirements can vary widely between vehicles within any specific model series, the sequence presented in figure 3-1 is typical rather than specific. The actual test and operation sequences which determine handling requirements are specified by the LMSC test plans, test procedures, work schedules, and other official documents developed for each individual vehicle.

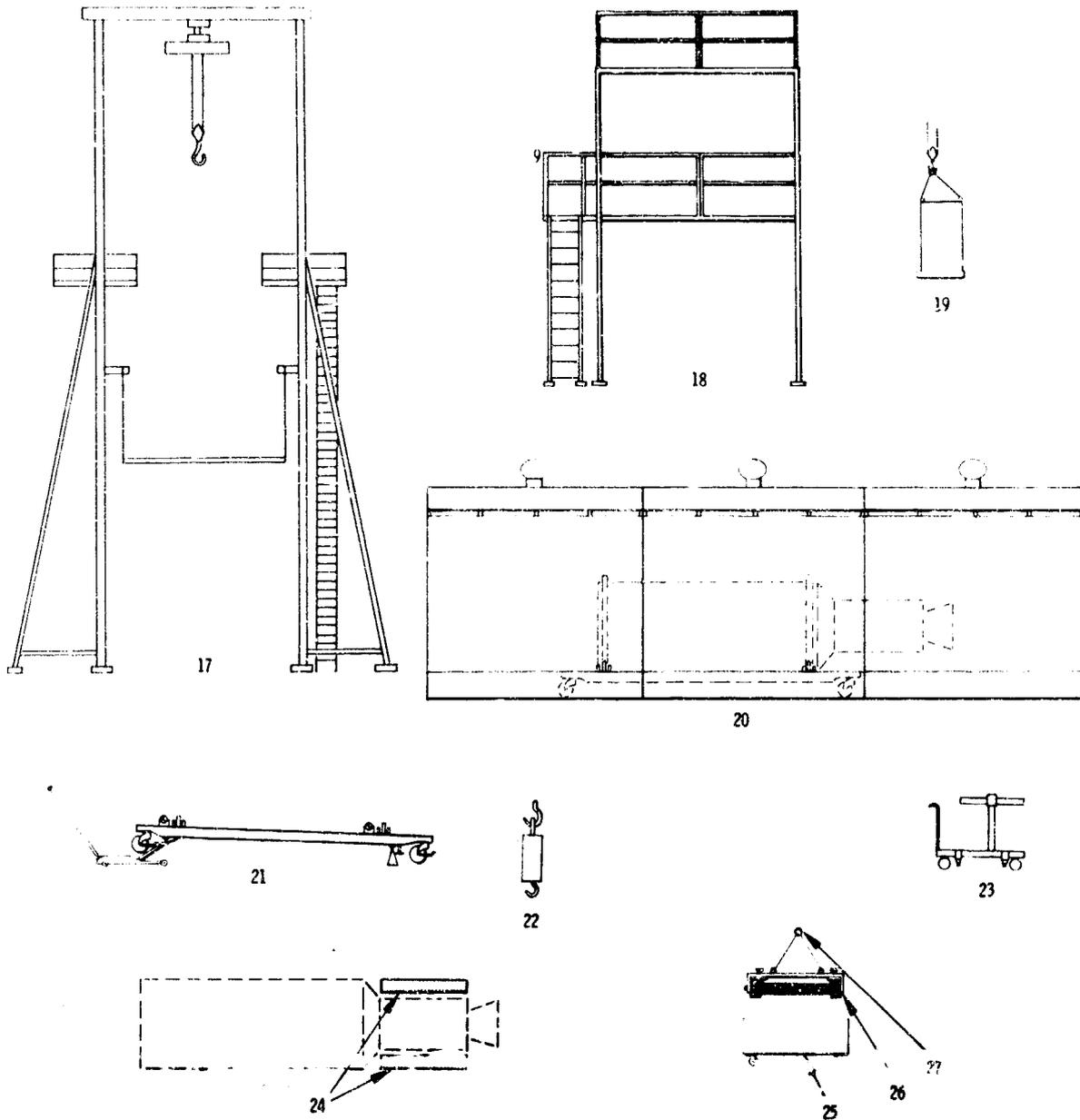
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Figure 3-1. Typical Vehicle Handling Sequence (Sheet 1 of 17)

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- 17. CENTER OF GRAVITY AND MOMENT OF INERTIA EQUIPMENT 1506710
- 18. VERTICAL WORKSTAND 1503450
- 19. VERTICAL YOKE REMOVAL SLING 1506526
- 20. VEHICLE SHELTER 1062737
- 21. VEHICLE TILT AND ROLL EQUIPMENT 1510878
- 22. LOAD CELL (REF)

- 23. PAYLOAD MATING AND HANDLING DOLLY (REF)
- 24. SOLAR ARRAY DUMMY (REF)
- 25. SOLAR ARRAY SHIPPING AND STORAGE CONTAINER (REF)
- 26. SOLAR ARRAY PROTECTIVE BAR (REF)
- 27. SOLAR ARRAY HOISTING SLING (REF)

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Figure 3-1. Typical Vehicle Handling Sequence (Sheet 2 of 17)

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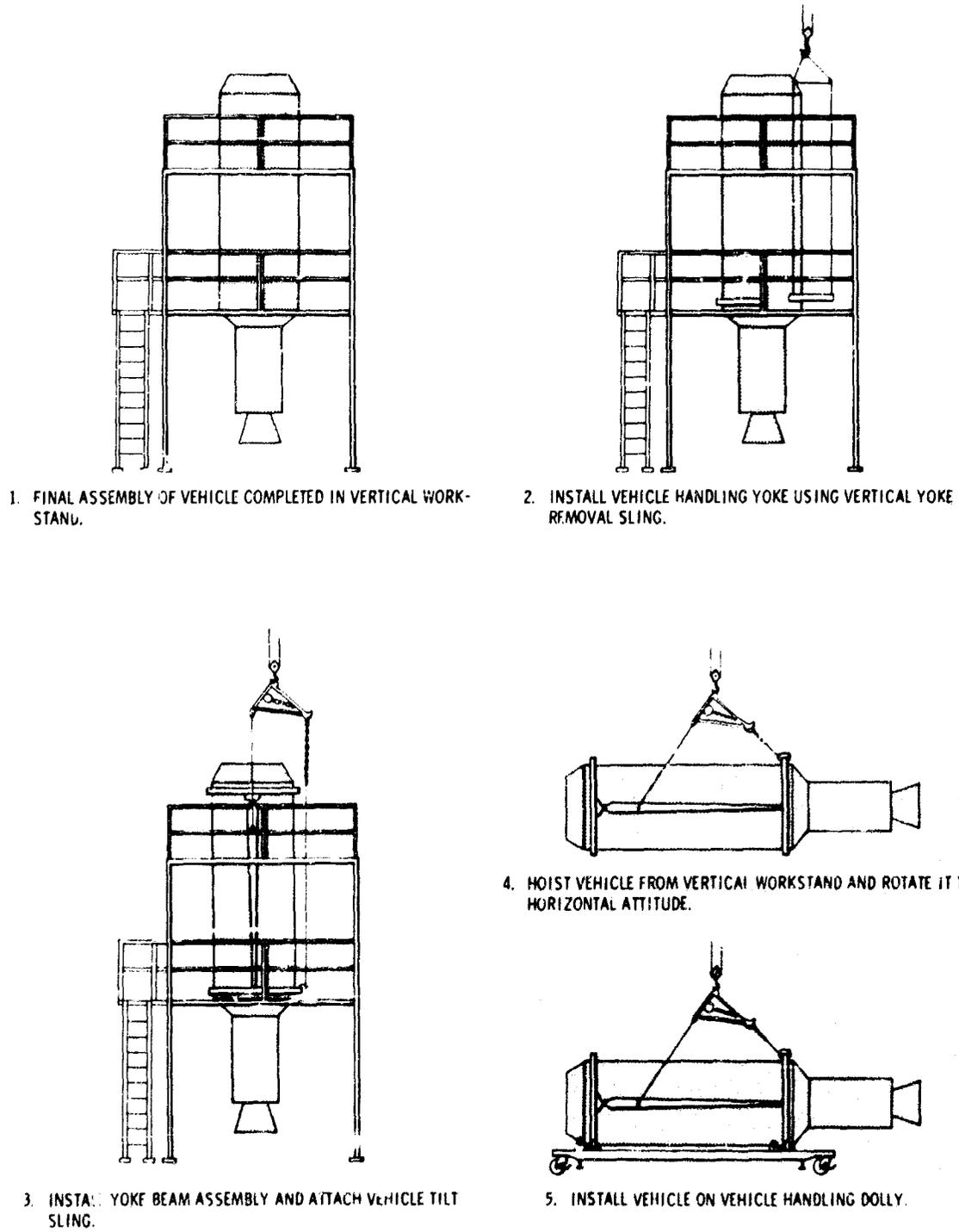
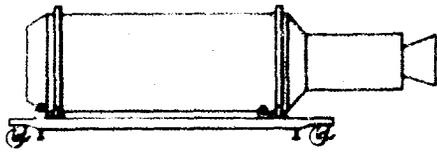
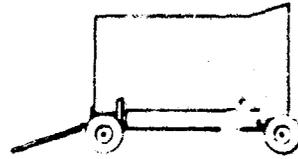


Figure 3-1. Typical Vehicle Handling Sequence (Sheet 3 of 17)

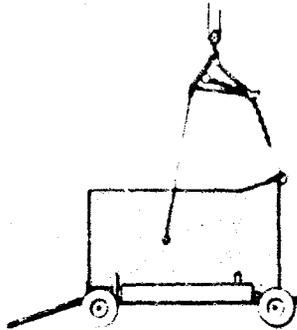
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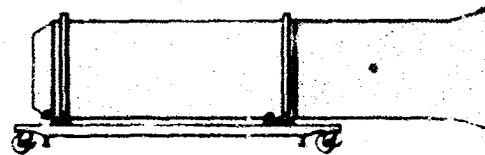
6 REMOVE VEHICLE TILT SLING AND YOKE BEAM ASSEMBLY. MOVE VEHICLE TO APPROPRIATE CHECKOUT AREA FOR SYSTEMS CHECKS AS APPLICABLE.



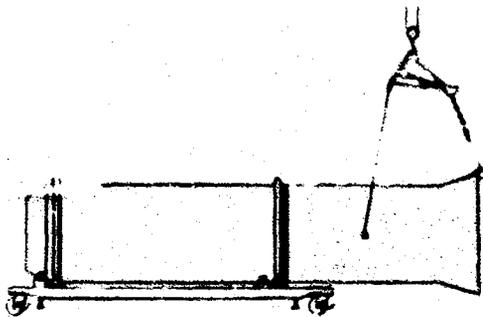
7 MOVE BOOSTER ADAPTER INTO CHECKOUT AREA ON ADAPTER HANDLING DOLLY.



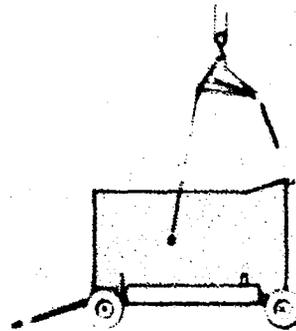
8 REMOVE ADAPTER PROTECTIVE COVER. ATTACH ADAPTER-HOISTING TILT SLING FITTINGS AND VEHICLE TILT SLING.



9 HOIST ADAPTER AND MATE IT TO VEHICLE FOR ALIGNMENT AND COMPATIBILITY CHECKS. DETACH VEHICLE TILT SLING.



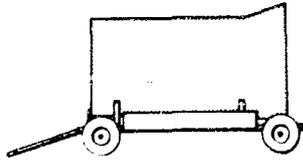
10 ATTACH VEHICLE TILT SLING TO ADAPTER-HOISTING TILT SLING FITTINGS.



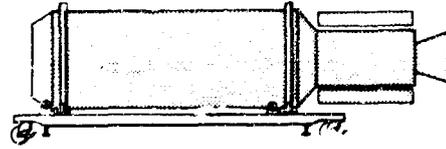
11 DEMATE ADAPTER FROM VEHICLE. HOIST ADAPTER AND PLACE IT ON ADAPTER HANDLING DOLLY.

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 4 of 17)

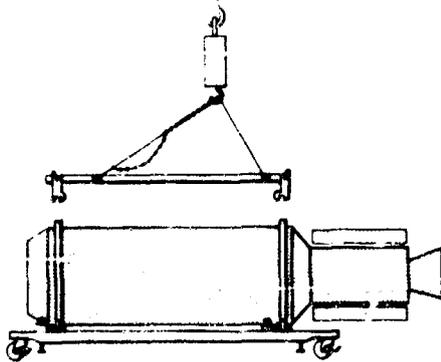
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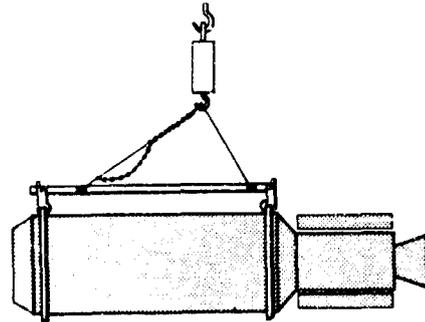
12. REMOVE HOISTING EQUIPMENT. INSTALL ADAPTER PROTECTIVE COVER AND MOVE ADAPTER TO STORAGE AREA. MOVE VEHICLE AS NECESSARY TO NEXT APPLICABLE CHECKOUT AREA.



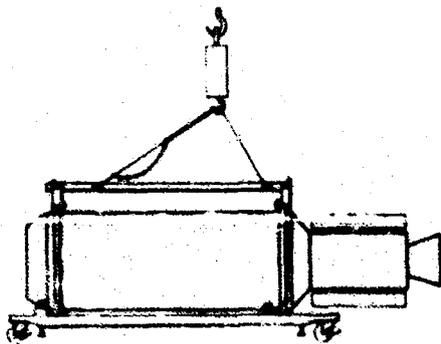
13. INSTALL SOLAR ARRAY DUMMIES ON VEHICLE. CHECK OPERATION OF STRONGBACK AND ASCENT LATCHES.



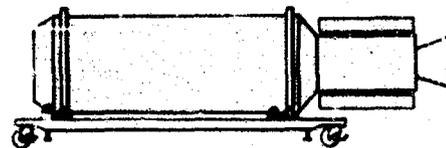
14. SUSPEND HORIZONTAL HOISTING SLING FROM LOAD CELL. ZERO LOAD CELL.



15. ATTACH HORIZONTAL HOISTING SLING TO VEHICLE. HOIST AND WEIGH VEHICLE.



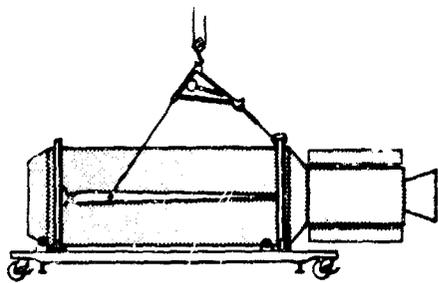
16. PLACE VEHICLE ON VEHICLE HANDLING DOLLY.



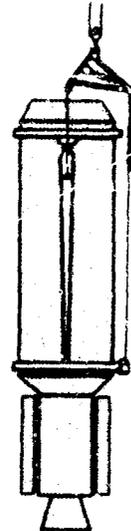
17. REMOVE HORIZONTAL HOISTING SLING AND LOAD CELL. MOVE VEHICLE ADJACENT TO CENTER OF GRAVITY AND MOMENT OF INERTIA EQUIPMENT IN HIGH BAY AREA.

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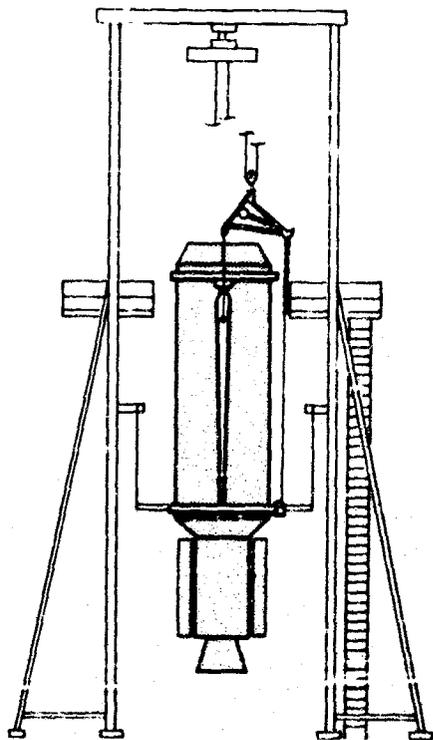
Figure 3-1. Typical Vehicle Handling Sequence (Sheet 5 of 17)



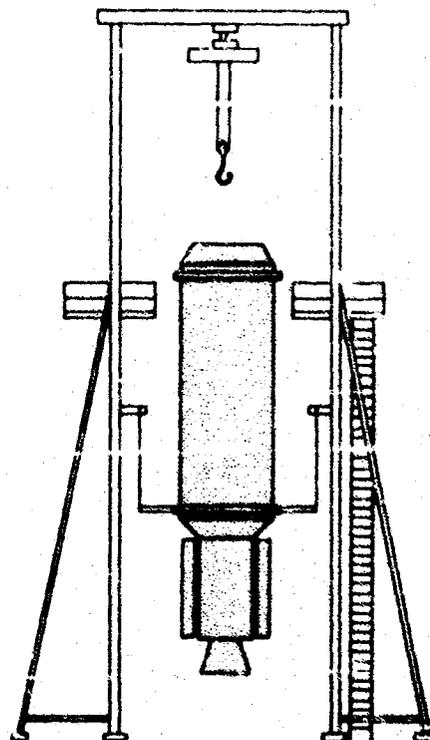
18. INSTALL YOKE BEAM ASSEMBLY AND ATTACH VEHICLE TILT SLING.



19. HOIST VEHICLE AND ROTATE IT TO VERTICAL ATTITUDE.



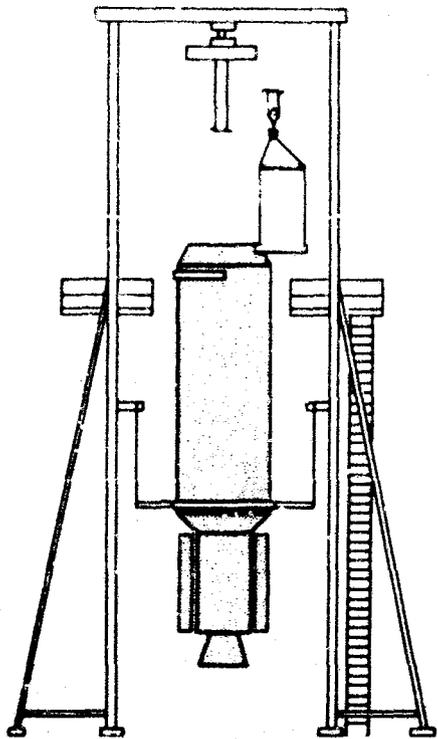
20. INSTALL VEHICLE IN CENTER OF GRAVITY AND MOMENT OF INERTIA EQUIPMENT.



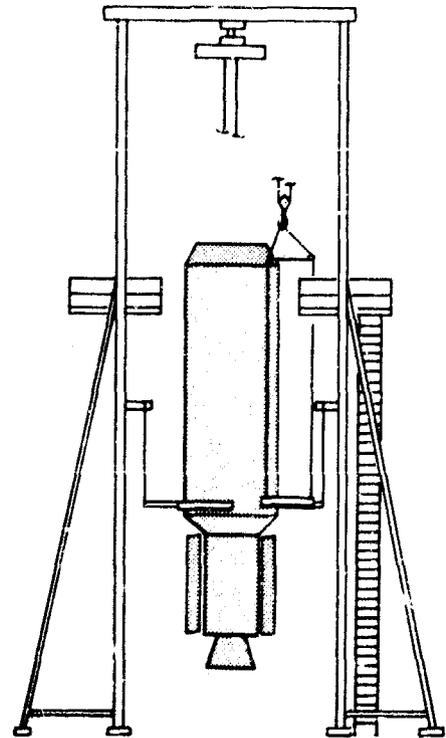
21. REMOVE VEHICLE TILT SLING AND YOKE BEAM ASSEMBLY.

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 6 of 17)

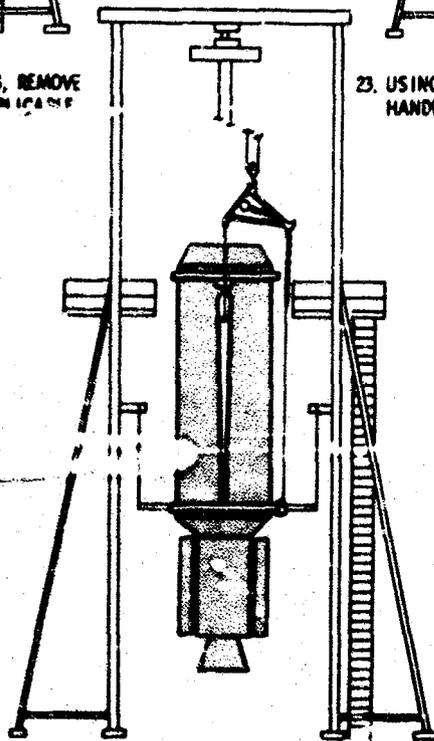
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**22. USING VERTICAL YOKE REMOVAL SLING, REMOVE HANDLING YOKE RINGS BEFORE APPLICATION OF TEST PROCEDURES.**

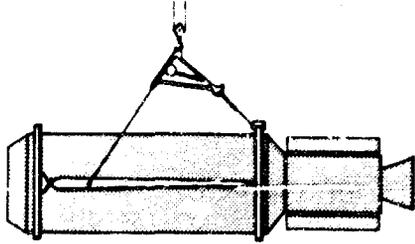


**23. USING VERTICAL YOKE REMOVAL SLING, REINSTALL HANDLING YOKE RINGS.**

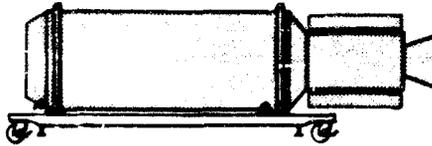


**24. REINSTALL YOKE BEAM ASSEMBLY AND ATTACH VEHICLE TILT SLING.**

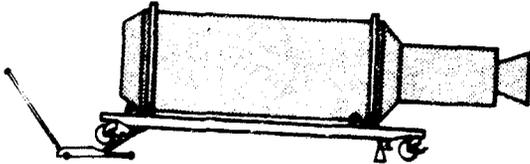
**Figure 3-1. Typical Vehicle Handling Sequence (Sheet 7 of 17)**



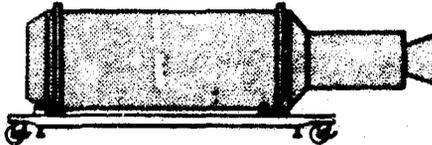
25. HOIST VEHICLE AND ROTATE IT TO HORIZONTAL ATTITUDE.



26. PLACE VEHICLE ON VEHICLE HANDLING DOLLY AND REMOVE VEHICLE TILT SLING AND YOKE BEAM ASSEMBLY. MOVE VEHICLE AS NECESSARY TO NEXT APPLICABLE CHECKOUT AREA.



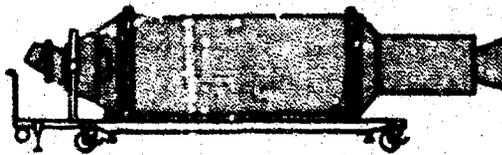
27. REMOVE SOLAR ARRAY DUMMIES AND INSTALL VEHICLE TILT AND ROLL EQUIPMENT. PERFORM SUBSYSTEM CHECKS AS APPLICABLE.



28. REMOVE VEHICLE TILT AND ROLL EQUIPMENT.



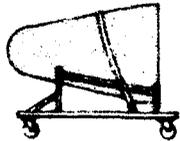
29. MOVE PAYLOAD INTO APPLICABLE CHECKOUT AREA ON PAYLOAD MATING AND HANDLING DOLLY.



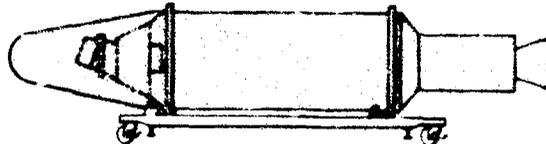
30. MATE PAYLOAD TO VEHICLE AND PERFORM ALIGNMENT AND COMPATIBILITY CHECKS AS APPLICABLE.

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 8 of 17)

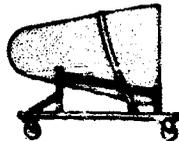
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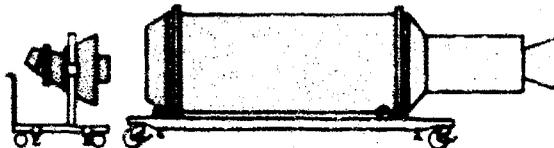
31. REMOVE PAYLOAD MATING AND HANDLING DOLLY AND MOVE NOSE CONE TO CHECKOUT AREA ON NOSE CONE HANDLING AND STORAGE DOLLY.



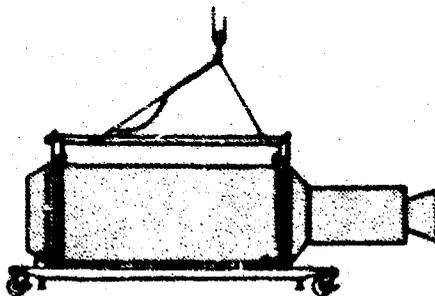
32. MATE NOSE CONE TO VEHICLE AND REMOVE NOSE CONE HANDLING AND STORAGE DOLLY. CONTINUE SUBSYSTEM CHECK AS APPLICABLE.



33. REMOVE NOSE CONE AND STORE IT ON NOSE CONE HANDLING AND STORAGE DOLLY.

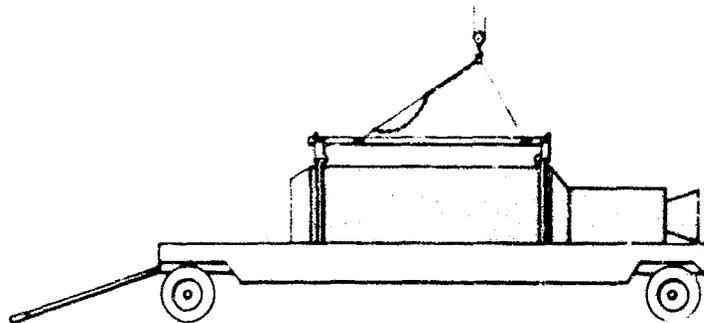


34. DEMATE PAYLOAD FROM VEHICLE. PREPARE VEHICLE AND PAYLOAD FOR TRANSFER TO LAUNCH BASE.

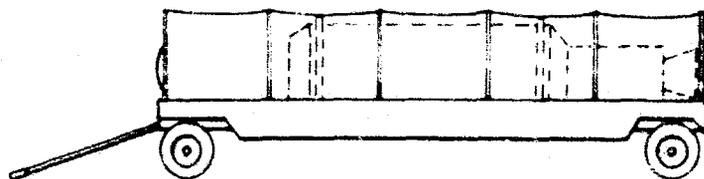


35. ATTACH HORIZONTAL HOISTING SLING TO VEHICLE.

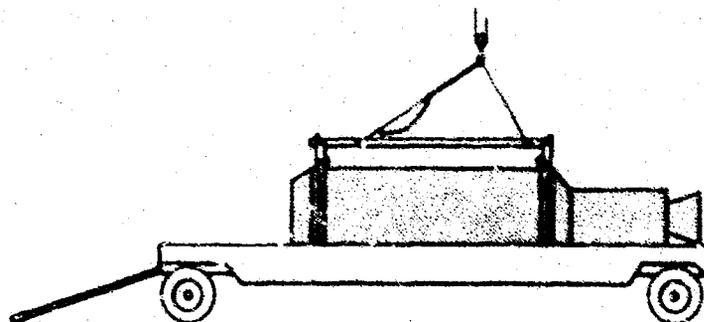
Figure 3-1. Typical Vehicle Handling Sequence (Sheet 9 of 17)



36. HOIST VEHICLE AND PLACE IT ON VEHICLE TRANSPORTER.



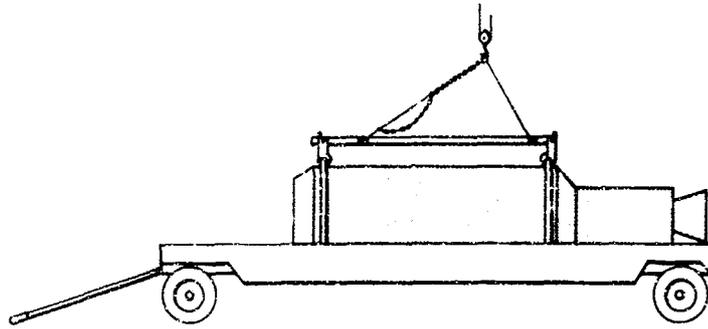
37. REMOVE HORIZONTAL HOISTING SLING AND INSTALL VEHICLE PROTECTIVE COVER. TRANSPORT VEHICLE TO LAUNCH BASE MISSILE ASSEMBLY BUILDING (MAB).



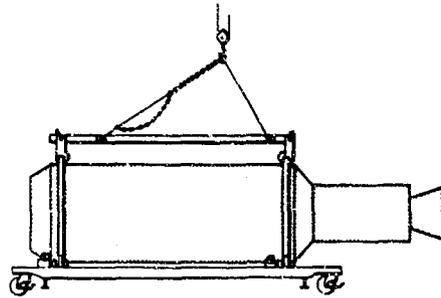
38. AT MAB, REMOVE VEHICLE PROTECTIVE COVER. PERFORM RECEIVING INSPECTIONS AS APPLICABLE.

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 10 of 17)

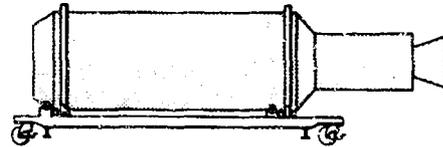
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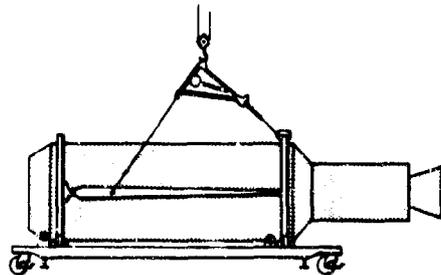
39. ATTACH HORIZONTAL HOISTING SLING TO VEHICLE.



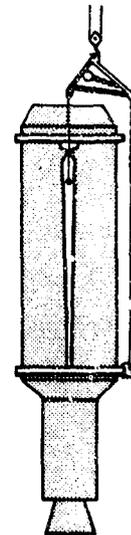
40. HOIST VEHICLE AND PLACE IT ON VEHICLE HANDLING DOLLY.



41. REMOVE HORIZONTAL HOISTING SLING. PERFORM QUALITY ASSURANCE (QA) INSPECTIONS AS APPLICABLE.



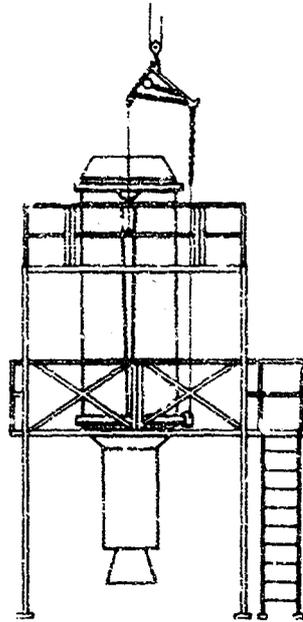
42. INSTALL YOKE BEAM ASSEMBLY AND ATTACH VEHICLE TILT SLING.



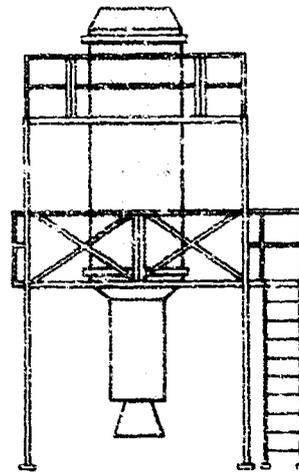
43. HOIST VEHICLE AND ROTATE IT TO VERTICAL ATTITUDE.

1607-33

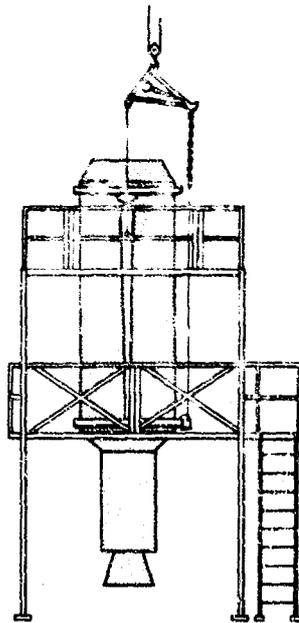
Figure 3-1. Typical Vehicle Handling Sequence (Sheet 11 of 17)



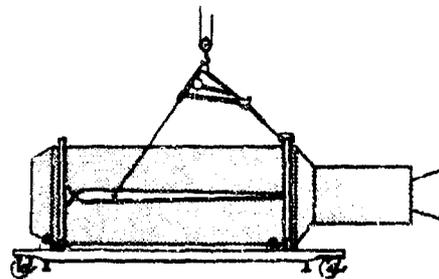
44. INSTALL VEHICLE IN VERTICAL ASSEMBLY FIXTURE.



REMOVE VEHICLE TILT SLING AND YOKE BEAM ASSEMBLY.  
REMOVE SUBSYSTEM COMPONENTS, AS REQUIRED, FOR BENCH  
CHECKS. MAKE ANY NECESSARY MODIFICATIONS.



46. COMPLETE ASSEMBLY OF VEHICLE AND INSTALL YOKE BEAM  
ASSEMBLY. ATTACH VEHICLE TILT SLING.

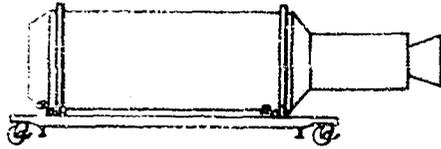


47. HOIST VEHICLE, ROTATE IT TO HORIZONTAL ATTITUDE, AND  
PLACE IT ON VEHICLE HANDLING DOLLY.

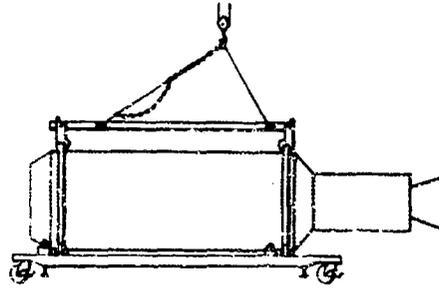
1402-34

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 12 of 17)

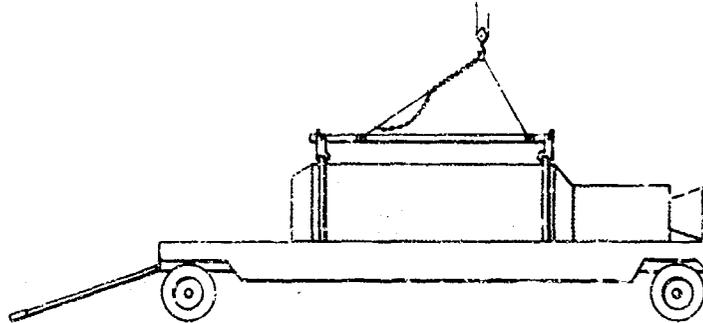
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Section III



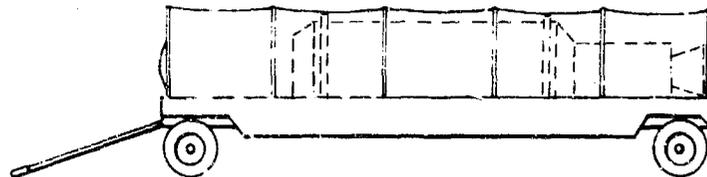
48. REMOVE VEHICLE TILT SLING AND YOKE BEAM ASSEMBLY. PERFORM ANY SYSTEM OR SUBSYSTEM CHECKS NECESSARY. PREPARE VEHICLE FOR TRANSFER TO LAUNCH PAD.



49. ATTACH HORIZONTAL HOISTING SLING TO VEHICLE.



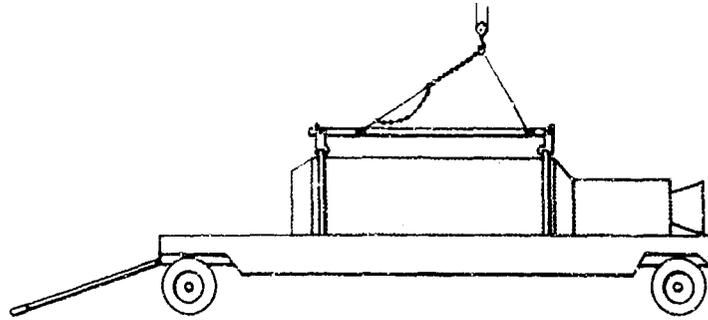
50. HOIST VEHICLE AND PLACE IT ON VEHICLE TRANSPORTER.



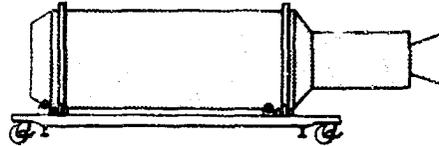
51. REMOVE HORIZONTAL HOISTING SLING AND INSTALL VEHICLE PROTECTIVE COVER. TRANSPORT VEHICLE TO LAUNCH PAD.

1402-35

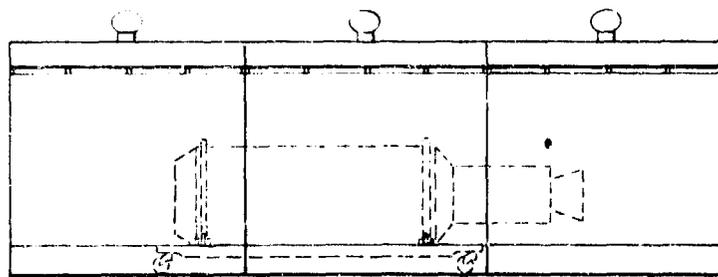
Figure 3-1. Typical Vehicle Handling Sequence (Sheet 13 of 17)



52. AT LAUNCH PAD, REMOVE VEHICLE PROTECTIVE COVER AND ATTACH HORIZONTAL HOISTING SLING TO VEHICLE.



53. HOIST VEHICLE AND PLACE IT ON VEHICLE HANDLING DOLLY. REMOVE HORIZONTAL HOISTING SLING.

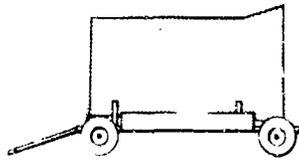


54. MOVE VEHICLE INTO VEHICLE SHELTER. PERFORM SYSTEM AND SUBSYSTEM CHECKS AS APPLICABLE.

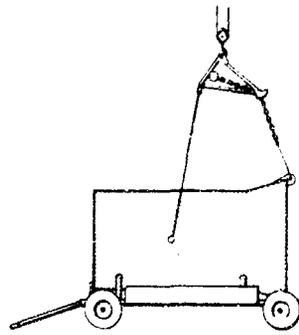
1402-50

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 14 of 17)

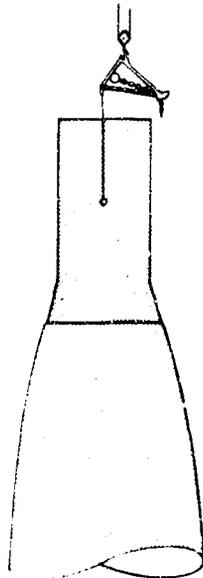
LMSC-916670A  
Section III



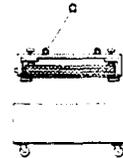
55. TRANSPORT BOOSTER ADAPTER TO LAUNCH PAD ON ADAPTER HANDLING DOLLY.



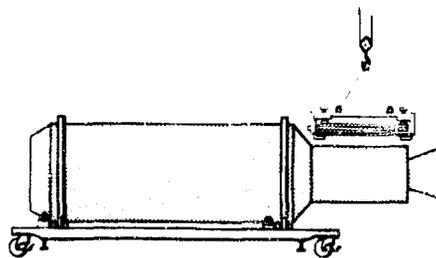
56. REMOVE ADAPTER PROTECTIVE COVER AND ATTACH ADAPTER-HOISTING TILT SLING FITTINGS AND VEHICLE TILT SLING.



57. ROTATE ADAPTER TO VERTICAL ATTITUDE AND HOIST IT TO TOP OF GANTRY. MATE ADAPTER TO BOOSTER AND REMOVE VEHICLE TILT SLING AND TILT SLING FITTINGS.



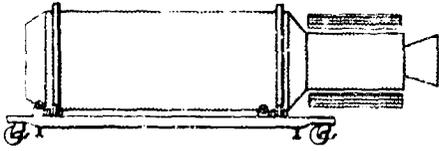
58. REMOVE SOLAR ARRAY FROM SHIPPING CONTAINER BY ATTACHING HOISTING SLING TO PROTECTIVE BAR.



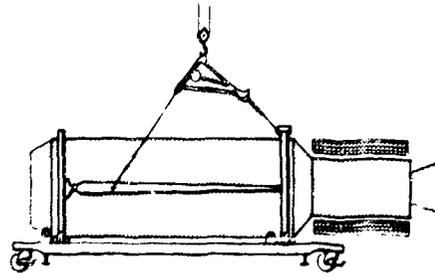
59. HOIST SOLAR ARRAY AND INSTALL IT ON VEHICLE AFT EQUIPMENT RACK.

1602-17

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 15 of 17)



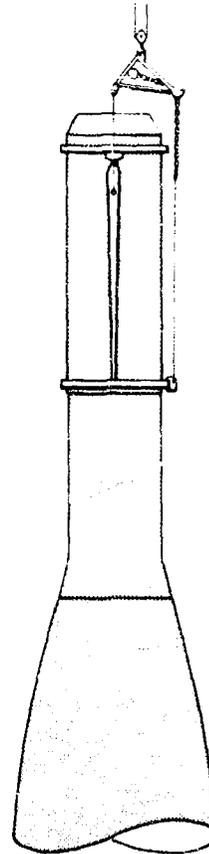
60. REMOVE HOISTING SLING AND PROTECTIVE BAR. ROTATE VEHICLE AND INSTALL SECOND SOLAR ARRAY.



61. INSTALL YOKE BEAM ASSEMBLY AND ATTACH VEHICLE TILT SLING TO VEHICLE.



62. HOIST VEHICLE AND ROTATE IT TO VERTICAL ATTITUDE.

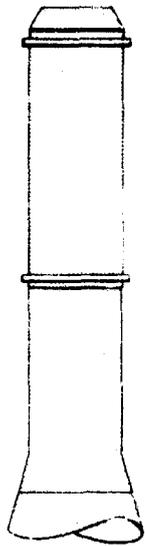


63. HOIST VEHICLE TO TOP OF GANTRY AND MATE IT TO BOOSTER ADAPTER.

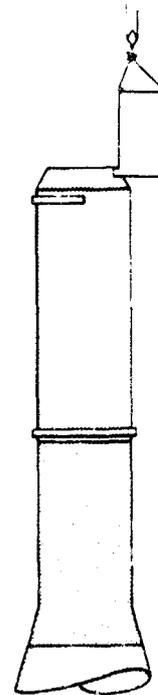
1407-20

Figure 3-1. Typical Vehicle Handling Sequence (Sheet 16 of 17)

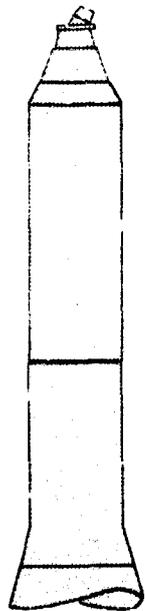
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64. REMOVE VEHICLE TILT SLING AND YOKE BEAM ASSEMBLY.



65. USING VERTICAL YOKE REMOVAL SLING, REMOVE HANDLING YOKE RINGS.



66. TRANSPORT PAYLOAD TO LAUNCH PAD AND MATE IT TO VEHICLE.



67. TRANSPORT NOSE CONE TO LAUNCH PAD AND MATE IT TO VEHICLE. VEHICLE IS NOW READY FOR FINAL LAUNCH PREPARATIONS.

**Figure 3-1. Typical Vehicle Handling Sequence (Sheet 17 of 17)**

**SECTION IV**  
**OPERATION INSTRUCTIONS FOR VEHICLE HANDLING YOKES**

**4-1. GENERAL.**

4-2. This section contains installation and removal instructions for the vehicle handling yokes described in section II. Installation or removal of the vehicle handling yokes is accomplished by using the vertical yoke removal sling (item 23, table 2-1) or applicable horizontal yoke removal sling (item 20, 21, or 22, table 2-1). (Refer to section V.)

**NOTE**

The X-X and Y-Y axes referred to in this section are marked on the vehicle exterior and are also indicated as applicable on the assembly drawings for each item of equipment. (See table 2-1.)

**4-3. INSTALLING VEHICLE HANDLING YOKE ON VEHICLE IN VERTICAL ATTITUDE.**

4-4. Select the applicable vehicle handling yoke listed in table 2-1. See figure 2-1 and proceed as follows:

a. Remove assembly bolts and nuts from half-ring assembly fittings, separate ring assemblies, and place them with marking, FWD FACE, up beside vehicle.

b. Attach appropriate cables of vertical yoke removal sling to half-ring lifting eyebolts. (See figure 2-4.)

**NOTE**

Before installing Aft Ring Assemblies, Part No. 1506807-503 and 1509205-503, on Agena vehicle, Model 6205, the four inner segments should be manually installed on the vehicle with the applicable attaching hardware indicated in table 4-1.

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c. Hoist half-ring into position above applicable vehicle mounting station with half-ring parting line parallel to X-X axis of vehicle. (See table 4-1.) On Agena vehicle, Model 6205, position half-ring parting line parallel to the Y-Y axis of vehicle.

**NOTE**

The cutouts on the inner surface of the half-ring will determine which half of the vehicle it should encompass.

d. Lower half-ring and slide it into position, taking care to prevent damage to vehicle fairings.

e. Insert applicable mounting bolts through mounting holes on inner flange of half-ring and thread them into matching boltholes on vehicle. (See table 4-1.) Maintain loose connection between vehicle and half-ring to allow for subsequent alinement.

**NOTE**

When Aft Ring Assemblies, Part No. 1506807-503 and 15092303-503, are installed the inner channel of each half-ring should be fitted over related inner segments previously attached to the Agena vehicle, Model 6205. The torque thumbscrews around the periphery of the half-ring should be tightened and secured with locknuts. (See table 4-1 for applicable mounting hardware.)

f. Detach vertical yoke removal sling from mounted half-ring assembly and attach it to remaining half-ring.

g. Hoist half-ring into position and bolt it to vehicle in same manner outlined in step e.

h. Detach vertical yoke removal sling from half-ring.

i. Aline ring assembly for snug fit and bolt half-rings together with applicable assembly bolts. (See table 4-1.)

j. Tighten assembly and mounting bolts securing yoke ring assembly to vehicle.

#### 4-5. REMOVING VEHICLE HANDLING YOKE FROM VEHICLE IN VERTICAL ATTITUDE.

4-6. To remove the vehicle handling yoke from the vehicle in vertical attitude, reverse the installation procedure outlined in paragraph 4-3.

#### 4-7. INSTALLING YOKE HALF-RINGS ON VEHICLE IN HORIZONTAL ATTITUDE.

4-8. To install the half-rings when the vehicle is in a horizontal attitude, see figure 2-1 and proceed as follows:

a. Using applicable horizontal yoke removal sling (item 20, 21, or 22, table 2-1), hoist half-ring into position above applicable vehicle mounting station. (See table 4-1.)

b. For Aft Ring Assemblies, Part No. 1506807-503 and 1509203-503, bolt inner segments to vehicle prior to hoisting half-ring. (See table 4-1 for attaching hardware.)

c. Lower half-ring to its proper position on vehicle.

**CAUTION**

To prevent damage to the vehicle fairings when positioning the half-rings with more than one cutout, bring half-rings into contact with the vehicle forward or aft of the fairings and slide them into position.

d. Insert bolts through mounting holes on inner flange of half-ring and thread them into matching bolt holes of vehicle. (See table 4-1 for applicable hardware.) Maintain loose connection between vehicle and half-ring to permit subsequent alignment.

e. For Aft Ring Assemblies, Part No. 1506807-503 and 1509203-503, fit inner channel of half-ring over inner segments.

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- f. Aline half-ring for snug fit and bolt half-rings together with ring assembly bolts and nuts. (See table 4-1 for applicable hardware.)
- g. Secure half-ring to vehicle by tightening mounting bolts.
- h. For Aft Ring Assemblies, Part No. 1506807-503 and 1509203-503, tighten torque thumbscrews around periphery of ring, and secure them with locknuts.
- i. Detach and remove horizontal yoke removal sling.

**4-9. REMOVING YOKE HALF-RINGS FROM VEHICLE IN HORIZONTAL ATTITUDE.**

**4-10. To remove the half-rings when the vehicle is in a horizontal attitude, proceed as follows:**

- a. Rotate vehicle so that half-ring to be removed is uppermost, with half-ring parting line horizontal.
- b. Reverse installation procedure outlined in paragraph 4-7.

**Table 4-1. Yoke Ring Assembly and Mounting Data**

<b>RING ASSEMBLY PART NO.</b>	<b>VEHICLE MOUNTING STATION</b>	<b>MOUNTING HARDWARE *</b>	<b>HALF-RING ASSEMBLY HARDWARE *</b>
<b>1506807-501</b>	<b>263.99</b>	<b>AN4-7A bolts (27)</b>	<b>AN7-11 bolts (6) AN365-624 nuts (6)</b>
<b>1506807-503</b>	<b>382.58</b>	<b>Type A, T-103A torque thumbscrews with locknuts (24)</b>	<b>AN7-11 bolts (4) AN365-720 nuts (4)</b>
<b>Inner segments (4 sections)</b>		<b>AN4-7A bolts (21)</b>	
<b>1506713-503</b>	<b>263.99</b>	<b>AN4-12A bolts (27)</b>	<b>AN6-11 bolts (6) AN365-624 nuts (6)</b>

Table 4-1. Yoke Ring Assembly and Mounting Data (Continued)

RING ASSEMBLY PART NO.	VEHICLE MOUNTING STATION	MOUNTING HARDWARE *	HALF-RING ASSEMBLY HARDWARE *
1508713-501	382.58	AN4-7A bolts (20)	AN6-11 bolts (6) AN365-624 nuts (6)
1509203-501	382.58	AN4-7A bolts (20)	AN6-11 bolts (6) AN365-624 nuts (6)
1509203-503	382.58	Type A, T-108A torque thumbscrews with locknuts (16)	AN6-11 bolts (6) AN365-624 nuts (6)
Inner segments (4 sections)		AN4-7A bolts (21)	
1510567-503	228.33	NAS501-4-10A bolts (28)	AN8H15A bolts (4) NAS1022A8 nuts (4) AN960C816L washers (4)
1510567-501	387.07 (Model 7205) 385.70 (Model 5205)	NAS501-6-10A bolts (18)	AN8H15A bolts (4) NAS1022A8 nuts (4) AN960C816L washers (4)
1510567-507	228.33	NAS501-4-10A bolts (38)	AN8H15A bolts (4) NAS1022A8 nuts (4) AN960C816L washers (4)
1510567-505	362.13	NAS501-4-10A bolts (18)	AN8H15A bolts (4) NAS1022A8 nuts (4) AN960C816L washers (4)

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Table 4-1. Yoke Ring Assembly and Mounting Data (Continued)

RING ASSEMBLY PART NO.	VEHICLE MOUNTING STATION	MOUNTING HARDWARE *	HALF-RING ASSEMBLY HARDWARE *
1585582-501	245.85	NAS501-4-10A bolts (28)	AN8H15A bolts (4) NAS1022A8 nuts (4) AN960C816L washers (4)
1585582-503	245.85	NAS501-4-10A bolts (25)	AN8H15A bolts (4) NAS1022A8 nuts (4) AN960C816L washers (4)

\* Quantities are indicated in parentheses.

**SECTION V**  
**OPERATION INSTRUCTIONS FOR VEHICLE HOISTING EQUIPMENT**

**5-1. GENERAL.**

5-2. This section contains the operation instructions for vehicle hoisting equipment described in section II. Detail procedures are given for only those items which require them. For operating equipment not discussed in this section, refer to applicable paragraphs in section II.

5-3. Before operating any hoisting equipment, observe the following:

- a. Use equipment in a cleared area served by an overhead crane.
- b. Make certain that all mobile equipment is properly secured with footbrakes, if provided, or blocks to prevent inadvertent rolling or slipping.
- c. To minimize transfer distance, position equipment to and from which vehicle is to be transferred in as close proximity as practical.
- d. Before attaching hoisting equipment to vehicle, make certain that all handling yokes are secure and properly mounted on the vehicle.
- e. Make certain that all cables are securely attached to equipment and are in serviceable condition.
- f. In performing hoisting operations, make certain to use cables of proper length for specific procedures.

**NOTE**

The X-X and Y-Y axes referred to in this section are marked on the vehicle exterior and are also indicated as applicable on the assembly drawings for each item of equipment. (See table 2-1.)

**5-4. VEHICLE TILT SLING AND AUXILIARY EQUIPMENT.**

5-5. **OPERATING TILT SLING AIR HOIST.** The air hoist is operated by hand controls on the pendant suspended from the sling. The controls consist of a red and a green pushbutton switch and a black trigger switch. The trigger switch must be squeezed into the control handle simultaneously with the activation of either of the pushbutton switches. Before the sling is used to tilt or stabilize its load, the load should be raised by the overhead crane until the sling has stabilized with respect to the center of gravity of its load. By pressing the green pushbutton and squeezing the trigger switch, the air hoist reels in the hoist chain, raising the aft end of the vehicle. Pressing the red pushbutton and squeezing the trigger switch causes the air hoist to reel out the hoist chain, lowering the aft end of the vehicle. For the vehicle to be rotated from a horizontal to a vertical attitude, the hoist chain is reeled out, allowing the aft end of the vehicle to drop slowly while transferring the full load of the vehicle to the two forward cables of the tilt sling.

5-6. **HOISTING VEHICLE.** To hoist the vehicle from either a horizontal or vertical attitude, see figure 2-2 and proceed as follows:

- a. Perform general operation instructions outlined in paragraph 5-3, as applicable.
- b. Install yoke beam assemblies, as applicable, on vehicle handling yokes. (Refer to paragraph 5-11.)
- c. If vehicle is positioned in a horizontal attitude, rotate vehicle as necessary to position quadrant II uppermost.

**NOTE**

The Agena vehicle, Model 6205, must be rotated to position the tilt sling hoisting trunnions, located on the forward yoke ring, in a horizontal plane. The tilt sling attachment lug, located on the aft yoke ring, must be positioned uppermost.

- d. Connect hook of overhead crane to hoisting shackle on tilt sling and raise sling to a convenient working level.
- e. Attach the two 74-inch or the two 110-inch forward cables, as applicable, to respective hoist fittings on tilt sling forward arm with key-slot hoist lugs on upper ends of cables.
- f. Attach key-slot hoist lugs provided to lower ends of forward cables.

**NOTE**

Vehicle tilt sling adapters (item 12, table 2-1) are used in place of the two forward cables on the vehicle tilt sling for hoisting the Agena vehicle, Model 6205.

- g. Connect an external source of air pressure (100 to 120 psig) to air hose fitting on tilt sling pendant.
- h. Raise tilt sling to position directly over vehicle.
- i. Attach connector on hoist chain pulley block of tilt sling to attachment lug on vehicle aft handling yoke ring with quick-release pin provided.

**NOTE**

The attachment lug is located on the forward side of the aft handling yoke ring. (See figure 2-1.)

- j. Attach the two tilt sling forward cables to respective hoisting trunnion assemblies on yoke beam assemblies.

**NOTE**

The hoisting trunnion assemblies can be positioned as necessary at one of four hole locations in their respective yoke beams to accommodate varying center of gravity conditions.

- k. On Agena vehicle, Model 6205, attach the two vehicle tilt sling adapters (item 12, table 2-1) to trunnions, provided on forward yoke ring, with adapter pads facing yoke ring.
- l. Operate tilt sling air hoist to take up slack in hoist chain. (Refer to paragraph 5-5 for description of air hoist operation.)
- m. Raise vehicle slowly with overhead crane and make center of gravity correction as necessary by operating tilt sling air hoist.
- n. Hoist vehicle and rotate it as required.

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**5-7. HOISTING VEHICLE ADAPTER.** To hoist the vehicle adapter, see figure 2-2 and proceed as follows:

- a. Perform general operation instructions outlined in paragraph 5-3, as applicable.
- b. Screw the two adapter stud fittings into sockets provided just forward of the midpoint on opposite sides of the adapter.

**NOTE**

For hoisting the Agena vehicle, Model 6205, adapter in the horizontal attitude, two adapter hoisting plates (item 24, table 2-1) may be used in place of the two stud fittings and clamp fitting. The hoisting plates are fastened to the adapter with thumbscrews which are attached to the plates by lanyards.

- c. Secure clamp fitting on rear fairing of adapter at a point 90 degrees from stud fittings until it is finger-tight.

**NOTE**

Do not tighten clamp screw with a wrench. Using too much force will rupture the adapter skin.

- d. Lower tilt sling, with forward cables attached, by overhead crane into position above adapter.

- e. Connect forward cables to stud fittings and connect hoist chain to clamp fitting.

**CAUTION**

When using adapter hoisting plates (item 24, table 2-1) in place of stud and clamp fittings, hoist chain of vehicle tilt sling must be in fully retracted position so that vehicle is not damaged.

f. Raise adapter slowly until sling has stabilized and adapter is in horizontal position. (Refer to paragraph 5-5 for air hoist operation.)

**5-8. HOISTING VEHICLE 2X TANK.** To hoist the vehicle 2X tank, see figure 2-2 and proceed as follows:

a. Perform general operation instructions outlined in paragraph 5-3, as applicable.

b. Attach slotted end of 2X-tank-hoisting fitting, with tube end of hoist fitting uppermost, by first installing a bolt through round hole in fitting and into matching bolthole in 2X tank. Install three bolts through the three remaining slots and into matching boltholes in tank.

c. Attach second fitting on opposite side of tank in same manner outlined in step b.

d. Tighten all bolts.

e. Fully retract vehicle tilt sling hoist chain and lower tilt sling, with forward cables attached, by overhead crane into position above tank. (Refer to paragraph 5-5 for air hoist operation.)

f. Remove key-slot hoist lugs from lower ends of forward cables.

g. Connect forward cables to hoisting fittings and secure them with quick-release pins provided.

h. Raise tank slowly until it has stabilized.

**5-9. YOKE BEAM ASSEMBLY.**

**5-10. REMOVING YOKE BEAM ASSEMBLY FROM VEHICLE.** To remove either one of the two yoke beam assemblies installed on the vehicle, see figure 2-2 and proceed as follows:

a. Perform general operation instructions outlined in paragraph 5-3, as applicable.

b. Attach one end of one of forward cables, provided with the vehicle tilt sling, to hook of overhead crane.

c. Attach opposite end of cable to hoisting trunnion assembly or yoke beam assembly.

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- d. Take up slack in cable, using crane.
- e. Remove attaching nut and separate yoke beam fitting from yoke beam.
- f. Slowly raise yoke beam while manually guiding adapter fitting on aft end of yoke beam out of socket fitting on air vehicle handling yoke ring.

**CAUTION**

Maintain a firm hold on yoke beam to prevent it from swinging against vehicle and damaging surface.

- g. Hoist yoke beam clear of vehicle, position it in designated area, and disconnect hoisting equipment.
- h. Remove nuts attaching yoke beam fitting to forward vehicle handling yoke ring and remove fitting.
- i. Replace mounting nuts on yoke beam fitting. Assemble yoke beam fitting on yoke beam and install attaching nut.

**5-11. INSTALLING YOKE BEAM ASSEMBLY ON VEHICLE.** To install yoke beam assembly on the vehicle, reverse removal procedure outlined in paragraph 5-10.

**5-12. VEHICLE HORIZONTAL HOISTING SLING.**

**5-13. HOISTING VEHICLE IN HORIZONTAL ATTITUDE.** To hoist the vehicle in the horizontal attitude, see figure 2-3 and proceed as follows:

- a. Perform general operation instructions outlined in paragraph 5-3, as applicable.
- b. Check that the two hoist fittings (one on each end of beam) are properly positioned to fit yoke rings. Fittings may be rotated 180 degrees, if required, by removing quick-release pins attaching support sleeves to beam.

**NOTE**

**Aft Hoist Fitting, Part No. 1585351,  
is used with vehicle handling yoke  
(item 5, table 2-1).**

- c. Attach sling to hook of overhead crane and raise it slightly. Attach chain grab hook in a chain link which will leave sling hanging horizontally.**
- d. Remove quick-release pins used to attach hoist fittings and support sleeves to yoke rings.**
- e. Remove quick-release pins from hoist fittings so that they can be rotated to clear outer flanges of yoke rings.**
- f. Rotate vehicle until yoke horizontal hoisting holes are positioned on top of vehicle.**
- g. Lower sling over yoke and align hoist fitting and support sleeve holes with matching holes in vehicle handling yoke horizontal hoisting holes. Install quick-release pins.**

**NOTE**

**On the aft yoke ring used with vehicle handling yoke (item 5, table 2-1), the aft hoist fitting attaches to the vehicle tilt sling attachment lug with an NAS-1338C3C14 quick-release pin. (See figure 2-1.)**

- h. Install quick-release pins, locking hoist fittings to their respective support sleeves.**
- i. Check loaded sling for horizontal balance by raising vehicle slightly. Relocate chain grab hook if necessary to gain horizontal balance.**
- j. Hoist vehicle as required.**

**5-14. VERTICAL YOKE REMOVAL SLING.**

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**5-15. REMOVING HANDLING YOKE FROM VEHICLE.** To remove the handling yoke from the vehicle when it is in a vertical attitude, see figure 2-4 and proceed as follows:

- a. Perform general operation instructions outlined in paragraph 5-3, as applicable.
- b. Remove yoke beam assemblies as outlined in paragraph 5-10.
- c. Connect hook of overhead crane to hoisting ring of yoke removal sling.
- d. Attach the three 121-inch cables to spreader ends of yoke removal sling.
- e. Raise yoke removal sling to position directly over one of forward yoke half-rings on vehicle. Attach shackles of sling cables to respective hoisting fittings located on forward side of yoke ring web.
- f. Raise yoke removal sling slowly to take up slack in cables.
- g. Remove bolts attaching yoke half-ring to vehicle.
- h. Separate yoke half-rings by removing attaching bolts and nuts.
- i. Carefully move yoke half-ring away from vehicle laterally and transfer it to designated area on floor.
- j. Disconnect yoke removal sling from yoke half-ring.
- k. Position yoke removal sling directly over remaining yoke half-ring and attach shackles of sling cables to respective hoisting fittings on yoke ring web.
- l. Repeat steps f through j.
- m. Attach the three 202-inch cables in place of 121-inch cables to spreader ends of yoke removal sling.
- n. Remove aft yoke half-rings from vehicle as outlined in steps e through l.

**NOTE**

When the aft yoke half-rings are being removed, it might be necessary to raise the half-ring vertically until it clears the vehicle wiring harness fairings before it is moved away from the vehicle laterally.

**5-16. ENGINE HOISTING SLING.**

**5-17. HOISTING ENGINE.** To hoist the engine in a horizontal attitude, see figure 2-5 and proceed as follows:

a. Perform general operation instructions outlined in paragraph 5-3, as applicable.

b. With hoisting ring positioned at center of gravity of beam, suspend sling from overhead crane.

c. Position sling over engine so that forward cables are over structure of engine mount and thrust chamber sling is over throat section of engine thrust chamber.

d. Attach the two hooks of forward cables to the two top tubular members of engine mount. Lock each hook with quick-release pin at end of lanyard.

e. Pass thrust chamber sling under throat section of engine thrust chamber. Connect both ends of sling to the anchor shackle and attach shackle to lug at rear of beam.

f. Hoist engine slightly to check for balance of engine and sling. Reposition hoisting ring on lifting bar as necessary until balance is achieved.

g. Hoist engine and transfer it, as required.

h. Remove sling from engine by reversing installation procedure.

**SECTION VI**  
**OPERATION INSTRUCTIONS FOR MOBILE EQUIPMENT**

**6-1. GENERAL.**

**6-2.** This section contains operation instructions for mobile equipment described in section II. Detail procedures are given for only those items which require them. For operation of equipment not discussed in this section, refer to applicable paragraphs in section II. Operation instructions for some of the equipment can be found in other LMSC manuals, vendor manuals, or other applicable documents. In these instances, references are made to applicable publications which are also listed in table 1-1.

**6-3.** Before operating any mobile equipment, observe the following:

- a. Position equipment in cleared area served by an overhead crane.
- b. Position equipment to or from which vehicle is to be transferred as close as practical to vehicle to minimize transfer distance.
- c. Secure equipment with footbrakes, if provided, or blocks to prevent inadvertent movement.
- d. Use appropriate vehicle hoisting equipment for any operation involving hoisting or transferring of vehicle. (Refer to section V.)

**NOTE**

The X-X and Y-Y axes referred to in this section are marked on the vehicle exterior and are also indicated as applicable on the assembly drawings for each item of equipment. (See table 2-1.)

**6-4. FORWARD MIDBODY STAND.**

**6-5. INSTALLING FORWARD MIDBODY IN FORWARD MIDBODY STAND.**  
To install the forward midbody on the stand, see figure 2-6 and proceed as follows:

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- a. Perform general operation instructions outlined in paragraph 6-3, as applicable.
- b. Loosen handknobs on stabilizing brackets and pull them outward to provide maximum clearance for positioning of vehicle forward midbody on the stand.
- c. Hoist forward midbody into position above stand, using vehicle vertical hoisting sling and forward midbody sling (items 19 and 26, table 2-1, respectively). (Refer to section V for applicable hoisting instructions.)
- d. Lower forward midbody slowly and center it in position on stand.
- e. Adjust stabilizing brackets to contact forward midbody surface and tighten handknobs.
- f. Remove hoisting equipment.

**6-6. REMOVING FORWARD MIDBODY FROM FORWARD MIDBODY STAND.** To remove the forward midbody from the stand, reverse the procedure outlined in paragraph 6-5.

**6-7. VEHICLE HANDLING DOLLY.**

**6-8. LOADING VEHICLE ONTO VEHICLE HANDLING DOLLY.** To load the vehicle onto the vehicle handling dolly, see figure 2-7 and proceed as follows:

- a. Perform general operation instructions outlined in paragraph 6-3, as applicable.
- b. Position front cradle with the vehicle rotating mechanism hand-wheel facing the forward end of the vehicle.
- c. Rotate yoke retaining clamps parallel to cradle crossmembers, and engage track locks on one cradle.
- d. Hoist vehicle in a horizontal attitude to position above dolly. Aline one vehicle yoke ring with rollers on the locked cradle.
- e. Move unlocked cradle into position under other vehicle yoke ring.

- f. Lower vehicle onto dolly with outer flanges of yoke rings positioned to fit over rollers on cradles.
- g. Rotate yoke retaining clamps on each cradle to engage yoke rings. Turn handknobs under clamps to secure vehicle on cradles.
- h. Engage track locks on unlocked cradle.
- i. Remove vehicle hoisting equipment.

**6-9. ROTATING VEHICLE IN VEHICLE HANDLING DOLLY.** To rotate the vehicle in the vehicle handling dolly, see figure 2-7 and proceed as follows:

- a. Check that track locks are engaged.
- b. Loosen yoke retaining clamps by turning handknobs under clamps.
- c. Rotate yoke retaining clamps parallel to cradles to provide clearance for yoke half-ring assembly fittings.
- d. Rotate handwheel of vehicle rotating mechanism on cradle carrying the majority of load to rotate vehicle.
- e. After vehicle is rotated to desired position, tighten yoke retaining clamps.

**6-10. LEVELING VEHICLE IN VEHICLE HANDLING DOLLY.** Leveling of the vehicle in the vehicle handling dolly is accomplished after the applicable vehicle alignment equipment (item 52, table 2-1) has been installed and aligned with the vehicle principal axes. To level the vehicle in the dolly, see figure 2-7 and proceed as follows:

- a. Rotate vehicle as outlined in paragraph 6-9, until rotational spirit level bubbles are centered.
- b. Turn leveling jacks until the longitudinal spirit level bubbles are centered.

**6-11. TOWING VEHICLE HANDLING DOLLY.** To prepare the vehicle handling dolly for towing, see figure 2-7 and proceed as follows:

- a. Check that yoke retaining clamps are tightened.

b. Move vehicle, if necessary, until cradle supporting engine end of vehicle straddles locking holes in work platform of dolly. Insert cradle locking pins through cradle locking holes and into matching holes in work platform.

c. Engage track locks.

d. Attach vehicle handling dolly tow bar (item 32, table 2-1) to end of dolly supporting forward end of vehicle.

e. Engage swivel locks on rear casters to lock casters in a fore-and-aft position. Disengage swivel locks on front casters.

f. Release footbrakes on all four casters.

**6-12. UNLOADING VEHICLE FROM VEHICLE HANDLING DOLLY.** To unload the vehicle from the vehicle handling dolly, reverse the loading procedure outlined in paragraph 6-8.

**6-13. VEHICLE TRANSPORTER AND AUXILIARY EQUIPMENT.**

**6-14.** For instructions on the operation and service of the vehicle transporter and auxiliary equipment (figure 2-8), refer to Operation and Service Manual, LSMD-446256.

**6-15. ADAPTER HANDLING DOLLY.**

**6-16. PREPARATION FOR USE.** To prepare the adapter handling dolly for installation of the vehicle adapter, see figure 2-9 and proceed as follows:

a. Perform general operation instructions as outlined in paragraph 6-3, as applicable.

b. Check that dolly tires are inflated to 65 psig.

c. Position rear saddle on dolly so that it will support adapter at a location just forward of conical skirt when forward end of adapter is placed against dolly fixed stops.

d. Position rear clamp assembly so that clamp bar is approximately 2 inches aft of adapter skirt when adapter is placed against dolly fixed stops and clamp is fully opened.

**6-17. INSTALLING ADAPTER ON DOLLY.** To install the vehicle adapter on the handling dolly, see figure 2-9 and proceed as follows:

- a. Prepare dolly for use as outlined in paragraph 6-16.
- b. Use vehicle tilt sling (item 9, table 2-1) and adapter-hoisting tilt sling fittings (item 10, table 2-1) or adapter hoisting plate (item 24, table 2-1), as applicable, to position adapter over dolly. (Refer to paragraph 5-7 for hoisting instructions.)
- c. Remove appropriate adapter protective cover from dolly storage box and partially cover bottom half of adapter.
- d. Before lowering adapter onto dolly, check that adapter fairings will not contact dolly saddles.
- e. While lowering adapter onto dolly, place forward end of adapter against dolly fixed stops and allow adapter to settle in saddles.
- f. Remove hoisting equipment and complete installation of adapter protective cover.
- g. Tighten rear clamp assembly against adapter skirt until adapter is held sufficiently to prevent movement in saddles.
- h. Remove tiedown straps from dolly storage box, position straps over top of adapter, and fasten straps to saddle supports. Secure adapter on dolly by tightening ratchet-type buckles at ends of tiedown straps.
- i. Release parking brakes before attempting to move dolly. Observe maximum towing speed of 20 miles per hour when towing dolly with a prime mover.

**6-18. REMOVING ADAPTER FROM DOLLY.** Remove the vehicle adapter from the handling dolly in reverse order of the installation procedure outlined in paragraph 6-17.

**6-19. VEHICLE MATING DOLLY, PART NO. 1087102-503.** (See item 37, table 2-1.)

**6-20.** For operation of the Installation and Removal Trailer, Model 4100B (figure 2-10), refer to vendor's Operation, Service and Repair Instructions manual. For operation of the Auxiliary Power Pack, Model 2410, used with

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the installation and removal trailer, refer to vendor's Installation and Operation Instructions manual. (See table 1-1.)

**6-21. VEHICLE HORIZONTAL MATING FIXTURE.** (See item 38, table 2-1.)

**6-22.** The vehicle horizontal mating fixture is used with the vehicle mating dolly (item 37, table 2-1). The procedures described in the following paragraphs give the detailed operation instructions for the vehicle horizontal mating fixture. For instructions detailing the operation of the vehicle mating dolly, refer to the vendor manuals on installation and removal trailer listed in table 1-1.

**6-23. INSTALLING MATING FIXTURE ON VEHICLE MATING DOLLY.** To install the mating fixture on the vehicle mating dolly, see figure 2-11 and proceed as follows:

- a. Position mating fixture as close as practical to vehicle mating dolly in a cleared area served by an overhead hoist.
- b. Back off the four roller adapter brake knobs on mating fixture so that brake jaws will straddle rails of vehicle mating dolly.
- c. Position hoist over approximate center of mating fixture.
- d. Pass a suitable shop sling, consisting of a cable with an eye or loop at each end, under mating fixture at each end of frame, forward and aft of roller adapters.
- e. Connect eyes of both slings to hoist and take up slack in slings.
- f. Check that slings are of equal length and that mating fixture is suspended in a horizontal attitude when it is slightly raised. Adjust slings as necessary.
- g. Hoist mating fixture so that roller adapters are positioned over rails of mating dolly and mating fixture is centered over mating dolly.
- h. Lower mating fixture until roller adapters rest lightly on rails of mating dolly.
- i. Check that roller adapter brake jaws are open and that they straddle rails of mating dolly.

j. Lower mating fixture so that total weight of fixture rests on rails of mating dolly.

k. Tighten each roller adapter brake knob so that mating fixture is firmly secured to rails of mating dolly.

**WARNING**

Injury to personnel and damage to equipment can result if roller adapter brakes are not locked when mating dolly is moved or rail assembly is tilted.

l. Remove hoisting equipment from mating fixture and from immediate area.

6-24. **INSTALLING VEHICLE ON MATING FIXTURE.** To install the vehicle on the mating fixture, see figure 2-11 and proceed as follows:

a. Position and align vehicle on mating dolly, with horizontal mating fixture installed, in front of mated booster and vehicle adapter.

b. Prepare mating dolly for receiving the vehicle. (For operation instructions, refer to vendor manuals on installation and removal trailer listed in table 1-1.)

c. Check that mating fixture yoke retaining clamps located on forward beam assembly are fully loosened.

d. Check that pin for yoke retainer located on aft beam assembly is pulled and yoke retainer is lowered.

e. Position vehicle along side of mating dolly with its aft end oriented toward forward end of vehicle adapter.

**NOTE**

This position should be as close as practical to mating dolly to minimize transfer distance.

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f. Hoist vehicle with vehicle horizontal hoisting sling (item 18, table 2-1). (Refer to section V.)

g. Lower vehicle over mating fixture so that outer flanges of vehicle handling yoke rings aline with respective support rollers on mating fixture.

**WARNING**

Make certain that roller adapter brakes are locked before lowering vehicle onto mating fixture; otherwise serious injury to personnel or damage to equipment could result.

h. Lower vehicle onto mating fixture, raise yoke retainer on aft beam assembly of mating fixture, and install retainer pin.

i. Tighten both yoke retaining clamps located on forward beam assembly.

j. Detach hoisting equipment from vehicle and remove it from immediate area.

**6-25. MATING VEHICLE TO BOOSTER.** To mate the vehicle to the booster, see figure 2-11, and proceed as follows:

a. Check that vehicle adapter is properly alined and mated with the booster.

b. Check that vehicle is properly installed on mating fixture as outlined in paragraph 6-24.

c. Move vehicle mating dolly as necessary to aline vehicle longitudinal axis with corresponding axis of booster and vehicle adapter.

d. Stabilize mating dolly in mating position and raise mating dolly rail assembly until longitudinal axis of vehicle is brought into the same approximate plane as the corresponding axis of the booster and vehicle adapter. (For operation instructions, refer to vendor manuals on installation and removal trailer listed in table 1-1.)

- e. Adjust attitude and position of mating dolly rail assembly to bring longitudinal axis of vehicle into coincidence with corresponding axis of booster and vehicle adapter.
- f. Loosen yoke retaining clamps located on forward beam assembly and disengage yoke retainer located on aft beam assembly.
- g. Aline X-X and Y-Y axes of vehicle with corresponding axes of vehicle adapter by rotating handwheel of vehicle rotating mechanism in the appropriate direction.
- h. Tighten both yoke retaining clamps and engage yoke retainer on forward and aft beam assemblies respectively.
- i. Loosen the four roller adapter brake knobs on mating fixture and roll vehicle along rails of mating dolly toward vehicle adapter.

**NOTE**

The mating fixture can be rolled along the mating dolly rails by rotating adapter rollers with a 1/2-inch-drive socket handle inserted in the socket at the outboard end of each adapter roller axle.

- j. Complete vehicle-to-booster mating operations according to applicable LMSC drawings and procedures. Repeat adjustment procedures described in steps d through g as necessary.

**NOTE**

The horizontal mating work platform (item 54, table 2-1) should be used for providing a convenient working level for personnel.

- k. After completion of mating operations, engage roller adapter brakes. Loosen yoke retaining clamps and disengage yoke retainer located on mating fixture forward and aft beam assemblies respectively.
- l. Lower upper frame of mating dolly, containing mating fixture, and move mating dolly clear of vehicle. (For operation instructions, refer to vendor manuals on installation and removal trailer listed in table 1-1.)

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m. Remove handling yoke rings from vehicle using yoke removal sling (item 22, table 2-1). (Refer to section V.)

n. Install applicable vehicle tension hoist strap (item 28 or 29, table 2-1).

**6-26. DEMATING VEHICLE FROM BOOSTER.** If it is necessary to demate the vehicle from the booster, reverse applicable steps of mating procedure outlined in paragraph 6-25.

**6-27. REMOVING VEHICLE FROM MATING FIXTURE.** To remove the vehicle from the mating fixture, reverse applicable steps of installation procedure outlined in paragraph 6-24.

**6-28. VEHICLE MATING DOLLY, PART NO. 1508690.** (See item 39, table 2-1.)

**6-29.** The vehicle mating dolly consists of an Installation and Removal Trailer, Model 4100B (figure 2-10), upon which is mounted a Vehicle Mating Fixture, Part No. 1506809 (figure 2-12). The procedures described in the following paragraphs give detailed operation instructions for the vehicle mating fixture. For instructions detailing the operation of the installation and removal trailer, refer to the vendor manuals listed in table 1-1.

**6-30. INSTALLING VEHICLE ON MATING DOLLY.** To install the vehicle on the mating dolly, see figure 2-12 and proceed as follows:

a. Position and align vehicle mating dolly in front of mated booster and vehicle adapter.

b. Prepare installation and removal trailer for receiving the vehicle. (For operation instructions, refer to vendor manuals listed in table 1-1.)

c. Check that the four yoke retaining clamps on mating fixture are fully loosened.

d. Check that mating fixture is centered on rail assembly of installation and removal trailer and that support roller brakes are fully engaged.

e. Position vehicle along side of mating dolly with its aft end oriented toward forward end of vehicle adapter.

**NOTE**

This position should be as close as practical to mating dolly to minimize transfer distance.

f. Hoist vehicle with vehicle horizontal hoisting sling (item 17 or 18, table 2-1). (Refer to section V.)

g. Lower vehicle over mating fixture so that outer flanges of vehicle handling yoke rings aline with respective support rollers on mating fixture.

**WARNING**

Make certain that roller adapter brakes are locked before lowering vehicle onto mating fixture; otherwise serious injury to personnel or damage to equipment could result.

h. Lower vehicle onto mating fixture and tighten the four yoke retaining clamps.

i. Detach hoisting equipment from vehicle and remove it from immediate area.

**6-31. MATING VEHICLE TO BOOSTER.** To mate the vehicle to the booster, see figure 2-12 and proceed as follows:

a. Check that vehicle adapter is properly alined and mated with the booster.

b. Check that vehicle is properly installed on mating dolly as outlined in paragraph 6-30.

c. Move vehicle mating dolly as necessary to aline vehicle longitudinal axis with corresponding axis of booster and vehicle adapter.

d. Stabilize installation and removal trailer in mating position and raise trailer rail assembly until longitudinal axis of vehicle is brought into the same plane as the corresponding axis of the booster and vehicle adapter. (For operation instructions, refer to vendor manuals listed in table 1-1.)

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- e. Adjust attitude and position of installation and removal trailer rail assembly to bring longitudinal axis of vehicle into coincidence with corresponding axis of booster and vehicle adapter.
- f. Loosen yoke retaining clamps on mating fixture.
- g. Aline X-X and Y-Y axis of vehicle with corresponding axes of vehicle adapter by rotating handwheel of vehicle rotating mechanism in the appropriate direction.
- h. Tighten yoke retaining clamps.
- i. Attach winch drawbar of installation and removal trailer to attachment clevis, located beneath the aft end of mating fixture, with quick-release pin provided.
- j. Loosen the four roller adapter brake knobs on mating fixture and roll vehicle along installation and removal trailer rails by operating winch assembly of trailer with drive handle provided.

**NOTE**

The mating fixture can also be rolled along the trailer rails by rotating adapter rollers with a 1/2-inch-drive socket handle inserted in the sockets at the cut board end of each adapter roller axle.

- k. Complete vehicle-to-booster mating operations according to applicable LMSC drawings and procedures. Repeat adjustment procedures described in steps d through g as necessary.
- l. After completion of mating operations, engage roller adapter brakes.
- m. Detach lower vehicle handling yoke half-rings from upper half-rings and from vehicle. (Refer to section IV.)
- n. Lower upper frame of installation and removal trailer until lower handling yoke half-rings are entirely clear of vehicle. Move trailer away from immediate vehicle mating area. (For operation instructions, refer to vendor manuals listed in table 1-1.)

o. Remove upper vehicle handling yoke half-rings from vehicle, using horizontal yoke removal sling (item 20, table 2-1) and overhead hoist. (Refer to section V.)

p. Install vehicle tension hoist strap (item 27, table 2-1).

6-32. **DEMATING VEHICLE FROM BOOSTER.** If it is necessary to demate the vehicle from the booster, reverse applicable steps of mating procedure outlined in paragraph 6-31.

6-33. **REMOVING VEHICLE FROM MATING DOLLY.** To remove the vehicle from the mating dolly, reverse applicable steps of installation procedure outlined in paragraph 6-30.

6-34. **VEHICLE CHECKOUT STAND.**

6-35. For instructions on the operation and service of the vehicle checkout stand (figure 2-13), refer to Operation and Service Manual, LMSD-446385.

6-36. **AUXILIARY HYDRAULIC CART.**

6-37. For instructions on the operation of the auxiliary hydraulic cart (figure 2-13), refer to Operation and Service Instructions Manual, LMSD-6278.

6-38. **VEHICLE HOLDING DOLLY, PART NO. 1585127.** (See item 42, table 2-1.)

6-39. **INSTALLING VEHICLE ON HOLDING DOLLY.** To install the vehicle on the holding dolly, see figure 2-14 and proceed as follows:

a. Position dolly in a cleared area served by an overhead crane. To minimize transfer distance, position dolly as close as practical to equipment from which vehicle is to be transferred.

b. Position vehicle handling yoke clamps parallel to dolly cross braces to which they are attached.

c. Hoist vehicle in a horizontal attitude over dolly.

d. Slowly lower vehicle onto dolly so that vehicle handling yoke channels fit over front and rear sets of rollers on dolly.

e. Rotate clamps on dolly cross braces to engage vehicle handling yokes and tighten clamps.

- f. Detach vehicle hoisting equipment.

**6-40. REMOVING VEHICLE FROM HOLDING DOLLY.** Remove the vehicle from the holding dolly in reverse order of the installation procedure outlined in paragraph 6-39.

**NOTE**

The vehicle can be rotated to the proper position for hoisting by turning the hand-wheel on the dolly rotating mechanism.

**6-41. ENGINE REMOVAL DOLLY.**

**6-42. PREPARATION FOR ENGINE REMOVAL.** To prepare the vehicle and associated handling equipment for removal of all or part of the engine, proceed as follows:

- a. Check that vehicle is properly installed on vehicle handling dolly (figure 2-7) and that the four track locks on dolly are engaged.
- b. Raise vehicle handling dolly off its casters with the four dolly leveling jacks.
- c. Break all connections between engine and vehicle, except engine mounting bolts and gimbal bolts.

**CAUTION**

The engine mounting bolts and gimbal bolts must remain secured to support the weight of the engine or damage to the engine can result.

- d. Remove any equipment from vehicle which would prevent a horizontal withdrawal of engine.

**6-43. REMOVING ENGINE FROM VEHICLE.** To remove the entire engine from the vehicle, see figure 2-15 and proceed as follows:

- a. Prepare vehicle and associated handling equipment for engine removal outlined in paragraph 6-42.

b. Remove hydraulic actuator from side of engine opposite turbine exhaust pipe. Remove Lift Bar Assembly, Part No. 1586428, from storage box on removal dolly and attach it in place of hydraulic actuator, using quick-release pins attached to lift bar.

c. Rotate vehicle on vehicle handling dolly until lift bar is directly on top of engine (with Y-Y axis, between quadrants III and IV in up position).

d. Position engine removal dolly at rear of vehicle with boom forward and in line with engine centerline.

e. Wheel engine removal dolly forward until clevis at end of dolly cable is directly over hoisting lug on lift bar. Attach clevis to lift bar hoisting lug with quick-release pin. Clevis may be raised or lowered as necessary by using removal dolly winch.

**WARNING**

The cable must be taut and the pawl on the winch must be securely locked to ensure that the engine will not drop when the engine mounting bolts are removed; otherwise injury to personnel and damage to equipment could result.

f. Remove A1124-1-1/2-45-6N strap assembly and AN6563-1 ring from storage box on engine removal dolly. Assemble ring onto strap assembly and attach ring to lug on removal dolly boom with quick-release pin.

**NOTE**

Two attaching points are provided in the lug to accommodate two engine configurations. The attaching point toward the winch end of the removal dolly is used for engine model No. 8086. The remaining attaching point is used for engine model No. 8081.

g. Pass strap assembly under engine at aft side of flange on engine thrust nozzle. Fasten strap assembly and tighten it securely to support thrust nozzle when engine mounting bolts are removed.

- h. Set floor locks on engine removal dolly.
- i. Remove the four engine mounting bolts.
- j. Release floor locks and withdraw engine from vehicle by carefully pulling engine removal dolly backwards.

**6-44. INSTALLING ENGINE IN VEHICLE.** To install the engine in the vehicle, reverse the removal procedure outlined in paragraph 6-43.

**6-45. REMOVING ENGINE THRUST CHAMBER FROM VEHICLE.** To remove only the thrust chamber section of the engine from the vehicle, see figure 2-15 and proceed as follows:

- a. Prepare vehicle and associated handling equipment for engine removal as outlined in paragraph 6-42.
- b. Rotate vehicle on handling dolly until engine turbine exhaust pipe is approximately 45 degrees to either right or left of top center.
- c. Remove Engine Removal Sling Assembly, Part No. 1500260, from storage box on removal dolly and attach it to dolly as follows: Attach clevis at end of dolly cable to engine removal sling assembly beam, using quick-release pin attached to sling. Attach lug, welded to engine removal sling assembly beam, to mating lug on removal dolly boom, using quick-release pin attached to sling.
- d. Position engine removal dolly at rear of vehicle with boom forward and in line with engine centerline.
- e. Wheel engine removal dolly forward until strap on aft end of sling assembly lines up with flange on engine thrust nozzle.
- f. Pass cable, on forward end of sling assembly, around engine combustion chamber and secure it to sling assembly with quick-release pins. Pull cable taut by operating winch on engine removal dolly and check that removal sling assembly beam remains approximately parallel to engine centerline.

**WARNING**

The engine removal sling assembly must be taut and the pawl on the winch must be securely locked to ensure that the engine will not drop when the engine gimbal bolts are removed; otherwise injury to personnel and damage to equipment could result.

g. Pass strap, on aft end of sling assembly, around engine at the aft side of flange on engine thrust nozzle. Secure and tighten strap.

h. Set floor locks on engine removal dolly.

i. Disconnect hydraulic actuators from engine thrust chamber and remove engine gimbal bolts.

j. Release floor locks and withdraw engine from vehicle by pulling engine removal dolly backwards.

**6-46. INSTALLING ENGINE THRUST CHAMBER IN VEHICLE.** To install the engine thrust chamber in the vehicle, reverse the removal procedure outlined in paragraph 6-45.

**SECTION VII**  
**OPERATION INSTRUCTIONS FOR FIXED**  
**STANDS AND SPECIAL EQUIPMENT**

**7-1. GENERAL.**

**7-2.** This section contains operation instructions for fixed stands and special equipment described in section II. Detail procedures are given for only those items which require them. For operation of equipment not discussed in this section, refer to applicable paragraphs in section II. Operation instructions for some of the equipment can be found in other LMSC manuals or other applicable documents. In these instances, references are made to applicable publications which are also listed in table 1-1.

**NOTE**

The X-X and Y-Y axes referred to in this section are marked on the vehicle exterior and are also indicated as applicable on the assembly drawings for each item of equipment. (See table 2-1.)

**7-3. VEHICLE PITCH AND ROLL STAND.**

**7-4.** For instructions on the use of the vehicle pitch and roll stand, refer to Operation and Service Manual, LMSD-447039.

**7-5. VERTICAL WORKSTAND.**

**7-6.** Detailed operation instructions for the vertical workstand (figure 2-18) are not required. However, the following precautions must be taken whenever a vehicle is installed on the work stand.

a. Make sure that Support Ring, Part No. 1587000, is properly oriented and securely attached to vehicle aft midbody structure assembly at station 388.55. Note that support ring is placarded for orientation with the vehicle X-X and Y-Y axes and quadrants I and IV.

**NOTE**

The support ring should be installed while the vehicle is supported in the horizontal attitude before being hoisted. AN5-5 bolts and AN960-5162 washers are used at eight places for attaching the support ring.

b. Before filling or flushing propellant tanks, make sure that the three load cells attached to vehicle supports are removed so that vehicle rests on the three vehicle supports only.

c. Before filling propellant tanks or performing flushing operations, install Vehicle Support Jacks, Part No. 1588732, under the three vehicle supports to relieve vertical compression loads.

d. After removable floor sections are reinstalled, make sure that MS35354-159 bolts, NAS1039-10 washers, AN935-1016 washers, and MS-21304-6 nuts are installed as placarded on workstand.

**7-7. VERTICAL ASSEMBLY FIXTURE.**

7-8. Detailed operation instructions for the vertical assembly fixture (figure 2-19) are not required. Follow general instructions and load limits placarded on the fixture.

**7-9. CENTER OF GRAVITY AND MOMENT OF INERTIA EQUIPMENT.**

7-10. For instructions on the use of the center of gravity and moment of inertia equipment, refer to Operation and Service Manual, LMSD-445923.

**7-11. VEHICLE TILT AND ROLL EQUIPMENT.**

**7-12. USING EQUIPMENT FOR PERFORMING VEHICLE TILT PROCEDURE.** To use the tilt and roll equipment for performing the vehicle tilt procedure, see figure 2-21 and proceed as follows:

a. Position vehicle on vehicle handling dolly (figure 2-7) and set footbrakes. Rotate vehicle to orient vehicle principal axes as required.

b. Engage the four track locks and the eight yoke retaining clamps to secure vehicle on handling dolly.

c. Position jack assembly under vehicle handling dolly crossmember at aft end of vehicle. Check that slotted guide on end of lifting arm engages positioning guide welded to dolly crossmember.

d. Raise aft end of vehicle handling dolly and attach pivot assemblies, with quick-release pins provided, to attaching lugs on handling dolly.

**NOTE**

The pivot attaching lugs are located on the underside of the vehicle handling dolly frame, adjacent to each of the four leveling jacks.

e. Lower jack assembly and allow vehicle handling dolly to settle on pivot assemblies.

f. Remove jack assembly and position it under crossmember at opposite end of vehicle handling dolly as outlined in step c.

g. Raise forward end of vehicle handling dolly as required to perform subsystem checks.

h. To remove vehicle tilt and roll equipment, reverse installation procedure outlined in steps c through g.

**7-13. USING EQUIPMENT FOR PERFORMING VEHICLE ROLL PROCEDURE.** To use the tilt and roll equipment for performing the vehicle roll procedure, see figure 2-21 and proceed as follows:

a. Position vehicle on vehicle handling dolly (figure 2-7) and set footbrakes. Rotate vehicle to orient vehicle principal axes as required.

b. Engage the four track locks and the eight yoke retaining clamps to secure vehicle on handling dolly. (See figure 2-7.)

c. Position jack assembly under one side of vehicle handling dolly frame at point that coincides with longitudinal center of gravity of vehicle.

d. Raise side of vehicle handling dolly and attach pivot assemblies, with quick-release pins provided, to attaching lugs on forward and aft ends of handling dolly.

**NOTE**

The pivot attaching lugs are located on the underside of the vehicle handling dolly frame, adjacent to each of the four leveling jacks.

e. Lower jack assembly and allow vehicle handling dolly to settle on pivots.

f. Remove jack assembly and position it under opposite side of vehicle handling dolly frame that coincides with longitudinal center of gravity of vehicle.

g. Raise side of vehicle handling dolly as required to perform subsystem checks.

h. To remove vehicle tilt and roll equipment, reverse installation procedure outlined in steps c through g.

**7-14. HORIZONTAL MATING WORK PLATFORM. (See item 54, table 2-1.)**

**7-15. Detailed operating instructions for the work platform are not required. However, the following precautions must be taken during assembly of the platform and during its use. (See figure 2-23.)**

a. Make certain that spring-loaded lockpins of the ladder and diagonal members are fully extended to their locked position when installed.

b. Make certain sliding collars of adjustable legs are pushed down to their locked position after leg adjustments are made.

c. Depress caster locks before utilizing platform for a work area.

d. Make certain plywood platform sections are seated over the four dowel pins.

e. Do not exceed maximum load placarded on side of ladder.