UNIMET

INSTALLATION AND MAINTENANCE INSTRUCTIONS

CONTENTS

5. OPERATION

6. ROUTINE MAINTENANCE

7. CORRECTIVE MAINTENANCE, REPLACEMENT OR ADJUSTMENT

1. SAFETY PRECAUTIONS

1.1 GENERAL

It is the duty of all persons, directly or indirectly associated with the installation, control, operation or maintenance of the equipment to eliminate or minimise any risks to health or safety. Attention is drawn to the "Health and Safety at Work etc. Act 1974" and BS6423 British Standard Code of Practice for Maintenance of Electrical Switchgear and Controlgear for voltages up to and including 650V.

All persons operating or working on the equipment must be competent and be aware of any dangers which may arise during normal operation.

Tools must not be used to gain access to any part without first referring to the appropriate instructions or drawings. Covers, doors or screens carrying a warning of live equipment must not be removed without ensuring that the equipment is first made dead.

NO ELECTRICAL CONDUCTOR SHOULD BE REGARDED AS BEING DEAD UNLESS IT HAS BEEN PROVED TO BE SO.

1.2 EMERGENCY PROCEDURES

Should an abnormal condition arise, either in the switchgear or its associated equipment and cables, then the following procedure must be adopted:

a) Immediately isolate from the supply any area of fault.

b) Should a fault have occurred in or adjacent to an incoming transformer panel, the associated H.V. circuit breaker must also be tripped.

c) In case of fire, the mains and standby supplies must be isolated.

d) Do not, under any circumstances, use water to put out a fire in or around electrical equipment.

e) For personal injury or electric shock, follow such instructions as laid down by the "British Safety Council's" publication: "Treatment for Asphyxia including Electric Shock" and seek immediate medical advice and attention.

f) After a fault and prior to reinstatement, equipment must always be checked by a competent person, to ascertain the cause and any remedial action taken. As soon as possible thereafter the routine maintenance programme (See Section 6) should be carried out. Work on H.V. equipment must always be carried out by authorised personnel only.

1.3 HANDLING

Each cubicle is fitted with lifting eyes to assist handling. Lifting arrangements must be such that the load is carried evenly between all the eyes provided and that as far as possible inclined loading is avoided. It is recommended that spreader frames must be used to achieve this since the safe working load of the eyebolt is significantly reduced when inclined loading is applied. (See BS4278 for details).

When rollers are used to assist handling a load bearing plate must be positioned between the cubicle base and the rollers. Special care must always be taken to prevent the cubicle toppling over when the rollers are employed, particularly on uneven or sloping surfaces.

1.4 INSTALLATION AND COMMISSIONING

Information on the design, construction and installation of equipment to ensure that so far as is reasonably practicable it is safe and without risk to health when properly used may be found in:

a) relevant British Standard Specifications and Codes of Practice

b) Electricity Supply Authority Specifications and Codes of Practice

c) IEE Regulations for Electrical Installations

d) Relevant Catalogues and Product Data Sheets of the equipment manufacturers.

The equipment should be installed or commissioned by or under the supervision of competent persons in accordance with IEE Wiring Regulations, Statutory Requirements and Instructions specifically advised by the manufacturer.

1.5 MAINTENANCE

Before carrying out any maintenance work ensure that the equipment is isolated and safe.

Consult manufacturer's Relevant manual covering maintenance and/or service of the particular equipment before proceeding further.

The incoming supply must be isolated by locking off: H.V. circuit breakers and fuse switches, generating plant, bus-couplers or supplies from other switchboards. The isolation should be checked with suitable reliable test equipment.

While all incoming supplies may have been isolated, certain auxiliary/control supplies may still be "live", eg. DC tripping supplies from a battery unit.

Although means of isolation is provided while working on the load side of devices by opening or tripping the respective circuit device, measures must be taken to prevent unintended re-closure, eg. padlocking in the off position.

2. DESCRIPTION OF EQUIPMENT

These instructions cover "Unimet" Switchboards and Motor Control Centres embodying Air Circuit Breakers, Moulded Case and Miniature Circuit Breakers, Fuse Switches and Switch Fuses, Motor Starters, Distribution Boards, Relay Panels and similar equipment. Full details of the individual devices and components are given in separate publications, available upon request from Ottermill.

Information on the particular Switchboard or Motor Control Centre regarding size, layout, arrangement of devices, ratings, etc. is given on the general arrangement drawings and circuit diagrams supplied with the equipment as part of the contract. More specific information can be obtained from the manufacturer by quoting the appropriate serial number of the equipment to be found on the switchboard rating label.

3. INSTALLATION

3.1 HANDLING

Cubicles may be lifted using eyebolts provided or manoeuvred into position on rollers with a load bearing plate between the base of the cubicle and the rollers. The cubicles must always be transported the right way up. When packed the case markings indicate the correct position. See also Section 1.3 regarding safety precautions.

3.2 STORAGE

The equipment must always be stored indoors in dry, clean conditions, free of contaminating or corrosive atmospheres. It should be stored in an upright position and where possible switching devices, (circuit breakers, fuse switches, etc.) should be placed in the "On" position.

3.3 ERECTION

3.3.1 General

The Switchboard or Motor Control Centre must be erected on a level and even surface. If necessary shims or packers should be used between the cubicle base and the floor to achieve correct alignment. On vented equipment there must be a minimum of 150mm clear space behind the cubicle to permit the free circulation of air.

When cubicles have been split for transport check the general arrangement drawing to ensure that they are erected in the correct sequence and that all cubicles are present. Each cubicle has provision for 4 foundation bolts and has 6 fixings securing it to the adjacent cubicle. The frame fixing screws, busbar fishplates and fixings are supplied in a plastic bag strapped to the framework adjacent to the jointing position. The foundation bolts should not be tightened down until the cubicle frame jointing bolts are correctly fitted.

3.3.2 FRAMEWORK JOINTING

Each framework is secured to the adjacent frame with M8 screws passing through clearance holes in the framework of the left-hand cubicle (viewed from the front) into weld nuts in the framework of the righthand cubicle. Jointing screws are supplied in a linen bag marked "Frame fixing screws" packed with the busbar fishplates, etc. Access to the screws is achieved as follows.

3.3.2.1 MODULE CUBICLES

Remove the front cable duct cover which is secured by 10 quarter turn fasteners. The frame fixing holes are on the right of the duct, 2 fitting into the angle immediately below the busbar chamber and 2 into each of 2 channels tying the front and rear uprights.

3.3.2.2 ACB CUBICLES

Remove the top and bottom front covers secured by M6 panhead screws. Remove the neutral link cover secured by M6 panhead screws to the immediate right of the ACB front panel. the frame fixing holes are now accessible on the right. When an instrument chamber is fitted access to the fixing screw obscured by the chamber is gained through a hole in the instrument chamber side sheet.

An additional 3 fixings are provided for fitting ACB cubicles to each other. The top hole is accessible through the busbar chamber either from the front if no instrument chamber is fitted or through the top by removing the busbar chamber covers. The bottom hole is accessible from the front in the same way as the other bottom fixing holes. The centre hole is only accessible if rear access is available so that the cubicle rear cover can be removed.

3.3 INSTALLATION

3.3.2.3 SINGLE TIER MCCB CUBICLES

Remove all front covers including the cover over the MCCB. The 3 front frame fixing holes are now accessible on the right hand side of the framework. Where screens have been fitted for BS5486 Class 3 equipment these must be removed to give access to the rear frame fixing holes. When an instrument chamber is fitted to the fixing screws obscured by the chamber is gained through a hole in the instrument chamber side sheet.

When the cubicles are correctly aligned and bolted together the foundation bolts may also be tightened. All screens and covers removed to permit jointing must be replaced before energising the switchboard or motor control centre.

3.4 CONNECTIONS

3.4.1 Main Busbars (R, Y, B, N and Earth)

The positions of the main busbars are shown on the general arrangement drawing. As standard the R, Y and B phase busbars are mounted in a compartment at the top rear of the cubicle in red, yellow and blue order from the rear. The neutral and earth busbars are fitted at the bottom of the cubicle, the neutral bar being mounted on insulated pillars slightly above and in front of the earth bar.

Access to the phase busbars may be made from the front or top by removing the appropriate covers. Neutral and earth covers are accessible by removing the front bottom cover and the cable duct cover (when appropriate).

The busbar fishplates, nut plates, screws, etc. are supplied in a plastic bag strapped to the framework adjacent to the site jointing position. Check that the contact faces of the busbars and fishplates are clean and free of defects before jointing up.

3.4.1.1 PHASE BUSBARS

Beginning with the rear most busbar place the fishplate to the front of the busbar and fit with the M10 screws and washers through from the front screwing into the nut plate fitted to the rear of the busbar. With all screws in place ensure that they are correctly tightened. (See Section 3.4.3 for recommended torque values). Repeat for the remaining busbars.

With all fishplates in position and secure, check that electrical clearances have been maintained and on insulated busbar systems that all joint shroud mouldings are correctly fitted and properly secured. Re-fit main covers.

3.4.1.2 NEUTRAL BUSBAR

Insert the correct length M10 screw fitted with a flat washer under the head through from the rear of the busbar. Fit the fishplate on the front of the busbar and secure with the washers and nuts provided. With all screws in place ensure that they are properly tightened. (See Section 3.4.3 for recommended torque values).

3.4.1.3 EARTH BUSBARS

The M12 bolts for fixing the earth busbar and fishplates are already in position. Swing the earth connecting link on to the adjacent panel screw and secure with nuts and washers provided, ensuring that the joints are properly tightened. (See Section 3.4.3 for recommended torque values).

3.4.2 Secondary Connections

Details of secondary wiring and connections are given on the relevant schematic and wiring diagrams. All bus wires must be terminated in accordance with the drawings which give information regarding the size, type and number of wires. Complete all other small wiring in accordance with the relevant drawings.

3.4.3 Recommended Torque Settings

The following table gives recommended torque values for busbar and connection joints when using standard ISO coarse thread, grade 8.8 hexagonal head bolts or screws with grade 8 nuts using plain washers under both screw, or bolt, head and nuts. They do not apply when using proprietary locking screws or nuts (Wedglok, Nyloc, etc.). These torque values are only applicable when both nut and bolt, (or screws) are in a new clean dry, unlubricated condition with standard plating finish. Lubricated threads may fail if torque values much above those quoted are used. In general the figures equate to a good spanner tightness and are those normally obtained using standard spanners.

SIZE	RECOMMENDED TORQUE		
	LB.-INS.	LB.-FT.	Nm
M5	50	4.2	5.7
M6	70	5.8	7.9
M8	150	12.5	17
M10	250	21	28
M12	400	33	45
M16	800	67	91
M20	1200	100	136
M24	1900	158	215

3.5 EARTHING

The complete Switchboard or Motor Control Centre must be adequately bonded to earth with solid copper strip, cable or substantial copper tape connected between the Switchboard earth terminal and the Sub Station earth bar.

When the system neutral to earth connection is an integral part of the switchboard, the standard arrangement is a removable link between the neutral and earth busbars. If a special arrangement is used it may be necessary to fit an additional connection from a terminal on the neutral to earth connection.

The main cubicle structures are effectively bonded to the earth bar as are individual devices mounted within the cubicle.

For further information regarding earthing arrangements reference should be made to BS162 - Electric Power Switchgear - Appendix D and relevant sections of IEE Regulations for Electrical Installations.

3.6 CABLING

Cabling should be carried out in accordance with cable manufacturers instructions ensuring that all contact surfaces are clean and all bolts or screws properly tightened. (See Section 3.4.3 for recommended torque.

For arrangements with side cable ducts the gland plates can be re-positioned on site to suit practical requires (see Section 7.2.3). The cable glands should always be securely bonded to earth (Section 3.5).

Care must always be taken to ensure the maintenance of electrical clearances. In particular care should be taken to avoid loose strands of cable. Where terminal shrouds are provided they should be securely fixed into their correct position, using screws provided or tape.

Under no circumstances should aluminium cables be directly terminated in clamp type terminals, the correct termination must always be used.

Appropriate precautions must be taken at cable entry points into the switchboard or motor control centre to ensure the IP.. degree of protection of the enclosure is maintained.

4. COMMISSIONING

It is essential that all unauthorised personnel are kept clear of the switchboard during operational checks or any tests involving high voltages.

4.1 VISUAL INSPECTION

4.1.1 General

Check that the cubicles are assembled in the correct order as shown on the general arrangement drawings. Check that main busbars jointing, connections, earthing and cabling have been correctly carried out and are complete.

Inspect the switchboard to ensure all insulation is clean and dry. If there is any sign of dampness heaters should be used accordingly, warm dry air applied for 2-3 hours will normally be sufficient. (WARNING: excessive heat can damage some thermo-plastics.

If the Switchroom is normally subject to dampness or condensation suitable room heaters should be installed.

Check that cable entry cut-outs maintain the required degree of protection of the enclosure and that all cable entries, gland plates and vermin sheets are correctly positioned and secure.

Check that there is adequate electrical clearance between conductors and between conductors and earth, paying particular attention to cable connections. Ensure that all screens, barriers and insulation are in place and secure.

Check that all removable devices are correctly plugged in and properly connected to their fixed contacts or the riser busbars as appropriate.

Ensure that the interior of the cubicle is clean and all swarf, pieces of cable or armour or any other foreign bodies, including tools, have been removed. Excessive dust should be removed by vacuum cleaning.

4.1.2 Instruments, Meters and Relays

Remove all temporary transit struts or packing. Meters and relays normally have packing inserted to prevent damage during transit. Such packing must be carefully removed in accordance with the instrument manufacturers recommendations.

4.1.3 Fuses

Check that the correct type and size of fuselink has been fitted and properly tightened on all fused equipment, eg. fuse switches, fuse distribution boards, motor starters, control circuits, etc. The normal fuse rating to be fitted is indicated on the appropriate wiring diagrams.

4.1.4 Air Circuit Breakers

Withdraw the ACB (Drawout models only) and check that the ACB is in good condition with no obvious damage. Check the operation of the mechanism and drawout (where appropriate) together with interlocks and indicators for correct adjustment and operation. Note that ACBs fitted with an undervoltage release will need to have the plungers held up in some safe way in order to check the ACB closing operation. Refer to the separate ACB Maintenance Manuals for details of adjustments. Remove arc chutes and check for damage or dampness, if the arc chutes are damp dry out as indicated in Section 4.1.1.

4.1.5 Fuse Switches and Switch Fuses

Check the device for any obvious signs of damage. Check the operation of the mechanism and interlocks. Check that fins (where fitted) are correctly positioned on top of the fuse link tag and that all fuse link fixings are properly tightened. Refer to the separate manual for further details.

4.1.6 Fuse Distribution Boards

Check the distribution board for any obvious signs of damage. Check that all shrouds and screens are fitted and that all fuse carriers are properly inserted.

4.1.7 Miniature and Moulded Case Circuit Breakers

Check the device for any obvious signs of damage. Operate the breaker to check the mechanism operation. Check correct operation of interlocks (where fitted).

4.1.8 Motor Starters

Check the starter for any obvious signs of damage. Check the contactor mechanisms are free. Check the isolator operation and the operation of any mechanical or electrical interlocks.

4.1.9 Contactor, Relay and General Equipment Panels

Check for any obvious signs of damage. Check for correct and free operation of mechanisms and interlocks. Check that all necessary shrouds, screens and barriers are properly fitted and secure.

4.2 MEGGER AND FLASH TESTS

Isolate all light current devices by removing the control circuit fuses and disconnecting the associated neutral leads. Remove all main neutral links. Disconnect voltage reference wires from electronic components, eg. transducers, rectifiers etc.

Megger the busbars, risers, etc. with a 1,000 volts megger between phases, each phase and neutral to earth and record the readings. A low reading will probably be due to dampness. However, if after drying out (see Section 4.1) readings are still unacceptable advice should be sought from the manufactures. Note that megger readings are dependent upon the actual equipment concerned and on the size and complexity of the switchboard and thus will differ within the product range.

When acceptable megger readings have been obtained a flash test of 2.5kV for a minimum of 15 seconds may be applied. A further megger test should give similar readings to those previously recorded.

Replace all fuses, links and connections, etc. and carry out operational checks confirm that the correct connections have been made.

4.3 OPERATIONAL CHECKS

Check all circuit breakers, fuse switches, isolators, etc. for correct and free mechanical operational. Check auxiliary supplies for security and stability.

Check all mechanical and electrical interlocks for correct functioning. Note: electrical interlocking schemes cannot be properly checked and the switchgear should not be operated unless all auxiliary circuit supplies are available and healthy.

Adjust or set all protection relays, trips and overload devices according to the overall discrimination scheme and manufacturers published information.

Ensure that all protective devices, auxiliary and control equipment, including closing contactors, anti-pump relays, timers, synchronising equipment, etc. are in sound working order and their operation results in correct operation of the equipment they control. Auxiliary tripping and inter-tripping relays should be checked for correct operation by energising the appropriate circuits.

Secondary injection testing should be carried out on protective devices as necessary.

4.4 ENERGISING

The phase rotation of each incoming supply should be checked. When there is more than one incoming supply ensure that each supply is correctly phased.

When all access covers have been secured in their correct positions the incoming supplies may be made available.

Full operational checks should be carried out in line with normal mode of operation to ensure the correct function and setting of each device.

5. OPERATION

5.1 GENERAL

A regular programme of maintenance should be considered part of the normal operating procedure (see Section 6).

Except for maintenance purposes it is not normally necessary to gain access to the interior of the switchboard or any device after commissioning.

If fuses blow or circuit breakers trip the cause must be ascertained and remedial action taken before the device is put back into service (See also Section 6.1).

5.2 DIRECTION OF OPERATING HANDLES

Manually operated devices carry labels clearly indicating the normal operating method.

ACBs are clockwise for "on".

H2S Fuse Switches are up for "On".

Rotary Isolators are clockwise for "On".

Miniature and Moulded Case Circuit Breakers with rotary motions are anti-clockwise for "On".

Miniature and Moulded Case Circuit Breakers with linear motion have the direction of switching indicated by a label. The direction being dependent upon the mounting method and position.

Under no circumstances should handles be forced. If excessive resistance is felt, firstly check that any locking or interlocking is not the cause. If all the locks and interlocks are free and the operating force required is still high, at the first opportunity, check the mechanism for possible damage. If still in doubt consult the manufacturer. Do not leave any damaged device in service, repair or replace at once.

6. ROUTINE MAINTENANCE

6.1 GENERAL

For switchgear operating under normal service conditions a programme of maintenance should be carried out annually. For very frequently operated equipment intermediate maintenance intervals of 6 or even 3 months should be considered. After short circuit interruption the cause must be ascertained and remedial action taken before putting back into service. As soon as possible thereafter the routine maintenance programme should be carried out.

6.1.1 Safety

Before carrying out any maintenance work ensure that the equipment is isolated and safe and that all safety procedures and safeguards are being applied. (See Section 1.1).

6.1.2 Inspection

All connections and busbar joints should be checked for signs of overheating. Any suspect joint face should be cleaned and properly tightened (see Section 3.4.3). Plated contacts and connections should be wiped or cleaned with metal polish if they appear black or oxidized. The use of abrasives should not be necessary.

Check that there adequate clearance between phases and to earth and that all mouldings, shrouds and barriers are in good condition and properly fitted. Any accumulation of dust should be removed, preferably with the aid of a vacuum cleaner.

6.1.3 Megger Test

Isolate all light current devices by removing the control circuit fuses and disconnecting the associated neutral leads. Remove all main neutral links. Disconnect voltage reference wires from electronic components, eg. transducers, rectifiers, etc. Megger the busbars, risers, etc. with a 1,000 volt megger between phases, each phase to neutral, each phase and neutral to earth and record the readings. The figures obtained should not be substantially lower than any previous recorded. Significantly reduced readings will probably be due to a build up of dust on, or dampness of, the insulation. However, if after cleaning and/or drying the insulation readings are still unacceptable advice should be sought from the manufacturers.

When acceptable readings have been obtained replace all fuses, links and connections, etc. and carry out operational checks to confirm that the correct connections have been made.

6.1.4 Operational Check

Carry out the operational checks detailed in section 4.3.

6.2 DEVICES

6.2.1 Instruments, Meters and Relays

Check the settings and adjust as necessary all protection relays, trips and overload devices. Ensure that all protective devices, auxiliary and control equipment including closing contactors, anti-pump relays, timers, synchronising equipment, etc. are in sound working order and their operation results in correct operation of the equipment they control.

6.2.2 Fuses

Check that fuse fixings are properly tightened on all fused equipment, eg. fuse switches, fuse distribution boards, motor starters, control circuits, etc. Any fuses showing obvious signs of overheating, eg. blackened terminals, should be replaced after ascertaining and correcting the reasons for overheating.

6.2.3 Air Circuit Breakers

The circuit breaker should be inspected and checked every 12 months or 500 operations if this is less. Check for any obvious signs of damage, excessive wear, loose screws, etc. and check the adjustment of the contacts and mechanism. Lightly oil bearings and shafts using only thin machine oil on trip levers and rollers (see Section 6.3). Insulation should be inspected and if necessary wiped clean and dry. Arc chutes should be removed and examined and the insides wiped clean.

Information regarding specific maintenance and adjustment of type OMA Air Circuit Breakers is contained in Ottermill Publication AC128 'Type OMA Air Circuit Breakers, Maintenance and Service Manual'.

6.2.4 Fuse Switches and Switch Fuses

Check the device for any signs of damage, excessive wear, loose screws, badly turned contacts, etc. Check the operation of the mechanism and interlocks. Check fuses as detailed in Section 6.2.2.

Mechanism pivots and bearings should be lightly oiled, wipe up any excess (see Section 6.3).

Clean out any dust or dampness, particularly on or around insulation.

Badly burned Type HDC Switch contacts may be lightly dressed with a smooth file to remove extreme high spots. Carefully remove all filings and dust and very lightly grease the contact faces (see Section 6.3). Silver tipped or silver plated contacts should only be wiped clean or any oxide removed with metal polish. Slight pitting and roughness on silver tipped contacts is of no consequence.

Detailed information regarding specific maintenance is given in the following Ottermill Publications:

'Type H2S Fuse Switch and Switch, Type H1S Switch Fuse and Switch. (63-200 amp). Installation and Service Manual' Ref: GB0110.

'HDC and HDS Fuse Switch Maintenance Manual' Ref: HDC006

'HDC H2S (630-800 amp) Fuse Switch and Switch Installation and Service Manual' Ref GB0114.

6.2.5 Fuse Distribution Boards

These should require no maintenance beyond checking of fuses (see Section 6.2.2), checking that all cable and connection joints are tight and all insulation shrouds, screens and barriers are in place and secure.

6.2.6 Miniature and Moulded Case Circuit Breakers

These are factory sealed units and no maintenance is required other than to check that all cable and connection joints are tight and that all insulation shrouds, screens and barriers are in place and secure.

6.2.7 Motor Starters

Check the starter for any sign of damage. Check that contactors are in good working order and the mechanisms are free. Check and adjust, if necessary, the setting of overload relays. Check the isolator operation and the operation of any mechanical or electrical interlocks. Check the fuses as detailed in Section 6.2.2. Check that all cable and connection joints are tight and that all insulation shrouds, screens and barriers are in place and secure. Check all push buttons and indicator lights for correct operation. Any failed lamps should be replaced promptly.

6.2.8 Contactor, Relay and General Equipment Panels

Check for any signs of damage or overheating. Check that all items are in good working order, any mechanisms are free and all time delay or overload devices are correctly set. Check the operation of any mechanical or electrical interlocks. Check that all connections are tight and that all insulation, shrouds, screens and barriers are in place and secure. Check all isolators, pushbuttons, switches and indicator lights for correct operation. Any failed lamps should be promptly replaced.

6.3 LUBRICATIONS

All devices, mechanisms and contact faces are oiled or greased during manufacture as necessary. During normal life these lubricants may evaporate or wipe off and lubrication should take place during routine maintenance as indicated. Excessive use of lubricants particularly on light mechanisms is not advised and surplus grease or oil should be wiped up. The following table gives general guidance as to the type of lubricant used.

LUBRICANT	APPLICATION
Marcole Evolube	Contact faces, ACB isolating clusters, auxiliary plugs and sockets, stab contacts and riser busbar contact faces, fuse unit, fuse switch and isolator contacts
Duckhams General Purpose Grease	ACB drawout mechanism, switch carriage guides.
Hypoid 90 Gear Oil	ACB moving portion slides and roller bearings, fixed housing guides, device operating mechanism.
Light Machine Oil (eg 3-IN-1)	ACB tripping mechanism, fuse switch and switch fuse mechanism.

7. CORRECTIVE MAINTENANCE, REPLACEMENT OR ADJUSTMENT

7.1 GENERAL

Many assemblies are jig built by the manufacturer and correct assembly, adjustment or alignment particularly of contacts or operating mechanism may be difficult without these jigs. In any case extreme care must be taken to ensure correct alignment and satisfactory operation.

If replacement parts are required only original manufacturers' genuine spare parts or components should be used. Whenever possible the manufacturer's advice or assistance should be obtained before undertaking such work.

Attention is drawn to the safety precautions detailed in Section 1.5, and in BS6423.

Whenever cables or connections are removed or disconnected care must be taken to note the correct phase notation or wire number to ensure that the connection, wire or cable can be correctly identified and reconnected in its proper place.

7.2 BASIC SWITCHBOARD

7.2.1 Main Horizontal Busbars

Access may be obtained from the top, rear or front by removing appropriate covers. The phase arrangement of the busbars is R, Y & B from the rear. Particular note should be taken of the displacement of the busbars and the positioning of jointing fishplates. No maintenance is normally required beyond that detailed in Section 6.1.2.

7.2.2 Riser Busbars

7.2.2.1 GENERAL

Access may be obtained from the rear or from the front after first removing any connected devices. No maintenance is normally required beyond that detailed in Section 6.1.2.

The riser assembly is jig built at the factory with the riser brace fixings at pre-set torques. If these are disturbed refer to works for guidance, do not attempt to re-set.

If for any reason (eg. fitting larger bars) it is necessary to remove the riser busbars first ensure that the safety precautions detailed in Section 1 are being applied and follow the procedure given in Section 7.2.2.2.

7.2.2.2 REMOVAL OF RISER BUSBARS

Remove all front covers, devices and dividing trays between the devices. Remove all safety shutters and front screens. Disconnect risers from the main horizontal busbars. Remove the riser to busbar chamber insulation barriers (where fitted).

Provide temporary support to the underside of the riser assembly. Note that when all fixing screws are removed, unless supported, the riser assembly will fall to the bottom of the cubicle. With the riser assembly suitable supported remove the screws fixing the riser brace channels to the vertical support angles. Lower the riser assembly to the floor of the cubicle.

If rear access is available it is simplest to lower the riser assembly out through the back of the cubicle.

If front access only is available then turn the assembly so that, (viewed from the front) the lefthand ends of the riser brace channels are as far back and as far left as they will go, ie. the ends are inside the frame corner rebate. Swing the righthand side forward, this will just clear the righthand vertical riser support angle. The riser assembly may now be lifted out.

7.2.2.3 REPLACEMENT OF RISER BUSBARS

To replace a set of risers follow the reverse procedure from that given in Section 7.2.2.2. If working with front access only ensure that the left-hand side of the assembly is well back and to the left before attempted to swing the righthand side into place. It is recommended that the spacers/support pillars on the ends of the riser brace channel are not fitted until the riser assembly is located in the cubicle behind the vertical riser support angles and at approximately the correct height.

7.2.3 Cable Glands

On Air Circuit Breaker Cubicles or large MCCB and Fuse Switch cubicles the gland plates are fixed. The only maintenance required being to ensure that suitable earthing arrangements are maintained and that where the gland plate forms part of the enclosure that the appropriate IP number degree of protection is maintained.

On module cubicles with a side cable duct the gland plates can be repositioned to suit practical requirements. The gland support plate is fitted to the main cubicle framework by two panhead screws at each end screwed into nut plates fixed to the framework. Where solid copper earth bonding to the support plate is used this screw fixing must also be removed. The nut plates are fixed to the cubicle framework by a single panhead screw, releasing the screw permits the nut-plates to be repositioned. The support plate can then be refitted in its new position. Any earth connections must be remade.

7.2.4 Device Fitting

7.2.4.1 GENERAL

For specific instructions concerning the various devices see Sections 7.3 to 7.6 inclusive.

7.2.4.2 DIVIDING TRAYS

Should it be necessary to re-arrange devices within the switchboard the dividing trays between modules may be easily be removed. The tray has two rear hooks which fit into slots in the riser support angles and is fixed with a single screw each side through slots in the tray side angles into the front vertical frame members. To remove the tray slacken the front screws and lift the tray front, raise the rear of the tray to disengage the hooks and pull the tray straight out. If the trays are fitted at one module spacings it may be easier to remove the tray if the screws holding the trays above and below are also slackened.

7.2.4.3 DOORS AND HINGES

The basic hinge permits the door to be lifted off when it is fully open, however, the door may be made non lift off by fitting a screw drive through the door to engage with the hinge. As standard doors with equipment and wiring fitted and fuse switch doors are non lift off.

To remove a lift off door open the door approximately 90 degrees and lift straight up, the door hinges will now be disengaged and the door can be removed. To refit the door hold the door at right angles to the front of the switchboard and engage the hooks on the door brackets with the turned down portion of the hinge pin or pins. The door may now be pushed down on to the hinge pins to fully engage.

Non lift off doors may be removed by unscrewing the hinge fixing screws and removing the doors complete with hinges.

7.3 AIR CIRCUIT BREAKERS

Information regarding specific maintenance or adjustment of type OMA Air Circuit Breakers is contained in Ottermill Publication ACB128 Type OMA Air Circuit Breakers, Maintenance and Service Manual'.

7.4 FUSE SWITCHES AND SWITCH FUSES

7.4.1 General

Information regarding specific maintenance or adjustment of Fuse Switches or Switch Fuses is contained in the following Ottermill Publications:

GB0114	H2S 63/80 Modular Fuse Switch. (630A-800A)
HDC006	HDC Fuse Switches (300-400A)
GB0110	H2S and H1S Fuse Switches and Switch Fuses (63-200A)

7.4.2 Removal

7.4.2.1 SAFETY

Attention is drawn to safety precautions detailed in Section 1.15. With the switch removed the apertures to the riser busbars should be closed. On fully insulated riser systems with safety shutters this is achieved automatically and the shutters may be padlocked closed using the padlocking device normally supplied stored in the adjacent cable duct. On air insulated riser systems a blanking plate, should be fitted. A blank door or cover also be fitted to prevent access to the vacant module space.

7.4.2.2 H2S FUSE SWITCH OR H1S SWITCH FUSE (63-200A)

The type H2S or H1S Switches have rear stab contacts plugged onto the riser busbars. The supply to the switch must be dead and the switch in the OFF position. The outgoing cables and any secondary or control wiring (eg. auxiliary switch wiring) must be disconnected from the switch and supported or tied back in a safe position. Access to the main cable terminals is from the side cable duct. The door must be removed (see Section 7.2.4.3) before attempting to remove the switch. The switch is held by two screws, one is accessible from the cable duct and screws through the side flange of the dividing tray immediately above the switch near the front. The second screws through the base of the switch near the lefthand side at the front to locate behind the front flange of the dividing tray immediately below the switch. With these screws removed the switch may be pulled straight out through the front.

To replace the switch following the reverse procedure to that described above.

7.4.2.3 HDC3 and HDC4 FUSE SWITCHES (300-400A)

These devices are bolted through solid copper connections to the riser busbars.

The supply to the Switch must be dead and the Switch in the OFF position. The outgoing cables and secondary or control wiring (eg. auxiliary switch or indicator lamp wiring) must be disconnected from the switch and supported or tied back in a safe position. Access to the main cable terminals is from the side cable duct. It is recommended that the door be removed, see Section 7.2.4.3 before attempting to remove the switch. Remove the top terminal barrier secured by two plastic cap nuts to gain access to the riser busbar connection fixing screws. These screws may be removed with an M10 socket or box spanner. Remove the screws retaining the switch side

7.4.2.3 Contd.

screen positioned to the left of the switch and slide the screen out through the front. The top and bottom fixing screws through the switch cross members should now be removed. The switch is now free. The switch needs to be slid slightly to the left to permit the cable terminals to clear the righthand frame.

A blank door or cover should be fitted to prevent access to the vacant module space.

To replace a switch follow the reverse procedure to that described above. To permit a switch to be fitted in a position different from that in which it left the factory the riser busbars must be drilled and riser insulation modified. It is recommended that these modifications are done at the factory by the manufacturer.

7.4.2.4 H2S FUSE SWITCH (630-800A)

These devices are bolted through copper pillars to the riser busbars. Before attempting removal the supply to the switch and cubicle must be dead and the switch in the OFF position.

Remove the switch door (see 7.2.4.3) after disconnecting wiring from any instruments and selector switches.

Contact carriage removal is recommended (see Manual GB.114), and in fact is necessary to gain access to disconnect wiring from any auxiliary switches that may be fitted.

All loose small wiring should be taped or tied in such a way to avoid damage and to facilitate re-connection later.

Remove handle escutcheon by removing screws above and below handle.

Remove cable duct cover at right of switch, which runs full height of cubicle.

Via cable duct there is now access to remove the side screens from within the cubicle adjacent to, and immediately below (downgoing cables), or above (upgoing cables), the switch.

If switch has downgoing cables, direct front cover below, disconnect main cables and remove screens, at front above and below the switch and also under the dividing tray, below the switch. Remove dividing tray and terminal shroud from the rear at top of switch.

Via the cable duct the small dish-shaped shaft cover must be removed, thus allowing withdrawal of 3mm diameter pin from shaft end, after which the operating handle may be extracted at front.

Now remove four screws securing black handle cover assembly to switch side and then remove cover assembly, first sideways to clear end of shaft, and then forwards. Switch handle boss must now be removed, but first note relationship of interlock disc with interlock levers to ensure correct replacement later. The nut securing the handle boss bolt has a self-locking feature and should be stiff to turn the first few threads. The 'O' ring on the handle boss should be kept in place for later reassembly.

The 2-M10 hexagon bolts in each riser terminal can now be unscrewed and withdrawn (nut plates at rear of riser are captive). Remove screws at front inside left and outside rear right of switch which fasten to cubicle framework, and be prepared to support weight of switch. Move the switch to the right to disengage retaining collars at rear left, and then the switch can be brought out from the front of the cubicle.

To replace a switch, carefully follow reverse procedure detailed above, ensuring current carrying joints are fully tightened and all insulated screens are replaced (see Manual GB.0114). Reconnect small wiring and ensure no loose items, such as screws, tools or other foreign matter are left inside.

7.5 MOULDED CASE CIRCUIT BREAKERS

7.5.1 General

MCCBs are factory sealed units and no maintenance is possible. On some types or ratings the overload trips are adjustable and this adjustment can be made with the MCCB in situ after opening the front door or cover. Note that on class 1 or class 2 units opening the door or removing the front cover will expose live connections and therefore the MCCB should be isolated from the supply before this done.

With the MCCB removed a blank door or cover should be fitted to prevent access to the vacant module space.

7.5.2 Removal of module 1 size

The MCCB is mounted on a removable chassis with rear stab contacts plugged onto the riser busbars. The chassis stab mounting plate is screwed to the riser support angles. The MCCB must first be isolated from the supply then the door or front cover removed. The outgoing cables must be disconnected and supported or tied back in a safe position and any secondary or control wiring disconnected from the MCCB. Remove any side or front screens. Access to cables, side screens and earth connection is from the side cable duct. Remove the screws fixing the stab mounting plate to the riser support angles. The MCCB complete with chassis may now be pulled straight out for approximately 100 millimetres (4 inches). It is then necessary to tilt the chassis above the flange of the dividing tray to completely remove the unit.

To replace the unit follow the reverse procedure to that described above taking care to ensure the stab contacts are correctly aligned with the riser busbars before pushing the unit fully home.

7.5.3 Removal of Module 2 - 4 sizes

The MCCB is mounted in a simple bracket riveted to the dividing tray and is solidly connected through bolted connections to the riser busbars.

The MCCB must first be isolated from the supply then the door or front cover removed. The outgoing cables must be disconnected and supported or tied back in a safe position and any secondary or control wiring disconnected from the MCCB. Remove any side or front screens and disconnect and remove all outgoing connections from the MCCB. Access to the cables, side screens and outgoing connections may be made from the side cable duct. Remove the screws fastening the riser connections to the MCCB and the fixing screws holding the MCCB to its mounting bracket. The MCCB may now be removed.

To replace the MCCB follow the reverse procedure to that described above ensuring that the insulating plate is correctly fitted between the MCCB and its mounting bracket.

7.5.4 Single Tier MCCB Cubicle

These are for MCCBs of greater than 800 amp rating, individually mounted in their own cubicle.

To remove the MCCB it must first be isolated from the supply. With the front cover removed together with the front and side screen, all accessible from the front, the MCCB fixings and terminals are accessible. Disconnect both incoming and the outgoing connections from the MCCB. The main breaker fixings may now be unfastened and the MCCB removed.

To replace the MCCB follow the reverse procedure to that described above taking care to ensure that all insulation and screening is correctly fitted and secure.

7.6 MOTOR STARTER MODULES

7.6. General

Motor Starter Modules whether fuse or MCCB protected are of two basic arrangements. The first type has rear stab contacts plugged on to the riser busbars and the module is complete with the isolating switch or MCCB. The second type has the isolating switch or MCCB in a separate but interlocking module and the isolator may be stabbed or solidly connected to the riser busbars depending upon the rating.

7.6.2 Removal of Starter with integral Isolator

To remove the first type of starter module complete with its isolating switch or MCCB the starter must be isolated from the supply and the isolator switched to the OFF position. The outgoing cables must be disconnected and supported or tied back in a safe position. Access to cable terminals is from the side cable duct. Secondary or control wiring plugs must be disconnected. It is recommended that the starter door be removed (see Section 7.2.4.3) before withdrawing the starter. The starter is latched in with two catches in the top cross member, these should be fully depressed to the bottom of their slots and the starter may now be pulled straight out. Note that there is a safety catch on the bottom left hand side which stops the module when it is about half way out, this catch must be raised to permit complete withdrawal of the module.

To replace the module follow the reverse procedure to that described above. Note that the catches are automatically reset when the module is correctly inserted. Note also that the module cannot be inserted if the isolator is in the ON position.

7.6.3 Removal of Starter with separate Isolator

This type of starter is arranged with the door of the isolating switch or MCCB interlocked with that of the starter module to prevent access to the starter without first switching the isolator OFF. The starter and isolator must be isolated from the supply and in the OFF position before attempting removal.

The starter module is removed as described in Section 7.6.2 after disconnecting the starter connections from the main isolator switch or MCCB.

After removing the starter module the main isolating switch or MCCB is removed as described in Sections 7.4 or 7.5 except that the outgoing connections are terminated in the starter module and not in the cable duct.