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Student Study Guide
1 March 1964

SITE STRUCTURE AND MECHANISMS

OBJECTIVE

To familiarize the student with launch site construction, dimensions, and the location of the site structures and their mechanisms.

INTRODUCTION

The American philosophy, "Strike back hard but never first", makes it imperative that the launch site be able to survive an attack. In the event of a nuclear attack, everything above ground within the blast area would be destroyed. For this reason the launch site has been placed under the ground.

LAUNCH COMPLEX

A typical launch complex (Figure 1) consists of two underground structures (launch control center and silo). The structures within the complex contain the equipment required to perform tests, checkout, and launch functions on the missile. The launch complex is capable of performing propellant loading exercises (wet countdowns), simulated countdowns, and tactical countdowns.

Launch Control Center

The launch control center (Figure 2) is a circular room 44 FT in outside diameter and contains a two story steel crib structure. This structure is buried 6-1/2 FT beneath the earth's surface and is located northwest of the silo.

Entrance to the launch control center is gained by means of a stairway in an entry tunnel leading from the ground level down to a vestibule.

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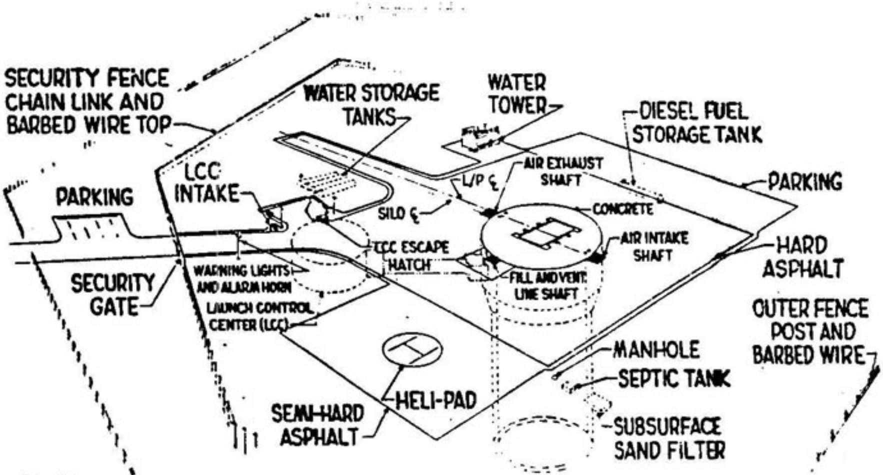


"F" LAUNCH COMPLEX GROUND LAYOUT (TYPICAL)

Figure 1

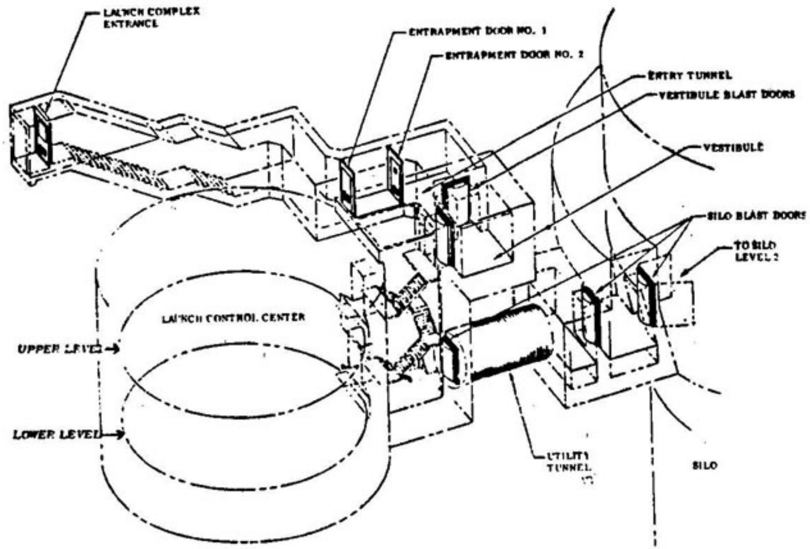


Figure 2 - Launch Complex Entrance

The diameter of the crib structure is approximately 38 FT. A small amount of rattle space is provided between the crib and the outside wall of the launch control center (LCC). This steel crib hangs from the ceiling of the concrete structure by a suspension system that is air cushioned to absorb ground shock. The suspension system is composed of four air cylinder spring supports attached from the ceiling of the structure to the first floor level. Four level-detecting devices are mounted between the second floor level and the concrete base. Should the floor level lower or tilt, the level detecting devices sense the change. Solenoid operated valves are then actuated to allow compressed air to enter or to be bled from the respective air cylinders.

On the lower floor of the launch control center is the communications equipment and the launch control console from which the missile launching is controlled. The upper floor contains mess facilities and berth facilities that allow up to ten days of complete isolation of the launch crew at the site in the event of a nuclear attack.

Launch Control Center (LCC) Equipment Locations

Upper Level (1st) (Figure 3)

The upper floor of the launch control center is divided into various rooms. The various rooms are listed as follows:

1. Ready room and storage area

2. Janitor room

3. Latrine

4. Kitchen

5. Heat vent and air conditioning room

6. Medical supplies room

Ready Room and Storage Area

The ready room and storage area consists of facilities such as bunks, lockers, book shelves, etc. Also in this area is the air receiver tank. This tank distributes pneumatic pressure to the support cylinders for the Launch Control Center.

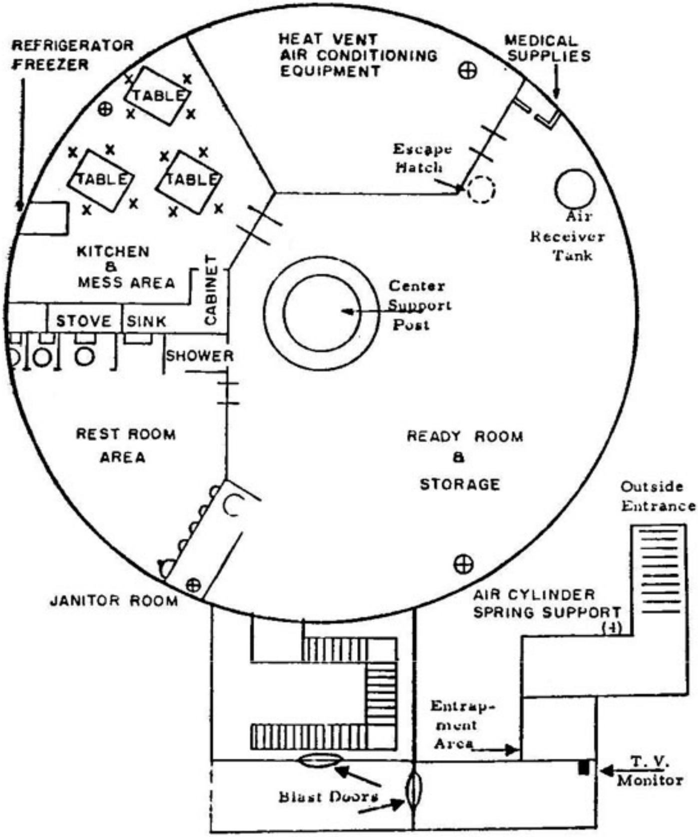


Figure 3 - Launch Control Center (Top Level)

Janitor Room

The janitor room contains supplies such as mops, buckets, and all other equipment necessary to maintain cleanliness of the launching facility.

Latrine

The latrine has the necessary facilities for the launch crew. These facilities consist of lavatories, mirrors, commodes, and shower.

Kitchen

The kitchen has all equipment necessary for the ten day isolation of the launch crew. This equipment consists of a stove, kitchen drain, refrigerator freezer, tables and chairs. Enough food is stored in the kitchen area to feed the launch crew during an isolation period.

Heat, Vent, and Air Conditioning Room

The heating, venting, and air conditioning equipment of the launch control center is located in this room. The launch control center temperature is controlled between 70° and 80°F. This equipment is capable of supplying approximately 5500 CFM of clean refrigerated and dehumified air to the launch control center. Venting is also accomplished by this equipment, including a ventilation fan in the kitchen area.

Medical Supplies Room

The launch site is usually some distance from the base and therefore some medical supplies will be stored at the launch site. These medical supplies located in the medical supplies room are for first aid treatment until medical aid can arrive.

Lower Level (2nd) (Figure 4)

The lower floor of the launch control center is divided into various rooms in which the launch equipment is located. The various rooms are listed as follows:

1. Launch Control Room

2. Office

3. Battery Room

4. Communications and Equipment Room

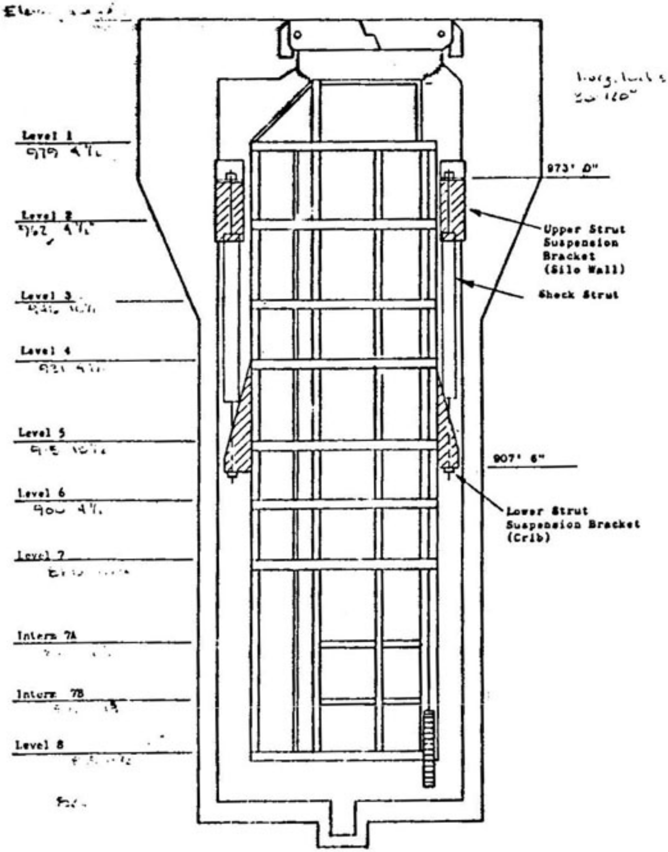


Figure 5 - Crib Suspension System - Silo/Crib Cross Section

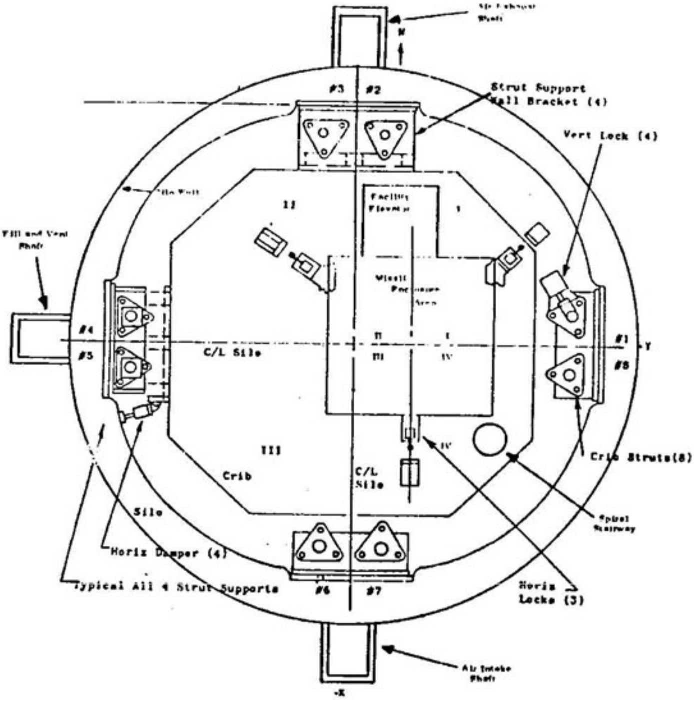


Figure 6 - Crib Strut Supports and Accessories - Top View

crib and crib-mounted equipment, including launcher platform and missile, is over 1,500 tons. There are also numerous pipes, cables, and ducts which carry electrical power, heating, ventilating, and air-conditioning liquids and gases essential to the weapon system. By mounting systems and plumbing on the crib structure, the equipment will move as an integral unit with the crib (not as individual, independent units), when a ground shock occurs. This increases reliability and eliminates many expensive flexible joints and lines.

Located slightly off the centerline axis X and Y, is the shaftway for the launch platform (Figure 6). This is the shaftway in which the launch platform is lowered to the standby position or is raised to the launching position. The shaftway dimensions are 72-1/2 FT by 21 FT. It is enclosed with insulated panels in order to aid in maintaining proper temperature control of the missile. Access doors are provided at work levels for maintenance and inspection requirements.

Crib Suspension System Assembly

The launch site must be capable of launching a missile after experiencing a near miss from a nuclear explosion. The crib suspension system assembly (Figure 7) provides for isolation of the missile, the launcher platform, the crib structure, and equipment located on the crib structure from the ground environment, so that damage from ground shock will be minimized. This system consists of the silo wall brackets and the crib suspension shock struts. The four wall brackets are mounted 90° apart on the silo wall near the top of the silo. They are capable of mounting and supporting the crib suspension shock struts, which in turn support the entire crib assembly. Eight shock struts are paired into four sets and each set is mounted in its corresponding wall bracket. Each strut is 65 FT long unloaded and consists of a spring capsule and two strut rods. The upper strut rod attaches to the silo wall and the lower one attaches to the center part of the crib structure. Each level of springs may contain as many as three springs, each being smaller than the other in total diameter and material thickness. The number of springs in a shock strut will depend on the amount of crib weight it is to support.

Facility Hydraulic System

The facility hydraulic system supplies the facility hydraulic operated equipment with hydraulic pressure.

The hydraulic power pack provides 3000 PSI of hydraulic pressure for use during the maintenance cycle, launch sequence and the return to

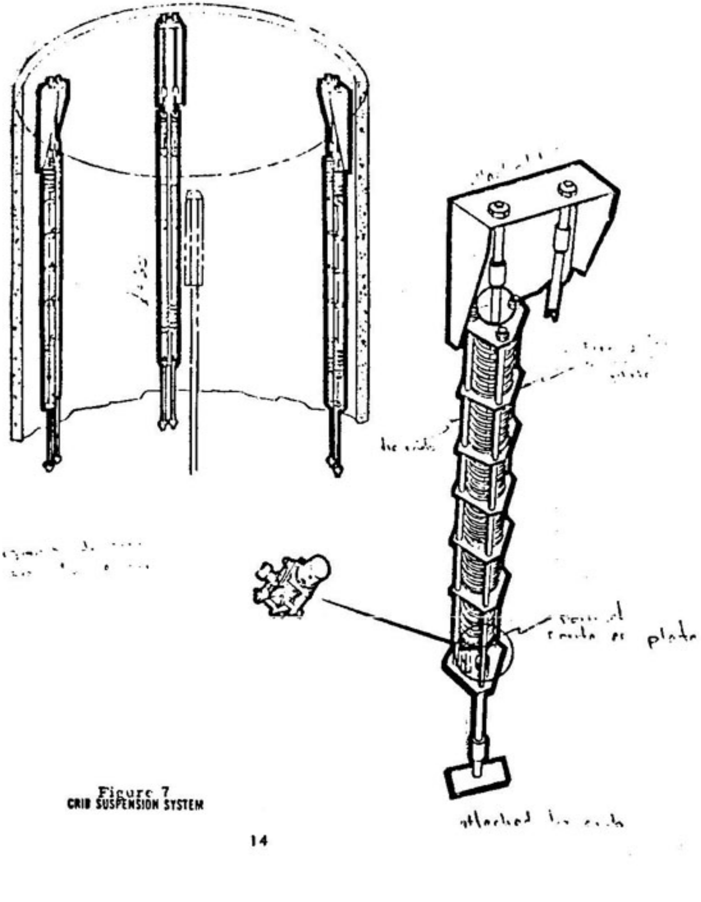


Figure 7
CRIB SUSPENSION SYSTEM

a site hard condition of the missile lifting system.

The hydraulic power pack is located on the second level of the silo crib structure in quadrants III and IV. The facility hydraulic system consists of the following assemblies:

1. Pump assembly (power pack)

   a. Low pressure pump system (Standby)

      The low pressure 1 HP pump will maintain 100 to 210 PSI of pressure in the facility hydraulic system during standby. This pump is controlled by pressure switches. Its purpose is to prevent line and accumulator draining.

   b. High pressure pump system (Normal)

      The high pressure 40 HP pump will supply 3,000 PSI of hydraulic pressure for operating silo hydraulic components except during a launch sequence.

2. Accumulator rack assembly (Tactical)

   This rack (bank) assembly provides facilities for storing the hydraulic power required (3,000 PSI) to operate all silo hydraulic systems during the firing and countdown phases of operation.

Crib Lock and Damper System Assembly

The lock and damper system assembly serves three purposes; it dampens vibration that results from ground shock, it locks the crib to the silo wall when it is necessary to establish a soft condition for launch or checkout, and it positions the crib centerline. This system does not include launch-platform-to-crib locking devices.

Horizontal Dampers (4)

There are four friction type horizontal dampers (Figure 8). These dampers are mounted at the bottom of each odd numbered shock strut. When the crib is shock mounted these dampers will retard crib oscillation. The section mounted to the crib contains two friction shoes under spring tension. A squared-off rod, which rides in between the two friction shoes, is mounted to the wall of the silo.

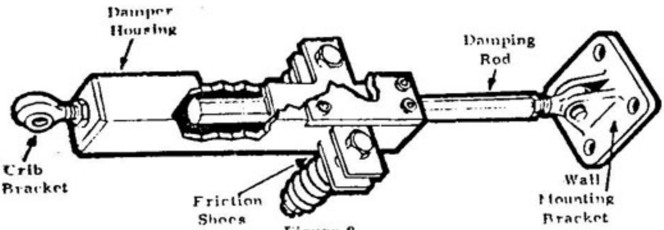


Figure 8
HORIZONTAL DAMPER

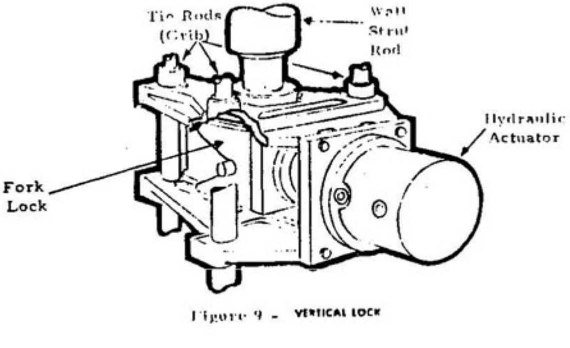


Figure 9 - VERTICAL LOCK

Vertical Crib Locks (4)

The vertical crib locks (Figure 9) secure the shock struts from vertical movement, and level the crib in the required horizontal position. One vertical lock is installed in each of the pairs of shock struts. The body of the vertical lock is attached to the lowest three tie-rods of the shock strut, hence to the crib. The body houses a hydraulically operated cam fork. When actuated, the cam fork engages a roller assembly on the bottom of the upper center strut rod and thus to the suspension bracket mounted on the silo wall. Limit switches indicate the position of the vertical locks.

Horizontal Crib Locks (3)

Three horizontal locks (Figure 10) are mounted 120 degrees apart (in Y-configuration) on the top beam of the crib structure. When actuated, the rods extend toward striker plates mounted in the silo cap. Extending the horizontal locks aligns the missile enclosure with the main missile doors. Limit switches indicate the position of the locks.

Launcher Platform

In the silo configuration, a missile must be supported above the ground for firing and below the ground for stowing. An elevator type structure (Figure 11) is required which will:

1. Support a fully loaded missile and the various OGE required for launch.

2. Provide personnel access for work on the missile engines and OGE.

3. Raise a missile to ground surface for launching.

4. Provide a means of preventing flames and missile exhaust gases from entering the silo during engine firing.

5. Withstand angular misalignment forces, engine exhaust temperatures, and engine blast.

This structure (Figure 11) is essentially an open cage-type elevator powered by electric hoists. The assembly is approximately 16 FT square, has an over-all height of approximately 49 FT, and weighs approximately 222,000 LB without missile and operating ground equipment. The elevator structure is divided into four unevenly spaced levels. The levels are supported by horizontal members framed between four vertical trusses.

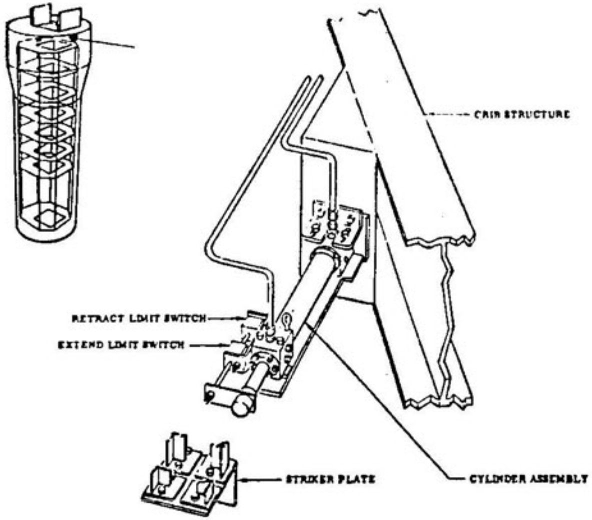


Figure 10 - Horizontal Locks

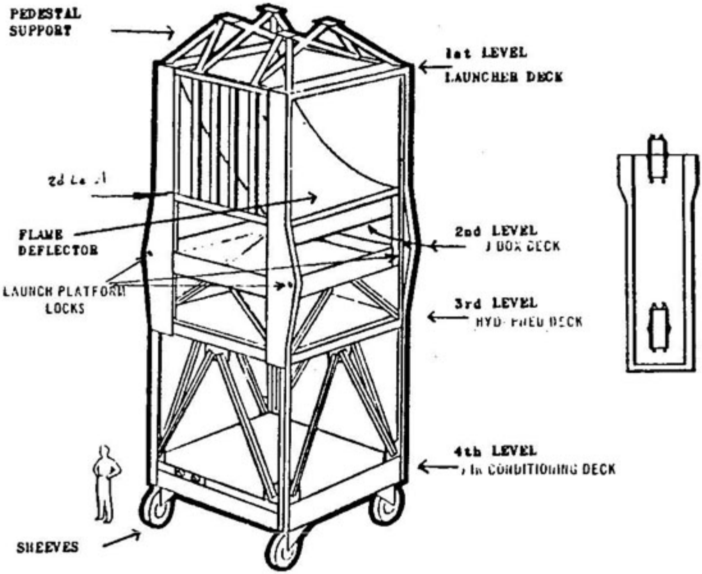


Figure 11 - Launcher Platform Structure

16' sq
42' high
22 [illegible] empty

Sheaves are installed on the bottom four corners for the elevation cables to raise or lower the missile.

The levels are referenced with the launcher platform in the full raised position. From the top down, the four levels are:

Levels	Elevation Reference
1. Launcher deck	1015 FT 4 IN
2. J Box deck	997 FT 4-3/4 IN
3. Hydraulic Pneumatic deck	990 FT
4. Air Conditioning deck	976 FT

The launcher deck (1st level) contains the pedestal support for mounting the missile holddown latches, riseoff connections, pod air conditioning duct, LN_2 and He coaxial line and disconnect, LN_2 drain line, fuel and LOX fill and drain connections, LOX topping line, fuel and LOX fill and drain connections, LOX topping line, fuel and LOX tank pressurization lines, missile umbilicals and the engine compartment access platform.

Below the launcher deck is the flame deflector (Figure 11) which directs the missile exhaust away from the silo opening and prevents flashback. The top opening at the launcher deck is a rectangular opening, 9 FT 7 IN wide by 15 FT 9 IN in length. The side opening, (flame is exhausted) is 14 FT high by 15 FT wide. The deflector plate is of 1-3/4 IN steel and the side plates are 1 IN. An accessory platform is used on the elevator structure. This is the engine compartment access platform. This platform is constructed of two aluminum grates installed at this level to cover the flame pit opening when personnel are working on the missile engines.

The J box deck (2nd level) contains the MAPCHE J box, MAPCHE power control unit, MA-3 engine valve control unit, umbilical J box, cable ducting and the launcher platform locking assembly with hydraulic manifold and plumbing lines. This locking assembly anchors the entire structure to the silo cap in the raised position, and to the crib structure in the lowered position. Also at deck two is a roller assembly for aligning the platform to the silo cap.

The third (hyd-pneu) deck contains the helium charge unit, hydraulic pumping unit, nitrogen control unit and two guide roller assemblies consisting of two rollers each, riding on two large I beam guide rails. As the launch platform travels upward, the tapered I beam becomes tightly wedged between the rollers. This will center the launcher platform to the crib and remove any slack or play of the launcher platform.

The fourth deck contains the liquid nitrogen drain line, pod air conditioning unit, the hot and cold disconnect panels to the crib, the cable loop support panel and cable ducting. Also l..ated on this deck are three guide roller assemblies that perform the same function as the rollers on deck three. All rollers and rails are mounted on the south side of the missile enclosure area.

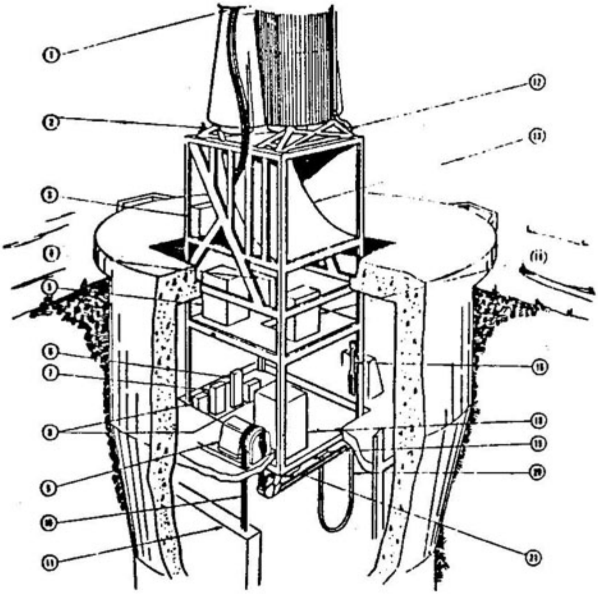
Missile launching from an underground crib structure requires elevating the missile to ground surface prior to launch (Figure 12). Various other operations, which involve checkout and test, also require missile surfacing. Equipment capable of raising the platform with a fully loaded missile and all OGE on the platform, from the stowed to launching position is required. The equipment provided must be designed to make controlled stops at any point of travel under any load conditions, and must raise the missile into launch position within prescribed time limits. Local and remote controls are required for operation of this equipment.

Launcher Platform Drive Assembly (Figure 13)

This system, which raises and lowers the launcher platform is comprised of the following subassemblies:

Motors

The two drive motors are 125 HP, 480V AC, 60-cycle, 3-phase induction motors which receive operating voltage from the drive motor control cabinets. Both motors will operate at two speeds, normal and creep speed. The high-speed motor drives directly into the main speed decreaser. The low-speed motor is connected to the auxiliary gear reduction unit whose output shaft is coupled to the main speed decreasers input shaft by a cutout gear coupling. The high-speed motor is used only to drive a fully loaded launcher platform up in tactical operations. The low-speed motor can drive the launcher platform up and is always used to lower the platform.



EQUIPMENT KEY

1 MISSILE UMBILICALS
2 LAUNCHER PEDESTAL SUPPORT
3 UMBILICAL JUNCTION BOX B1
4 HELIUM CHARGE UNIT
5 NITROGEN CONTROL UNIT
6 DISCONNECT PANEL (LIQUID OXYGEN AND LIQUID NITROGEN)
7 DISCONNECT PANEL (HYDRAULIC AND PNEUMATIC)
8 ELECTRICAL UMBILICAL SUPPORT PANELS
9 DRIVE MECHANISM
10 DRIVE SYSTEM CABLES

11 COUNTERWEIGHT
12 LIQUID-OXYGEN FILL AND DRAIN LINE
13 FLAME DEFLECTOR
14 HYDRAULIC PUMPING UNIT
15 TENSION EQUALIZER
16 POD AIR CONDITIONER
18 COLD DISCONNECT PANEL
20 CABLE LOOP
21 HOT DISCONNECT PANEL

Figure 12-Launcher Platform

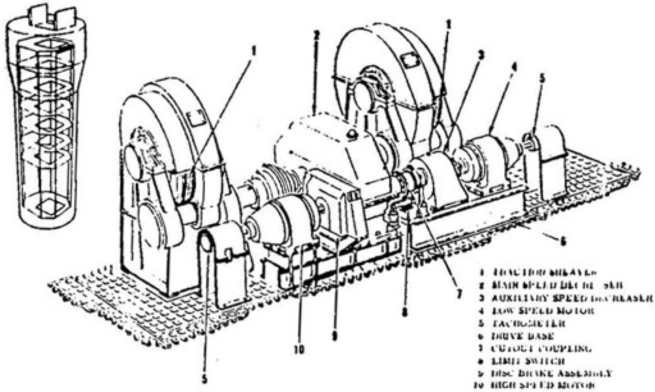


Figure 15 - Launcher Platform Drive

Main Reduction Gear

The high speed motor is connected directly to the main reduction gear which has a reduction ratio of 12 : 1. This reduction gear drives two traction sheaves, through flexible couplings, shafts, and drive gears.

Auxiliary Reduction Gear

The low-speed motor is connected to an auxiliary reduction gear through a shaft and flexible connection. This auxiliary reduction gear has a gear ratio of 12 : 1. Output of this reduction gear is transmitted to the main reduction gear for further reduction, through a shaft and clutch assembly.

Cutout Coupling

The auxiliary reduction gear is disconnected from the main reduction gear during high-speed operation by means of a cutout coupling. The coupling is located between the auxiliary and main reduction gears, and is disconnected by a hydraulic cylinder that actuates a lever connected to the gear coupling. The coupling is disengaged during standby.

Brake Assembly

A 28-1/4 IN diameter disk is attached to the shaft of the high-speed motor. A U-shaped yoke mounted around the disk holds four sets of hydraulically actuated brake shoes. These shoes, of fail-safe design, exert breaking pressure on both sides of the disk simultaneously.

Traction Sheaves

Two traction sheaves, driven from the main reduction gear, along with the wire rope subassemblies, provide the means of raising and lowering the launcher platform.

Motor Controls

Both motors are controlled from a common saturable-reactor type control network. Speed and direction commands are presented in the form of several preset commands voltages from a reference voltage supply. These command voltages are automatically switched into the reference voltage selection circuitry by outputs from the control monitor in control cabinet NO. 1. The saturable and secondary reactors, and the secondary resistors are housed in control cabinet NO. 2. Both cabinets are located on level 1 of the crib assembly. Local control for positioning the launch platform at desired levels in order to perform maintenance is located in the launch control center.

Operation

In countdown procedures, the launcher platform will rise to the full up position within 80 SEC by use of the high-speed motor assembly. Lowering of the launcher platf rm and local control of raising the launcher will be accomplished by the low speed motor which will raise or lower within a 15 MIN time period.

Cable and Guide System, Launcher Platform

The cables and guide assembly holds the launcher platform vertically in the shaftway and transmits elevating and lowering forces required to raise and lower the launcher platform. It minimizes the horizontal shifting or twisting of the launcher platform (Figure 14).

The wire rope subassembly consists of two wire rope sets, five wire ropes to a set. The sets are connected to the underside of the first level below the drive mechanism in quadrants I and IV in the counterweight shaft. Each set loops down and through the counterweight sheaves, up and over the drive sheaves, down the launcher platform shaft, under the launcher platform, and then up the launcher platform shaft to elevation 991 FT, where the ropes are secured in quadrants II and III. Each wire is 1-1/2 IN in diameter with a minimum breaking strength of 228,000 LBS.

The ropes terminate in a tension equalizer (Figure 14) in quadrants II and III. This tension equalizer evens the tension between the two sets of wire rope through a crossbar which transfers a portion of the excess tension in one set of wire ropes to the other set until the tension in both sets is equalized.

Four idler sheaves (Figure 14) are mounted on the underside of the launcher platform, one sheave at each corner. These sheaves ride on the wire ropes which support the launcher platform. Shortening or lengthening the wire ropes in the launcher platform shaft raises or lowers the launcher platform.

Counterweight System Assembly

The counterweight system assembly (Figure 14) counterbalances the

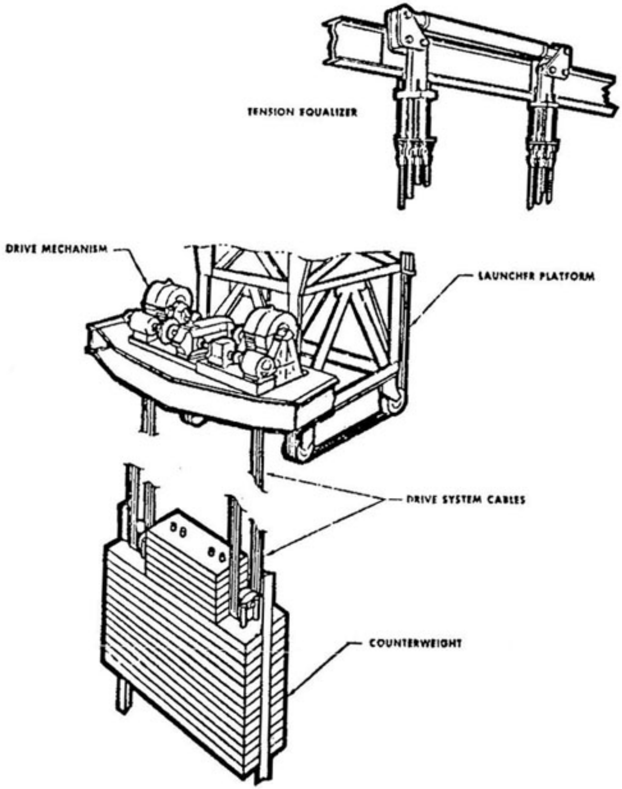


Figure 14
LAUNCHER PLATFORM DRIVE SYSTEM

weight of the launcher platform, the missile and facilities on the launcher platform by means of a system of pulleys and weights. Therefore, it is only necessary to overcome friction when the platform is to be raised. This assembly consists of iron and steel slabs and two sheave subassemblies. The slab unit is comprised of 26 cast iron and three steel slabs bolted together to form a 541,000 LB counterweight. The unit measures approximately 19 FT long, 3-1/2 FT wide and 24 FT high. Two sheave assemblies, each weighing approximately 4,650 LB, are bolted to the counterweight assembly, one on each side. Each sheave is provided with five grooves to accommodate the drive system wire ropes. A V-shaped groove in each vertical end of the counterweight accommodates a guide rail. Guide shoes (bronze) are mounted on the two faces of the top and bottom slabs to provide bearing surfaces for the guide rails.

The counterweight guide rails prevent lateral movement of the launcher platform counterweight under both static and dynamic conditions. These rails extend from just under crib level one to crib level eight.

Three vertical guide rails (Figure 15) are attached to the inner sides of the launcher platform shaft structure. These rails minimize lateral movement, or tilting of the launcher platform, and provide a smooth vertical track for the launcher platform guide rollers throughout the full range of launcher platform travel. The rails are of I-beam construction with the flanges machined to provide a smooth bearing surface. One I-beam rail, 17 IN deep, is located in quadrant III; two I-beam rails, one 17 IN deep and the other 16 IN deep, are located in quadrant IV.

Three guide roller subassemblies (Figure 16) are attached to the bottom level of the launcher platform and mate with the three guide rails. Two large roller subassemblies are attached to the launcher platform at the next higher level and mate with the two large guide rails. Each subassembly consists of two rollers mounted on a large casting. The guide rails pass between the rollers.

Locking Platform Locking System Assembly

The purpose of the launcher platform locking system is to locate and rigidly lock the launcher platform in the hard and soft conditions. The locking system is capable of supporting designated loads, and withstanding heat, blast and ground shock conditions. It provides locking to the silo cap when the launcher platform is in the launch position, and prevents launcher platform drift when the platform is in the stored position during standby. The system is broken into five main components:

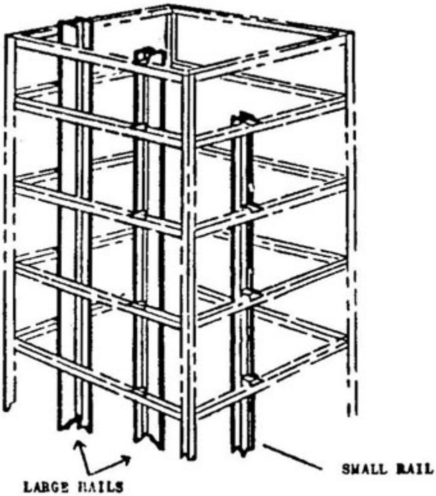


Figure 15 - Guide Rails - Launcher Platform

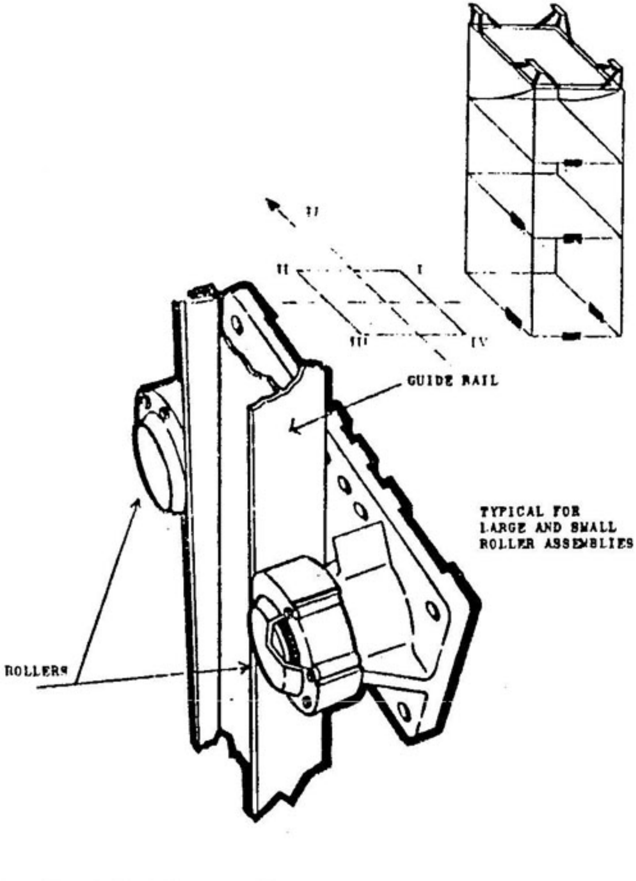


Figure 16 - Guide Roller Assembly - Launcher Platform System

Lock Actuators (Figure 17)

Four lock actuators are located on the same horizontal plane at each corner column of the launcher platform structure. Each lock actuator consists of a hydraulic cylinder, an actuator rod, linkage, and rollers. The lock actuator is capable of extending the actuator rod and pushing an upper guide roller along a prescribed cam surface, which drives a lower guide roller or stop into position to provide a rigid lock. The position of this actuator is monitored by limit switches and pressure switches.

Lock Actuator Interlock (Wedge lock)

The lock actuator interlock can maintain the lock actuator's fully extended position, even with complete decay of hydraulic pressure. This component consists of a hydraulic cylinder capable of driving a wedge into position behind the rod of the lock actuator cylinder when the rod is in the fully extended position. This wedge lock is self-locking because of the angle of the wedge. This wedge is extended or retracted by hydraulic pressure.

Platform Alignment Rail (Stub-up Rail)

This is a tapered rail mounted on the silo cap. This rail and the guide rollers on L/P deck two are to align the launcher platform with the door opening area. It also aligns the L/P locks and the up-lock strikers for proper operation.

Up-Lock Strikers (Figure 18)

In addition to the platform alignment rails, four up-lock strikers are mounted on the silo cap. Each striker acts as a cam for one of the four sets of guide rollers, thereby providing a launcher platform stop and a rigid locking position for the system. The launch platform locks and up strikers give the final alignment to the launch platform in its full up position.

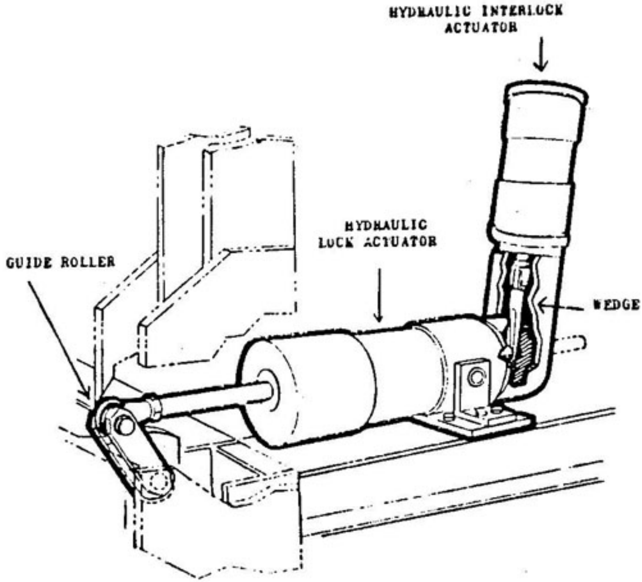
Down-Lock Strikers (Figure 18)

level 7A

Four down-lock strikers are mounted on the crib structure for locking the launcher platform in the down (stowed) position. These strikers form a rigid connection between the launcher platform and the crib structure.

Launcher Platform-to-Crib Cable Loop System (Figure 19)

During the raising or lowering of the launcher platform, it is necessary


HYDRAULIC INTERLOCK
ACTUATOR
HYDRAULIC
LOCK ACTUATOR
GUIDE ROLLER
WEDGE

17

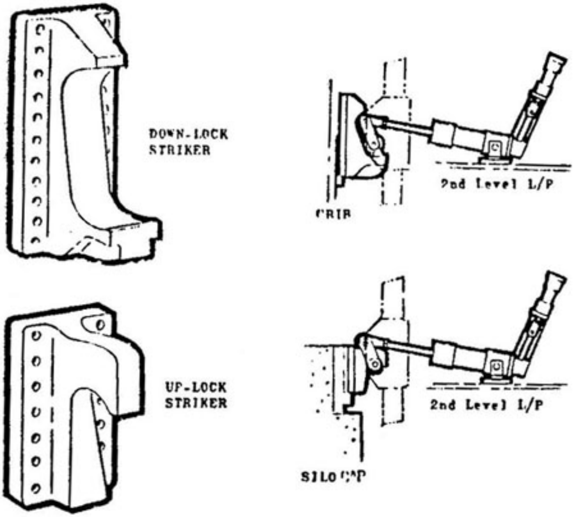


Figure 18 - Latch Strikers - Launcher Platform

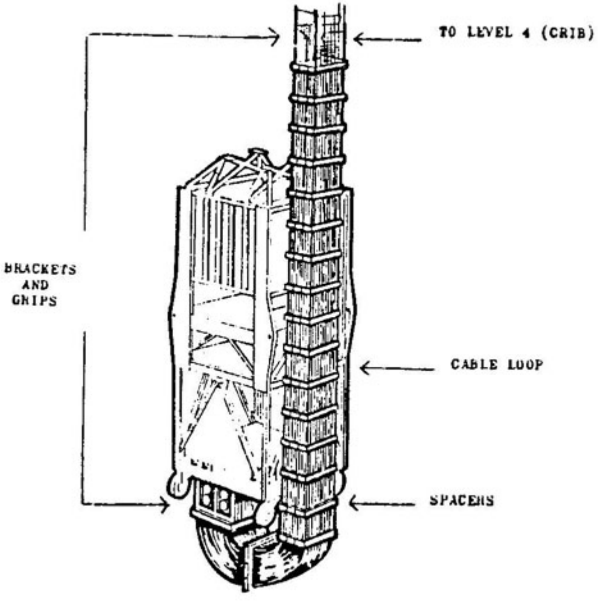


Figure 19 - Launcher Platform to Crib Cable Loop System

to maintain continuity between certain launcher and missile systems and the OGE in the silo and launch control center. The launcher platform to crib cable loop system serves as the flexible connection. This system will contain approximately 75 lines supported by brackets mounted under crib level 4 and under launch platform deck NO. 1. This assembly is located in the southwest corner of the missile enclosure. These lines are of sufficient length to permit full travel of the launcher platform between the stowed and launch position.

Description of Cables

Approximately 60 of these cables are electrical cables; most of them provide AC or DC power for monitoring and controlling signals. There are also a few used as communication lines between the launch platform and other areas of the site.

Five hydraulic lines, three supply and two return, connect the launch platform locks with the facility hydraulic systems.

Three chilled water lines supply the B-2 pod air conditioning unit regardless of its position in the silo. This air conditioner is mounted on deck 4 of the launch platform.

Silo Door System

The silo door system (Figure 20) is used to open and close the two reinforced concrete doors located on top of the silo cylinder at ground level. The total length of the two doors is 33 FT. They are 22 FT wide and have a 2-1/2 FT thickness. Each door weighs 150,000 LBS. At the center line the doors will overlap each other for a distance of 14 IN. Each door has synthetic rubber seals installed at the top and bottom sides to provide weather and radiation fallout protection. The two doors pivot on shafts which are mounted into roller bearing supports. These bearing supports are located in wells which are in line with the pivot shafts. Access covers of 2 IN concrete and 1 IN steel plates are provided to the bearing supports.

To aid in initial movement of the two doors and to break off any icing conditions, breakaway hydraulic cylinders are mounted in the cap opening near the overlap centerline. Each door has two cylinders, each cylinder has a 4 IN stroke and is capable of exerting an upward force of 37,500 LB. These cylinders are retracted by the weight of the doors at the end of the closing cycle.

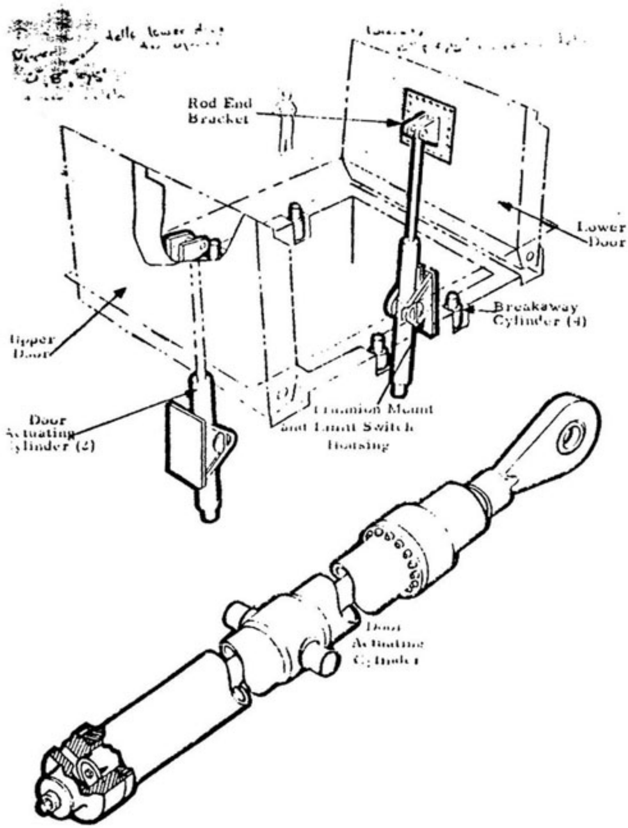


Figure 20 - Silo Door System

Each door at the opening centerline has a rod end bracket to which one end of the actuator assembly is attached. The hydraulic actuator, at approximately the center of its length is mounted to two separate trunnion brackets. Each trunnion bracket has a roller bearing mounted into a bushing to allow for radial shock or cushioning. At the end of this shaft bracket, there is a pad which allows for axial shock or cushioning. These bushings and pads also allow for misalignment of the actuator to the doors caused by thermonuclear explosions or shock waves. The hydraulic door actuator (Figure 20) is approximately 12 1/2 FT in length and 2-1/2 FT wide at the pivot mounts. The piston diameter is 12 IN with a stroke of 100 IN and exerts an upward force of 350,000 LBS. Internal operation of the actuator rod provides a deceleration of upward force as the door nears the full open position. Flexible hydraulic hose is connected from the crib structure to the actuator.

Control Station, Manual Operating Level (CSMOL) (Figure 21)

The control station manual operating level in the launch control room is capable of taking the launcher from a Standby Ready condition to an up and locked and back to a down and locked condition, by non-automatic sequence of separate operations. This permits operation of individual functions without running through an entire up and down cycle. The individual operations possible with the operating level control station are as follows:

1. Start the 40-HP motor to bring the hydraulic system to operating pressure
2. Lock the vertical crib locks
3. Lock the horizontal locks
4. Open the silo doors which includes sounding of the warning klaxons
5. Raise and lock the launcher platform
6. Lower and lock the launcher platform
7. Close the silo doors
8. Unlock the horizontal locks
9. Unlock the vertical locks
10. Turn off the 40-HP motor

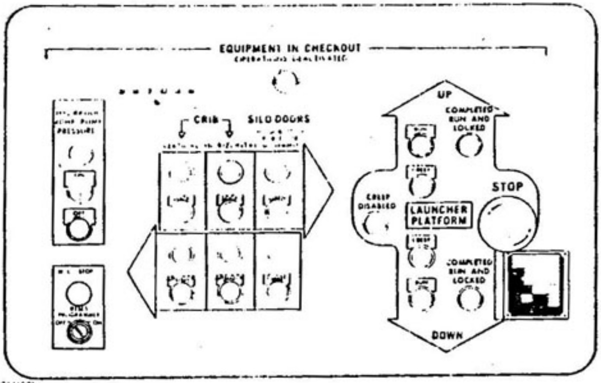


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Figure 21 - Control Station, Manual Operating Level

These different systems will operate only in a certain order. As an example the horizontal locks cannot be extended until the vertical locks are extended.

This panel can be used for operational checks on individual system and moving the launch platform into position for recycling the missile.

Work Platform System (Figure 22)

The purpose of the work platform system is to provide access for men and equipment for inspecting, servicing, and maintaining the missile when it is inside the silo. This system consists of six platforms: four work platforms, an engine access platform, and a safety platform. The four work platforms extend and retract from the missile enclosure walls under power of hydraulic cylinders and are controlled at local levels by three-position key switches. The mechanism for applying stretch to the missile is part of work platform one.

General Description

Construction

1. Platforms are constructed of a steel frame which supports a steel grating platform.

2. The platforms are attached to the silo crib structure and support hydraulic cylinders, knee braces, and linkage.

3. Some platforms have folding leaves that bridge gaps between adjacent platforms. Example: (Figure 22) first work platform 962 FT, 6 IN, platform 1A.

4. Located on the work platforms are hand rails, kick plates, chains, and stretch mechanism.

Work platforms NO. 1 through NO. 3 are controlled by 3 key switches. Each key switch is located next to the door going into the missile enclosure area to a particular work platform. Also located on the key switch is a "safe" light. This light will illuminate green when the platform is fully extended. The same microswitches which give light indications which are used by the logic system for monitoring platform positions.

Platform NO. 4 is mechanically linked to NO. 3 and is controlled by the key switch for platform NO. 3.

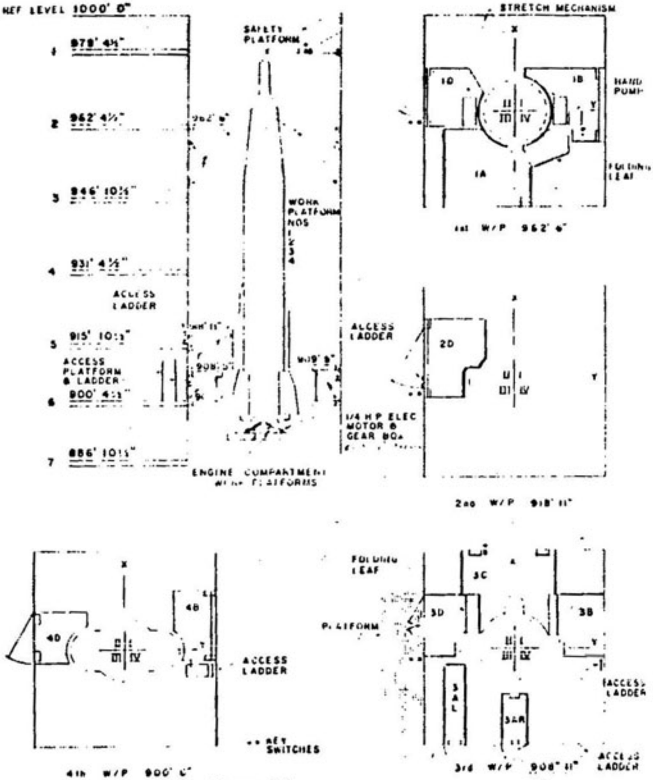


Figure 22

WORK PLATFORM IN SILO CRIB

Work Platform NO. 1

This platform contains 3 sections and provides access to the re-entry vehicle and boiloff valve area. Also mounted in two sections of this work platform is the stretch mechanism.

Work Platform NO. 2

This platform is made up of one section and provides access to the equipment part of the B-2 pod

Work Platform NO. 3

This platform contains 5 sections and provides access to the vernier engines, AIG pod, B-1 pod and umbilicals. Two sections of this platform are linked to platform NO. 4. The facilities elevator provides direct access to this platform.

Work Platform NO. 4

This platform contains 2 sections controlled by platform NO. 3, and provides access to the booster engine nacelle area.

Engine Compartment Work Platform (Figure 22)

The engine compartment work platform is on deck one of the launch platform and consists of two sections. These sections are driven to a retracted or extended position by two 1/4th HP electric motors and gear box.

Safety Platform (Figure 22)

The safety platform is located at crib level one and is one large section. The platform, when lowered will cover approximately half of the missile enclosure area. The platform will be extended when the main missile doors are open for an extended time. The platform is also used to receive equipment that is lowered into the silo area through the silo doors. The platform is raised and lowered by two hydraulic cylinders receiving pressure from a small accumulator charged with pneumatic pressure.

Stretch Mechanism

The stretch mechanism (Figure 23) is used to support the nosecone and prevent the missile tanks from collapsing in the event of a loss of

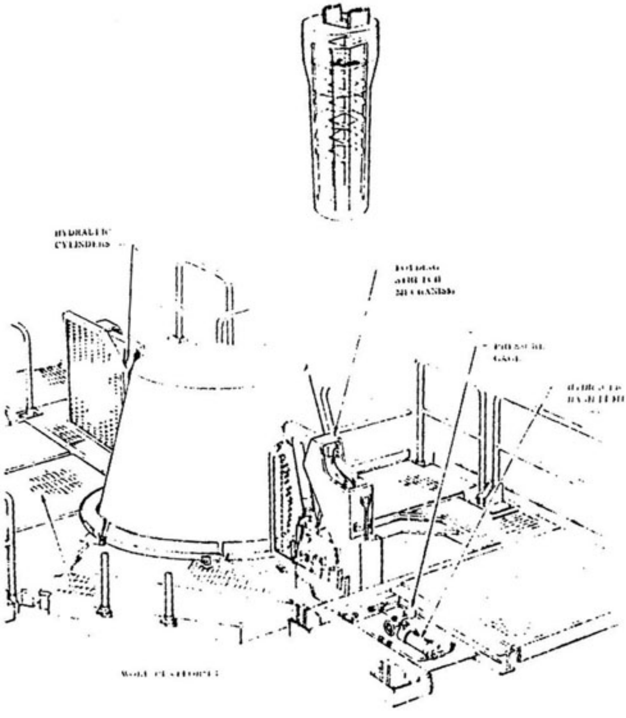


Figure 2[illegible] - Missile Stretch System (Silo) main propellant tank pressurization

A hand pump mounted on work platform NO. 1 is used to supply pressure to two hydraulic cylinders to actuate the stretch mechanism. Each mechanism consists of two separate sections. Each section contains three sections, a housing frame, stretch bar, and a hydraulic jack assembly.

Mounted in one section of the work platform is a hydraulic pump, a pressure gage and a relief valve.

Fa''ity Elevator

The facility elevator (Figure 24) provides the means of conveying personnel and general freight to any level of the silo. The facility elevator design and operating characteristics are similar to modern commercial elevators. The elevator has the capability of carrying a 6000 LB load to any of fourteen openings in the silo.

Description of Components

Car, Car Sling and Counterweight

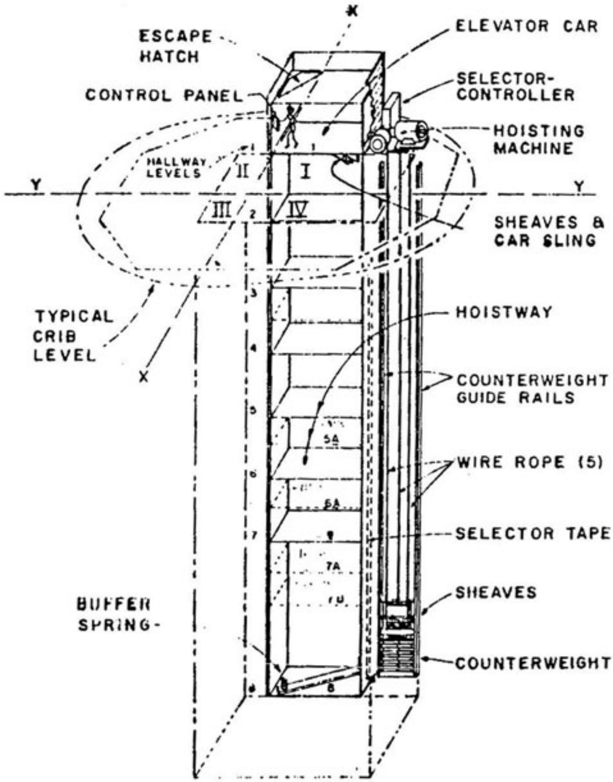
The elevator car is mounted on a steel platform measuring 9-1/2 FT by 8 FT. The top contains a hinged section for emergency exit. Two sides are provided with manually operated, vertically lifting, counterweighted wire mesh gates. The gates are equipped with electric contacts which prevent operation of the elevator if the gates are not completely closed.

The counterweight consists of a structural frame containing cast iron weights which provide a gross weight equal to the weight of the car plus 40% of the 6000 pound load capacity.

The elevator car and counterweight are suspended on five 1/2 IN special traction steel ropes with an ultimate breaking strength of 14, 500 LB per rope. This provides a safety factor of 10 to 1.

Drive System

The facility elevator drive motor is a two speed induction type motor and rated at 22 HP. The two speeds are 900 RPM and 225 RPM. The low speed is used for floor leveling. The power requirement to this motor is 480 volts, 60 cycle, 3 phase, AC.



SILO FACILITY ELEVATOR SYSTEM

Figure 24

The brake is a double shoe type which is mechanically applied by adjustable spring pressure and released electrically by a DC solenoid. The brake is so constructed that if power is removed, the car is brought to a smooth stop.

Controller, Selector and Tape Hitch

The controller contains magnetic operated switches and other components needed to start and stop the elevator. It also determines the direction of travel, regulates acceleration and deceleration, controls the proper running and leveling speeds and protects against overloads.

The selector is mounted integrally with the controller and it initiates and coordinates all elevator movement from the start to stop. In effect, the selector is a miniature elevator with a small car called a crosshead which travels up and down in exact synchronization with the elevator car. The crosshead is driven through a gear reduction by an endless toothed steel tape fastened to the elevator car sling. Loss of tape tension automatically stops the elevator and prevents it from operating until the failure has been corrected.

Operating Panel and Hall Buttons

The car operating panel is flush mounted in the car and contains the following items:

1. Two vertical rows of operating buttons numbered to correspond to the floors served by the elevator.

2. An emergency stop toggle switch. When actuated to the stop position, the switch stops the elevator or prevents it from running.

3. An emergency call button, when depressed sounds an emergency alarm bell on level NO. 2.

4. A light switch for car illumination.

The system contains flush type hall pushbutton fixtures, one mounted adjacent to each hoistway opening. Each contains an in-use light and an operating button. Momentary pressure on the operating button causes the car to run to the level at which the button was depressed, provided the in-use light is not illuminated. If the in-use light is illuminated, pressure on the operating button has no effect.

Operation

The facility elevator will operate under all conditions except during countdown. During the commit part of the countdown, power is removed from the non-essential Motor Control Center and the elevator will not operate.

Collimator System Assembly

The collimator enclosure is an insulated room which houses the collimator, collimator support platform and two reference prisms, (Figure 25). This enclosure is fastened to the concrete silo wall between level six and seven on the north side of the silo.

The collimator sight tube (Figure 25) provides an optically unobstructed path for a beam of light to transmit data from the collimator to the missile. The tube is constructed in two sections: one section is fixed, the other is movable. The fixed section extends from the collimator enclosure to the missile enclosure wall and mates with the hinged end of the movable section of the tube.

The movable section is fastened to the structure by a hinge. A seal fitting on the lower end of the movable section mates with a similar fitting on the fixed section when the tube is in the extended position. A thick neoprene gasket mates and provides a soft contact with the skin of the B-2 pod. The upper sleeve is also provided with a bar that acts as a window hook fastener to keep the tube locked to the missile.

The collimator sight tube retraction mechanism consists of a 190 LB counterweight. Upward movement of the missile causes the window hook fastener to release and the movable section of the tube to swing upward to a stowed position.

In order to align the collimator in reference to Polaris, a sight tube is necessary (Figure 26). From reference level 901 FT 3 IN, a 10 IN pipe is inserted in the silo wall at a 49° angle. This piping extends in a straight line to the surface, approximately 100 FT, where the top end is protected by a manhole type cover.

One insulated 6 IN air conditioning duct tees off at the bottom of collimator housing and enters into the bottom of the housing at two points. The temperature in the collimator must be maintained at $70^{\circ}F \pm 3^{\circ}$, 65 percent relative humidity maximum.

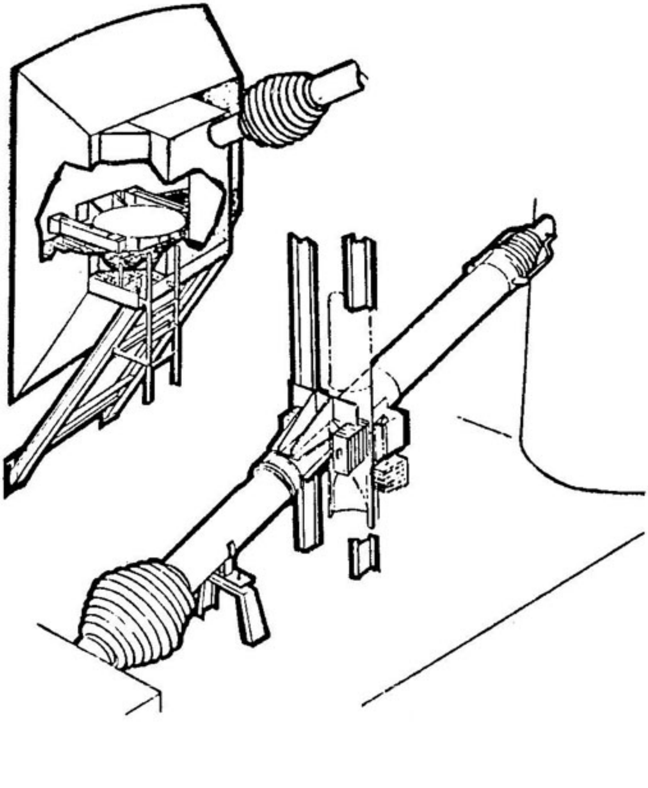


Figure 25 - Collimator Sight Tube and Retraction Mechanism

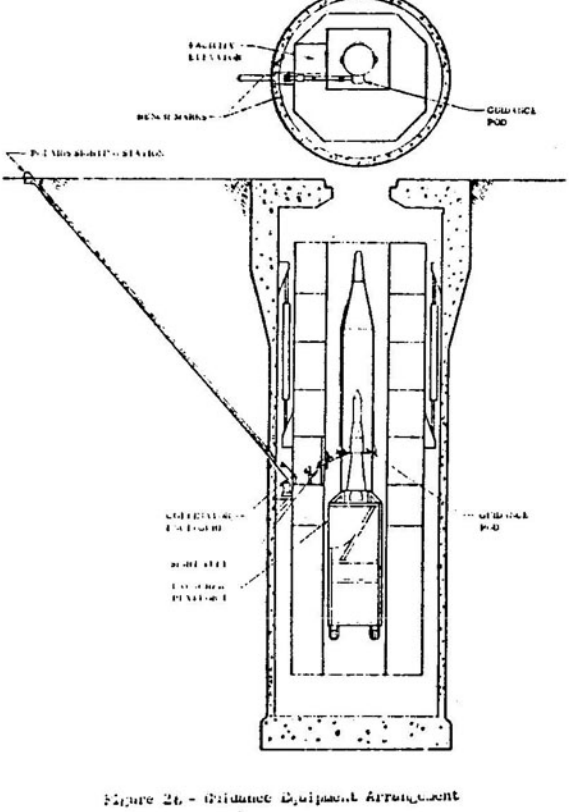


Figure 26 - Guidance Equipment Arrangement

Gaseous Oxygen (GOX) Vent Mechanism

The purpose of this vent is to exhaust gaseous oxygen escaping from the boiloff valve during countdown.

The GOX vent (Figure 27) is a large duct mounted in quadrant II at level II of the missile enclosure area. This vent extends to near the boil-off port on the R/V adapter and will direct any boiloff to the fill and vent shaft where it will be exhausted out of the silo.

Vent Retraction Mechanism

In the retracted position the rigid duct is stowed vertically and clear of the path of the missile and the launcher platform. This retraction is caused by the upward movement of the launch platform and a counter-weight.

In the horizontal position the duct is extended to within 9 inches of the missile boiloff vent port. This is rotated from the stowed to the horizontal position by the descent of the launch platform.

SUMMARY

The launch control center is the area from which the control and monitor of countdown and standby activities are performed. Mounted on the hung floor of the launch control center is the launch control equipment.

The launching silo is the location of the missile, launching platform, and the operating ground equipment. All of the equipment in the launching silo is mounted on the 8 levels of the silo crib which are shock-mounted to overcome the shockwave of a nuclear blast.

The two heavy silo doors are opened and closed by use of electronic and hydraulic equipment. They can be opened automatically by the launch control equipment during a tactical launch, or they can be opened and closed manually at the control station manual operating level.

The launch platform drive system contains two drive motors. The high speed motor is used during tactical launch only, and the low speed motor is used at all other times for platform movement.

The silo has two locking systems. The crib lock system to make the crib rigid during launch platform movement and the launch platform locks

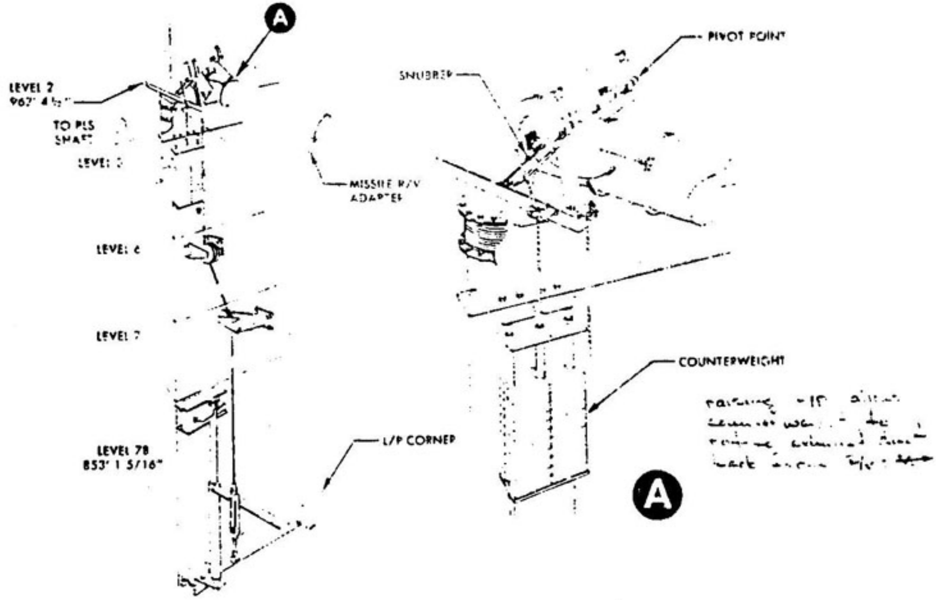


Figure 27 - Gaseous Oxygen Vent Installation (Silo)

to lock the platform at full up or full down position.

The collimator enclosure houses the collimator and bench mark supports. It is located between silo levels six and seven. A sight tube connects the collimator to the missile.

The facility elevator is an important installation in the launching silo. It is used to transport personnel and freight to all levels of the launching silo. Safe operation of the facility elevator is assured by six limit switches, three located at each end of the hoistway. The elevator is capable of operation at all times except during commit.

QUESTIONS

1. What equipment is located on the lower floor of the launch control center?

2. How is the launch control center hung floor suspended?

3. How will personnel be able to go from the launch control center to the launching silo?

4. What is the free space between the silo crib and the launching silo called?