ADVANCED BRAKING TECHNOLOGY

FAILSAFE WORKSHOP MANUAL

ISUZU NPS 300

1. Revision History

Revision	Issue Date	Author	Comments
1	06 Feb 2015	J. Leighton	Initial Release
2	21 May 2015	J. Leighton	Sections 8, 10, 11, 12 and 19 updated. Section 13 added.
3	06 Feb 2017	M. O'Driscoll	Sections 6, 8, 9, 14, 15, 16, 17 and 18 updated.
4	21 Nov 2018	M. Cornelius	Sections 8-11, 13, 16-18, 28 Updated. Added sections 19-27.

2. Table of Contents

3. Important Information

This manual applies to the fourth generation ABT™ Failsafe for the Isuzu NPS 300. The manual details how to install the ABT™ Failsafe system correctly to ensure optimum safety and performance. All information contained in this manual is based on the latest ABT™ Failsafe product information available at the time of publication.

This manual should be read in conjunction with the appropriate Isuzu vehicle manual for further information on removal and installation of any standard Isuzu components.

While every effort has been made to address all aspects of installation and servicing, please advise Advanced Braking of any omissions or suggestions on how this manual may be improved.

Advanced Braking Pty Ltd reserves the right to change the manual at any time without prior notice.

The most up to date version of the manual can be obtained by contacting the ABT Customer Service Manager.

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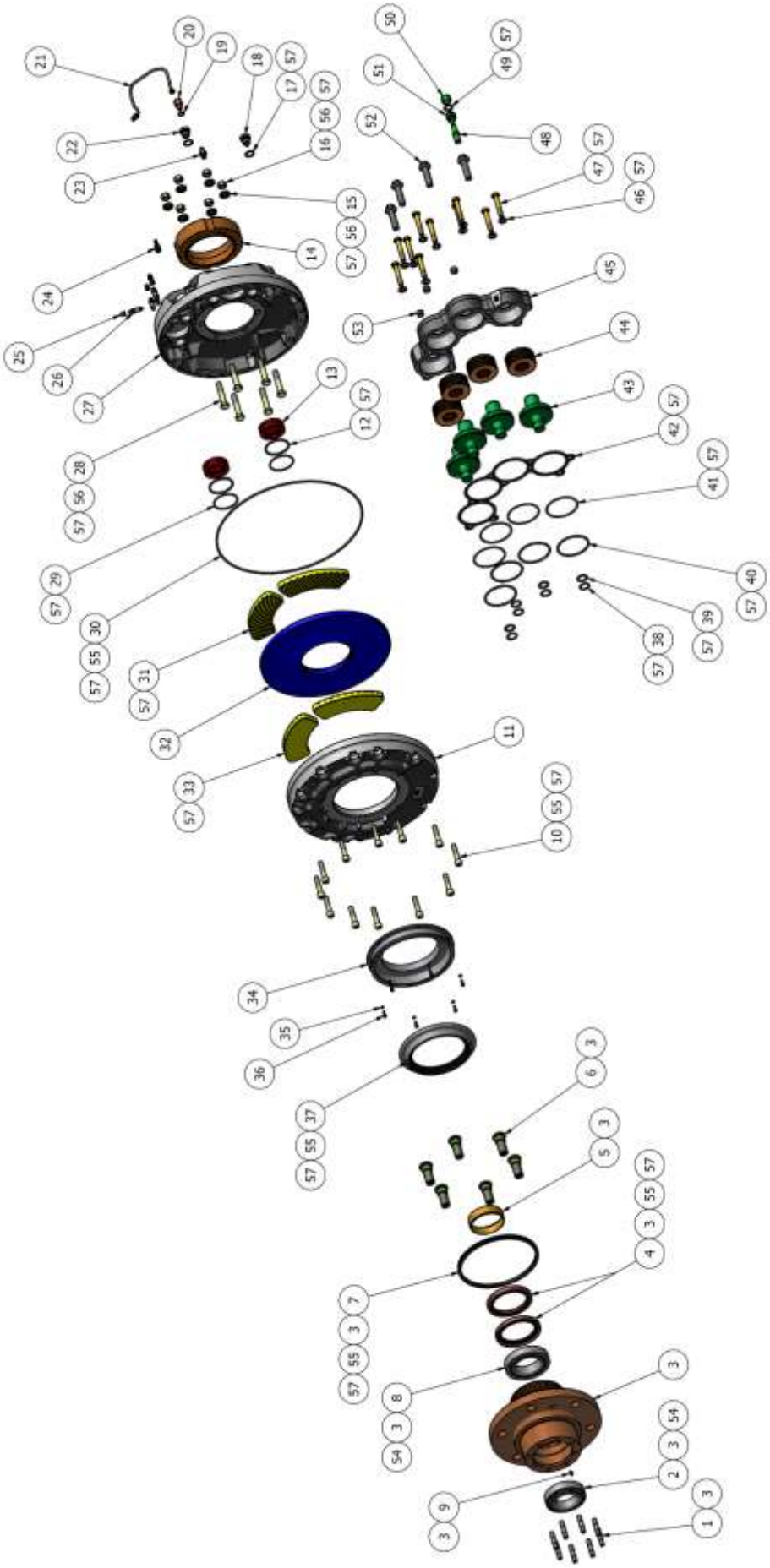
4. Terminology

ABS	Anti-lock braking system
ATF	Automatic transmission fluid
DPS	Door proximity system
Emergency Brake	Brakes automatically applied in an emergency
EMMA™	Electronically Modulated Mechanically Applied
HSI	Highway speed isolation
OEM	Original equipment manufacturer
Park Brake	Brakes applied independently of the service brake
PWI	Pad wear indicator
Service Brake	Brakes applied when driving via the foot pedal
ABT™ Failsafe	Wheel end mounted fully sealed brake with SAHR
ABT™ "Blend 20"	Specially formulated cooling fluid for use in ABT™ Failsafe and Failsafe Emergency brakes

5. Exploded Views & Parts Lists - Rear Brake Assembly

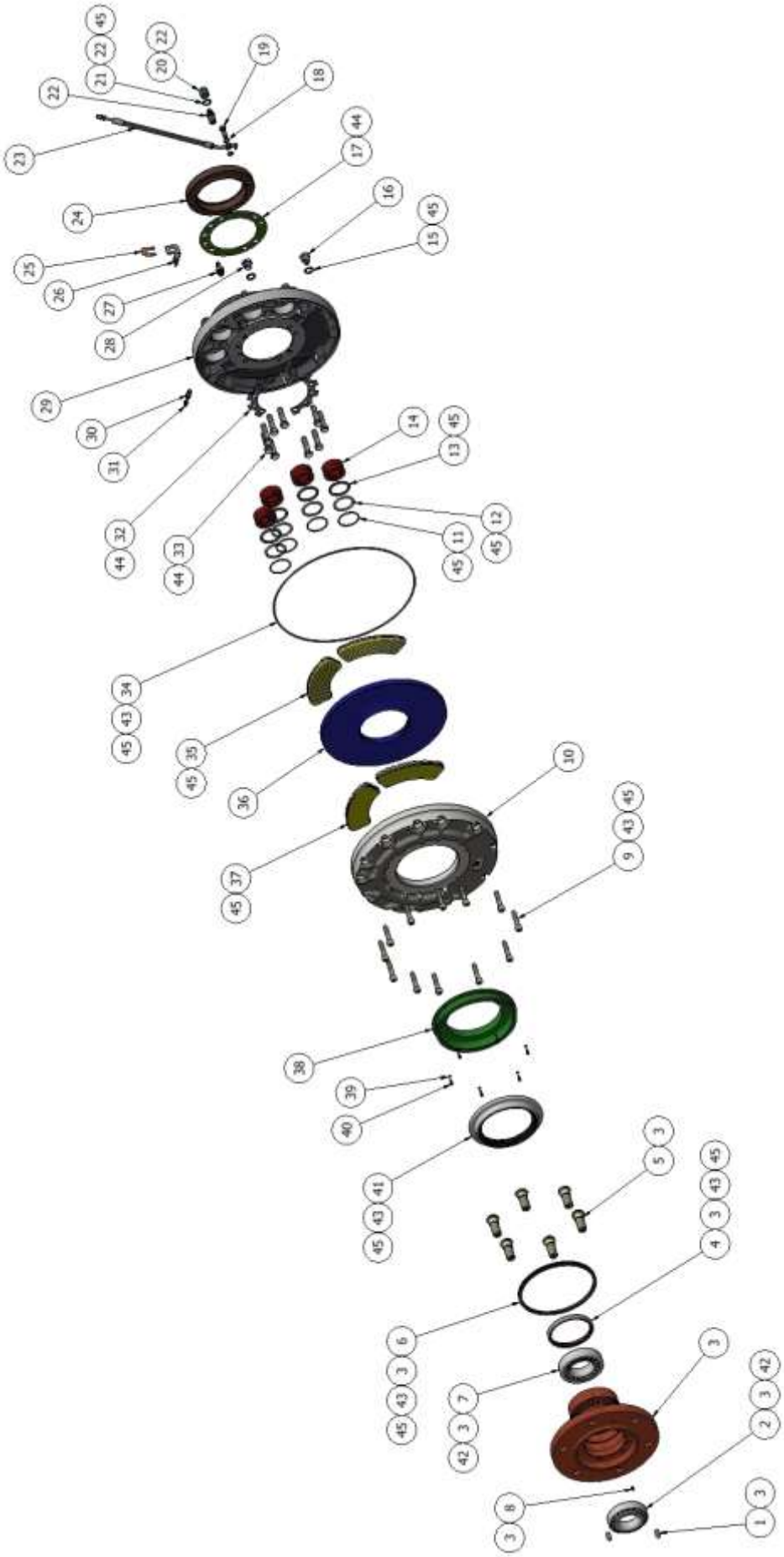


ITEM	PART NO.	DESCRIPTION	QTY/KIT (2 BRAKES)	TORQUE (Nm)
1	17-9000	STUD AXLE DRIVE	16	-
	-	NUT AXLE DRIVE	16	-
2	31-6003	BEARING WHEEL OUTER	2	-
3	17-4000	HUB ASSEMBLY REAR LH	1	-
	17-4001	HUB ASSEMBLY REAR RH	1	-
4	31-4005	SEAL HUB	4	-
5	17-2009	SLEEVE SHAFT REAR	2	-
6	17-2010	STUD WHEEL LH	6	-
	17-2011	STUD WHEEL RH	6	-
	-	NUT WHEEL	12	-
7	31-4006	SEAL V-LIP OUTER	2	-
8	31-6002	BEARING WHEEL INNER	2	-
9	31-5015	NIPPLE GREASE	2	8
10	30-0014	BOLT HOUSING	24	50
11	17-2004	HOUSING OUTER LH	1	-
	17-2005	HOUSING OUTER RH	1	-
12	31-2011	O-RING SERVICE PRIMARY REAR	4	-
13	17-2008	PISTON SERVICE REAR	4	-
14	17-2002	FLANGE MOUNTING REAR BRAKE	2	-
15	30-2009	WASHER MOUNTING REAR BRAKE	12	-
16	30-1001	NUT MOUNTING REAR BRAKE	12	-
17	30-2003	WASHER SEALING COPPER	4	-
18	25-2039	DRAIN PLUG	2	20
19	30-2004	WASHER SEALING COPPER	2	-
20	31-5026	CONNECTOR PIPE SERVICE BRAKE	2	20
21	17-4006	LINK PIPE SERVICE BRAKE	2	15
22	25-2038	FILL PLUG	2	20

23	31-5000	CONNECTOR HOSE EMMA	2	20
24	31-5025	CONNECTOR HOSE BREATHER	2	15
25	31-9000	CAP BLEED NIPPLE	8	-
26	31-5001	BLEED NIPPLE	8	15
27	17-5008	HOUSING INNER REAR LH W/PINS	1	-
	17-5009	HOUSING INNER REAR RH W/PINS	1	-
28	30-0009	BOLT MOUNTING REAR BRAKE	12	100
29	31-2012	O-RING SERVICE WIPER REAR	4	-
30	31-2006	O-RING HOUSING	2	-
31	25-4029	BRAKE PAD – CW	4	-
32	17-2003	ROTOR	2	-
33	25-4030	BRAKE PAD - ACW	4	-
34	17-2006	CARRIER HOUSING SEAL	2	-
35	30-2010	WASHER SPRING SEAL CARRIER MOUNTING	12	-
36	30-0010	BOLT SEAL CARRIER MOUNTING	12	-
37	31-4004	SEAL CASSETTE HOUSING	2	-
38	31-2001	BACK-UP RING EMMA SMALL	8	-
39	31-2000	O-RING EMMA SMALL	8	-
40	31-2002	O-RING EMMA LARGE	8	-
41	31-2003	BACK-UP RING EMMA LARGE	8	-
42	25-2061	GASKET SPRING COVER	2	-
43	17-2014	PISTON EMMA 44	8	-
44	31-0002	DISC SPRING	64	-
45	25-2010	SPRING COVER LH	1	-
	25-2011	SPRING COVER RH	1	-
46	30-2000	WASHER SPRING COVER	20	-
47	30-0008	BOLT SPRING COVER	20	60
48	25-2040	PLUNGER PAD WEAR INDICATOR	2	15
49	30-2005	WASHER SEALING PAD WEAR INDICATOR	2	-

50	25-2042	CAP PAD WEAR INDICATOR	2	10
51	25-2041	GLAND PAD WEAR INDICATOR	2	15
52	30-0028	RETRACTOR BOLT	8	80
53	31-5004	PLUG SPRING COVER	6	10
54	17-5002	KIT WHEEL BEARING PAIR REAR SET	1	-
55	17-5006	KIT INSPECTION REAR SET	1	-
56	17-5004	KIT MOUNTING REAR SET	1	-
57	17-5000	KIT SERVICE REAR SET	1	-

6. Exploded Views & Parts Lists - Front Brake Assembly



ITEM	PART NO.	DESCRIPTION	QTY/KIT (2 BRAKES)	TORQUE (Nm)
1	30-3003	DOWEL PIN	4	-
2	31-6005	BEARING WHEEL OUTER	2	-
3	17-4011	HUB ASSEMBLY FRONT LH	1	-
	17-4012	HUB ASSEMBLY FRONT RH	1	-
4	17-2019	SEAL HUB	2	-
5	17-2010	STUD WHEEL LH	6	-
	17-2011	STUD WHEEL RH	6	-
	-	NUT WHEEL	12	-
6	31-4006	SEAL V-LIP OUTER	2	-
7	31-6004	BEARING WHEEL INNER	2	-
8	31-5015	NIPPLE GREASE	2	8
9	30-0014	BOLT HOUSING	24	60
10	17-2004	HOUSING OUTER LH	1	-
	17-2005	HOUSING OUTER RH	1	-
11	31-2015	O-RING SERVICE WIPER FRONT	8	-
12	31-2016	BACK-UP RING SERVICE FRONT	8	-
13	31-2014	O-RING SERVICE PRIMARY FRONT	8	-
14	17-2020	PISTON SERVICE FRONT	8	-
15	30-2003	WASHER SEALING COPPER	4	-
16	25-2039	DRAIN PLUG	2	20
17	17-2023	GASKET SPINDLE FRONT	2	-
18	30-2004	WASHER SEALING COPPER	4	-
19	31-5009	BOLT BANJO	2	20
20	25-2055	CAP PAD WEAR INDICATOR	2	10
21	30-2005	WASHER SEALING PAD WEAR INDICATOR	2	-
22	25-4028	PAD WEAR INDICATOR ASSEMBLY FRONT	2	15
23	17-4016	BRAKE HOSE FRONT	2	-

24	17-2017	FLANGE MOUNTING FRONT BRAKE	2	-
25	31-9002	CLIP RETAINING BRAKE HOSE	2	-
26	17-2046	BRACKET BRAKE HOSE FRONT	1	-
27	31-5025	CONNECTOR HOSE BREATHER	2	-
28	25-2038	FILL PLUG	2	20
29	17-5010	HOUSING INNER FRONT LH W/PINS	1	-
	17-5011	HOUSING INNER FRONT RH W/PINS	1	-
30	31-5001	BLEED NIPPLE	2	15
31	31-9000	CAP BLEED NIPPLE	2	-
32	17-2021	LOCK TAB FRONT	4	-
33	30-0016	BOLT MOUNTING FRONT BRAKE	18	-
34	31-2006	O-RING HOUSING	2	-
35	25-4029	BRAKE PAD – CW	4	-
36	17-2003	ROTOR	2	-
37	25-4030	BRAKE PAD - ACW	4	-
38	17-2006	CARRIER HOUSING SEAL	2	-
39	30-2010	WASHER SPRING SEAL CARRIER MOUNTING	12	-
40	30-0010	BOLT SEAL CARRIER MOUNTING	12	-
41	31-4004	SEAL CASSETTE HOUSING	2	-
42	17-5003	KIT WHEEL BEARING PAIR FRONT SET	1	-
43	17-5007	KIT INSPECTION FRONT SET	1	-
44	17-5005	KIT MOUNTING FRONT SET	1	-
45	17-5001	KIT SERVICE FRONT SET	1	-

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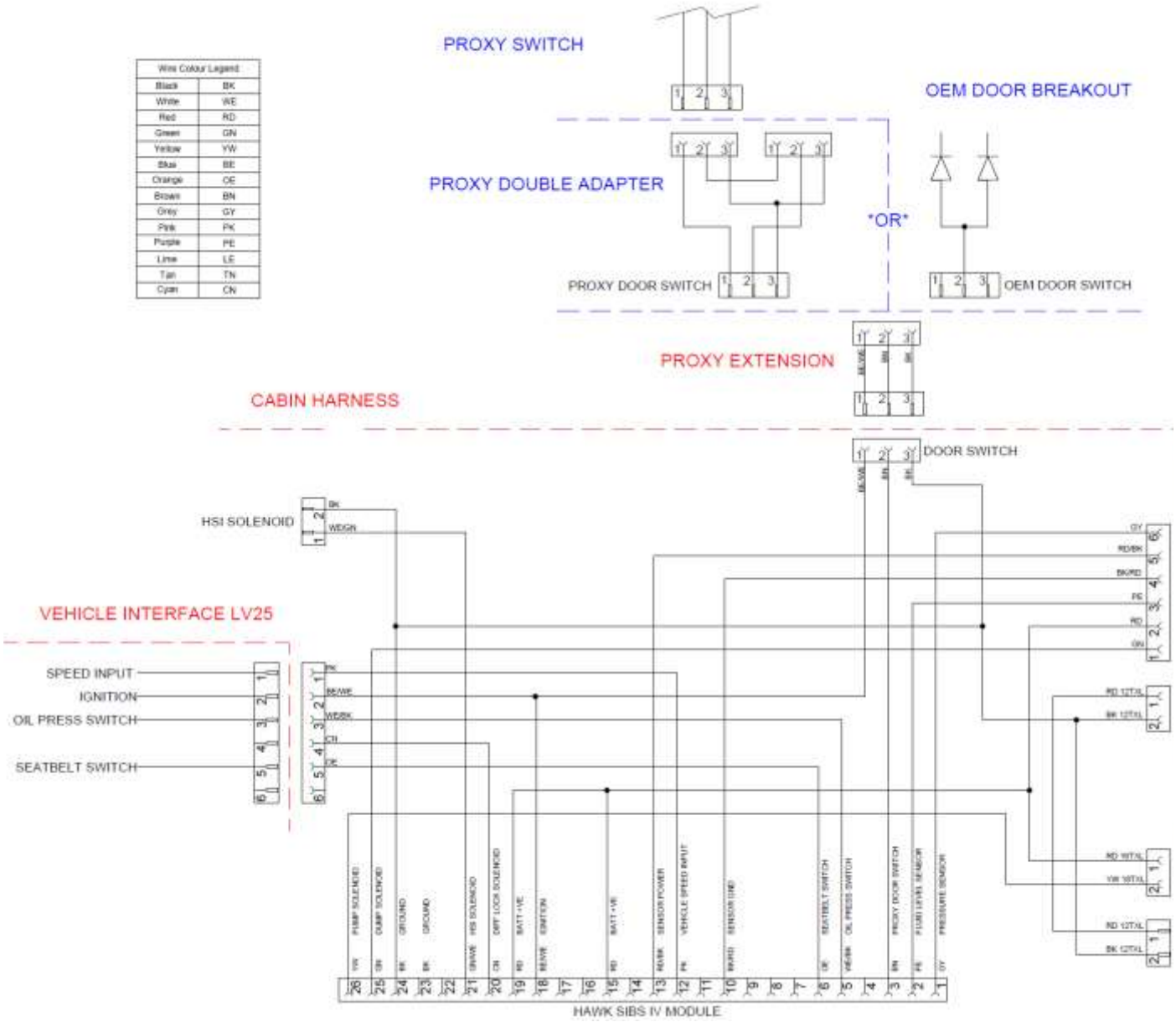
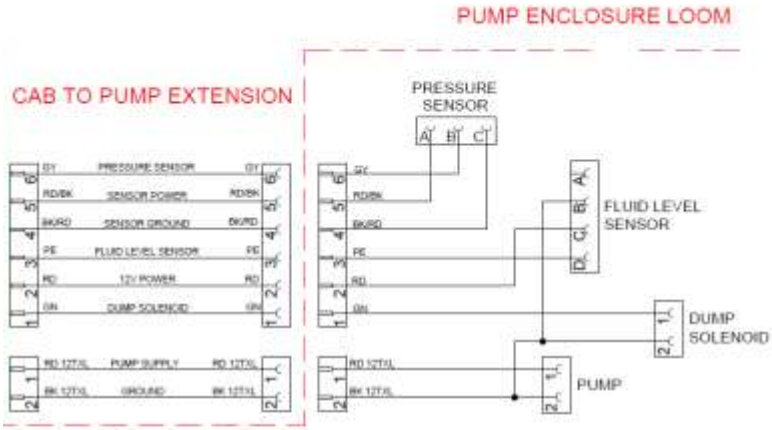
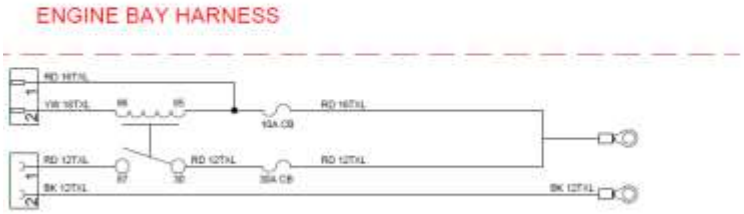
7. Wiring Diagram




PUMP ENCLOSURE LOOM
CAB TO PUMP EXTENSION
PRESSURE SENSOR
FLUID LEVEL SENSOR
DUMP SOLENOID
PUMP


ENGINE BAY HARNESS

8. Installation – Rear Brakes

1. Ensure all OEM Isuzu rear brake equipment has been removed from the vehicle:
   a. Remove both rear brake assemblies.
   b. Remove the two hydraulic brake lines across the rear axle.
2. Remove the handbrake lever from inside the cab and handbrake cable.
3. Clean the axle flange and spindle to remove any grease, dirt and gasket remains. If the flange is damaged or corroded it must be cleaned thoroughly with abrasive paper.

Figure 8-1: Clean axle flange.

4. Check the condition of the wheel bearing seal running surface. If the surface shows signs of degradation (e.g. corrosion or wear) repair by lightly sanding with abrasive paper, then wipe clean.
5. Apply Loctite 635 to the wheel bearing seal running surface and to the inside of the shaft sleeve (17-2009) provided in the ABT™ Failsafe kit.
6. Attach shaft sleeve to the shaft with the inside chamfer facing the centre of the vehicle and allow Loctite to cure.

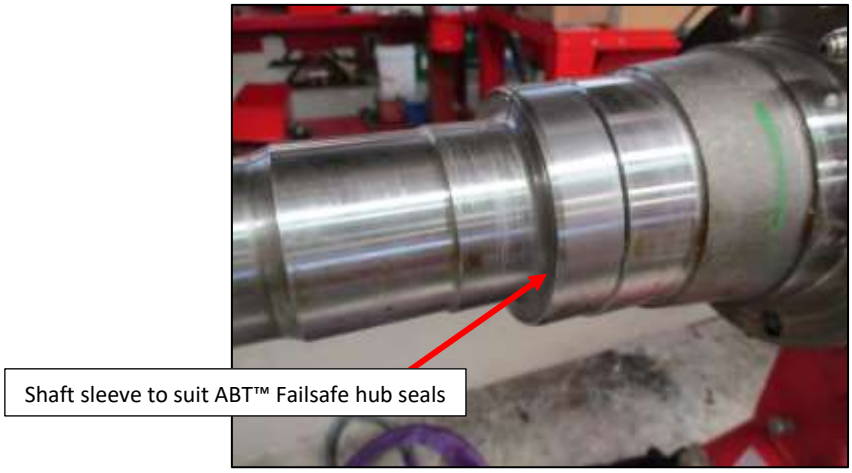


Figure 8-2: Attach shaft sleeve.

7. For vehicles fitted with ABS, find the ABS sensor mounting plate. Place it up against the flange and mark the spot where the ABS sensor meets the flange. Cut a slot in the flange for the ABS sensor wire.

   Note: Make sure to remove sharp edges and burs from the slot to ensure the wire is not damaged whilst in operation.

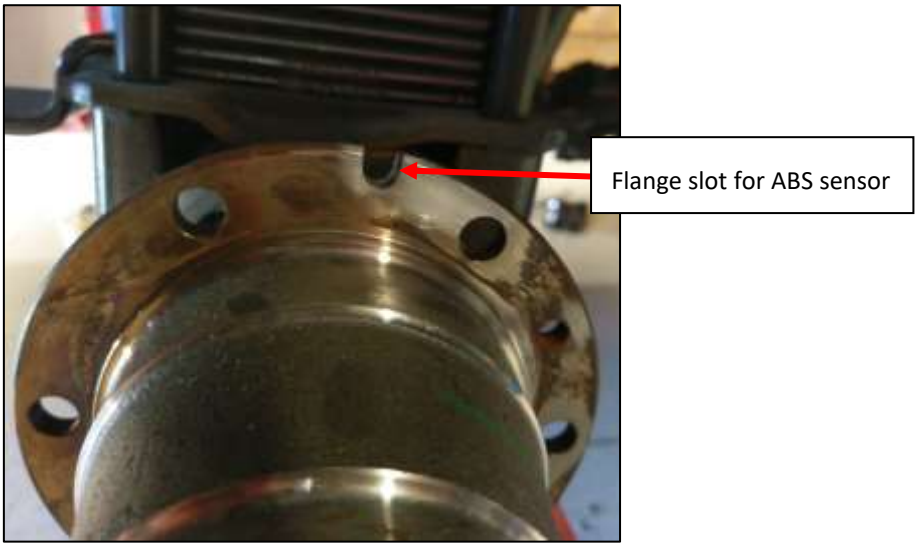


Figure 8-3: Flange slot for ABS sensor

8. Each brake unit is stamped with its corresponding position on the vehicle and must be installed accordingly. Stamp location is towards the bottom of the outer housing.
   a. LH = Left Hand
   b. RH = Right Hand
9. Each hub assembly is stamped with its corresponding position on the vehicle and must be installed accordingly. Stamp location is on the head of each wheel stud.
   a. L = Left Hand
   b. R = Right Hand
10. Remove the 12x M10 bolts from around the circumference of the outer housing.
11. Remove the inner housing from the assembly taking care not to damage the brake pads.
12. Apply Loctite 515 to the side of the brake mounting spacer where it mates to the inner housing in the corner of the lip and the face.
13. Attach the brake mounting spacer to the inner housing ensuring the holes are aligned. Tap the mounting spacer with a soft mallet to ensure it is fully in position.

Figure 8-4: Attach mountng spacer to inner housing.

14. Apply Loctite 515 to the vehicle axle flange face.

15. Locate the brake inner housing and mounting spacer on the axle flange face. Align the mounting holes. Use the drain plug as a guide, this is positioned towards the bottom of the brake when attached to the vehicle. The pistons and service brake inlet port are positioned towards the front of the vehicle.

16. Apply Loctite 515 under the heads of the brake mounting bolts and attach the disc-lock washers.

17. Apply Loctite 515 to the disc-lock washers.

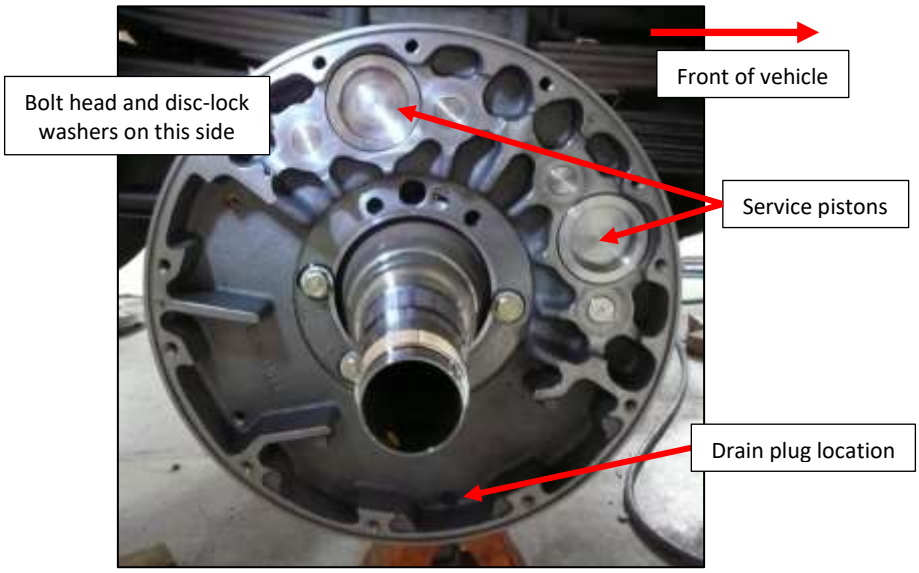


Figure 8-5: Attach mountng spacer and inner housing to vehicle.

18. For vehicles equipped with ABS:

    a. Attach the 4 x M12 lowermost brake mounting bolts and hex nuts and tighten hand tight.

    b. Remove the ABS sensor and mounting bolt from the rear Isuzu brakes.

    c. Remove the sleeve and gromet from the ABS sensor cable.

    d. Attach the ABS sensor to the mounting plate provided.

Figure 8-6: Attach ABS sensor to the mounting plate (Apply Loctite 515 to this side).

    e. Apply Loctite 515 between the sensor mounting plate and the brake inner housing.

    f. Feed the ABS sensor plug and cable through the hole in the brake inner housing and attach the sensor mounting plate.

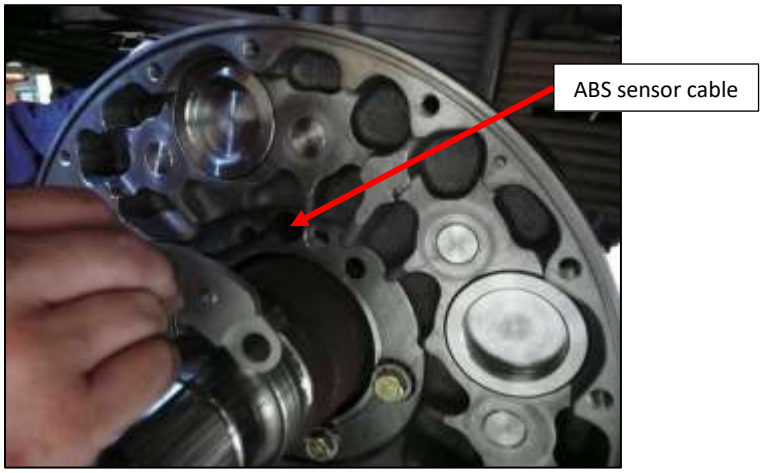


Figure 8-7: Attach the sensor to the inner housing.

g. Attach the 2 x M12 remaining brake mounting bolts and Hex nuts.

Figure 8-8: Inner housing attached to vehicle.

19. For vehicles not equipped with ABS. Bolt the inner housing onto the axle flange with the 6 x M12 brake mounting bolts and hex nuts.

20. Torque the 6x brake mounting bolts in a star pattern to 100 Nm. Repeat this process 3x times over a 5-minute period.

21. Install the inner brake pads in the inner housing ensuring correct orientation. A location pin on the brake pads will assist.

22. Find the outer housing Fill the cavity that sits behind the V-lip seal with a high temperature bearing grease (Castrol LMX recommended)

Figure 8-9: Greased V-Seal cavity

23. Find and place the hub assembly on a clean bench with studs facing down.

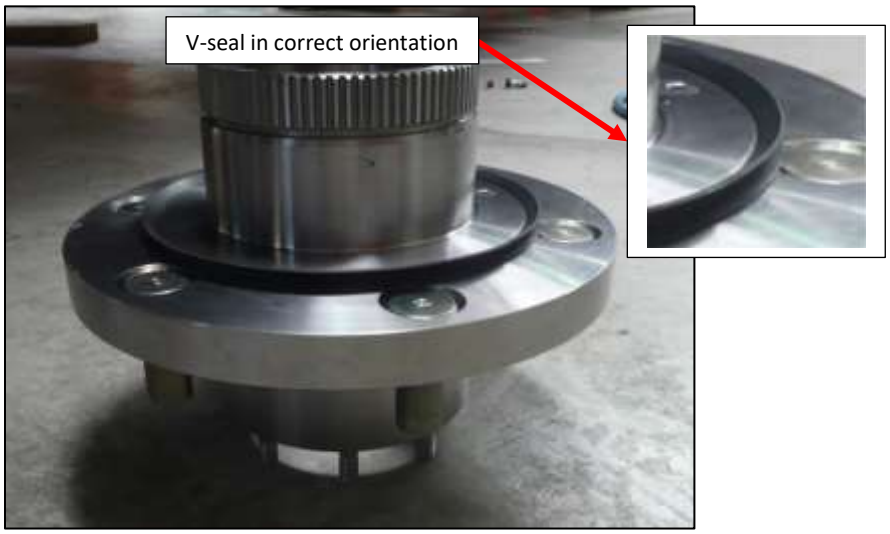


Figure 8-10: Hub assembly.

24. Give the V-seal a gentle stretch and attach it to the hub assembly.

25. Place the outer housing over the hub assembly.

26. Install the outer brake pads ensuring correct orientation. A location pin on the brake pads will assist.

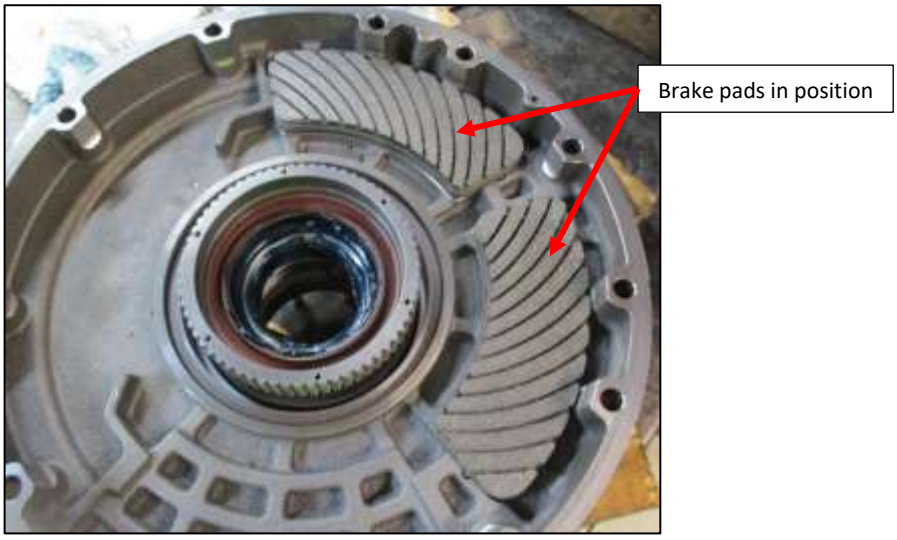


Figure 8-11: Outer housing attached to hub assembly.

27. Install the brake rotor onto the hub in the correct orientation, where the extruded side of the disk is facing towards the hub.

Figure 8-12: Brake rotor attached to hub assembly.

28. For vehicles equipped with ABS:

    a. Locate the M4 spring washers onto the cap head bolts for mounting the ABS rotor.

    b. Apply Loctite 222 to the first 5 threads of the ABS rotor mounting bolts.

    c. Attach the ABS rotor to the hub.

Figure 8-13: ABS rotor attached to hub assembly.

d. Torque 6x ABS rotor mounting bolts to 5 Nm and allow Loctite to cure.

29. Lubricate the hub inner lip seal with silicone grease, coat the shaft area with high temperature bearing grease and carefully fit the outer housing, hub and rotor assembly to the inner housing on the vehicle. 2x guide pins may assist with fitment.

Figure 8-14: Attach the outer housing/hub/rotor assembly onto inner housing.

30. Fit the 12x M10 bolts and torque to 60 Nm in sequence. Ensure each bolt is torqued twice.

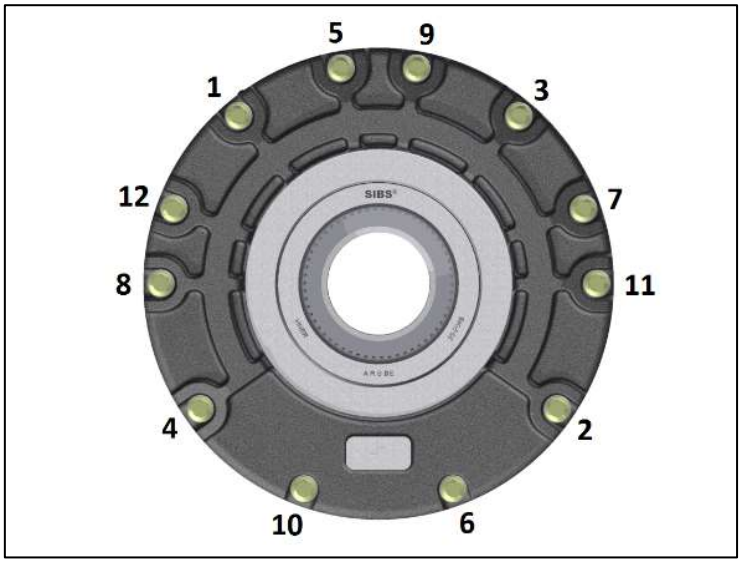


Figure 8-15: Housing bolt torque sequence.

31. Fit the outer wheel bearing assembly, refer to Isuzu manual for a detailed description.

32. Install the axle half shafts in accordance to Isuzu manual specifications and top up the differential oil as required.

33. Remove the 4x retractor bolts from the spring cover.

34. Fit the pad wear indicator to the lowest piston:

    a. Screw the pad wear indicator plunger into the lowest piston thread and torque to 15 Nm.

    b. Apply Loctite 222 to the gland fitting on the thread that attaches to the spring cover only.

    c. Fit the gland fitting over the piston and screw this into the spring cover. Torque to 15Nm.

    d. Fit the stainless steel protective cap and fibre washer to the gland fitting.

    e. Fit 3x supplied tapered plugs to seal the remaining holes in the spring cover. Use an anti-seize or a low strength thread locker on the threads to prevent the plugs seizing in the spring cover. The hex sockets may be filled with silicone or similar, to aid future removal.

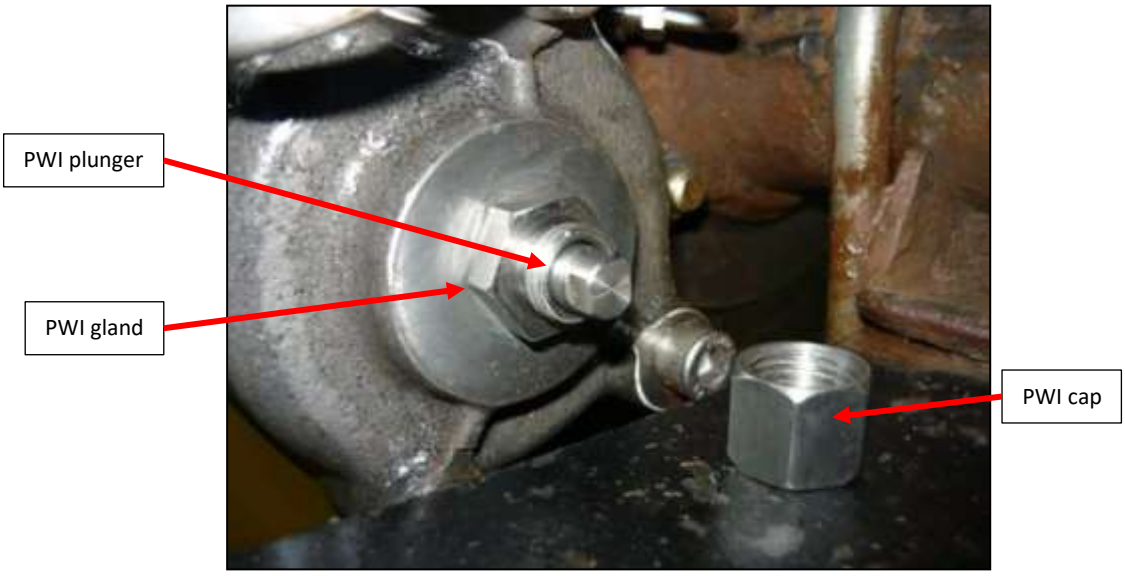


Figure 8-16: Pad wear indicator install in spring cover.

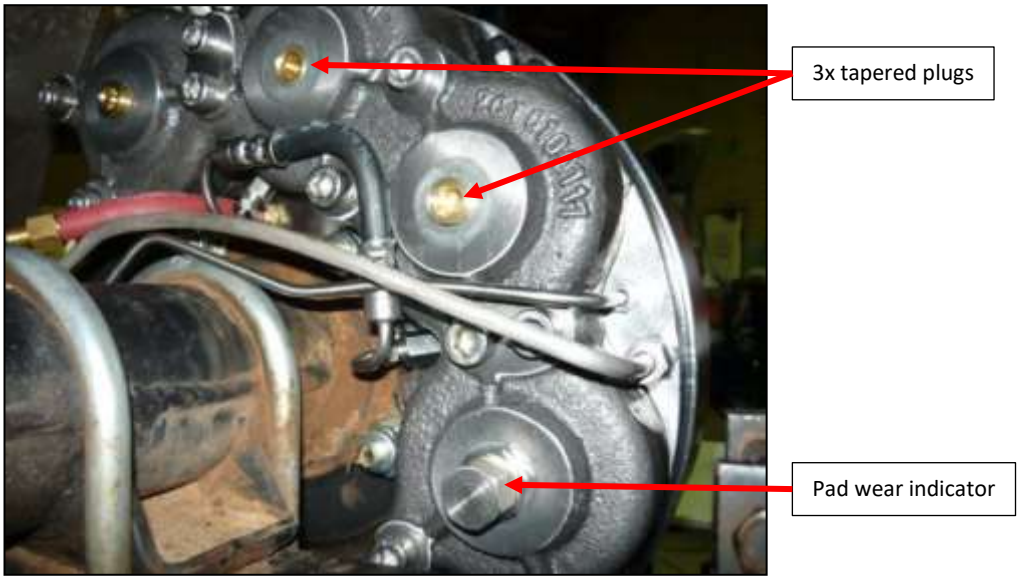


Figure 8-17: ABT™ Failsafe brake unit.

35. Remove the ABT™ “Blend 20” cooling fluid fill plug.

36. Fill the ABT™ Failsafe brake unit with new ABT™ “Blend 20” cooling fluid and refit the fill plug and copper washer. Approximately 800ml of ABT™ “Blend 20” cooling fluid is required per rear brake unit.

37. Repeat for the opposing brake unit.

38. Fit the expansion chambers with breather cap and breather hose:

    a. Mount the expansion chambers as high as possible in a protected location on the vehicle. ABT recommends inside the chassis rail or on the chassis cross-member above the brake towards the rear of the vehicle.

    b. Secure using supplied mounting hardware.

Figure 8-18: Expansion Chamber.

    c. Route the breather hose from the brake unit up to the chassis rail. Then along the chassis rail to a suitable location. Secure the hose along the chassis using supplied P-clips where possible. Allow extra length in the hose for axle articulation and avoid any hot or moving components.

    d. Ensure there are no kinks or low points in the breather hose.

9. Installation – Front Brakes

1. Ensure all OEM Isuzu front brake equipment has been removed from the vehicle:
   a. Remove both front brake assemblies.
   b. Remove the flexible hydraulic hoses from the front brakes to the OEM knuckle.
2. Clean the axle flange and spindle to remove any grease, dirt and gasket remains. If the flange is damaged or corroded it must be cleaned thoroughly with abrasive paper.

Figure 9-1: Clean axle flange and prepare gasket.

3. Check the condition of the wheel bearing seal running surface. If the surface shows signs of degradation (e.g. corrosion or wear) repair by lightly sanding with abrasive paper, then wipe clean.
4. Each brake unit is stamped with its corresponding position on the vehicle and must be installed accordingly. Stamp location is towards the bottom of the outer housing.
   a. LH = Left Hand
   b. RH = Right Hand
5. Each hub assembly is stamped with its corresponding position on the vehicle and must be installed accordingly. Stamp location is at the head of each wheel stud.
   a. L = Left Hand
   b. R = Right Hand
6. Remove the 12x M10 bolts from around the circumference of the outer housing.
7. Remove the inner housing from the assembly taking care not to damage the brake pads.
8. Attach the front brake hose to the inner housing.
9. Apply Loctite 515 to the side of the brake mounting spacer where it mates to the inner housing in the corner of the lip and the face.
10. Attach the brake mounting spacer to the inner housing ensuring the holes are aligned. Tap the mounting spacer with a soft mallet to ensure it is fully in position.

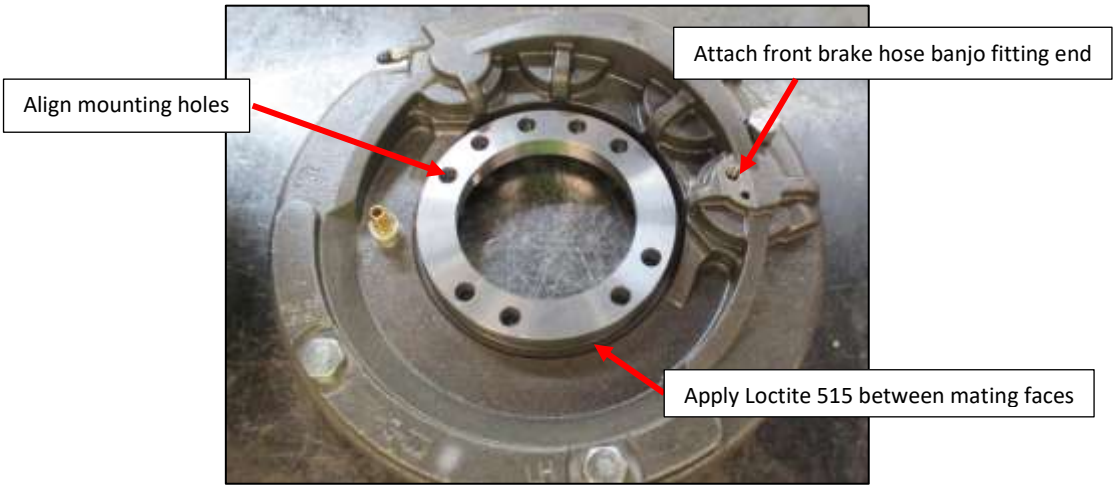


Figure 9-2: Attach mountng spacer to inner housing.

11. Apply Loctite 515 to both sides of the supplied gasket and attach to the vehicle spindle.
12. Locate the brake inner housing and mounting spacer on the axle flange face. Align the mounting holes, 5 towards the top and 4 towards the bottom.
13. Apply Loctite® 515™ flange sealant to the underside of the 9x M10 brake mounting screw heads.
14. Bolt the inner housing onto the stub axle flange with the 9x M10 brake mounting screws ensuring the lock-tabs are in position under the bolts. 2x guide pins may assist with fitment.
15. Torque the 9x brake mounting screws in a star pattern to 80 Nm. Repeat this process 3x times over a 5-minute period.
16. Bend over the lock tabs to secure the 9x brake mounting screws.

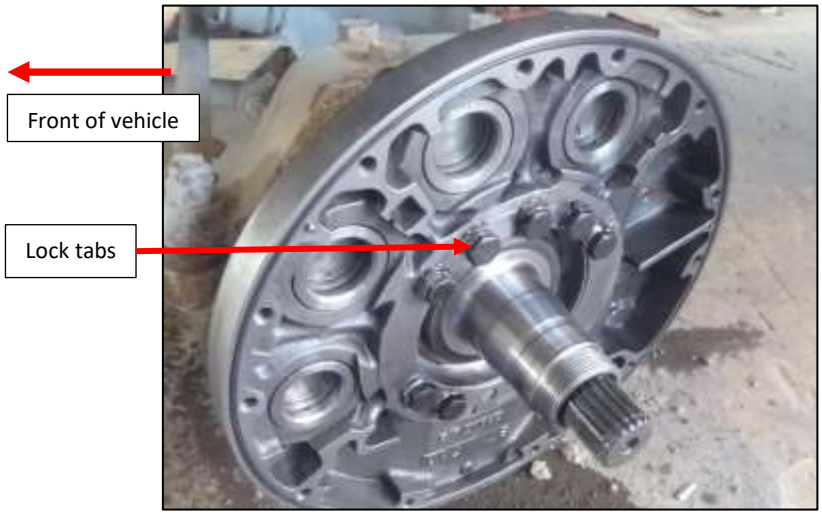


Figure 9-3: Bend lock-tabs over bolt heads.

17. Attach the front brake hose bracket to the top of the steering knuckle at the rear inner bolt. Position the bracket to suit the brake hose lengths.
18. Once bracket is in position, torque bolt to 147 Nm.
19. Attach the Isuzu brake hose to the bracket and secure using the brake hose retaining clip.

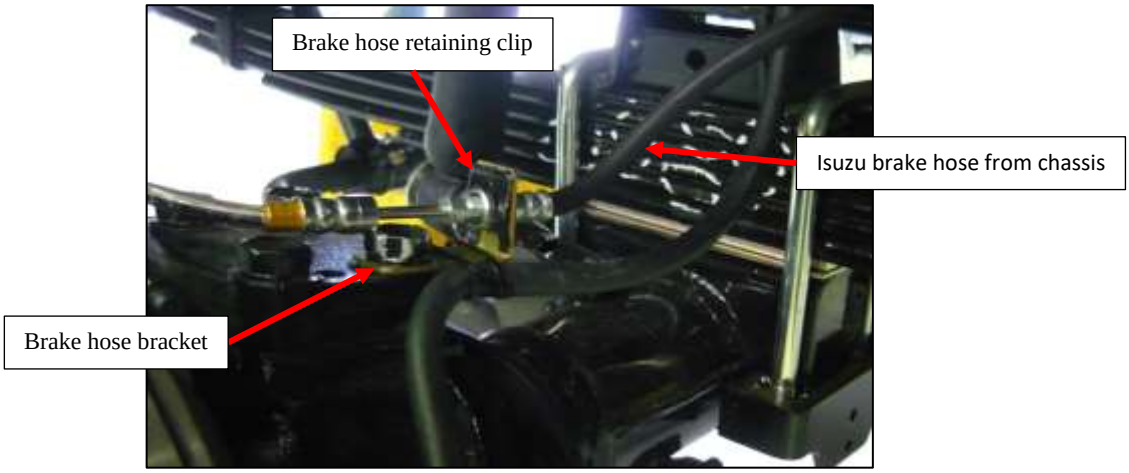


Figure 9-4: Brake hose bracket.

20. Route the ABT brake hose between the brake inner housing and the steering knuckle.

21. Attach the ABT brake hose to the Isuzu brake hose. Note: ABT brake hose supplied is rubber as per Isuzu brake hose from chassis.

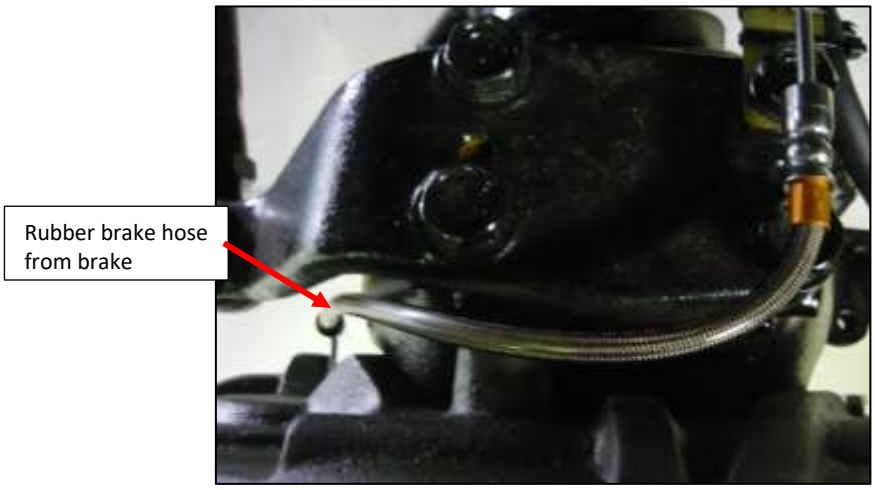


Figure 9-5: ABT front brake hose (NOTE: different hose type shown).

22. Install the inner brake pads in the inner housing ensuring correct orientation. A location pin on the brake pads will assist.

23. Find the outer housing Fill the cavity that sits behind the V-lip seal with a high temperature bearing grease (Castrol LMX recommended)

Figure 9-6: Greased V-Seal cavity

24. Place a hub assembly on a clean bench with studs facing down.

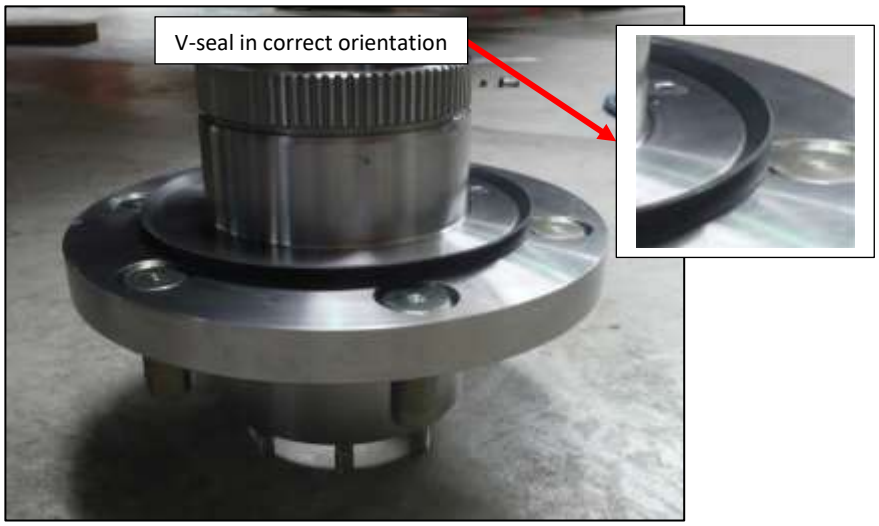


Figure 9-7: Hub assembly (rear hub assembly shown).

25. Give the V-seal a gentle stretch and attach it to the hub assembly.

26. Place the outer housing over the hub assembly.

27. Install the outer brake pads ensuring correct orientation. A location pin on the brake pads will assist.

28. Install the brake rotor onto the hub in the correct orientation, where the extruded side of the disk is facing towards the hub.

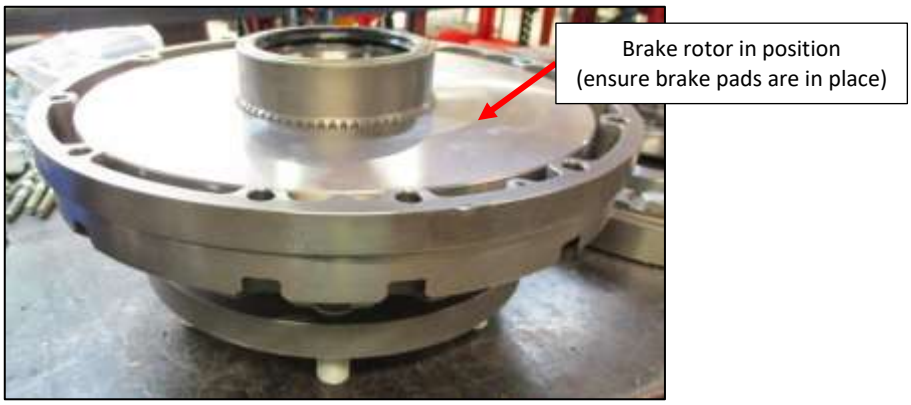


Figure 9-8: Outer housing attached to hub assembly.

29. Attach the inner bearing roller to the vehicle spindle.

Figure 9-9: Inner housing attached to vehicle.

30. Lubricate the hub inner lip seal with silicone grease and carefully fit the outer housing, hub and rotor assembly to the inner housing on the vehicle. 2x guide pins may assist with fitment.

Figure 9-10: Attach the outer housing/hub/rotor assembly onto inner housing

31. Fit the 12x M10 bolts and torque to 60 Nm in sequence. Ensure each bolt is torqued twice.

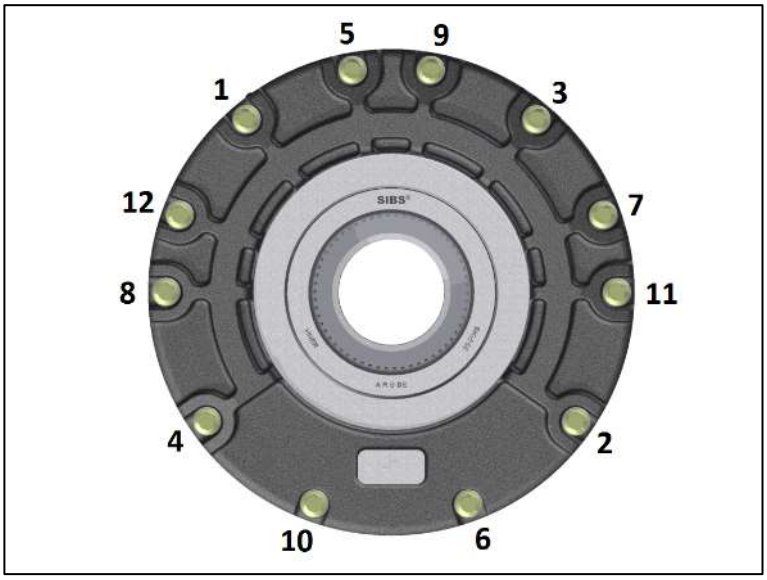


Figure 9-11: Housing bolt torque sequence.

32. Fill the wheel bearing cavity in the hub with a high temperature bearing grease.

33. Fit the outer wheel bearing assembly, refer to Isuzu manual for a detailed description.

34. Remove the ABT™ “Blend 20” cooling fluid fill plug.

35. Fill the ABT™ Failsafe brake unit with new ABT™ “Blend 20” cooling fluid and refit the fill plug and copper washer. Approximately 600 ml of ABT™ “Blend 20” cooling fluid is required per front brake unit.

36. Repeat for the opposing wheel-end.

37. Fit the expansion chambers with breather cap and breather hose:

    a. Mount the expansion chambers as high as possible in a protected location on the vehicle. ABT recommends behind the cab on both sides.

    b. Secure using supplied mounting hardware.

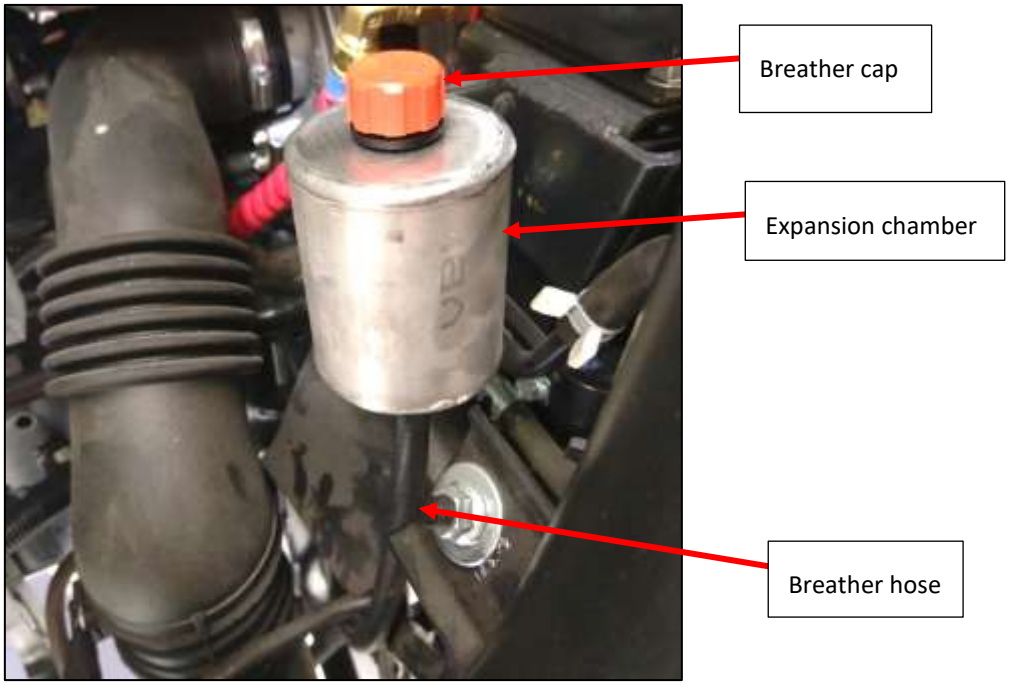


Figure 9-12: Expansion Chamber location

c. Route a length of breather hose from the bottom of the expansion chambers down to the barb fitting on each brake unit. Ensure there are no kinks or low points in the breather hose.

d. Ensure the wheel can turn from lock to lock without any interference. Allow extra length in the hose for axle articulation and avoid any hot or moving components.

e. Secure the hose along the chassis using supplied P-clips where possible.

10. Installation – Hydraulic System

1. Mount the ABT™ Failsafe pump enclosure in a suitable location on the vehicle.

   a. Drill the supplied mounting bracket as required and mount the ABT™ Failsafe pump using provided mounting hardware.

Figure 10-1: ABT™ Failsafe pump enclosure.

2. For vehicles not equipped with ABS replace the OEM service brake line tee connector on the rear axle with the supplied tee-connector and adapter.

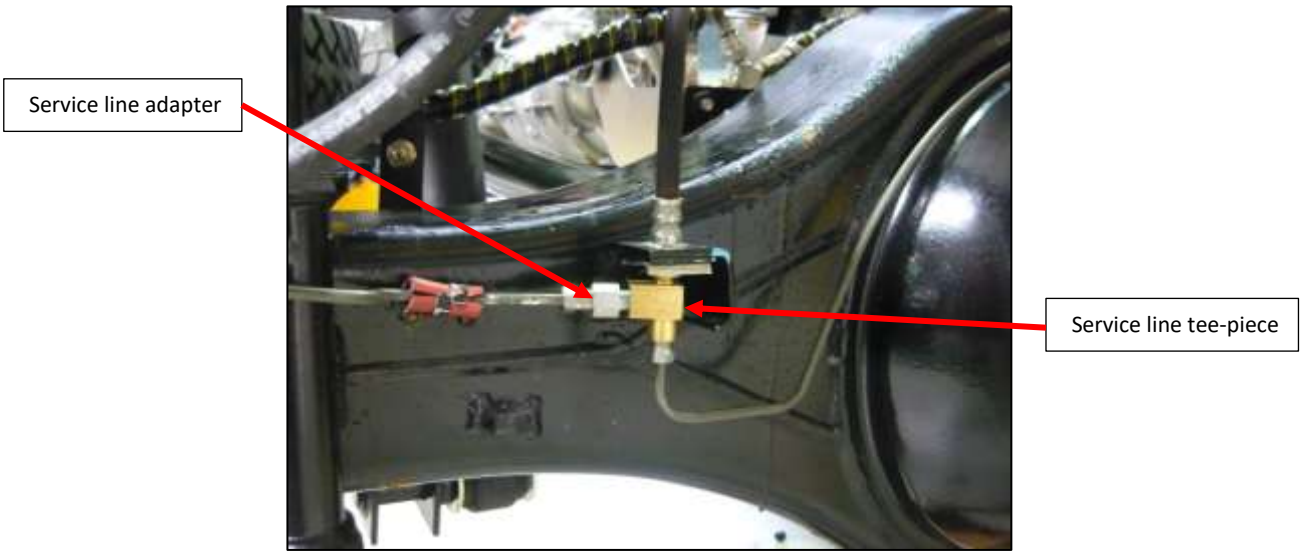


Figure 10-2: Rear service brake tee-connector.

3. Mount the park/emergency brake tee-union on the rear axle using the top-most diff housing bolt.

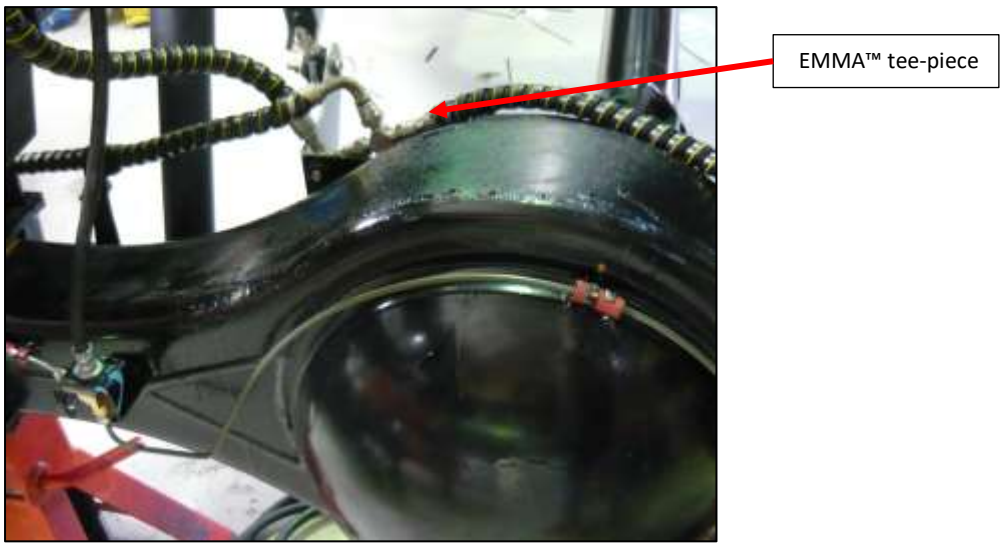


Figure 10-3: Mount park/emergency tee-ceonnector on rear differential.

4. Connect one end of the park/emergency brake hydraulic hose to the bulkhead fitting at the rear of the pump enclosure.
5. Route the other end of the hydraulic hose down to the tee-union on the rear axle and connect. Secure the hose along the chassis using supplied P-clips.

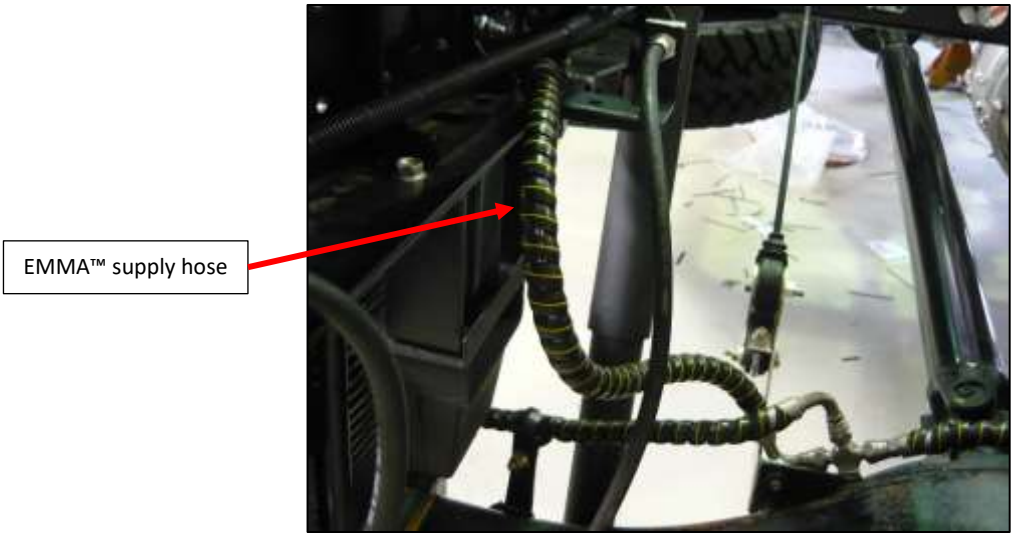


Figure 10-4: Route park/emergency brake supply hose along chassis to rear axle.

6. For vehicles not equipped with ABS fit the rear RH service brake line.
   a. Connect one end of the RH service brake line to the rear axle tee-union and the other end to the inlet on the RH brake unit.
   b. Secure the brake line using the OEM clips.
7. Fit the rear RH park/emergency brake hydraulic hose.
   a. Connect one end of the RH park/emergency brake hydraulic hose to the tee-union on the rear axle.
   b. Connect the other end to the inlet on the RH brake unit.

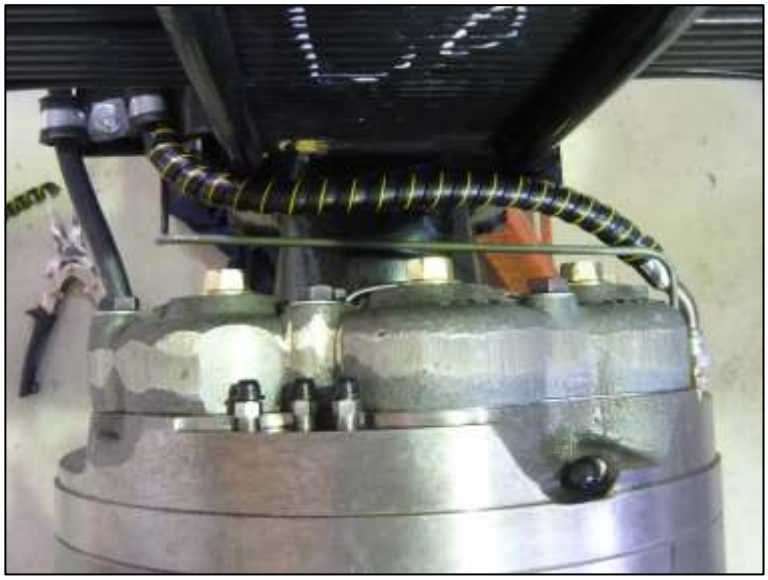


Figure 10-5: Brake lines connected to rear RH brake unit.

Figure 10-6: Rear RH brake line routing to brake unit.

Figure 10-7: Rear RH brake line routing from tee.

8. For vehicles not equipped with ABS fit the rear LH service brake line.
    a. Connect one end of the LH service brake line to the rear axle tee-union and the other end to the inlet on the LH brake unit.
    b. Secure the brake line using the OEM clips.
9. Fit the rear LH park/emergency brake hydraulic hose.
    a. Connect one end of the LH park/emergency brake hydraulic hose to the tee-union on the rear axle.
    b. Route the hydraulic hose across the rear axle and connect to the inlet on the LH brake unit.
    c. Secure the hydraulic hose along the rear axle using P-clips. Ensure the hose will not contact any moving suspension components.

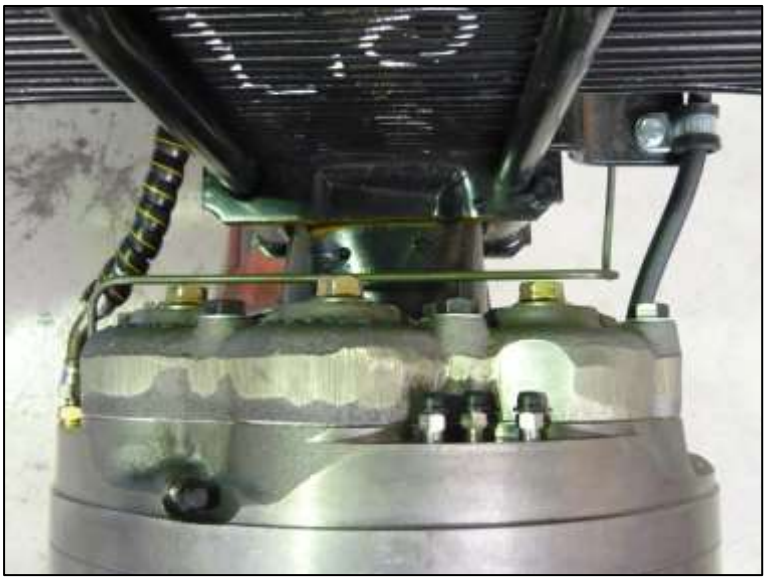


Figure 10-8: Brake lines connected to rear LH brake unit.

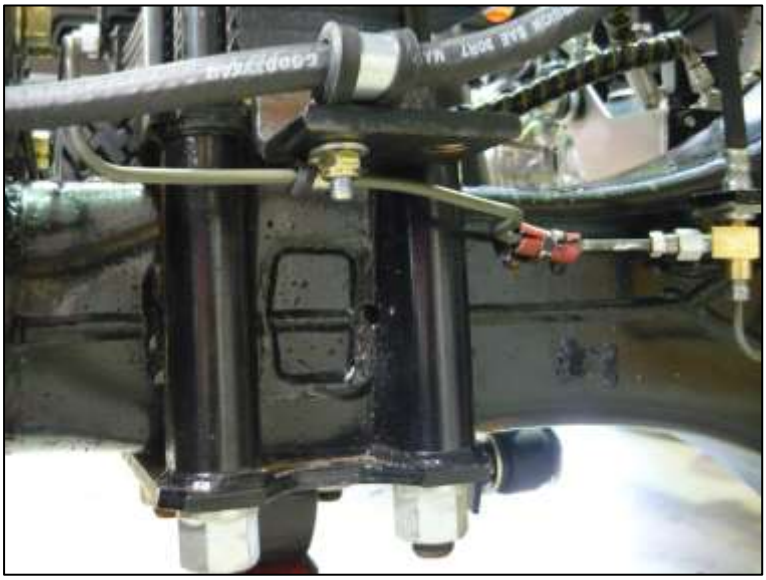


Figure 10-9: Rear LH service line routing from tee.

11. Installation – Electrical System

1. Isolate the vehicle battery.

NOTE:
Do not test the control system functions until the system is fully installed as this may confuse the control unit while learning – details on control unit setup can be found in Section 13.

2. Mount the control unit to the dash:
   a. Remove the vehicle radio/centre console.
   b. Mount the ABT™ control unit on the removable cover on the dash using the provided bracket. Position so that bracket is close to the driver and aligned with the vehicle axis. 4x holes will need to be drilled.
   c. For LH drive vehicles the control unit bracket can be reversed so that it is always facing the vehicle operator.

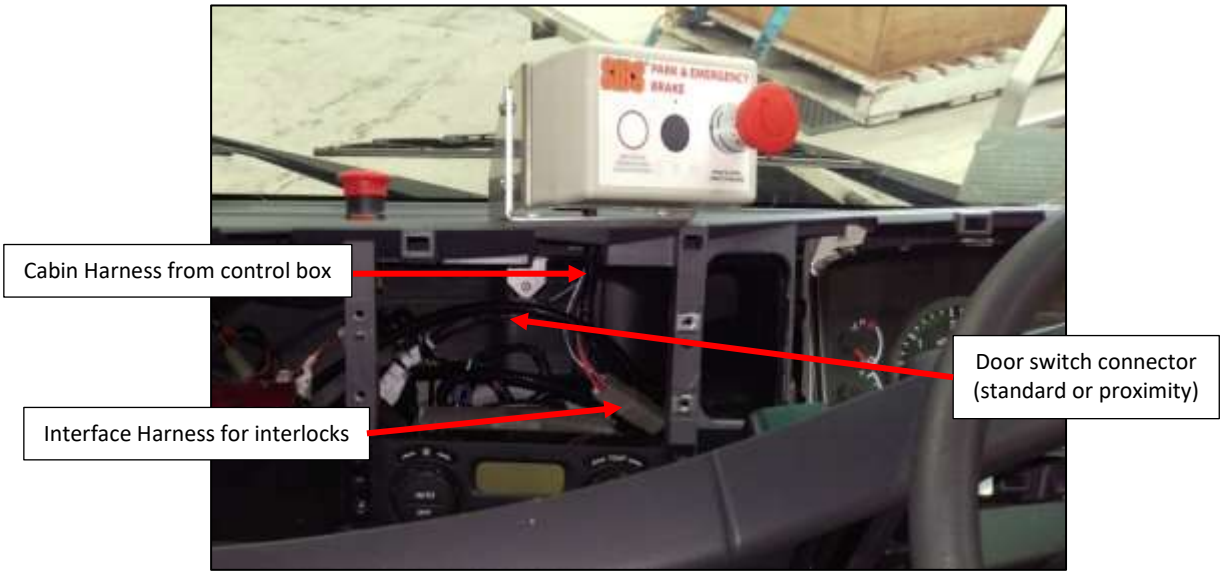


Figure 11-1: ABT™ Failsafe control unit mounted on dash.

3. Fit the ABT™ cabin harness:
   a. Open the front grille of the vehicle.
   b. Connect cabin harness branch to the rear of the control unit by passing up through the dash. A hole will need to be drilled in the dash to achieve this.
   c. It may be easier to route the cabin harness with 2 of the Deutsch connectors de-pinned.
      i. Locate the connectors for the battery power and relay, approximately 2 metres from the end of the harness.
      ii. De-pin both the 2 pin connector plug with the red and yellow cables attached and the large 2 pin connector socket next to it. Note the pin location.
   d. Route the harness down behind the dash and over to the passenger side.
   e. Locate the existing grommet and route the harness out through the grommet to the front of the vehicle. This is noted in the picture below.

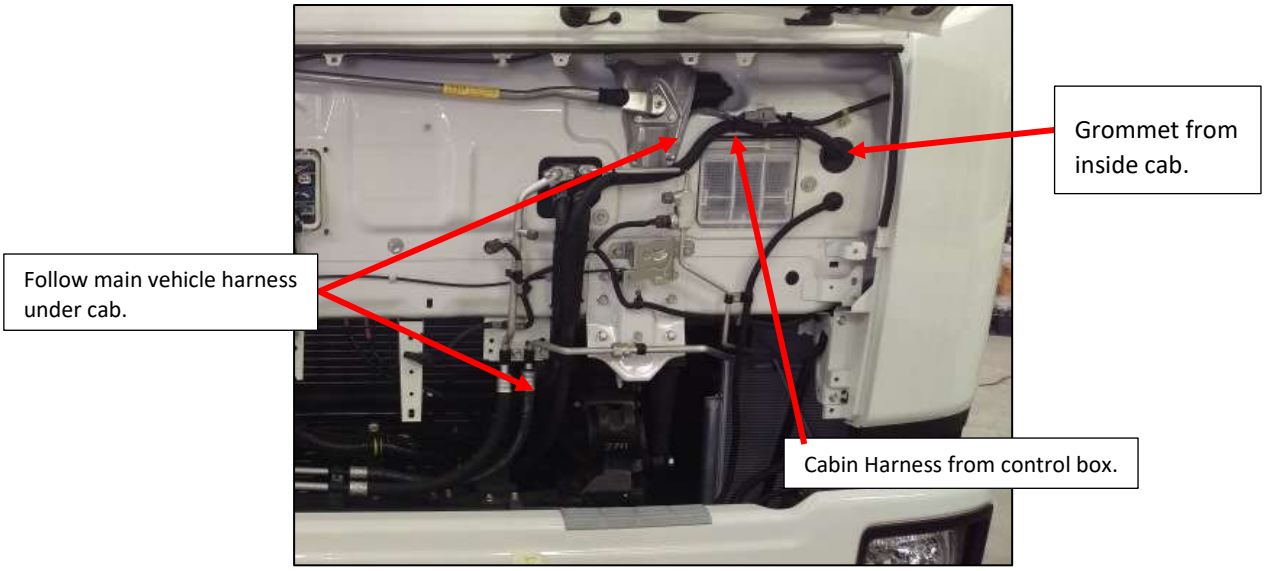


Figure 11-2: Cabin harness routing.

f. Follow the main vehicle electrical harnesses under the cab and along the chassis rail.

g. Secure the harness where necessary using P-clips and cable ties.

h. Re-pin the connectors. Pin to previously noted pin location.

4. Fit the vehicle interface harness (18-7007):

a. Remove the vehicle instrument cluster next to the steering column.

b. Find the white unused plug and separate the green/yellow silver flex ignition wire.

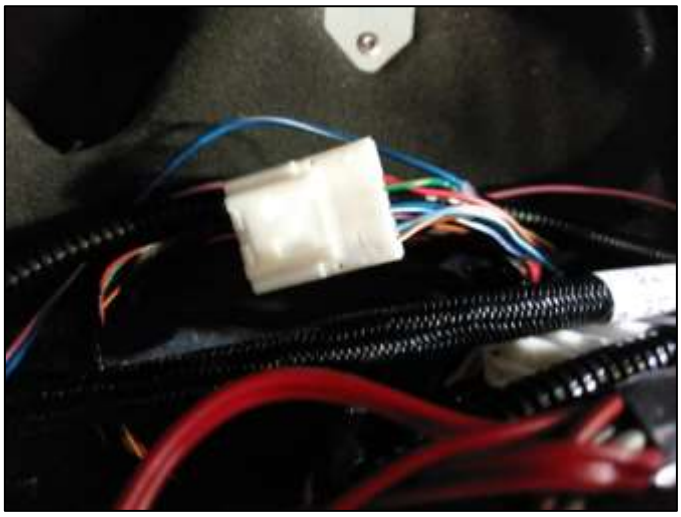


Figure 11-3: Unusued white plug

c. Find the vehicle interface harness (18-7007) harness and separate the blue/white wire.

d. Join the green/yellow silver flex ignition wire with the blue/white harness wire.

e. From inside the front grille find the two black plugs (see Figure 11-4). Get the right plug and sperate the speed signal green/yellow silver flex wire.

Figure 11-4: Front grille open.

f. Run a wire (ABT uses pink 18 AWG) from the speed signal green/yellow silver flex wire, with the cabin harness, through to the 18-7007 harness.

g. Join the speed signal wire to the pink wire of the 18-7007 harness. Connect to the main cabin harness.

5. Fit the OEM door harness 18-7008 (optional):

a. The OEM door harness is supplied with the vehicle interface harness – simply connect the additional 3-pin Deutsch connector to the ABT™ cabin harness behind the radio.

b. Do not connect if ABT™ door proximity sensors are to be fitted.

6. Fit the Battery power harness:

a. Extension harnesses may be required depending on vehicle battery location. If not required connect the cabin harness directly to the battery power harness and move to section ‘e’.

b. Connect the battery power extension harness to the 2x 2 pin connectors on the cabin harness located on the chassis rail beside the gearbox.

c. Route the battery power extension harness towards the vehicle battery.

d. Connect the battery power extension harness to the battery power harness.

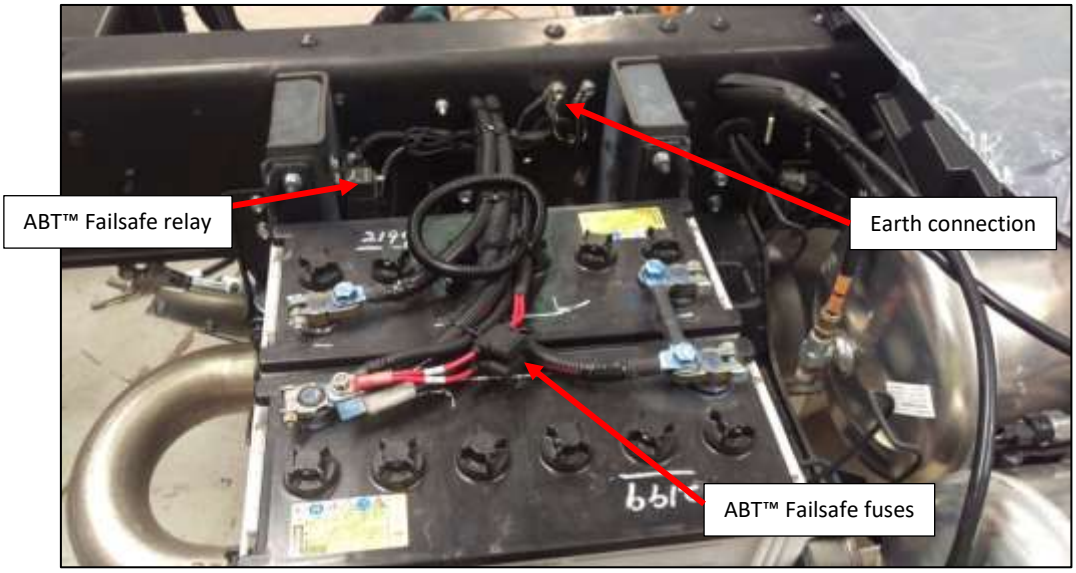


Figure 11-5: Battery power harness.

e. Connect the red wires to the positive battery terminal via the eyelet.

f. Connect the black wire to a vehicle earth point via the eyelet.

g. Secure the relay using the vehicle battery bracket.

h. Secure the harness where necessary using P-clips.

7. Connect to the Pump harness:

a. Extension harnesses may be required depending on EMMA™ pump assembly location. If not required connect the cabin harness directly to the pump harness.

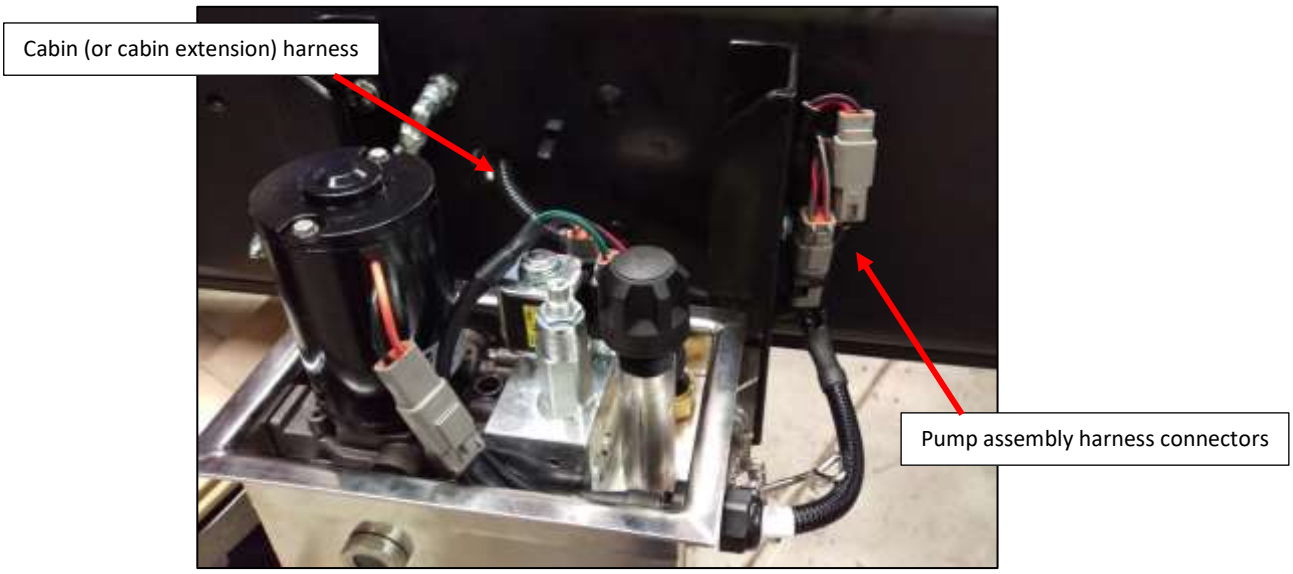


Figure 11-6: Pump harness connection.

b. Secure the harness where necessary using P-clips.

8. Fit the door proximity harness (optional):

a. Open the driver's door and remove the side kick panel fitted in the foot well.

b. Remove the side panel next to the driver's seat behind the door.

Figure 11-7: Door proximity sensor.

c. On the B-pillar measure 30mm up from the centre of the top mounting hole on the door latch. Mark a horizontal line.

d. Mark a vertical line directly above the centre of the top mounting hole on the door latch.

e. Make a centre-punch mark on the B-pillar where the lines intersect.

f. Drill a pilot hole followed by a 12mm finishing hole. Ensure there are no obstructions behind the hole.

g. Ensure all metal surfaces are repainted and sealed with a corrosion preventative. Paint or a site preferred corrosion inhibitor may be used.

h. Take the door proximity switch and adjust the rear nut so that it is approximately 10mm from the sensing end of the switch.

i. Place a toothed washer on the inner mounting face of the switch and push the switch through the B-pillar from behind.

j. Apply a smear of silicone sealant to the face of the outer washer that sits against the B-pillar.

k. Fit the outer retaining nut and tighten the nut to 10 Nm. The nut should be secured flush with the sensing face of the proximity switch.

l. Apply a ball of Plasticine/Blu-tack (or similar) on the sensing face and gently close the door to ascertain the sensing gap. This is the gap between the switch and door when the door is closed.

m. Adjust the switch to achieve a sensing gap of 1 mm approx. then tighten the nut to 15Nm.

n. Connect the door proximity sensor harness to the 3 pin connector on the door proximity extension harness.

o. Route the harness down to the floor and along the door sill under the kick panel to the A-Pillar.

p. Route the harness up the A-pillar behind the instrument cluster and across to the centre console under the ABT™ Failsafe Emergency brake control box.

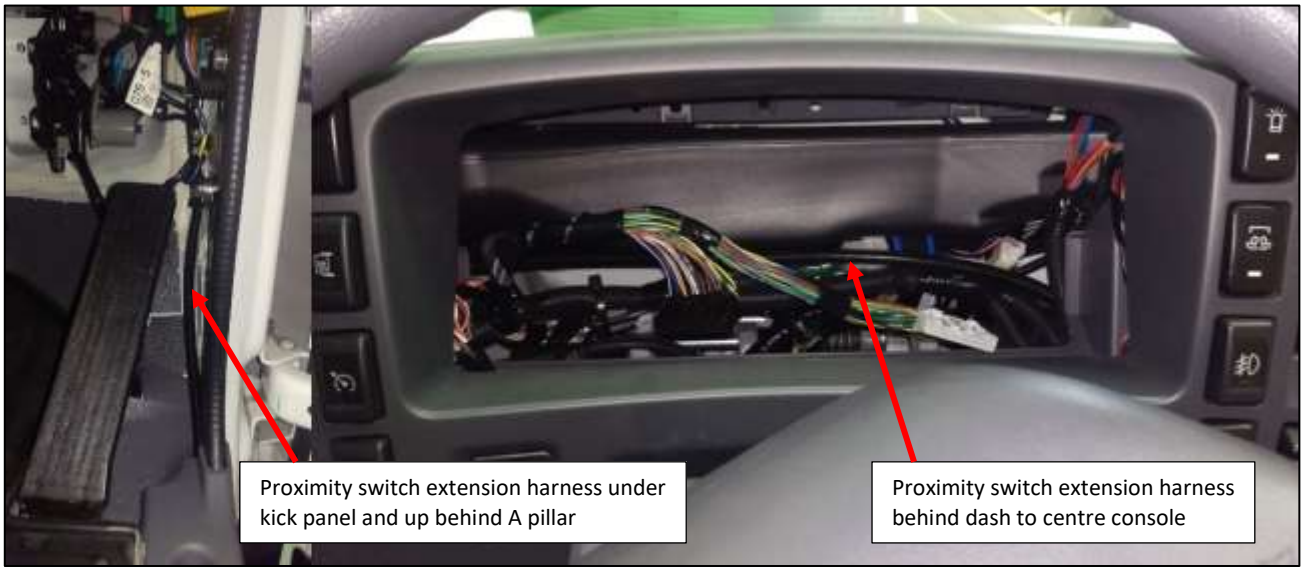


Figure 11-8: Door proximity harness routing.

q. Connect the door proximity harness to the 3 pin connector on the cabin harness (the OEM door connector may need to be unplugged first).

r. Dependent on how many doors have been specified will affect the number of proximity switches included in the harness.

9. Replace the instrument cluster, radio, glove box, seats, mats and all vehicle trim.

12. Pre-Service Inspection

1. Top up all reservoirs with the specified fluids.
   a. Use brake fluid specified in the Isuzu NPS vehicle manual for the brake master cylinder (service system).
   b. Use ATF Dexron III for the ABT™ Failsafe pump reservoir (park/emergency system).

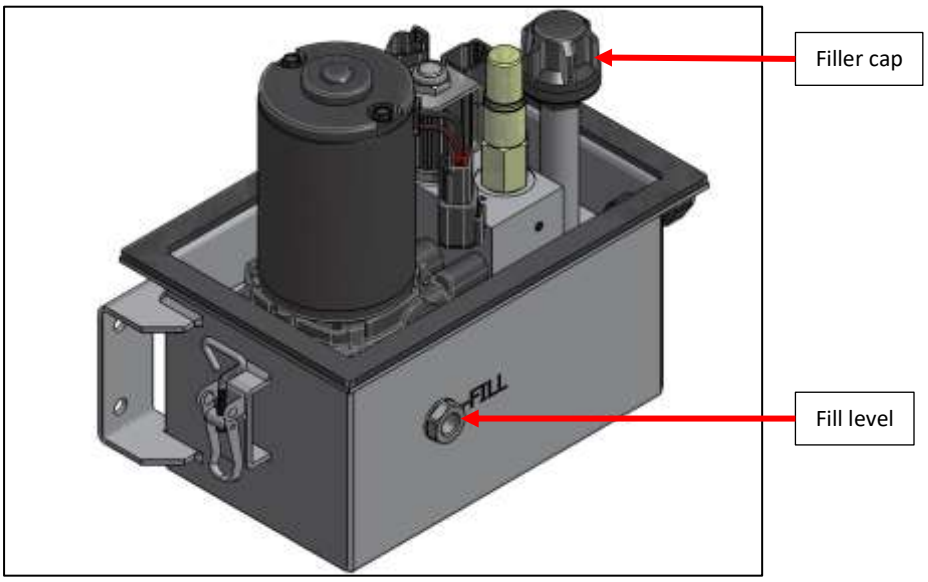


Figure 12-1: ABT™ Failsafe pump enclosure with lid removed.

2. Ensure the battery is in good condition – this is critical to ensure correct programming of the control unit.
3. Reconnect the vehicle battery to power the vehicle and ABT™ Failsafe system.
4. Bleed the service brake system:
   a. Connect a clear vinyl tube onto the service brake bleed nipple and the other into a clean container of brake fluid.
   b. Slowly pump the brake pedal several times.
   c. While an assistant presses on the brake pedal, loosen the bleed nipple until fluid runs out then close the nipple.
   d. Repeat this process until there are no more air bubbles in the fluid. Ensure the master cylinder reservoir is kept topped up during the procedure.
   e. The service brake system should be bled in the following sequence:
      i. LPSV (this is the highest point apart from the master cylinder in the system).
      ii. 2x bleed nipples on rear left hand brake (wheel end with the longest hydraulic line).
      iii. 2x bleed nipples on rear right hand brake.
      iv. 1x bleed nipple on front left hand brake.
      v. 1x bleed nipple on front right hand brake.

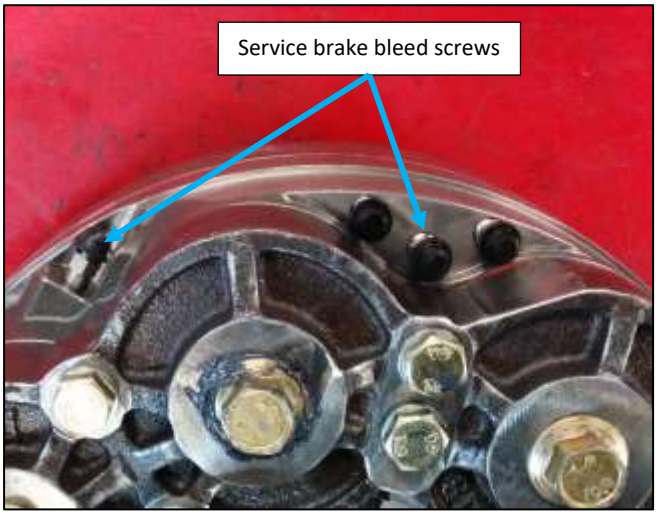


Figure 12-2: Service brake bleed screws.

5. Bleed the park/emergency brake system:
   a. Twist and release the red E-stop button on the control unit.
   b. If the control system detects air in the system on first release, it will enter bleed mode – this is indicated by the brake status light flashing green – system pressure will be limited to 100 psi.
   c. With the E-stop released, thoroughly bleed the brake system by opening and closing the park/emergency system bleed nipples until the fluid runs through clearly with no air bubbles. Ensure the pump reservoir is topped up regularly during the procedure.
   d. Once the system is bled, apply and then release the park/emergency brake again – if the system has been sufficiently bled then the brake status light should be solid green with the brake is released.

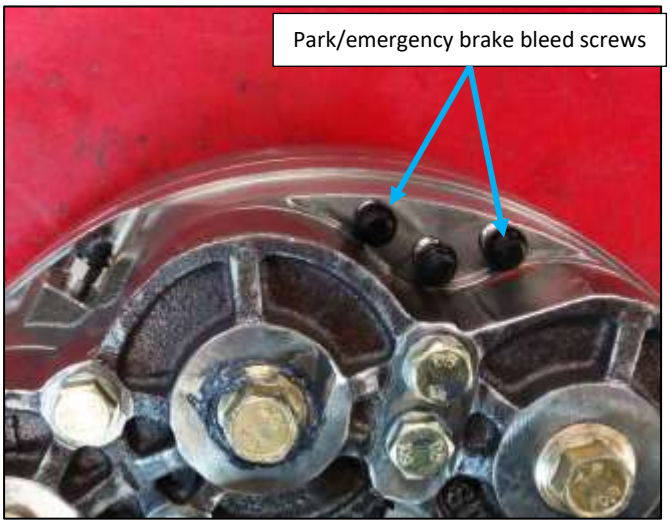


Figure 12-3: Park/emergency brake bleed screws.

6. Affix the ABT™ Failsafe caution label to the inside top corner of the windshield on the driver's side.
7. Complete a vehicle pre-start check.
8. If the vehicle is to be used on public roads it will require approval for road use.
   a. New and unregistered vehicles can be fitted with a second stage manufacturer plate.
   b. Used and already registered vehicles can be fitted with an aftermarket modification plate.
   c. Please contact ABT customer service for details regarding ABT™ Failsafe equipped vehicles requiring approval.

13. Controller Setup

1. Ensure the battery is fully charged and in good working condition before connecting the ABT™ Failsafe controller.
2. Set the HSI speed threshold:
   a. After releasing the brake for the first time the green HSI light will begin flashing – this indicates the HSI speed threshold needs to be set.
   b. The HSI system overrides the door, stall and seatbelt interlocks when the vehicle is travelling at speeds above the HSI threshold – this is designed to prevent unintended brake application at high speeds.
   c. Start the engine, release the brakes and accelerate the vehicle up to the desired HSI threshold speed (ABT recommends 20 km/h).
   d. While maintaining this speed, press and hold the grey button on the control unit for 3 seconds – the control unit will beep twice to confirm the speed has been accepted.
   e. If HSI is not required, simply complete the above procedure with the vehicle is stationary.

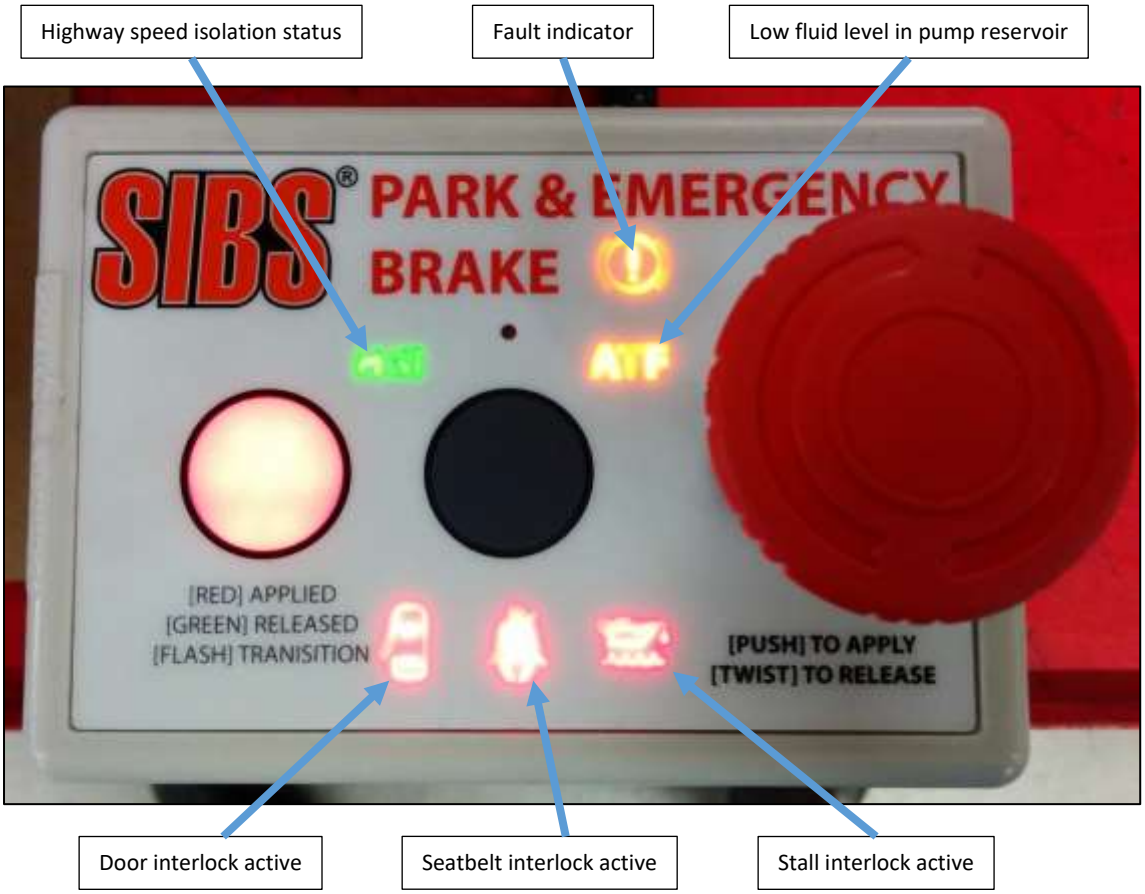


Figure 13-1: ABT™ Failsafe control unit warning lights

14. Service Schedule

The following table shows the recommended service intervals for ABT™ Failsafe brake systems fitted to vehicles being operated in a harsh mining environment. ABT recommends each site undertake a review of the service intervals and adjust to suit their specific conditions.

	Frequency
Pre-Start Check	Daily
Minor Service	Monthly or every 5,000 km or every 100 hours (whichever occurs first)
Major Service	When rear brake pad wear reaches minimum (as indicated by the pad wear indicator)

The pre-start check involves a quick check of the fluid levels and confirms proper brake system operation.

The minor service involves a general system inspection and replacement of the ABT™ “Blend 20” cooling fluid in the wheel-ends.

The major service involves a system inspection and replacement of any worn components to ensure continued reliable operation of the ABT™ Failsafe braking system.

15. Pre-Start Check

3. Check brake master cylinder reservoir level. If low, top up with brake fluid specified in the Isuzu NPS vehicle manual and check system for leaks.
4. Check ABT™ Failsafe pump reservoir level. If low, top up with ATF Dexron III and check system for leaks.
5. With the doors closed, engine running and driver's seat belt connected, press the E-Stop button:
    a. The brake status light on the ABT™ Failsafe control unit should be solid red.
    b. The park brake should be applied.
6. Twist and release the E-Stop button:
    a. The brake status light should flash red momentarily and then change to solid green.
    b. The park brake should now be released.
7. Check the park/emergency brake applies when (Note: optional interlock connections c, d and e if connected):
    a. The E-Stop is pressed.
    b. The ignition is switched to the 'ACC' position.
    c. The door is opened (door ajar warning light should display on control unit).
    d. The driver seatbelt is released (seatbelt warning light should display on control unit).
    e. The engine is stalled (low oil pressure warning light should display on control unit).
8. Check the service brake (foot brake) firmly applies the brake.
9. Carry out park brake performance test:
    a. Ensure the test is carried out on a level surface, with no obstructions in front of the vehicle.
    b. With engine running at normal operating temperature
        - Apply ABT™ Failsafe park/emergency brake
        - Depress clutch
        - Engage third gear low range
        - Do not press footbrake
        - Do not rev engine (engine should be idling as normal)
        - Slowly release clutch
        - Allow the engine rpm to slowly reduce until either the engine stalls or the vehicle rolls forward
        - Vehicle must stall without the vehicle driving through the brake
10. If the vehicle drives through the brake a Major Service must be performed.

    Note: The Pre-Start check does not replace visual inspection of the pad wear indicators.

16. Minor Service (100hrs)

1. Check the brake fluid level in the master cylinder. Top up if necessary.
2. Check service brake units for leaks:
    a. Engine running
    b. Press the brake pedal firmly for 30 seconds
    c. The pedal should not drop
3. Check the fluid level in the ABT™ Failsafe EMMA™ pump reservoir. Top up if necessary.
4. Check ABT™ Failsafe pump for leaks:
    a. Engine running
    b. Twist and release the E-stop button to release the park/emergency brake
    c. Release the brake for 30 seconds
    d. The alarm should remain silent and the pump should not recharge
5. Check hydraulic lines for cracks or damage.
6. Check the breather hose for cracks or damage.
7. Check the expansion chamber filler breather caps are clear.
8. Check all electrical connectors and wiring for damage or corrosion.
9. Ensure the vehicle battery is in good working order.
10. Check rear brake pad wear:
    a. Apply the park brake.
    b. Remove the protective cap on the pad wear indicator (found on the spring cover).
    c. The plunger should project out from the gland fitting.
    d. The distance the plunger projects shows the remaining brake pad wear available. (New pads = 2mm approx.).
    e. Refit the protective cap and fibre washer.

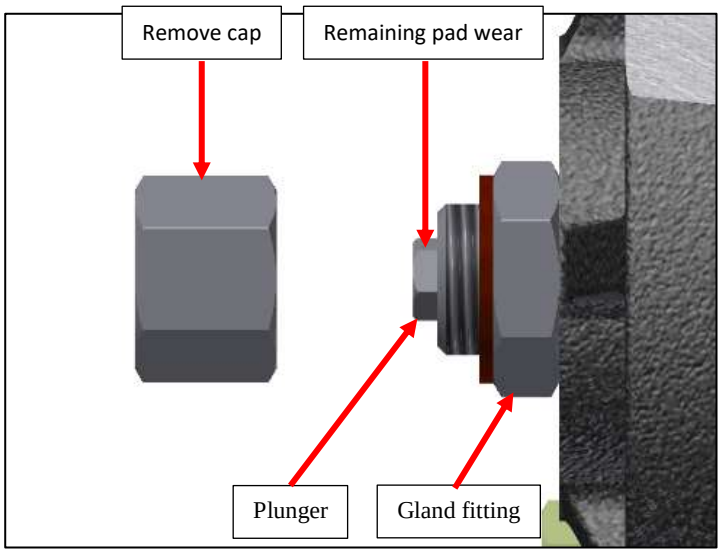


Figure 16-1: Rear pad wear indicator schematic.

11. If the brake pads have worn beyond the wear limit, then a major service must be completed.

12. Remove 3x tapered plugs, recoat each one with anti-seize and refit them. Silicon should be placed in the hex socket to aid future removal.

13. Drain and discard the ABT™ “Blend 20” cooling fluid from each wheel-end brake.

    a. At least 600 mL of ABT™ “Blend 20” cooling fluid should be found in each rear wheel-end. Check for leaks if this amount is not found.

    b. The ABT™ “Blend 20” cooling fluid should drain freely from the brake. If it comes out in a “glug, glug” fashion ensure there is no blockage in the ABT™ Failsafe breather line.

    c. Dispose of used ABT™ “Blend 20” cooling fluid responsibly in accordance with regulatory and environmental legislation.

14. Refit the drain plug with a new sealing washer.

15. Refill the wheel-end up to the level plug (fill to spill). 800ml of ABT™ “Blend 20” cooling fluid is required for each rear wheel-end.

16. Check front brake pad wear (if applicable):

    a. Apply the service brake.

    b. Remove the protective cap on the pad wear indicator.

    c. Push the plunger into the brake until it stops.

    d. The plunger should project out of the gland fitting.

    e. The distance the plunger projects shows the remaining brake pad wear available. (New pads = 4mm approx.).

    f. Refit the protective cap and fibre washer.

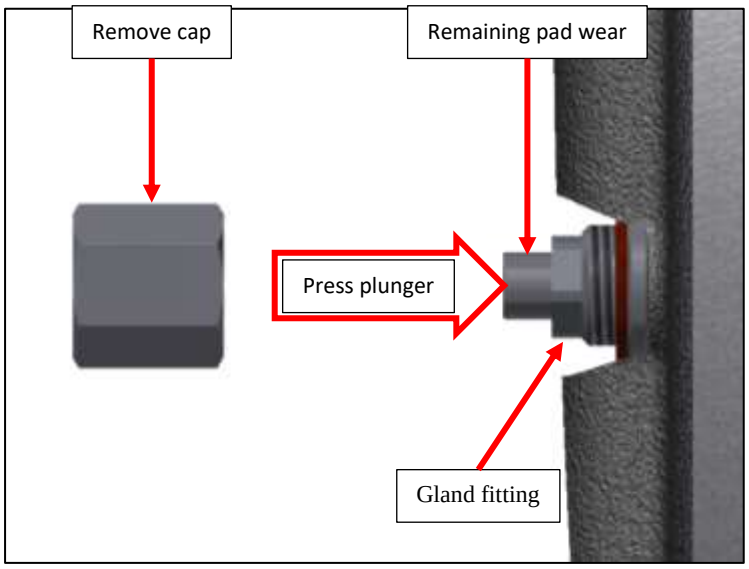


Figure 16-2: Front pad wear indicator schematic.

17. If the brake pads have worn beyond the wear limit, then a major service must be completed.

18. Drain and discard the ABT™ “Blend 20” cooling fluid from each wheel-end brake.

    a. At least 400 mL of ABT™ “Blend 20” cooling fluid should be found in each front wheel-end. Check for leaks if this amount is not found.

    b. The ABT™ “Blend 20” cooling fluid should drain freely from the brake. If it comes out in a “glug, glug” fashion ensure there is no blockage in the ABT™ Failsafe breather line.

c. Dispose of used ABT™ “Blend 20” cooling fluid responsibly in accordance with regulatory and environmental legislation.

19. Refit the drain plug with a new sealing washer.

20. Refill the wheel-end up to the level plug (fill to spill). 600 ml of ABT™ “Blend 20” cooling fluid is required for each front wheel-end.

21. Conduct a “vehicle pre-start check”.

17. Major Service – Rear

1. Check service brake and park brake systems for leaks.
2. If leaks are present replace damaged seals where necessary during the major service (section 25 EMMA piston seals and section 26 service piston seals).
3. Repair/replace damaged parts where necessary during the major service.
4. Test the EMMA springs and pistons (section 19).
5. Disassemble the brake (section 20 - Rear).
6. Perform a rotor service (section 21).
7. Perform a hub bearing and seal change (section 22).
8. Perform a pad change, seal change and housing service (section 23).
9. If the springs need to be replaced, perform a replacement now (section 24).
10. Assemble the brake (section 27 - Rear).
11. Conduct a “vehicle pre-start check”.

18. Major Service – Front

1. Check service brake system for leaks.
2. If leaks are present replace damaged seals where necessary during the major service (section 26).
3. Repair/replace damaged parts where necessary during the major service.
4. Disassemble the brake (section 20 - Front).
5. Perform a rotor service (section 21).
6. Perform a hub bearing and seal change (section 22).
7. Perform a pad change, seal change and housing service (section 23).
8. Assemble the brake (section 27 - Front).
9. Conduct a “vehicle pre-start check”.

19. EMMA Piston Test Procedure

1. Remove the 3x tapered plugs and 1x pad wear indicator from the spring cover. Refer to exploded view for more detail.
2. Operate the brake to check for fluid or grease washout. Any substances being ejected from the holes indicates a failed EMMA piston seal which will need to be replaced.
3. Fit 4x retractor bolts into the spring cover and torque to 80 Nm. Alternatively, while the system is active retract the pistons and wind in the retractor bolts in.
4. Loosen the retractor bolts until there is approximately 2mm gap to the spring cover.
5. A short test is required to check the integrity of the springs in the EMMA brake. Assistance is required for this test.
6. While the EMMA brake is applying/releasing observe the movement of the retractor bolts.
7. The 4 x retractor bolts should move in and out simultaneously.
8. If the retractor bolts move simultaneously then the spring integrity check is complete.
9. If the retractor bolts appear to be moving unevenly then check the following:
    a. While the brake is releasing (the pump is running) one or more bolts moves quickly out at the beginning of the pump cycle and is then followed by the remaining retractor bolts moving slowly as the pump cycle continues and then finishes.
    b. While the brake is applying (fluid dumping back to reservoir) the slow-moving bolt/bolts from the previous test move back into the spring cover first and are then followed by the remaining bolt/bolts.
10. If the retractor bolts behave as explained in step 9 then the spring covers must be removed to visually check the springs.
11. With the brake released retighten the retractor bolts.

20. Service Disassembly Procedure

A. Rear

1. Remove the rear wheels.
2. Clamp the rear brake lines.
3. Remove the 3x tapered plugs and 1x pad wear indicator from the spring cover. Refer to exploded view for more detail.
4. Fit 4x retractor bolts into the spring cover and torque to 80 Nm. Alternatively, while the system is active retract the pistons and wind in the retractor bolts in.
5. Drain and discard the ABT™ “Blend 20” cooling fluid from each wheel-end brake.
    a. At least 600 mL of ABT™ “Blend 20” cooling fluid should be found in each rear wheel-end. Check for leaks if this amount is not found.
    b. The ABT™ “Blend 20” cooling fluid should drain freely from the brake. If it comes out in a “glug, glug” fashion ensure there is no blockage in the ABT™ Failsafe breather line.
    c. Dispose of used ABT™ “Blend 20” cooling fluid responsibly in accordance with regulatory and environmental legislation.
6. Remove the axle shaft.
7. Remove the hub nut.
8. Remove and discard 2x housing bolts on opposite sides of the brake housing.
9. Attach 2x guide pins.
10. Remove and discard the remaining 10x housing bolts.
11. Note: on ABS models the ABS sensor needs to be removed now.
12. Carefully separate the inner and outer housings. 2x guide pins may assist with disassembly. The outer housing, hub, rotor and outer pads should remain as one assembly.
13. Stand the brake assembly on a clean bench, sit the outer housing, rotor and hub assembly face down on the hub studs.

Figure 20-1: Outer housing, rotor and hub assembly.

B. Front

1. Remove the front wheels.
2. Clamp the front brake lines.
3. Drain and discard the ABT™ “Blend 20” cooling fluid from each wheel-end brake.
    a. At least 600 mL of ABT™ “Blend 20” cooling fluid should be found in each rear wheel-end. Check for leaks if this amount is not found.
    b. The ABT™ “Blend 20” cooling fluid should drain freely from the brake. If it comes out in a “glug, glug” fashion ensure there is no blockage in the ABT™ Failsafe breather line.
    c. Dispose of used ABT™ “Blend 20” cooling fluid responsibly in accordance with regulatory and environmental legislation.
4. Remove the hub cap.
5. Remove the hub nut. The hub can now either be removed or left in place and removed with the rest of the brake.
6. Remove and discard 2x housing bolts on opposite sides of the brake housing.
7. Attach 2x guide pins.
8. Remove and discard the remaining 10x housing bolts.
9. Carefully separate the inner and outer housings. 2x guide pins may assist with disassembly. The outer housing, hub, rotor and outer pads should remain as one assembly.
10. Stand the brake assembly on a clean bench, sit the outer housing, rotor and hub assembly face down on the hub studs.

21. Rotor Replacement Procedure

1. Disassemble the outer housing according to section 20.
2. NOTE: On ABS models, the ABS rotor will need to be removed now. Remove the 6x mounting bolts and set aside.
3. Remove the rotor from the outer assembly, clean and inspect.
4. Inspect the rotor and hub splines for wear.
5. Check for movement between the rotor and hub. If there is excess movement between the splines of the mating components the rotor should be replaced.
6. Inspect the rotor friction surface. If there are signs of scouring covering more than 50% of the surface the rotor should be replaced.

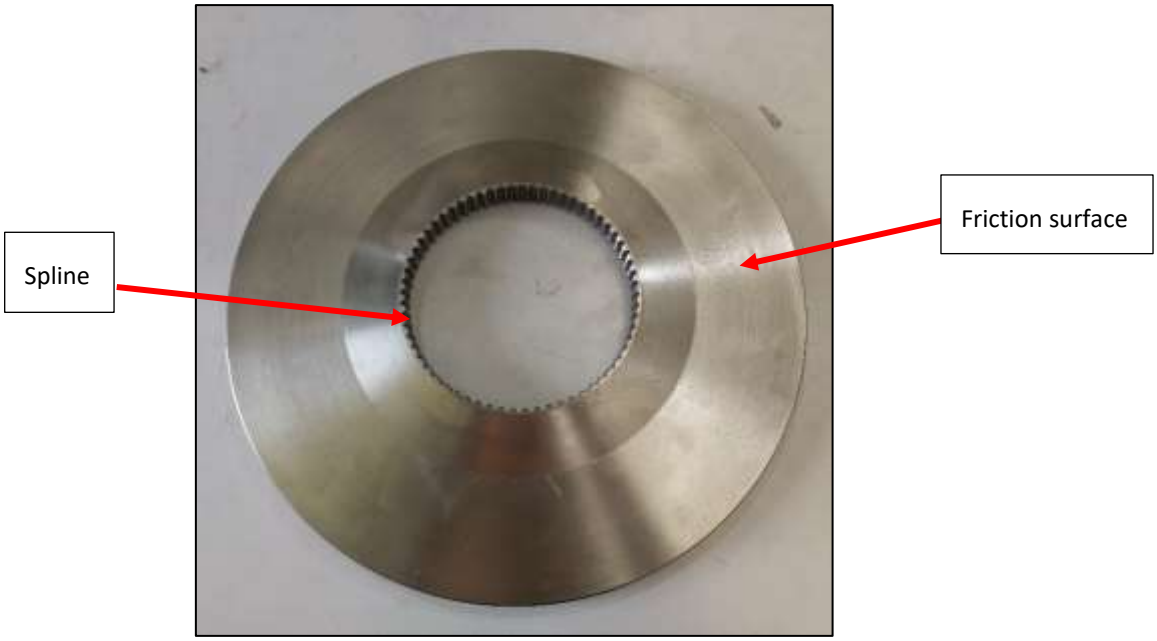


Figure 21-1: Rotor.

7. Measure the thickness of the friction surface using a micrometer at four evenly spaced position around the rotor. If thickness is below 14.0 mm the rotor should be replaced.

22. Wheel Bearing and Hub Seal Replacement Procedure

1. Disassemble the outer housing according to section 20.
2. Remove the hub from the outer housing.
3. Remove the V-seal and shaft seals from the hub and discard.
4. Remove 2x bearings from the hub, clean and inspect, if bearings show any sign of wear they should be replaced.
5. Using a punch push out the outer bearing races from the hub.
6. Clean the hub removing any grease and dirt.
7. Inspect all wheel studs, axle studs, dowel pins and grease nipple. Replace if showing any signs of thread damage or corrosion.

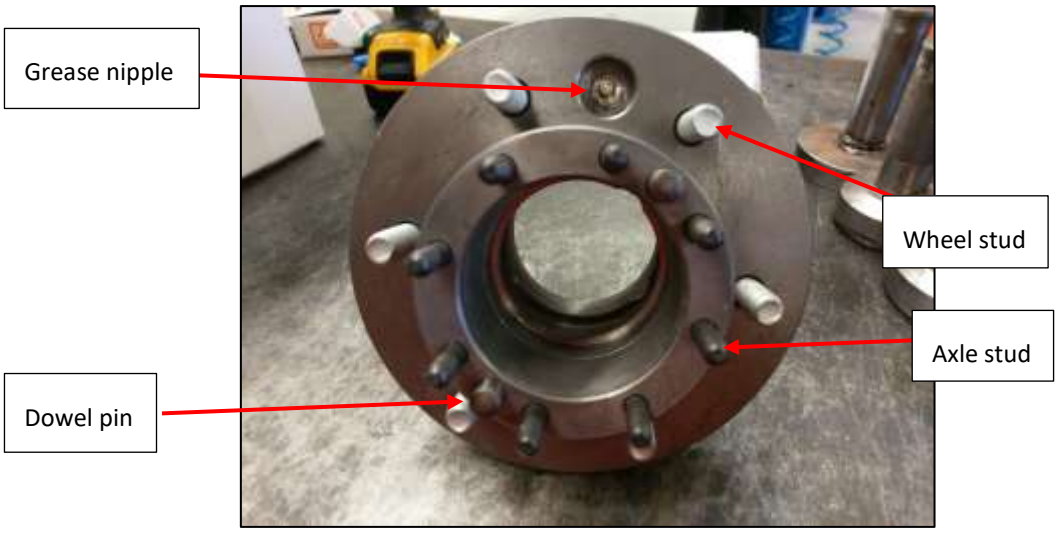


Figure 22-1: Hub

8. Before inserting the new bearings put a smear of grease around the inside of the hub.
9. Remove the outer races from the inner and outer bearings and using a large pushing tool push each of the outer races into position until they are seated on the lip.
10. Grease the bearings with a high temperature bearing grease (Castrol LMX recommended).
11. Install the inner bearing into the hub. Set the outer bearing aside for installation onto the vehicle.
12. Pack the hub with a high temperature bearing grease (Castrol LMX recommended).
13. Install the first shaft seal on top of the inner bearing with the open side facing towards the bearing, push it into place with a large pushing tool.
14. Install the second shaft seal with the open side facing upwards, push it into place with a large pushing tool.
15. Put a small amount of grease around inside of the shaft seals and pack inside the top seal with grease.

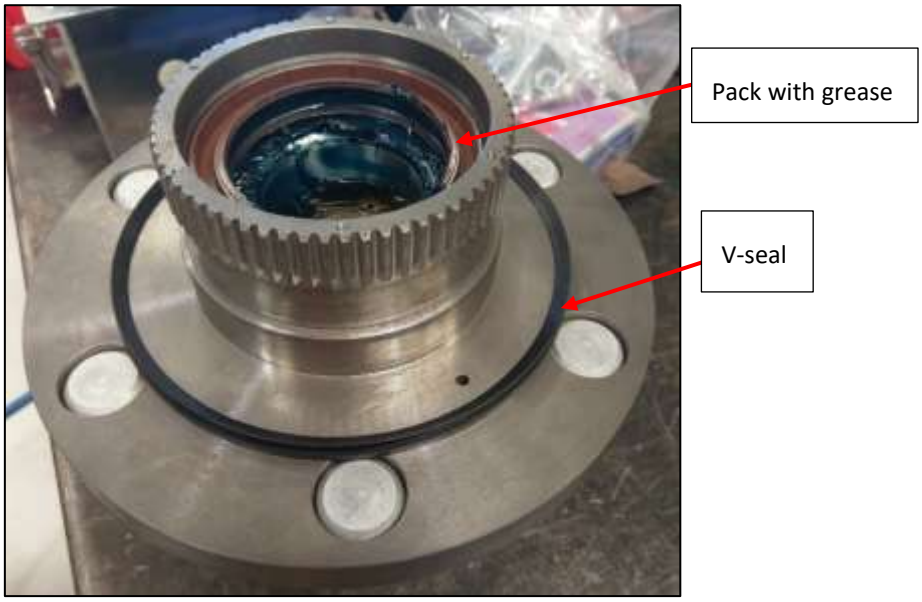


Figure 22-2: Shaft seal installed

16. Give the V-seal a gentle stretch and install it on the outside of the hub.

23. Pad Change, Seal Change and Housing Inspection

1. Disassemble the outer housing according to section 20.
2. Remove and discard the inner and outer brake pads.
3. Remove the cassette seal from the outer housing and discard.
4. Clean the outer housing and inspect for damage or wear.
5. Install a new cassette seal into the outer housing.
6. Push the outer housing onto the hub.
7. Install the outer brake pads in the outer housing ensuring correct orientation.

Figure 23-1: Brake pad position

8. Install the brake rotor onto the hub in the correct orientation, where the extruded side of the disk is facing towards the hub.
9. NOTE: On ABS models the ABS rotor must be reattached to the hub now.
    a. Locate the M4 spring washers onto the cap head bolts for mounting the ABS rotor.
    b. Apply Loctite 222 to the first 5 threads of the ABS rotor mounting bolts.
    c. Attach the ABS rotor to the hub.
    d. Torque 6x ABS rotor mounting bolts to 5 Nm and allow Loctite to cure.

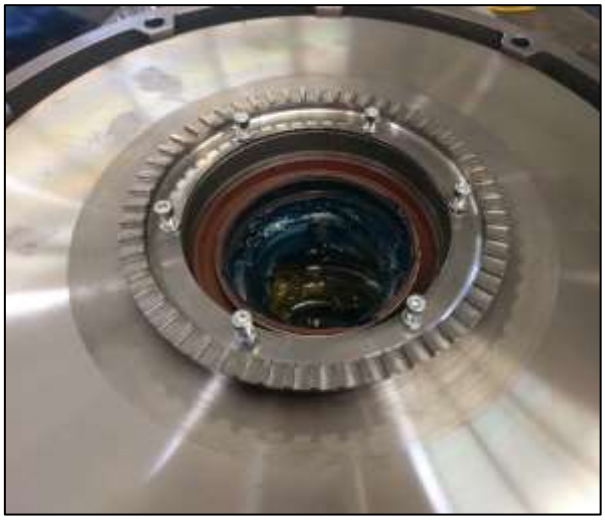


Figure 23-2: Pulsewheel installed

10. Remove the housing O-ring from the inner housing and discard.
11. Set aside a new inner housing O-ring and inner brake pads for installation during assembly procedure.
12. Note: For front brakes skip to the next section.
13. Disconnect the service brake line, the park/emergency brake hydraulic line, the breather line and ABS sensor (if connected) from the brake.
14. Remove and discard the 6x mounting bolts, washers and nuts that hold the brake onto the axle.
15. NOTE: On ABS models, disconnect the ABS sensor and remove with the inner brake assembly.
16. Lift the inner brake assembly clear from the axle. The inner housing may need to be tapped with a copper mallet to free it from the axle.
17. Inspect the mounting studs. Replace if showing signs of damage or corrosion.
18. If the Studs need replacing:
    a. Punch out the old studs. Ensure the mating parts of the housing and seal carrier are clean and free of debris.
    b. Apply a light smear of Loctite® 515 on the mating surface of the seal carrier and under the head of each stud as it is pushed into place. Note that the heads of the studs are 'D' shaped and need to be orientated correctly.
    c. Using spacers, attach 4x mounting nuts and tighten to 15 Nm.
19. Inspect all fittings for damage or corrosion and replace if necessary.
20. Inspect the brake mounting adapter. Clean off all traces of Loctite 515 from the mating faces.
21. Remove and discard the stub axle oil seal.
22. Inspect the inner seal carrier. Buff the seal surface with a fine wet & dry (600 – 1000 grit) if it shows signs of wear or replace if necessary.

24. Spring Replacement Procedure

1. Disassemble the outer housing according to section 20.
2. Remove the 10x spring cover bolts and discard.
3. Loosen the 4x retractor bolts progressively and in sequence no more than 3x full turns at a time until completely removed. Retain the retractor bolts for later use.
4. Remove the spring cover.
5. Remove and discard spring cover gasket.
6. Remove the disc springs and inspect each one for signs of excessive wear or cracking. If there are any cracked springs, then all 32x springs must be replaced.
7. If there are no cracked springs clean all thoroughly.

Figure 24-1: Spring stack

8. Perform a EMMA piston seal replacement now. (Section 25).
9. Lubricate all disc springs with a high-pressure grease (Castrol LMM recommended) and reinstall on the park/emergency pistons. There is 8x springs per piston, stacked 2 in parallel.
10. Install a new spring cover gasket and refit spring cover.

Figure 24-2: Spring cover in place with gasket

11. Install 10x spring cover bolts and washers finger-tight.
12. Reinstall the retractor bolts and torque to 80 Nm.
13. Install and torque all spring cover bolts progressively and in sequence (one full turn at a time) to ensure that the spring cover does not distort or crack, torque to 60 Nm. Ensure each bolt is torqued twice.

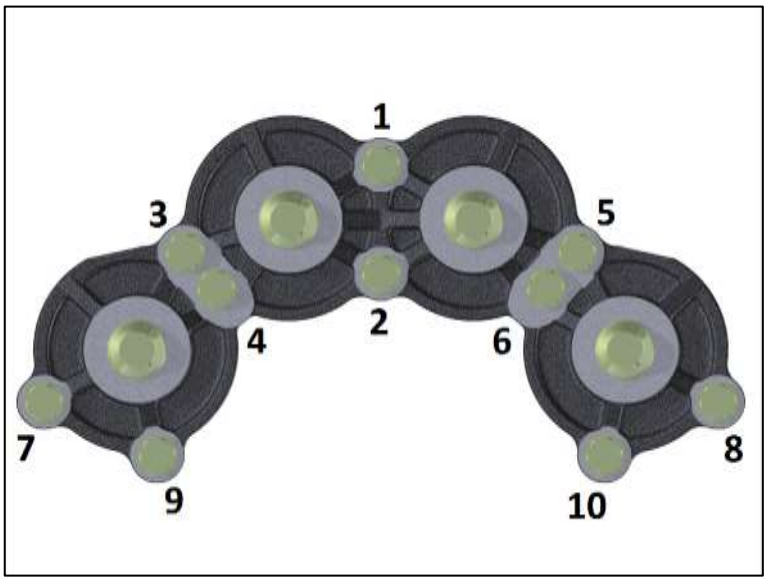


Figure 24-3: Spring cover bolt torque sequence.

25. EMMA Piston and Piston Seal Replacement Procedure

1. Follow steps 1-10 in section 24 to remove piston cover and springs.
2. Remove the pistons from the bore. A slide hammer may assist in removal.
3. Remove the piston O-ring seals and backup rings.
4. Clean the pistons with parts cleaner.
5. Inspect the pistons for damage, if there are signs of pitting and corrosion in the O-ring grooves the pistons should be replaced.
6. Apply a light smear of silicone grease to the pistons where the O-ring is seated (Parker Super O Lube recommended).
7. Attach the piston seals to the pistons. Ensure the O-rings and back-up rings are installed in the correct position and are not twisted.

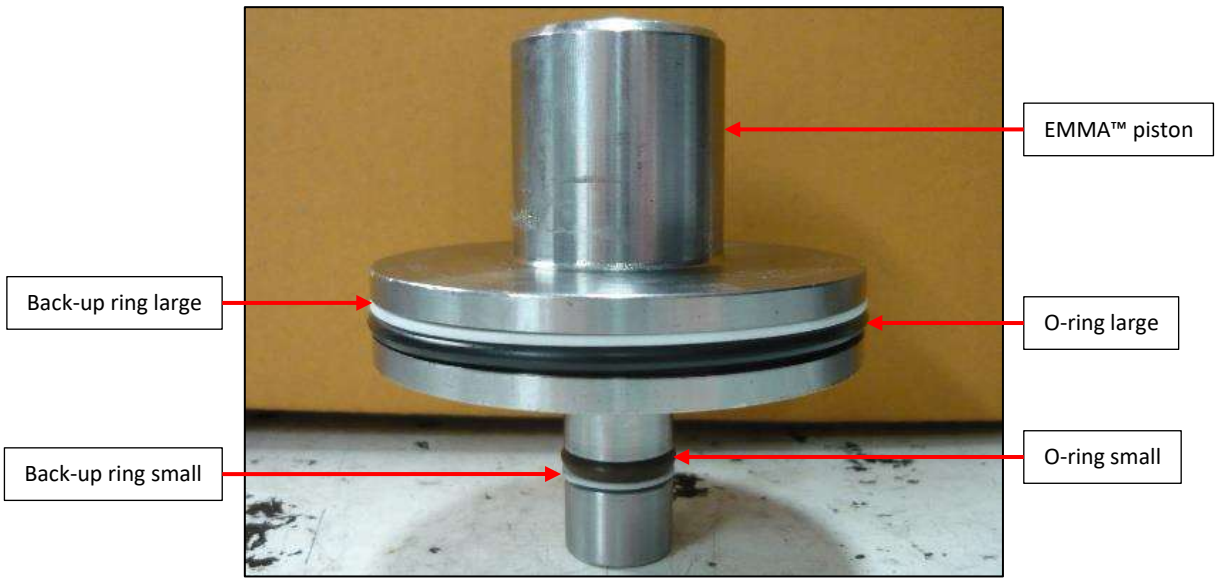


Figure 25-1: EMMA piston with seals installed.

8. Clean the exposed areas of the EMMA pistons in cases where the pistons have not been removed.
9. Ensure the piston seals avoid contamination during cleaning process.
10. Clean the inner housing and spring cover. Inspect both for damage.
11. Wipe the piston bores dry and apply a small amount of silicone grease in the piston bore.
12. Install any pistons that were previously removed.

Figure 25-2: Pistons installed in position

13. Follow steps 12-16 in section 24 to reassemble piston springs and spring covers.

26. Service Piston and Piston Seal Replacements Procedure

1. Disassemble the outer housing according to section 20.
2. Remove the pistons from the bore. A slide hammer may assist in removal.
3. Remove the piston O-ring seals.
4. Inspect each of the pistons for damage.
5. Clean the pistons with parts cleaner.
6. Apply a light smear of silicone grease to the piston O-ring seals.
7. Attach the piston seals to the pistons. Ensure O-rings are installed in the correct position and are not twisted.

Figure 26-1: Piston O-ring positions

8. Clean the inside of the inner housing with parts cleaner. Clean the piston bores thoroughly.
9. Ensure the piston seals avoid contamination during cleaning process in cases where the pistons have not been removed.
10. Wipe the piston bores dry and install any pistons that were previously removed. Pistons should be installed with the flat end inward. Apply pressure to the piston until it slides fully into place.

Figure 26-2: Pistons installed

27. Service Assembly and Bleed Procedure

A. Rear

1. Clean the axle flange and spindle to remove any grease, dirt and gasket remains. If the flange is damaged or corroded it must be cleaned thoroughly with abrasive paper.
2. Apply Loctite® 515™ directly to the axle flange face.
3. Each brake unit is stamped with its corresponding position on the vehicle and must be installed accordingly:
   a. LH = Left Hand
   b. RH = Right Hand
4. Fit the ABT™ Failsafe inner brake assembly unit over the stub axle. Align the mounting holes and locate the housing evenly and firmly against the axle flange.
5. NOTE: On ABS models, thread the ABS sensor through its mounting hole and place it in position.

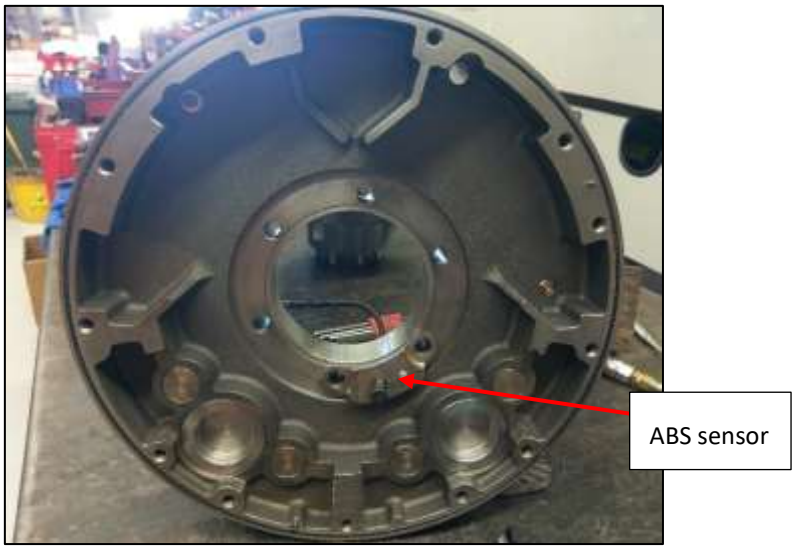


Figure 27-1: ABS sensor in place

6. Fit 6x new brake mounting bolts, washers and nuts.
7. Torque the brake mounting nuts to 100 Nm in a diagonal pattern. Repeat this procedure 3x over a 5-minute period.
8. Check the condition of the wheel bearing seal running surface. If the surface shows signs of degradation (e.g. corrosion or wear) repair using a speed-sleeve.
9. Fit a new housing O-ring into the groove around the circumference of the inner housing.
10. Install the inner brake pads in the inner housing ensuring the fit freely in the correct orientation.

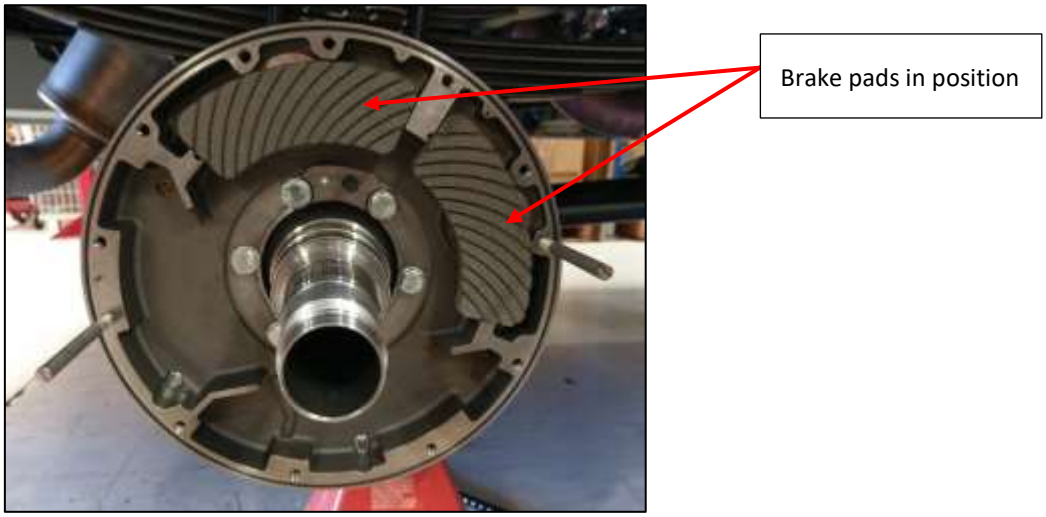


Figure 27-2: Brake pad position

11. Carefully fit the outer housing, hub and rotor assembly to the inner housing. 2x guide pins may assist with fitment.

Figure 27-3: Outer housing in place

12. Fit the 12x M10 bolts and torque to 60 Nm in sequence. Ensure each bolt is torqued twice.

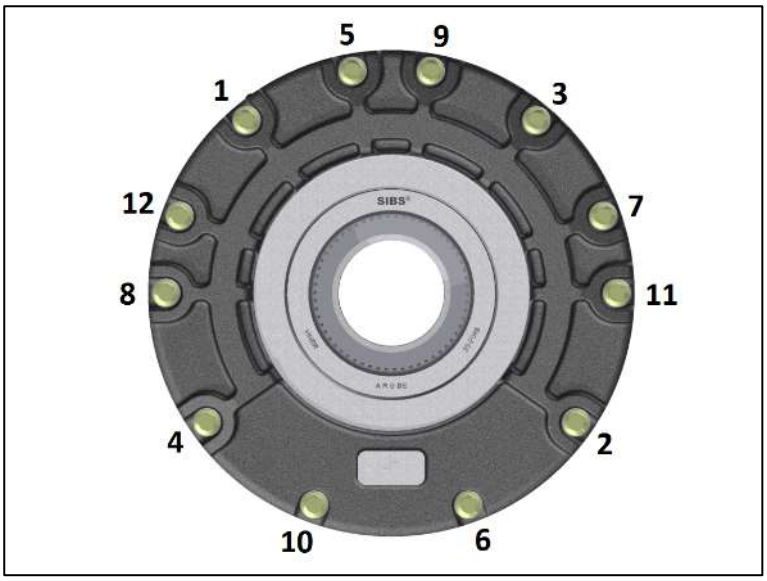


Figure 27-4: Housing bolt torque sequence.

13. Fit the outer wheel bearing and retaining collar and adjust to Isuzu specifications.

14. Fill the cavity behind the V-lip seal with a high temperature bearing grease (Castrol LMX recommended) via the grease nipple located on the hub face. Do not over-grease the V-lip cavity.

15. Install the axle half shafts in accordance to Isuzu manual specifications and top up the differential oil as required.

16. Remove the 4x retractor bolts from the spring cover.

17. Fit the pad wear indicator to the lowest piston:

    a. Screw the pad wear indicator plunger into the lowest piston thread and torque to 15 Nm.

    b. Apply Loctite 222 to the gland fitting on the thread that attaches to the spring cover only.

    c. Fit the gland fitting over the piston and screw this into the spring cover. Torque to 15Nm.

    d. Fit the stainless steel protective cap and fibre washer to the gland fitting.

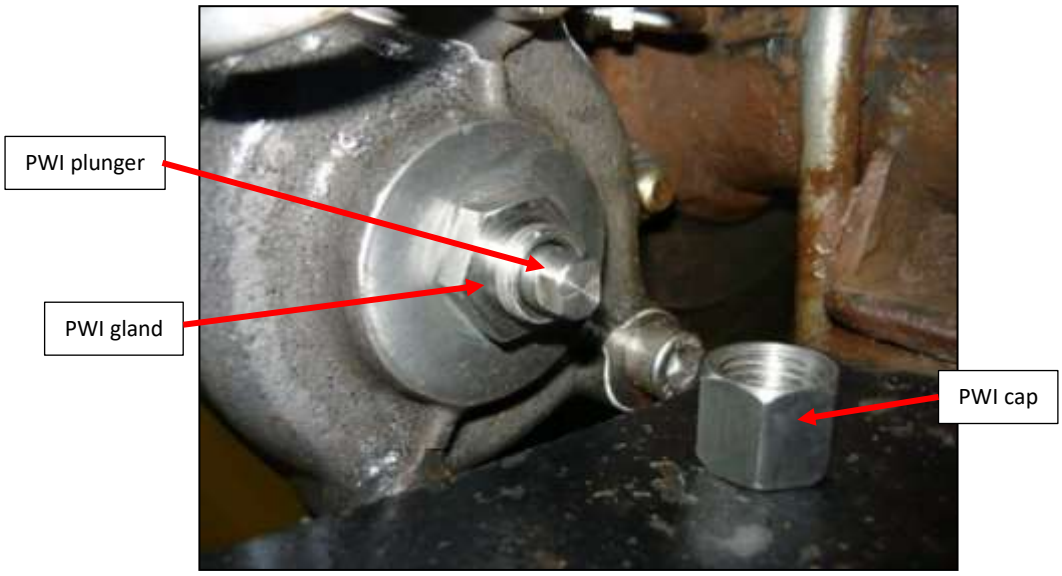


Figure 27-5: Pad wear indicator install in spring cover.

e. Fit 3x supplied tapered plugs to seal the remaining holes in the spring cover. Use an anti-seize or a low strength thread locker on the threads to prevent the plugs seizing in the spring cover. The hex sockets may be filled with silicone or similar, to aid future removal.

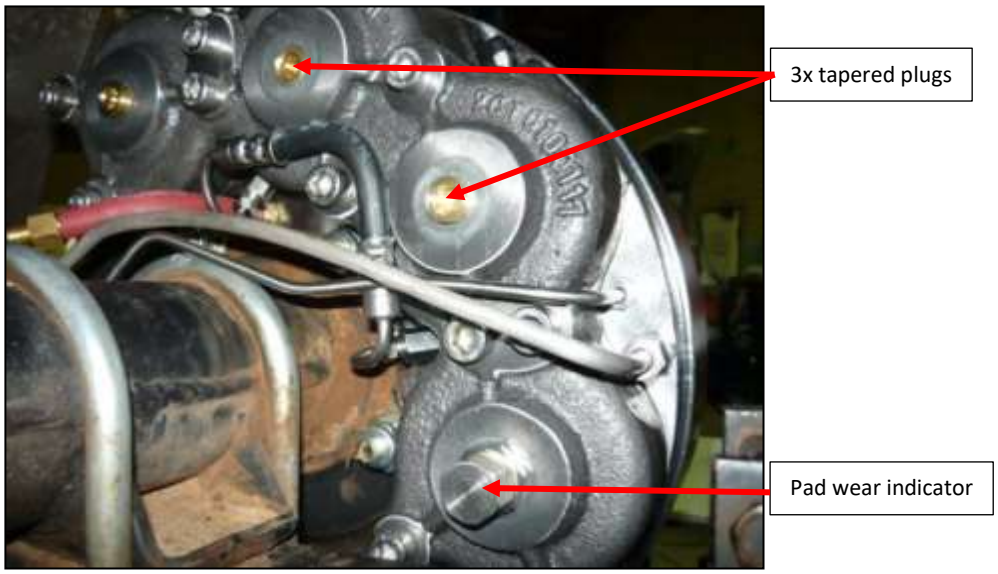


Figure 27-6: ABT™ Failsafe brake unit.

18. Remove the ABT™ “Blend 20” cooling fluid fill plug.
19. Fill the ABT™ Failsafe brake unit with new ABT™ “Blend 20” cooling fluid and refit the fill plug with a new copper washer. Approximately 800ml of ABT™ “Blend 20” cooling fluid is required per rear brake unit.
20. Repeat for the opposing brake unit.
21. Inspect all the park/emergency brake hydraulic hoses and replace as required.
22. Replace all rear breather hoses.
23. Flush the pump reservoir with new ATF Dexron III and then fill to level window.
24. Prime the ABT™ Failsafe pump by running intermittently (no more than 10 seconds at a time) until full hydraulic pressure is reached and the motor stops running automatically.
    a. To run the pump and release the EMMA™ brake, twist the red pushbutton on the control unit clockwise.
    b. To release hydraulic pressure and engage the EMMA™ brake, press the red operator pushbutton.
    c. While performing this priming process, ensure the EMMA™ reservoir is constantly topped up to prevent the pump from running dry.
25. Bleed the park/emergency brake system using the bleed screws on the rear brakes.
26. Remove any clamps on the rear service line.
27. Flush the master cylinder with brake fluid specified in the Isuzu NPS vehicle manual.
28. Bleed the rear service brake system of air.
29. Check that there are no leaks from the system.
30. Install wheels and torque all wheel nuts progressively and in sequence. Ensure each bolt is torqued as per Isuzu specifications.

B. Front

1. Non-ABS models: Inspect the inner seal carrier and replace if there are any signs of wear or damage.
2. Check the condition of the wheel bearing seal running surface. If the surface shows signs of degradation (e.g. corrosion or wear) repair using a speed-sleeve.
3. Fit a new housing O-ring into the groove around the circumference of the inner housing.
4. Install the inner brake pads in the inner housing ensuring correct orientation.
5. Carefully fit the outer housing, hub and rotor assembly to the inner housing. 2x guide pins may assist with fitment.
6. Fit the 12x M10 bolts and torque to 50 Nm in sequence. Ensure each bolt is torqued twice.

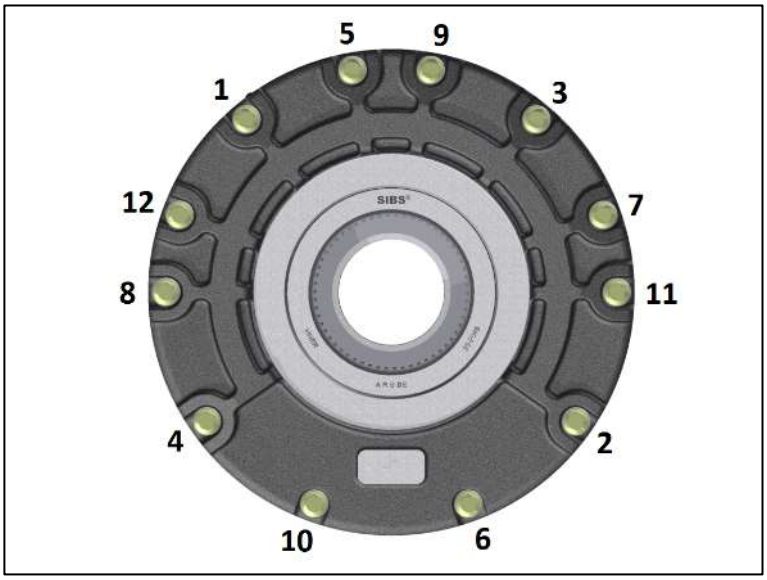


Figure 27-7: Housing bolt torque sequence.

7. Fit the outer wheel bearing and retaining collar and adjust to Isuzu specifications.
8. Fill the cavity behind the V-lip seal with a high temperature bearing grease (Castrol LMX recommended) via the grease nipple located on the hub face. Do not over-grease the V-lip cavity.
9. Remove the ABT™ “Blend 20” cooling fluid fill plug.
10. Fill the ABT™ Failsafe brake unit with new ABT™ “Blend 20” cooling fluid and refit the fill plug with a new copper washer. Approximately 600 ml of ABT™ “Blend 20” cooling fluid is required per front brake unit.
11. Repeat for the opposing brake unit.
12. Inspect all the front brake hydraulic hoses and replace as required.
13. Replace all front breather hoses.
14. Remove any clamps on the front service line.
15. Flush the master cylinder with brake fluid specified in the Isuzu NPS vehicle manual.
16. Bleed the front service brake system of air.
17. Check that there are no leaks from the system.
18. Install wheels and torque all wheel nuts progressively and in sequence. Ensure each bolt is torqued as per Isuzu specifications.

28. Troubleshooting

1. Problem
    a. Possible cause
        i. Solution

1. Fault light on control unit flashing.
    a. 2x flashes then rest – low battery fault (below 22V)
        i. Charge vehicle battery
        ii. Fault will self-clear when battery voltage is above 22V
    b. 3x flashes then rest – control unit PCB too hot
        i. Remove any sources of heat that could be causing the control unit to overheat
        ii. Fault will self-clear when the PCB temperature drops below a certain level.
    c. 4x flashes then rest - park/emergency brake took too long to release – operation aborted.
        i. Check pump reservoir level is not too low. If low check system for leaks.
        ii. Possible air in system causing slow release. Bleed park/emergency brake system.
        iii. Pump motor has is too hot and has lost effectiveness – allow to cool to ambient.
        iv. Cycle ignition to clear the fault from the control unit.
    d. 5x flashes then rest – pump relay fault
        i. Ensure wiring is not causing a short or open circuit to pump relay.
        ii. Check pump relay for correct function – replace if required.
        iii. Cycle ignition to clear the fault from the control unit.
    e. 6x flashes then rest – dump valve fault
        i. Ensure wiring is not causing a short or open circuit to dump valve.
        ii. Check dump valve for correct function – replace if required.
        iii. Cycle ignition to clear the fault from the control unit.
    f. 7x flashes then rest – diff lock solenoid fault
        i. Diff lock not fitted for NPS – check for interference with 6 pin connector behind radio.
        ii. Cycle ignition to clear the fault from the control unit.
    g. 8x flashes then rest – pressure sensor fault
        i. Ensure wiring is not causing a short or open circuit to pressure sensor.
        ii. Check pressure sensor for correct function – replace if required.
        iii. Cycle ignition to clear the fault from the control unit.
2. ATF warning light on control box on.
    a. Vehicle parked on steep incline causing sensor to read incorrect fluid level.
        i. Park vehicle on flat surface and check ATF warning light if off.

b. Low fluid level in ABT™ Failsafe pump reservoir.

i. Top up reservoir with ATF Dexron III and check system for leaks.

3. Brake status LED is solid green and control unit is not responding.

a. Control unit is in 'ABT™ Failsafe 3' mode.

i. Conduct a master reset of the control unit by holding the manual release button and cycling the E-stop button 3 times within 5 seconds. All lights on the control unit will flash once to confirm reset was successful and all settings have been cleared.

4. Brake pedal soft/spongy

a. Air in the service brake system

i. Bleed the brakes

b. Brake rotors binding on splines

i. Crimp off brake hoses to isolate offending brake.

ii. Strip wheel end & inspect.

5. Brake pedal hard/excessive force required to operate brakes/reduced braking performance.

a. Pads and rotor surface glazed.

i. Change ABT™ "Blend 20" cooling fluid and perform dry deglaze procedure if required.

b. ABT™ "Blend 20" cooling fluid contaminated with brake fluid, ATF or grease.

i. Remedy any leaks then change ABT™ "Blend 20" cooling fluid and perform dry deglaze procedure if required.

c. Vacuum system leak.

i. Inspect vacuum hoses, connections and booster for leaks.

6. Pedal goes slowly to floor with light application.

a. Master cylinder bypassing internally.

i. Strip and inspect. Replace cylinder or install overhaul kit.

b. Leak in brake lines/hoses or fittings.

i. Inspect brake lines and hoses for leaks.

ii. Ensure stainless fittings and bleed nipples are seated correctly. Tighten or replace as required.

c. Brake seals bypassing internally.

i. Strip brake and inspect service piston seals. Replace with new piston seal kit.

7. Brakes drag/brakes not fully releasing after operation.

a. Booster/master cylinder out of adjustment.

i. Adjust booster output pushrod.

b. EMMA™ piston seals bypassing or service piston seals contaminated & swollen preventing them from retracting.

i. Locate which wheel end is affected (which wheel is dragging) or inspect rear brakes for ATF leakage around rear of spring cover.

ii. Strip brake, inspect components. Replace seals as required.

c. Insufficient hydraulic pressure to release EMMA™ brake.

i. Place vehicle on hoist and release EMMA™ brake. Check to see if one or both wheels are dragging.

ii. If both sides: Carryout pressure check in EMMA™ circuit, should be 1700psi, if pressure is insufficient change pressure switch. If pressure still low, EMMA™ pump may be at fault.

iii. If only on one side: strip wheel-end & inspect.

8. Vehicle pulls to one side during braking.

a. Generally due to reduced effectiveness in one brake (brake steer). Vehicle will pull to the side with the more effective front brake. Usually caused by front brake issue.

i. If running OEM front brakes refer to Isuzu manual.

ii. If running ABT™ Failsafe front brakes check seized or sticking service pistons.

iii. Strip wheel ends and inspect service pistons & seals.

iv. Note: service brake seals can deteriorate (swell) if outer Viton seal fails allowing ABT™ “Blend 20” cooling fluid to come in contact with brake seal. Replace seals.

b. ABT™ “Blend 20” cooling fluid contaminated with brake fluid, ATF or grease.

i. Remedy any leaks then change ABT™ “Blend 20” cooling fluid and perform dry deglaze procedure if required.

9. Brakes shudder as vehicle slows to a stop.

a. Old/overused ABT™ “Blend 20” cooling fluid.

i. Change ABT™ “Blend 20” cooling fluid.

b. Brakes are cold.

i. Complete 3x medium/hard stops to warm brake.

ii. If shudder persists after more than first three brake applications, change ABT™ “Blend 20” cooling fluid and perform dry deglaze procedure if required.

10. ABT™ Failsafe park/emergency brake applies unexpectedly.

a. Faulty wiring causing intermittent loss of continuity.

i. Inspect/test 24 volt ignition switched & 24 volt constant supply. Ensure all connections are clean, secure and free of corrosion.

ii. Check door switches.

iii. Check seatbelt switches.

iv. Check oil-pressure switches.

11. ABT™ Failsafe park/emergency brake is poor. Brake not holding on inclines.

a. Brake pads and/or rotor worn.

i. Check pad wear indicators. If pads below wear limit conduct a major service.

12. ABT™ Failsafe park/emergency brake slow to apply

a. Brake pads worn.

i. Check pad wear indicators. If pads below wear limit conduct a major service.

b. ABT™ Failsafe relief valve set too high.

i. Adjust to desired application speed by loosening locknut and turning adjusting screw out. Adjust ½ turn at a time & test.

13. ABT™ Failsafe pump runs intermittently during service (brake status light flashes red and beeps occasionally).

a. Minor leak in park/emergency brake system

i. Check all hydraulic hoses and connections for signs of leaking ATF.

ii. Strip brake and check emergency/park brake piston seals and bores. Replace as required.

14. Pump does not run (ABT™ Failsafe park/emergency brake does not release).

a. Check interlocks are not preventing brake release

i. Close all doors, fasten driver's seatbelt, start vehicle engine.

b. Loss of power to ABT™ Failsafe control unit (indicated by lack of brake status LED).

i. Check all fuses. If blown identify cause and repair.

c. Loss of power to ABT™ Failsafe pump.

i. Check all fuses. If blown identify cause and repair.

ii. Check function of relay mounted at vehicle battery. Replace if required.

d. Faulty pump motor.

i. Replace pump motor.

15. ABS light illuminated on the dash.

a. ABS sensor is deformed or damaged.

i. Remove the ABS sensor and check for deformation or damage. Replace if required.

ii. Perform an EMMA piston test.

b. Failsafe Brake overheated.

i. Leave the brake to cool. Perform an EMMA piston test.

c. General vehicle faults.

i. Refer to the Isuzu manual.