TRAILER, MEDIUM PLANT TRANSPORTER, MC3 HAULMARK, 4 AXLE DOG

TECHNICAL DESCRIPTION

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

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INTRODUCTION

1. This EMEI describes the technical system and details of the Trailer, Medium Plant Transporter, MC3 Haulmark, 4 Axle Dog.

PRINCIPLES OF OPERATION

2. The Trailer, Medium Plant Transporter, MC3 Haulmark, 4 Axle Dog is a Haulmark four axle trailer designed to transport the Tractor, Medium, Full Tracked, Size 6, International TD 15C. In a secondary role, it is suitable for transporting other engineering equipment, wheeled vehicles, light armoured vehicles and ISO containers.

3. The trailer is designed to be towed by the Truck, Dump, 8 Tonne, MC3, Mack. The rated payload for the trailer is 20 000 kg, with a gross trailer mass of 28 100 kg.

ARRANGEMENT OF THE EQUIPMENT

4. The trailer has a prefabricated steel frame fitted with air brakes and leaf spring suspension. The frame is fitted with timber decking and incorporates twist-locks and tie-down points for securing loads. The trailer has an integrated dolly converter.

VERSIONS

5. This EMEI covers four versions of the Trailer. Reference in the EMEI to Versions 1 to 4 relates to the serial numbers appointed to the trailers.

6. Table 1 lists the serial numbers allocated to each version:

Table 1 Trailer Version to Serial Number Allocation

Ser	Version	Serial Number
1	1	9072 to 9099
2	2	10847 to 10874
3	3	11851 to 11865
4	4	12351 to 12361

DETAILED DESCRIPTION

AXLE ASSEMBLIES

7. The axles fitted to this trailer are a single, tubular beam-type axle, manufactured by Dana Spicer. They are fitted with 16.5 inch x 7 inch internal expanding shoe-type brakes, acting on 20 inch wheel hubs, which are in turn carried by grease lubricated, tapered roller bearings.

WHEEL ASSEMBLY

8. The wheels fitted to this trailer are an 8.25 x 22.5, single piece, pressed steel, tubeless type. For the current authorised tyres see EMEI Vehicle A 291-5 – Tyres and Tubes – Australian Defence Force B Vehicle Tyre Guide.

BRAKES – GENERAL

9. There are two brake air systems available on the four versions of the trailer. Versions 1, 2 and 3 are fitted with an air actuating system of a Westinghouse design, whilst Version 4 is fitted with an Air Brake Corporation design. The two braking systems are virtually identical, but with minor changes to the layout and the spring brake control valve. The information provided on the braking system covers both systems, with the minor differences being highlighted where appropriate.

10. Versions 1, 2 & 3 of the trailer are fitted with a Westinghouse design kit 900133 (Figure 1).

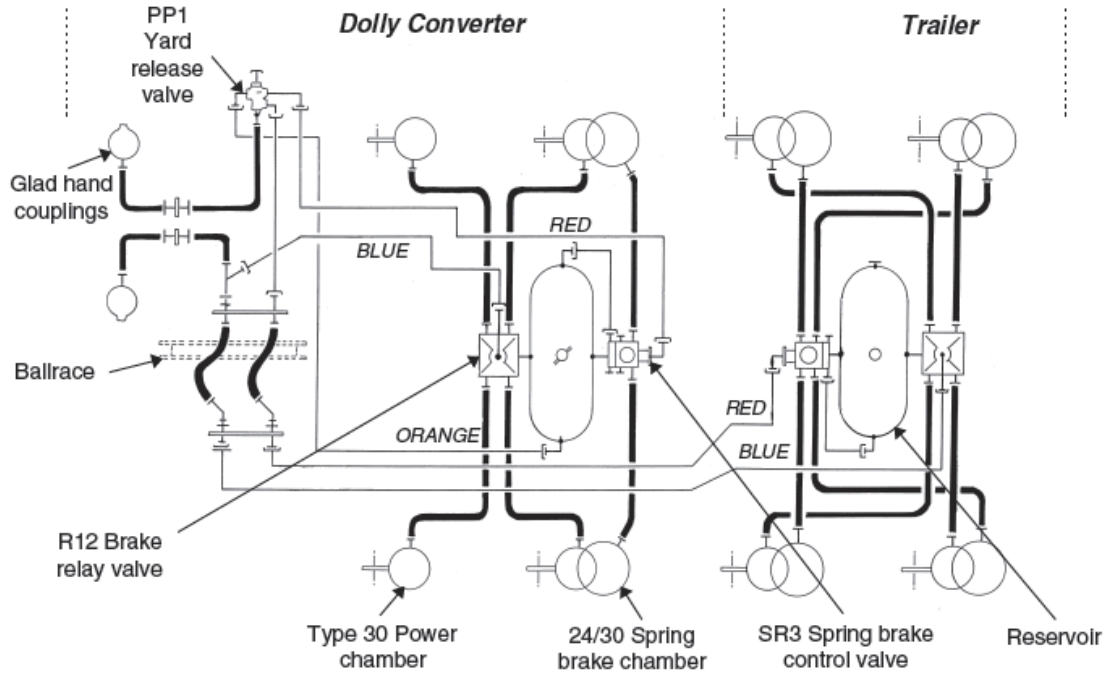


Figure 1 Trailer Versions 1, 2 & 3 Brake System – Westinghouse

11. Version 4 of the trailer is fitted with an Air Brake Corporation design kit ABK3854-H2 (Figure 2).

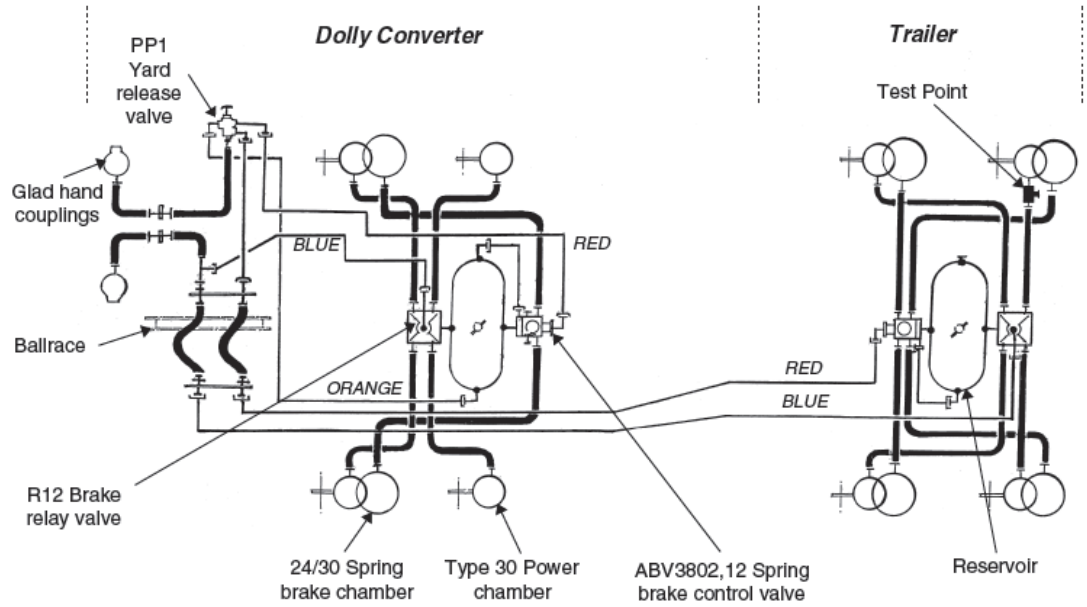


Figure 2 Trailer Version 4 Brake System – Air Brake Corporation

Brake Air Systems

12. The brake air system is a twin line type designed to comply with ADR 38. The system has spring brake assemblies provided on three axles and power chambers fitted to one of the axles of the dolly converter. The spring brake assemblies consist of a spring brake chamber and a power brake chamber. The power brake chambers are commonly referred to as the service brakes.

13. An R-12 service brake relay valve is mounted directly onto each of the air reservoirs of the trailer. These valves function as relay stations to speed up the application and release of the service brakes. The relay valves deliver

air from the reservoirs to, or release air to atmosphere from, the service brake chambers. These actions are carried out in proportion to the air pressure applied at the control port.

14. The spring brake chambers are controlled by SR3 or ABV3082 spring brake control valves which are also mounted directly onto the air reservoirs of the trailer. The spring brake control valves control the operation of the spring brakes during parking and emergency conditions.

15. During normal operation, the spring brake control valves prevent the passage of compressed air to the spring brakes until the air pressure in the trailer supply line reaches approximately 380 kPa. This ensures that the towing vehicle has the minimum required air pressure before replenishing the trailer reservoirs or releasing the spring brakes. Once this minimum air pressure has been achieved, compressed air is directed to both the trailer air reservoirs and the spring brake chambers concurrently.

16. During parking, when the parking control valve is actuated, air pressure is exhausted from the trailer supply line. When this occurs, the spring brake control valve exhausts all air from the spring brake chambers, causing the spring brakes to be applied by the internal spring pressure.

17. If air pressure is lost from the air reservoir whilst the spring brakes are released, the spring brake control valve retains a pressure of approximately 354-415 kPa in the supply line and the towing vehicle. This low pressure causes the warning systems to operate in the towing vehicle. The spring brakes remain released, allowing the trailer to be moved to a safe location for parking. Once the air pressure in the supply line has been exhausted by the use of the trailer supply valve or parking control valve, the spring brakes cannot be released until the system fault has been rectified.

CAUTION

The ABV3802 valve on the Version 4 trailer must never be replaced by any other valve, as this voids the ADR compliance of the trailer.

18. The spring brake control valve fitted to the reservoirs on the Version 4 trailer is a redesigned version of the Bendix SR3 valve, specially modified to meet the requirements of ADR 38/02. Whilst it is virtually identical in appearance to the SR3 valve, the ABV3802 valve can be easily distinguished by an ID label around the top cover, and the flat surface of a brass pressure protection valve piston which is visible in the end of the tank mounting nipple.

19. The pressure protection valve built into the ABV3802 valve prevents the release of the trailer spring brakes until air reservoir pressure exceeds 450 kPa, ensuring that effective service brake capability is available before the trailer can be moved. Both the SR3 and ABV3082 variants incorporate a check valve, which ensures that once the trailer spring brakes have released, they remain held off in the event of a loss of air pressure from the reservoir(s); thus avoiding sudden unexpected brake applications beyond the driver's control.

20. A yard release valve is fitted to the trailer. This valve allows the brakes to be released using air from the trailer reservoir, for ease of movement within a safe area only.

21. Glad hand type couplings are provided for easy connection between the trailer and the towing vehicle.

Air Reservoirs

22. The reservoirs provide compressed air for the following purposes:

- **a.** actuation and control air for the brake relay valves,
- **b.** actuating air for the service brakes,
- **c.** actuating air for the yard release facility, and
- **d.** release and control of the spring brakes.

Brake Chambers

23. Spring brake chambers provide service, parking and emergency braking to three axles under the direct control of the brake relay and spring brake control valves. The remaining axle is only fitted with brake power chambers, which are also actuated by the front brake relay valve. Each spring brake chamber has two separate air chambers, each equivalent in size, to provide the required braking functions. A heavy duty spring, fitted into the spring brake chamber, applies the brakes when air pressure is exhausted from the spring brake chamber. The spring brakes may be released mechanically by means of a release bolt, to aid in recovery of the trailer.

Foundation Brakes

24. The foundation brakes are a Dana Spicer 16.5 in diameter, 7 in wide, internal expanding, twin-shoe type. The two brake shoes are each mounted on individual non-adjustable anchor pins, which allow the brake shoes to pivot under the influence of an 'S' cam. The 'S' cam is fitted with an adjustable slack adjuster which has a twofold function.

a. It provides a means of connecting the camshaft to the spring brake chamber pushrod, converting the reciprocating motion of the brake chamber into the required rotary motion of the camshaft.

b. It provides a quick and simple means of brake adjustment, through the use of an internal worm and wheel gear. Adjustment is locked by a spring loaded locking collar.

Brake Relay Valve

25. The brake relay valve is a Bendix model R-12 air-operated, graduating, directional control valve with a high capacity and fast response (Figure 3). The valves are fitted to increase the speed of application and release of the brakes. The valve is mounted directly onto the brake air reservoir where they act as remote controlled brake valves. The valves deliver, or release, air to or from the brake chambers in response to the control air delivered from the towing vehicle's brake control valve.

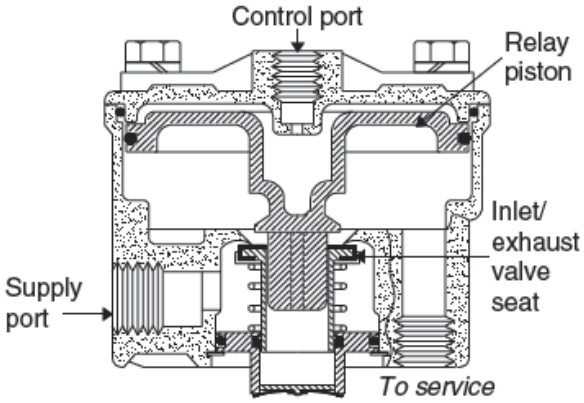


Figure 3 Brake Relay Valve – Cross Sectional View

Spring Brake Control Valve – SR3 – Trailer Versions 1, 2 & 3

26. The spring brake control valve (Figure 4) is fitted into the braking system to control the spring brakes during parking and emergency applications. It automatically applies the spring brakes and prevents trailer air pressure loss in the event of breakaway or supply line failure. The spring brake control valve also prevents the automatic application of the trailer spring brakes after the loss of trailer service reservoir pressure, while allowing failure indication to occur in the towing vehicle.

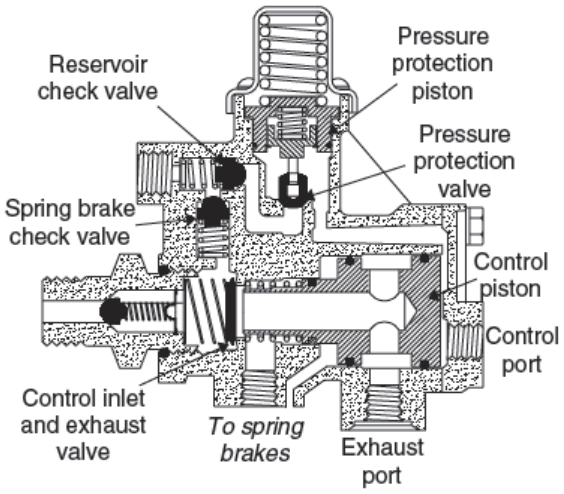


Figure 4 SR3 Spring Brake Control Valve – Cross Sectional View

Spring Brake Control Valve – ABV3802 – Trailer Version 4

27. The spring brake control valves (Figure 5) fitted to the air reservoirs on the Version 4 trailers are virtually identical to the Bendix SR3, with the exception of an added pressure protection valve. This valve prevents the release of the trailer spring brakes until the air reservoir pressure exceeds 450 kPa; ensuring that effective service brake capability is available before the trailer can be moved.

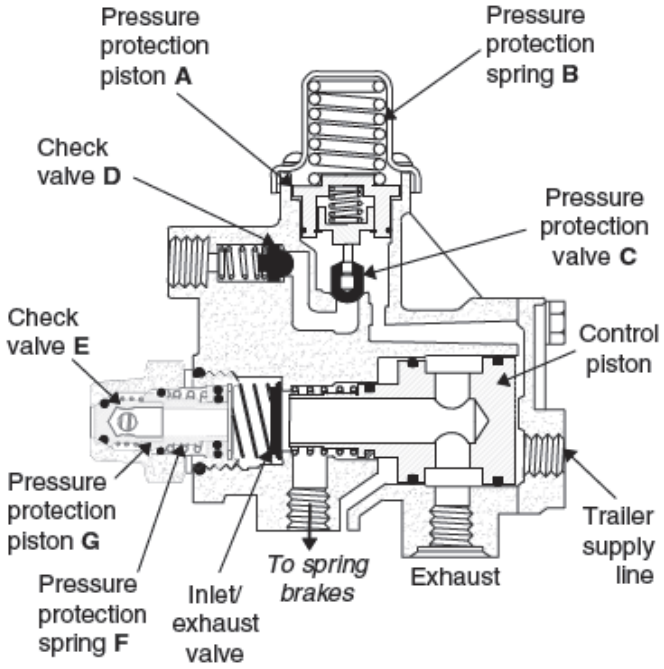


Figure 5 ABV3802 Spring Brake Control Valve – Cross Sectional View

BRAKES – OPERATION

Brake Relay Valve

28. Applying. Air pressure delivered to the control port enters the small cavity above the relay piston and moves the piston down. The exhaust seat moves down with the piston and seats on the inner or exhaust portion of the inlet/exhaust valve, sealing off the exhaust passage. At the same time, the outer or inlet portion of the inlet/exhaust valve moves off its seat, permitting supply air to flow from the reservoir, past the open inlet valve and into the service brake chambers (Figure 6).

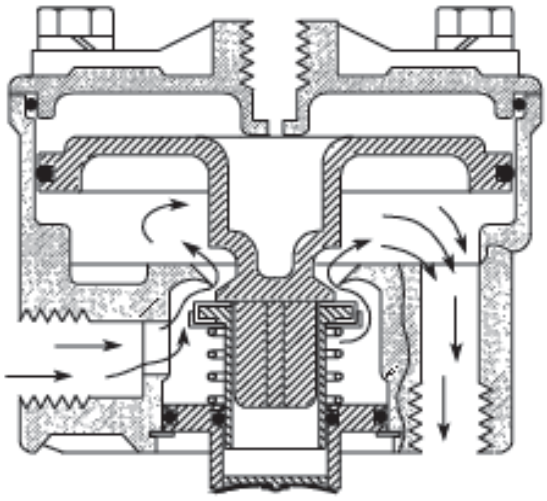


Figure 6 Brake Relay Valve – Applying

29. Balancing. The air pressure being delivered by the open inlet valve also acts on the bottom area of the relay piston. When air pressure beneath the piston balances with the service air pressure above, the piston lifts slightly and the inlet spring returns the inlet valve to its seat. The exhaust remains closed, as the service line pressure balances the delivery pressure. As air pressure is changed, the valve reacts instantly to the change, holding the brake application at the desired level (Figure 7).

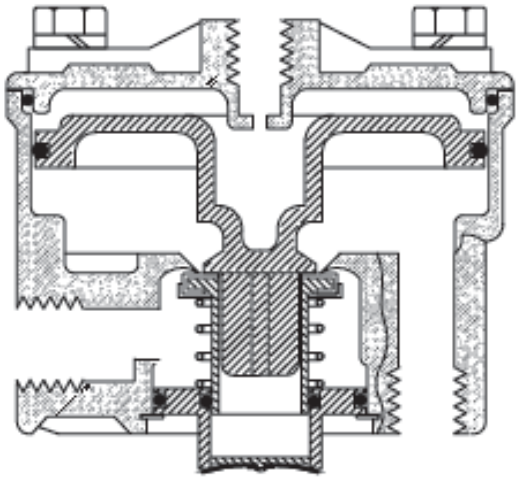


Figure 7 Brake Relay Valve – Balanced Position

30. Releasing. When air pressure is released from the control port and the air pressure in the cavity above the relay piston is exhausted, air pressure beneath the piston lifts the relay piston and the exhaust seat moves away from the exhaust valve, opening the exhaust passage. With the exhaust passage open, the air pressure in the brake chambers exhausts through the exhaust port, releasing the brakes (Figure 8).

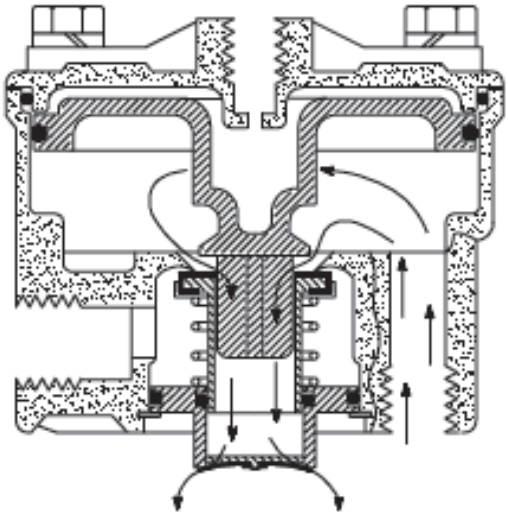


Figure 8 Brake Relay Valve – Releasing

Spring Brake Control Valve – SR3 – Trailer Versions 1, 2 & 3

31. Charging. Air from the trailer supply line enters the control port and moves the control piston into contact with the control port inlet and exhaust valve, sealing off the exhaust passage through the control piston, and opening the inlet (Figure 9). Air entering the control port is also directed to the underside of the pressure protection piston. When air pressure builds to approximately 380 kPa beneath the pressure protection piston, the piston moves against the force of the piston spring and remains open. Air flowing past the open pressure protection valve opens the reservoir check valve. Air passing through the reservoir check valve flows out the reservoir port and also opens the spring brake check valve, allowing air to fill the brake reservoir. As the air fills the brake reservoir, it also flows by the open control inlet valve, out the spring brake ports of the spring brake control valve and into the spring brake chambers, where it releases the spring brakes assemblies.

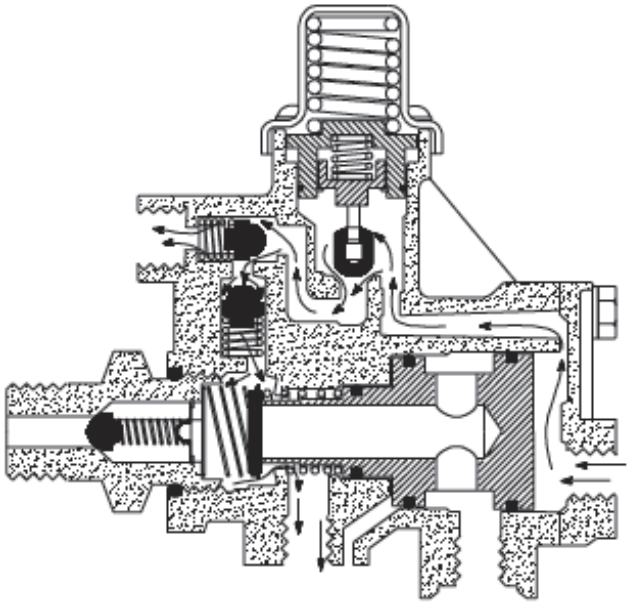


Figure 9 SR3 Spring Brake Control Valve – Charging

32. Park Application. To park the trailer, either the trailer valve or the parking control valve, which are located in the cab of the towing vehicle, are actuated, and this exhausts the trailer supply line. When the trailer supply line is exhausted, air pressure is removed from the control and pressure protection pistons (Figure 10). With air pressure removed, the return spring moves the control piston, the control inlet valve closes and the exhaust passage through the control piston opens. This allows air in the spring brake chambers to exhaust through the exhaust port of the spring brake control valve. Spring force above the pressure protection piston closes the pressure protection valve; while the brake reservoir check valves close and protect against loss of pressure in the reservoir.

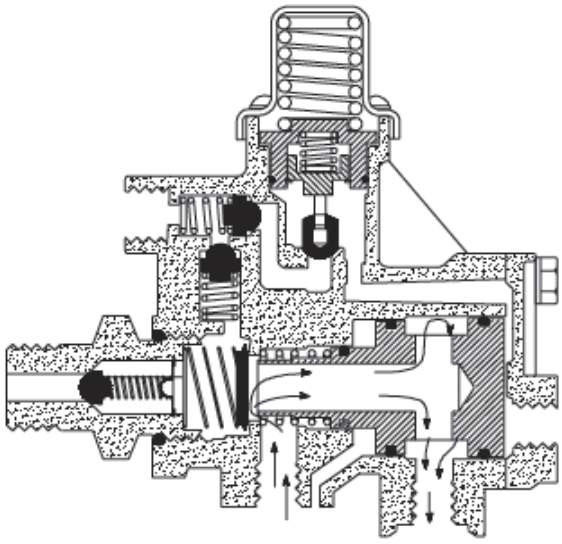


Figure 10 SR3 Spring Brake Control Valve – Park Application

33. Brake System Failure. If air pressure is reduced in the system, pressure in the trailer supply line and likewise in the towing vehicle is reduced, until the pressure protection piston, under spring pressure, moves and closes the pressure protection valve (Figure 11). This retains approximately 345-415 kPa in the trailer supply line and in the towing vehicle. With 345-415 kPa pressure held in the trailer supply line and against the control piston in the spring brake control valve, the trailer spring brakes remain released. A low pressure warning occurs in the towing vehicle to warn the driver.

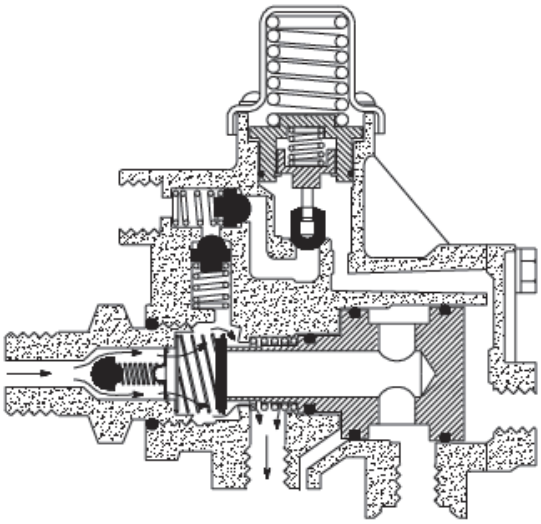


Figure 11 SR3 Spring Brake Control Valve – Brake System Failure

34. Emergency Application with System Failure. To apply the trailer brakes after a system failure has occurred, the trailer supply valve or parking control valve exhausts the remaining 345-415 kPa trailer supply line pressure. Exhausting the trailer supply line removes air pressure from the control piston of the spring brake control valve, allowing the control inlet valve to seat and the exhaust valve to open. Air from the spring brake chambers exhausts through the spring brake control valve and applies the brakes.

35. Once applied, the brakes cannot be released by air pressure until the fault has been rectified.

Spring Brake Control Valve – ABV3802 – Trailer Version 4

36. Charging. Air from the trailer supply line (Figure 12) enters at the trailer supply line port and depresses the control piston. This acts against the inlet/exhaust valve, closing the exhaust passage through the centre of the piston and opening the inlet. Air is also directed to the cavity under the pressure protection piston A. When air pressure builds to approximately 400 kPa beneath this piston, it moves against the force of pressure protection spring B and opens the pressure protection valve C. The air pressure now flows past check valve D, out of the service reservoir port and into the trailer reservoir(s). When air pressure in the reservoir(s) exceeds 450 kPa, check valve E opens against the force of the pressure protection spring F. This exposes the larger area of the pressure protection piston G to pressure, which snaps it and check valve E fully open. Air now flows through the centre of the pressure protection piston G via cross drillings in check valve E, past the open inlet/exhaust valve, and out of the spring brake ports to the spring brake chambers, causing the spring brakes to release.

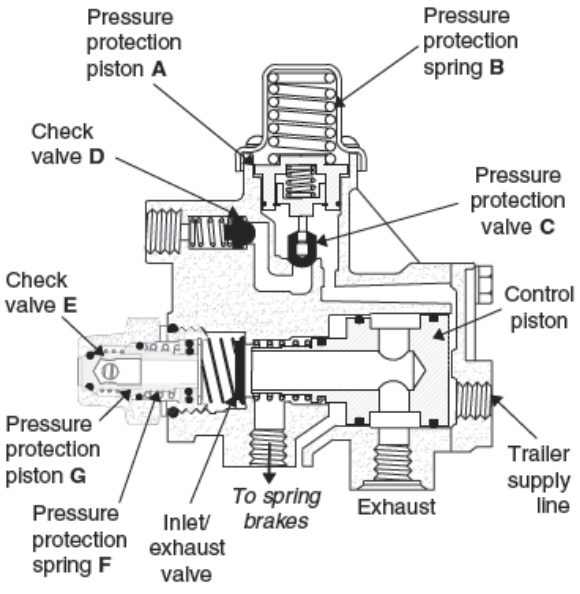


Figure 12 AB3802 Spring Brake Control Valve – Cross Sectional View

37. Park Application. To apply the trailer spring brakes, the trailer supply line is exhausted by means of one of the towing vehicle cab controls. Air pressure is removed from the control piston (Figure 12) and its return spring moves it to its rest position. This causes the inlet/exhaust valve to reseat and opens the exhaust passage through the centre of the control piston allowing air in the spring brake cavities to exhaust to atmosphere. Check valve D and pressure protection valve C close, retaining full air pressure in the reservoir(s).

38. Emergency/Breakaway Application. If the trailer supply line is exhausted by rupture due to separation of the trailer from its towing vehicle, the spring brakes are applied as described in Para 39.

39. System Failure. If air pressure in the trailer reservoirs falls, pressure in the trailer supply line (and in the towing vehicle) also falls, until pressure protection valve C closes, maintaining 350 to 400 kPa in the trailer supply line. This is sufficient to keep the control piston depressed and the inlet/exhaust valve open. Check valve E closes to prevent air in the spring brake cavities from flowing back into the leaking reservoir(s). This locks full system pressure in the spring brakes and keeps them released. The reduced pressure in the trailer supply line activates a low pressure warning in the towing vehicle, alerting the driver to the failure.

40. Emergency Application with Service System Failure. To brake the trailer after a service system failure, the remaining 350 to 400 kPa in the trailer supply line can be exhausted by the driver via the appropriate cab control valve (e.g. the park control valve). Following this action, the spring brakes can only be released manually one at a time with their respective release bolts, or by repairing the fault and recharging the trailer air system.

Yard Release Valve

41. The yard release valve is a push/pull, manually operated, ON/OFF, air control valve, with an exhaust function (Figure 13). The valve is pressure sensitive and automatically moves from the applied to the exhaust position as supply pressure is reduced to a set minimum (140 to 415 kPa).

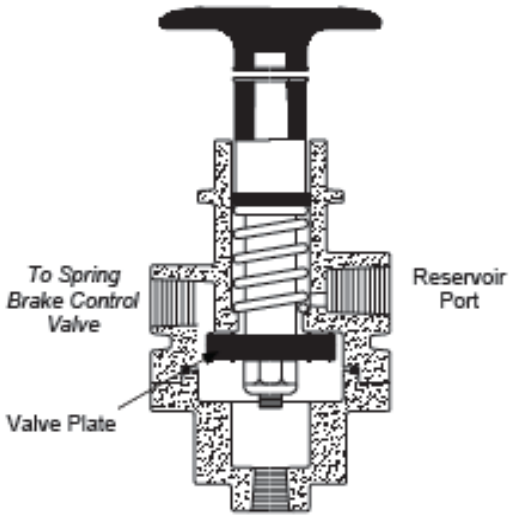
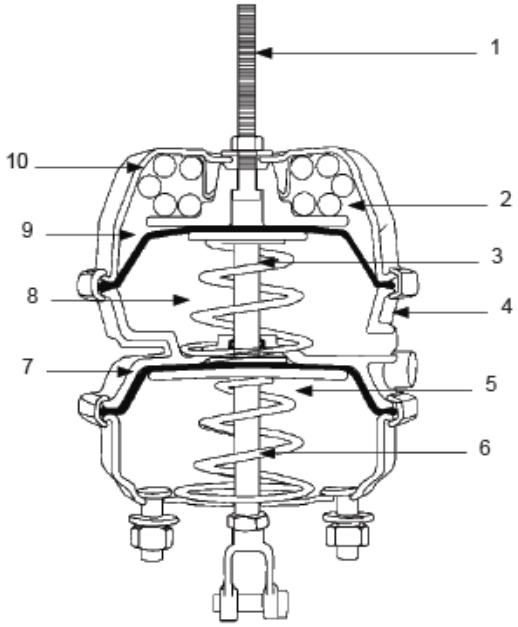


Figure 13 Yard Release Valve – Cross Sectional View

Spring Brake Chambers

42. General. The spring brake assemblies consist of a spring brake chamber and a service brake chamber. The spring brake chambers are fitted to operate as parking brakes and as automatic, emergency brakes in the event of loss of supply air pressure (Figure 14). The service brake chambers sole function is to act as service brake actuators. Service brake chambers are fitted to the front axle and spring brake assemblies are fitted to the remaining three axles. Air pressure is required to **release** the spring brakes, and air pressure is required to **apply** the service brakes. The spring brake can be mechanically released by using the spring brake release tool provided with each brake chamber.



1. Release bolt
2. Pressure plate
3. Adapter pushrod
4. Adapter housing
5. Service brake return spring
6. Pushrod assembly
7. Service brake diaphragm
8. Spring brake return spring
9. Spring brake diaphragm
10. Spring brake power spring

Figure 14 Spring Brake Chamber – Cross Sectional View

43. Spring Brake Released Position. Air supplied from the spring brake control valve enters the spring brake chamber through the adaptor housing and builds up pressure below the diaphragm. When the air pressure attains sufficient force, it overcomes the spring pressure and forces the diaphragm and pressure plate into the released position. The return springs move the adaptor and brake pushrod assemblies into the released position and the brakes are released.

44. Service Brake Application. As the brake control air pressure is supplied to the brake relay valve, service brake air is released from the reservoir, through the relay valve, to the service brake chamber. This air passes through the adaptor housing into the chamber above the service brake diaphragm and forces the diaphragm and pushrod assembly down to apply the brakes. On the spring brake chamber, the spring brake and the adaptor pushrod remain in the released position.

45. Spring Brake Application. As air pressure is exhausted from the air supply line to the spring brake control valve, the exhaust port opens releasing the air from the spring brake lines and the chamber. This allows the spring brake power spring to reapply force to the pressure plate and diaphragm. This force is applied through the adaptor pushrod to the brake pushrod assembly and compresses their respective return springs and applies the brakes.

46. Mechanical Release. The spring brake can be mechanically released by using the spring brake release tool supplied with the brake chamber. The spring brake release tool is engaged into the spring brake pressure plate through the access hole in the chamber housing. The brake is released by using the spring brake release tool to tighten the nut on the threaded shaft.

Slack Adjusters

47. The slack adjusters convert the reciprocating motion of the brake chambers into the required rotary motion of the brake camshaft to provide brake actuation (Figure 15). The slack adjusters are of cast construction, with an internal worm and wheel gear set which provides the adjustment facility. The brakes are adjusted by rotating the worm, which in turn rotates the worm gear. The rotation of the worm gear adjusts the position of the internal splines in relation to the body. The adjustment is locked by means of a spring loaded locking sleeve.

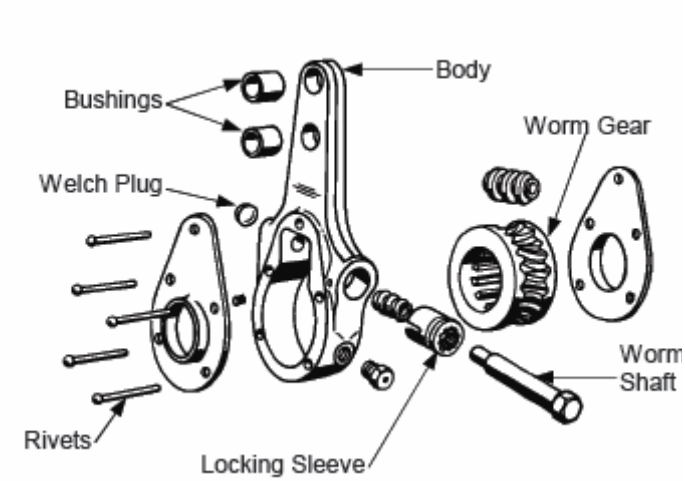


Figure 15 Slack Adjuster Assembly – Exploded View

SUSPENSION

Description

48. The trailer employs an Engineered Transport Equipment (ETE), overslung, spring-type suspension (Figure 16).

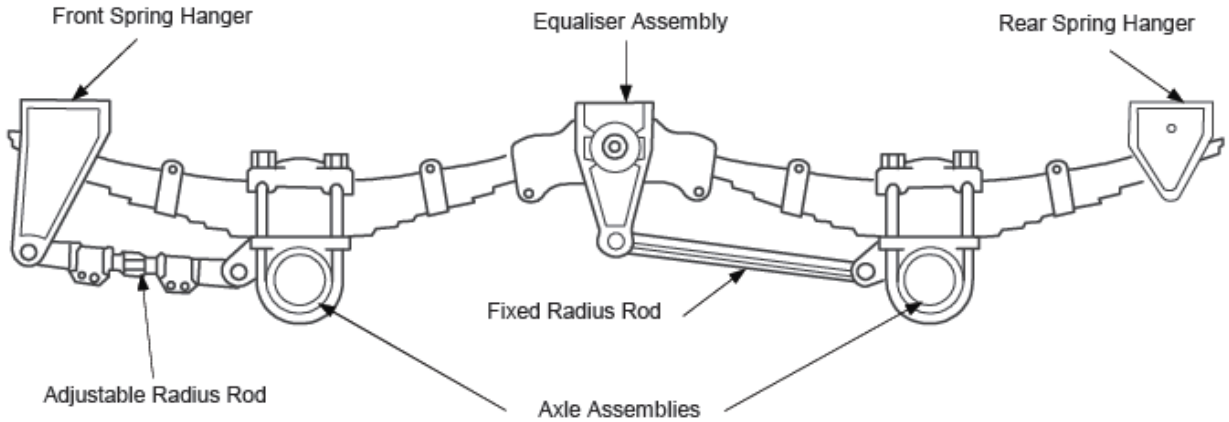


Figure 16 Trailer Suspension Layout

49. Load sharing capabilities are provided by the use of the centre mounted equaliser assemblies. The suspension has 8-leaf, semi-elliptic springs, that are free to slide at either end in their respective hangers. The axles are located by radius rods that allow free vertical movement of the axles for the full extent of suspension travel whilst maintaining correct axle alignment.

Springs

50. The springs are eight-leaf, semi-elliptic, sliding shackle types. They are fixed to the axle assemblies by steel U-bolts and located by cast steel spring seats welded to the axle assemblies. The third leaf of each spring assembly has one end folded down. The folded end is fitted into the equaliser and this prevents the spring sliding out of the equaliser.

Spring Hangers

51. The spring hangers are cast steel, front and rear, welded to the trailer and dolly converter frames. They are moulded to accept the curvature of the leaf spring, which are free to slide within the spring hangers as required by the suspension action. The springs are retained within the spring hangers by a ½ in UNF bolt fitted across the spring hangers.

Equaliser Assembly

52. The equaliser assembly provides the load sharing capabilities of the ETE suspension. The equaliser assembly consists of a centre mounted, cast steel, equaliser hanger carrying a cast steel equaliser beam which is pivoted on two tapered rubber bushes. As with the spring hangers, the springs are free to slide in the equaliser beam and are held in position by a single ½ in UNF bolt.

Radius Rods

53. The radius rods used in this application are both fixed length and adjustable types. Each type comes in two different lengths.

a. Fixed Length Rods. These are of cast construction, moulded to accept tapered rubber bushes in each end (Figure 17). The two lengths applicable to the fixed length radius rods are 498 mm and 397 mm. The longer of the two is fitted to the left-hand rear of the suspension whilst the shorter is fitted to the left-hand front.

b. Adjustable Rods. The two adjustable radius rods each consist of a steel rod threaded each end (one end left-hand thread and one end right-hand thread), and one each of left-hand and right-hand threaded cast steel ends (Figure 18). These adjusting ends are moulded to accept tapered rubber bushes. The longer of the two is fitted to the right-hand rear and the shorter to the right-hand front. The adjustment range of these rods is designed to suit the fixed rod lengths.

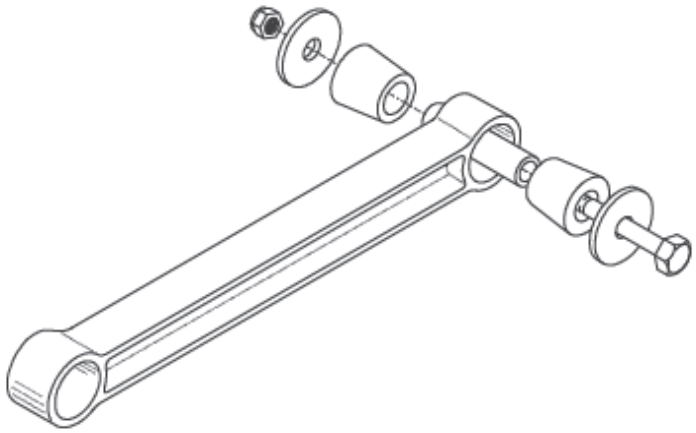


Figure 17 Fixed Length Radius Rod

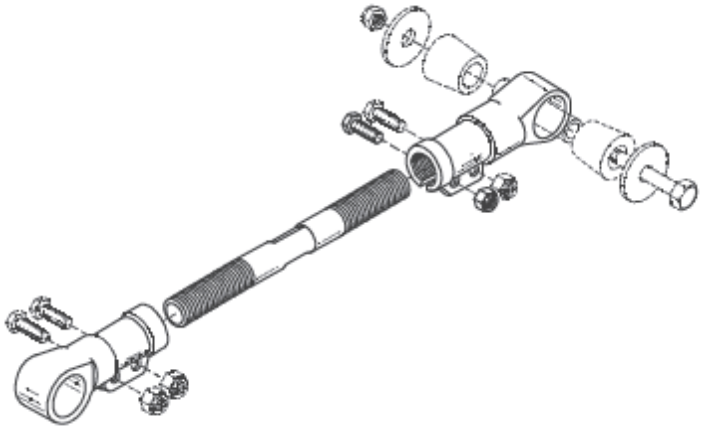


Figure 18 Adjustable Length Radius Rod

ELECTRICAL

Description

54. The electrical system is a basic 24-volt electrical system, coupled to the towing vehicle by a 12-pin NATO socket and plug. All lighting connected to the electrical system is 24-volt, with the exception of the blackout lighting, which are 12-volt dc electronic modules. A resistor is incorporated into the system for each module. These resistors are located in the plastic junction boxes fitted inside the beaver tail on either side of the trailer.

55. Electrical circuit diagrams are shown in Figures 19, 20 and 21.

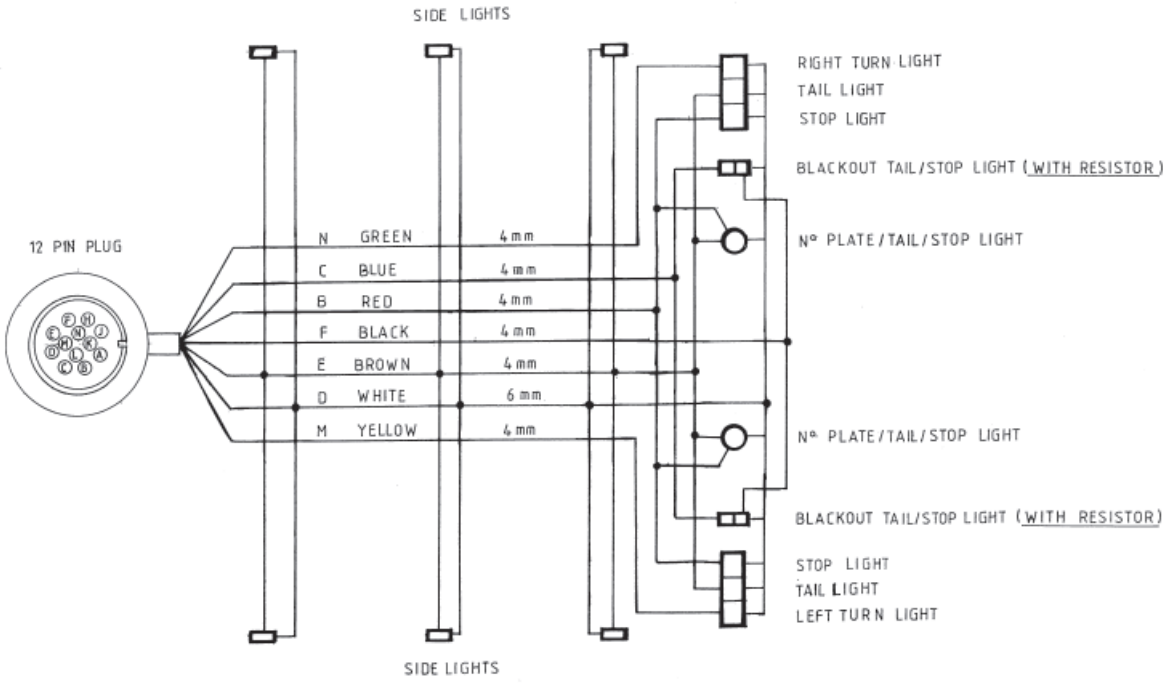


Figure 19 Electrical Circuit Diagram – Version 1

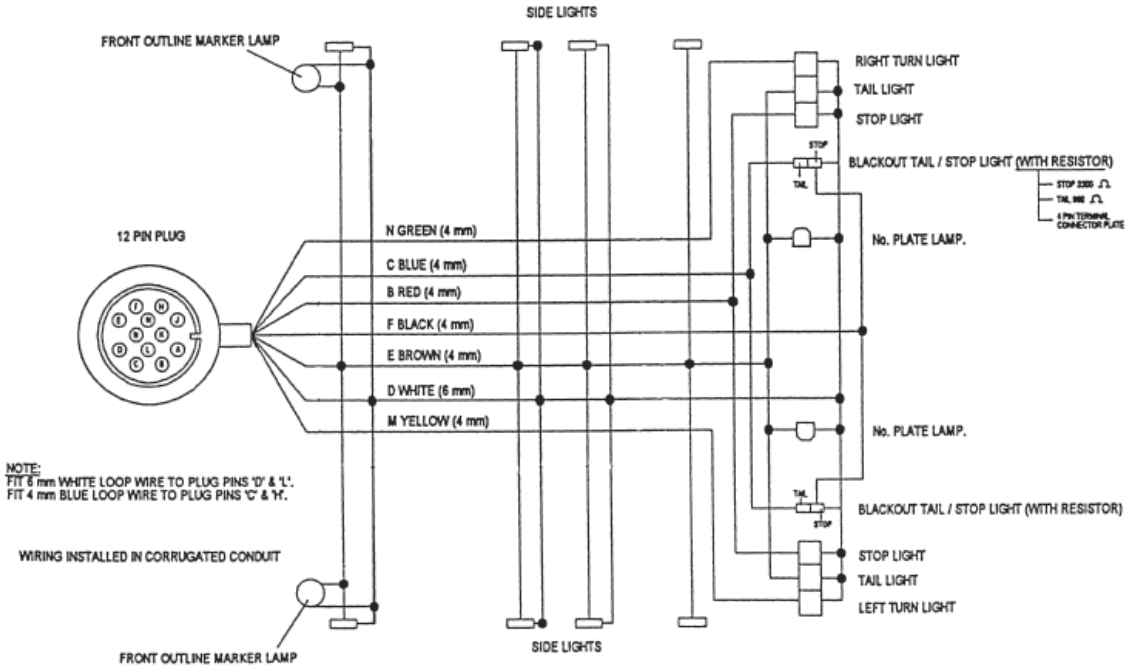


Figure 20 Electrical Circuit Diagram – Versions 2 & 3

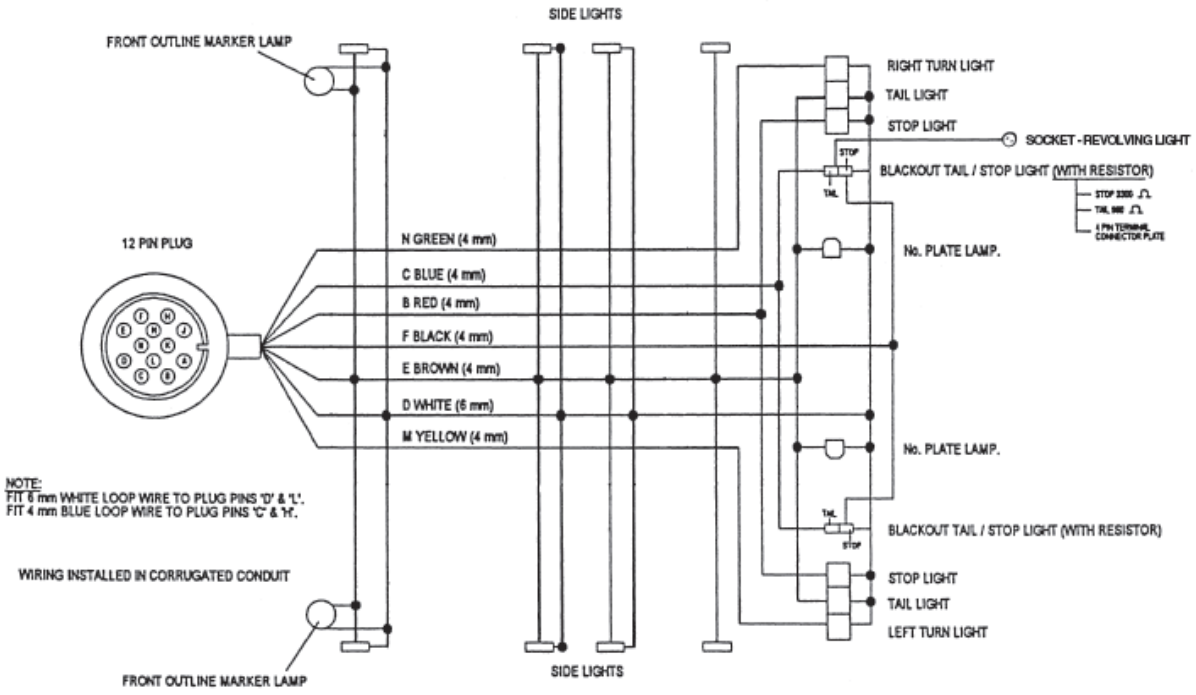


Figure 21 Electrical Circuit Diagram – Version 4

FRAME ASSEMBLY

Description

56. The trailer is a prefabricated steel frame construction consisting of two major components as follows:

a. the trailer main frame, and

b. the dolly converter frame.

57. The main frame and the dolly converter frame are connected by means of a ballrace which allows steering of the front axle assemblies. The dolly converter and the main frame cannot be separated during normal operation.

58. The dolly converter frame carries the front bogie suspension units and braking system, and the main frame carries the rear bogie, braking system, stowage facilities, spare wheel and loading ramps. A beaver tail formed at the rear of the trailer frame allows for ease of loading using the ramps. A pair of wind down legs supports the trailer during loading operations.

Loading Ramps

59. Two loading ramps are fitted to the trailer beaver tail. Three types of loading ramps have been fitted to the trailer during production, dependent on serial number. Later versions are fitted with a spring loaded assistance mechanism, which removes the weight from the operator whilst lowering or raising the ramps.

60. There are also variations in the ramp retaining devices; with later versions having claw type load binding devices and springs to tension the chains. Table 2 lists the ramp and retaining devices for the different serial numbers.

Table 2 Ramp Variations by Serial Number

Serial	Serial Numbers	Version	Ramp	Ramp Retaining Devices
1	9072 to 9099	1	Ramp assembly 1	Retaining chain 1
2	10847 to 10874	2	Ramp assembly 2	Retaining chain 1 + Load binder 1
3	11852 to 11865	3	Ramp assembly 2	Retaining chain 1 + Load binder 1
4	12351 to 12361	4	Ramp assembly 3	Retaining chain 2 + Load Binder 1 + Spring 1

Spare Wheel Winch

61. The spare wheel winch is a worm and wheel type winch enclosed in a prefabricated steel housing (Figure 22). The worm gear has a free fitting mild steel shaft.

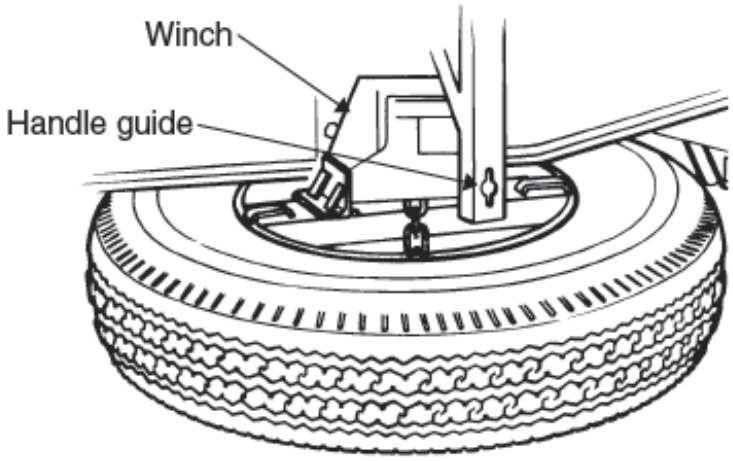


Figure 22 Spare Wheel Winch Mounting

62. This shaft incorporates the external driving dog which engages the winding handle. Drive is transferred to the worm gear by a steel roll pin fitted into the drive shaft and engaging with drive lugs on the worm gear.

63. The worm gear is engaged with the wheel gear which is also coupled to the lift chain. Rotation of the wheel gear raises or lowers the lift chain according to the direction of rotation. A spring type ratchet pawl holds the wheel gear stationary when not being driven by the worm gear.

64. A locking latch is also fitted to provide a positive lock to the chain, holding it in the raised position. This latch is spring loaded and is released by the action of the drive shaft during rotation. Immediately the drive shaft ceases to turn, the locking latch engages the chain.

END

Distribution List: **VEH H 05.0 – Code 2** (Maint Level)
(Sponsor: LV SPO, Mdm/Hvy B Vehicle Section)