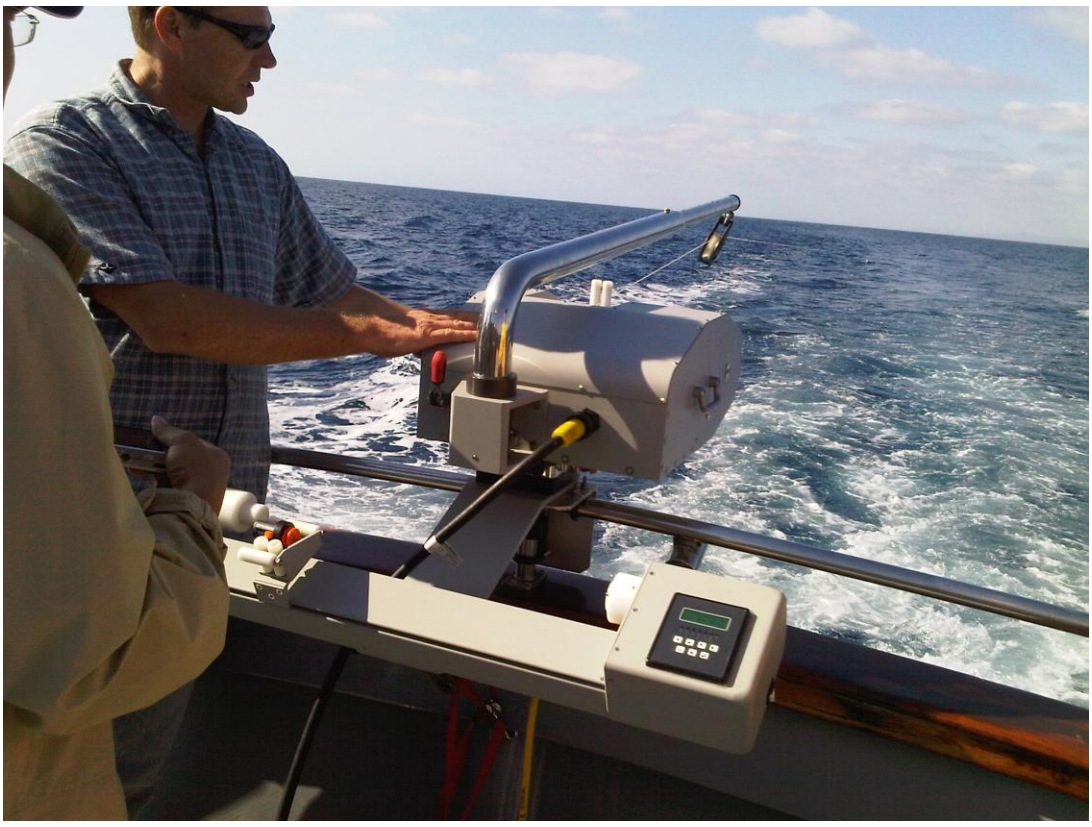
Oceanscience UCTD
Underway Profiling System

User Guide and Warranty



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UCTD 10-400 Components

This guide describes the Oceanscience UCTD 10-400. The UCTD is a s ship-based system for the measurement of conductivity and temperature profiles while underway. It is capable of profiling to over 400 m at a ship speed of 10 kt and can be used up to 13 kt at reduced profiling depth. The system consists of the following main components:

1. Probe Assembly
2. Winch
3. Rewinder
4. Davit
5. Power Supply

Probe Assembly

The probe assembly consists of a CTD instrument and a tail spool. The probe samples conductivity, temperature, and depth at a sampling rate of 16 Hz while descending vertically through the water column. The data are stored internally and downloaded wirelessly via Bluetooth to a host computer after deployment. The sensor is connected to a tail spool via a simple turn-and-lock mechanism which in turn is attached to the line on the winch (see Fig. 1).

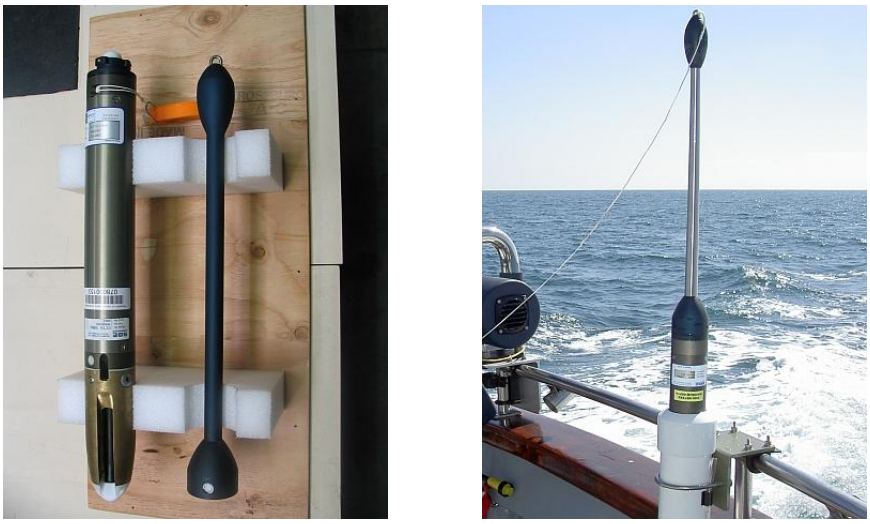


Figure 1 The picture on the left shows the CTD probe and tail spool separated. On the right, the two components are connected for deployment.

WINCH

The winch shown in Figure 2 has a capacity of over 1300 m of high strength Spectra line. It has a powerful two-speed DC motor for fast and safe recovery of the probe assembly. The automatic levelwind ensures proper winding of the line onto the spool during the reel-in phase.

Figure 2 UCTD winch and levelwind.

REWINDER

The rewinder is used to load the tail spool of the probe assembly with an amount of line equal to the desired profile depth. The rewinding of the tail spool is computer controlled and semi-automated for quick turnaround. Figure 3 shows the rewinder with the tail spool ready for line loading.

Figure 3 UCTD rewinder with tail spool loaded for rewinding.

DAVIT

The davit has a telescopic arm with a custom guide block for the Spectra line and a holder for the probe. It is also provides a convenient mounting platform for both the winch and rewinder. Since the arm and winch are fixed on a turntable, the rewinder can be facing forward or aft depending on whether the davit is attached to a rail as shown in Figure 4 or a post.

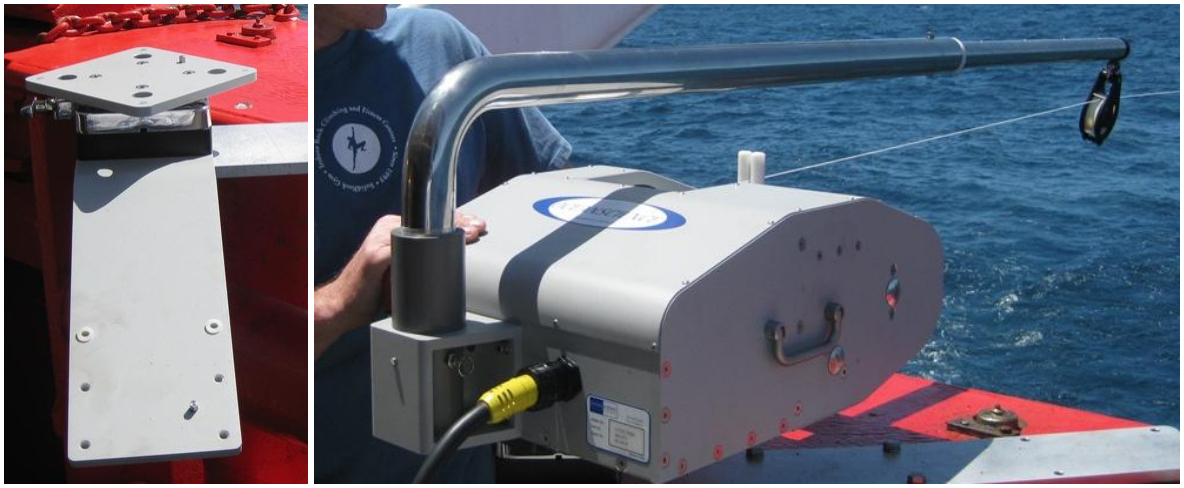


Figure 4 Rewinder and winch mounts (left) on the gunwale at the stern of a vessel. Davit arm mounted to the UCTD winch (right).

POWER SUPPLY

The UCTD system comes equipped with a universal power supply that accepts 110/220 Volts 45-60 Hz at 1500 W. It supplies the winch and rewinder with the required 24 V DC voltage. The receptacles have different form factors (Figure 5) to prevent connection errors by the operator.

Figure 5 UCTD power supply with all cables attached.

Modes of Operation

Static Profiling

By definition, static casts require the vessel to be stationary. The easiest way to perform static casts is to attach the tail spool to the probe without winding line on it first. The winch is then simply put into free-spool until the target depth is reached. It is possible to obtain deep profiles with the UCTD in less time it takes to complete a CTD station with a rosette to the same depth. This way, CTD data to over 1200 m can be gathered in less than one hour.

Tow-yo Casts

Tow-yo casts are most useful for shallower profiling, up to a depth of 300 m or less, at ship speeds not exceeding 10 kt. Again, no line is wound onto the tail spool and the profiling is accomplished by free-spooling the winch for a pre-determined duration, followed by reeling in the probe without fully recovering it after every cast. Repeating this sequence allows for a higher spatial sampling frequency compared to the free casts described below. A profile to 250 m at 10 kt ship speed for example can be completed in ~10 min. In this mode, the descent rate of the probe is not constant, so that the resulting data may require additional processing in order to reduce salinity spiking.

Free Casts

The primary mode of operation for the Oceanscience UCTD is the free-cast mode. Here the probe's descent is fully decoupled from the ship motion, i.e. its descent rate is independent of the vessel speed. The main difference here is that in this mode the tail spool is pre-loaded with an amount of line corresponding to the desired profile depth. On probe deployment, line is paid out from both the tail spool and the winch. Since it is necessary to re-load the tail spool with line after every cast and more line has to be reeled in after every dive, a profile to 500 m at 10 kt requires on the order of 30 to 40 min. The dive table in Figure 6 summarizes the drop time of the probe and the maximum ship speed for a given profile depth.

CARE MUST BE TAKEN THAT THE LINE DOES NOT COME INTO CONTACT WITH ANY OBJECTS. SINCE AMBIENT CONDITIONS SUCH AS CURRENTS, WAVES, AND WIND CAN MAKE IT DIFFICULT TO KEEP THE LINE CLEAR WITH A COMPLETELY STATIONARY SHIP, IT IS RECOMMENDED TO PERFORM STATIC PROFILES WITH A MINIMUM FORWARD SPEED 1 KT.

UCTD 10-400 DIVE TABLE		
CAST DEPTH [m]	DROP TIME [s]	SHIP SPEED [kt]
100	25	13.0
150	38	13.0
200	50	13.0
250	63	13.0
300	75	13.0
350	88	13.0
400	100	12.0
450	113	11.0
500	125	10.0
550	138	9.0
600	150	8.5
650	163	8.0
700	175	7.0
750	188	6.0
800	200	5.0
850	213	4.0
900	225	3.0
950	238	3.0
1000	250	2.0
1050	263	2.0
1100	275	1.0

Figure 6 Table of profile depths, drop times, and maximum ship speeds for the UCTD 10-400 model.

INITIAL PROBE SETUP

The initial setup of the UCTD probe requires the following steps (for detailed setup instructions and a complete list of commands see *90560 UCTD operating notes and commands firmware 1.02.pdf*):

1. Set up the wireless communication via Bluetooth either by using the computer's internal Bluetooth or by installing the software for the supplied USB Bluetooth module (for detailed information refer to *UCTD Probe Setup.pdf*).
2. Install the provided terminal application *UCTD Term*. Note the virtual serial port assigned to the USB Bluetooth device and configure *UCTD Term* to use this port with a baud rate of 115200.
3. Charge the battery pack of the probe to 8.10 V (for detailed instructions refer to section on below).
4. Set the desired recording time on probe via the `setstopseconds` command, e.g. `setstopseconds=100`, sets the sampling duration to 100 seconds.
5. Synchronize the real time clock of the probe with GMT. This is necessary to use the acquisition time in the data header to obtain location information from the ship-based GPS. The command `datetime` is used to synchronize the probe's real time clock with the GPS date and time, e.g. issuing `datetime=06152008105000` sets the clock of the probe to June 15, 2008 10:50:00.
6. There is enough memory available to store at least 50 casts with headers. If the number of casts headers exceeds 50, erase data stored on the probe via `initlogging`.

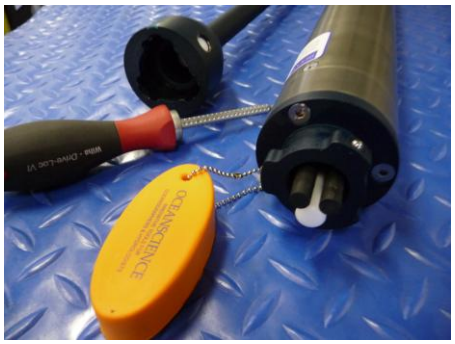
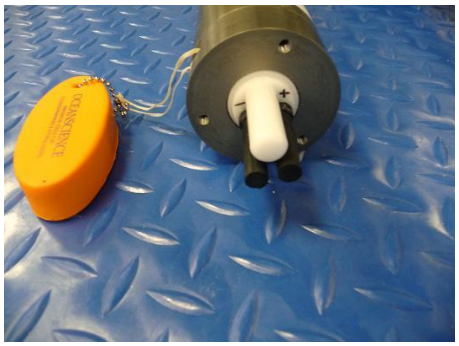
EXECUTING THE `initlogging` COMMAND PERMAMENTLY ERASES ALL DATA FROM THE MEMORY WITHOUT THE POSSIBILITY OF RECOVERY.

BATTERY CHARGING

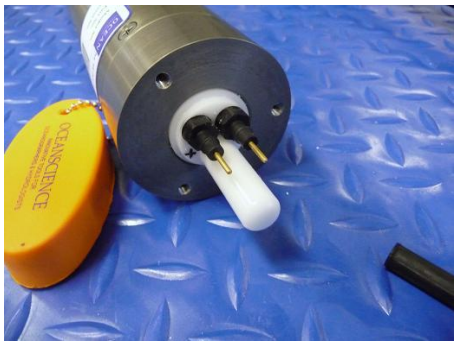
The Underway CTD Probe is powered by a pair of rechargeable Li-Ion batteries. Depending on ambient temperature, the batteries need to be charged after approximately 8 hours of continuous sampling at 16 Hz or approximately 50 casts of 250 s each. Battery charging takes approximately 2-4 hours. To charge the batteries, follow these steps below:

DO NOT CHARGE THE PROBE OVER 8.10 V. IT IS POSSIBLE TO MONITOR THE VOLTAGE DURING CHARGING, BY ISSUING THE `ds` COMMAND TO THE PROBE.

1. Remove the tail coupling

2. Remove the rubber caps from the charging pins



3. Attach charger terminals to charging ports of corresponding polarity (red to +, black to -)

4. Reverse steps 2 and 3.

IF CHARGER TERMINALS ARE REVERSED, BATTEREIES WILL NOT CHARGE!

WINCH OPERATING INSTRUCTIONS

This section covers the primary winch controls as well as the manual emergency retrieval mode. The picture below shows the control panel of the winch. These controls are labeled according to the component they operate except for the brake which is the red handle on the right in the picture.

The motor of the winch has two speed settings, FAST for reeling in the probe and SLOW for the final recovery phase when the probe is brought on board. When the clutch is set to OFF, the winch is in free-spool mode for probe deployment. In the FULL position of the clutch switch the motor is directly coupled to the line spool. The SLIP position of the clutch is only for use with the rewinder.

The levelwind is only employed during the reel-in phase of the probe (switch ON, guide rollers flipped up and line engaged). During the dive phase of the probe, the levelwind is always disengaged (switch set to OFF, guide rollers flipped down).

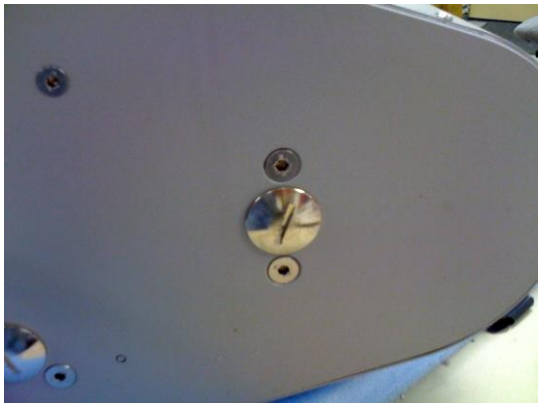
The brake is used to stop the descent of the probe when the target depth of the profile is reached. Pulling down on the lever activates the brake either partially or full (see pictures)

ALWAYS USE THE BRAKE TO STOP PAYING OUT LINE. NEVER ENGAGE THE CLUTCH WHEN THE SPOOL IS MOVING. DOING SO MAY LEAD TO THE LOSS OF THE PROBE.

MANUAL WINCH OPERATION

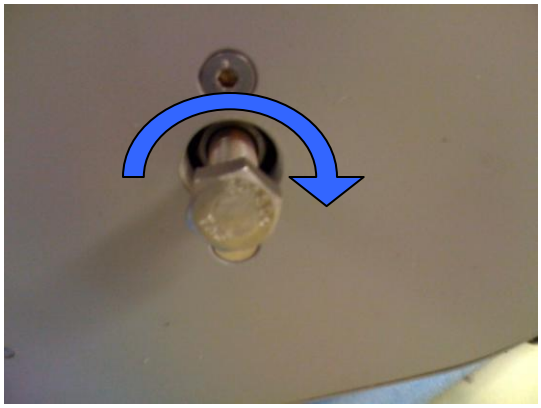
The winch is also equipped with a manual retrieval mechanism that can be used to retrieve the probe in case of a power failure. Without power neither the winch motor, levelwind, nor the clutch will be operational. Since it will be necessary to hold the brake to prevent any line from being paid out this operation may require two people. To use the manual retrieval mode, follow these steps:

1. Unscrew the cap on the right front part of the winch with a screw driver or a coin to gain access to the manual gear hub.




2. Screw the bolt supplied with the winch into the hex coupling until it bottoms out.

3. Now push on the bolt and rotate it until it engages the gear ring.



4. Use battery-powered drill or a hand crank with a 3/4" hex socket in CLOCKWISE direction to reel in line. Do not forget to release the brake before doing so.

IT WILL BE USEFUL TO PRACTICE ALL WINCH OPERATIONS, INCLUDING THE MANUAL RETRIEVAL, WITHOUT PROBE OR WITH A TRAINING PROBE BEFORE DEPLOYING THE UCTD PROBE.

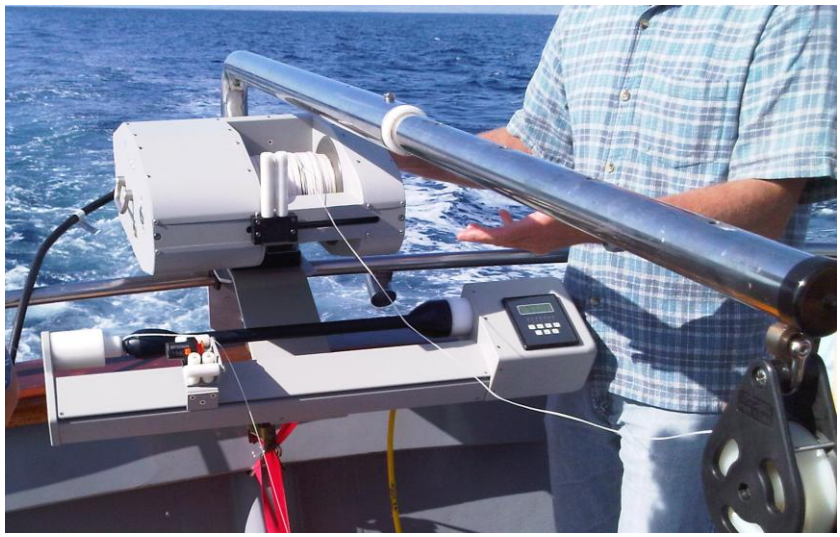
TAIL SPOOL REWINDING INSTRUCTIONS

Prior to deploying the probe in free-cast mode it is necessary to load the tail spool with the amount of line that corresponds to the desired profile depth. This is accomplished by winding line from winch to the tail spool under tension using the rewinder. Detailed rewinding instructions are given on the LCD screen and below or refer to the flow chart for a short summary.

NEVER USE THE REWINDER TO WIND LINE FROM A TAIL SPOOL BACK ONTO THE WINCH. DOING SO WILL DESTROY THE MOTOR CONTROLLER IN THE DRIVE UNIT OF THE REWINDER.

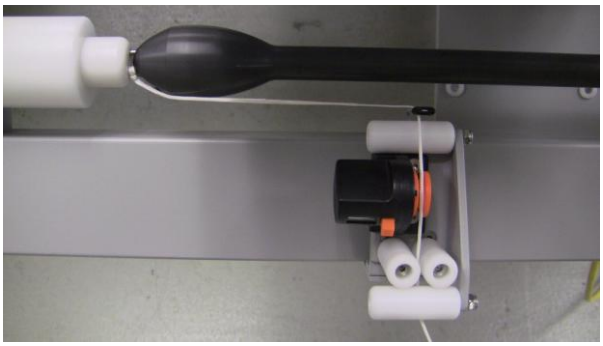
1. First, start up the rewinder by flipping its power switch to the ON position. Select line type and backlight mode (for night time operation) accordingly. The LEDs lights below the LCD screen indicate which keypad button refers to which option.

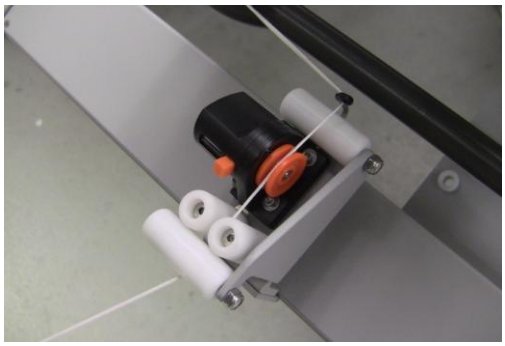
2. Rotate the winch into rewinding position. Load the tail spool into the rewinder by inserting the shackle end into the narrower of the two slots of the spring-loaded mount first. Now push the tail spool lightly in that direction and rotate the mount at the other end until the tail spool slips into place. The final arrangement should be as in the picture below.



3. Flip the CLUTCH switch on the winch into SLIP position and take up excess line slack using the SLOW mode of the winch. Then disengage the levelwind by flipping the rollers down.

4. Feed the line through the roller guide and line counter as shown below. The line should always run between two rollers of the same orientation and over the line counter wheel.





5. Reset the line counter to zero by pressing the orange button. It may be necessary to press the button several times or to turn the orange counter wheel while doing so in order to read 000.

6. Now start the rewinding and commence until the line counter equals the desired profile depth in meters, e.g. for a 400 m profile load the tail spool with line until the counter reads 400.

KEEP IN MIND THAT FOR OPTIMAL PROFILING WITH THE UCTD IT IS ALWAYS BEST TO STOP THE LINE LOADING NEAR THE SHACKLE END OF THE TAIL SPOOL RATHER THAN THE PROBE END.

7. The rewinding of the tail spool can be stopped at any time, except when the roller guide is about to reverse direction of travel, by pressing any of the buttons on the keypad of the LCD interface.

8. The rewinder alternates the direction of the motor driving the tail spool between profiles to minimize the overall accumulation of twists in the line. To do so, it is necessary to leave the controller powered up.

THE REWINDER ALTERNATES THE DIRECTION OF THE MOTOR DRIVING THE TAIL SPOOL BETWEEN PROFILES TO MINIMIZE THE OVERALL ACCUMULATION OF TWISTS IN THE LINE. FOR IT TO REMEMBER THE ORIENTATION OF THE LAST REWIND IT IS NECESSARY TO REMAIN POWERED UP.

9. After stopping the rewinding operation, the operator has the option to add more line to the tail spool or terminate the line loading. When the line loading is completed, rotate the CLUTCH switch back into the OFF position as shown below.

10. Just before deployment of the probe, remove the tail spool from the rewinder, attach it to the probe, and rotate the winch so that the davit points aft. The system is now ready for profiling operation.

IF THE REWINDING IS NOT STOPPED BY THE OPERATOR BEFORE THE MAXIMUM LINE CAPACITY FOR THE TAIL SPOOL IS REACHED (~800 M FOR 300 LB LINE, ~550 M FOR 500 LB LINE, AND ~ 350 M FOR 800 LB LINE), THE REWINDING IS TERMINATED AUTOMATICALLY TO PREVENT OVERLOADING OF THE TAIL SPOOL.

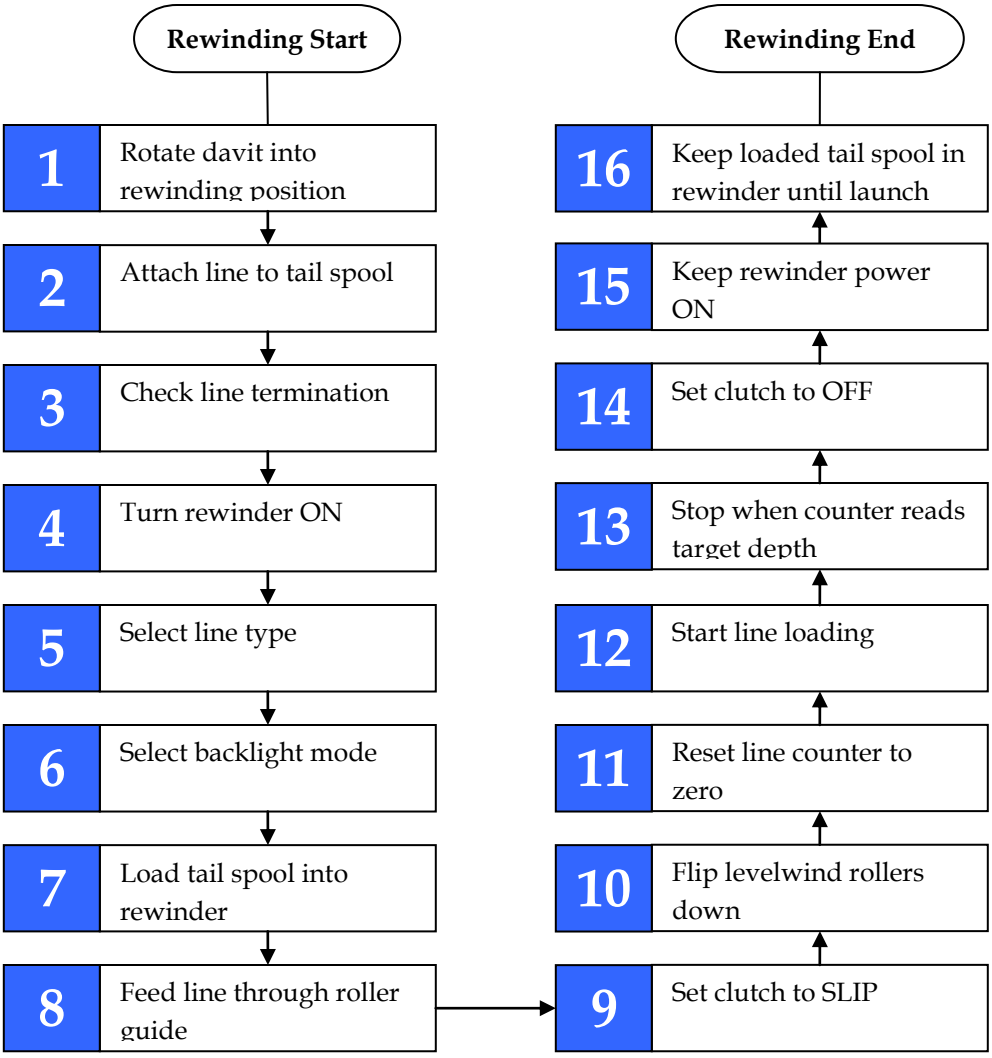


Figure 7 Flow chart for tail spool line loading.

Pre-Cast Check List

The following short list of checks should be completed prior to every probe deployment. It helps to prevent mistakes that could lead to the loss of the probe, data, or both:

1. **Verify** that the **line termination** is in good condition **before** rewinding line onto tail.
2. **Inspect** the **tail** and **shackle** for burrs which could lead to chafing of the line.
3. **Check screws** in the pressure case of the probe to ensure they are tight.
4. **Verify** that the **tail spool -probe connection** is locked.
5. **Check clutch** operation (OFF, FULL, SLIP).
6. **Check winch** operation (SLOW, OFF, FAST).
7. **Check levelwind** operation (OFF, ON).
8. **Check brake** operation (OFF, ON).

Profiling Instructions

After the initial setup of the components and prior to any probe deployment it should be verified that the clutch, motor, and levelwind function properly. Cycle the power on the levelwind to ensure it powers up and runs back-and-forth between its turnaround points. Winch motor operation is checked by first turning the clutch to the OFF position. This disengages the spool from the drive unit and the motor can be tested. Flip the power switch forward and the motor should be heard running continuously until the switch is put back into its neutral position. Pressing the same switch downward engages the motor at a lower speed as long as the switch is held in that position. Letting go of the switch from that position will turn the motor off immediately. Testing the clutch involves two steps. First, set the clutch switch to FULL. This engages the spool to the motor and the backstop. Pulling on line should not pay out any line from the spool. Flip the clutch switch to the SLIP position. Now it should be possible to pull line from the spool, albeit only if the tension exceeds several pounds. Turning clutch to OFF should allow free-spooling of the line drum. Engage to brake to verify that no line pays out while the lever is held down.

The following sections give a short overview over general profiling procedures. However, since the procedures for free cast and tow-yo casts differ, please refer to the respective flowcharts (see Figures 8 and 9) for detailed instructions.

In preparation of probe deployment it is useful to set a timer with the duration for the probe's dive to its target depth. Refer to the dive table in Figure 6 to choose the correct drop time for a given target depth. Since the probe average drop speed for the 10-400 UCTD is ~4 m/s, a dive to 400 m will take

approximately 100 s. The corresponding sampling duration on the probe should be set to be at least that long although it is of no disadvantage to lengthen that time.

Securely connect the tail spool to the probe via the twist-and-lock mechanism. An easy way to test whether the mechanism has engaged properly is done by trying to twist the tail spool with regard to the probe. This should not be possible in the case of a secure lock. Another test is to push in on the white button. One should feel the spring-loaded action of the button and upon release it should pop back out. Now the probe is ready for deployment.

ALWAYS MAKE SURE THAT THE SENSOR AND TAIL ARE CONNECTED SECURELY BEFORE DEPLOYING THE PROBE. FAILURE TO DO SO, CAN LEAD TO THE LOSS OF THE PROBE!

Set the clutch to OFF and pull the magnetic plug out from the probe. Wait 5 s before launching the probe and starting the timer. If the line on the spool has a tendency to birdsnest during this phase, apply a little brake to slow down the payout of the line.

BE SURE TO KEEP YOUR HANDS AND FINGERS AWAY FROM THE LINE AT ALL TIMES. THE LINE IS STRONG ENOUGH TO CUT THROUGH TISSUE AND BONE IF EXTREMITIES WERE CAUGHT IN IT WHEN COMES UNDER TENSION!

The descent of the probe is stopped by slowly pulling the brake lever down when the timer reaches the drop time for the desired target depth or when the running-out-of-line warning mark (red mark on the line) becomes visible on the winch, whichever occurs first. The running-out-of-line warning is section of red line, approximately 25 m from the end of the line.

NEVER PAY OUT ANY OF THE RED LINE. DOING SO CAN LEAD TO THE LOSS OF THE PROBE!

Once the descent of the probe has been stopped, hold the brake and engage the clutch by rotating the clutch switch to FULL. At this point the brake can be released and no more line should pay out. Start the levelwind and engage the rollers by flipping up the guide when it is just below the tightly tensioned line. Immediately start the winch motor in FAST (full speed) mode. Depending on the depth of the cast and the speed of the ship, reeling in the probe can take up to 25 min. When the probe is in the immediate proximity of the ship (less than 15 m aft), stop the winch. Turn levelwind OFF as it is not required during final recovery. Now use the SLOW mode of the winch (holding the switch) to guide the probe in safely.

AVOID ANY CONTACT BETWEEN SHIP AND PROBE DURING THE FINAL RETRIEVAL AS IT MAY DAMAGE THE GLASS CONDUCTIVITY CELL!

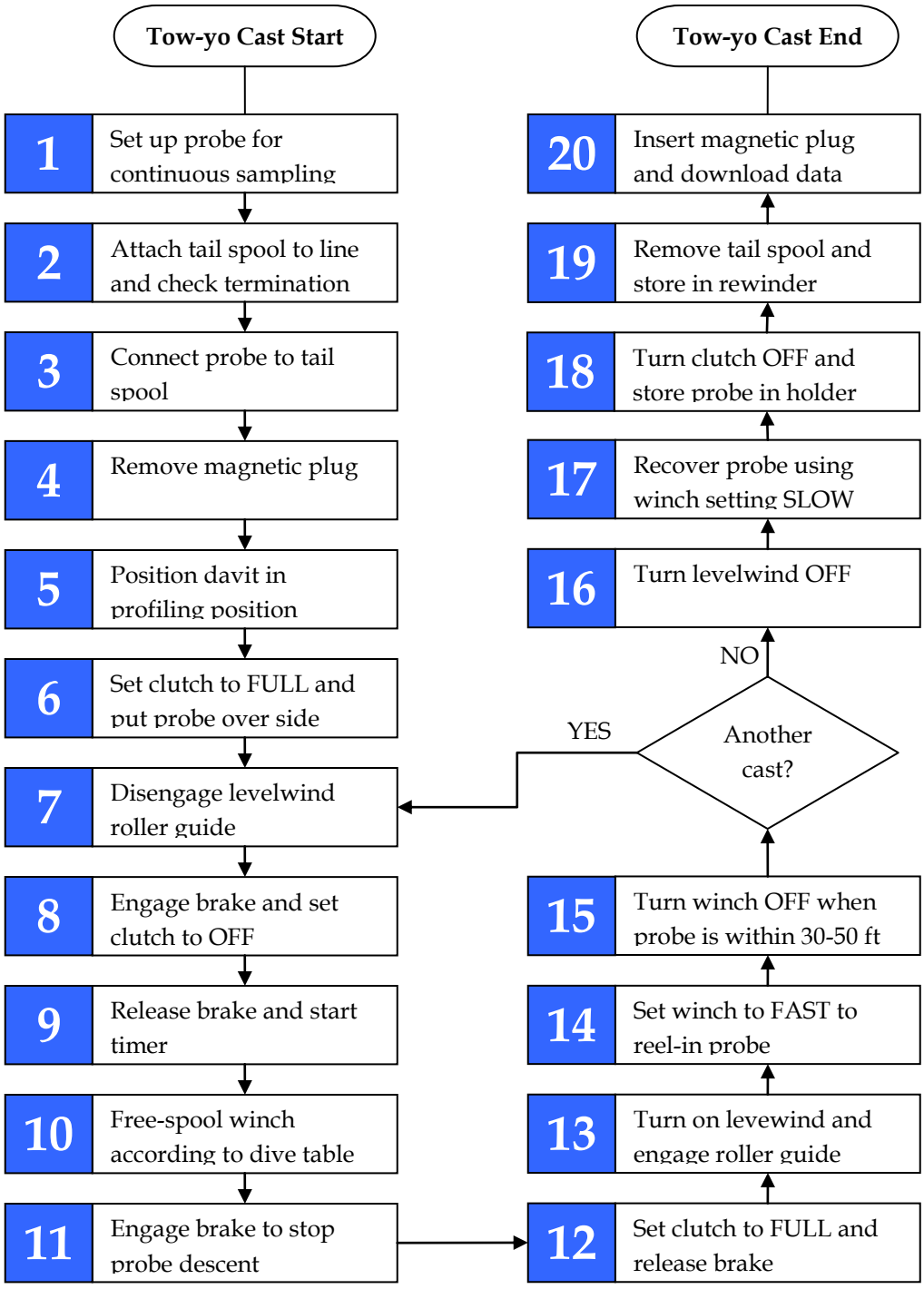


Figure 8 Flow chart for tow-yo casts.

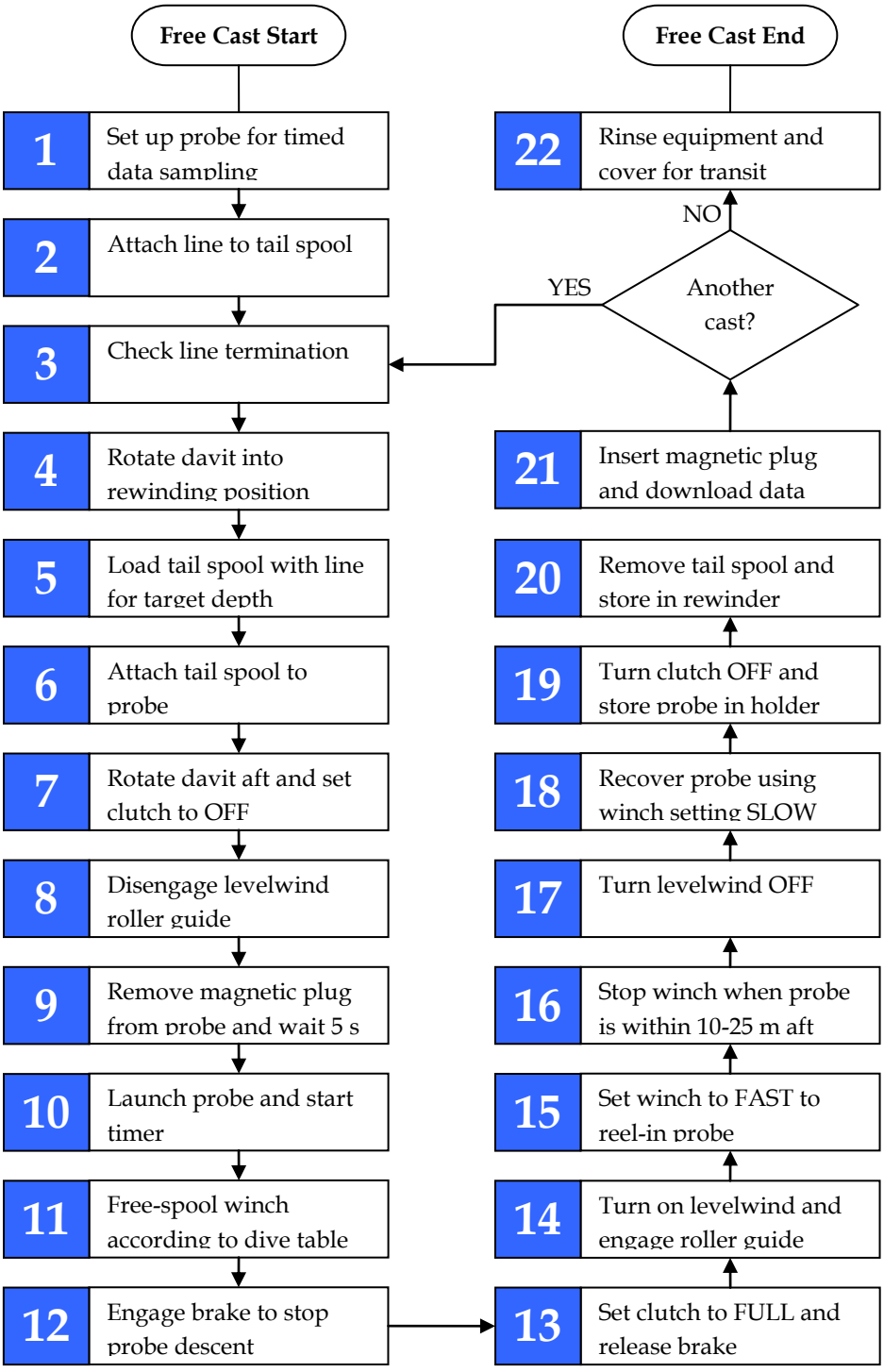


Figure 9 Flow chart for free casts.

LINE TERMINATION & SPLICING

Use the loop splice illustrated below to connect the line to the shackle in the tail spool. Typically, the line termination will last on the order of 10-50 casts. However, the loop splice should be replaced as soon as any signs of wear, such as fraying, are visible. To do so, cut off the termination with a sharp, non-serrated knife and redo the loop termination with the supplied splicing needles according to the instructions in Figure 10.

ALWAYS USE THE LOOP SPLICE TO CONNECT THE LINE TO THE TAIL SPOOL SHACKLE. NEVER USE A KNOT!

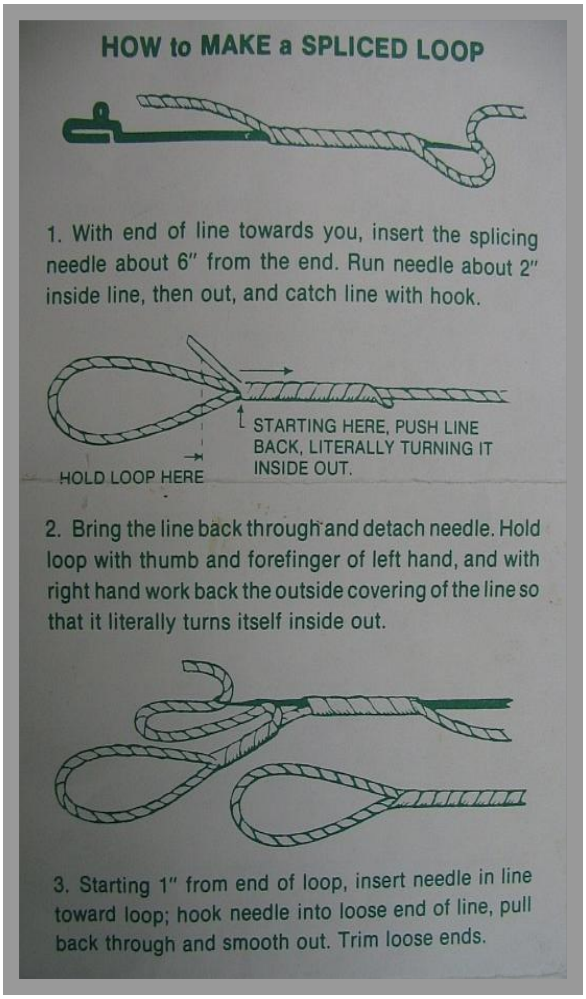


Figure 10 Loop splice instructions.

If the line is damaged or shows any wear in any place that is not near the termination, the full strength of the line can be restored by cutting out the damaged section and re-connecting the two parts via an inline splice. The instructions for this type of splice are given in Figure 11.

MAKE SURE THAT THE TWO OVERLAPPING SECTIONS OF THE SPLICE ARE AT LEAST 6″IN LENGTH EACH! IT IS GOOD PRACTICE TO COLOR THE SPLICE SECTION WITH A PERMANENT MARKER. IF THE ORIGINAL LINE COLOR SHOWS IN THE SPLICED SECTION IT MEANS THE SPLICE IS PULLING APART AND NEEDS TO BE REPLACED.

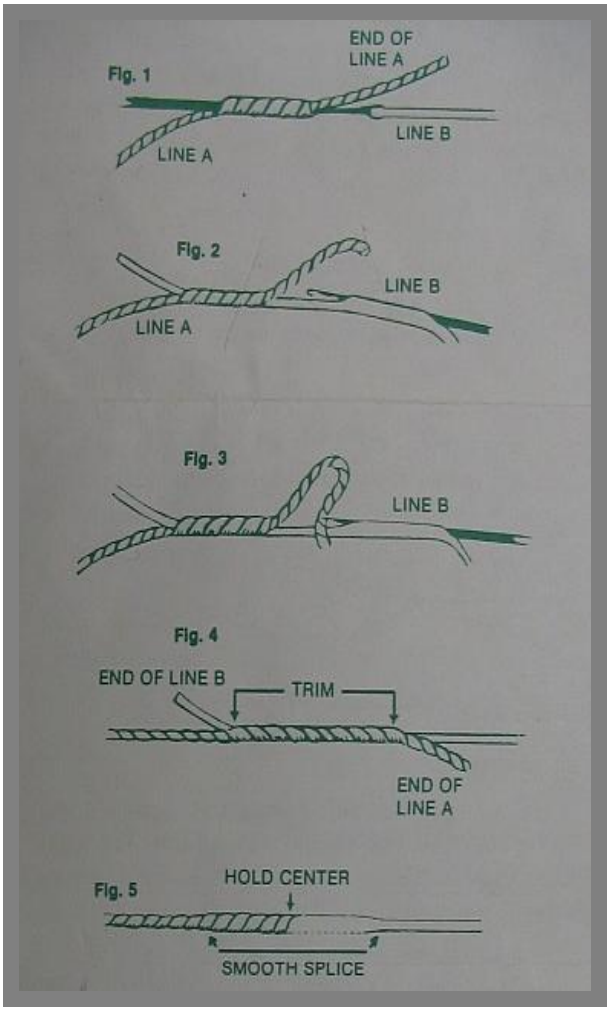


Figure 11 Insert splicing needle in line A about 8″ from end for a length of 6″. Pick up end of line B, pull back through line A and detach needle (Fig. 1). Approximately 6″ from splice, insert needle in line B (Fig. 2). Pick up loose end of line A with needle and pull through line B. Detach needle (Fig. 3) and work the splice together by pulling on both loose ends. Trim ends so that they disappear inside the line when splice is smoothed.

MAINTENANCE TIPS

PROBE ASSEMBLY

The probe should be kept in the instrument holder with a surfactant solution (a few drops of Triton-X per fill with fresh water) during profiling operations.

Inspect the shackle in the tail spool regularly for burrs and scratches that could damage the line termination and replace if necessary.

Before storing the probe assembly for longer periods, rinse all components thoroughly with freshwater. Remove tail coupling from sensor and loosen screw that secures the shackle termination in the tail spool. Then flush the conductivity cell on the probe with distilled water and let air-dry before stowing components in probe case.

WINCH

In order to keep the levelwind rollers in functioning condition, occasionally rinse with fresh water to prevent salt build-up. If the system is not used for extended periods, rinse with fresh water and cover with waterproof tarp.

WARRANTY

The Oceanscience Group, Ltd makes every effort to assure that its products meet the highest quality, reliability and durability standards and warrants to the original purchaser or original purchasing agency that each product be free from defects in materials or workmanship for a period of one year from date of shipment.

Warranty does not apply to defects due directly or indirectly to misuse, negligence or accidents, repairs or alterations outside of our facilities, or use of the UCTD for purposes other than profiling operations described above.

Oceanscience is not responsible for loss of mount, instruments, damage to property, injury or death associated with the use of any of its products or products that may be included or used with Oceanscience products.

All warranty services are FOB Oceanscience's facility in Oceanside, CA.

To take advantage of this warranty, contact Oceanscience at 760-754-2400 or info@oceanscience.com.