SERVICE WORK INSTRUCTION

SEAKEEPER BRAKE BUSHING REPLACEMENT

PRODUCT SEAKEEPER 2, 3, 5/6, 9, 16/18, 26, 35, AND 40

PURPOSE

This procedure guides the brake bushing replacement on Seakeeper 2, 3, 5/6, 9, 16/18, 26, and 40 models. It is not intended for use on models with integrated brake systems.

BACKGROUND

Brake bushings are a periodic maintenance item on all Seakeeper models. This procedure will be used with the Brake Service Procedure for system de-pressurization and post-maintenance bleeding and return to service.

TOOLS/SUPPLIES REQUIRED

- **Parts List**:
  - Bushing Replacement Set (Applicable to Seakeeper model) Obtain appropriate part number from Partner Center
  - Sili-Thane 803 marine sealant, or similar
  - Loctite #243
  - Rags or towels
  - AW46 Hydraulic Fluid
  - Cable ties
- **Service Drawing List** (Dealer Access site):
  - Seakeeper 2 Brake: 11863, 12569 & 12570
  - Seakeeper 3 Brake: 11357, 12582 & 12583
  - Seakeeper 3DC/5 Brake: 10929
  - Seakeeper 6/5 Brake: 11676, 12613 & 12614
  - Seakeeper 9 Brake: 10846, 12770 & 12771
  - Seakeeper 16/18 Brake: 12222, 12489, 12759
  - Seakeeper 26 Brake: 11087, 12401 & 12402
  - Seakeeper 35 Brake: 11129
  - Seakeeper 40 Brake: 12550 & 12551

Example of contents in bushing kit

- **Tools**:
  - Screwdriver, Straight-slot
  - Safety Glasses
  - Adjustable wrench
  - Torque wrench
  - Torque Multiplier (P/N 40761)(Seakeeper 26, 35, & 40 model gimbal caps, optional)
  - Torque Multiplier Channel (80759)(optional)
  - Sockets for gimbal caps:
    - 17 mm (Seakeeper 2)
    - 19 mm (Seakeeper 3)
    - 24 mm (Seakeeper 3DC/5(EM)/5/6)
    - 1-1/8-in. (Seakeeper 9/16/18)
    - 1-1/2-in. (Seakeeper 26/35/40)
  - Metric wrench set (ratcheting preferable, but not necessary)
  - 3/8 in. and 1/2 in. drive ratchets (Extended handle ½ in. drive is recommended for Seakeeper 26, 35 & 40 gimbal cap mounting screws)
  - Allen T or Allen wrench set (SAE & Metric)
  - Brake Service Kit
  - Brake Bushing Service Tool Kit (appropriate kit for model serviced)
    - Seakeeper 2, 3, 4, 4.5, 5(EM)/3DC, & 6/5 (P/N: 11367)
    - Seakeeper 9/7HD, 18/16/12HD & 26/20HD (P/N: 10449)
    - Seakeeper 35/30HD/40 (P/N: 11401)

REFERENCES

- **SB-90638, Seakeeper 6 Rod End Pin Access**
- **SWI-108/108A, Seakeeper Angle Sensor Calibration** procedure
- **SWI-103, Seakeeper Brake Service**

PRECAUTIONS/NOTES

1. BRAKE FLUID LEAKAGE FROM CYLINDER ROD SEALS MAY OCCUR if cylinder rod scratched or damaged.

2. SEAKEEPER PAINTED SURFACES MAY BE DAMAGED from dropping cylinder rods onto gimbal shafts.

PRODUCT SEAKEEPER 2, 3, 5/6, 9, 16/18, 26, 35, AND 40

PROCEDURE

1. **ENSURE:**

   a. Low-current DC breaker is ON at ships service panel.

   b. Seakeeper is at zero RPM at MFD or display.

2. **ACTIVATE** brake override at MFD app or display.

3. **RELEASE** brake pressure at all cylinder bleed ports per **SWI-103**.

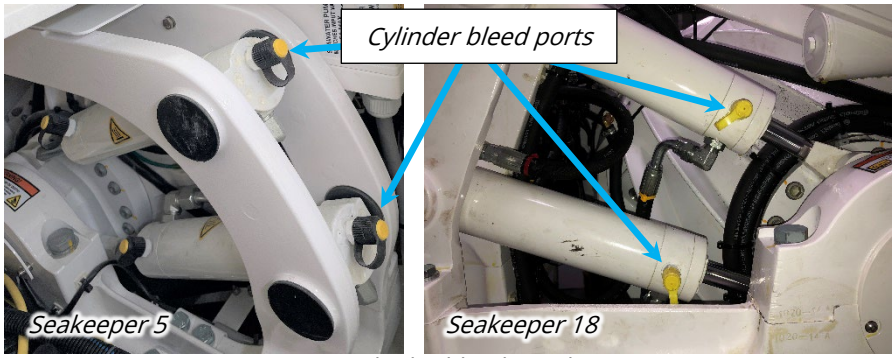


Figure 1: Cylinder bleed port locations

4. **REMOVE** angle sensor as follows:
   [N/A if Seakeeper 3DC/5 (early model) or 9/7HD with angle sensor on non-brake side]

   a. **REMOVE** mounting screws of gimbal angle sensor assembly.

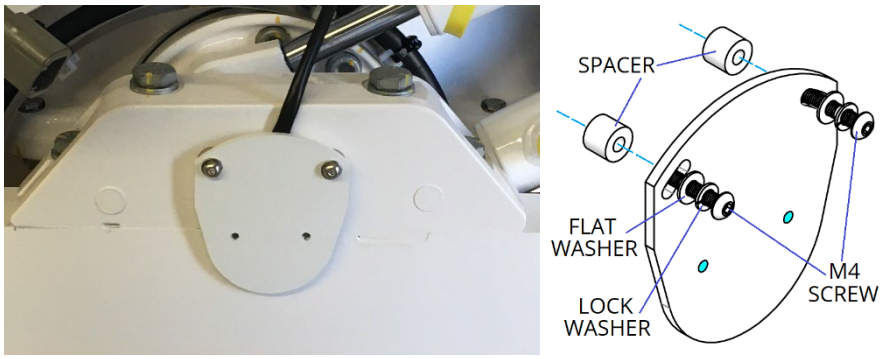


Figure 2: Seakeeper 2/3 details shown. Other models similar but may have differing hardware and sizes.

   b. **SAVE** all associated hardware for reassembly.

5. **REMOVE** gimbal cap:

   a. **IF** Seakeeper 3 (S/N 3-0494 or earlier),
   THEN REMOVE gimbal cap by performing following:

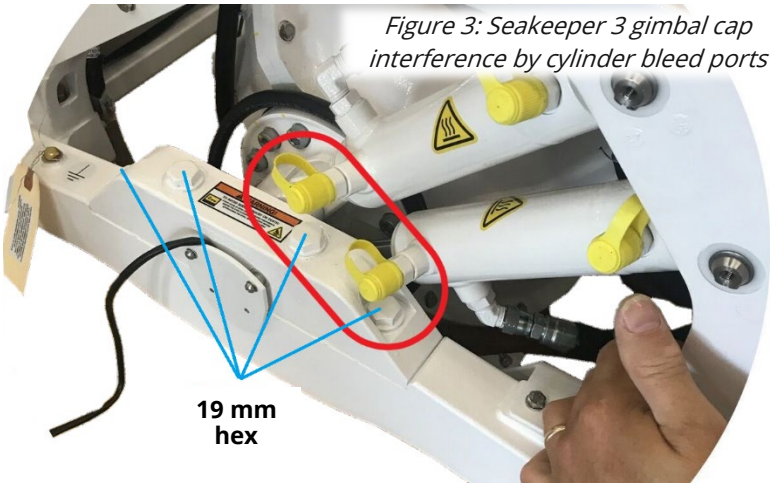
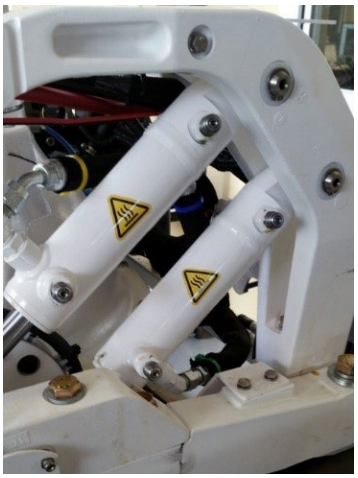


Figure 3: Seakeeper 3 gimbal cap interference by cylinder bleed ports



   i. **LOOSEN** bolts of gimbal bearing cap that can be accessed.

   ii. **LOOSEN** four cylinder brace bolts so that cylinder brace (brake arm) can be maneuvered up and forward to give clearance for wrench to loosen rear gimbal cap screws.

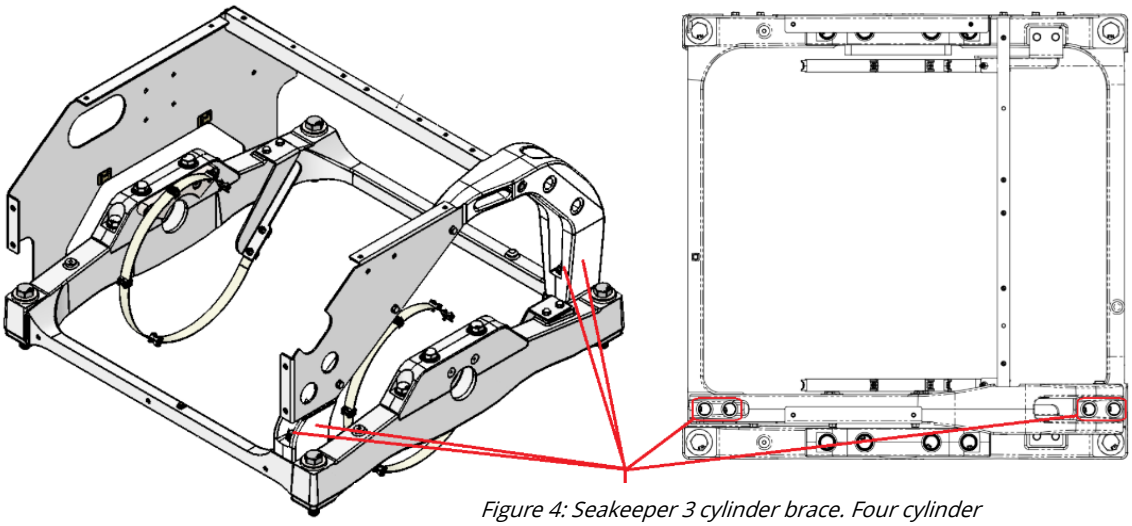


Figure 4: Seakeeper 3 cylinder brace. Four cylinder brace bolts – 17 mm Hex
Deep well socket with extension works best. Torque to 60 ft-lbs (82 Nm)

Step 5 continued

b. **REMOVE** any safety wire found on gimbal cap screws.

c. **IF** Seakeeper 26, 35, or 40 model,
THEN:

iii. **[OPTIONAL] INSTALL** torque multiplier channel (P/N 80759) with two 3/8"-16 X 2" hex flange screws (P/N 60798) over gimbal cap, as shown.

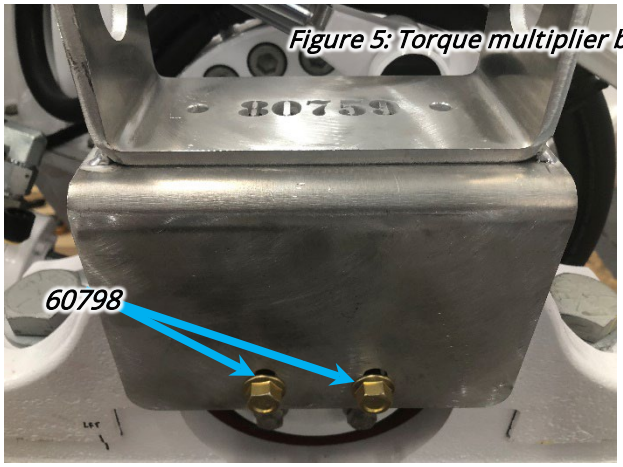
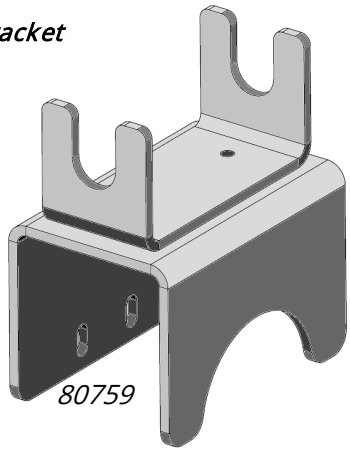


Figure 5: Torque multiplier bracket



iv. **MOUNT** torque multiplier (40761-1SP) with 1-1/2 in. socket over gimbal cap mounting screw.

v. **REMOVE** gimbal mounting screws with ½ in. drive extended handle ratchet.

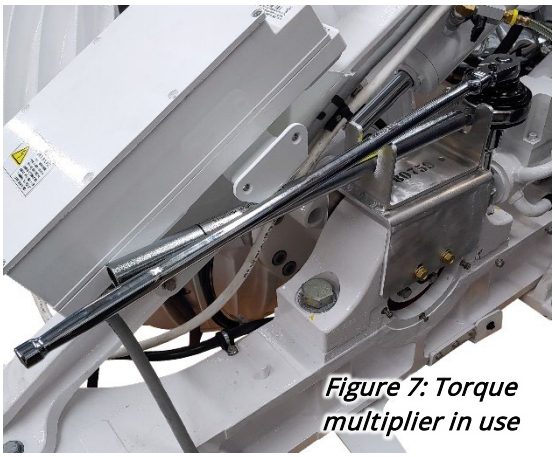


Figure 7: Torque multiplier in use

Figure 6: Torque multiplier in use

vi. **REMOVE** torque multiplier channel and repeat on opposite side.

Step 5 continued

d. **REMOVE** screws of gimbal cap.

e. **REMOVE** gimbal cap with aid of dead blow hammer.

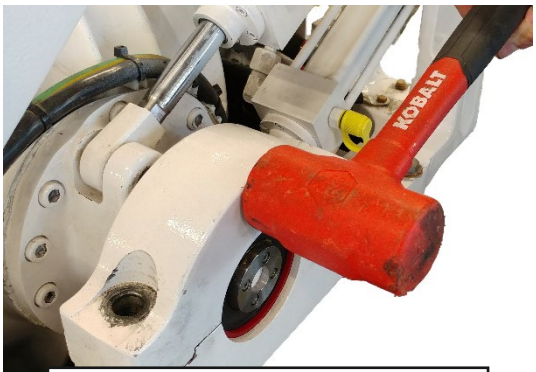


Figure 8: A dead blow hammer can assist in removing gimbal cap

6. **IF** Seakeeper 5 or 6,
THEN:

a. **REMOVE** glycol pump bracket from front panel.

b. **REMOVE** four 17 mm hex head screws of bump stop assembly per **SB-90638**.

c. **LEAVE** glycol pump bracket loose until completion.

7. **PRECESS** sphere to access rod-end pins.

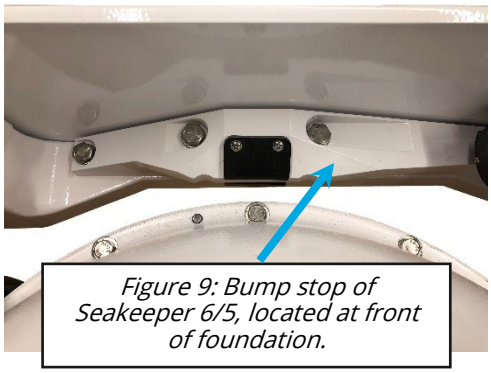


Figure 9: Bump stop of Seakeeper 6/5, located at front of foundation.

8. **REMOVE** protective plastic caps of rod-end pins.

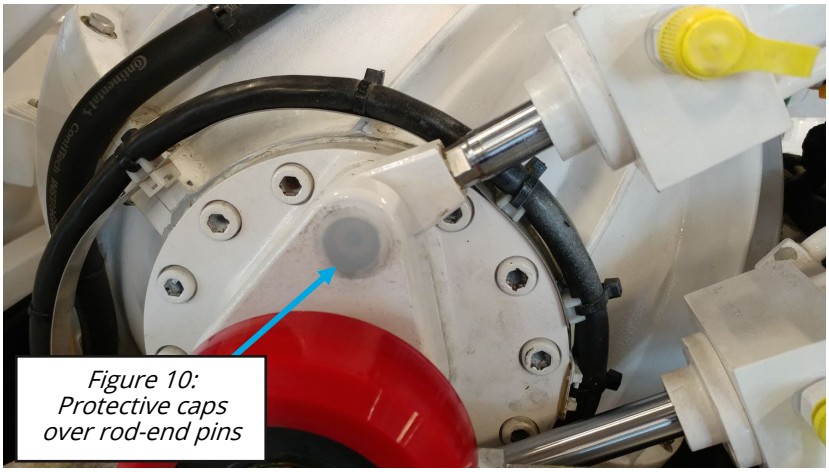


Figure 10: Protective caps over rod-end pins

9. **REMOVE** protective plastic caps of trunnions.

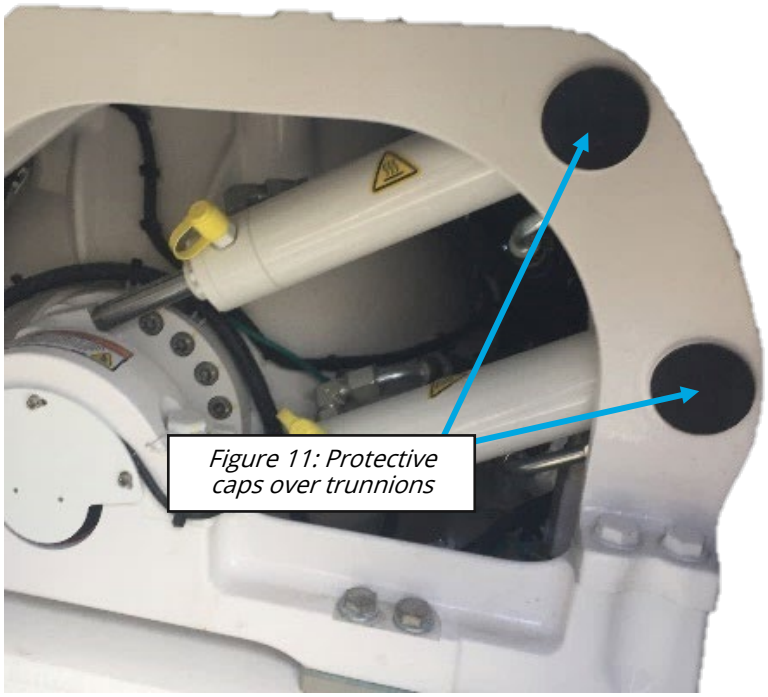


Figure 11: Protective caps over trunnions

10. **REMOVE** top cylinder(s) rod-end pins first in following steps, and then bottom cylinder(s).

> **WARNING:**
>
> Personnel injury may result from retaining ring potentially flying out when inserted or removed.

11. **REMOVE** internal retaining snap rings and spacers.

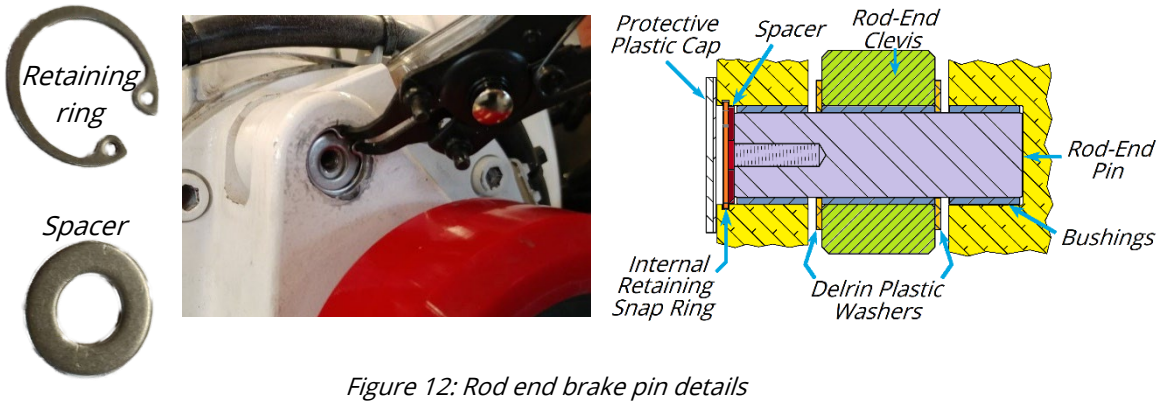


Figure 12: Rod end brake pin details

> **NOTE**:
>
> Seakeeper 35 and 40 models do not have plastic washers.

12. With bushing service kit, **REMOVE** cylinder rod pins and two plastic washers.

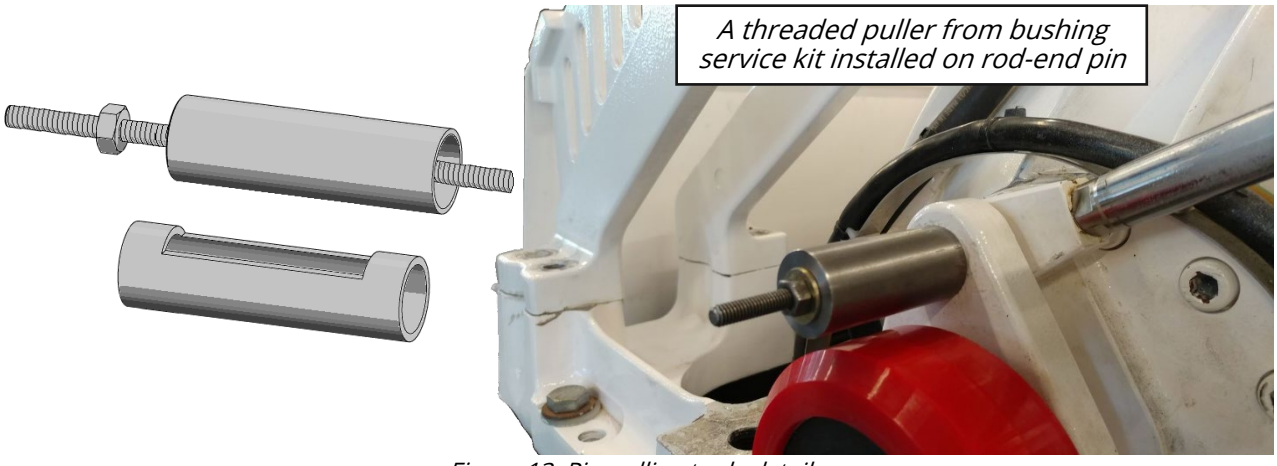


Figure 13: Pin pulling tools detail

13. **REMOVE** brake bushings as follows:

    a. **REMOVE** outer bushings from gimbal shaft using bushing insertion/removal tool provided (in bushing service kit) and hammer.

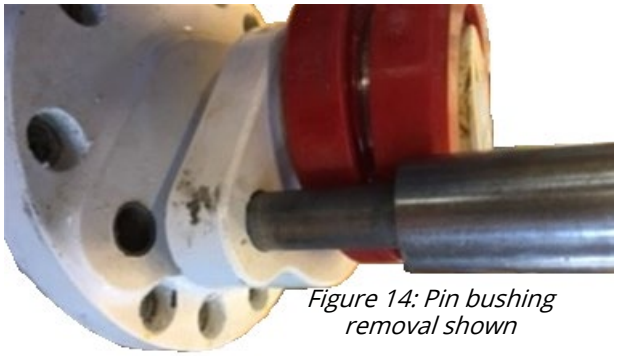
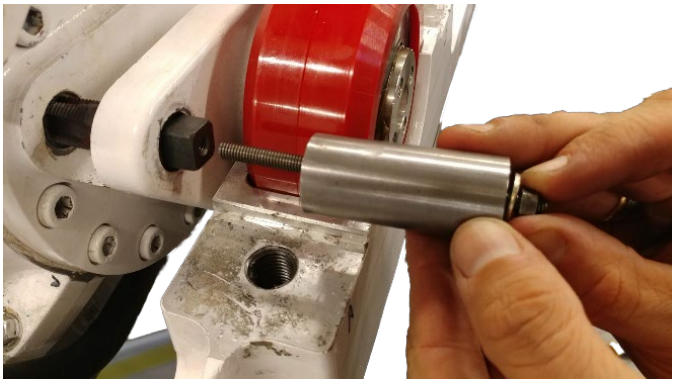


Figure 14: Pin bushing removal shown

    b. **REMOVE** inner bushings from gimbal shaft as follows:



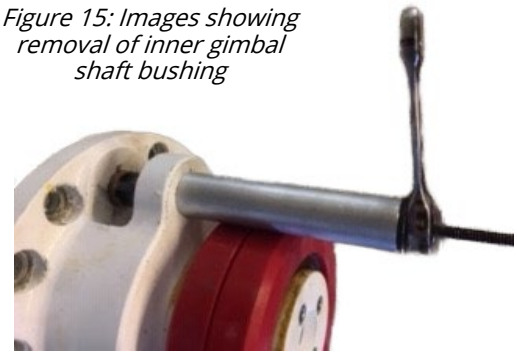


Figure 15: Images showing removal of inner gimbal shaft bushing

        i. **ROTATE CLOCKWISE** NPT Tap into inner rod-end bushing.

        ii. **<u>WHEN</u>** over half of bushing grabbed by tap,
        <u>THEN</u> PULL bushing with kit puller, as shown in figure 15.

Step 13 continued

c. **REMOVE** rod clevis bushing using bushing service kit threaded puller with bushing extraction tool.

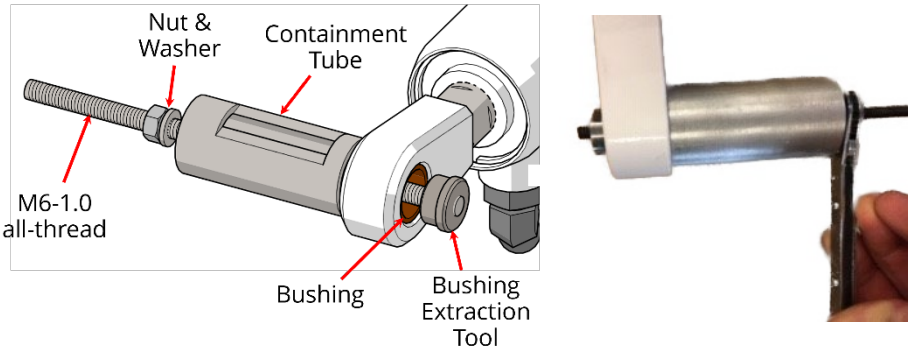


Figure 16: Images showing removal of rod clevis bushing

i. **IF** Seakeeper 35/30HD/40 models,
THEN:

1 **INSTALL** bushing kit tool components per figure 17 through the rod end clevis.

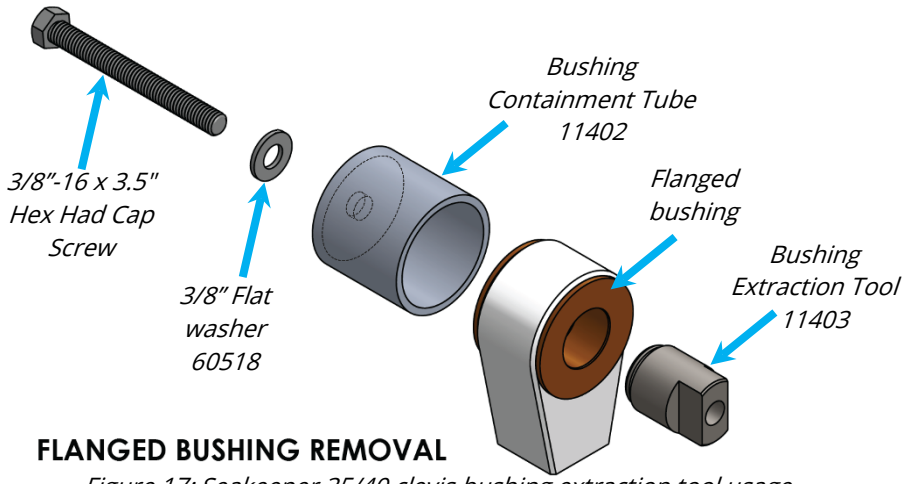


Figure 17: Seakeeper 35/40 clevis bushing extraction tool usage

2 While holding extraction tool with adjustable wrench, **TIGHTEN** 3/8"-16 bolt to break flanges of bushings and drive bushing into containment tube.

14. **INSERT** new rod-end bushings:

    a. **APPLY** thin film of moly grease to bushings internal and external surfaces.

    b. **APPLY** thin film of moly grease to rod-end pins.

    c. **INSERT** bushings into gimbal housings using bushing insertion tool provided until flush with inside surfaces.

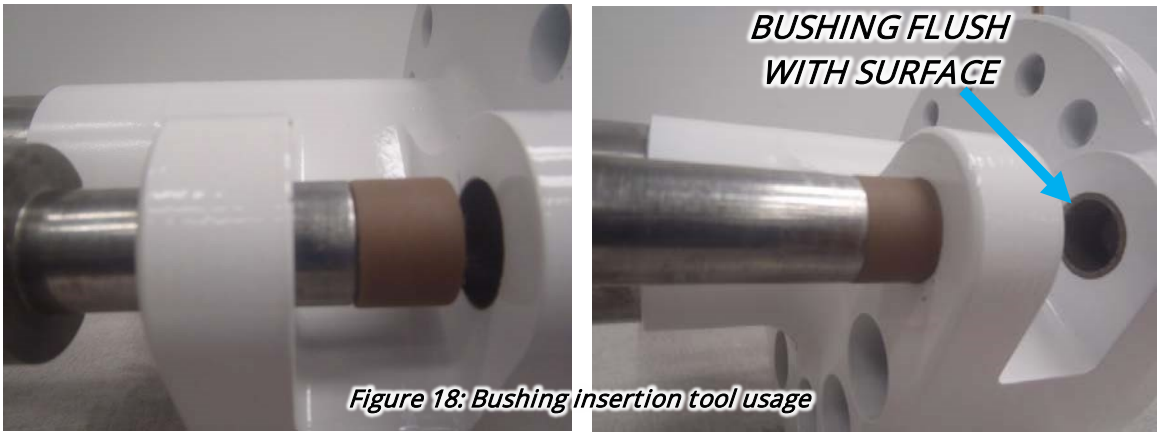


Figure 18: Bushing insertion tool usage

CAUTION!

Cylinder leak may result from using slide hammer on clevis bushings due to damage to cylinder rod seals.

    d. Using threaded puller tool only, **INSTALL** clevis bushings per figure 19.

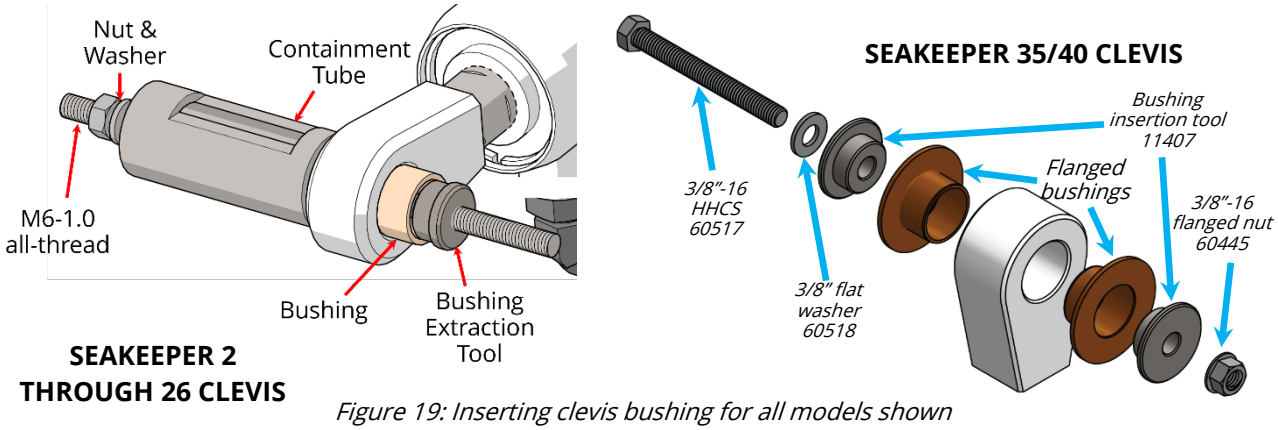
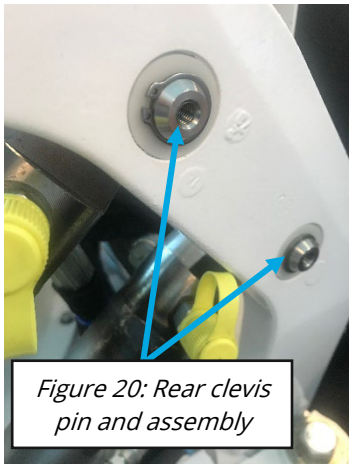


Figure 19: Inserting clevis bushing for all models shown

15. **IF** Seakeeper 2, 3, 26/20HD, 35/30HD/40,
THEN PERFORM following to remove rear clevis pins:



a. **REMOVE** cylinder rear clevis pin snap or spiral retaining rings.

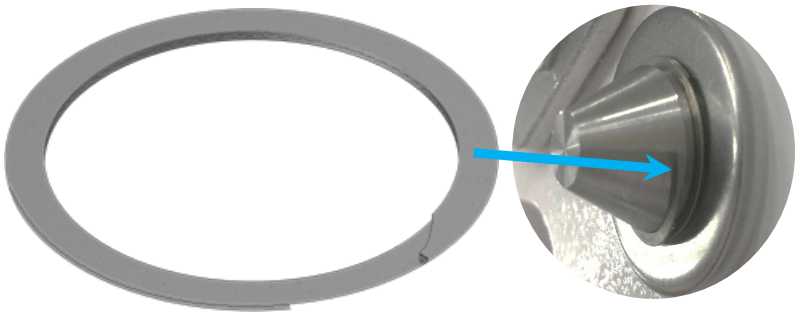


Figure 21: Example of spiral retaining ring found on Seakeeper 26

b. **REMOVE** cylinder rear clevis pins and washers.

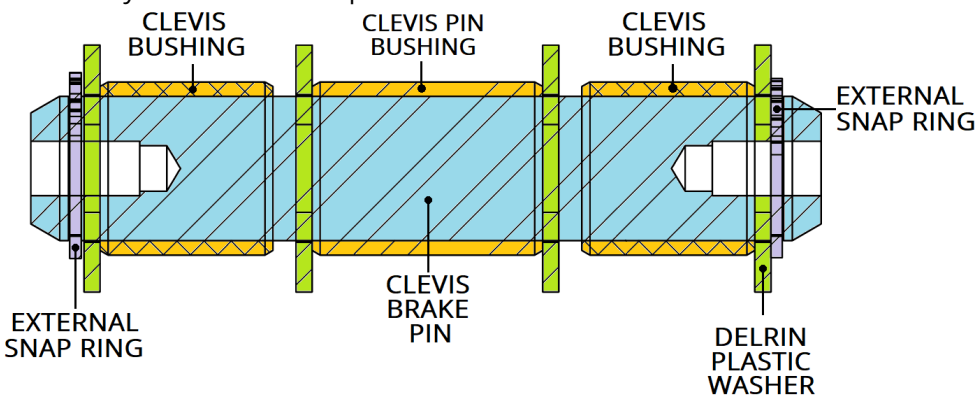


Figure 22: Rear clevis pin details

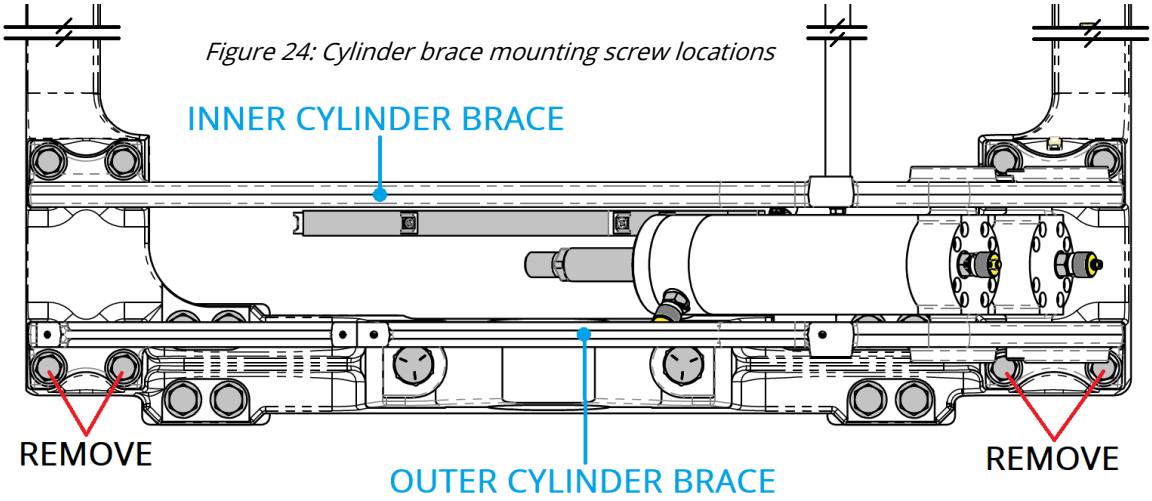
16. **IF** Seakeeper 5/3DC (EM), 6/5, 9/7HD **OR** 16/12HD/18 model, **THEN PERFORM** following to remove rear trunnions from braces:

    a. **[OPTIONAL] REMOVE** MDB to gain access to inner trunnions.

Figure 23: outer brace and MDB is removed from bracket for access to inner trunnion on Seakeeper 9

    b. **REMOVE** outer cylinder brace screws.

Figure 24: Cylinder brace mounting screw locations



    c. **REMOVE** screws holding front and top cover plates to outer cylinder brace(s).

    d. **REMOVE** outer cylinder brace(s) to allow removal of cylinder trunnions from inner cylinder brace(s).

17. **REPLACE** rear cylinder bushings:

    a. **IF** Seakeeper 2, 3, 26, 35, or 40 model,
    THEN:

        i. **REMOVE** rear cylinder bushings from cylinder brace using bushing insertion tool of bushing kit.

        ii. **REMOVE** cylinder rear clevis bushing in same manner as rod-end clevis.

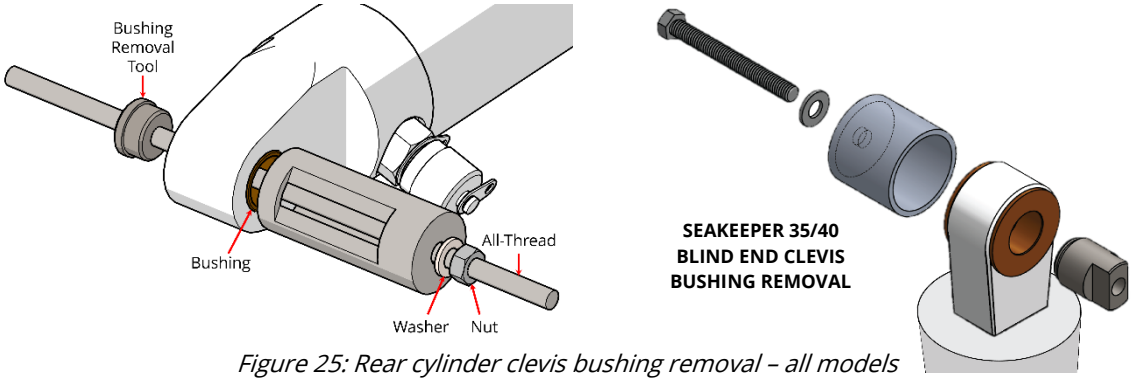


Figure 25: Rear cylinder clevis bushing removal – all models

        iii. **APPLY** thin layer of black-moly grease on inner and outer surfaces of replacement bushings.

        iv. **INSERT** bushings into cylinder brace(s) using bushing insertion tool of bushing kit.

        v. **INSERT** bushing into cylinder clevis using bushing kit.

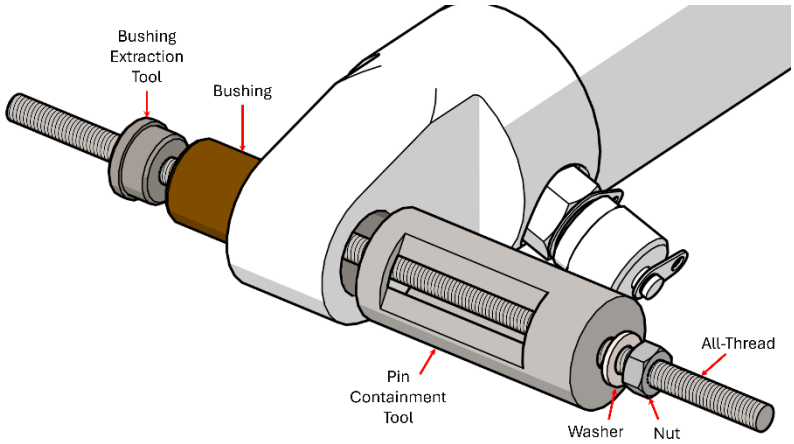


Figure 26: Use of bushing kit to install rear cylinder clevis bushing

Step 17 continued

b. **IF** Seakeeper 5/6, 5(EM), 9, or 16/18,
THEN:

i. **REMOVE** rear cylinder trunnion bushings from cylinder brace using bushing kit.

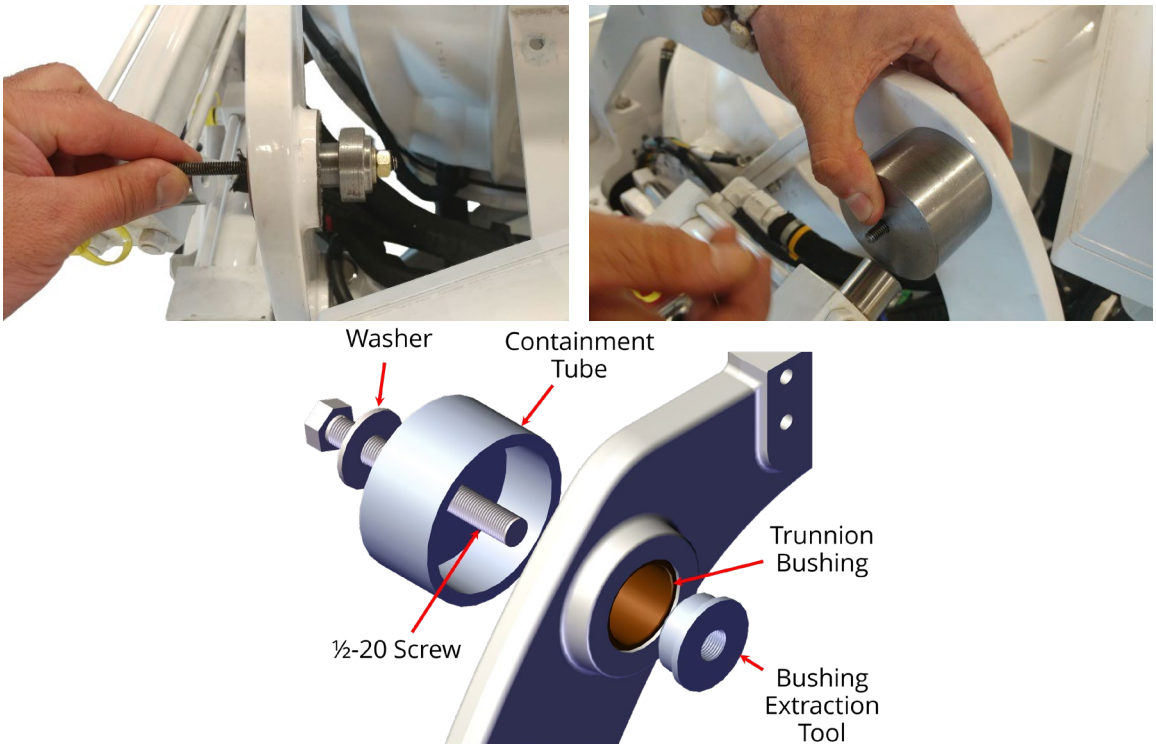


Figure 27: Rear cylinder trunnion bushing extraction

ii. **APPLY** thin film of black-moly grease on inner and outer surfaces of replacement trunnion bushings.

iii. **INSERT** trunnion bushings into cylinder brace(s).

18. **INSTALL** brake cylinders to cylinder braces:

    a. **IF** model with clevis pins,
    THEN ALIGN rear clevis/pivot pin openings with washers **AND DRIVE** clevis pins into rear clevis pin holes.

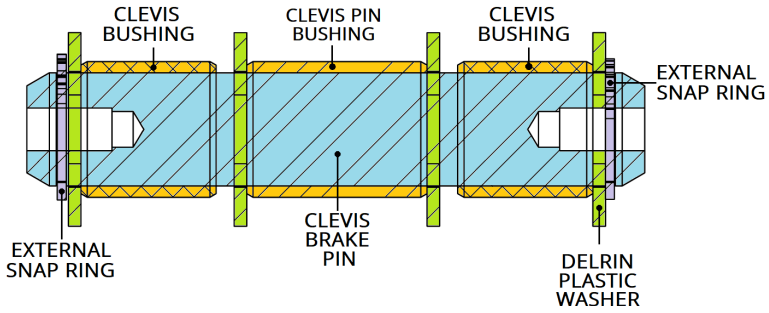


Figure 28: Rear cylinder clevis pin detail

    b. **IF** Seakeeper 5/6, 5(EM), 9, or 16/18,
    THEN:

        i. **INSERT** thrust washer (Seakeeper 9, 16, & 18 only) on trunnion with chamfer facing toward cylinder per figure 29.

        ii. **INSERT** trunnion shafts into inside cylinder brace(s).

        iii. **APPLY** sealant beneath washers of cylinder brace screws.

        iv. **APPLY** Loctite #243 to threads of cylinder brace screws.

        v. Loosely, **INSERT** screws of outer cylinder braces.

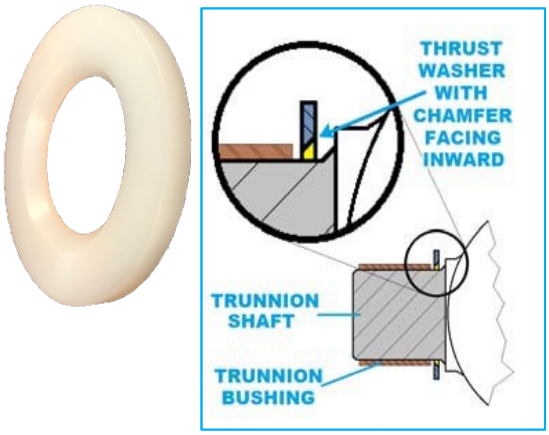


Figure 29: Thrust washer of Seakeeper 9

        vi. **INSERT** fasteners of front and top cover plates to outer cylinder brace(s).

        vii. **TORQUE** all fasteners of inside and outside cylinder braces **AND** front cover per **Attachment**.

Step 18 continued

WARNING:

PERSONNEL INJURY MAY RESULT from snap ring potentially flying out when inserted or removed.

c. **IF** Seakeeper 2, 3, 26. 35. or 40,
THEN INSTALL external snap or spiral retaining rings on rear clevis pins.

d. **IF** Seakeeper 5/6, 5(EM), 9, or 16/18,
THEN INSTALL protective plastic covers over trunnion shafts.

19. **INSTALL** rod-end pins to gimbal shaft assembly(s) as follows:

a. With layer of moly grease on clevis-side of plastic washers, **ADHERE** washers to clevis.

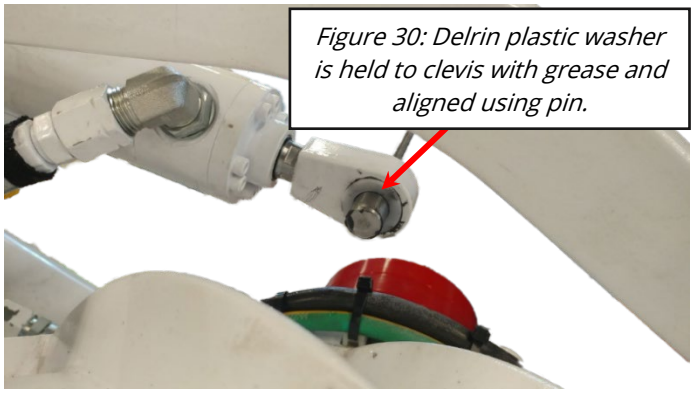


Figure 30: Delrin plastic washer is held to clevis with grease and aligned using pin.

Step 19 continued

CAUTION!

INABILITY TO REMOVE ROD END PIN may result if pin inserted with tapped hole facing enclosure.

b. With tapped hole facing outward, **INSERT** rod-end pin through gimbal housing and clevis with two plastic washers aligned.

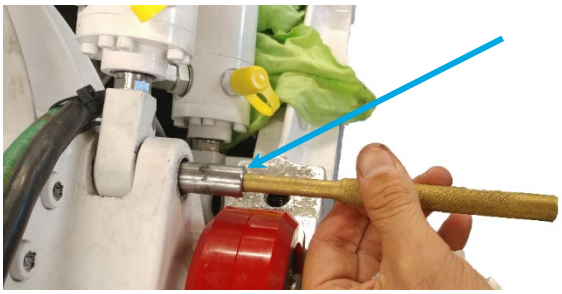


Figure 31: Pin is inserted through rod end clevis and gimbal pin openings

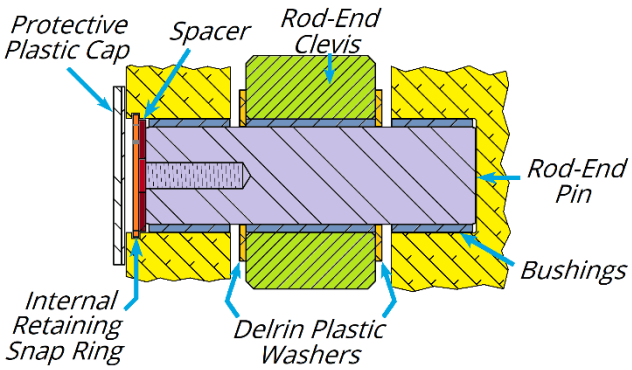


Figure 32: Rod end pin detail

WARNING:

Personnel injury may result from snap ring potentially flying out when inserted or removed. Wear eye protection.

c. **INSERT** spacer washers and internal retaining snap rings.

d. **INSTALL** protective plastic covers on rod-end brake pin holes.

20. **ENSURE** mating surfaces of foundation and gimbal bearing caps are clean.

21. **IF** gimbal cap fasteners found with lock wire,
THEN REPLACE gimbal bearing cap screws and hardware with new screws and wedge-lock washers. (P/Ns found in **Attachment**)

22. **APPLY** anti-seize to threads of gimbal cap screws.

23. **APPLY** sealant to underside of washers of gimbal cap screws.

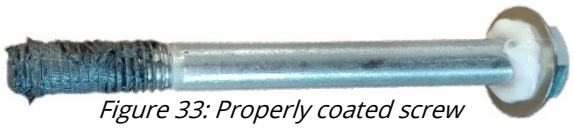


Figure 33: Properly coated screw

24. **APPLY** marine sealant to mating surface of gimbal bearing cap and foundation seating surface.

25. **INSTALL** gimbal cap(s).

26. **TORQUE** gimbal cap screws per **Attachment**.

Figure 34: Gimbal cap mating surface

27. **IF** Seakeeper 5 or 6,
THEN INSTALL mechanical bump stop (Fig. 35):

    a. **CLEAN** threads of four M10 screws.

    b. **INSERT** washers onto M10 screws.

    c. **APPLY** Loctite #243 to threads of screws.

    d. **APPLY** marine sealant beneath washers of screws.

    e. **TORQUE** screws to **25 ft-lbs** (**34 Nm**).

Figure 35: Seakeeper 5/6 bump stop

28. **TIGHTEN** all fasteners of rear crossbar or panel, front panel, and right-side panel.

29. **IF** Seakeeper requires brake service,
THEN PRESSURIZE brake system in accordance with SWI-103: Brake Service Work Instruction.

30. **IF** Seakeeper is **NOT** Seakeeper 5(EM)/3DC or 9/7HD,
THEN INSTALL angle sensor:

    a. **CLEAN** threads of angle sensor mounting fasteners.

    b. **INSTALL** washers on sensor mounting screws.

    c. **APPLY** Loctite #243 to threads of sensor mounting screws.

    d. **FASTEN** angle sensor bracket to foundation at gimbal.

        i. **ENSURE** bracket installed as indicated in attachment of SWI-108, Angle Sensor Calibration work instruction.

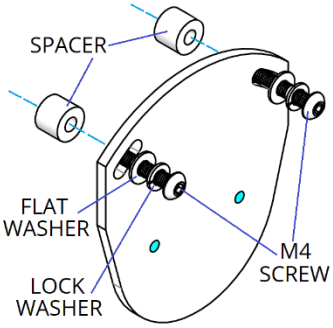


Figure 36: Angle sensor mounting details for Seakeeper 2 & 3

    e. **CHECK** angle sensor calibration per SWI-108, Angle Sensor Calibration work instruction.

        i. **IF** angle sensor out of calibration,
        THEN CALIBRATE per SWI-108: Angle Sensor Calibration work instruction.

31. **PERFORM** test run of Seakeeper.

32. **ENSURE** all alarms clear and proper operation of Seakeeper.

********** END **********

REVISION	DESCRIPTION	APPROVED	DATE
7	Remove additional text of Seakeeper 1 and 4/4.5.	A Patricio	21FEB2024
8	Removed M8000 content. Added figure numbers to images. Edited sections and steps to conform to standards. Corrected gimbal cap torque values in attachment.	A Patricio	07MAY2025

ATTACHMENT 1: TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS			
MODEL	**GIMBAL BEARING CAP (ft-lbs/Nm)**	**REPLACEMENT GIMBAL CAP FASTENER P/Ns**	**CYLINDER BRACE TORQUE (ft-lbs/Nm)**
Seakeeper 2	60 / 82	Screw, M10-1.5: • X 80 mm: 60537 • X 90 mm: 60538 Wedge-lock washer: 60531	60 / 82
Seakeeper 3	70 / 95	Screw, M12-1.75: • X 55 mm: 60477 • X 90 mm: 60478 Wedge-lock washer: 60479	
Seakeeper 5/3DC (EM)	160 / 217	Screw, M16-2 X 80 mm: 60579 Wedge-lock washer: 60456	50 / 68
Seakeeper 6/5	140 / 190		
Seakeeper 9/7HD	200 / 272	Screw, ¾-16 X 4”: 60557 Wedge-lock washer: 60558	79 / 107
Seakeeper 16/12HD/18	200 / 272	Screw, ¾”-16 X 4”: 60557 Wedge-lock washer: 60558	80 / 109
Seakeeper 26/20HD (26-0001 thru 26-0262)	400 / 544	Screw, 1”-12 X 3.5": 60614 Wedge-lock washer: 60617	75 / 102
Seakeeper 26/20HD (26-0263 and after)			60 / 82
Seakeeper 35/30HD/40 (All serial numbers)	400 / 544	Screw, 1”-12 X 3.5": 60614 Wedge-lock washer: 60617	100 / 136