


1. INTRODUCTION

SABER and SYSTEMS SABER submersible radio models meet the stringent requirements of U. S. MIL-STD-810C, Method 512.1, Procedure I, and MIL-STD-810D, Method 512.2, Procedure I, which require the radio to maintain watertight integrity when immersed in three feet of water for two hours. Radios shipped from the Motorola factory have passed the water immersion test and should not be disassembled. If disassembly is necessary, refer to qualified service personnel and service shops capable of restoring the watertight integrity of the radio.

CAUTION

It is strongly recommended that maintenance of the submersible radio be deferred to qualified service personnel and service shops. This is of paramount importance as irreparable damage to the radio can result from service by unauthorized persons. If disassembly is necessary, unauthorized attempts to repair the radio may void any existing warranties or extended performance agreements with Motorola. It is also recommended that submersibility be checked annually by qualified service personnel.

Submersible models can be identified by the black escutcheon with white lettering on top of the radio. If the radio is accidentally dropped in water, shake the radio to remove the excess water from the speaker grille area before operating; otherwise, the sound may be distorted until the water has evaporated from this area. Also, remove the battery and dry the battery contacts on the bottom of the radio.

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2. GENERAL INFORMATION

To ensure that the submersible radio is truly a watertight unit, special testing, test procedures, and specialized test equipment are required. The special testing involves a vacuum check of the radio and pressure testing (troubleshooting) for water leaks if the vacuum check fails. The specialized test equipment is needed to perform the vacuum check and pressure testing, if required.

NOTE

When ordering replacement batteries for a submersible radio, either NTN4596 (Ni-Cd, FM approved, Ultra-High-Capacity) or NTN4538 (Ni-Cd, FM approved, Medium-Capacity) should be ordered.

3. SPECIALIZED TEST EQUIPMENT

a. Vacuum Pump Kit, NLN9839

The vacuum pump kit includes a vacuum pump with gauge, and a vacuum hose. An adapter with gasket (NTN4264), which must be ordered separately, connects the vacuum hose to the radio's baseplate. The vacuum pump kit and adapter are also used on Motorola EXPO™ radios.

b. Pressure Pump Kit, NTN4265

The pressure pump kit includes a pressure pump with gauge, and a pressure hose; the pressure pump kit is also used on Motorola EXPO radios. As with the vacuum pump kit above, the NTN4264 adapter connects the pressure hose to the radio's baseplate.

c. Miscellaneous Hardware

Other items needed for testing the submersible radio include:

- Large water container.
- Fresh water
- A supply of replacement seals, O-rings, and gaskets (refer to the exploded view parts lists in the applicable service manual for Motorola part numbers).



Manual Scan

I hope this service manual is of use to you. Motorola does not make this available as a PDF and all other available copies are of poor quality.

Each page is captured at 600 DPI, and as 24-bit color, 8-bit grayscale or black and white and at the proper page size, up to 11x34 inches in many cases. OCR has been performed on the document, even on the large pages. The document is condensed into one single PDF with text overlay. You should be able to print the larger sheets on 11x17 or tile them onto 8.5x11 if needed.

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If something is incorrect here, or unreadable please reach out; I likely have the original lossless compressed images. In the final PDF that's color or grayscale will be JPEG 2000 format with highest quality selected. B&W images will be compressed using CCITT Group 4. This is quite close to the source material, but there may be some artifacts due to lossy compression. If there's a choice between file size and image quality, image quality will win. It's 2021 and storage and bandwidth is cheap.

This was captured on a Canon DR-G2140 scanner which is ~ 7500 USD unit circa 2021. You may note some artifacts and lines in on the scans, these are due to scratches on the sensor glass, and are minor. The replacement glass is about 250 USD if you're feeling generous :-)

If you have a hard to find/out of print manual and would like to make it available please reach out, I may be able to scan and return it to you.

Thank you,

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4. DISASSEMBLY AND REASSEMBLY

If disassembly and reassembly of the radio is required, refer to the "DISASSEMBLY/REASSEMBLY PROCEDURES" in the applicable service manual.

a. Disassembly

Disassemble the radio according to the "DISASSEMBLY" section of the applicable service manual; refer also to the "SERVICING MAJOR SUBASSEMBLIES" section.

b. Reassembly

Reassemble the radio according to the "REASSEMBLY" section of the applicable service manual; refer also to the "SERVICING MAJOR SUBASSEMBLIES" section. Tighten all hardware which was loosened or removed per the Torque Specifications table. **DO NOT RE-ASSEMBLE THE RADIO WITHOUT FIRST PERFORMING THE FOLLOWING PRELIMINARY INSPECTION PROCEDURE:**

- (1) Remove the main seal O-ring from the control top panel.
- (2) Inspect the seal area around the control top panel for foreign material that might prevent the main seal O-ring from sealing properly.
- (3) Install a new main seal O-ring; discard the old O-ring.
- (4) Check to ensure that both frame stud seals are in place and are not damaged in any way. Replace both frame stud seals if any damage or foreign material is visible.

CAUTION

The main seal O-ring should not be visible when looking at the top side of the radio. If the seal is visible, it is improperly installed.

NOTE

When seating the main seal O-ring in the radio housing, use hand pressure to press the radio into the housing. Make sure that the baseplate slotted-spanner nuts are properly aligned before tightening them.

5. VACUUM TEST

Refer to the exploded view diagrams and parts lists in the applicable service manual.

a. General

The vacuum test uses a vacuum pump and gauge. The pump creates a vacuum condition inside the radio, and the gauge monitors the radio for a stable vacuum reading; that is, checking for

a properly sealed, watertight unit. Before starting the vacuum test:

- Remove the battery and check the battery contact mounting screws for correct torque.
- Check the two baseplate slotted-spanner nuts for correct torque.
- Check the antenna bushing spanner nut for correct torque.
- Remove the universal connector cover to expose the universal connector.
- If the radio has a belt clip (NTN4741 only), check the revision letter stamped on the underside of the metal bracket. Revision "O" belt clips may cause leakage and should be replaced with a later version belt clip. *All radios with belt clips should be vacuum tested with the belt clip attached since the belt clip can affect the radio's leak rate.*

b. Conducting the Test

- (1) Attach the vacuum hose to the vacuum pump. Check the pump and hose for leaks by blocking off the open end of the hose and operating the pump a few times. The actual reading of the gauge at this point is not important; it is important that the gauge pointer remains steady, indicating no vacuum leaks in the pump.
- (2) Ensure that a rubber gasket is attached to the hose-to-baseplate adapter. Screw the adapter into the tapped hole in the baseplate.
- (3) Attach the open end of the hose to the adapter.
- (4) Operate the pump a few times until the gauge indicates 5 in. Hg; *do not pull more than 10 in. Hg of vacuum on the radio.* The gauge should indicate a leaking-down and should stabilize at some lower value. The leak-down is normal and important; it indicates that the pressure is equalizing across the port seal membrane.

NOTE

If this leak-down phenomenon does not occur, the port seal is probably missing, damaged, or wet. In this manual, refer to the "Baseplate Elastomer Seal or Vacuum Port Seal" paragraph of the "PRESSURE TEST" section.

Operate the pump again until the gauge indicates 5 in. Hg. Some additional leak-down will occur. After repeating this action two or three more times, the gauge should stabilize at 5 in. Hg.

(5) Observe the gauge for approximately two minutes.

- If the needle falls 2 in. Hg or less (for example, from 5 in. Hg to 3 in. Hg), then the radio has passed the vacuum test and is approved for submersibility. No additional testing will be required.
- If the needle falls more than 2 in. Hg (for example, from 5 in. Hg to less than 3 in. Hg), then the radio has failed the vacuum test and the radio might leak if submersed. Additional troubleshooting of the radio will be required; complete this procedure, then go to the "PRESSURE TEST" section of this manual.

(6) Remove the vacuum hose and adapter from the radio.

6. PRESSURE TEST

Refer to the exploded view diagrams and parts lists in the applicable service manual.

a. General

Pressure testing the radio is necessary only if the radio has failed the vacuum test. Do not perform the pressure test until the vacuum test has been completed. Pressure testing involves creating a pressure condition inside the radio, submersing the radio in water, and observing the radio for a stream of bubbles (leak). Since all areas of the radio are being checked, observe the entire unit carefully for the possibility of multiple leaks before completing this test.

b. Conducting the Test

- (1) Screw the adapter (with gasket) into the tapped hole in the baseplate.
- (2) Attach one end of the pressure hose to the adapter and the other end to the pressure pump.
- (3) Operate the pump until the gauge reads approximately 1 psig. Some leak-down is normal as the pressure equalizes across the port seal membrane.

CAUTION

Pressure any greater than 1 psig may push air around the main seal and may damage the grille area.

- (4) Maintain the pressure at 1 psig and submerge the radio into a water-filled container.

(5) Watch for any continuous series of bubbles.

NOTE

Some air entrapment may cause the accumulation of bubbles, especially in the grille area, but the bubbles should not be continuous.

(6) Note all of the seal areas that show signs of leakage. Pinpoint the problem(s) to one (or more) of the following areas:

- (a) housing
- (b) baseplate elastomer seal or vacuum port seal
- (c) antenna bushing seal or lightpipe seal
- (d) frequency switch and on/off/volume control
- (e) rf connector
- (f) dual-function switch and actuator assembly
- (g) frame stud seals
- (h) main seal

(7) Remove the radio from the water container and dry it thoroughly. Be especially careful to dry the area around the main seal to prevent contamination of the internal electronics while the unit is open. Also, to keep the area around the port seal dry, make sure that there is no water around the baseplate vacuum port.

(8) Remove the adapter and pressure hose added in steps (1) and (2).

c. Troubleshooting Leak Areas

Before repairing any leak, read all applicable area repair paragraphs. This will help to eliminate unnecessary disassembly and reassembly of a radio with multiple leaks. Troubleshoot only the faulty seal areas listed in the "PRESSURE TEST" section, and, when multiple leaks exist, in the order listed.

NOTE

Before reassembling the radio, always install a new main seal O-ring, and new O-rings in the defective area.

(1) Housing

If a leak occurs in any portion of the housing assembly (monitor, push-to-talk, or RAT switches, speaker grille, or universal connector), replace the housing.

(2) Baseplate Elastomer Seal or Vacuum Port Seal

(a) These seals can, and should, be repaired without removing the radio chassis from the housing assembly. Remove the baseplate by

loosening the slotted-spanner nuts and removing the center battery contact screw.

NOTE

Before removing the baseplate, note the location and orientation of the battery latch and battery latch spring.

(b) Inspect the elastomer seal for damage or foreign material; replace or clean as necessary. Remove the old vacuum port seal, and inspect the sealing surfaces of the housing and baseplate for damage; replace any faulty items, and install a new vacuum port seal.

(c) Ensure that the center O-ring portion of the elastomer seal is fully seated around the threaded bushing in the housing. Reassemble the baseplate with the convex surface of the latch spring toward the baseplate. Tighten the battery contact screws and slotted-spanner nuts to the correct torque.

(3) Antenna Bushing Seal or Lightpipe Seal

(a) Check the antenna bushing spanner nut for correct torque. If the nut is loose, tighten it to the correct value and run the pressure test again. If the nut is not loose, the antenna bushing must be replaced. This will require the removal of the main circuit board from the frame assembly according to the following procedure:

1. Referring to the "DISASSEMBLY" section in the applicable service manual, disassemble the radio until the speaker bracket assembly is disconnected and removed from the frame assembly.

CAUTION

Ensure that all static electricity safeguards are in place prior to beginning radio disassembly.

2. Read the precautions outlined in the "SERVICING MAJOR SUBASSEMBLIES" section of the service manual before performing steps 3 through 8, below.
3. Disconnect the PTT/controls flexible circuit from the radio circuit board.
4. Remove the back shield.
5. Remove the two bottom connector screws and three power amplifier module (U202) screws (one through the PC board, and two through the frame), securing the main circuit board.

6. Gently remove the ground clip. If the clip is bent during removal, replace it.

7. Remove the power amplifier module (U202).

8. Grasping the main circuit board at the bottom connector end, lift the board and carefully slide it out from under the control top panel.

CAUTION

When the main circuit board is removed, fragile wireform and ground contacts are exposed. Handle gently to avoid damage.

(b) The control top panel must now be removed from the frame assembly. Remove the two screws that hold the panel to the side of the radio frame.

(c) Remove the on/off/volume control and frequency switch knobs by grasping the tip of each knob with pliers and pulling the knob off the shaft of the switch. Open the insert by inserting a screwdriver blade into the insert's slot, then pull the insert off the shaft. Remove the torque washer from the volume control, if necessary.

(d) Remove the detent washer from around the frequency switch, noting the orientation of the washer, relative to the switch, prior to removal. Then, remove the spanner nut from each switch.

(e) Noting the location of the lightpipe, which will be loose, lift the control top panel off the frame.

(f) Remove the antenna bushing spanner nut and the antenna bushing from the control top panel. Inspect the sealing surfaces on the control top panel and bushing; replace faulty items as required. Remove and discard the old antenna bushing O-ring, and install a new one.

(g) Before reassembling the radio, inspect the O-rings on the lightpipe, on/off/volume control, and frequency switch for damage and foreign material. Also, ensure that the lightpipe and the antenna bushing's hex head are properly seated in the control top panel.

(h) Reassemble the radio in reverse order of disassembly, using new frequency switch and on/off/volume control knobs and inserts.

(4) *Frequency Switch and On/Off/Volume Control*

- (a) Remove the suspect knob by grasping it with pliers and pulling it off the shaft of the switch. Then, grasp the insert with the pliers and pull it off the shaft. If you are working on the frequency switch, remove the detent washer from around the switch as well, noting the orientation of the washer, relative to the switch, prior to removal. If you are working on the volume control, remove the torque washer as well, if necessary.
- (b) Check the switch's spanner nut for correct torque. If the nut is loose, tighten it to the correct value and rerun the pressure test. If the nut is not loose, determine if the leak is internal (from within the switch) or external (from around the switch) by pressurizing the radio to 1 psig, submersing the unit in water, and observing the flow of bubbles.
- (c) Following the procedures detailed in "(3) Antenna Bushing Seal or Lightpipe Seal," above, disassemble the radio until the control top panel is removed from the frame assembly.
- (d) If the leak is from the internal switch seal, replace the switch; follow the unsoldering and replacement instructions contained in the new switch's instruction sheet. If the leak is from the external switch seal, replace the switch's O-ring.
- (e) Before reassembling the radio, inspect the light pipe seal and both switch seals for damage and foreign material. Repair or clean as necessary.
- (f) Reassemble the radio in reverse order of disassembly, using new frequency switch and on/off/volume control knobs and inserts.

(5) *RF Connector*

- (a) To replace the rf connector seal, disassemble the radio until the main circuit board is removed from the frame assembly, following the procedures detailed in "(3) Antenna Bushing Seal or Lightpipe Seal," above.
- (b) While applying light pressure on the rf connector, pull and disconnect the rf ground clip. If the bubbles in the pressure test come through the rf connector (as opposed to around the connector), then replace the connector. Lift out the rf connector and replace the O-ring. Inspect the rf connector hole in the control top panel for foreign material, and clean as required.
- (c) Reassemble the rf connector, snapping the rf ground clip in place while applying pressure to the connector. Ensure that the ground clip is fully seated within the groove in the connector.

- (d) Reassemble the radio in reverse order of disassembly.

(6) *Dual-Function Switch and Actuator Assembly*

- (a) Remove the knob assembly by gently separating the two arms of the switch bracket (located between the switch and the main O-ring seal) and pulling the knob up and away from the control top.
- (b) Remove the O-ring from the knob's shaft and replace it with a new, prelubricated O-ring.

NOTE

The switch bracket should hold the switch firmly against the inside of the control top panel. If this is not the case, replace the switch bracket.

- (c) Before reinserting the knob into the switch bracket, ensure that the slot in the switch is properly aligned with the blade on the knob's shaft.
- (d) Reinsert the knob into the switch bracket; the arms of the switch bracket will snap into position (approximately 0.2 inches apart).

NOTE

The knob should not be loose in the switch bracket; if the knob is loose, replace the switch bracket.

(7) *Frame Stud Seals*

- (a) Remove the seals by pulling them off the frame studs.
- (b) Inspect sealing areas on the radio housing for foreign material, scratches, and nicks. Clean off foreign material as required; replace the housing assembly if it is damaged in any way.
- (c) Install the new seals, ensuring that they are fully seated against the radio frame before reassembling the radio.

(8) *Main Seal*

- (a) Remove and discard the old main seal O-ring around the control top panel. Inspect the sealing surfaces on the housing and control top panel, replacing faulty items and cleaning off any foreign material.
- (b) Inspect the speaker bracket assembly to ensure that the two tabs protruding from the top of the speaker bracket are properly seated *between* the frame and the control top panel. An improperly located speaker bracket will distort the housing in the seal area, causing leakage.

- (c) Remove the antenna before installing a new main seal O-ring. Install the main seal O-ring by first placing it in the groove on the antenna side of the radio, then by slowly stretching the O-ring around and over the frequency switch and on/off/volume control, and finally by dropping it into the groove on the push-to-talk switch side of the radio.
- (d) Inspect again for proper seating of the main seal all around the control top panel, and for foreign material. Observe carefully to ensure that the main seal O-ring is not pinched between the radio housing and the control top panel during insertion of the radio chassis into the housing assembly. Pinched main seal O-rings are one of the most common causes of vacuum test failures.

RELATED PUBLICATIONS AVAILABLE SEPARATELY

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| SABER I OPERATING INSTRUCTIONS..... | 68P81065C60 |
| SABER II/III OPERATING INSTRUCTIONS..... | 68P81065C65 |
| SYSTEMS SABER OPERATING INSTRUCTIONS..... | 68P81060C10 |
| SABER VHF SERVICE MANUAL..... | 68P81043C90 |
| SABER UHF SERVICE MANUAL..... | 68P81043C95 |
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