CHAPTER 10

MAINTAIN, REPAIR, ADJUST, TEST, OVERHAUL

If all the subjects listed in the title of this chapter were discussed only in this chapter, it would comprise about ninety percent of the book. The programs in each of these phases are the topics of this chapter. The administration of the programs is covered in the succeeding chapter.

The preceding course, which you have completed, defined preventive and corrective maintenance and maintenance levels - organizational maintenance (on shipboard), intermediate maintenance (tender), and depot or yard maintenance. Organizational maintenance includes operational and technical maintenance.

Operational maintenance consists of on-the-job inspection, cleaning, servicing, lubrication, adjustment, and preservation of components and assemblies. It also includes the replacement of minor parts when this does not require special skills, or necessitate alignment or adjustment as a result of the replacement.

Technical maintenance is limited normally to replacing unserviceable parts, assemblies, and subassemblies, followed by aligning, testing, and adjusting the equipment.

Tender/yard or depot maintenance involves major overhaul or complete rebuilding of the principal subassemblies, assemblies, or the total equipment.

In performing any type of maintenance, a GMM must use knowledge and skills of two types: First, he must have specific information relating to the particular equipment he is to maintain or repair. Second, he must possess and use certain general skills and knowledge which apply to many kinds of equipment.

The specific information required consists of detailed step-by-step procedures approved for a specific piece of equipment. This information is almost always found in classified publications prepared by the Naval Ordnance Systems Command or by a vendor of the equipment under contract to NAVORDSYSCOM.

You have acquired the general maintenance skills and information in progressing to your present rate. The procedures generally follow the practical factors which you must complete as part of your qualifications for advancement in rating. Procedures in soldering, use of basic handtools, performance of basic electrical measurements with devices such as voltmeters, ammeters, and ohmmeters, are examples of some of the general skills in maintenance.

Now that you are preparing for GMM 1 or GMM C, you must be prepared to teach the basic skills to lower rated men and at the same time, increase your knowledge and skill so you can take care of advanced work on the weapons system. You need to learn more about the over-all and continuing plan of maintenance and the administration of the plan.

The technical duties include the maintenance of specialized test equipment as well as the assembly, adjustment, maintenance, and testing of missile launching components. The manuals written for each missile system and for each series of test equipments provide the equipment details and the approved procedures for .repair and maintenance.

NAVORDSYSCOM PROGRAM FOR MAINTENANCE OF WEAPON SYSTEMS

Planned maintenance for a ship's weapon system has progressed from the division level to a Navy wide Planned Maintenance System

(PMS). The PM system includes all components of a ship's weapon system and provides a scheduled maintenance program which detail all necessary tests, cleaning, inspection, and lubrication of specific types of ordnance equipment for a specific type of ship. The procedures for a maintenance program for a GMLS are performed at the departmental organizational level and area part of a PMS for a Surface Missile System (SMS). The PMS/SMS concept involves Daily System Operability Tests (DSOT) and supple-mental system tests and maintenance procedures. The system tests determine the overall operability of a system whereas scheduled maintenance is performed on individual equipments of a system to detect possible trouble areas and to maintain a high degree of readiness. General guidelines for implementing PMS are contained in OPNAV 43P2, Maintenance and Material Management (3M) Manual.

Daily System Operability Tests (DSOTs) are used to give the weapons system a quick run-through each day. If any part does not function as it should, corrective maintenance is applied. The schedules of routine maintenance established for each equipment are performed on the days assigned to each according to the plan. By conscientious performance of scheduled maintenance, minor difficulties can be discovered and corrected before they become serious. No comparative figures are available at present, but it is anticipated that the 3-M system will reduce the number of breakdowns and the amount of downtime for missile systems.

The 3-M system does for the entire weapons system what earlier systems of maintenance did for components of weapons and for weapons. *Military Requirements for PO 1 & C*, NAVTRA 10057 contains a chapter that discusses the 3-M system from the standpoint of the responsibility of a PO 1 and C, that is, the managerial aspects of 3-M.

RESPONSIBILITIES OF GMM IN THE MAINTENANCE PLAN

A study of the quals on maintenance shows that the GMM 1 must be able to "overhaul, repair, and adjust, . . . , test and adjust, . . , , perform authorized maintenance,. . . , record system performance," while the GMM C must be able to "Plan, implement, and supervise the maintenance and repair program." Two exceptions to this division of responsibility are concerned with the indicator and receiver-regulator equipment in the power drive system. In those systems, it is the chief who must test, adjust, overhaul, and repair. Note that nearly all the "Knowledge Factors" are on the GMM 3 and 2 level, with the exception of principles of receiver-regulators, functions of fire control systems and equipment, and administrative and supply procedures.

The GMM 1 is expected to have knowledge of basic layout geometry for drawings and sketches, to be able to prepare freehand sketches, and to read and interpret diagrams and service instructions. The preceding course explained in some detail the use of different types of ordnance drawings in your work. Drawings of electrical, electronic, mechanical, and hydraulic systems are included. No additional requirements are stated for the GMM C he needs to be able to teach the use of drawings and sketches and their interpretation.

The decision whether to repair or replace a component often has to be made by you. This requires a knowledge of the equipment that is both detailed and broad in scope. Knowledge of the supplies or replacements available is indispensable. Before discarding any part, be sure there is a replacement aboard.

The success of any planned maintenance program depends to a very large extent on cooperation at the working level. Help your men to understand how their day-by-day work of lubrication, cleaning, and similar routine upkeep helps to prevent costly and time-consuming breakdowns and the consequent hard repair work.

The work of the PO 1 and C in administering the 3-M system of maintenance and the Maintenance Data Collection System (MDCS) are described in Military Requirements for PO 1 and C, NAVTRA 10057. Planning the daily work of maintenance by his men (and himself) to carryout the ship's plan is the responsibility of the GMM 1 and C.

STEPS IN MAINTENANCE PROCEDURE

Maintenance procedures include visual inspection, tests, lubrication, equipment operation,

performance tests, and cleaning parts. Preventive maintenance involves four major types of activity:

1. Periodic cleaning
2. Periodic lubrication
3. Periodic inspection
4. Periodic performance checks

Corrective maintenance is generally performed in three phases: (1) troubleshooting, (2) removal and replacement of parts, and (3) alignment and adjustment. There may be overlapping between corrective and preventive maintenance; there is no sharp dividing line.

VISUAL INSPECTION

All components, including explosives, receive frequent visual inspection. Although it is of limited value in detecting some types of weapons system troubles, it is the first method used in trying to find the source of trouble or potential trouble. Do not let it become a casual inspection. Normal ship vibration will cause screws and lugs to work loose; a good visual inspection will locate loosened ones. Loose terminal lugs and screws are a common source of trouble. Loose mounting bolts can be the cause of misalignment.

Cables should be inspected for looseness or damage at places where they enter equipment or at any other point in the cable run. Cables showing signs of damage or abuse should be either rerouted or protected. Particular attention should be given to the coaxial cable, which is easily damaged by dents or sharp bends.

Look for signs of overheating and faulty insulation. When these signs appear, the equipment may be blackened around the area of over-heating. Check the condition of tubes and tube sockets. Sometimes the shock of gunfire loosens tubes in the sockets. The light bulbs on control panels may be loosened by vibration.

Inspect junction boxes and other unit covers to see that they are properly dogged down. Tighten all retaining bolts and dogs evenly and firmly, alternating between diametrically opposite bolts or dogs.

Visual inspection discovers leaks in hydraulic systems, dents and similar damage in pipes, tanks, and other components. The efficient operation of any hydraulic system depends to a great extent on the effectiveness of the seals in keeping air and dirt out of the system and keeping the fluid in it. Fluid leakage can be discovered by visual inspection, though the accumulation of leaked fluid may be some distance from the leak and you have to trace it to its source. Do not "sell short" this simplest of troubleshooting methods; it can save much time and testing in locating troubles with your equipment.

CLEANING OF PARTS

One of the most important rules of preventive maintenance is "Keep it clean," and you have been reminded of this many times in your Navy career. Many of the equipments are highly machined and have close tolerances. Dirt, dust, or other foreign substances can cause the equipment to operate erratically. Grit can cause excessive wear of parts of a mechanism and can make it inaccurate. Moisture can cause corrosion, and this can cause inaccuracies in operation. Excessive grease or the wrong kind can hamper operation.

Scheduling of routine cleaning is part of your responsibility. In the 3-M as in previous systems of maintenance, the intervals of cleaning are based on normal conditions. If you have a situation other than normal, such as an extreme amount of dust, more frequent cleaning may be necessary. Prepare your daily and weekly schedules in accordance with the 3-M system and modify it to take care of any special situations on your ship. As each job is completed, check it off.

As supervisor and instructor of the men doing the cleaning of equipment, be sure that all safety precautions are observed. With any kind of solvent cleaner, ventilation is necessary to carry away fumes. Heat, fire, and sparks must be kept away from solvent cleaners. The Navy has tested many types of cleaners to find the best in effectiveness AND safety. Use the ones recommended in the OP for the equipment. Use the cleaners as sparingly as possible. Aside from cost savings, there are several reasons for this. Fumes will be less, reducing the health hazard; danger of fire is lessened; the solvent will not run into parts

where it can do damage, as in electrical parts and skin exposure is lessened, reducing the hazard of dermatitis. Because cleaners are used so frequently, the tendency to become careless with them needs to be held in check. The occurrence of a fatality from solvent fumes has heightened the stress on the need for ventilation when using solvents. Close the container of solvent when it is not in use, even though you must open it again in a few minutes. It is very easy for a container to be knocked over (as in the case of the fatality mentioned); besides, evaporation is continuous while the cover is off. A small amount of solvent on a clean, lintless cloth is the best way for cleaning small or delicate parts. Federal Specification P-D-680 Type I or O-T-634, Type II are the solvents most commonly used on mechanical parts to remove oil and grease (and dust, etc. embedded in it). Alcohol is used for cleaning cork and rubber parts. Always check the OP for the right type of cleaner to be used. OD 3000 describes the different types of solvents and cleaning compounds.

Arrange the layout of work so you have adequate working space, good lighting, and good ventilation. Planning the layout and the work sequence will do much to expedite the work, making it easier, and reducing mistakes and hazards.

LUBRICATION

You know the importance of lubrication in the maintenance of all equipment. You are acquainted with lubrication charts and have used them in your maintenance work. As a GMM 1 and C you will prepare checkoff schedules from lubrication charts, OPs, on-mount instructions, or other sources, and supervise the work of lubrication. The types of lubricants and types of lubricating tools were discussed in the preceding course of this series, and in OD 3000.

The parts of the launching system especially subject to corrosion are those that are entirely above deck and constantly exposed to sea spray and water. Maintain the paint on all painted surfaces and a protective coating of lubrication on unpainted surfaces. Flush, clean, and relubricate any bearing surfaces that have been flooded with salt water. Be sure to use the correct lubricant for the part being lubricated and for the weather conditions. Some cold weather lubricants must be used very sparingly to avoid "freezing" of parts. The lubrication charts, which have a NAVORD drawing number, show all points requiring lubrication, give access locations, designate the required lubricants, and tell you how often to lubricate at each point.

Caution against over lubrication is especially important where electrical components are concerned. Oil and grease must be kept off insulation of cables, and other electrical parts. They cause switches and solenoids to malfunction, and will ruin motor armatures.

An excess of lubricant in gear housings can be a source of trouble. When the oil heats up during operation of the unit, it expands, and it may seep out and into parts where it will cause damage. Always check the oil level during maintenance, and do not add oil above the indicated oil level.

Other cautions in regard to lubrication are concerned with cleanliness. If there is dirt, lint, or gummy substance at the area to be lubricated, clean the area before adding fresh lubricant. When grease-lubricated bearings or bearing surfaces are disassembled, all the old grease must be removed and the bearings and housing washed with solvent before fresh grease is applied. The lubricating tool (grease gun, grease pump, oiler, etc.) also must be clean. Wipe it clean before using it and also wipe the point of application on the unit being lubricated. Before opening an enclosed unit, especially one that is gasketted to keep out dust and moisture, wipe the outside of the container. Do the work in a clean area, and place clean parts on a clean cloth or paper. Just a few grains of grit in a delicate instrument can be ruinous.

Maybe you already are observing all these cautions; see that the cautions are observed by the men who are helping you and are learning from you.

Several grease guns should be available for use by your group so each one can be used for a different type of grease. If you have only one grease gun, you have to clean it thoroughly every time you have to use a different type of grease. Do not mix different types of lubricants. To reach some parts for lubrication, such as all parts of the training circle of the launcher, the train drive pinion, and elevation drive pinion,

the launcher must be moved from its stowed position. Take great care to avoid injury to personnel. The air motor is used to move the launcher and the trunnion tube. NEVER use automatic movement to train or elevate the launcher during servicing, or to move the trunnion tube. Be sure to return the trunnion tube and launcher to stow position, using the air motor, after completing the maintenance work.

Hydraulic systems need checking of fluid level at different points in the system. On some components, such as the ASROC adapter buffer used with the Terrier launching system, the fluid level may be noted through a viewing indicator. Hoist the adapter to the loader rail to inspect. If the level is too high, loosen the plug at the bottom of the reservoir and drain enough fluid to bring it down to the required level. A dip-stick inserted through the fill port is used to check the hydraulic fluid level in sumps. The fluid level in the train buffer should be maintained at the height of the filler plug. Oil level plugs mark the filling level on train and elevation gear boxes and hydraulic brakes. ALL hydraulic fluid MUST be strained into the hydraulic system through a 10 micron filter, even though it is being poured from a freshly opened can. Call upon your experience to impress on your men that the need for such care is not mere fussiness. You know the trouble just a little dirt in the hydraulic system can cause.

TESTS

It is hardly an exaggeration to say that at any given moment, some part of a weapons system is undergoing test. The processes of maintenance, testing, repairing, and operational checkout are continuous. The formal planned maintenance programs, from the Satterwhite system, then PRISM and IMP, and now the 3-M system, all were established to prevent forgetting some components in the maintenance and test programs. Other ratings perform some of the tests, on the missile itself, on the fire control system, and the weapons direction equipment. The ship's maintenance plan for the weapons system includes all of them. When you plan the assignments of your work week, you must coordinate the jobs with those in other units of the weapons system, and avoid interference in the performance of the work. The FTs test the missile and you and your men test the launching system. On some missiles you will prepare the battery for installation. On any missile system, you and your men will move the missile into position where the FTs can conduct the tests on it. Cooperation in planning and performance are essential for successful testing of a system. An understanding of the relationship among the parts of the system and the place of each in the whole is needed for intelligent cooperation. The types of tests and frequency of tests are subject to change. The analysis of results with the 3-M system will reveal need for greater frequency of some tests and less testing in other cases. Always check the latest MRC.

Daily Tests

Some tests and maintenance work must be performed every day. We'll use the Tartar system as an example. Daily preventive maintenance and a daily operational checkout are required for the Tartar system. A more comprehensive weekly operational checkout, plus monthly preventive maintenance, and prefiring and post-firing checkouts are required. Each day, in addition to the inspection for leaks, etc., checking of pressure, cleaning, and lubrication, certain tests must be made. Daily operation of the launching system perfects the training of the crew and also keeps the lubricants distributed on all bearing surfaces. A Tartar training missile is used. A safety watch is posted topside near the launcher and the EP-2 control panel is manned. The system is cycled three or four times in Step control and then in Automatic. The EXERCISE switch on the EP-l panel is set so the missiles do not receive actual warmup; the system then acts as if the missiles were on warmup.

The launcher captain stationed at the EP-1 control panel watches the cycling of the launching system. If any part does not perform in the cycle, it is rechecked in Step control. The action may be too slow, or it may not take place at all. Then a careful check must be made to locate the cause of the trouble. You may need to get the wiring diagrams.

Part of the daily testing is testing the firing circuits. Four tests are involved: (1) normal firing and misfire; (2) normal firing resulting in a

dud; (3) firing of a dud; and (4) emergency firing. During practice operation, tests 1 and 2 are performed daily; tests 3 and 4 are performed periodically.

The Tartar training missile is hoisted onto the launcher. Be sure the EXERCISE switch is set on the EP-1 panel during the entire checking of the firing circuits. The checking is done in cooperation with Weapons Control. Each man should have a checklist that tells him the things to do (buttons to push) at his station, and indicating lights to observe for each step.

Weekly Tests

A weekly schedule for testing, checking, servicing, and lubricating launcher components is listed on maintenance index page for a designated GMLS and contains a list of all Maintenance Requirements Cards (MRCs) applicable to the system. Each MRC contains step-by-step instructions for performing the weekly task and, where applicable, shows a lubrication chart for the component scheduled for maintenance. A lubrication chart shows the points requiring lubrication, the frequency of lubrication, and the type of lubrication. If the recommended lubricant is not available, a tested substitute with the same characteristics may be used. Substitute oils and lubricants are listed in OD 3000. Local environmental conditions may require the use of special lubricants such as cold-weather lubricant. Always cycle the equipment after lubrication. This distributes the lubricant and forces out any excess. Clean up any excess, and clean up your grease guns and other applicators after use, before you stow them.

HYDRAULIC CHECKS. - Checking hydraulic fluid levels can be a daily or weekly maintenance requirement. Fluid levels may be checked by a sight gage or a dip stick. Most header tanks have some type of sight gage for quick easy fluid checking where main supply tanks contain a dipstick mechanism. In most GMLS a main supply tank contains an oil fill and drain valve while most header tanks contain only a fill valve or fill cap.

CHECKING ACCUMULATOR PRESSURE. - In most missile jettison systems air and/or nitrogen pressures are checked daily. In other accumulator assemblies weekly checking is the rule. The correct pressure of each nitrogen accumulator system varies with the ambient temperature, A table of temperature-pressure requirements may be mounted near a nitrogen accumulator charging assembly. This table lists the required nitrogen pressure for a given temperature recorded on a centigrade thermometer attached to the nitrogen charging valve block assembly. If a table is not attached to the charging assembly, a temperature pressure tabulation chart will be included on the MRC for the system being maintained. If a launching system has been in operation prior to a maintenance requirement, wait about 2 hours before checking an accumulator system. The waiting period should allow the system to cool so that thermometer gage readings represent normal ambient temperatures.

Checking Fire Protection Systems

All missile magazines have either a salt water or a oil operated hydraulic sprinkling system actuated by an automatic (thermo-pneumatic) control system. Sprinkling systems are tested monthly to ensure proper operation. Tartar missile magazines also have a water injection system which is used to diffuse the exhaust flame resulting from rocket motor ignition in the magazine. Water injection systems are not tested but are checked periodically to ensure that the fresh water and air pressure used within the system are at their required levels. Built in carbon dioxide systems installed in missile magazines are tested in accordance with current ship's policy.

Monthly Tests

Certain tests and checks of the weapons system are regularly scheduled to be performed once a month (or every 30 days). The Terrier missile must be checked at 3-month intervals for the first three checks, and every 6 months thereafter (current regulations; subject to change). The battery of the Talos missile must be removed each month and replaced with a new or reconditioned battery. The battery is not tested before removal; experience indicates that the

battery is likely to need changing and we want to be absolutely sure the missile has a good power source.

A number of the monthly tests are checks on the operation of related parts of the weapons system, with the GMM 1 and C cooperating. You may be placed at the Launcher Captain's Control Panel to observe and report the indications at your panel. Monthly tests on the Mk 13 system repeat the daily and weekly tests, but with additional procedures. The lubricating job includes many additional places to lubricate. Testing the sprinkling system adds several procedures, including air testing of pneumatic lines for tightness and operability of the heat sensing devices, air testing for unobstructed flow between the sprinkling control valve and the sprinkling heads, flushing the associated firemains, cleaning the salt water strainers and the drain hole, giving the system an operational test, and checking the operation of all the valves. Review chapter 8 for these operations.

Testing the carbon dioxide system in the magazine was described in chapter 8. The monthly testing includes inspection to discover any breaks in the tubing or other leakage. The supply piping is air-tested for tightness, and the operation of the system activation alarms are tested. The supply of CO_2 is cut off during the tests by disconnecting the control and discharge heads and capping the connections to the supply tanks. These are precautions to prevent the escape of CO_2 while working in the launching system. Compressed air is used to test the operation of the system, connecting the ship's air supply to the carbon dioxide lines with an adapter. If the air pressure gage shows even a slight drop in pressure, the leak must be found and repaired. A drop in pressure could prevent the operation of the alarm system when it is needed to warn of a fire.

The control heads are checked with the use of a pneumatic hand pump and an air gage. Remember the warnings about the suffocation danger from CO_2 and see that the supply cannot be turned on accidentally. Connect or disconnect lines, .control heads, and discharge heads in the order given on the MRC or your check sheet so there is no outflow of carbon dioxide at anytime while anyone is working in the launching system.

Other monthly checks and maintenance procedures include cleaning of the steam strainer and fluid strainer and checking the bladder pressure in the anti-icing system, and checking the operation of interlock switches. Solenoid switch operation is checked quarterly. Among the interlock switches that are tested (whether for actuation or continuity) are numerous sensitive switches, single-element switches, paired switch elements, micro switches, and rotary switches. The table of interlock switch actuation adjustments for the Mk 13 launching system consists of 22 pages in the OP. The switches must be actuated and checked in the correct sequence; you can see that check sheets are a necessity for checking and adjustment of the interlock switches.

Some interlock switches require quarterly checking or adjustment; ship policy decides the adjustment period for others. This is likely to be the case when part of the system is under NAVSHIPS control, as in sprinkling systems.

Periodic Tests

Some tests are scheduled to be made every 3 months, or every 6 months, or yearly. Refer to the OP for your missile system for a listing and description. Other tests are listed as "unscheduled." They are made when there are indications that maintenance or testing is needed. Your experience and judgment are needed to decide. "Clean hydraulic filters," is an example of a periodic or unscheduled job. Noisy or erratic operation of hydraulic components may be an indication that the filters need cleaning, so you schedule the job to be done as soon as possible (immediately).

WARNING: Be sure that system pressure is relieved before disassembling or removing hydraulic components. High system pressure can cause serious injury to personnel.

Quarterly Tests

A series of tests that is usually scheduled to be performed quarterly is timing of operations. For the launching system to operate properly, the components must act within the time limits set for each, a matter of seconds. A stop watch

is needed for testing certain operations. An electric timer is used at the EP-2 panel. On the Tartar Mk 13 launching system, use a 60-second, 115-volt, a-c timer with a special, self-contained 24-volt, d-c rectifier. You will need the wiring diagram to make the proper connections. Each timing operation is repeated two or three times and the time is recorded. If the average is not within the limits needed for that action, you must search for the cause of the trouble and correct it. The tests are conducted with all the motors running (except where indicated otherwise) in STEP control, Figure 10-1 illustrates a test circuit used to time the operation of a Tartar system. Timing relay KCZ2 is connected into the circuit being tested by two excitation leads. The contacts of KCZ2 control the start and stop action of the timing mechanism. The following are some of the timing tests made on a Tartar launching system; similar tests are made on other GMLS.

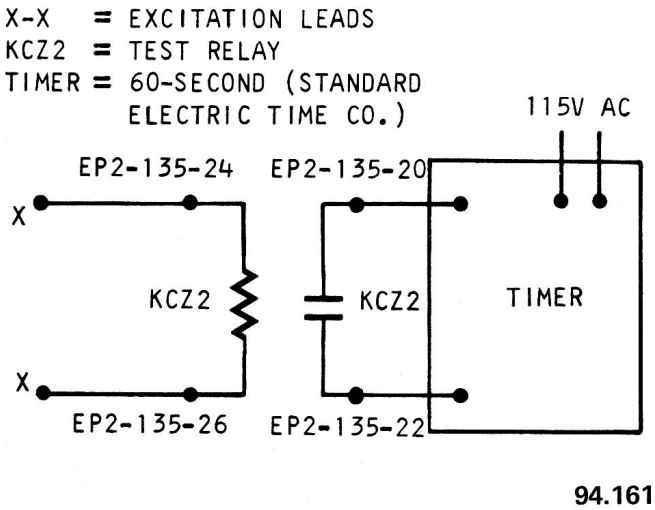

Figure 10-1.—KCZ2 and timer circuit, used in timing of operations.

1. Check and record the time that it takes to index between stations on both inner and outer rings of the ready service ring.
2. Check and record the time that it takes to extend and retract both the inner and outer hoist retractable rails.
3. Check and record the time that it takes to open and close the blast door.
4. Check and record the time that it takes to raise and lower the hoist chain under the designated conditions with the chain shifter at either the inner or outer ring (depending on which ring the Tartar training missile is stowed in).
5. Check and record the time that it takes to extend and retract the electrical contactor and fin opener housings.
6. Check and record the time that it takes to extend and retract the fin opener cranks.
7. Check and record the time it takes to arm and disarm a Tartar training missile.
8. Check and record the time it takes to extend the launcher retractable rail when it is empty.
9. Using a stop watch, check and record the time that it takes to retract the jettison piston (test circuitry and electric timer not used).
10. Check and record the time it takes to load a missile (1) from the initiation of a single load order until the fins are unfolded and the fin opener cranks are retracted, (2) from the initiation of a single load order until the next missile in the magazine is ready to hoist, (3) from activation of the system to AUTO until the launcher is loaded and synchronized to the load order, and (4) from activation of the system in AUTO until the launcher is loaded, synchronized, and ignition of a simulated missile is indicated.
11. Check and record the time that it takes to unload a missile from the launcher.
12. Check and record the effective time delays imposed by the time delay relays that remounted within the EP-l and EP-2 panels. In addition to the electric timer and a stop watch, a jumper is needed. Figure 10-2 shows how to wire up a time delay relay for testing purposes.

All these tests require careful attention to detail - connecting to the right circuit, exact time, particular sequence of steps, and careful recordkeeping. They cannot be done hurriedly. Schedule them for a time when they are not likely to be interrupted.

LAUNCHER SHIPBOARD PERFORMANCE TEST

Launcher performance tests determine whether launcher equipment functions satisfactorily under various operating conditions.

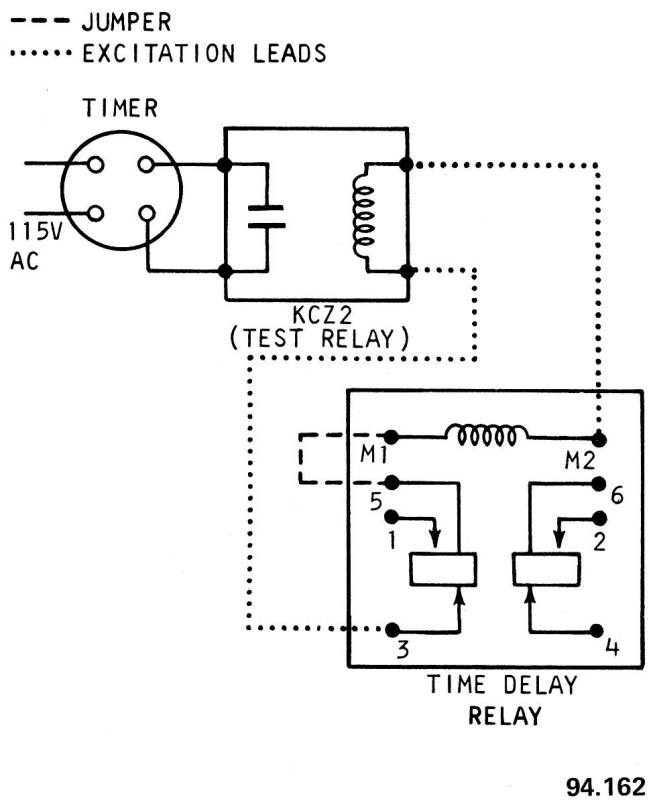

Figure 10-2.—Circuit for testing time delay relay.

Most launcher performance tests are conducted quarterly, but an existing condition (a suspected malfunction) may require that certain performance tests be conducted more frequently. Regardless of the frequency of performance tests, personnel conducting these tests must be familiar with both the testing procedures and the test equipment used. The test equipment is used to control and record the performance of the launcher power drives while they are being controlled by the launcher test panel. The responses that are recorded represent instantaneously the error position and velocity of the power drive unit under test. Most shipboard launcher systems have a test panel (EP3 Panel) which contains all the necessary test receptacles and test jacks for connecting the different test cables, leads, and jumpers to the test equipment required for a given performance test. Switches, pushbuttons, and control knobs used to control the launcher test equipment are located on the face of the test panel. A local director (internal director) is mounted within the test panel which enables the launcher to be positioned in train and elevation in local control or in a test mode of operation. A dummy director (external director), an error recorder, two limiter and demodulator units, and a frequency generator are used in conjunction with the EP-3 test panel when conducting launcher performance tests.

Some of the older GMLS do not have an EP3 test panel. These systems have separate local control panels, test panel, and system simulator panels for testing components.

DUMMY DIRECTOR AND ERROR RECORDER

Dummy directors and error recorders are used for routine shipboard dynamic testing of synchro controlled follow up systems such as train and elevation power drives for missile launchers. Their purposes are to simulate a command synchro signal, normally sent to the missile launcher power drive servo system by the missile fire control system, and to record the error between the selected input signal and the actual output response of the power drive servosystem under test. The information obtained is used for analysis of a launcher's electro-hydraulic control system and launcher power drives.

Dummy directors have been in use for many years, beginning with Mk 1. The one presently used with the Tartar and Terrier missile systems is the Mk 6 Mods 0 and 1. Figure 10-3 shows the control panel of the Mod 0. It was designed primarily for shipboard testing of guided missile launching systems. It does not replace test equipment used for laboratory, factory, shipyard, and installation tests. The records of installation tests are retained on board the ship, and the first record made with the dummy director and error recorder aboard the ship is kept for comparison with subsequent tests by the same test equipment. Each major unit of a ship's weapon system controlled by a synchro system and positioned by an electro-hydraulic power drive has a separate weapon system publication (OD) which lists all the individual shipboard tests conducted at the time of initial installation. Each major unit, a launcher, a gun mount, a rocket launcher, etc, is subject to a complete set of performance tests as detailed in an Installation Test Instruction OD for each unit installed. The results of all tests are recorded or added as

an appendix in a shipboard copy of the OD for future reference. Any information obtained from a routine shipboard performance test could result in detection of a significant performance deterioration of a launcher component and can warn of impending failure which could result in the need for corrective maintenance, repair, or overhaul.

Dummy Director Mk 6

Dummy Director Mk 6 Mod 0 weighs 78 pounds. It is housed in a portable, aluminum case approximately 19 inches long, 16 inches wide, and 12 inches high. It requires 1-ampere, 115-volt, 400-hertz a-c power for operation, and it accommodates either 400-hertz or 60-hertz synchro signals. All power is supplied from the launching system test panel via cable stored in the case. An auxiliary power conversion unit is required for 60 to 400 hertz conversion if the system to be tested is limited to 60-hertz power supply. The principal components of the dummy director are:

1. A main servodrive, with transistor and potentiometer control. It drives two synchro transmitters for 1- and 36-speed order signals, together with a 36-speed synchro control transformer for error detection purposes. It also drives a d-c tachometer for generation of a signal velocity order required for certain power drives.
2. An auxiliary servodrive, with similar transistor and potentiometer control, for generation

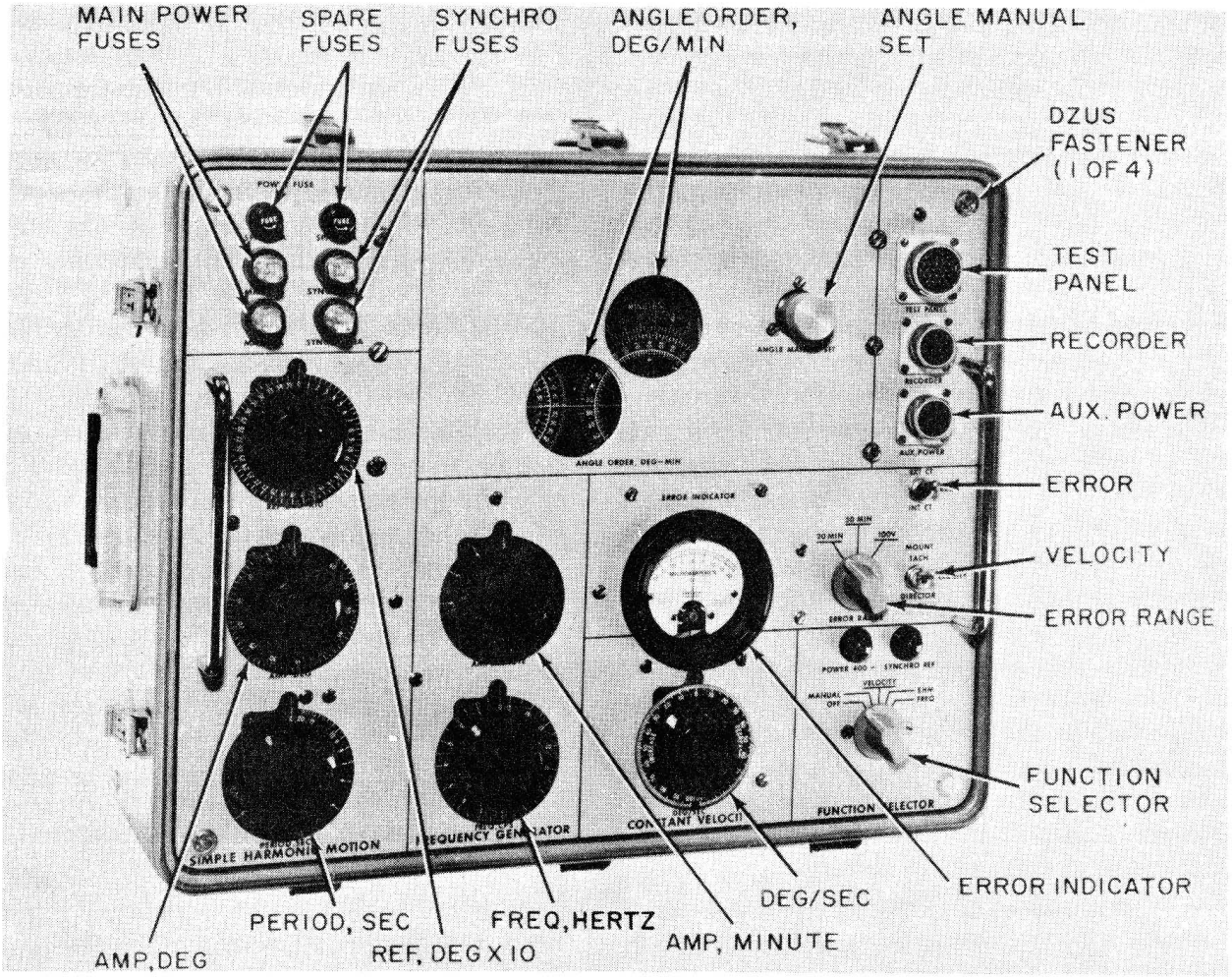

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Figure 10-3.—Dummy Director Mk 6 Mod 0, control panel.

of oscillating signals for simple harmonic motion control of the main servodrive for frequency generation.

All manual controls, indicators, and connectors are located on the control panel (fig. 10-3) for the following operations. These tests are made for train and for elevation.

MANUAL OPERATION. - During manual operation, the servo drives are disengaged from the synchro gear train, which permits the operator to position the output synchro rotors to any selected angle from where the particular test may begin. The manually set output signal is stationary, enabling the power drive under test to synchronize with the dummy director output. DO NOT, under any conditions, turn the knob on the 1X dial by hand.

CONSTANT VELOCITY OPERATION. - Constant velocity test signals are used to drive the unit under test at a constant speed. The velocity may be adjusted from 0 to 100 degrees per second in either direction. An oscillograph is used to make the test traces. (See chapter 5.)

SIMPLE HARMONIC MOTION OPERATION. - Simple harmonic motion test signals provide a sinusoidal input signal to the power drive under test. The sinusoidal signal causes the driven unit to oscillate about a present reference point, which is adjustable through 360 degrees. The period of oscillation is adjustable from 4.5 to 18 seconds, and the amplitude of the oscillation is adjustable to a maximum of 60 degrees at a period of 9 seconds and longer and up to 10 degrees at a period of 2 seconds.

FREQUENCY GENERATION OPERATION. - Frequency generation operation of the dummy director produces a sinusoidal signal of 0 to 12 minutes amplitude which is superimposed on the 36-speed synchro output signal. During frequency generation operation, the output command synchro transmitters of the dummy director are positioned automatically at a 10-degree electrical zero position. The frequency of the frequency generation signal is adjustable from approximately 0 hertz to 18 hertz.

The frequency generator components are mounted to the frequency generator chassis, which has a removable cover. A connecting cable is provided for connecting the generator to the EP-3 panel. Open and closed views of the frequency generator are shown in figure 10-4. It is used to test the frequency generator are shown in figure 10-4. It is used to test the frequency response characteristics of the launcher train and elevation systems.

Dummy Director Mk 1

The launcher power drives for the Talos launching system are tested with Dummy Director Mk 1 Mod 6. Two portable units are used, one to test the elevation power drive and the other for the train drive. The dummy director produces 1- and 36-speed, 400-hertz synchro signals for position orders and a 1-volt-per-degree-per-second (open circuit at l-speed) velocity order proportional to the velocity of the generated signal. The dummy directors are plugged into the rear of the control test panel to activate them. For a detailed description of the unit, refer to OD 17398, Operating Instruction for Dummy Director Mk 1 Mod 6.

Error Recorder For Talos System

A dual channel oscillograph is used to record error traces of the Talos weapon system. Three types of error traces are taken with it: B-end error traces, velocity traces, and position traces. Two different traces can be taken at the same time. This allows corresponding trace results to be compared. Calibrate the oscillograph before using it; follow the instructions in the OP on maintenance and testing of the launcher system. Some error traces were shown in chapter 5, along with some instructions on reading test traces, and description of an oscillograph.

Error Recorder Mk 12 Mods 0 and 1

Error Recorder Mk 12 Mods 0 and 1 (fig. 10-5) is housed in a portable, aluminum case approximately 21 inches long, 15 inches wide, and 21 inches high. It weighs 76 pounds. It requires 1.6-ampere, 115-volt, 60-hertz a-c power which is normally supplied from the launching

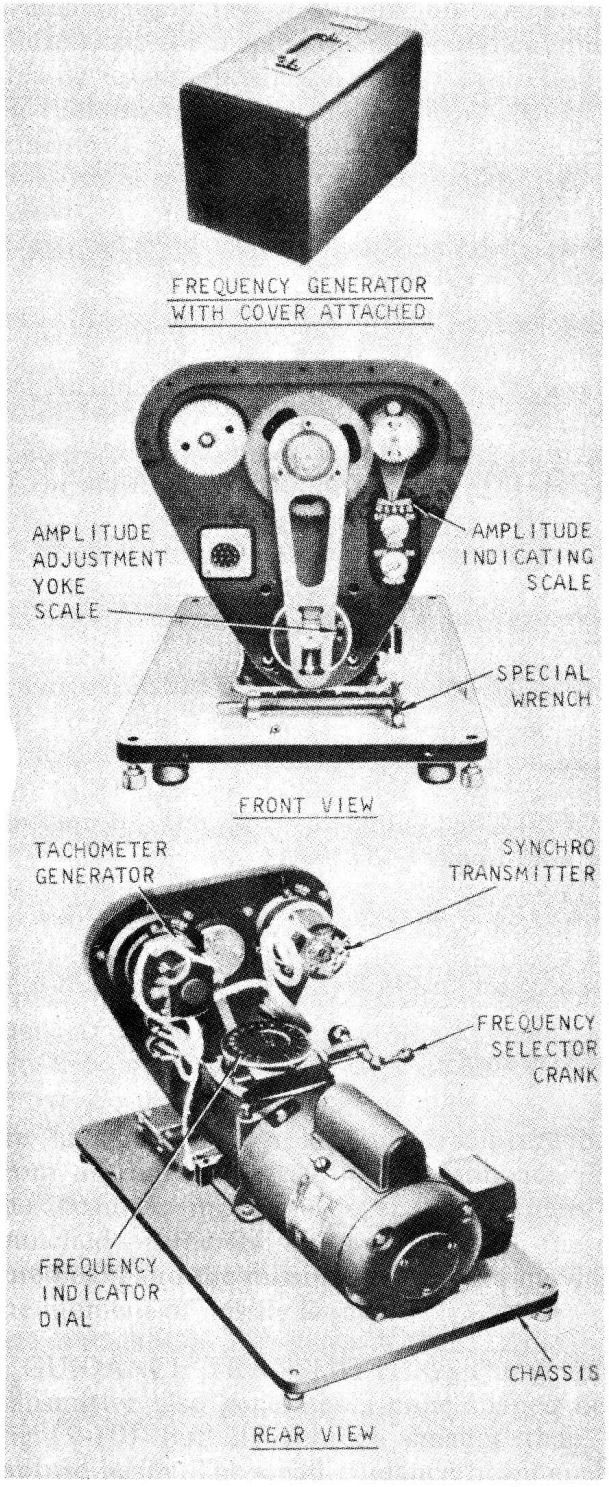

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Figure 10-4.—Frequency generator, enclosed and interior views.

system test panel via the dummy director. The principal component of the error recorder is a modified commercial Brush Instrument Company Recorder Mark III, which provides the immediately visible, permanent chart recording son two channels. It includes integral amplifiers for a pen deflection of 1-mm per 10-millivolts of input signal, up to 100 hertz. Simple adjustment and chart speed controls are located on the front panel (fig. 10-5), which also permit convenient change of chart paper. In addition to the two chart-recording pens, the recorder includes two event-marker pens, individually operated through remote control circuits. The recorder may also be used for time recordings of various launching system sequence operations.

The error recorder must be calibrated to zero position in relation to launcher zero train and elevation, and requires a warmup time of 15 minutes to provide an accurate error trace. (The time requirement may vary with the mod; observe the requirement stated in your instructions.) An error trace may be recorded of the launcher velocity, acceleration and deceleration, hunt, and ability of the launcher to follow static, constant velocity, or simple harmonic motion signals. These traces can be compared to those at installation.

The error recorder is connected by cable to the dummy director when in use, and the dummy director is connected to the launcher EP-3 control panel. The receptacles for connecting the dummy director, the two limiter and demodulator units, and frequency generator to the EP-3 control panel are on the lower part of the EP-3 panel, adjacent to the test jacks.

All required cabling for electrical interconnection of test instrumentation and connection of instrumentation to the test panel EP3 of missile launching systems control is provided with the test equipment. The special cables are designed with proper conductors, length, insulation, and connectors for optimum performance of equipment. Only the approved cabling should be used in the test instrumentation set up. Figure 10-6 illustrates the set up between the test panel EP3 and the test equipment used with a Talos missile launcher system. Only one dummy director is used at any one time, either for train or for elevation system testing.

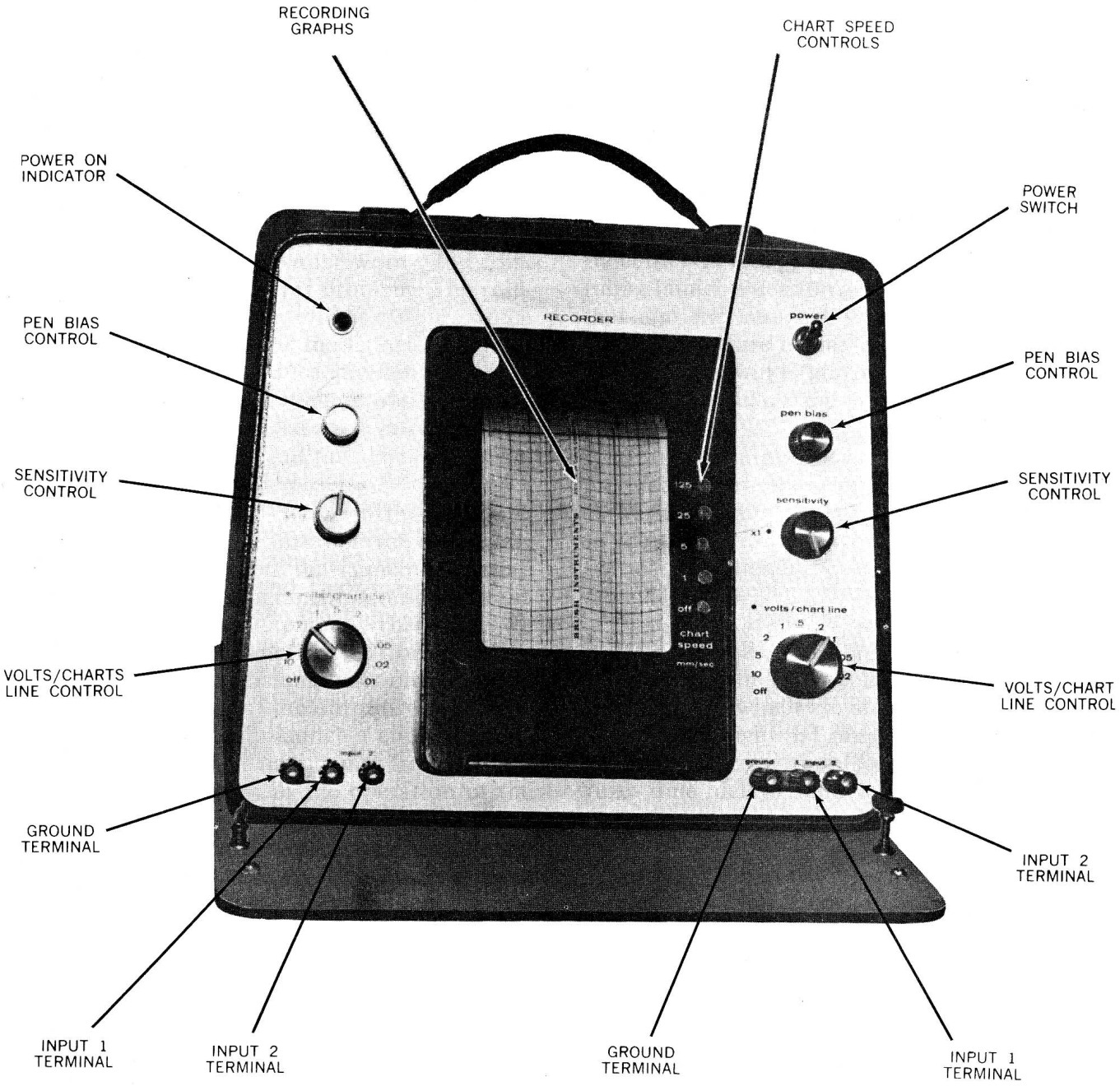

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Figure 10-5.—Error Recorder Mk 12, control panel.

Types of Tests and Test Procedures

Launcher systems having scheduled performance tests should have an associated Maintenance Requirements Card (MRC) for each power drive unit within a system which explains the step-by-steps procedure and also illustrates for reference purposes a sample trace of each test conducted.

In the Talos GMLS a performance test of the launcher train power drive is conducted quarterly and requires four hours to perform. The MR card consists of 38 pages with nine tests conducted in sequence. The tests listed on the

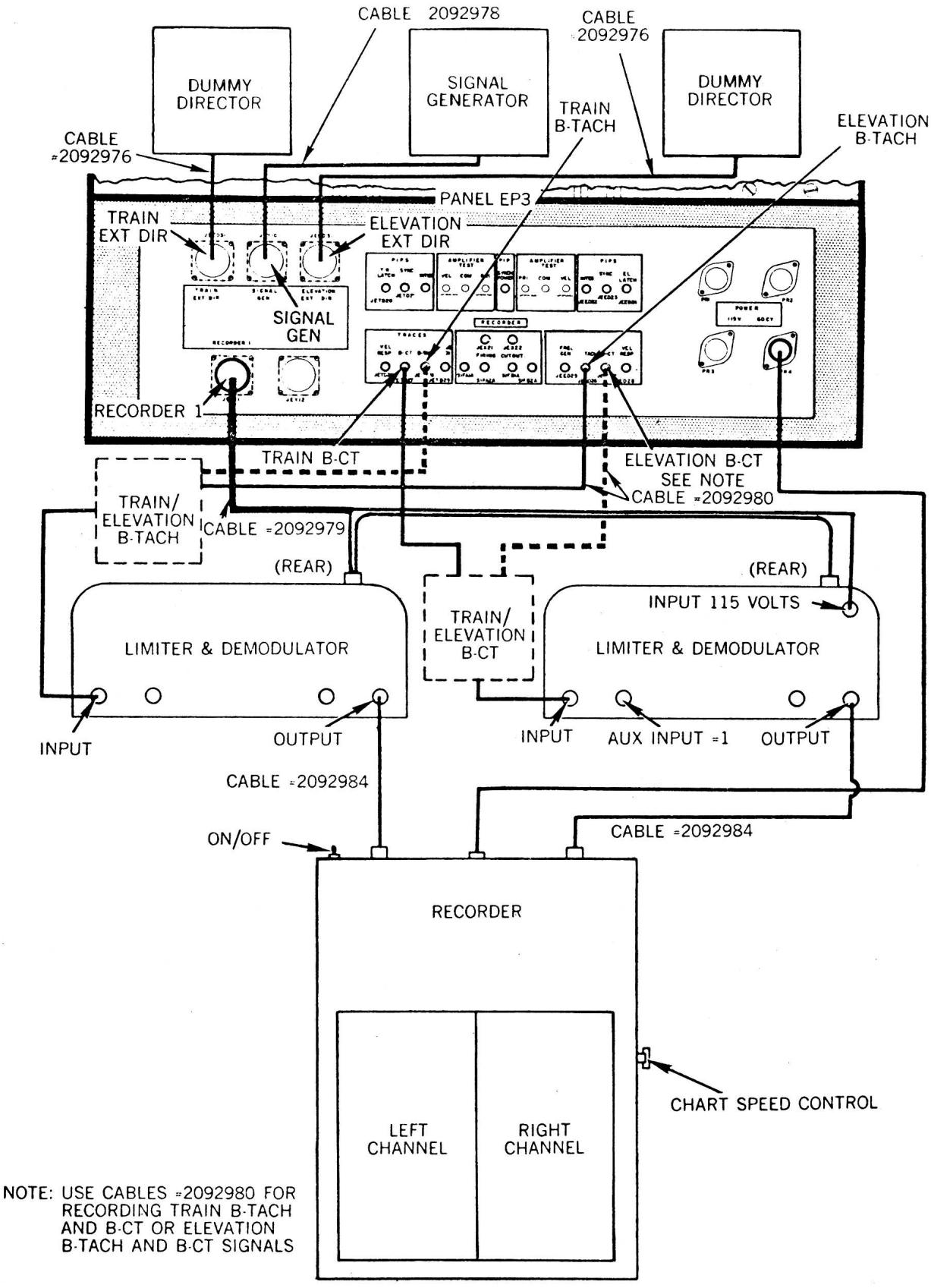

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Figure 10-6.—Launcher Test Equipment Set Up.

MR card accomplish the following; (I) check amplifier balance, (2) test train power drive accuracy, (3) record train power drive velocity and acceleration rates, (4) check launcher synchronizing time, (5) calculate launcher travel distance and maximum deceleration rate between synchro and main power failure points and actual launcher stop points. The sequence in which the launcher train power drive is tested and some of the sample test traces are shown in figure 10-7.

MISSILE SIMULATOR

The use of simulators for training in all phases of missile handling, launcher operation, firing, and securing has been developed to a high degree. A missile simulator combines in one piece of equipment the functions of the several equipment attached to the test panel EP3 in a missile launching systems. The Tartar missile simulator is placed in the training missile, as is the Terrier simulator. Since you will be training lower rated men in the operation of the launching system you need to become familiar with the operation of the missile simulator you have aboard ship. Missile Simulator SM-161/DSM, used to check the Tartar missile launching system aboard ship is installed in the Tartar Training missile (TSAM), occupying the space normally occupied by the auxiliary power supply (AS). The missile simulator test panel is located just under the missile skin and is accessible by a hinged cover. All electrical connections from the launcher to the missile simulator are made through the DTRM firing contacts on the skin of the DTRM, and through the missile-to-launcher contactor on the aft end of the tail cone. The missile simulator furnishes electrical loads equivalent to those in a tactical missile and provides indicators and test jacks as a means of checking the launcher firing control circuits.

Guided Missile Simulator SM-75A/DSM is used in Terrier Guided Missile Training Round Mk 14 Mod 0 (BT-3) or Mk 18 Mod 0 (BW-1). Guided Missile Simulator SM-159B/DSM is also used with those training rounds and, in addition, is used with Training Round Mk 43 Mod 0 (BT-3A/F/, BT-3B/F/), Mk 44 Mod 0 (BT-3A/N/, BT-3B/N/), or Mk 45 Mod 0 (HT-3) (HT-3A). The simulator provides the electrical responses and loads equivalent to the missiles, thus allowing realistic loading and firing drills.

Operational Cycle

Operation of the missile simulator is through the launcher control console. The operator at the launcher control console operates the push-buttons and switches in the sequence required for the test. being made, and the man at the simulator test panel watches the indicating lights that show if the proper response is taking place. He has a checklist, of course, and maintains communication with the console operator.

There are many possible combinations of situations that can beset into the simulator. The operator of the control panel operates the switches manually.

Before attempting to teach with the simulator, have clearly in your mind the steps you will take and what will happen each time. Since the orders must come from the attack console, coordinate your lesson with the men who will send the orders to your launching system. Manual operations are required at both stations. The men who are being trained are stationed at the control panels in the same manner as for an actual firing. The indicator lights show what has been simulated. The abbreviations used on the face of the launcher panel and missile simulator are explained in the OP, as are the code symbols used to indicate weapon system units and fire control symbols.

Maintenance of Simulator

It is part of your job to keep the simulator in operating condition. As long as the simulator operates satisfactorily, do not open it for cleaning and inspection. Lubrication is usually performed at the factory, and is not required on shipboard under normal conditions. Periodically clean and inspect the exterior only. Panel lamps may require replacement. If the simulator becomes inoperative, inspect the interior for security of the switches on the front panels, for loose or damaged connectors, broken or loose switch wafer wire connections, evidence of overheating, excessive wear, or corrosion of electrical parts, cracked or damaged O-rings, and damaged wiring. Before opening the unit, be fairly certain

PROCEDURE (continued)

Test Sequence	Test
1	Check magnetic amplifier balance
2	Train accuracy
	a. Simple harmonic motion
	b. Static condition
	c. Constant velocity
3	Train velocity and acceleration rates
4	Synchronized indicator checks
	a. Static error
	b. Time delay
	c. Synchronizing time to static signal of 5°, 10°, 20°, 45°, 90°
5	Synchronizing to harmonic motion
	a. 60°
	b. 90° right train
	c. 120°
	d. 90° left train
6	Return to load
7	Synchro power failure
8	Main power failure
9	Frequency response

Train Power Drive Test Relationship Summary

PAGE 29 OF 38 | 5Z | BAAF | X00 | 59 | BPXA

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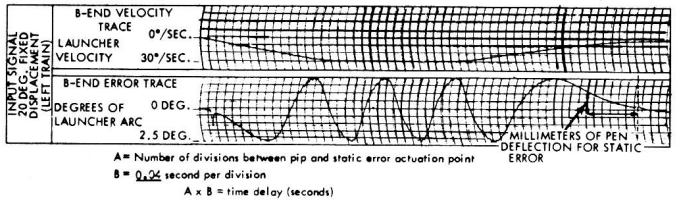
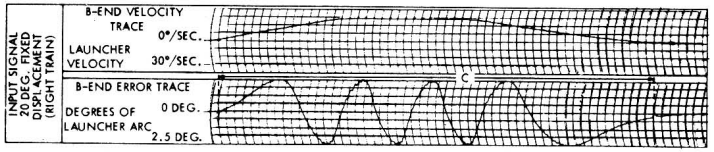
PROCEDURE (continued)



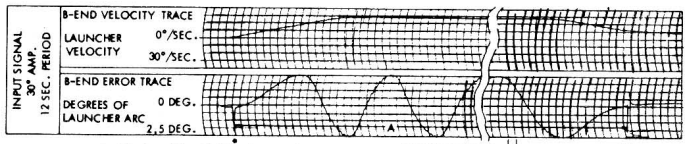
A = Number of divisions between pip and static error actuation point
B = 0.04 second per division
A x B = time delay (seconds)

Train Synchronized Indicator—Time Delay Sample Trace



C = Number of time divisions between pips
D = 0.04 second per division
C x D = synchronizing time (seconds)

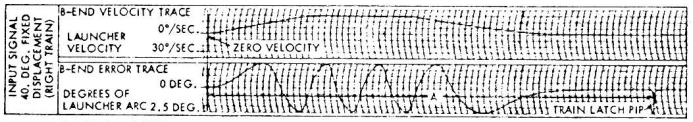
Train Synchronized Indicator—Synchronizing Time Sample Trace



A = Number of time divisions between pips
B = 0.04 second per division
A x B = Synchronizing time (seconds)

* SYNCHRONIZATION LOST
** SYNCHRONIZED

Harmonic Motion—Synchronizing Time Sample Trace



A = Number of divisions
B = 0.04 second per division
A x B = Synchronizing Time (seconds)

Return-to-Load Sample Trace

PAGE 35 OF 38 | 5Z | BAAF | X00 | 59 | BPXA

DATE 15 May 1969 | Q

94.193

Figure 10-7.—Test sequence and sample traces.

that the trouble is in the simulator. Failure of lamps and dials on the attack console, the simulator panel, and the LCCP are the most common indications of malfunctions.

WARNING: Do not attempt repair of a simulator panel until the panel has been deenergized.

Before removing any part, make a sketch of its position and wire connections to ensure its correct replacement. All wires have marked sleeves at each terminal end. The dummy steering power section is removed from the trainer missile before inspecting or cleaning the internal components of the simulator. A soft, clean cloth and a brush are used for cleaning the interior of the simulator. After cleaning and correcting any obvious faults, such as a loose wire, return the simulator to the dummy missile.

When the cause of the trouble is not obvious, make resistance checks of the circuits in the simulator. All power is removed from the missile simulator and the missile is disconnected from the launcher. A Simpson 260 or similar multimeter and it General Radio 1800A a-c vacuum tube voltmeter are used. Use the access jacks on the front of the simulator panel.

Use troubleshooting charts or wiring diagrams of the simulator. When you have located the remedy in the appropriate chart, follow the instructions for repair, adjustment, and/or replacement. Repairs other than those described in the OP should be done at an authorized repair station. Synchro alignment, for example, is done at a repair depot.

During the dynamic testing of the simulator, it is in the trainer missile on the launcher and is receiving stimulus voltages from the weapons system. A correct voltage reading .on the front panel of the simulator indicates that the simulator and the weapons system are functioning properly in the test. The voltages for each test point are listed in the OP.

Corrective maintenance must be done by persons familiar with the theory of operation and the method of operation of the simulator.

Weapon Electrical Simulator

The simulator used with the Talos GMLS simulates the electrical functions of an S or a W type Talos missile. The primary purpose of the simulator is to allow realistic warmup, power changeover, and firing drills by providing electrical circuits that furnish responses equivalent to those of an operational missile. It also serves as a test unit for checking the operation of the launcher warmup and firing circuits. In addition, the simulator gives all rail loaded indications at launcher Areas 1 and 2, it latches to the guide arm, and it engages the loader in the same manner as a missile. Forward and aft shoes, figure 10-8, similar to those on an operational missile, permit the simulator to be attached to the loader or launcher rail.

When the simulator is attached to the rail, the electrical warmup contactor in Area 1, or at the launcher, can be extended and mated with the contact pad on top of weapon simulator, figure 10-8. This pad is identical to the contact pad on a service missile. The contactor conducts warmup power as well as all input and output signals to and from the simulator, except for booster-squib voltages. Booster-squib ignition voltages are provided by two sets of contacts mounted on the forward simulator shoes, figure 10-8.

During warmup, power change-over, and firing phases of a drill, circuits within the simulator simulate or monitor the operation of missile warmup, power change over, and firing circuits. Indicator lights on the front panel display sequence and indications of voltages. A warmup load simulator, an accessory unit of the weapon simulator, can be used to simulate the loads that an operational missile would normally impose on the launcher during firing. In addition to indicator lights, the front panel of the weapon simulator contains all the necessary switches and plug in jacks necessary for a weapons electrical simulation test.

TRAINING MISSILES

The use of a trainer missile provides several kinds of training in addition to checking out shipboard launching systems. This includes training of missile handling crews in assembly techniques, packaging and transfer operations, checkout methods, launcher loading, and operation of the launcher firing sequence. The trainer is stowed in the missile magazine along with the other missiles; when it is to be used for checkout, it is brought up and loaded on the launcher.

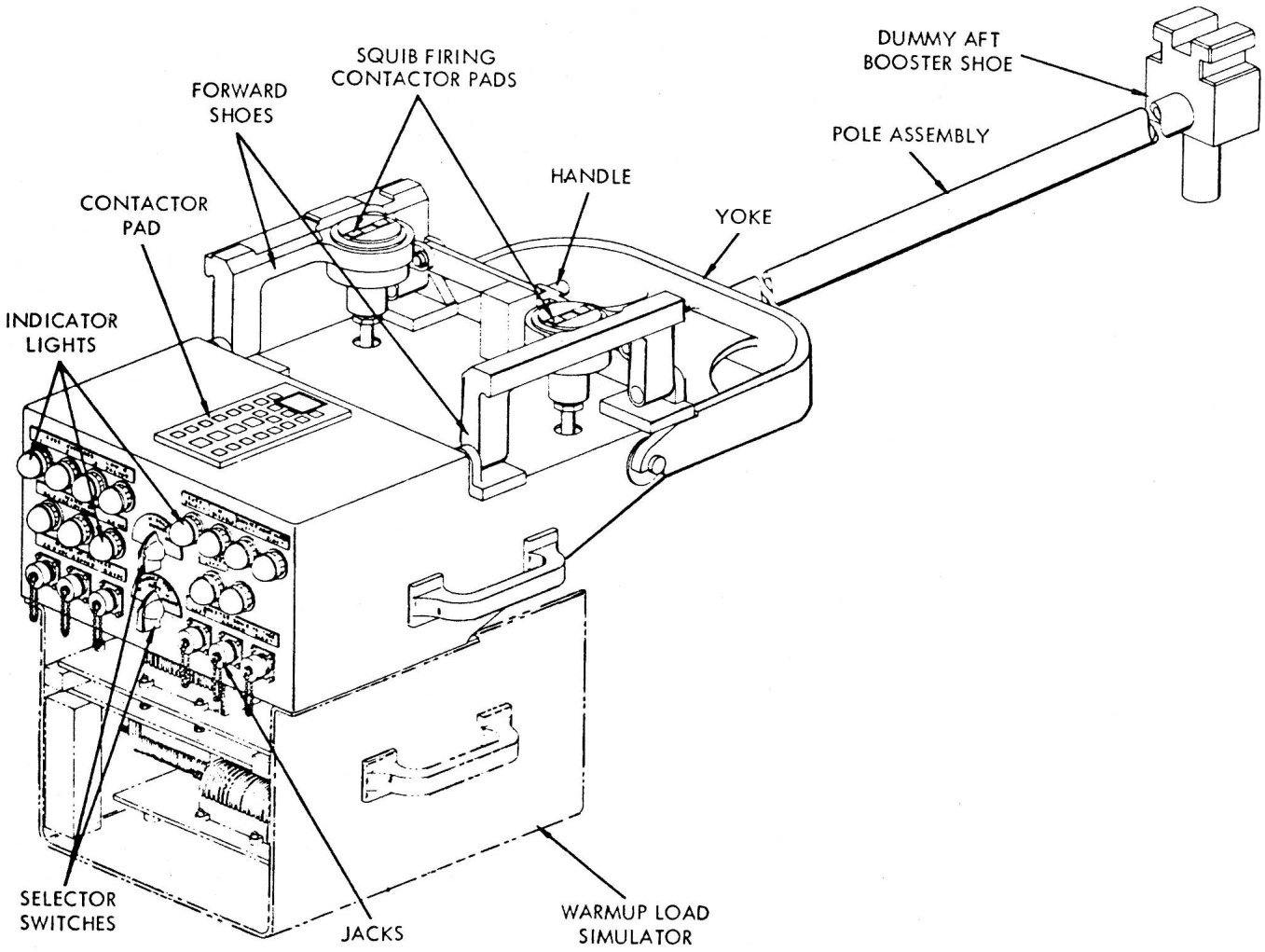


Figure 10-8.—Weapon Electrical Simulator.

The trainer missile is used with a code test fixture and RF oscillator to check the operation of the code comparator and associated weapon control ready-to-fire indicating circuits. The conductors from the code test fixture and the RF oscillator are connected to the simulator test panel in the trainer missile. The RF oscillator is ship's equipment, but the code test fixture is constructed from materials at hand. Figure 10-9 shows a schematic of a code select circuit. In the Tartar systems the missiles are checked out on the launcher, and therefore it is necessary to have the launcher trained and elevated to a position that is most convenient for the operator of the simulator panel.

WARNING: Be sure all personnel are cleared from the launcher area before energizing launcher circuits. A safety observer must be on deck, and in communication with the launcher control station.

Study the description of circuit action in the OP with the drawings before you. This type of follow-through will be very helpful in trouble-shooting.

Training Missiles Used With Simulators

Training missiles with dummy simulators or no simulators at all are used for practice in

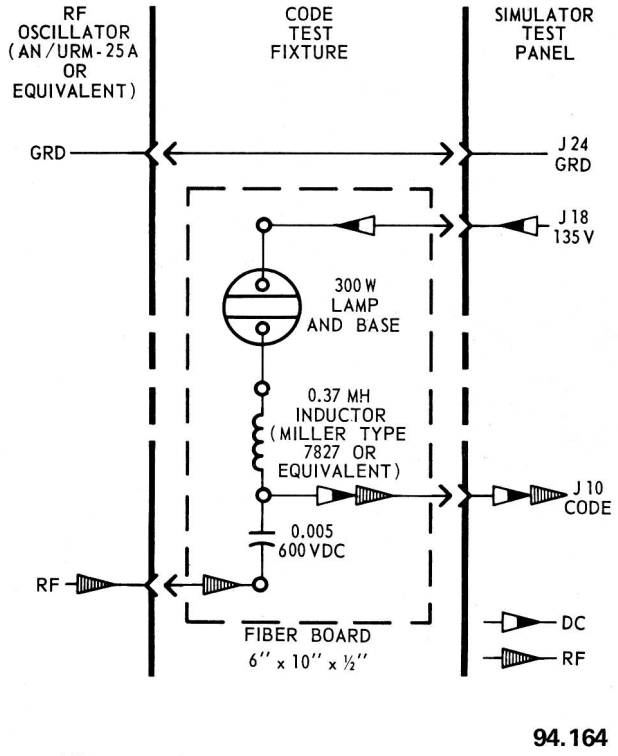


Figure 10-9.—Launcher system code select circuit check; schematic.

handling of missiles; but when any circuitry is involved, a real simulator must be connected. The simulator is electrically connected to the trainer via booster and missile power receptacles, shown on the left end of the simulator in figure 10-10.

Two Terrier training rounds and two Asroc training rounds are provided for each Mk 10 Mod 7 or 8 launching system. The guided missile simulator used in these training rounds is described in OP 2258, Guided Missile Simulator. OP 2905, Guided missile Simulators SM-75A/DSM and SM-159B/DSM, gives the instructions for use of the simulators for the Terrier missiles stowed in the Mk 10 Mods launching systems. There are variations in them to accommodate the different Terrier missile types, and changes have been made to improve the simulators, so be sure you have the latest revision of the OP.

The launching system is cycled through all its operations, using a training missile in place of an active missile. For testing the firing circuits, a Terrier training missile with the simulator installed is used, loaded on the launcher rail. It is tested for normal firing, A- and B-side, misfire, and dud firing. The launcher electrical contactor is mated to the trainer electrical contactor. During the warmup, power changeover, and firing phases of the training drill; circuits in the simulator represent or monitor the missile operations. All the input and output signals, except the booster squib ignition voltages, are conducted through the electrical contactor. Figure 10-10 shows the panel face of the Simulator SM-159B/DSM and its location on the missile when it is on the launcher. Automatic control is used for training drills; the observer of the simulator panel has a dangerous position because of launcher movement, and he must be constantly alert. All other personnel must be cleared from the launcher area.

The steps of operation will vary with the missile being tested and type of firing being simulated. Follow the steps exactly as given in the OP or the check sheets for the test you remaking.

SONAR SIMULATOR

The primary target detection unit of the Asroc Weapon System is Sonar Detecting-Ranging Set AN/SQS-26. The sonar detects and tracks submarine targets and provides target location data to the fire control group. For training use, a target must be simulated. Sonar Target Signal Simulator SM-170/SQS-26 is used to supply a signal similar to a submarine target. It simulates course, speed, depth, range, and own-ship course. Simulated sonar echoes are transmitted from a maneuverable artificial target. The operation of this equipment is not the responsibility of the GMM. The Sonarmen check out the sonar target signal simulator, but the GMMs check the Asroc weapons that they have in the Mk 10 launching system. The Asroc training missiles are made to resemble the rocket-thrown torpedo and the rocket-thrown depth charge forms. All forms of Asroc are used for ASW, and must therefore be checked out with the aid of sonarmen. The sonar target signal simulator is Unit 5 in Fire Control System Mk 114 Mods 9 and 12. The operator of this panel sets the problem. He sets in the target bearing, course, range, and speed, and own ship's speed. Other fire control units proceed to solve the

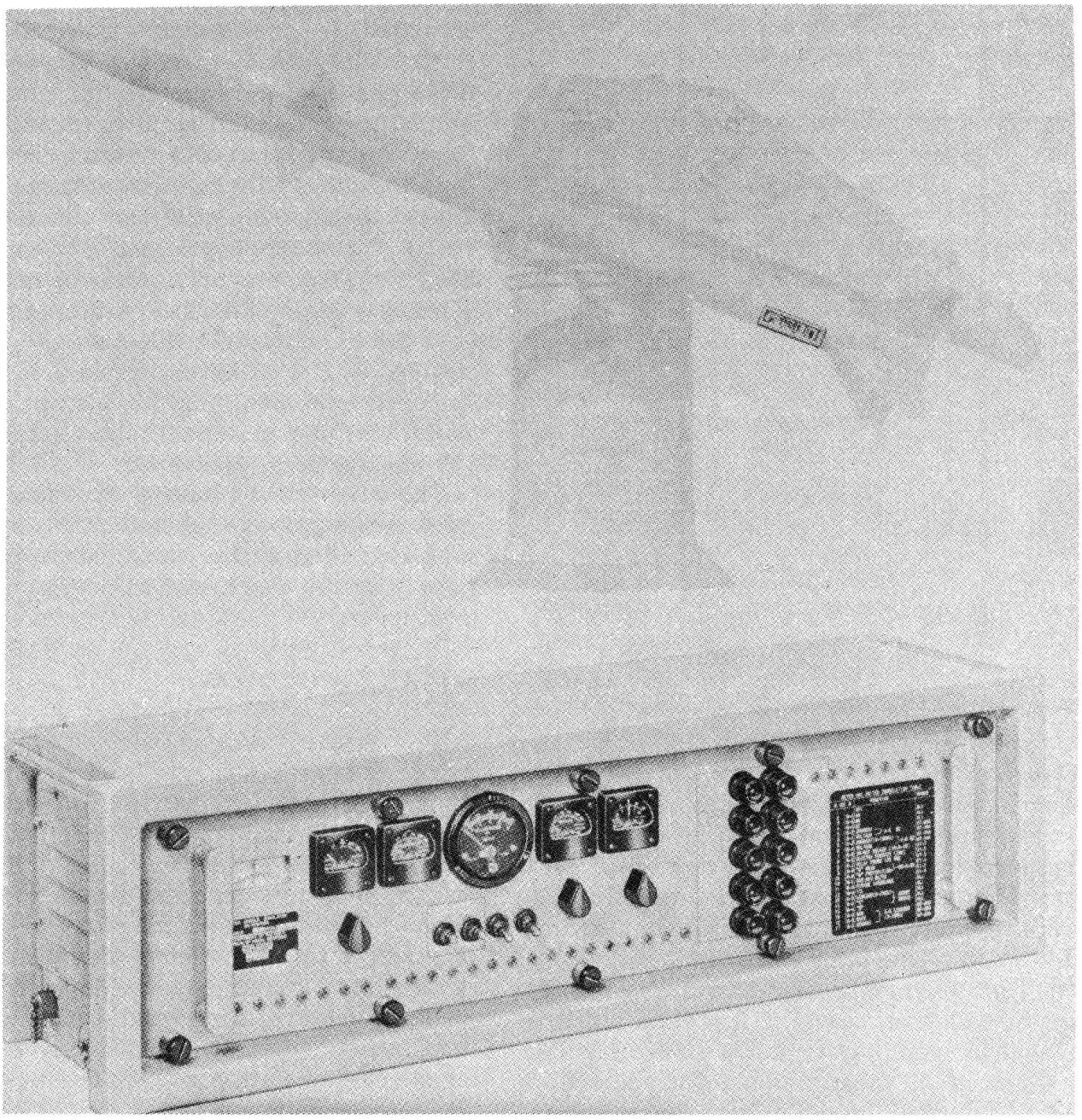


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Figure 10-10.—Missile Simulator SM-159B/DSM, and location on missile on launcher.

problem and transmit orders to the missile and. the launching system. The GMMs man the launcher panels. When the decision is made to fire either a torpedo or a depth charge, the correct form of training missile is brought up from the magazine by the launcher captain, and is loaded on the launcher arm.

TESTING THE MISSILE

Although maintenance of the missiles consists largely of removing a defective component or part and replacing it with a new one, frequent checking and testing of missiles is necessary to detect any faulty component. The development

of replaceable modules was one step in the reduction of missile testing aboard ship. The missile NO-TEST-aboard-ship programs are working toward the elimination of missile checkouts aboard tactical ships. The Tartar program has been completed and missile shipboard checkout equipment is being removed. The Terrier program is being worked on at present. The Guided Missile Surveillance Program monitors, measures, identifies, and interprets factors that influence missile readiness and reliability. The Missile Systems Test Monitoring Program utilizes analog data to validate missile checkout results. These data are analyzed to detect missile problems that may not be recognized or detected by missile checkout equipment. Some missiles aboard tactical ships were found to be in a failure condition that had not been disclosed by shipboard tests. These programs are carried on by the Naval Fleet Missile Systems Analysis and Evaluation Group with headquarters at Corona, Calif.

Until the NO-TEST program is perfected, missiles will be tested aboard ship to a limited degree.

Missile Systems Test (MST)

Several mods of Guided Missile Test Sets (GMTS) are in use. AN/DSM-60 (TATTE) is used to test the Talos; AN/DSM-54(V) is used with the Terrier; and the AN/DSM-55 and AN/DSM-55(V)B are used with the Tartar. Each of these has type modifications. These sets are connected to the missile by the GMM, but the tests of the missile may be conducted by Fire Control Technicians. At depots a pneumatic test set, the TS-1165/DSM, is also used with Terrier and Tartar missiles, but on shipboard only the electronic system is checked. External hydraulic power is used, supplied by the HD-259/DSM hydraulic pumping unit.

The AN/DSM-54(V) consists of four functional sections: (1) program section, (2) missile stimulator section, (3) evaluation and indication section, and (4) power supply section.

The Guided Missile Test Set applies a series of tape-controlled electrical stimuli to activate the missile guidance system. Missile functions and conditions simulated include warmup, launch, boost phase guidance, search, target acquisition, and intercept. Selected steering signals are applied to the missile. Missile responses to these signals are monitored at various points in the missile and compared to the tolerance limits within the missile test set. At the end of the test the GMTS will show a green GO light if the missile is functionally flight-ready and a red NO-GO light if it is not. One or more FAULT LOCATION lights will indicate the location of the trouble when the missile tests NO-GO

If the light is red, continue the tests to pin-point the trouble and correct it if you can. If the light is green, the GMMs return the missile to the magazine.

Because of different test requirements, different punched program tapes are installed in the missile test sets: for depot or for shipboard tests, for tactical missiles, for missiles with an exercise head, for testing the forward assembly only, and other specific conditions. The missile systems test is performed in approximately three minutes.

Before the test set is connected to the missile, the set performs an automatic check of its own evaluation and interlock circuitry, as well as the critical power supply voltages. The result of this self-check is displayed by indicator lights on the control panel, which show whether the test set is in condition for conducting the missile test. The self-test is initiated by pressing the OPERATE button on the test set. If any of the ready lights do not go on, the self-test has failed. When making the external connections of the test set to the missile, make sure that the missile is grounded at all times. Set the sustainer igniter arming mechanism to CHECK. After the completion of the test and after the GYRO CAGED lamp is illuminated, place the sustainer igniter arming mechanism on SAFE, and remove the connections from the missile.

WARNING: The test set will not remove power from the missile unless the gyro is caged.

The tests are performed on completely assembled missiles except for the warhead section, S&A device, and fuze booster. During tests, a warhead spacer is used in place of the warhead section between the forward end of the electronic section and the after end of the Target Detection Device (TDD). (On shipboard, the

missile is tested completely assembled. The only preparation needed is separation of the missile and booster before attaching cables and hoses.) A through cable for connecting the TDD and the electronic section is provided as part of the station installation to supply S&A launch-latch bypass and for powering the TDD and missile nose sections.

SIMILARITIES AND DIFFERENCES IN TEST SETS. - The AN/DSM-54 and AN/DSM-55 test sets are fully enclosed and housed in an aluminum enclosure. The -54 sets (fig. 10-11) weight approximately 266 pounds and the -55 sets about 275 pounds. They are placed in the checkout area but can be moved if necessary. The hydraulic pumping unit, HD-259/DSM, is placed nearby. The AN/DSM-60 (TATTE) test set, used for testing the Talos missile, includes four cabinets of equipment, each of which contains several subassemblies. These cabinets and the auxiliary equipment are installed in the missile checkout area (fig. 10-12). The -60 test set is a composite of the -18, -18A, -18B, and -18C capabilities.

All of them require a power supply, an altitude simulator, a telemetric data recording set, meters and tools. Special tools and maintenance equipment are supplied with each set for servicing the module.

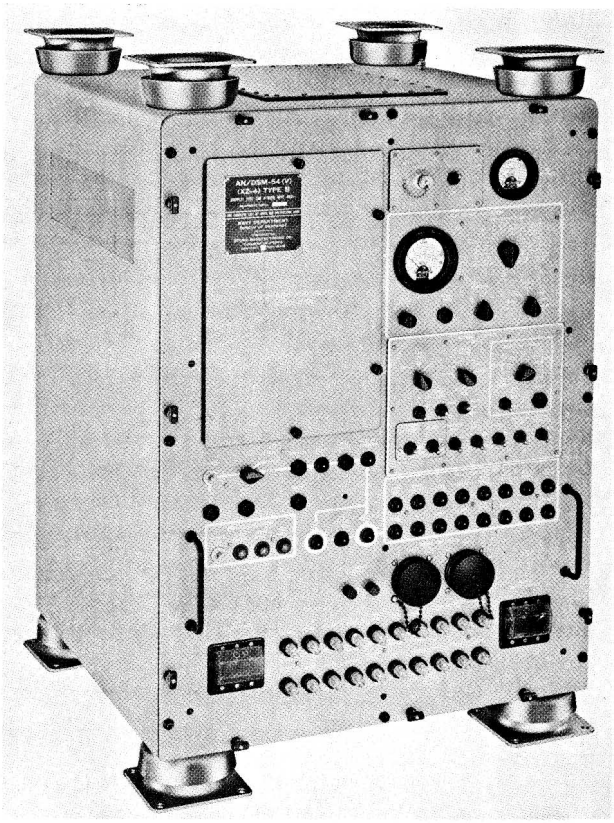

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Figure 10-11.—Guided Missile Test Set AN/DSM-54V; pictorial view.

WARNING: When power is on, high voltages are present in the GMTS. Use caution when performing inspection, adjustments, voltage measurements, and maintenance. High voltage (300 v-d-c) is present at test points. Do not service or adjust alone. Another person capable of rendering aid should be present.

PREPARATION FOR MISSILE CHECKOUT

Figure 7-18A illustrates the test set AN/DSM-54(V) connected for depot testing, and figure 7-18B shows it ready for shipboard testing. Configuration 2 (C2) of the test set is shown in these illustrations.

Terrier

The AN/DSM-54(V) is adaptable for testing any of the current Terrier missiles. Each set can be changed quickly to test any of the Terrier missiles and to operate on either X band or C band frequency.

NOTE: If the same 400-hertz voltage source is used for both the AN/DSM-54(V) and the HD-259/DSM, it is necessary to start the HD-259 first in order to prevent damage to the DSM-54(V).

After the equipment has been warmed up for at least 30 minutes, check all power supplies of the AN/DSM-54(V) for proper operation. If the power supplies are operating properly, check and, if necessary, adjust the missile stimulator section of the AN/DSM-54(V). Radar Test Set AN/SPM-9 is used to check Pulsed Radio Frequency, Frequency Modulation, Amplitude Modulation, Radio Frequency, Pulse Width, Pulse Coding, and R-F Power Out. The function generator section of the DSM-54 set is adjusted

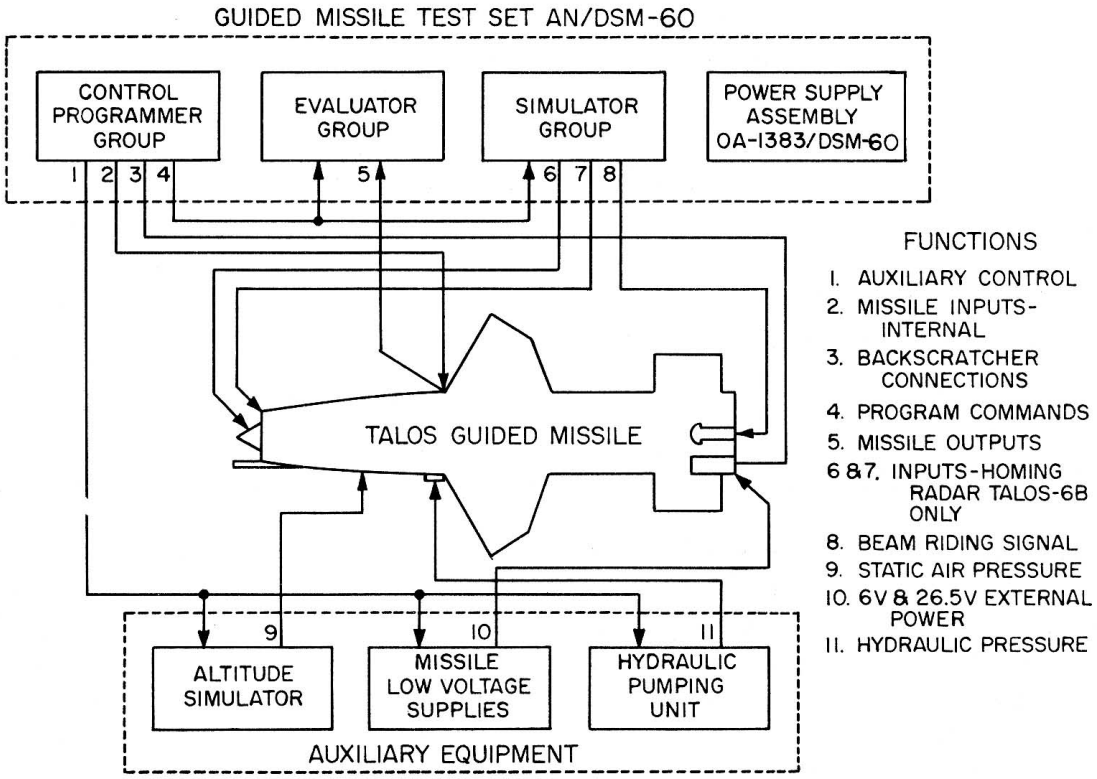

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Figure 10-12.—Talos missile checkout equipment; functional relationship of units.

for proper output of Roll (both LO and HIGH), Rate (LO and HIGH), and Acceleration. These adjustments are critical and require a highly accurate differential voltmeter. They may be made by other ratings, but you need to know how.

The test results are recorded by either Telemetric Data Recording Set AN/SKH-l or Telemetric Data Receiving, Recording, and Scoring Set AN/SKQ-l. These sets record on special photosensitive paper housed in the magazine of the oscillograph. The photosensitive paper is developed under fluorescent light. The developed recording may be analyzed and annotated. Future recordings are compared with it.

To prepare the HD-2S9/DSM, check the level the hydraulic fluid in the reservoir, as indicated in the sight glass on its front panel (fig. 10-13). If the level is low (below MIN), fill the reservoir to the proper level. Check the condition of the hydraulic lines running to the missile. Connect the supply lines to the return line by use of an adapter, and connect the unit to a source of 115-volt, 3-phase 400-hertz power.

Set the BYPASS valves to the OPEN position. Set the VALVE switch to the CLOSED position and the OSCILLATOR switch to the OFF position. Turn the MOTOR switch to ON. Note whether the motor starts and the indicator lights illuminate. The supply pressure gage should read about 100 psi.

Then close the supply bypass valve. Check to see that the supply pressure gage reads approximately 1000 psi, and that the temperature reading is normal. Place the return bypass in its closed position; the return pressure gage shouldered about 125 psi.

When all these conditions are met, the unit is ready to be connected to the missile for automatic test. During the missile test, the unit is remotely controlled by the AN/DSM-54(V)

Tartar

The basic test philosophy of the DSM-54 test set applies also to the DSM-55(V) - to perform a test, as nearly automatic as possible, to assure that the Tartar will function as it should. Three

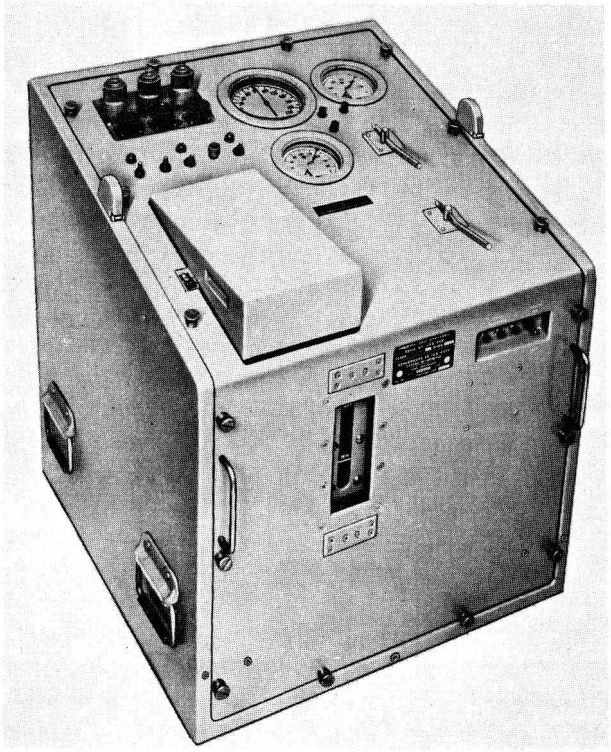

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Figure 10-13.—Hydraulic Fluid Pumping Unit HD-259/DSM.

modes of operation are provided in the DSM-55(V): a missile systems test (MST) for use on the assembled missile, an electronic ("E") test for use on the electronic section by itself, and a manual mode which permits the operator to test any missile response at will.

There are five stages in the operating sequence of the test set: (1) before use, (2) standby, (3) during use, (4) after use, and (5) "secure." In the "before use" stage, the operator makes at least one pretest checkout every 24 hours of operation. The drop cables need not be attached to the missile, but the operator should assure that all test set circuitry is functioning, that the tape (in the test set) advances smoothly, that power supply voltages are available, and that all indicator lamps are functioning properly. The test set is ready to operate when all the indicator lamps and the READY lamp illuminate.

With the main circuit breaker on, depressing the POWER ON button places the test set on "standby." This allows all filament and plate voltages to come up to required levels. A 30-minute warmup is sufficient. The blower cooling the klystron should operate at all times to avoid damage to the klystron. Turn off the power immediately if the klystron blower is not operating. The blower that cools the chassis should begin operating immediately if the ambient temperature is over 35°F. After the test, the set is returned to STAND-BY by pressing the reset button. To secure the test set, place the main circuit breaker in the OFF position. This removes all power from the test set and the missile.

PREPARATION FOR USE (PRETEST CHECKOUT). - Follow the steps below to check the test set before it is to be used to test a missile.

1. Make sure that all captive screws on the control panel are tight.
2. Check all drop cables for proper connection to transition boxes.
3. Assure that no cables are connected to a missile.
4. Place Missile Circuit Breaker in OFF position.
5. Place Main Circuit Breaker in ON position.
6. Depress POWER ON button. See that the klystron blower starts immediately, and that the blower cooling the chassis starts when the ambient temperature is over 35°.
7. See that the POWER light is on. The tape index light should be on. If it is not, press the reset button and wait for the tape to rewind. At index, the lamp will go on.
8. Allow 30 minutes for the system to warmup.
9. See that all fuse lamps are out. If one is on, it means that the fuse is open and must be replaced. Spare fuses are available on the back of the microwave access door.
10. Set test function switch to MST.
11. Press the OPERATE button. During the next 15 seconds, the self-test will be run and the ready lamp should light along with all the active fault locator lamps.
12. Press the TEST START button. All lamps except "power" and "test in progress" should go out.

13. The "test-in-progress" lamp will remain lit during an MST. The test will be completed in about 4 minutes. The "test-in-progress" lamp will then go out, and the tape will rewind.

14. Four minutes are required to rewind the tape. At the end of that time, the tape index lamp will illuminate.

15. See that the NO-GO and "Aft Mating" lamps come on. Since no missile was connected, an overall NO-GO should result at this point.

16. Press the reset button.

17. The pretest is now complete. If no missiles are to be tested with the next few hours, press the POWER OFF button.

There is no shipboard testing of Tartar missiles. All testing equipment for Tartar missiles has been removed from ships. Tartar GMLS are in a No-Test program which requires only missile stowage maintenance prior to missile firing. (Test set DSM 55 is used at shore stations only.)

Talos

Like the Terrier, Talos missiles should be given initial checkout and servicing as soon as possible after replenishment. Thereafter, check-out is accomplished periodically. Initial mating of the missile and booster includes installing the antenna lenses, matching the missile codes with those of the guidance radars, connecting the explosive lead to the warhead-booster assembly or electrically connecting the thermal-battery assembly. This routine is also followed in emergency operations, instead of the complete missile checkout.

PREPARATION OF THE TALOS MISSILE FOR CHECKOUT. - Preparatory steps for Talos missile routine checkout are as follows:

1. Select the round to be tested, remove it from the magazine, and transfer it to the check-out area.

2. By means of the ready service crane, transfer the round to the missile and booster dollies, and secure the round to the dollies.

3. Unmate the booster from the missile and return the booster to the magazine.

4. Remove the missile antenna lenses.

TALOS MISSILE CHECKOUT. - Talos missile checkout is accomplished by conducting a Tactical Missile Test (TMT), using the equipment previously described, and following instructions for the use of these equipments as contained in the applicable OPs. In general, the following steps are necessary.

1. Disconnect the flexible explosive lead (in Guided Missile Mk 11 Mod 2) or disconnect the thermal battery assembly (in Guided Missile Mk 11 Mod 4).

2. Check the nitrogen pressure in the inner-body assembly if the missile is Mk 11 Mod 4.

3. Make surveillance checks for fuel and hydraulic fluid leaks.

4. Match the codes and radio frequency to the guidance radars.

5. Conduct a "GO", "NO-GO" tactical missile test.

6. Perform missile maintenance as necessary.

7. Service the missile as necessary.

8. Test the innerbody assembly (if missile is Mk 11 Mod 4) by means of NAVORD Adapter Receptacle supplied with Test Set AK T-3074.

9. Reconnect the flexible explosive lead (in Mk 11 Mod 2) or reconnect the thermal-battery assembly (in Mk 11 Mod 4).

The TMT is also called the missile Operability Test (MOT), in fact, this term is replacing the earlier one.

When the above steps are completed, the missile and booster are remated in the checkout station, the antenna lenses are reinstalled, and the round is returned to the magazine. Subsequent to the initial checkout described above, periodic checkouts will be the same, except that it will not be necessary to again match the codes and radio frequency to the guidance radars unless the radar's code and frequency have been changed. If the TMT indicates NO-GO for the Talos and the fault has been indicated by means of the monitoring panel, replacement or adjustment of faulty components and modules should be accomplished.

Repair of missiles and boosters is limited to replacement of readily replaceable components, such as electronic packages, inner-body assemblies, booster shoes, and other items which do not require extensive disassembly operations,

servicing, and adjustment procedures. The original versions of missile incorporate the large size electronics packaging which require the assistance of handling equipment. Since the checkout compartments each stow one set of replaceable spare parts, the units may be taken from these areas and replaced during lull periods.

When the test is completed, reconnect the flexible explosive lead (Mk 11 Mod 2) or the thermal battery assembly (Mk 11 Mod 4). Remate the missile and booster in the checkout area, reinstall the antenna lenses, and return the round to the magazine. After the initial test, step 4 can be omitted unless the radars' code and frequency have been changed.

In the test equipment checkout and missile warmup period, the test set runs through two self-check sequences. The results of the tests are indicated in GO/NO GO fashion on the test panels. If any element covered by the test is found faulty, a TATTE failure lockout command stops the test.

The self-check portion of the overall test is at the beginning of the test tape, or a special tape may be provided which contains only the self-check portion. With the special tape, the self-check of the test equipment can be performed without doing the missile operability test (MOT).

OP 2900 (Volume 3), Guided Missile Test Set AN/DSM-60, Operation and Maintenance (U:C), contains the complete instructions for the use of the technicians who conduct the missile tests. If you need to help with the tests refer to that text.

OWN SHIP'S MAINTENANCE PROGRAM

The development of planned systems for maintenance of ordnance and ship's equipment was discussed in the preceding course and in earlier chapters of this text, and also in your military requirements courses. Each ship develops its own Current Ships Maintenance Project (CSMP) file which is used for planning and coordinating the ship's maintenance workload. The CSMP file is made up of deferred action report form 4790/2K for those maintenance actions which have been deferred because of a requirement for technical skills or special equipment not available on board ship. This information is also used for analyzing maintenance and logistic support problems; and, in addition, the CSMP makes it possible to record and report the need to delay an accomplishment of a required maintenance and can indicate the principal reason for the delay. The 3-M System of maintenance and material management, its purpose, organization, and procedures for shipboard use and the forms which make up the CSMP are explained in chapter 11 of this test.

SLOW-RUN-THROUGH (SRT)

Because all parts of the missile system must work together, testing of the complete system must be done before it is put into use, and at intervals thereafter. Shipbuilders and naval shipyards are given general and detailed specifications for installing the equipments and for checkout procedures after installation. The systems test after installation on shipboard is called the slow-run-through (SRT). Detail requirements for the SRT are established by the NAVSHIPSYSCOM. The SRT must demonstrate the satisfactory operation of the complete shipboard weapons installation, including supporting and auxiliary subsystems.

An SRT may also be necessary after a ship has undergone overhaul or conversion and after new or major alteration to the weapons system. Sometimes it is necessary after a minor alteration because of alignment problems. In that case the necessity for an SRT is determined by the type commander, NAVSHIPSYSCOM, and the shipyard. Any deficiencies revealed during the SRT must be corrected by the installing activity. The ship's personnel assist in conducting the SRT.

Testing of advanced ASW system installations, surface-to-surface, and surface-to-air missile installations begins with replenishment-at-sea and proceeds through all phases of strike-down, stowage, checkout, disassembly, servicing, checkout servicing, assembly, handling, and simulated launch. For ASW systems (Asroc), an actual or simulated sonar contact is introduced into the overall weapon system and checked through the underwater fire control system. On other systems, an actual or simulated output

from the ship's search radars is introduced into the overall missile system and checked through the weapons direction equipment, the missile fire control system, and the ready service feeder and launcher system. The feeder and launcher systems thereby receive orders that result in a missile being rammed on the launcher and the launcher trained and elevated to the position indicated by the initial input. Each magazine, launcher feeder, checkout, and strikedown system must be tested.

In addition to testing the weapons system, all supporting services and auxiliary subsystems must be tested. These include all associated lighting, air conditioning, humidity control, security alarms, sprinkling, damage control facilities, air sampler alarms, communications, and other utilities contributing to the effectiveness of the weapons system installation. Accurate time cycles must be recorded for parts of the system where the speed is part of the operational effectiveness.

When an SRT is being conducted on your ship, as a petty officer you will be assigned responsibility for checking the operation of parts of the ship's equipment and keeping the records of the operation. As a GMM 1 or C you will supervise the operation of parts of the launching system and the recording of results of the tests. The response of the launcher to train and elevation orders must be noted with care, and adjustment made if necessary. The correctness of the firing cutout cam is demonstrated by the launcher movement; the cam must prevent launcher movement into an area where the ship's structure or personnel would be endangered. Since there are differences in each installation, detailed instructions are prepared for each ship. From these instructions the tasks are apportioned among the ship's and contractor's personnel.

ORDALTS

Of course you know what an ORDALT is - you have worked with an on them a number of years in your Navy career. They are NAVORD authorized alterations to ordnance equipment, made to improve the existing ordnance. Many of the changes are made to improve the safety features of the equipment; others are changes to increase the accuracy or reliability of the equipment. Some are required and must be performed before the equipment is used again. Others are optional and mayor may not be performed before the equipment is used again. SHIPALTS are of NAVSHIPS cognizance and may be associated either with ORDALTS or alterations to equipment belonging to the NAVSHIPSYSCOM, but supervised by the weapons department. NAVALTS are handled as ORDALTS or SHIPALTS, as appropriate.

The program for accomplishing ORDALTS is described in the next chapter. The most essential changes must be made first; priority is assigned by the ship's Ordnance Accomplishment Requirement (OAR).

An ORDALT Instruction states the specific conditions of applicability of the ORDALT and the method by which it is to be accomplished. If it affects only a few units, the serial numbers of the equipments affected are given. All necessary drawings, sketches, etc., are included as part of the instructions. ORDALT kits should be ordered through normal supply channels. Authorization for accomplishment of ORDALTS on nonexpendable ordnance in accordance with NAVORD INSTRUCTION 8000.2, "Nonexpendable ordnance."

After the alteration has been made on the equipment, the ORDALT number must be stamped on the ORDALT plate on the equipment, if it has one. If it does not have an ORDALT plate, order one from Supply, inscribe the number of the completed ORDALT, and attach it to the equipment, if permissible. Guided missiles and torpedoes are examples of ordnance where it is not permissible to attach ORDALT plates.

As a GMM 1 and C you have more responsibility for getting the ORDALT promptly and precisely accomplished. Authorization for ORDALT accomplishment is by a specific work directive (letter, project order, allotment, etc.), and the current ORDALT are listed by number, name, and brief description in NAVORD ORDALT 00, in numerical order. Cancelled, completed, superseded, or disapproved OrdAlts are listed by number only. Keep informed on what changes are required for your equipment so you can plan to get the work accomplished on schedule. In some activities delay in

ORDALT accomplishment has seriously hindered and hampered the ship's mission. This is especially true when the ORDALT is intended to remove a safety hazard and the equipment may not be used until the ORDALT is performed.

Many of the ORDALT that apply to guided missile systems contain classified information and therefore are held by the publications custodian. Maintain the required security status when using them.

An ORDALT is not necessarily a complicated, lengthy alteration; some require only a few minutes to complete. The important thing is to schedule them for a definite time so they will be done at that time and not forgotten.

OVERHAUL

The quals require you to be able to overhaul mechanical, electrical, electronic, hydraulic, and pneumatic systems of the missile launching system.

That seems to include just about everything, and at first glance appears a well-nigh impossible requirement. However, the overhaul must be within the ship's capability as well as yours. Before you undertake an overhaul job, be sure you have the necessary equipment and facilities. Usually the OP for the equipment will state definitely whether it can be repaired or over-hauled aboard ship. Many electronic components are replaced rather than repaired aboard ship, and spares are carried in supply. In your daily practice session with the equipment you learn to make many repairs and adjustments, but in a combat situation it may be impractical to attempt repair of a sophisticated electronic unit.

The forms to be used in requesting and in reporting overhaul actions are discussed in the next chapter.

SUMMARY

This chapter covers the bare bones of the testing and maintenance program for the launching system, the missiles, and the operation of the weapons system. The systematic routine testing, inspection, and maintenance are discussed first for the launching system. The operability tests can be performed only with the assistance of other ratings. The system must be kept in operating condition, and therefore the Daily Systems Operability Test (DSOT) is necessary.

The missile must also be checked out frequently. The explosive components of course cannot be tested, but the reaction of the missile's electric, electronic, hydraulic, pneumatic, and mechanical parts to signals or commands are tested regularly with the aid of FTs. Although plans are being worked out so that missiles will not have to be tested aboard ship, shipboard testing of missiles will be continued according to schedule until such time as the NO-TEST system is ready.