

SISU AXLES

Maintenance Manual

Hub Reduction in SISU FRDP-, FRMP- & FRFP-13/16 AXLES

**FRDP Single Drive Axle
FRMP Foremost Tandem Drive Axle
FRFP Tridem Drive Axle**

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NOTE !

This Manual is intended for use by experienced mechanics using safe procedures in properly equipped shops. Safety precautions should always be followed such as wearing safety glasses, using adequate lifting aids, and using tools and equipment in good condition. Sisu Axles, Inc., its agents, associates or representatives are not responsible for damage or injury occurring while working on their components.

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REPAIR INSTRUCTIONS FOR HUB REDUCTION IN SISU TRIDEM, TANDEM AND SINGLE DRIVE AXLES

In this manual, there are repair instructions for the of the Sisu FRDP-13/16, FRMP-13/16 and FRFP-13/16 axles

An FR3P-39/48 Tridem axle consists of three separate axles. The foremost axle is an FRFP, the second an FRMP and the third an FRDP.

In tandem drive use the Sisu FR2P-26/32 Tandem drive axle consists of an FRMP foremost tandem axle and an FRDP rearmost tandem axle.

NOTE! Repair instructions for the drive gear and for the brakes are in separate manuals.

AXLE DESIGN

The axle casing is rectangular shaped and pressed of sheet steel.

The primary reduction of the axles takes place in the spiral ring and pinion gear while secondary reduction is accomplished in the planetary gears located in the wheel hubs.

TRIDEM

The planetary gear inter-axle differential of the foremost Tridem axle transmits 30.5% of the torque from the transmission to the foremost Tridem axle and the rest, 69.5%, is divided evenly between the second and third axles by the inter-axle differential of the middle axle.

TANDEM

The propeller shaft flange of the foremost tandem axle is installed on the drive gear input shaft and it drives the spider of the inter-axle differential through its splines. This always rotates when the propeller shaft is rotating. The inter-axle differential divides the torque equally between the forward and the rear axles of the tandem. The torque to the foremost tandem axle is transmitted through the front side gear of the inter-axle differential with splines on which a spur gear is installed. The spur gear drives another spur gear, which is installed, on the splines of axle pinion gear transmitting power to the primary reduction of the foremost tandem axle. Another side gear of the inter-axle differential drives the shaft from which the torque is transmitted to the rearmost tandem axle either through the optional drive release coupling or directly to the output shaft. This optional drive release coupling makes the SISU FR2P tandem unique.

PLANETARY GEAR ASSEMBLY REMOVAL

Remove drain plugs (arrow in picture No. 1) and drain oil from the planetary gears into a suitable container.



Picture 1. Wheel hub drain plug

Unscrew hub cover retaining screws (5 pcs.) and remove cover.
Remove locking ring (picture No. 3). The planetary carrier can now be removed.



Picture 2. Cover removal.



Picture 3. Lock ring removal.

PLANETARY GEAR DISASSEMBLY



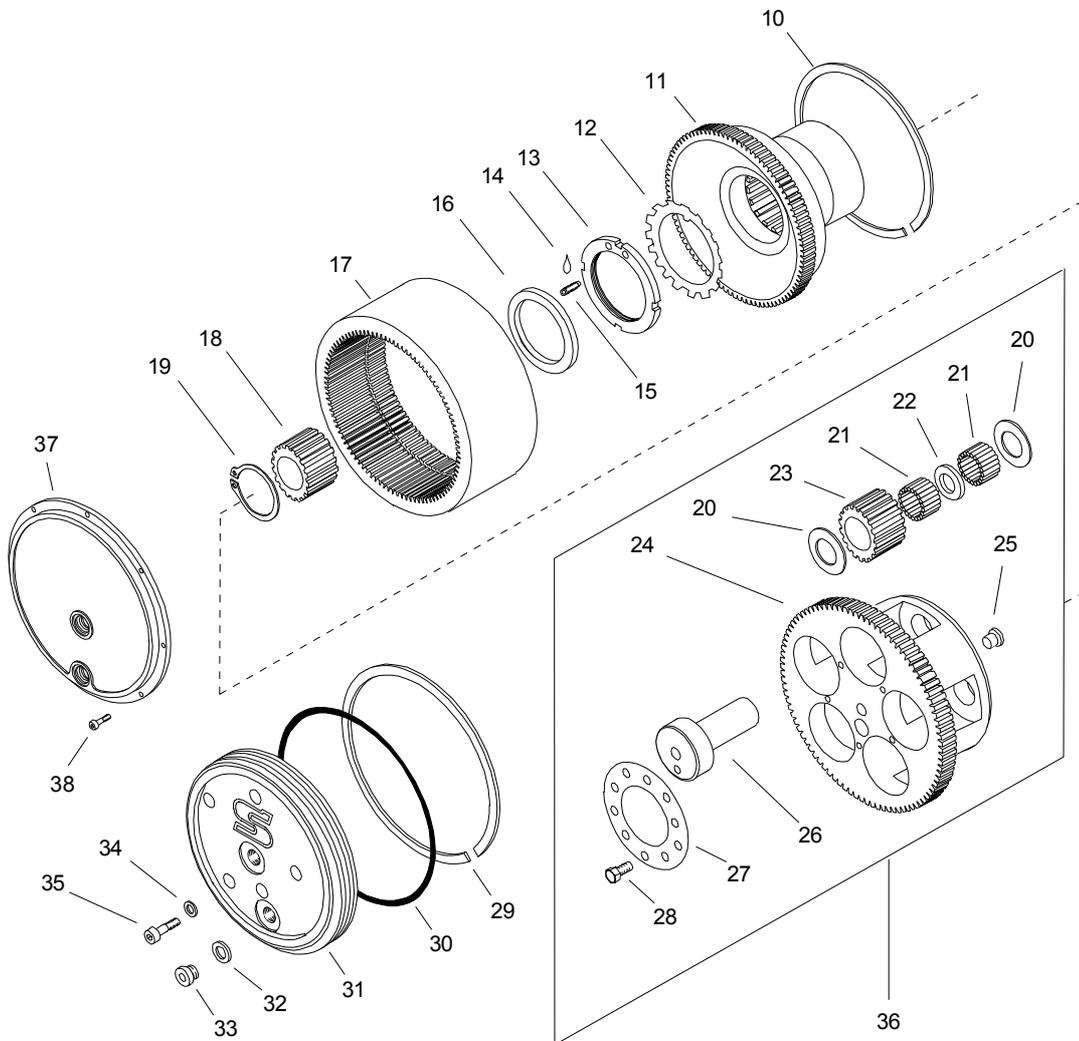
Picture 4. Planet gear shaft lock screws loosened.

Dismantle the planetary carrier by pressing the planet gear shafts out from the inside by using a shop press or with a hammer and drift.

With the planet gear shafts removed, take care to contain the bearing needles and spacers which are loose in the planetary gears. Do not lose the axle shaft thrust bearing (Item 25 in picture No. 6.)



Picture 5. Parts of one planetary gear (some bearing needles missing)



Picture 6. Exploded view of planetary hub.

ASSEMBLY OF PLANETARY GEAR

(See picture No. 6.)

Inspect all planetary gear components and discard all excessively worn or damaged parts. Insert bearing needles (21) and spacers. Use grease to make assembly easier and to ensure lubrication at startup.

Place planetary gears with thrust washers (20) in the planetary carrier casing and press in respective shafts (26) until flush with the carrier surface. Install locking ring (27) with screws (28). Use Loctite locking liquid on threads and tighten to 45 Nm [33 lb.-ft] torque.



Picture 7. Planet gear with planet gear shaft in place ready for installation in planetary carrier.

INSTALLATION OF PLANETARY GEAR:

(See picture No. 6)

Install the assembled planetary carrier. Make sure that the sun gear thrust bearing (25) is properly seated in the casing. (Use grease to hold it if necessary) Rotate carrier casing back and forth a little so that all the gears engage allowing you to slide the planetary carrier in to place. Lock the planetary carrier in place with the retaining ring (29).

Installing the earlier design hub cover (31) with five M8 fixing screws (35):

Tighten the screws (35) to 20 Nm [15 lb.-ft] torque.
Always install a new O-Ring (30) and copper washers (34).

Installing the later design hub cover (37) with eight M6 fixing screws (38):

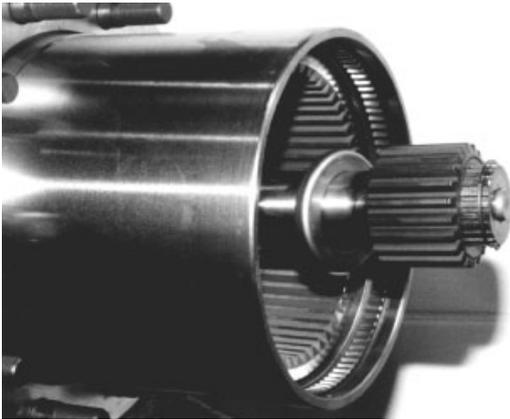
Tighten the screws (38) to 9 Nm [7 lb.-ft] torque with aluminum cover and to 16 Nm [12 lb.-ft] torque with cast iron cover.
Always install a new O-Ring (30).

Note!

Align the oil filling and draining plug holes in the hub cover to match the holes in the planetary carrier.

WHEEL HUB REMOVAL

Lift axle up and support it on axle stands.
Take off the wheel and tire assemblies.
Remove brake drum. Utilize pulling screws if necessary.



Picture 8. Axle shaft partially removed.

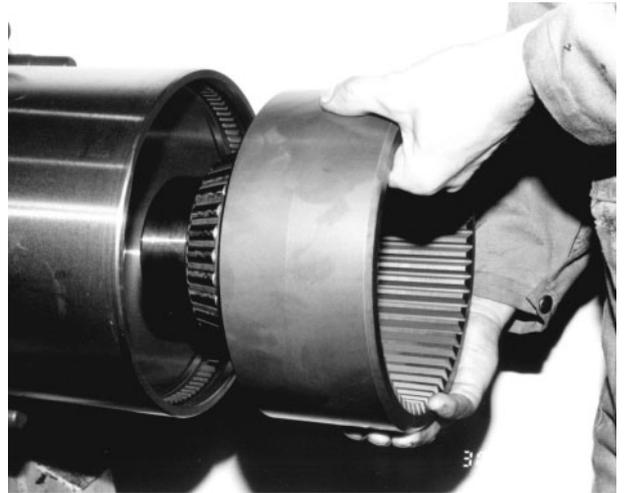
Pull the axle shaft out of the axle housing. Remove the protection plate under the sun gear on the axle threads.



Picture 9. Lock screw removed.

Remove the lock screws from the bearing adjustment nut.

*Only in the earlier design up to No. 80190 (2/98):
Straighten the lock plate tab in the groove of the nut.*
Remove the nut with a special tool. Remove the lock plate.

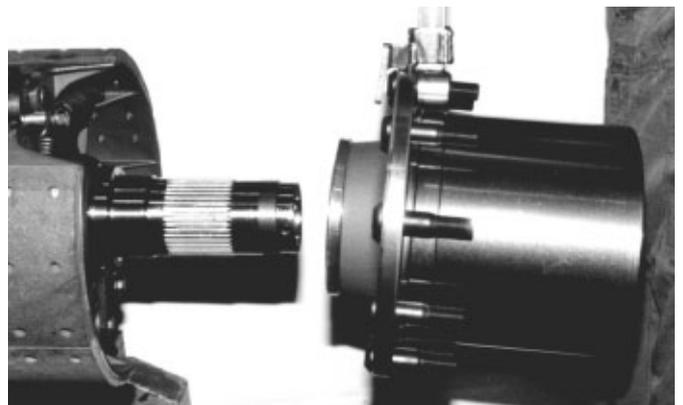


Picture 10. Removing the ring gear.

Remove the ring gear and hub from the axle tube. The outer bearing will follow the ring gear hub. To make removal easier, support the wheel hub

After removing the planetary ring gear and its hub, you can remove the wheel hub. The inner wheel bearing and the hub seal can now be removed.

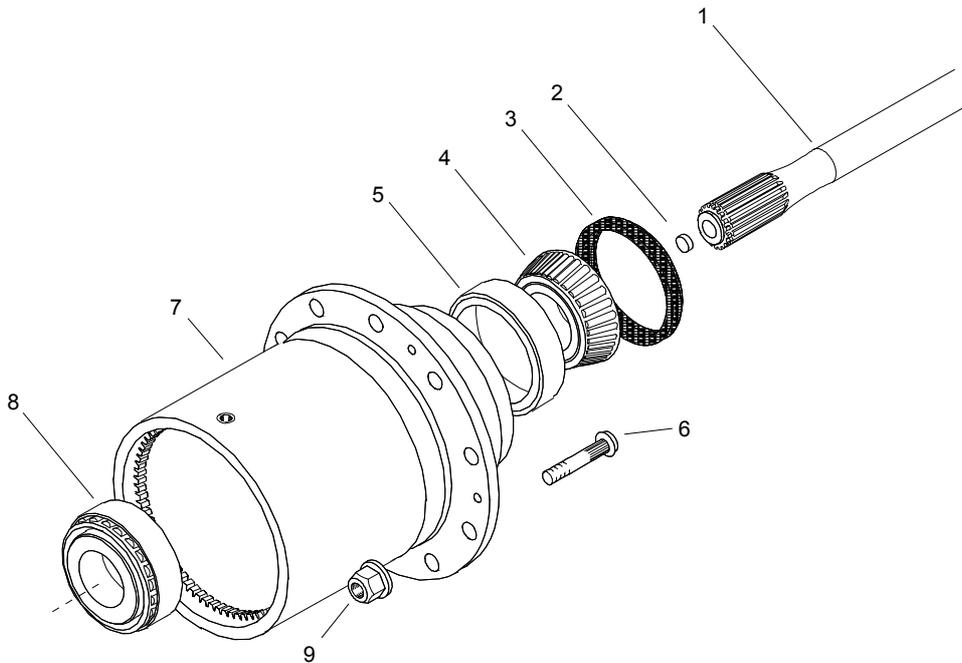
Remove the retaining ring (Item 10, Picture No. 6).
Remove the ring gear from the ring gear hub.



Picture 11. Removing the wheel hub. The brake drum is already removed.

WHEEL HUB DISASSEMBLY

Remove the hub seal and the inner wheel bearing. Remove the bearing cups from the hub with a soft drift if bearing replacement is required.



Picture 12. Exploded view of wheel hub.

WHEEL HUB ASSEMBLY

Inspect the wheel hub carefully before assembly. Always install a new wheel hub seal. Replace any bearings, which have any defects such as scratches, worn spots or discoloring. Ensure that bearing cups are tight in their seats. If cups are loose in the hub, **the hub must be replaced**. Inspect the planetary ring gear and its mounting in the hub. If any defects are found in the ring gear, **it must be replaced**.

Using a shop press, install the bearing cups in the wheel hub. Lubricate the seal and the bearing with grease.. Install the inner bearing cone and the wheel hub seal in the wheel hub.

WHEEL HUB BEARING ADJUSTMENT

Earlier design with sheet metal lock plate with locking tabs

1. Lift the wheel hub onto the axle tube. Install the lubricated outer hub bearing.
2. Install the lock plate and bearing adjusting nut and tighten slightly by wrench No. 7143 024 020. Adjust the wheel hub bearing as follows:
3. Tighten the adjusting nut to 200 Nm [147 lb.-ft] torque while rotating the hub. Then, loosen the nut by 1 locking tab places (approx. 19⁰) and lock the nut in this position with two lock screws and by bending a lock plate tab into the nut groove. Use Loctite locking liquid and tighten the lock screws to 12 Nm [9 lb-ft] torque with a torque wrench.

Later design of the wheel hub adjusting nut and lock plate from February 1998 (Thicker lock plate with holes.)

1. Lift the wheel hub onto the axle tube. Install the lubricated outer hub bearing.
2. Install the lock plate and bearing adjusting nut. Adjust the wheel hub bearing as follows:
3. Tighten the adjusting nut (13 in picture 6.) with tool No. 7543-050-020 to 500 Nm [370 lb.-ft] torque while rotating the hub. Then loosen the nut about 1/4...1/2 turns and tighten the nut to 250 Nm [185 lb.-ft] torque while rotating the hub again.

Then loosen the nut only so that the longer one of the lock screws can be installed in one of the two thread holes (M8) so that the tip of the longer lock screw goes to the a hole in the lock plate.

Use Loctite locking liquid and tighten the lock screws to 12 Nm [9 lb.-ft] torque.

Check the correct bearing clearance (0...0.05 mm) with a dial gauge by moving the hub in the direction of the axle spindle while rotating the hub.

Repeat the adjustment if necessary.

AXLE SHAFT INSPECTION AND INSTALLATION:

Inspect the axle shafts and associated sun gears prior to installation. Pay special attention to the condition of the sun gear teeth (Item 18 in picture No. 6.). If cracks or other defects are found, the sun gear **has to be replaced**.

If excessive clearance is found between the axle shaft splines and the sun gear, the sun gear and/or the axle shaft **have to be replaced**.

After the wheel bearing is adjusted, install the protection plate (Item 16 in picture No. 6.) on the shaft or the axle tube threads and ensure correct installation. Install the axle shaft.

WHEEL HUB BEARINGS WITH SPACER RINGS AND ADJUSTING SHIMS

Since serial No. 93330 (October 1999) spacer rings and adjusting shims have been installed between hub bearings. This change has been made to reduce the need for re-tightening the wheel hub bearings.

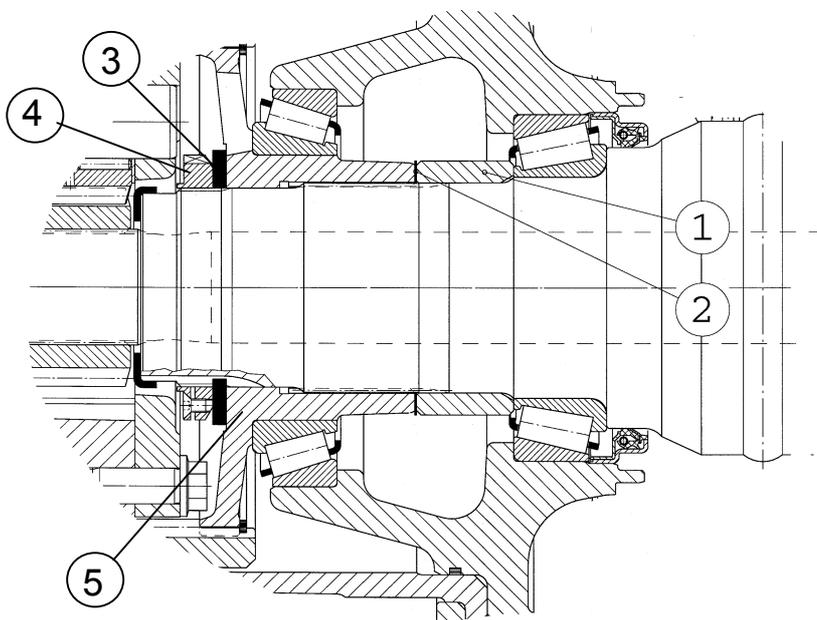
Interchangeability:

It is possible to install the new spacer rings and adjusting shims to the earlier design if desired. From the axle serial 80191 (February 1998), the installing of the spacer rings and the adjusting shims can be done without any other changes in the axle. In the axles with the earlier design of hub nut locking (made earlier than the axle above), the hub nut, the locking plate and the ring gear hub have to be replaced also according to the Service Bulletin S8001.

Part numbers of the spacer ring and the adjusting shims:

Description	New Part No.	Qty/axle
Spacer ring, l=29 mm	543-416-0310	2
Adjusting shim s=0.10 mm	590731-09510	As reqd.
Adjusting shim s=0.15 mm	590731-09515	As reqd.
Adjusting shim s=0.20 mm	590731-09520	As reqd.
Adjusting shim s=0.50 mm	590731-09550	As reqd.

1. Spacer ring
2. Shims
3. Locking plate (143-418-0510)
4. Hub nut (599-290-8004)
5. Ring gear hub

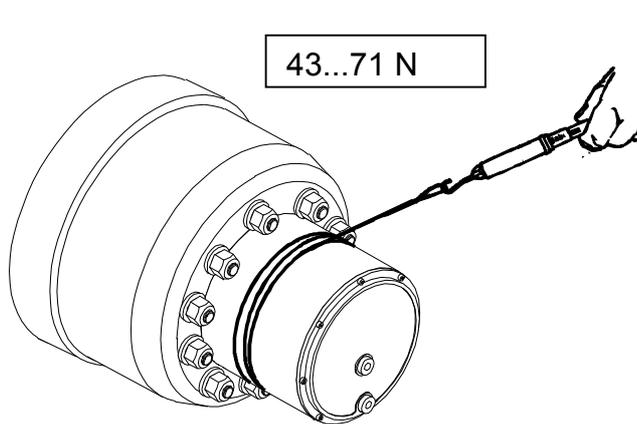


Picture 13. Hub bearings with spacer rings

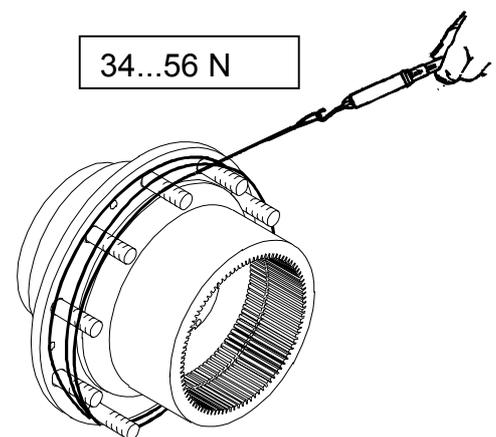
Adjustment of the wheel hub bearings with spacer rings:

1. Check the bearing clearance/preload with a dial indicator. Attach the dial indicator by its magnetic holder to the hub and place the tip of the gauge against the ring gear hub. Move the hub in the direction of the axle while turning it back and forth and read the clearance on the dial.
2. If the clearance is over 0.05 mm, [0.002 inches] remove the wheel bearing adjusting nut and remove the ring gear hub with the outer hub bearing inner race. Remove the adjusting shims to reduce the thickness of the shims so that the correct installing preload/clearance from -0.05 to +0.03 mm [-0.002 to 0.001 inches] can be achieved.
3. When adding the spacer rings and the adjusting shims to the earlier design use standard spacer ring (1 in Picture 13.) +1,2 mm thick shims (2 in picture 13.).
4. Install the hub and bearings as well the ring gear with the ring gear hub.
5. Install the hub nut locking plate and the hub nut.
6. Tighten the hub nut to 250 Nm [185 lb.-ft.] torque while rotating the hub.
7. If the hub rotation stops while torquing the nut, remove the wheel bearing adjusting nut and remove the ring gear hub with the outer hub bearing inner race and insert some additional shim(s).
8. Repeat working phases 4 thru 6 until the wheel hub rotates freely.
9. Tighten the wheel bearing adjusting nut to 1000 Nm [738 lb.-ft.] torque while rotating the hub.
10. Check the wheel hub rolling torque. It must be 8 ± 2 Nm [4.4 - 7.4 lb.] when measured by a torque wrench in the middle of the wheel hub cover (a special fixture is required). If the rolling torque is not correct, add or remove shims as required.

The rolling torque measurement can be done also by a spring scale and a piece of the string around the wheel hub circumference (43 - 71 N [9.7 - 16.0 lb.], Picture 14..) or from the wheel bolt circumference (34 - 56 N [7.6 - 12.6 lb.], Picture 15.).



Picture 14. Rolling torque measurement with a spring scale from the wheel hub circumference.



Picture 15. Rolling torque measurement with a spring scale from the wheel bolt circumference.

Note! This measurement shall be taken with rotating hub.

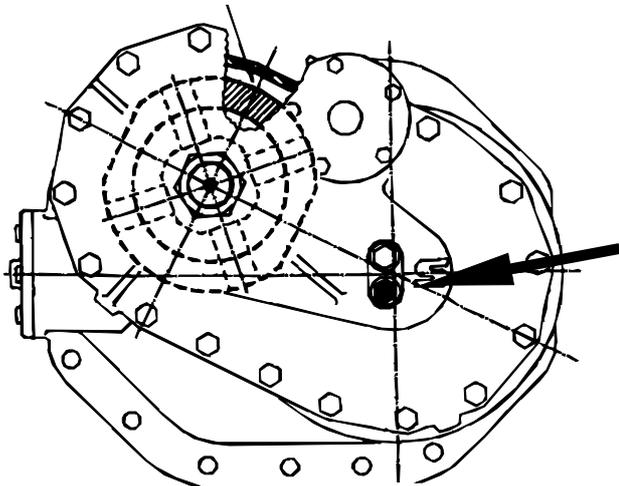
OIL CHECKS AND OIL CHANGES

When filling oil, always fill first the hubs and then the differential.
Always use new seal rings in oil plugs.

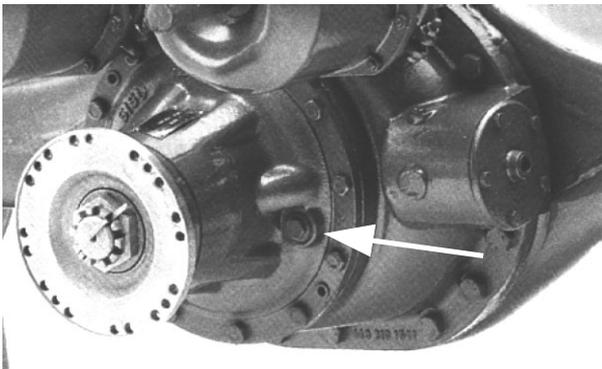
Oil quantities are listed on Page 11.

Differential oils

With the vehicle on level ground, oil level must be to bottom of inspection plug as shown (arrows in Pictures 16. and 17.) for most vehicle applications.



Picture 16. Oil level plug on forward (FRMP/FRFP-13/16) Tandem/Tridem axle.



Picture 17. Oil level plug for rear (FRDP-13/16) tandem axle.

Planetary wheel hub oils

Oil level in the planetary wheel hub gears must be at the level of the check plug opening (arrow in Picture 18.).

Check levels with the drain plug of the hub in its lowest position.

Fill with a pump with the nozzle fitting the level plug opening tightly to force oil past the gearing.

Check the differential oil level afterwards.



Picture 18. Oil level plug in the planetary wheel hub.

TORQUE VALUES

Description	Nm	Lb.-ft
Wheel nuts	550...650	406...480
Carrier housing to axle housing cap screws	240	177
Planetary gear aluminum cover bolts (5xM8, early design)	20	15
Planetary gear aluminum cover bolts (8xM6, later design)	9	7
Planetary gear cast iron cover bolts (8xM6)	16	12
Planet gear shaft locking ring bolts (10xM10)	45	34
Oil plugs	50-70	37-52

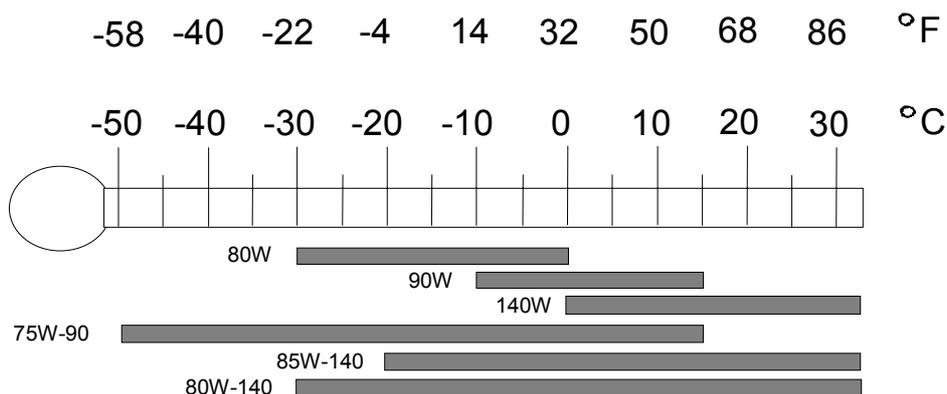
LUBRICATION

Oil viscosity & quality:

Axle oil quality API GL-5; use of synthetic oil is permitted too.

Viscosity according to prevailing ambient temperature as shown on the accompanying table.

We suggest in very cold operation conditions "full synthetic" SAE 75w-90 and in very hot conditions SAE 140 oil types.



OIL VOLUMES:

Filling volumes approx. -

Pinion in horizontal position

Metric U.S.

FRMP-13/16 and FRFP-13/16 axles differential	24 ltrs.....	51 pints
FRMP-13/16 and FRFP-13/16 axles total	26 ltrs.....	55 pints
FRDP-13-/16 axle differential	18 ltrs.....	38 pints
FRDP-13-/16 axle total	20 ltrs.....	42 pints
Wheel hubs, each	1 ltrs.....	2 pints
<i>Wheel hubs with cooled covers, each</i>	<i>2 ltrs.....</i>	<i>4 pints</i>
<i>FRMP-13/16 and FRFP-13/16 axles with cooled covers, total</i>	<i>28 ltrs.....</i>	<i>59 pints</i>
<i>FRDP-13-/16 axle with cooled covers, total</i>	<i>22 ltrs.....</i>	<i>46 pints</i>

SPECIAL TOOLS

Adjustment wrench for wheel hub bearing nut 099-290-8003 up to February 1998	7143-024-020
Adjustment wrench for the new design of the wheel hub adjusting nut 599-290-8004 from February 1998	7543-050-020

TECHNICAL DATA

Axle housings	Fabricated of pressed steel plate in both Standard and heavy duty models
Planetary wheel hub gears	5 planetary gear design, ratio 3.636 : 1
Clearance of wheel hub bearing	0 - 0.05 mm [0 - 0.002 in]

CHANGE IN WHEEL HUB SEALING

The type of hub sealing has changed mainly in the heavy front and rear truck drive axles. The hub sealing has changed also in the industrial SRDP-30-S and SSDP-18 axles. In the new wheel hub seal the pre-shielding before the actual sealing lip is better than in the older seal type. The outer shell of the new seal is rubber coated compared to the older seal where the outer surface was metal.

In addition, the dimensions of the seals have changed, except the inner diameter of the rear axle hub seal. The new dimensions are based on the International System of Units. The diameter dimensions of the rear axle seal are 127/160 mm (earlier 127/159) and respectively in the front axle seal 150/180 mm (earlier 133.4/187.5).

Cause of Change:

To improve sealing life and to prevent seal leaks.

Identify and Changed Parts:

Front Axles: FSDP-14, FSFP-14, FSMP-14, SSDP-18-G and also non-drive FSND-12 & FSFN-14.

Changed Parts in Front Axles:

Description	Old Part No.	New Part No.
Shaft seal	591122-13301	591122-15001
Spacer Ring	540-415-1010	540-415-1300
O-Ring Ø133*2.62 mm	--	91101-33026
Wheel Hub (FSXX-12/14 Axles)	541-411-1401	541-411-1410
Wheel Hub (SSDP-18 Axles)	541-411-1402	541-411-1412

Rear Axles: FRDP-11/13/16, FRMP-11/13/16, FRFP-11/13/16 and SRDP-30-S

Changed Parts in rear Axles:

Description	Old Part No.	New Part No.
Shaft Seal	91122-12701	591122-12702
Wheel Hub (FRDP/FRMP/FRFP-11/13/16 and SRDP-30-S Axles)	143-441-0410	543-441-0700
Wheel Hub, (FRDP/FRMP/FRFP-11/13/16 Axles with Al-Rims)	543-441-0600	543-441-0710
Wheel Hub (FRDP/FRMP/FRFP-11/13/16 with Compact Hub)	543-411-3510	543-411-3800

Interchangeability in Service:

It is not possible to install parts of the new design individually to an axle of the earlier design.

The new hub sealing is possible to install to the earlier design as follows:

Front Axles: Wheel hub, spacer ring, seal and o-ring to be replaced together.

Rear Axles: Wheel hub and seal to be replaced together.

Date of Change:

Axle Type	Serial No.	Date
FRDP/FRMP/FRFP-11/13 axles with compact hub	20322	February 2002
FRDP/FRMP/FRFP-13/16 axles (BTE-hub)	20580	March 2002
FSDP/FSFP/FSMP/FSFN-14, FSND-12, FSFN-14 & SSDP-18-G axles	20287	February 2002
SRDP-30-S axles	22055, 22072, 22073 and all since 22221	September 2002

Installing of the Hub Seals:

Following installing tools should be used when driving the new seal into it's place

- Seal 591122-12702 with tool **7543-071-020**.
- Seal 591122-15001 with tool **7541-040-150**.

Note! No sealing compound is allowed to use in installing.

The new seal type has rubber coated outer surface for sealing the gap between seal and seal housing.

When installing the assembled hub, the axle spindle has to wiped with blend of alcohol and water (1:1) to prevent friction between the spindle and the hub seal.

Oiling is not recommended because there are risk of the seal inner race turning with the hub on the axle spindle.

If installed dry, the internal pre-shielding in the hub seal may damage as result of the axial pressure.