

**TRUCK, CARGO, MEDIUM, CRANE, MC2 – UNIMOG
HEAVY GRADE REPAIR**

This instruction is authorised for use by command of the Chief of Army. It provides direction, mandatory controls and procedures for the operation, maintenance and support of equipment. Personnel are to carry out any action required by this instruction in accordance with EMEI General A 001.

TABLE OF CONTENTS

	Page No		Page No
Introduction	3	Second Extension Boom and Cylinder	5
Associated Publications	3	Outer Boom and Cylinder	7
Authorisation	3	Inner Boom and Cylinder	8
Precautions	3	Slewing System	9
Special Tools.....	3	Stabilisers	10
Heavy Grade Repair	4	Crane Assembly	13
First Extension Boom and Cylinder.....	4		

LIST OF FIGURES

	Page No		Page No
Figure 1 First Extension Boom Cylinder Components	5	Figure 4 Stabiliser	11
Figure 2 Second Extension Boom Cylinder Components	6	Figure 5 Stabiliser Cylinder Components	12
Figure 3 Inner and Outer Boom Cylinder Components.....	8	Figure 6 Inner, Outer and Extension Boom Components.....	15

LIST OF TABLES

	Page No		Page No
Table 1 Special Tools.....	3	Table 2 Legend to Figure 6.....	14

UNCONTROLLED IF PRINTED

UNCONTROLLED IF PRINTED

Blank Page

INTRODUCTION

1. This instruction details the Heavy Grade Repairs for the Truck, Cargo, Medium, Crane, MC2 - Unimog.

Associated Publications

2. Reference may be necessary to the latest issue of the following documents:
 - a. EMEI Vehicle G 60 Decade – Truck, Cargo, Medium, MC2 - Unimog;
 - b. EMEI Vehicle G 62 Decade – Truck, Cargo, Medium, Crane, MC2 - Unimog;
 - c. [EMEI Workshop H 108-1](#) - Cranes, Hoists and Winches – Inspection for Useability;
 - d. [RPS 02155](#) and [02157](#); and
 - e. [SCES 11756](#).

Authorisation

3. ECN 229 or civilian equivalents are authorised to carry out Heavy Grade Repair.

Precautions

4. Observe the following precautions before carrying out Heavy Grade Repairs:

WARNING

Before working on the hydraulic system ensure that the hydraulic fluid is sufficiently cool to avoid burns.

Only a qualified crane operator is permitted to test the crane.

CAUTION

Do not start the engine whilst repair procedures are carried out on the crane system components.

- a. Adhere to the instructions detailed in EMEI Workshop H 108-1.
- b. To prevent dirt, dust and foreign matter from entering or adhering to any component, maintain a high standard of cleanliness. Cap all disconnected hoses and lines with plastic caps.
- c. Discard all used seals, O rings, cotter-pins, washers, lockpins and drained hydraulic oil.
- d. When removing and installing crane booms and cylinders, use either a suitable capacity lifting facility and tackle for support, or operate the crane so that the booms rest on a prepared stand.

Special Tools

5. Table 1 lists the special tools required for Heavy Grade Repair.

Table 1 Special Tools

Serial	Part Number	Description	Function
1	P-T-2	125 mm C-spanner	Removal and installation of extension boom cylinder nuts
2	P-T-3	75 mm C-spanner	Removal and installation of inner and outer boom cylinder nuts
3	P-T-17	Strap-spanner	Removal and installation of slewing cylinders
4	P-T-5	150 mm internal pliers	Removal and installation of stabiliser cylinder circlip

HEAVY GRADE REPAIR

First Extension Boom and Cylinder

6. **Removal.** Remove the first extension boom and cylinder as follows (Figure 6):

- a. Disconnect the oil hoses from the extension boom cylinder (Item 20).

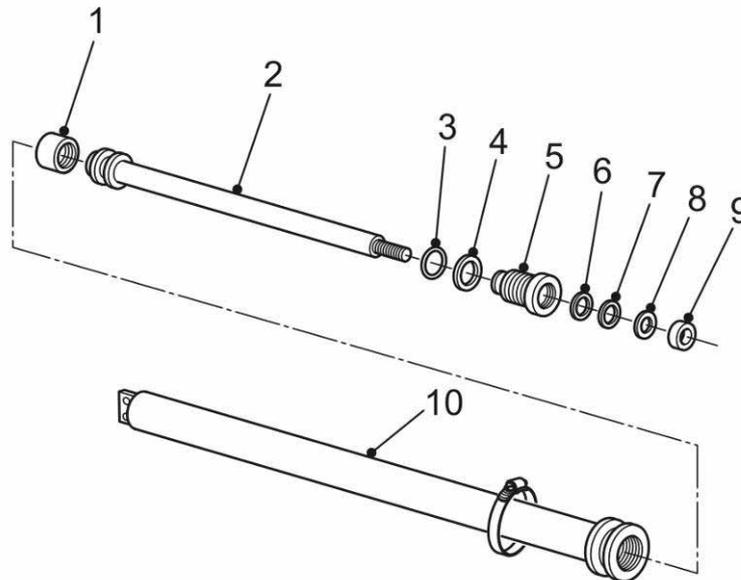
NOTE

Ensure the hoses are capped and a suitable container is used to collect any oil in the hoses.

- b. If the cargo hook (Item 26) is installed on the boom, withdraw the safety chain (Item 25) and remove the cargo hook pin (Item 27) and the hook (Item 26).
- c. Remove the piston nut (Item 24), the cylinder nut (Item 22) and the bolt (Item 28).
- d. Remove the first extension boom cylinder (Item 20) and the piston (Item 23) as a complete unit from the brackets.
- e. Remove the guide block screws (Item 18) and washers (Item 19) securing the two guide blocks (Item 21) to the second extension boom (Item 31).
- f. Slide out the guide blocks.
- g. Slide the first extension boom (Item 29) from the second extension boom (Item 31).

7. **Repair.** Repair the cylinder as follows (Figure 1):

- a. Using the C-spanner (Table 1, Serial 1), unscrew and withdraw the cylinder nut (Item 5).
- b. Withdraw the piston rod (Item 2) from the boom cylinder (Item 10).
- c. Remove and discard the washer (Item 8), the piston seal (Item 1), the spacer (Item 9), the wiper seal (Item 7) and the seal (Item 6).
- d. Remove and discard the O ring (Item 3) and the back-up ring (Item 4).
- e. Clean and inspect the piston rod and the cylinder. Replace any damaged items.
- f. Lightly coat all parts with hydraulic oil OM-33.
- g. Fit a new piston seal (Item 1), O ring (Item 3) and back-up ring (Item 4).
- h. Fit a new seal (Item 6), wiper seal (Item 7), spacer (Item 9) and washer (Item 8).
- i. Insert the piston rod (Item 2) into the extension boom cylinder (Item 10).
- j. Using the C-spanner (Table 1, Serial 1) tighten the cylinder nut (Item 5).



DE(EMEI)3551-4

Item	Description	Item	Description
1.	Piston seal	6.	Seal
2.	Piston rod	7.	Wiper seal
3.	O ring	8.	Washer
4.	Back-up ring	9.	Spacer
5.	Cylinder nut	10.	First extension boom cylinder

Figure 1 First Extension Boom Cylinder Components

- 8. Installation.** Install the first extension boom as follows (Figure 6):
- Slide the first extension boom (Item 29) into the second extension boom (Item 31).
 - Insert and secure the two guide blocks (Item 21) with the washers (Item 19) and screws (Item 18).
 - Align the extension boom cylinder (Item 20) and the piston (Item 23) to their respective brackets.
 - Secure the cylinder with the bolt (Item 28) and the nut (Item 22).
 - Secure the piston with the piston nut (Item 24).
 - Uncap and connect the oil hoses.
 - Attach the cargo hook (Item 26) with the pin (Item 27) and safety chain (Item 25). Operate the crane (Ref EMEI Vehicle G 622) and check the crane's operational performance. Ensure that no oil leaks exist and rectify as necessary.

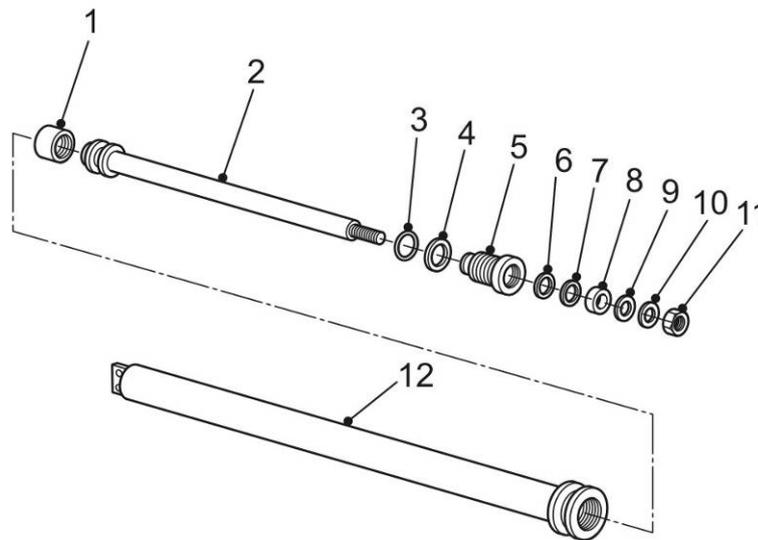
Second Extension Boom and Cylinder

- 9. Removal.** Remove the second extension boom and cylinder as follows (Figure 6):
- Remove the first extension boom and cylinder (Para 6).
 - Disconnect the hose lines from the second extension boom cylinder (Item 12).

NOTE

- Ensure the hoses are capped and a suitable container is used to collect any oil in the hoses.
- Remove the piston nut (Item 30), the cylinder nut (Item 16) and the bolt (Item 17).
 - Slide the second extension boom cylinder (Item 12) and piston (Item 32), as a complete unit, from the brackets.

- e. Remove the guide block screws (Item 13) and washers (Item 14) securing the guide blocks (Item 15) to the outer boom (Item 35).
 - f. Slide out the two guide blocks.
 - g. Slide the second extension boom (Item 31) from the outer boom (Item 35).
- 10. Repair.** Repair the cylinder as follows (Figure 2):
- a. Using the C-spanner (Table 1, Serial 1), unscrew and withdraw the cylinder nut (Item 5).
 - b. Withdraw the piston rod (Item 2) from the boom cylinder (Item 12).
 - c. Remove and discard the washers (Items 9 and 10), the plate (Item 8), the wiper seal (Item 7) and the seal (Item 6).
 - d. Remove and discard the piston seal (Item 1), the O ring (Item 3) and the back-up ring (Item 4).
 - e. Clean and inspect the piston rod and the cylinder. Replace any damaged items.
 - f. Lightly coat all parts with hydraulic oil OM-33.
 - g. Fit a new piston seal (Item 1), O ring (Item 3) and back-up ring (Item 4).
 - h. Fit a new seal (Item 6), wiper seal (Item 7), plate (Item 8) and washers (Items 9 and 10).
 - i. Insert the piston rod (Item 2) into the extension boom cylinder (Item 12).
 - j. Using the C-spanner (Table 1, Serial 1) tighten the cylinder nut (Item 5).



DE(EME)3551-5

Item	Description	Item	Description
1.	Piston seal	7.	Wiper seal
2.	Piston rod	8.	Plate
3.	O ring	9.	Washer
4.	Back-up ring	10.	Washer
5.	Cylinder nut	11.	Piston nut
6.	Seal	12.	Second extension boom cylinder

Figure 2 Second Extension Boom Cylinder Components

- 11. Installation.** Install the second extension boom as follows (Figure 6):
- a. Slide the second extension boom (Item 31) into the outer boom (Item 35).
 - b. Insert and secure the two guide blocks (Item 15) with the washers (Item 14) and the screws (Item 13).

- c. Align the second extension boom cylinder (Item 12) and piston (Item 32) to their respective bracket.
- d. Secure the cylinder with the bolt (Item 17) and the nut (Item 16).
- e. Secure the piston with the piston nut (Item 30).
- f. Uncap and connect the oil hoses.
- g. Install the first extension boom and cylinder (Para 6).
- h. Operate the crane (Ref EMEI Vehicle G 622). Check the operational performance and ensure that no oil leaks exist. Rectify as necessary.

Outer Boom and Cylinder

12. Removal. Remove the outer boom and cylinder as follows (Figure 6):

- a. Disconnect the hose lines from the outer boom cylinder (37).

NOTE

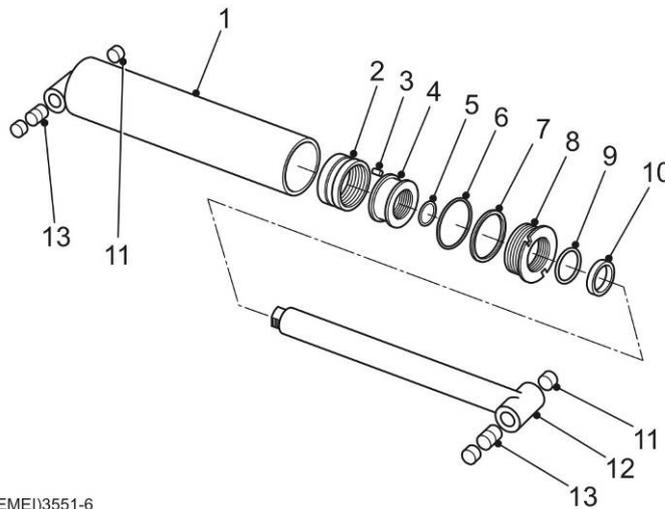
Ensure the hoses are capped and a suitable container is used to collect any oil in the hoses.

- b. Remove the first extension boom and cylinder (Para 6).
- c. Remove the second extension boom and cylinder (Para 9).
- d. Attach a suitable capacity sling around the outer boom (Item 35).
- e. Take the weight of the boom using a suitable lifting device.
- f. Punch out the roll pins (Items 33, 8 and 10).
- g. Support the outer boom cylinder (Item 37).
- h. Punch out the outer boom piston pin (Item 34) securing the outer boom piston (Item 36).
- i. Punch out the outer boom pin (Item 11) securing the outer boom (Item 35) to the inner boom (Item 9).
- j. Remove the outer boom (Item 35) using a lifting device.
- k. Punch out the outer boom cylinder pin (Item 7) securing the outer boom cylinder (Item 37) to the inner boom (Item 9).
- l. Remove the outer boom cylinder.

13. Repair. Repair the outer cylinder as follows (Figure 3):

- a. Remove and discard the bushes (Item 11) and the spacer bushes (Item 13) from the piston rod (Item 12) and the cylinder (Item 1).
- b. Using the C-spanner (Table 1, Serial 2), unscrew the cylinder nut (Item 8) from the cylinder (Item 1).
- c. Withdraw the piston rod (Item 12) from the cylinder.
- d. Remove and discard the piston seal (Item 2) from the piston (Item 4).
- e. Remove and discard the O rings (Items 5 and 6), the back-up ring (Item 7), the seal (Item 9) and the wiper seal (Item 10).
- f. Clean and inspect the piston rod and the cylinder. Replace any damaged or suspect items.
- g. Lightly coat all parts with hydraulic oil OM-33.
- h. Fit a new piston seal (Item 2), O rings (Items 5 and 6) and back-up ring (Item 7).
- i. Fit a new seal (Item 9) and wiper seal (Item 10).
- j. Insert the piston rod (Item 12) into the cylinder (Item 1).
- k. Using the C-spanner (Table 1, Serial 2) tighten the cylinder nut (Item 8).
- l. Fit new spacer bushes (Item 13) and bushes (Item 11).

- 14. Installation.** Install the outer boom as follows (Figure 6):
- a. Using the lifting facility, align the outer boom (Item 35) to the inner boom (Item 9).
 - b. Secure the outer boom with the outer boom pin (Item 11).
 - c. Insert the roll pin (Item 10).
 - d. Align the outer boom cylinder (Item 37) to the inner boom (Item 9) and secure it with the outer boom cylinder pin (Item 7).
 - e. Insert the roll pin (Item 8).
 - f. Extend the outer boom piston (Item 36) and secure it to the outer boom with the outer boom piston pin (Item 34).
 - g. Insert the roll pin (Item 33).
 - h. Install the second extension boom and cylinder (Para 9).
 - i. Install the first extension boom and cylinder (Para 6)
 - j. Uncap and connect the hose lines to the outer boom cylinder.
 - k. Operate the crane (Ref EMEI Vehicle G 622). Check the operational performance and ensure that no oil leaks exist. Rectify as necessary.



DE(EMEI)3551-6

Item	Description	Item	Description	Item	Description
1.	Cylinder	6.	O ring	11.	Bush
2.	Piston seal	7.	Back-up ring	12.	Piston rod
3.	Threaded pin	8.	Cylinder nut	13.	Spacer bush
4.	Piston	9.	Seal		
5.	O ring	10.	Wiper seal		

Figure 3 Inner and Outer Boom Cylinder Components

Inner Boom and Cylinder

- 15. Removal.** Remove the inner boom and cylinder as follows (Figure 6):
- a. Disconnect the oil hoses from the inner boom cylinder (Item 38).

NOTE

Ensure the hoses are capped and a suitable container is used to collect any oil in the hoses.

- b. Remove the first extension boom and cylinder (Para 6).

- c.** Remove the second extension boom and cylinder (Para 9).
- d.** Remove the outer boom and cylinder (Para 12).
- e.** Using a soft metal drift, punch out the roll pins (Items 6 and 40).
- f.** Support the inner boom cylinder (Item 38) and with a circular soft metal drift, punch out the inner boom piston pin (Item 5) and the inner boom cylinder pin (Item 39).
- g.** Remove the inner boom cylinder.
- h.** Attach suitable lifting tackle to the lifting lug (Item 50).
- i.** Operate the lifting equipment to take the inner boom weight.
- j.** Unscrew the nut (Item 4), washer (Item 3) and withdraw the bolt (Item 1).
- k.** Punch out the inner boom pin (Item 2) securing the inner boom (Item 9) to the support column (Item 49).
- l.** Remove the inner boom.
- 16. Repair.** Repair the cylinder as detailed in Para 10.
- 17. Installation.** Install the inner boom as follows (Figure 6):
- a.** Using the lifting equipment, align the inner boom (Item 9) to the support column (Item 49).
- b.** Secure the boom with the inner boom pin (Item 2).
- c.** Insert the bolt (Item 1), washer (Item 3) and nut (Item 4) to lock the inner boom pin.
- d.** Align the inner boom cylinder (Item 38) to the support column (Item 49) and secure it with the inner boom cylinder pin (Item 39).
- e.** Insert the roll pin (Item 40).
- f.** Extend the inner boom piston and secure it with the inner boom piston pin (Item 5).
- g.** Insert the roll pin (Item 6).
- h.** Install the outer boom and cylinder (Para 14).
- i.** Install the second extension boom and cylinder (Para 9).
- j.** Install the first extension boom and cylinder (Para 6).
- k.** Operate the crane (Ref EMEI Vehicle G 622). Check the operational performance and ensure that no oil leaks exist. Rectify as necessary.

Slewing System

- 18.** Remove the slewing cylinders and rack as follows (Figure 6):

NOTE

The slewing cylinders and rack can be removed without unstowing the crane.

- a.** Disconnect the oil pipes from the left-hand and right-hand slewing cylinders (Items 41 and 48).

NOTE

Ensure the hoses are capped and a suitable container is used to collect any oil in the hoses.

- b.** Using the Strap-spanner (Table 1, Serial 3), unscrew and remove the slewing cylinders.
- c.** Unscrew the piston bolt (Item 47) from each end of the piston and remove the pistons.
- d.** Remove and discard the piston seals (Item 44) from the piston ends.

NOTE

Mark the position of the rack in relation to the crane base before removing the rack. This will facilitate installation.

- e. Disengage and withdraw the slewing rack (Item 43) from the support column base. Withdraw the rack guide block (Item 42).

19. Repair. Repair the slewing cylinders as follows:

- a. Inspect the slewing rack (Item 43), the slewing guide block (Item 42), the pistons and the cylinders. Replace any damaged or suspect parts.
- b. Lightly coat all parts with hydraulic oil OM-33.
- c. Fit the new piston seals (Item 44) over the pistons.
- d. Install the pistons to the rack and secure them with bolts (Item 47).

20. Installation. Install the slewing system and rack as follows:

- a. Insert the slewing rack (Item 43) to engage the support column base wormwheel.
- b. Insert the slewing guide block (Item 42) to interlock the rack against the wormwheel.
- c. Install the left-hand slewing cylinder (Item 41) and the right-hand slewing cylinder (Item 48). Using the Strap-spanner (Table 1, Serial 3) tighten the cylinders.
- d. Uncap and connect the oil pipes to the cylinders.
- e. Operate the crane (Ref EMEI Vehicle G 622). Check the slewing operation and check that no oil leaks exist. Rectify any oil leaks as necessary.

Stabilisers

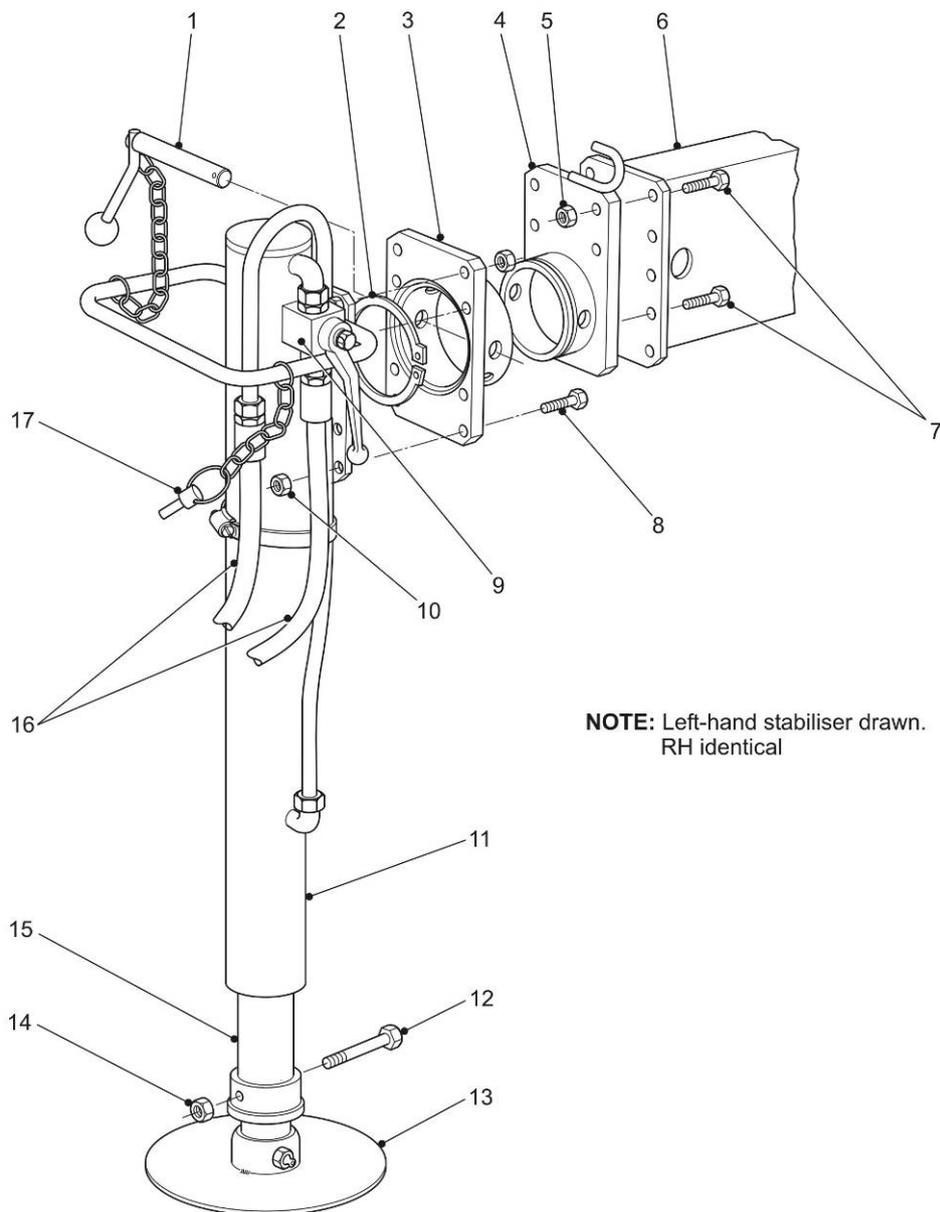
21. Removal. Remove the stabilisers as follows (Figure 4):

- a. Close the shut-off valve (Item 9).
- b. Disconnect the two oil hoses (Item 16).

NOTE

Ensure the hoses are capped and a suitable container is used to collect any oil in the hoses.

- c. Manually position the stabiliser cylinder (Item 11) vertically with the footplate (Item 13) downwards.
- d. Support the stabiliser cylinder (Item 11).
- e. Remove the nuts (Item 5) and bolts (Item 7) securing the outer swivel bracket (Item 4) to the extension box (Item 6). Remove the stabiliser.
- f. Remove the nuts (Item 10) and bolts (Item 8) securing the inner swivel bracket (Item 3) to the stabiliser.
- g. Using the 150 mm internal pliers (Table 1, Serial 4), remove and discard the circlip (Item 2) securing the outer swivel bracket (Item 4) to the inner swivel bracket (Item 3).
- h. Withdraw the safety chain (Item 17) and swivel bracket pin (Item 1).
- i. Remove the nut (Item 14) and bolt (Item 12) attaching the footplate (Item 13) to the stabiliser ram (Item 15).
- j. Remove the footplate.



NOTE: Left-hand stabiliser drawn.
RH identical

DE(EME)3551-7

Item	Description	Item	Description	Item	Description
1.	Swivel bracket pin	7.	Bolt	13.	Footplate
2.	Circlip	8.	Bolt	14.	Nut
3.	Inner swivel bracket	9.	Shut-off valve	15.	Stabiliser ram
4.	Outer swivel bracket	10.	Nut	16.	Oil hoses
5.	Nut	11.	Stabiliser cylinder	17.	Safety chain
6.	Outer extension box	12.	Bolt		

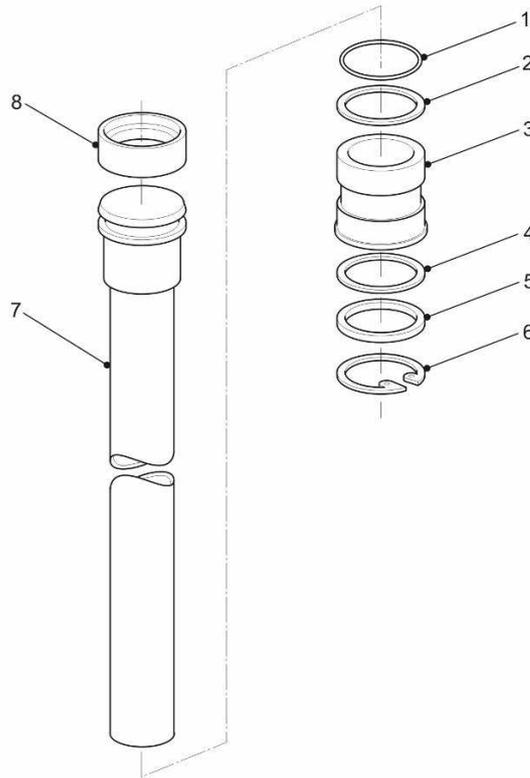
Figure 4 Stabiliser

22. Repair. Repair the stabiliser cylinder as follows (Figure 5):

- a. Using the 150 mm internal pliers (Table 1, Serial 4), remove and discard the circlip (Item 6).
- b. Slide the stabiliser ram (Item 7) from the cylinder.
- c. Remove and discard the seal (Item 8), the O ring (Item 1), the back-up ring (Item 2), the seal (Item 4) and the wiper seal (Item 5).

UNCONTROLLED IF PRINTED

- d. Clean and inspect the stabiliser ram (Item 7), the adapter (Item 3) and the stabiliser cylinder. Replace any damaged or suspect item.
- e. Lightly coat all parts with hydraulic oil OM-33.
- f. Fit a new seal (Item 8), O ring (Item 1), and back-up ring (Item 2).
- g. Refit the adapter (Item 3), the new seal (Item 4), and the wiper seal (Item 5).
- h. Slide the stabiliser ram (Item 7) into the stabiliser cylinder and secure it with a new circlip (Item 6) using the 150 mm internal pliers (Table 1, Serial 4).



DE(EMEI)3551-8

Item	Description	Item	Description	Item	Description	Item	Description
1.	O ring	3.	Adapter	5.	Wiper seal	7.	Stabiliser ram
2.	Back-up ring	4.	Seal	6.	Circlip	8.	Seal

Figure 5 Stabiliser Cylinder Components

- 23. Installation.** Install the stabiliser as follows (Figure 4):
- a. Attach the inner swivel bracket (Item 3) to the outer swivel bracket (Item 4) with a new circlip (Item 2) using the 150 mm internal pliers (Table 1, Serial 4).
 - b. Secure the inner swivel bracket to the stabiliser with the bolts (Item 8) and nuts (Item 10).
 - c. Insert the swivel bracket pin (Item 1) and safety chain (Item 17).
 - d. Align the outer swivel bracket (Item 4) to the outer extension box (Item 6) and secure it with bolts (Item 7) and nuts (Item 5).
 - e. Attach the footplate (Item 13) to the stabiliser ram (Item 15) with the nut (Item 14) and bolt (Item 12).
 - f. Uncap and connect the two oil hoses (Item 16).
 - g. Test the stabiliser (Ref EMEI Vehicle G 622).

UNCONTROLLED IF PRINTED

Crane Assembly

24. The crane assembly is to be removed from the truck only if the crane sustains severe damage, and not as a normal repair or maintenance procedure.
25. **Removal.** Remove the crane assembly as follows:



Remove the engine air cleaner before raising the cab.

- a. Raise and secure the cab (Ref EMEI Vehicle G 603).
- b. Remove the shift linkage from the FWD/REV selector lever (Ref EMEI Vehicle G 604).
- c. Manually position and lock both stabilisers vertically (facing down). Do not extend them hydraulically.
- d. Remove the supply and return oil hoses to the directional control valve bank and the connection tee-piece in the sensing valve (Ref EMEI Vehicle G 623).

NOTE

Ensure the hoses are capped and a suitable container is used to collect any oil in the hoses.



Use an overhead lifting device and lifting tackle with a greater safe working load than 1 tonne to lift the crane.

- e. Secure the lifting tackle to the lug welded on the inner boom of the crane.
 - f. Operate the lifting device sufficiently to take the weight of the crane from the chassis.
 - g. Remove the 16 nuts, and four bolts securing the mounting frame to the chassis.
 - h. Hoist the crane clear of the truck.
 - i. Manually operate the stabilisers to the normal stowage position of 45°.
 - j. Lower the crane to rest on its mounting frame at a prepared location.
26. **Installation.** Install the crane assembly as follows:
- a. Ensure that the stabilisers are vertical.
 - b. Fit the lifting tackle to the lug on the inner boom.
 - c. Lift the crane over the chassis and lower the crane to align with the bolt holes.
 - d. Secure the crane mounting frame to the chassis bolt holes with the four bolts, washers and nuts.
 - e. Tighten the nuts to 110 N.m.
 - f. Remove the lifting tackle.
 - g. Uncap and attach the supply and return lines to the directional control valve bank and the tee-piece. Attach the two lines to the sensing valve (Ref EMEI Vehicle G 623).
 - h. Attach the shift linkage to the FWD/REV selector lever (Ref EMEI Vehicle G 604).
 - i. Lower the cab (Ref EMEI Vehicle G 603).
 - j. Start the engine. Unstow the crane and operate the stabilisers (Ref EMEI Vehicle G 622).
 - k. Check for oil leaks at all connections. Check the crane's operational performance. Rectify any faults as necessary.

Table 2 Legend to Figure 6

1. Bolt	18. Guide block screw	35. Outer boom
2. Inner boom pin	19. Guide block washer	36. Outer boom piston
3. Washer	20. First extension boom cylinder	37. Outer boom cylinder
4. Nut	21. Guide block	38. Inner boom cylinder
5. Inner boom piston pin	22. Cylinder nut	39. Inner boom cylinder pin
6. Roll pin	23. First extension boom piston	40. Roll pin
7. Outer boom cylinder pin	24. Piston nut	41. Left-hand slewing cylinder
8. Roll pin	25. Safety chain	42. Slewing guide block
9. Inner boom	26. Cargo hook	43. Slewing rack
10. Roll pin	27. Cargo hook pin	44. Piston seal
11. Outer boom pin	28. Cylinder bolt	45. Lock-washer
12. Second extension boom cylinder	29. First extension boom	46. Banjo
13. Guide block screw	30. Piston nut	47. Screw
14. Guide block washer	31. Second extension boom	48. Right-hand slewing cylinder
15. Guide block	32. Second extension boom piston	49. Support column
16. Nut	33. Roll pin	50. Lifting lug
17. Bolt	34. Outer boom piston pin	

UNCONTROLLED IF PRINTED

UNCONTROLLED IF PRINTED

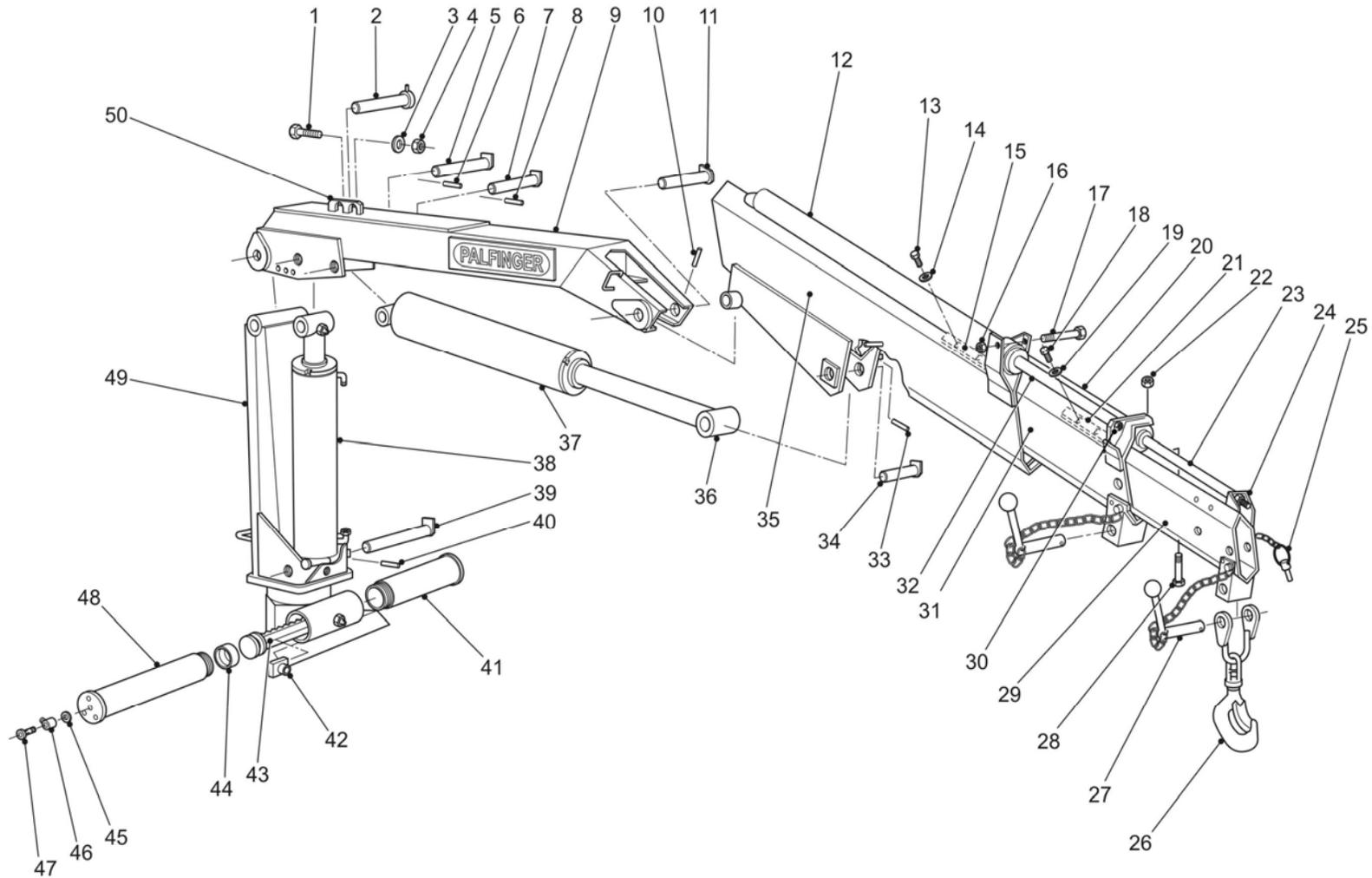


Figure 6 Inner, Outer and Extension Boom Components

END

Distribution List: **VEH G 32.0 – Code 4** (Maint Level)
(Sponsor: LV SPO, Med/Hvy B Veh)
(Authority: ECO LVSP0 030/08)