Coastal Acoustic Release Transponder

Operating Manual

Rev. A
August 2001
A980176

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1. General Information

1.0 Introduction

This manual describes the EdgeTech Coastal Acoustic Release/Transponder (CART). This model is a lightweight, robust and easily deployable instrument. It can function both as an acoustic release and/or transponder unit for use at depths up to 1000 meters and with loads up to 500 Kg.

1.1 General Description

The CART has been designed for use as an instrument location and recovery system on oceanographic moorings and platforms. Additionally, the precision, high output power transponder feature, when coupled with the extended deployment option, make this instrument ideal for use in long baseline (LBL) positioning and navigation systems.
The CART utilizes EdgeTech's proven Binary Acoustic Command System (BACS) code structure. This makes the CART fully compatible with any of EdgeTech's line of deck units, including the Model AMD200, 8011, 8011A, 8011Xs or PS8000 series acoustic navigation transceivers. The BACS coding structure provides 12,000 possible secure command codes. Each release is factory programmed with its own unique command set, including ENABLE, DISABLE and a RELEASE/ARM command. Whenever the instrument receives a command it responds with a status reply message which indicates the orientation of the instrument and the position of the release shaft (released/not released). The transponder function can be turned on or off with the ENABLE and DISABLE commands. When disabled the transponder will not reply when interrogated. This ensures that unit will not interfere with nearby instruments and that no battery energy will be wasted replying to 'spurious' noise sources during the deployment. The transponder is powered from a separate battery stack within the welded battery pack. This battery stack is coupled through diodes back to both the main electronics battery stack and the release circuit battery stack. The transponder Enable / Disable command has no effect on the Release command.
The RELEASE/ARM command causes the mechanism on the instrument to rotate to either the released or cocked position. When in the released position the instrument is free to mechanically disconnect from its release link. The RELEASE/ARM command is not effected by the state of the transponder function (enabled or disabled).

1.2 Specifications

1.2.1 Mechanical

Standard Instrument

Maximum depth rating	1000 m	3281 ft
Maximum release load	500 kg	1100 lb.
Maximum static load	750 kg	1653 lb.
Overall length	61cm	24 in.
Mean diameter	12.7 cm	5 in.
Weight in Water	3.6 kg	8 lb.
Weight in Air	9 kg	20 lb.

Extended Deployment Option

Maximum depth rating	1000 m	3281 ft
Maximum release rating	500 kg	1100 lb.
Maximum static load	750 kg	1653 lb.
Overall length	76.2 cm	30 in.
Mean diameter	12.7 cm	5 in.
Weight in Water	4.1 kg	9 lb.
Weight in Air	10.9 kg	24 lb.

* Housing Material:	Type 6061 Aluminum,
* Finish:	Hard anodized and Powder coated
* Hardware Material:	Type 316 Stainless Steel, NiAlBz
* Release type:	Mechanical (motor driven)

1.2.2 Acoustic

1.2.2.1 Command Receiver

* Sensitivity:	80 dB re 1 V/(Pa.
* Receiver type:	Multi-stage band pass with hard-Limited-output (2000Hz/300Hz Bandwidths)
* Pulse width:	22 ms
* Period:	250 ms
* Total Command Time:	9 s
* Total lock out time:	10 s re beginning
* Commands per tone pair:	2000

1.2.2.2 BACS Command Structure:

Two 8-bit words separated by a 5-sec interval. Each word comprised of 8 bits from a 16-bit command. The 16-bit command is a 15 bit, 11 block cyclic code with an overall parity bit appended to the end to form a 16-bit code with a minimum Hamming distance of 4 bits. Additionally, two transitions are required within each word, and no repetitions of words are allowed in a command.

1.2.2.3 BACS Command Coding:

* Binary FSK tone pairs:

Pair No.	"0"	"1"
1	9.488 kHz	9.901 kHz
2	9.488 kHz	10.288 kHz
3	9.488 kHz	10.684 kHz
4	9.901 kHz	10.288 kHz
5	9.901 kHz	10.684 kHz
6	10.288 kHz	10.684 kHz

1.2.2.4 Standard Command Functions:

ENABLE (Enable transponder)
DISABLE (Disable transponder)
RELEASE/ARM (Activate mechanical release mechanism)

1.2.2.5 Transponder:

* Sensitivity:	80 dB re 1 V/(Pa.
* Jitter:	< 0.1 ms
* Interrogate frequency:	11 kHz standard (others are optional)
* Post-filter bandwidth:	330 Hz.
* Minimum interrogate pulse width:	5 ms
* Reply frequency:	12.0kHz standard (7.5kHz - 15kHz available.)
* Reply pulse width:	10ms
* Reply Source Level:	192 dB re 1(Pa @ 1 m
* Turnaround Time:	12.5 ms
* Lockout time:	1 second

1.2.3 Power Supply, Standard Instrument

* 1 each, 9v / 12v welded alkaline battery pack

* Main supply	5v regulated
* Quiescent current drain:	280uA
* Design life (@ 0 degree C):	1.5 year
* Extended Life	2.0 year
* Transponder supply	9v nominal, unregulated
* Design life (@ 0 degree C):	40,000 replies @ 10 ms
* Extended Life	200,000 replies @ 10 ms
* Release supply	12v nominal, unregulated
* Design life (@ 0 degree C):	500 cycles

1.2.4 Environmental

1.2.4.1 Temperature:

* Operating:	-10 degree C to + 40 degree C
* Storage: (Batteries removed)	-20 degree C to + 60 degree C

2. Installation

Introduction

This section contains the information relative to the basic set up of EdgeTech's coastal acoustic release transponder (CART) including important details concerning the orientation of the unit on a mooring structure.

2.1 Installation Considerations

The transponder will operate in any orientation. However, specifics of the intended deployment will mandate special installation concerns.

2.2 Acoustic

Efforts should be made to ensure that there is a clear acoustic path between the CART transducer and the source (typically a dunking transducer from a deck unit). Structural elements of a mooring system which have a significantly different acoustic impedance than that of seawater will cause absorption or reflection of acoustic signals, which will degrade the operation of the unit. Floatation, including glass spheres, syntactic foam and plastic floats are particularly problematic. A float placed physically close to the transducer will create a blind area in the transducers beam pattern.

2.3 Mechanical

The release load is held through the tension bail, clevis assembly and release link. In some installations (such as a trawl resistant bottom mooring) the unit needs to be secured to the structure. It is important to verify that the release hook is not obstructed in its motion, which could prevent the release link from disengaging.
The release bearing and link are treated as disposable items in most applications. The release bearing is used to electrically isolate and reduce friction between the release hook and shaft. Failure to install a release bearing will most likely result in galvanic corrosion of the release mechanism. The release link is used to electrically isolate the release from the rest mooring. The release link is fabricated from type 316 Stainless Steel. If an alternate type of release link is used it is important that it be made of the same material and provide electrical isolation. Arbitrary choice of an alternate release link could result in jamming, galvanic corrosion or mooring failure due to insufficient strength.

2.3.1 Active Bio-Fouling Prevention

The coastal acoustic release transponder (CART) has been designed with a unique feature, periodically the release shaft is rotated back and forth. This "wiggle" is intended to keep the release mechanism moving freely by preventing marine growth from accumulating on the release shaft. An internal timer causes the CART to rotate 45deg

CCW, then 90deg CW and then 45deg CCW back to its armed position. The energy required to "wiggle" is inconsequential when compared to the battery packs capacity. The CART will not "wiggle" if release shaft position sensors indicate anything other than that the shaft is in the armed position. The release shaft position sensing logic has been designed to be "fail-safe" the CART will not attempt to "wiggle" if there is a sensor or position error.

2.4 Status Reply

The CART is equipped with sensors that monitor both tilt and release shaft position. This information allows the unit to send a coded status reply based on the instruments orientation and release shaft position. This feature is useful for ascertaining whether the mooring or platform that has been deployed has landed as planned. At the end of a deployment the information is useful in determining whether, forces such as strong currents, or trawl activity have affected the mooring or platform. The reply indicates one of four states, either "upright/released", "upright/not released", "tilted/released" or "tilted/not released". After any command has been received, the unit transmits a series of pings encoded as follows:

Pattern	Status
* 15 pings at 1 second intervals	"upright/released"
* 15 pings at 2 second intervals	"upright/not released"
* 7 pings at 1 second intervals	"tilted/released"
* 7 pings at 2 second intervals	"tilted/not released"

The tilt sensor is a 45-degree mechanical switch that is mounted on the release circuit board assembly. In the standard instrument configuration, with the release mechanism down, the unit is defined as not tilted. For applications requiring a narrower maximum allowable angle of tilt an optional 20-degree tilt switch is available.

3. Operating Instructions

Introduction

This section of the manual covers instructions for normal operations including turning on the instrument, opening and closing the housing, air acoustic tests, and post deployment considerations.

3.1 Turning on the unit

Coastal Acoustic Release Transponders (CART) are carefully tested and shipped from the factory with a new battery pack installed (battery packs are disconnected unless otherwise requested). To use the CART all that is required is opening the housing, plugging in the battery and then closing and purging the housing.

3.1.1 Opening the Housing

* Remove the Anode, the two 1/4-20 nuts and flat washers from the treaded end of the tension bail (clevis end of the instrument).
* Slide the tension bail out of the unit.
* Remove the purge port retaining clip by unscrewing the nylon screw that holds it in place (clevis end of the instrument).
* Pull the purge port out of the end cap (clevis end of the instrument).
* Gently pull the transducer end cap free from the housing. You may need to work it side to side to get it started, but once the initial resistance is overcome the transducer should slide out easily.
* The transducer is connected to a header at the end of the release electronics circuit board by a short cable.
* Remove the nut and washers that hold the electronics assembly and supplies ground to the housing.

3.1.2 Applying Power

* The electronics assembly and battery pack, are mounted to an aluminum plate that is attached to the release end cap.
* If the transducer cable has been disconnected from electronics assembly plug it back into its header on the circuit board.
* The battery pack has a 6-inch lead wire with a 4 contact connector on it, simply plug this connector into the four-pin header on the circuit board.
* The CART will ping once approximately two seconds after it has powered up and the transponder will be enabled.

3.1.3 Closing the Housing

*Make certain that the O-rings and O-ring surfaces are clean and lightly greased (use only silicone grease).
* Gently guide the electronics assembly back into the housing, taking care not to damage the sealing surface of the housing or pinch any cables. Be sure to align the bolt, which attaches the top of the assembly to the housing.
* Install the washers and nut, which secure the electronics assembly to the housing and supply ground to the housing.
* After connecting the cable from the transducer to the board gently guide it back into the housing, taking care not to damage the sealing surface of the housing or pinch any cables.
* As the O-ring enters the housing bore, firm but gentle pressure must be applied to seat the end cap fully against the housing.
* Replace the tension bail, making certain to include the shoulder washers on the transducer end cap. Install the washers and nuts on the bail, tighten the nuts evenly. Replace the Anode on the end of the bail.
* Purge the instrument as per section 3.1.4
* At this point it is good practice to perform an air acoustic test of the system by running through the command set for the CART (See section 3.3).

3.1.4 Leak Detection and Condensation Prevention

EdgeTech/ORE Offshore releases are provided with a 3/8-inch diameter purging port on the bottom (release end) end cap. The recommended procedure for preparation of the instruments atmosphere is as follows. The procedure assumes that the operator has a vacuum pump, dry nitrogen cylinder, gauge all arranged on a manifold setup.

1. After verifying that all other (other than the purge port) o-ring seals have been cleaned, lubricated and assembled.

2. Prepare the purge port plug for installation, the plug must be ready for immediate insertion.

3. Insert a purge port vacuum adaptor and draw a -3 PSIG vacuum, do not exceed -3 PSI.

4. Close the manifold valve to the instrument and allow the instrument to sit of for 15 minutes. Check the gauge afterwards and verify that the vacuum did not change. This step is performed to detect gross o-ring problems.

5. Open the valve to the instruments purge port and:

    * Backfill the housing with dry nitrogen gas, do not exceed +5 PSIG.

    * Draw a -3 PSIG vacuum on the instrument, do not exceed -5PSIG.

* In damp environments you should repeat this process up to four times.
* After drawing the final vacuum in this process, quickly insert the purging plug before the -3 PSIG vacuum is lost.
* Secure the purge plug with the fiber glass retainer and nylon screw.

NOTE: When purging the instrument, be careful not draw more than -5 PSIG vacuum, exceeding this figure can damage the batteries which in turn can result in instrument failure.

3.2 Arming the Instrument

The release mechanism is easily armed items required for arming are, 1 release link, 1 release bearing, a deck unit and the command set for the CART.
* Make certain that the release shaft is in the released position with the cut out in the release shaft facing out. If it is not then send the Release/Arm command to the CART from the deck unit.
* Insert a release link in the clevis.
* Slide a release bearing on to the release hook pin.
* Rotate the release hook down into the cut out in the release shaft, capturing the release link and bearing.
* Send the release/arm command. When the unit receives this command it will rotate the cut out section of the release shaft to the cocked position.
NOTE: When arming the release, make sure that there is a release bushing on the end of the release hook pin.

3.3 Air Acoustic Testing

3.3.1 Setup

The specific acoustic impedance of air is quite different from that of seawater, which renders the transducer a far less efficient receiver when out of water. For this reason it is necessary to place the source (deck unit transducer or speaker) within a meter or two of the units transducer, with no obstructions to the acoustic path. Depending on the environment, some experimentation may be necessary to find a suitable location.

3.3.2 Tests

For the following tests it will be necessary to have the proper six digit commands unique to the unit being tested. If it appears that commands are not getting through, verify that the serial number of the unit being tested matches that on the sheet of command codes. Using a deck unit ascertain whether the CART is enabled or disabled by interrogating it, if the unit has just be powered up it will be enabled. Unless otherwise specified the CART will be shipped from EdgeTech, with the interrogate frequency tuned to 11.0kHz and the reply frequency set to 12.0kHz.

Using the deck unit, send the ENABLE command. The instrument should reply with a series of pings based on the sensors in the electronics assembly. Next, verify that the motor is in the armed position, and send the RELEASE command. The cup should rotate to the released position after the command has been sent, and a status reply will again be transmitted.
Interrogate the instrument using the deck unit set at the appropriate interrogate frequency and tuned to the proper reply frequency. It is unlikely that the deck unit will display a valid range because of the proximity of the two transducers, but you should be able to verify that the instrument transmits a reply pulse.
Next send the DISABLE command. The instrument should reply with the appropriate series of pings to indicate sensor status. Now range on the instrument again with the deck unit. This time the unit should not transmit a reply pulse.
It is good practice to finish up by sending the ENABLE command, so that during the deployment operations the instrument will reply to range interrogations. Before leaving the deployment site send the disable command and confirm that the CART will not reply. This will conserve battery life while deployed. If the CART is being shipped or stored it should be disabled to conserve battery life.

3.4 Post Deployment

After recovery, the unit should be cleaned and rinsed with fresh water to avoid salt buildup and deterioration of mechanical parts. A visual check of the housing and release mechanism should be performed to detect any signs of damage, excessive wear, corrosion, etc. If the CART is not to be used again soon, the unit should be turned off (follow procedure described in Section 3.1).
If the unit is to be stored for a long period of time, the batteries should be removed. See Maintenance procedures in Section 5.

4.2 Introduction to Series 8000 Command Coding

The code that is employed is 16 bits long with 11 bits of information. Specifically it is referred to as a 15, 11 block cyclic code with an overall even parity bit appended to the end. The information bits occupy the first 11 bit positions, the cyclic parity or redundant bits occupy the four positions after the information bits, and the overall parity bit occupies the last position. This particular code has good mathematical structure. The parity bits are easily calculated and a minimum Hamming distance of four bits exists between any two codes. The command timing is as follows:

* 8 bits are sent with a period of about 250 ms and a pulse width of 22 ms
* A word decode interval is 7.0 seconds
* Following the first decode interval, a 60 ms detection window is open
* If a detection occurs in the window, a second word decode interval occurs
* Except during the window, detection is disabled for 9 seconds relative to the first detection.
* During any of the sample gate intervals, if both "D0" and "D1" are present or if neither one is present an abort will occur.
* To abort a command intentionally, it is recommended that an out of command band signal be sent in place of the code symbols for the duration of command. Employing 11.3 kHz as the abort tone is a good choice. This is outside the command spectrum so it will not confuse any commands.

From the 11 information bits there are approximately 2000 unique commands for each tone pair employed. Commands composed of equal or repeated words are excluded, as are some containing very few transitions. Since there are six tone pairs available (refer to the specification section), over 12,000 unique commands exist. Certain ranges of these codes, which are rich in transitions, are designated as "guarded" commands, requiring extra user interaction before being transmitted. These are typically used for release commands or special functions. The deck units, Model 8011, 8011A, and Model 8011XS determine if a valid command is guarded by checking whether it lies in such a range.

5. Maintenance

5.0 Maintenance

The CART requires minimal maintenance. Pre-deployment preparations and checks, and post-deployment cleaning will fulfill most of the maintenance requirements. The important tasks are battery replacement, 'O' ring care and maintenance, and general cleaning and inspection and lubrication of operational elements.

5.1 Battery Replacement

The CART uses a single EdgeTech P/N 00000000 welded alkaline battery pack. Or, if the instrument was purchased with the extended deployment option (longer housing) the battery pack used is EdgeTech P/N 000000000.

5.1.1 Battery Replacement Procedure

DANGER IF THE UNDERWATER UNIT HAS BEEN DEPLOYED!
THERE IS THE POSSIBILITY INTERNAL PRESSURIZATION!
EXERCISE EXTREME CAUTION WHEN OPENING THE INSTRUMENT!

* Open the instrument, refer to section 3.1.1
* Separate the release end from the housing by gently pulling them apart. Be careful not to scratch the housing throat when pulling the assembly from the tube.
* Disconnect the old battery cable from the electronics assembly (JP5) located at the transducer end of the unit.
* Remove the four screws that hold the battery mounting clips in place.
* Properly dispose, of the old battery.
* Position the new battery on the mounting bracket, positioning it with the leads facing the transducer end.
* Re-install the battery clips and be sure to include the lock washers.
* Assemble the instrument, refer to section 3.1.3

5.2 O ring considerations

The end cap assemblies of the CART use a standard 70-durometer Buna-N, O-ring (Parker 2-154) to provide watertight integrity to the electronics housing. Under normal usage, proper care and lubrication should provide several years of usage. However, like the batteries, the O-ring is an inexpensive component, which is absolutely critical to the successful operation of the entire system, affecting much more expensive equipment and components. It is good practice to replace the O-ring periodically, depending on frequency of use. It is essential to inspect the O-ring and seal surfaces before and after each deployment.
Prepare the sealing surfaces for assembly by cleaning with a lint-free towel or swab, moistened if needed with alcohol. Inspect for scratches or nicks which could impair the O-ring ability to provide a seal. Apply a light coat of O-ring lubricant (typically a silicone based grease) to the housing bore to facilitate insertion of the end cap. Make sure the lubricant is compatible with Nitrile rubber. Inspect the O-ring for damage such as tears, dimples or other defects in the rubber. Replace any O-ring that is questionable or old. Lightly coat the O-ring with O-ring lubricant. Protect O-rings when stretching them over large diameters (i.e., cover diameter with plastic sleeve).

APPLYING TOO MUCH O-RING LUBRICANT CAN COMPROMISE SEAL!

5.2.3 Additional O Rings

There are additional O-rings, which provide the watertight integrity to the housing. These are located on the purge port and release shaft bushing. The release shaft rotary seal uses an 80-durometer O-ring. Do not substitute the more commonly found 70-durometer O-rings in this position.

5.3 General Cleaning and Inspection

Whenever the unit has been recovered from a deployment, the unit should be cleaned and rinsed with fresh water to avoid salt buildup and deterioration of mechanical parts. A visual check of the housing and release mechanism should be performed to detect any signs of damage, excessive wear, corrosion, etc.

5.3.1 Inspection Particulars

* Check condition of release hook, particularly in the area of contact with the release link and release shaft.
* Verify that release hook pivots freely on the shoulder bolt that passes through the clevis assembly.
* Check for corrosion and wear on the nickel aluminum bronze release shaft and bushing.
* Check for wear, corrosion or distortion of the tension bail.
* Check for wear or corrosion of the hook shoulder bolt.
* Check the condition of the locking nuts on the end of the tension bail.
* Check for wear, corrosion, or stress cracks in the stainless steel clevis assembly.
* Check for corrosion of the purge plug.
* Check and replace if needed the two zinc anodes.
* Check the housing for signs of corrosion or damage to the hard coat.

APPENDIX A - DRAWINGS and FIGURES

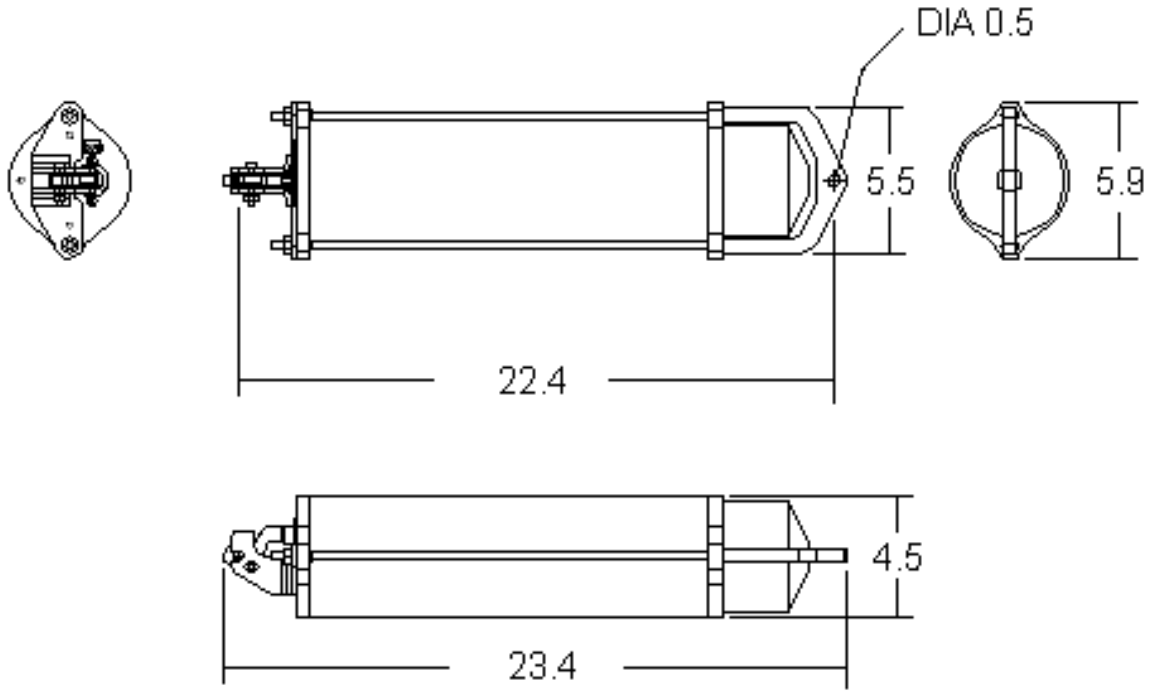


Figure 1 CART Mechanical

APPENDIX B – PARTS LISTS

Spare and Replacement Parts:

O-Rings		
End cap O-Rings 4 each	184411	(2-154)
Bushing O-Ring 1 each	184128	(2-116)
Shaft O-Ring 1 each	24800-B2011	(2-011)
Purge Port O-Rings 2 each	24800-B2008	(2-008)
Release Link	B980276 (includes release lever bushing)	
Welded Alkaline Battery Pack	B32174-002	

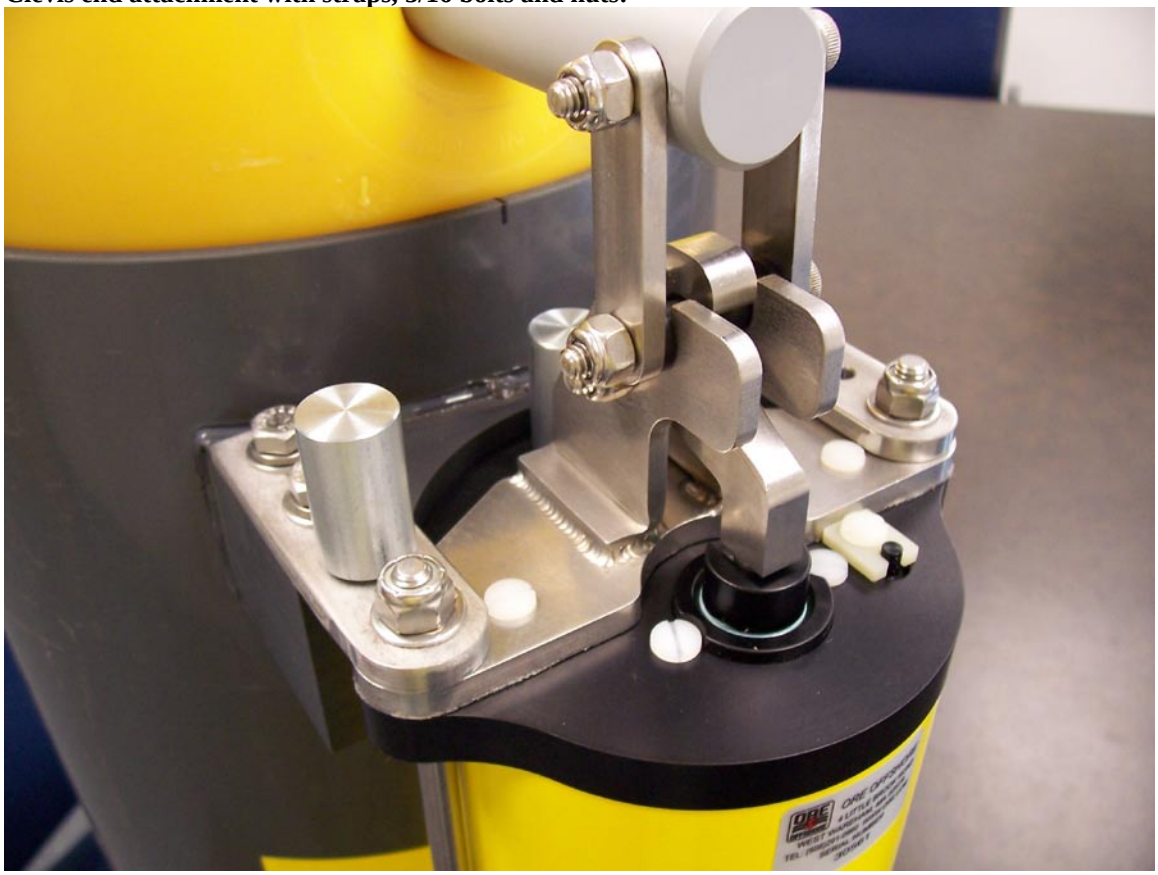
Appendix C
D980255, CART POP-UP MANUAL ADDENDUM

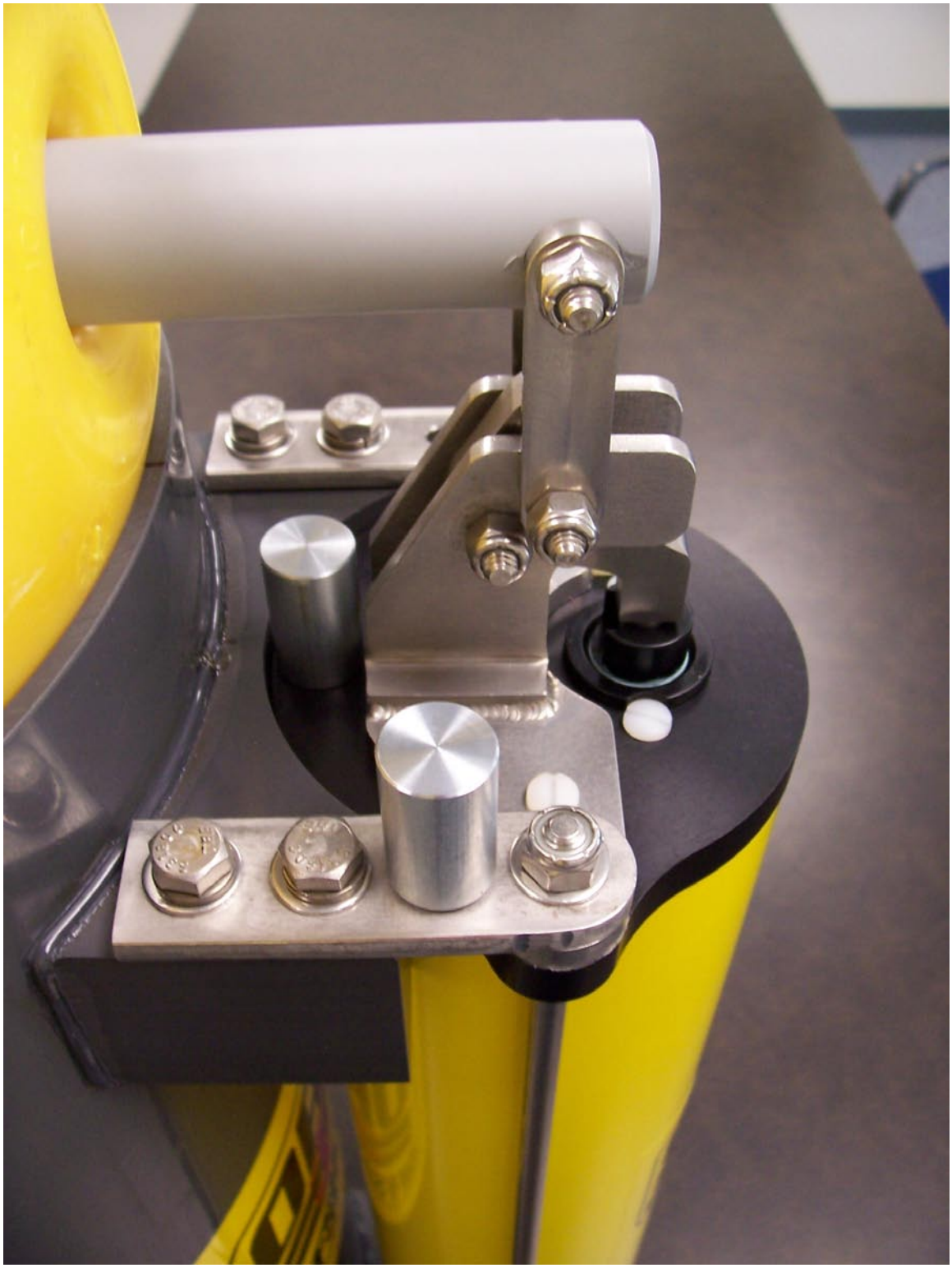
CAUTION: When configured for a pop-up buoy system the CART acoustic release is built with an inverted tilt switch and special "light load" clevis assembly. The release, when configured this way, is rated for a maximum working load of 100Kg.

Assembly:
The CART release and the pop-up line canister are shipped separately with the release's battery disconnected, unless otherwise requested. The release must be turned on, purged and then mounted to the canister before use. For instructions on opening and turning the release on, see section 3 of the CART Operating manual. The CART attaches to the line canister with two stainless steel straps and 5 stainless steel bolts (with washers). The assembly is self explanatory, see the following pictures. Note: The transducer and release end caps of the CART must have the holes

that the tension rods of the bail assembly pass thru on the same plain so that the CART will sit properly against the canister.

Clevis end attachment with straps, 5/16 bolts and nuts:





Transducer end attachment using 3/8 bolt:

Line and line packing:

The line capacity of the canister is a function of line diameter, line construction and material. Lines that are stiff and have significant "memory", for example 3 strand polypropylene, do not pack as well as single or double braid nylon. The decision of what diameter and type of line to be used needs to be carefully thought out, safe working loads and shock loading need to be considered.

There are numerous ways to terminate the lifting line, the line can exit the canister thru the side, it can pass thru the bottom of the canister, etc. How ever it is terminated, care must be taken to assure that the line will not put any force on the canister whether it is in-line or side loading.

When packing the canister with line, it is strongly recommended that the line be randomly "flaked" into the canister. Avoid coiling or laying the line in a pattern, randomly packing and tamping it down as it builds up will yield the best results. The top end of the line should be attached to the Nylon thimble at the end of the flotation assembly. The floatation assembly provides 28 lbs. of buoyancy and has a 2 meter, floating pick-up line between the two floats.

Side lifting line exit, line rigged to pull free from canister when pulled:

After the canister has been packed with line and the top end of the lifting line attached to the float assembly, insert the smaller of the two trawl float into the canister. There must be enough space left in the canister so that the larger of the two floats can sit flush against the canister opening. The short length of 1 ½" rod that exits from one end of the large float sits under the PVC U-bolt on the canister. The pick-up line that is spliced to this rod sits in the notch that is cut in the top of the canister. The other end of the float rod has a release link attached to it, it is captured in the clevis of the release by the hook on the release.

The nuts on the PVC U-bolt have been locked in place, do not try to adjust them.

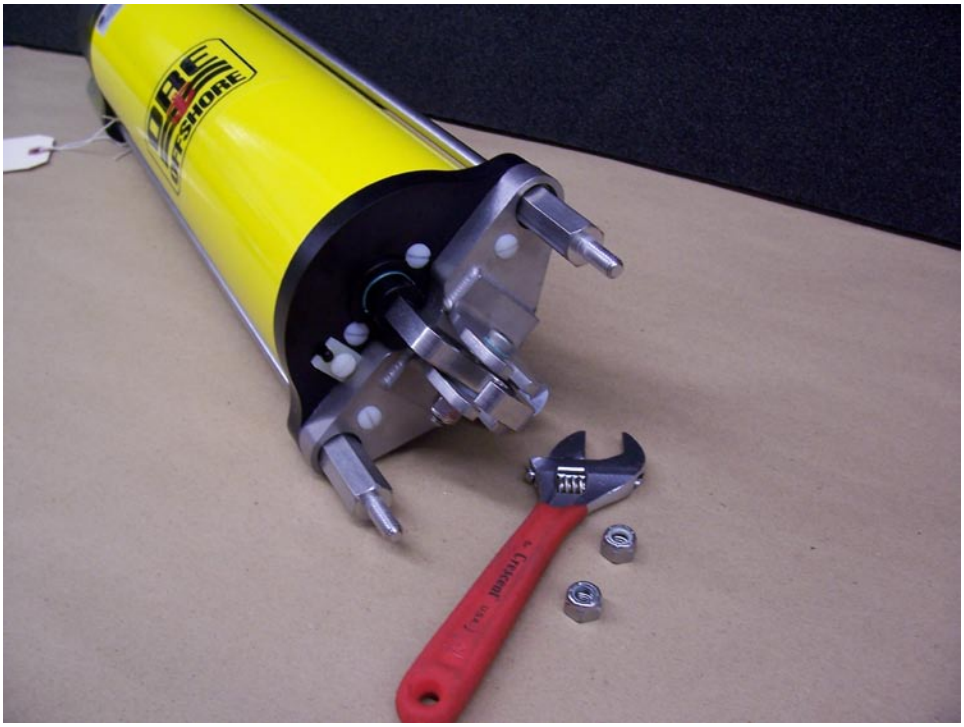
Float line exiting from the canister, rod shown captured by the PVC U-bolt:

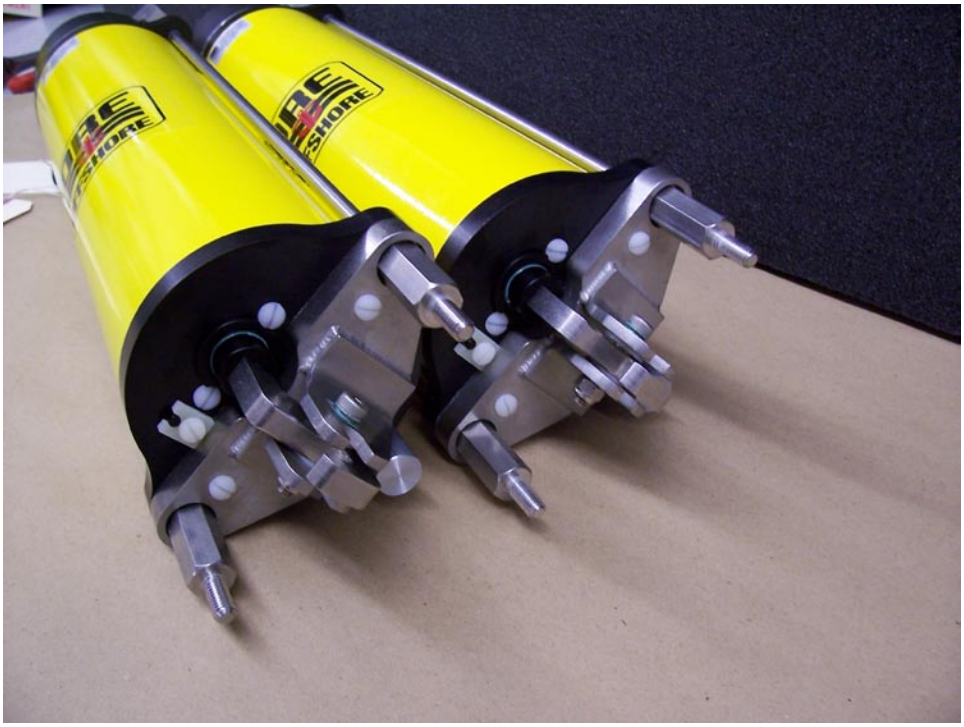
APPENDIX D

C.A.R.T. TANDEM ASSEMBLY Rev A

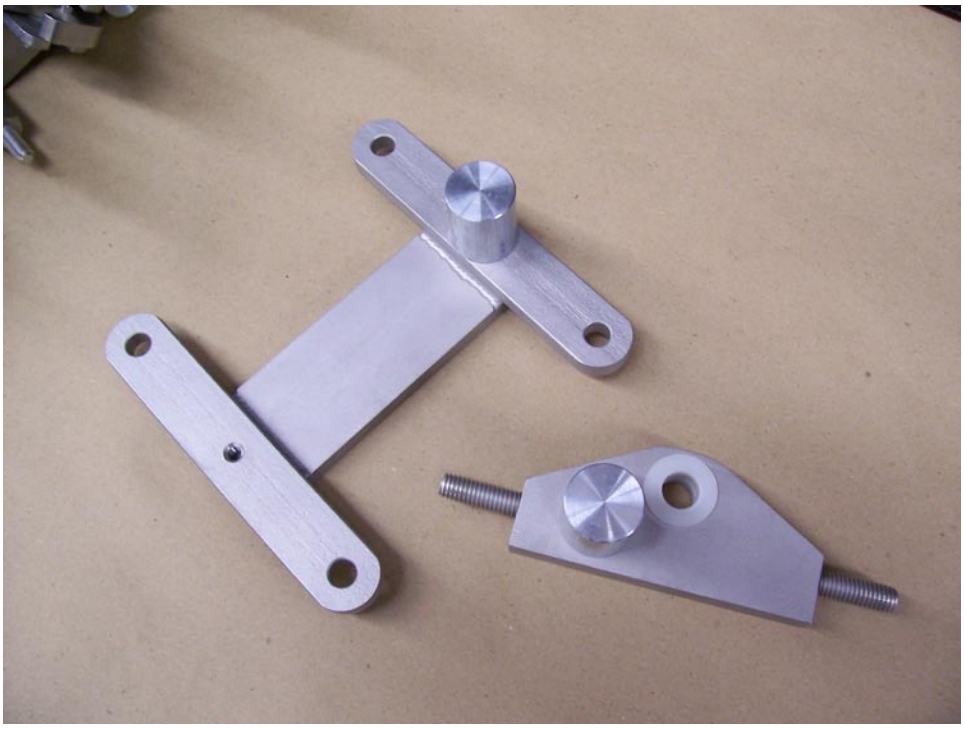
The C.A.R.T. Tandem unit is assembled using qty two existing C.A.R.T. units part # A980168-003 and qty one Tandem Kit part # B980229 and the following instructions.

First, start by removing the zinc on the base clevis, next using a 1/2” deep socket remove the two lock nuts on the base clevis. Replace those with qty 2 B980227 standoffs, tighten using an adjustable wrench. Repeat this process on both C.A.R.T.’s

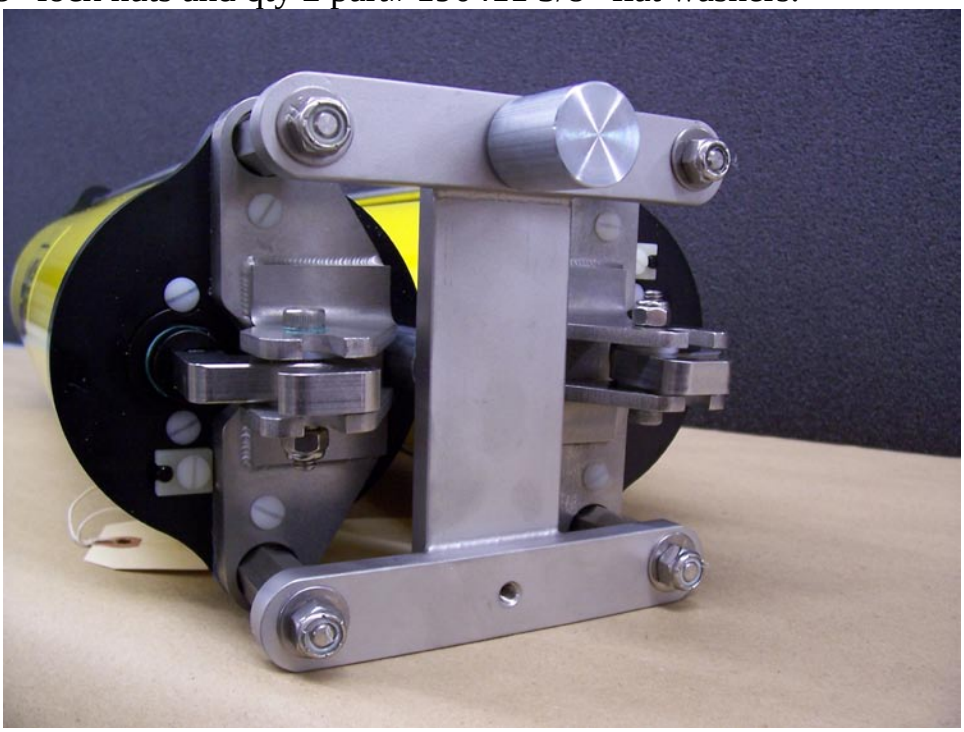




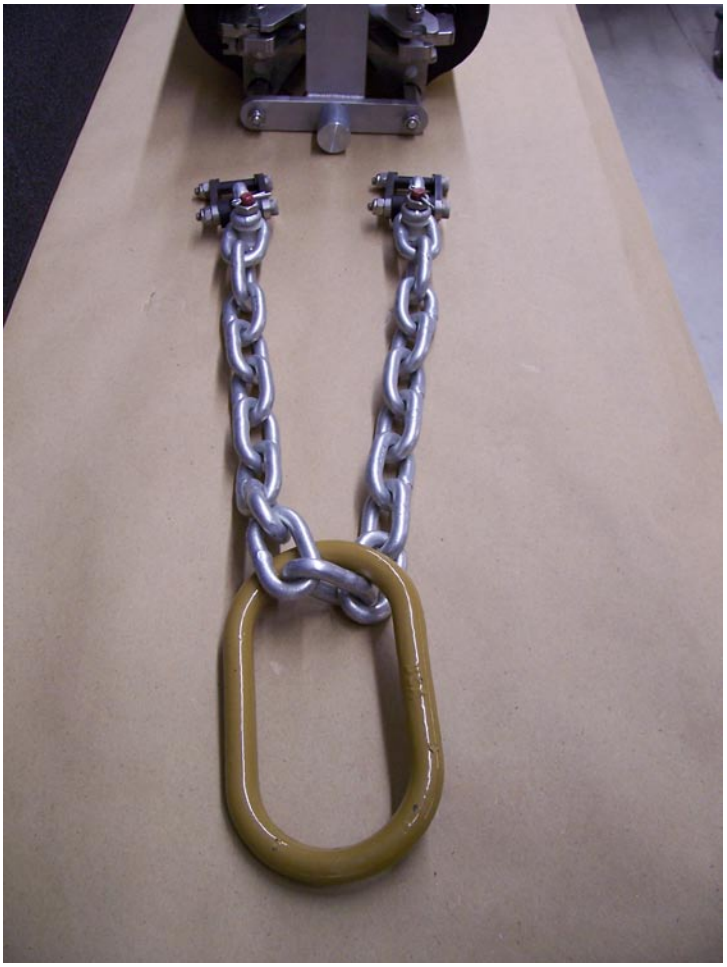
Next get qty 1 each of part number C980226 and C980228 these are the components that will physically connect the two units.



Install part # C980226 Bridge between the two C.A.R.T. units using qty 2 part# 194638 3/8” lock nuts and qty 2 part# 190411 3/8” flat washers.



Next install part# C980228 using qty 4 part# 184136 5/16” lock nuts and qty 4 part# 174211 5/16” flat washers.



Finally rig the drop link assembly with the welded ring and install in your C.A.R.T. unit hooks then arm the units. At this point the system has now been configured as a Tandem unit.

PART NUMBER	DESCRIPTION	QTY/ASSEMBLY
C980226	CART,BRIDGE,DUAL,TANDEM	1.000
C980228	CART,H-BAR DUAL,TANDEM	1.000
B980227	CART,BASE STANDOFF	4.000
18540X	STUD,316SS,1/4-20 X 3/4	2.000
A977110	ANODE,ZINC,AM200,AMT,AMTR	2.000

192430	WASHER,NYLON,1/4”	2.000
174211	WASHER,FLAT,5/16,316SS	4.000
184136	NUT, NYLOK, 5/16-18	4.000
B980276	ASSY,RELEASE LINK,CART	2.000
190411	WASHER,FLAT,316SS,3/8"	2.000
194638	NUT,NYLOCK,316SS,3/8-16	2.000
190519	SHACKEL,FORGED,GALV,5/16"	2.000
190616	CHAIN,5/16 COLD GALV PROOF COI	2.000
190713	LINK,OBLONG,1/2 FORGED	1.000
A980223	WASHER, SHOULDER, MODIFIED	2.000
19090X	WASHER,SHOULDER,NYLON,.378 ID	4.000