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Indian Railways

WAG9 Locomotive

31000 – 31021

Maintenance and Repair Manual

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51			1		C	3EHW411446	12.2001	Air Dryer	D3	1.3	~~10~~		
52			1		C	3EHW411447	12.2001	Reservoirs	D3	1.4	~~14~~		
53			1		C	3EHW411448	12.2001	Auxiliary Compressor	D3	1.5	~~6~~		
54			1		C	3EHW411449	12.2001	Brake Frame	D3	1.6	~~14~~		
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56			1		C	3EHW411451	12.2001	Brake Actuators	D3	1.8	~~46~~		
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58			1		C	3EHW411453	12.2001	Doors	D3	2.2	~~12~~		
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60			1		C	3EHW411455	12.2001	Lighting	D3	2.4	~~14~~		
61			1		C	3EHW411456	12.2001	Blinds	D3	2.5	~~18~~		
62			1		C	3EHW411457	12.2001	Cab	D3	2.6	~~52~~		
63			1		C	3EHW411458	12.2001	Key Interlocking	D3	2.7	~~4~~		
64			1		C	3EHW411473	12.2001	Cabling	D3	2.8	~~2~~		
65			1		C	3EHW411459	12.2001	Control System	D3	3.1	~~2~~		
66			1		C	3EHW411460	12.2001	Cab Control	D3	3.2	~~30~~		
67			1		C	3EHW411461	12.2001	Machine Room Control	D3	3.3	~~44~~		
68			1		C	3EHW411462	12.2001	Control Electronics	D3	3.4	~~8~~		
69			1		C	3EHW411463	12.2001	Loco-Loco-Bus	D3	3.5	~~8~~		

Preface

Introduction

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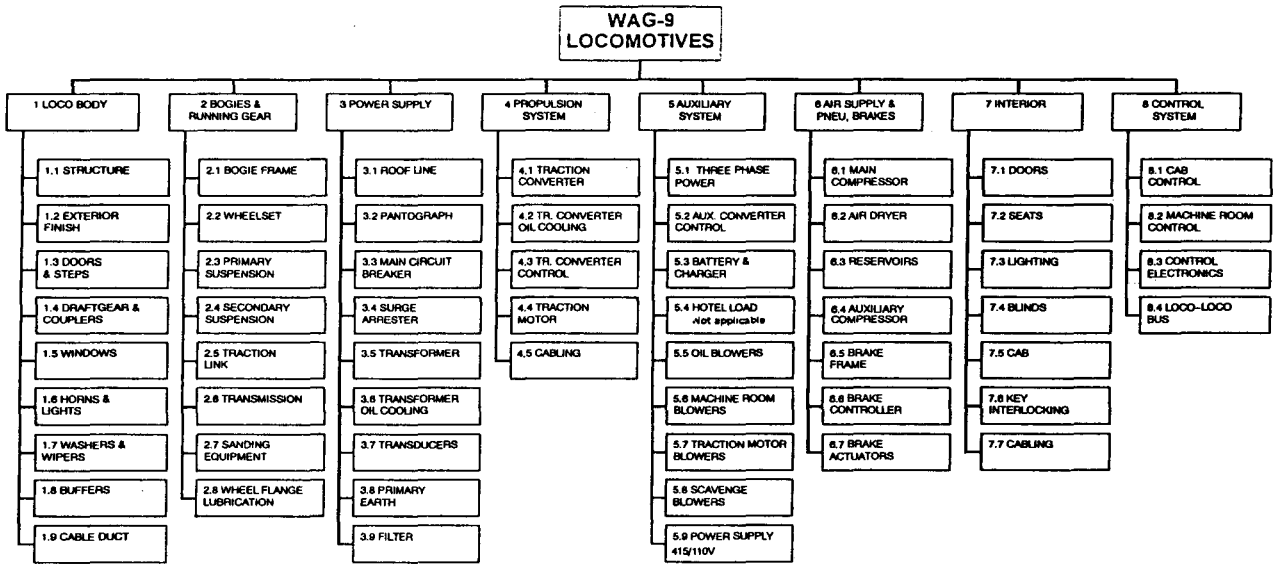
These Maintenance & Repair Manuals of technical documentation for the Indian Railways WAG-9 locomotives are divided into Chapters; each of which contains information pertinent to a specific area of the locomotive. The Chapter numbers correspond to the Breakdown Structure of the Locomotive (GAPL), shown on the inside front cover of this binder. The same delineation of Chapters is used throughout the technical documentation for the WAG-9 locomotives.

Information in each Chapter is divided into various Sections which describe the locomotive equipment and procedures required for maintenance. See Section Description, as follows.

The Maintenance & Repair Manuals span more than one binder. For ease of identification, each Volume is labelled on its spine and front cover, indicating the Volume and binder number, and the Chapters contained within.



Section Description

Section **Group Summary** describes the equipment covered by the Chapter. Figures show the various components and a legend beneath identifies the items.

Section **Functional Description** explains the function that the equipment performs on the locomotive.

Section **Technical Data** contains technical information and specifications on the equipment covered in the chapter. The information varies according to the type of equipment. In some instances, specifications for equipment may be located in the appropriate chapter of Volume F, Suppliers Documentation.

Section **Tolerances and Wear Limits List** contains information regarding the allowable in service wear or tolerance specifications for the equipment covered in the chapter. In some instances the service tolerances for equipment may be located in the appropriate chapter of Volume F, Suppliers Documentation.

Section **Tools & Special Tools** provides information of any non-standard tools and apparatus that are required to undertake the procedures described in the chapter. Throughout this documentation it is assumed that conventional railways workshop tools and equipment are available. As such, these items are not listed.

Section **Miscellaneous Materials** lists the materials required for the operations described in this chapter. Materials needed for the procedures in the chapter, such as sealants, thread locking agents, oil binding agents, solvents, cleaners and alike are listed in this section. It is assumed that normal workshop consumables and materials are available. As such, these items are not listed.

Section **Before Removal Operations** provides a list of procedures necessary prior to the removal of the equipment described in the chapter.

Many before removals operations require procedures described in other chapters or documents. The necessary references are given, see References.

Some before removals operations require isolation of other equipment. Details are provided as necessary, along with appropriate references. Isolation of equipment must always be carried out in accordance with the prevailing workshop safety regulations. Any equipment that is isolated as part of the before removals operations must be reconnected after the work is completed and the associated equipment tested to ensure it functions correctly.

Section **Removal** describes the procedures for removal of the entire equipment assemblies from the locomotive. Some equipment can be serviced in situ:-it may not be necessary to remove the entire assembly from the locomotive. See Scope of Work.

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Section **Removal** describes the procedures for removal of the entire equipment assemblies from the locomotive. Some equipment can be serviced in situ:-it may not be necessary to remove the entire assembly from the locomotive. See Scope of Work.

Section **Disassembly** describes procedures for the disassembly of equipment; generally once it is removed from the locomotive. However, some equipment can be serviced in situ. See Scope of Work.

Section **Inspection and Repair** describes how to inspect equipment for wear, defects or damage. Where appropriate, repairs may also be described in this section. In some instances, details of inspection and/or repair are given in Volume F, Suppliers Documentation. In such cases, the appropriate Volume and Chapter of Volume F is given in this Section, see References. Some equipment cannot be repaired. These items are replaced as an assembly, if unserviceable.

Section **Waste Disposal** provides information regarding special disposal requirements for particular items due to their composition or contents.

Section **Assembly** describes procedures for reassembly of equipment.

Section **Installation** describes the procedures for the reinstallation of entire equipment assemblies to the locomotive.

Section **After Installation Operations** provides a list of procedures necessary after reinstalling equipment to the locomotive.

Any equipment that is isolated or disconnected as part of the before removals operations must be reconnected and tested.

Section **Adjustments** describes any adjustments that are required for the equipment covered in the chapter.

Associated Volumes

Volume A:	Driver's Manual
Volume B:	Scheduled Maintenance Manual
Volume C:	Fault Finding
Volume E:	Spare Parts Catalogue
Volume F:	Suppliers Documentation
Volume G:	Cable Schematics

Repair Competencies

The procedures in this manual expect the user to have the appropriate competencies and skills. The scope of work associated with the procedures described should only be carried out by suitably qualified and properly trained railway engineers. Personnel must have an ap-

propriate level of technical and engineering understanding before undertaking any operations on the locomotive. This manual describes the technical procedures required to service and maintain the specifics of the WAG-9 series locomotives, not general locomotive engineering practices. Workshop procedures and practices are not covered within these instructions.

Scope of Work

Due to the complex nature of locomotive engineering, every instance in which equipment can be removed or installed cannot be taken into consideration in these Volumes.

Some equipment can be serviced in situ:-it may not be necessary to remove the entire assembly from the locomotive. For example, the valve sets can be removed from the traction converter without removing the traction converter from the locomotive. Before undertaking any work on the locomotive, the entire chapter must be read, and the user acquainted with all aspects of the procedures. The scope of work is then to be established.

General Information

Throughout this preface, the term 'equipment' refers to the components and systems that comprise the locomotive.

All figures in these volumes are graphical representations intended as general illustrations to represent the situation. They may not be dimensionally or otherwise accurate. Figures should not be used for scaling. Only the items numbered in an illustration are referenced in the associated text passages. No additional information should be inferred from the figure.

Figures, photographs and drawings may appear pictorially different from the physical situation being represented. Extraneous components may not be shown in the illustration for clarity. Others may be shown redundantly to provide a frame of reference for the situation.

References

Maintenance, removal or installation of some equipment on the locomotive can require interaction with other components described in different chapters, or volumes. In these cases, a reference is given directing the user to the appropriate documentation. For example, "refer to Chapter 3, Primary Suspension" directs the user to another chapter in Volume D where the necessary procedures are described. References, such as, "refer to Chapter 5, Oil Blowers of Volume F10, Suppliers Documentation." direct the user to the appropriate volume and chapter of the Suppliers Documentation, Volume F. Or "refer to Section Actual value Detection, Sheet 12A, Catenary & Battery Voltage of Volume G1, Cabling Documentation" directs the user to the appropriate sheet in the locomotive schematics, Volume G.

Safety Information

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Workshop Safety

All employees must take care to avoid the risk of injury to themselves and others. Precautions and care should be taken in accordance with the prevailing workshop regulations.

Caution signs, stating personal working on locomotive, are to be located at both ends of the locomotive whenever any maintenance procedures are undertaken.

Before carrying out maintenance or repairs on the locomotive, make sure that the locomotive is safely parked with the parked brakes released. Chock wheels to prevent locomotive movement.

Many systems on the locomotives interact with other systems, eg. powering-up the auxiliary converters causes the blowers to start. Therefore, if the operation of any ancillary equipment could endanger the safety of any person, then the appropriate systems must be isolated.

Electrical Precautions

Where the scope of work requires the isolation of the overhead catenary, the overhead must be isolated in accordance with the prevailing workshop regulations, before any person works on high voltage equipment. Refer Electrical Isolation of the Locomotive.

Whenever working on the roof area, the locomotive must be shunted to a section track that contains no overhead catenary, and the traction converter must earthed. Refer Electrical Isolation of the locomotive.

Do not attempt to make repairs or adjustments in the control cubicles or drivers desk when power is on. Ensure that the battery supply is isolated.

110V binary signal trainlines are a potential electrical hazard. Before working on the systems connected to these sockets, ensure that the locomotive is electrically uncoupled at both ends, the locomotive is isolated and earthed at the main circuit breaker, and that the batteries are isolated.

Do not operate the controls of functional apparatus (eg. move contactors, actuators, relay or EP valves by hand, connect or disconnect wires, remove temporary packing or interface with pneumatic equipment) of a locomotive undergoing maintenance/testing, without first ensuring that there are no persons engaged in any work on, within or beneath that locomotive, who may be injured in any way by the operation.

Care should also be taken to ensure that capacitor systems on the locomotive have discharged prior to undertaking operations. The traction converters and the BUR cabinets contain capacitors. Voltage indicators on these cabinets warn of any residual voltage in the cabinet. Always ensure that indicator LEDs are flashing slower than once every 15 seconds. See Electrical Isolation of the Locomotive, Chapters 4.1, Traction Converter and 5.1, Auxiliary Three-Phase Power for more information on voltage indicators. The filter cubicle also contains capacitors, but these are automatically discharged whenever the main circuit breaker is opened.

The gases generated by a battery are highly flammable. Where a battery is found to be or suspected to be overheated, extreme caution should be taken to prevent ignition until the gases have been allowed to disperse. Keep flames, lighted cigarettes and welding operations away from batteries.

Electronics Precautions

Do not use a buzzer, bell, megger, or flash test equipment until all circuits which include semiconductor devices have been isolated. Ensure the manufacturers directions are followed whenever testing electrical and electronic devices. Special tools and testing procedures may be required.

Whenever working with electrical equipment, it is good practice to become familiar with the related schematics. Volume G, Cabling Documentation contains the electrical schematics for the locomotive. Always ensure that any removed wiring is reconnected correctly, as incorrect wiring can cause irreparable damage to equipment and incomprehensible error messages from the control electronics.

When electrical and electronic equipment is to be removed, all wiring should first be tagged before it is disconnected. This will aid in the correct reinstallation and reconnection of the equipment.

In many chapters, references are given to the appropriate Sheet in Volume G, Cabling Documentation. Otherwise, wiring should be reconnected as tagged during removal. The wiring and terminal numbers located on equipment are referenced in the electrical schematics in Volume G.

Cabinets and Equipment Cubicles

WARNING:

Extreme care must be taken when approaching equipment which has been live, and could remain live for a short period of time because of the delayed discharge time of capacitors.

The following systems have covering panels to prevent accidental contact with electrical systems.

- Control Cubicles (SB1, SB2)
- Auxiliary Cubicles (HB1, HB2)
- Filter Cubicle (FB)
- Traction Converters (SR1, SR2)
- Auxiliary Converters (BUR1, BUR2, BUR3)
- Driver's Desk, including Cubicle F and Panels A, B, C and D

These systems contain high-power AC systems connected to the main transformer and/or DC systems connected to the battery. Electrical systems must be isolated and earthed, and the capacitor systems discharged prior to removing any panels from these areas or working on any of these systems. See Electrical Precautions. Covers on the HB, FB, SR (traction converters) and BUR cabinets require keys from the key interlocking system for access. See Electrical Isolation of the Locomotive.

Handling Precautions

Most locomotive equipment is heavy. Generally, the weight of equipment is listed in Section Technical Data. Care must be taken to avoid personal injury or damage to adjacent equipment. Heavy items must be lifted in accordance with the prevailing workshop safety regulations using suitable lifting equipment. Such lifting equipment must be rated to carry the weight involved. Always ensure that the weight of the item to be lifted is known before commencing the procedure. For example, some equipment contains oil or other fluids, which may not be included in the listed weight for the equipment. Operate the lifting equipment in accordance with the manufacturers recommendations. Always ensure that the item to be lifted is transported in accordance with its manufacturers directions.

Fluids Precautions

When handling lubricants, sealants, paints, adhesives, cleaning fluids or similar, the local workshop regulations or the manufacturer's instructions must be strictly observed.

Ensure that appropriate cleaning materials and preparations are used whenever cleaning any equipment. Ensure the manufacturers documentation for the equipment is consulted prior to cleaning any equipment, as some cleaning agents and solvents may cause damage to some equipment.

Always observe the cleaning solvent manufacturer's instructions. Some solvents may be toxic or flammable.

Lubrication Precautions

Clean lubricating points before applying the recommended lubricant, and remove any excess after applying new lubricant.

Pneumatic Precautions

Before performing any operations on systems incorporating pneumatic components, ensure the locomotive pneumatic system is isolated and vented, as described in Chapter 6.3, Main Reservoirs.

Before operating any pneumatic cocks, check the direction in which any air may be vented and ensure that the blast of compressed air cannot cause injury or damage.

Before attempting to dismantle or remove any equipment that is connected to a compressed air system, isolate it from the air supply and exhaust all air from it and the associated system.

When blowing out pipes with compressed air, wear goggles and take care to avoid any openings from which the air may blow out, as blown particles can be harmful.

During brake testing involving application and release of the brakes, ensure that no other personnel are in positions where they could be endangered by the movement of the brake blocks, rigging etc. Warning signs must be located at both ends of the locomotive during brake testing or brake maintenance. If the brake system is isolated, warning indicators must also be in position at each end of the locomotive and on both driver's desks.

Welding Precautions

When welding operations are being carried out on a vehicle, the welding return lead shall be secured as near as possible to the point of welding. All electronic devices shall be individually grounded. The locomotive structure is a critically stressed unit, and welding should only be carried out to an Approved Welding Procedure by suitably qualified technicians.

Technical Information

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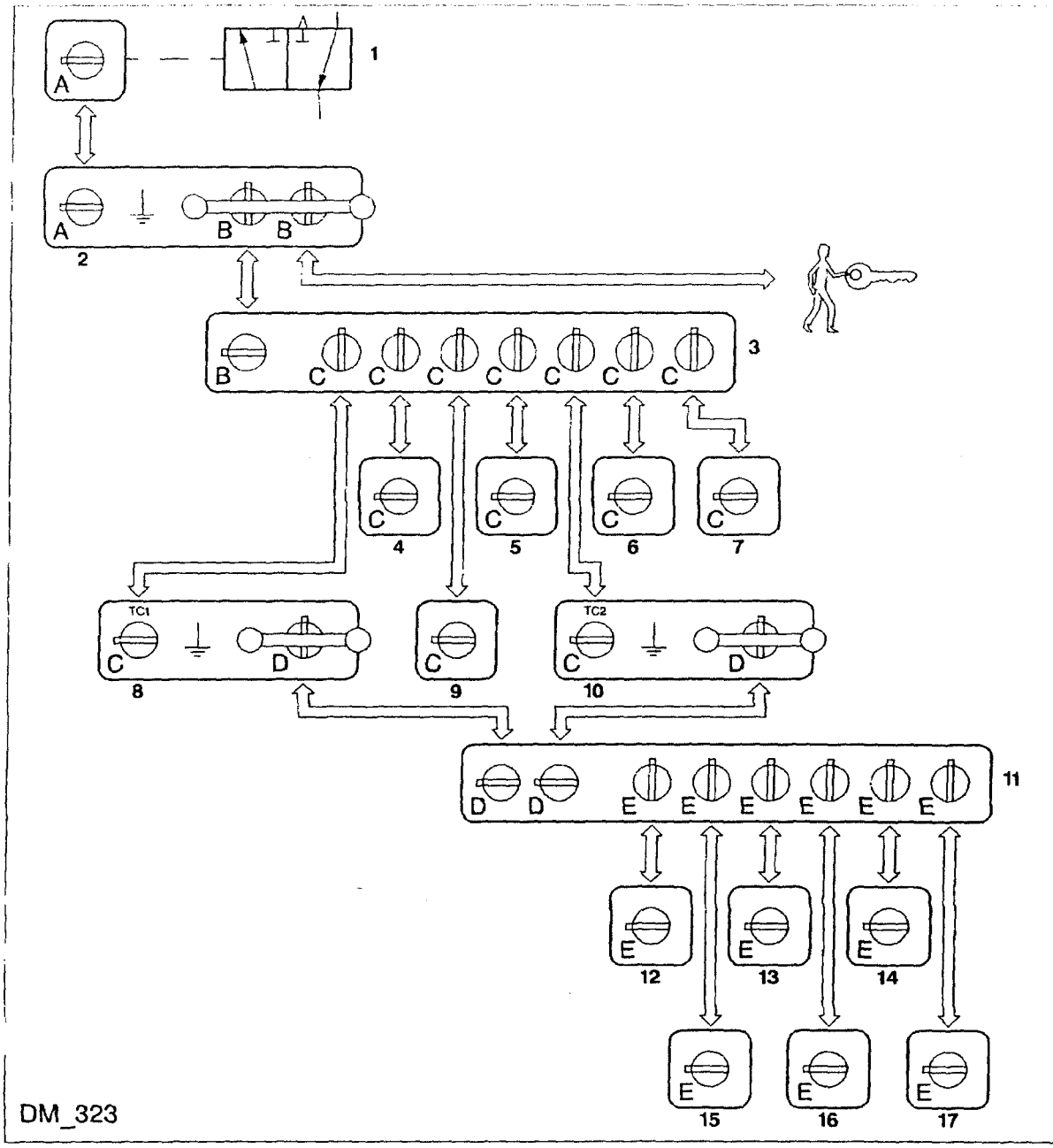
Electrical Isolation of the Locomotive



1	Pantograph air supply isolating cock	10	Earthing switch on traction converter 2
2	Earthing switch of main circuit breaker	11	Key multiplier 2
3	Key multiplier 1	12	Door lock, traction converter 1
4	Door lock auxiliary circuits, Block 1	13	Door lock, traction converter 1
5	Door lock auxiliary circuits, Block 2	14	Door lock, traction converter 1
6	Door lock auxiliary converter 1	15	Door lock, traction converter 2
7	Door lock auxiliary converter 2	16	Door lock, traction converter 2
8	Earthing switch on traction converter 1	17	Door lock, traction converter 2
9	Door lock on filter block		

When carrying out repairs or testing of electrical equipment (unless specifically authorised otherwise), the locomotive high voltage equipment must be isolated by using the Key Interlocking System. The key interlocking system isolates and earths various parts of the locomotive electrical system. The key interlocking system comprises five different key types; A, B, C, D and E. Each key type is coloured distinctly;

Key	Colour	Qty.	Location
A	Light Blue	1	Pantograph air supply isolating cock
B	Yellow	2	Main circuit breaker earthing switch
C	Green	7	Key Multiplier No. 1
D	Black	2	1 on each traction converter earthing switch
E	White	6	Key multiplier No. 2

The following steps describe how to earth and isolate the locomotive using the key interlocking system.

- Shut down the locomotive as described in Chapter 4, Vehicle Operation of Volume A, Driver's Manual.
- Turn off the air supply to the pantographs by switching Key A on the air supply isolating cock, located on the brake frame (pneumatic panel). The air in the system will be exhausted, locking the pantograph in the lowered position.
- To release Keys B, insert and turn key A in the main circuit breaker Earthing Switch. A bolt will be released, unlocking the arm of the main circuit breaker. Move the arm to the EARTH position then turn and remove the Keys B.
- One Key B should be held by the maintenance supervisor. The other is used in the key multiplier No. 1 to release Keys C. The seven Keys C are used for:

- Unlocking the earthing switch on traction converter 1
- Unlocking the earthing switch on traction converter 2
- Opening the auxiliary circuit block 1
- Opening the auxiliary circuit block 2
- Opening the auxiliary converter 1
- Opening the auxiliary converter 2
- Opening the filter block

- Move the battery isolating switch to the Off position, as required.
- The Keys C are used to unlock the earthing switches on each traction converter. Before operating the traction converter earthing switches, ensure the master switch on the driver's desk is in the "0" position and that the "Control Circuits Locomotive" (112.1) cir-

cuit breaker is in the "OFF" position. Circuit breaker 112.1 is situated in SB2. Ensure that there is no fault message, "Fault DC_Link Discharge", on display terminal in the cabin, and the voltage indicator LED is OFF for at least 15 seconds. From the time the locomotive is powered down, it can take approximately 5 minutes to completely discharge the DC-Link capacitors. Always ensure that indicator LED is flashing slower than once every 15 seconds before earthing the traction converter.

- To release Keys D from the traction converter, insert and turn a Key C in the traction converter earthing switch. A bolt will be released, unlocking the traction converter earthing switch arm. Move the arm to the EARTH position then turn and remove the Key D from the traction converter. Repeat the procedure on the other traction converter.
- Once both of the Keys D have been removed from the traction converters, they are used to release Keys E from key multiplier No. 2, located in the machine room behind the cab. The six keys E are used unlock:

- Traction converter 1, door locks 1 - 3
- Traction converter 2, door locks 1 - 3

Steam Cleaning

Steam cleaning equipment uses high pressure, high temperature steam and cleaning preparations to blast dirt, debris and other built up deposits from surfaces. Care must be taken to ensure that the nozzle of the steam cleaning equipment does not spray onto persons or sensitive equipment, as severe damage may occur. Always operate steam cleaning equipment in accordance with the manufacturers recommendations.

Some equipment contains air vents for cooling and venting, such as the vents in the axle boxes and traction motors. Steam cleaning of such equipment must be performed in a careful and controlled manner to ensure that the cleaning jet is not directed into such vents. Refer to Chapter 2.6, Transmission.

Non-Destructive Testing & Inspection

Non-Destructive Testing (NDT) is required in many areas of locomotive maintenance and repair. There are many forms of NDT that can be used as an aid to identify cracks, holes, flaws or other discontinuities in components. This section outlines the basic principals of five forms of NDT: visual inspection, penetrant, ultrasonic, magnetic and radiographic.

Information given in this section is intended as a guide only and is in no way an exhaustive list of NDT procedures, operation or techniques. All non-destructive testing must be performed by a qualified operator and the resulting data must be interpreted by qualified personnel.

Visual Inspection

Visual inspection is usually the first form of testing or evaluation performed. Many defects, cracks and points of corrosion may be quickly discovered through a visual inspection.

Impact or stress damage, flaking, scratches and other conditions may also be apparent during a visual inspection. This type of damage is usually specific for each component. The Inspection and Repair Sections in these Maintenance and Repair volumes give more specific details of the visual inspections necessary to identify likely damage or faults which may occur some of components and systems covered in these volumes.

The following information discusses some forms of damage that may be apparent during a visual inspection.

Corrosion

Corrosion is common on metallic surfaces and can be readily identified through discolouration, scaling and flaking. While certainly indicators of corrosion, these symptoms may be caused by a means other than corrosion and must not be used solely as confirmation of corrosion. Overheating may appear to be similar to corrosion, both giving a brown colour and a similar texture.

Overheating

Overheating can appear similar in colour and texture to corrosion. Discolouration from heat usually appears to fade at the edges, whereas corrosion generally has defined edges of a more constant colour. Overheating may also result in a bluish colouring, quite distinct from corrosion that fades towards the edges.

Cracking

Cracks may appear in many surfaces. A crack may appear to run along the surface or to be coming out from inside the component. In either case, the source of the crack and the extent of the crack must be evaluated, possibly by use of another NDT technique, to establish the best course of action regarding the repair or rejection of the cracked component.

Penetrant Testing

Cracks that penetrate the surface of a material may not always be visible to the naked eye. Dye penetrants can aid in identifying discontinuities in components.

Penetrants must always be used only by qualified personnel, in accordance with equipment manufacturers recommendations and within the prevailing workshop regulations.

When a penetrant is applied to a clean surface containing a crack, hole or other flaw, the penetrant is drawn into the discontinuity through capillary action. When the excess penetrant is cleaned from the surface, the penetrant within the discontinuity remains visible. If the penetrant and the cleaned surface provide sufficient visual contrast, the penetrant can be easily observed, revealing the discontinuity. Some penetrants may be fluorescent to provide a stark contrast, others require a specialised ultraviolet or laser light source to highlight the penetrant against the material.

Ultrasonic Testing

Ultrasonic testing uses high frequency sound waves to locate discontinuities in a component.

Ultrasonic testing must always be performed by personnel fully qualified in the particular type of equipment. Testing must be performed in accordance with the equipment manufacturers recommendations and within the prevailing workshop regulations.

A typical ultrasonic testing machine displays a graph representing discontinuities in a component on a Cathode Ray Oscilloscope (CRO). Peaks or spikes in the graph indicate the severity of the discontinuity; the bigger the spike, the greater the discontinuity.

When using ultrasonics to test for discontinuities, it is good engineering practice to maintain accurate records to develop a history of test results. The graph should be approximately the same for all items of a particular component type. This information can be used to develop a standard for a particular component type. For comparison purposes, reference can then be made to the standard to evaluate the condition of an individual component against a known standard. For example, axles should always produce a similar graph when tested. Each end of the axle, along with edges and shoulders machined into the axle will appear as spikes on the CRO. Variations may be an indication of a difference in a particular axle to the standard axle. Additional spikes, where no shoulder, edge or end exists on the axle, are indicators of discontinuities in the axle, such as cracks. Such a variation may indicate that a further, or a more in depth, test is required to fully evaluate the axles condition.

Magnetic Testing

When a discontinuity is present in a material, the magnetic flux within the material changes greatly as it approaches the discontinuity. This noticeable change in magnetic flux can be useful for finding and evaluating flaws and cracks in a material.

Magnetic testing equipment must always be operated by fully qualified personnel in accordance with equipment manufacturers recommendations and within the prevailing workshop regulations.

Some materials are ferromagnetic (eg. iron, steel, cobalt, nickel) and can be magnetised to provide a suitable magnetic flux for testing. Other materials, such as aluminium, copper and some stainless steels are not ferromagnetic and do not possess a magnetic flux suitable for testing. However, by inducing a current in such materials, a magnetic flux is also induced. This induced magnetic flux can be suitable for testing for discontinuities in the material.

Any item that has been magnetically tested must be demagnetised after the testing procedure, before re-use in service.

Radiographic Testing

Radiographic, or x-ray, testing involves exposing a component to a radiographic source (such as x-rays or gamma rays) and measuring the change in the source after it has passed through the material. Voids, porosity and cracks are shown as a change in radiographic distribution within the material. The distribution through a discontinuity is noticeably different than for the surrounding, continuous material.

Radiographic testing equipment must always be operated by fully qualified personnel in accordance with equipment manufacturers recommendations and strictly within the prevailing workshop regulations.

Sealant Preparation

Surfaces to be sealed and joined with Sikaflex 221, Sikalastomer 710 or Sikaflex 15LM must first be prepared in accordance with the sealant manufacturers directions. If the proper preparations are not performed, the integrity of the sealant can not be guaranteed.

Some sections of this volume require that sealed joins be cut in order that some components may be removed from the loco. When reinstalling such components, a new seal must also be achieved. Any traces of the previous seal must be completely removed and the surfaces prepared accordingly so that a new seal may be achieved.

The following table shows the preparations required for particular surface types and finishes prior to the application of Sikaflex 221.

Painted Surfaces	Painted surfaces must be cleaned with Sikacleaner 205.
Bare Metallic Surfaces	All unfinished metallic surfaces require three stages of preparation; surface scuffing, cleaning with Sikacleaner 205 and priming with Sikaprimer 210T.
Powder-coated Surfaces	Powder-coated surfaces must be cleaned with Sikacleaner 205 and then primed with Sikaprimer 210T.
Fibreglass Surfaces	Fibreglass (GRP or GFRP) must be cleaned with Sikacleaner 205 and then primed with Sikaprimer 210T. New fibreglass components must be ground down approximately 0.5 mm on the area to be sealed prior to cleaning. Gel-coats, waxes and other release agents present on the surface must be removed, as the sealant will not bond to these coatings.

Surface Preparations

The following table shows the preparation required prior to the application of Sikaflex 221.

Surface Scuffing	Using a suitable steel wool pad or equivalent, gently scour the surface area to be sealed. Gentle scuffing of the surface enables the sealant to adhere more fully with the surface.
Cleaning	Surfaces to be cleaned with Sikacleaner 205 must first be dry and clean of any loose paint flakes, oxides, grease, lubricants, release agents and other contaminants. Cleaning with Sikacleaner 205 should be done in two stages. First, apply Sikacleaner 205 with a clean cloth to the area to be sealed, wiping thoroughly. Allow this to dry, then clean area again with a clean cloth, wiping in one direction only. This is to prevent recontaminating the area just wiped by wiping over it again. Allow the cleaner to dry for the recommended time before applying sealant. If thirty minutes is exceeded before the sealant has been applied, lightly reapply Sikacleaner 205 as previously described.
Priming	Sikaprimer 210T is to be applied over an area already cleaned using Sikacleaner 205, as described previously. Once cleaned, allow to dry for 10 minutes then apply a thin, even coat of Sikaprimer 210T using a suitable brush. Allow to dry before applying sealant. If 5 hours is exceeded before sealant has been applied, lightly sand the surface, remove any dust and prime again.
Sealing	All areas to be sealed must first be cleaned and/or primed. Once the sealant has been applied to the surface to be joined, joining must take place as quickly as possible to avoid the sealant curing. As a general guide, Sikaflex 221 has a tack-free time of approximately 50 minutes at 20 °C and 50% relative humidity. This time is likely to be shorter in increased temperature and/or humidity. Once the sealant has been applied and the two surfaces joined, clamping must be applied if no other fixing method is used on the sealed components. Refer to the manufacturers documentation for details regarding tack-free times and curing rates.

Water Test

In various chapters throughout these Maintenance and Repair Volumes, a water test is required after work has been performed. The test is to be performed to ensure the locomotive is water tight. Any water leaks on the locomotive pose an operational hazard, as the ingress of water to the locomotive can cause damage to electrical components and corrosion of metallic parts.

The locomotive must be in full operational condition for the water test. All equipment is to be installed and all sealant curing times observed. All blowers are to be running during the water test.

Do not spray water directly into breather ports on axle boxes or traction motors, or into roof vents on the cab or the mushrooms on the machine room roof hatches.

The locomotive should be positioned below a spray gantry, consisting of horizontal top rows of nozzles, each with two vertical rows of nozzles, one on each side of the locomotive. Each row of nozzles should be capable of uniformly delivering 500 litres of water per minute at 200 kPa with 90° solid cone nozzle spray patterns. With all blowers running (traction motor, oil cooler and machine room blowers, complete with scavenge blowers), the locomotive should be tested under the gantry for a period of 15 minutes. During this period, personnel within the locomotive cabs and machine room should be inspecting the locomotive for leaks. Typical areas to inspect would be seals, through bolt holes, areas where equipment passes from the outside to the inside of the locomotive, and opening with covers/doors and windows.

Tightening Torques

The tightening torques in the following tables only apply to the grade and size of bolt listed, unless otherwise specified in the procedure described in these volumes, or Volume F, Suppliers Documentation.

As a general rule, a locking compound, such as Loctite, should be used when assembling fasteners, except on the bogies. A thread sealing compound should be used on all threads opening into any compartment of the locomotive structure, and on all pipe fittings. Some compounds and coatings may alter the required tightening torque. Use the compound manufacturer's recommendations for modification of the tightening torques to avoid mechanical failure.

Steel Hexagon Head Bolts and Screws

Size	Thread	Pitch (mm)	Tightening Torque (Nm)				
			Grade 4.6	Grade 5.8	Grade 8.8	Grade 10.9	Grade 12.9
M 1.6	Coarse	0.35	0.1	0.1	0.2	0.2	-
M 2	Coarse	0.4	0.1	0.2	0.3	0.5	-
M 2.5	Coarse	0.45	0.3	0.4	0.6	0.9	-
M 3	Coarse	0.5	0.4	0.7	1.1	1.6	1.9
M 4	Coarse	0.7	1	1.7	2.7	3.8	4.4
M 5	Coarse	0.8	2.1	3.5	5	8	8.9
M 6	Coarse	1	3.5	5.9	9	13	15
M 8	Fine	1	-	-	24	34	40
M 8	Coarse	1.25	8.5	14	22	32	37
M 10	Fine	1.25	-	-	46	66	77
M 10	Coarse	1.5	17	29	44	63	73
M 12	Fine	1.25	-	-	83	119	139
M 12	Coarse	1.75	30	49	77	109	128
M 14	Fine	1.5	-	-	132	189	220
M 14	Coarse	2	47	79	122	174	203
M 16	Fine	1.5	-	-	202	189	336
M 16	Coarse	2	73	124	190	270	316
M 18	Fine	1.5	-	-	304	418	493
M 18	Coarse	2.5	101	171	269	371	436
M 20	Fine	1.5	-	-	424	588	688
M 20	Coarse	2.5	143	242	372	528	620
M 22	Fine	1.5	-	-	572	788	924
M 22	Coarse	2.5	195	329	519	722	840
M 24	Fine	2	-	-	720	994	1162
M 24	Coarse	3	248	418	640	914	1066
M 27	Fine	2	-	-	1048	1447	1690
M 27	Coarse	3	361	610	967	1339	1561
M 30	Fine	2	-	-	1452	2010	2346
M 30	Coarse	3.5	491	828	1314	1817	2124
M 33	Fine	2	-	-	1960	2713	3168
M 33	Coarse	3.5	667	1135	1782	2449	2884
M 36	Fine	3	-	-	2426	3362	3924
M 36	Coarse	4	864	1454	2297	3173	3708
M 42	Coarse	4.5	1378	2327	3671	-	-
M 48	Coarse	5	2064	3485	5500	-	-
M 56	Coarse	5.5	3338	5611	8870	-	-
M 64	Coarse	6	5030	8473	13376	-	-

Steel Socket Head Cap Screws

Size	Tightening Torque (Nm)
M 1.4	0.2
M 1.6	0.3
M 2	0.7
M 2.5	1.3
M 3	2.4
M 4	5.7
M 5	11.4
M 6	19
M 8	46
M 10	88
M 12	162
M 14	257
M 16	397
M 18	552
M 20	772
M 24	1324
M 30	2685
M 36	4707
M 42	7539

Stainless Steel (304 & 316) Bolts and Screws

Size	Pitch (mm)	Tightening Torque (Nm)		
		Grade PC 50	Grade PC 70	Grade PC 80
M 1.6	0.4	0.1	0.2	0.4
M 2	0.4	0.3	0.3	0.4
M 2.5	0.5	0.5	0.6	0.7
M 3	0.5	1.0	1.1	1.6
M 4	0.7	1.3	2.6	3.5
M 5	0.8	2.4	5.1	6.9
M 6	1.0	4.1	8.8	11.8
M 8	1.3	10.1	21.4	29.0
M 10	1.5	20.3	44.0	58.0
M 12	1.8	34.8	74.0	100.0
M 14	2	56	119	159
M 16	2	86	183	245
M 18	2.5	133	260	346
M 20	2.5	173	370	494
M 22	2.5	234	-	-
M 24	3	298	-	-
M 27	3	421	-	-
M 30	3.5	571	-	-
M 33	3.5	779	-	-
M 36	4	998	-	-

BOMBARDIER TRANSPORTATION

IR WAG9

Volume D3

Air Supply & Pneu, Brakes

BOMBARDIER TRANSPORTATION

IR WAG9

Volume D3

Air Supply & Pneu, Brakes

6 Air Supply & Pneu, Brakes

For complementary information see following Chapters in Volume D2:

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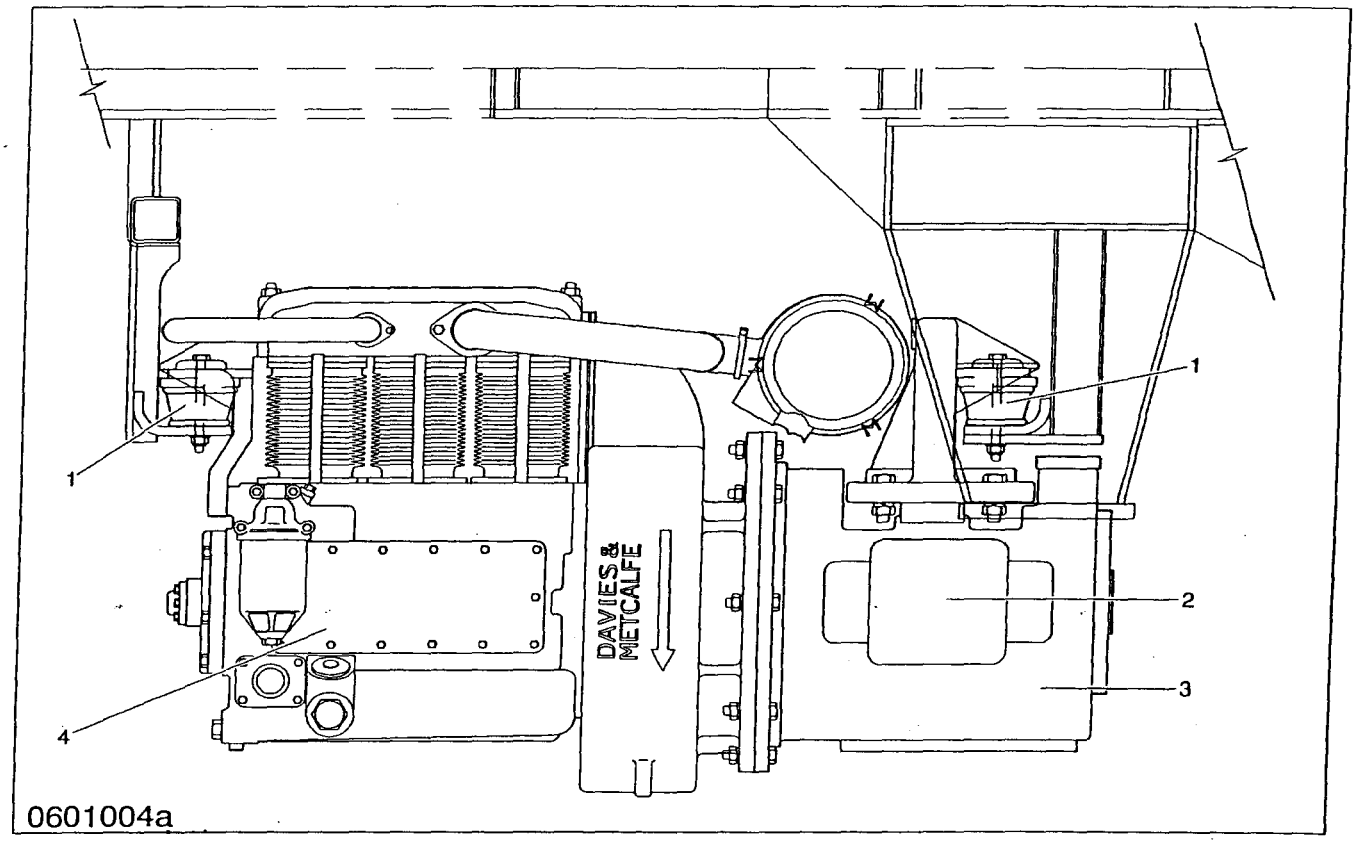
6

6.1 Main Compressor

Group Summary

@.1120

This chapter contains information regarding the main compressors for the locomotive pneumatic system.



1 Resilient mount
2 Electrical terminals
3 Main compressor motor
4 Main compressor assembly

Functional Description

@.1140

The WAG-9 loco is fitted with two electrically driven, three cylinder, Davies and Metcalfe Type 2A320D reciprocating air compressors. The main compressors provide the pneumatic supply on the locomotive.

Air from the atmosphere is drawn into the compressor through the air intake filter by the two low pressure cylinders. Output from the low pressure cylinders is fed past a safety valve, to the intercooler, then to the high pressure cylinder. Output from the high pressure cylinder, at a pressure of 10 bar, is fed past a second safety valve to the aftercooler, which is combined with the intercooler in a single unit. Final cooled air output is taken from a delivery port located at the top of the aftercooler. Condensate produced during the process is discharged to the atmosphere through an automatic drain valve fitted to the underside of the aftercooler.

The electric drive motor is connected to the compressor crankshaft by a Fenner HRC coupling with taper lock bush fixation. The coupling assembly also carries an impeller to provide cooling air for both the motor and compressor and two flywheels to smooth the rotation of the piston compressor. Air is drawn across the outside of the motor by the impeller, blown into the outlet duct, and through the intercooler/aftercooler housing. Leaving the cooler housing, the air then passes through the cylinder fins and out to the atmosphere.

A sight glass is fitted adjacent to the oil filler cap to enable a regular check to be made on the oil level. An oil pump, coupled directly to the drive shaft, ensures satisfactory circulation of the lubricating oil. A primary oil filter prevents any debris entering the crankcase when the unit is being topped up with new oil. A secondary filter in the oil circulation path, and a magnetic drain plug in the crankcase, maintain the oil in a clean condition.

The compressors are mounted to the locomotive underframe in three point frames with resilient mounts to reduce vibration.

Fault finding for the compressor is described in Chapter 8, Metcalfe Compressor of Volume F13, Suppliers Documentation.

Fault finding for the compressor motor is described in Chapter 9, Metcalfe Compressor Motor of Volume F13, Suppliers Documentation.

Technical Data

@.1160

Air Compressor

- Manufacturer	Davies & Metcalfe
- Model	2A320D, Type 32
- Type	Piston
- Free air delivery	1,745 litres per minute (nominal)
- Displacement	2,330 litres per minute (nominal)
- Operating speed	750 rpm
- Operating pressure	10 bar
- Weight	528 kg
- Outlet size	1 1/4 inch. BSP.

Motor

- Motor	15 kW
- Operating speed	730 RPM
- Voltage	415Volt AC, 3 phase

Lubrication

- Lubrication oil approved	Shell Corena P100 (1 year change period) Indian Oil Co. SS68 (3 month change period)
- Oil capacity	11 litres
- Oil pressure	2.8 - 3.4 bar

Tolerances and Wear Limits

@.1170

Lubrication

- Oil pressure	2.8 - 3.4 bar

Tolerances and wear limits applicable to the compressor are described in Chapter 8, Metcalfe Compressor of Volume F13, Suppliers Documentation.

For further information regarding the compressor motor, refer to Chapter 9, Metcalfe Compressor Motor of Volume F13, Suppliers Documentation.

Tools and Special Tools

@.1180

Conventional railways workshop tools and equipment are required for the maintenance procedures described in this chapter.

Overhaul of the compressor requires the special Davies and Metcalfe tools described in Chapter 8, Metcalfe Compressor of Volume F13, Suppliers Documentation.

Miscellaneous Materials

@.1200

Miscellaneous materials required for the procedures described in this chapter include:

- Plastic plugs for sealing pneumatic lines.
- Tags for tagging locations of pneumatic and electrical connections.
- Loctite 222 is also required for some fasteners.
- Oil to specification described in Section Technical Data is required for the main compressor.

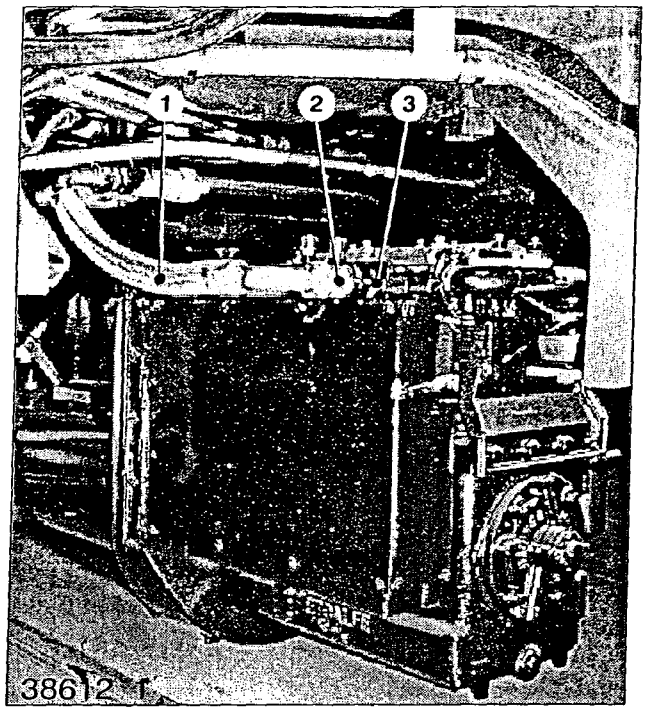
Before-Removal Operations

@.1220

Isolate the electrical power to the main compressor at the circuit breaker 47.1. Circuit breaker 47.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle 1 (HB1) and circuit breaker 47.1/2 for the No. 2 is located in Auxiliary Circuits Cubicle 2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Vent the locomotive pneumatics as described in Chapter 6.3, Main Reservoirs.

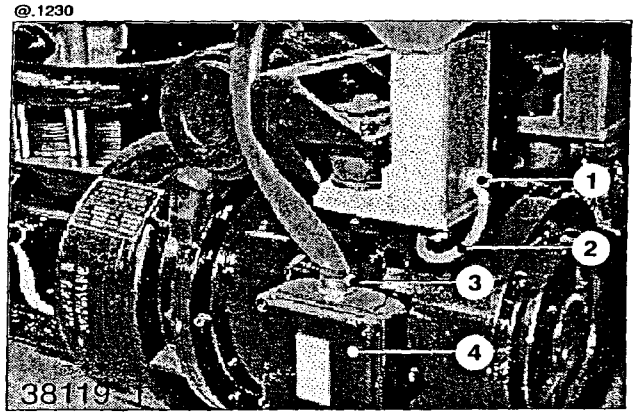
Removal



Crack loose the union (2) between the flexible pipe (1) and compressor outlet (3). Allow any residual pressure to vent, then disconnect the flexible pipe (1) from the compressor.

Seal the pipe and compressor union with suitable plastic plugs to prevent the ingress of foreign material.

@.1230



Remove the bolt (1) and the earthing cable (2).

Loosen the clamp (3).

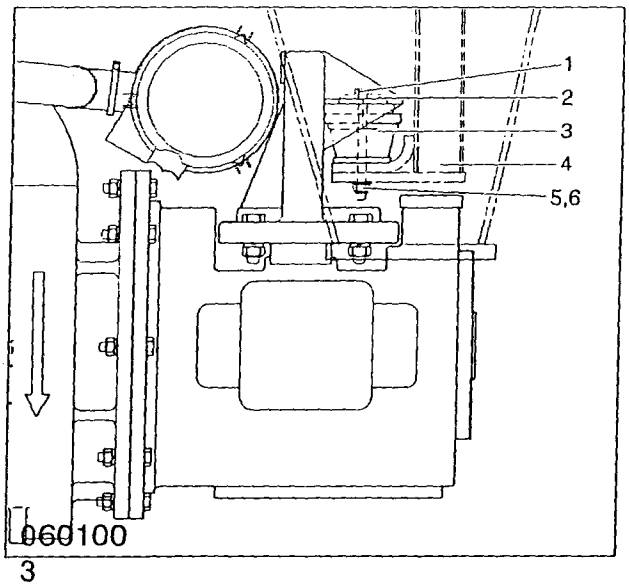
Remove the cover (4) from the compressor motor electrical terminals. Tag and disconnect the harness from the motor.

NOTE:

Do not use the motor cowl or casting to support the weight. These areas are not designed to support a load.

Support the compressors weight with suitable lifting equipment. Ensure the lifting equipment will not damage the compressor or its fittings.

Raise the lifting equipment slightly to support the weight of the compressor.



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Remove the nuts (5) and washers (6) securing the resilient mounts (3) to the mounting brackets (4), then withdraw the bolts (1) and washers (2).

Raise the compressor until the resilient mounts (3) are clear of the mounting brackets (4). Ensure the compressor does not collide with the surrounding structure.

Check to ensure nothing is entangled between the compressor and underframe, then withdraw the compressor from below the locomotive.

Disassembly

@.1240

Disassembly of the compressor is described in Chapter 8, Metcalfe Compressor of Volume F13, Suppliers Documentation.

Inspection and Repair

@.1250

Inspection and repair of the compressor is described in Chapter 8, Metcalfe Compressor of Volume F13, Suppliers Documentation.

Waste Disposal

@.1260

Dispose of waste parts and materials according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

Assembly of the compressor is described in Chapter 8, Metcalfe Compressor of Volume F13, Suppliers Documentation.

Installation

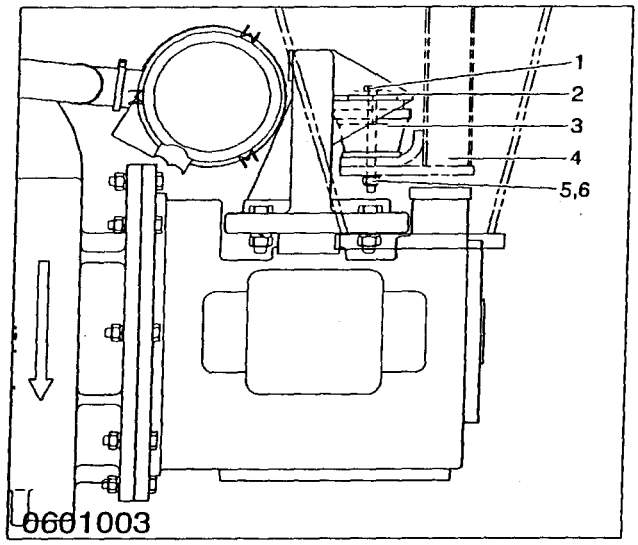
@.1280

NOTE:

Do not use the motor cowl or casting to support the weight. These areas are not designed to support a load.

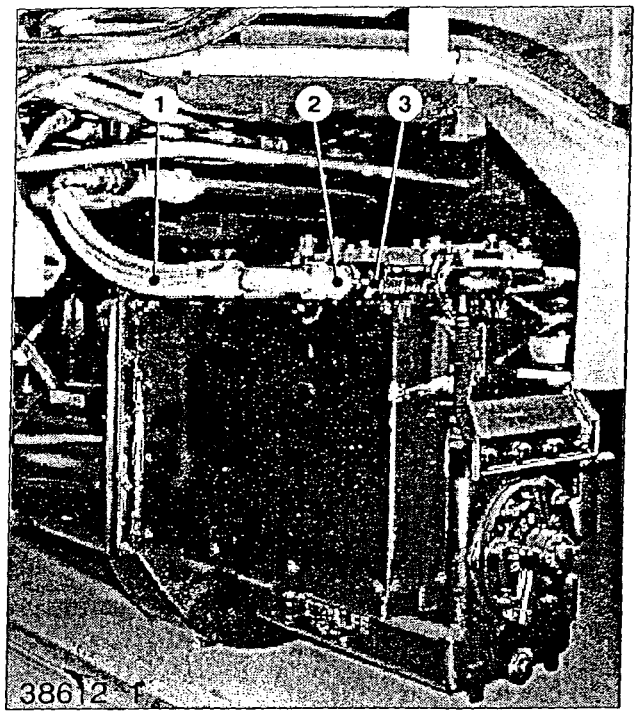
Support the compressors weight with suitable lifting equipment. Ensure the lifting equipment will not damage the compressor or its fittings.

Move the compressor into position on the locomotive underframe. Ensure the resilient mounts are above the mounting bracket feet.

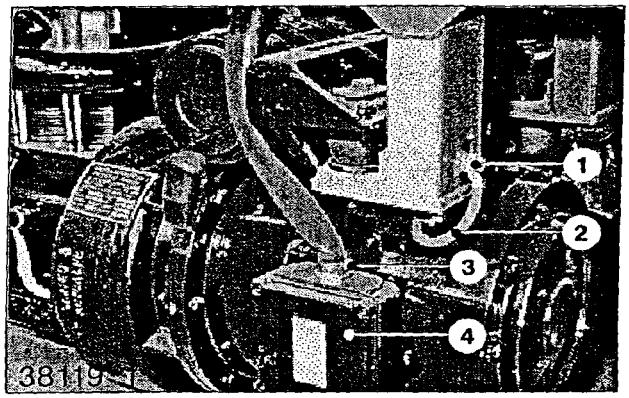


Align the holes in the resilient mounts (3) and mounting foot, then install the bolts (1) with washers (2) through the mount and foot.

Apply Loctite 222 to the threads. Install the nuts (5) and washers (6) on the bolts (1) and torque to 80 Nm.



Remove the protective plugs and attach the flexible pipe (1) to the union (2) on the compressor outlet (3).



Connect the electrical harness to the terminals at the compressor motor as tagged during removal. Refer to Chapter 2I, Aux. Circuits 3-Phase of Volume G1, Cabling Documentation. Replace the cover (4) and secure the screws.

Tighten the clamp (3) around the cable conduit.

Install the earthing wire (2) between the compressor and mounting frame. Tighten the bolt (1).

After-Installations Operations

@.1290

Close the pneumatic system exhaust cocks.

Close circuit breaker, 47.1/1 or 47.1/2 as appropriate, to the compressor.

Check the operation of the locomotive pneumatics and the main compressor as described in Chapter 13, Static Test of Volume F14, Suppliers Documentation.

Check, and if necessary, adjust the compressor oil pressure, refer to Section Adjustments.

Adjustments

@.1310

Adjustment of the compressor oil pressure is described in Chapter 8, Metcalfe Compressor of Volume F13, Suppliers Documentation.

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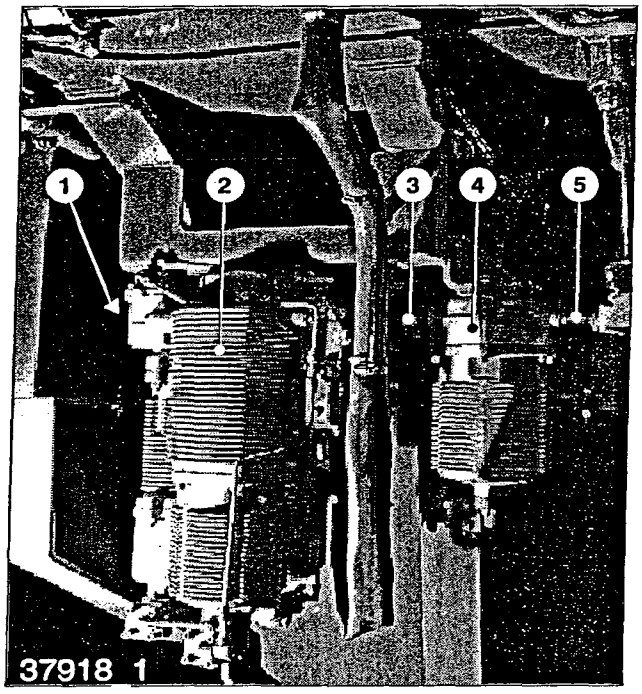
6.2 Air Dryer

Group Summary

@.1120

This Chapter contains information regarding the Salem twin tower air dryer which consists of: air dryer, connecting flange, final filter.

The locomotive is equipped with one air dryer located adjacent to the No. 2 End main compressor.



1	Air dryer inlet
2	Air dryer
3	Connecting flange
4	Final filter
5	Final filter outlet

36

Functional Description

@ 1140

WAG-9 Co Co locomotives are fitted with a Metcalfe Salem FF4092 twin tower air dryer to remove contaminates and moisture from the pneumatic system. The air dryer is situated behind right hand side of the cowcatcher at the Cab No.1 end.

Air from the main compressor is filtered and dried before being stored in the main reservoirs. The twin tower air dryer uses a pre-coalescer to remove impurities, and desiccants (molecular sieves) which absorb moisture from the compressed air supply. A final filter fitted after the outlet manifold removes any remaining impurities in the air stream.

The air dryer comprises two air finned dryer towers connected by manifolds. While one tower is cleaning and dehydrating the air supply from the compressor, the other tower is regenerating. During regeneration, impurities are exhausted through drain vales on the bottom of the tower and the desiccants beads are dried. The cycle between dehydrating and regeneration is controlled by an electronic timer.

Operation of the air dryer system is described in Chapter 10, Metcalfe/Salem Twin Tower Air Dryer and Final Filter of Volume Fl2, Suppliers Documentation.

Fault finding for the air dryer and final filter is described in Chapter 10, Metcalfe/Salem Twin Tower Air Dryer and Final Filter of Volume Fl2, Suppliers Documentation.

Technical Data

@.1160

Filter

- Type	Salem twin tower
- Model	FF4092
- Weight	48 kg
- Operating pressure	6.9 bar (100 psi)
- Working pressure	6.9 ± 0.34 bar
- Electrical requirement	67-130 Volt DC
- Coil Type	Class F (continuous duty)
- Outlet fitting	1 1/4 inch BSP
- Inlet fitting	1 1/4 inch BSP

Heater Thermostats

- Operating voltage	110 Volt DC
- Thermostat elements	3 x 35 Watts
- Opening temperature	0.7 - 3.7 °C
- Closing temperature	5.0 - 110 °C

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Tolerances and Wear Limits

@. 1170

Tolerances and wear limits applicable to the air dryer are described in Chapter 10, Metcalfe/ Salem Twin Tower Air Dryer and Final Filter of Volume Fl 2, Suppliers Documentation.

Tools and Special Tools

@1180

Conventional railways workshop tools and equipment are required for the maintenance procedures described in this chapter.

Miscellaneous Materials

@1200

Miscellaneous materials required for maintenance procedures described in this chapter include

- Plastic plugs for sealing pneumatic lines
- Tags for identification of pipes.

Before-Removal Operations

@ 1220

Allow the air dryer to cool to ambient temperature.

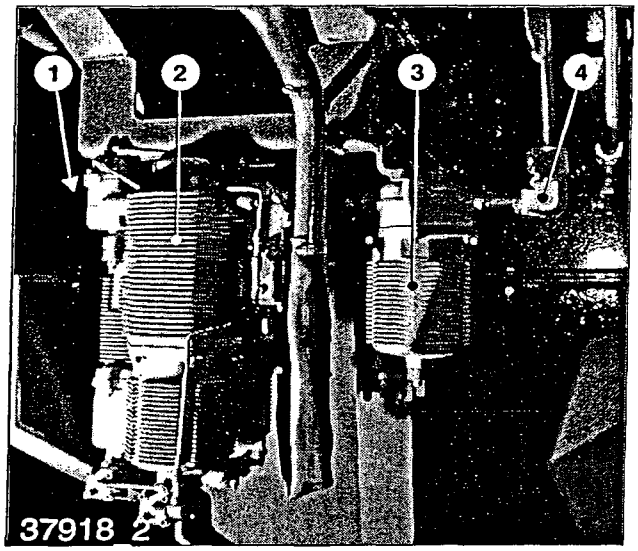
Isolate the electrical power to the air dryer by setting the "Pneumatic Panel" circuit breaker (127.7) to the Off position. The circuit breaker is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer Chapter 8.2, MR Control.

Close the isolating cock between the main compressor and air dryer. Close the two isolation cocks from the air dryer to the main reservoirs. The isolation cocks are situated adjacent to the air dryer.

Removal

@.1230

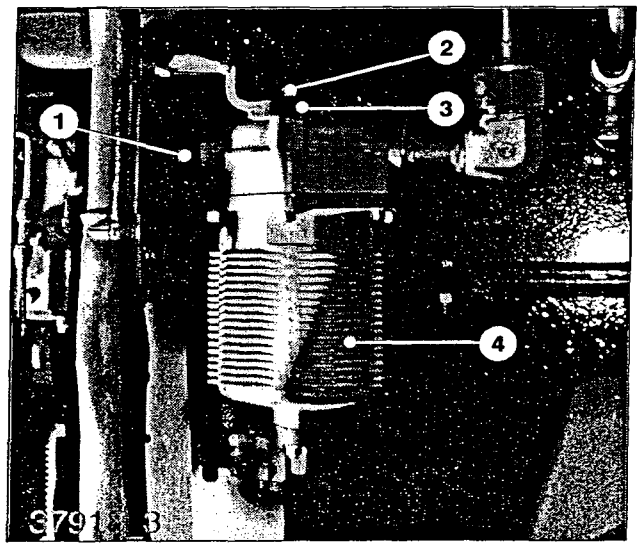
Remove the clamp securing the cable conduit to the union. Unscrew the ring, then remove the electrical harness from the air dryer junction box socket.



Crack loose the pipe unions (1,4) at the air dryer (2) and final filter (3).

Allow any residual pressure to vent, then disconnect the pipes from the air dryer and final filter.

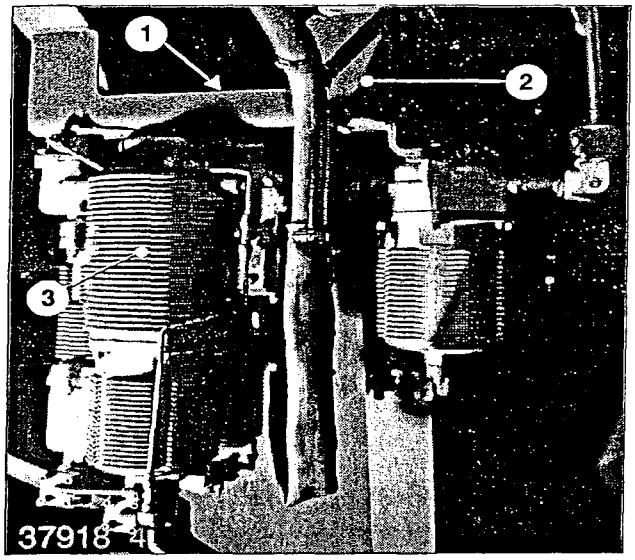
Seal the pipe, air dryer and final filter unions with suitable plastic plugs to prevent the ingress of foreign material.



Remove the bolts (1) securing the male and female flanges between the air dryer and final filter (4), then remove the flanges.

Remove the bolts (2) securing the final filter (4) to the bracket (3), then remove the final filter (4).

Support the air dryer using suitable lifting equipment. Raise slightly to support the weight.



Ensure the air dryer is properly supported with suitable lifting equipment.

Remove the bolts (1) and washers securing the air dryer (3) to the underframe bracket (2). Have an assistant hold the air dryer to stabilize it during the removal.

Lower the lifting equipment slightly and check to ensure nothing is entangled between the air dryer and underframe.

Withdraw the air dryer from below the locomotive.

Disassembly

@.1240

Disassembly of the air dryer is described in Chapter 10, Metcalfe/Salem Twin Tower Air Dryer and Final Filter of Volume F12, Suppliers Documentation.

Inspection and Repair

@.1250

Inspection and repair of the air dryer is described in Chapter 10, Metcalfe/Salem Twin Tower Air Dryer and Final Filter of Volume F12, Suppliers Documentation.

Waste Disposal

@.1260

Dispose of waste parts and materials according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

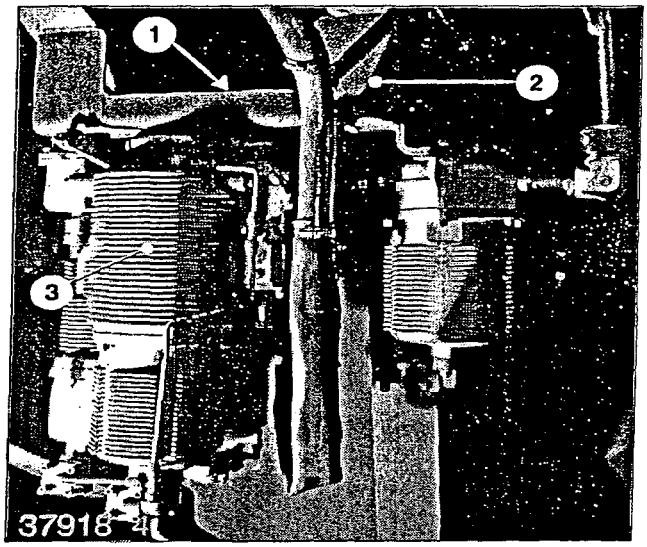
Assembly of the air dryer is described in Chapter 10, Metcalfe/Salem Twin Tower Air Dryer and Final Filter of Volume F12, Suppliers Documentation.

12

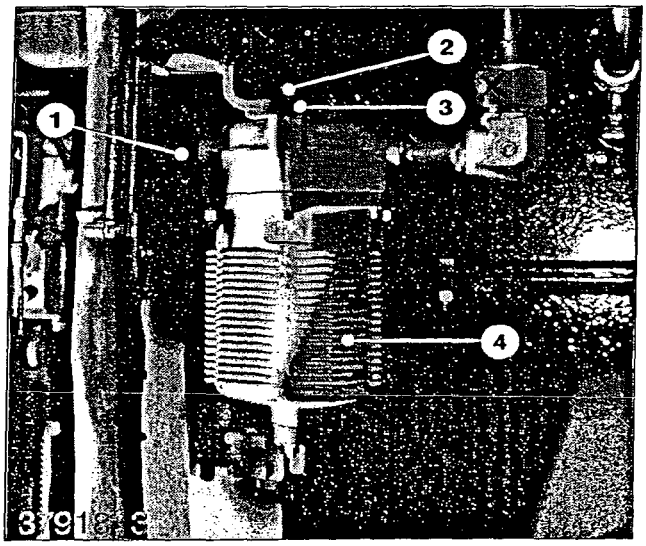
Installation

@.1280

Position the air dryer on suitable lifting equipment, then move the air dryer into position on the locomotive underframe. Have an assistant stablize the air dryer during positioning and installation of the bolts.



Align the holes in the underframe bracket (2) and air dryer (3), then install the bolts (1) with washers through the bracket (2) into the air dryer (3). Tighten the bolts finger tight.

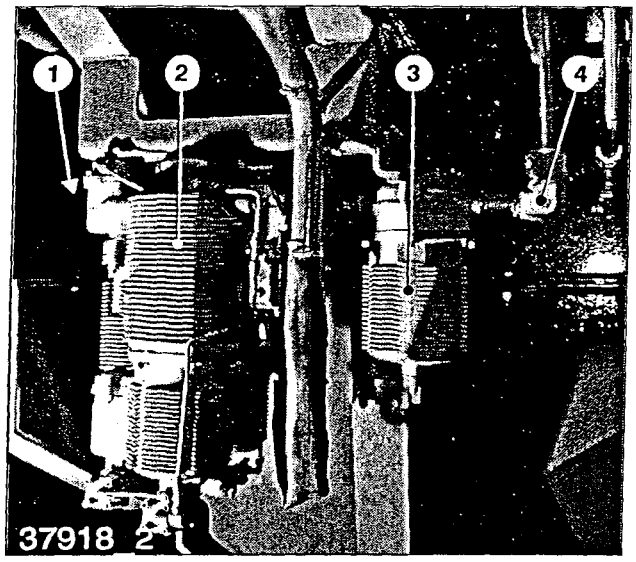


Position the final filter (4) on the underframe bracket. Ensure the outlet union is facing towards the main reservoir feed pipe.

Align the holes in the underframe bracket (3) and final filter (4), then install the bolts (2) with washers through the bracket (3) into the filter (4). Tighten the bolts finger tight.

Position the male and female flanges between the air dryer and final filter (4). Install the bolts (1) and washers, then tighten the bolts.

Tighten the bolts securing the air dryer and final filter to the underframe brackets.



Remove the protective plugs and attach the pipes (1,4) to the final filter (3) outlet union and the air dryer (2) inlet union.

Insert the air dryer harness plug into the socket on the air dryer. Secure the connector by tightening the ring.

Secure the cable conduit to the bracket using the clamp.

If necessary, refer to Chapter 6D, Control Pneumatic Devices of Volume G1, Cabling Documentation for air dryer electrical schematic details.

After-Installations Operations

@.1290

If necessary, close the drain cocks on the main reservoir tanks.

Open the main reservoir and air dryer isolation cocks at the No. 2 End of the locomotive.

Close the "Pneumatic Panel" circuit breaker (127.7) in Control Cubicle-2 (SB2). For more information on circuit breakers, refer Chapter 8.2, MR Control.

Run the compressor and allow the system to reach normal operating pressure. Ensure that no loose material is below the final filter drain cock. Then open the cock to exhaust the impurities from the final filter.

Test the operation of the loco pneumatic system and the air dyer unit as described in Chapter 13, Static Test of Volume F14, Suppliers Documentation.

Adjustments

@.1310

For more information on the air dryer, see Chapter 10, Metcalfe/Salem Twin Tower Air Dryer and Final Filter of Volume F12, Suppliers Documentation.

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6.3 Reservoirs

General Notes on Hazards in the Work Area

@.1040

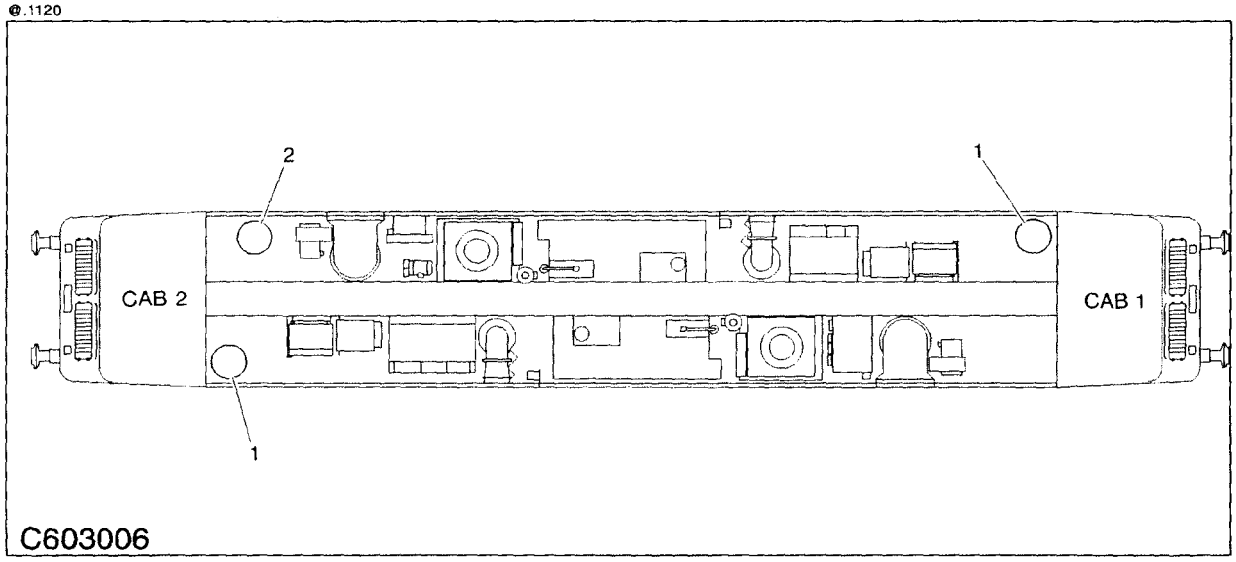
WARNING:

HIGH PRESSURE PNEUMATIC SYSTEMS. Ensure the pneumatic system is depressurised before commencing maintenance work.

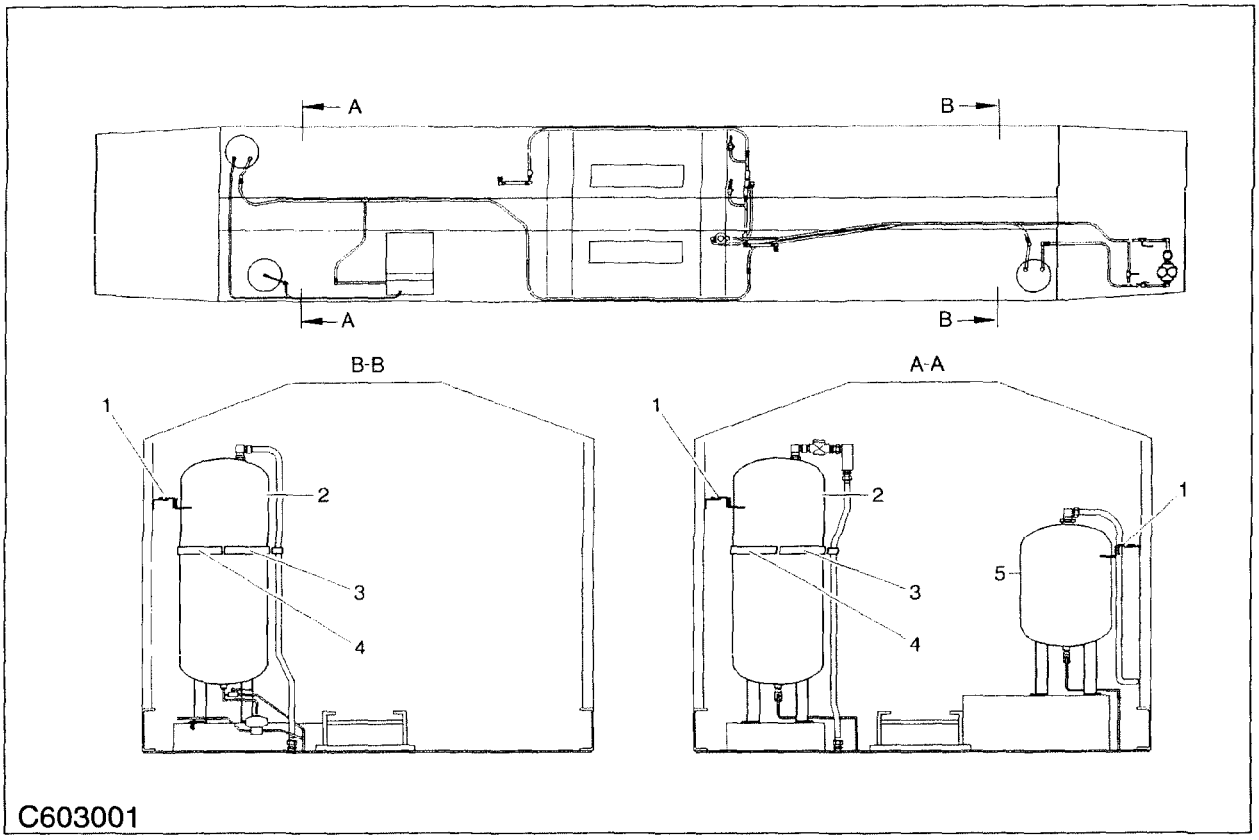
The reservoirs are heavy. To avoid personal injury use suitable lifting equipment to handle the reservoirs.

Overview

@.1120



The air reservoirs for the braking system are situated at each end of the machine room. A main reservoir (1) and an auxiliary reservoir (2) are situated near the Cab 2, while only a single main reservoir (1) is located near the Cab 1.



C603001

1	*Mounting angle*	4	*Tank bracket, rear*
2	Air reservoir 450L	5	Air reservoir 240L
3	Tank bracket, front		

Functional Description

@.1140

[Not applicable]

Technical Data

@.1160

– Main air reservoir capacity:	450 litres
– Auxiliary air reservoir capacity:	240 litres

Tolerances and Limits List

@.1170

[Not applicable]

Tools and Special Tools

@.1180

Standard Workshop Equipment is required for maintenance work.

Miscellaneous Materials

@.1200

Plastic plugs, or alike to seal the pneumatic pipes and reservoirs against the ingress of dirt, moisture and foreign material.

Before Removal Operations

@.1220

WARNING:

HIGH PRESSURE PNEUMATIC SYSTEMS. Air held at ten times atmospheric pressure.

Isolate the electrical power to the compressor.

Close the isolation cock between the compressor and the air dryer. Close the isolation cocks from the air dryer to the main reservoirs. The isolation cocks are situated adjacent to the air dryer.

WARNING:

Air in the reservoirs is under high pressure. Ensure the area below drain cocks is clear of all debris to prevent personal injury.

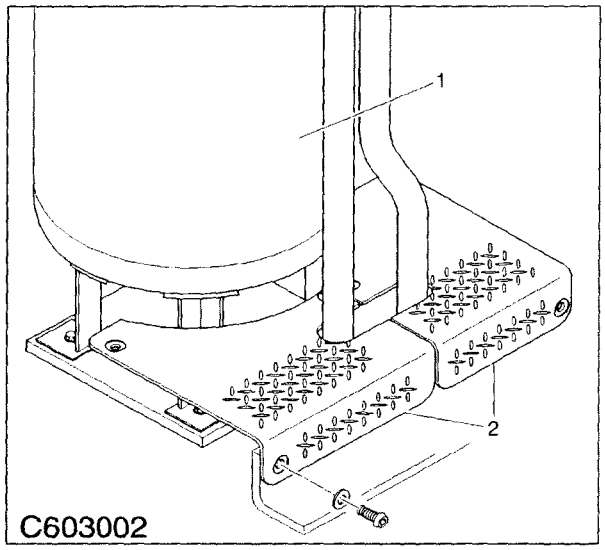
Open the drain cocks on all the main reservoir tanks and allow the pressure to vent.

Reservoirs must be lifted from the machine room through the roof aperture. Remove the pantograph roof hatches as described in Chapter Structure, Section Removal.

Removal

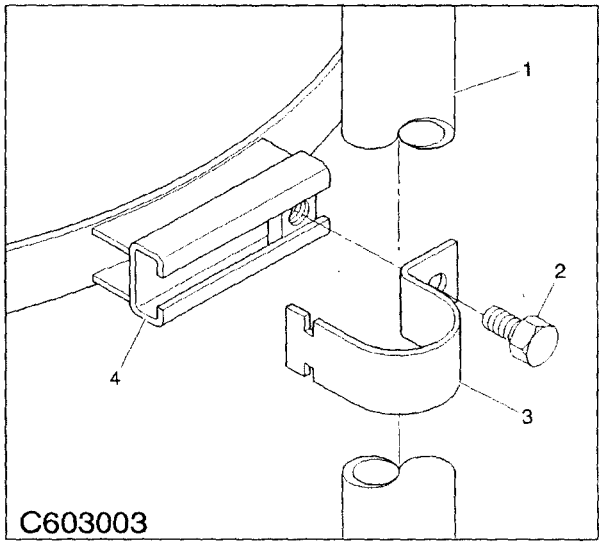
@.1230

Main Reservoirs



Purge the reservoirs of air as described in Section Before Removal Operations.

Remove the tread plates (2) from the machine room floor around the base of the reservoir (1).



Remove the bolt (2) securing the pipe saddle (3) to the tank bracket (4). Separate the pipe (1) and insulator from the bracket (4).

Crack loose the pneumatic connections at the top and bottom of the reservoir and allow any residual pressure to vent.

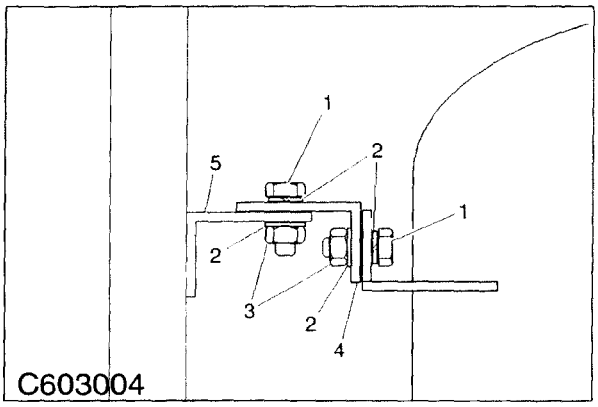
Tag and disconnect the pipes and other pneumatic equipment from the reservoir unions. Seal the pipes and apertures with suitable plastic plugs to prevent the ingress of foreign material.

50

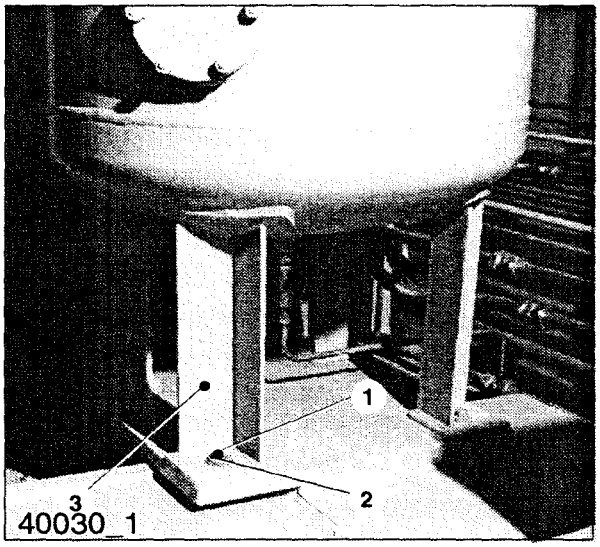
NOTE:

Ensure that none of the pneumatic equipment is entangled in the lifting equipment.

Attach suitable overhead lifting equipment to the reservoir and raise slightly to support the weight.



Remove the bolts (1), nuts (3) and washers (2) securing the mounting angle (4) to the tank and machine room wall (5). Remove the mounting angle (4) from the machine room.



Remove the four bolts (1) and washers (2) securing the reservoir legs (3) to the machine room floor.

NOTE:

When removing the reservoir it may be necessary to manoeuvre the pipes clear. Take care not to excessively bend the pipes. If necessary, remove the pipes to prevent damage.

Raise the reservoir slightly and ensure nothing is entangled. When all attachments are disconnected, lift the reservoir from the machine room through the pantograph hatch opening.

For inspection see supplier's documentation volumes F11 – F14.

Auxiliary Reservoir

Purge the reservoirs of air as described in Section Before Removal Operations.

Remove the tread plates from the machine room floor around the base of the reservoir.

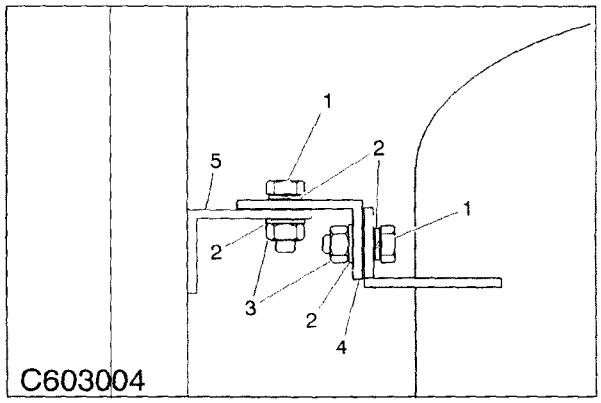
Crack loose the pneumatic connections at the top and bottom of the reservoir and allow any residual pressure to vent.

Tag and disconnect the pipes and other pneumatic equipment from the reservoir unions. Seal the pipes and apertures with suitable plastic plugs to prevent the ingress of foreign material.

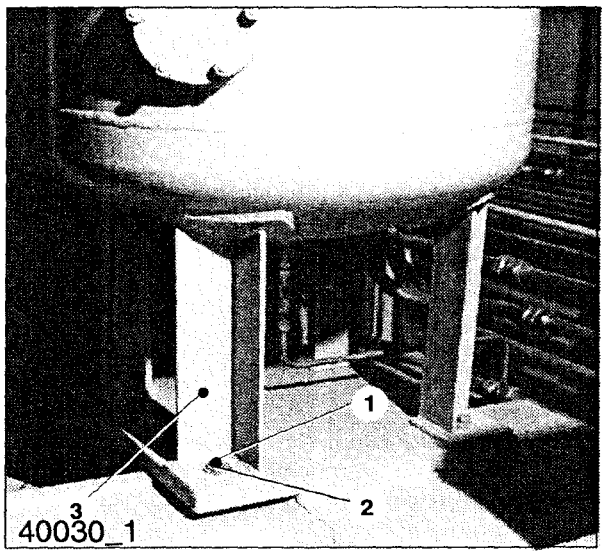
NOTE:

Ensure that none of the pneumatic equipment is entangled with the lifting equipment.

Attach suitable overhead lifting equipment to the reservoir and raise slightly to support the weight.



Remove the bolts (1), nuts (3) and washers (2) securing the mounting angle (4) to the tank and machine room wall (5). Remove the mounting angle (4).



Remove the four bolts (3) and washers (2) securing the reservoir legs (1) to the machine room floor.

NOTE:

When removing the reservoir it may be necessary to manoeuvre the pipes clear. Take care not to excessively bend the pipes. If necessary, remove the pipes to prevent damage.

Raise the reservoir slightly and ensure nothing is entangled. When all attachments are disconnected, lift the reservoir from the machine room through the pantograph hatch opening.

For inspection see supplier's documentation volumes F11 – F14.

Disassembly

@.1240

[Not applicable]

Inspection and Repair

@.1250

Disassembly, maintenance and inspection of the reservoirs are described in the Davies and Metcalfe manual.

Sanitation Parts/Operating Material

@.1260

[Not applicable]

Assembly

@.1270
[Not applicable]

Installation

@.1280

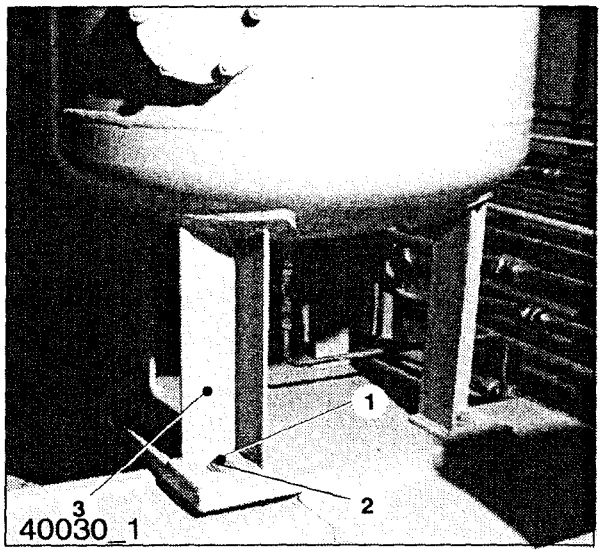
Main Reservoirs

NOTE:

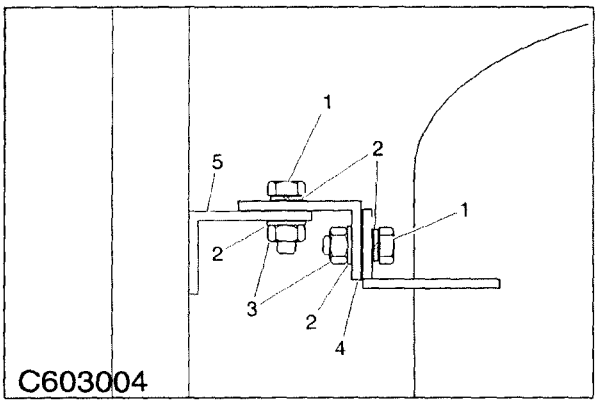
When installing the reservoir it may be necessary to manoeuvre it around the pneumatics pipes clear. Take care not to excessively bend the pipes. If necessary, remove the pipes to prevent damage.

Ensure that none of the pneumatic equipment is entangled with the lifting equipment.

Attach suitable overhead lifting equipment to the reservoir and raise the reservoir into the machine room through the pantograph hatch opening.



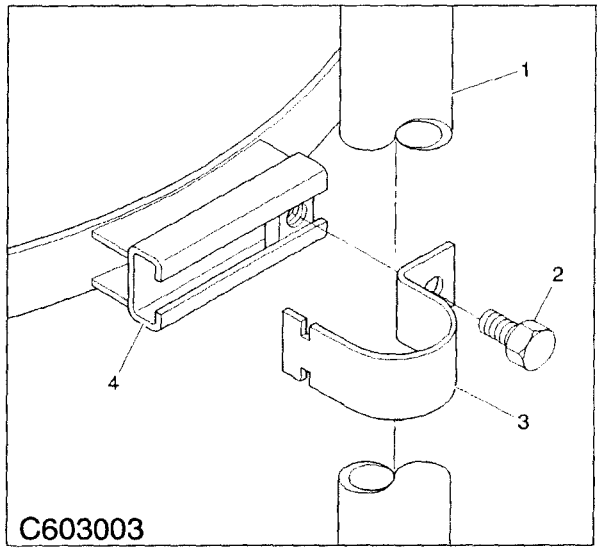
Align the bolt holes in the reservoir legs with those in the machine room floor. Install the four bolts (1) and washers (2) through the reservoir legs (3) into the machine room floor. Tighten the bolts finger tight.



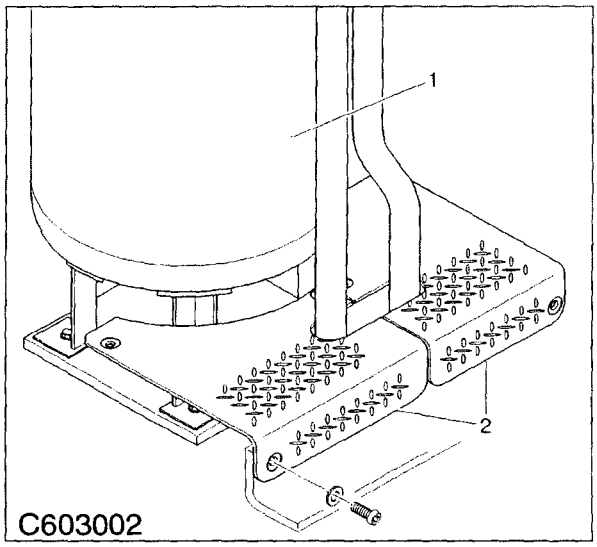
Install the mounting angle (4) between the machine room wall and reservoir. Align the holes, then install the bolts (1), nuts (3) and washers (2) the mounting angle (4) to the tank and machine room wall (5). Tighten the nuts (3) to specification.

Tighten the bolts in the reservoir legs to specification.

Remove the protective plugs and reconnect the pneumatic pipes and equipment to the reservoir as tagged during disassembly.



Secure the pipes (1) to the tank bracket (4) with the saddle (3). Ensure that the insulation is seated between the pipe and saddle. Install the bolt (2) through the pipe saddle (3) to the nut. Tighten the bolts to specification.



Install the tread plates (2) into the machine room floor around the base of the reservoir (1).

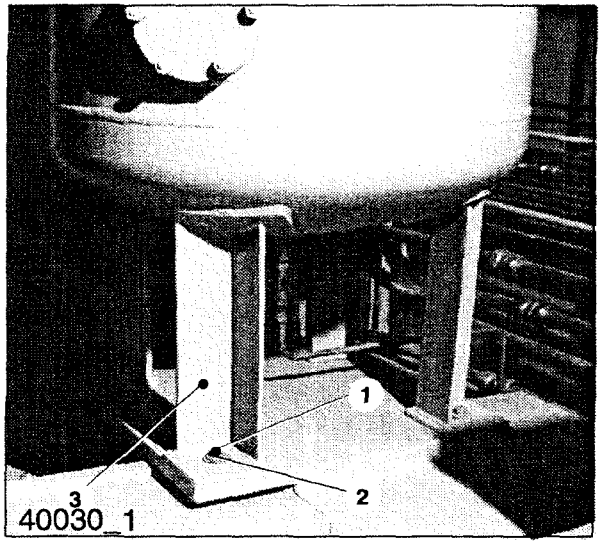
Auxiliary Reservoir

NOTE:

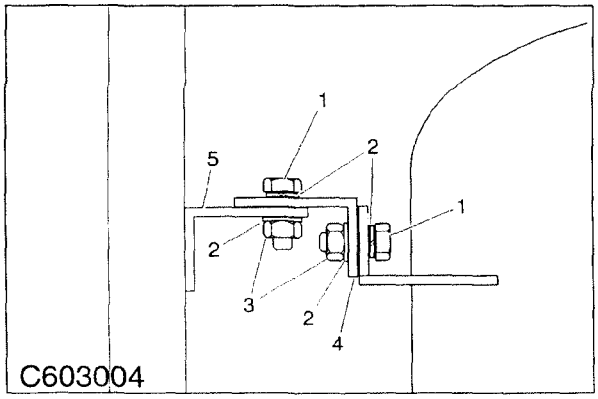
When installing the reservoir it may be necessary to manoeuvre it around the pneumatics pipes clear. Take care not to excessively bend the pipes. If necessary, remove the pipes to prevent damage.

Ensure that none of the pneumatic equipment is entangled with the lifting equipment.

Attach suitable overhead lifting equipment to the reservoir and raise the reservoir into the machine room through the pantograph hatch opening.



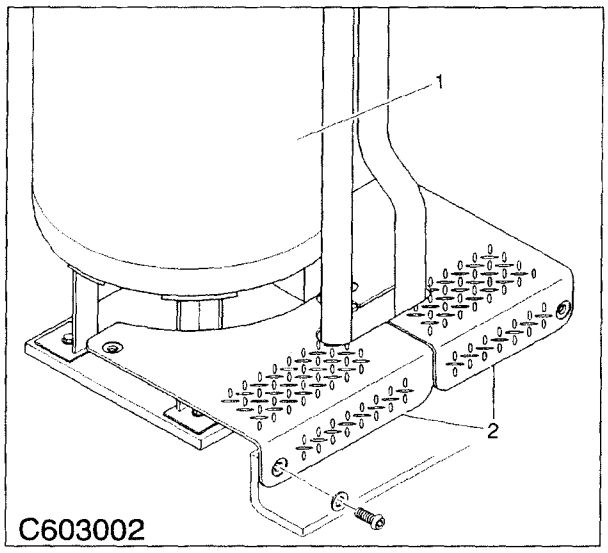
Align the bolt holes in the reservoir legs with those in the machine room floor. Install the four bolts (1) and washers (2) through the reservoir legs (3) into the machine room floor. Tighten the bolts finger tight.



Install the mounting angle (4) between the machine room wall (5) and reservoir. Align the holes, then install the bolts (1), nuts (3) and washers (2). Install the mounting angle (4) to the tank and machine room wall (5). Tighten the nuts (3) to specification.

Tighten the bolts in the reservoir legs to specification.

Remove the protective plugs and reconnect the pneumatic pipes and equipment to the reservoir as tagged during disassembly.



Install the tread plates (2) into the machine room floor around the base of the reservoir (1).

After Installation Operations

@.1290

[Not applicable]]

Adjustments

@.1310

Close the circuit breaker to the compressor.

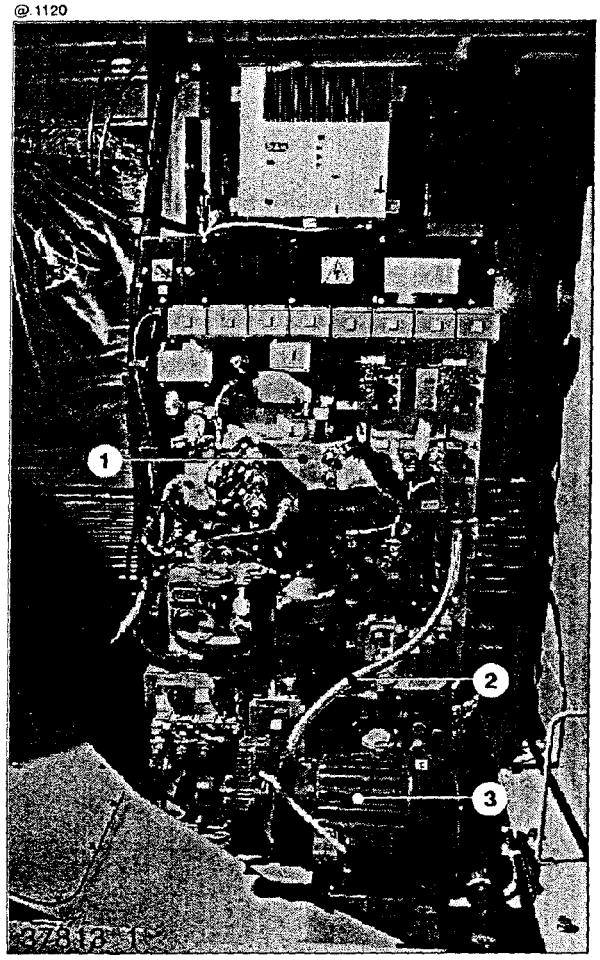
Test the operation of the compressor and check the unions for leaks. Rectify any faults found.

6.4 Auxiliary Compressor

Group Summary

This chapter contains information regarding the auxiliary compressor, which consists of an auxiliary compressor and compressor hose to the brake frame.

@ 1120



1	Brake frame
2	Pneumatic pipe auxiliary compressor - brake frame
3	Auxiliary compressor

6C

Functional Description

@.1140

The auxiliary air compressor is of the single-stage single-acting air-cooled type and is directly coupled and flange mounted to the electric motor, in the form of a self-contained unit.

The auxiliary compressor is used to raise the pantograph when the locomotive is not connected to catenary power and is powered by the batteries. The auxiliary compressor is mounted on studs on the machine room floor directly adjacent to the brake frame.

Technical Data

@.1160

Compressor

- Working pressure	7 bar (100 psi)
- Displacement	0.14 m^3/min
- Speed	1450 RPM
- Cylinder bore	2 x 50.8 mm
- Stroke	25.4 mm
- Oil capacity	150 ml
- Oil specification	SAE 20 for use < 5 °C
- Oil specification	SAE 30 for use > 5 °C
- Weight	50 kg (nominal)

Motor

- Output power	0.74 kW
- Voltage	110 Volt DC
- Drive	direct coupled

Tolerances and Wear Limits

@.1170

Tolerances and wear limits applicable to the auxiliary compressor and drive motor are described in Chapter 5, Auxiliary Air Compressor of Volume F12, Suppliers Documentation.

Tools and Special Tools

@.1180

Conventional workshop tools are required for the procedures described in this chapter.

Miscellaneous Materials

@.1200

Miscellaneous materials required for the procedures described in this chapter include:

- Plastic plugs for sealing pneumatic lines
- Cable ties to secure electrical wiring
- Tags for identification of pneumatic and electrical connections
- Oil to specification described in Section Technical Data is required for the auxiliary compressor.

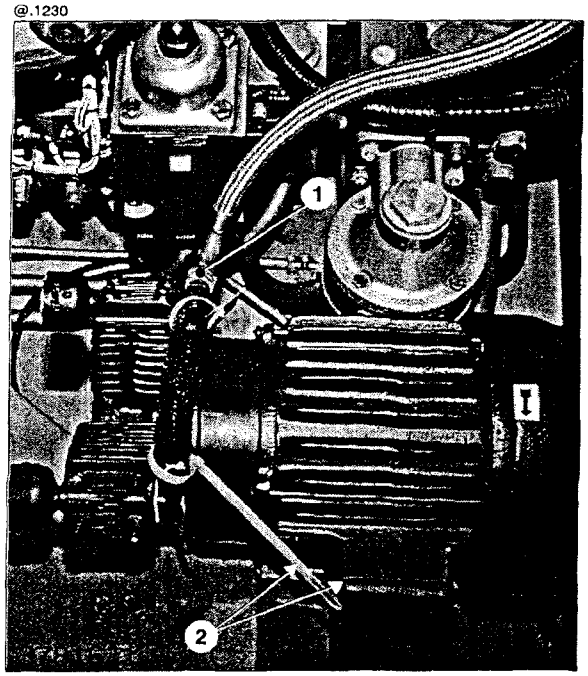
Before-Removal Operations

@.1220

Set the "Auxiliary Compressor" circuit breaker (48.1) to the Off position. The circuit breaker is situated in Control Cubicle 2 (SB2). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Removal

@.1230



Remove the cover from the junction box, then tag and disconnect electrical harness.

Crack loose the pipe from the compressor outlet (1) and allow any residual pressure to vent.

Disconnect the pipe from the compressor outlet union (1). Seal the pipes and compressor union with suitable plastic plugs to prevent the ingress of foreign material.

Remove the nuts (2) and washers securing *the auxiliary compressor to the studs on the* machine room floor.

Separate the compressor from the machine room floor bracket.

Disassembly

@.1240

For further information regarding the auxiliary compressor and drive motor, refer to Chapter 5, Auxiliary Air Compressor of Volume F12, Suppliers Documentation.

Inspection and Repair

@.1250

Inspection and Repair of the auxiliary compressor and drive motor is described in Chapter 5, Auxiliary Air Compressor of Volume F12, Suppliers Documentation.

Waste Disposal

@.1260

Dispose of waste parts and materials according to the prevailing environmental standards or workplace practices.

Assembly

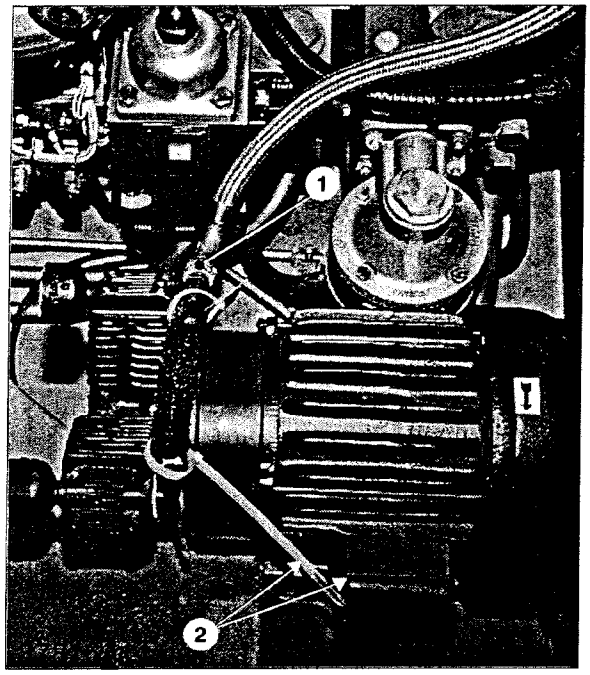
@.1270

For further information regarding the auxiliary compressor and drive motor, refer to Chapter 5, Auxiliary Air Compressor of Volume F12, Suppliers Documentation.

Installation

@.1280

Install the auxiliary compressor over the studs on the machine room floor bracket.



Install the nuts (2) and washers onto the studs, then tighten the nuts.

Remove the plastic plugs and reconnect the pneumatic supply line (1) between the auxiliary compressor and brake frame.

Reconnect the electrical cables to the auxiliary compressor as tagged during disassembly. Refer to Chapter 6D, Control Pneumatic Devices of Volume G1, Cabling Documentation.

Install and secure the junction box cover.

After-Installations Operations

@.1290

Close the auxiliary compressor circuit breaker, 48.1 located in Control Cubicle 2 (SB2).

Test the operation of the loco pneumatics and the auxiliary compressor as described in Chapter 13, Static Test of Volume F14, Suppliers Documentation. Check the union for leaks. Rectify any faults found.

Adjustments

@.1310

For more information on the auxiliary compressor and drive motor, see Chapter 5, Auxiliary Air Compressor of Volume F12, Suppliers Documentation.

6.5 Brake Frame

Group Summary

@.1120

Information in this chapter covers the Davies and Metcalfe brake equipment module (brake frame).

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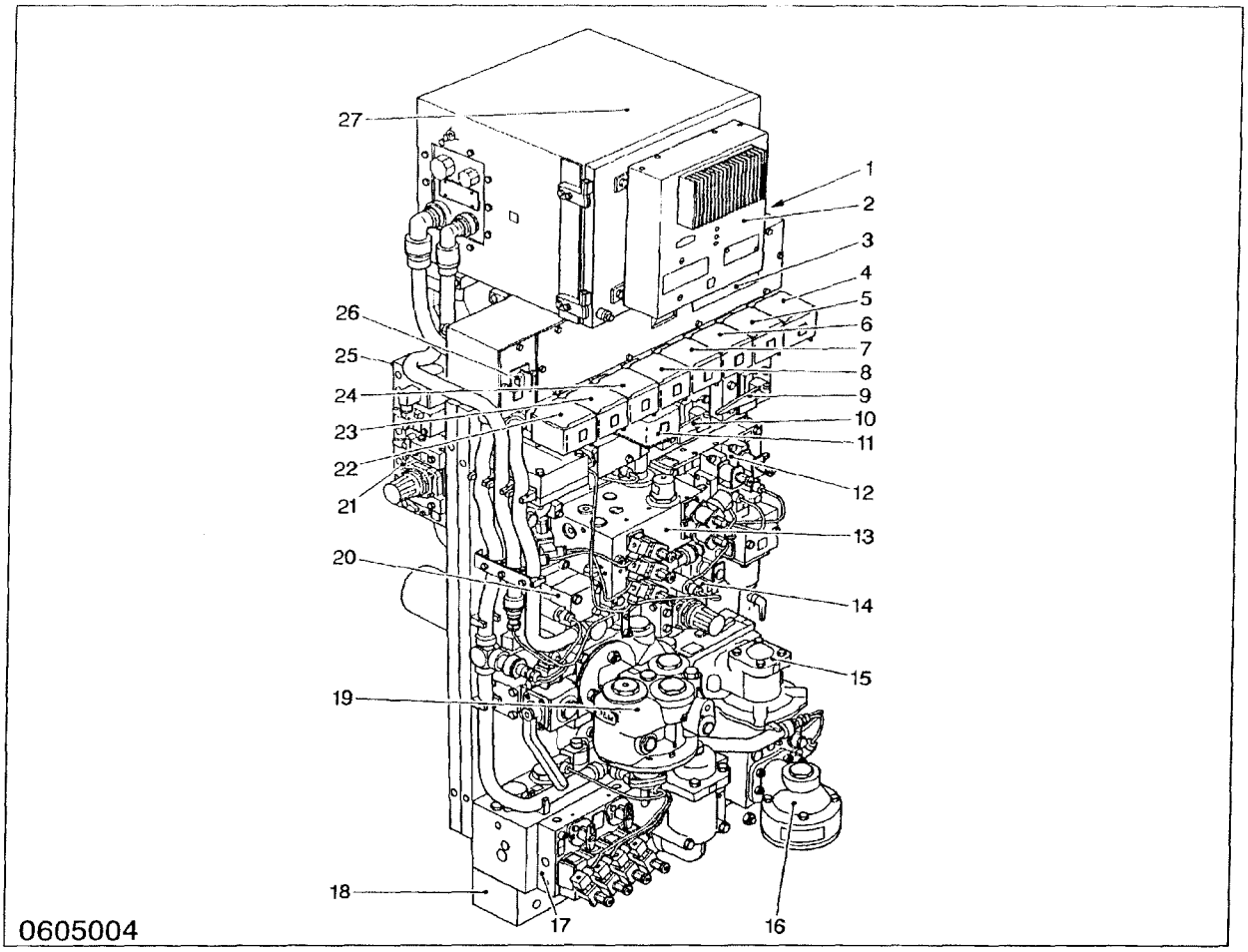


1	Control electronics pneumatic manifold	14	Pneumatic equipment
2	Vigilance control equipment	15	Relay valve, automatic brake
3	Instructions regarding isolating cock position	16	Relay valve, direct brake
4	Pressure switch pantograph 1	17	Pneumatic equipment sanding
5	Pressure switch pantograph 2	18	Distributor, automatic brake
6	Pressure switch emergency brake	19	Blending unit EBC5
7	Pressure switch auxiliary compressor	20	Pneumatic equipment, wheel flange lubrication, traction converter, filter cubicle
8	Pressure switch parking brake	21	Pressure switch, flow indication
9	Isolating cock brake pipe control system	22	Pressure switch, vigilance control
10	Isolating cock on emergency brake/ vigilance control	23	Pressure switch, brake feed pipe
11	Pressure switch direct brake	24	Rotary switch, pantograph selection
12	Pneumatic equipment, pantograph and VCB	25	Brake equipment frame to locomotive
13	Brake pipe control unit	26	Pantograph interface manifold
		27	Flange lubricate interface manifold

Functional Description

@.1140

The Davies and Metcalfe brake equipment module incorporates the brake and air system control equipment for the locomotive. The brake frame is located on the left hand side of the machine room, towards the No. 2 End of the locomotive.

The interface to the locomotive pneumatic system is through a floor mounted manifold and two secondary manifolds for the pantograph and auxiliary equipment. The electrical interface to the vehicle wiring is through three multi-pin plugs and sockets.

The braking system is described in more detail in Chapter 1, Metcalfe Brake System of Volume F11, Suppliers Documentation. The brake frame, and the equipment attached to it, are described in Chapter 3, Brake Equipment Module of Volume F11, Suppliers Documentation.

Technical Data

@.1160

- Weight (assembled)	445 kg
- Height	1,640 mm
- Width	894 mm
- Depth	767 mm

Technical data for the brake frame, and the equipment attached to it, are described in Chapter 3, Brake Equipment Module of Volume F11, Suppliers Documentation.

Tolerances and Wear Limits

@.1170

Tolerances and wear limits applicable to the brake frame, and the equipment attached to it, are described in Chapter 3, Brake Equipment Module of Volume F11, Suppliers Documentation.

Tools and Special Tools

@.1180

In addition to conventional railways workshop tools and equipment , the following are also required for the procedures described in this chapter:

- Davies and Metcalfe lifting brackets, MM3821/1 and MM3821/2, and 4 x M16 attachment bolts are required for lifting the brake frame.
- Once the brake frame is removed from the locomotive it should be fixed to Davies and Metcalfe transit frame MM3785.

Miscellaneous Materials

@.1200

Miscellaneous materials required for the procedures described in this chapter include:

- Plastic plugs for sealing pneumatic lines
- Tags for identification of pneumatic and electrical connections
- Plastic sheeting and tape to cover the brake frame and electrical connectors is required whenever the brake frame is removed from the locomotive.

Before-Removal Operations

@.1220

Isolate the electrical power to the compressor, as described in Chapter 6.1, Main Compressor.

CAUTION:

Air in the reservoirs is held under high pressure. To prevent personal injury, ensure that the area below the drain cocks is clear of all debris.

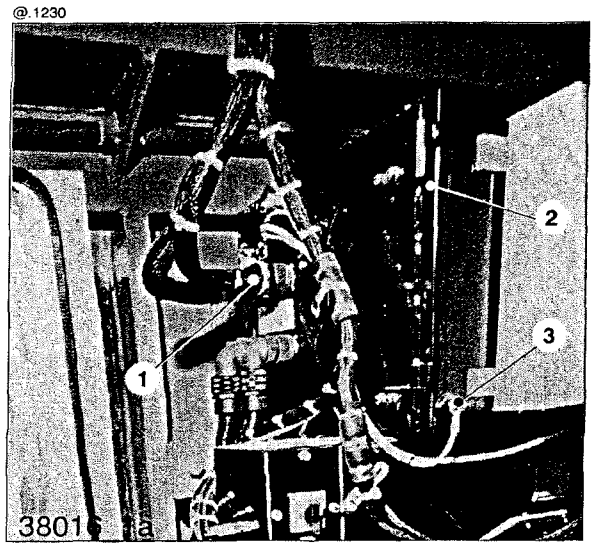
Open the drain cocks on the main reservoirs and allow the pressure to vent.

Ensure the Brake Cylinder Pressure gauge, Brake Feed Pipe/Main Reservoir Pressure gauges, Air Flow Meter and Brake Pipe Pressure gauge on Panel B all read zero pressure. For more information, refer to Chapter 3, System Description of Volume A, Driver's Manual.

Close the cocks once all the air is released.

Remove the No. 2 End pantograph roof hatch as described in Chapter 1.1, Structure.

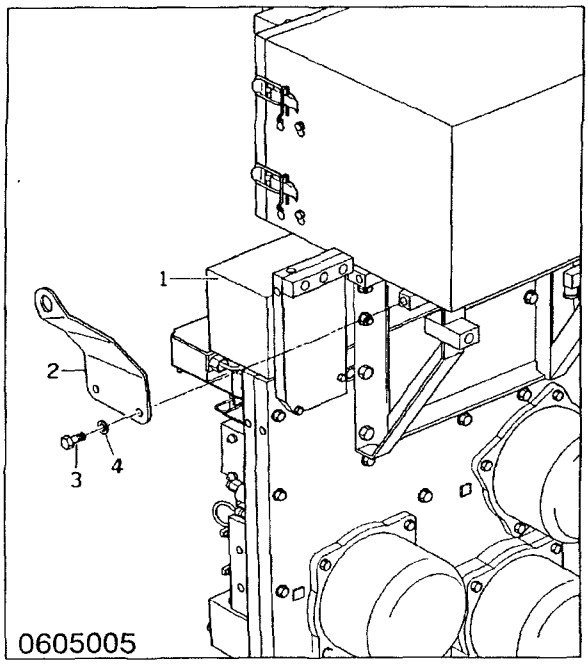
Removal



Tag and disconnect the wiring harness from the multi-pin socket on the vigilance unit.

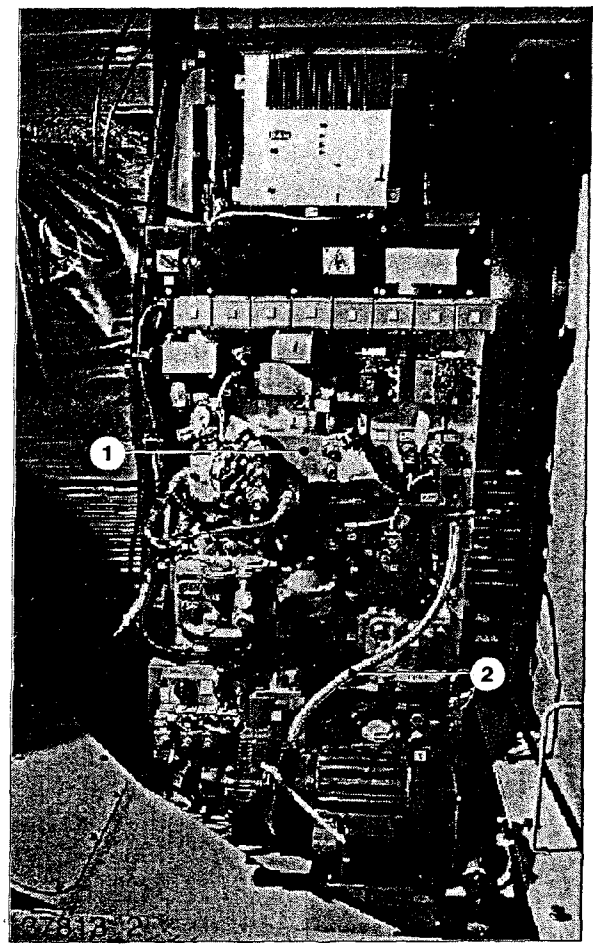
Tag and disconnect the earthing lead (3) from the stud adjacent to the connectors on the electronics enclosure (2).

Tag and disconnect the two wiring harnesses (1) from the multi-pin sockets on the electronics enclosure (2).

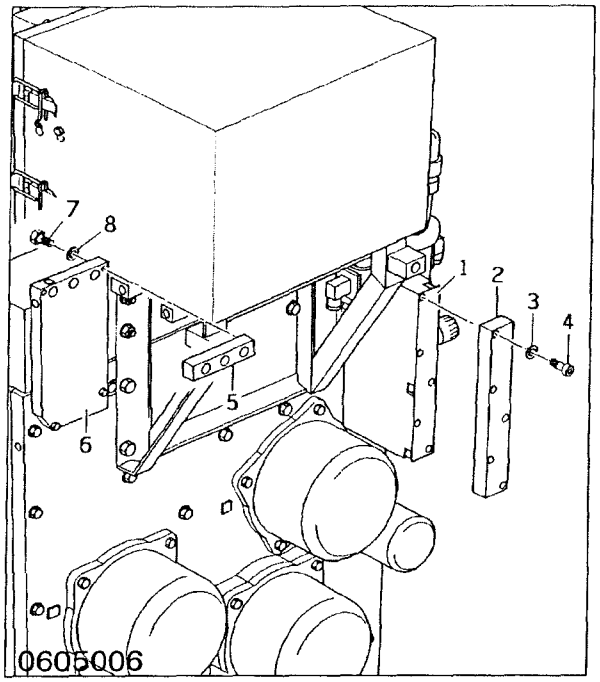


Attach lifting brackets, MM3821/1 and MM3821/2 (2) to the brake frame (1) using suitable M16 (2.0 mm pitch) bolts (3) at the attachment points (4).

Attach suitable overhead lifting equipment to the lifting brackets and raise slightly to take the weight.



Crack loose the flexible hose (2) between the brake frame (1) centrifugal strainer and auxiliary compressor. Allow the residual pressure to vent, then tag and disconnect the hose.

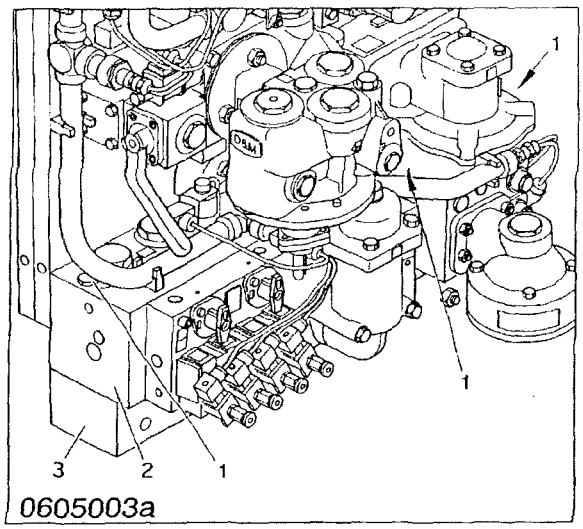


Before removing the mounting bolts, ensure the weight of the brake frame is properly supported by the lifting equipment.

Remove the two bolts securing the brake frame upper mounting bracket to the machine room wall.

Remove the five socket head bolts (4) and washers (3) securing the auxiliary equipment pipe bracket (2) to the auxiliary equipment manifold (1).

Remove the two screws (7) and washers (8) securing the pantograph pipe bracket (5) to the pantograph interface manifold (6).



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Loosen the five bolts (1) securing the brake frame (2) to the pipe bracket (3). The bolts cannot be removed with components on the brake frame in place. Ensure the bolts are fully loosened to allow removal of the brake frame.

Raise the lifting equipment and ensure nothing is entangled between the brake frame and locomotive, then carefully lift the brake frame from the machine room.

Remove and discard the o-rings from the pipe, pantograph and auxiliary equipment brackets.

Seal all pneumatic orifices on the brake frame and the three pipe brackets in the machine room with suitable plastic plugs to prevent the ingress of foreign material.

Cover the electrical connector plugs and sockets with plastic tape to prevent damage and the ingress of moisture.

Lower the brake frame into Davies and Metcalfe transit frame MM3785. Secure the brake frame to the transit frame using five M12 at the pipe bracket interface and two M16 through the upper mounting bracket.

Cover the brake frame with plastic sheeting to prevent contamination and the ingress of water if the brake frame is not to be reinstalled immediately.

Disassembly

@.1240

Disassembly of the brake frame is described in Chapter 3, Brake Equipment Module of Volume F11, Suppliers Documentation.

Inspection and Repair

@.1250

Inspection and repair of the brake frame, and the equipment attached to it, is described in Chapter 3, Brake Equipment Module of Volume F11, Suppliers Documentation.

Waste Disposal

@.1260

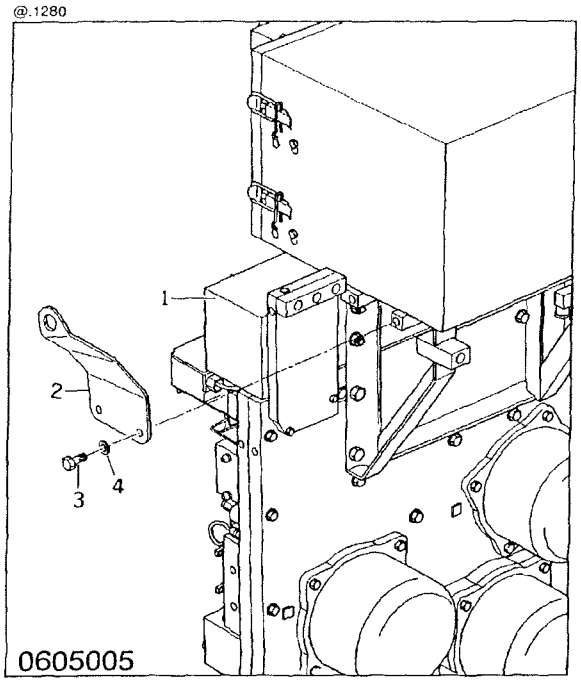
Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

Assembly of the brake frame, and the equipment attached to it, is described in Chapter 3, Brake Equipment Module of Volume F11, Suppliers Documentation.

Installation



Remove any protective covering from the brake frame.

If necessary, attach lifting brackets, MM3821/1 and MM3821/2 (2) to the attachment points (4) of the brake frame (1). Fasten the lifting brackets with M16 (2.0 mm pitch) bolts (3).

Attach suitable overhead lifting equipment to the lifting brackets and raise slightly to take the weight.

CAUTION:

Before removing the mounting bolts, ensure the weight of the brake frame is properly supported by the lifting equipment.

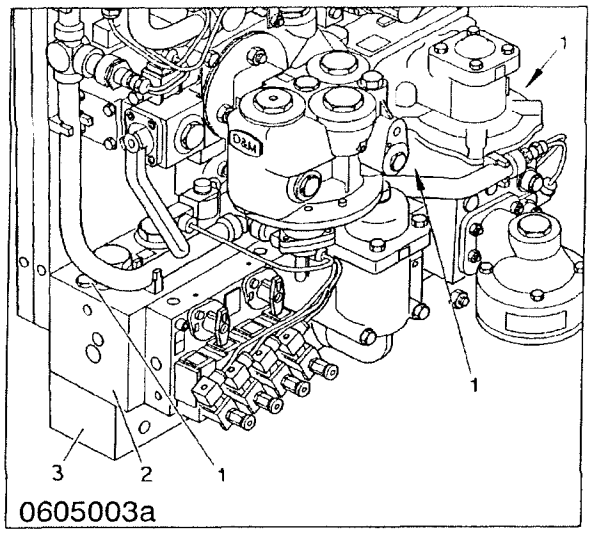
Loosen the M12 at the pipe bracket interface securing the brake frame to the transit frame. The bolts cannot be removed with components on the brake frame in place. Ensure the bolts are fully loosened.

Remove the M16 bolts securing the upper mounting bracket to the transit frame.

Remove any covering from harness connector plugs and sockets and sockets on the brake frame.

Remove any plastic plugs from the orifices on the brake frame and the three pipe brackets in the machine room.

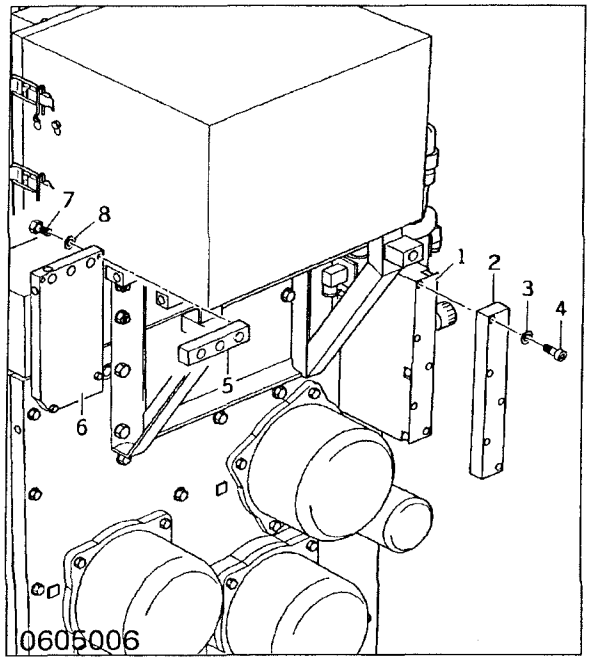
Position new o-rings into the pipe, pantograph and auxiliary equipment brackets.



0605003a

Carefully raise the lifting equipment and ensure nothing is entangled between the brake frame and transit frame, then carefully lower the brake frame into the machine room. Take care not to damage the brake frame or any equipment in the machine room during installation. Ensure the dowels of the pipe bracket engage correctly in the base of the brake frame.

Tighten the five bolts (1) securing the brake frame (2) to the pipe bracket (3).



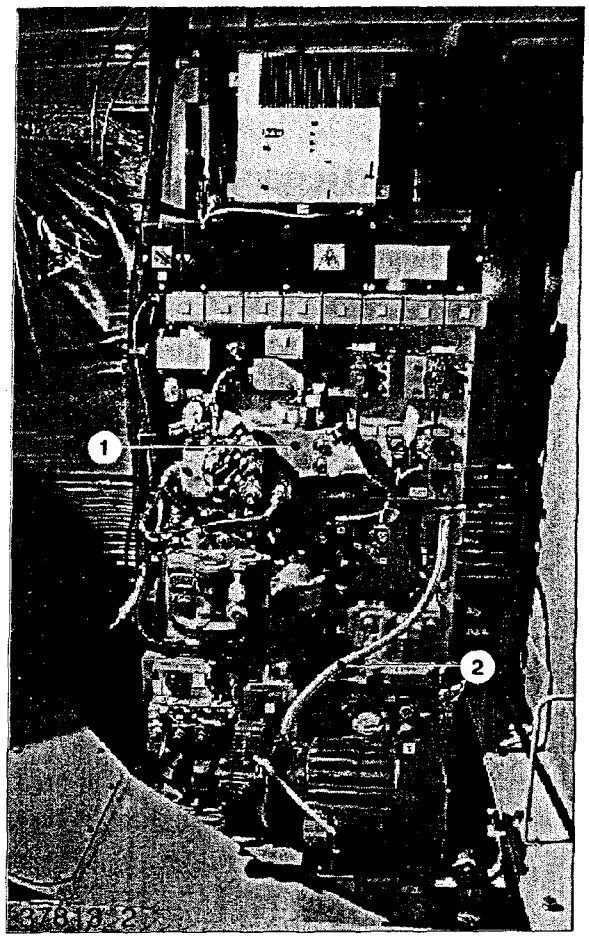
0605006

Install and tighten the two bolts securing the brake frame upper mounting bracket to the machine room wall.

Remove the lifting brackets.

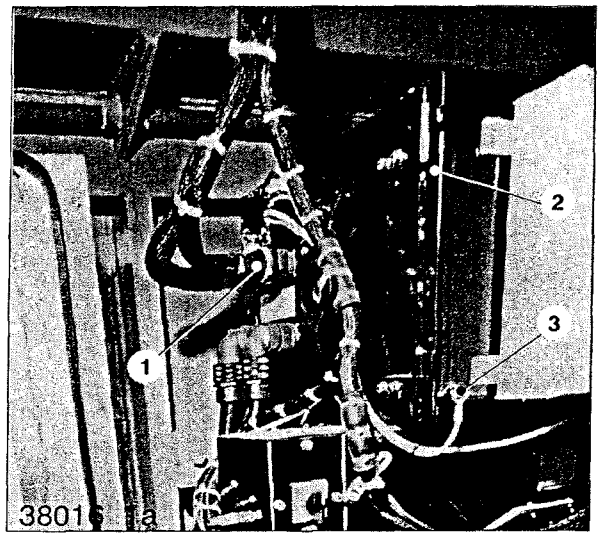
Install and tighten the five socket head bolts (4) and washer (3) securing the auxiliary equipment pipe bracket (2) to the auxiliary equipment manifold (1).

Install and tighten the two screws (7) and washer (8) securing the pantograph pipe bracket (5) to the pantograph interface manifold (6).



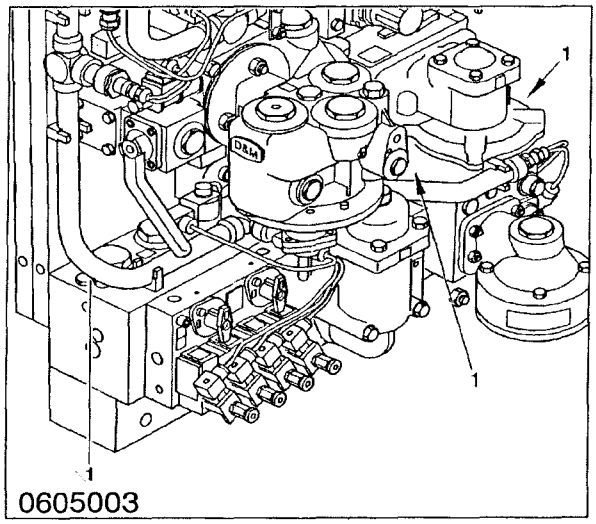
Remove any protection and connect the *flexible hose (2) between the brake frame* (1) centrifugal strainer and auxiliary compressor.

Connect the wiring harness from the multi-pin socket on the vigilance unit, as tagged during removal.



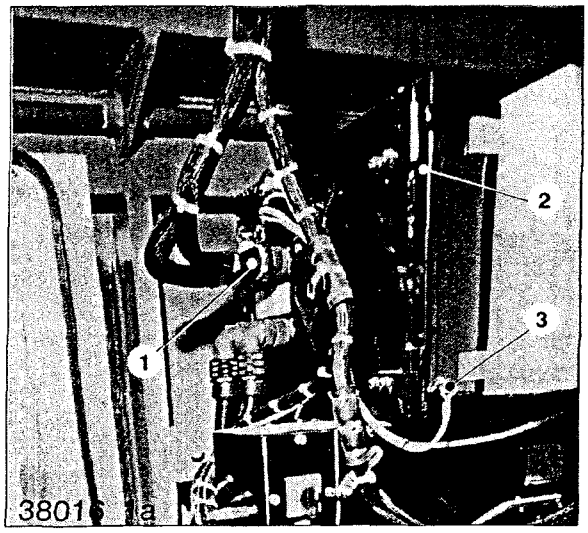
Connect the earthing lead (3) to the stud adjacent to the connectors on the electronics enclosure (2), as tagged during removal.

Connect the two wiring harnesses (1) to the multi-pin sockets on the electronics enclosure (2), as tagged during removal.



Install the bolts (1) and washers through the brake frame into the machine room floor. Tighten the bolts to specification.

Remove the temporary fixing holding the brake frame.



Remove the protective plugs and connect the electrical harness (1) to the electronic control module (2).

Remove the plugs covering the pneumatic pipes and brake frame pneumatic unions. Connect the pneumatic pipes to the brake frame as tagged during removal.

After-Installations Operations

@.1290

If necessary, close the drain cocks on the main reservoir tanks.

Open the main reservoir and air drier isolation cocks at the No. 2 End of the locomotive.

Close the compressor circuit breaker.

Check the pipe unions for leaks. Rectify any faults found.

Install the No. 2 End pantograph roof hatch as described in Chapter 1.1, Structure.

If necessary, close the drain cocks on the main reservoir tanks.

Open the main reservoir and air drier isolation cocks at the No. 2 End of the locomotive.

Close the circuit breaker to the main compressors, refer to Chapter 6.1, Main Compressor.

Test the operation of the brake frame and the locomotive and pneumatic systems as described in Chapter 13, Static Test of Volume F14, Suppliers Documentation. Rectify any faults found.

Adjustments

@.1310

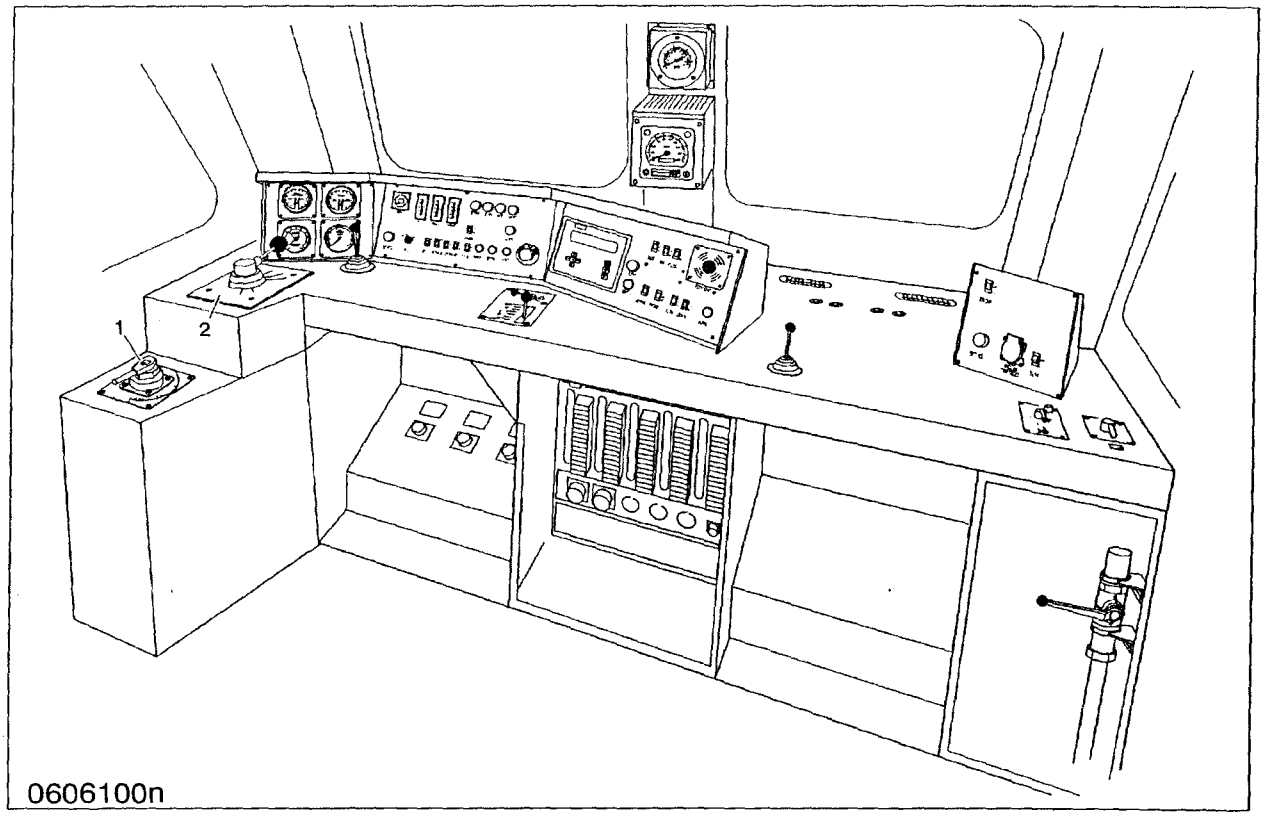
For more information on the auxiliary compressor, see Chapter 3, Brake Equipment Module of Volume F11, Suppliers Documentation.

6.6 Brake Controller

Group Summary

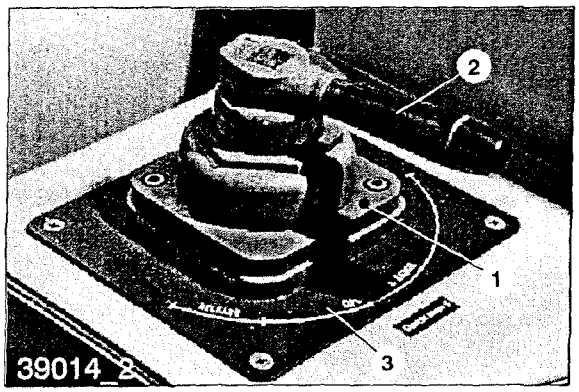
@.1120

This group contains information on the direct air brake valve and automatic train brake controller.



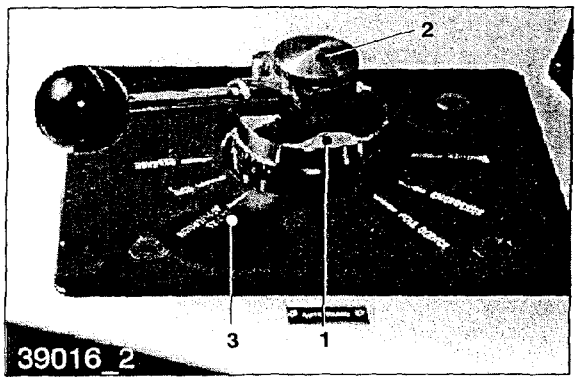
1 Direct air brake valve
2 Automatic train brake controller

Direct Air Brake Valve



1 Direct air brake valve
2 Handle
3 Legend plate

Automatic Train Brake Controller



1 Automatic train brake controller
2 Removable handle
3 Legend plate

Functional Description

@.1140

The locomotive braking system is controlled by the direct air brake valve, automatic train brake controller and master controller (TE/BE throttle). The controls are situated on the driver's side of the cab console. The master controller governs the regenerative braking of the locomotive. The direct air brake valve and automatic train brake controller govern the pneumatic braking of the locomotive. For further information on the loco braking system, refer to Chapter 3, System Description of Volume A, Driver's Manual.

Direct Air Brake Valve

The direct air brake valve is designed to provide accurately controlled, variable air pressure which is fed directly to the locomotive brake cylinders. The valve allows direct control of the locomotive brakes during slow speed manoeuvring, shunting operations or hill starts.

Rotation of the handle in an anticlockwise direction results in the application of direct braking effort to the locomotive only. In multiple operation, the slave locomotive direct braking system is also activated by the driver's direct air brake controller in the master locomotive. Full rotation of the controller handle in the clockwise direction results in the brakes being fully released. By varying the position of the controller handle, accurate control of the pneumatic braking system is possible.

Automatic Train Brake Controller

The automatic train brake controller is an electric switching device located on the driver's console.

Rotating the handle generates a variable voltage code in accordance with the position of the controller. A pneumatic valve is incorporated into the controller to provide a pneumatic emergency brake function. In normal operation, the voltage code is sent to the E70 unit within the machine room. The E70 unit then calculates the optimal braking requirements and applies the brakes accordingly. More information on the E70 system may be found in Chapter 4, E70 Brake Pipe Control System of Volume F13, Suppliers Documentation.

The driver's brake controller has six positions of operation, each position indicating a different demand of the braking system by the driver; Release, Running, Initial, Full Service, Emergency and Neutral.

Technical Data

@.1160

Direct Air Brake Valve

- Weight	3.3 kg
- Operating pressure	10 bar

Automatic Train Brake Controller

- Weight	8 kg
- Maximum working pressure	5 bar

Tolerances and Wear Limits List

@.1170

Tolerances and wear limits for the direct air brake valve are described in Chapter 5, Driver's Direct Air Brake Valve Type FD1 Overhaul of Volume F11, Suppliers Documentation.

Tolerances and wear limits for the automatic train brake controller are described in Chapter 2, Driver's Brake Controller Overhaul of Volume F13, Suppliers Documentation.

Tools & Special Tools

@.1180

Conventional railway workshop tools are required for the maintenance procedures described in this chapter.

A Davies & Metcalfe Electrical test Box MM3778 is required to check the automatic train brake controller when repairing the unit. The requirements are described in Chapter 2, Driver's Brake Controller Overhaul of Volume F13, Suppliers Documentation.

Miscellaneous Materials

@.1200

Miscellaneous materials required for the procedures described in this chapter include:

- Plastic plugs for sealing pneumatic pipes and apertures
- PTFE tape or a suitable pneumatic pipe thread sealant.

Before-Removal Operations

@.1220

Remove the panels from the cab console below the brake controllers. Refer to Chapter 7.5, Cab.

Direct Air Brake Valve

Isolate the locomotive pneumatic system. Isolate the main compressors from the pneumatic system and vent the main reservoirs.

Automatic Train Brake Controller

Isolate the locomotive pneumatic system. Isolate the main compressors from the pneumatic system and vent the main reservoirs.

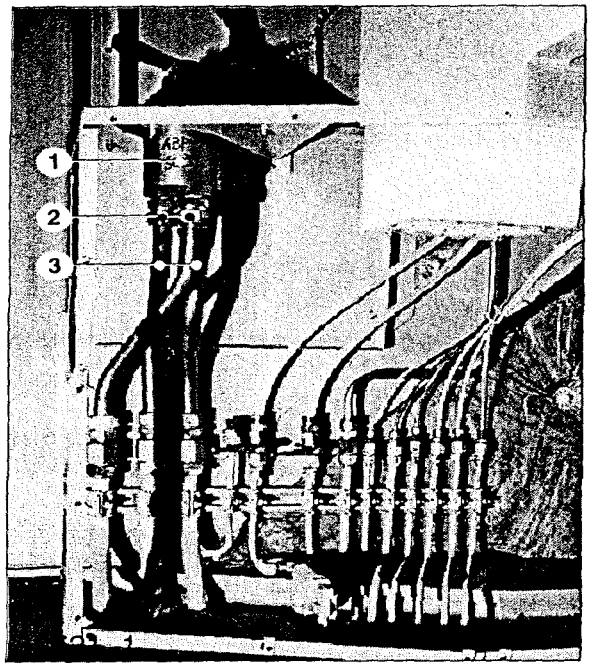
Move the automatic train brake controller handle to the emergency position to ensure the brake feed pipe is fully vented.

Set the "Driver's Cab" circuit breaker (127.3) to the Off position. Circuit breaker 127.3/1 for the No. 1 End is situated in Control Cubicle-1 (SB1) and circuit breaker 127.3/2 for the No. 2 End is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer Chapter to 8.2, MR Control.

Removal

@.1230

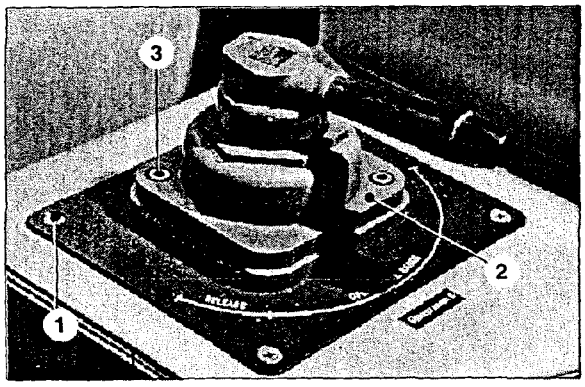
Direct Air Brake Valve



Loosen the bolt securing the handle to the spindle, then remove the handle from the valve.

From below the console, tag the pneumatic pipes (3), then crack loose the unions (2) and allow any residual pressure to vent. Disconnect the piping (3) from the direct air brake valve (1).

Seal piping and unions with suitable plastic plugs to prevent the ingress of moisture and foreign material.



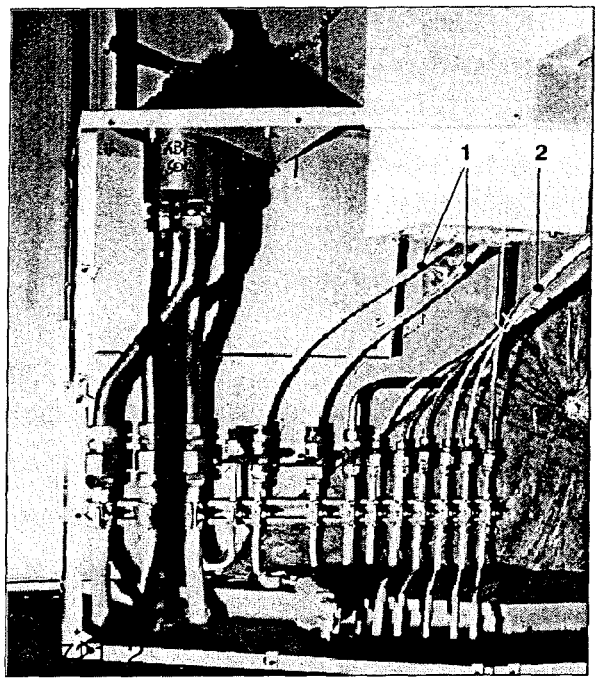
Remove the screws (3) securing the brake valve (2) to the console panel. Hold the nuts and washers, on the underside of the console panel, using a suitable spanner.

Withdraw the air brake valve (2) from below the console.

Replace the handle and secure the bolt finger tight.

If necessary, remove the screws (1) securing the legend plate to the console. Remove the plate.

Automatic Train Brake Controller

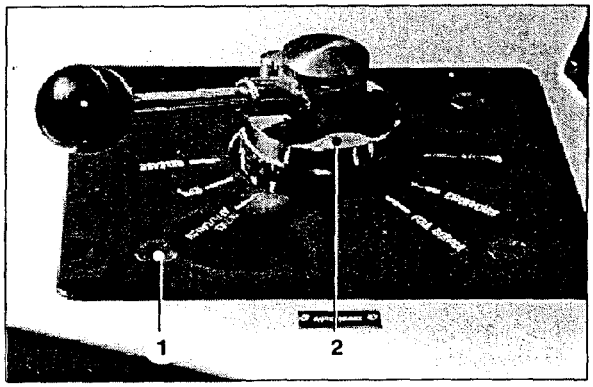


Rotate the handle to the Neutral position, then remove the handle from the controller.

From below the console, tag the pneumatic pipes (1, 2), then crack loose the unions and allow any residual pressure to vent. Disconnect the piping (1, 2) from the brake controller.

Seal piping and unions with suitable plastic plugs to prevent the ingress of moisture and foreign material.

Unscrew the retaining ring, then separate the electrical plug from the socket.



Remove the four screws (1) securing the brake controller (2) to the console panel. Hold the nuts and washers on the underside of the console panel.

Withdraw the brake controller (2) from below the console.

Replace the handle.

Disassembly

@.1240

Disassembly of the direct air brake controller is described in Chapter 5, Driver's Direct Air Brake Valve Type FD1 Overhaul in Volume F11, Suppliers Documentation.

Disassembly of the automatic train brake controller is described in Chapter 2, Driver's Brake Controller Overhaul in Volume F13, Suppliers Documentation.

Inspection and Repair

@.1250

Inspection and repair of the direct air brake controller is described in Chapter 5, Driver's Direct Air Brake Valve Type FD1 Overhaul in Volume F11, Suppliers Documentation.

Inspection and repair of the automatic train brake controller is described in Chapter 2, Driver's Brake Controller Overhaul in Volume F13, Suppliers Documentation.

Waste Disposal

@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

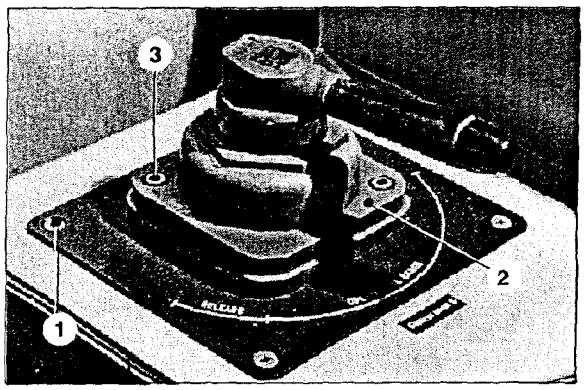
Assembly of the direct air brake controller is described in Chapter 5, Driver's Direct Air Brake Valve Type FD1 Overhaul in Volume F11, Suppliers Documentation.

Assembly of the automatic train brake controller is described in Chapter 2, Driver's Brake Controller Overhaul in Volume F13, Suppliers Documentation.

Installation

@.1280

Direct Air Brake Valve



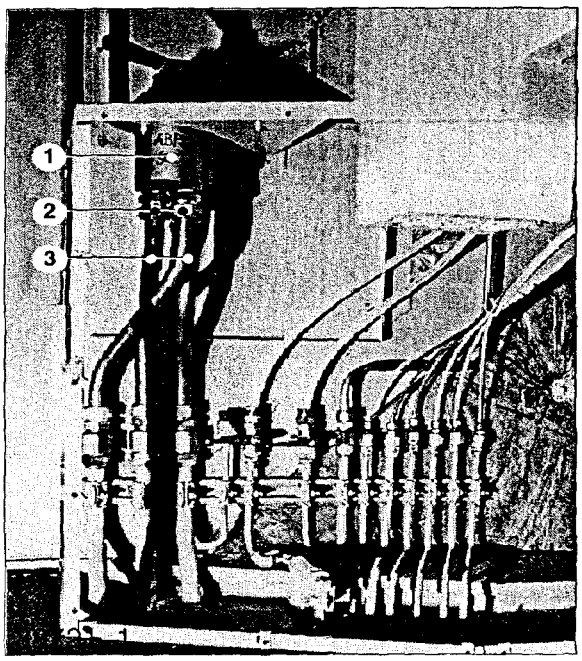
If necessary, install the legend plate to the console and secure using the four screws (1).

Loosen the bolt securing the handle to the spindle, then remove the handle from the valve.

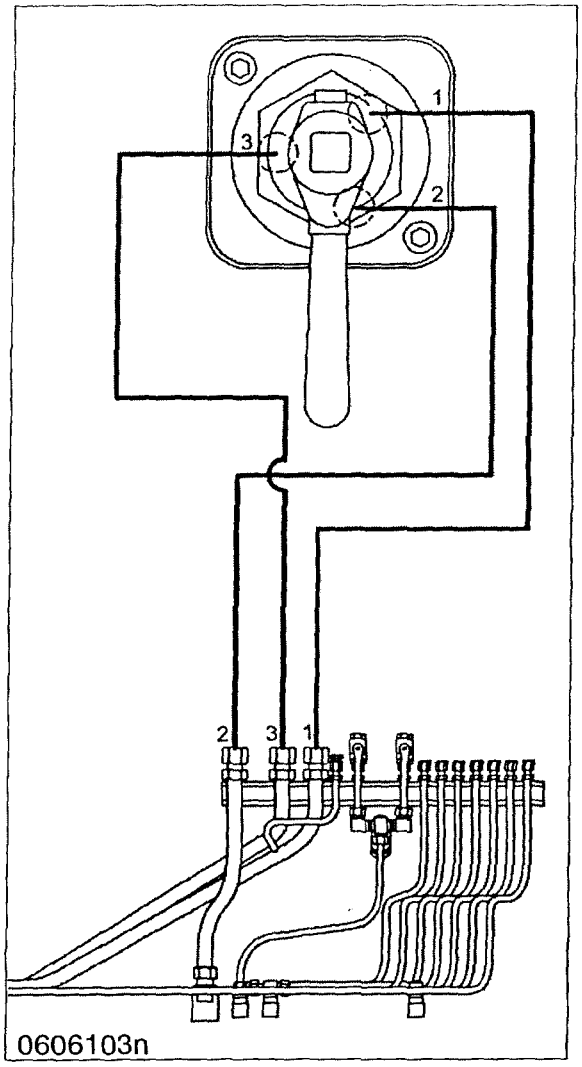
Position the air brake valve (2) from below the console. Align the screw holes in the air brake valve (2) with the holes in the console.

Install the two screws (3) through the valve body, then install the nuts and washers on the underside of the console panel.

Tighten the screws (3).

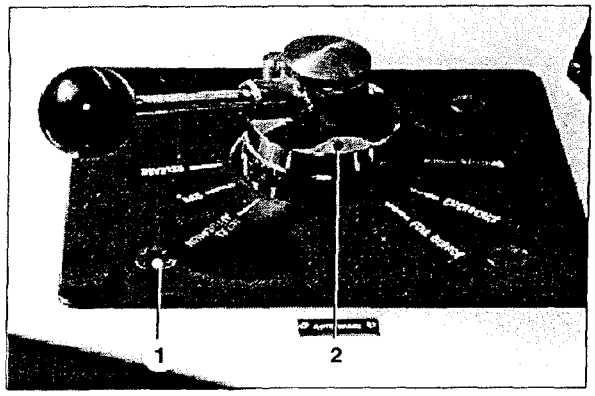


From below the console, connect the air lines (3) to the unions (2) on the air brake valve (1) as tagged during removal.



The valve ports are numbered 1 to 3. The diagram shows the locations of the pipe arrangement.

Automatic Train Brake Controller

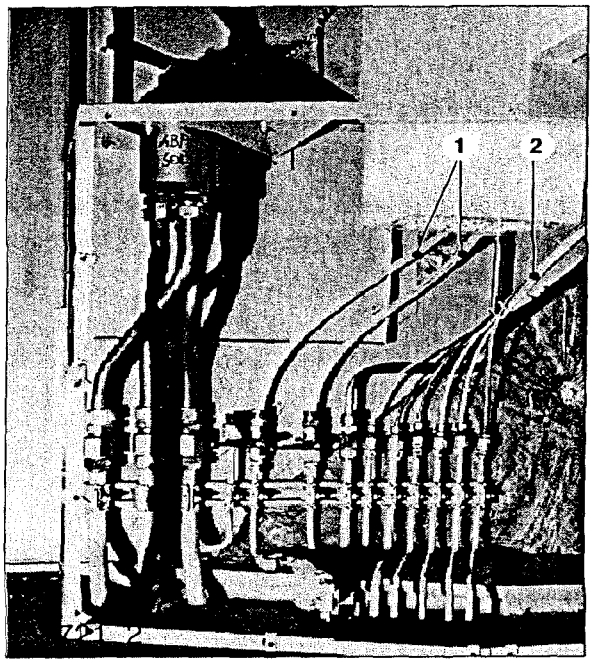


If necessary, remove the handle from the brake controller (2) before installing the brake controller.

Position the brake controller (2) in the console. Align the screw holes in the brake controller (2) with the holes in the console.

Install the four screws (1) and the nuts and washers on the underside of the console panel.

Tighten the four screws (1).



From below the console, connect the air lines (1, 2) to the unions on the brake controller as tagged during removal.

Reinstall the brake controller handle.

After-Installations Operations

@.1290

Test the operation of the direct air brake valve as described in Chapter 5, Driver's Direct Air Brake Valve Type FD1 of Volume F11, Suppliers Documentation.

Test the operation of the driver's direct air brake controller as described in Chapter 5, Driver's Direct Air Brake Valve Type FD1 Overhaul in Volume F11, Suppliers Documentation.

Test the operation of the brakes and brake controller units as described in Chapter 13, Static Test Specification For WAP5 Locomotive of Volume F14, Suppliers Documentation. Rectify any faults found.

Install the panels to the cab console below the brake controllers. Refer to Chapter 7.5, Cab.

Adjustments

@.1310

Adjustment of the driver's brake controller is described in Chapter 2, Driver's Brake Controller Overhaul in Volume F13, Suppliers Documentation.

Adjustment of the driver's direct air brake controller is described in Chapter 5, Driver's Direct Air Brake Valve Type FD1 Overhaul in Volume F11, Suppliers Documentation.

6.7 Brake Actuators

General Notes on Hazards in the Work Area

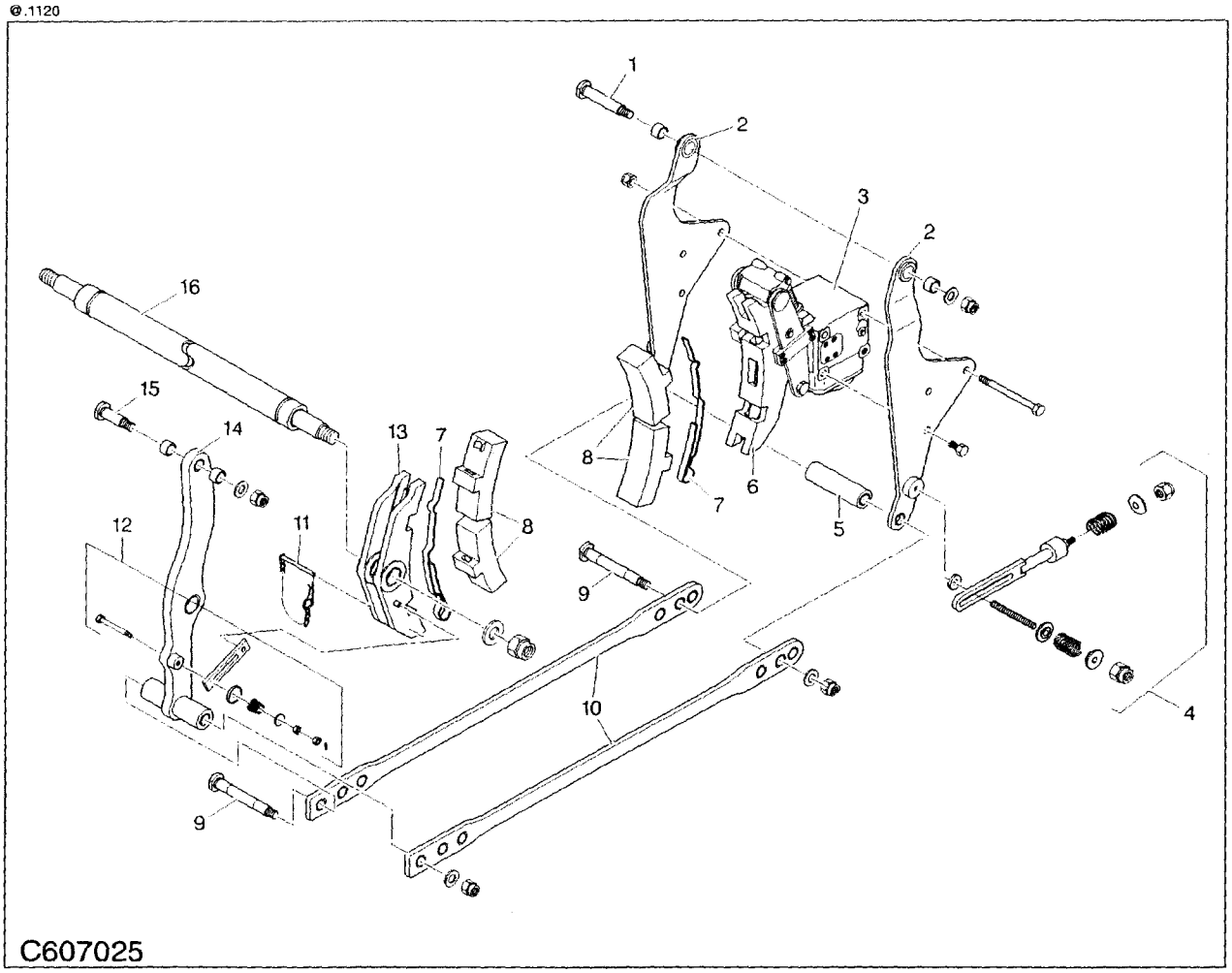
©.1040

WARNING:

High pressure pneumatic systems. Ensure the bogie pneumatic system is depressurised before commencing maintenance work.

The brake actuators are heavy; service brake actuators weigh over 55 kg and parking brake actuators weigh over 64 kg. Use lifting equipment to handle the brake actuators during maintenance to avoid personal injury.

Overview



1	Pivot bolt, hex. head	10	Brake rod
2	Actuator brake lever	11	Locking pin
3	Brake actuator	12	Adjusting equipment (Shoe support arm)
4	Adjusting equipment (Slack adjuster)	13	Slave brake shoe
5	Spacer tube	14	Slave brake lever
6	Actuator brake shoe	15	Pivot bolt, hex. head
7	Brake block key	16	Track rod
8	Brake blocks		
9	Pivot bolt, hex. head		

Functional Description

@.1140

Each wheel on the bogie is fitted with a tread brake operated by a pneumatic brake actuator and brake rigging. Application of the brakes is by either the driver's brake controller via the Davies & Metcalfe E70 brake frame, or directly through the driver's air brake valve.

Service brake actuators are fitted on left hand axles 1, 2 and 3 and the 2 right hand axle. Combination service and spring parking brake actuators are fitted to right hand axles 1 and 3. Axle 1 is located at the cab end of the bogie. Air pressure from the locomotive pneumatic system is required to release the parking brakes. In the event the locomotive pneumatic system fails, the loss of pressure causes the spring parking brakes to apply. Service brake actuators only apply the brakes when pressure is supplied from the brake pipe.

The brake rigging consists of levers and rods that distribute the force of the brake blocks on each half of the wheel tread. Slave and actuator brake levers are hung from pivot points on the bogie frame. Slave levers are located at the cab end of the wheel. The brake actuator is fixed within the actuator levers at the opposite side of the wheel. The slave and actuator levers are connected by a pair of brake rods, one on the inside and another on the outside of the wheel.

Each wheel has two brake shoes, one at the slave lever and the other at the actuator lever. The actuator shoe is integral to, and moved directly by, the brake actuator cylinder. The slave shoe is operated by the brake rods. Two brake blocks are situated within each shoe and clamp against the wheel tread by the action of the brake actuators and rigging.

Brake block wear is compensated for by slack adjusting equipment. All the brake actuators are equipped with internal automatic slack adjusters. A slack adjusting arm is fitted to the actuator lever to maintain the clearance between the brake block and wheel tread. A shoe support arm adjusts the operating angle of the slave shoe. Track rods situated between the slave levers on each side of the bogie maintain the alignment of the brake blocks with the wheel tread.

All pivot points on the brake rigging are fitted with bushes and hardened steel bolts to minimise friction and wear.

The actuator shoe moves away from the actuator when air pressure is applied to the actuator cylinder. The cylinder continues to expand moving the actuator blocks into contact with the wheel tread; the actuator levers move in the opposite direction, away from the wheel. The brake rods pull the slave lever, shoe and blocks, towards the wheel tread. The two levers remain in a parallelogram during brake application. The stroke of the actuator cylinder determines the friction between the brake blocks and wheel tread. The brakes return to their static position when the air pressure is released from the cylinder.

Technical Data

@.1160

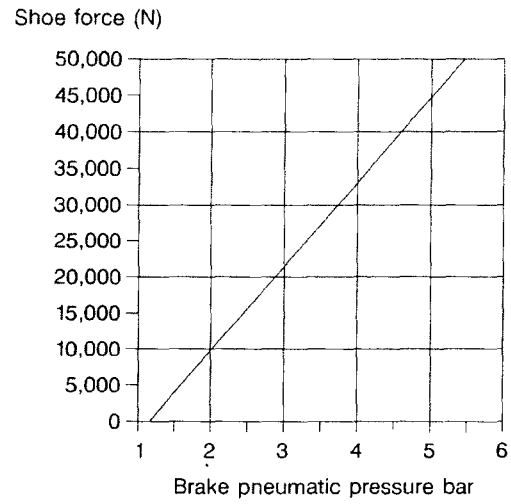
Braking Data

– Shoe force (maximum)	40,000 N
– Shoe force (emergency brake max)	50,000 N

Brake Actuators

– Service brake actuator weight	55 kg
– Parking brake actuator weight	64 kg
– Piston area	248.8 cm^2
– Operating pressure (min)	0.3 bar
– Operating pressure (max)	6.0 bar
– Service brake stroke (max)	18.0 mm
– Maximum automatic adjustment stroke	12.0 mm
– Maximum adjustment per stroke	6.0 mm

Brake Actuator Operating Force



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Brake Blocks

– Material	Grey Cast Iron
– Weight	9 kg
– Thickness (new)	60 mm
– Width (nominal)	80 mm
– Brake block surface area (new)	202.4 mm^2
– Brake block per wheel	4
– Wheel to brake block clearance (nominal)	5 mm

Brake Block Composition

– C (carbon)	2.80 – 3.30 %
– Mn (magnesium)	0.40 – 0.60 %
– S (sulphur)	0.15 % (maximum)
– Si (silicon)	1.30 – 2.00 %
– P (phosphorous)	0.90 – 1.20 %

Slack Adjuster Arm

– Adjustment capacity (max)	125.0 mm

Compression spring

– Free height [X]	101.2 mm
– Installed length	70 mm
– Number of active coils	5.0
– Wire diameter	10.0 mm
– Outside diameter	60 mm
– Spring rate	157.0 Nm (linear)

Return spring

– Free height [X]	71.0 mm
– Installed length	48 mm
– Number of active coils	3.5
– Wire diameter	4.0 mm
– Spring rating	10.2 Nm (linear)

Shoe Support Arm Compression Spring

– Free height [X]	48 – 52 mm
– Installed height	40 mm
– Number of active coils	3.5
– Wire diameter	7.5 mm

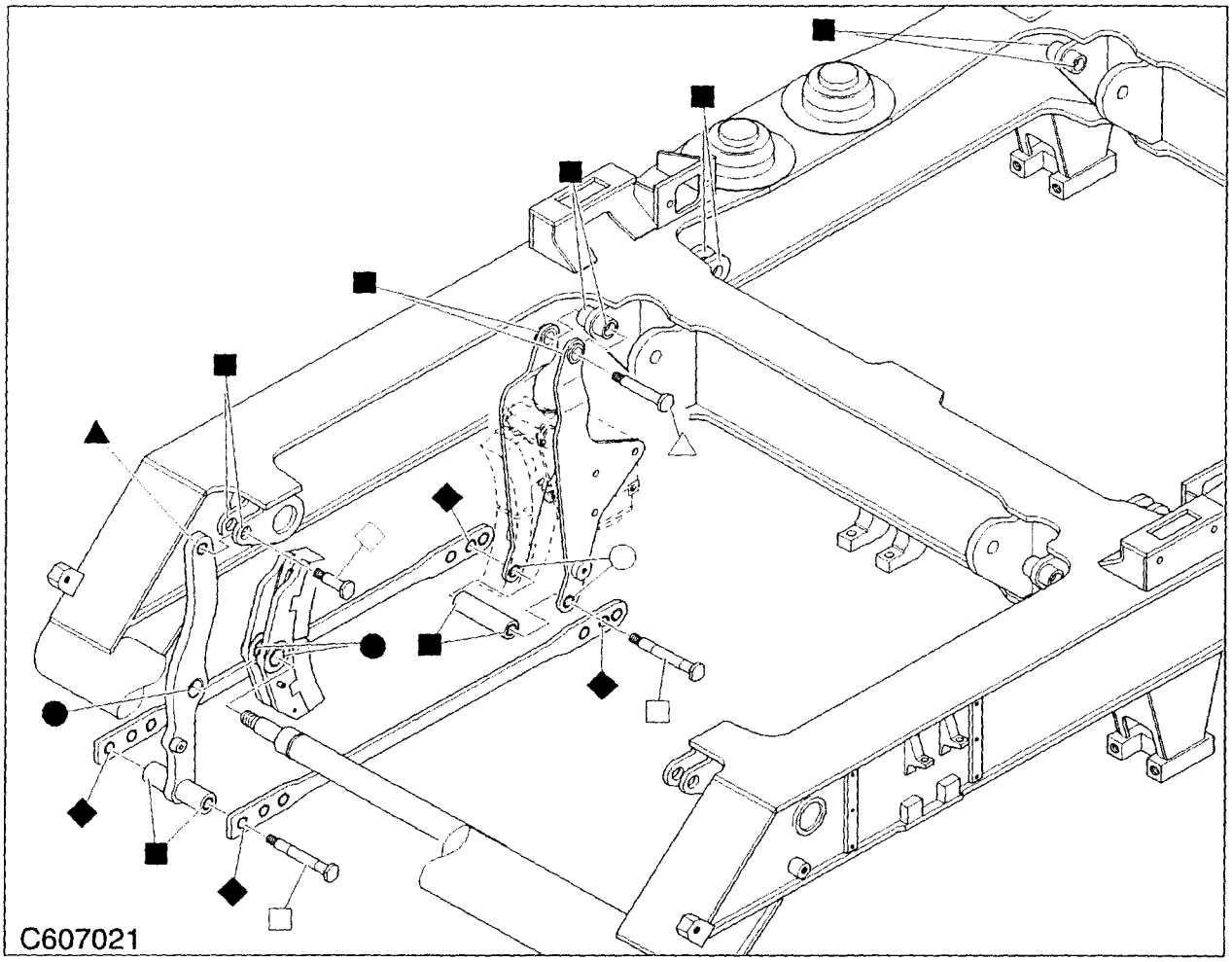
Tolerances and Wear Limits

@.1170

Brake Block

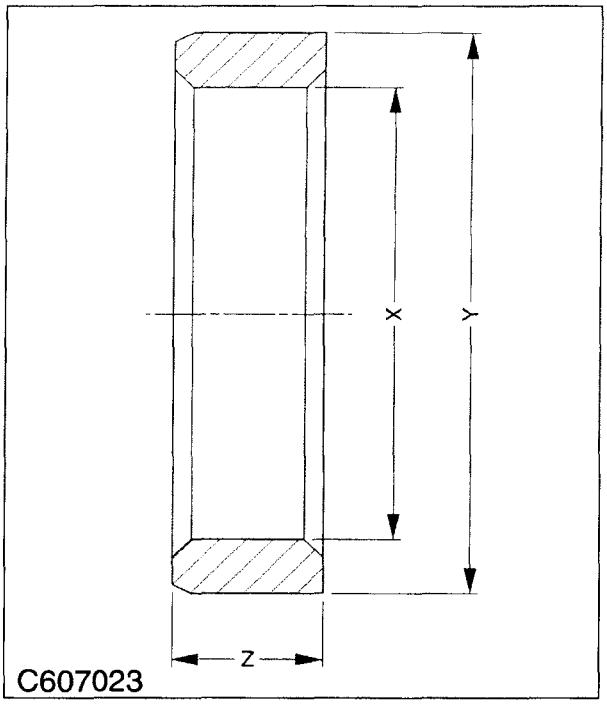
– Minimum thickness	10 mm
– Locking pin diameter (nominal)	14 mm
– Allowable brake block wear	50 mm
– Allowable wheel wear (diameter)	76 mm

Brake Rigging



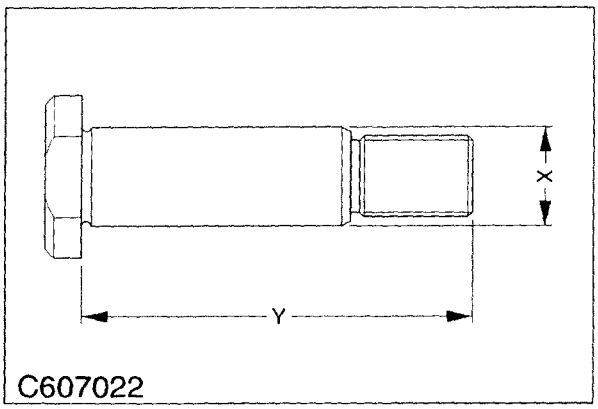
– Maximum bush to bolt clearance (all types)	1.5 mm

Bushes



Symbol Bush location	Y Outside diameter mm (ISO tolerance spec.)	X Inside diameter (min – max) mm	Z Length mm
● Bush	60 (x8)	50.00 – 50.75	30.0
■ Bush	40 (z8)	30.00 – 30.75	20.0
▲ Bush	40 (z8)	30.00 – 30.75	30.0
◆ Bush	40 (z8)	30.00 – 30.75	16.0
O Bush	40 (z8)	30.00 – 30.75	12.0

Pivot Bolts



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Symbol Bolt location	X Shank diameter (min – max) mm	Y Length mm
□ Bolt	29.25 – 29.90	295
Δ Bolt	29.25 – 29.90	177
◊ Bolt	29.25 – 29.90	112

Track Rod

– Bush journal diameter	49.210 – 49.370 mm

Tools and Special Tools

@.1180

Normal workshop tools are required for brake maintenance procedures.

Miscellaneous Materials

@.1200

Plastic plugs, or alike, to seal the brake cylinders and pneumatic piping against the ingress of foreign material.

Before–Removal Operations

@.1220

Steam clean the bogies. Remove all dirt and foreign material.

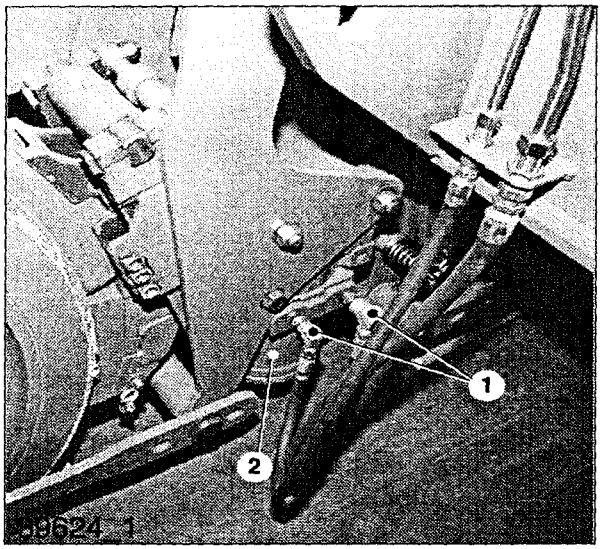
If necessary, remove the bogie from the locomotive. All brake maintenance can be performed while the bogie is attached to the locomotive. However, for ease of access it may be appropriate to remove the bogie from the locomotive.

Isolate the bogie air supply and drain all pressure from the bogie pneumatic system. Chock the wheels to prevent the bogie rolling, then cage the parking brake.

Removal

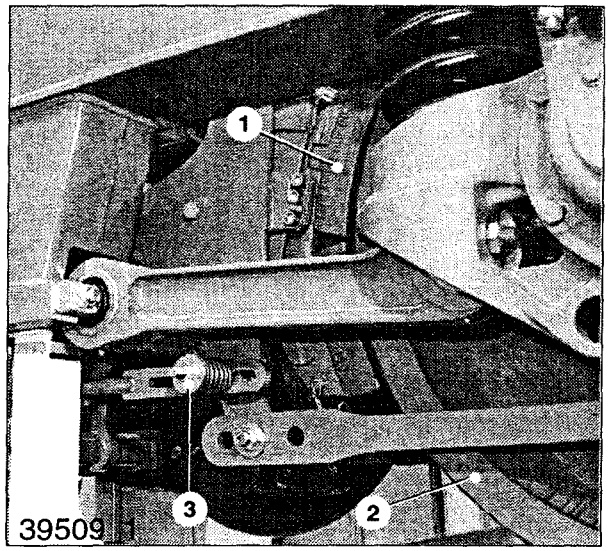
@.1230

Pneumatic Connections



Loose the pneumatic connections (1) to the brake actuators (2).

Brake Blocks

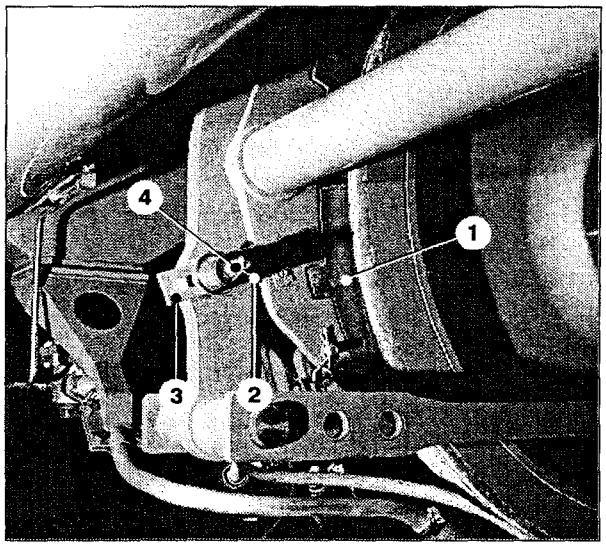


Chock the wheels and, if necessary, cage the parking brakes.

Approximately 12 mm of clearance is required between the brake blocks (1) and the wheel tread (2) for removal of the blocks.

At the actuator, loosen the actuator slack adjuster locking nut (3) until the maximum clearance is obtained between the brake block (1) and wheel tread (2).

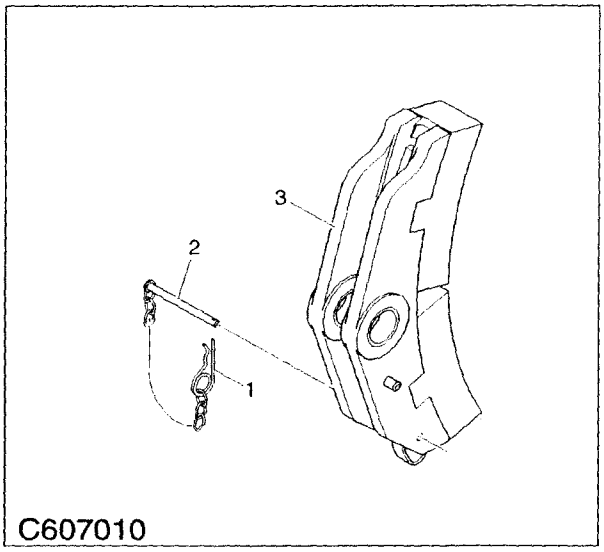
Loosen the nut (3) securing the slack adjuster arm to the brake lever. The arm must be free to slide against the brake lever without interference.



Remove the split pin (2), then loosen the lock nut (4) at the shoe support arm (3).

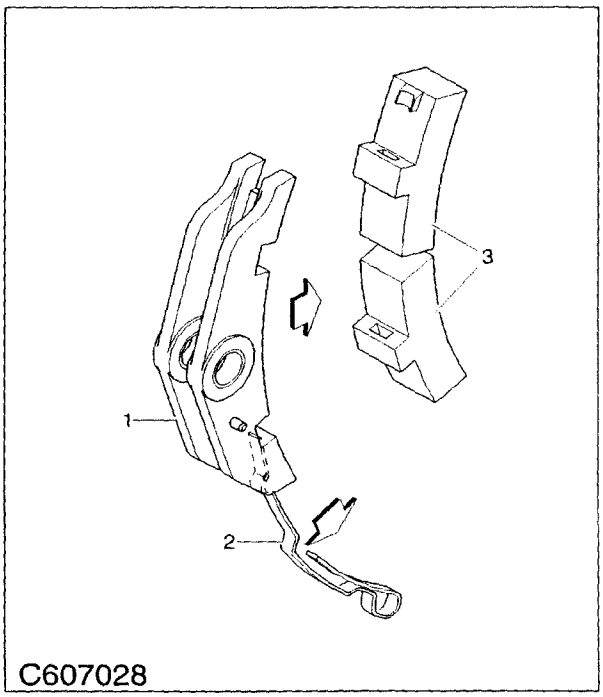
Loosen the shoe support arm lock and retaining nuts (4) until the brake shoe (1) is free to move without interference.

Move the actuator lever away from the wheel until the maximum clearance is obtained between the wheel tread and brake block.



C607010

Remove R–clip (1) from the locking pin (2), then withdraw the locking pin (2) from the brake shoe (3).



C607028

Pull the key (2) from the brake shoe (1). Withdraw the brake blocks (3) from the shoe (1).

Move the brake lever to the opposite end of its travel, then remove the brake blocks at the other side of the wheel in the same manner.

Inspect the brake block, key and R–clip as described in Section Inspection and Repair.

Brake Rigging

Actuator Lever

Disconnect the slack adjuster as described in Adjusting Equipment.

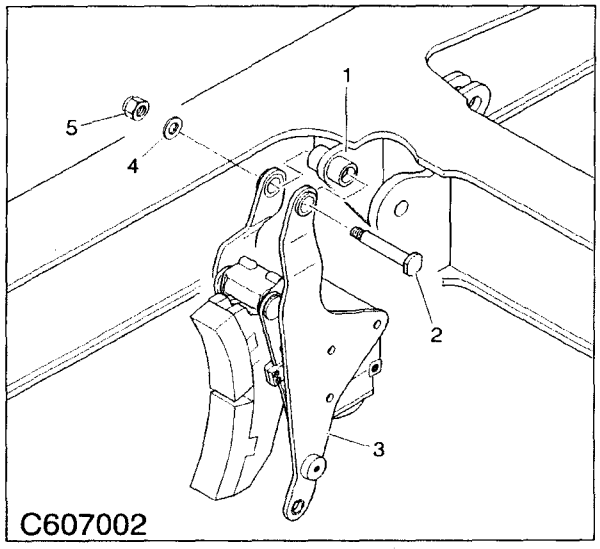
Remove the brake blocks as described in Brake Blocks.

Remove the brake actuator as described in Section Disassembly, Brake Actuator.

Disconnect the brake rods as described in Brake Rod

WARNING:

The brake actuators are heavy; service brake actuators weigh over 55 kg and parking brake actuators weigh over 64 kg. Use lifting equipment to handle the brake actuators during maintenance to avoid personal injury.



Support the lever (3) then undo the nut (5) and remove the washer (4) and pivot bolt (2).

Remove the lever (3) and actuator assembly from the bogie frame (1).

If necessary, separate the actuator from the levers as described in Section Disassembly, Brake Actuators.

Inspect the levers as described in Section Inspection and Repair.

Slave Lever

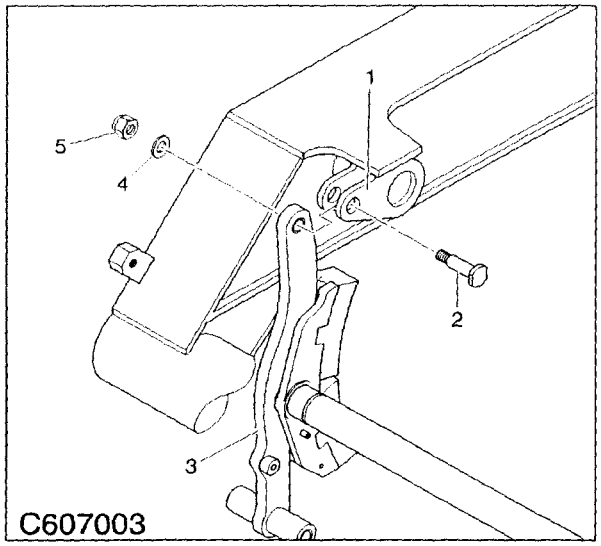
Support both ends of the track rod using suitable stands.

Remove the blocks as described in Brake Blocks.

Remove the shoe support arm as described in Adjusting Equipment.

Loosen the M36 nut securing the track rod and brake shoe to the slave brake lever.

Note the position of the brake rods to the brake lever adjusting holes.



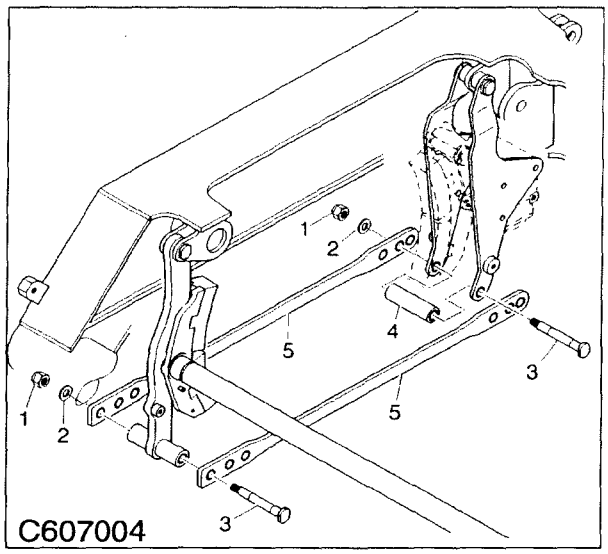
Undo the nut (5), then remove the washer (4) and withdraw the pivot bolt (2) securing slave brake lever (3) to the bogie frame (1).

Move the lever so that the top is clear of the bogie frame mounting lugs, then slide the lever and shoe from the track rod. Support the shoe during removal.

Separate the brake shoe from the lever.

Inspect the lever as described in Section Inspection and Repair.

Brake Rod



Note the position of the brake rods at the brake lever adjusting holes.

Undo and remove the nuts (1) and washers (2).

Support the brake rods (5), then withdraw the pivot bolt (3).

Remove the spacer tube (4) between the actuator levers.

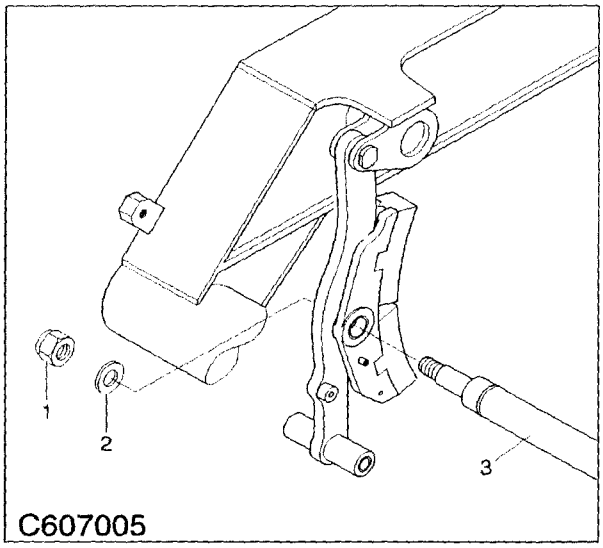
Lower the ends of the rods then repeat the procedure at the slave lever.

Inspect the brake rods as described in Section Inspection and Repair.

Track Rod

NOTE:

The track rod is heavy, over 37 kg. Use lifting equipment to handle the rod during maintenance procedures.
Support both ends of the track rod using suitable lifting equipment. Raise the equipment slightly to support the weight.



C607005

Loosen the M36 nuts (1) at each end of the track rod (3).

Remove the slave brake lever from one side of the bogie, as previously described.

Remove the M36 nut (1) and washer (2) securing the opposite end of the track rod (3) to the slave brake lever and shoe.

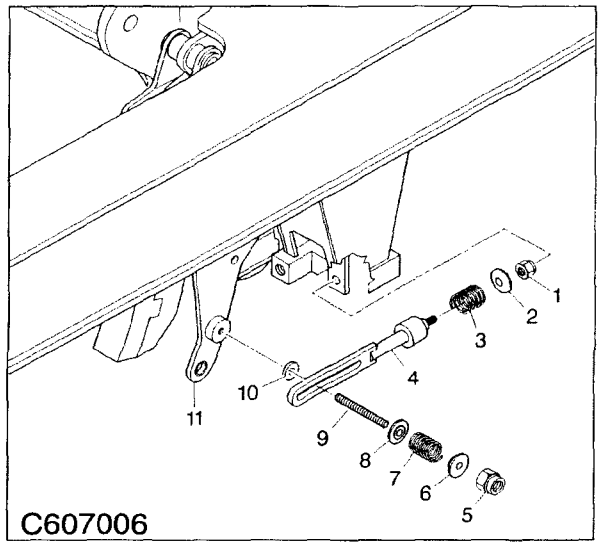
Slide the track rod (3) from the brake lever at the opposite end.

Lift the track rod from the bogie using the lifting equipment.

Inspect the track rod as described in Section Inspection and Repair.

Adjusting Equipment

Slack Adjuster



Remove the nut (1) and washer (2) from the end of the slack adjuster arm (4).

Loosen the nut (5) securing the slack adjuster arm (4) to the brake lever (11). The arm (4) will move as the nut (5) is loosened.

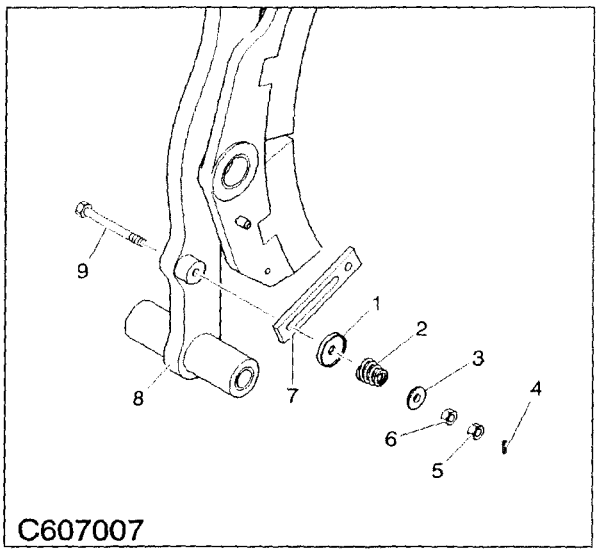
Remove the nut (5), compression spring (7), spring supports (6, 8), arm (4) and washer (10) from the brake lever (11).

Withdraw the arm (4) from the bogie frame lug. Hold the spring (3) to prevent it falling.

If necessary, remove the threaded rod (9) from the lever (11), using a pair of nuts locked against one another.

Inspect the slack adjuster components as described in Section Inspection and Repair.

Shoe Support Arm



C607007

Remove the split pin (4) from the bolt (9), then loosen the lock nut (5) and slowly remove the two nuts (5, 6) from the bolt (9).

Separate the washer (3), compression spring (2) and spring seat (1) from the lever (8).

Remove the shoe support arm spigot (7) from the brake shoe.

Inspect the condition of the shoe support arm components as described in Section Inspection and Repair.

Disassembly

@.1240

Brake Actuator

NOTE:

The brake actuators can be removed while the brake levers are attached to the bogie. Loosen the pivot bolts at the bogie frame and brake rods to allow clearance for removal.

Remove the brake lever and actuator assembly from the bogie as described in Section Removal, Brake Rigging.

WARNING:

High pressure pneumatic systems. Ensure the bogie pneumatic system is depressurised before commencing maintenance work.

Isolate the pneumatic supply to the bogie.

Crack loose the pneumatic connections at the actuator. Allow any residual pressure to vent, then separate the air lines from the unions.

Seal the air pipes and actuator unions with suitable plastic plugs to prevent the ingress of moisture and foreign matter.

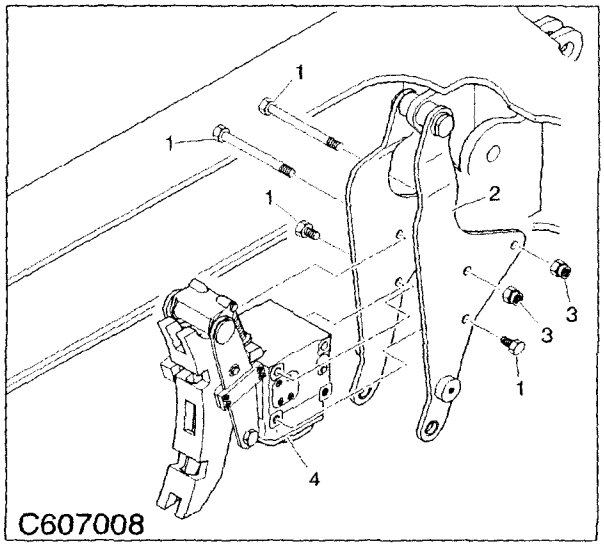
Disconnect the brake rods as described in Section Removal, Brake Rod.

Remove the slack adjuster arm as described in Section Removal, Adjusting Equipment.

Remove the brake blocks as described in Section Removal, Brake Blocks.

WARNING:

The brake actuators are heavy; service brake actuators weigh over 55 kg and parking brake actuators weigh over 64 kg. Use lifting equipment to handle the brake actuators during maintenance to avoid personal injury.



If necessary, remove the brake lever (2) from the bogie frame as described in Section Removal, Brake Levers.

Remove the bolts (1) and nuts (3) securing the actuator (4) to the levers (2).

Inspect the levers and actuator as described in Section Inspection and Repair.

Brake Rigging

Bushings

Bushings must be pressed out using a suitable hydraulic press and tooling. Do not drive out bushes using a drift and hammer.

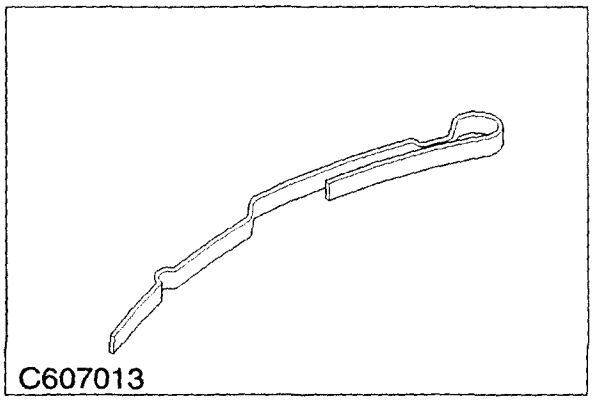
Inspection and Repair

@.1250

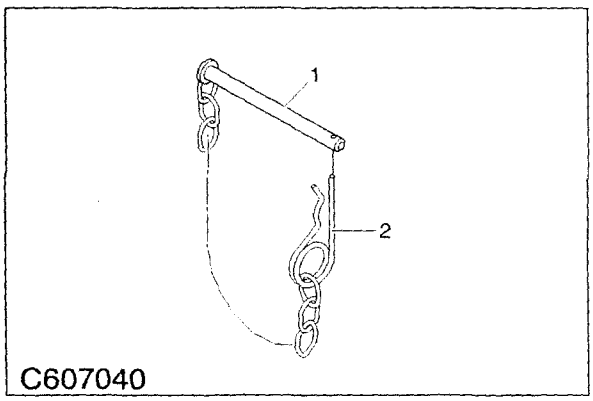
Brake Blocks

Inspect the brake blocks for wear cracks or damage. Replace the block if the minimum thickness is less than the dimension specified in Section Tolerances and Wear Limits List, or as appropriate.

The brake shoe and block keyways must be free of burrs and other obstructions. Check the brake blocks and shoes before installation to ensure clear passage for the key.


C607013

Inspect the brake block key for wear or damage.



C607040

Inspect the locking pin (1) and R–clip (2). Replace if worn, damaged or bent.

Brake Rigging

Bushings

NOTE:

Replace both the bush and pivot bolt if either part is worn. Never use a new bush with an old bolt, or vice versa.

Check all the bushes for wear or damage. Replace the bushes and pivot bolts as necessary. Dimensions of the bushes are given in Section Tolerances and Wear Limits List.

Bushes must be pressed in or out of the assembly using a suitable hydraulic press and tooling. Do not drive the bushes from any components with a hammer and drift.

Pivot Bolts and Nuts

NOTE:

Replace both the pivot bolt and bush if either part is worn. Never use a new bolt with an old bush, or vice versa. Always use a new lock nut on a new bolt.

Check all the pivot bolts for wear or damage. Replace the bolts and bushes as necessary. The outside diameter of pivot bolt shaft is given in Section Tolerances and Wear Limits List.

Check the condition of the threads. If necessary, repair the thread using an appropriate thread chaser, or replace the pivot bolt.

Do not reuse worn or damaged locking nuts. Discard locking nuts after 5 uses.

Brake Levers

Check the levers for cracks, damage or wear. Loose or worn brake rigging can cause wear on adjacent parts. Replace the levers if worn or damaged.

Check the condition of the bushes and measure the inside diameter as described in Bushes. Replace any bush where the inside diameter is larger than the dimension specified in Section Tolerances and wear Limits List.

Check all pivot holes for wear or damage. Wear must not exceed specification. Rectify any faults found. (allowable wear = 0.75 mm)

Check the welded joint between the slave lever and mounting bosses. Discard the lever if the weld is damaged or cracked.

Brake Rods

Check the brake rods for cracks, wear or damage. A loose connection between the brake rods and levers may cause wear on adjacent parts. Replace the rods if worn or damaged.

Check the condition of the bushes and measure the inside diameter as described in Bushes. Replace any bush where the inside diameter is larger than the dimension specified in Section Tolerances and wear Limits List.

Track Rod

Check the track rod for cracks, bend, wear or damage. Replace the rods if worn, bent or damaged.

Carefully inspect the welded joints at each end of the rod. Discard the rod if the weld is damaged or cracked.

Check the condition of the threads at each end of the track rod. If necessary, repair the thread using an appropriate thread chaser, or replace the track rod.

Measure the diameter of the bush journal at each end of the track rod. Recondition the track rod if the diameter is less than the dimension specified in Section Tolerances and Wear Limits.

Do not reuse worn or damaged lock nuts. Discard lock nuts after 5 uses.

Adjusting Equipment

Slack Adjuster

Check the condition of the thread at end of the slack adjuster arm. If necessary, repair the thread using an appropriate thread chaser, or replace the arm.

Do not reuse worn or damaged locking nuts. Discard locking nuts after 5 uses.

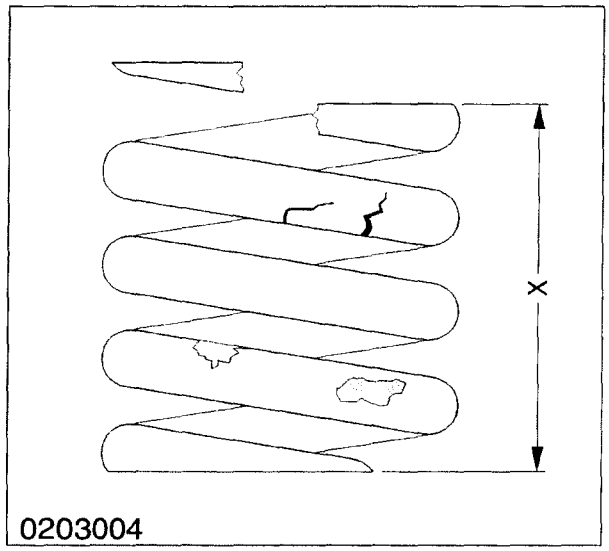
Check the bogie frame lug for wear, cracks or damage. Rectify any faults found.

Check the condition of the slack adjuster arm.

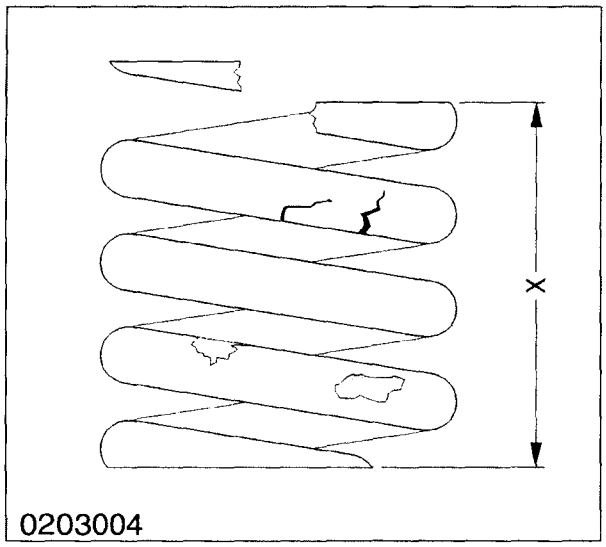
Inspect the spring support for excessive wear. Replace if worn or damaged.

Check the condition of the washer used between the arm and brake lever. Replace if worn or damaged.

Check the condition of the stop washer. Replace if worn or damaged.



Inspect the compression spring for cracks. Measure the free height [X] of the compression spring. Replace if less than the specification in Section Technical Data.

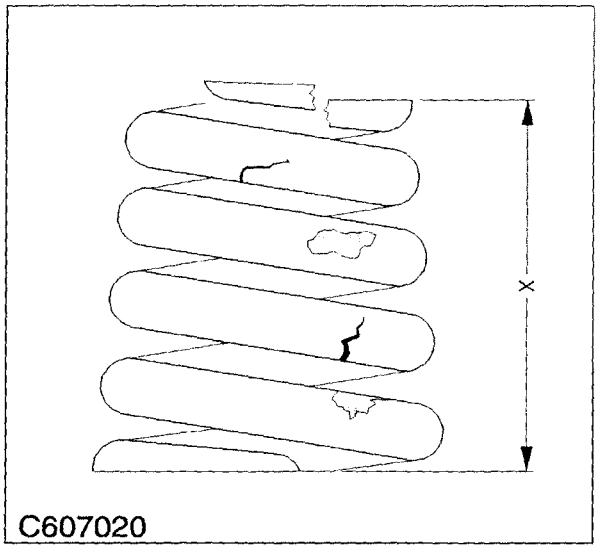


Inspect the return spring for cracks. Measure the free height [X] of the return spring. Replace if less than the specification in Section Technical Data.

Check the threaded rod is secure in the brake lever. If necessary, remove the rod check the condition of the thread. Repair using a thread chaser or replace, if necessary. Apply Loctite 271 to the first 6 mm of thread on the rod, then install and tighten the rod into the brake lever boss using a pair of locked nut.

Shoe Support Arm

Check the condition of the shoe support arm and parts for wear, bend or damage. Replace any damaged or worn parts.



C607020

Inspect the shoe support compression spring for cracks. Measure the free height [X] of the spring. Replace if less than the specification in Section Technical Data.

Check the condition of the spring seat. Replace if worn or damaged.

Check the condition of the bolt. Replace if the thread is damaged or the shaft is bent.

Check the condition of the washer and nuts. Replace if worn or damaged.

Discard the split pin. Install a new split pin during assembly.

Brake Actuators

Inspection of the brake actuators is described in the Davies and Metcalfe manual.

Sanitation Parts/Operating Material

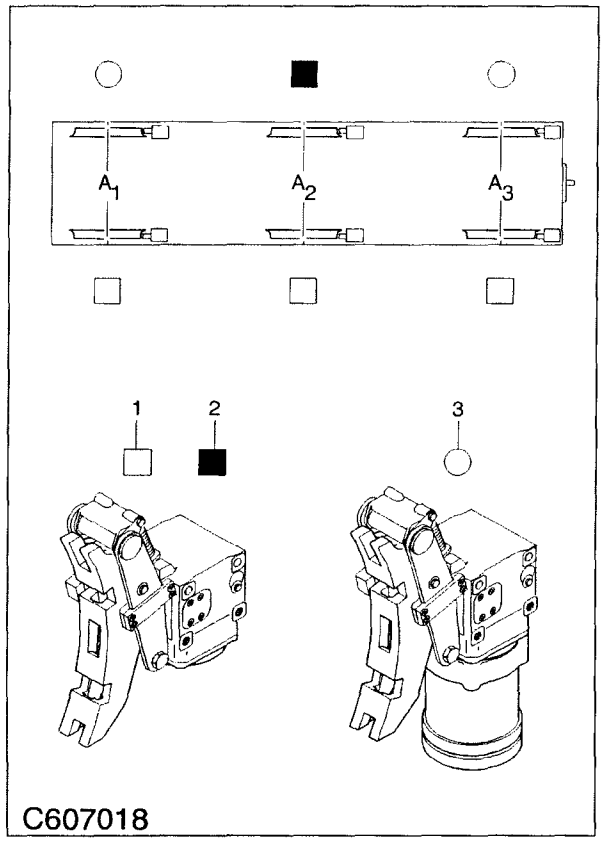
@.1260

[Not applicable]

Assembly

@.1270

Brake Actuators



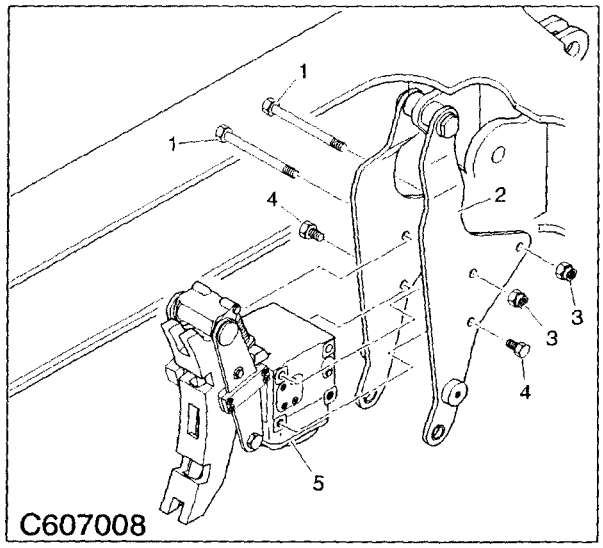
Parking brake actuators (3) are fitted at axles A1 and A3 on the right hand side of the bogie. Service brake actuators (1,2) are fitted to all left hand side axles and axle A2 on the right hand side. Two types of service brake actuators are fitted to Co–Co bogies and are handed for specific side installation. Right hand side service brakes (2) have the identification RC 61668/2 cast into the pivot webbing, while left hand side service brakes (1) have the identification RC 61668/1. All brake actuators, service and parking, are installed with the pneumatic inlet unions to the inside of the bogie frame.

WARNING:

The brake actuators are heavy; service brake actuators weigh over 55 kg and parking brake actuators weigh over 64 kg. Use lifting equipment to handle the brake actuators during maintenance to avoid personal injury.

NOTE:

The brake actuators can be assembled to the levers while the levers are attached to the bogie. Loosen the lever bolts at the bogie frame and brake rod to allow clearance for installation. Torque the bogie frame and brake rod bolts to 220 Nm after installation.



C607008

Position the brake actuator between the two actuator levers. Ensure that the brake levers are orientated as previously described.

Install the bolts (4) through the levers (2) into the brake actuators (5).

Install the bolt (1) through the levers (2) into the actuator (5), then install the lock nut (3).

Torque the bolts (1) and nuts (3) to M_A = 535 Nm.

Install the brake lever and actuator assembly onto the bogie as described in Installation, Brake Rigging.

Install the brake rods as described in Section Installation, Brake Rod.

Install the brake blocks as described in Section Installation, Brake Blocks.

Install the slack adjuster as described in Section Installation, Adjusting Equipment.

Open the air supply to the bogie and test the operation of the brakes. Rectify any faults found.

Brake Rigging

Whenever assembling brake rigging, apply a light film of a suitable lubricant to the inside of bushes and the bolt shafts.

Apply a light film of a suitable lubricant between any sliding surfaces.

Bushings

NOTE:

Replace both the bush and pivot bolt if either part is worn. Never use a new bush with an old bolt, or vice versa.

Bushes must be pressed in using a suitable hydraulic press and tooling. Do not drive the bushes in using a hammer.

Check the interference fit between the hole and bush before assembly.

Installation

@.1280

General Information

Always use new lock nuts on new bolts.

Do not reuse worn or damaged lock nuts. Discard lock nuts after 5 uses.

Coat any exposed metal surfaces using a suitable rust preventative after installation.

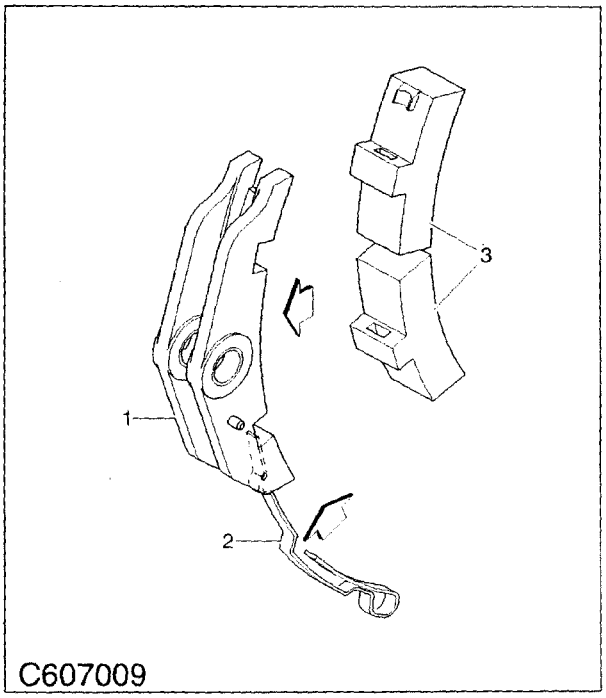
Never reuse split pins. Discard spit pins after removal and install new parts during installation.

Brake Blocks

Chock the wheels to prevent the bogie moving.

The brake shoe and block casting keyways must be free of burrs and other obstructions. Check the brake blocks and shoes before installation to ensure clear passage for the key.

Move the slave lever away from the wheel until the maximum clearance is obtained between the wheel tread and brake shoe to install the brake block.

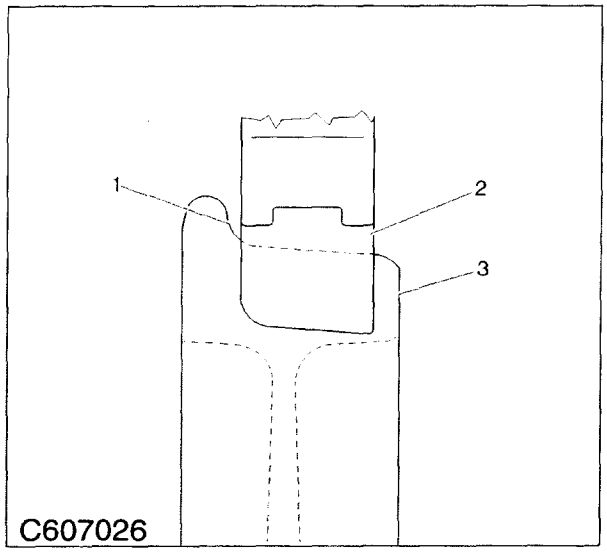


Install the brake blocks (3), with the radiused edge towards the wheel flange, into the brake shoe (1).

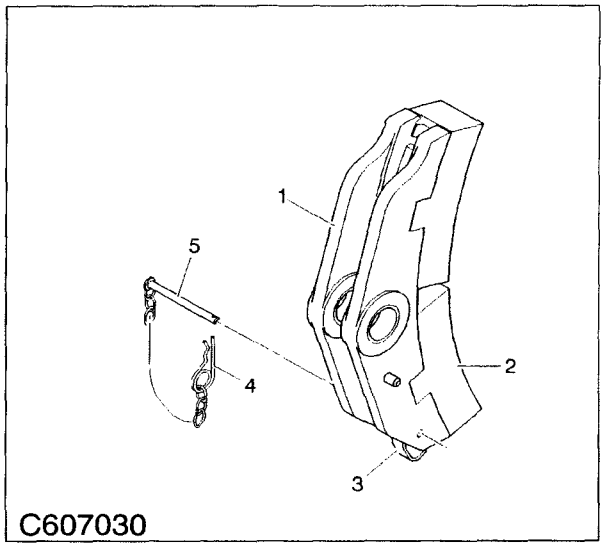
Insert the brake key (2) through the shoe (1) and blocks (3). Ensure the key (2) is correctly installed.

Move the actuator lever to the opposite end of its travel, then install the brake blocks (3) at the other shoe in the same manner.

Install the key (2) as before.



Check the brake blocks (2) are correctly aligned with the wheel tread (3). The block must not rub against the flange (1) or overlap the tread (3). Rectify any misalignment as necessary.



Ensure the brake blocks (2) and key (3) are correctly installed. Check the security of the blocks (2), then insert the locking pin (5) through the brake shoe (1) and key (3). Secure the R–clip (4).

Install and adjust the slack adjuster as described in Adjusting Equipment.

Install and adjust the shoe support arm on the slave lever as described in Adjusting Equipment.

Open the air supply to the bogie and test the operation of the brakes. Rectify any faults found.

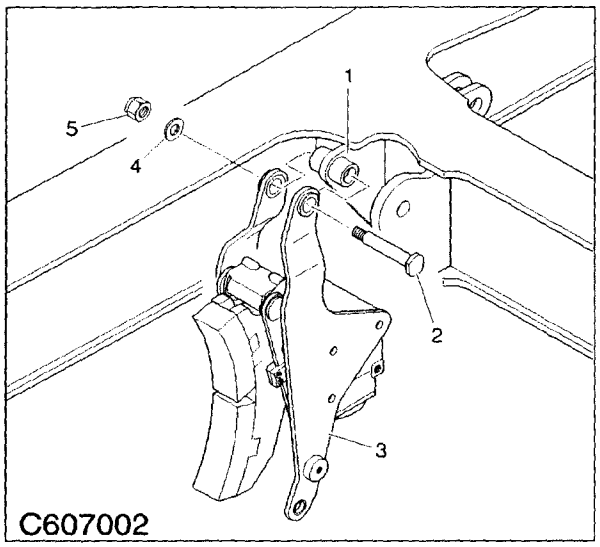
Brake Rigging

The bogie has three different types of brake actuators. The locations for installation are described in Section Assembly, Brake Actuators. Ensure the brake actuators are installed in the correct positions.

Actuator Lever

WARNING:

The brake actuators are heavy; service brake actuators weigh over 55 kg and parking brake actuators weigh over 64 kg. Use lifting equipment to handle the brake actuators during maintenance to avoid personal injury. If necessary, install the brake actuator to the brake levers as described in Section Assembly, Brake Actuators.



Position the lever (3) and brake actuator assembly on the bogie frame (1). Support the lever (3) using suitable stands. The locations of the three different actuators are described in Section Assembly, Brake Actuators.

Align the holes in the levers (3) and bogie frame hangers (1).

Install the pivot bolt (2) through the levers (3) and hangers (1).

Install the washer (4) and nut (5), then torque the nut to M_A = 220 Nm.

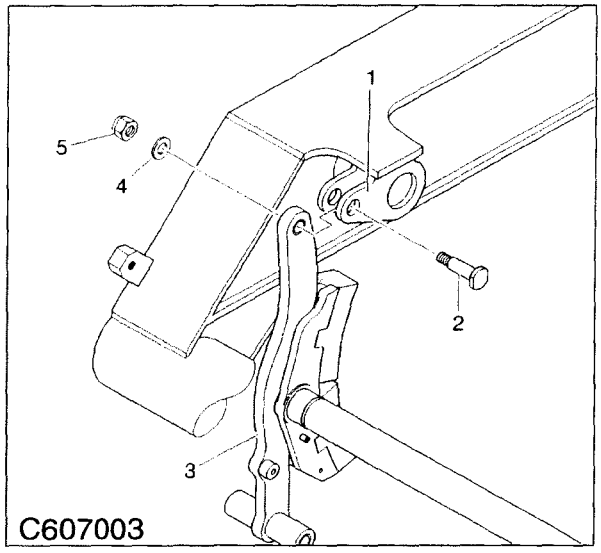
Connect the brake rods as previously described.

Install the brake blocks as described in Brake Blocks.

Install the slack adjuster as described in Adjusting Equipment.

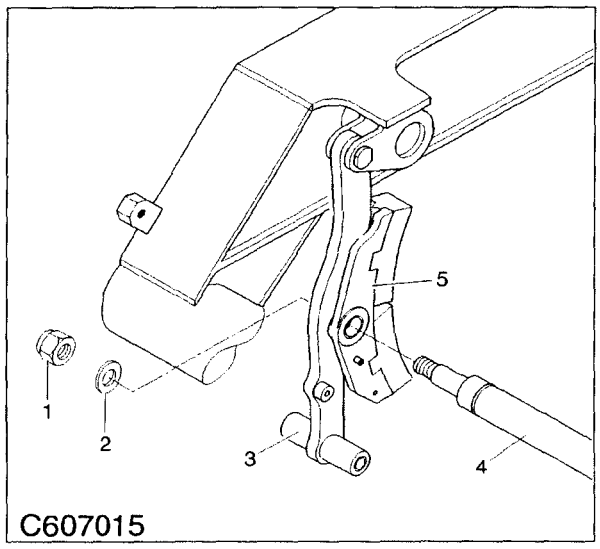
Open the air supply to the bogie and test the operation of the brakes. Rectify any faults found.

Slave Lever



Install one brake lever (3) in the bogie frame hangers (1). Align the holes in the lever (3) and hanger (1).

Install the pivot bolt (2) through the lever (3) and hanger (1). Install the washer (4) and nut (5), then torque the nut (5) to M_A = 220 Nm.

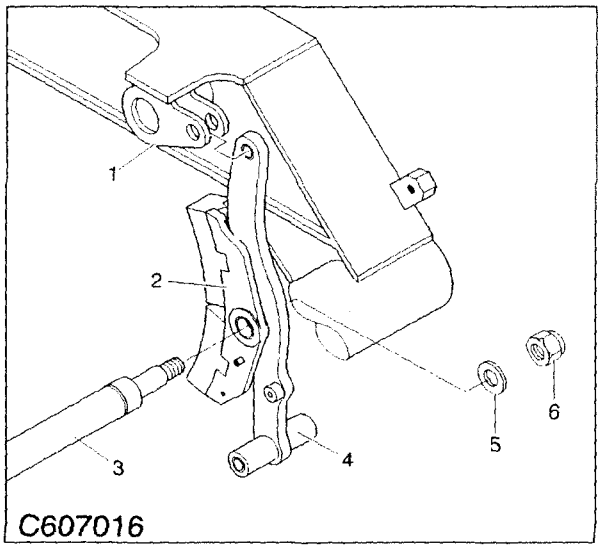


Install the track rod (4) as described in Track Rod. Support the rod (4) at each end using suitable stands.

Position the brake shoe (5) on the lever (3).

Insert one end of the track rod (4) through the brake shoe (5) and lever (3).

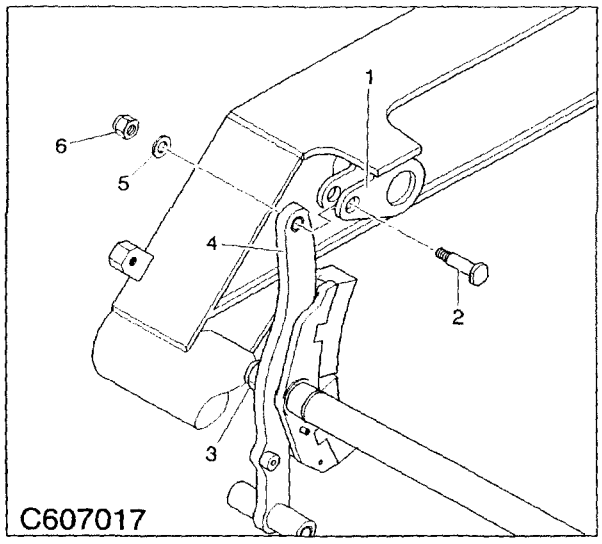
Install the washer (2) and nut (1) on the track rod (4). Tighten the nut (1) finger tight.



Slide the lever (4) and brake shoe (2) as an assembly onto the track rod (3).

Install the washer (5) and nut (6) on the track rod (3). Tighten the nut (6) finger tight.

Manipulate the lever (4) between the bogie frame mounting lugs (1).



Install the pivot bolt (2) through the levers (4) and hanger (1). Install the washer (5) and nut (6), then torque the nut (6) to M_A = 220 Nm.

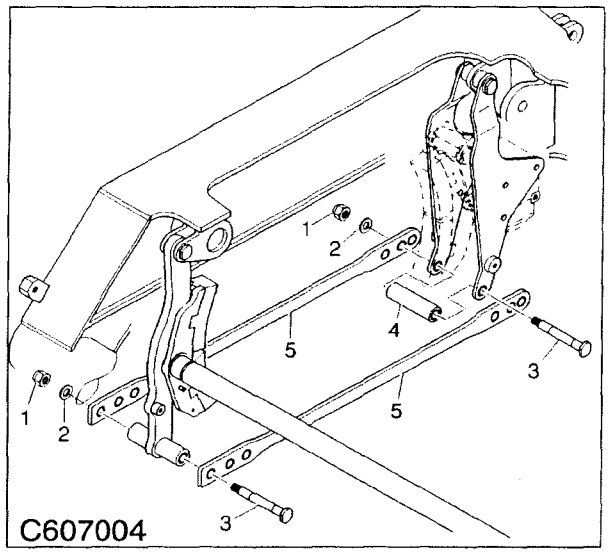
Torque the track rod nuts (3) to M_A = 770 Nm.

Install the blocks as previously described.

Install the brake rods as described in Brake Rod.

Install the slack adjuster and shoe support arms as described in Adjusting Equipment.

Brake Rod



Position the brake rods (5) between the slave and actuator levers. Support the rod (5) using suitable stands.

Align the holes in the brake rod (5) levers and spacer tube (4) as noted during disassembly. Positioning the brake rods (5) is described in Section Adjustments.

Apply a thin film of a suitable lubricant to the bolt shafts (3). Install the pivot bolt (3), washers (2) and nuts (1). Torque the nuts (1) to M_A = 220 Nm.

Adjust the slack adjuster and shoe support arms as described in Adjusting Equipment.

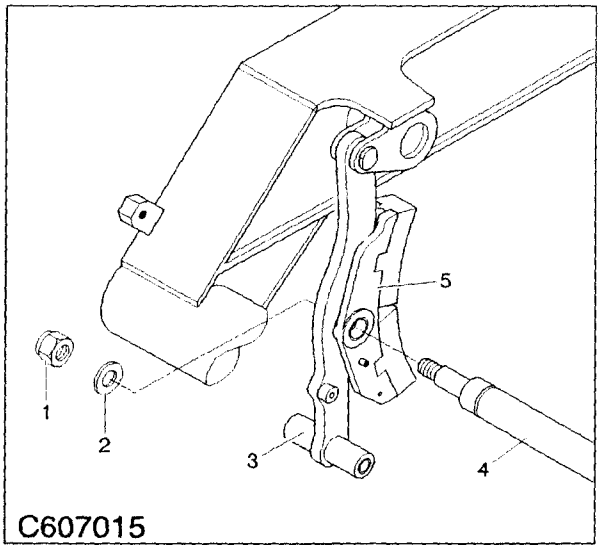
If necessary, install the brake blocks as previously described.

Open the air supply to the bogie and test the operation of the brakes. Rectify any faults found.

Track Rod

NOTE:

The track rod is heavy, over 37 kg. Use lifting equipment to handle the rod during maintenance procedures.



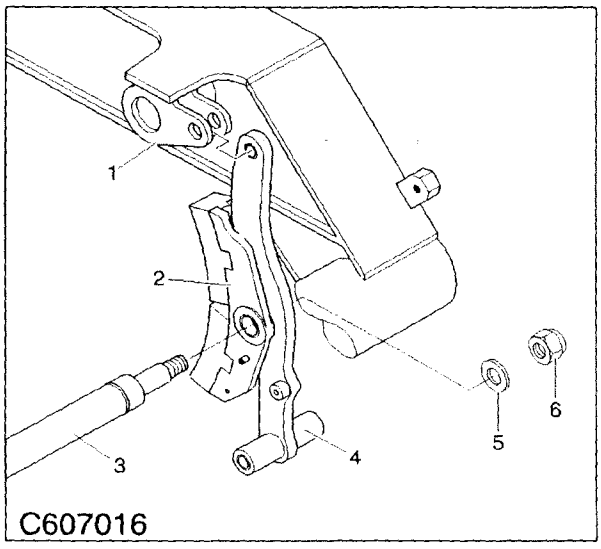
C607015

One of the slave brake levers must be removed to install the track rod.

Position the track rod in the bogie frame between the slave levers.

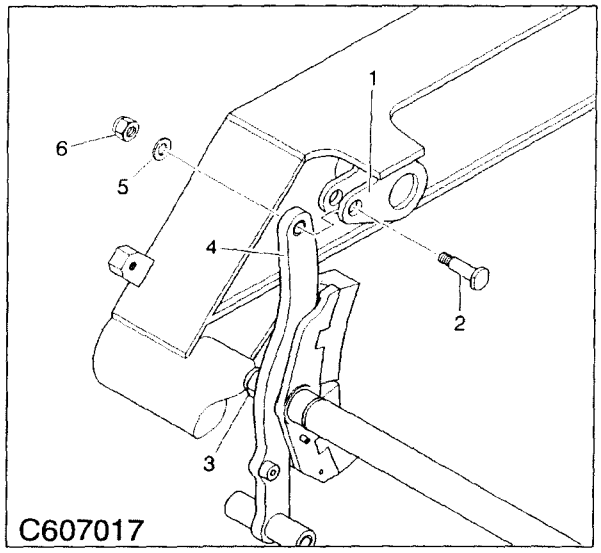
Support both ends of the track rod using suitable stands.

Install one end of the track rod (4) through the slave brake lever (3) and brake shoe (5). Install the washer (1) and nut (2). Tighten the nut (2) finger tight.



C607016

Install the brake lever (4) and shoe (2) at the other end of the track rod (3). Install the washer (5) and nut (6). Tighten the nut (6) finger tight.



Install the lever (4) to the bogie frame hangers (1) as previously described.

Torque the M36 track rod nuts (3) to M_A = 770 Nm.

If necessary, install the brake blocks as previously described.

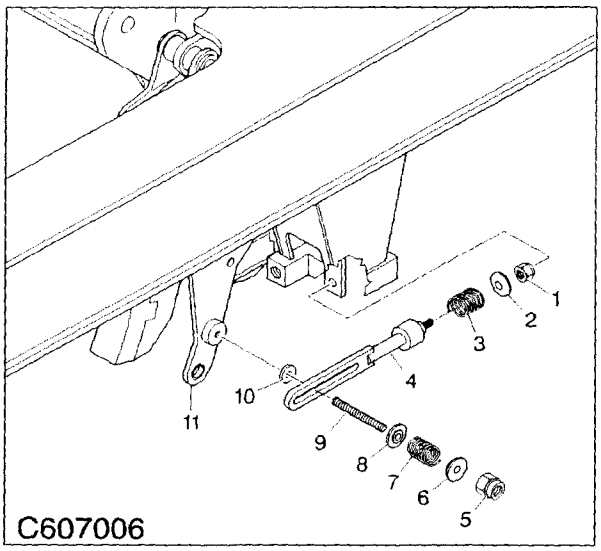
If necessary, install the slack adjuster as described in Adjusting Equipment.

If necessary, install the shoe support arm as described in Adjusting Equipment.

Open the air supply to the bogie and test the operation of the brakes. Rectify any faults found.

Adjusting Equipment

Slack Adjuster



Ensure the actuator cylinder slack adjuster nut is completely backed–off.

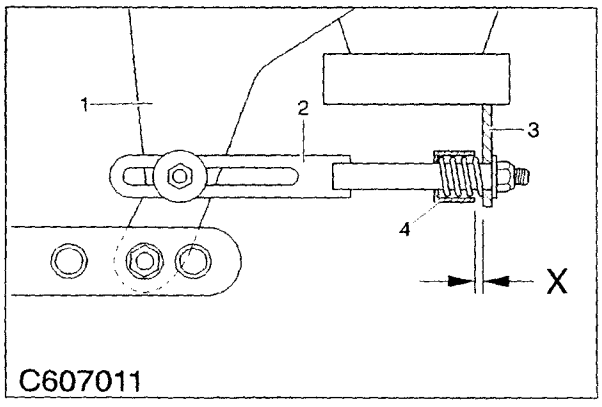
If necessary, install the threaded rod (9) into the lever (11). Apply Loctite 271 to the end of the threaded rod (9) before installation. Install and tighten the rod (9) using a pair of nuts locked against one another.

Install the return spring (3) into the cup at the end of the slack adjuster arm (4).

Install the threaded end of the slack adjuster arm (4) through the bogie frame bracket.

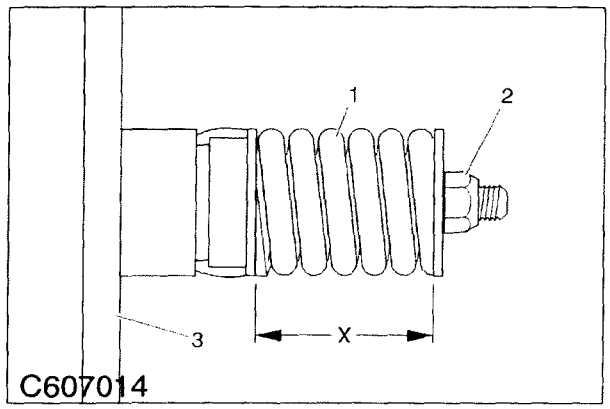
Install the spring support (2) and lock nut (1). Tighten the lock nut (1).

At the brake lever, install the washer (10), slack adjuster arm (4), spring supports (8, 6), spring (7), and lock nut (5).



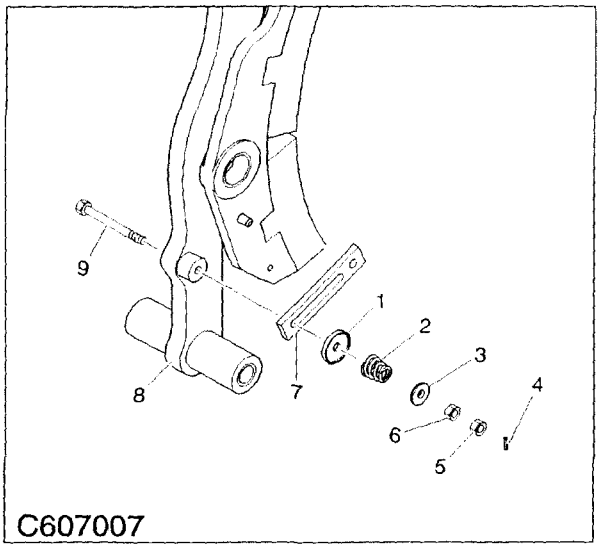
Position 5 mm thick shims between the brake blocks and wheel tread. Ensure the brakes are centralised over the wheel.

Adjust the position of the slack adjusting arm (2) on the lever (1) to the specified clearance between the slack adjuster cup (4) and the bogie frame lug (3). ([X] = 7.5 mm)



Screw the slack adjuster lock nut (2) at the brake lever (3) until the spring (1) is compressed to the specified length. ([X] = 70 mm)

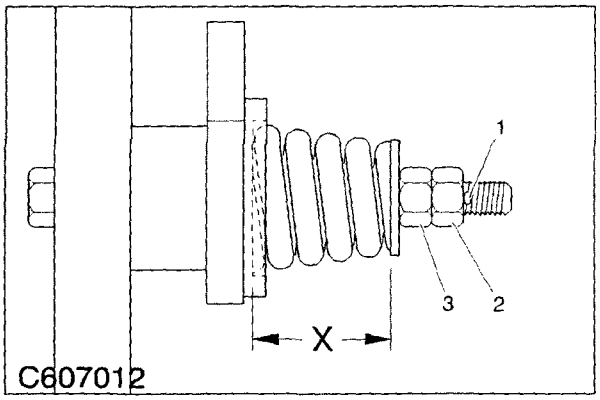
Shoe Support Arm



Install the shoe support arm spigot (7) into the brake shoe hole. Align the elongated slot in the arm with the boss on the lever.

Install the bolt (9) through the lever (8) and arm (7).

Place the spring seat (1), compression spring (2), and washer (3) on the bolt (9).



Centralise the shoe on the wheel tread. The clearance between the brake block and wheel tread should be the same for the top *and bottom extremities of the shoe.*

Install the nut (3) and lock nut (2). Screw the nut (3) until the spring height is compressed to the correct height. ([X] = 40 mm)

Tighten the lock nut (2) against the adjusting nut (3).

Install a new split pin (1).

After–Installations Operations

@.1290

Adjustments

@.1310

Brake Rod Adjustment

The brakes are equipped with two types of compensation for brake block and wheel wear:

a. Brake block wear is compensated for by internal adjustment within the brake actuators and the slack adjusting arm on the actuator lever. The actuator cylinder expands pressing the brake blocks at the actuator shoe against wheel tread. The actuator cylinder continues to expand pushing the actuator lever away from the wheel tread. This action pulls the brake rods, which in turn pulls the slave lever towards the wheel until the brake blocks at the slave lever contact the tread. The outward movement of the actuator arm causes the slack adjusting arm cup to contact the bogie frame bracket. Continued expansion of the cylinder overcomes the compression spring allowing the lever to move in the adjusting arm slot. The lever moves towards the bogie frame bracket decreasing the distance the slave lever will move away from the wheel when the brake is released. Once the pressure is released from the actuator cylinder the spring tension on both the slack adjusting and shoe support arms will hold the position of the lever. This arrangement ensures that the brake blocks maintain the correct clearance between the wheel tread.

   Similarly at the slave shoe, the force of the shoe equalising over its pivot point overcomes the shoe support arm spring pressure and aligns the brake shoe with the wheel tread.

b. Initial clearance between the brake block and wheel tread is set by the relationship of the brake rod and brake levers.

   Three holes arranged at each end of the brake rods allow for adjustment according to wheel diameter. The position of the brake rods requires adjustment only after wheel profiling has been performed or where the wheel has worn to the dimension shown in the table.

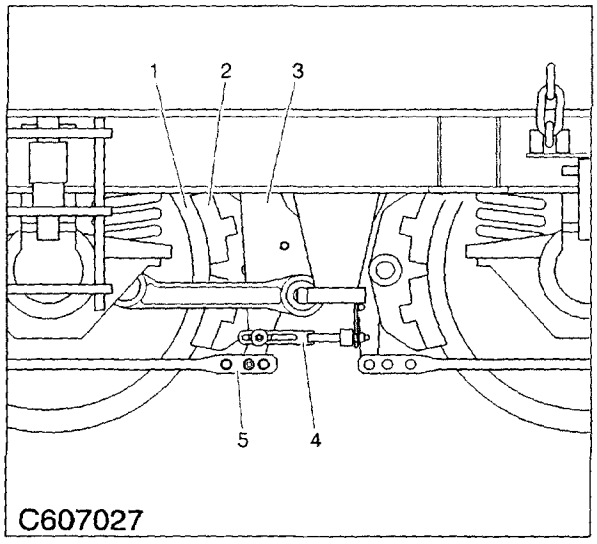
IMPORTANT:

Worn wheels should be re–profiled to the next appropriate size.

The arrangement of each set of three holes is such that moving the position of the brake levers as indicated in the table changes the distance between the brake shoes.

Never use combinations other than those described in the table.

Adjustment Procedure



The slack adjuster (4) allows for in service wear of brake block as previously described. Adjustment of brake rods (5) is only performed whenever the wheels are re–profiled or worn to the dimensions in the table.

At the actuator, loosen the actuator slack adjuster locking bolt about $^1/_2$ turn. Back–off the actuator slack adjuster nut until the maximum clearance is obtained between the brake blocks (2) and wheel tread (1).

Loosen the nut securing the slack adjuster arm (4) to the brake lever (3). The arm must be free to slide against the brake lever without interference.

Remove the split pin, then loosen the lock nut at the shoe support arm.

Loosen the shoe support arm lock and retaining nuts until the brake shoe is free to move without interference.

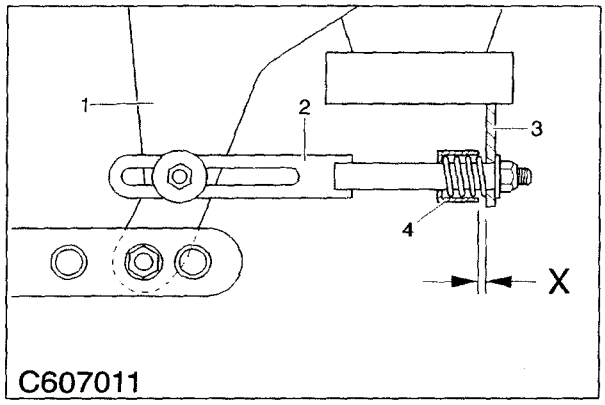
Remove the bolts securing one end of the brake rod to the brake lever.

Align the appropriate hole in the rod and lever (refer to the table) for the wheel diameter.

NOTE:

Wheels with a diameter of less than 1,032 mm should not be used.

Wheel Diameter	Brake Rod Leading End Bolt Position	Brake Rod Trailing End Bolt Position
1,092 mm	1	1
1,072 mm	2	2
1,052 mm	3	3
1,032 mm	4	4
IMPORTANT: DO NOT USE OTHER COMBINATIONS		



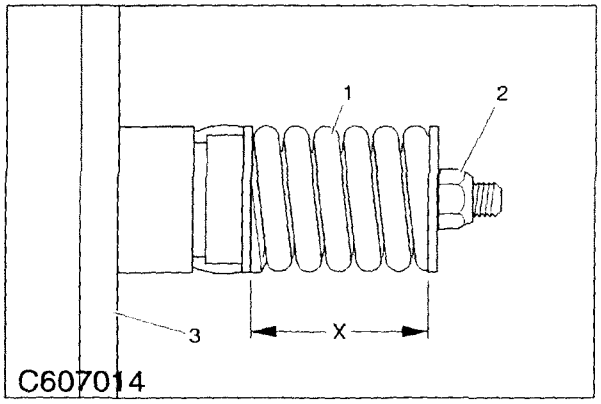
Apply a thin film of suitable lubricant to the shaft of the bolt and the inside of the bushes, then re–install the bolt through the lever and rods.

Install the washer and nut, then torque the nut. M_A = 220 Nm.

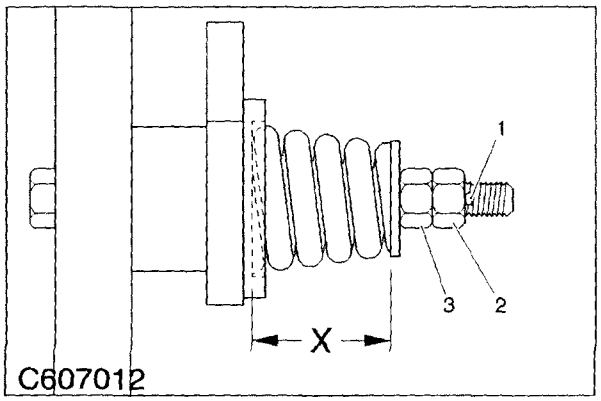
Repeat the procedure at the other brake lever.

Adjust the position of the slack adjusting arm (2) on the lever (1) to the specified clearance between the slack adjuster cup (4) and the bogie frame lug (3). ([X] = 7.5 mm)

Ensure the shoes are centralised over the wheel tread, then position 5 mm thick shims between each brake block and the wheel treads.



Screw the slack adjuster lock nut (2) at the brake lever (3) until the spring (1) is compressed to the specified length. ([X] = 70 mm)



Check the shoe support arm spigot is correctly positioned in the brake shoe hole.

The brake shoes must be centralised over the wheel tread. Screw the nut (3) until the spring height is compressed to the correct height. ([X] = 40 mm)

Tighten the lock nut (2) against the adjusting *nut* (3).

Install a new split pin (1).

Remove the shims and test the operation of the brakes.

Apply and release the brakes several times to allow the slack adjuster to move into the correct position.

With the brakes released, check the clearance between the brake blocks and wheel tread. Rectify any faults found.

BOMBARDIER TRANSPORTATION

IR WAG9

Volume D3

Interior

7 Interior

For complementary information see following Chapters in Volume D3:

Doors	7.1
Seats	7.2
Lighting	7.3
Blinds	7.4
Cab	7.5
Key Interlocking	7.6
Cabling	7.7

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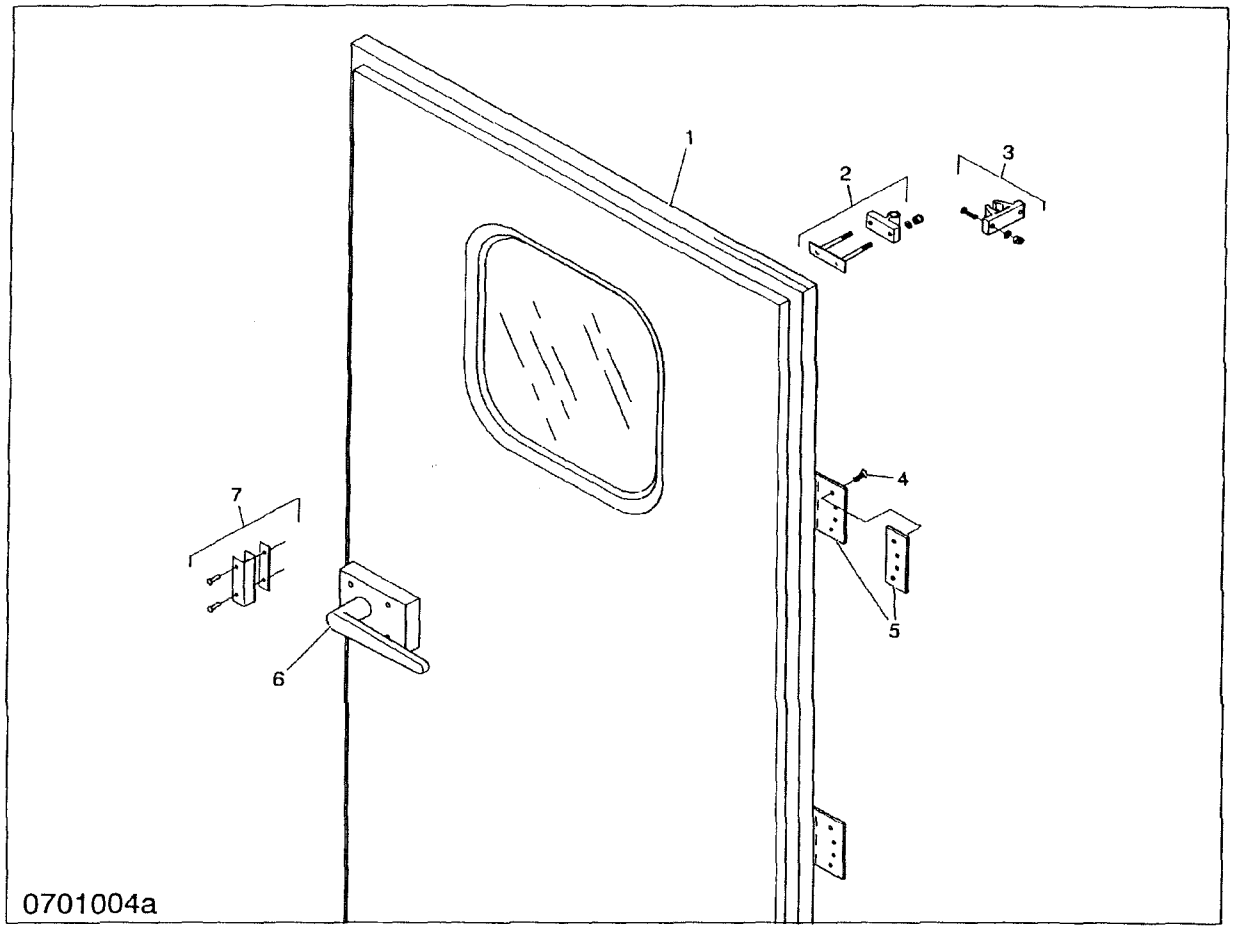
7.1 Doors

Group Summary

@.1120

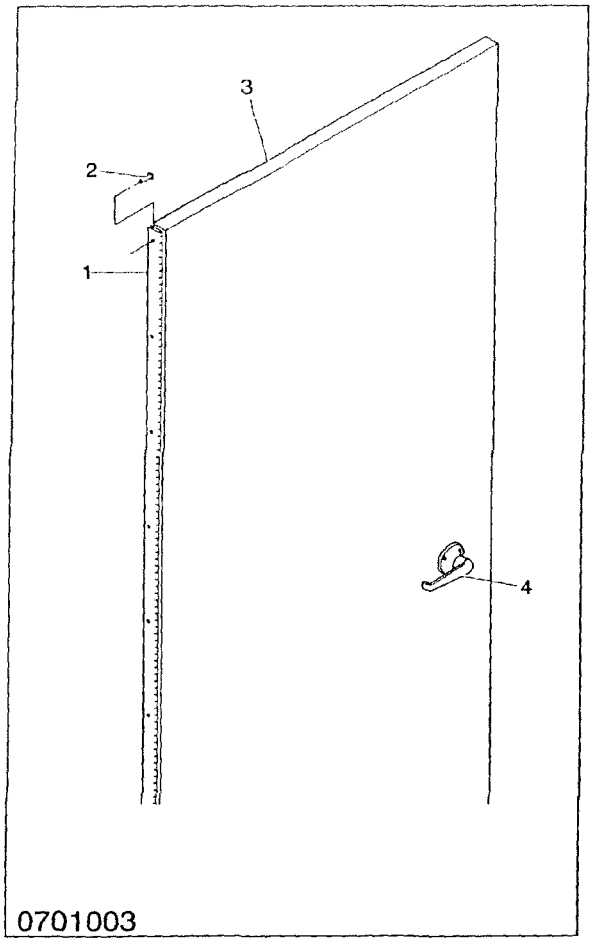
This chapter contains information on the machine room door and the locker door which consist of the door assembly, hinges and latch.

Machine Room Door



1	Door	5	Hinge
2	Door catch	6	Lock
3	Door catch clamp	7	Latch
4	Screw		

Locker Door



1	Piano hinge
2	Rivet
3	Door assembly
4	Lock

Functional Description

@.1140

Machine Room Doors

The machine room doors provide access from the cab to the machine room. Insulation in the doors and double glazed windows aid in reducing noise from the machine room being transmitted to the cab. Seals around the door surface provide an air tight seal between the door and the door frame to prevent the pressure differential between the cab and the machine room causing air flow past the door.

Locker Doors

Lockers are located in the cab to provide storage.

Technical Data

@.1160

Machine room doors

- Door assembly weight	41 kg
- Door to frame clearance	5 mm (nominal)
- Compressed seal height	14 ± 1 mm

Locker doors

- Door assembly weight	13 kg

Tolerances and Wear Limits List

@.1170

There are no tolerances or wear limits applicable to the machine room and locker doors.

Tools and Special Tools

@.1180

Normal workshop equipment is required for the procedures described in this chapter.

Miscellaneous Materials

@.1200

Suitable wooden wedges are required for removal and installation of the machine room doors.

Before-Removal Operations

@.1220

Machine Room Doors

Ensure the machine room, oil and traction motor blowers are not operating. Turn the key switch, BL on cab console panel A, to the '0' position to switch off the locomotive electrical systems.

Locker Doors

There are no before removal operations applicable to the machine room doors.

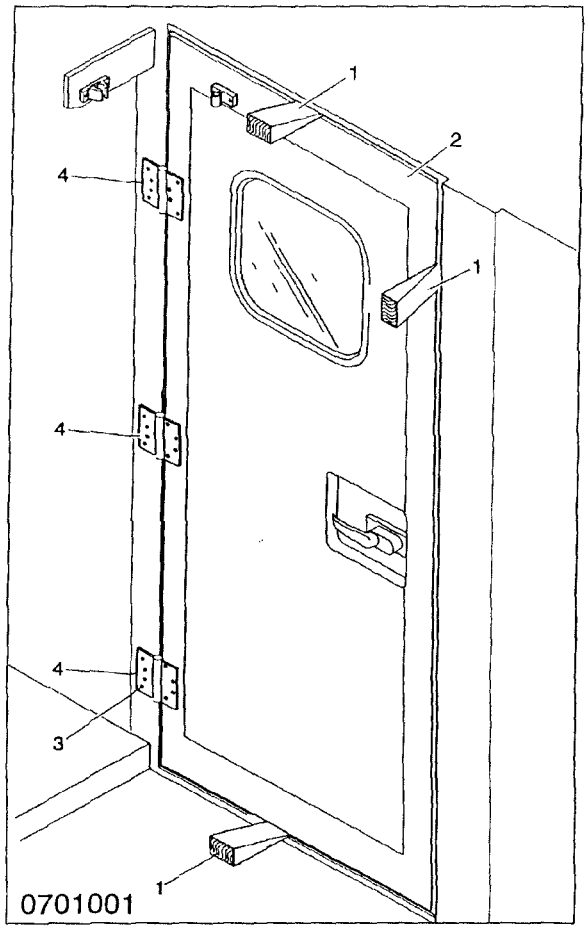
Removal

@.1230

Machine Room Door

NOTE:

The machine room door assembly is heavy. Have an assistant help when installing and removing the door



Unlatch the door (2).

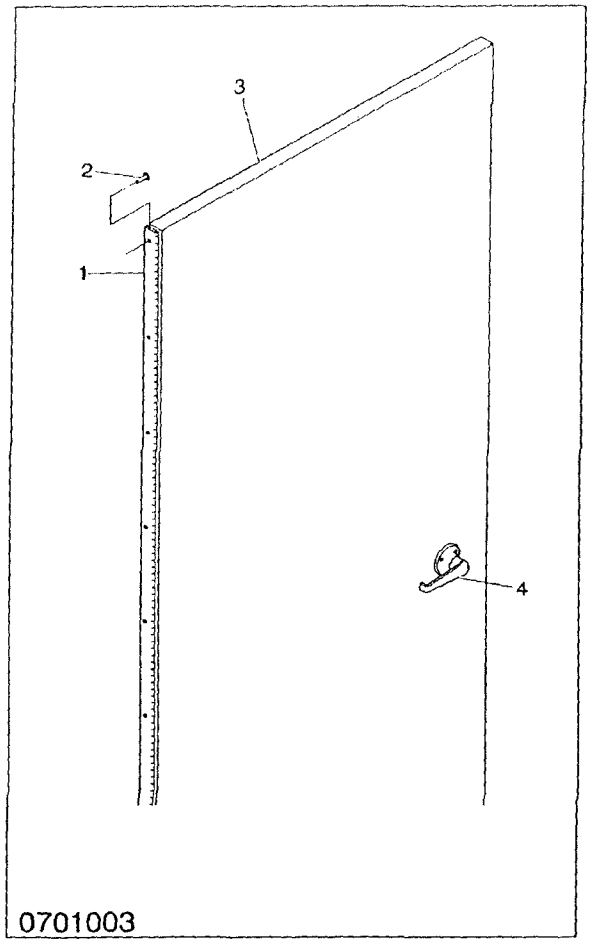
Chock the door (2) in position using suitable wedges (1).

Loosen the screws (3) in all three hinges (2) at the door pillar.

Remove the screws (3) starting at the bottom hinge.

With the aid of an assistant lift the door from the door opening, then remove the door from the cab.

Locker Door



Unlatch and open the locker door (3).

Have an assistant hold the door in position.

Using a suitable drill, drill out the pop rivets (2) starting at the bottom of the hinge (1).

With the aid of an assistant, lift the door from the opening.

Disassembly

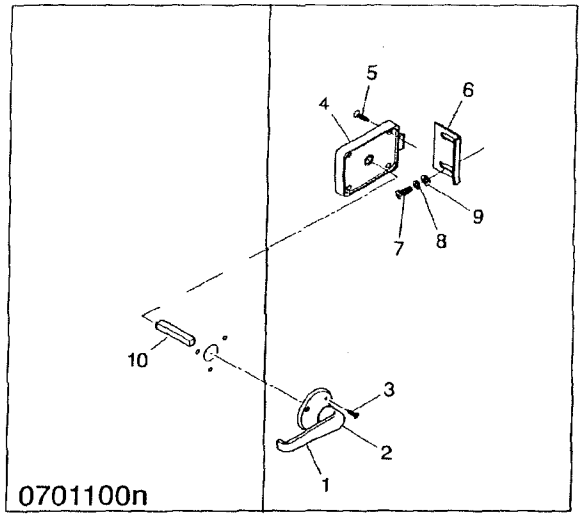
@.1240

Machine Room Doors

Disassembly of the machine room doors is described in the Chapter 1.3, Doors and Steps of Volume F1, Suppliers Documentation.

Locker Doors

If necessary, drill out the rivets securing the hinge to the door to remove the hinge from the door.



The lock assembly may be removed from the locker door with the door installed on the locker.

With the locker door open or removed, remove the screws (3) securing the front half of the lock assembly (2) to the locker door (1).

Withdraw the lock bar (10).

Remove the screws (5) securing the rear half of the lock assembly (4) to the locker door (1).

If necessary, remove the screws (7), spring washers (8) and washers (9) securing the keep plate (6) to the locker frame.

Inspection and Repair

@.1250

Machine Room Doors

Inspect the condition of the door seals, hinges and handles. Replace if worn or otherwise damaged, refer to Chapter 3, Doors and Steps of Volume F1, Suppliers Documentation.

Locker Doors

Inspect the condition of the locker door sealing strips, hinge and handle. Replace if worn or damaged.

Waste Disposal

@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

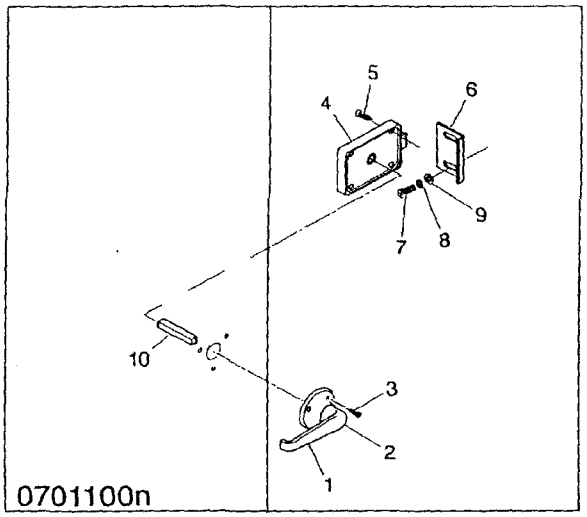
Assembly

@.1270

Machine Room Doors

Assembly of the machine room doors is described in the Chapter 3, Doors and Steps of Volume F1, Suppliers Documentation.

Locker Doors



Install the screws (5) through the rear half of the lock assembly (4) and into the locker door (1) and tighten.

Insert the lock bar (10) through the locker door (1) and into the lock assembly (4).

Position the outer half of the lock assembly (2) over the lock bar (10) and screw to the locker door (1) using the screws (3).

If necessary, secure the keep plate (6) to the locker frame with the screws (7), spring washers (8) and washers (9).

Installation

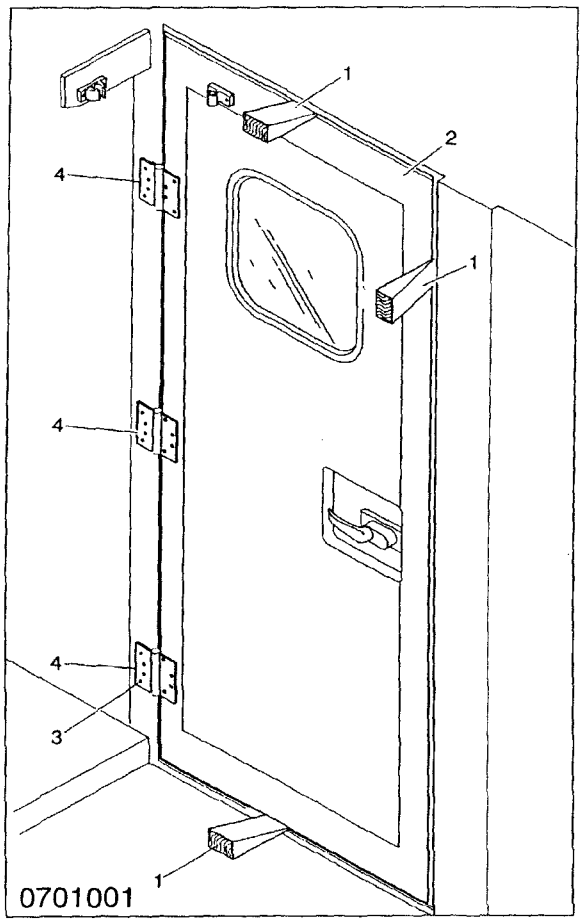
@.1280

Machine Room Door

NOTE:

The machine room door assembly is heavy. Have an assistant help when installing and removing the door.

Stand the door upright with the window towards the top and the door hinges facing inside the machine room.



Lift the door (2) into the door opening. Position suitable wedges (1) at the top bottom and sides of the door (2) to centralise it within the frame.

Install two screws (3) in the top and bottom hinge (4) then tighten the screws (3) to hold the door (2) in position.

Align the door (2) so that the gap between the door and opening is even around the entire perimeter. The gap dimension is given in Section Technical Data.

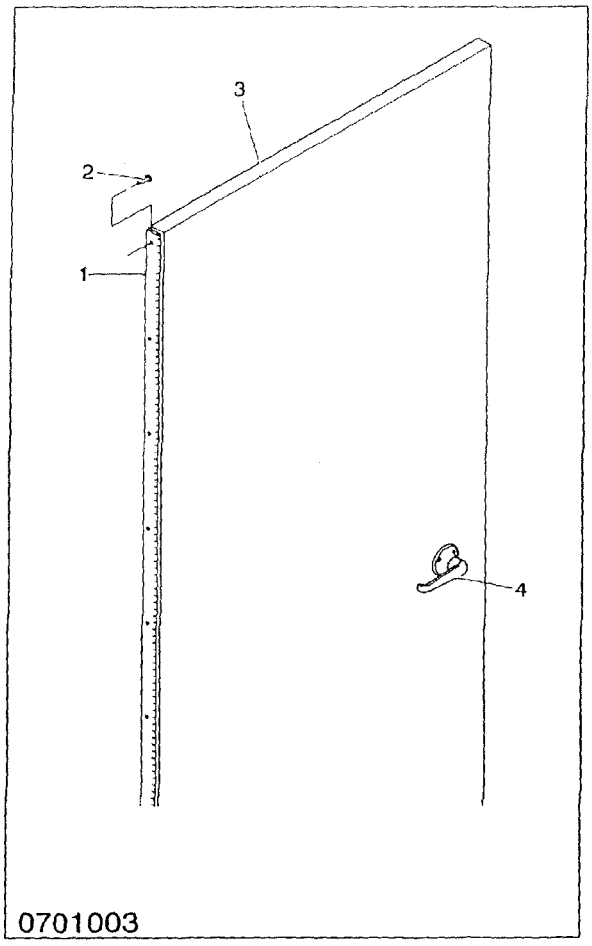
Tighten the screws in the hinges (4).

Install and tighten the remaining screws.

Remove all wedges.

Check the operation of the door. Ensure it latches securely.

Locker Door



Stand the door (3) upright with the door handle (4) facing inside the cab.

Position the door (3) on the locker.

With an assistant holding the door (3) in the open position and the hinge (1) towards the pillar, install a small number of pop rivets (2) in the middle, top and bottom of the hinge (1).

Check the operation of the door. Ensure it latches securely. Rectify any faults found.

Once satisfied that the door is latching correctly, install pop rivets (2) in the remaining holes in the hinge (1).

After-Installations Operations

@.1290

Machine Room Door

Check the operation of the door. Ensure it latches securely.

Check the distance between the door handle and cubicle face when the door is in the open position. A clearance of 25 mm should exist between the handle and the cubicle.

Adjust the door if necessary as described in Section Adjustments.

Locker Doors

Check the operation of the locker door. Ensure it latches securely without excessive slop. Adjust the position of the keep plate if necessary as described in Section Adjustments.

Adjustments

@.1310

Machine Room Doors

Adjustments to the machine room door are obtained by placing shims behind the hinges on the door or by changing the thickness of the striker plate.

Changing the thickness of the striker plate may be required if the door is not latching securely or the compressed height of the door seal is not within the specification given in Section Technical Data.

Shimming of the machine room door hinges may be required if the compressed height of the door seal is not within the specification given in Section Technical Data.

Locker Doors

The position of the keep plate may be adjusted by loosening the screws securing the keep plate sufficiently to allow the keep plate to be moved in or out. Once the keep plate is in a suitable position, the keep plate screws may be tightened to secure the keep plate.

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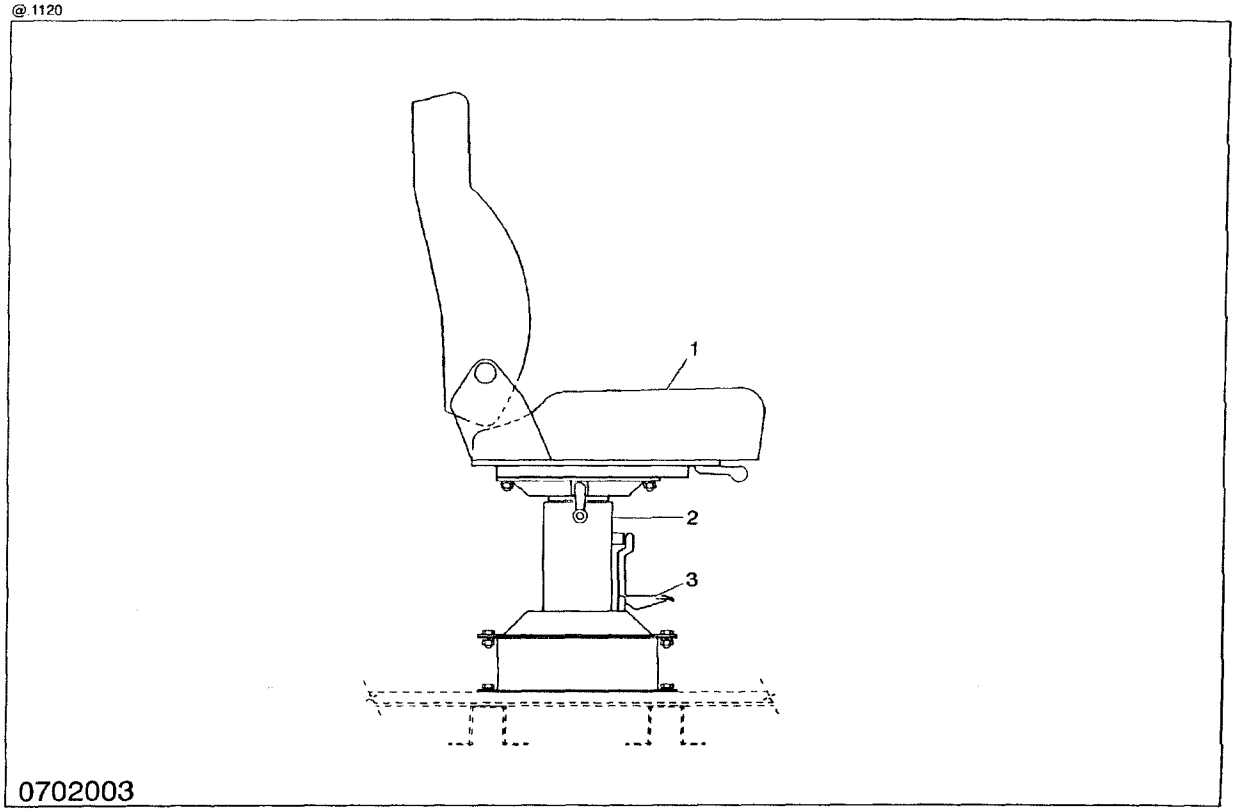
7.2 Seats

Group Summary

@.1120



1	Seat assembly
2	Seat pedestal
3	Pedal

Functional Description

@.1140

The same type of seat is used for the driver's and assistant's positions. The seats are equipped with various adjustments for the occupant's comfort and ease of operation. The seats are mounted on a height adjustable pedestal, that provides approximately 115 mm of vertical movement.

The horizontal position of the seat can be adjusted fore and aft to suit the requirements of the occupant by slides between the seat and pedestal. A total of 115 mm of fore aft adjustment is provided. The seat position can be locked in incremental positions by the lever.

The seat backrest can be inclined 35° from vertical according to the occupant's requirements. Backrest adjustment is controlled by a lever on the left hand side of the seat.

A foot operated lever on the seat pedestal allows swivel action of the seat and provides automatic positive lock in the driving position.

Technical Data

@.1160

Technical data for the driver's and crew seats is described in Chapter 2, Seats of Volume F15, Suppliers Documentation.

Tolerances and Wear Limits List

@.1170

Seat coverings should be repaired or replaced if worn or damaged. The mechanism should be repaired or replaced if loose, damaged or functioning incorrectly. Refer to Chapter 2, Seats of Volume F15, Suppliers Documentation.

Tools and Special Tools

@.1180

Conventional railways workshop tools and equipment are required for procedures in this group.

Miscellaneous Materials

@.1200

Miscellaneous materials required for the procedures described in this chapter include:

- Vinyl upholstery cleaner
- Clean water
- Light grease

Before-Removal Operations

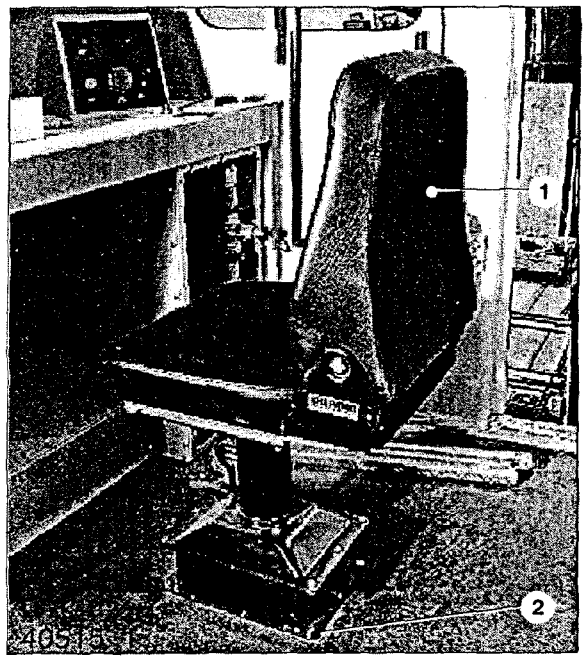
@.1220

Clean any debris from around the pedestal base to provide access to the bolts.

Removal

@.1230

Seat



Removal of the driver's and assistant driver's seats are identical.

Lower the seat height adjustment to minimum.

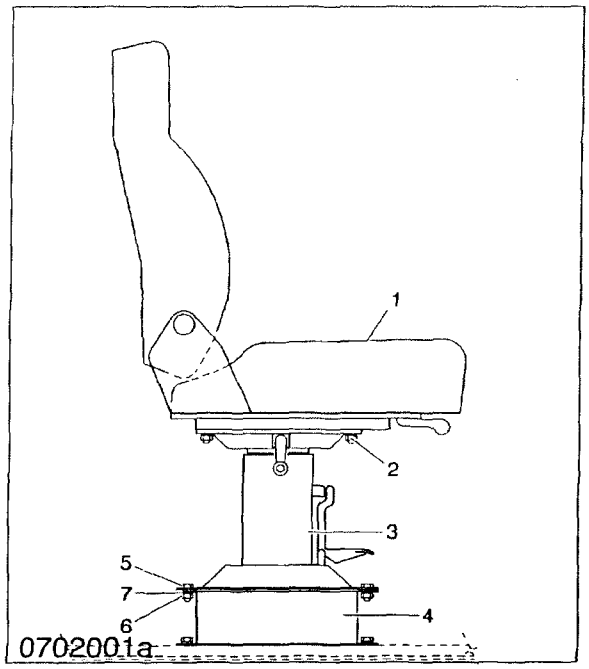
Remove the six bolts (2) and spring washers securing the seat assembly (1) to the cab floor.

Remove the seat assembly (1) from the locomotive cab.

Disassembly

@.1240

Seat



Disassembly of the driver's and assistant driver's seats are identical.

Remove the nuts (2) securing each seat runner to the seat pedestal (3).

Remove the seat assembly (1) from the seat pedestal (3).

If necessary, the seat pedestal (3) may be removed from the mounting pedestal (4) by removing the bolts, nuts and spring washers (5,6 and 7) securing the seat pedestal (3) to the mounting pedestal (4).

Inspect the seat (1) as described in Chapter 2, Seats of Volume F15, Suppliers Documentation.

Inspection and Repair

@.1250

Replace or repair the seat covers as necessary.

Check the operation of the seat and pedestal mechanisms. Rectify any faults found.

Refer to Chapter 2, Seats of Volume F15, Suppliers Documentation.

Waste Disposal

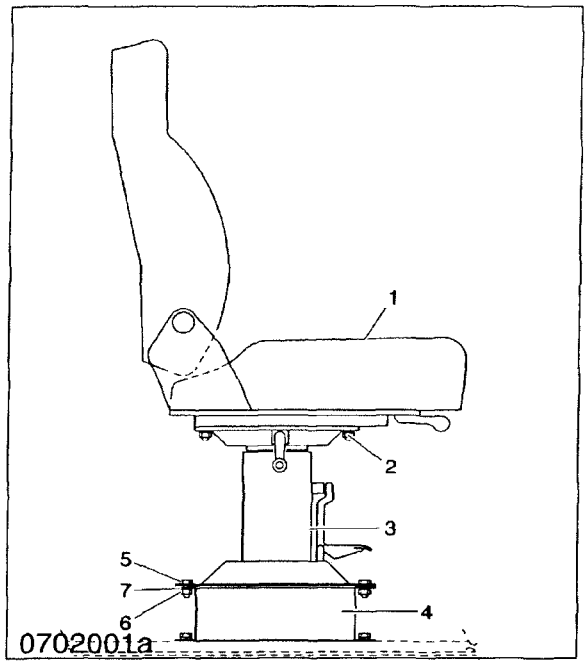
@.1260

Dispose of waste parts and materials according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

Seat



Assembly of the driver's and assistant driver's seats are identical.

Position the seat on the seat pedestal. Align the studs from the seat runners with the holes in the pedestal (3).

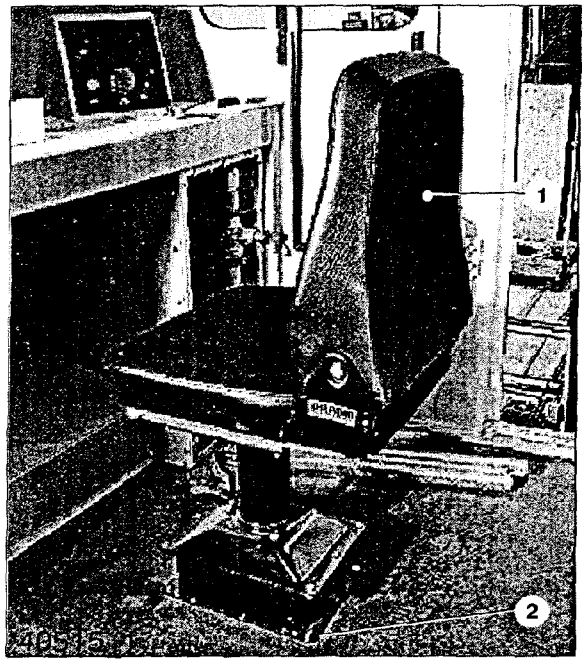
Install and tighten the nuts (2).

If necessary, position the seat pedestal (3) on the mounting pedestal (4) with the holes aligned. Install bolts, spring washers and nuts (5, 7 and 6) then tighten.

Installation

@.1280

Seat assembly



Align the holes in the seat assembly (1) with the holes in the cab floor. Ensure the seat assembly (1) is correctly oriented with the pedal facing towards the windscreen.

Install the bolts (2) and washers and tighten the bolts (2).

After-Installations Operations

@.1290

Check the operation of the seat and pedestal. Ensure the mechanisms move freely with minimal restriction. Lubricate the mechanism if necessary. Rectify any faults found.

Adjustments

@.1310

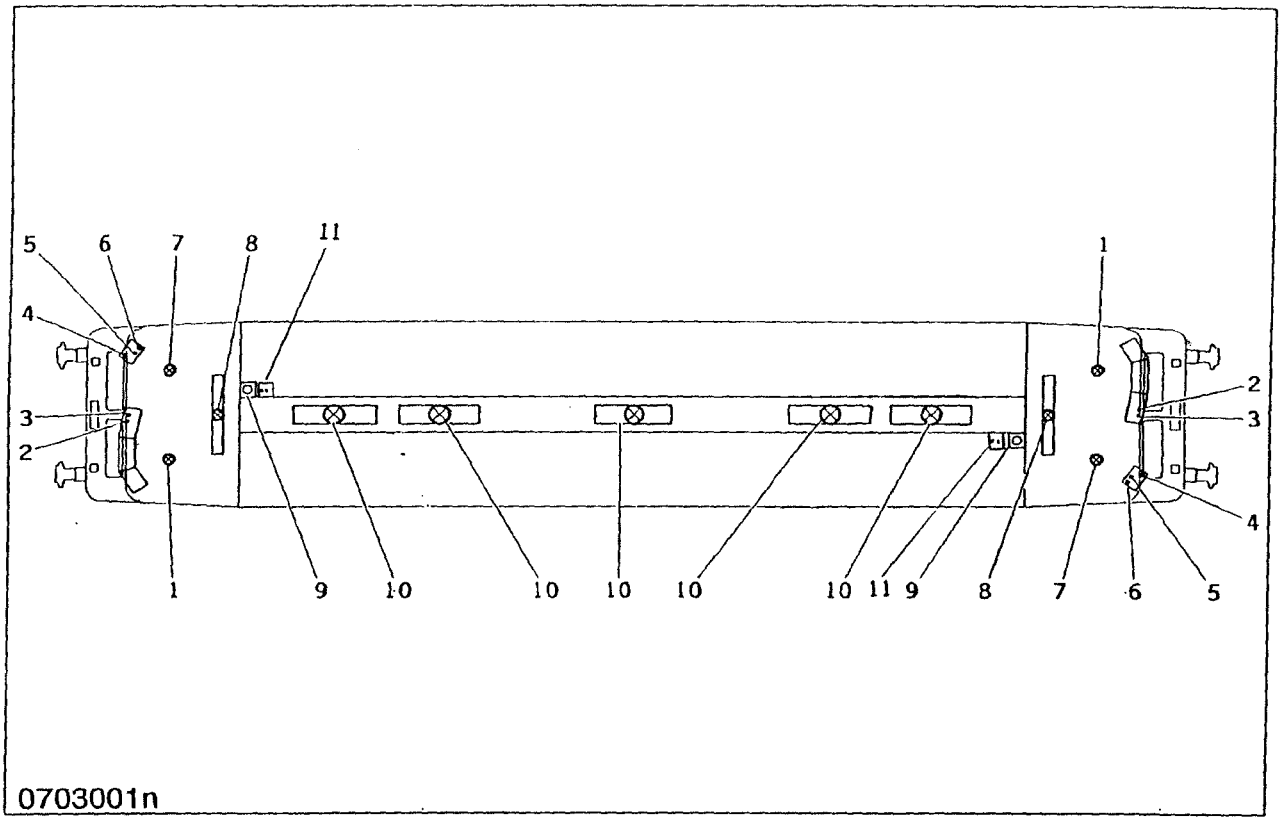
There are no adjustments applicable to maintenance procedures regarding the driver's or assistant driver's seats.

7.3 Lighting

Group Summary

@.1120

This chapter contains information on the internal lighting, including the cab lighting, machine room lighting, and the hand lamp sockets located in the cab and machine room.



0703001n

1	Lamp, driver's desk illumination	7	Lamp, assistant driver's desk illumination
2	Switch, cab lighting	8	Fluorescent lamp, cab lighting
3	Switch, driver's desk illumination	9	Latching push button, machine room lighting
4	Switch, assistant driver's desk illumination	10	Fluorescent lamp, machine room illumination
5	Socket, hand lamp	11	Terminal bar, 110 V DC
6	Switch, hand lamp socket		

Functional Description

@.1140

The driver's and assistant driver's desk illumination lamps are provided to illuminate the driver's and assistant driver's consoles when required. The incandescent lamps are switched on and off by a switch. The switches for the driver's and assistant driver's desk illumination lamps are ZLDD on Panel C and ZLDA on Panel D respectively.

A fluorescent light in each cab is provided for general cab illumination, and is controlled by switch ZLC on Panel C.

Socket PCLH on Panel D is provided for connection to a hand lamp. Switch ZLH on Panel D controls socket PCLH.

Five fluorescent lights in the roof of the machine room are provided for illumination of the machine room. A push button switch is located on the roof line, at each end of the machine room. The fluorescent lights in the machine room can be turned on or off at either end, regardless of the state of the switch at the opposite end.

A terminal bar, located near the machine room light switches, is provided at either end of the machine room for connection of a hand lamp.

For more information regarding Panel C and Panel D, refer to chapter 7.5, Cab.

Technical Data

@.1160

- Desk illumination lamps	24 V, 15 W
- Desk illumination lamp socket	B15d (DIN 49721)
- Cab illumination lights	110 V, 20 W
- Machine room lights	110 V, 20 W
- Hand lamp sockets	110 V
- Terminal bars	110 V

Tolerances and Wear Limits List

@.1170

There are no tolerances and wear limits applicable to the lighting.

Tools and Special Tools

@.1180

Conventional railway workshop tools are required for the procedures described in this chapter.

Miscellaneous Materials

@.1200

No miscellaneous materials are necessary for the procedures described in this chapter.

Before-Removal Operations

@.1220

Cab Lighting

CAB ILLUMINATION

Set the "Lighting Machine Room" circuit breaker (310.4) to the Off position. Circuit breaker 310.4 is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer Chapter 8.2, MR Control.

DRIVER'S AND ASSISTANT DRIVER'S DESK ILLUMINATION

Set the "24V/48V Power Supply" circuit breaker (127.91) to the Off position. Circuit breaker 127.91/1 for the No. 1 End is situated in Control Cubicle-1 (SB1) and circuit breaker 127.91/2 for the No. 2 End is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer Chapter 8.2, MR Control.

Hand Lamp Sockets and Terminal Bars

Set the "Lighting Machine Room" circuit breaker (310.4) to the Off position. Circuit breaker 310.4 is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer Chapter 8.2, MR Control.

Machine Room Lighting

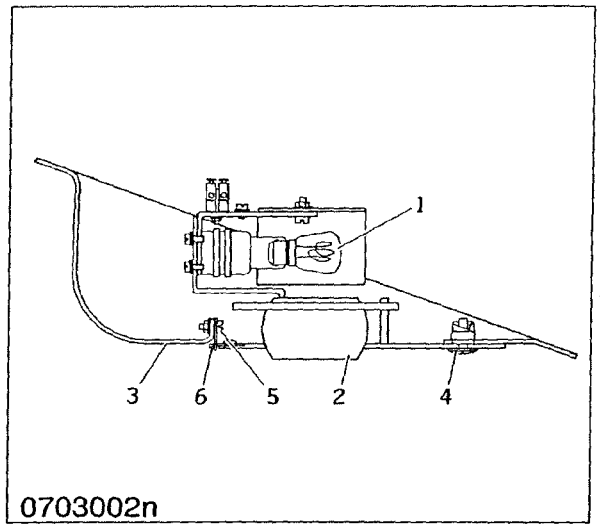
Set the "Lighting Machine Room" circuit breaker (310.4) to the Off position. Circuit breaker 310.4 is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer Chapter 8.2, MR Control.

Removal

@.1230

The globes can be replaced without removing the light assemblies. Refer to Section Disassembly

Desk Illumination Lamps



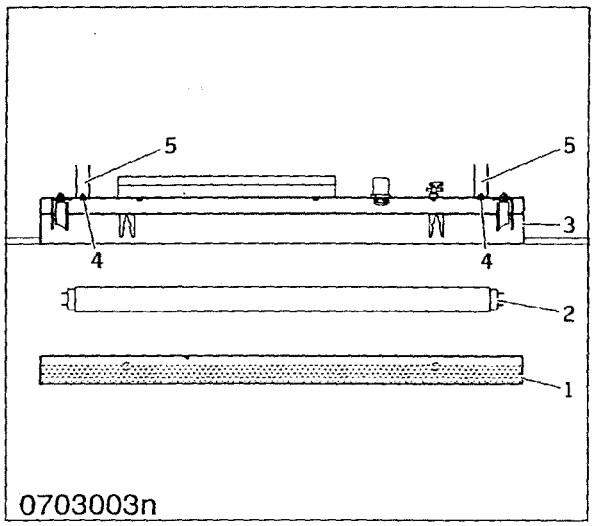
0703002n

Undo the clasp (4) securing the light assembly (2) to the cab ceiling (3). The light assembly (2) can then be swung downwards.

Tag and disconnect the wiring to the light assembly (2).

Loosen and remove the screws, washers and nuts (5) securing the light assembly hinge (6) to the cab ceiling (3), then withdraw the light assembly (2) from the cab ceiling (3).

Cab Lights



0703003n

Remove the cover (1) from the cab light assembly (3).

Loosen and remove the screws (4) fixing the cab light assembly (3) to the mounting bars (5) in the cab ceiling, then lower the assembly (3) slightly.

Tag and disconnect the wiring from the light assembly (3), then remove the assembly (3) from the cab ceiling.

Machine Room Lights

Tag and disconnect the wiring from the light assembly.

Remove the light assembly from the machine room roof.

Hand Lamp Sockets

Removal of Panel D is described in Chapter 7.5, Cab.

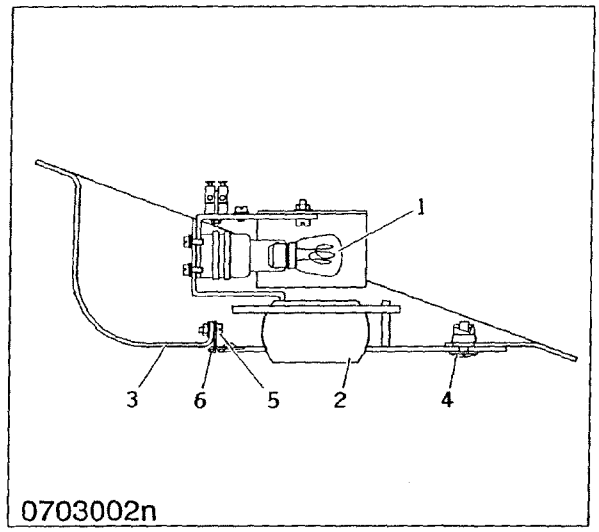
Terminal Bars

Tag and disconnect the wiring from the terminal bar, then remove the terminal bar from the machine room roof.

Disassembly

@.1240

Desk Illumination Lamps



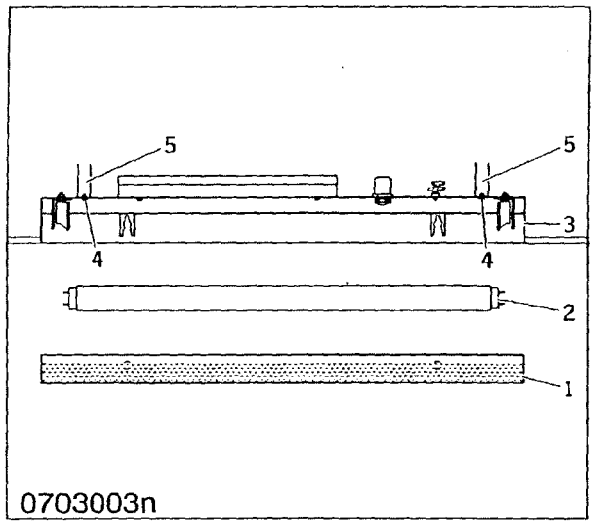
0703002n

Undo the clasp (4) securing the light assembly (2) to the cab ceiling (3), then swing light assembly (3) downwards, as required.

Remove the bulb (1) from the light assembly (2).

Replace the bulb (1), as necessary, as described in Section Assembly.

Cab Lights



0703003n

Remove the cover (1) from the cab light assembly (3), as required.

Remove the fluorescent tube (2) from the light assembly (3).

Replace the fluorescent tube (3), as necessary, as described in Section Assembly.

Machine Room Lights

Remove the cover from the machine room light assembly, as required.

Remove the fluorescent tube from the light assembly.

Replace the fluorescent tube, as necessary, as described in Section Assembly.

Hand Lamp Sockets

For more information regarding Panel D, refer to Chapter 7.5, Cab.

Terminal Bars

There is no disassembly applicable to the terminal bars.

Inspection and Repair

@.1250

Desk Illumination Lamps

Inspect the condition and operation of the desk illumination lamp assembly. Replace if necessary.

Inspect the condition of the desk illumination bulb. Replace if faulty or damaged.

Cab Lights

Inspect the condition and operation of the cab illumination light assembly. Replace if necessary.

Inspect the condition of the cab light cover. Replace if broken, cracked or damaged.
Inspect the condition of the cab illumination fluorescent tube. Replace if faulty or damaged.

Machine Room Lights

Inspect the condition and operation of the machine room illumination light assembly. Replace if necessary.

Inspect the condition of the machine room light cover. Replace if broken, cracked or damaged.

Inspect the condition of the machine room light fluorescent tube. Replace if faulty or damaged.

Hand Lamp Sockets

For more information regarding Panel D, refer to Chapter 7.5, Cab.

Terminal Bars

Inspect the condition of the terminal bars. Replace if faulty or damaged.

Waste Disposal

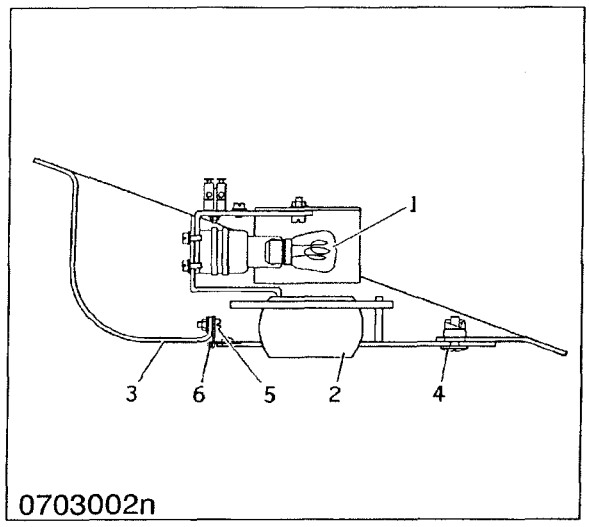
@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

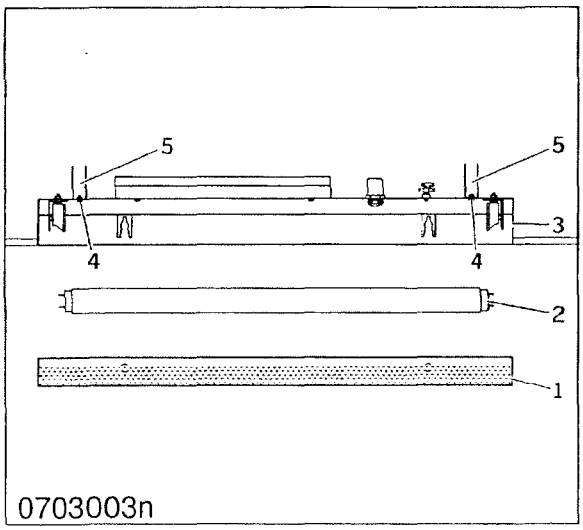
Desk Illumination Lamps



Install the bulb (1) to the light assembly (2).

Swing the light assembly (2) into position in the cab ceiling (3), as required, then secure with the fastener (4).

Cab Lights



Install the fluorescent tube (2) to the light assembly (3).

Install the cover (1) to the cab light assembly (3), as required.

Machine Room Lights

Install the fluorescent tube to the light assembly.

Install the cover to the machine room light assembly, as required.

Hand Lamp Sockets

For more information regarding Panel D, refer to Chapter 7.5, Cab.

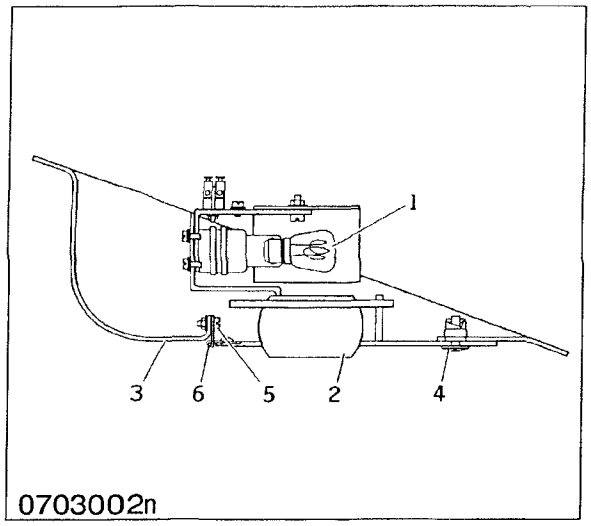
Terminal Bars

There is no assembly applicable to the terminal bars.

Installation

@ 1280

Desk Illumination Lamps



0703002n

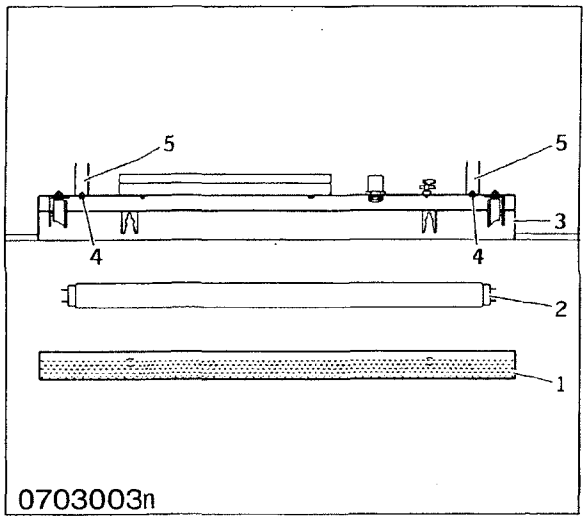
Position the light assembly (2) into the cab ceiling (3), then secure the light assembly hinge (6) to the cab ceiling (3) with screws, nuts and washers (5).

Reconnect the wiring to the light assembly (2) as tagged during removal.

Refer to Chapter 7A, Driver's Cab Lighting Control of Volume G, Cabling Documentation.

Swing the light assembly (2) into position in the cab ceiling (3), then secure with the fastener (4).

Cab Lights



0703003n

Reconnect the wiring to the light assembly (3) as tagged during removal, then install the assembly into the cab ceiling.

Refer to Chapter 7A, Driver's Cab Lighting Control of Volume G, Cabling Documentation.

Install screws (4) to fix the light assembly (3) to the mounting bars (5) in the cab ceiling.

Install the cover (1) to the cab light assembly (3).

Machine Room Lights

Reconnect the wiring to the light assembly, as tagged during removal.

Install the light assembly to the machine room roof.

Hand Lamp Sockets

Installation of Panel D is described in Chapter 7.5, Cab.

Terminal Bars

Install the terminal bars to the machine room roof, then reconnect the wiring as tagged during removal.

After-Installations Operations

@.1290

Close the circuit breakers, then test the operation of the locomotive internal lighting systems. Rectify any faults found.

Adjustments

@.1310

There are no adjustments applicable to the lighting.

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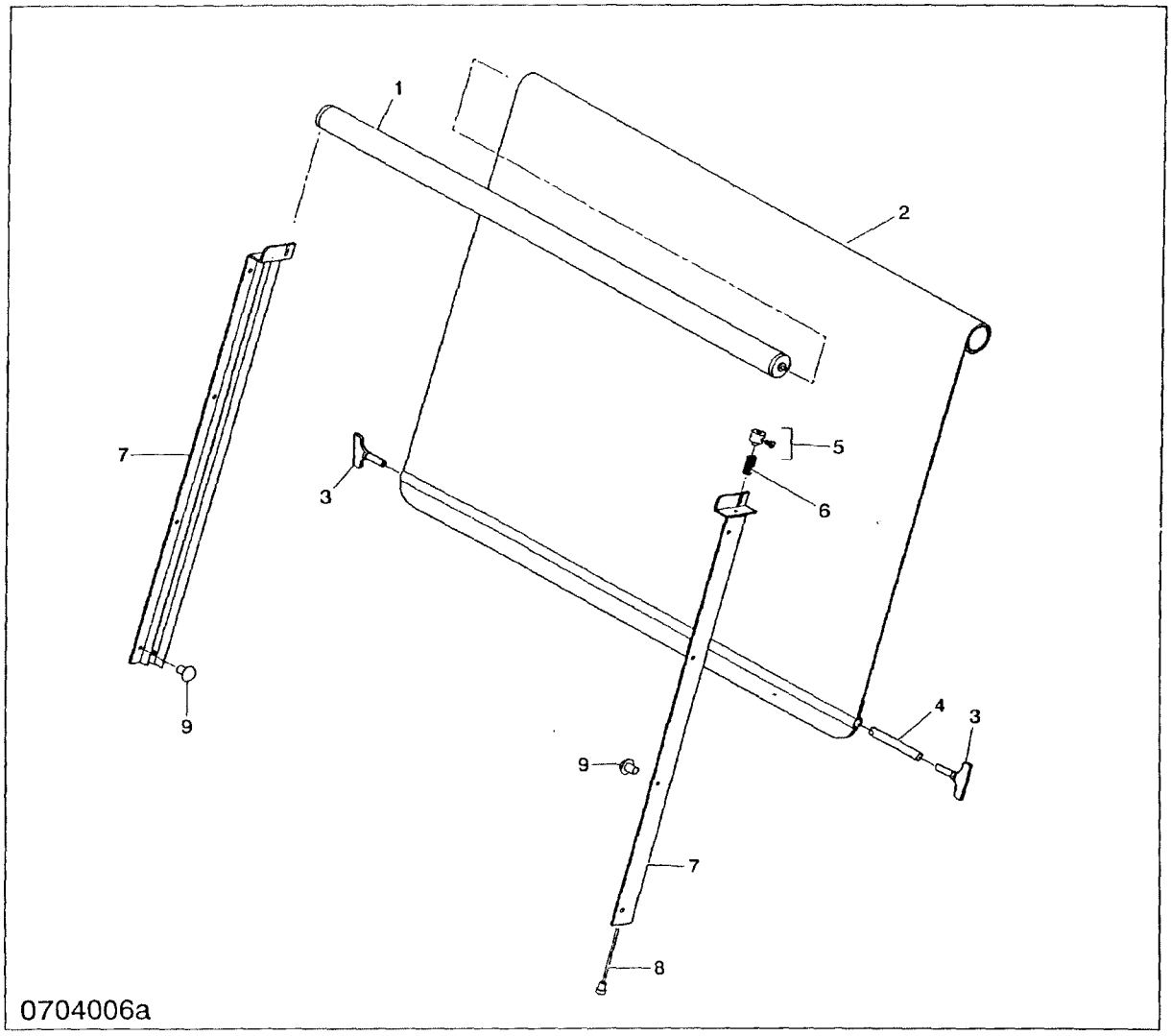
7.4 Blinds

Group Summary

@.1120

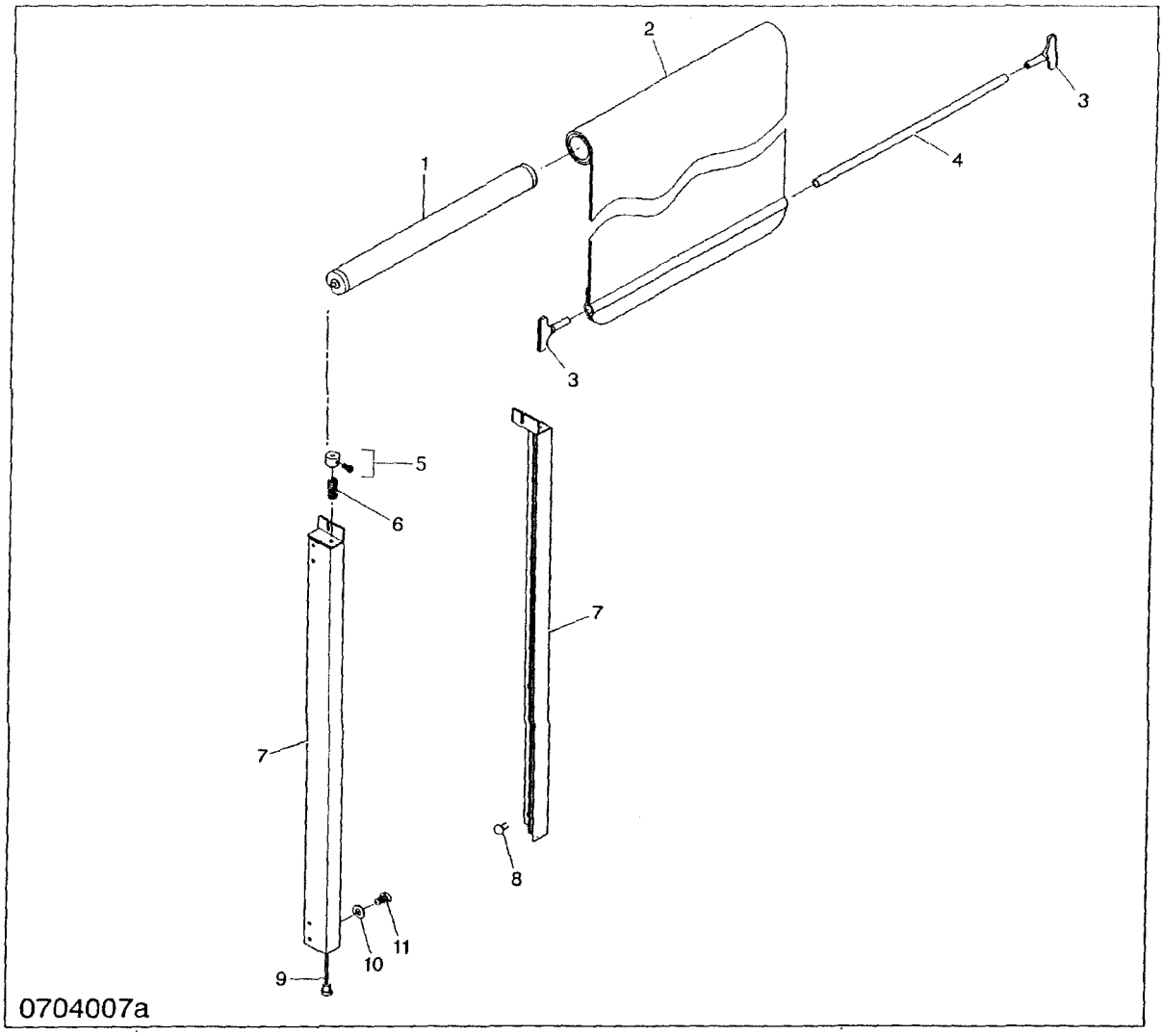
This chapter contains information regarding the windscreen and side window blinds fitted over the interior of each window in the cab.

Windscreen Blinds



1	Roller	6	Spring
2	Fabric	7	Guide rails
3	Guide block	8	Cable assembly
4	Tube	9	Pop rivet
5	Adjusting nipple assembly		

Side Window Blinds



1	Roller	7	Guide rails
2	Fabric	8	Pop rivet
3	Guide block	9	Cable assembly
4	Tube	10	Spring washer
5	Adjusting nipple assembly	11	Screw
6	Spring		

Functional Description

@.1140

Both cab side windows and the windscreens are fitted with vertically sliding binds that can be drawn over the windows to reduce glare. The blinds operates on a "Holland Blind" principle; pull the blind down to close, or lift using an upward action to open. The front blind rolls toward the windscreen, while the side window blinds away from the side window.

Guide rails maintain the alignment of the blind in relation to the windows. Guides for the windscreen are riveted to the cab pillars. The forward guide of the side window blind is riveted to brackets at the top and bottom of the window. The rear guide of the side window blind guide is fixed to the door pillar using screws.

Cables are used to counter-balance the spring tension of the blind roller. The cables are secured into the bottom of the guide rails, then through the guide block and tube, crossing to the opposite side. At the top of the guide, the cable is secured by a spring and adjusting nipple. The blind's restrictive effort can be altered by the adjusting nipple.

Technical Data

@.1160

- Material	Dura-cover 1100D TEX

Tolerances and Wear Limits List

@.1170

No specific tolerances or wear limits are applicable to the blinds. Items should be inspected as described in Section Inspection and Repair, and replaced or repaired as necessary.

Tools and Special Tools

@.1180

Conventional railways workshop tools and equipment are required for the procedures described in this Chapter.

A 4.8 mm diameter drill bit is required to remove the pop rivets securing the guide rails.

Miscellaneous Materials

@.1200

Miscellaneous materials required for the procedures described in this chapter include:

- A small nail, or a short piece of 2.5 mm diameter wire is required during the bind roller installation
- Vinyl upholstery cleaner
- Plastic tape or 3 mm diameter heat shrinkable plastic for the end of the blind cables.

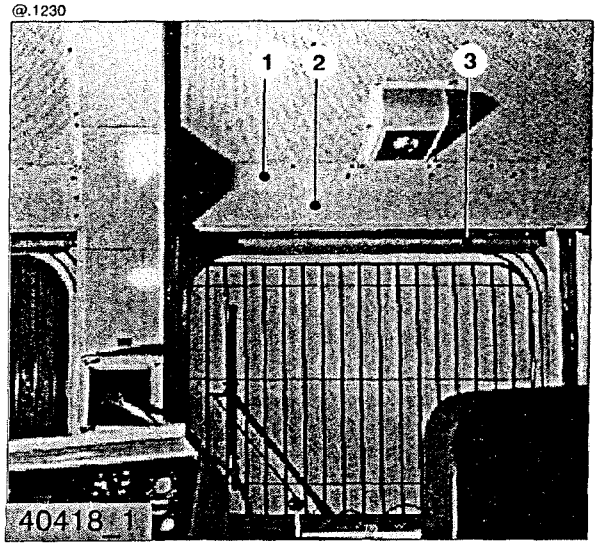
Before-Removal Operations

@.1220

There are no before removals operations applicable to the blinds.

Removal

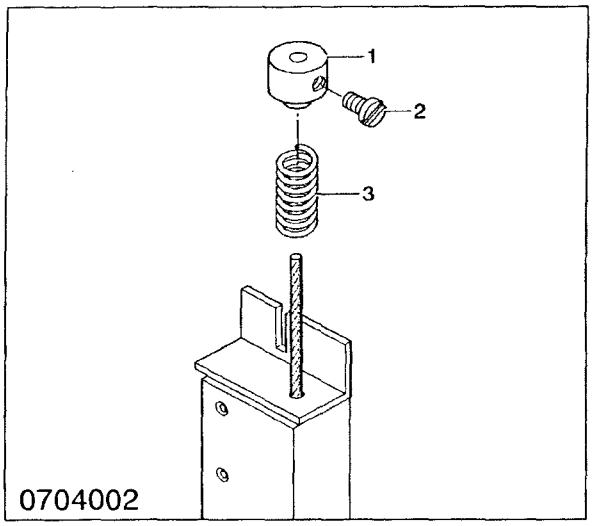
Windscreen Blinds



Removal of the left and right hand side windscreen blinds is the same.

Remove the screws (1) securing the cover panel above the windscreen blind.

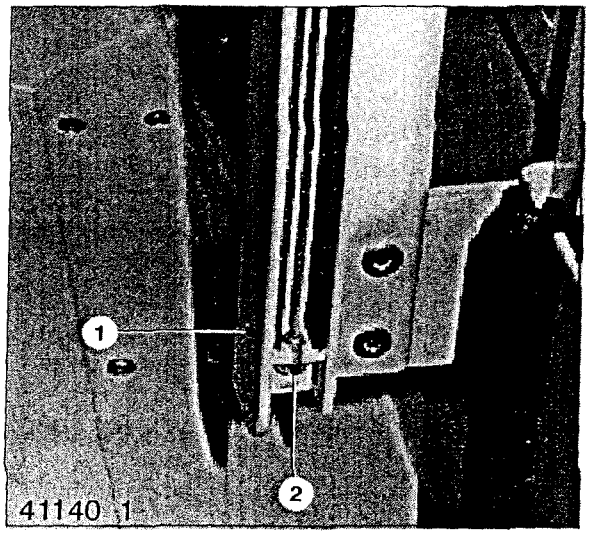
Remove the panel (2) from above the windscreen blind (3).



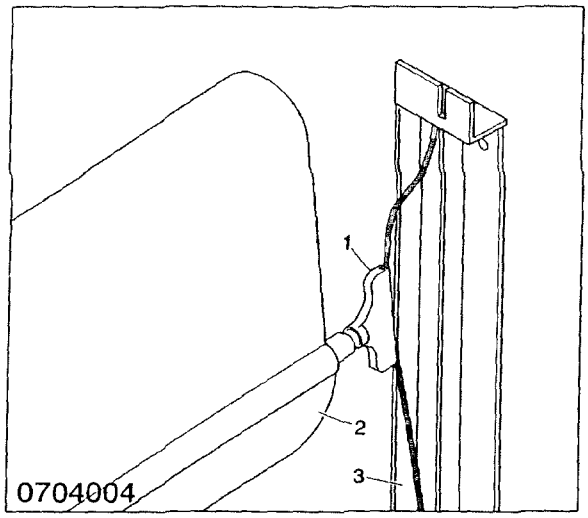
Remove the plastic tip from the top of the cable.

Slacken the screws (2) on the nipple (1) at the top end of the cable, located at the end of the cable.

Remove the nipple (1) and coil springs (3). Withdraw the cable from the top of the guide rail.



Disconnect the nipple (2) from the bottom of the guide rail (1) on both sides.



Lift the blind (2) up from the guide rails (3) (the blind spring will rapidly uncoil).

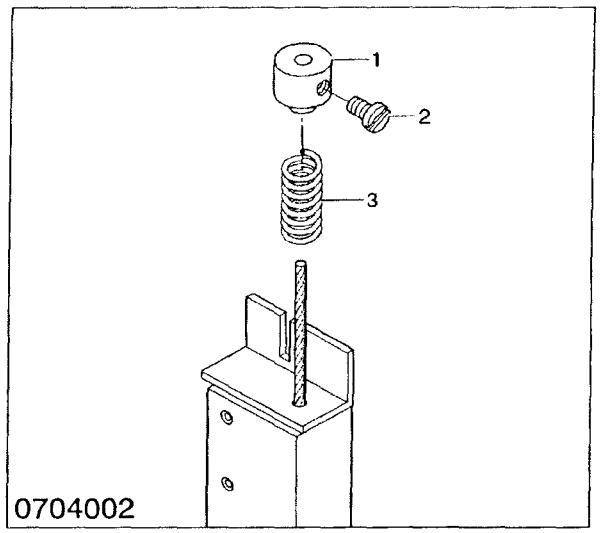
Raise the guide block (1) and lift from the top of the guide rails (3).

Withdraw the cable from the guide block (1) and the tube, if necessary.

Side Window Blinds

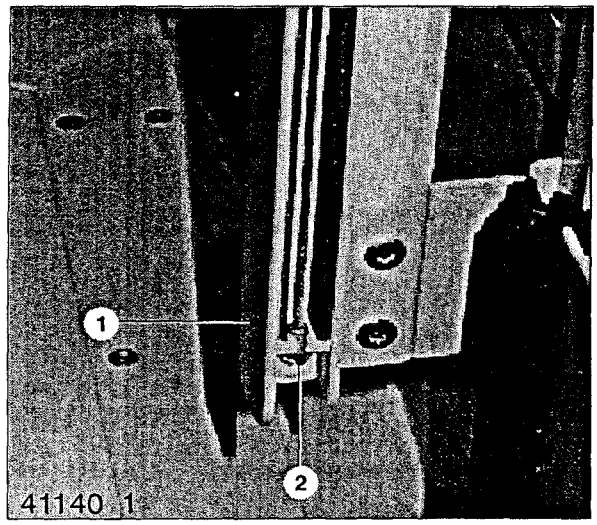
Removal of the left and right side window blind is the same.

Remove the plastic from the top end of the cables.

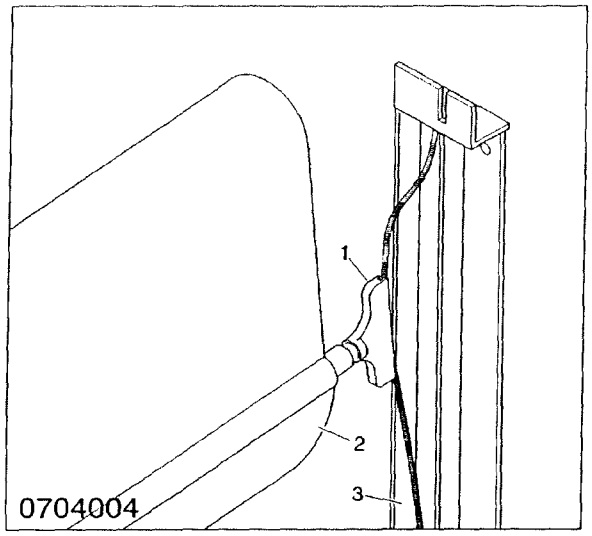


Slacken the screws (2) on the nipple (1) at the top end of the cable, located at the end of the cable.

Remove the nipple (1) and coil springs (3). Withdraw the cable from the top of the guide rail.



Disconnect the nipple (2) from the bottom of the guide rail (1) on both sides.



Lift the blind (2) up from the guide rails (3) (the blind spring will rapidly uncoil).

Raise the guide block (1) and lift from the top of the guide rails (3).

Withdraw the cable from the guide block (1) and the tube, if necessary.

Disassembly

@.1240

Blinds

Withdraw the cables from the tube, if necessary.

Separate the guide blocks from the tube, if necessary.

Withdraw the tube from the blind, if necessary.

The blind roller should not be disassembled, but replaced if faulty or damaged.

Guide Rails

The forward guide of the side window blind is riveted to brackets at the top and bottom of the window. The rear guide of the side window blind guide is fixed to the door pillar using screws.

Remove the pop rivets securing the guide rails using a 4.8 mm diameter drill, where necessary. Remove the screws securing the guide rail, where necessary.

Remove the guide rail.

Inspection and Repair

@.1250

Blinds

Check the blind fabric for rips, tears, damage or fraying. Repair or replace the blind as necessary. Clean the blinds with a suitable vinyl cleaning solution.

Blind Roller

Check the blind roller for bend, distortion or damage. Replace the roller if necessary.

Wind the roller spring four turns, then release. The spring should uncoil rapidly. Do not wind the spring more than four turns.

Blind Tube

Check the condition of the tube for bend or wear. Movement of the cables through the tube may cause wear grooves. Replace the tube if bent, worn or damaged.

Guide Blocks

Inspect the condition of the guide blocks. Check for wear caused by movement of the cables in the blocks and for wear on the guide rail contact surfaces. Replace the guide blocks if worn or damaged.

Cable

Check the condition of the cable over its full length for wear, damage or fraying.

Check the cable for kinks or bends.

Inspect the fixed nipple at the end of the cable for wear or the nipple or fraying of the cable.

Worn, damaged or fraying cables may restrict the movement of the blinds. Replace the cable if necessary.

Guide Rails

Inspect the condition of the guide rails for wear, bend, twist or damage.

Check the fixed nipple seat in the lower end of the guide rail for wear. Ensure the nipple fits securely in the seat.

Replace the guide rail if necessary.

Waste Disposal

@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

Blinds

Insert the tube into the pocket of the blind.

Insert the guide blocks into each end of the tube.

Install the cables through the guide blocks and tube. Each cable should be inserted from opposite sides.

Guide Rails

Position the guide rail in the cab ensuring the seat for the fixed nipple is facing downward.

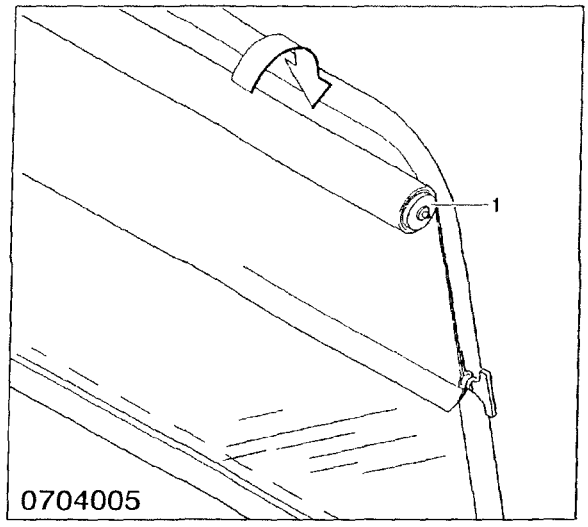
The forward guide of the side window blind is riveted to brackets at the top and bottom of the window. The rear guide of the side window blind guide is fixed to the door pillar using screws.

Secure the guide rail to the brackets using pop rivets or screws, as appropriate. Ensure the guide rails are parallel.

Installation

@.1280

Windscreen Blinds

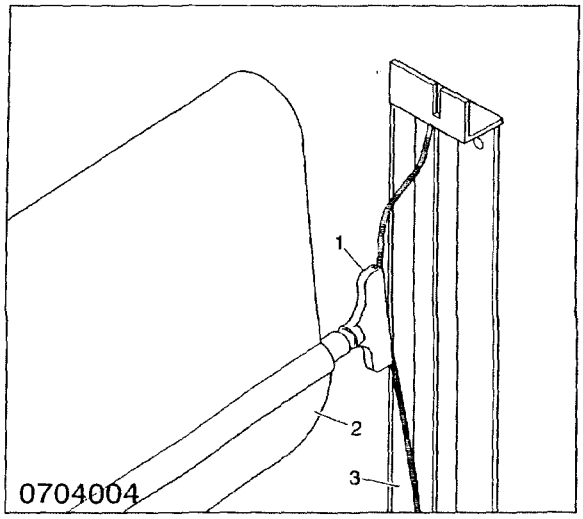


Installation of the left and right windscreen blind is the same.

Orientate the blinds so that the windscreen blind (1) unrolls towards the windscreen.

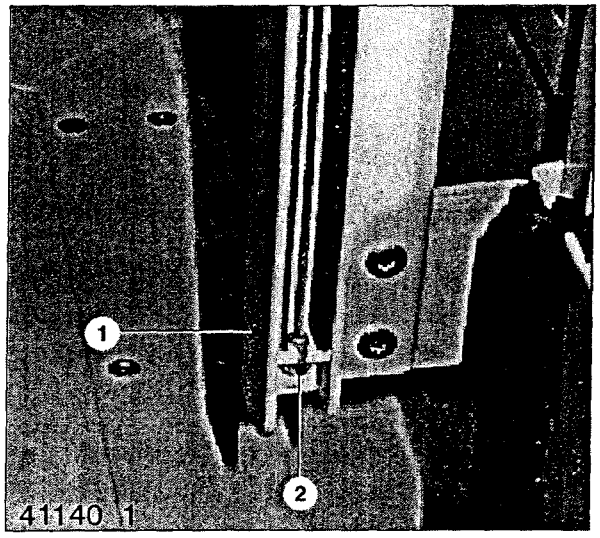
Pretension the blind springs by winding the spring end of blind 15 turns counter clockwise.

Align the lock hole in the inner (spring) tube with the hole in the outer tube and install a suitable locking device eg. nail or similar.

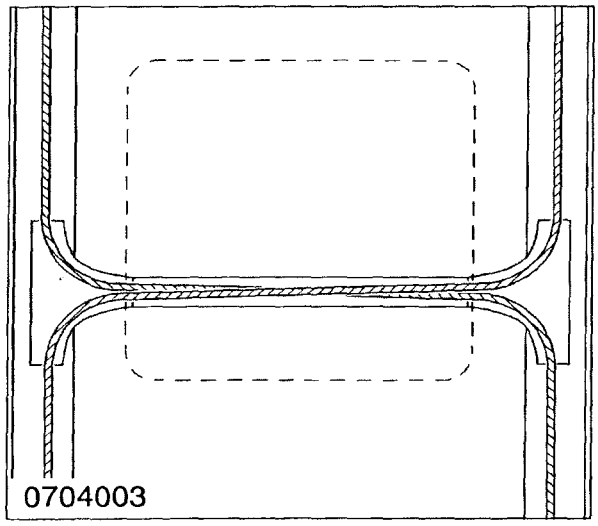


Insert the guide blocks (1) into the guide rails (3).

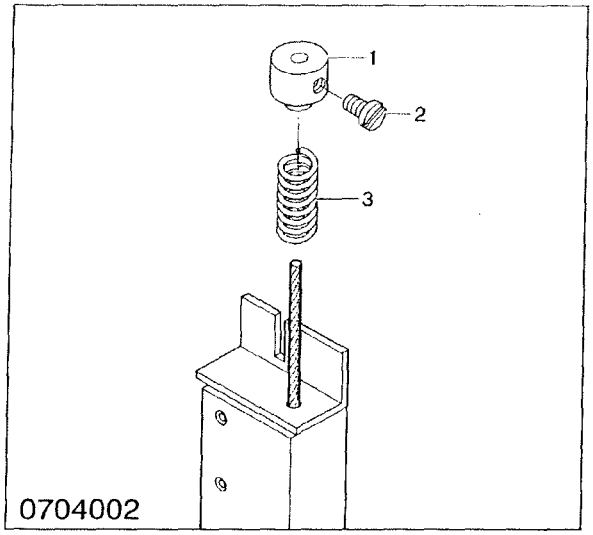
Position the blind (2) into the recesses in the top of the guide rails (3). Ensure the tang engages correctly in the grove.



Install the fixed nipple (2) of the cable into the bottom of the guide rail (1).



Bring the opposite end of the cable up the guide rail (1) and through the top of the guide rail (1).



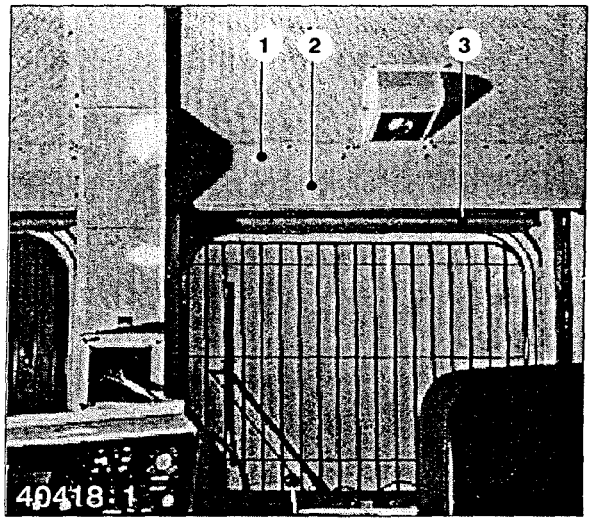
Install the spring (3) and top nipple (1), then tighten the screw (2) on the nipple (1) to hold the cable.

Repeat the procedure for the other cable.

Remove the locking pin from the blind roller.

Pull the cables taught and push the nipples (1) against the spring (3), to compress the spring (3) slightly, then tighten the screws (1) to clamp the cables.

Check the operation of the blinds to ensure that the blinds hold the selected position. Adjust the blinds as necessary as described in Section Adjustments.

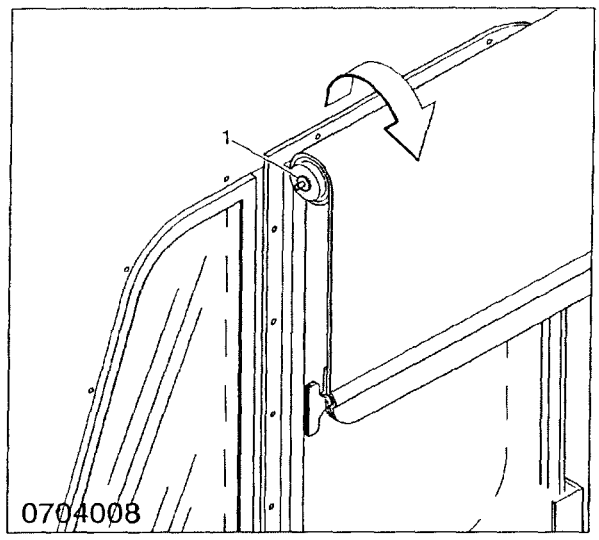


Position the panel (2) above the blind (3).

Align the holes in the panel with the holes in the cab panel.

Install and tighten the screws (1).

Side Window Blinds

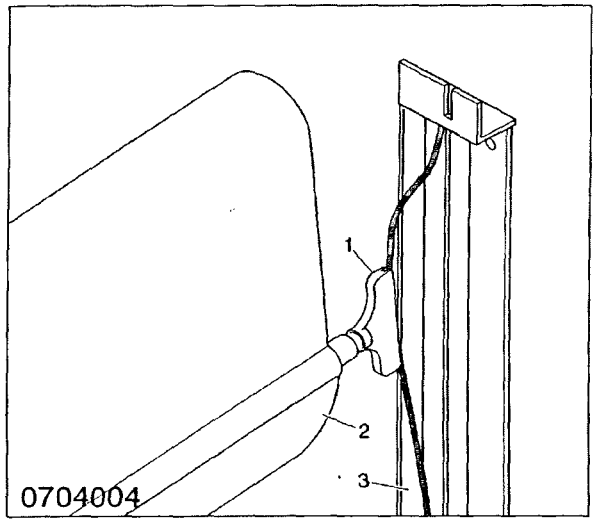


Installation of the left and right side window blind is the same.

Orientate the blinds so that the side window blind (1) unroll away from the side window.

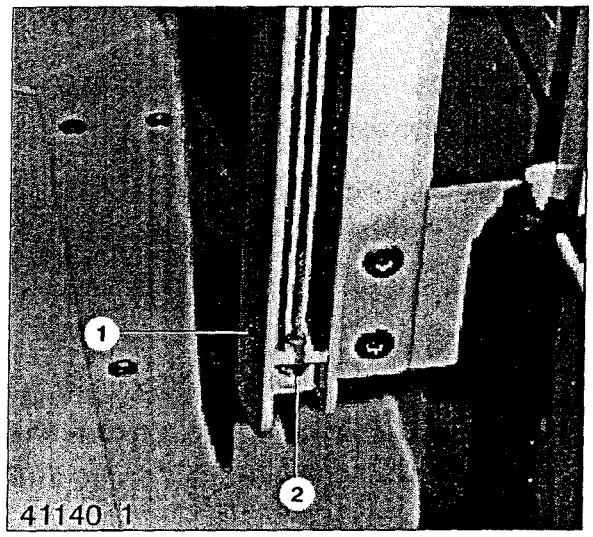
Pretension the blind springs by winding the spring end of blind 15 turns clockwise.

Align the lock hole in the inner (spring) tube with the hole in the outer tube and install a suitable locking device eg. nail or similar.

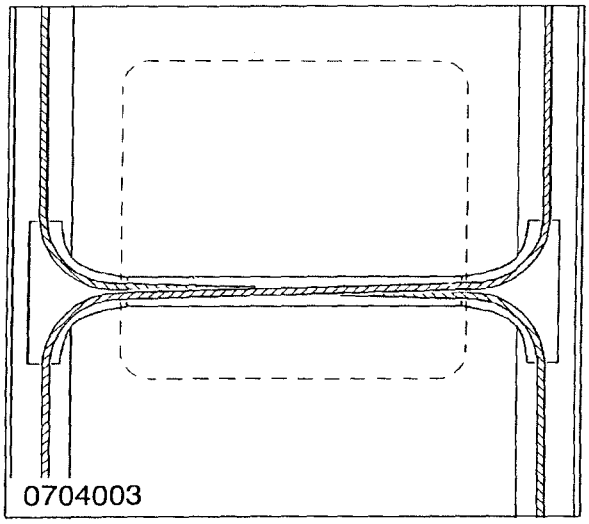


Insert the guide blocks (1) into the guide rails (3).

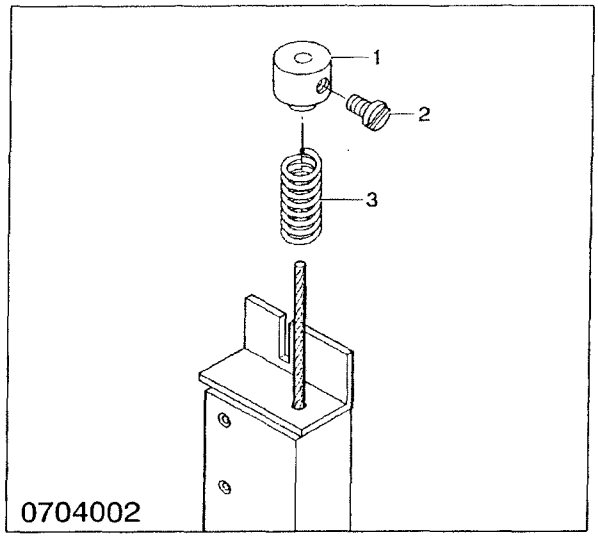
Position the blind (2) into the recesses in the top of the guide rails (3). Ensure the tang engages correctly in the grove.



Install the fixed nipple (2) ot the cable into the bottom of the guide rail (1).



Bring opposite end of the cable up the guide rail (1) and through the top of the guide rail (1).



Install the spring (3) and top nipple (1), then tighten the screw (2) on the nipple (1) to hold the cable.

Repeat the procedure for the other cable.

Remove the locking pin from the blind roller.

Pull the cables taught and push the nipples (1) against the spring (3), to compress the spring (3) slightly, then tighten the screws (1) to clamp the cables.

Check the operation of the blinds to ensure that the blinds hold the selected position. Adjust the blinds as necessary as described in Section Adjustments.

After-Installations Operations

@.1290

There are no after installation operations applicable to the blinds.

Adjustments

@.1310

Test the operation of the blind. The blind should be free to move up and down with minimum restriction, and hold in position when released. If necessary, adjust the blind to achieve proper operation.

Loosen the screw on the top nipple of one cable. Adjust the position of the nipple to provide greater or less tension on the spring as required, then tighten the screw.

Repeat the process for the opposite cable, then re-check the operation of the blind. Re-adjust the top nipples if necessary.

Cover the ends of the cable with heat shrinkable plastic, or plastic tape.

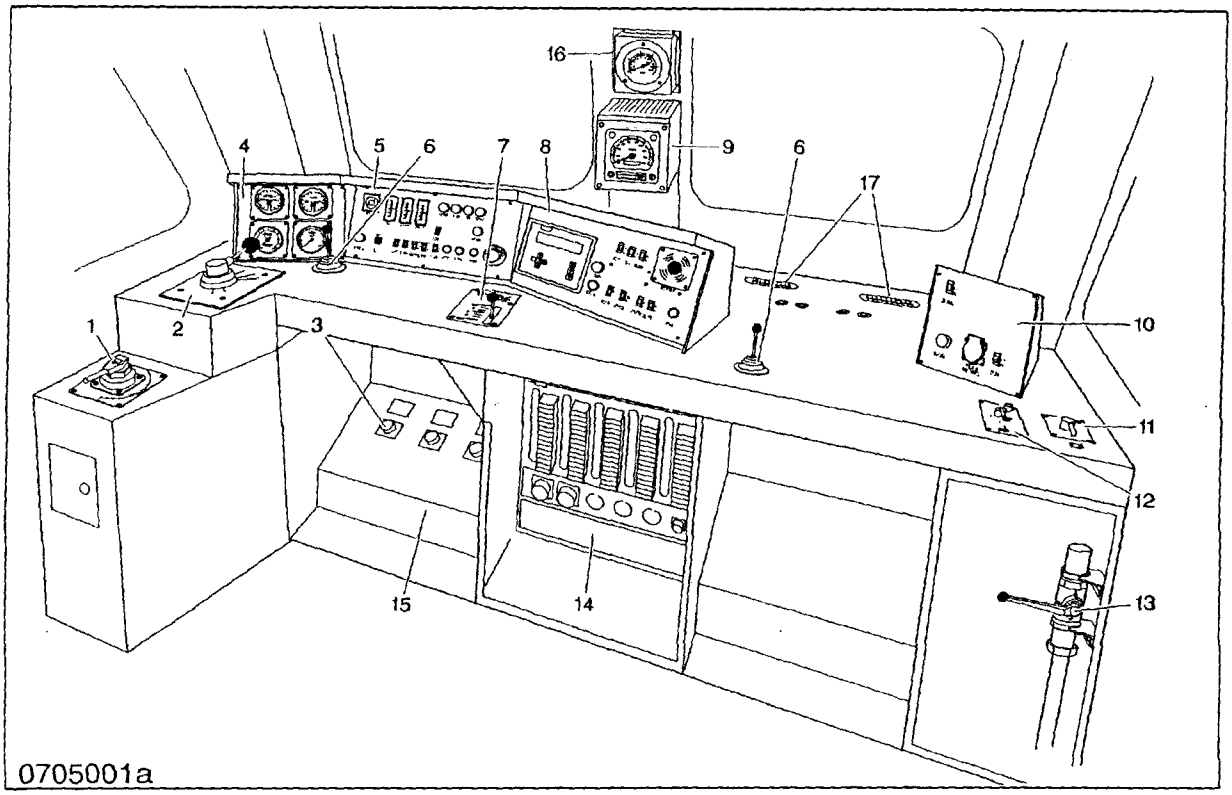
7.5 Cab

Group Summary

@1120

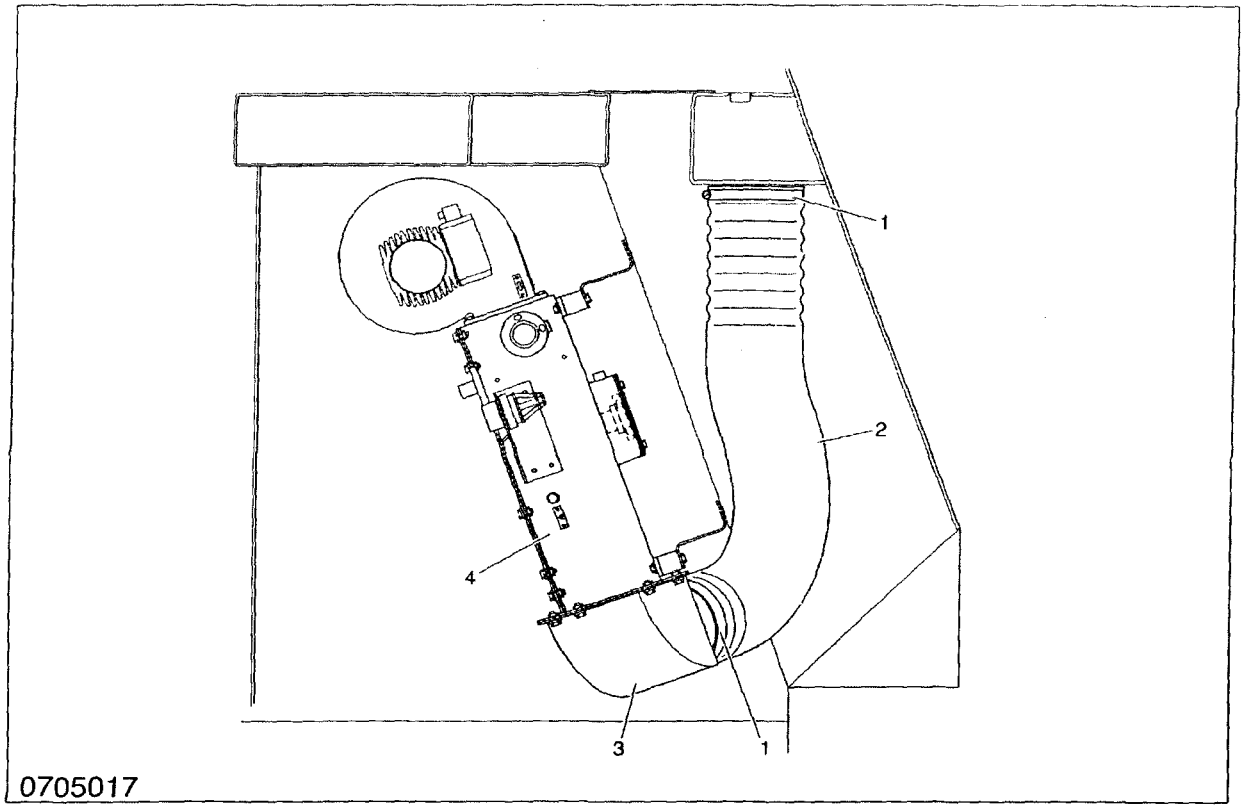
This chapter contains information on the locomotive cab and equipment, which consists of: cab console, panels "A", "B", "C" and "D", cab heater, cab heater control switch, crew fans, fire extinguisher, horn control, wiper/washer control, TE/BE master controller, Memotel recorder/Speedometer, parking brake pressure gauge, cubicle "F" and foot pedals.

Cab Overview



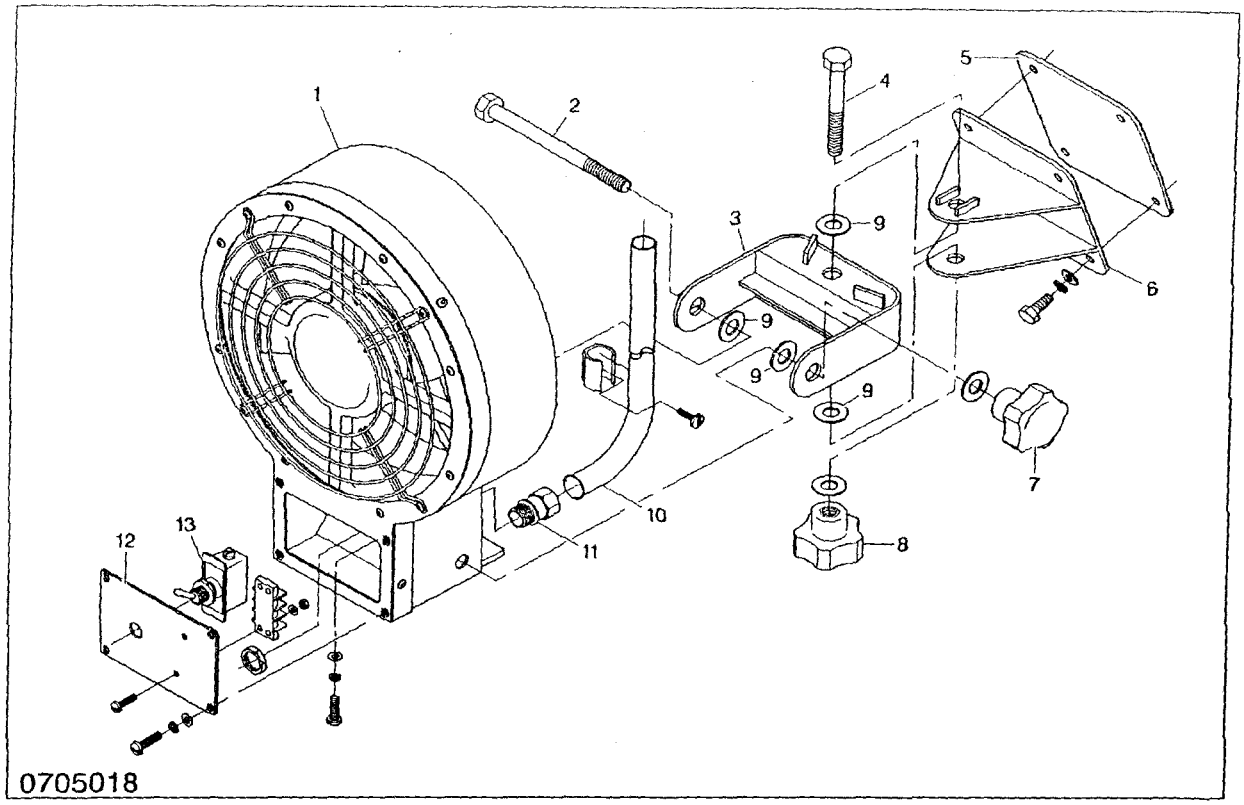
1	Driver's air brake valve	10	Panel "D"
2	Automatic train brake controller	11	Heater control
3	Foot switch	12	Wiper/washer control
4	Panel "B"	13	Emergency-isolating cock
5	Panel "A"	14	Cubicle "F"
6	Horn control	15	Plate-foot pedal
7	Master controller	16	Parking brake pressure gauge
8	Panel "C"	17	Cab heater exhaust vents
9	Speedometer recorder		

Cab Heater



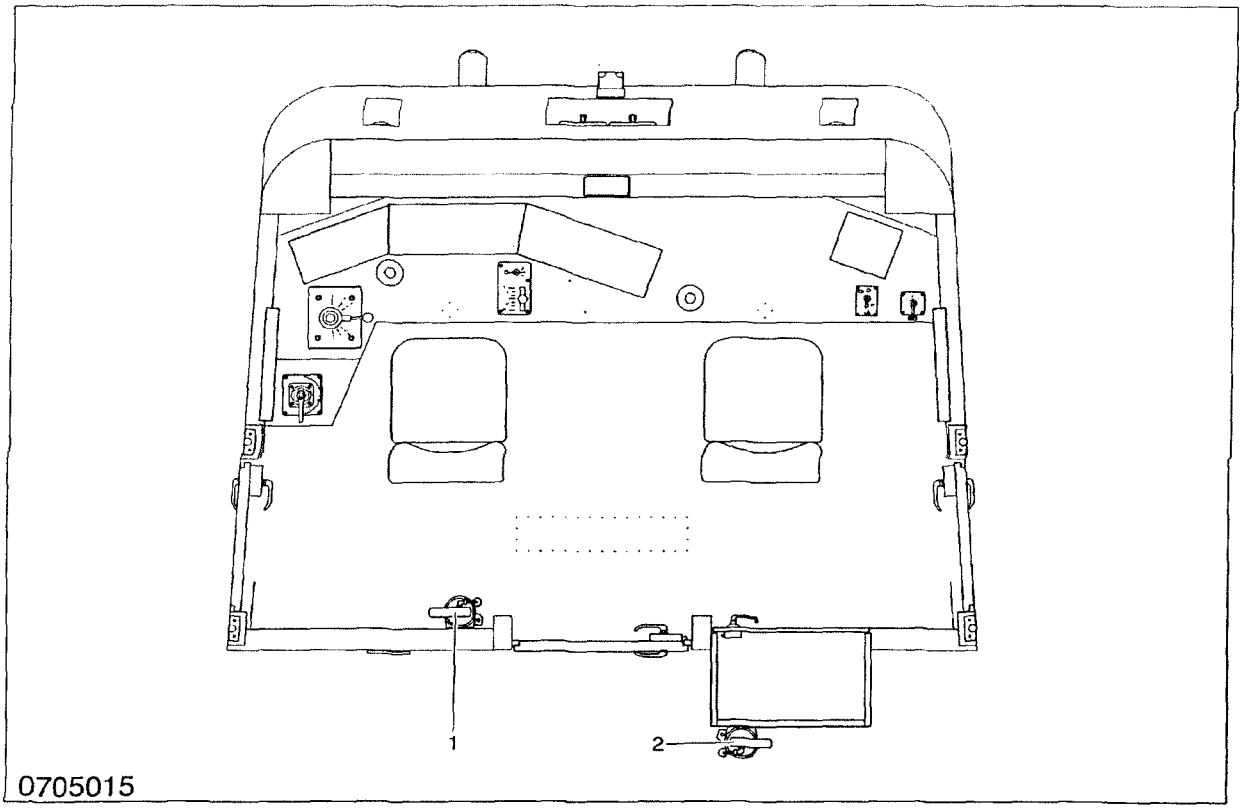
1	Clamp	3	Heater bend
2	Flexible duct	4	Heater unit

Crew Fan



1	Fan housing assembly	8	Adjustment knob, vertical
2	Adjustment bolt, horizontal	9	Fibre washer
3	Mounting bracket	10	Conduit
4	Adjustment bolt, vertical	11	Fitting
5	Insulation pad	12	Access cover
6	Frame bracket	13	Switch
7	Adjustment knob, horizontal		

Fire Extinguisher



1 Fire extinguisher in crew cab

2 Fire extinguisher in machine room

Functional Description

@.1140

Panels A, B, C, D

Panels contain various switches, sockets, gauges and lights required for locomotive operation. Refer to Volume A, Driver's Manual for further information regarding the panels.

Cab Heater

The cab heater provides normal and heated air flow, which is vented upwards from the cab desk onto the windscreens. This provides heating for the cab and demisting for the windscreens.

Cab Heater Control Switch

The cab heater control switch operates the cab heater.

Crew Fans

Crew fans are provided near the driver's and assistant driver's desks. These fans circulate the air in the cab when activated.

Fire Extinguisher

A fire extinguisher is provided in each cab.

Horn Control

The horn control levers are used to activate the two-tone horn system, which is described in Chapter 1.6, Horns and Lights.

Wiper/Washer Control

The wiper/washer control lever activates the windscreen wiper and washer system, which is described in Chapter 1.7, Wipers and Washers.

TE/BE Master Controller

The master controller regulates the tractive and braking effort of the traction control system. Refer to Volume A, Driver's Manual for further information regarding the master controller.

Speedometer Recorder (MEMOTEL)

The MEMOTEL is an autonomous, microprocessor-controlled indicating and recording unit. This multi-functional device is used for measuring and displaying the speed, and for recording the speed together with other operating data either in the internal memory or on a memory card.

For further information regarding the Memotel unit, refer to Volume A, Driver's Manual and *Chapter 1, Sécheron Memotel of Volume F16, Suppliers Documentation.*

Parking Brake Pressure Gauge

The parking brake pressure gauge displays the pressure in the parking brake system.

Cubicle F

Cubicle F contains connectors for integrating the cab electronics to the locomotive electronics. Cubicle F also contains a resistor for the headlight dimming function and a transformer for the voltage display on Panel A.

Foot Pedals

Foot pedals are located within the driver's foot well. For further information regarding the function of the foot pedals, refer to Volume A, Driver's Manual.

Technical Data

@.1160

Panel A

GAUGE WORKING RANGES

- Battery voltmeter	0 - 150 V
- Catenary voltmeter	0 - 30 kV
- Bogie tractive effort	BE 100 - 0 - 100 % TE

Panel B

GAUGE WORKING RANGES

- Brake cylinder pressure	0 - 7 kg/cm2
- Brake pipe pressure	0 - 7 kg/cm2
- Brake pipe flow meter	dimensionless ratio, LP to HP
- Main reservoir pressure	0 - 11 kg/cm2
- Brake feed pipe pressure	0 - 11 kg/cm2

Panel C

- Diagnostic display terminal	ICT-30.XX
- Display	LCD with LED backlight
- Power consumption	6 W

Cab Heater

- Heater	110 V AC
- Blower	110 V single phase, asynchronous

Crew Fans

- Fan motor	110 V, 1 A, single phase

Fire Extinguisher

- Model	FCO 2.0
- Capacity	2 kg
- Type	Carbon Dioxide (CO2)

TE/BE Master Controller

- Direction selector	Rotary switch, type SG 460039 P1
- Drive/Brake handle	contact elements, type AM 400660 R1
- Direct current	24 V/16 A
	48 V/4 A
	110 V/1 A
- Drive/Brake handle	angle converter, type 7W1
Input	24 V/30 mA
Output	20-2-20 mA

Memotel Recorder/Speedometer

- Pointer deflection	240°
- Illumination	11 LED's on dial
- Brightness control	Manual, stepless from 0 to 100 %
- Digits	8 digit, 6 mm high
- Accuracy	±1 %
- Power consumption	20 W
- Memory type	Flash Memory
- *Memory capacity, internal*	*256 kB*
- Memory capacity, memory card	384 kB or 1.5 MB

Brake Pipe Pressure Gauge

- Working range	0 - 7 kg/cm2

Tolerances and Wear Limits List

@.1170

No specific tolerances or wear limits are applicable to the equipment described in this chapter. Items should be inspected as described in Section Inspection and Repair, and replaced or repaired as necessary.

Tools and Special Tools

@.1180

Conventional railway workshop tools are required for the procedures described in this chapter.

Miscellaneous Materials

@.1200

Plastic plugs or alike to seal pneumatic pipes and valve unions against the ingress of dirt and foreign material.

Before-Removal Operations

@.1220

General

Some parts of the cab console may need to be removed prior to removing/disassembling some components in the cab. If necessary, remove the appropriate cab console panels as described in Section Removal.

Set the "Driver's Cab" circuit breaker (127.3) to the Off position. Circuit breaker 127.3/1 for the No. 1 End is situated in SB1 and circuit breaker 127.3/2 for the No. 2 End is situated in SB2. For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Set the "Power Supply 24V/48V" circuit breaker (127.91) to the Off position. Circuit breaker 127.91/1 for the No. 1 End is situated in SB1 and circuit breaker 127.91/2 for the No. 2 End is situated in SB2. For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Set the "Control Circuits Locomotive" circuit breaker (112.1) to the Off position. Circuit breaker 112.1 is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Cab Console

Some cab console panels cover electrical and pneumatic systems, and isolation of these systems is required prior to the removal of these panels. For example, the removal of the panel covering cubicle F requires the same before-removal operations as cubicle F.

Panel B

Isolate and vent the pneumatic systems monitored by the gauges on Panel B. This includes the brake cylinders, the brake feed pipe, the main reservoirs and the locomotive pneumatic system.

Horn Control

Open the cover marked "Wiper & Horn Isolation" on the driver's side of the cab console. Turn the horn isolation cock to the Off position.

Heater

Set the "Cab Heater" circuit breaker (69.62) to the Off position. Circuit breaker 69.62 is situated in Auxiliary Circuits, Cubicle-1 (HB1). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Set the "Cab Ventilation" circuit breaker (69.61) to the Off position. Circuit breaker 69.61 is situated in Auxiliary Circuits, Cubicle-1 (HB1). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Heater Control

Set the "Cab Heater" circuit breaker (69.62) to the Off position. Circuit breaker 69.62 is situated in Auxiliary Circuits, Cubicle-1 (HB1). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Set the "Cab Ventilation" circuit breaker (69.61) to the Off position. Circuit breaker 69.61 is situated in Auxiliary Circuits, Cubicle-1 (HB1). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Crew Fan

Set the "Crew Fan" circuit breaker (69.71) to the Off position. Circuit breaker 69.71 is situated in Auxiliary Circuits, Cubicle-1 (HB1). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Wiper/Washer Control

Open the cover marked "Wiper & Horn Isolation" on the driver's side of the cab console. Turn the wiper isolation cock to the Off position.

TE/BE Master Controller

Isolate the locomotive pneumatic system. Isolate the main compressors from the pneumatic system and vent the main reservoirs.

Emergency Isolation Cock

Isolate the locomotive pneumatic system. Isolate the main compressors from the pneumatic system and vent the main reservoirs.

Move the emergency isolation cock to the emergency position to ensure the brake feed pipe is fully vented.

Memotel/Speedometer

Set the "MEMOTEL speedometer" circuit breaker (127.92) to the Off position. Circuit breaker 127.92 is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Cubicle F

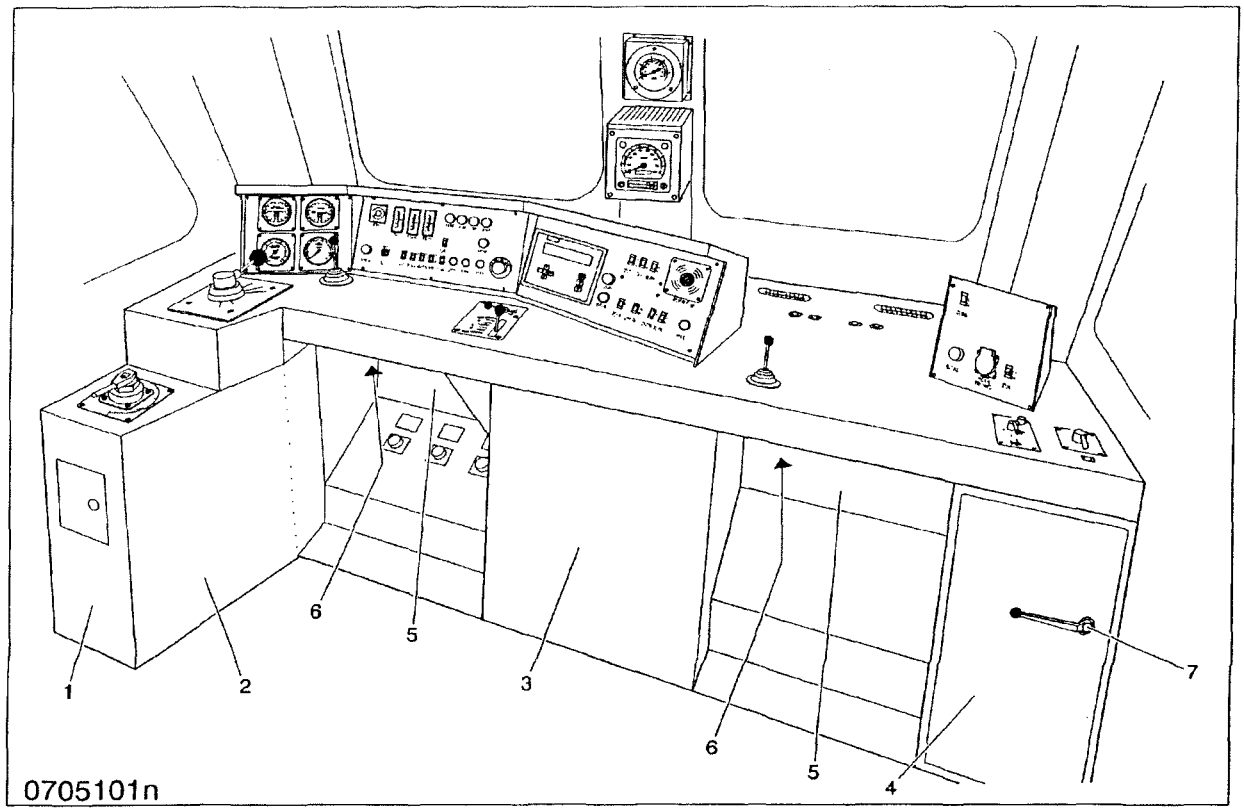
Set the "Lighting Front" circuit breaker (310.0) to the Off position. Circuit breaker 310.0 is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Set the "Marker Lights" circuit breaker (310.7) to the Off position. Circuit breaker 310.7 is situated in Control Cubicle-2 (SB2). For more information on circuit breakers, refer to Chapter 8.2, MR Control.

Removal

@.1230

Cab Console

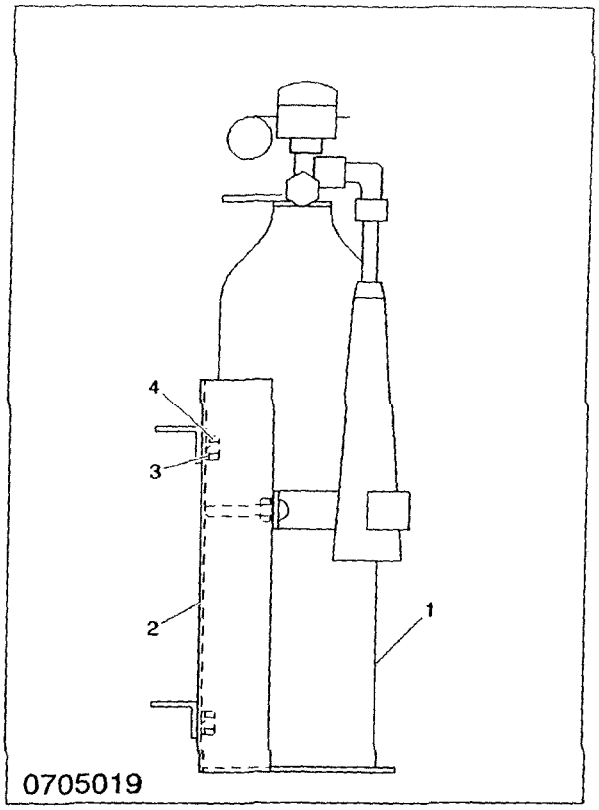


The panel (1) containing the door for wiper and horn isolation can be removed if required. However, most operations requiring access behind this panel can be achieved by opening the wiper and horn isolation door, or by removing the panel (2) adjacent to the driver's seat.

The panel (4) containing the emergency isolation cock (7) can be removed if required. The isolation cock handle (7) must first be removed before the panel (4) can be removed.

Panels (1,2,3,4,5,6) can be removed simply by removing the screws securing the panels in place.

Fire Extinguisher Bracket



Open the retaining clamp, then remove the fire extinguisher from the bracket.

Remove the fire extinguisher (1) from the bracket (2).

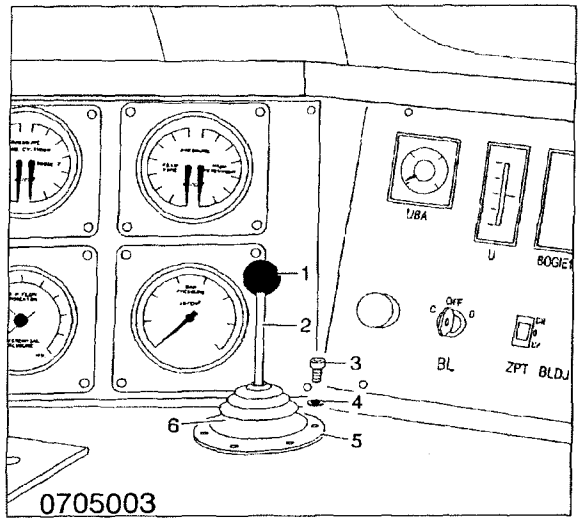
Remove the bolts (4) and spring washers (3).

Remove the bracket (2) from the cab wall.

Horn Control

The procedure is the same for the horn control on either the driver's or assistant driver's side.

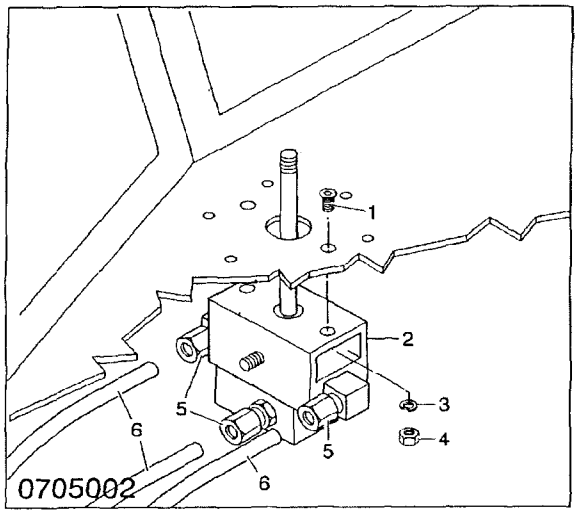
Remove the access panel from the foot well.



Unscrew the knob (1) from the lever arm (2).

Remove the six screws (3) and washers (4) securing the retaining ring (5) to the console.

Remove the rubber boot (6).



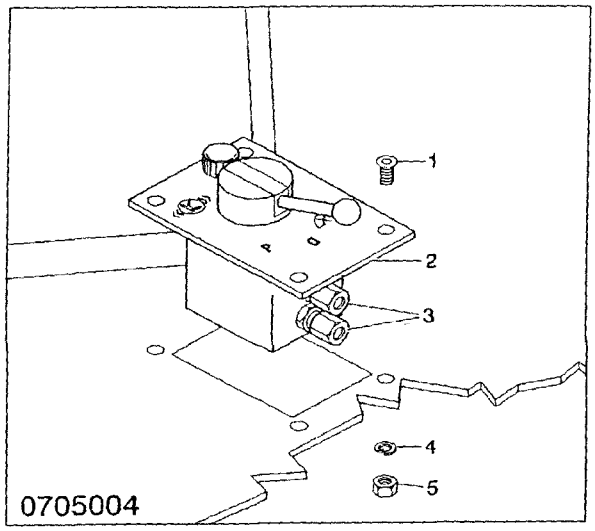
Tag and disconnect the three air lines (6) from the valve unions (5). Seal the air lines (6) and valve unions (5) with suitable plastic plugs to prevent the ingress of foreign material.

Remove the two screws (1) securing the valve (2) to the console. Hold the valve (2), nuts (4) and washers (3) on the underside of the console panel.

Withdraw the valve from below the console.

Wiper/Washer Control

Remove the access panel from the assistant's foot well.



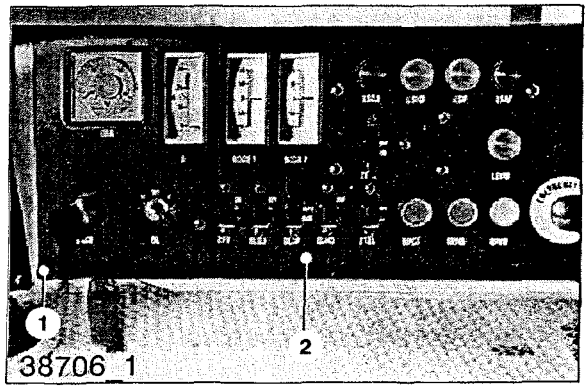
Tag and disconnect the air lines from the unions (3) on the control valve (2). Seal the air lines and valve unions with suitable plastic plugs to prevent the ingress of foreign material.

Remove the four screws (1) securing the control valve (2) to the console. Hold the nuts (5) and washers (4) on the underside of the console panel.

Remove the control valve (2) from the console.

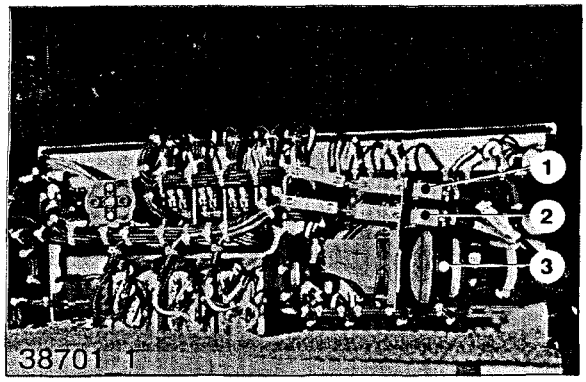
Panel A

Individual switches, indicator lights and gauges are held in the panel "A" with screws and nuts either on the front or the rear of the panel. The panel assembly must be removed from the console to remove any one switch, indicator light or gauge.



Remove the screws (1) securing the panel (2) to the console.

Tilt the top of the panel (2) forwards until it is clear of the console brow. Lift the panel (2) from the console.

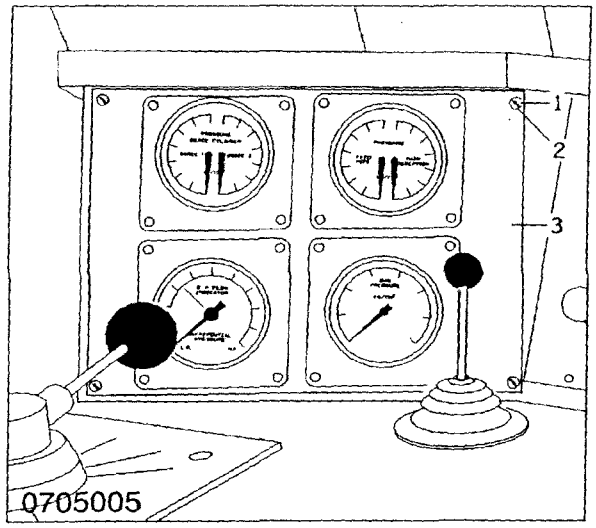


Tag and disconnect the plugs (1, 2, 3) from the panel.

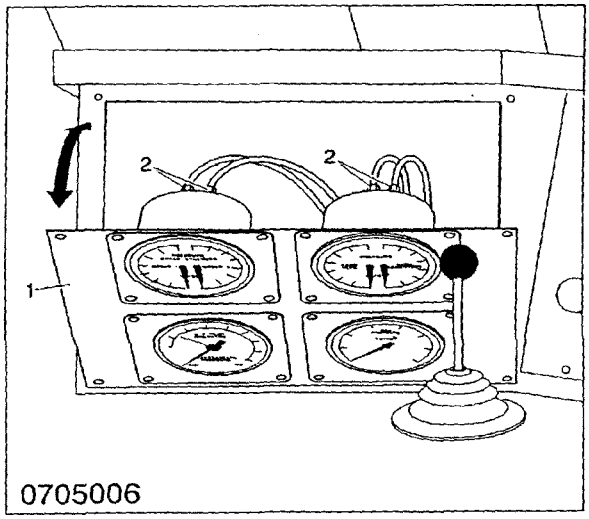
Withdraw the panel from the console.

Panel B

The instrument cluster is on panel "B" of the driver's console. Individual gauges are held in the panel with screws and nuts on the rear of the panel. The panel assembly must be removed from the console to remove any one gauge.



Remove the screws (1) and washers (2) from each corner of the panel (3).



Tilt the top of the panel (1) forwards until it is clear of the console brow. Lift the panel (1) from the console.

NOTE:

The air lines are still connected and the panel (1) can only be moved a short distance from the console.

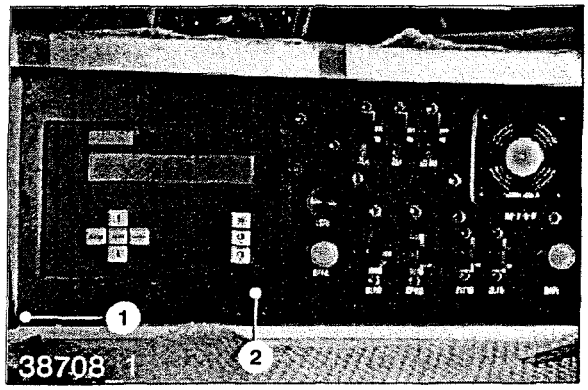
Crack loose the pneumatic connections (2) at the instruments. Allow any residual pressure to vent.

Tag and disconnect the air lines from the unions (2) on the gauges. Seal the air lines and valve unions with suitable plastic plugs to prevent the ingress of foreign material.

Withdraw the panel (1) from the console.

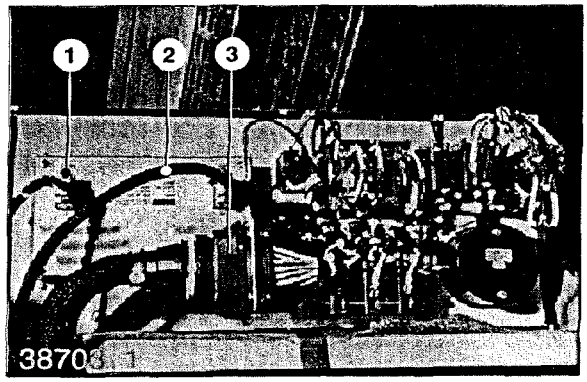
Panel C

Individual switches, indicator lights and gauges are held in the panel "C" with screws and nuts either on the front or the rear of the panel. The panel assembly must be removed from the console to remove any one switch, indicator light or gauge.



Remove the screws (1) securing the panel (2) to the console.

Tilt the top of the panel (2) forwards until it is clear of the console brow. Lift the panel (2) from the console.

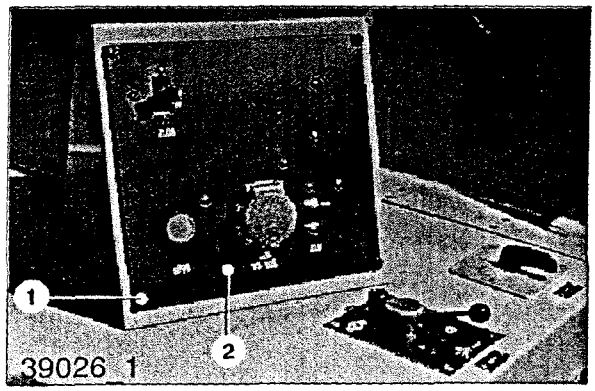


Tag and disconnect the plugs (1, 2, 3) from the panel.

Withdraw the panel from the console.

Panel D

Individual switches and indicator lights are held in the panel "D" with screws and nuts either on the front or the rear of the panel. The panel assembly must be removed from the console to remove any one switch or indicator light.



Remove the screws (1) securing the panel (2) to the console.

Tilt the top of the panel (2) forwards until it is clear of the console brow. Lift the panel (2) from the console.

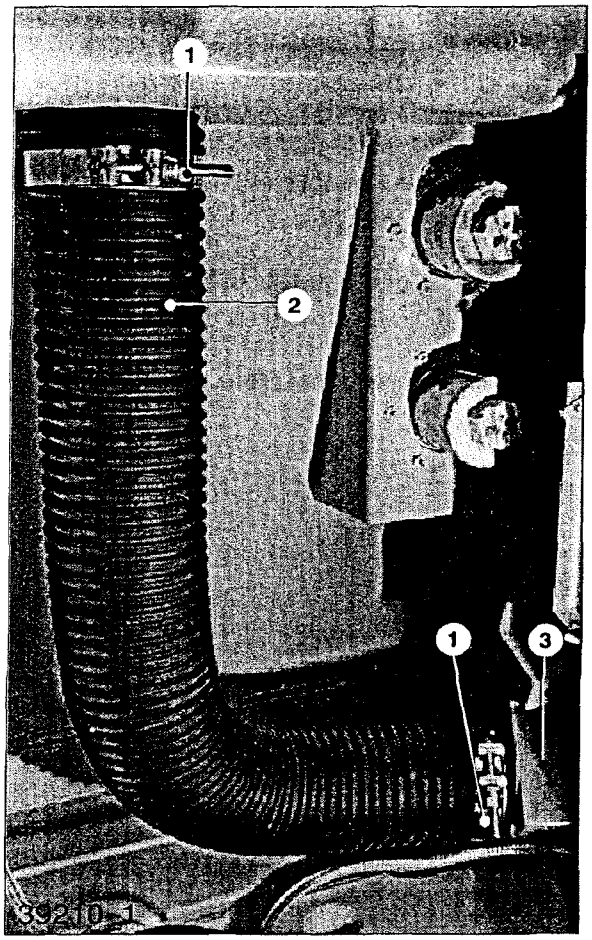
Tag and disconnect the plugs from the panel.

Withdraw the panel from the console.

Cab Heater

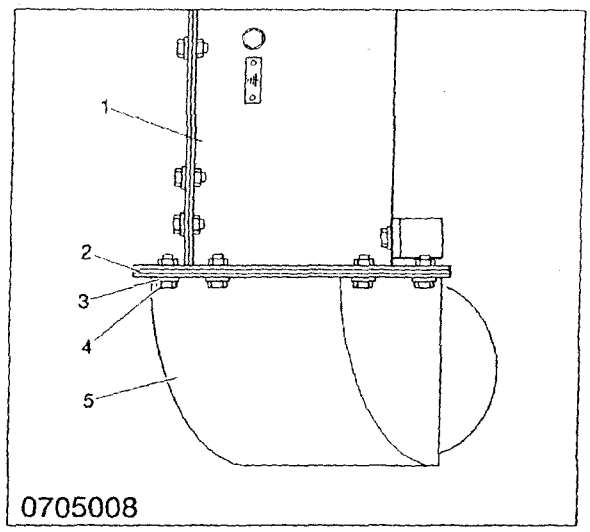
HEATER DUCT

Remove the access cover from the assistant's foot well.



Loosen the clamps (1) at the demister inlet and at the heater bend (3).

Disconnect and remove the flexible duct (2).

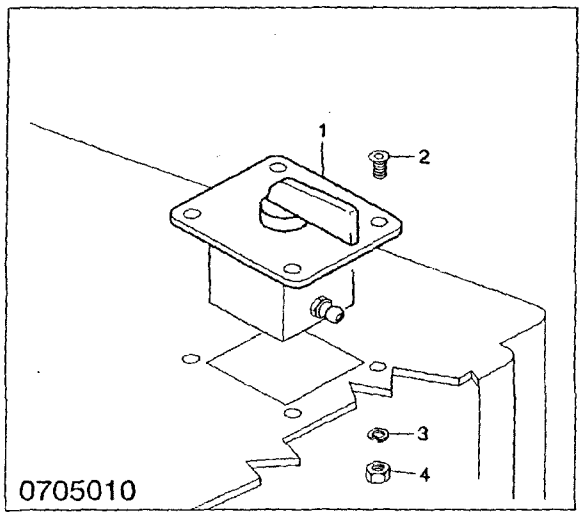


Remove the bolts (4) and washers (3) securing the heater bend (5) to the heater unit (1).

Remove the gasket (2) and inspect. Replace if damaged.

HEATER CONTROL

Remove the access panel from the assistant's foot well.

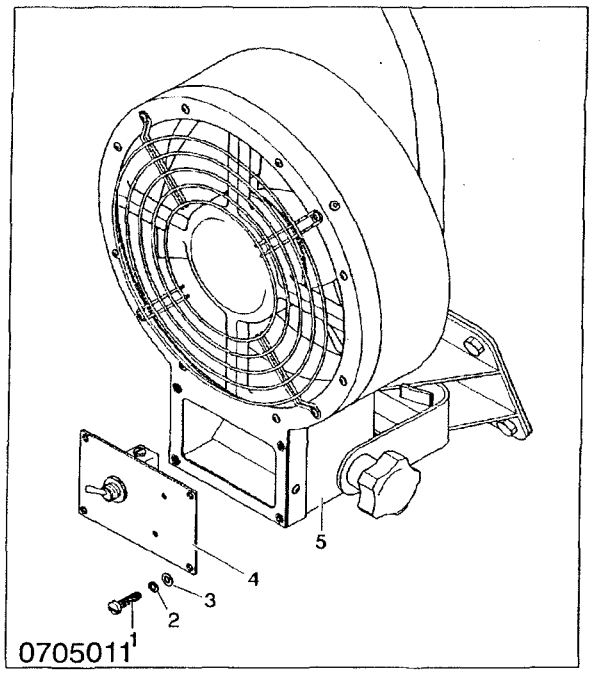


From below the console, tag and disconnect the wires from the terminals on the heater control switch (1). Cover any exposed wires with suitable insulation.

Remove the four screws (2) securing the control switch (1) to the console panel. Hold the nuts (4) and washers (3) on the underside of the console panel.

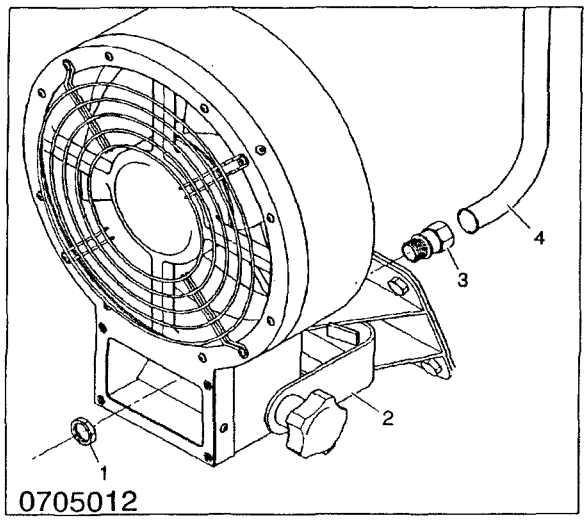
Withdraw the control switch (1) from the console.

Crew Fan



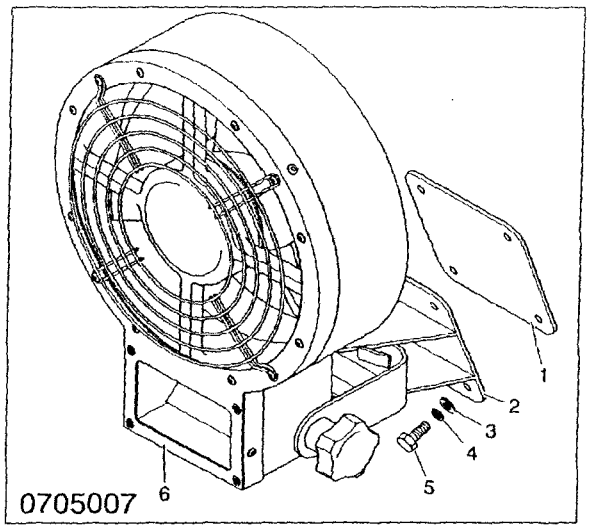
Remove the four screws (1), spring washers (2) and plain washers (3).

Withdraw the cover (4).



Tag and disconnect the wires from the terminal block. Cover any exposed wire with suitable insulation.

Undo and remove the nut (1) holding the conduit fitting (3) to the fan housing (2).



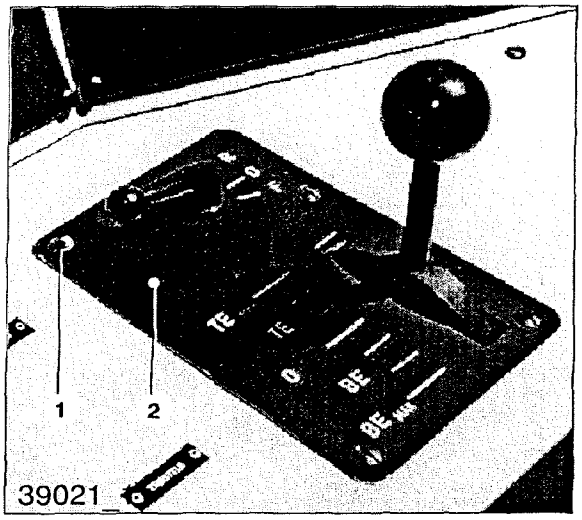
Remove the four bolts (5) with the spring washers (4) and the washers (3).

Remove the crew fan assembly (6) and the insulating mounting pad (1) from the pillar.

TB/BE Master Controller

Remove the access panel on the underside of the console.

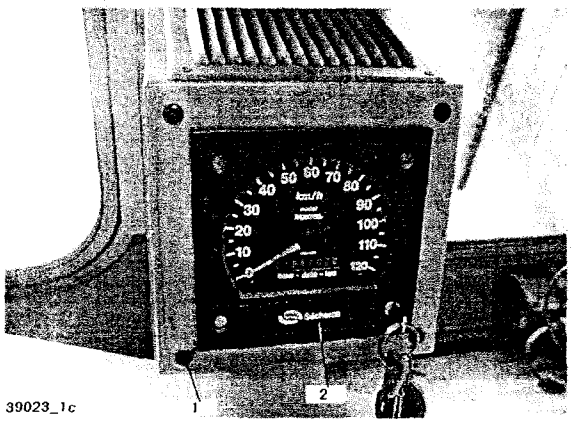
From below the console, tag the air lines and the electrical wires on the master controller. Remove the electrical connections to the master controller. Crack loose the pneumatic connections and allow any residual pressure to vent, then disconnect the pneumatic connections.



Remove the four screws (1) securing the master controller (2) to the console panel. Hold the nuts and washers on the underside of the console panel.

Withdraw the master controller (2) from the console.

Speedometer Recorder (MEMOTEL)



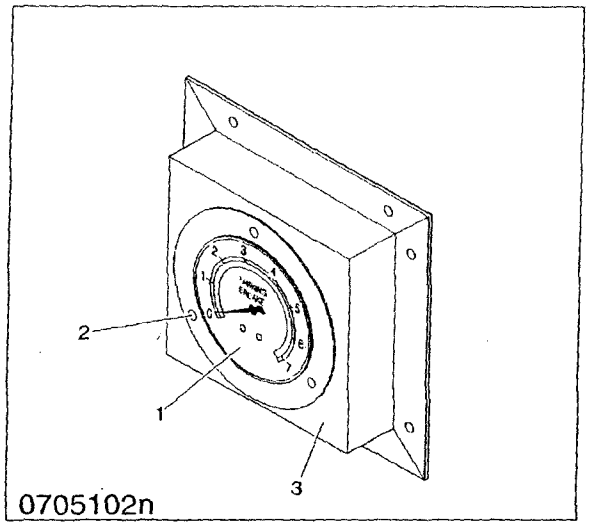
Remove the screws (1) securing the speedometer recorder (2) to the console.

Tilt the top of the panel (2) forwards until it is clear of the console brow.

Tag and disconnect the wires from the speedometer recorder.

Withdraw the speedometer recorder from the console.

Parking Brake Pressure Gauge

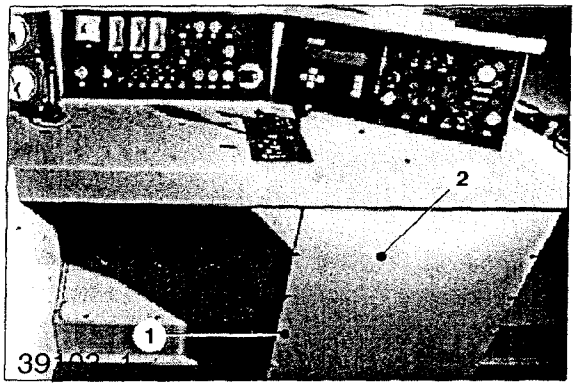


Loosen and remove the screws (2) securing the gauge (1) to the gauge housing (3).

Withdraw the gauge (1) from the housing (3) slightly to gain access to the connections on the rear of the gauge (1).

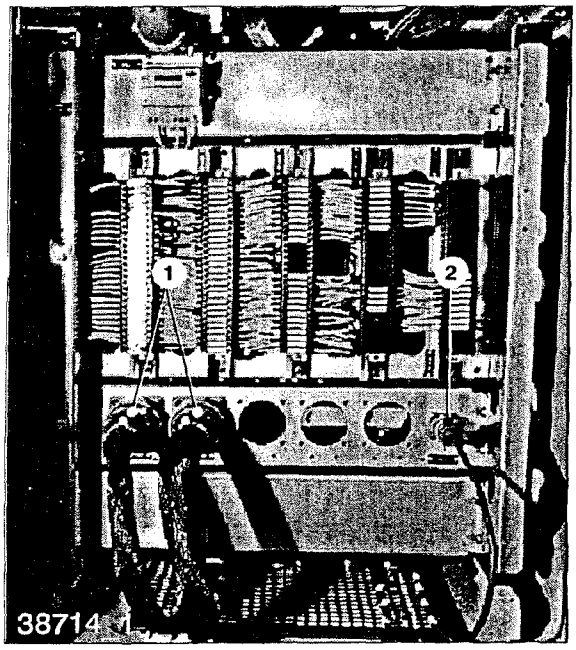
Tag and disconnect the connections from the rear of the gauge (1), then remove the gauge (1).

Cubicle F



Remove the screws (1).

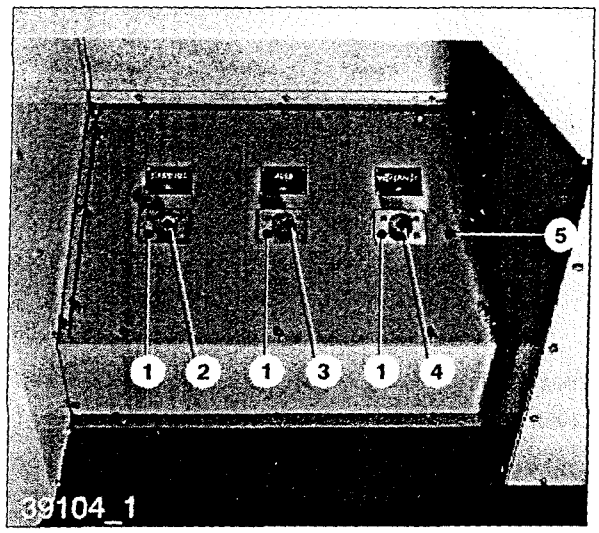
Remove the access panel (2).



Tag and disconnect the wires from the cubicle "F".

Withdraw the cubicle "F" from the console.

Plate-Foot Pedal



Remove the twelve screws securing the plate (5).

Remove the panel (5).

Tag and disconnect the wires at the back of the plate-foot pedal.

Withdraw the plate-foot pedal from the foot well.

Disassembly

@.1240

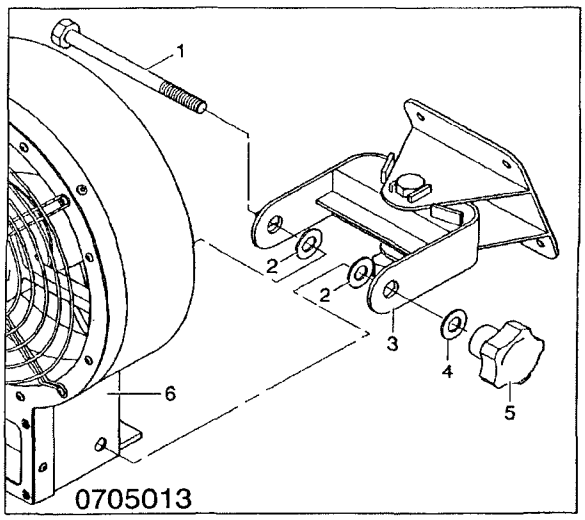
Horn Control

For further information regarding the horn control, refer to Chapter 3, Metcalfe Duplex Air Valve of Volume F12, Suppliers Documentation.

Wiper/Washer Control

For further information regarding the wiper/washer control, refer to Chapter 7, Washers/ Wipers of Volume F1, Suppliers Documentation.

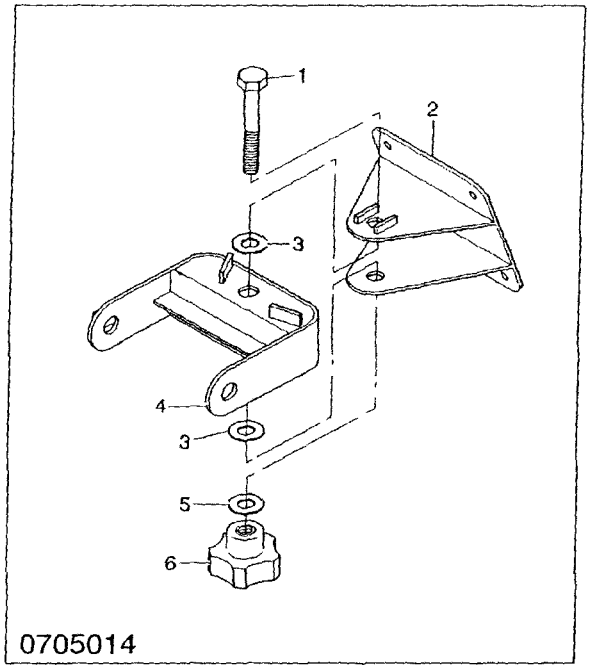
Crew Fan



Unscrew the knob (5). Remove the knob (5) and the washer (4).

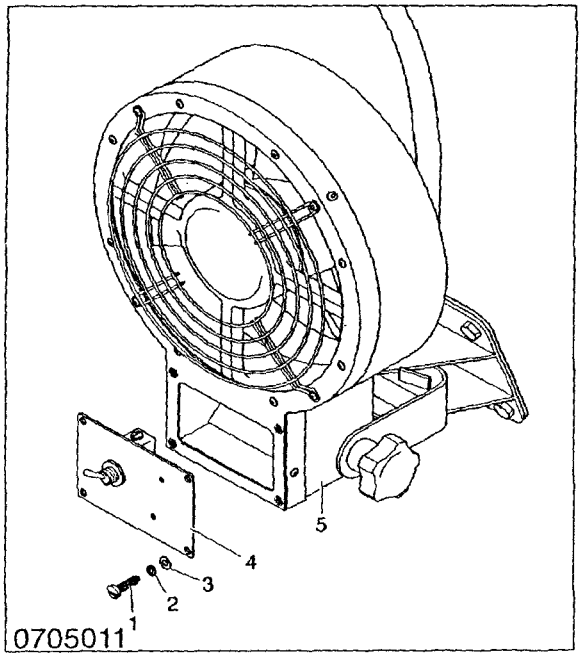
Withdraw the bolt (1) and separate the fan housing (6) from the bracket (3). Fibre washers (2) are situated between the bracket (3) and housing (6).

Inspect the fan as described in Section Inspection and Repair.

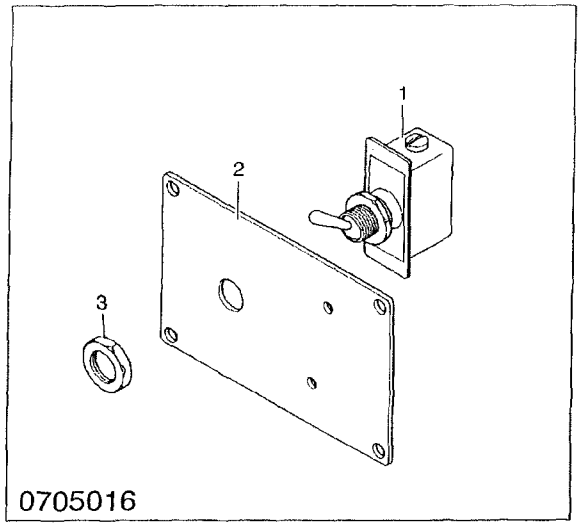


Unscrew the knob (6).

Withdraw the bolt (1) and separate the bracket (4) from the frame bracket (2). Fibre washers (3) are situated between the frame bracket (2) and bracket (4).



Remove the four screws (1), spring washers (2) and plain washers (3) securing the access cover (4). Withdraw the access cover (4).



Tag and disconnect the wires from the switch (1). Cover any exposed wire with suitable insulation.

Remove the nut (3).

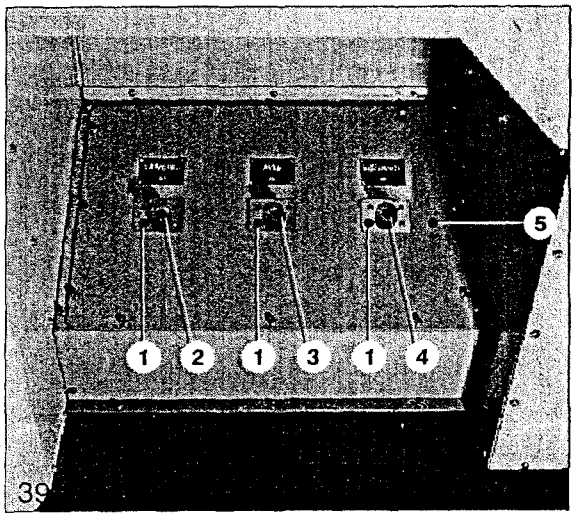
Withdraw the switch (1) from the access cover (2).

Speedometer Recorder (MEMOTEL)

Refer to Chapter 1, Sécheron Memotel of Volume F16, Suppliers Documentation.

Plate-Foot Pedal

FOOT SWITCH



Remove the four screws (1) securing the foot switches (2,3,4) to the plate-foot pedal (5).

Remove the foot switch (2,3 or 4) as required.

Inspection and Repair

@ 1250

Horn Control

For further information regarding the horn control, refer to Chapter 3, Metcalfe Duplex Air Valve of Volume F12, Suppliers Documentation.

Wiper/Washer Control

For further information regarding the wiper/washer control, refer to Chapter 7, Washers/ Wipers of Volume F1, Suppliers Documentation.

Crew Fan

Heater Duct

Inspect the flexible duct for cracks, tears or damage. Replace if required.

Speedometer Recorder (MEMOTEL)

Refer to Chapter 1, Sécheron Memotel of Volume F16, Suppliers Documentation.

Waste Disposal

@ 1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

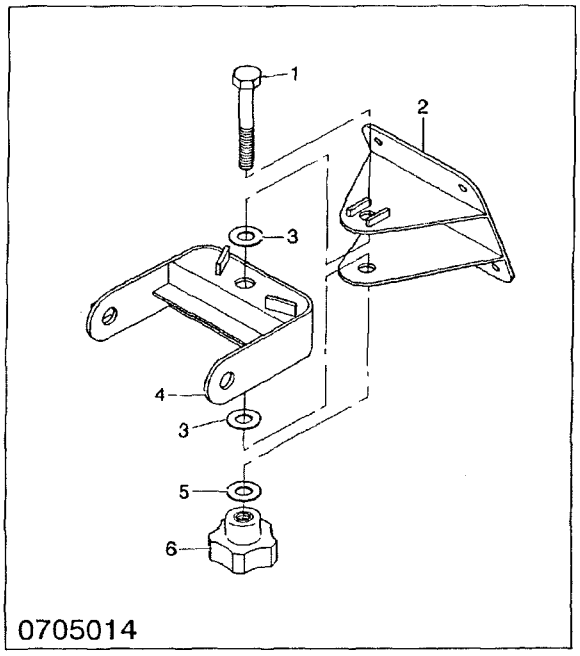
Horn Control

For further information regarding the horn control, refer to Chapter 3, Metcalfe Duplex Air Valve of Volume F12, Suppliers Documentation.

Wiper/Washer Control

For further information regarding the wiper/washer control, refer to Chapter 7, Washers/ Wipers of Volume F1, Suppliers Documentation.

Crew Fan



0705014

NOTE:

The lugs to capture the horizontal adjustment bolt head must face upwards.

Place fibre washers (3) on each side of the bracket (4) over the pivot hole.

Position the bracket (4) between the frame bracket plates.

NOTE:

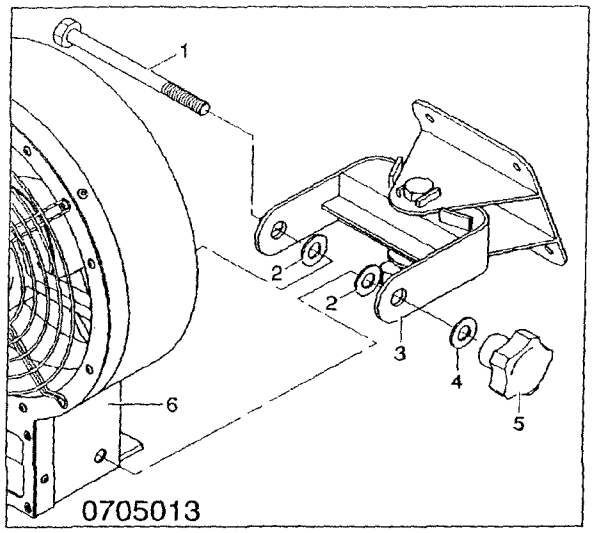
Ensure the stop lugs are facing upwards and the fibre washers (3) remain aligned over the pivot hole.

Insert the bolt (1) through the frame bracket (2) and the bracket (4).

NOTE:

Ensure the fibre washers (3) are correctly aligned and positioned.

Place the washer (5) and knob (6) on the bolt (1). Tighten the knob (6).



Position the fibre washers (2) over the pivot holes on the fan housing (6).

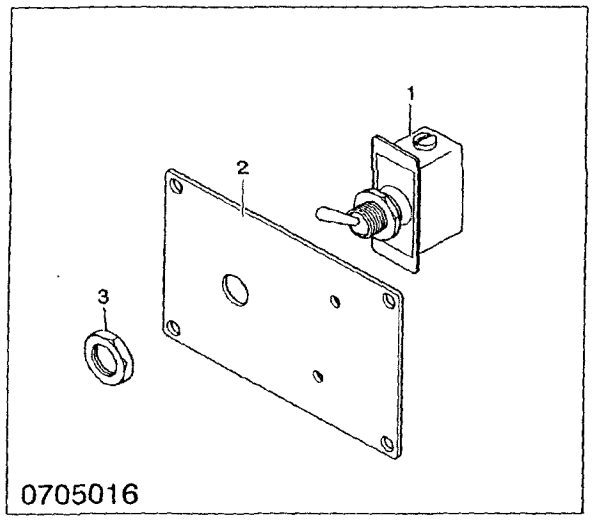
Slide the fan housing (6) into the bracket (3) and align the pivot holes.

NOTE:

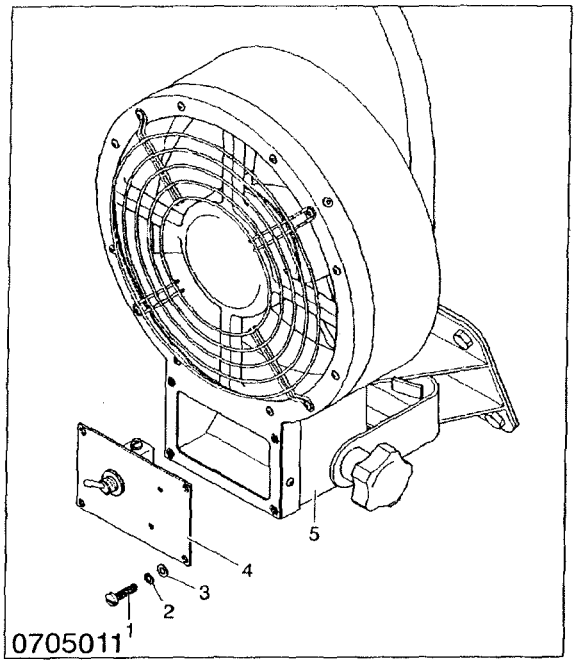
Ensure the fibre washers (2) are correctly positioned and aligned with the pivot holes.

Insert the bolt (1) through the bracket (3) and fan housing (6).

Place the washer (4) and knob (5) on the bolt (1). Tighten the knob (5).



Install the switch (1) into the access cover (2) and secure the nut (3).



Remove any temporary insulation, then connect the wires to the switch as tagged during removal.

Position the access cover (4) on the fan housing (5).

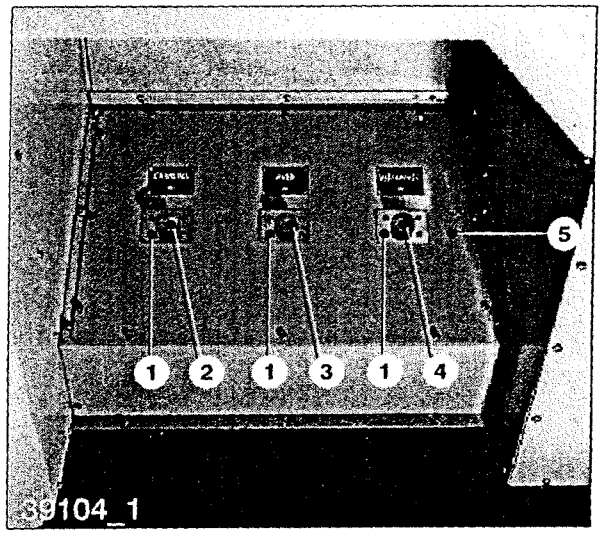
Install the screws (1) with spring washers (2) and plain washers (3). Tighten the screws (1).

Speedometer Recorder (MEMOTEL)

Refer to Chapter 1, Sécheron Memotel of Volume F16, Suppliers Documentation.

Plate-Foot Pedal

FOOT SWITCH



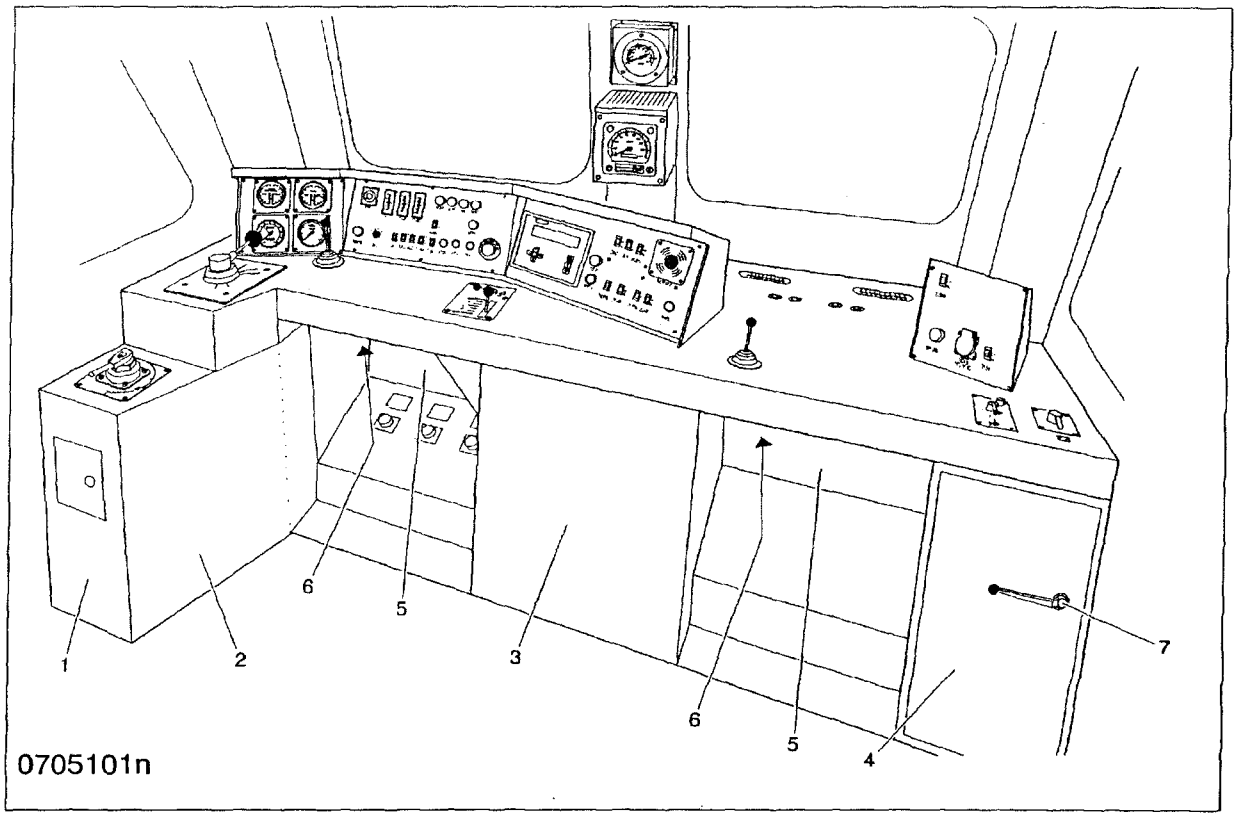
Position the foot switches (2,3,4) into the plate-foot pedal (5) as tagged during disassembly.

Install and tighten the four screws (1).

Install the plate-foot pedal (5) as described in Section Installation.

Installation

@.1280

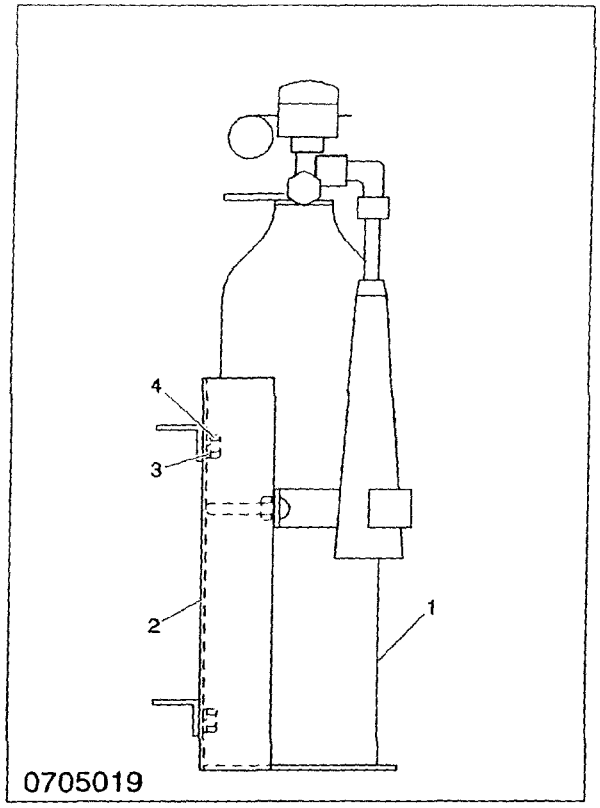


Installation of panels (1, 2, 3, 4, 5, 6) only to be done after all other components have been installed/assembled.

Place the appropriate panel in place, then secure with screws.

The panel (4) containing the emergency isolation cock (7) can be removed if required. The isolation cock handle (7) must first be removed before the panel (4) can be removed.

Fire Extinguisher Bracket



Position the bracket (2) on the cab wall.

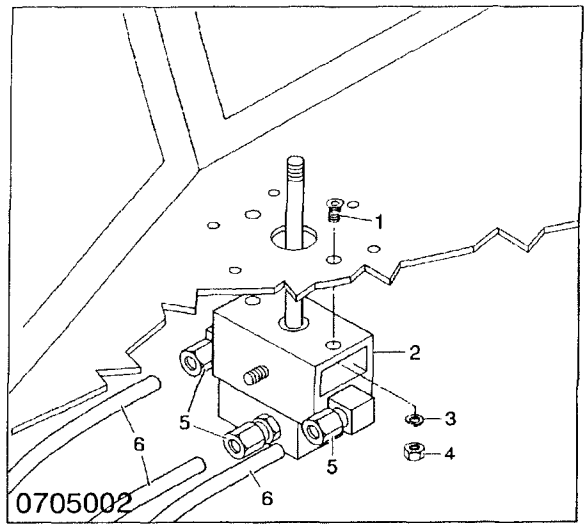
Install the bolts (4) with spring washers (3). Tighten the bolts (4).

Position the fire extinguisher (1) into the bracket (3).

Secure the fire extinguisher (1).

Horn Control

The procedure is the same for the horn control on either the driver's or assistant driver's side.



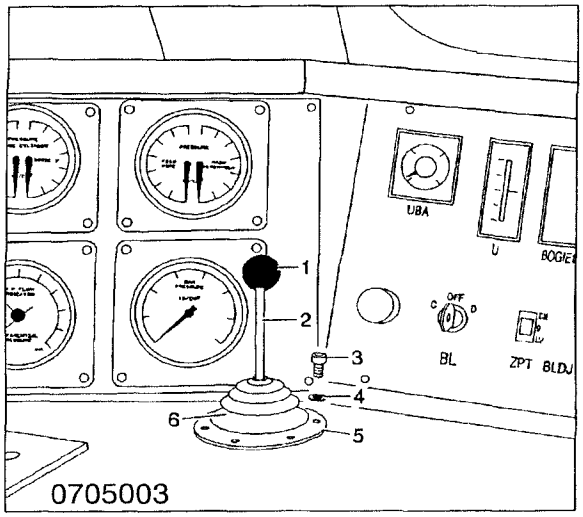
Position the valve (2) from below the console. Ensure the unions (5) are facing in the appropriate direction to meet the pneumatic pipes.

Install the two screws (1) through the console panel and valve (2).

From below the console, install the washers (3) and nuts (4) on the screws (1). Tighten the screws (1).

Remove the plastic plugs from the air lines (6) and valve unions (5).

Connect the air lines (6) to the valve unions (5) as tagged during removal.



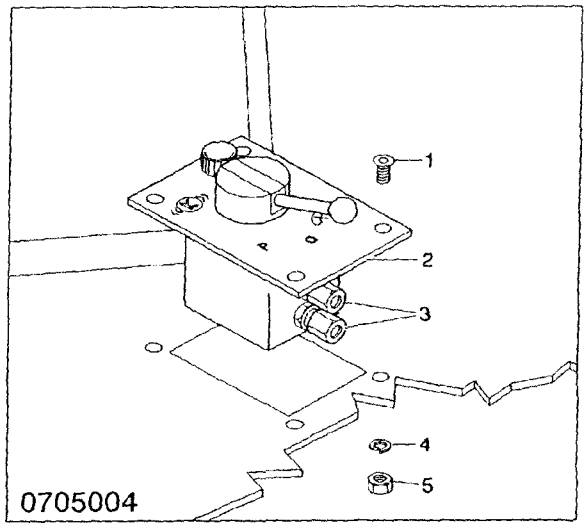
Install the rubber boot (6) over the lever arm (2). Position the retaining ring (5) over the boot (6).

Align the holes in the console panel, boot (6) and retaining ring (5).

Install the six screws (3) with spring washers (4). Do not over tighten the screws (3).

Screw the knob (1) onto the lever arm (2).

Wiper/Washer Control



Position the control valve (2) in the console.

Install the four screws (1) through the control valve (2) and console panel.

From below the console, install the spring washers (4) and nuts (5) on the screws (1). Tighten the screws (1).

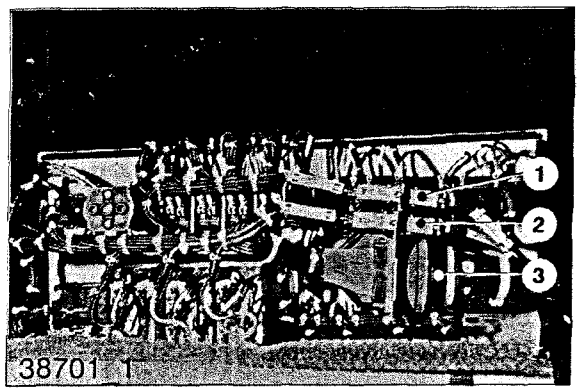
Remove the plastic plugs from the air lines and valve unions (3).

Connect the air lines to the valve unions as tagged during removal.

Test the operation of the wipers and washers as described in Chapter 1.7, Washers and Wipers. Rectify any faults found.

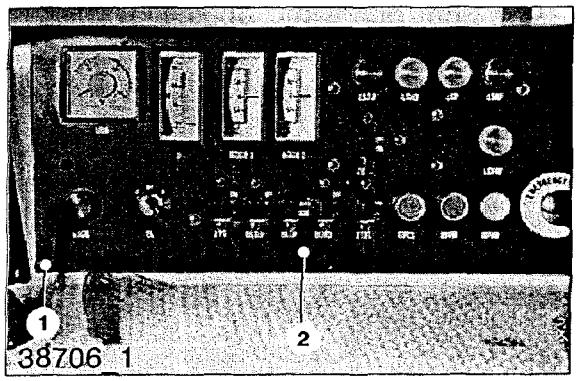
Reinstall the access panel in the foot well.

Panel A



Position the panel at the console. Tilt the panel to allow access to the unions (1,2,3) on the back of the panel.

Connect the plugs (1,2,3) as tagged during removal.

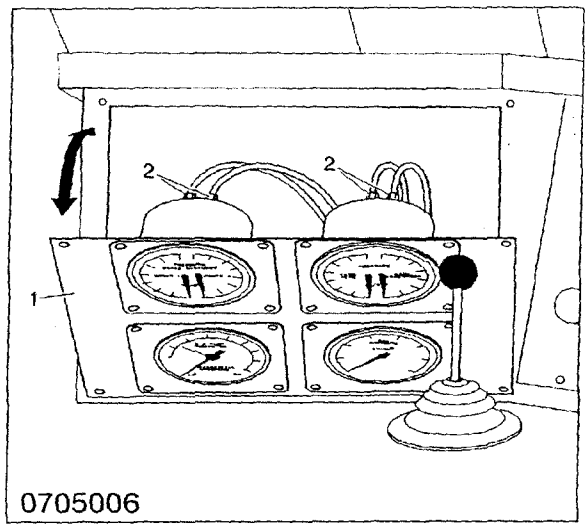


Manipulate the panel (2) into position in the console.

Install the screws (1) through the panel (2) into the console. Tighten the screws (1).

Connect electrical power to the instrument gauges, indicator lights and switches.

Panel B

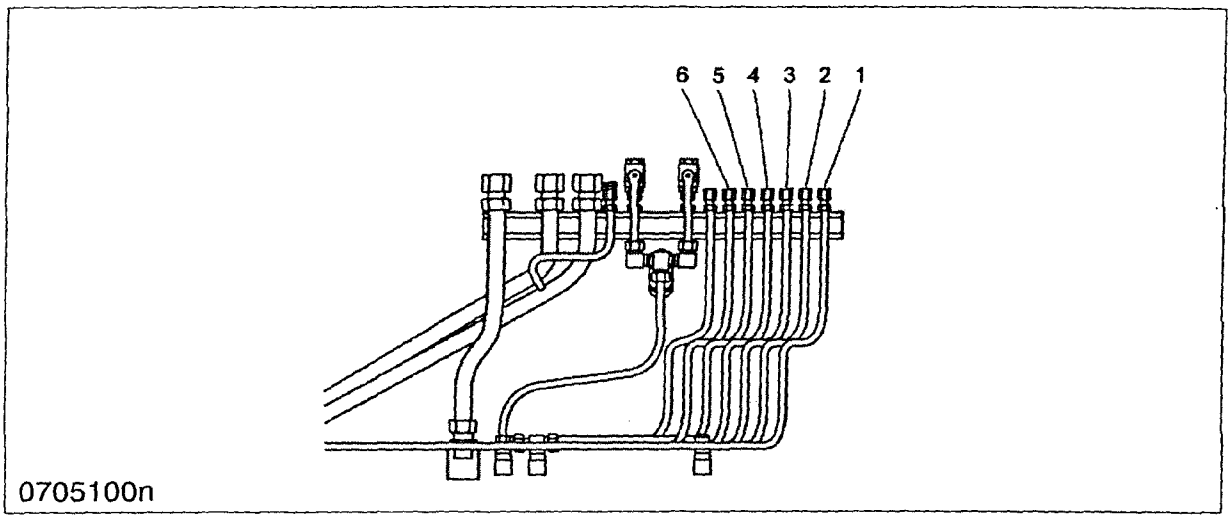


0705006

Position the panel (1) at the console. Tilt the panel (1) to allow access to the unions (2) on the back of the gauges.

Remove the plastic plugs from the air lines and valve unions (2) of the gauges.

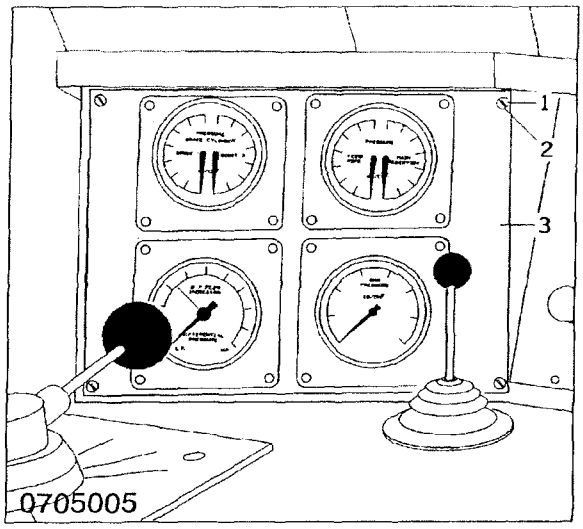
Connect the air lines to the valve unions (2) as tagged during removal.



0705100n

1	to gauge #122, Brake Pipe Pressure Gauge, BP	4	to gauge #131, Brake Cylinder Pressure Gauge, Bogie 1, BC1
2	to gauge #132, Brake Pipe Flow Meter, FM	5	to gauges #121, Main Reservoir Pressure Gauge, MR and to gauge #132, Brake Pipe Flow Meter
3	to gauge #131, Brake Cylinder Pressure Gauge, Bogie 2, BC2	6	to gauge #121, Feed Pipe Pressure Gauge, FP

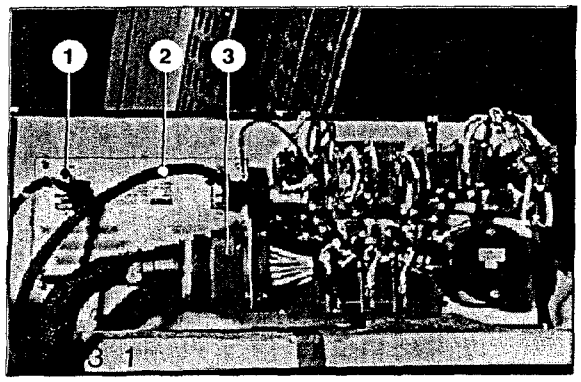
For further information regarding the cab piping, refer to the Pneumatic Schematic located in Chapter 1, Metcalfe Brake System of Volume F11, Suppliers Documentation.



Manipulate the panel (3) into position in the console.

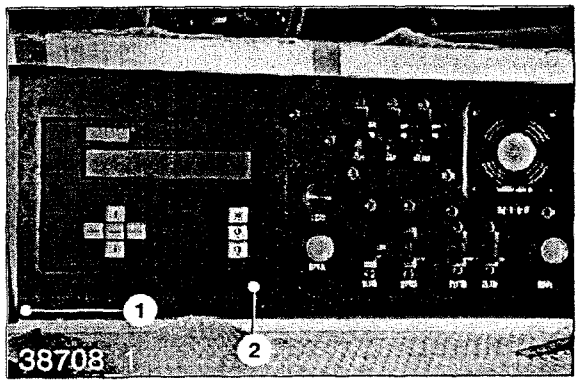
Install the screws (1) with spring washers (2) through the panel (3) into the console. Tighten the screws (1).

Panel C



Position the panel at the console. Tilt the panel to allow access to the unions (1,2,3) on the back of the panel.

Connect the plugs (1,2,3) as tagged during removal.



Manipulate the panel (2) into position in the console.

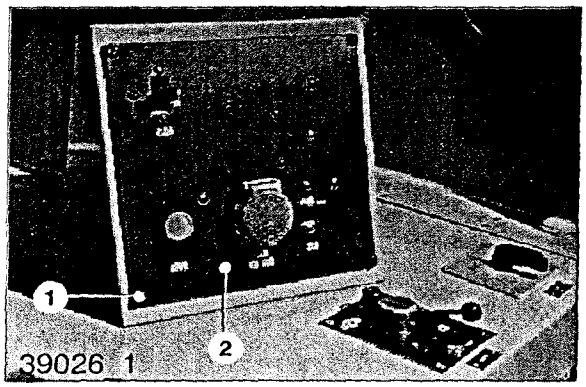
Install the screws (1) through the panel (2) into the console. Tighten the screws (1).

Connect electrical power to the instrument gauges, indicator lights and switches.

Panel D

Position the panel at the console. Tilt the panel to allow access to the unions on the back of the panel.

Connect the plugs as tagged during removal.



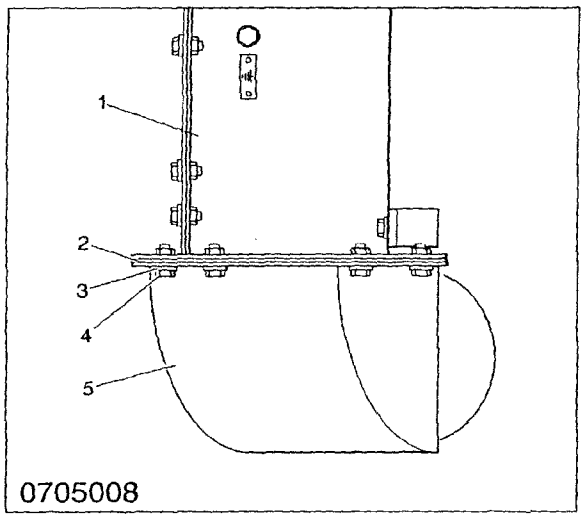
Manipulate the panel (2) into position in the console.

Install the screws (1) through the panel (2) into the console. Tighten the screws (1).

Connect electrical power to the indicator lights and switches.

Cab Heater

Heater Duct

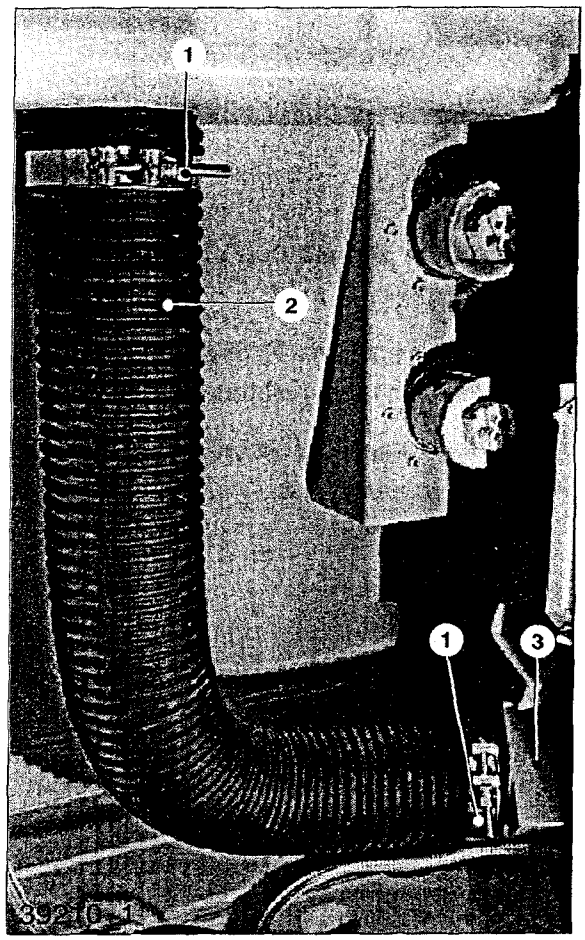


Place the gasket (2) on the heater bend (5).

Position the heater bend (5) with the gasket (2) on the heater unit (1).

Install the bolts (4) with spring washers (3) through the heater unit (1) and gasket (4) into the heater bend (5).

Tighten the bolts (4).



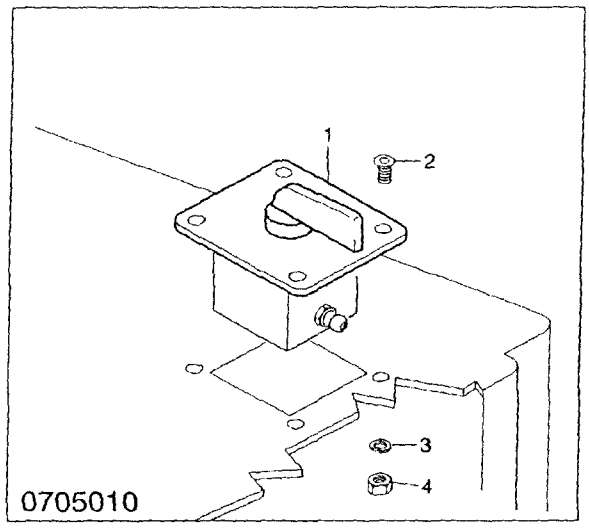
Place a clamp (1) on each end of the flexible duct (2).

Install one end of the flexible duct (2) onto the heater bend (3). Tighten the clamp (1).

Install the other end of the flexible duct (2) onto the demister inlet.

Tighten the clamp (1).

Heater Control

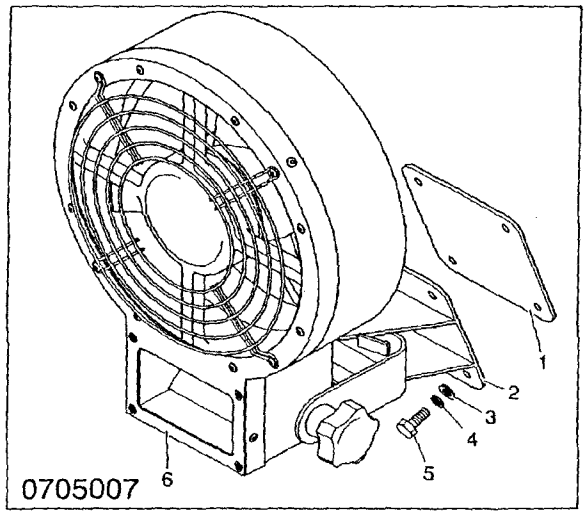


Position the heater control switch (1) in the console. Align the screw holes in the panel and control switch.

Install the four screws (2) through the control switch (1) and console panel.

From below the console, install the spring washers (3) and nuts (4) on the screws (2). Tighten the screws (2).

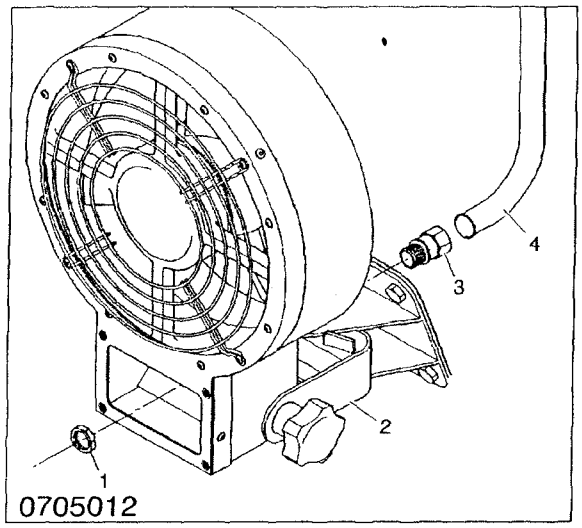
Crew Fan



Position the crew fan assembly (6) and the insulation mounting pad (1) on the pillar.

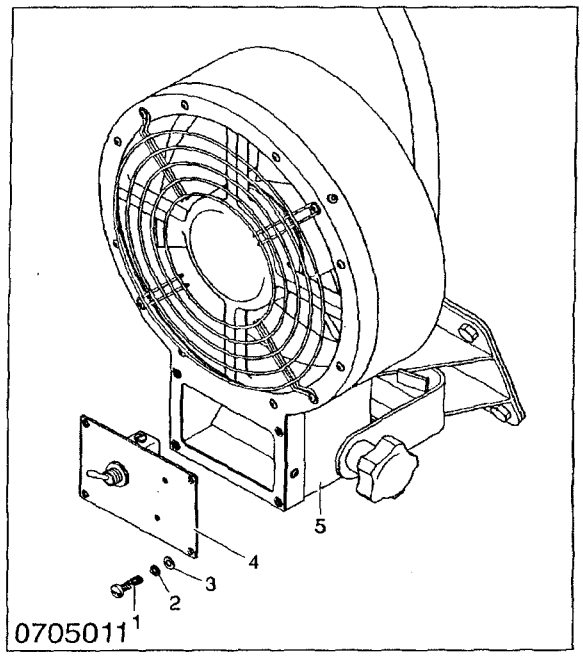
Align the holes in the frame bracket (2) with the holes in the pillar.

Insert the four bolts (5) with the spring washers (4) and the washers (3) through the frame bracket (2) into the pillar.



Feed the wires through the hole in the back of the fan housing (2).

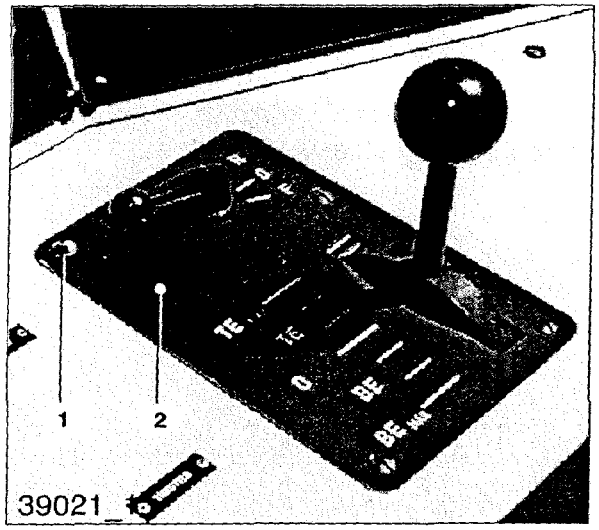
Insert the conduit fitting (3) into the hole. Install the nut (1) from inside the fan housing (2).



Remove any temporary insulation and connect the wires to the terminal block as tagged during removal.

Install the access cover (4) onto the fan housing (5). Install the screws (1) with spring washers (2) and plain washers (3). Tighten the screws (1).

TB/BE Master Controller



Position the master controller (2) in the console. Align the screw holes in the master controller (2) with the holes in the console.

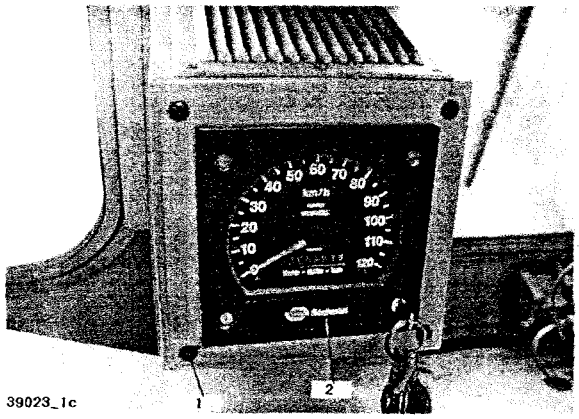
Install the four screws (1) and the nuts and washers on the underside of the console panel.

Tighten the four screws (1).

From below the console, connect the air lines and the electrical wires to the master controller as tagged during removal.

Reinstall the access panel.

Speedometer Recorder (MEMOTEL)

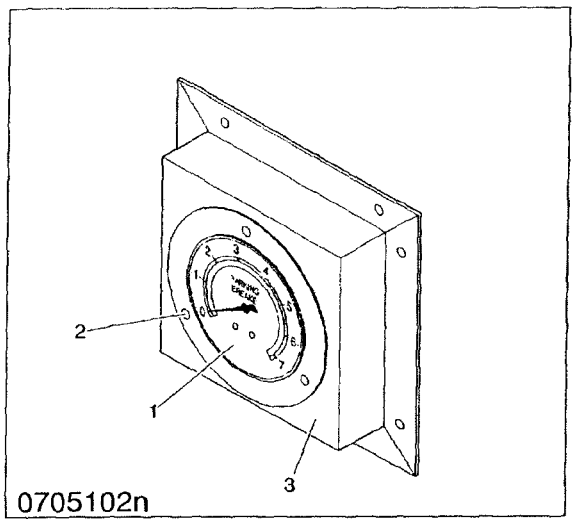


Connect the wires to the speedometer recorder as tagged during removal.

Position the speedometer recorder (2) in the console. Align the screw holes in the speedometer recorder (2) with the holes in the console.

Install and tighten the four screws (1).

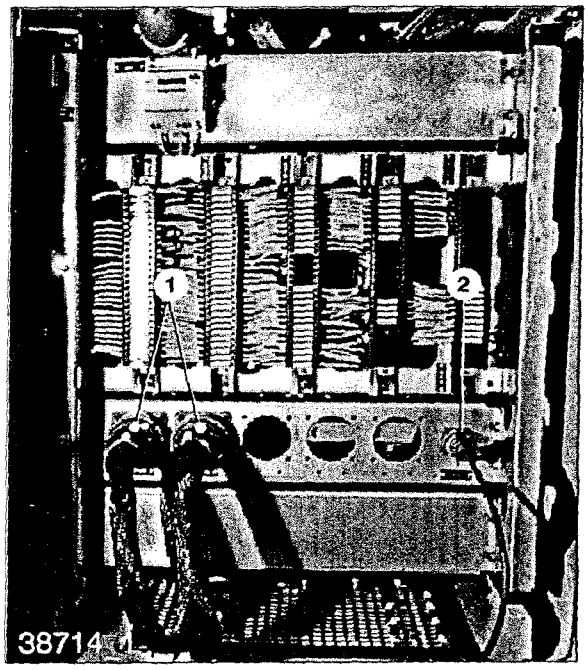
Parking Brake Pressure Gauge



Connect the connections to the rear of the gauge (1) as tagged during removal.

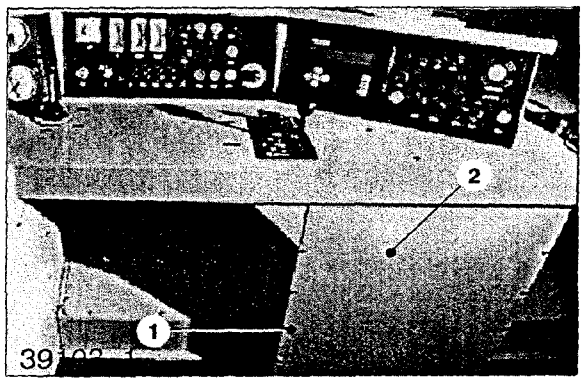
Install the gauge (1) into the housing (3) and secure using screws (2).

Cubicle F



Position the cubicle "F" into the console.

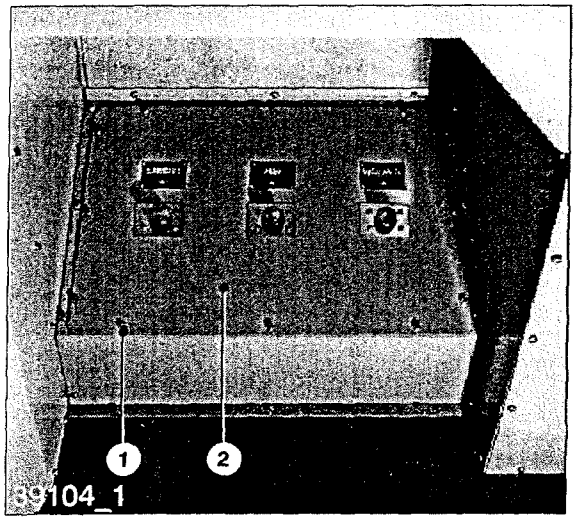
Connect the wires to the cubicle "F" as tagged during removal.



Position the access panel (2). Align the holes in the access panel (2) with the holes in the console.

Install and tighten the screws (1).

Plate-Foot Pedal



Connect the wires to the plate-foot pedal as tagged during removal.

Position the plate-foot pedal (5) on the foot-well. Align the holes in the plate-foot pedal (5) with the holes in the foo twell.

Install and tighten the twelve screws.

After-Installations Operations

@.1290

Panel A

Test the operation of the instrument gauges, indicator lights and switches. Rectify any faults found.

Panel B

Open the air supply to the instruments.

Close the instrument circuit breaker.

Test the operation of the instruments. Rectify any faults found.

Panel C

Test the operation of the instrument gauges, indicator lights and switches. Rectify any faults found.

Panel D

Test the operation of the indicator lights and switches. Rectify any faults found.

Cab Heater

Close the circuit breaker and test the operation of the heater. Rectify any faults found.

Reinstall the access cover into the assistant's foot well.

Crew Fans

Close the crew fan circuit breaker and test the operation of the fan. Rectify any faults found.

Horn Control

Test the operation of the horns, as described in Chapter 1.6, Horns/Lights. Rectify any faults found.

Reinstall the access panel in the foot well.

Wiper/Washer Control

Test the operation of the wipers and washers as described in Chapter 1.7, Washers/Wipers. Rectify any faults found.

Reinstall the access panel in the foot well.

Cab Heater Control Switch

Close the heater circuit breaker and test the operation of the heater. Rectify any faults found. Connect the wires to the terminals as tagged during disassembly.

Reinstall the access panel in the foot well.

TE/BE Master Controller

Open the air supply to the master controller.

Close the electrical power circuit to the master controller.

Test the operation of the master controller. Rectify any faults found.

Memotel Recorder/Speedometer

Close the electrical power circuit to the speedometer recorder.

Test the operation of the speedometer recorder. Rectify any faults found.

Brake Pipe Pressure Gauge

Foot Pedals

Close the electrical power circuit to the plate-foot pedal.

Test the operation of the foot switches. Rectify any faults found.

7.6 Key Interlocking

Functional Description

Access to high voltage power equipment such as the filter cubicle, auxiliary converters, traction converters, auxiliary cubicles and control cubicles, is strictly forbidden unless the equipment is de-energised and grounded by means of the appropriate earth switches. Maintenance staff are required to operate a key interlock system which ensures access to power equipment is only permitted once the equipment is safe.

The key interlock system comprises 5 different types of colour coded keys, each identified by a letter stamped on the key head. The keys of colour type are interchangeable with keys of the same colour but not with keys of a different colour. When used in the correct sequence, the different keys isolate specific systems on the locomotive, allowing safe operation and maintenance on the locomotive and its sub-systems.

Key Location

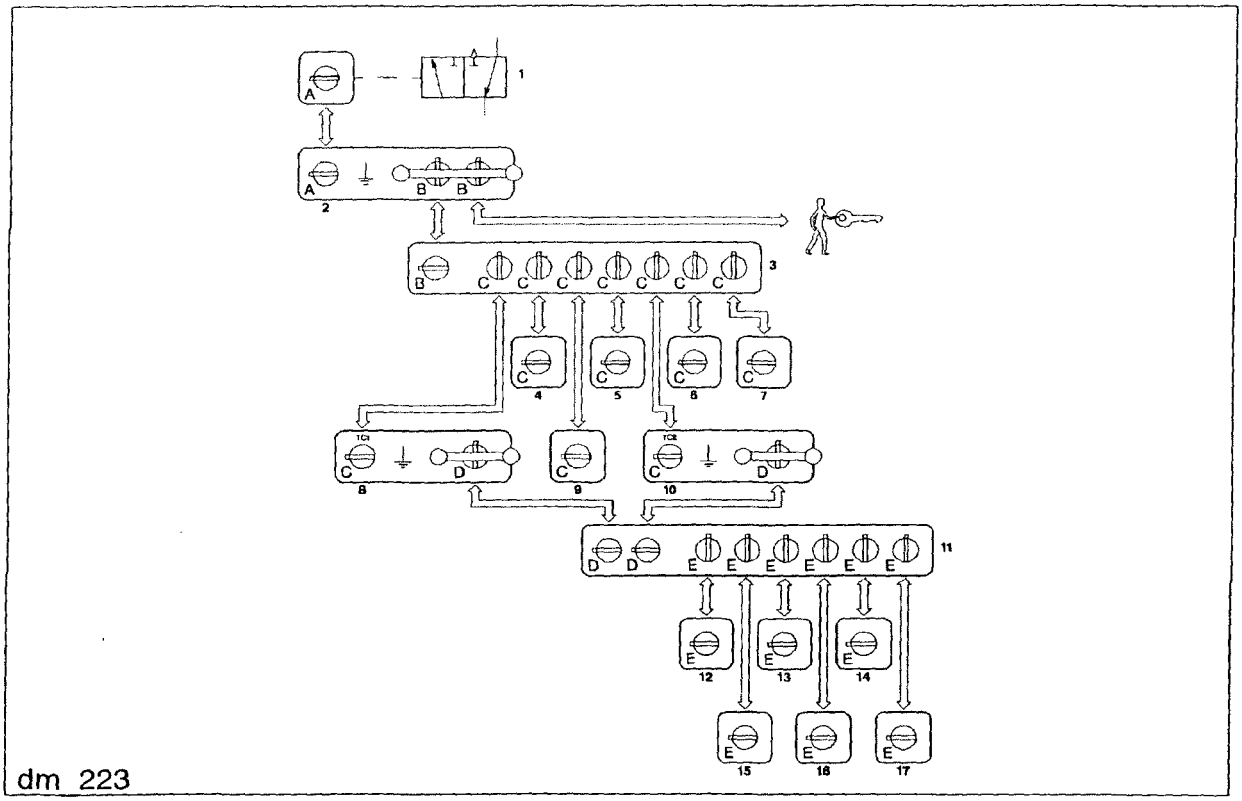
The normal locations for the various keys are given below:

Type	Colour	No. Of	Location
A	light blue	1	Pantograph air supply isolating cock
B	yellow	2	Earthing Switch of main circuit breaker
C	green	7	Key Multiplier No. 1
D	black	2	1 Key on the Earthing Switch of each Traction Converter
E	white	6	Key multiplier No. 2

Operation of the Key Interlocking System

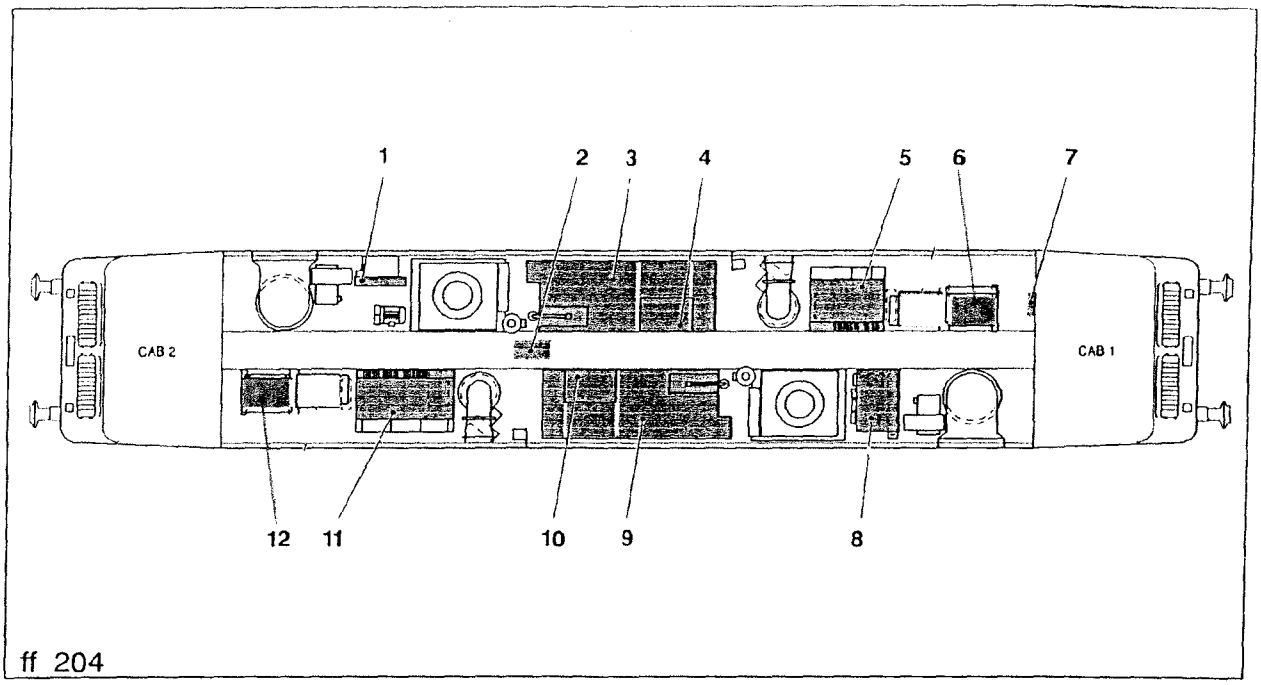
For information regarding the operation of the key interlocking system, refer to Chapter 4, Vehicle Operation of Volume A, Driver's Manual.

Interlocking concept



1004.1	1	Pantograph air supply isolating cock	15.82/1	8	Earthing switch on traction converter 1
4	2	Earthing switch of main circuit breaker	1004.4	9	Door lock on filter block
1004.2	3	Key multiplier 1	15.82/2	10	Earthing switch on traction converter 2
1004.4	4	Door lock auxiliary circuits, Block 1	1004.5	11	Key multiplier 2
1004.4	5	Door lock auxiliary circuits, Block 5	1004.6	12	Door lock, traction converter 1
1004.4	6	Door lock auxiliary converter 1	1004.6	13	Door lock, traction converter 1
1004.4	7	Door lock auxiliary converter 2	1004.6	14	Door lock, traction converter 1
			1004.6	15	Door lock, traction converter 2
			1004.6	16	Door lock, traction converter 2
			1004.6	17	Door lock, traction converter 2

Location Key Interlocking



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1	Pantograph air supply isolating cock, pneumatic panel	6	Door lock, cubicle auxiliary circuits 1
2	Earthing switch main circuit breaker, middle roof hatch	7	Key multipliers
3	Three door locks, traction converter 1	8	Door lock on filter block
4	Earthing switch, traction converter 1	9	Three door locks, traction converter 2
5	Door lock, auxiliary converter 1	10	Earthing switch, traction converter 2
		11	Door lock, auxiliary converter 2
		12	Door lock, cubicle auxiliary circuits 2

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7.7 Cabling

21

For complementary information see Suppliers Documentation Volume G:

ABB Three Phase Electric Drive Locomotive WAG-9
Cabling Schematics

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BOMBARDIER TRANSPORTATION

IR WAG9

Volume D3

Control System

8 Control System

For complementary information see following Chapters in Volume D2:

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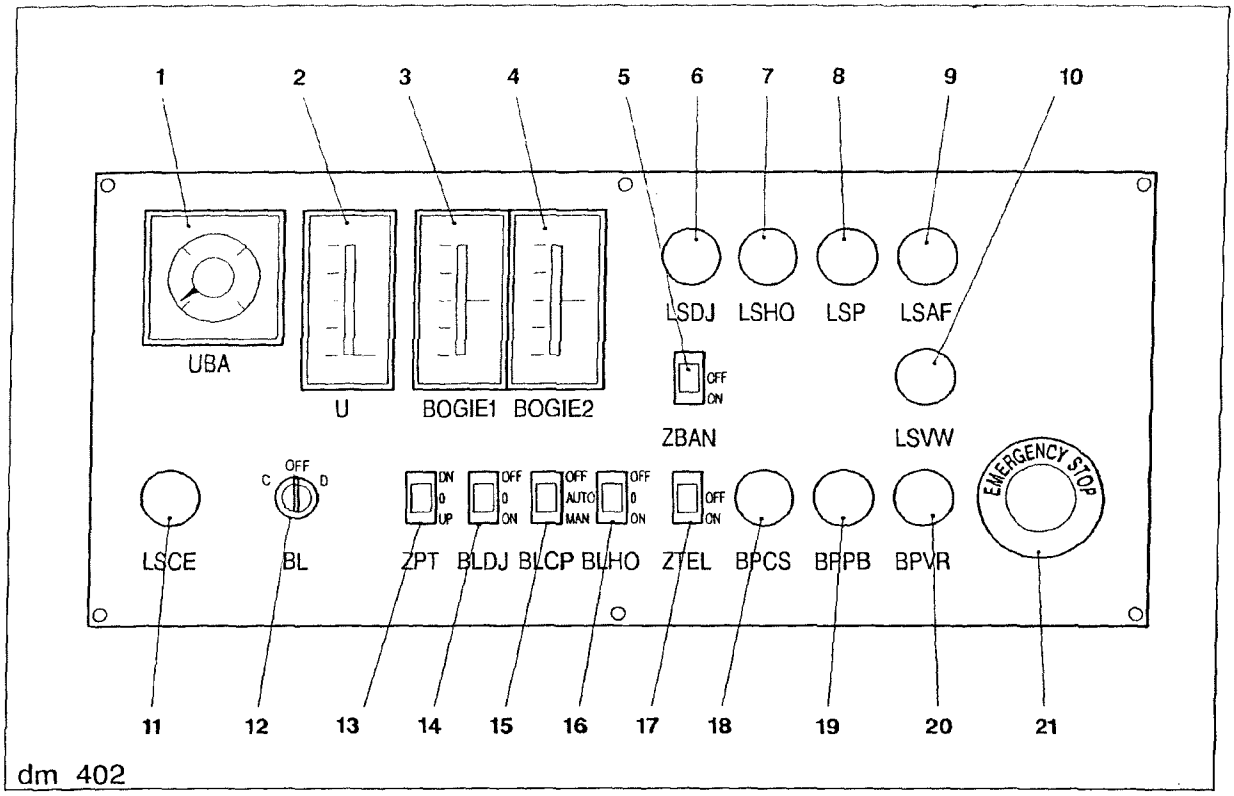
8.1 Cab Control

Group Summary

@.1120

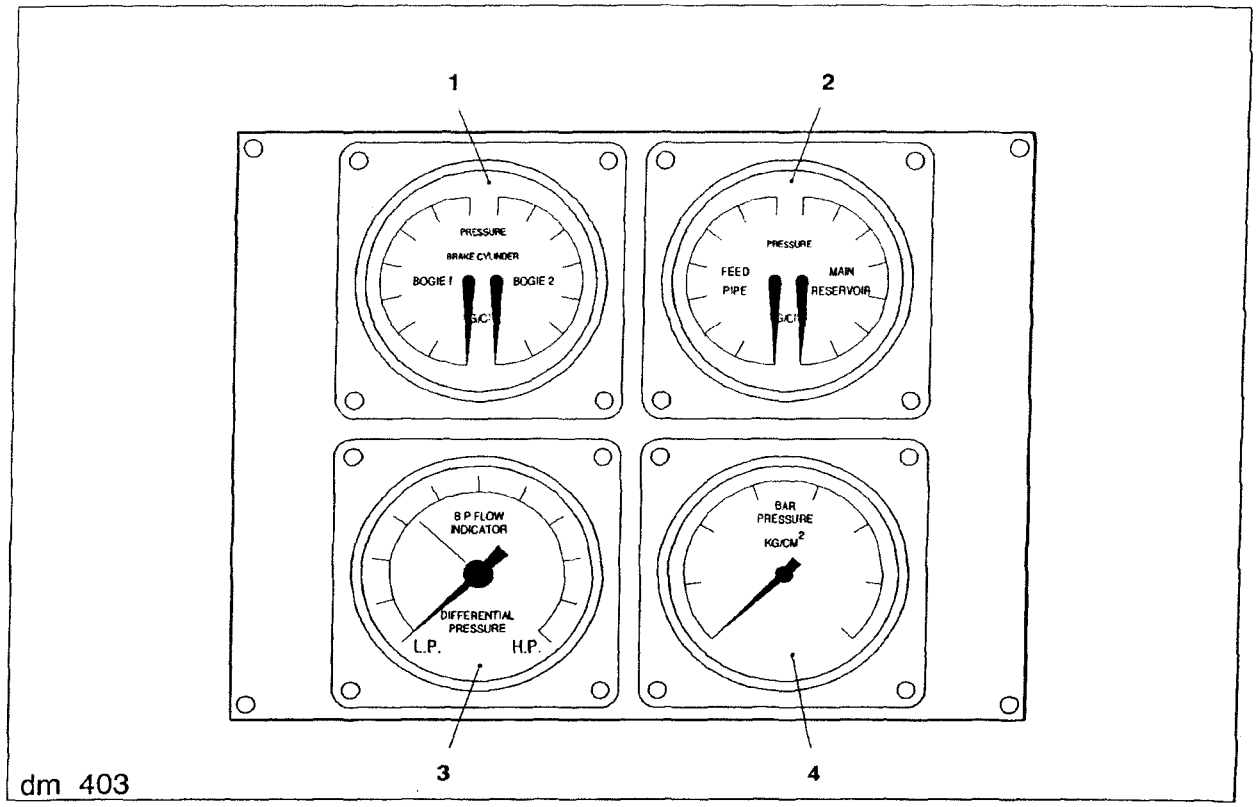
This chapter contains information regarding the components located in panels A, B, C and D in the driver's cab.

Panel A



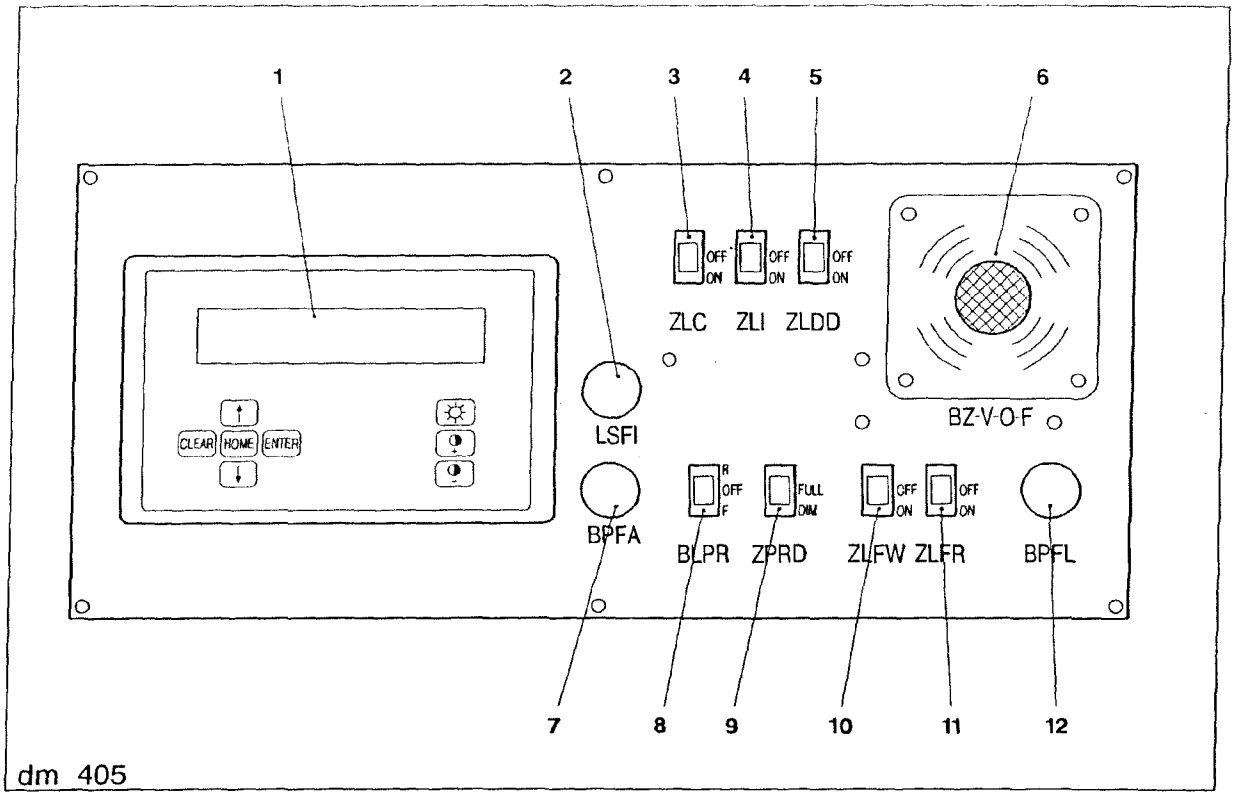
1	Voltmeter, battery "UBA" (116)	12	Key switch, cab activating "BL" (125)
2	Voltmeter, catenary "U" (74)	13	Spring loaded switch, pantograph "ZPT" (129)
3	Meter, tractive/braking effort bogie 1 (79.1)	14	Spring loaded switch, VCB "BLDJ" (134)
4	Meter, tractive/braking effort bogie 2 (79.2)	15	Spring loaded switch, main compressor "BLCP" (172)
5	Switch, banking operation "ZBAN"(153)	16	Spring loaded switch, hotel load supply "BLHO" (169.1)
6	Indication lamp, VCB "LSDJ" (137.3)	17	Switch, maximum tractive effort limitation "ZTEL" (151.1)
7	Indication lamp, hotel load supply "LSHO" (169.3)	18	Illuminated push button, constant speed control "BPCS" (151.4)
8	Indication lamp, wheel slipping "LSP" (92)	19	Illuminated push button, parking brake "BPPB" (268)
9	Indication lamp, train parting "LSAF" (81.5)	20	Push button, vigilance control reset "BPVR" (237.5)
10	Indication lamp, vigilance warning "LSVW" (242.1)	21	Push button, emergency stop (244)
11	Indication lamp, control electronic temperature "LSCE" (166)		

Panel B



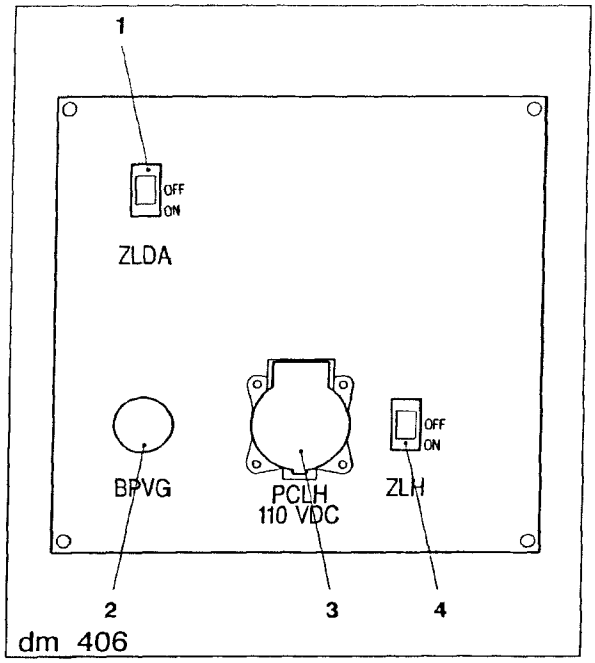
1	Gauge, bogie 1 & 2 brake cylinder pressure	3	Meter, air flow
2	Gauge, brake feed pipe / main reservoir pressure	4	Gauge, brake pipe pressure

Panel C



1	Terminal, fault indication and diagnostics (435)	7	Illuminated push button, fault indication/acknowledge "BPFA" (163.1)
2	Lamp, fault status "LSFI" (163)	8	Switch, headlights "BLPR" (316)
3	Switch, driver's cab lighting "ZLC" (324)	9	Switch, headlights Intensity "ZPRD" (317)
4	Switch, instrument lighting "ZLI" (324.1)	10	Switch, marker lights white "ZLFW" (316.11)
5	Switch, driver's desk illumination "ZLDD" (324.21)	11	Switch, marker lights red "ZLFR" (316.12)
6	Buzzer, overspeed/fire alarm/vigilance warning (238)	12	Illuminated switch, emergency flash lights "BPFL" (316.2)

Panel D



1	Switch, assistant's desk illumination "ZLDA" (324.22)
2	Push button, vigilance control "BPVG" (236)
3	Socket, handlamp "PCLH" (334.1)
4	Switch, handlamp "ZLH" (337)

Numbers in brackets ( ) denote the electrical equipment apparatus item number used in the locomotive schematics, refer to Volume G, Cabling Documentation.

Functional Description

@.1140

Panels contain various switches, sockets, gauges and lights required for locomotive operation. Refer to Volume A, Driver's Manual for further information regarding the instruments located in the panels.

Technical Data

@.1160

Gauge Working Ranges

- Battery voltmeter	0 - 150 V
- Catenary voltmeter	0 - 30 kV
- Bogie tractive effort	BE 100 - 0 - 100 % TE
- Brake cylinder pressure	0 - 7 kg/cm^2
- Brake pipe pressure	0 - 7 kg/cm^2
- Brake pipe flow meter	dimension-less ratio, LP to HP
- Main reservoir pressure	0 - 11 kg/cm^2
- Brake feed pipe pressure	0 - 11 kg/cm^2

Tolerances and Wear Limits List

@.1170

No specific tolerances or wear limits are applicable to the equipment described in this chapter. Items should be inspected as described in Section Inspection and Repair, and replaced or repaired as necessary.

Tools and Special Tools

@.1180

Conventional railway workshop tools are required for the procedures described in this chapter.

Miscellaneous Materials

@.1200

Plastic cable clamps for re-fixing the cable connections after replacement of components.

Before-Removal Operations

@.1220

Lower the pantograph and isolate the locomotive from the overhead catenary. Earth the locomotive at the vacuum circuit breaker. Refer to the Preface of this Volume.

Set the "Battery Charger Input" circuit breaker (100) to the Off position. Circuit breaker 100 is situated in auxiliary converter cubicle-2 (BUR_Box_2). For more information on circuit breakers, refer to Chapter 5.1, Auxiliary Three Phase Power.

Ensure the voltage indicators on the BUR cubicles are not flashing. A flashing voltage indicator shows a voltage present in the cabinet. No work should be performed until the capacitor banks have discharged, indicated by no flashing on the voltage indicator. Ensure the voltage indicator does not flash for a period of at least 15 seconds.

Set the "Battery Charger Output" circuit breaker (110) to the Off position. Circuit breaker 110 is situated in control cubicle-2 (SB2). For more information on circuit breakers, refer to Chapter 8.2, Machine Room Control.

Isolate the batteries at the battery box isolation switch, as described in Chapter 5.3, Battery / Charger.

Isolate the electrical power to the main compressor at circuit breaker 47.1. Circuit breaker 47.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle 1 (HB1) and circuit breaker 47.1/2 for the No. 2 is located in Auxiliary Circuits Cubicle 2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Vent the locomotive pneumatics as described in Chapter 6.3, Main Reservoirs.

Remove the appropriate panels from the driver's cab before removing components from the panels. Refer to Chapter 7.5, Cab for details on removing Panels A, B, C and D.

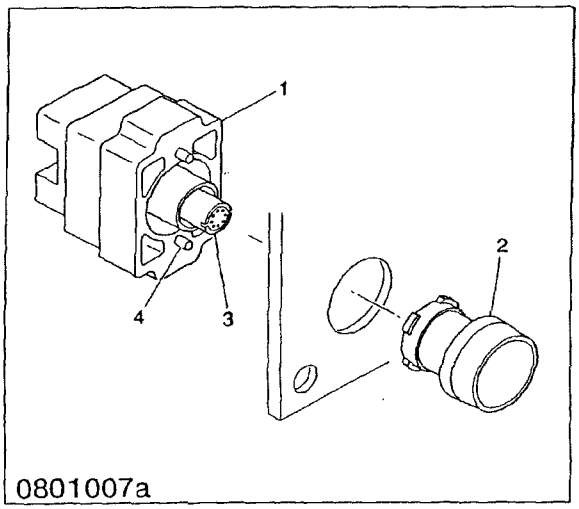
Removal

@.1230

Indication Lamps

The procedure described here is applicable to the items shown in the following table.

Description	Indication Lamp	Location	Equipment Item Number
Vacuum Circuit Breaker	LSDJ	Panel A	137.3
Hotel Load Supply	LSHO	Panel A	169.3
Wheel Slipping	LSP	Panel A	92
Train Parting	LSAF	Panel A	81.5
Vigilance Warning	LSVW	Panel A	242.1
Control Electronic Temperature	LSCE	Panel A	166
Fault Status Lamp	LSFI	Panel C	163



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Tag and disconnect the cables from the electrical terminals.

From behind the panel, loosen the screws (4) in the lamp body (1).

Rotate the lamp head (2) 90° counterclockwise to release the locking mechanism.

From behind the panel, pull the lamp body (1) from the lamp head (2).

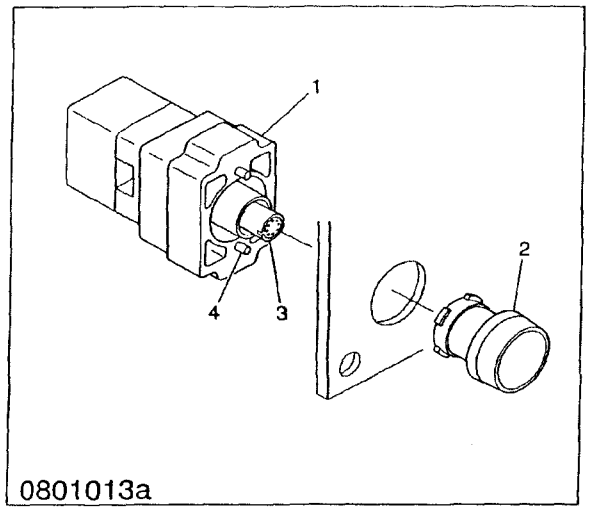
Depress the two tangs on either side of the lamp head (2) and withdraw the head from the panel.

The LED (3) is a bayonet mounting in the same way as a light bulb. If necessary, push the LED (3) inwards slightly and rotate counterclockwise to release, then withdraw the LED (3) from the lamp body (1).

Illuminated Push Buttons

The procedure described here is applicable to the items shown in the following table.

Description	Indication Lamp	Location	Equipment Item Number
Fault Indication/Acknowledge	BPFA	Panel C	163.1
Constant Speed Control	BPCS	Panel A	151.4
Parking Brake	BPPB	Panel A	268
Vigilance Reset Control	BPVR	Panel A	237.5
Vigilance Control	BPVG	Panel D	236



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Loosen the two screws (4) in the button's body (1).

Rotate the button's head (2) counterclockwise to loosen it.

Remove the head (2) and the body (1).

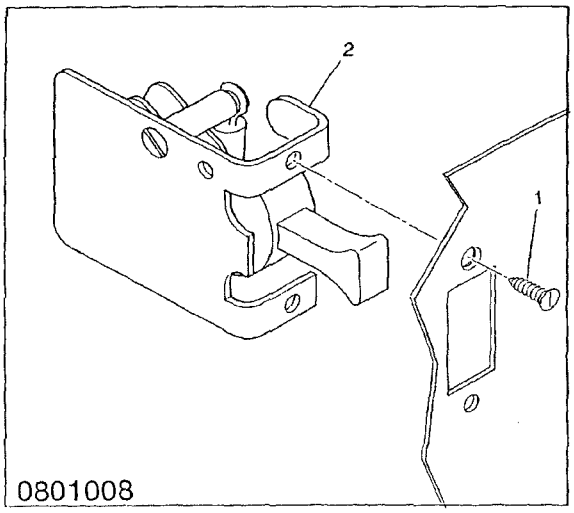
If it is necessary to change the LED (3), slightly push downwards. Turn counterclockwise and remove.

Rocker Switches

The procedure described here is applicable to the items shown in the following table.

Description	Switch	Location	Equipment Item Number
Banking Operation	ZBAN	Panel A	153
Pantograph Operation	ZPT	Panel A	129
Vacuum Circuit Breaker	BLDJ	Panel A	134
Main Compressor	BLCP	Panel A	172
Hotel Load Supply	BLHO	Panel A	169.1
Maximum Tractive Effort Limitation *	ZTEL	Panel A	151.1
Driver's Cab Lighting	ZLC	Panel C	324
Instrument Lighting	ZLI	Panel C	324.1
Driver's Desk Illumination	ZLDD	Panel C	324.21
White Marker Lights	ZLFW	Panel C	316.11
Red Marker Lights	ZLFR	Panel C	316.12
Driver's Assistant's Desk Illumination	ZLDA	Panel D	324.22
Socket Hand Lamp	ZLH	Panel D	337

* This switch is inactive on the WAP-5 locomotive



Tag and take off the cables on the switch's rear side.

Loosen the two front screws (1) above and below the switch (2).

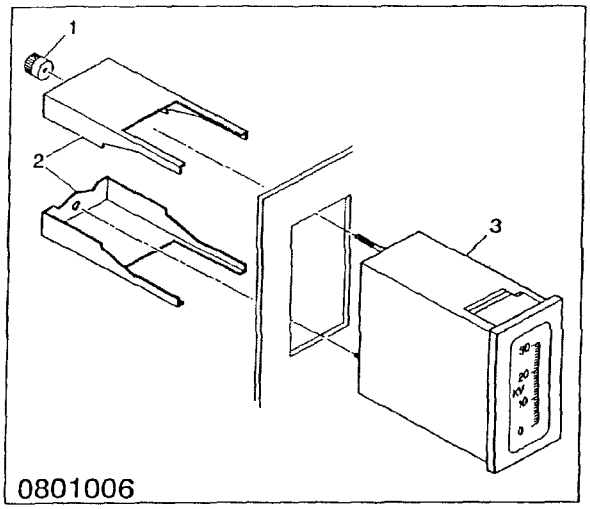
Remove the screws (1) and the switch (2).

Panel A

Meters

The procedure described here is applicable to the items shown in the following table.

Description	Meter	Equipment Item Number
Catenary Voltmeter	U	74
Tractive/Braking Effort Meter, Bogie 1	Bogie 1	79.1
Tractive/Braking Effort Meter, Bogie 2	Bogie 2	79.2

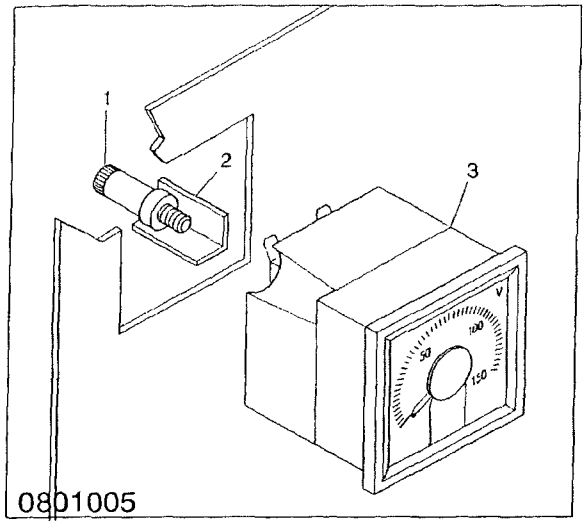


Tag and disconnect the cables from the terminals.

Remove the nuts (1) and clamps (2).

Remove the meter (3) from the front.

Voltmeter Battery "UBA" (116)

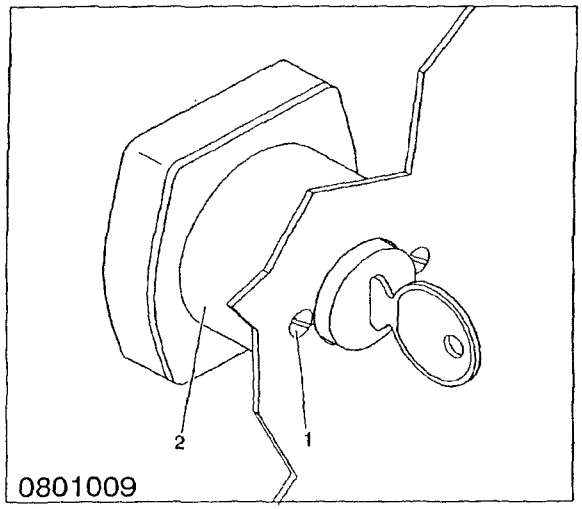


Tag and disconnect the cables from the terminals.

Remove the screws (1) and clamps (2).

Remove the meter (3) from the front of the panel.

Cab Activating Key Switch "BL" (125)

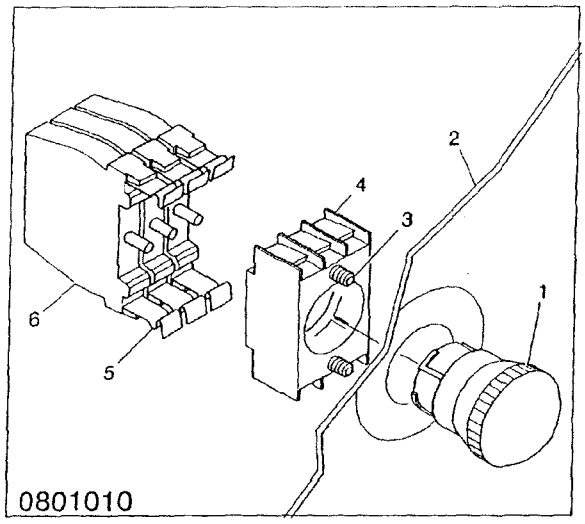


Tag and disconnect the cable connections on the rear of the switch.

Loosen the two front screws (1) fastening the key switch to the panel.

Remove the screws (1) and the key switch (2).

Push Button Emergency Stop (244)



Tag and disconnect the cables from the terminal blocks (6).

Remove the outer terminal blocks first, then the remaining block in the middle. Release the snap-on clips (5) to remove the terminal block (6).

Loosen the screws (3) that fasten the flange (4) to the panel (2).

NOTE:

Ensure the screws (3) are rotated counterclockwise, otherwise the front plate (2) will be damaged.

Rotate the loosened flange (4) 90° counterclockwise and remove.

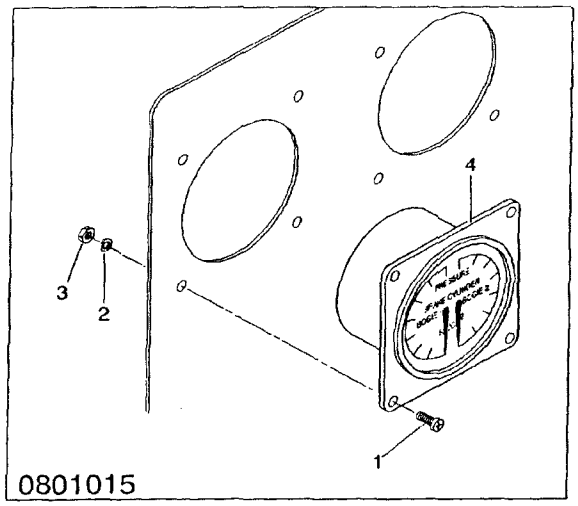
Push the button head (1) from behind out of the panel recess (2).

Panel B

Gauges

The procedure described here is applicable to the items shown in the following table.

Description	Meter	Equipment Item Number
Pressure Brake Cylinder Gauge	Bogie 1,2	131
Pressure Brake Main Reservoir / Feed Pipe Gauge	MR - FP	121
Pressure Brake Pipe	BP	122



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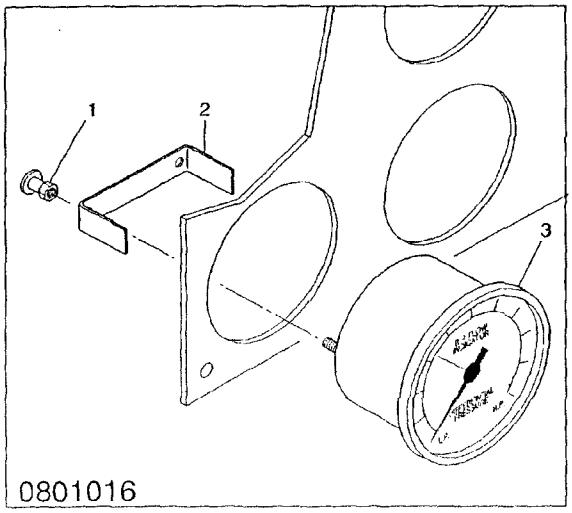
Loosen the four nuts (3). Remove the nuts (3) and lock washers (2). Remove the screws (1).

Slightly tilt the gauge (4) and lift it out of the panel recess.

Disconnect the pneumatic line from the gauge.

Gauge BP Flow Indicator (Pneumatic Item Number 132)



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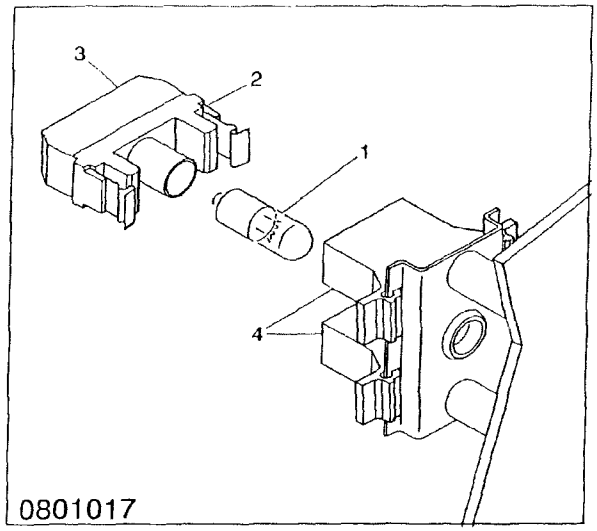
Loosen the two nuts (1). Remove the nuts (1) and the holder (2).

Take the gauge (3) off the panel recess from the front.

Disconnect the pneumatic line from the gauge.

Panel B Lighting



Tag and disconnect the cables from the terminal block.

Release the clamps (2) and remove the lamp block (3).

NOTE:

It is not necessary to remove the block (4).

Turn the lamp (1) counterclockwise to release the spring contact, then remove the lamp (1).

Panel C

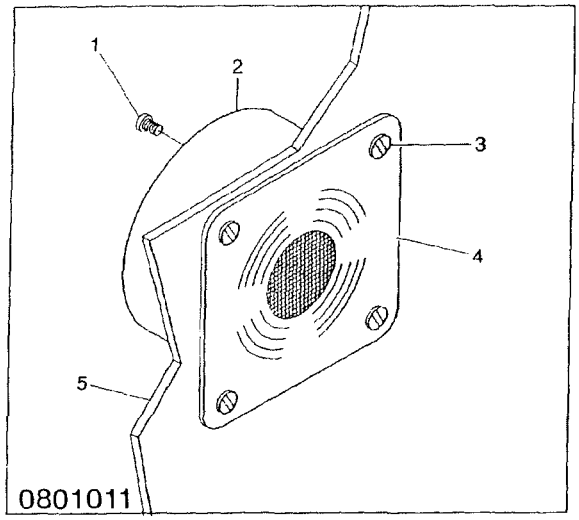
Terminal Fault Indication And Diagnostics (435)

Tag and disconnect the cables to the diagnostic terminal.

Loosen the screw connections that fasten the terminal to the panel.

Remove the screws and the terminal.

Buzzer Overspeed / Fire Alarm / Vigilance Warning (238)



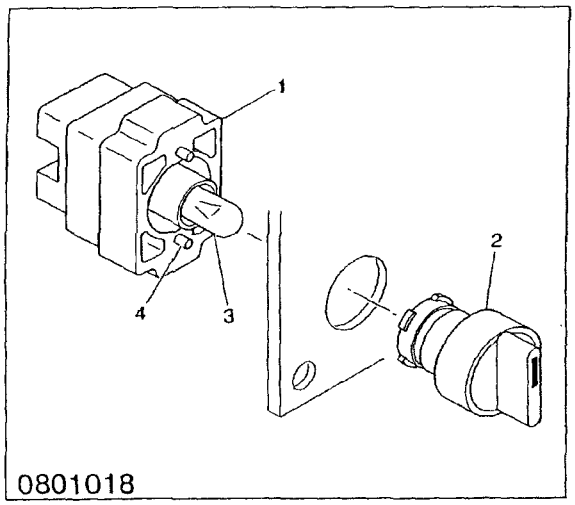
Loosen the two screws (1) and remove the cover (2).

Tag and disconnect the cables from the terminals.

Loosen the four front screws (3). Remove the nuts, lock washers. Remove the screws (3).

Remove the buzzer (4) from the panel recess (5).

Illuminated Switch Emergency Flash Light "BPFL" (316.2)



Tag and disconnect the cables from the terminals.

Loosen the two screws (4) in the lamp's body (1).

Rotate the switch's head (2) counterclockwise to loosen it.

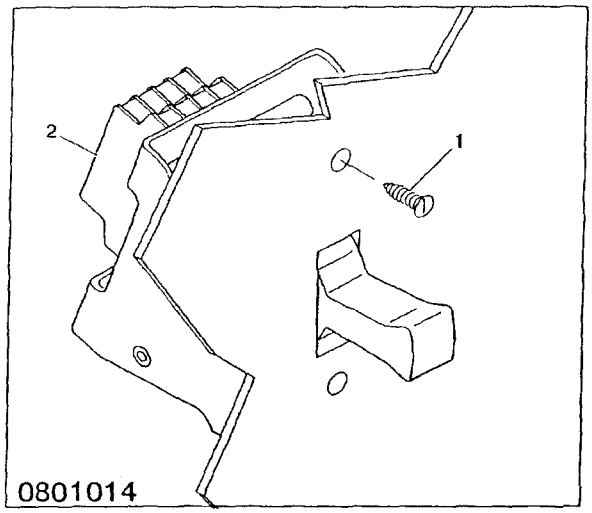
Remove the head (2) and the body (1).

If it is necessary to change the lamp (3), push the lamp slightly to release the spring contact. Turn counterclockwise and remove.

Illuminated Switches

The procedure described here is applicable to the items shown in the following table.

Description	Meter	Equipment Item Number
Switch Headlights	BLPR	316
Switch Headlights Intensity	ZPRD	317



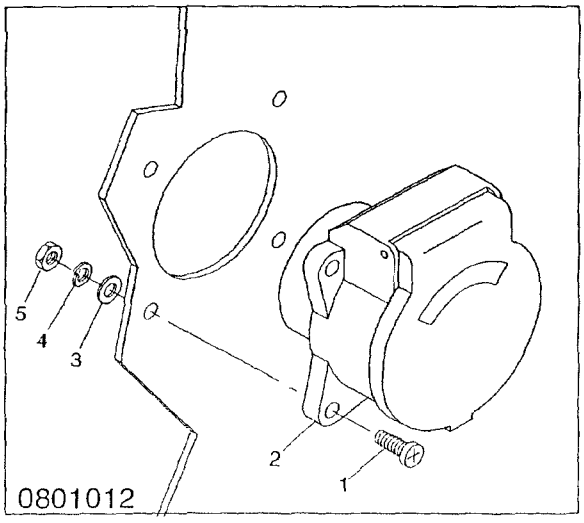
Tag and disconnect the cables from the rear of the switch.

Loosen the two front screws (1) above and below the switch (2).

Remove the screws (1) and the switch (2).

Panel D

Socket Handlamp "PCLH" (334.1)



Tag and disconnect the cables from the socket (2) terminals.

Loosen the four nuts (5) on the screws (1). Remove the nuts (5), lock washers (4) and washers (3) from behind the panel. Remove the screws (1) from the front.

Remove the socket (2).

Disassembly

@.1240

There is no disassembly applicable to the components located in the cab panels.

Inspection and Repair

@.1250

Check rubber cover on push buttons for cracks and replace rubber if necessary. Check translucent plastic heads on indication lamps, push buttons and switches for cracks. Replace head if necessary.

Waste Disposal

@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

There is no assembly applicable to the components located in the cab panels.

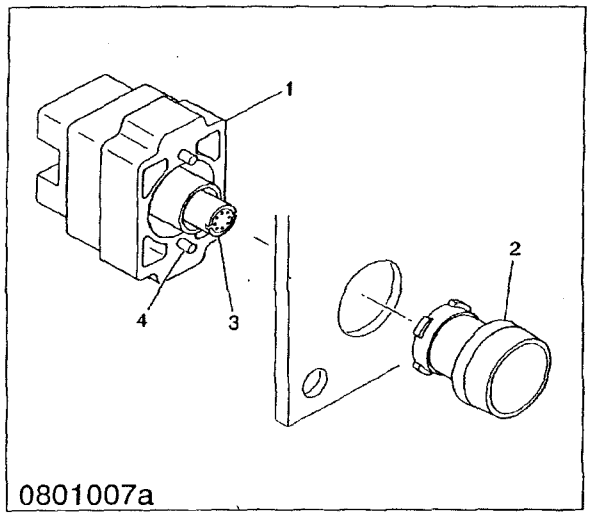
Installation

@.1278

Indication Lamp

The procedure described here is applicable to the items shown in the following table. Details of the electrical connections are given in the locomotive schematics, Volumes G, Cabling Documentation. The table gives the schematic sheet number where the electrical connections are shown.

Description	Indication Lamp	Location	Equipment Item Number	Schematic Reference
Vacuum Circuit Breaker	LSDJ	Panel A	137.3	05C
Hotel Load Supply	LSHO	Panel A	169.3	05D
Wheel Slipping	LSP	Panel A	92	08E
Train Parting	LSAF	Panel A	81.5	06F
Vigilance Warning	LSVW	Panel A	242.1	11A
Control Electronic Temperature	LSCE	Panel A	166	08B
Fault Status Lamp	LSFI	Panel C	163	17A



0801007a

Insert the LED (3) into the lamp's body (1). Slightly push and turn to the right at the same time.

Insert the lamp's head (2) through the front panel recess.

Insert the lamp body (1) from behind the panel. Rotate the head (2) clockwise until locked.

NOTE:

Do not over-tighten. Excessive force when tightening may result in damage to the panel.

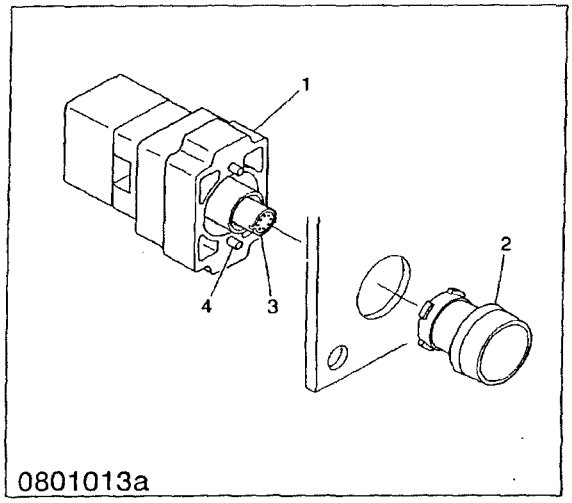
Slightly tighten the two screws (4) in the body (1) until they just touch the panel. Tighten screws (4) evenly.

Reconnect the electrical cables as tagged during disassembly.

Illuminated Push Buttons

The procedure described here is applicable to the items shown in the following table. Details of the electrical connections are given in the locomotive schematics, Volumes G, Cabling Documentation. The table gives the schematic sheet number where the electrical connections are shown.

Description	Indication Lamp	Location	Equipment Item Number	Schematic Reference
Fault Indication/Acknowledge	BPFA	Panel C	163.1	17A
Constant Speed Control	BPCS	Panel A	151.4	08E
Parking Brake	BPPB	Panel A	268	06B
Vigilance Reset Control	BPVR	Panel A	237.5	11A
Vigilance Control	BPVG	Panel D	236	11A



0801013a

Insert the LED (3) into the button's body (1). Push slightly and turn clockwise.

Insert the button's head (2) through the front panel recess.

Insert the body (1) from behind the panel. Rotate the head (2) clockwise until it is locked.

NOTE:

Do not over-tighten. Excessive force when tightening may result in damage to the panel.

Slightly tighten the two screws (4) in the body (1) until they just touch the panel. Tighten screws (4) evenly.

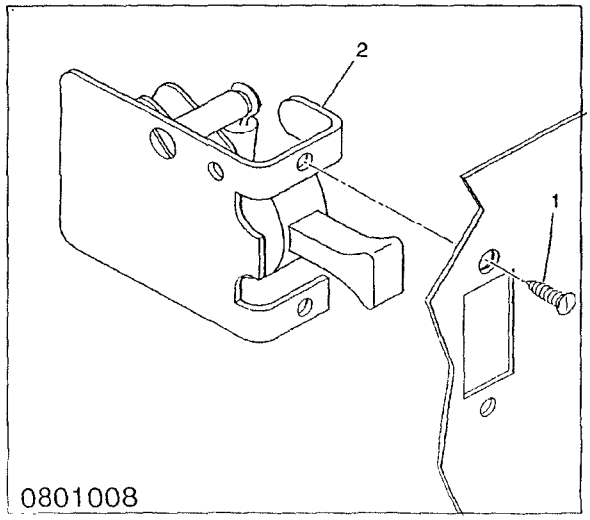
Reconnect the electrical cables as tagged during disassembly.

Rocker Switches

The procedure described here is applicable to the items shown in the following table. Details of the electrical connections are given in the locomotive schematics, Volumes G, Cabling Documentation. The table gives the schematic sheet number where the electrical connections are shown.

Description	Indication Lamp	Location	Equipment Item Number	Schematic Reference
Banking Operation	ZBAN	Panel A	153	06F
Pantograph Operation	ZPT	Panel A	129	26B
Vacuum Circuit Breaker	BLDJ	Panel A	134	26B
Main Compressor	BLCP	Panel A	172	26B
Hotel Load Supply	BLHO	Panel A	169.1	26B
Maximum Tractive Effort Limitation *	ZTEL	Panel A	151.1	08E
Driver's Cab Lighting	ZLC	Panel C	324	07A
Instrument Lighting	ZLI	Panel C	324.1	07E
Driver's Desk Illumination	ZLDD	Panel C	324.21	07A
White Marker Lights	ZLFW	Panel C	316.11	07C
Red Marker Lights	ZLFR	Panel C	316.12	07C
Driver's Assistant's Desk Illumination	ZLDA	Panel D	324.22	07A
Socket Hand Lamp	ZLH	Panel D	337	07A

* This switch is inactive on the WAP-5 locomotive



Insert the switch (2) from behind the panel and install the screws (1).

Tighten the screws (1).

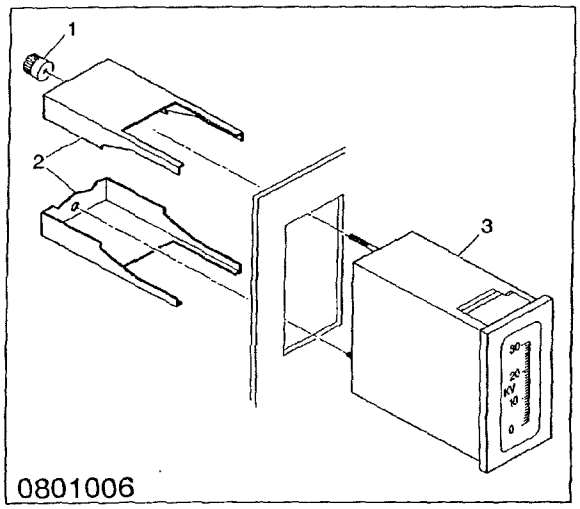
Reconnect the electrical cables as tagged during disassembly.

Panel A

Meters

The procedure described here is applicable to the items shown in the following table. Details of the electrical connections are given in the locomotive schematics, Volumes G, Cabling Documentation. The table gives the schematic sheet number where the electrical connections are shown.

Description	Meter	Equipment Item Number	Schematic Reference
Catenary Voltmeter	U	74	07E
Tractive/Braking Effort Meter, Bogie 1	Bogie 1	79.1	07E
Tractive/Braking Effort Meter, Bogie 2	Bogie 2	79.2	07E

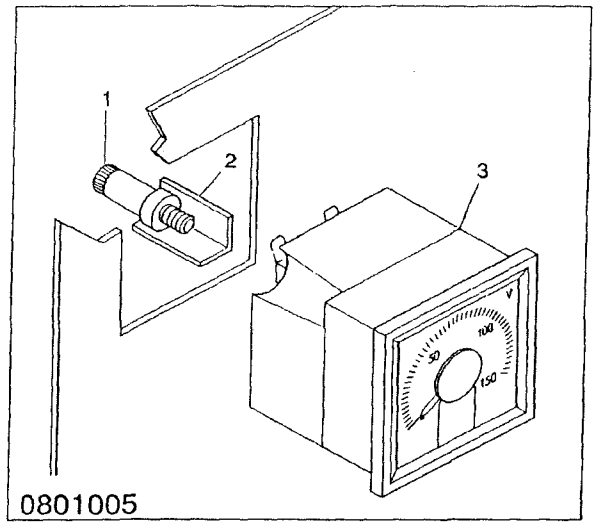


Insert the voltmeter (3) through the panel recess from the front.

Install the clamps (2) and screws, then tighten the screws (1).

Reconnect the electrical cables as tagged during disassembly.

Voltmeter Battery "UBA" (116)



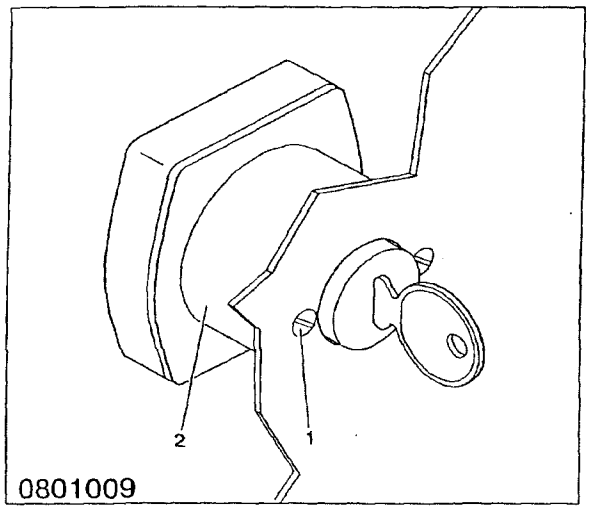
Insert the voltmeter (3) through the panel recess from the front.

Install the clamps (2) and screws, then tighten the screws (1).

Reconnect the electrical cables as tagged during disassembly.

Refer to Section Actual value Detection, Sheet 12A, Catenary & Battery Voltage of Volume G1, Cabling Documentation for electrical connections.

Cab Activating Key Switch "BL" (125)



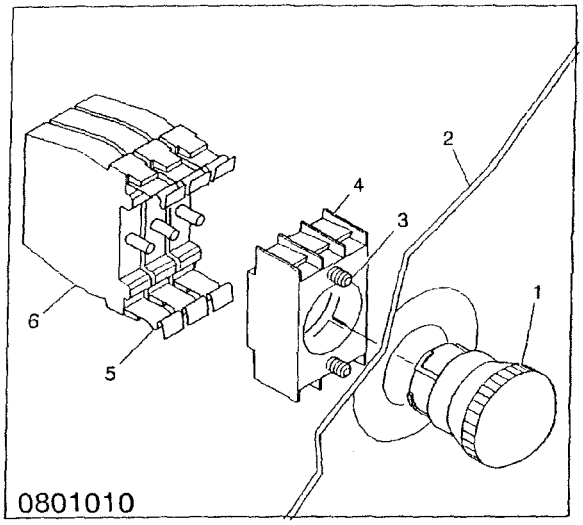
Insert the key switch (2) from behind the panel and install the screws (1).

Tighten the screws (1).

Reconnect the electrical cables as tagged during disassembly.

Refer to Section Pin Assignments, Electrical Components, Sheet 26B, Switches of Volume G2, Cabling Documentation for electrical connections.

Push Button Emergency Stop (244)



Fit the button head (1) into the panel recess. Slightly push in the button head until the retention lugs touch the panel's surface.

Insert the flange (4) onto the head (1) and rotate 90° clockwise.

NOTE:

Do not over-tighten. Excessive force when tightening may result in damage to the panel.

Slightly tighten the two screws (3) until they just touch the panel (2). Tighten screws (3) evenly.

Snap in the central terminal block (6) onto the flange (4), then fit the adjacent terminal blocks.

Reconnect the electrical cables as tagged during disassembly.

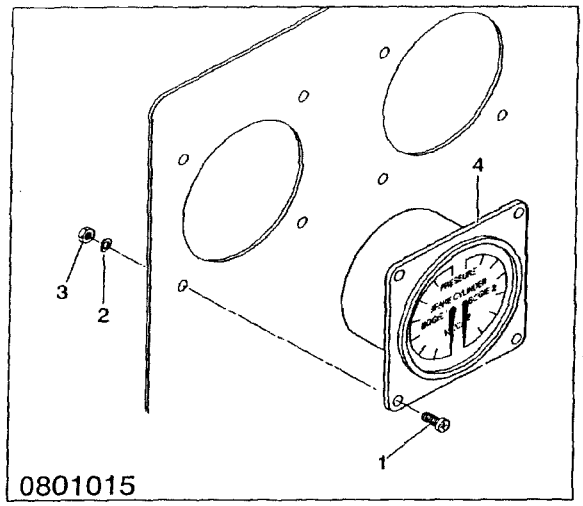
Refer to Section Pin Assignments, Electrical Components, Sheet 26B, Switches of Volume G2, Cabling Documentation for electrical connections.

Panel B

Gauges

The procedure described here is applicable to the items shown in the following table.

Description	Meter	Equipment Item Number
Pressure Brake Cylinder Gauge	Bogie 1,2	131
Pressure Brake Main Reservoir / Feed Pipe Gauge	MR - FP	121
Pressure Brake Pipe	BP	122



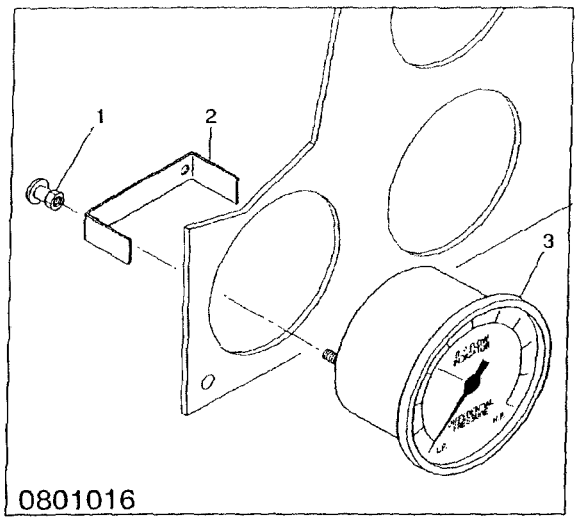
Insert the gauge (4) from the front of the panel.

Install the screws(1).

Install the lock washers (2) and nuts (3) from behind the panel. Tighten the nuts (3).

Reconnect the pneumatic lines as tagged during disassembly.

Gauge BP Flow Indicator (Pneumatic Item Number 132)

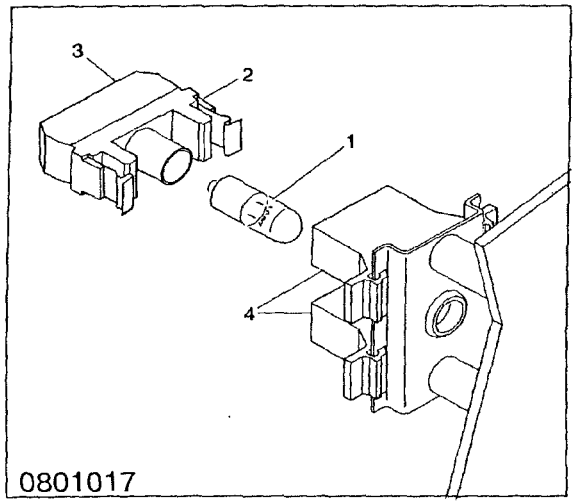


Insert the gauge (3) from the front.

Install the holder (2) and tighten the two nuts (1).

Reconnect the pneumatic lines as tagged during disassembly.

Panel B Lighting



Install the lamp (1) onto the lamp block (3) and turn clockwise.

Snap the lamp block (3) onto the rail.

Reconnect the electrical cables as tagged during disassembly.

Refer to Section Lighting Control, Sheet 07E, Instrument Lighting Test Lamp of Volume G1, Cabling Documentation for electrical connections.

Panel C

Terminal Fault Indication And Diagnostics (435)

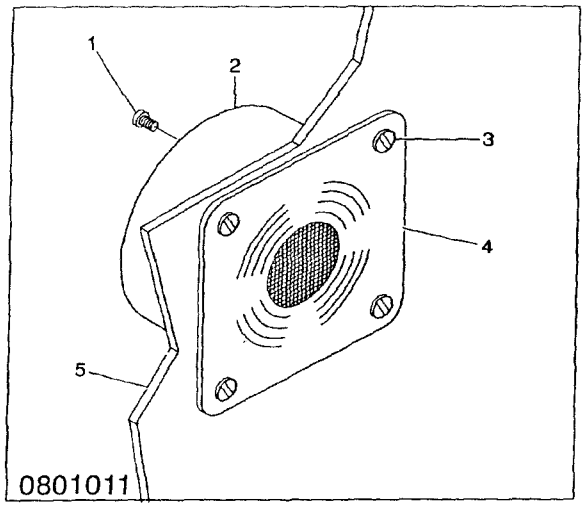
Insert the terminal into the panel recess.

Install all of the screws. Then tighten screws in a cross pattern.

Reconnect the electrical cables as tagged during disassembly.

Refer to Section Pin Assignments, Third Party, Sheet 26B, Fire Detection, Display Memotel of Volume G2, Cabling Documentation for electrical connections.

Buzzer Overspeed / Fire Alarm / Vigilance Warning (238)



Insert the buzzer (4) into the panel recess (5) from the front.

Install the screws(3).

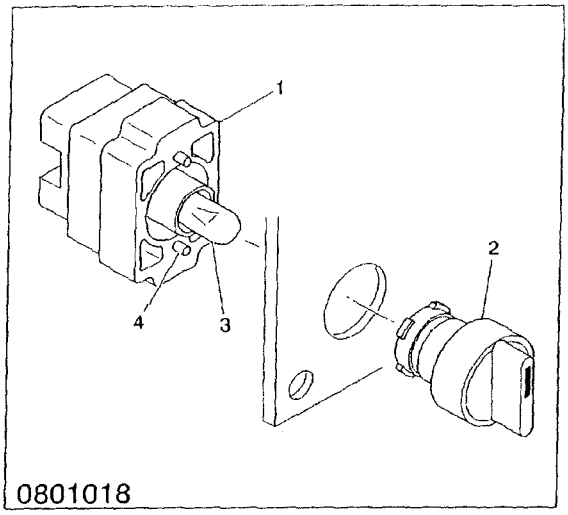
Install the two screws (1) through the cover (2).

Install the lock washers and nuts. Tighten the nuts.

Reconnect the electrical cables as tagged during disassembly.

Refer to Section Main Power Circuit, Sheet 11B, Vigilance, Fire Detection of Volume G1, Cabling Documentation earthing coil electrical connections.

Illuminated Switch Emergency Flash Light "BPFL" (316.2)



Insert the lamp (3) into the lamp's body (1). Slightly push and turn clockwise.

Insert the lamp's head (2) through the front panel recess.

Insert the lamp's body (1) from behind the panel. Rotate the head (2) clockwise until it is locked.

NOTE:

Do not over-tighten. Excessive force when tightening may result in damage to the panel.

Slightly tighten the two screws (4) in the lamp's body (1) until they just touch the panel. Tighten screws (4) evenly.

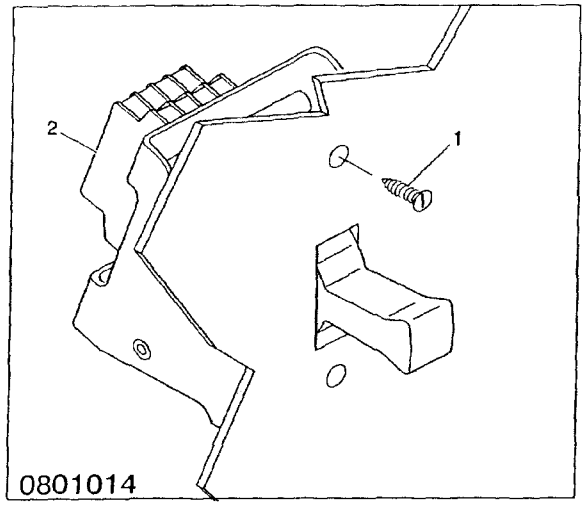
Reconnect the electrical cables as tagged during disassembly.

Refer to Section Lighting Control, Sheet 07D, Emergency Flashing Lights of Volume G1, Cabling Documentation earthing coil electrical connections.

Illuminated Switches

The procedure described here is applicable to the items shown in the following table. Details of the electrical connections are given in the locomotive schematics, Volumes G, Cabling Documentation. The table gives the schematic sheet number where the electrical connections are shown.

Description	Switch	Equipment Item Number	Schematic Reference
Switch Headlights	BLPR	316	07C
Switch Headlights Intensity	ZPRD	317	07C



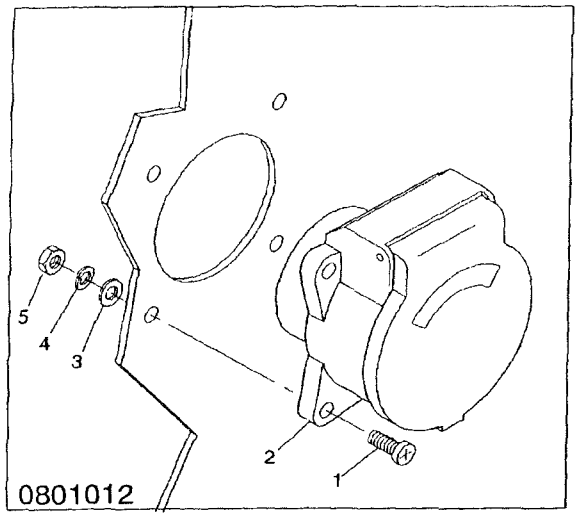
Insert the switch (2) from behind the panel.

Install and tighten the screws (1).

Reconnect the electrical cables as tagged during disassembly.

Panel D

Socket Handlamp "PCLH" (334.1)



Insert the socket (2).

Install the screws (1) through the socket.

Install the washers (3), lock washers (4) and nuts (5). Tighten the nuts (5) in a cross pattern.

Reconnect the electrical cables as tagged during disassembly.

Refer to Section Lighting Control, Sheet 07A, Driver's Cab Lighting of Volume G1, Cabling Documentation for socket electrical connections.

After-Installation Operations

@1290

Install the panels to the driver's console as described in Chapter 7.5, Cab.

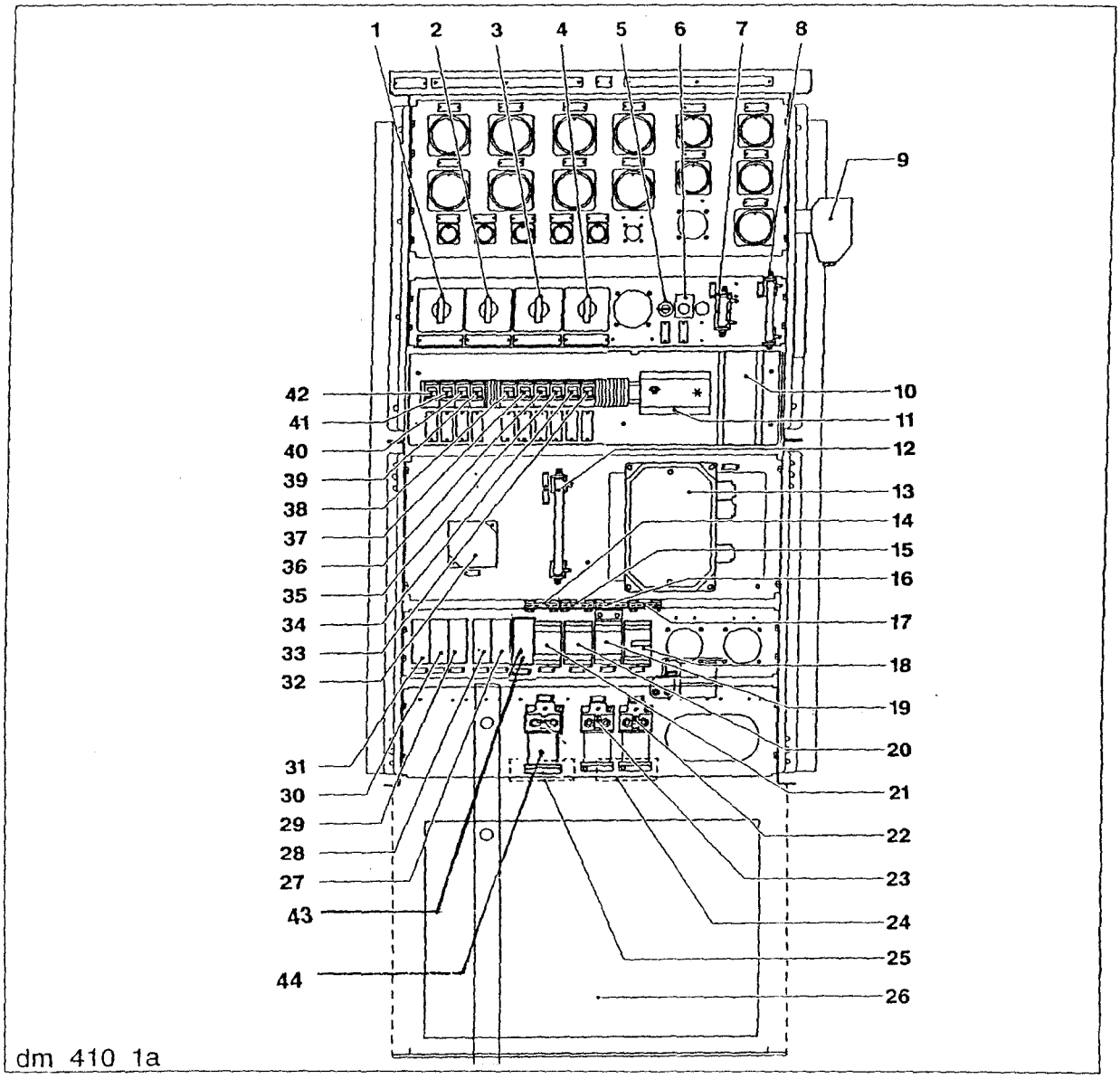
8.2 Machine Room Control

Group Summary

Control Cubicle SB1

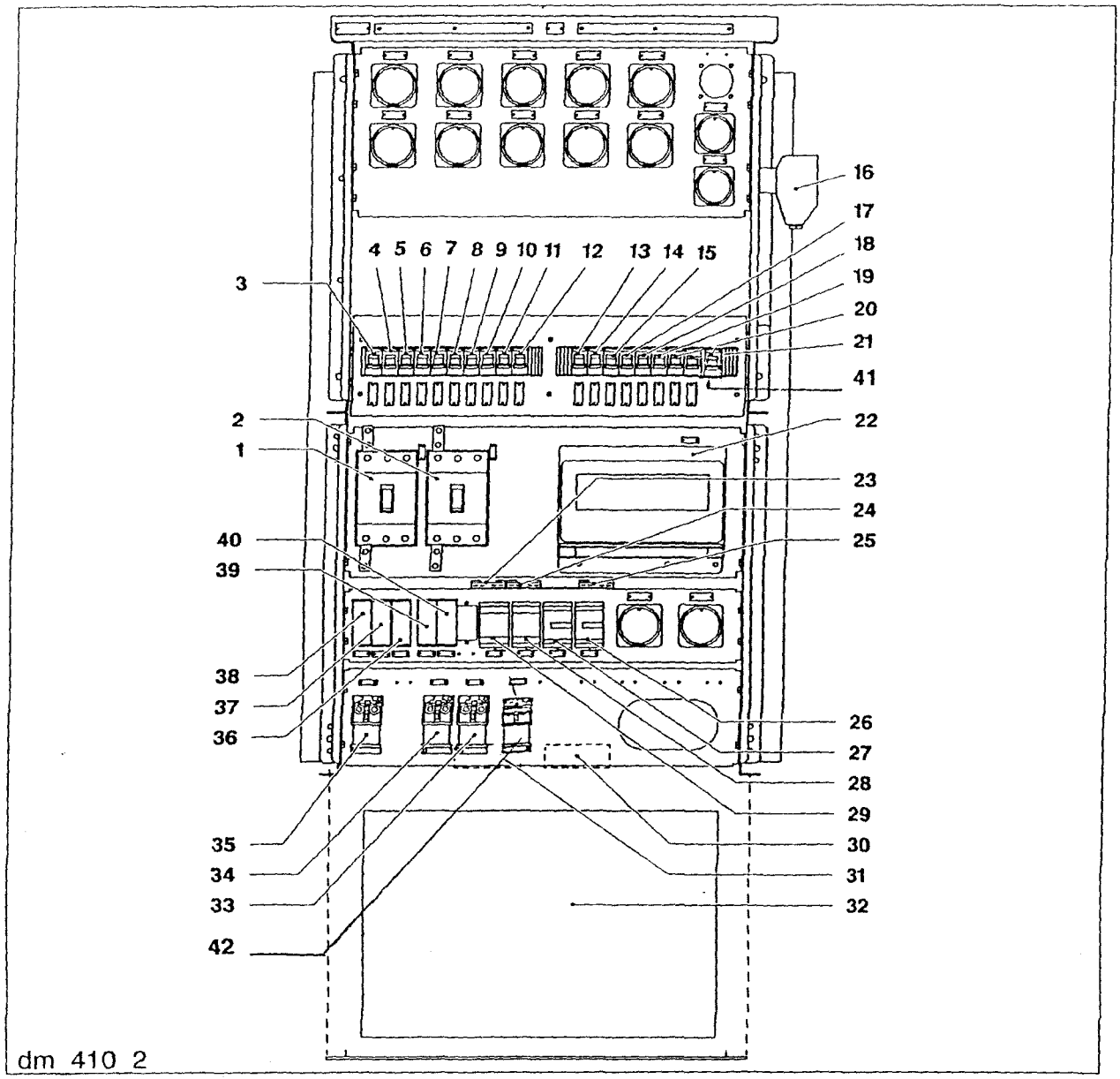
@.1120

This chapter contains information regarding the machine room control systems, which includes all the devices in the SB cubicles.



1	152	Rotary switch	Failure mode operation
2	154	Rotary switch	Bogie cut-out
3	160	Rotary switch	Configuration
4	237.1	Rotary switch	Vigilance device cut-off
5	179	Key switch	Simulation
6	161	Illuminated push-button	Configuration
7	381.71	Wire resistor	Earthing screen Train bus
8	78.1	Resistor	Maximum current relay
9	211.1/1	Thermostat	Control electronics
10	78	Relay	Maximum current
11	86	Relay	Minimum voltage
12	90.7	Resistor	Earth fault detection, Control circuit
13	381.7	Connecting box	Train bus
14	126.5A	Relay	Control electronics "OFF"
15	136.4A	Snubber circuit to item 136.4	
16	126.7A	Snubber circuit to item 126.7	
17	136.3A	Snubber circuit to item 136.3	
18	136.3	Relay	Time delay VCB
19	136.4	Contactor	Auxiliary contactor VCB
20	126.7/1	Contactor	Power supply cab
21	126.5	Relay Control Electronics OFF	
22	218	Contactor	Control electronics
23	126	Contactor	Control circuits "ON"
24	118.5/1	DC/DC converter	
25	118.4/1	DC/DC converter	
26	411	Rack	Central electronics (CEL1)
27	123.1/1	Blocking diode	Illumination test
28	123/7	Blocking diodes	
29	123/5	Blocking diodes	
30	123/3	Blocking diodes	
31	123/1	Blocking diodes	
32	89.7	Relay Earth fault	Control circuit
33	127.9/2	Circuit breaker	Central electronics
34	127.9/1	Circuit breaker	Central electronics
35	127.22/1	Circuit breaker	Electronics, auxiliary converter
36	127.2/1	Circuit breaker	Monitoring
37	127.11/1	Circuit breaker	Power supply Gate Units
38	127.1/1	Circuit breaker	Electronics traction converter
39	310.1/1	Circuit breaker	Lighting front
40	127.91/1	Circuit breaker	Power supply 24V/48V
41	127.12	Circuit breaker	Pantograph/VCB Control
42	127.3/1	Circuit breaker	Driver's cab
43	123/9	Blocking diode	Head light
44	338/1	Contactor	Head light

Control Cubicle SB2



1	110	Circuit breaker	Output battery charger
2	112.1	Circuit breaker	Control circuit locomotive
3	127.81	Circuit breaker	Commissioning 1
4	127.15	Circuit breaker	Vigilance control
5	127.7	Circuit breaker	Pneumatic panel
6	127.82	Circuit breaker	Commissioning 2
7	48.1	Circuit breaker	Auxiliary compressor
8	127.3/2	Circuit breaker	Driver's cab
9	127.91/2	Circuit breaker	Power supply 24V/48 V
10	310.7/1	Circuit breaker	Marker lights
11	310.1/2	Circuit breaker	Lighting front
12	310.4	Circuit breaker	Lighting machine room
13	127.1/2	Circuit breaker	Electronics traction converter
14	127.11/2	Circuit breaker	Power supply Gate Units
15	127.2/2	Circuit breaker	Monitoring
16	211.1/2	Thermostat	Control electronics
17	127.22/2	Circuit breaker	Electronics auxiliary converter
18	127.22/3	Circuit breaker	Electronics auxiliary converter
19	127.9/3	Circuit breaker	Central electronics
20	127.9/4	Circuit breaker	Central electronics
21	127.92	Circuit breaker	MEMOTEL speedometer
22	212	Fire detection equipment	
23	130.1A	Snubber circuit to item 130.1	
24	211.A	Snubber circuit to item 211	
25	126.7A/2	Snubber circuit to item 126.7	
26	126.7/2	Contactor	Power supply driver's cab
27	126.6	Safety relay	Control electronics "ON"
28	211	Relay	Temperature control, electronics
29	130.1	Auxiliary contactor	Pantograph
30	118.5/2	DC/DC converter	
31	118.4/2	DC/DC converter	
32	412	Rack	Central electronics (CEL2)
33	300.3/2	Auxiliary contactor	Wheel flange lubrication
34	300.3/1	Auxiliary contactor	Wheel flange lubrication
35	48.2	Contactor	Auxiliary compressor
36	123/6	Blocking diodes	
37	123/4	Blocking diodes	
38	123/2	Blocking diodes	
39	123/8	Blocking diodes	
40	123.1/2	Blocking diodes	Illumination test
41	127.24	Circuit breaker	Electronics auxiliary converter
42	338/2	Auxiliary Contactor	Head Light

Functional Description

@.1140

The SB cubicles are located within the machine room. SB1 is situated near the No. 1 End wall and SB2 is located near the No. 2 End wall. The two machine room control cubicles, SB1 and SB2, are fitted with different components.

Refer to Volume F17, Supplier's Documentation for information on the components within the SB cubicles.

Cubicle SB1

Rotary Switches (152, 154, 160, 237.1)

Rotary switch 152 is for failure mode operation.

Rotary switch 154 is for bogie cut-out.

Rotary switch 160 is for control electronics configuration.

Rotary switch 237.1 is a cut-off switch for the vigilance device.

Key Switch (179)

Key switch 179 is used to activate simulation of circuits during commissioning.

Illuminated Push Button (161)

Illuminated push button 161 is a control electronics configuration button.

Wire Resistor (381.71)

Resistor 381.71 is for the earthing screen of the train bus.

Resistor (78.1)

Resistor 78.1 is used to increase the current setting of maximum current relay 78 during VCB closing. Resistor 78.1 is connected in parallel to relay 78 through the action of timing relay 136.3.

Thermostat (211.1/1)

Thermostat 211.1/1 monitors the control electronics temperature and opens at 70 °C and de-energises relay 211.

Circuit Breakers

Circuit breakers are safety devices that protect electrical circuits from the effects of excessive currents. A circuit breaker will be tripped whenever the circuit in which it is connected is made to carry a current larger than that for which the circuit breaker will allow.

A clear protective panel covers the circuit breakers in the SB cubicles. An aperture in the panel allows access to the switch on the circuit breaker mechanism.

Circuit Breaker Driver's Cab (127.3/1)

Circuit breaker 127.3/1 is the circuit breaker to the electrical equipment in the No. 1 end cab.

Minimum Voltage Relay (86)

Minimum voltage relay 86 is closed when catenary voltage is greater than 17.5 kV and opens if catenary voltage falls below 17.5 kV.

Maximum Current Relay (78)

Maximum current relay 78 picks up when the output from the primary current transformer 6.1 increases beyond a preset value.

Earth-fault Relay (89.7)

Earth fault relay 89.7 is provided to detect earth faults in the control circuit to the battery charger.

Resistor (90.7)

Resistor 90.7 is connected across the 110 V DC output of the auxiliary converter and feeds the earth fault relay 89.7.

Connecting Box (381.7)

Connecting box 381.7 is a connection junction for the train bus.

Blocking Diodes (123 /1, 123/3, 123/5, 123/7, 123.1)

Blocking diodes are used to prevent return current flows in other circuits powered from a common source, when a circuit is activated.

Snubber Circuits (126.5A, 136.4A, 126.7A, 136.3A)

Snubber circuits are used to reduce the overvoltage peaks that occur during the energising or de-energising of certain electrical equipment, such as relays.

Relays And Contactors (126.5, 136.4A, 126.7/1, 136.3)

Relay 126.5 is a normally de-energised relay. In the open state, contactor 126 remains powered by the control electronics until the coil of relay 126.5 is energised, which opens contactor 126.

Auxiliary relay 136.4A is used to close timing relay 136.3 when the locomotive is in cooling mode.

Contactor 126.7/1 provides power to the No. 1 end cab.

Timing relay 136.3 is used to provide the closing coil of the main circuit breaker with power for a period of one second. Timing relay 136.3 is closed by auxiliary relay 136.4 when the locomotive is in cooling mode and by the control electronics when the locomotive is in driving mode.

Contactors (126, 218)

Contactor 126 supplies power to the pantograph, vacuum circuit breaker and other control circuits.

Contactor 218 connects supply to central and auxiliary converter electronics, which switches the auxiliary converters (three-phase supply) outputs.

DC-DC Converters (118.4/1, 118.5/1)

DC to DC converters 118.4 and 118.5 convert 110 V DC from the battery to 48 V DC and 24 V respectively. The 48 V DC supply is used to run cooling fans in the cubicles and the 24 V DC supply is used for driver's desk illumination and indication lamps.

Cubicle SB2

Thermostat Control Electronics (211.1/2)

Thermostat 211.1/2 monitors the control electronics temperature and opens at 70 °C and de-energises relay 211.

Circuit Breakers

Circuit breakers are safety devices that protect electrical circuits from the effects of excessive currents. A circuit breaker will be tripped whenever the circuit in which it is connected is made to carry a current larger than that for which the circuit breaker will allow.

A clear protective panel covers the circuit breakers in the SB cubicles. An aperture in the panel allows access to the switch on the circuit breaker mechanism.

Circuit Breaker Output Battery Charger (110)

Circuit breaker 110 is fitted to the output of the battery charger to prevent excessive charging of the batteries.

Circuit Breaker Control Circuit Locomotive (112.1)

Circuit breaker 112.1 is the circuit breaker to the locomotive control circuits.

Fire Detection Equipment (212)

Fire detection equipment 212 monitors the air in the machine room. Appropriate messages are displayed in the active cab if a fire or smoke is detected. Refer to Chapter 3, System Description of Volume A, Driver's Manual.

Blocking Diodes

Blocking diodes are used to prevent return current flows in other circuits powered from a common source, when a circuit is activated.

Snubber Circuits

Snubber circuits are used to reduce the overvoltage peaks that occur during the energising or de-energising of certain electrical equipment, such as relays.

Auxiliary Contactor Pantograph (130.1)

Contactor 130.1 is opened by the control electronics to lower the pantograph if the air pressure in the pantograph falls below a specified value. Contactor 130.1 is closed by the control electronics for raising the pantograph.

Relays And Contactors (211, 126.6, 126.7/2)

Relay 211 is opened whenever thermostat 211.1/1 or 211.1/2 reaches 70 °C. This signals high control electronics temperature to the control electronics and also illuminates lamp 166 on the driver's desk to inform the driver of high control electronics temperature.

Control electronics safety relay 126.6 closes only when the cab switch 125 is in the driving (D) position.

Contactor 126.7/2 provides power to the No. 2 end cab.

Contactor (48.2)

Contactor 48.2 provides power to the auxiliary compressor.

Auxiliary Contactors Wheel Flange Lubrication (300.3)

Contactors 300.3 are auxiliary contactors for the wheel flange lubrication system.

DC-DC Converters (118.4/2, 118.5/2)

DC to DC converter 118.4 and 118.5 convert 110 V DC from the battery to 48 V DC and 24 V DC respectively. The 48 V DC supply is used to run cooling fans in the cubicles and the 24 V DC supply is used for drivers desk illumination and indication lamps.

Technical Data

@.1160

Key Switch, Simulation

Nominal current IN	2 Amp
Nominal voltage UN	250 Volt AC

Earth-Fault Relay

Internal resistance at nominal current RI	43 Ω
Nominal current IN	150 mA

Blocking Diodes DIBLO-5

Nominal current IN	1.5 Amp
Nominal voltage UN	1.6 kV

Blocking Diodes DIBLO-8

Nominal current IN	0.3 Amp
Nominal voltage UN	1.6kV

Tolerances and Wear Limits List

@.1170

Refer to Chapter 2, Machine Room Control of Volume F16, Suppliers Documentation for more information on tolerances and wear limits applicable to the components in the SB cubicles.

Tools and Special Tools

@.1180

In addition to conventional railway workshop tools, the following are required for the procedures described in this chapter.

- Detector extraction tool DZ1101. Refer to Chapter 2, Machine Room Control, Section Cerberus OptoRex Wide Spectrum Smoke Detectors of Volume F16, Suppliers Documentation.

Miscellaneous Materials

@.1200

Molycote White is required for a procedure described in this chapter

Cable ties

Before-Removal Operations

@.1220

Lower the pantograph and isolate the locomotive from the overhead catenary. Earth the locomotive at the vacuum circuit breaker. Refer to the Preface of this Volume.

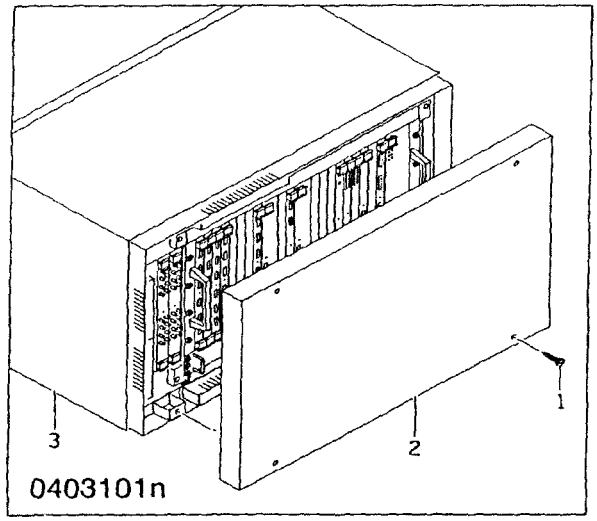
Isolate the batteries at the battery box isolation switch, as described in Chapter 5.3, Battery / Charger.

Remove the pantograph roof hatches from the locomotive body as described in Chapter 1.1, Structure.

Removal

@ 1230

The procedure in this Chapter describes removal of the SB cubicle from the machine room with the MICAS vehicle control unit cubicle (411 or 412) attached. Removal of the MICAS vehicle control unit cubicle from the SB cubicle is described in Chapter 8.3, Control Electronics.

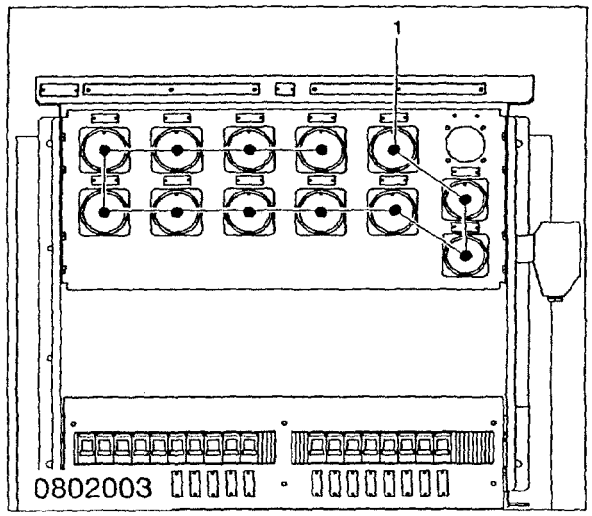


Hold the MICAS vehicle control unit cubicle cover (2) to prevent it falling, then remove the screws (1) securing the cover (2) to the control unit rack (3).

Press the upper edge of cover (2) slightly backwards. Pull the lower edge slightly forward. Slide the cover (2) upward and remove it from the vehicle control unit rack (3).

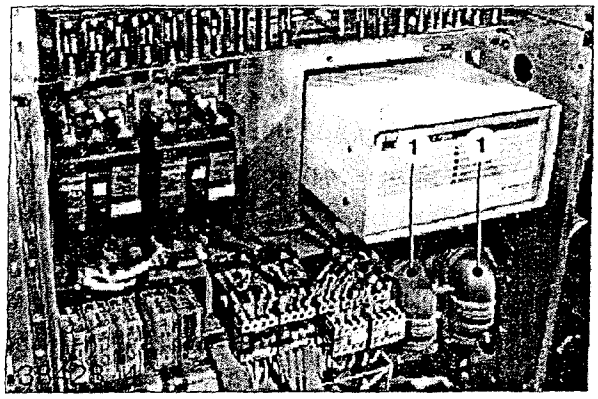
Remove the cover plates from the cable flanges, then tag and disconnect the wires and fibre optic connections from the modules in the MICAS vehicle control rack (3).

Cut the ties securing the cables to the looming bars and cable ducts. Manipulate the cables clear of the cubicles.



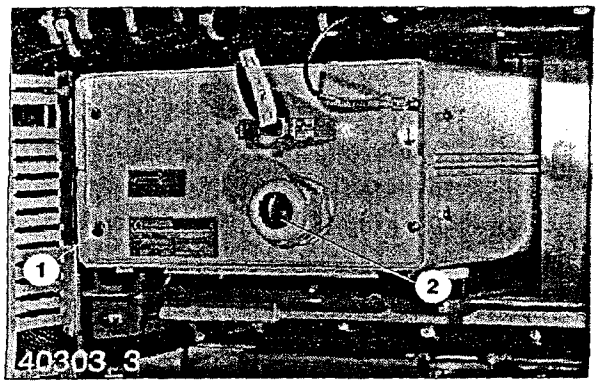
Disconnect the harness from the sockets (1) at the top of the SB cubicles. Turn the rings counterclockwise to release the bayonet connector.

Cut the ties securing the cables to the SB cubicle and cable duct.

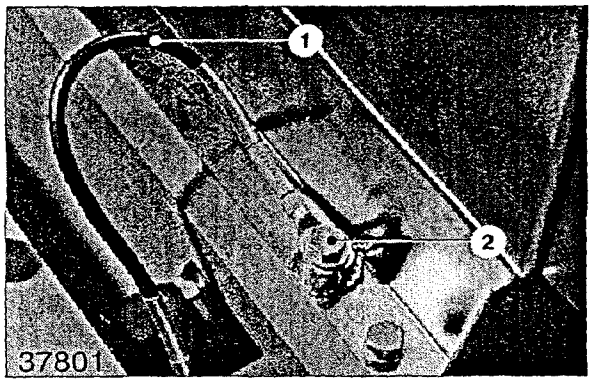


For cubicle SB2; open the SB cubicle doors, then disconnect the harness (1) from the sockets below the fire detection unit. Turn the rings counterclockwise to release the bayonet connector.

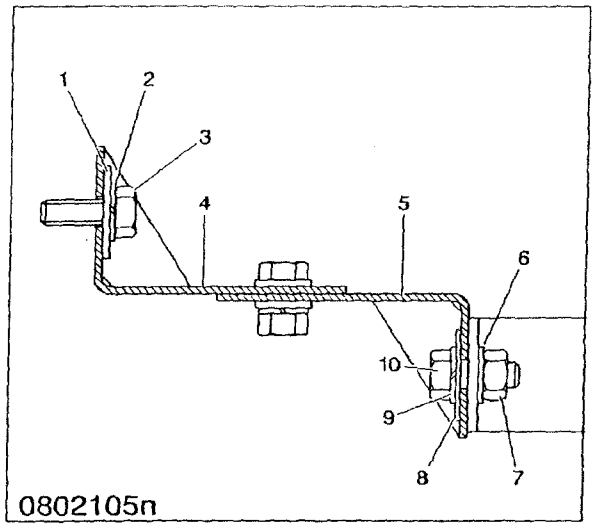
Cut the ties securing the cables and manipulate the harness from the cubicle. Secure the cables clear of the cubicle.



Disconnect the hose from the socket (2) of the fire detection equipment (1) at the back of cubicle SB2.

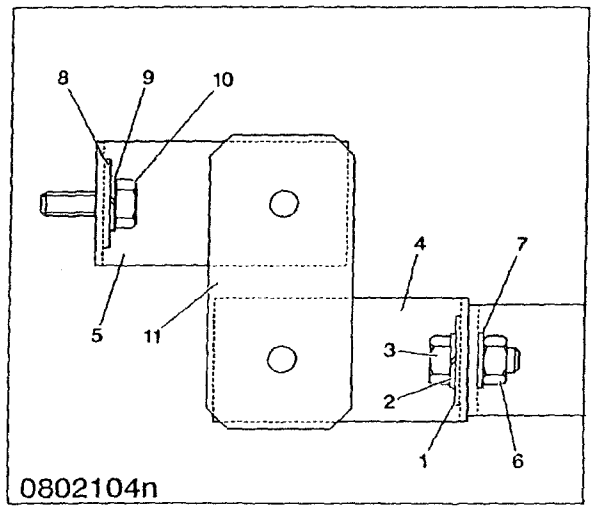


Remove the bolt (2) and washers securing the earthing cable (1).



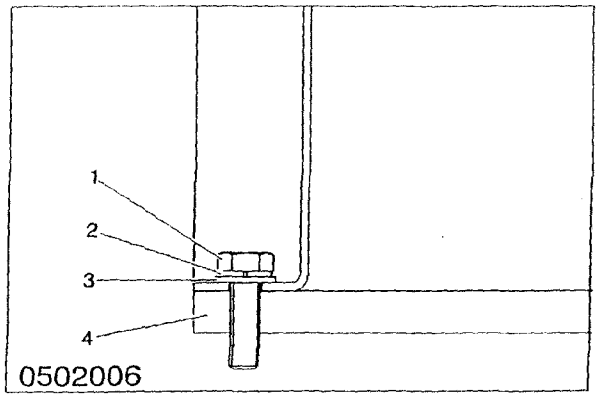
Remove the bolt (10), plain and spring washers (8, 9) and nut (7) securing the angle bracket (5) to the SB cubicle on the right hand side.

Remove the bolt (3), plain and spring washers (1, 2) securing the angle bracket (4) to the machine room wall. The angle brackets (4, 5) remain together.

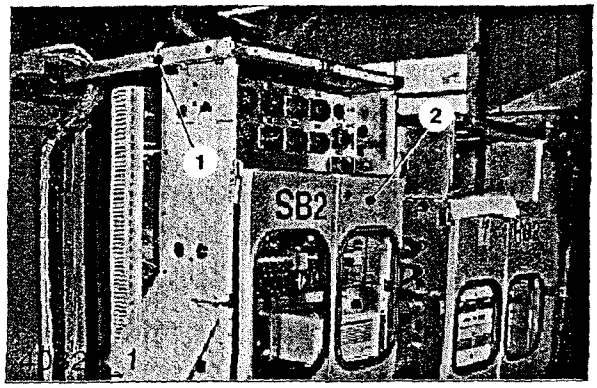


Remove the bolt (10), plain and spring washers (8, 9) securing the angle bracket (5) to the SB cubicle on the left hand side.

Remove the bolt (3), plain and spring washers (1, 2) securing the angle bracket (4) to the bracket on the machine room wall with nut (6) and washer (7). The angle brackets (4, 5) remain bolted together with connection plate (11).



Remove the bolts (1) spring and plain washers (2, 3) securing the front corners of the MICAS vehicle control unit cubicle to the machine room floor member (4).



*Attach suitable lifting equipment to the eye-*bolts (1) on the SB cubicle (2). Raise the lifting equipment slightly to take the weight of the cubicle (2).

Ensure that all the harnesses are disconnected and clear of the cubicle, then lift the SB cubicle slightly. Ensure that nothing is entangled between the locomotive and the SB cubicle, then lift from the locomotive machine room.

Disassembly

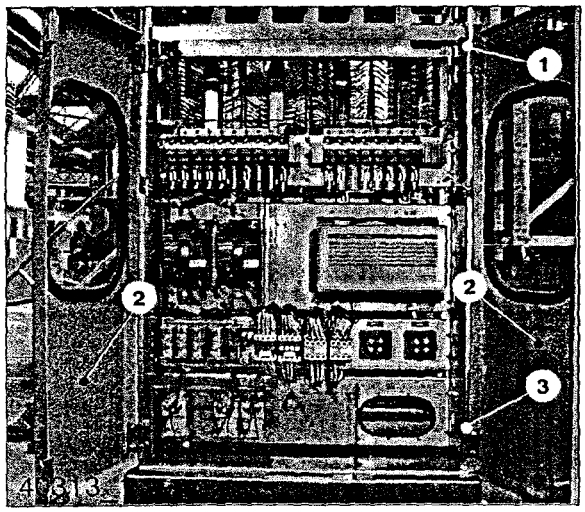
@.1240

The two machine room control cubicles SB1 and SB2 are fitted with different components. Refer to Section Group Summary.

Cubicle Doors

The removal of the doors of both control cubicles SB1 and SB2 is the same.

Open the locks (1) using a square key, then open the doors (2).



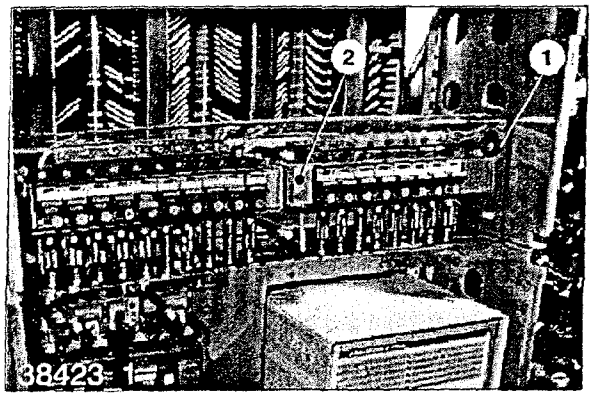
Support the door (2) to prevent it falling.

Remove pin (1) between the two halves of the upper hinge using a hammer and suitable drift.

Remove pin (3) between the two halves of the lower hinge using a hammer and suitable drift.

Remove the door (2) from the cubicle.

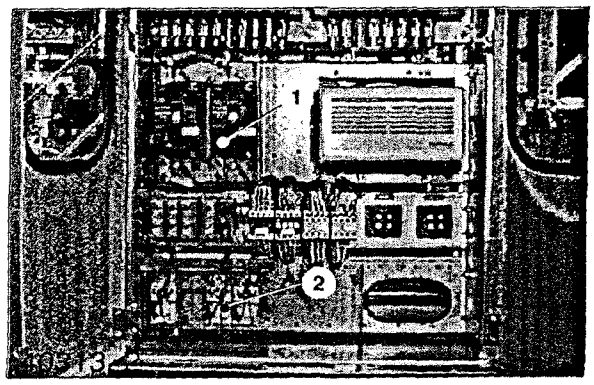
Protective Covers



Support the protective cover (2) to prevent it falling once the fasteners are removed.

Remove the screws (1) securing the protective cover (2) to the cubicle frame.

Remove the protective cover (2) from the cubicle.



The battery charger output and control circuits locomotive circuit breakers also have protective covers.

Remove the protective covers on the battery *charger output and control circuits* locomotive circuit breakers (electrical equipment Nos. 110 & 112.1) in cubicle SB2.

Support the protective cover (1) to prevent *it falling once the fasteners are removed.*

Remove the screws securing the protective cover (1) to the cubicle frame.

Remove the protective cover (1) from the cubicle.

Remove the protective covers on the wheel flange lubrication auxiliary contactors and auxiliary compressor contactor (electrical equipment Nos. 300.3/1, 300.3/2 & 48.2) in cubicle SB2.

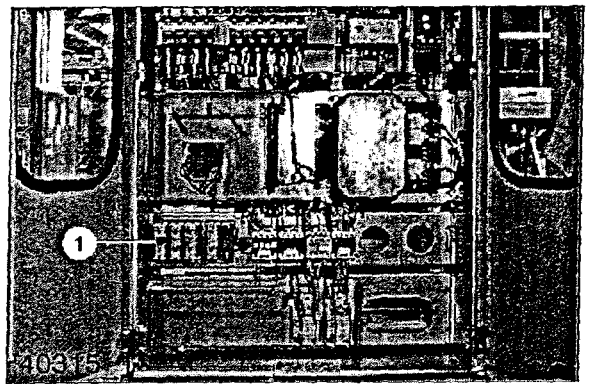
Support the protective cover (2) to prevent it falling once the fasteners are removed.

Remove the screws securing the protective cover (2) to the cubicle frame.

Remove the protective cover (2) from the cubicle.

Blocking Diodes (123/1, 123/3, 123/5, 123/7, 123.1; 123/2, 123/4, 123/6, 123/8, 123.1/2)

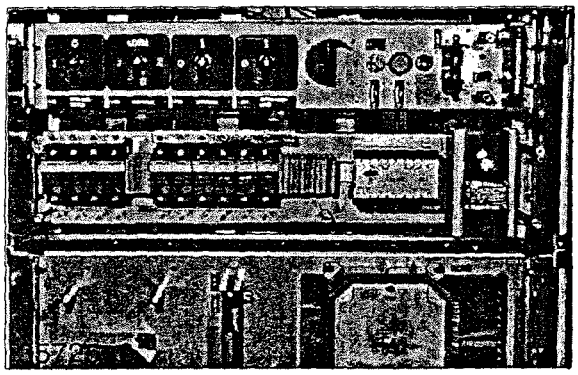
Removal of the blocking diodes from the panel is the same for all diodes. The diode shown is for illustrative purposes only.



Pull the diode carefully so that the connections do not bend. Pull out diode (1) horizontally towards the front of the cabinet.

Circuit Breakers (127.1/1, 127.2/1, 127.3/1, 127.9/1, 127.9/2, 127.11/1, 127.12, 127.22/1, 127.91/1, 310.1/1; 48.1, 127.1/2, 127.2/2, 127.3/2, 127.7, 127.9/3, 127.9/4, 127.11/2, 127.15, 127.22/2, 127.22/3, 127.81, 127.82, 127.91/2, 127.92, 310.7, 310.1/2, 310.4)

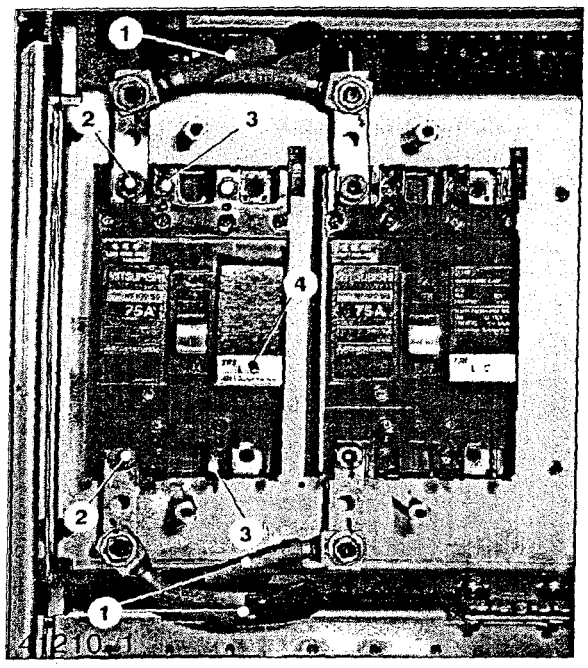
The removal procedure is the same for all these circuit breakers. The circuit breaker shown is for illustrative purposes only.



Loosen the screws at the terminals, then tag and disconnect the cables from the circuit breaker terminals. It is not necessary to disconnect the cable from the rail.

Using a screwdriver, press the spring clip (at the bottom) downwards, and simultaneously tilt the circuit breaker to remove it from the rail.

Circuit Breakers (110, 112.1)



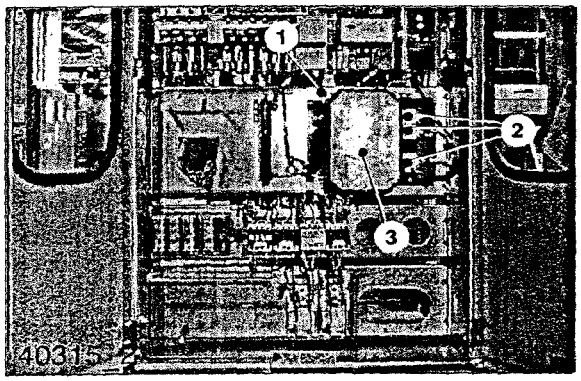
Remove the protective cover as described in Protective Covers in this Section.

Tag and disconnect the cables from the terminals. Remove the screws (2) and disconnect the cables from the terminals.

Support the circuit breaker (4); note that it is heavy. Loosen the screws (3).

Remove the circuit breaker (4).

Connecting Box (381.7)

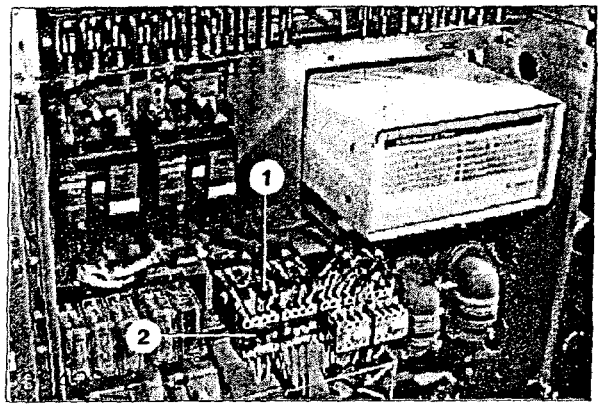


Tag and disconnect the plugs (2) from the connection box (3).

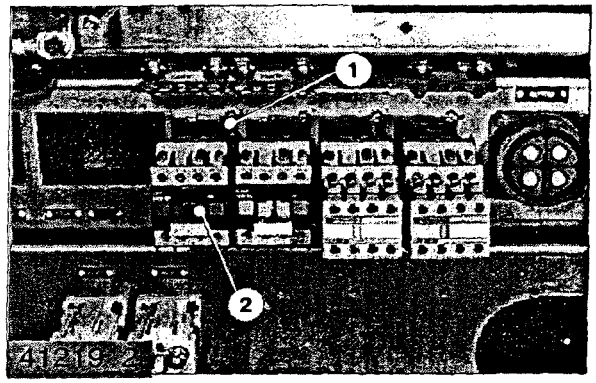
Remove the screws (1), washers and lock washers.

Remove connection box (3).

Contactors (126.5, 136.4A, 126.7, 136.3; 130.1, 211, 126.6, 126.7/2)



Tag and disconnect the cables from the contactor terminals. Loosen the screws securing the cables (1) to the contactors (2), but do not remove the screws.

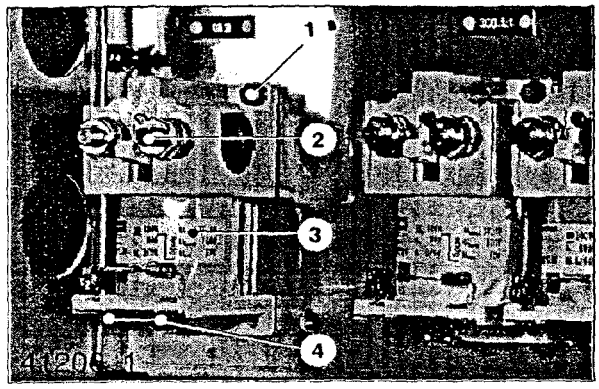


Remove the screws (1), washers, lock washers securing the contactor (2).

Remove the contactor (2).

The contactor shown is for illustrative purposes only.

Contactors (48.2, 300.3; 126, 218)



Tag and disconnect the cables from the terminals (4). Remove the nuts (2), washers and spring washers securing the cables to the terminals (4). Disconnect the cables.

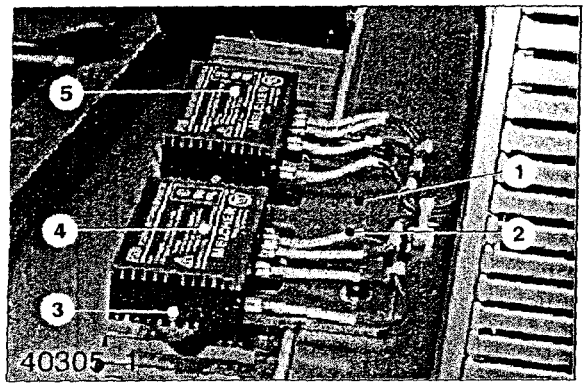
Remove the screws (1), washers securing the contactor (3).

Remove the contactor (3).

Contactor shown is for illustrative purposes only.

DC-DC Converters (118.4/2, 118.5/2; 118.4/1, 118.5/1)

The DC-DC converters with item numbers 118.4 and 118.5 are fitted on the back of the control cubicle.

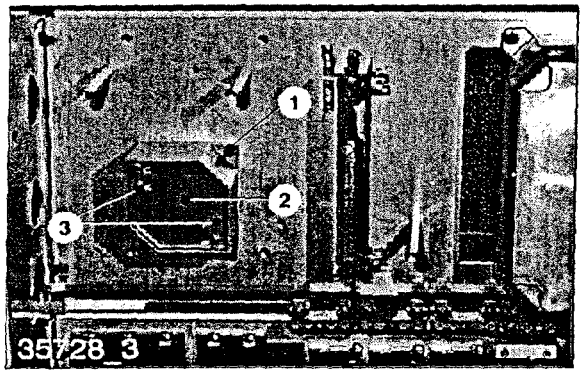


Tag and disconnect the cables (2) from the terminals.

Remove the screws (3) and washers securing the converter.

Remove the converters (4, 5) from the panel assembly.

Earth-Fault Relay (89.7)

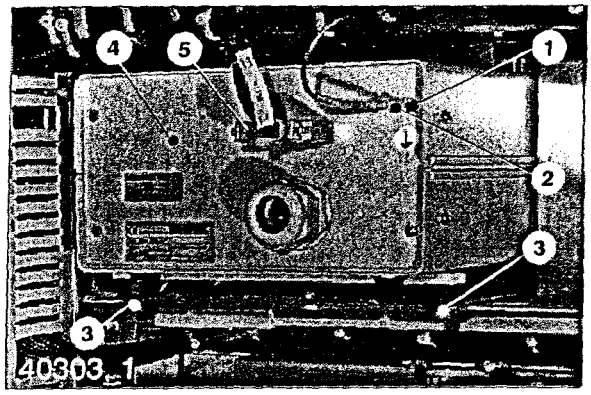


Remove the protective cover as described in Protective Covers in this Section.

Tag and disconnect the cables from the four connections (3). Remove the screws (1), washers and lock washers securing the cables.

Remove the relay (2).

Fire Detection Equipment (212)



Tag and disconnect the plug (5) from the socket. Remove the screw (1) and take off cable (2).

From the front of the panel, remove the screws (3), washers and lock washers.

Carefully pull the box (4) towards the rear of the panel.

If necessary, smoke detectors can be removed using detector extractor tool DZ1101. Tag and disconnect the cables from the detector, then remove the detector from the machine room.

Illuminated Push Button (161)

Tag and disconnect the cables from the switch.

Loosen, but do not remove, the two screws on the back of the flange of the push-button body. Rotate the push-button head counterclockwise and remove the head.

Remove the push-button body from the back of the plate.

Key Switch (179)

Ensure the key has been removed from the key switch.

At the rear of the switch, tag and disconnect the cables from the switch.

Remove the fasteners securing the key switch to the panel.

Remove the switch from the panel.

Relay Minimum Voltage (86)

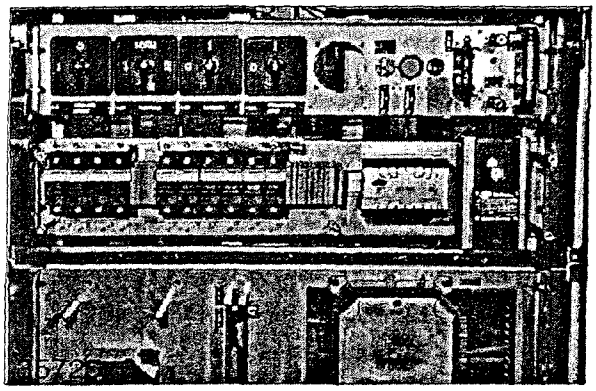
Loosen the screws securing the cables to the relay, then tag and disconnect the cables. To prevent the screws from falling out, screw them back in again slightly. It is not necessary to disconnect the cable from the rail.

Remove the clip on the lower side of the relay. Tilt the relay forward, lift slightly and remove from the rail.

Relay (78)

Remove the screws securing the relay to the panel, then pull the relay from the panel.

Resistor (78.1)



Remove the protective cover as described in Protective Covers in this Section.

Tag and disconnect the cables from the resistor terminals.

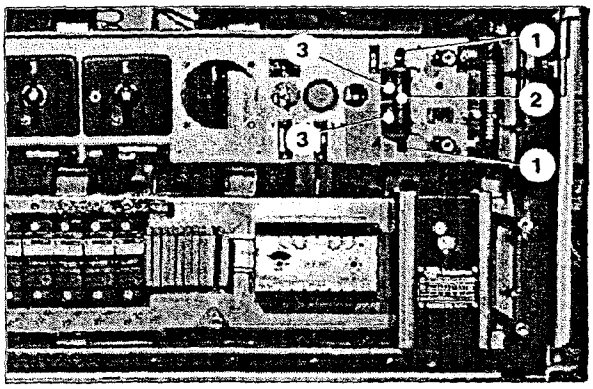
Remove the bolts securing the resistor brackets to the panel, then remove the resistor.

Resistor (90.7)

Tag and disconnect the cables from the resistor terminals.

Remove the bolts securing the resistor to the panel, then remove the resistor.

Resistor (381.71)



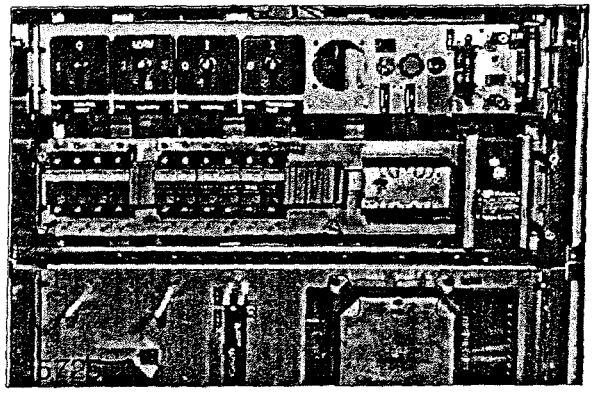
Remove the protective cover as described in Protective Covers in this Section.

Remove the nuts (1) and spring washers from the resistor terminals. Then tag and disconnect the cables from the terminals.

Remove the screws (3) and lock washers securing the resistor assembly to the panel.

Remove resistor (2) from the panel.

Rotary Switches (152, 154, 160, 237.1)



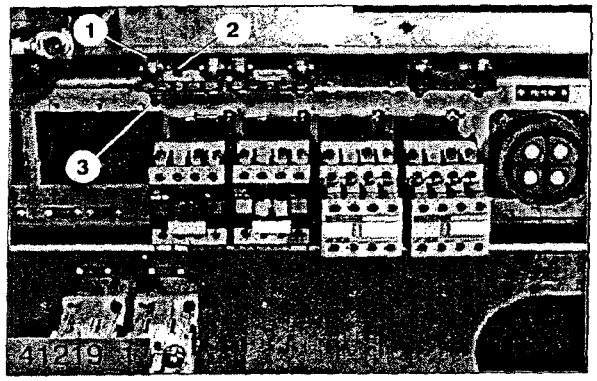
Loosen, but do not remove, the screw in the centre of the knob. Remove the knob from the rotary switch.

Remove the nut from the centre of the switch, then remove the covering plate from the switch.

Remove the bolts securing the switch to the panel.

Tag and disconnect the cables from the switch, then remove the switch from the panel.

Snubber Circuits (126.5A, 136.4A, 126.7A, 136.3A; 130.1A, 211.A & 126.7A/2)



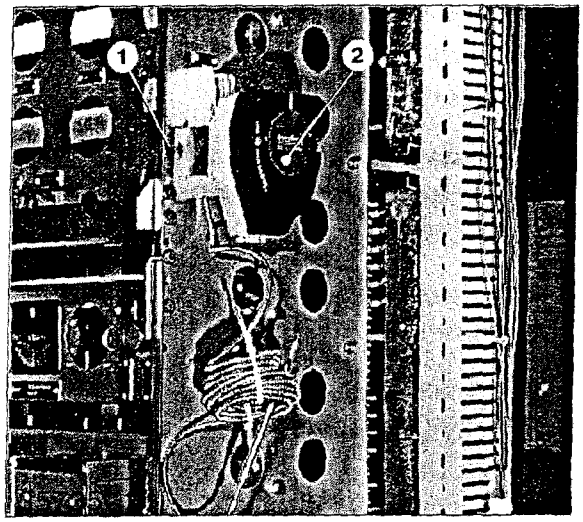
The snubber circuits are fitted immediately above the corresponding relay or contactor. The snubber circuit shown is for illustrative purposes only.

Tag and disconnect the cables from the terminals (3).

Remove the screws (1), washers and lock washers.

Remove the snubber circuit (2).

Thermostat (211.1/1, 211.1/2)



Thermostat (2) is fitted on the right of the control cubicle.

Cut the cable ties securing the capillary tube to the cubicle frame.

Disconnect the temperature probe.

Remove the screws (1) securing the thermostat (2) to the cubicle frame.

Remove the thermostat (2) from the cubicle.

Inspection and Repair

@.1250

Inspect the condition and operation of electrical components as required. Replace any faulty or damaged components. Electrical items are to be replaced as assemblies.

Inspect the condition of the SB cubicles. Inspect the surface finish for wear, cracks or chips. Re-coat the cubicles if necessary, as described in Chapter 1.2, Exterior Finish.

Inspect the glass panels in the SB cubicle doors. Replace the glass if cracked, damaged or broken.

Replace the protective covers inside the SB cubicles if cracked, damaged or broken.

Relay (78)

Inspection and repair of maximum current relay (78) is described in Chapter 2, Machine Room Control, Section Maintenance of DI Relay of Volume F16, Suppliers Documentation.

Waste Disposal

@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270

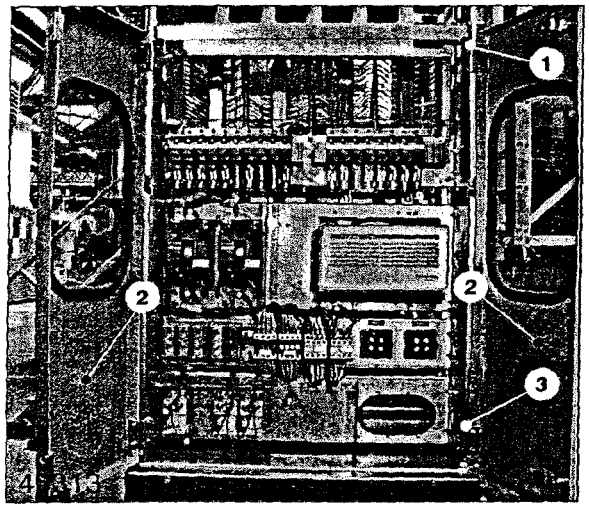
CAUTION:

The cables are labelled to facilitate assembly. Always check the connections before assembly. If in doubt, refer to Volume G, Cabling Documentation. Wrongly connected cables can irreparably damage components or cause incomprehensible error messages on the diagnosis monitor.

The two machine room control cubicles SB1 and SB2 are fitted with different components. Refer to Section Group Summary.

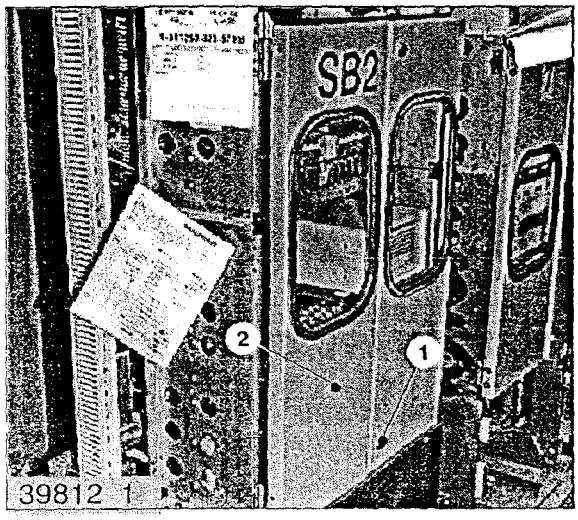
Cubicle Doors

Assembly of the doors onto the control cubicles is the same for both SB cubicles.



Lift the door (2) and insert the pin (1) into the upper hinge.

Align door (2) and insert the pin (3) into the lower hinge.



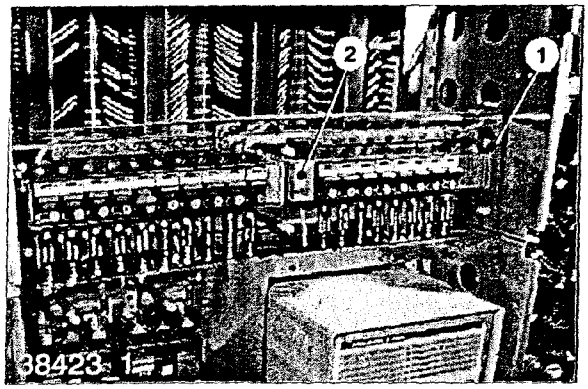
Close the doors (2) and check the alignment.

If necessary, adjust the position of the hinges until the door alignment is correct.

Lock the locks (1) with a square key.

Protective Covers

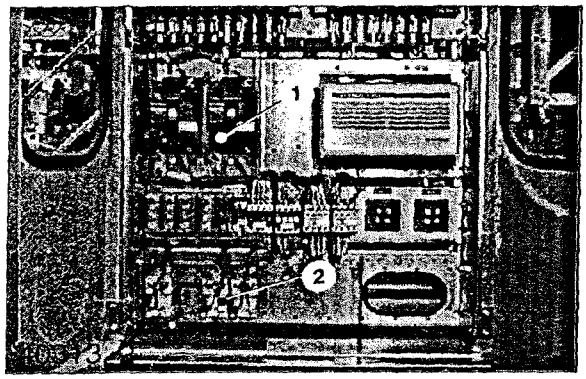
The protective covers are fitted in the same way in both control cubicles SB1 and control cubicle SB2.



Align the protective cover (2).

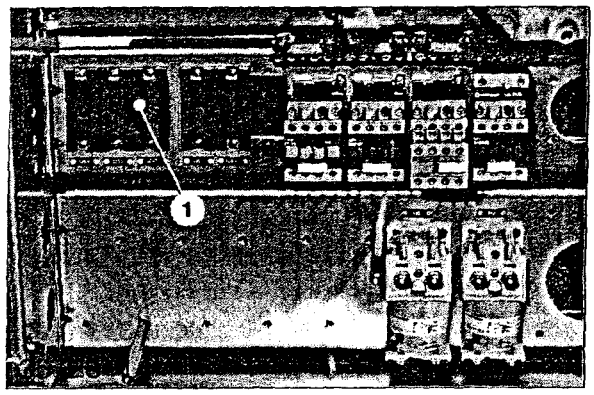
Install, but do not tighten, the screws (1) in the corners of the cover.

Once all six screws have been installed, align the cover, then tighten the screws (1). Do not over tighten the screws (1).



Assemble the remaining protective covers in the same manner.

Blocking Diodes (123/1, 123/3, 123/5, 123/7, 123.1;/1 123/2, 123/4, 123/6, 123/8, 123.1/2)



NOTE:

Fit the diode carefully. The long connections are easily bent.

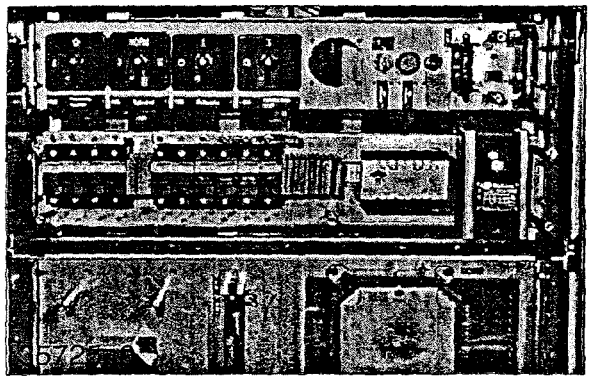
Installation of the blocking diodes is the same for all diodes. The diode shown is for illustrative purposes only.

Mount the diode on the connection plate (1).

Refer to Section Pin Assignment Electrical Components, Sheet 26C, Diode Blocks of Volume G2, Cabling Documentation for electrical connections.

Circuit Breakers (127.1/1, 127.2/1, 127.3/1, 127.9/1, 127.9/2, 127.11/1, 127.12, 127.22/1, 127.91/1, 310.1/1; 48.1, 127.1/2, 127.2/2, 127.3/2, 127.7, 127.9/3, 127.9/4, 127.11/2, 127.15, 127.22/2, 127.22/3, 127.81, 127.82, 127.91/2, 127.92, 310.7, 310.1/2, 310.4)

The installation procedure is the same for all these circuit breakers. The circuit breaker shown is for illustrative purposes only.

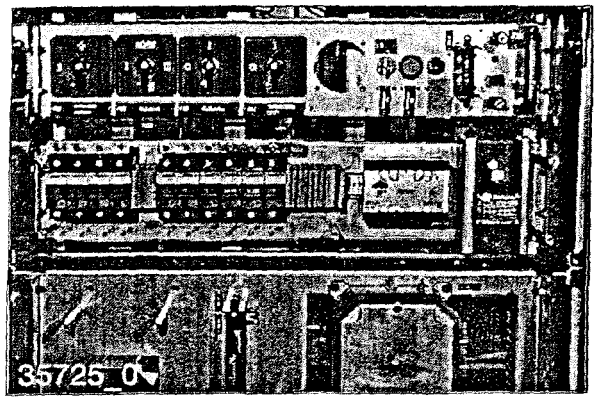


Attach the circuit breaker to the upper edge of the rail. The spring on the back of the contactor snaps into place with slight pressure.

Connect the cables to the terminals as tagged during disassembly. Install and tighten the screws on the terminals.

Refer to Section Control Circuits, Sheets 04B, 04C, 04D and 04E of Volume G1, Cabling Documentation for electrical connections.

Circuit Breakers (110, 112.1)



Position and support the circuit breaker; note that it is heavy.

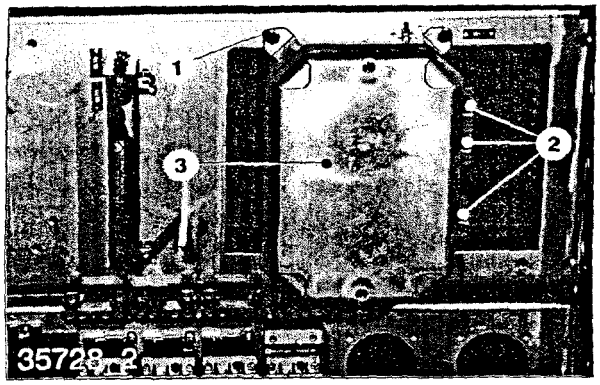
Attach the circuit breaker to the upper edge of the rail. The spring on the back of the contactor snaps into place with slight pressure.

Connect the cables to the terminals as tagged during disassembly. Install and tighten the screws on the terminals.

Install the protective cover as described in Protective Covers in this Section.

Refer to Section Pin Assignment Electrical Components, Sheet 25A, Circuit Breakers of Volume G2, Cabling Documentation for electrical connections.

Connecting Box (381.7)



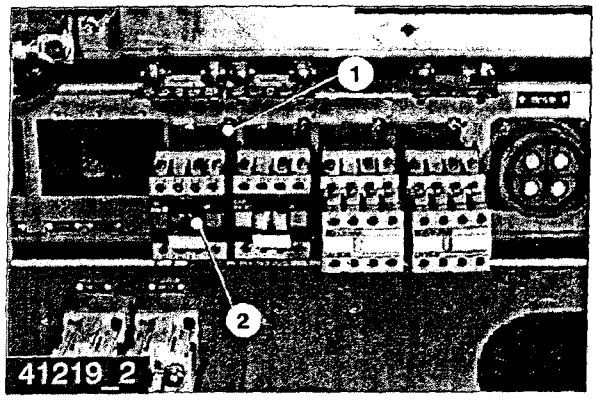
Mount the connection box (3) and align the holes.

Secure connection box (3) with screws (1), washers and lock washers.

Connect the cables to the terminals (2) as tagged during disassembly.

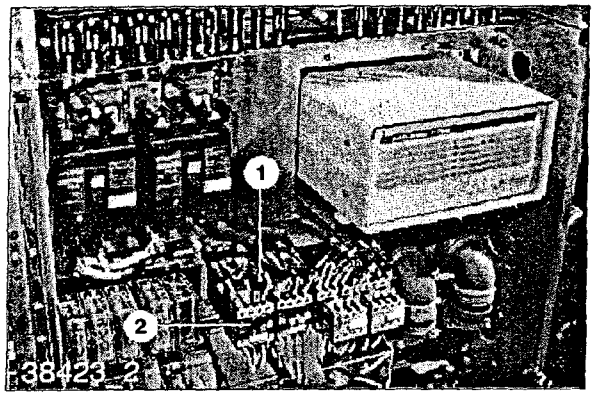
Refer to Section Trainbus, UIC-Line, Sheet 13A, Trainbus of Volume G2, Cabling Documentation for electrical connections.

Contactors (126.5, 136.4A, 126.7, 136.3; 130.1, 211, 126.6, 126.7/2)



Mount the contactor (2) and align the holes.

Secure the contactor (2) with two diagonally positioned screws (1), washers and lock washers.

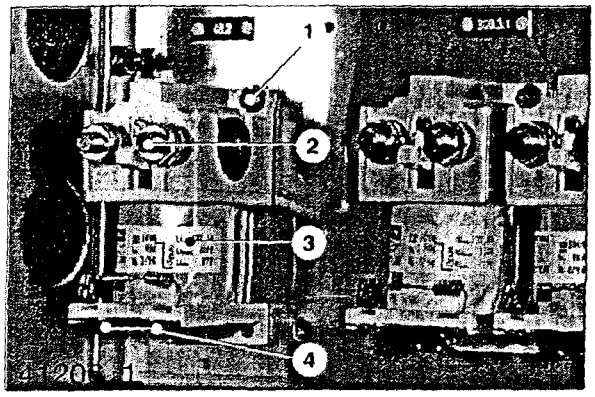


Connect the cables (1) to the contactor (2) terminals as tagged during disassembly. Loosen, but do not remove, the screws. Install the cables (1) to the terminals, then tighten the screws.

The contactor shown is for illustrative purposes only.

Refer to Section Pin Assignment Electrical Components, Sheet 25C, Low Voltage Contactors and Relays of Volume G2, Cabling Documentation for electrical connections.

Contactors (48.2, 300.3; 126, 218)



Mount the contactor (3) and align the holes in the panel.

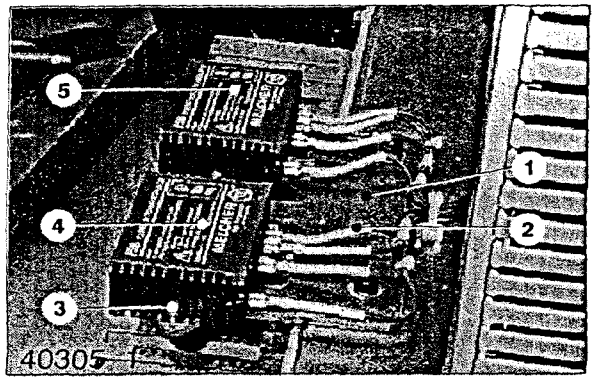
Secure contactor (3) with two screws (1) and washers.

Connect the cables to the contactor terminals (4) as tagged during disassembly.

The assembly procedure is the same for all contactors (3). Contactor shown is for illustrative purposes only.

Refer to Section Pin Assignment Electrical Components, Sheets 25B and 25C, Low Voltage Contactors and Relays of Volume G2, Cabling Documentation for electrical connections.

DC-DC Converters (118.4/2, 118.5/2; 118.4/1, 118.5/1)



Position the DC-DC converters on the back of the control cubicle.

Mount the converter (4) onto assembly plate (1).

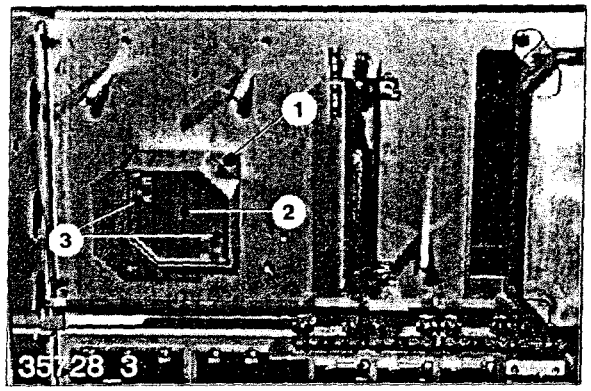
Align the converter (4) with the holes.

Secure the converter (4) with two screws (3) onto assembly plate (1).

Connect the cables (2) to the terminals as tagged during disassembly.

Refer to Section Control Circuits, Sheet 04F, DC-DC Converters 24V/48V of Volume G1, Cabling Documentation for electrical connections.

Earth-Fault Relay (89.7)



Position the relay (2) on the panel, and align with the holes in the plate.

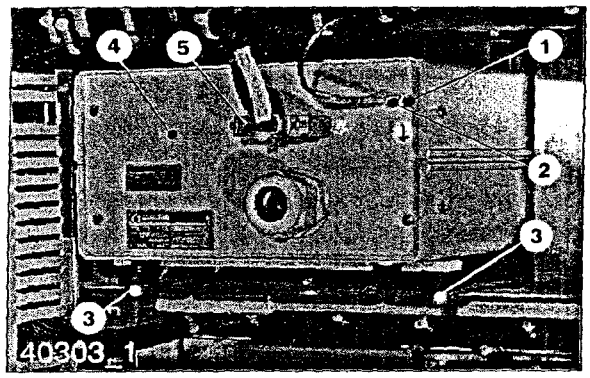
Secure the relay (2) with the screws (1), plain and lock washers.

Connect the cables to the terminals (3) as tagged during disassembly.

Install the protective cover as described in Protective Covers in this Section.

Refer to Section Pin Assignment Electrical Components, Sheet 26A, Earth Fault-, Min/ Max-Relays; Fuses of Volume G2, Cabling Documentation for electrical connections.

Fire Detection Equipment (212)



NOTE:

Handle the fire detection module (4) with care. The module (4) electronics can be damaged by jolts.

Install the module (4) from the rear of the cubicle.

Align module (4) with the holes in the mounting plate.

Secure the module (4) with the screws (3), plain and lock washers.

Secure the earth cable (2) with the screw (1).

Plug in plug (5).

Reconnect the cables to the detector as tagged during disassembly.

Refer to Section Vigilance, Fire Detection, Sheet 11B, Fire Detection of Volume G1, Cabling Documentation for electrical connections.

Illuminated Push Button (161)

Install the push-button from the back of the plate.

Fit the push-button head by turning in clockwise.

Tighten the two screws on the back of the push-button.

Connect the cables to the switch as tagged during disassembly.

Refer to Section Special Modes, Sheet 17B, Configuration, Bogie Cut-Out of Volume G2, Cabling Documentation for electrical connections.

Key Switch (179)

Install the switch from the rear of the panel.

Install the bolts to secure the switch to the panel.

Install the shimming plates removed during disassembly. Ensure the switch cover will sit flush over the switch and panel, then install the covering plate to the switch. Add or remove shimming plates as necessary to ensure the covering plate sits flush.

Reconnect the cables to the switch as tagged during disassembly.

Refer to Section Special Modes, Sheet 17A, Fault Acknowledge, Simulation, Failure Mode of Volume G2, Cabling Documentation for electrical connections.

Relay Minimum Voltage (86)

Attach the relay to the upper edge of the rail. The spring on the back of the relay snaps into place with slight pressure.

Connect the cables to the relay as tagged during disassembly.

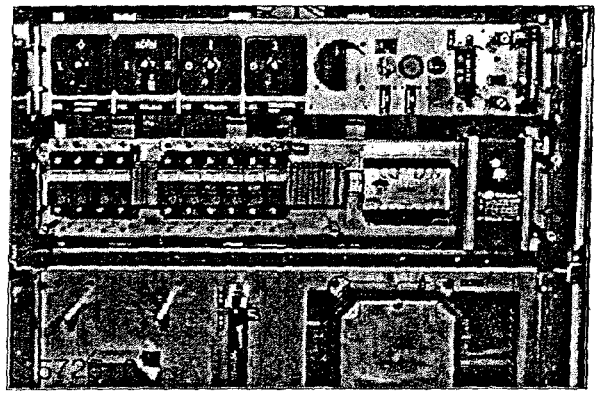
Refer to Section Pin Assignment Electrical Components, Sheet 26A, Earth Fault-, Min/Max-Relays; Fuses of Volume G2, Cabling Documentation for electrical connections.

Relay (78)

Relay 78 is of the plug-in type. To install the relay, plug the relay into the socket on the panel, then insert and tighten the retaining screws to secure the relay into the panel.

Refer to Section Pin Assignment Electrical Components, Sheet 26A, Earth Fault-, Min/Max-Relays; Fuses of Volume G2, Cabling Documentation for electrical connections.

Resistor (78.1)



Mount the resistor on the panel.

Install and tighten the bolts to secure the resistor to the panel.

Connect the cables to the resistor terminals as tagged during disassembly.

Install the protective cover as described in Protective Covers in this Section.

Refer to Section Actual Value Detection, Sheet 12A, Catenary, Battery Voltage of Volume G1, Cabling Documentation for electrical connections.

Resistor (90.7)

Position the resistor and align with the holes in the panel.

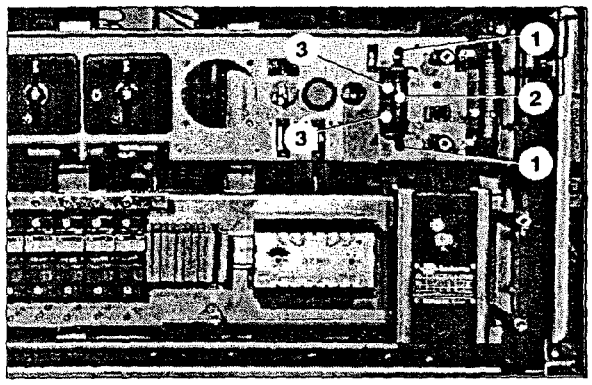
Install and tighten the bolts to secure the resistor to the panel.

Connect the wires to the connectors on the resistor.

Connect the cables to the resistor terminals as tagged during disassembly.

Refer to Section Control Circuits, Sheet 04C, Control Circuits 1 of Volume G1, Cabling Documentation for electrical connections.

Resistor (381.71)



Mount the resistor (2) on the panel and align with the holes.

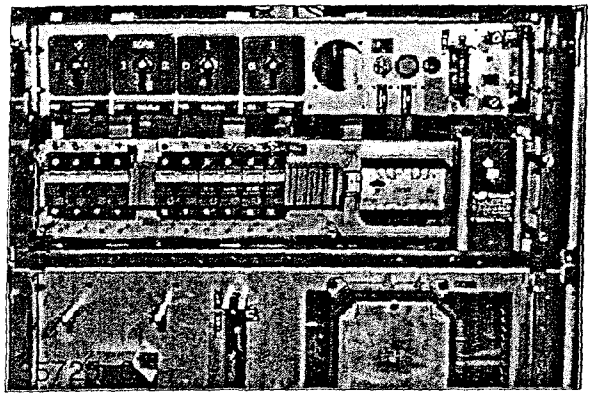
Secure resistor (2) with two screws (3) and lock washers.

Connect the cables to the resistor terminals as tagged during disassembly. Install the spring washers and nuts (1), then tighten the nuts (1).

Install the protective cover as described in Protective Covers in this Section.

Refer to Section Trainbus, UIC Line, Sheet 13A, Trainbus of Volume G2, Cabling Documentation for electrical connections.

Rotary Switches (152, 154, 160, 237.1)



Connect the cables to the switch as tagged during disassembly.

Install the switch into the panel.

Install the bolts to secure the switch to the panel.

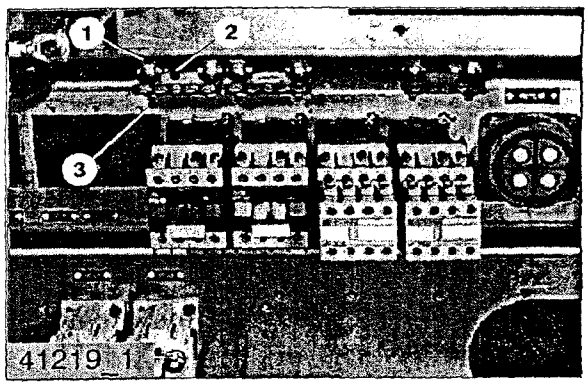
Install the covering plate on the switch. Install the nut to the switch to secure the covering plate.

Install the knob on to the rotary switch, then tighten the screw in the centre to secure the knob. Tighten the screw sufficiently to secure the knob. Do not over tighten the screw.

Refer to Section Special Modes, Sheets 17A and 17B of Volume G2, Cabling Documentation for electrical connections.

Refer to Section Pin Assignments, Electrical Components, Sheet 26B, Switches of Volume G2, Cabling Documentation for electrical connections.

Snubber Circuits (126.5A, 136.4A, 126.7A/1, 136.3A; 130.1A, 211.A & 126.7A/2)



Mount the snubber circuit (2) on the panel.

Secure the snubber circuit (2) to the panel with the screws (1), plain and lock washers.

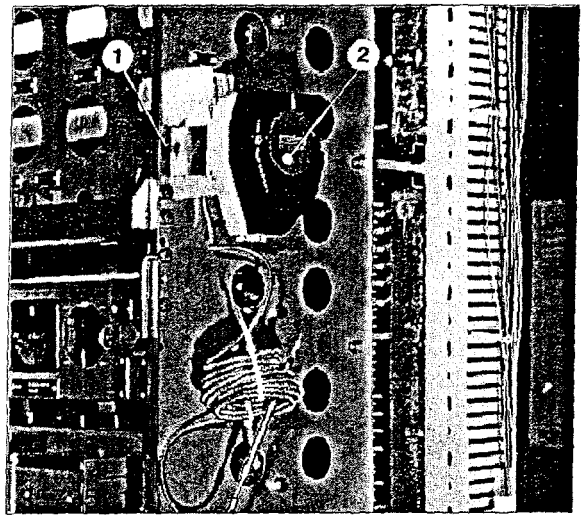
Connect the cables to the terminals as tagged during disassembly.

The snubber circuits are fitted immediately above the corresponding relay or contactor. The snubber circuit shown is for illustrative purposes only.

Refer to Section Control Main Apparatus, Sheets 05A and 05B of Volume G1, Cabling Documentation for electrical connections.

Refer to Section Traction Control, Sheets 08A and 08B of Volume G1, Cabling Documentation for electrical connections.

Thermostat (211.1/1, 211.1/2)



Position the thermostat (2) on the right of the control cubicle.

Align the thermostat (2) with the mounting holes.

Install the screws (1) securing the thermostat (2) to the cubicle frame. Tighten the screws (1).

Reconnect the temperature probe.

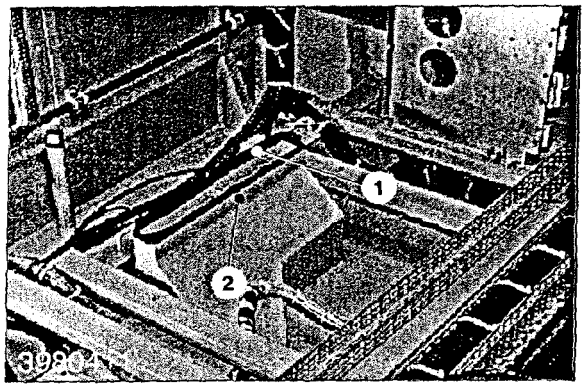
Secure the capillary tube to the cubicle frame using cable ties.

Refer to Section Traction Control, Sheet 08B, Temperature Control Electronics of Volume G1, Cabling Documentation for electrical connections.

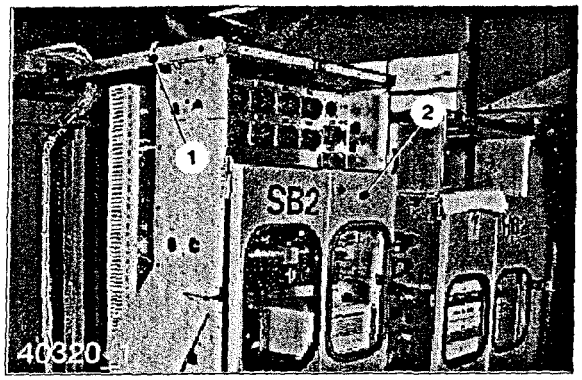
Installation

@.1280

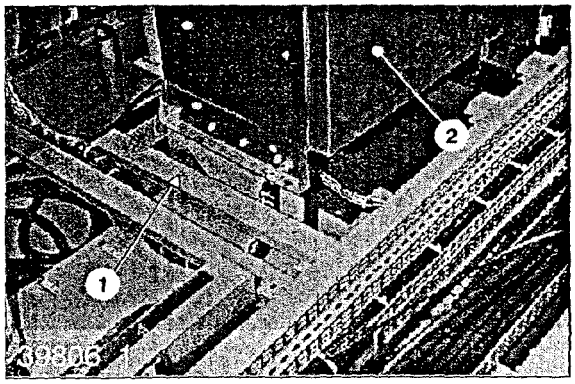
The procedure in this Chapter describes installation of the SB cubicle with the MICAS vehicle control unit cubicle (411 or 412) attached. Assembly of the MICAS vehicle control unit cubicle to the SB cubicle is described in Chapter 8.3, Control Electronics.



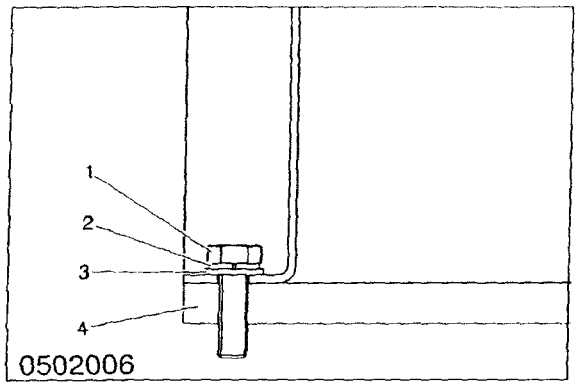
Seal the edges of the air supply (2) with sealing tape (1).



Attach suitable lifting equipment to the eyebolts (1) on the SB cubicle (2).



Slowly lower the SB cubicle (2) over the assembly studs (1). Ensure the control cubicle locating holes are correctly aligned with the locating studs (1) before fully lowering the cubicle (2).

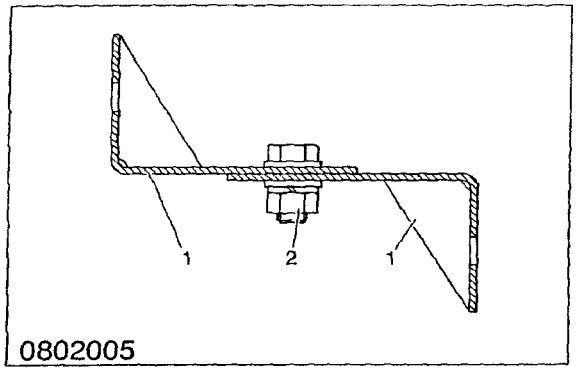


Place the plain (3) and spring washers (2) o the bolts (1).

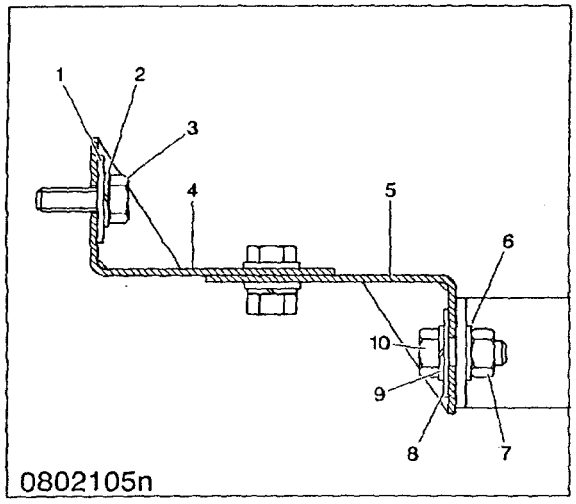
Apply a coat of Molycote White to the threads of the bolts (1).

Install the bolts (1) to secure the SB cubicle and MICAS vehicle control unit cubicle to the machine room floor member (4).

Tighten the bolts (1).



The angle brackets (1) are adjustable to suit the space between the SB cubicle and the machine room wall. Loosen the nut (2) on the bolt securing the two angle brackets (1). Do not remove the nut (2).

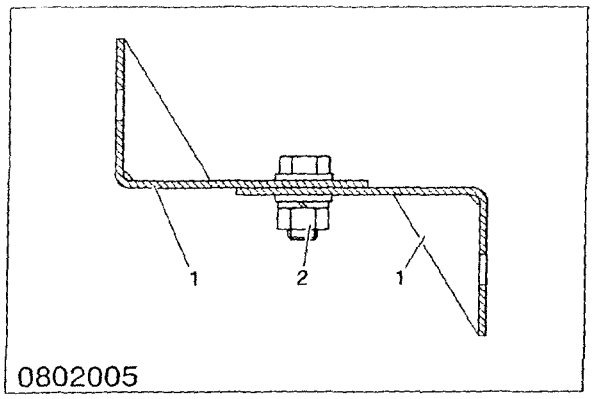


Position the angle bracket assembly (4, 5) between the SB cubicle and machine room wall on the right hand side.

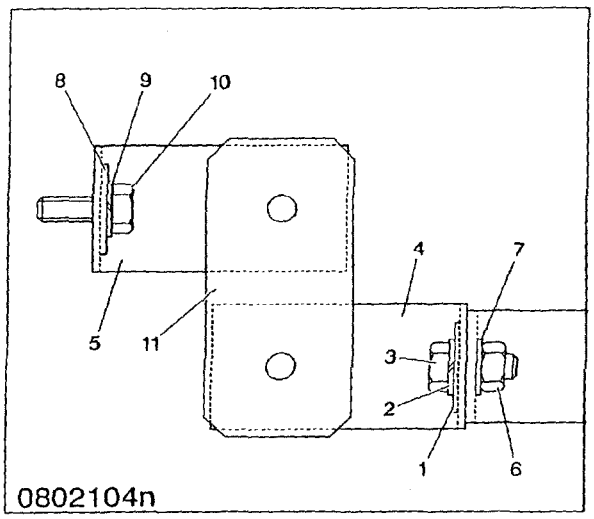
Install the bolt (3), spring and plain washers (2, 1) to secure the angle bracket to the machine room wall. Do not tighten the bolt (3).

Install the bolt (10), spring and plain washers (9, 8) between the angle bracket to the cubicle. Install the washer (6) and nut (7).

Tighten the bolts (3, 10).



Tighten the nuts (2) to secure the two halves of the angle bracket (1).



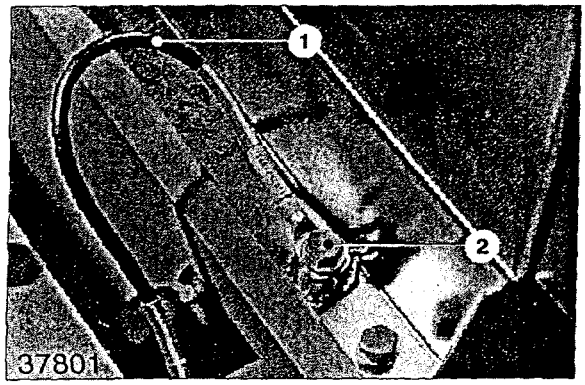
Position the angle brackets (4,5) between the SB cubicle and the machine room wall on the left hand side.

Install the bolt (3), washer (2) and spring washer (1) *through the bracket (4) and into* the bracket in the machine room wall. Position the angle brackets (4,5) correctly, then install washer (7) and nut (6) and tighten.

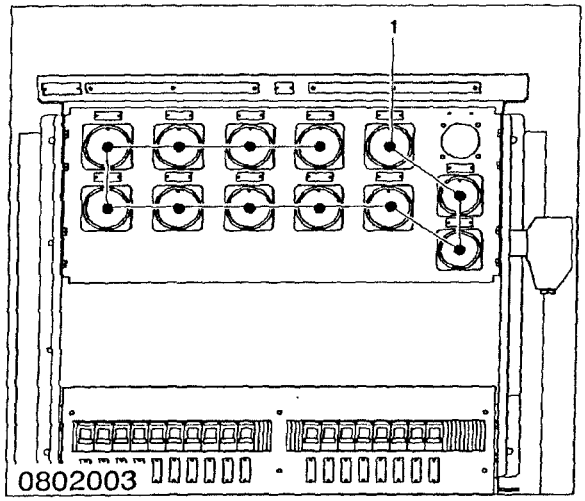
*It may be necessary to loosen the bolts se*curing the connection plate (11) to the angle brackets (4,5) to position the bracket (5) correctly on the SB cubicle.

*Once the bracket (5) is in the correct posi*tion, install the bolt (10), spring washer (9) and plain washer (8) and tighten.

Tighten the bolts securing the connection plate (11) to the brackets (4,5) as necessary.



Install the earthing cable (1). Tighten the screw (2).

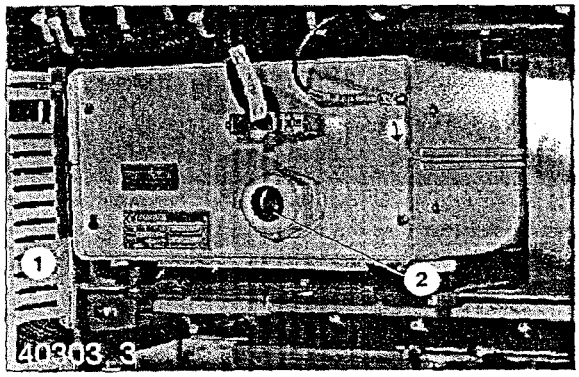


CAUTION:

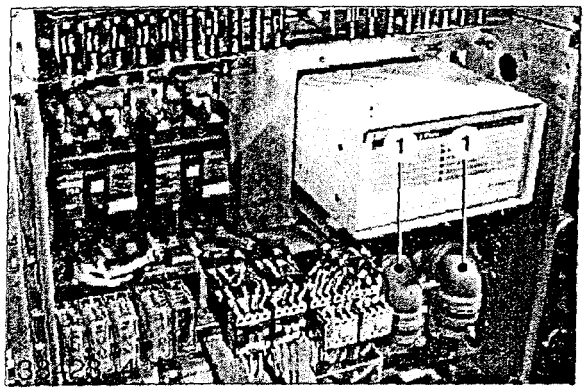
The cables and sockets are labelled to facilitate assembly. Always check the connections before assembly. If in doubt, refer to Volume G, Cabling Documentation. Wrongly connected cables can irreparably damage components or cause incomprehensible error messages on the diagnostic display.

Connect the harnesses to the sockets (1) at the top of the SB cubicles. Turn the rings clockwise to secure the bayonet connector.

Secure the cables to the SB cubicle and cable duct using cable ties.



Connect the hose to the socket (2) of the fire detection equipment (1) at the back of cubicle SB2.



For cubicle SB2; open the SB cubicle doors, then manipulate the harness into the cubicle. Connect the harness (1) to the sockets below the fire detection unit. Turn the rings clockwise to secure the bayonet connector.

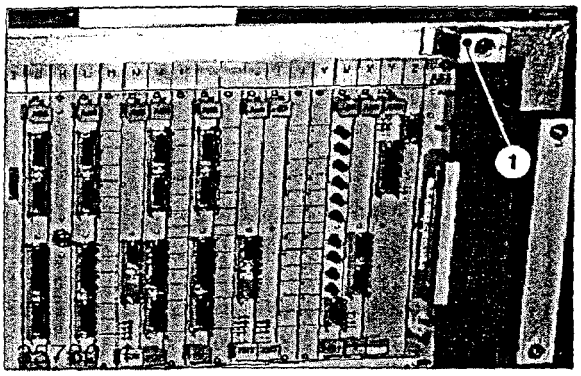
Secure the cables to the looming bars and cable duct using cable ties.

Manipulate the cables into the MICAS vehicle control cubicle.

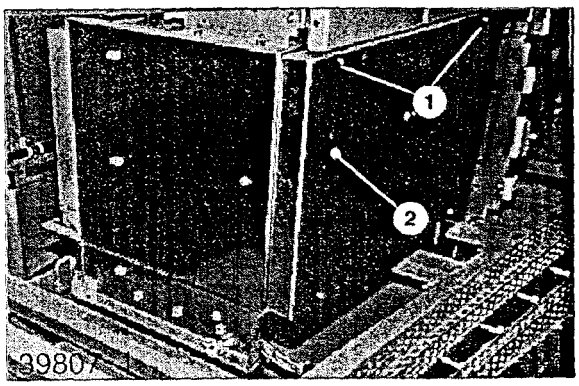
Connect the harnesses and fibre optic connections at the sockets on the MICAS vehicle control rack.

Secure the cables to the looming bars and cable ducts.

Install the cover plates over the cable flanges.



Place the metal cover above the two angle brackets (1). Guide the metal cover carefully over the lower angle brackets.



Hold the cover (2) so that it does not fall.

Secure cover (2) in place on the control unit with screws (1).

After-Installation Operations

@.1290

Test the operation of the control circuits. Rectify any faults found.

Adjustments

@.1310

There are no adjustments applicable to the control circuits cubicles and equipment.

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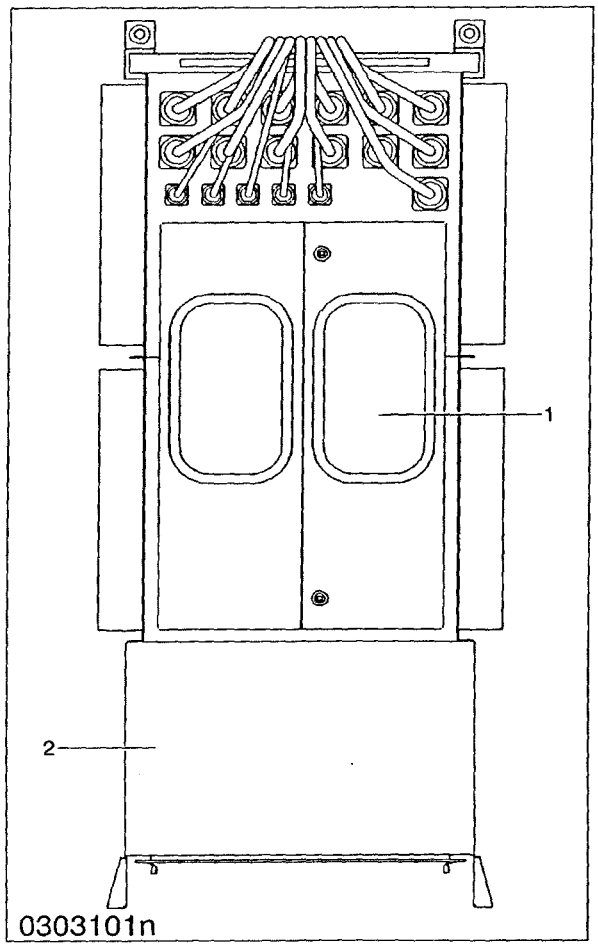
8.3 Control Electronics

Group Summary

@.1120

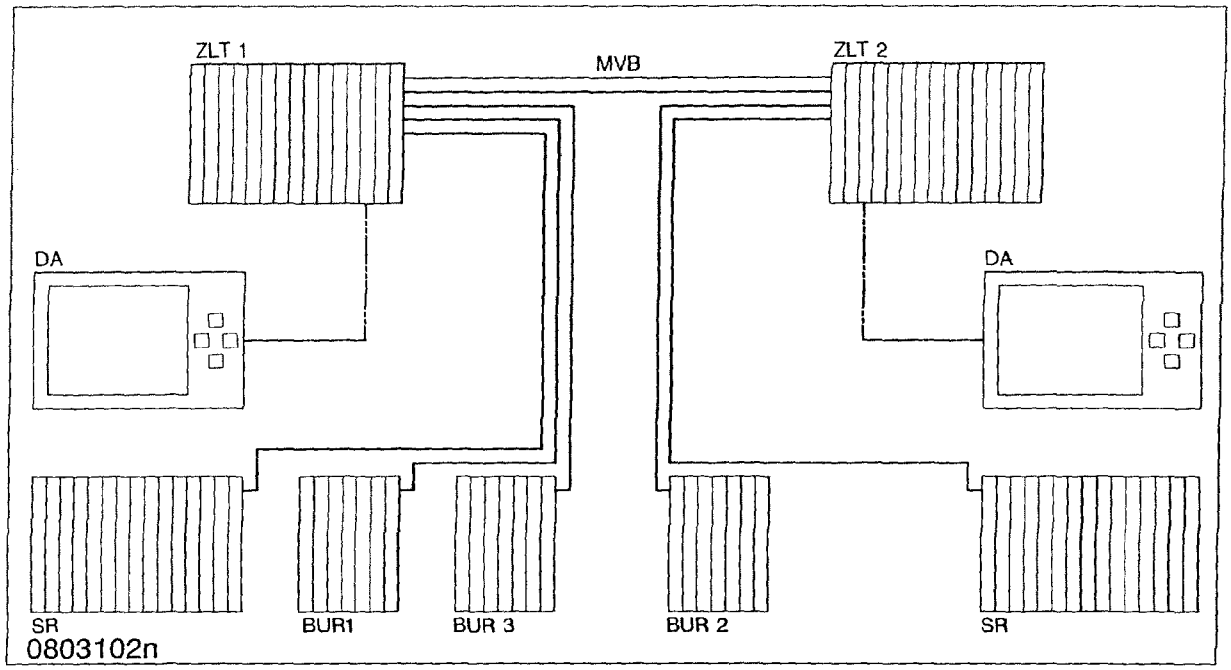
This chapter contains information regarding the Central Electronics (CEL1/2), MICAS vehicle control units located below the SB cubicles. Electrical Equipment Apparatus Item Numbers for CEL1 and CEL2 are 411 and 412, respectively.



1 SB cubicle
2 Control electronics vehicle control unit

Functional Description

@.1140



The vehicle control (ZLT) units are connected to the multi-functional vehicle bus (MVB) and form a part of the MICAS S2 vehicle control system. Other components in the MICAS S2 system include the traction converter (SR) control units, the auxiliary converter (BUR) control units, and the diagnostic display (DA).

The SR, BUR and DA systems receive control instructions from the ZLT control units. Changes in driver inputs, along with automated control functions, are interpreted within the ZLT units. These inputs are computed and suitable control instructions, along with diagnostic information is generated. Diagnostic information generated is fed to the DA units, located in the cabs. Control instructions are fed to the BUR and SR control units, which interpret these instructions and control the BUR and SR units accordingly.

Information regarding the current condition of the SR and BUR systems is fed to the ZLT control units. The ZLT control units interpret this data and changes to BUR and SR operation are made if required.

In order to keep the control unit cool, air is ducted up from the machine room floor and blown through the unit. The air is then vented into the machine room.

For further information regarding the function of the converter control unit, refer to Volume F17, Suppliers Documentation.

Trouble shooting for the MICAS vehicle control unit is described in Chapter 11, Repairing Instruction Bus Station of Volume F17, Suppliers Documentation.

The SB cubicles are described in Chapter 8.2, Machine Room Control.

Technical Data

@.1160

Weight

- Empty rack	21 kg
- Rack complete with components	32 kg

Power Consumption

- Maximum power consumption	126 W
- Typical power consumption	107 W

Permissible Conditions

- Minimum temperature	-25 °C
- Maximum temperature	65 °C
- Recommended temperature	30 to 40 °C
- Mean relative humidity	< 75 %

Tolerances and Wear Limits List

@.1170

For further information regarding the MICAS vehicle control unit, refer to Volume F17, Suppliers Documentation.

Tools and Special Tools

@.1180

Conventional railway workshop tools are required for the procedures described in this chapter.

Fault finding and servicing of the MICAS vehicle control unit requires additional tools and instruments. These are given in Volume F17, Suppliers Documentation.

Miscellaneous Materials

@.1200

No miscellaneous materials are required for the procedures described in this chapter.

Before-Removal Operations

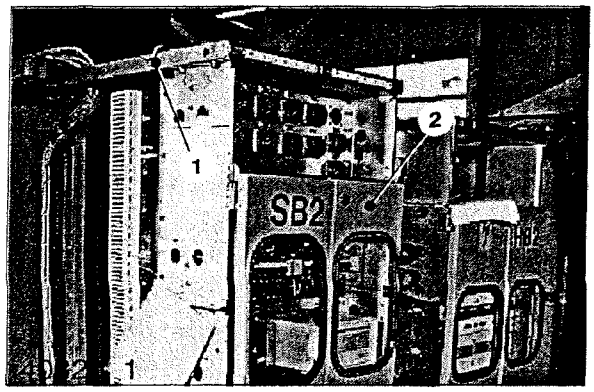
@.1220

Remove the SB cubicle from the locomotive machine room as described in Chapter 8.2, Machine Room Control.

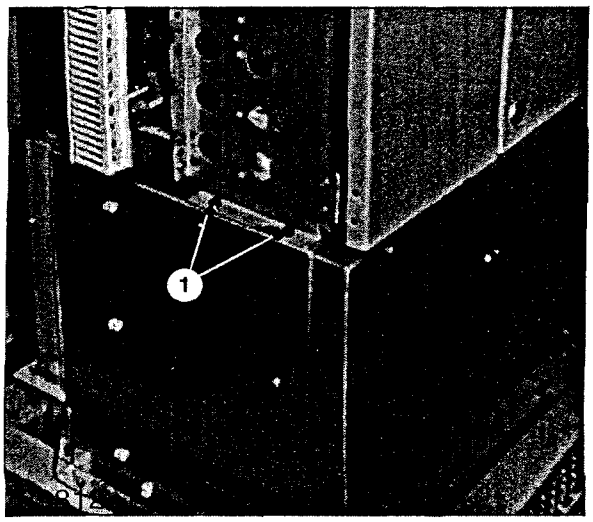
Removal

@.1230

Removal of the assembled SB cubicle and MICAS vehicle control unit cubicle is described in Chapter 8.2, Machine Room Control.



Attach suitable lifting equipment to the eye bolts (1) on the SB cubicle (2). Raise the lifting equipment slightly to take the weight of the cubicle (2).



Remove the bolts (1) spring and plain washers (2, 3) securing the front corners of the MICAS vehicle control unit cubicle to the machine room floor (4).

Ensure nothing is entangled and that the cubicle will not foul on anything during removal, then lift the cubicle out of the locomotive machine room.

Follow manufacturers instructions regarding the transport and storage of the MICAS vehicle control unit, as described in Chapter 7, Transport, Storage, Installation/Removal of Volume F17, Control Electronics Vehicle Control Unit.

Disassembly

@.1240

For further information regarding the MICAS vehicle control unit, refer to Chapters 1 to 17, Control Electronics Vehicle Control Unit of Volume F17, Suppliers Documentation.

Inspection and Repair

@.1250

For further information regarding the vehicle control unit, refer to Chapters 1 to 17, Control Electronics Vehicle Control Unit of Volume F17, Suppliers Documentation.

Waste Disposal

@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

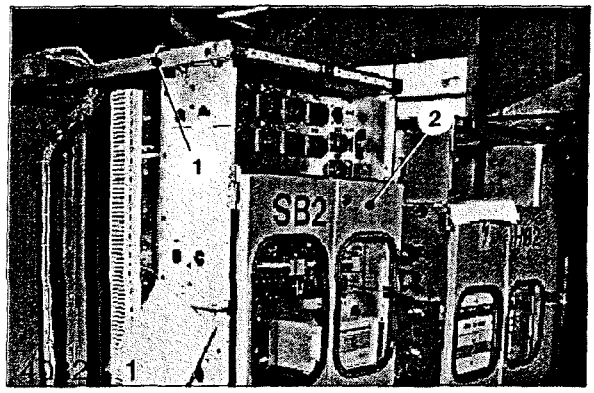
@.1270

For further information regarding the MICAS vehicle control unit, refer to Chapters 1 to 17, Control Electronics Vehicle Control Unit of Volume F17, Suppliers Documentation.

Installation

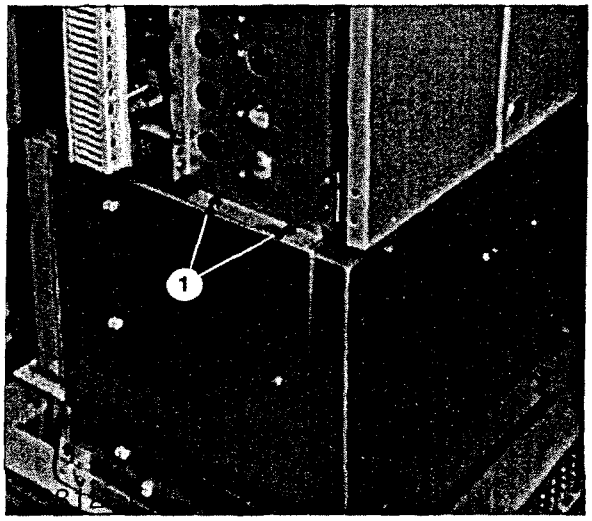
@.1280

Installation of the assembled SB cubicle and MICAS vehicle control unit cubicle is described in Chapter 8.2, Machine Room Control.



Attach suitable lifting equipment to the eye bolts (1) on the SB cubicle (2). Raise the SB cubicle into position above the MICAS vehicle control unit cubicle.

Slowly lower the SB cubicle onto the MICAS vehicle control unit cubicle, aligning the holes in the SB cubicle flange with those in the control unit cubicle.



Install the bolts (1) spring and plain washers (2, 3) through the corners of the SB cubicle flange into the MICAS vehicle control unit cubicle.

After-Installations Operations

@.1290

Test the operation of the MICAS vehicle control electronics. Rectify any faults found.

Adjustments

@.1310

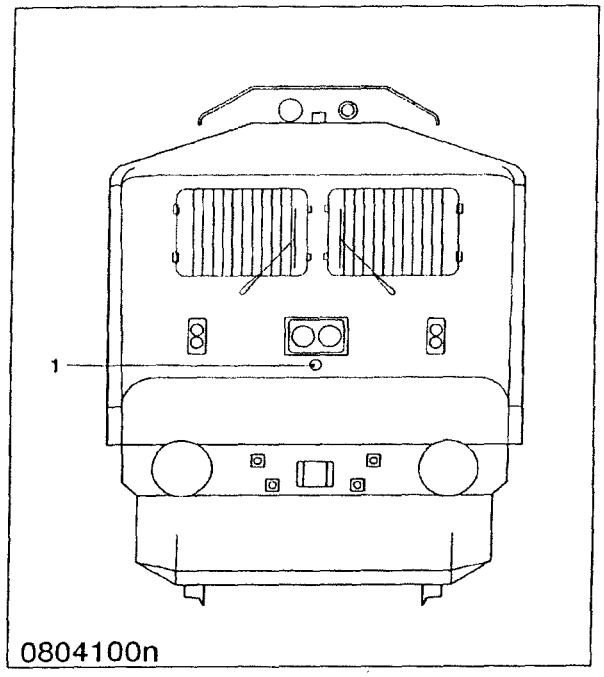
There are no adjustments applicable to the MICAS vehicle control units.

8.4 Loco-Loco Bus

Group Summary

@.1120

This chapter contains information regarding the loco-loco bus socket. The loco-loco bus UIC socket is Electrical Equipment Apparatus Item Number 353.3.



1 Loco-loco bus socket

Functional Description

@.1140

The loco-loco bus is used to connect two locomotives together during multiple unit operation. In multiple unit operation, a master locomotive and a slave locomotive are connected together to provide more motive power than is available from a single locomotive. The master locomotive and slave locomotive are connected together electronically via the loco-loco bus. The loco-loco bus allows the master locomotive to control certain functions of the slave locomotive. In addition to this, operating conditions and fault messages from the slave locomotive are transmitted to the master locomotive. Fault messages are displayed in the driver's cab of the master locomotive.

For further information regarding multiple unit operation, refer to Chapter 4, Vehicle Operation of Volume A, Driver's Manual.

Technical Data

@.1160

Loco-Loco Bus

- Data transmission method	FSK (Frequency Shift Keying) modulation

Tolerances and Wear Limits List

@.1170

No specific tolerances or wear limits are applicable to the equipment described in this chapter. Items should be inspected as described in Section Inspection and Repair, and replaced or repaired as necessary.

Tools and Special Tools

@.1180

The following tools and special tools are required for the procedures described in this Chapter.

- Crimping tool WZ 25-2.3 UIC
- Extractor tool 1440 0303 774

Miscellaneous Materials

@.1200

Miscellaneous materials required for the procedures described in this chapter include:

- Loctite 222
- Sikalastomer 710

Before-Removal Operations

@.1220

Lower the pantograph and isolate the overhead catenary. Earth the locomotive at the vacuum circuit breaker. Refer to the Preface of this Volume.

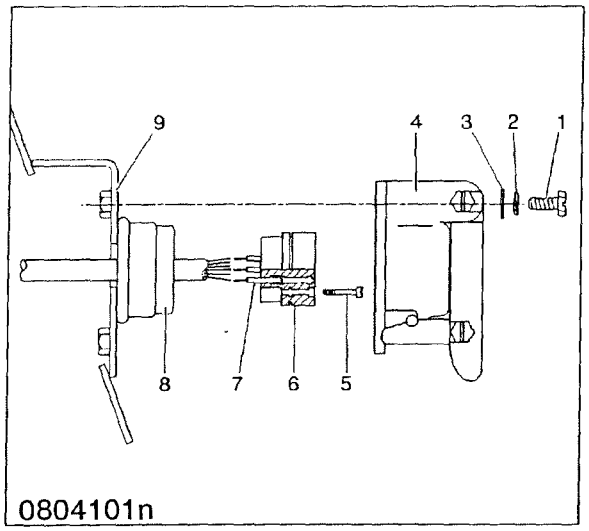
Earth the traction converter as described in Chapter 4.1, Traction Converter. Operation of the key interlocking system is described in Chapter 3.11, Protection Concept of Volume A, Driver's Manual.

Removal of some cab panels is required to access the loco-loco bus socket wiring from within the cab. Refer to Chapter 7.5, Cab for information regarding cab panels.

Removal

@.1230

Socket and Cover



From inside the locomotive, remove strain relief device to allow the cable to be pulled slightly through the front of the locomotive.

From outside the cab, loosen and remove the screws (1), flat washers (3) and spring washers (2) securing the socket cover (4) to the front of the locomotive (9), then withdraw the socket cover (4).

Loosen and remove the screws (5) securing the socket (6) to the locomotive, then withdraw the socket (6) and cable from the locomotive slightly. To completely remove the socket, the pins (7) with wires must be pressed from the socket (6) using the extractor tool.

Once the socket (6) has been removed, the rubber seal (8) may be removed.

Disassembly

@.1240

For further information regarding the loco-loco bus socket, refer to Chapter 4, Loco-Loco Bus of Volume F16, Suppliers Documentation.

Inspection and Repair

@.1250

Socket Cover

Inspect the loco-loco bus socket assembly for wear, cracks or any other signs of damage. Ensure the handle and cover plate function correctly. Replace any damaged or defective components.

For further information regarding the loco-loco bus socket, refer to Chapter 4, Loco-Loco Bus of Volume F16, Suppliers Documentation.

Socket and Pins

Inspect the socket for wear, cracks or any other signs of damage. Replace any damaged or defective components. Remove the pins as necessary using extractor tool 1440 0303 774 described in Section Tools and Special Tools. Replace the socket if worn, cracked or otherwise damaged.

Inspect the condition of the pins. Replace the pins if worn, bent, oxidised, or otherwise damaged. New pins can be crimped on to wire using crimping tool WZ 25-2.3 UIC described in Section Tools and Special Tools.

Waste Disposal

@.1260

Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

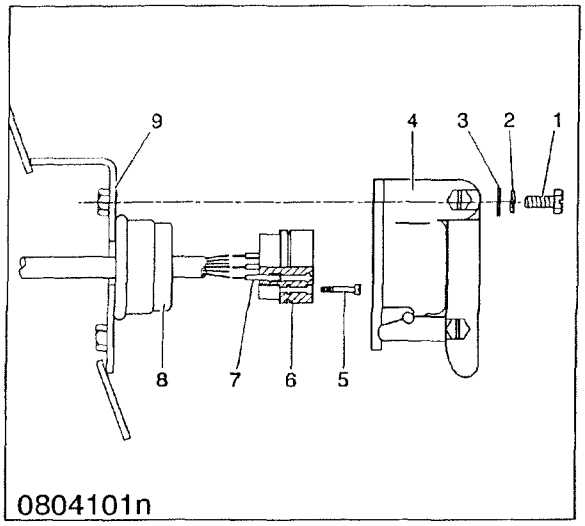
@.1270

For further information regarding the loco-loco bus socket, refer to Chapter 4, Loco-Loco Bus of Volume F16, Suppliers Documentation.

Installation

@.1280

Socket and Cover



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Position the rubber seal (8) over the socket mounting hole.

If necessary, press the pins (7) with wires into the socket (6).

Position the socket (6) in the mounting hole in the locomotive, then insert and tighten the screws (5) securing the socket (6) to the front of the locomotive (9).

Install the strain relief device and tension the device to relieve any strain in the socket from the wires.

Apply a continuous 7 mm diameter bead of Sikalastomer 710 to the perimeter of the mounting face on the socket cover (4) then position the socket cover (4) on to the front of the locomotive (9).

Apply Loctite 222 to the threads of the screws (1), then install and tighten the screws (1), flat washers (3) and spring washers (2) to secure the socket cover (4) to the front of the locomotive (9).

After-Installations Operations

@.1290

Water test the area around the loco-loco bus sockets. Refer to Water Test in the Preface of this Volume. Ensure no water leaks through the front of the locomotive, or into the socket.

Adjustments

@.1310

There are no adjustments applicable to the loco-loco bus or its socket.

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