CHAPTER 18

WEIGHT AND BALANCE

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18-10 Leveling

NOTE

Perform leveling and weighing in a zero-wind environment.

NOTE

Verify spirit level is calibrated by placing level on a designated surface and noting bubble position. Rotate spirit level 180°; verify bubble is in the same position.

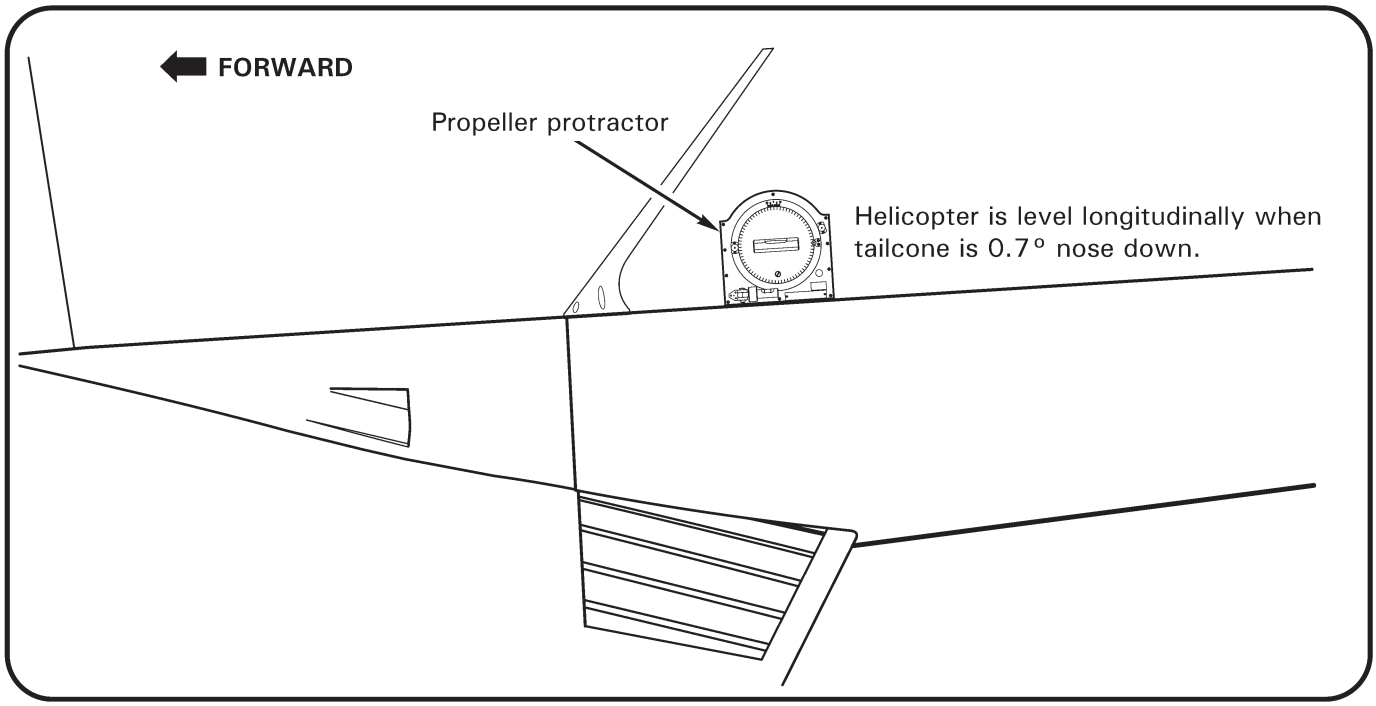

FIGURE 18-1 LEVELING USING TAILCONE

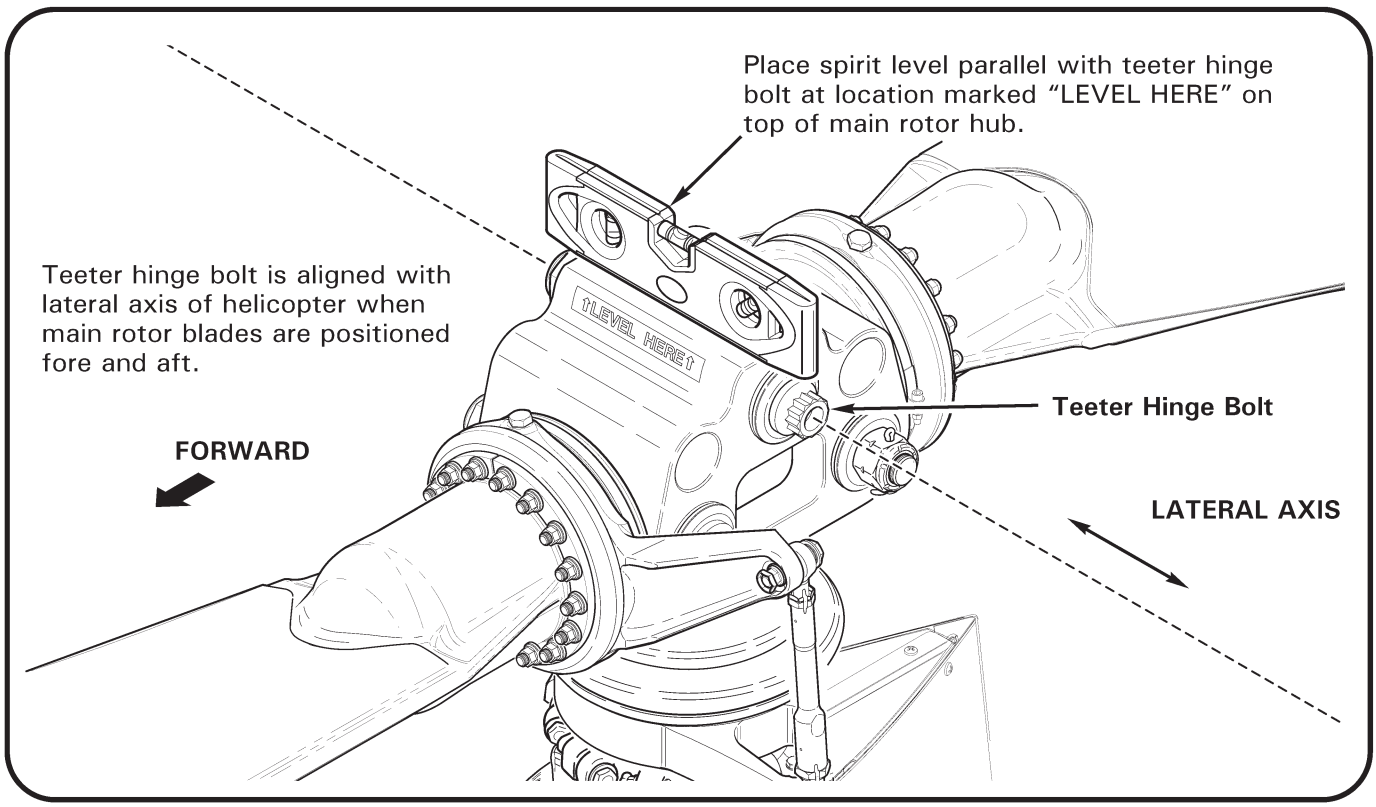

FIGURE 18-2 LEVELING AT MAIN ROTOR HUB
(Lateral shown)

18-11 Leveling Using Tailcone and Aft Landing Gear Cross Tube

1. Refer to Figure 18-1. Place a propeller protractor or digital level on top of tailcone forward bay.
2. Level helicopter longitudinally by placing shims under landing gear skid tubes or jacking per § 17-10. Helicopter is level longitudinally when tailcone is 0.7° nose down.
3. Verify aft cross tube is not bent. Place a level on center of aft cross tube.
4. Level helicopter laterally by placing shims under landing gear skid tubes or jacking per § 17-10.
5. Recheck longitudinal level. Repeat steps 2 thru 4 as required.

18-12 Leveling at Main Rotor Hub

1. Inspect main gearbox (4) rubber mounts. Verify no deterioration. Replace mount(s) if deteriorated.
2. Rotate main rotor until teeter hinge bolt is aligned with longitudinal axis of helicopter.
3. Refer to Figure 18-2. Place a spirit level atop main rotor hub parallel to teeter hinge bolt at location marked “LEVEL HERE”.
4. Level helicopter longitudinally by placing shims under landing gear skid tubes or jacking per § 17-10.
5. Rotate main rotor until teeter hinge bolt is aligned with lateral axis of helicopter.
6. Level helicopter laterally by placing shims under landing gear skid tubes or jacking per § 17-10
7. Recheck longitudinal level. Repeat steps 3 thru 5 as required.

18-20 Weighing

Reweigh helicopter when helicopter empty weight and empty weight center of gravity have been modified, or if accuracy of data is suspect.

Maintain a continuous record of the helicopter's weight and balance using the Weight and Balance Record in applicable Pilot's Operating Handbook (POH) Section 6.

> NOTE
>
> Verify scales are calibrated. Operate scales according to scale manufacturer's instructions.

> NOTE
>
> Never weigh helicopter in wind. Weigh helicopter on a level, flat, hard surface in a zero-wind environment for accurate scale readings.

18-21 Preparing Helicopter for Weighing

1. Defuel helicopter per § 1.150, including gascolator and both fuel tank sumps.
2. Service engine oil, hydraulic fluid, and main & tail rotor gearboxes per Chapter 1.
3. Clean aircraft per § 23-10. Ensure helicopter is completely dry prior to weighing.
4. Remove items that are not installed equipment (tools, rags, charts, etc.) from baggage compartments and stowage areas.
5. Verify cowlings, removable panels, cabin doors, removable controls, and applicable Pilot's Operating Handbook (POH) are installed.
6. Verify Equipment List/Weight and Balance Data sheet (RF 134) and modifications recorded in the Weight and Balance Record correspond with installed equipment and recorded equipment locations.

18-22 Weighing Procedure and Calculations

NOTE

- Arm is the distance in inches from datum.
- Datum is located 100 inches forward of main rotor centerline.
- CG (arm) is determined by dividing total moment by total weight.

1. Refer to § 18-20. Prepare helicopter for weighing per § 18-21.
2. Hoist helicopter per § 17-20 approximately one foot above ground. Have one person hold tail skid while hoisting to stabilize helicopter.
3. With main rotor blades oriented approximately fore and aft, raise both blades off droop stops to allow hub to teeter freely. Raise tail slightly, release, and allow to settle.
4. Refer to Figure 18-3. With aircraft hanging freely and steady, use a water level and measure difference in vertical height between tail rotor gearbox centerline and cabin belly at vertical firewall. Ensure no air bubbles in water level tube.

   Record height difference: _____ inches

5. Slowly lower both main rotor blades. Determine uncorrected longitudinal center of gravity:

   114.34 – [0.32 x (height difference from step 4)] = _____ inches

6. Place a 1000-lb capacity (minimum) scale under each skid. Locate center of scales approximately 6 inches forward of ground handling wheel supports.
7. Lower helicopter until it rests entirely on scales. Helicopter must be well balanced on scales before releasing tail. Be sure helicopter is level laterally by placing level on center of aft landing gear cross tube.
8. Determine uncorrected empty weight:

   Right scale reading: _____ lb

   Left scale reading: + _____ lb

   Tare (leveling shims, hoist fixture, etc.): – _____ lb

   Uncorrected empty weight: = _____ lb

9. Calculate CG with full fuel and 150 lb pilot:

$$\frac{[(\text{CG from step 5}) \times (\text{Empty weight from step 8})] + 37333}{(\text{Empty weight from step 8}) + 436.2} = \text{\_\_\_\_\_ inches}$$

   Adjust ballast per step 10 as required until calculated CG is between 101.5 and 102.5 inches.

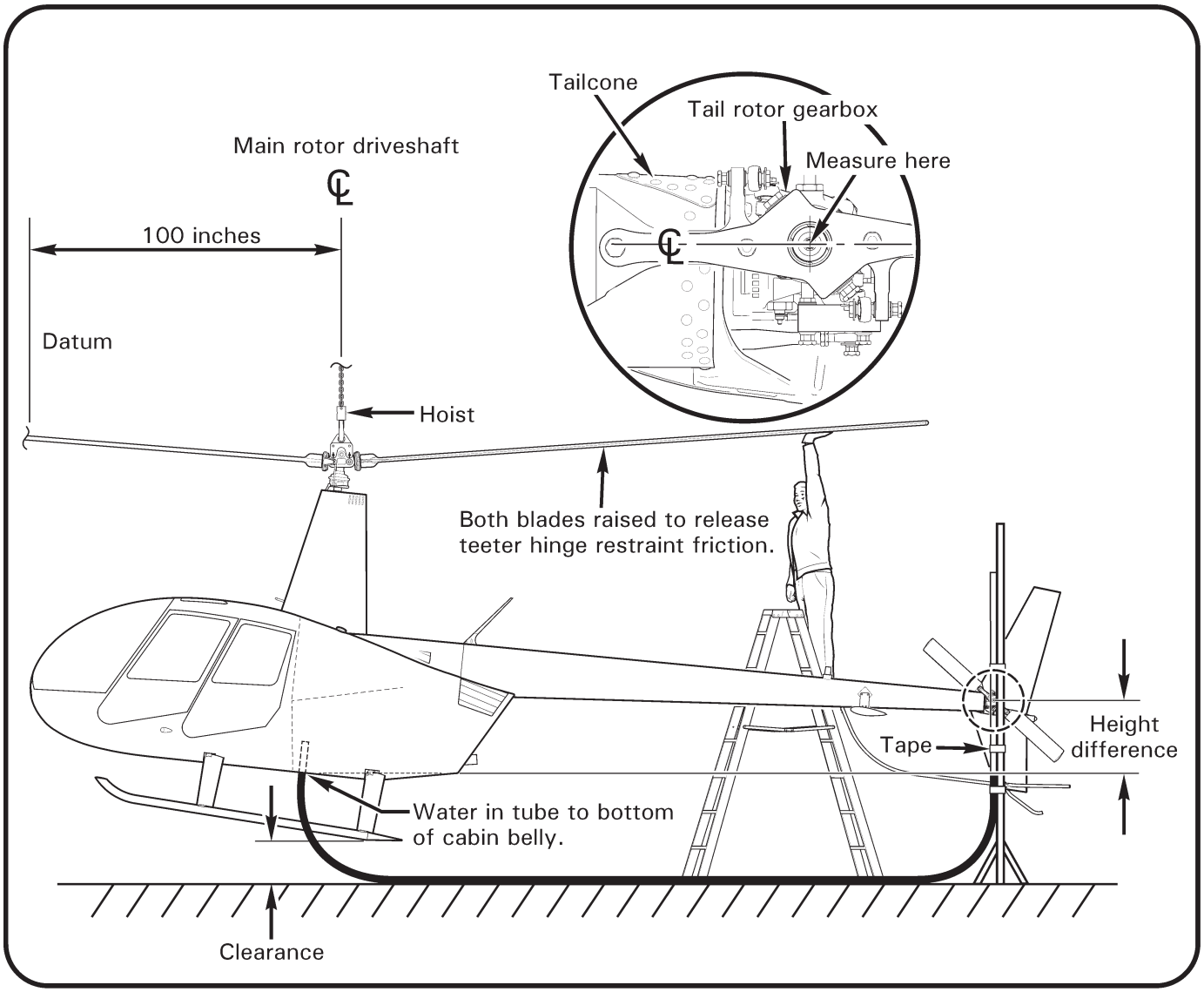

FIGURE 18-3 DETERMINING CG USING WATER LEVEL

18-22 Weighing Procedure and Calculations (continued)

10. a. If calculated CG from step 9 is aft of 102.5 inches, determine nose ballast required:

$$\frac{[(\text{CG from step 5} - 102.5) \times (\text{Empty weight from step 8})] - 7378}{95.5} = \_\_\_\_\_ \text{ lb}$$

Round ballast weight up to nearest 0.25 lb: _____ lb

Install nose ballast per § 18-31. Repeat steps 2 thru 10 and revise measurements and calculations.

b. If calculated CG from step 9 is forward of 101.5 inches and nose ballast is installed, determine nose ballast to remove:

$$\frac{(102.5 - \text{Calculated CG from step 9}) \times (\text{Empty weight from step 8} + 436.2)}{95.5} = \_\_\_\_\_ \text{ lb}$$

Round ballast weight down to nearest 0.25 lb: _____ lb

Remove nose ballast per § 18-31. Repeat steps 2 thru 10 and revise measurements and calculations.

c. If calculated CG from step 9 is forward of 101.5 inches and nose ballast is not installed, install empennage ballast per § 18-32. Repeat steps 2 thru 10 and revise measurements and calculations.

11. Adjust weight and balance to correct for drained unusable fuel:

Item	Weight (lb)		Longitudinal CG (arm, inches)		Moment (in.-lb)
Helicopter as weighed	_____ *(step 8)*	x	_____ *(step 5)*	=	_____
Unusable fuel (add):	+7.2	x	96.0	=	+691
Basic empty weight and CG (includes unusable fuel & full oil)	_____	x	_____ *	=	_____

* CG location (arm) is determined by dividing total moment by total weight

CAUTION

Calculated CG with full fuel and 150 lb pilot must be at, or forward of, 102.5 inches aft CG limit.

12. Determine lateral center of gravity:

$$\frac{(\text{Right scale reading} - \text{Left scale reading})}{(\text{Right scale reading} + \text{Left scale reading})} \times 41.2 = \_\_\_\_\_ \text{ inches}$$

13. Determine lateral moment:

(Basic Empty Weight) x (lateral CG) = _____ in.-lb

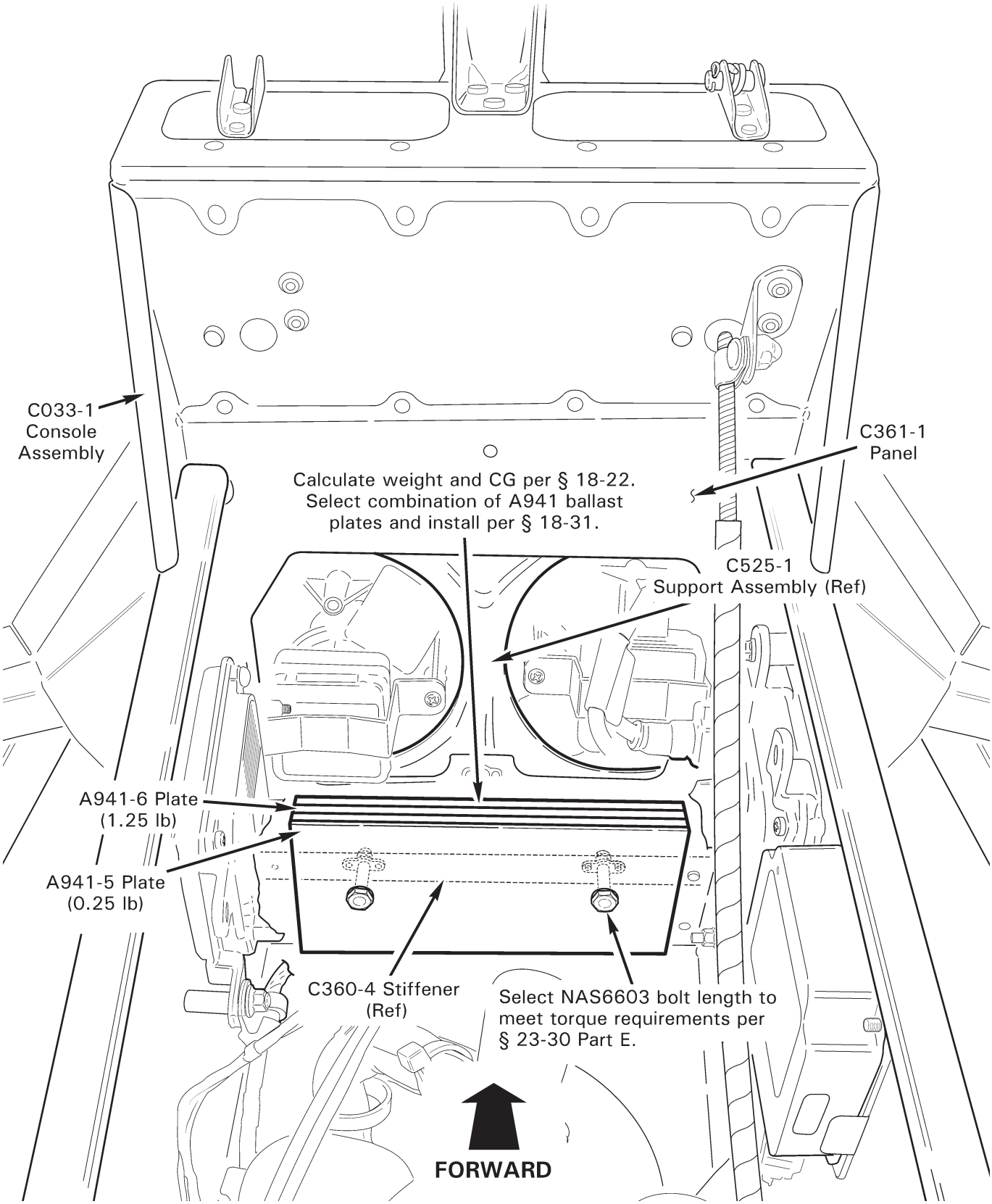

FIGURE 18-4 NOSE BALLAST
(View inside lower console assembly with upper console hinged aft)

18-30 Fixed Ballast

18-31 Nose Ballast

NOTE

Maximum allowable nose ballast is 20.00 lb if console assembly has C360-4 (or -2) stiffener installed, or 10.00 lb maximum without stiffener.

CAUTION

Changing fixed ballast amount affects helicopter empty weight & center of gravity (CG). If helicopter empty weight & CG historical data is suspect, weigh helicopter per § 18-20.

1. Open or remove console assembly per § 13-80.
2. As required, remove landing lights per § 26-13 to access ballast attaching hardware.
3. Refer to Figure 18-4. If installed, remove hardware securing A941-5 or -6 (or -2 or -3) ballast plate(s) to C361-1 panel.
4. Remove or install ballast plates per calculations performed in § 18-22. Select NAS6603 (or NAS428-3A) bolt length per to meet § 23-30 Part E.5. Install hardware, standard torque bolts per § 23-32, and torque stripe per Figure 2-1.
5. Install or close console assembly per § 13-80. Verify security.
6. Reweigh and/or calculate basic empty weight and CG per § 18-20.
7. Revise Weight and Balance Record in applicable Pilot's Operating Handbook (POH) Section 6 to reflect ballast removal or installation using the following data:

Item	Weight	Longitudinal Arm	Longitudinal Moment	Lateral Arm	Lateral Moment
Nose ballast	0–20.00 lb	7.0 in.	Variable	0.00 in.	0.00 in.-lb

18-32 Empennage Ballast

NOTE

Approved materials are listed in § 23-70.

CAUTION

Changing fixed ballast amount affects helicopter empty weight & center of gravity (CG). If helicopter empty weight & CG historical data is suspect, weigh helicopter per § 18-20.

A. Removal

CAUTION

Maximum allowable empennage ballast is 3.00 lb. One upper weight and one lower weight are required.

1. Remove D079-1 tail rotor guard per § 4.430.
2. Leaving NAS6606-78 bolts installed in C004-2, or F004-2 empennage assembly, remove palnuts, nuts, washers, and lower D301-2 ballast weight from empennage.
3. Remove one bolt then rotate upper ballast weight to expose empty bolt hole. Install NAS6606-47 bolt and associated hardware in exposed hole, finger tight (install [1] or [2] NAS1149F0663P washers as required under nut to meet § 23-30 Part E.5).
4. Remove second bolt & upper ballast weight from empennage assembly. Install NAS6606-47 bolt and associated hardware (install [1] or [2] NAS1149F0663P washers as required under nut to meet § 23-30 Part E.5). Standard torque bolts securing empennage to C148 bulkhead per § 23-32. Install palnuts and standard torque per § 23-32, do not torque stripe at this time.
5. As required, solvent-clean upper & lower surfaces of empennage assembly around and between attach bolts. Apply light coat zinc-chromate or epoxy primer to noted surfaces and hardware. Apply topcoat as desired.
6. Apply torque stripe to hardware per Figure 2-1.
7. Install tail rotor guard per § 4.430.
8. As required, weigh helicopter or calculate basic empty weight & CG per § 18-20.
9. Revise Weight and Balance Record in applicable Pilot's Operating Handbook (POH) Section 6 to reflect ballast removal using Table 8-1.

18-32 Empennage Ballast (continued)

B. Installation

CAUTION

Maximum allowable empennage ballast is 3.00 lb. One upper weight and one lower weight are required.

1. Remove empennage assembly per § 4.400.
2. Solvent-clean around and between 0.375 inch diameter holes on upper & lower surfaces of F044-1 vertical stabilizers mount assembly or C044-1 horizontal stabilizer, as applicable.
3. Temporarily position two D301-2 weights on mount assembly (or horizontal stabilizer) using two NAS6606-78 bolts & associated hardware finger tight.
4. Trace outline of weights onto mount assembly (or horizontal stabilizer) upper & lower surfaces using felt-tip marker or tape. Remove weights.
5. Remove paint within traced outlines on mount assembly (or horizontal stabilizer) using approved stripper (ref. § 23-71), or by block sanding (to maintain flatness) using 320-grit or finer aluminum-oxide abrasive sandpaper.
6. Remove tracing tape, if installed. Solvent-clean bare metal on mount assembly (or horizontal stabilizer) & weight clamping surfaces. Conversion coat upper & lower bare metal surfaces of mount assembly (or horizontal stabilizer) per § 23-51.
7. Apply approved chromated-epoxy primer (ref. § 23-75) per § 23-60 to bare metal clamping surfaces of weights and mount assembly (or horizontal stabilizer). While primer is still wet, install empennage assembly per § 4.400.
8. As required, apply primer and topcoat to exposed hardware.
9. Weigh helicopter or calculate basic empty weight and CG per § 18-20.
10. Revise Weight and Balance Record in applicable Pilot's Operating Handbook (POH) Section 6 to reflect ballast installation using Table 8-1.

Item	Weight	Longitudinal Arm	Longitudinal Moment	Lateral Arm	Lateral Moment
Empennage Ballast	3.0 lb	325.4 in.	976.2 in.-lb	4.45 in.	13.35 in.-lb

TABLE 8-1 EMPENNAGE BALLAST WEIGHT AND BALANCE

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