



ARC-1

Acoustic Release Control System



Photo: Robert Schwimmer

Operator's Manual

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Important Note for First-Time Users of the ARC-1 System

The operational reliability of the ARC-1 system depends to a significant degree on proper operator training and the establishment and verification through testing of operational procedures. DO NOT expect to use the ARC-1 system without prior training and testing of your procedures. Instead, reserve a day at sea for training and go through the steps of system preparation, deployment and recovery a few times until the bugs are worked out and everyone is comfortable with the system.

Each operation is different, however, here are a few points to consider.

What anchor will you use?

The anchor could be a sand bag, a lead weight, a concrete block or some other device. It must be heavy enough to avoid dragging due to currents. Yet, it must be easy enough to handle so that the full anchor weight will not rest on the release wire during deployment, causing it to break.

How will you attach the anchor to the ARC-1?

We recommend the use of a wire loop manufactured from a plastic sheathed and crimped stainless steel wire to link the ARC-1 to the anchor assembly. The wire must fit into the small weight attachment slot of the ARC-1 device. If you use a crimp to manufacture the loop, make sure it is stainless steel as well, or else you may suffer loop breakage due to dissimilar metal corrosion.

How much flotation will you use?

We recommend the use of about 15 lb of flotation. That is enough to trigger the mechanism even if some fouling exists, yet it does not stress the release wire too much. However, you may need more flotation if you are in an area with high current where your instrument assembly may be pulled sideways.

How will you deploy the ARC-1?

Just prior to use, you will attach the anchor and payload. After that, it is necessary to lower the assembly into the water without putting a shock load on the release. Can you do this on a rolling deck?

How will you relocate the ARC-1?

You should make use of the system's GPS position logging function. In any case, it is critical that you record the location of each station. The serial number of the station at the location must be recorded, because it is used to trigger the release.

Noise testing

If noise levels are too high, the ARC-1 may not fall asleep and its battery will deplete prematurely. Also, you may have trouble talking to the station. Conduct a noise test at your work site.

Acoustic communication, release and recovery testing

Once everything is worked out, make sure to perform a few releases and recoveries to test and refine your procedures. Be prepared to send a diver in during those tests if something goes wrong. (Use a recovery line for testing beyond diver depth). Carefully consider the results of your testing, and decide if you are ready for actual deployments. It's better to implement improvements and re-test than risk losing your instruments.

1. Introduction

The ARC system is an acoustic release system for managing the deployment and retrieval of seafloor payloads. It consists of at least one ARC-1 release station (transponder/release unit), the surface station hardware, and the ARC surface station software. As the name “acoustic release” implies, the surface station communicates with the ARC-1 release stations using acoustic (sonar) signals.

This manual describes the system in detail, how to deploy and retrieve ARC-1 stations with their payloads, how to manage the record of the operation, and how to export the ARC position data for mapping in a GIS program (such as ARCVIEW). It also describes how to change ARC-1 batteries and reload a spent ARC-1 with a new release wire.

The ARC-1 Station

The transponder is part of our modular acoustic systems so it can be controlled with either of our standard surface stations, the STM-1 or the the STM-10, and station firmware can be upgraded through download, to support new functions.

The Release Device

The ARC-1 release unit is based on an innovative design concept for the release device (patent pending). To release the payload from its anchor a corrosion-resistant connecting wire is melted with an electrical charge. Compared to traditional acoustic release units, which often use an electromagnetic release device (solenoid), this increases reliability and decreases cost.



Figure 1.1: ARC-1 Acoustic Release

2. Operating the surface station

Surface Station Equipment & Software

The ARC-1 acoustic release is controlled from a Desert Star surface station model STM-1HP/48 or STM-10HP/48. The surface station is connected to a Windows PC, which runs the ACOUSTIC RELEASE CONTROL software. The surface station and software are not included with the ARC-1 and must be purchased separately. We recommend the model STM-1HP/48 for surface station operation in a dry environment (boat cabin), and the model STM-10HP/48 for operation in an open boat.

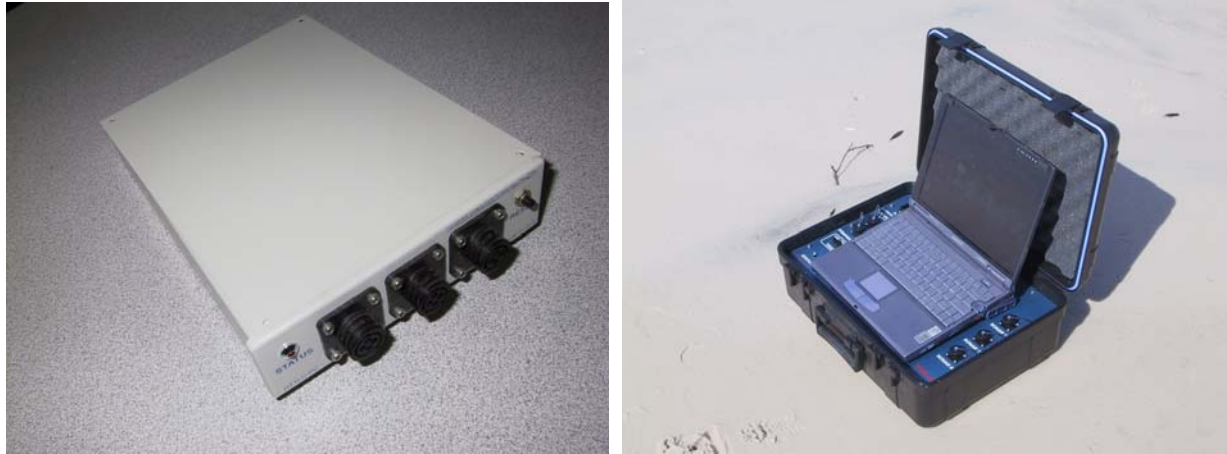


Figure 2.1: Surface station models STM-1HP/48 (left) and STM-10HP/48 (right)

The ARC-1 can also be interrogated from a model VLT-1HP/48 ROV station, to aid in the recovery of a stuck station. The station is mounted on the ROV and communicates via a twisted wire pair in the umbilical with the Windows PC (running ACOUSTIC RELEASE CONTROL) at the surface. The operator will obtain distance to a selected ARC-1, and can fully control the ARC-1 via commands issued by the VLT-1HP/48 ROV station.



Figure 2.2: Model VLT-1HP/48 ROV Station

The surface station or ROV station links to the Windows PC via a RS-232 COM port. We also recommend the connection of a GPS receiver to the PC, via a second COM port. If your PC does not have sufficient COM ports, use a USB-to-serial adapter, which are widely available via web sites and at computer stores.

Following installation of the ACOUSTIC RELEASE CONTROL software (supplied on CD), start it by clicking on its icon.



Next, select the COM port for the surface station and GPS receiver by clicking on **Options**.

The Control Display

The Acoustic Release Control screen allows you to manage all deployment and release activities and provides a record of **Deployed** and **Released** stations. Figure 2.3 describes the data fields that have abbreviated names. The serial number of an ARC-1 station that has been deployed is listed with a green symbol next to it and one that has been released has a red symbol next to it.

Adjusting column widths

The column widths can be adjusted manually, by clicking and dragging the column-title dividers, or automatically by double-clicking the column-title dividers.

Note: Do not use commas in the Comments column, they will be deleted by the software because commas are used to parse the data record.

The screenshot shows the 'Acoustic Release Control' window. It features a menu bar (File, Action, Options, About) and a main data table titled 'Deployed Station Data'. The table has columns for SN, Latitude:Longitude, Comment, Time:Date, Range, and %. Below the table are buttons for 'Deploy Station' and 'Release', and a status section showing 'Current GPS Location', 'Active Station Data', and 'Current Status'.

SN	Latitude:Longitude	Comment	Time:Date	Range	%
963	3640.8967N/12145.8152W	Camera #1	18:11:21 11/12...	450.50	99.0
964	3642.6629N/12145.8152W	Camera #2	18:11:21 11/12...	502.25	96.5
965	3645.7628N/12145.8152W	Camera #3	18:11:21 11/12...	475.50	100.0
967	3645.8168N/12145.8152W	Camera #4	18:11:21 11/12...	486.23	98.7
968	3645.9370N/12145.8152W	Test Equipment	18:11:21 11/12...	500.26	100.0
969	3646.0571N/12145.8152W	Camera #5	18:11:21 11/12...	498.73	94.3

Callouts in the image point to: 'Deployment Time and Date' (Time:Date column), 'Distance to Station (m)' (Range column), 'Signal Success Rate' (% column), 'Deployed Station Position' (Latitude:Longitude column), and 'Serial Number and Status Indicator (green is Deployed, Red is Released)' (SN column).

Figure 2.3: The Acoustic Release Control Display

Managing the Mission Record

During a mission there are actually four states that an ARC-1 station may be in: **Ready-to-deploy**, **Deployed**, **Released** (from the seafloor), and **Recovered**. As stated above, the ARC software tracks two of these, **Deployed** and **Released**. A **Released** station can be removed from the displayed list but it is recommended that they be left on the list (for the record) until after the mission is over and/or the mission information has been saved as a file separate from the default Deployment Log (which is over-written every time a change is made).

However, if an ARC-1 station is to be used again immediately it must be removed from the list before it can be deployed again. In this case, if you want to easily record the fact that it was released and re-deployed you can save a text record of the current Deployment Log by selecting **Save Deployment Log As** from the **File** menu. This will allow you to give the file a different name, such as the date/time or a series number.

Working with release stations

To add a station to the list: With the ARC software running and the surface station transducer and release station transducer in a bucket of water together, click the **Deploy Station** button or select **Deploy Station** from the **Action** menu. Enter the appropriate information and click the OK button.

To perform an action on a station: Select the station from the list by clicking on it. This will "activate" the release station, i.e. the surface station will try to communicate with it.

If you have just selected a station and want to cancel the activation, select off the list (anywhere there is not a station listed) or you can right-mouse-click the currently activated station. This will stop communication attempts and deselect the station.

When activating a station the **Current Status** window will display the following messages:

1. "Activating : 1127... Sending ID Packet #1"
2. "Activating : 1127... Sending ID Packet #2"

If a station falls asleep while still selected: The station is asleep if the station is selected but no new data is being received (indicated in the Current Status area). The station will need to be reselected. To do this you can either select off of the station and then reselect the station to reactivate it or you can double-click the sleeping station.

GPS Integration

Any GPS with a serial port connector can be used to provide automatic position data entry (the Garmin Etrex Summit has been used with good results). You will need a serial cable and possibly the instructions for changing output settings. You can select the com port for the GPS under **Options/GPS Com Port**. The ARC software will automatically recognize the GPS when it is plugged in. If it does not, restart the ARC software.

Manual GPS position entry

If GPS integration is difficult or not available a GPS position can be manually entered into the comment column each time a station is deployed.

3. Equipment Preparation

Before any stations are deployed they must be prepared and the performance of the STM-1 (or STM-10) surface station and all ARC-1 stations must be tested to ensure proper functioning. We recommend that you prepare the equipment in an unhurried fashion well before the time of deployment. This is your opportunity for a good inspection.

1. Install batteries (see section nine).
2. Conduct a test of the ARC-1 station. Do this by first letting the station rest for more than 30 seconds without any noise (put it on a table) to allow it to fall asleep. Then, forcefully knock against the sonar transducer with a pen. The station should wake up and emit two clicks through its sonar transducer. This verifies proper operation of its receiver, sonar transmitter and the microprocessor. If you don't get any clicks, let the station rest for once more, then try again (the ARC-1 will only respond with clicks if it has been asleep). The ARC-1 also has an internal LED for factory test purposes. Its glow is visible through the white Delrin housing in a darkened room or at night. Table 3.1. lists the LED patterns.



Figure 3.1:
50 lb load test.

Blink Pattern	Station Status
One short blink per second	Working normally
Double-blink	It received an interrogate or reply
No blink	Station sleeping or battery dead

Table 3.1: LED Blink Patterns

3. Mark each station with your return information in case of a loss. Use a bold permanent marker. Alternatively, Desert Star can provide labels with custom printed return information on request.
4. For missions of more than one-month duration, we recommend spray painting the release mechanism with an anti-fouling paint.
5. As the final step of equipment preparations, we recommend conducting the communication test (see section below). This test adds the ARC-1 to the list of available stations and verifies that it will indeed communicate with the surface station. Alternatively, you may conduct this test at the deployment site, with your instrument assembly already in the water but still secured by a line. Testing at the time of deployment however requires the surface vessel to linger in place for a couple of minutes and the instrument assembly to be held secure at the surface. This may not be practical under many conditions.

Performing a Communication Test

Caution

The acoustic communication test verifies that the system is working properly. This test may be conducted as the last step of the equipment preparation process (by placing the ARC-1 and the surface station transducer in a water filled bucket) or at the moment of deployment. However, be careful. The ARC-1 sonar transmitter and the release mechanism are powered by the same set of four 'AA' cells. These cells deplete completely within about 2 hours of acoustic communication. Therefore, keep the communication test short – two to three minutes should suffice.

1. Choose **Deploy Station** from the **Action** menu, enter the ARC-1 station serial number, and follow the instructions in the window that is displayed. Click OK to proceed to Communication Connection Test Dialog window (Figure 3.1).
2. In the following window you will be instructed to place the station in the water for a System Communication Test .
3. **Perform this step if you are conducting the communication test at deployment time:** When communication is established the connection status will display **Successful Communication Link to Station**. The station is now ready to deploy. When you reach the target deployment position, hit the **Continue** button and drop the instrument assembly at the same time. The GPS position and deployment time is recorded at that moment, and the station is marked as deployed by a green square in the station list. **Caution:** Unless you are directly on-target when you hit **Continue**, the recorded GPS position will be incorrect. Disregard it until you are on-target, then you can use the **Mark GPS** command (or hot-key "M") to correct it.
4. **Perform this step if you are conducting the communication test as part of station preparation (not at deployment time):** When communication is established the connection status will display **Successful Communication Link to Station**. Complete the test by clicking on **Continue**. The ARC-1 is now added to the station list, and it is marked as deployed by a green square in the station list. A GPS position is recorded, but it will be in error because you are not at the deployment site. Next, check the battery and capacitor integrity by noting their levels in the **Current Status** field at the bottom of the main window. The battery level should recover to 5 V or

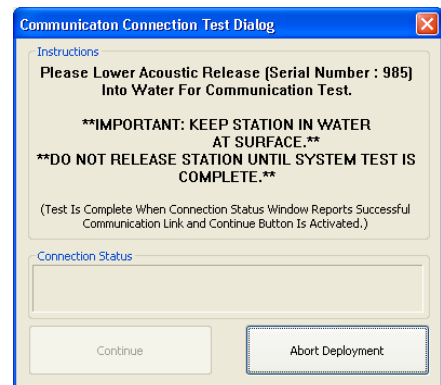


Figure 3.2: System Communication Test

more after charging the capacitor and the capacitor should read 25 V or greater to ensure proper release functioning. **If they do not: DO NOT DEPLOY THE UNIT, its release function may be impaired. Read the instructions in the box below.**

Interpreting Battery and Capacitor Voltage Reports

The ARC-1 surface control software reports the battery and capacitor voltage of an interrogated ARC-1 station in the **Current Status** field. The readings are subject to certain important conditions that may cause confusion. Please use the following information to properly interpret the data.

1. The voltage reporting acoustic telemetry is designed for maximum efficiency of reporting. It is NOT secured against erroneous reporting and some incorrect readings due to acoustic noise in the environment, echoes or a weak signal are expected. Typically, such problems manifest themselves as erratic and sometimes impossible readings. If you notice erratic readings, ignore obvious outliers. If the readings change somewhat in a random fashion, it is reasonable to assume the approximate average reading to be correct.
2. The capacitor voltage is measured across the burn-wire. This feature can be used to verify proper installation of the burn-wire. If you get a persistent capacitor voltage reading of just a few volts while testing in the air, then the burn-wire is not installed correctly. Check the wire and correct the problem before proceeding. (A low reading is not normally seen in salt water, because the conductivity of the salt water is sufficient to report the capacitor voltage even if the burn wire is not installed).
3. A persistent battery voltage indication of below 5V indicates a not fully charged battery. However, the unit may still function down to reporting voltages of approximately 3.5V. Nevertheless, the battery should be changed before a deployment.

4. Deploying an ARC-1 Station

1. Before deploying the first station, and for selected stations thereafter, perform a **Noise Test** (see following subsection) to ensure that noise levels are not too high in the area of deployment.
2. Rig stations for deployment. We recommend the use of 15lb of flotation. This is enough to ensure reliable trigger even if some mechanism fouling should occur; yet it does not stress the release wire unduly. In no case should the flotation be less than 10 lb or more than 40 lb.
3. Install release wire on all stations (see section eight "ARC-1 Hardware").
4. **Critical Step:** Perform a load test by attaching a 50 lb weight to the release and lifting carefully. Scuba diving weights work well. See figure 3.1.
5. Disconnect the load weight and instead attach the anchor.
6. **Perform this step if the communication test has been done during the equipment preparation process:** On the station list, select the station to be deployed, then upon reaching the designated site hit the **Mark GPS** keystroke, "M", (or select **Mark GPS** from the **Action** menu) and at the same time lower the station into the water.
7. **Perform this step if no communication test has been done yet:** Perform a communication test (refer to the section above).
8. **Be careful not to exceed the holding capacity of the release wire as the instrument assembly is deployed.** Hold onto the anchor weight until it reaches the water, then let go of the ARC-1 and payload, and finally let go of the anchor weight..

Performing a Noise Test

Common sources of noise include running engines and snapping shrimp (or other biological noise). A noise test will tell you if this background noise will interfere with system communication and also indicate if it may be high enough to keep the release station awake, thus draining its batteries prematurely. If the noise level is too high, look for sources of noise that can be turned off, such as engines. You can also reduce sensitivity by raising the signal **Threshold Level**, with the slider. However, this will reduce range. In these cases, baseline station distance may have to be reduced.

1. Place the release station's transducer in the water and select **Noise Test** from the **Action** menu.
2. Set the Threshold Level slider to 120 dB, see Figure 4.1, (the recommended noise limit) and press the **Start Test** button
3. Test for 30 seconds to a minute. If the noise crosses the threshold every five seconds or more then you should adjust the threshold slider **upwards**. If there is very little noise you can move it downwards to increase the range of the system.
4. Hit the **End Test** button when you are done. The surface station will now use the last setting of the detection threshold.



Figure 4.1: The noise test display

Possible Deployment Problems

1. **Alkaline battery polarity:** Alkaline batteries can be installed backwards. If this happens the unit may not be able to charge the capacitor to 29V (it may remain in the 10V range). The unit should work fine once the problem is corrected.
2. **Boat Equipment Interference:**
 - Boat engine in idle may or may not be a problem.
 - Generators may cause high noise events every few seconds or so, but if it does not cause a system communication problem it can be left running during deployment.
 - During a previous mission a 50 kHz depth sounder generated about four strong (gain 1, 90 units) pulses per second at 44 kHz, and it was switched to 200 kHz during deployment. No noise was detected when operating at 200 kHz. In one test, sounder operations at 50 kHz still allowed ARC-1 to operate, but use of a 50 kHz sounder during ops should be avoided.
 - Scanning sonar can cause excessive noise and is not recommended during ARC-1 operations.
3. **Biological Noise:**

If biological noise is high the unit may not fall asleep after deployment, this would reduce the battery life and thus causing recovery failure. If there is high biological noise in the area put the release station in the water for 30 seconds without the boat engine or generator running. If it falls asleep (LED stops blinking) then the noise level is acceptable.

5. Releasing and Recovering an ARC-1 Station

1. Select the ARC-1 station you wish to retrieve from the available list and choose **Release Station** from the **Action** menu.
2. A dialog box will appear to double-check that this is the correct station you want to release from its anchor (Figure 5.1). Check that the ARC-1 station serial number is correct and select the **Yes** button.
3. The Current Status window displays the following.
 - 1) "Arming Station For Release... Please Wait".
 - 2) If arming fails it will show: "Arm Station Attempt # 1" (Count increases until successful)
 - 3) If successful: "Station Armed. Triggering Release"
 - 4) If triggering fails: "Trigger Station Attempt # 1" (Count increases until successful).
 - 5) "Station Release Command Acknowledged". This means the selected station has successfully received the release command and will now charge capacitors and burn the release wire (may take up to 30 seconds).
4. Watch for your instrument assembly to appear at the surface. You will be able to track its vertical progress using the range value for the released station.
5. To remove released stations from the list select **Remove All Released Stations From List** from the **Action** menu. This action is useful to keep your deployment log tidy.

Releasing All Stations

Caution

This option is provided for emergencies only. It will release any Desert Star Systems ARC-1 transponders within range of the signal. Do not use the command unless you are certain that no stations belonging either to you or another researcher are in the area and may be lost due to use of this command.

The Release All capability allows you to release all ARC-1 stations that are within range. Unlike individual station releases, this command does not require a successful two-way communication link. **This command must only be executed if you are certain that there are no other ARC-1 stations in the area that may pick up the command and surface without being noticed.** Nevertheless, it has proved useful for certain emergency situations:

- Release of a station under poor acoustic conditions, after several individual release attempts have failed.
- Recovery of a station with unknown serial number due to improper record keeping.
- Recovery of a station with a defective transmitter that prevents it from acknowledging an individual release request.

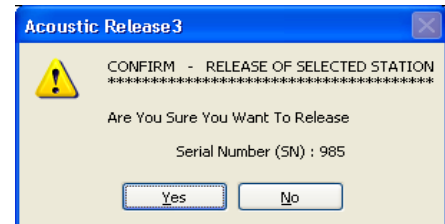


Figure 5.1: Release Confirmation

To release all stations, select: **Release All Control** from the **Action** menu, then click on **Release All Stations**.

When the **Release All Stations** command is given a dialog box will appear and count the number of attempted cycles of "release all" command and the Current Status display show the following:

1. "Sending Arm Command To Stations", then 10 seconds later:
2. "Sending Trigger Command To Stations"

This sequence repeats until you click the abort button on the dialog box. **Caution:** Click abort as soon as you are done to prevent accidental releases.

If you execute this command the released ARC-1's must be recovered and their status on the list must each be manually changed to "Released". This is because when using this command the software has no way of knowing if a station was in range or not, unless you tell it. To change the status of a station on the list, select the station and choose **Mark Selected Station Released** from the **Release All Command** submenu.

6. ARC-1 Mission-Life Test Procedure

This test is a recommendation only. It may have to be modified to suit your needs. It will decrease the probability of release station failures due to fouling, battery drain (i.e. sleep-mode failure), or mechanical abrasion (wave or current action).

Ideally, one or several ARC-1 in a network should be periodically tested to obtain early warning of impending failure of the deployed array. The test station should be in a location where wave energy is highest (shallow water) and where acoustic noise may be strongest (reefs, shallow water). Test initially in short intervals, then in longer intervals. For example, after 1 week, after one month and then every three months. Follow this procedure:

1. Activate and range to deployed station. Make sure communication works fine and capacitor charges OK.
2. If possible, retrieve the station without triggering release using a diver or ROV, then proceed with step three. Otherwise, issue release command and proceed with step five.
3. Perform a 50 lb load test on the station.
4. Measure resistance across release wire. **It should not be more than 0.2 Ohms.** (Note: Scrape a small portion of retainer screws, then hold probes tightly on scraped shiny screw surface.)
5. Inspect the station, in particular the release arm. Make sure the arm is not fouled and can move freely.
6. Re-deploy the station.

7. Data Reporting and Exporting

Printing the Deployment Log

Choose **Print Deployment Log** from the **File** menu to print the list of stations that are presently displayed. The printed list depicts a released station with an R before the serial number and a deployed station will have a D before the serial number.

GIS Data Exporting

If you would like to export the data in the Deployment Log to a GIS program for mapping it is very likely you will have to convert it from a text format to a DBF format. The DBF file format can be used by most, if not all, GIS programs.

The Deployment Log is automatically saved as a comma delimited text file in the same folder as the ARC program. This can be opened in MicroSoft Excel, modified to suit the needs of your GIS program (i.e. lat/long terms in the correct format, etc...), and saved as a DBF file.

The text format stored on disk is as follows:

Serial Number, Comment Field, Time in seconds since UTC (since 1970), range in meters, success rate percent, Deployment Status, NMEA GPGLL without the \r\n

Example: 1105,Camera#1,1038265511,1.000000,51.612903,DEPLOYED,\$GPGLL,3713.3991,
N,12145.8152,W,230942,V,S*57

Combining Cells in Excel

You may have to combine lat/long terms before your GIS program can use them. If you need to combine the terms in two columns (such as "3640.7642" and "N") you can find instructions for this in Excel's Help feature. The term to search for in Help is called "**concatenation**" (combining cells).

8. ARC-1 Release Mechanism

The ARC-1 uses an innovative (patent pending) release mechanism that consists of a replaceable nickel chromium wire connection (the release-wire) through which an electrical charge from a capacitor is shorted in order to melt it when the acoustic release signal is given. The release-wire runs between two posts and holds a hinged lever in place. This hinged lever in turn prevents a wire loop from escaping until the release-wire is melted by the electrical charge. The anchor weight is attached to the wire loop.

Replacing the Release Wire

Supplies needed:

- Nickel chromium release wire, as per specification in section ten of this manual
- Torque wrench with 5/64" Allen head to consistently tighten the set screws.
- 3/16" crescent wrench to hold the support post in alignment.
- Wire loops for the anchor attachment. Manufacture the wire loops from plastic sheathed stainless steel cable of not more than 1/8" overall diameter, crimped with a stainless steel crimp. **Caution: The wire loop has been identified as a cause of system failures. To date, two failure modes have been identified. (1) The wire loop fails at the crimp on account of the use of a crimp not made from stainless steel. This causes dissimilar metal corrosion. (2) The wire loop fails due to improper crimping, resulting in a loose or cracked crimp. Crimping must be done with the proper tool, and the operator must be trained in the proper crimping procedure.**

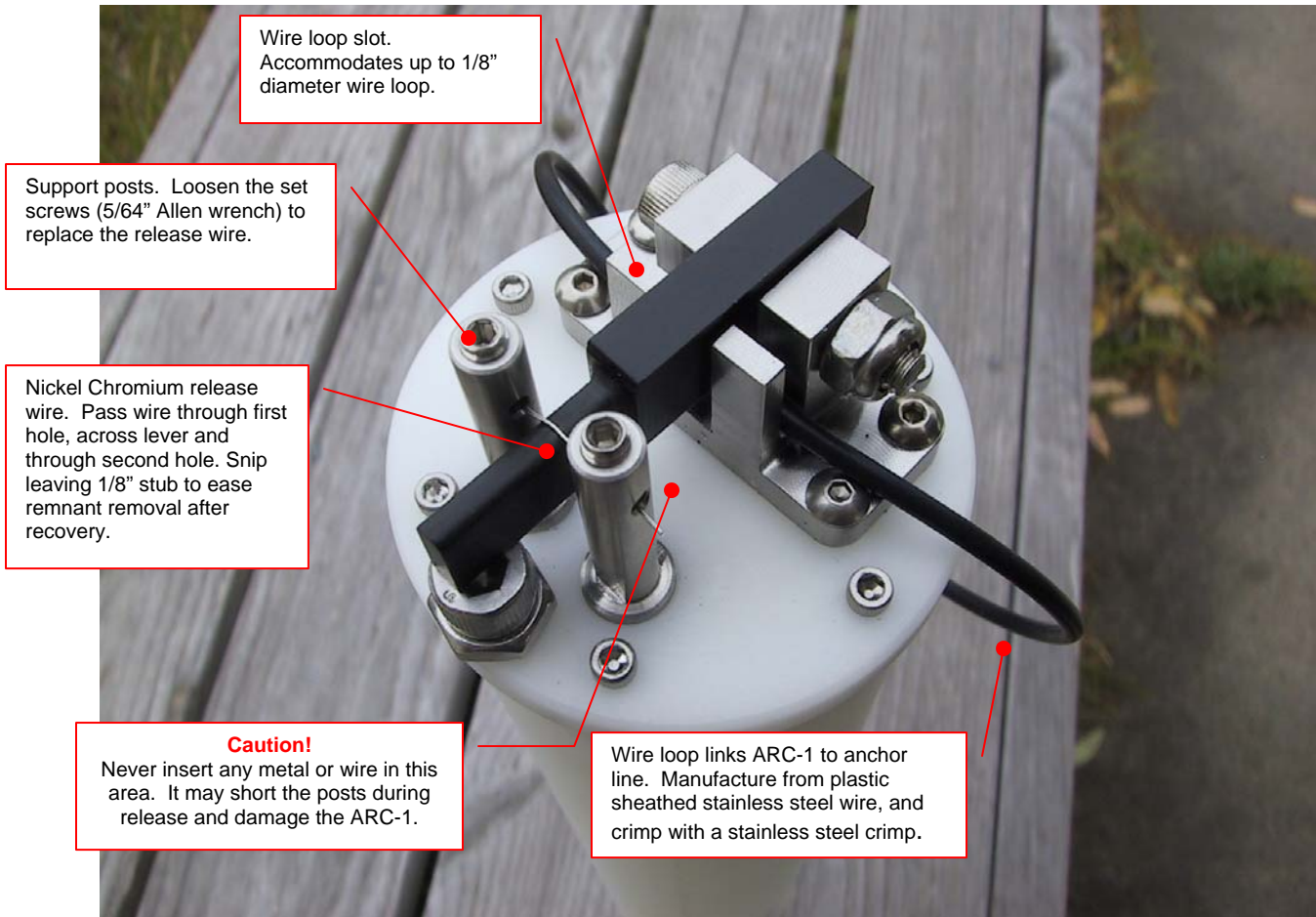


Figure 8.1: The Release End Cap

Replace the release wire using this procedure:

1. Loosen the setscrews at the top of the two posts using a size 5/64" Allen wrench.
2. **Critical step:** Remove any wire remnants from the previous deployment. Carefully inspect each wire hole and remove debris with a needle shaped stainless steel poking tool.
3. Insert the wire loop into the wire loop slot. The anchor weight will attach to this wire loop.
4. Insert a length of nickel chromium release wire from the outside through the hole in one post, across the lever arm and out through the hole in the second post.
5. Tighten the two setscrews to about 4 inch-pounds while holding the posts in alignment (preventing them from turning) with a 3/16" crescent wrench applied to the flat spots of the post. Use a torque wrench to obtain a consistent torque. Do not worry if the posts should turn slightly as each is sealed by an O-ring, however excessive turning could shorten the solder lugs on the inside of the instrument or weaken the wire.
6. Snip the excess wire, leaving about 1/8" to ease remnant extraction after recovery.

9. Changing the ARC-1 Batteries

Review the available battery options for the ARC-1, as specified in section ten of this document.

Follow this procedure to change the batteries:

1. Loosen and remove the six screws on the transducer end cap (opposite the release end cap) using a 3/32" Allen wrench.
2. Remove the end-cap by slightly twisting back and forth and pulling at the same time. Be careful, the sonar transducer wire is attached to the inside of the end cap.
3. **If ARC-1 is equipped for battery option #1:** Replace the four alkaline 'AA' cells in the holder, using Duracell MN-1500 batteries only. Be careful to note the proper polarity. Replace the Tadiran TL-5930/F lithium cell. Disconnect at the connector. Press the latch and gently pull.
4. **If ARC-1 is equipped for battery option #2:** Replace the Desert Star BAT00345 pack. Disconnect at the connector. Press the latch and gently pull.
5. Carefully slide the new batteries into the ARC-1.
6. Inspect the O-ring on the end cap. If you notice debris, remove the O-ring from its groove using the corner of a credit card for leverage. Wipe clean and apply a thin film of silicone grease. Replace the O-ring. Caution: Also inspect the O-ring for any cuts. Discard any cut O-ring and replace. See technical specification (section 10) for O-ring specifications.
7. Push the end cap back onto the housing, making sure that the no wire is getting caught between the O-ring and the housing. Align the screw holes and re-insert the end cap screws. Tighten to a snug fit, but do not over tighten to avoid stripping the threads.

Caution!

Only use the specified battery brand and model. While other battery brands and models may work, Desert Star has only conducted tests for the specified batteries and field use recommendations are valid for these batteries only.

10. ARC-1 Technical Specifications

Summary

- 2" OD housing, approx. 21.5" long.
- Buoyancy: slightly negative.
- Capable of supporting a payload of 40 pounds (2X safety factor).
- Depth rating: 1000 feet.
- Powered by standard alkaline batteries.
- Battery life: 6 months (2X safety factor).
- Housed in serviceable Delrin and Noryl plastic housing with stainless steel release hardware.
- Transponder functions support ranging to the units.
- Station firmware can be upgraded through download, to support new functions.
- Standard Desert Star surface stations can be used as interrogators.

Load Ratings

Design strength of components (other than release wire):	200 lb
Factory acceptance load test (with 26AWG wire):	80 lb
Recommended pre-deployment load test:	50 lb
Rated maximum load:	40 lb
Recommended nominal load:	15 lb
Rated minimum load:	10 lb

Release Wire

The ARC-1 is specified for use with the following release wire only.

Material:	Nickel Chromium Alloy (60% nickel, 16% chromium, 24% iron)
Gauge:	26 AWG
Supplier:	McMaster-Carr Part #8880K24 (1/4 lb spool) Desert Star Part #WIR00332

O-Ring Specifications

End caps:	Parker 2-130, Compound E515 (qty 2). Desert Star Part #ORI00058
Support Posts:	Parker 2-010, Compound E515 (qty 2). Desert Star Part #ORI00053

Battery Specification

Two battery options exist for the ARC-1. A standard battery option is supplied, see below. For long duration use, we recommend procuring a lithium D cell battery (explained below).



Figure 10.1: ARC-1 Standard Battery Pack

Standard Battery Pack

Release and sonar transmitter battery: Four Duracell Model MN-1500 'AA' alkaline cells, 2.5 Ah
Nominal battery life: 520 days

Microprocessor battery: Four Duracell Model MN-1500 'AA' alkaline cells, 2.5 Ah
Nominal battery life: 130 days

Note 1: Under laboratory conditions, assuming power consumption at maximum limit for factory acceptance testing (0.8 mA for microprocessor in sleep mode, less than 0.05 mA for sonar/release section in sleep mode).

Note 2: We recommend putting a safety margin in for the battery life. A very conservative approach would be half of the expected life time of the battery. You should also take the environment into consideration; you have a better chance of draining the battery in a very noisy harbor than you would in an open ocean.

Long Duration Battery Pack: Lithium D Cell

Microprocessor system battery: Tadiran model TL-5930/F 3.6V lithium 'D' cell, 18.5 Ah
Nominal battery life (note 1): 963 days

Note: We can not supply the D cell battery due to hazmat regulations. You can still use the battery with the connectors in the ARC-1; the standard connector that comes with the Tadiran battery also connects directly to the ARC-1. You can find a list of suppliers using "Google".

Caution

The 'D' size lithium battery used as part of 'battery option #1' is regulated under U.S. DOT and UN rules, and must be shipped as 'Class 9 hazardous material'. There are significant fines for improper shipping.

Other Battery Configurations

Please call customer service at Desert Star if you want to use a different battery configuration.