



# Marvel

Manufacturing Company

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Operation and Service  
Instructions

**BALANCING & ADAPTER KITS  
FOR  
AIRCRAFT  
ROTATING COMPONENTS**

BALANCING KITS

ADAPTER KITS

	7A051	7HEL052	7HEL061
7A050	7A052	7HEL054	7HEL062
	7A053	7HEL055	7HEL064
7HEL053	7A054	7HEL056	7HEL065
	7A055	7HEL058	7HEL154
7JET051	7HEL050	7HEL059	7HEL254
	7HEL051	7HEL060	7HEL354

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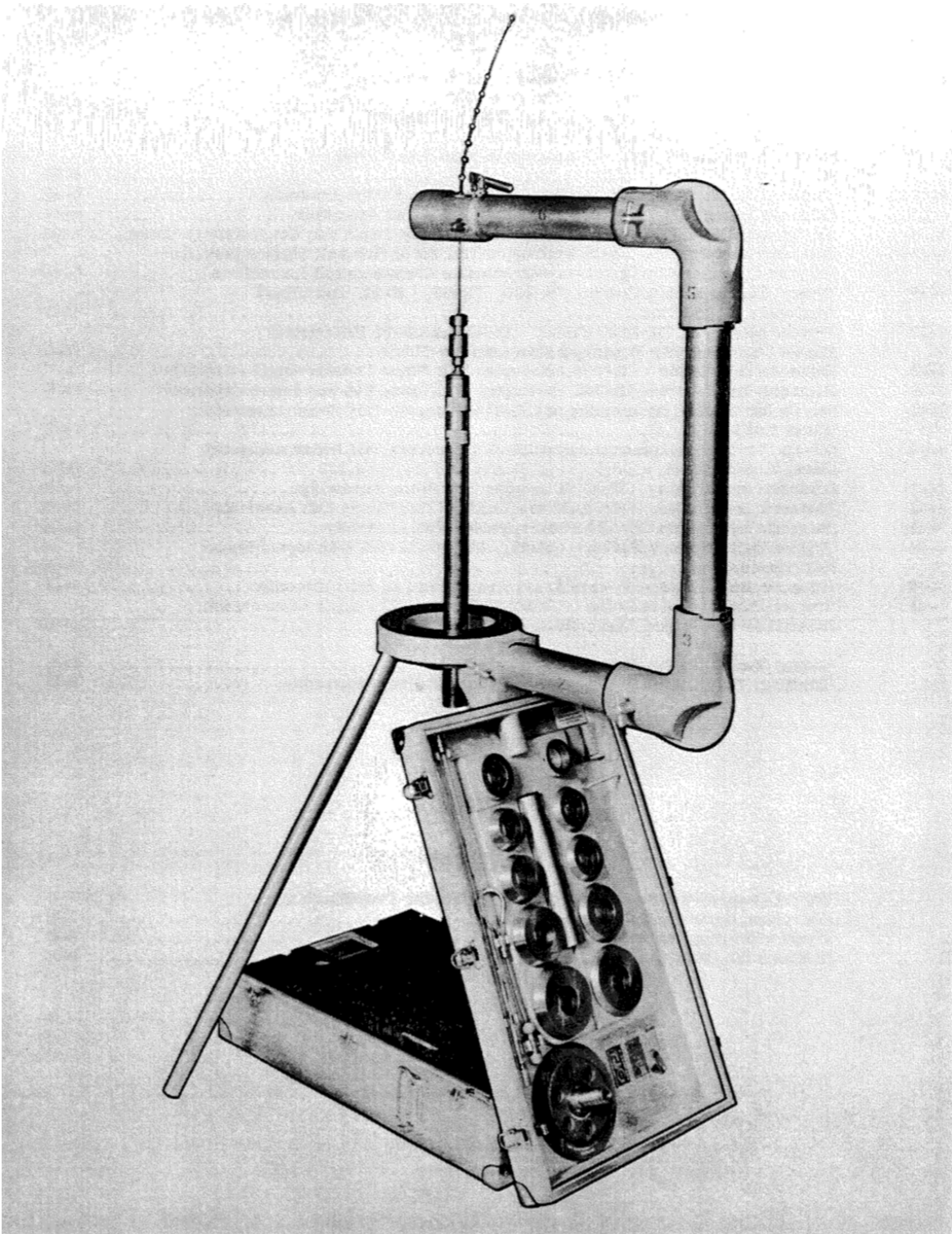
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**Figure 1-1. Balancing Kit 7A050 Assembled for Use**

SECTION 1

INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION.

1-2. This manual provides operation and service instructions for the Marvel Propeller Suspension Balancing Kit, Part No. 7A050 (figure 1-1), and the various related Propeller Components Balancing Adapter Kits listed numerically in Table 1, and shown in figures 1-14 through 1-18. This manual also contains operation and service instructions for the Helicopter Balancing Tracking, and Aligning Kit, Part No. 7HEL050. This latter kit, shown as a complete kit in figure 3-6, actually consists of six sub-kits listed and indented numerically under the 7HEL050 part number in Table 1. Individual views of these kits may be found in figures 1-19 through 1-24.

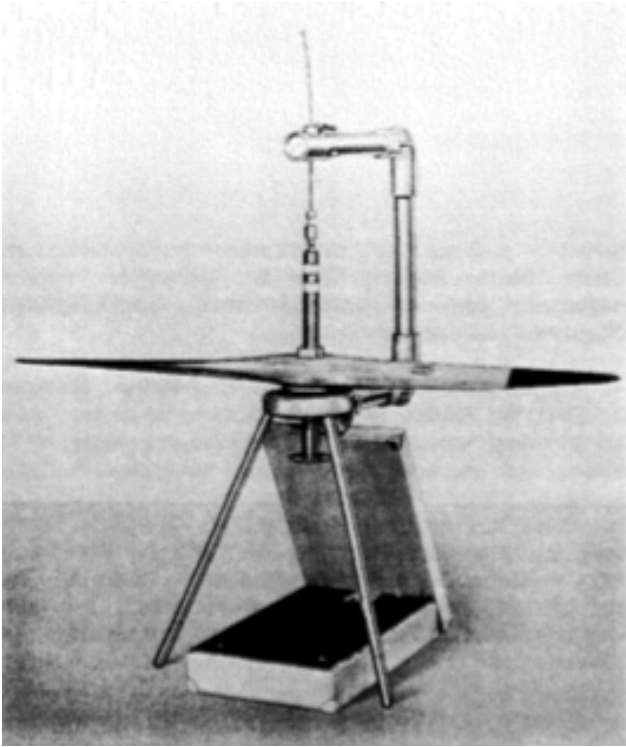
Operation and service instructions for the additional related Marvel Adapter Kits for Helicopter rotating components also are included herein and illustrated in figures 1-25 through 1-32.

1-3. The primary component of the Marvel Balancer Kit, Part No. 7A050, is a precision-made arbor which is a true and accurate indicating device, designed to balance and suspend loads to 700 pounds. Typical applications of this kit and various adapter kits are shown in figures 1-2 through 1-12. The Marvel Small Balancer Kit, Part No. 7HEL053 and the Compressor Rotor Stage Sub-Assemblies Balancing Kit, Part No 7JET051, contain a small arbor that adequately balance and suspend loads to 150 pounds.

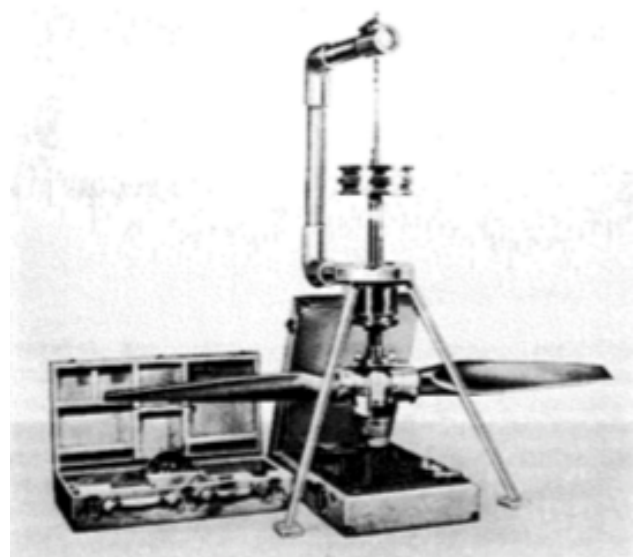
TABLE 1

MARVEL SUSPENSION BALANCING AND ADAPTER KITS  
FOR PROPELLER AND HELICOPTER ROTATING COMPONENTS

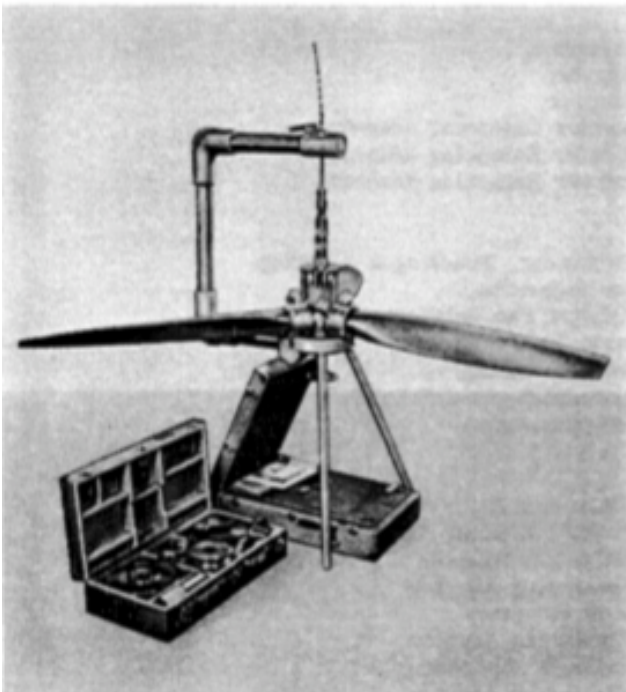
Marvel Kit Part No.	Nomenclature
7A050	Kit, Propeller Balancing
7A051	Kit, Regulator Adapter
7A052	Kit, Propeller Adapter
7A053	Kit, Propeller Spinner Balancing Adapter
7A054	Kit, Propeller Spinner Balancing Adapter
7A055	Kit, Propeller Spinner Balancing Adapter
7HEL050	Kit, Helicopter Balancing, Tracking & Aligning
* 7HEL051	* Kit, Tail Rotor Balancing
* 7HEL052	* Kit, Tail Rotor and Fan Balancing
* 7HEL053	* Kit, Small Parts Balancing
* 7HEL054	* Kit, Main Rotor Balancing
* 7HEL055	* Kit, Fan Track and Concentricity Checking
* 7HEL056	* Kit, Optical Trammeling
7HEL058	Kit, Tail Rotor Balancing Adapter
7HEL059	Kit, Tail Rotor Blade Balancing Adapter
7HEL060	Kit, Tail Rotor Balancing Adapter
7HEL061	Kit, Main Rotor Balancing Adapter
7HEL062	Kit, Rotor Balancing Adapter
7HEL064	Kit, Main Rotor Balancing Adapter
7HEL065	Kit, Tail Rotor Balance Positioning
7HEL154	Kit, Main Rotor Balancing Adapter
7HEL254	Kit, Main Rotor Balancing Adapter
7HEL354	Kit, Main Rotor Balancing Adapter
7JET051	Kit, Compressor Rotor Stage Balancing



**Figure 1-2. Typical Suspension – Fixed Pitch, Flange-Mounted Propeller Assembly**



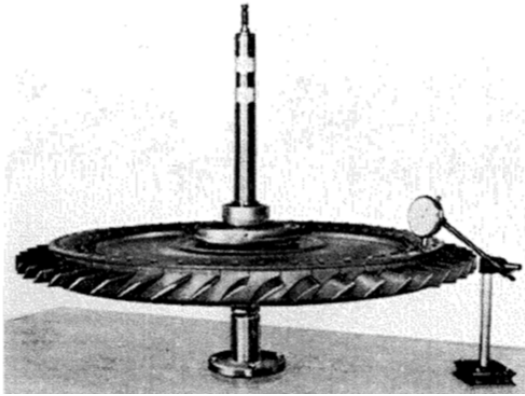
**Figure 1-4. Typical Underslung Suspension – Flange-Mounted Propeller Assembly Having No Center Hole for Installation of Balancing Arbor through Propeller**



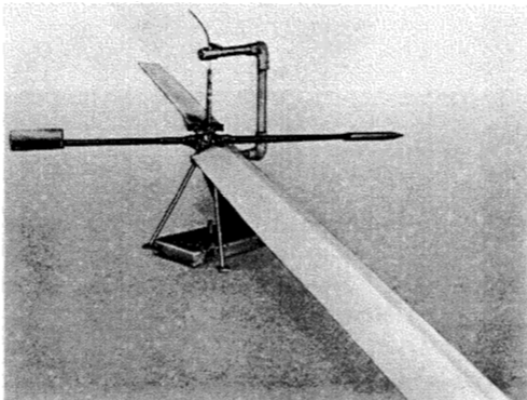
**Figure 1-3. Typical Suspension – Propeller Assembly with Shaft Nut Enclosed in Hub, Utilizing Pitch Positioning Plate**



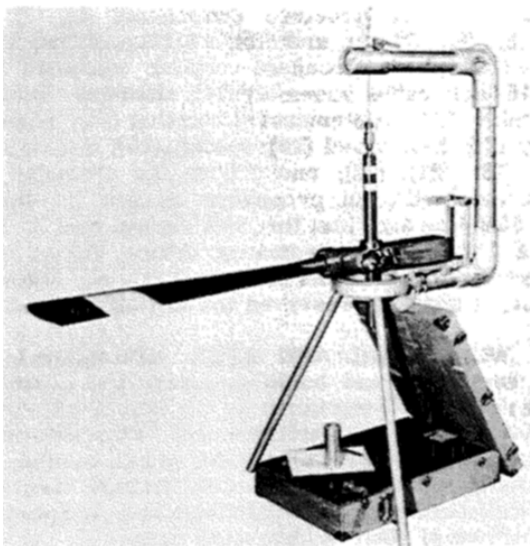
**Figure 1-5. Typical Balance Checking Set-up – Helicopter Engine Fan Assembly**



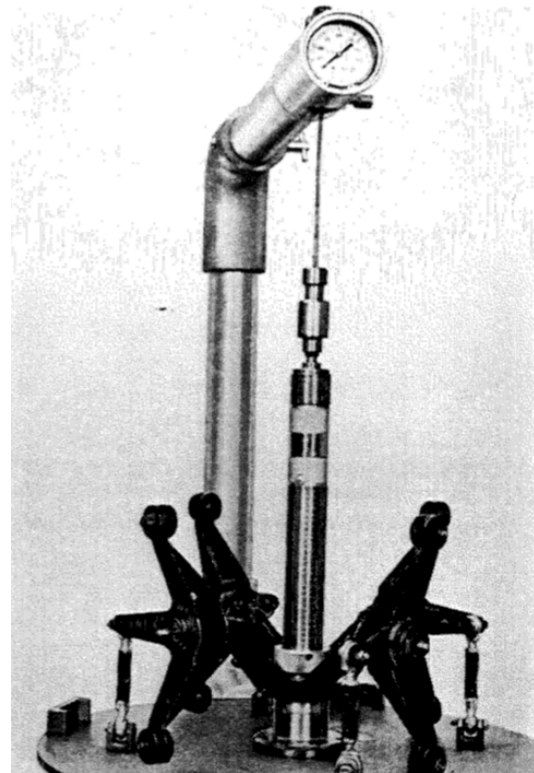
**Figure 1-6. Typical Track and Concentricity Checking Set-up – Helicopter Engine Fan Assembly**



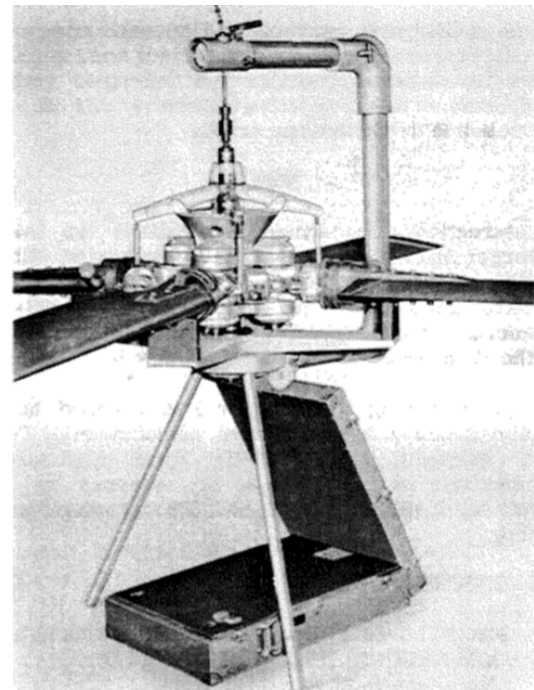
**Figure 1-7. Typical Balance Checking Set-up Helicopter Main Rotor Assembly**



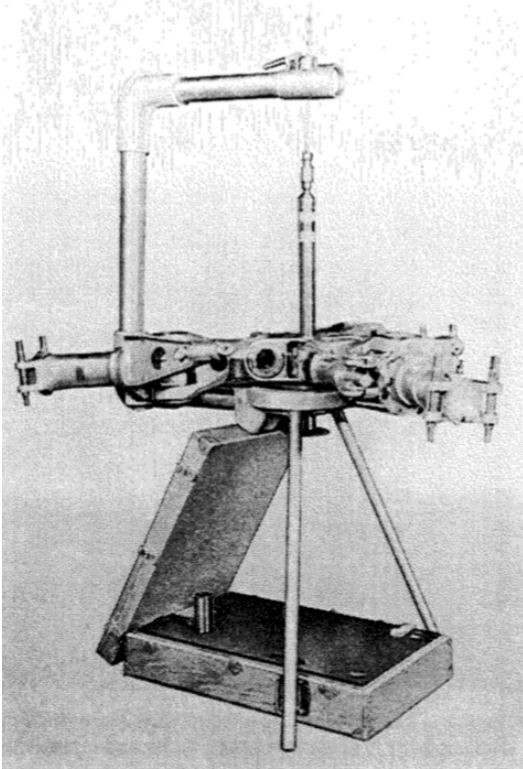
**Figure 1-8. Typical Balance Checking Set-up – Helicopter Rotor Blade with Counterweight**



**Figure 1.9. Typical Balance Checking Set-up – Helicopter Tail Rotor Counterweight Assembly**



**Figure 1-10. Typical Balance Checking Set-up – 4-Bladed Helicopter Tail Rotor Assembly.**



**Figure 1-11. Typical Balance Checking Set-up, Helicopter Rotor Head Assembly**

Precisely designed, machined and balanced components and adapters in the various kits control and accurately locate the assorted propeller and helicopter rotating components on the respective arbors so that all mass is concentric to the balance arbor.

**Note**

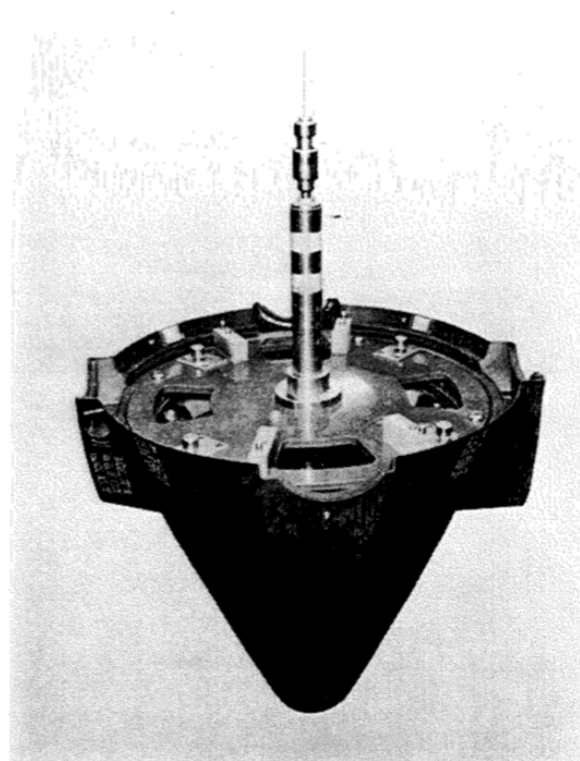
Instructions concerning applications for the larger Marvel Part No. 7A100 Balancing Kit may be found in Marvel Bulletin No. 77. The 7A100 Kit includes an arbor capable of balancing and suspending loads greater than the capacity of arbors covered herein.

1-4. All balancing and adapter kits covered herein are manufactured by Marvel Manufacturing Company, Fairfield, N.J., 07007. Their applications, are described in this manual, are covered by U.S. Patents No. 2,481,256; No. 2,647,398 and other Patents pending.

1-5. DESCRIPTION

1-6. PROPELLER AND HELICOPTER ROTATING COMPONENTS BALANCING KIT 7A050.  
(See figure 1-13.)

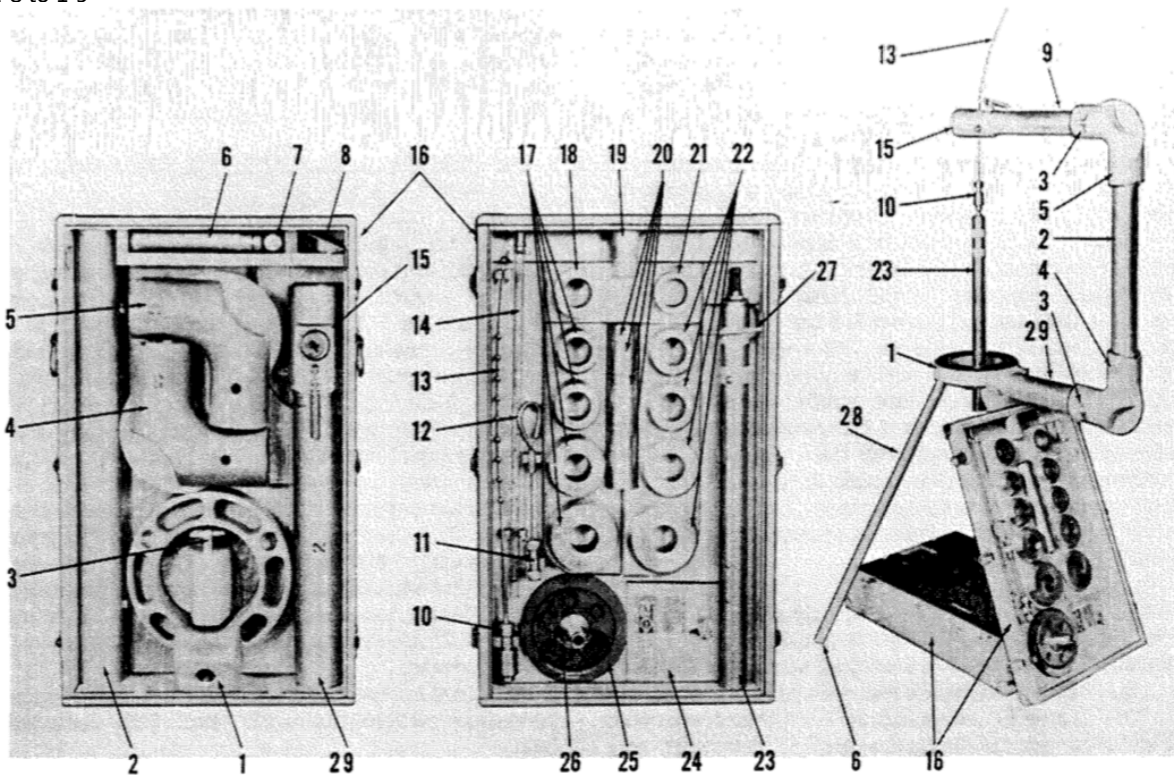
1-7. GENERAL. The parts comprising the Propeller and Helicopter Components Balancing Kit 7A050 are packed



**Figure 1-12. Typical Balance Checking Set-up, Propeller Spinner Assembly**

in a finished hardwood, portable storage and work support case. The case measures 7 x 20 x 30 inches and when packed with all kit parts, weights 130 pounds. The kit can be quickly assembled without tools, and, for most applications, requires no supplementary shop facilities. The kit consists of work stand and hoist structure components (1), (2), (3), (4), (5), (6), (7), (9), and (15); a 3/16-inch suspension cable (13); quick disconnect coupling assembly (10); a 1/16-inch cable assembly (14); alternate hoist eye assembly (12); supplementary coupling (11); balancing arbor (23); hand wheel (26); spacers (20); and adapters (17), (18), (21), (22), and (25) for the assembly and balancing testing of propellers of SAE 20 through SAE 50 spline size and for SAE flange type 1, 2, 3, and 4. The balance indicating device (arbor) shall be handled with extreme care at all times. When not in use, it shall be preserved and stored.

1-8. WORK STAND AND HOIST. (See figure 1-13.) The work stand and hoist structure are comprised of demountable components for convenient storage in the 7A050 balancing kit storage case. When assembled, the two tubular legs, a circular stand casting, and the reinforced bottom half of the storage case form the work stand upon which the assemblies are prepared for balancing. Unless instructed otherwise, the work stand has sufficient strength and rigidity for supporting the propeller and helicopter assemblies described in this handbook with a large safety factor.



- |   |  |   |
|---|--|---|
| 1 Stand table assembly (2291)   | 10 Quick-disconnect coupling (2266)  | 20 Spacers (2201, 2202, 2203, and 2204)                                       |
| 2 Tube (2288) long, 2-7/8 inch diameter, with legs (28) (P/N 2364) stored inside tube | 11 "Quickie" coupling (2260-1)   | 21 SAE 20 spline front bushing (2211)   |
| 3 Pin - hoist support (2285)  | 12 Alternate hoist eye assembly (2261)                                     | 22 SAE 20, 30, 40, 50, and 51 spline front cones (2224, 2206, 2208, and 2227) |
| 4 Elbow (2284-1)  | 13 3/16-Inch suspension cable (2264)                                       | 23 Balancing arbor (2259)   |
| 5 Elbow (2284-2)  | 14 1/16-Inch suspension cable (2262)                                       | 24 Packing layout   |
| 6 Stand leg extensions (2365)   | 15 Hydraulic pump assembly (2282)  | 25 Flanged type 1, 2, 3, and 4 front plate (2209)                             |
| 7 Stub leg (2366)   | 16 Storage, carrying, and work support case (2272)                         | 26 Hand wheel (2215)  |
| 8 1/8-inch hex wrench   | 17 SAE 20, 30, 40, 50 and 51 spline rear cones (2223, 2205, 2207 and 2228) | 27 Safety spring arbor retaining  |
| 9 Tube (2287) 2-7/8 inch dia. Normally stored inside tube (29) (P/N 2286) 3-inch dia. | 18 Flange type 1, 2, 3, and 4 rear bushing (2210)                          | 28 Stand leg assemblies (2364)  |
|   | 19 Work stand stub leg support   | 29 Tube (2286) 3-inch dia.  |

Figure 1-13. 7A050 Kit Components and Assembly

The overhead hoist structure eliminates a requirement for auxiliary shop hoists in most applications of the balancing kit, and the offset support arm provides for freedom of movement in performing balancing operations and from interference with suspended loads. The upper arm of the hoist structure incorporates a hydraulic pump assembly which provides for precisely controlled suspension of assemblies to be balance checked.

1-9. HYDRAULIC PUMP ASSEMBLY (15, figure 1-13.)  
The hydraulic pump assembly contains a manually operated pressure pump and integral hydraulic ram designed for cable suspension of loads through the hollow center of the ram piston. Ram cylinder pressure is continuously indicated by a load indicating gage, which is calibrated in pounds of weight

actually suspended from the ram piston. Engraved lines on the dial window indicate load limits for the 7A050 balancing kit's 1/16-inch and 3/16-inch suspension cables. The integral hydraulic fluid reservoir provides for years of normal service without refilling. A pump valve provides for by-passing ram pressure to the fluid reservoir at closely controllable rates so that lowering of the hydraulic ram may be done quickly or slowly as desired. A movable lifting plate, on top of the ram piston, provides for engaging any one of the suspension cable balls.

## Paragraphs 1-10 to 1-18

1-10. **SUSPENSION CABLES AND QUICK-DISCONNECT COUPLING ASSEMBLIES.** (See figure 1-13.) The 3/16-inch suspension cables (13), normally assembled to the quick-disconnect coupling (10), incorporates a series of swaged balls, any one of which may be engaged by the lifting plate of the hydraulic pump assembly. Choice of ball engagements provides an effective selection of cable lengths to accommodate the suspension of various balancing assemblies. A second, shorter cable, incorporating a standard hoist eye (12) and "quickie" coupling (11), may be quickly coupled to the end of the first cable for use with regular shop hoists if desired. A third suspension cable (14), similar to the first but having a diameter of 1/16 inch, is provided for use with extremely light loads if desired. Its terminal fitting provides for assembly in quick-disconnect coupling (10) in place of the 3/16-inch cable. The quick-disconnect coupling provides for instantaneous engagement and disengagement with the suspension rod of the balancing arbor. The coupling is so designed that, while normal no-load coupling and uncoupling are accomplished easily with one hand, it cannot be disengaged under load.

1-11. **BALANCING ARBOR.** (23, figure 1-13.) The balancing arbor, upon which an assembly to be balance checked is mounted, is of the horizontal suspension type and features high sensitivity and accuracy. The arbor is so designed that there are no internal wearing surfaces; consequently, there is no frictional resistance or requirement for internal inspection, reconditioning, or parts replacement. An integral fail-safe feature effectively prevents dropping of a suspended load in case of internal suspension failure. External load-bearing and piloting surfaces of the arbor are nitrided. The bottom end of the arbor is internally threaded to receive a hand wheel assembly which supports arbor loads and provides for clamping adapters and balance loads securely in position. The top end of the arbor suspension rod is machined for engagement with the quick-disconnect coupling. A fluid reservoir in the balancing arbor, filled with a specified oil, provides a dash-pot for damping out excessive oscillation of the sensitive balance indication. Oil filler and drain holes are sealed by two screws on opposite sides of the arbor near the upper end. Degree of oscillation damping may be regulated by raising or lowering the dash-pot oil level or by using oil of higher or lower viscosity.

1-12. **ADAPTER CONES AND BUSHINGS.** (See figure 1-13.) Precise piloting of assemblies to be balance checked, to ensure that their axis of rotation coincides with the centerline of the balancing arbor, is accomplished by adapter cones and bushings. These components provide for snug slip fits on the balancing arbor and very close concentricity and squareness between arbor and propeller mounting surfaces. They are of high-alloy steel, heat treated to a high degree of hardness to preclude wear of piloting surfaces, and chrome plated on non-piloting surfaces to minimize the possibility of corrosion. Set screws are provided for locking cones and bushings in position on the balancing arbor when desired. All adapters, cones, bushings, and spacers are designed and fabricated to SAE size specifications.

1-13. **REGULATOR ADAPTER KIT 7A051.** (See figure 1-14.) This kit consists of a single balancing adapter packed in a finished hardwood case measuring approximately 10-1/2 x 10-1/2 x 4-1/8 inches. The adapter, of high alloy steel, heat treated precision machined, provides a multiple application to several models of AeroProducts regulators.

1-14. **PROPELLER ADAPTER KIT 7A052.** (See figure 1-15.)

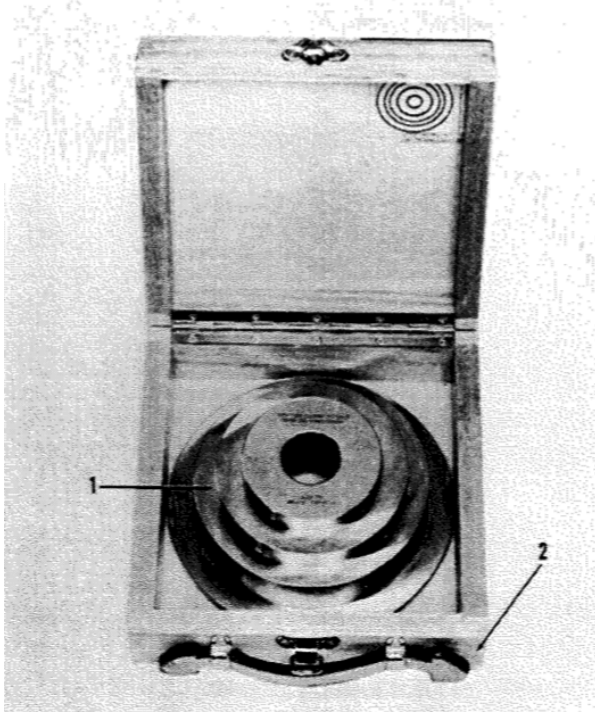
1-15. The adapters comprising Propeller Adapter Kit 7A052 are packed in a finished hardwood, portable storage case. The case measures approximately 29-1/2 x 15 x 7-1/2 inches and, when packed with all adapters, weighs approximately 146 pounds. Kit adapter components are of high-alloy steel heat treated to a high degree of hardness to ensure virtually unlimited service life. Piloting fits are controlled to very close tolerances and are super finished to within a few micro-inches. Non-piloting surfaces are chrome plated for protection against corrosion. The 7A052 adapter kit extends the utility of propeller balancing kit 7A050 by making possible balance checking of the following additional types of assemblies.

- a. Flange mounted propeller assemblies having no center hole through the hub for installation of the balancing arbor.
- b. Single-cone, SAE No. 20 and No. 30 splined hub propeller assemblies with shaft nuts enclosed in the hub.
- c. Balancing of double-cone, SAE No. 50 splined propeller assemblies with shaft nuts and front cones enclosed in hub.
- d. Special propeller assembly configurations, such as propeller assemblies with dome or cylinder-counterweight assemblies.
- e. Flange-mounted turbo-propellers of the reversing type.

1-16. **PROPELLER SPINNER ADAPTER KIT 7A053.** (See figure 1-16.) The kit provides adapter components for use with 7A050 Kit in individual static balancing of the three component assemblies comprising the spinner assemblies for 54H60-77 (P3V) and -81 (L-188) Propellers. The finished hardwood case for this kit measures approximately 34-3/4 x 23 x 5 inches and the kit weighs approximately 57 pounds.

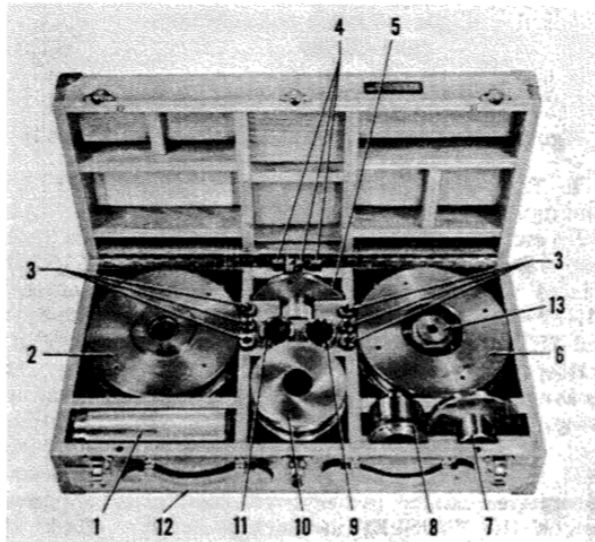
1-17. **PROPELLER SPINNER ADAPTER KIT 7A054.** (See figure 1-17.) This kit provides adapter components for use with the 7A050 Kit in individual static balancing of the three component assemblies comprising the spinner assemblies for 54H60-89(GV-1) and -91(C130E) Propellers. The finished hardwood case for this kit measures approximately 36 x 24 x 5 inches and the kit weighs approximately 67 pounds.

1-18. **PROPELLER SPINNER ADAPTER KIT 7A055.** (See figure 1-18.) This kit consists of balancing adapter components for use with the 7A050 kit in balancing components of the Model 53C51 spinner assemblies. The 7A055 kit is supplied in a finished hardwood case measuring approximately 18 x 23 x 4-1/2 inches and the complete kit weighs approximately 40 pounds.



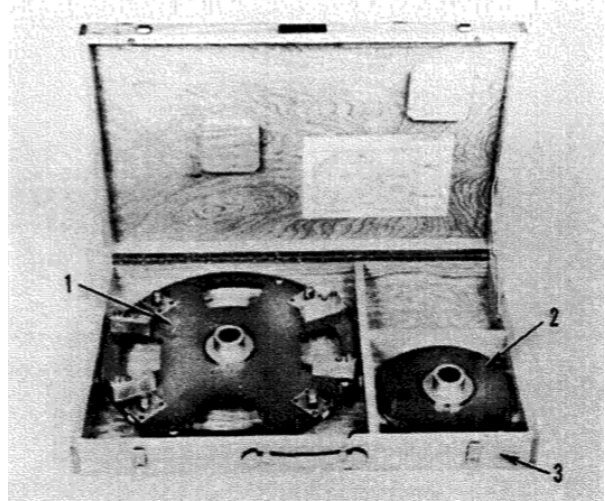
1 Adapter (2397)      2 Case assembly (2428)

**Figure 1-14. Regulator Adapter Kit 7A051**



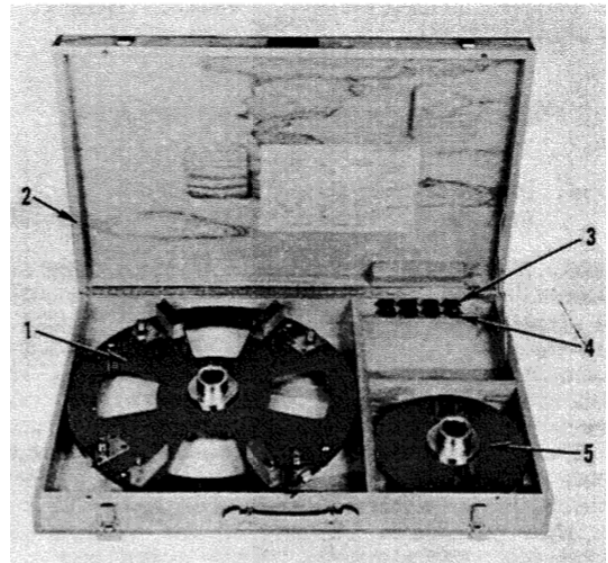
1 Installing tool (2452)      8 SAE 50 spline adapter (2459)  
 2 Weight assembly (2432)      9 SAE 20 spline adapter (2453)  
 3 Dowel bushing (2451)      10 Weight (2434)  
 4 Blade positioning wedges wedges (2247)      11 SAE 30 spline adapter (2454)  
 5 Link arm plate assembly (2455)      12 Kit case (2476)  
 6 Counterweight (2450)      13 Plug-screw (2435)  
 7 Flange adapter (2433)

**Figure 1-15. Propeller Adapter Kit 7A052**



1 Adapter assembly – spinner section and front bulkhead (2692)  
 2 Adapter assembly – front bulkhead (2691)  
 3 Case assembly (2689)

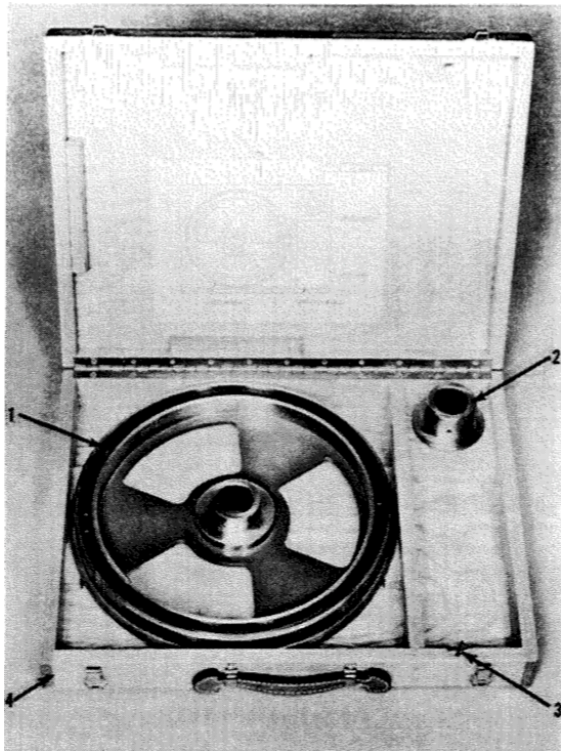
**Figure 1-16. Propeller Spinner Balancing, Adapter Kit 7A053**



1 Adapter assembly – spinner section and front bulkhead (2748)  
 2 Case assembly (2751)  
 3 Bar ring limiting (2749)  
 4 Bar ring limiting (2750)  
 5 Adapter assembly - front bulkhead (2691)

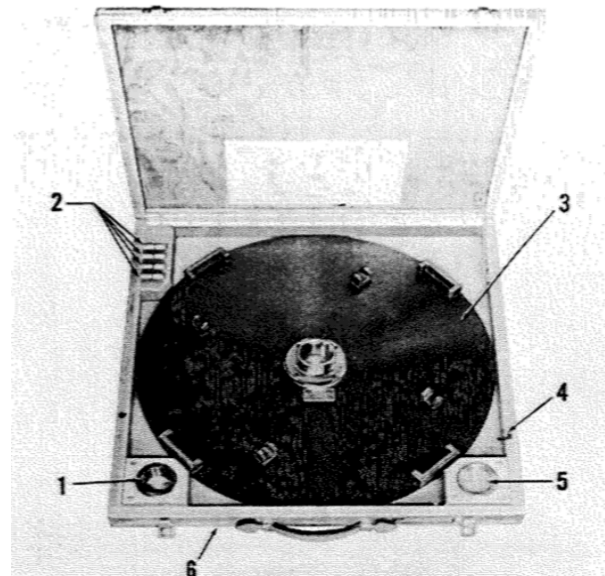
**Figure 1-17. Propeller Spinner Balancing, Adapter Kit 7A054**





1 Adapter assembly (2753)      3 Wrench (1/8 hex)  
 2 Adapter (2582)              4 Case (2754)

**Figure 1-18. Propeller Spinner Balancing, Adapter Kit 7A055**



1 Pilot bushing (2242)  
 2 Blade positioning wedge (2247)  
 3 Adapter assembly (2238)  
 4 1/8-Inch hex wrench  
 5 Counterweight support spacer (2246)  
 6 Kit carrying and storage case (2248)

**Figure 1-19. Tail Rotor Balancing Kit 7HEL051**

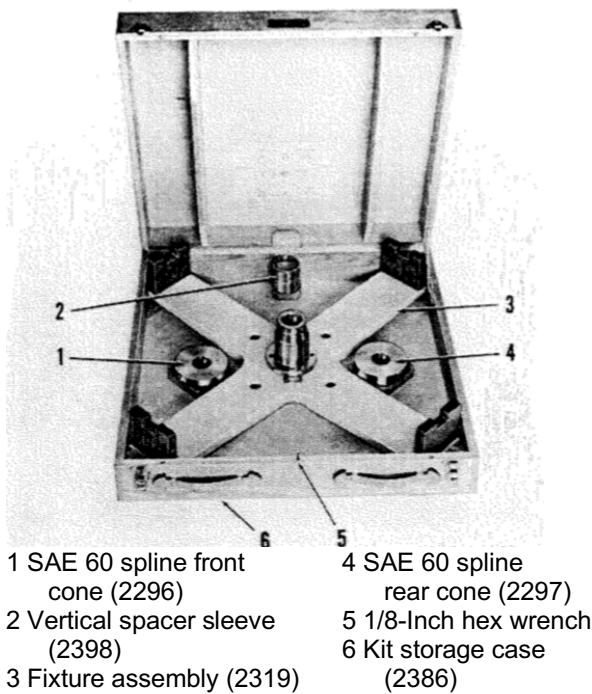
1-19. HELICOPTER BALANCING, TRACKING, AND ALIGNING KIT 7HEL050. (See figure 3-6).

1-20. GENERAL. The components comprising this assembly of helicopter adapter kits extend the utility of Propeller and Tail Rotor Balancing Kit 7A050 by providing for the balancing and aligning of helicopter main and tail rotors and balancing, tracking, and concentricity checking of engine cooling fans. The six sub kits which form Helicopter Balancing, Tracking, and Aligning Kit 7HEL050, when packed as a complete 7HEL050 assembly, are contained in a strongly constructed wood storage and shipping case. The case is skid mounted to permit fork-lift handling and measures approximately 34-1/2 inches high x 38 inches wide x 32 inches deep. The complete package weights approximately 500 pounds. The individual sub kits, each of which is contained in its own separate hardwood carrying and storage case, contain components as follows.

a. Tail Rotor Balancing Kit 7HEL051. (See figure 1-19) – Adapters for use with the 7A050 kit to enable balance checking of SH-34G helicopter tail rotor hub and blade assembly and tail rotor counterweight assembly. The sub kit storage case measures approximately 23-3/4 x 23-3/4 x 2-3/4 inches and, complete with all kit components, weighs approximately 34 pounds.

b. Tail Rotor and Fan Balancing Kit 7HEL052. (See figure 1-20.) – Adapters for use with the 7A050 kit to enable balance checking of helicopter tail rotors and engine fans, for use with 7A050 and 7HEL055 kits to enable track and concentricity checking of CH-37 helicopter engine fans, and for use with 7A050 and 7HEL056 Kits to enable optical trammeling of helicopter tail rotors. The sub kit storage case measures approximately 31 x 31 x 7-3/4 inches and, complete with parts, weighs approximately 88 pounds.

c. Small Parts Balancer Kit 7HEL053. (See figure 1-21.) A small balancing arbor for use on helicopter assemblies having center bores too small for mounting on the 7A050 Kit balancing arbor. Used with adapters in this kit, the small balancing arbor enables the balance checking of TH-13, UH-13 and UH-1 helicopter tail rotors, CH-19 helicopter tail rotors, OH-23 helicopter tail rotors and tail rotor hubs, and TH-13, CH-13 and OH-23 helicopter engine fans. Used with 7HEL055 Kit, the 7HEL053 Kit enables the track and concentricity checking of TH-13, CH-13 and OH-23 helicopter engine fans. Quick-disconnect coupling provisions for the small balancing arbor are interchangeable with similar provisions in the 7A050 Kit suspension system. Consequently, the 7HEL053 Kit may be used in conjunction with the 7A050 Kit work stand and hoist assembly. Maximum load limit for the arbor shall not be exceeded. The sub kit



- 1 SAE 60 spline front cone (2296)
- 2 Vertical spacer sleeve (2398)
- 3 Fixture assembly (2319)
- 4 SAE 60 spline rear cone (2297)
- 5 1/8-Inch hex wrench (2386)
- 6 Kit storage case

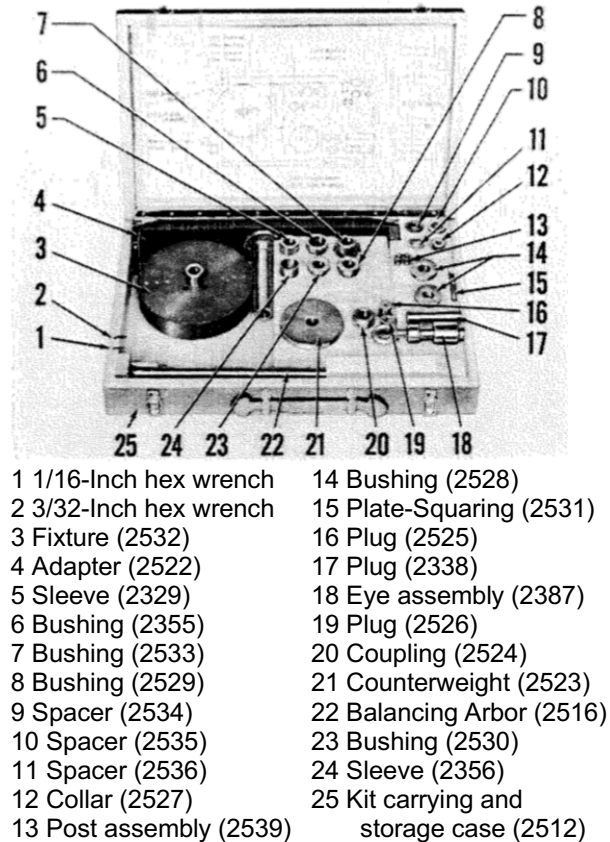
**Figure 1-20. Tail Rotor and Fan Balancing Kit 7HEL052**

storage case measures approximately 23 x 15 x 4 inches and, complete with kit components, weighs approximately 38 pounds.

d. Main Rotor Balancing Kit 7HEL054. (See figure 1-22.) Adapters for use with the 7A050 Kit to enable the balance checking of TH-13, UH-13, UH-21 and OH-23 helicopter main rotor hubs (with blades or without blades) and CH-21 helicopter rotor hub assemblies. The sub kit storage case measures approximately 11-1/2 x 21 1/4 x 10 inches and, complete with kit components, weighs approximately 100 pounds.

e. Fan Track and Concentricity Checking Kit 7HEL055. (See figure 1-23.) Adapters and indicator assembly for use with the 7A050 Kit to enable the track and concentricity checking of CH-19, CH-21, UH-25, and SH-34G helicopter engine fans, for use with 7HEL053 Kit to enable track and concentricity checking of TH-13, UH-13 and OH-23 helicopter engine fans, and for use with 7A050 Kit to enable balance checking of CH-19 helicopter engine fans. The sub kit storage case measures approximately 20 x 19 x 7 inches and, complete with kit components, weighs approximately 49 pounds.

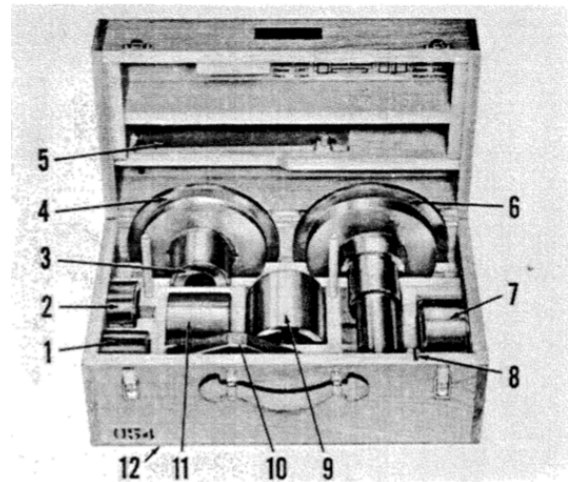
f. Optical Trammeling Kit 7HEL056. (See figure 1-24.) – Adapters, scopes, scope support, and aligning target for use with the 7A050 and 7HEL052 kits to enable optical trammeling of CH-37 helicopter tail rotors. The sub kit storage case measures approximately 20 x 19 x 7 inches and, complete with kit components, weighs approximately 49 pounds.



- 1 1/16-Inch hex wrench
- 2 3/32-Inch hex wrench
- 3 Fixture (2532)
- 4 Adapter (2522)
- 5 Sleeve (2329)
- 6 Bushing (2355)
- 7 Bushing (2533)
- 8 Bushing (2529)
- 9 Spacer (2534)
- 10 Spacer (2535)
- 11 Spacer (2536)
- 12 Collar (2527)
- 13 Post assembly (2539)
- 14 Bushing (2528)
- 15 Plate-Squaring (2531)
- 16 Plug (2525)
- 17 Plug (2338)
- 18 Eye assembly (2387)
- 19 Plug (2526)
- 20 Coupling (2524)
- 21 Counterweight (2523)
- 22 Balancing Arbor (2516)
- 23 Bushing (2530)
- 24 Sleeve (2356)
- 25 Kit carrying and storage case (2512)

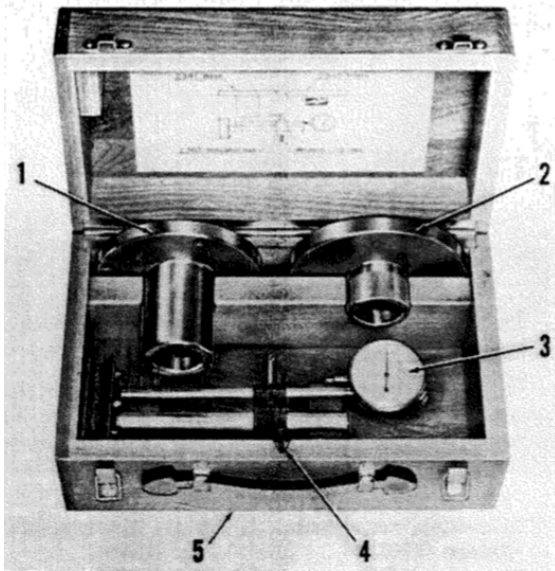
**Figure 1-21. Small Parts Balancer Kit 7HEL053**

- 1 Sleeve (2467)
- 7 Sleeve (2465)



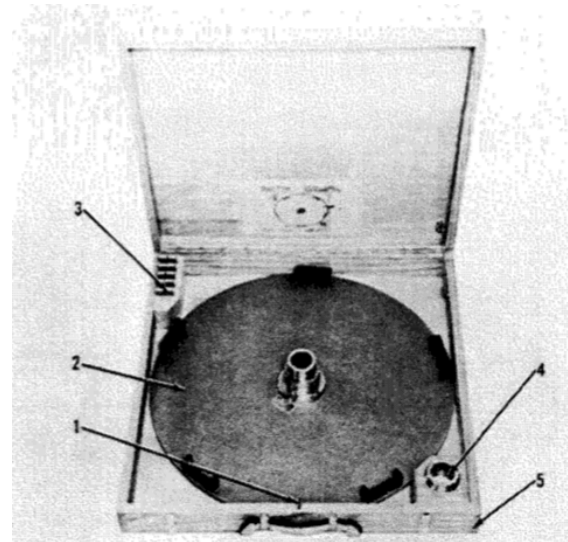
- 2 Adapter (2373)
- 3 Bushing (2463)
- 4 Plug (2250)
- 5 Strut gage (2489)
- 6 Fixture (2337)
- 8 1/8-Inch hex wrench
- 9 Sleeve (2464)
- 10 Plate (2468)
- 11 Adapter (2466)
- 12 Kit carrying and storage case (2488)

**Figure 1-22. Main Rotor Balancing Kit 7HEL054**



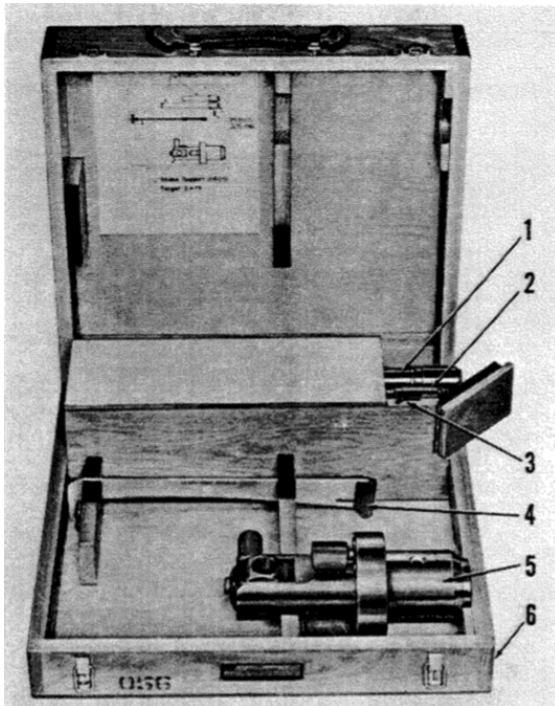
- 1 Base (2341)
- 2 Adapter (2342)
- 3 Indicator (2363)
- 4 1/8-Inch hex wrench
- 5 Case assembly (2395)

**Figure 1-23. Fan Track and Concentricity Checking Kit 7HEL055**



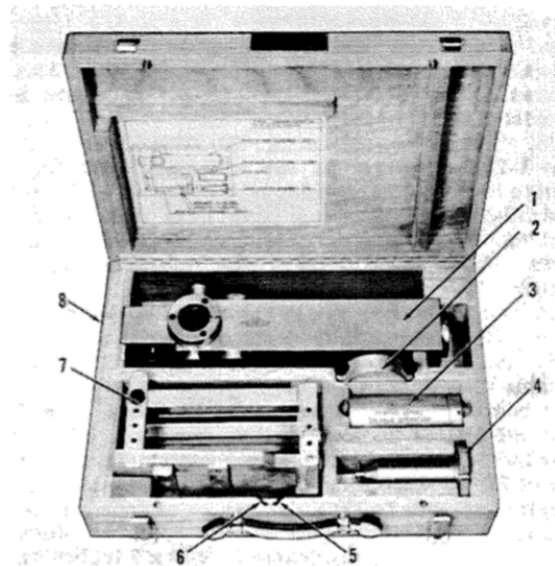
- 1 1/8-Inch hex wrench
- 2 Plate assembly (2442, 7HEL958)
- 3 Wedge (2247)
- 4 Cone (2439)
- 5 Case assembly (2444, 7HEL058)
- Plate assembly (2573, 7HEL060)
- Case assembly (2571, 7HEL060)

**Figure 1-25. Tail Rotor Hub Adapter Kit 7HEL058 and 7HEL060 Typical**



- 1 Short scope (2420)
- 2 Long scope (2421)
- 3 3/16-Inch hex wrench
- 4 Target assembly (2475)
- 5 Scope support assembly (2400)
- 6 Kit carrying and storage storage case (2415)

**Figure 1-24. Optical Trammeling Kit 7HEL056**



- 1 Fixture (2565)
- 2 Clamp (2568)
- 3 Gage (2561)
- 4 Pin (2565)
- 5 5/32-Inch hex wrench
- 6 3/32-Inch hex wrench
- 7 Adapter (2568)
- 8 Case assembly (2569)

**Figure 1-26. Tail Rotor Blade Balancing Adapter Kit 7HEL059**

1-21. TAIL ROTOR HUB BALANCING KIT 7HEL058. (See figure 1-25, Typical.) This kit provides adapter components for use with the 7A050 Kit in balance checking of early type (prior to extended spindle) SH-3A Rotary Rudder Hub Assemblies. The finished, hardwood case for this kit measures approximately 26-5/8 x 26-5/8 x 4-3/8 inches and the complete kit weighs approximately 48 pounds.

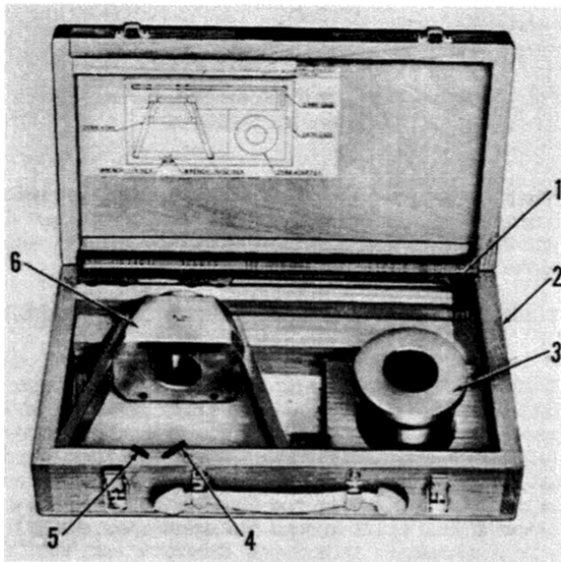
1-22. TAIL ROTOR BLADE BALANCING ADAPTER KIT 7HEL059. (See figure 1-26.) This kit provides adapter components for use with the 7A050 Kit in balancing individual UH-2A Tail Rotor Blades against a master counterweight. The finished hardwood case for this kit measures approximately 21-1/2 x 15 x 5-3/4 inches and the complete kit weighs approximately 75 pounds.

1-23. TAIL ROTOR HUB BALANCING ADAPTER KIT 7HEL060. (See figure 1-25, Typical.) This kit provides adapter components for use with the 7A050 Kit in balancing of late SH-3A ("Extended Spindle") Rotary Rudder Hub Assemblies. The finished hardwood case for this kit measures approximately 30-5/8 x 30-5/8 x 4-3/8 inches and the kit weighs approximately 54 pounds. The kit components are almost identical with those shown in figure 1-25 wherein appropriate identification is made.

1-24. MAIN ROTOR BALANCING ADAPTER KIT 7HEL061. (See figure 1-27.) This kit supplements the 7HEL054 Kit to provide adapter components for use with the 7A050 Kit, applicable to UH-1A, B, D, E, F Helicopter Main Rotor Hub Assemblies. The finished hardwood case for this kit measures approximately 17-3/4 x 10 x 4-1/2 inches and the complete kit weighs approximately 32 pounds.

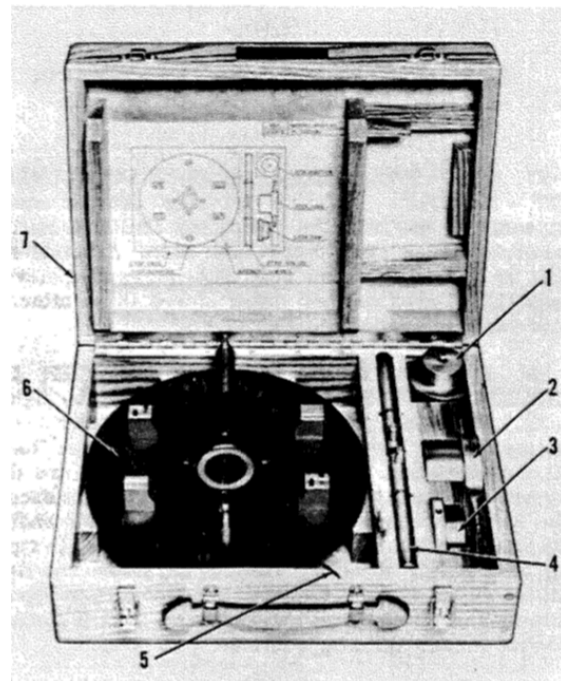
1-25. ROTOR BALANCING ADAPTER KIT 7HEL062. (See figure 1-28.) This kit provides adapter components for use with the 7A050 Kit in balancing QH-50C Drone Helicopter Rotor Assemblies. Finished hardwood case for this kit measures approximately 17-3/4 x 14 x 5-1/2 inches and the complete kit weighs approximately 30 pounds.

1-26. CH-53A ROTARY RUDDER HEAD BALANCING ADAPTER KIT 7HEL064. (See figure 1-29.) This kit provides adapter components for use with the 7A050 kit in balancing the CH-53 Helicopter Rudder Head Assembly with a complete set of master blades or factory new blades installed in the Rudder Head Assembly. Pitch Control linkages are removed from the pitch horns during balancing. The finished hardwood case for this kit measures approximately 23-3/4 x 11-1/4 x 4-1/2 inches and the completely assembled kit weighs approximately 30 pounds.



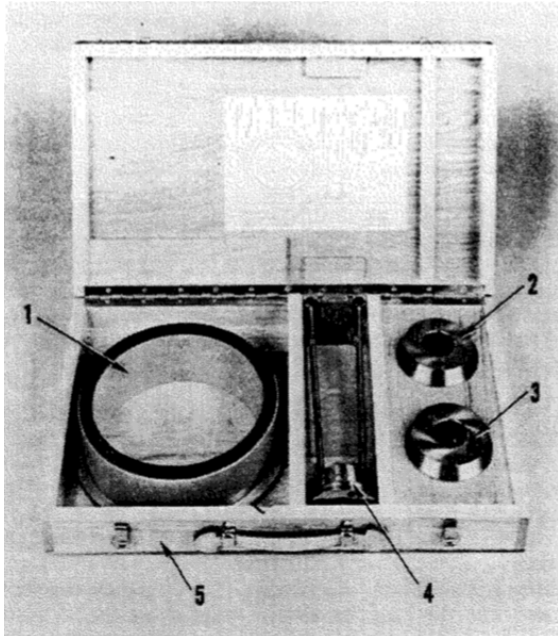
- 1 Gage (2486)
- 2 Case assembly (2605)
- 3 Adapter (2588)
- 4 5/32-Inch hex wrench
- 5 1/8-Inch hex wrench
- 6 Yoke (2589)

**Figure 1-27. Main Rotor Balancing Adapter Kit 7HEL061**



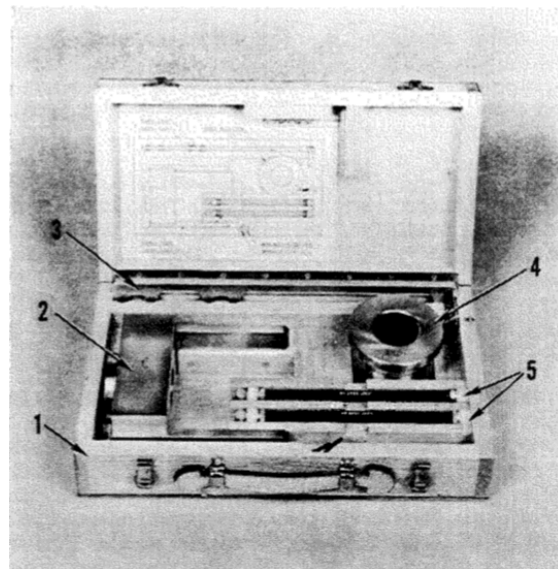
- 1 Adapter (2731)
- 2 Yoke assembly (2728)
- 3 Cam assembly (2734)
- 4 Pin assembly (2730)
- 5 1/8-Inch hex wrench
- 6 Adapter (2729)
- 7 Case assembly (2732)

**Figure 1-28. Rotor Balancing Adapter Kit 7HEL062**



- 1 Adapter – Stand Support (2818)
- 2 Cone – Piloting Adapter (2827)
- 3 Cone – Piloting Adapter (2828)
- 4 Support – Positioning (2826)
- 5 Case Assembly (2829)

**Figure 1-29. Rotary Rudder Head Balancing Adapter Kit 7HEL064**



- 1 Case Assembly (2850)
- 2 Yoke (2846)
- 3 Gage (2486)
- 4 Adapter (2588)
- 5 Jack (2865)

(INACTIVE)

**Figure 1-30. Main Rotor Hub Balancing Adapter Kit 7HEL066**

1-27. UH-1 TAIL ROTOR BALANCE POSITIONING KIT – 7HEL065. This kit provides adapter components for use with the 7A050 and 7HEL053 kits in balancing UH-1 Tail Rotor and Blade Assemblies. The kit consists of two post assemblies and eleven sets (11) of matched bar pairs stored in an attache' type hardwood case.

1-28. MAIN ROTOR BALANCING – ADAPTER KIT 7HEL154, 7HEL254, 7HEL354 (Typical). (See figure 1-31.) These kits provide adapter components for balancing CH-21, Model 107 and CH-47A Helicopter Rotor Head assemblies. Components of these kits are designed to be used with the 7A050 Balancing Kit except the hoist structure shall not be used for suspending the heavier loads of the CH-47A Rotor Heads. A typical kit consists of a plug, bushing and sleeve and each kit is supplied in a finished hardwood case whose dimensions are approximately 9 x 9 x 10-1/2 inches. Weight of each kit is approximately 50 pounds.

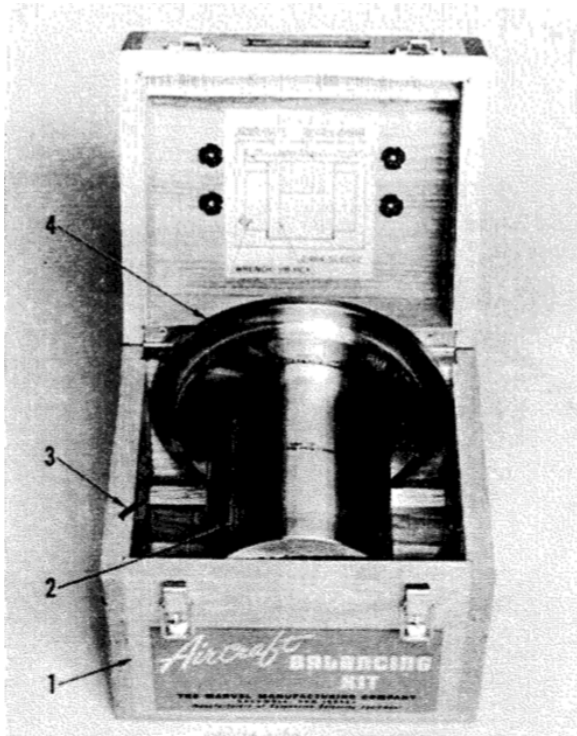
1-29. COMPRESSOR ROTOR STAGE SUB-ASSEMBLIES BALANCING KIT 7JET051. (See figure 1-32.) This kit provides balancer, suspension and adapter components to balance each of the disc and spacer subassemblies of the rotors in CJ805-3, -23 and J79 Jet Engines. Components of this kit are designed to be used with the work stand and hoist

and coupling components in the 7A050 kit. The finished hardwood storage case for the 7JET051 kit measures approximately 31-3/4 x 23-3/4 x 5-3/8 inches and the complete kit weighs approximately 80 pounds.

**1-30. BALANCING ARBOR-PRINCIPLES OF OPERATION.**

1-31. GENERAL. (See figure 1-33.) The characteristic response of the suspended balancing arbor to an assembly in a state of unbalance is a tilting action (View B). This tilting action occurs through an internal flexible suspension element (6) at the lower end of the arbor suspension rod (3). The upper end of the arbor is free to tilt around the suspension rod to the extent necessary to indicate direction and relative magnitude of unbalance forces.

1-32. BALANCE INDICATIONS. (See figure 1-34.) Because of the length of the arbor assembly (from the flexible suspension element to the indicator disc), arbor tilt produces a magnified displacement of the top end of the arbor with relation to the vertical line of suspension. The resulting eccentricity between the black indicator disc, which moves the tilt of the arbor, and the indicator bushing, which remains in the line of suspension, reveals the direction and degree of unbalance.



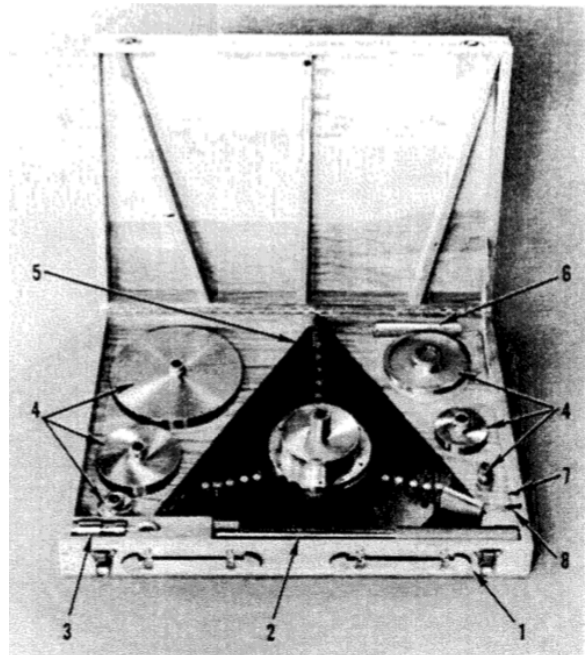
- 1 Case assembly (2487, 7HEL154; 2551, 7HEL254; 2552, 7HEL354;)
- 2 Sleeve (2464, 7HEL154; 2485, 7HEL254; 2484, 7HEL354)
- 3 Wrench (1/8 hex)
- 4 Plug (2250) with Bushing (2463) (not visible)

**Figure 1-31. Main Rotor Balancing Adapter Kit 7HEL154, 7HEL254, 7HEL354 (Typical)**

1-33. If an assembly has been properly mounted and the specified sensitivity setting for that assembly has been observed in accordance with Section IV, Operation Instructions, an assembly perfectly balanced will be indicated by the indicator bushing being concentric (perfectly centered) within the black indicator disc, as shown in View A. If the assembly is slightly out of balance, but within allowable balance tolerance, the black indicator disc will be slightly eccentric with the indicator bushing (more of the black disc will be visible on one side of the bushing than on the opposite side), as shown in View B. If the assembly is out of balance to its maximum allowable balance tolerance, one edge of the black disc will be exactly even (tangent) with one edge of the indicator bushing, as shown in View C. If the assembly is out of balance beyond its allowable balance tolerance, an edge of the black disc will pass under the edge of the indicator bushing as in View D.

**Note**

If the assembly being balanced is positioned too high on the balancing arbor, the system becomes unstable, like an inverted pendulum. When this condition is present, the arbor will



- 1 Case assembly (2626)
- 2 Arbor assembly (2516)
- 3 Eye assembly-quick disconnect (2387)
- 4 Cone assembly (2614, 2616, 2618, 2620, 2622, 2624)
- 5 Fixture assembly (2607)
- 6 Sleeve-protector (2627)
- 7 1/16-Inch hex wrench
- 8 3/16-Inch hex wrench

**Figure 1-32. Compressor Rotor Stage Sub-Assemblies Balancing Kit 7JET051**

remain tilted in whatever direction it is manually pushed. Even though an assembly is in perfect balance, no balance indication can be achieved while this condition exists.

**1-34. MEASUREMENT OF STATIC UNBALANCE FORCES.**

1-35. Relative magnitude of static unbalance forces is most generally expressed in ounce-inch units. An ounce-inch is the amount of unbalance (tilting force) produced by a weight of one ounce acting at an offset distance of one inch from the line of suspension or other effective pivot point. (See figure 1-35.)

1-36. In view A, unbalance force is zero because the weight of the rigid horizontal bar is equally distributed on either side of the pivot point. In View B, addition of a weight "w" at a distance "d" from the pivot point introduces a tilting force, "m", expressed numerically as "w" (number of ounces) times "d" (number of inches) in the general formula:

$$m = w \times d$$

Substituting typical values:

$$m = 2 \text{ (ounces)} \times 6 \text{ (inches)}$$

$$m = 12 \text{ ounce - inches}$$

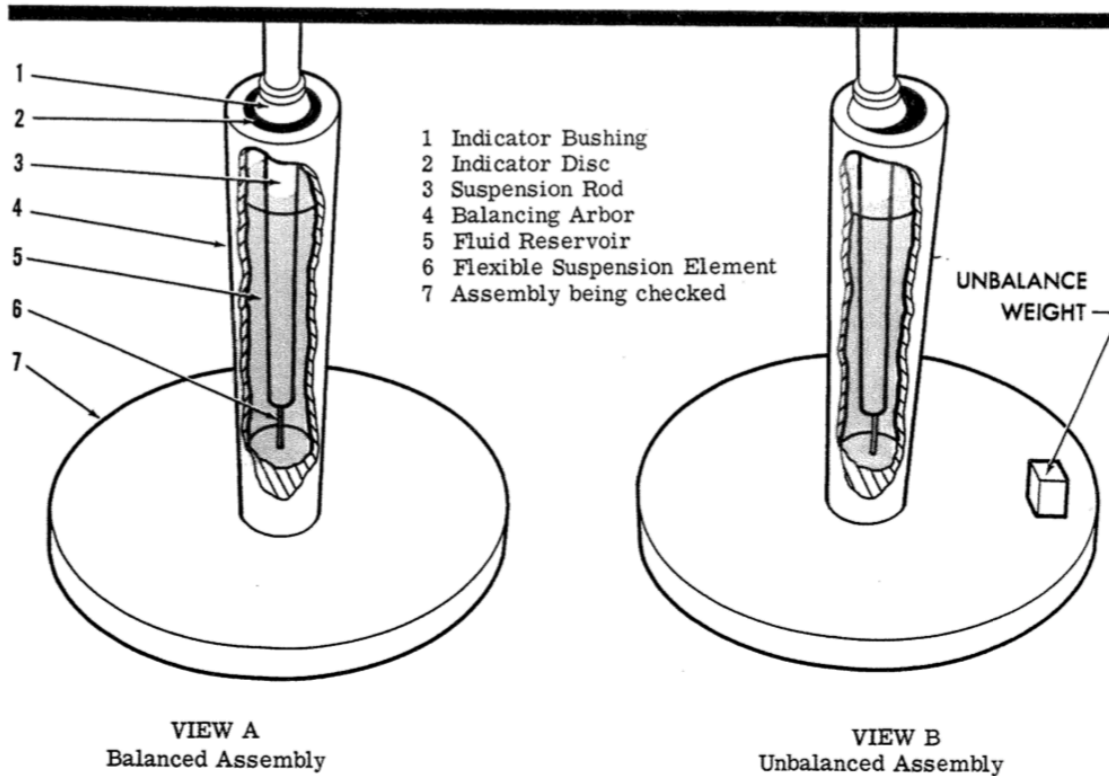


Figure 1-33. Basic Operation of Suspension Balancer.

1-37. It is evident that the amount of unbalance force will remain the same if the typical values shown are reversed. That is, a weight of 6 ounces at a distance of 2 inches produces the same amount of tilting force as a weight of 2 ounces at a distance of 6 inches. Similarly, any other combination, such as 4 ounces x 3 inches, whose product is the same, will produce the same magnitude of tilting force. In comparing amounts of unbalance, the product of  $w \times d$  is always the significant figure. It follows, naturally, that a 2-ounce weight at a distance of 12 inches will produce twice as much tilting force as the same 2-ounce weight at a distance of 6 inches.

1-38. If, as sometimes happens, weights are expressed in pounds instead of ounces, the products will be in pound-inches instead of ounce-inches. While the operation of the general formula is identical in either case, it must be remembered that 1 pound-inch represents 16 times as much tilting force as 1 ounce-inch. Similarly, since 1 ounce equals 28 grams (approximately), 1 ounce-inch represents 28 times as much tilting force as 1 gram-inch. These units must, of course, be converted to ounce-inches before their tilting force can be directly compared with other tilting forces expressed in ounce-inches.

1-39. BALANCE TOLERANCE

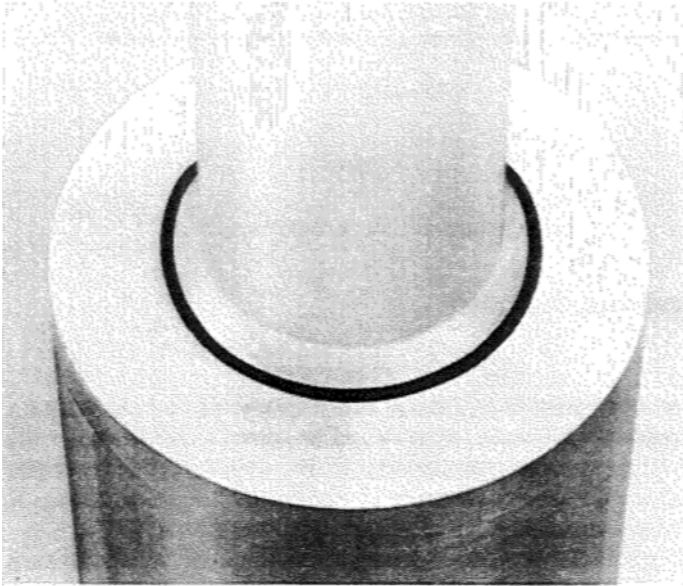
1-40. Balance tolerance is the amount of unbalance established as the maximum that can be tolerated in a

specific propeller or helicopter component. The specified balance tolerance means, in effect, that the assembly need not be perfectly balanced, which would be an ideal but impractical condition. Since, however, the balance tolerance does limit the amount of unbalance which can be tolerated, a method is needed to determine whether the amount of unbalance actually present in a specific assembly is smaller or greater than the limiting amount. (Refer to paragraph 1-43.)

1-41. Static balance tolerance for the specific assembly being balanced is usually specified in the applicable maintenance or overhaul instructions for the assembly. The static balance tolerance may be expressed directly in ounce-inch units; it may also, however, be expressed in several other ways, any of which can be converted to ounce-inch units for easy measurement and direct comparison. For example, propeller balance tolerances are sometimes expressed as "0.001 inch x propeller weight." Since 0.001 is already in inches, it can be substituted directly for  $d$  in the general formula,  $m = w \times d$ . If the weight of the propeller, in ounces, is substituted for  $w$  in the formula, the product will be propeller balance tolerance in ounce-inches. Example: Propeller weight = 200 pounds (3200 ounces). Propeller balance tolerance = 0.001 x propeller weight. Substituting specific values in general formula  $m = w \times d$ :

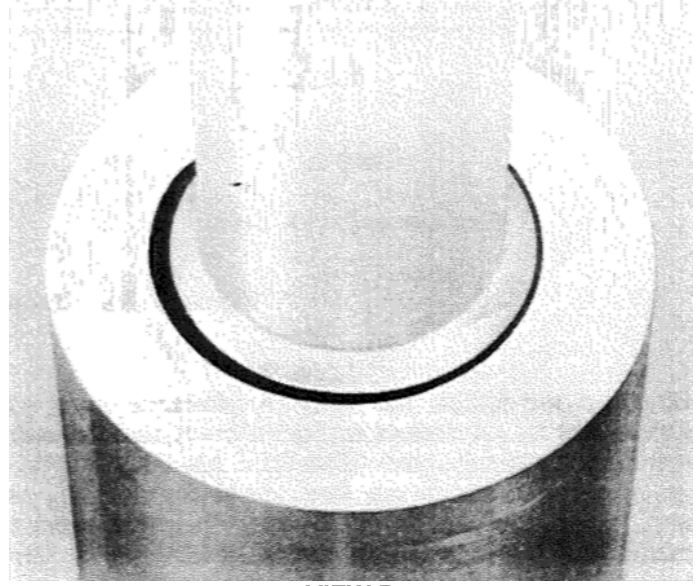
$$m = 3,200 \text{ (ounces)} \times 0.001 \text{ (inches)}$$

$$m = 3.20 \text{ ounce-inches} - \text{propeller balance tolerance.}$$



**VIEW A**

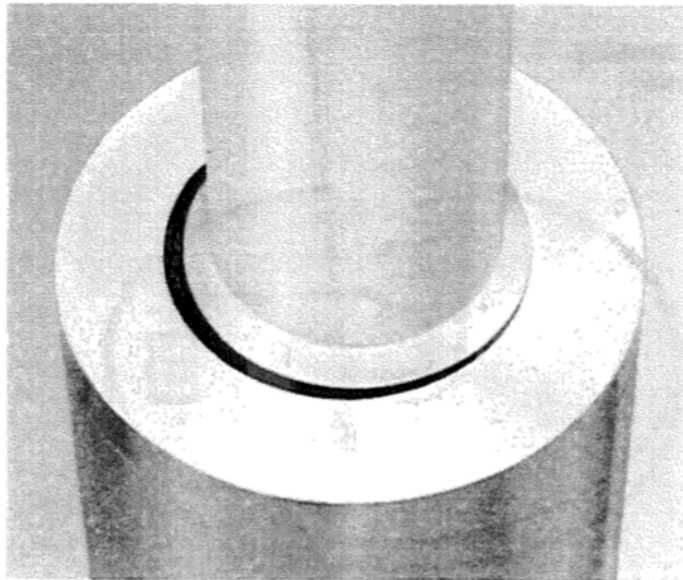
Indicator Circles Concentric  
(Assembly in Perfect Balance)



**VIEW B**

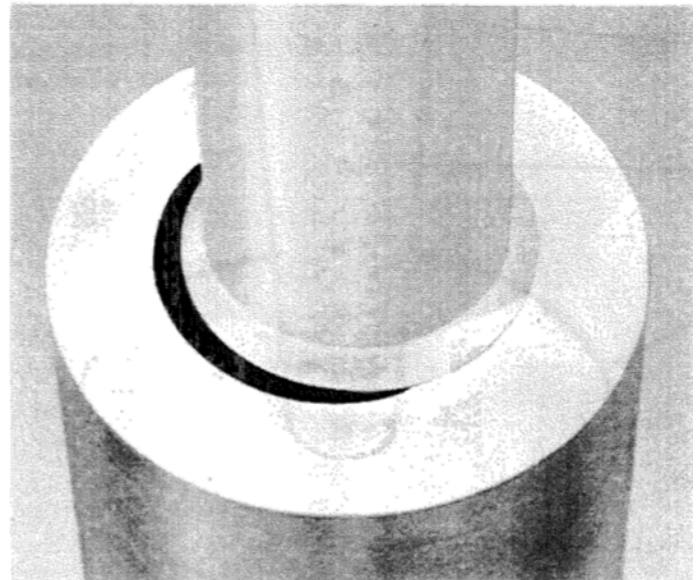
Indicator Circles Slightly Eccentric  
(Assembly Slightly Out-of-Balance but  
Within Allowable Unbalance Tolerance)

**Figure 1-34. Interpretation of Balancer Indications (Sheet 1 of 2)**



**VIEW C**

Indicator Circles Tangent  
(Assembly Out-of-Balance to Maximum  
Allowable Unbalance Tolerance)



**VIEW D**

Indicator Circles Overlapping  
(Assembly Out-of-Balance Beyond  
Allowable Unbalance Tolerance)

**Figure 1-34. Interpretation of Balancer Indications (Sheet 2 of 2)**



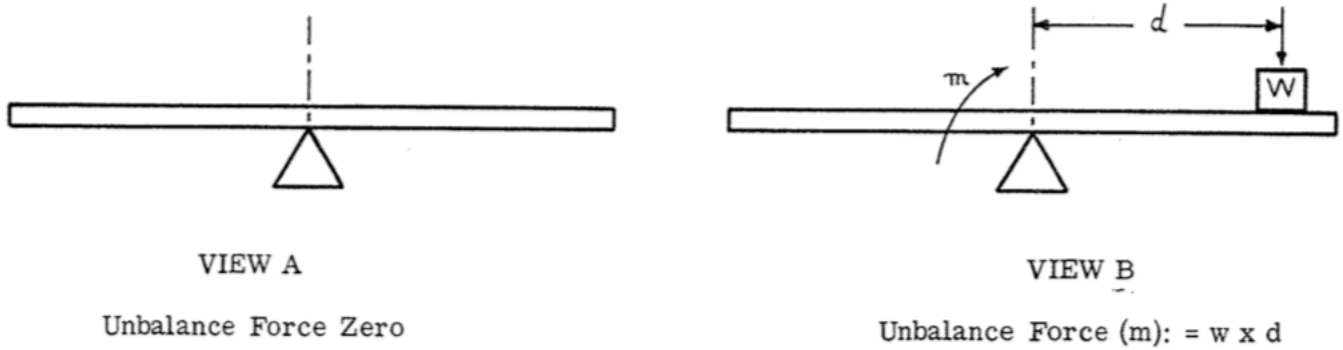


Figure 1-35. Balance vs Unbalance Condition

1-42. In other cases, the balance tolerance may not be expressed in any numerical units at all, but directly in terms of a specific part (Example: AN-XXX washer) at a specific location on the assembly. Since, in these cases, the weight (w) of the specified part is constant and its location on the assembly (d) is also constant, the limiting amount of permissible unbalance is controlled just as effectively as if

the balance tolerance had been expressed in ounce-inch units. If, for comparison purposes, it is desired to express such a balance tolerance in terms of ounce-inches, it is only necessary to multiply the weight of the specified part (in ounces) by its distance (in inches) from the effective pivot point.

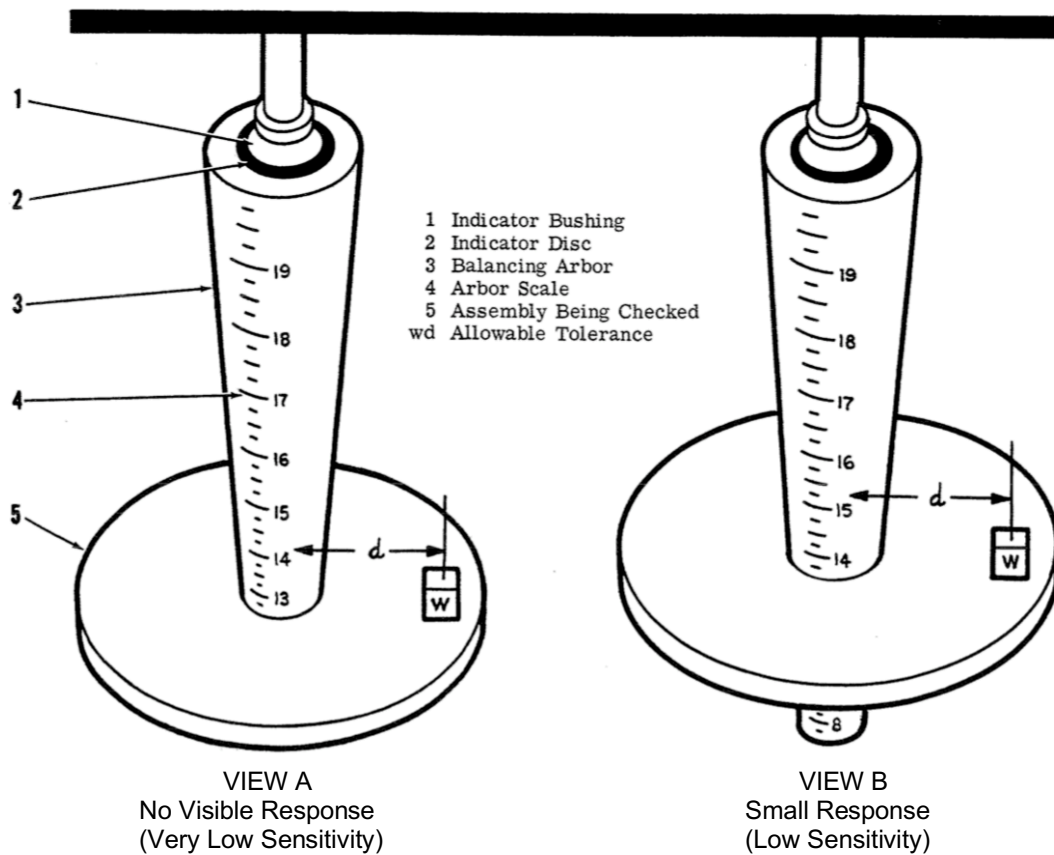


Figure 1-36. Effect of Sensitivity Setting on Balance Indication (Sheet 1 of 2)

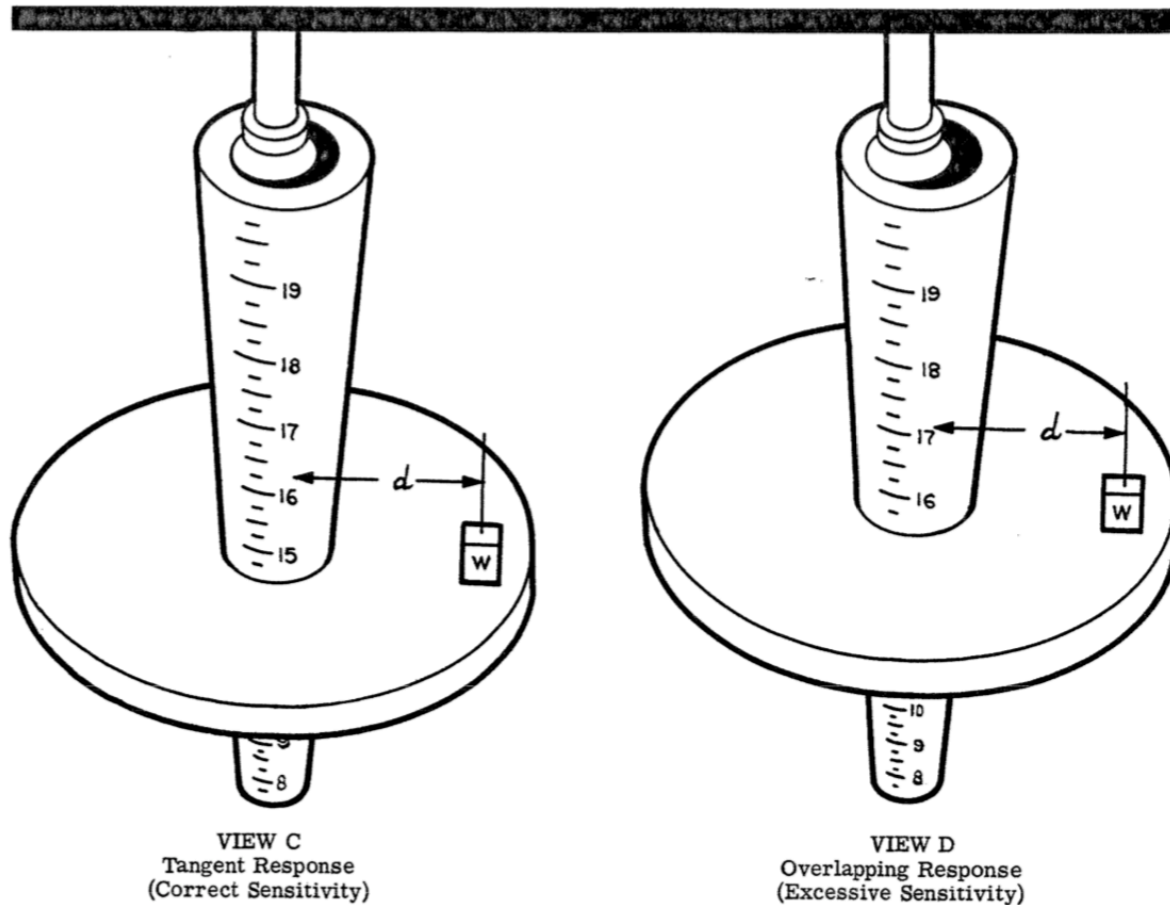


Figure 1-36. Effect on Sensitivity Setting on Balance Indication (Sheet 2 of 2)

1-43. “GO-NO GO” BALANCE INDICATIONS.

1-44. Sensitivity of the suspension balancers can be readily adjusted so that a specific deflection of the black indicator disc with respect to the indicator bushing (tangency of the indicator circles) will occur when the limiting amount of permissible unbalance is present in the assembly being checked. (See figure 1-36.) Once this setting has been established, subsequent similar assemblies, using the same setting, are directly indicated as “inside” or “outside” balance tolerance limits by the relative position of the indicator circles. This feature eliminates the need for any calculations by the operator; when the indicator bushing circle is anywhere inside the black indicator disc circle, the indicated unbalance is smaller than the balance tolerance limit.

1-45. EFFECT OF VERTICAL HEIGHT SETTING ON SENSITIVITY OF UNBALANCE INDICATION. (See figure 1-33.)

1-46. The bare disc in all four views of figure 1-36 represents the same balanced mass. The small unbalance force, introduced by addition of weight  $w$  at distance  $d$ , is the same in all four views and represents the maximum permissible unbalance for the assembly. In View A, with the disc mounted at the lower end of the arbor, balance sensitivity is

too low to provide a visible indication of the small unbalance force. In View B, mounting the disc higher on the arbor increases sensitivity so that a visible indication of the small unbalance force is observed. By mounting the disc still higher on the arbor, sensitivity is further increased until the indicator bushing circle becomes tangent with the indicator disc circle, as in View C. This is correct sensitivity for the assembly (balance tolerance =  $w \times d$ ). In View D, mounting the disc still higher on the arbor results in an excessive degree of sensitivity, or actual instability.

1-47. DETERMINATION OF CORRECT SENSITIVITY.

1-48. Correct sensitivity setting for a specific assembly may be determined as follows:

- a. Select combination of adapters to pilot the assembly firmly and concentrically on the arbor.
- b. Estimate vertical center of gravity location of the assembly. Position piloting adapters on arbor so that assembly c.g. aligns approximately with 7-inch position on arbor scale.
- c. Install quick-disconnect coupling; hoist arbor and balancing assembly approximately  $\frac{1}{4}$  inch off work stand or other support. Check to ensure that suspended assembly is free from interference with stand or other objects.
- D. Observe stabilized balance indication and add temporary weights, as required, to centralize balance indication. If

balance indication cannot be centralized, too high a c.g. position on the arbor (instability) is indicated. Try lower positions of the assembly on the arbor until the balance indication can be centralized by addition of temporary weights.

e. Once the centralized indication is established, add to the assembly a measured amount of unbalance ( $w \times d$ ) equal to the balance tolerance. Addition of this amount of unbalance should cause the centralized balance indication

to shift until the black indicator disc circle becomes tangent with the indicator bushing circle. If this occurs, sensitivity is satisfactory and the height setting of the assembly should be recorded for future use with similar assemblies.

f. If the indicator deflection from the centralized position, caused by addition of the balance tolerance,  $w \times d$ , is less than the tangency point of the two circles, insufficient sensitivity is indicated; repeat the procedures above with assembly mounted higher on the arbor. Conversely, if the introduction of the balance tolerance,  $w \times d$ , causes displacement of the balance indication beyond the tangency point of the two circles, sensitivity is too great and the assembly should be repositioned lower on the arbor. Forward defective arbors to the manufacturer for repair.

SECTION II

SPECIAL SERVICE TOOLS

2-1. GENERAL.

2-2. No special service tools are required to perform the operations described in this manual.

SECTION III

PREPARATION FOR USE, STORAGE, OR SHIPMENT

3-1. PREPARATION FOR USE.

3-2. PROPELLER AND HELICOPTER ROTATING COMPONENTS KIT 7A050

3-3. UNPACKING. Remove shipping case as follows:

- a. Cut metal bands, and pull out all nails from one of the shipping case plywood sides.
- b. Remove this side, and lay the shipping case, open side down, on the floor.
- c. Lift shipping case off balancing kit storage case, and put shipping case aside for future use.

3-4. OPENING KIT STORAGE CASE. Open case as follows:

- a. Lay balancing kit storage case flat on floor with red decal upward. (See figure 3-1.) Note stencil: "To open lay flat this side up."

- b. Release six trunk-type latches on sides of case and, grasping handles, lift top half of case from bottom half. (See figure 3-2.)
- c. Lay top half, felt side upward, flat on floor beside bottom half, and remove felt-covered tray by releasing two tray latches and lifting tray from case.

CAUTION

The balancing kit storage case is designed to be opened from this position only. Opening case in any other way may result in spilling of and damage to the precision finished parts.

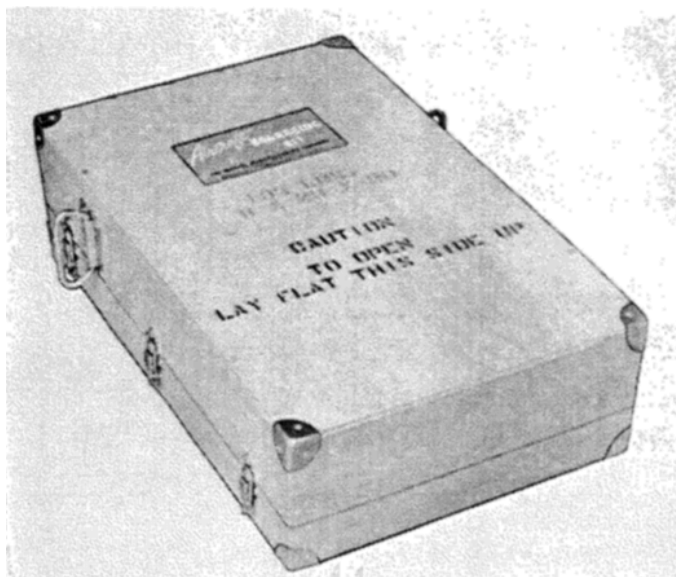


Figure 3-1. 7A050 Kit Ready for Opening

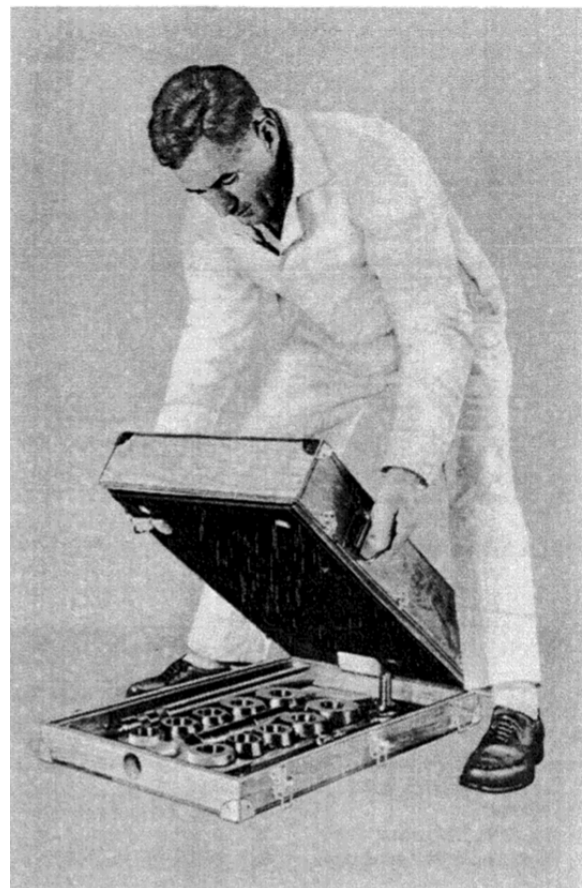


Figure 3-2. Opening 7A050 Kit Storage Case

3-5. ASSEMBLY OF WORK STAND AND HOIST.

(See figure 3-3.)

- a. Remove long No. 4 tube (4) from top half of balancing kit 7A050 storage case. Remove two work stand legs (11) from inside tube.
- b. Leaving circular stand casting (1) in storage case, push small ends of legs (11) (with friction lock rings) into the two bores provided in circular part of stand casting, making certain legs are fully bottomed in bores.
- c. Install two leg extensions (12) in end of legs (11), making certain leg extensions are fully seated.
- d. Install stub leg (9) in bore of heavy boss on stand casting (1), making certain stub leg is fully seated.
- e. Remove stand casting and leg assembly from case and hold in upright position (casting up, legs down).

Carefully tilt bottom half of storage case (10) upward and insert stub leg (9) of stand casting into the hole of stub leg support (19, figure 1-13) in upper end of storage case bottom half. (See figure 3-4.) Seat large No. 1 boss of stand casting solidly on top of storage case bottom half.

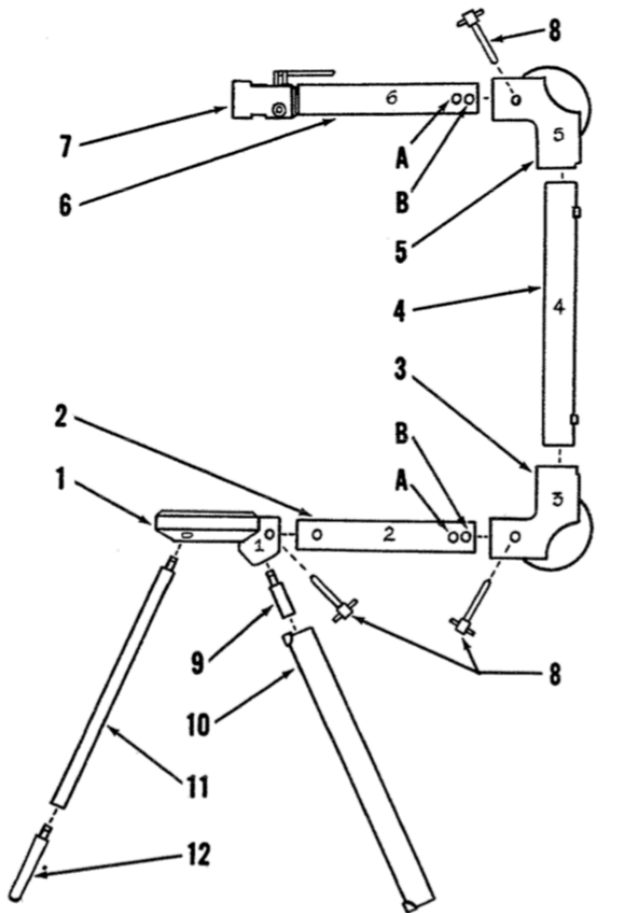
CAUTION

To avoid spilling finished parts, do not tilt bottom half of storage case beyond the vertical position.

- f. Remove No. 6 tube (6) and hydraulic pump assembly (7) from storage case top half. Remove No. 2 tube (2) from No. 6 tube.

Note

Except as otherwise called for in specific application instructions, Section IV, assemble hoist structure components in numerical sequence with all red numbers on components facing operator and right side up, as shown in figure 3-3.



- |                         |                      |
|-------------------------|----------------------|
| 1 Stand Table           | 8 Engaging Pin       |
| 2 No. 2 Horizontal Tube | 9 Stub Leg           |
| 3 Elbow                 | 10 Case Bottom Half  |
| 4 No. 4 Vertical Tube   | 11 Stand Leg         |
| 5 Elbow                 | 12 Leg Extension     |
| 6 No. 6 Horizontal Tube | 13 A Inner Pin Holes |
| 7 Hydraulic Pump Assy.  | 14 B Outer Pin Holes |

Figure 3-3. Assembly of 7A050 Kit Work Stand and Hoist



Figure 3-4. Assembling Work Stand Casting to Bottom Half of Storage Case.

g. Assemble No. 2 tube (2) in No.1 stand casting (1), and secure connection by inserting pin (8) through pin hole in tube and stand casting

h. Assemble No. 3 elbow (3) to No.2 tube (2), and secure connection by inserting pin (8) through elbow pin hole and inner pin hole (A) of tube.

**Note**

In assembling elbows to horizontal tubes, engage pins (8) in inner set of pin holes (A). In the event of insufficient radial clearance, elbows may be moved outward on horizontal tubes so that pins (8) engage outer set of pin holes (B). Since this arrangement provides shorter load bearing surface of tubes in elbows, limit loads to 200 pounds when hoist support is assembled in this manner.

i. Assemble No. 4 vertical tube (4) to No. 3 elbow (3) and No. 5 elbow (5), engaging lugs on tube with central portion of aligning slots in elbows.

j. Assemble No. 6 tube (6) to No. 5 elbow (5), and secure connection by inserting pin (8) through elbow pin hole and inner pin hole (A) of tube.

**3-6. INDICATING DEVICE (ARBOR).**

**3-7. UNPACKING.**

a. Disengage arbor retaining spring (27, figure 1-13), remove balancing arbor (23, figure 1-13) from 7A050 storage case, and screw hand wheel (26, figure 1-13) into bottom end of arbor. Stand arbor and hand wheel assembly upright on bench.

b. Using tag string, pull upper oil seal sleeve off end of arbor suspension rod.

c. Loosen set screw of indicator bushing (see figure 3-5) and lift indicator bushing from suspension rod. Remove lower oil seal (O-ring) from suspension rod outer sleeve. Carefully clean all residual oil and preservative compound from top surface of arbor, suspension rod assembly and indicator bushing. For best indicator contrast, thoroughly degrease these surfaces, using clean cloth moistened with Solvent, Federal Specification P-D-660 or equivalent volatile cleaner.

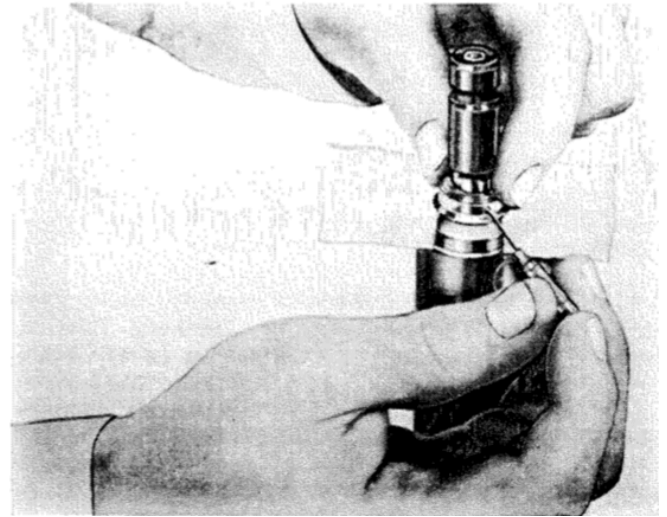
d. Using two small pieces of paper under indicator bushing as shims, re-install indicator bushing and tighten set screw. (See figure 3-5.)

e. Remove paper shims, and check to ensure that indicator bushing moves freely over black indicator disc (2, figure 1-33) without binding.

**Note**

For temporary storage, keep arbor and kit case in upright position, as dash-pot damping oil can leak out after removal of arbor seals if arbor lies on its side.

**3-8. HANDLING.** The balancing arbor is a precision instrument, and if treated accordingly, will give good service indefinitely. However, to prevent critical damage, always observe the following handling precautions as listed in the paragraphs a through d. Adhere to the recommendations.



**Figure 3-5. Setting Balancing Arbor Indicator Bushing**

a. Particularly avoid excessive sidewise or downward loading of the projecting suspension rod end, since internal damage to the sensitive internal suspension element may result. For example, dropping the inverted arbor on the suspension rod end from any appreciable height will result in permanent critical damage. Similarly, any bumping of the projecting suspension rod end, in any position, should always be avoided.

b. The outside diameter of the arbor is a precision finished piloting surface. This surface should always be protected against accidental contacts which would cause nicks, burrs, abrasion or corrosion. Leaving the bare arbor standing on end where it may be knocked over is a particularly bad practice.

c. Always handle the arbor by the knurled section, supporting the lower end with the other hand. Always return the arbor to its place in the storage case when not actually in use.

d. Do not disturb pressed-in plugs in eight holes in lower section of arbor, and do not attempt removal of the arbor top cap. Arbor must be returned to factory for repair if these parts are disturbed.

e. For lubrication instructions to be observed prior to each application of the arbor and for instructions on adding damping oil to the arbor fluid reservoir, refer to Section V.

**3-9. 7A050 KIT ADAPTER CONES, BUSHINGS, AND SPACERS.** (See figure 1-13.)

**3-10 UNPACKING.** Opening of the 7A050 kit case makes all kit components directly accessible without further unpacking.

**3-11. HANDLING.** Surfaces of adapter cones, bushings, and spacers are precision finished. Exercise care in handling these parts so as to protect them against accidental nicks, burrs, abrasion, or corrosion. For lubrication instructions to be observed prior to each application, refer to Section V.

3-12. REGULATOR ADAPTER KIT 7A051 AND PROPELLER ADAPTER KIT 7A052. (See figures 1-14 and 1-15.)

3-13. UNPACKING. The storage case for regulator adapter kit 7A051 and for propeller adapter kit 7A052 are so designed that opening of the hinged cover provides direct, independent accessibility to all kit components without further unpacking.

3-14. HANDLING. Surfaces of regulator and propeller kit components are precision finished. Exercise care in handling these components so as to protect them against accidental nicks, burrs, abrasion, or corrosion. For lubrication instructions to be observed prior to each application, refer to Section V.

3-15. PROPELLER SPINNER BALANCING ADAPTER KITS 7A053, 7A054, AND 7A055. (See figures 1-16, 1-17, and 1-18.)

3-16. UNPACKING. Storage cases for propeller spinner balancing adapter kits are designed to provide direct accessibility without additional unpacking once the hinged cover is unlatched and opened. Adapters and small bars are suitably braced and retained in individual compartments.

3-17. HANDLING. Adapters are precision finished and balanced. Avoid excessive or rough handling so as not to cause accidental damage or contamination. Nicks, burrs, or corrosion are detrimental. Refer to Section V for appropriate lubrication instructions prior to use.

3-18. MAIN ROTOR AND TAIL ROTOR BALANCING ADAPTER KITS 7HEL058, 7HEL059, 7HEL060, 7HEL061, AND 7HEL062. (See figure 1-25 through 1-28.)

3-19. UNPACKING. The storage cases for each of above adapter kits are so designed that unlatching and opening the hinged cover of the case assembly permits direct accessibility to all components in each kit. Separate and individual compartments provide secure retention of each component.

3-20. HANDLING. Excessive and needless handling shall be avoided and each part shall be returned to its proper compartment when not actually in use. Components are precision made. Accidental damage such as nicks, burrs, abrasion or corrosion shall be avoided. For lubrication instructions to be observed prior to each application, refer to instructions in Section V.

3-21. ROTARY RUDDER HEAD BALANCING ADAPTER KIT 7HEL064. (See figure 1-29.)

3-22. UNPACKING. The storage case is designed for ease of accessibility to all components after the hinged cover is unlatched and opened and no additional unpacking is necessary.

3-23. HANDLING. Surfaces of components of the Rotary Rudder Head Balancing Adapter Kit are precision made and damage shall be avoided. Care is especially required to cone seats and the anchor. Avoid nicks, burrs, abrasion or corrosion and do not distort anchor legs. Store components in case when not being used.

3-24. MAIN ROTOR HUB BALANCING ADAPTER KIT 7HEL066. (See figure 1-30.)

3-25. UNPACKING. The storage case provides accessibility to all kit components after the cover is unlatched and opened. No additional unpacking is necessary.

3-26. HANDLING. Surfaces of Main Rotor Hub Balancing Adapter Kit components are precision made and finished. Avoid excessive damage by handling components carefully and only when necessary. Nicks, burrs, abrasion and corrosion are detrimental. Refer to Section V for appropriate lubrication instructions prior to actual use.

3-27. MAIN ROTOR BALANCING ADAPTER KITS 7HEL154, 7HEL254 and 7HEL354. (See figure 1-31.)

3-28. UNPACKING. The storage case provides accessibility to the adapter (packed assembled) components after the cover is unlatched and opened. No additional unpacking is necessary.

3-29. HANDLING. Surfaces of the components are precision made and finished. Handle each part carefully to avoid nicks, burrs, or detrimental scratches. A light film of lubricant as described in Section V facilitates usage of components and prevents corrosion.

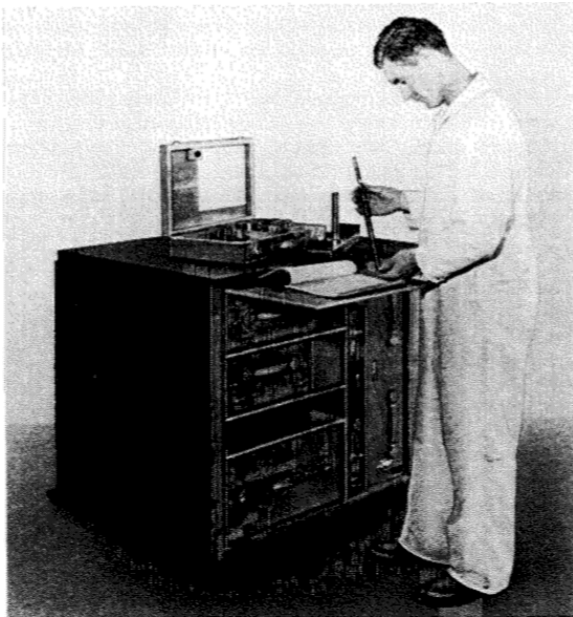
3-30. COMPRESSOR ROTOR STAGE SUBASSEMBLIES BALANCING KIT 7JET051. (See figure 1-32.)

3-31. UNPACKING. Unlocking the latches to permit opening the storage case cover, provides accessibility to the components of this kit. No additional unpacking is necessary.

3-32. HANDLING. Surfaces of the fixture, adapter and other components shall be handled carefully so as to avoid marring any of the details. The arbor shall be handled and prepared for use as described in paragraph 3-38 below.

3-33. HELICOPTER BALANCING, TRACKING, AND ALIGNING KIT 7HEL050.

3-34. UNPACKING. Open outer storage and shipping case by unscrewing six bolts in the two front side rails and removing front cover. Interim storage of front cover during use of the 7HEL050 kit is provided for by holes in the rear side rails through which the six front cover attaching bolts can be inserted to secure front cover against back of storage and shipping case. Pull-out panel in top of case can be used as handbook reference surface, while top surface of case provides convenient work table for selection and assembly of adapter components. (See figure 3-6 for a general view of the complete storage case containing the six sub-kits.



**Figure 3-6. 7HEL050 Kit Storage and Shipping Case. Showing Sub-Kit Storage Cases**

3-35. The six helicopter sub-kits contained in the 7HEL050 storage and shipping case are packed in individual cases, each of which is identified by a red stencil marking. Each sub-kit case is so designed that opening of the hinged cover provides direct, independent accessibility to every kit component.

3-36. **HANDLING.** Surfaces of helicopter kit components are precision finished. Exercise care in handling these components so as to protect them against accidental nicks, burrs, abrasion, or corrosion. For lubrication instructions, refer to Section V.

3-37. **SMALL BALANCING ARBOR (P/N 2516)**

3-38. **UNPACKING AND HANDLING.** Remove arbor assembly from opened arbor kit case by lifting exposed end of arbor and carefully slipping arbor out of tilting support block. Preparation of this arbor for use differs from that of the larger 7A050 arbor in the following principal respects:

a. As shipped, the top end of the small arbor is sealed by an internal, spring-loaded seal located on the suspension rod under the indicator bushing. In addition to preventing loss of dash-pot oil, this seal also supports the suspension rod in a fixed position in the arbor during shipment. To unseat the spring-loaded seal and free the suspension rod for normal operation, push the indicator bushing downward, against light spring tension, so that its bottom surface clears the black indicator disc by approximately 0.003 inch. (For use of paper spacing shims, see figure 3-5.) Lock indicator bushing in this position with indicator bushing set screw, using hex wrench provided in the 7HEL053 kit. Remove paper shims and check to ensure indicator bushing moves freely.

b. In handling the small arbor, particular care should be exercised to avoid all impact or excessive downward pressure on the suspension rod. (Refer to paragraph 4-7 for special instructions on installation of quick-disconnect coupling.)

3-39. **DEPRESERVATION.**

3-40. As received from the manufacturer, all kit components susceptible to corrosive attack are coated with soft-film preservative compound. This material may be readily removed by washing the parts in clean mineral spirits and wiping with clean, lint-free cloth or paper cleaning tissue.

**CAUTION**

Immersion of helicopter sub kit assemblies in vapor degreaser or heated cleaning solvents is not recommended, since nonmetallic assembly details may be adversely affected. Never immerse balancing arbors in vapor degreaser or heated cleaning solvents, since arbor's internal assembly may be adversely affected, and never immerse the dial indicator (7HEL055 kit) or the optical trammeling scopes (7HEL056 kit) in cleaning solvents or other fluids.

3-41. Following depreservation, immediately coat all exposed steel surfaces, particularly unplated piloting surfaces, of kit components with mineral oil, Specification MIL-L-15018 Grade 5150. After the application of the protective mineral oil, avoid unnecessary handling of the components to eliminate possibility of damaging fingerprint stains.

3-42. **STORAGE OR SHIPMENT.**

3-43. **INTERIM STORAGE OF KITS IN INTERMITTENT USE.**

a. Using cleansing tissue or lint-free cloth, carefully remove accumulated old oil or preservative compound from all kit components. Coat all ferrous parts, with particular attention to unplated piloting surfaces, with mineral oil specified in 3-41 above.

b. Replace all kit components in their respective hardwood cases. Refer to packing diagrams, installed in each kit case, for proper positioning of kit components.

c. Store 7A050, 7HEL053 and 7JET051 kits, containing unsealed balancing arbors, on end with arbors in upright position to avoid loss of dash-pot oil.

3-44. **PREPARATION OF KITS FOR INACTIVE STORAGE OR SHIPMENT.**

3-45. In addition to Paragraph 3-43, steps a and b, observe the following procedures.

a. Install locally fabricated circular gasket seal under indicator bushing of 7A050 balancing arbor as follows:



1. Loosen indicator bushing set screw and remove indicator bushing from suspension rod.

2. Install circular gasket over suspension rod so that gasket covers black indicator disc.

3. Re-install and lock indicator bushing tightly.

b. Seal center opening around 7A050 arbor suspension rod, directly above indicator bushing, by wrapping tightly with suitable tape.

c. Seal upper end of small balancing arbor (contained in 7HEL053 and 7JET051 kits) by loosening indicator bushing set screw and allowing internal seal spring to push indicator bushing upward.

d. Dial Indicator (7HEL055 kit) – Enclose dial indicator in moisture-resistant paper or plastic film. Seal enclosure with tape.

e. Enclose individual hardwood kit cases in suitable protective wood packing or shipping case. Use of original shipping containers, if available, is recommended.

f. 7HEL050 Kit Assembly – Install sub kits in their individual compartments in the 7HEL050 storage and shipping case (see figure 3-6), with red stencils outward and in upright position. Re-install 7HEL050 kit front cover, using six side-rail bolts supplied with kit.

SECTION IV  
OPERATION INSTRUCTIONS

4-1. GENERAL.

4-2. The detailed operation instructions included in this Section explain the proper and recommended usage of the respective kits listed in Table 1.

4-3. It is essential that all components of a kit be clean and free from damage before any attempt is made to perform the operations in this Section.

CAUTION

Burrs, nicks or detrimental contamination have an adverse effect on balancing operations. Unless balancing components and equipment are absolutely clean and undamaged, results will prove unsatisfactory. Always handle kit components with care and with clean hands or cloths. Store components in their respective cases when not in use.

4-4. Before attempting to perform the detailed operations described in this section, be certain to understand the general principles of operation of the balancing kit, which are explained in Section I. Observe the instructions for assembly of the work stand and hoist (see figure 3-3) and other preparations for use of the balancing kit components, which are described in Section III. Understand the instructions on operations of the balancing kit components which follow.

4-5. For permissible unbalance, tracking, or alignment tolerances and for specific assembly modifications to a particular propeller or helicopter assembly required to correct indicated unbalance, refer to the applicable propeller or helicopter manual.

4-6. BALANCING KIT COMPONENTS. Operation instructions for the balancing kit components apply at various steps in the sequence of balancing check procedures. For example, when a procedural step calls for installation of the suspension cable and quick-disconnect coupling assembly, instructions in the paragraph, Quick-Disconnect Coupling, which immediately follows this paragraph, apply. The same is true for instructions on operation of the hydraulic pump assembly to raise and lower loads and for instructions on the proper method for installing the suspension cable in the ram piston of the hydraulic pump assembly.

4-7. QUICK-DISCONNECT COUPLINGS. The quick-disconnect coupling (10, figure 1-13), normally assembled to the 3/16-inch diameter suspension cable, is ready for use when removed from the balancing kit storage case. Install coupling as follows:

a. Place open end of coupling socket over end of arbor suspension rod, and press straight downward on top end of coupling assembly, against moderate spring resistance, until a definite click is felt and heard. (See View A, figure 4-1.) This is the locked position of the coupling.

CAUTION

Avoid imparting excessive downward or sidewise pressure on arbor suspension rod, as damage to the flexible suspension element within the arbor may result. Should the coupling fail to engage with moderate downward pressure, inspect coupling and suspension rod end for foreign matter which might cause interference.

4-8. Before disengaging the coupling, be certain there is no load (suspended assembly) on the coupling and that the arbor is held so that it will not drop. Disengage coupling as follows.

- a. Hold the arbor by the knurled section with one hand and press straight downward on the coupling sleeve with the other hand. (See View B, figure 4-1).
- b. Release coupling sleeve and lift coupling off arbor suspension rod.

CAUTION

When installing or removing quick-disconnect coupling from small balancing arbor, Part No. 2516 (7HEL053 and 7JET051 kits), grasp upper suspension rod and de-coupler assembly only, so as to prevent excessive compression loading of the sensitive suspension element. (See Views C and D, figure 4-1.)

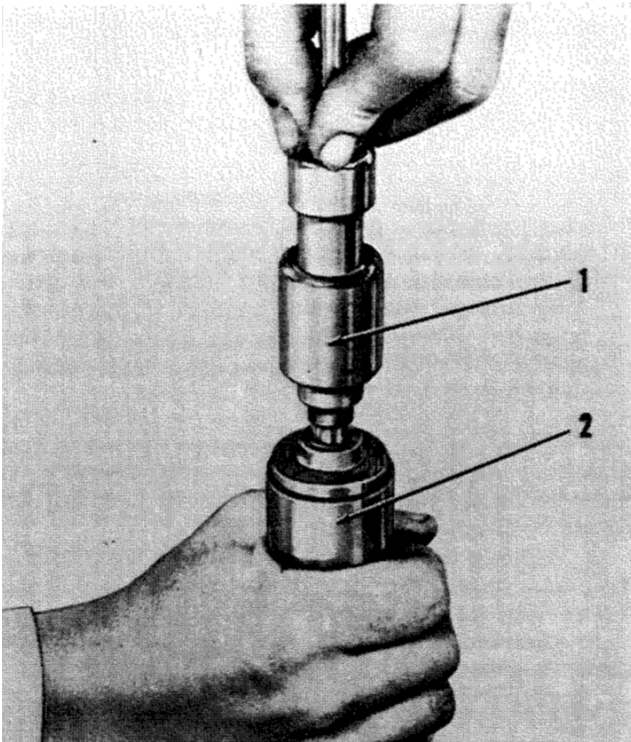
4-9. HYDRAULIC PUMP ASSEMBLY. (See figure 4-2.) The hydraulic pump assembly contains hydraulic fluid and is ready for use when removed from the balancing kit storage case and positioned on the stand assembly. Operation of the hydraulic pump assembly is as follows:

- a. To raise (hoist) a suspended load, turn the pump valve (5) counter-clockwise to the limit of its travel. This closes the ram by-pass and directs pressure to the ram cylinder. Actuate the pressure pump handle (3) to raise the ram piston (6) to desired level within the piston's normal travel of approximately 1-1/2 inches.

CAUTION

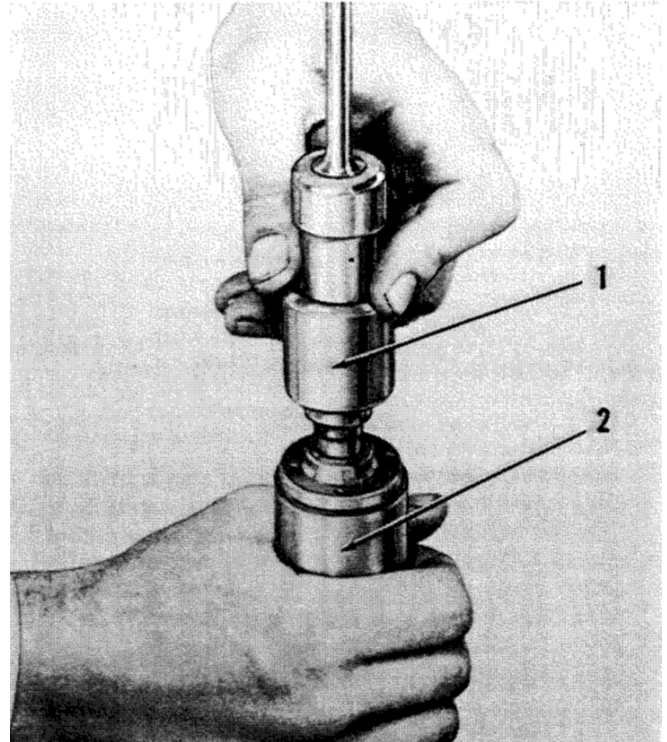
Upward travel of the ram piston is limited by a piston stop washer and retaining ring (1). With the ram piston against this stop, further actuation of the pressure pump will result in a build-up of internal pressure which may cause damage to the load indicating gage (8) or to internal pump parts. Never operate the pump beyond an indicated load of 800 pounds.

- b. To lower as suspended load, turn the pump valve clockwise to gradually open the ram by-pass and unload the ram piston. For slow descent, a partial turn of the valve is sufficient. For more rapid descent, the valve may be turned clockwise as desired up to the limit of its travel.



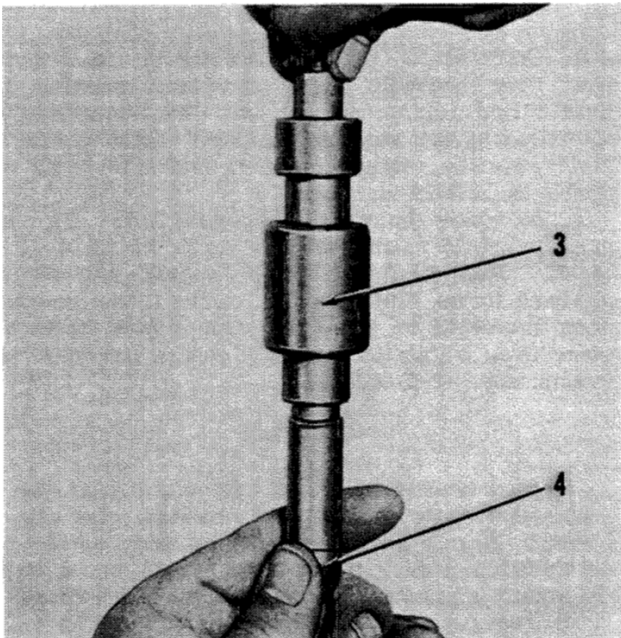
VIEW A

Installing Quick-Disconnect Coupling on Balancing Arbor, Part No. 2259 (7A050 kit)



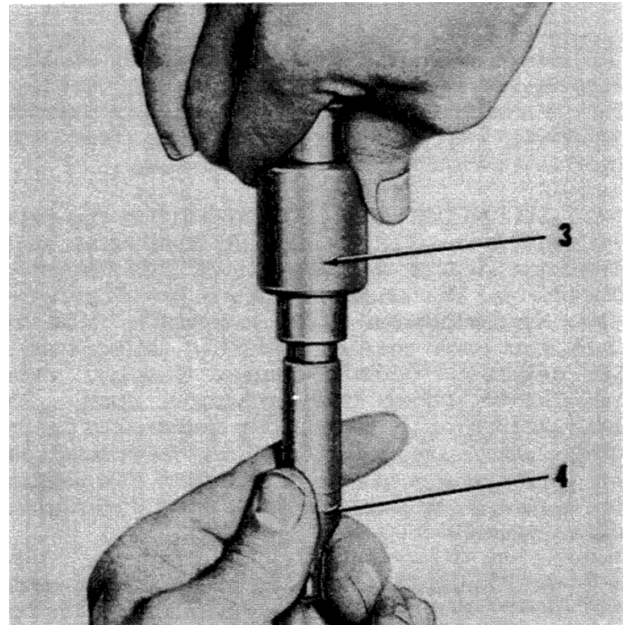
VIEW B

Removing Quick-Disconnect Coupling From Balancing Arbor, Part No. 2259 (7A050 kit)



VIEW C

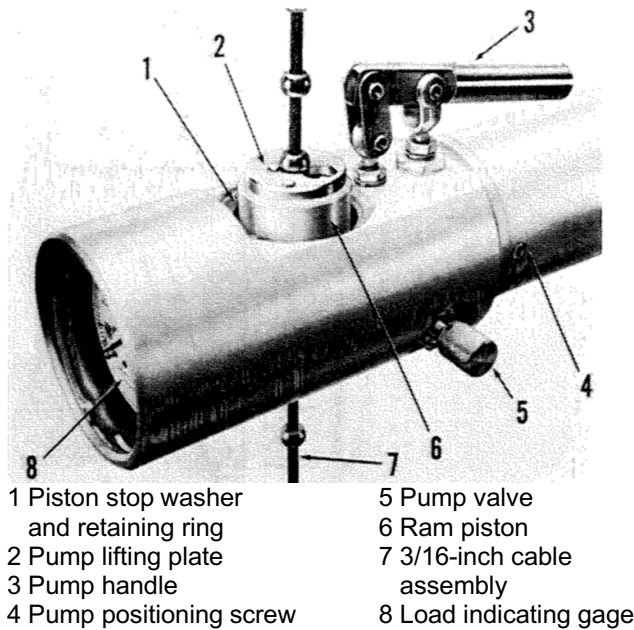
Installing Quick-Disconnect Coupling on Small Balancing Arbor, Part No. 2516 (7HEL053 and 7JET051 kits) 1 Coupling 2 Arbor



VIEW D

Removing Quick-Disconnect Coupling from Small Balancing Arbor, Part No. 2516 (7HEL053 and 7JET051 kits) 3 Coupling 4 Arbor

Figure 4-1. Installing and Removing Quick-Disconnect Couplings



- |   |                            |
|---|----------------------------|
| 1 Piston stop washer and retaining ring | 5 Pump valve               |
| 2 Pump lifting plate                    | 6 Ram piston               |
| 3 Pump handle                           | 7 3/16-inch cable assembly |
| 4 Pump positioning screw                | 8 Load indicating gage     |

**Figure 4-2. Hydraulic Pump Assembly**

4-10. SUSPENSION CABLES. Install suspension cable (13, figure 1-13) in ram piston (6, figure 4-2) of hydraulic pump assembly as follows:

- Insert ball end of cable upward through center hole in ram piston guide. Position pump lifting plate (2, figure 4-2) sidewise to permit free upward passage of cable and balls.
- Move pump lifting plate toward center to engage one of the cable balls so that the suspension cable and quick-disconnect coupling assembly may be suspended from lifting plate. Make cable engagement with ram piston in full down position. Engagement of lowest possible cable ball will ensure adequate hoisting of balance load within range of ram piston travel.

**CAUTION**

Do not exceed load limits engraved on load indicating gage (8, figure 4-2) of hydraulic pump for either 1/16-inch or 3/16-inch suspension cable.

4-11. PROPELLER BALANCING APPLICATION

**Note**

All kit components provide for close-tolerance slip fits. Clean all mating surfaces thoroughly and apply clean lubricating oil immediately before each kit component installation.

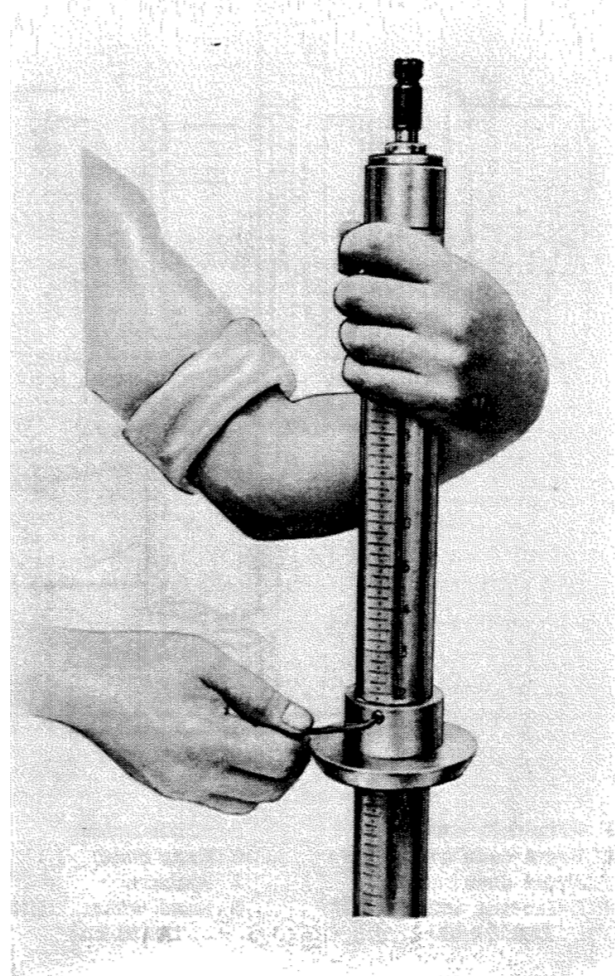
4-12. AEROPRODUCTS PROPELLERS.

4-13. MODELS A322 and A422 – HUB AND BLADE ASSEMBLY ONLY. (See figure 4-4.)

- Center propeller assembly (1), with front side of

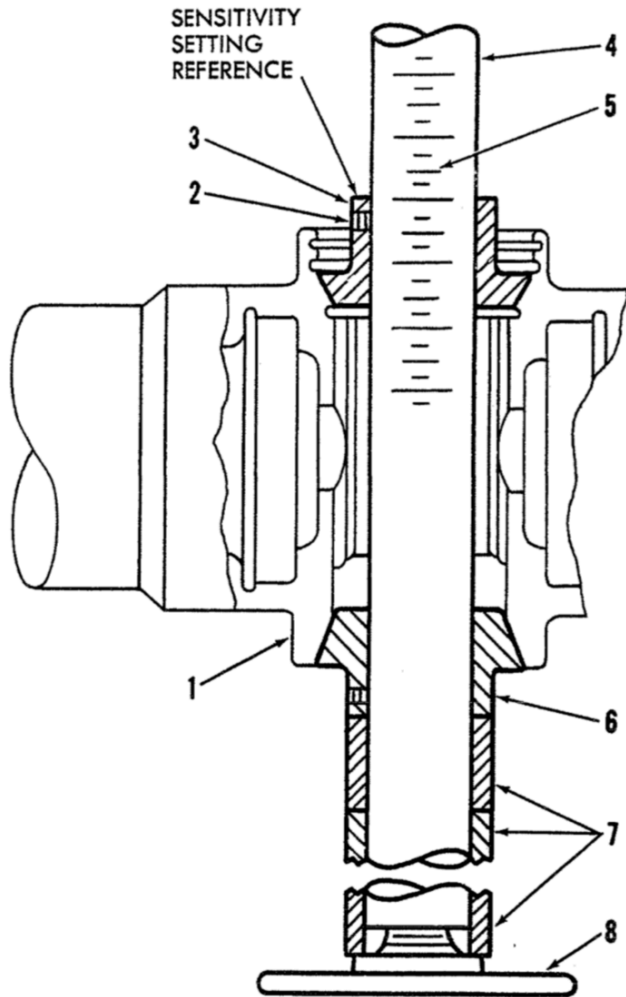
propeller upward, on work stand (1, figure 1-13).

- Select front cone (3), P/N 2206 (A322), P/N 2207 (A422). Install cone, hub upward, on arbor (4) so that top of cone hub aligns on arbor scale (5) in accordance with sensitivity setting specified in applicable propeller manual. Secure cone on arbor by tightening set screw (2) with 1/8" hex wrench (8, figure 1-13). See figure 4-3 for typical method of setting sensitivity correctly.



**Figure 4-3. Mounting Adapter Cone in Alignment with Arbor Scale Sensitivity Setting**

- Install arbor and front cone assembly downward through propeller hub, seating cone in propeller cone seat.
- Install applicable rear cone (6), hub downward, over lower end of arbor and into propeller hub rear cone seat. Do not secure rear cone on arbor by tightening set screw.
- Install applicable spacers (7), P/N 2201 through P/N 2204, as required, on arbor under rear cone.
- Install hand wheel (8) in lower end of arbor, and tighten wheel to secure cones in propeller hub cone seats.
- Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.



- |                                     |                                |
|-------------------------------------|--------------------------------|
| 1 Propeller assembly                | 5 Arbor scale                  |
| 2 Front cone set screw              | 6 Rear cone                    |
| 3 Front cone                        | 7 Spacers                      |
| 4 Balancing arbor (2259, 7A050 kit) | 8 Hand wheel (2215, 7A050 kit) |

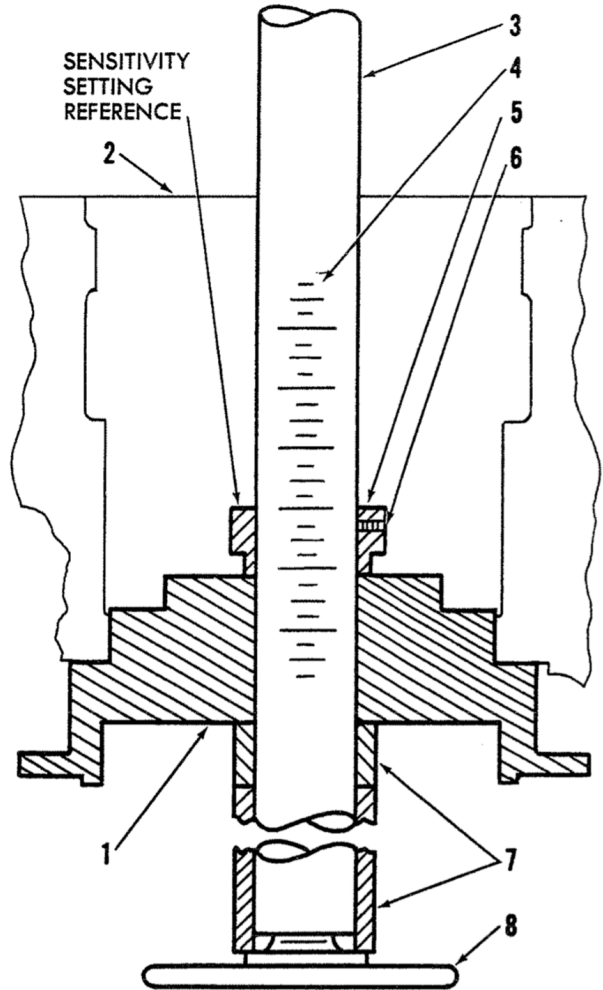
**Figure 4-4. Typical Balancer Installation – Double Cone Propeller Hub and Blade Assemblies**

h. Hoist entire assembly approximately ¼ inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand or other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

**Note**

Should interference occur between hand wheel (8) and inside diameter of work stand make and install ¾-inch (approximate thickness) wood blocks under the two work stand legs so as to center the suspended arbor.

i. For balance tolerance and application of balance corrections, refer to applicable propeller manual.



- |                                     |                                |
|-------------------------------------|--------------------------------|
| 1 Adapter (2397, 7A051 kit)         | 5 Bushing (2211, 7A050 kit)    |
| 2 Regulator assembly                | 6 Bushing set screw            |
| 3 Balancing arbor (2259, 7A050 kit) | 7 Spacers (7A050 kit)          |
| 4 Arbor scale                       | 8 Hand wheel (2215, 7A050 kit) |

**Figure 4-5. Typical Balancer Installation – Aero product Regulator Assemblies**

4-14. Models A322, A422, A634FN-D1, AND A644-FN-REGULATOR ASSEMBLY ONLY (See figure 4-5.)

a. Center adapter (1) on work stand (1, figure 1-13) with stepped section upward.

b. Install regulator assembly (2), with its piloting diameter downward, over mating pilot diameter of adapter. Ensure that regulator is seated firmly on supporting shoulder of adapter.

c. Install bushing (5) (knurled hub upward, on balancing arbor (3) so that top surface of bushing aligns on arbor scale (4) in accordance with sensitivity setting specified in applicable regulator manual. Using a 1/8" hex wrench (8, figure 1-13), lock bushing firmly in this position by tightening bushing set screw (6).

d. Insert lower end of arbor downward through center bore of adapter (1) until bushing (5) seats firmly on top surface of adapter.

e. Install applicable spacers (7) on lower end of arbor. Use spacer P/N 2203 and P/N 2204 on all regulators and P/N 2201 replaces P/N 2202 when balancing FN series regulators.

f. Install hand wheel (8) in bottom end of arbor, and tighten to clamp spacers, adapter, and bushing.

g. Install suspension cable (14, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand or other objects, and note balance condition indicated by the black indicator disc at the top end of the arbor.

i. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

#### 4-15. BEECH PROPELLERS

#### 4-16. MODELS B200 214, AND 215 – SHAFT NUT REMOVED. (See figure 4-6.)

a. Center propeller assembly (1), front side of propeller upward, on work stand (1, figure 1-13).

b. Install front bushing (2), knurled hub upward, on balancing arbor (3), and align top surface of bushing on arbor scale (4) in accordance with sensitivity setting specified in applicable manual. Lock bushing securely in this position by tightening set screw (5) with 1/8" hex wrench (8, figure 1-13).

c. Insert arbor downward through propeller hub, seating pilot of bushing (2) into pilot bushing of propeller hub.

#### Note

Accurate alignment of arbor with rear cone (6) seat may be necessary before bushing (2) pilot will seat properly.

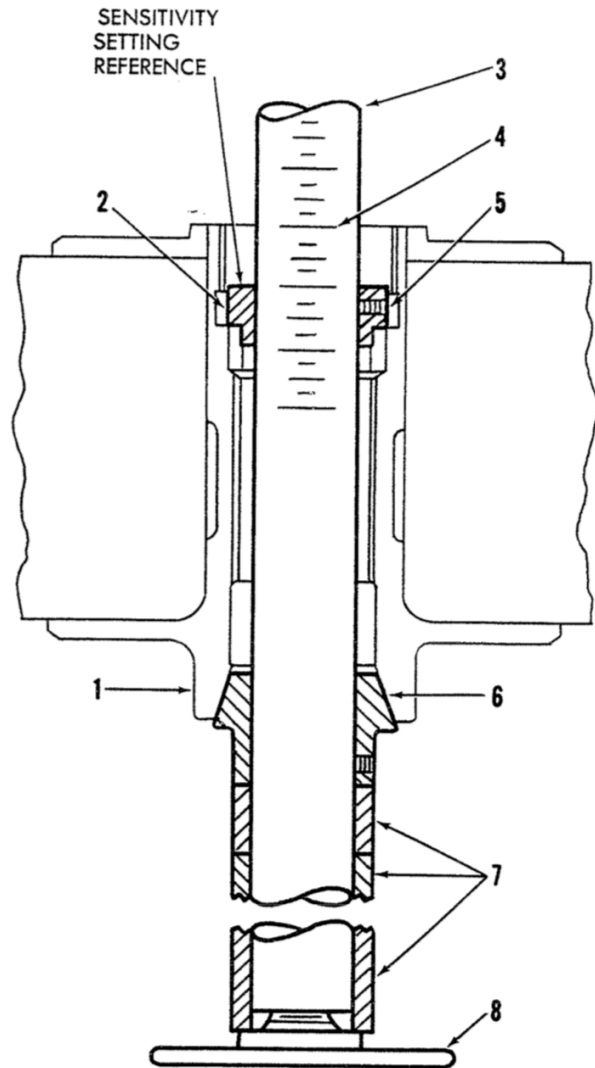
d. Install rear cone (6), hub downward, over lower end of arbor and into propeller hub cone seat.

e. Install applicable spacers (7), P/N 2202 and P/N 2204 on lower end of arbor, and install hand wheel (8) in end of arbor. Tighten hand wheel to clamp rear cone securely into propeller hub cone seat.

f. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

g. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand or other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

h. For balance tolerance and application of balance corrections, refer to applicable propeller manual. Balance corrections shall be made at the location and within tolerance specified.



- |                                    |                                |
|------------------------------------|--------------------------------|
| 1 Propeller assembly               | 5 Front bushing set screw      |
| 2 Front bushing (2211, 7A050 kit)  | 6 Rear cone (2223,7A050)       |
| 3 Balancing arbor (2259 7A050 kit) | 7 Spacers                      |
| 4 Arbor scale                      | 8 Hand wheel (2215, 7A050 kit) |

**Figure 4-6. Typical Balancer Installation – Single Cone, SAE 20 Splined Hub Propeller Assemblies with Shaft Nut Removed**

#### 4-17. MODEL R200 – SHAFT NUT AND FRONT CONE REMOVED. (see figure 4-4.)

a. Center propeller assembly (1), with front side of propeller upward, on work stand (1, figure 1-13).

b. Install front cone (3), Part No. 2224 (7A050 kit), hub upward, on balancing arbor (4) so that the top of cone hub aligns with 13-inch position on arbor scale (5). Secure cone on balancing arbor by tightening set screw (2) with 1/18 inch hex wrench (8, figure 1-13).

- c. Install arbor and front cone assembly downward through propeller hub, seating cone in propeller cone seat.
- d. Install rear cone (6), Part No 2223 (7A050 kit), hub downward over lower end of arbor and into propeller hub rear cone seat. Do not secure rear cone on arbor.
- e. Install spacers, Parts Nos. 2202 and 2204 (7A050 kit), on arbor under rear cone.
- f. Install hand wheel (8) in lower end of arbor, and tighten wheel to secure cones in propeller hub cone seats.
- g. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.
- h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand or other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.
- i. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

4-18. MODELS 278 and 297 – COMPLETE ASSEMBLY.  
(See figure 4-13.)

- a. Install plug (2) (with spiral retaining ring) in flange adapter (3).
- b. Install adapter (3) on flange of propeller assembly (1) with 3/4 –inch flange holes over propeller hub dowels (14).
- c. Select matched pair (similar dash numbers) of bushings (13) which when installed in adapter flange bushing holes, will give tightest fit on propeller flange dowels.
- d. Secure adapter (3) to propeller hub, using two propeller attaching nuts (11) or bolts, as applicable, 180° apart.
- e. Place two auxiliary support blocks (2, figure 4-17) on felt tray under work stand. Walk propeller assembly under and through work stand; and, with propeller hub approximately centered under work stand lower propeller assembly, allowing blade shanks to rest on auxiliary support blocks.
- f. Insert balancing arbor (9) downward through work stand and into flange of adapter (3). Screw arbor onto plug (2) until firmly bottomed in adapter.
- g. Install bushing (4) on arbor, and align top surface of bushing on arbor scale (6) in accordance with sensitivity setting specified in applicable propeller manual. Lock bushing securely in this position by tightening set screw (5) with wrench (8, figure 1-13).
- h. Carefully install adjustable weight (10), grooved end downward, over top end of arbor, and seat counterweight on top surface of bushing (4).
- i. Carefully install weight assembly (7), retaining ring upward, over top of balancing arbor, seating weight assembly firmly on top end of arbor.
- j. Carefully install counterweight (8), part number upward, on pilot shoulder of weight assembly (7).
- k. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

l. Hoist entire assembly approximately 1/4 inch off auxiliary support blocks. Check to ensure that the suspended assembly is free from interference with work stand or other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

m. For balance tolerance and application of balance corrections, refer to applicable propeller manual and adhere to specified recommendations.

4-19. CURTISS PROPELLERS.

4-20. MODEL C432S – HUB AND BLADE ASSEMBLY WITH SLAVE POWER GEAR.

- a. Arrange three auxiliary supports (saw horses or equivalent) for propeller assembly blade shanks on floor under suitable shop hoist. Place propeller assembly in horizontal position with rear side of propeller upward, blade shanks resting on auxiliary supports.
  - b. Insert cone, Part No 2208 (7A050 kit), edgewise between blade gears inside lower face of propeller hub and leave cone resting, hub downward, on blade gears.
  - c. Install slave propeller power gear and plate assembly on lower face of propeller hub, indexing power gear and blade gears in accordance with applicable propeller service instructions. Temporarily secure blade gear plate to propeller hub, using three attaching cap screws.
  - d. Install cone, part No. 2207 (7A050 kit), hub upward, on balancing arbor and align its top surface with 17-1/2 inch position on the arbor scale. Lock cone securely in this position by tightening cone set screw with 1/8 inch hex wrench (8, figure 1-13).
  - e. Install balancing arbor downward through propeller hub and front pilot cone seating rear cone in top cone seat of propeller hub.
  - f. Install spacers, Part Nos. 2202, 2203 and 2204 (7A050 kit), over lower end of balancing arbor, pushing front cone upward into propeller front cone seat. Install hand wheel, Part No 2215 (7A050 kit), in bottom of arbor, and tighten wheel to clamp cones securely in propeller hub cone seats.
  - g. Install “quickie” coupling assembly (11, figure 1-13) of alternate hoist eye assembly (12, figure 1-13) on end ball of suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13). Attach eye to shop hoist, and install quick-disconnect coupling on suspension rod of balancing arbor.
  - h. Hoist entire assembly approximately 1/4 inch off propeller blade supports. Check to ensure that the suspended assembly is free from interference with adjacent objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.
  - i. For balance tolerance and application of balance corrections, refer to applicable propeller manual.
- 4-21. HAMILTON STANDARD PROPELLERS.
- 4-22. MODELS 2B20, 2D30, 12D40, 22D30, 3D40, and 23D40 – HUB AND BLADES ONLY. (See figure 4-4.)
- a. Set all blades of propeller assembly to same pitch angle in accordance with instructions in applicable propeller manual.

b. Center propeller assembly (1), with front side of propeller upward.

**CAUTION**

Block or hold round propeller hub barrels of 2-blade assemblies to prevent propeller assembly from rolling off stand. During the balancing operations described in the following paragraphs make sure the pitch setting is not disturbed. Repeat balance operations if this occurs.

c. Select applicable front cone (3, figure 4-4) and install cone, hub upward, on balancing arbor (4) so that top surface of cone hub aligns on arbor scale (5) in accordance with sensitivity setting specified in applicable propeller manual. Lock cone securely in this position by tightening set screw (2) with 1/8 inch hex wrench (8, figure 1-13).

d. Install arbor and cone assembly downward into propeller hub, seating cone in propeller front cone seat.

e. Install applicable rear cone (6, figure 4-4) Hub downward, over lower end of arbor and push cone upward into propeller rear cone seat. Do not lock rear cone set screw.

f. Install applicable spacers (7, figure 4-4) on lower end of arbor. Install hand wheel (8) in bottom end of arbor, and tighten wheel to clamp cones securely in propeller cone seats.

g. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand or other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

i. For balance tolerance and application of balance corrections refer to applicable propeller manual.

**Note**

Should interference occur between hand wheel (8) and inside diameter of work stand, make and install 3/4-inch (approximate dimension) wood blocks under the two work stand legs so as to center the suspended arbor in relation to the work stand.

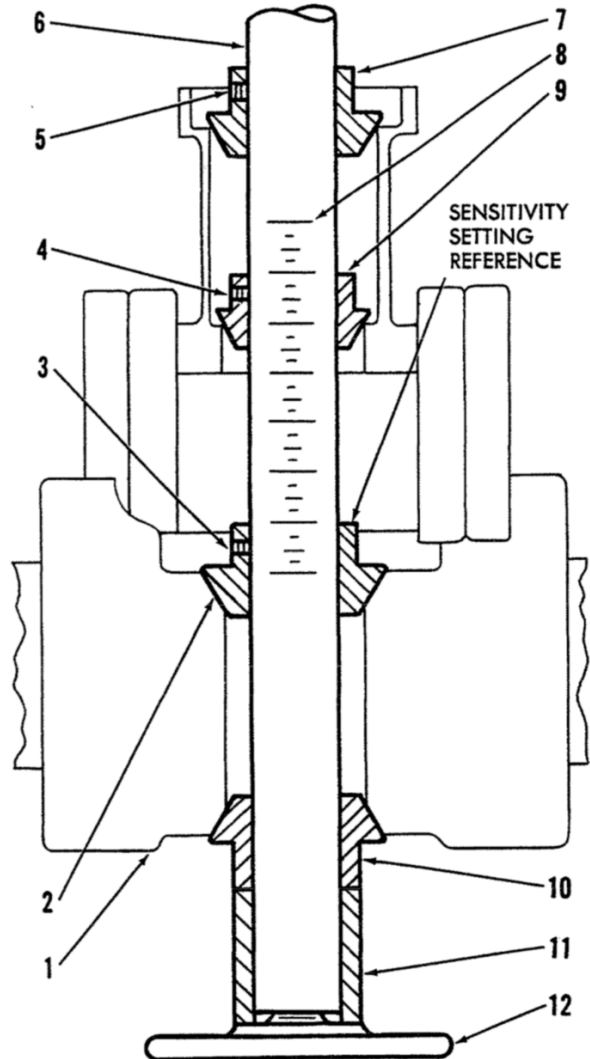
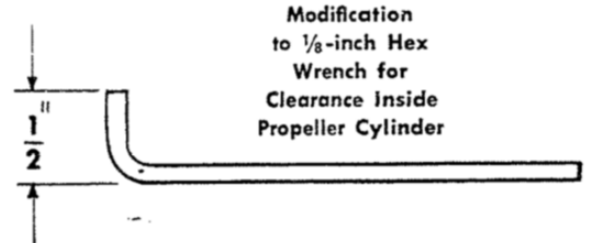
**4-23. MODELS 2B20 AND 2D30 – WITH CYLINDER AND COUNTERWEIGHTS. (See figure 4-7.)**

a. Set blades of propeller assembly as near to flat pitch as possible. Adjust cylinder position so as to be visually centered and in line with propeller hub bore.

b. Center propeller assembly (1), with cylinder and counterweights upward, on work stand.

**CAUTION**

Hold or block propeller hub barrel to prevent propeller assembly from rolling off work stand.



- |                        |                                 |
|------------------------|---------------------------------|
| 1 Propeller assembly   | 7 Top cylinder cone             |
| 2 Front cone           | 8 Arbor scale                   |
| 3 Front cone set screw | 9 Bottom cylinder cone          |
| 4 Bottom cylinder cone | 10 Rear cone                    |
| 5 Top cone set screw   | 11 Spacers                      |
| 6 Arbor (2259)         | 12 Hand wheel (2215, 7A050 kit) |

**Figure 4-7. Typical Balancer Installation - Hamilton Standard Propeller Assemblies with Cylinders and Counterweights**



- c. Select applicable front cone (2, figure 4-7); insert cone, hub upward, under propeller cylinder, and place cone in front cone seat of propeller hub.
- d. Install lower end of balancing arbor (6) downward through propeller cylinder and pilot bore of front cone (2) so that top surface of cone hub aligns on arbor scale (8) in accordance with sensitivity setting specified in applicable propeller manual. Lock cone securely by tightening set screw (3) with wrench (8, figure 1-13) modified as shown in figure 4-7 inset.
- e. Install applicable rear cone (10, figure 4-7), hub downward, over lower end of arbor (6), and push cone upward into propeller rear of cone seat.
- f. Install applicable spacers (11), as shown in figure 4-7, on lower end of arbor (6). Install hand wheel (12) in bottom end of arbor, and tighten wheel to clamp cones securely in propeller hub cone seats.
- g. Install applicable bottom cylinder cone (9), as shown in figure 4-7, hub upward, over top end of a balancing arbor (6), and seat cone firmly in bottom end of propeller cylinder. Move cylinder as required to make certain that cone is centrally seated. Lock cone securely in this position by tightening cone set screw (4) with 1/8-inch hex wrench (8, figure 1-13) modified as shown in figure 4-7 inset.
- h. Install applicable top cylinder cone (7), as shown in figure 4-7, hub upward, over top end of balancing arbor (6) and seat cone firmly in top end of propeller cylinder. Move cylinder as required to make certain that cone is centrally seated. Lock cone securely in this position by tightening set screw (5) with 1/8-inch hex wrench (8, figure 1-13).
- i. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.
- j. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that hand wheel (12) does not make contact with inside surface of work stand casting, and note the balance condition indicated by the black indicator disc at the top of the arbor.

**Note**

Insertion of 3/4-inch wood blocks under two legs of work stand may be necessary to free hand wheel from interference with work stand casting.

- k. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

**4-24. MODEL 3D40 – WITH CYLINDER AND COUNTERWEIGHTS (See figure 4-4.)**

- a. Set blades of propeller assembly (1) as near to flat pitch as possible. Center propeller assembly, cylinder and counterweights upward, on work stand (1, figure 1-13).
- b. Insert front cone (3), Part No. 2208 (7A050 kit), hub upward, under propeller cylinder and into propeller front cone seat.
- c. Install balancing arbor (4) downward through propeller cylinder and pilot diameter of front cone (3) so that top surface of cone hub aligns with 11-inch position on arbor

scale (5). Secure arbor in this position by tightening cone set screw (2) with 1/8 inch hex wrench (8, figure 1-13) modified as shown in figure 4-7 inset.

- d. Install rear cone (6), Part No. 2207 (7A050 kit), hub downward over lower end of arbor (4) and into propeller rear cone seat. Do not lock rear cone set screw.
- e. Install spacer (7), Part No. 2203 (7A050 kit), on arbor.
- f. Install hand wheel (8) in lower end of arbor, and tighten wheel to clamp cones firmly into propeller cone seats.
- g. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor and engage suspension cable in lifting plate of hydraulic pump assembly.
- h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.
- i. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

**4-25. MODEL 12D40 – WITH CYLINDER AND COUNTERWEIGHTS. (See figure 4-7.)**

- a. Set blades of propeller assembly as near to flat pitch as possible. Adjust cylinder position so as to be visually centered and in line with propeller hub bore.
- b. Center propeller assembly (1) on work stand (1, figure 1-13) with cylinder upward.

**CAUTION**

Block or hold round propeller hub barrel to make certain that propeller assembly does not roll off work stand.

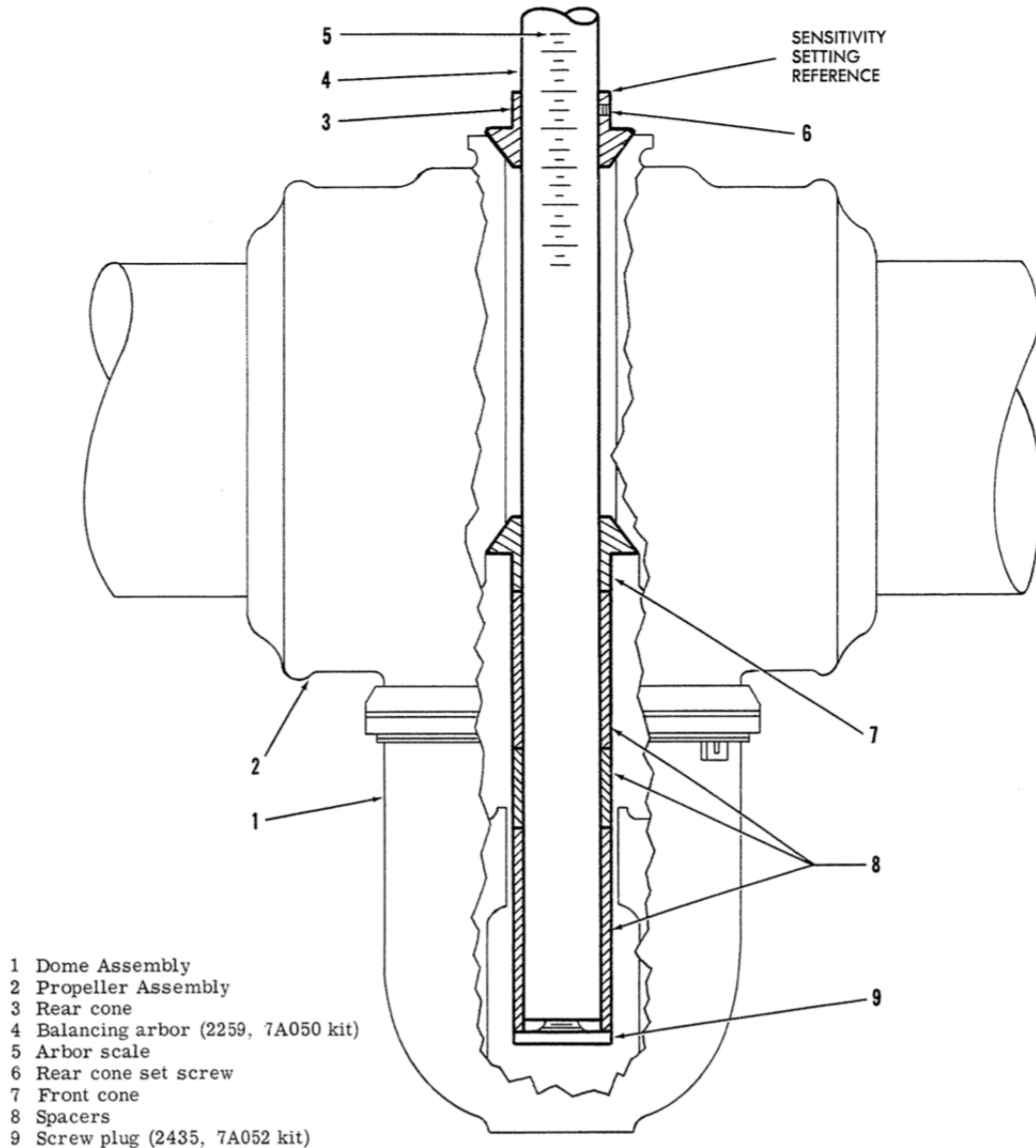
- c. Insert front cone (2), Part No. 2208 (7A050 kit), hub upward, under propeller cylinder and into propeller front cone seat.
- d. Install balancing arbor (6) downward through propeller cylinder and front cone. Align top surface of cone hub with 11-inch position on arbor scale (7). Lock cone securely in this position by tightening cone set screw (3) with 1/8-inch hex wrench (8, figure 1-13) modified as shown in figure 4-7 inset.
- e. Install adapter, Part No. 2459 (7A050 kit), in place of cone (10), slotted hub downward, over lower end of arbor, and seat adapter in rear cone seat of propeller hub.
- f. Install spacer (11), Part No 2203 (7A052 kit), on arbor.
- g. Install hand wheel (12) in lower end of arbor and tighten wheel to clamp front cone (2) and adapter (10) firmly into propeller cone seats.
- h. Install cone (9), Part No 2207 (7A050 kit), hub upward, over top end of arbor, and seat cone firmly in bottom of propeller cylinder. Adjust position of cylinder as required to ensure uniform seating of cone. Lock cone firmly in this position by tightening cone set screw (4) with 1/8-inch hex wrench (8, figure 1-13) modified as shown in figure 4-7 inset.
- i. Install cone (7), Part No 2227 (7A050 kit), hub upward, over top end of arbor, and seat cone in top of propeller cylinder. Adjust position of cylinder as required to

ensure uniform seating of cone. Lock cone firmly in this position by tightening set screw (5) with 1/8-inch hex wrench.

j. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

k. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

l. For balance tolerance and application of balance corrections, refer to applicable propeller manual.



**Figure 4-8. Typical Balancer Installation – Double Cone Propeller Assemblies, Shaft Nut and Front Cone Removed, but Dome Assemblies Installed.**

#### 4-26. MODELS 22D30 AND 23D40 – WITH DOME ASSEMBLY. (See figure 4-8.)

a. Arrange auxiliary supports (saw horses or equivalent) for propeller blade shanks on floor under suitable shop hoist.

b. Place propeller assembly (2), rear side of propeller upward, on blade shank supports so that both upper and lower surfaces of propeller hub are accessible.

c. Remove dome assembly (1) from propeller hub.

d. Install applicable rear cone (3), P/N 2205 or P/N 2207, hub upward, on balancing arbor (4). Align top surface of cone hub with applicable sensitivity setting, as specified in applicable propeller manual, on arbor scale (5). Lock cone firmly in this position by tightening cone set screw (6) (8, figure 1-13).

e. Install arbor downward through propeller hub, seating cone (3) in propeller cone seat.

f. Install applicable front cone (7), P/N 2206 or P/N 2208, hub downward over lower end of arbor, seating cone in propeller front cone seat. Do not lock cone set screw.

g. Install applicable spacers (8), as shown in figure 4-8, on lower end of arbor.

h. Install screw plug (9) in bottom of arbor, and tighten plug to clamp cones firmly into propeller cone seats.

i. Install propeller dome assembly (1) (with piston sleeve removed in case of 22D30 assembly) over lower end of balancing arbor; and secure dome assembly temporarily by hand tightening dome retaining nut.

j. Install “quickie” coupling assembly (11, figure 1-13) of alternate hoist eye assembly (12, figure 1-13) on end ball of suspension cable (13, figure 1-13) and quick disconnect coupling assembly (10, figure 1-13). Engage coupling eye with suitable shop hoist. Install quick-disconnect coupling on arbor suspension rod.

k. Hoist entire assembly approximately 1/4 inch off blade shank supports. Check to ensure that the suspended assembly is free from interference with blade shank supports and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

l. For balance tolerance and application of balance corrections, refer to applicable propeller manual. Adhere to recommended instructions.

#### 4-27. MODEL 43D50 – HUB AND BLADES ONLY.

(See View A, figure 4-9.)

a. Arrange three supports (saw horses or equivalent) for blade shanks of propeller assembly (1) on floor under suitable shop hoist.

b. Set the three propeller blades at the same pitch angle. Maintain symmetrical pitch throughout subsequent balance checking operation.

c. Place propeller assembly, rear side of propeller upward on blade shank supports so that both upper and lower surfaces of propeller hub are accessible.

d. Engage installing tool (2) in slotted end of adapter (7). Install adapter downward through propeller hub and through propeller front cone, screwing threaded end of adapter firmly into propeller shaft nut (9) inside propeller hub. Disengage and remove installing tool from adapter.

e. Install rear cone (5), hub upward, on balancing arbor (3) so that top surface of cone hub aligns with 18-1/8 inch position on arbor scale (6). Lock cone securely in this position by tightening cone set screw (4) with 1/8-inch hex wrench (8, figure 1-13).

f. Install arbor downward through propeller hub and adapter (7), seating cone (5) in propeller rear cone seat.

g. Install spacers (10), (11), (12), and (13) over lower end of arbor.

h. Install hand wheel (14) in end of arbor, and tighten wheel to clamp cone (5) in propeller rear cone seat.

i. Install “quickie” coupling assembly (11, figure 1-13) of alternate hoist eye assembly (12, figure 1-13) on end ball of suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13). Engage coupling eye with suitable shop hoist. Install quick-disconnect coupling on arbor suspension rod.

j. Hoist entire assembly approximately 1/4 inch off blade shank supports. Check to ensure that the suspended assembly is free from interference with blade shank supports and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

k. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

#### 4-28. MODEL 43D50 – WITH DOME ASSEMBLY.

(See View B, figure 4-9.)

a. Arrange three supports (saw horses or equivalent) for blade shanks of propeller assembly (1) on floor under suitable shop hoist.

b. Place propeller assembly, rear side of propeller upward, on blade shank supports so that both upper and lower surfaces of propeller hub are accessible.

c. Remove dome assembly (17) from propeller hub.

d. Engage installing tool (2) in slotted end of adapter (7). Install adapter downward through propeller hub and through propeller front cone, screwing threaded end of adapter firmly into propeller shaft nut (9) inside propeller hub. Disengage and remove installing tool from adapter.

e. Install rear cone (5), hub upward, on balancing arbor (3) so that top surface of cone hub aligns with 19-inch position on arbor scale (6). Lock cone securely in this position by tightening cone set screw (4) with 1/8-inch hex wrench (8, figure 1-13).

f. Install arbor downward through propeller hub and adapter (7), seating cone (5) in propeller rear cone seat.

g. Install spacers and bushing over lower end of arbor in the following sequence: spacer (10), bushing (15), spacer (11), spacer (12), and spacer (13).

h. Install screw plug (16) in end of arbor, and tighten plug to clamp cone (5) firmly in propeller rear cone seat.

i. Install propeller dome assembly (17) over lower end of balancing arbor, and secure dome temporarily by hand tightening of dome retaining nut.

j. Install “quickie” coupling assembly (11, figure 1-13) of alternate hoist eye assembly (12, figure 1-13) on end ball of suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13). Engage coupling eye with suitable shop hoist. Install quick-disconnect coupling on arbor suspension rod.

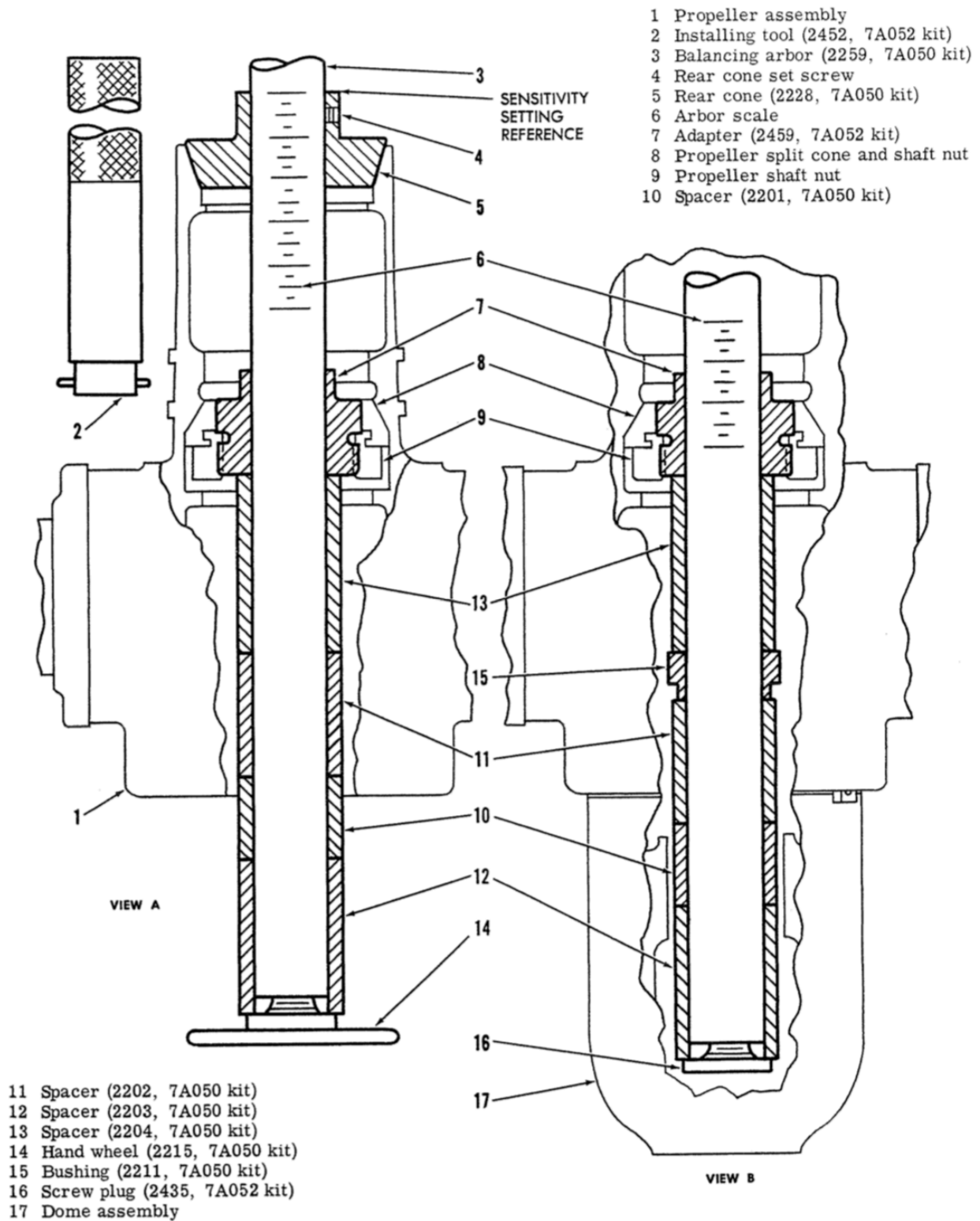


Figure 4-9. Typical balancer Installation – SAE50 Splined Hub Propeller Assemblies with Shaft Nuts and Front Cones Enclosed in Hub.

k. Hoist entire assembly approximately 1/4 inch off blade shank supports. Check to ensure that the suspended assembly is free from interference with blade shank supports and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

l. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

4-29. MODEL 53C51 – HUB AND BLADES ONLY.  
(See figure 4-8 for cone installation only.)

Note

Assembly to be balance checked shall not include oil transfer tube, low pitch stop assembly, or pitch lock assembly.

a. Arrange three auxiliary supports (saw horses or equivalent) for blade shanks of propeller assembly (2) on floor under suitable shop hoist.

b. Set the three propeller blades at the same pitch angle. Maintain symmetrical pitch throughout subsequent balance checking operation.

c. Place propeller assembly, rear side of propeller upward, on blade shank supports so that both upper and lower surfaces of propeller hub are accessible.

d. Install rear cone (3), Part No 2228 (7A050 kit), hub upward, on balancing arbor (4) so that upper surface of cone hub aligns with 19-1/2-inch position on arbor scale (5).

Note

The 19-1/2-inch position is 1/2 inch beyond upper end of etched scale.

e. Lock cone (3) securely in this position by tightening cone set screw (6) with 1/8-inch hex wrench (8, figure 1-13).

f. Install arbor downward through propeller hub, seating cone (3) in propeller rear cone seat.

g. Install front cone (7), Part No. 2208 (7A050 kit), hub downward, over lower end of arbor. Do not lock cone set screw.

h. Install rear bushing, Part No. 2210 (7A050 kit), over lower end of arbor; do not lock bushing set screw. Then install the following spacers (8) in sequence over lower end of arbor: Part No. 2201, Part No. 2202, Part No. 2203, and Part No. 2204, (all from 7A050 kit).

i. Install hand wheel, Part No. 2215 (7A050 kit), in lower end of arbor, and tighten wheel to clamp cones firmly into propeller cone seats.

j. Install “quickie” coupling assembly (11, figure 1-13) of alternate hoist eye assembly (12, figure 1-13) on end ball of suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13). Engage coupling eye with suitable shop hoist. Install quick-disconnect coupling on suspension rod.

k. Hoist entire assembly approximately 1/4 inch off blade shank supports. Check to ensure that the suspended assembly is free from interference with blade shank supports and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

l. For balance tolerance and application of balance corrections refer to applicable propeller manual

4-30. MODEL 53C51 – WITH DOME ASSEMBLY.  
(See figure 4-8).

Note

Assembly to be balance checked shall not include dome cap, oil transfer tube low pitch, stop assembly, or pitch lock assembly.

a. Arrange three auxiliary supports (saw horses or equivalent) for blade shanks of propeller assembly (2) on floor under suitable shop hoist.

b. Place propeller assembly, rear side of propeller upward, on blade shank supports so that both upper and lower surfaces of propeller hub are accessible.

c. Remove dome assembly (1) from propeller hub.

d. Install rear cone (3), Part No. 2228 (7A050 kit), hub upward, on balancing arbor (4) so that upper surface of cone hub aligns with 20-inch position on arbor scale (5).

Note

The 20-inch position is 1 inch beyond upper end of etched scale.

e. Lock cone (3) securely in this position by tightening cone set screw (6) with 1/8-inch hex wrench (8, figure 1-13).

f. Install arbor downward through propeller hub, seating cone (3) in propeller rear cone seat.

g. Install front cone (7), Part No. 2208 (7A050 kit), hub downward, over lower end of arbor. Do not lock cone set screw.

h. Install bushing, Part No. 2210 (7A050 kit) and bushing, Part No. 2211 (7A050 kit), over lower end of arbor. Do not lock bushing set screws.

i. Install the following spacers (8) in sequence over lower end of arbor: Part No. 2201, Part No. 2202, Part No. 2203, and Part No. 2204 (all from 7A050 kit).

j. Install screw plug (9) in lower end of arbor, and tighten plug to clamp cones firmly into propeller cone seats.

k. Install propeller dome assembly (1) over lower end of balancing arbor, and secure dome temporarily by hand tightening the dome retaining nut.

l. Install “quickie” coupling assembly (11, figure 1-13) of alternate hoist eye assembly (12, figure 1-13) on end ball of suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13). Engage coupling eye with suitable shop hoist. Install quick-disconnect coupling on arbor suspension rod.

m. Hoist entire assembly approximately 1/4 inch off blade shank supports. Check to ensure that the suspended assembly is free from interference with blade shank supports and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

n. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

o. Correct for unbalance conditions at the exact location and within the balance tolerance specified to eliminate possibility of subsequent propeller removal for rebalance.

#### 4-31. MODEL 53C51 – SPINNER ASSEMBLY BALANCE

##### Note

Since this spinner assembly cannot be accommodated on the 7A050 work stand and hoist assembly, the larger half of the 7A050 case assembly, on the floor with its felt tray upward, is suggested as a convenient resting place for the spinner assembly during installation and removal of the balancing adapters. Use of available standard shop hoist (not supplied) rather than the 7A050 hoist, is recommended in this instance for suspension of the balancing assembly.

a. Install 2582 adapter (7A050 kit) hub upward, on lower end of balancing arbor (7A050 kit) so that top surface of its hub aligns with the 1-1/4 inch position on arbor scale. Lock adapter in this position on arbor with adapter set screw, using 1/8 inch hex wrench (7A050, 7A055 kits).

b. Holding spinner front nut with commercial 3/4 inch socket wrench (not supplied), screw 2582 adapter all the way into spinner front nut until flange of the adapter bottoms firmly on spinner front support. Do not overtighten.

c. Install 2227 and 2228 cones (7A050 kit) over top end of arbor and seat them firmly against hub of 2582 adapter. These cones serve as counterweights to properly position the center of gravity of the balancing assembly.

d. Install 2753 adapter (7A055 kit), hub downward over top end of arbor and push downward until its' grooved ring engages the circle of positioning dowels in the rear face of the spinner assembly. Insure the adapter is firmly bottomed on the dowel screws.

e. Install 2266 quick-disconnect coupling (7A050 kit) with 2264 cable (7A050 kit) on arbor suspension rod. Couple 2261 eye assembly to end ball of cable assembly using 2260-1 "quickie" coupling (7A050 kit). Engage hoist eye with shop hoist and suspend entire assembly free of interference. Note balance indication at top of arbor.

f. For balance tolerances and application of balance corrections, refer to applicable propeller maintenance handbook.

#### 4-32. MODEL 54H60-77 AND -81 – SPINNER COMPONENTS ONLY. (See figure 4-10.)

#### 4-33. BALANCING OF SPINNER BULKHEAD-HUB MOUNTING.

a. Set 2692 adapter assembly (1, figure 4-10) hub upward, centrally on work stand (7A050 kit). (View A). Insure that all four movable locks (2, figure 4-10) of the 2692 adapter are positively engaged in their radially outward positions. (Lift knobs to move inward or outward.)

b. Place spinner bulkhead (3) with spinner mounting ring downward, on four support blocks of the 2692 adapter so that four of the bulkhead dowel holes engage the four index pins (4) of the 2692 adapter. Insure that the bulkhead plate is seated squarely down against the four stop pins and adjacent

to the adapter index pins.

c. Rotate the loose spinner mounting ring in a clockwise direction as far as possible and tighten its clamp-screw by fingers only until the ring just contacts the four stop pins of the 2692 adapter assembly. Temporarily mark the position of one end of the spinner mounting ring on the adjacent surface of the bulkhead plate. Loosen the clamp-screw (7). Rotate the spinner mounting ring counterclockwise as far as possible; retighten clamp-screw and again mark position of the same end of the ring. Again loosen the clamp-screw; position the end of the ring midway between the two extreme positions noted above and retighten the clamp-screw, with fingers only, just sufficiently to take up the radial clearance between the ring and the four adapter stop pins.

d. Install 2259 arbor assembly (7A050 kit) (6, figure 4-10) downward through hub (5) of 2692 adapter and align 11-inch position on arbor scale with top surface of adapter hub. Lock arbor in this position with hub set screw (8), using 1/8 inch hex wrench (7A050, 7A053 kits).

e. Install quick-disconnect coupling (7A050 kit) on arbor suspension rod and hoist entire assembly approximately 1/4 inch off work stand. Insure assembly is suspended free of interference with stand or adjacent objects and note balance indication at top of arbor.

f. For balance tolerances and application of spinner bulkhead balance corrections, refer to applicable propeller maintenance handbook.

#### 4-34. BALANCING OF SPINNER REAR SECTION.

a. Set 2692 adapter assembly (3, figure 4-10) hub downward, centrally on work stand (7A050 kit). Position adapter so that blocks on underside clear the No. 2 stand tube. Insure that all four movable locks of the 2692 adapter are positively engaged in their radially outward positions. (Lift knobs to move inward and outward.)

b. Place spinner rear section (5, figure 4-10) small diameter downward, on 2692 adapter so that four of its flange dowel holes engage the four positioning pins (4) of the 2692 adapter. Insure that the spinner rear section flange is squarely seated against the stop shoulders of positioning pins at all four locations.

c. Install 2259 arbor (7A050 kit) (6, figure 4-10), downward through hub (1) of 2692 adapter and align 7 inch position on arbor scale with top surface of adapter hub. Lock arbor in in this position with hub set screw (2), using 1/8 inch hex wrench (7A050, 7A053 kits).

d. Install quick-disconnect coupling (7A050 kit) on arbor suspension rod and hoist entire assembly approximately 1/4 inch off work stand. Insure that assembly is suspended free of interference with stand or adjacent objects and note balance indication at top of arbor.

e. For balance tolerances and application of spinner rear section balance corrections, refer to applicable propeller maintenance handbook.

##### Note

All corrections for unbalance shall be accomplished precisely at the locations recommended in the applicable propeller maintenance manual.

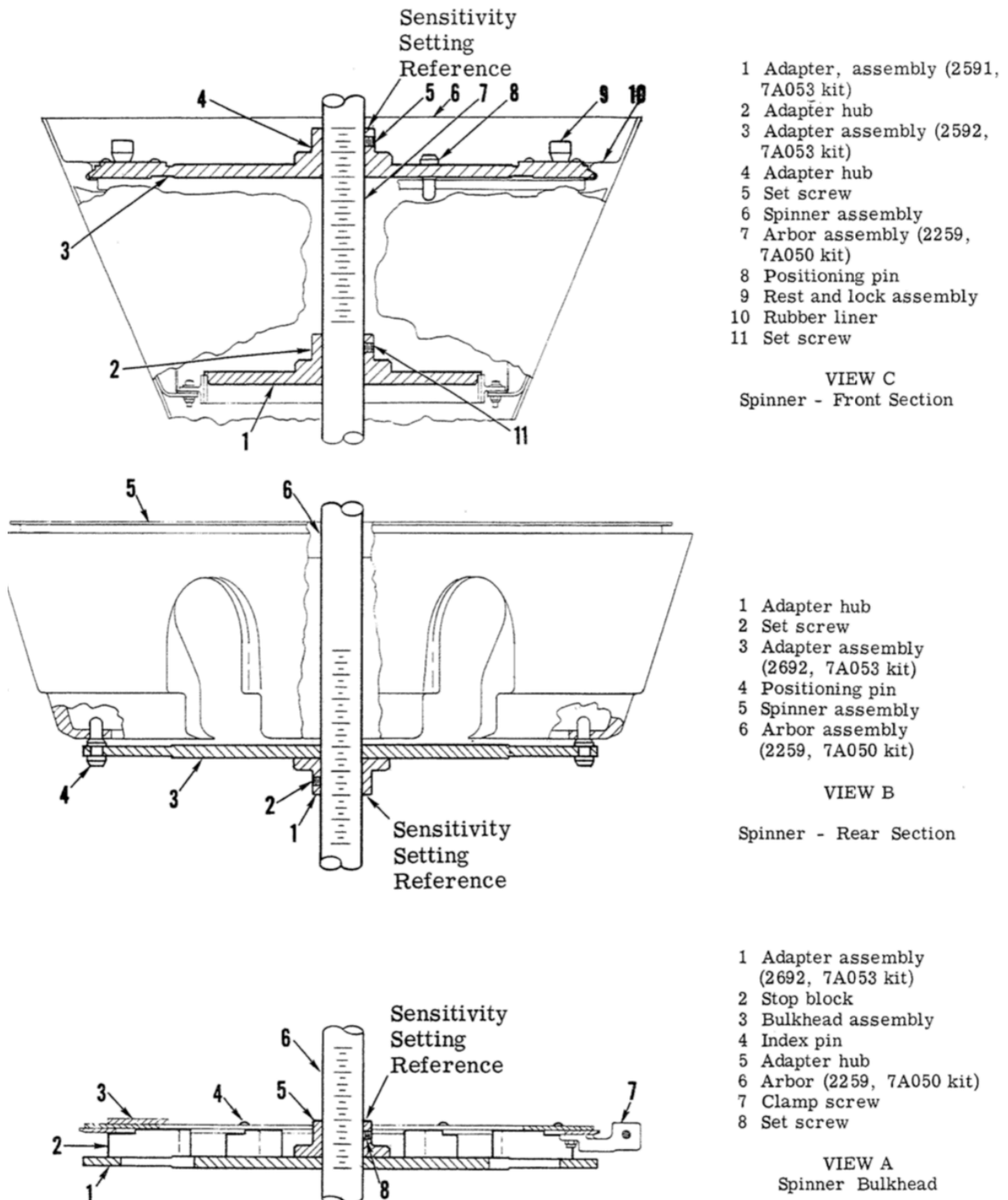
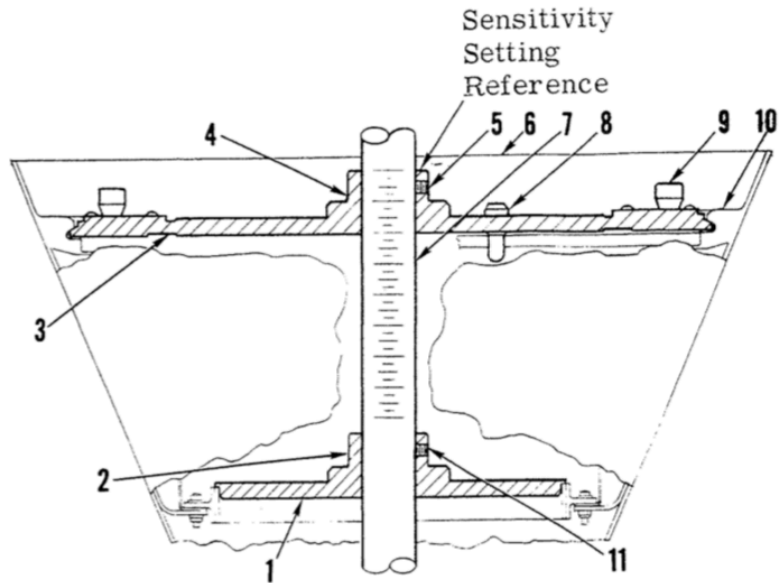


Figure 4-10. Typical Balancer Installation – Model 53H60-77 and -81 Spinner Components Only

- 1 Adapter assembly (2691, 7A054 kit)
- 2 Adapter hub
- 3 Adapter assembly (2748, 7A054 kit)
- 4 Adapter hub
- 5 Set screw
- 6 Spinner assembly
- 7 Arbor assembly
- 8 Positioning pin
- 9 Rest and lock assembly
- 10 Rubber liner
- 11 Set screw

VIEW C

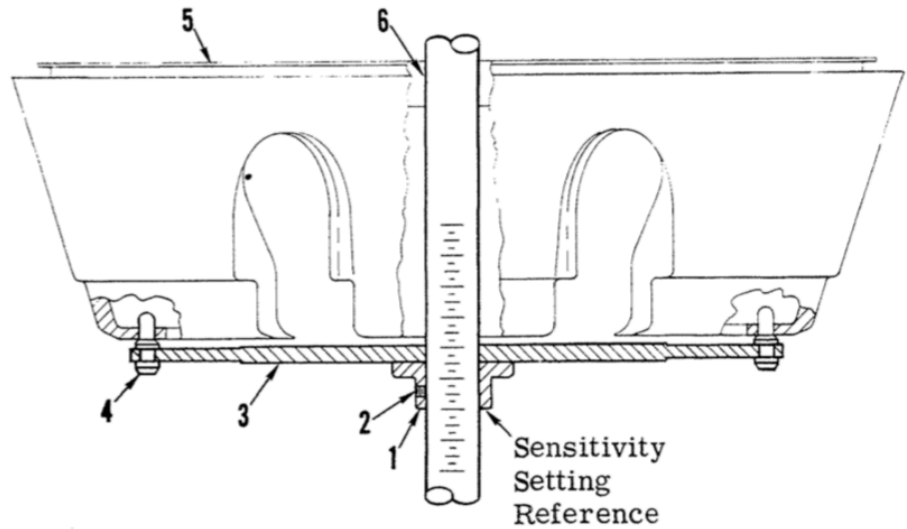
Spinner - Front Section



- 1 Adapter hub
- 2 Set screw
- 3 Adapter assembly (2748, 7A054 kit)
- 4 Positioning pin
- 5 Spinner assembly
- 6 Arbor assembly (2259, 7A050 kit)

VIEW B

Spinner - Rear Section



- 1 Adapter assembly (2748, 7A054 kit)
- 2 Support block
- 3 Bulkhead assembly
- 4 Index pin
- 5 Ring limiting bar (2749, 7A054 kit)
- 6 Ring limiting bar (2750, 7A054 kit)
- 7 Adapter hub
- 8 Arbor
- 9 Clamp screw
- 10 Set screw

VIEW A

Spinner Bulkhead - Hub Mounting

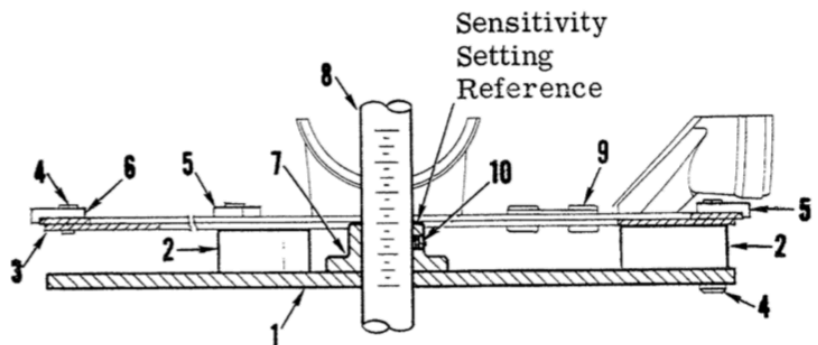


Figure 4-11. Typical Balancer Installation – Model 54H60-89 and -91 Spinner Components Only



#### 4-35. BALANCING OF SPINNER FRONT SECTION.

##### Note

Since the spinner component cannot be accommodated on the 7A050 work stand and hoist assembly, the larger half of the 7A050 case assembly, on the floor with its felt tray upward, is suggested as a convenient resting place for the spinner section during installation and removal of the balancing adapters. Use of available standard shop hoist, is recommended in this instance for suspension of the assembly during actual balancing.

a. With rear end of spinner section (1, figure 4-10) upward (View C), place 2691 adapter assembly (7A053 kit), hub upward, in rubber liner (10 figure 4-10) of spinner front bulkhead (6, figure 4-10). Insure diameter of adapter is fully engaged with liner and square with major axis of spinner section.

b. With (4) upward and four movable locks retracted (lift knobs to move inward or outward), place 2692 adapter (3) in spinner section so that the four positioning pins (8) on its underside engage four positioning dowel holes of the spinner section. Press these pins into the dowel holes until the four movable locks (4) of the 2692 adapter align with the tapered mounting groove by moving them to their radially outward positions. Insure that all four locks are positively engaged in this position.

c. Install 2259 arbor (7A050 kit) (7, figure 4-10), downward through hubs of 2692 adapter and 2691 adapter; continue moving arbor down through both adapters until 14 inch position of arbor scale aligns with top surface of 2692 adapter hub screw (5) using 1/8 inch hex wrench (7A050, 7A053 kits).

d. Install 2266 quick-disconnect coupling (7A050 kit), with 2264 cable (7A050 kit) or arbor suspension rod. Couple 2261 cable assembly – eye to end ball of 2264 cable and engage eye with standard shop hoist. Suspend entire assembly free of interference and note balance indication at top of arbor.

e. For balance tolerances and application of spinner front section balance corrections, refer to applicable propeller maintenance handbook.

#### 4-36. MODEL 54H60-89 and -91 SPINNER COMPONENTS ONLY. (See figure 4-11)

#### 4-37. BALANCING OF SPINNER BULKHEAD-HUB MOUNTING.

a. Set 2748 adapter assembly (7A054 kit), (1, figure 4-11), hub upward, centrally on work stand (7A050 kit) (View A). Insure that all four movable locks of the 2748 adapter are positively engaged in their radially outward positions. (Lift knobs to move inward or outward).

b. Place spinner bulkhead (3, figure 4-11) with spinner mounting ring upward, on four support blocks (2) of the 2748 adapter so that four of the bulkhead dowel holes engage the four index pins (4) of the 2748 adapter. Insure that the bulkhead plate is seated squarely down against the four support blocks.

c. Install four 2749 ring limiting bars (5) over adapter positioning pins as shown. Install four 2750 ring limiting bars (6) through bulkhead dowel holes as shown. Adjust clamp screw (9) of the spinner mounting ring to expand the ring against the retaining lips of the ring limiting bars.

d. Install 2259 arbor assembly (7A050 kit) (8, figure 4-11) downward through hub (7) of 2748 adapter and align 11 inch position on arbor scale with top surface of adapter hub. Lock arbor in this position with hub set screw (10) using 1/8 inch hex wrench (7A050, 7A054 kits).

e. Install quick-disconnect coupling with suspension cable (7A050 kit) on arbor suspension rod and hoist entire assembly approximately 1/4 inch off work stand. Insure assembly is suspended free of interference with stand or adjacent objects and note balance indication at top of arbor.

f. For balance tolerances and application of spinner bulkhead balance correction, refer to applicable propeller maintenance handbook.

#### 4-38. BALANCING OF SPINNER REAR SECTION.

a. Set 2748 adapter assembly (7A054 kit) (3, figure 4-11) hub downward, centrally on work stand (7A050 kit, View B). Position so that blocks on underside of adapter clear the No. 2 stand tube. Insure that all four movable locks of the 2748 adapter are positively engaged in their radially outward positions. (Lift knobs to move inward or outward.)

b. Place spinner rear section (5, figure 4-11), diameter downward on 2748 adapter so that four of its flange dowel holes engage the four positioning pins (4) of the 2748 adapter. Insure that the spinner rear section flange is squarely seated against the stop shoulders of positioning pins at all four locations.

c. Install 2259 arbor (7A050 kit) (6, figure 4-11) downward through hub of 2748 adapter and align 7 inch position on arbor scale with top surface of adapter hub (1). Lock arbor in this position with hub set screw (2), using 1/8 inch hex wrench (7A050, 7A054 kits).

d. Install quick-disconnect coupling with suspension cable (7A050 kit) on arbor suspension rod and hoist entire assembly approximately 1/4 inch off work stand. Insure that assembly is suspended free of interference with stand or adjacent objects and note balance indication at top of arbor.

e. For balance tolerances and application of spinner rear section balance corrections, refer to applicable propeller maintenance handbook.

#### 4-39. BALANCING OF SPINNER FRONT SECTION.

##### Note

Since the spinner component cannot be accommodated on the 7A050 work stand and hoist assembly, the larger half of the 7A050 case assembly, on the floor with its felt tray upward, is suggested as a convenient resting place for the spinner section during installation and removal of the balancing adapters. Use of available standard shop hoist (not supplied), is recommended in this instance for suspension of the assembly during actual balancing. Damage to the hoist structure could ensue unless the precaution to utilize a shop hoist is disregarded.

a. With rear end of spinner section upward (View C), place 2691 adapter assembly (7A054 kit) (1, figure 4-11) hub upward (2) in rubber liner (10) of spinner front bulkhead (6). Insure diameter of adapter is fully engaged with liner and square with major axis of spinner section.

b. With hub upward and four movable locks retracted (lift knobs to move inward or outward), place 2748 adapter (3) in spinner section so that the four positioning dowel holes of the spinner section are over the pins. Press these pins into the dowel holes until the four movable locks (9) of the 2748 adapter align with the tapered mounting groove by moving them to their radially outward positions. Insure that all four locks are positively engaged and locked in this position.

c. Install 2259 arbor (7A050 kit) (7) downward through hubs of 2748 adapter and 2691 adapter; continue moving arbor down through both adapters until 14 inch position of arbor scale aligns with top surface of 2748 adapter hub. Lock set screw (5) using 1/8 inch hex wrench (7A050, 7A054 kits).

d. Install 2266 quick-disconnect coupling with suspension cable (7A050 kit), on arbor suspension rod. Couple 2261 cable assembly – eye to end ball of suspension cable and engage eye with standard shop hoist. Suspend entire assembly free of interference and note balance indication at top of arbor.

e. For balance tolerances and application of spinner rear section balance corrections, refer to applicable propeller maintenance handbook.

#### 4-40. HARTZELL PROPELLERS.

#### 4-41. MODEL HC12X20 – SHAFT NUT AND FRONT CONE REMOVED. (See figure 4-4.)

a. Center propeller assembly (1), with symmetrical blade pitch and front side of propeller upward, on work stand (1, figure 1-13).

#### Note

For instructions on use of jack plate to maintain symmetrical blade pitch, refer to applicable propeller manual.

b. Install front cone (3), Part No. 2224 (7A050 kit), hub upward, over top end of balancing arbor (4) and align top surface of cone with 11-1/2 inch position on arbor scale (5). Lock cone securely in this position by tightening cone set screw (2) with 1/8-inch hex wrench (8, figure 1-13).

c. Install arbor downward through propeller hub, seating cone (3) in propeller front cone seat.

d. Install rear cone (6), Part No 2223 (7A050 kit), hub downward, over lower end of balancing arbor (4). Do not lock cone set screw.

e. Install spacer (7), Part No. 2204 (7A050 kit), on arbor.

f. Install hand wheel (8) in lower end of arbor, and tighten wheel to clamp cones firmly into cone seats.

g. Install wedges, Part No. 2247 (7A052 kit), between propeller hub and blade butts. (See figure 4-12.) Insert wedges on opposite sides of hub to ensure symmetrical distribution of weight, and tap wedges lightly to make certain that play in blade bearings is taken up in a radially outward

direction.

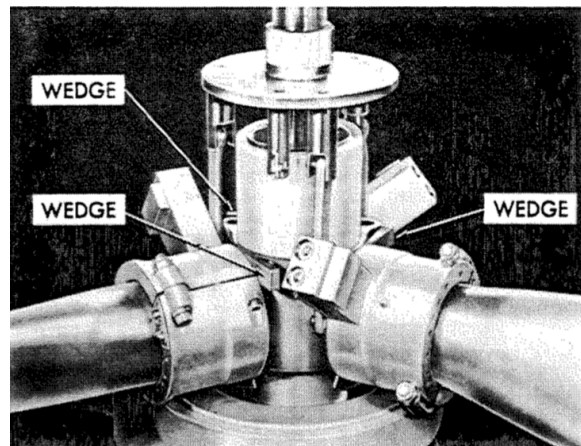


Figure 4-12. Typical Use of Wedges to Load Propeller Blade Bearings in Radically Outward Direction

h. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

i. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

j. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

#### 4-42. MODELS HC82XF, HC82XG, HCA2XF, HC83XF, HC92ZK, AND HC93ZF – COMPLETE ASSEMBLY (See figure 4-13.)

a. Install screw plug (2) and retaining ring in flange adapter (3).

b. Install adapter (3) on flange of propeller assembly (1), with adapter pilot diameter seated in center pilot bore (12) of propeller mounting flange. Secure adapter with two propeller flange attaching nuts or bolts (11) as applicable, 180° apart.

c. Place auxiliary support blocks (2, figure 4-17), two or three as required, on felt tray of 7A050 kit case underneath work stand, as shown in figure 4-17.

d. For 2-blade propeller assemblies walk propeller through and under work stand and center propeller hub under work stand with blade shanks resting on auxiliary support blocks.

e. For 3-blade propeller assemblies, first remove overheard hydraulic hoist arm assembly from work stand. Then separate work stand casting from supporting kit case (See figure 3-4). Lay stand casting and tubular leg assembly aside while propeller assembly is placed on auxiliary support blocks on felt tray. Reinstall stand casting on supporting kit case and reassemble overheard hydraulic hoist arm.

f. Install bushing (4), knurled hub upward, on balancing arbor (9) so that top surface of bushing aligns on arbor scale (6) in accordance with sensitivity setting specified in applicable propeller manual. Lock bushing securely in this position by tightening bushing set screw (5) with 1/8-inch hex wrench (8, figure 1-13).

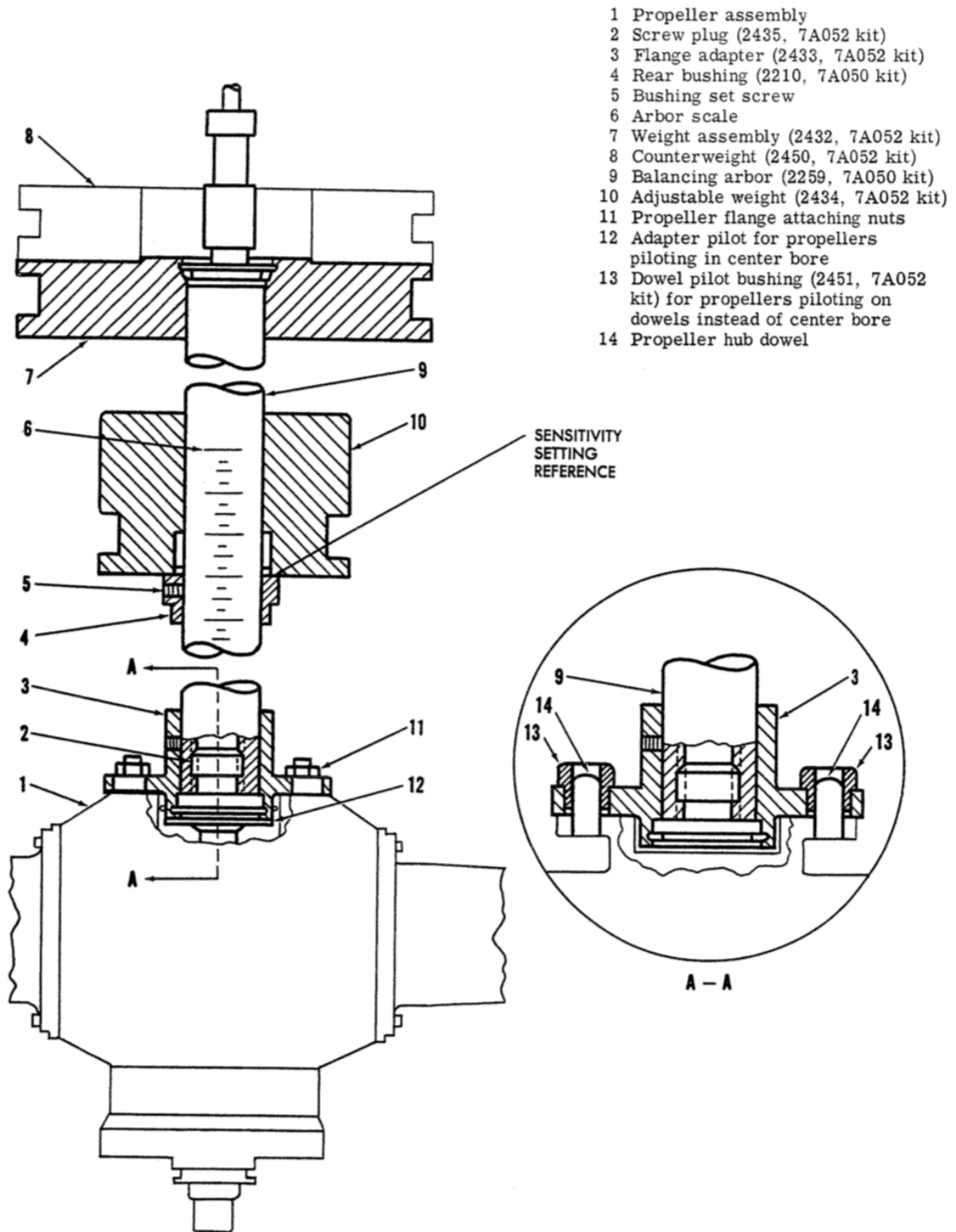


Figure 4-13. Typical Balancer Installation – Flange – Mounted Propeller Assemblies Having no Center Hole for Installation of Balancing Arbor through Hub

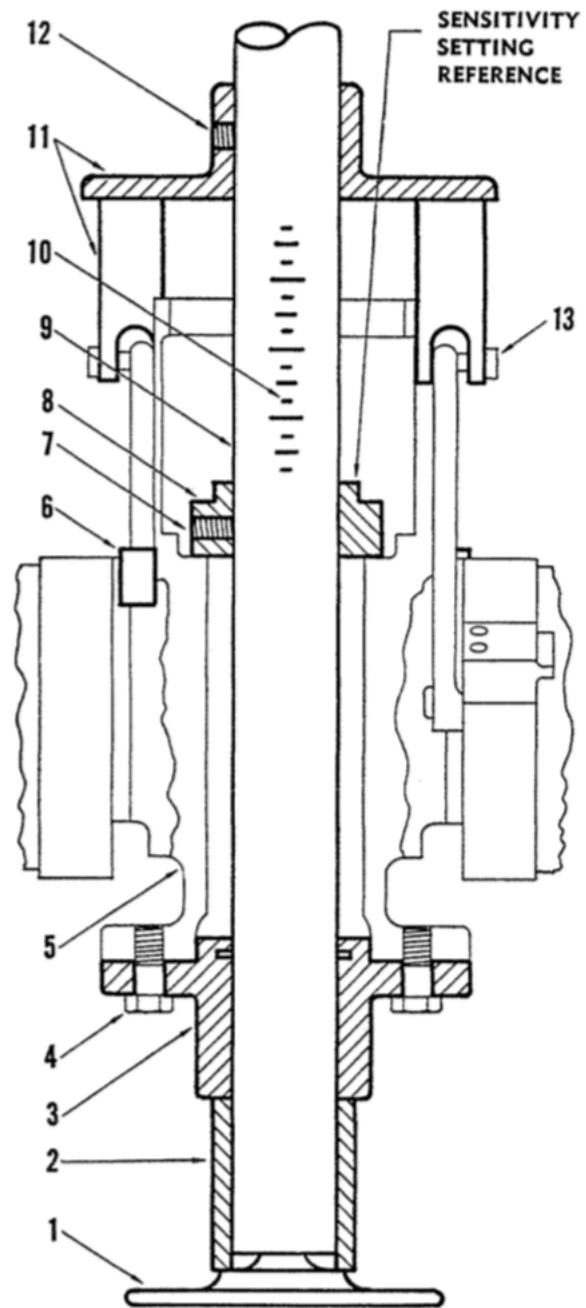
- g. Insert arbor downward through work stand casting and into adapter (3). Screw arbor onto plug (2) until firmly bottomed in adapter (3).
- h. Install adjustable weight (10), grooved end downward, over top of balancing arbor seating weight on top surface of bushing (4).
- i. Install weight assembly (7), retaining ring upward, making certain it is fully seated on top end of arbor.
- j. If applicable and it is used, install counterweight (8), part number upward, on pilot shoulder of weight assembly (7). Check to ensure that the two weights are squarely seated together.
- k. Install wedges, Part No. 2247 (7A052 kit), between propeller hub and blade butts. (See figure 4-12.) Insert wedges consistently from leading edge side of blades to ensure symmetrical distribution of weight, and tap wedge lightly to make certain that play in blade bearings is taken up in a radially outward direction.
- l. Install suspension cable (13, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.
- m. Hoist entire assembly approximately 1/4 inch off auxiliary support blocks. Check to ensure that the suspended assembly is free from interference with blocks, work stand, and other objects, and note balance condition indicated by the black indicator disc at the top end of arbor.
- n. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

4-43. ALTERNATE METHOD OF BALANCING HARTZELL FLANGE-MOUNTED PROPELLERS, FEATHERING TYPE. (See figure 4-14.)

Note

Paragraph 4-42 above provides instructions for balancing the subject propeller models in their complete assembly configuration, using "underslung" suspension with arbor counterweights. Removal of the piston and feathering spring from the subject propeller assemblies permits use of the simplified balancer installation outlined below and shown in figure 4-14.

- a. Remove P/N 2435 plug-screw, with its retaining ring, (if installed) from P/N 2433 adapter flange (3, figure 4-14).
- b. Insure pilot diameters and mating surfaces of propeller mounting flange and adapter (3) are completely clean and freshly oiled. Install adapter (3) as shown, carefully insuring that flanges are seated squarely together and secure in position with 2 propeller flange attaching bolts (4) spaced 180° apart.
- c. Place propeller assembly, flange downward, centrally on work stand (7A050 kit).
- d. Install bushing (8), knurled hub downward, on arbor (9), so that top edge of bushing aligns with 13-inch position on arbor scale (10). Secure bushing in this position with bushing set screw (7), using 1/8-inch hex wrench (7A050 kit).



- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1 Handwheel (2215, 7A050 kit)      | 8 Bushing (2210, 7A050 kit)         |
| 2 Spacer (7A050 kit)               | 9 Arbor (2259)                      |
| 3 Flange adapter (2433, 7A052 kit) | 10 Arbor scale                      |
| 4 Propeller flange bolts           | 11 Plate assembly (2455, 7A052 kit) |
| 5 Propeller assembly               | 12 Plate set screw                  |
| 6 Wedge (2247, 7A052 kit)          | 13 Pitch arm link screw             |
| 7 Bushing set screw                |                                     |

Figure 4-14. Balancer Installation – Alternate Method – Hartzell Flanged Propellers

e. Install arbor downward through propeller hub and adapter (3) until bushing (8) seats in top surface of propeller hub. Install suitable spacer (2204 in case of HC82XF and HC82XG propellers) over lower end of arbor. Install hand wheel (1) in bottom of arbor and tighten to clamp spacer and flange adapter firmly together.

f. Complete balancer installation and propeller balance check in accordance with Paragraphs h, i, j, k, l, and m, paragraph 4-44 and figure 4-15, sheet 1 of 2).

4-44. MODELS HC83X20 HC93Z20, HC93Z30, AND HCB3Z30 – PISTON AND FEATHERING SPRING REMOVED. (See figure 4-15, Sheet 1 of 2).

- a. Center propeller assembly (1), with front cylinder upward, on work stand (1, figure 1-13).
- b. Engage installing tool (7) in applicable adapter (2), as shown in figure 4-15 (sheet 1 of 2). Insert adapter upward through bottom of propeller hub, and screw threaded end firmly into propeller shaft nut. Disengage and remove installing tool from adapter.
- c. Install bushing (4), knurled hub upward, on balancing arbor (8) so that top surface of bushing aligns on arbor scale (6) in accordance with sensitivity setting specified in applicable propeller manual. Lock bushing securely in this position by tightening bushing set screw (5) with 1/8-inch hex wrench (8, figure 1-13).
- d. Install arbor (8) downward through propeller shaft nut and adapter, seating bushing (4) on propeller shaft nut.
- e. Install applicable rear cone (11), as shown in figure 4-15 (sheet 1 of 2) hub downward, over lower end of arbor.
- f. Install spacers (12), as shown in figure 4-15 (sheet 1 of 2).
- g. Install hand wheel (13) in lower end of arbor, and tighten wheel to clamp cone (11) firmly into propeller cone seat.

h. Install plate (9), hub upward, over top end of arbor. Align plate pitch positioning pins, as applicable, with propeller blade pitch arms and secure plate temporarily by inserting propeller pitch arm link screws through plate pins and pitch arms.

i. Position blade pitch in desired range, and lock plate (9) on arbor by tightening plate set screw with 1/8-inch hex wrench (8, figure 1-13).

j. Install wedges (3) between propeller hub and blade butts. (See figure 4-12.) Insert wedges consistently from leading edge sides of blades to ensure symmetrical distribution of weight, and tap wedges lightly to make certain that play in blade bearings is taken up in a radically outward direction.

k. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

l. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand and other objects, and note balance condition indicated by the black indicator disc at the top end of the arbor.

m. For balance tolerance and application of balance corrections, refer to applicable propeller manual.

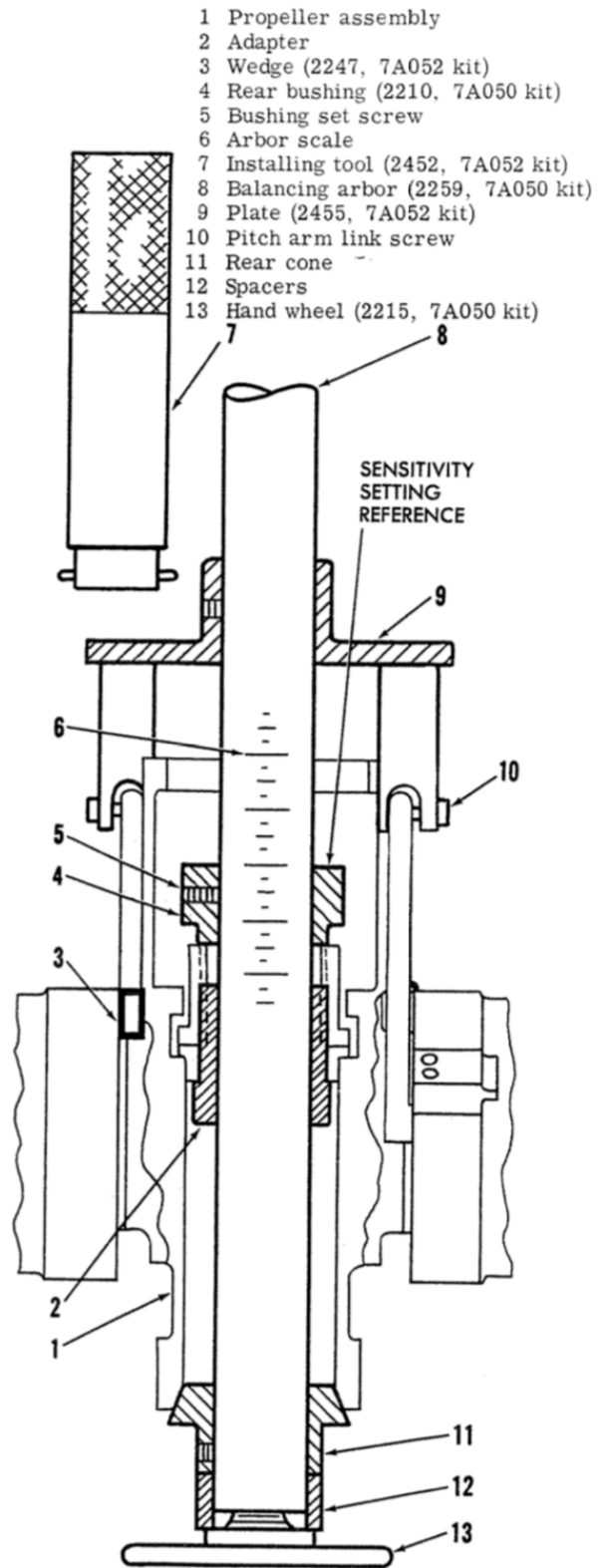
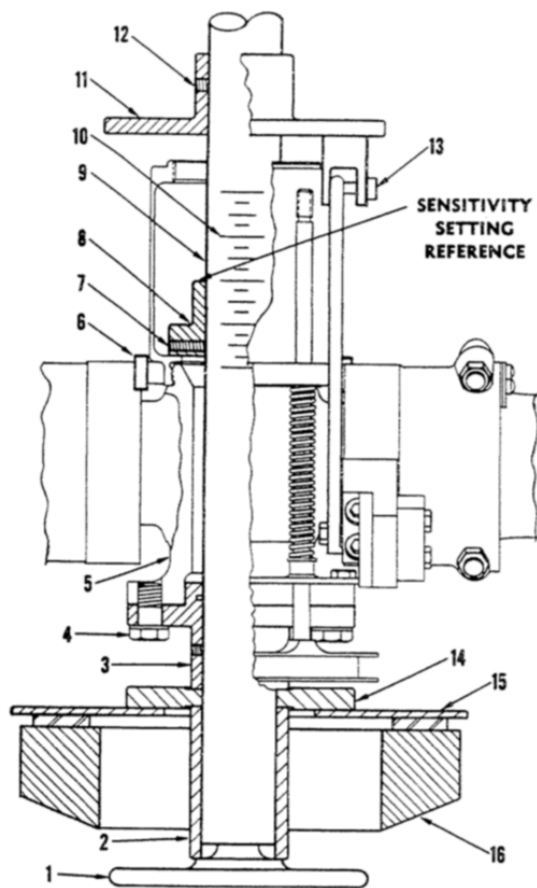


Figure 4-15. Typical Balancer Installation – Single Cone, Splined Hub Propeller Assemblies with Shaft Nuts Enclosed in Hub, Utilizing Pitch Positioning Plate (Sheet 1 of 2)



- |                               |                                     |
|-------------------------------|-------------------------------------|
| 1 Handwheel (2215, 7A050 kit) | 8 Bushing (2210, 7A050 kit)         |
| 2 Spacer (2204, 7A050 kit)    | 9 Arbor (2259)                      |
| 3 Flange adapter (2816)       | 10 Arbor scale                      |
| 4 Propeller flange bolts      | 11 Plate assembly (2455, 7A052 kit) |
| 5 Propeller assembly          | 12 Plate set screw                  |
| 6 Wedge (2247, 7A052 kit)     | 13 Pitch arm link screw -3          |
| 7 Bushing setscrew            | 14 Plate (2792)                     |
|                               | 15 Plate (2793)                     |
|                               | 16 Stand Table                      |

**Figure 4-15. Balancing Hartzell Flange-Mounted Turbo Propellers – Reversing Type (HC-B3TN-3 Typical) (Sheet 2 of 2)**

4-45. BALANCING HARTZELL FLANGE-MOUNTED TURBO-PROPELLERS, REVERSING TYPE-MODEL HC-B3TN-3 TYPICAL (See figure 4-15, Sheet 2 of 2.)

Note

Supplemental components not provided in normal adapter kits are required to accomplish instructions included below. These parts consist of: P/N 2769 Tube; P/N 2792 Base Plate; P/N 2793 Stand Adapter Plate; and P/N 2816 Flange Adapter Assembly.

a. Remove piston and feathering spring assembly, if installed from the propeller. Assemble 7A050 work stand and hoist assembly using P/N 2769 tube assembly in lieu of P/N 2288 tube (no. 4) provided in 7A050 kit.

b. Insure prop flange and pilot bore as well as mating surfaces of the 2816 adapter (3) are completely clean and freshly oiled. Install pilot of adapter (3) in prop flange bore. Check to insure adapter flange seats squarely against prop flange. Retain with two prop flange bolts, 180° apart.

c. Place 2793 plate (15) centrally on 7A050 stand table; place plate (14) centrally on top of plate (15). Set propeller with flange adapter downward, on top of P/N 2792 plate (14) and visually align inside bore of adapter (3) with bore of plate (14).

d. Install bushing (8), hub downward, on arbor (9) so that top surface of bushing aligns with 13 inch position on arbor scale. Lock bushing securely in this position with bushing set screw.

e. Install arbor downward through prop hub, adapter (3) and plate (14) until hub of bushing (8) comes to rest at bottom of prop cylinder.

f. Install spacer (2) over bottom end of arbor, insuring that top of spacer passes through slot in plate (15), to contact plate (14). Install handwheel (1) in bottom of arbor and tighten to clamp balancing assembly together.

g. Hoist balancing assembly approximately 1/4 inch off plate (15) and remove plate (15) from stand table. Check to insure balancing assembly is suspended free of interference with stand or adjacent objects. Observe balance indication at top of arbor.

Note

Re-install plate (15) on stand table before lowering balancing assembly onto stand.

h. For balance tolerance and installation of balance corrections, refer to applicable propeller manual.

4-46. McCauley Propellers.

4-47. MODELS 1A175, 1A200, AND 1B90 – ONE PIECE FIXED PITCH (See figure 4-16.)

a. Center plate (1) on work stand (1, figure 1-13).

b. Center propeller assembly (2), front face downward, on plate(1)

c. Install bushing (3), knurled hub upward, on balancing arbor (5) so that top surface of bushing aligns on arbor scale (6) in accordance with sensitivity setting specified in applicable manual. Secure bushing in this position by tightening busing set screw (4) with 1/8 inch-hex wrench (8, figure 1-13).

d. Install arbor downward through propeller hub and plate (1), seating pilot diameter of bushing (3) firmly into center bore of propeller hub.

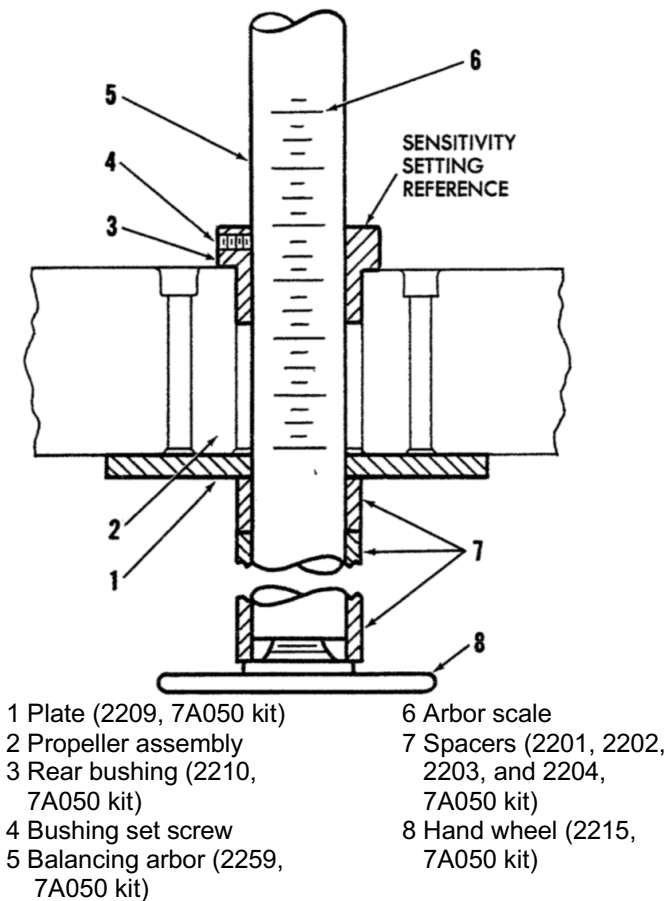
e. Install spacers (7), as shown in figure 4-16 over lower end of arbor.

f. Install hand wheel (8) in bottom end of arbor, and tighten wheel to clamp parts securely together.

g. Install suspension cable (13, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

h. Hoist entire assembly approximately 1/14 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand and other objects, and note balance condition indicated by the black indicator disc at the top end of the arbor.

i. For balance tolerance and application of balance corrections, refer to applicable propeller manual.



- |                                     |   |
|-------------------------------------|---|
| 1 Plate (2209, 7A050 kit)           | 6 Arbor scale                                     |
| 2 Propeller assembly                | 7 Spacers (2201, 2202, 2203, and 2204, 7A050 kit) |
| 3 Rear bushing (2210, 7A050 kit)    | 8 Hand wheel (2215, 7A050 kit)                    |
| 4 Bushing set screw                 |   |
| 5 Balancing arbor (2259, 7A050 kit) |   |

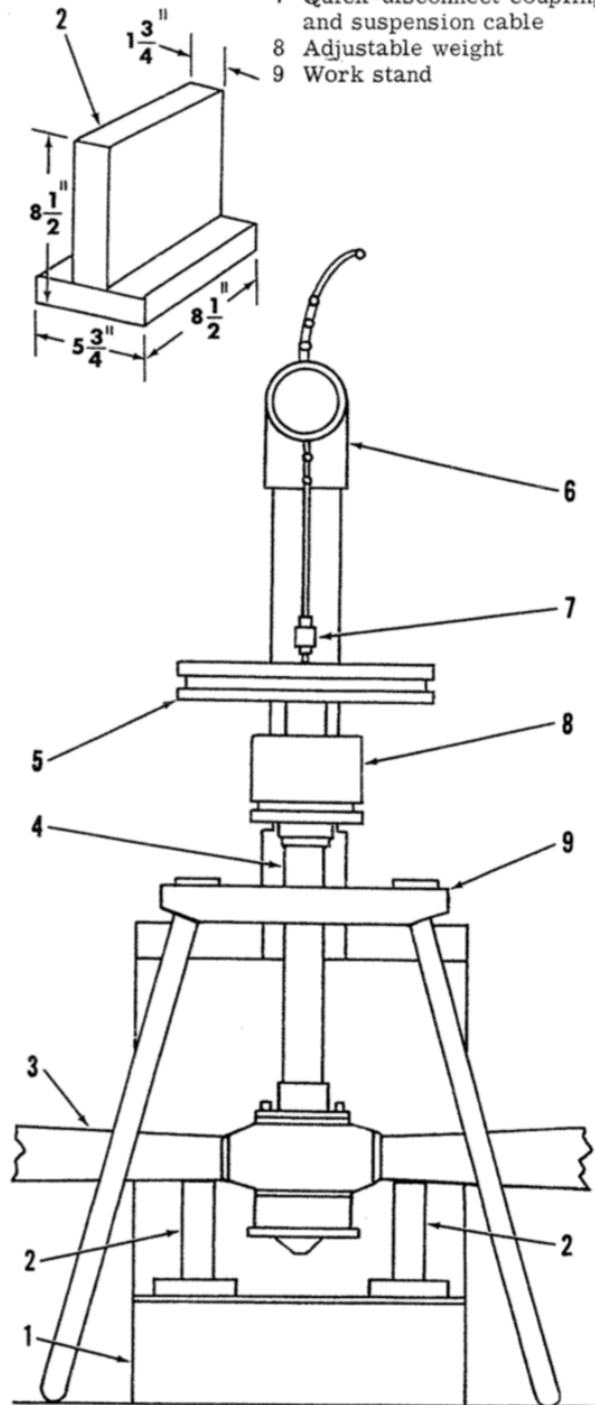
**Figure 4-16. Typical Balancer Installation – Fixed Pitch, Flange-Mounted Propeller Assemblies**

4-48. MODELS 2A36 AND 2D36 – COMPLETE ASSEMBLY.  
(See figure 4-13.)

- Install screw plug (2) and retaining ring in flange adapter (3).
- Install adapter (3) on flange of propeller assembly (1), with adapter pilot diameter seated in center pilot bore (12) of propeller mounting flange. Secure adapter with two propeller flange attaching nuts or bolts (11), as applicable, 180° apart.
- Place two auxiliary support blocks (2, figure 4-17) on felt tray of 7A050 kit case underneath work stand as shown in figure 4-17.
- Walk propeller through and under work stand, and center propeller hub under work stand with blade shanks resting on auxiliary support blocks.
- Install bushing (4), knurled hub upward, on balancing arbor (9) so that top surface of bushing aligns on arbor scale (6) in accordance with sensitivity setting specified in

applicable manual. Lock bushing.

- 7A050 Kit storage case (bottom half)
- Auxiliary support blocks
- Propeller assembly
- Balancing arbor
- Weight assembly
- Hydraulic hoist
- Quick-disconnect coupling and suspension cable
- Adjustable weight
- Work stand



**Figure 4-17. Typical Support Arrangement – Underslung – Suspended Propeller Assembly**

## Paragraphs 4-48 to 4-52

f. Install arbor downward through work stand casting and into adapter (3). Screw arbor onto plug (2) until firmly bottomed in adapter (3).

g. Install adjustable weight (10), grooved end downward, over top of balancing arbor, seating weight on top surface of bushing (4).

h. Install weight assembly (7), retaining ring upward, making certain it is fully seated on top end of arbor.

i. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

j. Hoist entire assembly approximately 1/4 inch off auxiliary support blocks. Check to ensure that the suspended assembly is free from interference with blocks, work stand, and other objects, and note the balance condition indicated by the black indicator disc at the top end of the arbor.

k. For balance tolerance and application of balance corrections, refer to applicable propeller manual. Make corrections precisely where indicated.

4-49. ROTOL PROPELLERS – TYPES R130/, R139/, R148/, R175/, R179/, R184/, R186/, R187, AND R193/, WITH FRONT CYLINDERS AND BACK PLATES INSTALLED. (See figure 4-4.)

## Note

Special details, P/N 2427 Cone, Front; and P/N 2460 Tube are required to perform operations described below. These special details are not provided in the 7A050 kit.

a. Assemble 7A050 work stand and hoist assembly as shown in figure 3-3 except use P/N 2460 Tube in lieu of No. 4 tube supplied in kit. Make a wooden support ring, 1-3/4 inches thick, having an O.D. of 10-1/2 inches and an I.D. of 7-1/2 inches, to position propeller properly and prevent interference.

b. Place the fabricated auxiliary support ring centrally on top of work stand to provide suitable support surface for propeller hub and to provide clearance for projecting switch block on rear surface of propeller hub.

c. Place propeller assembly, front side upward, centrally on auxiliary support ring, carefully insuring that projecting switch block clears inside diameter of auxiliary support ring.

d. Install No. 2427 cone, hub upward, on 2259 arbor (7A050 kit) so that top surface of cone hub aligns with arbor scale position as follows:

R. 130/, R.139/, R.148/ Series Propellers	9-3/4 inches
R.175/, R.179/ Series Propellers	9-1/2 inches
R.184/, R186/, R.187/, R.193 / Series Propellers	9-1/4 inches

e. Lock cone securely in this position with cone set screw, using 1/8 hex wrench (7A050 kit).

f. Install arbor and cone assembly downward through propeller hub, seating cone in propeller cone seat.

g. Install No. 2207 rear cone (7A050 kit), hub downward, over lower end of arbor. Install No. 2204 Spacer (7A050 kit) with R.130/, R.139/, R.148/, R.175/, R.179 Propellers or spacer No. 2201 (7A050 kit) with R.184/, R.186/, R.187/, R.193/ Propellers. Install No 2215 hand wheel (7A050 kit) in bottom of arbor and tighten to clamp cones firmly into propeller cone seats. (Refer to figure 4-4 for typical installation.)

h. Install quick-disconnect coupling, with 3/16-inch suspension cable (7A050 kit) on arbor suspension rod and engage suspension cable in lifting plate of hydraulic pump (7A050 kit). (See figure 4-2.)

i. Hoist entire assembly approximately 1/4 inch off auxiliary support block and check to insure suspended assembly is free from interference with work stand or other objects. Note balance conditions indicated by black indicator disc at top end of arbor.

j. For balance tolerance and application of balance corrections, refer to applicable propeller manual. Accomplish corrections carefully and precisely.

4-50. SENSENICH PROPELLERS.

4-51. MODEL M-76 – ONE PIECE FIXED PITCH. (See figure 4-16.)

a. Center plate (1) on work stand (1, figure 1-13).

b. Center propeller assembly (2), front face downward on plate (1).

c. Install rear bushing (3), knurled hub upward, on balancing arbor (5) so that top surface of bushing aligns on arbor scale (6) in accordance with sensitivity setting specified in applicable manual. Secure bushing in this position by tightening bushing set screw (4) with 1/8-inch hex wrench (8, figure 1-13).

d. Install arbor downward through propeller hub and plate (1), seating pilot diameter of bushing (3) firmly into center bore of propeller hub.

e. Install spacers (7), as shown in figure 4-16, over lower end of arbor.

f. Install hand wheel (8) in bottom end of arbor and tighten wheel to clamp parts securely together.

g. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that the suspended assembly is free from interference with work stand and other objects, and note balance condition indicated by the black indicator disc at the top end of the arbor.

i. For balance tolerance and application of balance corrections, refer to applicable propeller manual. Make corrections precisely in the locations specified in the manual. Recheck propeller balance as required.

4-52. HELICOPTER APPLICATIONS.

## Note

All kit components provide for close tolerance slip fits. Clean all mating surface thoroughly and apply clean lubricating oil immediately before each kit component installation.



Paragraphs 4-53 to 4-55

## 4-53. BELL TH-13 AND UH-13 HELICOPTERS.

## 4-54. TH-13 AND UH-13 ENGINE FAN ASSEMBLIES BALANCE CHECK. (See figure 4-18.)

a. Install pilot bushing (1), flange upward, on balancing arbor (6) so that inner top surface of bushing aligns with 6-3/4-inch position on arbor scale (7). Lock bushing in this position by moderate and uniform tightening of two bushing set screws (2), using 3/32-inch hex wrench (7HEL053 kit).

b. Carefully install engine fan assembly (3), pulleys downward, over top end of arbor. Ensure that flange of pilot bushing (1) enters fan hub bearing sleeve and seats squarely on outer race of bearing.

c. Install bushing (5), flange downward, over top end of balancing arbor, and seat firmly on top surface of fan hub bearing inner race. Lock bushing in this position by moderate and uniform tightening of two bushing set screws (4), using 3/32-inch hex wrench (7HEL053 kit).

d. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free of interference. Note balance condition indicated by black indicator disc at top end of the arbor.

e. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

## 4-55. TH-13 AND UH-13 ENGINE FAN ASSEMBLIES TRACK AND CONCENTRICITY CHECK. (See figure 4-19.)

a. Clamp fixture assembly (2), recessed side downward, on surface plate (1) or other firm surface.

b. Install pilot bushing (3), flange upward, on balancing arbor (8) so that bottom of bushing hub aligns approximately with 2-inch position on arbor scale (9). Lock bushing in this position by moderate and uniform tightening of two bushing set screws (4), using 3/32-inch hex wrench (7HEL053 kit).

c. Install lower end of arbor in hub of fixture (2) so that bottom of bushing (3) rests on top of fixture assembly hub. Do not lock fixture hub set screws.

d. Carefully install fan assembly (5), pulleys downward, over top of arbor, ensuring that bushing (3) flange enters fan hub bearing sleeve and seats squarely on fan bearing outer race.

e. Install bushing (7), flange downward, over top end of arbor, and seat firmly on inner race of fan bearing. Lock bushing in this position by moderate and uniform tightening of two bushing set screws (6), using 3/32-inch hex wrench (7HEL053 kit).

f. Install 1/2 -inch mushroom point on dial indicator (10) and adjust height gage assembly (11) to read track or concentricity variations as required. Rotate fan to determine range of variations.

g. For track and concentricity tolerances and application of corrections, refer to applicable manual.

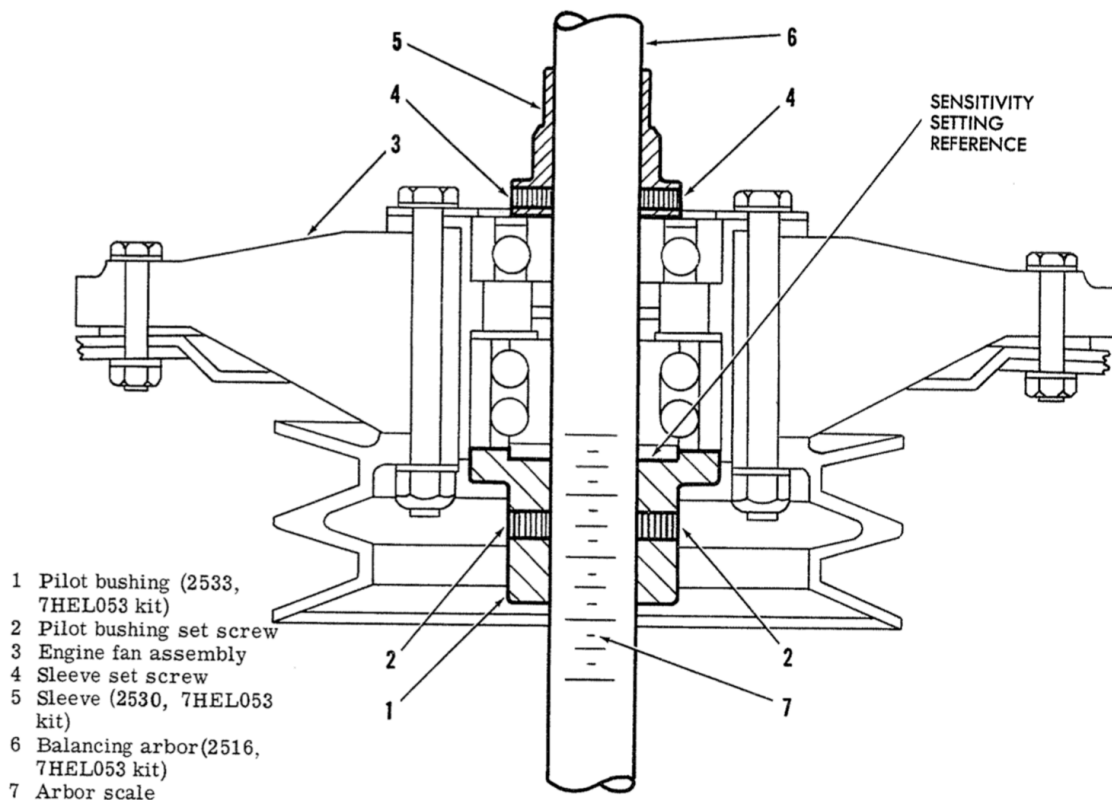
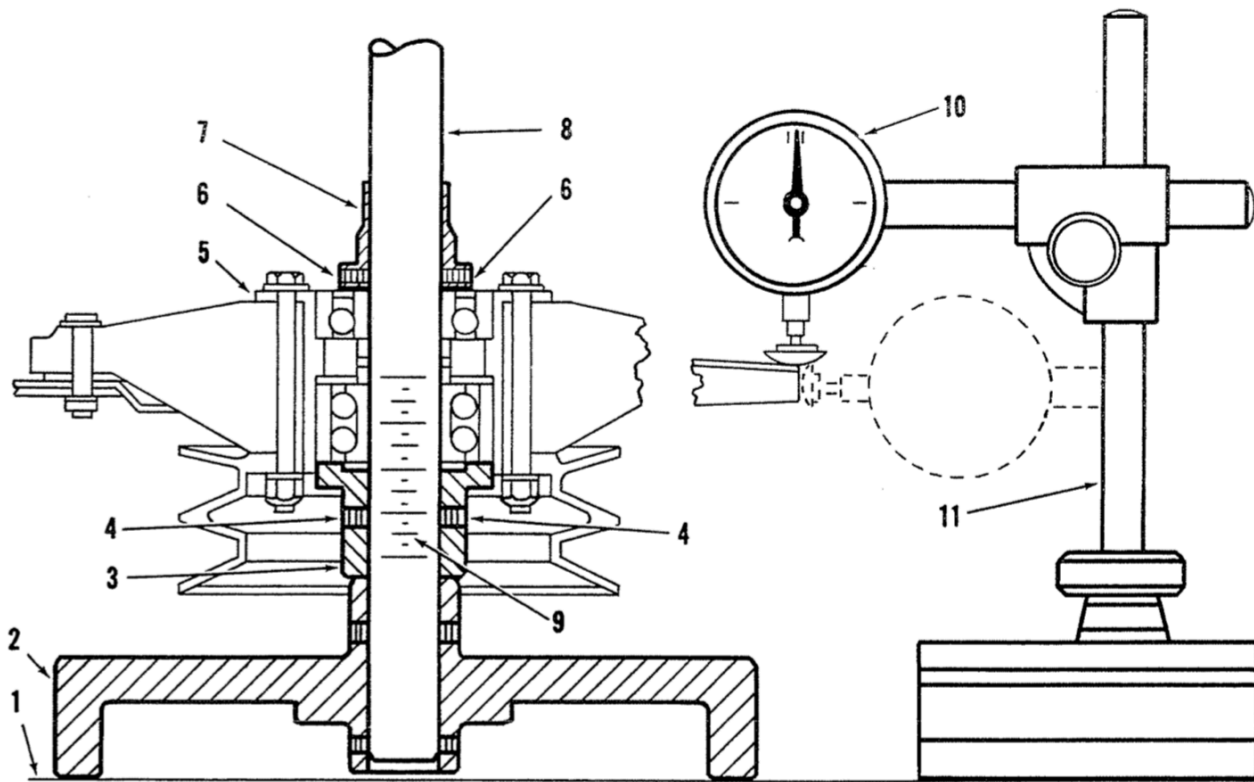


Figure 4-18. Balancer Installation – TH-13 and UH-13 Helicopter Engine Fan Assemblies



- |   |  |   |
|---|--|---|
| 1 Surface Plate                           | 5 Engine Fan Assembly                    | 9 Arbor scale                           |
| 2 Fixture Assembly (2532,<br>7HEL053 kit) | 6 Sleeve set screw                       | 10 Dial indicator (7HEL053 kit)         |
| 3 Pilot bushing (2533,<br>7HEL053 kit)    | 7 Sleeve (2530,<br>7HEL053 kit)          | 11 Height gage assembly<br>7HEL053 kit) |
| 4. Pilot bushing set screw                | 8 Balancing arbor (2516,<br>7HEL053 kit) |   |

**Figure 4-19. Set-up for TH-13 and UH-13 Helicopter Engine Fan Assemblies Track and Concentricity Check**  
using 3/32-inch hex wrench (7HEL053 kit).

**4-56. TH-13 TAIL ROTOR HUB AND BLADE ASSEMBLY BALANCE CHECK.**

(See figure 4-20.)

a. Set fixture assembly (2), recessed side downward, on auxiliary support blocks (1) as shown. Screw stud ends of two post assemblies (3) into two diametrically opposite tapped holes (Holes C, View A) in top surface of fixture. Using fingers only, ensure that post assemblies are firmly seated on fixture.

b. Place one bushing (8), flange downward, centrally on top of fixture hub. Install tail rotor hub and blade assembly (4) over pilot diameter of bushing, ensuring that hub seats firmly on flange of bushing and that blade shanks are clear of interference with posts (3).

c. Install second bushing (8), flange upward, in top of rotor hub, seating bushing flange against top of rotor hub.

d. Insert lower end of balancing arbor (6) downward through two bushings (8) and hub of fixture (2) until 7-1/4-inch position on arbor scale (7) aligns with top surface of upper bushing (8). Lock arbor in this position by moderate and uniform tightening of two lower fixture set screws (9),

e. Rotate swivel heads on posts (3), and rotate rotor hub on arbor until small ends of index pins enter rotor pitch arm bracket holes. Seat index pins and swivel heads radially outward against the rotor pitch arm brackets.

f. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free of interference, and note the balance condition indicated by black indicator disc at top end of the arbor.

g. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

**4-57. UH-13 TAIL ROTOR HUB AND BLADE ASSEMBLY BALANCE CHECK.**

(See figure 4-21.)

a. Set fixture assembly (2), recessed side downward, on auxiliary support blocks (1) as shown. Screw stud ends of two post assemblies (3) into two diametrically opposite tapped holes (Holes B, View A) in top surface of fixture. Using fingers only, ensure that post assemblies are firmly seated on fixture.

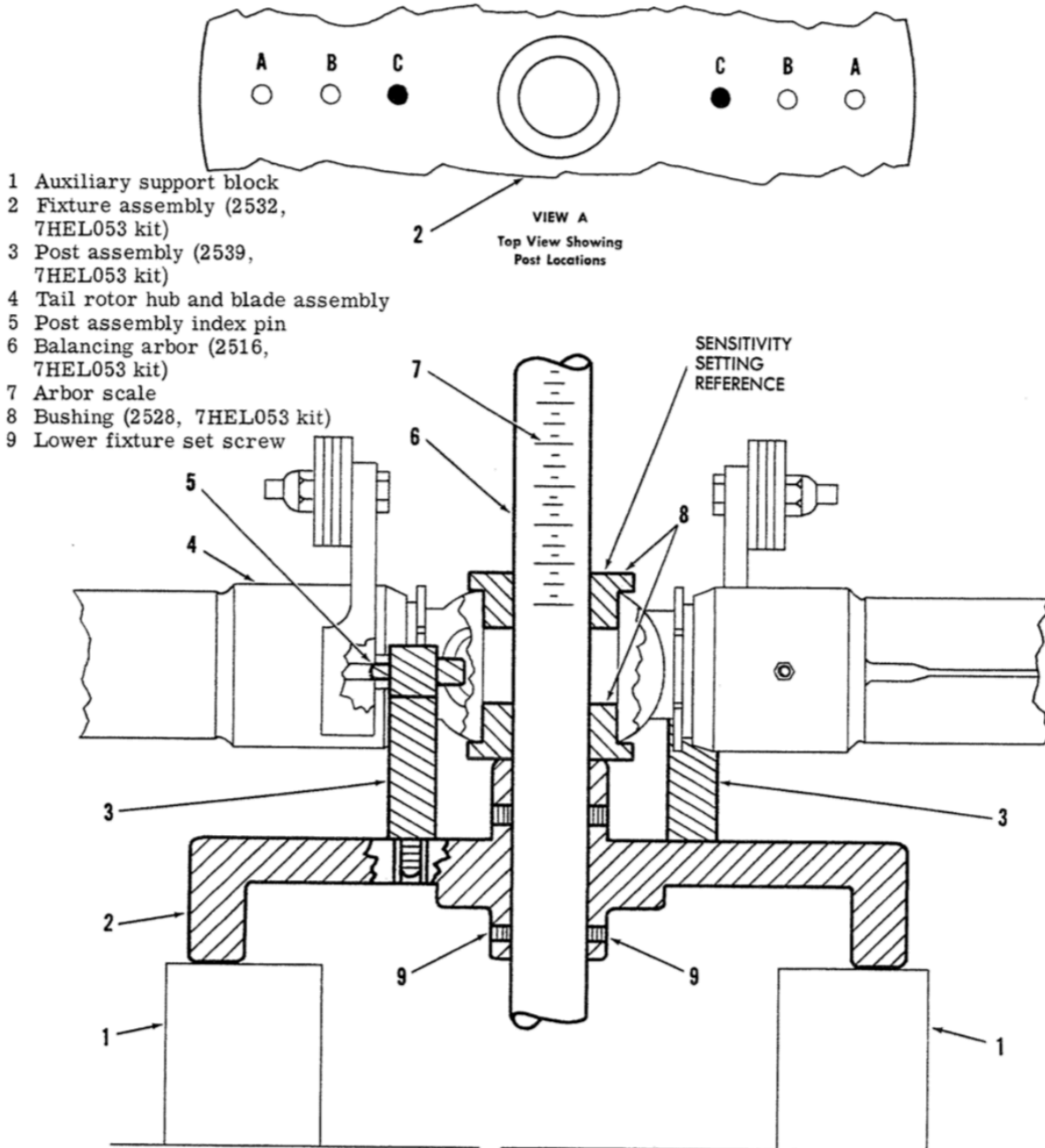
b. Place spacer (13) centrally on top of fixture hub (2).

c. Install pilot bushing (12), flange upward on balancing arbor (8) so that its top surface aligns with 7-inch position on arbor scale (9). Lock bushing in this position by moderate and uniform tightening of two bushing set screws (11), using 3/32-inch hex wrench (7HEL053 kit).

d. Set tail rotor hub and blade assembly (4) on fixture (2) so that bottom (flat) surface of rotor hub trunnion rests on spacer (13); flat surface of rotor hub is upward, and rotor blade shanks are clear of posts (3).

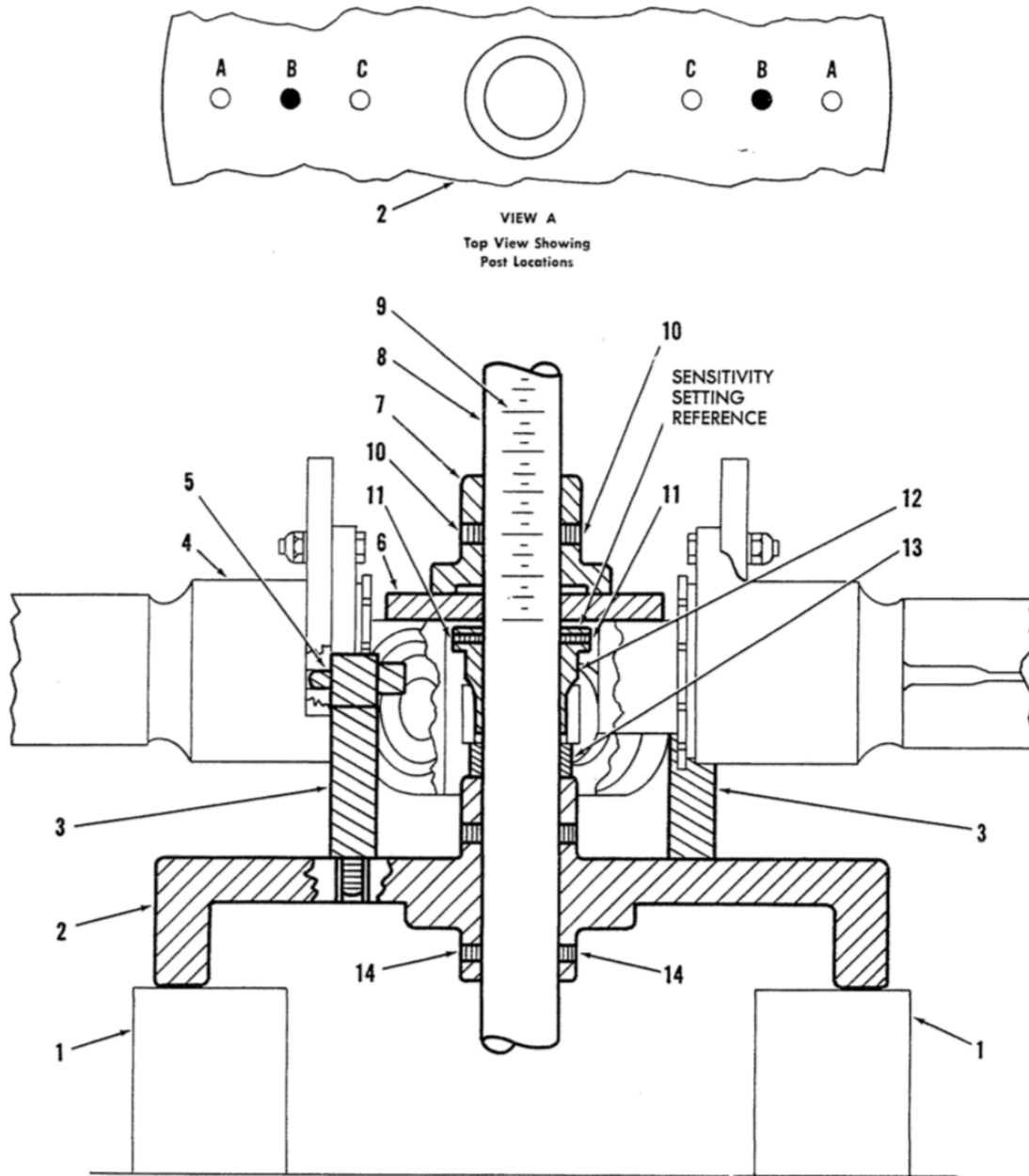
e. Insert lower end of arbor downward through rotor hub trunnion, spacer (13), and hub of fixture (2). Press cone of pilot bushing (12) firmly into cone seat of rotor hub trunnion, and lock arbor in this position by moderate and uniform tightening of two lower fixture set screws (14).

f. Rotate swivel heads of posts (3), and rotate rotor hub on arbor until small ends of index pins (5) enter rotor pitch arm bracket holes. Seat index pins and swivel heads radially outward against the rotor pitch arm brackets.



- 1 Auxiliary support block
- 2 Fixture assembly (2532, 7HEL053 kit)
- 3 Post assembly (2539, 7HEL053 kit)
- 4 Tail rotor hub and blade assembly
- 5 Post assembly index pin
- 6 Balancing arbor (2516, 7HEL053 kit)
- 7 Arbor scale
- 8 Bushing (2528, 7HEL053 kit)
- 9 Lower fixture set screw

Figure 4-20. Balancer Installation – TH-13 Helicopter Tail Rotor Hub and Blade Assembly



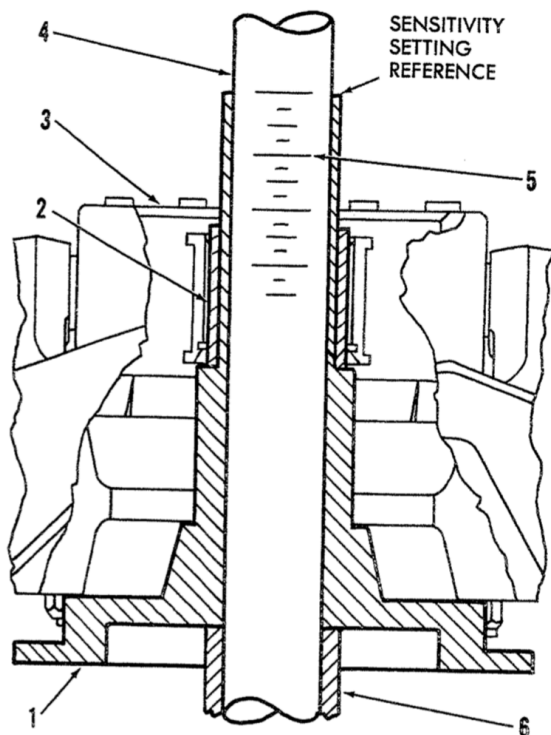
- |  |                                       |                                      |
|--|---------------------------------------|--------------------------------------|
| 1 Auxiliary support block              | 6 Plate (2586, 7HEL153 kit)           | 11 Pilot bushing set screw           |
| 2 Fixture assembly (2532, 7HEL053 kit) | 7 Bushing (2533, 7HEL053 kit)         | 12 Pilot bushing (2530, 7HEL053 kit) |
| 3 Post assembly (2539, 7HEL053 kit)    | 8 Balancing arbor (2516, 7HEL053 kit) | 13 Spacer (2536, 7HEL053 kit)        |
| 4 Tail rotor hub and blade assembly    | 9 Arbor scale                         | 14 Lower fixture set screw           |
| 5 Post assembly index pin              | 10 Bushing set screw                  |                                      |

**Figure 4-21. Balancer Installation – UH-13 Helicopter Tail Rotor Hub and Blade Assembly**

g. Install plate (6) over top end of arbor, followed by bushing (7) with flange downward. Press bushing and plate firmly downward against flat top surface of rotor hub, and lock plate and bushing in this position by moderate and uniform tightening of two bushing set screws (10). Procure P/N 2586 plate (6).

h. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free of interference. Note the balance condition indicated by the blank indicator disc at top end of the arbor.

i. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.



- 1 Fixture (2337, 7HEL054 kit)
- 2 Sleeve (2467, 7HEL054 kit)
- 3 Rotor hub and blade assembly

- 4 Balancing arbor (2259, 7A050 kit)
- 5 Arbor scale
- 6 Spacers

**Figure 4-22. Balancer Installation – TH-13 and UH-13 Helicopter Main Rotor Hub and Blade Assemblies**

**4-58. TH-13 AND UH-13 MAIN ROTOR HUB AND BLADE ASSEMBLIES BALANCE CHECK.**  
(See figure 4-22.)

a. Assemble hoist support structure (7A050 Kit) as shown in page 3-2, figure 3-3, except use Part No. 2769 Tube Assembly in lieu of Part No. 2288 Tube Assembly to provide additional arm height. The Part No. 2769 Tube Assembly is not available in the 7A050 Kit; therefore, it must

be requisitioned.

Note

Deleted

b. Center fixture (1), with sleeve (2) installed, on work stand (1, figure 1-13).

c. Carefully lower rotor hub and blade assembly (3) over top of fixture (1), guiding rotor hub trunnion spline inside diameter over sleeve (2). Make certain that base of rotor hub yoke seats squarely on fixture.

d. Set blade pitch of assembly (3) approximately at zero position.

Note

Since pitch equalizer linkage ensures symmetrical blade pitch variations, locking of pitch arms is not required.

e. Install balancing arbor (4) through pilot bore of fixture (1).

f. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

g. Adjust suspended height of arbor so that top of fixture (1) aligns with arbor scale (5) position as follows:

- 1. TH-13L and M Rotor Assemblies (short wood blades) – 15-3/4 inches.
- 2. TH-13N and UH-13 Rotor Assemblies (long wood blades) -18-1/4 inches.

h. Install spacers (6) on bottom end of arbor as follows:

- 1. TH-13L and M Rotor assemblies (short wood blades) – spacers, Part No. 2202 and 2204 (7A050 kit).
- 2. TH-13N and UH-13 Rotor assemblies (long wood blades) – spacers, Part No. 2201, 2203, and 2204.

i. Install hand wheel, Part No. 2215 (7A050 kit), in bottom end of arbor, and tighten wheel to seat spacers (6) firmly under base of fixture (1). Check to ensure that sensitivity setting specified in step g. has been maintained.

j. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note balance condition indicated by black indicator disc at top end of arbor.

Note

The span of the rotor blades makes it essential that this balance check be performed in a draft free area and that the movement of personnel in the area be held to a minimum.

k. For balance tolerances and application of balance corrections, refer to applicable manual.

4-59. BELL UH-1 HELICOPTER.

4-60. UH-1 MAIN ROTOR HUB ASSEMBLY  
BALANCE CHECK. (EXCEPT 540 ROTOR)  
(See figure 4-23.)

- a. Assemble hoist support structure (7A050 kit) with Part No. 2769 tuber assembly instead of Part No. 2288 tube assembly (7A050 kit) to provide additional hoist arm height.
- b. Center fixture (1) on work stand (7A050 kit).
- c. Install sleeve (2) over top of fixture (1) and seat sleeve on upper shoulder of fixture's central projection.
- d. Install adapter (3), heavy end downward, over top of fixture (1) and seat on top of sleeve (2). Lock adapter in this position by tightening adapter set screw (4) using 1/8-inch hex wrench (7A050, 7HEL054, 7HEL061 kits).
- e. Carefully lower rotor hub assembly (8) over fixture (1), aligning inside diameter of splined trunnion with piloting diameter of adapter (3), and ensuring that cone surface of splined trunnion seats firmly on cone surface of adapter (3).
- f. Install pitch positioning locks. These are available, as manufacturer designed, Bell Tool No. T101402. Install carefully, and adjust blade grips to symmetrical pitch positions. To accomplish this, place a bevel (bubble) protractor on flat top surface of rotor hub, across the grip pitch axis; adjust protractor to center bubble. Transfer protractor, keeping it in same transverse position, to bottom inside surface of either blade grip fork and align protractor base with the transverse milled line in the fork surface. Adjust grip pitch only to again center protractor bubble. Transfer protractor, in same transverse position, to opposite grip fork and repeat grip pitch adjustment. Repeat grip pitch adjustment operation if necessary.
- g. Using raw-hide or rubber mallet, tap heads of rotor blade retention bolts in radially outward direction to ensure blade grips are fully seated in their radially outward positions.
- h. Install yoke (5), legs downward, on arbor (6) and position so that top surface of its locking collar (sensitivity setting reference) aligns with arbor scale as follows:

UH-1A	
With Counterweights	15-1/2 inch
MODEL 204B	
Without Counterweights	14-3/4 inch
With Counterweights	14-1/2 inch

Lock yoke (5) firmly in this position on arbor with its collar clamp screw, using 3/16-inch hex wrench (7HEL061 kit).

- i. Install arbor (6) downward through rotor trunnion and fixture (1) assembly, seating both yoke (5) legs firmly on flat top surface of rotor hub, in line with blade grip pitch axis.
- j. For UH-1A install part No. 2202 spacer (7A050 kit) over lower end of arbor (6). For Helicopter Models 204B, install Part No. 2201 spacer (7A050 kit). Install 2215 hand wheel (7A050 kit) in bottom end of arbor and tighten to clamp both legs of yoke (5) firmly against top surface of rotor hub.

k. Using gage (11) as shown, swing rotor hub drag struts to symmetrical angular positions. For UH-1A use gage inner position (12); for Models 204B, use gage outer position (13). Remove gage from rotor assembly during subsequent balance check.

l. Install quick-disconnect assembly with 3/16-inch cable (7A050 kit) on arbor (6) suspension rod and engage cable in lifting plate of hydraulic pump assembly (7A050 kit). Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note balance condition indicated by black indicator disc at top end of arbor.

Note

In order to ensure that the Part No. 2215 hand wheel suspends free of interference within the inside diameter of the stand table, it may be necessary to adjust the level of the stand assembly by installing suitable wood blocks or spacers under the two tubular stand legs.

m. For balance tolerance and application of balance correction, refer to applicable helicopter manual.

4-61. Recently intensive engineering research tests have indicated that the 540 Main Rotor Hub Assembly static suspension balancing is no longer a requirement. Hence, the balancing procedures and related illustrations are being deleted from this issue. It will be noted however, that the appropriate kit listing (P/N 7HEL066) still exists herein. See page 1-12 and figure 1-30.

Note

In order to eliminate confusion in the field regarding static suspension balancing of UH-1 series Tail Rotor Hub and Blade assemblies, a single procedure is now recommended as described in paragraph 4-62 below and as illustrated in figures 4-24, Sheets 1 of 2 and 2 of 2.

4-62. TAIL ROTOR HUB AND BLADE ASSEMBLIES

(See figure 4-24, Sheets 1 of 2 and 2 of 2.)

a. Assemble the 7A050 kit work stand and hoist assembly as described in Section III. If a 7A050 work stand is not available, auxiliary support blocks may be used to act as a support stand. Place the P/N 2532 fixture (2) recessed side downward, on the table pad or support blocks as shown in figure 4-24, Sheet 1 of 2, view A.

b. Prior to installing post assemblies (4, 7HEL065 kit), adjust movable index pins (15) of the position post assemblies to proper dimension shown in figure 4-24, Sheet 1 of 2, view B, depending on the specific rotor assembly being balanced. View B illustrates the rotor configurations and corresponding proper index lengths. Tighten the locking set screw (15) using 3/32" hex wrench (7HEL053 kit) to maintain proper setting.

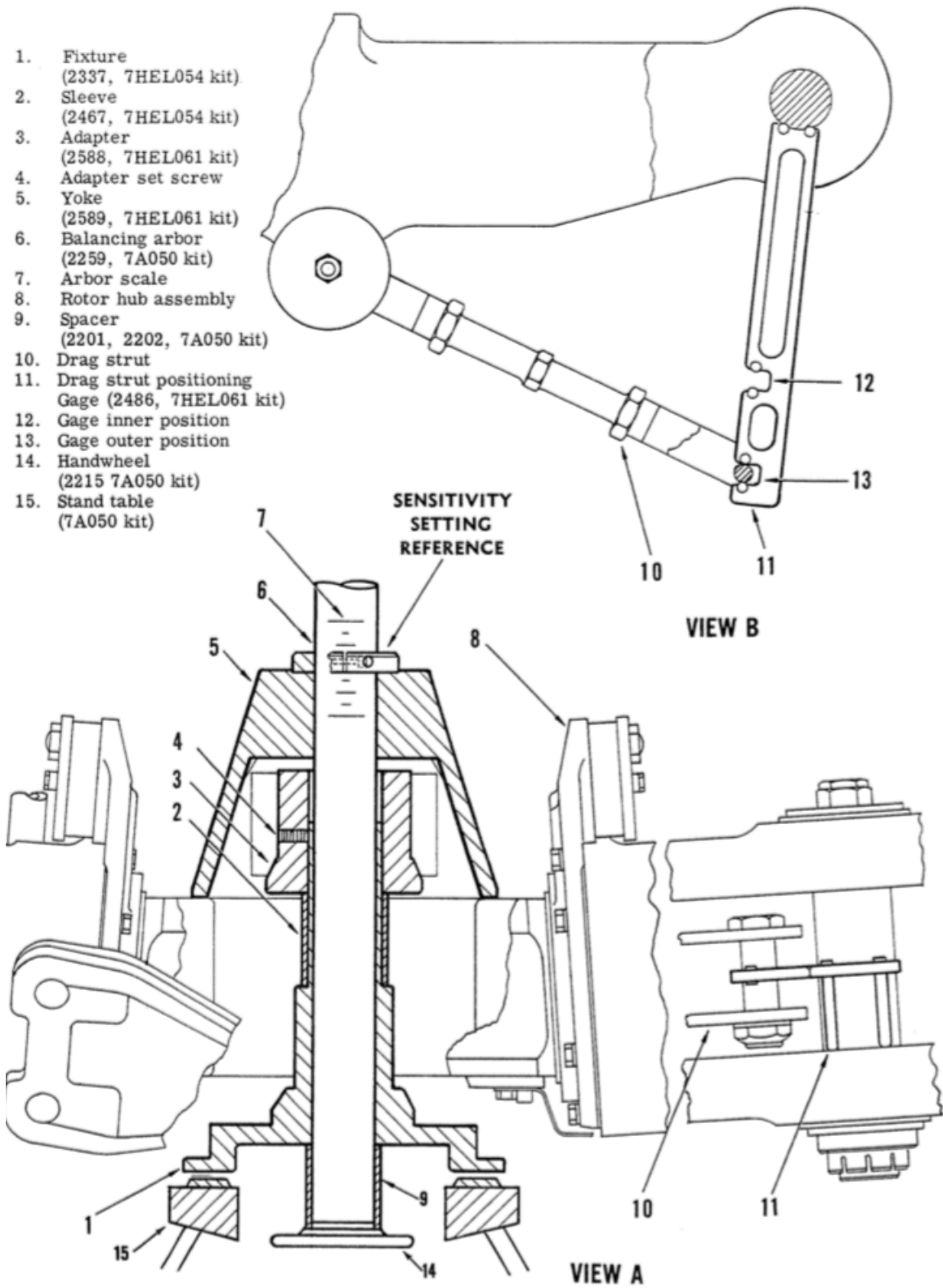


Figure 4-23. Balancer Installation – Bell (UH-1A Typical) 204B (UH-1B, UH-1C, UH-1D, UH-1E, UH-1F, Typical) Helicopter Main Rotor Hub Assemblies (except 540 Rotors)

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Stand table<br/>(7A050 kit)</li> <li>2. Fixture assembly<br/>(2532, THEL053 kit)</li> <li>3. Bar Pair (11 Sets)<br/>2940 thru 2950 (THEL065 kit)</li> <li>4. Post assembly (2)<br/>(2939, THEL065 kit)</li> <li>5. Tail rotor hub and<br/>blade assembly</li> <li>6. Plate<br/>(2586, Procure)</li> </ol> | <ol style="list-style-type: none"> <li>7. Bushing<br/>(2533, THEL053 kit)</li> <li>8. Balancing arbor<br/>(2516, THEL053 kit)</li> <li>9. Arbor scale</li> <li>10. Bushing set screw</li> <li>11. Pilot bushing<br/>(2529 THEL053 kit)</li> <li>12. Lower fixture set screw</li> <li>13. Post thread</li> <li>14. Movable index section</li> <li>15. Index pin and set screw</li> <li>16. Tail rotor attaching nuts</li> <li>17. Tail rotor attaching bolts</li> </ol> |
|---|--|

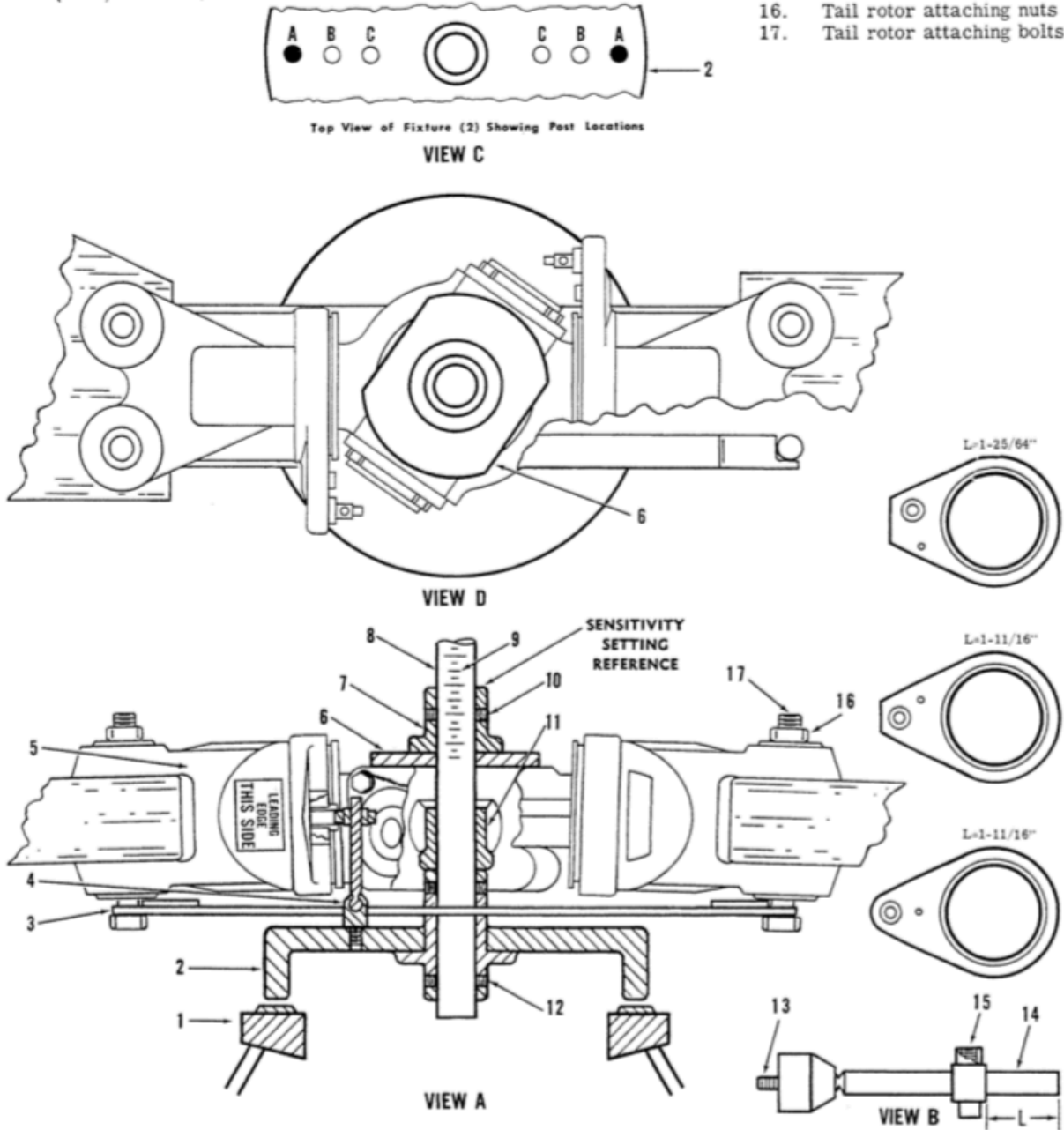
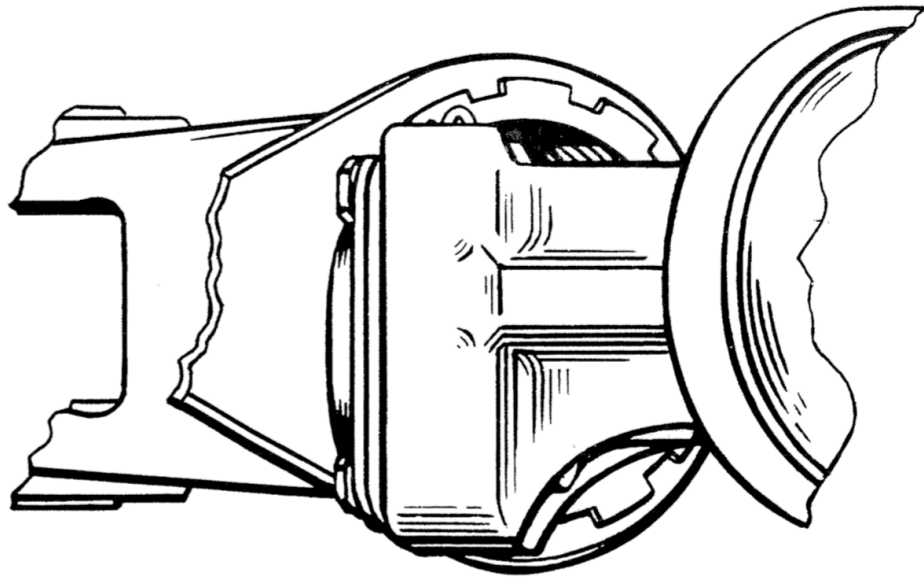
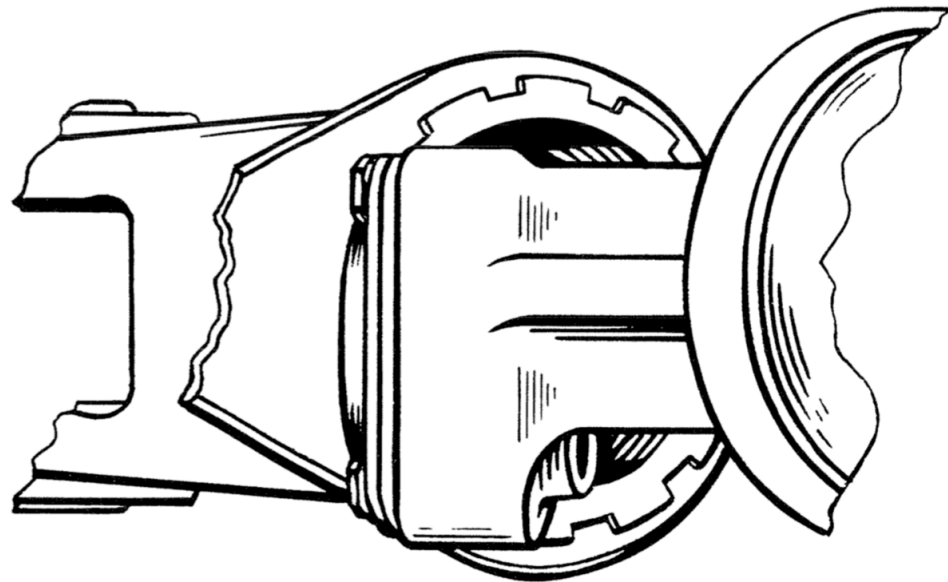


Figure 4-24. Balancer Installation – Bell (UH-1A Typical) 204B (UH-1B, UH-1C, UH-1D, UH-1E, UH-1F and UH-1E (Except 540) Typical) Tail Rotor Hub and Blade Assemblies (Sheet 1 of 2)





**VIEW A**



**VIEW B**

**Figure 4-24. Tall Rotor Yoke Configuration – For Proper Arbor Scale Setting Identification (Sheet 2 of 2)**

c. After adjusting post assemblies properly, thread the post assemblies (4) into two diametrically tapped holes of fixture (2), shown as holes A in top view of fixture (view C).

d. Locate the P/N 2529 pilot bushing (11), large end down, centrally on top of fixture hub.

e. Remove or loosen nuts (16) from tail rotor blade attaching bolts (17). Drive bolts partially out of yoke assembly to obtain an approximate 9/32 inch gap under the bolt heads as shown in view A.

f. Set tail rotor on fixture (2) so that blade shanks clear posts (4); flat surface of hub is upward, and inside diameter of rotor splined trunnion fits over diameter of pilot bushing (11).

g. Install P/N 2533 bushing (7), flange end downward on P/N 2516 balancing arbor (8) so that top surface of bushing aligns with 7 1/14" or 7 3/8" position on arbor scale (9) depending on the yoke configuration. Figure 4-24, Sheet 2 of 2 illustrates the differences in yoke designs and it will be noted that the "beefed-up" yoke with the half-moon cut-out portion at the bottom as shown in view A of figure 4-24, Sheet 2 of 2, requires the 7 3/8" setting. View B, illustrates the yoke configuration requiring the 7 1/4" setting. Lock bushing in this position by moderate and uniform tightening of bushing set screws (10) using 3/32" hex wrench (7HEL053 kit).

h. Place P/N 2586 plate (6) centrally on top surface of rotor hub as shown in top view of assembly and insert lower end of balancing arbor (8) downward through plate (6), bushing (11) and hub of fixture (2). Seat assembly firmly together by pressing downward on bushing (7) and lock in this position by moderate and uniform tightening of two lower fixture set screws (12).

i. Rotate the rotor hub on fixture, positioning the index pins (15) of the two post assemblies (4) until the indexing diameters enter the pitch linkage holes in grip arms to their full depth.

j. From the matched sets of positioning bars (3), P/N 2940 thru 2950, 7HEL065 kit), select the pair (set) identified as having the lowest part number (2940). Make sure each bar bears the same matched pair serial number and the same part number. Trial install the matched set of bars (3), blocks upward, between opposite blade attachment bolts; contacting shanks underneath the bolt heads. Do not force bars onto the shanks of the bolts. If bars are too short, continue the trial installation using increasingly longer bar sets (identified by matched pair serial numbers and identical part numbers) as necessary until the longest matched pair that can be installed between the bolt shanks without force has been precisely established. Once this set and length have been determined, select the next higher part number bar pair, but make sure each bar also carries the same matched pair serial number. This is the matched pair bar set that shall be used during the balance operations. Be certain that the pair is identified correctly with a matched pair serial number and the same part number.

k. Carefully lift upward on both rotor blades at their tips simultaneously to produce increase span distance between the blade bolts; install the properly matched and identified pair of bars described and selected in paragraph (j)

above. Then, release blade tips, allowing the bolt shanks to rest firmly upon the bar ends. Move bars precisely into final position by pressing upward to seat block section against rotor grip bushing face surface and inwardly to seat stop tang of bars against the bolt shanks. See view D, figure 4-24, Sheet 1 of 2.

l. Investigate to make sure that the position post index sections are engaged in grip pitch arm holes and that the arbor (8) with bushing (7) is tight against the rotor hub.

m. Sight beneath the rotor hub across the positioning bar pair (3) to make sure they are in the same plane. Correct, if required, by readjusting the index section of each position post on its mounting rod an equal amount.

n. Install quick-disconnect coupling (7HEL053 kit or 7A050 kit) on arbor suspension coupler and suspend entire assembly free of interference. Note balance condition indicated by black indicator disc at top of balancing arbor.

o. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

#### 4-63. GYRODYNE QH-50C DRONE.

#### 4-64. QH-50C ROTOR ASSEMBLY BALANCE CHECK. (See figure 4-25).

##### Note

The following procedural steps apply to both upper and lower rotor assemblies of the QH-50C. Illustrations show lower rotor as generally typical.

a. Immediately prior to the balancing operation, clean all surfaces of the rotor blades and tip brakes, as well as the rotor hub assembly, to remove any accumulations of oil and foreign material.

b. Freshly lubricate rotor hub assemblies to insure bearing cavities are uniformly filled with grease.

c. Prior to assembly of the rotor on the balancing adapters, temporarily install rotor blades in blade spindle and pitch horn assemblies (detached from rotor side plates) and adjust rod ends of the tip brake actuating rod assemblies, using Gyrodyne Tool No. Y63-345700-158 (not shown) in accordance with applicable helicopter maintenance handbook. Remove adjusting tool and blades from spindle and pitch horns.

d. Install link bolts, washers and nuts finger-tight in the arms of the rotor spindle and pitch horn assemblies.

e. Insure that rotor hub plate bushings and adapter piloting (8) are thoroughly clean and freshly lubricated with clean oil. Install adapter (8), flat surface upward, together with the tip brake shaft assemblies, blade spindle and pitch horn assemblies, in the rotor side plates. Install the two upper hub plate bolts (7) only, together with their washers and nuts, finger tight only. In place of the two lower hub plate bolts, install two pins-rotor positioning (5) through hub plates as shown.

##### Note

For both upper and lower rotor assemblies, pin (5) on the left will have its T-handle toward the operator; pin (5) on the right will have its plain end toward the operator.

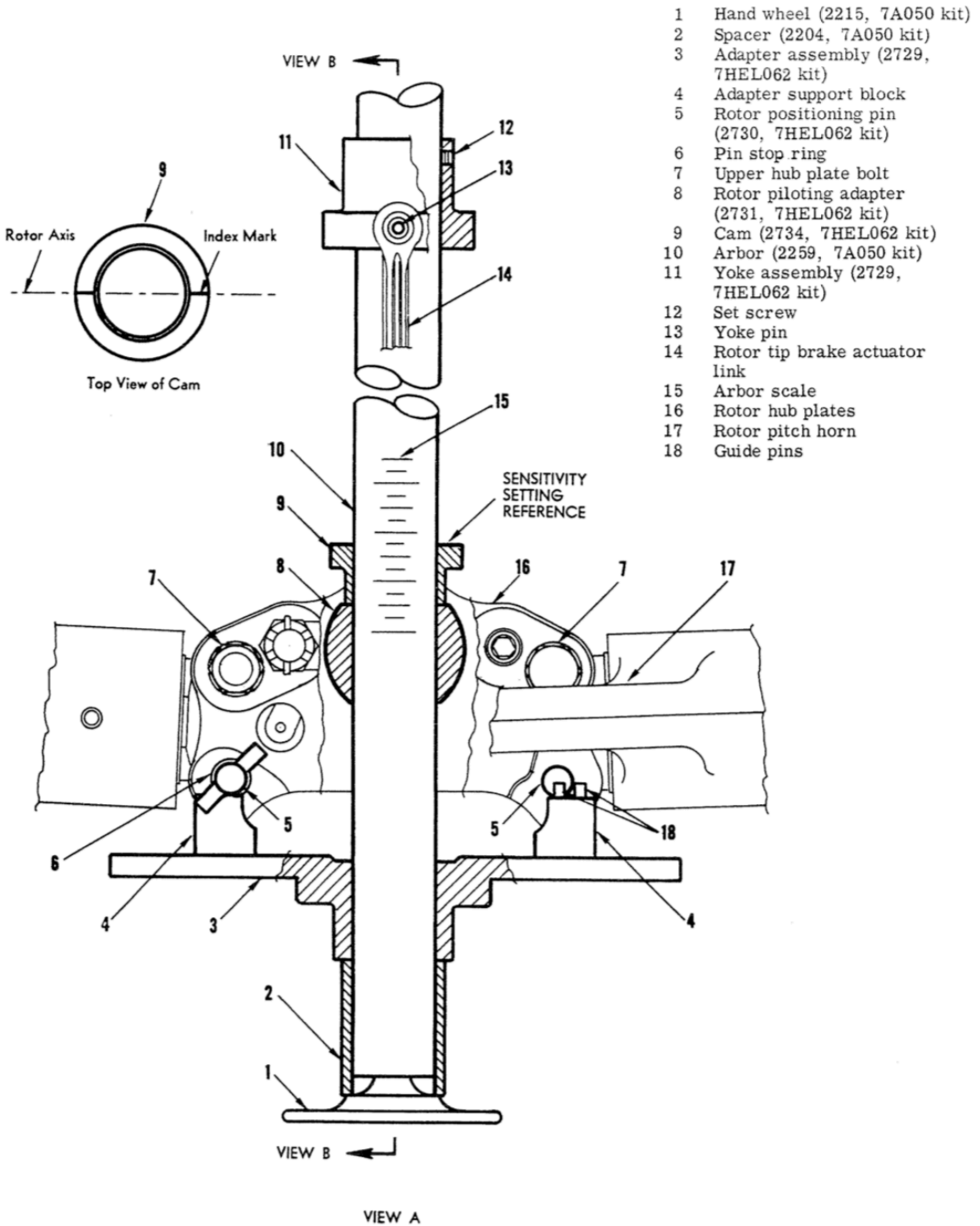


Figure 4-25. Balancer Installation – Gyrodyne QH-50C Drone Helicopter Upper and Lower Rotor Assemblies (Sheet 1 of 2)

f. Insure that pin stop rings (6) are firmly seated against hub plates; tighten upper hub plate bolts to a uniform torque of approximately half that specified for final assembly.

g. Install the tip brake actuator link and bell-crank assemblies on the tip brake actuator shafts. Secure with

attaching nuts.

h. Position adapter assembly (3), hub downward, centrally on work stand of 7A050 kit so that its two posts lie in the plane of the overhead hoist arm.

- 1 Hand wheel (2215, 7A050 kit)
- 2 Spacer (2204, 7A050 kit)
- 3 Adapter assembly (2729, 7HEL062 kit)
- 4 Adapter support block
- 5 Rotor positioning pin (2730, 7HEL062 kit)
- 6 Pin stop ring
- 7 Upper hub plate bolt
- 8 Rotor piloting adapter (2731, 7HEL062 kit)
- 9 Cam (2734, 7HEL062 kit)
- 10 Arbor (2259, 7A050 kit)
- 11 Yoke assembly (2728, 7HEL062 kit)
- 12 Set screw
- 13 Yoke pin
- 14 Rotor tip brake actuator link
- 15 Arbor scale
- 16 Rotor hub plates
- 17 Rotor pitch horn
- 18 Guide pins
- 19 Pitch positioning post

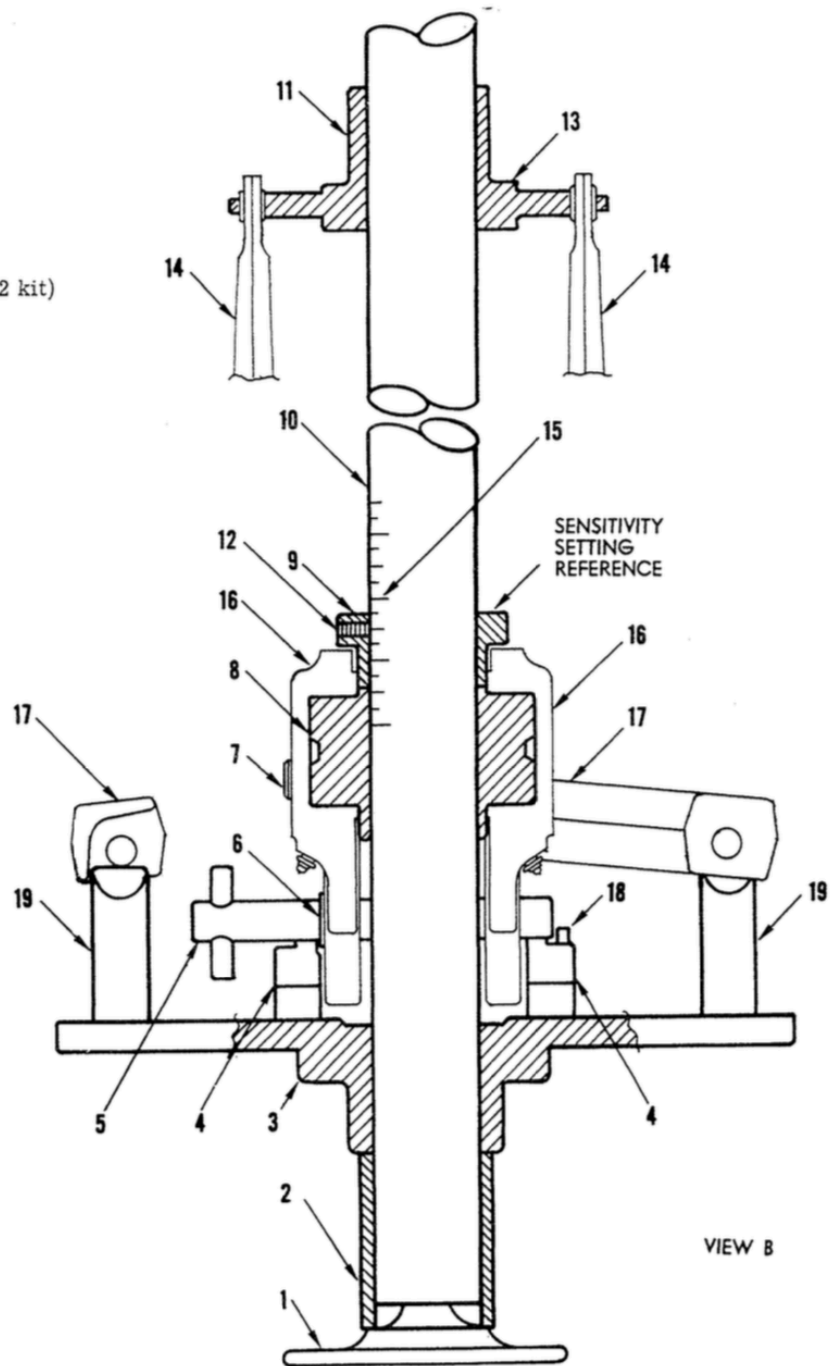


Figure 4-25. Balancer Installation – Gyrodyne QH-50C Drone Helicopter Upper and Lower Rotor Assemblies (Sheet 2 of 2)

i. Carefully set rotor hub assembly on adapter assembly (3) so that projecting ends of rotor positioning pins (5) rest on four adapter support blocks (4). Plain ends of rotor positioning pins shall rest inside guide pins (18) of two diametrically opposite support blocks.

j. Install rotor blades and blade retaining bolts in rotor spindle and pitch horn assemblies; install washers and nuts and tighten to 120 inch-pounds.

**CAUTION**

Weight of first blade to be installed must be supported until second blade is installed.

k. Install the rotor tip brake control rod ends to the tip brake shafts and secure with bolts, washers and nuts.

l. Position rotor pitch arms so that their link bolts rest solidly on top of pitch positioning posts (19).

m. Install blade indexing adapter plug (Gyrodyne Tool No. Y63-345700-502), (not shown) downward through rotor piloting adapter (8) and hub of adapter assembly (3). Rotate blade indexing adapter so that its cut-out section parallels the blade feathering axis.

n. Install the line assembly of the blade index adapter in the feathering axis detents of the blade tips so that the line weights hang clear and the center of the line passes through the cut-out section of the blade indexing adapter plug.

o. Adjust center scope of blade index adapter plug to bring the line into sharpest focus. Shift blade tips chordwise as required, by gentle hand tapping to align center of line with scope cross hair intersection.

p. Being careful to avoid shifting blade chordwise positions, tighten rotor blade nuts to final assembly torque specified.

q. Re-check scope to insure line position has not been disturbed; carefully remove line assembly, together with blade index plug, from rotor assembly.

**CAUTION**

If position of blades is inadvertently disturbed, repeat alignment operation before proceeding with balance check.

r. Install cam (9), knurled flange upward over top end of arbor (10); align top surface of cam with 11-3/4 inch position on arbor scale (15) and lock in this position with cam set screw (12, view B), using 1/8-inch hex wrench (7A050, 7HEL062 kits).

s. Install arbor (10) downward through adapter (8) and hub of adapter assembly (3); rotate arbor to align index marks (top view of cam, view A) with long axis of rotor and lower arbor until lower surface of cam seats firmly on top surface of adapter (8). Rotate cam and arbor in counter-clockwise direction until cam surfaces contact flanges of the two rotor hub plate bushings.

t. Install spacer (2) over lower end of arbor; install hand wheel (1) in bottom end of arbor and tighten gently to secure balancing assembly together.

u. Install yoke assembly (11), flange downward over top end of arbor and align yoke pins (13) with upper ends of rotor tip brake actuating links (14). Install upper ends of

actuating links over yoke pins, seating link bearings against shoulders of yoke pins. Position yoke assembly on arbor so that the rotor tip brakes are just at the point of closing and lock yoke in this position on arbor using 1/8-inch hex wrench (7A050, 7HEL062 kits).

v. Install 3/16 inch cable (7A050 kit) with quick-disconnect coupling (7A050 kit) on arbor suspension rod. Hoist entire assembly approximately 1/4 inch off work stand observe indicated balance condition.

w. For balance tolerances and application of balance corrections, refer to helicopter maintenance manual.

x. Following attachment of indicated balance corrections, remove arbor and repeat steps m, n, and o to verify alignment of blades. If blades are misaligned, realign them and repeat balance check of rotor, revising previous balance corrections as required. Again recheck blade alignment until satisfactory.

**4-65. HILLER OH-23 HELICOPTER.**

**4-66. OH-23 ENGINE FAN ASSEMBLIES BALANCE CHECK. (See figure 4-26.)**

a. Select applicable extension pilot plug as follows: use plug (1) for fans prior to OH-23 Series D (See View A); use plug (13) for OH-23 Series D and subsequent fans (see View B).

b. Assemble applicable extension pilot plug in coupling (11) against coupling stop pins (5) as shown. Secure plug with two lower coupling set screws (4), using 3/32 inch hex wrench (7HEL053 kit).

c. Insert extension pilot plug through fan hub (3) from flat side of fan.

d. Install collar (12) over projecting end of extension pilot plug as follows: for fans prior to OH-23 Series D, install collar with flat end toward fan (see View A); for OH-23 Series D and subsequent fans, install collar with cone end toward fan (see View B). Seat collar and extension pilot plug firmly against sides of fan hub, and lock in position with collar set screw (2), using 3/32-inch hex wrench.

e. Insert lower end of balancing arbor (9) in open end of coupling (11), bottoming arbor against coupling internal stop pins (5). Lock arbor securely in this position by moderate and uniform tightening of two upper coupling set screws (6), using 3/32-inch hex wrench.

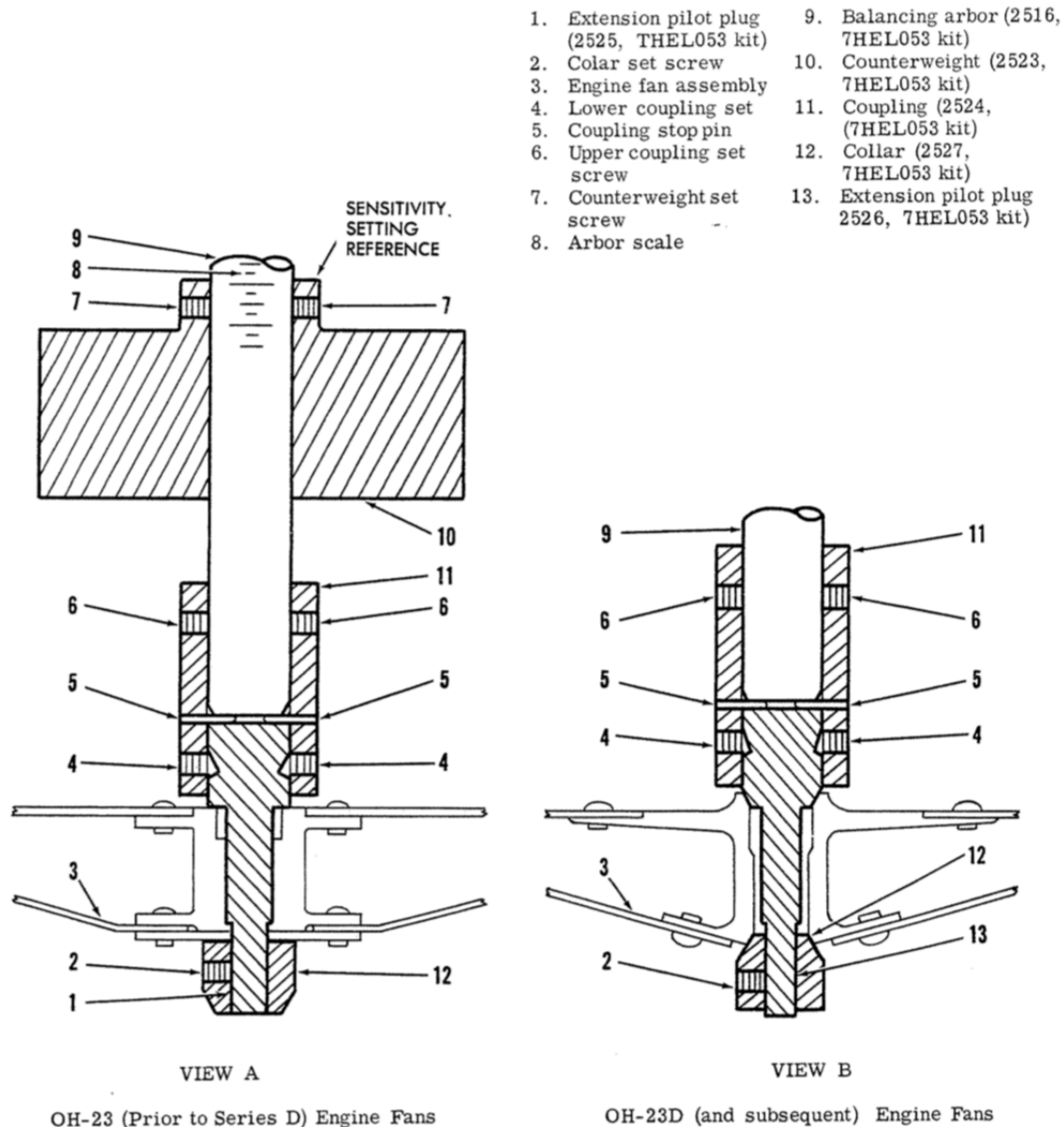
f. Install counterweight (10), hub upward, over upper end of arbor assembly. Position counterweight so that top surface of hub aligns on arbor scale (8) as follows:

1. Fans prior to OH-23D – 10-inch position
2. OH-23D series and subsequent fans – 10-1/4 inch position

g. Lock counterweight in this position by moderate and uniform tightening of two counterweight set screws (7), using 3/32-inch hex wrench.

h. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free of interference. Note balance condition indicated by black indicator disc at top end of arbor.

i. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.



**Figure 4-26. Balancer Installation – OH-23 Helicopter Engine Fan Assembly**

4-67. OH-23 ENGINE FAN ASSEMBLIES TRACK AND CONCENTRICITY CHECK.

(See figure 4-27.)

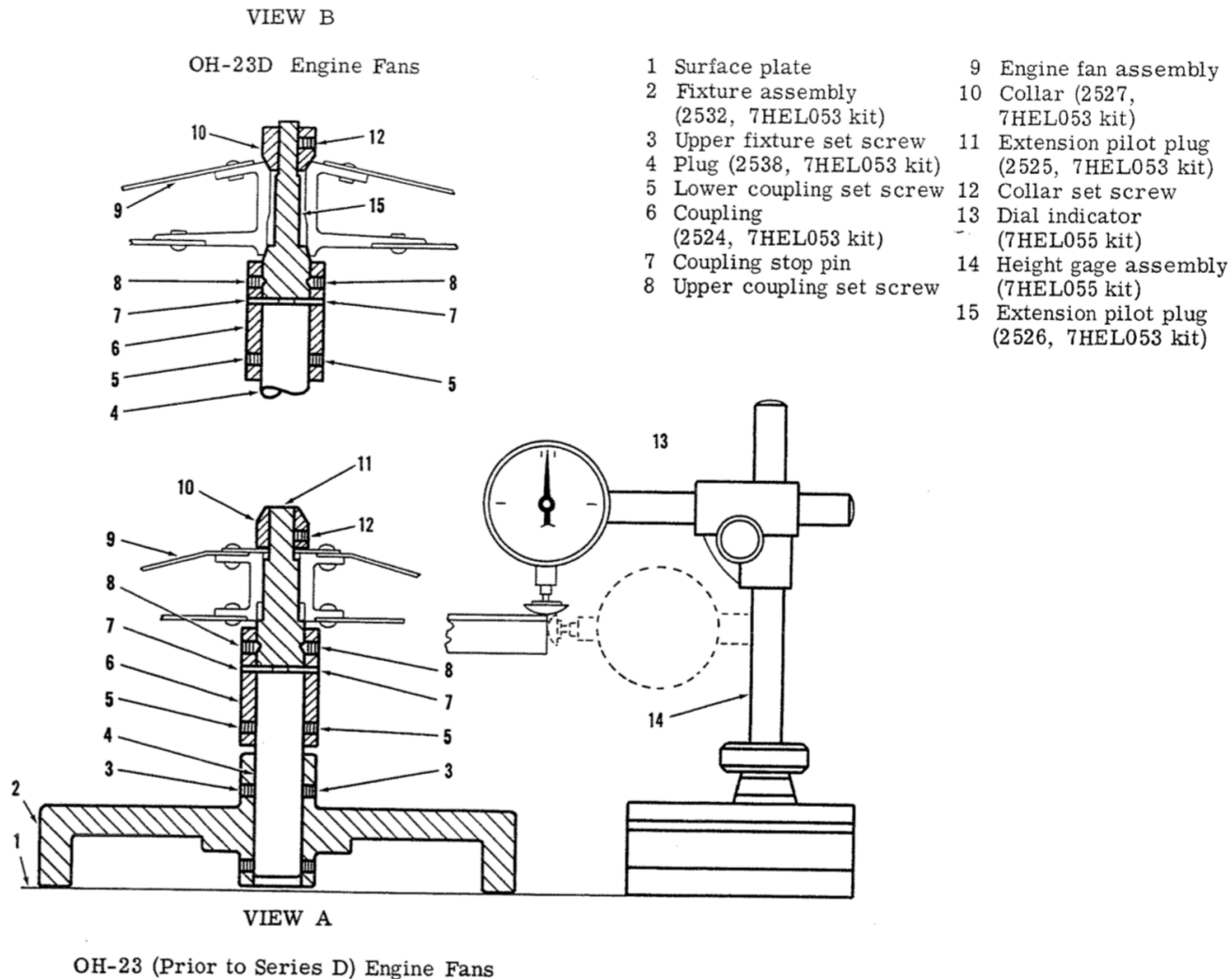
a. Select applicable extension pilot plug as follows: use plug (11) for fans prior to OH-23 Series D (See View A); use plug (15) for OH-23 Series D and subsequent fans (see View B).

b. Assemble applicable extension pilot plug in coupling (6) against coupling stop pins (7) as shown. Secure plug with two upper coupling set screws (8) at extension pilot plug end of coupling, using 3/32-inch hex wrench (7HEL053 kit).

c. Insert extension pilot plug through fan (9) hub from flat side of fan.

d. Install collar (10) over projecting end of extension pilot plug as follows: for fans prior to OH-23 Series D, install collar with flat end toward fan (see View A); for OH-23 Series D and subsequent fans, install collar with cone end toward fan (see View B). Seat collar and extension pilot plug firmly against sides of fan hub, and lock in position with collar set screw (12), using 3/32-inch hex wrench.

e. Clamp fixture (2), recessed side downward, on surface plate (1) or other firm support surface.



**Figure 4-27. Set-Up for OH-23 Helicopter Engine Fan Assembly Track and Concentricity Check**

f. Install plug (4) in fixture (2) hub so that approximately 1-3/4 inches of plug projects above top of fixture hub. Lock plug securely in this position with two upper fixture hub set screws (3), using 3/32-inch hex wrench (7HEL053 kit).

g. Install open end of coupling (6) (attached to fan assembly) over plug (4), bottoming plug against coupling stop pins (7). Do not lock coupling lower set screws.

h. Install 1/2-inch mushroom point on dial indicator (13), and adjust height gage assembly (14) to read track or concentricity variations as required. Rotate fan to determine range of variations.

i. For track and concentricity tolerances and application of corrections, refer to applicable helicopter manual.

**4-68. OH-23 (PRIOR TO SERIES D) TAIL ROTOR-COMplete ASSEMBLY BALANCE CHECK.**  
(See figure 4-28.)

a. Install sleeve (4), hub upward, on balancing arbor

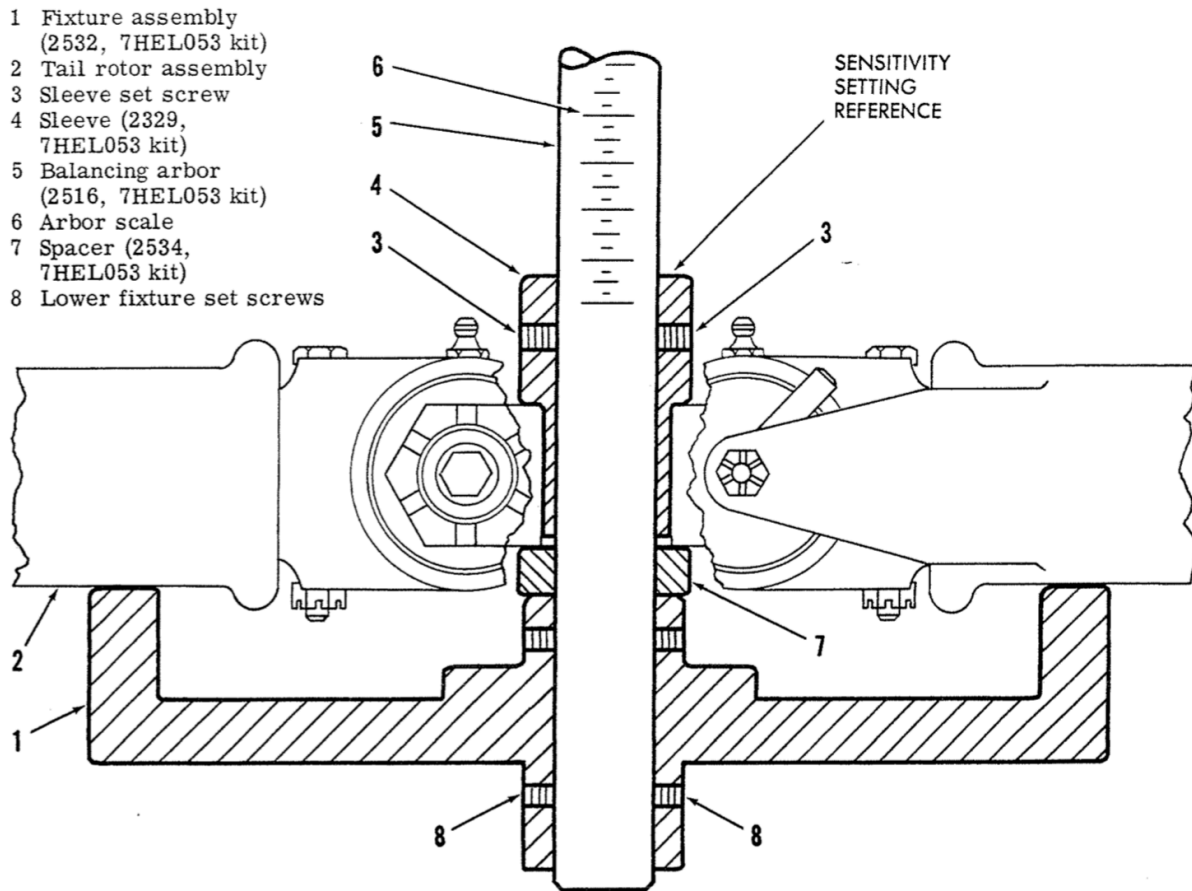
(5) so that top sleeve hub aligns with 7-1/4-inch position on arbor scale (6). Lock sleeve in this position by moderate and uniform tightening of two sleeve set screws (3), using 3/32-inch hex wrench.

b. Insert lower end of arbor and pilot of sleeve (4) through rotor hub (2) splines, ensuring that sleeve hub seats firmly against rotor hub.

c. Install spacer (7) and fixture (1), recessed side upward, over lower end of arbor. Press downward on sleeve (4) and upward on fixture (1) to seat all components firmly together. Lock components in this position by moderate and uniform tightening of fixture lower set screws (8).

d. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free of interference. Position pitch arm ball ends (if installed) against centers of slot ends; keep them symmetrically positioned during balancing operation, and note the balance condition indicated by black indicator disc at top end of the arbor.

e. For balance tolerance and application of balance corrections, refer to applicable manual.



**Figure 4-28. Balancer Installation - OH-23 (Prior to Series D) Helicopter Tail Rotor Complete Assembly**

4-69. OH-23 (SERIES D AND SUBSEQUENT) TAIL ROTOR HUB AND YOKE ASSEMBLY ONLY BALANCE CHECK. (See figure 4-29.)

- a. Set fixture (2), recessed side up, on suitable auxiliary block (1).
- b. Place spacer (3) centrally on top of fixture (2) hub.
- c. Set tail rotor hub assembly (4) centrally on spacer (3), with hub shafts resting on rim of fixture (2).
- d. Insert lower end of balancing arbor (5) downward through rotor hub splines, spacer (3), and fixture hub (2) until 7-5/8-inch position on arbor scale (6) aligns with top surface of rotor splined hub. Lock arbor in this position by moderate and uniform tightening of two lower fixture set screws (7), using 3/32-inch hex wrench (7HEL053 kit).
- e. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free of interference, and note the balance condition indicated by black indicator disc at top end of the arbor.
- f. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

**Note**

Adhere to specified instructions.

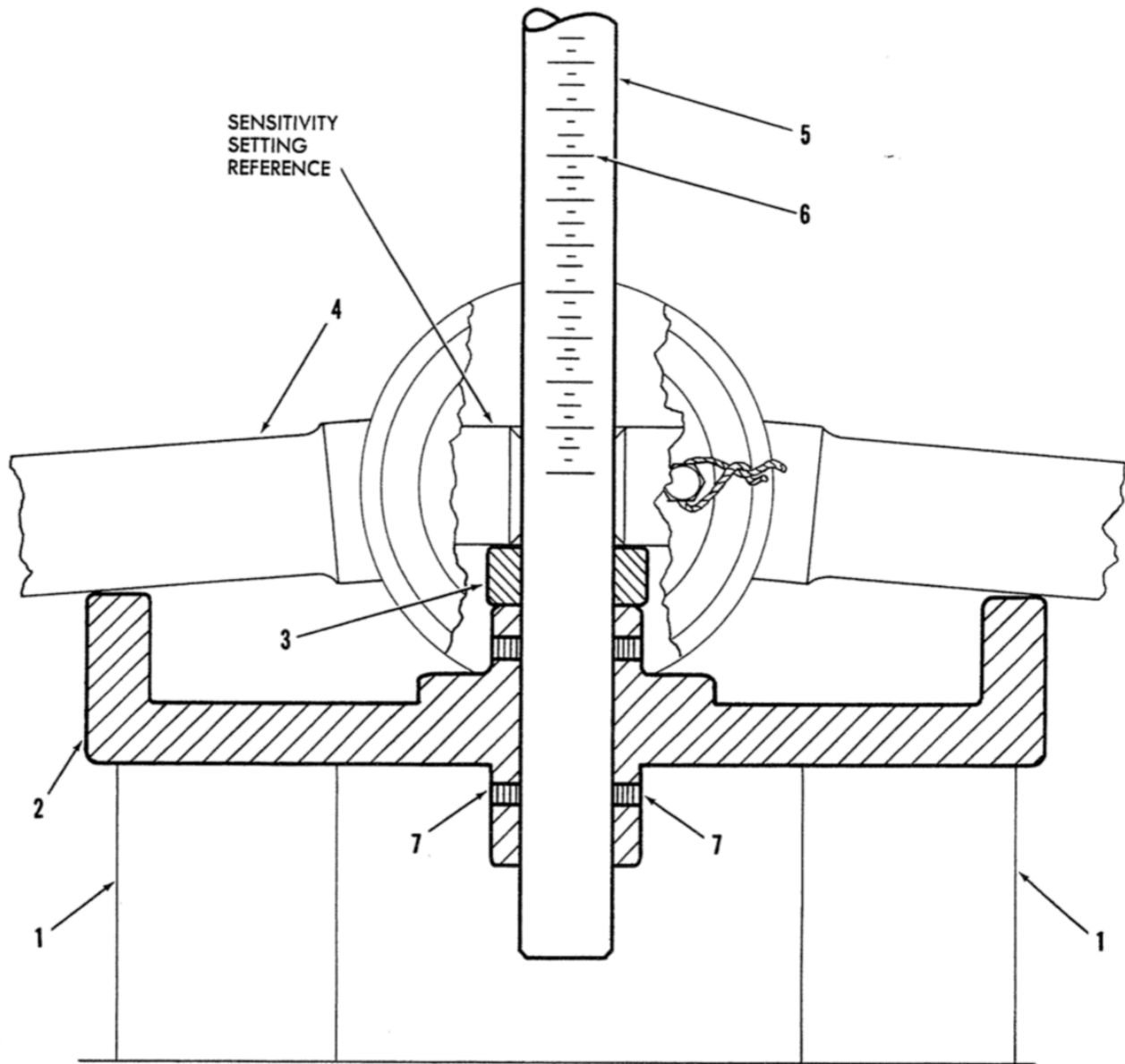
4-70. OH-23 (SERIES D AND SUBSEQUENT TAIL ROTOR COMPLETE ASSEMBLY BALANCE CHECK. (See figure 4-30.)

**Note**

The following procedure shall be used in cases where selective matching of used or repaired rotor blades with new replacement blades is required. For prior balancing of rotor hub and yoke assembly only, see paragraph 4-69.

- a. Set fixture (2), recessed side up, on suitable auxiliary support block (1).
- b. Place spacer (3) centrally on top of fixture hub (2).
- c. Set tail rotor hub and blade assembly (4) approximately centered on fixture.
- d. Install sleeve (6), hub downward, on balancing arbor (7), aligning top of sleeve with 8-inch position on arbor scale (8). Lock sleeve in this position by moderate and uniform tightening of two sleeve set screws (5), using 3/32-inch hex wrench (7HEL053 kit).
- e. Insert lower end of arbor downward through rotor hub splines, spacer (3), and fixture (2), pressing all components firmly together. Lock components in this position by moderate and uniform tightening of two lower fixture set screws (9), using 3/32-inch hex wrench.





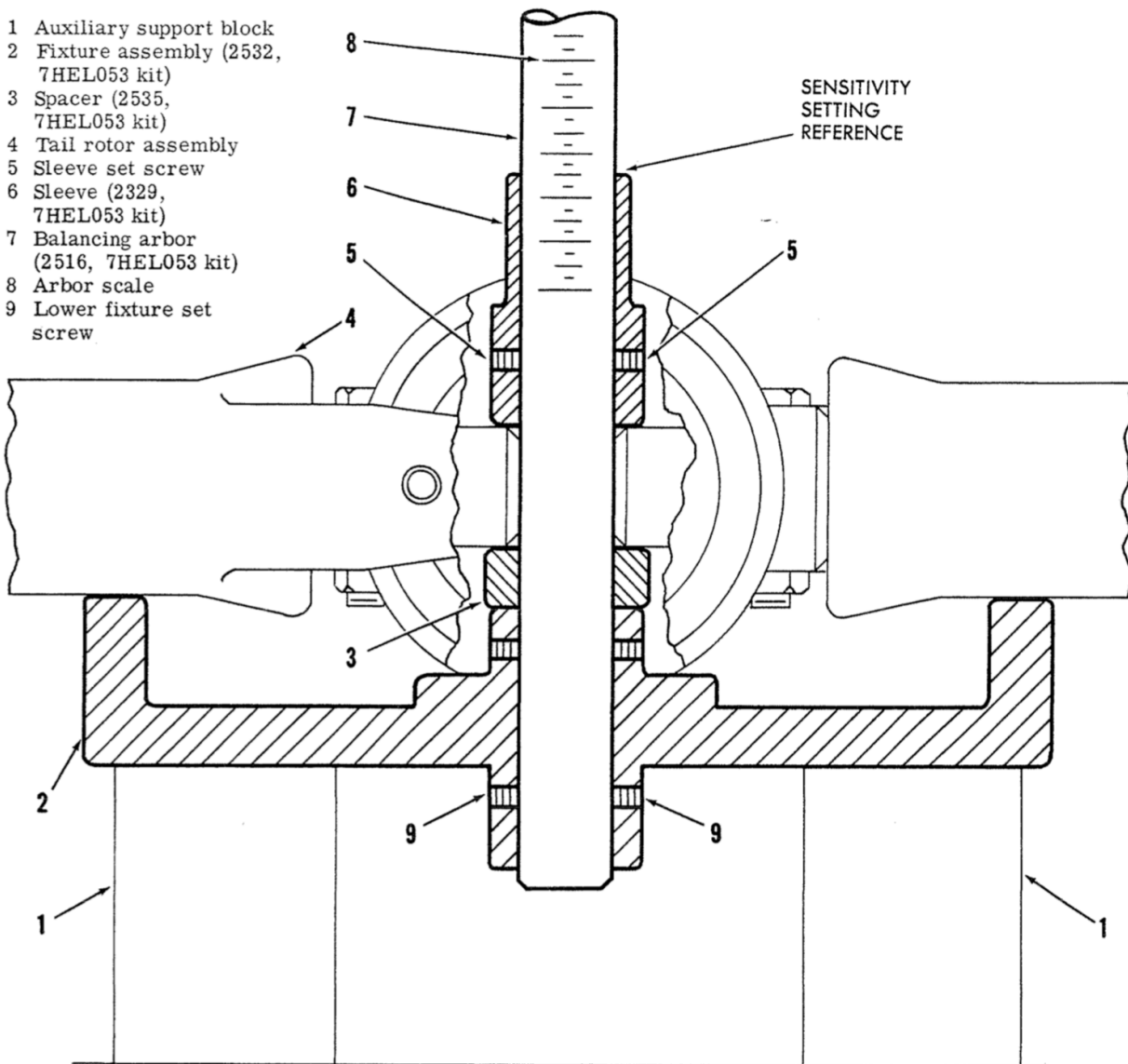
- |  |                                       |
|--|---------------------------------------|
| 1 Auxiliary support block              | 4 Tail rotor hub and yoke assembly    |
| 2 Fixture assembly (2532, 7HEL053 kit) | 5 Balancing arbor (2516, 7HEL053 kit) |
| 3 Spacer (2535, 7HEL053 kit)           | 6 Arbor scale                         |
|  | 7 Lower fixture set screw             |

**Figure 4-29. Balancer Installation – OH-23 (Series D and Subsequent) Helicopter Tail Rotor Hub and Yoke Assembly**

f. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free of interference. Position rotor pitch arm ball ends vertically downward and keep them symmetrically

positioned during balance checks, and note the balance condition indicated by black indicator disc at top end of the arbor.

g. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.



**Figure 4-30. Balancer Installation – OH-23 (Series D and Subsequent) Helicopter Tail Rotor Complete Assembly**

**4-71. OH-23 MAIN ROTOR HEAD AND CONTROL ROTOR ASSEMBLY BALANCE CHECK.**  
(See figure 4-31.)

- a. Center fixture (1) on work stand (1, figure 1-13).
- b. Carefully lower rotor assembly (2), with drag struts removed, over fixture (1) so that upper diameter of fixture enters inside diameter of hub splined trunnion. Make certain that base of rotor hub seats squarely on base of fixture.

**Note**

Rotor forks shall be locked in symmetrical positions, using arm assemblies, blade leveling, FSN 4920-509-5193. Refer to applicable helicopter manual.

- c. Install balancing arbor (3) downward through fixture pilot hole.

- d. Install suspension cable (13, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

- e. Adjust suspended height of arbor so that 14-1/4 inch position on arbor scale (4) aligns with top surface of fixture (1).

- f. Install spacers (5), Part Nos. 2202 and 2203 (7A050 kit), on bottom end of arbor.

- g. Install hand wheel, Part No. 2215 (7A050 kit), in bottom end of arbor, and tighten wheel to seat spacers (5) under base of fixture (1). Check to ensure that sensitivity setting specified in step e. has been maintained.

h. Hoist entire assembly approximately ¼ inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by black indicator disc at top end of the arbor.

i. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

**4-72. OH-23 MAIN ROTOR HEAD AND BLADE ASSEMBLY BALANCE CHECK.**

(See figure 4-31.)

a. Assemble hoist support structure (7A050 Kit) as shown in page 3-2, figure 3-3, except use Part No. 2769 Tube Assembly in lieu of Part No. 2288 Tube Assembly to provide additional arm height. The Part No. 2769 Tube Assembly is not available in the 7A050 Kit; therefore, it must be requisitioned.

Note

Deleted

b. Center fixture (1) on work stand (1, figure 1-13).

c. Carefully lower rotor assembly (2) over fixture (1) so that upper diameter of fixture enters inside diameter of hub splined trunnion. Make certain that base of rotor hub seats squarely on base of fixture.

Note

Rotor forks shall be locked in symmetrical position, using arm assembly, blade leveling, FSN 4920-509-5193. Refer to applicable helicopter manual.

d. Install balancing arbor (3) downward through fixture pilot hole.

e. Install suspension cable (13, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

f. Adjust suspended height of arbor so that top surface of fixture (1) aligns with arbor scale (4) as follows:

1. Wood-blade rotor assemblies – 11-3/4 inch position.
2. Metal-blade rotor assemblies – 9-1/2 inch position.

g. Install spacers (5) on bottom end of arbor as follows:

1. Wood-blade rotor assemblies – Part No. 2203 (7A050 kit).
2. Metal-blade rotor assemblies – Part No. 2201 (7A050 kit).

h. Install hand wheel, Part No. 2215 (7A050 kit), in bottom end of arbor, and tighten wheel to seat spacer (5) under base of fixture (1). Check to ensure that sensitivity setting specified in step f. has been maintained.

i. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by black indicator disc at top end of arbor.

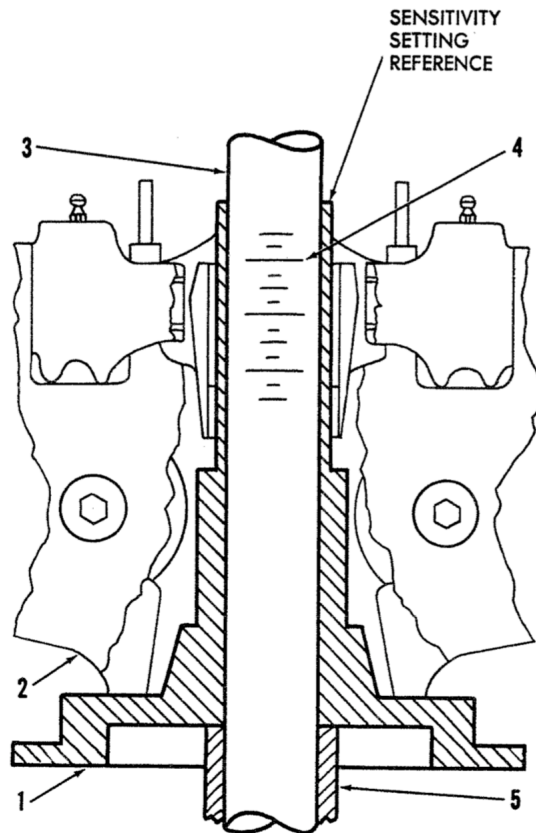
Note

The span of the rotor blades makes it essential that this balance check be performed in a draft free area and that the movement of personnel in the area be held to a minimum.

j. For balance tolerance and application of balance corrections refer to applicable helicopter manual.

Note

Adhere to the instructions included in the appropriate manual to ensure a balanced assembly.



- |                                     |               |
|-------------------------------------|---------------|
| 1 Fixture (2337, 7HEL054 kit)       | 4 Arbor scale |
| 2 Rotor assembly                    | 5 Spacers     |
| 3 Balancing arbor (2259, 7A050 kit) |               |

**Figure 4-31. Balancer Installation – OH-23 Helicopter Main Rotor Head and Control Rotor Assembly**

4-73. KAMAN UH-2A HELICOPTER.

4-74. UH-2A TAIL ROTOR BLADE AND GRIP ASSEMBLY  
BALANCE CHECK.  
(See figure 4-32.)

Note

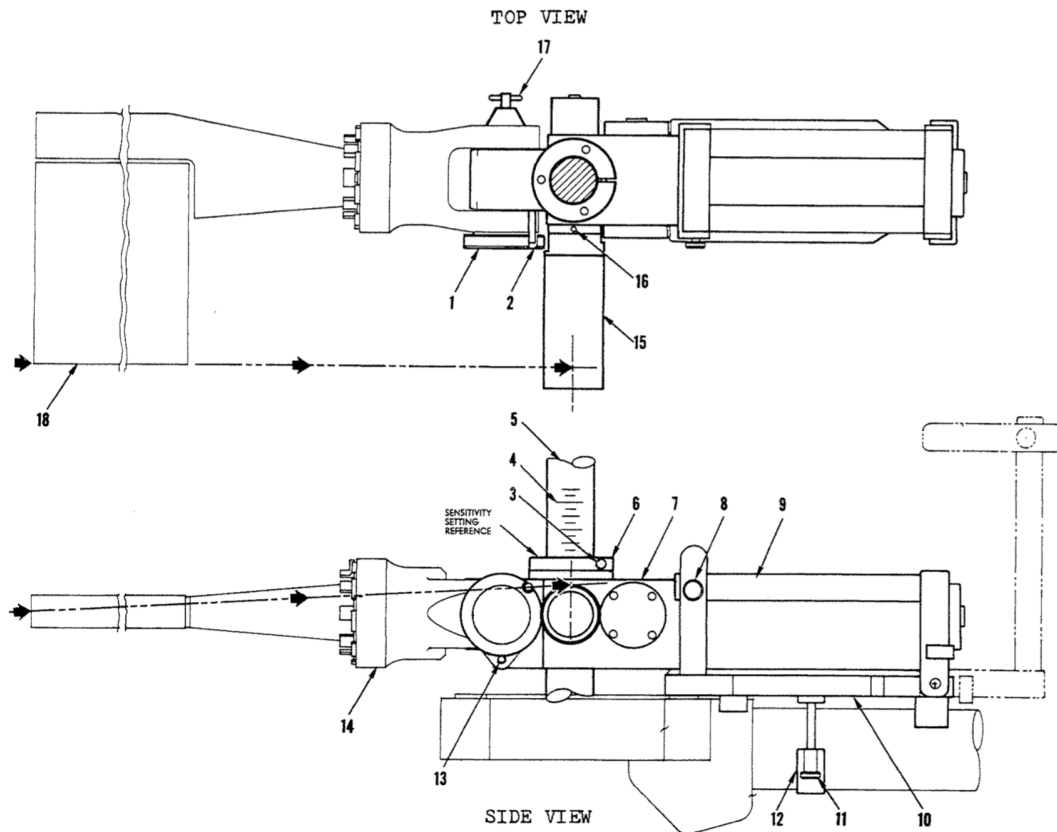
The assembly is balanced with pitch arm and fly – weight. “Purging” is required to ensure bearing sleeves and uniformly filled with grease; for this procedure, see applicable helicopter maintenance handbook.

a. Place adapter base (10) on work stand (7A050 kit) as shown; open end of adapter base shall align with inside

diameter of round work stand casting. Install adapter clamp assembly (12) and uniformly tighten the two knurled adapter clamp screws (11) to hold adapter firmly in position on work stand.

b. With adapter cage (9) opened as shown in phantom view, place fixture body (7) on rubber pad of adapter base so that fixture clamp ring (6) is visually centered over diameter of work stand casting. Adjust position of fixture body (7) so that adapter cage (9) can be closed over the square end of fixture body. Lock adapter cage and fixture together in this position by tightening knurled adapter cage lock screw (8) against side of fixture body.

c. Temporarily install pin (13) through two small holes in fork of rotor blade grip. With this side of the blade grip downward, carefully fit fork of blade grip over end of fixture as shown. Install fixture pin (1) through blade fork and pilot



- 1 Fixture pin (2565, 7HEL059 kit)
- 2 Fixture pin index slot
- 3 Fixture clamp ring lock screw
- 4 Arbor scale
- 5 Balancing arbor (2259, 7A050 kit)
- 6 Fixture clamp ring

- 7 Fixture body (2565, 7HEL059 kit)
- 8 Adapter cage lock screw
- 9 Adapter cage (2568, 7HEL059 kit)
- 10 Adapter base (2568, 7HEL059 kit)
- 11 Adapter clamp screw (2)

- 12 Clamp assembly
- 13 Pin MS20392-5-93, (Rotor installation)
- 14 Tail rotor blade and grip assembly
- 15 Blade aligning gage (2651, 7HEL059 kit)
- 16 Gage lock screw
- 17 Fixture pin lock screw
- 18 Blade trailing edge

Figure 4-32. Balancer Installation – UH-2A Tail Rotor Blade and Grip Assembly

hole in fixture; ensure that index slot (2) in head of fixture pin aligns with projecting dowel in side of fixture and that head of fixture pin seats firmly against fork of blade grip. Tighten fixture pin lock screw (17) to secure fixture pin and blade grip in final balancing position.

**CAUTION**

Chordwise and spanwise moments of the 2565 fixture assembly (7), including its matched fixture pin assembly (1), have been carefully matched with factory master blade moments. Moment adjustments in the fixture are carefully locked and sealed to ensure against inadvertent shifting and to discourage casual tampering. Using activities are cautioned against removing any of the various sealed screws and plugs from the fixture or its matched fixture pin, since any such removal will invalidate its basic function as a moment standard against which chordwise and spanwise moments of UH-2A tail rotor blade and grip assemblies may be gaged. Continued accuracy of the fixture moments may be verified by balance checking factory-new blade and grip assemblies using the procedures described above; chordwise and spanwise moments of such factory-new blades shall balance those to the fixture within the blade and grip assembly balance tolerances specified by the aircraft manufacturer.

d. Install balancing arbor (5) downward through fixture clamp ring and fixture pilot bore until 12 inch position on arbor scale aligns with top surface of fixture clamp ring (sensitivity setting reference). Lock firmly in this position by tightening clamp ring lock screw (3), using 5/32-inch hex wrench (7HEL059 kit).

e. Install gage (15) over small ground plate on side of fixture as shown. Tighten gage lock screw (16), using 3/32-inch hex wrench (7HEL059 kit) to secure gage squarely against side of fixture body.

f. Sighting along blade trailing edge (18) as indicated by arrows, adjust blade pitch so that projection of blade trailing edge aligns with top surface of gage (15); be sure to remove gage from fixture before proceeding with balancing operations.

g. Observe caution note engraved on gage (15). Be sure to remove gage from fixture before proceeding with balancing operations.

h. Install quick-disconnect coupling (7A050 kit) with 3/16 inch cable (7A050 kit) and take up slack in cable with hydraulic pump (7A050 kit). Loosen adapter cage lock screw (8) and tilt cage to full open position as shown in phantom view.

i. Hoist fixture and blade assembly approximately 1/4 inch of adapter base. Check to insure that the suspended assembly is free from interference with the work stand or adjacent objects. Observe balance condition indicated by indicator disc at top of balancing arbor.

j. For balance tolerances and application of balance corrections, refer to applicable helicopter maintenance handbook.

4-75. SIKORSKY CH-19 HELICOPTER

4-76. CH-19 ENGINE FAN ASSEMBLY BALANCE CHECK  
(See figure 4-33.)

a. Center fan assembly (1), with shroud upward, on work stand (1, figure 1-13).

b. Install cone (2), hub upward, on balancing arbor (3) so that top surface of cone hub aligns with 12-1/2 inch position on arbor scale (4). Secure cone in this position by tightening cone set screw (5) with 1/8-inch hex wrench (8, figure 1-13).

c. Install arbor downward through fan hub, seating bottom surface of cone (2) in the approximate center and on top of the fan hub.

d. Install plate (6), hub downward, over bottom end of arbor. Seat pilot lip on top surface of plate firmly and squarely over pilot diameter on bottom surface of fan hub. Do not tighten plate hub set screw.

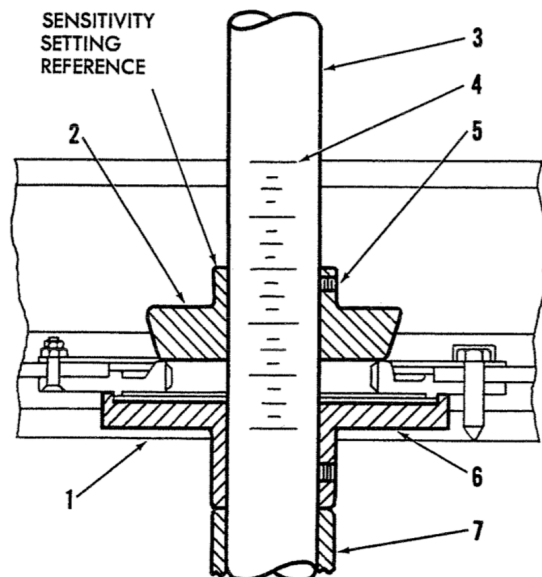
e. Install spacers (7) on arbor under plate hub (6).

f. Install hand wheel, Part No. 2215 (7A050 kit), in bottom of arbor, and tighten wheel to clamp spacers, plate, fan hub, and top cone securely together.

g. Install suspension cable (14, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by black indicator disc at top end of the arbor.

i. For balance tolerance and application of balance corrections, refer to applicable manual.



- |                                     |   |
|-------------------------------------|---|
| 1 Engine fan assembly               | 5 Cone set screw                            |
| 2 Cone (2228, 7A050 kit)            | 6 Plate (2342, 7HEL055 kit)                 |
| 3 Balancing arbor (2259, 7A050 kit) | 7 Spacers (2202, 2203, and 2204, 7A050 kit) |
| 4 Arbor scale                       |   |

**Figure 4-33. Balancer Installation – CH-19 Helicopter Engine Fan Assembly**

4-77. CH-19 ENGINE FAN ASSEMBLY TRACK AND CONCENTRICITY CHECK.

(See figure 4-34.)

a. Set base (2) on surface plate (1) or other firm and level support surface. Bolt or clamp base securely to support surface.

b. Install lower end of balancing arbor (3) in base pilot hole (2). Make certain that arbor is firmly bottomed and free to rotate in base.

c. Install plate (4), hub downward, on arbor so that bottom of plate hub clears top of base (2) by approximately 1/4 inch. Secure plate in this position by tightening plate set screw (8) with 1/8-inch hex wrench (8, figure 1-13).

d. Install fan assembly (7), shroud upward, on plate (4). Check to ensure that fan hub pilot diameter seats firmly and squarely inside plate pilot lip.

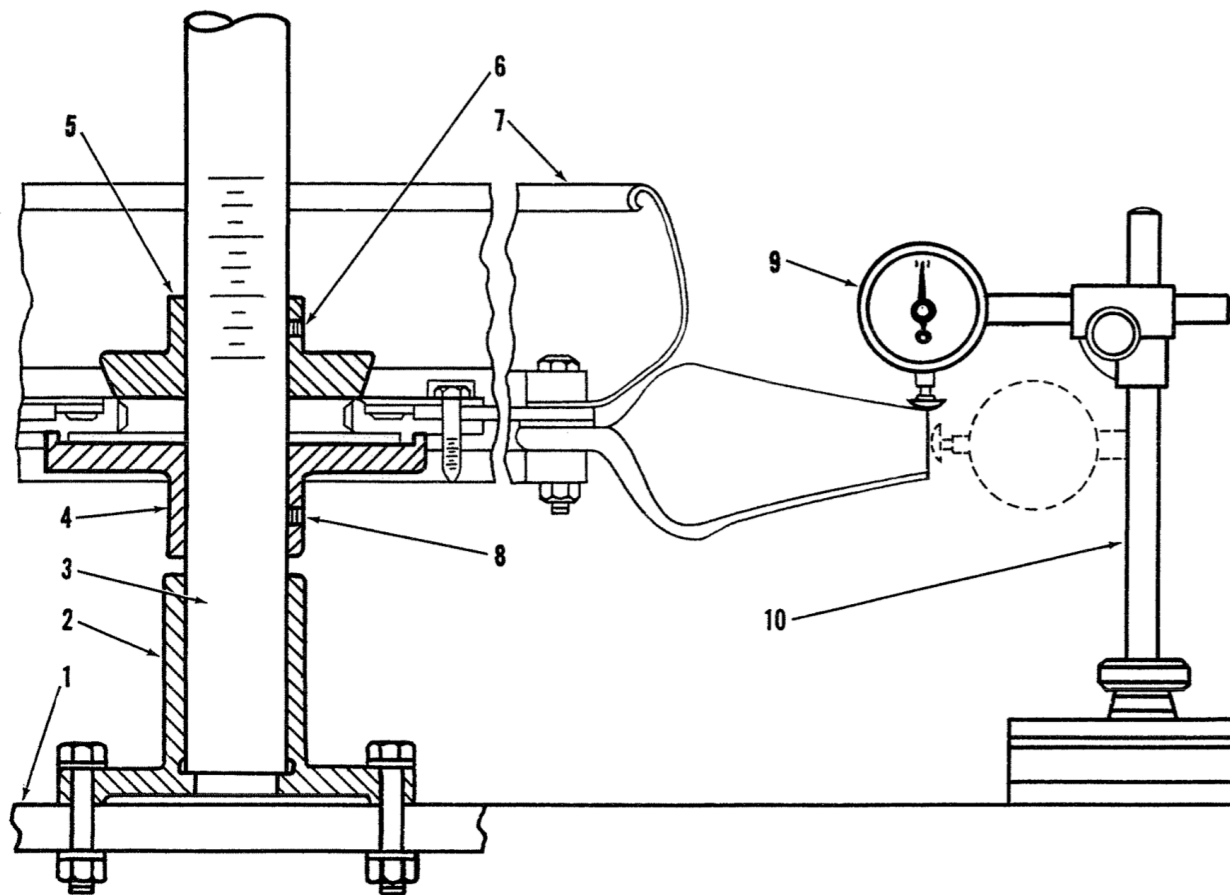
e. Install cone (5), hub upward, over top of arbor. Press cone (5), firmly against top of fan hub, and secure cone in this position by tightening cone set screw (6) with 1/8-inch hex wrench.

f. Install 1/2 inch mushroom point on dial indicator (9), and adjust height gage assembly (10) to read track or concentricity variations as required. Rotate fan and arbor assembly to determine range of variations.

g. For track and concentricity tolerances and application of corrections, refer to applicable helicopter manual.

Note

Make sure dial indicator and gage assembly are solidly positioned.



- |                                     |                                       |
|-------------------------------------|---------------------------------------|
| 1 Surface plate                     | 6 Cone set screw                      |
| 2 Base (2341, 7HEL055 kit)          | 7 Engine fan assembly                 |
| 3 Balancing arbor (2259, 7A050 kit) | 8 Plate set screw                     |
| 4 Plate (2342, 7HEL055 kit)         | 9 Dial indicator (7HEL055 kit)        |
| 5 Cone (2228, 7A050 kit)            | 10 Height gage assembly (7HEL055 kit) |

Figure 4-34. Set-Up for CH-19 Helicopter Engine Fan Assembly Track and Concentricity Check

4-78. CH-19 TAIL ROTOR HUB AND BLADE ASSEMBLY  
BALANCE CHECK – 105-INCH DIAMETER  
CONFIGURATION WITH MOVABLE  
COUNTERWEIGHTS. (See figure 4-35.)

a. Insert lower end of balancing arbor (6) into piloting hub of adapter (1). Align top of adapter hub with 6-3/4 inch position on arbor scale (7). Lock arbor securely in this position by moderate and uniform tightening of two adapter set screws (4), using 3/32-inch hex wrench (7HEL053 kit).

b. Insert sleeve (9) into tail rotor counterweight support spacer, and install spacer between rotor hub trunnion and bottom surface of counterweight support.

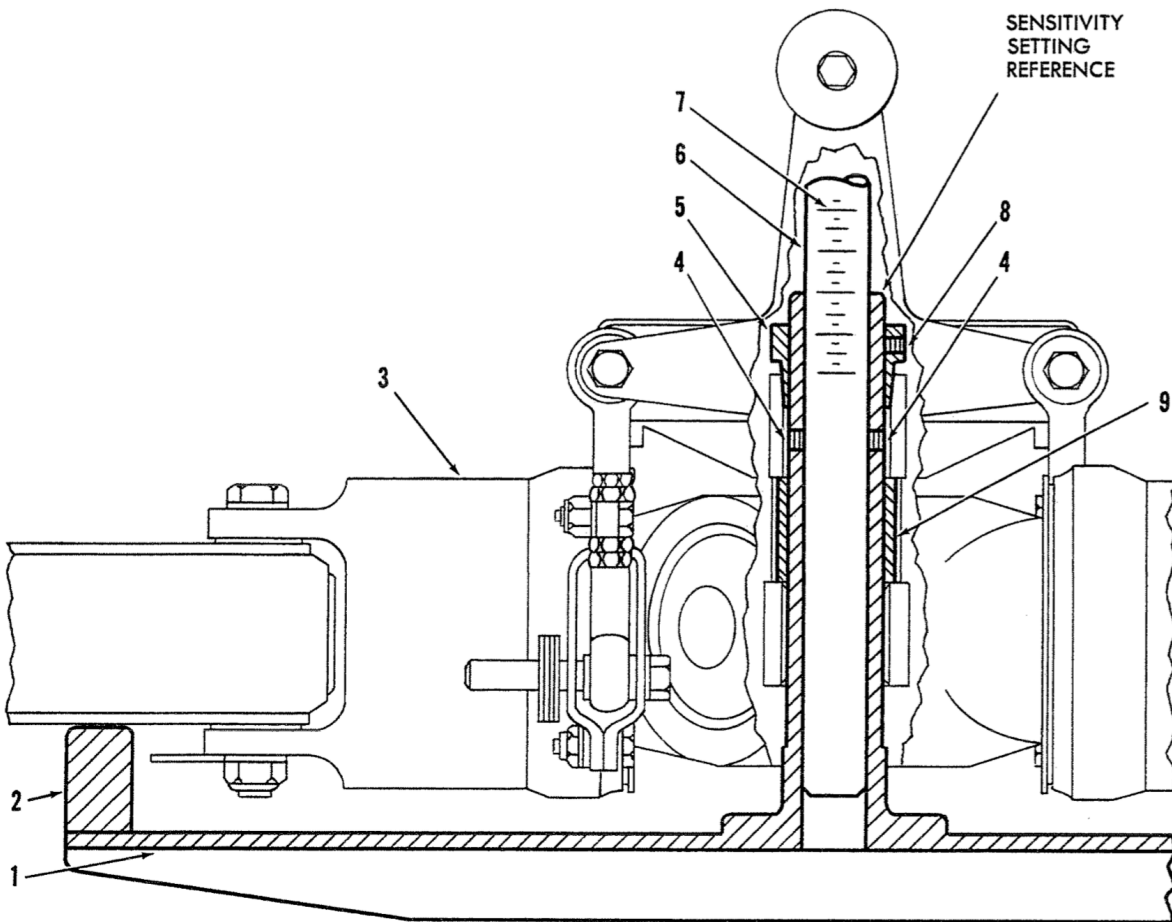
c. Carefully lower rotor hub (3), spacer, and counterweight support over arbor and adapter piloting hub. Align blades with adapter support blocks (2), and ensure that weight of rotor assembly rests squarely on support blocks.

d. Install bushing (5) over arbor and adapter hub. Press tapered pilot on this bushing lightly into upper counterbore of counterweight support, and lock bushing securely in this position by moderate and uniform tightening of two bushing set screws (8), using 3/32-inch hex wrench.

e. Push AN-4-21A pitch control bracket bolts radially outward with heads seated against blade pitch brackets. Ensure that these bolts remain in this position throughout balancing operation.

f. Install quick-disconnect coupling (7HEL053 or 7A050 kit) on arbor suspension coupler, and suspend entire assembly free form interference, and note the balance condition indicated by black indicator disc at top end of the arbor.

g. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.



- 1 Adapter assembly (2522, 7HEL053 kit)
- 2 Adapter support block
- 3 Tail rotor hub and blade assembly
- 4 Adapter set screw
- 5 Bushing (2355, 7HEL053 kit)

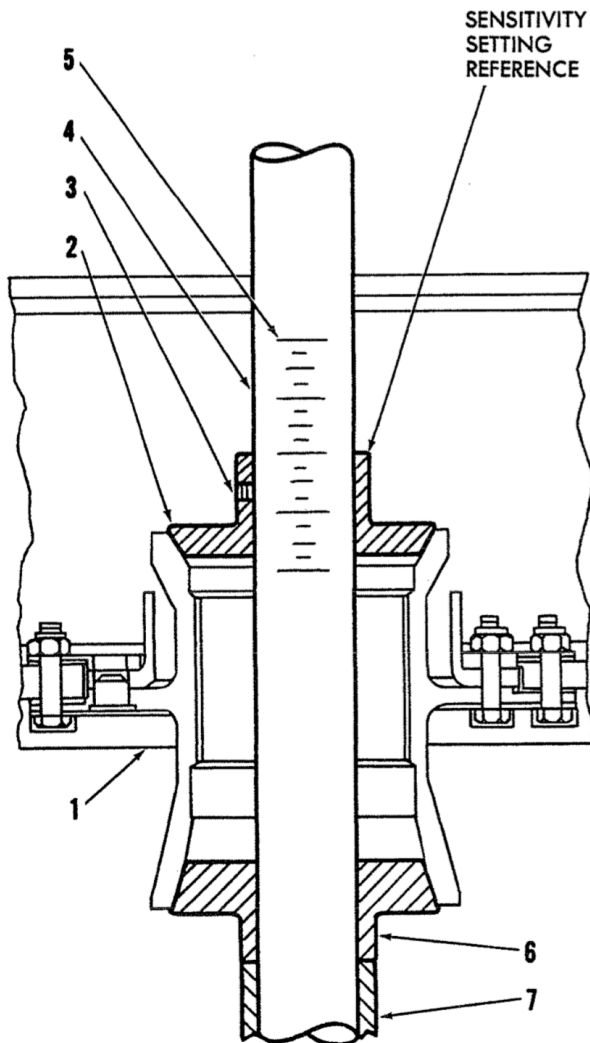
- 6 Balancing arbor (2516, 7HEL053 kit)
- 7 Arbor scale
- 8 Bushing set screw
- 9 Sleeve (2356, 7HEL053 kit)

Figure 4-35. Balancer Installation – CH-19 Helicopter Tail Rotor Hub and Blade Assembly – 105-inch Diameter Configuration with Movable Counterweight Installation

4-79. SIKORSKY SH-34G HELICOPTER.

4-80. SH-34G ENGINE FAN ASSEMBLY BALANCE CHECK. (See figure 4-36.)

- a. Assemble hoist support (2, 3, 4, 5, and 9, figure 1-13) with No. 3 and No. 5 elbows in outermost positions on No. 2 and No. 6 tubes so as to provide radial clearance for fan assembly.
- b. Center fan assembly (1), with shroud (if installed) upward, or work stand (1, figure 1-13).



- 1 Engine fan assembly
- 2 Cone
- 3 Cone set screw
- 4 Balancing arbor (2259, 7A050 kit)
- 5 Arbor scale
- 6 Cone
- 7 Spacers

**Figure 4-36. Typical Balancer Installation – SH-34G, CH-37, CH-21, and UH-25 Helicopter Engine Fans.**

- c. Install cone (2), Part No. 2227 (7A050 kit), hub upward, on balancing arbor (4) so that top of cone hub aligns with 13-3/4 inch position (shrouded fans) or 13-7/8 inch position (unshrouded fans). Lock cone set screw (3) with 1/8-inch hex wrench (8, figure 1-13).
- d. Insert arbor (4) downward through fan hub until cone (2) contacts upper cone seat of fan hub.
- e. Install cone (6), Part No. 2228 (7A050 kit), upward on bottom of arbor (4), making certain that cone sets firmly in bottom cone seat of fan hub.
- f. Install spacers (7), Part Nos. 2202 and 2204 (7A050 kit), on arbor (4) under cone (6) hub.
- g. Install hand wheel, Part No. 2215 (7A050 kit), in bottom end of arbor, and tighten wheel to clamp spacers, bottom cone, fan hub, and top cone securely together.
- h. Install suspension cable (14, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.
- i. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by black indicator disc at top end of the arbor.
- j. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

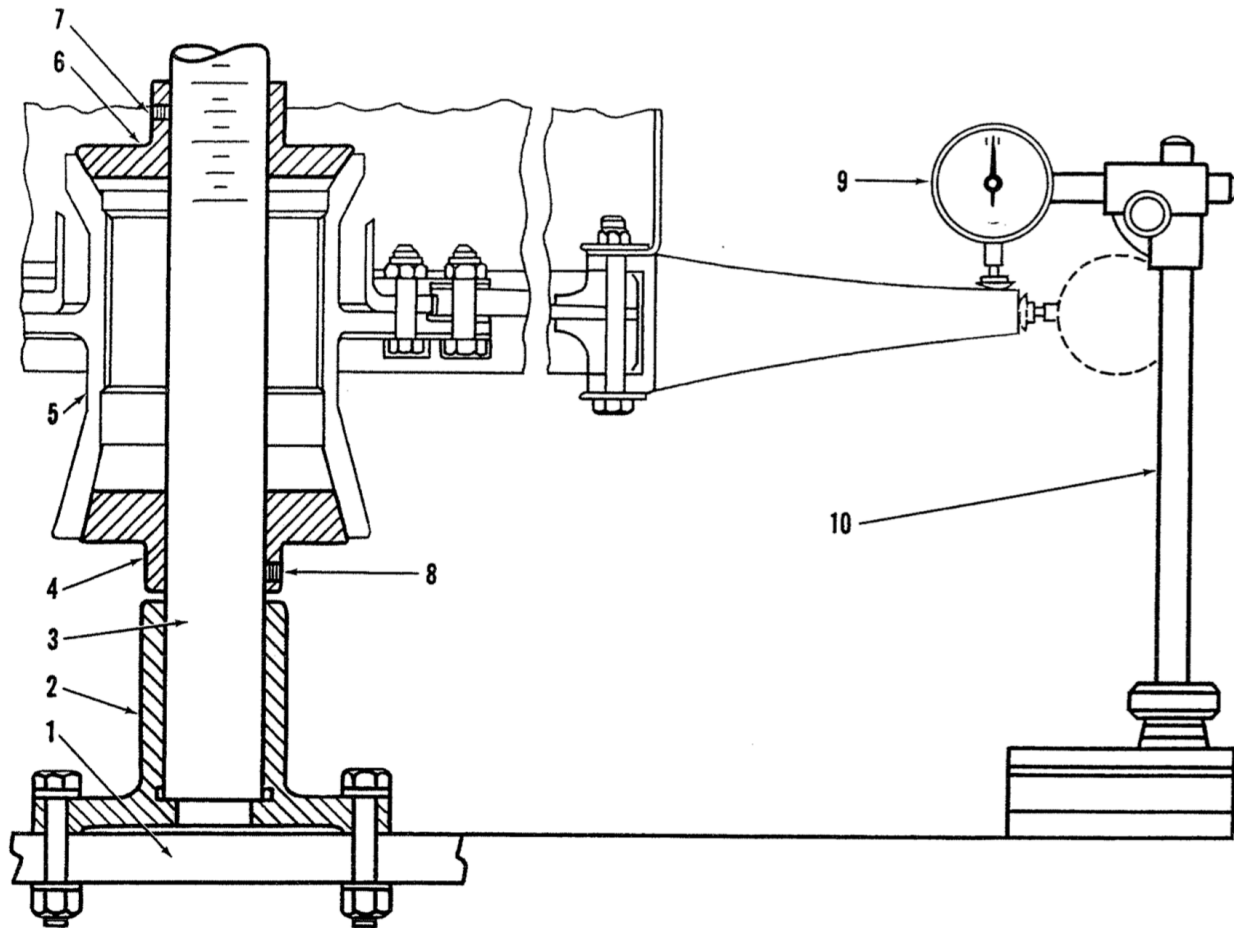
4-81. SH-34G ENGINE FAN ASSEMBLY TRACK AND CONCENTRICITY CHECK.

- (See figure 4-37).
- a. Set base (2) on surface plate (1) or other firm and level support surface. Bolt or clamp base securely to support surface.
  - b. Install lower end of balancing arbor (3) in base (2) pilot hole. Make certain that arbor is firmly bottomed and free to rotate in base.
  - c. Install cone (4), Part No. 2228 (7A050 kit), hub downward, on arbor (3) so that bottom of cone hub clears top of base (2) by approximately 1/4 inch. Secure cone in this position by tightening cone set screw (8) with 1/8-inch hex wrench (8, figure 1-13).
  - d. Install fan assembly (5), with shroud upward, over arbor (3). Seat fan hub squarely on cone (4) seat.
  - e. Install cone (6), Part No. 2227 (7A050 kit), hub upward, over arbor (3), and seat cone firmly in top cone seat of fan hub. Secure cone in this position by tightening cone set screw (7) with 1/8-inch hex wrench.
  - f. Install 1/2 inch mushroom point on dial indicator (9), and adjust height gage assembly (10) to read track or concentricity variations as required. Rotate fan and arbor assembly to determine range of variations.
  - g. For track and concentricity tolerances and application of corrections, refer to applicable helicopter manual.

4-82. SH-34G TAIL ROTOR COUNTERWEIGHT ASSEMBLY ONLY BALANCE CHECK.

- (See figure 4-38.)
- a. Center adapter plate assembly (1), with plate hub projection upward, on work stand (1, figure 1-13).
  - b. Place spacer (2) on top of plate (1) hub with inside chamber of spacer upward.





- |                                     |  |
|-------------------------------------|--|
| 1 Surface plate                     | 7 Cone set screw                       |
| 2 Base (2341, 7HEL055 kit)          | 8 Cone set screw                       |
| 3 Balancing arbor (2259, 7A050 kit) | 9 Dial indicator (7HEL055 kit)         |
| 4 Cone                              | 10 Height gage assembly (7HEL055 kit). |
| 5 Engine fan assembly               |  |
| 6 Cone                              |  |

**Figure 4-37. Typical Set-up for SH-34G, CH-37, CH-21, and UH-25 Helicopter Engine Fan Assembly Track and Concentricity Check**

c. Center flat face of counterweight assembly (3) hub on spacer (2).

d. Install bushing (4), with pilot end downward, on balancing arbor (6) so that top surface of bushing aligns with 12-inch position on arbor scale (7). Secure bushing in this position by tightening bushing set screw (5) with 1/8-inch hex wrench (8, figure 1-13).

e. Insert lower end of arbor (6) downward through counterweight assembly (3) hub, spacer (2), and plate (1) hub, pushing arbor all the way down until tapered pilot on bushing (4) seats firmly into counterbore of counterweight assembly hub.

f. Install spacers (9) on lower end of arbor (6). Install hand wheel, Part No. 2215, in bottom end of arbor, and tighten to clamp assembly firmly together.

g. Rotate counterweight assembly (3) so that

turnbuckles align vertically with plates clevis blocks (8) and counterweights are positioned counterclockwise from their respective clevis blocks.

h. Insert ball ends of turnbuckles in slots of clevis blocks (8), and install four AN4-13A bolts through clevis blocks, with bolt heads toward outside edge of plate (1). Align turnbuckles approximately parallel with arbor (6).

**Note**

Installation of nuts on AN4-13A bolts is not essential, but check frequently to make certain that bolts do not shift position in clevis blocks during balance checking operations.

i. Install suspension cable (13, figure 1-13) and quick-disconnect coupling assembly (10, figure 1-13) on suspension rod at top of arbor, and engage suspension cable in lifting plate of hydraulic pump.

j. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note balance condition indicated by black indicator disc at top end of the arbor.

k. For balance tolerance and application of balance corrections, refer to applicable manual.

**4-83. SH-34G TAIL ROTOR HUB AND BLADE ASSEMBLY ONLY-BALANCE CHECK.**

(See figure 4-39.)

a. Center adapter plate assembly (1), with plate hub projection upward, on work stand (1, figure 1-13).

b. Place recessed side of tail rotor hub (3) over plate (1) hub, with rotor hub grease fittings downward and position blades so that heads of blade attaching bolts fall inside clearance cut-outs in blade support blocks (2).

c. Install bushing (4), with small diameter downward, on balancing arbor (6) so that top surface of bushing aligns with 11 inch position on arbor scale (7). Secure bushing in this position by tightening bushing set screw (5) with 1/8-inch hex wrench.

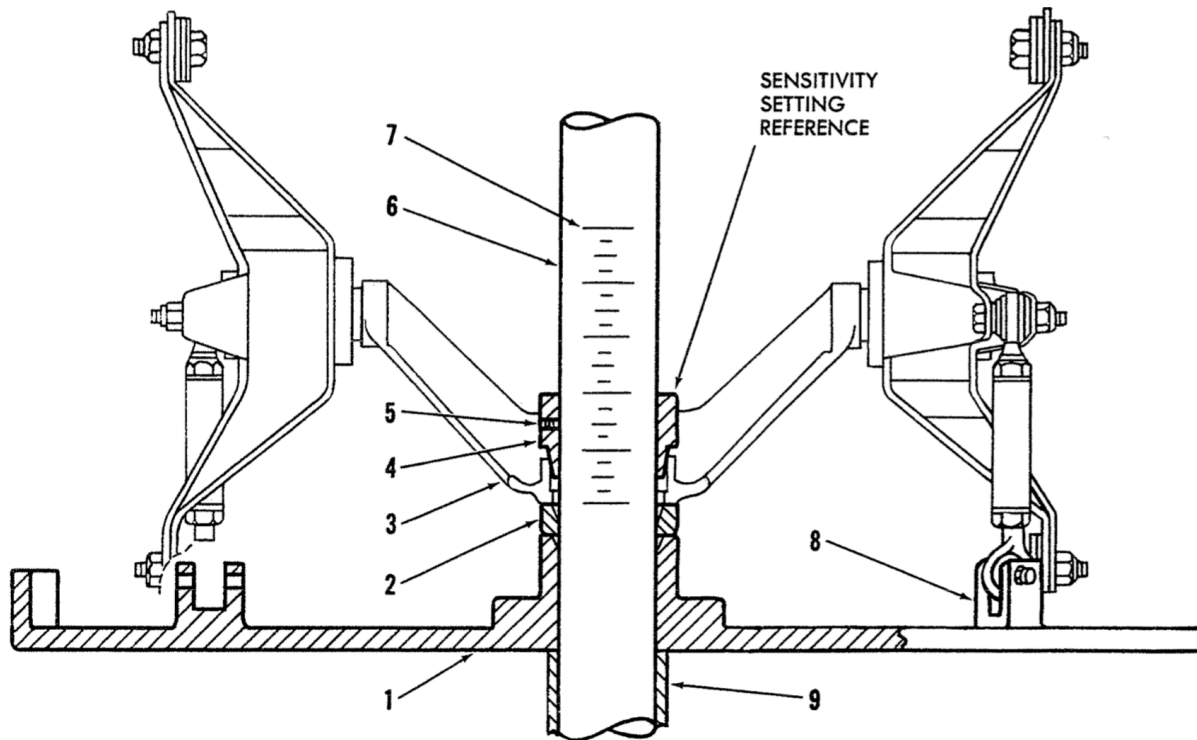
d. To facilitate rotor hub and plate hub alignment, raise rotor blade grips off plate support blocks. Insert lower end of arbor (6) downward through rotor hub (3) and plate (1); push downward until lower end of bushing (4), rotor hub, and plate hub are seated firmly together. Reposition rotor blade grips centrally on plate support blocks.

e. Install spacers (9) over lower end of arbor.

f. Install hand wheel, Part No. 2215 (7A050 kit), in bottom end of arbor, and tighten to clamp assembly firmly together.

g. Using rawhide or rubber mallet, tap shoulder of each blade hinge, adjacent to square head of hinge bolt, so as to position blade chordwise in direction of its trailing edge. Then insert two wedges (8), symmetrically spaced across blade centerline, into each blade hinge. (See View at A.) Seat wedges firmly by pressing with thumb.

h. Install suspension cable (13, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.



- |   |   |
|---|---|
| 1 Adapter plate assembly<br>(2238, 7HEL051 kit) | 6 Balancing arbor<br>(2259, 7A050 kit)        |
| 2 Spacer (2246, 7HEL051 kit)                    | 7 Arbor scale                                 |
| 3 Tail rotor counterweight<br>assembly          | 8 Adapter plate<br>clevis block               |
| 4 Bushing (2242, 7HEL051 kit)                   | 9 Spacers (2201,<br>2203, and 2204 7A050 kit) |
| 5 Bushing set screw                             |   |

**Figure 4-38. Balancer Installation – SH-34G Helicopter Tail Rotor Counterweight Assembly**

i. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by black indicator disc at top end of the arbor.

j. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

4-84. SIKORSKY CH-37 HELICOPTER.

4-85. CH-37 ENGINE FAN ASSEMBLY BALANCE CHECK.  
 (See figure 4-36.)

a. Center fan assembly (1), with hub extension upward, on work stand (1, figure 1-13).

b. Install cone (2), Part No. 2296 (7HEL052 kit), hub upward, on balancing arbor (4) so that top of cone hub aligns with 16-1/2 inch position on arbor scale (5). Secure cone in this position by tightening cone set screw (3) with 1/8-inch hex wrench.

c. Insert arbor (4) downward through fan hub, seating cone (2) in upper cone seat of hub.

d. Install cone (6), Part No. 2297 (7HEL052 kit), hub downward, on lower end of arbor (4), making certain that cone seats firmly in bottom cone seat of fan hub.

e. Install spacers (7), Part Nos. 2203 and 2204 (7A050 kit), on arbor (4) under cone (6) hub.

f. Install hand wheel, Part No. 2215 (7A050 kit), in bottom end of arbor, and tighten wheel to clamp spacers, cones, and fan hub securely together.

g. Install suspension cable (14, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump.

h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects. Note the balance condition.

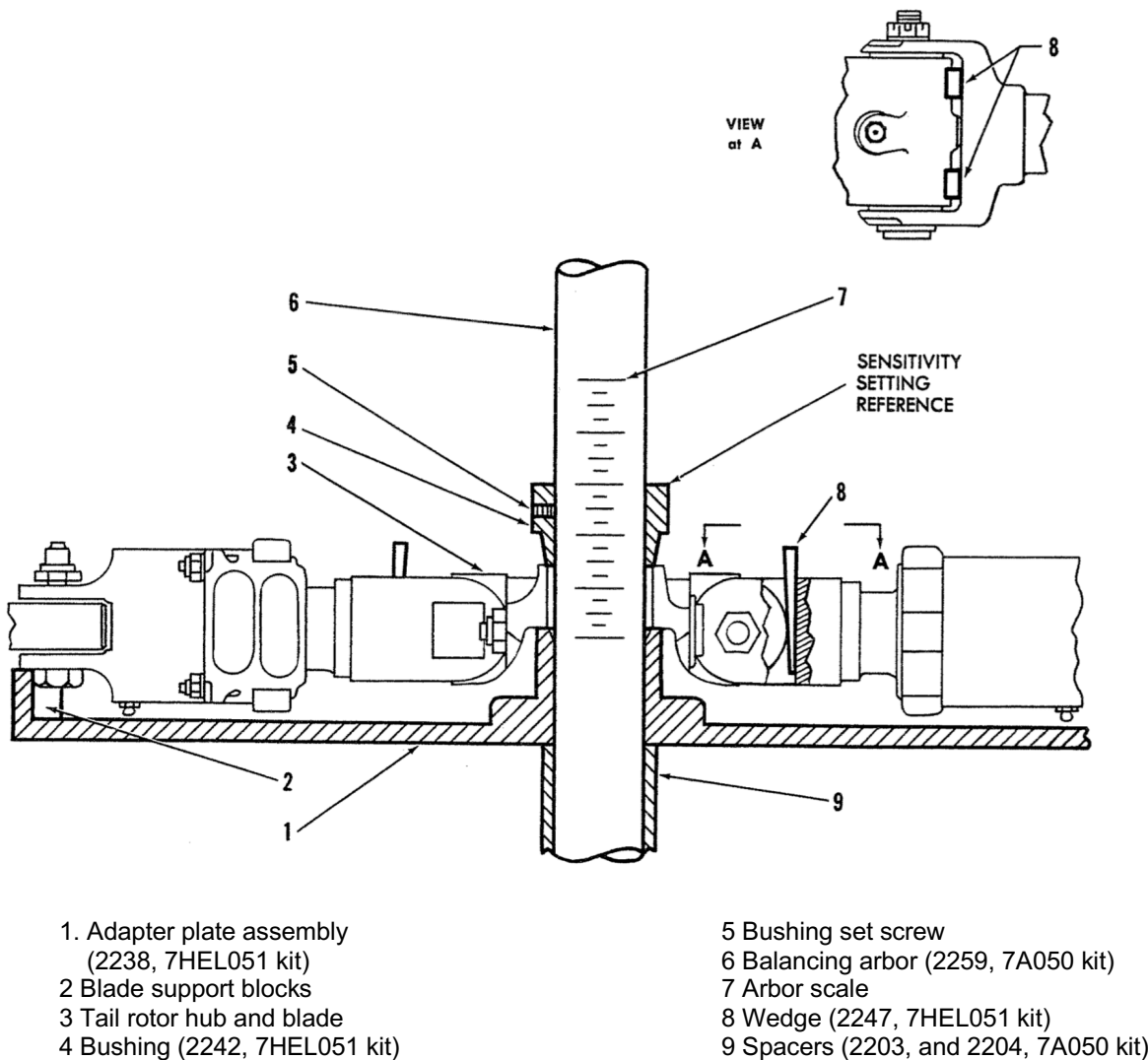


Figure 4-39. Balancer Installation – SH-34G Helicopter Tail Rotor Hub and Blade Assembly

4-86. CH-37 ENGINE FAN ASSEMBLY TRACK AND CONCENTRICITY CHECK.

(See figure 4-37.)

a. Set base (2) on surface plate (1) or other firm support surface. Bolt or clamp base securely to surface.

b. Install lower end of balancing arbor (3) in base (2) pilot hole. Make certain that arbor is firmly bottomed and free to rotate in base.

c. Install cone (4), Part No. 2297 (7HEL052 kit), hub downward, on arbor (3) so that bottom of cone hub clears top of base by approximately 1/4 inch. Secure cone in this position by tightening cone set screw (8) with 1/8-inch hex wrench (8, figure 1-13).

d. Install fan assembly (5), with hub extension upward, over arbor (3). Seat fan hub squarely on cone (4) seat.

e. Install cone (6), Part No. 2296 (7HEL052 kit), hub upward, over arbor (3), and seat cone firmly in top cone seat of fan hub. Secure cone in this position by tightening cone set screw (7) with 1/8-inch hex wrench.

f. Install 1/2 inch mushroom point on dial indicator (9), and adjust height gage assembly (10) to read track or concentricity variations as required. Rotate fan and arbor assembly to determine range of variations.

g. For track and concentricity tolerances and application of corrections, refer to applicable helicopter manual.

4-87. CH-37 TAIL ROTOR ASSEMBLY OPTICAL TRAMMELING AND BALANCE CHECK.

4-88. OPTICAL TRAMMELING. (See figure 4-40.)

a. Install 3/4 inch thick wood block on floor under each of the tubular legs of work stand (1, figure 1-13). Do not assemble overhead hoist structure at this time.

b. Center fixture assembly (15) with blade support blocks upward on work stand.

c. Carefully lower tail rotor assembly (2) onto fixture (15). Align blades with fixture support blocks (1), studs with clearance holes in fixture arms, and bottom rotor cone seat with fixture hub. Ensure that blade cuffs rest squarely on blade support blocks and that rotor hub is fully seated on fixture hub cone. Disconnect pitch control linkages at blade cuffs, and turn rotor pitch control rocker arms so that their inner ends are in the full upward position. (See View A.) Disconnect four tail rotor dampers at adjustment end only.

d. Install scope support assembly (3), Part No. 2400 (7HEL056 kit), over top of balancing arbor (11), ensuring definite bottoming on end of arbor. Secure scope support assembly in this position by tightening scope support assembly set screw (4) with 1/8-inch hex wrench (8, figure 1-13).

Note

Zero position of scope support internal index plate (10) lies directly above scope support set screw (4). If index pin (5) is not in this position, lift index pin and rotate scope support on index plate until index pin can be engaged in index plate directly over scope support assembly set screw. (See View A.)

e. Apply light grease or heavy oil to surface of rotor hub upper cone seat, and install arbor (11) downward through rotor hub and fixture (15) pilot hole, seating lower end of scope support assembly (3) firmly into rotor hub top cone. Install bushing (12), knurled hub upward, over lower end of arbor, seating bushing against bottom surface of fixture (15). Do not lock bushing set screw.

f. Install spacers (13), over lower end of arbor, and install hand wheel (14) in bottom end of arbor. Do not fully tighten hand wheel at this time.

g. Install scope (7), Part No. 2420 (7HEL056 kit), through support scope wheel (8). Adjust scope eyepiece (6) to bring scope cross-hairs into sharpest focus. Tilt scope wheel (8) and rotate scope support and arbor assembly to align intersection of scope cross-hairs on exact center of crossed-line intersection on top surface of any one of the four rotor lag hinge caps. (See View A.) Slide scope (7) in scope wheel (8) to bring this target into sharpest focus, and lock scope in this position with scope lock screw (9). Re-check alignment of scope cross-hair intersection of hinge cap crossed lines, and adjust as required.

h. Tighten hand wheel (14) in bottom end of arbor to clamp spacers (13), fixture (15) hub, rotor hub, and scope support assembly (3) firmly together.

Note

To prevent misalignment of scope with rotor hub, it is essential that no rotation between these parts be permitted during the remainder of the blade alignment operation.

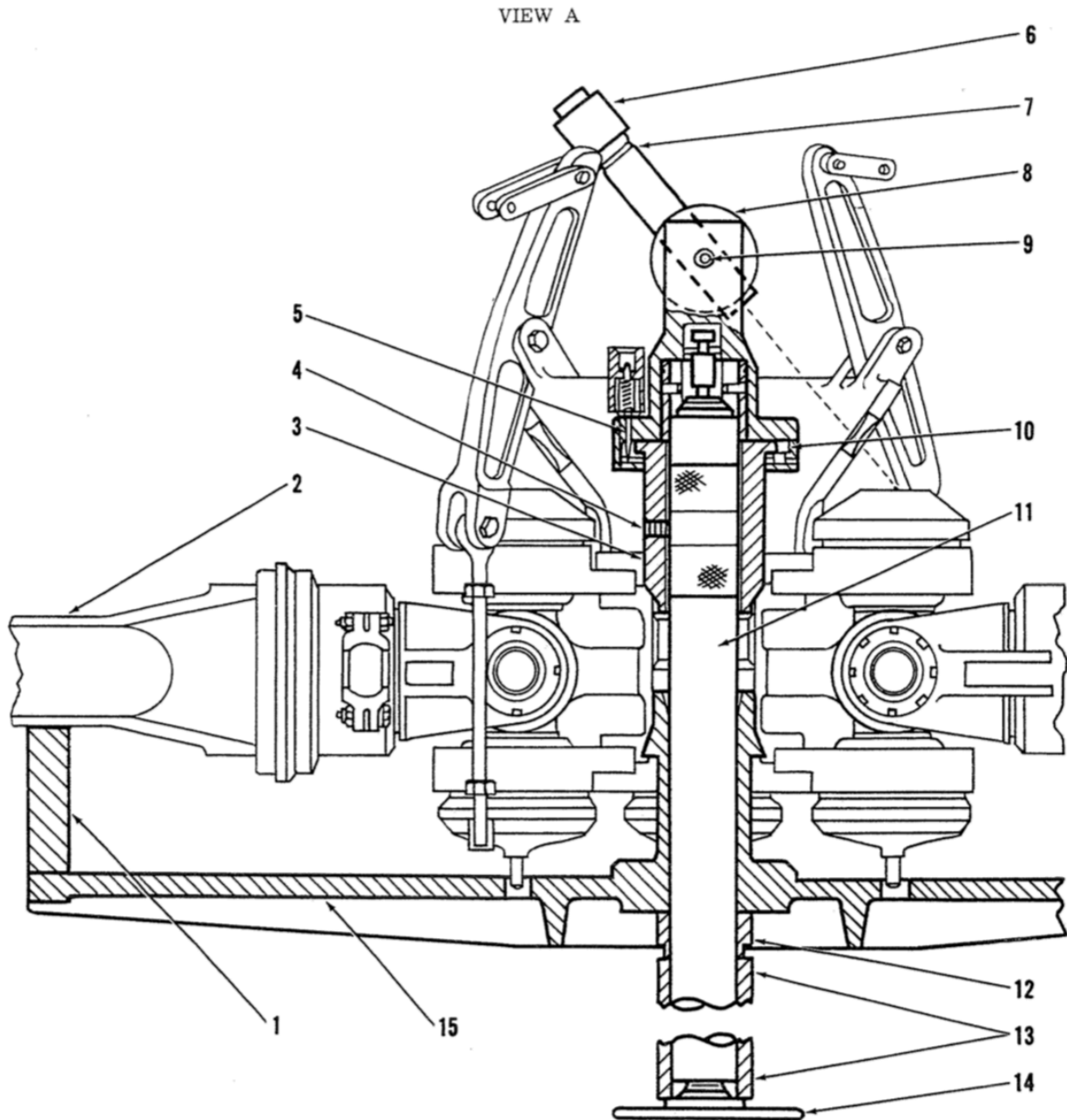
i. Re-check alignment of cross-hairs on target. If necessary, loosen hand wheel (14) to adjust cross-hair alignment; always be sure hand wheel is firmly tightened before proceeding.

j. Install target assembly (17) on tip of rotor blade in line with scope by holding two gage pins (16) across leading edge of rotor blade and snapping spring-loaded roller across trailing edge of rotor blade. (See Views B and D.) Gage pins shall align with inboard edge of blade tip cap, with body of target assembly parallel to inboard edge of blade tip cap.

k. Remove scope (7), Part No. 2420 (7HEL056 kit), from scope wheel (8). Install scope (7), Part No. 2421 (7HEL056 kit), and adjust eye-piece to bring cross-hairs into sharpest focus. Tilt scope wheel (8) in vertical plane to align cross-hairs on body of target assembly (17) at rotor blade tip. Shift blade tip chordwise by gentle hand tapping as required to bring alignment target into visual field of scope. Slide scope (7) in scope wheel (8) to bring target circles (18) into sharpest focus, and lock scope in this position with scope lock screw (9). Bring blade into final precise alignment by hand tapping of blade tip and / or vertical tilting of scope wheel so that point of intersection of scope cross-hairs lies well within innermost circle of alignment target (see View C). This aligns blade in its 2° lead angle position.

Note

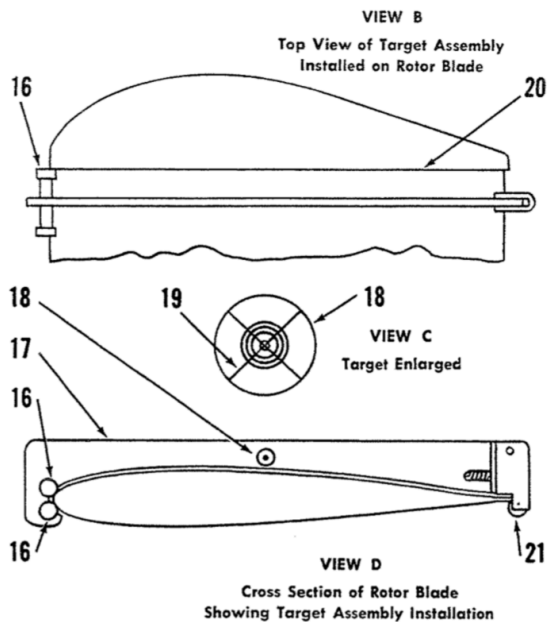
To prevent faulty indications, do not disturb position of this blade during remainder of trammeling and balance checking operations.



- 1 Fixture support block
- 2 Tail rotor assembly
- 3 Scope support assembly (2400, 7HEL056 kit)
- 4 Scope support set screw
- 5 Scope support index pin
- 6 Scope eye piece
- 7 Scope
- 8 Scope wheel
- 9 Scope lock screw

- 10 Scope support index plate
- 11 Balancing arbor (2259, 7A050 kit).
- 12 Bushing (2211, 7A050 kit)
- 13 Spacers (2201, 2202, 2203 and 2204, 7A050 kit)
- 14 Hand wheel (2215, 7A050 kit)
- 15 Fixture assembly (2319, 7HEL052 kit)

Figure 4-40. Set-up for Optical Trammeling of CH-37 Helicopter Tail Rotor Assembly (Sheet 1 of 2)



- |  |                               |
|--|-------------------------------|
| 16 Target assembly gage pin            | 18 Alignment target           |
| 17 Target assembly (2475, 7HEL056 kit) | 19 Scope cross hairs          |
|  | 20 Blade tip cap inboard edge |
|  | 21 Roller                     |

**Figure 4-40. Set-up for Optical Trammeling of CH-37 Helicopter Tail Rotor Assembly (Sheet 2 of 2)**

l. Carefully remove target assembly (17) from first blade tip and re-install in same position on next adjacent blade to be aligned.

m. Tilt scope wheel (8) to place scope (7) in approximately vertical position. Lift scope support index pin (5) to disengage internal index plate (10), and rotate scope support (3) approximately 90° in direction of next blade to be aligned.

n. Hold light downward pressure on index pin (5), and adjust angular position of scope support (3) until index pin again engages index plate (10). This will position the scope support exactly 90° from its previous position.

o. Tilt scope wheel (8) to align scope (7) with target on new blade. Shift blade chordwise by gentle hand tapping at the blade tip and / or tilt scope wheel slightly to bring point of intersection of scope cross-hairs within innermost circle of alignment target.

**Note**

To prevent faulty indications, do not disturb position of this blade during remainder of trammeling and balance checking operations.

p. Adjust damper assembly between the two trammed blades so that, in neutral position, its attaching bolt hole aligns precisely with attaching bracket hole of the trammed blade. Install damper bolt, with original washers, being careful not to disturb position of either trammed blade.

q. Repeat steps l, m, n, o, and p to align remaining two rotor blades, and install damper bolts.

r. Repeat steps l, m, n, and o to re-check alignment of all rotor blades to make certain no shift has occurred during trammeling operations or installation of damper bolts.

**Note**

Blades shall remain in their trammed positions throughout subsequent balancing operation. If position of blades is inadvertently disturbed, repeat entire trammeling operation before proceeding with balance check.

s. Remove scope (7), Part No. 2421 (7HEL056 kit), from scope wheel (8). Remove hand wheel (14), spacers (13), and bushing (12). Remove arbor (11) and scope support assembly (3) from fixture (15) and rotor hub. Remove scope support assembly (3) from balancing arbor (11). Remove target assembly (17) from rotor blade.

**4-89. CH-37 TAIL ROTOR BALANCE CHECK (See figure 4-41.)**

a. Assemble hoist arm (4, figure 3-3) on work stand (1, figure 1-13) with vertical spacer sleeves, Part No. 2398 (7HEL052 kit), in elbows (3 and 5, figure 3-3) to provide special hoist arm height required for balancing this rotor assembly. Install one of these spacers in the vertical section of each of the two elbows prior to installation of the vertical No. 4 tube in these elbows.

**Note**

Since, with arrangement, vertical tube lugs will be disengaged from elbow aligning slots, hoist arm shall be visually aligned over center of work stand prior to hoisting component

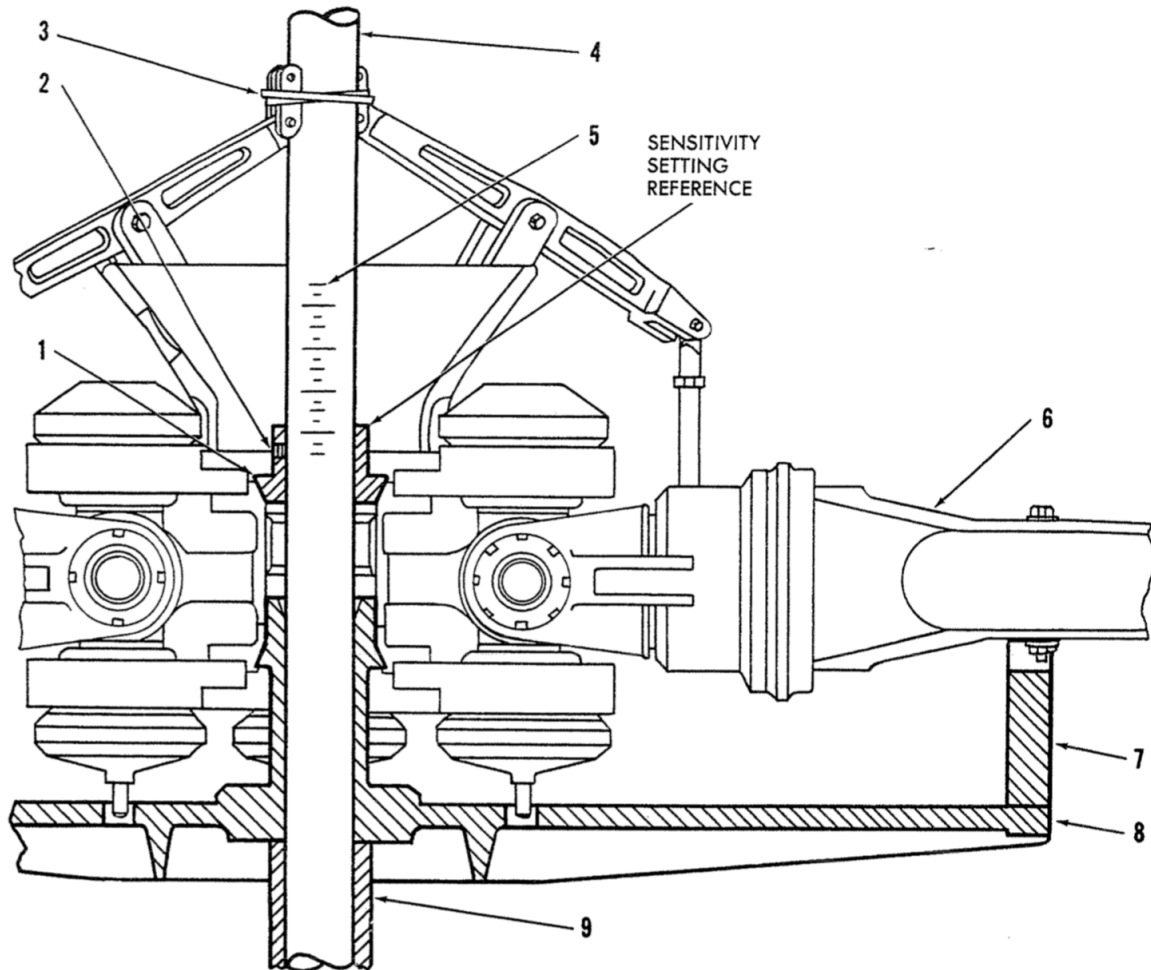
b. Install cone (1), hub upward, on balancing arbor (4) so that top surface of cone hub aligns with 12-3/4 inch position on arbor scale (5). Secure cone in this position by tightening cone set screw (2) with 1/8-inch hex wrench (8, figure 1-13).

c. Install balancing arbor (4) downward through rotor hub (6) and fixture (8) hub, seating cone firmly in rotor hub top cone seat.

d. Position rotor hub pitch change beams so that their inner ends rest against sides of balancing arbor (4) with links vertical against sides of arbor. Install suitable heavy elastic band or O-ring (3) around links to hold links and pitch change beams in this position during balance check.

e. Install spacer (9) on lower end of arbor (4). Install hand wheel, Part No. 2215 (7A050 kit) in bottom of arbor, and tighten wheel to clamp spacer, fixture (8), rotor hub, and top cone (1) firmly together.

f. Install suspension cable (14, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on arbor suspension rod end, engage suspension cable in lifting plate of hydraulic pump assembly, and hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand or other objects. Observe balance condition indicated by black indicator disc at top end of arbor, and apply balance



1 Cone (2206, 7A050 kit)  
 2 Cone set screw  
 3 Elastic band  
 4 Balancing arbor (2259, 7A050 kit)

5 Arbor scale  
 6 Tail rotor assembly  
 7 Fixture support block  
 8 Fixture assembly  
 9 Spacer (2203, 7A050 kit)

**Figure 4-41. Balancer Installation – CH-37 Helicopter Tail Rotor Assembly**

corrections to rotor assembly as required.

**Note**

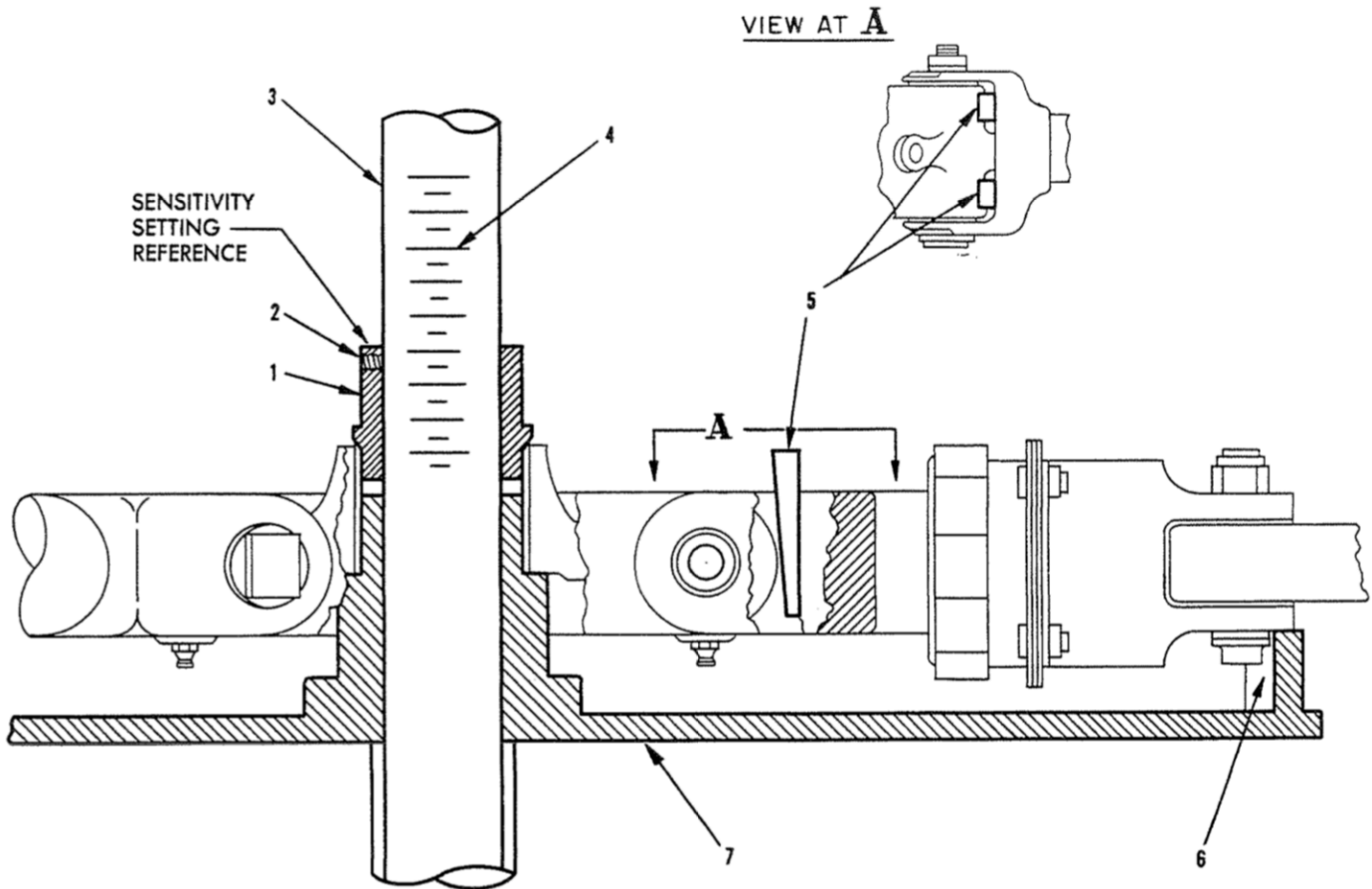
Due to blade span of this rotor assembly, stability of balance indication is dependent on complete absence of moving air currents. Balance check shall be performed in completely draft-free area, and movement of personnel in this area shall be restricted to a minimum during the balance checking operation.

g. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

h. Following addition of rotor balance corrections, carefully lower balanced assembly onto work stand.

Remove quick-disconnect coupling from arbor suspension rod. Rotate upper hoist arm (4, figure 3-3) approximately 30° to provide working clearance. Remove elastic band (3) from arbor (4). Remove hand wheel, Part No. 2215 (7A050 kit), and spacer (9) from lower end of arbor. Lift out arbor and cone assembly.

i. In order to verify that the rotor blades actually were in the proper trammed position during addition of rotor balance correction, reinstall scope support assembly (3). Install target assembly (17, figure 4-40) on any blade, and install scope (7, figure 4-40), Part No. 2421 (7HEL056 kit), in scope wheel (8, figure 4-40). Align scope cross-hairs on target circle by tilting scope and rotating arbor in rotor hub. Do not shift position of blade.



- 1 Cone (2439, 7HEL058, 7HEL060 kits)
- 2 Cone set screw
- 3 Arbor (2259, 7A050 kit)
- 4 Arbor scale

- 5 Wedge (2247, 7HEL058, 7HEL060 kits)
- 6 Blade support block
- 7 Plate assembly (2442, 7HEL058 kit; 2573, 7HEL060 kit)

**Figure 4-42. Balancer Installation – SH-3A Rotary Rudder (Tail Rotor) Hub Assembly**

j. With scope cross-hairs aligned in smallest target circle, lock arbor (11) with scope support assembly (3, figure 4-40) to rotor hub with hand wheel (14, figure 4-40).

k. Carefully transfer target assembly (17, figure 4-40) to next adjacent blade and re-index scope support (3, figure 4-40) to next 90° position in index plate (10, figure 4-40). By tilting scope wheel (8, figure 4-40) only in vertical plane, intersection of scope cross-hairs shall fall within smallest circle of target.

l. Repeat step k. to check alignment of remaining two rotor blades.

m. Should steps i., j., k., and l. indicate that blades, after balancing, are still in their correct 90° relationship, balance of the rotor may be considered satisfactory. Should this check indicate blade position was disturbed during or prior to addition of balance corrections, realign blades 90° apart and re-check rotor assembly balance.

4-90. SIKORSKY SH-3A HELICOPTER.

4-91. SH-3A ROTARY RUDDER (TAIL ROTOR) HUB ASSEMBLY BALANCE CHECK. (see figure 4-42.) For early tail rotors, prior to “extended spindle” type, use 7HEL058 kit-tail rotor balancing adapter. For “extended spindle” type tail rotors, use 7HEL060 kit-tail rotor balancing adapter.

**Note**

This tail rotor hub assembly is balanced with a complete set of master blades, or factory new blades, installed. Pitch horn linkages shall be moved from pitch horns balancing operation.

a. Center plate assembly (7) with hub projection upward, on work stand (7A050 kit). Select proper plate as shown in figure 4-42.



b. Place recessed side of tail rotor hub (grease fitting downward) over hub of plate assembly (7) and position rotor blades so that heads of blade attaching bolts lie inside clearance cut-outs in blade support blocks (6). Check to ensure that rotor hub spline diameter is positioned over pilot diameter of plate assembly hub and firmly seated on hub shoulder.

c. Install cone (1), with cone face downward, on arbor (3), so that top surface of cone hub aligns with 12-5/8 inch position on arbor scale. Lock cone firmly in this position with cone set screw, using 1/8-inch hex wrench.

d. Insert lower end of arbor downward through rotor hub and plate hub, until pilot diameter of cone (1), enters rotor hub spline diameter and cone is seated in rotor hub chamber.

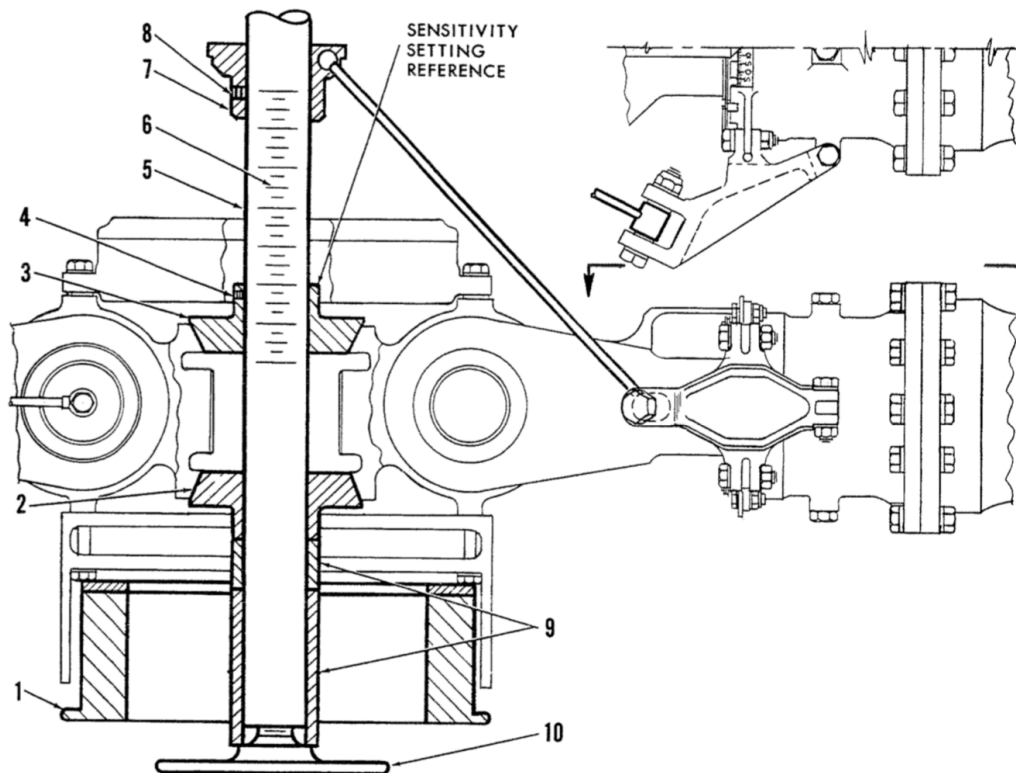
e. Install spacers, 2201, 2203, 2204 (7A050 kit) over lower end of arbor; install 2215 hand wheel (7A050 kit) in bottom of arbor and tighten to clamp cone (1), rotor hub, plate hub and spacers firmly.

f. Using raw-hide or rubber mallet, tap shoulder of one rotor blade flap hinge, adjacent to square head of hinge bolt, to position blade chordwise in the direction of its trailing edge. Then insert two wedges (5) into flap hinge as shown and seat wedges firmly by hand pressure only. Repeat this procedure at four remaining flap hinges.

g. Install 3/16 inch suspension cable and quick-disconnect coupling (7A050 kit) on arbor suspension rod and engage suspension cable in lifting plate of hydraulic pump assembly (7A050 kit).

h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and adjacent objects.

i. For balance tolerance and application of balance corrections, refer to applicable helicopter maintenance or overhaul handbook. Make corrections at proper locations as described in the applicable handbooks to ensure balance.



- 1 Support adapter (2818, 7HEL064 kit)
- 2 Cone (2828, 7HEL064 kit)
- 3 Cone (2827, 7HEL064 kit)
- 4 Cone set screw
- 5 Balancing arbor (2259, 7A050 kit)
- 6 Arbor scale

- 7 Support pitch positioning (2826, 7HEL064 kit)
- 8 Support hub screw
- 9 Spacers (2201, 2204, 7A050 kit)
- 10 Hand wheel (2215, 7A050 kit)

Figure 4-43. Balancer Installation – CH-53A Rotary Rudder Hub Assembly

4-92. SIKORSKY CH-53A HELICOPTER.

4-93. CH-53A ROTARY RUDDER HEAD ASSEMBLY BALANCE CHECK. (See figure 4-43.) This rotor head assembly is balanced with complete set of master blades, or factory new blades, installed. Pitch control linkages shall be removed from pitch horns during balancing operation.

- a. Assemble work stand and hoist assembly (7A050 kit) with supplementary 2460 tube assembly in place of 2288 vertical hoist arm tube (No. 4) normally used in 7A050 kit.
- b. Place 2818 support (7HEL064 kit), flange downward, centrally on stand table of 7A050 kit.
- c. Carefully set rotor head assembly in 2818 support so that inside diameter of rotor head cam clears diameter of support uniformly all around.
- d. Install 2827 cone (7HEL064 kit), hub upward on 2259 arbor assembly (7A050 kit), so that its top hub surface aligns with 11 inch position on arbor scale. Lock cone securely in this position with cone set screw, using 1/8-inch hex wrench (7A050 , 7HEL064 kits).
- e. Install arbor downward through rotor hub until 2827 cone seats in top cone surface of rotor hub. Install 2828 cone (7HEL064 kit), hub downward, over lower end of arbor followed by 2201 and 2204 spacers (7A050 kit). Install 2215 handwheel in lower end of arbor and tighten to clamp cones securely in rotor head cone seats.
- f. Install 2826 pitch positioning anchor (7HEL064 kit), hub downward, over top of arbor. With rotor blades at 15° position, engage positioning anchor arms with blade pitch arms and install pitch arm bolts symmetrically with respect to arbor. Lock 2826 pitch positioning anchor on arbor with its hub lock screw, using 1/8-inch hex wrench.
- g. Install quick-disconnect coupling, with 3/16 inch cable, on arbor suspension rod and hoist rotor assembly approximately 1/4 inch off the 2818 support. Check to ensure suspended assembly is free from interference with stand or adjacent objects and note balance indication.

Note

In this application, suspended clearance between 2818 support and inside of rotor cam is critical; also, in order to ensure that Part No. 2215 hand wheel suspends free of interference within the inside diameter of the stand table, it may be necessary to adjust the level of the stand assembly by installing suitable wood blocks under the two tubular stand legs.

- i. Note balance indication at top of arbor. Check to insure that balance indications are not affected by drafts or movement of nearby personnel. For balance tolerances and application of balance corrections, refer to applicable helicopter maintenance manual.

4-94. VERTOL HELICOPTERS.

4-95. CH-21 ENGINE FAN ASSEMBLY BALANCE CHECK. (See figure 4-36.)

- a. Center fan assembly (1), with triangular adapter upward, on work stand (1, figure 1-13).

- b. Install cone (2), Part No. 2227 (7A050 kit), hub upward, on balancing arbor (4) so that top of cone hub aligns with 13-1/2 inch position on arbor scale (5). Secure cone in this position by tightening cone set screw (3) with 1/8-inch hex wrench (8, figure 1-13).

- c. Insert arbor (4) downward through fan hub, seating cone (2) in top cone seat of hub.

- d. Install cone (6), Part No. 2228 (7A050 kit), hub downward, on lower end of arbor (4), pushing cone upward on arbor until cone contacts bottom cone seat in fan hub.

- e. Install spacers (7), Part Nos. 2201 and 2204 (7A050 kit), on lower end of arbor (4).

- f. Install hand wheel (26, figure 1-13) in bottom end of arbor, and tighten wheel to clamp spacers, bottom cone, fan hub, and top cone securely together.

- g. Install suspension cable (14, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.

- h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by black indicator disc at top end of the arbor.

- i. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

4-96. CH-21 ENGINE FAN ASSEMBLY TRACK AND CONCENTRICITY CHECK. (See figure 4-37.)

- a. Set base (2) on surface plate (1) or other firm support surface. Bolt or clamp base securely to support surface.

- b. Install lower end of balancing arbor (3) in base (2) pilot hole. Make certain that arbor is firmly bottomed and free to rotate in base.

- c. Install cone (4), Part No. 2228 (7A050 kit), hub downward, on arbor (3) so that bottom of cone hub clears top of base (2) by approximately 1/4 inch. Secure cone in this position by tightening cone set screw (8) with 1/8-inch hex wrench (8, figure 1-13).

- d. Install fan assembly (5), with adapter upward, over arbor (3). Seat fan hub squarely on cone (4) seat.

- e. Install cone (6), Part No. 2227 (7A050 kit), hub upward, over arbor (3), and seat cone firmly in top cone seat of fan hub. Secure cone in this position by tightening cone set screw (7) with 1/8-inch hex wrench.

- f. Install small point (for track check on rim of fan disc) or 1/2 inch mushroom point (for concentricity check at blade tips) on dial indicator (9), and adjust height gage assembly (10) to read track or concentricity variations as required. Rotate fan and arbor assembly to determine range of variations.

- g. For track and concentricity tolerances and application of corrections, refer to applicable helicopter manual.

Note

After accomplishing necessary corrections at the proper locations as specified in the applicable manuals, repeat the track and concentricity checks.

4-97. CH-21, CH-47A AND MODEL 107 ROTOR HEAD ASSEMBLIES – BALANCE

(See figure 4-44.)

Note

Since weight of CH-47A rotor head assembly exceeds recommended limits for the 7A050 kit hoist arm structure, use of this hoist arm within its hydraulic pump assembly is not recommended in balancing of CH-47A rotor heads.

- a. Center plug (1) with bushing (2) installed, on work stand (7A050 kit).
- b. Install pilot sleeve (3), or (9) as applicable, lock sleeve firmly in position with sleeve set screws (4) using 1/8-inch hex wrench (7HEL154, 7HEL254, 7HEL354 kits).
- c. Carefully lower rotor head assembly so that splined hub of rotor assembly fits over outside diameter of pilot sleeve. Ensure that rotor hub seats firmly on shoulder of pilot sleeve (9) or base of plug (1) as applicable. Allow rotor arms to rest against droop stops. Position pitch bearing housing in flat position and dampers (CH-21) in fully closed position.
- d. Install balancing arbor (6) downward through center bore of bushing (2). Install quick-disconnect coupling (7A050 kit) with 3/16 inch suspension cable (7A050 kit) on arbor suspension rod. For the CH-21 and 107 rotor heads, engage suspension cable in lifting plate of hydraulic pump assembly (7A050 kit). For the CH-47A rotor head, install alternate hoist eye (7A050 kit) with "quickie" coupling (7A050 kit) on end ball of suspension cable and attach alternate hoist eye to suitable shop hoist (not supplied).
- e. Adjust suspended height of arbor (6) as follows:

CH-21 Rotor Heads: Align 9-inch position on arbor scale (7) with top surface of sleeve (3).

107 Rotor Heads: Align 6-inch position on arbor scale (7) with top surface of sleeve (9).

CH-7A Rotor Heads: Align 7-inch position on arbor scale (7) with top surface of sleeve (3).

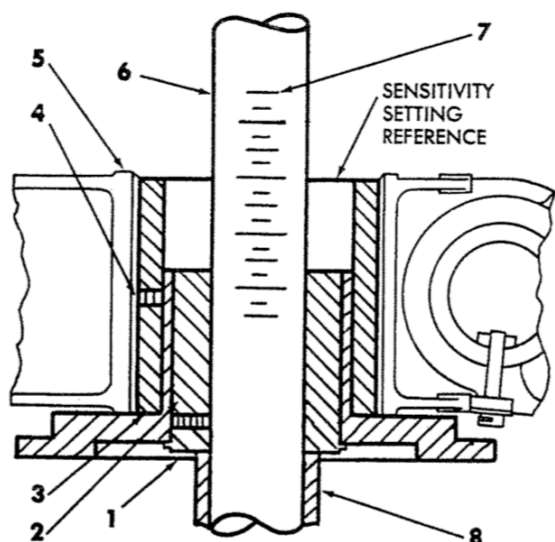
f. For the CH-21 only, install spacers (2202 and 2203, 7A050 kit) over lower end of arbor.

g. Install hand wheel (7A050 kit) in bottom end of arbor ensuring that it seats firmly against spacer (8) (CH-21) or bottom of bushing (2) (107 and CH-47A). Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note balance condition.

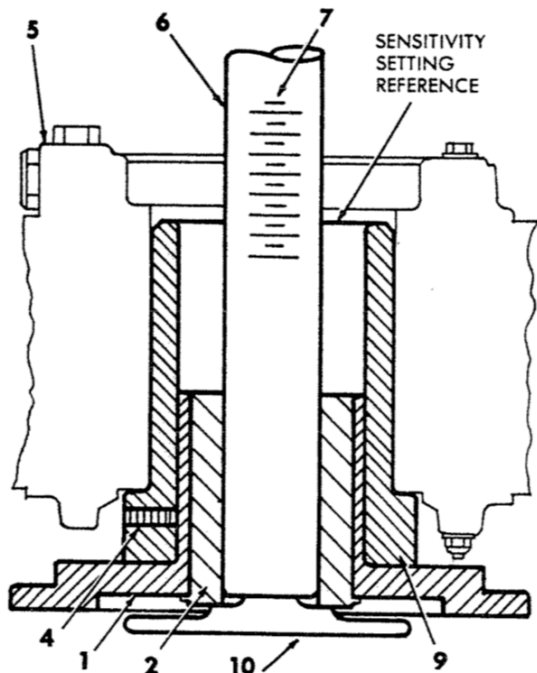
CAUTION

In using available shop hoist for suspending CH-47A rotor heads, care shall be exercised to avoid excessive acceleration loading (jerking) of the arbor suspension rod.

h. For balance tolerances and application of balance corrections, refer to applicable helicopter manual. Accomplish corrections carefully at location prescribed in manual.



View A - CH-21 and CH-47A Typical



View B - 107

- 1 Plug (2250; 7HEL154, 7HEL254, 7HEL354 kits)
- 2 Bushing (2463, 7HEL154, 7HEL254, 7HEL354 kits)
- 3 Sleeve (2464, 7HEL154) (2484, 7HEL354)
- 4 Sleeve set screw
- 5 Rotor hub assembly
- 6 Balancing arbor assembly (2259, 7A050 kit)
- 7 Arbor scale
- 8 Spacers (2202, 2203, 7A050 kit)
- 9 Sleeve (2485, 7HEL254 kit)
- 10 Handwheel (2215, 7A050 kit)

Figure 4-44. Typical Balancer Installation – CH-21, 107, and CH-47A Helicopter Rotor Hub Assemblies

Paragraphs 4-98 to 4-103

## 4-98. VERTOL UH-25 HELICOPTER.

4-99. UH-25 ENGINE FAN ASSEMBLY BALANCE CHECK.  
(See figure 4-36.)

- a. Center fan assembly (1), with adapter upward, on work stand (1, figure 1-13).
- b. Install cone (2), Part No. 2205 (7A050 kit), hub upward, on balancing arbor (4) so that top of cone hub aligns with 14-1/4 inch position on arbor scale (5). Secure cone in this position by tightening cone set screw (3) with 1/8-inch hex wrench (8, figure 1-13).
- c. Insert arbor (4) downward through fan hub, seating cone (2) in hub top cone seat.
- d. Install cone (6), Part No. 2205 (7A050 kit), hub downward, on bottom of arbor (4), making certain that cone seats firmly in bottom cone seat of fan hub.
- e. Install spacers (7), Part Nos. 2201, 2203, and 2204 (7A050 kit) on arbor (4) under cone (6) hub.
- f. Install hand wheel (26, figure 1-13) in bottom end of arbor, and tighten wheel to clamp spacers, bottom cone, fan hub, and top cone securely together.
- g. Install suspension cable (14, figure 1-13) and quick-disconnect coupling (10, figure 1-13) assembly on suspension rod at top end of arbor, and engage suspension cable in lifting plate of hydraulic pump assembly.
- h. Hoist entire assembly approximately 1/4 inch off work stand. Check to ensure that suspended assembly is free from interference with work stand and other objects, and note the balance condition indicated by black indicator disc at top end of the arbor.
- i. For balance tolerance and application of balance corrections, refer to applicable helicopter manual.

## 4-100. UH-25 ENGINE FAN ASSEMBLY TRACK AND CONCENTRICITY CHECK. (See figure 4-37.)

- a. Set base (2), Part No. 2341 (7HEL055 kit), on surface plate (1) or other firm support surface. Bolt or clamp base securely to support surface.
- b. Install lower end of balancing arbor (3) in base (2) pilot hole. Make certain that arbor is firmly bottomed and free to rotate in base.
- c. Install cone (4), Part No. 2205 (7A050 kit), hub downward, on arbor (3) so that bottom of cone hub clears top of base (2) by approximately 1/4 inch. Secure cone in this position by tightening cone set screw (8) with 1/8-inch hex wrench (8, figure 1-13).
- d. Install fan assembly (5), with adapter upward, over arbor (3). Seat fan hub squarely on cone (4) seat.
- e. Install cone (6), Part No. 2206 (7A050 kit), hub upward, over arbor (3), and seat cone firmly in top cone seat of fan hub. Secure cone in this position by tightening cone set screw (7) with 1/8-inch hex wrench (8, figure 1-13).
- f. Install small point (for track check at rim of fan disc) or 1/2 inch mushroom point (for concentricity check at fan blade tips) on dial indicator (9), and adjust height gage assembly (10) to read track or concentricity variations as required. Rotate fan and arbor assembly to determine range of variations.
- g. For track and concentricity tolerances and application of corrections, refer to applicable helicopter manual.

h. Repeat operations if unbalance corrections are accomplished. Balance shall be tolerable.

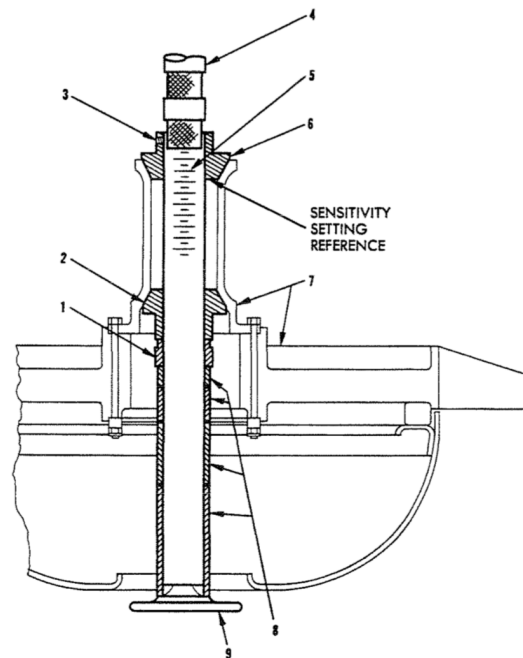
## 4-101. MISCELLANEOUS APPLICATIONS.

## 4-102. SZ-1B / EZ-1B AIRCRAFT

## 4-103. SZ-1B / EZ-1B ENGINE FAN AND HUB.

(See figure 4-45.)

- a. For this application, assemble work stand (7A050 kit) without overhead hoist arm. Position work stand centrally under suitable shop hoist.
- b. Remove coupling flange from front face of fan hub. Temporarily install 1/4 inch thick spacers on fan hub bolts and reinstall nuts.
- c. Place fan assembly, nose downward, centrally on work stand.
- d. Install 2207 cone, hub upward, on balancing arbor (7A050 kit) so that bottom surface of cone aligns with 17-5/8 inch position on arbor scale.
- e. Install lower end of arbor downward through fan hub, seating 2207 cone in rear cone seat of fan hub.
- f. Install 2208 cone, hub downward, over lower end of arbor. Seat cone in fan hub front cone seat.
- g. Install 2211 bushing over lower end of arbor followed by 2201, 2202, 2203 and 2204 spacers. Install 2215 hand wheel in bottom of arbor and tighten to clamp cones firmly into cone seats.



- |                  |                                    |
|------------------|------------------------------------|
| 1 Bushing (2211) | 6 Rear cone (2207)                 |
| 2 Cone (2208)    | 7 Fan and hub assembly             |
| 3 Cone set screw | 8 Spacers (2201, 2202, 2203, 2204) |
| 4 Arbor (2259)   | 9 Handwheel (2215)                 |
| 5 Arbor scale    |                                    |

**Figure 4-45. Balancer Installation –SZ-1B / EZ-1B Engine Fan and Hub Assembly**

h. Install quick-disconnect assembly with 3/16 inch cable, on arbor suspension rod. Install quickie coupling (11, figure 1-13) with alternate hoist eye assembly (12, figure 1-13) on end ball of 3/16 inch cable. Attach alternate hoist eye to shop hoist.

i. Hoist entire assembly approximately 1/4 inch off work stand and note balance condition indicated by the black indicator disk at the top end of the arbor.

j. For balance tolerance and application of balance corrections, refer to applicable aircraft maintenance or overhaul manual.

4-104. BALANCING COMPRESSOR ROTOR DISC AND SPACER SUB-ASSEMBLIES – GENERAL ELECTRIC CJ805-3, -23, AND J79 JET ENGINES. (See figure 4-46.)

a. Place fixture (7), flat surface downward, centrally on work stand (7A050 kit) or conventional work bench, as applicable. If work bench is used, support fixture (7) on wood blocks as required to provide clearance for projecting lower end of arbor (1).

b. Install arbor assembly (1) downward through fixture hub; adjust height of arbor in fixture so that top of fixture hub (sensitivity setting reference) aligns with applicable position on arbor scale (2) as specified under sensitivity setting below. Lock arbor firmly in this position by tightening fixture clamp screw (8), using 3/16-inch hex wrench (7JET051 kit).

Compressor Rotor Stage	Sensitivity Setting Arbor Scale, inches	Centering Cone Assy (7JET051 kit)
1	4-3/4	2614
2	4-3/4	2614
3	4-3/4	2614
4	4-3/4	2614
5	5-1/8	2614
6	5	2614
7	5-1/2	2616
8	5-3/8	2618
9	5-3/8	2618
10	5-3/4	2618
11 (With Cone)	5-3/8	2618
12 " "	5-1/2	2618
13 " "	5-5/8	2620
14 " "	5-5/8	2620
15	5-5/8	2620
16	5-3/8	2622
17	6-1/8	2624

c. Install protector sleeve (3) over top end of arbor.

d. Carefully lower compressor rotor disc and spacer assembly (5) over top end of arbor so that spacer rests on set of three fixture support surfaces (6), as applicable.

e. Remove protector tube (3) from top of arbor and install applicable centering cone (4), as specified in listing over top end of arbor; seat taper of centering cone firmly, by hand pressure only, in center bore of compressor rotor disc.

Note

Center bores of all centering cones except P/N 2624 provide pilot-fits directly on the balancing arbor; center bore of cone 2624 provides pilot fit on center extension of fixture hub.

f. Install quick-disconnect coupling (2387, 7JET051 kit or 2266, 7A050 kit) on arbor suspension coupler. Hoist entire assembly approximately 1/4 inch off work stand or work bench and check to insure that suspended assembly is free from interference with stand or other objects. Note balance condition at top of arbor.

g. For balance tolerances and selection of rotor blades for balance correction, refer to applicable engine overhaul manual.

h. In cases where the moment weight classification of the rotor blades is illegible or absent, "blind" balancing of the disc and spacer assemblies may be accomplished as follows:

1. Note direction of initial disc assembly unbalance and place a temporary balance correction on the surface of the disc where required to center the balance indication.

2. Select two diametrically opposite rotor blades lying approximately in line with the temporary balance correction, mark them by suitable temporary means, and exchange their positions on the disc. Note whether this exchange reduces or increases the amount of temporary balance correction required to centralize the balance indication. If the exchange increases the temporary balance correction required, return the two blades to their original positions, which will be final for this pair of blades. If the exchange reduces the temporary balance correction required, leave the two blades in their new positions and adjust the temporary balance correction to again centralize the balance indication. (The temporary balance correction will move closer to the center of the disc, showing that the disc is more nearly in balance than it was before the blade exchange).

3. Working either clockwise or counterclockwise around the disc, mark the next adjacent pair of diametrically opposite blades and repeat (2).

4. Repeat (3) until the disc assembly, without any temporary balance corrections, is within the specified balance tolerance (View A or View B, of figure 1-34).

Note

Under no circumstances are rotor blades to be considered acceptable, unless unbalance corrections have been accomplished precisely as stipulated in the applicable manual and within the specified tolerances. Repeat balance operations until satisfactory.

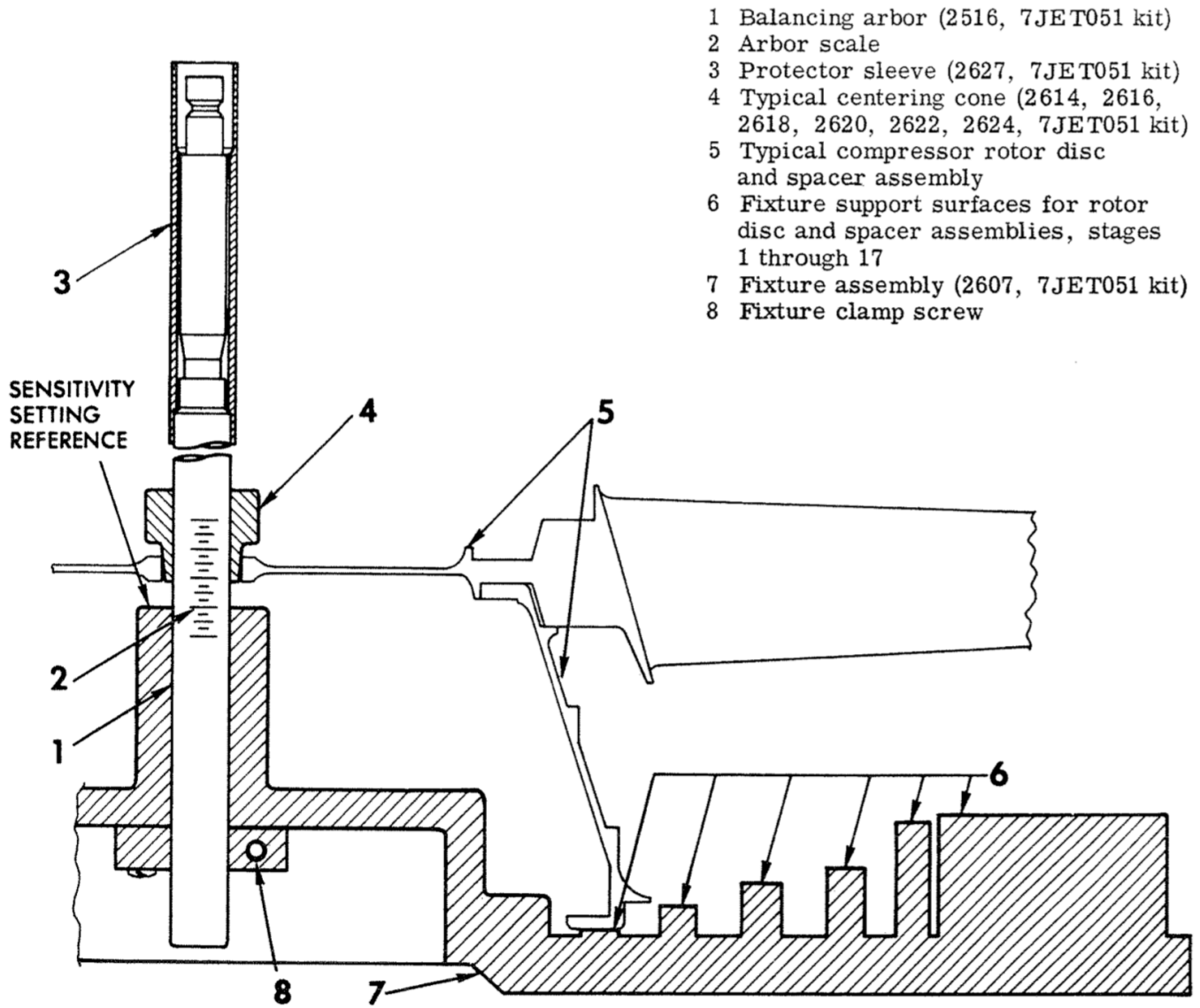


Figure 4-46. Typical Balancer Installation – CJ805-3, -23, and J79 Engine Compressor Rotor Disc and Spacer Assemblies

SECTION V

PERIODIC INSPECTION, MAINTENANCE, AND LUBRICATION

5-1. INSPECTION.

5-2. GENERAL. Inspection of the equipment described in this manual at regularly scheduled intervals is not required. However, the following inspections shall be performed each time the equipment is removed from storage and prepared for use.

5-3. BALANCE ARBORS. Visually examine all surfaces of the arbor for detrimental physical damage such as burrs, nicks, dents, scratches or corrosion. If an arbor is reportedly discrepant and/or is suspected of having been damaged wherein the internal suspension element is bent or deformed, a serviceability check of the arbor shall be accomplished. First, inspect for possible binding of the indicator bushing and correct for this condition, if necessary. Appropriate indicator bushing instructions are provided in Paragraph 3-7. Check the oil in the arbor to make sure it is clean, fluid, and authorized. Drain unsatisfactory oil; clean and refill arbor, if required, as described in paragraph 5-21. If an arbor has been stored on its side (horizontally) for a considerable length of time, particularly at low temperature, eccentric balance indications may be due to improper distribution and/or congealing of the dash-pot oil. This condition shall be corrected by suspending the arbor at room temperature until the oil becomes fluid and uniformly distributed. If it is necessary to verify the correct alignment and condition of the arbor's internal suspension element, adhere to the following instructions.

a. PART NO. 2259 ARBOR. Suspend cleaned, bare arbor to be checked using the 1/16" cable (2262) and the quick-disconnect coupling (2266). Install and secure the rear cone (2228), collar up, at the extreme top end of the suspended arbor. Stabilize the suspended assembly. Eliminate its tendency to resolve or swing. Free the suspended assembly from any obstruction or interference. See note below. After the suspended assembly has stabilized, note the indicator bushing position in relation to the black indicator disc. An arbor that indicates balance eccentricity to the point of tangency illustrated in view C, figure 1-34, is acceptable and completely serviceable. However, overlapping circles are an indication that the arbor is out-of-balance beyond acceptable limits (providing indicator bushing interference, dash-pot oil, and cable discrepancy possibilities have been eliminated). See view D, figure 1-34.

Note

Do not attempt field repair of out-of-balance arbors. Return them to the manufacturer for calibration.

Note

Cables shall be straight, without kinks or twists. Early suspension cables incorporating a swaged shank junction at the coupling end may introduce errors due to a bent swaged connection. To check if a cable is satisfactory revolve it 180° and observe whether the unbalance indicated, if present, approximately follows the rotated cable or remains in a constant location. If the unbalance indication follows the rotated position of the cable, the cable is damaged or the swaged section is bent. The cable shall be replaced or repaired satisfactorily before proceeding with the balance check of the arbor.

b. PART NO. 2516 ARBOR. First check the suspected arbor for possible indicator bushing binding or dash-pot oil discrepancies as described in Paragraph 5-3 above. If necessary, check the alignment of the internal suspension element by adhering to the following instructions. Suspend the cleaned, bare arbor to be checked using the eye assembly (2387) or a suspension cable (2262 or 2264) in combination with the quick-disconnect coupling (2266) available in the 7A050 Kit. Install the counterweight (2523), small collar up, on the arbor so that the top of the counterweight collar is in line with the 9-3/4 inch scale mark on the arbor. Tighten the set screw to retain the counterweight on the arbor. Because of the design of the 2516 arbor, cable discrepancies have no effect on the balance indications. Stabilize the suspended assembly and note the indicator bushing position in relation to the black indicator disc. An arbor that exhibits balance eccentricity to the point of tangency illustrated in view C, figure 1-34, is acceptable and completely serviceable. However, overlapping circles as shown in view D, figure 1-34, are an indication that the arbor is out-of-balance beyond acceptable limits (providing indicator bushing interference and dash-pot oil discrepancy possibility have been eliminated). Out-of-balance arbors shall be removed from service and forwarded to the manufacturer for repair.

CAUTION

Do not attempt to disassemble balancing arbors. Except for adjustment of indicator bushings (refer to paragraph 3-7) and removal of oil filler screws (refer to paragraph 5-21), these arbors are permanent assemblies, and any disassembly by using activities will result in critical damage requiring factory repair.

## Paragraphs 5-4 to 5-21

5-4. **ADAPTER CONES AND BUSHINGS.** Visually check all surfaces for nicks, dents, burrs, scratches, or corrosion. Check adapters for snug fit on balancing arbor (mating surfaces shall be thoroughly cleaned and freshly oiled). If interference is encountered, carefully check for possible mutilation of mating surfaces.

5-5. **BALANCE OF ADAPTER ASSEMBLIES.** As a routine check, suspend adapter on balancing arbor at height settings, specified for typical applications (refer to Section IV), and observe balance indication. A more precise check of adapter balance may be obtained by increasing the sensitivity (vertical height) setting of the adapter on the arbor. (Refer to Section I for details.)

5-6. **QUICK-DISCONNECT COUPLINGS.** Install coupling on suspension rod end and check for freedom of action and positive locking. Check release action (refer to paragraph 4-7 for operation). If binding or interference is found, carefully inspect assembly for possible foreign matter. (For corrective instructions, refer to paragraph 5-16.)

5-7. **SUSPENSION CABLES.** Visually check cables for fraying, kinks, mutilation, and security of swaged fittings.

5-8. **HYDRAULIC PUMP ASSEMBLY.** With pump in horizontal position, check for proper functioning (refer to paragraph 4-9 for operation). If malfunction of assembly is indicated, check reservoir fluid level. (Refer to paragraph 5-22.)

5-9. **STAND AND HOIST STRUCTURE.** Visually check stand and hoist structure for free of fits of all mating parts. If interference is found, check for mutilation or deformation of affected parts. Check wood case for splits, cracks, or loosening of components parts. Visible deflection of hoist structure under load is normal and should not be interpreted as incipient failure.

5-10. **DIAL INDICATOR (7HEL055 KIT).** Check indicator and mounting stand parts for mutilation or corrosion. Check stand assembly for proper functioning and security of indicator positioning. Check the indicator head for smoothness and continuity of indicating action.

5-11. **SCOPE SUPPORT ASSEMBLY (7HEL056 KIT).** Visually check scope support assembly for mutilation or corrosion. Raise index pin and check rotation of scope support on index plate for smoothness and security. Check indexing action of index pin in 0°, 90°, 120°, 180°, 240°, and 270° positions. Insert scope in scope wheel and check tilting action of scope wheel for smoothness and security. Check locking action of scope lock screw.

5-12. **ALIGNMENT SCOPES (7HEL056 KIT).** Visually check for mutilation or corrosion. Check fits in scope wheel for smoothness and security. Visually check lenses for cleanliness, mutilation, and security of mounting. Avoid any abuse of the scope as it is carefully adjusted and assembled at the factory. Do not attempt any repair.

5-13. **MAINTENANCE.**

5-14. **GENERAL.** Careful preservation of precision finished piloting surfaces of kit components against corrosive attack or accidental surface damage constitutes the most effective preventive maintenance.

5-15. **CORRECTION OF MINOR MUTILATION OR CORROSION.** Local stoning and polishing of arbor and adapter piloting surfaces to remove raised portions of minor nicks, dents, burrs, or scratches may be performed in most cases without seriously affecting accuracy of piloting fits. Complete blending out of larger nicks and dents or removal of large areas of corrosion having a perceptible depth is not recommended. Any repair involving re-grinding of these parts requires return of the complete kit assembly to the factory for overhaul.

5-16. **QUICK-DISCONNECT COUPLINGS – (7A050, 7HEL053 AND 7JET051 KITS).** Binding or erratic action of the quick-disconnect coupling due to presence of dirt or chips may usually be corrected by agitation of the complete coupling assembly while immersed in kerosene or other light petroleum distillate. Following such immersion, allow assembly to drain 15 minutes, then immerse complete assembly in a medium lubricating oil, Specification No. MIL-L-15016 to ensure lubrication of internal parts. Again allow assembly to drain and wipe excess oil from outside surfaces.

5-17. **DIAL INDICATOR (7HEL055 KIT).** Local repair of this unit is not recommended. If malfunction of the dial indicator occurs, send to qualified instrument repair shop or return to manufacturer for overhaul.

5-18. **OPTICAL ALIGNMENT SYSTEM (7HEL056 KIT).** Local repair of this unit is not recommended. If malfunction of the scope support assembly or the scopes should occur, return to complete 7HEL056 kit to the manufacturer for overhaul.

5-19. **LUBRICATION.**

5-20. **GENERAL.** Immediately prior to each application of kit components, carefully wipe all external and internal mating surfaces of arbors and adapter components with lint-free cloth or paper cleansing tissue to remove old oil and accumulations of fine dust or other foreign matter. Recoat components with mineral oil, Specification No. MIL-L-15018 Grade 5150. This procedure will facilitate installation of closefitting pilot adapters, cones, and bushings on balancing arbors. Seizing of cones, and bushings on the arbors is almost invariably caused by fine particles of dirt or other foreign matter, or by improper lubrication.

5-21. **ADDDITION OF DAMPING OIL TO BALANCING ARBORS.** Should excessive oscillation of balance indications develop due to inadvertent loss of arbor dash-pot oil, or should change of dash-pot oil or oil level become necessary, proceed as follows:

a. **Balancing Arbor, Part No. 2259 (7A050 Kit) –** Remove the two filler hole screws located in the knurled section of the arbor and, with the arbor in the upright position, fill arbor to



the filler hole level with mineral oil, Specification No. MIL-L-15018 Grade 5150. To ensure that small air spaces inside the arbor are completely filled, repeat this operation two or three times at intervals of ten minutes. To drain arbor dash-pot chamber, lay arbor on its side and allow oil to drain through one of the open filler screw holes. Always re-install filler hole screws following completion of draining or re-filling operation.

b. Balancing Arbor, Part No. 2516 (7HEL053 AND 7JET051 Kits) – Use light mineral oil, Specification No. 15017 Grade 2075H in the dash-pot of this arbor. One oil hole is located in the side of the arbor approximately 11/16 inches below the indicator bushing; another is located in the opposite side approximately 2-1/2 inches from the lower end of the arbor. To fill arbor, remove both oil hole screws, using 1/16-inch hex wrench (7HEL053 kit). Using positive-pressure, pump-action oil can, pump oil into lower arbor oil hole until oil appears at level of upper arbor oil hole. Re-install lower and upper filler hole screws. If positive-pressure-type can is not available, arbor dash-pot may be filled through upper hole only, leaving lower screw installed in arbor. In this case, repeat the filling operation two or three times at 10-minute intervals to ensure small air spaces are completely filled. Always ensure that filler hole screws are carefully reinstalled following filling or draining operation.

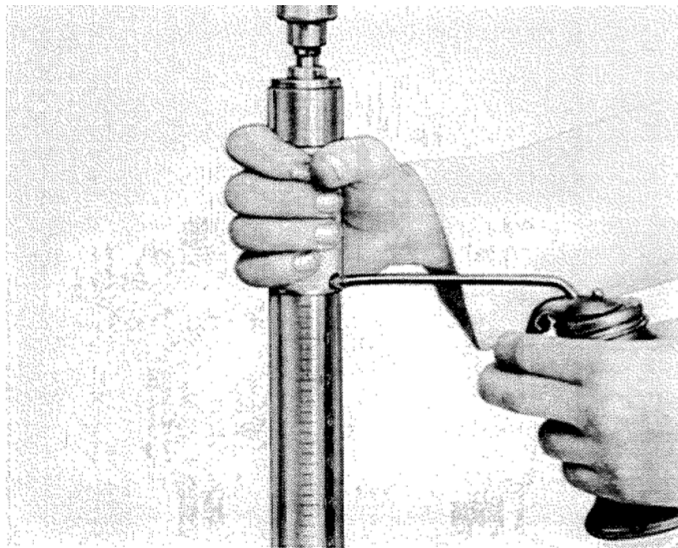


Figure 5-1. Adding Damping Oil to Balancing Arbor

#### 5-22. REFILLING HYRDAULIC PUMP RESERVOIR.

a. Remove pump positioning screw in end of No. 6 hoist support tube, and remove pump assembly from tube.

b. Stand pump assembly on gage end, and remove center screw from reservoir cover plate. Remove cover retaining ring.

c. Replace center screw with No. 10-32 screw (not furnished) having sufficient length to serve as a puller handle, and remove reservoir cover plate.

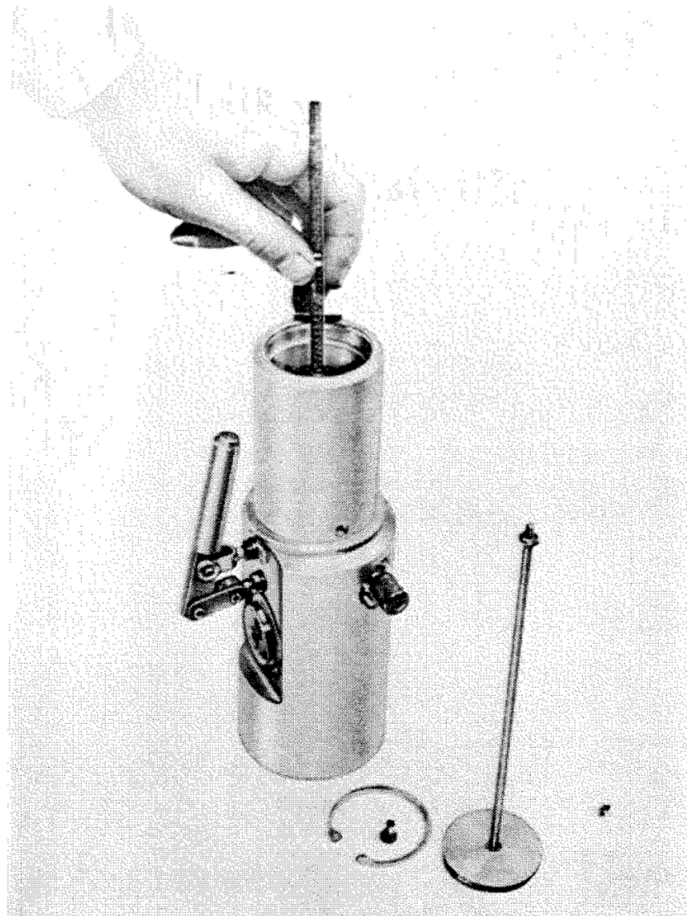


Figure 5-2. Checking Fluid Level in Reservoir of Hydraulic Pump Assembly

d. Press ram piston in to its full bottomed position (refer to paragraph 4-9 for operating instructions), and observe fluid level in reservoir, with pump standing on gage end. Fluid level, with ram fully bottomed should be 1-1/4 to 1-3/8 inch below top edge of fluid reservoir. (See figure 5-2.) If necessary, refill to this level, using hydraulic brake fluid, Specification No. VV-H-910.

e. Before re-installing the reservoir cover, pump ram piston to its full outward position and press it back to its full bottomed position several times. Observe return flow of fluid into the reservoir for bubbles which would indicate entrapped air in the system. Repeat this process until no bubbles are observed.

f. Re-install reservoir cover, ensuring that the AN6227-3 seal is in proper position. Re-install pump assembly in No. 6 hoist support tube, and lock in position with pump positioning screw.

#### Note

Operation of the pump with the assembly standing on the reservoir end will result in pumping air into the ram pressure system and consequent malfunction. Should this occur, repeat steps b. through f.

SECTION VI

TROUBLE SHOOTING

6-1. GENERAL.

6-2. Table II, TROUBLE SHOOTING, provides symptoms, probable causes, and remedies which will assist maintenance personnel in diagnosing and correcting discrepancies in the indicating devices (balancing arbors).

TABLE II

TROUBLE SHOOTING TABLE

TROUBLE	PROBABLE CAUSE	REMEDY
Balancing arbor lacks sensitivity.	Sensitivity setting incorrect.	Increase sensitivity. (Refer to Section I for procedure.)
Balancing arbor remains tilted. Indicator cannot be centralized.	Physical interference with arbor or suspended mass.	Check to ensure arbor and balancing assembly are suspended free of interference.
	Sensitivity setting incorrect – balancer unstable.	Reduce sensitivity. (Refer to Section I for procedure.)
Balance indicator seems to catch or lock in various positions.	Interference between indicator bushing and top end of arbor.	Loosen indicator bushing and raise to provide 0.002 to 0.003 inch clearance. Re-set bushing set screw. (Refer to Section III.)
Balancer oscillates excessively.	Air currents disturbing balancing assembly.	Isolate from air disturbances.
	Loss of dash-pot oil Dash-pot oil viscosity too low.	Re-fill arbor fluid reservoir. (Refer to Section V.)
Balancing arbor response is too slow.	Dash-pot oil too cold or viscosity too high.	Refer to Section V.
Balance indications inconsistent.	Cones or other adapters improperly seated.	Check for security of mounting, nicks, or foreign matter on adapter or balancing assembly mating surfaces. (Refer to Section V.)
	Shifting of balancing assembly parts.	Check for movement of assembly parts. Ensure consistent positioning of movable parts.

SECTION VII  
CALIBRATION

7-1. BALANCE ARBORS.

7-2. Since, as described in Section I, no internal bearing surfaces are involved in the tilting action of suspension balancing arbor, there is no wear. Thus, balance indication is not affected through normal usage and consequently there is no basis for specifying periodic overhaul of calibration checks as a function of time in service. However, balance indication accuracy may be seriously affected by accidental damage that results in distortion (bending, misalignment, etc.) of the internal flexible suspension element identified in figure 1-33. This detrimental distortion can occur through excessive downward loading or impact on the projecting end of the suspension rod and/or through inadvertent dropping of the balance arbor from an appreciable height.

7-3. A check of a single calibration point at the light end of the load range of the balancer shall suffice to determine whether the original alignment of its internal suspension element has been disturbed through accidental damage. For this check, refer to procedures described in paragraph 5-3. Correction for obvious deformation or misalignment of the internal element requires specialized techniques and equipment not normally available at field activities due to the infrequency of requirement; therefore, a discrepant balancer shall be returned to the manufacturer for repair.

7-4. LOAD INDICATING GAGE-CALIBRATION.

Note

To accomplish the dead-weight test of the load indicating gage, two fixed, known weights of 150 pounds and 500 pounds each shall be adapted for suspension capability to the eye of the cable assembly (2264).

a. Insert 3/16" suspension cable (2264), end ball down, through the hydraulic pump assembly (2282) and revolve the lifting plate (2, figure 4-2) to engage one of the balls and retain the cable.

b. Couple the quickie coupling (2260-1) to the end ball of the cable and the cable assembly (2264) to the quickie coupling. This provides the coupling eye for attachment of the test weight.

c. Turn the pump valve (5, figure 4-2) counterclockwise to the limit of its travel to load the ram piston. Operate the pump handle several strokes to raise the ram piston to the approximate mid-travel position.

d. Suspend the 150-pound weight from the eye of the quickie coupling. Note the reading on the load indicating gage (8, figure 4-2). The gage is acceptable if it indicates between 135 and 165 pounds.

e. Remove the 150-pound weight and install the 500-pound weight. Again check the gage reading. The load indicating gage is acceptable in this test if it registers between 475 to 525 pounds.

f. Remove test weight and cable.

Note

Review instructions and information contained in paragraph 1-9 and Section V before rejecting supposedly discrepant components.

SECTION VIII  
REPLACEMENT PARTS LISTING

8-1. GENERAL.

8-2. Table III, REPLACEMENT PARTS LISTING, includes an alphanumeric listing of all Marvel Kits covered in this bulletin and the numerical breakdown of the details in each kit. Each detail is assigned an item number and quantity per kit number. Included with each kit nomenclature is the appropriate figure number in which the detail may be found and identified.

TABLE III  
REPLACEMENT PARTS LISTING

Marvel Part Number	Description	Item No.	Qty Per Kit
7A050	Kit-Propeller Balancing (See figure 1-13)		
2201	Spacer – 1 inch	20	1
2202	Spacer – 2 inch	20	1
2203	Spacer – 3 inch	20	1
2204	Spacer – 4 inch	20	1
2205	Cone – Rear No. 30	17	1
2206	Cone – Front No. 30	22	1
2207	Cone – Rear No. 40	17	1
2208	Cone – Front No. 40	22	1
2209	Plate – Front	25	1
2210	Bushing – Rear	18	1
2211	Bushing – Front	21	1
2215	Hand Wheel Assembly	26	1
2223	Cone – Rear No. 20	17	1
2224	Cone – Front No. 20	22	1
2227	Cone – Front No. 50	22	1
2228	Cone – Rear No. 50	17	1
2259	Arbor Assembly	23	1
2260-1	Tru-Loc “Quickie” Coupling	11	1
2261	Cable Assembly – Eye	12	1
2262	Cable Assembly – 1/16 inch dia.	14	1
2264	Cable Assembly – 3/16 inch dia.	13	1
2266	Quick-Disconnect Assembly	10	1
2272	Case Assembly	16	1
2282	Pump Assembly	15	1
2284-1	Elbow	4	1
2284-2	Elbow	5	1
2285	Pin-Hoist Support	3	3
2286	Tube – 3 Inch dia.	29	1
2287	Tube – Short – 2-7/8 inch dia.	9	1
2288	Tube – Long – 2-7/8 inch dia.	2	1
2291	Stand Table Assembly	1	1
2364	Leg Assembly – Long – Stand	28	2
2365	Extension Assembly – Stand – Leg	6	2
2366	Leg Assembly - Stub	7	1

Marvel Part Number	Description	Item No.	Qty Per Kit
7A051	Kit - Regulator Adapter (See figure 1-14)		
2397	Adapter	1	1
2428	Case Assembly	2	1
7A052	Kit – Propeller Adapter (See figure 1-15.)		
2247	Wedge – Blade Positioning	4	3
2432	Weight Assembly	2	1
2433	Adapter Assembly – Flange	7	1
2434	Weight – Adjustable	10	1
2435	Plug – Screw	13	1
2450	Counterweight – Dowel Pilot	6	1
2451	Bushing – Dowel Pilot (Provision in matched sets)	3	6
2452	Installing Tool	1	1
2453	Adapter – 20 Spline	9	1
2454	Adapter – 30 Spline	11	1
2455	Plate Assembly	5	1
2459	Adapter – 50 Spline	8	1
2476	Case Assembly	12	1
7A053	Kit – Propeller Spinner Balancing Adapter (See figure 1-16)		
2689	Case Assembly	3	1
2691	Adapter Assembly – Front Bulkhead	2	1
2692	Adapter Assembly – Spinner Section & Front Bulkhead	1	1
7A054	Kit – Propeller Spinner Balancing Adapter (See figure 1-17)		
2691	Adapter Assembly – Front Bulkhead	5	1
2748	Adapter Assembly – Spinner Section & Front Bulkhead	1	1
2749	Bar – Ring Limiting	3	4
2750	Bar – Ring Limiting	4	4
2751	Case Assembly	2	1
7A055	Kit – Propeller Spinner Balancing Adapter (See figure 1-18)		
2582	Adapter Assembly – Spinner Positioning & Retaining	2	1
2753	Adapter Assembly – Spinner Positioning	1	1
2754	Case Assembly	4	1
7HEL050	Kit – Helicopter Balancing, Tracking and Aligning (See figure 3-6)		
7HEL051	Kit – Tail Rotor Balancing		1
7HEL052	Kit – Tail Rotor & Fan Balancing		1
7HEL053	Kit – Small Parts Balancing		1
7HEL054	Kit – Main Rotor Balancing		1
7HEL055	Kit – Fan Tracking & Concentricity Checking		1
7HEL056	Kit – Optical Aligning		1
2545	Case Assembly		1

Marvel Part Number	Description	Item No.	Qty Per Kit
7HEL051	Kit – Tail Rotor Balancing (See figure 1-19)		
2238	Adapter Assembly	3	1
2242	Bushing – Pilot	1	1
2246	Spacer – Counterweight Support	5	1
2247	Wedge – Blade Positioning	2	8
2248	Case Assembly	6	1
7HEL052	Kit – Tail Rotor & Fan Balancing (See figure 1-20.)		
2296	Cone – Front – 60 Spline	1	1
2297	Cone – Rear – 60 Spline	4	1
2319	Fixture Assembly – Tail Rotor Assembly	3	1
2386	Case Assembly	6	1
2398	Sleeve – Vertical Spacer	2	2
7HEL053	Kit – Small Parts Balancer (See Figure 1-21)		
2329	Sleeve – Pilot	5	1
2338	Plug – Extension Pilot	17	1
2355	Bushing – Counterweight Pilot	6	1
2356	Sleeve – Spacer Pilot	24	1
2387	Eye Assembly – Quick Disconnect	18	1
2512	Case Assembly	25	1
2516	Arbor Assembly	22	1
2522	Adapter Assembly	4	1
2523	Counterweight	21	1
2524	Coupling - Extension	20	1
2525	Plug – Extension Pilot	16	1
2526	Plug – Extension Pilot	19	1
2527	Collar – Retaining	12	1
2528	Bushing – Pilot	14	2
2529	Bushing – Pilot	8	1
2530	Bushing – Pilot	23	1
2531	Plate – Squaring	15	1
2532	Fixture Assembly	3	1
2533	Bushing – Pilot	7	1
2534	Spacer	9	1
2535	Spacer	10	1
2536	Spacer	11	1
2539	Post Assembly	13	2
7HEL054	Kit – Main Rotor Balancing (See Figure 1-22)		
2250	Plug Assembly	4	1
2337	Fixture – Rotor Hub Piloting	6	1
2373	Adapter – Rotor Hub Piloting Sleeve	2	1
2463	Bushing – 7A100 – 7A050 Adapter	3	1
2464	Sleeve – Rotor Hub Piloting	9	1
2465	Sleeve – Rotor Hub Piloting	7	1
2466	Adapter – Rotor Hub Piloting Sleeve	11	1
2467	Sleeve – Rotor Hub Piloting	1	1
2468	Plate – Rotor Hub Support	10	1
2488	Case Assembly	12	1
2489	Gage – Drag Strut Positioning	5	1

Marvel Part Number	Description	Item No.	Qty Per Kit
7HEL055	Kit – Fan Track & Concentricity Checking (See figure 1-23)		
2341	Base – Support	1	1
2342	Plate – Fan Piloting Adapter	2	1
2363	Indicator Assembly	3	1
2395	Case Assembly	4	1
7HEL056	Kit – Optical Aligning (See figure 1-24)		
2400	Scope Support Assembly	5	1
2415	Case Assembly	6	1
2420	Scope – Aligning – Short	1	1
2421	Scope – Aligning – Long	2	1
2475	Target Assembly	4	1
7HEL058	Kit – Tail Rotor Balancing Adapter (See figure 1-26)		
2247	Wedge – Blade Positioning	3	10
2439	Cone	4	1
2442	Plate Assembly	2	1
2444	Case Assembly	5	1
7HEL059	Kit – Tail Rotor Blade Balancing Adapter (See figure 1-26)		
2565	Fixture Assembly (includes pin (4))	1	1
2568	Adapter Assembly (includes clamp (2))	7	1
2569	Case Assembly	8	1
2651	Gage	3	1
7HEL060	Kit – Tail Rotor Balancing Adapter (See figure 1-25)		
2247	Wedge – Blade Positioning	3	10
2439	Cone	4	1
2571	Case Assembly	5	1
2573	Plate Assembly	2	1
7HEL061	Kit – Main Rotor Balancing Adapter (See figure 1-27)		
2486	Gage	1	1
2588	Adapter – Rotor Hub Piloting	3	1
2589	Yoke Assembly	6	1
2605	Case Assembly	2	1
7HEL062	Kit – Rotor Balancing Adapter (See figure 1-28)		
2728	Yoke Assembly	2	1
2729	Adapter Assembly	6	1
2730	Pin Assembly	4	2
2731	Adapter Assembly	1	1
2732	Case Assembly	7	1
2734	Cam Assembly	3	1
7HEL064	Kit – Rotary Rudder Head Balancing Adapter (See figure 1-29)		
2818	Adapter – Stand Support	1	1
2826	Support – Pitch Positioning	4	1
2827	Cone – Piloting Adapter	2	1
2828	Cone – Piloting Adapter	3	1
2829	Case Assembly	5	1

Marvel Part Number	Description	Item No.	Qty Per Kit
7HEL065	Kit – Tail Rotor Balance Positioning (See figure 4024, Sheet 1 of 2)		
2938	Case		
2939	Post – Positioning	4	2
2940	Bar Pair – Blade Positioning	3	11 sets
thru 2950	Bar Pair – Blade Positioning		
7HEL154	Kit – Main Rotor Balancing Adapter (See figure 1-31)		
2250	Plug Assembly	4	1
2463	Bushing (not visible)	3	1
2464	Sleeve	2	1
2487	Case Assembly	1	1
7HEL254	Kit – Main Rotor Balancing Adapter (See figure 1-31)		
2250	Plug Assembly	4	1
2463	Bushing (not visible)	3	1
2485	Sleeve	2	1
2551	Case Assembly	1	1
7HEL354	Kit – Main Rotor Balancing Adapter (See figure 1-31)		
2250	Plug Assembly	4	1
2463	Bushing (not visible)	3	1
2484	Sleeve	2	1
2552	Case Assembly	1	1
7JET051	Kit – Compressor Stage Balancing (See figure 1-32)		
2387	Eye Assembly – Quick Disconnect	3	1
2516	Arbor Assembly	2	1
2607	Fixture Assembly	5	1
2614	Cone Assembly	4	1
2616	Cone Assembly	4	1
2618	Cone Assembly	4	1
2620	Cone Assembly	4	1
2622	Cone Assembly	4	1
2624	Cone Assembly	4	1
2626	Case Assembly	1	1
2627	Sleeve – Protector	6	1

## 8-3. MISCELLANEOUS SUPPLEMENTARY ITEMS.

1807	Coupling Assembly (less cable & eye)
1819	Protector – Arbor (7A100)
1868	Plate – Base (7A100)
1869	Plate – Stand Adapter (7A100)
2427	Cone Special - 40° front (7A050)
2460	Tube Assembly – 34" long (7A050)
2671	Cone Assembly – Front (7A050)
2672	Cone Assembly – Rear (7A050)
2769	Tube Assembly – 38" long (7A050)
2773	Adapter – Trunnion Support
2792	Plate – Base (7A050)
2793	Plate – Stand Adapter (7A050)
2816	Adapter – Propeller Flange (7A050)
2862	Protector – Arbor (7A050)



**THE MARVEL MANUFACTURING COMPANY  
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**SERVICE BULLETIN**

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**SUBJECT**

Model 7BAL150 Kit – Balance Indicator.

**REFERENCE**

Bulletin No. 79, Operation and Service Manual.

**APPLICATION**

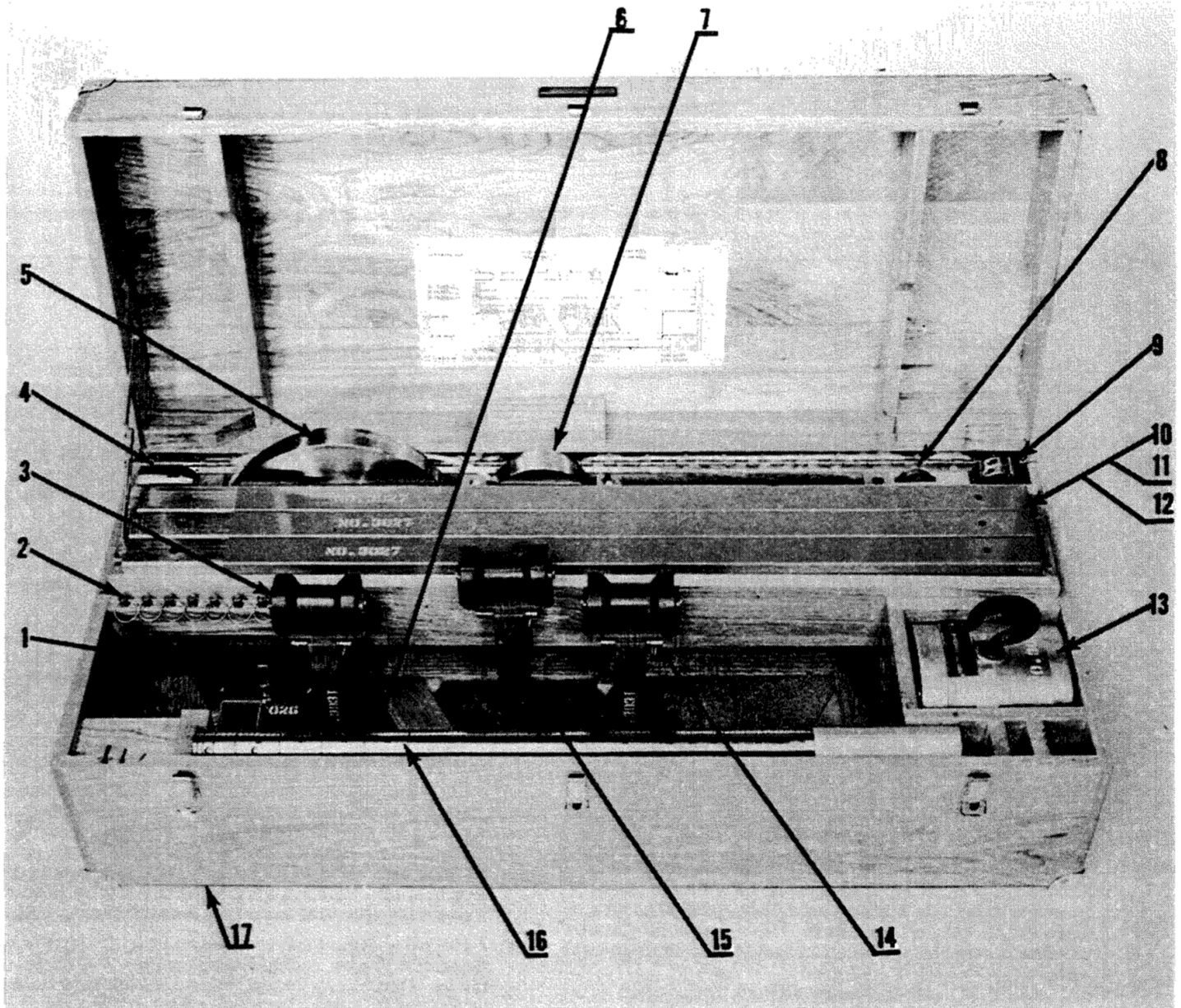
- (a) The Model 7BAL150 Kit, Balance Indicator, covered herein, consists of basic hoisting and balance indicating equipment. This equipment has to be supplemented with separately kitted adaptering required by the specific balance application intended. The supplemental adaptering is available in separate kit form and usually completes the balance equipment for any application involved.
- (b) Parts and assemblies which are adapted and suited to this 7BAL150 Kit system of balance are those without a through, or deep axial bore, or where the part center of gravity is not in a location beneficial for use with the shorter arbor in the Model 7A050 Kit. Representative of such accommodated parts and assemblies are flange and integrally shaft-mounted propellers.
- (c) Applicable Service Bulletins are provided for each of the diverse applications. Each Bulletin identifies the respective adapter kit components and includes necessary instructional and procedural data.

**DESCRIPTION**

- (a) The primary component of the 7BAL150 Kit, (see Figure I) is a precision, balance indicating arbor designed to balance suspended loads weighing a maximum of 700 pounds. Although its maximum capacity is no greater than that of the balance indicating arbor in the 7A050 Kit, this longer arbor is designed particularly to accommodate flange and integrally shaft-mounted propellers.
- (b) The balance indicating arbor is of the horizontal suspension type and features high sensitivity and accuracy. The arbor assembly consists of a precisely machined nitrided shaft; an internal suspension element immersed in a reservoir of SAE 40 viscosity mineral oil; a suspension rod end machined to engage with the suspension cable assembly coupling; a dull-matt finished indicator bushing; and a black, circular indicating disc embedded in the top of the arbor shaft.

- (c) A series of grooves are machined on the bottom end of the arbor shaft O.D. at specific intervals. These grooves accept two-piece retaining rings that hold respective special adapters on the shaft. A precise sensitivity setting scale in 1/4" increments, is etched on the shaft O.D. to provide easy and simple settings. Four oil filler holes, sealed with button-head hex socket screws, are spaced at approximately 8" intervals on the shaft O.D.
- (d) Except as otherwise instructed herein, the use, care, handling, and precautions, to be observed for this arbor, apply as in Section III of reference manual for the 7A050 Kit arbor.
- (e) Related accessories to the indicating arbor included in the 7BAL150 Kit are a large and small back balance weight used to adjust, as required, the center of gravity location of the total suspended mass for balance indication sensitivity. These weights are easily removed or restored in the kit case by the use of the provided rope slings.
- (f) Additional accessories include a quick-disconnect coupling and cable assembly to interconnect between the indicating arbor and the hoist hook; anchor rings to retain weights at the specific location on the arbor shaft; an arbor rod end protector; and retaining ring sections which are also normally provided in the special adapter kits.
- (g) Hoisting equipment consists of a tripod stand assembly and a chain hoist rated at 1/2 ton. The tripod stand includes a head assembly to which is welded a hook eye to suspend the chain hoist, and three square tubular socket stubs. The three stubs accept three groups of telescoping legs of successively smaller diameters. Each leg is pinned to its respective mate. When completely assembled, the tripod assembly is approximately 11 feet in height.
- (h) The clutch-type geared chain hoist has a capacity of more than 1/2 a ton and includes two swivel hooks. The top hook attaches to the hook eye welded onto the tripod head and the chain hook accepts the suspension cable eye.
- (i) The assembled tripod stand assembly shall be located in an adequately cleared area free of drafts or obstructions. The tripod stand assembly is easily demountable for restorage in the kit case.
- (j) Three support stand assemblies are provided in the kit to support equipment to be balanced. These stand assemblies can be placed in any position desired on the floor centered under the tripod stand head. Each stand base includes a

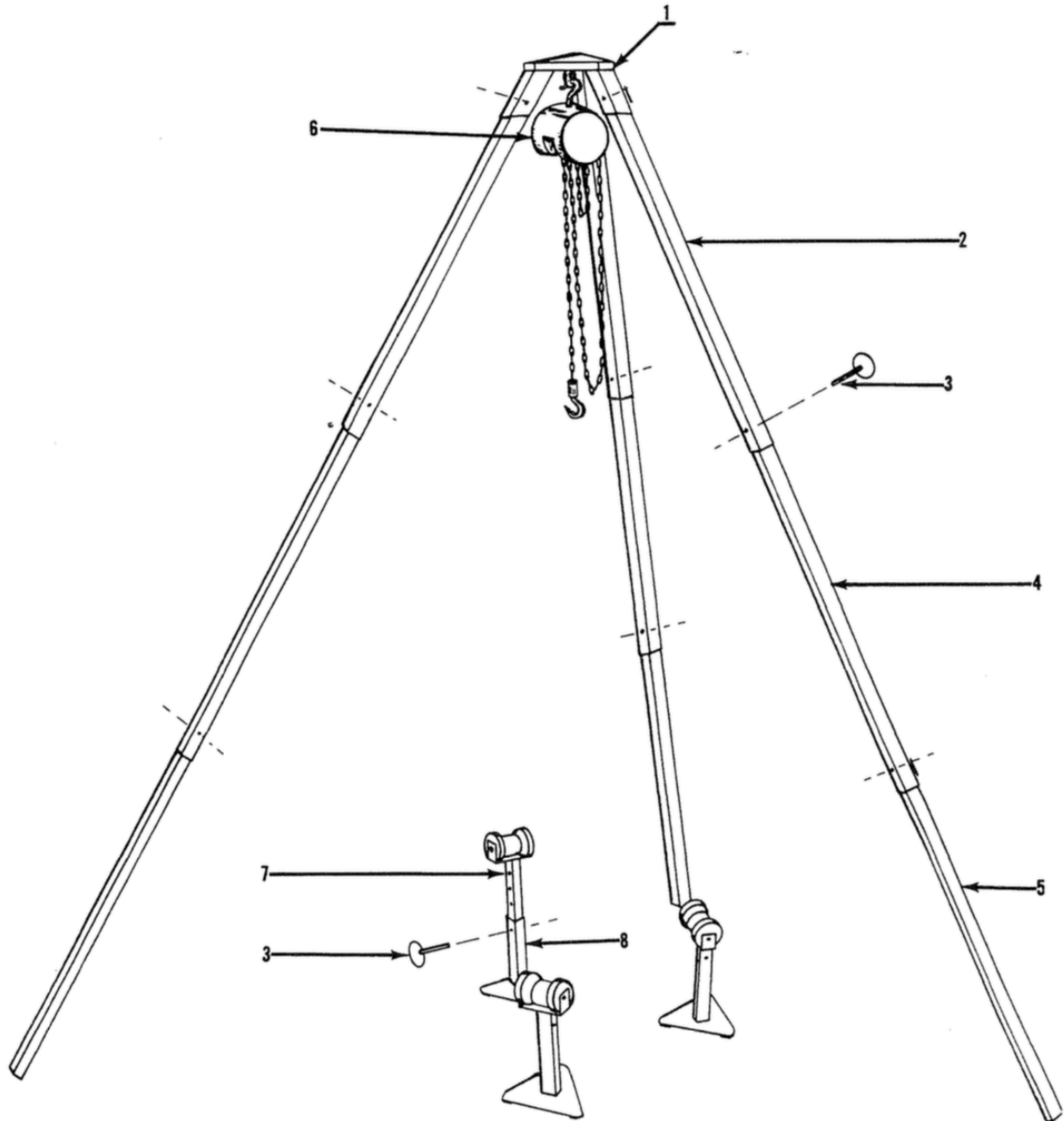




- |                                 |   |
|---------------------------------|---|
| 1. Head, Tripod (3026)          | 10. Leg, Upper, Tripod (3027) (3)             |
| 2. Pin, Detent (3025) (10)      | 11. Leg, Middle, Tripod (3028) (3) (obscured) |
| 3. Extension Stand (3033) (3)   | 12. Leg, Lower, Tripod (3029) (3) (obscured)  |
| 4. Protector, Arbor (3007)      | 13. Hoist Assembly (3030)                     |
| 5. Weight, Large (2998)         | 14. Pin, Detent (3025) (3)                    |
| 6. Cable Assy (obscured) (2994) | 15. Base, Stand (3032) (3)                    |
| 7. Weight, Small (3020)         | 16. Indicator Arbor (3015)                    |
| 8. Ring, Section (3009) (6)     | 17. Case Assembly (3017)                      |
| 9. Ring, Anchor (2742) (2)      |   |

Important: Position rope slings in front of large back balance weight prior to closing case lid.

**Figure 1. 7BAL150 Balance Indicator Kit**



- |                        |                              |
|------------------------|------------------------------|
| 1. Head, Tripod (3026) | 5. Leg, Lower (3029)         |
| 2. Leg, Upper (3027)   | 6. Hoist, Chain (3030)       |
| 3. Pin, Detent (3025)  | 7. Extension Stand (3033)    |
| 4. Leg, Middle (3028)  | 8. Base Stand Support (3032) |

Figure II. Tripod Stand Hoist and Support Stand Assemblies assembled for use. One support stand shown extended.

welded tube that accepts a telescoping extension. The extension is adjustable to four different heights. A detent pin is used to retain the extension at the height desired. A rubber roller on the extension provides the protective cradling for the equipment being balanced.

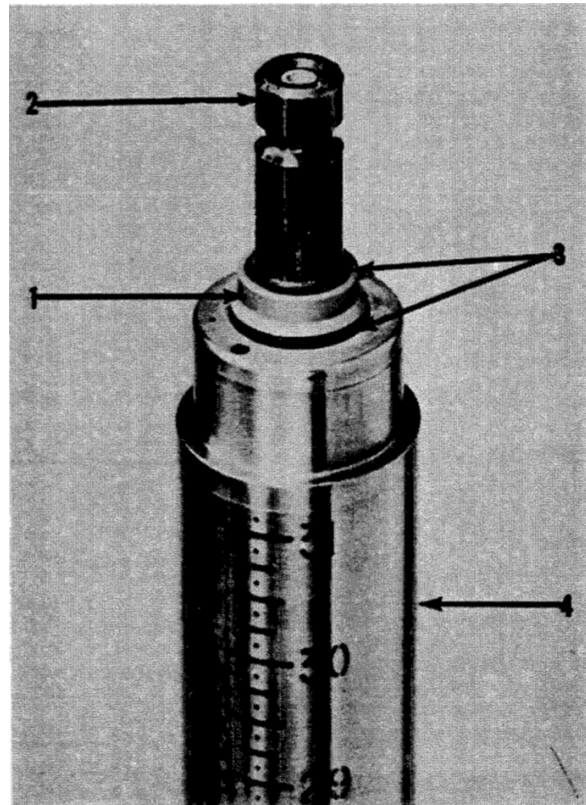
- (k) To restore the stand base assemblies in the kit case, it is necessary to lower and pin the extension to its lowest position on the stand base.
- (l) The total weight of the 7BAL150 Kit is 310 pounds and includes a fitted hardwood and carrying case for component storage and protection. Case size is 47" x 19 1/2" x 14 1/4".
- (m) Figure 1 is a view of the 7BAL150 Kit showing most of the components and the corresponding part number identification. It should be noted that some kit details such as the cable assembly (2994) are obscured in the illustration although the references are included in the parts identity listing. The two rope slings which are normally positioned in front of the large back balance weight to allow case lid to be closed, are hidden behind the weight in this illustration.

#### PREPARATION FOR USE

- (a) Tripod Stand and Hoist Assembly. Erect the tripod stand assembly and attach the chain hoist in accordance with the procedure described below and as shown in Figure II.
  - 1. Place the 3026 tripod head (1, Figure II), flat on the cleared floor, with leg sockets up.
  - 2. Install a 3027 upper leg (2, Figure II), in each of the three leg sockets. Engage plated end and align cross pin bores. Install 3025 pins to secure (3, Figure II).
  - 3. Position above assembly on its side, resting along sides to two legs and tripod head.
  - 4. Install three each 3028 middle legs (4, Figure II) engaging plated ends and aligning cross pin bores. Install 3025 pins to secure.
  - 5. Install one 3029 lower leg (5, Figure II) into one leg group extending along the floor and 3029 lower leg into group extending upward from floor. Engage plated ends and align cross pin bores; install 3025 pins to secure.
  - 6. With partially assembled tripod still on its side, engage the topside hook of the 3030 chain hoist (6, Figure II) into the eye of the tripod head.
  - 7. Raise and rotate tripod as necessary to rest upright on the two completely assembled legs; continue to raise by the short leg until sufficient clearance is obtained to install the remaining 3029 lower leg. Engage plated end and align cross pin bores; install 3025 pins.
- (b) Support Stand Assemblies:
  - 1. The three 3034 stand assemblies are stored in the kit case at their lowest adjustable height.
  - 2. Locate the support stands in the desired location on the floor under the tripod head.
  - 3. To adjust height, remove 3025 pin (3, Figure II); raise 3033 extension (7, Figure II); align cross pin bores and reinstall pin through 3032 base (8, Figure II) and extension holes. Equalize height of all three stand assemblies as desired.

- (c) Balance Indicating Arbor.
  - 1. Remove 3015 arbor from case storage section and stand it upright in square compartment at forward right hand corner of case.

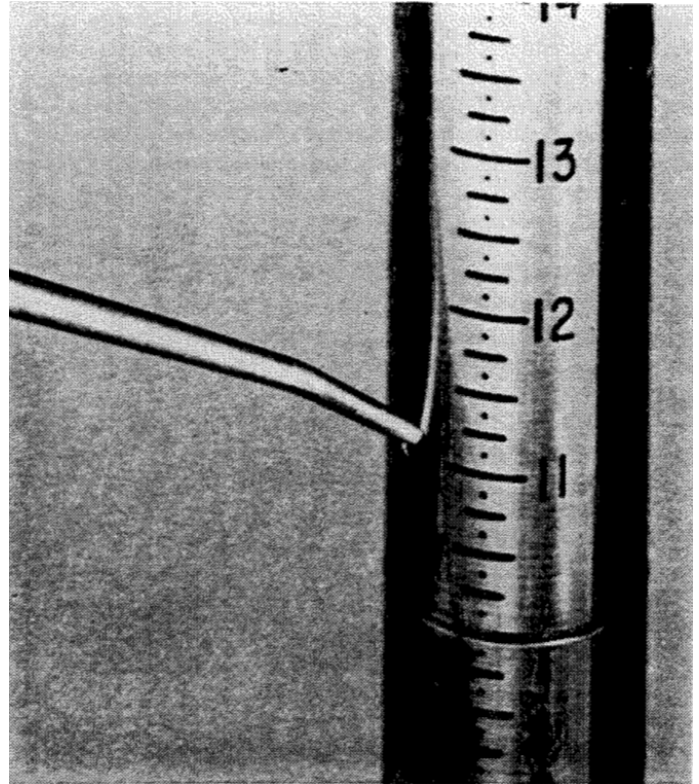
CAUTION: Always handle indicating arbor with care. Avoid sharp jolts or accidental contact with other objects that would cause physical damage. See Section II of reference manual for precautionary details.
  - 2. The 3015 is shipped and normally stored with two "O" ring seals in place at the rod end of the arbor to retain the damping oil, (See figure III). The seals shall be removed prior to arbor use and shall be conserved for reinstallation. Simply lift off the upper "O" ring seal located above the indicator bushing. Loosen set screw of indicator bushing and remove bushing. Remove exposed lower "O" ring seal.
  - 3. Carefully clean all residual oil and preservative compound from the surface of the arbor, exposed suspension rod section and the removed indicator bushing. For best indication contrast, finish indicator area cleaning by using a clean cloth moistened with solvent, Federal Specification P-D-660 or an equivalent volatile cleaner.



- 1. Indicator Bushing
- 2. Suspension Rod End
- 3. "O" Ring seals (Used for storage only)
- 4. Indicating Arbor Shaft

Figure III. Sealing "O" Rings shown in position for Arbor Storage.

4. Using two small pieces of paper as shims (approximately .003 inch thick) under indicator bushing, reinstall the indicator bushing and tighten the set screw to secure; remove paper shims. Refer to Section III of reference manual for more complete details.
5. Check that the indicator moves freely, without any evidence of binding, over the black indicator disk incorporated into the arbor end.  
NOTE: Since oil seal "O" rings have now been removed, maintain the arbor in an upright position during any subsequent handling to prevent loss of damping oil. Whenever arbor is to be stored in a horizontal position, reinstall the oil seal "O" rings, above and below the bushing.
6. For a specific balance operation to be accomplished, refer to the applicable Service Bulletin which will provide instructions covering the installation of adaptering and associated equipment on the indicating arbor and the procedural steps to be followed.
7. If it is evident that arbor indicator oscillation damping is excessive due to inadvertent loss of arbor dash-pot oil, or should change of oil level be necessary, the condition can be easily corrected by raising or lowering the level of the oil contained within the arbor. A clean mineral oil of SAE 40 viscosity shall be used.
8. The four oil filler openings on the arbor are sealed with button-head hex socket screws. The damping oil in the arbor may be drained, or oil may be added, through these orifices in the arbor wall. It is recommended that the opening of the 11-inch scale position be used either to drain or to add oil with a pump type oil can and the arbor upright. (See Figure IV). Openings at the 19" and 27" positions can be used to determine actual oil level. A 5/64" hex key wrench is furnished for removing and installing the oil filler hole screws.



**Figure IV. Pumping SAE 40 Mineral Oil into Indicating Arbor at 11-inch Oil Filler Hole.**

**IMPORTANT:** For general handling procedures, care and precautions to be observed, cleaning and preserving of equipment covered herein, refer to reference manual since similar equipment and details are involved.

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SERVICE BULLETIN

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SUBJECT

Balancing Hamilton Standard Model 33LF-337 and 33LF-338 Flange-Mounted Propellers.

REFERENCES

- (a) Bulletin No. 79. Operation and Service Manual.
- (b) Service Bulletin No. 79-08, Model 7BAL150 Balance Indicator Kit.
- (c) Service Bulletin No. 79-10, Model 7A060 Propeller Balancing Adapter Kit.

EQUIPMENT REQUIRED

7BAL150 Kit, Balance Indicator (See referenced Service Bulletin No. 79-08).

7A060 Kit, Propeller Balancing Adapter (See referenced Service Bulletin No. 79-10).

PROCEDURE

- (a) Prepare the Model 33LF-337/338 assembly for balance in accordance with instructions provided in the propeller manufacturer's applicable manual.
- (b) Erect the tripod stand assembly and prepare for use the required components of the 7BAL150 Kit as described in Service Bulletin No. 79-08. Locate the tripod in a draft-free area.
- (c) Balance the Hamilton Standard Model 33LF-337 and the 33LF-338 propellers as described in the detailed procedures included below.
  - 1. Adjust extended height of the three support stand assemblies (7BAL150 Kit) equally to provide floor clearance for the propeller spinner. Place stand assemblies (1, Figure I) under the tripod hoist in the approximate position the blade shanks will need support.
  - 2. With the prepared propeller assembly (2, Figure I) in a nose-down condition, move it centrally under the tripod hoist; reposition the support stands as necessary to support under the rounded shank sections of the blades and lower propeller on the stand rubber rollers.
  - 3. If not previously done, remove oil seal "O" ring seals from indicator section of 3015 arbor (7BAL150 Kit) and adjust indicator bushing gap in accordance with Service Bulletin No. 79-08. Retain "O" ring seals for

subsequent reinstallation.

CAUTION: Maintain indicator arbor (4, Figure I) in an upright position after removing seals to prevent loss of damping dash-pot oil.

- 4. Install the 3007 protector (7BAL150 Kit) to protect the suspension coupling rod. (See Figure II), Engage protector fully over shaft reduced diameter until it seats on shaft shoulder. Lightly tighten locking set screw with 1/8" inch hex key wrench (7BAL150 and 7A060 Kits).

NOTE: Clean and freshly oil the joining diameters of balance equipment precision parts immediately before use in subsequent operations.

- 5. Install the 2958 flange adapter (7A060 Kit), flanged end down, over the installed 3007 protector. Temporarily position the adapter on the 3015 arbor shaft at approximately its mid-length. Lightly tighten the locking set screw to secure (12, Figure I).
- 6. Remove the 3007 protector. Install 2994 quick disconnect cable (7BAL150 Kit) to the 3015 arbor coupling (6, Figure I). Attach the assembled group to the tripod hoist hook; position to insure bottom end of arbor clears the propeller hub a minimum of 10 inches.
- 7. Install two (2) sections 3009 retaining ring (3, Figure I), (7BAL150 and 7A060 Kits), in bottom groove of 3015 arbor. Loosen 2958 adapter locking set screw and lower the adapter (10, Figure I) until it is seated on the installed rings. **Do not** tighten adapter set screw (12, Figure I).
- 8. Install two (2) sections 3009 retaining ring (9, Figure 1), (7BAL150 and 7A060 Kits), in arbor groove immediately above 2958 adapter top end.
- 9. To insure proper balance indications, lightly stone flange attaching surfaces of propeller hub to remove raised edges, burrs, and nicks. It is important that mating and joining surfaces of the propeller hub and 2958 adapter devoid of nicks, burrs or other surface irregularities.
- 10. Carefully lower arbor and assembled 2958 adapter (10, Figure I) to engage the adapter with the propeller hub. Position to align attaching bolt holes. Install four (4) each 2882 bolts (7A060 Kit) spaced at 90° intervals. Tighten bolts (11, Figure 1) evenly and equally to a torque of 180 to 200 pound-inch.

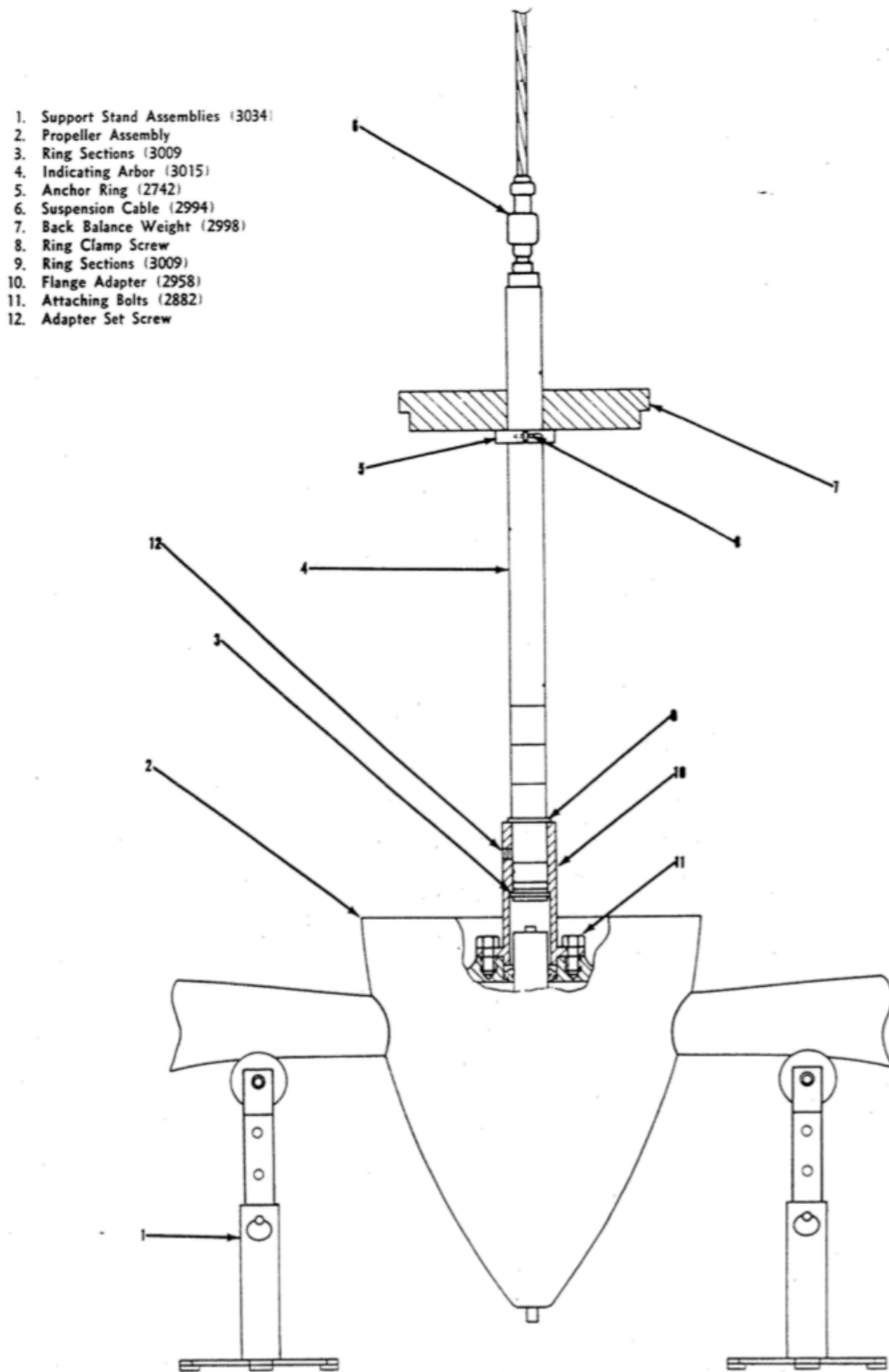
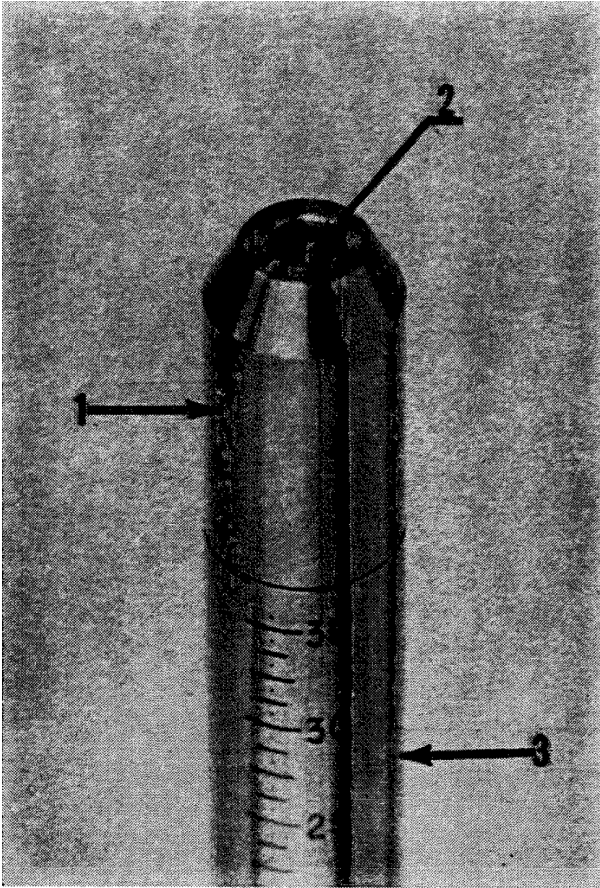


Figure I. Balancing Set-up for Hamilton Standard Model 33LF-337 and 33LF-338 Propellers.



1. Protector (3007)
2. Arbor Rod End
3. Arbor Shaft

**Figure II. Arbor Protector (3007) in Position on Arbor Shaft Shoulder.**

11. Decouple the 2994 cable (6, Figure I) from the arbor. Reinstall the 3007 arbor protector.
12. Install 2742 anchor ring (7BAL150 Kit) flat surface up, over the 3007 protector and onto 3015 arbor. Locate the top flat surface of the 2742 anchor ring (5, Figure I) at the 24-inch arbor scale position. Secure anchor ring at this position by tightening the clamping screw (8, Figure I) with the 5/32" hex key wrench (7BAL150 Kit).
13. Carefully install the 2998 back balance weight (7, Figure I), (7BAL150 Kit), edge flange up, over the 3007 protector and onto 3015 arbor. Seat the back balance weight on the installed anchor ring and make sure anchor ring top, flat surface remains at the 24-inch scale position.
14. Remove 3007 protector. Reinstall 2994 quick disconnect cable and engage it with the tripod hoist hook.
15. Hoist the entire assembly approximately 1 ½ inches to suspend it free of the support stands. Stabilize swing and rotational movements of assembly and relocate support stands beneath blade shanks to insure there is no interference with propeller surfaces.
16. Note balance indication indicated by black indicator disc at top of arbor.
17. For balance tolerance and balance corrections, refer to applicable propeller manual.

**CAUTION:** When removing the 3009 retaining ring sections (3) and (9) from arbor grooves, do not pry against arbor surfaces. It is recommended that a smooth-edged washer or coin be used with appropriate finger pressure to separate the two ring sections.



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**SUBJECT**

Model 7A060 Kit-Propeller Balancing Adapter.

**REFERENCE**

Bulletin No. 79, Operation and Service Manual. Service Bulletin No. 79-08, Model 7BAL150 Balance Indicator Kit.

**APPLICATION**

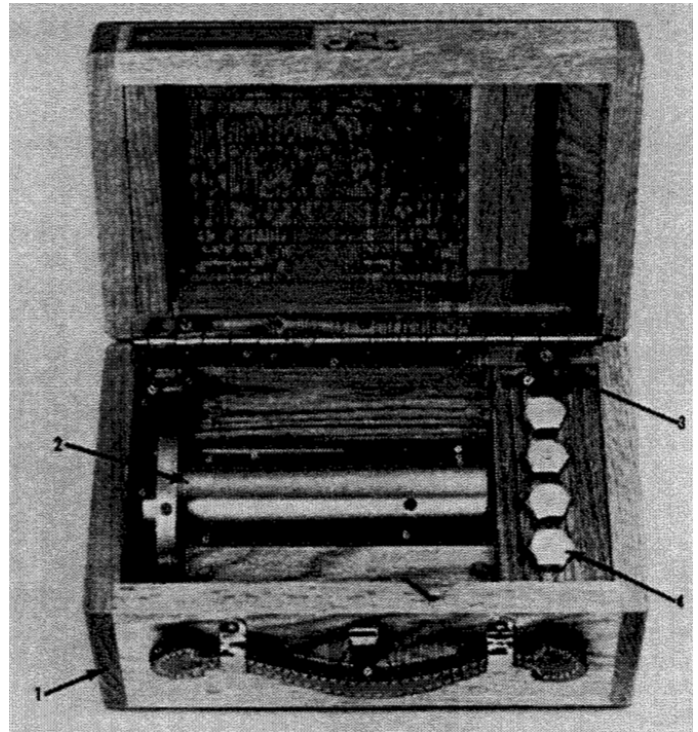
- (a) The 7A060 Adapter Kit is primarily intended to be used with the Model 7BAL150 Balance Indicator Kit and provides the adapting and associated components required to balance flange-mounted propellers having a 2 9/16" basic diameter locating bore and 4 1/4" basic diameter 8-hole attaching bolt circle.
- (b) Propellers may be balanced as complete assemblies with spinners and other components installed. Refer to applicable Service Bulletin for balance procedures to be followed for specific propeller models.

**DESCRIPTION**

- (a) The 7A060 Adapter Kit is illustrated in Figure I and shows component part number identification. Kit total weight is 15 pounds and includes a fitted, finished hardwood storage and carrying case for parts protection. Case size is 11 3/4" x 7" x 6 1/4".

**PERPARATION FOR USE, STORAGE  
OR SHIPMENT**

- (a) Refer to Bulletin No. 79, Section III, for procedures applying to similar parts.



- 1. Case Assembly (3010)
- 2. Flange Adapter (2958)
- 3. Ring Section (4) (3009)
- 4. Attaching Bolts (4) (2882)

**Figure I. 7A060 Kit, Propeller Balancing Adapter.**

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**FAIRFIELD, NEW JERSEY 07006**

**SERVICE BULLETIN**

*This Bulletin supplements the referenced Operation and Service Manual. To maintain the manual in current revision status, insert Service Bulletin as a supplementary appendix. Additional copies of Service Bulletins, as well as the referenced Operation and Service Manual, are available upon request.*

**SUBJECT**

Balancing Bell Helicopter Main and Tail Rotor Hub & Blade Assemblies, Models 206A, TH-57A, OH-58A.

**REFERENCES**

1. Bulletin 79, Operation and Service Instructions – Balancing and Adapter Kits.
2. Bulletin 79-11, Model 7BAL050 Kit – Balance Indicating.
3. Bulletin 79-12, Model 7HEL069 Kit – Main & Tail Rotor Balancing Adapter.

**EQUIPMENT REQUIRED**

1. Universal to Main and Tail Rotor Balance
  - a. 7A050 Kit – Propeller Balancing (Bulletin 79).
  - b. 7HEL069 Kit – Main & Tail Rotor Balancing Adapter (Bulletin 79-12).
2. Main Rotor Balance
  - a. 2769 Tube Assembly (Bulletin 79).
  - b. 2337 Fixture – Rotor Hub Piloting (7HEL054 Kit Component) (Bulletin 79).
3. Tail Rotor Balance
  - a. 7HEL153 Kit – Small Parts Balancing (Bulletin 79).
4. Alternate Equipment
  - a. 7A050 – N1 Kit – Propeller Balancing, will equally substitute for the 7A050 Kit.
  - b. 7BAL050 Kit – Balance Indicating. (Bulletin 79-11) can be substituted for the 7A050 Kit and 2769 Tube when a shop hoist and suitable work support stand or bench are provided.
  - c. 7HEL053, or – N2; 7HEL153 – N2, - N5, -N6, -N7, or N9 Kit – Small Parts Balancing, will equally substitute for the 7HEL153 Kit.

**PROCEDURE**

1. Tail Rotor Hub and Blade Assembly Balance (Fig. 1)
  - a. Assemble 7A050 Kit work stand and hoist structure. (Bulletin 79, Section III).
  - b. Place 2532 Fixture (2) (7HEL153 Kit), recessed side downward, central on work stand table (1).
  - c. Assemble 3063 Spacer (13) (7HEL069 Kit) to threaded end of two 2539 Post Assemblies (3) (7HEL153 Kit). Install assembled units into tapped holes A, view A of 2532 Fixture (2). Use fingers only to tighten.
  - d. Place 3077 Adapter (4) (7HEL069 Kit), large end downward, over hub extension of 2532 Fixture.
  - e. Position tail rotor assembly to place static stop (machined) surface of yoke section upward and index to locate trunnion bearing restrictions adjacent to flat sides of adapter. Engage trunnion bore with pilot diameter and install to seat upon adapter shoulder.

- f. Place 2586 Plate (5) (7HEL153 Kit), or 2531 Plate (5), (7HEL053 Kit), central on top surface of rotor hub.
- g. Install 2533 Bushing (6) (7HEL153 Kit) on 2516 Arbor (7HEL153 Kit) with its flanged end downward. Position to align its top surface (sensitivity setting reference) with the 8 <sup>3</sup>/<sub>4</sub> inch arbor scale location for rotors incorporating flyweight ring type pitch horns or 9 <sup>1</sup>/<sub>2</sub> inch location for non-weighted horns. Secure by tightening the two bushing set screws (8) evenly.
- h. Install arbor, with bushing, downward thru plate on rotor hub, adapter and fixture. Seat tightly against plate and rotor hub. Tighten 2 lower set screws (9) of fixture hub evenly to maintain clamping pressure.
- i. Position rotor assembly and adjust blade pitch to locate pitch horn studs (10) adjacent to post assemblies (3) below their indexing pin sections (12). Rotate upper section (11) of posts to position knurled length of index pin (12) above pitch horn studs. Readjust pitch of blades to seat studs upward against extending index pin knurled section, See View B. Fig 1.
- j. Attach 2266 Quick Disconnect Coupling with 2264 Cable (7A050 Kit) to 2516 Arbor. Engage cable ball into lifting plate of stand hoist. (Bulletin 79)
- k. Hoist assembly approximately <sup>1</sup>/<sub>4</sub> inch above stand table stabilize movements, and observe balance indicated by black disc in top surface of arbor shaft (Bulletin 79). Check to insure balance indications are not affected by interferences from the stand, air drafts or movement of nearby personnel.
- l. For balance tolerances, method of correction and other assembly requirements, refer to applicable helicopter maintenance manual.

2. Main Rotor Hub and Blade Assembly Balance (Fig. II)
  - a. Assemble 7A050 Kit work stand and hoist structure, substituting the 2769 Tube Assembly for the 2288 Tube Assembly supplied in the kit. (Bulletin 79).
  - b. Place 2337 Fixture (2) central on table surface of work stand. (1)
  - c. Place 2775 Adapter (3) (7HEL069 Kit), large end downward, over top extension of 2337 Fixture.
  - d. Install 3035 Pitch Positioning Locks (4) (7HEL069 Kit) to rotor assembly between pitch arms and hub lower flange while mounted on helicopter mast (View A). Lightly tighten ring nut (5) securing hub clamp section (6) of locks and adjust blades to approximately flat pitch with arm positioning ring nuts (7). Remove rotor from helicopter.

1. Stand Table (7A050)
2. Fixture (2532, 7HEL153)
3. Post Assembly (2) (2539, 7HEL153)
4. Adapter (3077, 7HEL069)
5. Plate (2586, 7HEL153) or (2531, 7HEL053)
6. Bushing (2533, 7HEL153)
7. Arbor (2516, 7HEL153)
8. Set Screws, 2533 Fixture Hub
9. Set Screws, 2532 Fixture Hub
10. Studs, Pitch Horn
11. Section, Upper, 2539 Post
12. Indexing Pin, 2539 Post
13. Spacer (2) (3063, 7HEL069)

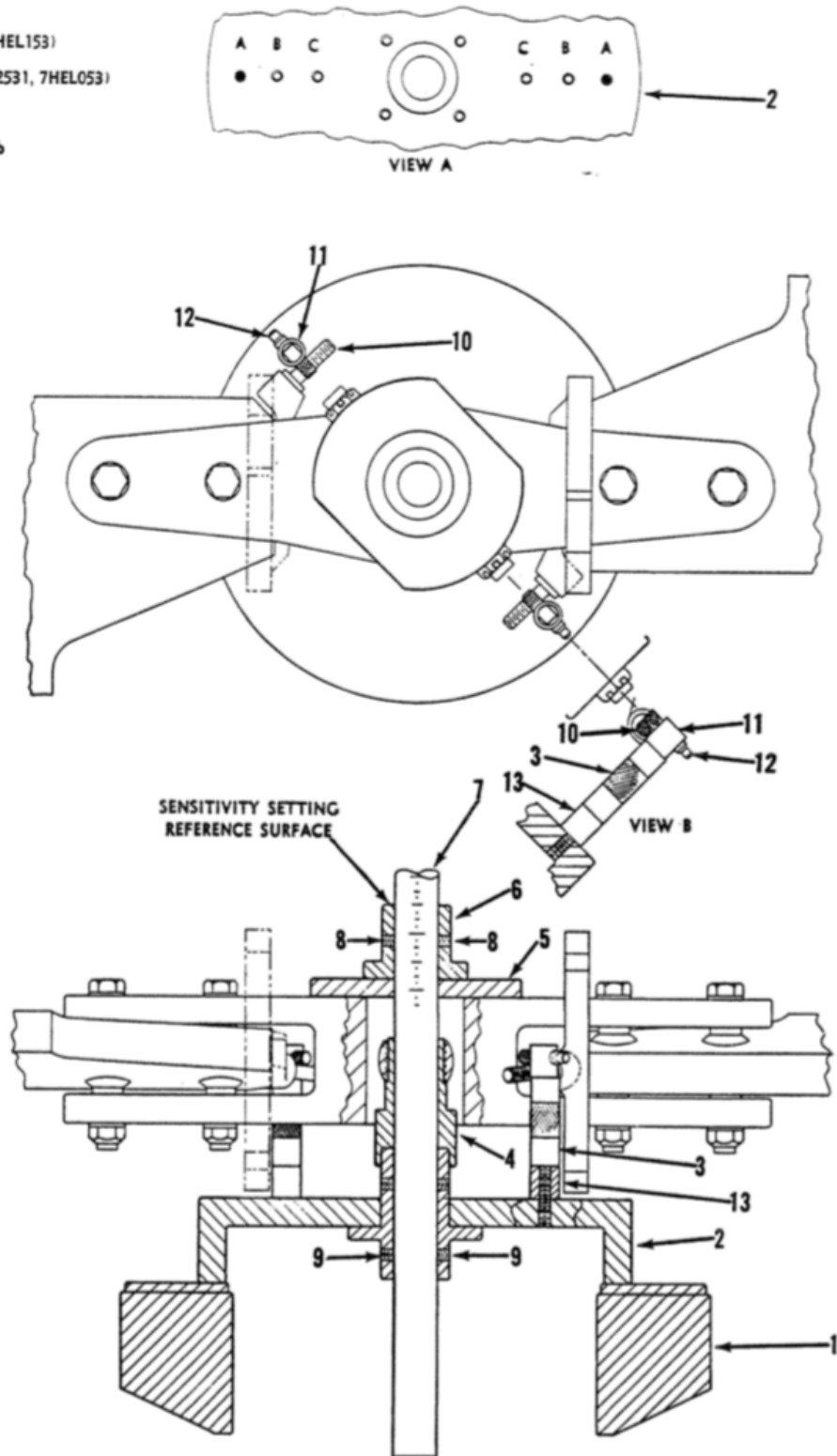


Figure I. Balancer Installation – Bell Helicopter Models, 206A, TH-57A, & OH-58A Tail Rotor - Typical

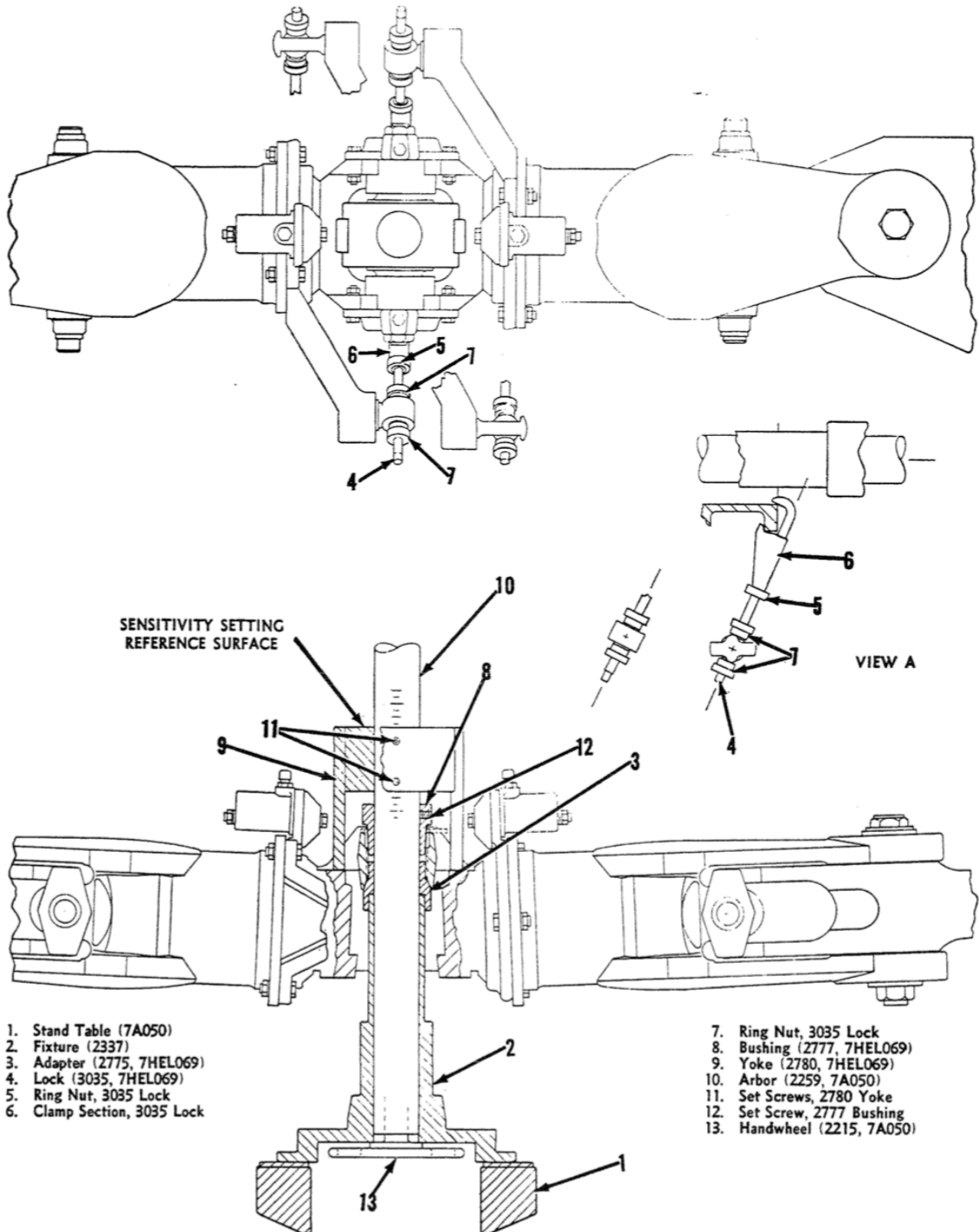


Figure II. Balancer Installation – Bell Helicopter Models 206A, TH-57A, & OH-58A Main Rotor – Typical.

- e. Carefully install rotor assembly on 2775 Adapter (3) and its support (2), engaging trunnion bore over pilot diameter of adapter and seating firmly on cone surface.
- f. Remove centrifugal tilt stop assembly from rotors incorporating this mechanism.
- g. Observe oil level in grip and trunnion oil reservoir sight glasses. Fill as required in accordance with applicable Helicopter Maintenance Manual.
- h. Where not previously accomplished, install 3035 Pitch positioning Locks (4) on rotor assembly in accordance with instructions of step d.
- i. Position Blade grips to flat pitch and secure.  
NOTE: Observe this operation in this step sequence only when rotor blade alignment is to be accomplished. Refer to applicable Helicopter Maintenance Manual for blade alignments requirements and procedures.
  1. Place 2780 Yoke (9) (7HEL069 Kit), legs upward, centrally on the top surface of rotor trunnion.
  2. Place base of bubble protractor head on exposed surface of 2780 Yoke and align at 90° (across) to pitch axis. Adjust protractor to center bubble and lock.
  3. Transfer protractor, keeping it in the same transverse position, to the machined surface of a grip adjacent to its blade retention bolt and again align at 90° to the pitch axis.
  4. Adjust and moderately tighten ring nuts (7) of pitch positioning lock (4) (installed in step d) to recenter bubble by positioning grip.
  5. Locate clamp block section (6) of lock to provide full length contact with rotor hub flange edge and moderately tighten clamping ring nut (5).
  6. Readjust grip pitch if necessary to maintain bubble in central position.
  7. Transfer protractor, keeping same transverse position, to like location and 90° alignment on opposite grip.
  8. Repeat pitch adjustment and clamping operations.
  9. Recheck bubble for central position on trunnion (yoke) reference and again on initial grip.  
NOTE: Following each blade sweep adjustment, recheck grip pitch settings and maintain at zero condition.
- j. Install 2780 Yoke (9) (7HEL069 Kit), legs downward on 2259 arbor (10), (7A050 Kit). Position to align its top flat surface (sensitivity setting reference) with the applicable arbor scale location listed below and secure by tightening the two set screws (11).

Model	206A	15 1/8
Model	TH-57A	15 1/8
Model	OH-58A	15 1/8
- k. Install 2777 Bushing (8) (7HEL069 Kit), knurled section upward, on arbor and position against lower surface of yoke body. Lightly tighten retaining set screw (12) to maintain position.
- l. Install arbor, with assembled group, downward

- through rotor trunnion engaging adapter and fixture. Position legs to align with blade pitch axis and seat on top surface of rotor hub.
- m. Place rotor blades in their radially outward position. Lift both blades at their tips evenly to approach the preconed angle. Maintain an outward load on each blade while slowly allowing them to return their initial hub supported condition.
- n. Loosen set screw (12) of bushing (8) and seat bushing taper firmly in rotor trunnion bore. Do not retighten bushing set screw at this time.
- o. Screw 2215 Handwheel (13) (7A050 Kit) into lower end of arbor and moderately tighten to seat yoke legs against hub surface. Maintain alignment of yoke legs along pitch axis and seat of bushing taper into trunnion bore.
- p. Tighten bushing set screw (12) to maintain position.
- q. Position blade grips to flat pitch and secure. Refer to instructions contained in step l, except place protractor base on top flat surface of 2780 Yoke (9) for adjustment of bubble to indicate central.
- r. Attach 2266 Quick Disconnect Coupling, with 2264 Cable (7A050 Kit) to arbor. Engage cable ball into lifting plate of stand hoist. (Bulletin 79).
- s. Hoist assembly approximately ¼ inch above stand table, stabilize movements, and observe balance indicated by black disc in top surface of arbor shaft (Bulletin 79). Check to insure balance indications are not affected by interferences from the stand, air drafts or movement of nearby personnel.
- t. For balance tolerance and methods of correction, refer to applicable Helicopter Maintenance Manual.

#### CAUTION

Forces generated during wrenching operations required for blade sweep balance adjustment can damage the balance indicating and adapting equipment. Prior to and after accomplishing each adjustment, observe the following process steps:

- u. Release hoist, allowing the support fixture (2) to rest on stand table (1).
- v. Loosen set screw (12) securing bushing (8) to arbor (10).
- w. Loosen handwheel (13) at base of arbor a minimum of 5 turns.  
NOTE: Blade sweep adjustment operations may now be safely made; however, restrain rotor tilt and forces applied to pitch positioning locks (4) by pitch arms. Following adjustment, continue as follows:
- x. Repeat step m to radially reposition blades.
- y. Insure bushing (8) is seated firmly in rotor trunnion bore. Do not tighten its locking set screw.
- z. Retighten handwheel (13) to seat yoke legs against hub surface. Maintain alignment of yoke legs along pitch axis and seat of bushing taper into trunnion bore.
- aa. Tighten bushing set screw (12) to maintain position.
- ab. Check blade grip positioning and return to flat pitch if required.
- ac. Repeat hoist operation, stabilize and observe balance indication.