SERVICE WORK INSTRUCTION

SEAKEEPER CYLINDER REPLACEMENT

PRODUCT SEAKEEPER 2 THROUGH 40

PURPOSE

To provide instructions on the replacement of brake cylinders on all Seakeeper stabilizers.

BACKGROUND

Cylinder replacement is a necessity in situations where there is oil seepage from the rod seal or pressure boundary; a standardized work instruction is needed to share experiences gained from this activity. An understanding of the Seakeeper model to be worked should be gained; the Seakeeper website provides many engineering drawings of each model in pdf format. Replace only the cylinder showing leakage; it is not necessary to replace all cylinders when only one is found leaking.

TOOLS / SUPPLIES NEEDED

- Parts List
  - Sili-Thane 803 Marine Sealant, or similar
  - Rags/towels
  - Cable ties
  - Black Moly Grease

- Tools
  - Screwdriver, straight slot
  - Safety Glasses
  - Torque Wrench
  - 7/16-in., ½-in. & 1-1/8-in. sockets
  - SAE offset socket (crowfeet) set
  - Metric wrench set (preferable ratcheting, but not necessary)
  - Allen T or Allen wrench set (SAE & Metric)
  - Brake Service Kit w/ Brake Bushing Service kit

- Documentation
  - **SWI-103 - Brake Service instruction**
  - **SWI-108 – Seakeeper Angle Sensor Calibration**
  - **SWI-109 - Brake Bushing Replacement instructions**
  - **SB-90638 – Seakeeper 6/5 Lower Rod End Pin Removal**
  - Applicable Seakeeper Brake Sub-system or Assembly drawing

PRODUCT SEAKEEPER 2 THROUGH 40

PRECAUTIONS

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

2. SEAKEEPER OPERABILITY MAY BE COMPROMISED IF FOREIGN MATERIAL ENTERS BRAKE SYSTEM. Protect all openings with tape or covers to minimize material intrusion into the system.

3. USE caution to protect Seakeeper painted finish to minimize early appearance degradation.

INITIAL CONDITIONS

1. **VENT** brake subsystem completely to 0 psi per SWI-103 before starting cylinder replacement.

2. **IF** Seakeeper being serviced is older than 1 year,
THEN CONSIDER ordering a bushing kit in event they necessitate replacement.

3. **ENSURE** low-current DC power available to Seakeeper to activate overrides.

4. [OPTIONAL] **PHOTOGRAPH** arrangement of cable ties and brake cylinder hoses before work for reference.

PROCEDURE

1. **ENSURE** Low Current DC supply breaker ON.
2. **ENSURE** High Current DC or AC supply breaker OFF **AND** flywheel at zero RPM.
3. **ACTIVATE** brake override at MFD app/display.
4. **REMOVE** gimbal bearing cap(s) to allow access to rod-end pins of brake cylinders as follows:
   a. **DISCONNECT** wiring from gimbal angle sensor assembly and secure sensor safely aside.
   b. **IF** Seakeeper 3 (S/N 3-0494 or earlier),
   THEN REMOVE brake-side gimbal bearing cap by performing following:
      i. **LOOSEN** fasteners of gimbal bearing cap that can be accessed.

Figure 1: Seakeeper 3 Gimbal Bearing Cap interference by cylinder bleed ports

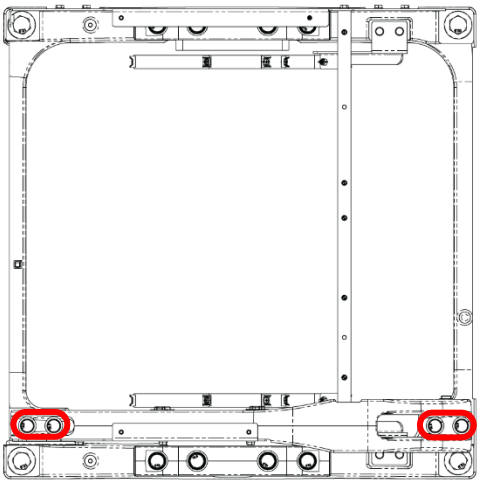


Figure 2: Seakeeper 3 frame with cylinder brace screws identified

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

Step 4.b continued

iii. **REMOVE** fasteners and gimbal bearing cap.

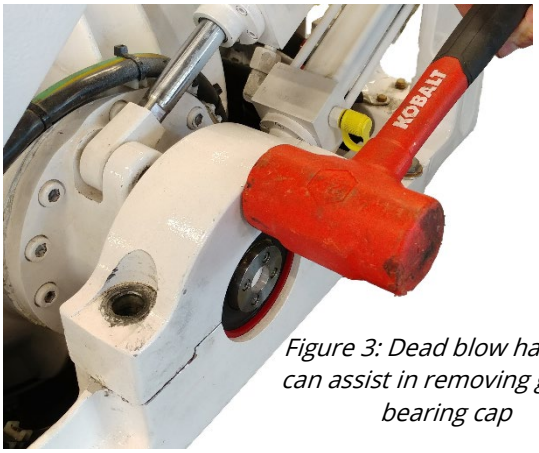


Figure 3: Dead blow hammer can assist in removing gimbal bearing cap

c. **IF** other Seakeeper 3 model (3-0495 or after),
THEN REMOVE four fasteners that hold gimbal bearing cap to foundation.

d. **DISCARD** any lockwire found on gimbal cap screws.

5. **IF** Seakeeper 5 or 6,
THEN REMOVE bump stop to allow full precession to gain access to cylinder rod end brake pins (Fig. 4).

6. **PRECESS** enclosure to access cylinder rod end pins.

[**NOTE**: It may be desirable to hold sphere in position with a ratchet strap.]

Figure 4: A bump stop of a Seakeeper 5, located at front of foundation.

7. **REMOVE** protective plastic covers of rod-end pins.

8. **REMOVE** protective plastic covers of trunnions on Seakeeper 5 through 18 models (Fig.6).

Figure 6: trunnion covers shown

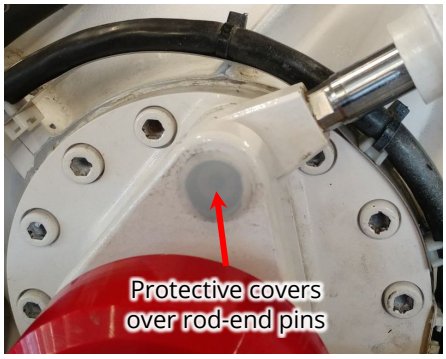


Figure 5: Brake pin cover shown

WARNING:

PERSONNEL EYE HAZARD EXISTS from retaining ring releasing from pliers under tension

9. **REMOVE** internal snap retaining rings and spacer shims of rod-end brake pins.

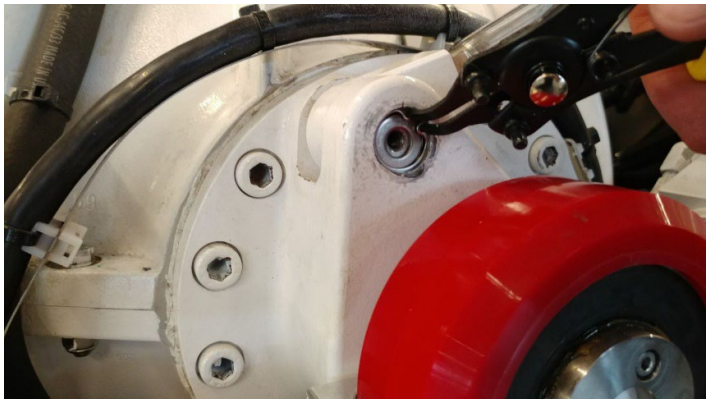


Figure 7: Retaining ring removal shown

10. **REMOVE** cylinder rod-end pins with brake bushing service kit tools (Fig. 8).

Figure 8: Puller from bushing service kit installed on a rod-end pin

11. **REMOVE** Delrin plastic washers.

12. **IF** Seakeeper 2, 3, 26/20HD, 35/30HD or 40, **THEN PERFORM** following to remove rear clevis pins (Fig. 9):

    a. **REMOVE** cylinder rear clevis pin retaining snap rings and plastic washers.

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

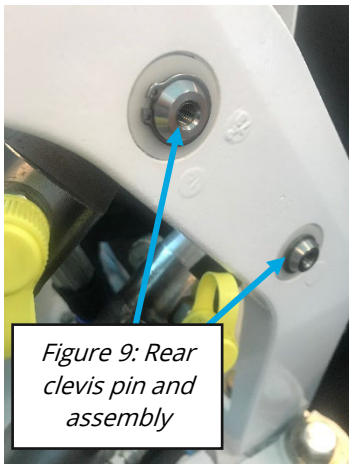


Figure 9: Rear clevis pin and assembly

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

    a. **REMOVE** fasteners of outer cylinder brace(s) and to front cover.

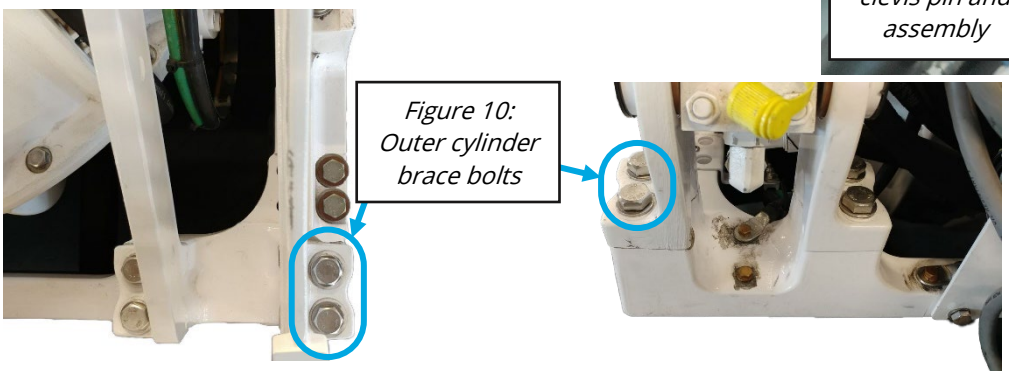


Figure 10: Outer cylinder brace bolts

    b. **REMOVE** associated outer cylinder brace(s) away from trunnion to release trunnion shafts.

Step 13 continued

c. **LOOSEN** inner cylinder brace(s) to finger tight.

Figure 11: Outer brace removed and MDB is removed from bracket for access to inner trunnion on a Seakeeper 9

14. **CLEAN** any corrosion from hose fittings and exposed threads before loosening on cylinder(s) being replaced.

CAUTION:

SEAKEEPER OPERABILITY WILL BE ADVERSELY AFFECTED if brake hose routing incorrect.

15. **LABEL** brake hoses noting where they connect to cylinder being replaced.

16. **REMOVE** brake hoses from cylinder(s) being replaced.

17. **COVER** openings of hoses and cylinder(s) with plugs/caps to minimize oil leakage and protect from foreign material entry into hoses if left open for any time.

18. **INSTALL** replacement cylinder(s) as follows:

    a. **APPLY** thin coat of black moly grease to trunnion axles or rear clevis pins.

    b. **APPLY** thin film of black moly grease inside rod-end assemblies for rod-end brake pins.

    c. **RECONNECT** brake hose fittings to cylinder(s) and tighten in accordance with table below. [**NOTE**: fittings use compression and do not require tape or putty for sealing.]

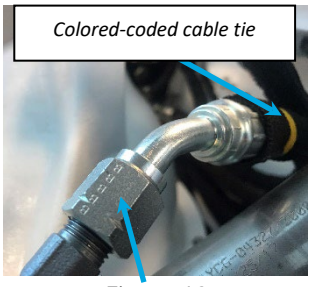


Figure 12: Compression fitting

JIC 37° DRY TORQUE SPECIFICATION TABLE			
Seakeeper Model	Fitting Size	Minimum Torque ft-lb (Nm)	Maximum Torque ft-lb (Nm)
Seakeeper 2 & 3	06	17 (23)	19 (26)
Seakeeper 5/6 and up	08	34 (47)	38 (52)

    d. **IF** cylinder of trunnion design (Seakeeper 5/3DC, 6, 9/7HD, or 12HD/16/18),
    THEN PERFORM following:

        i. **INSERT** inside trunnions into inner cylinder brace trunnion holes. [**NOTE: On Seakeeper 9/7HD & 12HD/16/18** thrust washer must be inserted on trunnion with chamfer facing toward cylinder, as in illustration.

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

        iii. **APPLY** Loctite #243 to cylinder brace screw threads.

Thrust washer of Seakeeper 9

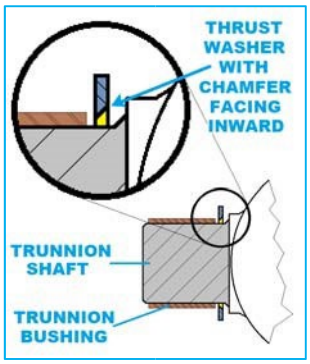


Figure 13: Thrust washer details

        iv. **SECURE** outer cylinder brace screws to foundation only finger tight.

        v. **INSERT** fasteners of front plate to outer cylinder brace(s), if applicable.

        vi. **ENSURE** cylinder evenly spaced between cylinder braces at trunnions.

        vii. **TORQUE** all fasteners of inside and outside cylinder braces and front cover to proper torque values.

        viii. **APPLY** bead of marine sealant along seam of cylinder brace and foundation.

Step 18 continued

WARNING:

PERSONNEL EYE HAZARD EXISTS from retaining ring releasing from pliers under tension.

e. **IF** cylinders are of rear clevis pin design (Seakeeper 2, 3, 26/20HD, 35/30HD, and 40), **THEN INSTALL** external snap retaining rings on clevis pins.
[**NOTE**: Properly installed rings should be able to rotate easily.]

f. **INSTALL** protective plastic caps over trunnion shafts, if applicable.

CAUTION:

BRAKE PIN WILL BE DIFFICULT TO REMOVE IF INSTALLED WITH TREADED HOLE FACING INWARD.

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

a. **APPLY** thin layer of black moly grease to rod end brake pins **AND** side of shims.

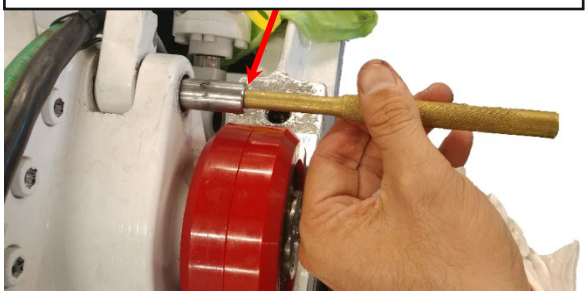
b. **ALIGN** rod-end brake pin openings with plastic washers **AND DRIVE** rod-end brake pins into holes (Fig. 15).

c. **INSTALL** spacer rings and internal snap retaining rings into brake pin openings.

d. **INSTALL** protective covers on gimbal pin holes.

Figure 14: Delrin plastic washer is held to rod-end of cylinder with grease and aligned using brake pin.

Figure 15: Brake pin is inserted through rod end clevis and gimbal pin openings



20. **ENSURE** alignment of cylinders with gimbals by precessing enclosure as necessary to ensure slight side to side movement in cylinder trunnions or on rear clevis pins.

21. **ENSURE** mating surfaces of foundation and gimbal bearing cap are clean.

22. **APPLY** anti-seize to threads of gimbal bearing cap fasteners **AND APPLY** sealant to underside of washers (Fig. 16).

Figure 16: Gimbal cap screw with anti-seize and sealant applied

23. **INSTALL** gimbal bearing cap(s) and torque fasteners in accordance with torque specifications for model.

24. **IF** lock (safety) wire had been removed from gimbal bearing cap fasteners,
THEN REPLACE hardware with new screws and wedge lock washers (Fig. 17) per Attachment 1.

Figure 17: An example of a wedge-lock style washer set

25. **INSTALL** mechanical bump stops, if removed earlier.

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

27. **BLEED** all air from brake hydraulic system and re-pressurize brake system per **SWI-103: Brake Service Work Instruction**.

28. **CHECK** angle sensor calibration.

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

29. **PERFORM** Sea Trial to ensure proper Seakeeper operation.

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

Revision	Description	Approval	Date
2	Seakeeper 40 introduction. Updated header. Minor edits throughout.	A Patricio	19JUL2023
3	Added Attachment for torque values and component part numbers. Reworded Step 24. Removed M8000.	A Patricio	07MAY2025

SEAKEEPER CYLINDER REPLACEMENT

PRODUCT SEAKEEPER 2 THROUGH 40

ATTACHMENT 1: TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS - GIMBAL CAP & CYLINDER BRACE			
MODEL	**GIMBAL 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	80 / 109 (Crossbar: 6/8)
Seakeeper 16/12HD/18	200 / 272	Screw, ¾-16 X 4”: 60557 Wedge-lock washer: 60558	80 / 109 (Crossbar: 10/13.5)
Seakeeper 26/20HD (26-0001 thru 26-0251)	400 / 544	SCREW, 1-12 X 3.5": 60614 Wedge-lock washer: 60617	75 / 102 (Crossbar: 28/38)
Seakeeper 26/20HD (26-0252 and after)			60 / 82 (Crossbar: 28/38)
Seakeeper 35/30HD/40 (All serial numbers)	400 / 544	SCREW, 1-12 X 3.5": 60614 Wedge-lock washer: 60617	100 / 136 (Crossbar: 28/38)