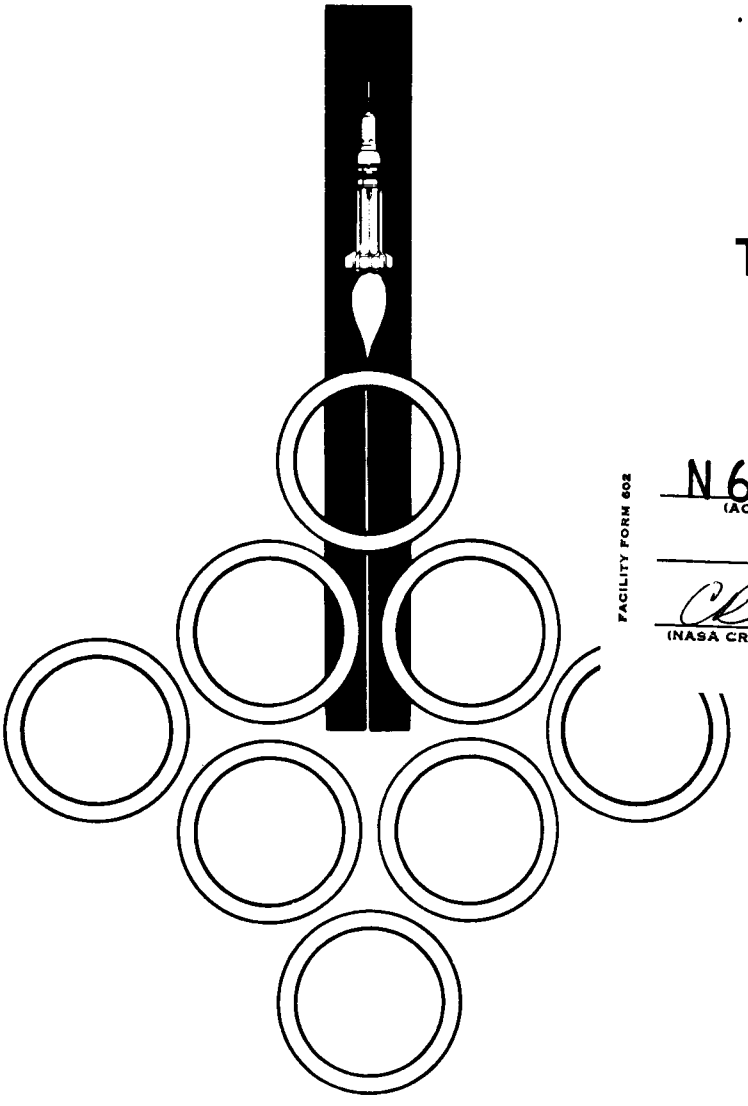


ENGINEERING DEPARTMENT

TECHNICAL MANUAL

SDES-64-415

Saturn I

LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION

Volume VII

LAUNCH PAD ACCESSORIES
FUNCTIONAL DESCRIPTION, INDEX OF
FINDING NUMBERS, AND MECHANICAL SCHEMATICS

SPACE DIVISION CHRYSLER CORPORATION

SDES-64-415

SATURN I
LAUNCH VEHICLE SA-10
AND
LAUNCH COMPLEX 37B
FUNCTIONAL SYSTEMS DESCRIPTION

VOLUME VII
LAUNCH PAD ACCESSORIES
FUNCTIONAL DESCRIPTION, INDEX OF
FINDING NUMBERS, AND MECHANICAL SCHEMATICS

July 1964

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

FOREWORD

This volume is one of a set of eleven volumes that describe mechanical and electromechanical systems of the Saturn I, SA-10 launch vehicle and launch complex 37B. The eleven volume set is prepared for the Functional Integration Section, Systems Integration and Operations Branch, Vehicle Systems Division, P&VE Laboratory, MSFC, by Systems Engineering Branch, Chrysler Corporation Space Division under Contract NAS 8-4016. Volume titles are listed below:

Volume I	RP-1 Fuel System
Volume II	LOX System
Volume III	LH_2 Fuel System
Volume IV	Nitrogen and Helium Storage Facility
Volume V	Pneumatic Distribution System
Volume VI	Environmental Conditioning Systems
Volume VII	Launch Pad Accessories
Volume VIII	H-1 Engine and Hydraulic System
Volume IX	RL10A-3 Engine and Hydraulic System
Volume X	Separation and Flight Termination Systems
Volume XI	Supplement: Legend and Composite Schematic

The technical content of this volume reflects the most up-to-date design information available from the S-I/S-IB Project Engineer, R-P&VE on June 1, 1964.

System mechanical schematics are provided in section 3 to support the functional description of the system. The index of finding numbers in section 2 provides physical and functional descriptions of components identified on the mechanical schematics.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION I

FUNCTIONAL DESCRIPTION

1.1 INTRODUCTION N65-23070

The launch pad accessories group consists of three umbilical swing arms, two propellant masts, two short cable masts, and eight holddown arm assemblies. This group attaches the vehicle to the launcher and provides the necessary connections between the vehicle and the launch complex for propellant transfer, environmental conditioning, and pneumatic and electrical services required prior to liftoff.

The three swing arms (figure 1-1) carry service lines to the S-I stage, the S-IV stage, and the vehicle instrument unit. Swing arm No. 1 is connected to the forward area of the S-I stage, swing arm No. 2 is connected to the aft area of the S-IV stage, and swing arm No. 3 is connected to the vehicle instrument unit.

The tail area of the S-I stage is serviced by short cable masts No. 2 and No. 4, and by the LOX and fuel masts. (See figure 1-2.) The holddown arms, one located at each of the eight fins, support the vehicle on the launcher and restrain the vehicle during engine ignition and thrust build-up.

At launch commit time, the holddown arms release the vehicle. At the same time, the swing arms and masts release and swing clear of the vehicle liftoff drift pattern.

This section contains the description and operation of the launch pad accessories group. Each launch pad accessory is given a general description followed by a more detailed description of major components. The operation of each launch pad accessory includes those operations that are performed to prepare the accessory for vehicle launch as well as the operation at launch commit. author

1.2 UMBILICAL TOWER SWING ARMS

Three swing arms are attached to the umbilical tower to support the various service lines that connect the vehicle to the ground support equipment. The three swing arms are located at different levels on the umbilical tower. Swing arm No. 1 is located between the 108- and 118-foot levels, swing arm No. 2 is between the 128- and 138-foot levels, and swing arm No. 3 is between the 158- and 168-foot levels.

Pneumatic and hydraulic pressures are used to uncouple the service lines from the vehicle. and to rotate the swing arms clear of the vehicle liftoff drift pattern. Viewed from above, swing arm No. 1 rotates counterclockwise, while No. 2 and No. 3 arms rotate clockwise.

1.2.1 Description - Major components of each swing arm assembly include the basic arm, hinge assembly, quick-release mechanism, rotary hydraulic actuator, lanyard release cable, bumper assembly and swing arm control panel. These components are briefly described in the following paragraphs.

1.2.1.1 Basic Arm (Figure 1-1). The basic arm is a four-sided truss structure with an attachment plate assembly located at each end. The main attachment plate, on the tower end of the swing arm, is fastened to the hinge assembly. Swing arms No. 2 and No. 3 are equipped with an extension arm that is fastened to the attachment plate on the vehicle end of the basic arm. These extensions increase the length of the basic arm to compensate for the difference in the distance between the umbilical tower and the vehicle at the upper stage attachment points. A sheet metal tray, running the length of the swing arm, supports the various vehicle servicing lines.

1.2.1.2 Hinge Assembly (Figure 1-1). The hinge assembly is connected to a weldment on the umbilical tower. The bottom hinge contains a lockpin assembly that secures the arm in the servicing position. The lockpin prevents arm rotation, which might be caused by wind loads or hydraulic leakage. A coil spring in the lockpin assembly holds the lockpin piston in the extended or locked position until hydraulic pressure is applied. Retracting the lockpin, mechanically opens a mechanical valve in the hydraulic supply line; thus ensuring that the swing arm is free to rotate before hydraulic pressure is applied to the lanyard retract cylinder or the rotary actuator. A cam-operated valve located on the top portion of the hinge assembly is actuated by a camplate. As the arm rotates away from the vehicle, the cam gradually closes the valve and restricts flow in the hydraulic return line, progressively reducing the rate of arm travel as the arm approaches the bumper assembly.

1.2.1.3 Quick-Release Mechanism (Figure 1-1). The quick-release mechanism is located at the outer extremity of each swing arm. The mechanism secures the various service lines to the vehicle during ground operation, then releases and ejects these lines from the vehicle at liftoff. The quick-release mechanism for swing arms No. 1 and No. 3 (figure 3-1 and 3-3) consists of a housing, a ball-lock device, and four pneumatically actuated kickoff pistons. At liftoff, pneumatic pressure is applied to the ball-lock devices on swing arms No. 1 and No. 3 to unlock the swing arms.

The quick-release mechanism for swing arm No. 2 (figure 3-2) consists of a connector plate and two pneumatic kickoff cylinders, each of which also incorporates two arms that hook over pins on the S-IV stage umbilical plate. At liftoff, pneumatic pressure is applied to the kickoff cylinders to release the arms from the pins and separate the connector plate from the vehicle.

The GH_2 vent line on swing arm No. 3 connects to the vehicle through a 6-inch quick-disconnect coupling. The coupling is secured to the vehicle by a spring lock assembly inside the coupling. At liftoff, the outer shell of the coupling is kicked back by two kickoff pistons and the spring lock releases and separates the vent line from the vehicle.

1.2.1.4 Rotary Hydraulic Actuator (Figure 1-1). The vane-type rotary hydraulic actuator develops the 210,000 inch-pounds of torque required to rotate the swing arm 135 degrees. As the swing arm pivots a cam-operated valve gradually closes and causes the swing arm to decelerate. When the arm has traveled approximately 120 degrees, the valve is fully closed and return hydraulic fluid is metered through an orifice to limit back pressure on the rotary actuator. A relief valve protects the rotary actuator from excess back pressure.

1.2.1.5 Lanyard Release Cable (Figure 1-1). Mechanical pull from the lanyard release cables releases any umbilical connector that has failed to disconnect. Each lanyard release cable is connected to a hydraulic cylinder that receives hydraulic fluid at 1500 psig when the swing arm lockpin is retracted. The lockpin opens a mechanical valve in the hydraulic supply line and hydraulic pressure forces the piston to the bottom of the cylinder. The lanyard release cable then pulls the umbilical housing or connector plate away from the vehicle.

1.2.1.6 Bumper Assembly. A bumper assembly is attached to a channel beam mounted vertically on the tower at each swing arm installation. Each bumper is installed so that the forward end of the swing arm contacts the bumper when the swing arm is swung away from the vehicle. Rubber pads cover the contact area and absorb the shock. A microswitch mounted on each bumper assembly is actuated and transmits a signal to the launch control center when the arm is fully retracted

1.2.1.7 Swing Arm Control Panel (Figures 3-1, 3-2, and 3-3). A swing arm control panel located on the umbilical tower adjacent to each swing arm, is provided for controlling swing arm hydraulic and pneumatic systems.

The hydraulic system provides the fluid medium required to operate the rotary hydraulic actuator, the lockpin assembly, and the lanyard retract cylinder. Pressurized hydraulic fluid is supplied to the system from a hydraulic power cart located in the Automatic Ground Control Station (AGCS).

The pneumatic system provides the GN_2 control pressure required to actuate the swing arms. The GN_2 is also used to purge various areas of each swing arm. Three GN_2 lines supply all three swing arms. A 3000 psig line is used to precharge the hydraulic accumulator and pneumatic reservoir in the swing arm control panel. A 750-psig line is used to actuate control valves and the quick-release mechanism. The 750-psig line is also used to purge the umbilical housing on swing arm No. 1 and swing arm No. 3. The third line supplies a 50-psig GN_2 purge to components in the swing arm control panel.

1.2.2 Operation - The description of the operation of the swing arms is divided into the following separate discussions: System preparation, rotation of the swing arm into the vehicle servicing position, and the umbilical release and swing arm rotation at liftoff. Since the operation of each of the three swing arms is essentially the same, only swing No. 1 is discussed; therefore, finding number references are to figure 3-1 only.

1.2.2.1 System Preparation. Before the swing arm can be operated, the hydraulic accumulator must be filled and the pneumatic system must be pressurized. This is accomplished as follows:

a. Solenoid Valve A3043, Manual Valve A3007, and Pneumatic Valves A3012 and A3036 are closed. Pneumatic Valves A3012 and A3036 are closed by energizing Solenoid Valve A3018.

b. The hydraulic pump motor on Hydraulic Power Cart A4850 is started and the flow control valve is opened. Hydraulic fluid flows up the tower through the tower hydraulic supply line.

c. Manual Valve A5500 is opened to allow hydraulic fluid to flow into Hydraulic Accumulator A3000, through Filter A3020, and Check Valve A3003.

d. Hydraulic Accumulator A3000 is filled until the fluid forces a piston within the accumulator to the bottom and actuates the accumulator full Indicator Switch A3022.

e. Pump pressure increases to 1700 psig, at which time fluid flow to Hydraulic Accumulator A3000 ceases.

f. Manual Valve A3001, located on the swing arm control panel, is opened and 3000-psig GN_2 from valve panel No. 5 (volume V) flows to pneumatic Pressure Regulator A3006 through Check Valve A3027.

g. Pneumatic Pressure Regulator A3006 is opened until Pneumatic Reservoir A3002 is pressurized to 1500 psig as indicated by Pressure Gage A3005 and Pressure Transducer A3016. When 1500-psig pressure is obtained, Manual Valve A3001 is closed.

h. A manual valve (A2130, volume V) on valve panel No. 5 is opened and 750-psig GN_2 for valve actuation, umbilical housing purge, and umbilical housing release is supplied to the system.

1.2.2.2 Rotation of Swing Arm into Vehicle Servicing Position. To service the vehicle, the swing arm must be rotated into position and the umbilical housing fastened to the vehicle as follows:

a. A toggle switch, located on the swing arm control panel, is moved to the CLOSE position. Normally closed Solenoid Valve A3018 is energized and 750-psig GN_2 pressure closes Pneumatic Valves A3012 and A3036 in the main hydraulic supply line.

b. Manual Valve A3007 is opened and hydraulic fluid flows from Hydraulic Accumulator A3000 through A3007 to four-way Manual Valve A3008. The four-way valve is opened and hydraulic fluid flows through the extend line to Rotary Hydraulic Actuator A3013 which rotates the swing arm toward the vehicle. Return hydraulic fluid flows back through the retract line to A3008 and through Check Valve A3038 to the hydraulic return line and Reservoir A4851.

c. When the swing arm reaches the launch vehicle servicing position, four-way Manual Valve A3008 is closed and Manual Valve A3028 is opened.

d. Manual Valve A3026 is opened long enough to allow the hydraulic fluid in Lockpin Assembly A3021 to drain through Check Valve A3038 into the hydraulic return line and Reservoir A4851. Venting the lockpin assembly allows the lockpin to extend and lock the swing arm in the servicing position.

e. Manual Valve A3009 is opened momentarily to allow the lockpin to retract enough to open Mechanical Valve A3023. The piston of lanyard retract Hydraulic Cylinder A3011 is manually extended. This forces hydraulic fluid from the cylinder through Orifice A3078, Mechanical Valve A3023, Manual Valve A3028, and Check Valve A3038 into Reservoir A4851. When the lanyard retract piston is at maximum extension, A3009 is closed.

f. Umbilical Housing Assembly A3060 is positioned against the vehicle umbilical plate and ball-lock device is secured. Manual Valve A3028 is closed and Manual Valve A3068 is opened.

g. Hydraulic Accumulator A3000 and Pneumatic Reservoir A3002 are recharged and Solenoid Valve A3018 is deenergized. The swing arm is now ready for vehicle servicing and automatic retraction at liftoff.

1.2.2.3 Operation at Liftoff. At vehicle liftoff, the umbilical housing assembly is released and pulled away from the vehicle, and the swing arm is rotated out of the vehicle liftoff drift pattern. The swing arm retract actuation signal is sent by either of two swing arm retract switches located on two of the holddown arms.

a. The signal from the swing arm retract switches energizes Solenoid Valve A3039 which permits 750-psig GN_2 to flow to the release mechanism and to the kickoff cylinders. The release mechanism releases the umbilical housing assembly from the vehicle, and the kickoff cylinders separate it from the vehicle.

b. Simultaneously, the signal from the swing arm control switches energizes Solenoid Valves A3017 and A3041; 750-psig pneumatic pressure then opens Pneumatic Valves A3012 and A3036 in the hydraulic supply line. Fluid from Hydraulic Accumulator A3000 flows through A3012, A3036, and Check Valve A3004 into swing arm Lockpin Assembly A3021. Pressurized hydraulic fluid in A3021 causes the lockpin to retract, and allows the swing arm to rotate.

c. Retraction of the lockpin opens Mechanical Valve A3023. Hydraulic fluid flows through A3023 and Orifice A3078 to Hydraulic Cylinder A3011. The lanyard retract cylinder pulls the umbilical housing and service lines from the vehicle. Hydraulic fluid flow through A3023 is also directed through Check Valve A3031 and the retract line to Rotary Hydraulic Actuator A3013. Return flow is through the extend line, Manual Valve A3068, Cam-operated Valve A3032, Orifice A3077, and Check Valve A3038 to Reservoir A4851.

d. Hydraulic fluid flow through Rotary Hydraulic Actuator A3013 causes the swing arm to swing away from the vehicle. As the arm completes 55 degrees of

rotation, Cam-operated Valve A3032 is gradually closed by the cam on top of the hinge assembly. As the valve closes, the flow of hydraulic fluid from the return side of the rotary hydraulic actuator is restricted and the swing arm decelerates. When the swing arm has completed approximately 120 degrees of rotation, the cam-operated valve is completely closed. This action forces the hydraulic fluid to flow through Orifice A3044 and causes further deceleration of the arm. Relief Valve A3067, which relieves at 2000 psig, prevents excessive pressure buildup in the rotary hydraulic actuator. The hydraulic fluid flows through Orifice A3077 and into the tower hydraulic return line through Check Valve A3038.

e. As the swing arm completes 130 to 135 degrees of rotation, it contacts the tower bumper assembly. A microswitch in the bumper assembly signals the launch control center that the swing arm is fully retracted.

1.3 SHORT CABLE MASTS

Two short cable masts are mounted on the launcher to provide quick-disconnect capability for electrical cables and pneumatic lines that connect the ground support equipment to the S-I stage. Short cable masts No. 2 and No. 4 are similar in construction and identical in operation. Significant differences are type, size, quantity, and routing of cables and pneumatic lines required for each mast. Because of these similarities, only the description and operation of short cable mast No. 2 is given in the following paragraphs.

1.3.1 Description (Figure 1-2) - Each short cable mast assembly consists of a support platform, a mast weldment, two kickoff cylinders, a quick-release housing, a latch-back mechanism, and a trunion.

1.3.1.1 Support Platform. The support platform is a four-sided truss structure that forms the structural base of the short cable mast. One side of the support platform is a ladder that furnishes access to the rest of the cable mast. The support platform provides sufficient elevation so that the quick-release housing will mate with the vehicle umbilical plate. Two detachable work platforms and one extension platform are attached to the top of the support platform to furnish a working area during prelaunch operations. The detachable work platforms are removed and the extension platform is folded and secured prior to launch.

1.3.1.2 Mast Weldment. The mast weldment extends from the top of the support platform to the vehicle umbilical plate. The weldment consists of four bracket arms and two hinge assemblies which allow the quick-release housing and service lines to pivot away from the vehicle at liftoff. A retract cylinder, secured between the two hinges, pivots the mast backward and pulls the quick-release housing clear of the vehicle at liftoff.

1.3.1.3 Kickoff Cylinders. Spring-loaded kickoff cylinder assemblies mechanically eject the quick-release housing from the vehicle. The cylinders are secured to the upper bracket arms of the mast weldment by hinges and the cylinder piston rods are inserted in pin-holddown devices on the vehicle. At liftoff, vehicle movement causes

the piston to compress the cylinder springs. After approximately two inches of vehicle motion, the pistons bottom within the cylinders and mechanically eject the mast from the vehicle. The kickoff cylinder rods slip out of the pin-holddown devices and the short cable mast is free to be pivoted clear of the vehicle drift pattern.

1.3.1.4 Retract Cylinder. A double-acting pneumatic retract cylinder supplies the force necessary to pivot the short cable mast. At liftoff, 750-psig GN_2 flowing into the top of the retract cylinder pivots the mast backward. Fifty-psig GN_2 is constantly vented at the bottom of the cylinder to cushion the backward swing of the mast.

1.3.1.5 Quick-Release Housing. The quick-release housing, mounted at the upper end of the mast weldment, contains electrical cable and pneumatic service line connectors which link the vehicle to the ground support equipment. The housing is secured to the S-I stage umbilical plate by a ball-lock release pin assembly. A release arm is attached to the pin assembly to retract it from the ball-lock mechanism . As the vehicle lifts approximately two inches, a roller mounted on the other end of the release arm moves down a groove in the mast arm. The release arm pivots about a hinge and forces the pin to retract; thus the quick-release housing is freed from the S-I stage umbilical plate.

1.3.1.6 Latch-Back Mechanism. A latch-back mechanism, bracketed between the mast weldment and the trunnion, provides a positive lock for the mast in either of three retracted positions. The lock prevents the mast from rebounding into the vehicle liftoff drift pattern. The first position holds the mast approximately four inches from the vehicle to prevent the mast from striking the vehicle during mast erection. The mid-position secures the mast out of the vehicle liftoff drift pattern. The kickoff cylinders should force the mast to this position even if a failure occurs in the pneumatic retraction system. The third position is the fully retracted position; normally, the retraction system positions the mast to this position.

1.3.1.7 Trunnion. The trunnion provides a mounting point and pivot for the mast weldment. The latch rod bracket and the lower retract cylinder hinge assembly are also mounted on the trunnion. The trunnion provides a means of adjusting the vertical position of the mast.

1.3.2 Operation (Figure 3-4) - Short cable mast operation includes the sequence for prelaunch erection and automatic launch retraction. The operation of short cable mast No. 2 and short cable mast No. 4 is identical; therefore, only the operation of short cable mast No. 2 is discussed.

1.3.2.1 Mast Erection. The short cable mast is erected as follows:

a. The latch-back mechanism is manually released and the mast is manually moved toward the vehicle.

b. The piston rods of kickoff Cylinders Assemblies A6511 and A6526 are inserted into the vehicle pin holddown devices.

c. Vent port Check Valve A6523 is removed and a variable (250-to 750-psig) GN_2 supply is attached to Orifice A6516 to supply pneumatic pressure to the bottom of Retract Cylinder A6522.

d. As Retract Cylinder A6522 is gradually pressurized, the mast moves forward and Release Pin Assembly A6500 is guided into the S-I Stage umbilical plate receptacle. The kickoff cylinders are further compressed as the mast moves toward the vehicle.

e. After the housing is secured to the S-I stage umbilical plate, pressure is bled from the auxiliary supply line and the retract cylinder. The auxiliary supply line is then removed and vent port Check Valve A6523 is re-installed.

f. All service lines are connected to the proper nipples and connectors on the quick-release housing and are secured.

1.3.2.2 Automatic Mast Retraction. Automatic mast retraction is as follows:

a. At T minus 5 seconds, a solenoid valve (A5602, volume V) in the launcher is energized and 750-psig GN_2 flows through Check Valve A6514 to pre-pressurize the upper part of Retract Cylinder A6522. The 750-psig GN_2 also flows through Pressure Regulator A6518 and Check Valve A6517 into the lower part of the retract cylinder. Pressure in the bottom of the cylinder is constantly vented through Orifice A6516 and Check Valve A6523. At approximately T plus 3 seconds a second signal concurrent with the launch commit signal, opens another solenoid valve (A5603,volume V) in the launcher. This allows 750-psig GN_2 to flow through Check Valve A6520 to provide backup pressure for the mast retract system.

b. At vehicle liftoff, the quick-release housing moves upward with the vehcile. This upward movement causes the pistons in the kickoff cylinders to further compress the kickoff cylinder springs.

c. The quick-release housing release arm roller moves along the mast groove for approximately two inches of vehicle motion. The roller movement pivots the release arm, disengages Release Pin Assembly A6500, and frees the quick-release housing from the vehicle. Simultaneously, the pistons within kick-off Cylinder Assemblies A6511 and A6526 provide an outward force on the mast weldment.

d. Kickoff Cylinder Assemblies A6511 and A6526 provide enough outward force to disconnect the cable and line connectors from the vehicle. The springs within the cylinders help accelerate the mast away from the vehicle.

e. After disconnect occurs, Retract Cylinder A6522 pulls the mast away from the vehicle. The 50-psig GN_2 constantly venting from the bottom of the retract cylinder cushions mast travel.

f. As the mast reaches the end of travel, the latch-back mechanism engages and prevents the mast from rebounding into the vehicle liftoff drift pattern, or in the event of pneumatic failure, from falling back against the vehicle.

1.4 FUEL AND LOX MASTS

The fuel and LOX masts connect propellant transfer lines to the vehicle storage tanks. The LOX mast is located on the launch pedestal between stub fin 2 and fin III. The fuel mast is located on the launch pedestal between fin I and stub fin 1.

1.4.1 Description (Figure 1-2) - The two masts are similar in construction; however, the fuel mast is 18 inches longer and contains the turbine exhaust duct. Major components of both masts are a retractable coupling assembly, cylinder assemblies, a mast arrestor, a retract assembly, a mounting assembly, and a valve box assembly. The description of the two masts is essentially the same; therefore, only the fuel mast is described. Differences, where applicable, are described.

1.4.1.1 Retractable Coupling Assembly. The retractable coupling assembly is a mechanically actuated, telescoping device used to mate the fuel mast to the S-I stage fuel fill and drain nozzle. Primary components of the coupling are guide vanes and a bellows which is mounted in a shield assembly. The guide vanes align the retractable coupling with the fuel nozzle during mast erection while the bellows control the coupling action. A Teflon seal between the coupling and the fuel nozzle provides a positive seal during fuel transfer operations. The shield assembly protects the bellows.

1.4.1.2 Cylinder Assemblies. Two cylinder assemblies are used to control the contraction and expansion of the bellows in the retractable coupling assembly. Each cylinder assembly consists of two clevises, a piston rod, a spring, a pressure port and a cylinder body. The top clevis is connected to the retractable coupling assembly and the bottom clevis is connected to the upper pipe weldment of the mast. The spring in the cylinder is preloaded to maintain the piston, with the attached retractable coupling assembly, in the extended position. When 750-psig GN_2 is applied to the pressure port, the piston is forced down in the cylinder body and the spring is compressed. The piston rod causes the bellows to contract and retract the coupling assembly. When the pressure in the cylinder is vented, the spring forces the piston to return to the original position. This action expands the bellows and extends the coupling assembly.

1.4.1.3 Mast Arrestor. The mast arrestor automatically secures the mast in the retracted position. This prevents the mast from rebounding into the vehicle liftoff drift pattern or falling against the vehicle in the event of pneumatic failure. The mast arrestor consists of a mounting bracket attached to a cylinder assembly, a dual arrestor hook, an arrestor cylinder assembly that is spring-loaded to the arresting position. The spring load on the arrestor cylinder assembly keeps the arrestor hook in the locked position until pneumatic pressure overcomes spring tension and pivots the arrestor hook to the released position.

1.4.1.4 Retract Assembly. The retract assembly is an adjustable pneumatic cylinder that pivots the upper portion of the mast either into position under the fuel nozzle,

or away from the vehicle. The retract assembly consists of a retract cylinder assembly with extend and retract ports, a cylinder support, a clevis, and an adjustment wheel. The retract cylinder assembly is connected to the upper portion of the mast by the cylinder support and the clevis. Application of 750-psig pneumatic pressure to the cylinder assembly retract port forces the cylinder piston down and causes the upper portion of the mast to swing away from the vehicle. The adjustment wheel controls the amount of swing by lengthening or shortening the retract assembly. Pneumatic pressure applied to the erect port, and vented from the retract port, moves the cylinder piston to the original position and swings the upper portion of the mast to the servicing position under the fuel nozzle.

1.4.1.5 Mounting Assembly. The mounting assembly is the connecting link between the upper and lower pipe weldments, and is secured to the support stand. The mounting assembly contains a trunnion support assembly, to which the retract cylinder assembly and a support bracket assembly are connected. An adjustment ring and two adjustment screws on the mounting assembly provide mast assembly adjustment. The ring permits height adjustment of the mast to attain correct clearance between the retractable coupling assembly and the fuel nozzle. The adjustment screws are used to make lateral adjustments to align the mast with the fuel nozzle.

1.4.1.6 Valve Box Assembly. The valve box assembly, located on the support stand, provides manual and automatic control of mast operation. Manual control of circuits for mast erection, retraction, and checkout is accomplished through use of pushbutton valves located on the valve box assembly.

1.4.1.7 Turbine Exhaust. The turbine exhaust duct consists of several 1/4-in. thick plates welded together to form a vent for hot exhaust gasses from the No. 5 H-1 engine turbine. The duct collects and routes the exhaust gasses down through the mast support stand to the atmosphere. The turbine exhaust duct is a part of the fuel mast only and is not on the LOX mast. Due to the flammable nature of RP-1 fuel, the fuel mast also incorporates a flame arrestor. The flame arrestor consists of an inner and an outer screen arrangement installed in the fuel flow path between the upper pipe weldment and the retractable coupling assembly. The flame arrestor prevents flame from entering the fuel line through the retractable coupling assembly at liftoff.

1.4.2 Operation (Figure 3-4) - The fuel and LOX masts are erected and aligned prior to launch by using the valve box assembly. The fuel and LOX masts are retracted automatically during the launch operation. The two masts operate in the same manner; therefore, only the fuel mast operation is discussed.

1.4.2.1 Mast Erection. The fuel mast is erected to the servicing position as follows:

a. Button-operated Manual Valve A4511 on the valve box assembly is opened, allowing 750-psig GN_2 from valve panel No. 10 to flow through A4511 and Check Valve A4515 to Cylinder Assemblies A4502, A4503, and A4508. GN_2 also flows through Check Valve A4512 and Orifice A4527 to the retract port of Cylinder Assembly A4504 and through Pressure Regulator A4522 to the erect port of A4504.

b. Cylinder Assemblies A4502, A4503, and A4508 are brought to operating pressure before Cylinder Assembly A4504 reaches operating pressure due to the low flowrate through Orifice A4527. This allows Retractable Coupling Assembly A4500 to retract and the arrestor hook to pivot to the released position prior to movement of the mast. Pressure at the erect port of the retract assembly is reduced to approximately 185 psig and serves as cushion pressure against sudden movement of the retract assembly piston. Check Valve A4518 and button-operated Manual Valve A4516 prevent 750-psig GN_2 from entering the retract assembly erect port.

c. Button-operated Manual Valve A4511 is released and pneumatic pressure is trapped in the system. The trapped pressure keeps Retractable Coupling Assembly A4500, Cylinder Assembly A4504, and mast arrestor Cylinder Assembly A4508 in the retracted position.

d. Button-operated Manual Valves A4514 and A4516 are mechanically linked for simultaneous operation. When actuated, A4514 vents the retract port of Cylinder Assembly A4504 and A4516 allows 750-psig GN_2 to flow to the erect port of the cylinder assembly. The mast then moves into position under the S-I stage fuel fill and drain nozzle. Speed of mast movement is limited by restricting the release of pressure from the retract port by Orifice A4513.

e. Button-operated Manual Valves A4514 and A4516 are closed when the mast is in position under the fuel nozzle. Trapped pressure in Cylinder Assemblies A4502, A4503, and A4508 keeps the arrestor hook in the released position and Retractable Coupling Assembly A4500 in the retracted position.

f. Button-operated Manual Valve A4521 is opened to vent the entire mast assembly. This allows Retractable Coupling Assembly A4500 to mate with the fuel nozzle and the arrestor hook to return to the arresting position.

1.4.2.2 Automatic Mast Retraction. Automatic mast retraction at vehicle launch occurs as follows:

a. A holddown arm release signal energizes a solenoid valve (A5601, volume V) in the launcher which allows 750-psig GN_2 from valve panel No. 10 to flow through Check Valve A4523 to the retract port of Cylinder Assembly A4504. The 750-psig GN_2 forces the piston to the bottom of the cylinder and the piston travel retracts the mast.

b. GN_2 at 750 psig also flows to Pressure Regulator A4522 and is reduced to approximately 185 psig. The 185-psig GN_2 then flows through Relief Valve A4520 and Check Valve A4519 to the erect port of Cylinder Assembly A4504 to decelerate the mast and cushion the retracting motion.

c. The arrestor hook is spring loaded to the arresting position to provide positive engagement with the pivot pin in the mounting bracket assembly. The arrestor hook locks the mast in the fully retracted position and prevents the mast from

rebounding into the vehicle liftoff drift pattern or falling forward in the event of pneumatic failure.

1.5 HOLDDOWN ARMS

The eight holddown arm assemblies (figure 1-2) support the vehicle on the launcher and prevent liftoff until engine thrust builds up and stabilizes and the engine hydraulic systems reach operating pressure. Similar arm assemblies are located under each vehicle fin. The cast steel holddown arm assemblies are 7-foot structures that are bolted to the launcher. A blast shield protects the linkage and separator device from engine exhaust during ignition and liftoff. Doors located on both sides of the holddown arm frame provide access for replacing the shear pin module and for repositioning the tip of the ball-lock separator after the release operation. A removable winch assembly is used for positioning the holddown arm assemblies in the proper holddown position.

1.5.1 Description (Figure 3-5) - Each hold down arm consists primarily of an arm and two pin-jointed links. The arm is joined to the hold-down frame at pin joint "A" which allows the arm to pivot upward and away from the vehicle tie-down points. The other end of the arm is supported at pin joint "B" by an assembly composed of two pin-jointed links. These links are jointed end to end and are attached to the holddown frame at pin joint "D". The connecting joint between these two links, pin joint "C", is connected to pneumatically-operated Quick-Release Mechanism A4400. The links are mounted so that they slant inward toward the vehicle. A swivel nut moves the linkage outward when torqued to the required value. This causes the holddown arm to clamp down on the vehicle holddown fitting. When pneumatic pressure is applied to the quick-release mechanism, the link assembly is released at pin joint "C". This forces the arm to rotate around pin joint "A" and release the vehicle. The link assembly folds downward, rotating around pin joint "D". The lower link encounters a replaceable shear pin module which absorbs kinetic energy and decelerates the motion of the arm and link. With the holddown arm in the retract position, Microswitch A4411 transmits a signal to the launch control center to indicate that the holddown arm has been released. Two liftoff switches are located on holddown arms I and III and two swing arm control switches are located on holddown arms II and IV. The switches are spring operated and are held open by the weight of the vehicle. At liftoff the switches are released. The liftoff switches signal the launch control center that liftoff has been accomplished. The swing arm control switches send a signal to the swing arms to initiate swing arm retraction. To provide environmental protection against fire and explosion due to electrical sparks, the switches are purged with 50-psig GN_2 from a regulator (A2121, volume V) located in valve panel No. 5. The purge begins immediately before propellant loading and continues until liftoff.

1.5.2 Operation (Figure 3-5) - The operation of the holddown arms consists of attachment of the arms to the vehicle, pressurization of the holddown arms release control panel, and holddown arms release at vehicle liftoff.

1.5.2.1 Attachment to the Vehicle. The holddown arms are attached to the vehicle as follows:

a. A winch assembly is attached to the holddown arm assembly and used to position the holddown arm on the vehicle fin holddown fitting.

b. Two access doors are removed from the holddown arm housing and a shear pin module is installed. Quick-Release Mechanism A4400 is connected and the required torque is applied to the swivel nut; after which, the access doors are replaced and the winch assembly is removed.

1.5.2.2 System Pressurization. The holddown arms release control panel is pressaurized as follows:

a. Manual Valves A4431 through A4438 are opened.

b. Manual Valve A4444 is opened, allowing 750-psig helium (He) to flow from valve panel No. 10 (volume V) through Check Valve A4443, into Pneumatic Reservoir A4441. The pressure within the system is indicated by Pressure Gage A4440.

c. Pressure Switch A4418 actuates at 625 (±20) psig to arm the engine ignition system.

1.5.2.3 Liftoff and Release Sequence. The holddown arms release sequence is as follows:

a. After the H-1 engines ignite and build up maximum thrust and the hydrau- ·aulic systems reach operating pressure, a signal from the launch control center energizes Solenoid Valves A4416 and A4417 allowing 750-psig He from Pneumatic Reservoir A4441 to flow to Shuttle Valve A4439 and Manifold A5687. System pressure to the manifold is supplemented by 750-psig He flow from valve panel No. 10 (volume V) through Check Valve A4443, Manual Valve A4444, the solenoid valves and the shuttle valve.

b. Helium at 750-psig flows from Manifold A5687 to each holddown arm assembly simultaneously. Helium flows to Quick-Release Mechanism A4400, located at holddown arm No. I, through Manual Valve A4431. Pneumatic pressure releases the quick-release mechanism which allows the link assembly to fold to the retract position. The lower link of the assembly shears the pins in the shear pin module and comes to rest. Microswitch A4411 energizes the fin I release indicator in the launch control center.

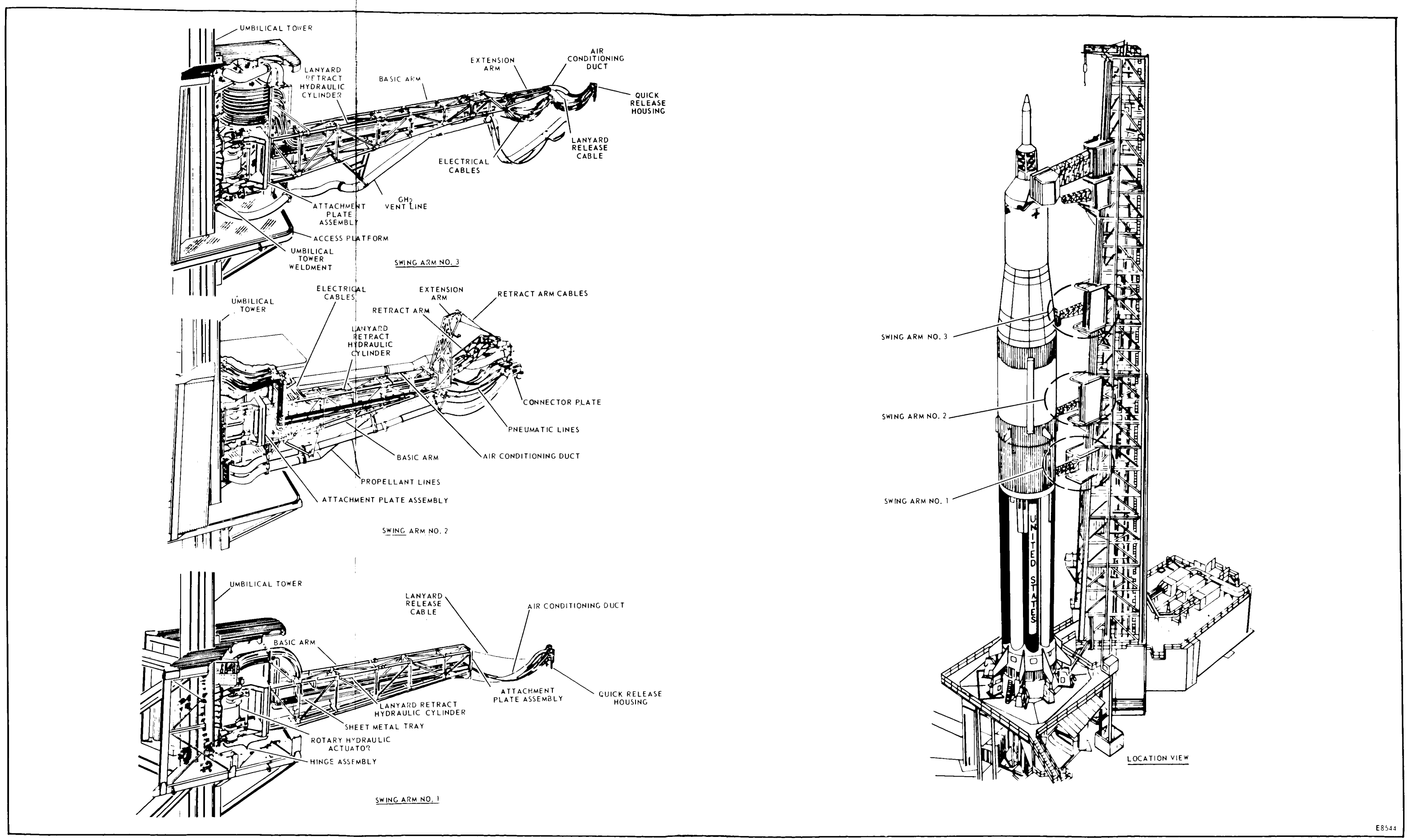
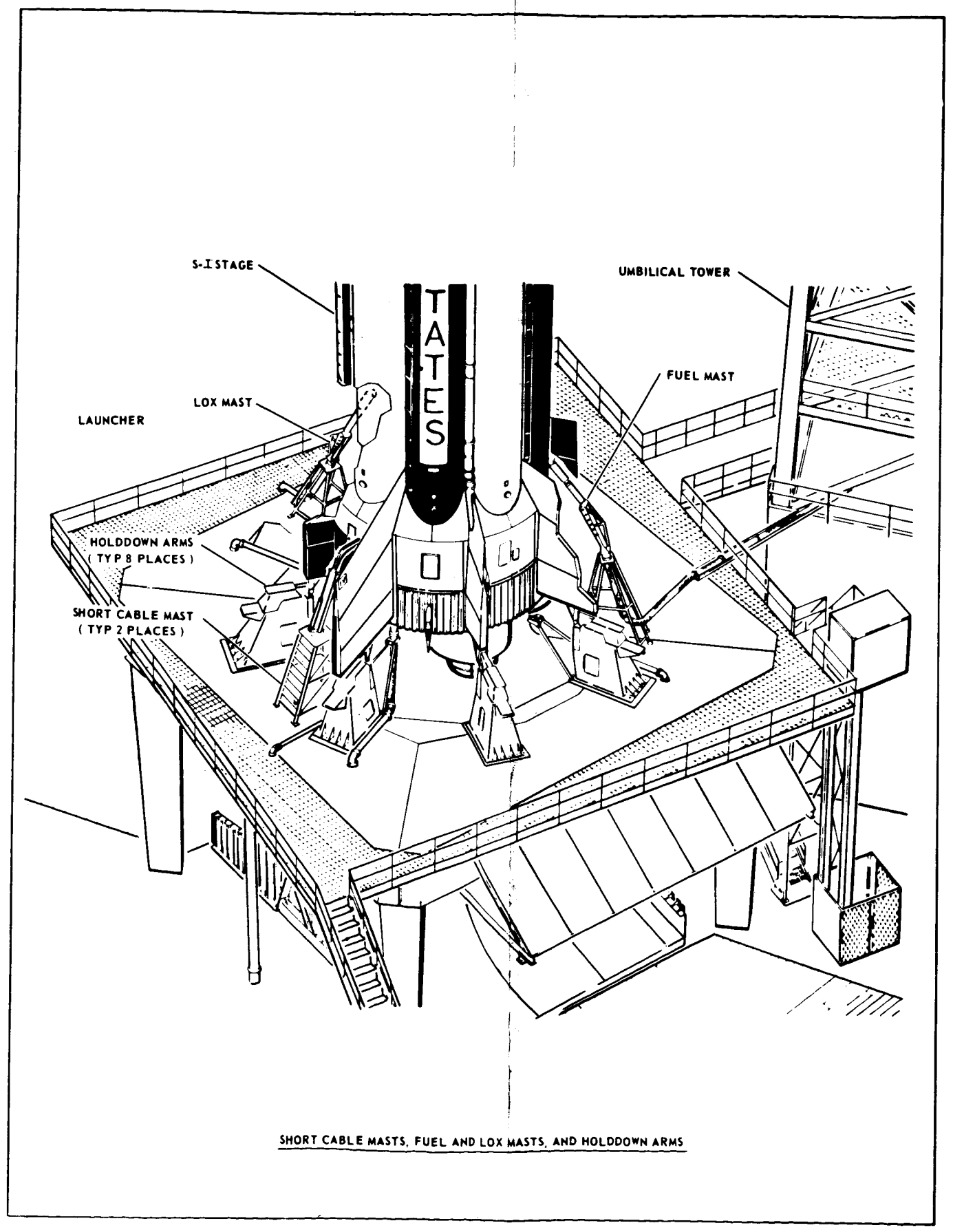
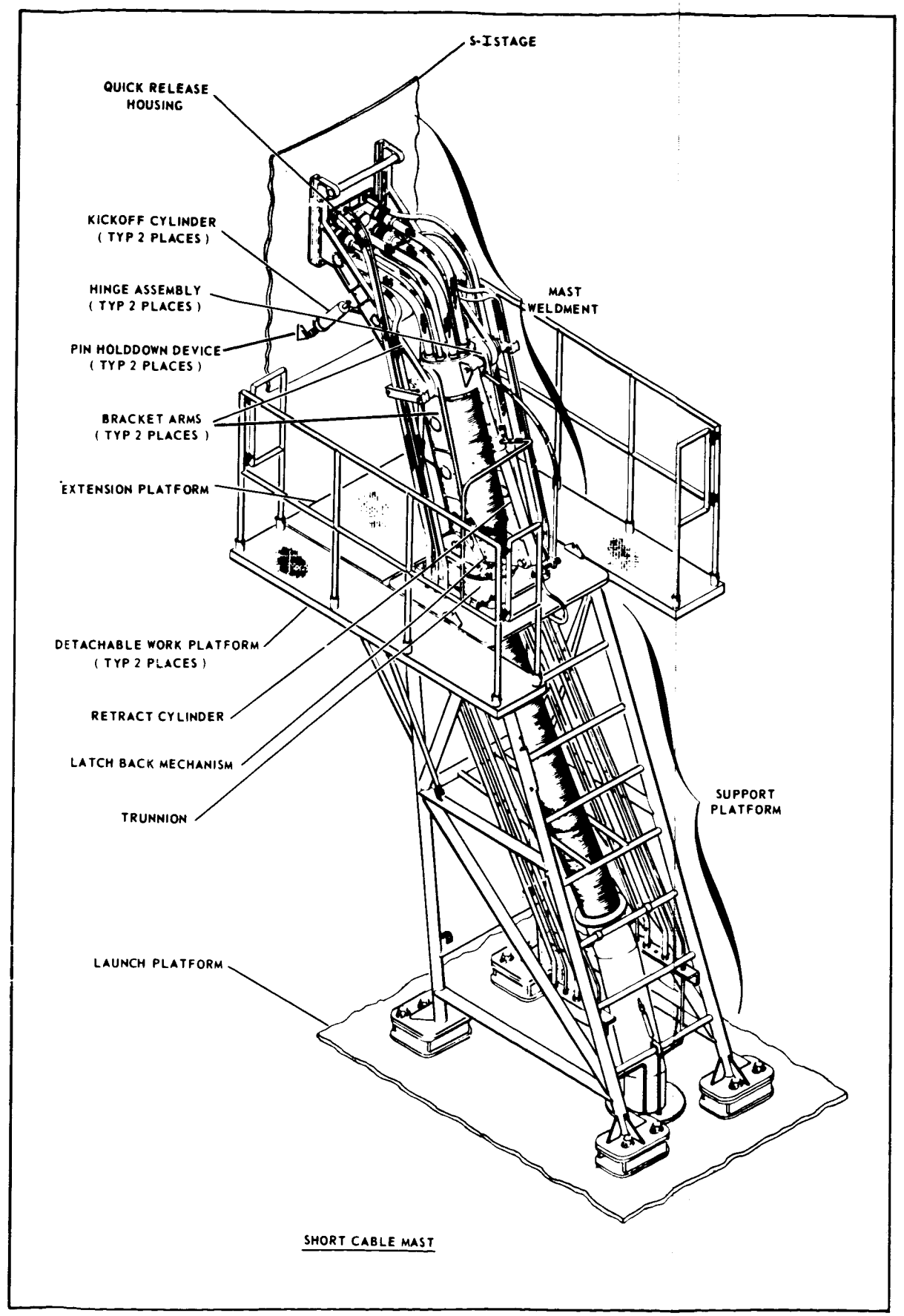


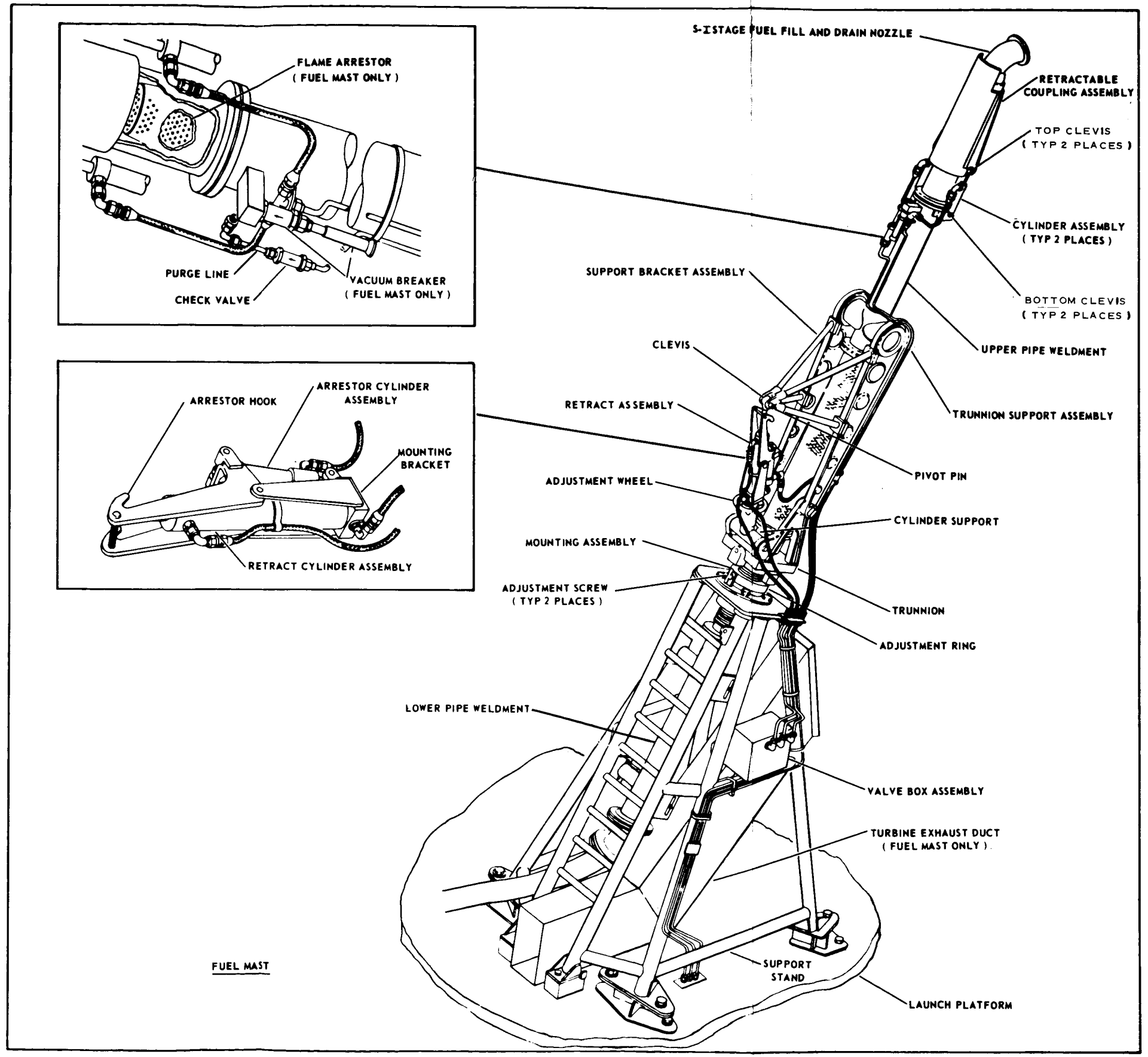
Figure 1-1. Umbilical Tower Swing Arms



SHORT CABLE MASTS, FUEL AND LOX MASTS, AND HOLDDOWN ARMS



SHORT CABLE MAST



FUEL MAST

E8541

Figure 1-2. Launcher Accessories

SECTION 2

INDEX OF FINDING NUMBERS

This section contains an alpha-numerical list, by finding number, of the launch pad accessories components that function during a prelaunch countdown. The finding numbers listed identify components on system mechanical schematics provided in section 3. Additional columns in the index of finding numbers provide such pertinent information as component description and function, part number, and the supplier's name and part number. A break will occur in the alpha-numeric sequence of finding numbers when a component, or component series is non-functional during the countdown, functional only in the event of a malfunction, functional in terms of a maintenance operation only, or is part of another functional system.

The letter prefix of a finding number identifies the component location with respect to either the launch complex or an area of the launch vehicle. The letter prefixes used in this eleven-volume set are listed below.

FINDING NUMBER PREFIX	DESIGNATED AREA
A	Launch complex
B	S-I stage
E	S-IV stage
G	Instrument unit
H	Payload

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A3000	1	Accumulator, Hydraulic	1155-cu-in. capacity, 1500 psig; Hydraulic fluid	Parker Hydraulics Div. P/N A6A1155B31K	75M00453	
A3001	1	Valve, Manual	1/4 in.	Robbins Aviation Co. P/N SSNA-250-4T-787	75M01305-1	
A3002	1	Reservoir, Pneumatic	1190-cu-in. capacity; 1500-psig GN_2	Parker Hydraulics Div. P/N B6A1155B4K	75M00449	
A3003	1	Valve, Check	3/8 in.	James, Pond & Clark P/N 279T-6TT	75M00452	
A3004	1	Valve, Check	3/4 in.	James, Pond & Clark P/N 279T-12TT	75M00696	
A3005	1	Gage, Pressure	1500-psig normal indication, 0-to 2000-psig range	James P. Marsh P/N 210-3SSFMH	75M50147-13	
A3006	1	Regulator, Pressure	3000-psig input, 1500-psig output	Grove Valve & Regulator Company P/N 15KX-10931MA2B	75M50165-13	
A3007	1	Valve, Manual	1/4 in.	Robbins Aviation Co. P/N SSNA-250-4T-787	75M01305-1	
A3008	1	Valve, Manual	3/8 in.; 4-way, 3-position	Parker Aircraft Co. P/N H59E0023-1	75M01949	
A3009	1	Valve, Manual	1/4-in.; button-operated, lockpin retract	Futurecraft Valve Corp. P/N 30130	75M03568	
A3010	1	Valve, Manual	1 in.	Flodyne Controls Inc. P/N 10C12L	75M00442	
A3011	1	Cylinder, Hydraulic	2-in. bore, 48-in. stroke; lanyard retract	Hannifin Company P/N CBB-HLS13	10427203	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A3012	1	Valve, Pneumatic	1 in.; NC	Flodyne Controls Inc. P/N 10C15	75M00455	57A11A7
A3013	1	Actuator, Rotary Hydraulic	210,000 in-lbs torque, 290 degrees rotation	Excello Corp. Air & Hydraulic Engr. Co.	10428419	
A3014 and A3015 are not functionally applicable to this system.						
A3016	1	Transducer, Pressure		Giannini Controls Inc. P/N 461267AD-G-200-20	75M03149-1	57A11A15
A3017	1	Valve, Solenoid	3/8 in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 204424 MV123	104257701	57A11A2
A3018	1	Valve, Solenoid	3/8 in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 204424 MV123	10425701	57A11A9
A3019	1	Valve, Manual	1/4 in.; drain	Robbins Aviation Co. P/N SSNA-250-4T-787	75M01305-1	
A3020	1	Filter	12 gpm capacity	Purolator Products P/N AN6235A4	MS 28720-12	
A3021	1	Lockpin Assembly	Hydraulic, 1500-psig operating press.	MSFC	10427900	
A3022	1	Switch, Indicator	Level control	Parker-Hannifin Corp. P/N MS 3102E-10SL-4P	75M05383	57A11A4
A3023	1	Valve, Mechanical	1 in., ball-type	Flodyne Controls Inc. P/N 10C17	75M03021	
A3024 and A3025 are not functionally applicable to this system.						

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A3026	1	Valve, Manual	1/4 in.; button-operated	Futurecraft Valve Corp. P/N 30130	75M03568	
A3027	1	Valve, Check	1/4 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 279-T-4TT	10425928-1	
A3028	1	Valve, Manual	1/4 in.; button-operated	Futurecraft Valve Corp., P/N 30130	75M03568	
A3029 is not functionally applicable to this system.						
A3030	1	Orifice	3/8-in. to 1/4-in. union; 0.75 gpm at 900 psig and 70 F	A. U. Stone Company P/N P 883	75M03155	
A3031	1	Valve, Check	1 in.	James, Pond & Clark P/N 279-T-16TT	75M00189	
A3032	1	Valve, Cam-Operated	1 in.; N.O.	Flodyne Controls, Inc. P/N 10C19	75M04253	
A3033 and A3034 are not functionally applicable to this system.						
A3035	1	Orifice	0.020-in. dia., 1/4-in. union	A. U. Stone Company P/N H92C-020	75M00456	
A3036	1	Valve, Pneumatic	1 in.	Flodyne Controls Inc. P/N 10C15	75M00455	57A11A8
A3037	1	Switch, Pressure	Adjustable, set at 625 psig	Southwestern Industries P/N PS-3807-D625	75M01965	57A11A3
A3038	1	Valve, Check	1 in.	James, Pond & Clark P/N 279-T-16TT	75M00189	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A3039	1	Valve, Solenoid	3/8 in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 204424 MV123	10425701	57A11A11
A3040	1	Orifice	0.020-in dia., 1/4-in. union, 5.0 scfm flowrate; sintered	Del Manufacturing Co. P/N DR 4-5.0	75M04000-18	
A3041	1	Valve, Solenoid	3/8 in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 204424 MV123	10425701	57A11A13
A3042	1	Valve, Solenoid	3/8 in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 304423 MV123-B	75M02986-1	57A11A17
A3043	1	Valve, Solenoid	3/8 in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 304423 MV123-B	75M02986-2	57A11A16
A3044	1	Orifice	0.060-in. dia., 1/4-in. union	A.U. Stone Company P/N H92C-060	75M02823	
A3045 is not functionally applicable to this system.						
A3046	1	Switch, Pressure	Adjustable, set at 625 psig	Southwestern Industries P/N PS-3807-D625	75M01965	
A3047 through A3054 are not functionally applicable to this system.						
A3055	1	Valve, Vent	3/8 in.; 0- to 2000-psig operating press.	James, Pond & Clark P/N P 6-698-3	75M00177	
A3056 through A3059 are not functionally applicable to this system.						
A3060	1	Housing Assembly	Swing arm No. 1 umbilical disconnect	MSFC	75M02049	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A3061 through A3066 are not functionally applicable to this system.						
A3067	1	Valve, Relief	2000 (±100)-psig min nom cracking press.	James, Pond & Clark P/N 5159T-4TT-2000	75M06178-1	
A3068	1	Valve, Manual		Flodyne Controls Inc. P/N 10C12L	75M00442	57A11A24
A3069 through A3072 are not functionally applicable to this system.						
A3073	1	Orifice	0.031-in. dia.; 1-in. union	A.U. Stone Co. P/N H228-.031	75M50562	
A3074 and A3075 are not functionally applicable to this system.						
A3076	1	Orifice	1.2 scfm at 70 degrees F and 750-psig upstream press.	Del Manufacturing Co. P/N DRH-1.2	75M04000-11	
A3077	1	Orifice	0.188-in. dia ; 1-in union	A.U. Stone Co. P/N H264C-.188	75M07280-1	
A3078	1	Orifice	0.156-in. dia ; 1/2-in. union	A.U. Stone Co. P/N H276-.156	75M07281-1	
A3079 through A3099 are not functionally applicable to this system.						

NOTE

Electrical symbols for swing arm No. 2 are the same as for swing arm No. 1 except that the first five numerals are 57A12.

Swing arm No. 2 components (A3100 through A3180) are identical to swing arm No. 1 components (A3000 through A3080) with the following exceptions.

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A3111	1	Cylinder, Hydraulic	3-1/4-in. bore, 30-in. stroke	Hannifin Company P/N CBB-HLS13	75M02818	
A3140 is not functionally applicable to this system.						
A3147	1	Switch, Pressure	Adjustable, set at 975(±50) psig	Southwestern Industries P/N PS-3807-975	75M03197-1	57A12A5
A3148	1	Valve, Solenoid	3/8 in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 204424 MV113	10425701	57A12A19
A3149	1	Cylinder Assembly	Pneumatic, retract arm		75M04725	
A3158	1	Housing, Umbilical	Swing arm No. 2 umbilical disconnect		75M04577	
A3179	1	Orifice	0.250-in. dia , 1-in.union	A. U. Stone Co. P/N H264C-250	75M07280-2	
A3180	1	Orifice	0.250-in. dia , 1/2-in. union	A. U. Stone Co. P/N H276C-250	75M07281-2	
NOTE Electrical symbols for swing arm No. 3 are the same as for swing arm No. 1 except that the first five numerals are 57A13. Swing arm No. 3 components (A3200 through A3284) are identical to swing arm No. 1 components (A3000 through A3078) with the following exceptions.						
A3245	1	Switch, Pressure	Adjustable, set at 725(±50) psig	Southwestern Industries P/N PS-3800-D 725	75M03198	57A13A5
A3257	1	Valve, Vent	3/8-in.; 0- to 2000-psig operating press.	James, Pond & Clark P/N P 6-698-3	75M00177	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A3258	1	Valve, Vent	1/4-in., port check	James, Pond & Clark P/N P-4-698-3	75M00178	
A3263	1	Valve, Solenoid	3/8-in.; 3-way, 2-position, NC	Marotta Valve Corp. P/N 204424 MV123	10425701	
A3284	1	Housing Assembly	Swing arm No. 3 umbilical disconnect		75M07037	
A3285 through A4399 are not functionally applicable to this system.						
A4400	1	Mechanism, Quick-Release			75M01843	
A4401 and A4402 are not functionally applicable to this system.						
A4403	1	Mechanism, Quick-Release			75M01843	
A4404 is not functionally applicable to this system.						
A4405	1	Mechanism, Quick-Release			75M01843	
A3259	1	Orifice	Air bearing bleed vent	A. U. Stone Co. P/N P 881-8	75M04165-8	
A4406 is not functionally applicable to this system.						
A4407	1	Mechanism, Quick-Release			75M01843	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A4408	1	Microswitch	Fin release indicator control		75M02096	
A4409	1	Microswitch	Fin release indicator control		75M02096	
A4410	1	Microswitch	Fin release indicator control		75M02096	
A4411	1	Microswitch	Fin release indicator control		75M02096	
A4412 through A4415 are not functionally applicable to this system.						
A4416	1	Valve, Solenoid	1 in.; 3-way, 2-position, NC	Marotta Valve Corp. Mod. MV 526B-modified per 904044-10255	75M03978	
A4417	1	Valve, Solenoid	1 in.; 3-way, 2-position, NC	Marotta Valve Corp. Mod. MV 526B-modified per 904044-10255	75M03978	
A4418	1	Switch, Pressure	Actuates at 625 (±20) -psig decreasing press.; 50-psig max diff press.	Southwestern Industries P/N PS 5116-D625	75M04207	
A4419	1	Mechanism, Quick-Release			75M01843	
A4420	1	Microswitch	Fin release indicator control		75M02096	
A4421 is not functionally applicable to this system.						
A4422	1	Mechanism, Quick-Release			75M01843	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A4423	1	Microswitch	Fin release indicator control		75M02096	
A4424 is not functionally applicable to this system.						
A4425	1	Mechanism, Quick-Release			75M01843	
A4426	1	Microswitch	Fin release indicator control		75M02096	
A4427 is not functionally applicable to this system.						
A4428	1	Mechanism, Quick-Release			75M01843	
A4429	1	Microswitch	Fin release indicator control		75M02096	
A4430	1	Valve, Check	3/8 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 279-T-6TT	75M04049-1	
A4431	1	Valve, Manual	1/2 in.	Flodyne Controls, Inc. Model 5A10	75M02297	
A4432	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4433	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4434	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A4435	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4436	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4437	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4438	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4439	1	Valve, Shuttle	1 in.; pneumatic	James, Pond & Clark P/N 423A-16BBB	75M03977	
A4440	1	Gage, Pressure	1/4 in.; 750-psig nominal indication, 0- to 1500-psig range		75M04208	
A4441	1	Reservoir, Pneumatic	400-cu in. capacity	Walter Kidde & Co. Inc. Model No. 212259	75M03975	
A4442	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4443	1	Valve, Check	1/2 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 259T-8TT	75M04049-2	
A4444	1	Valve, Manual	1/2 in.	Flodyne Controls Inc. Model 5A10	75M02297	
A4445 through A4499 are not functionally applicable to this system.						
A4500	1	Retractable Coupling Assembly	90-psig operating pressure	Flexonics Inc. P/N 107435	75M00253	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A4501 is not functionally applicable to this system.						
A4502	1	Cylinder Assembly	1-1/2-in. bore, 4-in. stroke	Tomkins-Johnson Co. P/N LSM-3-750	75M00248	
A4503	1	Cylinder Assembly	1-1/2-in. bore, 4-in. stroke	Tomkins-Johnson Co. P/N LSM-3-750	75M00248	
A4504	1	Cylinder Assembly	Extends and retracts mast	MSFC	10426689	
A4505 is not functionally applicable to this system.						
A4506	1	Orifice	1-scfm (±20%) flowrate; sintered	Del Manufacturing Co. P/N D6S-1.00B 20N-750A	75M04979	
A4507	1	Orifice	1-scfm (±20%) flowrate; sintered	Del Manufacturing Co. P/N D6S-1.00B 20N-750A	75M04979	
A4508	1	Cylinder Assembly	Mast arrestor			
A4509 and A4510 are not functionally applicable to this system.						
A4511	1	Valve, Manual	1/4 in.; button-operated	Futurecraft Valve Corp. P/N 30130	10425920	
A4512	1	Valve, Check	3/8 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 239T-6TT	10426693	
A4513	1	Orifice	3/8 in.; 0.030 (+0.002, -0.000)-in. dia	A.U. Stone Company P/N 883-1	10426711	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A4514	1	Valve, Manual	1/4 in.; button-operated	Futurecraft Valve Corp. P/N 30130	10425920	
A4515	1	Valve, Check	3/8 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 239T-6TT	10426693	
A4516	1	Valve, Manual	1/4 in.; button-operated	Futurecraft Valve Corp. P/N 40170-1	10425920	
A4517	1	Valve, Check	3/8 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 239T-6TT	10426693	
A4518	1	Valve, Check	3/8 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 239T-6TT	10426693	
A4519	1	Valve, Check	3/8 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 239T-6TT	10426693	
A4520	1	Valve, Relief	400(±25)-psig relief, 325-psig min reseat	Cornelius Company P/N 118-B-100-16	10426704	
A4521	1	Valve, Manual	1/4 in.; button-operated	Futurecraft Valve Corp. P/N 30130	10425920	
A4522	1	Regulator, Pressure	1/4 in.; 750-psig input; 185 (+5, -0)-psig output	Futurecraft Valve Corp. P/N 30130	10426705	
A4523	1	Valve, Check	3/8 in.; 0.5- to 1.0-psig cracking press.	James, Pond & Clark P/N 239T-6TT	10426693	
A4524 through A4526 are not functionally applicable to this system.						
A4527	1	Orifice	0.030-in. dia	A.U. Stone Company P/N H93C-.030	10426725	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A4528 through A4600 are not functionally applicable to this system.						
NOTE LOX mast components (A4600 through A4627)are identical to fuel mast components (A4500 through A4527) with the following exceptions.						
A4601	1	Cylinder Assembly	1-1/2-in. bore, 4-in. stroke	Tompkins-Johnson Co. P/N LSM-3-750	75M00248	
A4602	1	Cylinder Assembly	1-1/4-in. bore, 4-in. stroke	Tompkins-Johnson Co. P/N LSM-3-750	75M00248	
A4603	1	Cylinder Assembly	Extends and retracts mast	MSFC	10426689	
A4604	1	Orifice	1-scfm (±20%) flowrate; sintered	Del Manufacturing Co. P/N D6S-1.00B20N-750A	75M04979	
A4605	1	Orifice	1-scfm (±20%) flowrate; sintered	Del Manufacturing Co. P/N D6S-1.00B20N-750A	75M04979	
A4606	1	Cylinder Assembly	Mast arrestor			
A4627 through A4849 are not functionally applicable to this system.						
A4850	1	Power Cart, Hydraulic	Motor-driven	Sun Electric Company	75M00566	
A4851	1	Reservoir		Sun Electric Company	75M01016	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A4852	1	Filter		Sun Electric Company	75M01009	
A4853 through A4873 are not functionally applicable to this system.						
A4874	1	Switch, Pressure	Actuates at 1270 (±70) psig	Southwestern Industries P/N PS3810-D1270	10437818-2	
A4875 through A5499 are not functionally applicable to this system.						
A5500	1	Valve, Manual	Ball-type	Flodyne Controls Inc. 5A11	75M51077-3	
A5501	1	Valve, Manual	Ball-type	Flodyne Controls Inc. 5A11	75M51077-3	
A5502	1	Valve, Manual	Ball-type	Flodyne Controls Inc. 5A11	75M51077-3	
A5503 through A5546 are not functionally applicable to this system.						
A5547	1	Valve, Check		Valve & Primer Corp. P/N 5-1224	75M04003-5	
A5548 through A5686 are not functionally applicable to this system.						
A5687	1	Manifold	Holddown arms release distributor		75M03508	
A5688 through A6071 are not functionally applicable to this system.						

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A6072	1	Coil, Pneumatic	Length correcting			
A6073	1	Coil, Pneumatic	Length correcting			
A6074 through A6499 are not functionally applicable to this system.						
A6500	1	Release Pin Assembly	Ball-lock type	MSFC	75M02855	
A6501 through A6505 are not functionally applicable to this system.						
A6506	1	Orifice	0.030-in. dia, 1/4-in. union	A. U. Stone Company R/N 881-2	75M04165-2	
A6507 through A6510 are not functionally applicable to this system.						
A6511	1	Cylinder Assembly	Kickoff	Parker Hydraulics Div. P/N 1641-582082	75M02614	
A6512 is not functionally applicable to this system.						
A6513	1	Valve, Vent	1/4 in.; 3-psig cracking press.	James, Pond & Clark P/N P-4-698-3	75M00178	
A6514	1	Valve, Check	1/4 in.; 3-psig cracking press.	James, Pond & Clark P/N HP279T1-4BT	75M02661	
A6515	1	Valve, Manual	1/4 in. button-operated	Futurecraft Valve ny Corp. P/N 30130	10425920	

Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
A6516	1	Orifice	.015-in. dia, 1/4-in. union	A. U. Stone Company P/N H92C-.015	75M02852	
A6517	1	Valve, Check	1/4 in.; 3-psig cracking press.	James, Pond & Clark P/N HP279T1-4TT	75M02675	
A6518	1	Regulator, Pressure	1/4 in.; preset at 50 (±5) psig	Futurecraft Valve Corp. P/N 30130	75M02663	
A6519 is not functionally applicable to this system.						
A6520	1	Valve, Check	3/8 in.; 3-psig cracking press.	James, Pond & Clark P/N HP279T1-6TT	75M02676	
A6521 is not functionally applicable to this system.						
A6522	1	Cylinder, Retract	Pneumatic, double-action	Futurecraft Valve Corp.	75M02697	
A6523	1	Valve, Check	1/4 in.; 3-psig cracking press.	James, Pond & Clark P/N 4-698-3	75M00178	
A6524 and A6525 are not functionally applicable to this system.						
A6526	1	Cylinder Assembly	Kickoff	Parker Hydraulics Div. P/N 1641-582082	75M02614	
A6527 through A6599 are not functionally applicable to this system.						

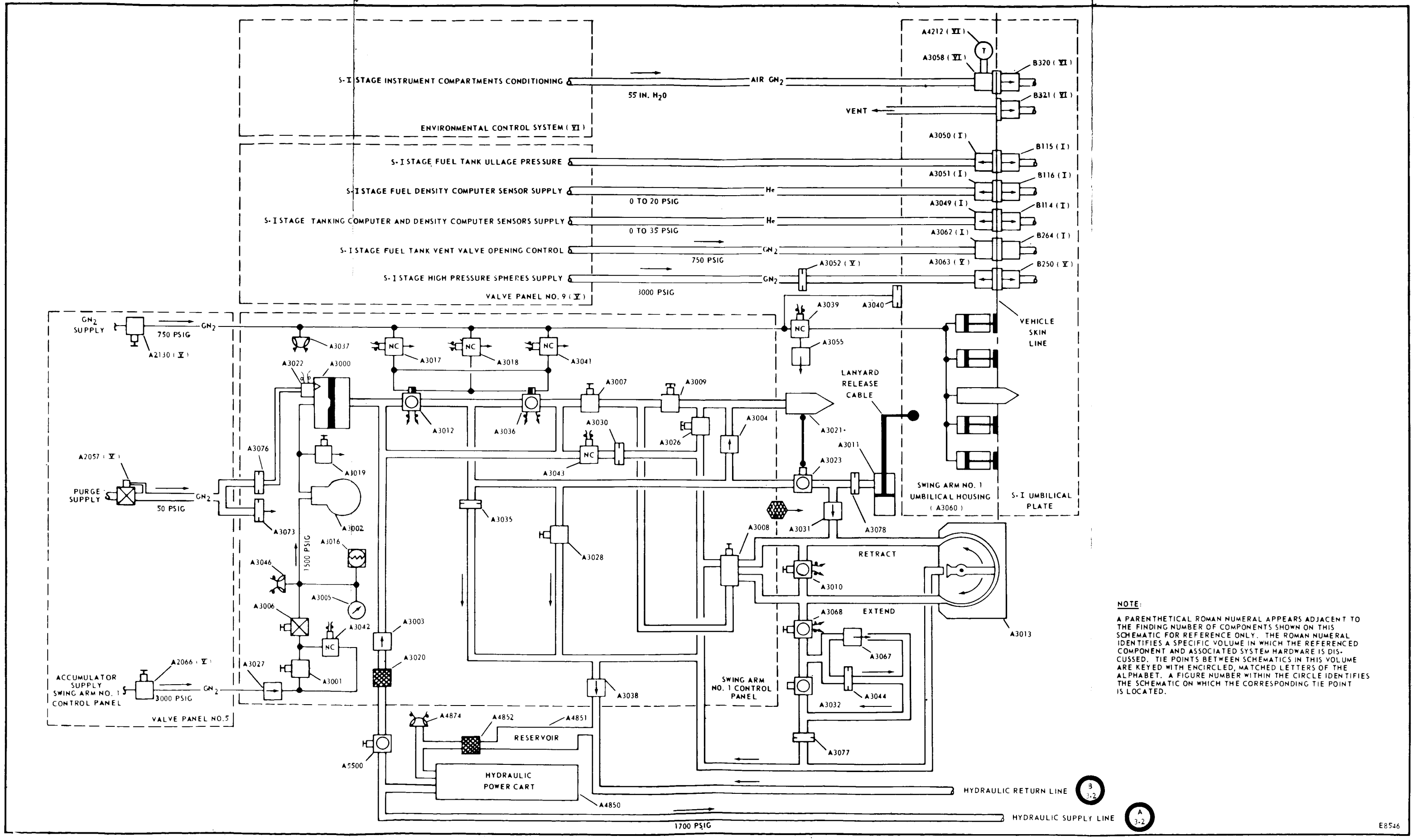
Finding Number	Reqd	Component	Remarks	Vendor	Drawing Number	Elec. Sym.
NOTE Short cable mast No. 4 components (A6600 through A6628) are identical to short cable mast No. 4 components (A6500 through A6528) with the following exception.						
A6628	1	Orifice	0.063 (±0.001) -in. dia, 3/8-in. union	A. U. Stone Company P/N H93C-063	75M05177	

SECTION 3

MECHANICAL SCHEMATICS

This section contains mechanical schematics that show the functional arrangement of launch pad accessories components listed in section 2.

For a definition of the mechanical symbols used, see MSFC-STD-162A.



NOTE:

A PARENTHETICAL ROMAN NUMERAL APPEARS ADJACENT TO THE FINDING NUMBER OF COMPONENTS SHOWN ON THIS SCHEMATIC FOR REFERENCE ONLY. THE ROMAN NUMERAL IDENTIFIES A SPECIFIC VOLUME IN WHICH THE REFERENCED COMPONENT AND ASSOCIATED SYSTEM HARDWARE IS DISCUSSED. TIE POINTS BETWEEN SCHEMATICS IN THIS VOLUME ARE KEYED WITH ENCIRCLED, MATCHED LETTERS OF THE ALPHABET. A FIGURE NUMBER WITHIN THE CIRCLE IDENTIFIES THE SCHEMATIC ON WHICH THE CORRESPONDING TIE POINT IS LOCATED.

Figure 3-1. Swing Arm No. 1 - Mechanical Schematic

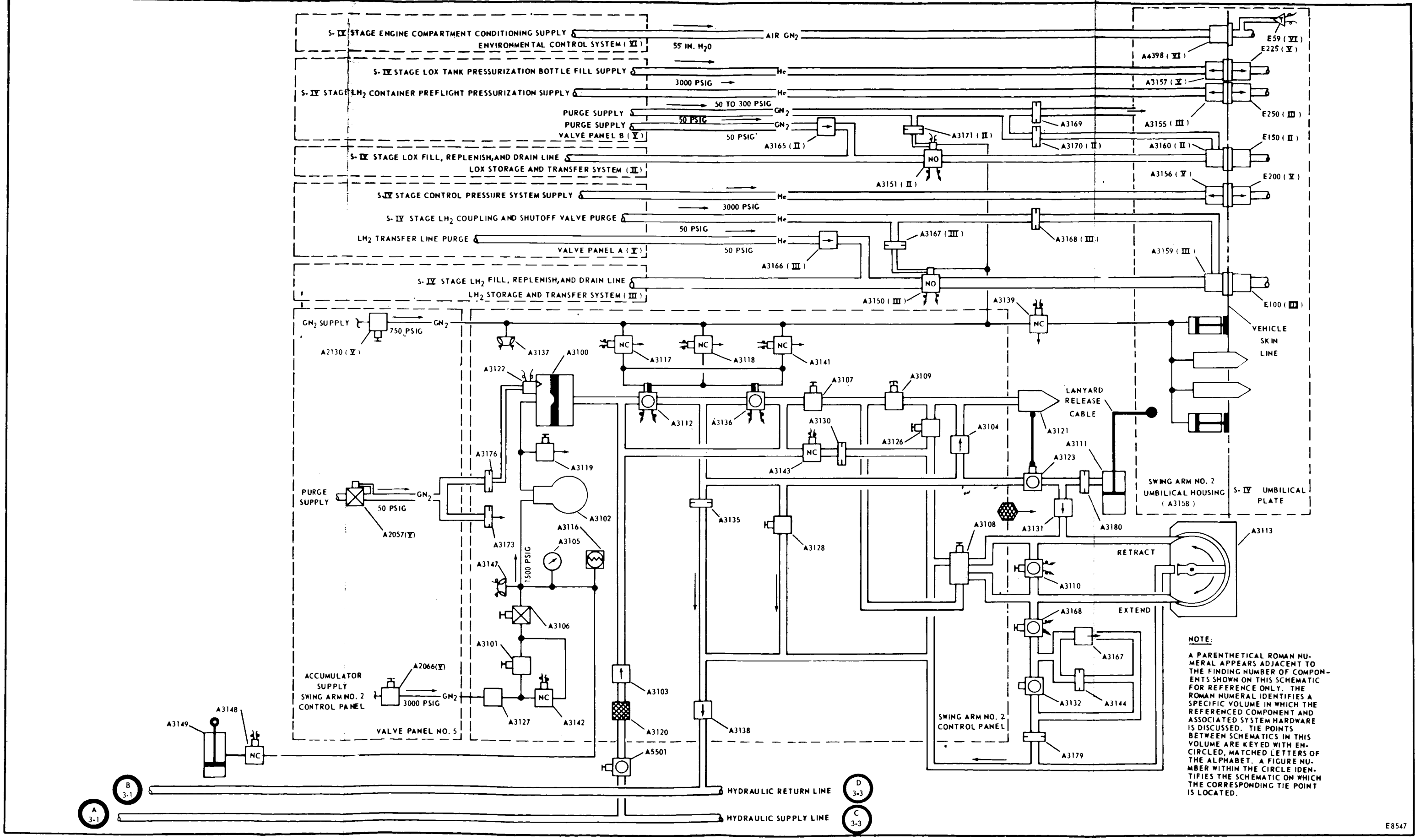


Figure 3-2. Swing Arm No. 2 - Mechanical Schematic

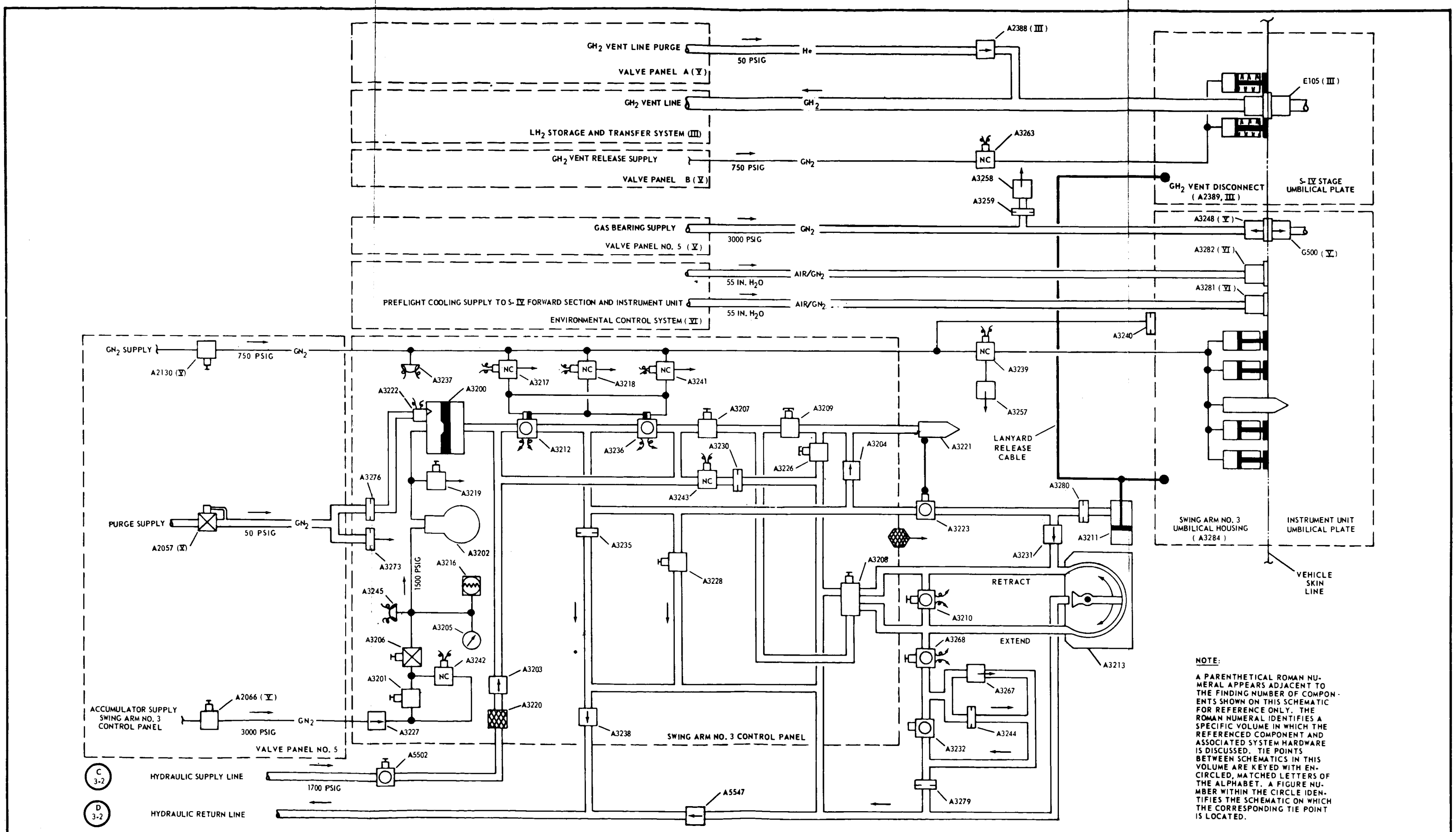


Figure 3-3. Swing Arm No. 3 - Mechanical Schematic

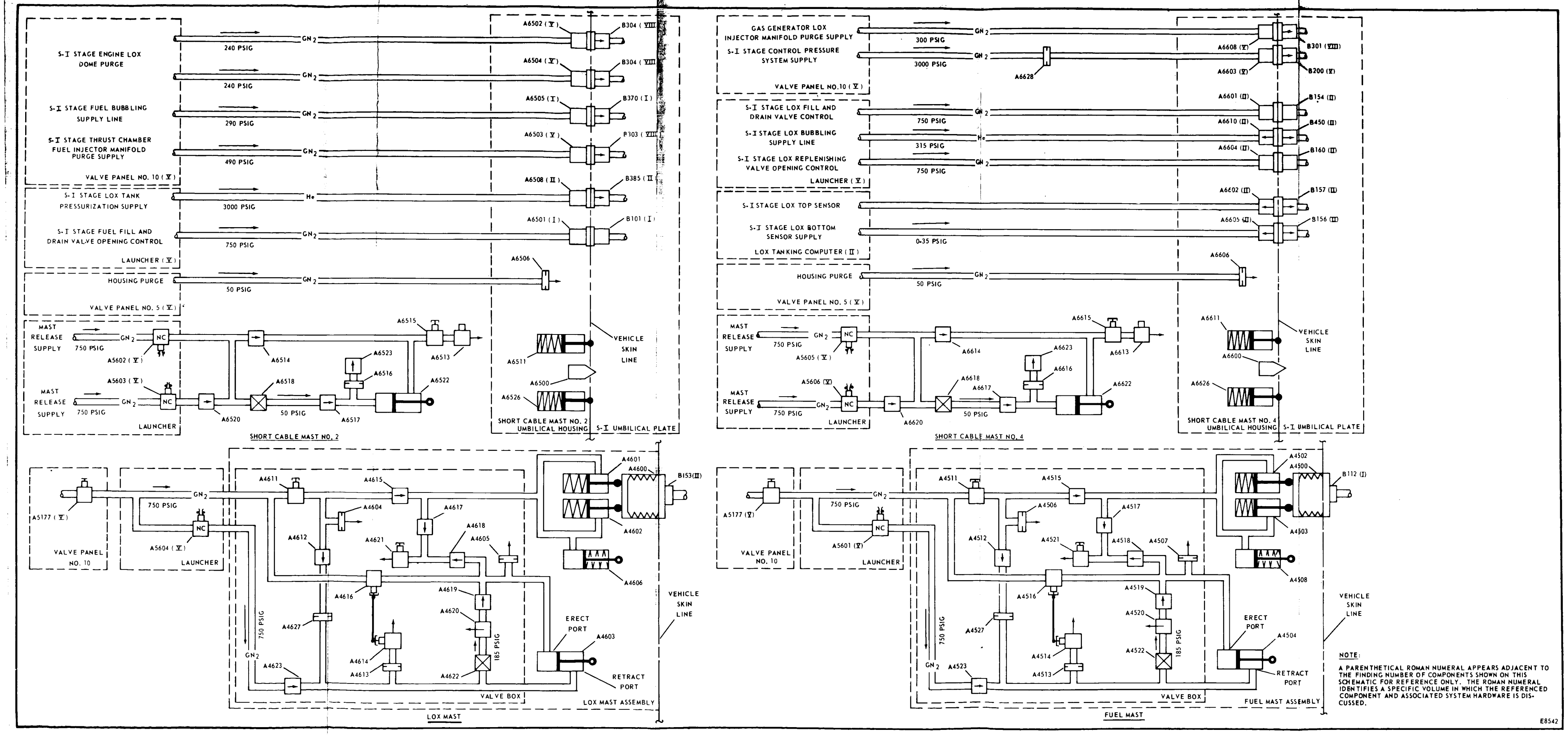


Figure 3-4. Fuel Mast, LOX Mast, and Short Cable Masts-Mechanical Schematic

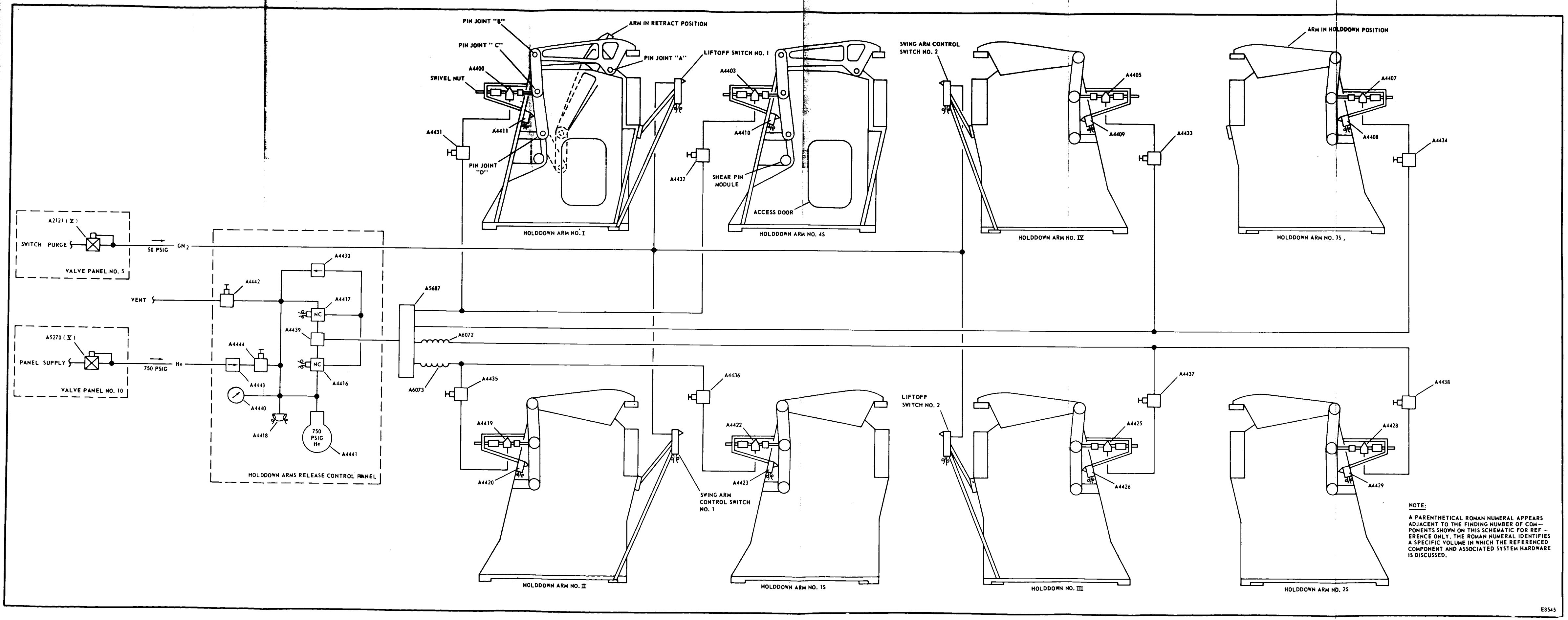


Figure 3-5. Holddown Arms, Holddown Arms Release Control Panel and Accessories - Mechanical Schematic