6500M ELEVATOR MANUAL

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TECHNICAL SPECIFICATIONS SHEET

This elevator's purpose is to carry scientific equipment and samples to and from the bottom of the ocean. It achieves this with a calculated and reconfigurable balance of syntactic foam blocks and releasable steel ballast. This manual covers how to re-ballast the elevator, use the dive planner tool that accompanies the elevator, and collapse the mast for stowage.

MAX DEPTH: 6500 m

MAX ALLOWABLE TOTAL WEIGHT: 2000 lbs-air

MAX HEIGHT: 141 in

STOWED HEIGHT: 110 in

FOOTPRINT: 79 x 79 in

BASKET SPACE: 66 x 66 in / 3827 in^2

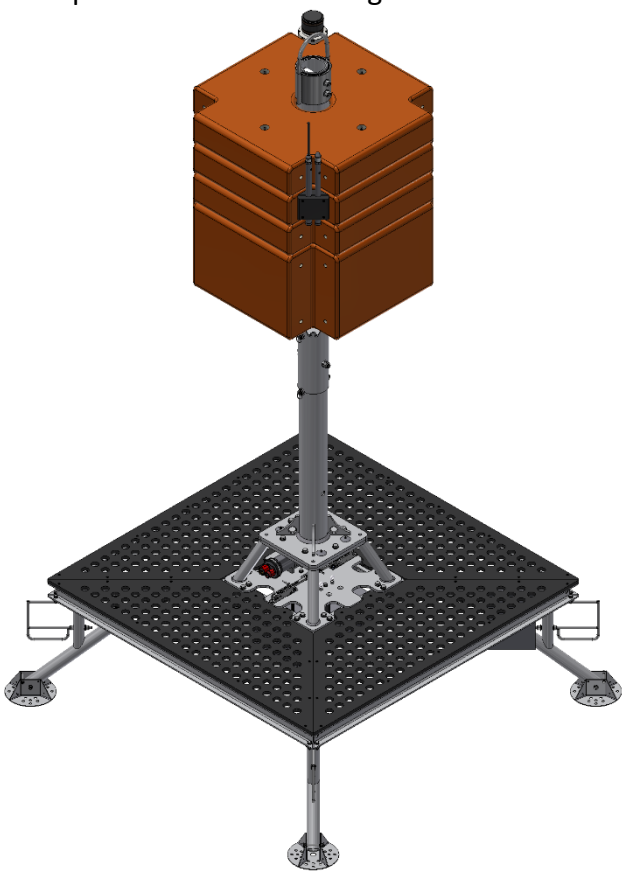


FIGURE 1: 6500m Elevator

TABLE 1: 6500m Elevator Max Allowable Weight Limit (at Standard Targets & 6500m)

CONFIG	BASE ELEVATOR + MARGIN FOAM WEIGHT	MAX ALLOWABLE SCI PAYLOAD + MARGIN STEEL WEIGHT	MAX ALLOWABLE SCI PAYLOAD + MARGIN STEEL WEIGHT
-	LBS IN AIR	LBS IN AIR	LBS IN S/WTR
3 MARGIN BLK	1270	455	385
2 MARGIN BLK	1111	631	269
1 MARGIN BLK	954	807	153
BASE BLK ONLY	796	965	37

1 – FOAM BLOCKS

The foam is broken up into 4 blocks, each with a footprint of 36 x 36 inches. The largest is the **base block** which offsets the weight of the elevator itself and is 18 inches tall. This remains with the elevator at all times via 4 tie rods. The smaller 3 are the **margin blocks** which are equally sized at about 6 inches tall. These are used to adjust the elevator's buoyancy and are attached via their own tie rods. Their various weights are summarized in Table 2. Negative weights are buoyant.

TABLE 2: Steel & Foam Weight Data

MATERIAL	AIR WT	WTR WT @0M
-	LBSA	LBSW
STEEL PLATE	18.4	16.0
MARGIN FOAM BLOCK (BLKS 1 - 3)	158.0	-116.0
BASE FOAM BLOCK	425.0	-333.0

ADJUSTING FOAM CONFIG:

Special Supplies: Crane, pallet, lift gear, tie rods & hardware, Loctite 243, 1/4 & 9/16 wrenches.

1. Secure elevator to deck and remove lift bail.
2. Attach lifting hardware to foam inserts and position crane above block.
3. Remove margin foam tie rods if necessary.
4. Carefully lift foam and lower onto pallet or elevator mast. Ensure proper alignment.
5. Secure margin foam on elevator with appropriately sized tie rods and Loctite 243.
6. Reinstall lift bail and align properly when ready.

2 – WEIGHT RELEASES

Steel ballasting is broken into 3 groups: the **ascent weight, descent weight, and margin steel**. The ascent and descent weights are releasable Alvin-style weights that sink the elevator. Once the elevator has descended, the descent weight can be released via pull-pin reducing the elevator's subsea weight to a manageable 50 lbs. When the elevator is ready to come up, the ascent weight is released via pull-pin or burn wire. Note that the burn wire is connected to both ascent and descent weights and can thus serve as an emergency dump. The margin steel serves as "fine-tuning" ballast and can either be mounted onto non-releasable weight hangers under the basket or serve as removeable pitch plates. Steel plate data is summarized in Table 2.

LOADING ASCENT & DESCENT (A/D) WEIGHTS:

Special Supplies: Pallet jack, dunnage, steel weights, ½" hardware (12" bolt), nylon pull-line, polypro loop handle, flattened pull-pins, RBF pins, burn wire, long thin zip-ties, rubber bands.

1. Tie off flattened pull-pins to nylon pull-lines, and run lines through the frame corners, loop guides, and up through the fiberglass eyebolts (Figure 2). Ensure there is little/no slack in the pull-lines & tie a knot (or use a washer) at the free end of each line to prevent slacking. Tie a polypro loop handle to the nylon line and secure it to the corner of the elevator with rubber bands.

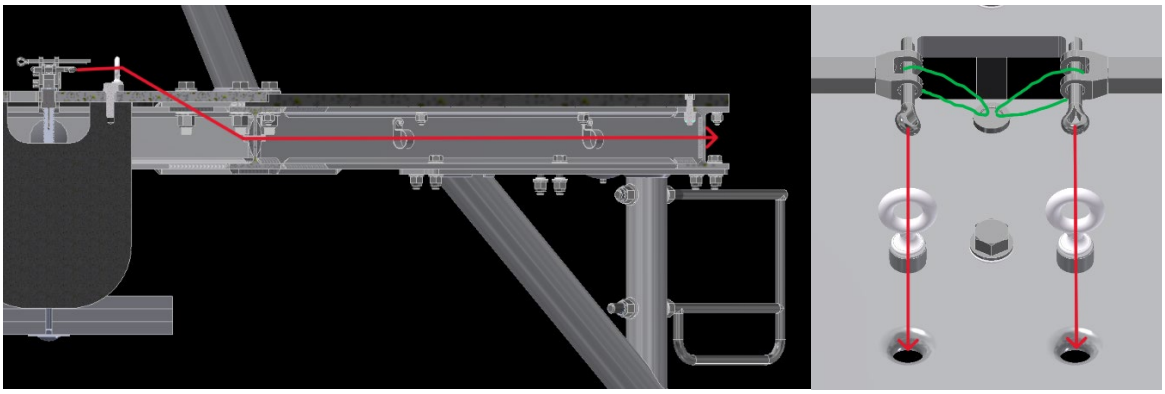


FIGURE 2: Pull-pin line routing and release setup.

2. Build up the pallet jack with dunnage so the end of the weight bolt can almost touch the frame when the pallet jack is fully lowered. This will ensure there is enough stroke length for the pallet jack to install the weight. Build the A/D weights Alvin-style and ensure a nut is secured to the top end of the bolt (IAW current practice).
3. Install 1 stack into a release, similar to how one would install an Alvin weight stack. With the weight pushed up into the release levers, lower the top lever and install the “Remove Before Flight” (RBF) pin.
4. Repeat weight & RBF pin installation for the 2nd weight.
5. Install both pull-pins into their respective clevises and ensure they can be pulled out with little force.
6. Install the burn wire into the center hole between releases. This can be done by sitting on the basket & inserting it from underneath the release cage weldment through the hand slot near the center.
7. Use 2 long thin zip-ties to connect the burn wire to the pull-pins (between the clevises).
8. Remove the RBF pins one at a time to ensure the release holds SAT.
9. Reinstall the RBF safety pins if not deploying elevator immediately.

3 – COLLAPSIBLE MAST

The elevator's mast can be collapsed for easy stowage. This involves supporting the upper mast and buoyancy blocks with a crane and removing three mast pins shown in Figure 3. It is recommended to place elevator mast in stowed position and secure with straps when transiting, experiencing heavy weather, or not in use.

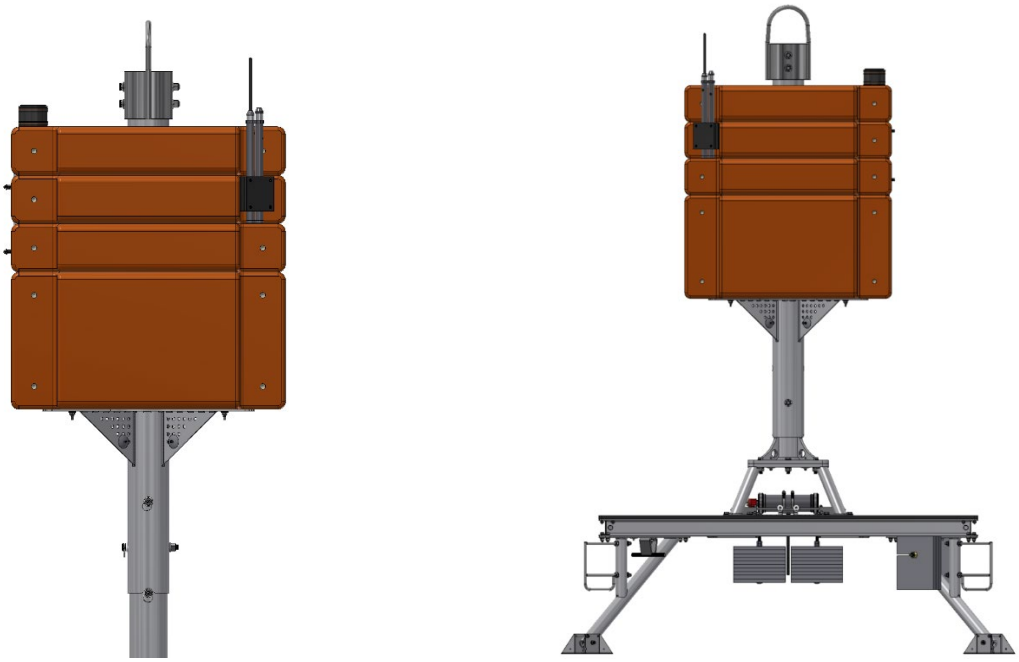


FIGURE 3: Elevator mast pins (left) & elevator in stowed configuration (right).

RAISING THE MAST:

Special Supplies: Crane, lift gear, hard hat, mast pins & associated hardware, Aqua Shield, large crescent wrench, 3/8 Allen key.

1. Prepare & stage mast pin hardware before raising mast. Attach tag line(s) if desired.
2. Use crane to raise/remove upper mast. It is safest move the upper mast away so it is not directly overhead.
3. Install the lowest mast pin first. This will help support the upper mast while installing the remaining mast pins.
4. Lower upper mast slowly onto pin so it slightly rests on the installed pin while the crane supports. Guide rotation so pin holes are aligned.
5. Install the remaining 2 mast pins. Once all pins are secure, crane is no longer needed.

LOWERING THE MAST:

Special Supplies: Crane, lift gear, mast pins & associated hardware, Aqua Shield, large crescent wrench, 3/8 Allen key.

1. Connect the crane to the elevator's lift bail and remove excess slack.
2. Remove the upper two mast pins leaving the bottom third installed.

3. Use crane to raise/remove upper mast. It is safest move the upper mast away so it is not directly overhead.
4. Remove the lowest mast pin. (If desired, a line can be tied to the lower mast pin's keyring to allow pulling from a distance.)
5. Lower upper mast slowly. Guide rotation so pin holes are aligned.
6. Install mast pin to complete placing the mast in its stowed configuration.

4 – DIVE PLANNER

The dive planner tool takes science payload air/water weight inputs and outputs the necessary foam, margin steel, and A/D weights for a dive to a specified depth. The general process for re-ballasting an elevator for a given science payload involves the following steps:

1. Calculate the amount of foam needed based on the given science payload. Because of the broad resolution 1 margin block provides, the elevator will be more buoyant than it needs to be. Fine tuning the ballasting with margin steel will be addressed in Step 2.
2. Correct for the extra buoyancy by calculating the margin steel required to bring the elevator's buoyancy down to the appropriate range (typically ~100lbsw buoyant). If the elevator is left too buoyant, larger ascent/descent weights will be needed, wasting steel. Ballasting with margin steel saves resources and time, since it remains with the elevator and is non-releasable.
3. Calculate the size of the ascent/descent weights needed to get the elevator to the seafloor. Once there, the descent weight is removed to lighten the elevator from ~100lbsw heavy to ~50lbsw heavy for Alvin to handle. To resurface the elevator, the ascent weight is dropped which lightens the elevator from ~50lbsw heavy to ~100lbsw buoyant.

The elevator has a maximum allowable total weight limit and maximum allowable water weight limits. These limits are budgeted among the science payload, foam, margin steel, and ascent/descent steel. The science payload's water weight will define how much buoyant foam is necessary (Step 1). An increase in foam will reduce some of the air weight budget, but expand the water weight budget, as seen in Table 1. Thus, users must remove foam to "buy" more air weight, at the cost of allowable water weight.

Once both weight budgets are set by the foam, the margin steel needed to fine tune the elevator's water weight is defined (Step 2). The sum of the margin steel's and science payload's air/water weights must not exceed the air/water weight limits set forth by the foam. This is illustrated in Figure 4.

PLANNING A DIVE:

NOTE ON COLOR CONVENTION: Inputs = white/yellow, outputs = greens, do not touch = grey.

SCI GEAR LOADOUT DIRECTIONS (SEE FIGURE 4):

1. Enter Dive #, Date, and Target Depth.

SYMMETRICALLY LOADED DIVES:

1. In the Descent Table, select/enter Sci Gear Air Weight, Water Weight, and Quantity.
2. In the Ascent Table, copy/enter all sci gear from the Descent Table ensuring both final sums are equal.
3. Proceed to Dive Planner Sheet.

ASYMMETRICALLY LOADED DIVES:

COLLECTIONS SUBSEA:

1. In the Descent Table, select "Pitch Plate" and adjust the quantity to match the subsea collection's expected water weight as closely as possible.
2. In the Ascent Table, enter the expected water weight of subsea collection. Ensure both final sum water weights are equal.
3. Proceed to the Dive Planner Sheet.

NOTE: Pitch Plates should be removed subsea only after collection is placed in elevator.

DEPLOYMENTS SUBSEA:

1. In the Descent Table, select/enter Sci Gear Air Weight, Water Weight, and Quantity.
2. In the Ascent Table, copy/enter all sci gear returning with the elevator from the Descent Table.
3. In the Dive Planner Sheet, add the Sci Gear Water Wt difference (Δ) to the Target Ascent Wt. (Example: Δ = -32, so set Target Ascent Wt = -132)

NOTE: Expect Actual Descent Wt to be greater than Target Descent Wt. This process reallocates Margin Steel to the Ascent Stack so the elevator can still return to surface if the sci gear cannot be deployed.

6500 ELEVATOR DIVE PLANNER DIRECTIONS (SEE FIGURE 5):

1. Enter Target Descent, Ascent, and Carry Weights. If deploying gear, add the Sci Gear Water Wt Difference (Δ) to the Target Ascent Wt. (Example: Δ = -32, so set Target Ascent Wt = -132)

NOTE: Expect Actual Descent Wt to be greater than Target Descent Wt. This process reallocates Margin Steel to the Ascent Stack so the elevator can still return to surface if the sci gear cannot be deployed.

2. Select 4500m or 6500m versions of tracking equipment installed.
3. Select lowest Margin Foam Block # without receiving errors. Use Sci Payload Limits Chart to aid. Chart displays initial and final sci gear loadouts into appropriate Margin Foam Block # range.
4. Check all outputs to ensure setup is as desired.
5. Note the Estimated Descent/Ascent Speeds/Times.
6. Save/print the Sci Gear Loadout and Dive Planner Sheets.

SUBSEA ORDER OF OPS:

1. Deploy sci gear.
2. Release Descent Wt to carry elevator.
3. Release Ascent Wt to surface elevator.

Collections can occur anytime as long as you add collection before removing Pitch Plates. Will not reliably achieve desired Target Carry Weight if you haven't deployed first.

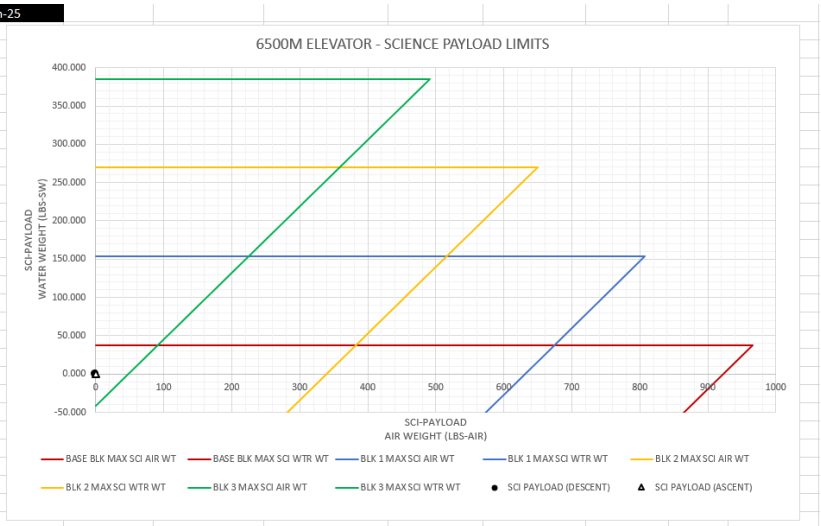
ELEVATOR SCI GEAR LOADOUT												
DIVE #:	XXXX											
DATE:	24-Jan-2025											
TARGET DEPTH (M):	6500											
						Δ						
DESCENT TOTAL SCI GEAR				0.0	0.0	0.0	ASCENT TOTAL SCI GEAR				0.0	0.0
SCI GEAR DESCRIPTION	ITEM AIR WT	ITEM WATER WT	QTY	QTY AIR WT	QTY WATER WT		SCI GEAR DESCRIPTION	ITEM AIR WT	ITEM WATER WT	QTY	QTY AIR WT	QTY WATER WT
SELECT/ENTER SCI GEAR	LBS	+ LBSW = SINK	#	LBS	+ LBSW= SINK		COPY/ENTER SCI GEAR	LBS	+ LBSW = SINK	#	LBS	+ LBSW= SINK
Sample Gear 1	18.0	10.0	0	0	0		Sample Gear 1	18.0	10.0	0	0	0
Pitch Plate	18.4	16.0	0	0	0		Pitch Plate	18.4	16.0	0	0	0

FIGURE 4: Sci Gear Loadout sheet. Descent and ascent loadouts are left and right, respectively.

ELEVATOR DIVE PLANNER	NDE REV: 24-Jan-25
XXXX	
INPUTS	+ LBSW = SINK
SCI PAYLOAD DESCENT AIR WT (LBSA)	0.0
SCI PAYLOAD DESCENT WATER WT @ 0M (LBSW)	0.0
SCI PAYLOAD ASCENT AIR WT (LBSA)	0.0
SCI PAYLOAD ASCENT WATER WT @ 0M (LBSW)	0.0
SCI PAYLOAD WATER WT Δ (LBSW)	0.0
TARGET DEPTH (M)	6500
TARGET DESCENT WT @DEPTH (MIN TGT = 100)	100
TARGET ASCENT WT @0M (MIN TGT = -100)	-100
TARGET CARRIED WT @DEPTH (TYPICAL = 50)	50
MARGIN FOAM BLOCK #	0

ESTIMATED DESCENT SPEED (M/MIN)	29
ESTIMATED DESCENT TIME (MIN)	222
ESTIMATED ASCENT SPEED (M/MIN)	34
ESTIMATED ASCENT TIME (MIN)	192

OPERATING LIMITS BASED ON INPUTS	
CRITERIA	LBS
MAX SCI PAYLOAD WATER WT - BASE BLOCK	37
MAX SCI PAYLOAD WATER WT - BLOCK 1	153
MAX SCI PAYLOAD WATER WT - BLOCK 2	269
MAX SCI PAYLOAD WATER WT - BLOCK 3	385
MAX SCI PAYLOAD + MARGIN STEEL AIR WT	965
ABSOLUTE MAX TOTAL ELEVATOR AIR WT	2000



W&B DIVE STAGES										
ASSEMBLY	INI AIR WT	0M - DISPL	0M - DESCENT	DEPTH - DESCENT	DEPTH - DEPLOY SCI	DEPTH - CARRY	DEPTH - ASCENT	0M - ASCENT	# PLATES	STACK HEIGHT
-	LBSA	CU.IN	LBSW	LBSW	LBSW	LBSW	LBSW	LBSW	#	IN
TARGETS	-	-	-	100	-	50	-	-100	-	-
ELEVATOR	1071	26102	103	93	93	45	-114	-105	-	-
SCI PAYLOAD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
MARGIN STEEL	36.8	129.3	32.0	31.9	31.9	31.9	31.9	32.0	2	-
ASCENT/DESCENT STEEL	239.2	840.5	208.0	207.1	207.1	159.3	0.0	0.0	13	-
ASCENT WEIGHT	184.0	646.6	160.0	159.3	159.3	159.3	0.0	0.0	10	6.3
DESCENT WEIGHT	55.2	194.0	48.0	47.8	47.8	0.0	0.0	0.0	3	1.9
MARGIN FOAM BLOCKS 1-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
BLOCK 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
BLOCK 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
BLOCK 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
BASE ELEVATOR	795.5	25132.1	-137.4	-146.3	-146.3	-146.3	-146.3	-137.4	-	-
BASE BLOCK	425.0	20420.3	-333.0	-336.8	-336.8	-336.8	-336.8	-333.0	-	-
BARE ELEVATOR (NO FOAM)	326.8	4213.4	170.4	165.9	165.9	165.9	165.9	170.4	-	-
BURN BOTTLE AL3402-0101-000 (6500M)	6.3	84.2	3.2	3.1	3.1	3.1	3.1	3.2	-	-
SONARDYNE AVTRACK 6HP (6500M)	34.4	387.9	20.0	19.6	19.6	19.6	19.6	20.0	-	-
METOCEAN MMF-INF MINI-FLASHER (6500M)	1.4	12.9	1.0	0.9	0.9	0.9	0.9	1.0	-	-
METOCEAN MMB-INF MINI-BEACON (6500M)	1.5	13.5	1.0	1.0	1.0	1.0	1.0	1.0	-	-

FIGURE 5: The dive planner tool. Inputs, speeds/ETAs, and fixed parameters are displayed in the top left. The payload limit chart is located in the top right. The dive stages table is located across the bottom.

MAINTENANCE CHECK LIST **CRUISE/DATE _____**

CIRCLE ONE: **PRE-CRUISE** **POST-CRUISE**

1. CHECK INVENTORIES & ORDER AS NEEDED

_____ ELEVATOR SPARES

_____ BURN WIRES & BURN BOTTLE

_____ WEIGHT HARDWARE

_____ ANODES

_____ TRACKING:
(AVTRAK, BEACON, STROBE)

2. VISUAL & TACTILE INSPECTIONS

Record any damage/findings & alert Engineering if necessary.

_____ BOLTED & PINNED JOINTS

_____ WELDED JOINTS

_____ FOAM BLOCKS

_____ RELEASE ASSEMBLIES

_____ ANODES

3. RINSE WITH FRESHWATER AND/OR SALTAWAY (POST-CRUISE)