ADVANCED BRAKING TECHNOLOGY

FAILSAFE EMERGENCY WORKSHOP MANUAL

ISUZU NPS (DRIVELINE BRAKE)

1. Revision History

Revision	Issue Date	Author	Comments
A	28 Aug 2017	M. O'Driscoll	Draft Release
1	12 Dec 2018	M. Cornelius	Updates to section 17, 18. Added sections 6, 19-25.

2. Table of Contents

3. Important Information

This manual applies to the fourth generation ABT™ Failsafe emergency for the Isuzu NPS 4x4 Trucks. The manual details how to install the ABT™ Failsafe emergency system correctly to ensure optimum safety and performance. All information contained in this manual is based on the latest ABT™ Failsafe emergency 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

ATF	Automatic transmission fluid
DPS	Door proximity system
Driveline Brake	Single brake unit acting on the rear axle differential
Emergency Brake	Brakes automatically applied in an emergency
EMMA™	Electronically Modulated Mechanically Applied
OEM	Original equipment manufacturer
Park Brake	Brakes applied independently of the service brake
PWI	Pad wear indicator
ABT™ Failsafe emergency	Differential mounted fully sealed brake with SAHR
ABT™ "Blend 20"	Specially formulated cooling fluid for use in ABT™ Failsafe and Failsafe Emergency brakes

5. Brake Description

The ABT™ Failsafe Emergency brake is a Spring Applied Hydraulic Release system operating in isolation from any other braking system fitted to the vehicle. It has been configured for mounting to the driveline of light trucks through to heavy goods vehicles. The brake is bolted to the input side of the rear differential carrier. The torque generated by the brake is transmitted to the rear wheels via the differential and axle shafts.

The ABT™ Failsafe Emergency brake operates as a spring applied hydraulic release emergency driveline brake only. The hydraulic system has been designed to modulate the application preventing shock loads damaging the driveline.

ABT™ Failsafe Emergency is an enclosed single rotor high-speed disc brake. It provides greater reliability in a compact enclosed package. The brake is designed for harsh mining environments and can be submerged for short periods without affecting operation.

6. Important Emergency Brake Information

1. **The brake is intended as an emergency brake only for use in the event of a service brake system failure. The system is not designed as an additional service brake.**
2. **Do not perform dynamic stops unless in an emergency situation. If the brake is used in an emergency situation it is recommended to strip and inspect the brake and diff components.**
3. **The ABT™ Failsafe Emergency driveline brake is not designed as a vehicle retarder and should only be used in the case of an emergency.**
4. ***The ABT™ Failsafe Emergency Driveline Brake System HV19 is designed for "off highway" use. Whilst it is possible to operate the vehicle with the brake attached at highway speeds without damage, unintended application of the brake will rapidly and effectively arrest the vehicle. ABT™ recommends that the brake is disabled for highway use or when the vehicle is to be driven above speeds of 60kph by installing the supplied retractor bolts. This recommendation applies to delivery of the vehicle to site and any other extended "on highway" or "above speeds of 60kph" use.***

WARNING:	
	Before operating the vehicle on a mine site, the retractor bolts **MUST** be removed and replaced with plugs and pad wear indicator. Power to the control box **MUST** be restored.

NOTE:
Ensure the ABT™ Failsafe emergency caution and warning labels are attached to a prominent position on the windshield. Refer Section **Error! Reference source not found.**.

NOTE:
Ensure the Control Box Tag is attached to the Control Box if the brake has been made inoperable due to the fitment of retractor bolts. While retractor bolts are fitted the Failsafe Emergency control system must be made inoperable by disconnecting the control box on the dash or by removing the main fuses from the battery power harness.

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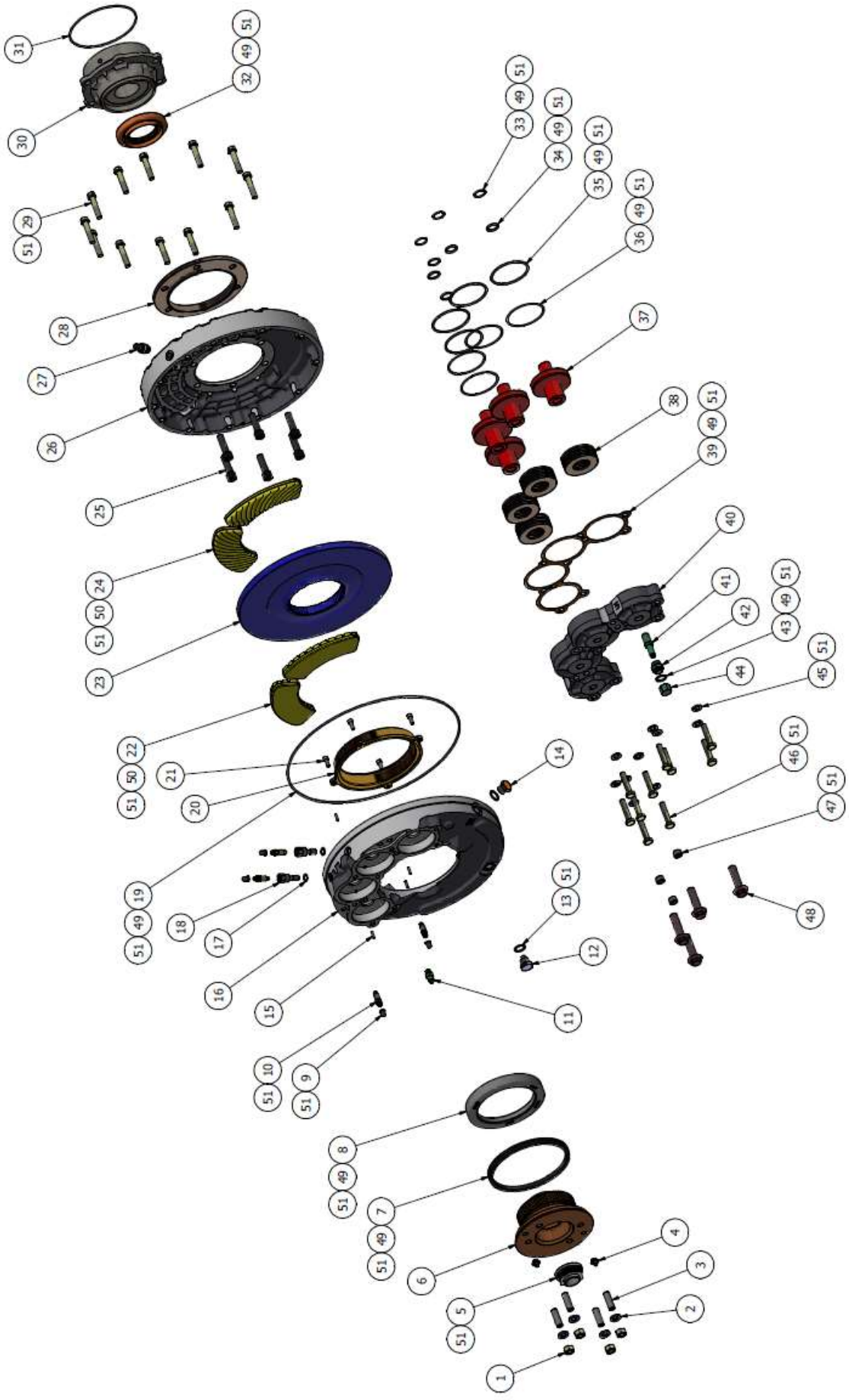
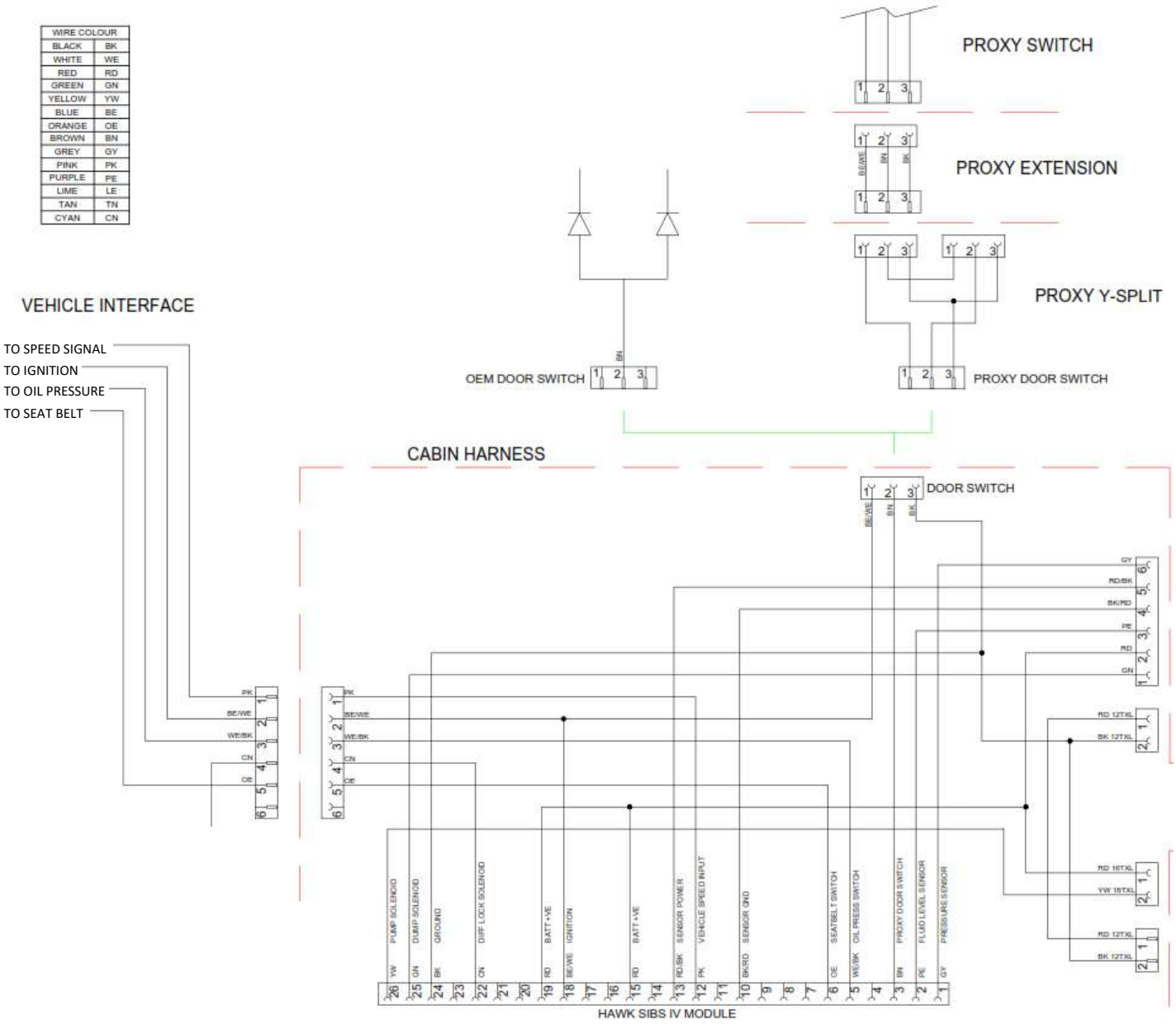
7. Exploded Views & Parts Lists - Differential Brake Assembly

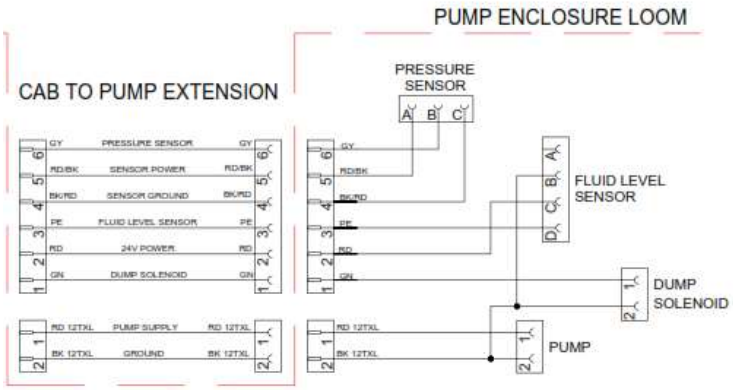


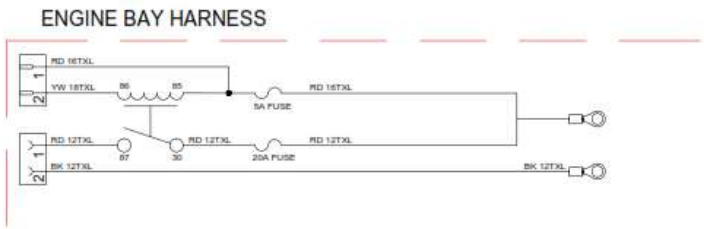
ITEM	PART NO.	DESCRIPTION	QTY/ BRAKE	TORQUE (Nm)
1	30-1001	NUT DRIVE SHAFT	4	100
2	30-2028	WASHER DRIVE SHAFT	4	-
3	21-2007	STUD DRIVE SHAFT	4	100
4	31-5015	NIPPLE GREASE	2	5
5	21-9002	NUT PINION	1	441 – 598
6	21-2002	YOKE DRIVE SHAFT	1	-
7	31-4013	SEAL V-LIP	1	-
8	25-2049	SEAL CASSETTE HOUSING	1	-
9	31-9000	CAP BLEED NIPPLE	4	-
10	31-5001	BLEED NIPPLE	4	15
11	31-5000	CONNECTOR HOSE EMMA	1	20
12	25-2039	PLUG DRAIN	1	20
13	30-2003	WASHER SEALING COPPER	2	-
14	31-5035	PLUG FILL	1	20
15	31-3001	PIN DOWEL	4	-
16	21-2001	HOUSING OUTER	1	-
17	31-2004	WASHER SEALING COPPER	2	-
18	21-2006	ADAPTER BLEED NIPPLE	2	20
19	31-2006	O-RING HOUSING	1	-
20	21-2005	CARRIER HOUSING SEAL	1	-
21	30-0059	BOLT SEAL CARRIER	4	10
22	25-4030	BRAKE PAD OUTER	2	-
23	25-2000	BRAKE ROTOR	1	-
24	25-4029	BRAKE PAD INNER	2	-
25	30-0060	BOLT BRAKE MOUNTING	6	75
26	21-2000	HOUSING INNER	1	-
27	31-5032	CONNECTOR BARB BREATHER HOSE	1	15

28	21-2004	FLANGE BRAKE MOUNTING	1	-
29	30-0003	BOLT BRAKE HOUSING	12	50
30	21-2003	CAGE BEARING MODIFIED (FROM VEHICLE)	-	-
31	21-9003	O-RING PINION BEARING CAGE	1	-
32	21-9001	SEAL PINION	1	-
33	31-2001	BACK-UP WASHER SMALL EMMA PISTON	4	-
34	31-2000	O-RING SMALL EMMA PISTON	4	-
35	31-2002	O-RING LARGE EMMA PISTON	4	-
36	31-2003	BACK-UP WASHER LARGE EMMA PISTON	4	-
37	25-2006	PISTON EMMA	4	-
38	31-0002	DISC SPRING	24	-
39	25-2061	SPRING COVER GASKET	1	-
40	25-2008	COVER SPRING EMMA	1	-
41	25-2040	PLUNGER PAD WEAR INDICATOR	1	15
42	25-2041	PLUG PAD WEAR INDICATOR	1	15
43	30-2005	WASHER PAD WEAR INDICATOR	1	-
44	25-2042	CAP PAD WEAR INDICATOR	1	10
45	30-2000	WASHER FLAT SPRING COVER	10	-
46	30-0001	SPRING COVER BOLT	10	60
47	31-5004	PLUG SPRING COVER	3	10
48	30-0028	RETRACTOR BOLT	4	80
49	21-5002	KIT SEAL NPS	1	-
50	25-5047	KIT BRAKE PAD	1	-
51	21-5003	KIT MAJOR SERVICE NPS	1	-

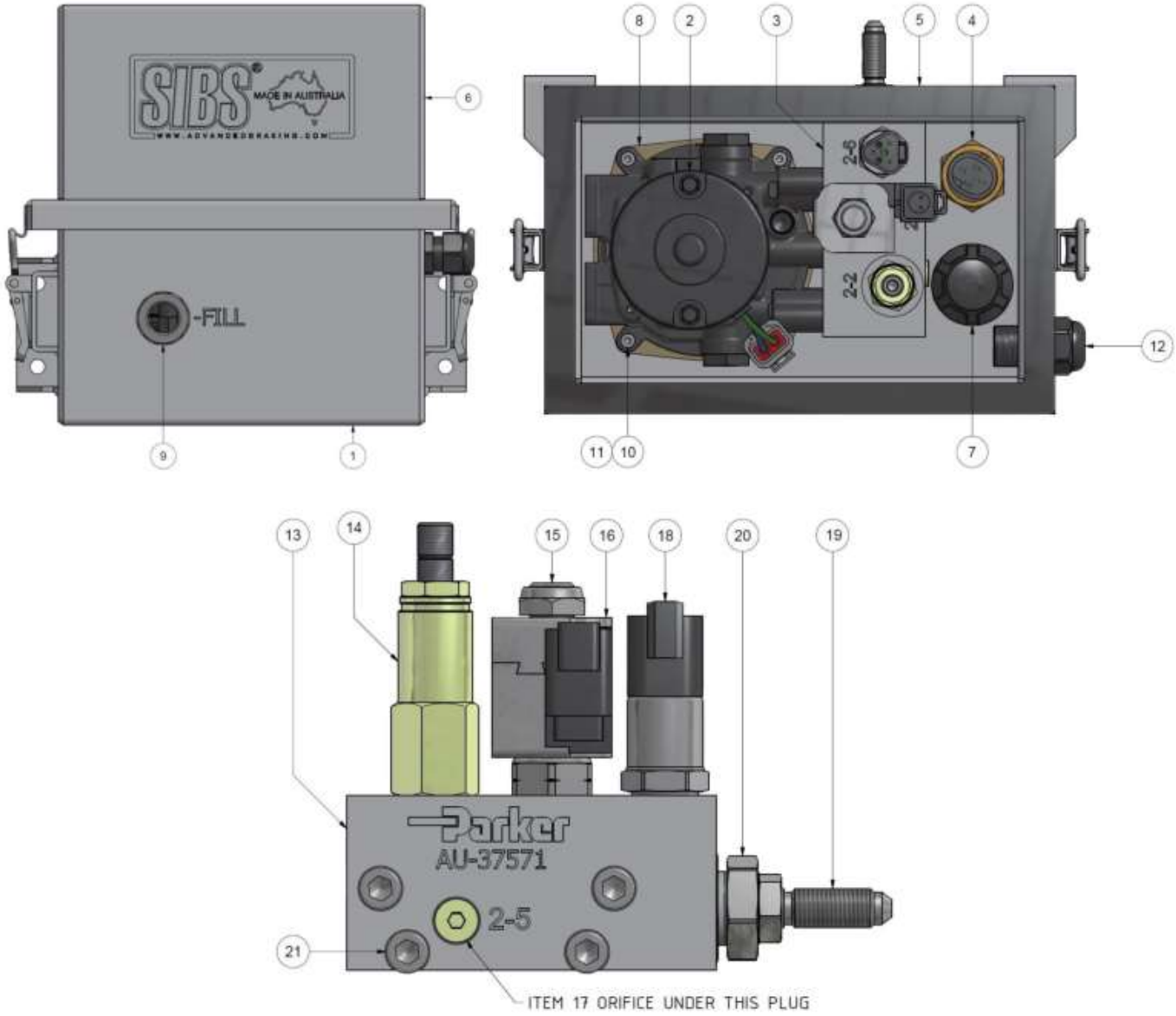
8. Wiring Diagram 24V




PUMP ENCLOSURE LOOM
CAB TO PUMP EXTENSION
PRESSURE SENSOR
A B C
GY PRESSURE SENSOR GY
RD/BK SENSOR POWER RD/BK
BK/RD SENSOR GROUND BK/RD
PE FLUID LEVEL SENSOR PE
RD 24V POWER RD
GN DUMP SOLENOID GN
RD 12TXL PUMP SUPPLY RD 12TXL
BK 12TXL GROUND BK 12TXL
FLUID LEVEL SENSOR
DUMP SOLENOID
PUMP


ENGINE BAY HARNESS
RD 16TXL
YW 18TXL
86
85
5A FUSE
RD 12TXL
87
30
20A FUSE
BK 12TXL

9. Pump Hardware Parts List 24V



ITEM	PART NO.	DESCRIPTION	QTY/KIT
1	18-9015	ENCLOSURE BASE/RESERVOIR	1
2	18-9044	POWER UNIT 24V (PUMP + ADAPTER + MOTOR)	1
3	18-9025	MANIFOLD ASSEMBLY 24V	1
4	18-9027	LEVEL SENSOR	1
5	18-9028	ENCLOSURE GASKET	1
6	18-9028	ENCLOSURE LID	1
7	18-9024	FILL CAP	1
8	18-9029	POWER UNIT GASKET	1
9	18-9030	LEVEL WINDOW	1
10	18-9031	SCREW POWER UNIT	4
11	18-9032	WASHER SPRING POWER UNIT	4
12	18-9033	CABLE GLAND	1
13	18-9034	MANIFOLD BLOCK	1
14	18-9035	RELIEF VALVE	1
15	18-9036	SOLENOID VALVE	1
16	18-9022	COIL 24V	1
17	18-9037	ORIFICE 0.5mm	1
18	18-9017	PRESSURE SENSOR	1
19	18-9038	BULKHEAD FITTING	1
20	18-9039	ADAPTER FITTING MANIFOLD TO BULKHEAD	1
21	18-9040	SCREW MANIFOLD BLOCK	4
22	18-4033	MANIFOLD O-RING SEAL KIT	1

10. Installation – Driveline Brake (Light - Medium Trucks)

1. The ABT™ Failsafe Emergency driveline brake is installed on the forward side of rear differential carrier.

Figure 1: Rear differential carrier.

2. Drain and keep enough diff oil from the rear differential carrier to prevent spillage as the pinion bearing cage will be removed for ABT™ Failsafe Emergency brake installation.
3. Remove drive shaft from rear yoke. The drive shaft may be removed completely if desired.
4. Remove the yoke from the pinion shaft and discard the pinion nut.
5. Remove the pinion bearing cage and retain any shims for later use. Ensure no dirt ingress into the diff centre.

Figure 2: Rear differential carrier with bearing cage removed.

6. Remove and keep the bearing rollers and O-ring seal. Remove and discard pinion seal.
7. The pinion bearing cage must be machined as per ABT drawing to suit the attachment of the ABT™ Failsafe Emergency brake.
8. Ensure the pinion bearing cage including the oil gallery, is clean and free of swarf.
9. Attach the O-ring to the modified pinion bearing cage.

10. Attach the modified pinion bearing cage to the diff centre as per Isuzu NPS manual. Ensure all shims are reused. Do not attach any mounting bolts at this stage.
11. Attach the outer bearing roller and pull the pinion shaft forward to ensure it is positioned correctly.
12. Attach the pinion seal to the bearing cage.
13. Apply Loctite 515 between the bearing cage and the ABT™ Failsafe Emergency brake mounting adapter flange.
14. Attach the ABT™ Failsafe Emergency brake mounting adapter flange to the bearing cage and align the mounting holes.

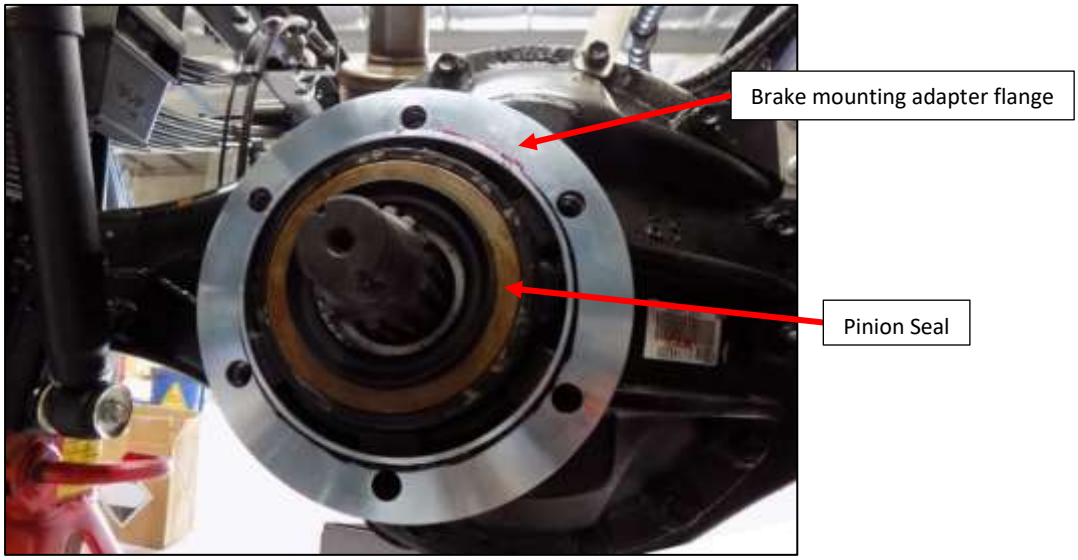


Figure 3: Brake mounting adapter mounted on bearing cage.

15. Apply Loctite 515 between the ABT™ Failsafe Emergency brake mounting adapter flange and the ABT™ Failsafe Emergency inner brake housing.
16. Attach the ABT™ Failsafe Emergency inner brake housing to the ABT™ Failsafe Emergency brake mounting adapter flange with the machined brake pad pockets positioned towards the top of the brake. Align the holes in both parts.
17. Attach the mounting bolts and washers. Torque to 75Nm. Repeat 3 times over 5 minutes.

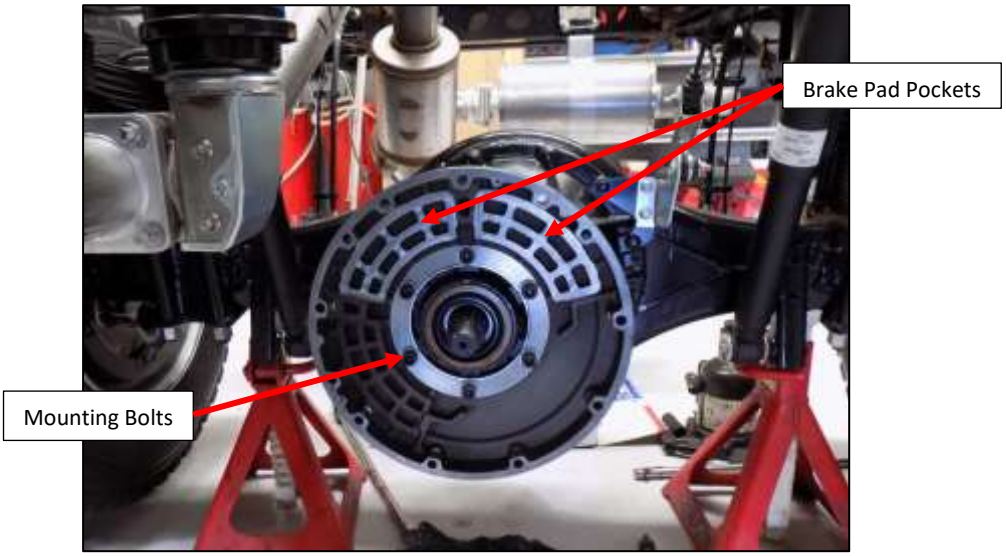


Figure 4: Diff centre with inner housing attached.

18. Ensure the brake pads are in position on the inner brake housing.

Figure 5: Inner housing with brake pads.

19. Attach the V-seal to the yoke.

20. The preassembled outer housing should be attached to the yoke and rotor. Ensure brake pads are attached to the outer housing.

21. Ensure the housing o-ring is attached to the outer brake housing.

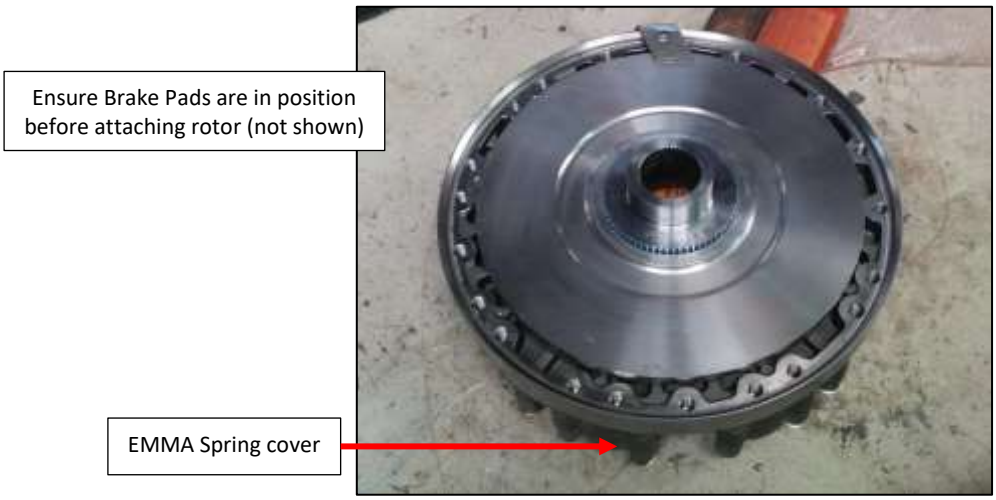


Figure 6: Outer housing, yoke and rotor assembly.

22. Attach the outer housing, yoke and rotor to the inner brake housing. Use of a jack, chain and tackle or similar is recommended to assist with lifting the assembly into position.

23. Hold the brake rotor to prevent it from detaching from the yoke during assembly.

24. Lift outer assembly and align the yoke with the pinion shaft with the EMMA spring covers positioned towards the top of the brake.

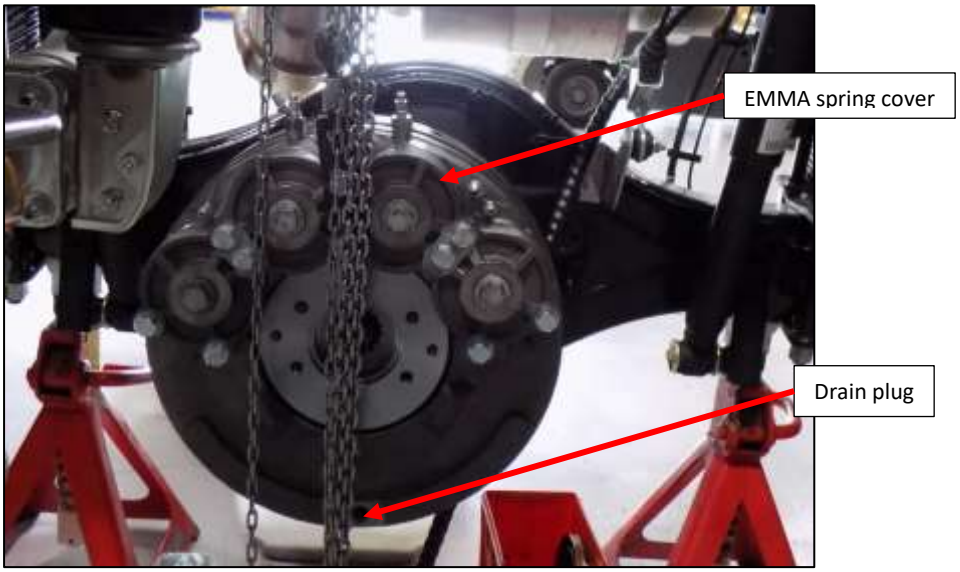


Figure 7: Outer housing assembly lifted into position.

25. The yoke may need to be rotated slightly to align with the spline on the pinion shaft.

26. Once the brake is held by the pinion shaft it should slide most of the way into position.

27. Remove any rotor retaining devices once the inner and outer housings are as close to each other as possible.

28. Align the dowel pins with corresponding holes before attaching the housing bolts.

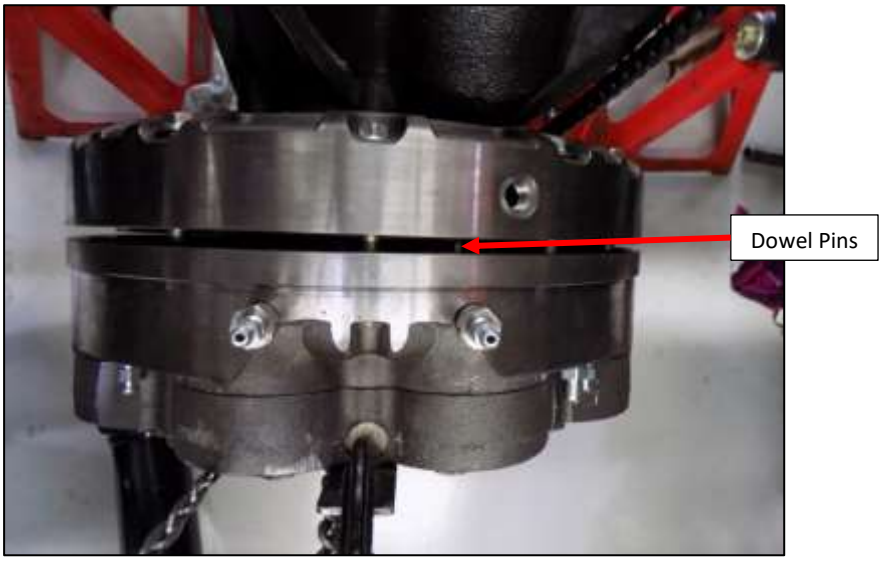


Figure 8: Align dowel pins and holes.

29. Fit the 12x M10 housing bolts and torque to 50Nm in sequence. Ensure each bolt is torqued twice.

Figure 9: Housing bolts.

30. Attach the 2x grease nipples to the yoke.

31. Attach the pinion shaft nut. Set preload and torque as per Isuzu NPS Manual.

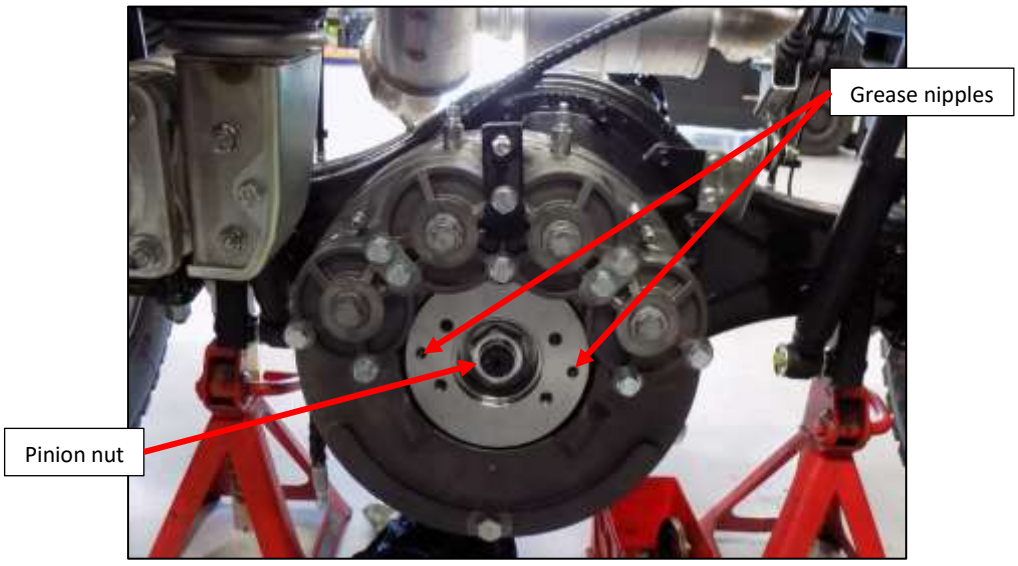


Figure 10: Pinion nut attached.

32. Ensure the diff rotates freely while the retractor bolts are still fitted and the ABT™ Failsafe Emergency brake is released.

33. Remove any lifting aids that may have been attached to the brake assembly. Ensure any bolts removed are retorqued to the correct specification.

34. Assemble the drive shaft onto the ABT yoke and align the 4 x holes.

35. Apply Loctite 222 to the first 5 threads of the 4 x studs. Torque to 100Nm.

36. Attach the 4 x washers and 4 x nuts to the studs. Torque to 100Nm.

37. Complete the hydraulic and electrical installations as per sections 10 and 11 of this manual.

38. Remove the 4 x retractor bolts from the brake and retain in the vehicle.

Figure 11: ABT™ Failsafe Emergency brake assembly with retractor bolts.

39. Attach 3 x taper plugs to the spring covers. Use Loctite Silver Grade Anti-seize on the threads of the taper plugs to assist with future removal. Torque to 10Nm.

40. Silicone may be used to fill the socket head of the taper plugs to prevent dirt ingress.

41. Attach 1 x pad wear indicator plunger to the EMMA piston inside the remaining hole in the spring cover. Torque to 15Nm.

42. Attach the pad wear indicator plug to the spring cover over the pad wear indicator plunger. Ensure it is threaded all the way onto the spring cover. Torque to 15Nm.

43. Attach the fibre washer and cap. Torque to 10Nm.

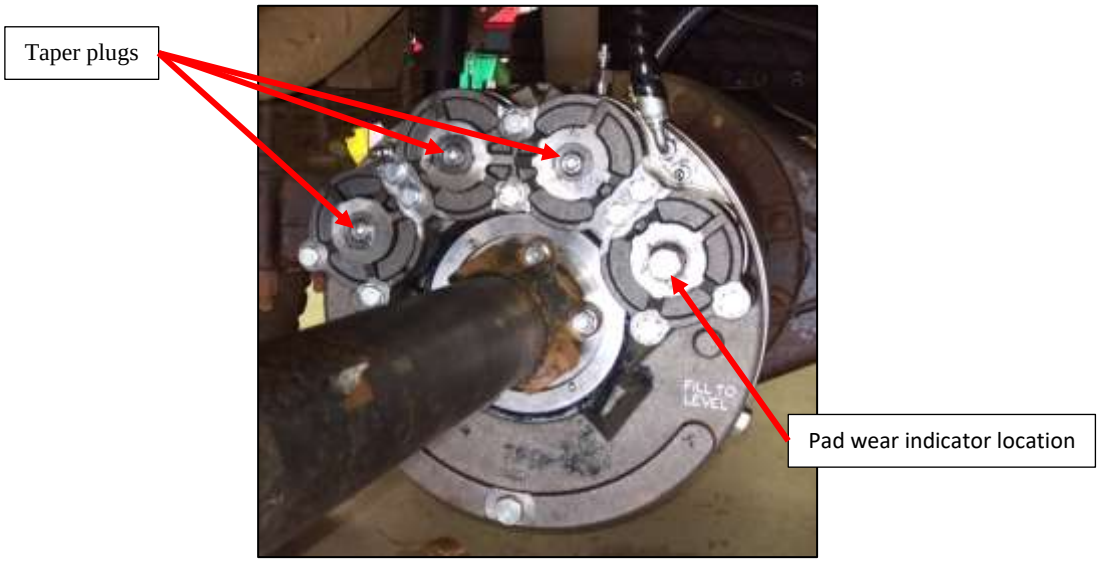


Figure 12: ABT™ Failsafe Emergency Brake assembly with pad wear indicator.

44. Mount the expansion chamber as high as possible in a protected location on the vehicle. ABT recommends mounting to the chassis cross-member or inside the chassis rail.

45. Secure using the supplied mounting hardware.

46. Run a length of breather hose between the expansion chamber and the brake unit.

47. Route the hose away from the exhaust and any moving components. Allow extra length for axle articulation.

48. Protect areas of the hose that may abrade using spiral guard.

49. Ensure ABT™ Failsafe Emergency fluid can easily drain back into the brake units.

50. Secure the hose using supplied P-clips.

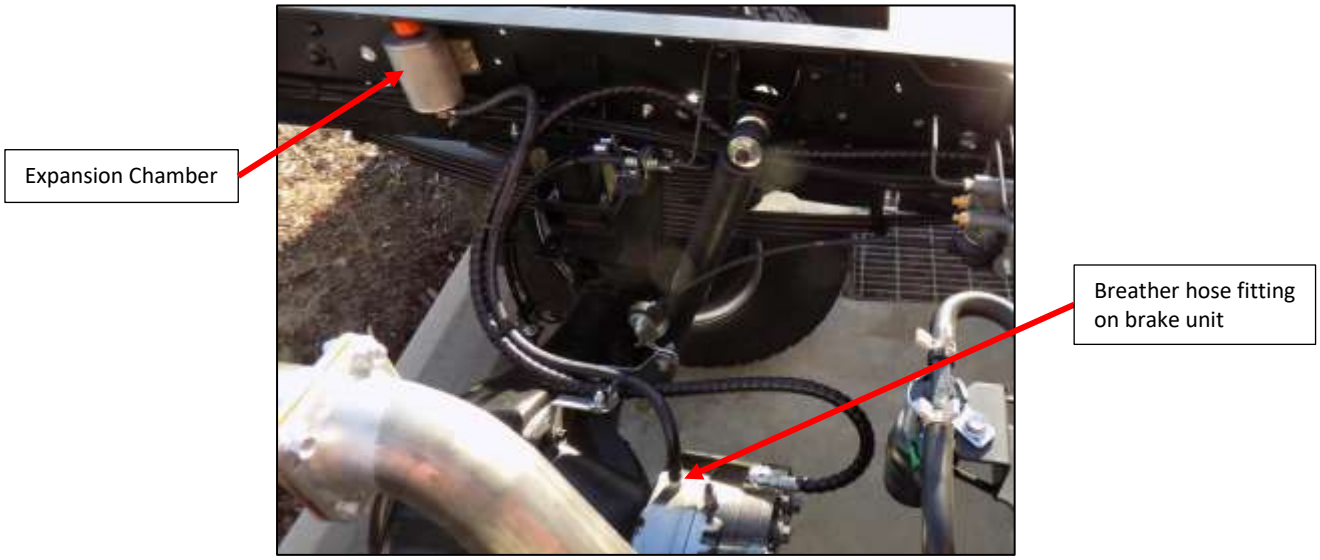


Figure 13: ABT™ Failsafe Emergency Brake assembly attached to rear diff centre.

11. Installation – Hydraulic System

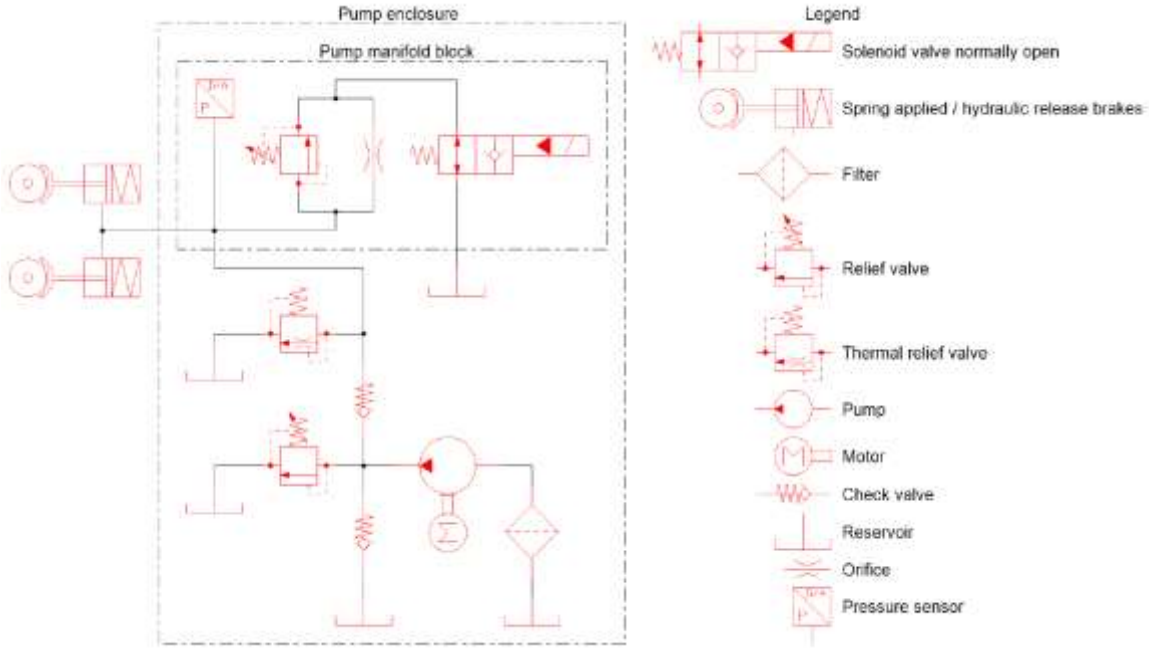


Figure 14: ABT™ Failsafe Emergency Hydraulic Schematic.

1. Mount the ABT™ Failsafe Emergency pump enclosure in a suitable location on the vehicle chassis as close to the battery as possible.
2. Drill the pump mounting bracket as required and mount the ABT™ Failsafe Emergency pump using provided mounting hardware.

Figure 15: ABT™ Failsafe Emergency pump enclosure.

3. Connect one end of the short park/emergency brake hydraulic hose to the bulkhead fitting at the rear of the pump enclosure.

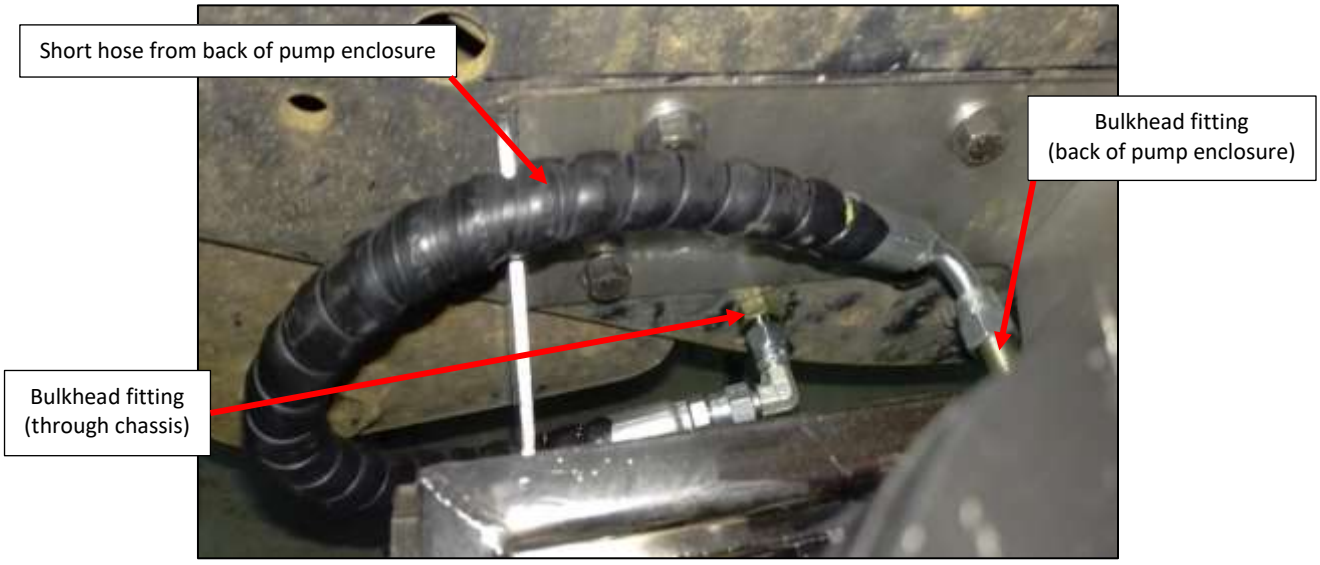


Figure 16: Hydraulic connections.

4. Attach bulkhead fitting to the vehicle chassis rail behind the pump enclosure.
5. Attach the other end of the short hydraulic hose to this bulkhead fitting on the outside of the vehicle chassis.
6. Attach one end of the long hydraulic hose to the bulkhead fitting on the inside of the chassis rail.
7. Route the other end of the hydraulic hose down along the chassis rail to the brake on the rear diff centre and connect. Secure the hose along the chassis using supplied P-clips.

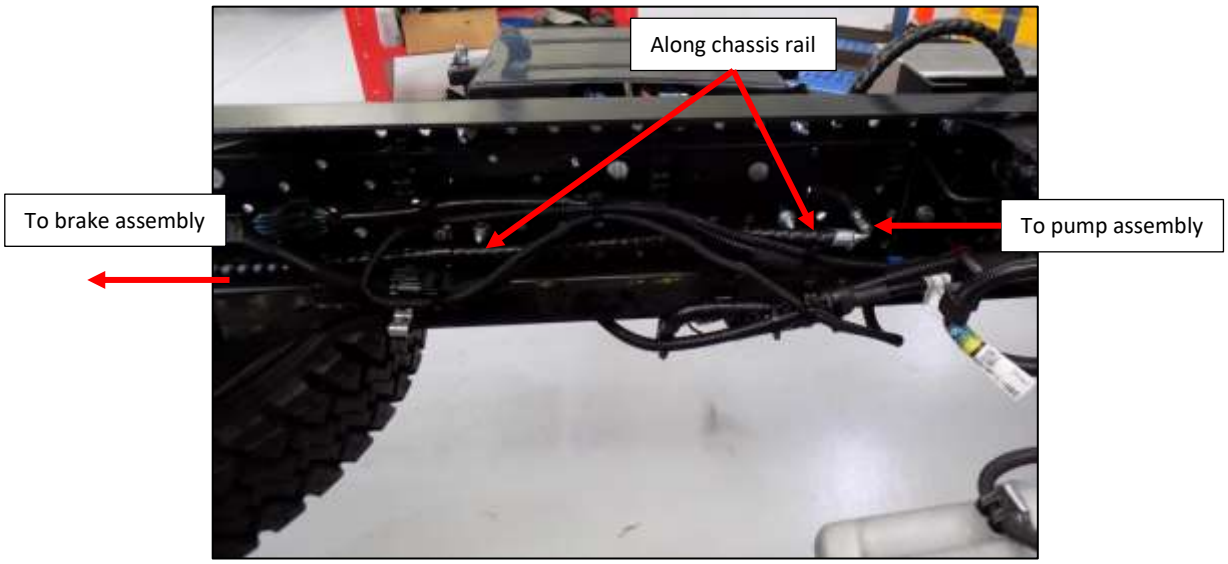


Figure 17: Hydraulic hose routing to brake.

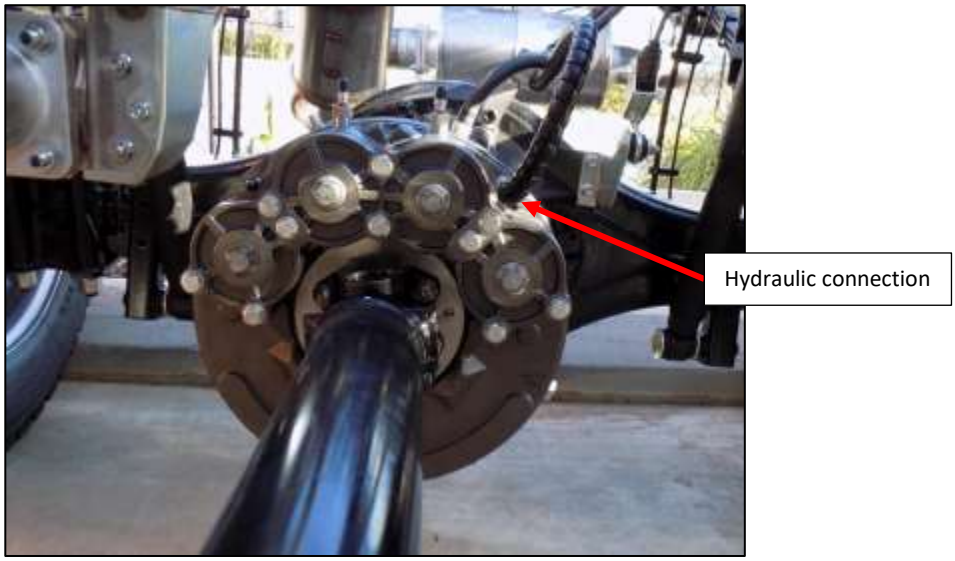


Figure 18: Hydraulic connection to brake.

12. Installation – Electrical System

1. Isolate the vehicle battery.
2. 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 14.
3. Mount the control unit to the dash:
   a. Remove the vehicle radio/centre console.
   b. Mount the ABT™ Failsafe Emergency control unit on the dash above the centre console 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 19: ABT™ Failsafe Emergency control unit mounted on dash.

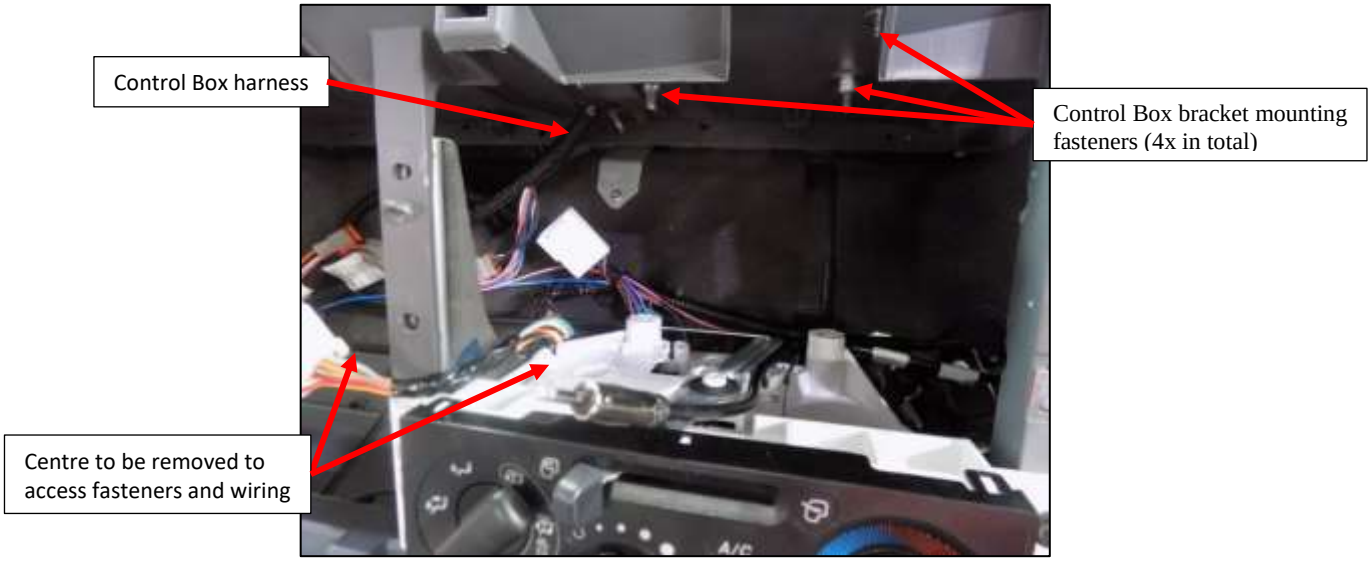


Figure 20: Centre console removed.

4. Fit the ABT™ Failsafe Emergency cabin harness 18-7012:

   a. Remove the front grille of the vehicle.

   b. Remove the plastic cover to expose the vehicle electrical connectors.

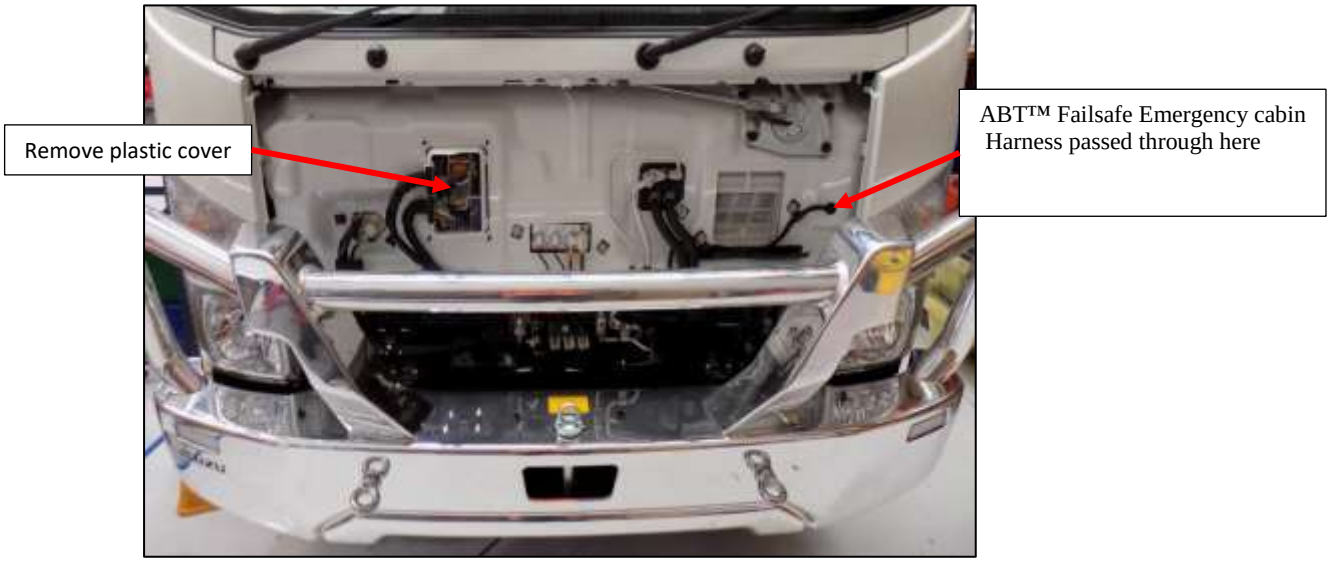


Figure 21: Front grille removed.

   c. Pass the cabin harness down through the dash. A 16mm hole will need to be drilled in the dash to achieve this.

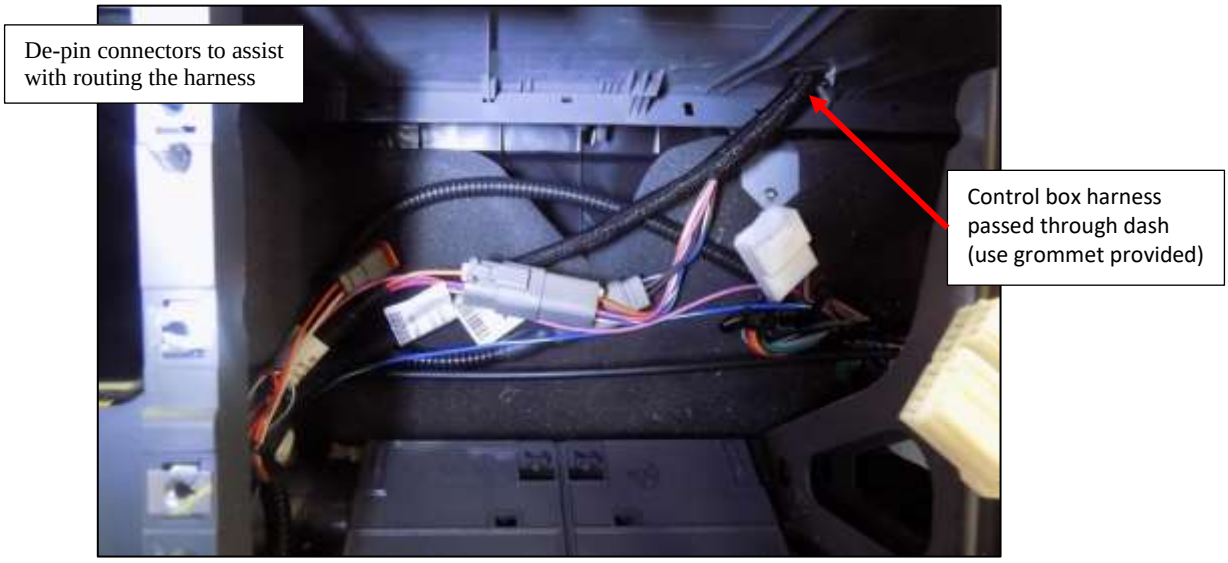


Figure 22: Control unit wiring.

   d. Route the cabin harness with 5 of the Deutsch connectors de-pinned. Note the pin location.

      i. The door switch connector does not require de-pinning.

   e. Remove the panel from in front of the passenger seat.

   f. Route the harness behind the dash and over to the passenger side.

Figure 23: Cabin harness routing.

g. Drill a 16mm hole through the front panel of the vehicle from the outside using an existing circular indentation as a guide. Drill inside the circle.

h. Route the harness in front of the windscreen wash reservoir and out through the drilled hole.

i. Secure the harness where necessary using cable ties.

j. Secure the grommet on the dash and the other on the front panel of the vehicle.

k. Re-pin the connectors. Pin to the previously noted configuration.

l. Follow the main vehicle electrical harness along the underside of the cab towards the chassis rail.

m. Route the harness back along the chassis rail towards the vehicle battery. Secure with p-clips where necessary.

n. Use extension harnesses provided if required.

o. Secure the harnesses where necessary with p-clips or cable ties.

5. Fit the vehicle interface harness:

   a. Connect the Deutsch end of the vehicle interface harness to the 6-pin connector on the ABT™ Failsafe Emergency cabin harness.

   b. Connect the interface harness wires to the desired vehicle interlock wires behind the centre console. Cut the wires to the desired length.

   c. 24V Ignition signal.

      i. Locate the 18-pin vehicle connector behind the centre console.

      ii. Connect the blue/white from the ABT™ Failsafe Emergency interface harness to the green/yellow from the 18-pin connector.

   d. Speed signal for stall interlock.

      i. Locate the 22-pin vehicle connector at the front of the vehicle.

      ii. Connect the pink from the ABT™ Failsafe Emergency interface harness to the yellow/green from the 22-pin connector. It may be easier to connect an extra length of cable externally first and then feed it back into the cab to connect to the interface harness.

   e. De-pin any unwanted wires from the interface harness.

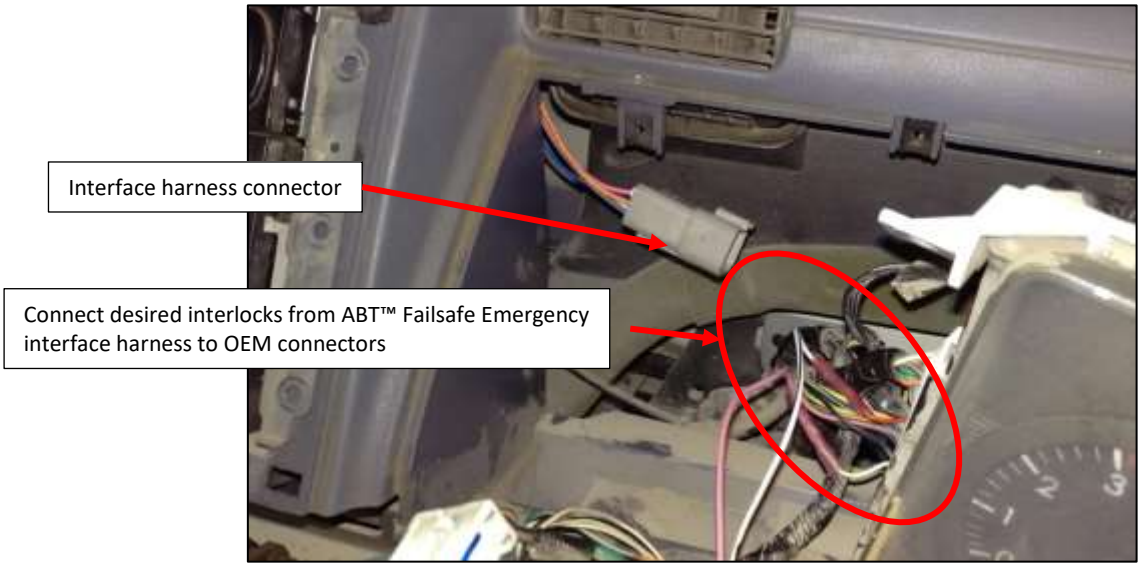


Figure 24: Connection for interlocks behind the instrument cluster.

6. 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™ Failsafe Emergency cabin harness located in the dash under the control box and connect this brown cable to the vehicle door switch signal.

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

7. 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 ‘d’.

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

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

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

Figure 25: 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 harness where necessary using P-clips or cable ties.

8. 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 26: Pump harness connection.

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

13. Pre-Service Inspection

1. Top up all reservoirs with the specified fluids.
   a. Use ABT™ “Blend 20” cooling fluid for the brake. 800ml approx. required.
   b. Use ATF Dexron III for the ABT™ Failsafe Emergency pump reservoir (park/emergency system).

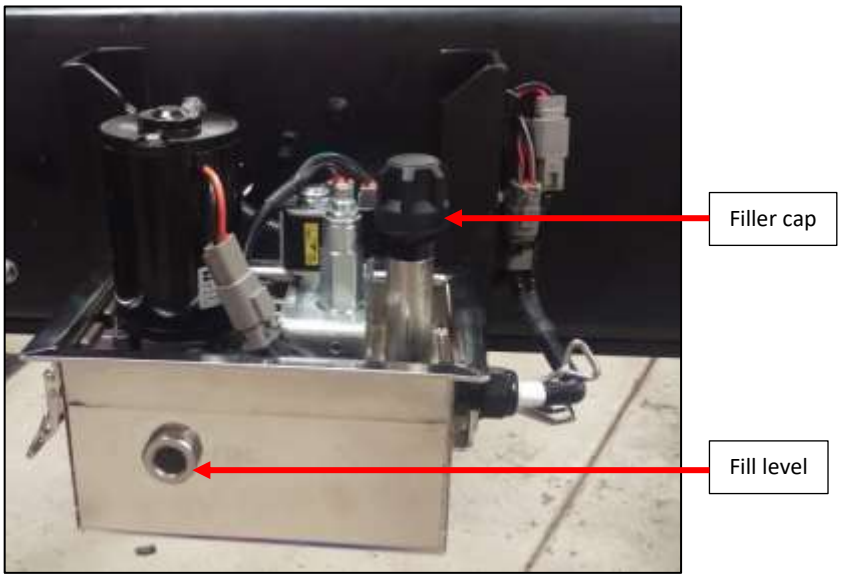


Figure 27: ABT™ Failsafe Emergency pump enclosure with lid removed.

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 Emergency system.

4. Bleed the park/emergency brake system:

   a. Ensure the battery is fully charged and in good working condition before connecting the ABT™ Failsafe Emergency controller.

   b. Twist and release the red E-stop button on the control unit.

   c. 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.

   d. 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.

   e. 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.

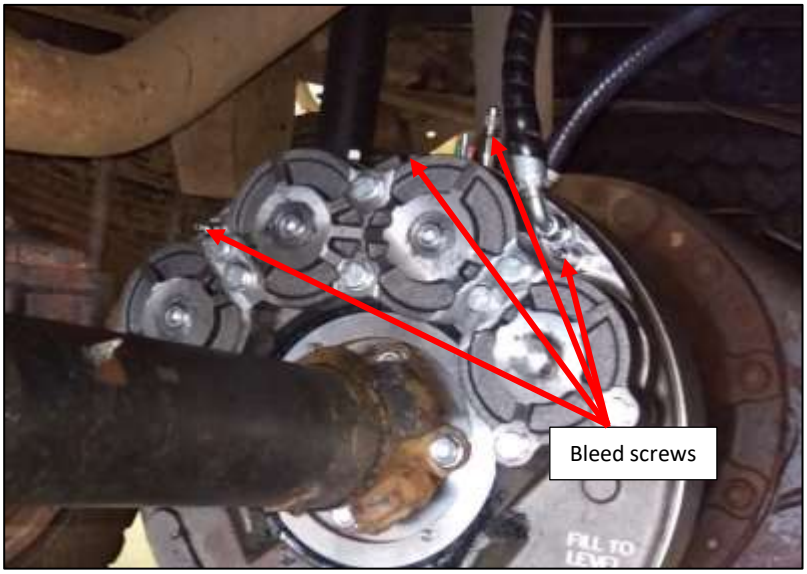


Figure 28: Park/emergency brake bleed screws.

5. Affix the ABT™ Failsafe Emergency caution label to the inside top corner of the windshield on the driver's side.

6. Complete a vehicle pre-start check.

7. If the vehicle is to be used on public roads it will require approval for road use.

   a. All vehicles can be fitted with an aftermarket modification plate.

   b. Please contact ABT customer service for details regarding ABT™ Failsafe Emergency equipped vehicles requiring approval.

14. Control System Setup

1. Ensure the battery is fully charged and in good working condition before connecting the ABT™ Failsafe Emergency controller.
2. With the vehicle engine running, twist and release the red E-stop button to release the brakes - the system will automatically detect the correct brake release pressure during its first release.
3. Activate all connected interlocks and check function:
   a. To activate the door interlock – open and close a vehicle door.
   b. To activate the seat belt interlock – connect and disconnect the driver's seatbelt.
   c. To activate the stall interlock – switch the ignition off, wait for 5 seconds, then start the engine, run for 10 seconds and then switch the engine off again.
   d. The corresponding warning light on the control unit should display when each interlock is activated (note: interlock warning lights are only displayed when ignition is on).
4. 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 40 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.

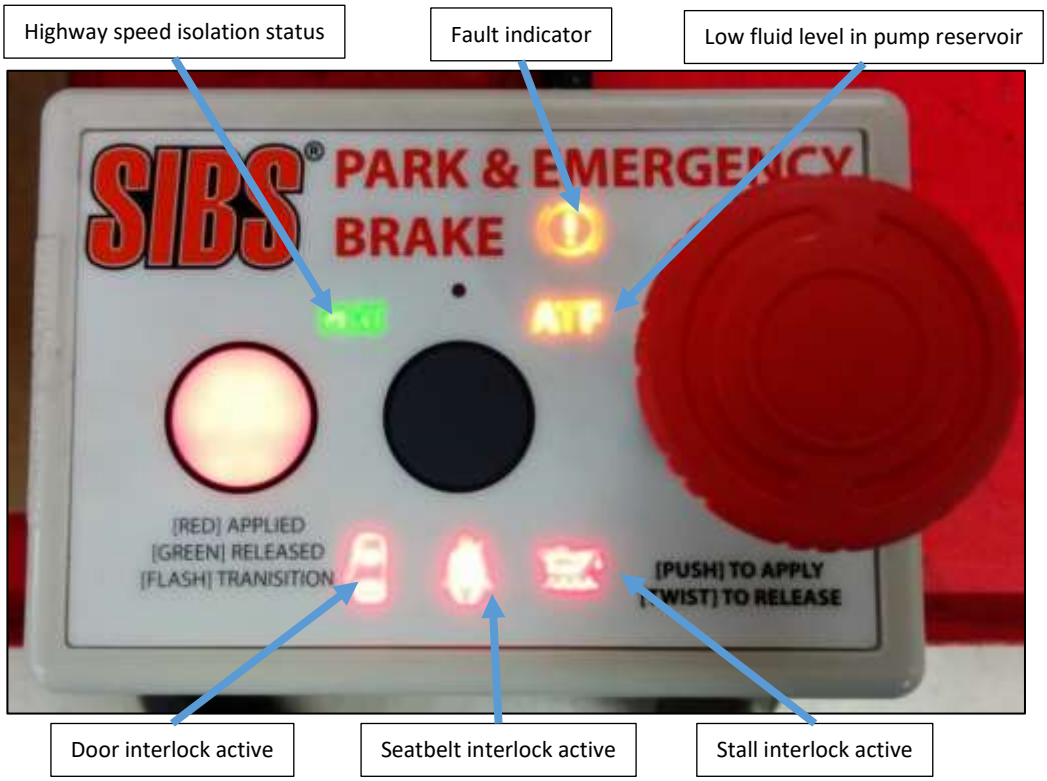


Figure 29: ABT™ Failsafe Emergency control unit warning lights

15. Service Schedule

The following table shows the recommended service intervals for ABT™ Failsafe Emergency 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 brake.

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

16. Pre-Start Check

1. Check ABT™ Failsafe Emergency pump reservoir level. If low, top up with ATF Dexron III and check system for leaks.
2. 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 Emergency control unit should be solid red.
   b. The park brake should be applied.
3. 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.
4. 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).
5. 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 Emergency 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
6. 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.

17. Minor Service (100 hrs)

1. Check brake unit for leaks:
2. Check the fluid level in the ABT™ Failsafe Emergency EMMA™ pump reservoir. Top up if necessary.
3. Check ABT™ Failsafe Emergency 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
4. Check hydraulic lines for cracks or damage.
5. Check the breather hose for cracks or damage.
6. Check the expansion chamber filler breather cap is clear.
7. Check all electrical connectors and wiring for damage or corrosion.
8. Ensure the vehicle battery is in good working order.
9. Check brake pad wear:
    a. Apply the ABT™ Failsafe Emergency driveline 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.

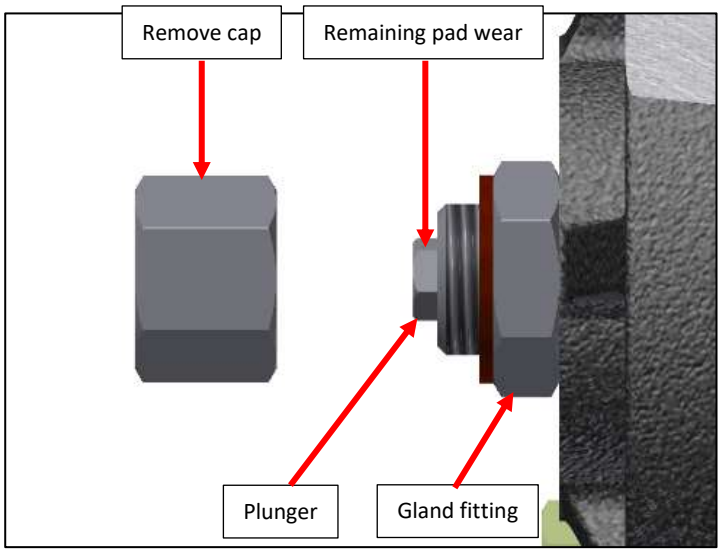


Figure 30: Rear pad wear indicator schematic.

10. If the brake pads have worn beyond the wear limit, then a major service must be completed.
11. 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.
12. Drain and discard the ABT™ “Blend 20” cooling fluid from the driveline brake.

a. At least 800 ml of ABT™ “Blend 20” cooling fluid should be found in the brake. 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 Emergency breather line.

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

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

14. Refill the brake up to the level plug (fill to spill). Approximately 1 litre of ABT™ “Blend 20” cooling fluid is required.

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

18. Major Service

1. Check ABT™ Failsafe Emergency driveline brake systems for leaks.
2. If leaks are present replace damaged seals where necessary during the major service (section 24).
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).
6. Perform a rotor service (section 21).
7. Perform a pad change, seal change and housing service (section 22).
8. If the springs need to be replaced, perform a replacement now (section 23).
9. Assemble the brake (section 25).
10. 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 detailed information
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 ABT™ Failsafe Emergency brake. Assistance is required for this test.
6. While the ABT™ Failsafe Emergency brake is applying/releasing observe the movement of the retractor bolts.
7. The 4x 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 8 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

12. Remove the 3x tapered plugs and 1x pad wear indicator from the spring cover. Refer to exploded view for detailed information

13. 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.

14. Drain and discard the ABT™ “Blend 20” cooling fluid.

    a. At least 800 mL of ABT™ “Blend 20” cooling fluid should be found. 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 emergency breather line.

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

15. Remove the drive shaft from the rear-rear yoke.

16. Disconnect the driveline brake hydraulic line from the brake.

17. Undo to pinion nut and remove from the pinion shaft.

18. Remove and discard the remaining 12x housing bolts.

19. Carefully separate the inner and outer housings until there is a slight gap between them.

20. Carefully rotate the outer assembly by 180° so the spring covers are located at the bottom of the assembly. The outer housing, rotor, yoke and outer pads should remain as one assembly.

21. With the aid of a trolley jack or similar, remove the outer assembly completely. Care must be taken as the outer assembly is heavy.

22. Sit the outer housing assembly, yoke and rotor on a clean bench.

21. Rotor Replacement Procedure

1. Disassemble the outer housing according to section 20.
2. Remove the yoke and rotor from the assembly. Clean the rotor.
3. Inspect the rotor and yoke splines for wear.
4. Check for movement between the rotor and yoke. If there is excessive movement between the splines of the mating components the rotor should be replaced.
5. Inspect the rotor friction surface. If there are signs of scouring covering more than 50% of the surface the rotor should be replaced.

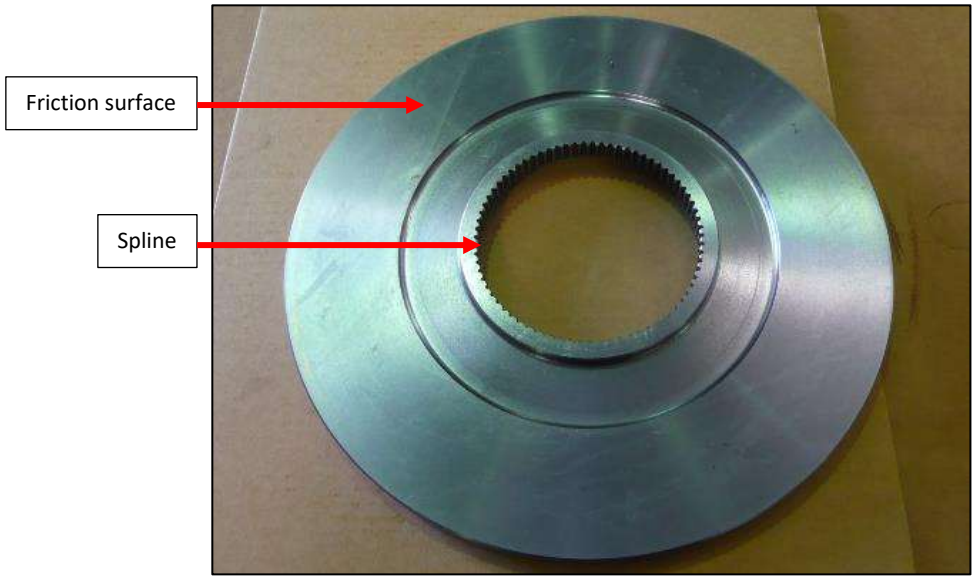


Figure 31: Rotor.

6. 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. 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. If the seal is to be replaced, inspect the pinion bearings and replace if necessary
4. Remove the housing O-ring from the inner housing and discard.
5. Clean the inner housing and inspect for damage or wear.
6. If the springs or EMMA piston seals need to be replaced, do so now (section 23,24).
7. Install a new O-ring onto the inner housing.
8. Install the inner brake pads in the inner housing ensuring correct orientation.

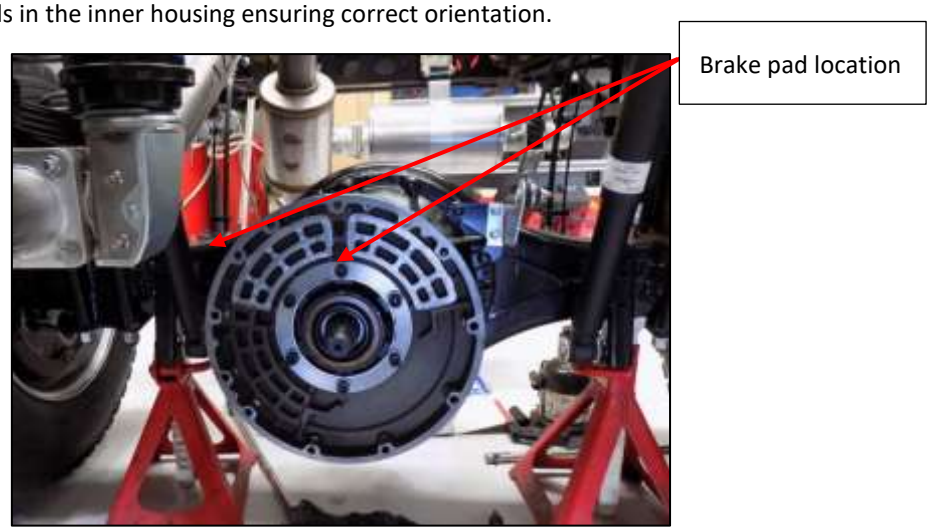


Figure 32: Brake pad locations

9. Remove the cassette seal from the outer housing and discard.
10. Clean the outer housing and inspect for damage or wear.
11. Install a new cassette seal into the outer housing.
12. Install the outer brake pads in the outer housing ensuring correct orientation.
13. Install the v-seal cover to the yoke.
14. Install a new v-seal onto the yoke.
15. Install the outer housing assembly onto the yoke.
16. Install the rotor onto the yoke spline ensuring correct orientation.
17. Inspect all fittings for damage or corrosion and replace if necessary.

23. 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 gaskets.
6. Remove the disc springs and inspect each one for signs of excessive wear or cracking. If there are any cracked springs, then all 48x springs must be replaced.
7. If there are no cracked springs clean all thoroughly.
8. Perform an EMMA piston seal replacement now. (Section 24).
9. Lubricate all disc springs with a high-pressure grease (Castrol LMM recommended) and reinstall on the park/emergency pistons. There is 12x springs per piston stacked 2 in parallel.

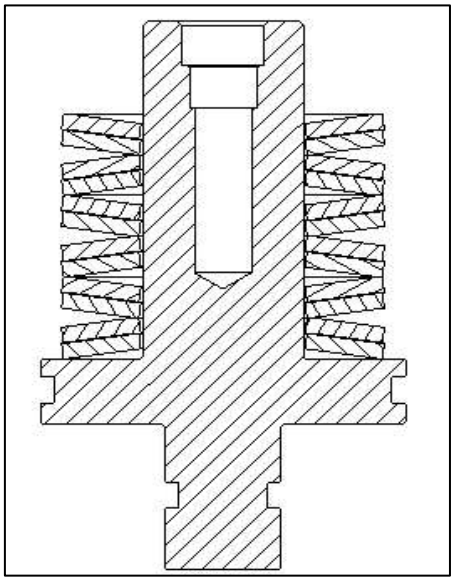


Figure 33: Disc springs installed on Failsafe Emergency brake piston.

10. Install new spring cover gasket and refit spring cover.
11. Install 10x spring cover bolts and washers finger-tight.
12. Reinstall the retractor bolts and torque to 80Nm.
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.

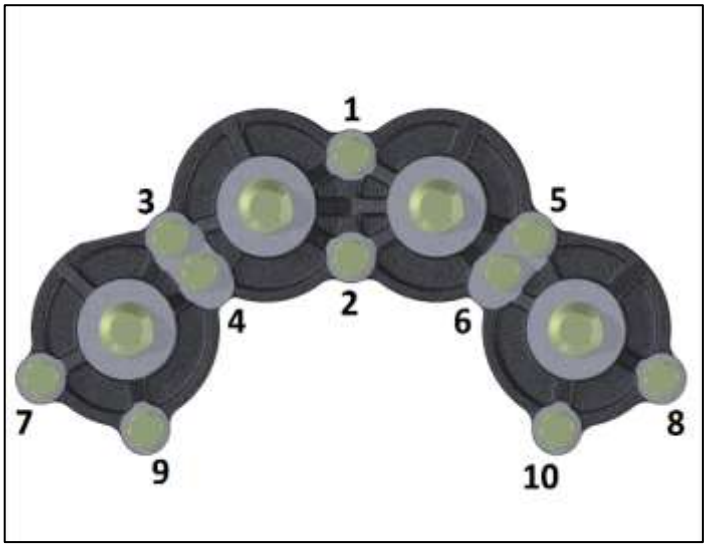


Figure 34: Spring cover bolt torque sequence.

24. EMMA Piston and piston Deal replacement Procedure

1. Follow steps 1-7 in section 23 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 washers are installed in the correct position and not twisted.

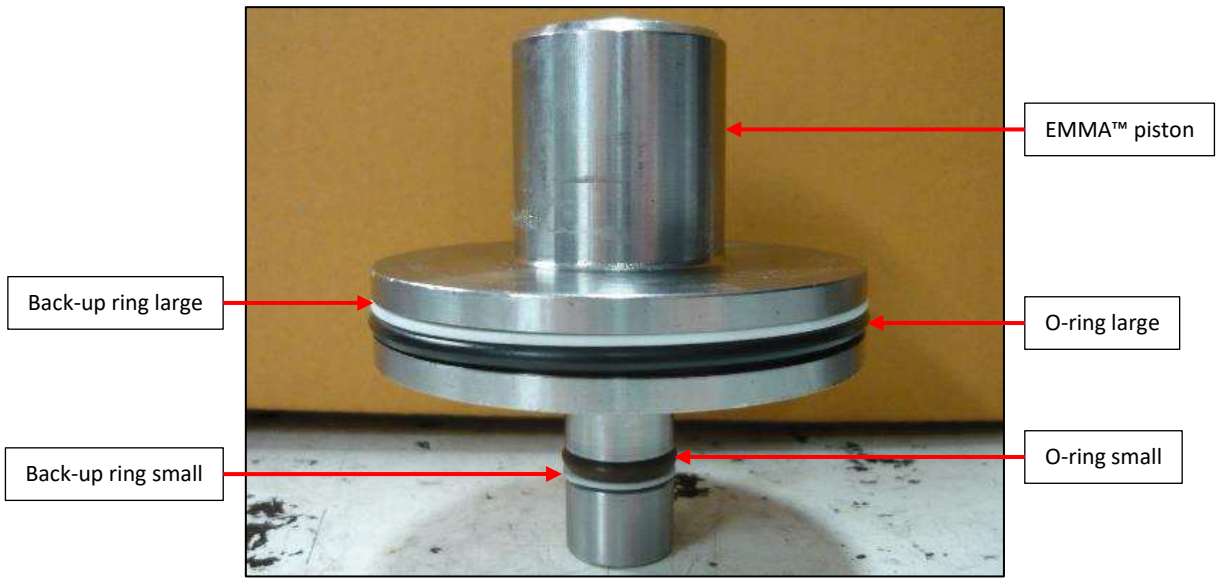


Figure 35: EMMA piston with seals installed.

8. Clean the exposed areas of the Failsafe Emergency pistons in cases where the pistons have not been removed.
9. Ensure the piston seals avoid contamination during cleaning process.
10. Clean the outer 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.
13. Follow steps 9-13 in section 23 to reassemble piston springs and spring covers.

25. Service Assembly and Bleed Procedure

1. Using a suitable lifting apparatus fit the ABT™ Failsafe Emergency brake unit over the pinion shaft.
2. Hold the brake rotor to prevent it from detaching from the yoke during assembly.
3. Lift outer assembly and align the yoke with the pinion shaft with the EMMA™ spring covers positioned towards the bottom of the brake.
4. Once the brake is held by the pinion shaft, rotate the outer housing until the EMMA™ spring covers are positioned towards the top of the brake.

Figure 36: brake in place

5. Remove any rotor retaining devices once the inner and outer housings are as close to each other as possible.
6. Fit the 12x M10 bolts and torque to 50 Nm in a star sequence. Ensure each bolt is torqued twice.

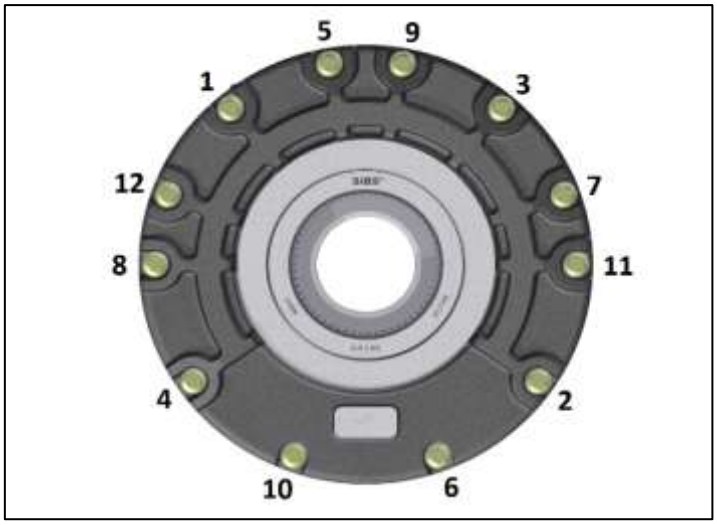


Figure 37: Housing bolt torque sequence.

7. Attach the pinion shaft nut and washer. Torque to correct Isuzu specifications.
8. Ensure the diff rotates freely when the ABT™ Failsafe Emergency brake is released.
9. Assemble the drive shaft onto the ABT™ yoke and align the 4x mounting holes.
10. Apply Loctite 262 to the threads on the short end of the 4x drive studs. Torque drive studs to 100 Nm.
11. Attach 4x washers and nuts to the drive studs. Torque nuts to 130 Nm.

Figure 38: installed brake

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

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

14. 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.

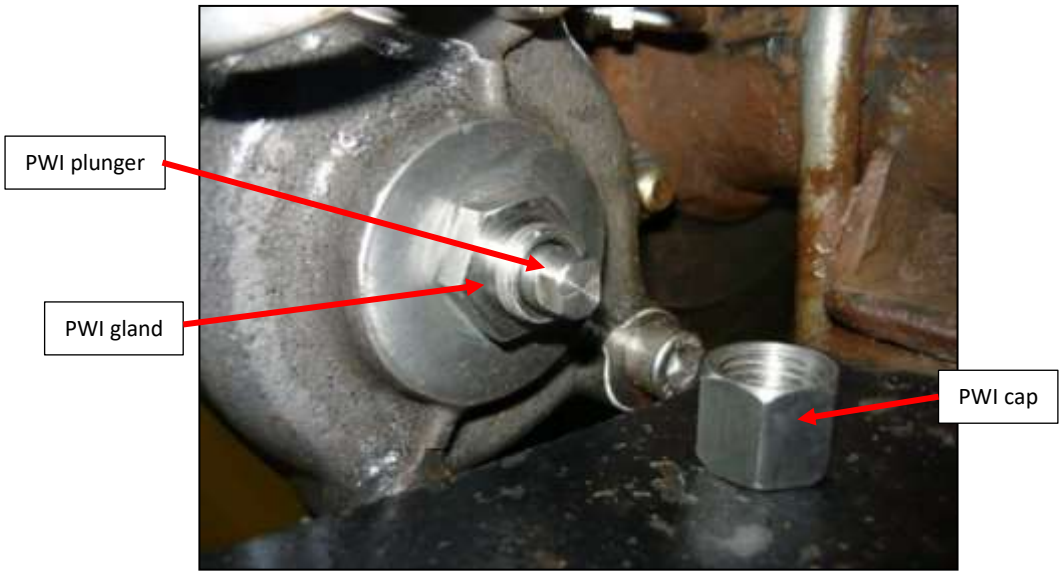


Figure 39: Pad wear indicator install in spring cover.

    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.

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

16. Fill the ABT™ Failsafe emergency brake unit with new ABT™ “Blend 20” cooling fluid and refit the fill plug with a new copper washer. Approximately 1000ml of ABT™ “Blend 20” cooling fluid is required.
17. Check the differential oil level and top up if necessary.
18. Inspect all the driveline brake hydraulic hoses and replace as required.
19. Replace all breather hoses.
20. Flush the pump reservoir with new ATF Dexron III and then fill to level window.
21. Prime the ABT™ Failsafe emergency brake 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.
22. Bleed the driveline brake system as per the installation instructions.
23. Check that there are no leaks from the system.

26. Troubleshooting

1. Problem
    a. Possible cause
        i. Solution

2. Fault light on control unit flashing
    a. 2x flashes then rest – low battery fault (below 11V (below 22V on a 24V system))
        i. Charge vehicle battery
        ii. Fault will self-clear when battery voltage is above 11V (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. Check vehicle diff lock is functioning correctly
        ii. Check wiring connections to diff lock switch
        iii. Check ABT™ Failsafe Emergency diff lock relay
        iv. 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

3. ATF warning light on control unit 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 Emergency pump reservoir
        i. Top up reservoir with ATF Dexron III and check system for leaks
4. Brake status LED is solid green and control unit is not responding
    a. Control unit is in 'ABT™ Failsafe Emergency 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
5. Brakes drag/brakes not fully releasing after operation
    a. Control unit may have learned the incorrect release pressure (retractor bolts left in place during initial set-up)
        i. Perform a master reset of the control unit
    b. EMMA™ piston seals bypassing or seals contaminated & swollen preventing them from retracting
        i. Inspect brake 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 if required and release EMMA™ brake
        ii. Carryout pressure check in EMMA™ circuit should be 850psi, if pressure is insufficient change pressure switch. If pressure still low, EMMA™ pump may be at fault
        iii. Strip brake & inspect
6. ABT™ Failsafe Emergency 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
7. ABT™ Failsafe Emergency 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
8. ABT™ Failsafe Emergency 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 Emergency 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

9. ABT™ Failsafe Emergency 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
10. ABT™ Failsafe Emergency park/emergency brake does not release (Pump runs continuously. Runs freely - no load)
   a. Low ATF fluid level in reservoir
      i. Check fluid level and top up with ATF Dexron III if necessary
   b. Solenoid valve not closing
      i. Check battery voltage
      ii. Check operation of solenoid coil
      iii. Check solenoid valve for possible blockage
   c. Pump internal relief valve bypassing
      i. Remove valve and clean
11. ABT™ Failsafe Emergency park/emergency brake does not release (Pump runs continuously. Runs under load)
   a. Pressure sensor vault
      i. Check for loose/faulty connection in the wiring harness
   b. Solenoid valve malfunctioning
      i. Check vehicle alternator
      ii. Check solenoid valve for partial blockage
   c. Pump worn – not developing sufficient pressure
      i. Measure the pressure generated by the pump – target 850psi
12. ABT™ Failsafe Emergency park/emergency brake does not release. (Pump does not run)
   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 Emergency 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 Emergency pump
      i. Check all fuses. If blown identify cause and repair
      ii. Check function of relay mounted at vehicle battery. Replace if required
      iii. Check for continuity of wiring from battery to pump motor and relay to control unit
   d. Faulty pump motor
      i. Replace pump motor