CHAPTER 2
AIRCRAFT HANDLING EQUIPMENT, NONSKID, AND MARKINGS

As Naval aircraft become more complex, so must support equipment. Many different types of support equipment are required to perform the various functions necessary to maintain aircraft in top condition. Most of today's equipment is used in the direct support of the aircraft itself. Aircraft squadrons and the air department aboard carriers and large deck amphibious ships are the principal users of support equipment. Within the air department, flight deck and hangar deck aircraft handling crews use aircraft handling equipment such as tow tractors, spotting dollies, aircraft tiedown chains, aircraft wheel chocks, and aircraft towbars. As a user of the equipment, the Aviation Boatswain’s Mate Handler (ABH) depends upon personnel of the Aviation Support Equipment Technician (AS) rating for their expertise in maintaining ground support equipment (GSE). However, even the best maintained GSE must have a surface that provides the best traction possible, if maximum effectiveness is to be achieved. As an ABH, you must be knowledgeable in all areas of nonskid preparation, application, and corrosion prevention. Properly applied, a nonskid coating will provide the appropriate surface coating on your flight deck or hangar deck for safely handling naval aircraft.

Although a good quality non-slip deck surface is a proven asset to aircraft handlers, the pilots, aircrews, and deck crews rely on the special markings, known as Visual Landing Aids (VLA), for a wide range of information that leads to successful flight operations. VLA markings, in both the flight deck and hangar deck, are used in the launch and recovery evolutions, firefighting, first aid and emergency situations, and much more. As an ABH, you should be the resident expert for visual markings located on flight and hangar decks and bulkheads.

LEARNING OBJECTIVES

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

1. Describe the various types of GSE.
2. Describe the capabilities of various GSE.
3. State the licensing procedures for GSE.
4. Identify various types of aircraft handling equipment.
5. Describe how to properly use aircraft handling equipment.
6. Describe the functional operation of an aircraft elevator.
7. Identify the various watch stations and personnel responsibilities associated with operating an aircraft elevator.
8. Identify the various types of Nonskid.
9. Describe how to prepare for proper Nonskid application.
10. Identify Visual Landing Aids on Carrier, Fixed Wing Aircraft, Nuclear (CVN), Multipurpose Amphibious Assault Ship (LHD), General Purpose Amphibious Assault Ship (LHA), and Air Capable Ship (ACS) platforms.

GROUND SUPPORT EQUIPMENT (GSE) TOW TRACTORS

The tow tractor is the primary means of moving most aircraft that are on the ground or deck and with engines not running. Features of most value to the ABH are the tow tractor's weight, maneuverability, and drawbar pull.
The maneuverability of the tractor depends on the tractor's dimensions and turning radius. The smaller the dimensions and turning radius, the more maneuverable the tractor. Drawbar pull is the amount of force that the tractor can exert. The drawbar pull of any tractor is dependent on the type and condition of the surface on which the tractor is being used. Dry concrete gives the most traction, hence the most drawbar pull for a given tractor. On a wet, fuel soaked flight deck the force may be greatly reduced. Towing capacity is normally stated in drawbar pull. The maximum aircraft weight that a tractor can safely handle is 10 times the drawbar pull. In other words, a tractor with an 8,000-pound drawbar pull can tow aircraft weighing up to 80,000 pounds.

The engine and transmission types allow for easy maneuverability of the tractor and for installing aircraft starting and firefighting equipment. The type of transmission may also contribute to ease in handling the tractor. Support equipment for supplying electric power and/or compressed air for aircraft engine starting or servicing and electric power for brake operation may be installed on some tractors.

You should know how to use the different pedals and levers in the operation of these vehicles. Certain daily functions such as checking the water, air, oil, and fuel are done before operation of this equipment. These items are on a checklist and are part of the standard procedures for use of motorized equipment throughout the Navy. All other maintenance is the responsibility of the aircraft intermediate maintenance department (AIMD) aboard carriers and at air stations. Operating a tow tractor requires good judgment and general knowledge of motorized equipment. The driver must be licensed in accordance with Department of the Navy Commander Naval Air Forces COMNAVAIRFORINST, 4790.2(series) before assuming control of the vehicle. The tractors are equipped with either pintle or automatic tow couplers both front and rear. Some tractors, if outfitted with support equipment on the rear end of the tractor, may not be equipped with a towing coupler.

**Tow Tractor Types**

Throughout this chapter, the following tow tractors will be discussed: A/S32A-30A, Figure 2-1, (Support Equipment & Aircraft Towing Tractor); A/S32A-32 (Aircraft Towing Tractor); A/S32A-31A (Aircraft Towing Tractor); A/S32A-45 (Aircraft Mid-Range Tow Vehicle); A/S32A-37 (Aircraft Towing Tractor). These tow tractors represent the most common types of towing vehicles that an ABH would use both at-sea and ashore.

**A/S 32A-30A (Support Equipment & Aircraft Tow Tractor)**

This tractor was designed primarily for towing mobile support equipment such as starting units, mobile electric power plants (MEPPs), work stands, and other tractors. Commonly called the GSE tractor, it can also be used to tow munitions trailers and, as a secondary mission, to tow light aircraft and helicopters. It is a shore based unit and routinely used around hangars and warehouses. The unit is powered by a four-cycle diesel motor and is a dual wheeled, rear drive tractor. For specific information concerning this tractor, refer to Support Equipment & Aircraft Tow Tractor, NAVAIR 19-40-520. Table 2-1 lists the leading particulars.

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**Figure 2-1 — A/S32A-30A support equipment and aircraft tow tractor.**
Table 2-1 — Leading Particulars of the A/S32A-30A Aircraft Tow Tractor

<table>
<thead>
<tr>
<th>Gross vehicle weight</th>
<th>6,970 lbs.</th>
<th>Towing capacity</th>
<th>40,000 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic length</td>
<td>102 inches</td>
<td>Turning radius</td>
<td>142 inches</td>
</tr>
<tr>
<td>Height</td>
<td>84 inches</td>
<td>Width</td>
<td>70 inches</td>
</tr>
<tr>
<td>Fuel capacity</td>
<td>12 gallons</td>
<td>Electrical system</td>
<td>12 volt</td>
</tr>
<tr>
<td>Min. oil pressure</td>
<td>7 psi</td>
<td>Tire pressure</td>
<td>50 psi</td>
</tr>
</tbody>
</table>

A/S32A-32 Towing Tractor (SD-2 Spotting Dolly)

This vehicle is formally known as a towing tractor; however, it is commonly referred to as a spotting dolly, SD-2 (Figure 2-2). Table 2-2 lists the leading particulars. The movement of aircraft on the ground has historically been accomplished by means of towbars and tractors, but in crowded areas, that method becomes ineffective. The A/S32A-32 tow tractor (spotting dolly) can provide maximum maneuverability, tow, turn, and spot several types of aircraft equally as effectively in congested areas such as the hangar bay. The spotting dolly can also be operated under most aircraft, since its heights is only 30 inches. Self-propelled, the AS/32A-32 towing tractor can move an aircraft by picking up the nosewheel and moving in any direction. The tractor requires no turning radius. The tractor can approach an aircraft head on, pick up the nosewheel, spin on its own axis, and then tow the aircraft out at any angle to the aircraft's original line of direction. It can turn an aircraft through 360 degrees while the center of the landing gear remains stationary. A hydraulic drive system permits one wheel of the tractor to be driven forward and the other in reverse. This allows the tractor to spin completely about without moving the aircraft's nosewheel. The A/S32A-32 towing tractor is a three-wheel vehicle, two of the wheels are driven, and the third is an independent caster. You can control the tractor by using a joystick handle on the end of the control console. Steering is accomplished by pushing the handle to the left or to the right. You can control direction (forward or reverse) by moving the handle away from you (forward) or toward you (reverse). The maximum speed when carrying a load is 2 miles per hour; unloaded, 5 miles per hour. The usual manner of loading aircraft onto either of the tractors is to maneuver the spotting dolly into the loading position, in front of the braked aircraft, with the lifting arms spread to their maximum width. Slowly move the tractor toward the aircraft until the

Figure 2-2 — A/S32A-32 aircraft tow tractor (SD-2 spotting dolly).
lifting arms are astride the nosewheel of the aircraft. Try to keep the tractor centered with the nosewheel of the aircraft. Make certain the correct axle pins in the lifting arms are installed. Adjust the lifting arms by using one of the control panels until the axle pins are in line with the nosewheel axle. Lock one axle pin at a time in the nosewheel. After the nosewheel has been securely engaged, raise the lifting arms upon the director's signal, and proceed as directed. Specific information concerning the A/S32A-32 can be found in the Aircraft Towing Tractor, A/S32A-32, NAVAIR 19-1-157.

Table 2-2 — Leading Particulars of the A/S32A-32 Tow Tractor (Spotting Dolly)

<table>
<thead>
<tr>
<th>Overall length</th>
<th>148 inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall width</td>
<td>81 inches</td>
</tr>
<tr>
<td>Overall height</td>
<td>30 inches</td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>11,500 lbs.</td>
</tr>
<tr>
<td>Drawbar pull</td>
<td>14,000 lbs.</td>
</tr>
<tr>
<td>Maximum lifting capacity</td>
<td>16,000 lbs.</td>
</tr>
<tr>
<td>Minimum turning radius</td>
<td>0 inches</td>
</tr>
<tr>
<td>Ground clearance</td>
<td>5 inches</td>
</tr>
<tr>
<td>Fuel</td>
<td>JP-5</td>
</tr>
</tbody>
</table>

The A/S 32A-31A Aircraft Tow Tractor

The A/S 32A-31 aircraft tow tractor is designed for towing aircraft aboard ship (Figure 2-3). It is a conventional six-wheel vehicle equipped with dual rear drive and front wheel steering with a three speed automatic transmission. A 24-volt electrical system powers the starting, lights, and the engine protective devices. Provision is made for mounting an MSU-200NAV air start unit (MSU) on the rear of the tractor. Fuel for the starting unit comes from the tractor tank. The control panel for the starting unit is installed at the right side of the tractor operator. When the starting unit is not installed, counterweights are used to load the drive wheels and achieve the rated drawbar pull. Towing pintles are located at the front and the rear of the tractor. A single seat for the operator is located on the left side. The engine has a three-cylinder, two-cycle diesel with an automatic four-speed transmission and one reverse gear. The tractor has mechanical steering, assisted with
hydraulic power. If hydraulic pressure is lost, steering is maintained through the mechanical linkage from the steering wheel to the spindles. Brakes for the tractor are also hydraulically operated. They are a wet-disc type, and are located in the rear axle wheel ends. The brakes are NOT adjustable and brake squeal is quite normal with this type. For proper operation, the accumulator-charging valve is set to detect when the pressure drops below 1500 psi. The charging valve will then signal the pump to recharge the accumulator. When towing an aircraft with the A/S32A-31A, be sure that the transmission selector lever is in either the "1" or "R" position. Never shift the transmission through to "N" (neutral) while the tractor is in motion; damage may result to the transmission. The A/S32A-31A has a brake warning light that will illuminate when the pressure in the accumulator falls below 1350 psi. The engine/transmission warning light will illuminate when the torque converter reaches temperatures above 300 °F, engine temperatures go above 215 °F, or engine oil pressure falls below 6 psi. You should always make sure that the engine water temperature never exceeds 196 °F and the transmission temperature remains below 220 °F. Table 2-3 list the leading particulars. Specific operating procedures for this tractor can be located in Aircraft Towing Tractor, A/S32A-31A, NAVAIR 19-40-521.

Table 2-3 — Leading Particulars of the A/S32A-31A Aircraft Tow Tractor

<table>
<thead>
<tr>
<th>Gross vehicle weight</th>
<th>Drawbar pull</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,400 lbs.</td>
<td>8,500 lbs.</td>
<td>40 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basic length</th>
<th>Width</th>
<th>Ground clearance</th>
<th>Fuel capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>117 inches</td>
<td>70 inches</td>
<td>7-1/2 inches</td>
<td>85 gallons</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Front tire pressure</th>
<th>Rear tire pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 psig</td>
<td>60 psig</td>
</tr>
</tbody>
</table>

MSU-200NAV Air Start Unit

The MSU-200NAV air start unit (MSU) is designed to provide for aircraft main engine start (MES) and to supply onboard environmental control systems (ECS) with compressed air. The MSU delivers sufficient bleed air to start the main engines of all aircraft whose requirements are within the performance range of the unit. The MSU comes in two variations. In the land based version (Figure 2-4), the MSU is mounted on an MSU trailer, A/M32U-16A.

Figure 2-4 — MSU-200NAV air start unit.
When installed on the trailer, the unit’s display/control panel (DCP) is mounted on the enclosure, and the fuel for the MSU is supplied by a fuel cell mounted on the trailer. In the shipboard configuration (Figure 2-5), it is installed on a shipboard tow tractor (STT) using a special MSU L-frame assembly. The DCP is positioned at the tractor driver’s location and fuel is provided by the fuel tanks. The intake air required for the operation of the MSU is drawn in through the air intake grill on the left side of the enclosure (ship configuration) and forward part of the enclosure (shore-based configuration) and then drawn into compressor compartment. The intake air grill can be closed with the sliding door and a switch is installed on the door, which precludes operation of the MSU unless the sliding door is fully opened.

The MSU-200NAV is equipped with a sophisticated internal built-in test equipment (BITE) and full authority digital engine control (FADEC) system that checks all electrical sensors and valves for proper operation prior to starting the unit and supervises the operating data and its limits during startup and operation. Depending on the failure and the operating mode, the unit will be shut down and faults will be displayed in plain text on the DCP. A storage compartment for the pneumatic starter duct is located on both configurations of the MSU carrying platform. You must take extra special precautions as to where an air-start unit (ASU) is positioned during operation, especially aboard ship where aircraft are parked closely together. High-volume air pressure, extreme exhaust temperatures, jet intake suction, high noise levels, and unqualified operators are all potential hazards. Proper operation of the aircraft starting unit requires the operator to pay close attention to the aircraft director, the sound of the starter motor and engine compressor rotation, the engine rpm, oil pressure, and exhaust temperature throughout the start and acceleration cycle. For specific information on the operating procedures of the MSU-200NAV air start unit, you should refer to GTE (GTCP-100) Tractor Mounted Enclosure A/S47A-1, NAVAIR 19-105B-60.

A/S32A-45 Mid-Range Tow Tractor (MRTT)

The A/S32A-45 mid-range tow tractor (Figure 2-6) is a 4-cylinder, diesel-powered, 3-speed automatic transmission, liquid-cooled, rear-wheel-drive tractor designed for towing aircraft weighing up to 80,000 pounds. The frame is a welded-steel, one-piece unit, with Brierton dead steer front axle with power-assisted front steering and has a 50-degree turning angle. An adjustable driver’s seat is located on the left side of the vehicle, and a second seat is located on the right side for a passenger. Standard disc brakes are provided on the front wheels, and integrated hydraulic wet brakes are provided on the rear wheels. It employs a 12-volt, 800-cold-cranking-amp batteries consisting of spiral cell technology to supply power for the lights and accessories, horn, starter motor, ignition, and instrumentation. The mid-range tow tractor is geared to travel at a maximum speed of 15 mph forward and 7 mph in reverse with no towing load. Front- and rear-tow couplers (pintles) and tie-down attachment part are provided. Table 2-4 list the leading particulars.
Figure 2-6 — A/S32A-45 aircraft mid-range tow vehicle.

<table>
<thead>
<tr>
<th>Gross vehicle weight</th>
<th>13,000 lbs.</th>
<th>Drawbar pull</th>
<th>10,000 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle length</td>
<td>124 inches</td>
<td>Vehicle width</td>
<td>70 inches</td>
</tr>
<tr>
<td>Vehicle height</td>
<td>46 inches</td>
<td>Ground clearance</td>
<td>5 1/2 inches</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>13 miles per hour</td>
<td>Turning radius</td>
<td>200 inches</td>
</tr>
<tr>
<td>Fuel capacity</td>
<td>20 gallons</td>
<td>Tire pressure</td>
<td>60 psig</td>
</tr>
</tbody>
</table>

A/S32A-37 Aircraft Towing Tractor

This shore-based tractor (*Figures 2-7*) is used to move large, heavy shore-based aircraft. It comes in two different configurations, Class 1 and Class 2. There is no visible physical difference between the Class 1 and Class 2; the difference is that the Class 2 has a ballast kit installed. The Class 2 version is likely to be found at shore stations with poor weather conditions for aircraft towing. The tractor operates on a liquid cooled, six-cylinder, four-cycle diesel engine. The transmission is automatic, with six forward speeds and three reverse speeds. Additionally, the A/S32A-37 has four-wheel drive, power steering, and four-wheel power disc brakes. The electrical system is 24 volt dc (VDC). The engine’s normal idle speed is 800 rpm, and should have a minimum oil pressure of 10 psi at idle. The Class 1 version has a maximum drawbar pull of 20,000 lbs., and the Class 2 has a maximum drawbar pull of 35,000 lbs. Further information on this tow tractor can be found in *Aircraft Towing Tractor, A/S32A-37*, NAVAIR 19-40-519.

A/S32A-48 Large Land-Based Tow Tractor (LLTT)

The lower profile version of the A/S32A-37 tow tractor or “buddha,” (*Figure 2-8*), is currently used to move large Navy, Marine Corps, and Air Force aircraft weighing between 80,000 and 350,000 pounds. The new LLTT is modified to meet the Navy specification and will replace the fleet’s aging A/S32A-37 tow tractors.
Figure 2-7 — A/S32A-37 aircraft towing tractor.

Figure 2-8 — A/S32A-48 large land-based tow tractor (LLTT).
A/S37A-3 Shipboard Mobile Electric Power Plant (MEPP)

The A/S37A-3 shipboard MEPP (Figure 2-9) is designed to provide 115-volt alternating current (VAC), 3-phase, 400-Hertz (Hz) or 28 VDC electrical power for aircraft aboard ship. The MEPP is a four-wheeled, self-propelled vehicle powered by a three-cylinder diesel engine. The engine drives the electrical generator and hydraulic propulsion system. A 24-VDC vehicle electrical system provides starting, lighting, and instrumentation. The variable displacement axial piston pump provides hydraulic pressure to two gear pumps that drive the rear wheels. Power steering is provided to the front axle for ease of vehicle movement in congested areas on the flight deck and hangar bay. The ac and dc power cables are stored in a compartment near the driver. They deliver 115 VAC, 3-phase, 400-Hz, or 28-VDC electrical power to the aircraft. All controls, propulsion direction shifter, parking brake, and electrical power are located on right-hand side of operator’s seat. The MEPP is designed for air transport and is provided with tie-down rings and forklift channels. The MEPP has an emergency stop system that can be engaged manually by pressing the EMERGENCY STOP button, or occur automatically in certain emergency conditions. Automatic shutdown will occur if the engine exceeds 2400 rpm, if the oil pressure drops to 10 psi, or if engine temperature rises to 220 °F. Table 2-5 list the leading particulars of the MEPP. For further information refer to the Shipboard Mobile Electric Plant A/S37A-3, NAVAIR 19-45-26.

Table 2-5 — Leading Particulars of the A/S37A-3 Mobile Electric Power Plant

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross vehicle weight</td>
<td>5,060 lbs.</td>
</tr>
<tr>
<td>Turning radius</td>
<td>13 feet</td>
</tr>
<tr>
<td>Fuel capacity</td>
<td>18 gallons</td>
</tr>
<tr>
<td>Hyd. drive pressure</td>
<td>1500 psi (2400 max)</td>
</tr>
<tr>
<td>Vehicle length</td>
<td>102 inches</td>
</tr>
<tr>
<td>Vehicle width</td>
<td>58 inches</td>
</tr>
<tr>
<td>Vehicle height</td>
<td>45-1/2 inches</td>
</tr>
<tr>
<td>Ground clearance</td>
<td>7 inches</td>
</tr>
</tbody>
</table>

Towing Operation

All drivers who perform towing operations must be fully qualified. No attempt should be made to train a beginning driver during an actual towing operation, no matter how simple the procedure may seem. The training of drivers is an operation of its own. A training program must be used in order for the beginner to be instructed in the proper techniques. Close supervision must be exercised until the trainee is thoroughly competent. An area should be laid out where traffic can be controlled and where the aircraft being towed is not likely to strike anything. Figure 2-10 illustrates a towing evolution in progress. Speed limits with tow tractors must be a matter of common sense. Directives and instructions can give maximum speed limits; however, they cannot cover every situation that may be encountered. It is hard to imagine any situation that can justify exceeding the maximum speed limits.

Figure 2-9 — A/S37A-3 mobile electric power plant.
You should always maintain a reasonable speed when towing an aircraft. At night the speed of the tractor should be such that it can be stopped in the distance that the driver can see. For example, if the driver can see only 15 feet, and the tractor can only be stopped in 20 feet, the driver cannot avoid hitting anything that may come into his path.

Weather conditions, traffic congestion, and many other factors should be taken into consideration when determining safe speeds. Stopping distances, for instance, become greater on wet surfaces. As a general rule, the tractor can safely tow an aircraft that weighs ten times the tractor’s drawbar pull over level dry concrete. Weather conditions, deck conditions, and terrain can affect the weight that the tractor can safely tow. Tow tractors are not “wreckers.” They should not be used to push or pull any equipment other than that specified. You should check your local instructions and directives on this item and follow them closely.

Tractors should be operated in a gear that will allow the tractor engine to reach its full rpm. Any time the load on the tractor becomes such that the engine speed drops 10%, the transmission should be shifted to a lower gear. Lugging (that condition in which the engine is running at a low speed with the throttle fully open) should be avoided, as it can cause rapid wear or serious damage to the engine.

Tractors that are being used continuously or under heavy loads during hot weather are subject to overheating; in cold weather the reverse is encountered. Either condition can seriously affect the reliability of the engine. Operating temperatures for the engine are given in the technical manual for the tractor and should be closely followed.

The proper approach to an aircraft with the tow tractor must be a matter of sound judgment on the part of the driver and/or the aircraft director. Position additional safeties along the path of travel if there is going to be less than 5 feet of clearance from any obstacle.

⚠️ WARNING ⚠️

When attempting to hook the towbar to an aircraft with its engines running, you should be extremely careful. This practice should be avoided whenever possible.
The approach should be made so as to minimize the danger of hitting the aircraft. Tractor brakes have failed before. Never allow the tractor to pass under any part of the aircraft unless it is absolutely essential to the towing operation. When this is necessary, ensure that someone is stationed so that all clearances between the tractor and the aircraft can be observed. Be especially watchful for antennas, bomb racks, and so forth, as they always seem to be where least expected. When you are backing a tractor to hook onto a towbar already attached to an aircraft, stop the tractor a few feet ahead of the bar and ease the tractor backward to the correct position.

After the hookup is made and before any attempt is made to remove tiedowns or move the aircraft, the aircraft director must make sure the aircraft cockpit is manned by a qualified brake rider, who understands the operation to be performed. All tiedowns must be completely removed from the aircraft, and the chocks pulled before the tow is started.

Before any towing operation, make sure that the towbar is in the best condition and properly connected to both the tractor and the aircraft. Extreme care must be taken to avoid jackknifing the tractor into the towbar when backing a towed aircraft. Care must also be taken to avoid sharp turns while towing aircraft. A sharp turn may cause the towbar to strike the rear of the tractor, inflicting damage to the towbar and/or the tractor. Tractors are not to be parked with their engines running, nor are they to be used for workstands.

**Maintenance**

General inspections and preventive maintenance that pertain to practically all tow tractors are as follows:

1. Preoperational inspection
2. Periodic inspection
3. Detailed maintenance inspection

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*CAUTION*

Never allow a defective tractor to be used.

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Keeping your tractor ready for service requires that the inspection and preventive maintenance program be followed. Preventive maintenance is also a factor in accident prevention. With equipment, the failure of a single part may cause the loss of the entire assembly. Loss of that equipment may cause the loss of personnel, and may be the difference between the success and failure of an important mission. Good preventive maintenance keeps a piece of equipment safe and in working order for a long time. An enforced preventive maintenance program is the key to a successful operation. Preoperational checklist cards have been completed for major items of aircraft handling equipment such as tow tractors and spotting dollies. Maintaining and repairing support equipment is not a requirement of an ABH. That responsibility belongs to the AIMD or the activity having permanent custody of the equipment performs these tasks. However, to properly carry out your duties as a tractor driver, you must have some knowledge of the mechanical difficulties that may be encountered in its operation.

Never use the tractor in a towing operation until preoperational checks have been made and the noted discrepancies are corrected. These checks, using the applicable NAVAIR preoperational checklist, must be made before the first operation of the day and/or before each use. In conjunction with the daily preoperational inspection, there is equipment servicing that must be carried out on the tractor periodically. There are fittings to be lubricated, oil to be checked or changed, filter elements to be changed, and a number of other components to be cleaned. Servicing these systems is to be done at prescribed intervals depending on the number of operating hours the tractor has. These periodic service and inspection intervals are in terms of engine operating time. Operating time (hours of
operation) can be found in the operation, service, and repair instructions or the MRCs for the tractor concerned. The ABH supervising the equipment should ensure that the checks and servicing are accomplished by AIMD. Any unusual gage indications are warnings of possible trouble. The operator should become familiar with the average operating points of the various instruments and report immediately any radical deviation from the normal. Major difficulties encountered should be reported and corrected as soon as possible. Minor difficulties should be noted and corrected, when possible, to avoid the development of major repairs. Any difficulty that affects the safety of operation is a major difficulty.

Safety Precautions

The importance of safety cannot be overstated. Safety must be the first considerations of any job. Investigation after a mishap almost invariably shows that the mishap could have been prevented by exercising a few simple precautions, which should then be posted for future guidance. The process of exercising safety precautions before engaging in a job is known as Operational Risk Management (ORM). Safety precautions must always be observed. One of the major causes of mishaps is the lack of attention to the job being done. The safety precautions necessary for the safe operation of each piece of equipment should be studied and discussed at length with personnel concerned before any operation is attempted. The safety precautions are issued by individual commanding officers to suit particular needs of activities, ships, and operating schedules. All personnel concerned with tow tractor operation should be familiar with these instructions. Only qualified drivers should be allowed to operate a tow tractor. To be a qualified tractor driver, you must have satisfactorily completed the Personnel Qualification Standards (PQS) for tow tractors particular to your duty assignment (carrier or amphibious, flight deck or hangar deck). Remember, being licensed does not automatically mean being qualified. Basic Handling and Safety Manual, or refer to COMNAVAIRFORINST 4790.2(series).

The following precautions must be observed while aircraft are being towed:

1. Look in the intended direction of travel to be sure no personnel or obstructions are in the way. Sufficient clearances must exist on all sides of the tractor and load while both are moving as a unit.
2. Move slowly on wet or slippery surfaces and in congested areas.
3. Pull the load gradually and tow it at a steady rate, keeping in mind the type of surface being traveled.
4. Tow in a gear range and at a speed that minimizes sudden speed changes; for example, operate in a speed range that allows full acceleration of the engine and allows ample turning space.

The tow tractor should be used only for those jobs for which it was designed or has been authorized. It should not be used to push-start other tractors or vehicles. Passengers should be carried only on those tractors that have seats installed for this purpose. Tractors should not be used as a truck to haul parts or other equipment. The tractor must be operated so as to avoid any sudden stops or starts. Extreme care must be taken when towing an aircraft over rough ground and/or arresting gear pendants. Jerking, bumping, and bouncing can quickly disconnect the towbar from the aircraft or tractor, or cause damage to a strut.

WARNING

Hot exhaust from an aircraft-starting unit is a serious hazard when operating in close proximity to aircraft, aircraft components, fuel, weapons, equipment, and personnel.
When operating a tractor with an installed MSU-200NAV air start unit, you must observe additional safety precautions. The starting and operating procedures for the turbine are given on a plate fixed to the tractor instrument panel and must be followed. Before starting the unit, make sure that the area around the compressor inlet and exhaust outlet is clear of all loose gear. All personnel must stand clear of the compressor air inlet, the exhaust outlet, and the area adjacent to the plane of rotation of the high-speed compressor and turbine assembly. Personnel handling the flexible air ducts should wear gloves when connecting and disconnecting the duct to the aircraft and should stand well clear of the duct quick-disconnect fittings during starting operations.

This warning means that you must take extra precautions as to where an MSU-200NAV air start unit is positioned when the unit is started and operating. This is particularly true aboard ship, where aircraft are parked close together. You, as the operator, must know where the exhaust is pointed and make absolutely sure it is not directed at something the heat or velocity can damage, set on fire, or cause to explode. When an MSU is operating under load conditions, the danger zone is normally considered to be a 10-foot semicircle from its exhaust to 90 degrees on either side. For detailed information on positioning a tractor equipped with an enclosed MSU for aircraft starts, you should refer to the *Air Department Standard Operating Procedures, (SOP)* COMNAVAIRPAC/COMNAVAIRLANTINST, 3100.5(series).

**GSE LICENSING PROCEDURES**

The GSE operator training and licensing program has two distinct parts: Phase 1 and Phase 2. Phase 1 covers the GSE (ground support equipment), and Phase 2 covers the operation or use of the GSE on a specific type of aircraft. You will get your Phase 1 training from expert AS ratings at the GSE school run by AIMD. At Phase 1 training, the instructors will introduce you to and familiarize you with the gear and will cover daily pre/postoperational inspections, safety, and operating procedures on each specific type of equipment. The training will normally satisfy the requirements of the 100/200 operator series of the Personnel Qualification Standards (PQS) program.

Your own division or unit will handle your Phase 2 training. This will be practical on-the-job training (OJT) relating what you learned in GSE School with actual aircraft handling, servicing, or maintenance. Normally, this training will satisfy the 300/400 operator series of the PQS. While you are in Phase 2 training, you will be under the direct supervision of a fully qualified and licensed operator of the GSE you are using. Upon completion of Phase 2 training you are eligible for an *Aviation Support Equipment Operators License, U.S. Navy*, OPNAV Form 4790.102(series), commonly known as a Yellow License. This license is required to check out certain types of support equipment (SE) and/or to operate the SE. In the case of self-propelled GSE, a valid state driver's license is a prerequisite to the issuance of a GSE license. When you complete Phase 1 of the operator's course, a certificate of completion similar to the one in *Figure 2–11* will be issued to your unit. It certifies completion of Phase 1 training only and does not authorize you to operate any given piece of GSE. When you complete Phase 2 training in your unit, you will be issued your Yellow License, signed by the AIMD Officer. The certificate of completion shows that you have received training in the operation of towing equipment and that you have read and understand the operations section of the technical manual for the tractor you will operate. For more detailed information on licensing, you should read *U.S. Navy Support Equipment Common*, NAVAIR 00-80T-96.
## SE LICENSE CERTIFICATION

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First</th>
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<th>SSN</th>
<th>Activity</th>
<th>T/M/S Aircraft</th>
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<th>U.S. Government Motor Vehicle Operator's License</th>
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<tr>
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<td>License No.</td>
</tr>
<tr>
<td>☐ Yes ☐ No</td>
<td>Flight Line Training Date</td>
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### PHASE I SECTION

**Training Activity**

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<tr>
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<td>Flight Line Training Date</td>
<td>Weight Handling Equipment Physical</td>
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**SE DIVISION OFFICER**

DATE:

### PHASE II SECTION

☐ NEW (Parts A, B, C, D, and E required)
☐ RENEWAL (Parts C, D and E required)
☐ PROFICIENCY (Parts C and E required)

#### PART A. REQUIRED READING

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<thead>
<tr>
<th></th>
<th>Trainee Signature</th>
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<tr>
<td>A. COMNAVAIRFORINST 4790.2, Volume V, Chapter 17</td>
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<td></td>
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<tr>
<td>B. NAVAIR 00-80T-96, Chapter____, Page____</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. NAVAIR 00-80T-105 &quot;Aircraft Emergency Procedures&quot;, Chapter____, Page____</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td></td>
<td></td>
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<tr>
<td>E.</td>
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#### PART B. ON THE JOB TRAINING

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<th>Date</th>
<th>Instructor's Signature</th>
<th>Date</th>
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<tbody>
<tr>
<td>1. Discuss ramp/flight line/hangar deck procedures.</td>
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<tr>
<td>2. Discuss safety precautions.</td>
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<tr>
<td>3. Discuss emergency procedures (Fuel spill, A/C or SE fire, etc.).</td>
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<tr>
<td>4. Discuss personnel requirements and positioning.</td>
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<tr>
<td>5. Discuss hand signals and other communication devices.</td>
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<td>6. Perform and document pre-operational inspection.</td>
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<tr>
<td>7. Perform proper driving/towing procedures.</td>
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<tr>
<td>8. Properly position and hook up SE.</td>
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</tr>
<tr>
<td>9. Perform maintenance/servicing tasks with the SE.</td>
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</tbody>
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**Figure 2-11 — Aviation support equipment license certification (front and back).**

2-14
AIRCRAFT HANDLING EQUIPMENT
Aircraft Wheel Chock

The Navy uses several types of aircraft wheel chocks for providing aircraft security both at-sea and ashore. New materials have greatly improved the performance of the wheel chock. Although simple, the operation of walking chocks should never be taken lightly. Far too many injuries and even fatalities have occurred during this operation. Attention to detail, direction, and procedures are essential ingredients for a safe and successful aircraft move.

**WARNING**

The proper position to walk chocks is abreast the main wheel, with the adjustable block towards the aft end of the aircraft. At no time will the chock walker place themselves in the direction of aircraft travel, either forward or aft of the main mount. The chock is walked on the opposite side of the brake/strut assembly. It must be installed on the side opposite the brake/strut assembly to avoid becoming jammed under the aircraft during fueling or in case of a flat tire.

NWC- 4 Universal Wheel Chock

The NWC-4 universal wheel chock (*Figure 2-12*) is approved for shipboard use for all aircraft (except H-1 series; the NWC-4A is the wheel chock designed to be used with this series aircraft). It is made out of polyurethane and must be cleaned and visually inspected at least monthly. The effectiveness of a wheel chock will be greatly reduced if dirt, grease, and oil are allowed to build up on its surface. When you inspect the wheel chock, look for excessive wear, frayed cable, and missing components. Never use a defective wheel chock, and report all discrepancies to AIMD. The molded tread increases traction and also displaces liquids on the deck by a squeegee-type action. The polyurethane end blocks are sufficiently rigid to prevent crushing, but will still deform enough to permit the aircraft tire loads to be readily transferred through the end block to the flight deck. The polyurethane end blocks not only provide vastly superior traction, but they require no painting, will not corrode, are self-extinguishing in fire, and are environmentally and chemically resistant to deterioration. This chock uses polyurethane extensively in a redesigned rack (bar running between the end blocks) and a latching mechanism that has far fewer parts. These features should further minimize the need for repairs and greatly improve reliability. The NWC-4 chock is adjustable to fit main landing gear wheels up to approximately 45 inches in diameter. To aid easy removal, the chock should be inserted with the adjustable block toward the after end of the aircraft. Wheel chocks approved for shore base use are also manufactured from polyurethane and in some instances, wooden chocks can be authorized. Metal chocks are not authorized for use ashore. Since land-based aircraft may be much larger than
shipboard aircraft, the wheel chocks for shore stations are found in three different sizes. These chocks are available in the following sizes: 1) to chock tires up to 33 inches in diameter; 2) to chock tires over 33 inches in diameter; 3) to chock dual wheels. For further information on wheel chocks, refer to the Aircraft Securing and Handling Procedures for Aircraft Restraint Devices and Related Components, NAVAIR 17-1-537.

**TD-1B Aircraft Tiedown Chain Assembly**

The TD-1B quick-release aircraft tiedown chain assembly (*Figure 2-13*) has been used almost exclusively aboard ship and ashore for nearly 10 years. This chain has two bumps or nodes formed by "staking" one end of each link. These nodes will not permit half of the link to be inserted in the chain pocket of the tensioner assembly. The TD-1B tiedowns contains better materials and heat treatment of tensioner assembly components for increased strength and reduced wear. A piece of heavy wall tubing and a bolt and nut is in place decreases any chance of failure, and eliminates any potential foreign object damage (FOD) hazard. A clamp secures the end of the chain to the tensioner assembly. The Naval Air Warfare Center is also experimenting with several ways to add reflective markings to the tiedown and thus improve its visibility at night. Part numbers 1540AS100-1 (9-foot version) and 1540AS100-2 (14-foot version) identify each version. You can adjust the length of the TD-1B from 1 foot 6 inches to 9 feet 10 inches. The TD-1B weighs about 12 pounds and has a safe working load of 10,000 pounds. Another version, used only on amphibious ships, has a 14-foot chain for high-point tiedowns. Otherwise, the two are identical.

**High-Power Tiedown Assembly**

There is another authorized tiedown you may be required to use called the Aero Full-Power Tiedown Assembly (*Figure 2-14*). It is commonly called the A/B tiedown (for afterburner). It has a deck attachment fitting, a safety lock retainer, a chain, and a coupler that fits the aircraft catapult holdback fitting. This assembly is not used for normal securing of aircraft. It is used as
an added safety measure, which is installed when an aircraft must perform a full-power turn-up while secured to the deck for maintenance purposes. The tiedown assembly has a working load of 30,000 pounds. It weighs about 102 pounds and has no adjustments to lengthen or shorten it. Joining two tiedowns together with a dummy link can modify the chain if required. A newer version of the A/B tiedown, called an aircraft restraint, has a different deck attachment fitting. Otherwise, the two are identical. Special high-strength deck fittings are installed aboard ships and at shore stations in designated engine run-up areas. Specific A/B tiedown instructions for each type of aircraft are contained in the maintenance information manual (MIM).

You should have a good working knowledge of both nylon and manila line, as they are frequently used in securing of gear and equipment aboard ships. Handling of line and the rule of thumb for safe working loads are covered in detail in Chapter 1 of this training manual. Further information concerning aircraft tiedown assemblies is located in Aircraft Securing and Handling Procedures for Aircraft Restraint Devices and Related Components, NAVAIR 17-1-537.

Aircraft Towbars

The ALBAR Universal Aircraft Towbar, (*Figure 2-15*), is the type most commonly used by the Navy today. It is designed to provide for the nose tow of aircraft and has four different sizes of nosewheel axle tow pins. The ALBAR is also designed for towing aircraft provided with fuselage and landing gear tow rings. The locking pins on the end of the tubes are also used to attach to the standard shipboard crash dollies to provide positive control while moving damaged aircraft supported with crash dollies. The term *ALBAR* is a word form for "Adjustable Length Towbar." ALBARs are presently designed in four lengths. They are the model 8 ALBAR (9 feet long), the 15 ALBAR (15 feet long), the 20 ALBAR (20 feet long), and the 24 ALBAR (25 feet long). These towbars are designated universal since one type of towbar can be used on all carrier-based aircraft.

When the CH-53E helicopter was being introduced into the fleet, the Naval Air and Engineering Center (NAVAIRENGCEN) was requested to design a lightweight, easily maintained, 20-foot-long towbar. Through use of simple bolt-on leg extensions to the existing towbars, the requirements for the CH-53E were met, and a simple design concept for adjusting the length of the towbar for other applications was born. The result is a towbar design called the ALBAR. The 8 ALBAR is designed for shipboard movement and spotting of H-46 helicopters on LHAs, LHDs, and LPDs. The 15 ALBAR is the standard towbar for moving most land-based and shipboard based aircraft weighing up to 90,000 pounds. Its configuration is virtually identical to the existing model ALBAR towbar, but it can be easily expanded to make the 20 and 24 ALBARs. The 20 ALBAR was designed to handle the CH-53E helicopter when it is equipped with an in-flight refueling probe, the AV-8B, and the F/A-18 ashore. Because of the lower height of the shipboard A/S32A-31A tow tractors, the F/A-18 can be safely towed aboard CVNs with the 15 ALBAR. The 24 ALBAR was expressly designed to handle the SH-60B helicopter. This extra length is needed to reach into the tailwheel for towing this aircraft. The ALBAR concept offers many advantages, including that spare parts, except leg extensions, are identical. The 20 and 24 ALBARs can be broken down for shipment in a standard 15-foot towbar container. Bent towbar tubes on the 20 and 24 ALBAR (caused by "jack-knifing" the tractor) can be easily repaired with replacement extensions, or the damaged extension can be removed, leaving a usable 15 ALBAR.

The ALBARs also possess other design improvements. These include:

- A grease fitting in the movable leg pivot to facilitate lubrication. The tighter tolerances improve the fit of spare parts and there are tightened specifications for welding and painting.
- Improved fasteners for better service life (they remove easily and reduce corrosion)
- Instead of the old riveted-on I.D. tag (which was easily lost or caused corrosion), the towbar is now impression-stamped with the needed identification data
Most carrier aircraft have provision for towing from the nosewheel axle. Since these aircraft have been provided with four different sizes of holes, ranging from a 3/4-inch diameter to a 2 1/2-inch diameter, the tow pins have been sized to suit. Before attaching the towbar to the aircraft nosewheel, you must select the proper size pin. A close-up of the method of installing axle tow pins in the towbar is shown in Figure 2-15. The axle tow pin has been metal-stamped on the appropriate axle tow pin diameter as shown. The detent pins is employed in a like manner for this installation. Before installing the detent pins, you may have to rotate the axle pins to align the holes through the axle pins with the holes in the aircraft attachment fittings. With these holes aligned, install the detent pins by pushing them all the way down against the attachment fittings. Spread towbar tubes to fit the aircraft to be towed (see Figure 2-15). Lift the towbar and insert the axle tow pins into the towing holes on the aircraft. Slide chain through sleeve to take up the slack after turning knob until chain barrel protrudes as far as possible from towbar tube. Be sure that the axle pins are in the holes on the aircraft as far as they can go. Engage the nearest link of chain in the slot in the sleeve, rotating the chain if necessary. Stow fid in one of the grommet holes in the towbar tube so that the chain does not drag on the ground. Turn the knob so that the barrel retracts into the towbar tube and causes tension to build up in the chain. Information on the towbar(s) for any given aircraft can be found in the general information section of the MIM for that aircraft. There is one modification made to the ALBAR towbar for towing H-1 series helicopters. The modification simply reverses the right and left tube ends, which contain the aircraft attachment fittings, so the hooks fit the helicopter skid pins. Maximum towing weight for the ALBAR 20 is 20,000 pounds, so the usual stencil on the ALBAR towbar, "MAX CAPACITY 90,000 LBS AIRCRAFT GROSS WT" is deleted on the ALBAR and replaced by the stencil "ALBAR TOW BAR CONFIGURED FOR TOWING OF H-1 SERIES HELICOPTERS ONLY." For technical information on the ALBAR, you should refer to Technical Manual Operation and Intermediate Maintenance Instructions with Illustrated Parts Breakdown, Towbar, Aircraft, NAVAIR 19-1-137, Model ALBAR and Model ALBAR/ALBAR. For detailed information on support equipment, you should refer to the U.S. Navy Support Equipment Common Basic Handling and Safety Manual, NAVAIR 00-80T-96. Table 2-7 list the specific ALBAR used for each shorebase and shipboard aircraft.

Figure 2-15 — Parts of the ALBAR.
### Table 2-7 — Leadings Particulars for the ALBAR

<table>
<thead>
<tr>
<th>Model Number</th>
<th>8 ALBAR</th>
<th>15 ALBAR</th>
<th>20 ALBAR</th>
<th>24 ALBAR</th>
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<tbody>
<tr>
<td>Part Number</td>
<td>1479AS100-1</td>
<td>1479AS200-1</td>
<td>1479AS300-1</td>
<td>1479AS400-1</td>
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<tr>
<td>Length</td>
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</tr>
<tr>
<td>Width</td>
<td>14 inches</td>
<td>14 inches</td>
<td>14 inches</td>
<td>14 inches</td>
</tr>
<tr>
<td>Height</td>
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<td>10 inches</td>
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<tr>
<td>Weight</td>
<td>128 lbs.</td>
<td>170 lbs.</td>
<td>218 lbs.</td>
<td>255 lbs.</td>
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#### AIRCRAFT

<table>
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<td>MV-22</td>
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<td>See Note 5</td>
<td>See Note 5</td>
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**NOTES:**

1. Exchange aircraft attachment fittings, P/N 1479AS103-1 & 2, to mate hooks to helicopter skid rings. See paragraph 19, page 8, (WP-00300) NAVAIR 19-1-137
2. For shipboard use when not equipped with in-flight refueling (IFR) probe
3. For land based use when not equipped with the IFR probe
4. For shipboard / land based use when equipped with the IFR probe
5. Aircraft outfitted with the fixed IFR probe require that a 20/24 foot ALBAR be used for spotting evolutions on the flight deck
AIRCRAFT ELEVATORS

All aircraft carriers and large deck amphibious assault ships are equipped with aircraft deck edge elevators. The operating principles are basically the same for all elevators, although the size and capacity may vary.

Operation of the aircraft deck edge elevator is done under the cognizance of the aircraft handling officer. The flight deck and hangar deck officers are responsible for ensuring that all elevator operators and safeties are trained and qualified.

For detail information on qualification and certification of elevator operators must be documented as prescribed in the aircraft elevator PQS; the *Air Department Standard Operating Procedures (SOP)*, COMNAVAIRPAC/ COMNAVAIRLANTINST, 3100.5(series); the *CVN NATOPS Manual*, NAVAIR 00-80T-120; or the *LHA/LHD NATOPS Manual*, NAVAIR 00-80T-106, as appropriate.

Operation of the elevators is a joint responsibility of the V-1 (flight deck), V-3 (hangar deck), and A division (machinery room). V-1 and V-3 divisions may also have some maintenance requirements associated with upkeep of the elevator locks and safety stanchions. Overall maintenance and operational upkeep of the elevator machinery rooms and systems are responsibilities of A division.

The elevator platform is a welded structure of either steel or aluminum. The platform serves as a foundation for the guide rollers, the face rollers, and the safety shoes. Guide rails are securely bolted to the ship's structure, one located on the aft side and one on the forward side of the elevator platform, and serve as guides for the guide and face roller travel. There are two sets of double guide rollers and one face roller on the forward and aft sides of the platform.

When not in use, the elevator platform is locked at the flight deck level by horizontal locking bars, which slide into housings supported by the ship's structure, engaging the platform. These locking bars are independently operated by a double-acting air engine for normal operations.

On most ships, a manually operated gear system is also provided for each locking bar, in the event of a loss of air pressure. Each locking bar system includes a safety interlock. It prevents the locking bar from being extended when the platform is not at the flight deck level, or from being withdrawn when there is insufficient pressure in the hydraulic engine cylinder to force the platform against the flight deck stops.

For the protection of personnel, power operated safety stanchions are provided for each main deck and flight deck elevator opening. There are two sets at each flight deck opening and one set at each hangar deck opening. Each flight deck set can be raised automatically when the elevator's DOWN push button is pressed. The hangar deck set can be raised automatically when the elevator's UP push button is pressed. Although elevator stanchions can be raised or lowered automatically when the elevator's DOWN or UP button is pushed, this is never done, because of safety considerations.

Stanchion controls are always set on the manual and NOT the automatic mode. Stanchions should not be operated in the automatic mode.

After aircraft elevator safety stanchions have been raised or the warning given, no person is to attempt to board or leave the elevator.

All stanchions are lowered automatically by action of hydraulic engine-mounted limit switches. Hand crank operation for emergency lowering of each set of stanchions is also provided on some ships at
the power unit. A limit switch is provided on the magnetic brake housing to de-energize the motor when the hand crank is inserted.

The platform is connected to the hydraulic engine by a series of cables. These cables are shackled to a cable hitch on each side of the platform. They then pass over the overhead sheaves to the end sheaves and around the plunger sheaves to the dead end hitch on the engine. A broken or slack cable switch assembly is designed so that the slacking or breaking of an individual hoist cable stops the elevator operation.

The platform is equipped with serrated safety shoes for wedging the platform between the guide rails to bring the platform to rest with a minimum amount of damage should the hoist cables break on either side of the platform.

With all pumps in use and the elevator loaded to capacity, the duty cycle is about 60 seconds. This includes 15 seconds at the top and 15 seconds at the bottom stations for loading and unloading. When the elevator is operating on the cycle specified, should there be a loss of electric power at any point in the cycle, the residual capacity of the pressure tanks is sufficient to permit returning the loaded platform to the flight deck. It should also be possible to raise the loaded elevator at any time within 30 minutes of loss of power, in spite of normal system leakage. There are two control stations for each of the deck edge elevators. One control station is located on the hangar deck and one in the gallery walkway on the flight deck.

The control station is bolted to the hangar deck where the operator has an unobstructed view of the deck edge elevator opening on that deck. This station contains a master switch; horn button; horn cutout switch; power available light (white); control energized light (green); on certain ships, a hand wheel for manual operation; and a gearbox assembly.

The ABH at the gallery walkway station has semiautomatic control over the operation of the elevator platform. The control station consists of the following:

1. A three-unit, watertight, pushbutton station for elevator platform control
2. A single-unit, watertight, pushbutton station for horn operation
3. Two three-unit, watertight, pushbutton stations for flight deck automatic stanchion operation
4. An automatic stanchion watertight selector switch
5. A signal light selector switch
6. A watertight signal enclosure
7. A locking gear air operating valve
8. A bypass valve
9. A manual locking gear lever

For satisfactory aircraft elevator performance, operating personnel must carry out the instructions posted on instruction plates mounted at the hangar deck station and gallery walkway station. Sound-powered phones interconnect the stations. When putting the elevator into operation or during an emergency, the personnel at the gallery walkway and hangar deck control stations must wait for instructions from the machinery room before performing any operation.

The normal operating instructions for personnel at the hangar deck station are as follows:

1. Check with the machinery room to determine that the system is ready
2. Check the power available light; it should be illuminated
3. Turn the horn switch to ON
4. When all is clear within the elevator platform area and upon signal from the yellow shirt, turn the master switch to ON. This switch must be held in the ON position.

5. Release the master switch at the end of the operation, or if an emergency arises, during the operation.

**NOTE**

The elevator machinery room must notify all stations immediately of an electric power failure or any other emergency. Communication from the machinery room to each station is relayed via an emergency call phone.

Should electric power fail when the platform is not locked at the flight deck, perform the following operations immediately:

1. Raise the platform to the flight deck. (During the emergency, keep in close contact with the elevator machinery room.) If the emergency is caused by failure of the high-pressure system, the platform is raised to the flight deck by the sump pumps.

2. Lock the platform at the flight deck until the power is restored. When the platform is locked at the flight deck, notify the machinery room.

The normal operating instructions for personnel at the gallery walkway station are as follows:

1. Check to make sure the white and green signal lights are on.

2. Withdraw the platform locks.

3. Sound the horn before operating the elevator.

4. Lock the platform at flight deck level only at the end of service or in case of power failure.

5. Use the STOP button to stop the elevator in emergencies. When the elevator is stopped within the slowdown zone, it is necessary to run the elevator out of the zone with the hand control before proceeding. Ensure that the removable coaming (if installed) is in the UP position.

All aircraft elevators have a safety net configuration to provide safety for the crews. These nets are located on the outboard side of the elevator platform. These nets are storable type nets; the V-1 and V-3 divisions are responsible for raising and lowering them. The elevator nets are lowered for the following purposes, though not limited to them:

1. To jettison aircraft.

2. To accommodate conveyor belts in port.

**Doors**

**Deck Edge Elevator Doors**

The deck edge elevator doors are designed to close the hangar deck opening to the aircraft elevators. The doors provide a barrier which protects the hangar deck areas from exposure to the weather, fire and smoke, and weapons effects. The doors are also designed to be light-tight, permitting lights to be on in the hangar bay during darken ship conditions. Deck edge elevator doors are installed on CVN, LHA, and LHD class ships. Deck edge elevator doors are designed to open or close in 60 seconds. Hangar division doors are designed to open or close in 20 seconds.

**Hangar Division Doors**

Hangar division doors are designed to divide the hangar bay into two or three sections to provide fire containment. Hangar division doors are installed on all aircraft carriers. Doors are normally operated.
from local control stations in the hangar bay just forward or aft of the door, but can also be operated remotely from one or more of the hangar bay conflagration stations. A typical control station consists of either a lever-operated or push-button master switch that spring-returns to the OFF position and operates as "dead man" type controls for opening and closing the door. Additional push-button controls for emergency run and emergency stop and indicating lights are also provided. The power reel assemblies reel in and feed out the electric power supply cables to each door panel during door movement. This prevents the cables from being damaged during door operation. Each type of door can be operated in electric mode and also in emergency mode. Both types of operating procedures can be found in the equipment-level technical manuals and on label plates mounted at door control stations. For detailed technical information, refer to Naval Ships' Technical Manual (NSTM) chapter 588, Naval Sea Systems Command (NAVSEA), S9086-T3-STM-010, entitled “Aircraft Elevators”.

SLIP-RESISTANT DECK COVERING (NONSKID)

Slip-resistant (nonskid) deck coverings are high performance textured organic materials that are applied to primed steel, or aluminum aboard ship to provide safe footing for personnel and a slip resistant surface for vehicles and aircraft. With the exception of the carrier landing area, which has the special requirement that the slip resistant deck covering not abrade or otherwise damage the steel arresting cables, nonskid coverings are functionally the same. Surface preparation and application procedures of nonskid compounds most routinely used by the ABH are discussed in following paragraph.

**NOTE**

Prior to using nonskid compound, you should consult the appropriate directives and the Naval Ships' Technical Manual (NSTM) chapter 634, Naval Sea Systems Command (NAVSEA), S9086-VG-STM-010, entitled "Deck Coverings". This is the governing publications concerning nonskid.

Nonskid Slip-Resistant Systems

The slip resistant systems covered include:

1. General-purpose exterior (includes the carrier flight and hangar deck, except for the landing and cable run-out areas)
2. Carrier landing area (contains an aggregate that is nonabrasive to the arresting cable); helicopter landing pads

General Purpose Use of Nonskid

A general purpose, abrasive type nonskid coating is normally satisfactory for most shipboard applications. The abrasive type nonskid coating uses a coarse aggregate of silicon carbide, furnace slag, or aluminum oxide to provide the nonskid texture. The nonabrasive type nonskid coating used on the carrier landing area uses an aggregate, typically aluminum metal that is nonabrasive to the steel arresting cable. The special nonabrasive characteristic is not required for helicopter landing pads. Nonskid materials in the federal supply system have a shelf life of 1-year (shelf life code F). Only materials that are less than 1 year old, as determined from the date of manufacture, should be used. The coatings are supplied as a two component kit, and the two components must be thoroughly mixed and blended to produce the coating. The two components are carefully matched to each other during manufacture, and should only be used only with each other. Components from different kits (manufacturers) are NOT interchangeable. Nonskid deck coatings are critical materials for aircraft safety and must meet the requirements set in MIL-PRF-24667.
Either improper application or a poorly prepared surface causes most nonskid coating failures; either will lead to premature failure. *Table 2-7* outlines the recommended environmental conditions for the nonskid process. Application over a hot or cold surface will dramatically affect the cure time and workability of the nonskid material. When it is applied on a hot surface, the cure time will be significantly decreased; on a cold surface the cure time will be significantly increased. Ideally, the nonskid system should be applied over a white, or near white, abrasive blasted surface that is free from oil, grease, or other contaminants. It should be applied on a day when the relative humidity limits are not exceeded and the air temperature is within the designated range. Adhesion of nonskid materials, just as for other coatings, is dependent upon the degree of surface preparation and the environmental conditions under which they are applied.

Nonskid coatings have an abrasive or a nonabrasive coating applied over the proprietary primer specific to the particular application. The primer not only improves the adhesion of the nonskid coating but also prevents rapid failure or undermining of the nonskid topcoat should it become cut, pierced, or otherwise damaged.

Before removing old nonskid, precautions must be taken to protect all deck penetrations and equipment (for example, deck drains, wash down nozzles, tiedown cups, catapult tracks, zipper tracks) from contamination by dirt, grit, and nonskid material. Drop cloths and masking should be used to prevent damage from the abrasive material. Deck openings must be covered with strips of sponge rubber, adhesive plates/circles, or similar material. The covering should extend at least one-half inch past the opening onto the deck. *Table 2-9* illustrates the nonskid material application spread rates.

<table>
<thead>
<tr>
<th>Environmental Condition</th>
<th>Minimum (min)</th>
<th>Maximum (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term storage temperature</td>
<td>55 °F</td>
<td>100 °F</td>
</tr>
<tr>
<td>24 hours prior to mixing (nonskid/primer/color topping)</td>
<td>70 °F</td>
<td>80 °F</td>
</tr>
<tr>
<td>Ambient air temperature</td>
<td>55 °F</td>
<td>100 °F</td>
</tr>
<tr>
<td>Deck temperature</td>
<td>55 °F</td>
<td>100 °F</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>N/A</td>
<td>85%</td>
</tr>
<tr>
<td>Wind</td>
<td>N/A</td>
<td>15mph</td>
</tr>
<tr>
<td>Dew point</td>
<td>The deck temperature must be 5 °F (min) above the dew point temperature</td>
<td></td>
</tr>
</tbody>
</table>

*MIL-PRF-24667* addresses nonskid materials for application to weather decks, flight decks, hangar decks, and other areas requiring nonskid. The coatings can be applied to steel, aluminum decks by spraying, rolling, or troweling. *Table 2-8* is a list of nonskid applications in accordance with *Naval Ship's Technical Manual (NSTM)*, chapter 634.
Nonskid products qualifying to this specification are of the following types:

- Type I: High durability, rollable deck coating
- Type II: Standard durability, rollable or troweled deck coating
- Type III: Standard durability, rollable resilient deck coating for use on exterior wooden decks, GRP, or metal decks where flexibility is required and where increased weight is not a factor
- Type IV: Standard durability, sprayable deck coating
- Type VI: High durability, fast cure, rollable deck coating
- Type VII: Fast cure, temporary repair, rollable deck coating
- Type VIII: Low-temperature cure, rollable deck coating
- Type IX: High-temperature resistance deck coating
- Type X: Submerged applications

These ten types of nonskid systems are subcategorized into two different compositions: Composition G and Composition L.

Composition G is for general use and has an abrasive coating. This composition is available in each system type: I, II, III, and IV.

Composition L is a limited use, non-abrasive coating, used on CVN landing areas. Service life limits for each nonskid system are shown in Table 2-10.

<table>
<thead>
<tr>
<th>Area</th>
<th>Service Life</th>
<th>MIL-PRF-24667 Type &amp; Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVN flight deck landing areas</td>
<td>up to 15,000 landings</td>
<td>MIL-PRF-24667, TYPE V, COMP L</td>
</tr>
<tr>
<td>CVN flight deck landing areas</td>
<td>up to 10,000 landings</td>
<td>MIL-PRF-24667, TYPE I, VI, or VIII COMP L</td>
</tr>
<tr>
<td>Hangar decks, flight decks &amp; vertical replenishment deck areas</td>
<td>up to 3 years</td>
<td>MIL-PRF-24667 TYPE V,COMP G or L</td>
</tr>
<tr>
<td>Hangar decks, flight decks &amp; vertical replenishment deck areas</td>
<td>up to 12 months</td>
<td>MIL-PRF-24667 TYPE I, VI, or VIII, COMP G or L</td>
</tr>
<tr>
<td>Hangar decks, flight decks &amp; vertical replenishment deck areas</td>
<td>up to 6 months</td>
<td>MIL-PRF-24667 TYPE II, COMP G</td>
</tr>
<tr>
<td>Hangar decks, flight decks, vertical replenishment deck &amp; areas and CVN flight deck landing areas, walk areas and all other deck areas</td>
<td>up to 30 days</td>
<td>MIL-PRF-24667, TYPE VII COMP G or L</td>
</tr>
<tr>
<td>Walk areas (all deck areas other than hangar decks, flight decks &amp; vertical replenishment deck areas)</td>
<td></td>
<td>MIL-PRF-24667, TYPE I, V, VI, or VIII, COMP G or L or MIL-PRF-24667, TYPE II, III, IV, COMP G or L MIL-PRF-24667, TYPE XI, COMP PS</td>
</tr>
</tbody>
</table>
### Table 2-9 — Nonskid Material Application Spread Rates

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum [ft2 /gal.]</th>
<th>Maximum [ft2 /gal.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>I, V, VI, VII, and VIII (rolled)</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>II, III, IX and X (rolled)</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>II, III, IX and X (trowelled)</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>IV and IX (sprayed)</td>
<td>N/A</td>
<td>60</td>
</tr>
</tbody>
</table>

### Table 2-10 — Minimum Service Life

<table>
<thead>
<tr>
<th>Type</th>
<th>Composition G (Time)</th>
<th>Composition L (Landings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>12 months</td>
<td>10,000</td>
</tr>
<tr>
<td>II</td>
<td>6 months</td>
<td>5,000</td>
</tr>
<tr>
<td>III</td>
<td>6 months</td>
<td>N/A</td>
</tr>
<tr>
<td>IV</td>
<td>6 months</td>
<td>N/A</td>
</tr>
<tr>
<td>V</td>
<td>3 years</td>
<td>15,000</td>
</tr>
<tr>
<td>VI</td>
<td>12 months</td>
<td>10,000</td>
</tr>
<tr>
<td>VII</td>
<td>30 days</td>
<td>1,600</td>
</tr>
<tr>
<td>VIII</td>
<td>12 months</td>
<td>10,000</td>
</tr>
<tr>
<td>IX</td>
<td>12 months</td>
<td>10,000</td>
</tr>
<tr>
<td>X</td>
<td>12 months</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### DECK PREPARATION FOR NONSKID COATING ON METAL DECKS

Many cases of nonskid coating failures have been the result of improper surface preparation or application. The degree of adhesion of a nonskid coating is directly proportional to the degree of surface preparation and cleaning. Reduction in the degree of surface preparation is usually accompanied by a proportionate reduction in performance. Various degrees of surface preparation specifically relating to gradations in performance have not been established nor can they be assessed with any degree of confidence. Also, there are other factors such as cost, time, abrasive equipment availability, grit disposal, and dust and machinery contamination, which must be considered. Therefore, every effort should be made to achieve or approach the optimum surface within the constraints encountered in each situation. Ideally, the nonskid coating system should be applied over a metal surface that is free of corrosion products and other contaminants, degreased, and coated with a NAVSEA-approved metal primer.

#### Surface Preparation Procedures

##### Abrasive Blast

A abrasive blast cleaning encompasses direct-pressure blast (open blast), and closed loop, vacuum-blast cleaning. The open blast process poses difficulties in containing the blast medium (aluminum oxide, garnet, etc.) and requires significantly longer cleanup times compared with the use of a vacuum system. An open blast process requires environmental containment and a full protective suit with a fresh air source must be worn because of all the debris in the air. When vacuum blasting is
performed only safety glasses, safety shoes, ear protection, and a dust mask, as specified by the safety officer, needs to be worn. Steel shot centrifugal-wheel vacuum-blast cleaning rapidly removes existing nonskid, but blast media that escapes causes extensive cleanup requirements. Since poor surface preparation is the cause of most coating failures, the procedures outlined herein shall be followed. All abrasively blasted steel surfaces shall be prepared to a near-white finish, or better. Extreme care shall be taken to ensure that all blast media is removed from the surface before painting, and that no blast media is caught in joints, cracks near hangar doors, or wedged in crevices. A 3.0 to 4.5 mil anchor tooth profile shall be obtained for surfaces abrasively blasted. The depth of the profile is dependent upon the size of the blast medium and the speed of the blasting equipment.

**Water-Jetting**

Water-jetting relies on the energy of fresh water striking a surface to remove the existing coating. This technique eliminates dust pollution and disposal requirements for spent abrasives. High pressure (HP) water-jetting operates at pressures between 10,000 to 30,000 psi and ultra-high pressure (UHP) operates at pressures above 30,000 psi. The primary advantages of water-jetting include no dust pollution, significantly less waste to dispose of, elimination of foreign object damage hazard (steel shot not used), and less disruption of other ship work in the vicinity of the nonskid work. The water-jet facility shall comply with all local, state, and federal regulations regarding the proper storage, use, collection, and disposal of all abrasive materials and wastewater. Compliance with these requirements is the responsibility of the water-jet facility. Water-jetting is the preferred method of surface preparation because it tremendously decreases a FOD hazard, compared to abrasive blasting. Water-jet surfaces will retain the surface profile of prior surface treatments. In areas where the substrate may have been smoothed, abrasive blasting shall be required to achieve the required 3.0 to 4.5 mil anchor tooth profile.

**Power Tool Cleaning**

Power tool cleaning is used only for areas that cannot be satisfactorily prepared with other surface preparation techniques (e.g., abrasive blasting or UHP water jetting). However, power tool cleaning, *(Table 2-11)* is an acceptable surface preparation method for peel and stick nonskid installations. Areas that the centrifugal blast or water-jet equipment cannot access (deck coaming, deck edges), or surface preparation for the application of peel and stick nonskid, shall be prepared by power tool cleaning to a surface cleanliness of SSPC-SP 11. The following power tools may be used: Descobrade, power rotary brush, scaling hammers, needle scalers, sanders, and grinders. When using power tools, a minimum profile of 2 mils is required for areas where nonskid is to be applied. All other areas require a minimum profile of 1 mil.

**Small Area Nonskid Repair**

Damage to the nonskid coating, which exposes either primer or metal substrate and is repairable by ship's force, must be repaired as follows:

1. Determine the failed area by scraping or hammering loose chips or sheets of nonskid from the deck
2. Use power tool cleaning procedures, as described earlier in this RTM to remove damaged nonskid and extended repair area 6 to 10 inches in undamaged nonskid area
3. Remove all loose debris by vacuum cleaning, and immediately follow with a solvent degreaser to clean the surface
4. Tiedowns are of particular interest in small area repair since the coating is lost very quickly due to constant use, and the exposed steel is left to rust. Power tools may be used for removing the old coating in accessible areas; however, the bars that cover the dish area, especially their underside, should be wire-brushed and primed.
Table 2-11 — Power Tools for Small Areas

<table>
<thead>
<tr>
<th>Tool</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumatically driven tools (hammers/rotary hammers)</td>
<td>Dislodge stubbornly adherent materials.</td>
</tr>
<tr>
<td>Scalers (chisels, needle guns)</td>
<td>Remove all mill scale, rust, weld slag, and paint. Effective in crevices, pits, and grooves.</td>
</tr>
<tr>
<td>Rotary impact tools (Descobraders, deck crawlers)</td>
<td>The flap wheel (roto-peon) fractures and removes coatings and mill scale. Also, the substrate is peened, giving a 1 mil minimum profile.</td>
</tr>
<tr>
<td>Wire brushes</td>
<td>Remove paint, loose mill scale, and weld slag. Polish the surface (will need additional tools to profile the surface).</td>
</tr>
<tr>
<td>Grinders or sanders equipped with coated abrasive</td>
<td>Remove paint, loose mill scale, and rust. Remove substrate.</td>
</tr>
</tbody>
</table>

Surface Priming

An anticorrosive primer is normally required over metal surfaces beneath the nonskid topcoat. Primer not only improves the adhesion of the nonskid topcoat, but also enhances the total performance of the nonskid system. Primer should be stored between 70 °F and 80 °F for 24 hours prior to mixing. Before mixing any components together, be sure the components are from the same manufacturer. Never mix the components of epoxy primer from different manufacturers.

1. The primer should be mixed per the manufacturer instructions to achieve a dry film thickness (DFT) between 2 to 4 mils. The surface to be primed should be clean and dry, and abrasive-blasted to a white or near white finish. The primer should be applied as soon as practical (within 1 hour) after the metal is cleaned, to lessen the possibility of surface corrosion and contamination. Some primers may require an induction time (stand time), to allow the mixed components to remain in the pail, chemically reacting to each other, before application. Thinning primer is prohibited

2. Primer can be applied by either rolling or spraying. If the primer is sprayed, be sure to consult the manufacturer’s American Society for Testing and Materials (ASTM) F-718 sheets for spray data. The sheets will have information on the required pressure, hose sizes, and nozzle sizes. When applying the primer by rolling, make sure that only rollers outfitted with a nap range between 3/4" and 1" are used. Hard-to-reach areas can be brushed

3. Throughout the application process, wet film thickness (WFT) readings are to be taken to ensure that the desired DFT primer coverage is obtained. Refer to NSTM CH. 634-3.35.5 to learn more about the tools used for determining the WFT

4. Be sure to frequently inspect the area being primed for complete primer coverage. Bare spots (holidays) will allow corrosion to set in and risk degrading the process

5. The cure time of primer will generally range between 6 and 12 hours depending on the weather. If the primer was applied during cool weather, the cure time will be longer. If the weather was warm, then the cure time will be shorter. In either case, the primer should be allowed to cure until it is tack free. ASTM D-1640 contains the procedures for determining when the primer coating is tack free.
6. To ensure correct primer coverage, the DFT readings must be taken once the primer has cured. The magnetic dial gauge (banana gauge), the single fixed probe magnetic gauge (PosiTector 2000 or 3000), and the dual fixed probe magnetic gauge (Elcometer) are all tools used for determining DFT. **NSTM CH. 634-3.35.6** can be referred to for more information concerning these gauges and the procedures for taking DFT. For maximum performance between the primer coat and the nonskid, the nonskid should be applied within 36 hours from the application of the primer coat. It is extremely important for the primed surface to be inspected for traces of any contaminants, such as moisture, oil, grease, etc. Make certain that the surface is wiped down with lint free rags and an approved solvent cleaner. The timetable guidelines for nonskid application are as follows in Table 2-12.

<table>
<thead>
<tr>
<th>Time Elapsed Between Coatings</th>
<th>Surface Preparation Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 36 hours</td>
<td>Inspect for contaminants; clean/dry as needed</td>
</tr>
<tr>
<td>Between 36-72 hours</td>
<td>Inspect for contaminants; clean/dry as needed</td>
</tr>
<tr>
<td>Between 3-7 days</td>
<td>Wipe surface with lint free rags and solvent; lightly sand surface; repeat wipedown; apply a primer tack coat (1-2 mils)</td>
</tr>
<tr>
<td>More than 7 days</td>
<td>Reblast area to a near white surface; reprime</td>
</tr>
</tbody>
</table>

**Nonskid Coating**

After the primer has cured, the nonskid is applied. The nonskid should normally be applied within 36 hours for optimum adhesion. Be sure to follow the manufacturer's instructions for pre-mixing storage temperatures, mixing times, and procedures. Environmental conditions must be closely monitored and documented, and examples of the documentation sheets can be found in **COMNAV AIRLANT/AIRPACINST Air Department Standard Operating Procedures (SOP) 3100.4C, Enclosure (3)**.

1. Nonskid is usually applied by the roller method. Trowel application is also authorized, but guidance from the Type Commander (TYCOM) must be obtained to determine the location and direction of the troweling. While some nonskid types may be applied by spraying, spraying of nonskid is not authorized on any flight deck. The roller should be a long handled, smooth surfaced hard-phenolic core roller (9") unless otherwise designated by the nonskid manufacturer.

2. Proper application of nonskid is extremely important to the ABH. Flight decks and hangar bays are the largest areas on any ship, so ABH must be alert and watchful during the curing phase of a nonskid job. The targeted surface profile of properly cured nonskid should be between 1/32" (minimum) to 1/16" (maximum). Some standard precautions you should be aware of to help better the chance of obtaining a good nonskid job are as follows:
   a. Do not apply nonskid coating over color toppings
   b. Do not thin nonskid mixtures
   c. Do not apply nonskid over already existing nonskid. (A small overlap to create a seam is acceptable)
   d. Do not apply nonskid within approximately 5" of the deck edge or deck edge coaming or within 2" of padeye deck fittings and deck protrusions.
   e. Cover or protect padeye deck fittings and deck protrusions, catapult and zipper tracks, deck drains, and flush deck nozzles prior to applying nonskid.

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3. The quality of the ridge formation of fresh nonskid will depend on the curing process. During this curing phase, it is very important for the ABH to keep the area roped off with signs and watches posted. Your ship's announcing system should also be used to announce frequent reminders to keep clear of the new nonskid. The ambient temperature plays an important role on the curing process. The cooler the temperature, the slower the cure and vice-versa. The following timeline represents typical traffic allowed in relation to the curing process:
   a. Nonskid usually cures sufficiently for foot traffic 24 hours after application
   b. Nonskid can normally be exposed to vehicular traffic after minimum of 96 hours following application
   c. Nonskid should normally be fully cured and acceptable for flight operations after 7 days following application

For the specific guidelines and detailed procedures for nonskid removal, deck preparation, priming equipment to be used, and new nonskid application and quality assurance checkpoints, you should refer to Naval Ships Technical Manual (NSTM), Chapter 634, S9086-VG-STM-010, “Deck Coverings.”

**Nonskid Safety Precautions**

Each of the compounds in the discussion of slip resistant deck coverings contains volatile solvents. These solvents are flammable so adequate safety precautions must be observed during application.

1. Some individuals are more sensitive than others to the materials and may develop a skin rash. To prevent this possibility, gloves should be worn. If materials are spilled on the hands or other parts of the body, they should be wiped off and the skin washed with soap and water. In case of accidental contact with the eyes, flush the eyes immediately with clear water and contact a physician. Clothing and gloves contaminated with the uncured resins should not be worn again until they have been thoroughly cleaned. To prevent hazards due to solvent entrapment, adequate exhaust ventilation is necessary where these materials are used in closed spaces. When the proper precautions are taken to ensure cleanliness, ventilation, and protective clothing, no difficulty should be encountered during the use or handling of epoxy resins, hardeners, or solvents

2. Where optimum slip resistance and heavy wear resistance is required, such as on carrier and helicopter flight decks, the nonskid materials should be applied by roller or trowel

3. The following safety and health precautions apply in general to epoxy and polyurethane coatings. You should refer to the product's Material Safety Data Sheet (MSDS) for specific requirements and precautions
   - Spray painters shall wear protective garments that fit snugly at their ankles, necks, and wrists. They shall wear gloves and approved filter type respirators while spraying, mixing dry colors, or using other finishing materials that create flammable vapors.
   - Personnel mixing these coatings should wear solvent resistant synthetic rubber gloves and an apron. Sleeves should be kept rolled down. National Institute for Occupational Safety and Health (NIOSH) approved respiratory protection is required when air sampling data indicates solvent concentrations in excess of the threshold limit values, or when it is reasonable to assume that solvent vapor concentrations cannot be controlled by ventilation and are expected to exceed the threshold limit value for the solvent involved.
   - Solvents are flammable and toxic. They should be used only in well-ventilated areas. They should not be used near any source of flame or sparks such as a welding operation or disc sander usage. Prolonged contact with the skin must be avoided.
VISUAL LANDING AIDS (VLA)

On board aircraft carriers (CVN) and amphibious aviation ships (LHA/LHD/ACS), V-1 division is responsible for the general upkeep of the flight deck. This includes the painting of specific markings on the flight deck and reporting lighting problems. Similarly, V-3 division is responsible for those markings located within the hangar bay.

Flight Deck Markings

Visual landing aids on the flight deck are not only used by the pilots of aircraft approaching the ship for a landing, but also by the ABH's as a quick reference for locating equipment, and identifying areas for safety concerns. For instance, wheel-stop coamings are marked with a 12" wide, color-coded stripe that goes up and over the wheel stop. These stripes are placed to correspond with locations of carbon dioxide (CO2) fire bottles, Purple-K-Powder (PKP) fire bottles, and aqueous film-forming foam (AFFF) hose reel stations, just to list a few. On those areas of the flight deck where there is no wheel-stop coaming to correspond with equipment location, the VLA is placed right on to the deck or on the bulkhead of the island structure.

Hangar Deck Markings

While flight deck markings offer a source of information to pilots, landing signalman enlisted (LSEs), and ABHs, the markings located in the hangar bay provide important information and safety warning to a large population of shipboard personnel. Once the ship deploys, the hangar deck turns into a crowded work center filled with aircraft. Bulkhead VLA markings are placed 14' up from the deck to direct personnel to Battle Dressing Stations (BDS), first aid boxes, eye wash stations, fire stations, aircraft power outlets, as well as a host of other items. The ships frame number markings are placed on both the starboard and port bulkheads, at 10 frame intervals, for easy location identification in an emergency. The Naval Air Warfare Center Visual Landing Aids General Service Bulletin, No. 8(series), is the bulletin that establishes standard certification requirements and inspection procedures for the markings (called VLA systems) for aircraft carriers (CVNs). For information on amphibious ships refer to Amphibious Assault Ship Aviation Facilities Bulletin No. 1(series). NAEC-ENG-7576(series) is also an excellent source of information. Figure 2-16 is a print of the standard flight deck markings on CVN aircraft carrier. (For further information on LHD, LHA, and ACS flight decks refer to Figures 2-17, 2-18, and 2-19).

Flight Deck Lighting

Other VLA components include lights, transformer relay boxes, control panels, and other devices used in the visual guidance of landing aircraft. You should always make sure you have the correct VLA bulletin for your ship.
Figure 2-16 — CVN class ship flight deck markings.
Figure 2-17 — LHA-1 class ship flight deck markings.
Figure 2-18 — LHD-1 class ship flight deck markings.
NOTES:

1. MARKING OF HULL NUMBERS WITHIN A LANDING AREA, VERTREP/HOVER AREA OR COMBINATION LANDING-VERTREP/HOVER AREA IS OPTIONAL.

2. LOCATION OF HULL NUMBERS SHALL BE AS SHOWN IN THIS FIGURE.

3. ON SINGLE HELICOPTER OPERATING AREAS THE SIZE AND SPACING OF NUMBERS SHALL BE AS SHOWN IN DETAILS A AND B. DETAIL A IS INTENDED FOR SHIPS WITH SMALL HELICOPTER AREAS, SUCH AS DESTROYERS.

4. ON MULTIPLE HELICOPTER OPERATING AREAS (LPD TYPE SHIPS) THE SIZE AND SPACING OF NUMBERS SHALL BE AS SHOWN IN DETAIL C.

5. HULL NUMBERS MUST NOT TOUCH OR INTERSECT LINE-UP LINES OR TOUCH-DOWN CIRCLE.

6. NUMBERS MAY BE APPLIED WITH WHITE NON-SKID COMPOUND OR WHITE COLOR TOPPING.

7. NUMBER “8” SHALL BE A CLOSED “3”, NUMBER “9” SHALL BE A INVERTED “6”.

Figure 2-19 — Multiple helicopter operating area marking (LPD type).
End of Chapter Questions Chapter 2
Aircraft Handling Equipment, Nonskid, and Markings

Review Questions

2-1. The A/S32A-30A is primarily designed for towing__________.
   A. aircraft
   B. aircraft parts
   C. power plants
   D. ground support equipment

2-2. What is the secondary mission of the A/S32A-30A?
   A. Tow aircrafts parts
   B. Tow large aircraft
   C. Tow power plants
   D. Tow small aircraft

2-3. The A/S 32A-32 towing tractor (SD-2 spotting dolly) is controlled by the use of a _________.
   A. joystick
   B. remote control
   C. radio transmission
   D. steering wheel

2-4. What is the maximum towing capacity of the A/S32A-30A (support equipment & aircraft towing tractor)?
   A. 40,000 lbs.
   B. 50,000 lbs.
   C. 60,000 lbs.
   D. 70,000 lbs.

2-5. The overall height of the AS 32A-32 towing tractor (SD-2 spotting dolly) is ____________.
   A. 20 inches
   B. 30 inches
   C. 40 inches
   D. 50 inches

2-6. What is the drawbar pull of the AS 32A-32 towing tractor?
   A. 11,000 lbs.
   B. 12,000 lbs.
   C. 13,000 lbs.
   D. 14,000 lbs.
2-7. How many phases are there in the ground support licensing program?
   A. 1  
   B. 2  
   C. 3  
   D. 4

2-8. Who will handle the phase two portion of the ground support licensing program?
   A. AIMD expert  
   B. AIMD Officer  
   C. Division  
   D. Safety

2-9. Phase two of the ground support licensing program covers ________.
   A. on-the-job training  
   B. postoperation  
   C. pre-operation  
   D. safety

2-10. What type of material is the NWC-4 universal wheel chock made from?
   A. Aluminum  
   B. Plastic  
   C. Polyurethane  
   D. Wood

2-11. What is the difference between the regular TD-1B and the type used on amphibious assault ships?
   A. Capacity  
   B. Length  
   C. Material  
   D. Parts

2-12. For specific information concerning the high power tiedown assembly for each type of aircraft, you would refer to the ________.
   A. NAVAIR 00-80T-96  
   B. NAVAIR 17-1-537  
   C. NAVAIR 19-1-137  
   D. MIM

2-13. When utilizing the NWC-4 universal wheel chock, where should the adjustable end of the chock be placed on the aircraft wheel?
   A. Aft  
   B. Forward  
   C. Forward main mount  
   D. Outrigger
2-14. The TB-1B can be tightened by use of the_______.

A. chain pocket  
B. nodes  
C. tensioner assembly  
D. wall tube

2-15. The 24 ALBAR is designed specifically for what aircraft?

A. AV-8B  
B. CH-53  
C. SH-60  
D. MV-22

2-16. When the aircraft elevator is loaded to capacity, with all pumps in use, what is the total duty cycle time?

A. 50 seconds  
B. 60 seconds  
C. 70 seconds  
D. 80 seconds

2-17. The horizontal locking bars of the aircraft elevator are powered _______.

A. electronically  
B. hydraulically  
C. manually  
D. pneumatically

2-18. Aircraft elevator safety stanchions should not be operated in_________.

A. automatic mode  
B. emergency mode  
C. manual mode  
D. safe mode

2-19. V-1 division is responsible for what part of the aircraft elevator operation?

A. Hangar deck  
B. Flight deck  
C. Machinery room  
D. Pump room

2-20. V-3 division is responsible for what part of the aircraft elevator operation?

A. Hangar deck  
B. Flight deck  
C. Machinery room  
D. Pump room
2-21. A division is responsible for what part of the aircraft elevator operation?
   A. Hangar deck  
   B. Flight deck  
   C. Machinery room  
   D. Pump room

2-22. There are how many different compositions of nonskid?
   A. 2  
   B. 3  
   C. 4  
   D. 5

2-23. Nonskid coatings kits are supplied in how many components?
   A. 1  
   B. 2  
   C. 3  
   D. 4

2-24. The shelf life of nonskid is______.
   A. 1 year  
   B. 2 years  
   C. 3 years  
   D. 4 years

2-25. What is the most preferred method of nonskid removal?
   A. Abrasive-blasting  
   B. Power tools  
   C. Shot-blasting  
   D. Water-jetting

2-26. In order to ensure the correct primer coverage, the DFT reading must be taken when the primer has___________.
   A. cured  
   B. dried  
   C. reached ambient air temperature  
   D. reached ambient deck temperature

2-27. When completing the primer application process, what will allow corrosion to set in and degrade the process?
   A. Deck temperature  
   B. Holiday  
   C. Humidity  
   D. WFT
2-28. VLA markings on the hangar deck are placed______ from the deck.

A. 12 feet
B. 13 feet
C. 14 feet
D. 15 feet

2-29. The ships frame number markings are placed on both the starboard and port bulkheads at frame intervals of______.

A. 5
B. 10
C. 15
D. 20

2-30. For what class ship does the Naval Air Warfare Center Visual Landing Aids General Service Bulletin, No. 8 establish standard certification requirements and inspections?

A. ACS
B. CVN
C. LHD
D. LPD
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