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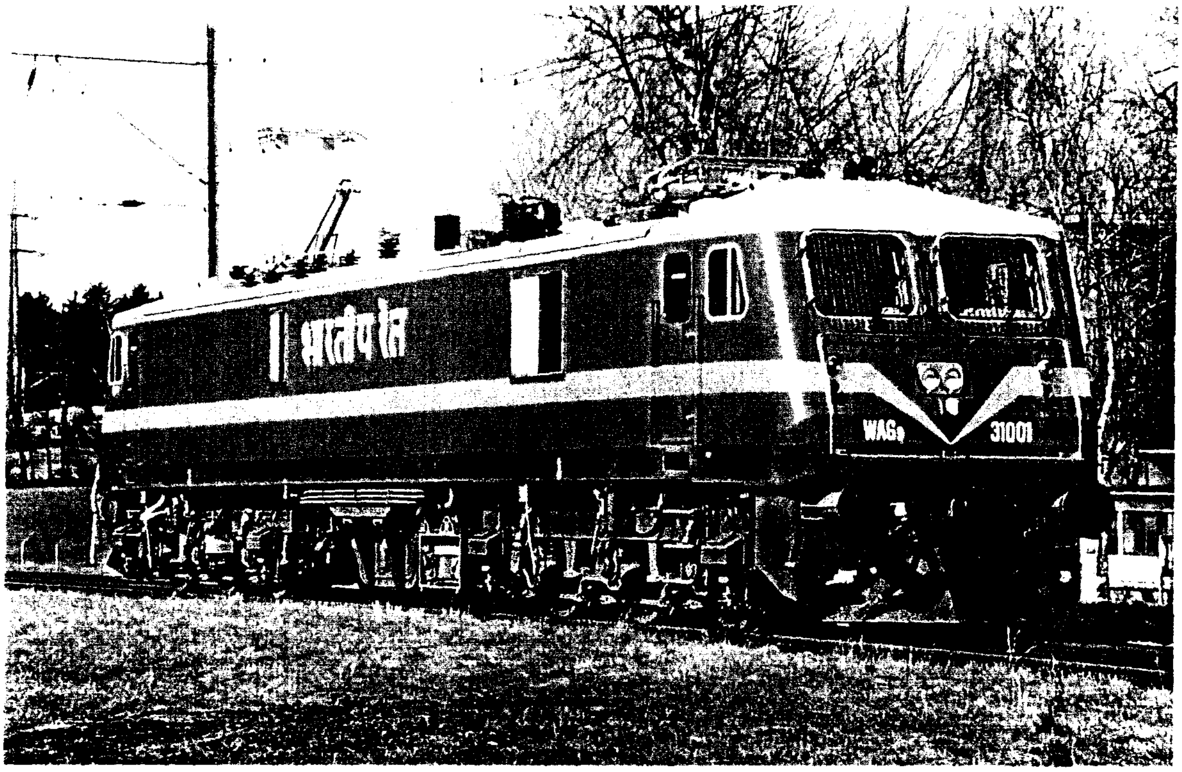
Indian Railways



WAG9 Locomotive

31000 – 31021

Maintenance and Repair Manual

D-2

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31			1		C	3EHW411479	12.2001	Preface	D2		18		
32			1		C	3EHW411429	12.2001	Propulsion System	D2	1.1	~~2~~		
33			1		C	3EHW411430	12.2001	Traction Converter	D2	1.2	~~52~~		
34			1		C	3EHW411431	12.2001	Traction Converter Oil Cooling	D2	1.3	~~14~~		
35			1		C	3EHW411432	12.2001	Traction Converter Control	D2	1.4	~~8~~		
36			1		C	3EHW411433	06.2002	Traction Motor	D2	1.5	~~60~~		
37			1		C	3EHW411471	12.2001	Cabling	D2	1.6	~~2~~		
38			1		C	3EHW411434	12.2001	Auxiliary System	D2	2.1	~~2~~		
39			1		C	3EHW411435	12.2001	Auxiliary Three-Phase Power	D2	2.2	~~90~~		
40			1		C	3EHW411436	12.2001	Auxiliary Converter Control	D2	2.3	~~6~~		
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42			1		C	3EHW411438	12.2001	Hotel Load	D2	2.5	~~2~~		
43			1		C	3EHW411439	12.2001	Oil Cooling Unit	D2	2.6	~~26~~		
44			1		C	3EHW411440	12.2001	Machine Room Blowers	D2	2.7	~~24~~		
45			1		C	3EHW411441	12.2001	Traction Motor Blowers	D2	2.8	~~22~~		
46			1		C	3EHW411442	12.2001	Scavenge Blowers	D2	2.9	~~34~~		
47			1		C	3EHW411443	12.2001	Power Supply 415/110V	D2	2.10	~~50~~		

Preface

Introduction

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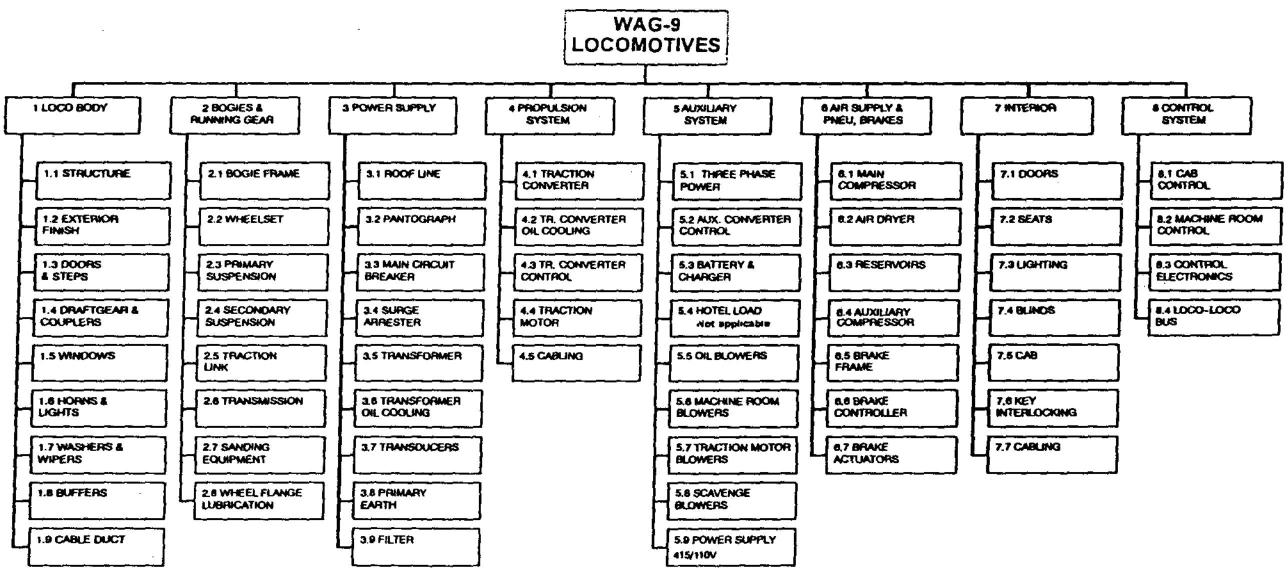
These Maintenance & Repair Manuals of technical documentation for the Indian Railways WAG-9 locomotives are divided into Chapters; each of which contains information pertinent to a specific area of the locomotive. The Chapter numbers correspond to the Breakdown Structure of the Locomotive (GAPL), shown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

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 appropriate 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 semi-conductor 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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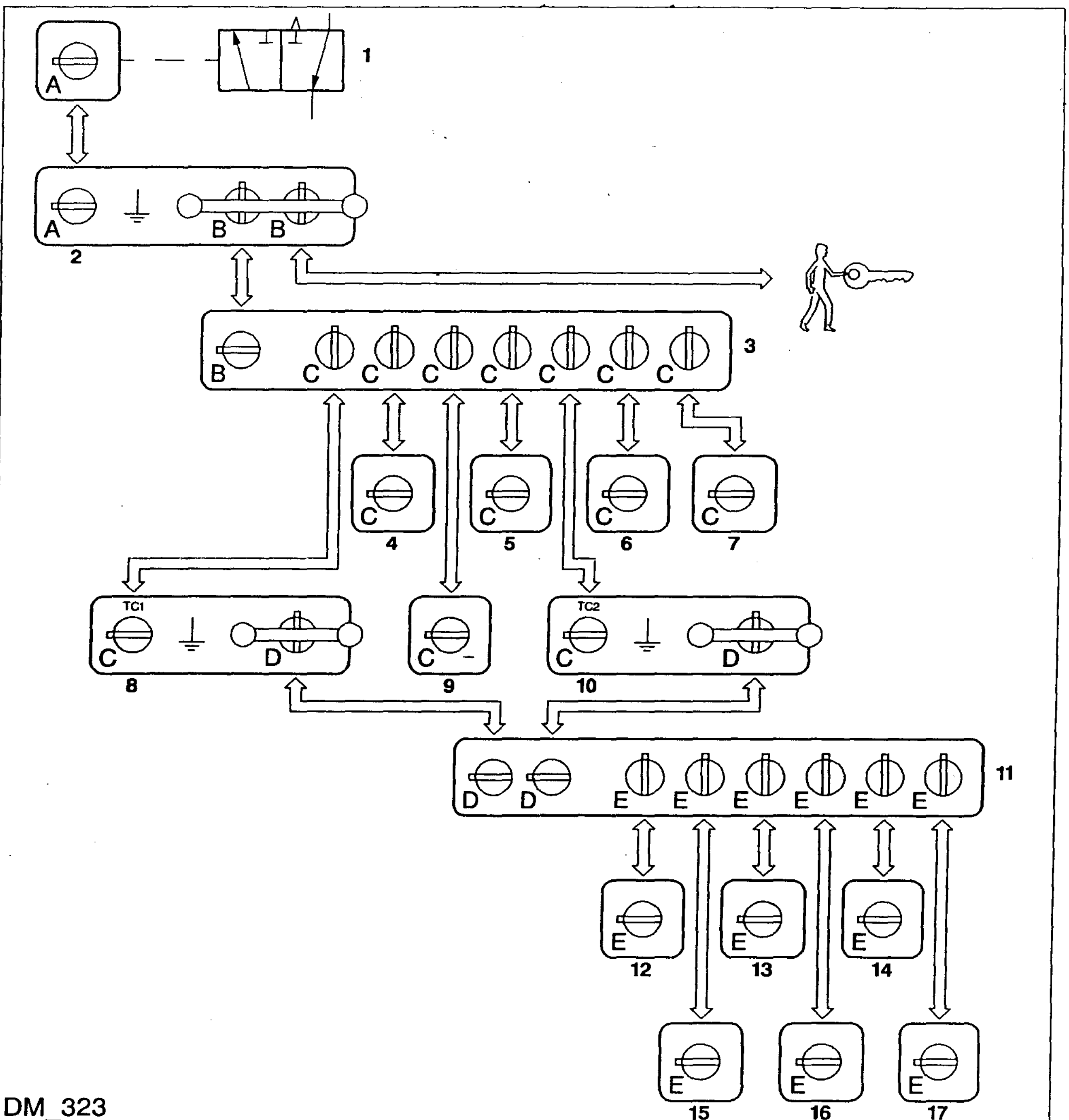
Electrical Isolation of the Locomotive



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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	-	-

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Volume D2

Propulsion System

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4 Propulsion System

For complementary information see following Chapters in Volume D2:

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6

4.1 Traction Converter

Group Summary

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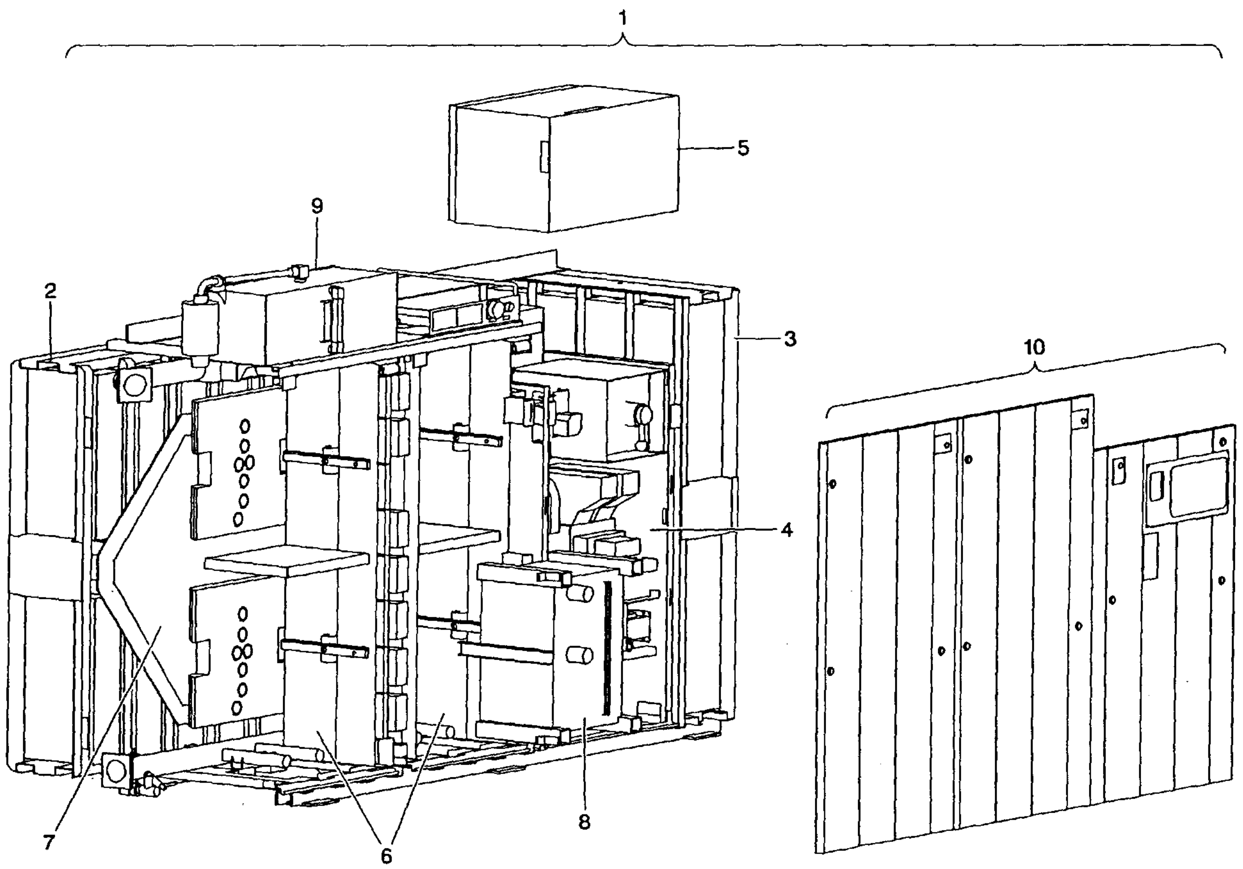
This chapter contains information on the traction converter system, which includes the traction converter, valve sets, gate unit, DC-Link, earthing switch and resonant circuit. The traction converter oil cooling system is described in Chapter 4.2, Traction Converter Oil Cooling. Traction converter control electronics are described in Chapter 4.3, Traction Converter Control.



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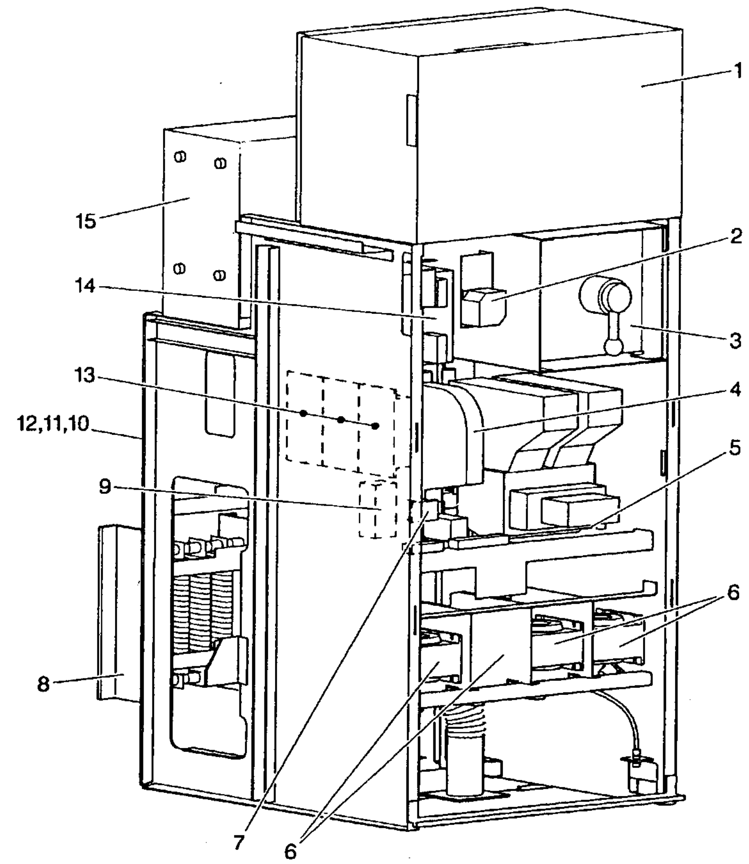
1	Traction converter	5	Electronics, converter control
2	Intermediate circuit cubicle (DC-Link capacitors)	6	Valve set cubicle
		7	Connection point
3	Series resonant cubicle (series resonant capacitors)	8	Valve set
		9	Expansion tank
4	Apparatus cubicle	10	Front covers

Apparatus Cubicle



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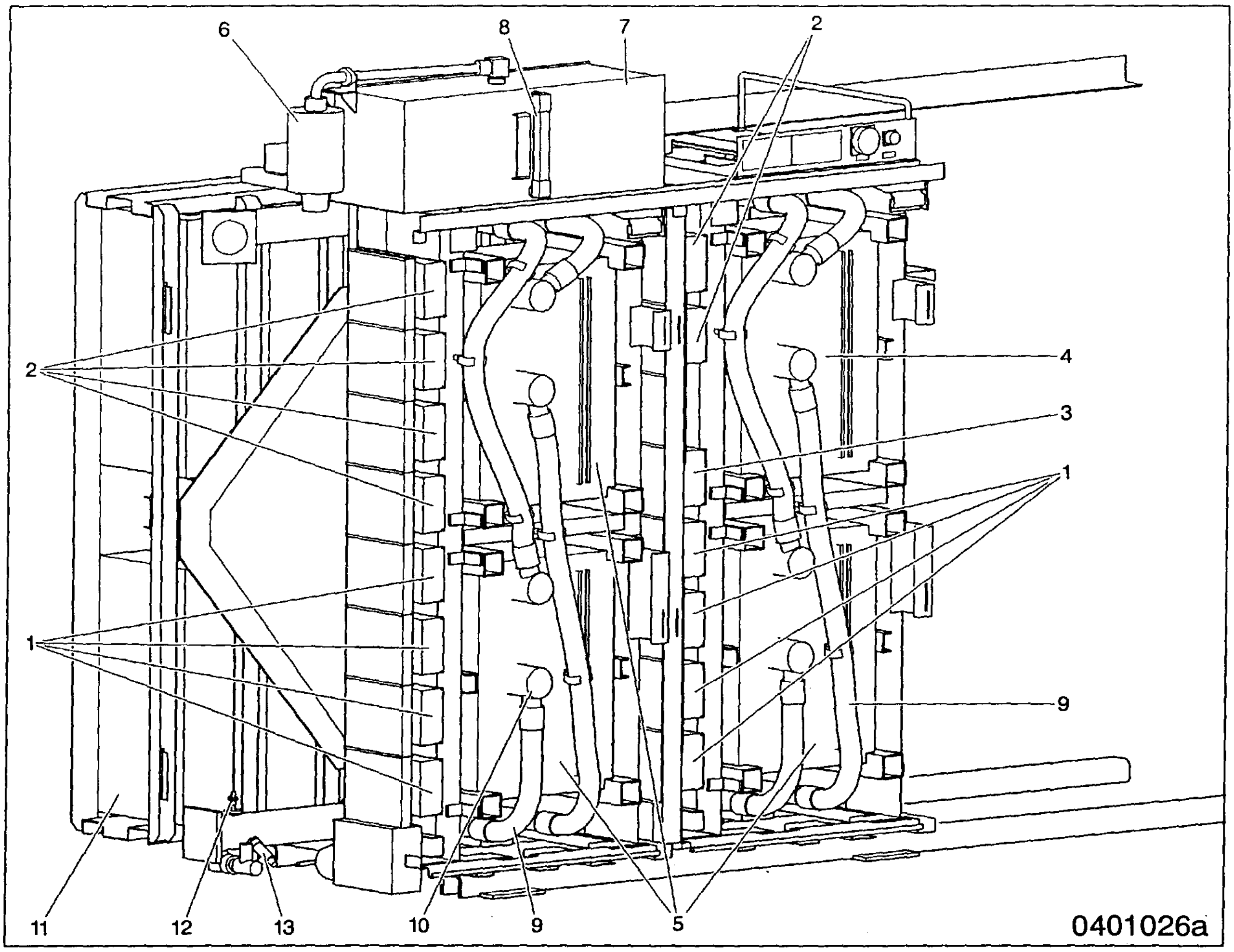
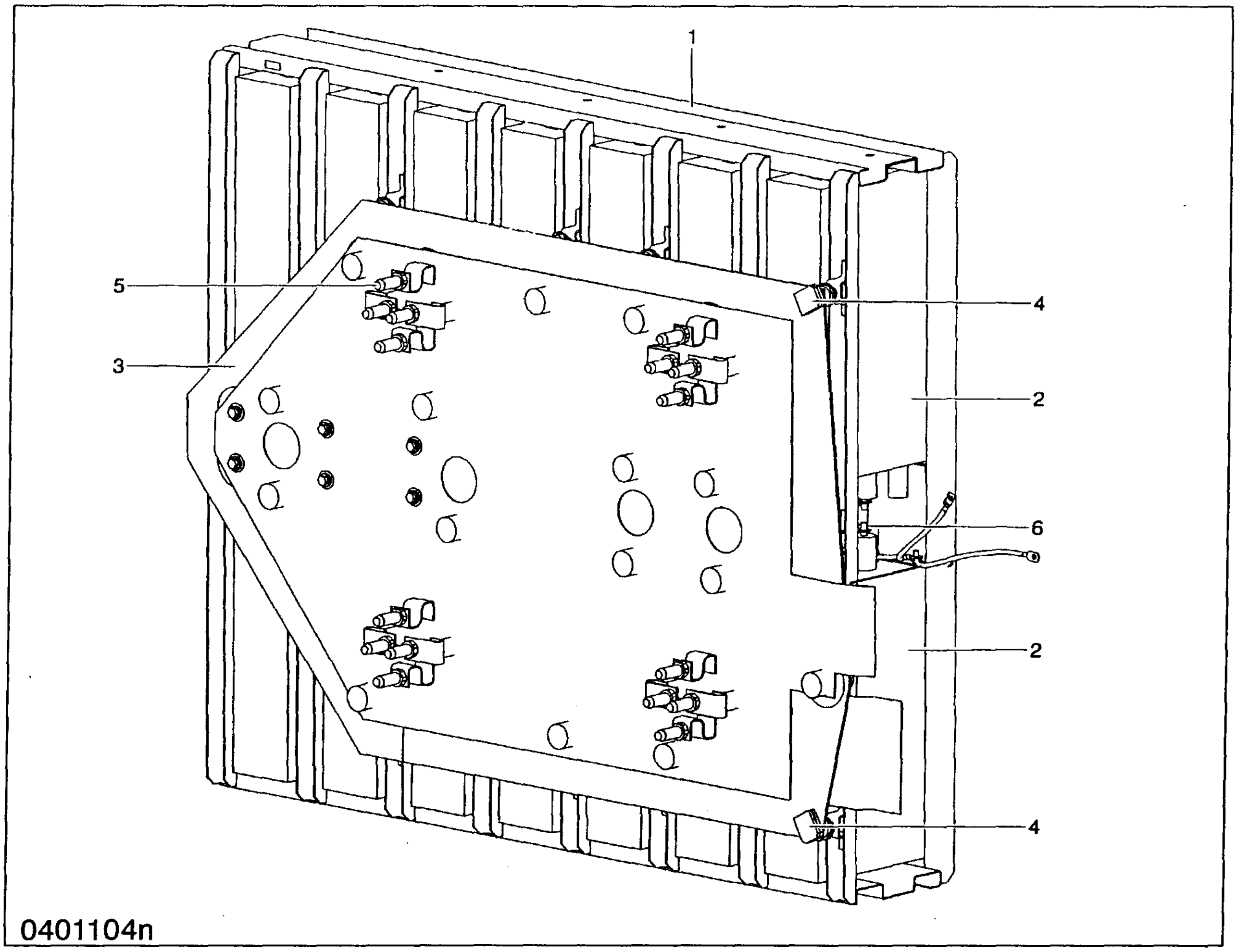
1	Electronics, converter control (415)	9	Contactor, gate unit power supply (218.2)
2	Voltage indicator, DC-Link (15.7)	10	Resistor, earth fault detection (90.62)
3	Earthing switch, DC-Link (15.82)	11	Resistor, earth fault detection (90.61)
4	Contactor, precharge (12.3)	12	Resistor, gate unit power supply pre-charge (219.1)
5	Contactor, converter (12.4)	13	Voltage transducer, DC-Link (15.6)
6	Current transducers	14	Power supply, gate unit (219)
7	Primary voltage transformer (224.1)	15	Resistor, overvoltage protection (15.1)
8	Resistor, converter precharge (14)		

Valve Set Cubicle



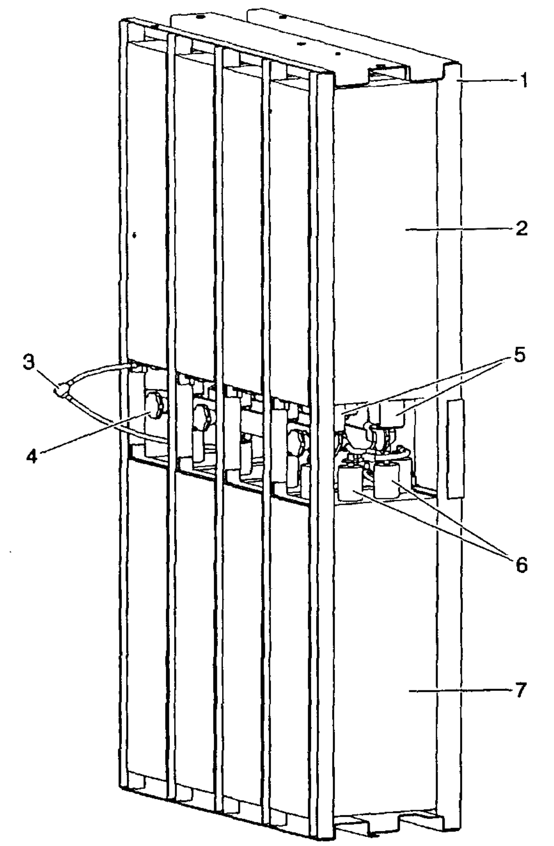
1	Gate units (227)	8	Oil level gauge
2	Gate units (228)	9	Oil hose
3	Gate units (229)	10	Quick connect fitting
4	Valve set ZV24 & MV23 (12)	11	DC-link capacitors
5	Valve set 2*ZV24 (13)	12	Temperature probe, oil cooling
6	Air dehumidifier	13	Pressure sensor, oil cooling
7	Oil expansion tank		

Intermediate Circuit Cubicle



1	Intermediate circuit cubicle frame	4	DC-Link electrical connection
2	Capacitor bank, DC-Link (15.5)	5	Valve set electrical connection
3	Connection plate	6	DC-Link capacitor terminals

Series Resonant Cubicle



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1	Series resonant circuit cubicle frame
2	Capacitor bank, series resonant circuit (15.4)
3	Electrical connection
4	Insulator
5	Series resonant capacitor terminals
6	Tuning capacitor terminals
7	Tuning capacitor

Numbers in brackets ( ) denote the electrical equipment apparatus item number used in the locomotive schematics, refer to Volume G, Cabling Documentation.

Functional Description

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Nomenclature

Generally, individual components within apparatus do not have an electrical equipment item number on the locomotive schematics, but can be identified using the schematic numbers from Volume F4, Suppliers Documentation. Within the functional descriptions, numbers within braces { } denote an individual component's schematic number from the suppliers documentation. This nomenclature provides, where possible, a cross reference between the locomotive schematics and the suppliers documentation. Additionally, this nomenclature gives the location of the listed equipment.

Item Description	Electrical Equipment Apparatus Number, Locomotive Schematics	Schematic Number, Suppliers Documentation	Location			
			Appa-ratus	Valve Set	Inter-medi-ate Circuit	Series Reso-nant Circuit
Capacitor Bank, DC-Link	15.5	A31			X	
Capacitor Bank, Series Resonant Circuit	15.4	A33				X
Contactor, Converter	12.4	K11	X			
Contactor, Gate Unit Power Supply	218.2	K08	X			
Contactor, Precharge	12.3	K01	X			
Current Transducer, Drive Inverter	18.5	U21 - U23	X			
Current Transducer, Line Converter	18.2	U11 - U14	X			
Earthing Switch, DC-Link	15.82	Q21	X			
Electronics, Converter Control	415	A01	X			
Gate Unit, Drive Converter	228	A211 - A222		X		
Gate Unit, Line Converter	227	A111 - A124		X		
Gate Unit, Overvoltage Protection (MUB)	229	A223		X		
Power Supply, Gate Unit	219	A08	X			
Primary Voltage Transformer	224.1	A04	X			
Resistor, Converter Earth Fault Detection	90.61 - 90.62	R51 - R52	X			
Resistor, Converter Precharge	14	R04	X			
Resistor, Gate Unit Power Supply Precharge	219.1	R08	X			
Resistor, Overvoltage Protection	15.1	R71	X			
Valve Set, 2xZV24	12	A11 - A12		X		
Valve Set, ZV24 + MV23	13	A22		X		
Voltage Indicator, DC-Link	15.7	H08	X			
Voltage Transducer, DC-Link	15.6	U01 - U02	X			
Voltage Transducer, Earth Fault Detection	89.4	U05	X			

Electrical power for locomotive operation is provided by the single-phase overhead catenary. The three-phase voltage required to operate the traction motors is converted within the machine room by two traction converters connected between the main transformer and the traction motors. One traction converter powers two traction motors in a single bogie. Therefore, should one traction converter fail, the locomotive may still be operated at half tractive power through one bogie.

To control the tractive or braking effort, and hence the speed of the vehicle, both the frequency and the amplitude of the three-phase converter output voltage are continuously changed according to the driver's demands at the master controller. Through this system, smooth changes in tractive and braking torques can be applied.

When braking electrically, the traction motors act as generators. In the converter, the resulting three-phase voltage is converted into a single-phase voltage which is fed back into the catenary through the main transformer.

Electrical energy for locomotive operation is supplied by the single phase AC (25,000 volt) overhead catenary. The traction converter changes the single phase catenary power to three phase AC for the traction motors, which provide propulsion. The locomotive's speed is controlled by adjusting the tractive effort according to the driver's demand at the TE/BE control on the console. Both the frequency and amplitude of the converter output is adjusted according to the demand for tractive effort.

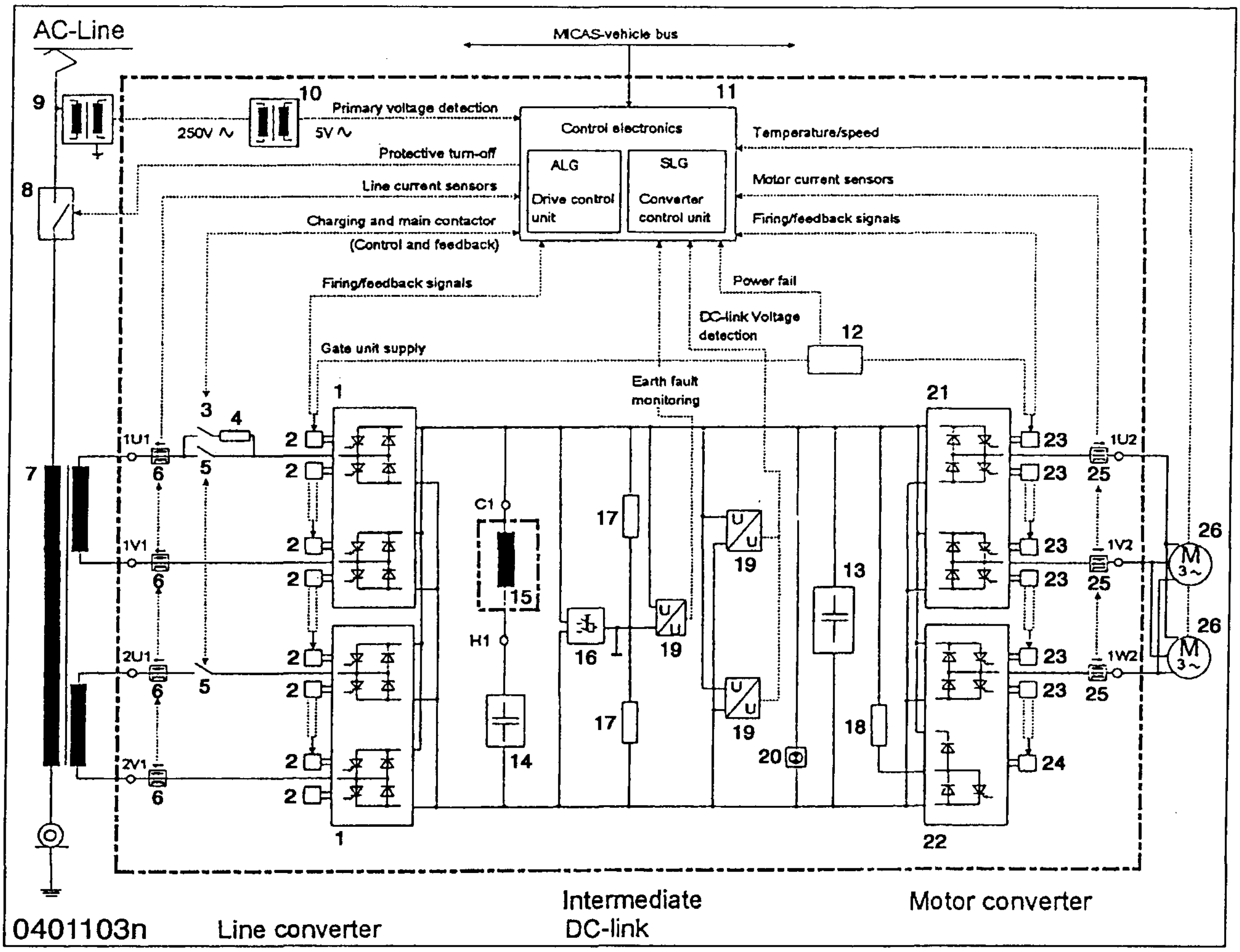
Each locomotive has two traction converters, situated one on each side of the machine room, both drawing power from a single main transformer mounted on the underframe. Each traction converter powers one bogie. In normal conditions both traction converters work simultaneously. However, should one converter fail, the locomotive can continue to operate on the other, driving with only one bogie providing traction.

Physically the traction converter is comprised of four main modules: Apparatus Cubicle, Valve Set Cubicle, Intermediate Circuit Cubicle and the Series Resonant Cubicle. The contents of each cubicle is shown in Section Group Summary. The individual components are described in this Section.

Troubleshooting for the traction converter and sub-systems can be found in Chapter 3, Installation, Servicing and Maintenance of Volume F4, Suppliers Documentation.

Traction Converter

Operation



Line Converter

1	Valve set, 2xZV24 (12)	4	Precharge resistor (14)
2	Gate unit (227)	5	Converter contactor (12.4)
3	Precharge contactor (12.3)	6	Current transducers (18.2)

Ancillary Equipment

7	Main transformer (7)	10	Primary voltage transformer module (224)
8	Vacuum circuit breaker (4)	11	Traction converter electronics (415)
9	Primary voltage transformer (3)	12	Gate unit power supply (219)

DC-Link

13	DC-Link capacitor bank (15.5)	17	Earthing resistors (15.82)
14	Series resonant circuit (part of 15.4)	18	Over voltage limitation resistor (15.1)
15	Series resonant choke, within main transformer tank (15.3)	19	Voltage transducers (15.6)
		20	Voltage indicator (15.7)
16	Earthing switch (15.82)		

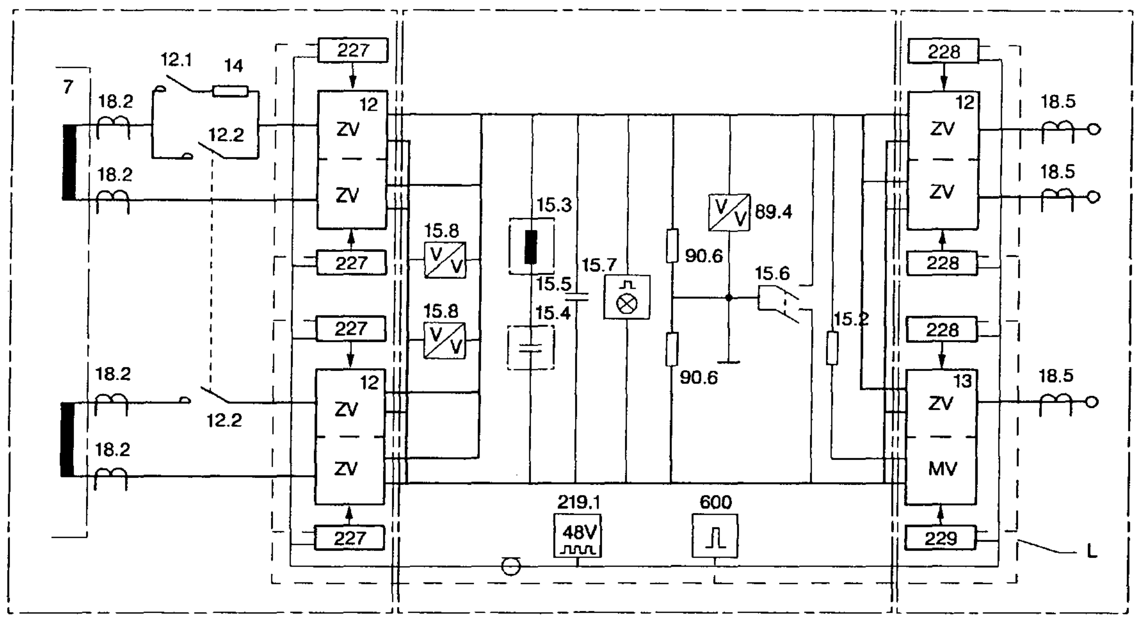
Drive Converter

21	Valve set, 2xZV24 (12)	24	Gate unit (229)
22	Valve set, ZV24 & MV23 (13)	25	Current transducers (18.5)
23	Gate unit (228)	26	Traction motor (20)

Power from the overhead catenary is directed to the main transformer (7), mounted on the locomotive underframe, via the pantograph (1). The traction circuit is split into two separate circuits after the main transformer (7).

The traction converters can conduct current from the catenary to the traction motors to provide propulsion, or can act as in the opposite manner:-conducting, and rectifying, current from the traction motors to the catenary. This allows the converter to work in both traction and braking mode. During braking the traction motors act as generators feeding power back into the catenary. The traction converters then act to convert the three phase into single phase for the catenary.

The traction converters provide continuous and automatic control of both speed and torque of the traction motors according to the driver's demand. The converters are controlled by the converter control electronics (415), and the locomotive central electronics (411, 412).



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The following is an overview of the traction converter function. A more detailed description can be found in Chapter 1, System Description of Volume F4, Suppliers Documentation and Chapter 11, Description of Main Power Circuit in Volume G2, Cabling Documentation.

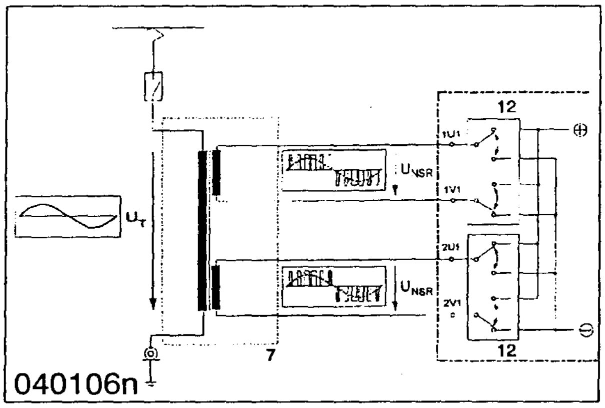
Two three phase asynchronous traction motors are connected in parallel to each traction converter.

The line converter (1) converts the alternating current supplied from the main transformer into direct current (motoring) and forwards this direct current to the intermediate DC-Link (2). However, it is also able to convert direct current from the intermediate DC-Link into alternating current and to supply this alternating current in turn to the main transformer (braking). Both functions are activated by the traction converter control electronics.

The intermediate DC-Link (2) performs two main tasks. Firstly, it smooths the direct current that flows through. Secondly, it also performs a storage function, thus covering the peak current demand of the line converter (1) or of the motor.

The drive converter (3) converts the direct current from the intermediate DC-Link (2) into three-phase current for the drive motors (motoring). Conversely, it is also able to convert the three-phase current generated by the drive motors into direct current for braking. The construction of the motor inverter valve set is identical to that of the line converter (1).

Line Converter



The line converter maintains the DC-Link voltage at a value dependant on the power, direction of energy flow and line voltage.

The line converter NSR consists of two pulse controlled single-phase full bridge circuits {A11 , A12} which are connected in parallel on the DC-Link side. On the AC side, they are connected to the secondary winding terminals (1U1, 1V1, and 2U1 2V1) of the main transformer (7).

The line converter is a self-commutating 4 quadrant converter. The AC terminals of the two bridge circuits {A11, A12}, within the valve sets (12), read the AC voltages formed by square wave pulses of identical amplitude. These pulses are produced by pulse-width-modulating (PWM) the DC-Link voltage.

The full bridge circuit GTO thyristors, within the valve sets (12), are switched at a frequency much greater than the line frequency. The switching signals for the four pairs of arms are shifted by 90° in relation to each other. This ensures that the AC current in the main transformer (7) primary winding is almost sinusoidal, and that the line harmonic currents are kept to a minimum over the entire operating range of the converter.

Intermediate DC-Link

The intermediate DC-Link consists of a capacitor bank (15.5) and acts as a buffer between the line and drive converters. This buffering action ensures that the DC-Link voltage remains constant under all operating conditions.

Drive Converter

The drive converter comprises of four quadrant modules connected on one side to the three phases of traction motors (20) and on the other, DC side, to the DC-Link.

Current from the DC-Link goes to the U phase of the traction motor (20) when the GTO thyristor {T1} is fired and the circuit is completed through either GTO {T4 or T6} or both, depending on which one is conducting at the time. Similarly phase V is supplied by GTO {T3}, and phase W is via GTO {T5}.

This switching of the GTO thyristor generates a DC voltage consisting of square wave pulses. The torque and speed of the traction motors (20) are controlled by varying both the fundamental wave frequency and the amplitude of the alternating voltage. The variation is achieved by the switching times and switching instances of the GTO thyristor.

Converter Front Covers

The three sheet-metal covers protect the components within the traction converter. The covers must be removed to perform maintenance tasks, checks, tests and to replace components.

Each front cover is seated on a profile rail and is locked at four points. The safety lock is a part of the key interlocking system and can only be opened with the relevant key belonging to the safety lock system of the vehicle.

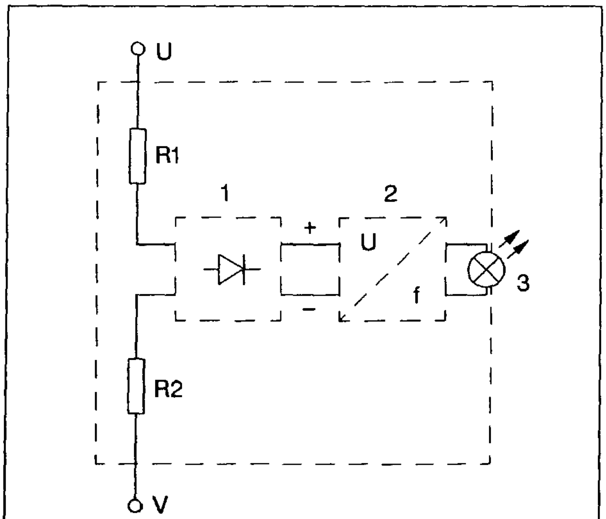
Apparatus Cubicle

Electronics, Converter Control (415)

The converter control electronics are situated in a ventilated enclosure mounted at the top of the apparatus cubicle. Refer to Chapter 4.3, Traction Converter Control for more information on the converter control electronics.

The housing of the converter control electronics is fitted with a heat exchanger, located at the rear of the housing, which is connected to the machine room ventilation system via a pipe. Air is forced upwards from the machine room ventilation into the housing, where it exits through vents in the top.

Voltage Indicator, DC-Link (15.7)



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The DC-Link voltage indicator (15.7) is situated in the apparatus cubicle adjacent to the earthing switch (15.82). It indicates the DC-Link voltage for monitoring and maintenance operations. A light-emitting diode (LED) flashes at a voltage from 45 V to 3.5 kV. The higher the voltage in the traction DC-Link rises, the faster the LED flashes. The LED is visible in the recess for the earthing switch.

The voltage indicator is connected to U and V of the DC-Link circuit. The unit draws power for its operation from this source. The circuitry in the voltage indicator is symmetrical in design and is independent of the polarity and potential of the DC-Link circuit voltage.

Current limitation is accomplished by two identical resistors {R1, R2}. Connected in series with the current limitation is an input rectifier (1) and a voltage-frequency converter (2) which controls the red LED (3).

Earthing Switch, DC-Link (15.82)

The earthing switch is mounted on the front at the right side of the apparatus cubicle and is accessible through an aperture in the converter front covers. The earthing switch (15.82) is used to earth the traction converter for safety reasons during maintenance.

A key interlock system prevents unauthorised switching on or off of the earthing system and also prevents access to potentially live components within the traction converter. For more information on the key interlocking system refer to the Preface of this Volume.

When moved to the earthing position, the earthing switch grounds all the components within the DC-link to earth, including the DC-link capacitor bank, and the series resonant circuit capacitor bank. Any potential difference relative to ground is removed.

Contactor, Precharge (12.3)

The precharge contactor is used to connect the precharge resistor (14) in line with the DC-link capacitors on start-up. The resistor is required to minimise oscillations in the DC-link and to limit the initial inrush of current to the DC-link circuit. Once the DC-link voltage has reached the peak secondary voltage of the main transformer, the main power contactor for the converter (12.4) is closed and the precharge contactor (12.3) is opened.

Contactor, Converter (12.4)

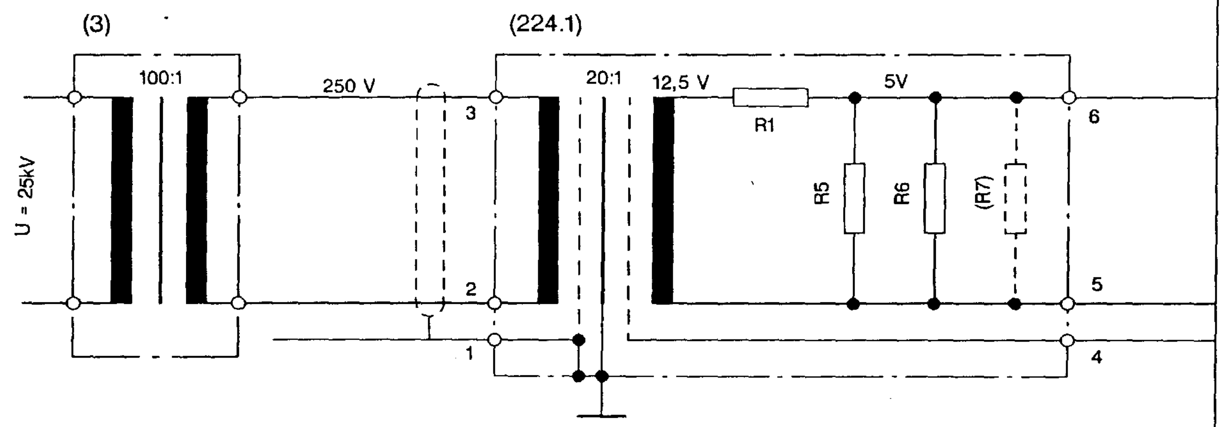
The converter contactor is mounted in the converter apparatus cubicle below the earthing switch (15.82). The converter contactor is operated by the control electronics. Activation and deactivation of the traction converter can be performed by the control electronics through the converter contactor. Should the control electronics detect a fault in the converter, the converter contactor is opened and the converter shut down.

Current Transducer, Drive Converter (18.5)

The current transducers (18.5) convert the high AC currents on the three outputs of the drive converter to a level suitable for measurement by the control electronics. From these measurements, the control electronics can monitor the amplitude and phase of the three phase output from the drive converter. Should the current output exceed a predefined maximum level, the control electronics takes protective measures to ensure no equipment is damaged.

Primary Voltage Transformer (224.1)

The voltage transformer module consists of an open transformer. On it is a printed circuit board (PCB) supported on hexagonal posts. The input terminal lugs (3) are situated on the PCBs left, the output terminal lugs (1) are on the right. The resistors are mounted on solder tags between them.



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The traction converter primary voltage transformer module (224.1) is fed from the primary voltage transformer (3), which transforms the catenary voltage in the ratio 125:1 from 25 kV to 200 V. The traction converter primary voltage transformer module (224.1) further reduces this voltage in the ratio 50:1 to 4 V. This reduction takes place in 2 stages:

- The transformer reduces the voltage from 200 V at the input in the ratio 20:1 to 10 V at its output.
- The voltage divider at the transformer output has a division ratio of 2.5:1, further reducing the output to 4 volts.

The overall transformation ratio of the traction converter primary voltage transformer module is 50:1 (20:1 x 2.5:1).

The resistors {R1, R5, R6 and R7} at the module's transformer output have further functions:

- They make the module's transformer output short circuit proof.
- They allow a test voltage to be fed into the following traction converter control without the need to open a circuit.

In order to prevent capacitive coupling from the input side to the output side, the module's transformer contains two shielding windings. These also protect against direct voltage flashovers from the input side to the output side.

In order to reduce interference voltages in the circuit, shielded cables are used on both sides of the module's voltage transformer. The shield of the input cable is earthed together with the first shielding winding on the transformer. The shield of the output cable is connected to the second shielding winding and is earthed at the input of the traction converter control.

Resistor, Converter Precharge (14)

To limit the current flow to the traction converter during initial power-up of the locomotive, the precharge resistor (14) is switched in series with the input to the line converter by the precharge contactor (12.1). Once the DC-Link voltage has reached operational level, the precharge contactor opens, removing the precharge resistor from the input to the line converter. At the same time, the traction converter contactor (12.2) closes, enabling normal operation.

The precharge resistor ensures a smooth charging of the series resonant capacitor bank (15.4) and of the DC-Link capacitor bank (15.5) in the traction DC-Link.

Resistor, Earth Fault Detection (90.61, 90.62)

The function of the earthing resistor networks (90.61 and 90.62) is to balance the DC-Link voltage in the traction DC-Link with respect to earth, as the entire main circuit is "floating", ie., it is not earthed.

Each resistor network comprises three resistors in series. Traction converter 1 contains resistors 90.61/1, 90.61/2, 90.61/2, 90.62/1, 90.62/2 and 90.62/3. Traction converter 2 contains resistors 90.61/4, 90.61/5, 90.61/6, 90.62/4, 90.62/5 and 90.62/6.

The idea of "floating potential" with respect to earth is to ensure insensitivity to an earth fault (ie. insulation defect) without disturbance of the locomotive in case of a single earth fault.

Current Transducer, Line Converter (18.2)

Current transducers (18.2) are connected between the traction converter line converter and the main transformer. Current flows from the main transformer to the traction converter, and vice versa, are monitored by the control electronics through the current transducers. Should the current flow exceed a predefined maximum limit, the control electronics shuts the traction converter down. Refer to Current Transducer, Driver Converter (18.5) in this Section for further information regarding current transducers.

Resistor, Gate Unit Power Supply Precharge (219.1)

The precharge resistor for the gate unit power supply serves to limit the initial inrush of current when the gate unit power supply is initially powered up, in much the same way as the precharge resistor (14) on the line converter limits start-up current flows into the DC-Link on locomotive start-up.

Voltage Transducers (15.6)

The two voltage transducers (15.6) in the DC-Link measure the DC-Link voltage. The outputs of the voltage transducers are at a level suitable for the control electronics to interpret.

Voltage Sensor (89.4)

The voltage sensor (89.4) measures the voltage across the DC-Link resistor networks (90.61, 90.62) relative to earth. A zero voltage across a resistor network relative to earth indicates an earth fault. A fault message is displayed in the cab should a zero voltage be measured across either resistor network. If a zero voltage is measured across both resistor networks, then a short circuit exists in the DC-Link and protective measures are taken by the control electronics.

Power Supply, Gate Unit (219)

The gate unit power supply is mounted on a support in the apparatus cubicle at the left side of the voltage indicator. All cable connections are on the front.

The gate unit power supply (219) is the common power supply source for all the gate units in the traction converter.

The gate unit power supply is supplied via an auxiliary contactor with the battery voltage of 110V. From this, it produces a regulated square-wave voltage to the 15 gate units. Also accommodated in the same housing is a supervision unit which enables the power supply at the request of the control unit and reports its functioning to the control.

For further information regarding the control unit, refer to Chapter 4.3, Traction Converter Control.

Resistor, Overvoltage Protection (15.1)

For various reasons, transient over-voltages may occur in the DC-Link. Through rapid loading of the over-voltage limitation resistor (15.1) all connected modules in the DC-Link are protected.

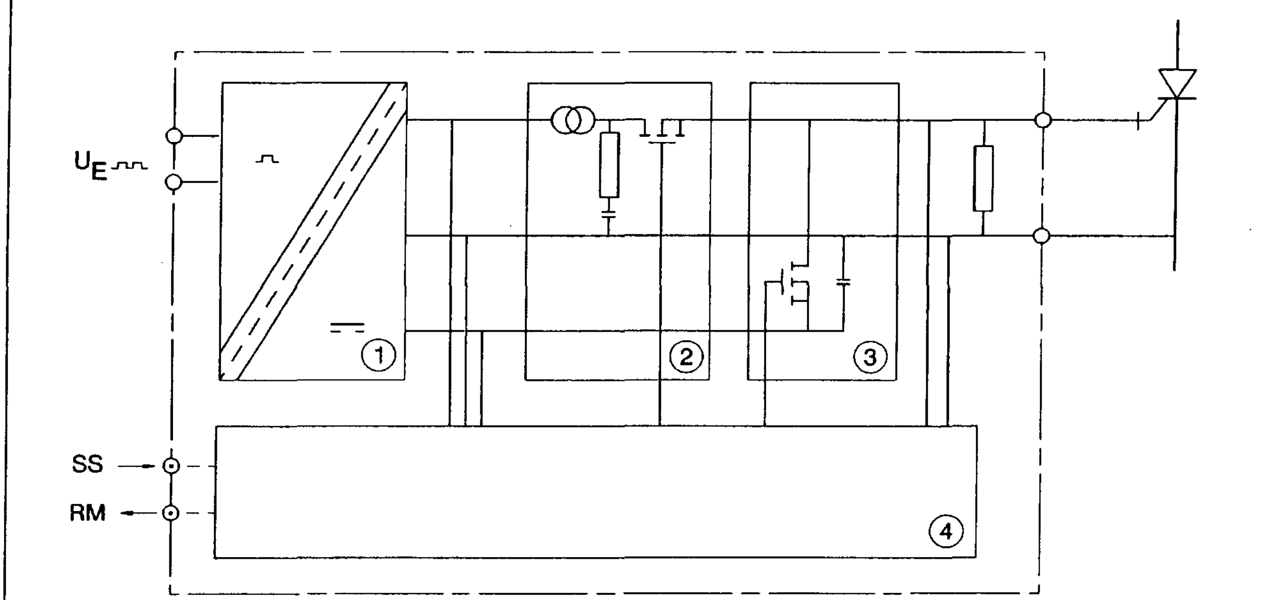
Depending on the magnitude of the DC-Link voltage, a two-position controller in the valve set ZV24+MV23 switches the over-voltage limitation resistor on and off.

Valve Set Cubicle

Gate Units (227, 228, 229)

The gate units serve to switch the Gate Turn-Off (GTO) thyristor within the valve sets. Switching of the gate units is controlled by a signal sent along an optical fibre link from the converter control electronics (415). The following signals are exchanged between the control electronics (415) and the gate units (227 - 229):

- turn-On pulse
- temperature-dependent, controlled continuous gate current to keep the thyristor conductive
- turn-Off pulse
- negative continuous gate voltage for keeping the GTO in permanently blocked condition
- optical check-back signal



0401036

The gate units (227 - 229) are supplied with a square wave signal (UE) from the 48 V/16 kHz gate unit power supply (219) which is rectified internally (1) and used without further stabilisation.

The logic block (4) monitors the incoming optical trigger pulses (SS) for minimum allowable duration and maximum frequency. In the case of faults, also in the case of a deviation of the internal supply voltages, one of the preselected safe conditions (default mode) is activated, ie. “continuous conducting”, “continuous blocking” or “no special reaction”. In the case of faults in the blocking phase, a check-back signal (RM) is generated which is transmitted optically to the control.

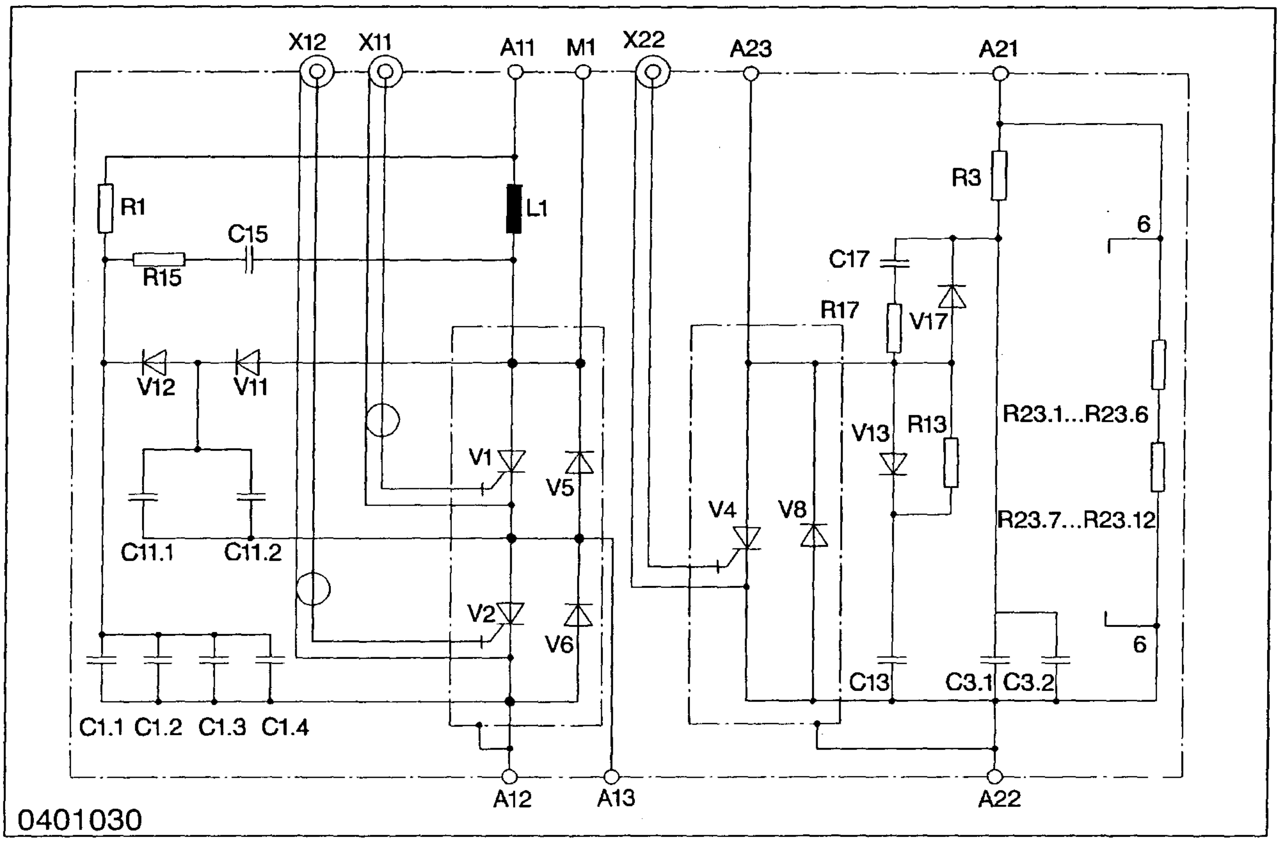
The On-pulses together with holding current are generated in the On-pulse block (2), which is controlled by the logic block (4).

The Off-pulses and the negative gate bias during the blocking phase of the GTO's are generated in the Off-pulse block (3), which is controlled by the logic block (4).

The gate units are situated at the left side of the corresponding valve set.

The gate units and the converter bus station are supplied with forced air for cooling. The air enters the ventilating duct at the bottom and exits it at the top where it flows into the machine room. There are two connections to the gate units; one at the left end of the traction converter and one more centrally located. Ventilation air for the bus station comes through the machine room floor without the use of any piping.

Valve Set ZV24 + MV23 (12)



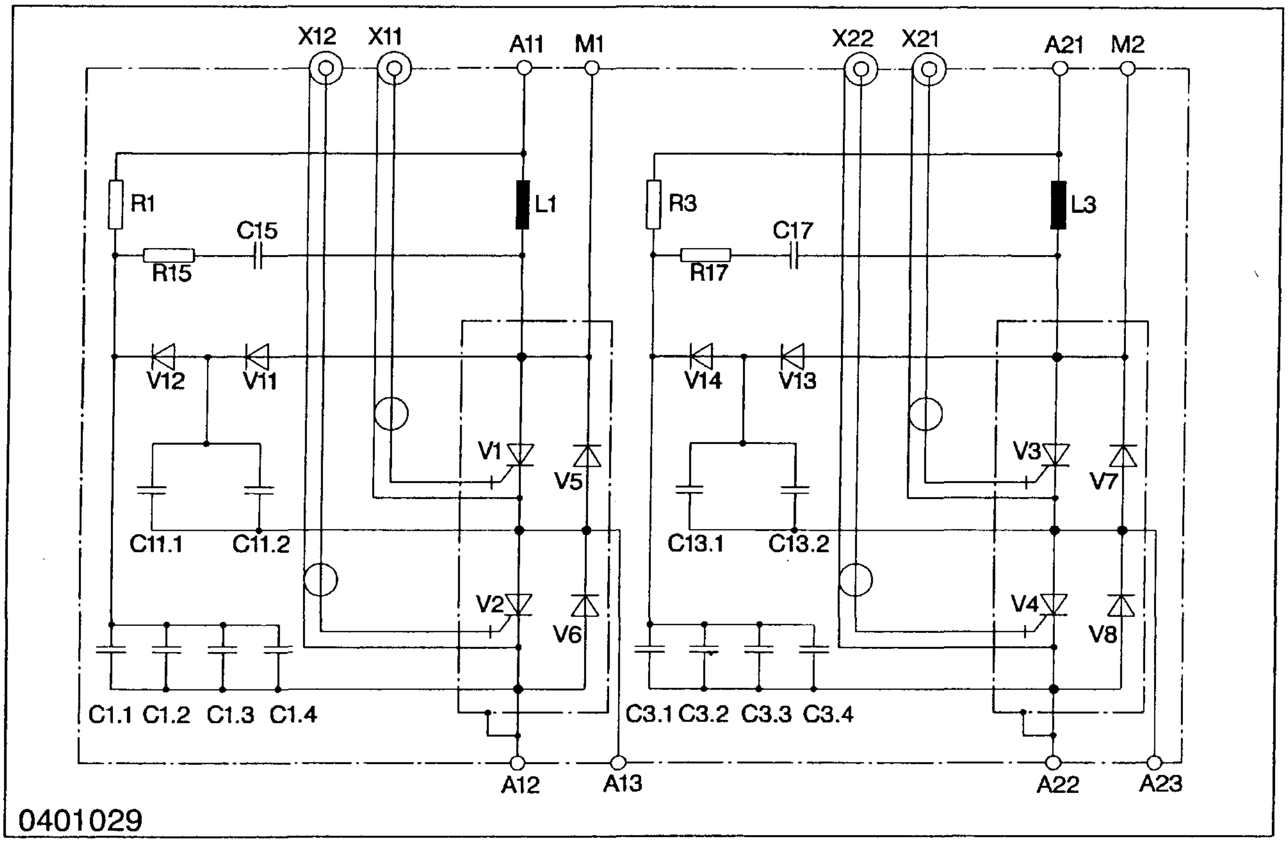
The left side of the valve set contains the ZV-diodes and thyristors and the right side of the valve set contains the circuitry of the MUB (overload limitation circuit).

The ZV circuit operates in the same way as the valve set described in Section Valve Set 2xZV24.

Overvoltage Limitation (MUB) circuit

The MUB circuit limits the overvoltage peaks in the DC-Link. It is also activated when powering down the locomotive in order to discharge the DC-Link capacitors (15.5). Refer to Resistor, Overvoltage Protection in this Section.

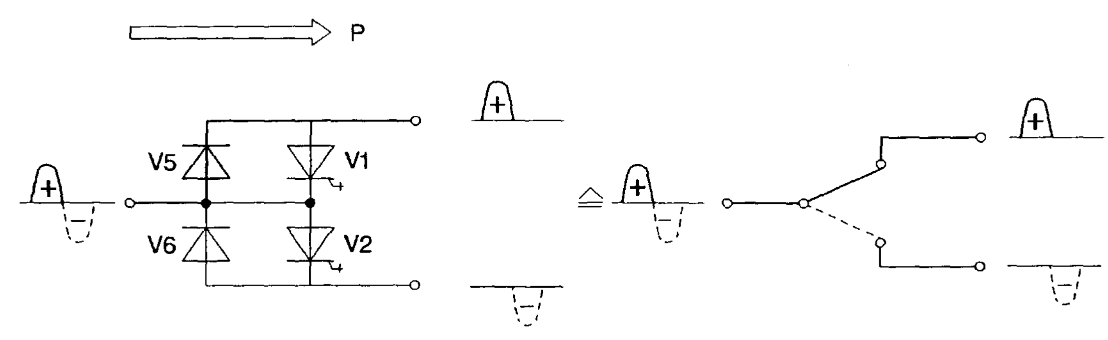
Valve Set 2xZV24 (13)



The valve set 2xZV24 (13) contains two identical circuits. They are able to convert AC into DC and DC into AC

The ZV module in the GTO stack is a half-bridge, which is capable of acting as a rectifier or as an inverter. As the system is symmetrical, Sections Rectifier Mode and Inverter Mode contain a description of only one of the two bridges.

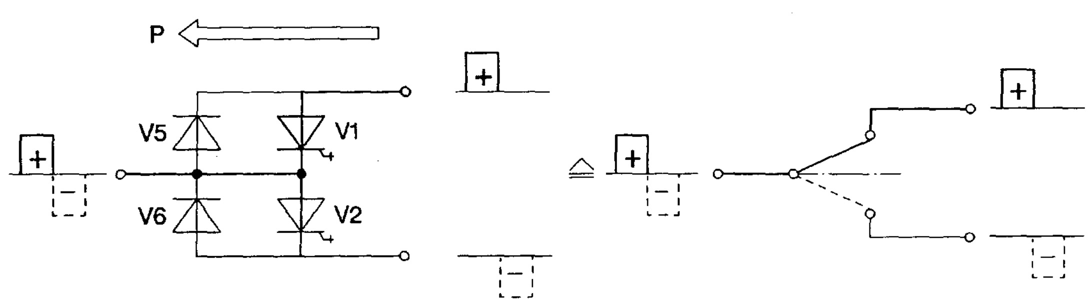
Rectifier Mode



0401031

When the direction of energy flow (P) is from the AC side to the DC side, the diodes {V5, V6} are in use. An incoming positive half-wave is directed by diode {V5} to the positive output, whereas diode {V6} does not conduct in the blocking direction. This corresponds to the "top" switch position. If the incoming half-wave is negative, diode {V5} does not conduct in the blocking direction; in return, diode {V6} conducts to the negative output. This corresponds to switch position "bottom".

Inverter Mode

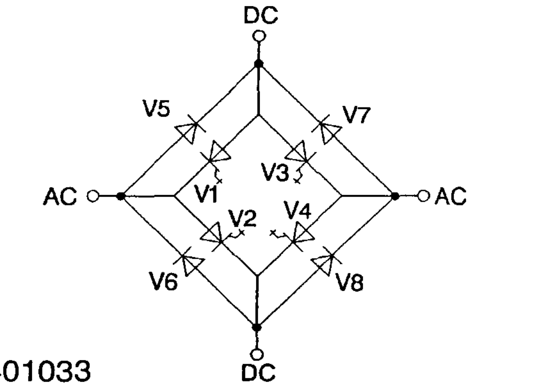


0401032

When the power flow (P) is from the DC side to the AC side, the DC voltage is applied to both diodes {V5, V6} in the blocking direction; therefore neither of them conduct. The thyristors

{V1, V2} are now fired alternately at the rate of the desired AC voltage frequency, which connects either the positive polarity or the negative polarity of the DC-Link to the AC voltage side, generating a square-wave AC voltage.

Full-bridge operation

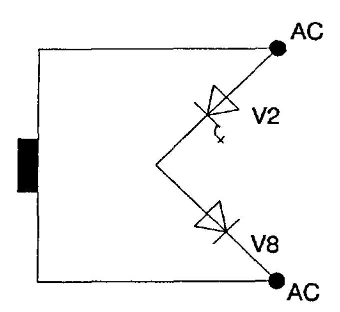


0401033

The two ZV groups of a GTO stack, one half-bridge each, are joined together in the circuit to form a full-bridge. This results in two parallel full-bridges, one of diodes and the other of thyristors:

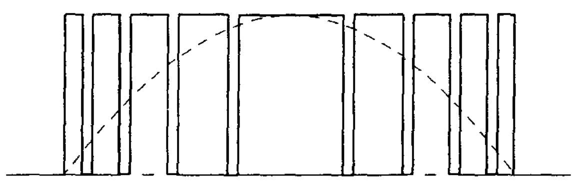
In operation, the thyristors are not only fired at the rate of the frequency of AC voltage required, as described above. The very high switching speed available with the thyristors permits additional functions.

In rectifier mode, the short conducting of a thyristor results in the supplying winding of the transformer, or of the motor (acting as generator), being short-circuited via the diode in the circuit (see figure). Consequently, a strong magnetic field is built up in the magnetic circuit of transformer or motor, with this magnetic field causing an additional voltage surge upon its collapse after the thyristor blocks. This pumping effect makes it possible for a voltage of approximately 2.8 kV to be generated in the link circuit, although, for example, in motoring mode only 1.33 kV AC comes from the transformer, corresponding to a rectified peak value of 1.89 kV. Therefore, the link circuit voltage is increased by the firing of the thyristor. The link circuit voltage can also be regulated by the manner in which the firing of the thyristors is timed. In this way, it is possible to compensate for fluctuations in the overhead line voltage or in the generator voltage supplied by the motors.



401034

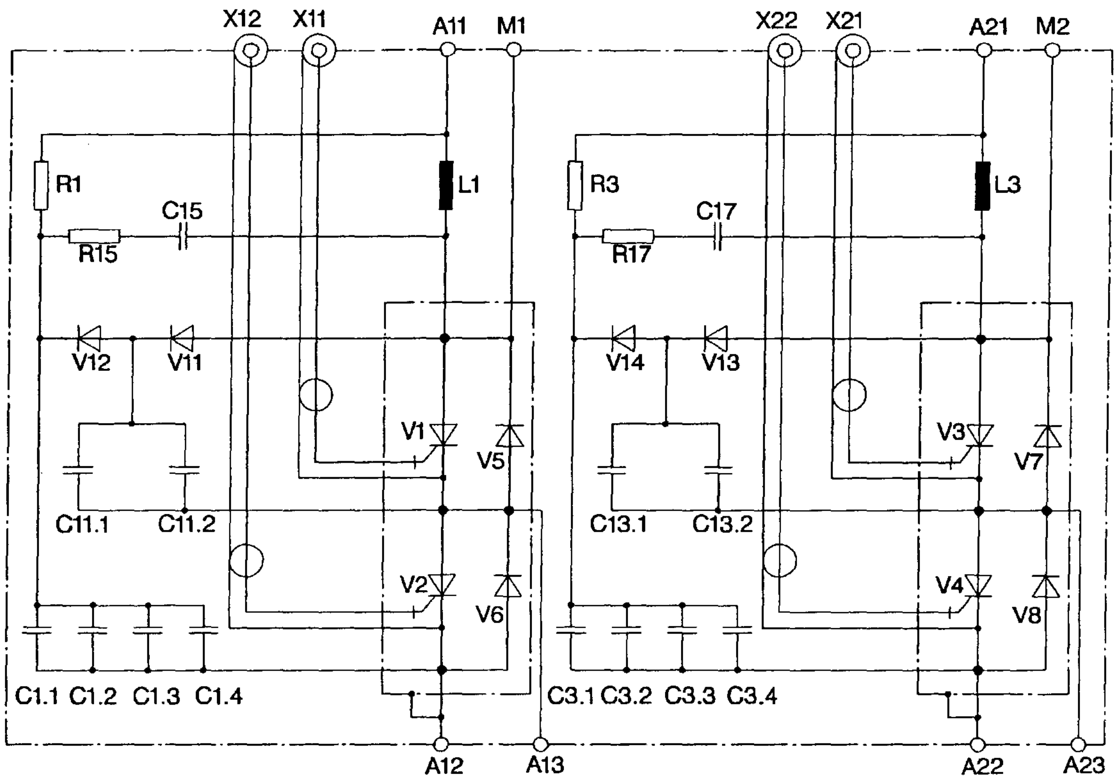
In inverter mode, a square-wave voltage is generated. If the conducting of a thyristor is interrupted several times during a half-wave, with the power transmission thus being divided into individual packets, it is possible to approximate the desired sinusoidal shape of the AC voltage. This is known as chopper mode.



0401035

Various ratios of blocking time and conducting time are possible in order to obtain a suitable approximation of the sinusoidal shape required.

Snubber Circuits



0401029

The function of the diodes {V1 - V4} and thyristors {V5 - V8} have been described in Section Valve Set 2xZV24. All other snubber circuit components on the diode/thyristor bridges are for the proper and safe switching of the GTO thyristors (current and voltage limitation). Some energy is consumed in resistors and some energy is stored and released by the capacitors.

Oil Cooling

For information regarding the air dehumidifier and oil expansion tank, refer to Chapter 4.2, Traction Converter Oil Cooling.

Oil Hose

Oil hoses form an integral part of the oil circuit between the valve set tanks and the traction converter oil cooling system. By-pass pipes can be installed between the oil hoses to complete the oil circuit for draining and filling procedures. For further information regarding the traction converter oil cooling system, refer to Chapter 4.2, Traction Converter Oil Cooling.

Quick Connect Fitting

Self sealing quick connect fittings are fitted to the oil pipes and valve set tanks. This enables the oil piping to be disconnected from the valve set tanks without the need to seal the oil piping or the valve set tank. For further information regarding the traction converter oil cooling system, refer to Chapter 4.2, Traction Converter Oil Cooling.

Temperature Probe (210.61)

The temperature probe measures the temperature of the cooling oil within the traction converter. The control electronics monitors the temperature probe and shuts the traction converter down should the temperature exceed a pre-set limit. For further information regarding the traction converter oil cooling system, refer to Chapter 4.2, Traction Converter Oil Cooling.

Pressure Sensor (210.62)

The pressure sensor measures the pressure of the cooling oil within the traction converter. The control electronics monitors the pressure sensor and shuts the traction converter down should the pressure exceed a pre-set limit. For further information regarding the traction converter oil cooling system, refer to Chapter 4.2, Traction Converter Oil Cooling.

Intermediate Circuit Cubicle

Capacitor Bank, DC-Link (15.5)

The rectified output of the line converter is a series of pulses at twice the frequency of the overhead supply. Due to this, the power coming into the DC-Link is also pulsed at twice the line frequency. The three-phase output generated by the drive converters requires a constant supply of power. The DC-Link capacitor bank (15.5) serves as an intermediate storage device for the energy supplied in pulses from the line converter and thus smooths the voltage in the DC-Link. This guarantees a flow of energy from the DC-Link to the drive converters that is constant and independent of the line frequency.

Series Resonant Cubicle

Series Resonant Circuit

As described in Section Intermediate Circuit Cubicle, the input to the DC-Link is formed of pulses at 100Hz, which is twice the line frequency of 50 Hz. The series resonant circuit consists of the Series Resonant Circuit Reactor (15.3) and the Series Resonant Circuit Capacitor Bank (15.4) and is tuned to 100 Hz. The series resonant circuit performs two functions:

1. Suppression of the 2nd harmonic

The pulsing of the line converter produces harmonic waves in the DC-Link circuit, which is generally undesired. Within the harmonic spectrum, the 2nd harmonic with a frequency of 100 Hz is the strongest. The series resonant circuit forms a short circuit at this frequency, thereby eliminating this harmonic. As a general guideline, the harmonic component of the 2nd harmonic should not exceed 2%. To satisfy this requirement, it is sufficient to tune the resonant frequency to within 10% of the theoretical value.

2. Intermediate storage of energy

The series resonant circuit gives off stored energy during the mains zero crossing, thereby contributing towards the stabilisation of the DC-Link voltage and towards a continuous flow of energy between converter and motors in the same way as the DC-Link capacitor bank. The DC-Link capacitor bank must damp the higher order harmonics and is able to store 1.5 times the energy of the series resonant circuit. For further information regarding the DC-Link capacitor bank, refer to Section Intermediate Circuit Cubicle.

Capacitor Bank, Series Resonant Circuit (15.4)

The series resonant circuit capacitor bank (15.4) contains capacitors 15.4/1 to 15.4/7, along with tuning capacitor 15.41. The total capacitance of the series resonant capacitor bank can be adjusted at the tuning capacitor. For further information regarding tuning the series resonant capacitor bank, refer to Section 3.4.3.2, Tuning the Resonant Circuit in Chapter 3, Traction Converter, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Technical Data

@.1160

General

- Weight	3,300 kg
- Length	3,050 mm
- Width	1,103 mm
- Height	2,000 mm
- Load	2 three phase induction motors in parallel
- Power dissipation, converter block P	105 kW
- Coolant oil	Mineral oil SHELL DIALA DX
- Maximum coolant temperature υoil	65° C
- Minimum coolant temperature υoil	0° C
- Coolant flow rate, υoil	918 l/min
- Pressure drop between the inlet and outlet Δp	2,700 mbar
- Maximum cooling air temperature υair	70° C
- Minimum cooling air temperature υair	0° C
- Air flow rate (bus-station, QAirBS)	approx. 60 dm^3/s
- Air flow rate (gate units, QAirGU)	approx. 2 x 30 dm^3/s
- Maximum ambient temperature A	47° C
- Minimum ambient temperature A	0° C

Electrical

Input

- Input voltage U1 (RMS)	2 x 1,269 Volt
- Input current I1 (RMS)	2 x 1,142 Amp
- Input frequency f1	50 Hz

DC-Link Circuit

- DC-Link circuit nominal voltage Ud	2,800 Volt
- Nominal capacitance Cd	10.8 - 12.0 mF

Output

- Output voltage U2 (line-line voltage, RMS)	2,180 Volt
- Output current I2 (per phase, RMS)	740 Amp
- Output power P2	2,105 kW

Components

Fibre optic cable

- Bending radius	≥ 50 mm

Earthing switch (15.82)

- Resistance (closed switch)	< 100 mΩ
- Resistance (switch opened)	> 10 kΩ

Capacitor banks

- Capacitance (DC-Link)	11.4 mF ± 0.6 mF
- Capacitance (resonant circuit)	5.04 mF ± 0.15 mF

Gate Units

- Voltage gate-cathode (cables ordinarily connected)	14.5 - 17.5 Volt

Overvoltage Limitation Resistor (15.1)

- Rated resistance RN	2.5 Ω
- Tolerance over the whole temperature range	±5 %
- Operating temperature range amb, min	- 40 °C
- Minimum operating voltage UDC-Link	2.8 kV
- Rated voltage (short time operation) UN(STO)	4.05 kV
- Series inductance LS(min) (at 1400 A)	10 µH
- Series inductance LS(max)	25 µH
- Peak surge current îmax	1,705 Amp
- Maximum di/dt	340 A/µs

Current Sensor

- Rated primary current IP (RMS)	2 kA
- Maximum permanent current I (RMS)	2.4 kA
- Winding ratio	1:5,000
- Rated secondary current at IS (RMS)	400 mA
- Offset current (IP = 0A, υ = +25 °C)	≤ 0.75 mA
- Offset current drift (υ= -40...+70 °C)	< 0.6 mA
- Internal secondary resistance RS (υ= +70 °C)	< 25 Ω
- Number of windings	1,000

PRIMARY Voltage Transformer Module

Primary Side

- Windings N1	8,000
- Resistance R1	2,597 Ω
- Voltage (without load) U	1.6 kV
- Voltage (with load) U	1.6 kV

Secondary Side

- Windings N2	410
- Resistance R2	40 Ω
- Voltage (without load) U	31.5 V
- Voltage (with load) U	30 V
- Resistance (loaded) RL	15 Ω

Gate Unit Power Supply

- Input voltage	110 Volt
- Output voltage U_{out}	96 V P-P
- Output frequency f_{out}	16 kHz ± 10%

Tolerances and Wear Limits List

@.1170

Tolerances and wear limits applicable to the components contained in the traction converter are given in Chapters 1 to 5, Traction Converter of Volume F4, 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;

- LED source, Type 257A
- Power meter Type 557A (RIFCOS Corp. Camarillo, California, USA)
- To perform capacitance measurements use either a measuring bridge of the type "AIM 6421" (made by "PRISM ELECTRONICS") or an equivalent unit.
- For transporting the complete traction converter, lifting frame [HDGF031178] is required, along with special bolts [HDGF321193].
- For transporting the heavy valve sets outside the converter use the lift type 36 [3EHF 601 027].
- Test Box for the Gate Unit Power Supply.
- Adjustable DC current source (DC power supply) with current limitation; a voltage of approx. 10 V and current of approx. 1 A is required.
- Voltmeter (digital multimeter), range approx. 20 V
- Ammeter (digital multimeter), range approx. 2 A and smaller
- Hoisting crane to transport the valve sets.

Refer to Volume F4, Suppliers Documentation for further details regarding these and other tools and equipment.

Miscellaneous Materials

@.1200

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

- General purpose grease to lubricate some threads.

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.

NOTE:

The earthing switch should only be operated if there is no fault message on display "Fault DC_Link Discharge" 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.

Earth the traction converter at the earthing switch. Operation of the key interlocking system is described in the Preface of this Volume.

Isolate the traction converter control circuits at the circuit breaker (127.1). Circuit breaker 127.1/1 for the number-1 end traction converter control is located in cubicle SB1. Circuit breaker 127.1/2 for the number 2 end traction converter control is located in cubicle SB2. Refer to chapter 8.2, Machine Room Control for further information.

If necessary, remove the front covers, as described in Section Disassembly.

Remove the converter roof hatch from the locomotive, as described in Chapter 1.1, Structure.

Disconnect the signal cables from the converter control unit as described in Chapter 4.3, Traction Converter Control.

Drain the traction converter oil cooling, as described in Chapter 4.2, Traction Converter Oil Cooling.

For further information regarding before-removal operations and safety, refer to Section 0, Safety Regulations in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

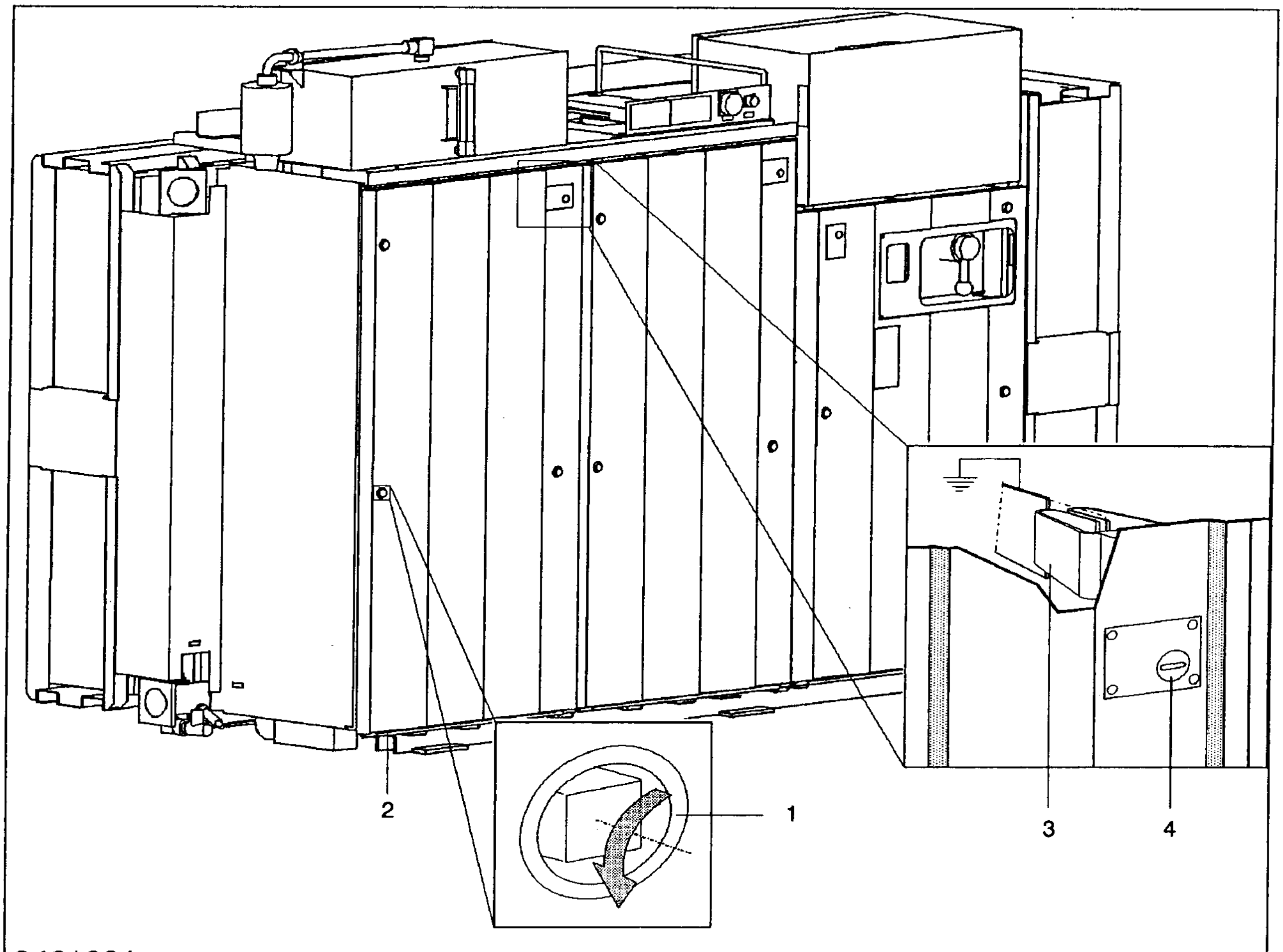
Removal

@.1230

Certain operations may, after consultation with after-sales service, be carried out on site by an authorised service technician.

CAUTION:

Interventions on the traction converter, such as repairs or the replacement of individual components, may be carried out only by ABB specialists. Unauthorised interventions may void the manufacturer's warranty.



0401001

Open the locks (1) using a square key.

Open the interlocking locks (4) using the appropriate key. Operation of the key interlocking system is described in the Preface of this Volume.

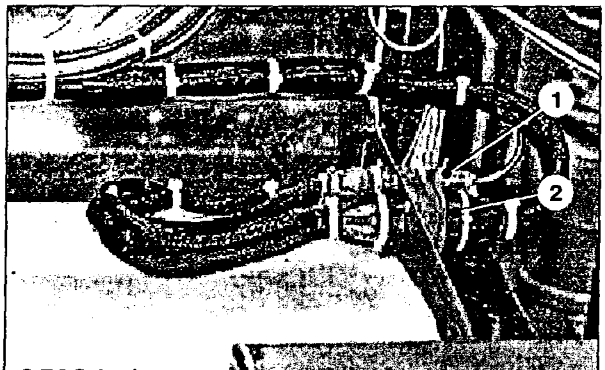
Pull the top of the cover forwards until the contact stud (3) is pulled out of the earth resistance meter.

Lift the front cover from the profile (2), then place the cover away from the work area.

Remove the cover from the converter control unit above the apparatus module and disconnect the cables from the converter control unit that are cable tied to the XK**A and XK**B cables, as described in Chapter 4.3, Traction Converter Control.

The XK**A connector is a 35-pole UIC connector. It supplies the converter with analogue and digital control voltages and feeds the bus station's ventilation.

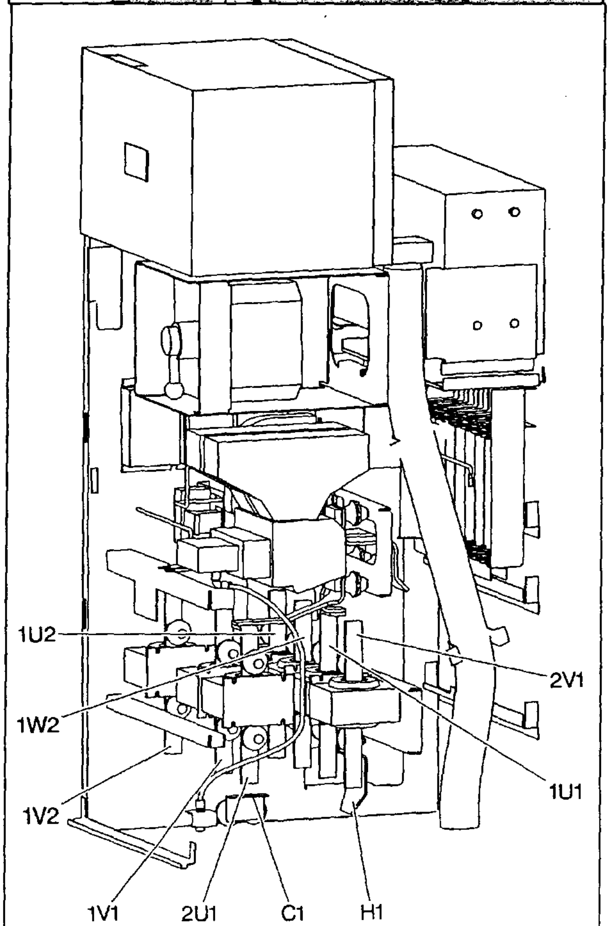
The connector XK**B is 5-pole UIC connector and for safety reasons it is only used for the analogue signal of the line voltage.



37834_1

Tag and disconnect the harness XK**A (2), on the left, turn the knurled sleeve (grey ring) counterclockwise.

Tag and disconnect the harness XK**B (1), at the right, turn the grey ring counterclockwise.

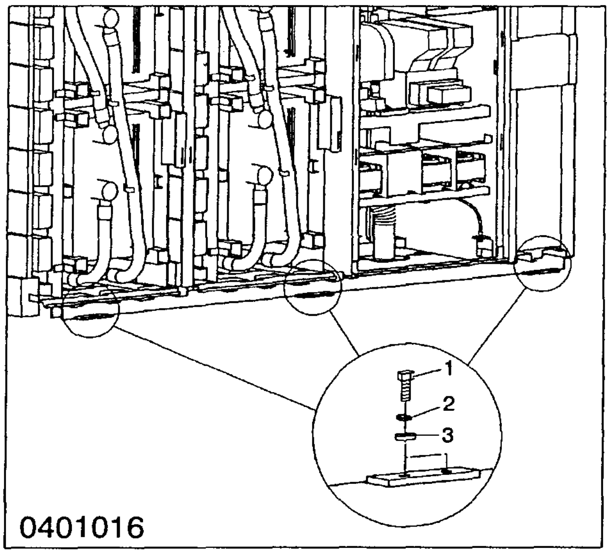


0401101n

Tag and disconnect the earthing (E), traction motor (1U2,1V2,1W2), series resonant circuit (C1,H1) and line converter (1U1,1V1,2U1,2V2) connections to the traction converter.

In traction converter 1, series resonant circuit reactor connections C1 and H1 are connected to X11 and X12 on the main transformer, with line converter connections 1U1, 1V1, 2U1 and 2V1 connected to 2U1, 2V1, 2U4 and 2V4, respectively, on the main transformer.

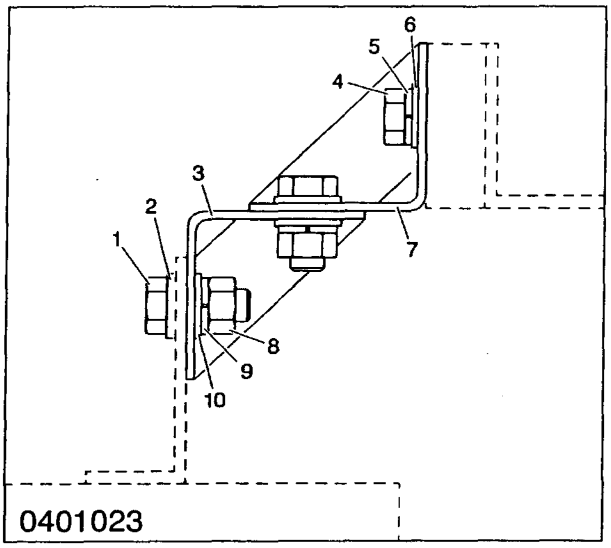
In traction converter 2, series resonant circuit reactor connections C1 and H1 are connected to X21 and X22 on the main transformer, with line converter connections 1U1, 1V1, 2U1 and 2V1 connected to 2U2, 2V2, 2U3 and 2V3, respectively, on the main transformer.



0401016

The traction converter is fixed by six bolts on the front. The bolts are arranged in groups of two. One pair is located at the left, one in the centre and one at the right.

Remove the bolts (1), spring washers (2) and washers (3).

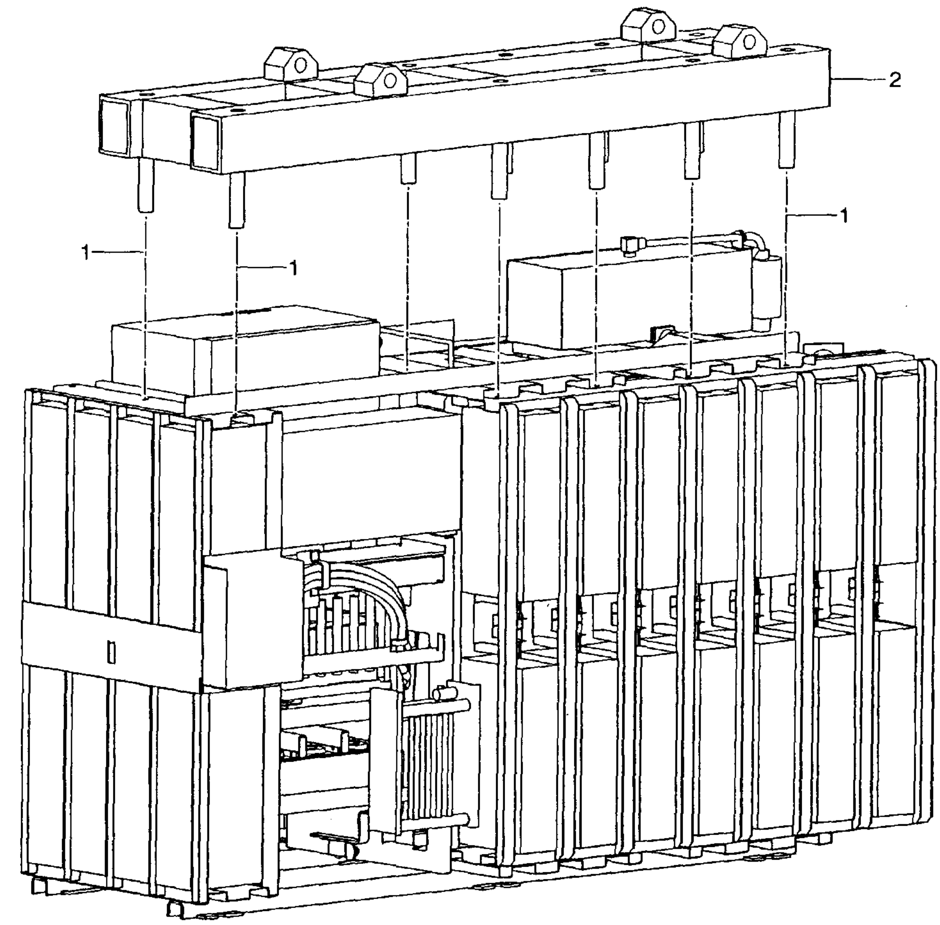


0401023

Loosen the bolt (1) and nut (8) securing the angle bracket assembly (3,7) at the rear top of the traction converter. Remove the nut (8), spring washer (9) and washer (10). Remove the bolt (1) and the washer (2) from the other side.

Remove the bolt (4), spring washer (5) and washer (6) securing the bracket assembly (3,7) to the machine room wall, then remove the bracket assembly (3,7).

Repeat for the remaining angle brackets.



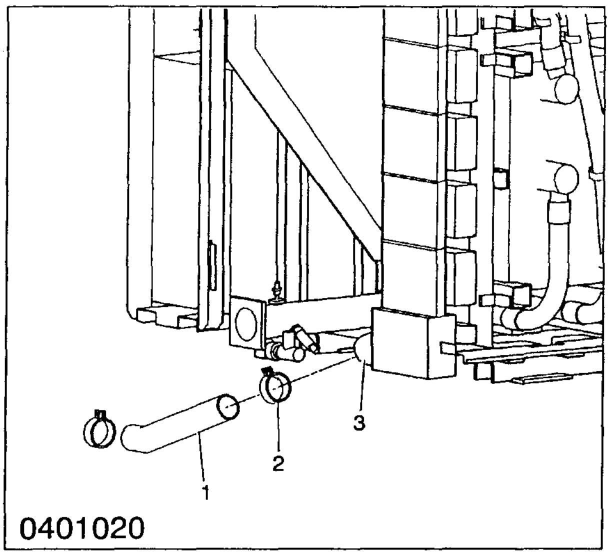
NOTE:

The traction converter must only be lifted using the special lifting frame.

Attach the lifting frame (2) HDGF031178 to the traction converter mounting points (1) using the attaching bolts HDGF321193, refer to Section Tools and Special Tools. Ensure the lifting frame (2) is correctly attached to the traction converter.

To disconnect the air connections, it may be necessary to raise the traction converter slightly to obtain access to the air ducting connections.

Attach suitable lifting equipment to the traction converter lifting frame. Raise the lifting equipment slightly. Ensure the traction converter is fully disconnected from the machine room, then raise the traction converter slightly. Ensure nothing is entangled, and then raise the traction converter half a metre from the machine room floor. Position suitable safety stands beneath the traction converter before attempting any work beneath the partially raised traction converter.



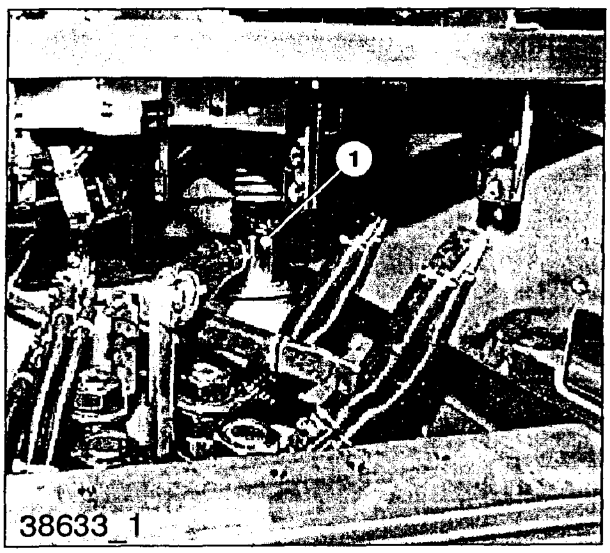
There are two air connections for the gate units. These air connections supply the cooling air that is forced upwards through each column of gate units. One air connection is situated at the left edge of the traction converter at the base of the gate units. The other air connection is situated near the centre of the traction converter behind the gate units.

Loosen the clamp (2) securing the air hose (1) to the gate unit ducting (3).

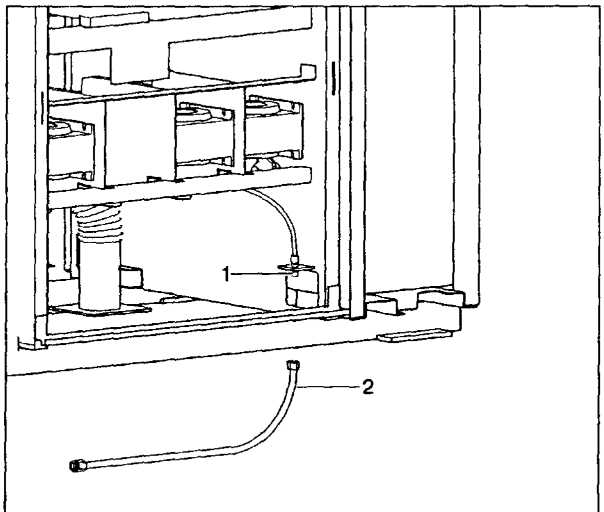
Disconnect the hose (1) from the connection to the gate unit ducting (3).

Loosen the clamp securing the centre air hose to the traction converter.

Disconnect the centre hose from the traction converter.



The tube (1) that supplies the converter bus station with air flow is fixed at the bottom of the apparatus cubicle. The black sealing strip, mounted on the duct in the machine room floor, ensures an airtight connection. No connections need to be removed for this air duct.



0401021

Remove the pneumatic hose (2) from the union (1) in the apparatus cubicle.

Reinstall the front covers.

Lift the traction converter from the machine room.

NOTE:

The converter must be transported in its normal operating position and with the front covers installed to prevent damage to components. The converter must only be put on a flat, level surface. The oil tubes must not contact the floor.

Once the traction converter has been removed from the locomotive, the front covers remain installed to prevent any part of the traction converter being damaged. Refer to Section 1.7, Storage in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation for traction converter storage details.

The front covers must be installed for transport and during storage of the traction converter.

If necessary, tag and disconnect the remaining cables to the transformer. Cables for the auxiliary converter chokes are located beneath traction converter 2. Cables for the high voltage connection, primary earth, auxiliary converter power supply, hotel load and filter windings are located beneath traction converter 1.

For further information regarding the high voltage connection, refer to Chapter 3.1, Roof Line.

Disassembly

@.1240

Front Covers

Remove the front covers as described in Section 3.3.2, Removing/Fitting the Front Covers in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Apparatus Cubicle

Electronics, Converter Control (415)

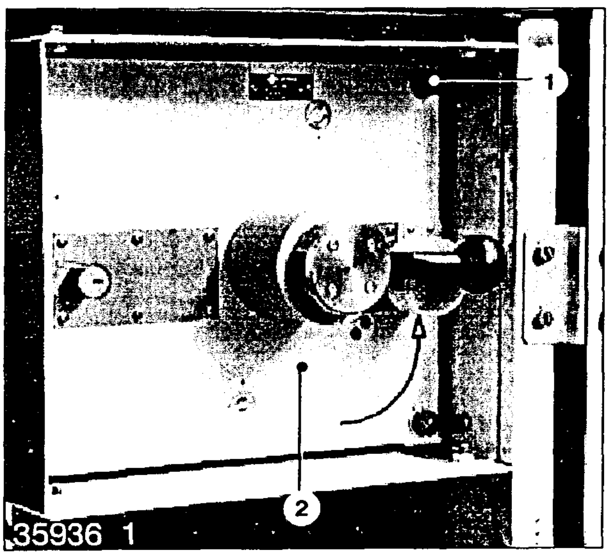
For information regarding the converter control module, refer to Chapter 4.3, Traction Converter Control.

Voltage Indicator, DC-Link (15.7)

Remove the voltage indicator as described in Section 3.3.9, Removal/Fitting Voltage Indicator in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Earthing Switch, DC-Link (15.82)

Earth the DC-Link components if not already done.



Unscrew the four bolts (1) on the front of the earthing switch.

Pull earthing switch (2) out of the metal housing sufficiently to access the terminals inside.

Tag and disconnect the connections from terminals A and terminals B.

Remove strain washers and cables.

Withdraw earthing switch fully from the metal housing.

Contactor, Precharge (12.3)

Remove the precharge contactor arc chute as described Section 3.3.10, Replacing the Arc Chute on the Precharge Contactor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Tag and disconnect the electrical connections to the precharge contactor.

Loosen and remove the screws securing the contactor to the fixing plate, then remove the contactor from the apparatus module.

Contactor, Converter (12.4)

Remove the converter contactor arc chute as described in Section 3.3.11, Replacing the Arc Chute on the Converter Contactor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Tag and disconnect the electrical connections to the converter contactor.

Disconnect the pneumatic hose at the front of the converter contactor.

Loosen and remove the screws securing the contactor to the fixing plate, then remove the contactor from the apparatus module.

Current Transducer, Drive Converter (18.5)

Remove the current transducer as described in Section 3.3.7, Fitting/Removing a Current Transducer in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Primary Voltage Transformer (224.1)

Remove the primary voltage transformer as described in Section 3.3.8, Fitting/Removing the Primary Voltage Transformer Module in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Resistor, Converter Precharge (14)

Remove the converter precharge resistor as described in Section 3.3.15, Fitting/Removing the Precharge Resistor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Contactor, Gate Unit Power Supply K08 (218.2)

Remove the gate unit power supply (GUSP) contactor as described in Section 3.3.13, Fitting/Removing the GUSP Contactor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Resistor, Earth Fault Detection (90.61 - 90.62)

Remove the earthing resistors as described in Section 3.3.12, Removal/Fitting the Earthing Resistors and Precharge Resistor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Current Transducer, Line Converter (18.2)

Remove the current transducer as described in Section 3.3.7, Fitting/Removing a Current Transducer in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Resistor, Gate Unit Power Supply Precharge (219.1)

Remove the gate unit power supply precharge resistor as described in Section 3.3.12, Removal/Fitting the Earthing Resistors and Precharge Resistor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Voltage Transducers (15.6, 89.4)

Remove the voltage transducers as described in Section 3.3.6, Fitting/Removing a Voltage Transducer in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Power Supply, Gate Unit (219)

Remove the gate unit power supply as described in Section 3.3.5, Fitting/Removing the Gate Unit Power Supply (GUSP) in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Valve Set Cubicle

Gate Units (227, 228, 229)

Remove the gate units as described in Section 3.3.4, Fitting/Removing a Gate Unit in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Valve Sets, 2xZV24, ZV24 + MV23 (12, 13)

Remove the valve set as described in Section 3.3.3, Fitting/Removing a Valve Set in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

For storage details for the valve sets, refer to Section 1.7.2, Storage of Valve Sets in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Temperature Probe (210.61)

Remove the temperature probe as described in Section 3.3.16, Removing/Fitting the Pressure and Temperature Sensors in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Pressure Sensor (210.62)

Remove the pressure sensor as described in Section 3.3.16, Removing/Fitting the Pressure and Temperature Sensors in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Inspection and Repair

@.1250
Inspection and repair procedures for the traction converter are described in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

MUB Resistor Test R71 (15.1)

The temperature-rise of the MUB-resistor R71 (15.1) is monitored in the converter control unit SLG, using an equivalent software model. A protective shut-down of the converter should prevent the resistor from a thermal overload. Therefore, thermal overloading of the resistor points to faulty monitoring and a possible error in the control of the MUB-arm.

Hence, when recommissioning the converter, both the SLG-control functions and the MUB-arm control have to be thoroughly tested. If there is no malfunction in the control, it is necessary to have the manufacturer check the thermal model of the resistor.

Waste Disposal

@.1260
Dispose of waste parts, materials and fluids according to the prevailing environmental standards or workplace practices.

Assembly

@.1270
Refer to Section 1, Main Power Circuit of Volume G1, Cabling Documentation for traction converter electrical connections.

Front Covers

Refit the front covers as described in Section 3.3.2, Removing/Fitting the Front Covers in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Apparatus Cubicle

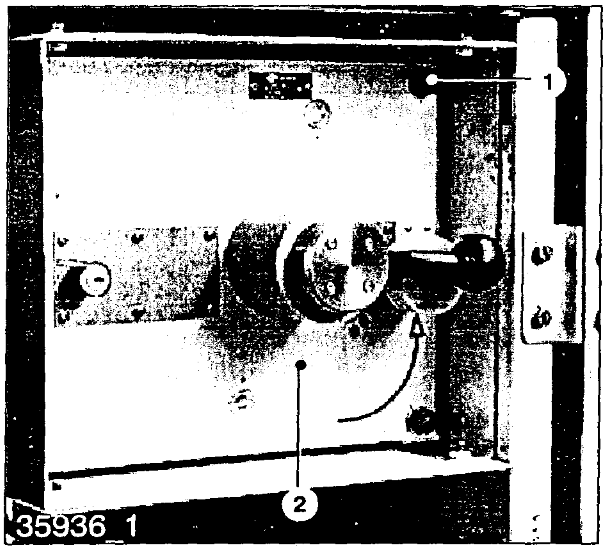
Electronics, Converter Control (415)

For information regarding the converter control module, refer to Chapter 4.3, Traction Converter Control.

Voltage Indicator, DC-Link (15.7)

Install the voltage indicator as described in Section 3.3.9, Removal/Fitting Voltage Indicator in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Earthing Switch, DC-Link (15.82)



Install earthing switch partially into the metal housing. Ensure there is sufficient access to the terminals inside.

Install strain washers and cables.

Reconnect the connections to terminals A and terminals B as tagged during removal.

Install the earthing switch fully into the metal housing.

Install and tighten the four bolts (1) on the front of the earthing switch.

Contactor, Precharge (12.3)

Mount the contactor on the fixing plate within the apparatus module, then secure the contactor with the fixing screws.

Reconnect the electrical connections to the precharge contactor as tagged during removal.

Install the precharge contactor arc chute as described in Section 3.3.10, Replacing the Arc Chute on the Precharge Contactor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Contactor, Converter (12.4)

Mount the contactor on the fixing plate within the apparatus module, then secure the contactor with the fixing screws.

Reconnect the electrical connections to the converter contactor as tagged during removal.

Reconnect the pneumatic hose at the front of the converter contactor.

Install the converter contactor arc chute as described in Section 3.3.11, Replacing the Arc Chute on the Converter Contactor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Current Transducer, Drive Converter (18.5)

Install the current transducer as described in Section 3.3.7, Fitting/Removing a Current Transducer in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Primary Voltage Transformer (224.1)

Install the primary voltage transformer as described in Section 3.3.8, Fitting/Removing the Primary Voltage Transformer Module in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Resistor, Converter Precharge (14)

Install the converter precharge resistor as described in Section 3.3.15, Fitting/Removing the Precharge Resistor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Contactor, Gate Unit Power Supply K08 (218.2)

Install the gate unit power supply (GUSP) contactor as described in Section 3.3.13, Fitting/ Removing the GUSP Contactor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Resistor, Earth Fault Detection (90.61, 90.62)

Install the earthing resistors as described in Section 3.3.12, Removal/Fitting the Earthing Resistors and Precharge Resistor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Current Transducer, Line Converter (18.2)

Install the current transducer as described in Section 3.3.7, Fitting/Removing a Current Transducer in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Resistor, Gate Unit Power Supply Precharge (219.1)

Install the gate unit power supply precharge resistor as described in Section 3.3.12, Removal/ Fitting the Earthing Resistors and Precharge Resistor in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Voltage Transducers (15.6, 89.4)

Install the voltage transducers as described in Section 3.3.6, Fitting/Removing a Voltage Transducer in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Power Supply, Gate Unit (219)

Install the gate unit power supply as described in Section 3.3.5, Fitting/Removing the Gate Unit Power Supply (GUSP) in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Valve Set Cubicle

Gate Units (227, 228, 229)

Install the gate units as described in Section 3.3.4, Fitting/Removing a Gate Unit in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Valve Sets, 2xZV24, ZV24 + MV23 (12, 13)

Install the valve set as described in Section 3.3.3, Fitting/Removing a Valve Set in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Temperature Probe (210.61)

Install the temperature probe as described in Section 3.3.16, Removing/Fitting the Pressure and Temperature Sensors in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Pressure Sensor (210.62)

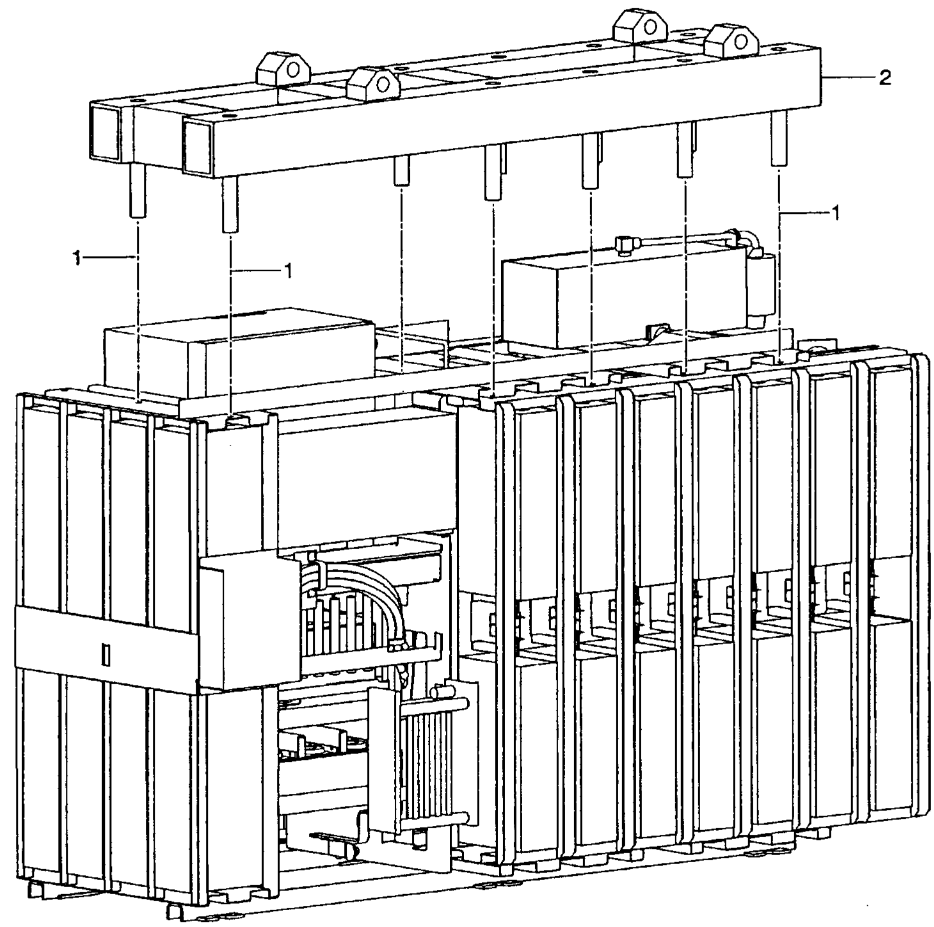
Install the pressure sensor as described in Section 3.3.16, Removing/Fitting the Pressure and Temperature Sensors in Chapter 3, Installation, Servicing, Maintenance of Volume F4, Suppliers Documentation.

Installation

@.1280

NOTE:

The converter must be transported in its normal operating position and with the front covers installed to prevent damage to components. The converter must only be put on a flat, level surface. The oil tubes must not contact the floor.



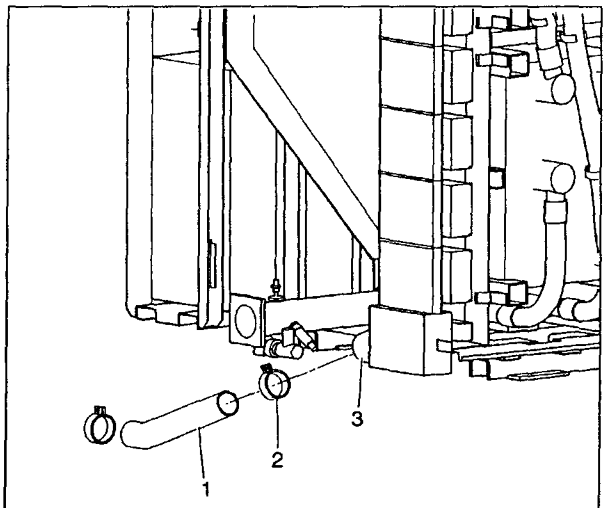
0401100n

NOTE:

The traction converter must only be lifted using the special lifting frame.

Attach the lifting frame (2) HDGF031178 to the traction converter mounting points (1) using the attaching bolts HDGF321193, refer to Section Tools and Special Tools. Ensure the lifting frame (2) is correctly attached to the traction converter before attempting to lift the traction converter.

Attach suitable lifting equipment to the traction converter lifting frame. Raise the lifting equipment slightly. Ensure the traction converter is fully supported by the lifting frame, then position the traction converter over the machine room of the locomotive. Lower the traction converter into the machine room until the traction converter is about half a metre from the machine room floor. Position suitable safety stands beneath the traction converter before attempting any work beneath the traction converter.



0401020

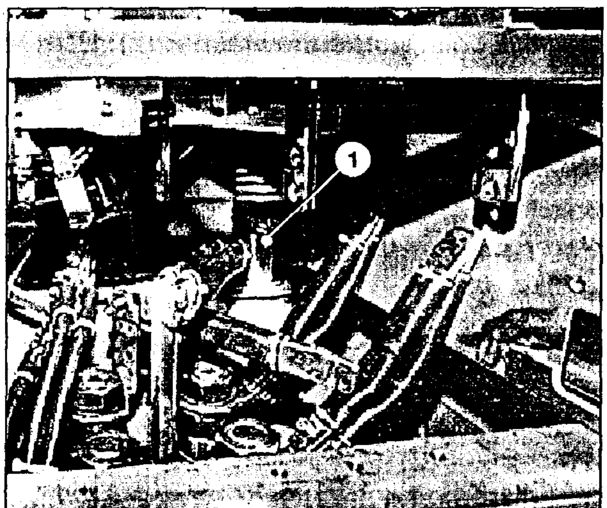
There are two air connections for the gate units. These air connections supply the cooling air that is forced upwards through each column of gate units. One air connection is situated at the left edge of the traction converter at the base of the gate units. The other air connection is situated near the centre of the traction converter behind the gate units.

Connect the air hose (1) to the to the gate unit (3) air duct.

Tighten the clamp (2) securing the air hose (1) to the duct.

Connect the centre air hose to the to the traction converter.

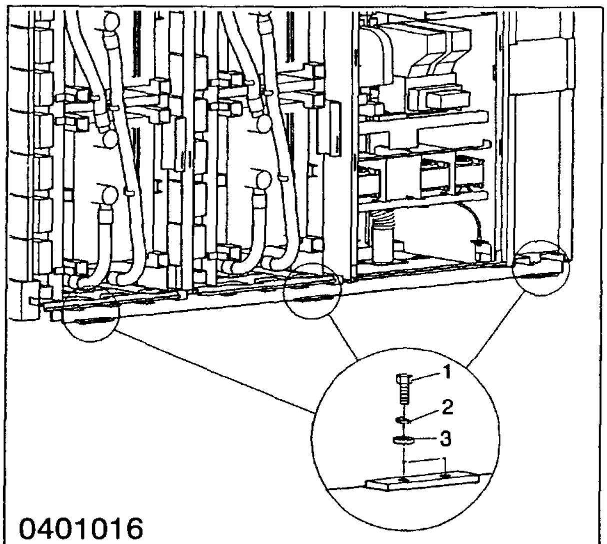
Tighten the clamp securing the centre air hose to the traction converter.



38633_1

The tube (1) that supplies the converter bus station with airflow is fixed at the bottom of the apparatus cubicle. The black sealing strip, mounted on the duct in the machine room floor, ensures an airtight connection. Ensure the sealing strip is in good condition. Renew if required before installation of the traction converter.

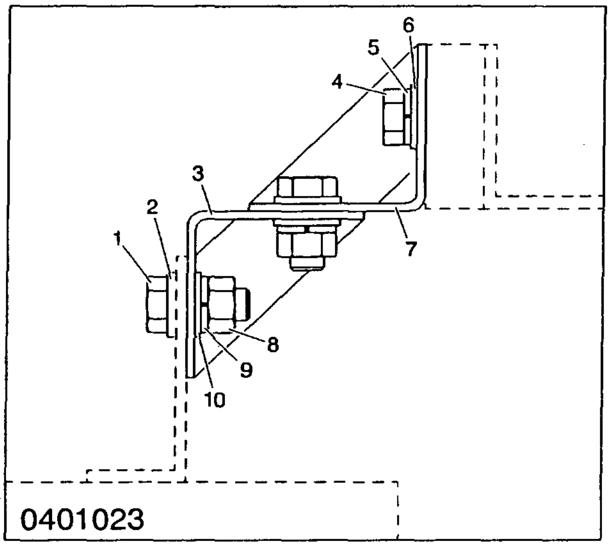
Remove the safety stands from beneath the traction converter. Ensure the traction converter is correctly aligned with its mounting location, then slowly lower the traction converter into position in the machine room. Check before the traction converter is fully lowered that the converter mounting holes are aligned with the holes in the machine room floor.



0401016

The traction converter is fixed by six bolts on the front. The bolts are arranged in groups of two. One pair is located at the left, one in the middle and one at the right.

Apply a thin coating of grease to the threaded holes in the machine room floor, then install and tighten the bolts (1), spring washers (2) and washers (3).



0401023

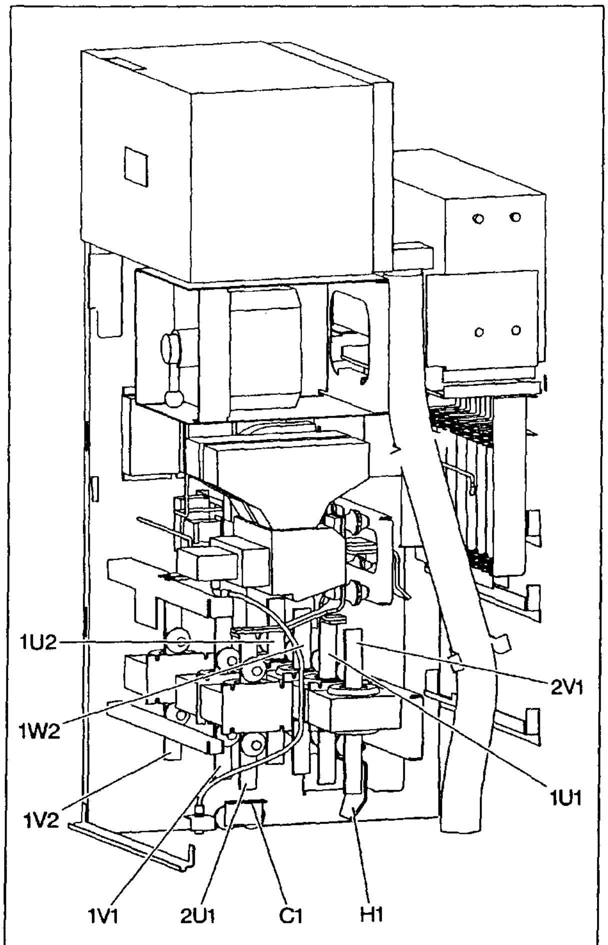
Loosen the nuts and bolts securing the angle brackets (3,7) together. Do not remove the nuts and bolts. Loosening these bolts allows the angle brackets (3,7) to be adjusted to suit the installed distance between the traction converter and the machine room wall.

Install the bolt (1) and the washer (2). Position the angle bracket assembly (3, 7) on the traction converter, then install the nut (8), spring washer (9) and washer (10). Tighten the bolt (1) and nut (8) securing the angle bracket assembly (3, 7) to the traction converter.

Install and tighten the bolt (4), spring washer (5) and washer (6) securing the bracket assembly (3, 7) to the machine room wall.

Tighten the nuts and bolts in the centre of the angle bracket assembly (3, 7) to secure the angle brackets (3, 7) relative to each other.

Repeat for the remaining angle brackets.



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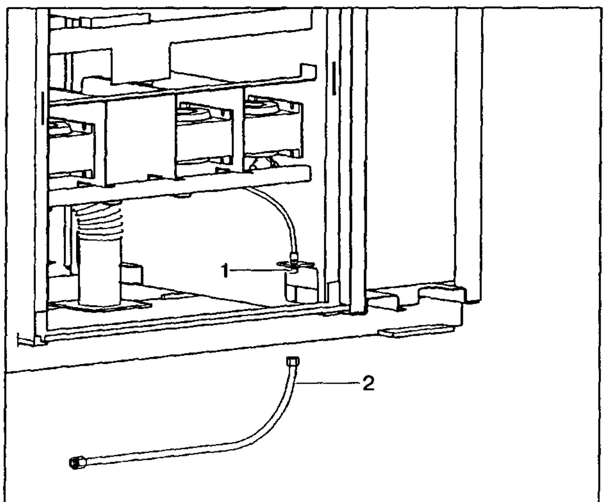
Refer to Section 1, Main Power Circuit of Volume G1, Cabling Documentation for traction converter electrical connections.

Reconnect the earthing (E), traction motor (1U2, 1V2, 1W2), series resonant circuit (C1,H1) and line converter (1U1, 1V1, 2U1, 2V2) connections to the traction converter.

In traction converter 1, series resonant circuit reactor connections C1 and H1 are connected to X11 and X12 on the main transformer, with line converter connections 1U1, 1V1, 2U1 and 2V1 connected to 2U1, 2V1, 2U4 and 2V4 on the main transformer.

In traction converter 2, series resonant circuit reactor connections C1 and H1 are connected to X21 and X22 on the main transformer, with line converter connections 1U1, 1V1, 2U1 and 2V1 connected to 2U2, 2V2, 2U3 and 2V3 on the main transformer.



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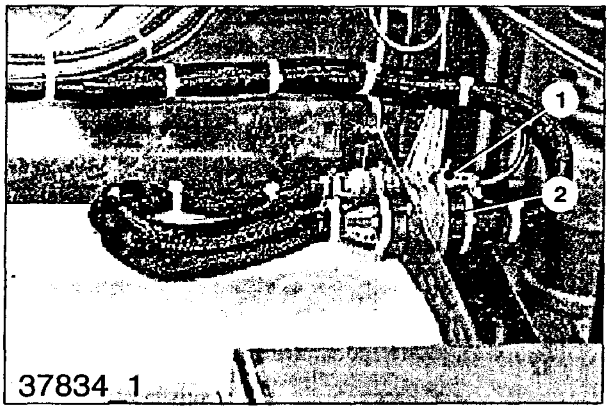
Reconnect the pneumatic hose (2) to the union (1) in the apparatus cubicle.



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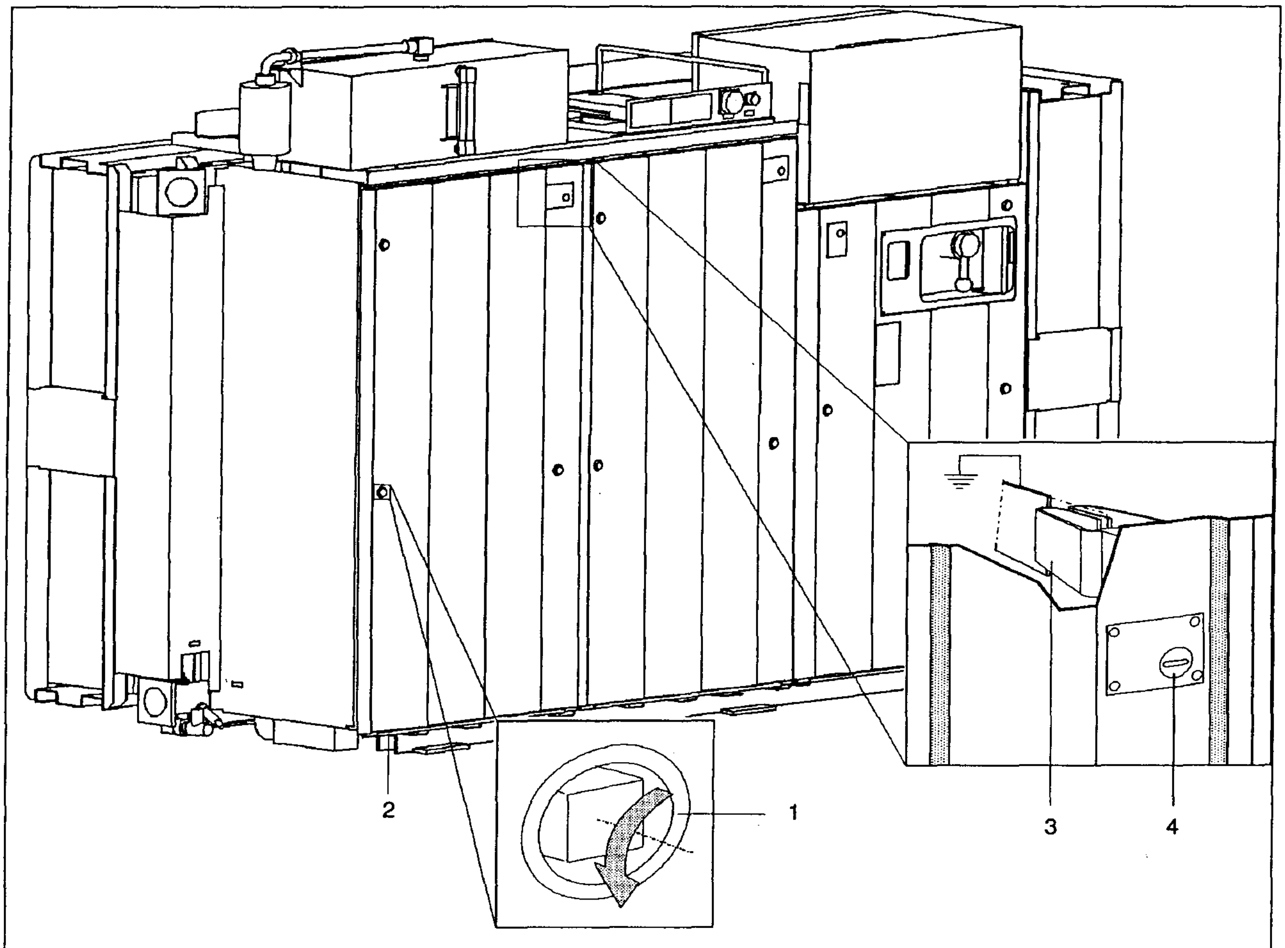
Insert the connector XK**A in the socket (2) and turn the knurled sleeve (grey ring) clockwise to secure the connector in the socket.

Insert the connector XK**B in the socket (1) and turn the grey ring clockwise to secure the connector in the socket.



0401001

Lift the base of the front cover into the profile (2) in the traction converter.

Push the top of the cover towards the converter until the contact stud (3) is aligned with the earth resistance meter. Once aligned, push the top of the cover firmly to seat the contact (3) over the earthing tang.

Close interlocking (4) with appropriate key. Operation of the key interlocking system is described in the Preface of this Volume.

Close locks (1) using a square key.

Remove the cover from the converter control unit above the apparatus module and reconnect the cables to the converter control unit that are cable tied to the XK**A and XK**B cables, as described in Chapter 4.3, Traction Converter Control.

After-Installations Operations

@.1290

Traction Converter

Replace the traction converter oil cooling system and refill, as described in Chapter 4.2, Traction Converter Oil Cooling.

Adjustments

@.1310

Check and adjust if necessary the traction converter cooling oil levels, as described in Chapter 4.2, Traction Converter Oil Cooling.

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6

4.2 Traction Converter Oil Cooling

General Notes on Hazards in the Work Area

@.1040

WARNING:

The oil in the traction converter cooling system can operate at high temperatures. Ensure the cooling system has cooled to ambient conditions prior to undertaking any operations on the oil cooling system.

Group Summary

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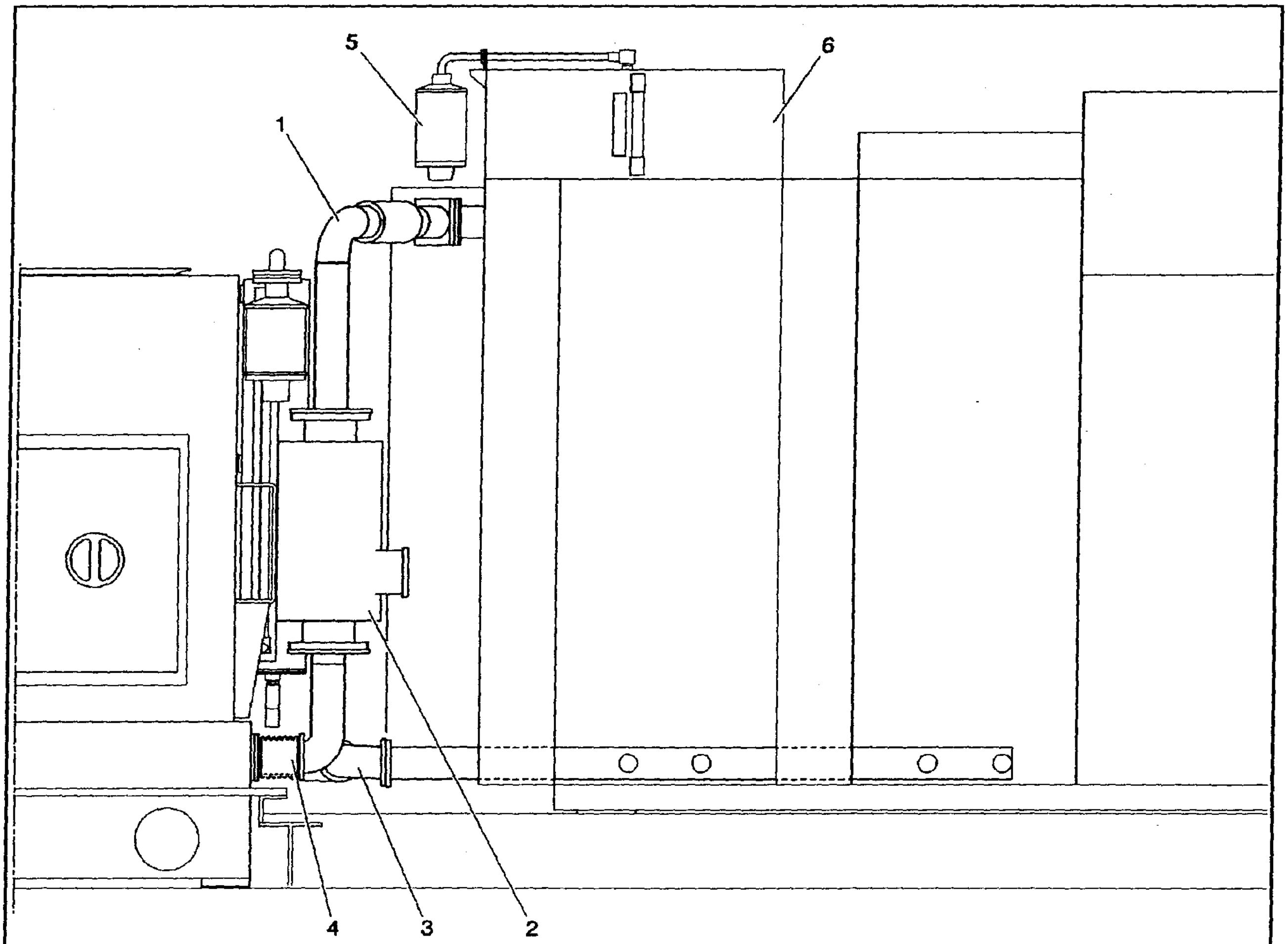
This chapter contains information regarding the traction converter oil cooling system, which consists of; oil pumps, oil piping, expansion tank and oil system breather.



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1	Tube K	4	Tube L
2	Traction converter oil pump	5	Silica gel breather
3	Tube M	6	Expansion tank with oil gauge

Functional Description

@.1140

The traction converter oil cooling system circulates cooling oil through the traction converter and the oil blower radiator. Heat generated in the traction converter valve sets is absorbed into the cooling oil. This heat is then removed from the cooling oil in the oil blower.

The cooling oil is pumped through the oil cooling system by the traction converter oil pump, which is bolted to the oil blower assembly. Oil piping ducts the oil from the pump to the oil blower, from the oil blower to the converter and the from the converter back to the pump. Oil pipes have flexible compensators to allow for movement and expansion between the traction converter and oil blower units.

Self-sealing connectors on the valve sets permit the removal of individual valve sets without disrupting the sealing of the oil cooling circuit. However, proper venting of the valve set must be performed when necessary to ensure only a minimum amount of air is present in the oil cooling system.

For further information regarding the traction converter, refer to Chapter 4.1, Traction Converter.

For further information regarding the oil blower and radiator, refer to Chapter 5.5, Oil Blowers.

Technical Data

@.1160

Oil Cooling System

- Cooling oil type	Shell Diala DX
- Cooling system oil volume	375 litres
- Nominal oil flow rate	916 l/min.
- Maximum allowable oil temperature	65 °C
- Minimum allowable oil temperature	0 °C
- Oil system pressure drop	2.7 bar

Oil Pump

- Model	Plummet TC 10-2183/29
- Power	16.8 kW @ 60 °C
- Motor	3 phase, 2 pole, 415 V

Tolerances and Wear Limits List

@.1170

Oil Specifications

The cooling oil must meet the specifications given in Document 3EHN 600 386, Taking & Testing of Mineral Oil Samples of Chapter 5, Operating Instructions of Volume F4, Suppliers Documentation.

- Recommended oil	Shell Diala DX
- Breakdown voltage	30 kV
- Water content	50 ppm
- Dielectric loss factor, tan δ at 90 °C	1.0
- Neutralisation number (acid number)	0.5 mg KOH/g

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;

- Clean containers are required for the taking of oil samples. Document 3EHN 600 386, Taking & Testing of Mineral Oil Samples of Chapter 5, Operating Instructions of Volume F4, Suppliers Documentation provides further information on taking of oil samples.
- Bypass pipes for removing the valve sets from the oil circuit.
- Clean receptacles for draining and storing 375 litres of oil.

Miscellaneous Materials

@.1200

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

- Molycote for sealing o-rings.
- Cleaning rags and oil binding agents for oil related activities.
- Shell Diala DX Mineral Oil is required to refill the oil cooling circuit.

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 "Oil Pump, Converter" circuit breaker (63.1) to the Off position. Circuit breaker 63.1/1 for the No. 1 End is situated auxiliary circuits cubicle-1 (HB1) and circuit breaker 63.1/2 for the No. 2 End is situated in auxiliary circuits cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Earth the traction converter as described in Chapter 4.1, Traction Converter. Operation of the key interlocking system is described in the Preface of this Volume.

Draining oil

CAUTION:

The handling of the converter oil must be accompanied by utmost cleanliness. Solid impurities may result in short circuits in the valve sets. Use clean vessels.

NOTE:

Before removing any parts of the converter oil cooling circuit, the oil of the oil cooling circuit has to be drained at the draining valves.

The traction converter cooling oil must not be hot when draining. Ensure that the cooling oil is at ambient temperature.

The oil should be drained prior to; removing the traction converter from the locomotive, removing the traction converter oil pump or piping, or when removing the oil cooling radiator from the locomotive.

If necessary, oil samples should be taken during the oil draining procedure. Further information regarding taking oil samples is given in Document 3EHN 600 386, Taking & Testing of Mineral Oil Samples of Chapter 5, Operating Instructions of Volume F4, Suppliers Documentation.

Oil from the traction converter cooling system should be drained into a suitably sized, clean container that is evacuated prior to filling with oil. Once the oil has been drained, appropriate tests may be performed on the oil. Some reconditioning of the oil may be required prior to the oil re-entering service.

To drain the oil, all valve sets must be disconnected from the oil circuit, and by-pass pipes placed between the oil pipe connectors to re-establish the cooling circuit.

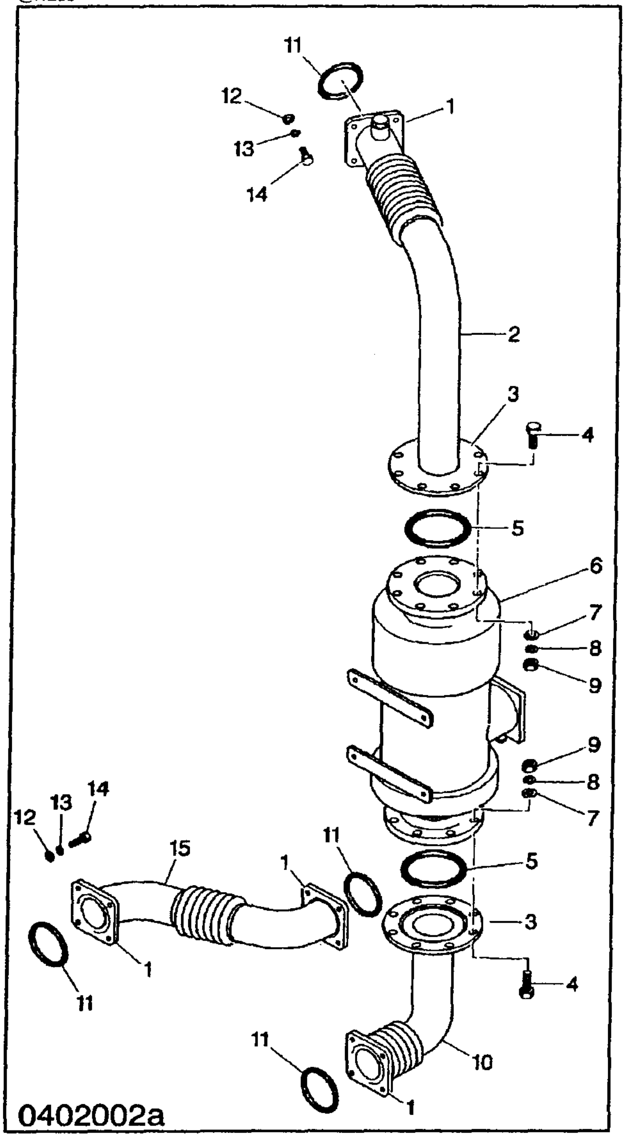
The drain valve, located inside the machine room, can then be opened. The oil drains to the outside of the locomotive through the drain pipe that passes through the machine room floor. The valve located at the end of this drain pipe can then be opened. The oil will now empty from the traction converter cooling system.

Once the expansion tank is empty, the venting screw can be opened to speed up the draining process.

Once the oil has been completely drained, all venting and bleed screws and both valves on the drain pipe must be closed to prohibit the entry of moisture to the system.

Removal

@.1230



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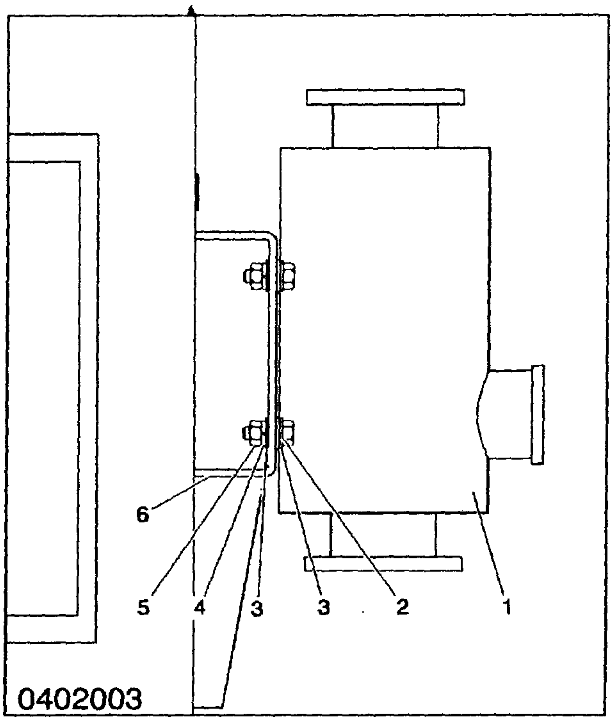
Loosen the bolts (4, 14) at the flanges (1, 3) of the tubes (2, 10, 15). Remove the bolts (4, 14), spring washers (8, 13), washers (7, 12), o-rings (5, 11), nuts (9) and tubes (2, 10, 15).



Remove the terminal box cover plate, then tag and disconnect the wires to the oil pump.

Attach suitable lifting equipment to the oil pump (1), then loosen the bolts (2) on the bracket (6). Raise the lifting equipment slightly to take the weight of the pump.

Remove the bolts (2), spring washers (4), washers (3) and nuts (5), then remove the oil pump (1) from the bracket (6) using the lifting equipment.

Disassembly

@.1240

Oil pump

For further information regarding the oil pumps, refer to Chapter 2, Traction Converter Oil Cooling of Volume F5, Suppliers Documentation.

Inspection and Repair

@.1250

Oil Circuit

For further information regarding the oil pumps, refer to Chapter 2, Traction Converter Oil Cooling of Volume F5, Suppliers Documentation.

Check the condition of the flanges and o-rings. Replace if worn, cracked or damaged.

Inspect the pipe expansion joints for damage or cracking. Replace any pipe with damaged or cracked expansion joints.

Check the expansion tank for damage, cracking or corrosion. Rectify any faults found or replace the expansion tank as necessary.

Inspect the condition of the oil pump. Replace the pump if worn or damaged.

WARNING:

Do not pressurise the oil cooling system when testing for leakages. Check for leaks at normal operating pressure.

Check the oil cooling system for leakages. Rectify any leakages found.

Colour of Silica gel Filling

The water absorption capacity of Silica gel is limited. Dry Silica gel is blue whereas humid Silica gel is pink.

If more than half of the Silica gel in the dehumidifier is pink, it has to be replaced by either treated or new gel.

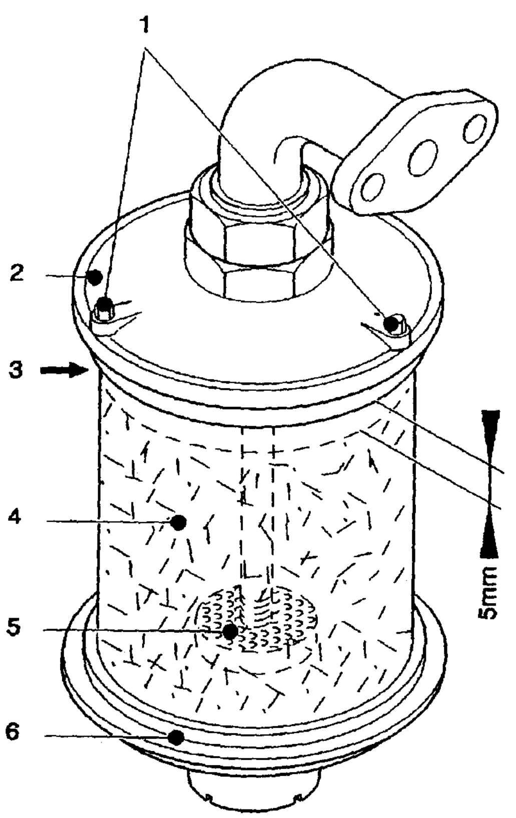
In this case, the seals and the filter of the dehydrator have to be checked and, if necessary, cleaned or replaced.

Treating or Replacing the Silica gel

Humid Silica gel can be treated several times by heating it to between 150 °C and 180 °C in a suitable baking oven.

In doing so, the Silica gel turns evenly blue again. If, however, the colour of the Silica gel is not a clear blue and shows a brownish discolouration, it must be replaced.

Silica gel Replacement



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Remove breather bottom part (6) by loosening the three bolts (1) on the cover (2).

Turn the bottom part of the breather (6) upside down and drain silica gel through openings in top part.

Inspect the filter plate (5) through the glass cylinder (4). The filter openings must be largely clear and not clogged by grains of silica gel. If the grains cannot be removed by light tapping, blow out the filter or clean with a bristle brush.

Fill the cylinder with regenerated or new silica gel through the opening in top part until approximately 5 mm below the cover flange.

Check the gasket (3) for damage; if necessary, use a new gasket and install the breather bottom part (6) on the cover (2) with the cover bolts.

Waste Disposal

@.1260

Cooling oil must be disposed of in accordance with prevailing environmental regulations.

Silica gel is non-poisonous (silica) and can be disposed of as normal refuse.

Assembly

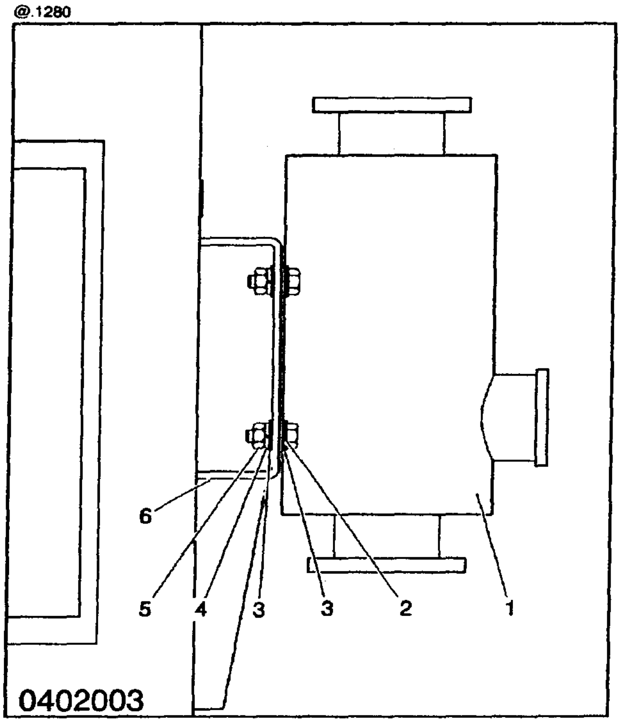
@.1270

Oil Pump

For further information regarding the oil pumps, refer to Chapter 2, Traction Converter Oil Cooling of Volume F5, Suppliers Documentation.

Installation

@.1280

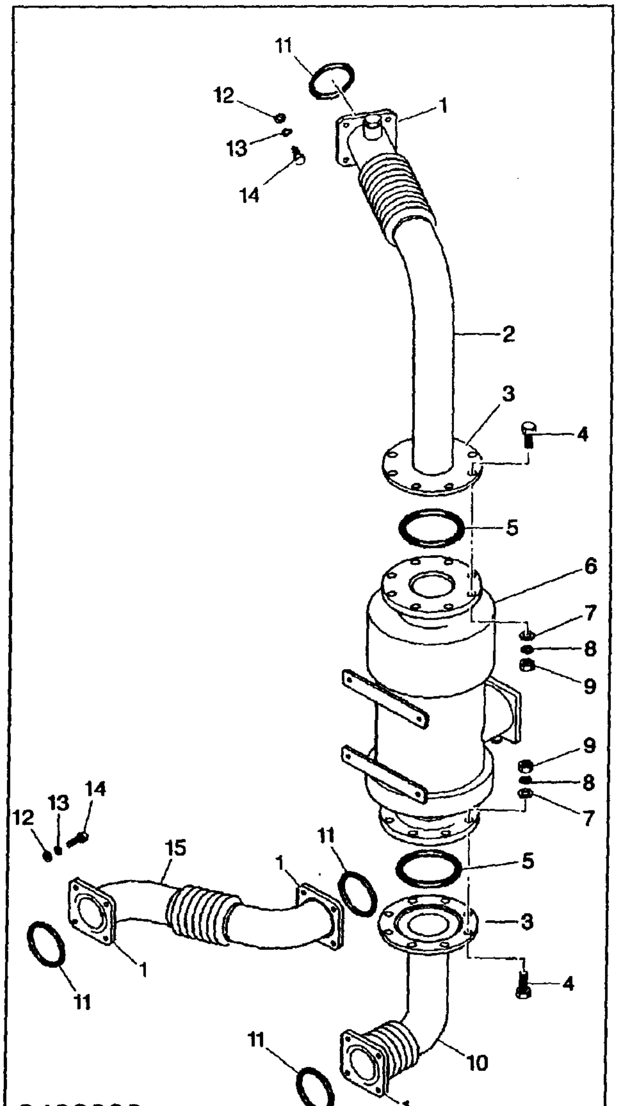


Lift the oil pump (1) onto bracket (6) using suitable lifting equipment. Align the holes in the oil pump (1) with the holes in the bracket (6).

Fasten the pump (1) with bolts (2), washers (3), spring washers (4) and nuts (5).

Reconnect the wires to the pump as tagged during removal.

Reinstall the terminal box cover plate.



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Apply a film of Molycote to the o-rings (5,11). Place the o-rings (5,11) into the groove of the tubes (2,10,15).

Align the holes in the flanges (1,3) of the tubes (2,10,15) with the holes in the connecting flanges and fasten the tubes with bolts (4,14), spring washers (8,13), washers (7,12) and nuts (9).

Refer to Section Aux. Circuits 3-Phase, Sheet 02I, Oil Pumps and Compressor of Volume G1, Cabling Documentation for traction converter oil pump electrical connections.

After-Installations Operations

@.1290

Filling the Cooling System with Oil

The traction converter oil cooling system must be refilled before the traction converter is put into operation.

The procedure for filling the traction converter is dependant of the current state of the cooling system and the valve sets.

Once the oil circuit has been filled and vented the by-pass pipes can be removed and the full valve sets can be connected to the oil circuit and the oil circuit vented again.

The oil cooling system is to be filled and vented according to document 3EHN 610 179, Filling and Draining Procedures for Oil Filled H4 Converter in Chapter 5, Operating Instructions of Volume F4, Suppliers Documentation.

Oil Pump

WARNING:

Ensure the oil cooling system, the pump and the traction converter are filled with oil prior to operating the pumps. Running the pumps when the cooling system is empty can damage the pumps.

Check the direction of rotation of the pump, as described in Chapter 2, Traction Converter Oil Cooling of Volume F5, Suppliers Documentation. Ensure the oil pump is connected correctly prior to activating the oil cooling system.

Refer to Section Aux. Circuits 3-Phase, Sheet 02I, Oil Pumps and Compressor of Volume G1, Cabling Documentation for traction converter oil pump electrical connections.

Adjustments

@.1310

Converter Expansion Tank Oil Level

The oil level should lie within the marks on the oil level gauge.

The oil level of relatively new vehicles may drop considerably for some time after commissioning. This is due to the expulsion of residual air pockets.

In such cases, perform the following checks dealing with the tightness of:

- Pipe couplings at the front of the valve sets
- Steel flexi-pipes or rubber pipes
- Flexi-pipe connection to the oil manifold pipes (behind the valve sets at the top and bottom of the cubicle) can be seen from the front using a torch
- Main oil pipes and their flanges
- Valve set cover; for these checks the valve sets have to be withdrawn from the valve set recess (refer to Section Removal)
- Welded seams on valve set tanks

Slight oil films, recognisable by dust adhering to the surface, are acceptable if there is no dripping leak. Replace any components as required to rectify any leakage found.

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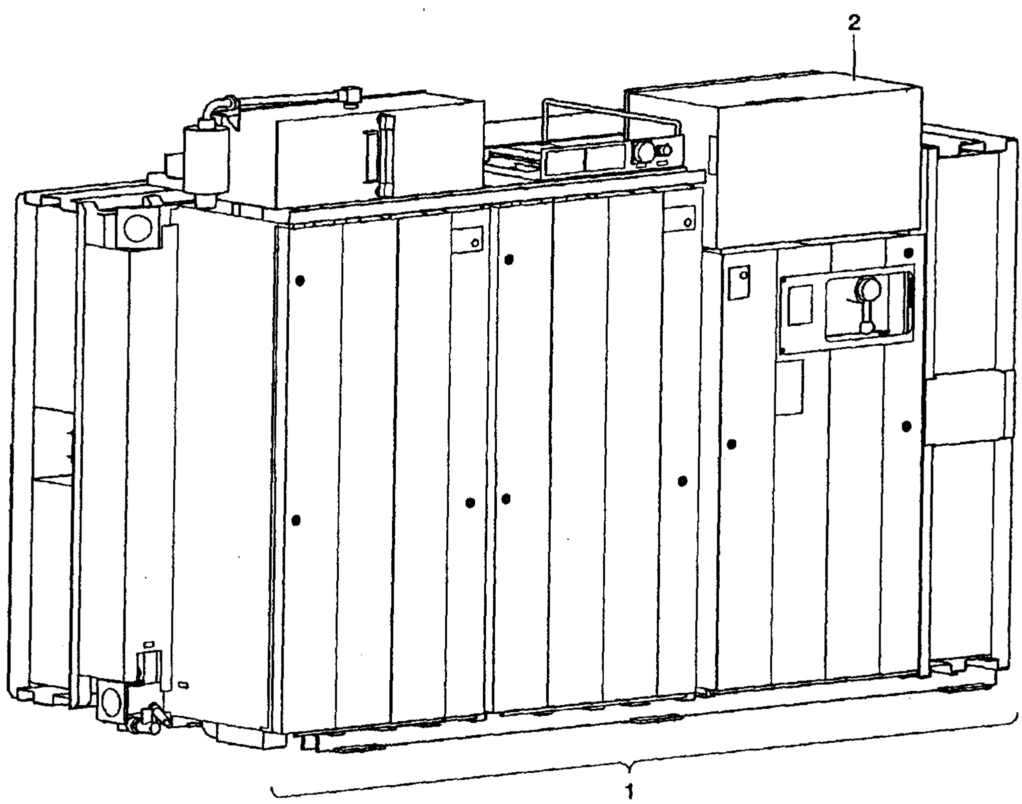
6

4.3 Traction Converter Control

Group Summary

@.1120

This chapter contains information regarding the Central Electronics MICAS traction converter control units located above the apparatus cubicle of the traction converter. The Electrical Equipment Apparatus Item Number for traction converter control units is 415.



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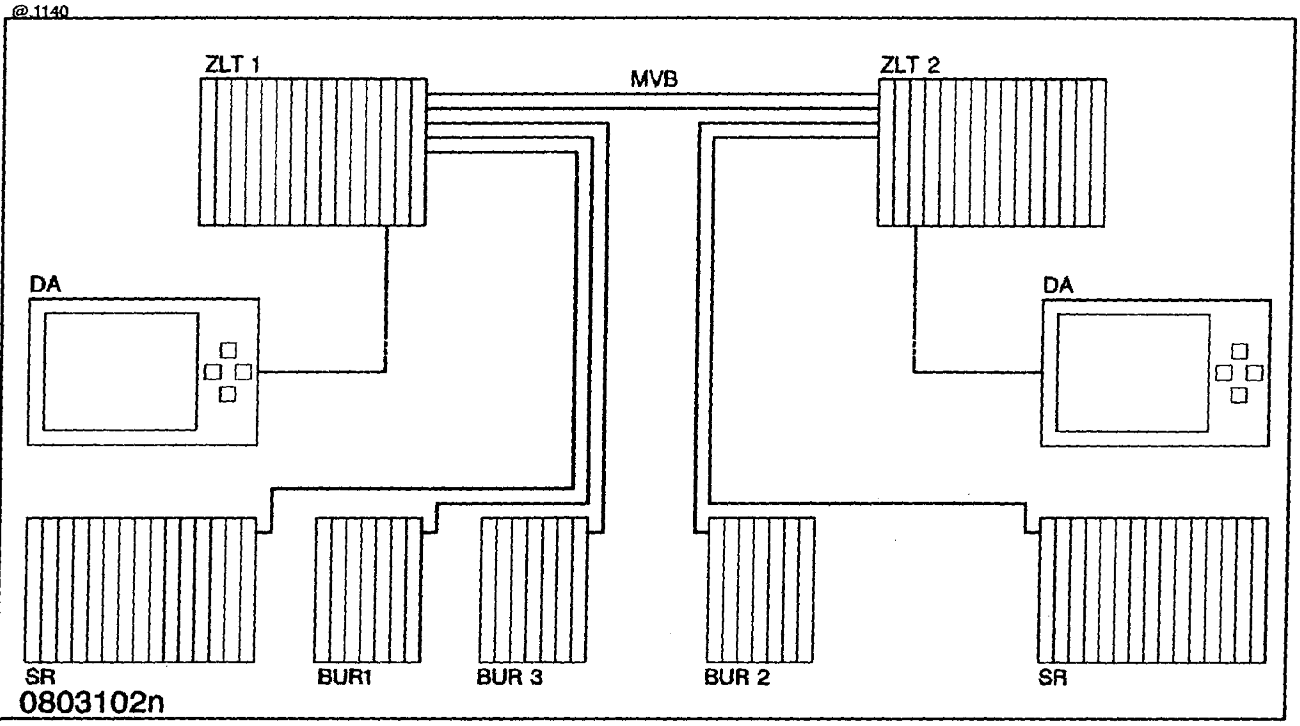
1	Traction converter
2	Converter control unit

Functional Description



The traction converter (SR) control units are connected to the multifunctional vehicle bus (MVB) and form a part of the MICAS S2 vehicle control system. Other components in the MICAS S2 system include the vehicle control (ZLT) units, the auxiliary converter (BUR) control units and the diagnostic display (DA).

Гhe 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.

formation 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 ade if required.

e traction converter (SR) control unit provides the operating instructions for the gate units, ich control the operation of the GTO thyristors in the valve sets. Feedback from the gate ts to the traction converter control unit is used to monitor the operation of the traction conter valve sets.

rder to keep the control unit cool, air is ducted up from the machine room floor and blown ugh the unit. The air is then vented into the machine room.

For further information regarding the traction converter, refer to Chapter 4.1, Traction Converter.

For further information regarding the function of the converter control unit, refer to Chapter 2, Functional Description ALG MICAS-S2 H114 of Volume F6, Suppliers Documentation.

Trouble shooting for the traction converter control unit is described in Chapter 11, Repairing Instruction Bus Station of Volume F6, Suppliers Documentation.

Technical Data

@.1160

Weight

- Empty rack	20 kg
- Rack complete with components	31 kg

Power Consumption

- Maximum power consumption	193 W
- Typical power consumption	126 W

Permissible Conditions

- Minimum temperature	-25 °C
- Maximum temperature	65 °C
- Recommended temperature	30 to 45 °C
- Mean relative humidity	< 75 %

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.

Fault finding and servicing of the control unit requires additional tools and instruments. These are given in Volume F6, Suppliers Documentation.

Miscellaneous Materials

@.1200

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

Before-Removal Operations

@.1220

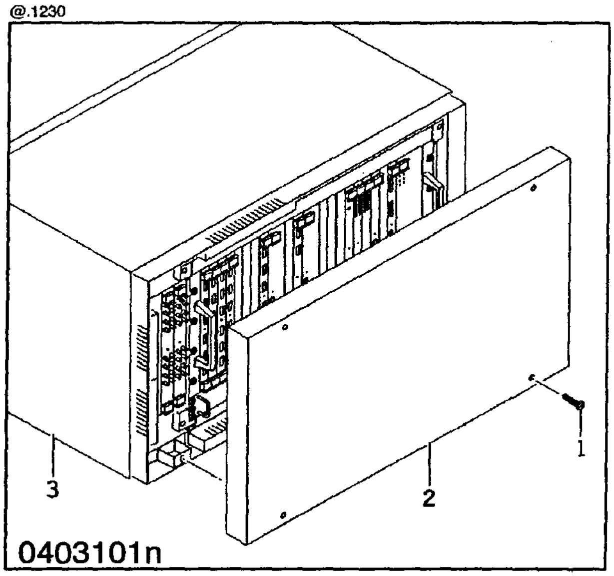
Using the key interlocking system, earth the traction converter, as described in Chapter 4.1, Traction Converter.

If necessary, remove the converter roof hatch as described in Chapter 1.1, Structure.

Remove traction converter from the locomotive if required, otherwise remove the converter control unit from the traction converter as described in Section Removal.

Removal

@.1230



Loosen and remove the screws (1) securing the cover (2) to the control unit rack (3), then remove the cover (2).

Remove the cover plates from the cable flanges, then tag and disconnect the wires and fibre optic connections from the modules in the converter control rack.

Remove the bolts securing the converter control rack to the apparatus module.

Attach suitable lifting equipment to the lifting eyes on converter control unit, then raise the lifting equipment slightly to support the weight.

Ensure no mechanical or electrical connections remain fastened and that nothing will foul or entangle when the unit is removed, then lift the unit off the apparatus module.

Follow manufacturers instructions regarding the transport and storage of the unit, as described in Chapter 7, Transport, Storage, Installation/Removal of Volume F6, Traction Converter Control.

Disassembly

@.1240

For further information regarding the traction converter control unit, refer to Chapters 1 to 17, Control Electronics Traction Converter Control Unit of Volume F6, Suppliers Documentation.

Inspection and Repair

@.1250

For further information regarding the traction converter control unit, refer to Chapters 1 to 17, Control Electronics Traction Converter Control Unit of Volume F6, Suppliers Documentation.

Waste Disposal

ɘ.1260

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

Assembly

ɘ.1270

For further information regarding the traction converter control unit, refer to Chapters 1 to 17, Control Electronics Traction Converter Control Unit of Volume F6, Suppliers Documentation.

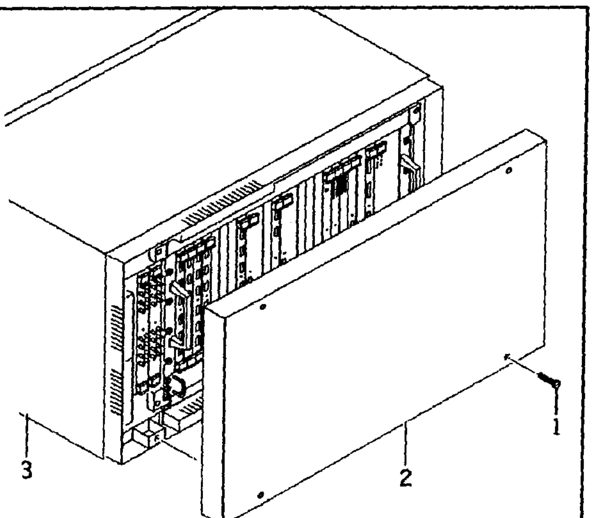
Installation

.1280

Using suitable lifting equipment, lower the traction converter control unit onto the apparatus module.

Install and tighten the bolts, securing the unit to the apparatus module.

Secure all cables in the appropriate cable flanges, then reconnect the fibre optic and cable connections as tagged during removal. Reinstall the cable flange cover plates.



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Install the cover (2) on the converter control unit (3), then secure cover (2) in place with screws (1).

After-Installation Operations

@.1290

If necessary, reinstall the traction converter into the locomotive, as described in Chapter 4.1, Traction Converter.

If necessary, reinstall the converter roof hatch, as described in Chapter 1.1, Structure.

Test the operation of the traction converter control. Rectify any faults found.

Adjustments

@.1310

There are no adjustments applicable to the traction converter control unit.

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4.4 Traction Motor

(9)

General Precaution

These chapter contains all the necessary information and instructions which are required for the commissioning, operation and maintenance (servicing and overhaul) of the ABB traction motor.

The careful and complete carrying out of the specified maintenance instructions is of decisive importance for the operative reliability of the traction motors.

If the replacement of operating materials or parts is required, we advise the use of the brands and suppliers, respectively, which we recommend, as well as original ABB spare parts.

In the case of damage to the traction motors, we recommend having the clarification of extent of damage and the repair carried out at the ABB production works.

If there are any inclarities during the maintenance, in operation or in the case of a malfunction, please inform the relevant ABB Sales Department. In these cases the following details are useful:

- Number of the locomotive concerned
- Km–reading of the locomotive or of the bogie in which the motor was or is installed
- The number of the bogie and of the axle concerned
- The motor number corresponding to the ABB rating plate (HT 150'...)

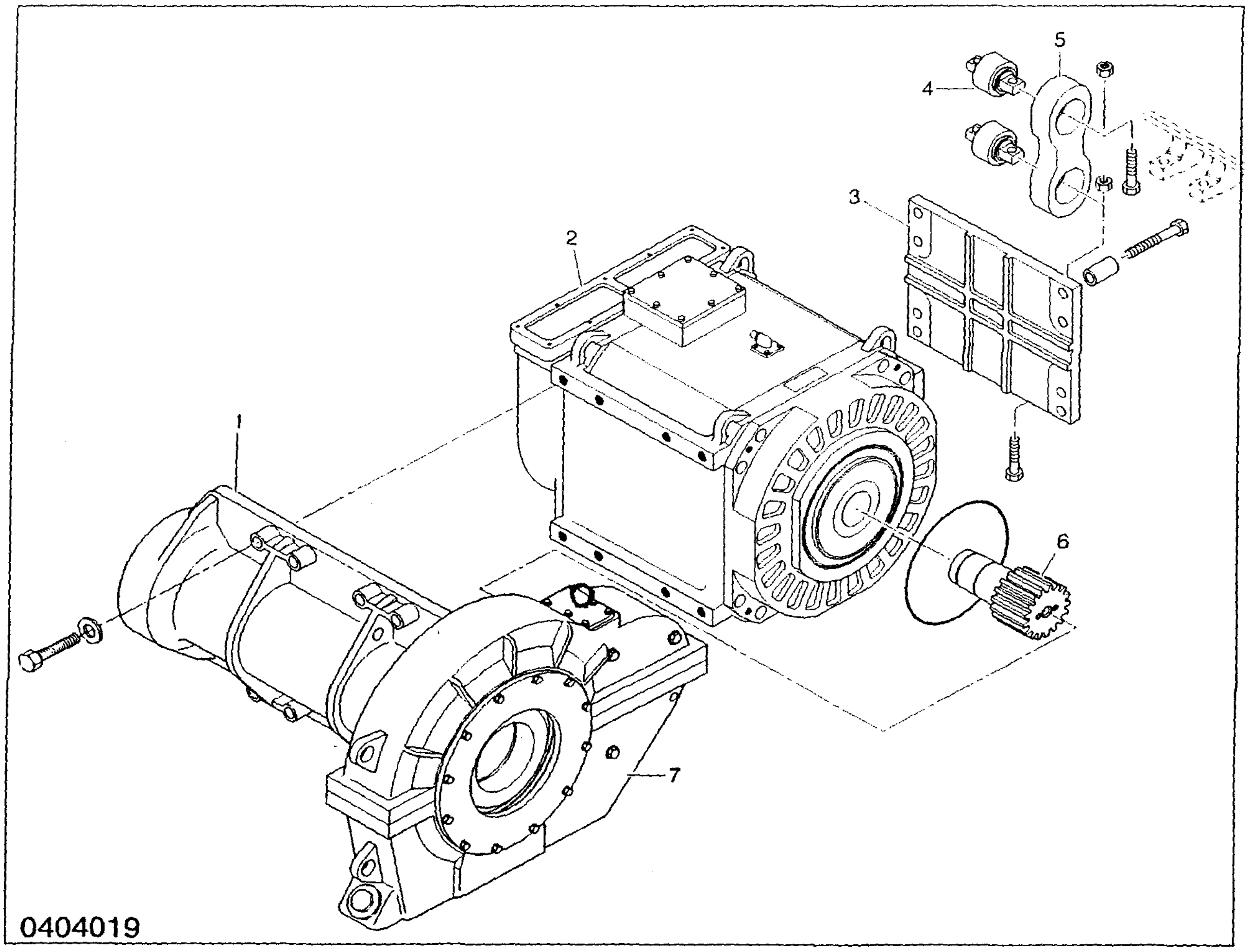
The motor number can be seen from the rating plate of the motor. If the rating plate is missing or illegible, the production numbers imprinted on the stator and on the end plates are to be stated.

We expressly refuse to accept responsibility for damage which is due to impermissible operating conditions or missing or faulty safety devices.

Overview

⊕.1120

This group contains information on the traction motor and the gear case.



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1	Suspension tube	5	Torque arm
2	*Air inlet/outlet*	6	*Pinion*
3	Mounting plate	7	Gear case
4	Spheriblocs		

Functional Description

⊕.1140

General

The ABB traction motor type 6FRA 6068 is a 6–poles squirrel–cage rotor asynchronous motor which was specially developed for operation with a three–phase converter.

The traction motor is forced–air cooled and intended for transverse installation in a 3–motor bogie. The power transmission is effected via a spur–wheel gear.

The traction motor type 6FRA 6068 belongs to a construction series of 6–poles asynchronous traction motors of the construction size 60 which are specially designed for use in standard–gauge rail locomotives and similar traction vehicles (speed trains, power cars).

Structure and function

The active part of the stator is laminated. The stator stack is held on both sides by wrap–around rings which are firmly welded together by traction rails. To protect the stator winding from thermal overload, temperature probes are installed in the stator stack.

The openings for air inlet and outlet are integrated in the end plates. The plug–in cartridge for the rotary speed transmitter is on the non–drive end (nDE) endplate.

The stator winding is insulated with the ABB class "C" insulating system "Veridur". In the case of this insulating system the stator is impregnated under vacuum conditions with a solvent–free silicon resin of the class "C".

Although the rotor plate is laminated directly onto the shaft, a faulty shaft can be exchanged for a new shaft without any other parts, for instance the squirrel–cage rotor, having to be renewed.

The non–drive end (nDE) roller bearing is at the same time a guide bearing. The non–drive end (nDE) bearing and the drive end (DE) bearing are lubricated with grease and provided with radial non–contacting seals which protect the bearings from the loss of grease and from the penetration of dirt.

Technical Data

@.1160

Traction Motor

– Type	6FRA 6068
– Kind of motor	6–poles/alternating current – asynchronous motor
– Characteristics	refer to "Details on the rating plate"
– Installation	Transverse installation
– Cooling	Forced–air cooling
– Overspeed ns	3250 1/min
– Test voltage $U_{prüf}$	8300 Volt
– Insulation class	Class "C" Veridur ® ABB–Insulation System
– Test	IEC 349
– Mass	2150 kg
– Rotary speed control	"Wiegand" transmitter system 120 pulses per rev.
– Power supply	Alternating current from ABB current–fed converter
– Axle drive	Denture clutch with spur gear
– Temperature recording	2 thermal resistance elements installed in a stator tooth

Output P (kW)

– continuous	850
– approach	850
– max.	850

Rotary speed n (1/min)

– continuous	1283
– approach	892
– max.	2680

Voltage U (V)

– continuous	2180
– approach	1660
– max.	2180

Current Intensity I (A)

– continuous	270
– approach	370
– max.	370

Frequency f (Hz)

– continuous	65
– approach	45.7
– max.	137

Torque Arm

– Eye Inside Diameter	**110.000 - 110.054 mm**

Spheribloc

– Outside Diameter	**110.144 - 110.198 mm**

Tolerances and Wear Limits List

●.1170

Spheribloc

– Axial Wear	Less than 0.6 mm

Tools and Special Tools

@.1180

Normal workshop equipment is required for the procedures in this Chapter.

NOTE:

Work with solvents should be carried out only in well ventilated rooms. In some cases special precautions may be necessary. In special cases it is advisable to perform cleaning in special installations with a closed circuit.

The safety rules to be respected in the various countries must be observed.

Cleaning fluids may not be discharged into the sewage system after use.

Miscellaneous Materials

@.1200

Cleaning agents

Principally only cleaning agents free from halogens may be used.

When cleaning silicone rubber coatings, the aromatic content of the solvent must not exceed 30%.

NOTE:

Solvents containing halogens can cause stress corrosion cracks in steels alloyed with Cr and/or Ni (e.g. shafts, draw–bolts, etc.) and are therefore not admissible.

Permissible solvents

- White spirit, free from halogens, not readily volatile, flammable.

Properties

– Density	0.76–0.8 g/cm^3
– Range of boiling points	140–200 °C
– Flash point as per Abel–Pensky	> 21 °C
– Aromatic content	20 ± 5% by volume
– Hazard class to DIN 51755	A II
– Toxicity class (CH)	4–5 depending on aromatic content

- Xylol CHR (chemically pure), free from halogens, moderately volatile, flammable

Properties

– Density	0.86–0.87 g/cm^3
– Range of boiling points	137–143 °C
– Flash point as per Abel–Pensky	20–25 °C
– Hazard class to DIN 51755	A I
– Toxicity class (CH)	4

Not recommended cleaning agents

- Trichlorethane 1.1.1

Trade names: Chlorothene, Genklene, Arthalon, Solvethane, Baltane, etc.

- Trichlorethylene, Perchlorethylene
- Safety solvents

Trade names: Pentex 77, SS 26, Turca–Solv, Dilnan, Disolver, Gamlen Solvent 26, Ommer El–Mot Cleaner, etc.

Electrical safety solvent, etc.

- Fluorinated solvents

Trade names: Frean TF (Du Pont), Flugene (Rhone–Poulenc)

For use by specialists only

All these solvents contain halide and some of them are toxic. Furthermore, for safety reasons, the use of highly volatile solvents is not admissible for cleaning motors.

Examples: Acetone, nitro thinners, volatile motor spirits

List of brands and manufacturers of detergents recommended for cleaning motors (W = washing, R = rinsing).

Manufacturer	Trade name	Proportions
Henkel & Co. AG CH–4133 Pratteln	W: P3–KF special R: P3–T225 W: P3–Saxin R: P3–VR–740–N–20	6.5 kg/m^3 water 7.5 kg/m^3 water 25 kg/m^3 water 5 kg/m^3 water
Fa. Cetema Ijsselstraat 41 NL–Oss Postbus 19	Cetenal 2904	10 kg/m^3 water

List of solvents and manufacturers of them which may be used for cleaning motors

Manufacturer	Trade name	Boiling point range °C	Flash point °C	Aromatic content % by vol.
Impag, CH–Zürich	Turpentine substitute	140–200	21	20 ± 5
Hauser, CH–Wädenswil	Turpentine substitute Air Ro 17–05	155–196	39	17
F. Steinfels AG, CH–Zürich	Crystal oil 30			
Shell				

Other admissible products

Shell	Aromat 45	155–200	39	45*
Esso	Varsol	155–185	38	18
BP	White spirit	150–200	40	35*
Mobil Oil	White spirit	157–196	41	18
Chevron	White spirit	162–196	35	35*
Valvoline	White spirit	160–200	40	25
Castrol	White spirit	155–187	38	18

Admissible lubricating greases for ABB Traction Motors

The following lubricating greases are admissible for the roller bearings in ABB traction motors. All grease qualities listed in table I are lubricating greases based upon lithium with mineral oil. All can be mixed together. *The grease listed in table II is based on a synthetical basic oil.* The lubricating greases below are not mixable.

Admissible lubricating greases based upon lithium

Quality/brand	Dripping temper. according to ISO 2176 °C	Worked penetration to DIN 51804 mm/10	NLGI [1] [2] [3]	Viscosity of basic oil $mm^2/_s$	Applicable for temper. °C	Notes
ESSO Beacon EP2	+185	280/287	2	198 (40 °C)	–30/+110	= Standard
SKF LGMT2 SKF LGEP2			2 2	92 195	–30/+110 –30/+110	
MOBIL-GREASE 22 Mobilux EP2	> +163 +186	265/295 265/295	2 2	150 (40 °C)	–50/+120 –20/+130	
OPTIMOL–Longtime PD2	> +180	265/295	2	95 (40 °C)	–35/+140	
EXXON Ronex MP (USA) EXXON Unirex EP2 (USA) EXXON Unirex N2 EXXON Lidok EP2	+260 +260 +288 +177	280 270 275 280	2 2 2 2	146 (40 °C) 178 (40 °C) 113 (40 °C) 150 (40 °C)	–40/+160 –30/+150 –40/+120 –34/+107	
BP Energrease LS–EP2	+195	265/295	2	190 (40 °C)	–25/+140	
Shell Calithia EPT2	+180	265/295	2	250 (40 °C)	–20/+130	[4]

Legend:

[1] NLGI–grade according to DIN 51818 (consistence grade)
2 (worked penetration 265–295) = soft

[2] NLGI = National Lubricating Grease Institute (USA)

[3] DIN = German (Deutsche) Industrie Standard (Norm)

[4] Substitute grease quality for Shell Alvania EP2

Admissible lubricating greases based upon a synthetic basic oil

Quality/brand	Dripping temper. according to ISO 2176 °C	Worked penetration to DIN 51804 mm/10	NLGI [1] [2] [3]	Viscosity of basic oil $mm^2/_s$	Applicable for temper. °C	Notes
Klüber	> 185	–	2	–	–60/+160	
Isoflex Topas L152	> 220	280/287	2	–	–50/+150	
Isoflex Topas NCA52						

Legend:

[1] NLGI–grade according to DIN 51818 (consistence grade)
2 (worked penetration 265–295) = soft

[2] NLGI = National Lubricating Grease Institute (USA)

[3] DIN = German (Deutsche) Industrie Standard (Norm)

Before–Removal Operations

@.1220

Apply the parking brakes and chock the wheels to prevent the locomotive moving.

Remove the bogie assembly from the locomotive as described in Chapter 2.00.

Position the bogie in a clean work area.

Position suitable safety stands below the bogie frame and traction motor.

Clean the traction motor bellows and the surrounding area before removing the traction motor.

WARNING:

DANGER OF HIGH VOLTAGE ELECTRIC SHOCK. To avoid personal injury, disconnect the train from the overhead power supply. Ensure the locomotive is earthed according to key interlocking system.

Removal

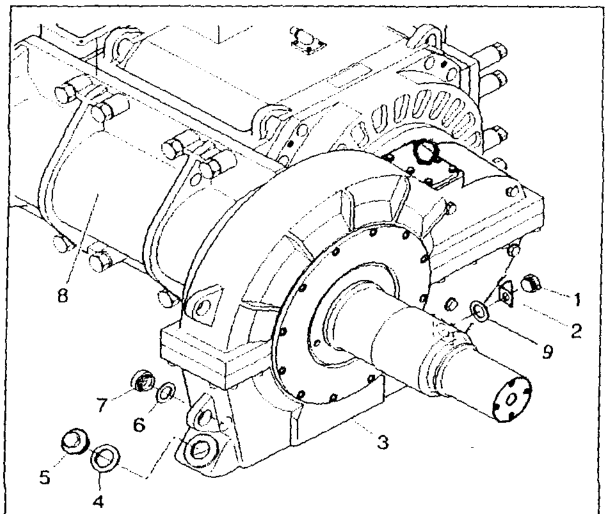
@.1230

Traction Motor

- Attach suitable lifting equipment to the eyes on the traction motor. Raise the equipment slightly to support the weight.
- Remove all electrical connections
- Tag the electrical cables to aid re–installation
- Remove the screws which fix the bellows to the traction motor

NOTE:

The two gear case halves are machined sets. Gear case halves should be kept together as sets. Matching numbers are stamped on the sides of the mating flanges for identification.



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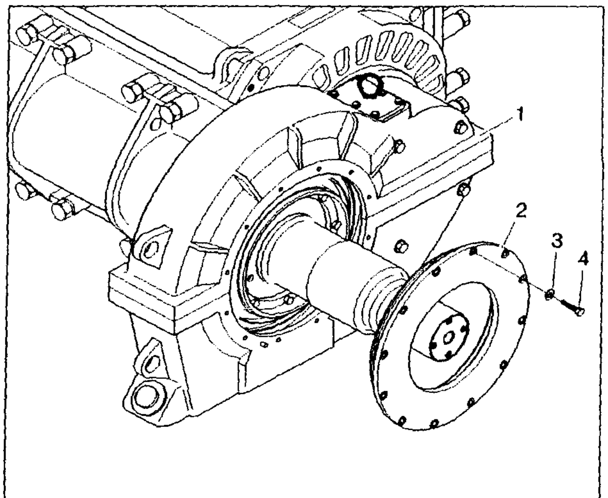
Thoroughly clean the suspension tube (8) and gear case.

Remove all traces of dirt, debris, grease and oil.

Place a receptacle with capacity for 5.2 litres below the gear case, then remove the drain plug (1), locking tab (2) and the gasket (9) from the lower gear case (3). Drain the lubricating oil into the receptacle.

If necessary, remove the filler plug (5) and gasket (4) from the gear case (3).



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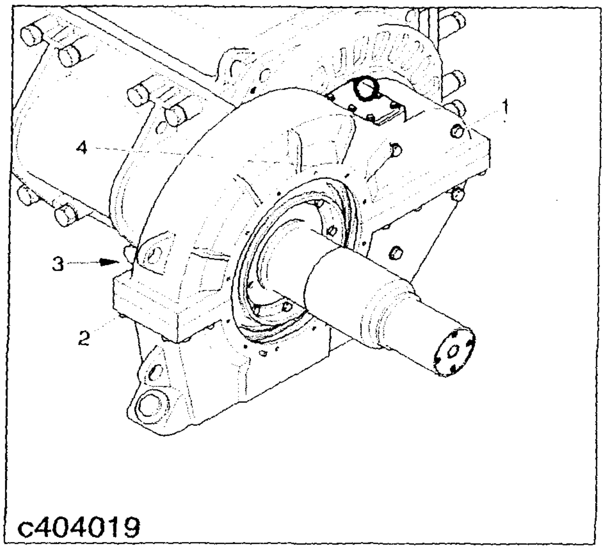
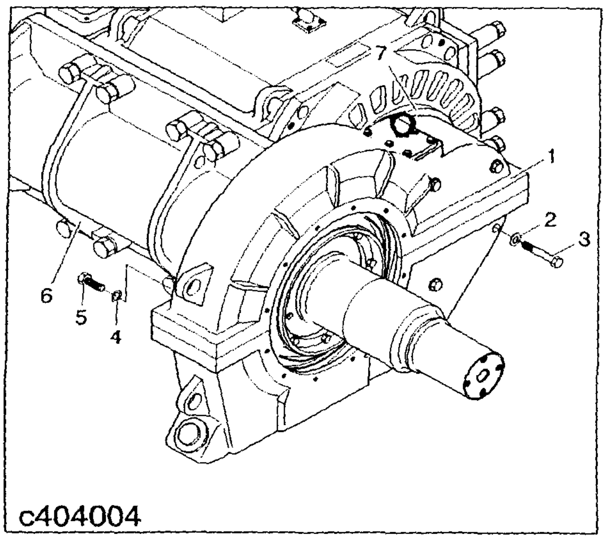
Remove the bolts (4) and washers (3) securing labyrinth ring (2) to the gear case (1). Separate the labyrinth ring (2) from the case (1), then move the ring (2) as far as possible towards the wheel.



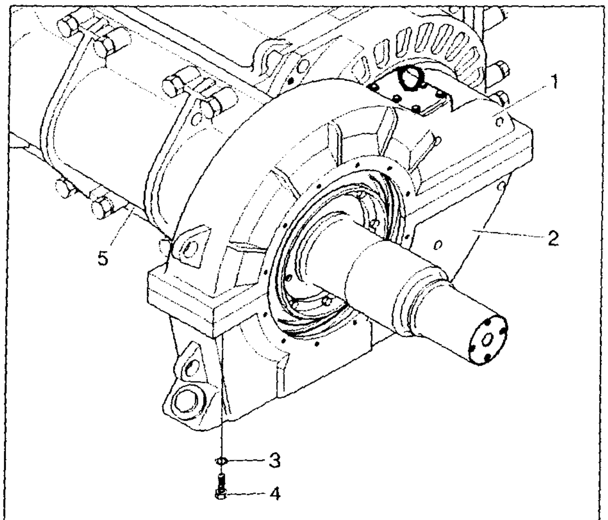
Loosen the gear case bolts in the following order: (1), (2), (4) and (3).

Remove the bolt (4) with washer from the back of the gear case.



Remove the bolts (3) and washers (2) securing the gear case (1) to the traction motor end shield (7).

Remove the bolts (5) and washers (4) securing the gear case (1) to the suspension tube (6).



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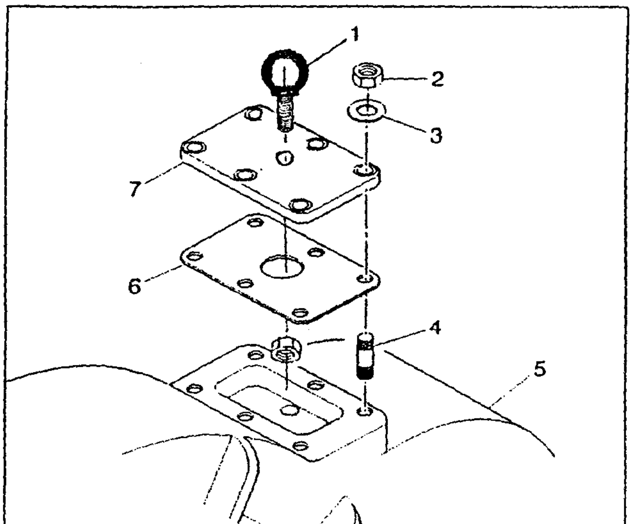
Remove the bolts (4) and washers (3) securing the two halves of the gear case (1 and 2).

Remove the two gear case halves from the suspension tube (5).

WARNING:

The gear case halves are heavy. Use suitable lifting equipment to manoeuvre the cases from the drive assembly.

Attach suitable lifting equipment to the upper gear case. The lower gear case should still be supported by stands or jacks. Separate the two halves of the gear case. Take care not to damage any adjacent components while manipulating the cases free of the drive assembly.



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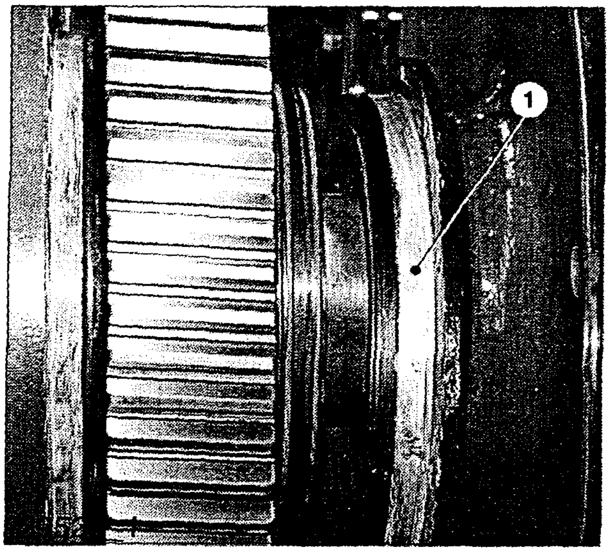
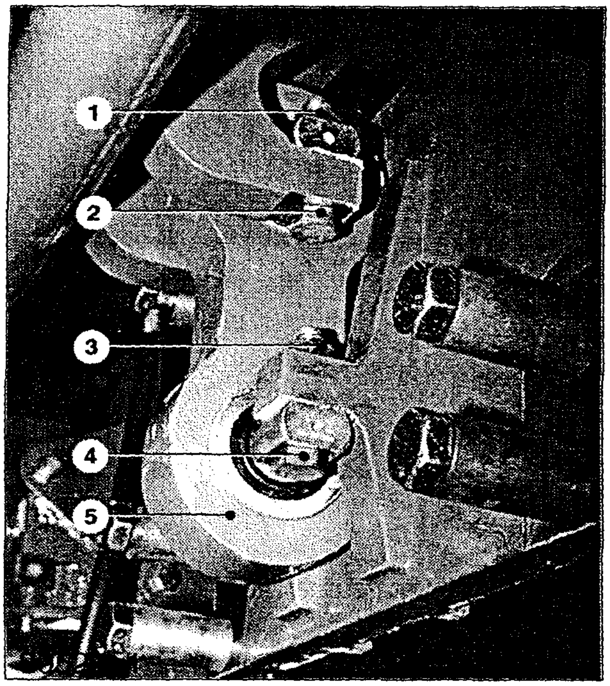
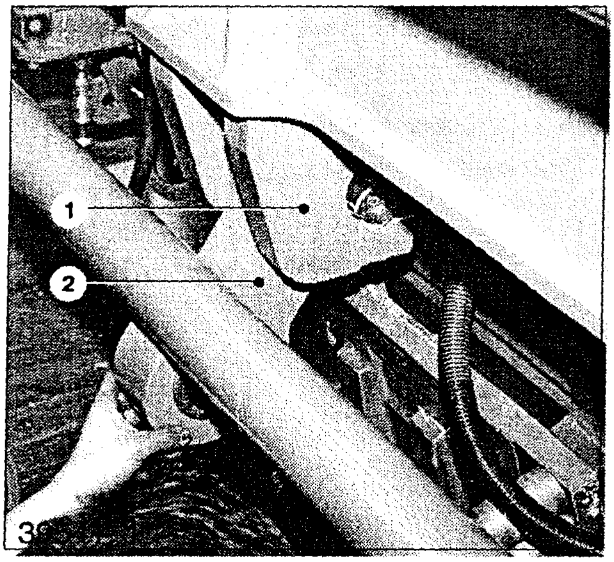


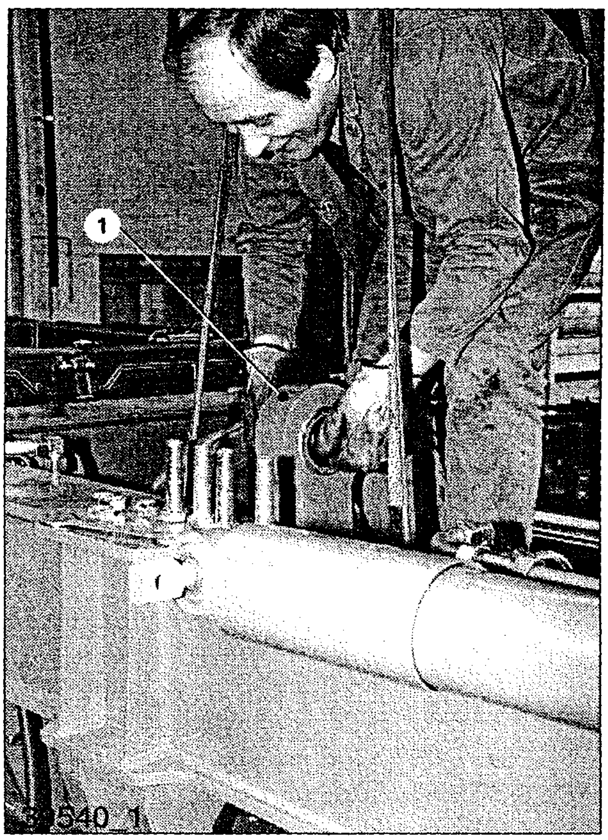
Remove the labyrinth ring (1) from the gear.



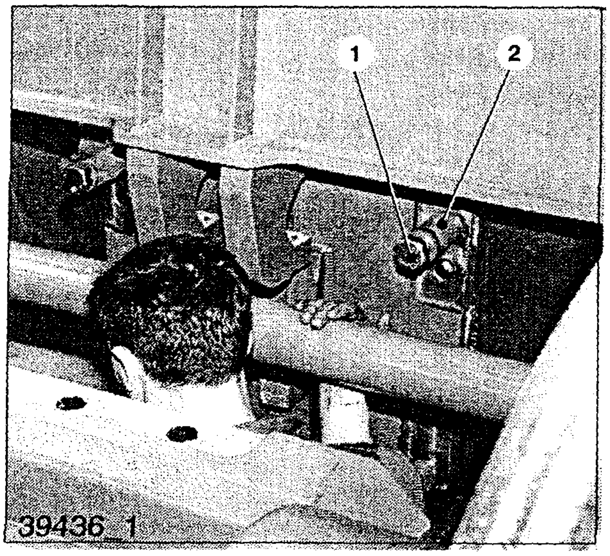
Loosen the nuts (1,3) and remove them together with the bolts (2,4) which fix the torque arm (5).



Raise slightly the traction motor until the torque arm (2) can swing in the support bracket (1).

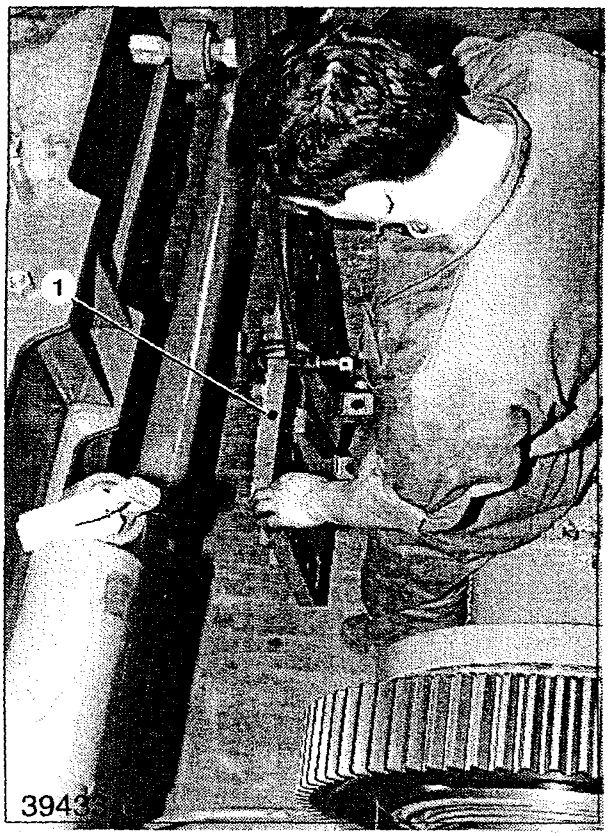


Remove the torque arm (1)

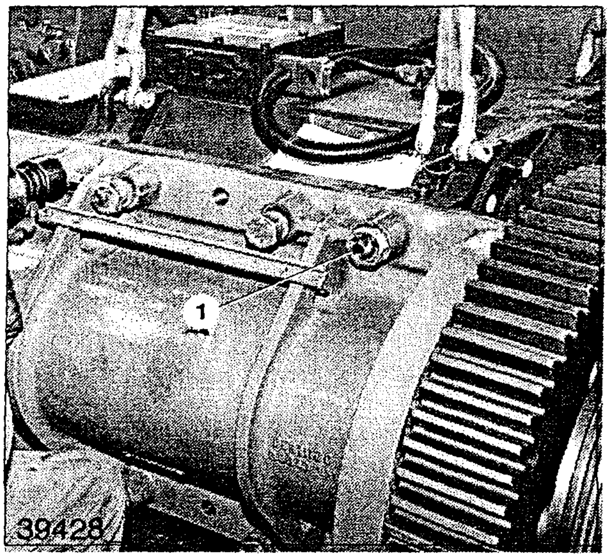


Attach a suitable lifting equipment to the mounting plate.

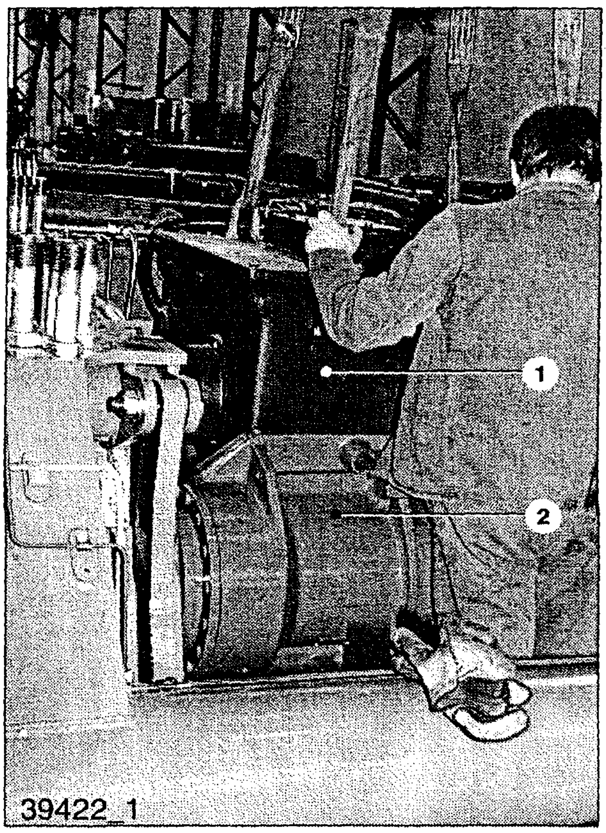
Loosen the bolts (1) and remove them together with the spacers (2).



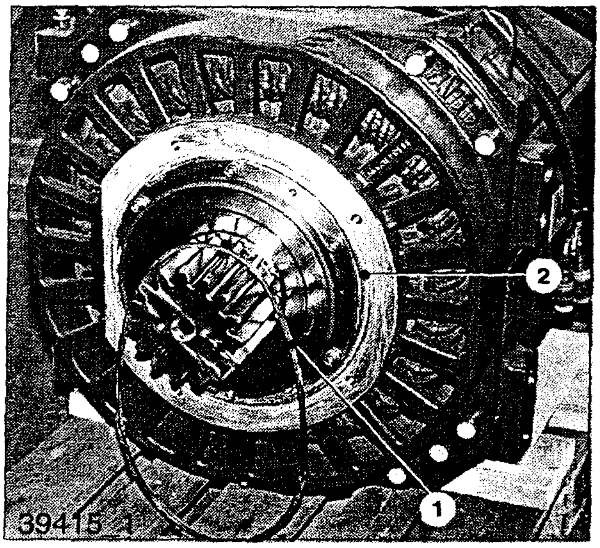
Raise and remove the mounting plate (1).



Loosen the bolts (1) on the suspension tube and remove them.



Turn slightly the suspension tube (2) and lift the traction motor (1) slightly.
Ensure that nothing is entangled, then lift the traction motor from the bogie frame and position on a suitable stand
Inspect the traction motor, torque arm, Spheriblocs as described in Section Inspection and Repair.

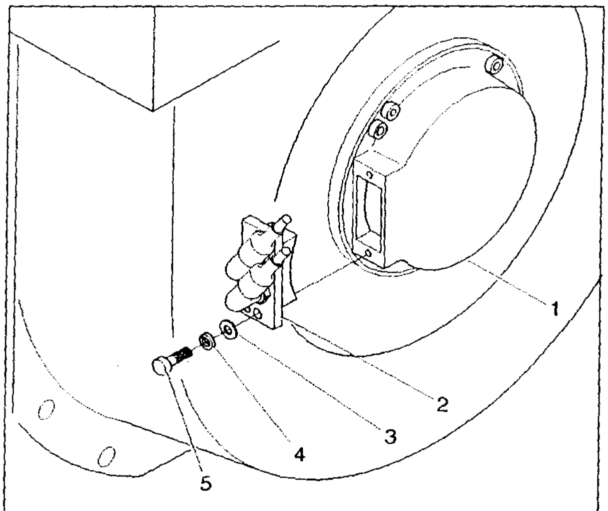


Remove the O–ring (1) from the groove (2).

Disassembly

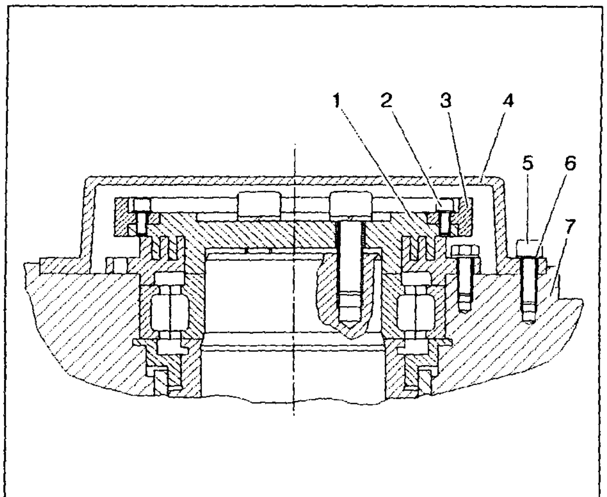
⊕.1240

Rotary speed transmitter cartridge



0404015

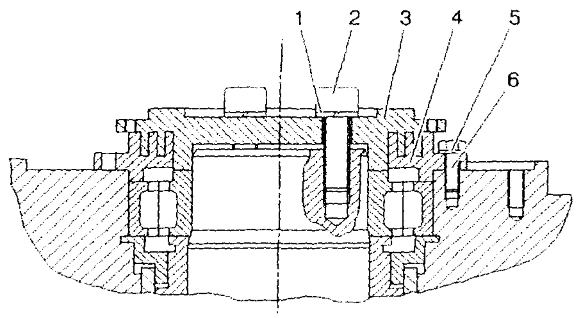
Remove screws (5), washers (3) and spring washers (4) securing the speed transmitter cartridge (2) to the bearing cover nDE (1). Remove the speed transmitter cartridge (2).



0404016

Remove screws (5) and spring washers (6) securing the bearing cover nDE (4) to the traction motor (7). Remove the bearing cover (4). Pay attention to the pulse transmitter ring (3).

Remove screws (2) securing the pulse transmitter ring (3) to the support (1). Remove the pulse transmitter ring (3).

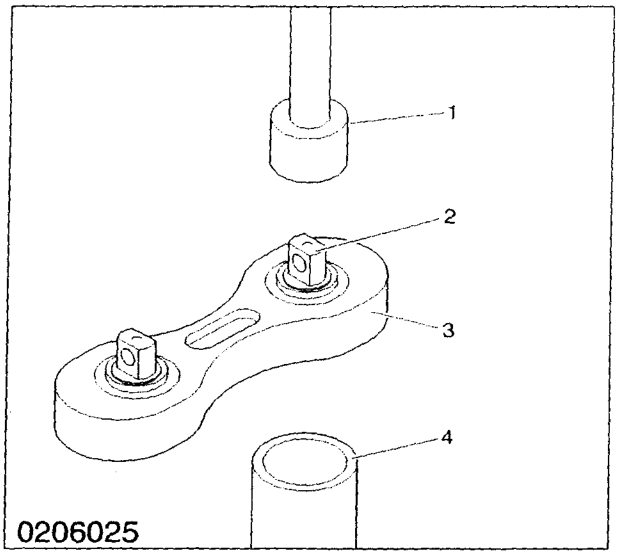


0404017

Remove the screws (2) and spring washers (1) securing the pulse transmitter ring support (3). Remove the pulse transmitter ring support (3).

Remove the screws (6) and spring washers (5) securing the thrust collar (4). Remove the thrust collar (4).

Spheribloc Removal



Mark the location of the Spheribloc (2) to aid in diagnosis during inspection.

Position the torque arm (3) in a suitable press (1,4).

Support the eye around the Spheribloc (2) using a suitable steel tube (4). Ensure the tube (4) will not interfere with the Spheribloc (2) during removal.

Position a suitable mandrel (1), slightly smaller than the outer diameter of the collar, over the Spheribloc (2). Check that the mandrel (1) is square with the yoke on the press and contacts around the entire perimeter of the Spheribloc collar.

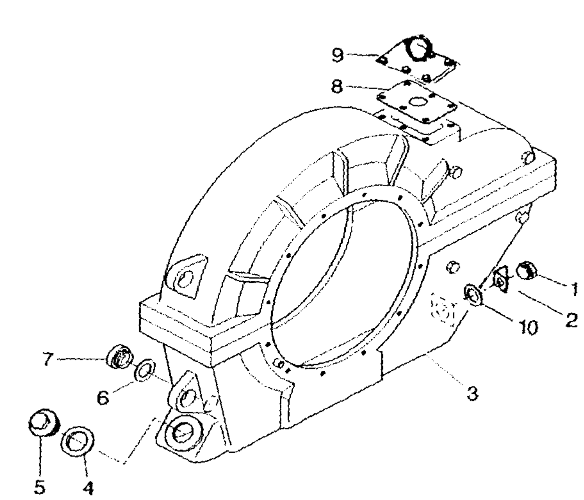
Press the Spheribloc (2) out.

Test and inspect the Spheriblocs (2) as described in Section Inspection and repair.

Inspection and Repair

@.1250

Gear case



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Remove all build-up of debris and foreign materials around the cover plate (9), sealing plate (8), filler plug (5) and oil gauge glass (7).

Check the condition of the drain plug (1) gasket (2), replace if damaged.

Check the condition of the filler plug (5), gasket (4), replace if damaged.

Check the condition of the oil gauge plug (7) and gasket (6), replace if damaged

Main gear

Check the condition of the threads in the main gear hub. Repair any damaged threads.

Greasing instruction for roller bearings

ABB traction motors equipped with cylindrical roller bearings or spherical roller bearings.

Quality of grease

The quality Esso Beacon EP2 is only to be applied.

IMPORTANT:

If by urgent reason another quality should be used, the choice of the quality has to be made in accordance with ABB Switzerland.

Quantity of grease applied filling the bearings

Roller bearing

- All voids have to be filled completely (voids between outer ring/rolls/cage).

Bearing covers and endshields

- The spaces have to be filled by 50%, filling in only the lower half–section of the space.

Labyrinth parts

- Only one of the corresponding labyrinth parts is to be filled (resp. the part having the grooves).

Proceeding for filling the bearings

Cleaning

Roller bearing

- So far as new bearings are applied, being packed in the original packing, it is not necessary to wash away the anti–corrosion film. It can be left. This is only possible in combination with the grease quality (Esso Beacon EP2).

NOTE:

For other qualities of grease, ABB Switzerland is to consult.

Bearing seat and bearing covers

- Clean it completely
- Grease–ducts in the endshields (so far as existent) are to be carefully cleaned.

Filling

Roller bearing

The filling is executed in a tool by means of a grease gun.

Take away the inner bearing ring. Put in a convenient filling plug. Put the bearing and filling plug in the tool and close it.

Press grease into the tool by means of the grease gun until it comes out of the check opening, free from bubbles. For spherical roller bearings the complete bearing is to be handled in an analog manner.

Spaces in the covers and endshields: by means of a spatula.

Labyrinth: by means of a spatula.

Grease–ducts in the endshields (so far as existing) are to be completely filled by grease gun.

Greasing in service

Motors without greasing ducts (normal condition)

No regreasing is needed and possible. The original filling lasts for the overhaul period (see "Operating Instruction Manual"). After that period, the bearing has to be cleaned and refilled, eventually replaced.

Motors with greasing ducts (for special heavy duty application)

To regrease, feed the lubricating nipple with the grease gun.

In special cases, i.e. axle bearings of canon boxes, a supplement part of grease has to be added at the first assembling.

It is done by the grease gun and the corresponding lubricating nipples.

Traction Motor

Inspect the condition of the traction motor.

Check the Spheribloc mounting eyes. Rectify any faults found.

Check the condition of the torque arm mounting flange. Rectify any faults found.

Dry cleaning

Used for motors which are dirty in an average amount, with little or no oil.

Before cleaning wet motors, they should be dried in an oven at 120 °C.

Procedures:

Blow through with dry compressed air (free from oil)

and/or clean with a vacuum cleaner

and/or clean with brushes

and/or clean with towels (which have to be frequently changed, etc.)

Take care when using a spatula or scraper directly on windings.

Washing with detergent followed by rinsing

Cleaning procedure

	Temp. (°C)	Pressure (bar) 1)	Time (min)
Pre–wash with water or containing detergent. Soften and remove coarse dirt	80–90	0.5–5	5
Main wash with water and detergent	80–90	0.5–5	5
Rinse with water alone or with water containing rust–inhibiting additives	80–90	0.5–5	5
Dry in an oven or in an autoclave	120 80	— vacuum approx. 1 mbar	24 h 3–6 h
Renewing of the covering varnishing (by spray)	room temp.		air–drying: min 12 h

1) Depending on the type of nozzle, adjust the pressure to an optimal value at which the insulation is not damaged.

Detergents recommended

The concentration of the detergent has to follow the instruction of the detergent–manufacturer.

Cleaning installations

Installations with a closed liquid circuit incur low costs, are hygienic to work with and comply with the requirements of environmental protection. Such installations are manufactured in numerous countries.

Addresses in Switzerland:

- Otto Dürr AG, CH–8401Winterthur (BOAG)
- Ammann Technik, CH–5742 Kölliken
- Lebag, CH–5430 Wettingen

Cleaning is effected by:

P3	–KF special	for washing
P3	–T 225	for rinsing

Cleaning with solvents

This can be used as supplement to dry cleaning when the dirt is very oily, or when the motor has to be repaired, unless the washing procedure described in is employed.

After cleaning, it is necessary to renew the covering varnish of the insulations, normally by spray and air drying.

Cleaning procedure

- Apply the cleaning agent with a brush or by spraying, etc.
- Allow to act for 5 to max. 10 min.
- Wipe off with a cloth or rinse with the cleaning agent for max. 5 min.
- Dry in the oven for 24 h at 120 °C or in an autoclave at 80 °C and approx. 1 mbar for 3–6 h.
- Renew the covering varnishing of the windings, normally with spraying air–drying varnish.
- Checking the insulation in Service and after Cleaning and Drying

The insulation resistance R_{ins} is measured by applying a DC voltage and taking a reading 1 min after application of the voltage.

Motors rated up to 1.5 kV:	Test voltage 1000–1250 V
Motors rated up to 3.0 kV:	Test voltage 1000–1250 V

Motors in service, dirty but externally dry, at room temperature (minimum service values)

$R_{ins} \geq U_n$ in MΩ, where U_n = Rated voltage in kV

e.g. 600 V = 0.6 kV: $R_{ins} \geq 0.6$ MΩ

After dry cleaning and after drying in an oven, if necessary measured at room temperature

$R_{ins} \geq C (U_n + 1)$ in MΩ, where U_n = Rated voltage in kV

c =	10	9	8	7	6	5	4	3	2	1
For motor ratings (kW)	≤100	200	300	400	500	600	700	800	900	≥1000

e.g. 600 V P = 1240 kW $R_{ins} \geq 1 (0.6 + 1) = 1.6$ MΩ
600 V P = 75 kW $R_{ins} \geq 10 (0.6 + 1) = 16$ MΩ

After washing an renewing covering varnish, measured at room temperature

$R_{ins} \geq X (U_n + 1)$ in MΩ, where U_n = Rated voltage in kV

x =	100	90	88	70	60	50	40	30	20	10
For motor ratings (kW)	≤100	200	300	400	500	600	700	800	900	≥1000

e.g. 600 V P = 1240 kW $R_{ins} \geq 10 (0.6 + 1) = 16$ MΩ
600 V P = 75 kW $R_{ins} \geq 100 (0.6 + 1) = 160$ MΩ

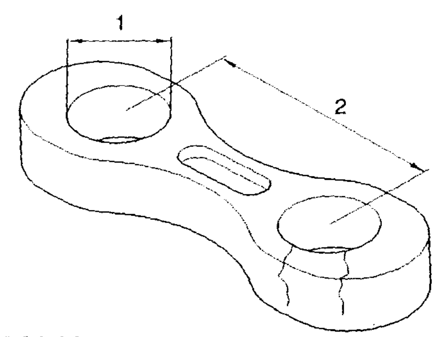
Repairs

High–voltage test at U_{test}

$U_{test} = 0.6\ U_{t.n}$

$U_{t.n}$ = test voltage in new condition on test bed

Torque Arm



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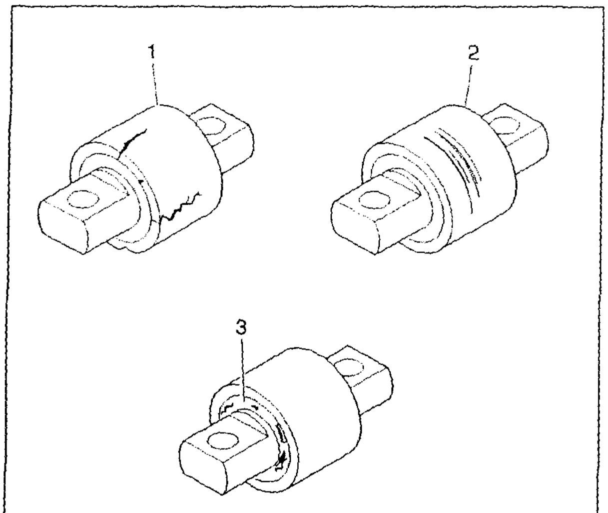
Visually inspect the torque arm for cracks or damage. Pay particular attention to the eye.

Measure the inside diameter of the eye bore (1). If greater than specification, refer Section Technical data, build–up with weld and ream to specification.

Use a penetrate dye or ultrasonic equipment to test for cracks around the eye and length of the arm (2).

Spheriblocs



0202100

NOTE:

No damage or wear is permissible on either the metal or rubber parts of the Spheriblocs. Discard damaged or suspect components and replace with new parts.

Press the Spheriblocs from the torque arm. Refer Section Disassembly.

Check the Spheribloc collar (1) for the formation of cracks, pitting or damage and replace if necessary.

Scratches or gouge marks around the circumference (2) of the collar may indicate rotation of the Spheribloc. Discard any Spheriblocs that show signs of rotation and carefully inspect the torque arm or traction motor for damage.

Inspect the rubber areas (3) for tears, cracks or evidence of disintegration. Replace if worn or the rubber is becoming detached from the collar or is loose and ragged. No damage is permissible to the rubber or collar of the Spheribloc.

Spheribloc Axial Wear Test

Before conducting the axial wear test, remove the Spheribloc from the torque arm and store for 48 hours.

Position the Spheribloc in a press and support the collar on a piece steel tube. Ensure there is sufficient space within the tube to allow clearance of the rubber part of the Spheribloc. The collar of the Spheribloc must be supported around its entire perimeter while conducting the test.

Apply an axial load of 50 kg to the Spheribloc cross–pin, then position the plunger of a dial indicator on the shoulder of the cross–pin and zero the dial indicator.

Increase the load on the cross–pin to 1500 kg, one time only, then decrease the load to 50 kg and maintain for one minute.

Check the reading on the dial indicator. If the reading is below 0.6 mm, turn over the Spheribloc and repeat the procedure on the other side. If the reading still remains below 0.6 mm the Spheribloc is serviceable. If either reading was greater than 0.6 mm, replace the Spheribloc.

Sanitation Parts/Operating Material

@.1260

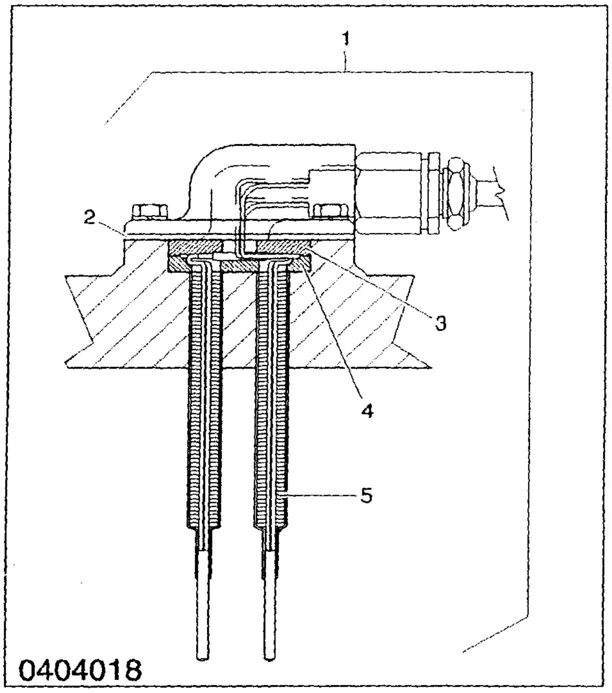
[NOT REQUIRED]

Assembly

@.1270

Traction Motor

Mounting of the Resistance elements



Location boreholes for resistance elements (5) in the stator. Fill them 1/3 full with resin combination. Reverse draw the cover 8 mm over the metal cylinder.

Dip the metal cylinder in resin combination. Insert the resistance elements (5) into the base of the borehole.

Fill up the boreholes with resin combination.

Insert the lower foam plate (4). Thread in the upper foam plate (3).

Connect the temperature measurement cables to the resistance element cables by means of a compression joint. Squeeze in the connections using the upper foam plate (3) and after that mount the cover together with the gasket (2).

Spheribloc Installation

Torque Arm

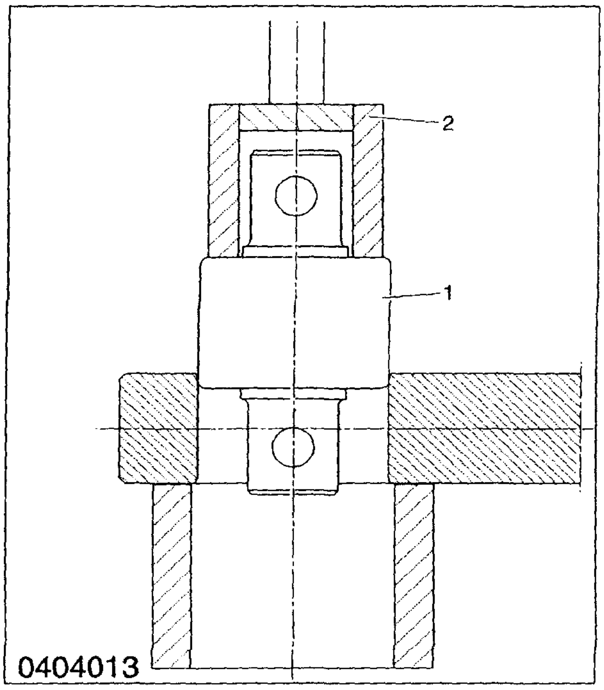
Inspect the Spheribloc and torque arm eyes as described in Section Inspection and Repair.

Remove any burrs or scratches from the Spheribloc collar and the eyes as necessary.

Apply a thin film of machine oil, or other suitable lubricant, to the Spheribloc collar.

Position the torque arm in a suitable press. Support the torque arm beneath the eye with a piece of suitable steel tube. Ensure that the tube will not interfere with the cross–pin.

Position the Spheribloc on the eye, align the centre line of the cross–pin bolt holes to run parallel with the torque arm.



Position a suitable bush (2) above the Spheribloc (1), ensuring contact around the entire perimeter of the Spheribloc collar.

Ensure the Spheribloc (1) is square with the torque arm eye.

Press the Spheribloc (1) into the eye until the collar is flush. Repeat the procedure for the other Spheribloc.

Installation

0.1280

General

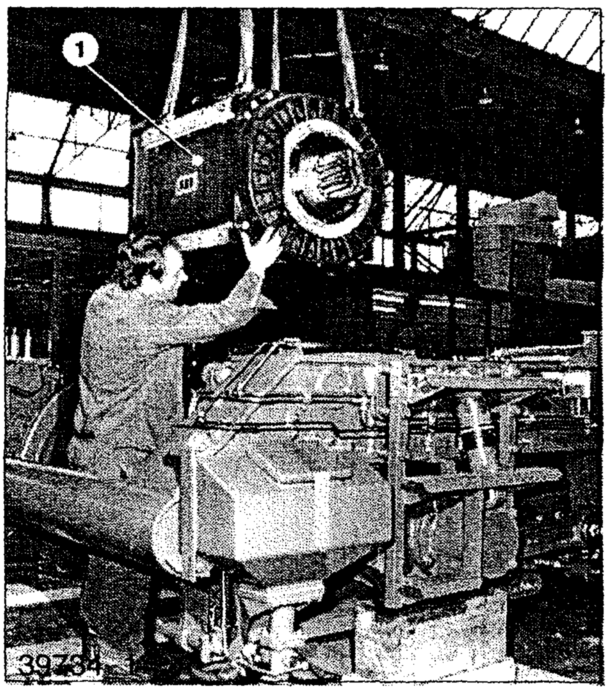
At the production works each individual ABB asynchronous traction motor was submitted to various checks and detail inspections and has passed the series examinations, among them the load run.

The installation shall be conducted in a clean environment by a suitably qualified personnel.

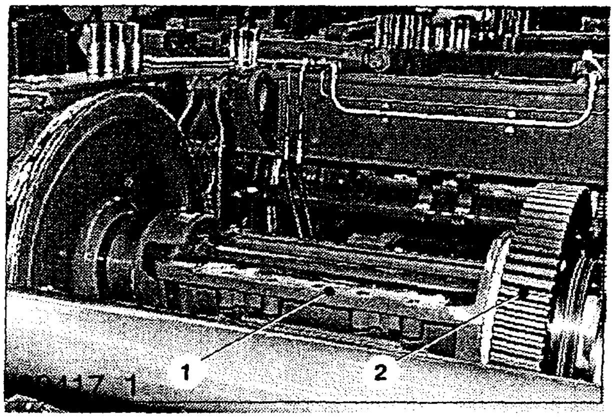
If during the assembly any specified value is outside the given range, the supervising staff should be notified immediately and the corrective action should be carried out before the next assembly step is taken.

All nominated tightening torques shall be achieved using calibrated torque wrenches.

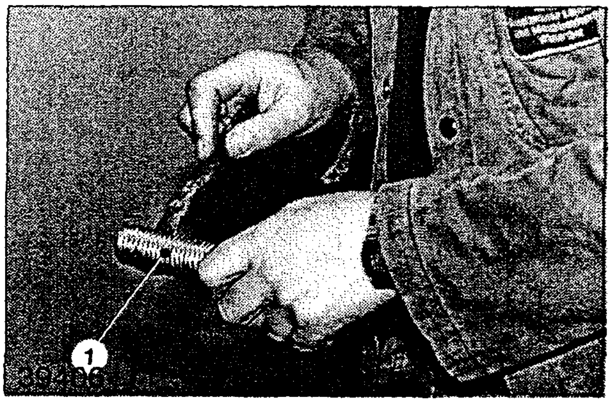
Prerequisites



Raise the traction motor into position above the bogie. Check to ensure that nothing will become entangled during installation, then lower the traction motor into position.



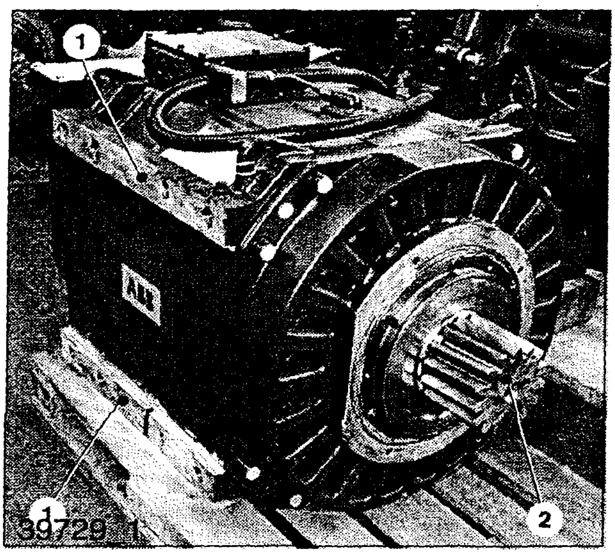
The complete bogie frame assembly shall include the axles fully installed, the main gears (2) and the suspension tubes (1) fitted.



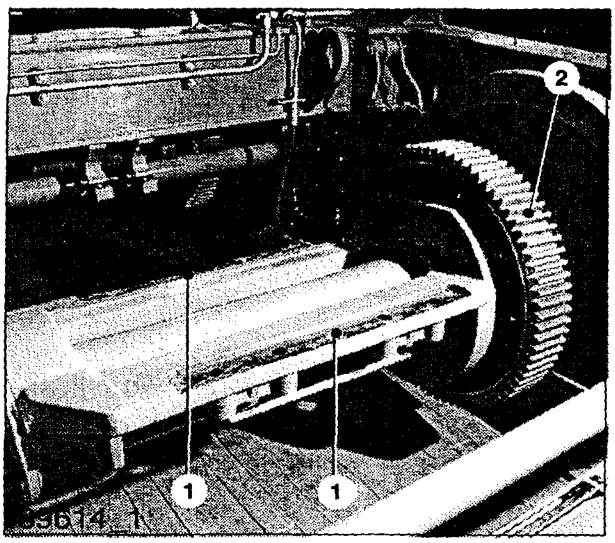
Make sure that all the screws and bolts (1) are lubricated prior to use.

Installation of the traction motor

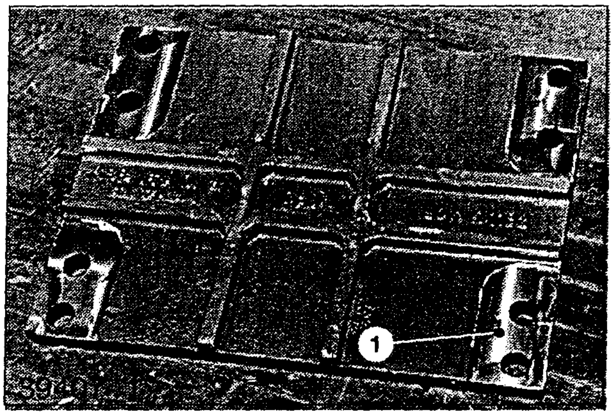
Remove the anti–corrosion coating and clean all contact surfaces thoroughly:



on the traction motor (1), including the pinion (2)

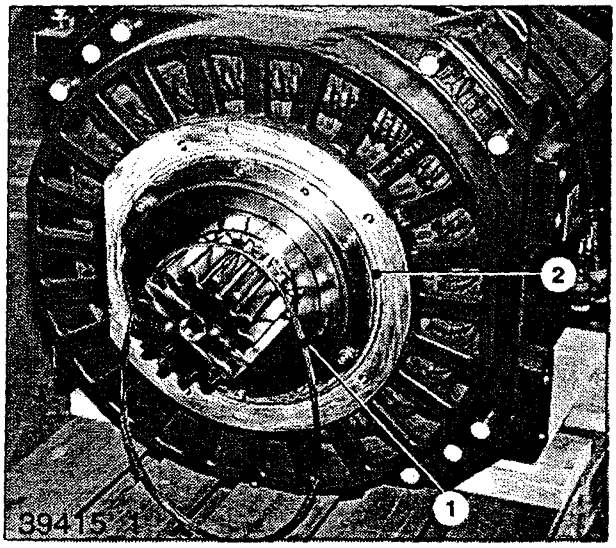


on the suspension tube (1), including the gear (2)

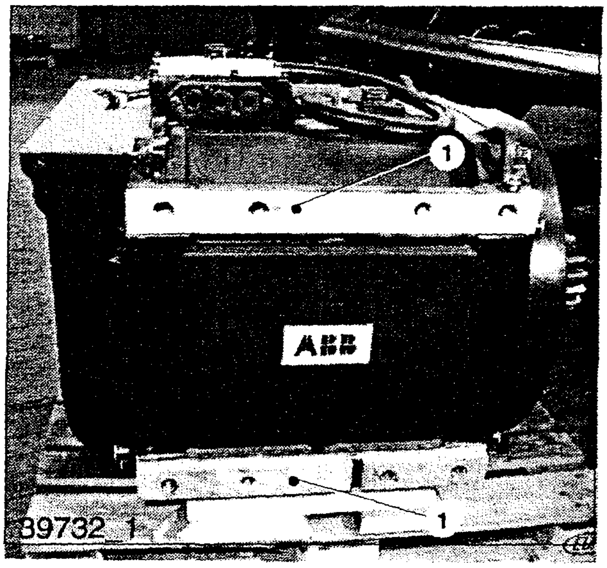


Remove the anti–corrosion coating and clean all contact surfaces thoroughly on the mounting plate (1).

Inspect the seat areas, all machined surfaces shall be smooth, without burrs. Break the edges if required.



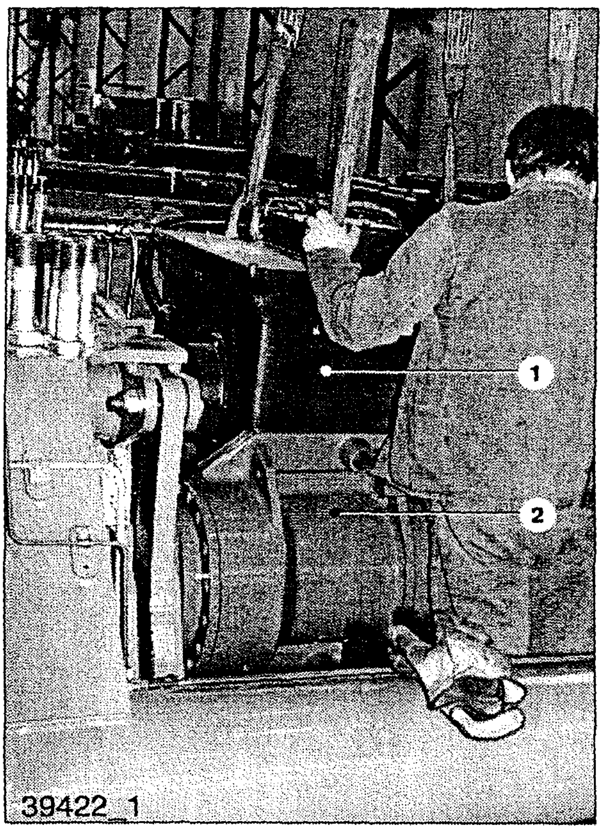
Lubricate the traction motor on the side facing the gears and insert the O–ring (1) in the groove (2) on the traction motor end-shield.



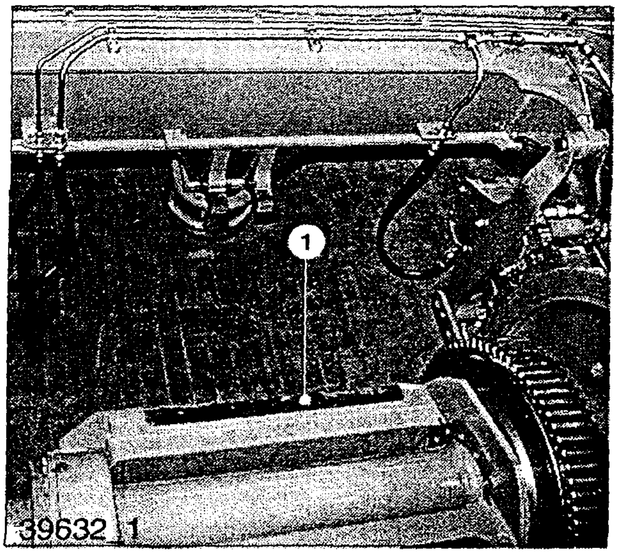
Lubricate the contact surfaces (1) facing the axle with a light coat of Molykote GN.

NOTE:

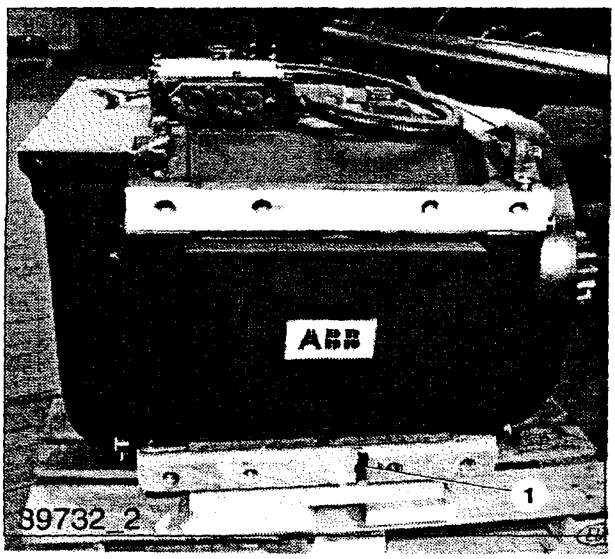
Do not lubricate the contact surfaces facing the mounting plate



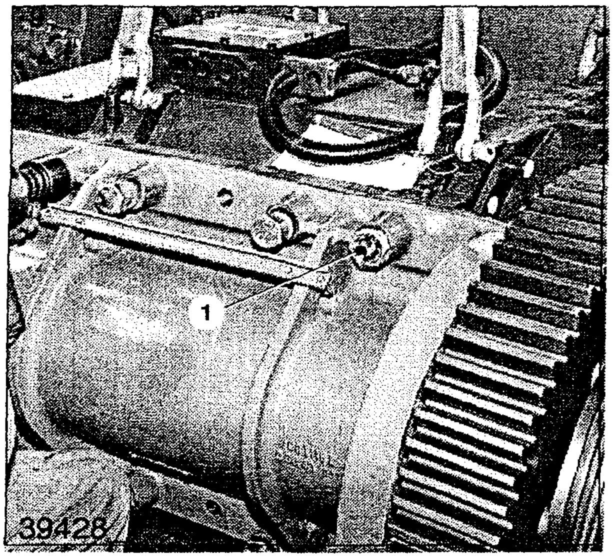
Turn the suspension tube (2) and position the traction motor (1).



Take care that the blindshaft (1) on the suspension tube fits properly in the keyway of the traction motor.



Take care that the keyway (1) in the traction motor fits properly in the blindshaft of the suspension tube.



Fit the screws (1) and tighten them.

Before applying the assembly torque check the gear–case seat engaging surface.

The tolerance for the motor endshield and the suspension tube face is 0–0.4 mm.

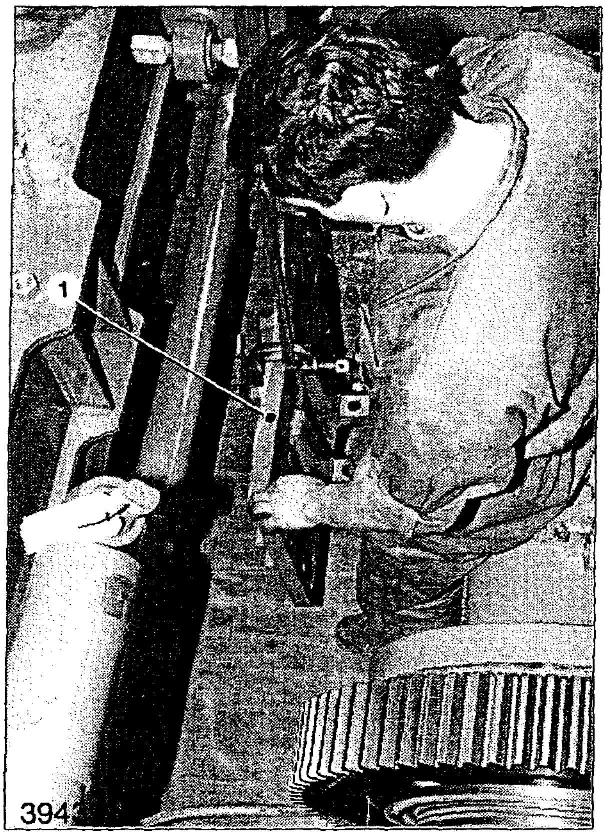
Do not install a motor if this tolerance is not achieved.

Apply the proper torque of 1260 Nm on the bolts.

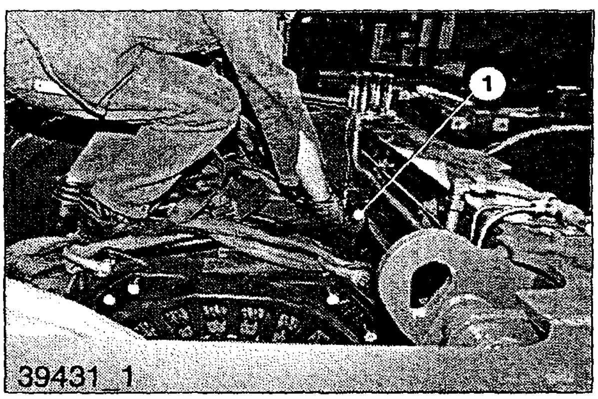
Lower the traction motor on blocks of wood.

NOTE:

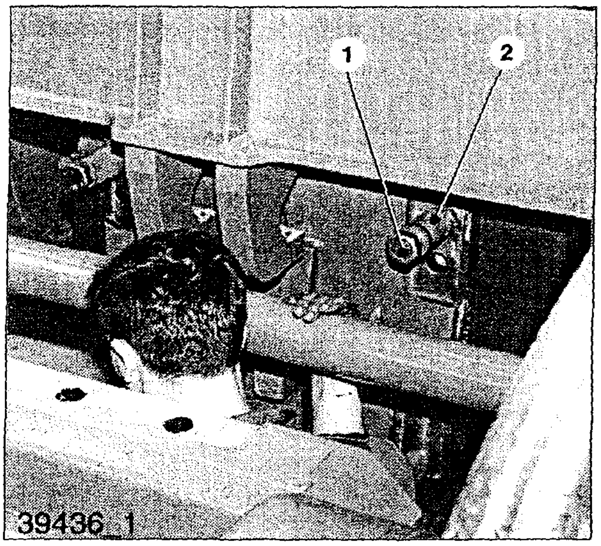
The traction motor has to be below the axle when the mounting plate is attached to allow subsequent lifting of the motor into the position. The motor cannot be placed into its position from the top.



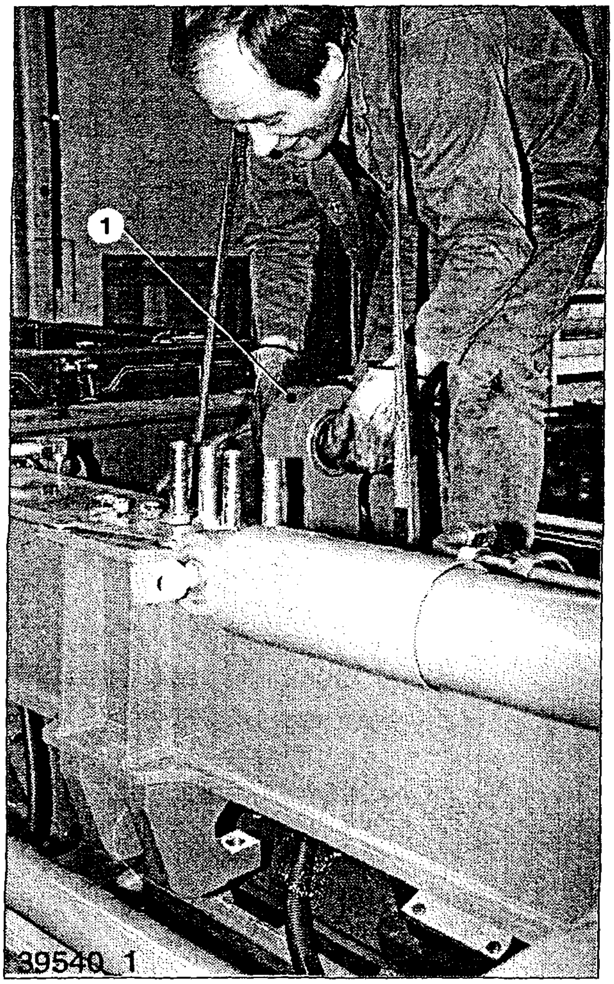
Move the mounting plate (1) under the bogie frame.



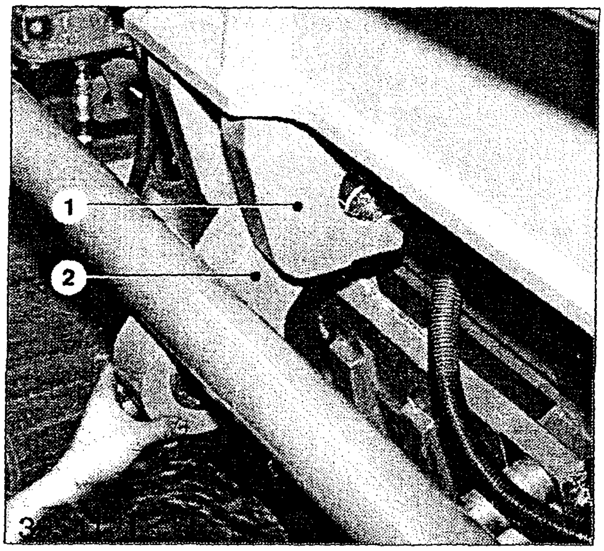
Lift the mounting plate (1) with the crane at the other side and place it into its proper position.



Fit the bolts (1) and spacers (2) and tighten them with a torque of 1330 Nm.



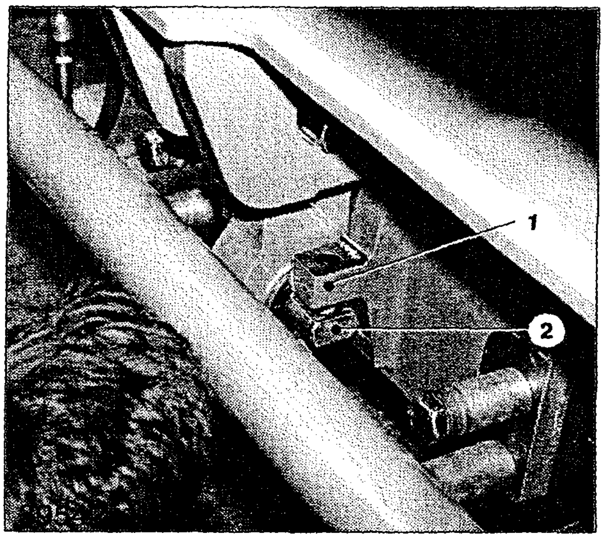
Place the torque arm (**1**) from the top.



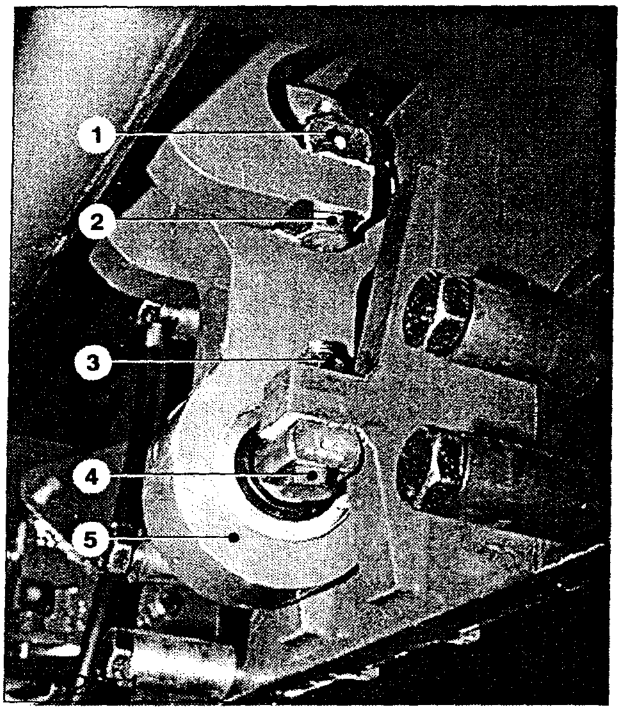
Place the torque arm (2) onto the bogie frame support bracket (1)

Move the torque arm (2) away from the lifting motor.

Raise the traction motor. This will allow the motor to swivel around the axis.

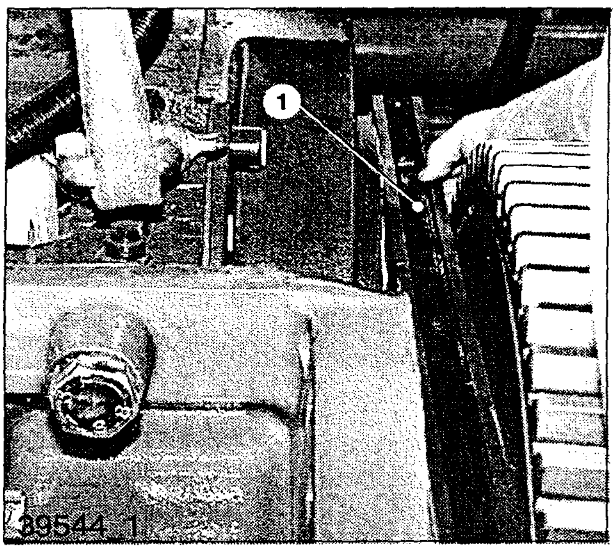


Lift the traction motor until the torque arm (2) is in its proper position on the mounting plate (1).

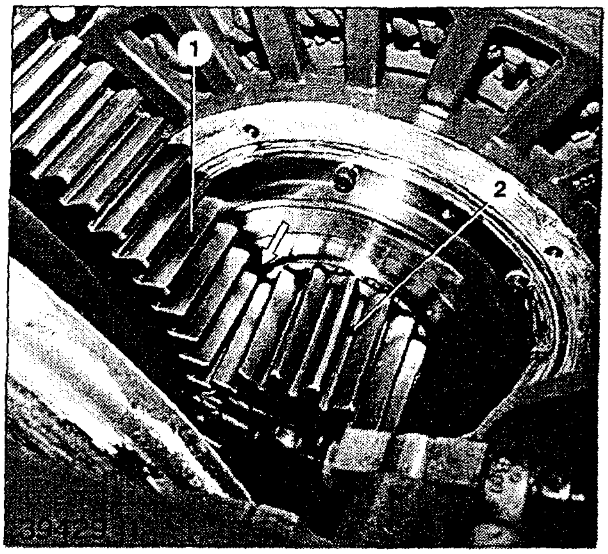


With the torque arm (5) in place, insert the bolts (2,4) and nuts (1,3).

Apply a torque of 665 Nm.



Measure (1) and record on the check sheet the clearance between the motor endshield and the suspension tube face. The tolerance given for the flatness is 0 – 0.4 mm.



Measure and record on the check sheet the circumferential backlash for each axle.

Insert a thin tin wire between the pinion (2) and the gear (1) and turn the gear. Afterwards measure the thickness of the tin wire. Under new conditions the backlash is 0.25 – 0.46 mm.

Gear Case Assembly Procedure

Refer the attached procedure dated 15-April-2002: -

WAG9 Gear Case Assembly Procedure (7 pages)
WAG9 Gear Case Assembly Procedure Depicted in Photographs (4 pages)

Bombardier Transportation Australia Pty Ltd

Title: WAG9 Gear case Assembly Procedure

Contract: 876 | Date: 15-04-02 | Page 1 of 7

Prepared by: R.Sriram | Approved by: J.ALSTON

Assembly Part No: (Incl. Rev): | Component Serial No:

No	Activity	Completed By
1	Place the disassembled Gear case on a wooden surface on the shop floor. **Note:** Do Not rest the machined faces of the gear case components on the concrete floor.	
2	Thoroughly clean the gear case halves using lint free cloths (**NOT** JUTE) removing any residue of oil and sealing medium.	
3	Run a machine tap down all the threaded holes about the GC and TM DE End Shield and ensure that the threads are free of any debris. Take special care whilst cleaning the threaded holes.	
4	Check the threaded holes on the TM DE End shields with the GO / NO Gauge. (QE / SQE) **Note:** If any of the M16 threads are found damaged and out of tolerance with respect to the thread plug gauge, the end shield must be withdrawn from service and sent for *Helicoil insertion*. (X 4) **Note:** Special care must be taken at the time of machining the M16 threaded holes prior to *Helicoil insertion* not to allow any debris to enter the bearing. (Cover the Bearing, both sides). The end shields must **NOT** be inter changed between rotors. (Clearly Identify the End Shield with its respective Rotor prior to despatch).	
	CHECK POINT	
5	Clean all the through holes on the Gear case, suspension tube and labyrinths, especially the drainage bore.	
6	Remove the O-Rings and thoroughly examine their condition. Discard damaged O-Rings. **Note:** Flat O-Rings must **NOT** be reused.	
7	Thoroughly clean the O-Ring grooves on the Suspension Tube, Traction Motor and Gear case Labyrinth, ensure that the grooves are free of any debris. Remove any metal projections on the machined surfaces by filing/grinding. **Note:** Use ***Loctite cleaner 7061*** to clean the machined faces of the Gear case halves, Suspension Tube, Traction Motor and Gear case labyrinth. (**Note:** Use a lint free dry cloth for cleaning, **NOT** JUTE) .	
8	Check using the <u>edge</u> of a 12" Steel Rule that the machined plane of Traction Motor End Shield and Suspension Tube are in the same plane (Note: **DISCREPANCY upto 0.25mm PERMITTED)**	

Bombardier Transportation Australia Pty Ltd **Title: WAG9 Gear case Assembly Procedure** Contract: 876 Date: 15-04-02 Page 2 of 7 Prepared by: R.Sriram Approved by: J.ALSTON		
Assembly Part No: (Incl. Rev):	Component Serial No:	
No	**Activity**	**Completed By**
9	Apply ***White Optimol*** paste within the O- Ring grooves on the Suspension Tube, the Drive End End shield and Gear case labyrinth. (**Note:** Do **NOT** apply any *Optimol paste* to the machined contact surfaces of the Gear case / Suspension Tube / Traction Motor End shield, wipe clean any residue).	
10	Before installing new O-Rings, cut the rings vertically into two halves to make a clean butt joint. Clean the cut portion with *acetone solution* to remove any traces of oil/grease. **NOTE**: Do not use any other medium which may react with "O" ring rubber. Paste the two halves with ***Loctite 406***, and apply a uniform pressure by hand for a minimum of 60 seconds. NOTE: Ensure that the two faces do not slide apart during the bonding process. (Check the integrity of the joint)	
11	Apply little amount of ***White Optimol*** paste uniformly about the O-rings and fit them into the grooves on the Suspension Tube, Drive End End shield and Gear case labyrinth, wipe clean any residue. Always ensure that the cut portion of the O-ring is positioned at the top of the groove. (12 O-clock position).	
12	Apply a uniform covering of ***Loctite 518*** on the machined contact surface of the Suspension Tube, Traction Motor End Shield (Refer attached Photo #1) and Gear case labyrinth, outside the O-Ring grooves. **Note:** Take care not to apply loctite on the "O" Rings **Note:** Take special care not to allow any sealing medium to enter the threaded holes	
	CHECK POINT	

Bombardier Transportation Australia Pty Ltd

Title: WAG9 Gear case Assembly Procedure

Contract: 876 | Date: 15-04-02 | Page 3 of 7

Prepared by: R.Sriram | Approved by: J.ALSTON

Assembly Part No: (Incl. Rev):		Component Serial No:
No	**Activity**	**Completed By**
	LOWER HALF GEARCASE PREPARATION AND ASSEMBLY	
13	**Lower Half Gear case Preparation** Use ***Loctite cleaner 7061*** to clean the machined faces of the GC, removing any residue of oil prior to applying a uniform covering of ***Loctite 518*** as outlined below. (**Note:** Refer to the attached photographs for clarification). a) Apply ***Loctite cleaning medium 7061*** to the machined surfaces of the gear case halves (Refer attached photo #2) (**Note:** Use a lint free dry cloth for cleaning, **NOT** JUTE) b) Apply ***Loctite sealing medium 518*** to the machined surfaces of the lower GC half (Refer attached photos 3 & 4) NOTE: Take special care not to allow any sealing medium to enter the threaded holes. c) Apply ***Silicon Sealant ONLY*** to the mating area secured by allen bolt, reference 57. (Refer attached photo# 5) d) Apply ***White Optimol Paste*** only to the non- bolted machined inner surfaces of the labyrinth and suspension tube diameter (big ones). (Refer attached photos 3 and 4) **Note:** No Optimol Paste is to be applied to the non-bolted machined inner surface on the smaller diameter.(Refer attached photo # 6)	
	CHECK POINT	
14	Place the Lower Gear case Half on the " Lifting Platform" (Refer attached photos 7 & 8), still supported by the crane. Lift the Gear Case lower half and align the respective holes of the Gear Case with the Suspension Tube and Traction Motor holes, use two or three bolts to achieve the alignment. **Note:** Take special care to ensure that the O-Rings are in position. **Ensure that they are not trapped or cut.**	
15	**CHECK POINT**	

Bombardier Transportation Australia Pty Ltd

Title: WAG9 Gear case Assembly Procedure

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Prepared by: R.Sriram | Approved by: J.ALSTON

Assembly Part No: (Incl. Rev): | Component Serial No:

No	Activity	Completed By
16	**Preparation of bolts** Apply little amount of the *Optimol paste* to the shank and the threaded portion of **all** the gear case bolts. (Refer attached photo # 9). **Note:** NO *Optimole past* is allowed to get in the area under the head of the bolts. This will reduce the friction as much, that the bolts will be damaged by appling the fixing torque.	
17	After satisfactorily aligning the holes place two, 2mm shims at equidistance between the Gear case half and the Suspension Tube / Traction Motor DE End shield. (Refer attached photos 10 & 11) **Note:** Do **NOT** draw the lower gear case half towards the suspension tube and TM end shield at this point in time.	
UPPER HALF GEARCASE PREPARATION / ASSEMBLY		
18	**Upper Half Gear case Preparation** a) Use ***Loctite cleaner 7061*** to clean the machined faces of the GC, removing any residue of oil. (**Note:** Use a lint free dry cloth for cleaning, **NOT** JUTE) b) Apply ***White Optimol Paste*** only to the non- bolted machined inner surfaces of the labyrinth and suspension tube diameter(big ones). **Note:** No Optimol Paste is to be applied to the non-bolted machined inner surface on the smaller diameter.	
19	Lift the upper gear case half with slings, lower the upper gear case slowly placing it on top of the lower gear case half and align the respective holes of the upper Gear case with the Lower Gear case, Suspension Tube and Traction Motor holes, use two or three bolts to achieve the alignment. **Note:** Take special care to ensure that the O-Rings are in position. **Ensure that they are not trapped.**	
20	**CHECK POINT**	

FASTENING (Hand Tightening Sequence) Refer to Drawing IB011-00267	

Bombardier Transportation Australia Pty Ltd

Title: WAG9 Gear case Assembly Procedure

Contract: 876 | Date: 15-04-02 | Page 5 of 7

Prepared by: R.Sriram | Approved by: J.ALSTON

Assembly Part No: (Incl. Rev): | Component Serial No:

No	Activity	Completed By
21	After satisfactorily aligning the holes, bolt together the Gear case halves uniformly with items 56 (M12x75), 62 (Ser.Washer M12) and 85 in a diagonally opposite sequence till the two halves are closed completely. Do not tighten the bolts yet. **Note:** Make sure that the Serrated washers are put in the right way. (With Convex surface towards the bolt head)	
22	Place two, 2mm shims at equidistance between the upper Gear case half and the Suspension Tube / Traction Motor Drive End, End shield (Refer attached photo # 12). **Note:** Draw both the upper and lower gear case halves towards the suspension tube and Traction Motor end shield in a uniform manner as outlined in the sequence described below lightly clamping the shims.	
23	Bolt together the GC with item 57 (M12x160), 62 (Ser. Wash M12) and 85. Do not tighten the bolt yet.	
24	Bolt together the suspension tube with items 42 (M12x70), 62 (Ser. Wash M12) and 85 in a diagonally opposite sequence. Do not tighten the bolts completely.	
25	Bolt together the Traction Motor End shield with items 45 (M16x200), 63 (Ser. Wash M16) and 85. Do not tighten the bolts completely.	
26	Insert the labyrinth ring item 12 into the Gear case. Make sure that the bore in this ring corresponds to the pin in the lower half of the Gear case. (Labyrinth drainage slot must be positioned at the bottom)	
27	Bolt the labyrinth ring item 12 onto the Gear case with items 40 (M12x30) 62 (Ser. Washer M12) and 85 in a diagonal sequence. Do not tighten the bolts completely.	
28	Remove the 4 shims carefully.	
29	Bolt together the suspension tube and gear case with item 42 so that the metal faces touch each other completely. Do not tighten the bolts completely.	
30	Bolt together the traction motor end shield and gear case with item 45 so that the metal faces touch each other completely. Do not tighten the bolts completely	
TORQUING SEQUENCE		
31	Fully tighten the Suspension Tube bolts to the Gear case item 42 (M12x70) and apply torque to 115 Nm in a diagonal sequence.	

Bombardier Transportation Australia Pty Ltd

Title: WAG9 Gear case Assembly Procedure

Contract: 876 Date: 15-04-02 Page 6 of 7

Prepared by: R.Sriram Approved by: J.ALSTON

Assembly Part No: (Incl. Rev): Component Serial No:

No	Activity	Completed By
32	Fully tighten 4 Nos Gear Case / Traction Motor End shield bolts item 45 (M16x 200) and apply torque to 300 Nm in a diagonally opposite sequence.	
33	Fully tighten 12 Nos labyrinth ring bolt item 40 (M12X30) and apply torque to 115 Nm in a diagonal sequence.	
34	Fully tighten 15 Nos Gear case joining bolt item 56 (M12x75) and apply torque to 115 Nm in a diagonal sequence.	
35	Fully tighten 1 No. long allen bolt item 57 (M12x160) and apply torque to 115 Nm.	
36	After 5 minutes loosen one of the M16 X 200 bolts and retighten it to 300Nm checking that the bolts are not prebent due to misallignent. Repeat the same for the other three bolts.Do it in a diagonal sequence.	
37	**CHECK POINT**	
38	In case the drain plug is removed, clean the Magnetic plug free of oil and metal residue.Clean the thread free from ***Loctite***, replace the Cu washer and the tab washer and tighten the drain plug with ***Loctite 243*** with an applied torque of 150 Nm.	
39	Remove the oil Filling plug and discard the Copper gasket. Clean the threads free of oil.	
40	Fill ~5 litres of GC oil using a graduated vessel. The high viscose oil needs time to flow in the gear case. If it seems full wait for 5 minutes to see if the level stays constant or else more oil has to be filled in.	
41	Fit new copper gasket and tighten the Oil Filling plug onto the Gear case with an applied torque of 210 Nm.	
42	Repeat the same assembly Procedure for all the other Gear cases.	
43	Re- tighten all the gear case bolts to the specified torque settings in the same sequence as outlined above.	
	CHECK POINT	
44	**BEFORE LOCO LEAVES MAINTANANCE BAY THIS WORK INSTRUCTION MUST BE SIGNED OFF AS BEING COMPLETED BY AUTHORISED SIGNATORY**	
45	**AUTHORISED SIGNATORY. SIGNATURE: DATE:**	
	NAME:	

Bombardier Transportation Australia Pty Ltd **Title: WAG9 Gear case Assembly Procedure**		
Contract: 876	Date: 15-04-02	Page 7 of 7
Prepared by: R.Sriram	Approved by: J.ALSTON	
Assembly Part No: (Incl. Rev):	Component Serial No:	
No	Activity	Completed By

INSPECTION SUMMARY

NO	ACTIVITY	REFERENCE DOCUMENT	CONTROL AND VERIFICATION DOC TYPE		WORK INSPECTED BY	HOLD POINTS	HOLD POINT RELEASE AUTHORITY	BOGIE / LOCOMOTIVE INTERFACE ASSEMBLY VERIFIED.
			DOC NO:	P		H		
	GC Assembly	Drive 15AN 21 R1 Instruction for assembly and Diassy (WAG9)	AEB 452511 F	X	Q Eng	X	Authorised Signatory	

RELEASE: Yes / No   Srkanth Sahoo (**SIGNATURE**) ______________ Date: ____________

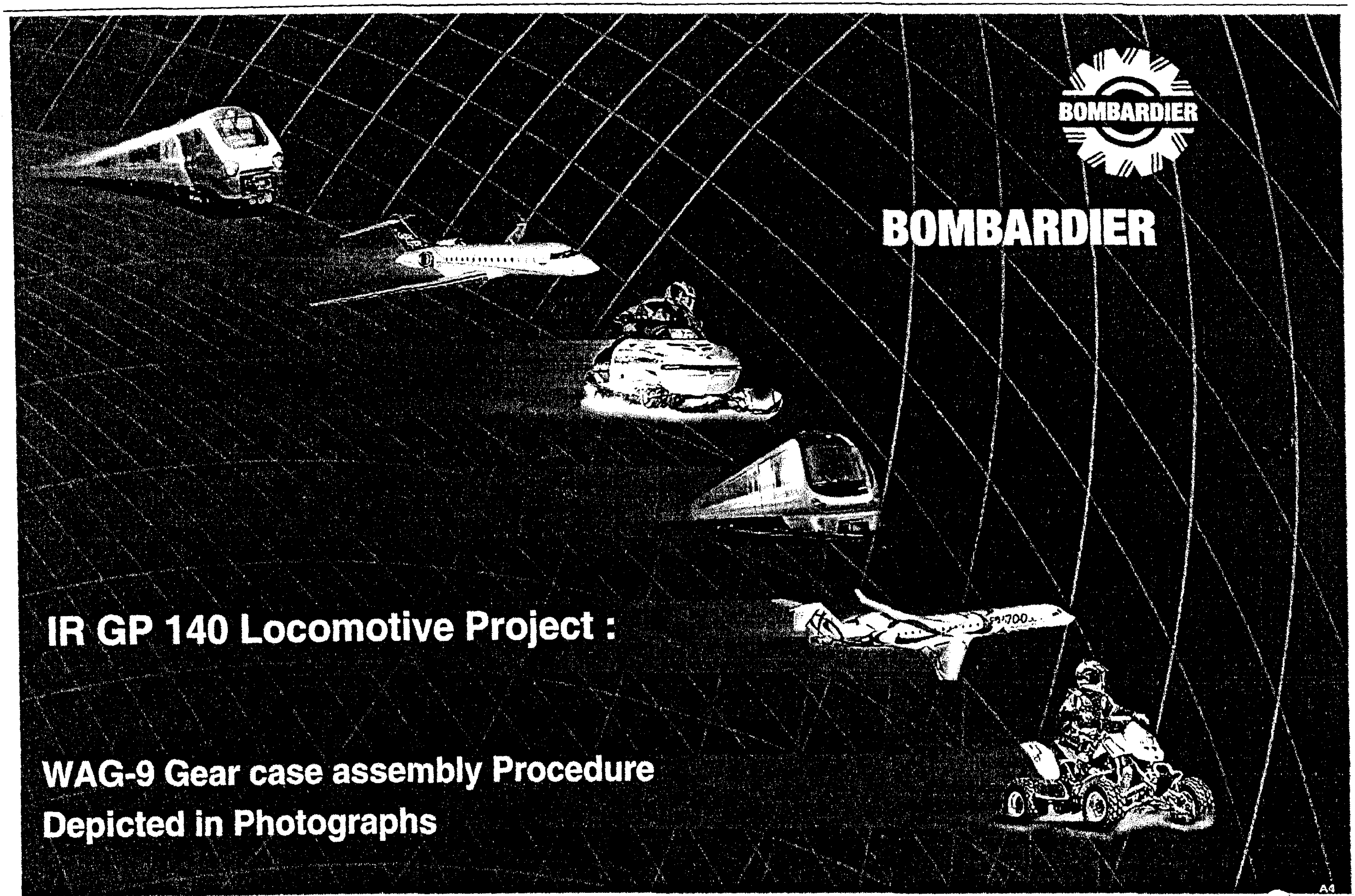
AUTHORISED SIGNATORY (NAME & SIGNATURE) ______________ Date: ____________

AUTHORISED SIGNATORIES: R. SRIRAM. SITE MANAGER (GMO) MODIFICATION MANAGER
KAROLY CSURGAY

LEGEND

P PROCEDURE

H MANDATORY HOLD POINT WHERE NO FURTHER OPERATIONS CAN BE UNDERTAKEN UNTIL AUTHORISED TO PROCEED.
AT CHECK POINTS, ALL ACTIVITIES ARE REVIEWED.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BOMBARDIER
IR GP 140 Locomotive Project :
WAG-9 Gear case assembly Procedure
Depicted in Photographs

IR GP 140 Locomotive Project :
WAG-9 Gear Case Assembly Procedure Depicted in Photographs

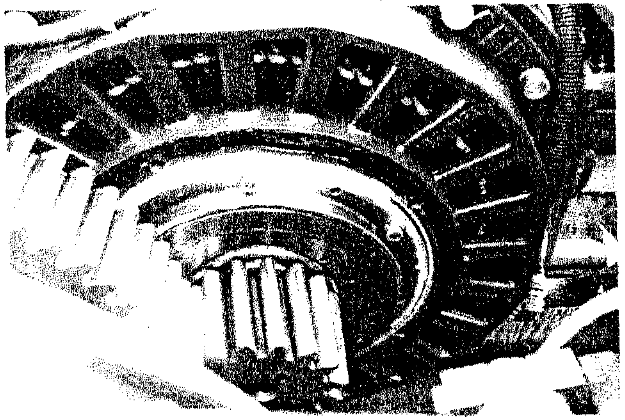


Photo # 1 - Loctite 518 on TM EndShield

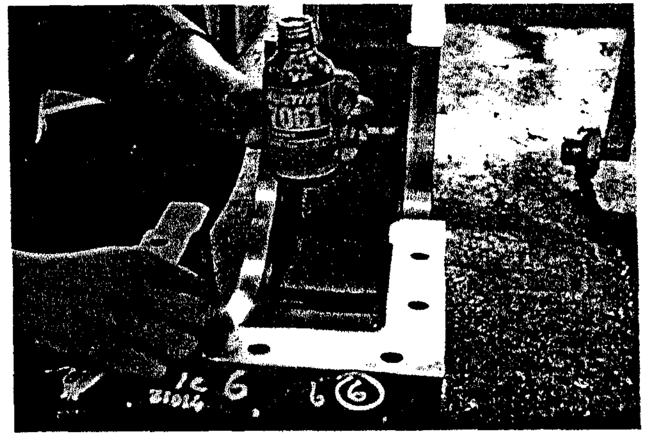


Photo # 2 - Applying Loctite Cleaner 7061

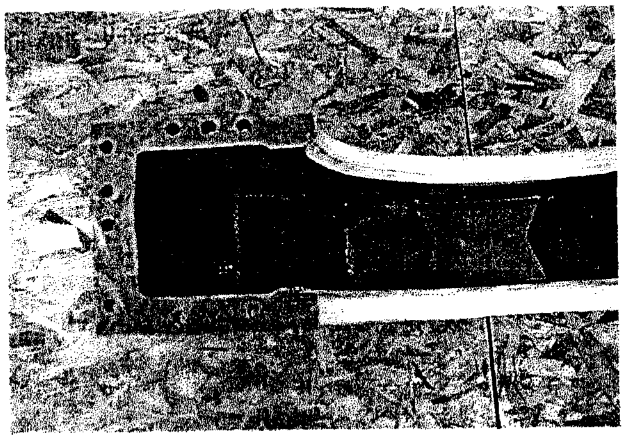


Photo # 3 - Applying Loctite 518 to lower gear case sides

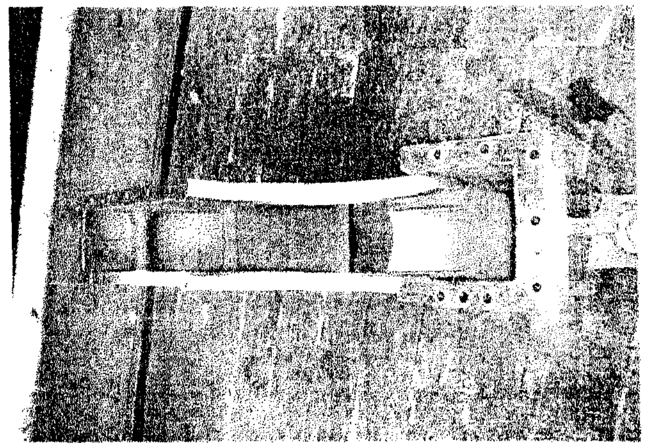


Photo # 4 - Applying Loctite 518 to lower gear case sides

IR GP 140 Locomotive Project :
WAG-9 Gear Case Assembly Procedure Depicted in Photographs

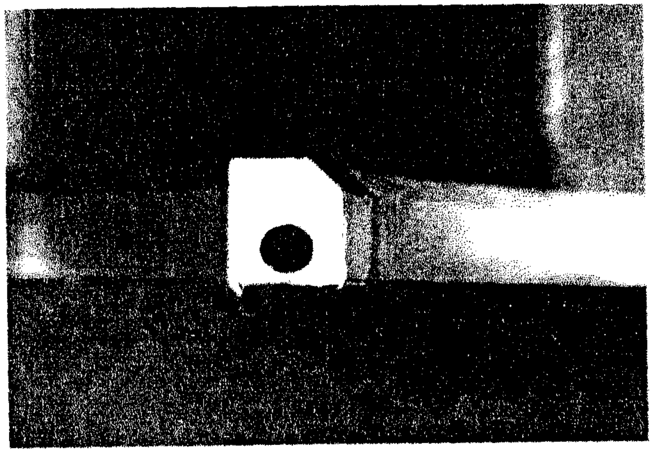


Photo # 5 - Applying Silicon sealant (Socket Head Bolt Area)

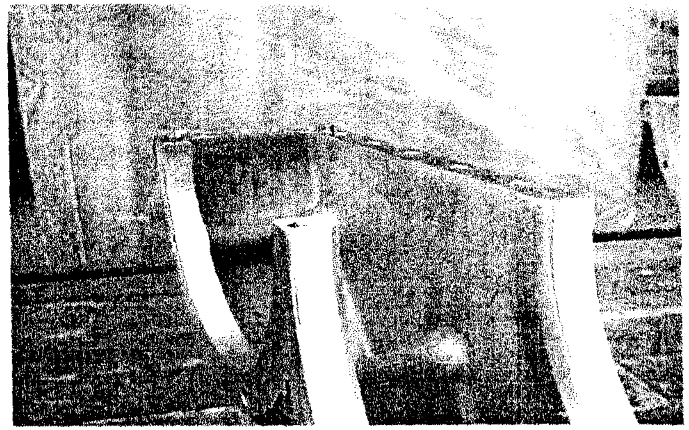


Photo # 6 - No Optimol paste on the smaller diameter

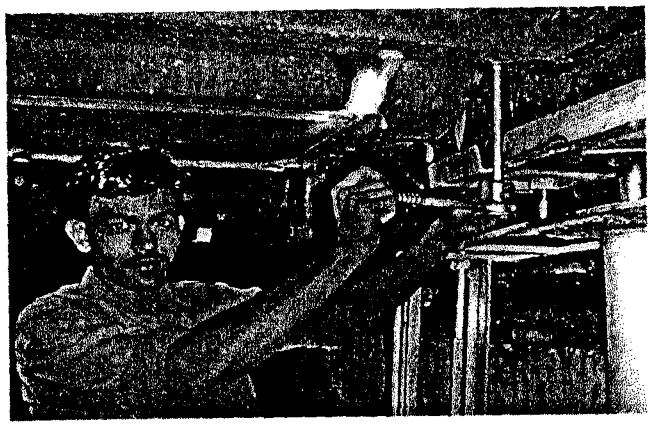


Photo #7 - Assy of GC using GC support frame . **#8**

Photo #8 - Assy of GC using GC support frame.

IR GP 140 Locomotive Project :
WAG-9 Gear Case Assembly Procedure Depicted in Photographs

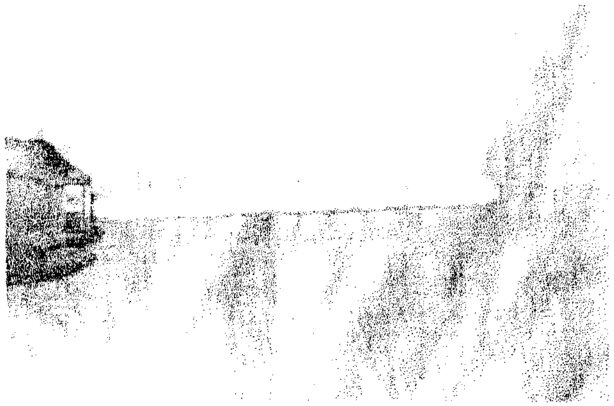


Photo # 9 - Applying anti corrosive medium to the bolt.

Photo # 10 - Shim inserted between GC and DE End shield

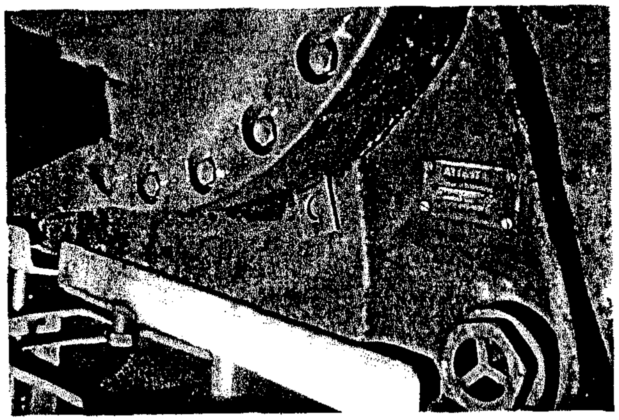
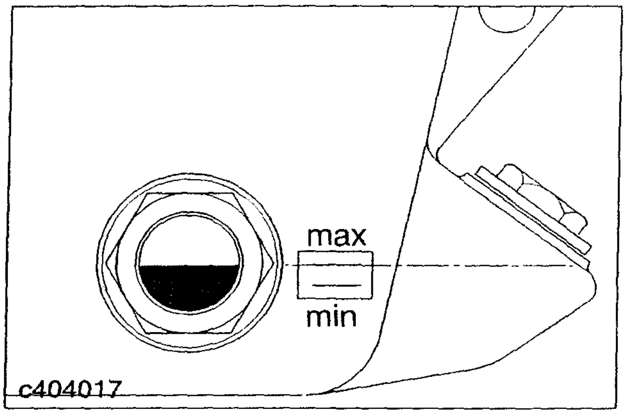
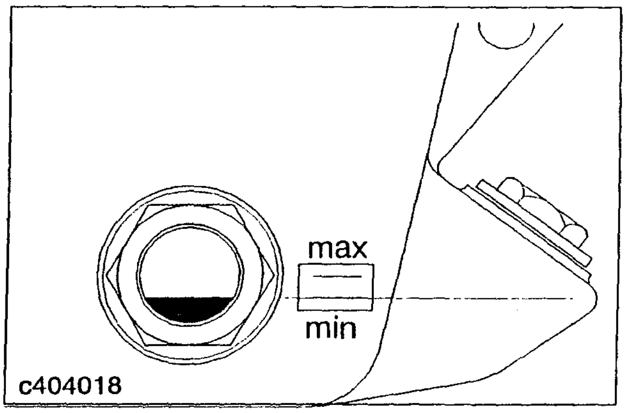


Photo # 11 - Shim between GC and Suspension Tube.

Photo # 12 - Shim between Upper GC half and TM DE End shield.

Oil Level Indication





Check oil level. Oil level has to be between the marks "min" and "max".

Adjust the height of the drive assembly as described in Chapter 2.06.

Install the bogie assembly to the locomotive as described in Chapter 2.00.

10

4.5 Cabling

For complementary information see Suppliers Documentation Volume G:

ABB Three Phase Electric Drive Locomotive WAG-9
Cable Schematics

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BOMBARDIER TRANSPORTATION

IR WAG9

Volume D2

Auxiliary System

11

5 Auxiliary System

For complementary information see following Chapters in Volume D2:

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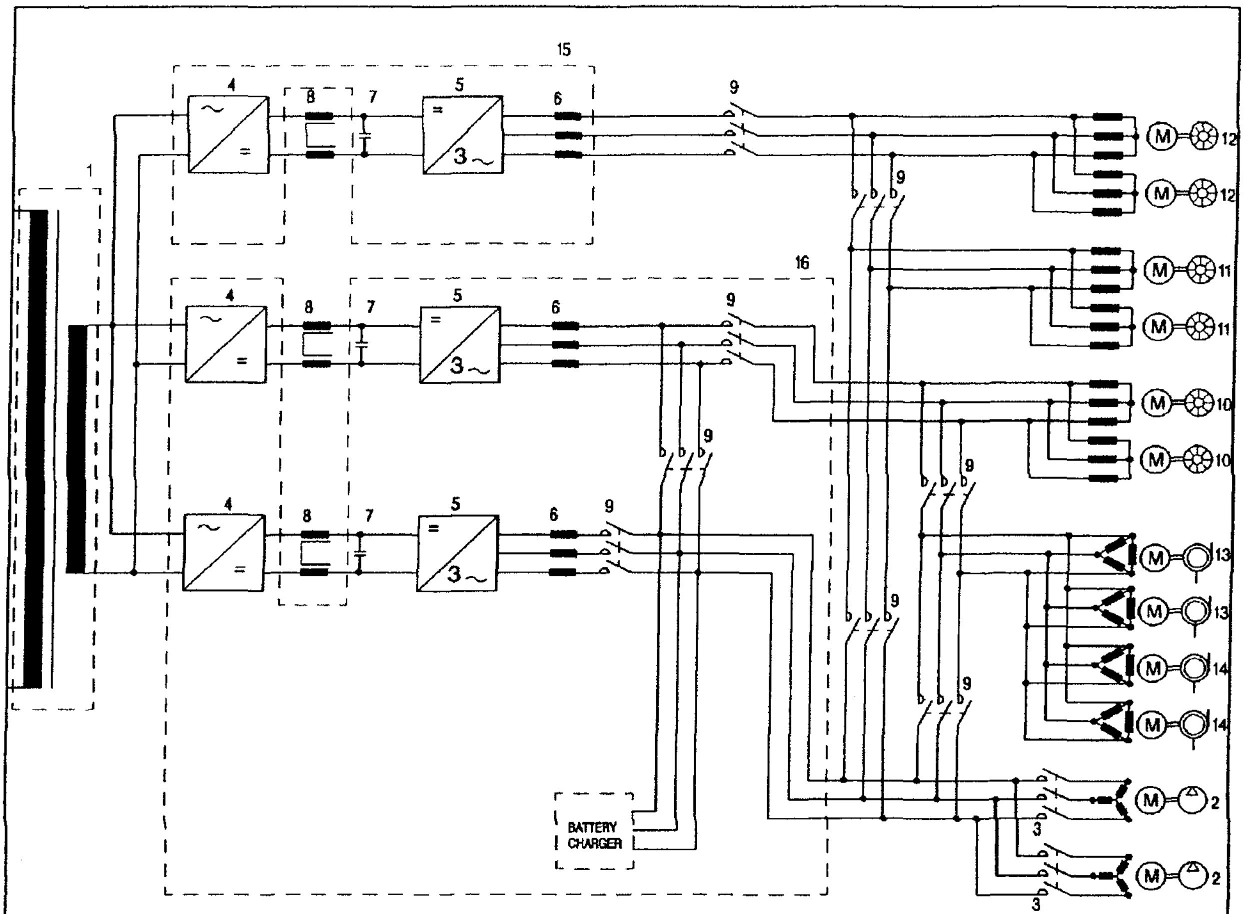
5.1 Auxiliary Three-Phase Power

Group Summary

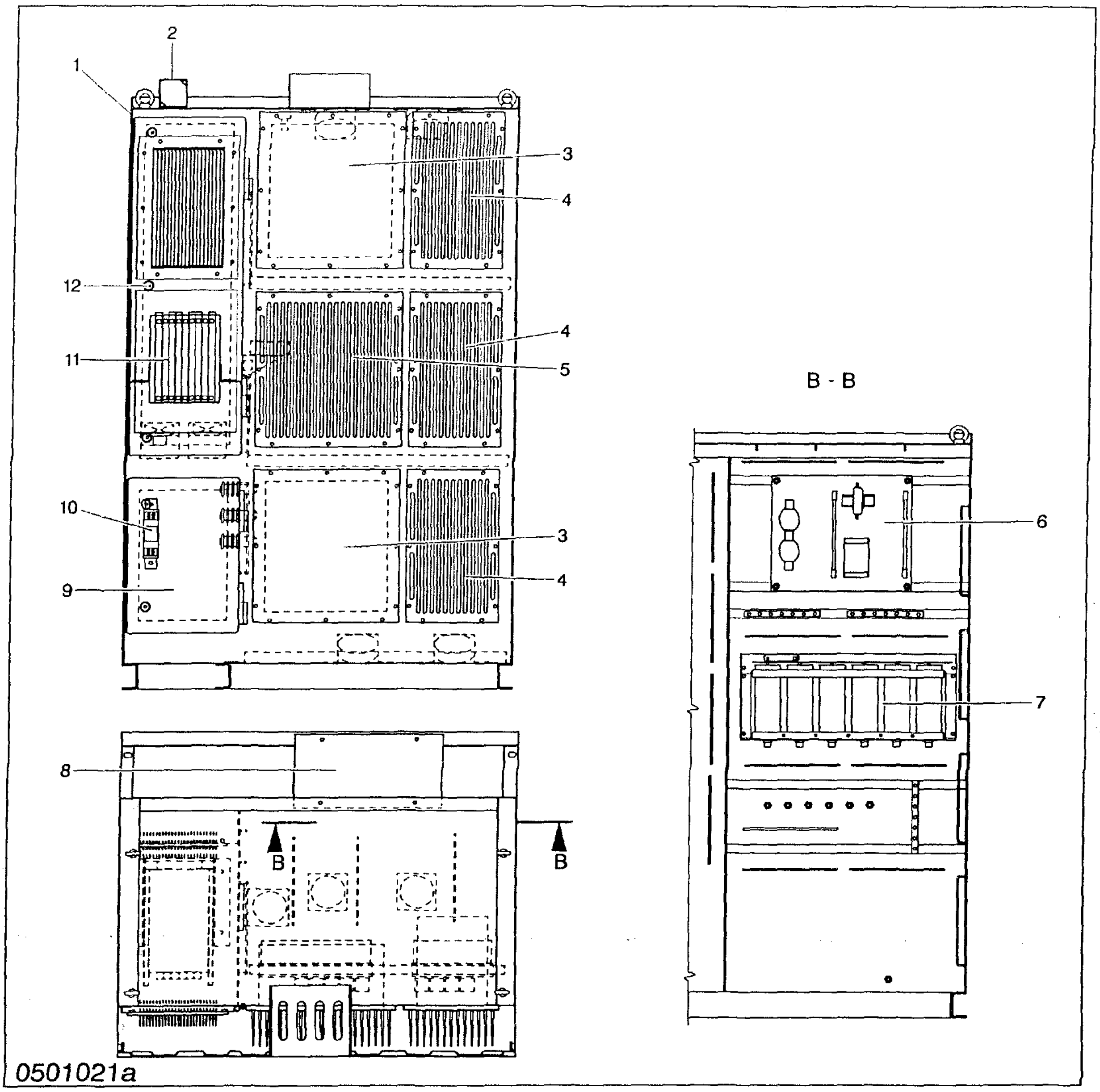
@.1120

This chapter contains information regarding the auxiliary converter systems BUR1, BUR2 and BUR3.



0501101n

1	Main transformer (7)	10	Traction motor blower (53)
2	Main compressor (47)	11	Scavenge blowers, traction motor/oil cooler blowers (55)
3	Contactors, main compressor (47.2)	12	Oil cooling unit, transformer/converter (59)
4	Rectifier module (50.11)	13	Oil pump transformer (62)
5	Inverter module (50.12)	14	Oil pump converter (63)
6	Three-phase output choke (50.9)	15	BUR-Box_1 "BUR1" (1050.1)
7	Capacitor bank, DC-Link (51.1)	16	BUR-Box_2 "BUR2 & BUR3" (1050.2)
8	DC-Link choke (51.3)		
9	Contactors (52)		



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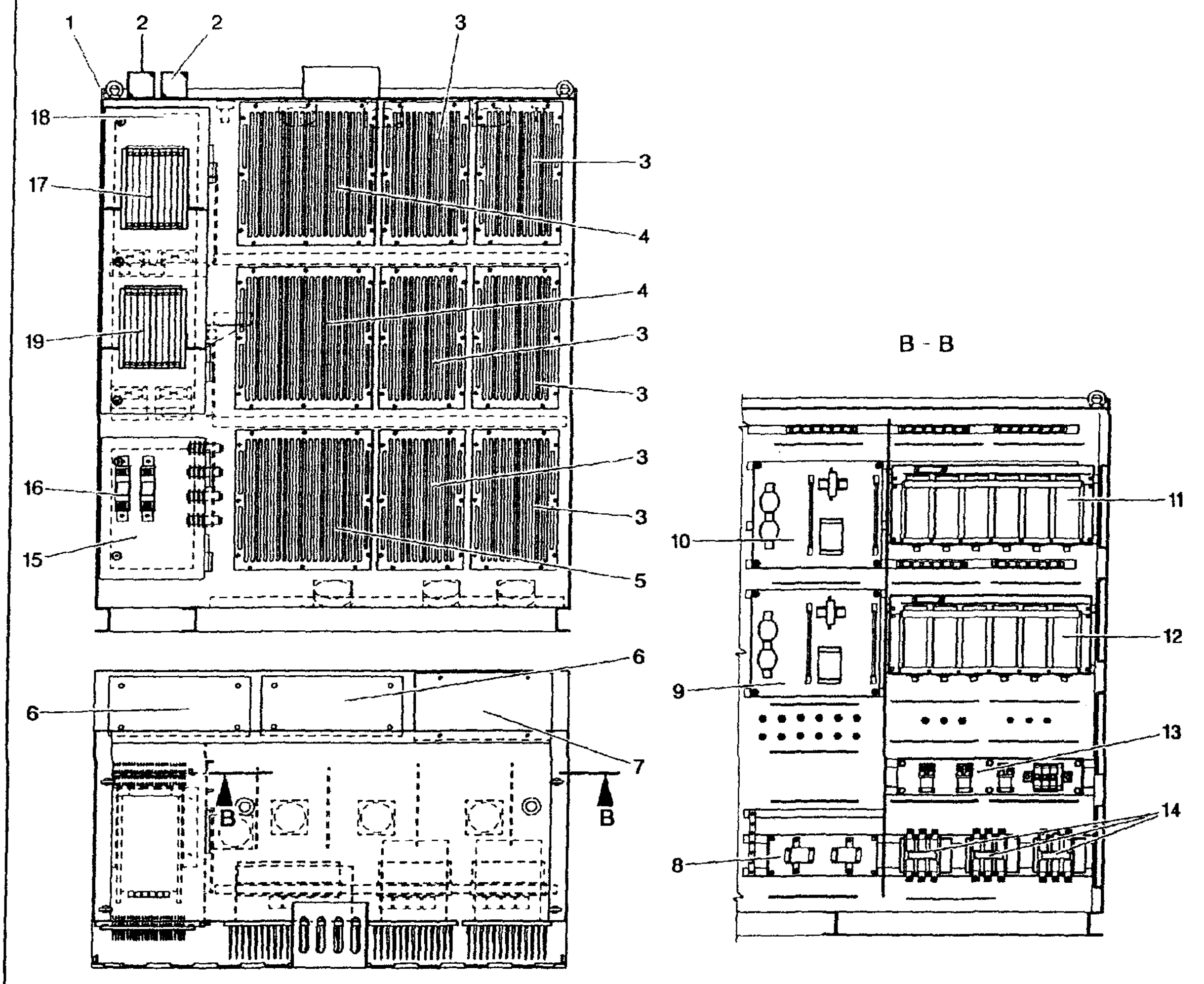
1	BUR-Box_1 "BUR1" (1050.1)	7	Capacitor bank (51.1/1)
2	Voltage indicator (51.4)	8	Three-phase output choke (50.9)
3	Cover Plate	9	Door, junction cubicle
4	Inverter module "WRE 445.3" (50.12)	10	Fuse (40)
5	Rectifier module "GG 576.3" (50.11)	11	Control electronics (426/1)
6	Protective measurement group	12	Door, electronic cubicle



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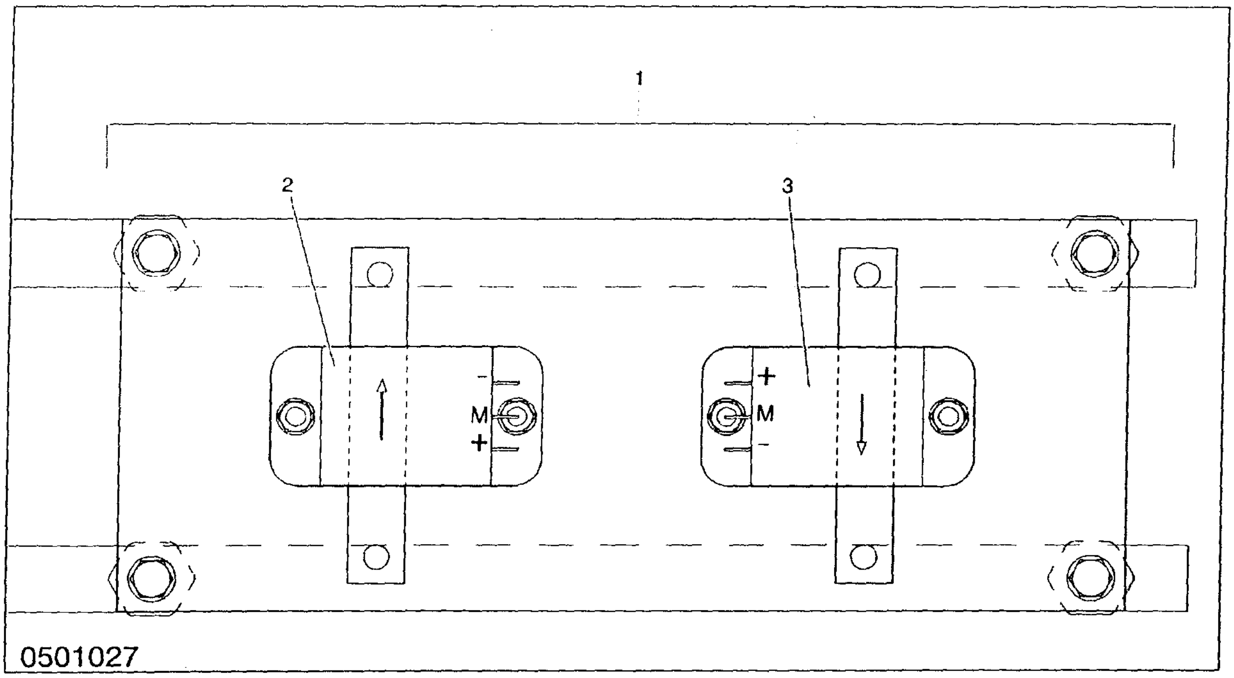
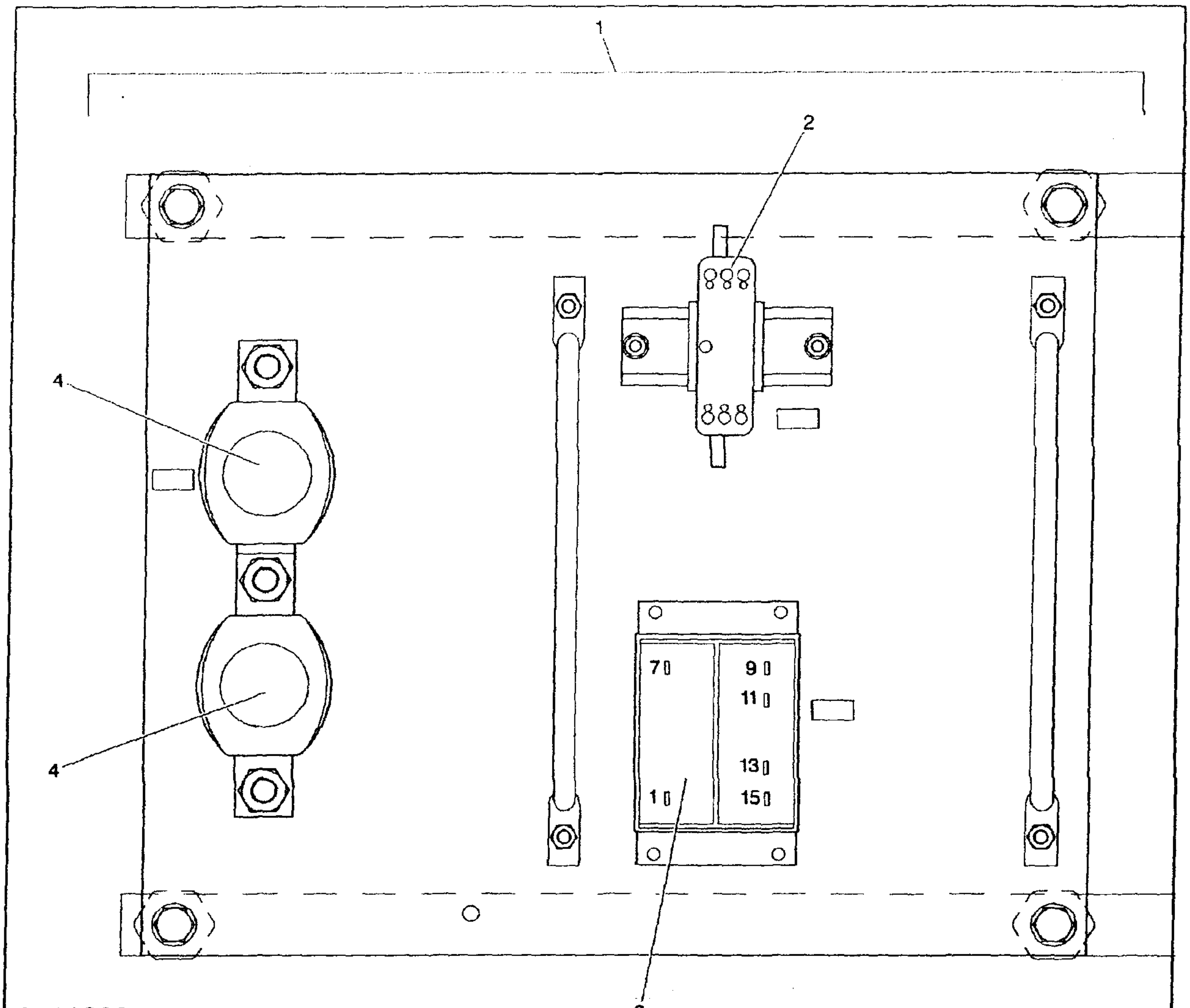
1	BUR-Box_2 (BUR2 & BUR3) (1050.2)	10	Protective measurement group provided for BUR2
2	Voltage indicator (51.4)	11	Capacitor bank (51.1/2)
3	Inverter module "WRE 445.3" (50.12)	12	Capacitor bank (51.1/3)
4	Rectifier module "GG 576.3" (50.11)	13	Protection group
5	Battery charger module "BL" 172.5 (107)	14	Three-phase contactor (52)
6	Three-phase output choke (50.9)	15	Door, junction cubicle
7	Transformer battery charger (107.1)	16	Fuse (40)
8	Current sensor module	17	Control electronics (426/2)
9	Protective measurement group for BUR3	18	Door, electronic cubicle
		19	Control electronics (426/3)



1	Current sensor module	3	Current sensor, battery charger (107.3)
2	Current sensor, battery charger (107.2)		



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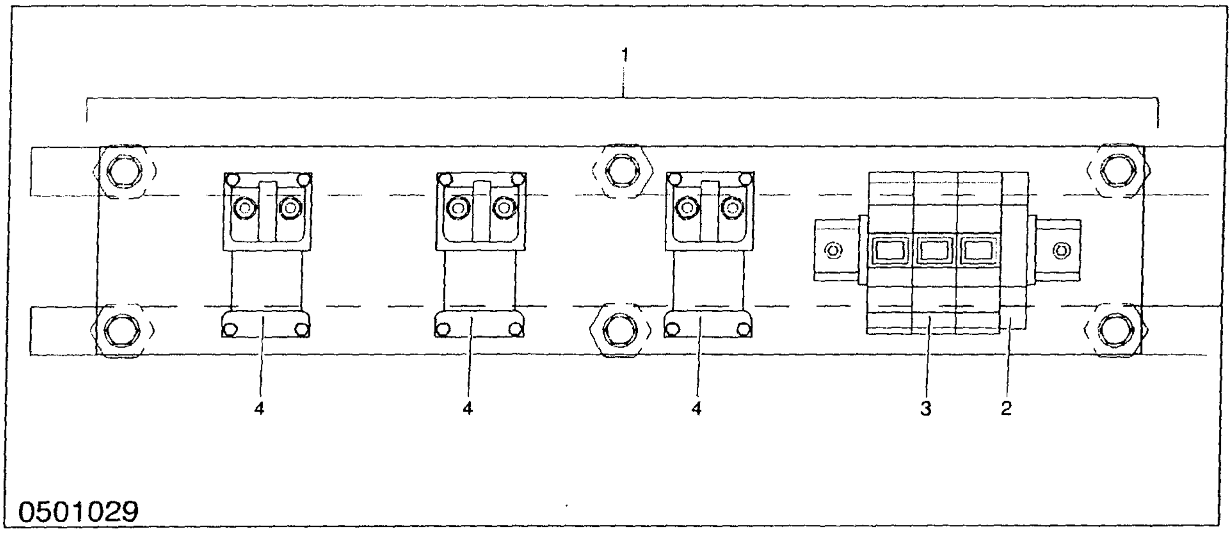
1	Protective measurement group	3	Synchronisation transformer (51.7)
2	Voltage transducer (51.5)	4	Surge arrester (40.1)



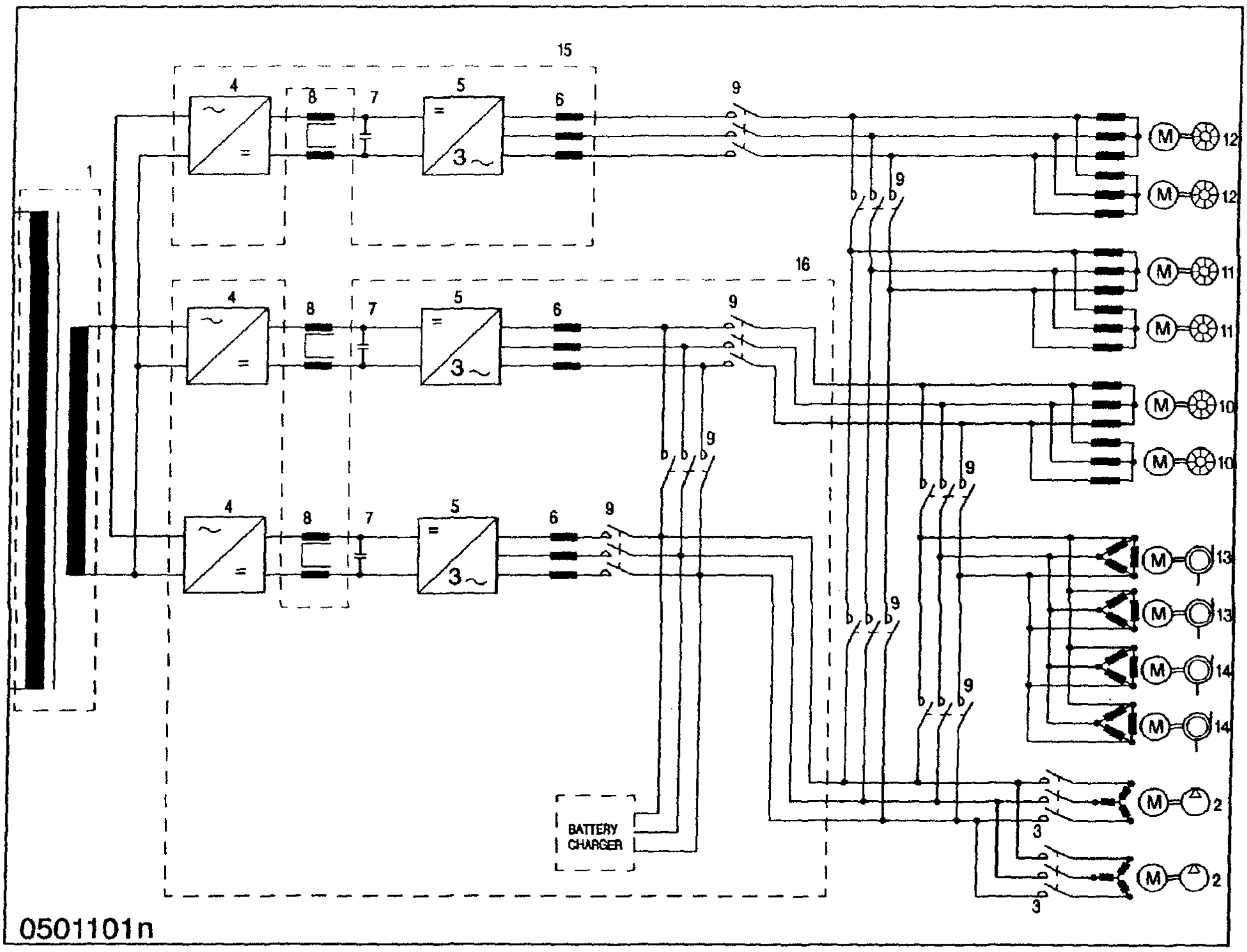
1	Protection group	3	Contactor in the battery-load circuit (100)
2	Varistor (52.A)	4	Contactor (52.3)

Numbers in brackets denote the electrical equipment apparatus item number used in the locomotive schematics, refer to Volume G, Cabling Documentation.

Functional Description

@.1140

General Description



1	Main transformer (7)	10	Traction motor blower (53)
2	Main compressor (47)	11	Scavenge blowers, traction motor/oil cooler blowers (55)
3	Contactors, main compressor (47.2)	12	Oil cooling unit, transformer/converter (59)
4	Rectifier module (50.11)	13	Oil pump transformer (62)
5	Inverter module (50.12)	14	Oil pump converter (63)
6	Three-phase output choke (50.9)	15	BUR-Box_1 "BUR1" (1050.1)
7	Capacitor bank, DC-Link (51.1)	16	BUR-Box_2 "BUR2 & BUR3" (1050.2)
8	DC-Link choke (51.3)		
9	Contactors (52)		

The three-phase power required to power auxiliary loads is supplied by the auxiliary converters (BUR1-3) which are fed from a secondary winding on the main transformer (7).

The following loads are connected to the auxiliary converters "BUR 1-3" (1050.1, 1050.2):

- Traction motor blowers (53)
- Oil cooler blower (59)
- Scavenge blowers, traction motor and oil cooling blowers (55)
- Transformer oil pumps (62)
- Traction converter oil pumps (63)
- Main compressors (47)
- Battery charger (107)

The auxiliary circuits are controlled as required. The traction motor and oil cooling blowers run only when required. The control electronics adjusts the blower speeds depending on measured operating temperatures, nominal traction values and speed.

Transformer and traction converter oil pumps work continuously whenever the auxiliary converters are operating.

For further information regarding the auxiliary converters, refer to Volumes F7 and F8, Suppliers Documentation.

Fault finding for the auxiliary converters is given in Chapter 5, Maintenance of Volume F8, Suppliers Documentation.

Three-Phase Power

Each locomotive is equipped with two boxes enclosing the static auxiliary converters system divided as follows:

- BUR-Box_1 contains one auxiliary converter (BUR1).
- BUR-Box_2 contains two auxiliary converters (BUR2 and BUR3) and the battery charger, which may be fed from one of the auxiliary converters and which may be considered a functional part of the converters system.

Three auxiliary converters are designed for connection to the auxiliary services winding of the main transformer. They feature a short-circuit-proof three-phase output with a rated voltage of 415 V. Each converter is rated for an output power of 100 kVA. The output frequency of the converters BUR1 and BUR2 is available from 0 to 50 Hz, while the output inverter of BUR3 works at 50 Hz (fixed frequency). They can feed inductive and resistive loads.

Under normal conditions the three-phase auxiliary supply is divided as follows:

- BUR1 is connected to both oil cooling blower units.
- BUR2 is connected to both traction motor blowers, both traction converter oil pumps and both transformer oil pumps.
- BUR3 is connected to both main compressors, both traction motor blower/oil cooler scavenge blowers and the battery charger.

Should one auxiliary converter fail, all auxiliaries will be connected to the two remaining auxiliary converters by switching the contactors (52) in a suitable manner.

The battery charger with a rated output of approximately 111 V charges the locomotive batteries and supplies the low voltage loads. The low-voltage output is electrically insulated from the input and from the three-phase output.

The converter requires externally supplied forced air cooling (5 m/s approximately). Inside the box, thermostats are located in the power cubicle. When the temperature is above 50 °C, fans run until the temperature drops below 35 °C. Fans run continually in the electronic cubicle.

Auxiliary converter functions are controlled by the MICAS S2 control electronics, located in the control electronics modules (426). These control modules are described in Chapter 5.2, Auxiliary Converter Control.

Both BUR cabinets and the three phase output chokes are mounted in the machine room. The cabinets are constructed from stainless steel to provide resistance to corrosion in salty and humid conditions.

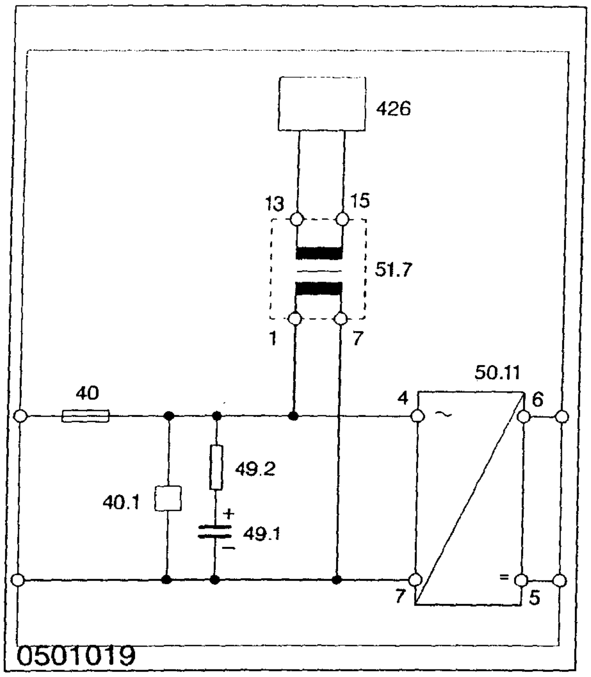
The auxiliary converter DC-Link chokes are situated within the transformer tank. The chokes are cooled by the circulation of the transformer oil. The DC-Link capacitor bank serves as an intermediate storage device for the power supplied by the rectifier module. The DC-link servers to smooth the pulsed output from the rectifier module, and to provide a constant power source to the inverter modules.

Modules and Circuits in BUR-Box_1 (1050.1)

The functional description can be divided into four modules and circuits:

- Input Circuit
- Rectifier Module (50.11)
- DC-Link
- Inverter Module (50.12)

Input Circuit



The Input Circuit contains the following components:

- Input Fuse (40)
- Surge Arrester (40.1)
- Synchronization Transformer (51.7)

Filter capacitor (49.1) and filter resistor (49.2) form the input filter for the auxiliary circuits. These items are located in 415/110 Volt auxiliaries cubicle HB2. The one input filter serves all three BUR's.

Input Fuse (40)

The fuse protects the circuit from serious damage, which could result in the event of failure of power components in the rectifier bridge or regulation defects in the actual value monitoring.

Surge Arresters (40.1)

The surge arresters protect the semiconductors of the rectifier bridge (50.11) from over-voltage peaks.

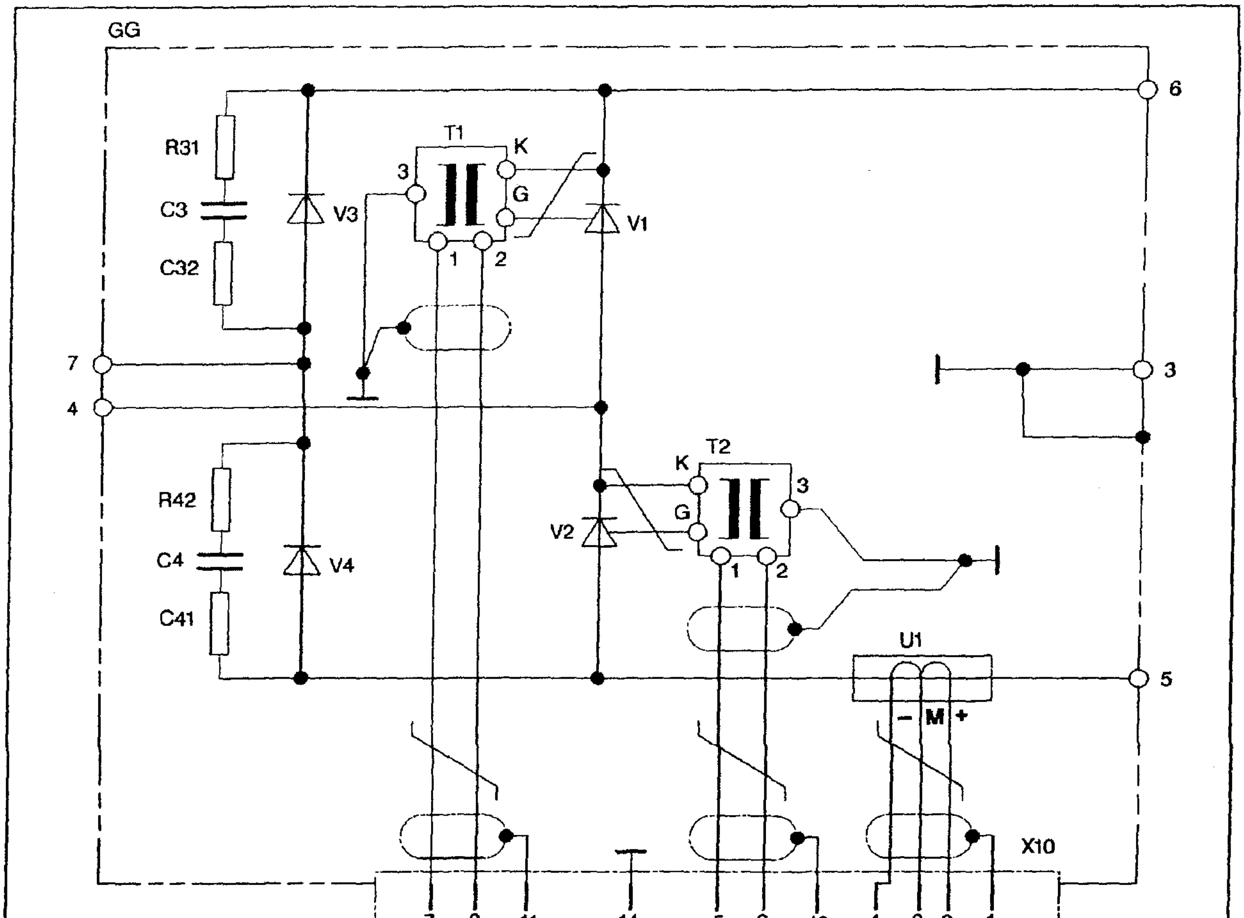
Input Filter (49.1, 49.2)

The input filter limits the rate of rise of voltage peaks in order to avoid spurious thyristor firing. The input filter is located in cubicle HB2, within the machine room.

Synchronisation Transformer (51.7)

The measuring transformer is used to provide the electronic control unit (426) with information about voltage amplitude and voltage phase required for accurate generation of the thyristor firing pulses.

Rectifier Module (50.11)



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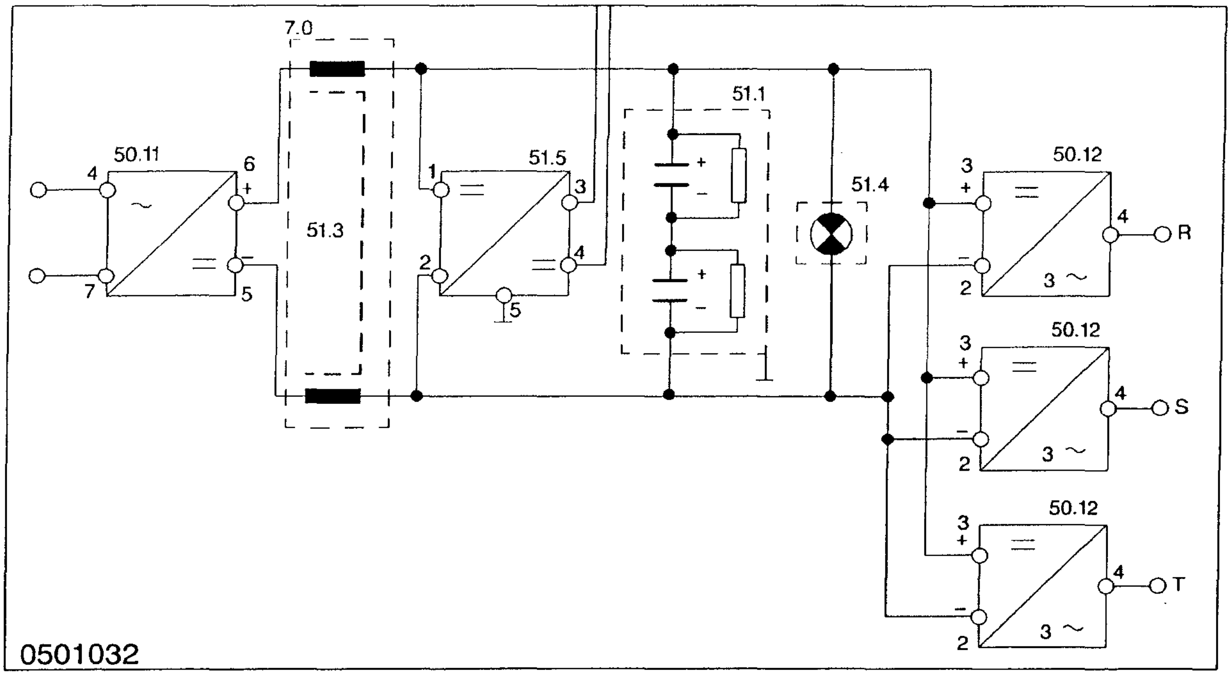
The GG-Module (576.3) is used to convert alternating voltage into DC-voltage. An external triggering unit is required for control purposes. The connection between the triggering unit and the module is performed via a multipolar signal cable. The rectifier used is designed as a half-wave asymmetrical bridge.

Two firing pulse transformers are used to provide the electrical insulation between the power circuitry and the electronic control and to forward the control signals to the thyristors. The diodes are equipped with an RC-snubber to attenuate any over-voltages.

The thyristors do not require a protection circuit as they are always commutated down at zero voltage and thus the reverse block voltage increases slowly.

The rectifier bridge is of half-controlled asymmetrical design. The rectifier reduces the input voltage UN, which can vary from 700 to 1,200 Volt depending on the overhead line voltage, to a stabilised value of approx. 550 Volt.

DC-Link



The DC-Link Circuit is connected between the Rectifier Module (50.11) and the Inverter Module (50.12). It contains the following components:

- LC-Filter (51.3; 51.1)
- Voltage Transducer (51.5)
- Voltage Indicator (51.4)

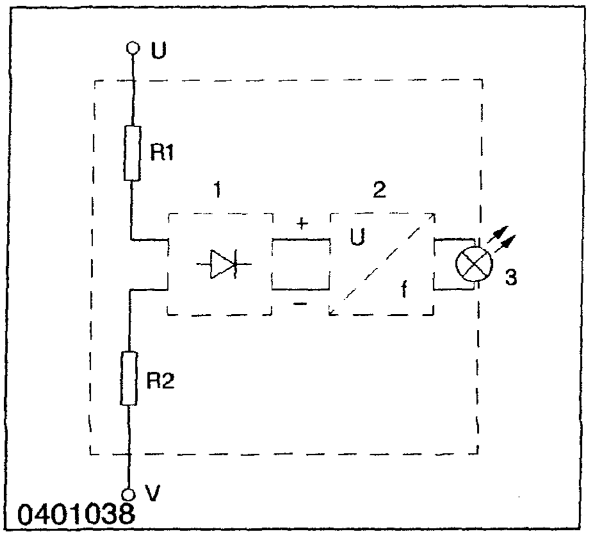
LC-Filter (51.5; 51.2)

The LC-Filter serves to smooth the rectified voltage and as a power reservoir for peak power requirements of the converter. The reactor is situated in the transformer tank and the capacitors in the BUR cabinets.

Voltage Transducer (51.5)

The voltage transducer serves to measure the intermediate circuit voltage UZ. It consists mainly of two resistors of 7 MW each dividing the actual voltage by 100 and supplying a low-voltage signal to the control unit.

Voltage Indicator (51.4)



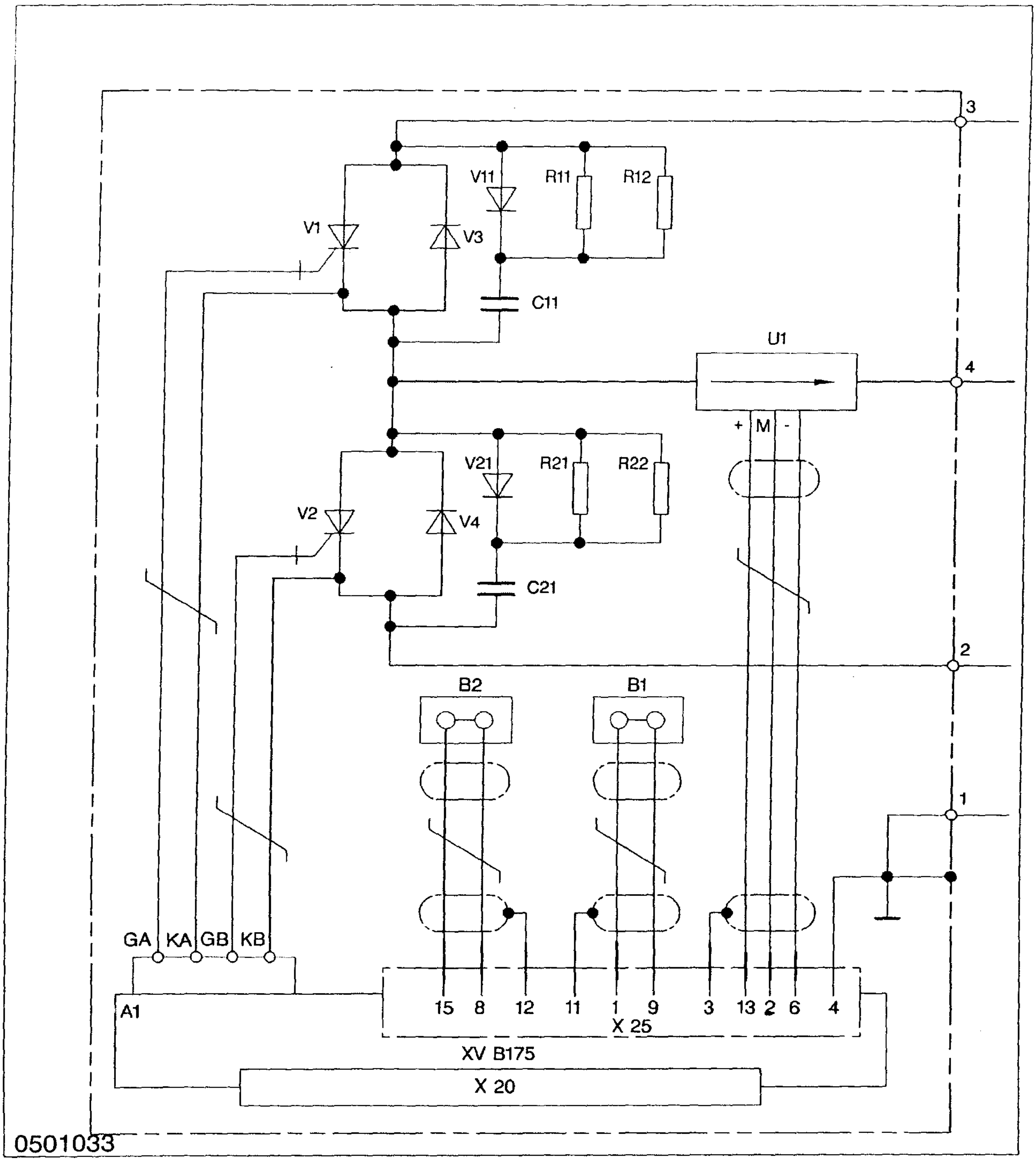
For safety, the auxiliary converter circuits contains voltage indicators to warn of dangerous voltages.

A light-emitting diode (LED) in the voltage indicator flashes at a rate proportional to the auxiliary converter DC-link voltage. The higher the voltage in the DC-link, the faster the LED flashes.

The voltage indicator is connected via connections U and V to the DC-link; which also provides the power supply to the indicator. The circuitry in the voltage indicator has a symmetrical design and is thus independent of the polarity and potential of the DC-link voltage.

The voltage indicator is situated on top of the auxiliary converter cubicles. BUR-Box_1 has one voltage indicator for BUR1, and BUR-Box_2 has two voltage indicators, one each for BUR2 and BUR3.

Inverter Module (50.12)



The WRE-Module (445.3), with an RCD snubber circuit, is part of the three-phase inverter.

Three of these single-phase modules are connected directly to the DC-Link. They generate a three-phase AC-voltage from the intermediate circuit DC-voltage by being appropriately switched on and off.

In steady state operating conditions, both voltage frequency and amplitude correspond to the set point, while in dynamic conditions these values can be set away from the reference value by Pulse Width Modulation (PWM) for better control of the process.

The two-channel gate-drive units are mounted on the modules. The protection logic integrated into the drive-unit monitors the phase current. Both gate channels are interlocked in order to avoid simultaneous firing of the Gate-Turn-Off thyristors (GTOs).

The WRE-Module is designed as a half-bridge circuit. The module is supplied with a DC-voltage at the (+) and (-) input terminals. The two GTO thyristors TH1 and TH2 are switched with the required sequences by a trigger unit.

The two diodes DH1 and DH2 are connected back-to-back with the GTO's, so that the inductive load current can continue to flow whenever a GTO is turned off. This prevents dangerous switching over-voltages.

Each GTO is provided with an RCD snubber circuit in order to limit the voltage stress. The snubber on one hand limits the rate of rise of the voltage when turning off the GTO, while on the other hand it absorbs the magnetic energy stored in the supply line stray inductance (between the DC-voltage source and the inverter) and thereby limits the over-voltage. If the GTO is switched on again, the snubber capacitor is discharged.

Protective Measurement Group

This module contains the following components:

- Surge Arrester (40.1)
- Voltage transformer DC-link (51.5)
- Synchronisation transformer (51.7)

Although the components mentioned are mounted on the same plate, they do not belong to the same circuitry.

Modules and Circuits in BUR-Box_2 (1050.2)

Operation of the auxiliary converter can be divided into the following modules and circuits:

- Input circuit
- Rectifier module (50.11)
- DC-link
- Inverter module (50.12)
- Protective measurement group
- Battery charger module (107)
- Protection group
- Current transducer module
- Three-phase contactor group

All of the functional descriptions are given in the Section BUR-Box_1, except for the Battery Charger Module, the Protection Group, the Current Transducer Module and the Three-Phase Contactor Group.

Battery Charger Module (107)

The Battery Charger Module consists of a six-pulse diode rectifier connected to the three-phase output of the static converter. The battery voltage regulation is performed by controlling the amplitude of the AC-voltage supplied to the charging transformer in such a way that the rectified mean value corresponds to the required DC level. The AC-amplitude may very easily be varied through control of the alternator excitation or the DC-Link voltage of the static inverter.

Protection Group & Three-Phase Contactors (52.3, 100, 52)

The protection group has three contactors (52.3) and the high performance automatic contactor in the battery-load circuit (100).

The contactors (52.3) are connected as working contacts. Their primary windings are controlled by the control electronics (426). The auxiliary windings of the contactors (52.3) can induce a current in the primary windings of the three-phase contactors (52). Depending on whether the primary windings of the three-phase contactors (52) are active with current or not, the connections from the auxiliary converter to the loads close or remain open accordingly.

The high performance automatic contactor in the battery-load circuit (100) cuts off the battery (111) from the circuit and thus interrupts battery charging.

The three-phase contactors (52) close the circuit of the various blowers, oil pumps and cooling systems.

Current Sensors (107.2, 107.3)

The current sensor group comprises two current sensors (107.2, 107.3) which monitor battery charging. When the currents through the two sensors are not equal, the control electronics switches off battery charging. In such cases, a danger exists due to the leakage of current.

Technical Data

@.1160

Static Converter

Dimensions, Weight And Thermal Losses

BUR-Box_1

- Dimensions (LxWxH)	1,160 x 1,000 x 1,800 mm
- Weight	608 kg
- *Thermal losses (at rated power)*	2 kW

BUR-Box_2

- Dimensions (LxWxH)	1,520 x 1,000 x 1,800 mm
- Weight	1,030 kg
- Thermal losses (at rated power)	5 kW

Input

- Supply voltage (nominal value)	1 kV AC
- Minimum voltage to maintain performance	0.7 kV AC
- Maximum voltage to maintain performance	1.2 kV AC
- Apparent power (nominal value)	100 kVA
- Current (RMS)	150 Amp
- Frequency	50 Hz

Intermediate Circuit

- Filter voltage (depending on load)	550 Volt DC
- Rated current IZrat	155 Amp DC
- Short-term overload (4s)	190 Amp DC
- Rated insulation voltage (capacitors)	900 Volt

Control Unit

- Supply voltage	77 - 137.5 Volt DC
- Power consumption	120 Watt

Cooling Ventilator

- Ventilator supply voltage	36 to 56 Volt DC
- Power consumption	5 Watt
- Air flow rate	5 m/s

Tolerance Data

- Peak Voltage Û	4.0 kV
- Current Imax	20 Amp
- Operating temperature	-60 to +75 °C

Test Data

- Test Voltage UT (coating to coating)	3.0 kV / 60s
- Tangent of voss angle (tan δ)	$< 3*10^{-4}$
- Time constant τ	$\geq$ 3000 s

Battery Charger Module (107)

- Weight	29 kg
- *Test voltage (during 60 s)*	*1.5 kV / 50 Hz*
- Maximum power	638 Watt
- Nominal isolation voltage	150 Volt
- Nominal power loss	446 Watt
- Cooling air temperature	- 40 to + 45 °C
- Nominal input power	21.4 kW
- Nominal input voltage UN (RMS)	77.8 Volt
- Nominal input voltage ÛN	110 Volt
- Maximum input voltage Umax (RMS)	113 Volt
- Maximum input voltage Ûmax	160 Volt
- Minimum input voltage Umin	0.0 Volt
- Transient input over-voltage U (RMS); (max. of 5 times per hour for a duration t <60s)	130 Volt
- Transient input over-voltage Û	184 Volt
- Nominal input current IN (RMS)	155 Amp
- Nominal input current ÎN	190 Amp
- Maximum input current *I* (RMS)	204 Amp
- Maximum input current Î	250 Amp
- Nominal input frequency fN	50 Hz
- Input frequency	10 - 70 Hz
- Nominal output power PN	20.9 kW
- Nominal output voltage UN	111 Volt
- Maximum output voltage Umax	160 Volt
- Minimum output voltage Umin	0.0 Volt
- Transient output over-voltage; (maximum of 5 times per hour, for a duration t <60s)	184 Volt
- Nominal output current IN	10 Amp
- Maximum output current Imax	250 Amp
- Transient output overcurrent (t <10ms)	2.5 kA

Three-Phase Output Choke (50.9)

- Nominal inductance LN	0.35 mH
- Nominal peak voltage Û	600 Volt
- Nominal current I (RMS)	140 Amp
- Maximal peak current Î	700 Amp
- Frequency range f	0 to 55 Hz
- Maximum temperature υmax	80 °C
- Maximum humidity	100 %
- Mass m	95 kg

Transformer Battery Charger (107.1)

- Primary peak voltages Û1	3*532 V
- Secondary peak voltages Û2	3*113 V
- Primary peak current Î2	110 A
- Maximum temperature υmax	80 °C
- Noise level NL	< 70dB
- Mass	150 kg

Varistor

- Coil voltage UC (RMS)	110 Volt
- Frequency range	0 to 60 Hz
- Maximum coil power	100 VA
- Attenuation factor	165 Volt
- Operational temperature	- 20 to + 70 °C

Rectifier

- Rated alternating voltage U (RMS)	800 Volt
- Rated current I (RMS)	15 Amp
- Maximum peak current Î	300 Amp
- Operational Temperature	- 65 to + 175 °C

Measurement Transformer

- Primary voltage U1 (RMS)	1.3 kV
- Secondary voltage U2 (RMS)	7.22 Volt
- Secondary current I2	30 mA
- Frequency f	16.67 Hz
- Deviation at I2 = 5 mA	0.05 %

Thyristor

- Clamping force FC	12 kN

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

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

- Cathode Ray Oscilloscope for testing the firing pulses and the current transformers
- Pulse current clamp meter for testing the firing pulses
- Digital voltmeter for testing the current transformer. Alternatively a cathode ray oscilloscope may be used
- Crimping pliers
- Dummy plug to test the voltage (suitable for module plug)
- Resistance meter
- Capacitance meter

Miscellaneous Materials

@.1200

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

- Molycote White is required to be applied whenever threads are to be greased
- Water spray or a stiff brush and water is needed for cleaning the module heatsinks
- Sealing tape is required for the air supply duct on the machine room floor
- Cable ties are required to secure electrical cables and harnesses

Before-Removal Operations

@.1220

Lower the pantograph and isolate the locomotive from the overhead catenary. Earth the locomotive using the key interlocking system. Refer to the Preface of this Volume.

Ensure the voltage indicators on the BUR cubicles are not flashing. From the time the locomotive is powered down, it can take approximately 5 minutes to completely discharge the capacitors. 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.

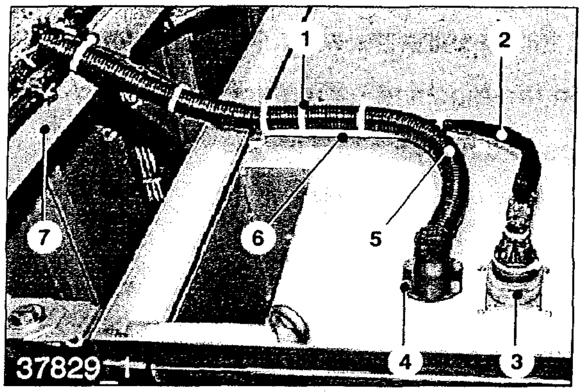
Isolate the batteries at the battery box isolation switch, as described in Chapter 5.3, Battery / Charger.

Remove the appropriate pantograph roof hatch from the locomotive as described in Chapter 1.1, Structure.

Removal

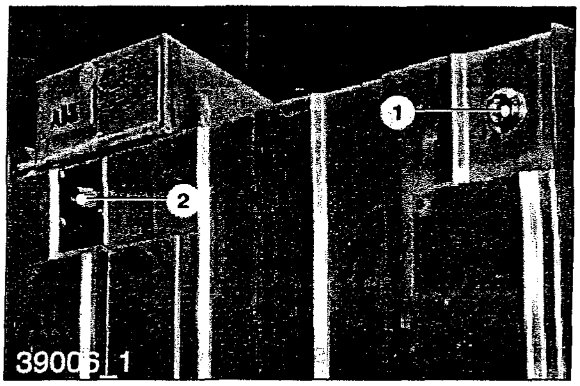
@.1230

BUR-Box_1 (1050.1)

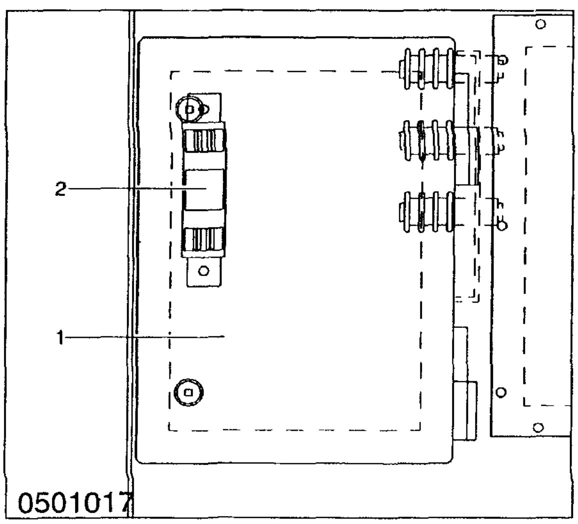


Tag and disconnect the cables 50.X1 (2) and 50.X2 (5) from the sockets at the top of the converter cubicle. Connection 50.X1 (2) is disconnected by unscrewing the retaining ring (3). Connection 50.X2 (5) is disconnected by removing the screws (4).

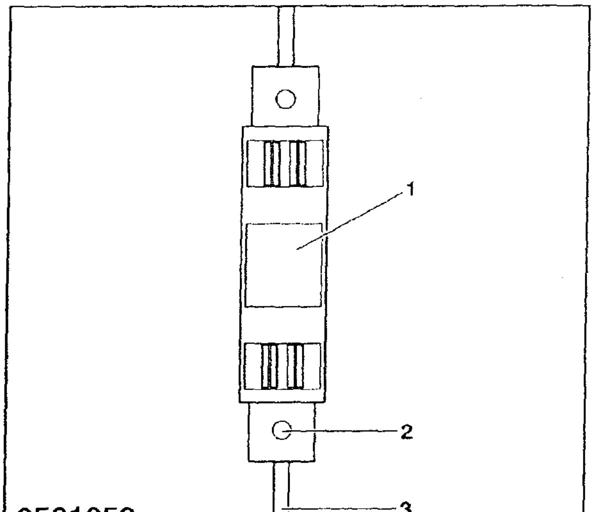
Cut the cable ties (1) which secure the cables (2, 5) on the looming bar (6). Lay cables (2, 5) carefully over the cable rail (7).



Open the lock (2) with a green key and the locks (1) with the appropriate square keys. Access can only be gained to the modules if the doors are removed. Operation of the key interlocking system is described in the Preface of this Volume.



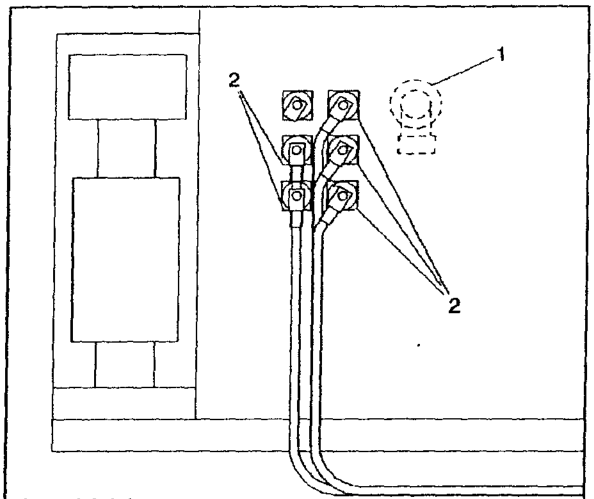
Open the connecting block door (1) using a square key to access the fuse (2) and high voltage connections.



0501059

The fuse (1) is mounted on the rear wall. It is connected below to the main transformer.

Tag and disconnect the cables from the fuse block (2) terminals. Remove nut (2), spring washer and washer. Remove the screw and disconnect the cable (3).



0501061

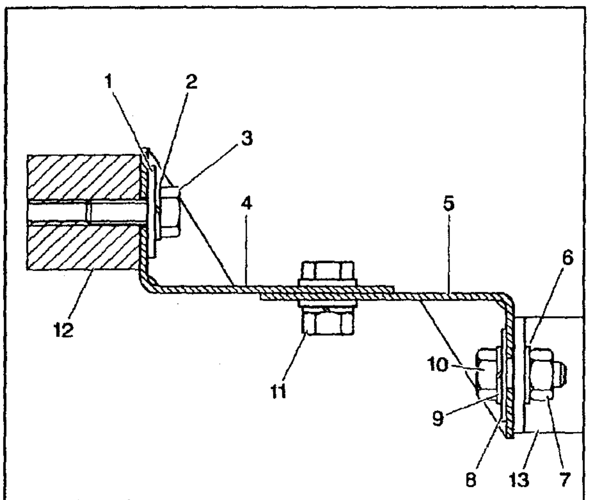
Tag and disconnect the harness (50.X4) from the socket (1).

Tag and disconnect the high voltage connections (2) from the terminals.

Cut the cable ties securing the cables and harness to the looming bars.

Take the cables and harness through the connecting block door and lay them carefully on the machine room floor.

Chock the connecting block door (1) open.



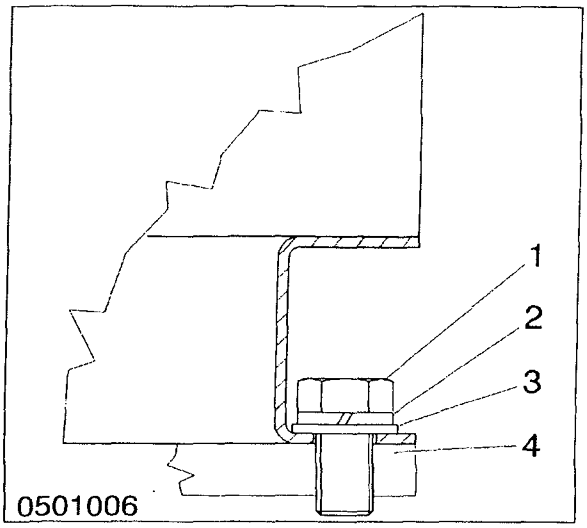
0501002a

Remove the bolt (10), spring and plain washers (9, 8), plain washer (6) and nut (7) securing the bracket assembly (4, 5) to the auxiliary converter (13).

Support the bracket to prevent it falling. Remove the bolt (3), plain and spring washers (1, 2) securing the bracket assembly (4, 5) to the machine room wall (12).

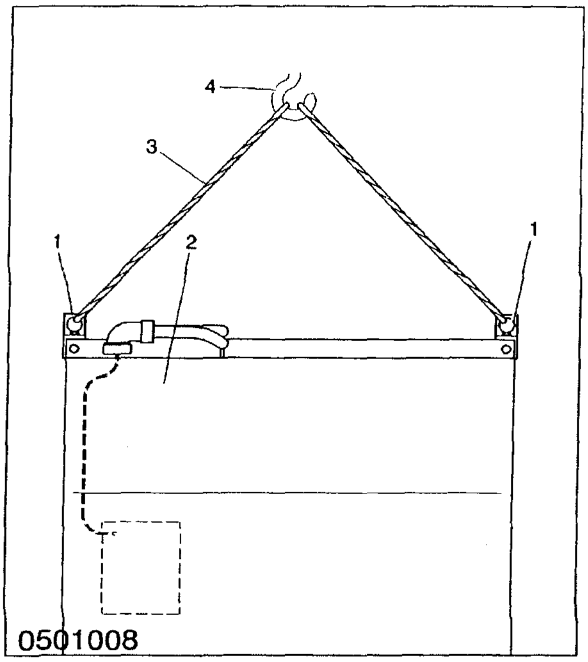
Remove the bracket assembly (4, 5). Remove the mounting bracket at the other side of the auxiliary converter in the same way.

There is no need to disassemble the bracket assembly (4, 5), unless it is damaged.



0501006

Remove the bolts (1), plain and spring washers (3, 2) securing each corner of the auxiliary converter to the machine room floor.

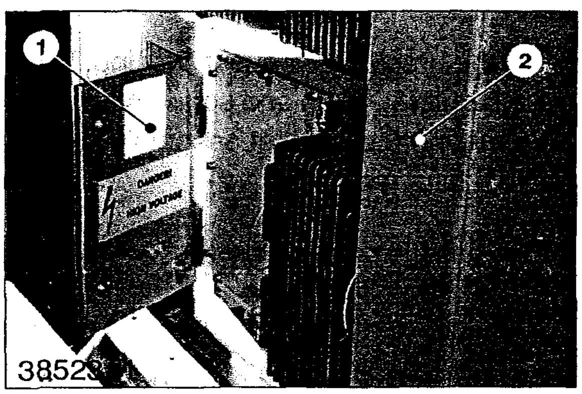


0501008

Attach suitable lifting equipment to the lifting eyes (1) on the auxiliary converter (2). Lay the cable (3) around the crane hook (4) in such a way that when lowering the auxiliary converter (2) the front tilts slightly forward.

Pull the auxiliary converter (2) forward slightly so that when raising it the converter does not contact the machine room wall.

Lift the auxiliary converter (2). Check to ensure that nothing is entangled between the auxiliary converter (2) and machine room.

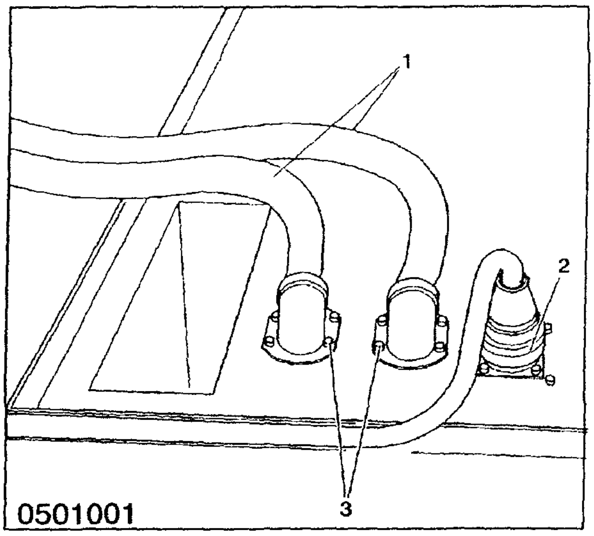


3852

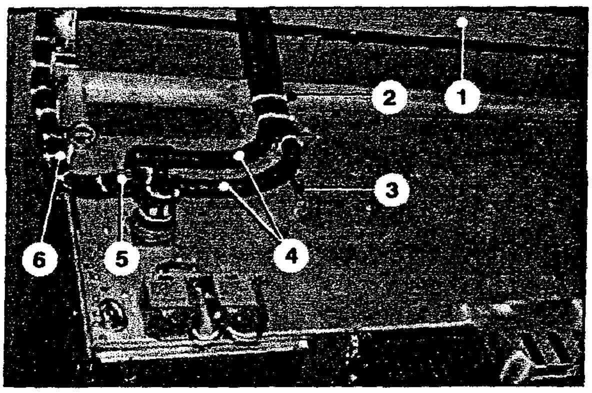
While raising the converter (2), when the converter is approximately 1/2 m above the machine room floor, bring the transformer and other cables through the connecting block door (1) then the bottom of the converter. Close the connecting block door.

Remove the auxiliary converter from the machine room.

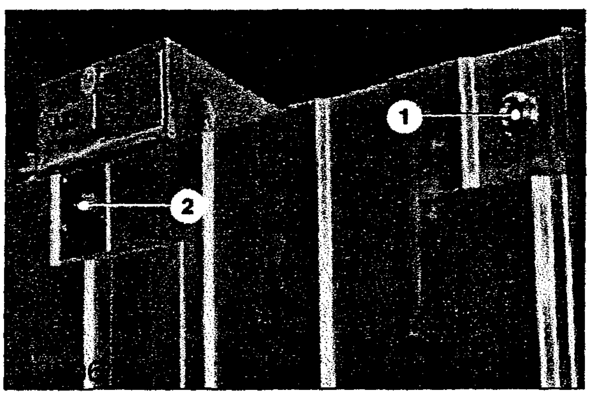
BUR-Box_2 (1050.2)



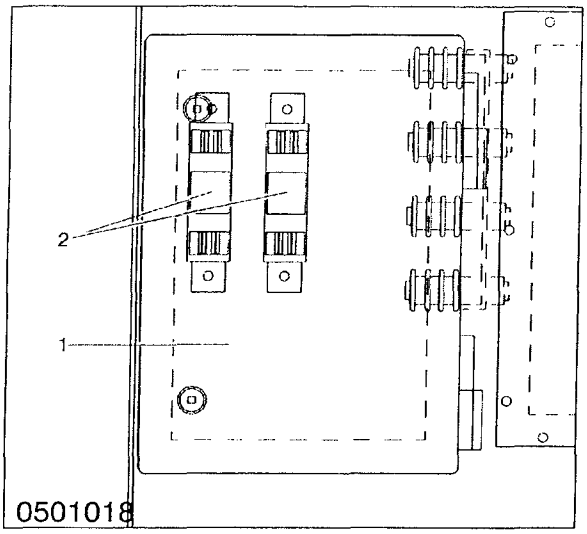
Tag and disconnect the cables 50.X1 (2), 50.X2 (3) and 50.X3 (3) from the sockets at the top of the converter cubicle. Connection 50.X1 (2) is disconnected by unscrewing the retaining ring. Connection 50.X2 and 50.X3 are disconnected by removing the screws (3).



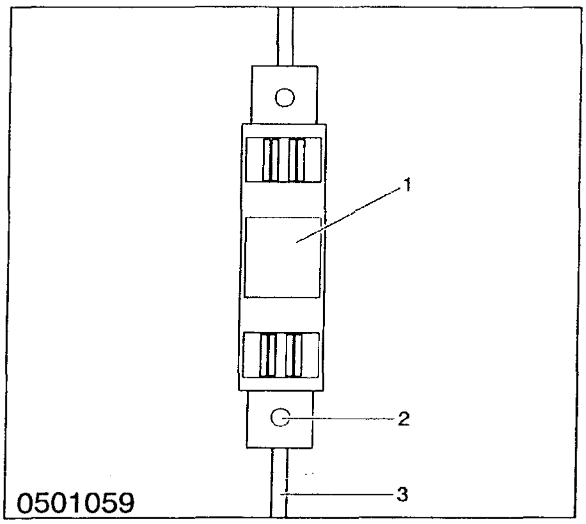
Cut the cable ties (6, 2) that secure the cables (4, 5) on the looming bar (3). Lay cables (4, 5) carefully over the cable rail (1).



Open the lock (2) with a green key and the locks (1) with the appropriate square keys. Access can only be gained to the modules if the doors are removed. Operation of the key interlocking system is described in the preface of this Volume.



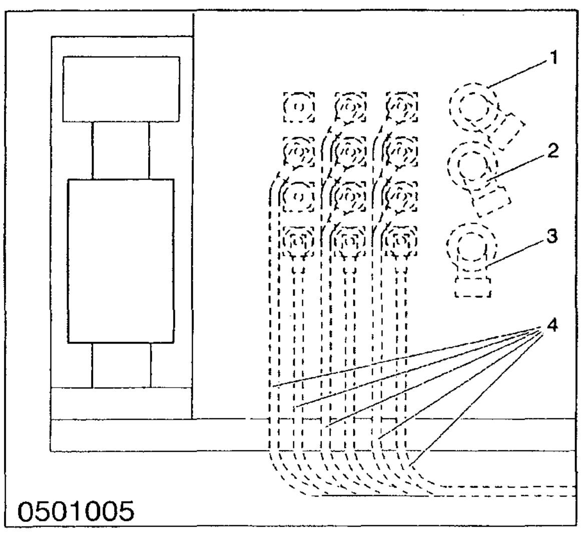
Open the connecting block door (1) using a square key to access the fuses (2) and high voltage connections.



The fuses (1) are mounted on the rear wall. They are connected below to the main transformer.

Tag and disconnect the cables from the fuse block (2) terminals. Remove nut (2), spring washer and washer. Remove the screw and disconnect the cable (3).

Repeat the procedure for the other fuse.



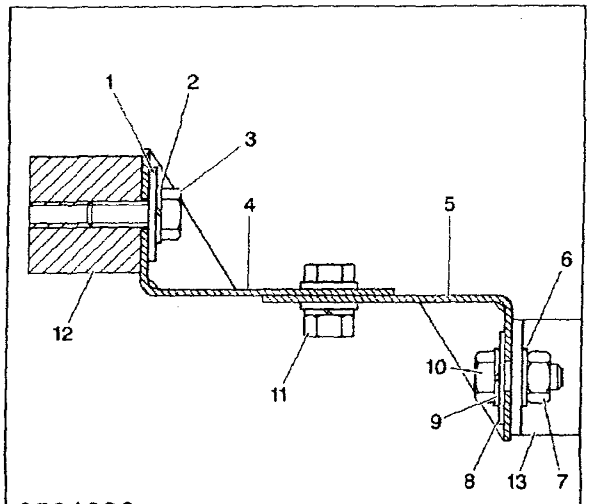
Tag and disconnect the harnesses (1, 2, 3) from the sockets.

Tag and disconnect the high voltage cables (4) from the terminals.

Cut the cable ties securing the cables and harness to the looming bars.

Take the cables and harness through the connecting block door and lay carefully them on the machine room floor.

Chock the connecting block door open.



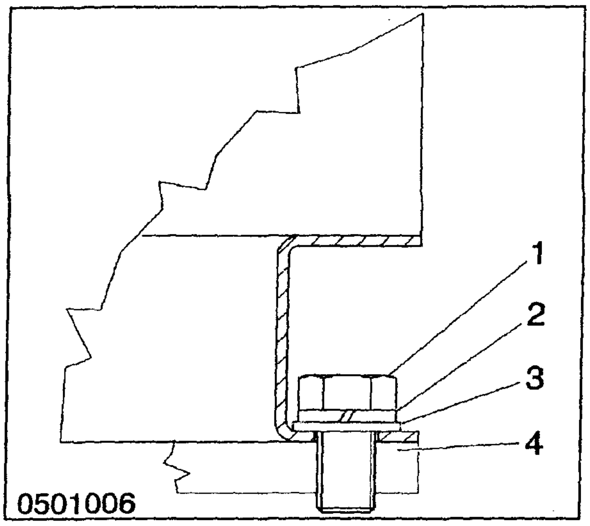
0501002a

Remove the bolt (10), spring and plain washers (9, 8), plain washer (6) and nut (7) securing the bracket assembly (4, 5) to the auxiliary converter (13).

Support the bracket to prevent it falling. Remove the bolt (3), plain and spring washers (1, 2) securing the bracket assembly (4, 5) to the machine room wall (12).

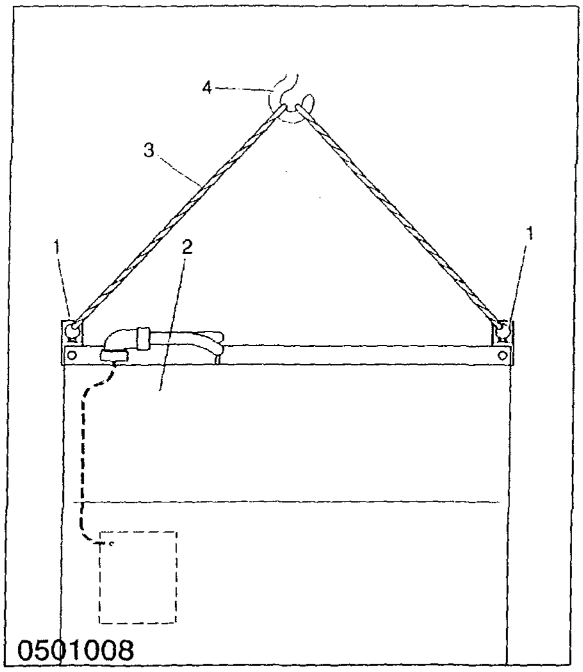
Remove the bracket assembly (4, 5). Remove the mounting bracket at the other side of the auxiliary converter in the same way.

There is no need to disassemble the bracket assembly (4, 5), unless it is damaged.



0501006

Remove the bolts (1), plain and spring washers (3, 2) securing each corner of the auxiliary converter to the machine room floor.



Attach suitable lifting equipment to the lifting eyes (1) on the auxiliary converter (2). Lay the cable (3) around the crane hook (4) in such a way that when lowering the auxiliary converter (2) the front tilts slightly forward.

Pull the auxiliary converter (2) forward slightly so that when raising it the converter does not contact the machine room wall.

Lift the auxiliary converter (2). Check to ensure that nothing is entangled between the auxiliary converter (2) and machine room.

While raising the converter (2), when the converter is approximately 1/2 m above the machine room floor, bring the transformer and other cables through the connecting *block door (1) then the bottom of the con*verter. Close the connecting block door.

Lift the converter (2) until the cables are clear of the door (1) opening, then close the door (1). Lift the converter (2) from the machine room.

Remove the auxiliary converter from the machine room.

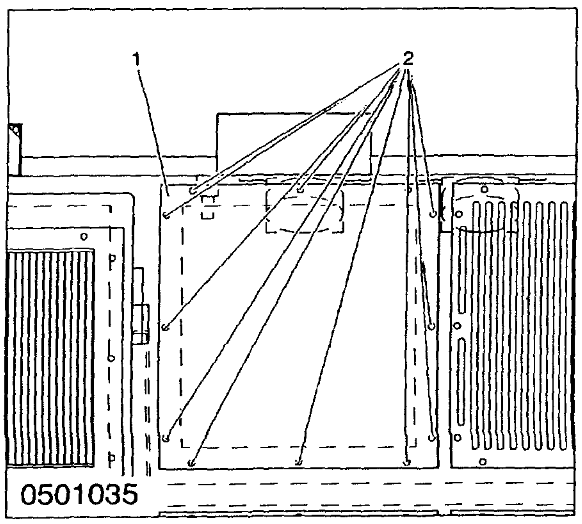
Disassembly

@.1240

NOTE:

The lower edges of the heatsinks of the battery charger, inverter and rectifier modules seat on angle brackets in the BUR cabinets. These angle brackets enable the modules to pivot along the lower edge and open outwards at the top, allowing the modules to lay horizontally, supported by cables attached between the modules and the BUR cabinet. Care must be taken when opening or removing the modules to prevent damaging the modules, or the components within the modules. Before opening any module, the heatsinks must be thoroughly cleaned to prevent any dirt, dust or debris from contacting the inner parts of the modules.

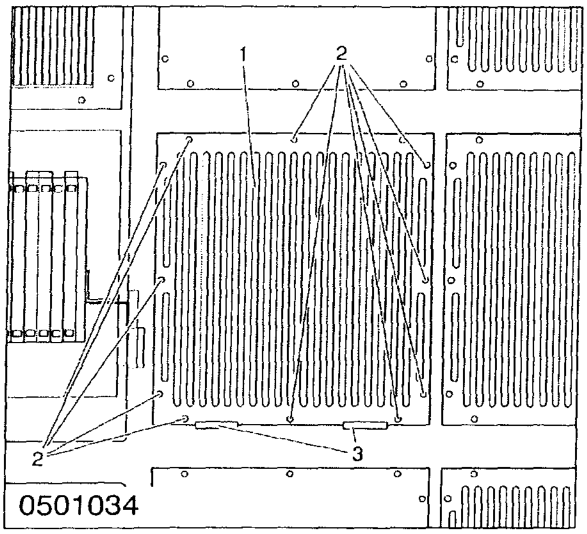
BUR-Box_1 Cover Plate



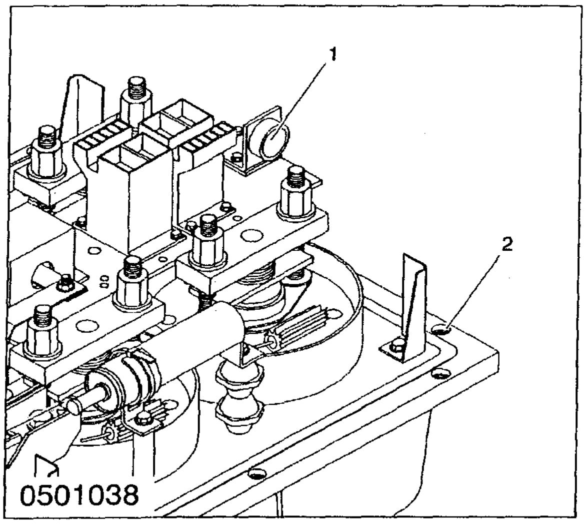
Remove the screws (2) and the washers.

Remove the covering plate (1).

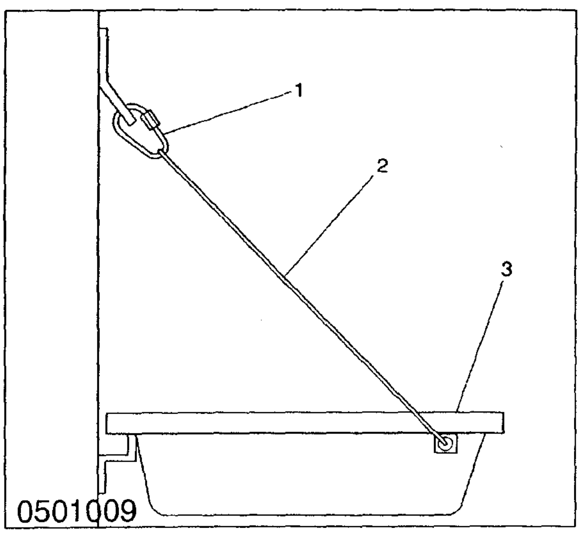
Rectifier Module (50.11)



Loosen the screws (2) securing the module (1) and carefully lower the module (1).



Disconnect the harness from the socket X10 (1) located at the back of the module (2).

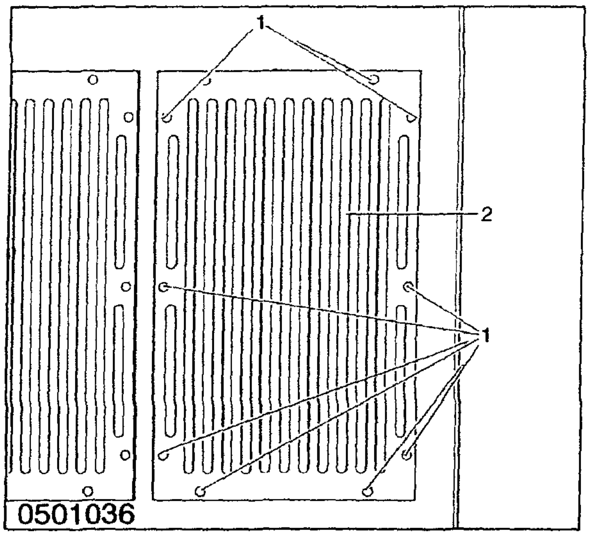


Support the module (3) to prevent it falling. Open one shackle (1), then lift the module (3) slightly and remove the fastening cable (2).

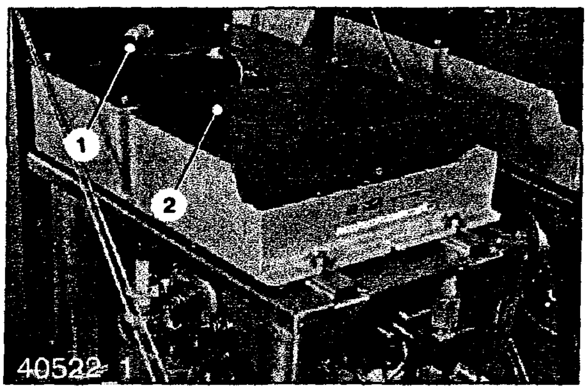
Open the other shackle (1), then lift the module (3) slightly and remove the fastening cable (2).

Remove the module (3) and store it in clean, dust-free covers until reassembly. The module must be protected against electrostatic charges.

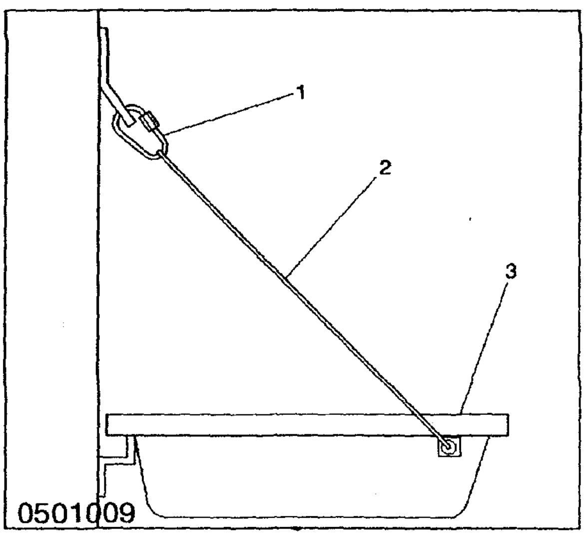
Inverter Module (50.12)



Loosen the screws (1) securing the module (2) and carefully lower the module (2).



Disconnect the harness from the socket X20 (1) located at the back of the module (2).

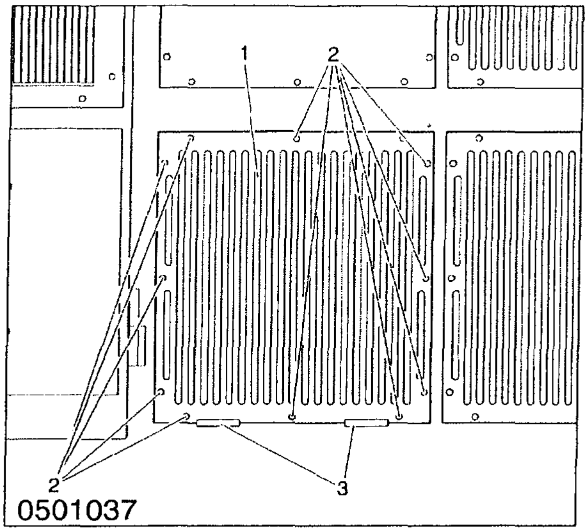


Support the module (3) to prevent it falling. Open one shackle (1), then lift the module (3) slightly and remove the fastening cable (2).

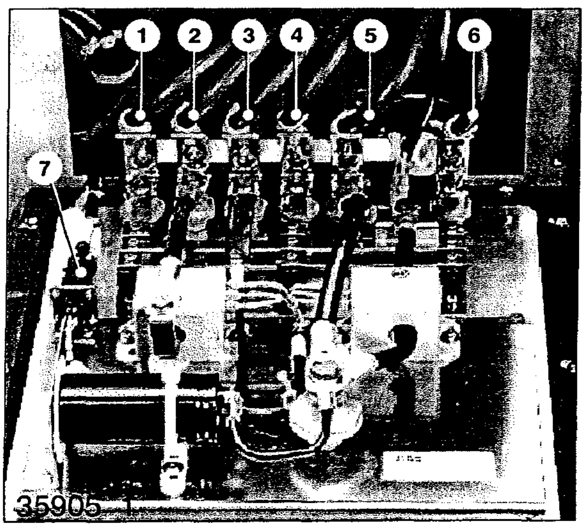
Open the other shackle (1), then lift the module (3) slightly and remove the fastening cable (2).

Remove the module (3) and store it in clean, dust-free covers until reassembly. The module must be protected against electrostatic charges.

Battery-Charger Module (107)



Loosen the screws (2) securing the module (1) and carefully lower the module (1).



Disconnect the harness from the socket (7) located at the back left hand side of the module (2).

The harness is fastened at the rear of the module. Remove the screws, plain and lock washers, and nuts.

NOTE:

The module must be removed in the sequence described below.

Tag and disconnect the cables from the electrical terminals in the following sequence. Remove the nuts and washers to disconnect the cables from the terminals.

Disconnect cable W (1) from pin 3.

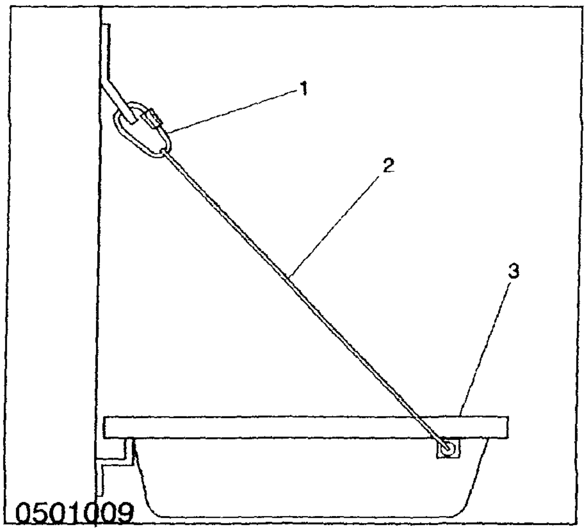
Disconnect the cable (2) from the current sensor 107.3, pin 5.

Disconnect the negative pole cable (3) from pin 6.

Disconnect the input cable V (4) from pin 2.

Disconnect the cable (5) from the current sensor 107.2.

Disconnect the input cable U (6) from pin 1.

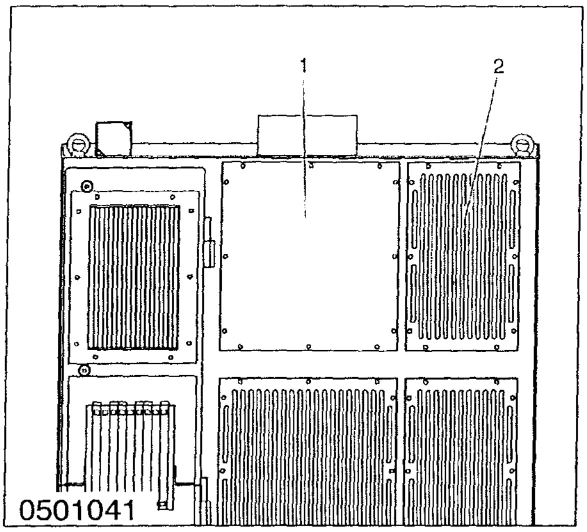


Support the module (3) to prevent it falling. Open one shackle (1), then lift the module (3) slightly and remove the fastening cable (2).

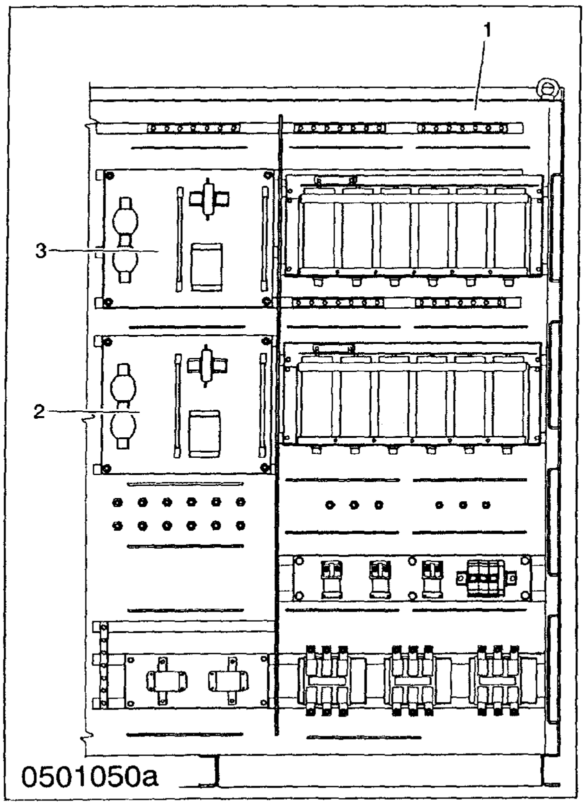
Open the other shackle (1), then lift the module (3) slightly and remove the fastening cable (2).

Remove the module (3) and store it in clean, dust-free covers until reassembly. The module must be protected against electrostatic charges.

Protective Measurement Group

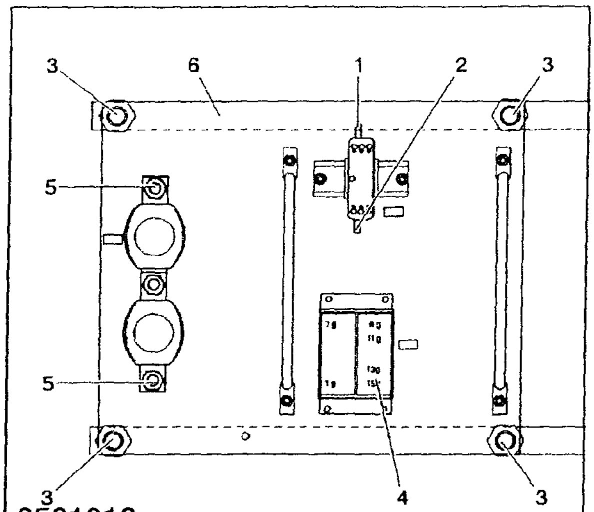


The protective measurement group in BUR-Box_1 is mounted on the inside of the auxiliary converter on the rear wall. It is only accessibly after removing the upper covering plate (1) and the Rectifier Module (50.11) (2). Refer to BUR-Box_1 Cover Plate in this Section. Refer to Rectifier Module (50.11) in this Section.



The protective measurement groups (2, 3) in BUR-Box_2 are mounted on the inside of the BUR-Box_2 (1) on the rear wall. The protective measurement group (3) for BUR2 is mounted on top and the protective measurement group (2) for BUR3 is mounted below.

Both modules are only accessible after removing the Rectifier Module (50.11). Refer to Rectifier Module (50.11) in this Section.



0501010a

Tag and disconnect the cables to the surge arrester (5) as described in Section Surge Arrester (40.1).

Tag and disconnect the cables at the connections (1,2) on the voltage transducer as described in Voltage Transducer (51.5) in this Section.

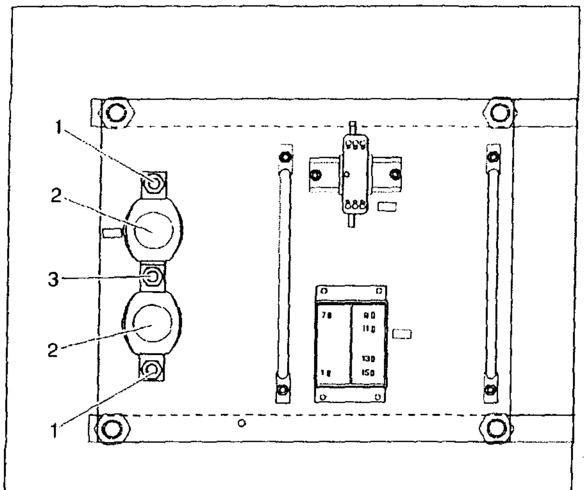
Tag and disconnect the cables to the synchronisation transformer (4) as described in Synchronisation Transformer (51.7) in this Section.

Disconnect the cables from the looming bars as required.

Remove the screws (3), then remove the plate from the cabinet.

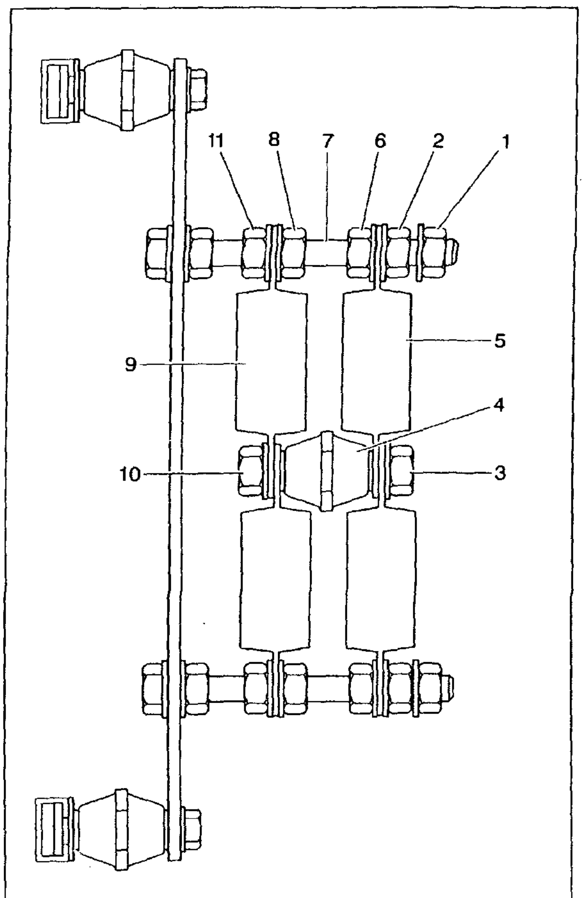
Disassembly procedures for the individual components of the protective measurement group are described as follows.

Surge Arrester (40.1)



0501011a

Tag and disconnect the cables from the surge arresters (2). Remove the nuts (1) *and washers securing the cables to the* surge arresters (2), then remove the cables from the surge arresters (2).



0501100n

Remove the nuts (2) and washers securing the upper surge arresters (5) to the posts (7).

Remove the nut (3) and washer securing the upper surge arresters (5) to the insulator (4).

Remove both upper surge arresters (5).

Remove the nuts (6) and washers that the upper surge arresters (5) are seated on.

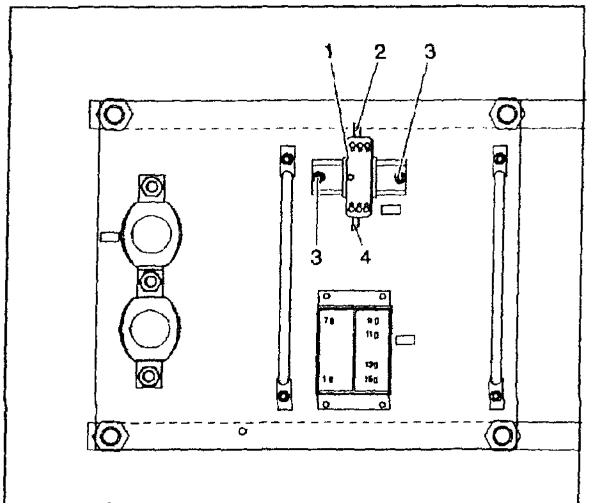
Remove the nuts (8) and washers securing the lower surge arresters (9) to the posts (7).

Remove both lower surge arresters (9). If necessary, remove the nut (10) securing the lower surge arresters (9) to the insulator (4).

NOTE:

To assist in reassembly of the lower surge arresters (9), do not move the nuts (11) on which the lower surge arresters (9) seat.

Voltage Transducer (51.5)

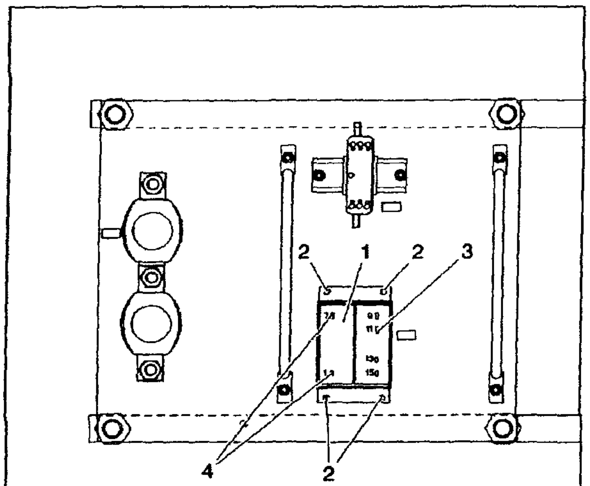


0501014a

Tag and disconnect the cables (2, 4) from the voltage transducer (1).

Remove the nuts (3) and lock washers, then remove the voltage transducer (1).

Synchronization Transformer (51.7)



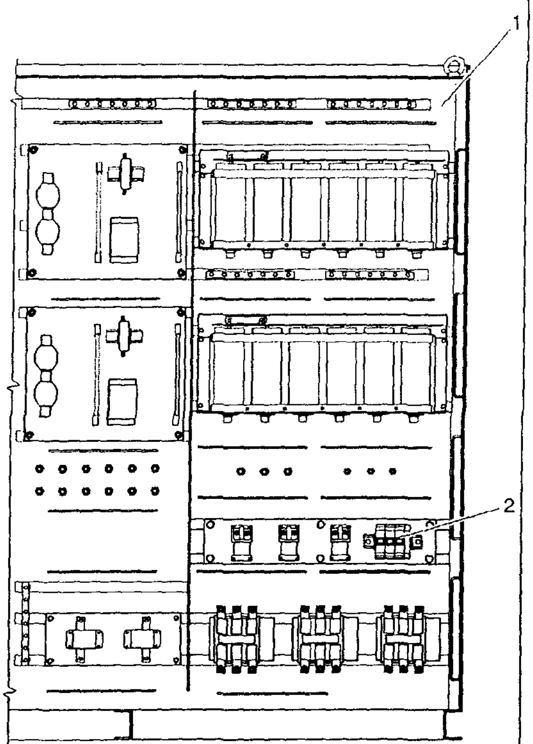
0501015a

Tag and disconnect the primary connections (4) and earthing connections (3) from the synchronisation transformer (1).

Remove the nuts (2), plain and lock washers securing the transformer.

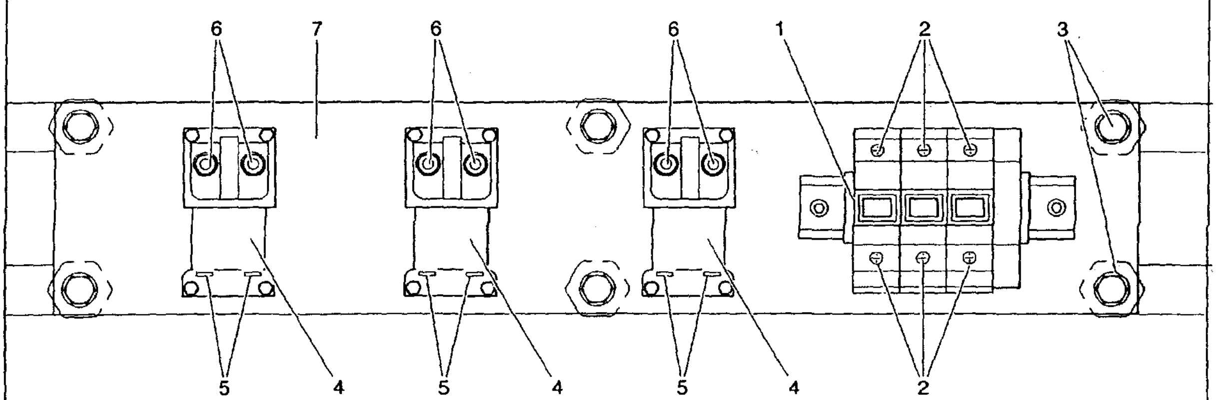
Remove synchronisation transformer (1).

Protective Group



0501044a

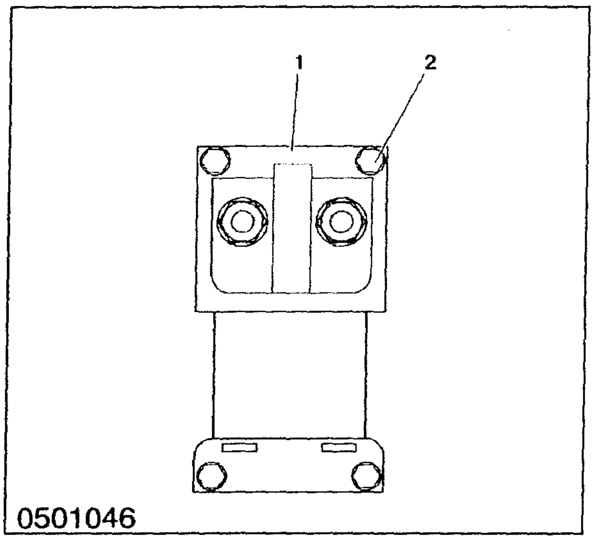
Protective group (2) in BUR-Box_2 (1) is mounted on the inside of the auxiliary converter on the rear wall. It is only accessible after removing inverter modules (50.12). Refer to Inverter Module (50.12) in this Section.



0501045

Disassembly procedures for the individual components of the protective group are described as follows.

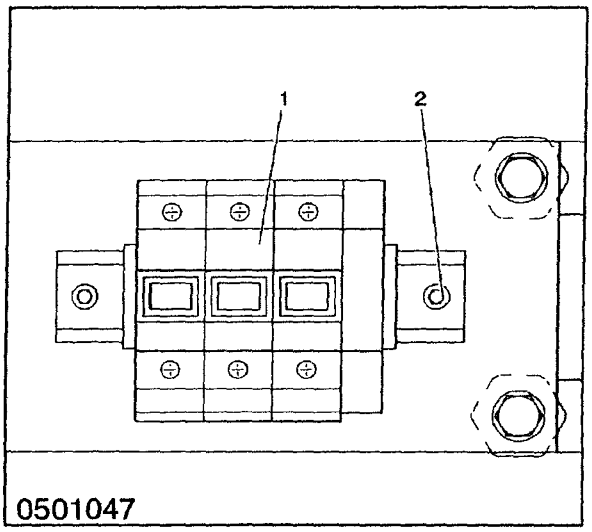
Contactor (52.3)



Remove screws (2), nuts, plain and lock washers securing the contactor (1).

Remove contactor (1).

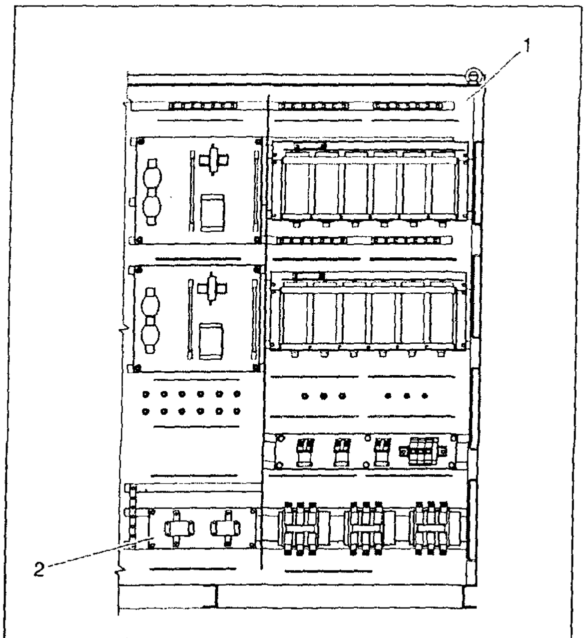
High performance automatic contactor (100)



Remove the screws (2), nuts, spring and plain washers securing the contactor (1).

Remove the contactor (1).

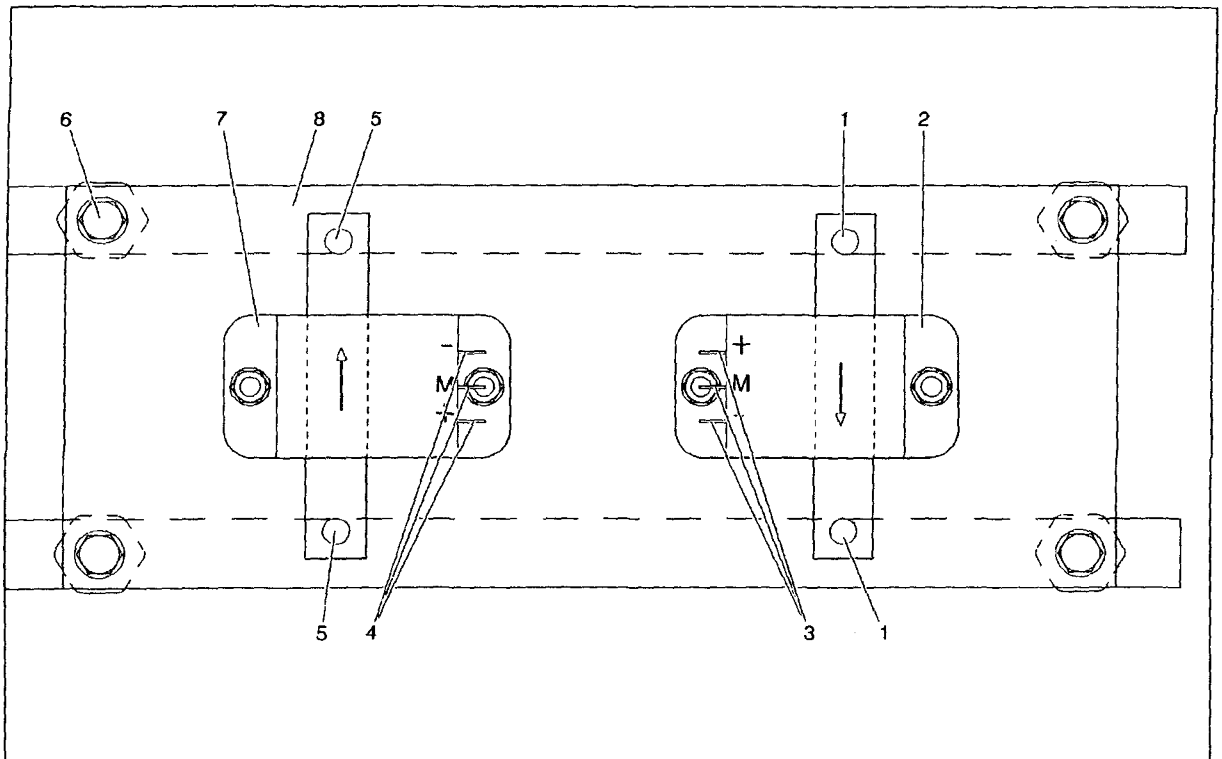
Transformer group



0501048a

Transformer group (2) in BUR-Box_2 (1) is mounted on the inside of the auxiliary converter to the rear wall. It contains the two transformers that monitor battery charging.

Transformer group (2) is only accessible after disassembling the battery charger module BL 172.5. Refer to Battery Charger Module (107) in this Section.

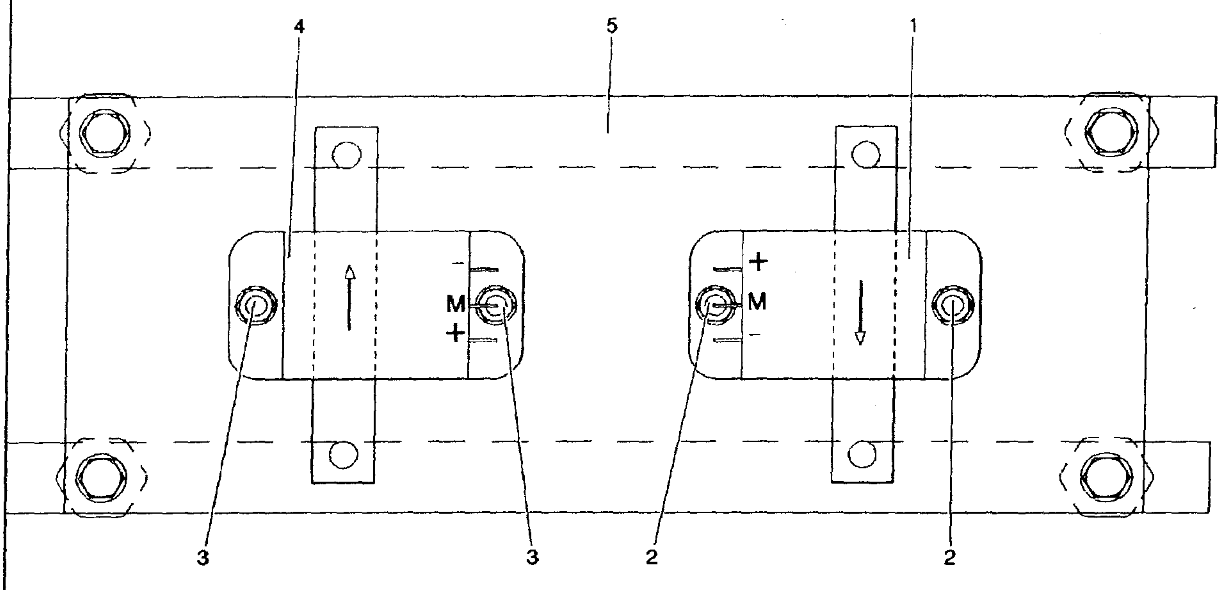


0501058

Tag and disconnect the cables from connections (3, 4) from the two transformers (2, 7).

Disconnect cable connections (1, 5). Remove the nuts, washers, spring washers and screws.

Remove the screws (6), plain and lock washers securing the plate (8). Remove the plate assembly (8). Note that the transformer group is heavy.



0501057

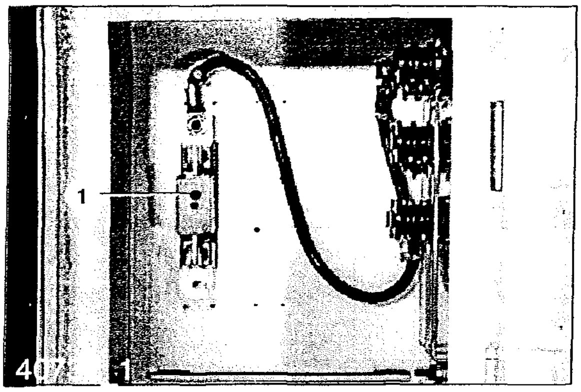
Remove the screws (2) securing the transformer (1) to the plate (5).

Remove transformer (1) from plate (5).

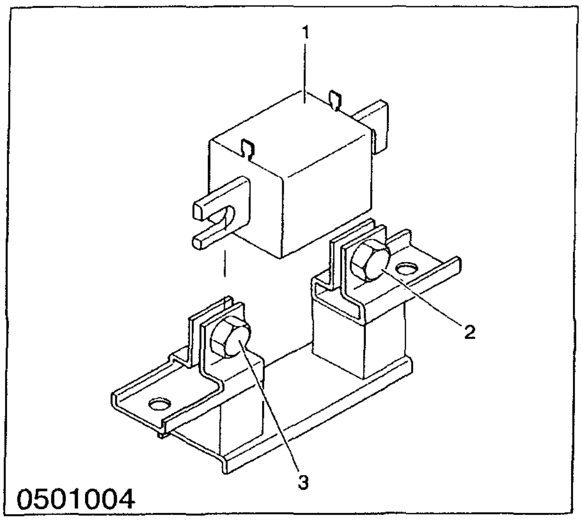
Remove the screws (3) securing the transformer (4) to the plate (5).

Remove transformer (3) from plate (5).

BUR-Box_1 Fuse (40/1)



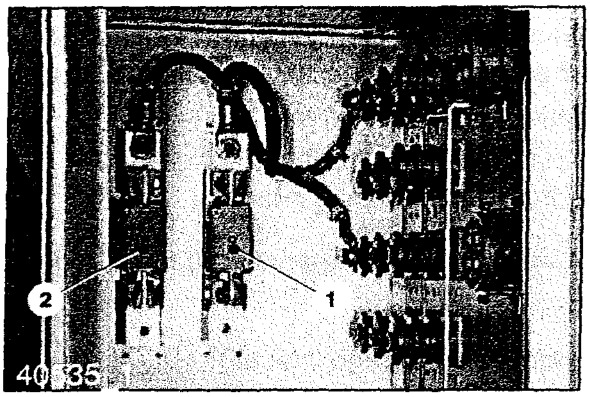
The fuse (1) is located in the connecting block of BUR-Box_1.



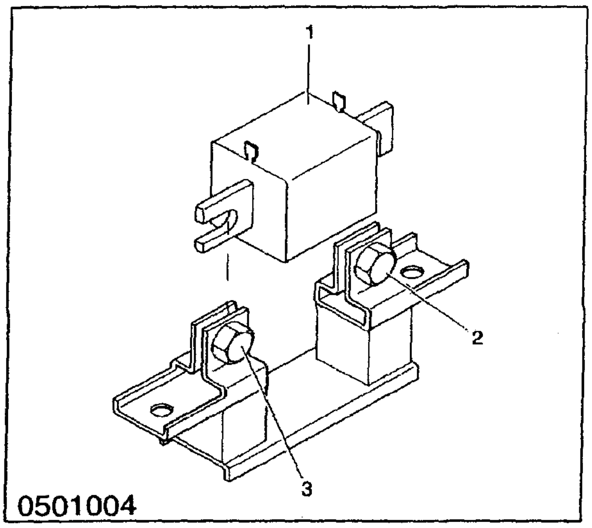
Loosen, but do not remove, the screws (2, 3).

Remove the fuse (1) over the upper screw (2). Lift the fuse (1) from the lower screw (3).

BUR-Box_2 Fuses (40/2, 40/3)



The two fuses (1, 2) are located in BUR-Box_2. Fuse (1) 40/3 protects the circuits in BUR3. Fuse (2) 40/2 protects the circuits in BUR2.

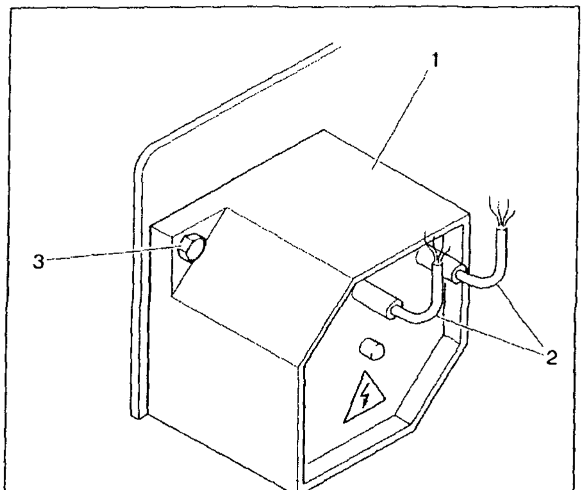


Loosen, but do not remove, the screws (2, 3).

Remove the fuse (1) over the upper screw (2). Lift the fuse (1) from the lower screw (3).

Voltage Indicator (51.4/1, 51.4/2, 51.4/3)

Voltage indicator 51.4/1 is mounted on the top of BUR-Box_1. Two voltage indicators are mounted on the top of BUR-Box_2. Indicator 51.4/2 is situated on the left side for BUR2 and indicator 51.4/3, for BUR3, is located on the right side.



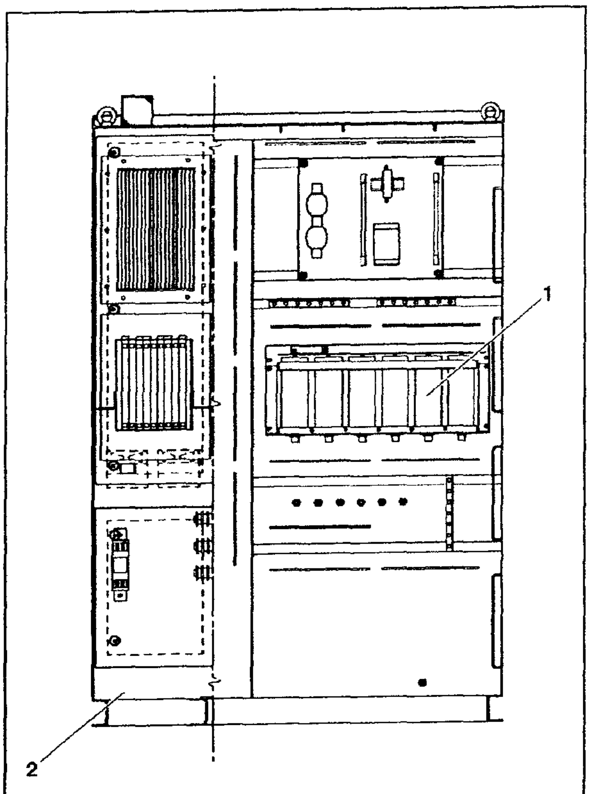
0501016

Tag and disconnect the measuring cables (2) from the DC-link plates.

Remove the two diagonally arranged bolts (3).

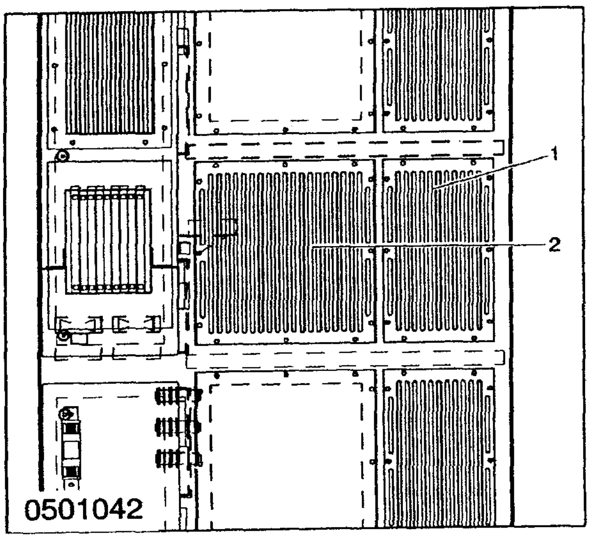
Remove the voltage indicator (1).

Capacitor Bank CZ 12.01 (51.1/1, 51.1/2, 51.1/3)



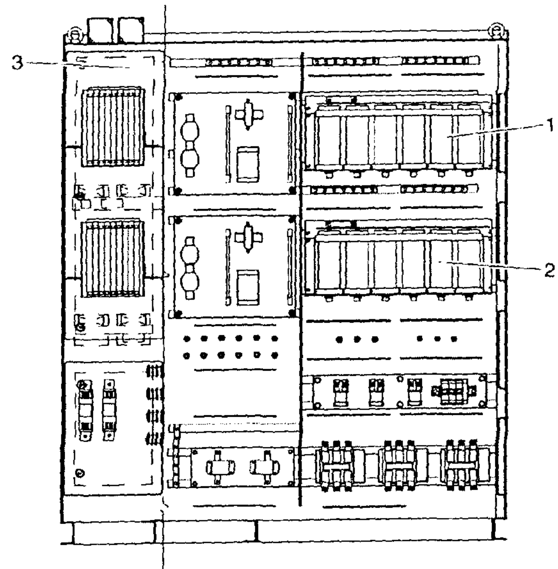
0501052a

In BUR-Box_1 the capacitor bank (1) is mounted on the inside on the rear wall of the cabinet (2).



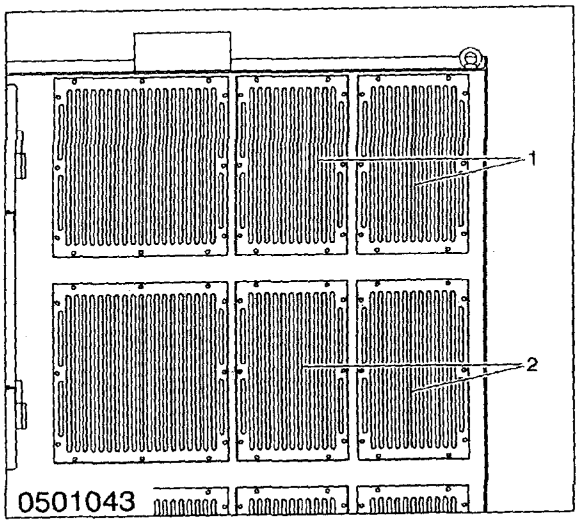
0501042

The capacitor bank is only accessible after removing the rectifier modules (1) and inverter modules (2). Refer to Rectifier Module (50.11) in this Section. Refer to Inverter Module (50.12) in this Section.



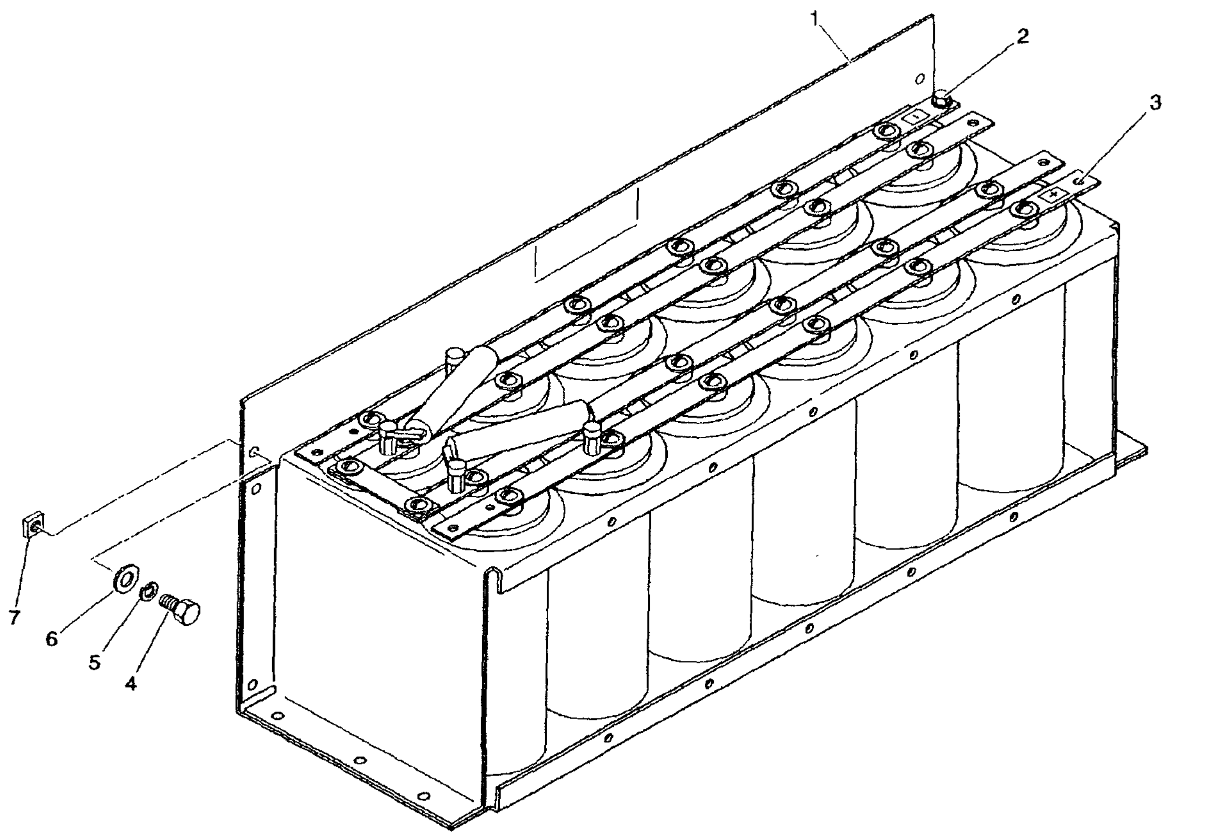
0501053a

In BUR-Box_2 the capacitor banks (1, 2) are mounted on the inside on the rear wall of the cabinet (3). The capacitor bank (1) for BUR2 is mounted at upper level. The capacitor bank (2) for BUR3 (3) is on the lower level.



0501043

The capacitor bank is only accessible after removing the Inverter Modules (50.12). Refer to Inverter Module (50.12) in this Section.



0501030a

Tag and disconnect the cables from the connections (2,3).

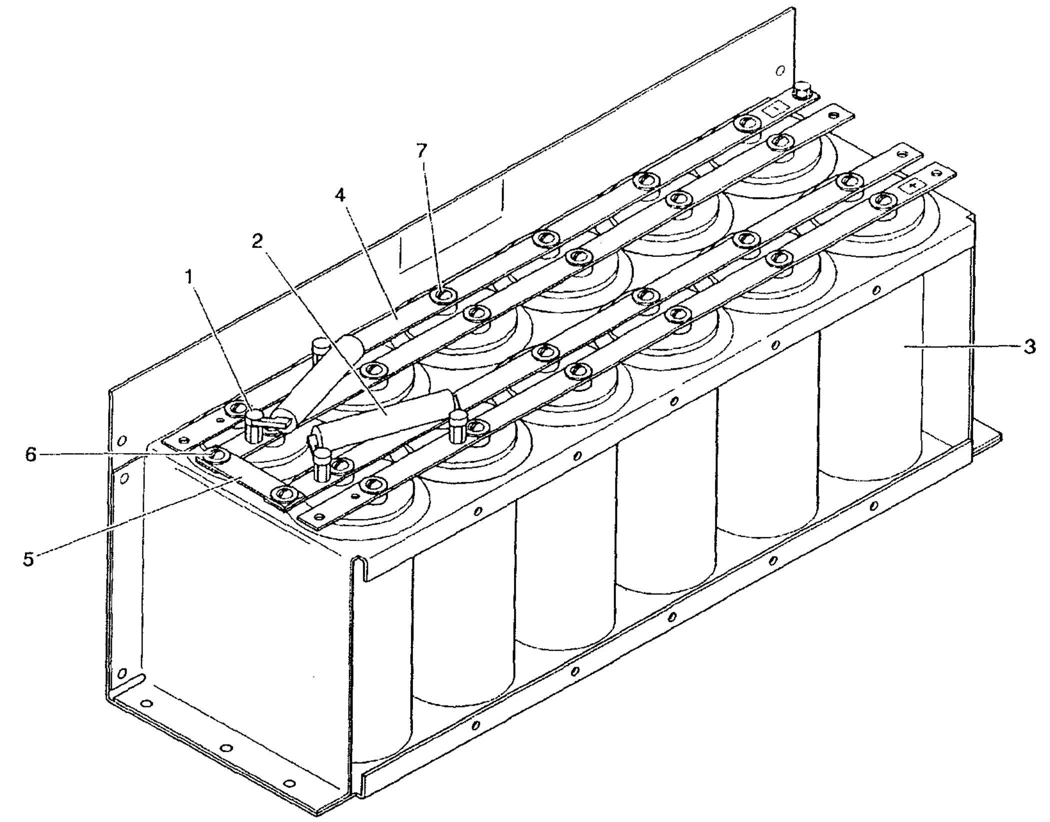
NOTE:

The capacitor bank (1) is heavy.

Support the capacitor bank (1) to prevent it falling.

Loosen and remove the screws (4), spring washers (5) and washers (6). The sliding nuts (7) remain in the U-profiles welded to the wall of the cabinet.

Remove the capacitor bank (1) from the cabinet.

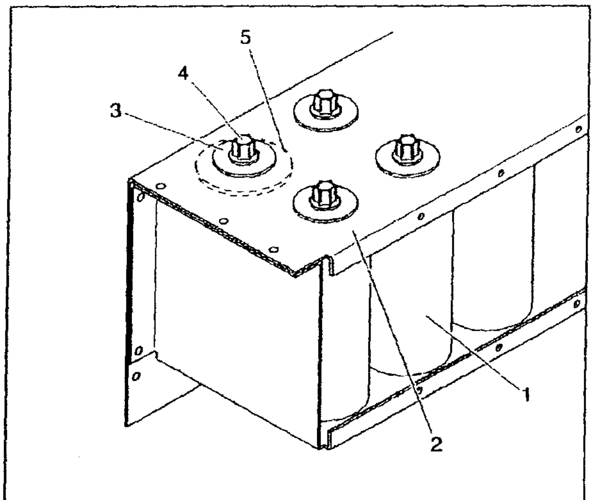


0501102n

Loosen and remove the screws (1), spring washers and washers securing the resistors (2) to the connecting rails (4). Remove the resistors (2).

Loosen and remove the screws (6) securing the intermediate link (5) to the connecting rails (4). Remove the intermediate link (5).

Loosen and remove the screws (7) securing the connecting rails (4) to the capacitors (3). Remove the connecting rails (4).



0501051

NOTE:

Figure shows the capacitor bank inverted.

Loosen and remove the nuts (4) securing the capacitors (1) to the mounting plate (2).

Remove the lower insulating disk (3).

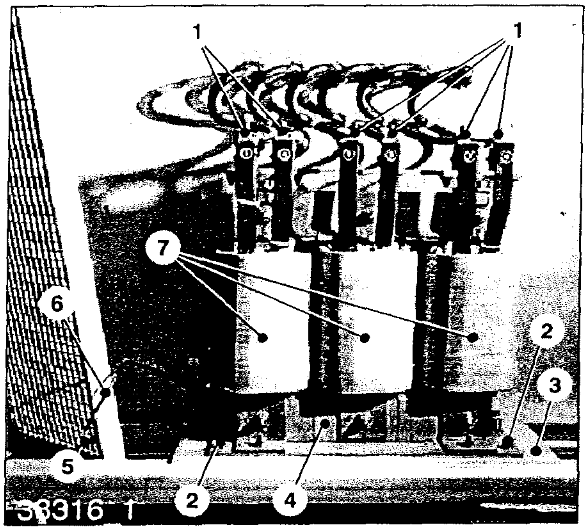
Remove the capacitors (1) from the mounting plate (2).

Remove the upper insulating disk (5).

BUR-Box_1 Three-Phase Output Choke (50.9)

A three-phase output choke is mounted on the rear wall of BUR-Box_1.

Remove the screws, spring and plain washers securing the grille, then remove the grille.

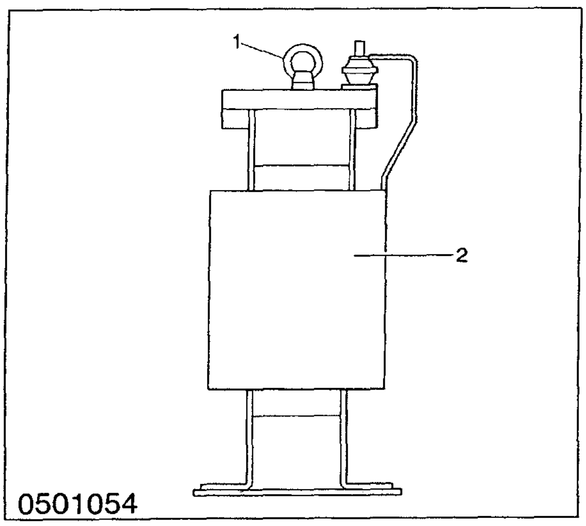


Tag and disconnect the cables from the terminals. Remove the nuts (1), spring and plain washers.

Tag and disconnect the earth cable (6) from the terminal. Remove the screw (5), plain and spring washer.

The three-phase choke consists of three individual chokes (7) mounted on a common plate (4). The metal plate (3) is welded to the two U-profiles on the back of the auxiliary converter.

Remove the screws (2).



Attach suitable lifting equipment to the eye-bolts (1) of the choke (2).

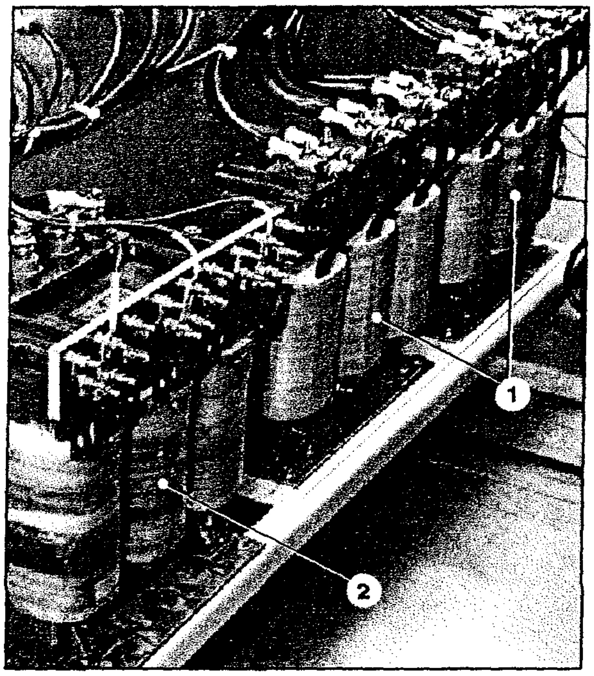
Raise the lifting equipment slightly to take the weight of the chokes (2).

Ensure the chokes (2) are not entangled in any way, then raise the lifting equipment and remove chokes (2) from the auxiliary converter.

BUR-Box_2 Three-Phase Output Choke (50.9)

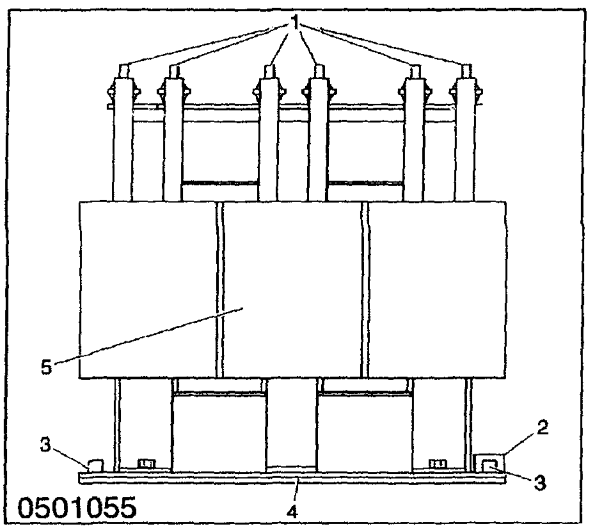
Two three-phase output chokes and a transformer are mounted on the back wall of BUR-Box_2.

Remove the screws, spring and plain washers securing the grille, then remove the grille.



The two three-phase chokes (1) are located on the right-hand rear side. Transformer (2) for charging the battery is located on the left-hand side.

The procedure is the same for both three-phase chokes (1).



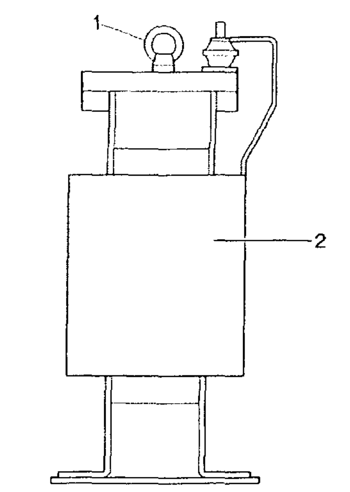
Tag and disconnect the cables from the choke terminals. Remove the nuts (1), spring and plain washers.

Tag and disconnect the earth cable from the earth connection (2).

Screw in the eyebolts (1) on both sides of choke (2).

The three-phase choke consists of three individual chokes (5) mounted on a common plate (4). The metal plate (3) is welded to the two U-profiles on the back of the auxiliary converter.

Remove the screws (2).



0501054

Attach suitable lifting equipment to the eye-bolts (1) of the choke (2).

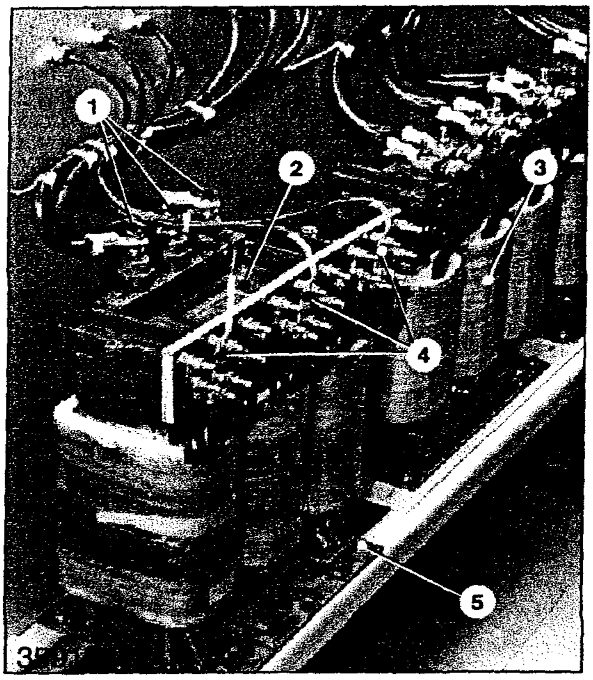
Raise the lifting equipment slightly to take the weight of the chokes (2).

Ensure the chokes (2) are not entangled in any way, then raise the lifting equipment and remove chokes (2) from the auxiliary converter.

Battery Charger Transformer (107.1)

The battery charging transformer is mounted on the back wall of BUR2 next to the two 3-phase chokes.

Remove the screws, spring and plain washers securing the grille, then remove the grille.

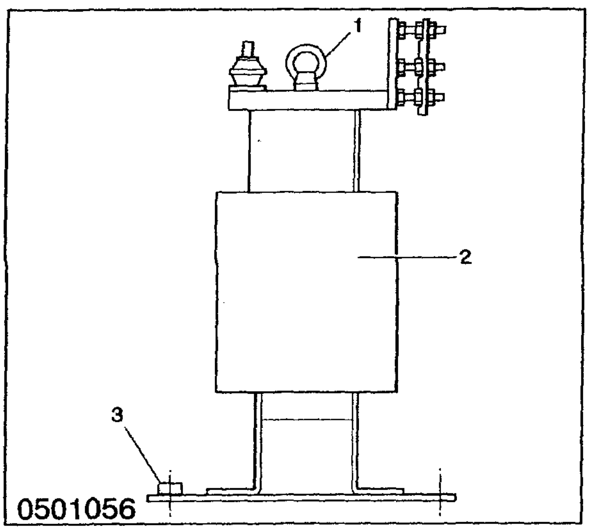


The battery charging transformer (2) is located on the left-hand side. Two 3-phase chokes (3) are mounted on the right-hand side.

Tag and disconnect the cables (4) from the transformer terminals. Remove the nuts, spring and plain washers, then disconnect the cables (4) from the terminals.

Tag and disconnect the earth cable. Remove the nuts, spring and plain washers, then disconnect the cable.

Remove the screws (5), spring and plain washers securing the transformer to the cabinet.



Attach suitable lifting equipment to the eye-bolts (1) of the transformer (2).

Raise the lifting equipment slightly to take the weight of the transformer (2).

Ensure the chokes (2) are not entangled in any way, then raise the lifting equipment and remove transformer (2) from the auxiliary converter.

Inspection and Repair

@.1250

IMPORTANT:

Do not use a steel brush to clean the module heat sinks as this will remove the paint

Inspect the heat sinks of the inverter, rectifier and battery charger modules. Should the module or the heat sink be dirty it may be cleaned using compressed air or a soft brush.

For further information regarding the auxiliary converters, modules and sub-systems, refer to Volumes F7 and F8, Suppliers Documentation.

Waste Disposal

@.1260

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

The following information is provided to assist in the identification of potentially hazardous materials.

Capacitors in the range B25 835 contain mineral oil; capacitors in the range B25 990 contain PXE.

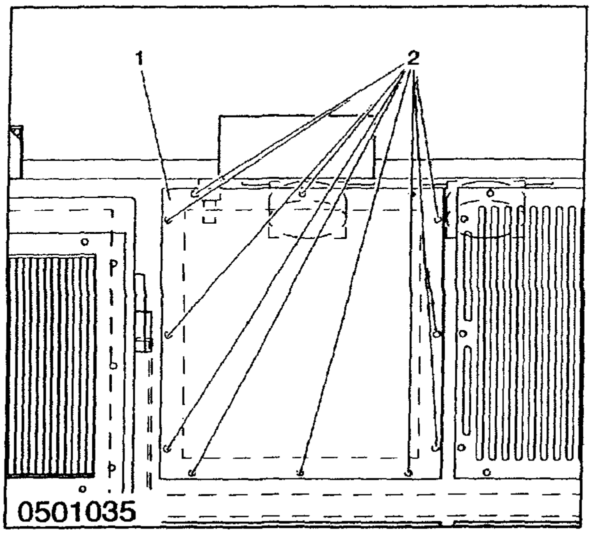
Semi-conductors consist of copper with a nickel-plated surface, apart from the ceramic casing and the silicon disk.

The heatsink and islands of the unit are made of aluminium. The blue resin is filled with aluminium oxide and is therefore not mechanically treatable. At this temperature, it is also possible to scrape the resin from the heatsink.

Assembly

@.1270

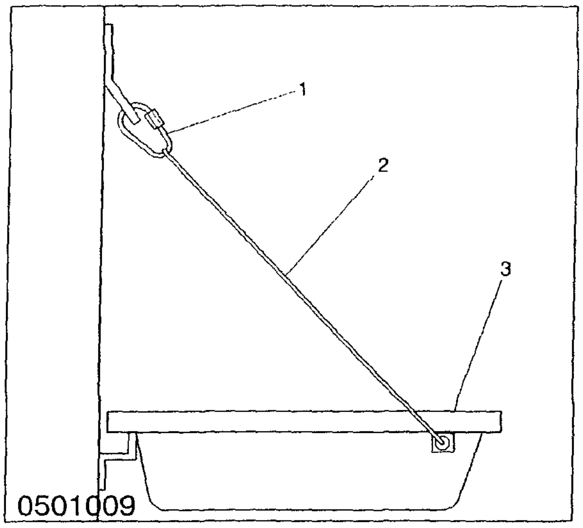
BUR-Box_1 Cover Plate



Position the covering plate (1).

Install the screws (2) and the washers. Tighten the screws (2).

Rectifier Module (50.11)

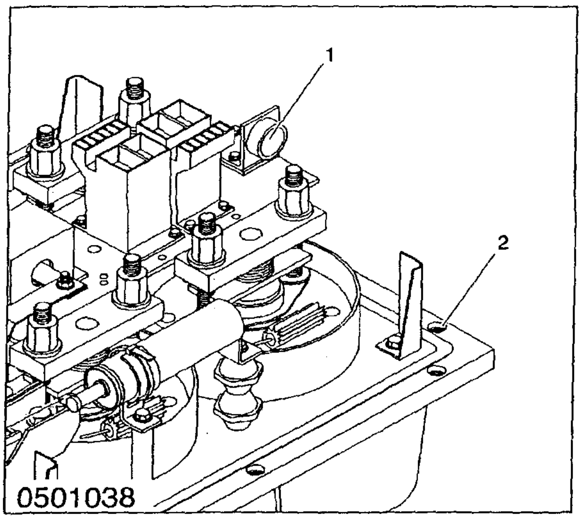


Lay the module (3) horizontally with the heatsink facing downwards.

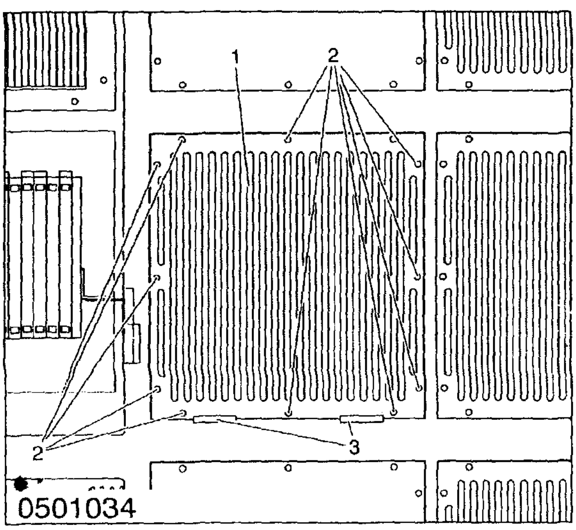
Support the module (3) to prevent it falling.

Position the lower edge of the modules heatsink over the angle brackets in the cabinet.

Open the shackle (1). Lift the module (3) slightly and attach shackle (1) to the bracket on the cabinet. Tighten the shackle. Repeat for the second cable (2) as required. The cables (2) should now take the weight of the module.



Connect the harness to the socket X10 (1), as tagged during disassembly, located at the back left hand side of the module (2).



NOTE:

When closing the module (1) be careful not to jam the cables between the module and the housing.

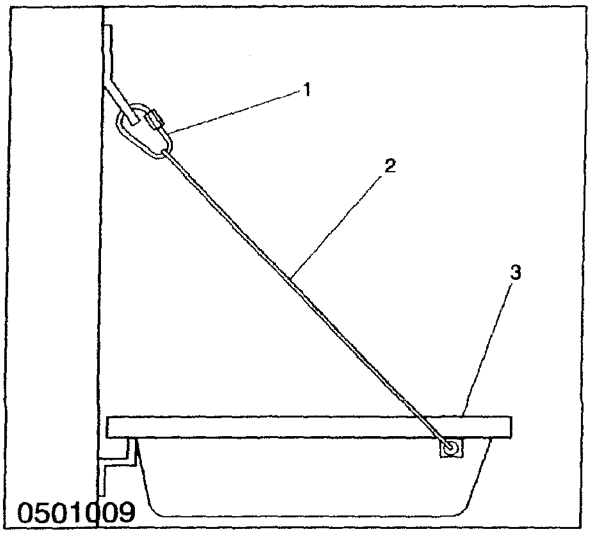
Grease all the screws (2) with Molycote White.

Carefully close the module (1).

Install the screws (2) finger tight.

Tighten screws (2) in an alternating pattern.

Inverter Module (50.12)

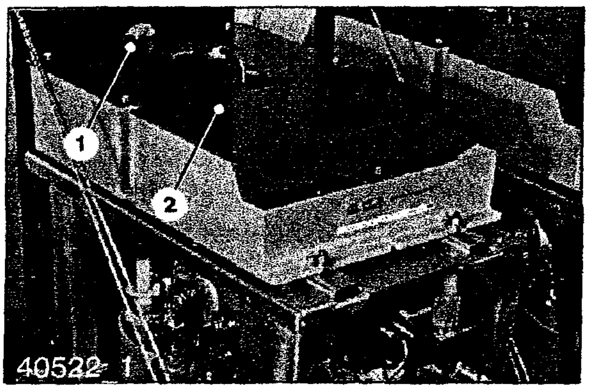


Lay the module (3) horizontally with the heatsink facing downwards.

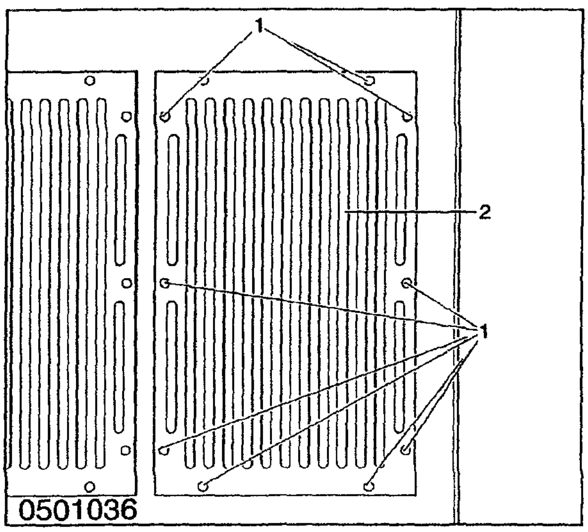
Support the module (3) to prevent it falling.

Position the lower edge of the modules heat-sink over the angle brackets in the cabinet.

Open the shackle (1). Lift the module (3) slightly and attach shackle (1) to the bracket on the cabinet. Tighten the shackle. Repeat for the second cable (2) as required. The cables (2) should now take the weight of the module.



Connect the harness to the socket X20 (1), located at the back of the module (2), as tagged during disassembly.



NOTE:

When closing the module (1) be careful not to jam the cables between the module and the housing.

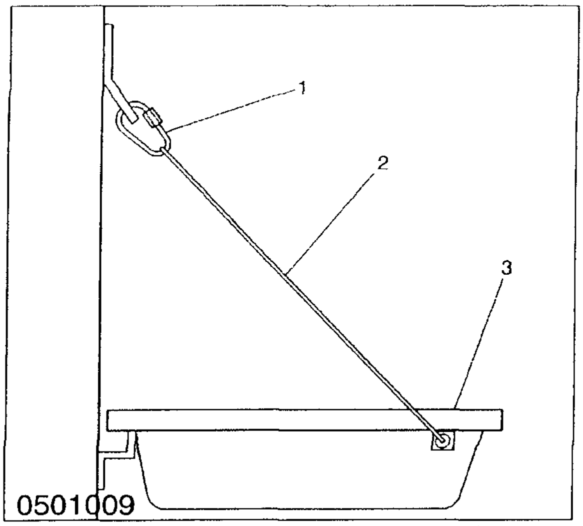
Grease all the screws (2) with Molycote White.

Carefully close the module (1).

Install the screws (2) finger tight.

Tighten screws (2) in an alternating pattern.

Battery-Charger Module (107)

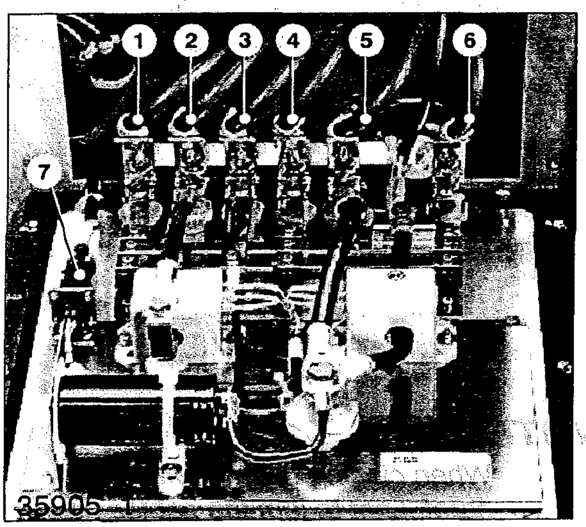


Lay the module (3) horizontally with the heatsink facing downwards.

Support the module (3) to prevent it falling.

Position the lower edge of the modules heatsink over the angle brackets in the cabinet.

Open the shackle (1). Lift the module (3) slightly and attach shackle (1) to the bracket on the cabinet. Tighten the shackle. Repeat for the second cable (2) as required. The cables (2) should now take the weight of the module.



NOTE:
The module must be assembled in the sequence described below.

Connect the cables to the electrical terminals as tagged during disassembly in the following sequence.

Connect cable W (1) to pin 3.

Connect the cable (2) to the current sensor 107.3, pin 5.

Connect the negative pole cable (3) to pin 6.

Connect the input cable V (4) to pin 2.

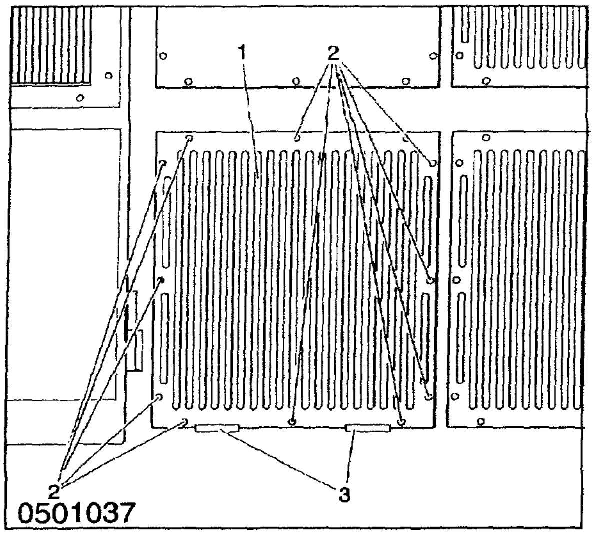
Connect the cable (5) to the current sensor 107.2.

Connect the input cable U (6) to pin 1.

Install the nuts and washers to secure the cables to the terminals, then tighten the nuts.

Refer to Section Control Circuits, Sheet 04A, Battery Charger of Volume G1, Cabling Documentation for battery charger module electrical connections.

Connect the harness to the socket (7), as tagged during disassembly, located at the back left hand side of the module (2).



NOTE:

When closing the module (1) be careful not to jam the cables between the module and the housing.

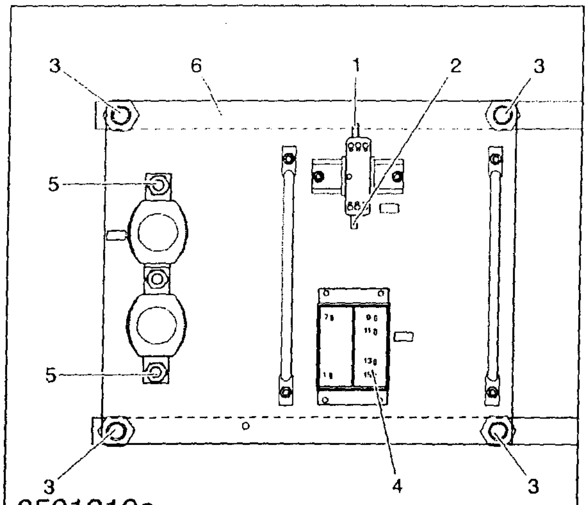
Grease all the screws (2) with Molycote White.

Carefully close the module (1).

Install the screws (2) finger tight.

Tighten screws (2) in an alternating pattern.

Protective Measurement Group



0501010a

Install the plate in position within the cabinet, then secure the plate with screws (3).

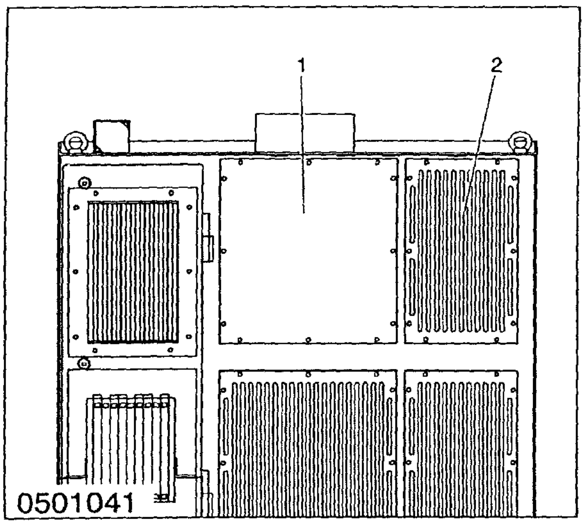
Reconnect the cables to the looming bars as required.

Reconnect the cables to the surge arrester (5) as described in Surge Arrester (40.1) in this Section.

Reconnect the cables at the connections (1,2) on the voltage transducer as described in Voltage Transducer (51.5) in this Section.

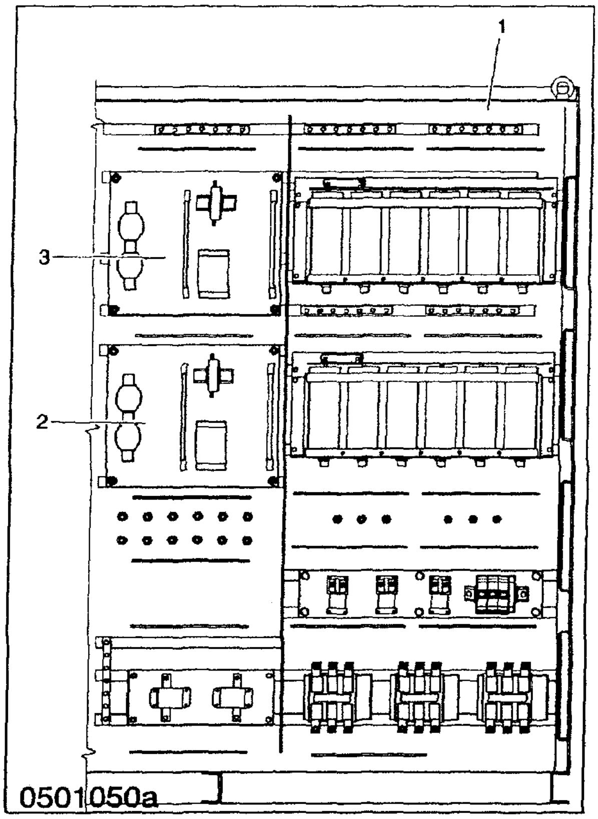
Reconnect the cables to the synchronisation transformer (4) as described in Synchronisation Transformer (51.7) in this Section.

Assembly procedures for the individual components of the protective measurement group is described as follows.



0501041

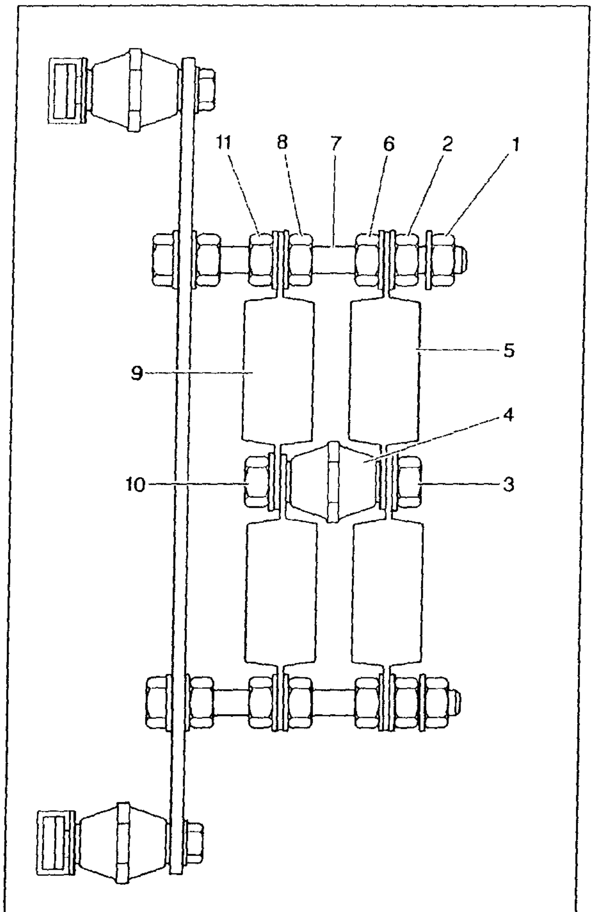
The protective measurement group in BUR-Box_1 is mounted on the inside of the auxiliary converter on the rear wall. Once the protective measurement group has been assembled in the cabinet, reinstall the upper covering plate (1) and the Rectifier Module (50.11) module (2). Refer to BUR-Box_1 Cover Plate in this Section. Refer to Rectifier Module (50.11) in this Section.



The protective measurement groups (2, 3) in BUR-Box_2 are mounted on the inside of the BUR-Box_2 (1) on the rear wall. The protective measurement group (3) for BUR2 is mounted on top and the protective measurement group (2) for BUR3 is mounted below.

Once the protective measurement group has been assembled in the cabinet, reinstall the Rectifier Module (50.11) modules. Refer to Rectifier Module (50.11) in this Section.

Surge Arrester (40.1)



0501100n

Install the nuts (8) and washer securing the lower surge arresters (9) to the insulator (4). Adjust the nuts (8) as necessary to ensure that the surge arresters (9) are flat. Do not tighten the nuts (8).

Install both lower surge arresters (9) on the posts (7).

Install the nuts (8) and washers, securing the lower surge arresters (9) to the posts (7).

Install the nuts (6) and washers that the upper surge arresters (5) seat on.

Install both upper surge arresters (5).

Install the nut (3) and washer securing the upper surge arresters (5) to the insulator (4), but do not tighten.

Install the nuts (2) and washers securing the upper surge arresters (5) to the posts (7), but do not tighten.

Ensure the upper surge arresters (5) are seated flat and are not bent. If necessary, raise or lower the nuts (2, 6) the achieve the desired mounting position of the upper surge arresters (5).

Once satisfied that the upper surge arresters are flat and not in bending, tighten the nuts (2) securing the upper surge arresters (5) to the post (7) and tighten the nut (3) securing the upper surge arresters (5) to the insulator(4).

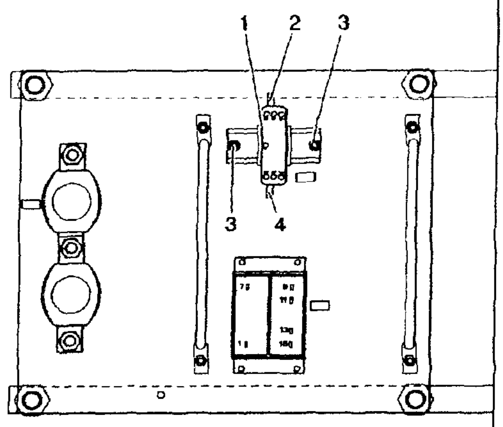
Reconnect the cables to the surge arresters, then secure the cables with the nuts (1) and the washers.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02B, Rectifier 1 of Volume G1, Cabling Documentation for BUR1 protective measurement group electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02D, Rectifier 2 of Volume G1, Cabling Documentation for BUR2 protective measurement group electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02F, Rectifier 3 of Volume G1, Cabling Documentation for BUR3 protective measurement group electrical connections.

Voltage Transducer (51.5)



0501014a

Mount the voltage transducer (1) on the panel.

Install the nuts (3), plain and spring washers to secure the transducer (1) to the panel. Tighten the nuts (3).

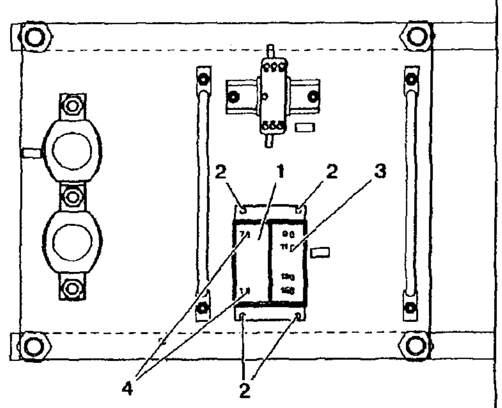
Connect the cables to the voltage transducer terminals (2, 4) as tagged during disassembly.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02B, Rectifier 1 of Volume G1, Cabling Documentation for BUR1 protective measurement group electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02D, Rectifier 2 of Volume G1, Cabling Documentation for BUR2 protective measurement group electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02F, Rectifier 3 of Volume G1, Cabling Documentation for BUR3 protective measurement group electrical connections.

Synchronisation Transformer (51.7)



0501015a

Mount the synchronisation transformer (1) on the panel.

Install the nuts (2), plain and spring washers to secure the transformer (1) to the panel. Tighten the nuts (2).

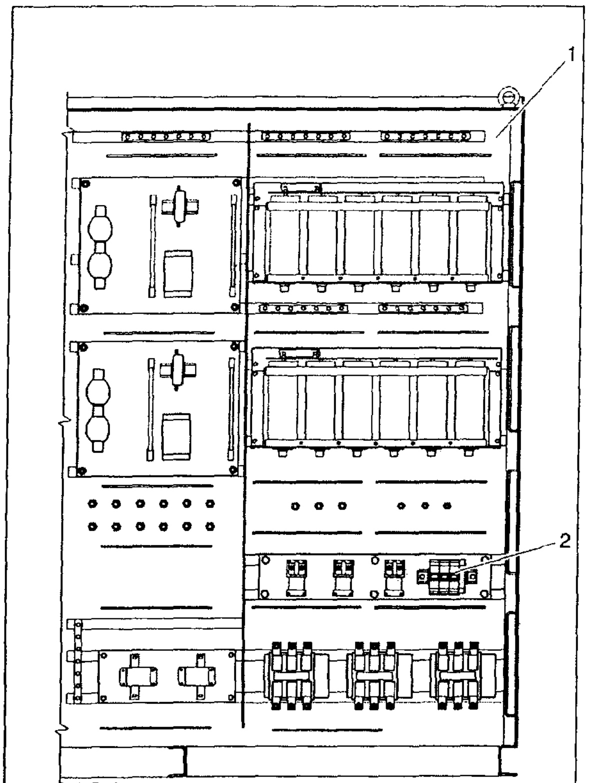
Connect the cables to the voltage transducer terminals (3, 4) as tagged during disassembly.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02B, Rectifier 1 of Volume G1, Cabling Documentation for BUR1 protective measurement group electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02D, Rectifier 2 of Volume G1, Cabling Documentation for BUR2 protective measurement group electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02F, Rectifier 3 of Volume G1, Cabling Documentation for BUR3 protective measurement group electrical connections.

Protective Group



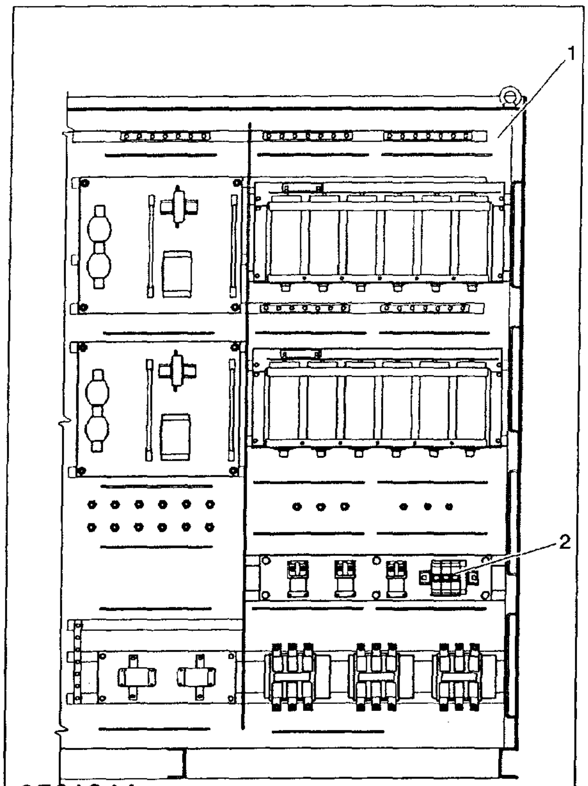
0501044a

Protective group (2) in BUR-Box_2 (1) is mounted on the inside of the auxiliary converter on the rear wall.

Procedures for assembly of the individual components to the panel are described as follows.

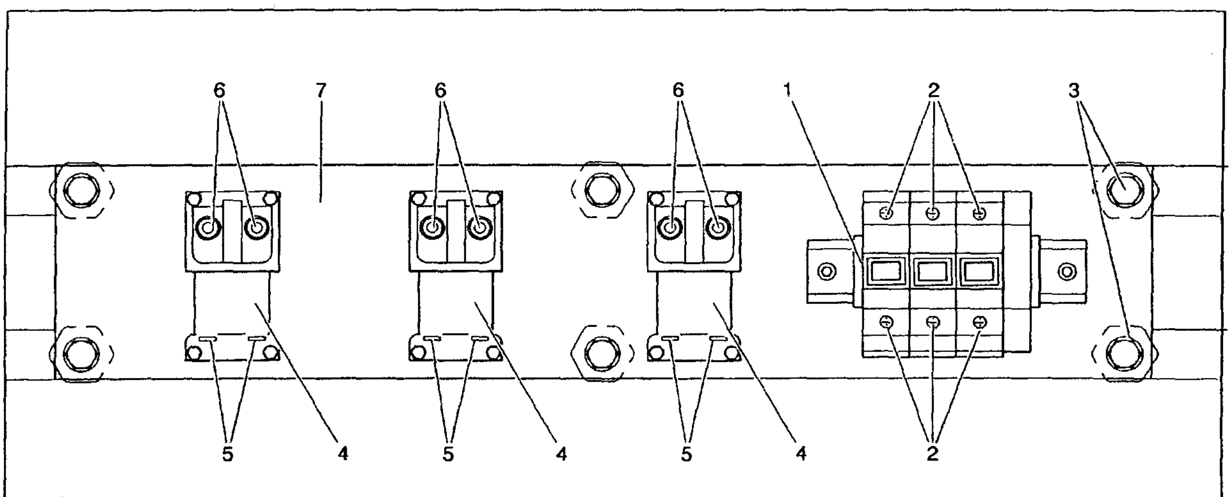
After assembly of the components to the panel, reinstall the panel to the auxiliary converter cubicle.

Panel



0501044a

Mount protective group plate assembly (2) on the inside of the auxiliary converter (1) on the rear wall.

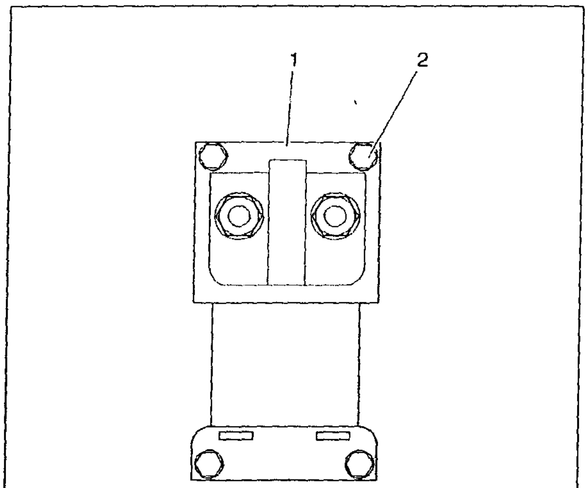


0501045

Install the screws (3) and washers securing the protective group plate assembly (7).
Tighten the screws (3) securing the panel (7).
Connect the cables to the contactors as tagged during disassembly.

Refer to Section Control Main Apparatus, Sheets 05I, 05J and 05K, Contactor Auxiliaries of Volume G1, Cabling Documentation for contactor electrical connections.
Refer to Section Pin Assignment Electrical Components, Sheet 25B, Low-Voltage Contactors of Volume G2, Cabling Documentation for auxiliary contactor electrical connections.
Install the inverter modules as described in Inverter Module (50.12) in this Section.

Contactor (52.3)



0501046

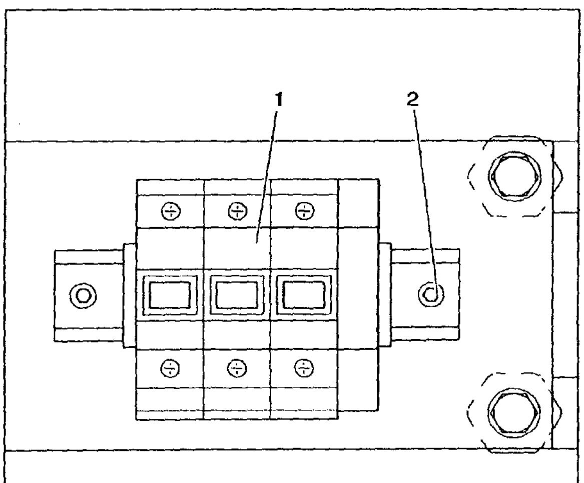
Mount the contactor (1) on the panel.

Install the screws (2) and plain washers to secure the transformer (1) to the panel. Install the nuts, spring and plain washers from behind the panel, then tighten the screws (2).

Install the other components to the panel as necessary. Then install the panel assembly into the auxiliary converter cubicle as described in this Section.

Refer to Section Control Main Apparatus, Sheets 05I, 05J and 05K, Contactor Auxiliaries of Volume G1, Cabling Documentation for contactor electrical connections.

High Performance Automatic Contactor (100)



0501047

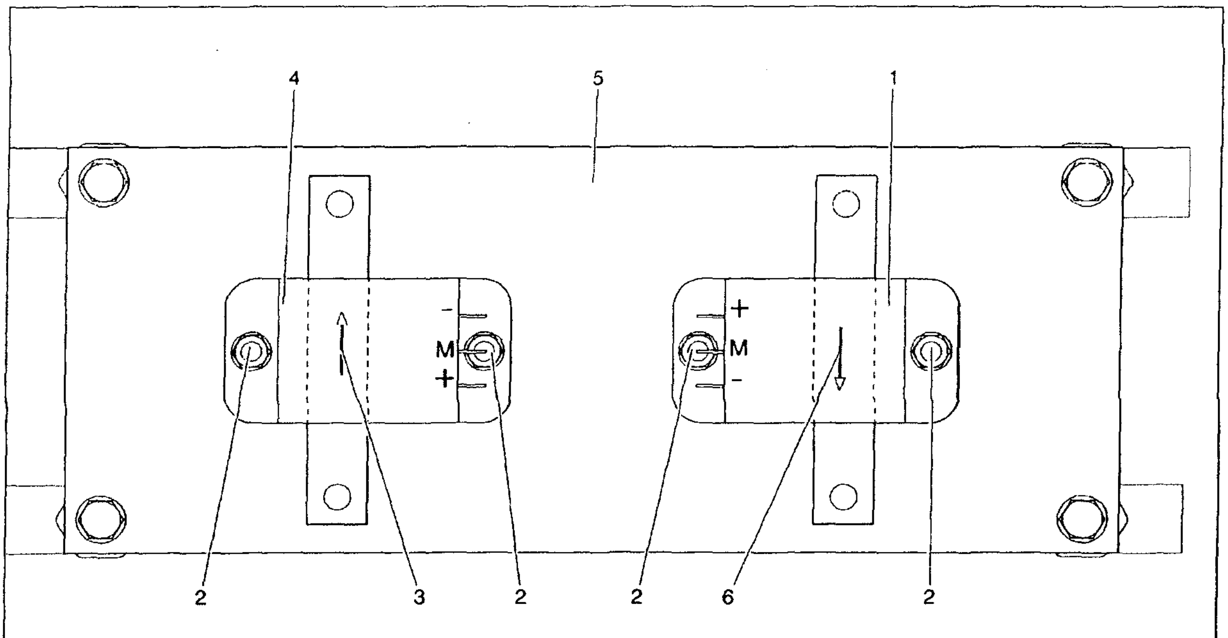
Mount the contactor (1) on the panel.

Install the screws (2) and plain washers to secure the rail to the panel. Install the nuts, spring and plain washers from behind the panel, then tighten the screws (2).

Refer to Section Pin Assignment Electrical Components, Sheet 25B, Low-Voltage Contactors of Volume G2, Cabling Documentation for auxiliary contactor electrical connections.

Install the other components to the panel as necessary. Then install the panel assembly into the auxiliary converter cubicle as described in Panel in this Section.

Transformer Group



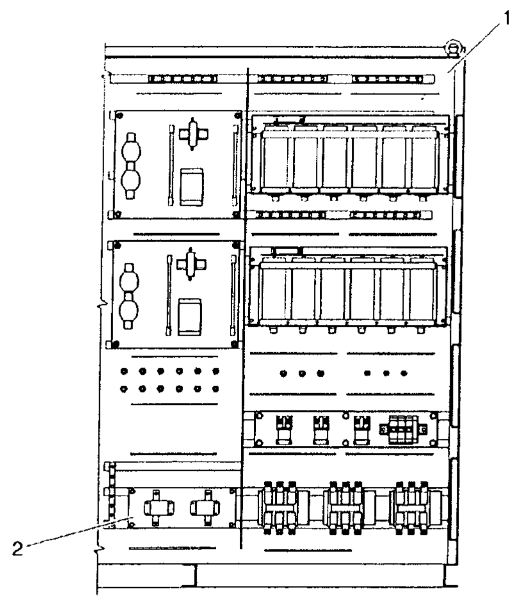
0501103n

Mount both current transformers (1, 4) to the plate (5). Transformer 107.2 (4) is mounted on the left and transformer 107.3 (1) is mounted on the right. Note the direction of the current flow arrows (3, 6) on the transformer (4, 1) cases. Transformer 107.2 (4), located on the left, has its arrow (3) pointing upwards. Transformer 107.3 (1), located on the right, has its arrow (6) pointing downwards.

NOTE:

The inlet to current sensor 107.2 (4) is located at the bottom. The inlet to current sensor 107.3 (1) is located on the top. Ensure current flow through each transformer matches the indication arrows (3, 6) on the transformer.

Install the screws (2) and washers. Install the nuts, plain and spring washers, from behind the panel. Align the current transformer, then tighten the screws (2).



0501048a

Install the transformer group panel assembly (2) to the inside of the auxiliary converter, BUR-Box_2 (1), on the rear wall.

Install the screws, plain and spring washers to secure the panel to the cabinet.

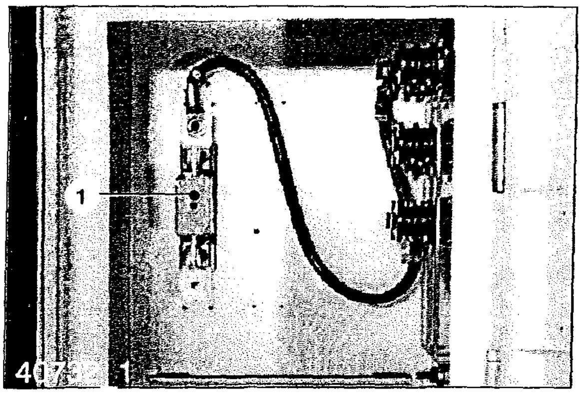
Align the plate, then tighten the screws.

Connect the cables to the transformer terminals as tagged during disassembly.

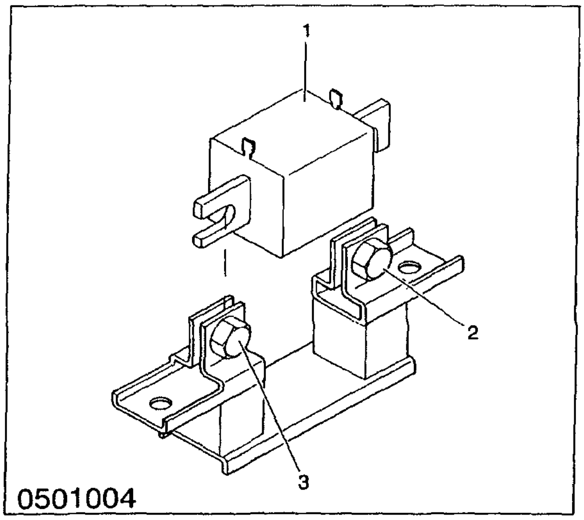
Refer to Section Control Circuits, Sheet 04A, Battery Charger of Volume G1, Cabling Documentation for current transformer electrical connections.

Install the battery charger module as described in Battery Charger Module (107) in this Section.

BUR-Box_1 Fuse (40/1)



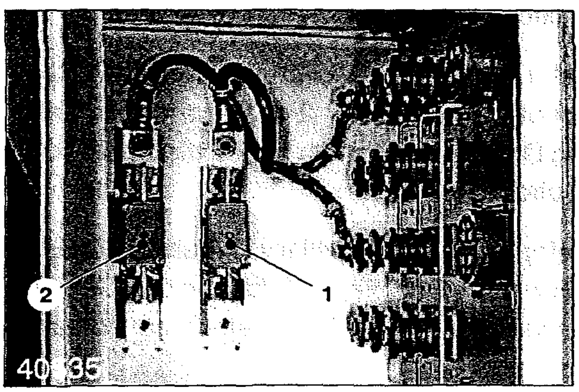
There is only one fuse, 40/1, in BUR-Box_1.



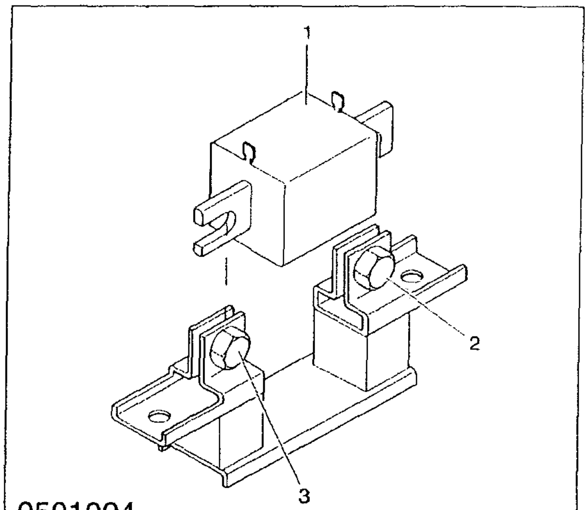
Loosen, but do not remove, the screws (2, 3).

Push the fuse (1) from above over the screw (3). Swing the fuse (1) onto the upper terminal. Tighten the screws (2, 3).

BUR-Box_2 Fuses (40/2, 40/3)



The two fuses 40/3 and 40/2 (1, 2) are located in BUR-Box_2. Fuse (1) 40/3 protects the circuits in BUR3 and fuse (2) 40/2 protects the circuits in BUR2. Fuse 40/3 (1) is located on the right side; fuse 40/2 (2) is located on the left hand side.



0501004

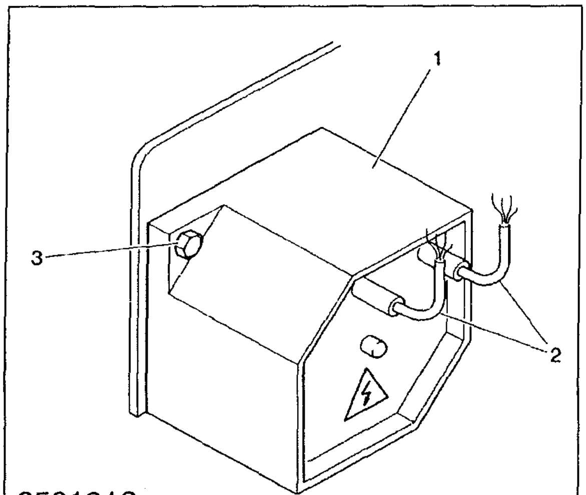
Loosen, but do not remove, the screws (2, 3).

Push the fuse (1) from above over the screw (3). Swing the fuse (1) onto the upper terminal. Tighten the screws (2, 3).

Repeat the procedure for the other fuse.

Voltage Indicator (51.4/1, 51.4/2, 51.4/3)

Voltage indicator 51.4/1 is mounted on the top of BUR-Box_1. Two voltage indicators are mounted on the top of BUR-Box_2. Indicator 51.4/2 is situated on the left side for BUR2 and indicator 51.4/3 on the right side for BUR3.



0501016

Mount the voltage indicator (1) onto the support above the auxiliary converter.

Install and tighten the bolts (3).

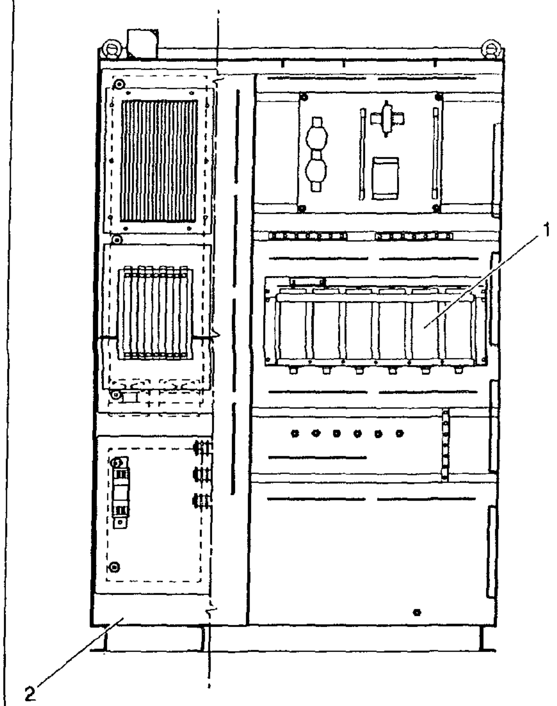
Connect the cables (2) to the indicator (1) as tagged during disassembly.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02B, Rectifier 1 of Volume G1, Cabling Documentation for BUR1 electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02D, Rectifier 2 of Volume G1, Cabling Documentation for BUR2 electrical connections.

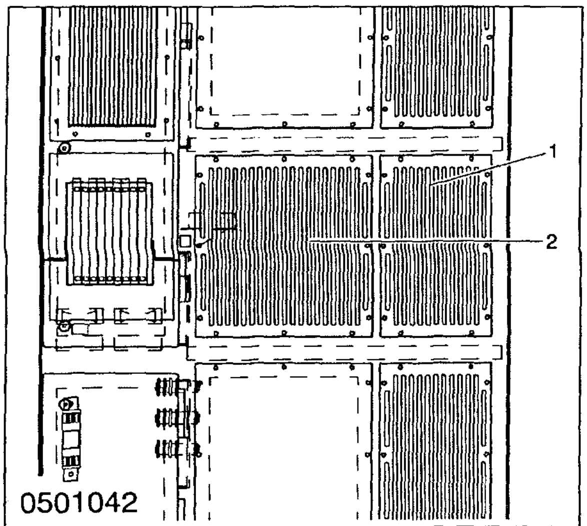
Refer to Section Auxiliary Circuits 3-Phase, Sheet 02F, Rectifier 3 of Volume G1, Cabling Documentation for BUR3 electrical connections.

Capacitor Bank CZ 12.01 (51.1/1, 51.1/2, 51.1/3)



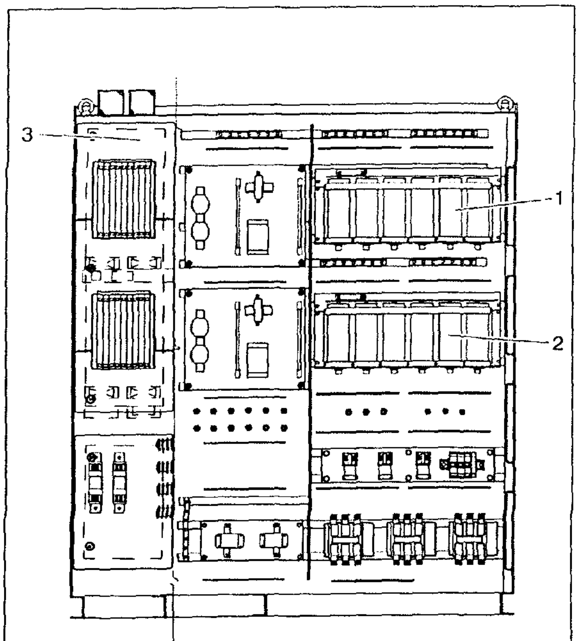
0501052a

In BUR-Box_1 the capacitor bank (1) is mounted on the inside on the rear wall of the cabinet (2).



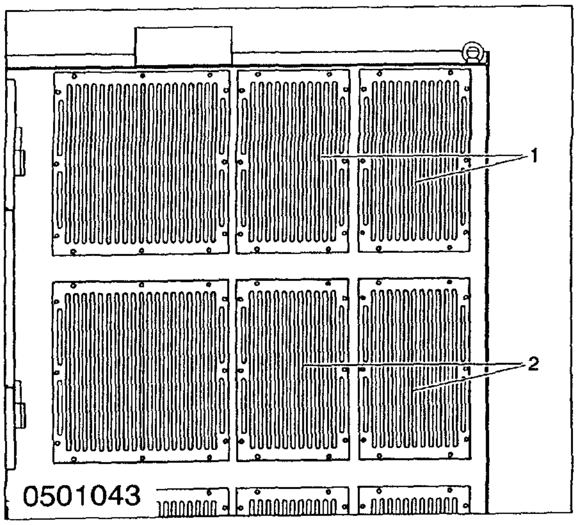
0501042

The capacitor bank is only accessible when removing rectifier modules (50.11) and inverter modules (50.12) are removed. Refer to Rectifier Module (50.11) in this Section. Refer to Inverter Module (50.12) in this Section.



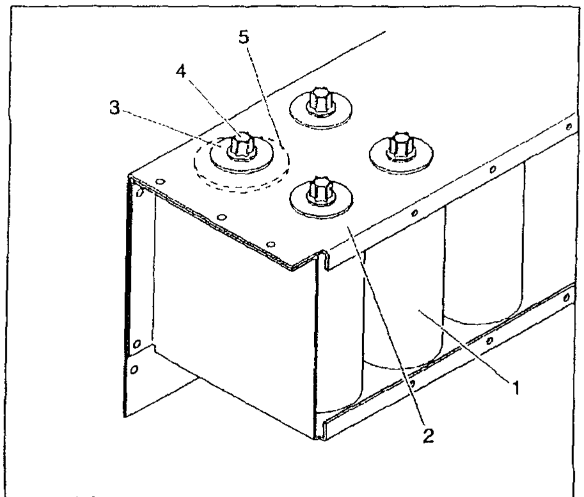
0501053a

In BUR-Box_2 the capacitor banks (1, 2) are mounted on the inside on the rear wall of the cabinet (3). The capacitor bank (1) for BUR2 is mounted at upper level. The capacitor bank (2) for BUR3 is on the lower level.



0501043

The capacitor bank is only accessible when the Inverter Module (50.12) is removed. Refer to Inverter Module (50.12) in this *Section.*



0501051

NOTE:

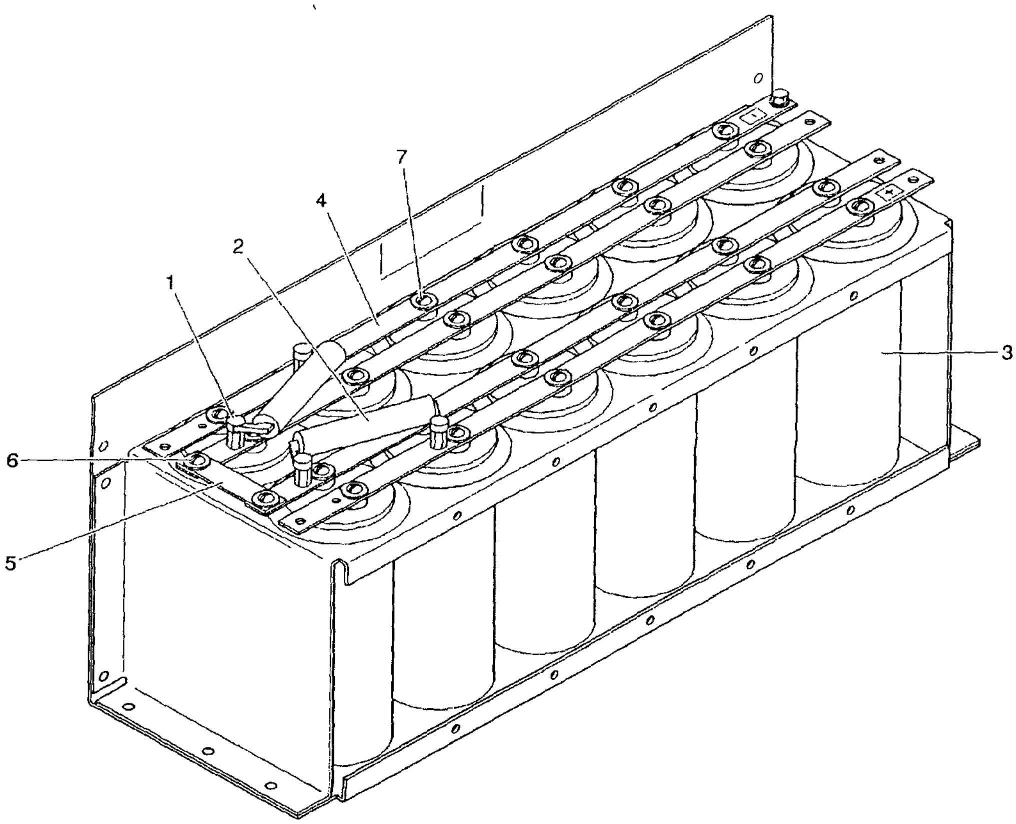
Figure shows the capacitor bank inverted.

Install the upper insulating disk (5).

Install the capacitors (1) from the mounting plate (2).

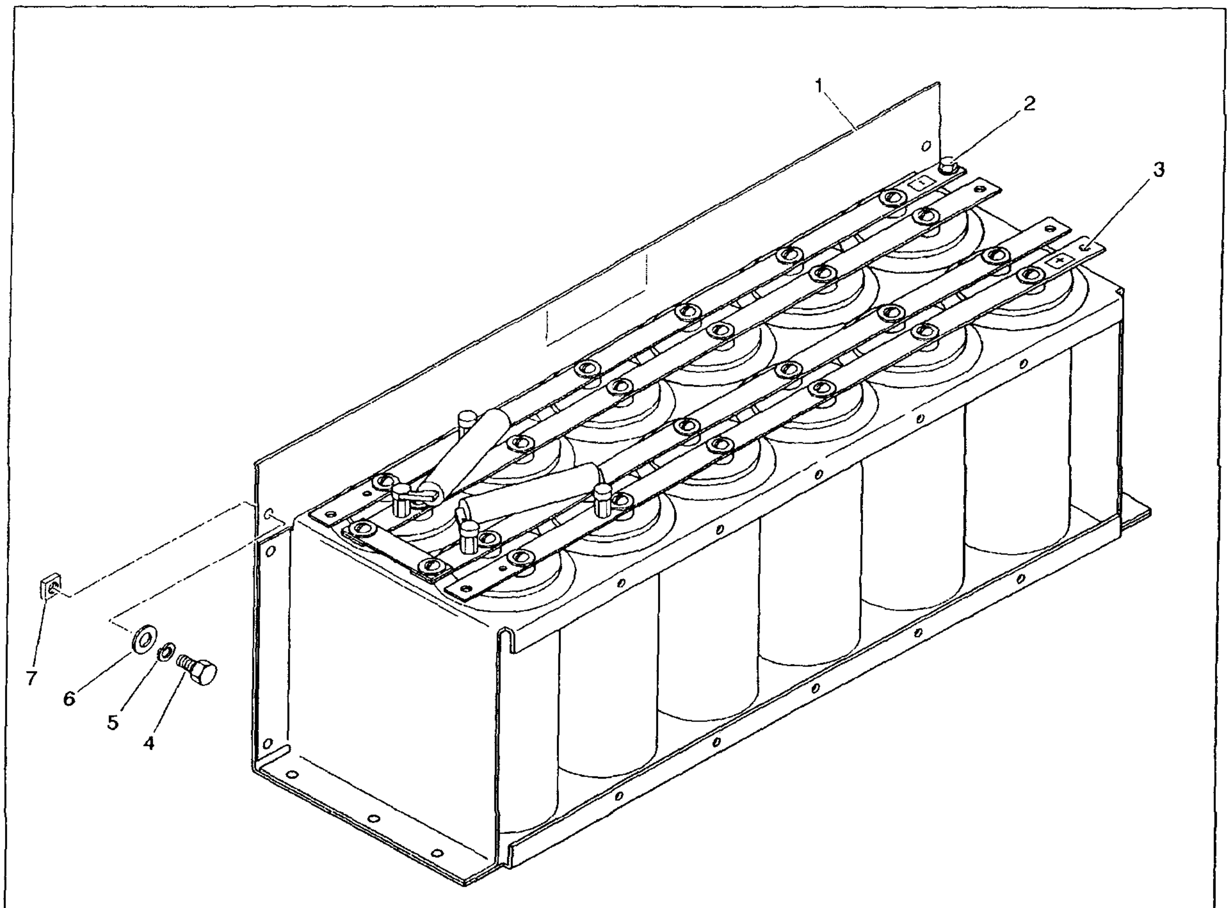
Install the lower insulating disk (3).

Install and tighten the nuts (4) securing the capacitors (1) to the mounting plate (2).



0501102n

Install the connecting rails (4). Install and tighten the screws (7) securing the connecting rails (4) to the capacitors (3).
Install the intermediate link (5). Install and tighten the screws (6) securing the intermediate link (5) to the connecting rails (4).
Install the resistors (2). Install and tighten the screws (1), spring washers and washers securing the resistors (2) to the connecting rails (4).



0501030n

Position the capacitor bank (1) in the cabinet.

Support the capacitor bank (1) to prevent it falling. Note that the capacitor bank is heavy.

Install the screws (4), spring washers (5) and washers (6). The sliding nuts (7) are captive in the U-profiles welded to the wall of the cabinet. Align the capacitor bank (1), then tighten the screws (4) securing the capacitor bank (1) in place.

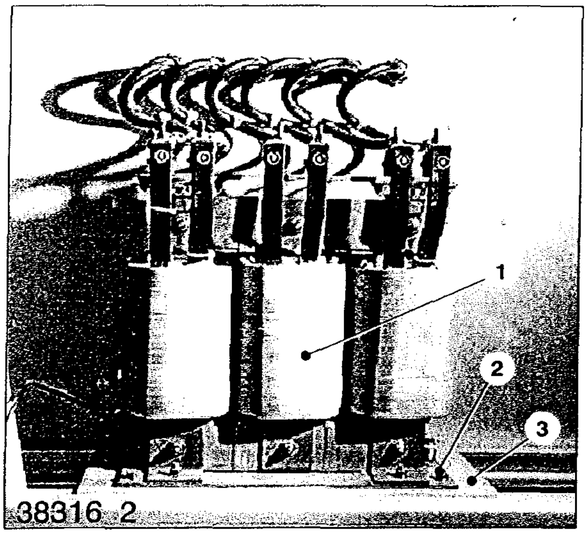
Reconnect the cables to the connections (2,3) as tagged during removal.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02B, Rectifier 1 of Volume G1, Cabling Documentation for BUR1 capacitor bank electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02D, Rectifier 2 of Volume G1, Cabling Documentation for BUR2 capacitor bank electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02F, Rectifier 3 of Volume G1, Cabling Documentation for BUR3 capacitor bank electrical connections.

BUR-Box_1 Three-Phase Output Choke (50.9)



The three-phase choke consists of three individual chokes (1) mounted on a common plate (3). The metal plate (3) is welded to the two U-profiles on the back of the auxiliary converter BUR-Box_1. Note that the chokes are heavy.

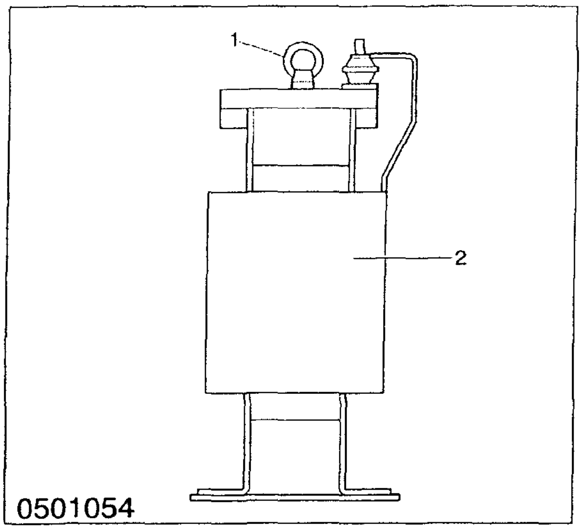
Attach suitable lifting equipment to the eye-bolts of the choke.

Lift the choke (1) into position on the plate (3).

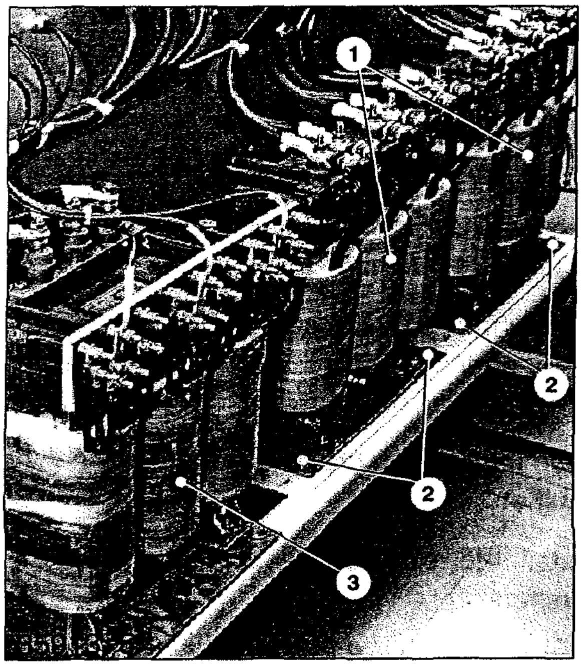
Align the holes in the plate (3) with those in the cabinet.

Install the screws (2), spring and plain washers. Tighten the screws (2).
Connect the cables to the choke terminals as tagged during disassembly.
Refer to Section Auxiliary Circuits 3-Phase, Sheet 02C, Inverter 1 of Volume G1, Cabling Documentation for earthing choke (50.9/1) electrical connections.
Position the grille, then install the screws, plain and spring washers. Tighten the screws.
Connect the earthing cable to the plate (3) as tagged during disassembly.

BUR-Box_2 Three-Phase Output Choke (50.9)



Attach suitable lifting equipment to the eye-bolts (1) on the choke (2).

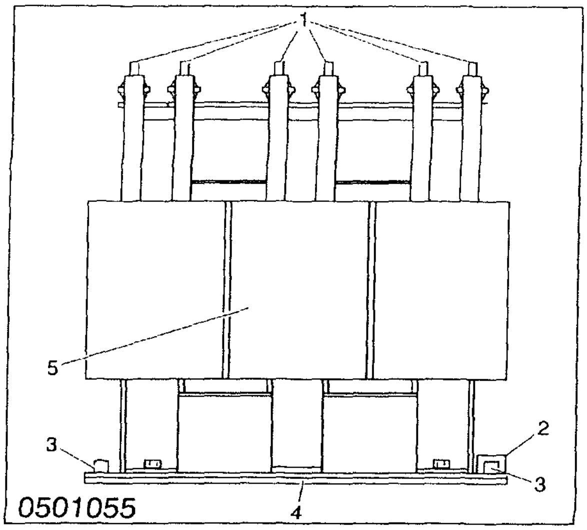


The two three-phase chokes (1) are located on the right-hand rear side. Transformer (3) for charging the battery is located on the left-hand side.

Lift the choke (1) into position on the plate adjacent to the transformer (3).

Align the holes in the choke plate with those in the cabinet base.

Install the screws (2), plain and spring washers, then tighten the screws (2).



Connect the cables to the choke terminals (1) as tagged during disassembly.

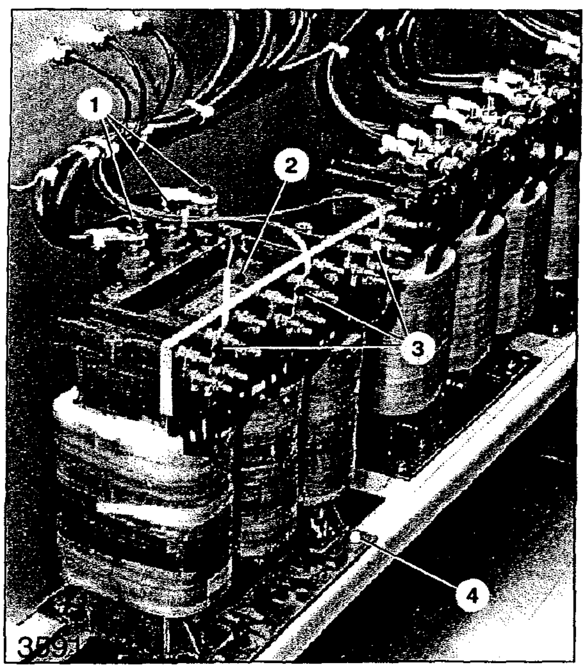
Install the earthing cable on the right of the *transformer as tagged during disassembly.*

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02E, Inverter 2 of Volume G1, Cabling Documentation for earthing choke (50.9/2) electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02G, Inverter 3 of Volume G1, Cabling Documentation for earthing choke *(50.9/3) electrical connections.*

Position the grille, then install the screws, plain and spring washers. Tighten the screws.

Battery Charger Transformer (107.1)



The battery charging transformer is mounted on the back wall of BUR-Box_2 next to the two 3-phase chokes.

*Attach suitable lifting equipment to the eye-*bolts of the transformer (2).

Lift the transformer (2) into position on the plate, on the outside left next to the three-phase chokes.

Align the holes in the plate with those in the cabinet.

Install the screws (4), spring and plain washers.

Tighten the screws (4).

Connect the cables (1, 3) to the transformer (2) as tagged during disassembly.

Refer to Section Control Circuits, Sheet 04A, Battery Charger of Volume G1, Cabling Documentation for battery charger transformer electrical connections.

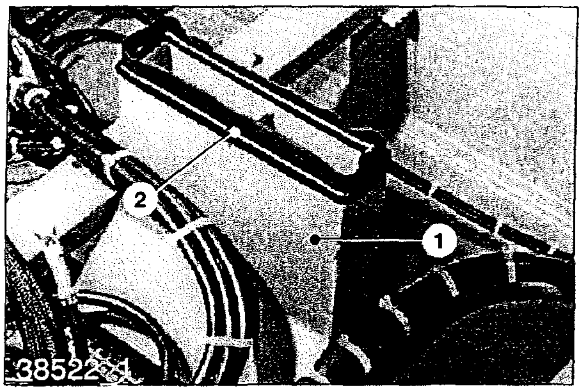
Position the grille, then install the screws, plain and spring washers. Tighten the screws.

Install the earthing cable on the right of the transformer as tagged during disassembly.

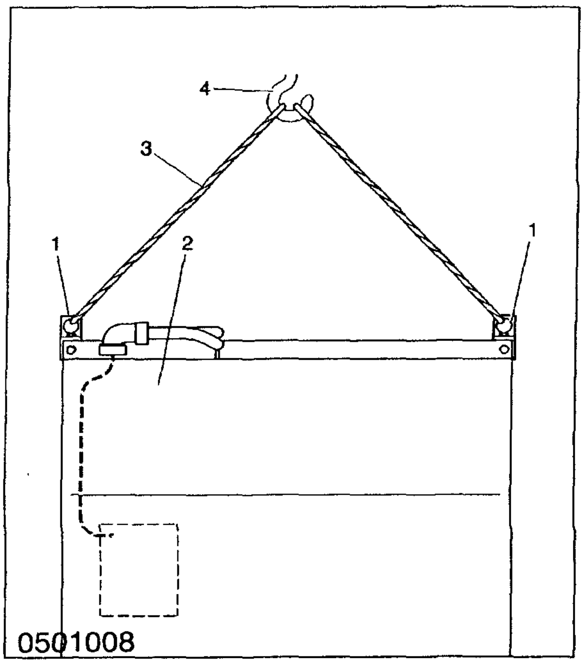
Installation

@ 1280

BUR-Box_1 (1050.1)



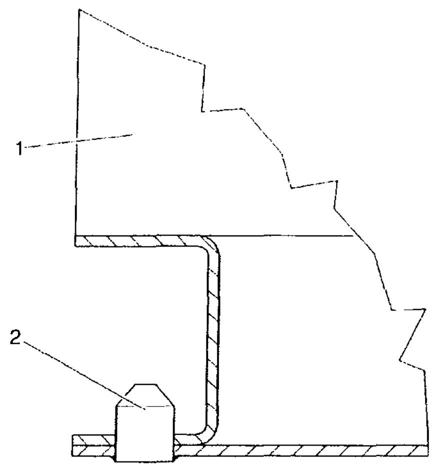
Wrap the edges of the air supply duct (1) with sealing tape (2).



Attach suitable lifting equipment to the lifting eyes (1) on the auxiliary converter (2). Lay the cable (3) around the crane hook (4) in such a way that when lowering the auxiliary converter (2) the front tilts slightly forward.

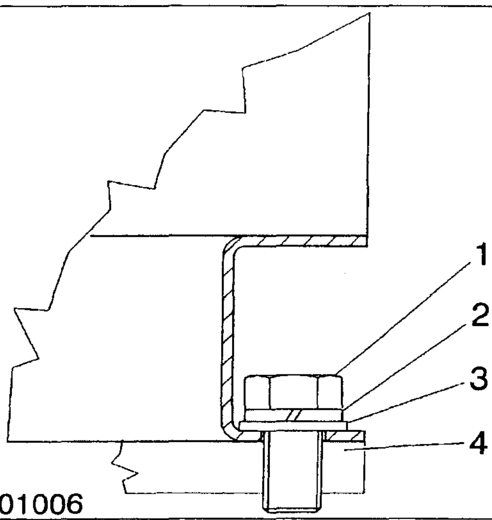
Pull the auxiliary converter (2) forward slightly so that when lowering it the side wall of the locomotive is not damaged by the back of the auxiliary converter.

While lowering the converter (2), open the connecting block door (1) when the converter is approximately 1/2 m above the machine room floor. Open the door (1) and bring the transformer and other cables through the bottom of the converter and out the connecting block door (1). Chock the door open to prevent damage to the cables.



0501007

Continue to lower the converter (1) over the air supply duct in the machine room floor and the mounting studs (2).



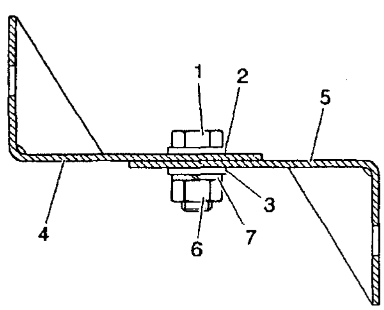
0501006

Align the holes in the auxiliary converter flange with the mounting holes in the machine room floor (4).

Apply Molycote White to the bolts (1). Install the bolts (1), spring and plain washers (3, 2) to secure the converter to the machine room floor (4). Do not tighten the bolts (1).

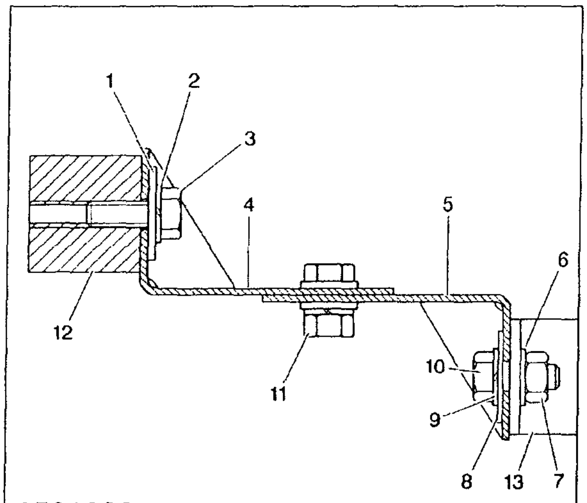
Check to ensure that the converter is correctly aligned, then completely lower the converter. Adjust the position of the converter, if necessary.

Tighten the bolts (1), then disconnect the lifting equipment.



0501003a

If necessary, assemble the two halves (4, 5) of the angle bracket. Install the bolt (1), plain washer (2), spring and plain washers (3, 7), and nut (6). Do not tighten the nut (6). A slot in the brackets (4, 5) allows them to be adjusted to suit the distance between the converter and machine room wall.



0501002a

Position the angle bracket assembly (4, 5) between the auxiliary converter (13) and machine room wall (12).

Align the bracket assembly (4, 5) with the mounting hole in the machine room wall (12). Install the bolt (3), plain and spring washers (1, 2) through the bracket assembly (4, 5) into the machine room wall (12). Do not tighten the bolt (3).

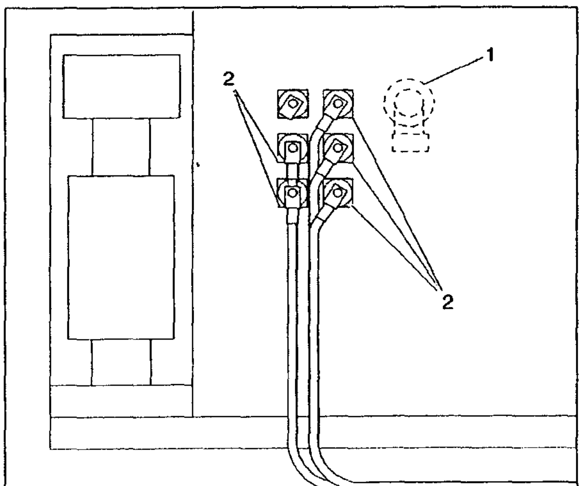
Align the hole in the bracket assembly (4, 5) with the mounting hole in the auxiliary converter (13). Install the bolt (10), spring and plain washers (9, 8), plain washer (6) and nut (7). Do not tighten the nut (7).

Install the mounting bracket at the other side of the auxiliary converter in the same way.

Tighten the bolt (3) securing the bracket assembly (4, 5) to the machine room wall (12). Tighten the bolt (3) securing the mounting bracket at the other side of the auxiliary converter in the same way.

Tighten the nut (7) securing the bracket assembly (4, 5) to the auxiliary converter (13). Tighten the nut (7) securing the mounting bracket at the other side of the auxiliary converter in the same way.

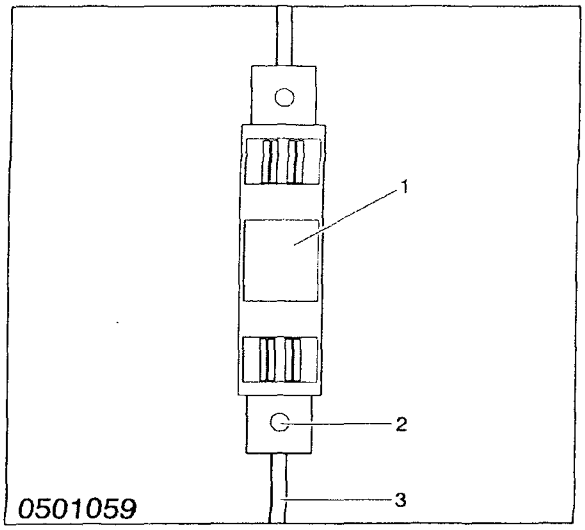
Tighten the nut between the two halves of the bracket assembly (4, 5). Tighten the nut (11) securing the two halves of the bracket assembly (4, 5) at the other side of the auxiliary converter in the same way.



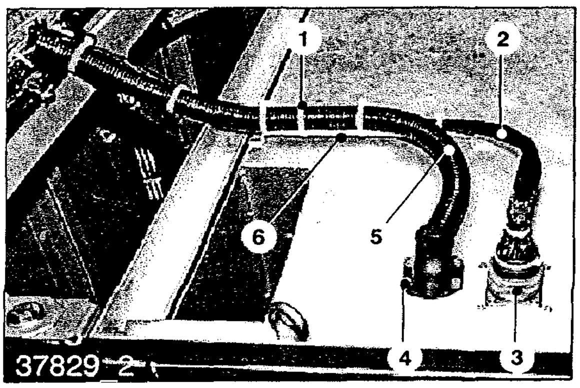
0501061

Connect the harness (1) to the socket as tagged during disassembly. Turn the retaining ring clockwise to secure.

Connect the cables (2) to the terminals as tagged during disassembly.



Connect the cables (3) to the fuse holder as tagged during disassembly, then tighten the nut (2).



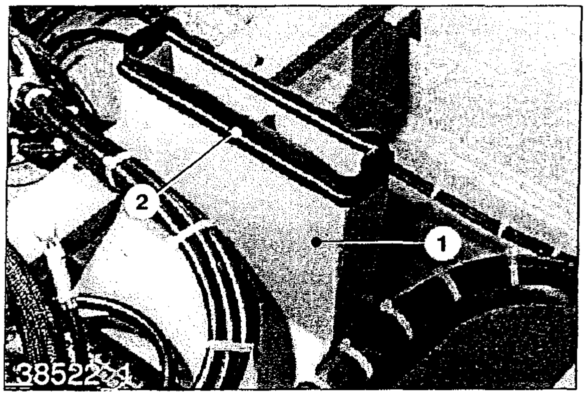
Connect the harnesses (5, 2) to the control unit sockets (4, 3), at the top of the converter cubicle, as tagged during disassembly. Secure the harnesses (5, 2) to the looming bar (6) using suitable cable ties (1).

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02B, Rectifier 1 of Volume G1, Cabling Documentation for electrical connections.

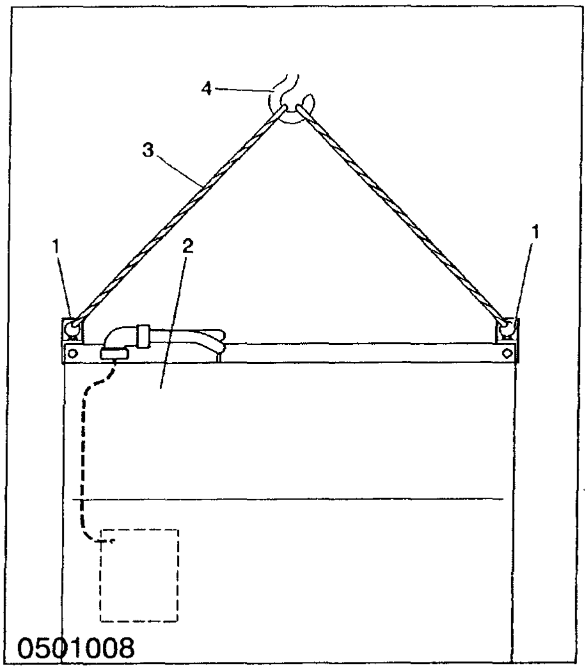
Refer to Section Auxiliary Circuits 3-Phase, Sheet 02H, Blowers of Volume G1, Cabling Documentation for electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02I, Oil Pumps and Compressors of Volume G1, Cabling Documentation for electrical connections.

BUR-Box_2 (1050.2)



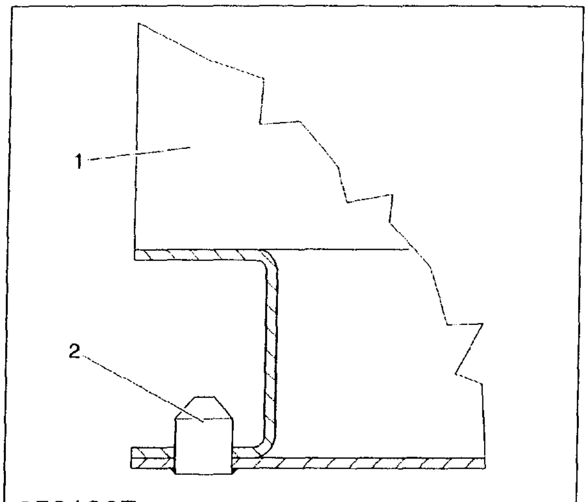
Wrap the edges of the air supply duct (1) with sealing tape (2).



Attach suitable lifting equipment to the lifting eyes (1) on the auxiliary converter (2). Lay the cable (3) around the crane hook (4) in such a way that when lowering the auxiliary converter (2) the front tilts slightly forward.

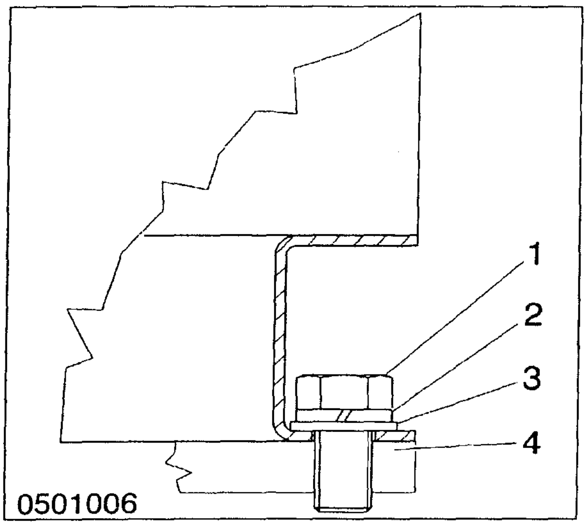
Pull the auxiliary converter (2) forward slightly so that when lowering it the side wall of the locomotive is not damaged by the back of the auxiliary converter.

While lowering the converter (2), open the connecting block door (1) when the converter is approximately 1/2 m above the machine room floor. Open the door (1) and bring the transformer and other cables through the bottom of the converter and out the connecting block door (1). Chock the door open to prevent damage to the cables.



0501007

Continue to lower the converter (1) over the air supply duct in the machine room floor and the mounting studs (2).



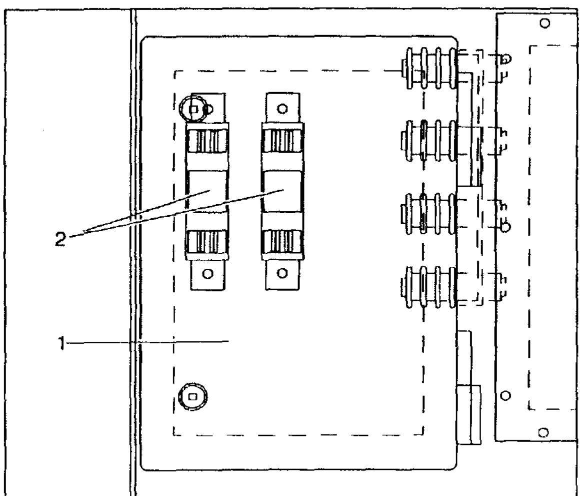
0501006

Align the holes in the auxiliary converter flange with the mounting holes in the machine room floor (4).

Apply Molycote White to the bolts (1). Install the bolts (1), spring and plain washers (3, 2) to secure the converter to the machine room floor (4). Do not tighten the bolts (1).

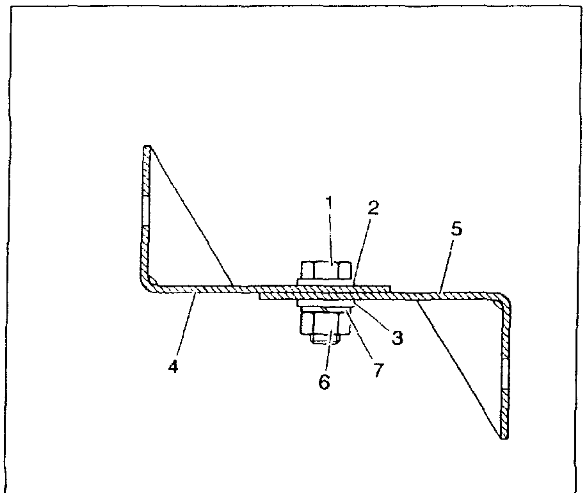
Check to ensure that the converter is correctly aligned, then completely lower the converter. Adjust the position of the converter, if necessary.

Tighten the bolts (1), then disconnect the lifting equipment.



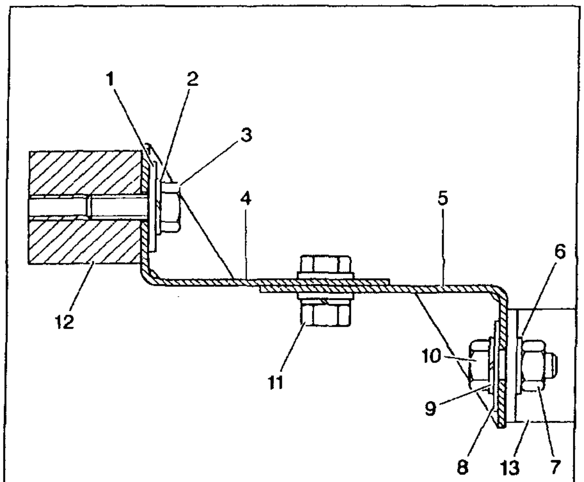
0501018

Lay the cables for controlling the blowers, the connections of the transformer to the fuses in auxiliary power circuit and the remaining cables from below to the connecting block of the auxiliary converter. So that no cables are jammed in while lowering the unit, open the door (1) 1/2 m above the floor.



0501003a

If necessary, assemble the two halves (4, 5) of the angle bracket. Install the bolt (1), plain washer (2), spring and plain washers (3, 5), and nut (6). Do not tighten the nut (6). A slot in the brackets (4, 5) allows them to be adjusted to suit the distance between the converter and machine room wall.



0501002a

Position the angle bracket assembly (4, 5) between the auxiliary converter (13) and machine room wall (12).

Align the bracket assembly (4, 5) with the mounting hole in the machine room wall (12). Install the bolt (3), plain and spring washers (1, 2) through the bracket assembly (4, 5) into the machine room wall (12). Do not tighten the bolt (3).

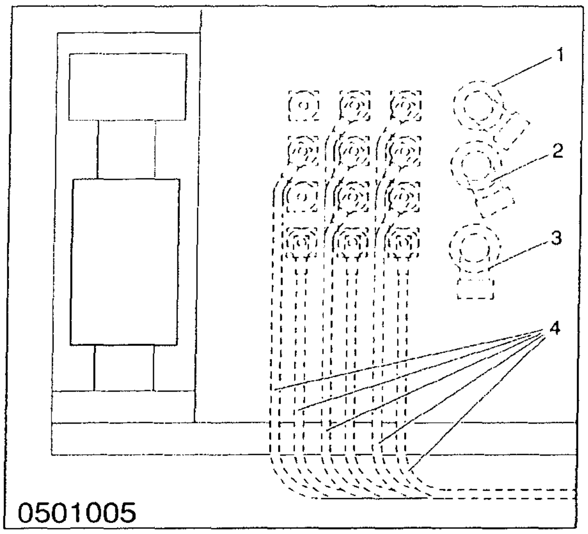
Align the hole in the bracket assembly (4, 5) with the mounting hole in the auxiliary converter (13). Install the bolt (10), spring and plain washers (9, 8), plain washer (6) and nut (7). Do not tighten the nut (7).

Install the mounting bracket at the other side of the auxiliary converter in the same way.

Tighten the bolt (3) securing the bracket assembly (4, 5) to the machine room wall (12). Tighten the bolt (3) securing the mounting bracket at the other side of the auxiliary converter in the same way.

Tighten the nut (7) securing the bracket assembly (4, 5) to the auxiliary converter (13). Tighten the nut (7) securing the mounting bracket at the other side of the auxiliary converter in the same way.

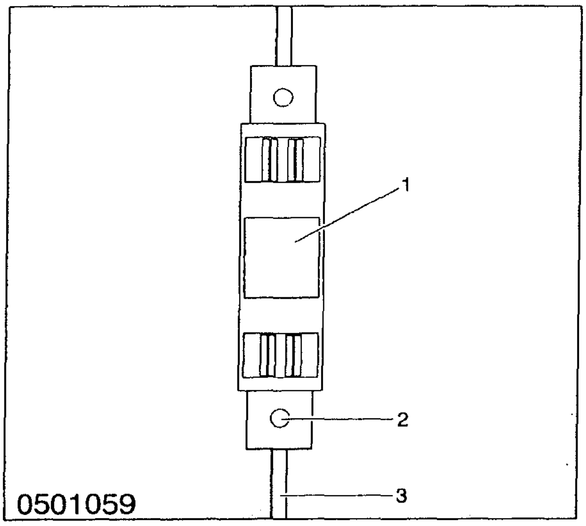
Tighten the nut between the two halves of the bracket assembly (4, 5). Tighten the nut (11) securing the two halves of the bracket assembly (4, 5). at the other side of the auxiliary converter in the same way.



0501005

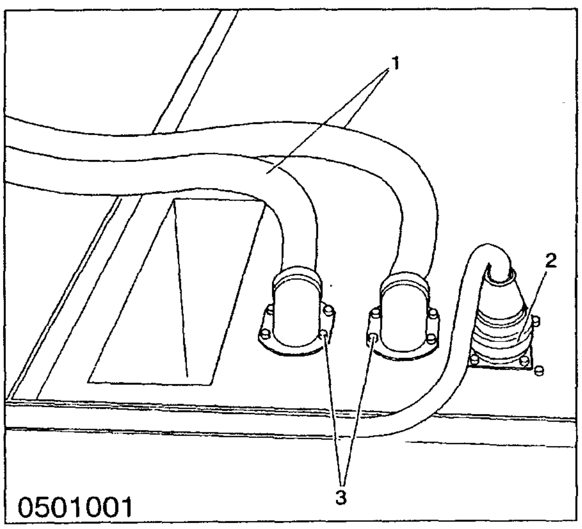
Connect the harnesses (1, 2, 3) to the sockets as tagged during disassembly. Turn the retaining rings clockwise to secure.

Connect the cables (4) to the terminals as tagged during disassembly.



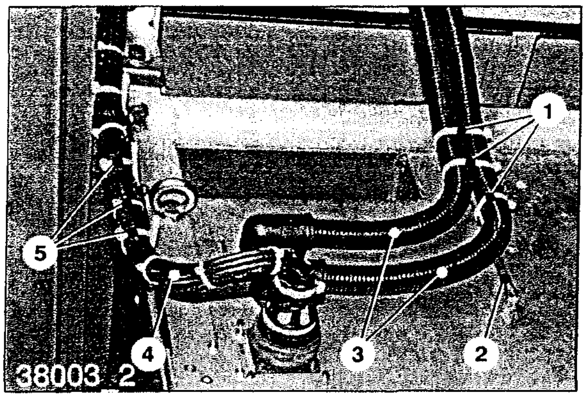
0501059

Connect the cables (3) to the fuse holders as tagged during disassembly, then tighten the nut (2).



0501001

Connect the harnesses (1) to the control unit sockets (2, 3), at the top of the converter cubicle, as tagged during disassembly.



Secure the harnesses (3, 4) to the looming bars (2) using suitable cable ties (1, 5).

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02D, Rectifier 2 of Volume G1, Cabling Documentation for electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02F, Rectifier 3 of Volume G1, Cabling Documentation for electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02H, Blowers of Volume G1, Cabling Documentation for electrical connections.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02I, Oil Pumps and Compressors of Volume G1, Cabling Documentation for electrical connections.

After-Installation Operations

@.1290

Reinstall the pantograph roof hatch, as described in Chapter 1.1, Structure.

Close the battery box isolation switch and reconnect the locomotive to the overhead, then test the operation of the auxiliary converters.

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183

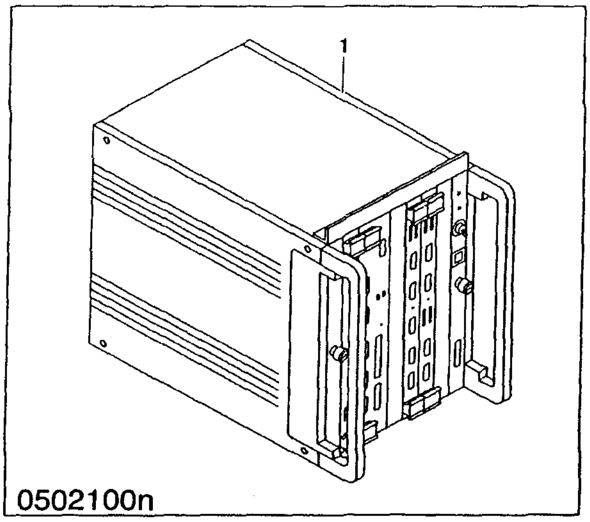
5.2 Auxiliary Converter Control

14

Group Summary

@.1120

This chapter contains information regarding the central electronics MICAS auxiliary converter control units located in the BUR boxes. The Electrical Equipment Apparatus Item Numbers for auxiliary converter control units are 426.1, 426.2 and 426.3.

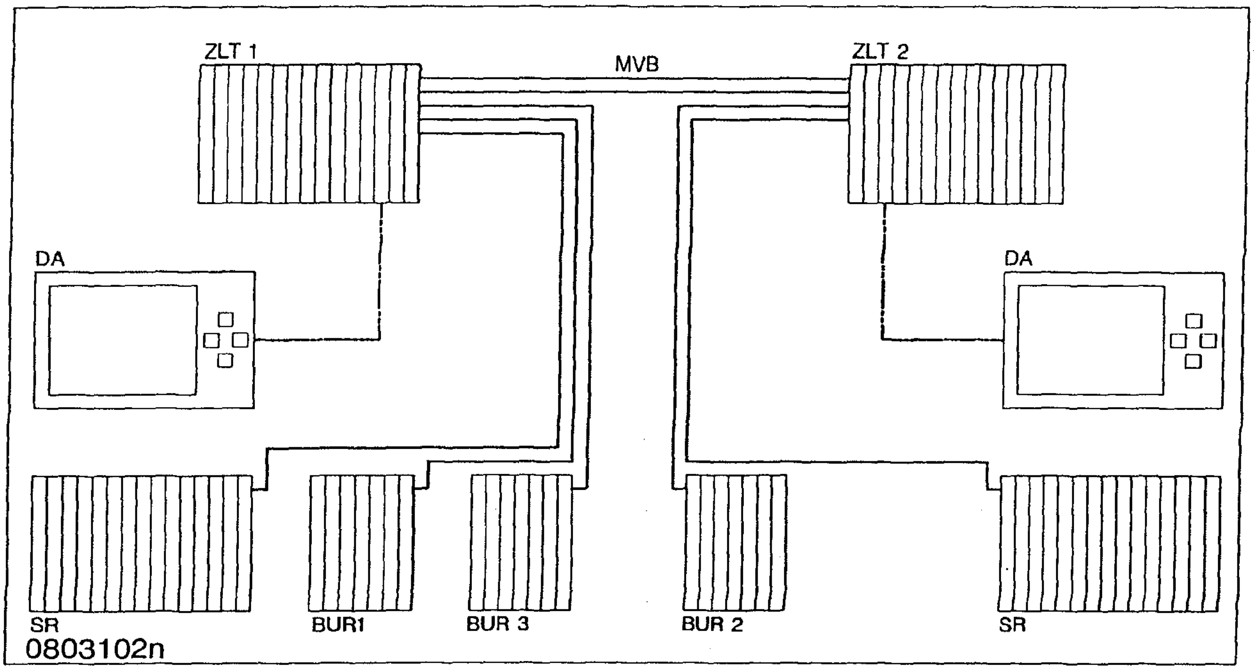


1 Auxiliary converter control electronics (426)

Functional Description

@.1140

The auxiliary converter MICAS control units are located in the BUR cabinets within the machine room. Auxiliary converter control 1 (426.1) is situated in BUR-Box_1. Auxiliary converter control units 2 and 3 (426.2 & 426.3) are located in BUR-Box_2, as it contains auxiliary converters 2 and 3.



The auxiliary converter (BUR) control units are connected to the multifunctional vehicle bus (MVB) and form a part of the MICAS S2 vehicle control system. Other components in the MICAS S2 system include the vehicle control (ZLT) units, the traction converter (SR) 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.

The auxiliary converter (BUR) control unit performs high level control, system monitoring and failure analysis for the auxiliary converter systems. Feedback from the systems to the auxiliary converter control units is used to monitor the operation of the auxiliary converters.

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 auxiliary converters, refer to Chapter 5.1, Auxiliary 3 Phase Power.

Technical Data

@.1160

Weight, complete rack	8 kg
Power dissipation	< 20 Watt
Operating temperature	-25 - +50 °C
Peak operating temperature	-25 - +60 °C

Tolerances and Wear Limits List

@.1170

For further information regarding the auxiliary converter control units, refer to Volume 9, Suppliers Documentation.

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

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

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.

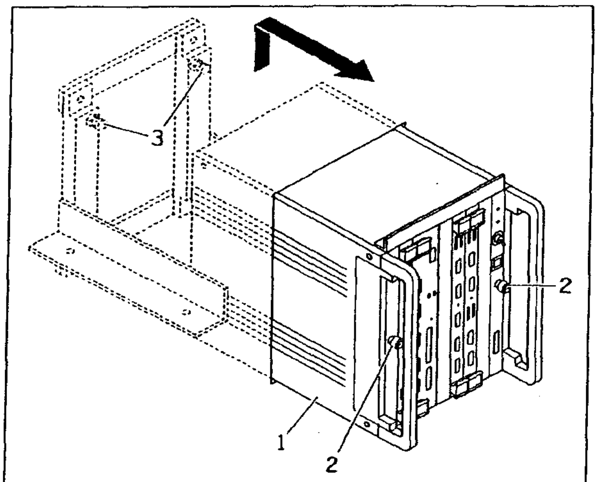
Ensure the voltage indicators on the BUR cubicles are not flashing. A flashing voltage indicator shows a voltage present in the cabinet. No work should be performed until the capacitor banks have discharged, indicated by no flashing on the voltage indicator. Ensure the voltage indicator does not flash for a period of at least 15 seconds.

Isolate the batteries at the battery box isolation switch, as described in Chapter 5.3, Battery / Charger.

Removal

@.1230

Removal of the MICAS auxiliary converter control units is the same for all modules. The following procedures describes the removal of the MICAS control unit from BUR-Box_1.



0502101n

Unlock the cubicle door using square keys then open fully to allow removal of the MICAS module.

Tag and disconnect the electrical and fibre optic cables from the cards in the MICAS module.

Fully loosen the screws (2) securing the MICAS module (1) to the BUR cabinet. The screws (2) are captive and cannot be removed.

NOTE:

Do not use a hammer, or other instrument, to dislodge the MICAS module.

Lift the MICAS module (1) vertically, using the handles, to disengage the module from the mounting spigots (3), then carefully pull the unit (1) from the BUR cabinet.

Disassembly

@.1240

For further information regarding the auxiliary converter control units, refer to Volume 9, Suppliers Documentation.

Inspection and Repair

@.1250

For further information regarding the auxiliary converter control units, refer to Volume 9, Suppliers Documentation.

Waste Disposal

@.1260

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

Assembly

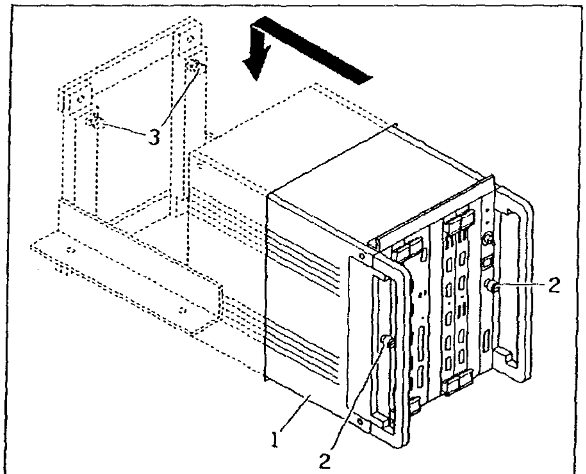
@.1270

For further information regarding the auxiliary converter control units, refer to Volume 9, Suppliers Documentation.

Installation

@.1280

Installation of the MICAS auxiliary converter control units is the same for all modules. The following procedures describes the installation of the MICAS control unit to BUR-Box_1.



0502102n

Using the handles on the MICAS module (1), insert the module (1) fully into the BUR cabinet until it seats on the mounting spigots (3). Push the MICAS module (1) vertically downwards, using the handles, until the module (1) seats correctly on the spigots (3).

Tighten the screws (2) securing the MICAS module to the BUR cabinet. Do not over tighten the screws (2).

Connect the electronic and fibre optic cables to the cards in the MICAS module as tagged during disassembly.

Close the cubicle door and lock using square keys.

After-Installation Operations

@.1290

Test the operation of the auxiliary converter control system. Rectify any faults found.

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5.3 Battery and Charger

General Notes On Hazards in the Work Area

@.1040

WARNING:

The alkaline electrolyte used in the batteries is a strong caustic agent. Wear rubber gloves, eye protection and cover all exposed skin when working on the batteries. Before working with electrolyte, ensure that a supply of clean, fresh water is available for washing. If electrolyte is splashed on skin or clothing, rinse immediately in water for 10 to 15 minutes. If eyes are contaminated flood with clean, fresh water and obtain immediate medical attention.

The batteries will produce a flammable gas during the last portion of high-rate charging. Do not adjust connections, etc. during, or for the first hour after, charging. Discharge any possible static electricity from clothes by touching an earth contact part. Never smoke or permit naked flames near the batteries.

NOTE:

Use tools with insulated handles. Do not place or drop metal objects on top of the batteries. Removal of metal wristwatches, rings and other jewellery that may come in contact with the batteries is recommended during all maintenance procedures.

15

5.3 Battery and Charger

General Notes On Hazards in the Work Area

@.1040

WARNING:

The alkaline electrolyte used in the batteries is a strong caustic agent. Wear rubber gloves, eye protection and cover all exposed skin when working on the batteries. Before working with electrolyte, ensure that a supply of clean, fresh water is available for washing. If electrolyte is splashed on skin or clothing, rinse immediately in water for 10 to 15 minutes. If eyes are contaminated flood with clean, fresh water and obtain immediate medical attention.

The batteries will produce a flammable gas during the last portion of high-rate charging. Do not adjust connections, etc. during, or for the first hour after, charging. Discharge any possible static electricity from clothes by touching an earth contact part. Never smoke or permit naked flames near the batteries.

NOTE:

Use tools with insulated handles. Do not place or drop metal objects on top of the batteries. Removal of metal wristwatches, rings and other jewellery that may come in contact with the batteries is recommended during all maintenance procedures.

Functional Description

@.1140

Batteries

The battery array provides a source of direct power for operation of the locomotive equipment. The locomotive is equipped with two battery boxes, one on each side of the underframe. Each battery box contains 13 batteries connected in series. Each battery contains three 1.4 volt Nickel-cadmium (NiCd) cells.

The battery boxes are constructed from stainless steel with slide out trays to facilitate access to the batteries within. The top of the box is covered with a heat shield to protect the batteries and breathers expel gasses from inside the battery box to reduce the fire hazard.

The battery trays slide on nylon guides separated by ball bearings. Handles secure the tray in place and prevent contact with the door. The door is hung from the top and is secured with six keyed locks to prevent unauthorised access. The door can be either swung upwards or removed completely.

Within the battery tray, the batteries are separated by corrugated fibreglass to prevent movement and damage to either the batteries or battery box.

A circuit breaker switch is located on the side of the number 1 end battery box to isolate all the batteries from the locomotive electrical system.

In order to keep the batteries cool and prevent the build-up of gases, air is ducted from the machine room floor and blown through the battery boxes via a ventilator hose. The air is then vented from the battery box through breathers.

The batteries are described in more detail in Chapter 3, Battery / Charger of Volume F10, Suppliers Documentation.

Battery Charger

The batteries are charged during locomotive operation from the overhead catenary using an ABB battery charger integrated in the auxiliary converter cubicle, within the machine room. The control software manages the battery charge.

The battery charger module is located in the BUR2 cabinet and is a part of the auxiliary three phase power system described in Chapter 5.1, Auxiliary Three-Phase Power.

The battery charging is described in more detail in Chapter 3, Battery / Charger of Volume F10, Suppliers Documentation. Also refer to Volume F7, Suppliers Documentation for a description of the auxiliary converter.

Functional Description

@.1140

Batteries

The battery array provides a source of direct power for operation of the locomotive equipment. The locomotive is equipped with two battery boxes, one on each side of the underframe. Each battery box contains 13 batteries connected in series. Each battery contains three 1.4 volt Nickel-cadmium (NiCd) cells.

The battery boxes are constructed from stainless steel with slide out trays to facilitate access to the batteries within. The top of the box is covered with a heat shield to protect the batteries and breathers expel gasses from inside the battery box to reduce the fire hazard.

The battery trays slide on nylon guides separated by ball bearings. Handles secure the tray in place and prevent contact with the door. The door is hung from the top and is secured with six keyed locks to prevent unauthorised access. The door can be either swung upwards or removed completely.

Within the battery tray, the batteries are separated by corrugated fibreglass to prevent movement and damage to either the batteries or battery box.

A circuit breaker switch is located on the side of the number 1 end battery box to isolate all the batteries from the locomotive electrical system.

In order to keep the batteries cool and prevent the build-up of gases, air is ducted from the machine room floor and blown through the battery boxes via a ventilator hose. The air is then vented from the battery box through breathers.

The batteries are described in more detail in Chapter 3, Battery / Charger of Volume F10, Suppliers Documentation.

Battery Charger

The batteries are charged during locomotive operation from the overhead catenary using an ABB battery charger integrated in the auxiliary converter cubicle, within the machine room. The control software manages the battery charge.

The battery charger module is located in the BUR2 cabinet and is a part of the auxiliary three phase power system described in Chapter 5.1, Auxiliary Three-Phase Power.

The battery charging is described in more detail in Chapter 3, Battery / Charger of Volume F10, Suppliers Documentation. Also refer to Volume F7, Suppliers Documentation for a description of the auxiliary converter.

Miscellaneous Materials

@.1200

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

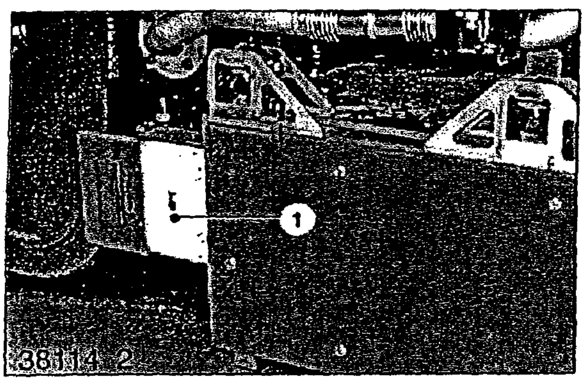
- A suitable corrosion inhibitor, such as petroleum jelly, is required to coat the battery terminals, connectors and bolts after installation. Ensure the inhibitor is suitable for use with stainless steel before application. Suitable tags are required during the disassembly procedure to identify the location of electrical connections. Tagging the cables during removal will assist in their correct reinstallation. Multi or general purpose grease is required for lubrication of the battery tray locking handles.
- Distilled or deionised water may be required for topping up the electrolyte levels in the batteries.

Before-Removal Operations

@.1220

If removing the batteries or battery box, steam clean the battery box and surrounding area. Remove all traces of dirt and debris. The batteries must be kept dry. Take care not to direct the spray stream into the breathers.

Lower the pantograph and isolate the locomotive from the overhead catenary. Earth the locomotive using the key interlocking system. Refer to the Preface of this Volume.



Isolate the batteries at the circuit breaker located on the side of the number 1 end battery box.

Miscellaneous Materials

@.1200

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

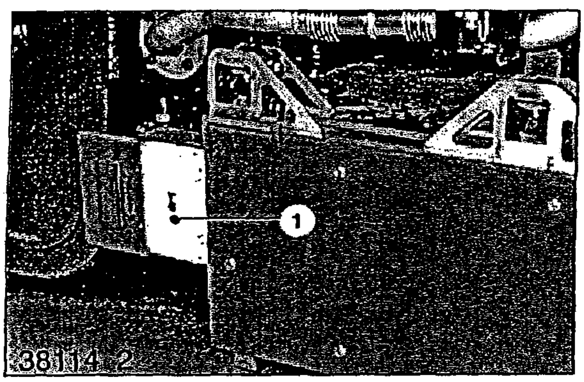
- A suitable corrosion inhibitor, such as petroleum jelly, is required to coat the battery terminals, connectors and bolts after installation. Ensure the inhibitor is suitable for use with stainless steel before application. Suitable tags are required during the disassembly procedure to identify the location of electrical connections. Tagging the cables during removal will assist in their correct reinstallation. Multi or general purpose grease is required for lubrication of the battery tray locking handles.
- Distilled or deionised water may be required for topping up the electrolyte levels in the batteries.

Before-Removal Operations

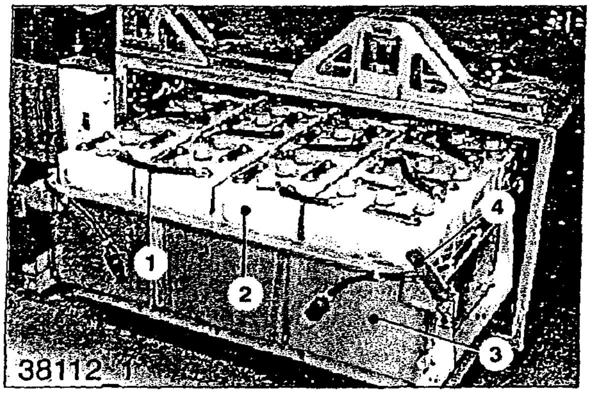
@.1220

If removing the batteries or battery box, steam clean the battery box and surrounding area. Remove all traces of dirt and debris. The batteries must be kept dry. Take care not to direct the spray stream into the breathers.

Lower the pantograph and isolate the locomotive from the overhead catenary. Earth the locomotive using the key interlocking system. Refer to the Preface of this Volume.



Isolate the batteries at the circuit breaker located on the side of the number 1 end battery box.



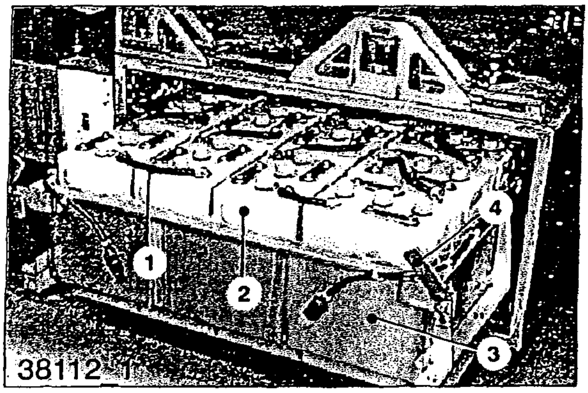
Lift the locking handles (4) and slide out the battery tray (3).

CAUTION:

Each battery weighs approximately 30 kg. Use care when handling the batteries to avoid spillage or contamination from the electrolyte. Refer to General Notes on Hazards in the Work Area, at the beginning of this Chapter.

Tag the location of the battery jumper cables, then remove the bolts and disconnect the jumper cables (1) from the batteries. Lift the individual batteries (2) from the battery tray (3) and store in a secure area.

Slide the battery tray (3) back into position and secure the locking handles (4).



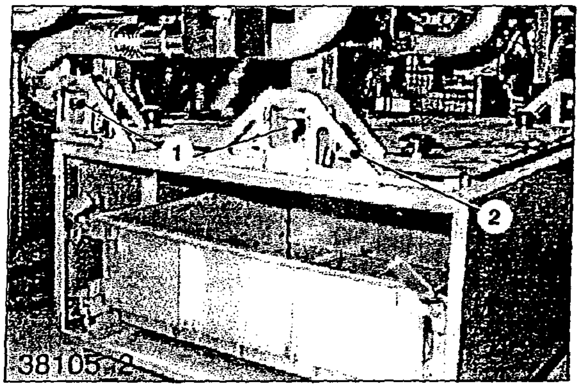
Lift the locking handles (4) and slide out the battery tray (3).

CAUTION:

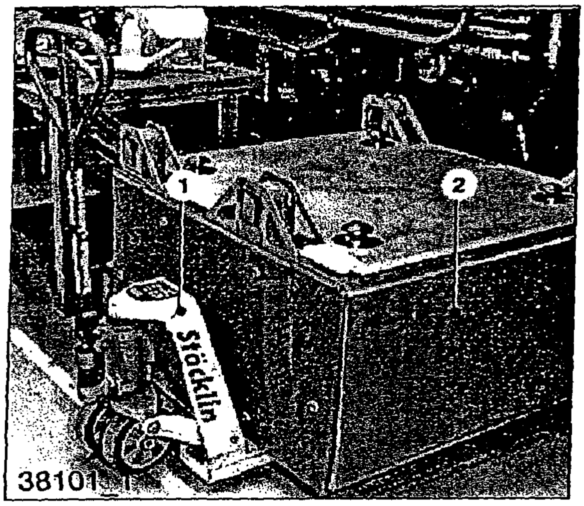
Each battery weighs approximately 30 kg. Use care when handling the batteries to avoid spillage or contamination from the electrolyte. Refer to General Notes on Hazards in the Work Area, at the beginning of this Chapter.

Tag the location of the battery jumper cables, then remove the bolts and disconnect the jumper cables (1) from the batteries. Lift the individual batteries (2) from the battery tray (3) and store in a secure area.

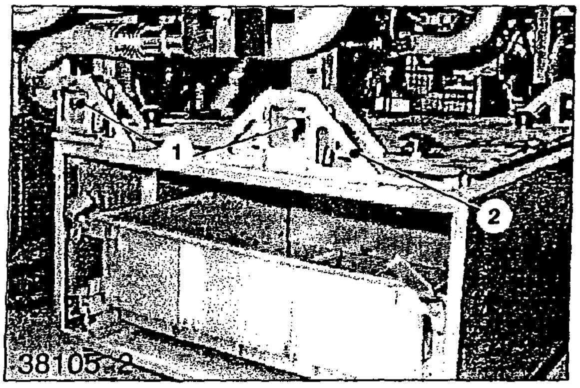
Slide the battery tray (3) back into position and secure the locking handles (4).



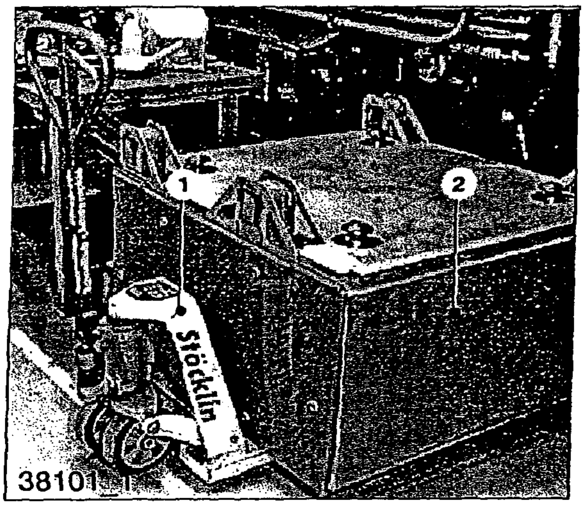
Remove the nuts (1) and washers from inside the battery box hangers (2).



Remove the battery box (2) from below the locomotive.

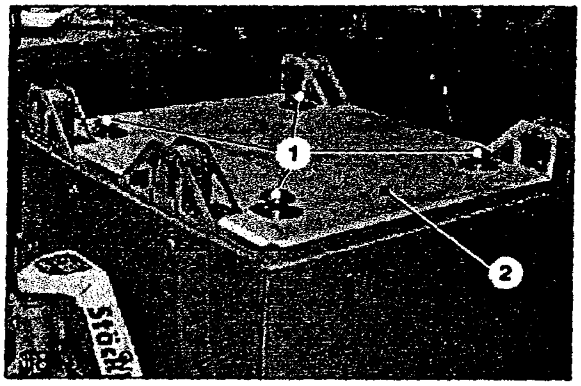


Remove the nuts (1) and washers from inside the battery box hangers (2).

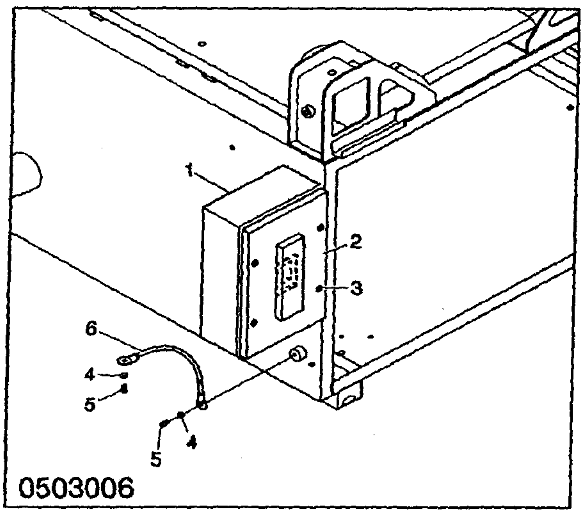


Remove the battery box (2) from below the locomotive.

Remove the bolts (6) and washers (5), then separate the slide tracks (3) from the battery box (1).

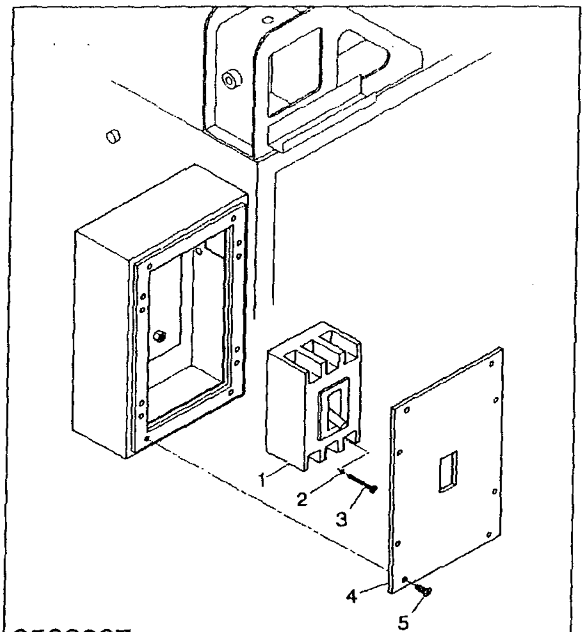


Unscrew the breathers (1) from the top of the battery box (2).



Remove the screws (5) and washers (4) securing the circuit breaker earthing cable (6).

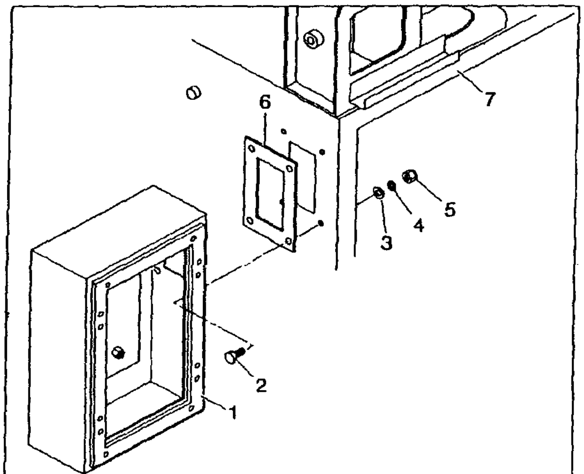
Remove the screws (3) and washers from the circuit breaker cover (2) panel, then remove the cover panel (2).



0503007

Remove the screws (5) from the circuit breaker protection plate (4).

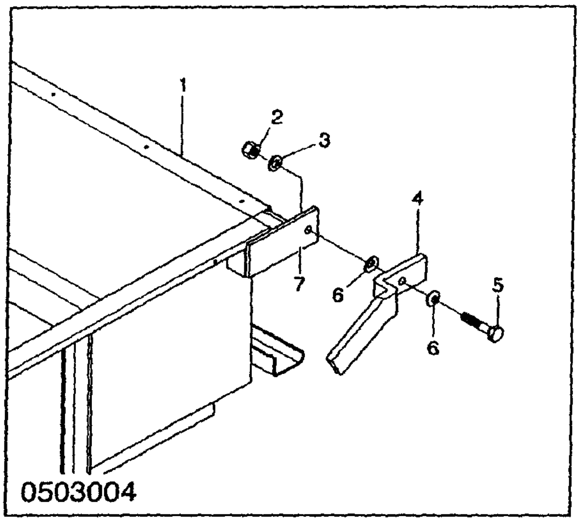
Tag and disconnect the electrical cables from the circuit breaker (1). Remove the screws (3) and washers (2) securing the circuit breaker (1) to the housing, then remove the circuit breaker (1).



0503008a

From inside the battery box, remove the nuts (5), spring and plain washers (3, 4) securing the circuit breaker box (1) to the battery box (7). Withdraw the bolts (2) and separate the circuit breaker box (1) and gasket (6) from the battery box (7).

Battery Tray



Remove the nuts (2) and washers (3) securing the locking handles (4) to the battery tray (1). Withdraw the bolts (5) and washers (6), then separate the handle (4) from the battery box (1).

Inspection and Repair

@.1250

Battery

WARNING:

Do not attempt to repair leaking or damaged batteries. Defective batteries must be replaced. Take care when handling the batteries. Refer to General Notes on Hazards in the Work Area, at the beginning of this Chapter.

Check the condition of each battery as described in Chapter 3, Battery / Charger of Volume F10, Suppliers Documentation.

Defective or damaged batteries should be returned to the manufacturer.

Check the level of the electrolyte in the battery. Top up as necessary using distilled or deionised water.

With the electrolyte at an acceptable service level, check the specific gravity of the electrolyte in the battery using a hydrometer. Adjust the electrolyte density, or replace the electrolyte as described in Chapter 5.3, Battery / Charger of Volume F10, Suppliers Documentation.

Battery Box

Steam clean the battery box and tray. Remove all dirt, debris and corrosion.

Inspect the battery box, tray and hanger brackets for cracks/damage or corrosion. The battery tray supports over 375 kg of batteries and must be in good order. Rectify any faults found or replace defective parts as necessary.

Check the slide tracks operate smoothly and without excessive movement. Replace the tracks if worn, damaged or binding.

Inspect the condition of the locking handles for wear or damage. Replace the handle if bent, damaged or excessively worn.

Check the movement of the handles. The handles must move freely and without excessive lateral movement. If necessary, apply a small amount of lubricant, such as oil, to free the handles. Adjust the tightness of the bolts for correct operation of the handles. Refer to Section Adjustments.

Clean and check the breathers. Replace if damaged or blocked.

Inspect the condition of the seal around the battery box cover. Replace the seal if worn or damaged.

Check the operation of the cover locks. Replace the lock if necessary.

Check the seal around the circuit breaker box protection panel. Replace the panel if the seal is damaged.

Inspect the condition of the conduits. Replace if worn or damaged.

Inspect the conditions of the electrical cables and connectors. Replace the cables if worn, damaged, frayed or if corrosion is evident.

Waste Disposal

@.1260

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

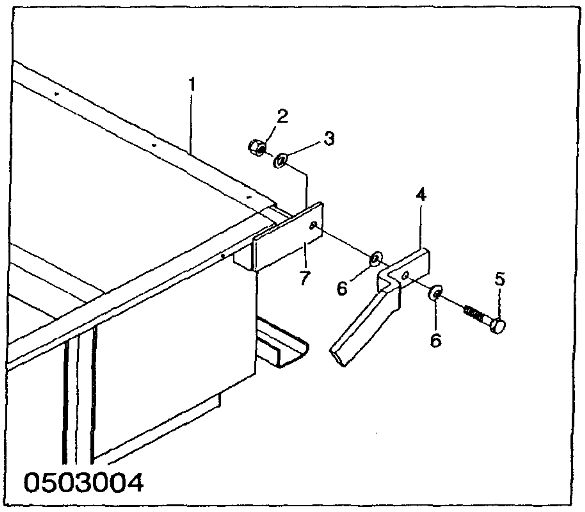
Assembly

@.1270

NOTE:

The battery tray is heavy. Support the tray properly and using lifting equipment to handle during maintenance procedures.

Battery tray

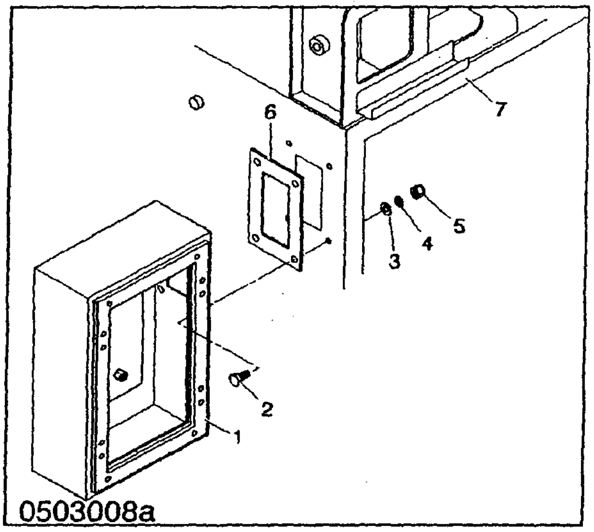


Apply a very light film of oil, or other suitable lubricant, to the bolt (5) shaft and washers (3, 6). Do not apply an excessive amount of lubricant.

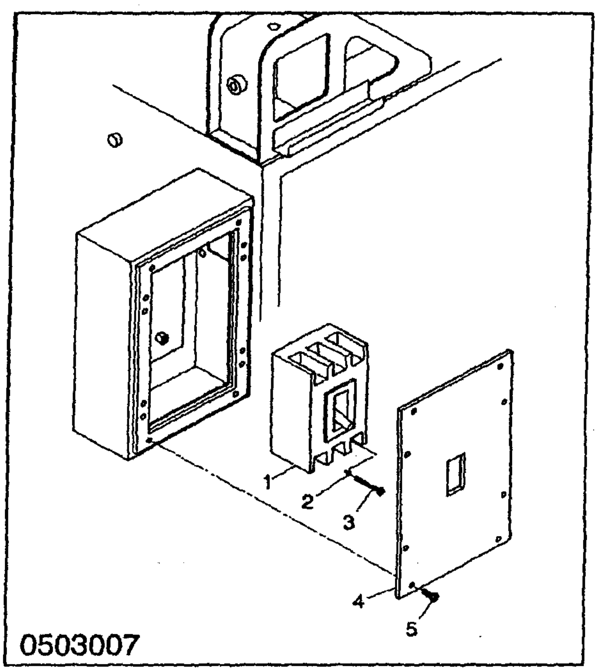
Install the bolt (5) with washer (6) through the locking handle (4). Position washer (6) between the locking handle (4) and tray boss (7), then install the locking handle (4).

Install the spring washer (3) and nut (2), then tighten the nut (2) sufficiently to remove any free play from the locking handle (4). Ensure the locking handle (4) moves freely. Adjust the tightness of the nut (2) if necessary to achieve correct operation of the handle. Refer to Section Adjustments.

Battery Box

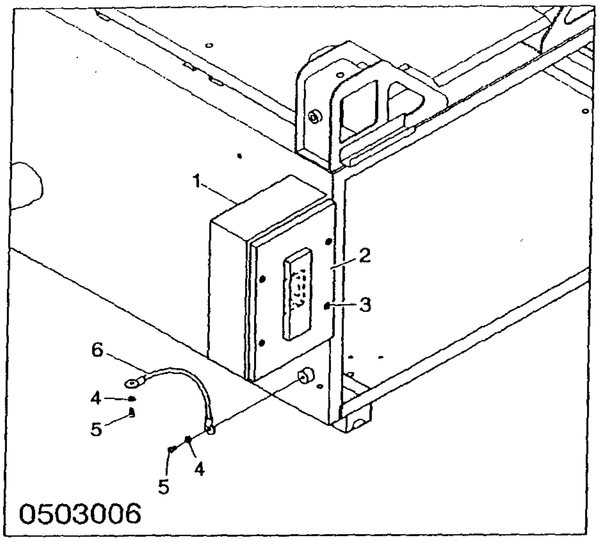


Position the circuit breaker box (1) and gasket (6) onto the battery box (7). Install the bolts (2), spring and plain washers (3, 4) and nuts (5). Then tighten the nuts (5).



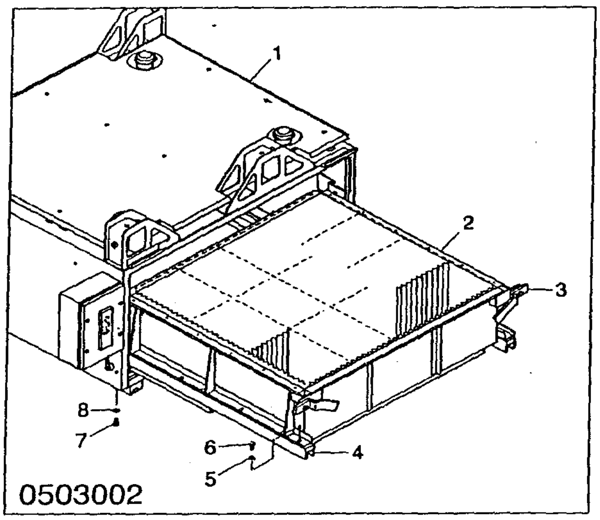
Install the circuit breaker (1) in the circuit breaker box with screws (3) and washers (2). Connect the cables, as tagged during disassembly, to the circuit breaker (1).

Install the circuit breaker protection plate (4) to the circuit breaker box and secure with screws (5).



Install the earthing cable (6) between the circuit breaker box (1) and battery box. Secure the cable using bolts (5) and washers (4).

Position the circuit breaker box cover (2), then secure using bolts (3) and washers.



NOTE:

The slide tracks (4) are made from a synthetic material. Do not over tighten the screws.

Position the slide tracks (4) in the battery box (1). Align the holes in the slide tracks (4) with the holes in the battery box (1). Install the bolts (7) and washers (8) to secure the tracks (4). Tighten the bolts (7).

WARNING:

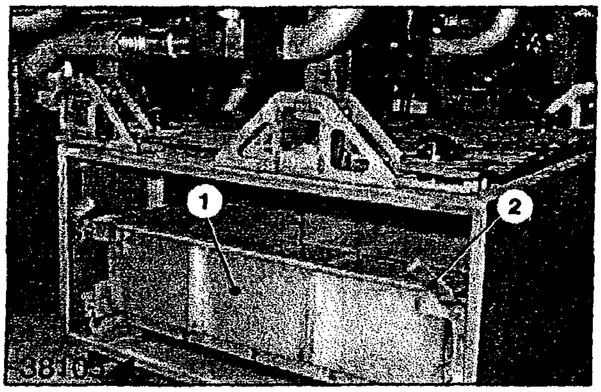
Ensure that battery box is secure before extending the battery tray. With the tray in the extending position, the battery box could over balance if not properly supported. Use suitable safety stands to support the weight of the tray.

Slide out both tracks (4).

The battery tray is heavy. Use suitable lifting equipment to handle the battery tray.

Lift the battery tray (2) into position on the slide tracks (4) using suitable lifting equipment. When lowering the battery tray (2) ensure the holes in the battery tray (2) are aligned with those in the tracks (4).

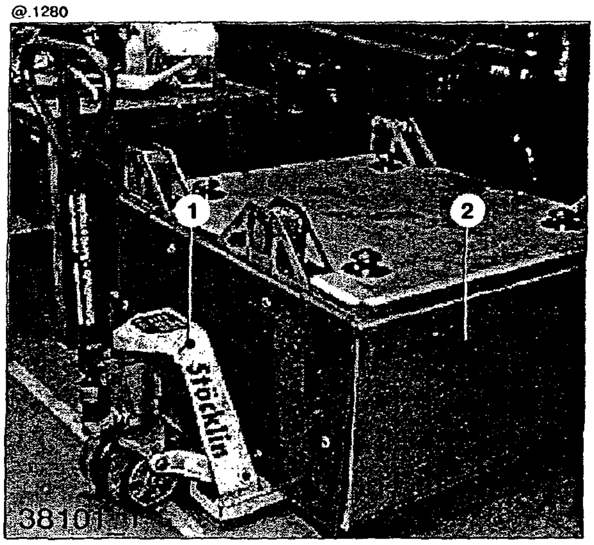
Install the bolts (6) and washers (5) through the flanges into slide tracks (4), then tighten the bolts (6).



Slide the battery tray into the battery box. Ensure the tray moves in and out with out restriction or excessive force. Secure the battery tray (1) using the locking handles (2).

Installation

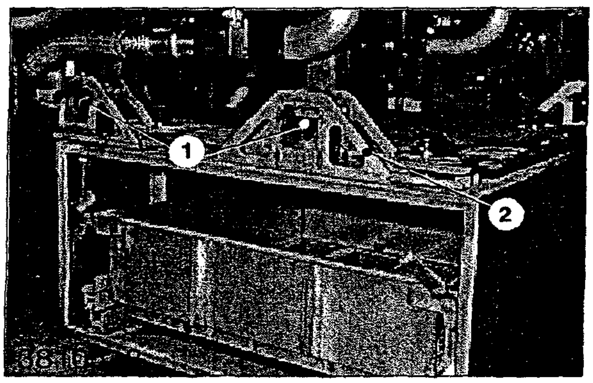
@.1280



WARNING:

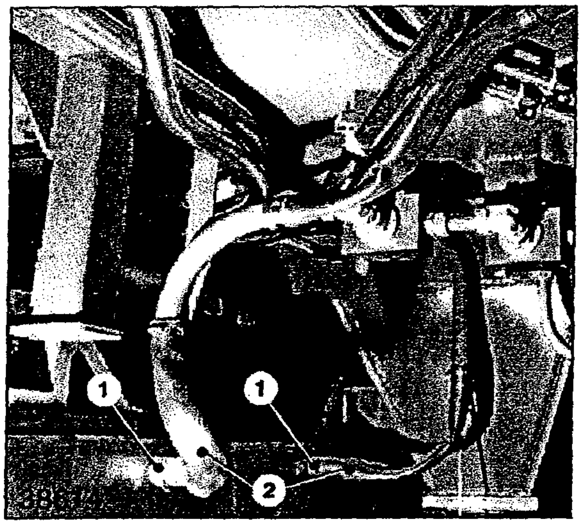
An empty battery box is heavy, over 100 kg. Use suitable lifting equipment to handle the battery box assembly. The battery box and tray should be installed onto the locomotive empty, without the batteries.

Attach suitable lifting equipment (1) to the battery box (2) then raise into position on the locomotive underframe, aligning the holes in the battery box hangers and locomotive underframe brackets.



Install the bolts through the underframe mounting brackets hangers.

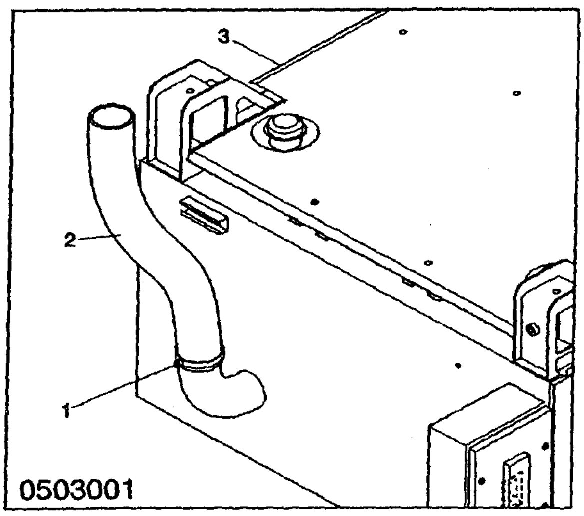
Install the nuts (1) and washers, then tighten the bolts.



Position the clamps (1) on the conduit (2). If necessary, install the cables into the conduit (2).

Install the electrical cables into the battery box through the apertures at the rear side of the box. Position the conduit, then tighten the clamps (1).

Reconnect the battery cables, as tagged during disassembly, to the connections within the battery box.

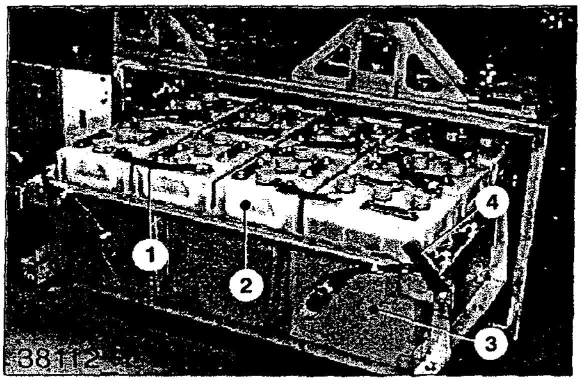


Install the ventilation hose (2) between the locomotive underframe and the left side of the battery box (3), then tighten the clamp (1).

Batteries

NOTE:

If new batteries are to be installed, ensure the precautions and directions given in Chapter 10, Battery / Charger of Volume F10, Suppliers Documentation are followed.

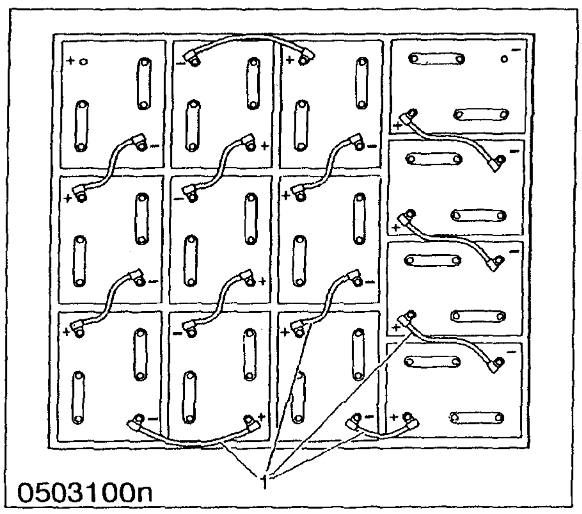


CAUTION:

Each battery weighs approximately 30 kg. Use care when handling the batteries to avoid spillage or contamination from the electrolyte. Refer to General Notes on Hazards in the Work Area, at the beginning of this Chapter.

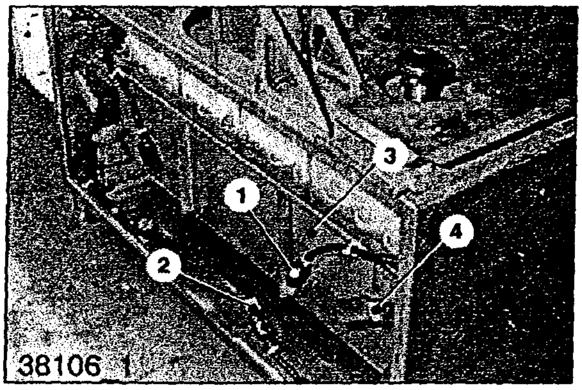
Lift the locking handles (4) and slide out the battery tray (3).

Install each battery (2) into the battery tray (3). Place a corrugated fibreglass panel between side the battery units (2).



Install the battery jumper cables (1) as tagged during disassembly.

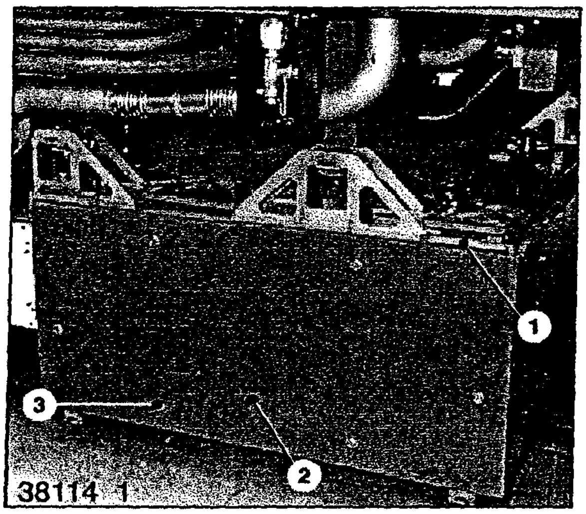
Secure the jumper and electrical cables to the battery terminals using the bolts. Torque the bolts to 30 Nm.



Connect the electrical cables (2) between battery tray (3) and battery box.

Coat the terminals with suitable agent to prevent corrosion.

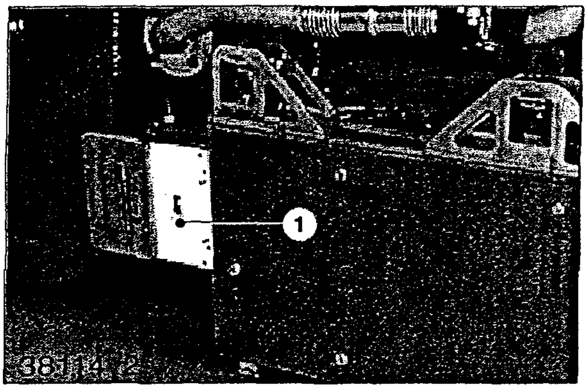
Slide the battery tray (3) back into position and secure the locking handles (4).



Lift the battery box cover (2) onto the hangers (1). Close the battery cover (2) and secure the six locks (3) around the battery box cover (2).

After-Installations Operations

@.1290



Close the circuit breaker (1) on the number 1 end battery box.

Test the operation of the batteries and charging system. Rectify any faults found.

Adjustments

@.1310

Check the operation of the locking handles. Ensure the locking handles move freely. Adjust the tightness of the nut if necessary to achieve correct operation of the handles. Tighten the nut sufficiently to remove any free play from the locking handle, but still allow unrestricted movement.

16

5.4 Hotel Load

Not applicable for WAG-9 locomotive.

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17

5.5 Oil Cooling Unit

General Notes On Hazards in the Work Area

@.0104

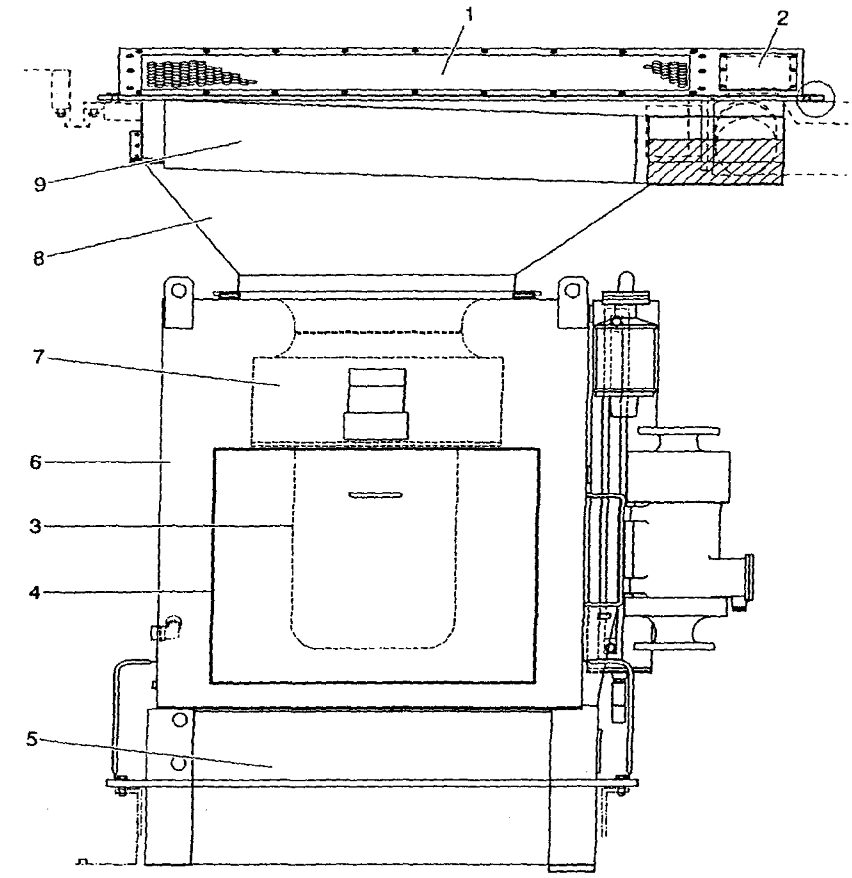
WARNING:

HIGH VOLTAGE! DANGER OF ELECTROCUTION.
NEVER WORK ON THE ROOF AREA WHILE THE LOCOMOTIVE IS UNDER A LIVE OVERHEAD.
Disconnect the pantograph from the overhead and isolate the overhead whenever working on the roof, or with high voltage components.

Group Summary

@.1120

This chapter contains information on the oil cooling blower system, including the oil cooler, oil blower and oil blower filter.



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1	Filter panel	6	Oil cooling unit
2	Inspection cover	7	*Fan wheel*
3	Oil blower motor	8	Filter duct
4	Service port cover	9	Filter
5	Oil cooler		

Functional Description

@.1140

During operation of the locomotive, the traction converter and transformer assemblies produce a considerable amount of heat. As excess heat adversely affects the performance of these units, cooling is required to keep them operating at optimal performance levels. To remove this heat, cooling oil is circulated through the traction converter and transformer assemblies. This oil is then passed through a heat exchanger which removes excess heat. This oil cooling unit draws air in through filter panels located in the pantograph roof hatch. These filters remove impurities and debris from the air. This debris is then removed from the filter panels by the scavenge system. For more information regarding the locomotive cooling concept, refer to Chapter 3, System Description of Volume A, Driver's Manual. For more information regarding the scavenge system, refer to Chapter 5.8, Scavenge Blowers/Filters.

The performance of the oil cooling unit can deteriorate as a result of internal and/or external contamination. It should be noted that the air side is exposed to environmental influences (dust, leaves, etc.) and is much more quickly soiled than the oil side. A build up of debris on the air side causes a drop in performance of the oil blower filter and scavenge system.

All seals must be kept in good condition for the system to function efficiently. Whenever conducting maintenance on the blower and its ducting ensure the seals are in good working condition. Replace any damaged or suspect seals.

The oil cooling unit consists of a blower and two oil/air heat exchangers, one for converter oil and one for transformer oil. The two heat exchangers (oil coolers) are assembled in a combined unit, with the converter cooler above the transformer cooler.

Fault finding for the oil blower is described in Chapter 5, Oil Blowers of Volume F10, Suppliers Documentation.

Technical Data

@.1160

Oil Cooling Unit

- Oil volume total	150 l
- Volume converter oil	78 l
- Volume transformer oil	72 l
- Weight empty	840 kg
- Painting	Topcoat RAL 7030 stone gray silky 45 ± 5%
- Test excess pressure converter oil	4 bar
- Test excess pressure transformer oil	4 bar

Oil Cooler Blower Fan Electric Motor

- Type	three-phase squirrel-cage motor
- Motor model	200L55-RH2A
- Voltage	3x415V ± 10%
- Current	43A
- Power supply	Square wave (inverter operated)
- Degree of protection	IP54
- Frequency	50Hz
- Normal speed	2,930 rpm
- Output	25 kW
- Isolation class	glimm (F)
- Weight	265 kg

Tolerances and Wear Limits List

@.1170

Tolerances and wear limits applicable to the blower fans, motor, filter panels and scavenge motors are described in Chapter 5, Oil Blowers of Volume F10, Suppliers Documentation.

Tools & Special Tools

@.1180

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

- Cleaning grate, part 04.882.30.500, BEHR Industrietechnik. For more information, refer to Chapter 5, Oil Blowers of Volume F10, Suppliers Documentation.
- A high pressure cleaner capable of delivering water at 80 bar at 70 °C.
- An industrial grade vacuum cleaner.
- An external compressed air supply capable of delivering air at 6 bar.
- A suitable heating oven capable of fitting the oil cooler and heating to 105 - 110 °C.
- A fluid cleaning system with a filter with a mesh size of 25 microns.
- A lifting eye-bolt suitable for attachment and lifting of the fan wheel and motor. Refer to Chapter 5.5, Oil Blowers of Volume F10, Suppliers Documentation.

Miscellaneous Materials

@.1200

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

- Sikaflex 221
- Sikalastomer 710
- Sikaflex 15LM
- Loctite 577 or equivalent
- Auco Alu B cold cleaning agent

NOTE:

Neither dummy flanges nor gaskets should be used in service.

- Dummy flanges suitable for sealing the inlet and outlet ports on the oil cooler are required. Such dummy flanges should be made from mild steel plate of a minimum 5 mm thickness with suitable holes drilled for bolting to the oil cooler. The cooling system pipe ends should be used as a template for the dummy flanges and for suitable gaskets, to be made from a suitable gasket material such as cork or rubber
- Cable ties
- Plastic plugs
- Plastic sheeting, cardboard sheets and masking tape
- Unisil foam tape, 200 mm wide, 9.5 mm thick, closed cell, low density, PVC foam 32 Duro type 3512, grey in colour, 0.18 kg per metre
- Dunlop Superbond contact adhesive, part no. 3581, 1.1 kg per litre
- Prepsol
- Black and yellow striped safety tape

Before-Removal Operations

@.1220

General

Isolate the locomotive electrical systems as described in the Preface of this Volume.
Set the "Oil Cooling" circuit breaker (59.1) to the Off position. Circuit breaker 59.1/1 for the No. 1 End is situated auxiliary circuits cubicle-1 (HB1) and circuit breaker 59.1/2 for the No. 2 End is situated in auxiliary circuits cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Traction Motor Blower and Oil Cooling Unit Scavenge Blower" circuit breaker (55.1) to the Off position. Circuit breaker 55.1/1 for the No. 1 End is situated auxiliary circuits cubicle-1 (HB1) and circuit breaker 55.1/2 for the No. 2 End is situated in auxiliary circuits cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Oil Pump Converter" circuit breaker (63.1) to the Off position. Circuit breaker 63.1/1 for the No. 1 End is situated auxiliary circuits cubicle-1 (HB1) and circuit breaker 63.1/2 for the No. 2 End is situated in auxiliary circuits cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Transformer Oil Pump" circuit breaker (62.1) to the Off position. Circuit breaker 62.1/1 for the No. 1 End is situated auxiliary circuits cubicle-1 (HB1) and circuit breaker 62.1/2 for the No. 2 End is situated in auxiliary circuits cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Oil Cooler Assembly

Disconnect the oil cooling piping from between the transformer and the oil cooler as described in Chapter 3.6, Transformer Oil Cooling.

Disconnect the oil cooling piping from between the traction converter and the oil cooler as described in Chapter 4.2, Traction Converter Oil Cooling.

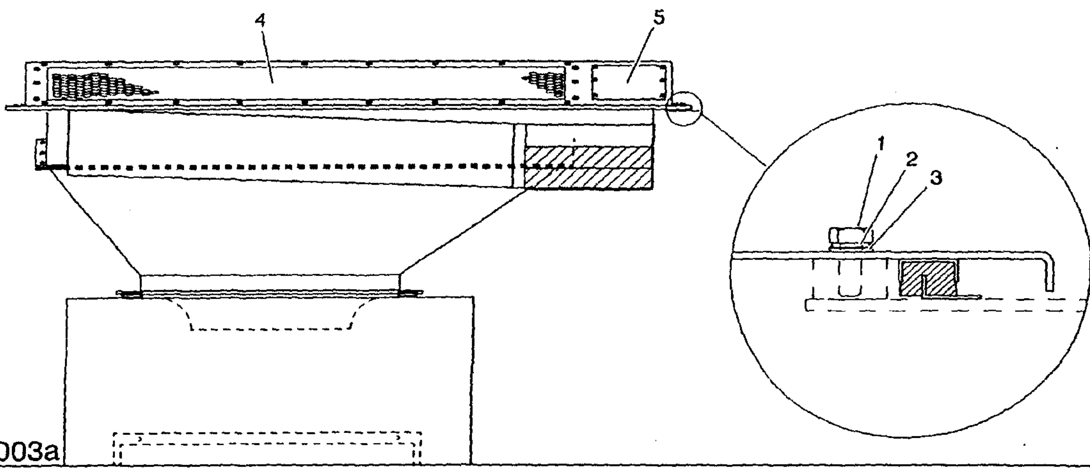
Oil Blower Filter

Steam clean the pantograph roof hatch and surrounding area, remove all traces of dirt, debris and build-up of grease. Refer to Steam Cleaning in the Preface of this Volume. Damage to the components can result from improper application of the steam cleaning equipment.

Removal

@.1230

Oil Blower Filter



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Mark the cab end of the filter screen (5) and filter duct using a permanent marking felt tip pen or similar.

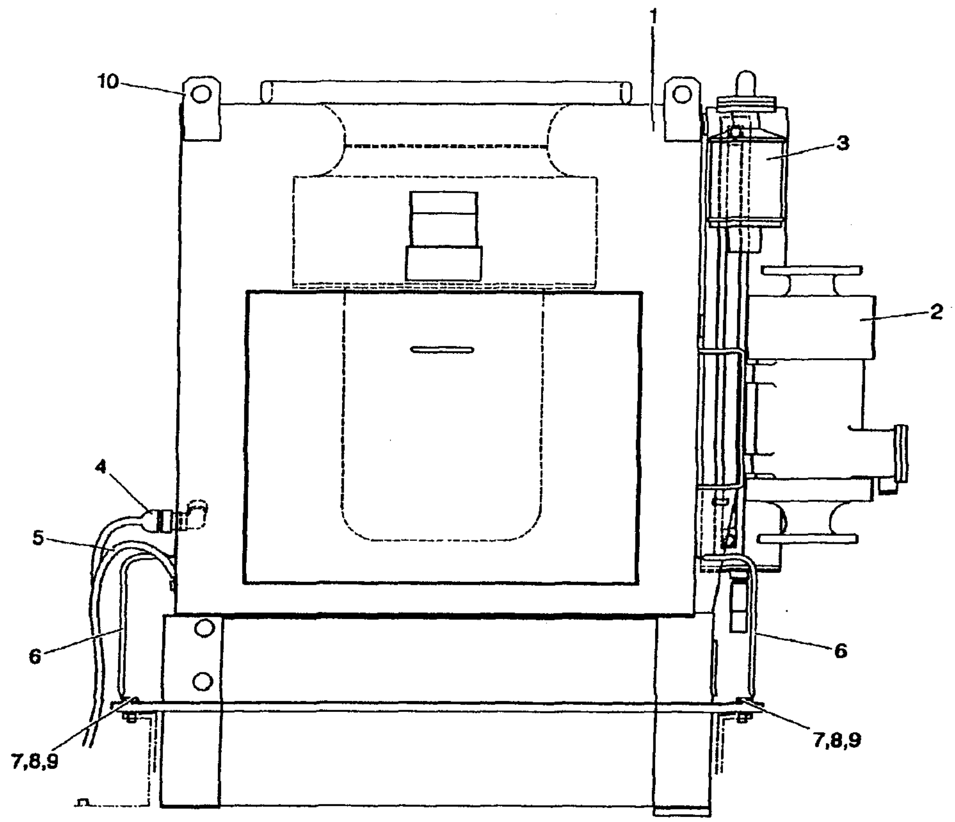
Attach suitable overhead lifting equipment to the filter assembly.

Remove the bolts (1), spring (2) and plain (3) washers securing the filter panel (4) to the pantograph roof hatch.

Raise the lifting equipment slightly and ensure that nothing is entangled, then lift the filter assembly (4) from the pantograph roof hatch.

Disconnect the filter duct and panel from the filters as described in Section Disassembly.

Oil Cooler and Blower Assembly



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If necessary, remove the traction converter oil pump (2) from the cooler assembly (1), as described in Chapter 4.2, Traction Converter Oil Cooling.

If necessary, remove the transformer oil expansion tank (3) from the cooler assembly (1), as described in Chapter 3.6, Transformer Oil Cooling.

Disconnect the electrical harness (4) from the outside of the oil cooling unit (1).

Unbolt the earth lead (5) to the cooling unit (1).

Cut the cable ties securing the wiring to the looming bar (6), then move cabling out of the way. Unbolt and remove the looming bar (6), if necessary.

Remove the three bolts, spring and plain washers (7, 8, 9) along each side of the cooling assembly (1).

NOTE:

The oil cooler must be sealed to prevent damage from foreign materials. Seal the oil cooler opening using a clean cardboard sheet and masking tape.

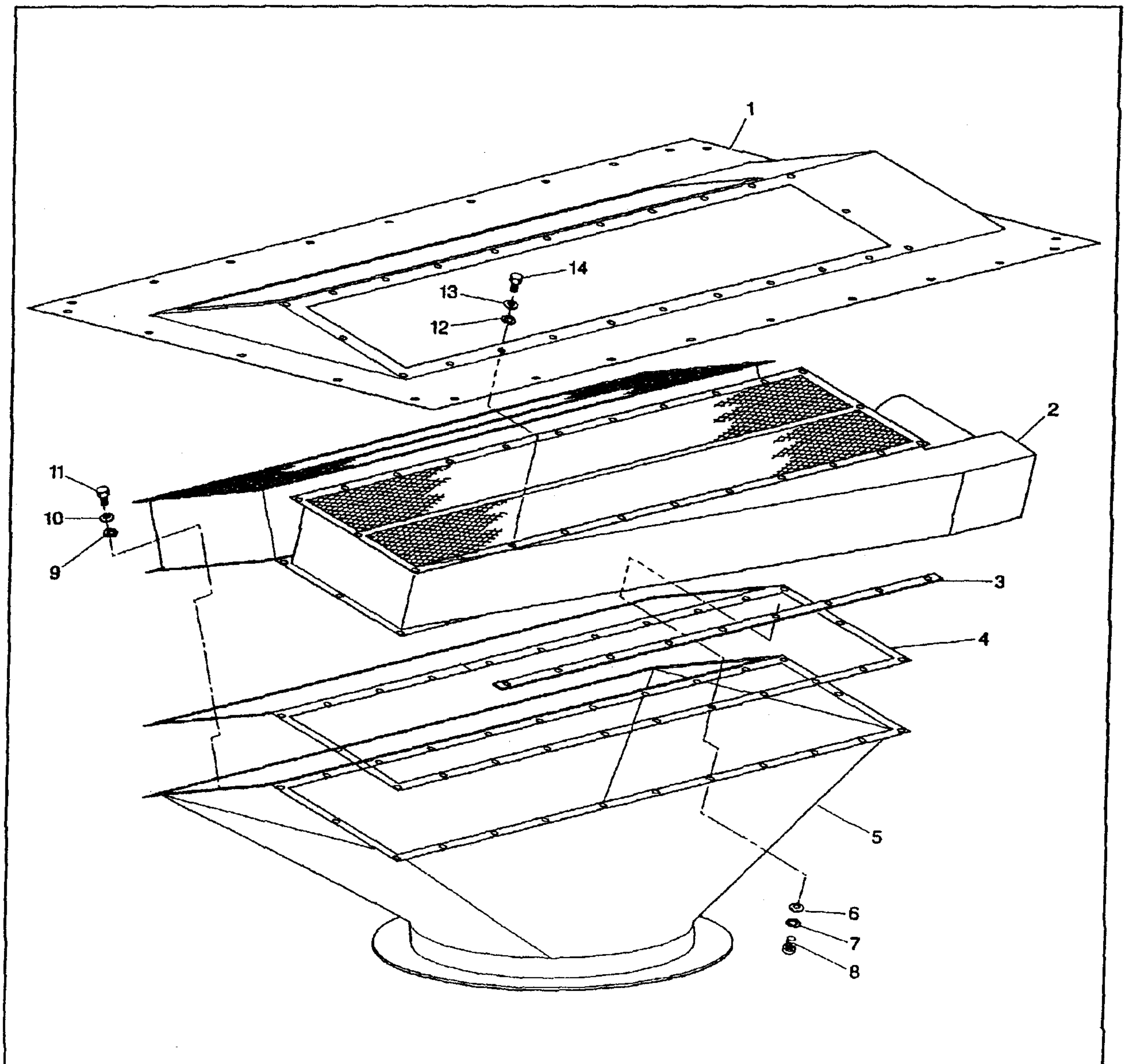
All oil cooler flanges must be sealed with dummy flanges before the oil cooler is moved to prevent the ingress of foreign materials and any possible outflow of oil.

Lift the oil cooling unit (1) from the locomotive using suitble lifting equipment attached to the lifting lugs (10). Take care not to damage any part of the assembly or other machine room components during the removal of the cooling unit assembly (1).

Disassembly

@.1240

Oil Blower Filter



NOTE:

The filter duct is heavy, approximately 40 kg. Use lifting equipment to handle the duct.

Remove the bolts (11), plain (9) and spring (10) washers securing the front and back edges of filter duct (5) to the filter flanges.

Loosen the bolts (8) securing the side edges of filter duct (5) to the filter flanges. The bolts (8) fix into a tapped plate (3) above the filter flange. Remove the bolts (8), plain (6) and spring (7) washers and tapped plate (3).

Separate the filter duct (5) and gasket (4) from the filter assembly.

Remove the bolts (14), spring (13) and plain (12) washers securing each filter (2) to the filter panel (1). The joint is sealed with sealant. It may be necessary to prise the joint apart and cut the sealant with a sharp blade.

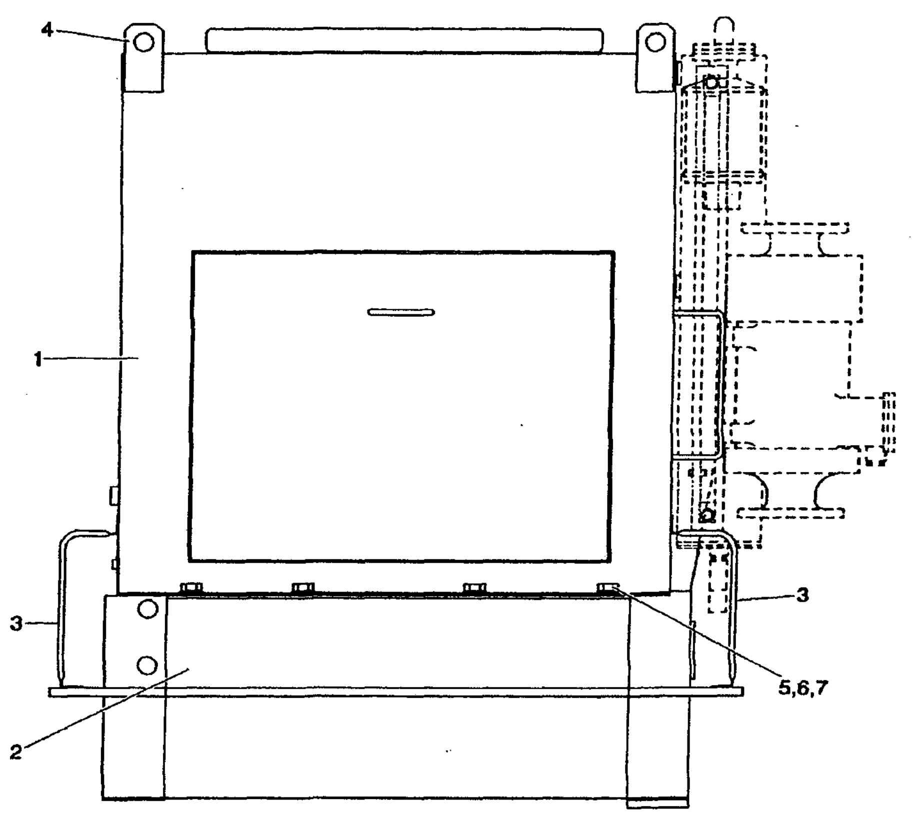
Separate the filters (2) from the filter panel (1)

Blower Fan and Motor

The blower fan and motor may be removed from the oil cooling assembly without removing the assembly from the locomotive. Once the filter has been removed, the fan and motor can be removed. Refer to Chapter 5, Oil Cooling Unit of Volume F10, Suppliers Documentation for further information on motor and fan wheel removal.

Oil Cooler Assembly

Oil cooler may be unbolted and removed from oil cooler assembly if required. This may be required for the oil cooler cleaning procedures described in Section Inspection and Repair.



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Remove the looming bars (3) if not removed previously.

Attach suitable lifting equipment to the lifting lugs (4).

Remove the eight bolts, spring washers and washers (5, 6, 7) securing the oil cooler assembly (1) to the oil cooler (2).

Lift the oil cooler assembly (1) from the oil cooler (2).

Inspection and Repair

@.125C

General

Some of the procedures required in this section do not require that the components to be serviced are removed from the locomotive. Each procedure will identify any components to be removed.

Only conduct repairs with the system switched off and secured. The system must have cooled down to room temperature (oil, air). Check the oil temperatures of the transformer and traction converter as required. Ensure the oil within these components is at room temperature.

Before working on the system, it must always be depressurised and disconnected from the power supply

Oil Cooler Cleaning

EXTERNAL (AIR SIDE) CLEANING

NOTE:

This procedure may be conducted with all components of the oil cooling system in place.

WARNING:

High pressure cleaning equipment used in this procedure is vented through the oil cooler to the underside of the locomotive. Ensure the escaping high pressure cleaning medium will not cause any injury or damage.

Remove the cover of the service port.

Impurities adhering to the top of the cooler (flowerbuds, leaves, etc.) should be removed with a powerful industrial vacuum cleaner and/or compressed air blown upwards through the cooling air ducts from beneath the locomotive.

The cooler should be sprayed with Auco-Alu B cold cleaning agent or equivalent and left for 20 minutes. Ensure the cleaning agent is used in accordance with the manufacturers directions.

Place the cleaning grate on top of the cooler.

Rinse through the cooling air ducts as specified below with the aid of a high-pressure cleaner.

NOTE:

The cooler must not be deformed or damaged under any circumstances. This applies above all for the cooling fins.

- Use a nozzle for a pencil shaped water jet.
- The operating pressure of the high-pressure cleaner should be approx. 80 bar.
- Use clear water at a temperature of approximately 70º C. Do not allow the water to be hot enough to steam.
- Slowly and systematically clean the cooling air ducts with a pencil jet applied perpendicularly to the cooling fins.
- Then blow compressed air (6 bar) vertically through the cooling air ducts from beneath the locomotive to dry the ducts.

Once the cooler has been cleaned, it is recommended that a bright light be shone through the cooling fins to verify that all foreign material and build up has been removed. If any area remains clogged of soiled, the cleaning procedure is to be repeated.

Remove the cleaning grate.

Replace the cover on the service port.

NOTE:

Excessive build up of debris on the air side of the cooler may indicate poor performance by the filter system. Thoroughly check all components of the filter system, including filters, seals and scavenge systems.

INTERNAL (OIL SIDE) CLEANING

NOTE:

This procedure requires the removal of the oil cooler radiator from the locomotive. Remove the oil cooling assembly as described in Section Removal then remove the oil cooler from the assembly as described in Section Disassembly.

A cleaning system with filter with a mesh size of 25 microns is required for this procedure.

Rinse the cooler using Auco-Alu B cold cleaning agent or equivalent.

Ensure the cleaning agent is used in accordance with the manufacturer's directions and the full dwell time is observed.

The cooler should be rinsed at room temperature with a maximum rising pressure of 2 bar, reversing the direction of flow several times. It should be rinsed for between 30 and 60 minutes, depending on the degree of contamination. After being cleaned, the cooler must be forcibly flushed with fresh water for approx. 20 minutes and then dried at 110 - 120 º C in an oven for approx. 3 hours.

The cooler must be protected against corrosion if it is not taken into service again immediately. Refer Oil Cooler Storage.

NOTE:

All gaskets must be replaced. Care must be taken to ensure that none of the cleaning liquor or cooling oil enters the sewage system, rivers, lakes, etc. Refer to Section Waste Disposal.

OIL COOLER STORAGE

Aluminium coolers must be filled with operating medium to above the upper edge of the cooling fins for storage. They must be stored in an upright position and sealed with dummy flanges in order to prevent corrosion while in storage.

The air side is not preserved. However, it must be packed in a waterproof and airtight wrapping containing an appropriate number of silica gel sachets or the coolers must be stored in dry, air-conditioned rooms. The cooling fins must be covered with cardboard in order to protect them against mechanical damage (knocks and bumps, etc.) while in storage.

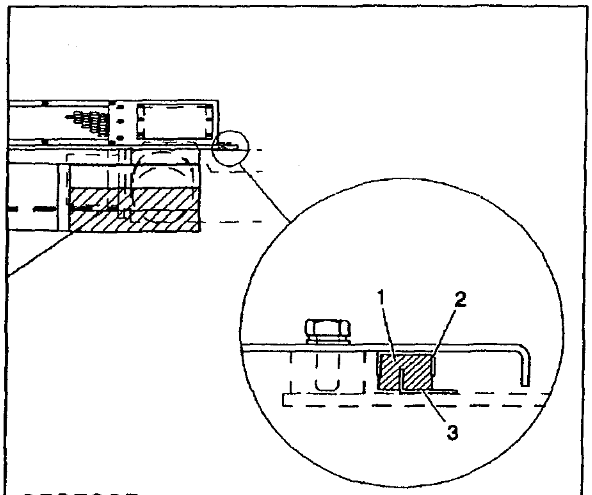
Oil Blower Filter

Inspect the condition of the panels, frame and seals. Replace worn or damaged components.

Replace the filter and all other components of the oil blower system and test the operation of the system, as described in Section After Installations Operations.

Check the condition of the filter panel gaskets. Replace if torn or damaged.

Check the condition of the filter screen, flanges and surrounding panel. Rectify any faults found.



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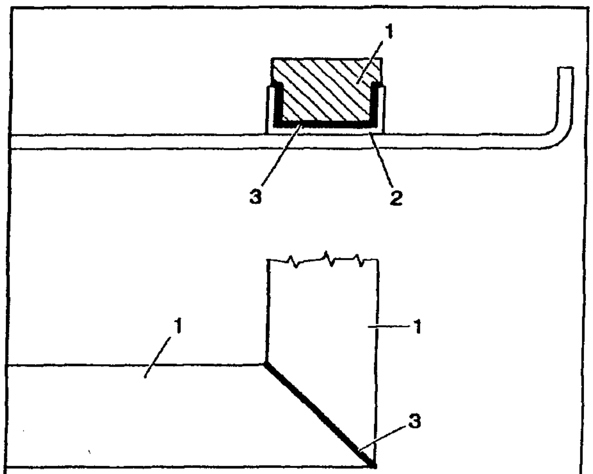
Check the condition of the seal (1) around the edge of the filter panel. Replace the seal (1) if worn, damaged or torn.

Indentation in the seal (1) from the lip (3) on the pantograph hatch is to be expected and should not be used as a reason to replace the seal unless this indentation is too great and will prevent the seal (1) from making proper contact with the lip (3).



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Replacement of the seal (1) requires that the old seal and any residual adhesive be completely removed. The new seal must be joined at the corners of the channel at 45º with contact adhesive (3). The seal (1) must also be adhered to the channel (2) at all contacting surfaces with contact adhesive (3). The channel (2) was sealed along both edges to the filter panel assembly with Sikaflex 15LM. Check to ensure that this seal is in good condition. Remove all traces of old sealant and reseal using Sikaflex 15LM. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

DRY CLEAN

Remove the filter panel from the pantograph hatch as described in Section Disassembly.

Using an industrial grade vacuum cleaner, vacuum the rear side of the filter panel and surrounding areas to remove and dust and debris. Repeat procedure on the outside of the filter panel.

Use a suitable brush to remove any debris in the Flosep filter tubes. Vacuum any debris from the tubes as it is dislodged. Compressed air may also be used to remove debris. Care must be taken to ensure no damage is caused to the filter tubes.

WET CLEAN

Remove the filter panels from the pantograph hatch as described in Section Disassembly.

Wash the panels with water and a suitable soap or other washing solution. Use only spray nozzles, as a strong jet of water may damage or dislodge the tubes. Ensure that the water temperature does not exceed 80 °C. After cleaning, rinse the panels with clean water. Once cleansed and rinsed, the panels must be dried to prevent any dust or debris sticking to the wet tubes. Drain the panels, then blow dry using compressed air.

SCAVENGE DUCT SAFETY TAPE

Inspect the condition of the safety tape located on the scavenge ducting corners of the inner-most filter panel. Ensure the safety tape and foam padding are in good condition. The safety tape must be clearly visible and free from wear, rips and tears. If necessary, replace the safety tape and foam padding as described below.

Remove old safety tape from scavenge ducting.

Clean the surface of the scavenge duct thoroughly and apply new safety tape to the scavenge duct.

Roughen the surface of the safety tape where the foam tape is to be applied with sandpaper and clean with Prepsol. Allow to dry.

Cut foam tape to size and apply contact adhesive to both foam tape and tape mounting surface on filter duct. Allow contact adhesive to touch dry.

Apply foam tape to the corner of the scavenge duct. Apply contact adhesive to the edges of the foam tape to ensure the foam to foam contact is adequate.

Blower Fan Motor and Fan Wheel

For more information regarding the blower fan motor and fan wheel, refer to Chapter 5.5, Oil Cooling of Volume F10, Suppliers Documentation.

Waste Disposal

@.1260

Dispose of oil, coolant and filters according to the prevailing environmental standards or workplace practices. Escaping oil must not seep into the ground or be channelled into the sewer system. If necessary, use binding agent, catch basins etc. and seal off leaks immediately.

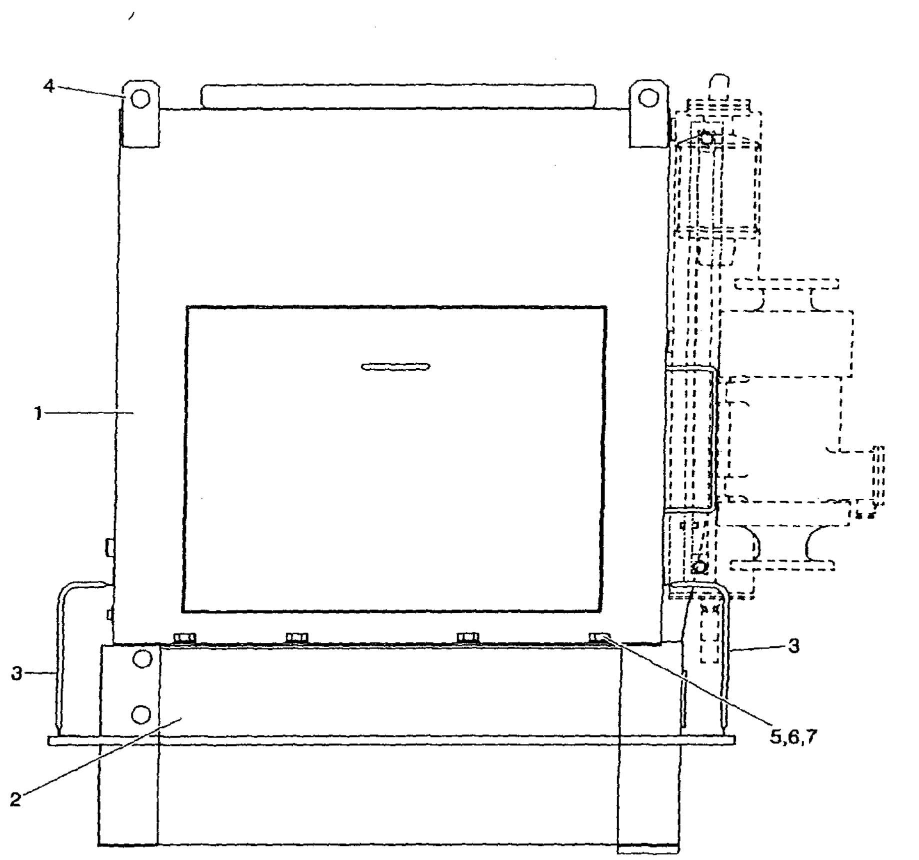
Assembly

@.1270

Blower Fan and Motor

The blower fan and motor may be installed to the oil cooling assembly with the assembly installed in the locomotive. Refer to Chapter 5, Oil Cooling Unit of Volume F10, Suppliers Documentation for further information on motor and fan wheel removal.

Oil Cooler Assembly



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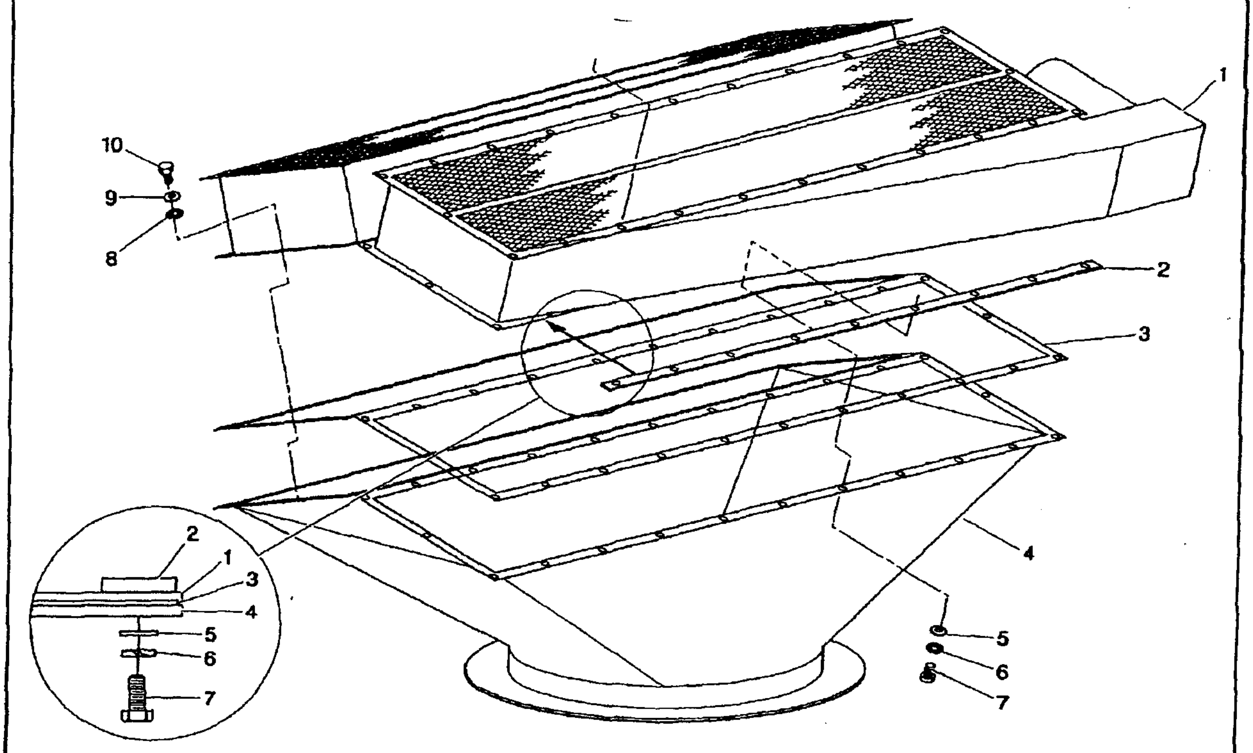
Attach suitable lifting equipment to the lifting lugs (4).

Lower the oil cooler assembly (1) onto the oil cooler (2).

Install the eight bolts, spring washers and washers (5, 6, 7) to securing the oil cooler assembly (1) to the oil cooler (2), then tighten the bolts (5).

Install the looming bars (3).

Oil Blower Filter



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NOTE:

Seal all fixing hardware during assembly with LOCTITE 577, or equivalent. Seal the threads, between the washers and under the bolt heads to ensure an air tight seal.

Apply a thin bead of Sikaflex 221 to the filter duct (4) then position the gasket (3) on the filter duct (4) and align the bolt holes. The gasket must be correctly positioned and sealed on the centre beam. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

NOTE:

The filter duct is heavy, approximately 40 kg. Use lifting equipment to handle the duct to avoid personal injury.

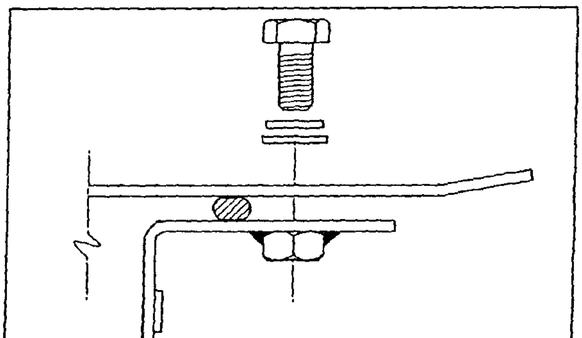
Apply a thin diameter bead of Sikalastomer 710 to the upper side of the gasket (3) then position the filter panel assembly (1) on the gasket (3). Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

The filter nozzles face towards the end of the duct (4) marked "CAB" during the removal procedure. The screened side of the filters face upward.

Secure the front and back edges of the filters (1) to the duct (4) using the bolts (10), plain (8) and spring (9) washers. Do not tighten the bolts at this time.

Check to ensure the gasket (3) and filters (1) are correctly seated on the duct centre beam.

Position the tapped plate (2) on top of the filter flange, then install the bolts (7) with spring (6) and plain (5) washers through the filter duct, gasket and filter flange into the tapped plate. Tighten the bolts (7,10) progressively to ensure the filter seals on the gasket at the duct centre beam.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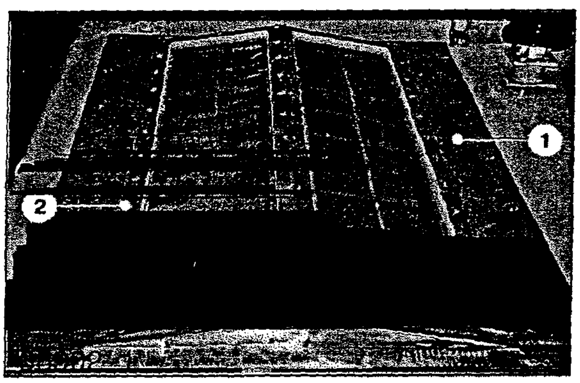
Apply a continuous 3 mm diameter bead of Sikaflex 221 to the inner edges of the filter flanges. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.



Install the filter panel over the filters. The end of the filter panel marked "CAB" should be facing the same way as the duct end also marked "CAB".

Install the bolts (2) with spring and plain washers through the filter panel (1) into the filter flanges.

Install the filter assembly into the pantograph roof hatch as described in Section Installation.

Installation

@.1280

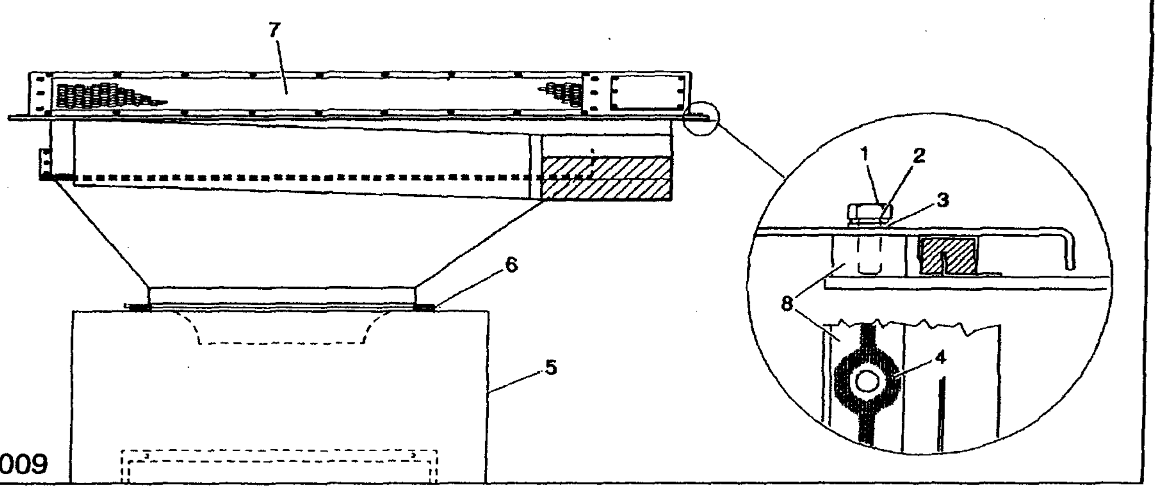
Oil Blower Filter

NOTE:

Seal all fixing hardware during installation with LOCTITE 577, or equivalent. Seal the threads, between the washers and under the bolts heads to ensure an air tight seal.

WARNING:

HIGH VOLTAGE! DANGER OF ELECTROCUTION. NEVER WORK ON THE ROOF AREA WHILE THE LOCOMOTIVE IS UNDER A LIVE OVERHEAD.



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Attach suitable lifting equipment to the filter assembly (7).

Raise the filter assembly (7) and position it over pantograph roof hatch.

Ensure the end of the filter assembly (7) marked "CAB" during disassembly faces towards the cab.

Apply a continuous 8 mm diameter bead of Sikalastomer 710 (4) around perimeter of the tapping plate (8) and both sides of the bolt holes. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

Ensure the filter duct flange (6) is correctly seated on the oil cooling unit (5).

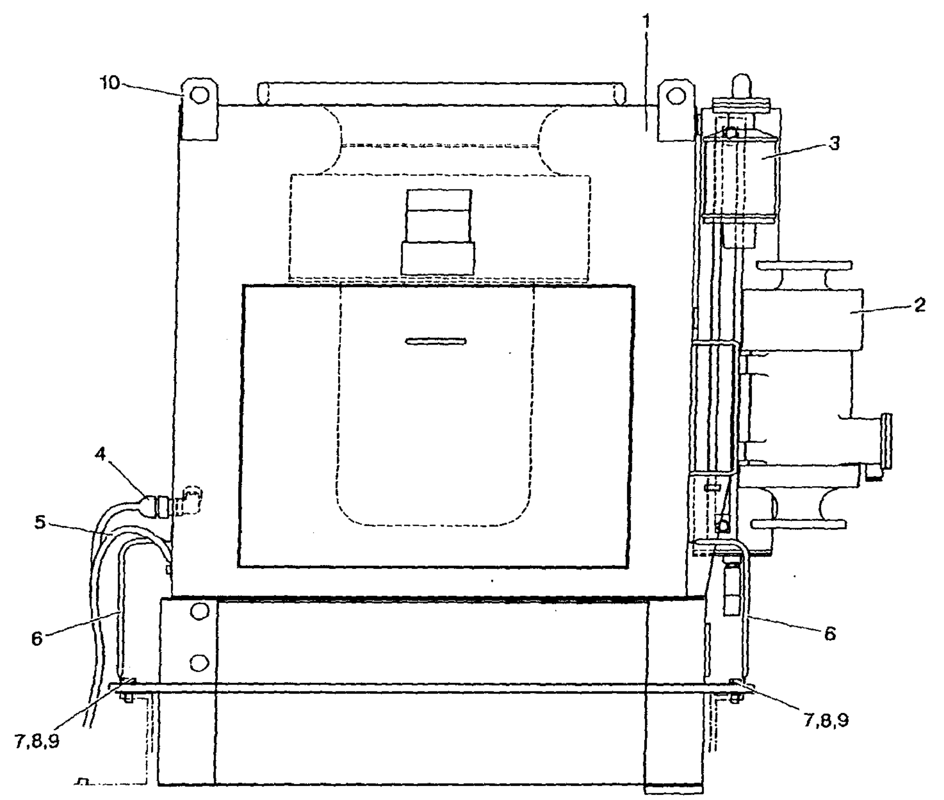
Install the bolts (1) with spring (2) and plain (3) washers through the filter panel into the roof hatch and tighten bolts (1) progressively, in an alternating pattern.

Oil Cooler and Blower Assembly

NOTE:

During transportation, all cooler flanges must be closed.

All oil cooler flanges must be sealed with dummy flanges before moving to prevent the ingress of foreign materials and the possible outflow of oil.



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If necessary, attach the transformer oil expansion tank (3) to the cooler assembly (1), as described in Chapter 3.6, Transformer Oil Cooling.

If necessary, attach the traction converter oil pumps (2) to the cooler assembly (1), as described in Chapter 4.2, Traction Converter Oil Cooling.

Lift the oil cooling unit (1) into the locomotive floor using suitable lifting equipment attached to the lifting lugs (10). Take care not to damage any part of the assembly or other machine room components during the installation of the cooling unit.

Install the three bolts, spring washers and washers (7, 8, 9) along each side of the oil cooler, then tighten the bolts (7).

Install the looming bars (6), if necessary.

Connect the electrical harness (4) to the outside of the oil cooling unit as tagged during removal.

Bolt the earth lead (5) to the cooling unit.

Using suitable cable ties, secure the wiring (4, 5) to the looming bar (6).

After-Installations Operations

@.1290

Water test pantograph roof hatch and surrounding area as described in the Preface of this Volume. Rectify any faults found.

Refill and bleed the oil cooling circuits for the transformer and traction converter, as described in Chapter 3.6, Transformer Oil Cooling and Chapter 4.2, Traction Converter Oil Cooling respectively. Check that all seals are functioning correctly and adjust or replace as required. Rectify any faults found. Test the operation of the oil cooling unit as described below. Ensure the scavenge system functions correctly. Refer to Chapter 5.8, Scavenge Blowers/Filters.

BEFORE STARTING

Do not operate the system with defective instruments, monitoring devices or control systems. All protective devices must be permanently mounted and operable. Following maintenance or repairs, all loose objects or tools must be removed from the system. Keep the system free of oily and flammable material. No persons may be in the immediate vicinity of the system before and during starting.

STARTING

Test and monitoring work within the system may only be carried out by appropriately trained personnel. Check the display instruments after starting in order to ensure that everything is operating properly.

After starting, check the system for leaks.

Do not leave the system unattended during test operation.

NOTE:

The operation or test run may only be carried out under observance of the accident prevention regulations.

Rectify any faults found.

Adjustments

@.1310

There are no adjustments applicable to the oil cooling unit.

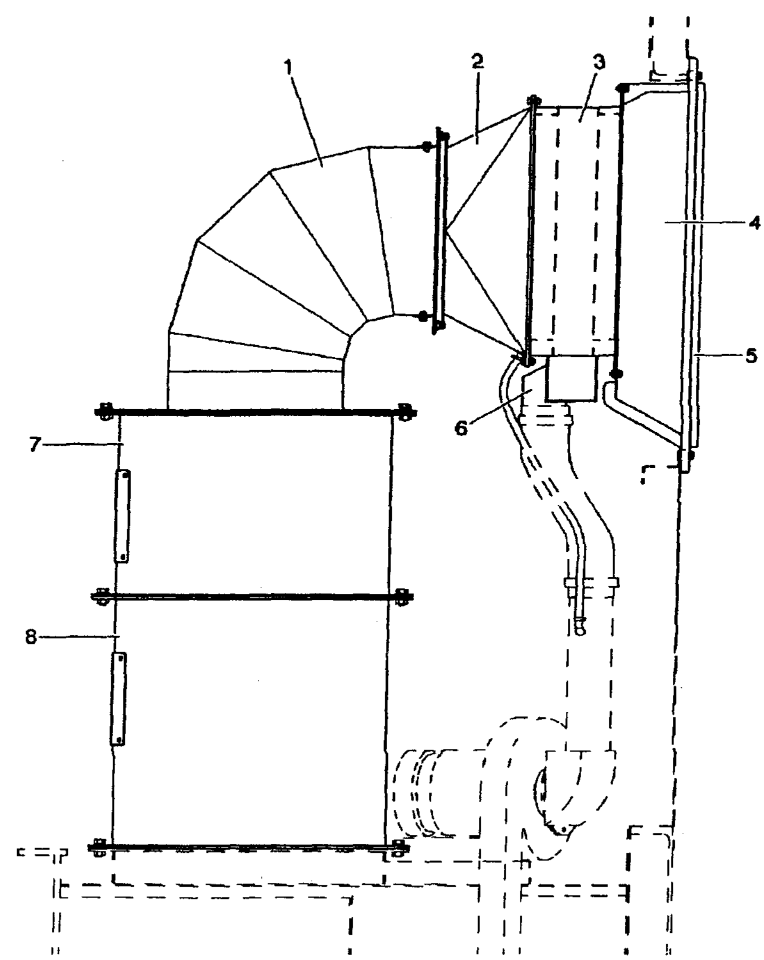
18

5.6 Machine Room Blowers

Group Summary

@.1120

This chapter contains information on the machine room blower which consists of; the machine room blower fan and motor, filter, louvre and screen, plenum box, bend duct and lower duct.



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1	Bend duct	5	Louvre panel
2	Transition duct	6	Scavenge duct outlet
3	Filter	7	Blower fan assembly
4	Plenum box	8	Lower duct

Functional Description

@.1140

General

The machine room blower provides filtered cooling air to the machine room. Filter panels located in the walls of the machine room remove large particles from the inlet air stream. A Flosep venturi filter system then extracts the smaller particles of dirt and other foreign material from the inlet air stream and exhausts it through the scavenge system. The inlet air then passes through ducting in the machine room floor. These ducts direct the cooling air to appropriate locations in the machine room to cool equipment and pressurise the machine room. In addition to this, the machine room blowers pressurise the machine room to approximately 100 Pa above atmospheric pressure to hinder the entry of dust into the machine room.

The blower is a vertically mounted, direct driven centrifugal fan with backward curved blades. A 415 volt, single phase AC motor directly drives the impeller. A capacitor is fitted to assist the motor during starting. Grease nipples are provided in the motor end cases to allow for periodic lubrication of the motor bearings.

All seals must be kept in good condition for the system to function efficiently. Whenever conducting maintenance on the blower and its ducting ensure the seals are in good working condition and providing a proper barrier. Replace any damaged or suspect seals.

For more information on the filter and scavenge system, refer to Chapter 5.8, Scavenge Blowers/Filters.

Technical Data

@.1160

Motor and Fan Assembly

- Motor type	single phase, asynchronous
- Motor model	Landert, 132M38-RF Xh
- Impeller model	HCBX-415-60
- Impeller dimensions	415 x 60 mm
- Voltage	415 Volt
- Output power	2.6 kW
- Rotational speed	2,940 rpm
- Weight	140 kg

Tolerances and Wear Limits List

@.1170

Blower Fan Impeller

- Maximum imbalance	5.5 mm/s RMS
- Circumferential clearance between inlet cone and fan wheel	1.5 - 6 mm
- Distance between base of impeller and inlet cone	83 - 88 mm

Slip Joint Seal Plate

- Minimum thickness	2.5 mm

Tools & Special Tools

@.1180

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

An industrial grade vacuum cleaner is required to remove debris from the filters and plenum box.

Miscellaneous Materials

@.1200

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

- Sikalastomer 15LM sealant
- Loctite 577 is required to seal screw threads, as noted in Section Installation.
- Soapy water is required for cleaning the filter panels.
- Urethane adhesive

Before-Removal Operations

@.1220

General

Set the "Machine Room Blower" circuit breaker (54.1) to the Off position. Circuit breaker 54.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle-1 (HB1) and circuit breaker 54.1/2 for the No. 2 End is situated in Auxiliary Circuits Cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Scavenge Blower to Machine Room Blower" circuit breaker (56.1) to the Off position. Circuit breaker 56.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle-1 (HB1) and circuit breaker 56.1/2 for the No. 2 End is situated in Auxiliary Circuits Cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Blower Fan

Removal of the blower fan assembly requires the prior removal of the pantograph roof hatch, as described in Chapter 1.1, Structure.

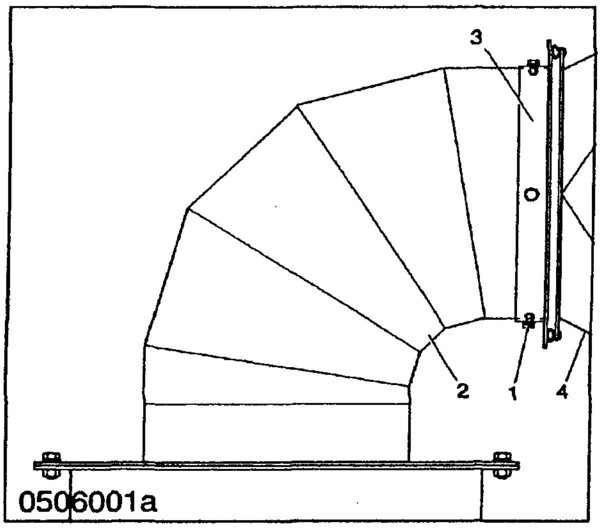
Removal

@.1230

WARNING:

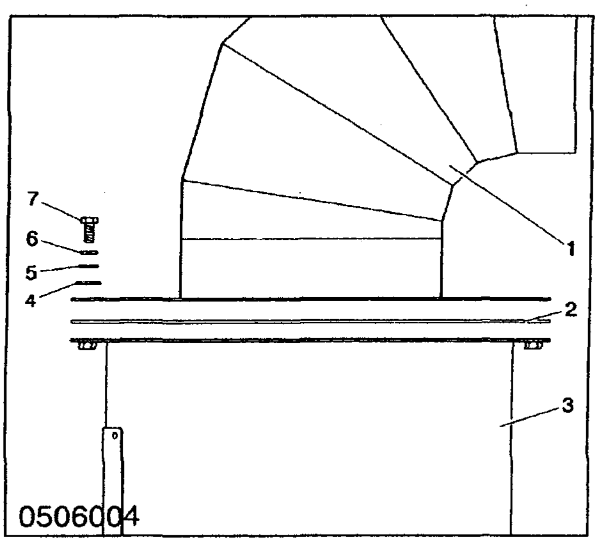
The machine room blower assembly is very heavy, over 140 kg. Use lifting equipment to handle the blower assembly to avoid personal injury or damage to the locomotive.

Bend Duct



Loosen the four bolts (1) securing the slip joint (3) to the bend duct (2).

Push the slip joint (3) away from the transition duct (4).

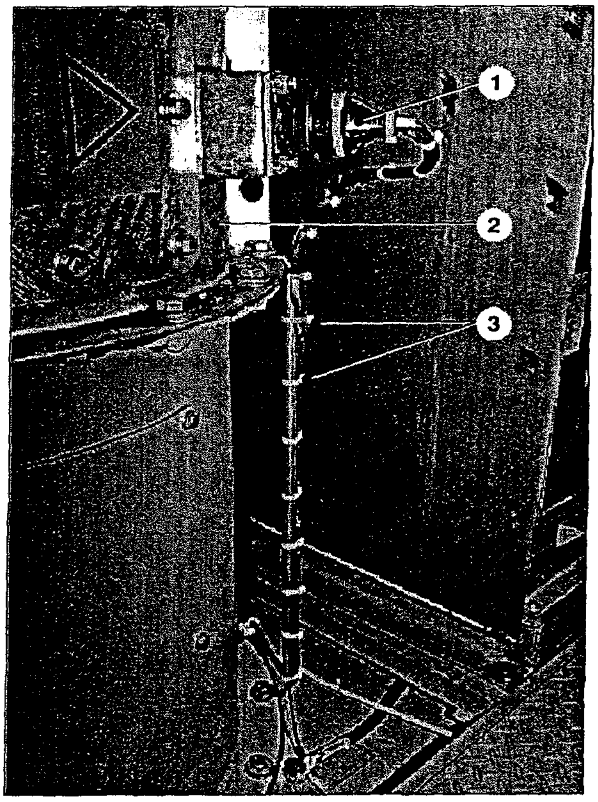


Remove the bolts (7), large (4) and small (5) plain washers and the spring washers (6) from around the bend duct flange.

Separate the bend duct (1) and gasket (2) from the blower fan housing (3).

Blower Fan

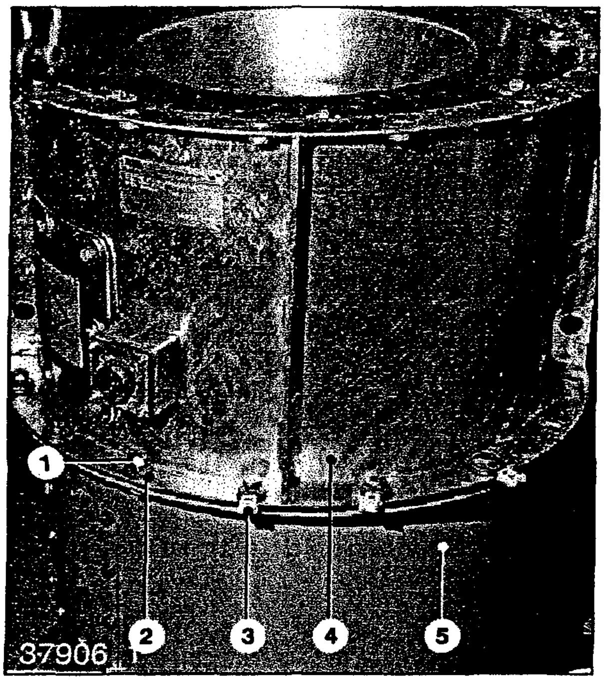
Remove the transition duct as previously described.



Unscrew the ring, then disconnect the harness (1) from the socket on the fan housing (2).

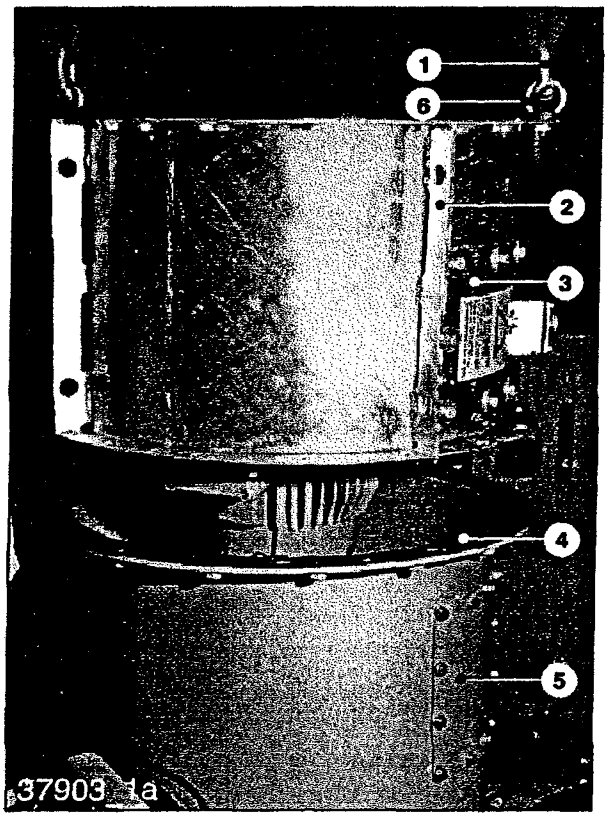
Cut all the cable ties (3) and secure the harness away from the work area.

Unbolt and remove the looming bar (4).



Remove the bolts (1), spring washers (2) and plain washers securing the fan housing (4) to the lower duct (5).

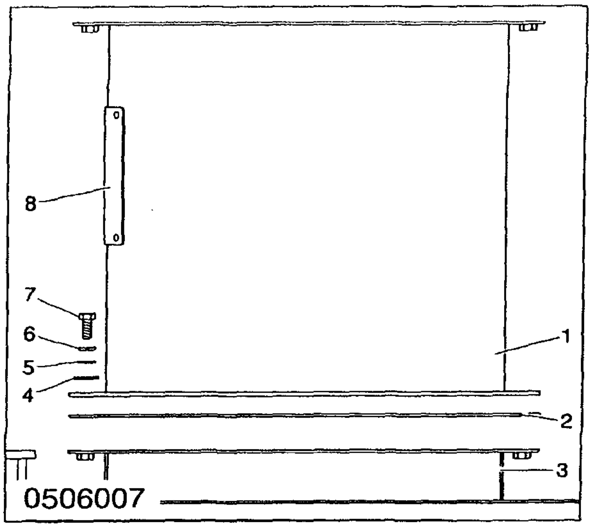
Using a felt-tipped pen, match mark the location of the clips and stand-offs (3) on the duct (4).



Secure suitable lifting eyes (6) to opposing bolt holes on the fan housing flange. Attach suitable lifting equipment (1) to the lifting eyes (6).

Raise the lifting equipment (1) slightly and ensure nothing is entangled. Lift the blower fan assembly (2) from the lower duct (5).

Lower Duct



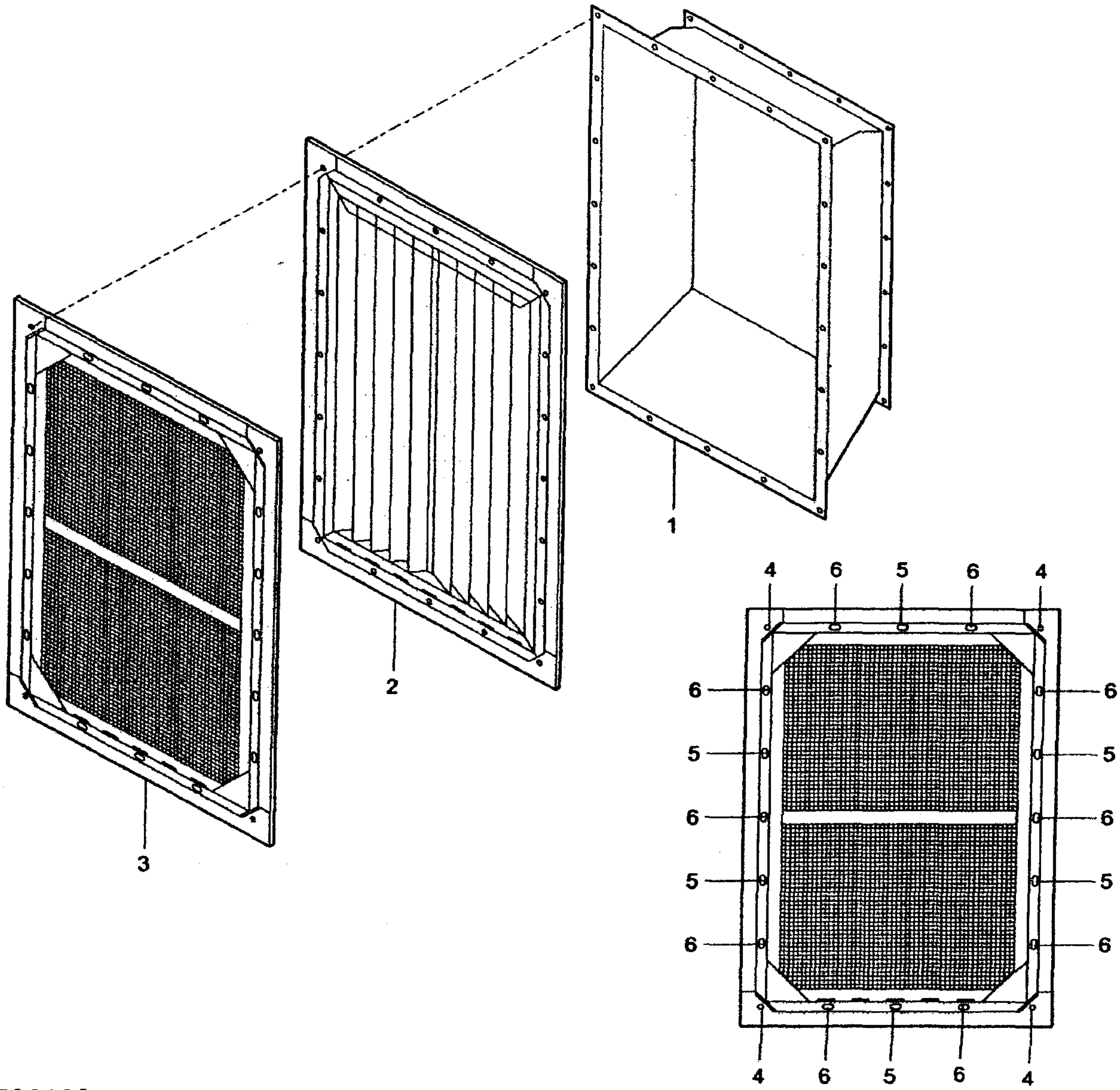
Remove the bend duct as previously described.

Remove the blower fan assembly as previously described.

Remove the bolts (7), spring washers (6) and plain washers, (large (4), small (5)) securing the lower duct (1) to the machine room floor duct (3).

Separate the lower duct (1) and gasket (2) *from the floor duct (3).*

Louvre Panel and Mesh Screen



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From outside the locomotive, have an assistant support the mesh screen and louvre. Loosen and remove the bolts (5, 6), spring washers and slot washers that secure the mesh screen (3) and louvre panel (2) to the plenum box (1). Do not loosen the bolts (4) at each corner, as these secure the plenum box (1) to the locomotive body.

Once the bolts (5,6) have been removed, the mesh screen (3) can be removed from the louvre panel (2).

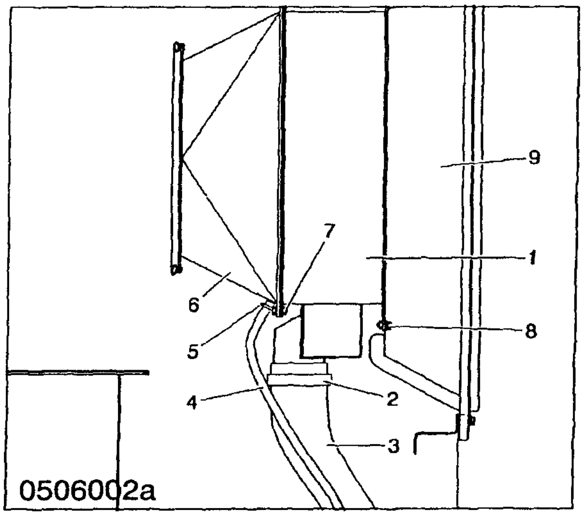
Once the mesh screen (3) has been removed, separate the louvre panel (2) from the plenum box (1).

Filter Assembly

The following procedure describes removal of the filter panel from the plenum box while the box is installed in the locomotive. However, the filter can be removed with the plenum assembly if required, as described in Plenum Box.

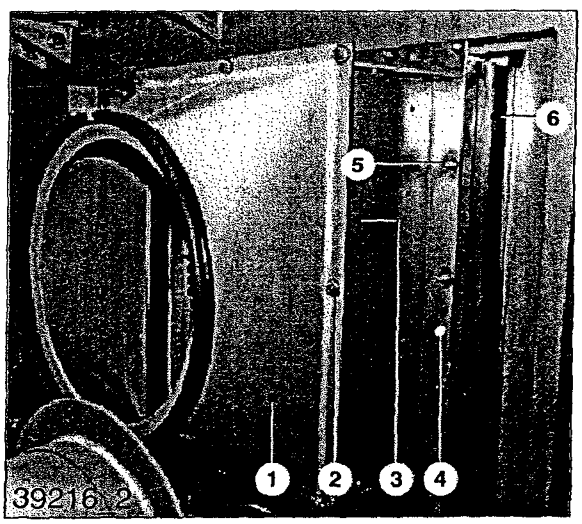
Remove the louvre panel and mesh screen as previously described.

Remove the bend duct as previously described.



Loosen the clamp (2) securing the flexible duct (3) to the filter assembly (1). Separate the flexible duct (3) from the filter assembly (1).

Undo the clamp (5) and disconnect the 10 mm diameter hose (4) from the bottom of the transition duct (6). Separate the hose (4) from the transition duct (6).



Remove the bolts (2), spring washers and plain washers securing the transition duct (1) to the filter (4).

Separate the transition duct (1) and gasket (3) from the filter (4).

Hold the filter in position, then remove the bolts (5), spring washers and plain washers securing the filter (4) to the plenum box (6).

Once all the bolts (5) have been removed, separate the filter (4) from the plenum box (6). The filter (4) is sealed to the plenum box (6) with sealant. It may be necessary to prise the joint apart and cut the sealant using a sharp knife. Take care not to damage the flange of the plenum box or filter.

Plenum Box

The plenum box can be removed from the locomotive with the filter attached.

Remove the louvre panel and mesh screen as previously described.

Remove the filter assembly from the plenum box if required. If the filter is to remain attached to the plenum box, removal all components from the filter as described in Filter Assembly.

NOTE:

If the filter is still attached to the plenum box, lifting equipment is recommended for plenum box removal.

From outside the locomotive have an assistant hold the plenum. Loosen and remove the four bolts located at the corners of the plenum box.

Remove the plenum box from the locomotive body. Note that the plenum box is sealed to the locomotive body with a mastic sealant. It may be necessary to prise the joint apart and cut the sealant using a sharp knife. Take care not to damage the flange of the plenum box.

Disassembly

@.1240

Blower Fan

If necessary, remove the blower fan and impeller from the housing as described in Chapter 6, Machine Room Blowers of Volume F10, Suppliers Documentation.

Inspection and Repair

@.1250

General

Inspect all finished surfaces for wear, cracks, chips or other damage. Any damage to finished surfaces must be repaired to manufacturers specification.

Filter

DRY CLEAN IN SITU

NOTE:

For this procedure, the machine room blower fan must be isolated at the circuit breaker, as described in Section Before Removal Operations, however the scavenge fan must be operable.

Remove the louvre panel and mesh screen as described in Section Removal.

From inside the machine room, remove the bend duct as described in Section Removal. The exposed opening to the blower fan must be covered with a suitable dummy flange or a sheet of wood or steel to prevent foreign material entering the machine room blower system. Disconnect the electrical harness to the blower fan as described in Section Removal.

Using an industrial grade vacuum cleaner, vacuum the rear side of the filter panel and surrounding areas to remove and dust and debris. Repeat procedure on the outside of the filter panel.

With the scavenge fan running, use a suitable brush to remove any debris in the Flosep filter tubes. Compressed air may also be used. Care must be taken to ensure no damage is caused to the filter tubes.

WET CLEAN

NOTE:

Wet cleaning of the filters may be carried out in situ, however it is recommended that the filter assembly be removed for cleaning.

Remove the filter assembly as described in Section Removal.

Wash the panels with water and a suitable soap or other washing solution. Use only spray nozzles, as a strong jet of water may damage or dislodge the tubes. Ensure that the water temperature does not exceed 80° C. After cleaning, rinse the panels with clean water. Once cleaned and rinsed, the panels must be dried to prevent any dust or debris sticking to the wet tubes. Drain the panels, then blow dry using compressed air.

Inspect the condition of the panels, frame and seals. Replace any worn or damaged components.

Replace the filter and all other components of the machine room blower system and test the operation of the system, as described in Section After Installations Operations.

Louvre

Steam clean the louvres, remove any build-up of dirt or dust from the seal plate and obstructions from the drain holes. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Check the condition of the louvre. Damaged louvres can cause restrictions, which reduce the efficiency of the blower system. Rectify any faults found.

Check the mounting flanges for cracks or damage. Rectify any faults found.

Screen

Steam clean the mesh screen, remove any build-up of dirt or debris. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Inspect the screen for any holes in the wire mesh. The mesh prevents larger debris entering the plenum and filter. Holes or gaps in the gap can allow larger objects, such as leaves and other debris, to clog the filter panel. Replace the mesh if damaged.

Plenum Box

Steam clean the plenum box, remove any build-up of dirt or debris. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Inspect the plenum box for cracks or damage. Rectify any faults found.

Inspect the condition of the seal. Replace the seal if worn or damaged.

Check the joint of the seal at the middle bottom of the plenum box. Replace the seal if any gaps, tears or damage exists.

Check the seal for irregularities, cracks, wear or damage. Wear must be even around the entire perimeter. Replace the seal if wear is uneven.

Transition Duct

Steam clean the transition duct, remove any build-up of dirt or debris. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Inspect the transition duct for cracks or damage. Rectify any faults found.

Inspect the condition of the seal. Check for irregularities, wear or damage. Replace if required.

Check the seal joint. Replace the seal if the joint is torn or does not meet.

Check the condition of the gasket. Replace if torn or damaged.

Bend Duct

Steam clean the bend duct, remove any build-up of dirt or debris. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Inspect the bend duct for cracks or damage. Rectify any faults found.

Check the surface of the bend duct slip joint where the transition duct seal contacts. The surface must be even and without irregularities. Replace the slip joint seal plate if the minimum *thickness of the plate is less than the specification in Section Tolerances and Wear Limits.*

Check the condition of the gasket. Replace if torn or damaged.

Blower Duct

Remove all traces of dirt and dust from the blower motor and fan.

Inspect the condition of the housing. Check for cracks around the flange area or damage to the body. Rectify any faults found or replace the housing as necessary.

Inspect the condition of the gaskets, replace if damaged or torn.

Lower Duct

Check for cracks around the flange area or damage to the body. Rectify any faults found or replace the duct as necessary.

Inspect the condition of the gaskets, replace if damaged or torn.

Blower Fan and Motor

Inspect the blower fan and motor as described in Chapter 6, Machine Room Blowers of Volume F10, Suppliers Documentation.

Remove the impeller and clean. Remove all build up of dust and debris. Dust and debris can cause imbalance in the impeller.

Check, and if necessary adjust, the clearance between the impeller and inlet cone. Refer to Chapter 6, Machine Room Blowers of Volume F10, Suppliers Documentation.

Lubricate the motor bearings at the grease nipples on the motor end cases. Refer to Chapter 6, Machine Room Blowers of Volume F10, Suppliers Documentation.

Waste Disposal

@.1260

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

Assembly

@.1270

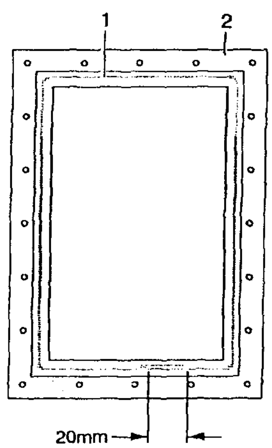
Blower Fan

If necessary, assemble the blower fan and impeller into the housing as described in Chapter 6, Machine Room Blowers of Volume F10, Suppliers Documentation.

NOTE:

Seal all fixing hardware during assembly with Loctite 577 or equivalent. Seal the threads, between the washers and under the bolts heads to ensure an air tight seal.

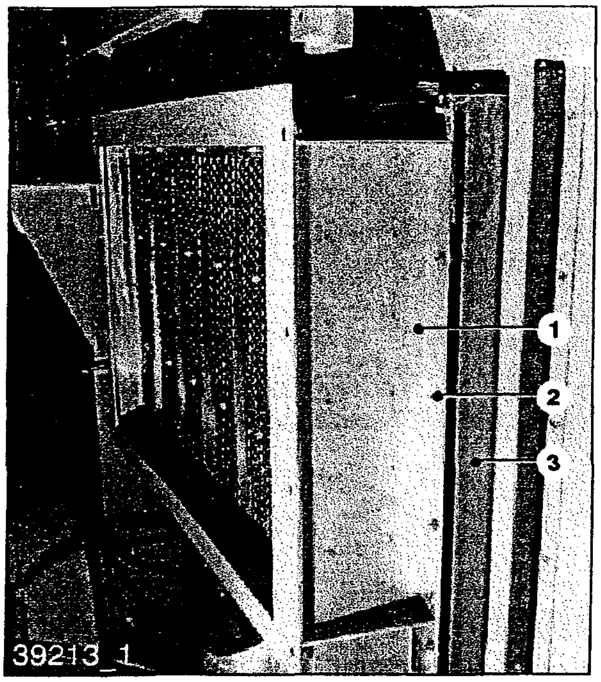
Filter Assembly



0506015

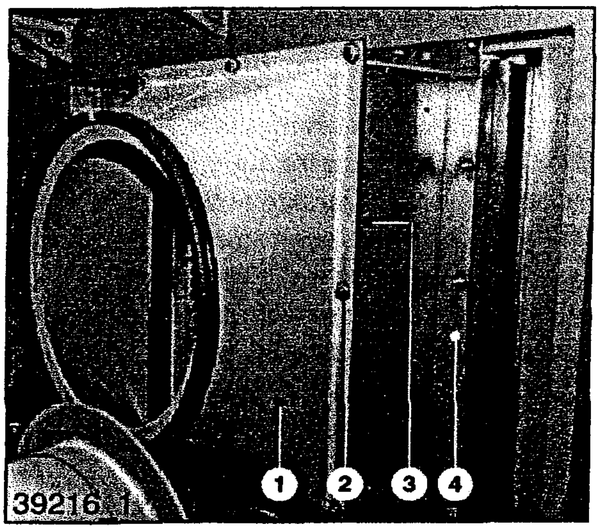
Install the seal into the groove of the plenum box. The joint must be at the middle bottom and overlapped by 20 mm.

Apply a continuous 3 mm diameter bead of Sikaflex 15LM (1) around the plenum box flange (2) inside perimeter of the bolt holes. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.



Position the filter (1) on the plenum box (3) with the scavenge duct outlet facing downwards.

Install the bolts (2), spring washers and plain washers securing the plenum box (3) to the filter (1). Tighten the bolts (2) using an alternating pattern.



Install the gasket (3) and transition duct (1) onto the filter assembly (4). Align the holes and install the bolts (2), plain washers and spring washers.

Tighten the bolts (2).

Install the seal around the lip of the transition duct. Join the seal at the top centre of the duct using urethane adhesive.

Installation

@.1280

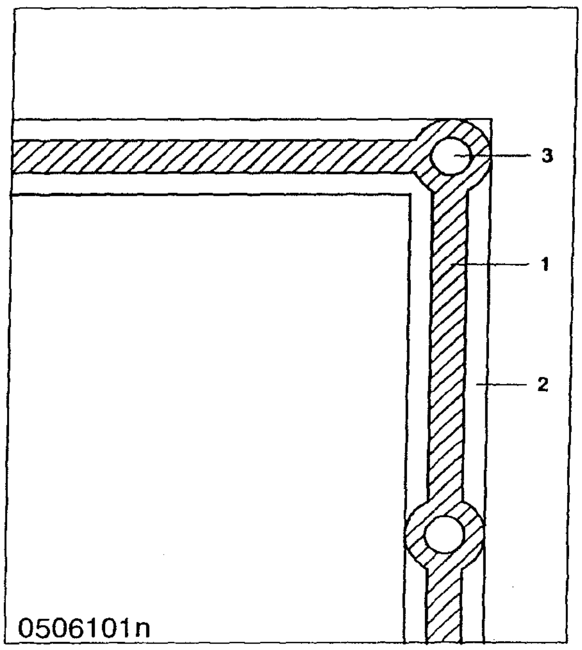
WARNING:

The machine room blower assembly is very heavy, over 140 kg. Use lifting equipment to handle the blower assembly to avoid personal injury or damage to the locomotive

NOTE:

Seal all fixing hardware during installation with LOCTITE 577 or equivalent. Seal the threads, between the washers and under the bolt heads to ensure an air tight seal.

Plenum Box



NOTE:

The plenum box may be installed with the filter assembly connected. Should this be done, lifting equipment is recommended for the following procedure.

Apply a continuous 8 mm diameter bead of Sikaflex 15LM (1) to the tapping plate (2) located on the locomotive side body. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume. The bead must be continuous and once the plenum box is installed, a complete seal must be achieved. Sealant in bolt holes (3) should be avoided.

Position the plenum box in place on the locomotive body. Press the plenum box into place to ensure the mastic sealant spreads evenly. Install the four bolts together with spring washers and plain washers in the corners of the plenum box and tighten bolts.

Filter Assembly

NOTE:

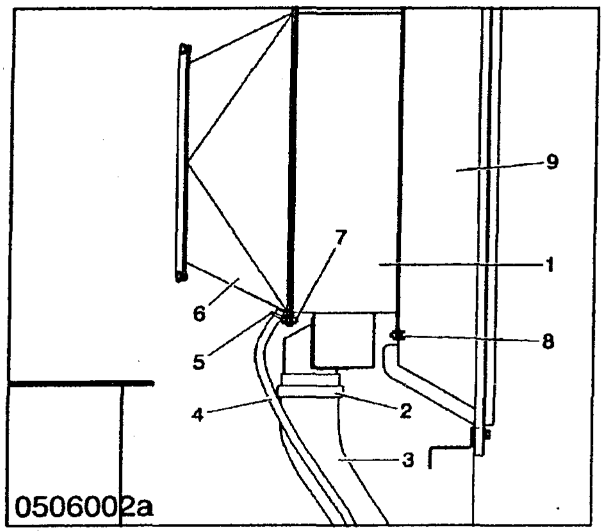
> *The filter assembly may be connected to the plenum box, and then installed as an assembly. To do this, attach the filter assembly to the plenum box as described below, then install the plenum box. Complete remaining steps in this procedure once filter and plenum are installed.*

Install the plenum box as previously described if required.

Apply a continuous 6 mm diameter bead of Sikaflex 15LM around the flange where the filter assembly mounts to the plenum box. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

Align the bolt holes, then position the filter assembly on the plenum box.

Install the bolts, spring washers and washers to secure the filter assembly to the plenum box, then tighten the bolts.

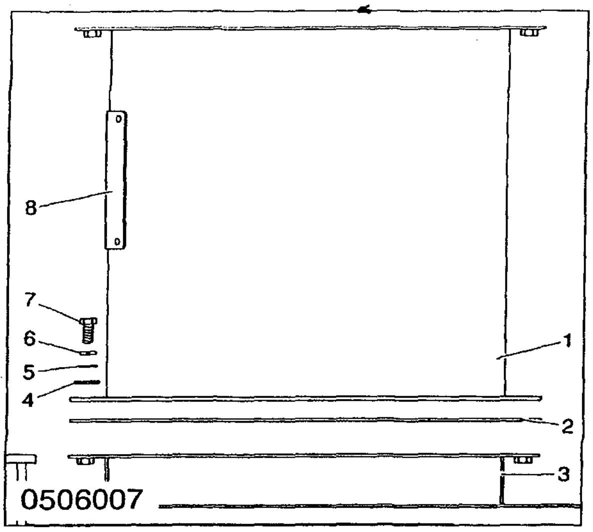


Position the gasket on the transition duct (6) then position transition duct in place on the filter assembly (1). Once in position with the holes aligned, install the bolts, spring washers and washers (7) to secure the transition duct to the filter assembly. Tighten bolts.

Connect the 10 mm diameter hose (4) to the bottom of the transition duct (6), then install the clamp (5) and tighten to secure the hose (4).

Connect the flexible duct (3) to the filter assembly (1), then install the clamp (2) and secure the flexible duct (3) to the filter assembly (1).

Lower Duct



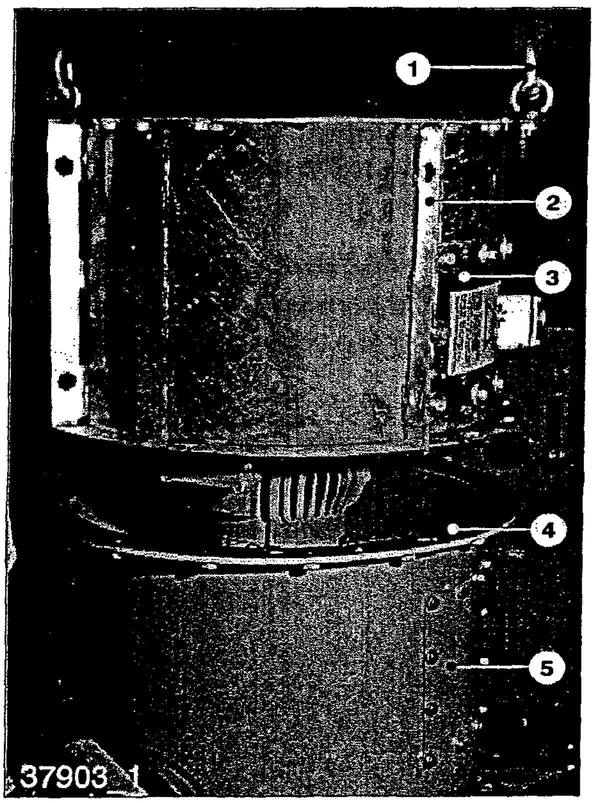
Install the gasket (2) on the machine room floor duct (3). Align the holes in the gasket (2) and the floor duct (3).

Position the lower duct (1) into the machine room floor duct (3) with the access panel (8) facing the opposite side wall.

Align the bolt holes in the flanges and gasket (2).

Install the bolts (7), spring washers (6) and *plain washers, (large (4), small (5)) around* the lower duct flange.

Blower Fan

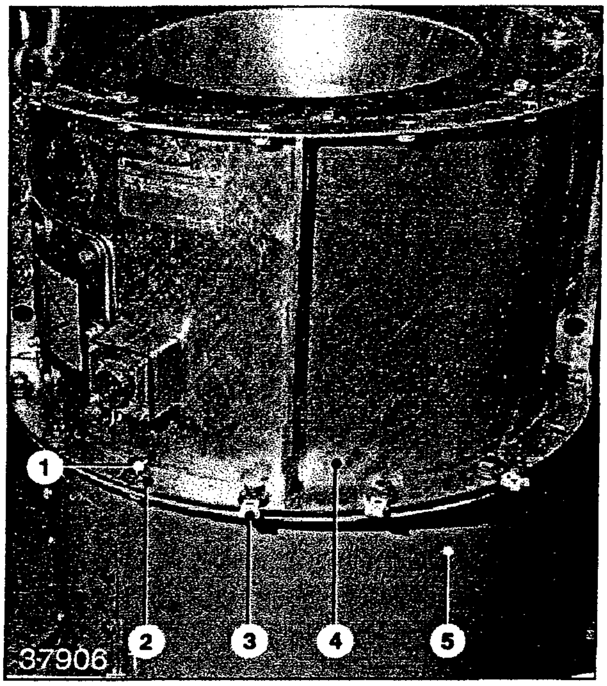


Install the lower duct as described in Lower Duct.

Position the gasket (4) on the lower duct (5) and align the holes in the gasket (4) and the lower duct (5).

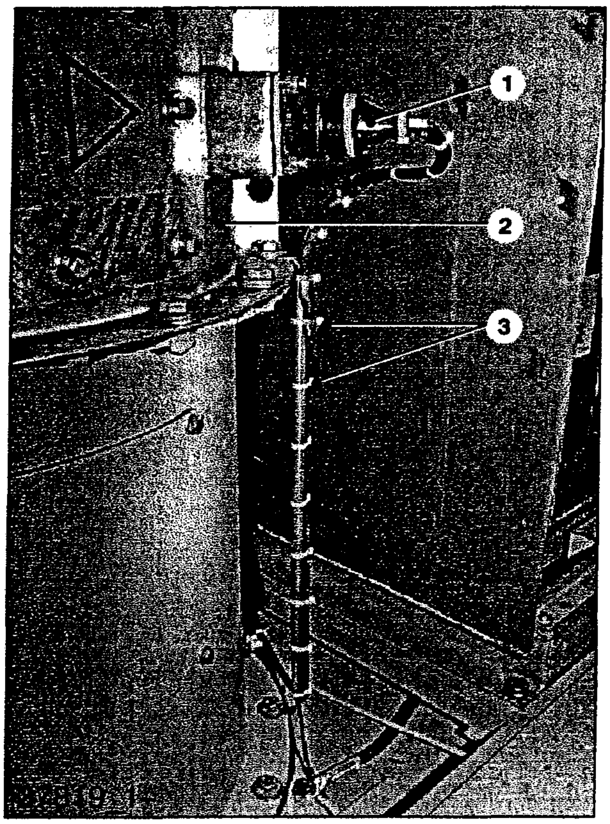
Attach suitable lifting equipment (1) to the blower fan assembly (2) and load the blower into the machine room through the roof aperture.

Position the blower fan assembly (2) onto the lower duct (5) using suitable lifting equipment. Ensure the access cover (3) faces towards the opposite side wall.



Install the bolts (1) with spring washers (2) and plain washers through the blower housing (4) and gasket into the lower duct (5). Tighten the bolts using an alternating pattern.

Remove the lifting equipment from the blower fan assembly.



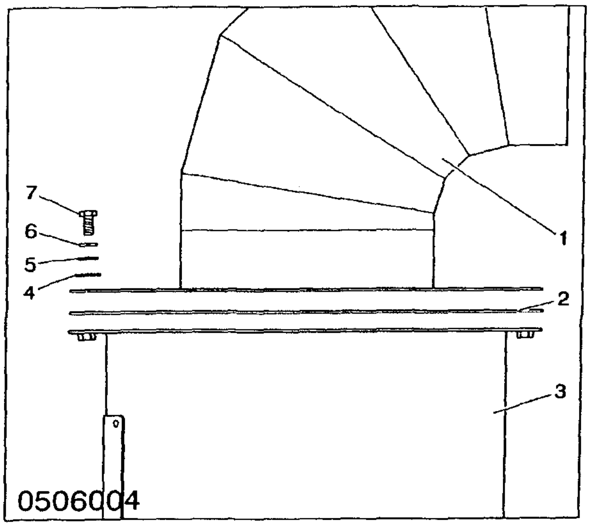
Connect the harness (1) to the socket on the blower fan assembly (2).

Install the looming bar, then attach the wire with wire straps (3) to the looming bar.

Bend Duct

Install the lower duct as previously described.

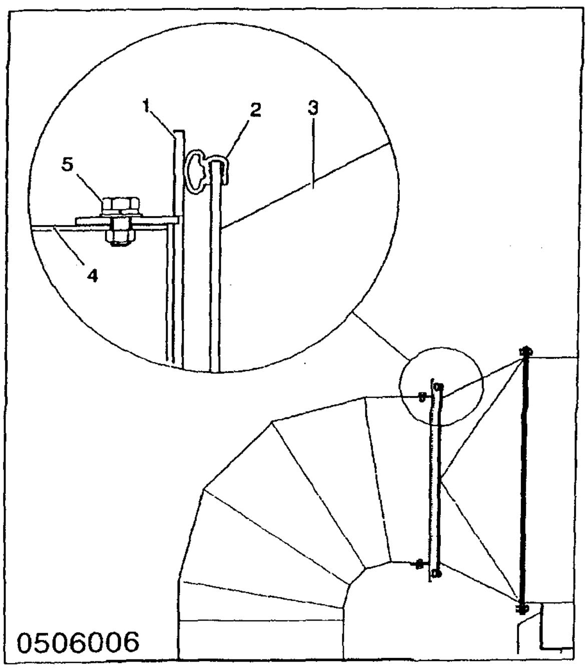
Install the machine room blower as described in *Blower Fan*.



Position the gasket (2) on the fan housing (3). Align the holes in the gasket (2) and fan housing (3).

Position the bend duct (1) facing towards the transition duct onto the fan housing (3). Align the bolt holes in the flange, gasket (2) and fan housing (3).

Install the bolts (7), plain washers (4,5) and spring washers (6) through the bend duct and gasket (2) into the fan housing flange (3) and tighten the bolts (7).

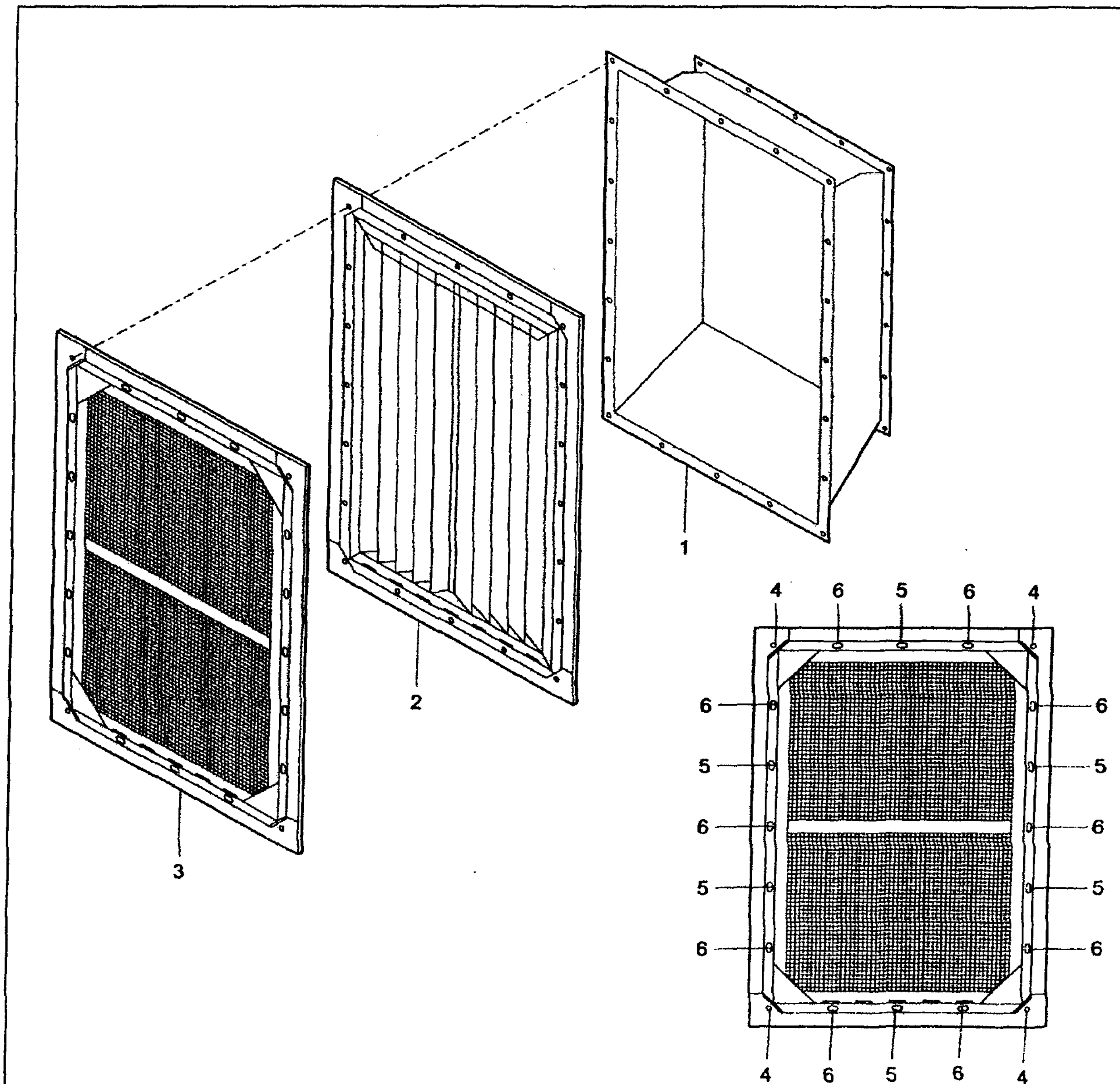


Slide the slip joint (1) towards the transition duct seal (2) until the face of the slip joint (1) is contacting the seal (2) around the entire perimeter.

Apply pressure evenly around the slip joint (1) and compress the seal (2) until the distance between the transition duct (3) and bend duct flanges (4) is 12 mm. Ensure the gap is even around the entire perimeter. Tighten the four bolts (5) securing the slip joint (1).

Louvre Panel and Mesh Screen

Install the plenum box and filter assembly as previously described.



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Position the louvre panel (2) and mesh screen (3) on the mounted plenum box (1).

NOTE:

M8 x12 mm long and M8 x 20 mm long screws must be inserted in the correct positions. Item 6 indicates 12 mm long screw, item 5 indicated 20 mm long screw.

Install the screws (5,6), spring washers and slot washers, then tighten screws to secure the mesh screen and the louvre panel to the plenum box.

After-Installations Operations

@.1290

Close the circuit breaker to the blower fan, then test the operation of the fan. Rectify any faults found.

Water test louvre, filter panel and surrounding area as described in the Preface of this Volume. Rectify any faults found.

Adjustments

@.1310

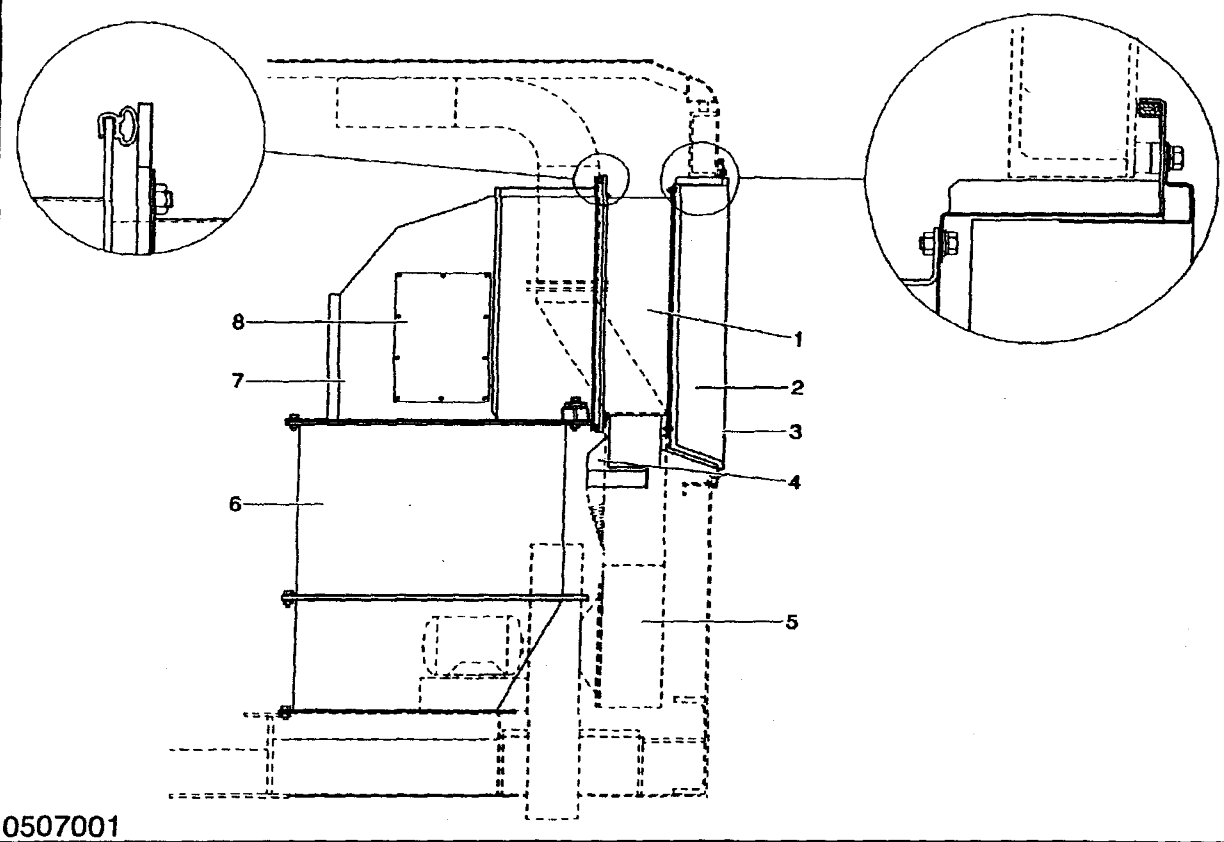
Adjust flange slip joint seals on the transition duct if leakage is observed during testing.

5.7 Traction Motor Blowers

Group Summary

@.1120

This chapter contains information for the traction motor blower, which comprises the filter duct, louvre, mesh screen, filter assembly and blower fan assembly.



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1	Filter	5	Scavenge blower
2	Plenum box	6	Blower fan assembly
3	Louvre panel and mesh screen	7	Filter duct
4	Scavenge duct outlet	8	Access cover

Functional Description

@.1140

The traction motor blower provides filtered cooling air to the traction motors. Mesh screens and louvres located in the walls of the machine room remove large particles from the inlet air stream and prevent larger objects from blocking the venturi. A Flosep venturi filter system then extracts the smaller particles of dirt and other foreign material from the inlet air stream and exhausts it through the scavenge system. The inlet air then passes through ducting in the machine room floor and into the traction motors via bellows between the locomotive underframe and the bogie. Air is then exhausted through the traction motor end plates.

For the system to work efficiently, all seals must be kept in good condition to provide a proper barrier.

Technical Data

@.1160

Motor and Fan Assembly

- Motor type	three-phase squirrel cage
- Motor model	Landert, 200L55-RF Xh
- Fan model	HCBX-605-115
- Rotational speed	2,920 rpm
- Output power	22 kW
- Weight	404 kg

Tolerances and Wear Limits List

@.1170

FILTER SEAL PLATE

- Minimum thickness	4 mm

Tools & Special Tools

@.1180

Conventional railway 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:

- Sikaflex 15LM sealant
- Loctite 577 is required to seal screw threads, as noted in Section Installation
- Loctite 767 is required for the threads on the captive bolts in the filter duct
- Soapy water is required for cleaning the filter panels

Before-Removal Operations

@.1220

General

Set the "Traction Motor Blower" circuit breaker (53.1) to the Off position. Circuit breaker 53.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle-1 (HB1) and circuit breaker 53.1/2 for the No. 2 End is situated in Auxiliary Circuits Cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Scavenge Blower to Traction Motor and Oil Cooler Blowers" circuit breaker (55.1) to the Off position. Circuit breaker 55.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle-1 (HB1) and circuit breaker 55.1/2 for the No. 2 End is situated in Auxiliary Circuits Cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

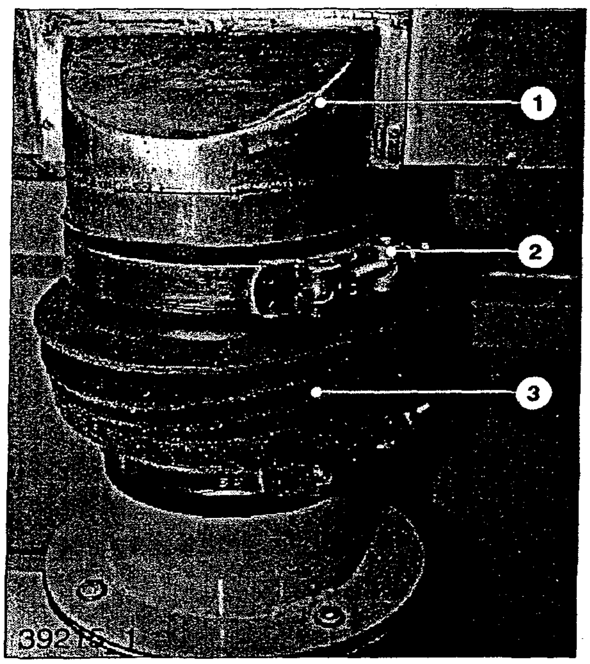
Blower Fan

Removal of the blower fan assembly requires the prior removal of the pantograph roof hatch, as described in Chapter 1.1, Structure.

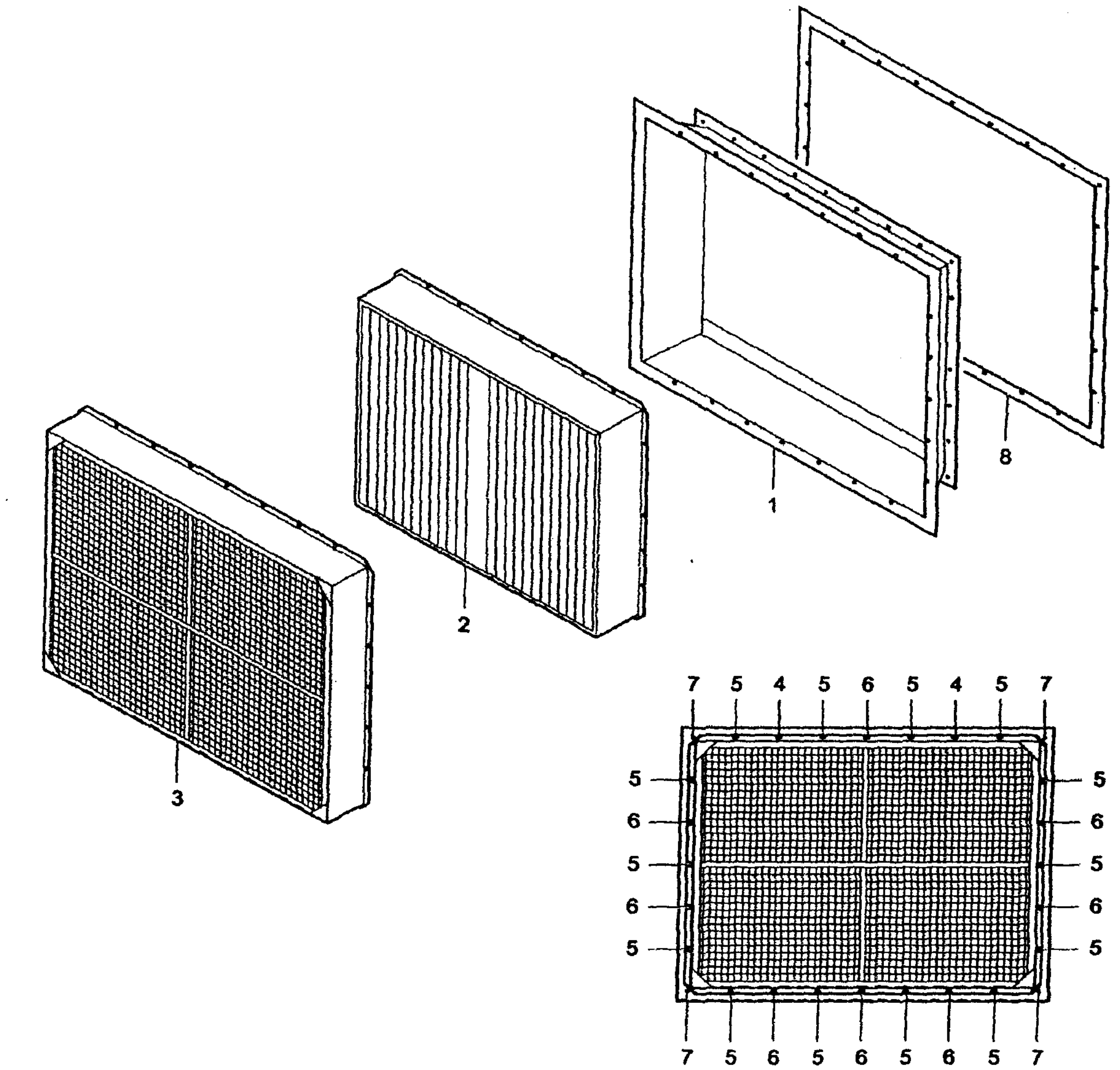
Removal

@.1230

Filter Assembly



Undo the clamp (2) and separate the flexible duct (3) from the filter (1).



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NOTE:

The filter assembly is bolted to the plenum box. The filter duct is sprung against the filter assembly by the seal. The force will slightly push the filter assembly and plenum box out of the bodyside panel.

From outside the locomotive, loosen the bolts (5), then the bolts (6) around the louvre panel (2) and mesh screen (3). Do not loosen the bolts (7) at each corner, these secure the plenum box (1) to the locomotive. Remove the slot washers, spring washers and bolts (6, 5).

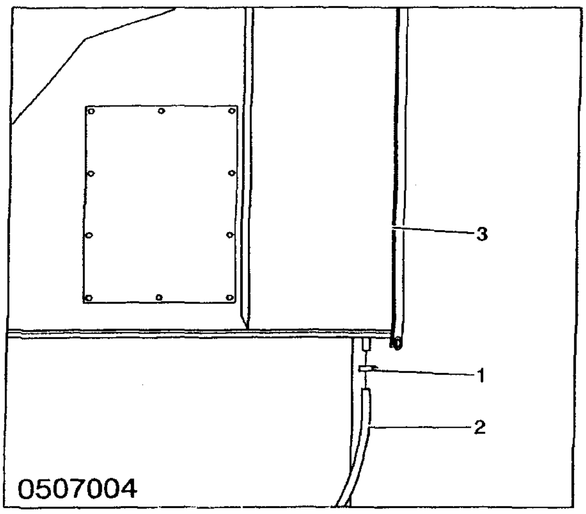
Studs (4) located in the locomotive bodyside tapping plate (8) are provided to support components during installation and removal. Remove the nuts, slot washers and spring washers from the studs (4).

Once the bolts (5,6) and nuts on the studs (4) have been removed, remove the mesh screen (3) and the louvre panel (2) from the plenum box (1).

Support the plenum box (1), then remove the four bolts (2), spring washers and plain washers securing the corners of the plenum box (1) to the tapping plate (8).

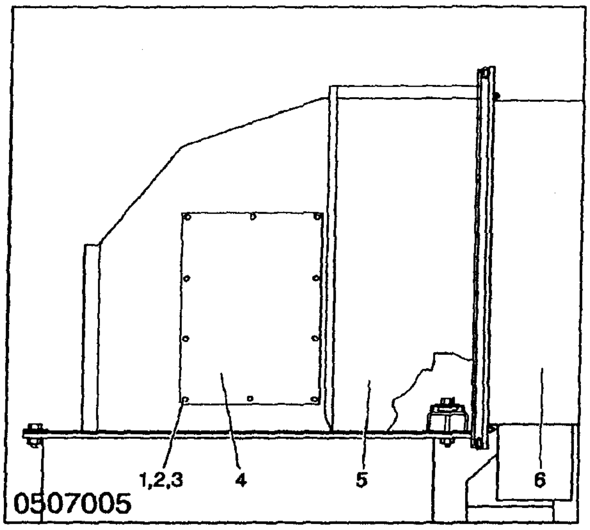
Using suitable lifting equipment, carefully manipulate the plenum box and filter assembly from the body side panel.

Filter Duct



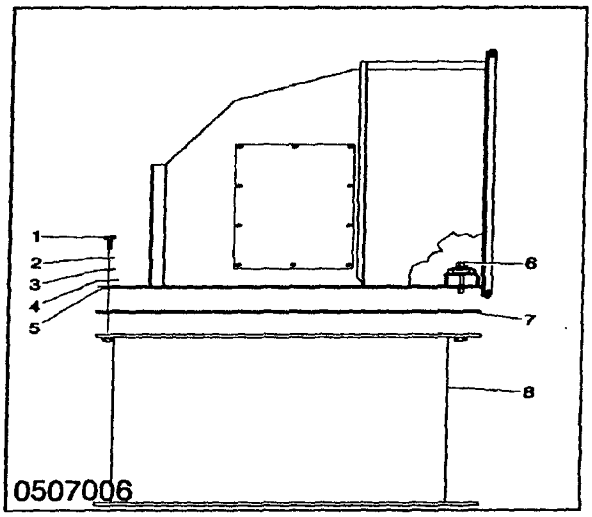
Remove the filter assembly as previously described.

Undo the clamps (1) and disconnect the 10 mm diameter hoses (2) from the bottom of the filter duct (3). Separate the hoses (2) from the filter duct (3).



Remove the bolts (1), spring washers (2) and plain washers (3) securing the access cover (4) to the filter duct (5).

Separate the access cover (4) and gasket from the filter duct (5).



Loosen the bolts (1) securing the filter duct flange (5) to the blower fan assembly (8).

NOTE:

Bolts (6) located inside the filter duct are captive bolts.

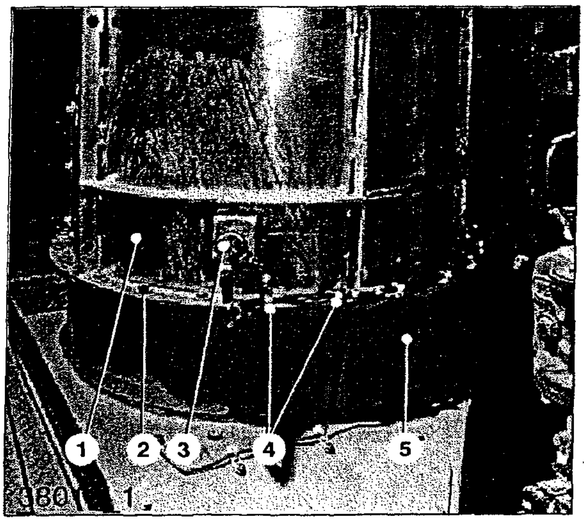
Loosen the bolts (6) inside the filter duct (5) through the access aperture or through the filter assembly opening in the bodyside.

Ensure the captive bolts (6) have been fully unscrewed from the filter flange. Ensure the bolts (6) are secured so as not to interfere with the removal of the filter duct (5).

Remove the bolts (1), large plain washers (4), small plain washers (3) and spring washers (2) from around the filter duct flange (5).

Separate the filter duct (5) and gasket (7) from the blower fan assembly (8).

Blower Fan



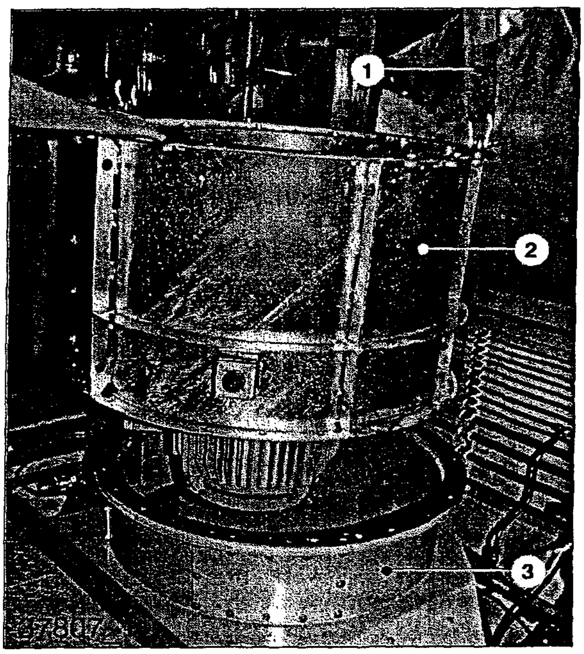
The blower fan assembly is very heavy. The blower can be removed and disassembled inside the machine room. However, it may be appropriate to remove the pantograph hatch, then lift the assembly to a suitable work site outside the locomotive.

Remove the filter duct as previously described.

Disconnect the electrical harness (3) from the blower fan motor socket.

Cut and remove all wire straps (4). Remove the electrical harness (3).

Remove the bolts (2), spring washers and plain washers securing the blower fan assembly (1) to the machine room floor duct (5).



Attach suitable lifting equipment (1) to the blower fan assembly (2).

Raise the lifting equipment (1) and ensure nothing is entangled.

NOTE:

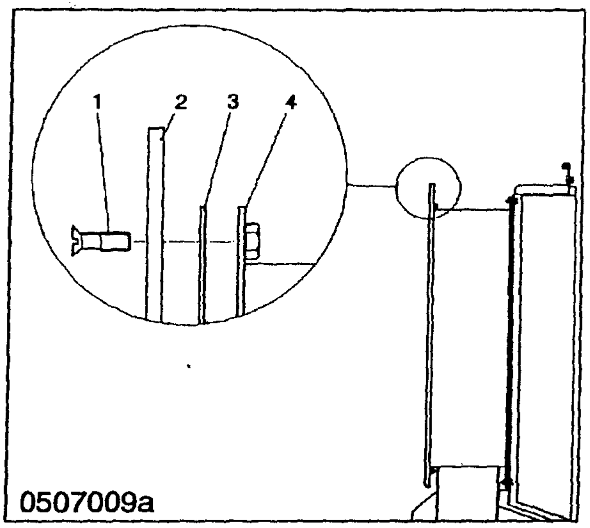
The blower fan assembly (2) is sealed to the machine room floor duct (3). It may be necessary to cut through the sealant using a sharp knife in order to break the seal.

Lift the blower fan assembly (2) from the machine room floor duct (3) to a suitable work area. Use care not to cut or damage the gasket during removal.

Disassembly

@.1240

Filter Assembly



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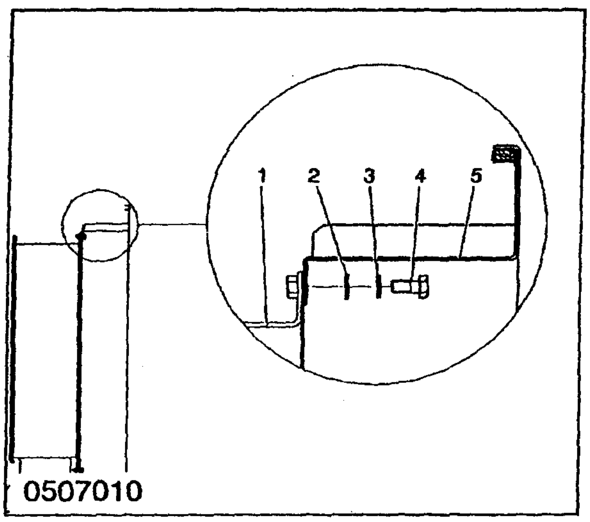
Remove the countersunk screws (1) securing the seal plate (2) to the filter (4).

Separate the seal plate (2) and gasket (3) from the filter (4).



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Remove the bolts (4), spring washers (3) and plain washers (2) securing the plenum box (5) to the filter (1).

Separate the filter (1) from the plenum box (5). The joint is sealed. It may be necessary to prise the joint apart and cut the sealant using a sharp knife. Take care not to damage the flange of the plenum box (5) or filter (1).

Inspection and Repair

@.1250

General

Inspect all finished surfaces for wear, cracks, chips or other damage. Any damage to finished surfaces must be repaired to manufacturers specification.

Filter

DRY CLEAN

Remove the filter panel assembly from the plenum box as described in Section Disassembly.

Using an industrial grade vacuum cleaner, vacuum the rear side of the filter panel and surrounding areas to remove and dust and debris. Repeat procedure on the outside of the filter panel.

Use a suitable brush to remove any debris in the Flosep filter tubes. Vacuum any debris from the tubes as it is dislodged. Compressed air may also be used to remove debris. Care must be taken to ensure no damage is caused to the filter tubes.

WET CLEAN

Remove the filter panel assembly from the plenum box as described in Section Disassembly.

Wash the panels with water and a suitable soap or other washing solution. Use only spray nozzles, as a strong jet of water may damage or dislodge the tubes. Ensure that the water temperature does not exceed 80 °C. After cleaning, rinse the panels with clean water. Once cleansed and rinsed, the panels must be dried to prevent any dust or debris sticking to the wet tubes. Drain the panels, then blow dry using compressed air.

Seal Plate

Remove any build-up of dirt or dust from the seal plate.

Inspect the seal plate for cracks or damage. Replace if necessary.

Check the surface of the plate where the filter duct seal contacts. The surface must be even and without irregularities.

Replace the plate if the minimum thickness of the plate is less than the specification in Section Tolerances and Wear Limits List.

Check the condition of the gasket. Replace if cut, torn or damaged.

Louvre

Steam clean the louvres, remove any build-up of dirt or dust from the seal plate and obstructions from the drain holes. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Check the condition of the louvre. Damaged louvres can cause restrictions, which reduce the efficiency of the blower system. Rectify any faults found.

Check the mounting flanges for cracks or damage. Rectify any faults found.

Screen

Steam clean the mesh screen, remove any build-up of dirt or debris. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Inspect the screen mesh for any breaks in the wire. The mesh prevents larger debris entering the plenum and filter. Holes or gaps in the mesh can allow larger objects, such as leaves and other debris, to clog the filter panel. Replace the mesh if damaged.

Plenum Box

Steam clean the plenum box, remove any build-up of dirt or debris. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Inspect the plenum box for cracks or damage. Rectify any faults found.

Inspect the condition of the seal. Replace the seal if worn or damaged.

Check the joint of the seal at the middle bottom of the plenum box. Replace the seal if any gaps, tears or damage exists.

Check the seal for irregularities, cracks, wear or damage. Wear must be even around the entire perimeter. Replace the seal if wear is uneven.

Filter Duct

Steam clean the filter duct, remove any build-up of dirt or dust and ensure there are no obstructions in the small tubes. Refer to Steam Cleaning in the Preface of this Volume. Damage to components or personal injury can result from improper application of the steam cleaning equipment.

Inspect the filter duct for cracks or damage. Rectify any faults found.

Check the access cover and gasket for damage. The cover and gasket must provide an air tight seal.

Inspect the condition of the seal. Check for irregularities, wear or damage. Replace if required.

Check the condition of the gasket. Replace if torn or damaged.

Blower

Inspect the blower fan and motor as described in Chapter 7, Traction Motor Blowers of Volume F10, Suppliers Documentation.

Remove the impeller and clean. Remove all build up of dust and debris. Dust and debris can cause imbalance in the impeller.

Check, and if necessary adjust, the clearance between the impeller and inlet cone. Refer to Chapter 7, Traction Motor Blowers of Volume F10, Suppliers Documentation.

Lubricate the motor bearings at the grease nipples on the motor end cases. Refer to Chapter 7, Traction Motor Blowers of Volume F10, Suppliers Documentation.

Waste Disposal

@.1260

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

Assembly

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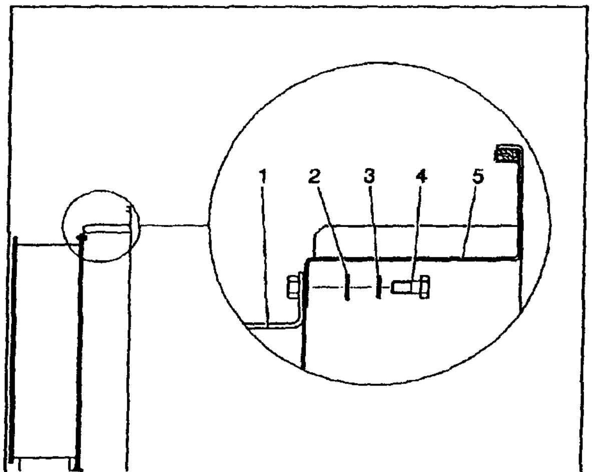
NOTE:

Seal all fixing hardware during assembly with Loctite 577 or equivalent. Seal the threads, between the washers and under the bolts heads to ensure an air tight seal.

Filter Assembly



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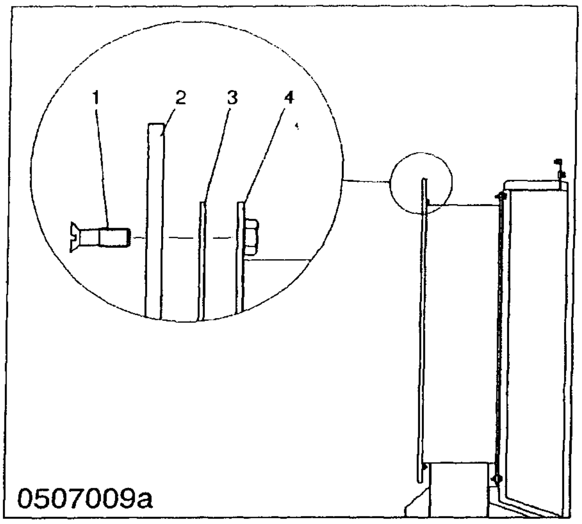
Install the seal into the groove of the plenum box. The joint must be positioned at the middle bottom and overlapped by 20 mm.

Apply a continuous 3 mm diameter bead of Sikaflex 15LM around the inside perimeter of the bolt holes on the plenum box (5) flange where the filter assembly (1) mounts. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

Position the filter (1) on the plenum box (5) with the scavenge nozzle facing downwards.

Apply Loctite 577 to the fixing hardware, then install the bolts (4), spring washers (3) and plain washers (2) securing the plenum box (5) to the filter (1). Tighten the bolts (4) in an alternating pattern.



Position seal plate (2) and gasket (3) on the filter (4). Align the holes. Apply Loctite 577 to the threads, then install the countersunk screws (1). Tighten the screws (1) in an alternating pattern.

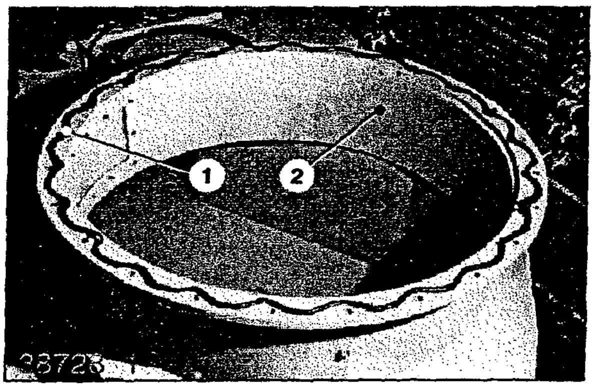
Installation

@.1280

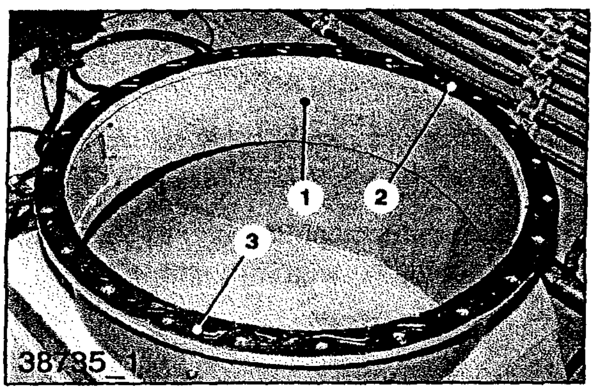
NOTE:

Unless otherwise stated, seal all fixing hardware during installation with the specified Loctite or equivalent. Seal the threads, between the washers and under the bolts heads to ensure an air tight seal.

Blower Fan

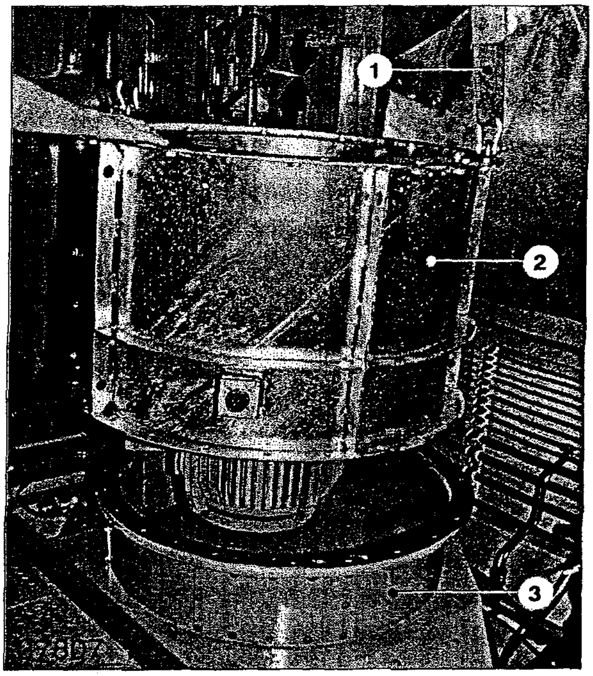


Apply a continuous 6 mm diameter bead of Sikaflex 15LM (1) around the machine room floor duct flange (2) inside perimeter of the bolt holes. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.



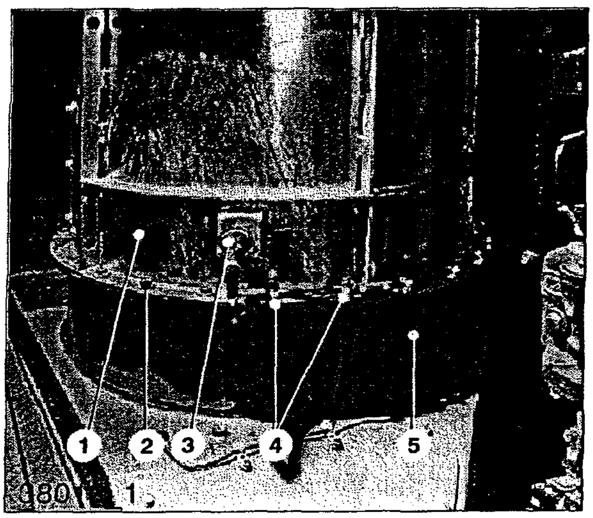
Position the gasket on the machine room floor duct and align the holes in the gasket and duct.

Apply a continuous 6 mm diameter bead of Sikaflex 15LM on the gasket inside perimeter of the bolt holes. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.



Attach suitable lifting equipment (1) to the blower fan assembly (2) and lower the blower fan assembly (2) into the machine room through the roof aperture.

Position the blower fan assembly (2) onto the machine room floor duct (3) using suitable lifting equipment. Ensure the socket on the blower fan assembly faces towards the access cover on the machine room floor duct (3).

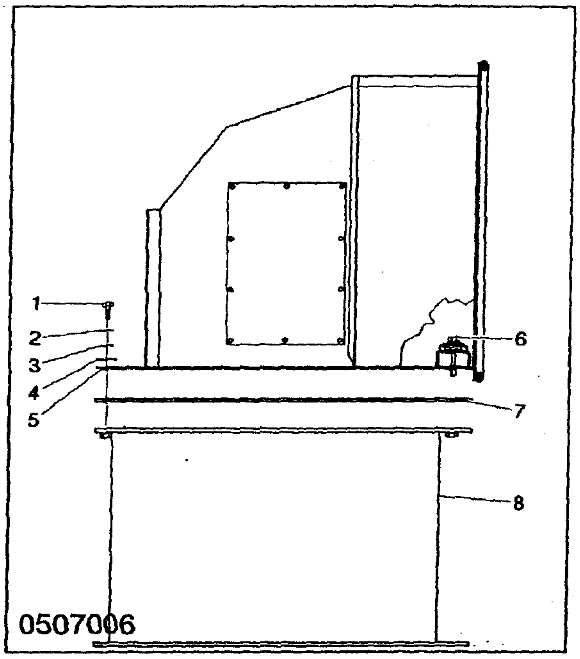


Apply Loctite 577 to the fixing hardware, then install the bolts (2) with spring washers and plain washers through the blower fan housing (1) and gasket into the machine room floor duct (5). Tighten the bolts (2) using an alternating pattern.

Connect the electrical harness plug (3) to the socket on the blower fan assembly (1).

Attach the electrical harness to the blower fan assembly (1) with wire straps (4).

Filter Duct



Install the seal around the edge of the filter duct. The joint must be positioned at top centre of the duct and bonded with contact adhesive.

Apply a continuous 6 mm diameter bead of Sikaflex 15LM to both sides of the gasket (7). Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

Position the gasket (7) on the blower fan housing (8). Align the holes in the gasket (7) and blower fan housing (8).

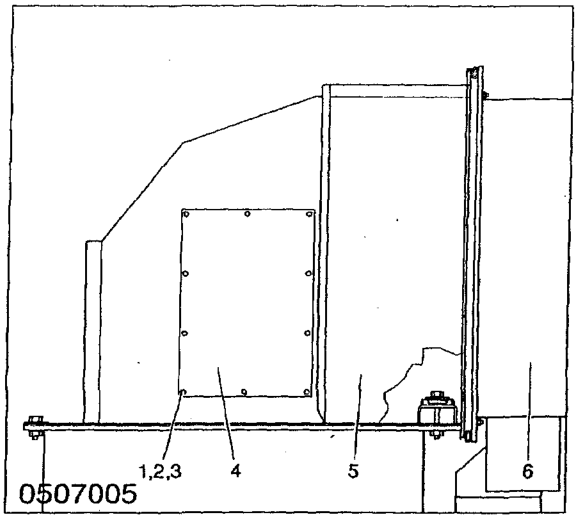
Apply Loctite 767 to the captive bolts (6) prior to installing the filter duct (5) onto the blower fan housing (8).

Position the filter duct (5) with the seal face towards the filter opening into the blower fan housing (8). Align the bolt holes in the flange, gasket (7) and blower fan housing (8).

Install the bolts (1), large plain washers (4), small plain washers (3) and spring washers (2) around the filter duct flange (5).

Either through the access cover or through the filter opening in the locomotive body-side, align the captive bolts (6) with the filter flange holes inside the duct.

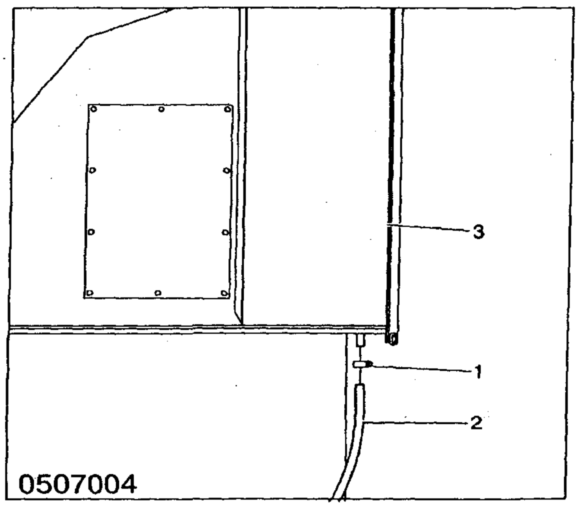
Tighten the bolts (1,6).



Position the access cover (4) and gasket on the filter duct (5).

Apply Loctite 577 to the fixing hardware, then install the bolts (1), spring washers (2) and plain washers (3) securing the access cover (4) to the filter duct (5).

Tighten the bolts (1) in an alternating pattern.



Position the clamps (1) on the hoses (2), then place the 10 mm diameter hoses (2) on the filter duct unions.

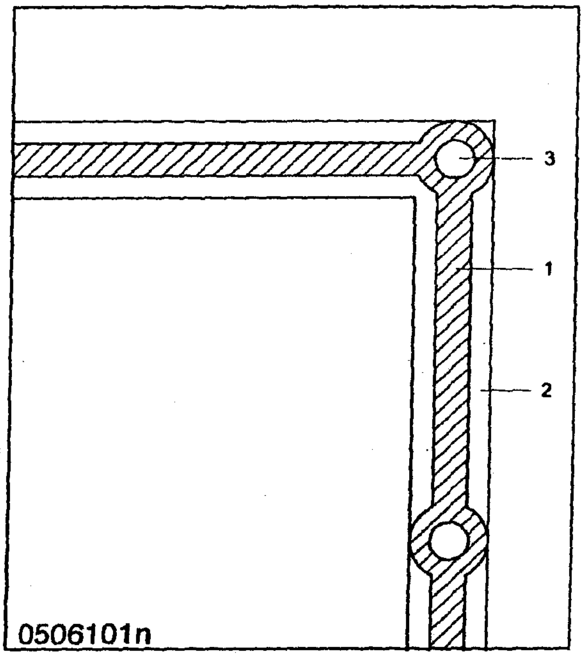
Tighten the clamps (1).

Filter Assembly

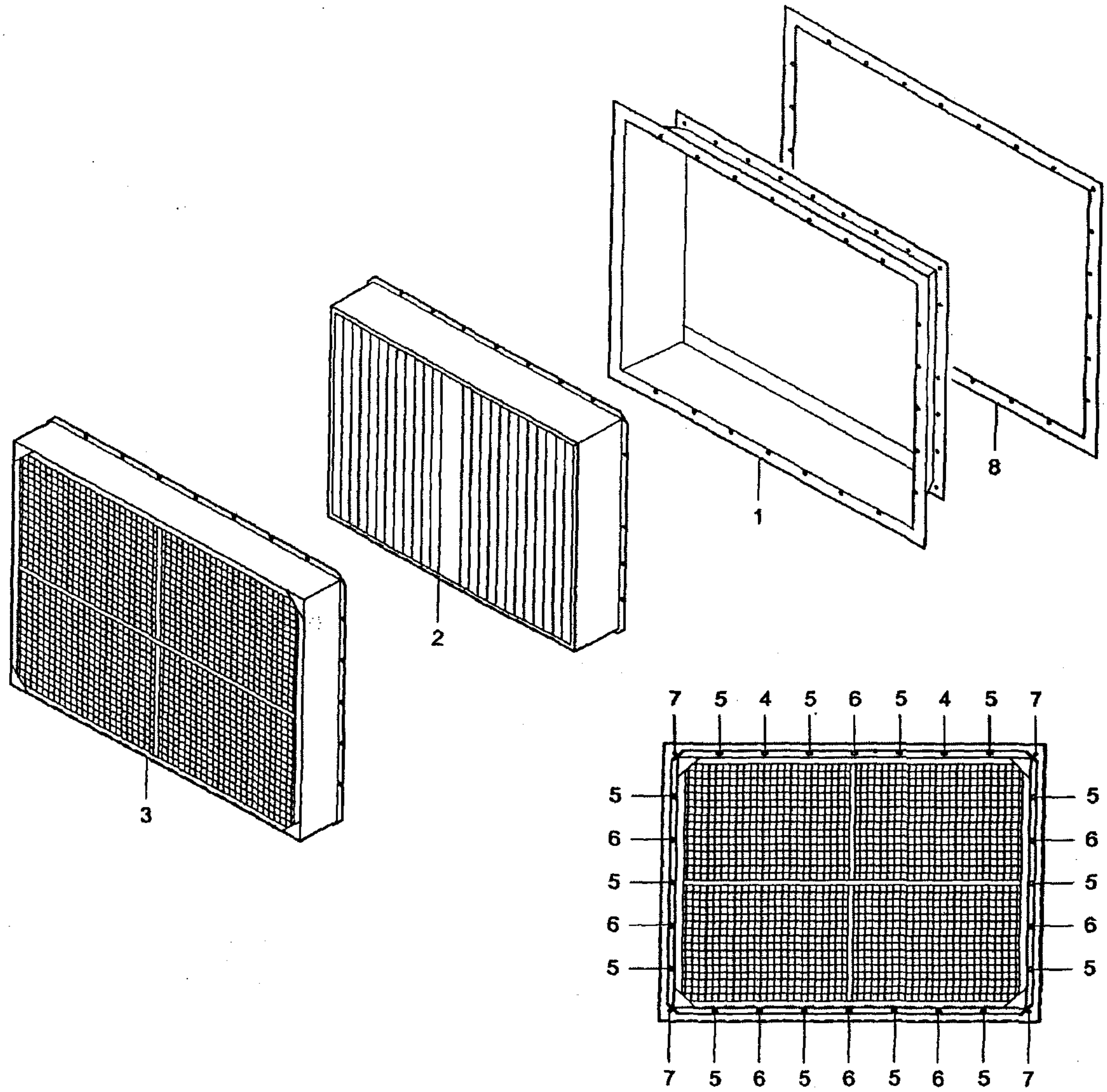
Assemble the filter and plenum box as described in Section Assembly.

NOTE:

The bend duct seal is compressed when the filter assembly is installed. Some effort may be required to ensure that the plenum box seats correctly on the locomotive bodyside tapping plate.



Apply a continuous 8 mm diameter bead of Sikaflex 15LM (1) to the tapping plate (2) located on the locomotive side body. The bead must be continuous and once the plenum box is installed, a complete seal must be achieved. Sealant in bolt holes (3) should be avoided. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.



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Position the plenum box (1) in place on the locomotive body. The studs (4) will help support the plenum box (1), louvre panel (2) and mesh screen (3) during installation.

Press the plenum box (1) into place to ensure the mastic sealant spreads evenly between the plenum box (1) and the locomotive bodyside tapping plate (8). Apply Loctite 577 to the fixing hardware, then install the four bolts (7) with spring washers and plain washers through each corner of the plenum box (1) into the body side panel.

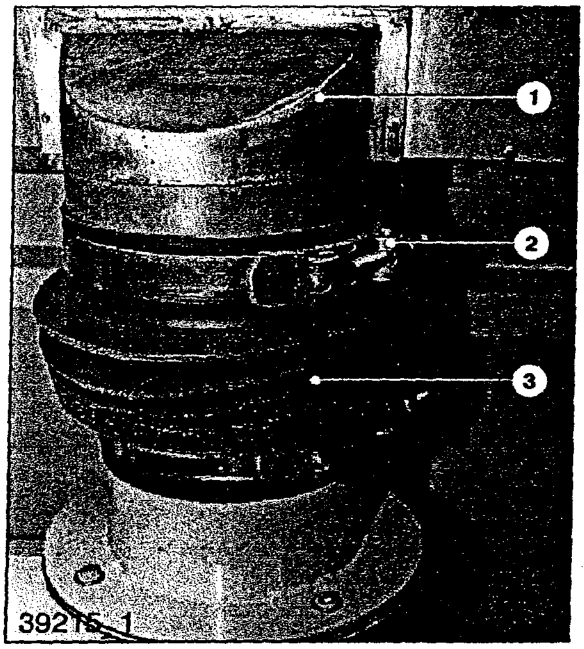
Position the louvre panel (2) with the drain holes facing downwards on the filter assembly.

Position the mesh screen (3) over the louvre panel.

Apply Loctite 577 to the fixing hardware, then install the M8 x 12 mm bolts (5) and the M8 x 20 mm bolts (6) along with slot washers and spring washers around the louvre panel (2) and mesh screen (3).

Apply Loctite 577 to the stud threads, nut faces and slotted washers, then install the nuts, slot washers and spring washers on the studs (4).

Tighten all the bolts (5,6) and nuts in an alternating pattern.



Position the clamp (2) on the flexible duct (3), then connect the flexible duct (3) to the filter assembly (1).

Tighten the clamp (2).

After-Installations Operations

@.1290

Close the circuit breakers to the blower fan and scavenge fan, then test the operation of the traction motor blower system. Rectify any faults found.

Water test louvre, filter panel and surrounding area as described in the Preface of this Volume. Rectify any faults found.

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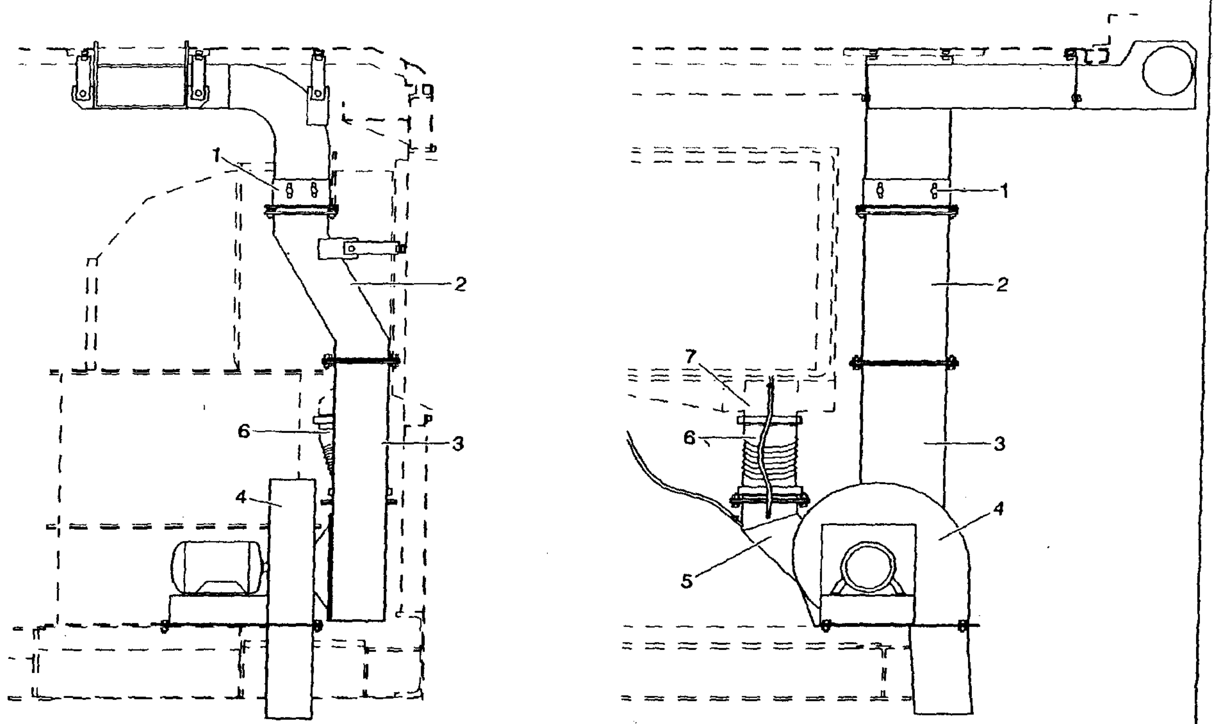
5.8 Scavenge Blowers

Group Summary

@.1120

This chapter contains information for the scavenge systems for the traction motor and oil blowers, and the machine room scavenge systems which consist of: the scavenge fan assemblies, fans, motors, housings, plenum assemblies, plenums and scavenge ducting.

Traction Motor & Oil Blower Scavenge



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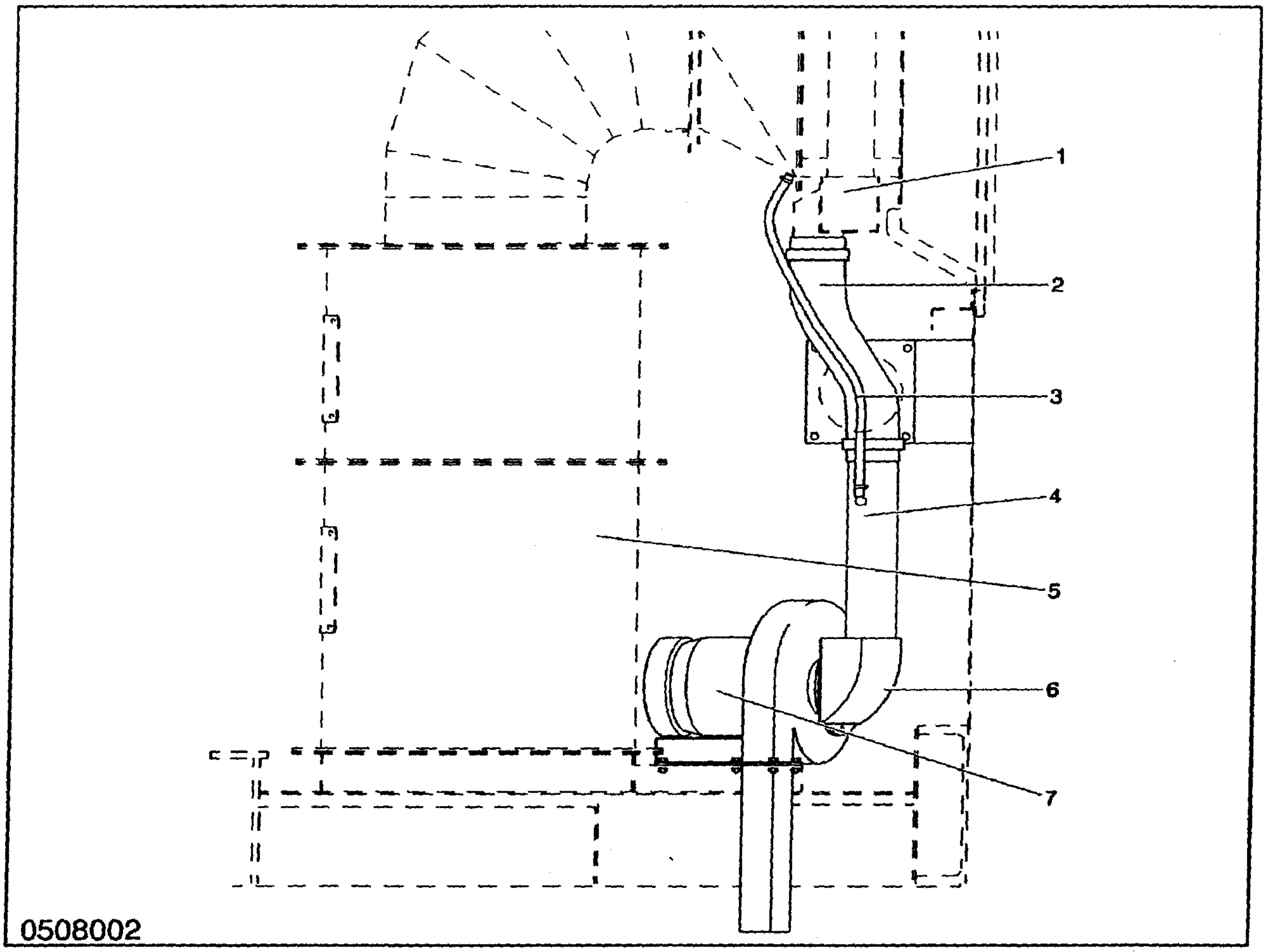
1	Slip joint	5	Traction motor blower scavenge plenum
2	Oil blower scavenge duct	6	Flexible duct
3	Oil blower scavenge plenum	7	Traction motor blower filter assembly
4	Scavenge blower		

Machine Room Scavenge



1	Filter assembly	5	Machine room blower assembly
2	Flexible duct	6	Plenum box
3	10 mm diameter hose	7	Fan assembly
4	Plenum box tube		

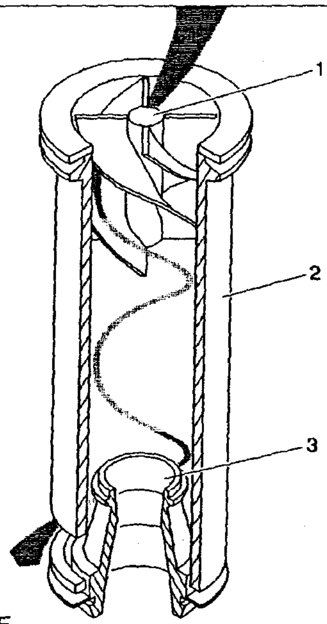
Functional Description

@.1140

Scavenge System

Dust particles and other debris separated from the air stream by the Flosep tubes is removed from the filter panels by the scavenge systems and exhausted through ducting in the machine room floor to below the locomotive.

The traction motor and oil blower scavenge comprises a single scavenge motor and fan that scavenges for both the traction motor blower and oil blower filter systems. The machine room blower scavenge applies only to the machine room blower.



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The venturi filter system comprises three elements; the vortex generator (1), tube (2) and mouthpiece (3). There is a scavenge opening on the tube through which debris is ejected. The vortex generator comprises four blades turned through 180°. When air flows through the tube, the vortex generator induces swirl into the flow. The resulting centrifugal force displaces the particles within the air stream onto the wall of the separator. The cleaned air flows through the mouthpiece, while dust particles are expelled through the scavenge opening.

For the system to work efficiently, all seals must be kept in good condition to provide a proper barrier.

Technical Data

@.1160

Machine Romm Blower Scavenge System

- Motor type	single phase, two-pole asynchronous
- Motor speed	2,830 RPM
- Power output	0,75 kw
- Flow rate	0.3 m^3/s
- Motor and fan assembly number	MB55

Traction Motor and Oil Blower Scavenge System

- Motor type	three phase, four-pole asynchronous
- Motor speed	1,430 RPM
- Power output	2.2 kw
- Flow rate	1.2 m^3/s
- Motor and fan assembly number	MB55

Tolerances and Wear Limits List

@.1170

For more information regarding the scavenge systems, refer to Chapter 8, Scavenge Blowers/Filters of Volume F10, Suppliers Documentation.

Tools and Special Tools

@.1180

Conventional railway 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:

- Loctite 577
- Sikaflex 15LM sealant
- General purpose grease
- Silicone sealant

Before-Removal Operations

@.1220

General

Removal of the pantograph hatch may be required to remove some of the components from the machine room. For removal of the pantograph hatches, refer to Chapter 1.1, Structure.

Machine Room Blower Scavenge System

Set the "Scavenge Blower to Machine Room Blower" circuit breaker (56.1) to the Off position. Circuit breaker 56.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle-1 (HB1) and circuit breaker 56.1/2 for the No. 2 End is situated in Auxiliary Circuits Cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Machine Room Blower" circuit breaker (54.1) to the Off position. Circuit breaker 54.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle-1 (HB1) and circuit breaker 54.1/2 for the No. 2 End is situated in Auxiliary Circuits Cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Traction Motor and Oil Blower Scavenge System

Set the "Traction Motor Blower and Oil Cooling Unit Scavenge Blower" circuit breaker (55.1) to the Off position. Circuit breaker 55.1/1 for the No. 1 End is situated in auxiliary circuits cubicle-1 (HB1) and circuit breaker 55.1/2 for the No. 2 End is situated in auxiliary circuits cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Traction Motor Blower" circuit breaker (53.1) to the Off position. Circuit breaker 53.1/1 for the No. 1 End is situated in Auxiliary Circuits Cubicle-1 (HB1) and circuit breaker 53.1/2 for the No. 2 End is situated in Auxiliary Circuits Cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Set the "Oil Cooling" circuit breaker (59.1) to the Off position. Circuit breaker 59.1/1 for the No. 1 End is situated in auxiliary circuits cubicle-1 (HB1) and circuit breaker 59.1/2 for the No. 2 End is situated in auxiliary circuits cubicle-2 (HB2). For more information on circuit breakers, refer Chapter 5.2, Auxiliary Converter Control.

Removal

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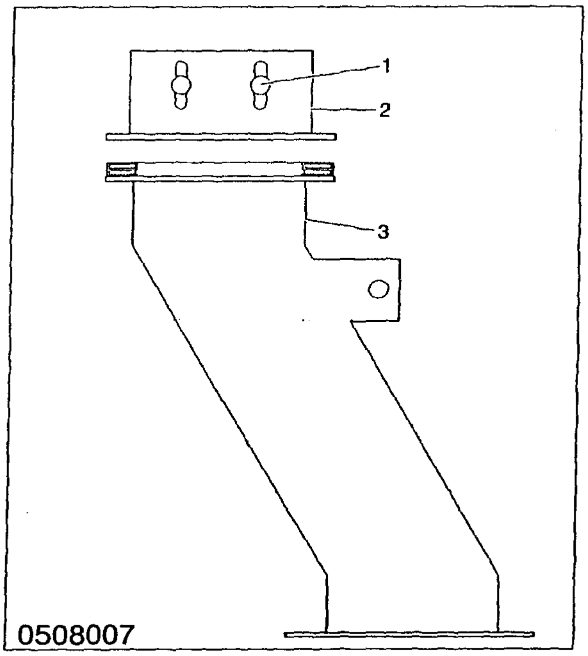
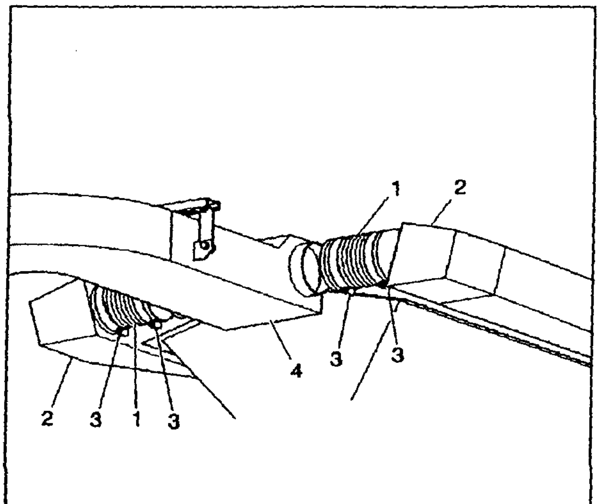
Oil Blower Scavenge Ducting



Loosen the bolts (1) securing the slip joint (2) to the oil blower scavenge duct (3), then *slide the slip joint (2) up as far as possible to* provide clearance between the scavenge plenum.



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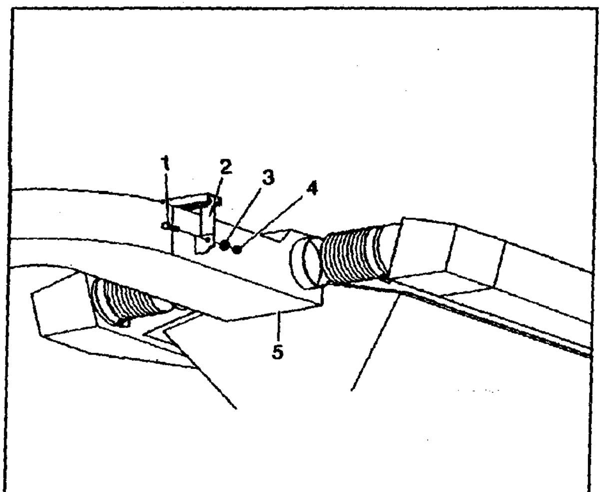
Loosen the clamps (3) securing the connecting hoses (1) to each filter (2).

Loosen the clamps (3) securing the connecting hoses (1) to the scavenge duct (4).

Slide the connecting hoses (1) onto the filter nozzle until the hose clears the scavenge duct nozzle by approximately 25 mm.



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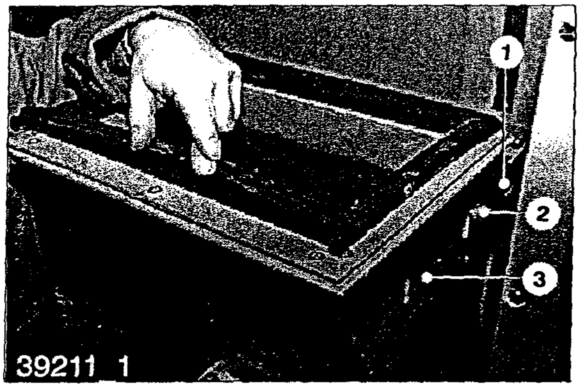
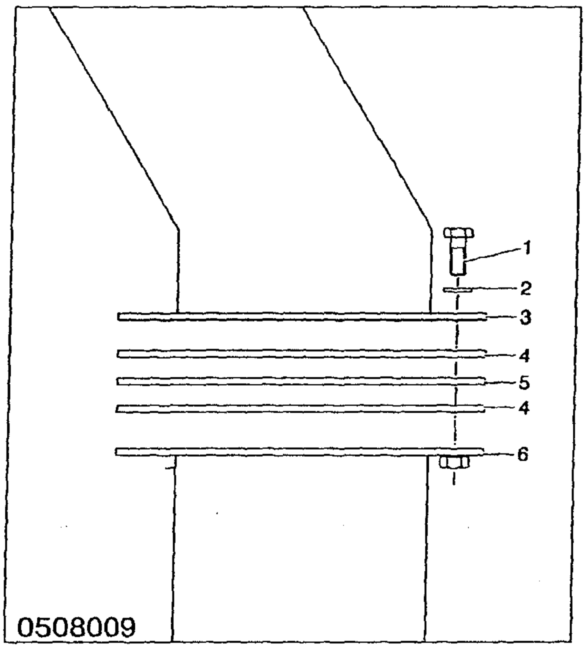
Support the scavenge duct (5), then remove the bolts (1), nuts (4) and washers (3) securing the three hanger brackets (2) to the duct (5).

Remove the scavenge duct (5).



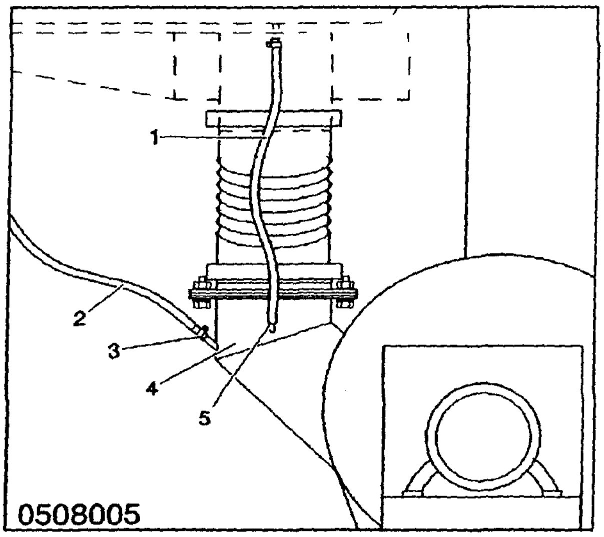
Remove the bolts (2) securing the scavenge duct bracket (3) to the support (1).



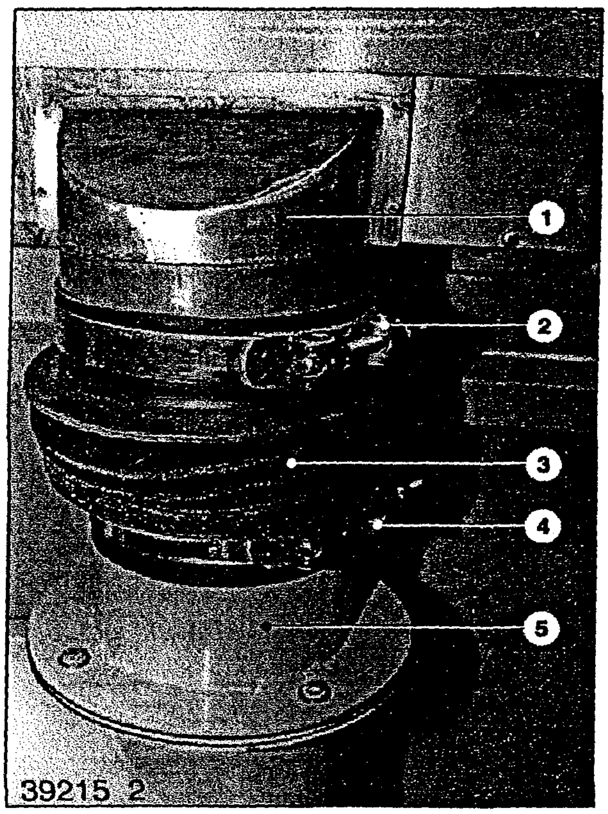
Remove the bolts (1) and washers (2) securing the scavenge duct (3) to the scavenge plenum (6).

Separate the scavenge duct (3), gaskets (4) and orifice plate (5) from the scavenge plenum (6). The gaskets are sealed to the duct flanges and to the orifice plate. It may be necessary to prise the seal apart, then cut the seal with a sharp knife. Ensure no damage is caused to the flanges, orifice plate or gaskets when cutting.

Traction Blower Scavenge Ducting

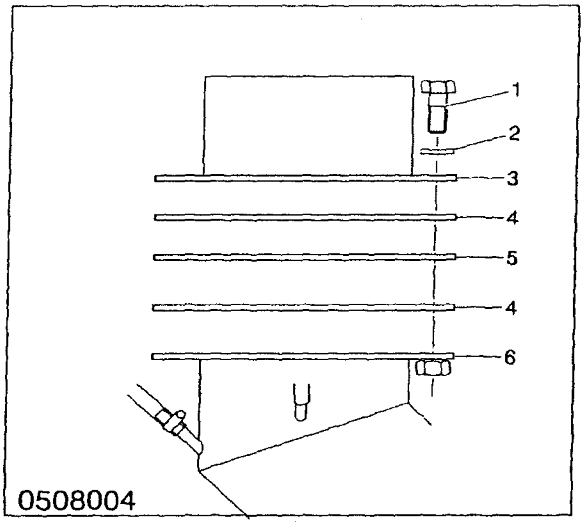


Tag the 10 mm diameter hoses (1, 2) on the scavenge plenum tube (4), then loosen the clamps (3, 5) and disconnect the hoses (1, 2).



Loosen the clamp (2) securing the flexible duct (3) to the filter (1).

Loosen the clamp (4) and separate the flexible duct (3) from the filter (1) and the plenum duct (5).



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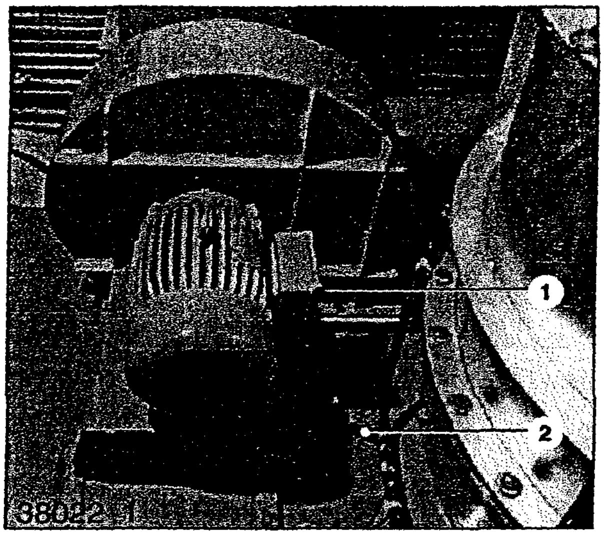
Remove the four bolts (1) and washers (2) securing the plenum duct (3) to the scavenge plenum tube (6).

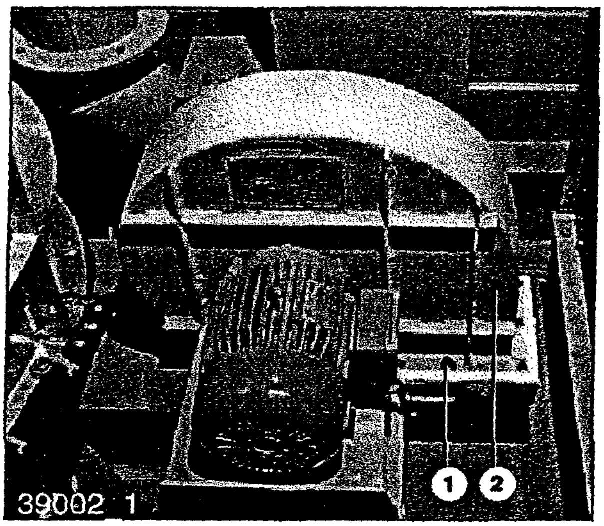
Separate the plenum duct (3), gaskets (4) and orifice plate (5) from the scavenge plenum tube (6). The gaskets are sealed to the duct flanges and to the orifice plate. It may be necessary to prise the seal apart, then cut the seal with a sharp knife. Ensure no damage is caused to the flanges, orifice plate or gaskets when cutting.

Traction Motor & Oil Blower Scavenge Blower



Remove cover from the terminal box (1) located on the side of the motor.

Tag and disconnect the electrical connections (2) from the scavenge fan motor terminals.



Remove the bolts (1) and washers securing the scavenge fan and plenum assembly (2) to the machine room floor ducting.

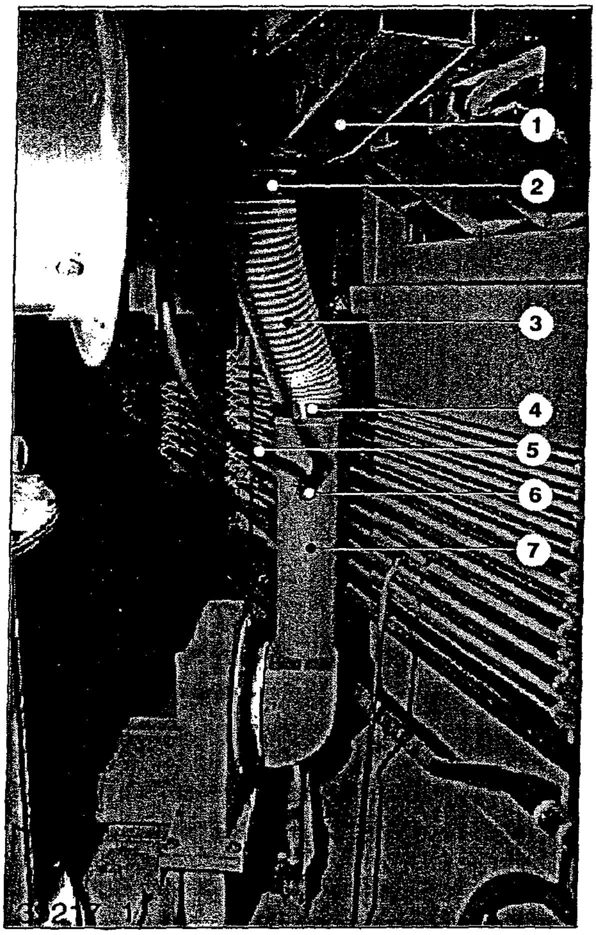
Attach suitable lifting equipment to the scavenge fan and plenum assembly (2).

Raise the assembly clear of the floor ducting. Take care not to damage the oil blower scavenge duct with the scavenge plenum.

Move the fan and plenum assembly to a suitable work location.

If necessary, disassemble the scavenge fan and plenum as described in Section Disassembly.

Machine Room Blower Scavenge Ducting



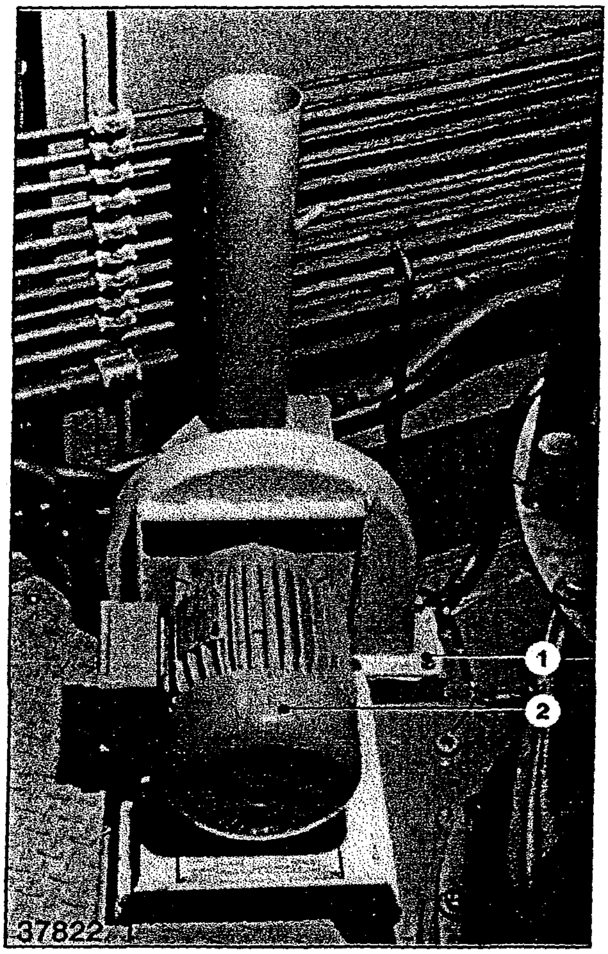
Loosen the clamp (2) securing the flexible duct (3) to the filter (1). Separate the flexible duct (3) from the filter (1).

Loosen the clamp (4) securing the flexible duct (3) to the plenum box tube (7). Separate the flexible duct (3) from the plenum box tube (7).

Loosen the clamp (6) and disconnect the 10 mm diameter hose (5) from the plenum box tube (7).

Machine Room Blower Scavenge Blower

Tag and disconnect the electrical harness from the scavenge fan motor terminals.



Remove the bolts (1) and washers securing the scavenge fan and plenum assembly (2) to the machine room floor.

Separate the scavenge fan and plenum assembly from the machine room floor. The assembly is sealed to the floor with urethane adhesive, it may be necessary to prise the joint apart and cut the adhesive using a sharp blade.

Move the fan and plenum assembly to a suitable work location.

Disassembly

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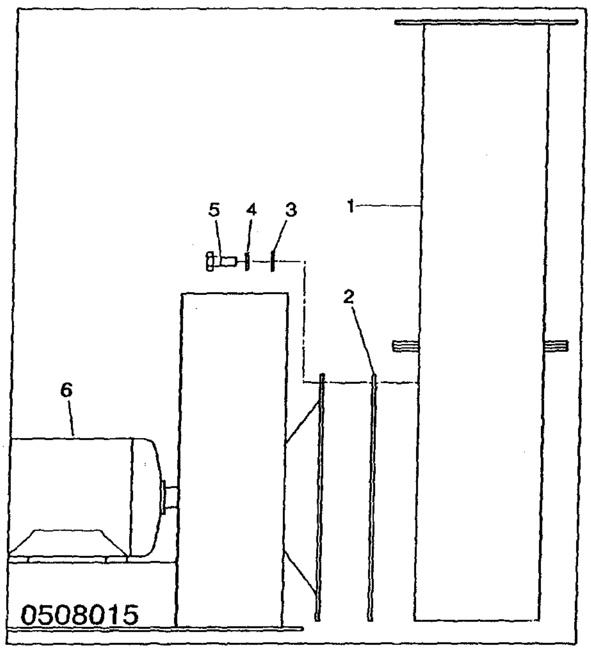
Traction Motor & Oil Blower Scavenge

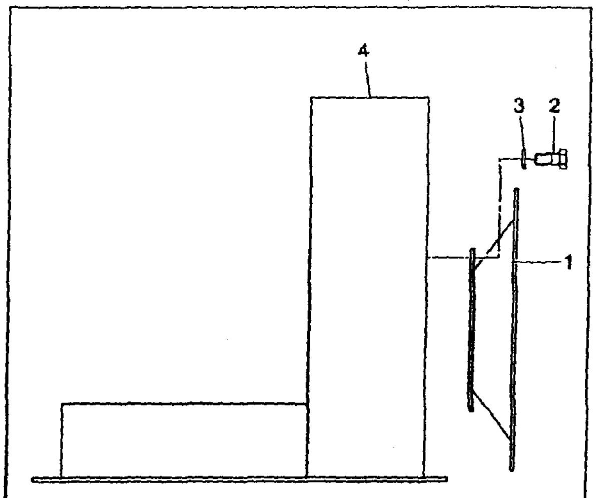
Scavenge Fan

If required, remove the scavenge fan and plenum assembly from the machine room as de-scribed in Section Removal.



Remove the bolts (5), spring washers (4) and plain washers (3) securing the adaptor flange to the scavenge plenum (1).

Separate the scavenge plenum (1) *from the* fan housing assembly.



0508016

Remove the bolts (2) and washers (3) securing the adaptor flange (1) to the fan housing (4).

Separate the adaptor flange (1) from the fan housing (4). The joint is sealed with sealant. It may be necessary to prise the joint apart and cut the sealant with a sharp blade.

Loosen and remove the bolt and washer securing the fan wheel to the fan motor shaft.

Withdraw the fan from the fan housing (4) and inspect as described in Section Inspection and Repair.

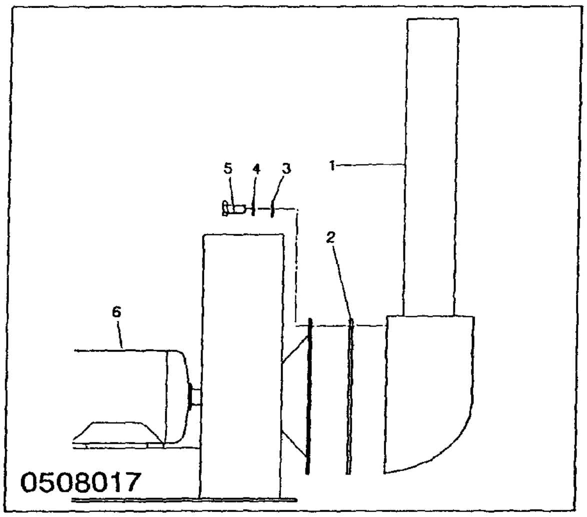
If required, unbolt the fan motor from the fan housing. Note the position and thickness of the shims, if any, between the fan motor and the fan housing.

Inspect the scavenge fan motor as described in Section Inspection and Repair.

Inspect the fan housing and gaskets as described in Section Inspection and Repair.

Machine Room Blower Scavenge

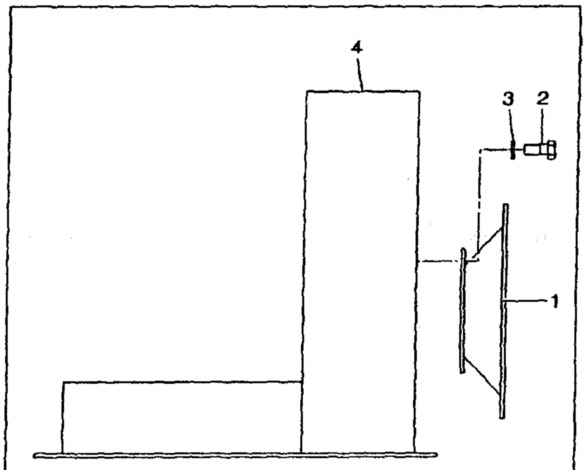
If required, remove the scavenge fan and plenum assembly from the machine room as described in Section Removal.



0508017

Remove the bolts (5), spring washers (4) and plain washers (3) securing the adaptor flange to the plenum box (1).

Separate the plenum box (1) from the fan housing assembly.



0508018

Remove the bolts (2) and washers (3) securing the adaptor flange to the fan housing (4).

Separate the adaptor (1) from the fan housing (4). The joint is sealed with sealant. It may be necessary to prise the joint apart and cut the sealant with a sharp blade.

Loosen and remove the bolt and washer securing the fan wheel to the fan motor shaft.

Withdraw the fan from the housing (4) and inspect as described in Section Inspection and Repair.

If necessary, unbolt and remove the fan motor from the fan housing. Note the position and thickness of the shims, if any, between the fan motor and the fan housing.

Inspection and Repair

@.1250

Traction Motor & Oil Blower Scavenge

Inspect the flexible duct for cracks or tears. Replace the flexible duct if damaged.

Inspect all rubber gaskets for tears or damage. Replace any damaged gaskets.

Inspect the scavenge duct seal. Wear must be even around the seal surface. Replace the seal if damaged, torn or excessively worn.

Inspect the scavenge duct and plenum for damage. Rectify any faults found.

Check all rubber parts for deterioration. Replace as necessary.

SCAVENGE FAN HOUSING

Remove the build-up of foreign materials from around the scavenge fan exhaust outlet. Ensure all traces of debris are removed.

Check the scavenge fan mounting pedestal for cracks or damage. Rectify any faults found.

Inspect the fan housing for cracks or damage. Rectify any faults found.

Remove all traces of sealant from the adaptor flange and the fan housing.

FAN WHEEL

Remove the fan from the housing as previously described.

NOTE:

Do not blast clean the fan and housing.

Steam clean the fan wheel and the inside the fan housing as described in the Preface of this volume. Ensure all traces of dirt, dust and other debris are removed.

Check the fan wheel for cracks or fatigue using a non-destructive testing procedure, as described in the Preface of this Volume. Replace the fan wheel if any cracks are found.

Inspect the fan housing for cracks or damage. Rectify any faults found.

Machine Room Scavenge

Inspect the flexible duct for cracks or tears. Replace the flexible duct if damaged.

Inspect all rubber gaskets for tears or damage. Replace any damaged gaskets.

Inspect the plenum box for damage. Rectify any faults found.

Check all rubber parts for deterioration. Replace as necessary.

SCAVENGE FAN HOUSING

Remove the build-up of foreign materials from around the scavenge fan exhaust outlet. Ensure all traces of debris are removed.

Check the scavenge fan mounting pedestal for cracks or damage. Rectify any faults found.

Inspect the fan housing for cracks or damage. Rectify any faults found.

Remove all traces of sealant from the adaptor flange and the fan housing.

FAN WHEEL

Remove the fan from the housing as previously described.

NOTE:

Do not blast clean the fan and housing.

Steam clean the fan wheel and the inside the fan housing as described in the Preface of this volume. Ensure all traces of dirt, dust and other debris are removed.

Check the fan wheel for cracks or fatigue using a non-destructive testing procedure, as described in the Preface of this Volume. Replace the fan wheel if any cracks are found.

Inspect the fan housing for cracks or damage. Rectify any faults found.

Waste Disposal

@.1260

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

Assembly

@.1270

NOTE:

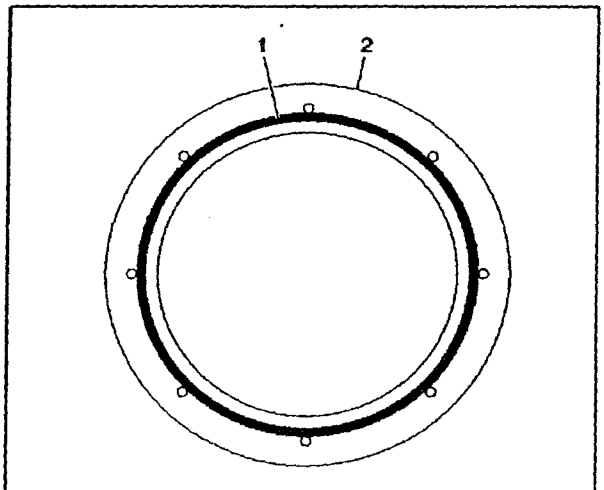
Seal all fixing hardware during assembly with Loctite 577 or equivalent. Seal the threads, between the washers and under the bolts heads to ensure an air tight seal.

Traction Motor & Oil Blower Scavenge

Install the fan motor to the fan housing. The fan motor shaft must be centrally located in the fan housing. Reinstall the shims, if any, as noted during disassembly and check to ensure the fan motor shaft is centrally located. If necessary, remove or add shims to achieve the desired position of the fan motor shaft.

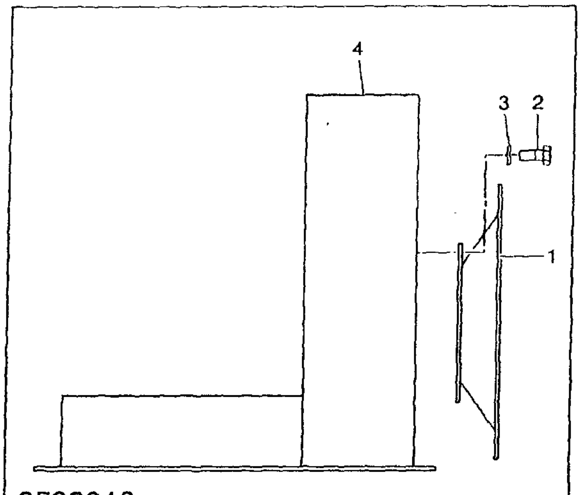
Insert the key into the keyway slot on the fan motor.

Grease the fan motor shaft, then install the fan with the shaft keyway towards the motor side of the housing. Install the bolt and washer to secure the fan wheel to the fan motor shaft, then tighten the bolt.



0508019

Apply a continuous 3 mm diameter bead of Sikaflex 15LM to the inner edge of the adaptor flange (2). Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

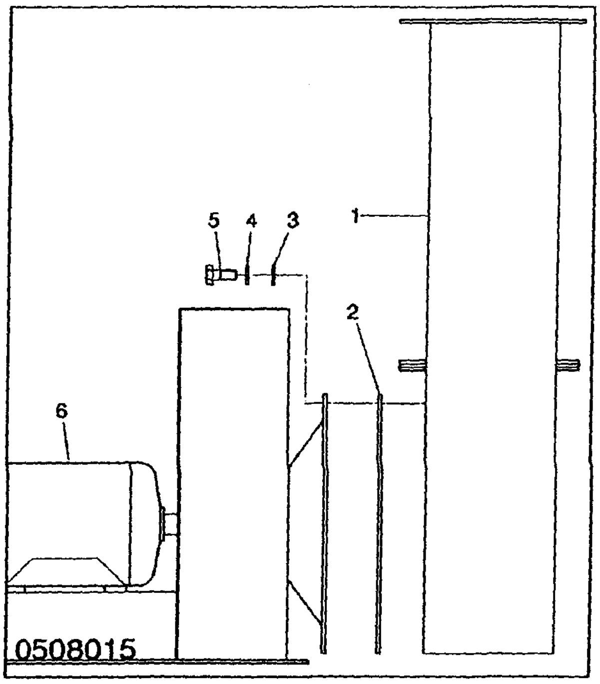


0508016

Position the adaptor flange (1) onto the fan housing (4) and align the holes in the adaptor flange (1) with those in the fan housing (4).

Apply Loctite 577 to the fixing hardware, then install the bolts (2) and washers (3) through the adaptor flange (1) into the fan housing (4).

Tighten the bolts (1) in an alternating pattern.



Apply a continuous 3 mm diameter bead of Sikaflex 15LM to each side of the gasket (2) Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

Position the gasket (2) on the scavenge plenum (1) and align the holes.

Position the fan housing (6) on the plenum (1). Ensure the scavenge plenum tube and the base of the fan housing are both at the bottom.

Align the holes in the plenum and adaptor flange.

Apply Loctite 577 to the fixing hardware, then install the bolts (5), spring washers (4) and plain washers (3) through the adaptor and gasket (2) into the scavenge plenum (1).

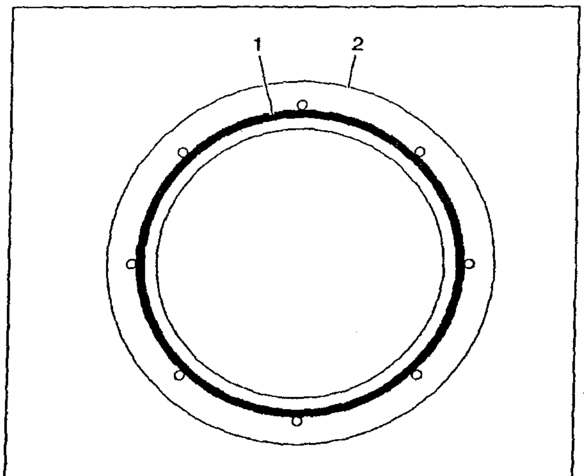
Tighten the bolts (5) in an alternating pattern.

Install the scavenge duct assembly into the machine room as described in Section Installation.

Machine Room Scavenge

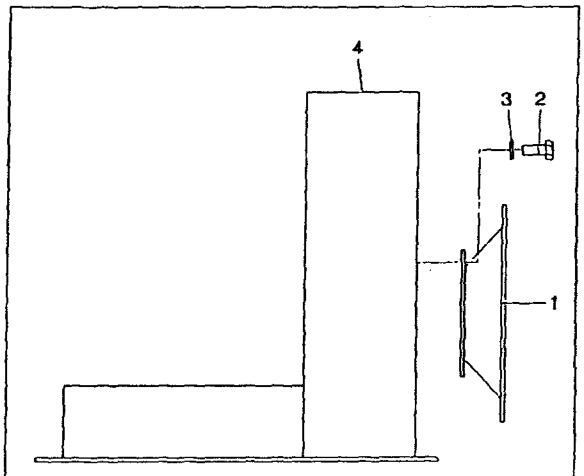
Install the fan motor to the fan housing. The fan motor shaft must be centrally located in the fan housing. Reinstall the shims, if any, as noted during disassembly and check to ensure the fan motor shaft is centrally located. If necessary, remove or add shims to achieve the desired position of the fan motor shaft.

Insert the key into the keyway slot on the fan motor. Grease the fan motor shaft, then install the fan with the shaft keyway towards the motor side of the housing. Install the bolt and washer to secure the fan wheel to the fan motor shaft, then tighten the bolt.



0508019

Apply a 3 mm diameter bead of silicone sealant (1) to inner edge of the adaptor flange (2).

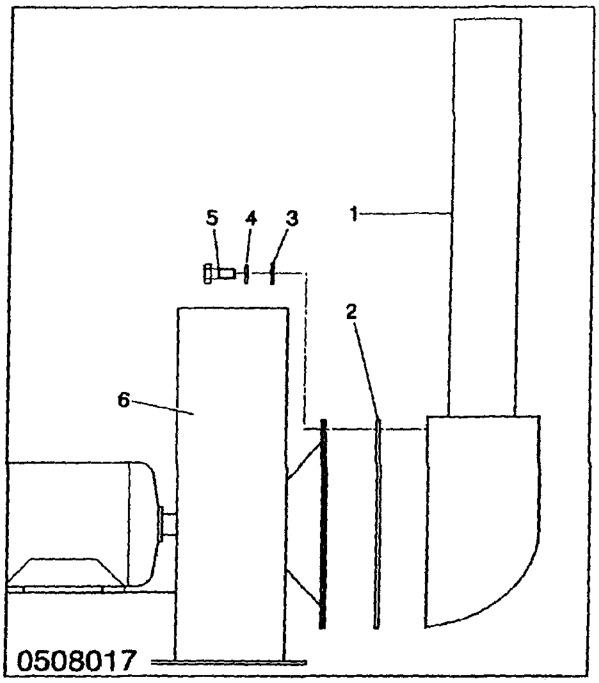


0508018

Position the adaptor flange (1) onto the fan housing (4) and align the holes in the adaptor (1) with those in the housing (4).

Apply Loctite 577 to the fixing hardware, then install the bolts (2) and washers (3) through the adaptor (1) into the fan housing (4).

Tighten the bolts (2) in an alternating pattern.



Apply a continuous 3 mm diameter bead of Sikaflex 15LM to each side of the gasket (2). Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

Position the gasket (2) on the scavenge plenum (1) and align the holes.

Position the fan housing (6) on the plenum box (1). Ensure the plenum box tube faces upwards.

Align the holes in the adaptor flange and plenum box.

Apply Loctite 577 to the fixing hardware, then install the bolts (5), spring washers (4) and plain washers (3) through the adaptor and gasket (2) into the plenum box (1).

Tighten the bolts (5) in an alternating pattern.

Install the scavenge fan and plenum assembly into the machine room as described in Section Installation.

Installation

@.1280

NOTE:

Seal all fixing hardware during installation with LOCTITE 577 or equivalent. Seal the threads, between the washers and under the bolts heads to ensure an air tight seal.

Traction Motor & Oil Blower Scavenge

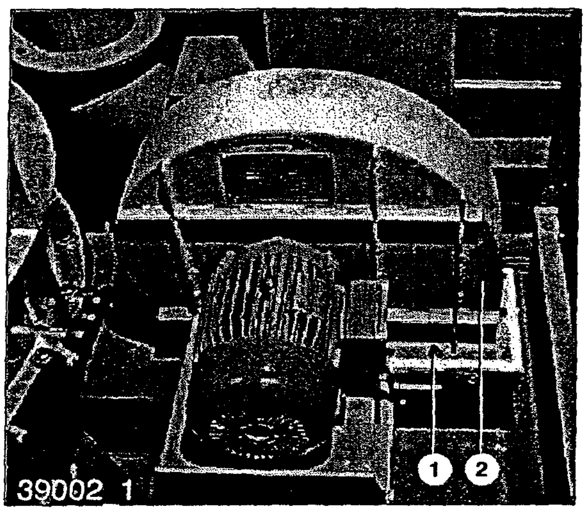
Assemble the scavenge fan and plenum as described in Section Assembly.

NOTE:

The scavenge fan and plenum is heavy, over 100 kg. Use lifting equipment to avoid personal injury and damage.

Attach suitable lifting equipment to the fan and plenum assembly.

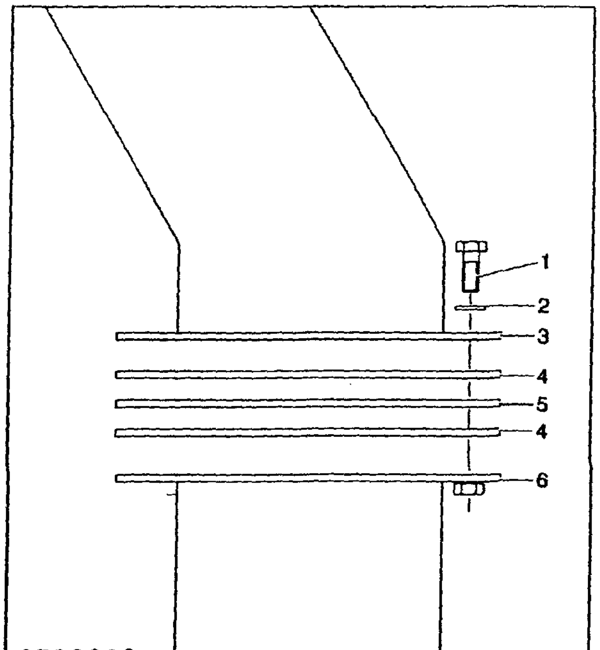
Raise the assembly into position over the floor ducting. Where the roof hatch is still installed, take care not to foul the plenum tube on the filter and the scavenge plenum upright duct on the oil blower scavenge duct.



Apply a continuous 6 mm diameter bead of Sikaflex 15LM to the mounting base for scavenge blower assembly. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.

Lower the assembly (2) onto the machine room floor ducting and align the bolt holes.

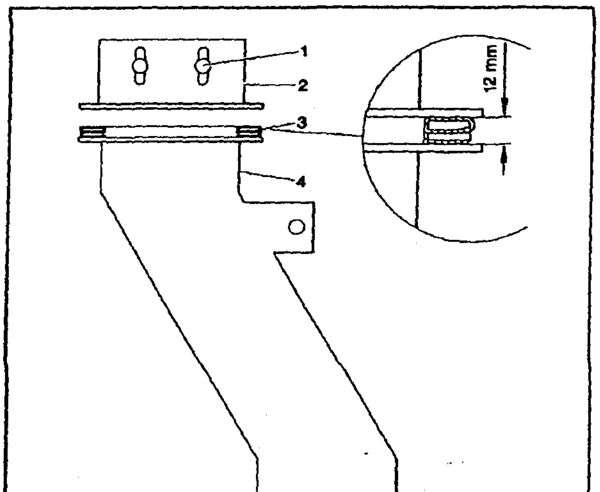
Apply Loctite 577 to the fixing hardware, then install the bolts (1) with washers through the pedestal into the floor, then tighten the bolts.



0508009

Position the scavenge duct gaskets (4) and orifice plate (5) on the scavenge plenum (6).

Align the holes in the duct, gaskets, orifice plate and scavenge plenum (3), then install the bolts (1) and washers (2), then tighten the bolts (1).

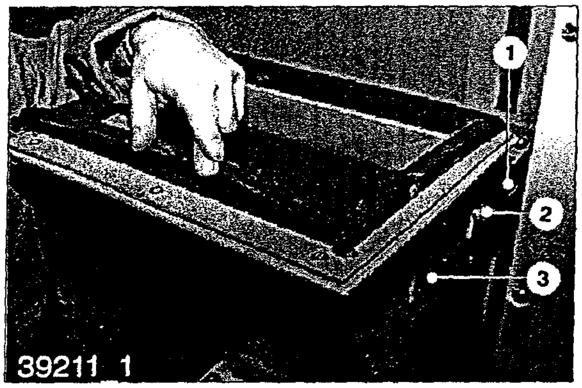


0508011

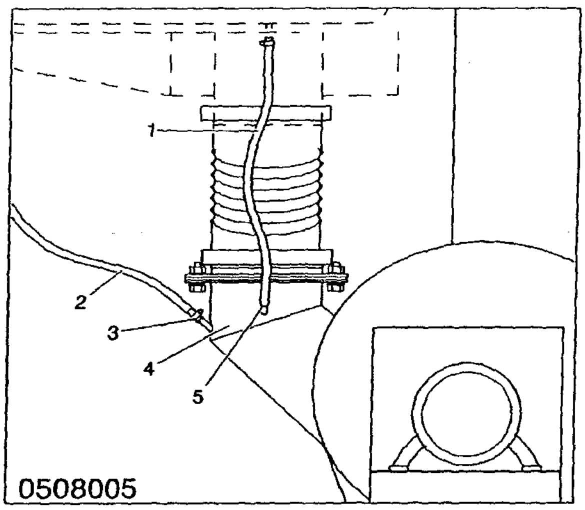
Lower the slip joint (2) onto the scavenge duct seal (3).

Press the slip joint (2) down until the seal (3) is compressed and the distance between the slip joint (2) and scavenge duct flanges (4) is 12 mm.

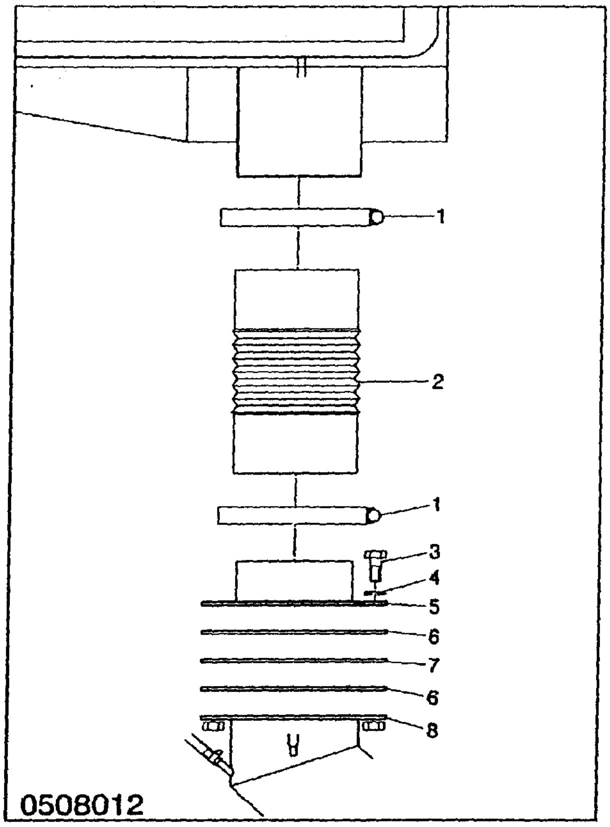
Tighten the bolts (1) on the slip joint (2).



Apply Loctite 577 to the fixing hardware, then install the bolts (2) into the scavenge duct bracket (3), then tighten the bolts.



Connect the 10 mm diameter hoses (1, 2) to the scavenge plenum tube (4) as tagged during disassembly. Tighten the clamps (3, 5).



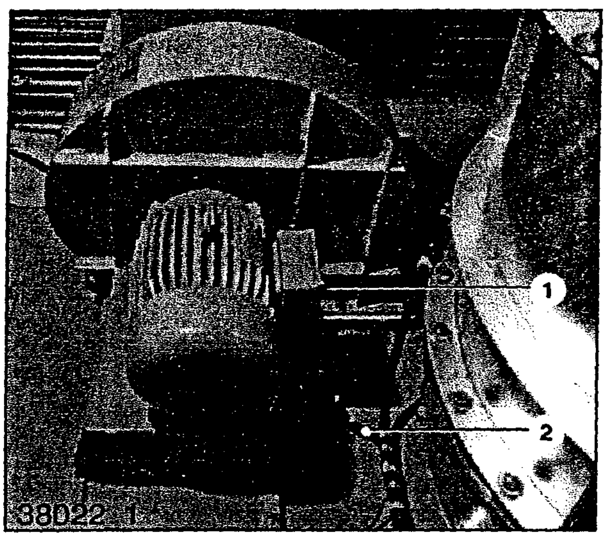
Place a clamp (1) on each end of the flexible duct (2).

Install one end of the flexible duct (2) on the plenum duct (5).

Position the gaskets (6), orifice plate (7) and plenum duct (5) on the scavenge plenum tube (8) and connect the flexible duct (2) to the filter.

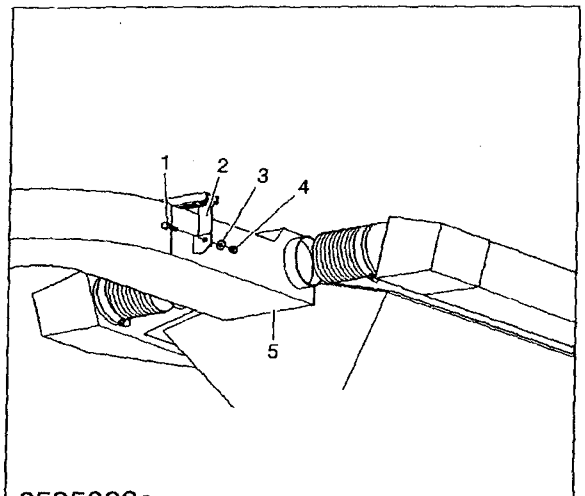
Apply Loctite 577 to the fixing hardware, then install the bolts (3) and washers (4) through the plenum duct (5) into the scavenge plenum tube (8), then tighten the bolts.

Tighten the clamps (1) around the flexible duct (2).



Connect the electrical wiring (2) to the scavenge fan motor terminals as tagged during removal.

Install the cover (1) over the terminals.

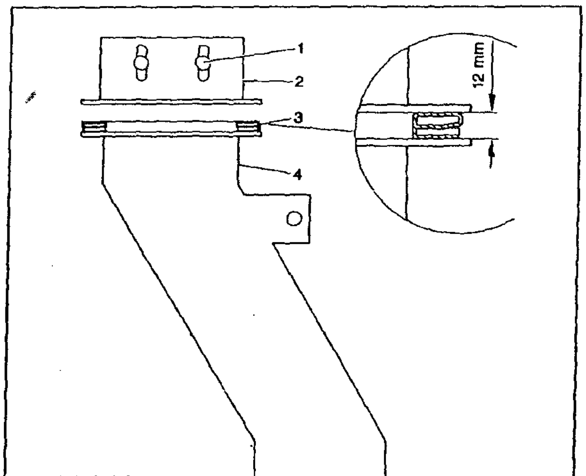


0505002a

Position and support the scavenge duct (5) between the filters and the plenum duct.

Align the holes in each of the three hanger brackets (2) and install the bolts (1), nuts (4) and washers (3). Tighten the bolts finger tight.

Place the clamps on the connecting hoses.



0508011a

Lower the slip joint (2) onto the scavenge duct seal (3).

Press the slip joint (2) down until the seal (3) is compressed and the distance between the slip joint (2) and scavenge duct (4) flanges is 12 mm. Tighten the bolts (1) on the slip joint (2).

Install the bolts into the scavenge duct bracket, then tighten the bolts.

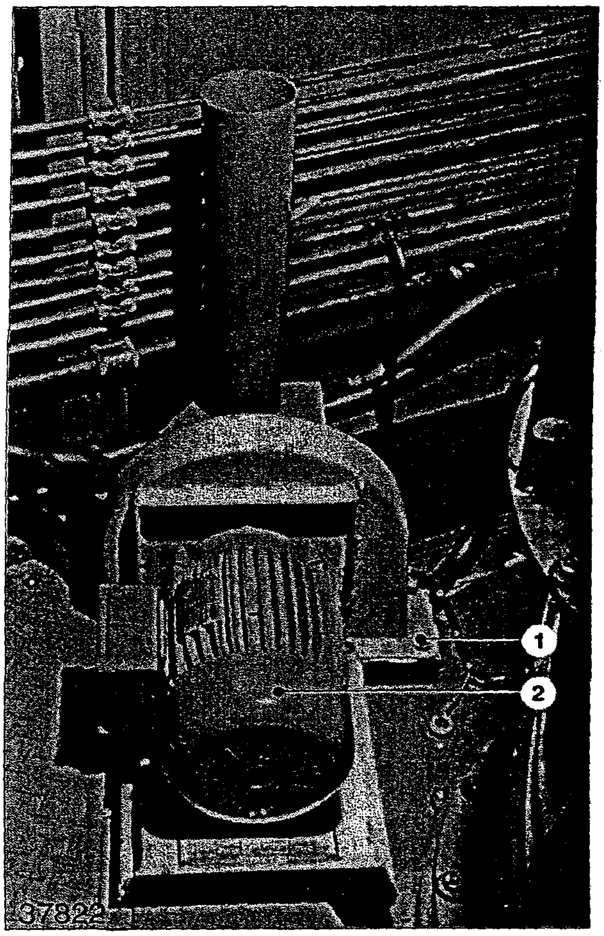
Machine Room Scavenge

Assemble the scavenge fan and plenum box as described in Section Assembly.

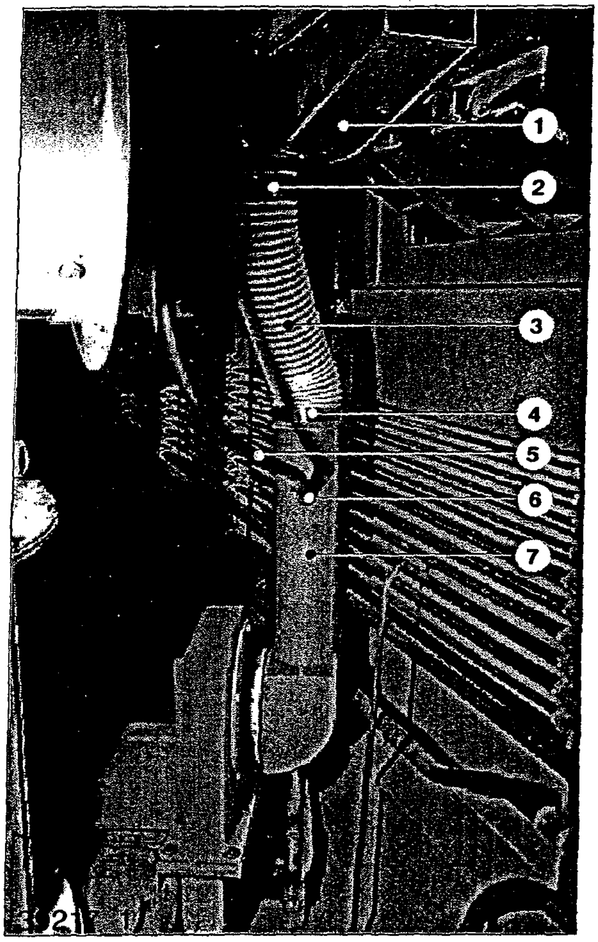
Attach suitable lifting equipment to the fan and plenum assembly.

Raise the assembly into position over the floor ducting, take care not to foul the plenum box tube on the filter.

Apply a continuous 6 mm diameter bead of Sikaflex 15LM around the bottom edge of the pedestal. Ensure all surfaces have been correctly prepared prior to application of the sealant, as described in the Preface of this Volume.
Lower the assembly onto the floor ducting and align the bolt holes.



Apply Loctite 577 to the fixing hardware, then install the bolts (1) with washers through the pedestal (2) into the floor.



Place the clamp (2, 4) on each end of the flexible duct (3).

Connect the flexible duct (3) to the plenum box tube (7) and the filter (1). Tighten the clamps (2, 4).

Connect the 10 mm diameter hose (5) to the plenum box tube (7). Tighten the clamp (6).

Connect the electrical wiring from the scavenge fan motor terminals as tagged during removal.

After-Installations Operations

@.1290

Apply electrical power to the scavenge fan then test its operation. Rectify any faults found.

Check to ensure the slip joint on the oil blower scavenge ducting is sealing correctly and that no air is entering the ducting through the slip joint. If necessary, adjust the slip joint as described in Section Adjustments.

Adjustments

@.1310

Loosen the bolts on the slip joint, then reposition the slip joint to maximise the sealing of the slip joint. Tighten the slip joint bolts, then test the sealing of the slip joint.

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20

5.9 Power Supply 415/110 V

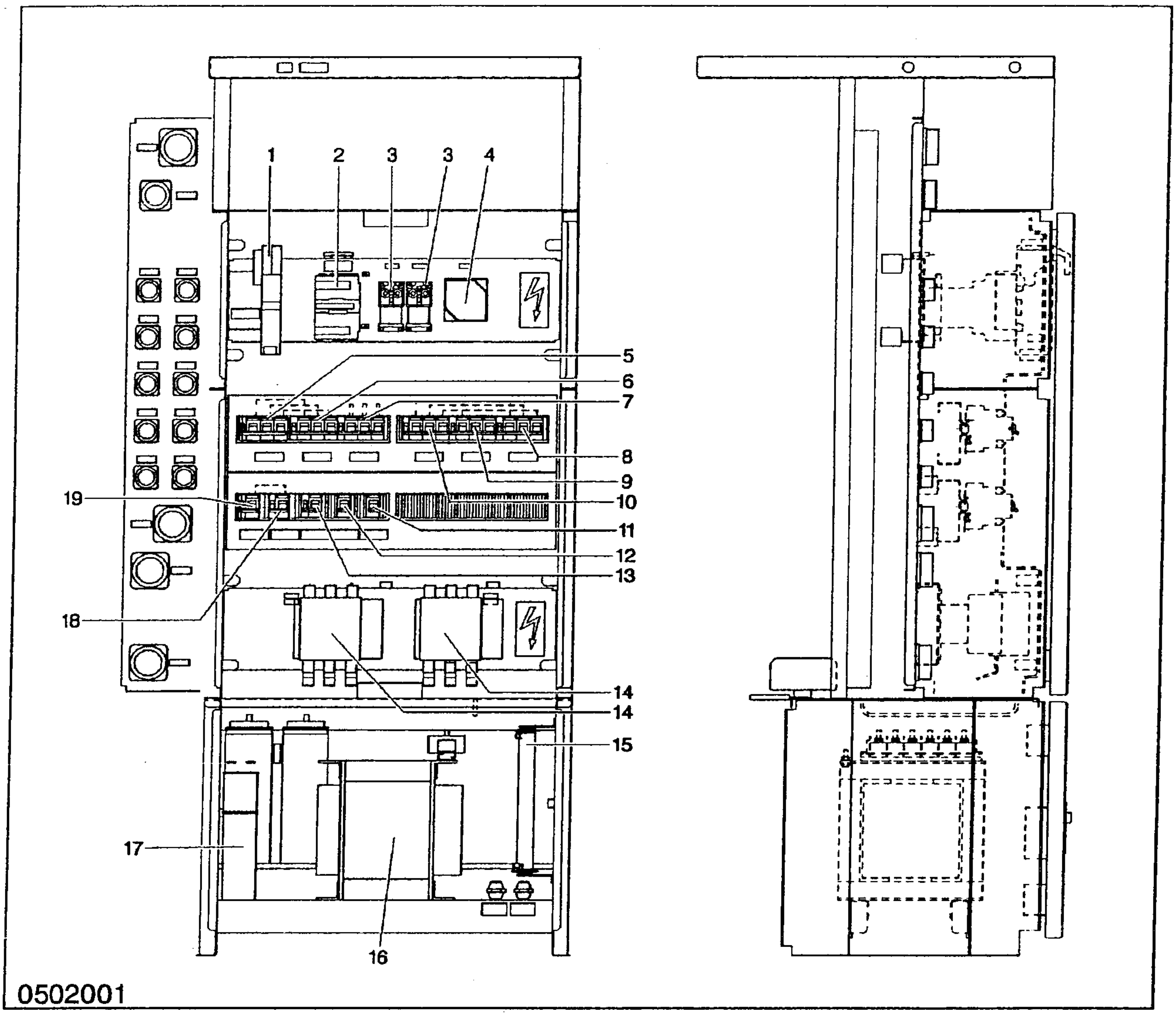
01

Group Summary

@.1120

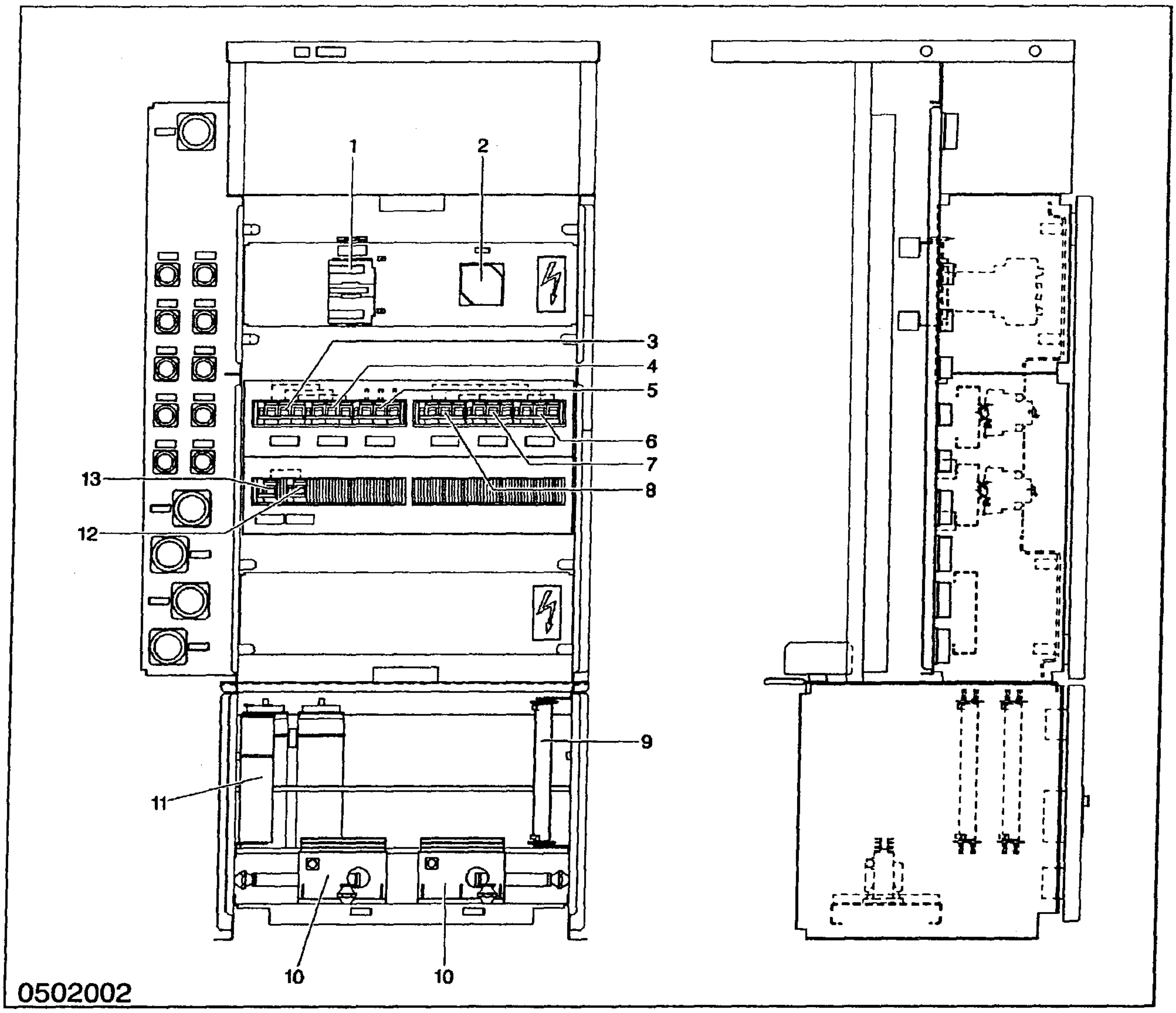
This chapter contains information regarding the 415 and 110 volt power supply systems located in auxiliary cubicles HB1 and HB2 within the machine room.

Control Cubicle HB1



1	Fuse (41)	10	Circuit breaker, traction motor blower (53.1/1)
2	Contactor main compressor (47.2)	11	Circuit breaker, crew fan (69.71)
3	Auxiliary contactor (52.3)	12	Circuit breaker, cab heater (69.62)
4	Earthing relay, 415/110 V circuit (89.5)	13	Circuit breaker, cab ventilation (69.61)
5	Circuit breaker, transformer oil pump (62.1/1)	14	Three-phase contactor (52)
6	Circuit breaker, converter oil pump (63.1/1)	15	Resistors, earth fault detection (90.41, 90.42)
7	Circuit breaker, main compressor (47.1/1)	16	Auxiliary transformer (67)
8	Circuit breaker, transformer/converter oil cooling unit (59.1/1)	17	Capacitor, machine room blower (54.5/1)
9	Circuit breaker, traction motor scavenge blower (55.1/1)	18	Circuit breaker, machine room scavenge blower (56.1/1)
		19	Circuit breaker, machine room blower (54.1/1)

Control Cubicle HB2

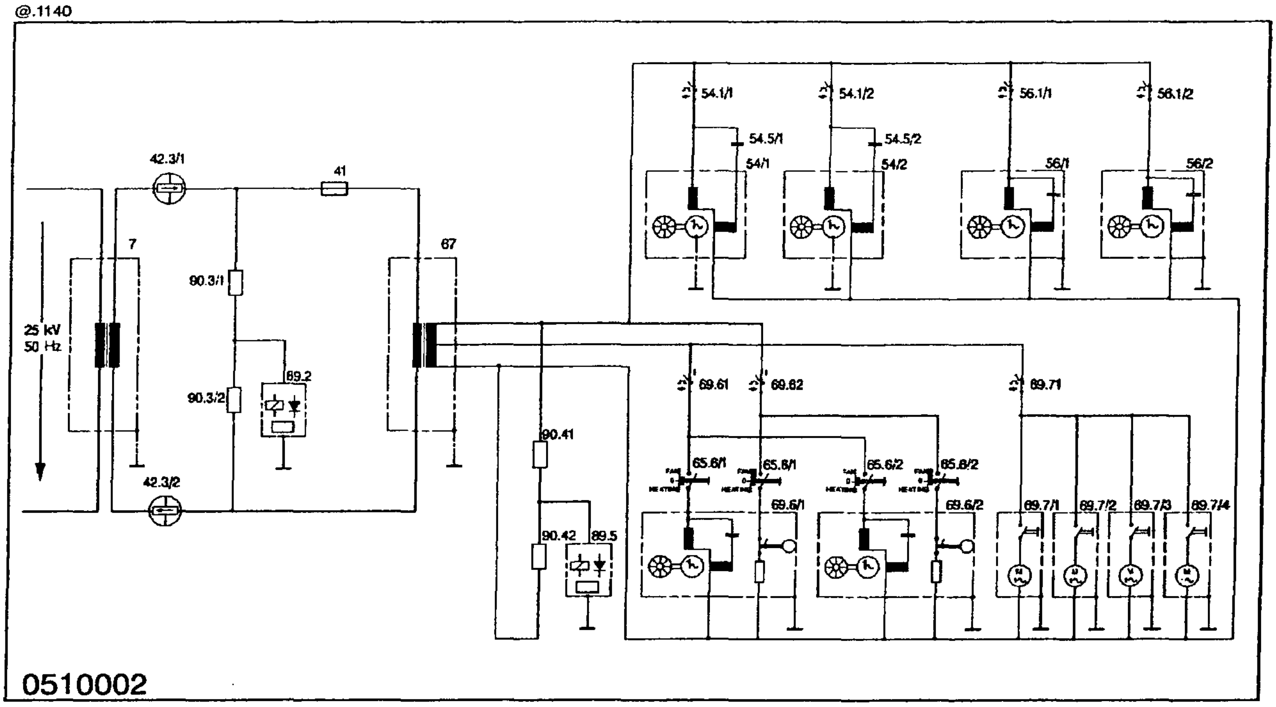


1	Contactor, main compressor (47.2/2)	8	Circuit breaker, traction motor blower (53.1/2)
2	Relay, auxiliary circuit earth-fault (89.2)	9	Resistors, auxiliary converter earth fault detection (89.2)
3	Circuit breaker, transformer oil pump (62.1/2)	10	Current sensor, auxiliary circuit (42.3)
4	Circuit breaker, converter oil pump (63.1/2)	11	Capacitor, machine room blower (54.5/2)
5	Circuit breaker, main compressor (47.1/2)	12	Circuit breaker, machine room scavenge blower (56.1/2)
6	Circuit breaker, transformer/converter oil cooling unit (59.1/2)	13	Circuit breaker, machine room blower (54.1/2)
7	Circuit breaker, traction motor scavenge blower (55.1/2)		

Numbers in brackets ( ) denote the electrical equipment apparatus item number used in the locomotive schematics, refer to Volume G, Cabling Documentation.

Functional Description

@.1140



One part of the 415/110 Volt power supply is fed directly by the main transformer (7). This enables the blowers to be operated without the auxiliary converter (BUR) operating.

Auxiliary Transformer (67)

The auxiliary transformer (67) supplies two load cycles.

- The main coil (67) supplies the machine room blowers (54), the scavenge blowers (56) for the machine room blower and the cabin heating (69.6). These 415 Volt loads are characterised by having a large power consumption.
- The 110 volt connection supplies the cab heater fans and crew fans (69.7) in the driver's cab.

Earth-Fault Detection

The primary circuit of the auxiliary transformer (67) is connected to earth. Two resistors (90.3/1, 90.3/2) are wired in parallel to the auxiliary winding of the main transformer (7) and the earth-fault relay (89.2) is connected across them.

If one of the connections is earthed, a message is displayed in the operator's cabin. Safety measures are only necessary in case both transformer connections go to earth and the transformer short-circuits.

The secondary circuit of the auxiliary transformer (67) also has an earth-fault detection. This circuit works in the same way as the auxiliary transformer primary circuit, with parallel resistors (90.41, 90.42) and earth-fault relay (89.5)

Fuse (41)

The fuse protects the circuit, in particular the auxiliary transformer (67), against overvoltages.

Current Sensors Auxiliary Circuit (42.3)

The input current sensor (42.3/1) measures the incoming current and compares it with the outgoing current measured by the output current sensor (42.3/2). If the two values differ, a current leakage exists and the control electronics breaks the circuit.

Machine Room Blower Motor Capacitors (54.5, 54.8)

Two capacitors (54.5, 54.8) are connected in parallel to the machine room blower (54) for start-up and low-speed operation. The capacitors cause the phase of the current in the stator winding of the motor to be displaced (electrically) to the phase in the rotor winding. Both phases together result in a simple rotary field that generates a greater motor torque at start-up and low motor speeds. As the motor speed increases, a relay (54.2) disconnects one capacitor (54.8) from the circuit. This reduces the phase difference between the rotor and sta-

Technical Data

@.1160

Auxiliary Transformer

- Weight	100 kg
- Primary voltage U1	1,000 Volt
- Secondary voltage U21	415 Volt
- Secondary voltage U22	110 Volt
- Apparent power SA, maximum	15 kVA

Machine Room Blower Capacitor (54.5)

Nominal Values

- Start-up capacitance CN	69 μF ± 10 %
- Running capacitance	22 μF ± 10 %
- Voltage UN	900 Volt
- Effective voltage Ueff	640 Volt
- Current IN	80 Volt
- Inductance LC	180 nH
- Tangent of loss angle tan (δ)	$2*10^{-4}$
- Resistance R	1.4 mΩ

Maximum Values

- Voltage û	1.1 kV
- Current î	5 kA
- du/dtmax	190 V/μs

Earth-Fault Relays

- Internal resistance	43 Ω

Resistors

- Resistance (resistors 90.3/1, 90.3/2)	each 3.9 kΩ
- Resistance (resistors 90.41, 90.42)	each 1.8 kΩ
- Maximum power	250 W

Auxiliary Contactor (52.3)

- Coil output	11 Watt

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

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

- Molycote White

Before-Removal Operations

@.1220

Lower the pantograph and isolate the locomotive from the overhead catenary. Earth the locomotive using the key interlocking system. Refer to the Preface of this Volume.

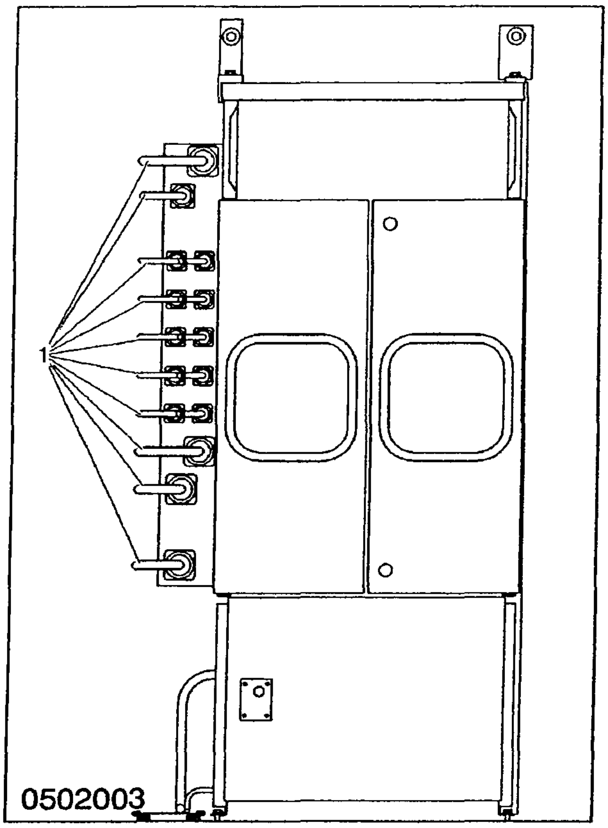
Isolate the batteries at the battery box isolation switch, as described in Chapter 5.3, Battery and Charger.

Remove the appropriate pantograph roof hatch from the locomotive as described in Chapter 1.1, Structure.

Removal

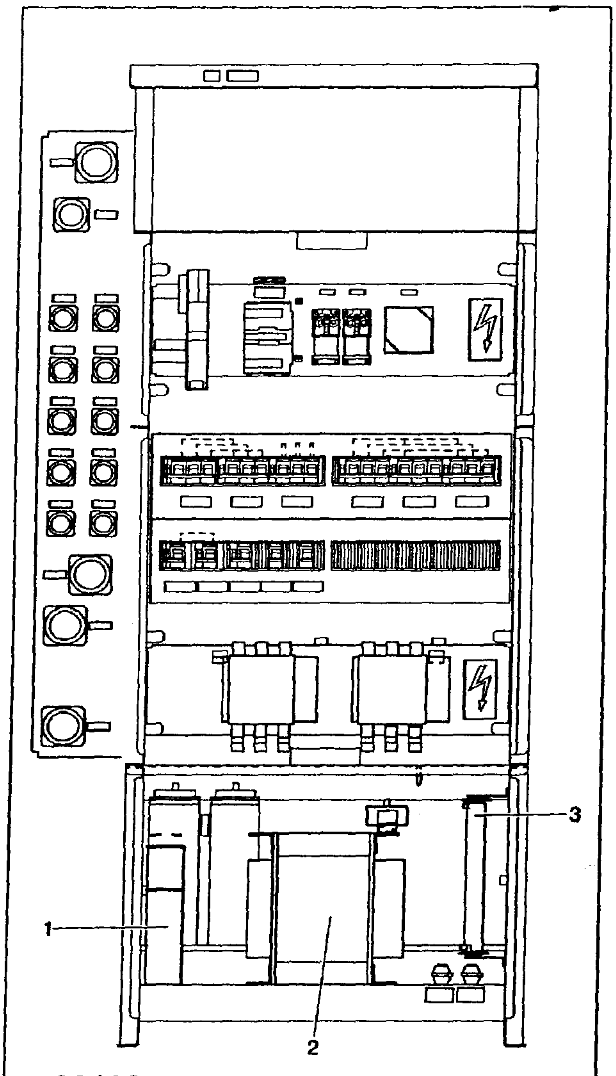
@.1230

Cubicle HB1



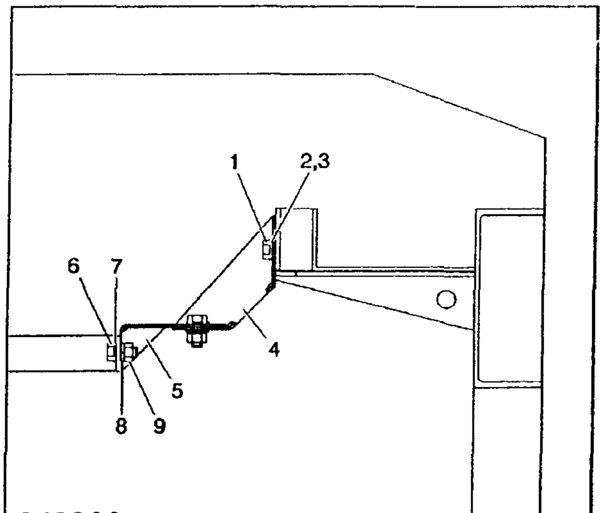
Disconnect the harness from the sockets (1) at the top of the HB cubicle. Turn the rings counterclockwise to release the bayonet connector.

Unlock the lower HB1 cabinet door using a green key. Operation of the key interlocking system is described in the Preface of this Volume. Open the lower HB1 cabinet door.



0509100n

Tag and disconnect the high voltage cables to the machine room blower capacitors (1), auxiliary transformer (2) and earth fault detection resistors (3).



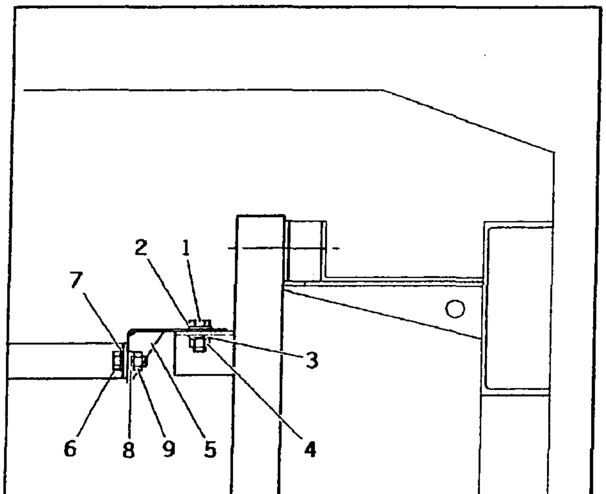
0502004a

Remove the bolt (1), spring and plain washers (2, 3) securing the right hand side angle bracket (4) to the machine room wall.

Hold the angle bracket assembly (4, 5) to prevent it falling during removal. Remove the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

Remove the bolt (6) and the washer (7) from the other side of the bracket.

Remove the angle bracket assembly (4, 5).



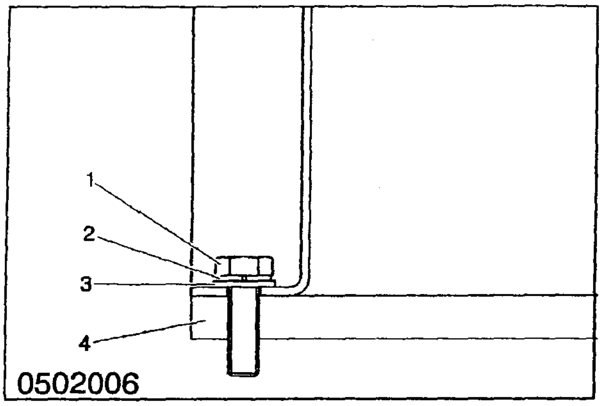
0502005a

Remove the bolt (1), washers (2, 3) and nut (4) securing the left hand side angle bracket (5) to the machine room wall.

Hold the angle bracket (5) to prevent it falling during removal. Remove the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

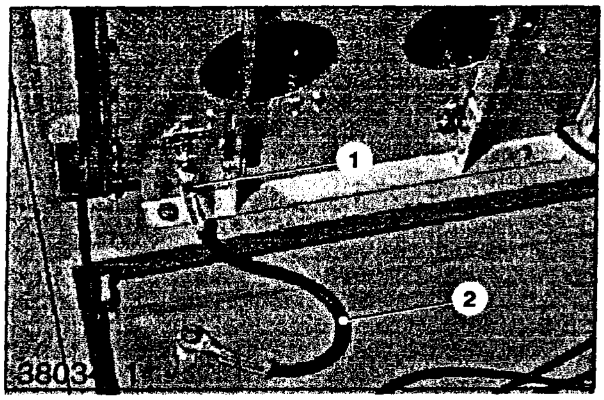
Remove the bolt (6) and the washer (7) from the other side of the bracket.

Remove the angle bracket (5).

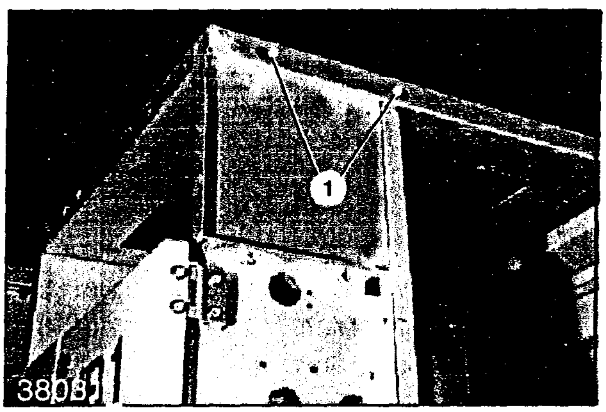


The cubicle is secured to the floor frame (4) by two bolts (1).

Remove the bolts (1), spring and plain washers (2, 3).



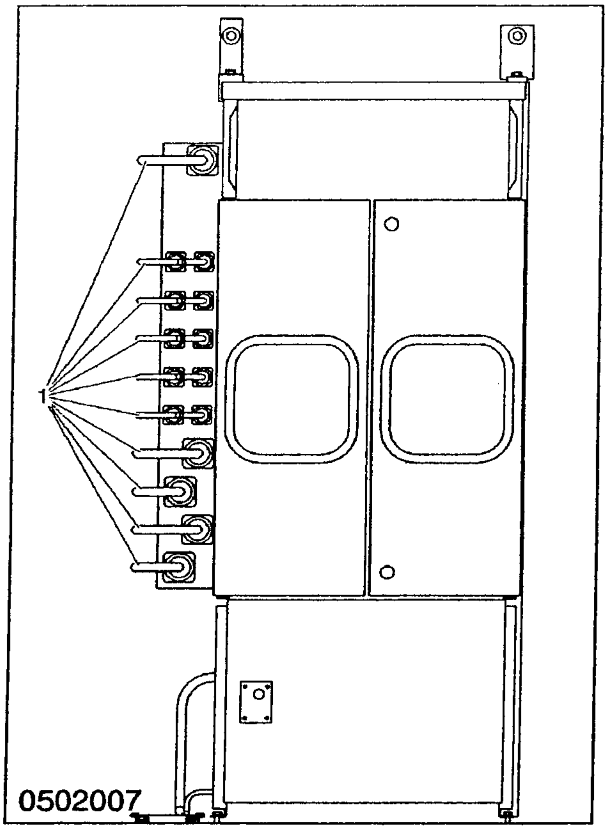
Remove the nut (1) and washers securing the earthing cable (2). Replace the nut (1) and washers finger tight.



Attach suitable lifting equipment to the eyelets (1) on the HB cubicle. Raise the lifting equipment slightly to take the weight of the cubicle.

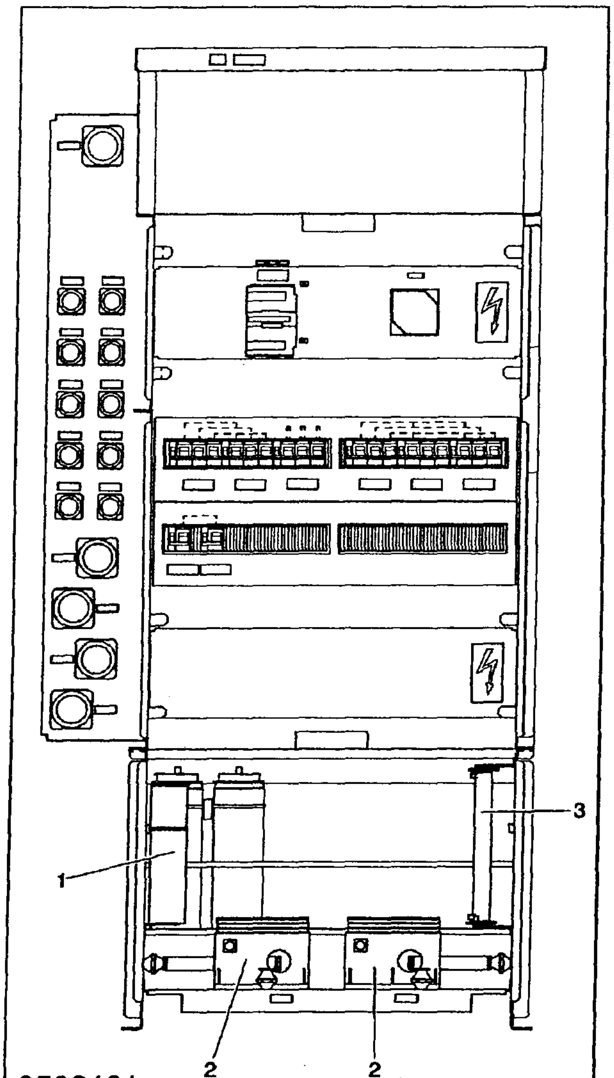
Ensure that all the harnesses are disconnected and clear of the cubicle, then lift the HB cubicle slightly. Ensure that nothing is entangled between the locomotive and the HB cubicle, then lift the cubicle from the locomotive machine room.

Cubicle HB2



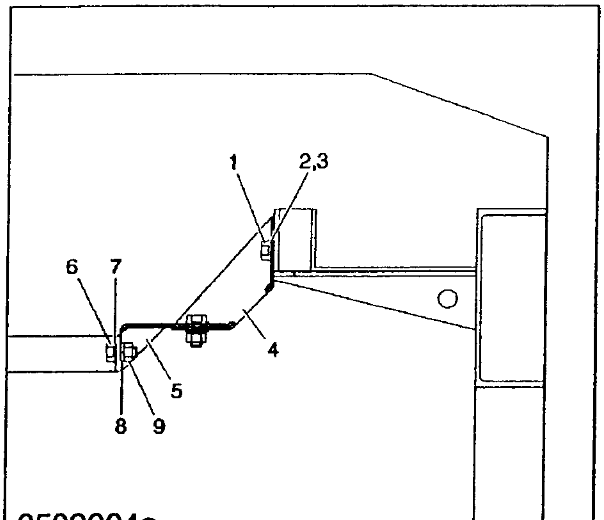
Disconnect the harness from the sockets (1) at the left of the HB cubicle. Turn the rings counterclockwise to release the bayonet connector.

Unlock the lower HB2 cabinet door using a green key. Operation of the key interlocking system is described in the Preface of this Volume. Open the lower HB2 cabinet door.



0509101n

Tag and disconnect the high voltage cables to the machine room blower capacitors (1), auxiliary circuit current sensors (2) and earth fault detection resistors (3).



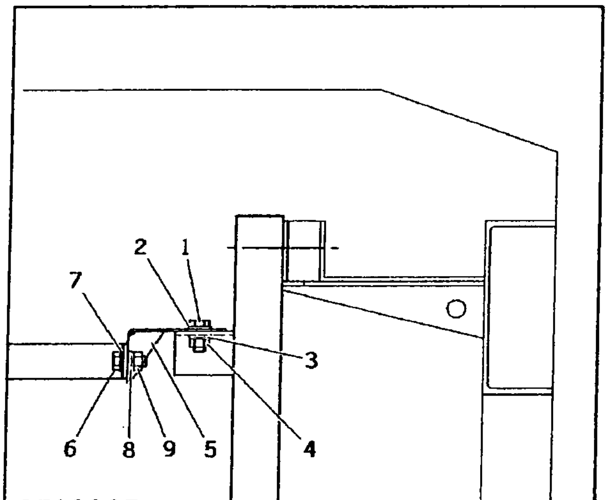
0502004a

Remove the bolt (1), spring and plain washers (2, 3) securing the right hand side angle bracket (4) to the machine room wall.

Hold the angle bracket assembly (4, 5) to prevent it falling during removal. Remove the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

Remove the bolt (6) and the washer (7) from the other side of the bracket.

Remove the angle bracket assembly (4, 5).



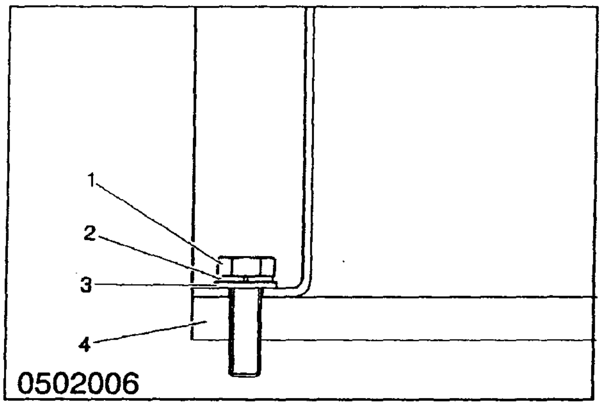
0502005a

Remove the bolt (1), washers (2, 3) and nut (4) securing the left hand side angle bracket (5) to the machine room wall.

Hold the angle bracket (5) to prevent it falling during removal. Remove the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

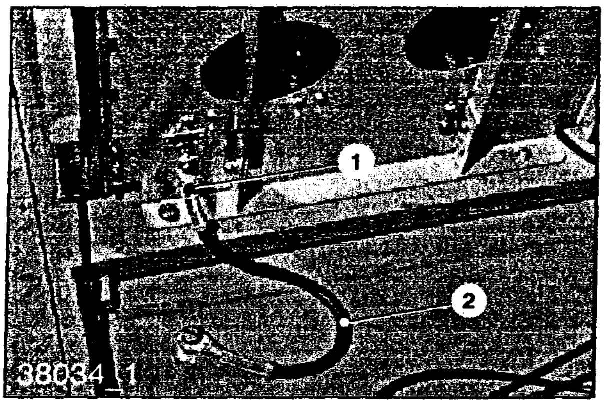
Remove the bolt (6) and the washer (7) from the other side of the bracket.

Remove the angle bracket (5).

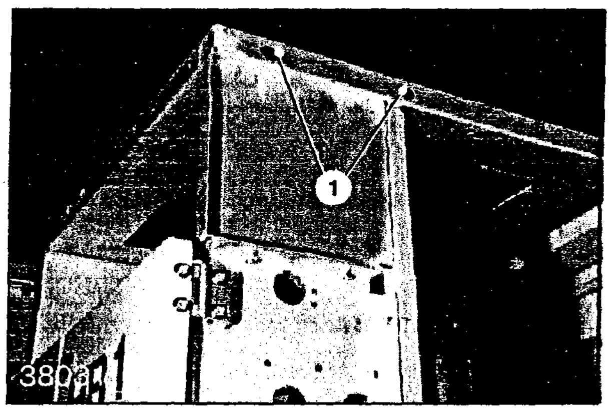


The cubicle is fixed by two bolts (1) to the floor frame (4).

Remove the bolts (1), spring and plain washers (2, 3).



Remove the nut (1) and washers securing the earthing cable (2). Replace the nut (1) and washers finger tight.



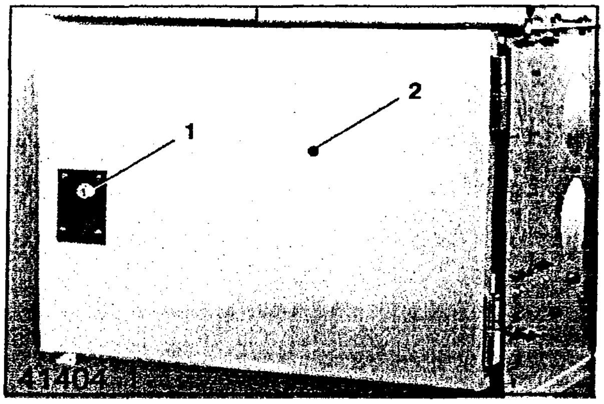
Attach suitable lifting equipment to the eye-bolts (1) on the HB cubicle. Raise the lifting equipment slightly to take the weight of the cubicle.

Ensure that all the harnesses are disconnected and clear of the cubicle, then lift the HB cubicle slightly. Ensure that nothing is entangled between the locomotive and the HB cubicle, then lift the cubicle from the locomotive machine room.

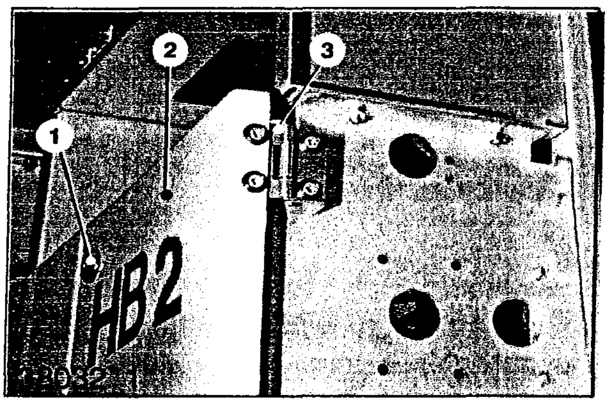
Disassembly

@.1240

Cubicle Doors



If necessary, unlock the lower cabinet door lock (1) using a green key. Operation of the key interlocking system is described in the Preface of this Volume. Open the lower cabinet door.

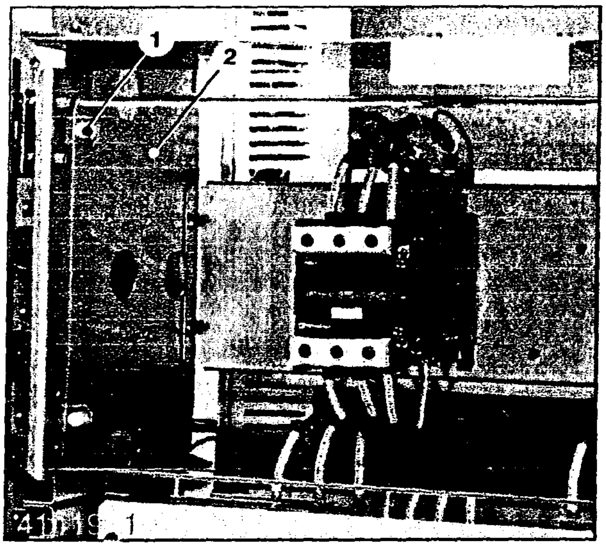


Open both locks (1) with a square key.

Support the doors to prevent them falling.

Remove the bolts securing the doors to the cubicle cabinet.

Clear Cover

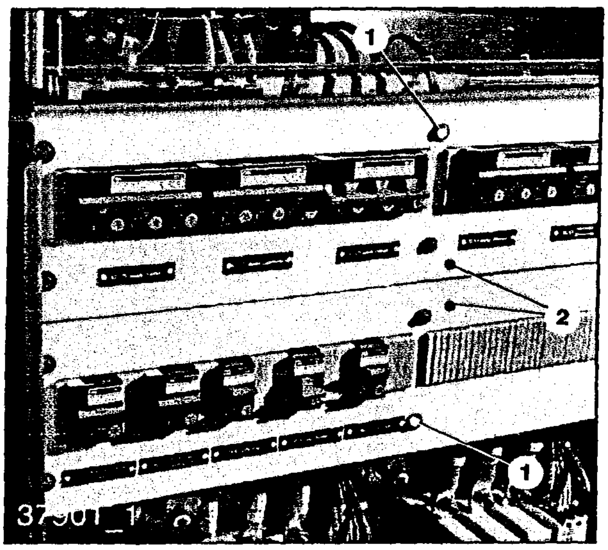


Support the clear cover (2) to prevent it falling.

Remove the nylon screws (1) securing each corner of the clear cover to the brackets.

Remove the clear cover.

Protective Covers



Support the protective cover (2) to prevent it falling.

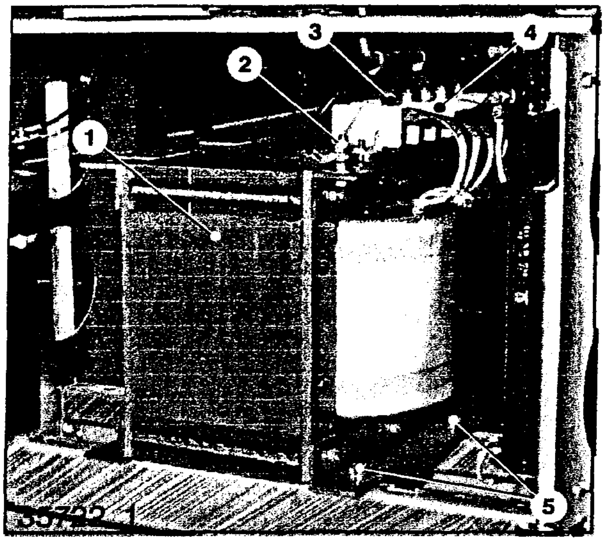
Remove the screws (1), spring and lock washers securing the covers (2) to the cubicle cabinet.

Remove the covers (2).

Components in Auxiliary Cubicle HB1

The control cubicles HB1 and HB2 are fitted with different components. Refer to Section Group Summary.

Auxiliary Transformer 415 Volt/110 Volt (67)



Remove the nut (2) and washers securing the earthing cable to the auxiliary transformer (1).

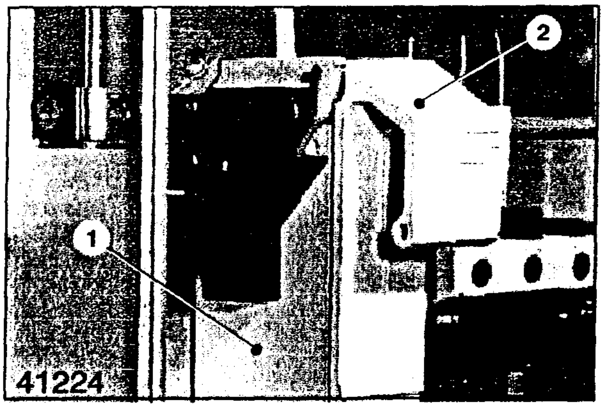
Tag and disconnect the cables (4) from the auxiliary transformer terminals (3).

Remove the screws (5) securing the auxiliary transformer to the cubicle cabinet.

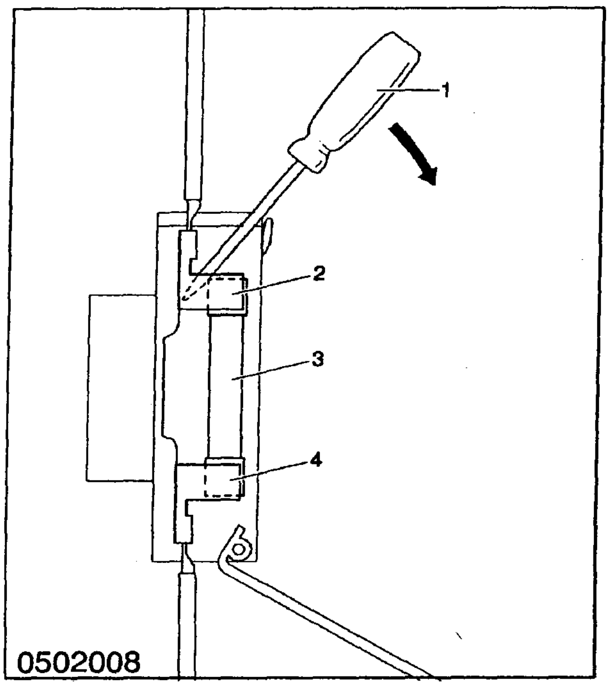
The auxiliary transformer (1) is heavy. Push a wooden board onto the brace at assembly height and pull the transformer (1) onto the wooden board.

Attach suitable lifting equipment to the auxiliary transformer (1). Lift the transformer (1) from the machine room.

Fuse (41)



Pull the housing covering (2) downward and open the fuse housing (1).

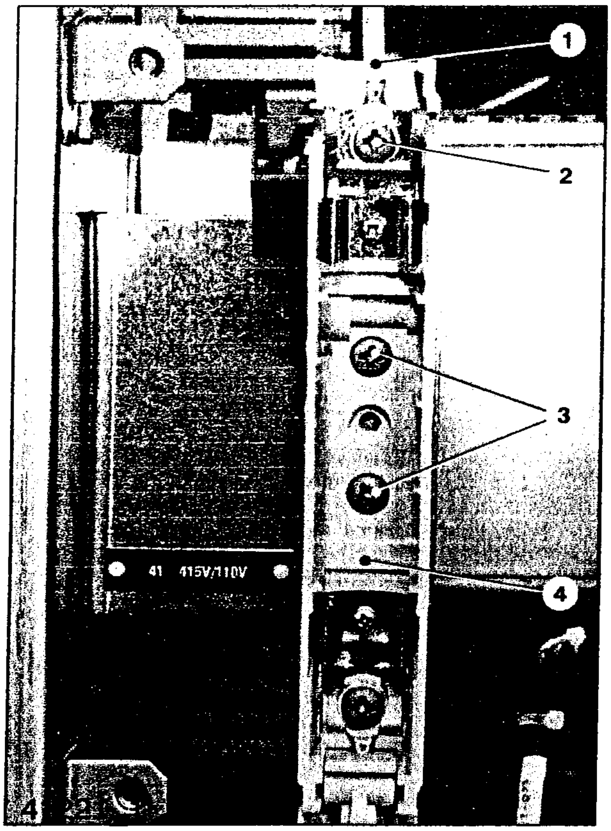


Using a suitable screw driver, carefully prise the fuse (3) forward so that the upper part of the fuse springs out of the upper holder (2). Pull the fuse (3) carefully out of the lower holder (4).

CAUTION:

The fuse (3) is encased in glass. Handle the fuse with care to avoid breaking the glass.

Fuse Holder

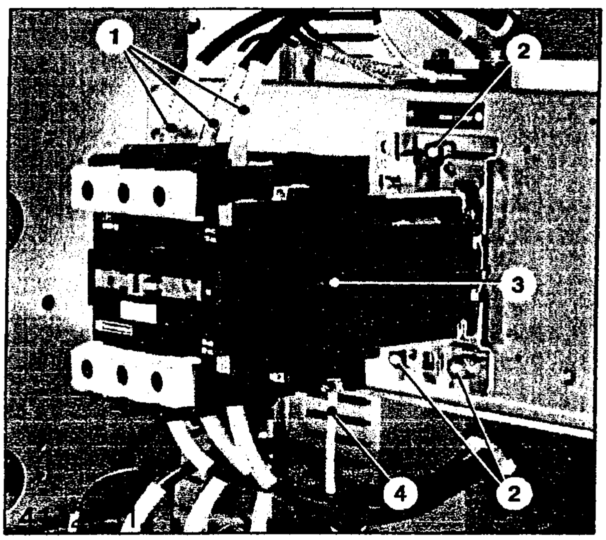


Loosen the screws (2) at either end of the fuse holder.

Tag and disconnect the cables (1) from the terminals.

Remove the screws (3) and remove the fuse housing (4).

Contactor Main Compressor (47.2/1)



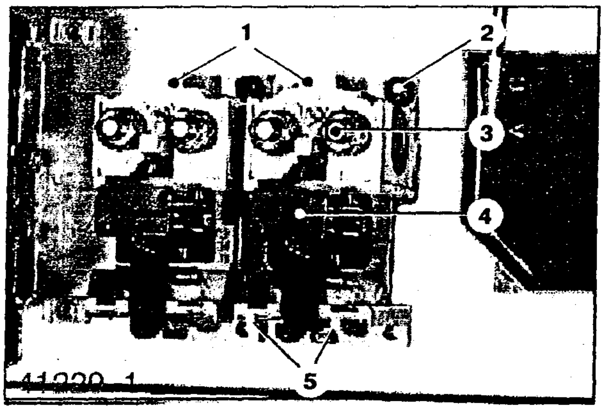
Tag and disconnect the cables (1) from the contactor. Loosen, but do not remove, the screws securing each of the six cables (1) to the contactor (3).

Tag and disconnect the cables (4) from the contactor. Loosen, but do not remove, the screws securing each of the six cables (4) to the contactor.

Loosen, but do not remove, the three screws (2).

Lift contactor (3) slightly, detach and remove.

Auxiliary Contactor (52.3/4, 52.3/5)

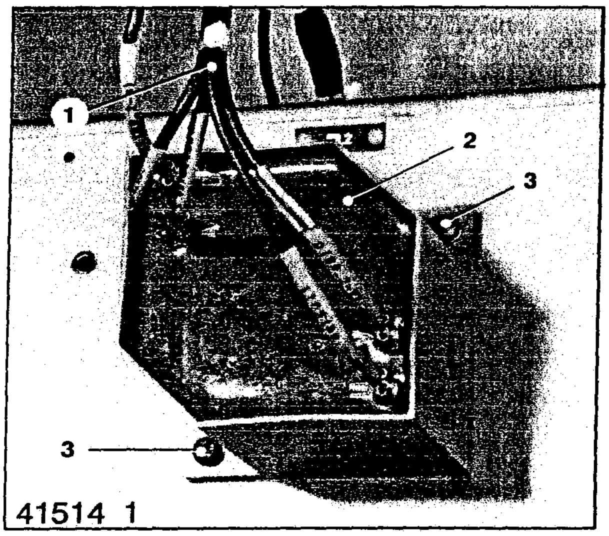


Tag and disconnect the cables from the connections (5).

Tag and disconnect the cables from the auxiliary contactor. Remove the nuts (3), washers and spring washers. Screw the nuts (3), washers and spring washers back on finger tight.

Loosen the diagonally positioned screws (2). Remove the screws (2) and the contactor (1).

Earth-fault Relay (89.5)



Tag and disconnect the cables (1) from the terminals.

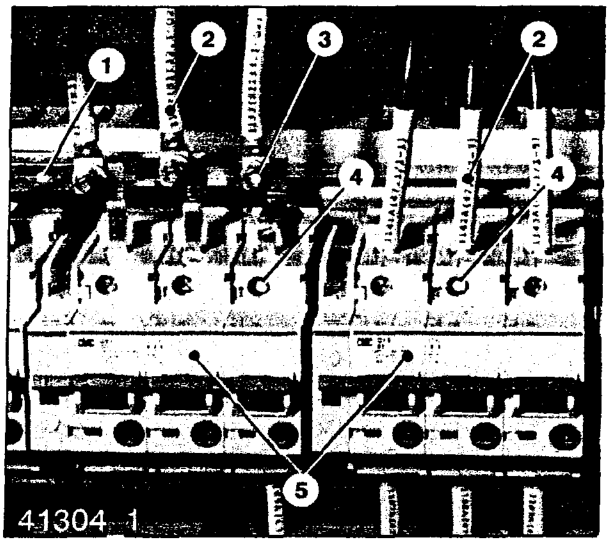
Support the relay (2), then remove the screws (3) securing the earth-fault relay (2).

Remove the relay (2).

Circuit Breaker (62.1/1, 63.1/1, 47.1/1, 53.1/1, 55.1/1, 59.1/1)

Remove the clear cover as described in Clear Cover in this Section.

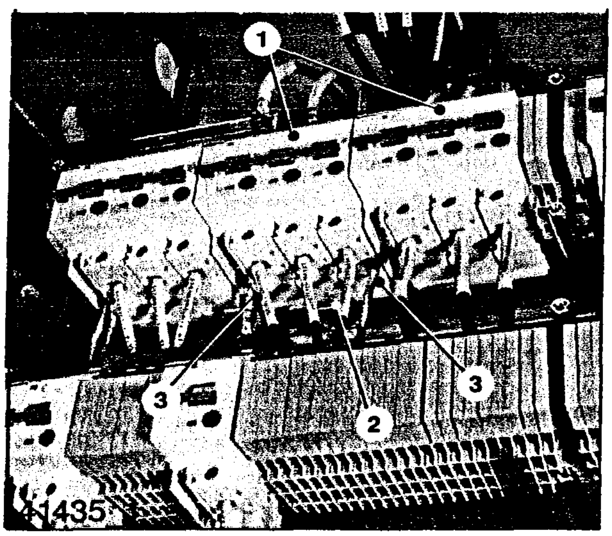
Remove the protective covers as described in Protective Covers in this Section.



Loosen the six screws (4) for the relevant contactor (5).

Tag and disconnect the cables (2) or connecting rails (1) from both the upper and lower sockets of the contactor (5).

So that the screws (4) do not fall out, screw the screws (4) back in again slightly. To assist with reassembly, do not loosen the screw connections (3) that fasten the cable (2) to the connecting rail (1).



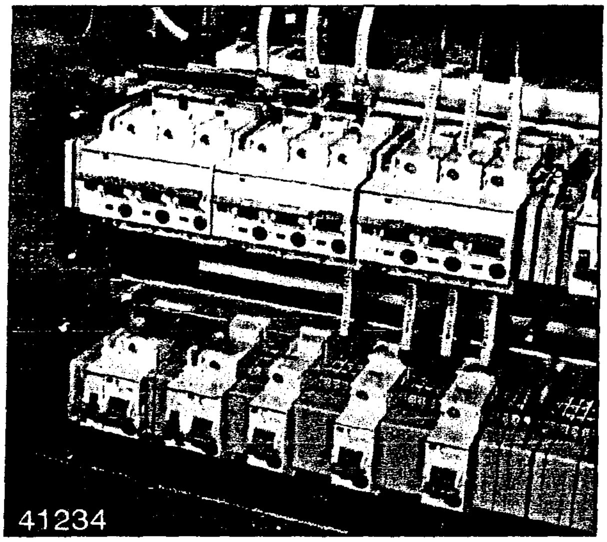
Tag and disconnect the laterally fastened cables (3) after loosening the appropriate screws. Screw in the screws again slightly.

Press the spring (2) downward with a suitable tool. Prise the contactor (1) forward, lift slightly and remove.

Circuit Breaker (54.1/1, 56.1/1, 69.61, 69.62, 69.71)

Remove the clear cover as described in Clear Cover in this Section.

Remove the protective covers as described in Protective Covers in this Section.



Loosen the two screws for the relevant contactor.

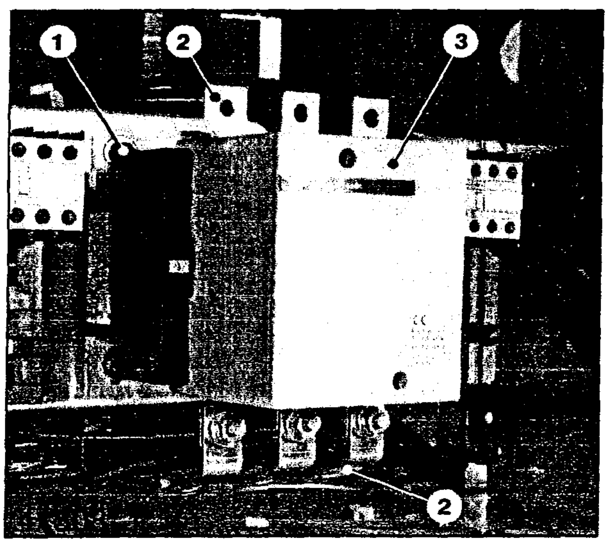
Tag and disconnect the cables or connecting rails from both the upper and lower sockets of the contactor.

So that the screws do not fall out during disassembly, screw the screws back in again slightly.

Tag and disconnect the laterally fastened cables after loosening the appropriate screws. Screw in the screws again slightly.

Press the spring securing the circuit breaker to the rail downward with a suitable tool. Prise the contactor forward, lift slightly and remove.

Three-phase Contactor (52/4, 52/5)

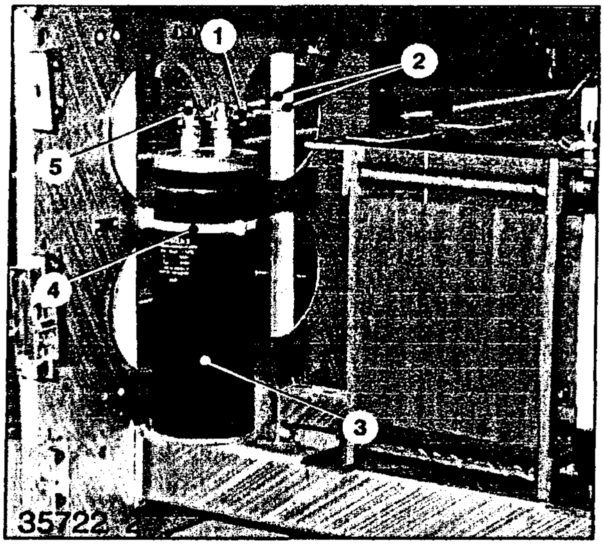


Tag and disconnect the cables from the contactor terminals. Remove the nuts, plain and lock washers, then disconnect each of the six cables (2).

Remove the screws (1), plain and lock washers securing the contactor to the wall. Note that the three-phase contactor (3) is heavy.

Remove the three-phase contactor (3).

Machine Room Blower Motor Capacitors (54.5/1, 54.8/1)



The capacitor (3) is situated at the bottom left in the auxiliary cubicle.

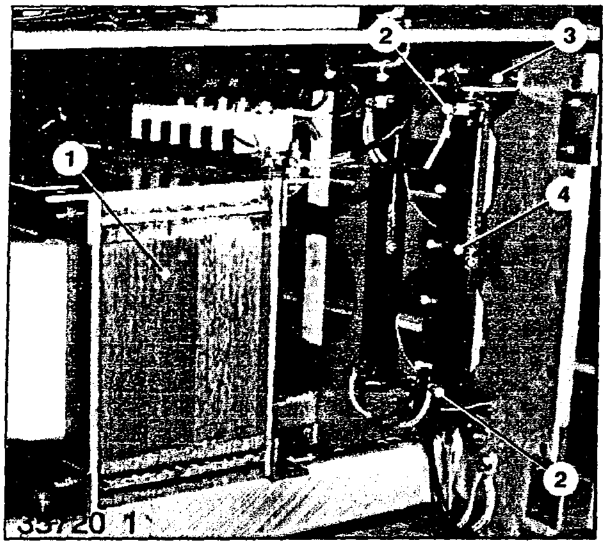
Tag and disconnect the cables (2). Remove the screws and nuts (1). Do not remove the nuts (5) from the capacitor (3).

Remove the nut and lock washer securing the capacitor (3) to the brace. A cable tie (4) holds the capacitor (3) in place.

Hold the capacitor (3) so that it does not fall, then cut the cable tie (4).

Remove the capacitor (3) from the brace.

Earthing Resistors (90.41; 90.42)



The earthing resistor (90.41) (4) is secured to the side wall at the bottom of the auxiliary cubicle, adjacent to the auxiliary transformer (1). It is the foremost of the two resistors.

Tag and disconnect the cables. Remove the screws (2) securing the cables.

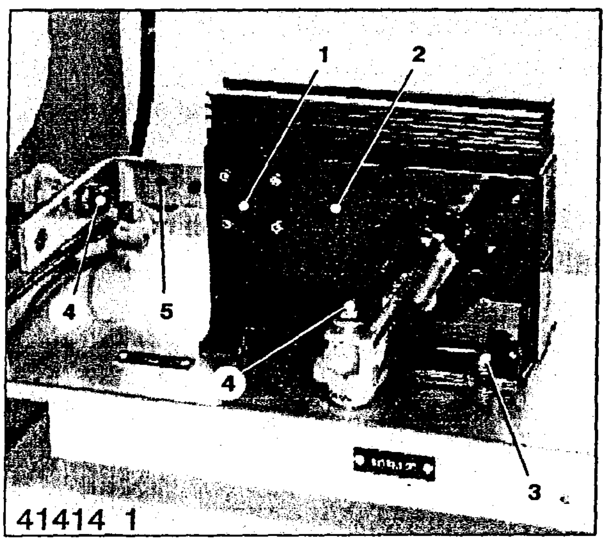
Hold the resistor (4) so that it does not fall, then remove the screws (3) securing the resistor (4) to the cabinet.

Remove the resistor (4).

Components in Auxiliary Cubicle HB2

The control cubicles HB1 and HB2 are fitted with different components. Refer to Section Group Summary.

Current Sensor (42.3/1, 42.3/2)



Tag and disconnect the 9-pole plug from the socket (1). Turning the retaining ring counterclockwise, then pull the plug from the socket.

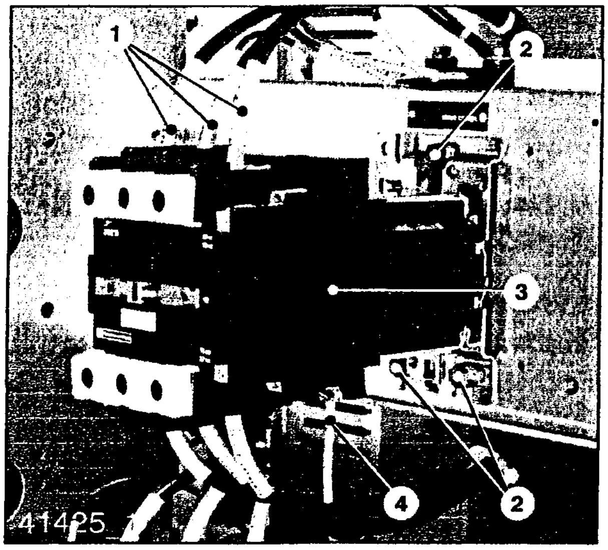
Remove the screws (4), plain and lock washers securing the conducting rail (5) to the insulators.

Remove the conducting rail (5) towards the rear.

Remove the screws (3), plain and lock washers securing the sensor (2).

Remove the current sensor (2) from the assembly plate. Note that the current sensor (2) is heavy.

Contactor Main Compressor (47.2/2)



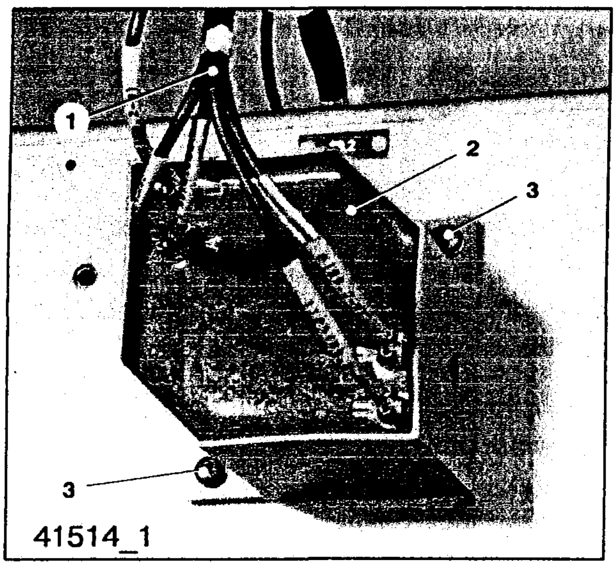
Tag and disconnect the cables (1) from the contactor. Loosen, but do not remove, the screws securing each of the six cables (1) to the contactor (3).

Tag and disconnect the cables (4) from the contactor. Loosen, but do not remove, the screws securing each of the six cables (4) to the contactor.

Loosen, but do not remove, the three screws (2).

Lift the contactor (3) slightly, then detach and remove.

Earth-fault Relay (89.2)



Tag and disconnect the cables (1) from the terminals.

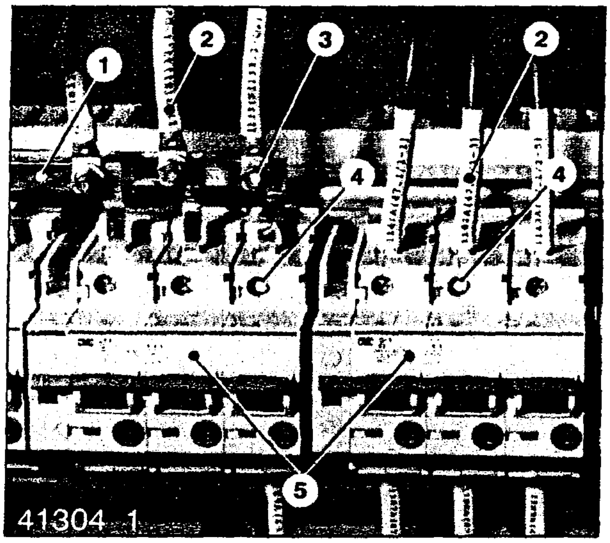
Support the relay (2), then remove the screws (3) securing the earth-fault relay (2).

Remove the relay (2).

Circuit Breaker (62.1/2, 63.1/2, 47.1/2, 53.1/2, 55.1/2, 59.1/2)

Remove the clear cover as described in Clear Cover in this Section.

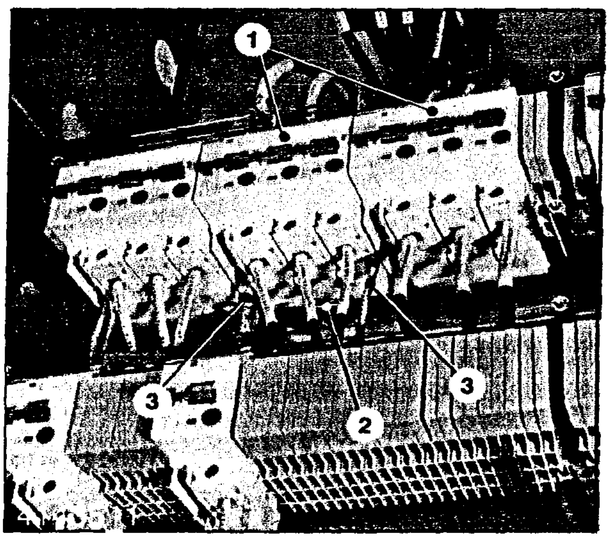
Remove the protective covers as described in Protective Covers in this Section.



Loosen the six screws (4) for the relevant contactor (5).

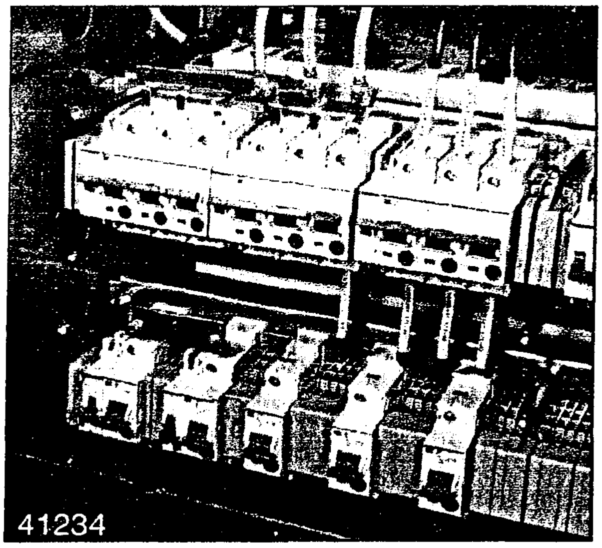
Tag and disconnect the cables (2) or connecting rails (1) from both the upper and lower sockets of the contactor (5).

So that the screws (4) do not fall out, screw the screws (4) back in again slightly. To assist with reassembly, do not loosen the screw connections (3) that fasten the cable (2) to the connecting rail (1).



Tag and disconnect the laterally fastened cables (3) after loosening the appropriate screws. Screw in the screws again slightly.

Press the spring (2) downward with a suitable tool. Prise the contactor (1) forward, lift slightly and remove.



Loosen the two screws for the relevant contactor.

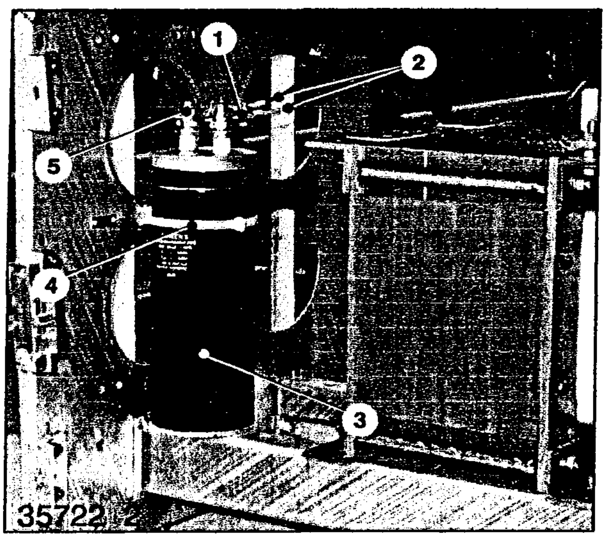
Tag and disconnect the cables or connecting rails from both the upper and lower sockets of the contactor.

So that the screws do not fall out during disassembly, screw the screws back in again slightly.

Tag and disconnect the laterally fastened cables after loosening the appropriate screws. Screw in the screws again slightly.

Press the spring securing the circuit breaker to the rail downward with a suitable tool. Prise the contactor forward, lift slightly and remove.

Machine Room Blower Motor Capacitor (54.5/2, 54.8/2)



The capacitor (3) is situated at the bottom left in the auxiliary cubicle.

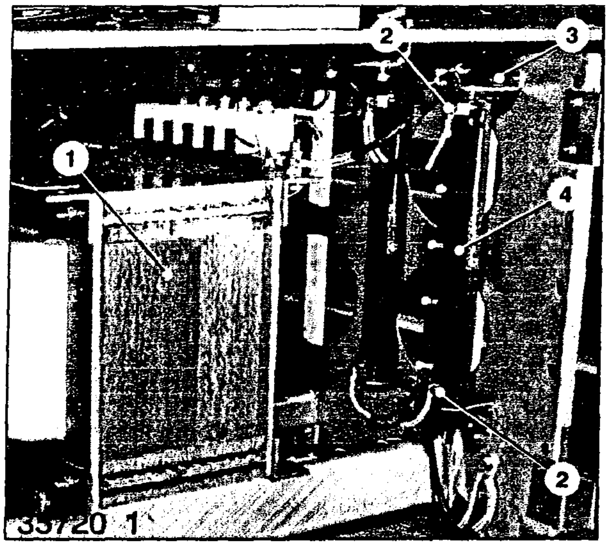
Tag and disconnect the cables (2) from the capacitor (3). Remove the nuts, screws and washers (1) securing the cables (2) to the terminal bars. Do not remove the nuts (5) from the capacitor (3).

Remove the nut and lock washer securing the capacitor (3) to the brace. A cable tie (4) holds the capacitor (3) in place.

Hold the capacitor (3) so that it does not fall, then cut the cable tie (4).

Remove the capacitor (3) from the brace.

Earthing Resistor (90.3/1, 90.3/2)



Tag and disconnect the cables from the resistor terminals (2). Remove the screws securing the cables to the resistor terminals (2).

Hold the resistor (4) so that it does not fall, then remove the screws (3) securing the resistor (4) to the cabinet.

Remove the resistor (4).

Inspection and Repair

@.1250

Inspect the condition of the fuse housing. Replace the housing if worn, cracked or otherwise damaged.

For further information regarding the HB cubicle sub-systems, refer to Chapter 10, Power Supply 415/110V of Volume F10, Suppliers Documentation.

Waste Disposal

@.1260

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

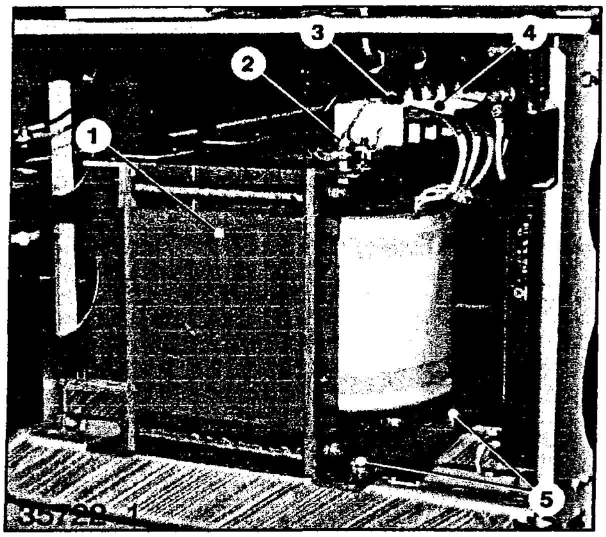
Assembly

@.1270

Components in Auxiliary Cubicle HB1

The control cubicles HB1 and HB2 are fitted with different components. Refer to Section Group Summary.

Auxiliary Transformer 415V/110V (67)



Place a wooden board onto the brace at assembly height in the machine room. Attach suitable lifting equipment to the auxiliary transformer (1). Lift the transformer (1) into position in the machine room and lower it onto the wooden board.

Push the transformer (1) from the wooden board into position within the HB1 cubicle.

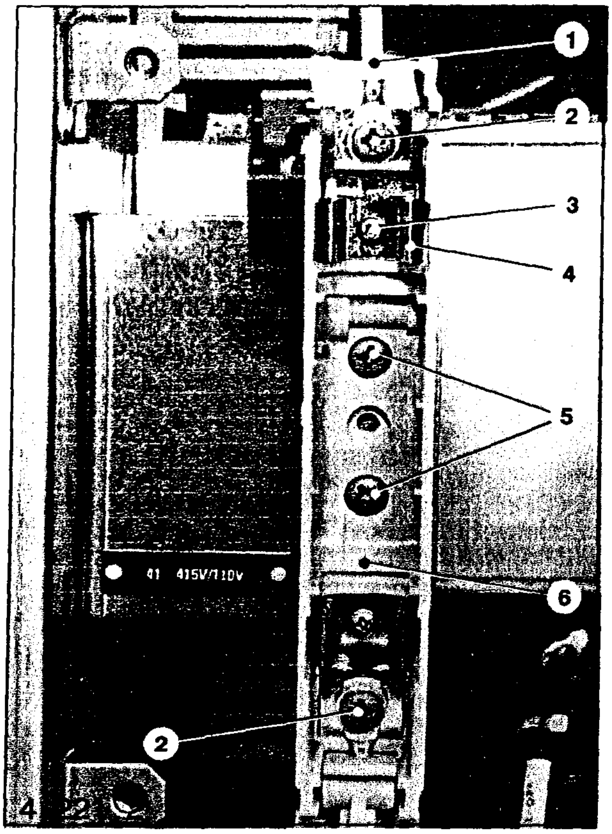
Secure the auxiliary transformer to the cabinet using the screws (5).

Reconnect the cables (4) to the auxiliary transformer terminals (3) as tagged during removal.

Secure the earthing cable (1) to the auxiliary transformer using the nut (2) and washers.

Refer to Section Auxiliary Circuits 1-Phase, Sheet 03A, Auxiliaries 415/110V Single Phase of Volume G1, Cabling Documentation for auxiliary transformer (67) electrical connections.

Fuse Holder

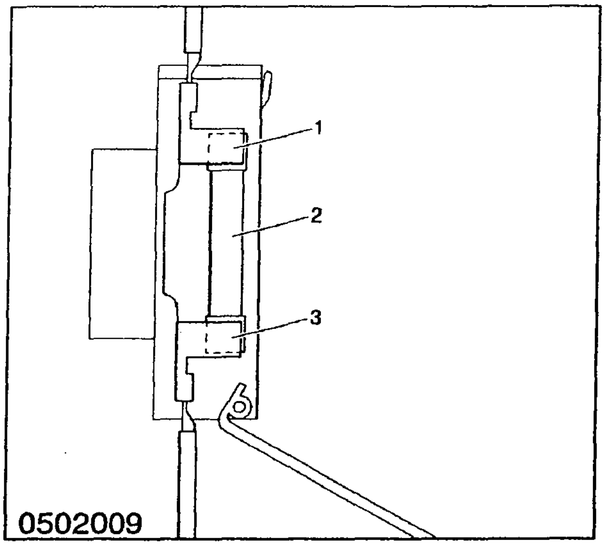


Align the plastic fuse housing (4) and install the screws (3).

Reconnect both cables (1) as tagged during disassembly, then tighten the screws (2) at either end of the fuse holder.

Refer to Section Auxiliary Circuits 1-Phase, Sheet 03A, Auxiliaries 415/110V Single Phase of Volume G1, Cabling Documentation for fuse holder (41) electrical connections.

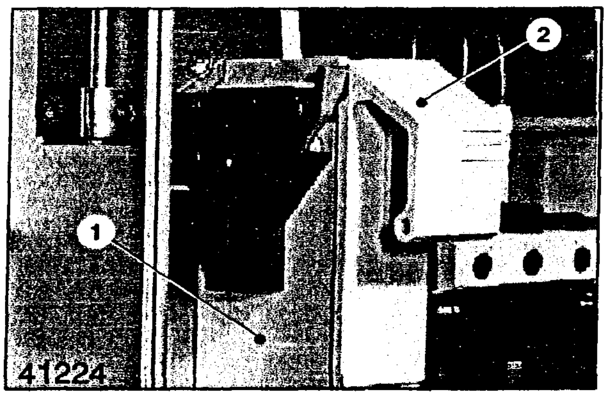
Fuse (41)



CAUTION:

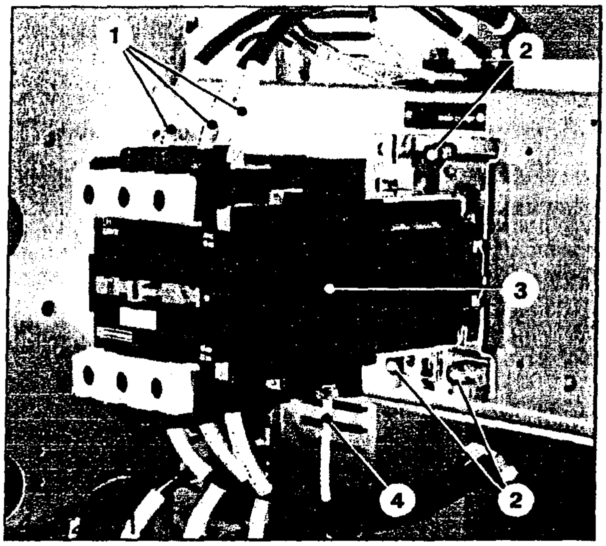
The fuse (2) is enclosed in glass. Handle the fuse with care to avoid breaking the glass.

Press the lower part of the fuse (2) into the holder (3). Press the upper part of the fuse into the holder (1).



Press the housing grip (2) upward and close the fuse housing (1).

Contactor Main Compressor (47.2/1)



Position the contactor (3) over the mounting screws (2).

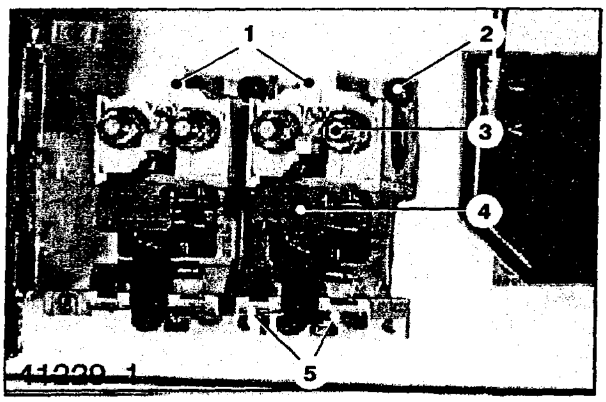
Tighten the screws (2) to secure the contactor (3).

Install the cables (4) as tagged during disassembly. Tighten the screws.

Install the six cables (1) as tagged during disassembly. Tighten the screws.

Refer to Section Pin Assignment Electrical Components, Sheet 25B, Low-Voltage Contactors of Volume G2, Cabling Documentation for main compressor contactor (47.2/1) electrical connections.

Auxiliary Contactor (52.3/4, 52.3/5)

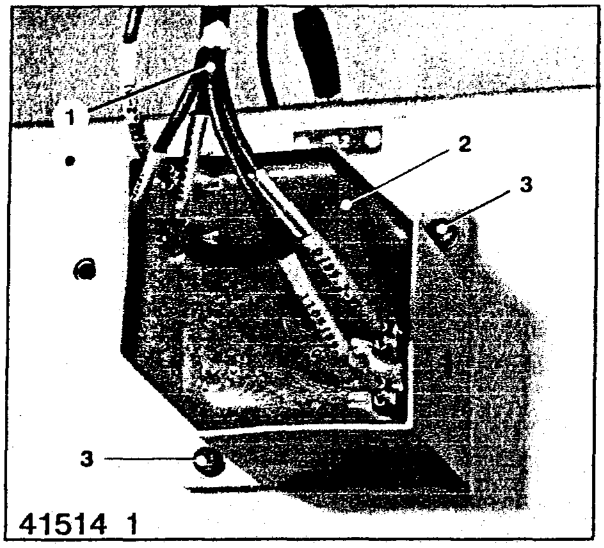


Fit the auxiliary contactor (1) in the upper level of auxiliary cubicle HB1.

Fasten the contactor (1) with two screws (2). Fasten the cables as tagged during disassembly to the contactor with nuts (3), washers and spring washers. Plug the cables onto the contacts (5). Reconnect the cables to the auxiliary contact (4) as tagged during disassembly.

Refer to Section Pin Assignment Electrical Components, Sheet 25B, Low-Voltage Contactors of Volume G2, Cabling Documentation for auxiliary contactor (52.3/4, 52.3/5) electrical connections.

Earth-Fault Relay (89.5)



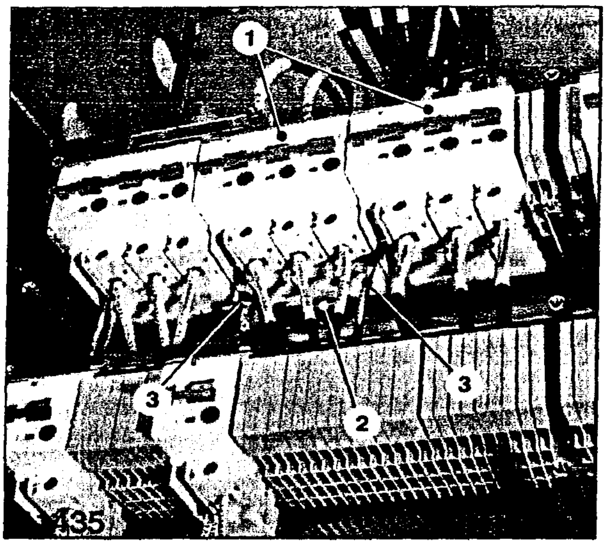
Install the earth-fault relay (2) on the uppermost level of the cabinet.

Position the earth-fault relay (2) at the diagonally opposed corners using the screws (3). Tighten the screws (3).

Reconnect the cables (1) to the contact earth-fault relay (2) as tagged during disassembly.

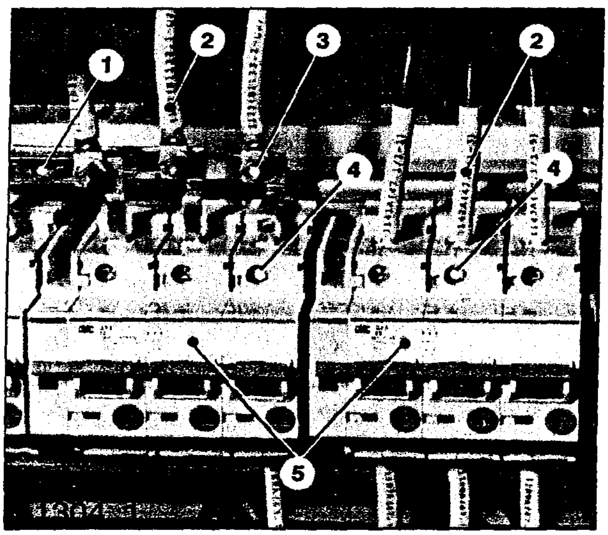
Refer to Section Pin Assignment Electrical Components, Sheet 26A, Earth Fault-, Min/Max- Relays; Fuses of Volume G2, Cabling Documentation for earth-fault relay (89.5) electrical connections.

Circuit Breaker (62.1/1, 63.1/1, 47.1/1, 53.1/1, 55.1/1, 59.1/1)



Install the circuit breaker (1) onto the rail. The spring (2) on the back of the circuit breaker (1) snaps into place with a slight push.

Reconnect the cables (3) to the circuit breaker (1) as tagged during disassembly. Tighten the screws.



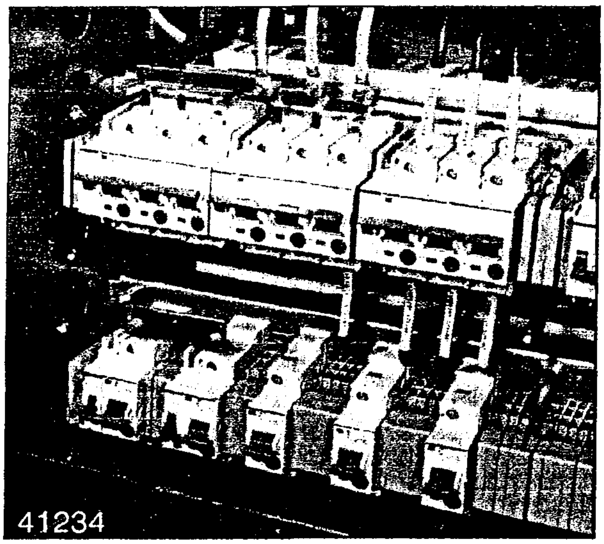
Reconnect the cables (2) to the circuit breaker (5), or terminal bar (1) as tagged during disassembly. Tighten the screws (4) or nuts (3) as necessary.

Install the protective covers as described in Protective Covers in this Section.

Assemble the clear cover as described in Clear Cover in this Section.

Refer to Section Pin Assignment Electrical Components, Sheet 25A, Circuit Breakers of Volume G2, Cabling Documentation for circuit breaker (62.1/1, 63.1/1, 47.1/1, 53.1/1, 55.1/1, 59.1/1) electrical connections.

Circuit Breaker (69.71, 69.62, 69.61, 56.1/1, 54.1/1)



41234

Attach the circuit breaker to the upper edge of the fixed profile. The spring on the back of the circuit breaker snaps into place with slight backward pressure.

Slightly loosen the screws on the left-hand side but do not remove them. Fasten the cables with the screws as tagged during disassembly.

Loosen the screws slightly but do not remove. Fasten the corresponding cables or connecting rails with the screws to the upper and lower points on the circuit breaker as tagged during disassembly. If connecting rails are to be connected, tighten the screws in the adjacent circuit breaker as well.

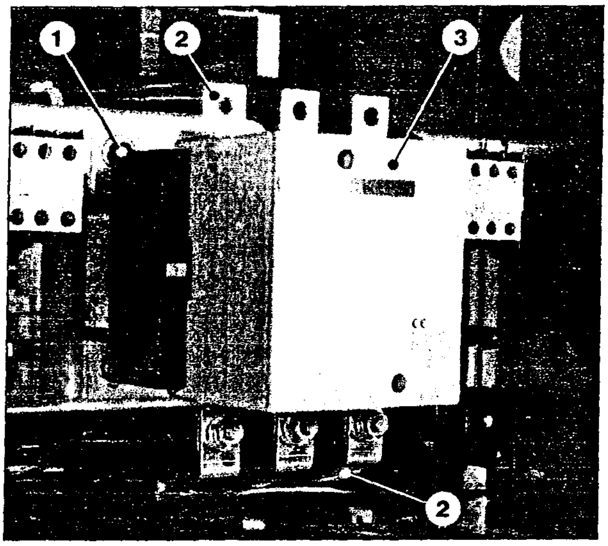
Install the protective covers as described in Protective Covers in this Section.

Assemble the clear cover as described in Clear Cover in this Section.

Refer to Section Pin Assignment Electrical Components, Sheet 25A, Circuit Breakers of Volume G2, Cabling Documentation for circuit breaker (56.1/1, 54.1/1) electrical connections.

Refer to Section Auxiliary Circuits 1-Phase, Sheet 03A, Auxiliaries 415/110V Single Phase of Volume G1, Cabling Documentation for circuit breaker (69.71, 69.62, 69.61) electrical connections.

Three-Phase Contactor (52/4, 52/5)



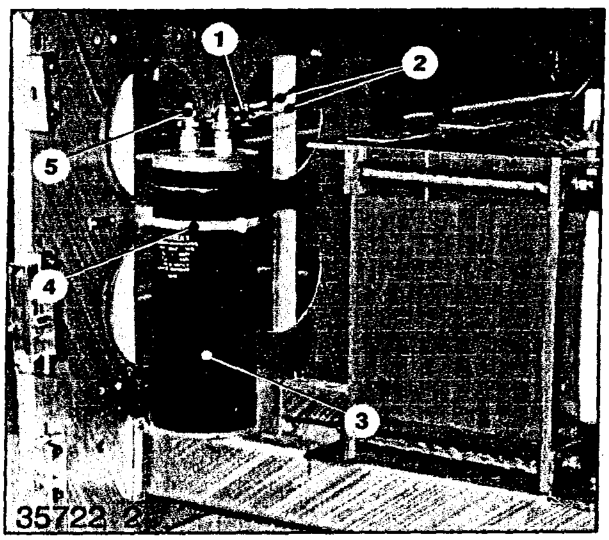
Position the three-phase contactor (3) on the panel. Align the holes in the contactor (3) with those in the panel. Note that the three-phase contactor (3) is heavy.

Install the screws (1), plain and spring washers to secure the contactor (3). Tighten the screws (1).

Reconnect the cables to the terminals (2) as tagged during disassembly. Install the screws, plain and spring washers, and nuts. Tighten the nuts.

Refer to Section Pin Assignment Electrical Components, Sheet 25B, Low-Voltage Contactors of Volume G2, Cabling Documentation for contactor electrical connections.

Machine Room Blower Motor Capacitors (54.5/1, 54.8/1)



Position the capacitor (3) on the left-hand side of the lowermost level on the cabinet. Inserting the stud at the lower end of the capacitor (3) through the hole in the brace. Hold the capacitor (3) so that it does not fall.

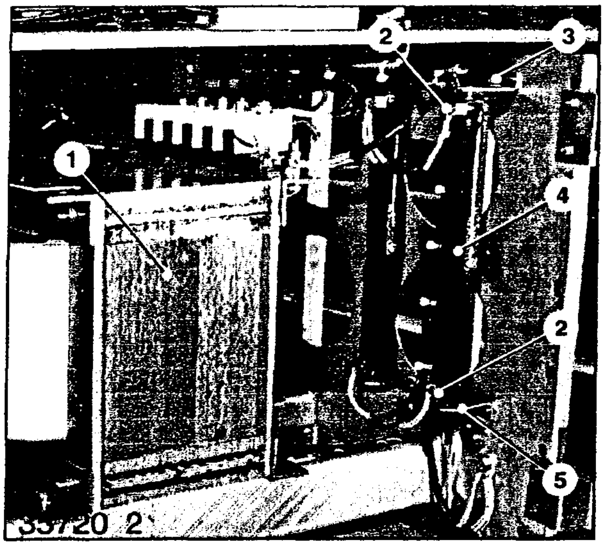
Secure the capacitor (3) using a suitable cable tie (4).

Install the nut, plain and spring washers on the stud, then tighten the nut.

Reconnect the cables (2) to the capacitor (3) as tagged during disassembly. Secure the cables (2) with screws and nuts (1).

Refer to Section Auxiliary Circuits 1-Phase, Sheet 03A, Auxiliaries 415/110V Single Phase of Volume G1, Cabling Documentation for machine room blower capacitor electrical connections.

Earthing Resistors (90.41; 90.42)



Position the earthing resistor (4) on the lower brackets (5, 3).

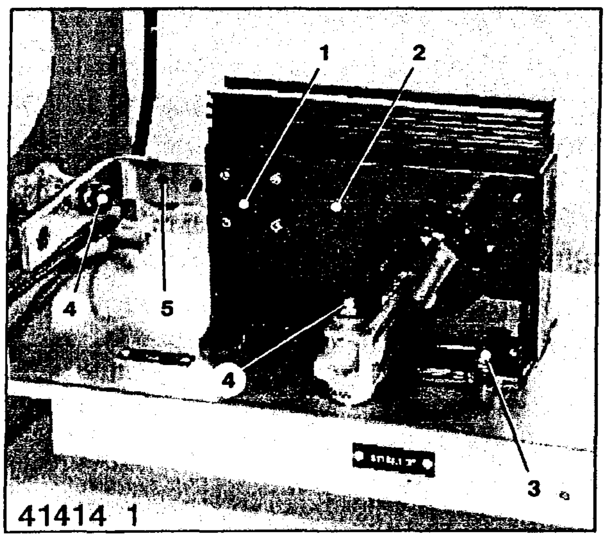
Install the screws to secure the resistor (4). Tighten the screws.

Reconnect the cables to the resistor (4) as tagged during disassembly. Tighten the screws securing the cables to the resistor (4).

Refer to Section Auxiliary Circuits 1-Phase, Sheet 03A, Auxiliaries 415/110V Single Phase of Volume G1, Cabling Documentation for earthing resistor (90.41, 90.42) electrical connections.

Components in Auxiliary Cubicle HB2

Current Sensors (42.3)



Position the current sensor (2) on the plate. Hold the current sensor (2) so that it does not fall. Note that the current sensor (2) is heavy.

Align the mounting holes in the current sensor (2) with those in the plate.

Install the screws (3) and washers to secure the current sensor, then tighten the screws (3).

Install the conducting rail (5) from through the sensor (2) aperture.

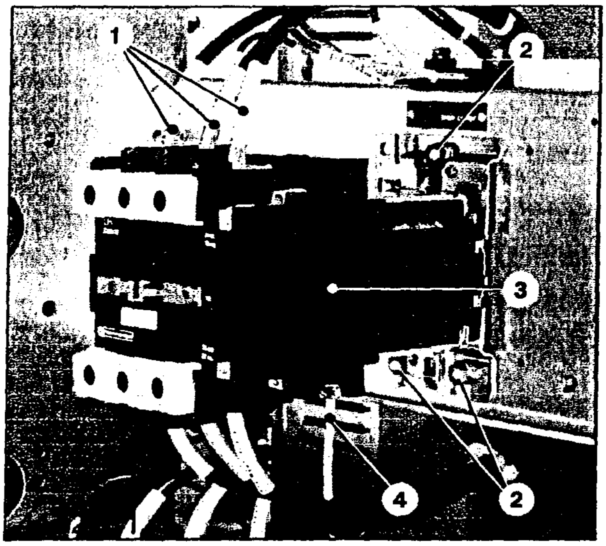
Secure the conducting rail (5) to the insulator using the screws (4), spring and plain washers. Tighten the screws.

Reconnect the cables to the conducting rail as tagged during disassembly.

Reinsert the 9-pole socket at plug (1). Fasten the socket by turning the retaining ring clockwise.

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02A, Earth Fault Detection of Volume G1, Cabling Documentation for current sensor (42.3/1, 42.3/2) electrical connections.

Contactor Main Compressor (47.2/2)



Position the contactor (3) over the mounting screws (2).

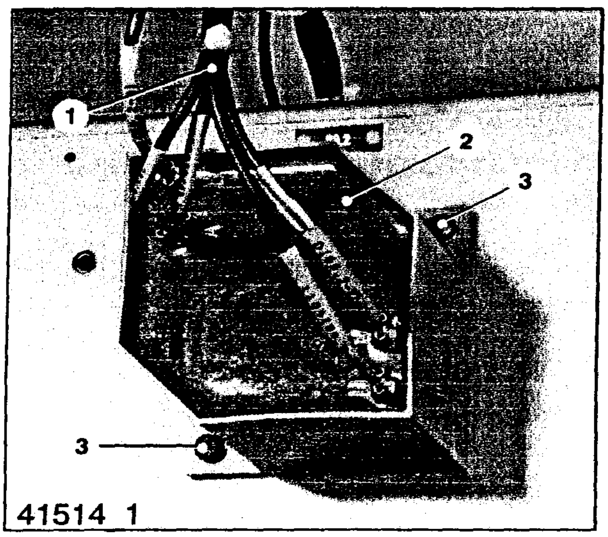
Tighten the screws (2) to secure the contactor (3).

Install the cables (4) as tagged during disassembly. Tighten the screws.

Install the six cables (1) as tagged during disassembly. Tighten the screws.

Refer to Section Pin Assignment Electrical Components, Sheet 25B, Low-Voltage Contactors of Volume G2, Cabling Documentation for main compressor contactor (47.2/2) electrical connections.

Earth Fault Relay (89.2)

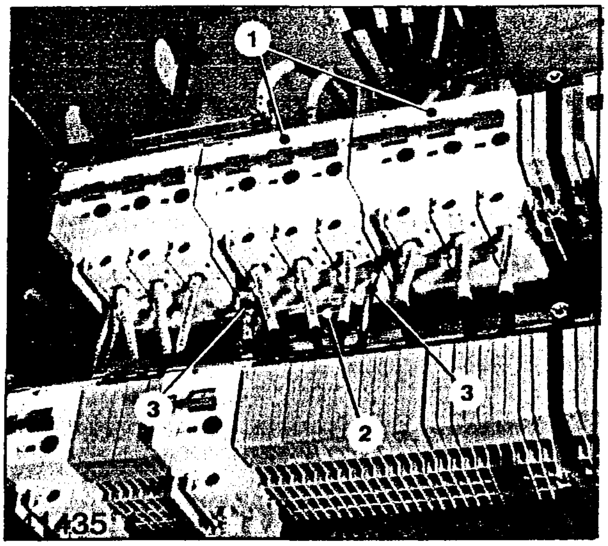


Fit the earth-fault relay (2) on the uppermost level within the cabinet.

Fasten the earth-fault relay (2) with both diagonally positioned screws (3). Reconnect the cables (1) to the contact earth-fault relay (2) 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 earth-fault relay (89.2) electrical connections.

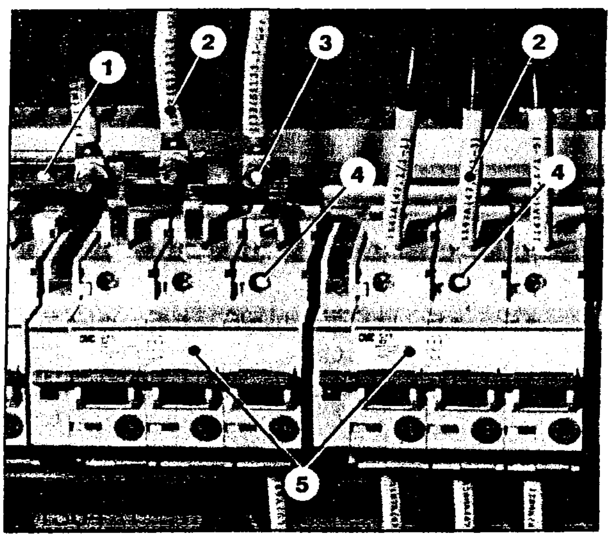
Circuit Breaker (62.1/2, 63.1/2, 47.1/2, 53.1/2, 55.1/2, 59.1/2)



Attach the circuit breaker (1) to the upper edge of the fixed profile. The spring (2) on the back of the circuit breaker snaps into place with slight backward pressure.

Slightly loosen the screws on the left-hand side but do not remove them. Fasten the cables (3) with the screws as tagged during disassembly.

Refer to Section Pin Assignment Electrical Components, Sheet 25A, Circuit Breakers of Volume G2, Cabling Documentation for circuit breaker (62.1/2, 63.1/2, 47.1/2, 53.1/2, 55.1/2, 59.1/2) electrical connections.

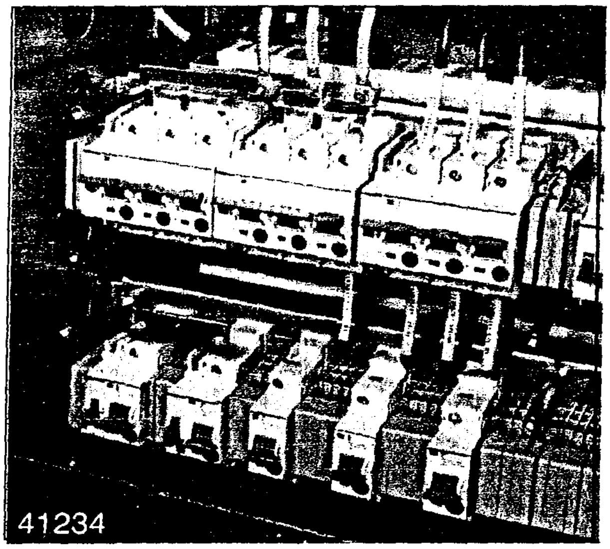


Loosen six screws (4) slightly but do not remove. Fasten the corresponding cables (2) or connecting rails (1) with the screws (4) as tagged during disassembly. If connecting rails (1) are to be connected, tighten the screws (4) in the adjacent circuit breaker (5) as well.

Install the protective covers as described in Protective Covers in this Section.

Assemble the clear cover as described in Clear Cover in this Section.

Circuit Breaker (56.1/2, 54.1/2)


41234

Attach the circuit breaker to the upper edge of the fixed profile. The spring on the back of the circuit breaker snaps into place with slight backward pressure.

Slightly loosen the screws on the left-hand side but do not remove them. Fasten the cables with the screws as tagged during disassembly.

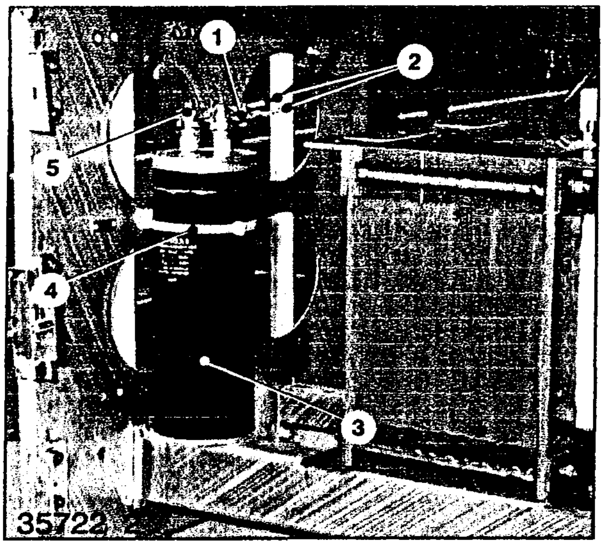
Loosen the screws slightly but do not remove. Fasten the corresponding cables or connecting rails with the screws to the upper and lower points on the circuit breaker as tagged during disassembly. If connecting rails are to be connected, tighten the screws in the adjacent circuit breaker as well.

Install the protective covers as described in Protective Covers in this Section.

Assemble the clear cover as described in Clear Cover in this Section.

Refer to Section Pin Assignment Electrical Components, Sheet 25A, Circuit Breakers of Volume G2, Cabling Documentation for circuit breaker (56.1/2, 54.1/2) electrical connections.

Machine Room Blower Motor Capacitor (54.5/2, 54.8/2)



Fasten the capacitor (3) on the lowermost level on the left-hand side.

Guide the screw thread at the lower end of the capacitor through the opening in the brace. Place the capacitor on the brace. Hold the capacitor (3) so that it does not tip over.

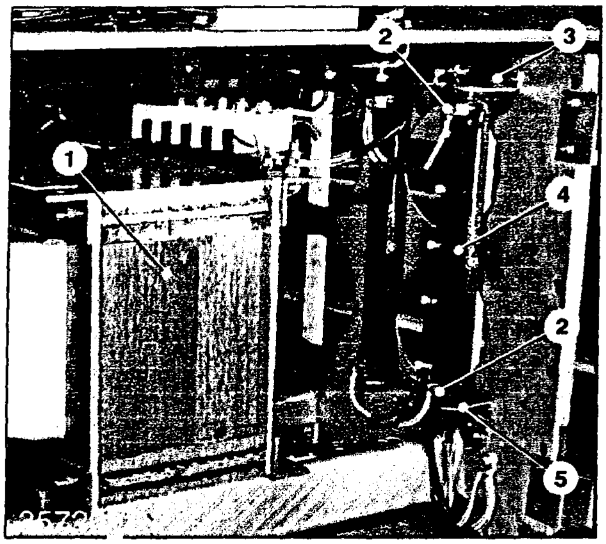
Fasten the cable tie (4) around the capacitor (3).

Fasten the lower part of the capacitor (3) with a high tension spring lock washer and nut to the metal brace.

Reconnect the cables (2) to the capacitor (3) as tagged during disassembly. Secure the cables (2) with screws and nuts (1).

Refer to Section Auxiliary Circuits 1-Phase, Sheet 03A, Auxiliaries 415/110V Single Phase of Volume G1, Cabling Documentation for machine room blower capacitor (54.5/2) electrical connections.

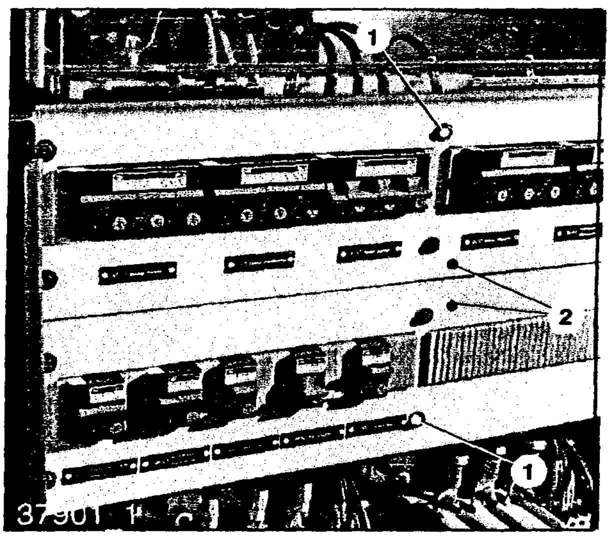
Earthing Resistors (90.3/1, 90.3/2)



Position the earthing resistor (4) on the lower angle (5) and fasten the upper angle with hexagonal head screws (3). Fasten the cables with screws (2).

Refer to Section Auxiliary Circuits 3-Phase, Sheet 02A, Earth Fault Detection of Volume G1, Cabling Documentation for earthing resistor (90.3/1, 90.3/2) electrical connections.

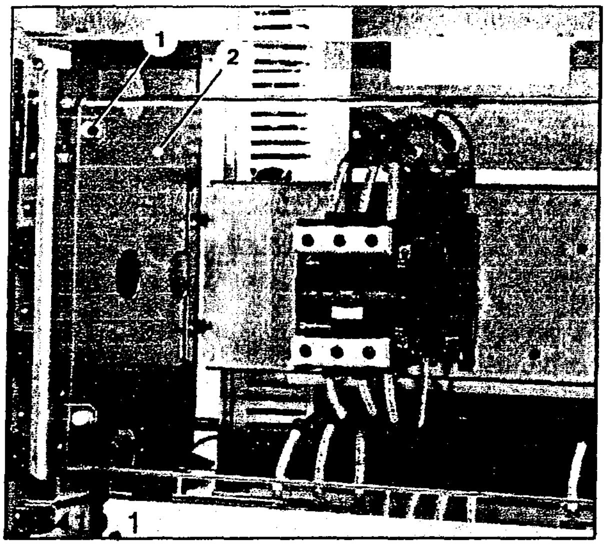
Protective Covers



Position the protective covers (2), aligning the holes in the cover with those in the support brackets.

Secure the protective covers (2) using the screws (1), plain and spring washers.

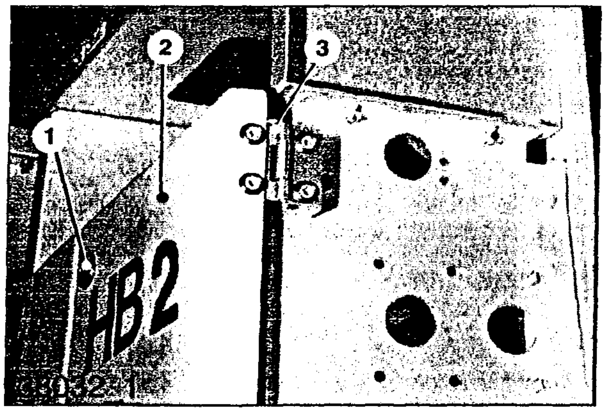
Clear Cover



Align the holes in the clear covers (2) with the mounting holes in the brackets.

Install and tighten the nylon screws (1) into each corner to secure the covers (2).

Doors

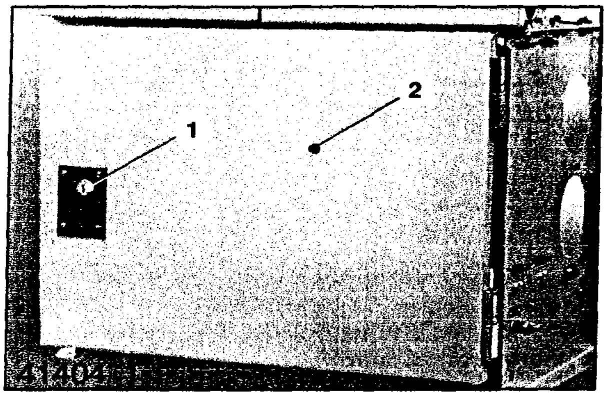


Lift the door (2) and push the bolt (3) into the upper hinge.

Align door (2) and push the other bolt (3) into the lower hinge.

The procedure for the other door (2) is identical.

Close the locks (1) with a square key.



If necessary, close the door (2), then close the lock (1) using a green key. Operation of the key interlocking system is described in the Preface of this Volume.

Installation

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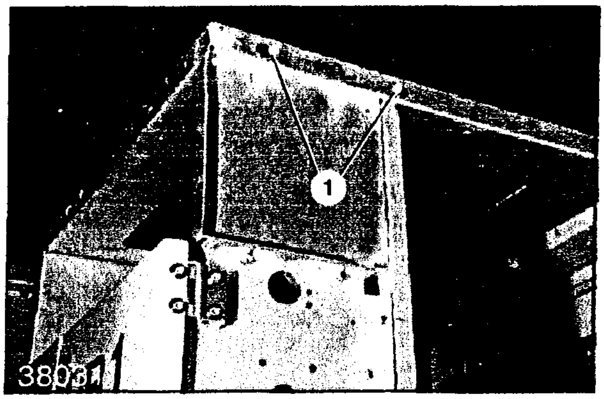
Auxiliary Cubicle HB1

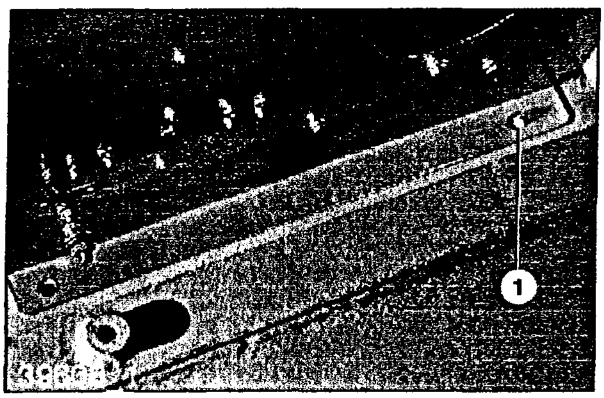
IMPORTANT:

Position the lifting equipment in such a way that, when lifting the auxiliary cubicle, the front tilts forward slightly.

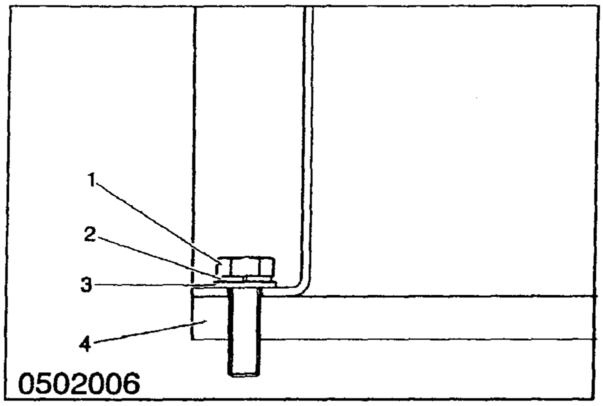


Attach suitable lifting equipment to the eyelets (1) on the HB cubicle. Raise the lifting equipment slightly to take the weight of the cubicle.

Ensure that nothing is entangled between the locomotive and the HB cubicle, then lower the HB cabinet into the locomotive machine room.

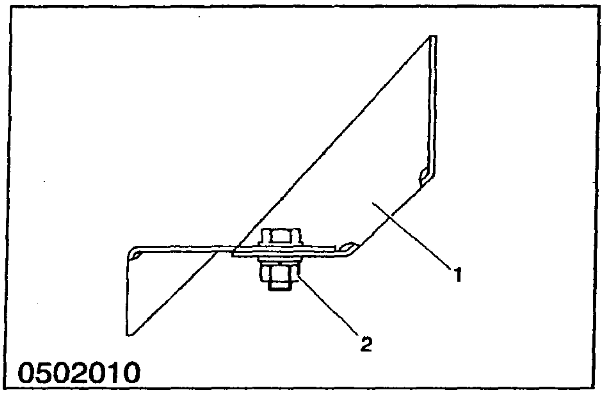


Lower the HB cubicle slowly into position. Guide the holes in the profile of the HB cubicle over the locating studs (1) in the machine room floor.

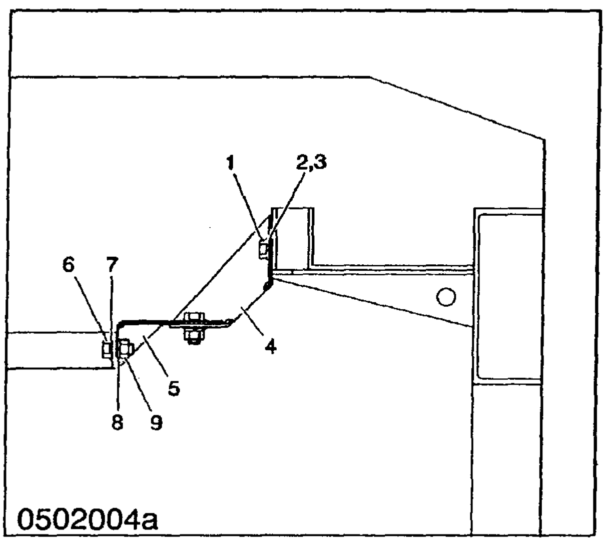


The cubicle is fixed by two bolts (1) to the floor frame (4).

Apply Molycote White to the threads of the bolts, then install the bolts (1), spring and plain washers (2, 3). Do not tighten the bolts (1) until the cabinet is correctly aligned.



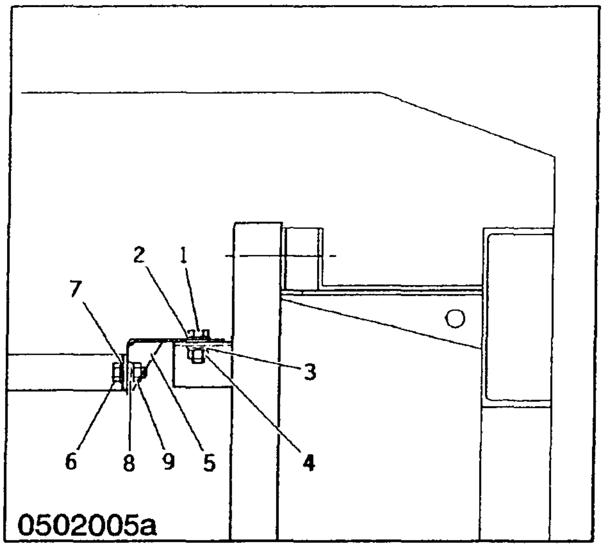
Loosen the nut (2) in the right hand side angle bracket (1) to aid in aligning the bracket.



Hold the angle bracket assembly (4, 5) in position on the right hand side of the HB cabinet. Install the bolt (6) and the washer (7) through the bracket. Install the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

Install the bolt (1), spring and plain washers (2, 3) securing the right hand side angle bracket (4) to the machine room wall.

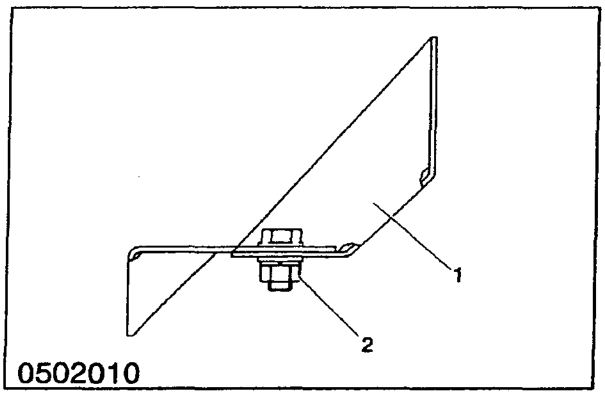
Tighten bolts (1, 6).



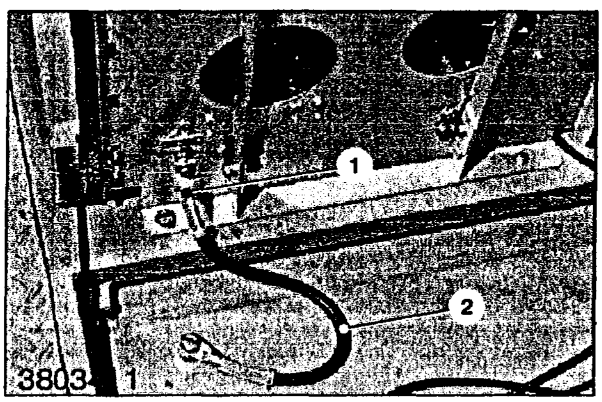
Hold the angle bracket (5) in position on the left hand side of the HB cabinet. Install the bolt (6) and the washer (7) through the bracket. Install the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

Install the bolt (1), washers (2, 3) and nut (4) securing the left hand side angle bracket (5) to the machine room wall.

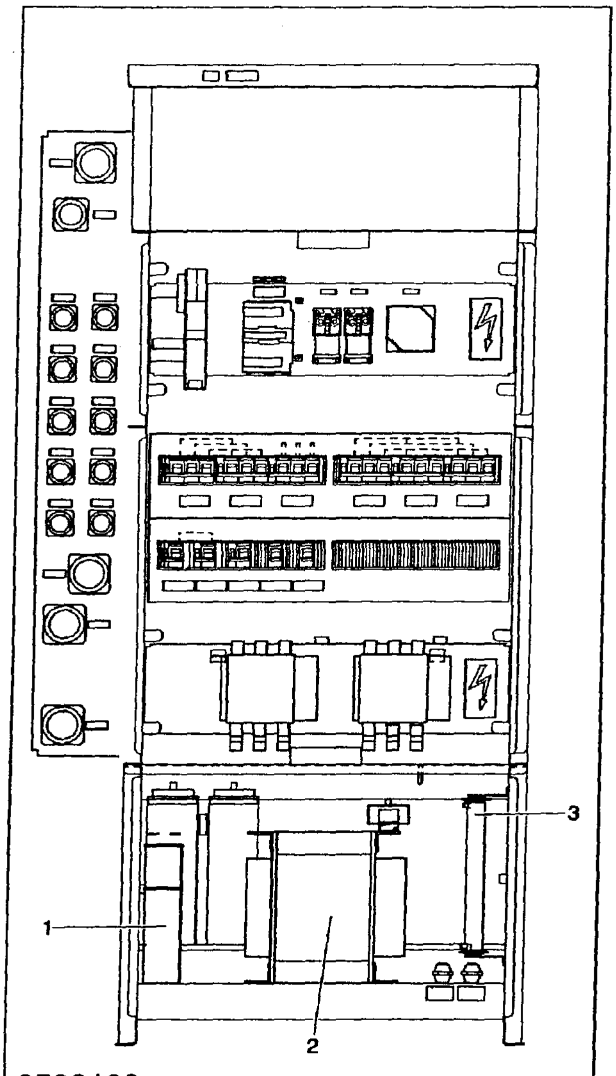
Tighten the bolts (1, 6).



Once both brackets have been secured to the HB cabinet and the machine room wall, tighten the nut (2) on the right hand side bracket (1).



Remove the nut (1) and washers and reconnect the earthing cable. Replace the nut (1) and washers and tighten.



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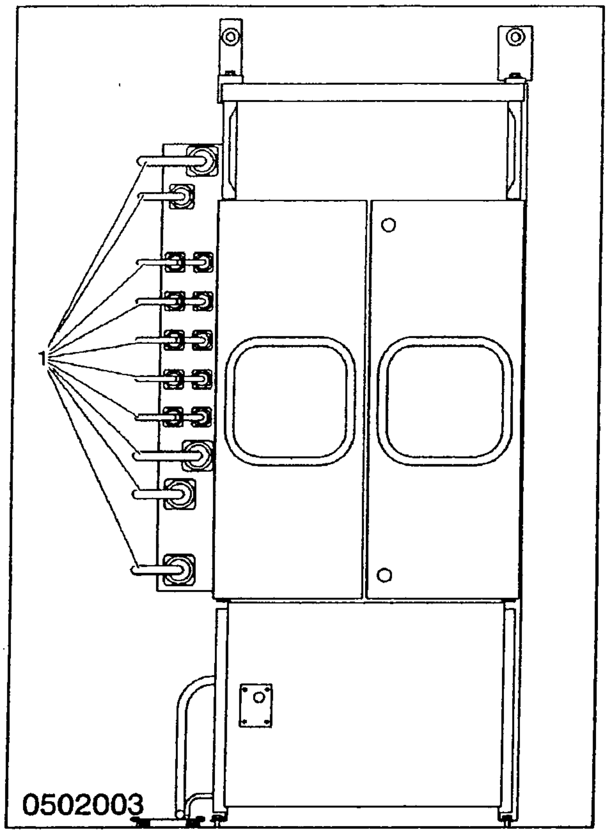
Reconnect the high voltage cables to the machine room blower capacitors (1), auxiliary transformer (2) and earth fault detection resistors (3) as described in Section Assembly.



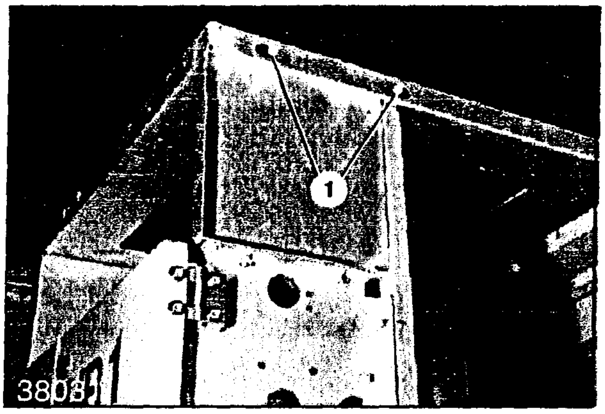
Reconnect the harnesses to the sockets (1) at the top of the HB cubicle. Turn the rings clockwise to secure the bayonet connectors.

Close and lock the lower HB1 cabinet door using a green key. Operation of the key interlocking system is described in the Preface of this Volume. Open the lower HB1 cabinet door.

Auxiliary Cubicle HB2

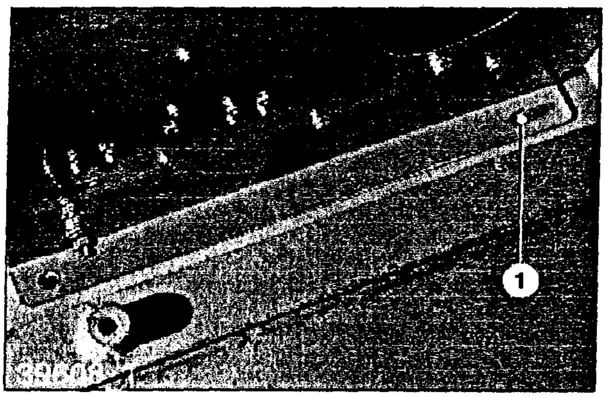
IMPORTANT:

Position the lifting equipment in such a way that, when lifting the auxiliary cubicle, the front tilts forward slightly.

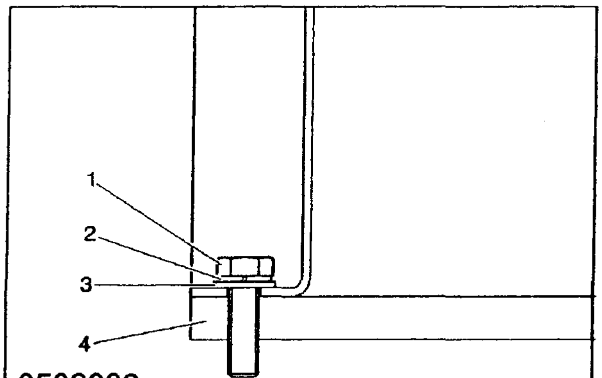


Attach suitable lifting equipment to the eyelets (1) on the HB cubicle. Raise the lifting equipment slightly to take the weight of the cubicle.

Ensure that nothing is entangled between the locomotive and the HB cubicle, then lower the HB cabinet into the locomotive machine room.



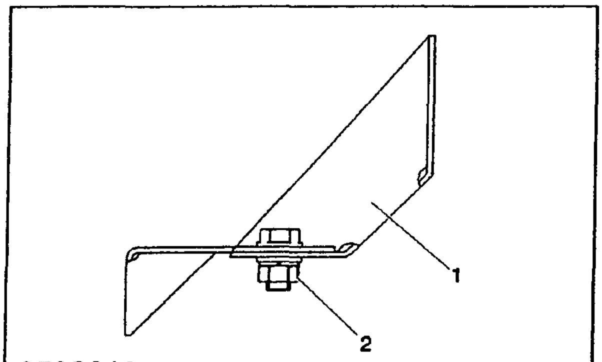
Slowly lower the HB cubicle over the assembly studs (1). Ensure that the locating holes are correctly aligned with the studs (1) before fully lowering the cubicle.



0502006

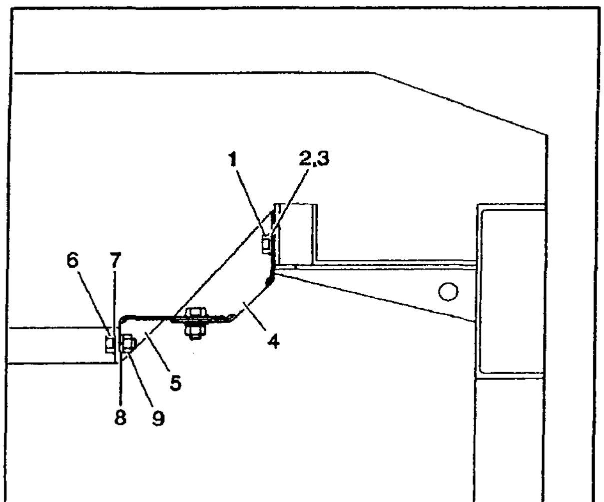
The cubicle is fixed by two bolts (1) to the floor frame (4).

Apply Molycote White to the threads of the bolts, then install the bolts (1), spring and plain washers (2, 3). Do not tighten the bolts (1) until the cabinet is correctly aligned.



0502010

Loosen the nut (2) in the right hand side angle bracket (1) to aid in aligning the bracket.



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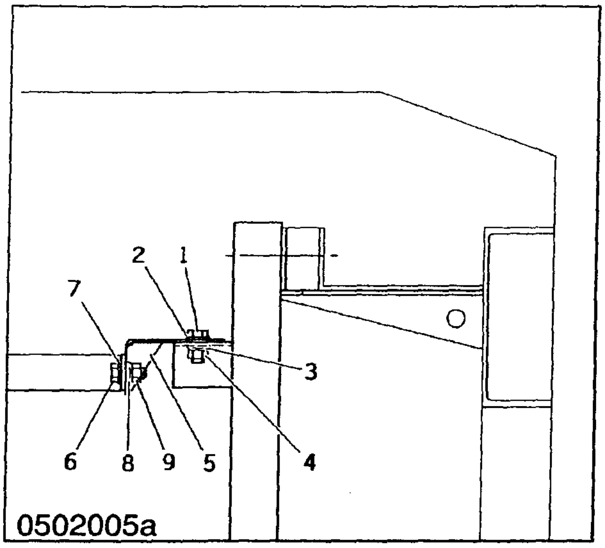
Hold the angle bracket assembly (4, 5) in position on the right hand side of the HB cabinet. Install the bolt (6) and the washer (7) through the bracket. Install the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

Install the bolt (1), spring and plain washers (2, 3) securing the right hand side angle bracket (4) to the machine room wall.

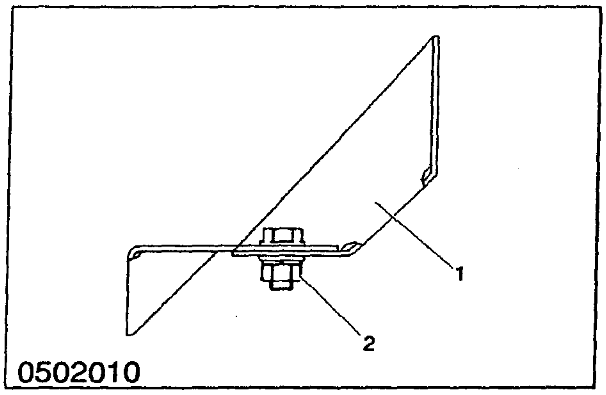
Tighten the bolts (1, 6).



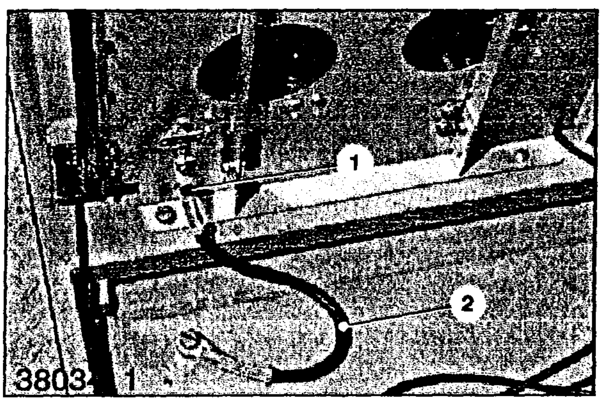
Hold the angle bracket (5) in position on the left hand side of the HB cabinet. Install the bolt (6) and the washer (7) through the bracket. Install the nut (9) and the spring washer (8) securing the bracket (5) to the control cubicle.

Install the bolt (1), washers (2, 3) and nut (4) securing the left hand side angle bracket (5) to the machine room wall.

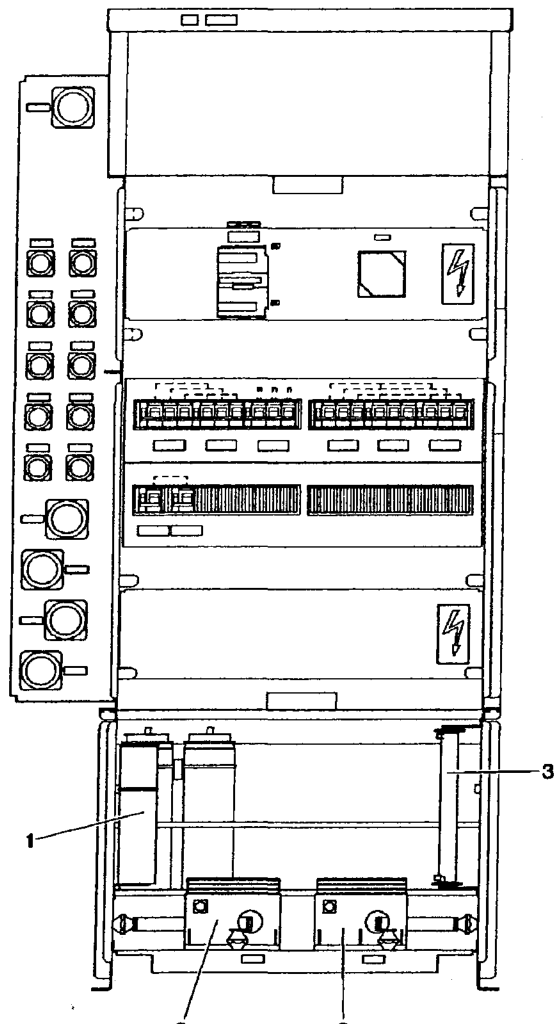
Tighten bolts (1, 6).



Once both brackets have been secured to the HB cabinet and the machine room wall, tighten the nut (2) on the right hand side bracket (1).



Remove the nut (1) and washers and reconnect the earthing cable. Replace the nut (1) and washers and tighten.



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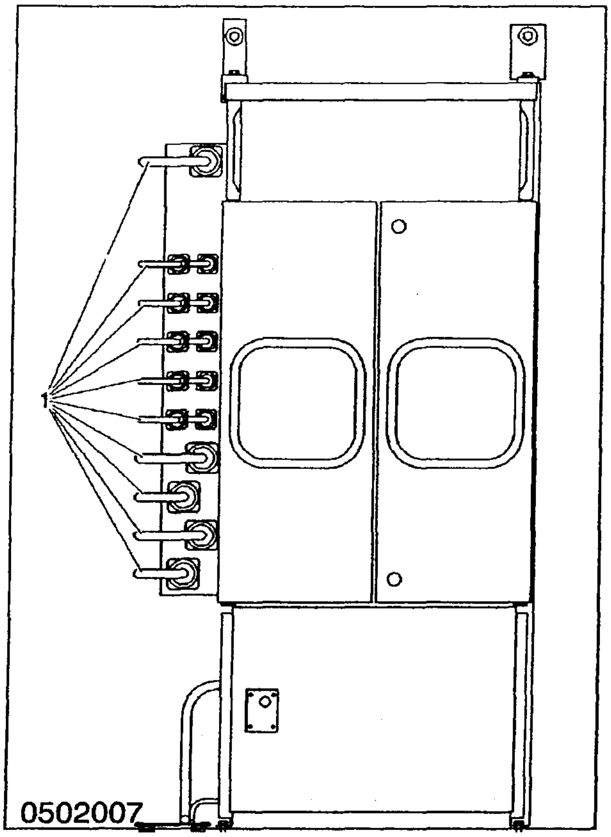
Reconnect the high voltage cables to the machine room blower capacitors (1), current sensors (2) and earth fault detection resistors (3) as described in Section Assembly.



Reconnect the harnesses to the sockets (1) at the left of the HB cubicle. Turn the rings clockwise to secure the bayonet connectors.

Close and lock the lower HB2 cabinet door using a green key. Operation of the key interlocking system is described in the Preface of this Volume. Open the lower HB1 cabinet door.

After-Installation Operations

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Install the pantograph roof as described in Chapter 1.1, Structure.

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