Gillison's Variety Fabrication, Inc.

GVF Rough Terrain Forklift

Axle Service Manual

PD70 Series Axles

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International TRANSMISSIONS LTD
ON/OFF HIGHWAY DRIVELINE SYSTEMS

Service Manual

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NOTE
All references in this manual to 'Forward' and 'Reverse' assume a front-mounted engine.

PD70 SERIES AXLES

Publication No. 9803/9100
Issue 6

PD70 Axles Service Manual

Publication No. 9803/9100

Record of Changes

5th Update

Date	Page	Issue	Changes
June 2004	Cover	6	Issue number raised.
	1/2-1	4	Extra Oils and Greases added.
	1/4-1	3	Service Tools Numerical List revised.
	1/5-1	3	Service Tools - Some removed.
	1/5-2	5	Service Tools - removed.
	1/5-3	2	Service Tools - additions.
	1/5-4	1	New page - Service Tools - Wheel Hub Service Tools added.
	1/5-5	1	New page - Service Tools - Solid Spacer Setting Tool Kit - added.
	1/5-6	1	New page - Service Tools - Solid Spacer Setting Tool Kit Numerical List added.
	2/2-1	3	Decal Warning updated.
	3/1-1	4	Service Schedules revised.
	4/i	3	Contents revised.
	4/1-1	4	Additional Gear and Brake options.
	4/2-1	3	Revised Cut-away illustration.
	4/3-1	4	Revised Removal and Replacement illustration.
	4/3-2	4	Note regarding Differential Lock added.
	4/3-3	2	Revised illustration.
	4/4-1	4	Revised to include Brake Disc.
	4/5-2	4	Illustrations revised to exclude Spacer.
	4/5-3	4	Note regarding Wheel Hub Service Kit added.
	4/5-4	4	Note regarding Dirt Shield added.
	4/5-5	4	Notes added as page 5-3 and 5-4.
	4/5-6	4	Revised Rolling Forces.
	4/5-8	1	New page - Driveshaft Removal and Replacement added.
	4/5-9	1	New page - Use of Wheel Hub Service Kit - Dismantling .
	4/5-10	1	New page - Use of Wheel Hub Service Kit - Assembly.
	4/6-1	4	Note regarding Soft Engage Differential Lock added.
	4/6-2	4	Note regarding Stake Nut sizes added..
	4/6-4	3	Note regarding Collapsible Spacer added.
	4/6-5	3	Solid Spacer detail added.
	4/6-6	3	Solid Spacer detail added.
	4/6-7	1	New page - Information moved from old 4/6-5.
	4/6-8	1	New page - Crown Wheel and Pinion Assembly.
	4/6-9	1	New page - Collapsible Spacer Assembly.
	4/7-1	4	Illustration revised.
	4/7-2	4	Torque Figures revised.
	4/8-1	1	New page - Soft Engage Differential Lock.
	4/8-2	1	New page - Soft Engage Differential Lock.
	4/8-3	1	New page - Soft Engage Differential Lock.

Date	Page	Issue	Changes
June 2004	4/8-4	1	New page - Soft Engage Differential Lock.
	4/8-5	1	New page - Soft Engage Differential Lock.
	4/8-6	1	New page - Soft Engage Differential Lock.
	4/8-7	1	New page - Soft Engage Differential Lock.
	4/8-8	1	New page - Soft Engage Differential Lock.
	4/8-9	1	New page - Soft Engage Differential Lock.
	4/8-10	1	New page - Soft Engage Differential Lock.
	4/8-11	1	New page - Soft Engage Differential Lock.
	4/8-12	1	New page - Soft Engage Differential Lock.
	4/8-13	1	New page - Crownwheel and Pinion Meshing.
	5/i	4	Revised Contents List.
	5/1-1	3	Technical Date revised.
	5/1-2	1	New page - Controlled Back-off added.
	5/2-2	4	Check for Quality etc. added.
	5/3-2	4	Check for Quality etc. added.
	5/3-4	2	Checks for Alignment added.
	5/4-1	1	New page - PD70 Axle - Central Drivehead - Controlled Back-off added.
	5/4-2	1	New page - PD70 Axle - Central Drivehead - Controlled Back-off added.
	5/4-3	1	New page - PD70 Axle - Central Drivehead - Controlled Back-off added.
	5/4-4	1	New page - PD70 Axle - Central Drivehead - Controlled Back-off added.
	5/5-1	1	New page - PD70 Axle - Modular Drivehead added.
	5/5-2	1	New page - PD70 Axle - Modular Drivehead added.
	5/5-3	1	New page - PD70 Axle - Modular Drivehead added.
	5/5-4	1	New page - PD70 Axle - Modular Drivehead added.
	5/5-5	1	New page - PD70 Axle - Modular Drivehead added.
	5/6-1	1	New page - Brake System Piston Seal Leakage Test information moved for old page 5/5-1.
	5/7-1	1	New page - Bleeding Procedure information moved from old page 5/6-1.
	5/8-1	1	New page - Axle Breather information moved from old page 5/7-1.
	5/9-1	1	New page - Parking Brake Disc Option.
	5/9-2	1	New page - Parking Brake Disc Option.
	5/9-3	1	New page - Parking Brake Disc Option.
	5/9-4	1	New page - Parking Brake Disc Option.
	5/9-5	1	New page - Parking Brake Disc Option.
	5/9-6	1	New page - Parking Brake Disc Option.
	5/9-7	1	New page - Parking Brake Disc Option.

PD70 Axles Service Manual

Publication No. 9803/9100

Record of Changes

4th Update

Date	Page	Issue	Changes
Dec 1998	Cover	5	Issue number raised.
	1/cont i	4	Axle Build Identification was Limited Slip Differential.
	2/4-2	3	Warnings GEN-1-12 and GEN-1-13 added.

PD70 Axles Service Manual

Publication No. 9803/9100

Record of Changes

3rd Update

Date	Page	Issue	Changes
Sept 1998	Cover	4	Issue number raised.
	1/1-1	3	Axle Build Identification heading was Limited Slip Differential.

PD70 Axles Service Manual

Publication No. 9803/9100

Record of Changes

2nd Update

Date	Page	Issue	Changes
July 1997	Cover	3	Issue number changed.
	1/i	3	Contents revised.
	1/1-1	2	Limited Slip Differential information added.
	1/2-1	3	Mobil HP222 Grease added.
	1/3-1	2	Hexagon A/F tables added.
	1/4-1	2	Page number changed. Torque measuring tool added. Superbonder added.
	1/5-1	2	Part number 992/07609 deleted.
	1/5-2	3	Annulus Removal Tool added. Flange spanner deleted. Oil Seal Insertion Tool added.
	1/5-3	1	New page. Torque measuring tool.
	1/6-1	3	Part numbers revised. Superbonder added.
	3/i	2	Lubricants - Health and Safety added to contents.
	3/1-1	3	Service check note added. Brake repair note added.
	3/1-3	1	New Page. Lubricants Health and Safety added.
	4/1-1	3	Option 2 corrected.
	4/3-1	3	Text replaced by illustration.
	4/3-2	3	Information moved to 4/3-3.
	4/3-3	1	New page. Information moved from 4/3-2.
	4/4-1	3	Items 2 and 4 changed. Notes added. Photographs replaced by illustration.
	4/5-1	3	Item 3 changed. Photographs replaced by illustrations.
	4/5-2	3	Items 8 and 9 changed. Item 10 changed. Photographs replaced by illustrations.
	4/5-3	3	Item 13 note changed. Photographs replaced by illustrations.
	4/5-4	3	Item 14 was item 12 - text changed. Photographs replaced by illustration.
	4/5-5	3	Note 2 changed. Photographs replaced by illustrations.
	4/5-6	3	Item 5- Note changed. Photographs replaced by illustrations. Item 7 - Note added.
	4/5-7	2	Item 11 changed. Item 12 changed. Photographs replaced by illustrations.
	4/6-1	3	Leading text and notes revised. Photographs replaced by illustrations.
	4/6-2	3	Photographs replaced by illustrations.
	4/6-3	2	Information moved from 4/6-4. Photographs replaced by illustrations.
	4/6-4	2	Information moved from 4/6-6 and 4/6-7. Photographs replaced by illustrations.
	4/6-5	2	Information moved from 4/6-8 and 4/6-9. Photographs replaced by illustrations.
	4/6-6	2	Information moved from 4/6-5.
	4/7-1	3	Exploded view illustration changed.
	4/7-2	3	Illustration deleted. Heading note altered.
	5/i	3	Contents revised.
	5/2-1	2	Photographs replaced by illustration. Text moved to 5/2-2.
	5/2-2	3	Items 1 and 2 text revised. Item 6 text revised. (Dismantling) Photographs replaced by illustration.
	5/2-3	1	Page deleted.
	5/3-1	3	Information moved from 5/4-1.
	5/3-2	2	Information moved from 5/4-2.

Date	Page	Issue	Changes
July 1997	5/3-3	1	New page. Information moved from 5/4-3.
	5/3-4	1	New page. Information moved from 5/4-4.
	5/7-1	1	New page. Axle Breather added.

PD70 Axles Service Manual

Publication No. 9803/9100

Record of Changes

Date	Page	Issue	Changes
Nov 1996	Cover	2	'Gears' removed from note.
	1/i	2	Contents revised.
	1/2-1	2	Axle oil changed to Mobil Fluid 424. Notes 1 and 2 added. Technical Data removed.
	1/5-2	2	Part Number 993/59500 deleted.
	1/6-1	2	Item 8 revised - cylinder changed from ram.
	2/2-1	2	Alcohol and drugs warning added.
	2/3-1	2	Warning text revised.
	2/4-1	2	Warning text revised.
	2/4-2	2	Warning text revised.
	3/1-1	2	Axle oil change revised to include 100 and 500 hours.
	3/1-2	2	Item 5 revised to include section reference.
	4/i	2	Section heading changed. Contents titles revised.
	4/1-1	2	Section heading changed. Technical Data moved from page 1/2-1.
	4/2-1	2	Section heading changed. Page title added.
	4/3-1	2	Section heading changed. Page heading changed.
	4/3-2	2	Propshaft information inserted.
	4/4-1	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/7-1. Item 2 revised. Note added to item 2.
	4/4-2	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/7-2. Note added to item 4. Item 4 revised.
	4/5-1	2	Section heading changed. Page heading changed. Page title added. Item 1 revised. Information moved from page 4/2-1.
	4/5-2	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/2-2.
	4/5-3	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/2-3.
	4/5-4	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/2-4. Note 3 added.
	4/5-5	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/3-1.
	4/5-6	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/3-2. Note added to item 8. Illustration to item 6 corrected.
	4/5-7	1	New page. Information moved from page 4/3-3.
	4/5-8	1	New page. Information moved from page 4/3-4.
	4/6-1	2	Section heading changed. Page heading changed. Page title added. Note 1 added. Information moved from page 4/4-1.
	4/6-2	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/4-2.
	4/6-3	1	New page. Information moved from page 4/4-3.
	4/6-4	1	New page. Information moved from page 4/5-1.
	4/6-5	1	New page. Information moved from page 4/5-2.
	4/6-6	1	New page. Information moved from page 4/5-3.
	4/6-7	1	New page. Information moved from page 4/5-4.

Date	Page	Issue	Changes
Nov 1996	4/6-8	1	New page. Information moved from page 4/5-5.
	4/6-9	1	New page. Information moved from page 4/5-6.
	4/7-1	2	Section heading changed. Page heading changed. Page title added. Information moved from page 4/6-1.
	4/7-2	2	Section heading changed. Page heading changed. Page title added. Note added regarding axle identification.
	5/i	2	Contents revised. Standard and Positive retraction information inserted.
	5/1-1	2	Technical Data moved from page 1/2-1.
	5/2-1	2	Page heading added. Note 3 added. Information moved from page 5/1-1.
	5/2-2	2	Page heading added. Information moved from page 5/1-2.
	5/2-3	1	New page. Information moved from page 5/1-3.
	5/3-1	2	Page heading added. Information moved from page 5/2-1.
	5/3-2	1	New page. Information moved from page 5/2-2. Item 7 - Note added regarding oil filling.
	5/4-1	2	Brake bleeding removed. Positive retraction brakes inserted.
	5/4-2	1	New page. Information continued from page 5/4-1.
	5/4-3	1	New page. Information continued from page 5/4-2.
	5/4-4	1	New page. Information continued from page 5/4-3.
	5/5-1	2	Information moved from page 5/3-1. Page heading added.
	5/5-2	1	Page deleted.
	5/5-3	1	Page deleted.
	5/5-4	1	Page deleted.
	5/5-5	1	Page deleted.
	5/6-1	1	New page. Page heading added. Information moved from page 5/4-1.

Contents	Page No.

General Description

The PD70 axle has a centre casing (drivehead), two axle arms and wheel hub assemblies which are bolted to the axle arms.

The drivehead holds the differential gearing and two oil immersed disc brake units. The differential gearing has specially shaped spider gears that provide 'torque proportioning'. This means that drive transmitted to the road wheels will be kept on one wheel if the other is slipping.

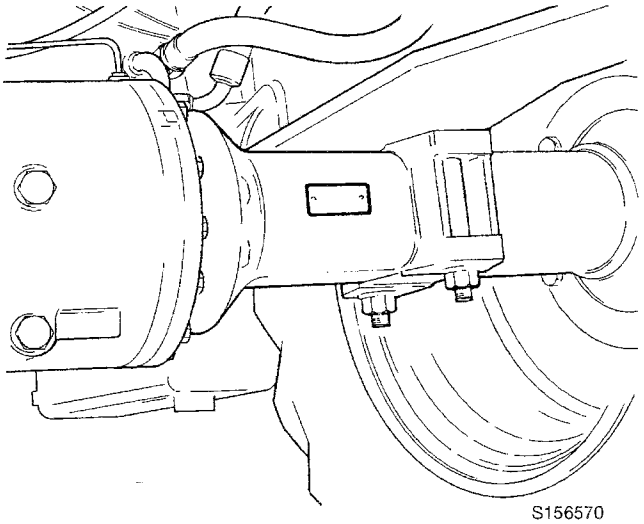
The axle arms house halfshafts, drive from the drivehead differential gearing is transmitted via the halfshafts to sun-and-planet gears inside the wheel hubs.

The axle is either pad mounted directly to the chassis or pivot mounted to the chassis (Pin Mount or Trunnion Mount).

Unit Identification

Axle Serial Plate

The PD70 axle serial number is stamped on a plate mounted to the front face of the axle, as shown.


S156570

1 When replacement parts are required, always ensure that the correct parts are obtained, e.g. in the case of gear replacements, always check the part number stamped on the gear, and the number of teeth.

2 When ordering replacement parts, quote the details on the serial plate as shown.

234620

3 It is essential that all gaskets and seals removed while dismantling are renewed on reassembly.

4 On reassembly care should be taken that all parts are correctly replaced since any component omitted or incorrectly assembled can lead to a complete failure.

5 Lubricants should comply with the recommended list as provided in this manual. It is important to adhere to the oil changing procedure.

6 It is advisable to lightly lubricate with a recommended lubricant, parts such as gears, shafts, thrust washers and oil seals during reassembly.

* Axle Build Identification

To identify an axle build, the number on the axle data plate should be cross-referenced with the part number in the parts information.

Example:

450 / 2760 / 1 / 0091
Ⓐ Ⓑ Ⓒ

Ⓐ 450/2760: Axle assembly part number (450/27600) without the final zeros.

Ⓑ /1: Internal issue number of the main manufacturing drawing.

Ⓒ /0091: Axle serial number. The complete 12 digit number must be quoted for warranty purposes. The parts information will detail the number of friction plates required for the axle.

Lubricants & Capacities

ITEM	CAPACITY Litres	CAPACITY UK Gal	FLUID/LUBRICANT	INTERNATIONAL SPECIFICATION
* PD70 Axle	23	5.0	**Mobil 424, Q8 T2000**	API GL4, M2C-41B/134D JD20C, MF M1135/M1141/M1143
* Grease	-	-	**Mobil HP222, Q8 Rubens EP2.5**	Mobil HP222
* Brake System	1.2	0.26	**Mobil DTE11M, Q8 Handel 15**	ISO VG15
			CAUTION: DO NOT USE ORDINARY BRAKE FLUID (J1703)	

Note 1: Mobil 424 should always be used for axles fitted with brakes. For axles without brakes Mobilube HD90 or Mobil Fluid 424 can be used.

Note 2: Axles with limited slip differentials must use Mobil Fluid 424.

Torque Settings

Use only where no torque setting is specified in the text. Values are for dry threads and may be within three per cent of the figures stated. For lubricated threads the values should be REDUCED by one third.

*** UNF Grade 'S' Bolts**

Bolt Size in	(mm)	Hexagon (A/F) in	Torque Settings Nm	kgf m	lbf ft
1/4	(6.3)	7/16	14	1.4	10
5/16	(7.9)	1/2	28	2.8	20
3/8	(9.5)	9/16	49	5.0	36
7/16	(11.1)	5/8	78	8.0	58
1/2	(12.7)	3/4	117	12.0	87
9/16	(14.3)	13/16	170	17.3	125
5/8	(15.9)	15/16	238	24.3	175
3/4	(19.0)	1 1/8	407	41.5	300
7/8	(22.2)	15/16	650	66.3	480
1	(25.4)	1 1/2	970	99.0	715
1 1/4	(31.7)	1 7/8	1940	198.0	1430
1 1/2	(38.1)	2 1/4	3390	345.0	2500

*** Metric Grade 8.8 Bolts**

Bolt Size in	(mm)	Hexagon (A/F) in	Torque Settings Nm	kgf m	lbf ft
M5	(5)	8	7	0.7	5
M6	(6)	10	12	1.2	9
M8	(8)	13	28	3.0	21
M10	(10)	17	56	5.7	42
M12	(12)	19	98	10	72
M16	(16)	24	244	25	180
M20	(20)	30	476	48	352
M24	(24)	36	822	84	607
M30	(30)	46	1633	166	1205
M36	(36)	55	2854	291	2105

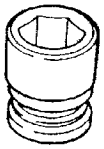
Metric Grade 12.9 Bolts

Bolt Size	(mm)	Torque Settings Nm	kgf m	lbf ft
M8	(8)	48	4.9	35
M10	(10)	94	9.6	69
M12	(12)	166	16.9	122
M14	(14)	320	32.6	236
M16	(16)	400	40.8	295

Note: All bolts are high tensile and must not be replaced by bolts of a lesser tensile specification.

* Service Tools Numerical List

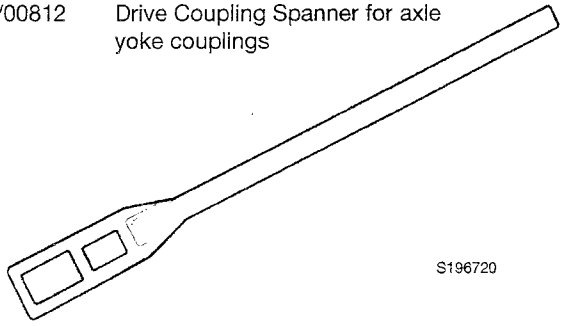
Service Tools



S216290

892/00817 17 mm A/F x 3/4 in square drive
892/00818 22 mm A/F x 3/4 in square drive
892/00819 15 mm A/F x 1/2 in square drive
892/00333 19 mm A/F x 3/4 in square drive

892/00812 Drive Coupling Spanner for axle yoke couplings



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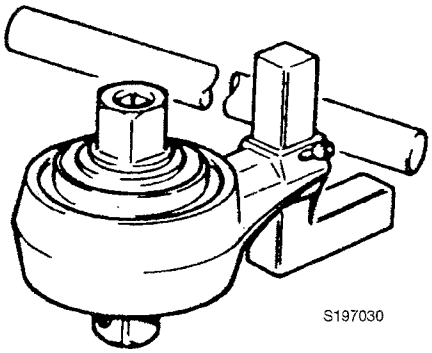
* 

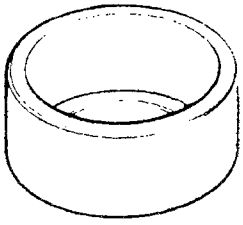
S197030

992/04000

Torque Multiplier (use in conjunction with a torque wrench to give a 5:1 multiplication when tightening pinion nuts)

* 892/00174

Measuring Cup - Pinion Head Bearing



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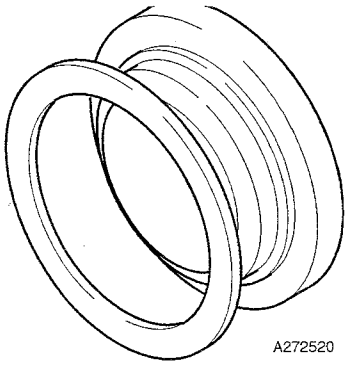
* 

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892/00891

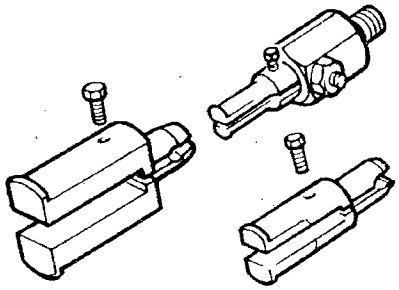
Oil Seal Insertion Tool

* 

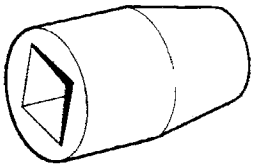
892/00224

Impulse Extractor Set for Hub Bearing Seals S197070

Service Tools (cont'd)



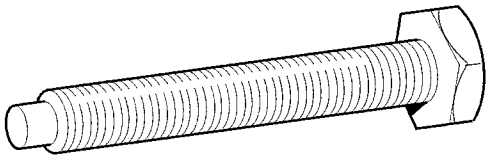
892/00225 Adapter - Impulse Extractor
Small 17mm to 25mm
Medium 25mm to 45mm
Large 45mm to 80mm



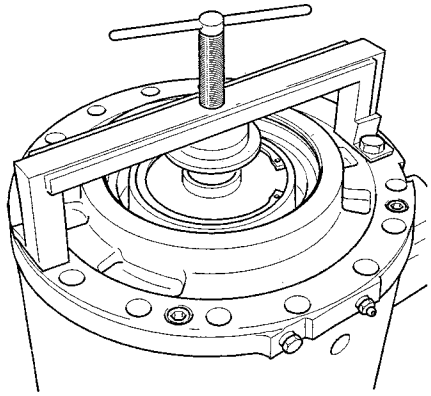
892/00822

Splined Bolt Socket for driveshafts

S197060



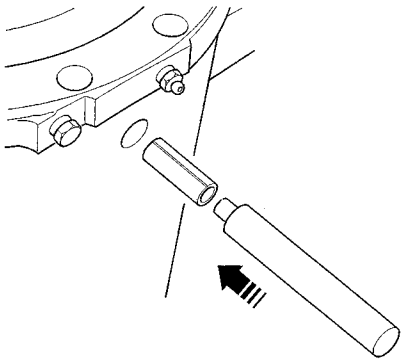
892/00833 Annulus Removal Tool



716550

892/01166

Spring Compression Tool - for compressing differential lock spring (Soft Engage Differential Lock Only) 716550

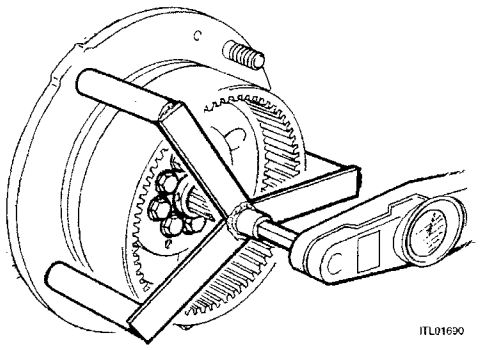


716560

892/01167

Extension Rod - for inserting side nut locking pin (Soft Engage Differential Lock only) 716560

Service Tools (cont'd)



Torque Measuring Tool for Wheel Hub Seals

Manufacture locally, procedures in this manual show checking the wheel hub seal using a rolling force. However, the torque can be measured using above locally manufactured tool.

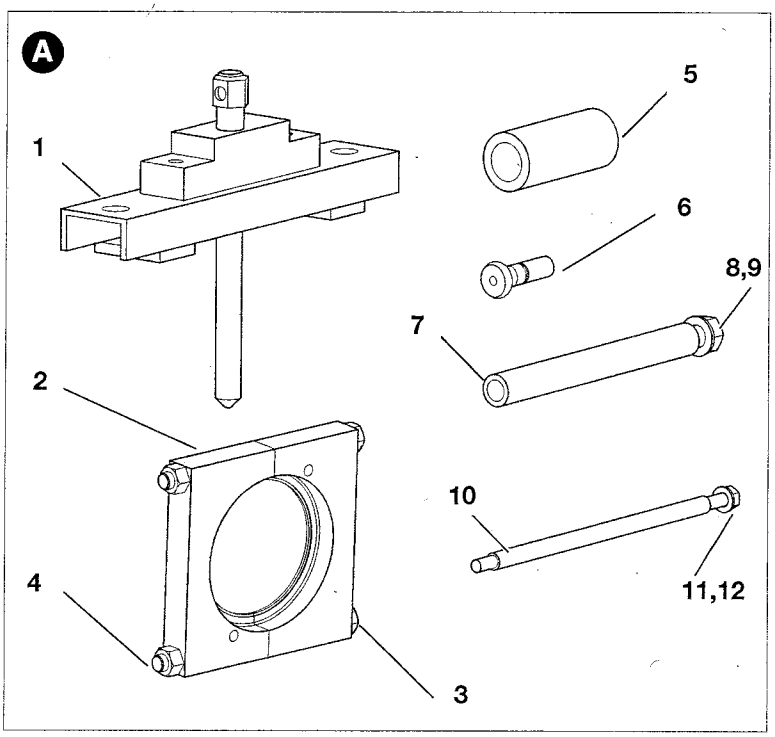
Bearing rolling torque is 12 to 22 Nm (9 to 16 lbf ft) excluding seal drag. Maximum permissible including seal dray is 40 Nm (29.5 lbf ft).

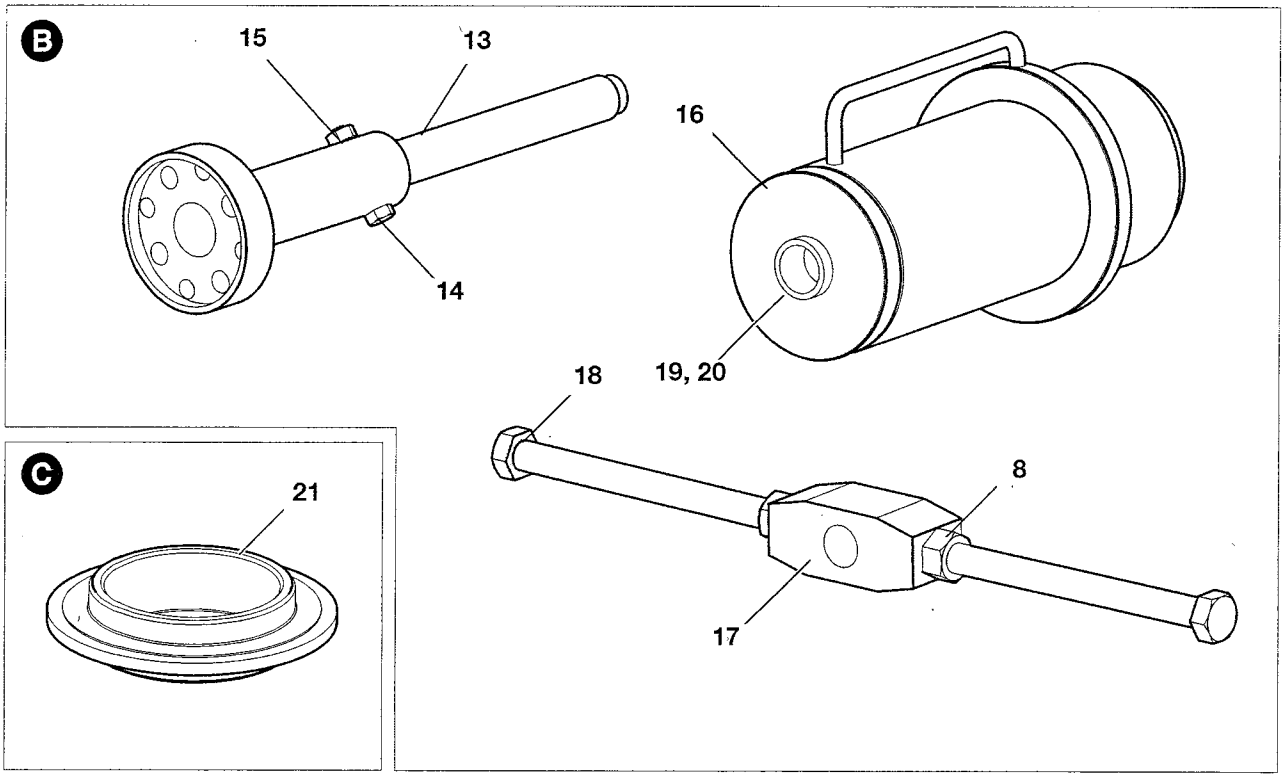
Service Tools (cont'd)

Wheel Hub Service Tool -

A Bearing Puller
B Bearing Press
C Hub Seal Dolly

Item	Description	Part No.	Qty
A, B & C	Hub Service Kit	892/01092	1
comprises of:			
1	Puller Beam	998/10623	1
2	Inner Bearing Plate	998/10607	1
3	Bolt M16x220	1315/3731Z	2
4	Nut M16	1370/0601Z	2
5	Reaction Tube	998/10614	1
6	ModifiedWheel Stud	998/10624	2
7	Wheel Bearing Carrier Puller	998/10615	2
8	Nut M20	1370/0701Z	4
9	Washer M20	1420/0012Z	2
10	Puller Rod	998/10610	2
11	Nut M12	1370/0401Z	2
12	Washer M12	1420/0009Z	2
13	Bearing Centre Puller	998/10608	1
14	Bolt M10x60	1315/3414Z	1
15	Nut M10	1370/0301Z	1
16	Bearing Fitting Tube	998/10606	1
17	Puller Handle Nut	998/10616	1
18	Bolt M20x300	1315/3835Z	2
19	Washer	445/12303	2
20	Bearing	917/02800	1
21	Seal Dolly	892/00891	1





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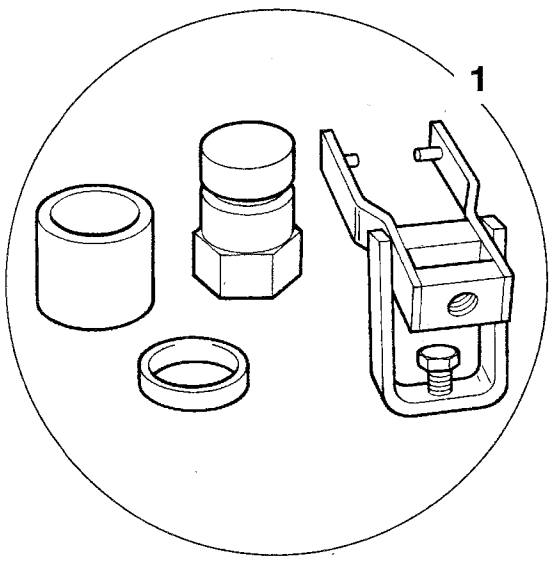
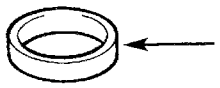
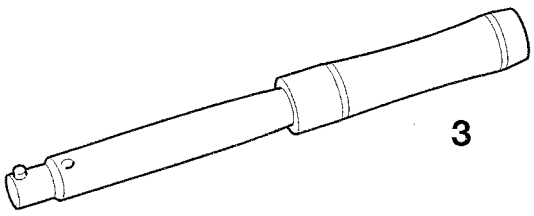
Service Tools (cont'd)

Solid Spacer Setting Tool Kit







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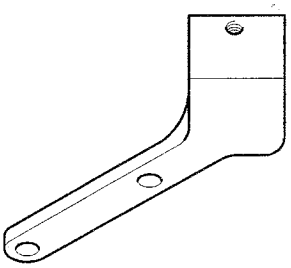

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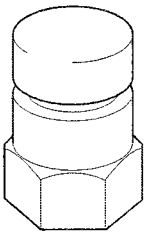

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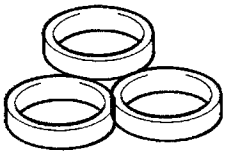


Service Tools (cont'd)

Solid Spacer Setting Tool Kit
Synchro Shuttle Gearbox, SD70, SD80 Axles

1	892/00918	Setting Tool Kit
2	921/52627	Spacer 14.20 Service use
3	993/70111	Breakback Torque Wrench
4	Not used	
5	892/01075	Support Bracket PD70, SD80 Rear Axles
6	Not used	
7	998/10567	SD80 Pinion Shaft Adaptor
8	921/53300	Spacer Kit - SD55 Axles

Comprises of:

	Spacer thickness mm
921/53322	13.550
921/53323	13.575
921/53324	13.600
921/53325	13.625
921/53301	13.650
921/53302	13.675
921/53303	13.700
921/53304	13.725
921/53305	13.750
921/53306	13.775
921/53307	13.800
921/53308	13.825
921/53309	13.850
921/53310	13.875
921/53311	13.900
921/53312	13.925
921/53313	13.950
921/53314	13.975
921/53315	14.000
921/53316	14.025
921/53317	14.050
921/53318	14.075
921/53319	14.100
921/53320	14.125
921/53321	14.150

9	921/53400	Spacer Kit - Sychro Shuttle Gearbox, SD70, SD80 Axles

Comprises of:

	Spacer thickness mm
921/52628	12.600
829/30405	12.625
921/52629	12.650
829/30406	12.675
921/52630	12.700
829/30407	12.725
921/52601	12.750
829/30408	12.775
921/52602	12.800
829/30409	12.825
921/52603	12.850
829/30410	12.875
921/52604	12.900
829/30411	12.925
921/52605	12.950
829/30412	12.975
921/52606	13.000
829/30413	13.025
921/52607	13.050
829/30414	13.075
921/52608	13.100
829/30415	13.125
921/52609	13.150
829/30416	13.175
921/52610	13.200
829/30417	13.225
921/52611	13.250
921/53424	13.275
921/53425	13.300
921/53426	13.325
921/53427	13.350
921/53428	13.375
921/53401	13.400
921/53402	13.425
921/53403	13.450
921/53404	13.475
921/53405	13.500
921/53406	13.525
921/53407	13.550
921/53408	13.575
921/53409	13.600
921/53410	13.625
921/53411	13.650
921/53412	13.675
921/53413	13.700
921/53414	13.725
921/53415	13.750
921/53416	13.775
921/53417	13.800
921/53418	13.825
921/53419	13.850
921/53420	13.875
921/53421	13.900
921/53422	13.925
921/53423	13.950
921/52626	14.000

* Sealing and Retaining Compounds

Loctite 574 or **Permabond A136**	A medium strength sealant suitable for all sizes of gasket flanges, and for hydraulic fittings of 25-65 mm diameter.	4102/1212	
Loctite 275 or **Permabond A140**	For all sizes of flange where the strength of the joint is important.	† 4102/0552	
Loctite 932 or **Permabond A137**	For all retaining parts which are likely to be dismantled and for use on threads larger than 50 mm dia.	4101/0451	
Loctite 242 or **Permabond A113**	A medium strength locking fluid for sealing and retaining nuts, bolts, and screws up to 50 mm diameter, and for hydraulic fittings up to 25 mm diameter.	† 4101/0251	
Loctite 243	A medium strength locking fluid similar to Loctite 242 but with greater resistance to thread contamination.	4101/0250	
Loctite 648 or **Permabond A118**	For retaining parts which are unlikely to be dismantled.	4101/0651	
Loctite 577	A medium strength thread sealing compound.	4102/1951	
Superbonder	Bonding/Sealant	† 4103/0955	
Loctite Activator	A cleaning primer which speeds the curing rate of anaerobic products.	† 4104/0251 † 4104/0253	Aerosol Bottle
Cleaner/Degreaser	For degreasing components prior to use of anaerobic adhesives and sealants.	† 4104/1557	Aerosol
Anti-Seize Paste	A compound used for assembly and prevention of thread seizure.	† 4003/0211	

Note: The above list is the range of sealants and retaining compounds available. Items marked † are those referred to within the sections.

Contents

Safety Notices

In this publication there are safety notices. Each notice starts with a signal word. The signal word meanings are given below.

⚠ DANGER

Denotes an extreme hazard exists. If proper precautions are not taken, it is highly probable that the operator (or others) could be killed or seriously injured.
INT-1-2-1

⚠ WARNING

Denotes a hazard exists. If proper precautions are not taken, the operator (or others) could be killed or seriously injured.
INT-1-2-2

⚠ CAUTION

Denotes a reminder of safety practices. Failure to follow these safety practices could result in injury to the operator (or others) and possible damage to the machine.
INT-1-2-3

All machinery, whether mobile or static, can be hazardous. When equipment is correctly operated and properly maintained it can be safe to work with. But when it is carelessly operated or poorly maintained it can become a danger.

Do not work with any equipment until you are sure that it is serviceable, that you know how to control it and be aware of all relevant safety requirements.

If the equipment covered by this manual forms part of a larger product (eg. a vehicle) be sure to observe the safety requirements which relate to the product as a whole, as well as those given in this manual.

On this and the following pages and throughout this manual, you will find safety messages. Please read and understand these safety messages before using and working on the equipment covered in this manual.

Make sure you also read and understand all other safety messages contained in operator handbooks and service manuals concerned with the product of which this equipment forms part.

Remember

BE CAREFUL
BE ALERT
BE SAFE

General Safety

⚠ WARNING

Decals

This equipment may include safety decals

You can be injured if you do not obey the decal safety instructions. Keep decals clean. Replace unreadable or missing decals with new ones before operating the machine. Make sure replacement parts include warning decals where necessary.

⚠ WARNING

Care and Alertness

All the time you are working with or on the machine, take care and stay alert. Always be careful. Always be alert for hazards.

INT-1-3-5

⚠ WARNING

Clothing

You can be injured if you do not wear the proper clothing. Loose clothing can get caught in the machinery. Wear protective clothing to suit the job. Examples of protective clothing are: a hard hat, safety shoes, safety glasses, a well fitting overall, ear-protectors and industrial gloves. Keep cuffs fastened. Do not wear a necktie or scarf. Keep long hair restrained.

INT-1-3-6

⚠ WARNING

Lifting Equipment

You can be injured if you use faulty lifting equipment. Make sure that lifting equipment is in good condition. Make sure that lifting tackle complies with all local regulations and is suitable for the job. Make sure that lifting equipment is strong enough for the job.

INT-1-3-7

⚠ WARNING

Raised Attachments

Raised attachments can fall and injure you. Do not walk or work under raised attachments unless they are safely blocked.

INT-1-3-8

⚠ WARNING

Alcohol and Drugs

It is extremely dangerous to operate machinery when under the influence of alcohol or drugs. Do not consume alcoholic drinks or take drugs before of whilst operating the machine or attachments. Be aware of medicines which can cause drowsiness.

INT-1-3-9

Operating Safety

⚠ WARNING

Equipment Condition

Defective equipment can injure you or others. Do not operate equipment which is defective or has missing parts. Make sure all maintenance procedures are completed before using the equipment

⚠ WARNING

Controls

You or others can be killed or seriously injured if you operate the control levers from outside the cab. Operate the control levers only when you are correctly seated inside the cab.

INT-2-1-3

⚠ WARNING

Equipment Limits

Operating equipment beyond its design limits can damage the equipment, it can also be dangerous. Do not operate the equipment outside its limits. Do not try to upgrade the equipment performance with unapproved modifications.

⚠ WARNING

Engine/Steering Failure

If the engine or steering on the 'parent' machine fails, stop the machine as quickly as possible. Do not operate the machine until the fault has been corrected.

⚠ WARNING

Engine

The engine on the 'parent' machine has rotating parts. Do not open the engine cover while the engine is running. Do not use the machine with the cover open.

⚠ DANGER

Sparks

Explosions and fire can be caused by sparks from the exhaust or the electrical system. Do not use the machine in closed areas where there is flammable material, vapour or dust.

INT-2-2-10

⚠ WARNING

Exhaust Gases

Breathing the 'parent' machine exhaust gases can harm and possibly kill you. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, fit an exhaust extension. If you begin to feel drowsy, stop the machine at once. Get out of the cab into fresh air.

⚠ WARNING

Communications

Bad communications can cause accidents. Keep people around you informed of what you will be doing. If you will be working with other people, make sure any hand signals that may be used are understood by everybody. Work sites can be noisy, do not rely on spoken commands.

INT-2-2-3

⚠ WARNING

The transmission can be in 4 wheel drive until de-selected by hydraulic pressure to 2 wheel drive. If the machine is to be raised and the engine/transmission run, make sure all four wheels are off the ground and supported by axle stands. If only the rear wheels are raised, the machine could still drive through the front axle.

Maintenance Safety

⚠ WARNING

Repairs

Do not try to do repairs or any other type of maintenance work you do not understand. To avoid injury and/or damage get the work done by a specialist engineer.

GEN-1-5

⚠ WARNING

Modifications and Welding

Non-approved modifications can cause injury and damage. Welds on cast iron can weaken the structure and break. Do not weld cast iron. Contact your distributor for advice before modifying the equipment.

⚠ WARNING

Metal Splinters

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or drift to remove and fit metal pins. Always wear safety glasses.

INT-3-1-3

⚠ WARNING

Electrical Circuits

Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

INT-3-1-4

⚠ WARNING

Battery Gases

Batteries give off explosive gases. Keep flames and sparks away from the vehicle battery. Do not smoke close to the battery. Make sure there is good ventilation in closed areas where batteries are being used or charged. Do not check the battery charge by shorting the terminals with metal; use a hydrometer or voltmeter.

⚠ WARNING

Hydraulic Fluid

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin, get medical help immediately.

INT-3-1-10/1

⚠ DANGER

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

⚠ WARNING

Oil

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

INT-3-2-3

⚠ WARNING

Soft Ground

A machine can sink into soft ground. Never work under a machine on soft ground.

INT-3-2-4

⚠ WARNING

Always wear safety glasses when dismantling assemblies containing components under pressure from springs. This will protect against eye injury from components accidently flying out.

GEN 6-2

⚠ CAUTION

Cleaning

Cleaning metal parts with incorrect solvents can cause corrosion. Use only recommended cleaning agents and solvents.

INT-3-2-11

⚠ CAUTION

'O' rings, Seals and Gaskets

Badly fitted, damaged or rotted 'O' rings, seals and gaskets can cause leakages and possible accidents. Renew whenever disturbed unless otherwise instructed. Do not use Triochloroethane or paint thinners near 'O' rings and seals.

INT-3-2-12

Maintenance Safety (cont'd)

⚠ WARNING

Fires

Do not use water to put out an equipment fire, you could spread an oil fire or get a shock from an electrical fire. Use carbon dioxide, dry chemical or foam extinguishers. Contact your nearest fire department as quickly as possible. Firefighters should use self-contained breathing apparatus.

⚠ WARNING

Jacking

A machine can roll off jacks and crush you unless the wheels have been chocked. Always chock the wheels at the opposite end of the machine that is to be jacked. Do not work underneath a machine supported only by jacks. Always support a jacked-up machine on axle stands before working underneath it.

INT-3-2-8

⚠ WARNING

Hydraulic Hoses

Damaged hoses can cause fatal accidents. Inspect the hoses regularly for:

- Damaged end fittings
- Chafed outer covers
- Ballooned outer covers
- Kinked or crushed hoses
- Embedded armouring in outer covers
- Displaced end fittings.

INT-3-3-2

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground. Apply the parking brake, put the transmission in neutral and stop the engine. Chock both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine

GEN-1-2/IT

⚠ WARNING

To avoid burning, wear protective gloves when handling hot components. To protect your eyes, wear goggles when using a wire brush to clean components.

HYD 1-3

⚠ WARNING

Some lubricants contain lead. The repeated swallowing of very small quantities can cause chronic lead poisoning. Do not smoke or touch food while handling this lubricant. Dispose of waste (rags etc.) in accordance with local regulations.

2-1-1-8/IT

⚠ WARNING

Fluoroelastomeric Materials

Certain seals and gaskets (e.g. crankshaft oil seal) may contain fluoroelastomeric materials such as Viton, Fluorel and Technoflon. Fluoroelastomeric materials subjected to high temperatures can produce highly corrosive hydrofluoric acid. THIS ACID CAN SEVERELY BURN.

New fluoroelastomeric components at ambient temperature require no special safety precautions.

Used fluoroelastomeric components whose temperatures have not exceeded 300°C require no special safety precautions. If evidence of decomposition (e.g. charring) is found, refer to the next paragraph for safety instructions DO NOT TOUCH COMPONENT OR SURROUNDING AREA.

Used fluoroelastomeric components subjected to temperatures greater than 300°C (e.g. engine fire) must be treated using the following safety procedure. Make sure that heavy duty gloves and special safety glasses are worn:

1 Ensure that components have cooled then remove and place material into plastic bags.

2 Thoroughly wash contaminated area with 10% calcium hydroxide or other suitable alkali solution, if necessary use wire wool to remove burnt remains.

3 Thoroughly wash contaminated area with detergent and water.

4 Contain all removed material, gloves etc. used in this operation in sealed plastic bags and dispose of in accordance with Local Authority Regulations.

DO NOT BURN FLUOROELASTOMERIC MATERIALS.

If contamination of skin or eyes occurs, wash the affected area with a continuous supply of clean water or with calcium hydroxide solution for 15-60 minutes. Get medical attention immediately.

INT-3-3-5/1/IT

* ### ⚠ WARNING

Protect your eyes when grinding metal. Wear safety glasses or goggles. Remove or protect any combustible materials from the area which could be ignited by sparks.

GEN-1-12

* ### ⚠ WARNING

Before carrying out any servicing, park the machine on firm level ground and apply the parking brake. Make sure the transmission selector and gear lever are in the neutral position. Switch OFF the engine and remove the starter key. Operate the control levers and remove the hydraulic filler cap to vent any residual pressure. Disconnect the battery.

GEN-1-13

Contents	**Page No.**

Service Schedules

A badly maintained axle is a danger to the operator and the people working around him. Make sure that the regular maintenance and lubrication jobs listed in the service schedules are done to keep the axle in a safe and efficient working condition.

The schedules are based on machine running hours. Do not use a machine which is due for a service. Make sure any defects found during the regular maintenance checks are rectified immediately.

Calendar equivalents:
50 Hours = Weekly
500 Hours = Six Months
1000 Hours = Yearly
2000 Hours = 2 Years Service checks should be carried out as in the table at whichever time occurs first.

Service Points and Fluid Levels	Operation	10 Hr	50 Hr	†100 Hr	500 Hr	1000 Hr	2000 Hr
Axle Oil Level (incl. Hubs when applicable) ①	- Check			•	•	•	•
* Axle Oil (incl. Hubs when applicable)	- Change				•②	•	•
Tightness of mounting bolts	- Check				•	•	•

† **Note:** First 100 Hours Service only.

① **Note:** Check for leaks every 50 hours, check level if leaking.

* ② **Note:** Limited Slip Differential and Differential Lock only.

Note: Faults in the braking system must be rectified **immediately.** Ensure the correct brake fluid is used (see **Lubricants and Capacities**, Section 1) and all equipment is clean and free from water contamination. Under no circumstances should water be allowed to enter the braking system.

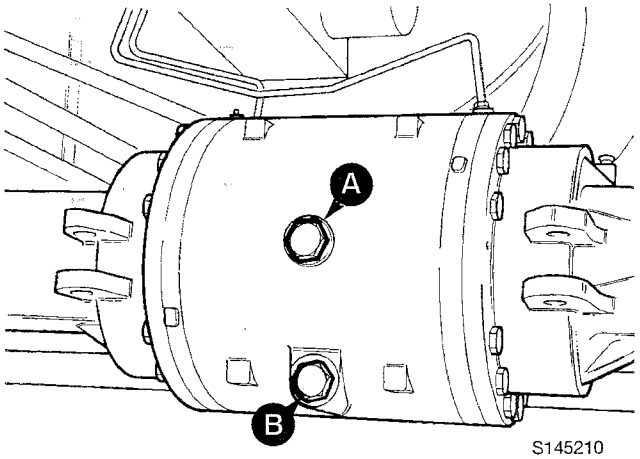
Axle Oil Level

Check Oil Level - *for Interval see Service Schedule*

Note: It is essential that the machine is parked on level ground to ensure accurate oil level checking.

1 At the drive head casing remove fill/level plug **A**. Oil should be level with the bottom of the fill/level hole.

2 If necessary, top up with recommended axle oil. Clean and refit fill/level plug **A**.



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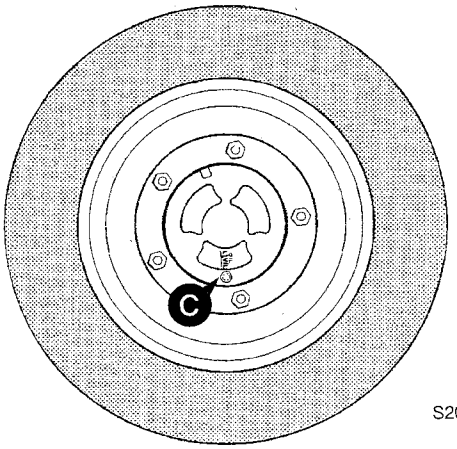
Change Oil - *for Interval see Service Schedule*

1 Set the machine level, with the machine tyres just clear of the ground. Manually rotate both wheels of the axle to bring the **OIL LEVEL** mark on the hubs to the vertical position, with the fill/level plugs **C** at the bottom.



S209320

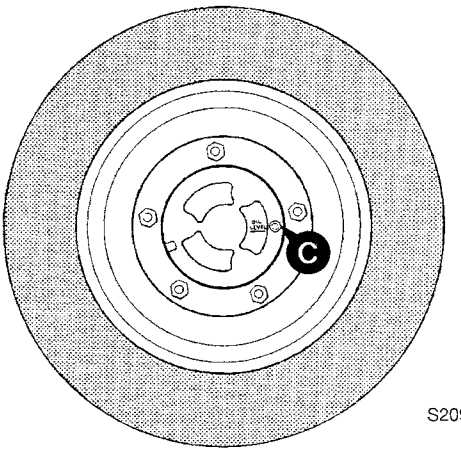
2 Remove fill/level plugs **C** from the hubs and drain plug **B** from the drive head casing. Allow time for the oil to drain out.

3 Clean and refit drain plug **B**.

4 Set both hub **OIL LEVEL** marks to the horizontal.

*5 Fill the axle with the specified quantity of oil through drive head casing fill/level plug **A** (see **Lubricants and Capacities**, Section 1). If the machine has been set level, oil should just dribble out both hub fill/level points.

6 Clean and refit both hub fill/level plugs **C** and fill/level plug **A.**



S209320

Hygiene

Lubricants are not a health risk when used properly for their intended purposes.

However, excessive or prolonged skin contact can remove the natural fats from your skin, causing dryness and irritation.

Low viscosity oils are more likely to do this, so take special care when handling used oils, which might be diluted with fuel contamination.

Whenever you are handling oil products you should maintain good standards of care and personal and plant hygiene. For details of these precautions we advise you to read the relevant publications issued by your local health authority, plus the following.

Storage

Always keep lubricants out of the reach of children.

Never store lubricants in open or unlabelled containers.

Waste Disposal

All waste products should be disposed of in accordance with all the relevant regulations.

The collection and disposal of used oil should be in accordance with any local regulations. Never pour used oil into sewers, drains or on the ground.

Handling

New Oil

There are no special precautions needed for the handling or use of new oil, beside the normal care and hygiene practices.

Used Oil

Used lubricants contain harmful contaminants.

Here are precautions to protect your health when handling used oil:

1 Avoid prolonged, excessive or repeated skin contact with used oils.

2 Apply a barrier cream to the skin before handling used oil.

3 Note the following when removing oil from skin:

- **a** Wash your skin thoroughly with soap and water.
- **b** Using a nail brush will help.
- **c** Use special hand cleansers to help clean dirty hands.
- **d** Never use petrol, diesel fuel, or paraffin for washing.

4 Avoid skin contact with oil soaked clothing.

5 Don't keep oily rags in pockets.

6 Wash dirty clothing before re-use.

7 Throw away oil-soaked shoes.

First Aid - Oil

Eyes
In the case of eye contact, flush with water for 15 minutes. If irritation persists, get medical attention.

Swallowing
If oil is swallowed do not induce vomiting. Get medical advice.

Skin
In the case of excessive skin contact, wash with soap and water.

Spillage

Absorb on sand or a locally approved brand of absorbent granules. Scrape up and remove to a chemical disposal area.

Fires

Extinguish with carbon dioxide, dry chemical or foam. Fire-fighters should use self-contained breathing apparatus.

Contents

* PD70 Axle - Central Drivehead (Inboard Brakes) and Integral Parking Brake

Note: It is essential that the correct ratio axle in relationship to the gearbox ratio is fitted to a machine. Do not fit a new axle with a different ratio to the axle being replaced.

* Type	3 piece, spiral bevel input with epicyclic hub reduction and inboard braking. Pinion mounted parking brake disc.					
Designation	PD70					
Installation	Rigid pad mount, pin mount or trunnion mount					
Weight (dry and without wheels)	386 kg (851 lb) approx.					
Half (Axle) Shaft Braking/Type	5 plate (each half shaft)					
* Input Type	Yoke or Disc					
Oscillation (pin or trunnion mount)	± 5°					
Hub Reduction	5.4:1					
Ratios	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5	OPTION 6
* Overall	15.78:1	18.16:1	13.7:1	10.46:1	12.49:1	24.975:1
Number of Teeth						
Crownwheel	38	37	33	31	37	37
Pinion	13	10	13	16	16	8

* **Options**
  - Limited Slip Differential
  - Soft Engage Differential Lock

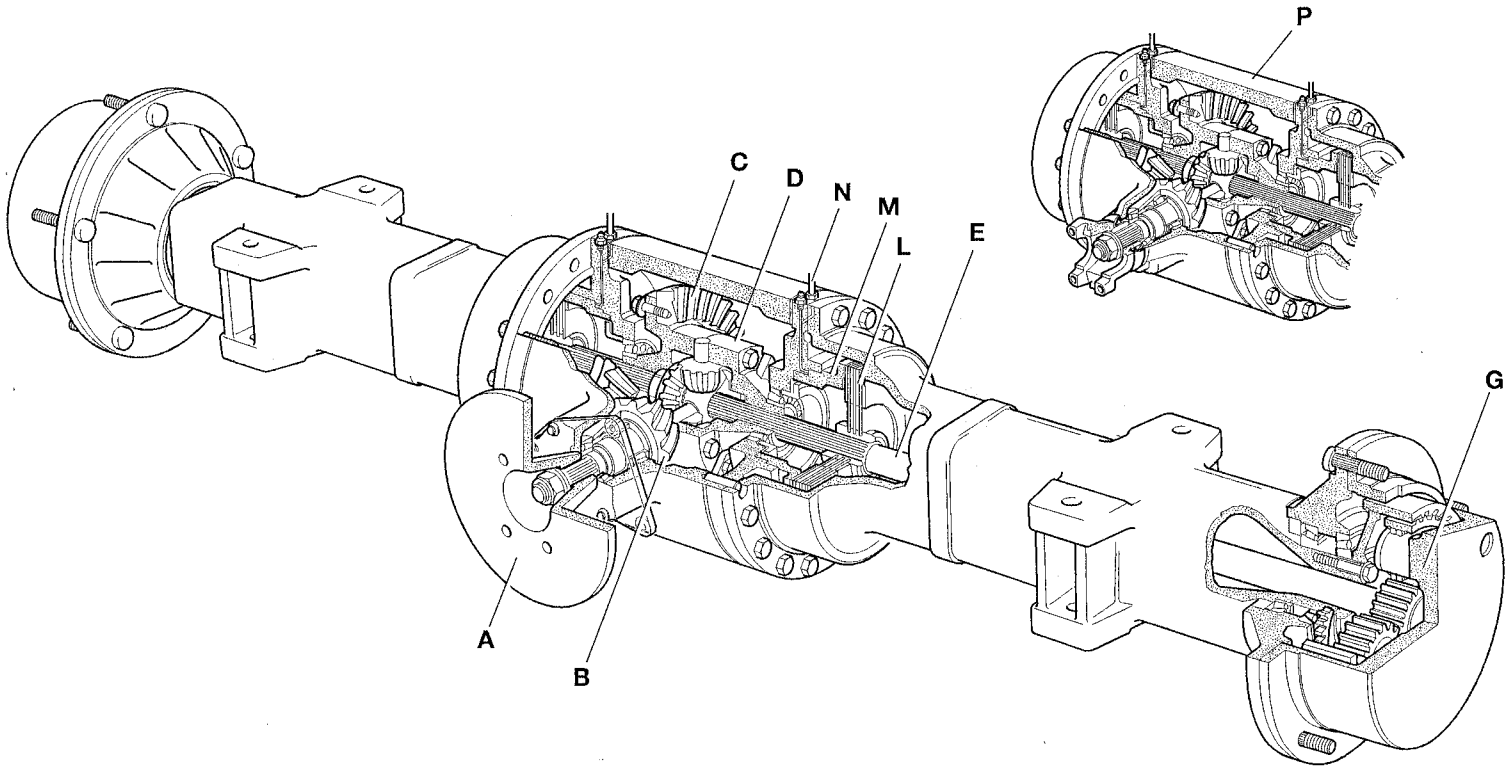
* **Service Brake Options**
  - **1** Standard Retraction
  - **2** Positive Retractive
  - **3** Controlled Retraction

* Rear Axle - Type PD70 (2 Wheel Steer Machines)

Component Identification

The illustration shows a typical 2 wheel steer rear axle. 2WS machines are fitted with non steer axles (PD70).

A Parking brake disc. The disc is fitted to the pinion instead of a yoke. The propshaft is bolted to the centre of the disc. The axle casing also carries a bracket for location of the parking brake caliper.
B Pinion
C Crownwheel
D Differential unit
Note: Items A, B, C, and D form the 'drivehead' part of the axle.
E Drive shaft
G Reduction gear hub
L In-board oil immersed multi-plate disc brakes
M Brake actuating piston
N Hydraulic brake lines
P Yoke version of the drivehead



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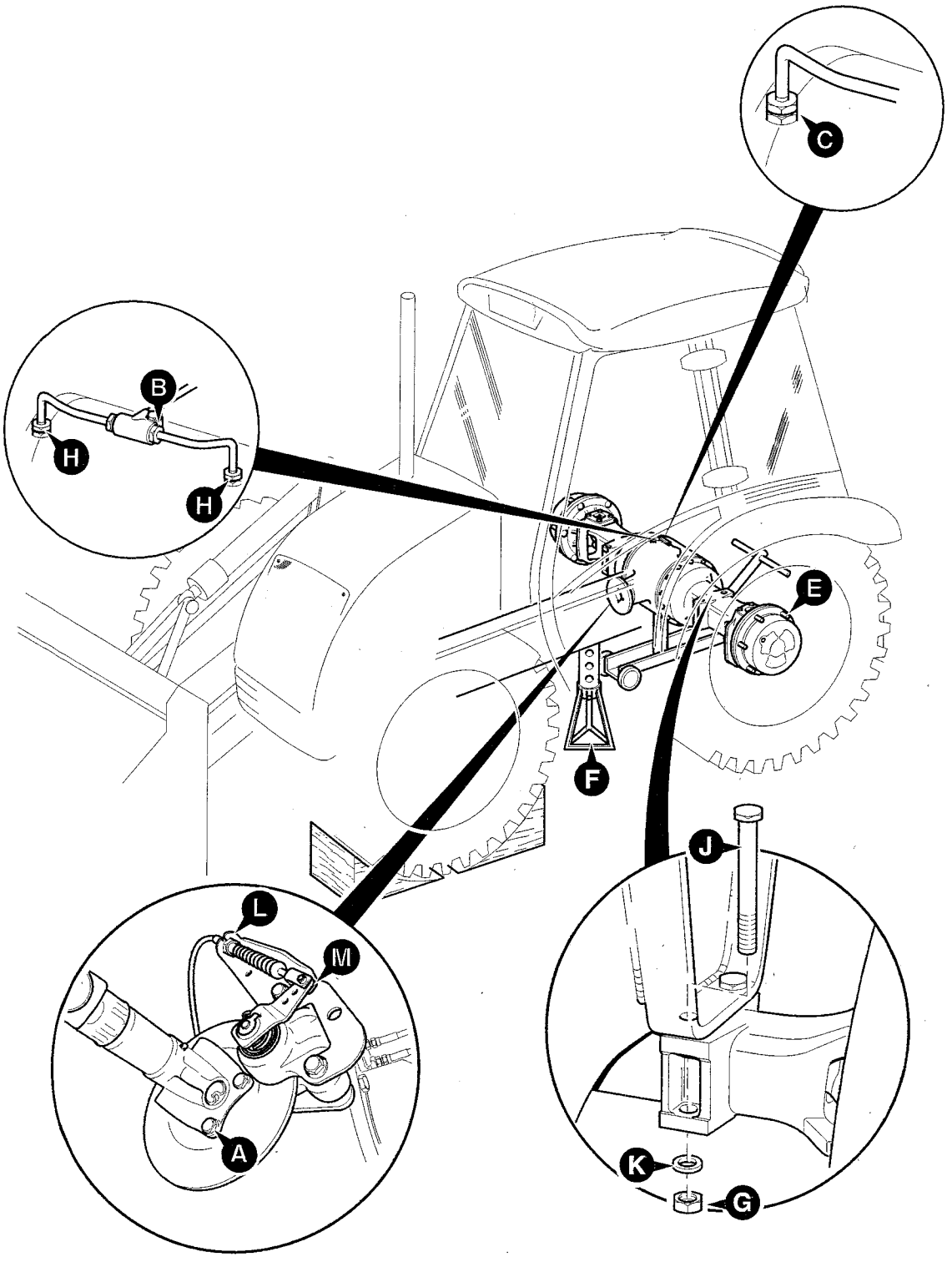
Section 4 Axles 2 - 1
Descriptions

Removal and Replacement

* **Note:** The axle shown is typical but the proceduress are the same.

*



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Removal and Replacement (cont'd)

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN 1-1

Removal

⚠ WARNING

When the propshaft is disconnected the parking brake will no longer function. The machine must be securely chocked to prevent any machine movement before disconnecting the propshaft.
TRAN 1-2

* 1 Release the parking brake. Loosen the parking brake cable bulkhead bolts at bracket **L**. Disconnect the cable from caliper **M**. Tie the cable up out of harms way.

* 2 Using tool 892/00822 remove bolts **A** to disconnect the driveshaft from the axle (see **Propshaft - Removal and Replacement**).

* 3 Disconnect the brake pipes from the brake piston housings, shown at **H**. Remove tee piece **B** retaining bolt and remove the tee piece. Blank off exposed connections.

* **Note:** If the drivehead is fitted with a Differential Lock then the hydraulic pipe **C** must be removed and blanked off.

* 4 Loosen the road wheel retaining nuts **E**.

* 5 Make sure that the front wheels are blocked, use the stabiliser legs to raise the rear end of the machine with the wheels and tyres clear of the ground.

* 6 Prop the machine one each side as shown at **F**.

* 7 Remove the road wheels.

* 8 Position a jack underneath the balance point (centre) of the axle and support the axle weight.

* **Note:** Attach a 'cradle' to the jack that will partially embrace the axle.

* 9 Remove nuts **G**, bolts **J** and washers **K**.

* 10 Lower the jack and remove the axle.

Replacement

Replacement is the reverse of the removal sequence.

⚠ WARNING

If, for whatever reason, a wheel stud is renewed, all the studs for that wheel must be changed as a set, since the remaining studs may have been damaged.
2-3-2-8

Whenever a wheel has been removed, check the wheel nut torques every two hours until they stay correct.

⚠ WARNING

Bleed the brake system before driving the machine.
BRAK 1-6

Bleed the brake system as described in **Bleeding Procedure**, Section 5.

Apply Loctite 243 to the threads of bolts **A**.

Torque Settings

Item	Nm	kgf m	lbf ft
* **A**	79	8	58
E	680	69	500
G	607	62	448

Propshafts

Removal and Replacement

Removal

Before removing propshafts always mark both companion flanges and also mark the sliding joints prior to removal.

Replacement

Upon reassembly, after lubricating sliding joints with Mobil HP222 grease, align the shafts against identification marks previously made or, in the case of a shaft being renewed, use the manufacturer's alignment markings.

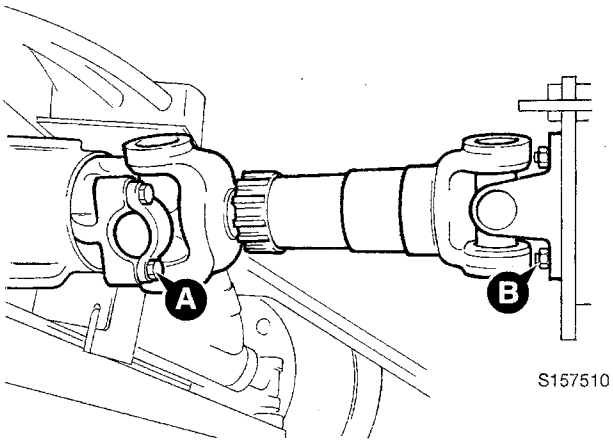
Apply Loctite 242 to threads of all flange bolts.

Retaining straps **C** stretch with use, therefore these straps must always be replaced with new ones.

The propshaft must have both ends exactly on the same plane as shown at **X.** The yokes must not be at right angles as at **Y** or at an intermediate angle as at **Z**.

Torque Settings

Item	Nm	kgf m	lbf ft
A	75 - 85	7.7 - 8.7	55 - 63
B	118	12	87



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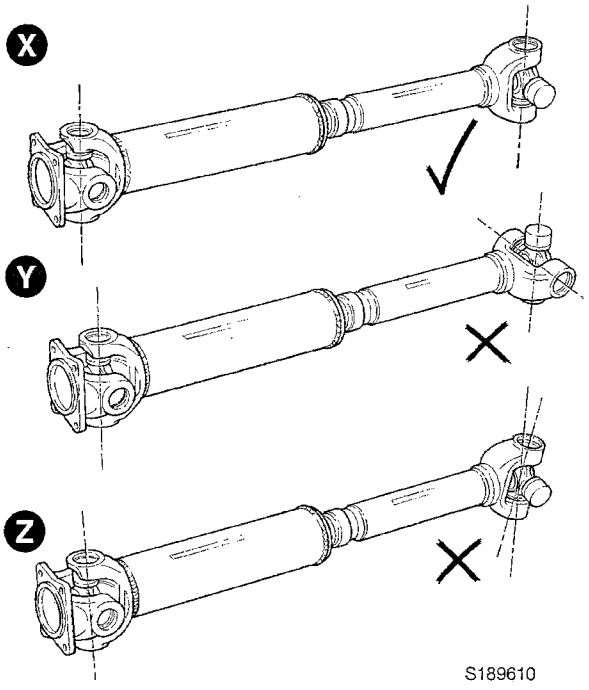

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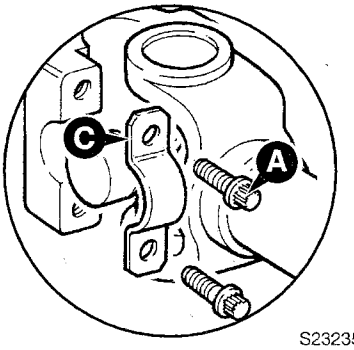

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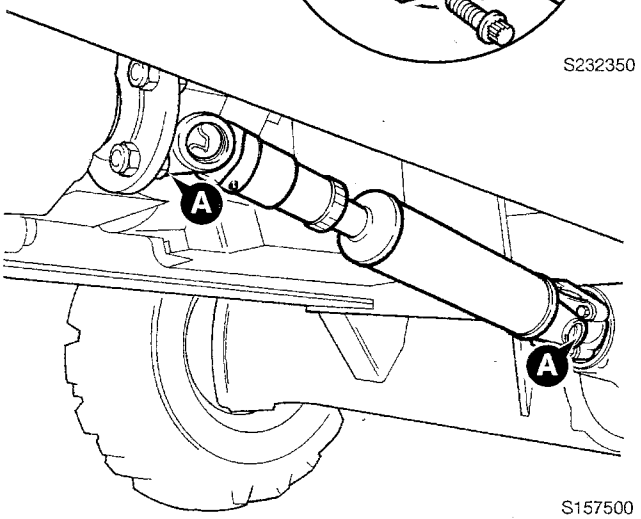

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Renewing the Pinion Oil Seal

The pinion oil seal **3** may be renewed without removing the axle from the machine.

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN-001

* **Note 1:** These axles are fitted with a brake disc/drive flange in place of the yoke. For Brake Disc Removal procedure see **Brakes, Service Procedures**, Section 5.

* **1** Remove the roadwheels and uncouple the axle driveshaft. Measure the axle rolling torque and record reading. Mark the relative positions of the pinion shaft **4** and nut **2** with a scriber.

* **2** Using Service Tool 892/00812, remove the drive yoke **1** together with its stake nut **2**.

* **3** Remove seal **3** and fit a new one. Be sure not to damage the seal housing. Pack between the lips of the new seal with grease before fitting.

* **4** Check the sealing surface on the yoke for wear or damage. Renew the yoke if necessary. Check the brake disc for damage or wear.

* **5** Fit the yoke and temporarily fit the old stake nut **2**. Tighten the nut with a torque wrench, aligning the scriber marks. Note the tightening torque required.

* **6** Remove and discard the old nut. Fit a new nut and tighten to the torque determined at step 5.

6.1 Measure the rolling torque. The reading should be 0.5 to 1 Nm (0.37 to 0.74 lbf ft; 0.05 to 0.1 kgf m) more than that recorded in Step 1 (see **Note**).

6.2 If necessary, progressively torque tighten nut to a maximum of 300 Nm (221 lbf ft; 30.6 kgf m) to achieve correct rolling torque.

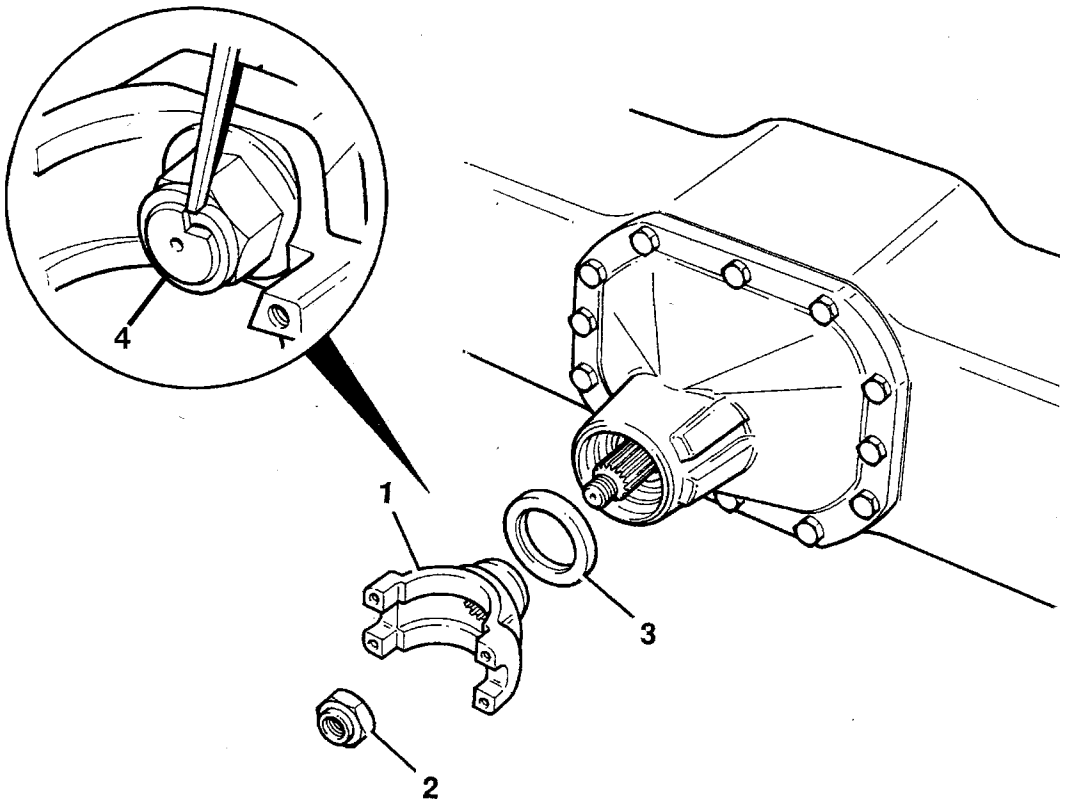
* **Note 2:** If the rolling torque figure (new pinion seal fitted) exceeds the reading recorded in step 1 by 1 Nm (0.74 lbf ft; 0.1 kgf m) or more, or a minimum torque of 250 Nm (184 lbf ft; 25.5 kgf m) cannot be achieved then the pinion assembly must be re-built using a solid spacer, see the appropriate axle assembly procedure.

6.3 Stake the nut using a square ended staking tool.

* **7** Refit the roadwheels and couple the propshaft.

* **Note 3:** All axles with Parking Brake Disc will have a solid spacer and NOT a collapsible spacer. This also applies to Differential Lock versions.

*



Hub and Driveshaft - Dismantling

The following illustrations show the axle removed from the machine but the hubs may be dismantled without removing the axle.

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN 1-1

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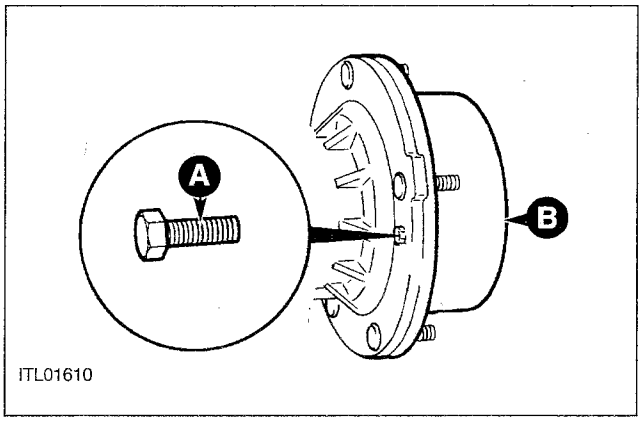
* **1** Drain oil from the hub.

Note: The illustration shows a typical axle.

2 Remove screws **A**.

3 Lever the planet gear carrier **B** off the bearing carrier. Remove and discard the 'O' ring.



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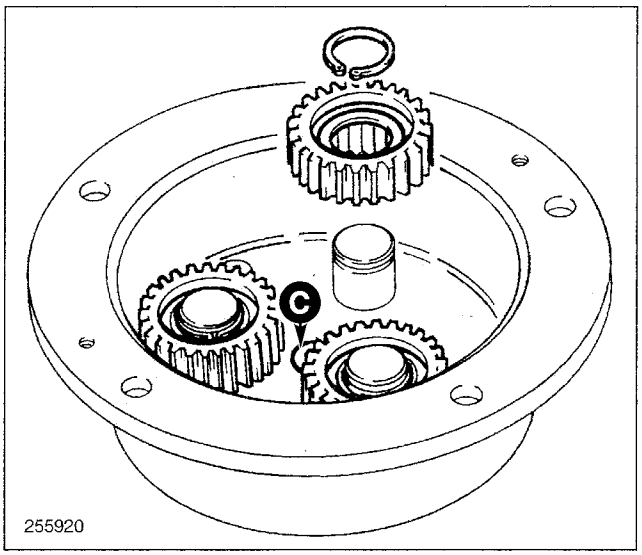
4 Remove planet gears only if defective. Note that gears can only be removed as assemblies, which comprise the gear, the bearing and two 'L' shaped circlips. To remove a planet gear, first remove the external circlip.

5 Pull off the planet gear.

6 The driveshaft thrust pad **C** is drilled and tapped M6 for removal purposes.



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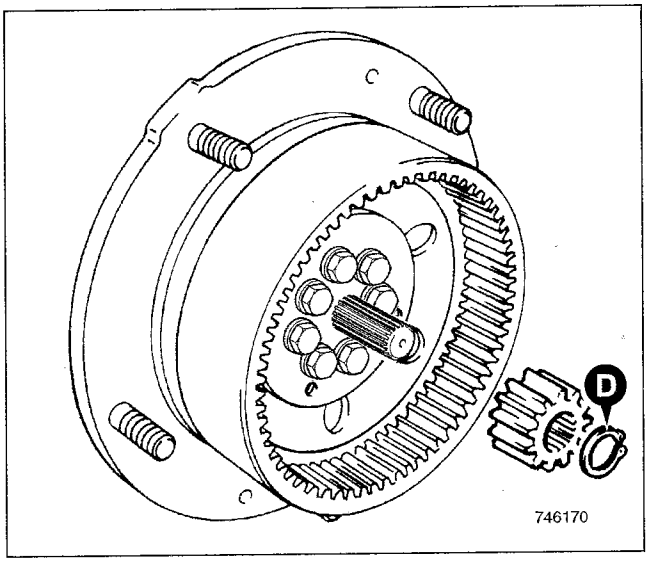
Hub and Driveshaft - Dismantling (cont'd)

7 Remove circlip **D** to allow the sun gear to be slid off the driveshaft.

* **Note:** If required, remove the driveshaft with sun gear.

*

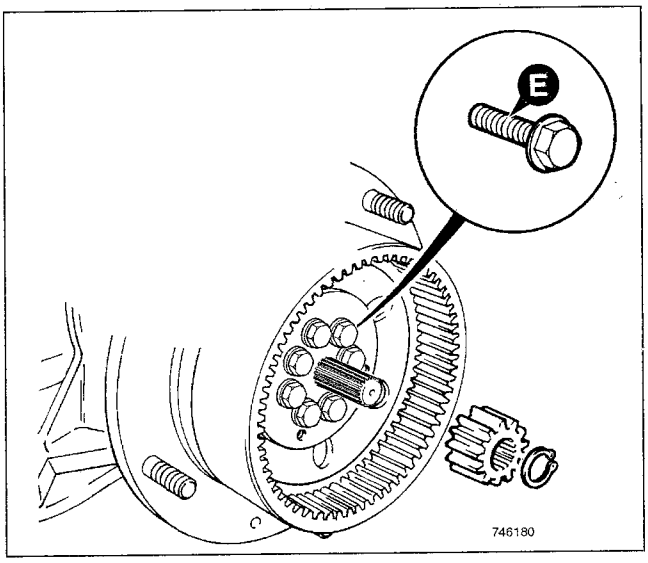


8 Remove 'Verbus Ripp' bolts **E** using a special tool (part number 892/00333).

9 These bolts are very tight and care must be taken not to distort the bolt heads. Use as short an extension bar as possible with a six sided socket.

10 Discard the Verbus Ripp bolts after removal.

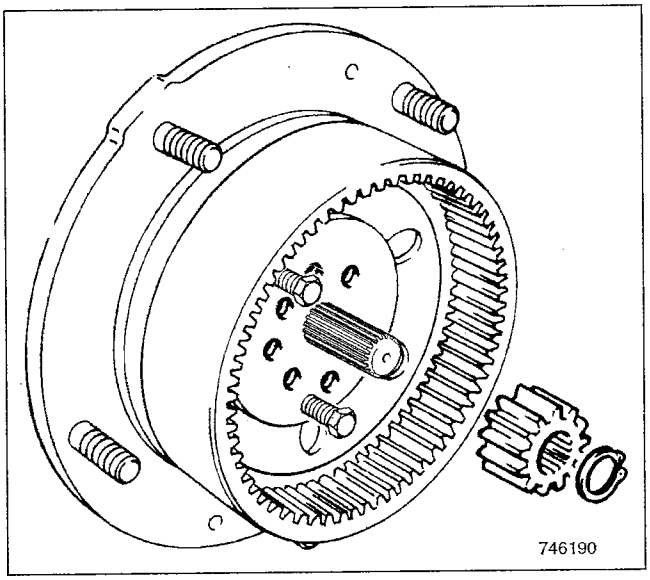
*



11 Using 2 high grade M12 bolts as jacking screws, remove the annulus carrier.

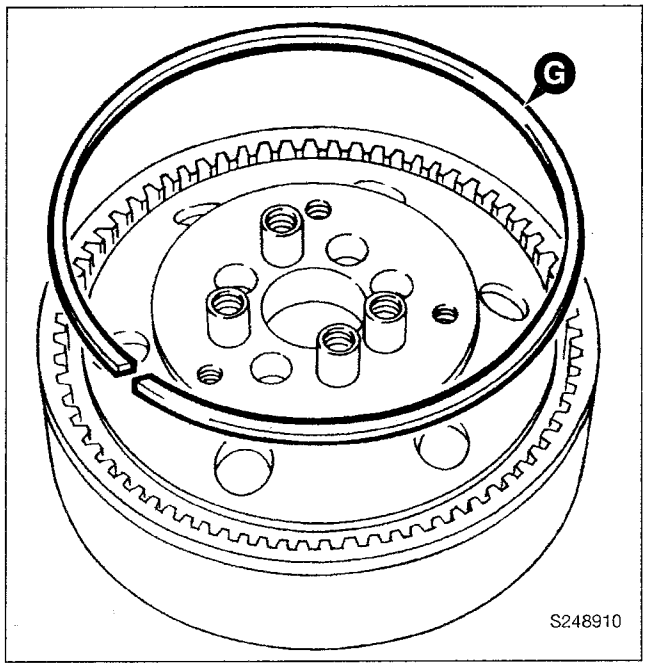
Note: Fretting between the hub swivel and annulus carrier mating faces might be evident; this condition is normal, do not attempt to repair. If the hub swivel and annulus carrier are to be re-used, the carrier must be assembled in the same angular position it was removed; match mark the hub swivel and carrier before removing the carrier.

*



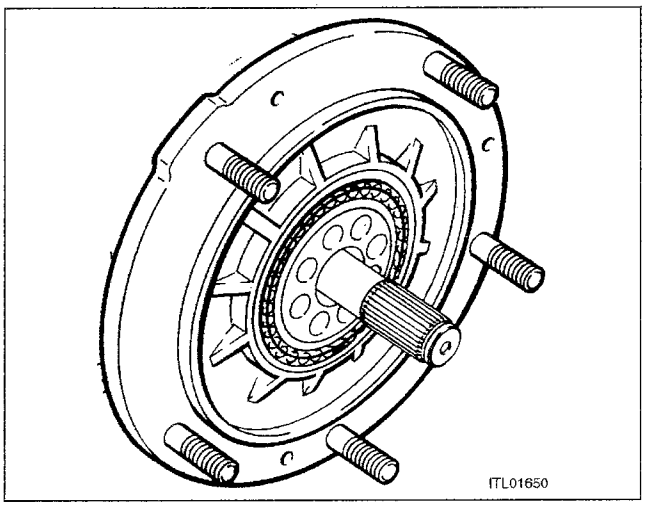
Hub and Driveshaft - Dismantling (cont'd)

12 Remove circlip **G** to separate the annulus ring from the annulus carrier.

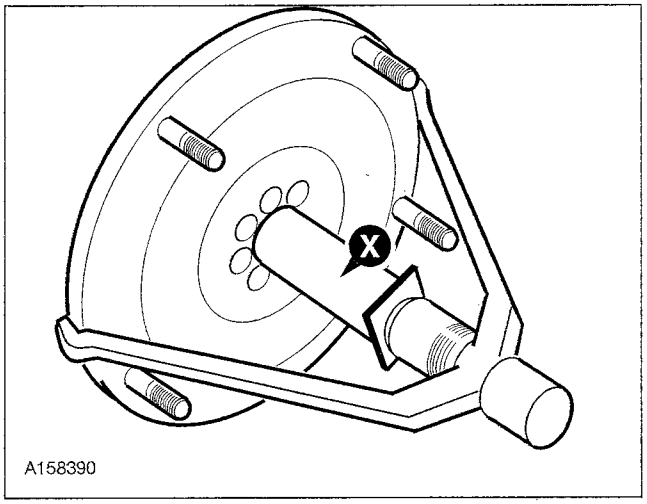


* **Note:** If the Wheel Hub Service Kit (Part No. 892/01092) is available, this should be used at this stage (see **Service Tools** - Section 1). Details of the procedure are to be found on page 4/5-9.

13 Pull off the bearing carrier together with the outer bearing cone and its bearing cup. Withdraw the inner bearing cup from the inboard side of the carrier.



Note: To prevent damaging the combination seal, do not lever against the half shaft. Place a tube over the half shaft and lever against the tube, as shown at **X**.

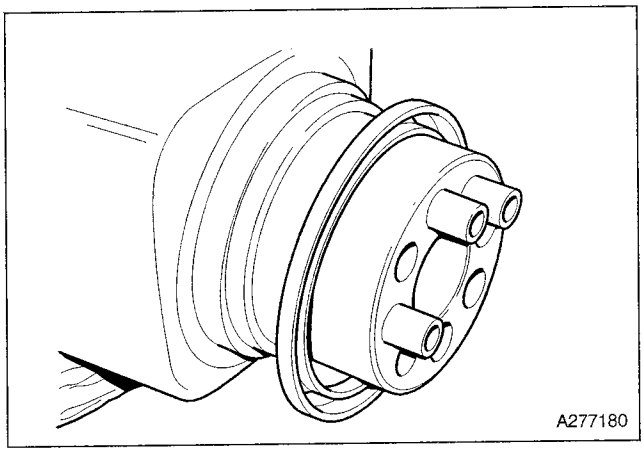


Hub and Driveshaft - Dismantling (cont'd)

14 Remove and discard the combination seal. When assembling the axle, a new combination seal must be used.

Note: If there has been a component failure, remove all traces of debris and clean the magnetic drain plug.

* **Note:** If a new dirt shied is to be fitted see page 4/5-10.

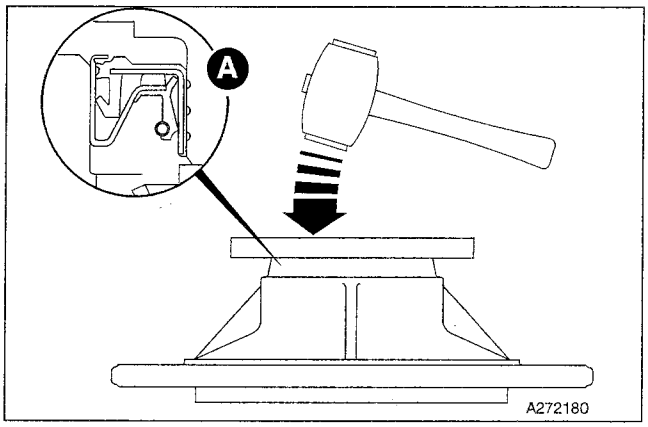


Hub and Driveshaft - Assembly

1 Lightly oil the inner wheel bearing. Assemble the inner and outer bearing cups, and the inner bearing cone into the bearing carrier.

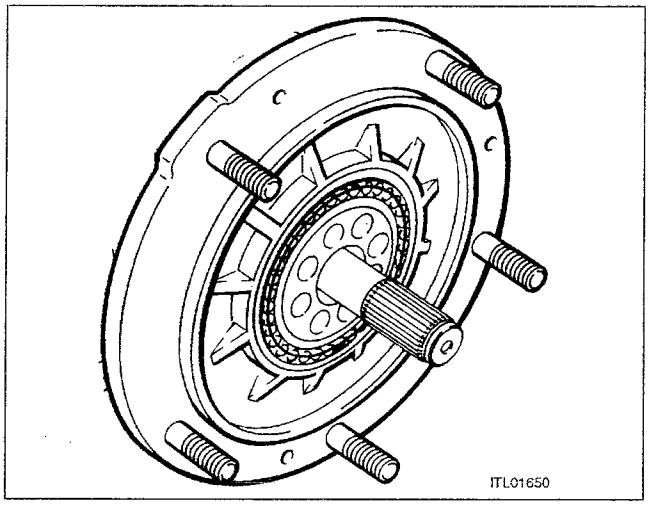
* 2 Fit a new combination oil seal. Lightly lubricate the outside diameter and the inside diameter of the seal when fitting. Using the service tool and spacer, drive the seal squarely into the carrier until the locating lip is flush as shown at **A**.

* **Note:** See detail of Dirt Shield on page 4/5-10.

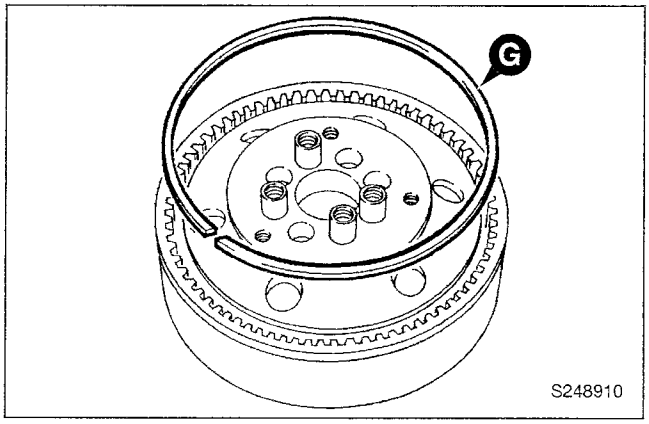


3 Fit the bearing carrier onto the axle arm. Lightly oil the outer wheel bearing race. Fit the bearing onto the axle arm. Rotate the bearing during fitting.

* **Note:** If the Wheel Hub Service Kit (Part No. 892/01092) is available, this should be used at this stage (see **Service Tools**, Section 1). Details of the procedure are to be found on page 4/5-10.

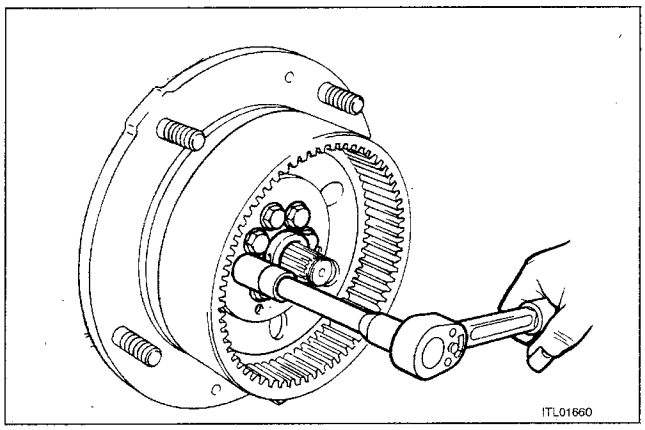


4 Assemble the annulus ring to the annulus carrier. Secure with circlip **G**.



* Hub and Driveshaft - Assembly (cont'd)

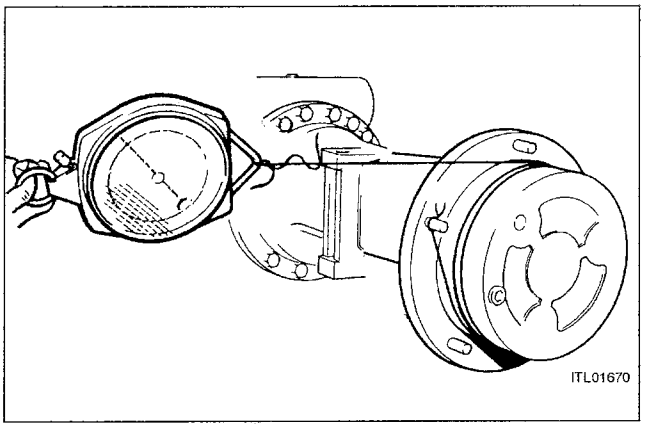
5 Fit annulus assembly in the same angular position as removal (see **Note**, page 4/5 - 2, step 11) using new 'Verbus Ripp' bolts. Do not fully tighten bolts but allow the bearing carrier to rock slightly. Measure seal drag rolling force - see step 6.



Note: Steps 5 to 8 describe measurement of rolling force. To measure rolling torque (simplified process), a special tool is required. Refer to **Service Tools**, Section 1.

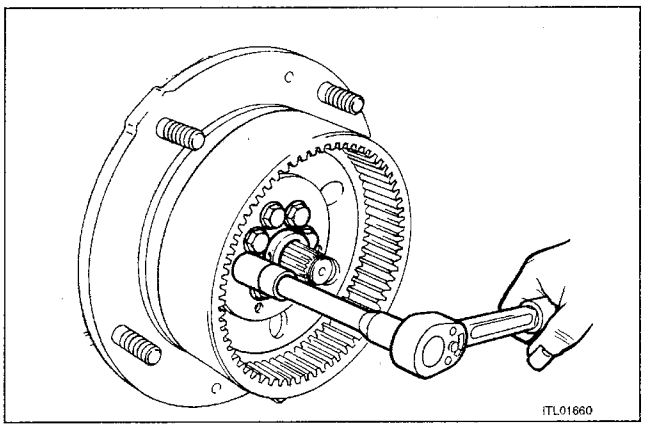
6 To measure seal drag rolling force:

- Refit the planet gear carrier - DO NOT FIT THE SUN GEAR.
- Use a spring balance and cord wrapped around the planet carrier flange as shown.
- Pull the spring balance so that the hub rotates, do several times to let the seal bed in and record the reading.
- Remove planet gear carrier.



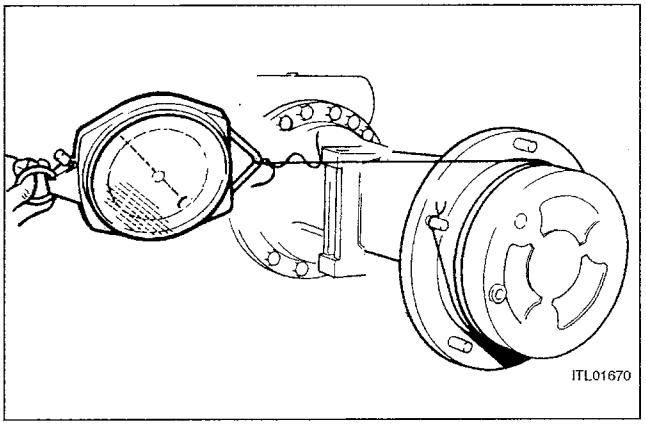
7 Tighten M14 Verbus Ripp bolts to 320 Nm (236 lbf ft, 33 kgf m) and then measure rolling force - see step 8.

Note: Rotate bearing carrier during torque tightening sequence.



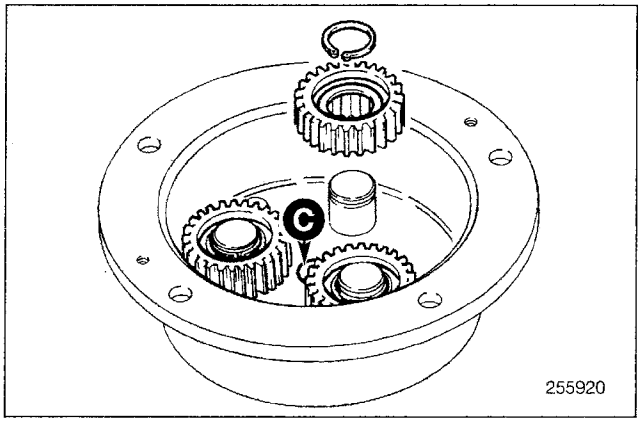
8 To measure rolling force:

- Refit the planet gear carrier - DO NOT FIT THE SUN GEAR. Use a spring balance and cord wrapped around the planet gear carrier flange as shown. Pull the spring balance so that the hub rotates and record the reading.
- To get the rolling force, subtract seal drag rolling force (see step 6) from reading obtained at this step, the result should be 64 to 117 N (14 to 26 lbf).
- If the resulting figure is outside these limits check: the seal is fitted correctly; and/or renew bearings if necessary; and/or new fitted components.
- Remove planet gear carrier.



*Hub and Driveshaft - Assembly (cont'd)

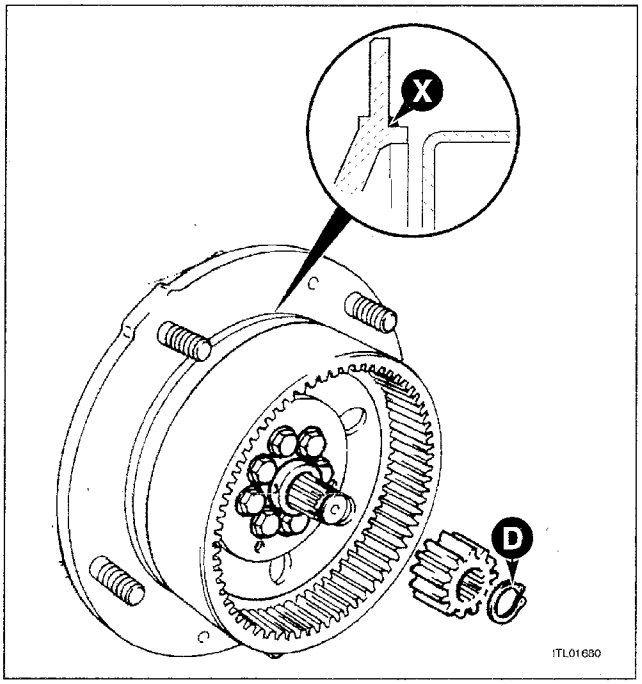
9 Press the drive shaft thrust pad **C** (chamfered side lowermost) into the recess in the planet carrier.



10 Fit new planet gears in place of any that were removed. (See step 4, **Dismantling**). Secure with circlip.

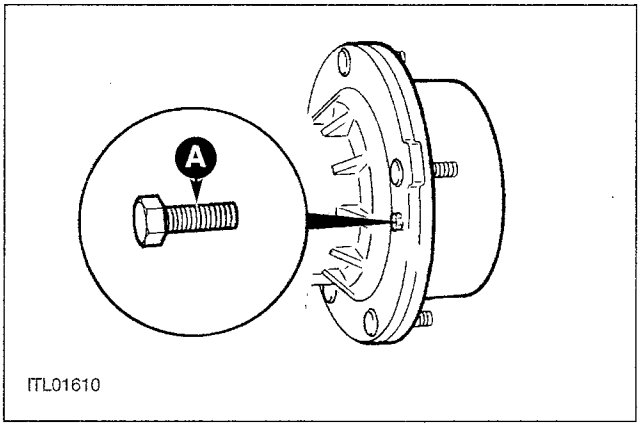
Note: Make sure that the SMALL radius on the gear bearing internal diameter is facing uppermost, that is at the circlip end of the planet pin.

11 Fit the sun wheel onto the driveshaft and secure with circlip **D**. Fit a new 'O' ring to the bearing carrier as shown at **X**.



Note: The sun gear must be fitted with the 1.5 mm (0.060 in) x 45° chamfer inboard.

12 Fit the planet carrier onto the bearing carrier, turning it slightly to engage the gear teeth and aligning the two tapped holes in the planet gear carrier with their mating holes in the bearing carrier. (The tapped holes are diametrically opposite one another.) Ensure the planet gear carrier butts fully against the bearing carrier. Fit and torque tighten screws **A** to 56 Nm (41 lbf ft, 5.7 kgf m) after applying Loctite 242 to the threads.



Note: Do not strike the centre of the planet gear carrier when fitting as this may dislodge the driveshaft thrust pad fitted at step 17.

Re-fill hubs with the correct grade oil (see **Lubricants and Capacities**, Section 1).

Removal and Replacement

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN 1-1

Removal

1 Drain oil from the hub.

2 Remove screws **1**.

3 Lever the planet gear carrier **2** off the bearing carrier **15**. Remove and discard 'O' ring **3**.

4 If the driveshaft is to be renewed, remove circlip **7** to allow the sun gear **8** to be slid off the driveshaft.

5 Withdraw the driveshaft from the axle.

Replacement

Replacement is the reverse of removal but note the following:

1 Rotate the driveshaft slightly to locate the splines with the brake and drivehead assembly.

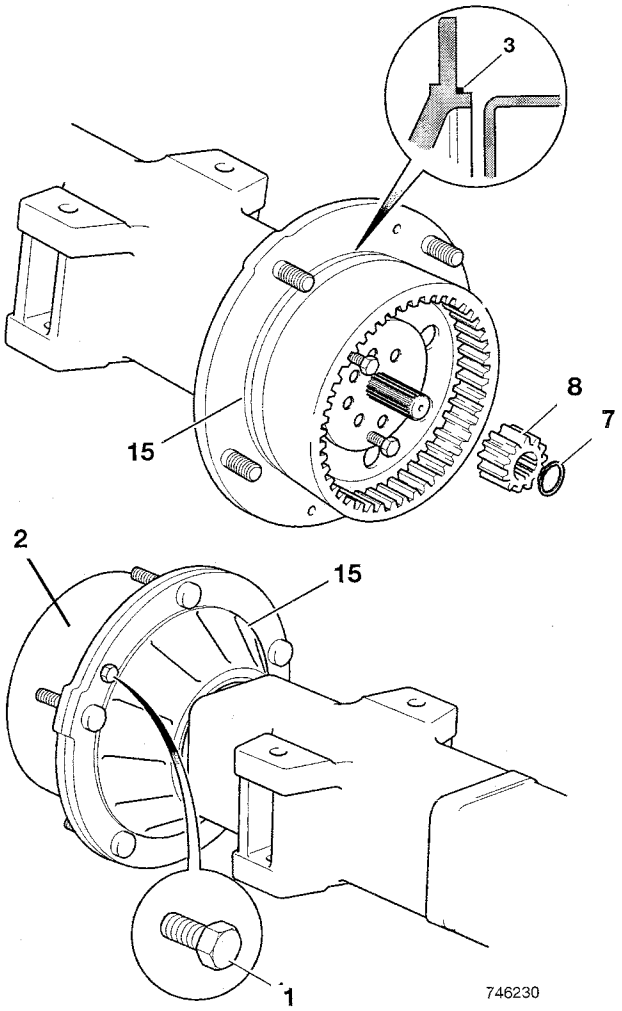
2 Fit a new 'O' ring **3**.

3 If the sun gear **8** was removed, fit with the 1.5 mm (0.060 in) x 45° chamfer inboard. Fit circlip **7**.

4 Fit the planet carrier **2** onto the bearing carrier **15**, ensuring that the two tapped holes are in line with those on the bearing carrier. Fit and torque tighten screws **1** to 56 Nm (41 lbf ft; 5.7 kgf m) after applying Loctite 242 to the threads.

Note: Do not strike the centre of the planet gear carrier when fitting as this may dislodge the driveshaft thrust pad.

5 Re-fill hubs with the correct grade oil.



Use of Wheel Hub Service Kit

Note: The Bearing Puller from the Wheel Hub Service Kit 882/01092 (see **Service Tools**, Section 1) is required throughout steps 1 to 5.

1 Assemble the puller **B**, screwing the legs **A** onto, two diametrically opposite wheel studs and placing reaction tube **C** over the driveshaft (not visible).

Note: Reaction Tube **C, MUST** be used, otherwise damage to the driveshaft and drive shaft bearings will occur.

Note: On five wheel stud axles, the modified wheels studs from the Wheel Hub Service Kit must be used. Bolt to two diametrically opposite holes provided on the bearing carrier.

2 Screw in **D** slowly until the bearing carrier together with the outer bearing cone and its cup are released from the axle. If the wheel hub starts to turn use a suitable bar **Y** to prevent further rotation.

Note: If **D** becomes to hard to turn, tap the back of the hub with a plastic hammer to help release the bearing.

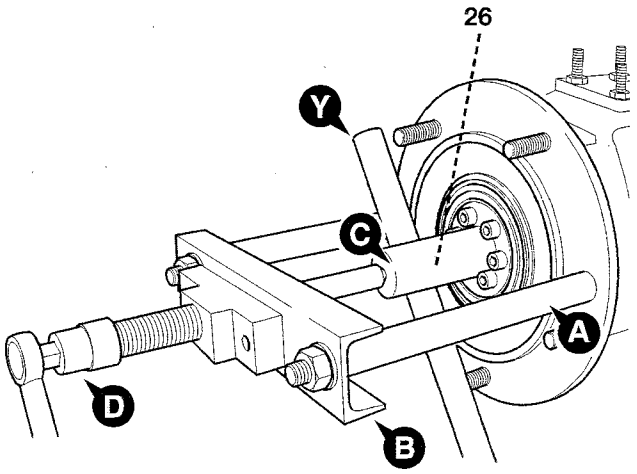
3 Remove and discard the outer part of combination seal **19** by cutting the outer seal with a sharp chisel **X**. Carefully force the inner seal fully on to the stub axle, taking **CARE** not to damage the seal seat on the stub axle.

4 Assemble the puller **B**, with the inner bearing plate **E** clamped around the inner bearing **18**, attach the puller rods **F** and reaction tube **C** over the driveshaft **26**.

Note: Reaction tube **C, MUST** be used, otherwise damage to the driveshaft and driveshaft bearings will occur.

5 Slowly screw in **D** until the bearing **18** is released. Remove and discard the inner section of seal **19**.

Note: Do not attempt to remove the dirt shield (if fitted).



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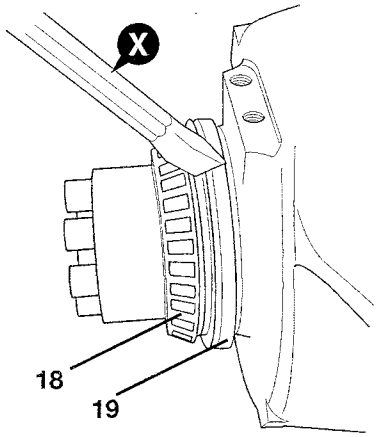

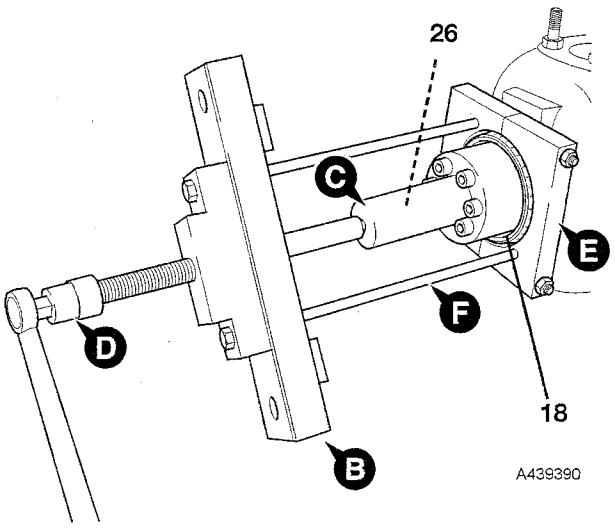

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Use of Wheel Hub Service Kit (cont'd)

Note: The bearing press from the wheel hub service Kit 882/1092 (see **Service Tools**, Section 1) is required throughout steps 1 to 10.

1 Attach the bearing centre puller **H** to the centre of the hub **23** using the existing 'Verbus Ripp' bolts **11**.

Note: When refitting the annulus carrier, NEW 'Verbus Ripp' bolts must be used.

2 Install outer bearing race from bearing **17** into bearing carrier **12**.

3 Install the inner bearing **18** into the bearing carrier **12.** Fit a new combination oil seal **19** as follows:
Do not lubricate before fitting.
Use seal dolly **M** (892/00891) to fit the seal. Be sure to use the correct side of the dolly (the dolly is stamped A and B) as follows:
Axles with steel dirt shield **22**, use side **A** as shown at **X**.
Axles with no dirt shield **22**, use side **B** as shown at **Y**.
Fit the seal over the dolly and then use a soft faced hammer to drive the seal squarely into the carrier until the dolly flange is up against the carrier.

4 Lightly oil the inside diameter of the seal **19** and the inner wheel bearing **18**. Position the bearing carrier (complete with inner bearing) onto the stub over the centre puller **H**.

5 Slide the bearing fitting tube **K** over the centre bearing puller **H** (the wide opening towards the bearing). Make sure that the bearing and carrier are square to the shaft.

6 Attach the puller handle **J** to the bearing centre puller **H,** making sure that the thrust bearing is fitted between two thrust washers at **L**. Using the puller handle, screw in the bearing fitting tube **K** until the inner bearing **18** is pressed correctly into position.

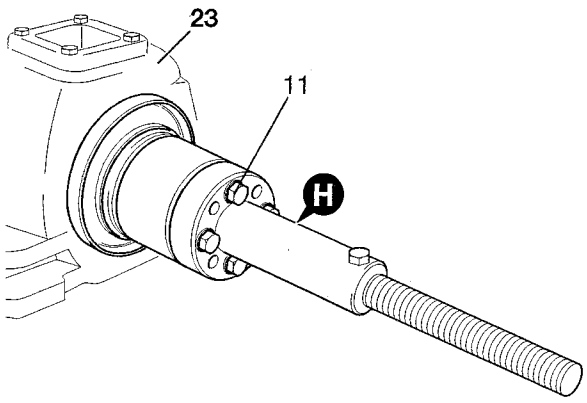
7 Remove the puller handle **J** and bearing fitting tube **K**.

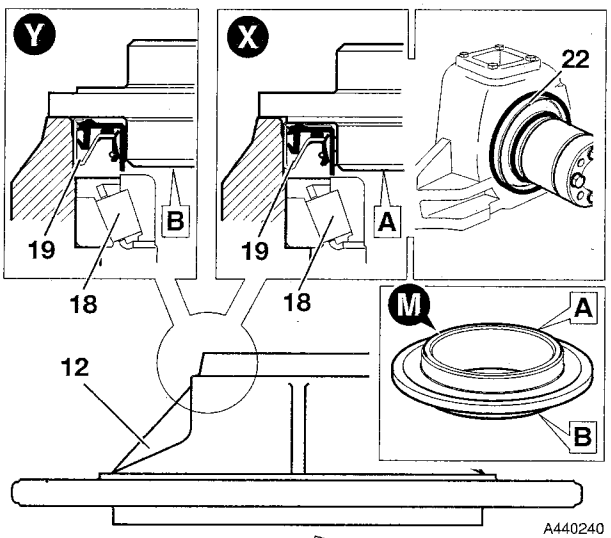
8 Install the outer bearing **17** in the bearing carrier **12**.

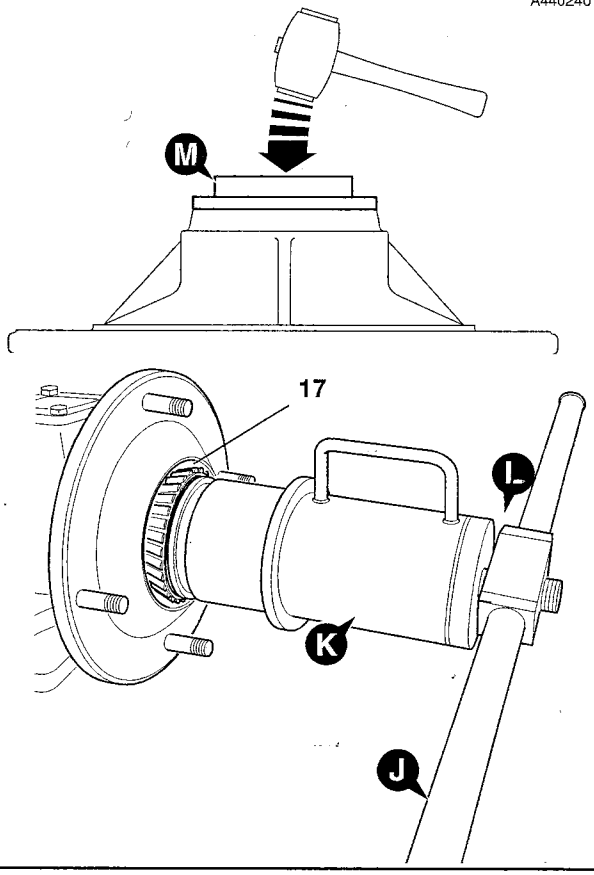
9 Assemble the puller handle **J** and bearing fitting tube **K** onto the centre puller **H**.

10 Using the puller handle **J**, screw in the bearing fitting tube **K** until the outer bearing **17** is pressed correctly into position so as to remove most of the free play.

Note: DO NOT overload the bearing **17** when pressing into position.







Drivehead - Dismantling

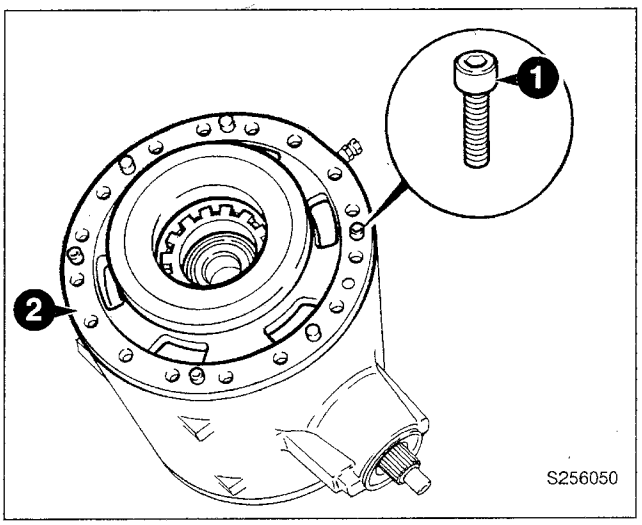
As the drivehead cannot be dismantled whilst fitted on the machine, we recommend that the complete axle is removed. See **Removal and Replacement** for axle arm removal procedure.

The crownwheel and pinion are matched and should be renewed as a pair if either one is damaged or excessively worn. The two differential case halves are also matched as are the differential side gears and planet gears, do not use unmatched halves or gears.

Note 1: Drain oil from the axle before dismantling.

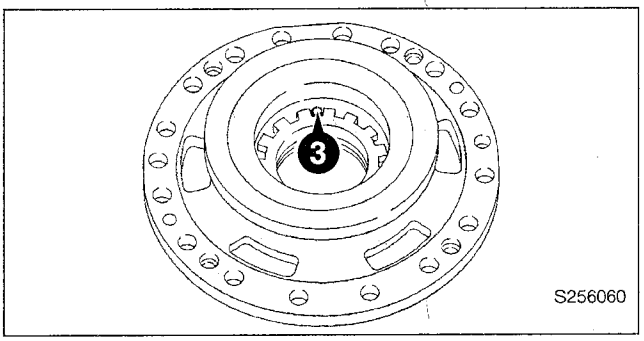
Note 2: For axles with limited slip differential, see **Limited Slip Differential**.

* **Note 3:** For axles with soft engage differential lock, see **Soft Engage Differential Lock**.



1 Position the drive head as shown, with the crownwheel at the top. (For coupling removal see '**Renewing the Pinion Oil Seal**'.) Remove capscrews.

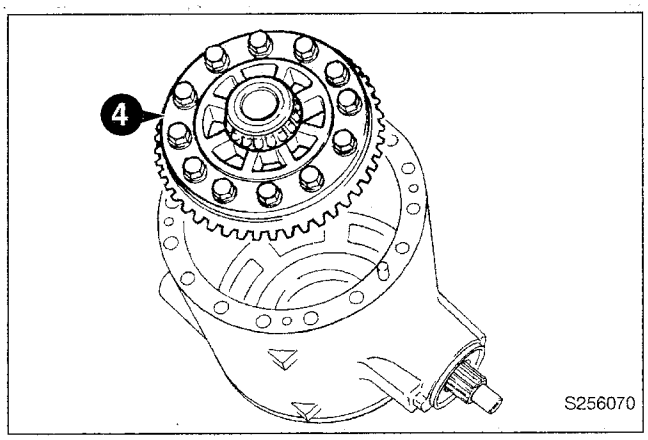
* 2 Match - mark the brake piston housing and drive head. Pull off the brake piston housing. After removing bolts 1 pull off dowels.



* 3 Drive out the differential side nut locking pin **3**, to allow readjustment on assembly. Remove the other brake piston housing only if damaged, but remove its locking pin regardless (to allow sideload adjustment on assembly).

4 Lift out the crownwheel/differential assembly.

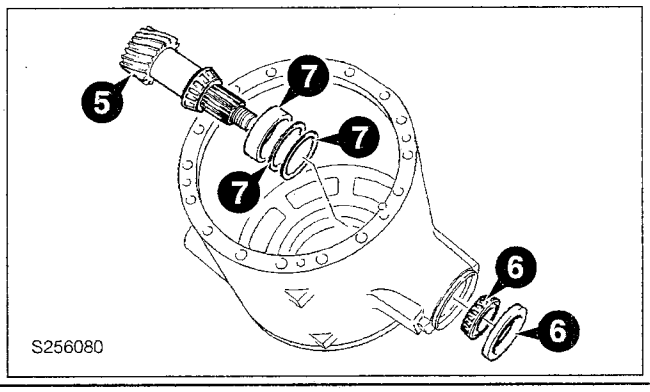
Note: If both brake piston housings are to be removed, mark the crownwheel end of the drive head casing to ensure that the assembly is returned to its original position.



5 Using a soft faced hammer, hit the pinion end shaft until the pinion is free from its front bearing, then withdraw the pinion.

6 Withdraw the pinion seal and outer bearing cone.

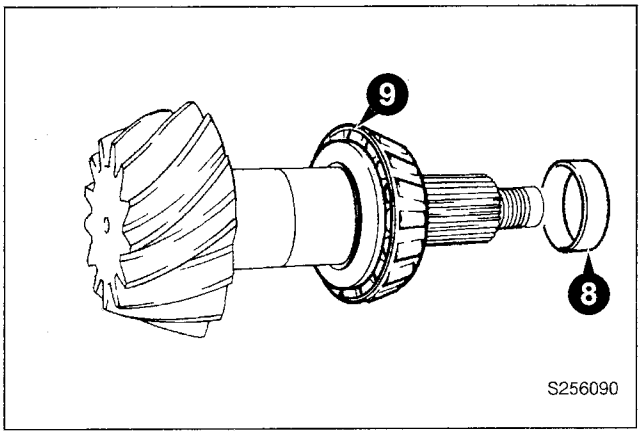
7 If necessary, drive out the pinion inner bearing cup and shims. Discard the shims. Repeat for the outer bearing cup if required. Note that there are no shims for the outer bearing cup.



Drivehead - Dismantling (cont'd)

* **8** Remove and discard the pinion collapsible spacer **8**. If fitted keep the solid spacer.

9 Pull off the bearing cone **9**.



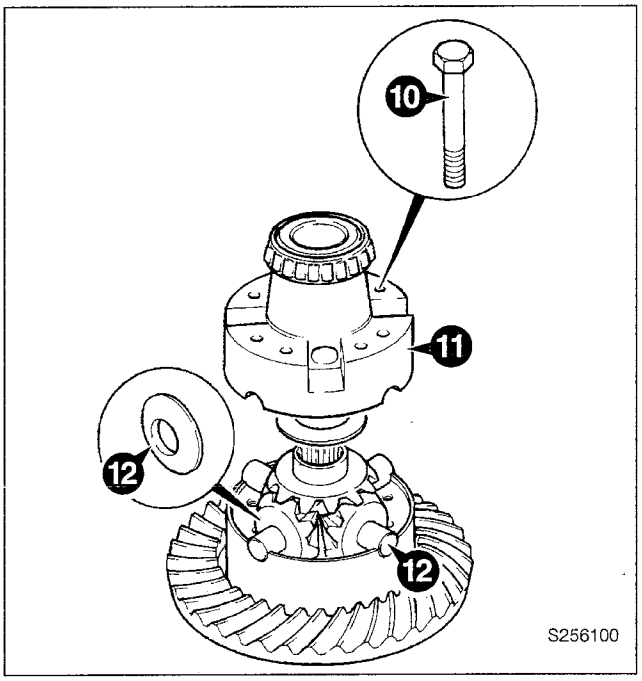
10 To dismantle the differential assembly, first remove bolts **10**.

11 Lift off the top half housing **11**.

12 Remove the differential gears and spherical washers. Pull off both differential bearing cones.

Note: If required, remove the crownwheel to differential case-half retaining bolts and remove the crownwheel.

* **Note:** If a yoke is fitted to the drivehead, then an M24 pinion (hence an M24 stake nut), if a brake disc is fitted then an M30 pinion is used (hence an M30 stake nut). Torque figures when assembling will vary as stated in **Drivehead - Assembly**.



* Drivehead - Assembly

Pinion Depth

Determine the pinion depth setting as follows:

Note: See page 4/6-6 for general guidance on crownwheel and pinion adjustment.

1 Assemble the pinion inner bearing and its cup on a flat surface.

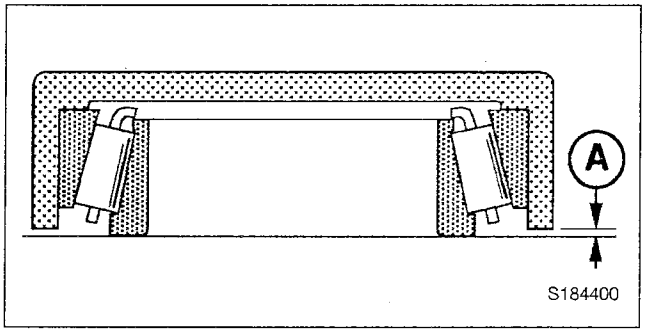
2 Place Service Tool 892/00174 over the bearing assembly. Measure gap **A**. Add tool depth (30.01 mm) to gap **A** to give bearing depth.

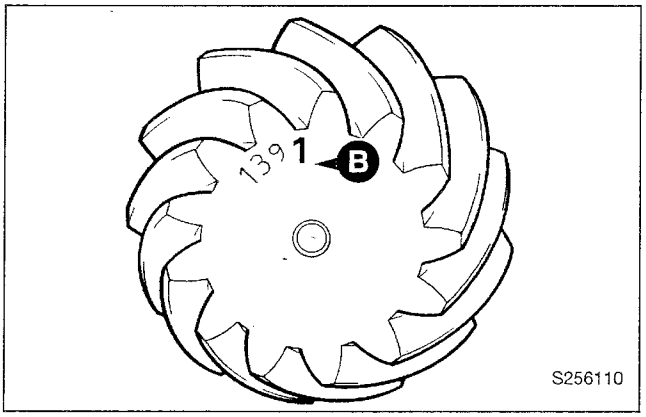
3 Note the mounting distance figure **B** etched on the pinion and the deviation figure **C** on the drive head housing. Both figures are in units of 0.01 mm.

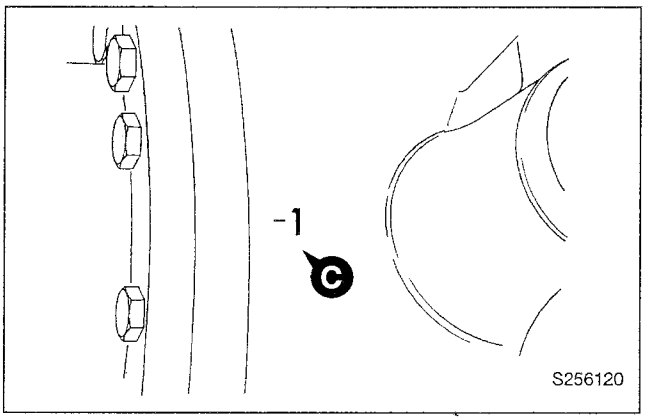
4 If dimension **B** is **positive**, **add** it to the bearing depth. If dimension **B** is **negative**, **subtract** it from the bearing depth.

5 If dimension **C** is **positive**, **subtract** it from the total. If dimension **C** is **negative**, **add** it to the total.

6 Subtract the result from the standard value of 31.19 mm to give the required shim thickness.







Example (Dimensions in mm)

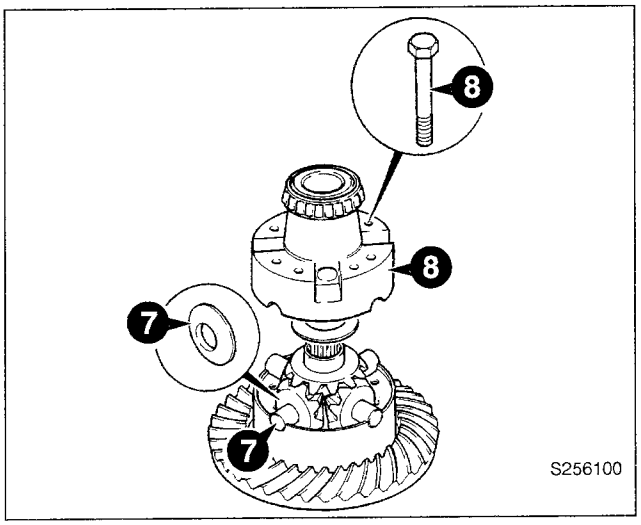
Dimension **A**	0.25
Add tool depth	+ 30.01
Total	**30.26**
Add dimension **B** if positive. (Subtract if negative.)	+ 0.01
Total	**30.27**
Add dimension **C** if negative. (Subtract if positive.)	+ 0.01
Total	**30.28**
Standard Value	31.19
Less calculated total from above	- 30.28
SHIM THICKNESS	**0.91**

Drivehead - Assembly (cont'd)

Note: The crownwheel and pinion are matched and should be renewed as a pair if either one is damaged or excessively worn. The two differential housing halves are also matched. Do not use unmatched halves. If required, fit a new crownwheel to the differential case half, torque tighten crownwheel retaining bolts to 166 Nm (122 lbf ft; 17 kgf m).

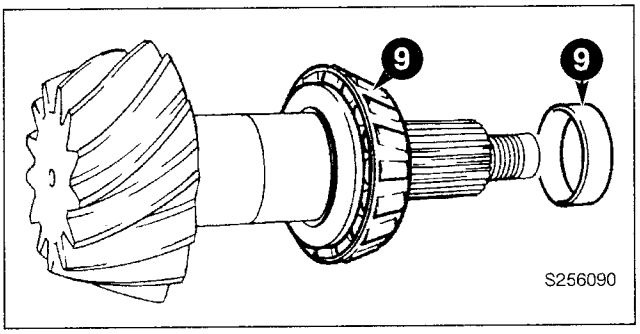
7 Assemble the differential gears and their spherical washers into the bottom half housing. Fit the differential bearing cones.

8 Position the top half housing onto the differential, aligning the match mark letters (see **Note** above). Apply Loctite 242 to the threads of bolts, then fit and torque - tighten to 56 Nm (42 lbf ft, 6 kgf m). Check the gears for free rotation.



* **9** Fit the pinion inner bearing cone and a new 14.20 mm solid spacer from the Service Kit.

* **Note:** It should be noted that the axle should be assembled using a solid spacer. However, in the absence of the special tools required or the correct size solid spacer it is acceptable to fit a collapsible spacer.

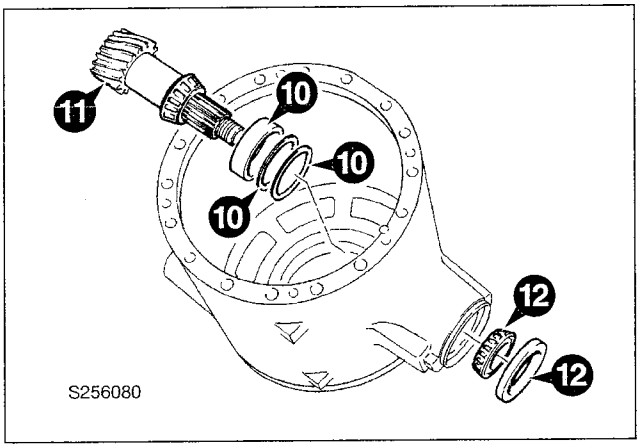


10 Fit the pinion inner bearing cup, together with the required thickness of shims to give correct pinion depth, see **Pinion Depth**, steps 1 to 6. To ensure that the cup is fitted square, use a suitable puller assembly. Do not use a hammer. Fit the outer bearing cup.

11 Insert the pinion into its bore. (Before inserting, ensure that the pinion matches the crownwheel. The code numbers etched on the pinion end face and the crownwheel perimeter should be the same.)

* **12** Fit the pinion outer bearing cone.

* **Note:** If a collapsible spacer has to be used then items 13 to 21 must be changed. See **Collapsible Spacer Assembly**, Section 4.



Drivehead - Assembly (cont'd)

* **13** Fit special tool sleeve **B** and special pinion shaft adapter **C**. Tighten adapter **C** to approximately 50 Nm (37 lbf ft; 5 kgf m), making sure the pinion is free to rotate and there is end float, this will prevent any damage to the bearing. If the pinion is not free to rotate or there is no end float at this stage check the bearing is fitted correctly. Also check the correct size spacer has been fitted.

* **14** Fit special bracket **D** to the drive-head housing using two M16 x 30 bolts. Fit special tool support pillar **E** to bracket **D** so that the fork end engages in adapter **C**. Ensure that fork **E** is centrally located on adapter **C**. If necessary, re-align bracket **D** to suit.
Fit dial test indicator (DTI) **F**. Ensure that the DTI is mounted on the drive head and not on bracket **D**.

* **15** Set torque wrench **G** to 35 Nm (25.8 lbf ft; 3.5 kgf m) and measure the end float while rotating the shaft.

* **16** To select the right size spacer, subtract the end float obtained at step 14 from the solid spacer size (14.20 mm). Also subtract 0.04 mm to allow for theoretical bearing tolerance and pre load. The result is the size of spacer to be fitted from the solid spacer setting kit. If there is no spacer of this size, fit the next nearest size spacer, refer to **Service Tools** - Section 1.

Example

Temporary spacer size	14.20
Subtract end-float	0.25
Total	13.95
Subtract tolerance & preload	0.04
Result	**13.91**

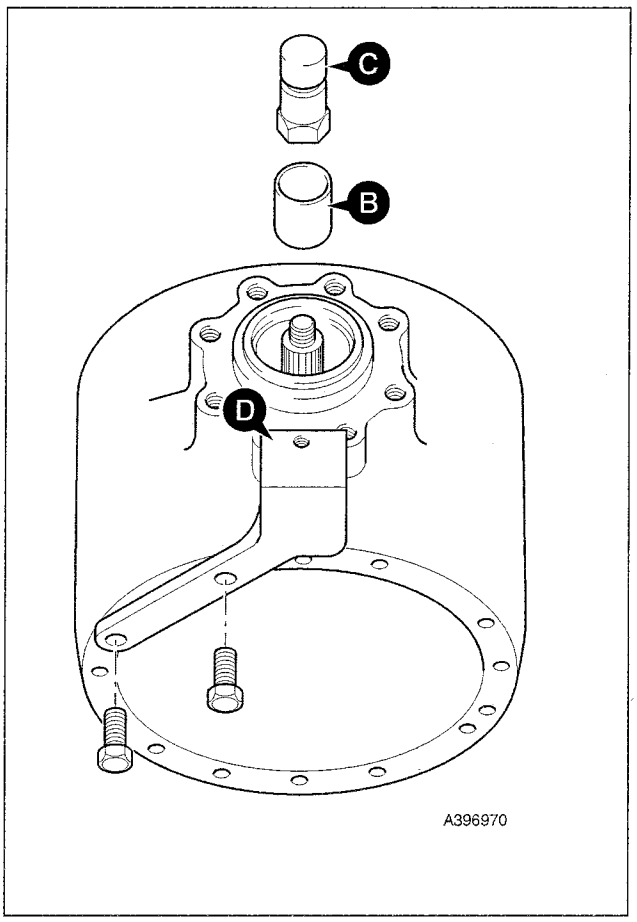
(No spacer available this size, use next nearest size spacer i.e 13.900)

* **17** Remove sleeve **B** and bearing and temporary spacer. fit correct size spacer from solid spacer setting kit, refer to **Service Tools** - Section 1. During removal take care to avoid damaging the outer bearing.

* **18** Fit sleeve **B.** Tighten adapter **C** to no more than 50 Nm to protect against bearing damage while spacer selection is verified making sure the pinion is free to rotate. Check there is no end float and pinion is free to turn smoothly by hand. Remove adapter **C** and fit nut **16** and torque tighten to 50 Nm (37 lbf ft; 5 kgf m). Then check that rolling torque is less than 2.0 Nm (1.5 lbf ft; 0.2 kgf m). If the rolling torque exceeds 2.0 Nm (1.5 lbf ft; 0.2 kgf m, check that the shaft has been assembled correctly.

* **Note:** If the pinion is not free to rotate check the correct size spacer has been fitted.

*



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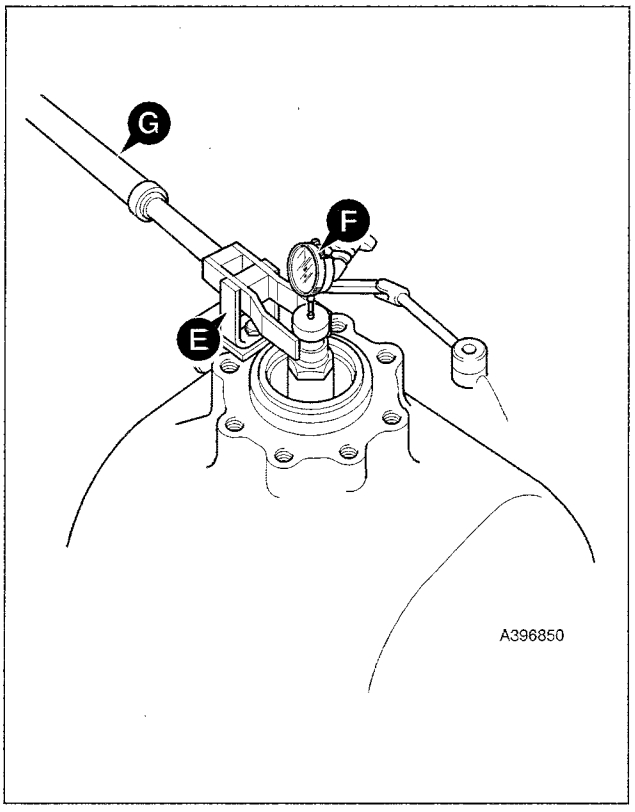

Drivehead - Assembly (cont'd)

* **19** If rolling torque measured at step 18 is too high, fit the next larger size spacer. If rolling torque is too low, fit the next smallest size spacer. If a correct spacer is not available from the range, check that drive head is assembled correctly.

* **Note:** A yoke or brake flange may be fitted.

* **20** Remove adapter **C** and sleeve **B**. Fit a new oil seal, grease between seal lips before fitting. Fit the brake calliper bracket **D** if a park brake is fitted to this axle. Fit a Verbus Ripp bolt **E** and torque tighten to 166 Nm (37.32 lbf ft, 16.9 kgf m). Fit the brake disc/coupling and a NEW stake nut **16**.

* **21** Progressively torque tighten the stake nut, occasionally rotating coupling yoke, up to 250 Nm (184 lbf ft; 25.5 kgf m). Providing the correct size spacer has been selected the rolling torque should be between 2.3 and 3.4 Nm(1.7 and 2.5 lbf ft; 0.23 and 0.35 kgf m) including seal drag.

* **Note:** The nut tightening torque can be increased to a maximum of 300 Nm provided that the pinion rolling torque does not exceed the maximum of 3.4 Nm (2.5 lbf ft; 0.35 kgf m).

* **22** Finally stake the nut **16** into the slot.

Note: Step 21 uses an M24 stake nut (for a yoke), for a brake disc type. Item 16 would be M30. Torque tighten to 370 Nm (273. lbf ft; 37 kgf m).

* **23** If both brake piston housings were removed, fit the one at the opposite end to the crownwheel, using the procedure in Step 24. Then install the crownwheel /differential assembly into the drive head.

* **24** Apply Loctite 574 to the drive head mating face, then fit the brake piston housing. Ensure that the match - marks made during dismantling are aligned. Fit capscrews **14**. Torque - tighten to 56 Nm (42 lbf ft, 5.7 kgf m). (Applies to both piston housings.)

* **25** Adjust differential side nuts **17** to give a bearing preload of 1.13-2.26 Nm (0.8-1.6 lbf ft; 0.1-0.2 kgf m). (Measure the preload by taking another rolling torque reading and subtracting the torque figure measured at step 21. The difference is the bearing preload.)

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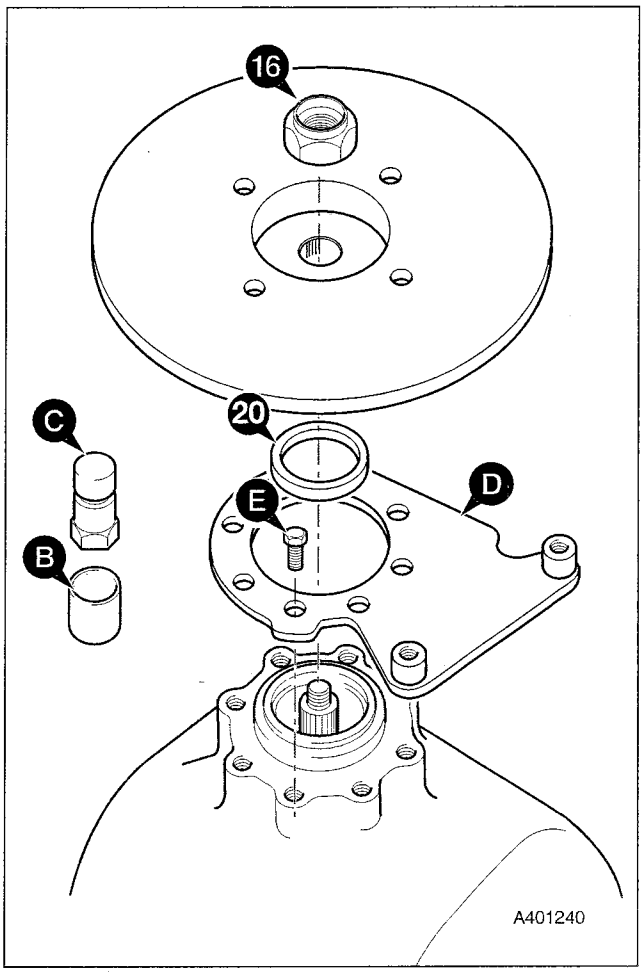

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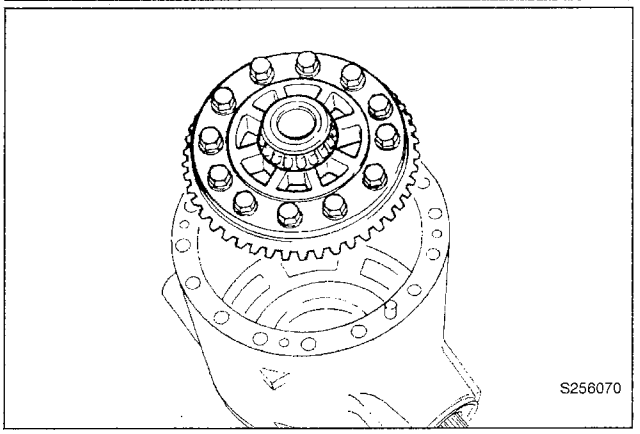

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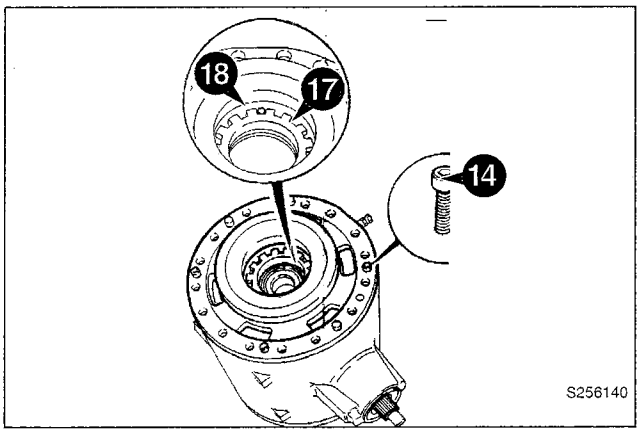
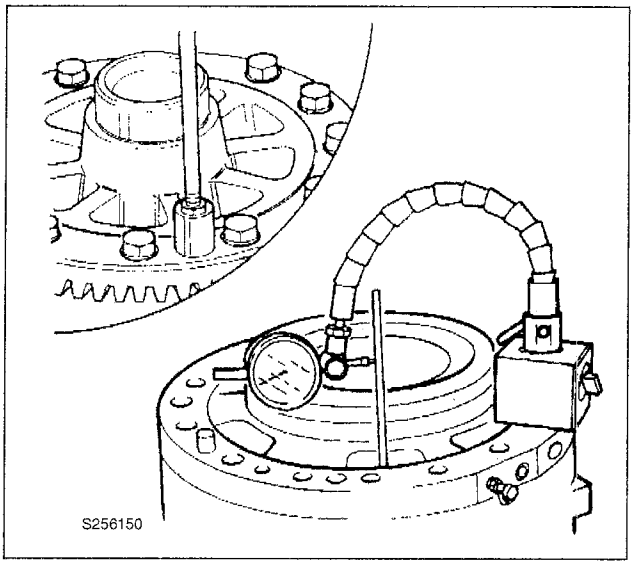


Drivehead - Assembly (cont'd)

26 Measure the crownwheel backlash, which should be 0.17-0.28 mm (0.006-0.010 in). Adjust the differential side nuts by equal amounts when altering backlash. When backlash and preload are both correct, fit the side nut locking pins, see step 25.



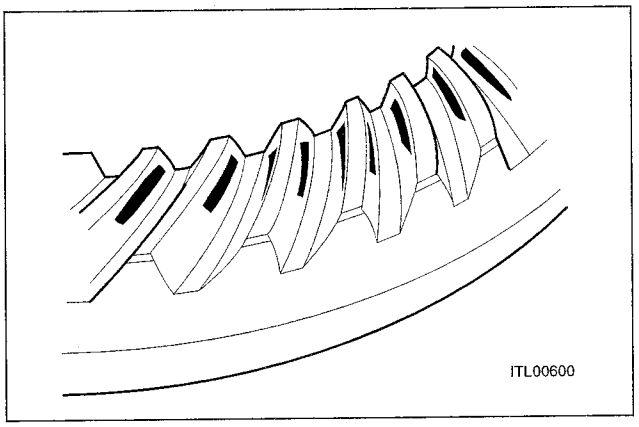
Drivehead - Assembly (cont'd)

Crownwheel and Pinion Adjustment

Meshing of the gears should be checked by marking three of the pinion teeth with engineers marking compound and rotating the pinion.

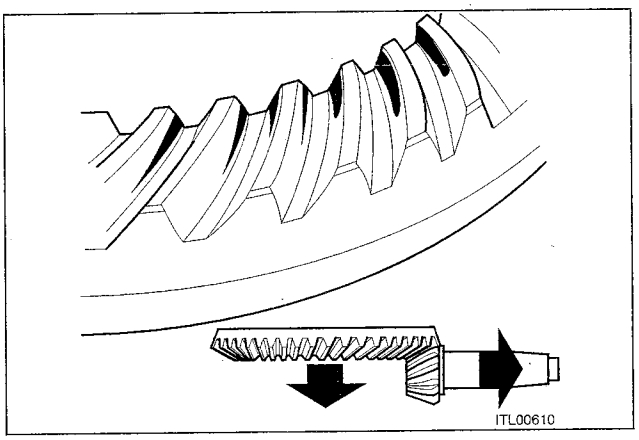
The marking will then be transferred to the crown wheel teeth.

Correct tooth marking.



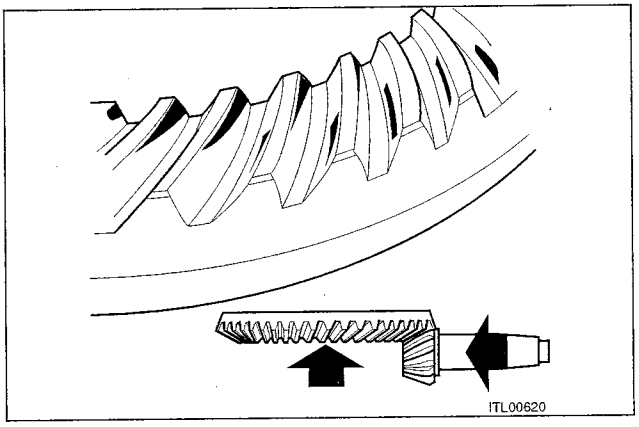
Pinion too deeply in mesh.

Decrease the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel towards the pinion to correct the backlash.



Pinion too far out of mesh.

Increase the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel away from the pinion to correct the backlash.



Collapsible Spacer Assembly

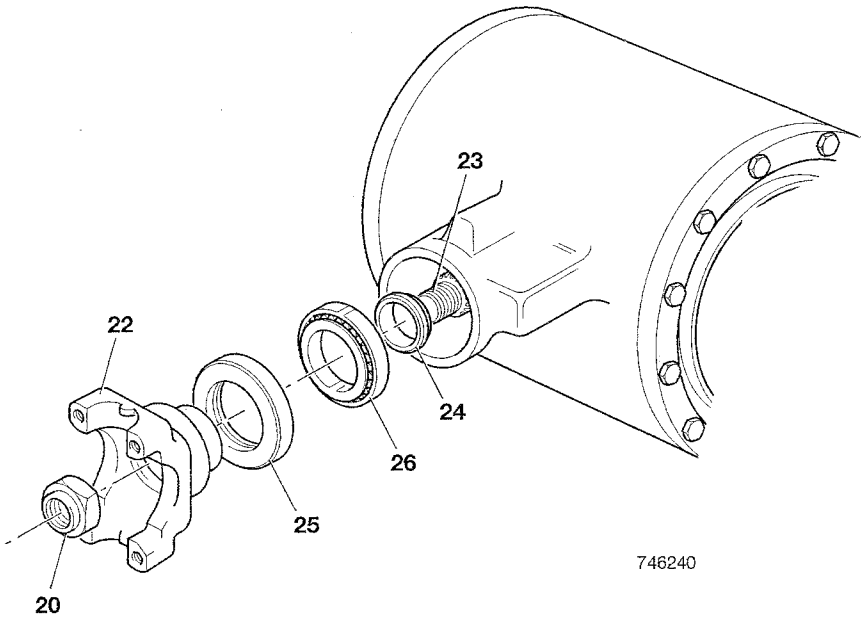
When assembling the axle, if the special tools listed in the **Service Tools** - Section 1 or if the correct size solid spacer is not available it is acceptable to fit a collapsible spacer using the procedure below. The illustration shows a typical axle, note that rear axle brake disc, or the yoke **22** shown.

1 Fit NEW collapsible spacer **24**, after smearing with Mobil HP222 fit outer bearing **26** followed by a new oil seal **25**. Grease between seal lips before fitting. Assemble yoke **22** or brake disc and NEW stake nut **20** with integral washer.

2 Tighten stake nut to achieve a rolling torque of 1.5 to 2.8 Nm (1.1 to 21. lbf ft), inclusive of seal drag.

Note: If this figure is accidentally exceeded the output shaft must be dismantled and the collapsible spacer **24** renewed.

3 Finally stake nut into slot.



Limited Slip Differential (optional)

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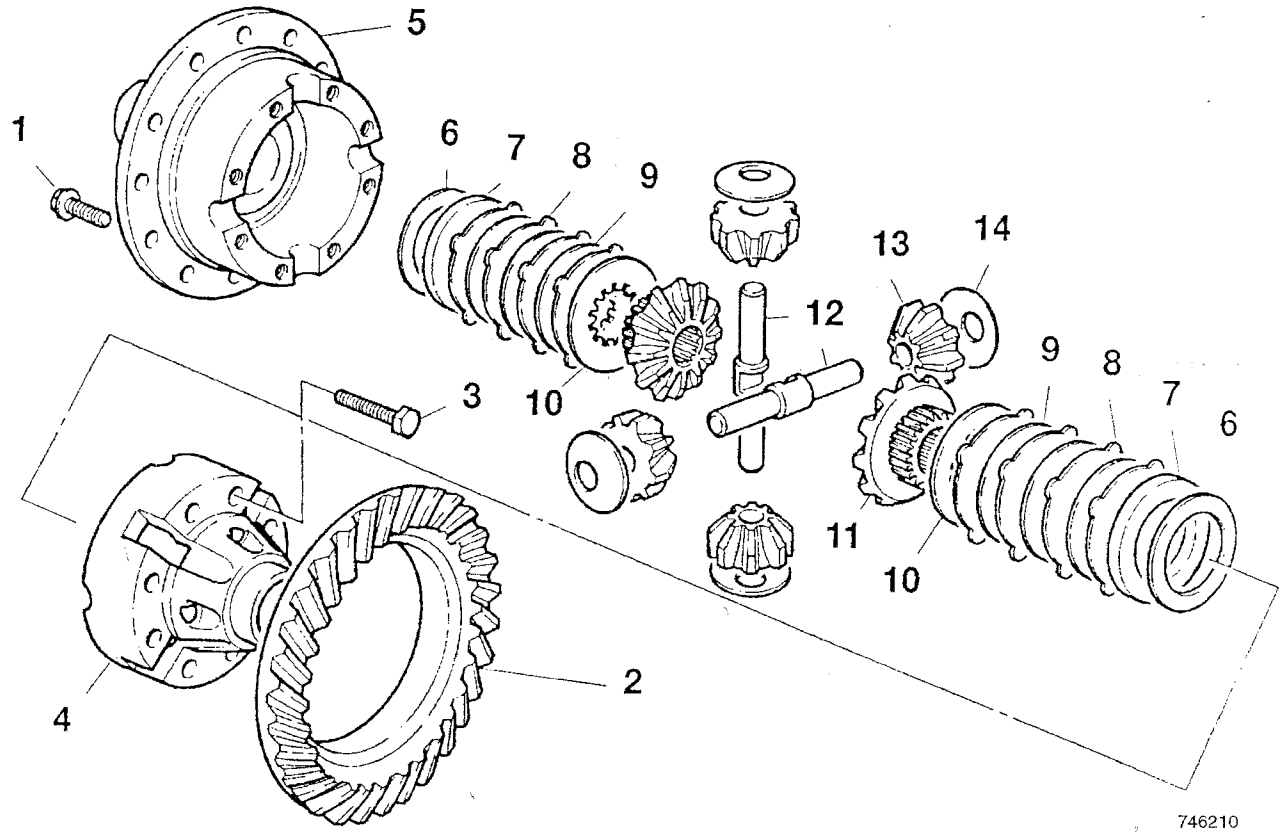
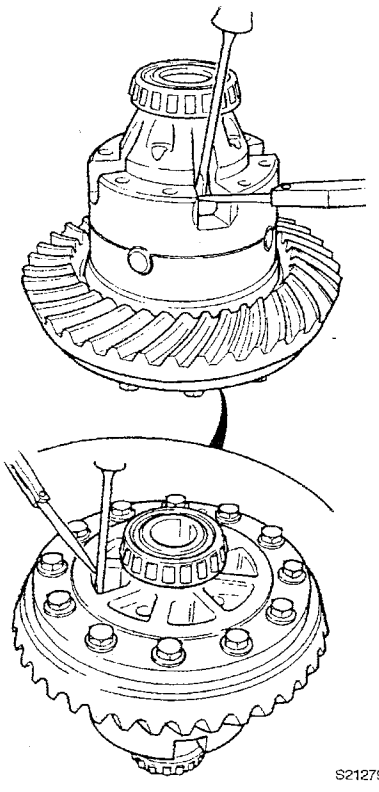
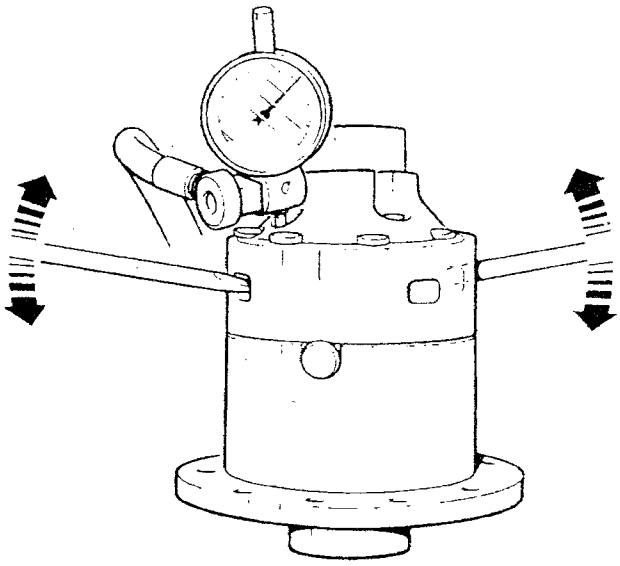






Limited Slip Differential (optional) (cont'd)

Note: The number of friction and counter plates shown in the illustration is typical only. The actual number of plates is specified by the manufacturer and **must not** be altered without approval. Refer to parts information.

The numerical sequence shown on the illustration is intended as a guide to dismantling.

Dismantling

Mark the two differential halves before dismantling, for subsequent assembly.

Note the relative positions of the friction and counter plates before dismantling, they must be fitted in the same positions.

If worn, the friction and counter plates must be renewed as a complete set.

Assembly

* 1 Assemble trunnion pins **12**, side gears **11**, with pressure plates **10**, counter plates **8**, friction plates **9**, pinion gears **13** and thrust washers **14** into 'crownwheel' half of the differential assembly **5**.

Note: Do not fit the shims **6** at this point.

2 Align the two halves of the differential assembly with the marks made during dismantling. Assemble using bolts **3**.

Determine shim value by either a dial test indicator or feeler gauges, refer to the relevant illustration.

3 With two screwdrivers or suitable levers, gently apply pressure to side gear **11** away from the trunnion pins **12** as shown. Measure and note the end-float of the side gear.

4 Turn the differential assembly over and repeat step 3 for the second side gear.

5 Dismantle the differential assembly. Add shims **6** to give end-float between 0.1 and 0.2 mm (0.004 and 0.008 in).

Note: Shimming must be carried out whenever the differential is dismantled, however the end float 0.1 and 0.2 mm (0.004 and 0.008 in) can be exceeded on previously assembled differential as this is only an initial setting figure.

* 6 Repeat steps 2, 3 and 4. If the end float is correct, tighten bolts **3** to 56 Nm (41 lbf ft; 5.7 kgf m). The differential gears should rotate with a little resistance.

* 7 Fit crownwheel **2** using new Verbus Ripp bolts **1** tightened to 166 Nm (122 lbf ft; 17 kgf m).

Friction Plate Wear Limits

Measure and note the thickness of the friction plate, the result must not be less than 1.25 mm (0.049 in).

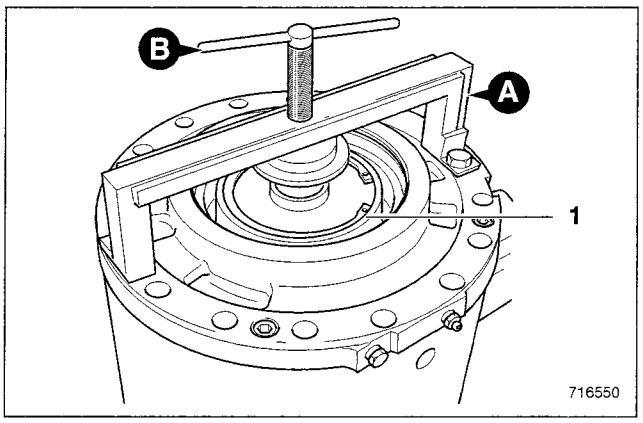
Check the condition of the friction material, which should be even over both surfaces.

If in doubt, discard the set (friction and counter plates).

Dismantling

As the drivehead cannot be dismantled whilst fitted on the machine, we recommend that the complete assembly is removed (see **PD70 Axle - Central Drivehead**).

Note: The crownwheel and pinion are matched and should be renewed as a pair if either one is damaged or excessively worn.



1 Drain the oil from the drivehead before dismantling (see **Drivehead - Change the Oil**, Section 3).

2 Remove the axle arm assemblies and brake callipers if fitted.

3 Position the drivehead as shown, with the differential lock housing at the top.

4 Mount the spring compression tool **A** (see **Service Tools**, Section 1) onto the drivehead as shown. Turn the screw handle **B** to push down on the end of the piston sufficiently to release the spring tension acting on the large internal circlip **1**. Carefully remove the internal circlip **1**, then remove the compression tool.

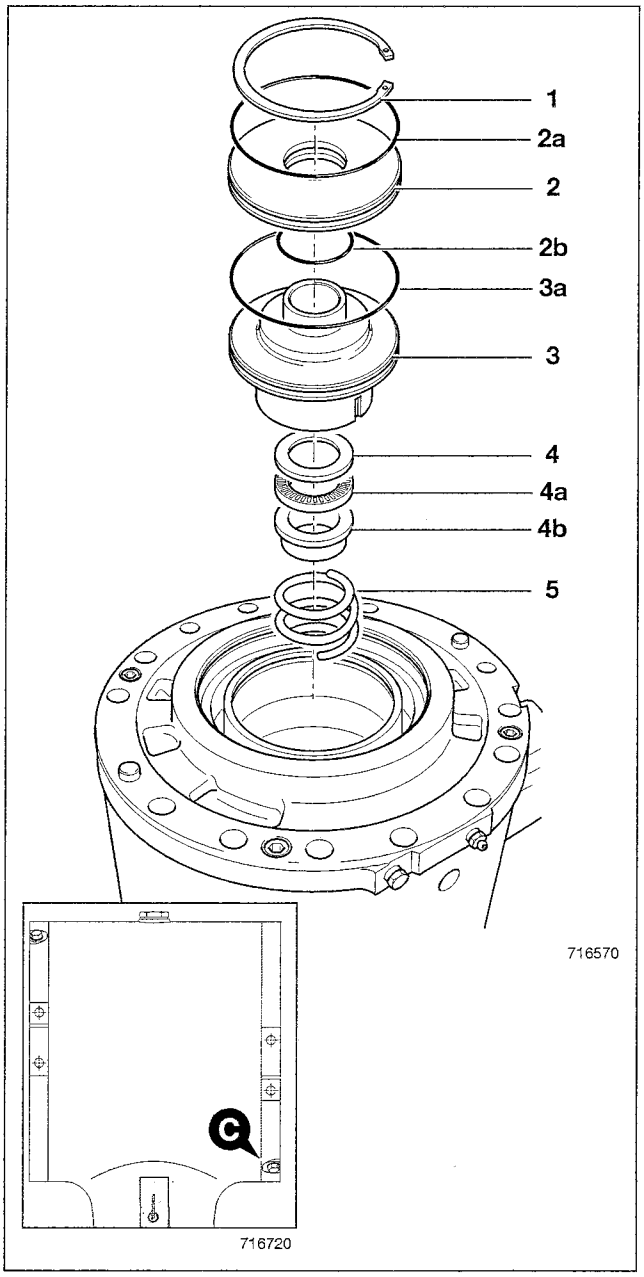
5 Apply compressed air through the differential lock oil feed port **C** to force out the piston back plate **2**. Remove and discard 'O' rings **2a** and **2b**.

⚠ WARNING

Compressed Air

When using compressed air, wear safety glasses and gloves. DO NOT direct compressed air at your skin.

8-3-4-2



6 Withdraw the piston **3**. Remove and discard 'O' ring **3a**.

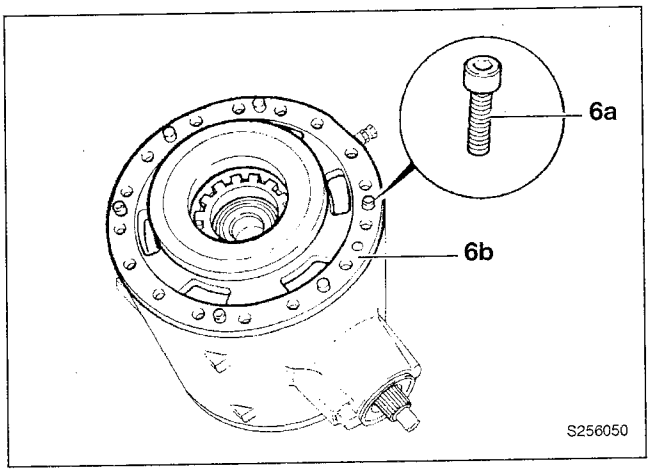
7 Remove the thrust washer **4**, axial roller bearing **4a** and thrust sleeve **4b**.

8 Withdraw the compression spring **5**.

Dismantling (cont'd)

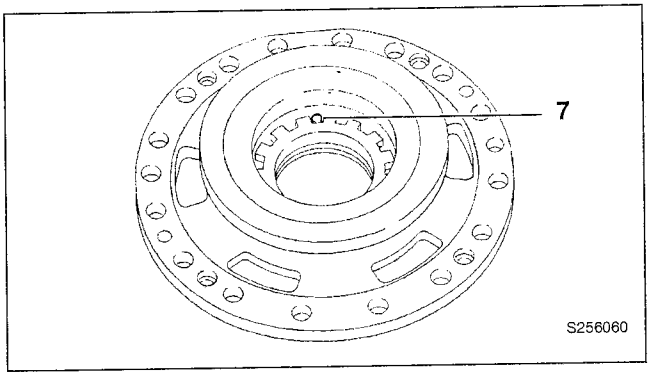
9 Turn the drivehead over so that the crownwheel end is at the top as shown.

10 Undo the four capscrews **6a** and pull off the brake piston housing **6b**. Match mark the brake piston housing and drivehead to ensure the assembly is returned to its original position.



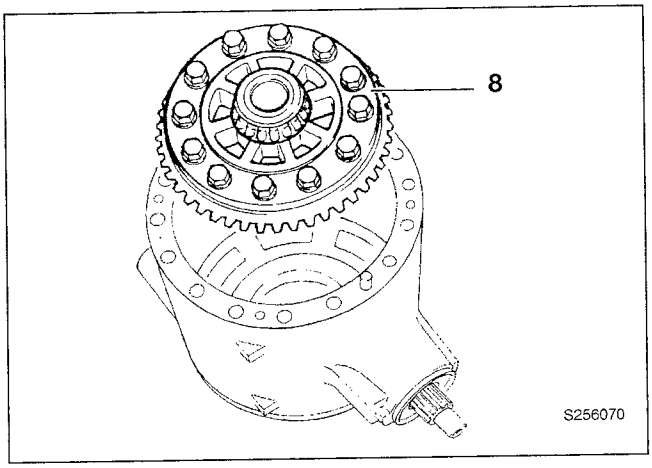
11 Drive out the differential side nut locking pin **7**, to allow readjustment on assembly. Remove the other brake piston housing only if damaged and is required to be replaced, but remove its locking pin regardless to allow for sideload adjustment on assembly.

Note: The locking pin in the other brake piston housing is driven out using an extension rod through a small access hole provided in the drivehead (see **Assembling**, step 21).



12 Lift out the crownwheel/differential assembly **8.**

Note: If both brake piston housings are to be removed, match mark the crownwheel end of the drivehead casing to ensure that the assembly is returned to its original position.

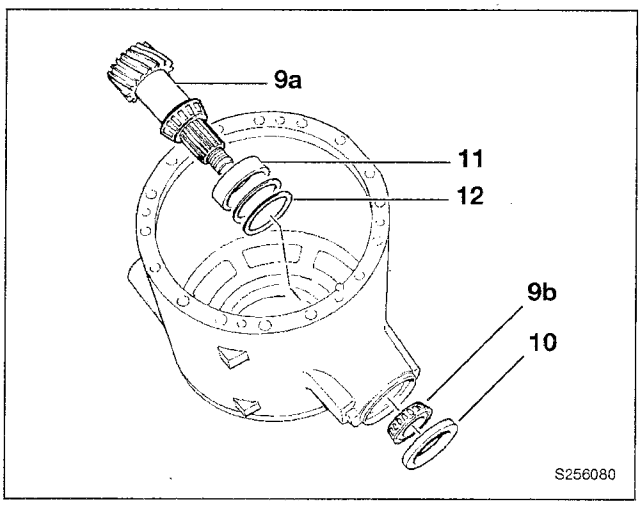


Dismantling (cont'd)

13 Remove the stake nut and yoke etc, (see page 4/4-1 - Renewing the Pinion Oil Seal). Using a soft faced hammer, tap the end of the pinion shaft **9a** until the pinion is free from the outer bearing **9b**, then withdraw the pinion.

14 Withdraw the pinion seal **10** and outer bearing cone **9b**.

15 If necessary, drive out the pinion inner bearing cup **11** and shims **12**. Discard the shims. Repeat for the outer bearing cup if required. Note that there are no shims for the outer bearing cup.

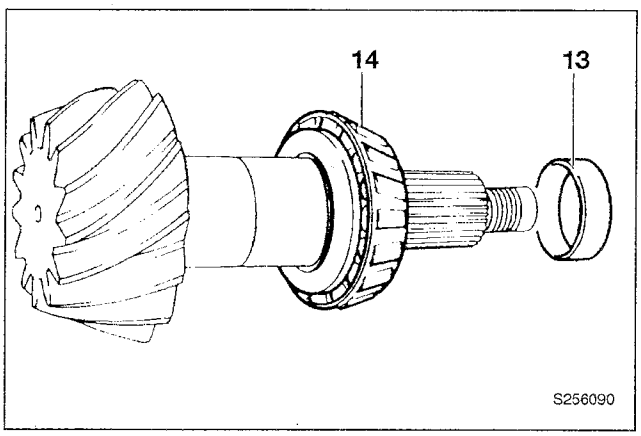


16 Remove the pinion spacer **13**.

17 Pull off the bearing cone **14**.

18 If required, dismantle the differential (see **Differential - Dismantling and Assembly**).

Note: If a yoke is fitted to the drivehead, then an M24 pinion (hence an M24 stake nut), if a brake disc is fitted then an M30 pinion is used (hence an M30 stake nut). Torque figures when assembling will vary as stated in **Drivehead - Assembly**.



Assembly

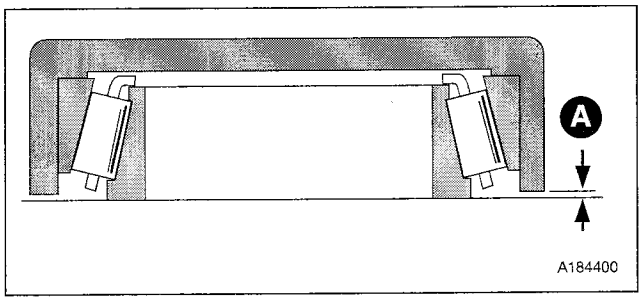
Pinion Depth

1 Determine the pinion depth setting as follows:

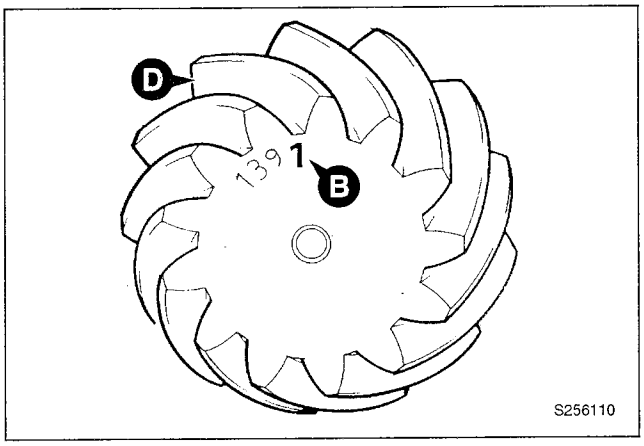
a Assemble the pinion inner bearing and its cup on a flat surface.

b Place service tool 892/00174 (see **Service Tools**, Section 1) over the bearing assembly. Measure the gap **A**. Add tool depth (30.01 mm) to gap **A** to give bearing depth.

c Note the mounting distance figure **B** etched on the pinion and the deviation figure **C** on the drivehead housing. Both figures are in units of 0.01 mm.



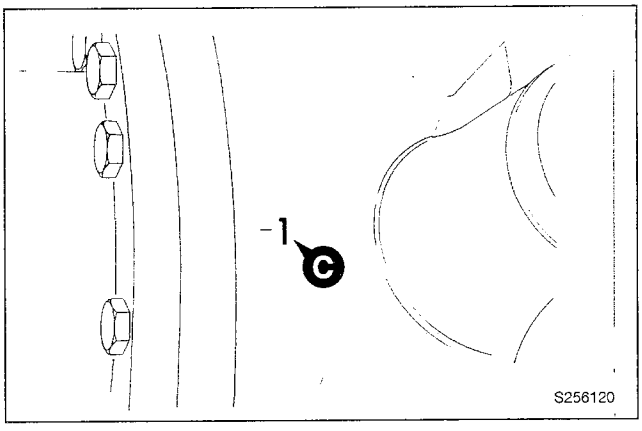
Note: The pinion depth may be etched on the gear face **B** or on the rear of a gear tooth **D**.



d If dimension **B** is **positive**, **add** it to the bearing depth. If dimension **B** is **negative**, **subtract** it from the bearing depth.

e If dimension **C** is **positive**, **subtract** it from the total. If dimension **C** is **negative**, **add** it to the total.

f Subtract the result from the standard value of 31.19 mm to give the required shim thickness.

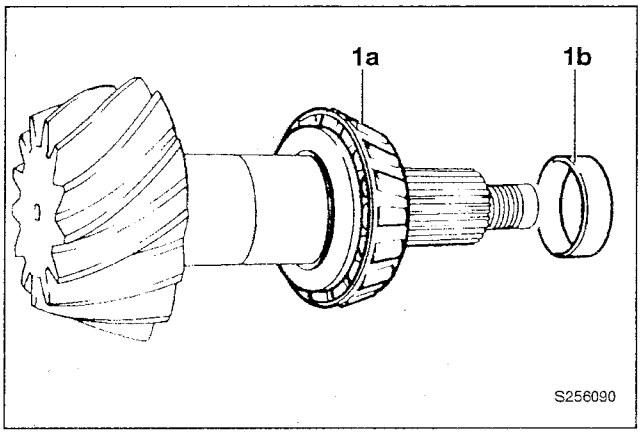


Example (Dimensions in mm)

Dimension **A**	0.25
Add tool depth	+ 30.01
Total	**30.26**
Add dimension **B** if positive. (Subtract if negative.)	+ 0.01
Total	**30.27**
Add dimension **C** if negative. (Subtract if positive.)	+ 0.01
Total	**30.28**
Standard Value	31.19
Less calculated total from above	- 30.28
SHIM THICKNESS	**0.91**

Assembly (cont'd)

2 Fit the pinion inner bearing cone **1a** and the largest available spacer **1b** (e.g. service spacer 14.20 mm) from the solid spacer setting kit (see **Service Tools**, Section 1).

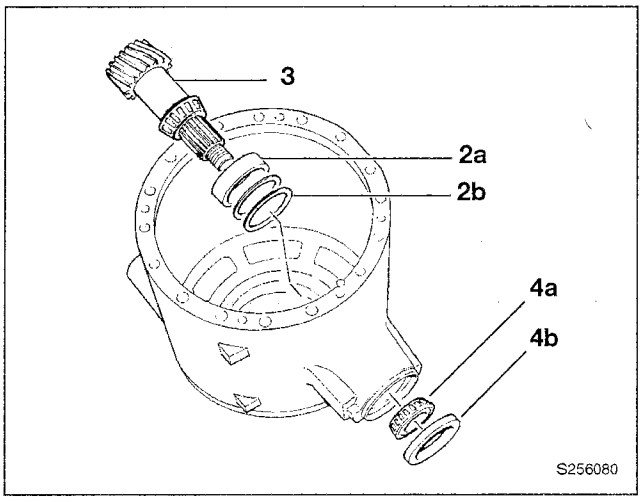


3 Fit the pinion inner bearing cup **2a**, together with the required thickness of shims **2b** to give correct pinion depth (see **Pinion Depth** steps 1a to 1f). To ensure the cup is fitted square, use a suitable puller assembly. Do not use a hammer. Fit the outer bearing cup.

4 Insert the pinion **3** into its bore.

Note: Before inserting, ensure that the pinion matches the crownwheel. The code numbers etched on the pinion end face and the crownwheel perimeter should be the same.

5 Fit the pinion outer bearing cone **4a**. Do not fit the oil seal **4b** at this stage.



Assembly (cont'd)

6 Fit special tool sleeve **B** and special pinion shaft adapter **C** from the solid spacer setting kit (see **Service Tools**, Section 1). Tighten adapter **C** to approximately 50 Nm, making sure the pinion is free to rotate and there is end float, this will prevent any damage to the bearing. If the pinion is not free to rotate or there is no end float at this stage check the bearing is fitted correctly. Also check the correct size spacer has been fitted.

7 Fit special bracket **D** from the solid spacer setting kit (see **Service Tools**, Section 1) to the drivehead housing using two M16 x 30 bolts. Fit special tool support pillar **E** to bracket **D** so that the fork end engages in adapter **C**. Ensure that fork **E** is centrally located on adapter **C**. If necessary, re-align bracket **D** to suit. Fit a dial test indicator (DTI) **F**. Ensure that the DTI is mounted on the drivehead and not on bracket **D**.

8 Set torque wrench **G** from the solid spacer setting kit (see **Service Tools**, Section 1) to 35 Nm (25.8 lbf ft) and measure the end float while rotating the shaft.

9 To select the right size spacer, subtract the end float obtained at step 8 from the temporary service spacer size (14.20 mm). Also subtract 0.04 mm to allow for theoretical bearing tolerance and preload. The result is the size of spacer to be fitted from the solid spacer setting kit. If there is no spacer of this size, fit the next nearest size spacer (see **Service Tools**, Section 1).

Example

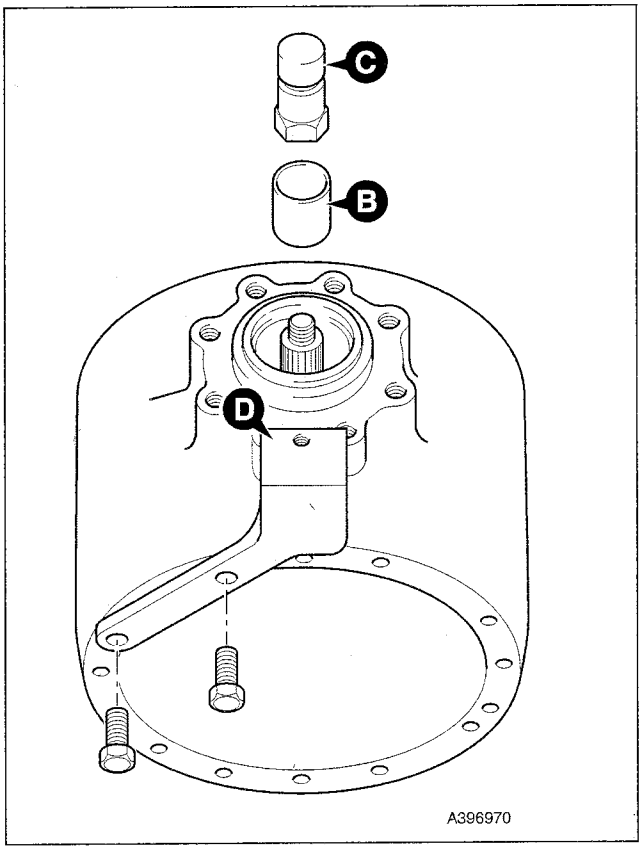
Temporary service spacer size	14.20
Subtract end-float	0.25
Total	13.95
Subtract tolerance & preload	0.04
Result	**13.91**

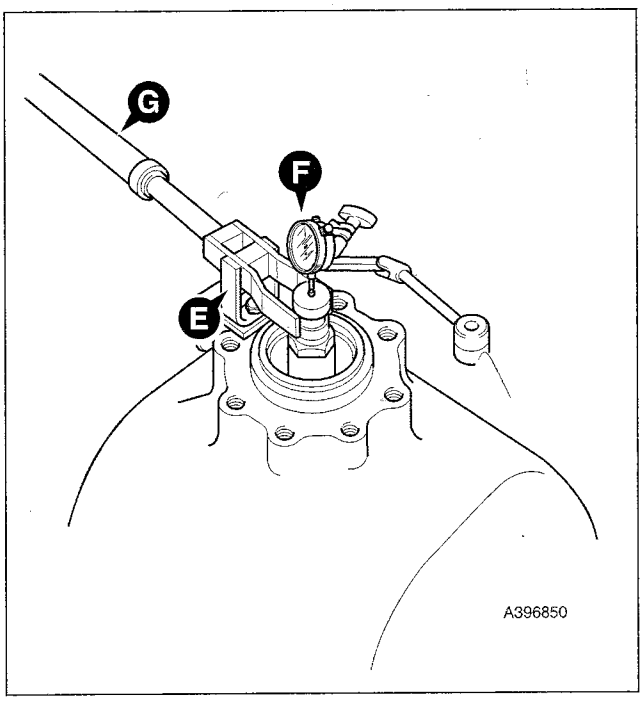
(No spacer available this size, use next nearest size spacer i.e 13.900)

10 Remove adapter **C**, sleeve **B** and the temporary service spacer, and fit the correct size spacer from solid spacer setting kit (see **Service Tools**, Section 1). During removal take care to avoid damaging the outer bearing.

11 Refit sleeve **B**. Tighten adapter **C** to no more than 50 Nm to protect against bearing damage while spacer selection is verified making sure the pinion is free to rotate. Check there is no end float and pinion is free to turn smoothly by hand.

Note: If the pinion is not free to rotate check the correct size spacer has been fitted.





Assembly (cont'd)

12 Check that rolling torque is less than 2.0 Nm. If the rolling torque exceeds 2.0 Nm, check that the pinion shaft has been assembled correctly.

Note: If rolling torque measured at step 12 is too high, fit the next larger size spacer. If rolling torque is too low, fit the next smallest size spacer. If a correct spacer is not available from the range, check that drivehead is assembled correctly.

13 Remove the adapter **C** and sleeve **B**. Fit a new oil seal **6**. Pack grease between the seal lips before fitting. Make sure the seal is pushed square to the housing.

14 Fit the coupling yoke (not shown) onto the pinion shaft.

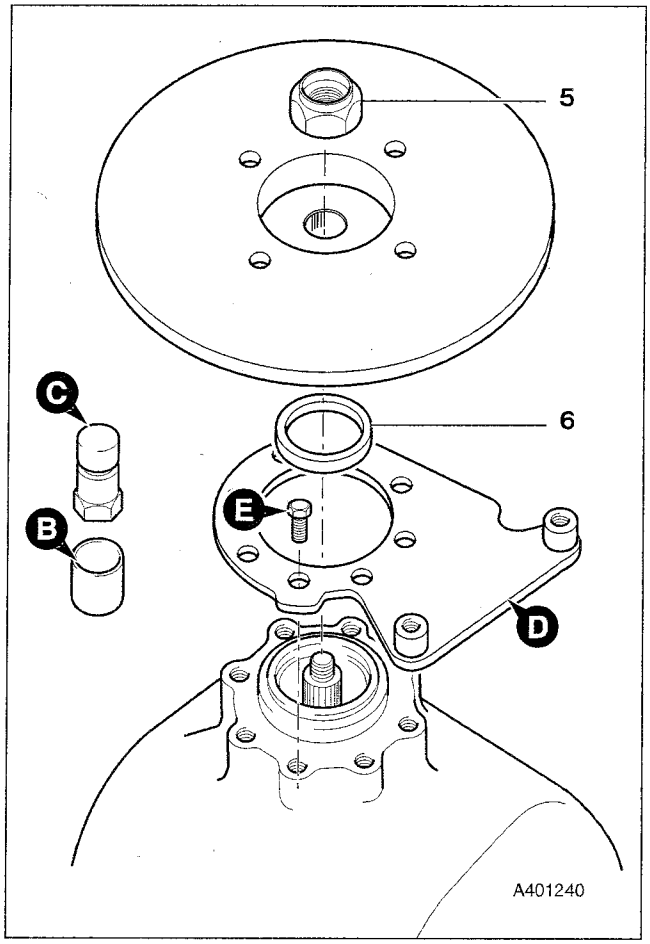
Note: For driveheads with the parking brake (option) as shown, fit the brake calliper bracket **D**. Apply Loctite 242 to the threads of bolts **E**, fit the bolts then torque tighten to 166 Nm (122 lbf ft). Fit the brake disc onto the pinion shaft.

15 Fit a new stake nut **5**. Progressively torque tighten the stake nut, occasionally rotating coupling yoke, up to 250 Nm. Providing the correct size spacer has been selected the rolling torque should be between 2.3 and 3.4 Nm (1.7 - 2.5 lbf ft) including seal drag.

Note: The nut tightening torque can be increased to a maximum of 300 Nm, provided that the pinion rolling torque does not exceed the maximum of 3.4 Nm (2.5 lbf ft).

Note: If the stake nut is an M30, then the final torque should be increased to 370 Nm (273 lbf ft).

16 Finally stake the nut **5** into the slot.



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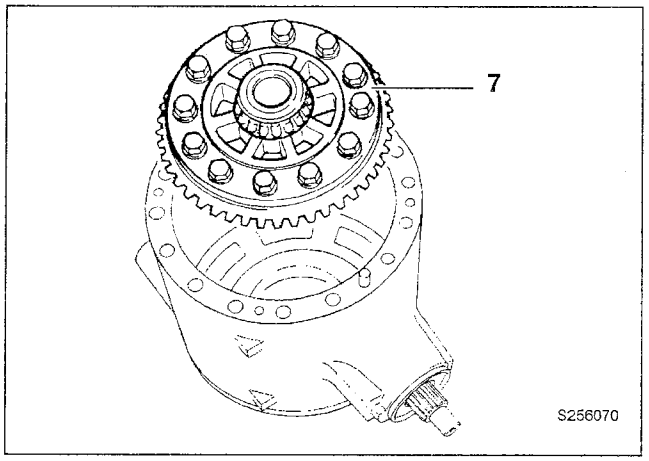
17 If both brake piston housings were removed, fit the one at the opposite end to the crownwheel, using the procedure in step 18. Then install the crownwheel /differential assembly into the drivehead **7**.

Partially start the locking pin **10** into its hole in the housing to aid final assembly (see Step 21).

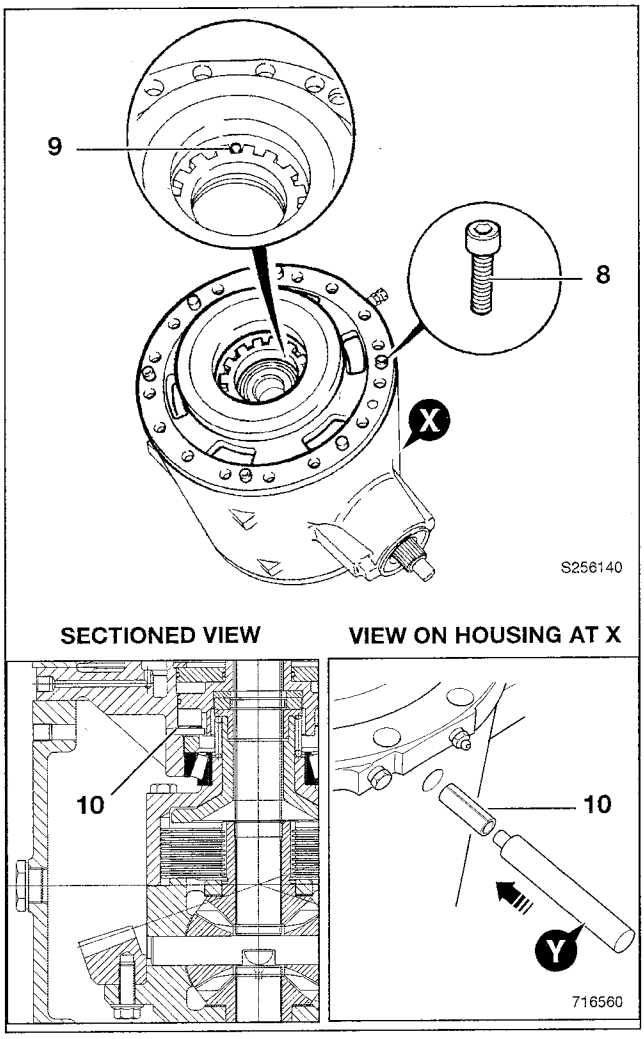


Assembly (cont'd)

18 Apply Loctite 574 Multigasket to the drivehead mating face, then fit the brake piston housing. Ensure that the match marks made during dismantling are aligned. Fit the four capscrews **8**. Torque tighten to 56 Nm (42 lbf ft, 5.7 kgf m).

19 Adjust the differential side nuts to give a bearing preload of 1.13 - 2.26 Nm (0.8 - 1.6 lbf ft; 0.1 - 0.2 kgf m).

Note: Measure the preload by taking another rolling torque reading and subtracting the torque figure measured at step 15. The difference is the bearing preload.

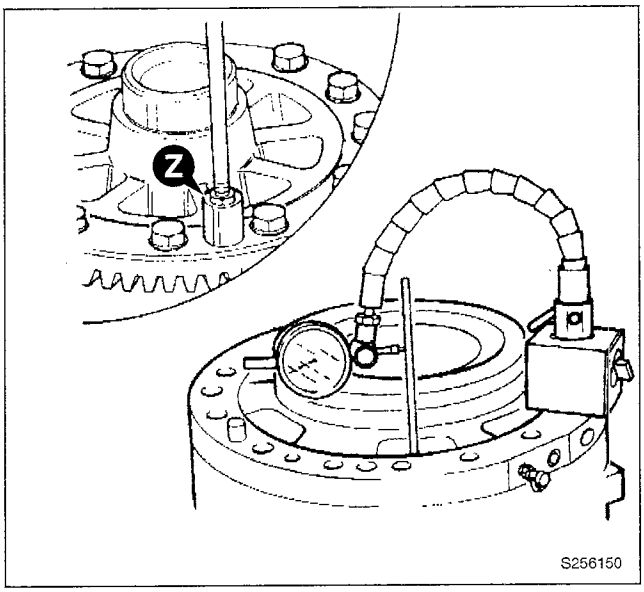


20 Measure the crownwheel backlash, which should be 0.17 - 0.28 mm (0.006 - 0.010 in). Adjust the differential side nuts by equal amounts when altering backlash.

Note: To measure the backlash, use a magnet drilled and tapped M6 to accept a length of rod threaded at one end. Position the magnet and rod **Z** between the crownwheel locking bolts as shown.

21 When backlash and bearing preload are both correct, fit the side nut locking pins **9** and **10**. Note that locking pin **10** is driven in using an extension rod **Y** (see **Service Tools**, Section 1) through a small access hole provided in the drivehead housing as shown (see Step 17).

Verify that the crownwheel and pinion are set correctly (see **Crownwheel and Pinion Meshing**).



Assembly (cont'd)

22 Fit new 'O' ring **11a** to the piston **11**. Sub-assemble piston **11**, thrust washer **12**, axial roller bearing **12a** and thrust sleeve **12b** and compression spring **13**.

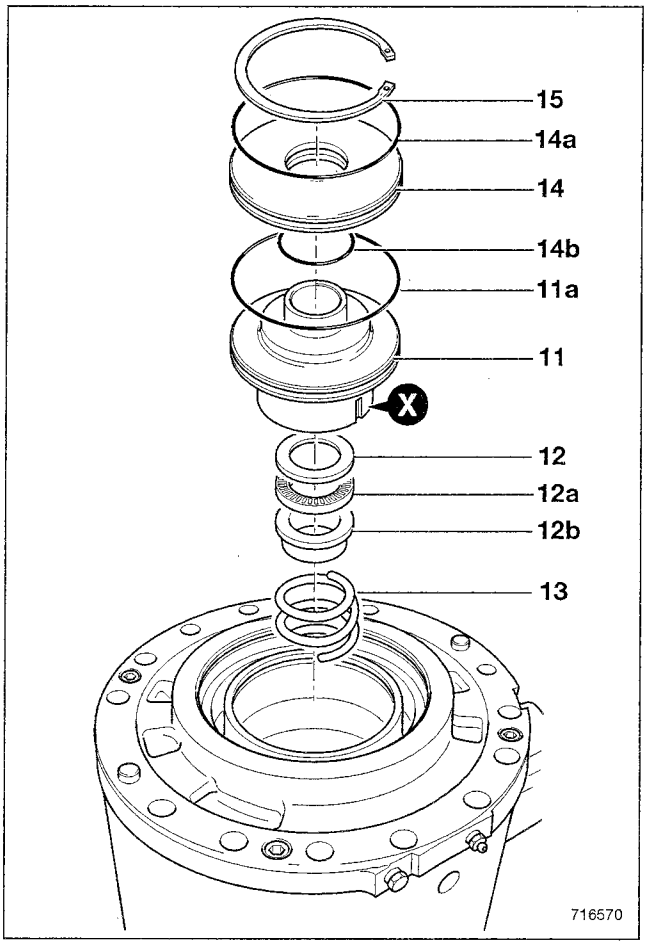
23 Grease the differential lock housing bore and fit the sub-assemble components. Make sure that the piston is inserted squarely into the bore. Ensure that the groove **X** in the piston **10** lines up with the locking pin **10** through the side nut castellation.

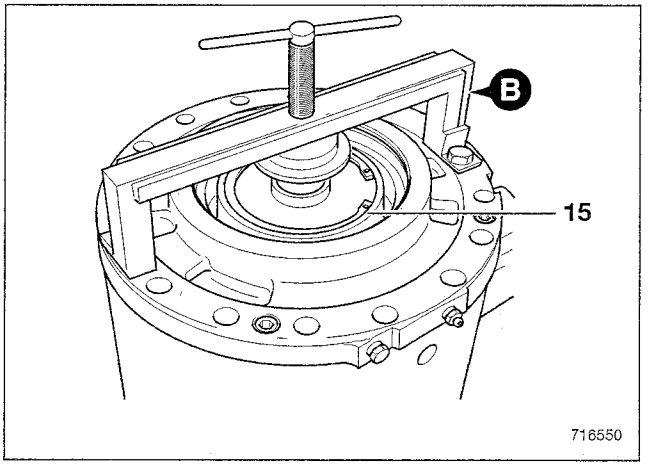
24 Fit new 'O' rings **14a** and **14b** to piston back plate **14**. Fit the back plate **14** over the piston **11**.

25 Mount the spring compression tool **B** (see **Service Tools**, Section 1) onto the drivehead and press down the differential lock piston assembly sufficiently to fit the internal circlip **15**. Remove the spring compression tool.

Note: If required, the assembly can be leak-tested by connecting a hand hydraulic pump to the hydraulic feed port (see page 4/8-10 Item 9) or with an integral park brake fitted (see page 5/5-1). Pressures should be checked against differential lock brake opening pressure.

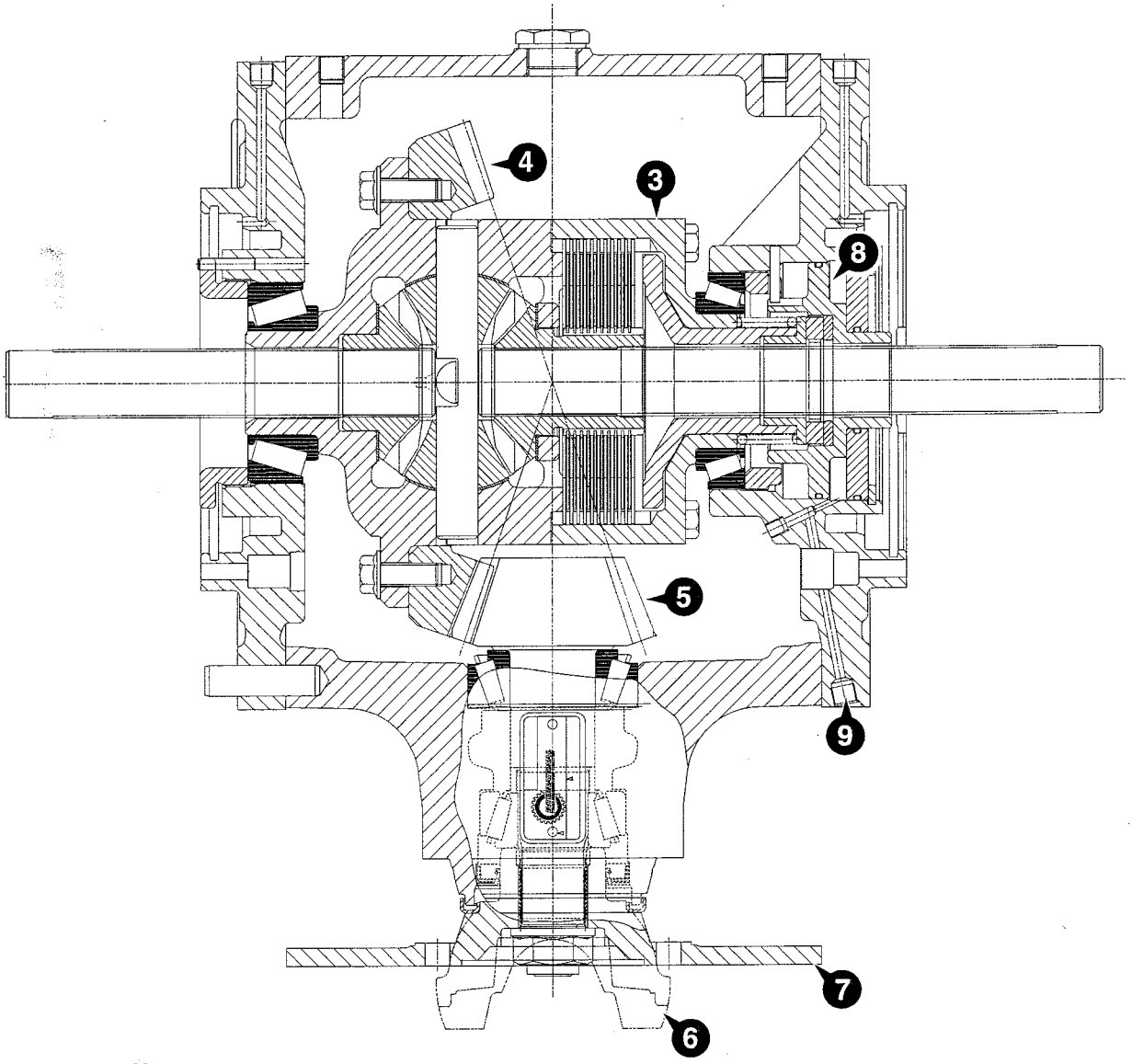
26 Fit the drivehead output shaft assemblies (see **Output Shafts - Assembly and Fitting**.





PD70 Series Modular Drivehead

(**Note:** Soft Engage Differential Lock Option Shown)



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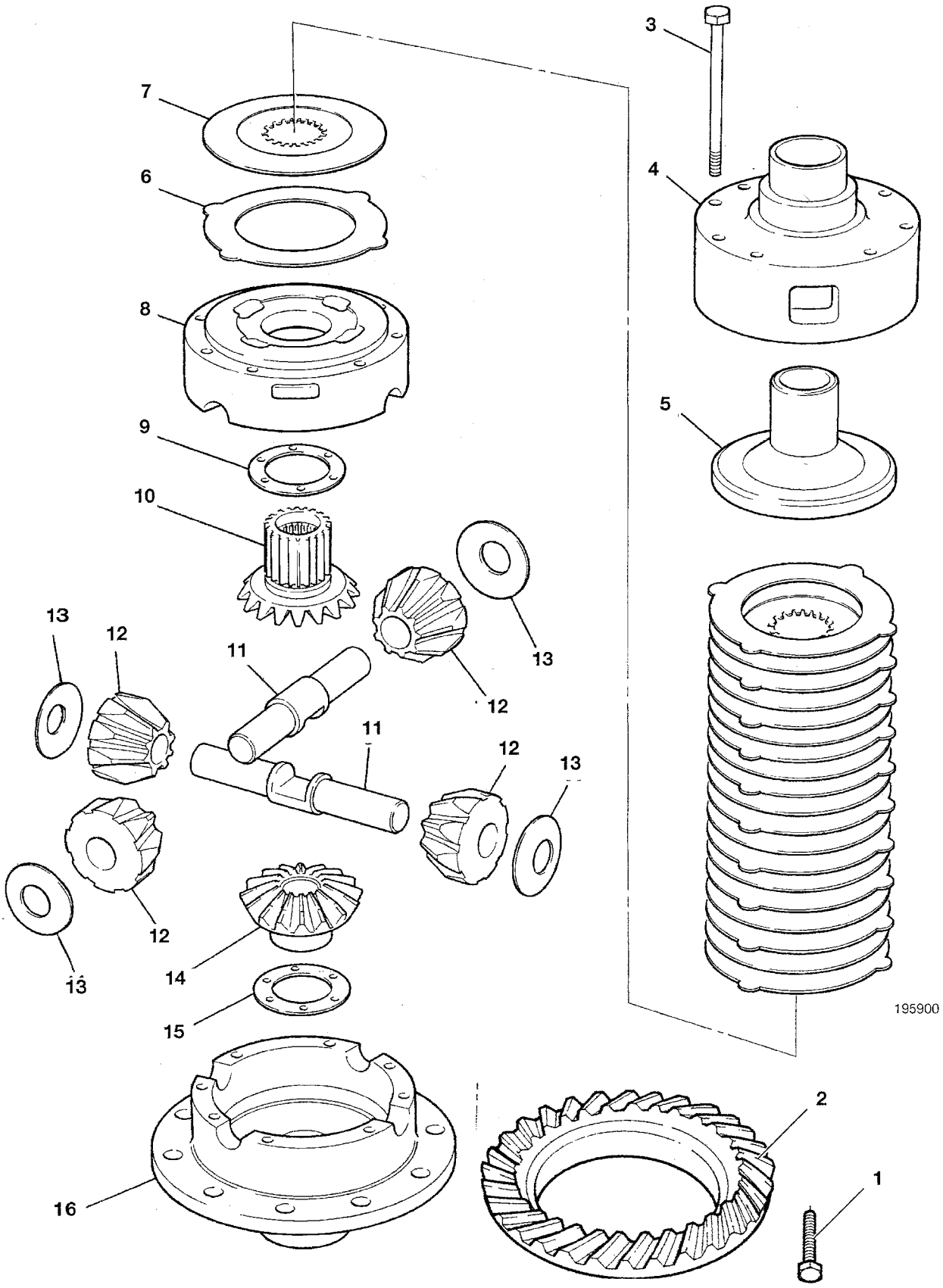
Component Key:

1 Not used
2 Not used
3 Differential Assembly
4 Crownwheel
5 Pinion
6 Coupling Yoke (Input Driveshaft)

Parking Brake Option Only:
7 Brake Disc

Soft Engage Differential Lock Option Only:
8 Hydraulic Piston Assembly
9 Hydraulic Feed Port

Differential
- Dismantling and Assembly



Differential - Dismantling and Assembly

The numerical sequence shown on the illustration is intended as a guide to dismantling.

Note: The differential side gears and bevel gears are matched, as are the two differential case halves. These must be renewed as sets if any of the components are damaged or excessively worn. Do not use unmatched halves or gears.

Note: The differential case halves are stamped for matching purposes. The stamp on the crownwheel case half can only be seen when the crownwheel is removed.

Dismantling

Note the relative positions of the friction and counter plates before dismantling, they must be fitted in the same positions.

If worn, the friction and counter plates must be renewed as a complete set.

1 Secure the assembly in a vice or suitable jig for dismantling and examination. Undo the bolts **1** and remove the crownwheel **2**.

2 Remove the bolts **3** and separate the differential lock case **4** from the rest of the assembly.

3 Remove actuating sleeve **5**.

4 Remove the counter plates **6** and friction plates **7** from the side gear **10**.

5 Separate the differential case halves **8** and **16**.

6 Remove the side gear **10**, bevel gears **12**, trunnion pins **11**, and thrust washers **13** from the case halves. Remove the thrust washers **9** and **15** from both case halves.

Assembly

1 Assemble the trunnion pins **11**, side gears and bevel gears **10**, **12**, **14**, and their thrust washers **9**, **13** and **15** into the 'crownwheel' half of the differential assembly **16**.

2 Position the top half housing **8** onto the differential, aligning the match mark letters.

3 Fit the counter plates **6** and friction plates **7**, starting and finishing with a counter plate. Make sure the counter plate tabs are aligned.

4 Position the actuating sleeve **5** on top of the last counter plate. Position the differential lock case **4** over the counter and friction plates and align the bolt holes with those of the differential case half **8**.

5 Apply Loctite 242 to the threads of bolts **3**, fit the bolts then torque tighten to 56 Nm (41 lbf ft). Check the gears for free rotation in the horizontal position. Note that if held vertically the friction and counter plates would prevent rotation.

6 Fit the crownwheel **2** using new Verbus Ripp bolts **1**.

Friction Plate Wear Limits

Measure and note the thickness of the friction plates, the result must not be less than 1.25 mm (0.049 in).

Check the condition of the friction material, which should be even over both surfaces.

If in doubt, discard the set (friction and counter plates).

Torque Settings

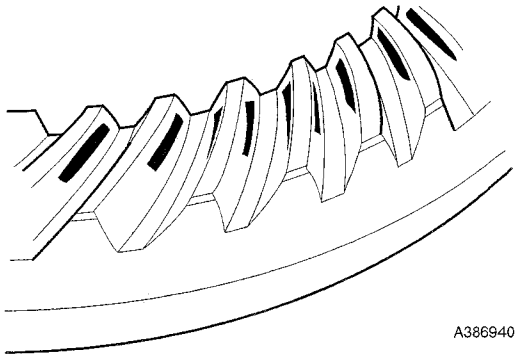
Item	Nm	kgf m	lbf ft
1	166	16.9	122
3	56	5.7	41

Crownwheel and Pinion Meshing

Meshing of the gears should be checked by marking three of the pinion teeth with engineers marking compound and rotating the pinion.

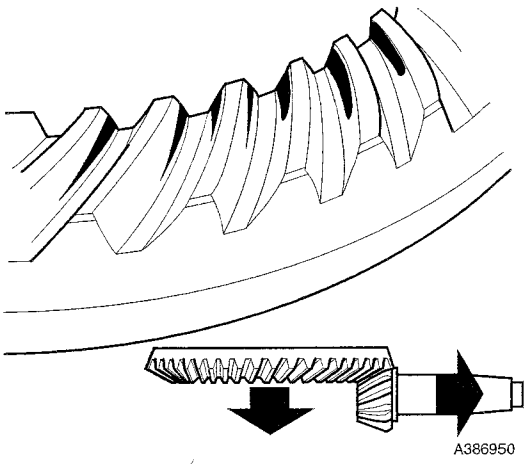
The marking will then be transferred to the crown wheel teeth.

Correct tooth marking.


A386940

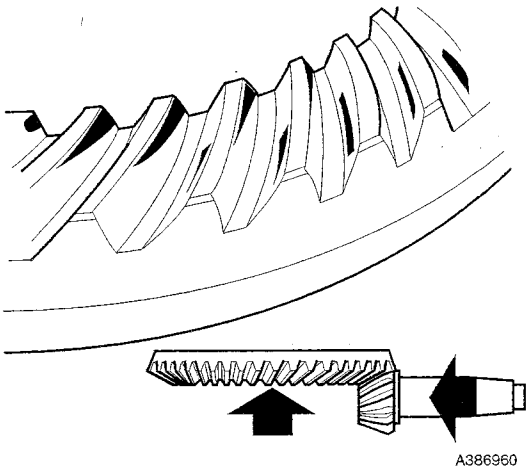
Pinion too deeply in mesh.

Decrease the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel towards the pinion to correct the backlash.


A386950

Pinion too far out of mesh.

Increase the shim thickness between the pinion inner bearing cup and the axle casing. Move the crown wheel away from the pinion to correct the backlash.


A386960

Contents

Service Brakes - PD70 Axle - Central Drivehead (Inboard Brakes)

3 or 5 Plate - Standard or Positive Retraction

Type	Oil-immersed multi-plate inboard disc braking
Actuation	Hydraulic
Location	Inboard - Axle Centre Casing (2 brake packs)
Friction Plates	3 or 5 pack
Outside diameter	220 mm (8.66 in)
Inside diameter	180 mm (7.09 in)
Nominal Facing Area/Plate	12616 mm^2 (19.5 in^2)
Hydraulic Piston diameter	216 mm (8.5 in)
* Piston Operation	Standard or positive retraction or controlled retraction.

* Service Brakes - PD70 Axle - Modular Drivehead

Type	External disc brakes with callipers. Single callipers are fitted as standard (an alternative calliper mounting position is provided on the drivehead housing). Twin callipers can be fitted as an option.
Actuation	Hydraulic brake fluid.
Location	Mounted on drivehead output shafts.
Disc Diameter	310 mm (12.2 in).

* Parking Brake (Options)

Type	Disc brake, manually adjusted calliper.
Actuation	Cable operated.
Location	Mounted on the rear axle drivehead.
Disc Diameter	279.4 mm (11 in)

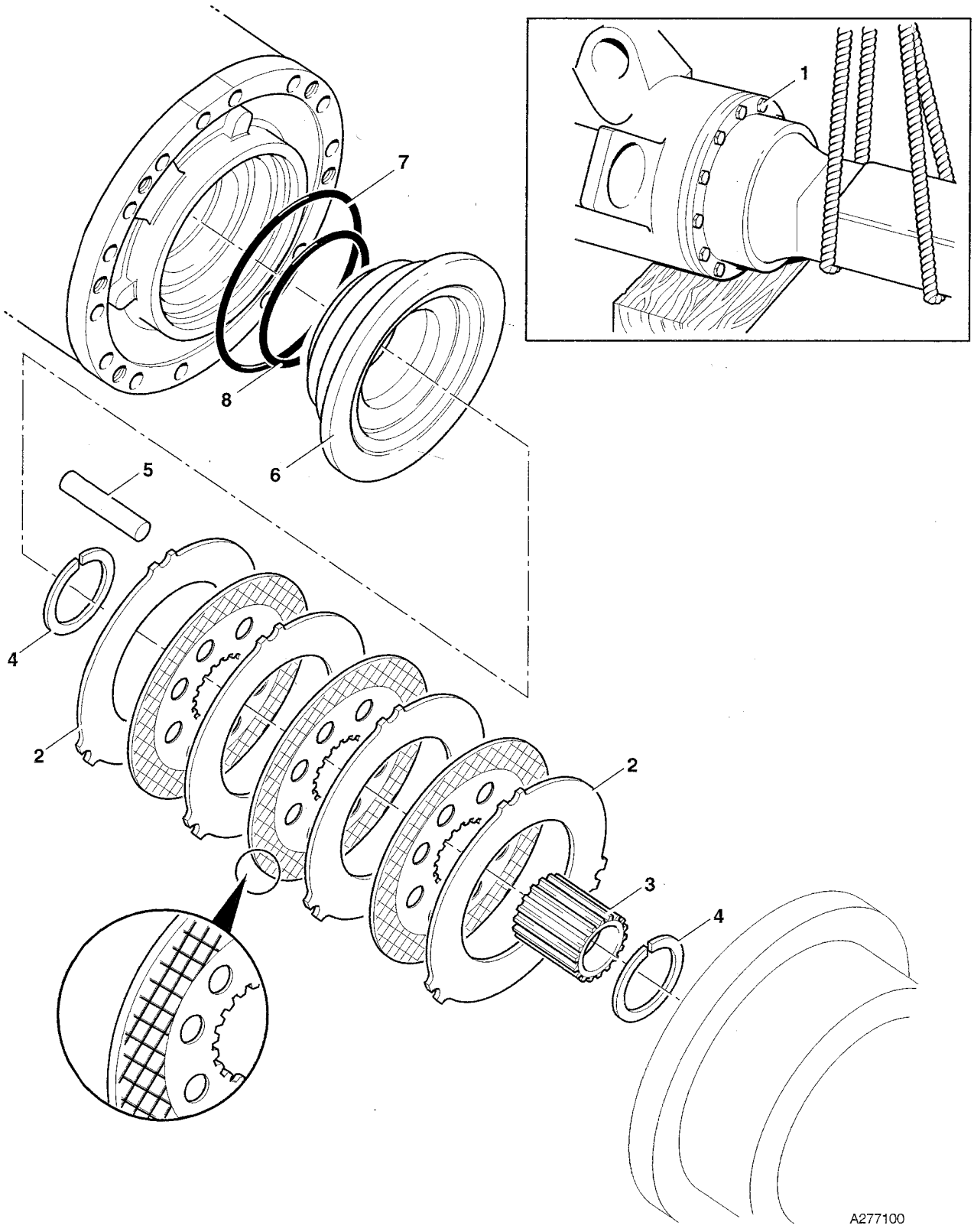
Note: Instructions for Dismantling and Assembly are detailed under **PD70 Axle - Central Drivehead - Standard Retraction, Dismantling and Assembly** and **PD70 Axle - Central Drivehead - Positive Retraction, Dismantling and Assembly. PD70 Axle - Central Drivehead - Controlled Retraction, Dismantling and Assembly.**

* **Note:** DO NOT assume that the brake system fluid is the same as in the drivehead. It may be different - always check before topping up/changing.

Service Brake - PD70 Axle - Central Drivehead - Controlled Back-off

Type	JCB Oil-immersed multi-plate disc
Actuation	Hydraulic - vacuum servo assisted
Location	Rear axle centre casing (2 brake packs)
Friction Plates (5 per brake pack)	
Outside Diameter	220 mm (7.992 in)
Inside Diameter	160 mm (6.299 in)
Nominal Facing Area per Plate	18603 mm^2 (28.8 in^2)
Hydraulic Piston Diameter	216 mm (8.5 in)

* Dismantling and Assembly



Dismantling

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN 1-1

1 It is recommended that the axle be removed from the machine when dismantling the brakes.

2 Drain the oil from the axle and hub.

3 Support the axle arm and remove bolts **1**. Use a heavy duty socket to unscrew them.

4 Separate the axle arm from the drivehead by tapping the flange with a soft faced hammer. Remove all traces of gasketing from the mating faces.

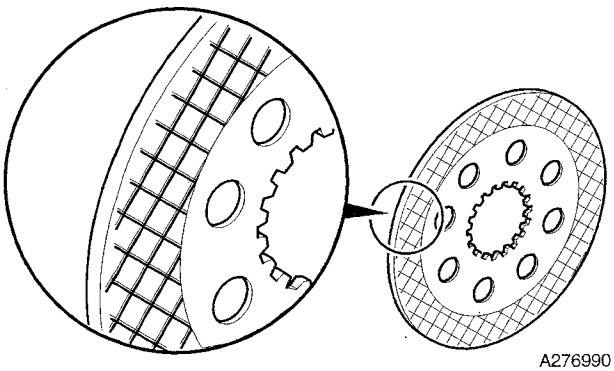
5 There are two counterplates **2**, one at each end of the brake pack, which are not secured to the plate carrier **3**. If the plates are to be re-used, note their positions and which way round they are, then withdraw the brake pack.

* **Note:** The brake pack may include either 3 friction plates or 5 friction plates.

6 Remove the circlip **4**. If the brake pack is to be re-used, note the positions of the plates before removing them.

Note: The plate carrier **3** has an internal chamfer at the end which faces away from the drivehead.

7 Wear limit of friction plates is to the depth of the crosshatching. Check all plates for flatness and damage. (Wear and polishing of the counterplates is normal.) Renew the brake pack complete if excessively worn or damaged. Do not renew individual plates.



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8 Remove the three reaction pins **5**. Inspect for damage.

9 Carefully withdraw the brake piston **6** from its housing, if removal is necessary. A hydraulic hand pump can be used to force the piston out of the housing.

* **10** Remove and discard seals **7** and **8**. Inspect the housing bore for damage and scoring. Nicks or cuts in the seals may be responsible for loss of brake fluid.

Check for ovality by fitting the piston into the housing without seals and rotate. If the piston becomes tight check the parts.

Assembly

* **1** Fit new seals **7** and **8**. Make sure they seat squarely in their grooves. Lubricate the seal and piston bore.

2 Carefully press the piston **6** all the way into its housing.

* **3** Assembly the friction plates and counterplates 2 onto the carrier **3**. If the original brake pack is being re-used, return the plates to their original positions (see **Dismantling**, Step 4). Soak new friction plates in gear oil before assembly. Fit circlip **4**. Line up the holes in the fiction plate.

4 Locate the three reaction pins **5** into their grooves, securing them with grease. Push the pins fully into their location holes in the housing.

5 Install one counterplate **2** into the housing, then the brake pack, then the other counterplate. Ensure that the chamfered end of the brake carrier **3** faces away from the drivehead. Return re-used counterplates to their original positions. Push the brake pack fully home.

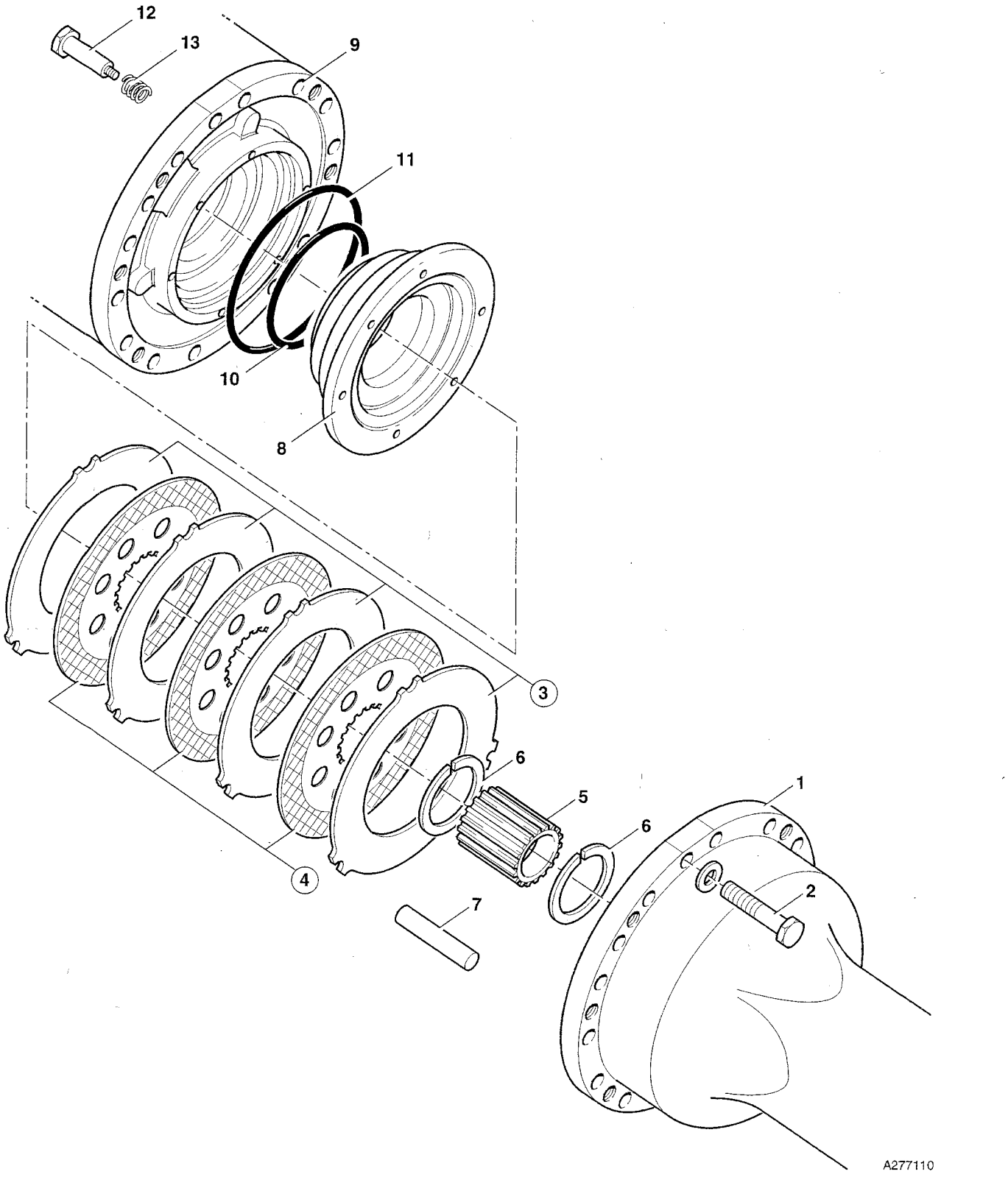
* **6** Apply Loctite 574 to the mating face of the drivehead, and Loctite 242 to the threads of bolts **1**. Locate the axle arm onto the drivehead, with the embossed word 'TOP' on the axle arm uppermost.

7 Fit bolts **1** and torque tighten.

Note: Check the grade of bolts fitted. Grade 8.8 should be tightened to 244 Nm (178 lbf ft, 24.9 kgf m), grade 12.9 should be tightened to 400 Nm (295 lbf ft, 40.8 kgf m).

8 Refill the differential with the correct grade of oil (see **Lubricants and Capacities**, Section 1).

*Dismantling



Dismantling (cont'd)

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN 1-1

1 It is recommended that the axle be removed from the machine when dismantling the brakes.

2 Drain the oil from the axle and hub.

3 Support the axle arm and remove bolts **2**. Use a heavy duty socket to unscrew them.

4 Separate the axle arm from the drive head by tapping the flange with a soft faced hammer. Remove all traces of gasketing from the mating faces.

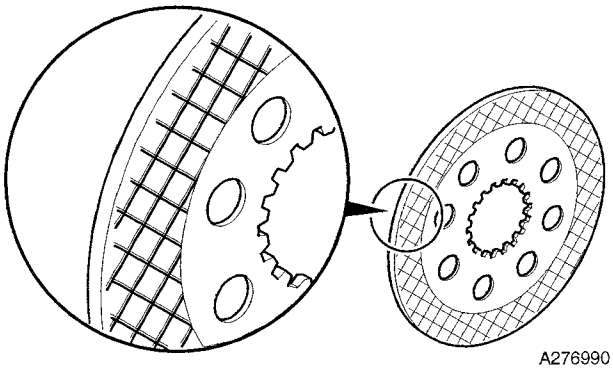
5 There are two counterplates **3**, one at each end of the brake pack, which are not secured to the plate carrier **5**. If the plates are to be re-used, note their positions and which way round they are, then withdraw the brake pack.

* **Note:** The brake pack may include either 3 friction plates or 5 friction plates.

6 Remove circlip **6**. If the brake pack is to be re-used, note the positions of the plates before removing them.

Note: The plate carrier has an internal chamfer at the end which faces away from the drive head.

7 The wear limit of friction plates is to the depth of the crosshatching. Check all plates for flatness and damage. (Wear and polishing of the counterplates is normal.) Renew with a complete brake pack if excessively worn or damaged. Do not renew individual plates.



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8 Remove the three reaction pins **7**. Inspect for damage.

9 Remove the piston housing from the drive head (see **Drive Head, Dismantling**, Section 4).

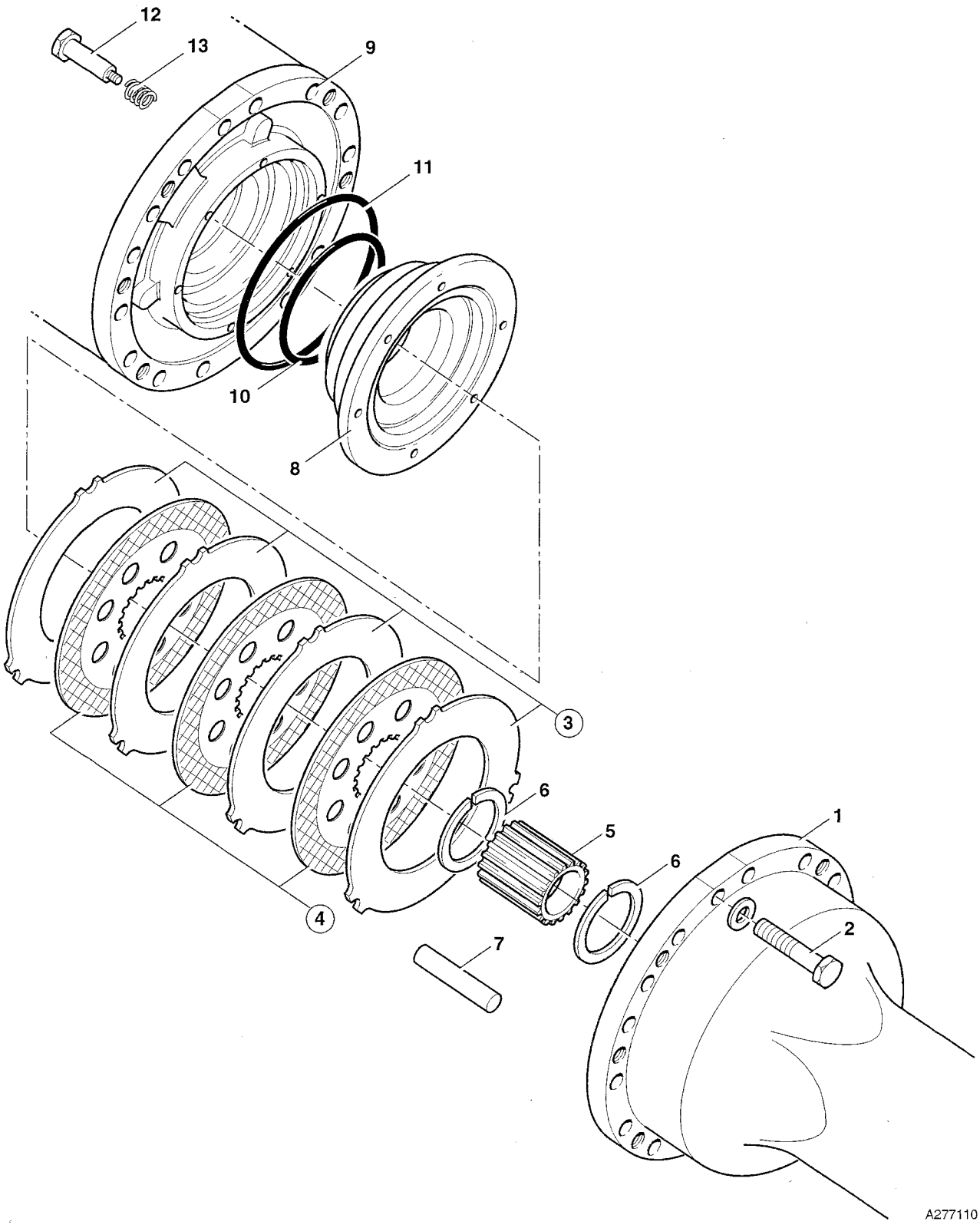
10 Remove threaded pins **12** and spring **13**. Inspect for damage.

11 Carefully withdraw the brake piston **8** from its housing **9**, if removal is necessary. A hydraulic hand pump can be used to force the piston out of the housing.

12 Remove and discard seals **10** and **11**. Inspect the housing bore for damage and scoring. Nicks or cuts in the seals may cause loss of brake fluid.

* Check for ovality by fitting the piston into the housing without seals and rotate. If the piston becomes tight check the parts.

Assembly



Assembly (cont'd)

*1 Fit new seals **10** and **11**. Make sure they seat squarely in their grooves. Lubricate the seals and the bore.

*2 Carefully press the piston **8** all the way into its housing **9**. Align the threaded holes with holes in the piston housing.

*3 Place the housing and piston on a firm flat surface, piston downwards. Install springs **13** and threaded pins **12**. Use Loctite 242 and torque tighten pins to 12 Nm (9 lbf ft; 1.2 kgf m)

4 Fit the piston housing to the drive head (see **Drive Head - Assembly**, Section 4).

*5 Assemble the friction plates **4** and counterplates **3** onto carrier **5**. If the original brake pack is being re-used, return the plates to their original position (see **Dismantling**, Step 4). Soak new plates in gear oil before assembly. Fit circlip **6**. Align the holes in the friction plates to improve the oil flow through the pack.

6 Locate the three reaction pins **7** into their grooves, securing them with grease. Push the pins fully into their location holes in the housing.

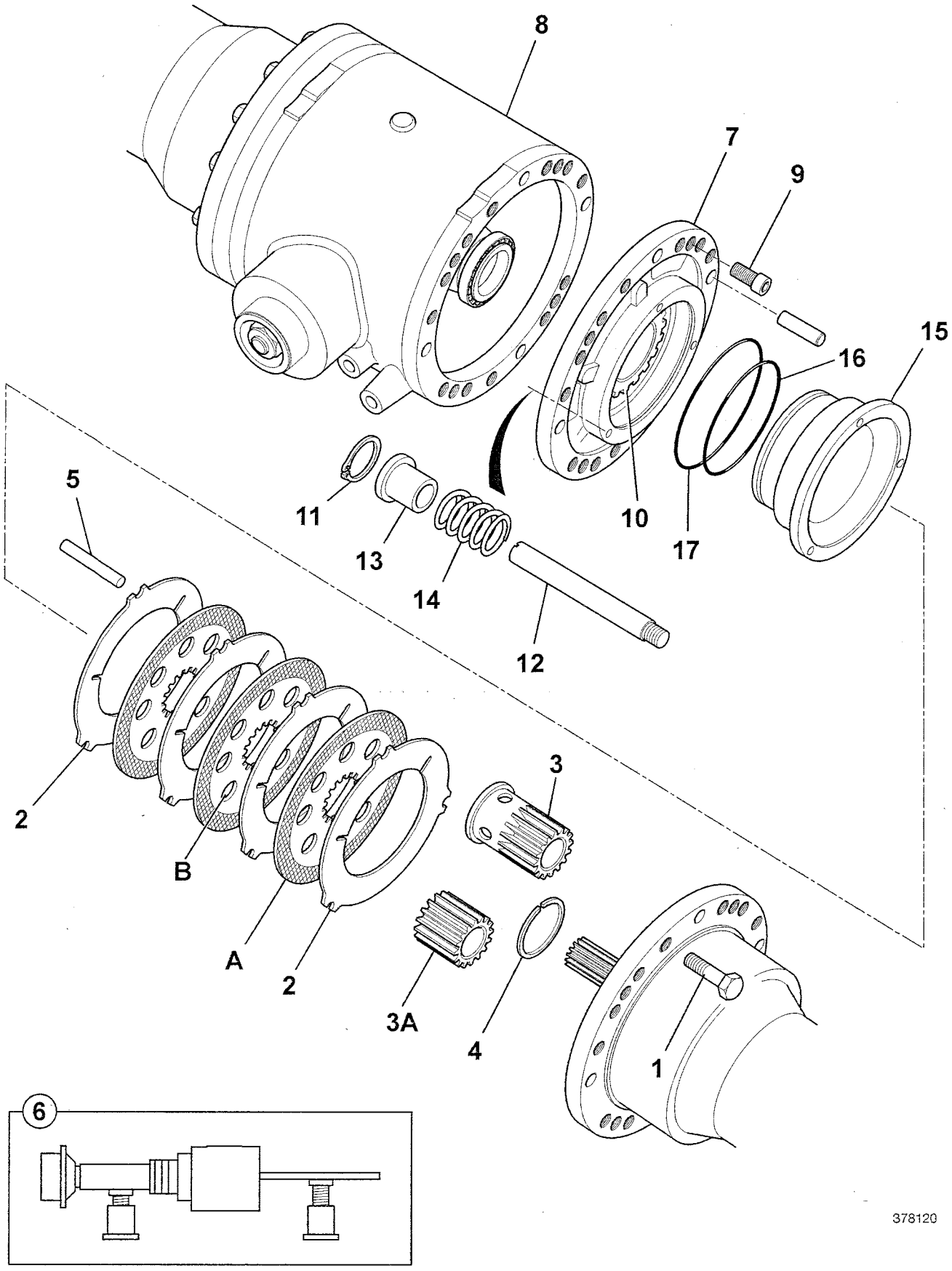
7 Install one counterplate **3** into the axle arm housing, then the brake pack, then the other counterplate **3**. Ensure that the chamfered end of brake carrier **5** faces away from the drive head. Return re-used counterplates to their original position. Push the brake pack fully home.

*8 Apply Loctite 574 to the mating face of the drive head, and Loctite 242 to the threads of bolts **2**. Locate axle arm **1** onto the drive head, with the word 'TOP' on the axle uppermost.

9 Fit bolts **2** and torque tighten.

Note: Check the grade of bolts fitted. Grade 8.8 should be tightened to 244 Nm (178 lbf ft, 24.9 kgf m), grade 12.9 should be tightened to 400 Nm (295 lbf ft, 40.8 kgf m).

10 Refill the differential with the correct grade of oil (see **Lubricants and Capacities**, Section 1).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378120

Brakes (with controlled back off)

Axles are fitted with brake controlled back off to maintain a constant clearance of 0.6mm (0.02in) within the brake pack.

It is important that only one side at a time is dismantled to prevent damage to the bearings and preserve the crownwheel and pinion backlash setting.

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN 1-1

Dismantling

1 It is recommended that the axle be removed from the machine when dismantling the axle brakes.

2 Remove bolts **1**. Use a heavy duty socket to unscrew them.

3 Jack the axle arm off the drive head, using the drive head securing bolts. Remove all traces of gasketing from the mating faces. If there are no threaded holes in the axle arm, use a soft faced hammer to open the joint. (Not all axles have threaded holes to help removal.)

4 There are two counterplates **2**, one at each end of the brake pack, which are not secured to the plate carrier **3**. If the plates are to be re-used, note their positions and which way round they are then withdraw the brake pack.

5 Remove the circlip **4**. If the brake pack is to be re-used, note the positions of the plates before removing them.

6 Wear limit of friction plates is to the depth of the cross hatching **A**. Check all plates for flatness and damage. (Some scoring of the counterplates is normal.) Renew the brake pack complete if worn or damaged. Do not renew individual plates.

7 Remove the three reaction pins **5**. Inspect for damage.

Note: If new brake and friction plates are being fitted new brake back off pins and tension bushes must also be fitted. Failure to do so could result in the brake being permanently on.

8 Before removing the brake housing and piston assembly support the differential with a drive shaft or other suitable support, as shown at **6**.

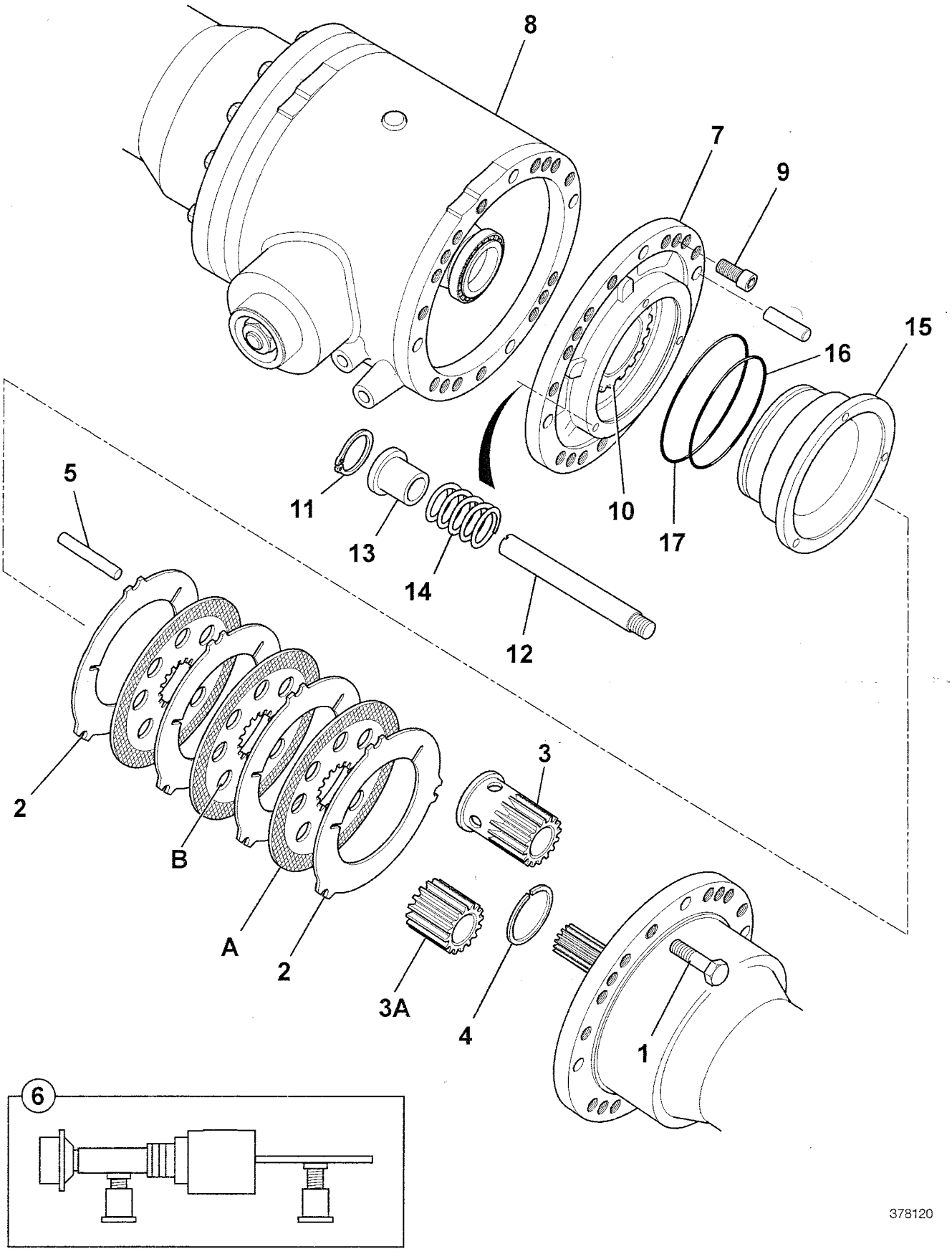
9 Match mark the brake piston housing **7** and the drive head. Undo four capscrews **9** and remove the brake housing and piston assembly.

Note: Do not disturb nut **10** otherwise the bearing pre load will have to be reset.

11 Remove circlips **11**, remove back off pins **12**, tension bushes **13** and springs **14**.

12 Remove brake piston **15** from brake housing **7**.

13 Remove and discard seals **16** and **17**. Inspect the housing bore for damage and scoring. Nicks or cuts in the seals may be responsible for loss of brake fluid.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378120

Brakes (with controlled back off) continued

Assembly

1 Clean all sealant from the mating faces of the drive head and the brake piston housing.

2 Fit new seals **17** and **16**. Make sure they seat squarely in their grooves.

3 Carefully press the piston **15** all the way into its housing **7**. Make sure the brake back off holes in the piston and housing align.

4 Apply Loctite 242 to threads of back off pins **12**. Screw the back off pins **12** into the brake piston and fit the springs **14** over the back off pins.

5 Place the tension bush **13** over the back off pin **12**. Using a suitable tool (steel tube) drive the tension bush onto the back off pin using a soft face hammer until the circlip **11** can just be fitted.

6 Apply Loctite 574 to the drive head mating face, then fit the brake piston housing assembly. Ensure that the match marks made during dismantling are aligned.

7 Fit capscrews **9** and torque tighten to 56 Nm (42 lbf ft, 5.7 kgf m).

8 Remove the differential support.

9 Assemble the friction plates and counterplates **2** onto the brake carrier **3**. If the original brake pack is being re-used, return the plates to their original positions, see 'Dismantling'. Soak new friction plates in Mobil 424 before assembly. Fit circlip **4**.

On assembly of the brake packs, the oil flow holes **B** must be aligned with each other when being fitted to the brake plate carrier.

Note: Item **3A** is fitted to non steer axles.

Note: The illustration is typical only, refer to parts book or General Bulletin 061 (G20/N.Am) for exact number of friction and counter plates.

10 Locate the three reaction pins **5** into their grooves, securing them with grease. Push the pins fully into their location holes in the housing.

11 Install one counterplate **2** into the housing, then the brake pack, then the other counterplate. Return re-used counterplates to their original positions. Push the brake pack fully home.

12 Apply Loctite 574 to the mating face of the drive head, and Loctite 242 to the threads of bolts **1**. Locate the axle arm onto the drivehead, with the embossed word 'TOP' on the axle arm uppermost.

13 Fit bolts **1** and torque tighten.

Note: Check the grade of bolts fitted. Grade 8.8 should be tightened to 244 Nm (178lbf ft, 24.9 kgf m), grade 12.9 should be tightened to 400 Nm (295 lbf ft, 40.8 kgf m).

* Calliper - Removal and Replacement

The illustration shows a typical calliper mounting position.

Removal

1 Park the machine on firm, level ground, apply the parking brake and remove the starter key.

⚠ WARNING

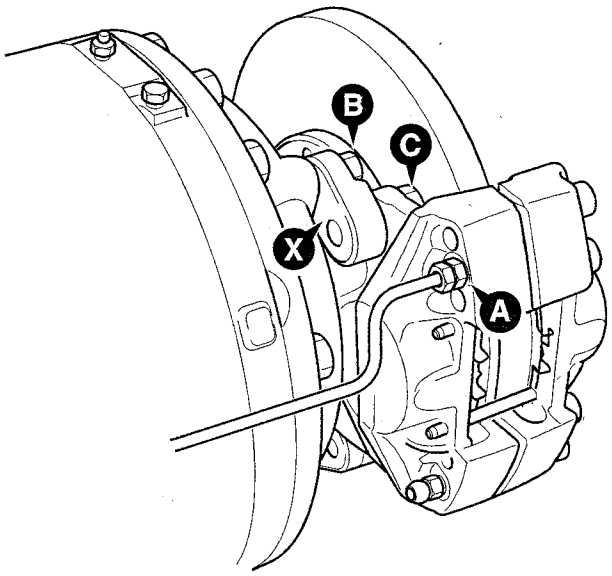
A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.
GEN-001

2 Chock the road wheels. Jack up the applicable wheel, support the machine on an axle stand and remove the wheel.

3 Disconnect the brake pipe **A** and catch the fluid in a suitable container.

4 If the pistons are free, force the pads back until they clear the disc. If necessary remove the pads to provide clearance (see **Renewing the Brake Pads**). Support the calliper and remove the two mounting bolts **B**. Lift the calliper (with the mounting brackets **X** still attached) clear of the brake disc.



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Note: Do not remove the mounting brackets **X** from the calliper unless they are damaged and are required to be renewed. When fitting a new calliper, undo bolts **C** and transfer the mounting brackets **X** to the new calliper.

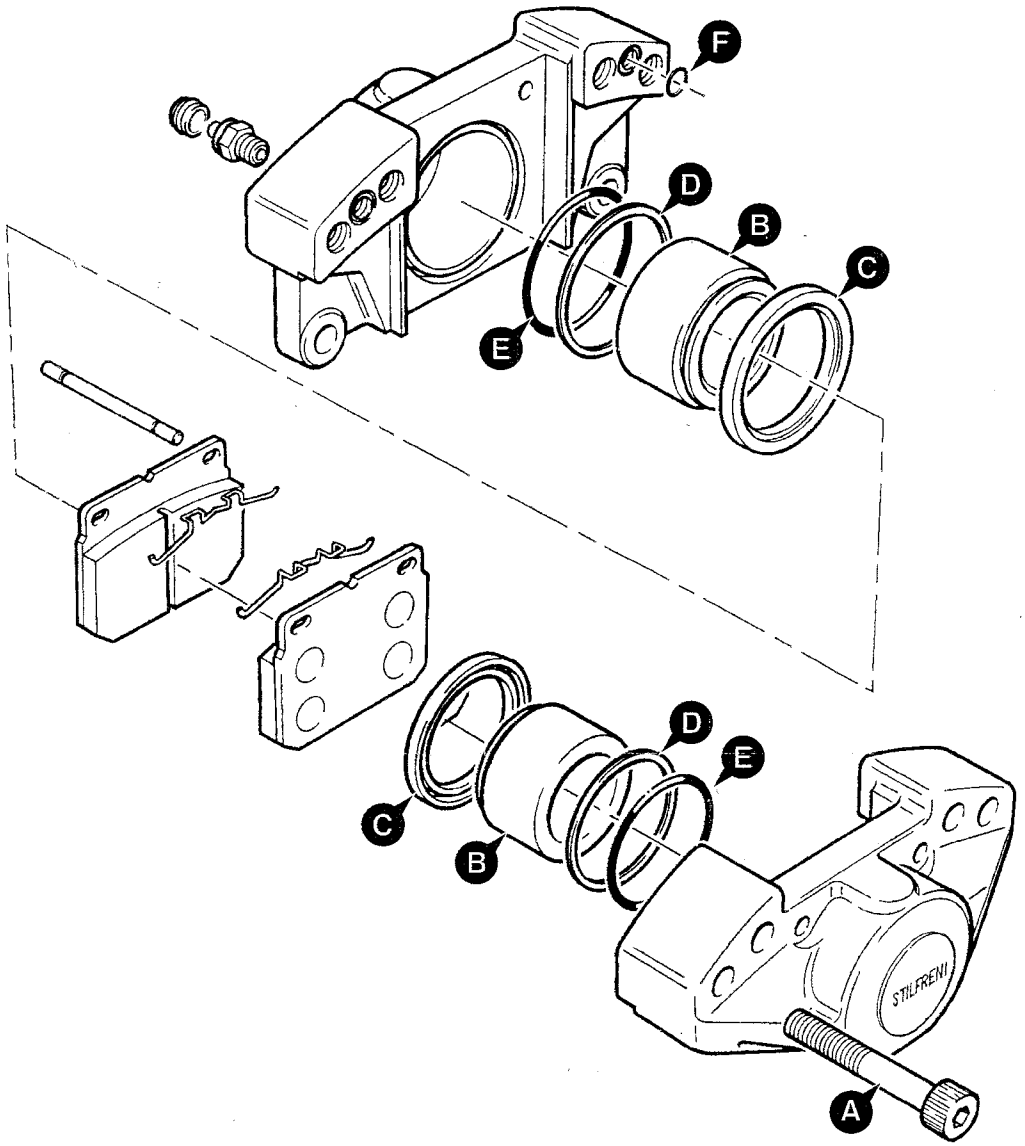
Replacement

Replacement is the reverse of the removal sequence. After replacement bleed the brake system (see **Brake System Bleeding**).

Torque Settings

Item	Nm	kgf m	lbf ft
B	98	10	72.3
C	244	24.9	180

Calliper
- Dismantling and Assembly



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Calliper - Dismantling and Assembly

Before dismantling, the calliper must be removed from the drivehead and thoroughly cleaned. Take great care to prevent entry of dirt and grit.

⚠ WARNING

Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper assemblies before commencing work. Clean hands thoroughly after work.
13-3-1-3

Dismantling

1 Remove the calliper brake pads and retaining pins (see **Renewing the Brake Pads**).

2 Remove capscrews **A** and separate the calliper halves.

3 Apply compressed air through the hydraulic fluid ports to force out the pistons **B**.

⚠ WARNING

Compressed Air

When using compressed air, wear safety glasses and gloves. DO NOT direct compressed air at your skin.
8-3-4-2

4 Remove and discard dust seals **C**, anti-extrusion rings **D** and 'O' rings **E** and **F**.

Inspection

1 Wash the piston bores with clean hydraulic brake fluid or oil. Check that the pistons and their bores are free from scoring and corrosion. If in doubt, renew the pistons or the complete calliper assembly as required.

2 Check the condition of the disc surface. Renew the disc if badly warped, pitted or worn.

Assembly

1 Ensure that the mating faces of the calliper halves are perfectly clean. Fit new anti-extrusion rings **D** and new 'O' rings **E** and **F** lubricated with clean hydraulic brake fluid or oil.

2 Fit new dust seals **C** and reassemble the calliper halves ensuring that the 'O' rings remain in position.

3 Fit new capscrews **A**, tightened evenly to the correct torque.

4 Fit the brake pads and retaining pins (see **Renewing the Brake Pads**).

Torque Settings

Item	Nm	kgf m	lbf ft
A	157-176	16-18	116-130

Brake System Bleeding

⚠ WARNING

Before proceeding with the bleeding procedure it is important to ensure that the parking brake is engaged and that one pair of wheels is blocked on both sides.
BRAK 1-2

1 Fill the brake fluid reservoir with the specified fluid (see **Lubricants & Capacities**, Section 1). Ensure that throughout the bleeding process the level is not allowed to fall below the lower mark on the reservoir.

⚠ WARNING

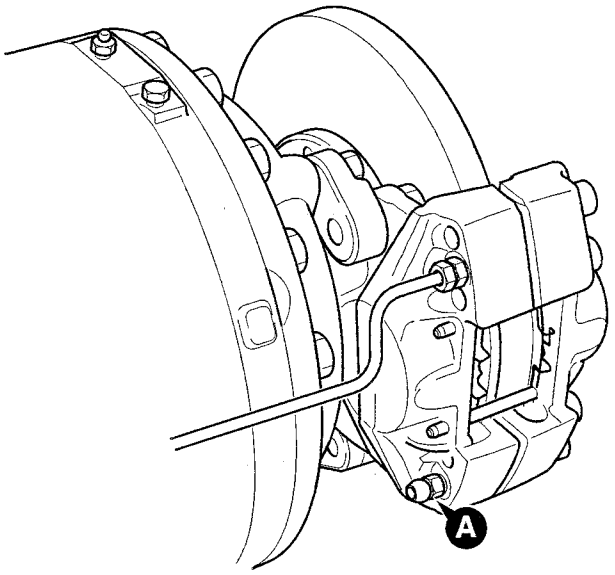
Using incorrect brake fluid could damage the system. See the Lubricants and Capacities chart in this manual for the correct fluid. The fluid can harm your skin. Wear rubber gloves. Cover cuts and grazes.
2-3-2-6/1

2 Attach a tube to the bleed screw **A**, ensuring that the free end of the tube is immersed in brake fluid or oil in a suitable container.

3 Open the bleed screw and apply full pedal strokes until all air is expelled. Close the bleed screw with the pedal fully depressed.

4 Repeat the procedure for the other brake on the opposite side of the machine.

5 Top up the brake fluid reservoir.



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Renewing the Brake Pads

The illustration shows a typical calliper.

⚠ WARNING

Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper before commencing work. Clean hands thoroughly after work.
13-3-1-3

Pad Removal

1 Tap out the pad retaining pins **A** as shown. Discard the pins and anti-rattle springs **B**.

2 Using a suitable lever, force the worn pads back against the pistons. Withdraw the pads, then force both pistons fully back, taking care not to damage the seals or pistons.

3 Ensure that the seals are not leaking and that both pistons move freely in the calliper. If they are not in perfect condition, the calliper must be renewed or serviced.

Pad Inspection

⚠ WARNING

Oil on the brake disc will reduce brake effectiveness. Keep oil away from the brake disc. Remove any oil from the disc with a suitable solvent. Read and understand the solvent manufacturer's safety instructions. If the pads are oily, fit new ones.
2-3-2-3/2

1 Check the thickness of the friction pads **C**. If the friction material is 3 mm (0.12 in) or less on any of the pads, fit a new set. Check also the surface condition of the brake disc **D**. If the surface of the disc is badly warped or pitted, it must be renewed.

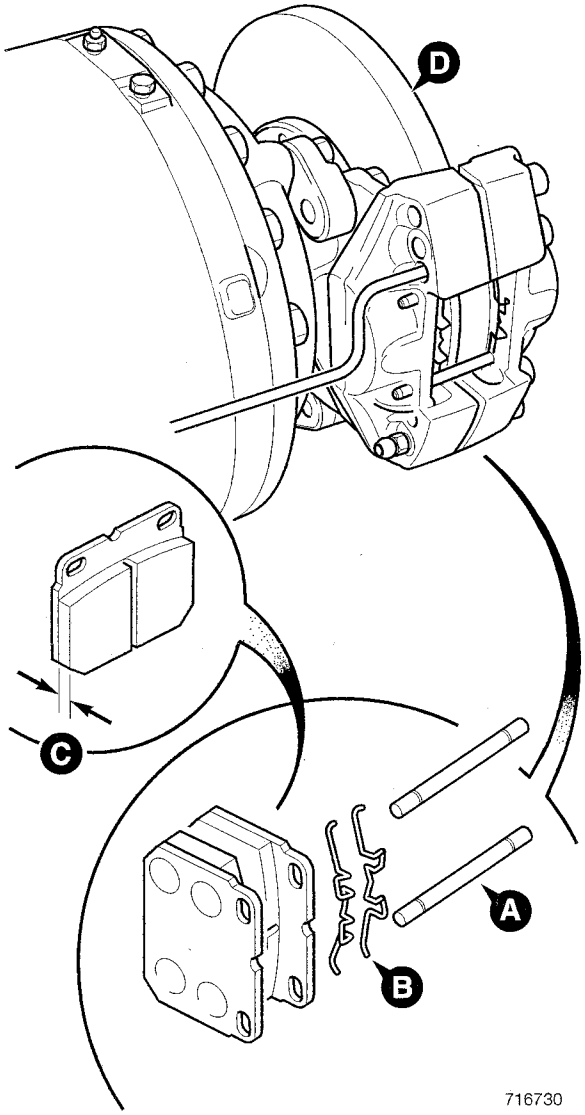
Pad Replacement

⚠ WARNING

Always renew brake pads and retaining pins in complete sets, using genuine parts, otherwise braking may be unsafe.

1 Slide in the new pads and fit new retaining pins **A** and anti-rattle springs **B** as shown. Ensure that the anti-rattle pins locate correctly into the grooves in the retaining pins.

2 Try to avoid heavy braking for the first 50 hours of operation after fitting new pads.



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* Brake Piston Seal Leakage Test

The following procedure explains how to check if a brake piston seal is severely damaged/perished or if the seal has a small cut or nick. The test must only be done when the axle is COLD.

⚠ WARNING

Before working on the brake system make sure the machine is on level ground and chock all four wheels.
BRAK 1-4

⚠ WARNING

Do not drive the machine with any part of its brake system disconnected. When the following test has been completed reconnect all brake pipes and bleed the brake system using the recommended procedure.
BRAK 2-1

1 Remove and cap brake piston feed pipe **A.**

2 Fill the brake piston housing with Light Hydraulic Fluid.

3 Check for severe piston seal damage:

3.1 Install a hand pump (see **Note 1**) fitted with a 0 - 40 bar (0 - 600 lbf/in²) pressure gauge to port **B**, as shown at **X**.

Note 1: The hand pump MUST be filled with Light Hydraulic Fluid. DO NOT exceed 69 bar (1000 lbf/in²).

3.2 Use the hand pump to generate a pressure in the brake piston housing.

3.3 If the pressure falls off rapidly, or if no pressure reading can be obtained, the seal is severely damaged and needs replacing with a new one.

4 Check for small cuts or nicks in the piston seal:

4.1 Install an adapter fitted with a piece of clear tube (approximately 122 mm [4.8 in] long) to the brake piston port **B**, as shown at **Y** (see **Note 2**).

Note 2: The tube must be kept vertical during the test, use tape to attach the tube to the side of the machine.

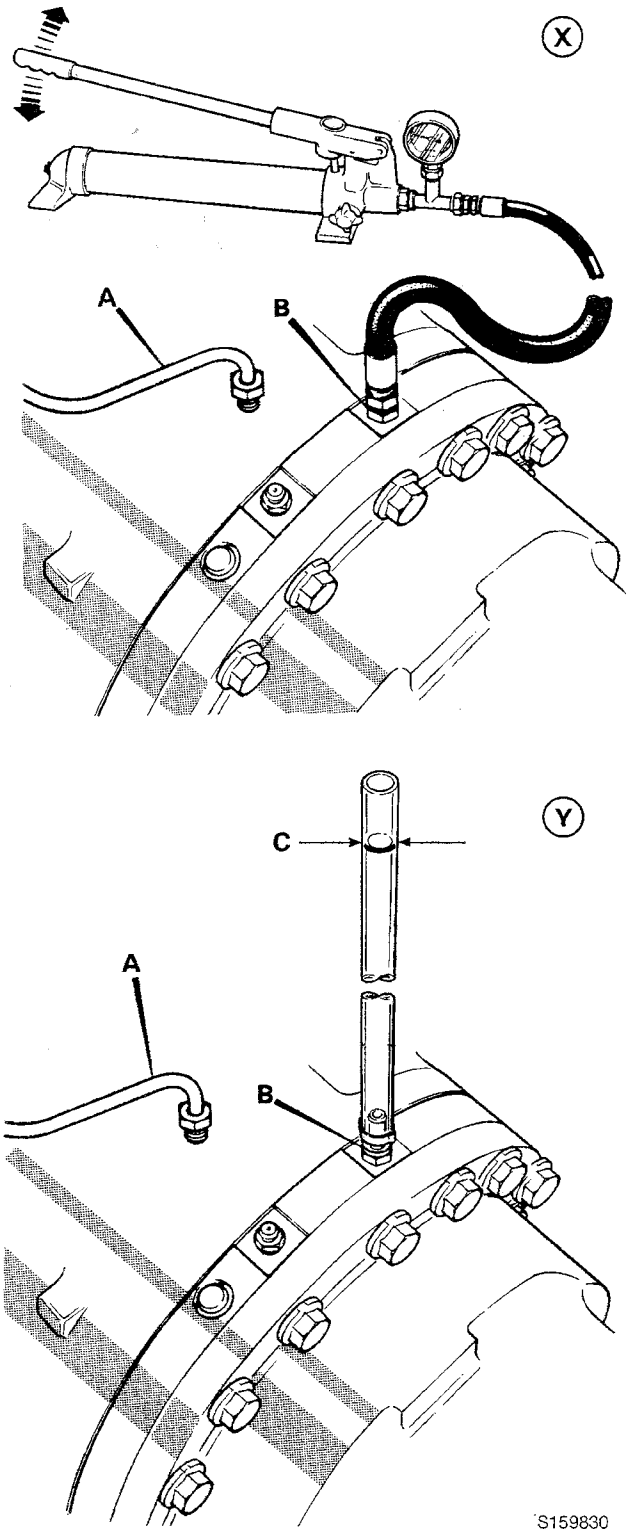
4.2 Fill the tube until approximately three quarters full with Light Hydraulic Fluid.

4.3 Using a suitable pen, mark the level line of the brake fluid on the tube, as shown at **C**.

4.4 After approximately 1/2 hour, check if the level has dropped below the original marked line, if it has then check the brake piston seal for slight nicks, cuts or generally for wear.

5 Repeat steps 1 to 4 for the opposite brake piston seal.

6 Reconnect all brake pipes and bleed the brake system as recommended on page 5/7-1.



* Bleeding Procedure

⚠ WARNING

Before proceeding with the bleeding procedure it is important to ensure that the parking brake is engaged and that one pair of wheels is blocked on both sides.
BRAK 1-2

⚠ WARNING

Use of incorrect fluid will cause serious damage to the seals which could in turn cause brake failure.
BRAK 1-1

Fill the master cylinder reservoir with the correct fluid, and ensure that throughout the bleeding process the level is not allowed to fall below the MINIMUM mark.

Bleed as follows:

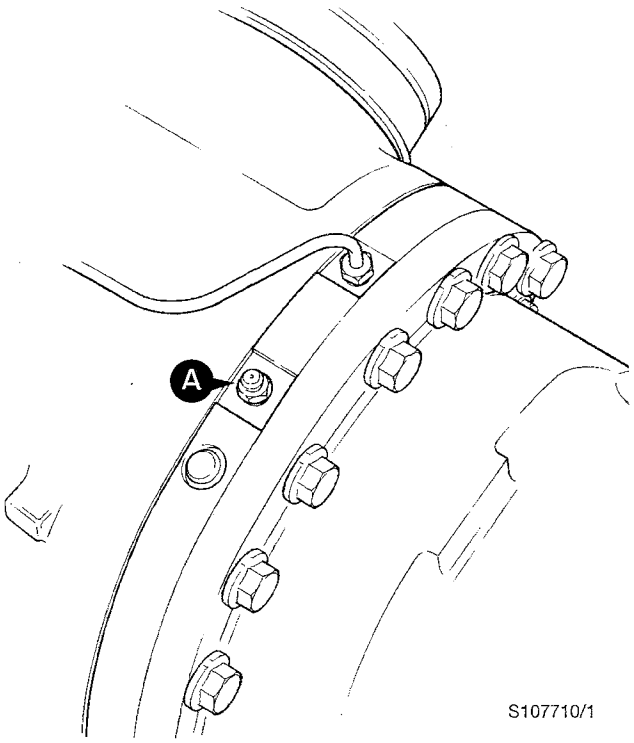
Attach a tube to the right hand brake bleed screw **A**, ensuring that the free end of the tube is immersed in fluid contained in a suitable container.

Open the brake bleed screw and apply full pedal strokes of the brake pedal until all air is expelled.

Close the brake bleed screw with the pedal fully depressed.

Repeat procedure using the left hand bleed screw.

Top up the reservoir to the full mark.



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Axle Breather

Later axles, having inboard brakes, are fitted with extended breathers **A** as shown in the illustration. Original breathers fitted to earlier units should be replaced using the following procedure:

The extended breather **A** is now available in either metal or plastic construction and is now fitted as standard to all inboard braked axles. Both metal and plastic breathers are fully interchangeable provided the correct fitting procedure is followed.

SERVICE PROCEDURE

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower all hydraulically operated fittings to the ground.

2 Remove debris and loose material from the top of the axle.

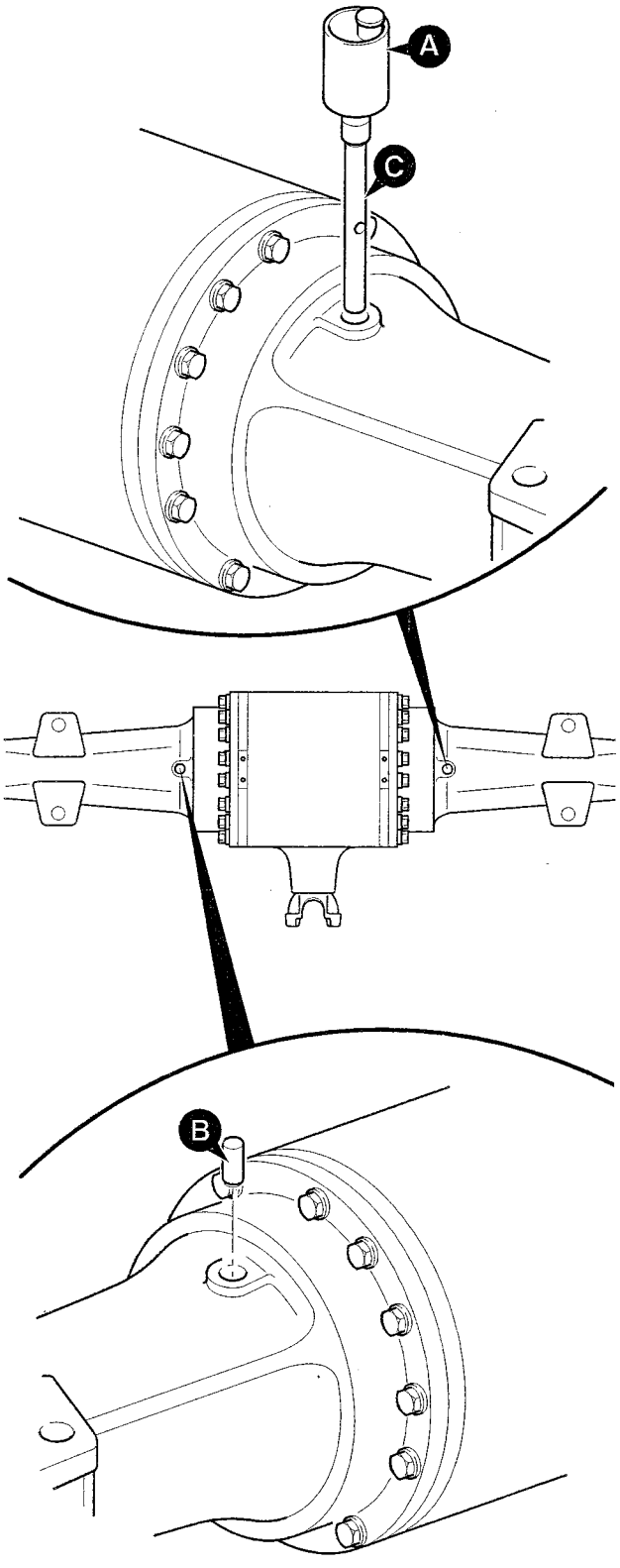
3 Remove existing breathers or degrease breather hole as applicable.

4 Refer to illustration and fit plug **B** (if not already fitted) and the extended breather after ensuring hole **C** in the breather is pointing towards the road wheel.

For plastic breathers either a suitable plastic to metal bonding sealant or bonding, part No. 4103/0955 is required, with sufficient preparation and cure time as specified in the manufacturer's instructions.

For the axle location of the plug **B** and breather **A** refer to the Machine Operator Handbook.

Note: Under no circumstances should an axle fitted with oil immersed brakes be operated without an approved breather.



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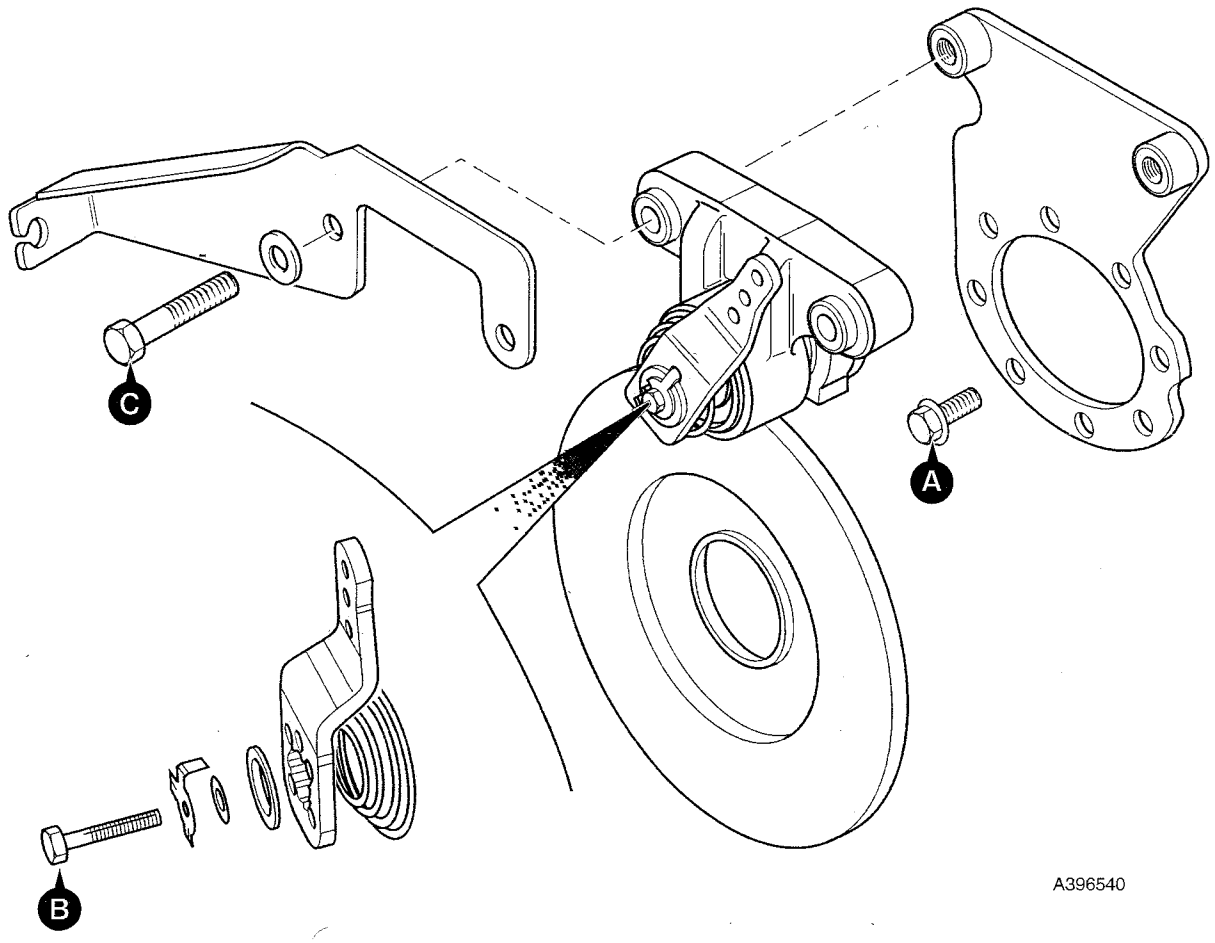
Torque Figures

The illustration shows a typical installation.

Where appropriate, the grade of bolt is indicated in parenthesis eg. (10.9). Refer also to relevant dismantling and assembly procedures.

Torque Settings

Item	Nm	lbf ft	
A	166	122	(12.9)
B	13-15	9-12	
C	255	188	(10.9 Tuflok)



Calliper
- Removal and Replacement

⚠ WARNING

This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.

Installation and mounting of the parking brake calliper requires tightening of the mounting bolts to a specific torque figure. Do not attempt to do this job unless you have the correct tools available.

0010

⚠ CAUTION

The parking brake must not be used to slow the machine from travelling speed, except in an emergency, otherwise the efficiency of the brake will be reduced.

Whenever the parking brake has been used in an emergency, always renew both brake pads.

4-2-1-1/2

⚠ WARNING

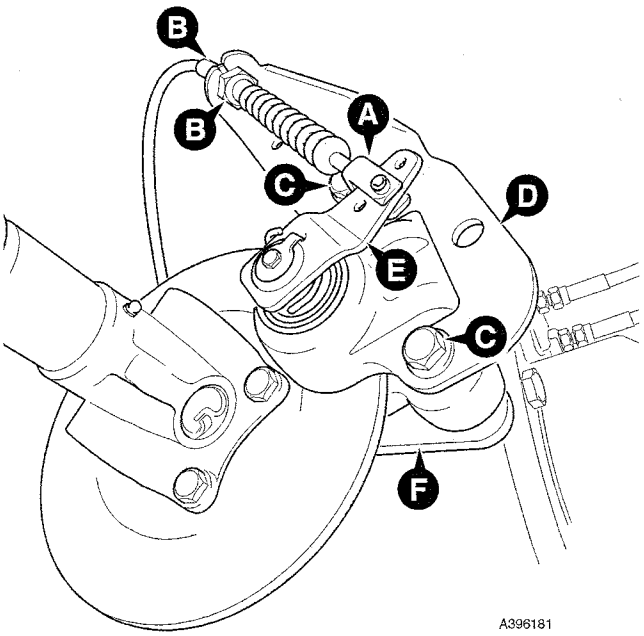
Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper before commencing work. Clean hands thoroughly after work.

13-3-1-3

⚠ WARNING

Before working on the parking brake, park on level ground and put chocks each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK 8-8



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Removal

1 Make sure precautions listed in the warnings are completed.

2 Release the parking brake lever.

3 Disconnect clevis **A** from operating lever **E**, note which of the three holes on the lever is used.

4 Undo locknuts **B** and disconnect the cable from the bracket **D**.

5 Support the caliper and remove the two mounting bolts and hardened washers **C**. Lift the caliper and bracket **D** clear of the brake disc.

Note: Do not remove the mounting bracket **F** unless it needs to be renewed.

Inspection

Check the thickness of the friction material on the two brake pads. If either pad is worn below 1 mm (0.04 in.) fit a new pair of pads. For reference, the thickness of friction material on new pads is 3.18 mm (0.125 in.) and 5.38 mm (0.212 in.).

Check also the surface condition of the brake disc. Replace the disc if it is badly warped, pitted or out of tolerance:

Minimum thickness	-	8.89 mm (0.350 in).
Runout	-	0.25 mm (0.010 in).

Replacement

Replacement is the reverse of the removal sequence.

1 Locate the caliper on the brake disc and fit new mounting bolts **C** with hardened washers, torque tighten to 255 Nm (188 lbf ft).

2 Insert cable into bracket **D**, do not tighten locknuts **B** at this stage as the brake will need adjusting

3 Refit the clevis **A** into the hole in the operating lever **E** as shown.

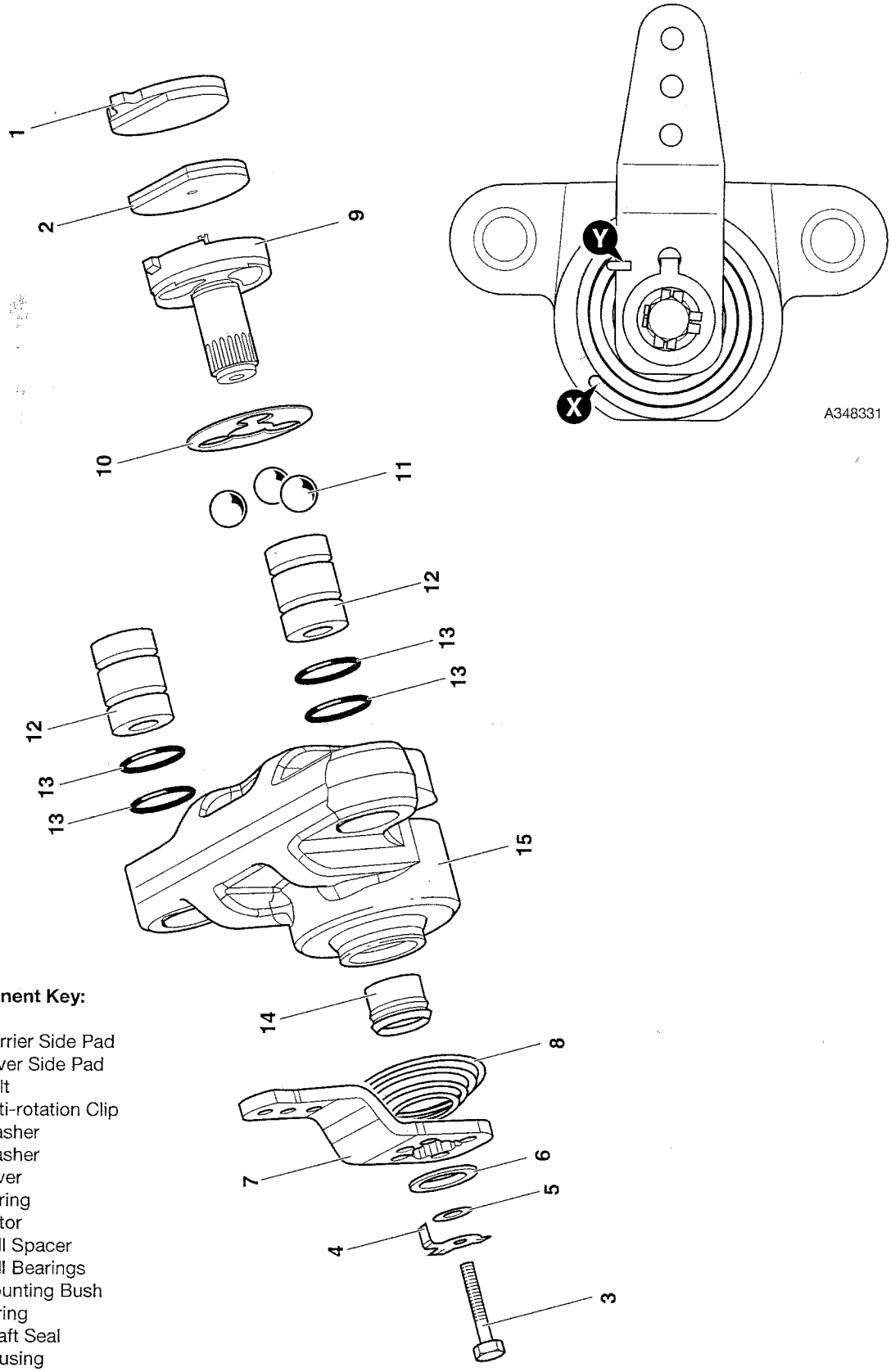
4 Make sure there is adequate freedom of movement of operating lever **E** to ensure a positive brake application, and that the lever returns to the rest position when the parking brake is released.

5 Adjust the parking brake (see **Setting Procedure**). **Never unscrew the clevis A to adjust the cable.**

Torque Settings

Item	Nm	kgf m	lbf ft
C	255	26	188

Calliper
- Dismantling and Assembly



Component Key:

1	Carrier Side Pad
2	Lever Side Pad
3	Bolt
4	Anti-rotation Clip
5	Washer
6	Washer
7	Lever
8	Spring
9	Rotor
10	Ball Spacer
11	Ball Bearings
12	Mounting Bush
13	O-ring
14	Shaft Seal
15	Housing

FIRST PAGE PREVIOUS PAGE NEXT PAGE LAST PAGE

Calliper
- Dismantling and Assembly

Dismantling

The numerical sequence shown on the illustration is intended as a guide to dismantling.

⚠ WARNING

Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper before commencing work. Clean hands thoroughly after work.
13-3-1-3

1 Remove the calliper brake pads (see **Renewing the Brake Pads**).

2 Bend the tabs on anti-rotation clip **4**. Remove bolt **3**, anti-rotation clip **4** and washers **5** and **6**. Hold lever **7** against the tension of the spring as the bolt is removed.

3 Note the position of lever **7** and the splines of the shaft. Mark the end of the shaft and lever **7** to aid assembly. Remove lever **7** and spring **8**.

4 Push out rotor **9** and remove ball spacer **10** and ball bearings **11**. Take care not to lose the ball bearings. Note that the rotor **9** incorporates a seal and bearing, not shown.

5 Push out mounting bushes **12** and remove O-rings **13**.

Note: Shaft seal **14** will not need to be renewed unless excessively worn or damaged. If removal is necessary, press the seal out from inside the housing using a suitable spacer block and bench press. Clean out any remains of the seal after removal.

Inspection

1 Clean and dry all parts. Check all parts are free from excessive wear, damage or corrosion. Light scores or stains should be removed. Renew corroded or deeply scored parts.

2 Check rotor **9** for damage or distortion. Renew if necessary. Check that the rotor seal has not melted. Check that the pad locator is not broken.

Note: Always renew both brake pads if the parking brake has been used in an emergency.

3 Check the ball pockets in housing **15** for signs of scoring, pitting, damage or corrosion. Renew the housing if damaged.

4 Check spring **8** is not broken or distorted.

5 Check the condition of the disc surface. Renew the disc if badly warped, pitted or worn.

Assembly

Before assembly make sure all parts are clean and serviceable.

1 Fit a new shaft seal **14** if removed. Install the seal as shown. Press the seal into the housing using a suitable spacer block and bench press.

2 Coat the shaft and ball pockets of rotor **9** and the ball pockets of housing **15** with silicone grease.

3 Insert the three ball bearings **11** into the pockets in the housing **15**. Insert ball spacer **10**.

4 Slide rotor **9** through the casting and seat the ball pockets against the bearings.

5 Position spring **8** over the shaft of rotor **9**. Insert the large diameter end of the spring into hole **X** in the face of the housing.

6 Locate the small diameter end of spring **8** around the outside edge of lever **7** as shown at **Y**.

7 Fit lever **7**. Align the lever to the mark made during dismantling.

8 Hold the lever against the tension of the spring and fit washers **6** and **5**, and new anti-rotation clip **4**. Fit bolt **3** and tighten to 13-15 Nm (9-12 lbf ft).

9 Bend up a tab of the anti-rotation clip that aligns with one of the flats on the bolt.

10 Fit the brake pads (see **Renewing the Brake Pads**).

11 Lubricate the O-rings **13** and bushes **12** with silicone grease. Fit O-rings into the housing and insert mounting bushes. Wipe off any excess grease.

12 Before fitting the calliper, ensure the lever rotates smoothly and that the lever side pad **2** returns to the off position when the lever is released.

13 Refit the brake caliper (see **Removal and Replacement**).

14 Adjust the parking brake (see **Setting Procedure**).

Torque Settings

Item	Nm	kgf m	lbf ft
3	13 - 16	1.3 - 1.6	9 - 12

Setting Procedure

If the parking brake calliper assembly has been dismantled or the brake pads renewed, then the calliper must be set as follows:

⚠ WARNING

Before adjusting the parking brake, make sure that the machine is on level ground. Put chocks each side of all four wheels. Disconnect the battery so that the engine cannot be started. Obey all the relevant safety instruction in the vehicle documentation. If you do not take these precautions the machine could run over you.

BRAK - 008

The method of setting the correct relationship between the calliper, the brake operating cable and the brake operating lever should be included in the vehicle documentation.

Locknuts **C** allow for adjustment at the calliper. Ensure locknuts **C** are retightened on completion.

After adjustment, test the brake as instructed in the vehicle documentation.

⚠ WARNING

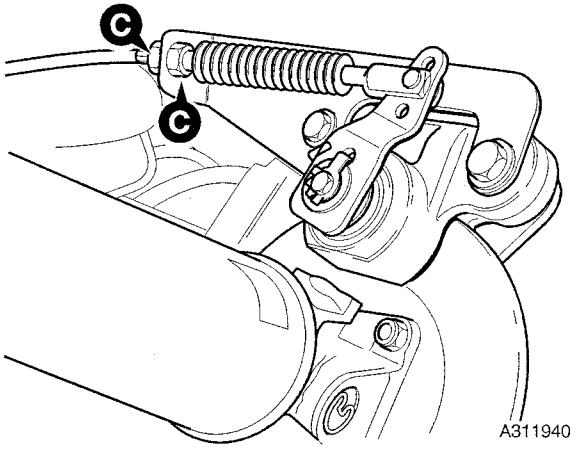
Do not use a machine with a faulty parking brake.

3-2-3-10

⚠ CAUTION

Non approved modifications to axle ratios, machine weight or wheel and tyre sizes may adversely affect the performance of the parking brake.

3-2-3-11



Renewing the Brake Pads

⚠ WARNING

Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper before commencing work. Clean hands thoroughly after work.
13-3-1-3

Pad Removal

1 Remove the parking brake calliper from the drivehead mounting bracket (see **Removal and Replacement**).

The brake pads **1** and **2** are removed through the brake disc slot in the calliper housing **15**.

2 Press carrier side pad **1** into housing **15** and remove. Ensure any residual silicone used for pad retention during assembly is removed.

3 Carefully lever pad **2** from the rotor seal inside the housing using a flat blade screwdriver. Take care to prevent damage to the plastic clip in the centre of the rotor **9** (there is no need to remove the rotor from the calliper).

Pad Inspection

⚠ WARNING

Oil on the brake disc will reduce brake effectiveness. Keep oil away from the brake disc. Remove any oil from the disc with a suitable solvent. Read and understand the solvent manufacturer's safety instructions. If the pads are oily, new ones must be fitted.
2-3-2-3/3

1 The minimum thickness of the friction material on either pad is 1 mm (0.04 in), providing adjustment is available.

2 Check the condition of the disc surface. Renew the disc if badly warped, pitted or worn.

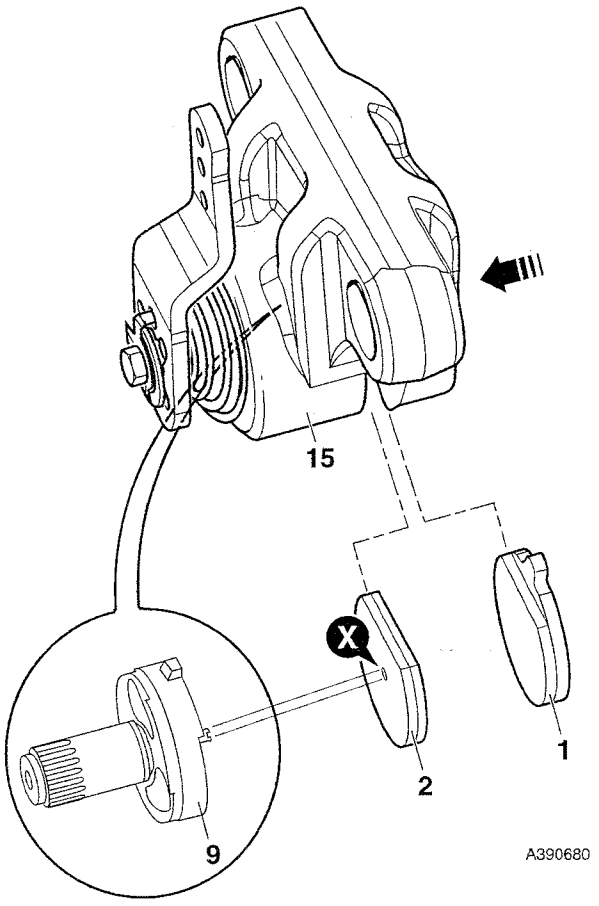
Pad Replacement

1 Fit the pad **2** to the lever side of the calliper. Position the pad inside housing **15**. Locate the plastic clip in the centre of the rotor **9** into the hole **X**, and press the pad into place.

2 Fit the pad **1** to the carrier side of the calliper. Add a small amount of silicon sealant to the back outer edge of the backing plate to hold the pad in place within the housing.

3 Replace the calliper (see **Removal and Replacement**).

Note: If there is insufficient adjustment after fitting new pads change the brake cable.



FIRST PAGE PREVIOUS PAGE NEXT PAGE LAST PAGE

Brake Disc
- Removal and Replacement

⚠ WARNING

This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.

⚠ WARNING

Before working on the parking brake, park on level ground and put chocks each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK 8-8

Removal

1 Disconnect the propshaft to the drivehead.

2 Remove the calliper from the mounting bracket **F**, refer to **Calliper - Removal and Replacement**.

3 Undo the stake nut and withdraw the brake disc from the drive pinion shaft.

Note: If the axle is not mounted to a machine, fit flange spanner (service tool 992/04800) to prevent brake disc and drive pinion shaft turning when loosening or tightening the stake nut. Refer to Section 1 - **Service Tools**.

Replacement

Replacement is the reverse of the removal sequence.

1 Fit a new stake nut and torque tighten to 300 Nm (221 lbf ft), see Note:

2 Re-stake the nut using a square ended staking tool.

Torque Settings

Item	Nm	kgf m	lbf ft
1	300	30.6	221