CHAPTER 6

ASSOCIATED LAUNCHING EQUIPMENT

The associated launching equipment discussed in this chapter is used in conjunction with catapults and arresting gear. This equipment includes the jet blast deflectors (JBD) and nose gear launch (NGL) equipment.

LEARNING OBJECTIVES

When you have completed this chapter, you will be able to do the following:

1. Identify the components of the jet blast deflectors (JBD).
2. Describe the operation of the JBD.
3. Describe the emergency operations of the JBD.
4. Identify the components of the Mark 2 (Mk 2) nose gear launch (NGL) system.
5. Describe the operations of the Mk 2 NGL system.

JET BLAST DEFLECTOR

The jet blast deflector (JBD) installation consists of water-cooled panels that are mounted flush with the flight deck. The panels are raised and lowered by hydraulic cylinders connected to mechanical operating gear. When raised, the JBDs serve to protect personnel, equipment and other aircraft from the hot jet exhaust created by an aircraft spotted on the catapult. Seawater, supplied from the ship’s fire main, is continuously circulated through the modules of each panel assembly to prevent overheating. Figure 6-1 shows a short video of JBD in operation.

JBD Assembly

The JBD assembly consists of a series of water-cooled panels and operating gear assemblies. The Mark (Mk) 7 Modification (Mod) 0 and Mk 7 Mod 2 JBD assembly (Figure 6-2) is comprised of six panel assemblies with three sets of operating gear, while the Mk 7 Mod 1 JBD assembly (Figure 6-3) has four panel assemblies and two sets of operating gear. The Mk 7 Mod 0/2 JBD contains two additional side plate cooling panels. The side plate cooling panels provide additional cooling which helps to prevent warping of the JBD panels.

Regardless of the JBD installation, the operation is the same. A pair of JBD panels is connected to a set of operating gear. The panel assemblies can be raised independently or simultaneously with others in the same installation. By connecting a pair of panels to a set of operating gear, one cylinder can raise or lower a pair of JBD panels in the event of a failure to the other cylinder.
MODIFICATIONS - MK 7 MOD 0 & 2

Six Water-Cooled Panel Assemblies

Figure 6-2 — Mk 7 Mod 0/2 JBD assembly.

MODIFICATIONS - MK 7 MOD 1

Four Water-Cooled Panel Assemblies

Figure 6-3 — Mk 7 Mod 1 JBD assembly.
Operating Gear Assembly

The operating gear assembly (Figure 6-4) provides the means of physically raising and lowering the JBD panels. A set of operating gear consists of two hydraulic cylinders, three bearing blocks, one trunnion shaft, two crank assemblies, and four linkage assemblies. Each linkage assembly consists of an arm, strut, and eye. The linkage for two JBD panels is connected to a single shaft. This allows raising and lowering of JBD panels in pairs. The trunnion shaft is mounted and supported by the three bearing block assemblies. The two hydraulic cylinders are connected to the trunnion shaft by means of the crank assemblies.

Movement of the hydraulic cylinder piston rods rotates the shaft. Rotation of the trunnion shaft extends or retracts the linkage to raise or lower the JBD panels. Magnets attached to the linkage arm and eye assemblies actuate limit switches mounted to brackets on the side of the operating gear deck cutouts to indicate position of the panel assemblies. Removable panel supports can be attached to the operating gear and flight deck to lock the panels in the raised position for maintenance, or if access to the area beneath the panels is required.
Water-Cooled Panel Assembly

A water-cooled panel assembly (Figure 6-5) is a reinforced rib-based aluminum alloy structure containing water inlet and outlet piping. Each panel assembly contains 14 module assemblies (7 on each side), bottom hinges, and lift fittings. The module assemblies are fastened to the panel base by screws, thereby permitting easy removal in the event of module failure. Each module contains water passages connected to inlet and outlet water manifolds by tube assemblies. Seawater, supplied from the ship’s fire main, is continuously circulated through the individual module assemblies to dissipate heat generated by jet exhaust. An orifice (not shown) located in the return line connection of each module controls the flow rate of cooling water within the module assemblies. A removable hinge protector plate is located below the bottom module of each panel assembly for easy access for maintenance.

Figure 6-5 — Water-cooled panel assembly.

⚠️ WARNING ⚠️

If the JBD is fully UP, use of JDB stanchion is mandatory while conducting maintenance. Movement of JBD panels could cause serious injury or death.
Cooling Water Piping Installation

The cooling water piping installation (Figure 6-6) consists of a strainer, swivel joint assemblies, orifice flange assemblies, temperature switch, pressure switch, pressure gauges, and associated piping and connections. Seawater, supplied by the ship’s fire main, is continuously circulated through each module assembly and then discharged overboard. The strainer removes particles that could clog water passages in the modules. The swivel joint assemblies provide a means of connecting the water manifolds, via hoses, to the seawater supply piping. The swivel joint also permits rotational movement of the piping as the JBD is raised or lowered. Two orifices flange assemblies are provided to regulate the cooling water flow rate. The inlet orifice flange is not used and cooling water flow at that location is line sized. The outlet flange assembly orifice is sized to provide a flow rate of approximately 1,200 gallons per minute (gpm). A temperature switch, located near the water discharge of one of the center JBD panels, will close if the cooling water reaches 210 degrees Fahrenheit (F) and alert the JBD operator by lighting a red temperature light on the deck edge control panel. A pressure switch, located in the line leading to the overboard discharge, will close if the water pressure drops below the setting that determines adequate flow rate and alert the JBD operator by lighting a red pressure light on the control panel. Pressure gauges, located on the control panel, provide an indication of the cooling water pressure being supplied by the ship’s fire main. The cooling water pressure must be maintained at a minimum of 90 pounds per square inch (psi). An additional pressure gauge, located upstream of the discharge orifice, is provided. A drop in pressure at this gauge indicates blockage within the cooling water system or inadequate fire main pressure. During JBD certification, the normal discharge pressure and pressure switch setting is determine.

An inlet flange assembly with orifice plate, which maintains control of fluid flow for both the raising and lowering sequence, is provided in the line to the raising side of the hydraulic cylinders. Shutoff valves are located in each line of the hydraulic cylinders for emergency and maintenance purposes.
Hose assemblies provide a flexible connection between the hydraulic cylinders and piping to compensate for movement of the cylinders during raising and lowering operations.

**Four-Way Control Valve (Stack Valve)**

A four-way control valve (commonly known as stack valve), shown in *Figure 6-7*, has four ports or openings and controls the flow of hydraulic fluid. The first port goes to the raise side, the second port goes to the lower side, the third port is the supply line (main line), and the fourth port is the return line (gravity tank). The stack valve is a solenoid-controlled pilot-operated valve assembly. The four-way control valve or stack valve consists of three small valves.

1. Solenoid operated valve – is an electromechanically operated valve and controlled by an electrical current (110 volts) through a solenoid.
2. Pilot-operated main valve – is a small valve that controls a limited flow of fluid and is often used in critical applications such as emergency or safety controls.
3. Sequence valve – is used to control the sequence of two or more hydraulic actuators.

All three valves are secured together to conserve space and simplify connection to a subplate or manifold as shown in *Figure 6-7*. One stack valve controls fluid flow for a pair of panel assemblies. Three stack valves are required for Mk 7 Mod 0/2 and two stack valves for Mk 7 Mod 1 JBDs. Hydraulic fluid at 2,500 psi from the associated catapult is supplied to the stack valve, with all fluid return lines going to that catapult gravity tank.
With hydraulic fluid at normal operating pressure and neither solenoid B (raise) nor solenoid A (lower) energized, fluid flows through the sequence valve and pilot valve to both sides of the slide in the main valve. This pressure to both sides of the slide keeps it centered and blocks fluid flow into and out of both ends of the hydraulic cylinders.

**WARNING**

Electrical shock can cause injury or death. Verify power is off by using an electrical power indicator device such as voltmeter prior performing any work on the solenoid-operated valve.

When a raise switch is actuated (Figure 6-8), solenoid B in the pilot valve energizes, shifting the spool and directing pressure to a pilot port at the main valve side. The slide shifts and directs fluid to port A of both hydraulic cylinders. The hydraulic cylinder pistons extend, pushing the crank assembly of the operating gear aft and rotating the shaft. Rotation of the shaft extends the operating gear linkage and raises the associated panel assemblies. During the raise cycle, fluid in the cylinder lower port B vents to the gravity tank through the main valve. If the raise switch is released during the raise cycle, solenoid B de-energizes, a spring returns the solenoid spool to the centered position, and panel movement will stop.

**NOTE**

Switches on the control panel, auxiliary panel, and portable panel assembly (chest pack) are momentary-contact “dead man” switches. They must be pressed until the panels are fully raised or fully lowered.
Figure 6-8 — Hydraulic fluid flow (rising).
When a lower switch is actuated (Figure 6-9), solenoid A in the pilot valve energizes, shifting the spool and directing pressure to a pilot port at the main valve slide. The slide shifts in the opposite direction (from rising) and directs fluid to port B of both hydraulic cylinders. The pistons retract, pulling the crank assembly of the operating gear forward and rotating the shaft. The rotation of the shaft retracts the operating gear linkage and lowers the panels. During the lower cycle, fluids in the raise port A vents to the gravity tank through the main valve. If the lower switch is released during the lower cycle, solenoid A de-energizes, a spring returns the solenoid spool to the centered position, and panel movement will stop.

![Diagram of hydraulic fluid flow (lowering)](image)

Figure 6-9 — Hydraulic fluid flow (lowering).
Cylinder Vent Piping Installation

The cylinder vent piping installation (Figure 6-10) consists of bleed valves, flexible hose assemblies, piping, and associated fittings. Each JBD hydraulic cylinder is vented through flexible hoses connected to vent ports directly above the cylinder raising and lowering ports. The hoses also connect the piping to a nearby vent station and bleed valves.

![Diagram of cylinder vent piping]

**NOTE**

Momentary contact switches light up in down and up position. With the JBD panels down, the **DOWN** light switches are **GREEN**. When the panels are raised, the green lights go out, and when fully raised the **UP** light switches turn **AMBER**. When the panels are lowered, the UP light switches’ amber lights go out, and when fully down the **DOWN** light switches turn green.

**WARNING**

JBD hydraulic pressure is 2,500 psi. Use extreme care when venting hydraulics, open bleed valves slowly, and use protective goggles wherever possible.
Electrical Control Assembly

The electrical control assembly (Figure 6-11) consists of a deck edge control panel, auxiliary control panel, transfer switch, relay terminal box, saltwater valve junction box, saltwater shutoff valve, cutout switch, cooling water temperature and pressure switch, and associated wiring and connectors. All JBD assemblies are electrically controlled through either a deck edge control panel or chestpack for normal operations. An auxiliary control panel, located below decks, is provided for use in emergencies. A transfer switch, located near the auxiliary panel, is used to transfer power between the control panels. The deck edge and auxiliary control panels are permanently mounted and are provided with a cover and padlock to protect the panels from the elements and use by unauthorized personnel. The cutout switch, located near the auxiliary panel, provides a common source of 115 volt, alternating current (AC), 60 hertz (Hz) electrical power. A 28 volt direct current (DC) on/off switch, located adjacent to the transfer switch, provides power to operate the chestpack. The relay terminal box serves as a central connection point for all relays and terminal boards used in the electrical control assembly. A saltwater valve junction box serves as a central connection point for terminal boards, fuses, and relays used to control the shutoff of cooling water from the chestpack.

Deck Edge and Auxiliary Control Panels

The deck edge control panel (Figure 6-12) and auxiliary control panel assemblies (Figure 6-13) are identical in design. The deck edge panel is mounted to the bulkhead, in the catwalk, in an area that will provide the operator with a direct line of sight to the respective JBD assembly. The auxiliary panel is mounted to the bulkhead in the corresponding catapult machinery space as shown in Figure 6-13. Each panel assembly contains four fuse lights, a power-on switch that lights up, a double indicator...
light (saltwater pressure and saltwater temperature), two push-to-test lighted switches, an emergency cooling water shutoff lighted switch, cooling water and hydraulic pressure gauges, and gauge isolation valves. In addition, the Mods 0, 2, and 3 panel assemblies contain six lighted switches and the Mod 1 panel assemblies contain four lighted switches which are used to raise and lower the JBD panels. The water shutoff switch is used, in emergencies, to remotely close the cooling water supply valve. The four fuse lights indicate a blown fuse and possible trouble in the applicable electrical circuit. The double indicator lights indicate that cooling water temperature is too high and/or cooling water pressure is below minimum. A plastic guard, mounted over the raise and lower switches, prevents accidental operation of panels. Electrical power is turned on by depressing the power-on lighted switch. Electrical system schematics for the deck edge and auxiliary control panel are provided in maintenance instruction *JBD Manual 51-70-13.*

Figure 6-12 — Deck edge control panel (Mods 0 and 2).

Figure 6-13 — Auxiliary control panel.
Chestpack Portable Control Assembly

The portable chestpack assembly (Figure 6-14) provides mobility for the JBD operator and allows the operator to ensure a clear “line of sight” to the corresponding JBD. This is especially important on JBDs Nos.1 and 2 aboard aircraft carriers nuclear powered (CVNs) 68 and later, where a clear line of sight is not possible from the catwalk areas. The chestpacks are connected to the JBD electrical system by an umbilical cable. The cable is attached to a common quick-release fitting on one end and hardwired to the chestpack through a stuffing tube and packing assembly arrangement on the opposite end. This method of attaching the cable to chestpack prevents water intrusion into the chestpack unit. A removable, rubber-type protective cover slides over the unit and serves to protect the chestpack. The switch panel contains six toggle switches, a yellow emergency water-off light, a green starboard (STBD) and red port (PORT) indicator light, a white light for illumination of the switch panel, and two handles. The switch panel components are protected by a guard mounted on the front of the panel.

Slots located in the sides of the guard and protective cover allows a neck strap to be inserted for use by the operator.

Four of the switches are used to raise and lower the JBD panels (one all-raise and three individual (right, center, left) panel raise or lower switches). The fifth switch is a defeat interlock switch which allows raising or lowering of the JBD in an emergency such as loss of JBD cooling water pressure. The last switch is an emergency water-off switch and is used in emergencies only to secure JBD cooling water. When the cooling water has been secured, the yellow “water-off” indicator light comes

6-13
on. The green STBD and red PORT indicator lights provide an indication to the operator regarding to which JBD the chestpack is connected. The green light, when lit, indicates the unit is connected to JBD No. 1 and the red light, when lit, indicates the unit is connected to JBD No. 2.

In some installations these chestpacks are used on JBD No. 3, which would be indicated by the green STBD indicator light. Power is supplied to the chestpack by a 28 volt DC power on/off switch located near the auxiliary control panel. Power for the remaining JBD electrical components is provided by the 115 volt 60 Hz on/off switch also located near the auxiliary panel. When the chestpack is plugged in, the transfer switch is in the PORT position, and the 28 volt DC switch is turned on, the applicable red or green indicator light will come on, indicating that power is now available to the chestpack and confirming to which JBD, Nos. 1, 2 or 3 (where applicable), the chestpack is currently connected.

Transfer Switches

The deck edge control panel transfer switch (Figure 6-15, view A) is a rotary-type switch with a rotary dial. The dial face is marked with two “deck edge” and two “auxiliary” (AUX) positions. The transfer switch is located near the applicable auxiliary control panel. When the transfer switch is in the deck edge position, the deck edge control panel is operable. Moving the dial to the AUX position shifts electrical power from the deck edge panel to the auxiliary panel. The only difference between the chestpack transfer switch and the deck edge transfer switch is the dial face (Figure 6-15, views A and B).

![Figure 6-15 — (A) Deck edge control panel transfer switch; (B) portable chestpack control transfer switch.](image)
The chestpack portable control transfer switch, like the deck edge control panel transfer switch (Figure 6-15, view B), is a rotary type with a rotary dial. The dial face is marked with two “portable edge” and two AUX positions. The transfer switch is located near the applicable auxiliary control panel. When the transfer switch is in the portable position, the chestpack is operable. Moving the dial to the AUX position shifts electrical power from the chestpack to the auxiliary panel.

Panel Support Installation and Emergency Lowering Device Installation

The panel support and emergency lowering device installation (Figure 6-16) consists of the panel support stanchions and panel supports (Figure 6-17). Panel support stanchions are to be used anytime panel supports are being installed or removed. The panel support stanchions are positioned between the raised JBD panel and the lip of the flight deck. The panel support stanchion is designed to support the weight of a pair of fully raised JBD panels; however, the stanchion will not prevent the lowering of JBD under pressure. To provide an extra margin of safety, panel supports must be properly installed prior to any maintenance being conducted under JBD panels. The panel supports attached to the JBD operating linkage arm assembly have a quick release pin and fit into an indentation in the depressed deck area (JBD pit) at the forward end. The panel supports are used to lock panels in the raised position for maintenance purposes or emergencies. A panel support is provided for each set of operating gear, three supports for Mk 7 Mod 0/2 and two for Mk 7 Mod 1 JBDs.

Figure 6-16 — Panel support stanchions.
The emergency lowering device (*Figure 6-18*) connects to a tow tractor on one end and fits against the operating linkage arm assembly at the other end. This allows the tractor to push the operating linkage “over-center”. With the emergency bypass valves open, the weight of the panels will then force fluid from the raise end of the hydraulic cylinders through the emergency bypass valve, permitting the panels to slowly lower.

The minimum time to lower the JBD during emergency operation is 35 seconds and the maximum time is 120 seconds. If the lowering times are outside these parameters, make sure the by-pass valves are fully open and orifice located on the return line is clean. Refer to *Maintenance Instructions Manual JBD 51-70-13* for additional information.

**Normal Operation**

For normal operation of the JBD, use the following procedures:

1. Perform the preoperational inspection according to the applicable maintenance requirement card (MRC).
2. Ensure that personnel, aircraft, and flight deck equipment are clear of the panel area before attempting to raise the JBDs.
3. Check to ensure salt water supplied from the ship's fire main is flowing through the water-cooled panels.
4. Functionally test the JBD hydraulic and electrical system for proper operation and leaks.

**Emergency Operation**

In the event of an emergency or a malfunction, the following procedures must be followed. The emergency lowering of a JBD will require a minimum of eight personnel:

1. One Topside Safety Petty Officer (overall in charge).
2. One Topside JBD phone talker.
3. One below-deck phone talker/valve operator.
4. Two personnel to install emergency lowering device.
5. Two safety observers (stationed at the port and starboard sides of the JBD panels).
6. One tractor driver.

**Electrical Failure**

Should the chestpack, deck edge, and auxiliary control panels become affected by an electrical power failure, but the hydraulic system is functional, proceed as follows:

1. Station a crewperson to act as a valve operator at the stack valves. The valve operator shall be equipped with a sound-powered phone set. The chestpack or JBD deck edge operator shall remain at his or her station and relay instructions to the valve operator. The JBD deck edge or auxiliary panel operator shall also monitor the pressure gauges.
2. The valve operator, when instructed by the chestpack or JBD deck edge operator, shall raise or lower the JBD panels by the manual push pins on the A and B solenoids of the stack valves. The B solenoid controls the raising of the panels, and the A solenoid controls the lowering.

**Hydraulic Failure**

Should the JBD hydraulic system fail with the JBDs in the FULL-UP position, the following procedures must be used to lower the panels:

1. Establish sound-powered phone communication between the valve operator and the chestpack or deck edge operator.
2. Close the main supply valve and attach a safety tag.
3. Open the applicable emergency bypass valves one-quarter turn or as necessary to control the lowering speed of the panel.
4. Using the panel emergency-lowering device, place the fitted end against the panel linkage arm and attach the ring end to a tractor tow hook. Push with the tractor until the operating gear linkage unlocks.
5. Adjust the panel lowering speed by opening/closing the emergency bypass valve.
6. Once the strut is over-center, the JBD panels will fall under its own weight until it is flush with the deck.

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**CAUTION**

Repair and checkout of the faulty panel or control box operation shall be accomplished at times when the raising or lowering of the JBD would not be prohibited by aircraft movement on the flight deck.
Inoperative Deck Edge Control Panel or Portable Chestpack

In the event of an emergency where the chestpack or the deck edge control panel cannot be used, the auxiliary control panel becomes operational.

1. Station a crewperson at the flight deck or deck edge to man the phone and relay instructions to the auxiliary-control-panel operator.

2. With the transfer switch in the AUX position, the auxiliary-control-panel operator shall operate the panel by the instructions relayed to him or her from the flight deck or deck edge personnel.

3. Continue operation of the auxiliary control panel until the faulty chestpack or deck edge control panel is completely checked out and restored to proper operating condition.

4. Return control of the JBD to the chestpack or deck edge operator.

WARNING

The crewperson acting as a safety observer should ensure that the area around the JBD is clear of aircraft, support equipment, and personnel.

MAINTENANCE

This section contains preventive and corrective maintenance information and procedures, some of which are general and apply to various items of the system and others of which are specific and apply to a particular part of the equipment.

Preventive Maintenance

The planned maintenance system furnishes all vessels and stations with MRCs containing specific maintenance instructions. These cards are used at required frequencies to maintain JBD equipment in operating condition and to prevent breakdown and subsequent shutdown of operations. The planned maintenance system and the maintenance data collection system are described in Operation Naval Instructions (OPNAVINST) 4790.4.

Current MRCs include the following inspection and cleaning procedures:

1. Preoperational inspections.
2. Post-operational inspections.
3. Cleaning and inspecting hydraulic piping orifice plate(s).

To ensure dependable operation of the JBD equipment, proper lubrication of the mechanical linkage is essential. Lubrication is part of the preoperational checks given in the MRC. Extension tubes are provided on trunnion bearings and hydraulic cylinder bracket assemblies so that all lube fittings can be reached from the deck.

Hoses, seals, and O-rings are selected on the basis of their compatibility with the hydraulic fluid. Therefore, replacement parts should be of the same material as original parts. O-rings must be removed and replaced with care to avoid damage to the O-ring and O-ring sealing surfaces of the various parts. O-rings must be free of cuts and not deformed. New O-rings must be installed at every reassembly of components. Before assembly, all O-rings must be lightly lubricated with the system hydraulic fluid. Hoses are subject to wear and require periodic replacement. Do not twist or bend hoses when installing.

When removing a component from the hydraulic system, cap or plug all openings to prevent entry of foreign matter. Use tape to protect pipe threads.
Hydraulic system components must be disassembled, cleaned, repaired, and reassembled as specified in the operation, maintenance, and overhaul instructions manual for the specific type of JBD installation on your ship.

**WARNING**

Before performing any maintenance actions behind a JBD panel in the raised position, install the panel supports to prevent the panel from lowering. Failure to do this could result in serious injury to personnel.

**Troubleshooting**

Most problems that occur on JBDs can be recognized as a failure of one of three systems—namely, hydraulic, electrical, or water. Information that allows operating and maintenance personnel to locate the source of problems or equipment failure are found in the *JBD Manual 51-70-13*.

**Safety Precautions**

The following safety precautions apply at all times.

1. The energy required to operate the JBD is supplied by fluid under pressure; therefore, when dealing with fluid under pressure, observe standard safety precautions that apply.
2. All moving parts and equipment should be checked for rags, tools, or other foreign material before operating any of the machinery.
3. Only qualified operators shall be allowed to operate the JBDs.
4. The parking of aircraft on the deflector panel should be avoided. The panels are designed to withstand only the temporary weight of an aircraft taxiing over them.
5. When you perform maintenance on the JBD, comply with the safety precautions listed on the MRC.
6. Personnel and equipment shall be clear of the JBD machinery enclosure and depressed deck when the panels are being raised or lowered. This includes the times when the panels are being operated during preoperational inspections and maintenance or overhaul tests and inspections.

**MK 2 NOSE-GEAR LAUNCH (NGL) SYSTEM**

The nose-gear-launch (NGL) equipment is designed to assist in the launching of aircraft by providing a positive and automatic means of attaching the aircraft launch bar to the catapult shuttle and spreader. This method of launching permits a positive, automatic engagement of aircraft to catapult. Automatic engagement of the aircraft launch bar to the catapult reduces the number of personnel required to be in close proximity to the aircraft during catapult hookup. The components of the Mk 2 NGL system consist of NGL assembly and NGL control system.

**NGL assembly**

The NGL assembly *(Figure 6-19)* is made up of seven components which serve to restrain and tension an aircraft on the catapult. Service change (SC) 609 provides a one-piece cover to housed all components. The one-piece plate cover *(Figure 6-19, view A)*, is shown below.

1. Guide tracks
Figure 6-19 — NGL assembly.

2. Slide assembly
3. Reset assembly
4. Drain pan assembly
5. Buffer cylinder assembly
6. Shock absorber (soft stop)
7. Tensioner (deck tensioner) cylinder assembly

Guide Tracks

The guide tracks (Figure 6-20), which guide the aircraft launch bar into engagement with the catapult shuttle spreader assembly, consist of an approach track, buffer-cylinder track, aft slide-access track, forward slide-access track, and a forward track. The approach track contains a V-shaped mouth, which guides the aircraft launch bar into the guide track. Grooves constructed in the individual tracks and top surface of the buffer cylinder guide the launch bar as the aircraft moves forward. Inserts installed in the forward slide-access tracks provide a camming surface, which ensures that the launch bar makes positive contact with the buffer hook actuator roller. Inserts installed in the forward track guide the launch bar up and over the spreader assembly for proper launch-bar-to-shuttle hook up.
Wheel guides bars are provided to guide the aircraft nose wheel along the guide track. The inner wheel guide bars keep the nose wheel straight during forward movement. The outer wheel guide bars prevent the nose wheel from sliding side to side once the nose wheel clears the inner guide bars, and aid in proper alignment of the launch bar with the spreader assembly.

Figure 6-20 — Guide tracks.
Slide Assembly

The slide assembly (Figure 6-21) consists of a body containing rollers, which reduce friction during forward and aft movement of the assembly; the buffer hook, which engages the aircraft hold-back bar; and the buffer-hook actuator assembly, which raises the buffer hook to flight-deck level. The slide assembly is mechanically connected to the buffer-cylinder piston rods by three links.

![Slide Assembly Diagram](image)

Figure 6-21 — Slide assembly.

During operation (Figure 6-22, view A), as the aircraft moves forward, the launch bar, sliding in the track-guide grooves, contacts the buffer-hook actuator assembly roller, forcing it to rotate forward and down. When the buffer hook actuator is forced down, it pushes against the underside of the buffer hook and raises the hook into position to engage the aircraft holdback bar. As the aircraft continues forward, the holdback bar engages the buffer hook and pulls the slide assembly forward. The slide assembly, connected to the buffer cylinder piston rods, pulls the three rods from the buffer cylinder assembly. Hydraulic resistance within the buffer cylinder assembly decelerates the aircraft. When the aircraft stops, it is in position for catapult shuttle hookup.

After launch, the piston rods are retracted into the buffer cylinder assembly automatically. As the slide assembly moves aft, the buffer hook assembly contacts the reset assembly slider (Figure 6-22, view B), causing the actuator lever to rotate down. This action permits the buffer hook to drop below deck level through an opening in the track into the deck housing. The slide assembly is now ready for the next aircraft hookup.
Figure 6-22 — (A) Buffer hook actuation; (B) buffer hook reset.

Reset Assembly

The reset assembly (Figure 6-23), which resets the buffer hook, causing it to drop below deck at the end of the buffer-cylinder-assembly retract stroke, is located below the slide assembly in the deck housing. The reset assembly consists of a housing, slider, slider-actuating spring, and retainer. The slider contains a machined surface to reduce wear due to contact with the buffer hook actuator lever. Grooves machined in the top of the slider provide a path for the flow of lubricant between the slider and the inner walls of the housing. The housing is chrome-plated to prevent corrosion. The actuating spring is housed in a hole in the bottom of the slider. The slider and spring are secured in the housing by means of the retainer.
During operation, when the slide assembly is forward, the reset-assembly slider is not restrained by the actuator assembly but is held above the surface of the housing by the slider actuating spring. After launch, as the slide assembly retracts, the buffer hook actuator contacts the extended reset slider, causing the actuator assembly to rotate downward. This action permits the buffer hook to drop below the deck through the track opening into the deck housing cavity as previously shown on Figure 6-22, view B. When the buffer hook is below deck, the actuator assembly lever holds the reset-assembly slider down in the reset assembly housing.

**Drain Pan Assembly**

The drain pan assembly (Figure 6-24) is bolted to the underside of the NGL housing, directly below the tensioner cylinder assembly. The drain pan assembly contains the hydraulic fittings and connections for the two tensioner cylinder assembly quick-disconnect couplings. The drain pan assembly serves to support and protect the quick-disconnect couplings and also provides a reservoir and drain for any and all fluids entering the NGL track slot. Normally, no corrective maintenance would be required for the drain pan assembly; however, minimal preservation is still required.

**Buffer Cylinder Assembly**

The NGL buffer cylinder (Figure 6-25) is located in the deck housing between the approach track and the aft slide-access track. The buffer-cylinder body has integral guide tracks on its top surface and contains three hydraulic cylinders. The two outer cylinders contain hollow piston rods; the center cylinder piston rod is solid. The forward end of each piston rod is attached to the slide assembly. Within each outer piston rod is an orifice tube, which meters fluid flow through the outer cylinders to absorb the forward energy of the aircraft during the buffering stroke. Prior to aircraft holdback bar/buffer hook engagement, the buffer cylinder assembly is in the standby cycle with the three piston rods fully retracted into the buffer cylinders. While in the standby cycle, hydraulic fluid is constantly circulated between the hydraulic system and the buffer cylinder assembly through two metering orifice...
screws at a rate of approximately 8.5 gpm. This metered flow, which is nonadjustable, maintains the hydraulic fluid in the system at the proper temperature. When the aircraft holdback bar engages the buffer hook, the slide assembly moves forward, pulling the three piston rods from the cylinders. As the piston rods move forward, fluid in front of each outer-cylinder piston is forced through the holes around the periphery of each outer-cylinder piston and through the metering holes in the two orifice tubes. As the pistons continue forward, the number of metering holes in the orifice tubes is progressively reduced, causing an increasing resistance to forward motion of the slide assembly, thus decelerating and bringing the aircraft to a smooth stop at the end of the buffering stroke. During the buffering stroke, fluid in front of the center-cylinder piston is forced through a port in the cylinder and through the hydraulic line into the NGL valve-manifold accumulator, which acts as a cushion and fluid reservoir. After launch, the fluid pressure established by the valve-manifold reducing valve acting on the forward side of the center cylinder forces the center piston aft, thus retracting the three rods into the cylinders.

**Shock Absorber (Soft Stop)**

The shock absorber assembly, also known as the soft stop (*Figure 6-26*), is mounted horizontally at the forward end of the NGL assembly. During the catapult retract cycle, the shock absorber provides uniform deceleration of the shuttle to bring it to a smooth, soft stop, eliminating impact forces that could cause damage to the grab assembly or the NGL assembly. The shock absorber is a compact, self-contained, sealed unit consisting of an all-steel body with an inner pressure chamber and an all-steel chrome-plated piston rod that requires no maintenance or adjustments.

**Tensioner (Deck Tensioner) Cylinder Assembly**

The tensioner cylinder assembly (*Figure 6-27*) is located forward, in the NGL housing, below the forward track and forward slide-access track. The tensioner cylinder assembly piston rod is fitted with a crosshead assembly at its forward end. The crosshead assembly is provided with a cam, which actuates the tensioner limit switches and rollers that support the piston throughout its stroke. The tensioner cylinder assembly piston rod exerts a force on the shuttle, via the grab, to tension the aircraft prior to launch.
Buffer Accumulator Assembly

The buffer accumulator assembly (Figure 6-28) is located below deck in line with and aft of the buffer cylinder assembly. The buffer accumulator consists of a hydraulic accumulator mounted in a support with a tee fitting and associated hardware. During operation, as the buffer cylinder piston rods are pulled forward, hydraulic fluid flows from the accumulator, through the tee fitting and associated piping, into the aft end of the buffer cylinder assembly, filling the void created as the piston rods move forward. After the launch, the buffer piston rods retract into the buffer cylinder forcing fluid from the buffer cylinder back to the accumulator. Fluid continues to flow into the accumulator until the pressure buildup exceeds the spring-load of the check valve located downstream from the accumulator. Opening of the check valve permits excess fluid from the buffer cylinder to be returned to the catapult gravity tank.

Figure 6-28 — Buffer accumulator assembly.

Valve Manifold Assembly

The valve manifold assembly (Figure 6-29) is located on the third deck level in close proximity to the aft end of the catapult. It consists of a welded support structure, two 2-way flow control valves, two 4-way solenoid control valves, a reducing valve, an accumulator, a terminal box with associated electrical connections, and hydraulic piping. The valve manifold assembly controls the flow of hydraulic fluid supplied from the catapult’s 2,500 psi hydraulic system to the buffer cylinder assembly.

WARNING

Electrical shock can cause injury or death. Before working on electrical connections, verify power is off using power indicator device such as voltmeter.
NGL Control System

On integrated-catapult control station (ICCS) ships the operation of the NGL equipment is automatic under normal operating conditions. The only controls provided are the buffer FORWARD (FWD) and the buffer AFT push buttons (Figure 6-30) installed on the monitor control console, deck edge, and the central charging panel (CCP).

On non-ICCS ships, the operation of the NGL equipment is automatic under normal operating conditions. Two control panels are provided for the operation of the NGL system. One panel is located adjacent to the catapult deck edge station for use during normal operations. A second panel is located in close proximity to the aft end of the catapult trough for emergency operations. The control panels are identical and each houses a relay, terminal board, power-on indicator light, buffer FWD and buffer AFT switches with integral indicator lights, and associated wiring. Panel selection is made by rotating a transfer switch (Figure 6-31) from its normal position to its emergency position.

Buffer Forward

The buffer FWD push button is used during an aircraft launch abort operation to move the buffer hook forward of the holdback bar so that the release element and holdback bar can be removed from the aircraft. When the buffer FWD push button is pressed, the buffer FWD solenoid A is energized, shifting the buffer forward solenoid valve, allowing medium-pressure hydraulic fluid to shift the piston.
of the flow control valve. When the piston of the flow control valve shifts, fluid flow from the aft end of the buffer cylinder assembly to the gravity tank is shut off. This causes a pressure buildup on the rear end of the buffer cylinder assembly pistons. Since the area on the rear side of the pistons is larger than the area on the forward side, the pistons, piston rods, and attached slide assembly are driven forward.

**Buffer Aft**

The buffer AFT push button is pressed during an abort operation when the aircraft holdback bar is connected to the buffer hook; the fluid pressure acting on the forward side of the buffer pistons will tow the aircraft aft. When the buffer has moved back 4 to 10 inches, the abort force is reduced because hydraulic pressure is bled off through exposed holes in the buffer-cylinder assembly orifice tubes. Aircraft braking is required prior to releasing the push button to hold the aircraft against its thrust load. When the buffer AFT pushbutton is pressed, the buffer AFT solenoid B is energized, shifting the buffer aft solenoid valve, allowing medium-pressure hydraulic fluid to shift the piston of the flow control valve. Medium-pressure hydraulic fluid flows through the flow control valve to the buffer cylinder assembly. Fluid pressure is applied to the forward side of the buffer pistons, and the pistons, piston rods, and slide assembly move back. As the pistons move back, fluid is forced out of the rear end of the buffer cylinder assembly, through a check valve and the other flow control valve, to the gravity tank.

**SUMMARY**

In this chapter, we have discussed the functions and operating procedures for the JBD and MK 2 NGL equipment. For additional information, see the *JBD Manual* 51-70-13 and *Catapult Manual* 51-15ABB-4.2 work packages (WPs) 038, 039, and 040.
End of Chapter 6
Associated Launching Equipment

Review Questions

6-1 What is the purpose of the JBD?
A. To protect flight deck lines from hot jet exhaust
B. To protect panels, gears and linkages
C. To protect personnel, equipment and other aircraft
D. To assist the pilot for easy take-off

6-2 What is used to prevent JBD modules from overheating?
A. Hydraulic engine coolant from the gravity tank
B. Seawater from ships fire main
C. Booster cooling pump from hydraulic cylinder
D. Temperature limiting valve from return line

6-3 What is the difference between the Mk 7 Mod 1 and Mk 7 Mod 2 JBD?
A. Mk 7 Mod 1 has four panels; Mk 7 Mod 2 has six panels
B. Mk 7 Mod 1 has six panels; Mk 7 Mod 2 has four panels
C. Mk 7 Mod 1 has eight panels; Mk 7 Mod 2 has six panels
D. Mk 7 Mod 1 has ten panels; Mk 7 Mod 2 has four panels

6-4 What is the function of side cooling panels?
A. Assist the shaft and the crank in raising and lowering panels
B. Provide cooling using lubricating line and fittings
C. Provide additional cooling to JBD panels
D. Provide extra protection to middle panels

6-5 How many removable module assemblies are on each panel assembly?
A. 4
B. 5
C. 6
D. 7

6-6 How many stack valves are required in the Mk 7 Mod 0/2 and MK 7 Mod 1 respectively?
A. 3 and 1
B. 3 and 2
C. 4 and 3
D. 4 and 4
6-7 What is the purpose of the control valve?
A. Controls the raising and lowering times of JBD
B. Sends pressurized fluid to gear assemblies
C. Dumps excess fluids back to return line
D. Controls the flow of fluid from and to cylinders

6-8 What solenoid energizes if the RAISE switch is actuated on the stack valve?
A. A
B. B
C. C
D. D

6-9 What solenoid energizes if the LOWER switch is actuated on the stack valve?
A. A
B. B
C. C
D. D

6-10 What is the only difference between the chestpack and the deck edge transfer switch?
A. Number of gauges
B. Knob
C. Dial face
D. Cover

6-11 What are the two positions on the deck edge control system transfer switch?
A. Aux and portable
B. Deck edge and portable
C. Deck edge and emergency
D. Deck edge and aux

6-12 What type of valve is a stack valve?
A. Three-way solenoid-operated control valve
B. Four-way solenoid-operated control valve
C. Five-way solenoid-operated control valve
D. Six-way solenoid-operated control valve

6-13 What is the maximum water temperature, in degrees, of the JBD’s cooling water?
A. 200
B. 205
C. 210
D. 215
6-14 What is the purpose of the NGL?
   A. Assists the pilot in centering the aircraft launch bar on the catapult.
   B. Assists the crew in positive attachment of the aircraft launch bar to the catapult.
   C. Assists the catapult in positioning the aircraft launch bar on the catapult.
   D. Assists the aircraft by automatic attachment of the aircraft launch bar to the catapult.

6-15 How many links does the slide assembly have mechanically connected to the buffer cylinder?
   A. Two
   B. Three
   C. Four
   D. Five

6-16 What assembly controls the flow of fluid from the catapult hydraulic system to the buffer cylinder assembly?
   A. Valve manifold
   B. Buffer accumulator
   C. Reset
   D. Pan

6-17 The housing, slider, and which of the following comprise the reset assembly?
   A. Base, pin
   B. Cap, slider-actuating spring
   C. Retainer, screw
   D. Slider-actuating spring, retainer

6-18 At approximately how many gallons per minute is the hydraulic fluid constantly circulated between hydraulic system and buffer cylinder assembly?
   A. 6.5
   B. 7.5
   C. 8.5
   D. 9.5

6-19 What permits the buffer hook to drop below deck at the end of the buffer cylinder stroke?
   A. Reset assembly
   B. Guide assembly
   C. Actuator
   D. Inserts

6-20 What provides uniform deceleration of the shuttle during the catapult retract cycle?
   A. Deceleration valve
   B. Orifice
   C. Shock absorber
   D. Small diameter return pipe
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