

GS 112-8

Guidance for Specification 112-8

LOW VOLTAGE SWITCHGEAR AND CONTROL GEAR

June 1993

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING											
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LOW VOLTAGE SWITCHGEAR AND CONTROL GEAR (Replaces BP Std 227)											
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SCOPE AND PURPOSE This Guidance for Specification identifies requirements for the design, selection and testing of LV switchgear. It further provides supplementary information giving guidance on preferred solutions together with background information. It identifies the international standards that are applicable to LV switchgear in context and further defines specific requirements from a range of options in the international standards that are necessary for BP installations.											
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

In identifying the international standards that are applicable to LV Switchgear in context and defining specific requirements from a range of options in the international standards that are necessary for BP installations, this document enables consistent fit for purpose specification of equipment via easily understood datasheets.

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification and may discuss alternative options. It also gives guidance on the implementation of any 'Specification' or 'Approval' actions; specific actions are indicated by an asterisk (*) preceding a paragraph number.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Specification Ready for Application

A Specification (BP Spec 112-8) is available which may be suitable for enquiry or purchasing without modification. It is derived from this BP Group Guidance for Specification by retaining the technical body unaltered but omitting all commentary, omitting the data page and inserting a modified Foreword.



Principal Changes From Previous Edition

This document replaces BP Engineering Standard 227, entitled Factory Built Assemblies of Low Voltage Switchgear and Control Gear which was last amended in November 1992.

The introduction of [IEC 947](#) has been incorporated into this document.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP International or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION/GENERAL

1.1 Scope

This Specification specifies BP general requirements for assemblies of low-voltage switchgear and control gear (Assembly) as detailed in [IEC 439 and 947](#) for indoor installation. It shall be read in conjunction with an enquiry or purchase order and the attached Data Sheets.

This Specification covers a range of equipment for operation at potentials up to 1000 V ac or 1500 V dc.

This Specification is for new equipment but appropriate clauses may be used by BP for the preparation of specifications for extensions to existing equipment.

It covers switchgear for application onshore and offshore. Mobile offshore installations may require further supplementary specification.

1.2 Exceptions

1.2.1 A manufacturer shall state in his tender that the equipment offered complies with the requirements of this Specification without exception, or shall detail on the Data Sheets the exceptions against the section numbers of this Specification.

1.2.2 A manufacturer may offer alternative proposals for price or technical advantage if he wishes, but such proposals shall form a supplement to the main tender.

1.3 Service Life

1.3.1 The switchgear shall be designed for a service life of at least 20 years in the environment and for the duty specified on the Data Sheets.

It is traditional to specify a minimum 20 year life and manufacturers standard equipment is likely to meet this requirement. However, thought should be given to any special service life requirements.

1.3.2 The switchgear shall be suitable for a minimum of 2 years normal continuous operation without maintenance at the duty specified on the Data Sheets.

* 1.3.3 Equipment installed offshore may be subject to shock and vibration associated with drilling and production facilities and to the deflection of the deck on which the switchgear is mounted. Equipment on mobile offshore installations needs to be suitable for operation whilst inclined (e.g. for trim or list), and additionally for acceleration, speeds and



angles associated with vessel motion. Requirements will be developed for specific Project applications by BP.

1.4 Rating

1.4.1 The switchgear ratings shall be as detailed on the Data Sheets. The manufacturer shall state any derating allowances which apply to satisfy the specific site conditions.

1.4.2 Ratings shall not be dependent on the use of cooling fans.

1.5 Quality Assurance

Verification of the vendor's quality system is normally part of the pre-qualification procedure, and is therefore not specified in the core text of this specification. If this is not the case, clauses should be inserted to require the vendor to operate and be prepared to demonstrate the quality system to the purchaser.

Further suggestions may be found in the BP Group RPSEs Introductory Volume

2. CIRCUIT-BREAKERS

2.1 General

2.1.1 Circuit-breakers shall comply with IEC 947-1 and -2, utilisation category B suitable for uninterrupted duty.

2.1.2 The performance of circuit breakers as specified in IEC 947-1 and 947-2 shall be verified when installed within the Assembly for the exact configuration supplied.

2.1.3 Circuit-breakers shall be withdrawable.

2.1.4 Circuit-breakers shall be of the type, duty and rating specified on the Data Sheets.

The short-circuit time rating is normally specified as 1 second. This may need to be increased in special circumstances, and will require discussion with the manufacturer at the earliest opportunity.

Where the manufacturer proposes supplying a circuit-breaker with a different rating to that in the data sheet, agreement should be confirmed with the purchaser.

2.1.5 The short circuit breaking capacity of all circuit-breakers shall be appropriate to the specified system short circuit power factor.

2.1.6 The required protection devices need to be considered and included in the Data Sheets.



2.2 Operating Mechanism

2.2.1 Operating mechanisms shall:-

- (i) Include an anti-pumping device
- (ii) Incorporate a local manual trip facility fitted with a guard to preclude inadvertant operation
- (iii) Give positive indication of switch position.

It is preferable that circuit-breakers have a positively driven mechanical indicating device to show whether the circuit-breaker is open or closed.

The type of closing mechanisms needs to be considered and specified in the Data Sheets. The following are a list of possible options:-

Independent manual.

Dependent power (d.c. solenoid).

Stored energy by spring, either manual or electric motor charged (a.c. or d.c. motor) and with either manual or electric closing release.

The preferred type is stored energy by motor charged spring and manual charging, with manual and electric closing release.

2.2.2 Tripping mechanisms shall be provided with a mechanical tripping device and a d.c. shunt trip coil.

It is preferable that circuit-breakers have trip-free operating mechanisms.

2.2.3 Spring operated, electric motor recharged mechanisms shall be provided with a means of manually charging the spring.

2.2.4 Operating mechanisms equipped for electrical closing shall include an interlock arranged such that closing cannot be initiated when a trip condition exists.

Consideration needs to be given to the inclusion of an early closing contact in the trip circuit of circuit-breakers. It should be arranged so that if it is attempted to close a circuit while a trip condition exists, the breaker will trip before the main contacts close.

2.3 Isolating Devices

2.3.1 Each CB shall be connected to the busbars and feeder circuits through plug and socket type isolating devices.

2.3.2 Isolating devices shall be self-aligning.



2.4 Earthing Devices

2.4.1 Earthing devices are not generally specified for assemblies.

Where they are deemed necessary, two alternatives may be provided:-

- (a) Certified earth switch, having a short circuit rating equivalent to that of the associated circuit-breakers, including the making duty.*
- (b) Earthing device, manually applied and fault current rated.*

Earthing devices provided shall be approved by the circuit breaker manufacturer.

2.5 Test Facilities

2.5.1 It shall be possible to operate each circuit-breaker in the isolated position, with all auxiliary circuits operational.

2.6 Intertripping

2.6.1 Incoming circuit-breaker protection and tripping circuits shall be provided with facilities for 2-way intertrip with sending end circuit-breaker via appropriate master trip/intertrip relays wired to outgoing terminals.

2.7 Safety Shutters

2.7.1 The degree of protection provided by the shutters shall be IP3X as defined in [IEC 529](#).

2.7.2 For circuit-breakers, safety shutters shall be provided to cover each group of busbar and feeder circuit fixed isolating contacts.

2.7.3 Shutters shall be actuated automatically by the insertion and withdrawal of the circuit-breaker or withdrawable unit. The shutters shall be closed by positive drive or by two independent means, each capable of closing the shutters alone.

2.7.4 Each set of shutters shall be capable of being operated individually and padlocked closed individually.

2.7.5 If means are provided for securing the shutters in the open position, such means shall be cancelled automatically and the automatic operation of the shutters restored upon reinsertion of the circuit-breaker or withdrawable unit.

2.7.6 Shutters shall be coloured and labelled.

The preference is for shutters to be coloured and labelled with the circuit voltage as follows:-

	Shutter Colour	Label	Letter Colour
Busbars	Red	Busbars Danger...Volts	Black
Circuit	Yellow	Circuit Danger...Volts	Black

Shutters for bus-section circuit-breakers in addition to be labelled with the busbar number and a white arrow pointing towards the section of the busbar with which the shutter is associated.

3. MOTOR STARTERS AND CONTACTOR FEEDERS

3.1 General

3.1.1 Motor starters and contactor feeder units shall comprise fuse or MCCB protected contactors.

Motor starters and contactor feeders of the swingout or fixed panel type are preferred. Withdrawable types may only be considered if there is means to prevent units from being forced out of the housing under fault conditions. Withdrawable units require the approval of BP.

3.1.2 The co-ordination between starters or contactor feeders and associated short circuit protective devices shall be in accordance with [IEC 947-4-1](#), type '2'. The manufacturer shall provide test evidence to verify that the specified co-ordination has been achieved.

Where type '2' co-ordination is achieved by use of a fuselink less than the maximum capacity of the fuse holder then a label needs to be provided with the following legend: 'Maximum fuse rating _____ A to maintain [IEC 947-4-1](#) type '2' coordination'.

3.1.3 A typical motor starter circuit is shown in Figure 1.

Contactor feeders for supplies to immersion heaters etc., and electric surface heating devices need not be fitted with overload relays but shall incorporate instantaneous earth fault protection. All protection devices need to be detailed on the Data Sheets, or as part of the package of documents associated with the procurement of the Assemblies.

3.2 Earth Fault Protection

3.2.1 Starters for all motors with full load current exceeding 30A shall be provided with instantaneous earth fault protection arranged to trip at 15% of full load current or 30A, whichever is the smaller.

Historically, there have been instances where instantaneous earth fault relays have tripped the motor during routine starting. Manufacturers should be advised of this problem, and assurances obtained that nuisance tripping of this type will not occur in the future.

- 3.2.2 Distribution contactor feeders with main fuses or MCCBs exceeding 200A shall be provided with earth fault protection.

Where earth fault protection is to be provided it shall preferably be either a direct connected hand reset earth leakage circuit-breaker or an instantaneous hand reset earth fault relay arranged to trip a contactor and interrupt the supply.

3.3 Control Circuit

- 3.3.1 A.C. control supplies shall be derived from the circuit side of the main circuit isolating device.

Control supply methodology should be agreed at the earliest opportunity. The preferred methods are either (i) 110 Vac supply stepped down from main circuit, or (ii) phase-to-neutral voltage.

- 3.3.2 The primary windings of control transformers shall be connected via a fuse for the phase connections and a link for the neutral connections. One pole of the secondary winding shall be earthed via a link and the other pole fused.

If a 110 V a.c. control supply is used, it shall be derived from two phases of the main circuit via a transformer (preferably to BS 3535). It is preferable that a metallic interwinding screen shall be provided, earthed to the frame of the transformer.

- 3.3.3 Phase-to-neutral control supplies shall be connected via a fuse and link.

- 3.3.4 Individual supplies shall be derived for each motor starter and contactor feeder.

The resistance of remote control circuits need to be considered. Generally, these should not be greater than 10 Ohms. Checks should be made to ensure that contactors can adequately tolerate control circuit voltage drops when closing.

Interposing relays should be avoided, as they introduce a further level of complication and increased possibility of failure.

3.4 Auxiliary Contacts

The requirement is for one contact closed when contactor is closed and one contact closed when the contactor is open each be wired to outgoing terminals. Alternative arrangements shall be specified in the Data Sheets.

It is preferable that auxiliary contacts are wired to terminals via two isolating contacts per circuit. If this cannot be achieved, then the minimum requirement is

for all cabling associated with externally powered circuits to be coloured differently from other cables. In addition, all associated terminals, lugs, etc. shall be fully shrouded and labelled to the effect that they need to be isolated externally before being touched.

3.5 Types of Motor Starter

3.5.1 Direct-on-line starters shall comply with [IEC 947-4-1](#).

3.5.2 Auto transformer starters shall comply with [IEC 947-4-1](#) and be suitable for Class 12 intermittent operating duty (12 starts per hour). They shall have tapings at 50%, 65% and 80% voltage. Transformers shall be selected assuming that motors have a starting characteristic in accordance with [BS 4999](#): Part 112 design D.

3.5.3 Star delta starters shall comply with [IEC 947-4-1](#).

3.5.4 Rheostatic rotor starters shall comply with [IEC 947-4-1](#).

4. MANUALLY SWITCHED FEEDERS

Manually switched feeders shall be of the swingout or fixed panel type, unless the use of withdrawable types is approved by BP.

5. DESIGN REQUIREMENTS

5.1 General

5.1.1 Assemblies shall be multicubicle type for indoor installation in accordance with [IEC 439](#) and [947](#).

5.2 Enclosures, General Construction and Rating

5.2.1 Enclosures of Assemblies shall provide an overall degree of protection [IP 42](#) to [IEC 529](#).

Where openings for ventilating circuit-breakers or starters are necessary, the Assembly enclosure protection may be relaxed to IP 32 but then baffle plates shall be provided to prevent access to live or moving parts.

5.2.2 Withdrawable equipment shall be equipped with a stop to limit the withdrawal distance.

5.2.3 When a functional unit is open or withdrawn the degree of protection from the inside of the open or withdrawn functional unit to all other compartments of the FBA shall be at least IP 40.



It is preferable that when a functional unit is isolated and open or withdrawn the degree of protection to any live part remaining live shall be at least IP 20 and any covers, shrouds etc. preventing access to live parts shall be fitted with labels stating the voltage as follows: 'Danger volts'. This may be achieved by safety shutters.

If this cannot be fully complied with, it shall only be possible to open or withdraw the functional unit with the use of tools. Labels shall be fitted to the outside and inside of the functional unit stating the voltage as follows:-

'Danger volts, isolate elsewhere before removing covers'.

Exception:-

Covers or shrouds not exceeding 50 mm measured along the greatest dimension, forming part of a volume produced product, e.g. a fuse holder, do not require to be fitted with a label, providing the cover or shroud is red or yellow.

5.2.4 Assemblies shall be extensible at either end.

Extending equipment should be without the need to cut or drill any part of the equipment. It is preferable to be able to erect extension panels at either end without isolating the Assembly, until it is required to connect the busbars.

5.2.5 The requirements for partially equipped compartments should be agreed with the manufacturer.

It is preferable that they be arranged so that they can be fully equipped without de-energising that section of the switchboard. Fuse holders or fused disconnectors shall be the largest that the unit can accommodate. The panels shall be labelled as follows: 'Empty compartment, max. current ... A'.

5.2.6 All equipment shall be rated for the full load current specified in the Data Sheets, assuming the 24 hour average maximum ambient temperature specified in the Data Sheet and assuming that all functional units including circuit breakers are operating at their rated full load current, with no diversity.

5.2.7 Equipment shall be designed such that anti-condensation heaters are not required in the environment specified.

Sheet steel enclosures should preferably be at least 1.5 mm thick.

The use of asbestos, toxic, hygroscopic or flammable materials should be avoided whenever possible.

5.2.8 When stated in the data sheet, test reports shall be provided confirming the switchboard capability of containing internal arcing faults in accordance with [IEC 298](#), Annex AA, Type A requirements. The test reports should confirm that the equipment satisfies test criteria No. 1 and No. 2. Such reports shall cover arcing faults upstream of short circuit interrupting devices unless it can be demonstrated that such

enclosure areas can be deemed 'fault free zones' by the use of all insulated components.

Containment of internal arcing faults is an important issue, which is presently not covered adequately by IEC standards directly associated with LV Switchgear. The main concern relates to providing evidence that internal arcing faults within the enclosure will not result in personnel sustaining injury when operating or in the vicinity of the equipment. During the fault arcing period there will be a pressure build up which will try to burst open doors and into adjacent compartments.

It is recommended that test reports are requested, unless there is deemed to be a low risk to operators. Low risk situations may include for example:-

- (a) *Where switchgear is installed in a remote substation and access is infrequent.*
- (b) *Where the switchgear is fuse supplied*
- (c) *Where the switchgear prospective fault level is significantly lower than its certified fault rating*

5.3 Covers

- 5.3.1 All covers with electrical apparatus attached to them shall be connected via a bonding conductor to the switchgear frame.

It is preferred that top covers shall be capable of supporting a person weighing 100 kg without permanent deformation and without reducing any electrical clearance within the switchboard.

It is preferable that doors be closed with not more than two fixings.

Doors opening to 120 degrees are preferred.

Door movement needs to be positively limited to prevent damage to wiring, equipment mounted on the door, or adjacent apparatus.

If doors have components mounted on them, it shall not be possible to lift them off their hinges without using tools.

All fastenings for covers shall preferably be captive.

5.4 Busbars

- 5.4.1 The description 'busbars' applies to both horizontal and vertical parts of the busbar system, which shall comply with [IEC 439-2](#).

- 5.4.2 Busbars shall be of copper.

- 5.4.3 Horizontal busbars shall be of the same current rating throughout their length. Any vertical busbar shall have a minimum rating not less than

the sum of the maximum full load ratings of the outgoing units connected to that busbar.

- 5.4.4 No wiring shall be contained within busbar compartments, other than the phase and neutral connections to incoming and outgoing main circuits.

- 5.4.5 Segregation barriers shall be provided along horizontal busbars, and between horizontal and vertical busbars.

Spacings between segregation barriers along horizontal busbars needs to be discussed with the manufacturer. The preferred spacing is 1 m. The intent of these barriers is to limit the spread of debris produced by a fault from spreading throughout the switchboard.

- 5.4.6 Busbar joints and connections shall be corrosion-protected and secured to prevent loosening.

- 5.4.7 Means shall be provided to prevent arc propagation across bus-section switching units.

- 5.4.8 All covers providing access to busbars shall carry a 'caution, risk of electric shock' symbol.

- 5.4.9 The need to insulate the busbars should be agreed with the manufacturer.

The preference is for phase and neutral busbars to be individually covered throughout their length with solid insulation. Such insulation to be not less than 1 mm thick. Joints to be encased in removable moulded or similar cases. Materials to withstand without damage or permanent distortion the effects of a through fault current (of the value and short time rating specified in Data Sheet), applied when the busbars have reached thermal equilibrium with rated continuous current, at maximum ambient temperature.

- 5.4.10 The numbering or colour coding of busbars is to be agreed with the manufacturer, and included on the Data Sheet.

The preferred method is for busbar insulation to be marked red, yellow or blue, according to phase, and black for neutral.

5.5 **Busbar Connections**

- 5.5.1 Connections to and from units incorporating circuit breakers shall be covered with solid insulation and have a short circuit current and time rating at least equal to that specified in Data Sheet.



- 5.5.2 Connections and circuit wiring to load circuit fuses shall have a continuous current rating at least equal to the largest fuselink which may be fitted.

The method by which load circuit fuse or MCCB connections are made need to be discussed with the manufacturer.

5.6 Neutrals

- 5.6.1 The current rating of neutral busbars shall be at least 50% of the corresponding phase busbars.

5.7 Internal Wiring and Marking

- 5.7.1 Internal wiring conductors shall have a minimum cross section of 1.5 sq mm and a minimum of seven strands, unless otherwise agreed by BP.

Consideration should be given to wiring for current transformers. Normally conductors with a minimum cross section of 4 mm² are used.

- 5.7.2 Insulation other than PVC may be used subject to approval by BP.

- 5.7.3 If wiring on the live side of control fuses is not routed across a door hinge, it shall be rated to at least half the current rating of the largest fuse link that can be fitted in the fuse holder protecting the wiring.

- 5.7.4 If wiring on the live side of control fuses is routed across a door hinge, it shall be rated to the current rating of the largest fuse link that can be fitted in the fuse holder protecting the wiring.

- 5.7.5 Connections relying solely upon solder are not acceptable.

- 5.7.6 Conductor ends should preferably be fitted with a crimped terminating device with an insulated shank.

- 5.7.7 All control and internal wiring shall be identifiable and traceable.

- 5.7.8 Wiring shall be positively identifiable



The following is preferred:-

Type of Wiring	Insulation Colour	Identification Ferrule Colour
a.c.	Black	Phases: Red, Yellow and Blue Neutral: None
d.c.	Grey	None
Earth	Green/Yellow	None
Circuits energised from outside the switchgear unit	Orange #	None

Colouring the insulation orange is the preferred method of identifying circuits that are energised from outside the switchgear unit. If this cannot be achieved, then the minimum requirement is that terminals associated with externally energised wires carry warning labels.

- 5.7.9 Wiring to be fitted with interlocking numbered identification ferrules. Ferrules to be fitted at both ends of the wire unless the wire is individually routed and is less than 100 mm long. Ferrules to be indelibly marked. It shall be necessary to disconnect the termination to remove the ferrules. Paper ferrules are not acceptable.
- 5.7.10 Wiring across door hinges shall be protected against mechanical damage, preferably by the use of flexible conduits.
- 5.7.11 Where the application of microprocessor based systems would be supported by a different approach to internal wiring and marking, the specific arrangements should be agreed with BP.
- 5.7.12 Not more than two wires shall be connected to any one terminal.

5.8 Provision for Installation of External Cables

- 5.8.1 Provision shall be included to support external cables.

Cable supports are recommended for the full height of the equipment at intervals not exceeding 450 mm.

- 5.8.2 Access for external cables shall be arranged so that with any necessary covers removed to facilitate installation of the cables to a single compartment, the remainder of the equipment maintains a degree of protection of at least IP 40 by the use of an individual cable box for each unit.

The methods by which cables enter the Assembly and are routed to compartments need to be discussed with manufacturers. The preferred method is that cables to any compartment may be routed from the top or the bottom of the equipment, if

necessary by site modification without additional parts. Special attention to be given to cable bending radius.

Special consideration should be given to the number, size and type of cables to be terminated at each compartment. This is important where outgoing cables have large derating factors applied. It is recommended that provisional information be given to manufacturers at the earliest opportunity. This is best done via Data Sheets or other contract documents (eg single-line-diagrams). As a minimum, manufacturers should be advised to make provision for terminating two control cables and one power cable for each motor starter and contactor feeder. Consideration should be given to the need for future cabling requirements.

- 5.8.3 Undrilled gland plates shall be provided. Where single core cables are used, gland plates shall be non-ferrous.

Single core cables should be bonded at one end and insulated from earth at the other.

5.9 Bus Wiring

- 5.9.1 The Bus Wiring methodology shall be agreed with BP

The following is a guide to the preferred bus wiring methodology:-

Provision to be made for wiring for interlocking, alarms etc. to be routed between compartments by means of a duct.

If tripping supplies require to be routed between compartments, these need to be within ducts separate from all other wiring.

Wiring for a specific functional unit should normally not be routed through another functional unit. Where this is unavoidable it shall be routed within a duct providing IP 40 degree of protection.

Size of bus wiring conductors should be considered. Generally a minimum size of 6 mm² is advisable.

5.10 Earthing

- 5.10.1 A copper earth bar suitably marked and sized shall extend the length of the Assembly.

The sizing of switchgear earth conductors is explained in [IEC 439-1](#), section 7.4.3.1.7.

- 5.10.2 Vertical earth bars shall be provided, to which each gland plate shall be bonded by connections complying with [IEC 439](#).

- 5.10.3 It shall be possible to install any cabling without dismantling any earth bar.

Provision needs to be made for joints between transport units. At the ends of the earth bar, provision for 70 sq mm copper external protective conductors will be necessary.



- 5.10.4 Within each cable box a brass stud shall be provided to connect any earth core in the external cable.
- 5.10.5 Control and instrument transformer secondaries shall be earthed via a link in accordance with Figure 1.
- 5.10.6 The method by which the neutral circuit of the incoming transformer is earthed needs to be discussed with the switchgear manufacturer.

The preferred method is that the neutral circuit of each transformer incomer shall be connected by bolted links to the earth busbar such that the connection is physically located on the busbar side of the neutral isolating facility. This facility can be either a bolted link or for 4 pole circuit breakers a switched pole. All earth links to be labelled 'neutral earthing link'. Provision to be made for the installation of current transformers on each incoming neutral connection both before and after the point where it is earthed, and on the connections to the earth bar.

5.11 Interlocks

- 5.11.1 If any mechanical interlock is capable of being defeated without the use of tools, provision shall be made for padlocking.
- 5.11.2 The requirements for interlocks should be discussed and agreed with the manufacturer.

The following are preferred:-

Mechanical interlocks to be provided as follows:-

- (a) *To prevent the door of the functional unit being opened unless the functional unit is isolated.*
- (b) *To prevent a functional unit being energised unless the door is closed.*
- (c) *To prevent the simultaneous closure of devices that may cause a fault by simultaneous closure, for example 'forward' and 'reverse' contactors.*
- (d) *To prevent a withdrawable unit being withdrawn unless the unit is isolated. It shall not be possible to close the isolating device unless the unit is in either a service or test position.*
- (e) *To prevent a withdrawable unit being placed in its service position unless the isolating device is open.*
- (f) *To prevent the closure of those isolators associated with mechanically latched contactors when the contactor is in the closed position.*

5.12 Locking Arrangements

- 5.12.1 Locking requirements need to be discussed and agreed with manufacturers.



The following provisions for padlocking are preferred:-

*Doors closed
Isolators open
Fuseswitches open
Safety shutters closed
Earthing switches closed*

5.12.2 All locking shall be arranged such that it can be achieved by the use of padlocks. Barrel type locks shall not be used.

5.12.3 It shall not be possible to padlock any switching device in the closed position, except switches used for earthing.

5.13 Nameplates, Labels and Markings

5.13.1 Nameplates to comply with [IEC 439-1](#), section 5.1.

It is preferable that all information detailed in [IEC 439](#) clause 5.1, shall be given on the nameplate except the following:-

*(m) measures for the protection of persons
(p) dimensions
(q) weight*

<i>Order number</i>	<i>Item number</i>
<i>Date of order</i>	<i>Order placed by.</i>

Nameplates of stainless steel are preferred.

5.13.2 Labels shall be attached to the front of each functional unit and the fixed part of its associated cable box detailing unit designation (i.e. connected equipment description and tag number) and rating.

Labels of stainless steel are preferred.

5.13.3 For withdrawable units, labels shall be duplicated on the withdrawable part and the fixed part.

5.13.4 Terminal markings shall comply with [IEC 445](#).

5.13.5 Danger and other labels shall be discriminating.

Danger labels with black lettering on yellow background to [IEC 417](#) are preferred. Other labels and markings should preferably be black lettering on a white background.

5.13.6 Fuses shall be labelled with their current rating.



If the colour coded wiring to fuses connected to the main circuit is not visible from the front of the fuses, the fuses shall preferably also be labelled with their phase colour.

Labels to identify the functions of equipment would be expected to cover the following:-

- (a) Each control switch or push button*
- (b) Each indicator lamp.*
- (c) Each component if more than one of the components is used in a functional unit.*
- (d) Each group of fuses protecting a circuit.*
- (e) Each position of selector switches.*
- (f) Each instrument except outgoing unit kilowatt-hour meters and ammeters.*
- (g) Each relay*

The following information should preferably be displayed:

- (a) A label shall be attached to each transport unit detailing:-

dimensions (in mm)
weight (in kg)*
- (b) All items of equipment which are dismantled during maintenance and whose weight exceeds 50 kg shall have a label fitted to the outer casing indicating the weight of the item as follows:-

Unit designation
Weight ... kg.*

5.13.7 All labels shall be in English.

English is the standard language for labelling, however, notice should be taken of the operators specific requirements.

5.14 Interchangeability and Duplication

5.14.1 Equipment of the same type, current rating and circuit duty shall be interchangeable.

Where incoming and bus-section circuit-breakers are of the same current rating it is preferable that they be interchangeable.

5.14.2 The following should be discussed and agreed with the switchgear manufacturer:-

The relative physical disposition of all circuit components on circuits of each type, current rating and circuit duty, shall be maintained and duplicated on all equipment supplied on any particular purchase order or series of purchase orders for any one contract.

5.15 Lifting and Moving Facilities

The method and equipment required for safely lifting and moving transportable assemblies shall be discussed with the manufacturer. Detailed instructions for lifting and moving the switchgear should be included in the Operating and Maintenance Instructions.

5.16 Test Facilities

5.16.1 All outgoing units incorporating control circuits shall have facility to be tested when isolated from the main circuit. Testing shall include all control circuits.

5.16.2 The method to be adopted for the assembly should be discussed and agreed with the manufacturer.

The preferred method is:-

One test supply unit connected to a main busbar section to be provided for each Assembly.

The supply unit to be accommodated in a self-contained compartment, rated to supply the control circuit of the largest functional unit and comprise the following elements. The design to be similar in all respects to other outgoing units of the Assembly.

- (a) An isolating device incorporating fuses of appropriate rating.*
- (b) A safety isolating transformer to [BS 3535](#) with the centre point of the secondary winding earthed and a voltage corresponding to the control circuit voltage.*
- (c) A double pole residual current device in accordance with [IEC 364](#) having a sensitivity of 30 mA and connected in the secondary circuit of the isolating transformer.*
- (d) A 2 pole and earth socket to [BS 4343](#) (or local national standards) mounted on the compartment door to permit connection via a plug to a flexible lead.*

All outgoing units incorporating control circuits to be equipped with a double pole change over test/normal switch located within the unit. In the test position the control circuit to be isolated from the main circuit and connected to a male plug corresponding to the socket of that above.

A flexible lead with earthed screen to be provided with matching plug and socket to connect the test supply unit to the outgoing circuit under test. This lead to be of sufficient length to connect all outgoing units integrated within the Assembly.



5.17 Special Tools and Equipment

- 5.17.1 Requirements for special tools and equipment necessary for the erection, operation, testing and maintenance of the switchgear needs to agreed with the manufacturer.

It is preferable that items be supplied in a suitable container and be clearly labelled to indicate the purpose for which each item is required.

5.18 Drawings

- 5.18.1 The drawing requirements should be discussed and agreed with the assembly manufacturer.

The following is a guide:-

Each drawing supplied by the manufacturer to incorporate the following information:-

Manufacturer's name and address

Drawing title

Name of the project

Manufacturer's order or contract number

Purchaser's order number

Manufacturer's drawing number and revision number

Date of original issue and dates of any revisions with details.

The following drawings with associated time schedule to be provided:-

- (a) *To be provided by the manufacturer with his quotation:-*
 - (i) *Outline drawing of the complete switchgear with its certified maximum dimensions and weight.*
 - (ii) *Typical schematic or circuit diagram for the control and protection circuits.*
- (b) *To be submitted by the manufacturer for approval at least 4 weeks before manufacture is started.*
 - (i) *Certified outline drawings showing dimensions and weight of each transportable unit, cable termination position, fixing details, withdrawable space and door swings where applicable and floor impact loadings for circuit-breakers.*
 - (ii) *Circuit wiring diagrams showing all connections and details (including cable sizes) with wiring identification numbers to enable all testing and fault tracing to be carried out.*
 - (iii) *Interconnection diagrams or schedules.*
- (c) *To be submitted by the manufacturer as soon as possible after the order is placed.*
 - (i) *Protection current transformer magnetisation curves.*

A separate circuit diagram shall be prepared for each different type of functional unit with space on each drawing for external circuitry to be shown.

5.19 Operating and Maintenance Instructions

5.19.1 Requirements for instructions need to be discussed and agreed with the manufacturer.

The following is a guide to these:-

Maintenance instructions to include a detailed list of recommended spare parts. (A separate list of recommended spares for installation and commissioning should also be provided).

Installation and maintenance instructions to include torque loadings of all bolts used in busbar joints.

Within the operation and maintenance instructions 'critical tasks' should be identified.

In addition to those called for under the terms of the order, a complete set of operating and maintenance instructions shall accompany the equipment when shipped. The location of these documents to be prominently displayed on the equipment.

5.20 Painting

5.20.1 The manufacturer's standard painting system needs to be sought and agreed. This includes colour.

6. COMPONENTS

6.1 Fuses, Fuse Holders and Links

6.1.1 Fuses shall comply with IEC 269-1 and 2.

It is preferable that fuse holders are self coloured black and link holders are self coloured white.

6.1.2 All unearthed poles of supplies shall be fused. Earthed poles shall be connected via a link holder.

6.1.3 Links used solely for earthing of control supplies and current transformers shall be of a type readily removable for test purposes, with the use of tools if necessary.



6.2 Indicating Instruments

6.2.1 Requirements for instrumentation should be discussed and agreed with the manufacturers. Details should be stated on the data sheets.

6.2.2 Instruments shall be flush mounted, complying with [IEC 51](#), class index 2.5. External zero adjustment shall be provided.

6.2.3 Incoming units shall be equipped with a voltmeter and selector switch arranged to measure each line-to-line voltage of the incoming supply.

6.2.4 Incoming units shall be equipped with an ammeter and selector switch having positions, R, Y, B and N for 4-wire systems.

If specified in the Data Sheets, incoming units shall be equipped with a 3 phase, 4 wire, unbalanced load kilowatt-hour meter with cyclometer dial preferably in accordance with [BS 5685](#) or a digital equivalent.

6.2.5 All remote ammeters shall be fed from current transformers.

Consideration to the use of current transducers may also be given.

If specified in the Data Sheets, outgoing units shall be equipped with an ammeter and/or kilowatt-hour meter. Ammeters shall be connected in the yellow phase except for those circuits for 4 wire systems with a full load current of 200A and over, which shall be equipped with an ammeter and a selector switch having positions R, Y, B and N.

Ammeters connected in motor starter main circuits to have suppressed upper scale readings to match the motor starting currents. If no other information is available then a suppressed scale to at least 6 times the range of the ammeter should be selected.

Ammeter scales should be selected so that full load current appears between 50% and 80% of the normal scale angular deflection.

Ammeters shall preferably be fed from current transformers for full load currents exceeding 40 A.

6.3 Electrical Protective Relays

6.3.1 General

6.3.1.1 Electrical protective relays shall comply with [BS 142](#) or other national standard approved by BP.

6.3.1.2 Protective relays shall be flush mounting.

- 6.3.1.3 It shall be possible to withdraw drawout relays with all circuits energised, without open-circuiting current transformer secondaries or causing protective relays to operate.

Protective relays should preferably be withdrawable. If withdrawable relays are not available, test terminals shall be provided.

- 6.3.1.4 Where master trip relays are used, the initiating relay shall directly trip the circuit and the master trip relay shall reinforce the trip.

- 6.3.1.5 Protective relays shall be located adjacent to the switching device they act upon, unless this would result in maloperation.

- 6.3.1.6 Where microprocessor protection systems are called for on the Data Sheets, this Specification shall be read in conjunction with Project specific requirements for these protection control devices.

Where microprocessor based protection relays are used, the protection settings should be retained within the relay without external power supply being available. Communication and control aspects associated with these relays will be contained in project specific documentation.

- 6.3.1.7 Protection settings shall self contained within the relay without possibility to change settings from a remote location.

Protective and other relays provided for the initiation of trip circuits shall preferably have hand reset mechanical indicators to show when operation has taken place and the type of fault where applicable. The resetting of indicators is best effected from outside the relay case.

- 6.3.1.8 Methods for testing relays should be agreed with the manufacturer.

As a guide:-

Testing provisions shall permit the shorting of any current transformer secondary and shall permit the selective disconnection of all circuits.

Each protective relay shall have provision for testing and calibrating the relay using an external power source, without the need to disconnect the permanent wiring. Any additional components such as test blocks necessary to achieve this shall be supplied.

It shall not be possible to close the covers of the relay or test terminals when the relay connections are in the test position.

- 6.3.2 Motor Overload Relays and Thermistor Control Units

- 6.3.2.1 Motor overload protection (in addition to short circuit protection) shall be by 3 pole thermal overload relays incorporating single phasing protection and ambient temperature compensation. Overload relays shall comply with [IEC 947](#).



It is preferable that overload relays shall be fed from current transformers for motor full load currents exceeding 40 A.

Overload relays may be of the self-reset or manually reset type as specified in the Data Sheets. If manually reset overload relays are specified, these shall be reset from outside the unit.

If alternative motor protection devices are considered suitable by the manufacturer these shall be offered as an alternative with the quotation.

If motors are equipped with thermistors this will be noted in the Data Sheet. If thermistors are specified thermistor control units shall be provided in addition to overload relays. Thermistor control units shall comply with [BS 4999](#).

For certain application e.g. electric overhead cranes subject to plugging, special overload protection devices may be required.

6.3.3 Earth Fault Protection Devices for Motor Starters and Contactor Feeders

6.3.3.1 Earth fault protection devices shall disconnect all phases.

6.3.3.2 Each earth fault protection device shall be equipped with a lamp on the compartment door arranged to illuminate when it has tripped.

6.3.3.3 For each earth fault protection device a test push button shall be provided.

It is preferable that the push button be fitted on the compartment door.

6.4 Contactors

6.4.1 Contactors shall comply with [IEC 947-4-1](#) and shall be air break, electromagnetically operated.

6.4.2 Unless specified in the Data Sheets, contactors shall be electrically held.

6.4.3 Contactors shall be rated for uninterrupted duty and intermittent duty class 30 to [IEC 947-4-1](#).

6.4.4 Contactors shall have an AC-3 utilisation category to [IEC 947-4-1](#) at the full load current of the outgoing unit.

6.5 Current Transformers

6.5.1 Current transformers shall comply with [IEC 185](#).

6.5.2 CT requirements need to be identified on the Data Sheets. The rated primary currents preferred by [IEC 185](#) should generally be selected.



- 6.5.3 All connections for secondary windings shall be terminated at terminals integral with, or adjacent to, the transformer. Slide-on connections are not acceptable.
- 6.5.4 All secondary windings shall be earthed at one point only by means of a removable link.
- 6.5.5 Test certificates and magnetisation curves shall be supplied for each protective current transformer.
- 6.5.6 Current transformers shall have short-time current ratings not less than that of the Assembly, or in the case of fuse-protected units shall be capable of withstanding the let-through current of the maximum rated fuse-link that may be fitted.
- 6.5.7 Accuracy classes for current transformers shall be to [IEC 185](#) as follows:-

Measuring incoming units	Class 1
Measuring outgoing units	Class 3
Protective	Class 10 P

For protective unites use Class X if required for special purpose applications.

Protective current transformers should preferably maintain their accuracy class up to the prospective r.m.s. fault current detailed in the Data Sheet. Where this is impractical because it leads to an excessive rated accuracy limit factor, the manufacturer shall state this in his tender.

It is preferable that the manufacturer supply all current transformers necessary for protective devices etc. within his supply.

Where protective circuit wiring is connected to external circuits, provision needs be made for the outgoing terminals to be shorted by a link. It is preferable that current transformers for remote equipment operation be rated at not less than 10 VA.

Current transformers should generally be fitted on the circuit side of switching devices.

Where current transformers are not readily accessible with the equipment energised, duplicate rating plates shall be fitted in an accessible location.

Where appropriate, a label containing the name, type and manufacturer of the dielectric medium used shall be attached to the transformer to ensure ultimate safe disposal at the end of the working life.

6.6 Voltage Transformers

- 6.6.1 Voltage transformers shall comply with [IEC 186](#).
6.6.2 Accuracy classes for voltage transformers shall be to [IEC 186](#) as follows:-

Measuring	Class 1.0
Protective	Class 3P

Where appropriate, a label containing the name, type and manufacturer of the dielectric medium used shall be attached to the transformer to ensure ultimate safe disposal at the end of the working life.

6.7 Isolating Devices (Disconnectors)

- 6.7.1 Isolating devices shall consist of a MCCB, disconnector-fuse or a fuse-disconnect.
- 6.7.2 Disconnector-fuse and fuse disconnectors shall be to [IEC 947-3](#) for uninterrupted duty, AC-23B utilization category.
- 6.7.3 The rated fused short-circuit current of a disconnector-fuse or fuse-disconnector shall at least be equal to the value specified in the Data Sheet.
- 6.7.4 The mechanism shall be of the independent manual type.
- 6.7.5 All external circuits not deriving their supply from the unit shall be connected via auxiliary contacts of the isolator.

6.8 Indicating Lamps

- 6.8.1 All motor starters and contactor feeder units shall be fitted with indication lamps indicating status of contactor and provide tripped indication.
- 6.8.2 Colours for indicating lamps shall comply with [IEC 73](#).

The following arrangements are preferable:-

- (a) *Indicating lamps to be of the flush mounting pattern, mounted so that they cannot rotate even if the retaining nut is not fully tightened.*
- (b) *Lamp holders and lenses to be designed to dissipate continuously the heat produced by the largest lamp that can be fitted, without deterioration or discoloration.*
- (c) *All lamps operating at the same voltage to be interchangeable.*
- (d) *Lamps operating at different voltages not to be interchangeable.*

(e) Lamp nominal voltages to be at least 110% of the supply voltage.

6.9 Control Devices

- 6.9.1 Push-buttons and related control switches shall comply with [IEC 947-5-1](#).

The rated thermal/breaking capacities of contacts need to be rated for their application. Without additional information, these should be specified as:-

1A at 500 V a.c. and 0.3 power factor

1A at 110 V d.c. inductive.

2A at 60 V d.c. inductive.

- 6.9.2 All push-button switches, except stop switches shall have a full shroud to prevent inadvertent operation.

- 6.9.3 All outgoing units incorporating a contactor shall be fitted with a stop push-button on the unit door.

The operating manual shall clearly indicate that the use of the stop push button for isolating purposes is not acceptable.

- 6.9.4 Stop push-buttons shall be of the stay put type, manually reset and coloured red. Stop switches with mushroom heads shall have guard rings.

6.10 Control Relays (Including Timers)

- 6.10.1 Control relays shall comply with [IEC 947-5-1](#) and shall not be of the plug-in type, unless approved by BP.

The rated thermal/breaking capacities of contacts need to be rated for their application. Without additional information, these should be specified as:

1A at 500 V a.c. and 0.3 power factor

1A at 110 V d.c. inductive.

2A at 60 V d.c. inductive.

- 6.10.2 Control relays shall operate correctly between 85% and 110% supply voltage, measured at the busbars.

- 6.10.3 Control relays shall remain energised without chatter at 75% supply voltage, measured at the busbars. The dropout voltage shall not be lower than 10% supply voltage.

6.11 Terminals

Arrangements should be discussed with manufacturers.

The following arrangements are preferable, although push quick fit devices can also be accepted:-

- (a) Terminals for external connections to incorporate a pressure plate.
- (b) Not more than two conductors to be connected to a terminal. When more than two conductors need to be connected together the requisite number of terminals interconnected by means of permanent solid links shall be provided.
- (c) Terminal blocks to have separate terminals for internal and external connections. External connections shall always be connected to the same side of terminal blocks for a complete equipment. Locking pins should not be used unless the terminals are subject to vibration.
- (d) Terminals remaining live when a functional unit is isolated are to be fitted with a label stating the voltage as follows: 'Danger volts isolate elsewhere', and shall be suitably shrouded. Terminals for tripping supplies shall also be labelled 'tripping supply'.
- (e) Terminals for external connections exceeding 6 mm² to be suitable for straight shanked lug type cable termination's.
- (f) Where terminals for external connections require the use of other than straight shanked compression lugs these are to be supplied and fitted by the manufacturer.
- (g) Terminals to be provided for all external connections and shall be located within the cable box allowing easy access for terminating, testing and maintenance. External connections shall not be made directly to terminals forming an integral part of components.
- (h) Terminals for lug type cable termination's to be provided with locking arrangements.
- (i) Power and control cables shall be segregated. Terminals for lug type cable terminations to be provided with locking arrangements.
- (j) The temperature rise of terminals for external conductors shall not exceed 50°C when tested in accordance with [IEC 439](#) clause 8.2.1.
- (k) Main circuit terminals preferably to be marked with the phase colours red, yellow or blue. Identification by taping is not acceptable.
- (l) The numbering system for control terminals for external connections shall preferably comply with Figure 1.

7. TESTING

7.1 General

- 7.1.1 For each type and rating of switchgear offered, the manufacturer shall provide certificates to prove that the design of switchgear has been



successfully tested in accordance with IEC 439. Full type test in accordance with TTA testing requirements are preferred. Switchgear tested in accordance with PTTA testing requirements may also be acceptable if fully supported by the following:-

- (i) type test certificates for similar equipment,
- (ii) details of changes between type test arrangement and that of equipment offered,
- (iii) supporting calculations.

Technical consideration needs to be given to the extrapolation of type tested equipment in support of PTTA testing requirements. Particular care should be given in the case of short-circuit withstand strength characteristics in which case acceptance of extrapolations is not recommended if:-

- (i) short circuit levels are higher than that for the type test*
- (ii) assembly configuration is significantly different from the type test case - eg corner unit(s) introduced.*
- (iii) components within assembly have significantly changed.*

7.1.2 Any type tests shall have been undertaken by a recognised testing authority.

Testing authorities would preferably be subject to independent approval and audit, eg KEMA and ASTA. However, where manufacturer's test facilities are administered as independent organisations and are considered reputable for the tests being undertaken, then these may also be considered to be acceptable.

7.1.3 Copies of certificates shall be included with quotations.

7.1.4 Requirements for witnessing tests should be agreed with the manufacturer.

It is recommended that the BP representative witness repeat testing of a minimum of 10% of each test. This minimum percentage sample may be varied at the discretion of the representative. If any of the sample tests result in failure, testing shall be continued at up to 100% at the discretion of the representative.

7.2 Type and Routine Tests

7.2.1 The switchgear shall be subjected to routine tests in accordance with IEC 439 at the manufacturers works. In this respect all units shall be deemed complex and an electrical functioning check is required. The units shall, wherever possible, be in their operating mode i.e. compartment doors closed. Each unit shall be individually tested and group testing of a number of units is not acceptable.



- 7.2.2 Verification of dielectric properties for each individual unit as detailed in [IEC 439-1](#) clause 8.2.2 type test shall be made.
- 7.2.3 Insulation resistance (using a 1000 V d.c. tester). The minimum acceptable value shall be 10 M ohms and the actual value obtained must be recorded for each separate unit as follows:-
- All phases including neutral to earth (control circuits earthed).
Red and yellow phases to blue phase and neutral.
Red and blue phases to yellow phase and neutral.
All phases including neutral and control circuits to earth.
- 7.2.4 Ratio and polarity of all current and voltage transformers shall be checked by primary injection.
- 7.2.5 Primary injection test of protective relays shall be performed.
- 7.2.6 All contactors and relays shall be checked to ensure that they close without chatter at 85% supply voltage and remain closed at 75% supply voltage. These voltages shall be measured at the busbars.

7.3 Test Certificates

- 7.3.1 The manufacturer shall provide certificates for all tests undertaken.

Test certificates are to include values for all test results.

It is preferred that test certificates for tests witnessed by the BP representative are available for signature by the representative on the day of the test.

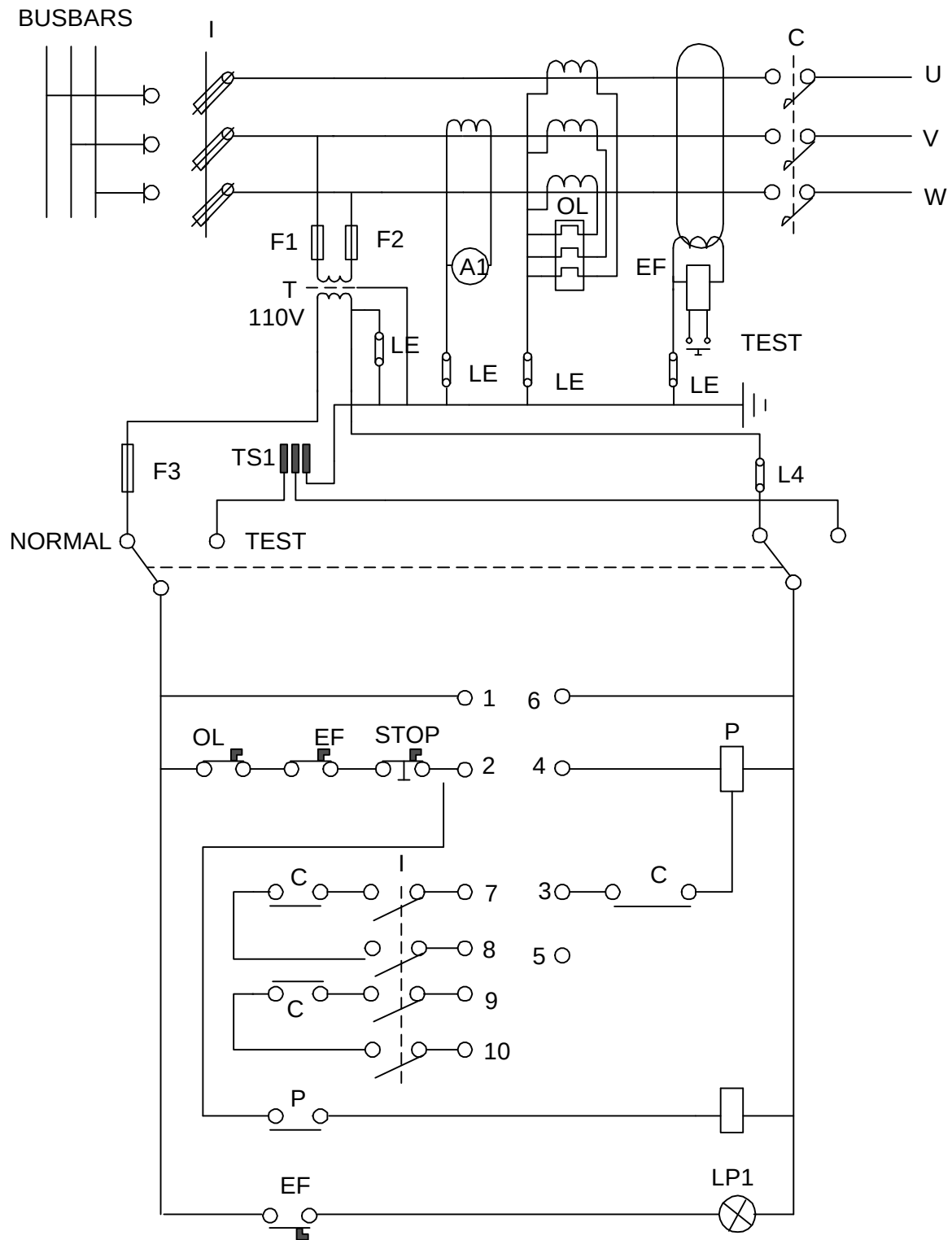


FIGURE 1

TYPICAL MOTOR STARTER (Page 1 of 2)

Key:-

U,V,W,	-	Motor Terminals
1 to 10	-	Control Terminals
* A1	-	Main Circuit Ammeter
C	-	Contactor
*EF	-	Earth Fault Relay
*F1&2	-	Control Transformer Primary Fuses
F3	-	Control Supply Fus
I	-	Isolating Device (Disconnecter)
L4	-	Control Supply Link
LE	-	Earth Links
*LP1	-	Earth Fault Lamp
OL	-	Overload Relay
*P	-	Interposing Relay
*T	-	Control Transformer
TSI	-	Test Supply Inlet
	*	If Specified in Data Sheets

NOTES

1. For two wire control connect initiating device between terminals 2 and 4.
2. For three wire control connect remote stop push button between terminals 2 and 5, link terminals 3 and 5, connect remote start push button between terminals 3 and 4.
3. For remote running indication connect remote running lamp between terminals 3 and 6.
4. For remote stopped indication link terminals 1 and 9, connect remote stopped lamp between terminals 10 and 6.

FIGURE 1
TYPICAL MOTOR STARTER (Page 2 of 2)



1.	Rated Operating Voltage		V
2.	Supply Voltage Tolerance	+ % - %	
3.	Rated Frequency		Hz
4.	Is Neutral Required?		YES/NO
5.	Star Point Earth Resistance (Solid or Ohmic Value)		
6.	System Short-Circuit Power Factor (e.g. 0.15)		
7.	Prospective r.m.s. Fault Current (e.g. 43.3 kA)		kA
8.	Short-Circuit Time Rating (e.g. 0.2, 1.0 or 3.0 Secs)		SECS
9.	Incoming Circuit Breaker Peak Fault Making Current (e.g. 105kA)		kA
10.	Devices Other Than Item (9) Peak Fault Making Current (e.g. 105kA)		kA
11.	Busbar Continuous Current Rating at Ambient Conditions		A
12.	Number of Busbar Sections		
13.	Control Circuit Voltage and Whether a.c or d.c		
14.	24 Hour Average Maximum Ambient Temperature If Over 35°C		°C
15.	Peak Maximum Ambient Temperature If Over 40°C		°C
16.	Minimum Ambient Temperature If Over -5°C		°C
17.	Altitude If Over 2000 m		m
18.	Maximum Relative Humidity If Over 50% At 40°C	%@	°C
19.	Special Conditions (e.g. Salt Air, Vibration, Shocks)		
20.	Overall Degree Of Protection If Different From IP42		
21.	Rear Access Required?		YES/NO
22.	Colour If Not Manufacturer's Standard		
23.	Height Restriction If Less Than 2.5 m		m
24.	Maximum Length Of Assembly That Can Be Accommodated		m
25.	Language For Labels And Marking		
26.	Number of Circuit Breaker Handling Trucks Required		
27.	Are Earthing Devices to be Supplied?		YES/NO
28.	Are test reports confirming internal arc containment capabilities required?		YES/NO

	DATE	REMARKS	BY	APP	JOB TITLE
					INDENT/ORDER NO.
					NO. REQUIRED
					PLANT
					DATE

GENERAL REQUIREMENTS





SCHEDULE OF UNITS (PAGE 1 OF 2)

LABEL	CONNECT TO BUSBAR NUMBER	DEVICE (SEE NOTE 1)	PROTECTION (SEE NOTE 2)	CIRCUIT FUSE OR CB RATING (A) (SEE NOTE 3)	CROSS IF AMMETER REQUIRED	FULL LOAD CURRENT (A)	NUMBER OF PHASES	CROSS IF NEUTRAL REQUIRED	CABLE TYPE AND SIZE (mm ²) (SEE NOTE 4)	REMARKS

NOTE 1

A = DIRECT ON-LINE (DOL) STARTER
B = AUTO-TRANSFORMER STARTER
C = STAR-DELTA STARTER
D = RHEOSTATIC ROTOR STARTER
E = INCOMING CIRCUIT BREAKER
F = BUS-SECTION CIRCUIT BREAKER
G = FEEDER CIRCUIT BREAKER
H = REDUCED VOLTAGE FEEDER
J = SWITCH-FUSE (OR FUSE-SWITCH)
K = SWITCH-FUSE (OR FUSE-SWITCH)
AND CONTACTOR
L = MARSHALLING COMPARTMENT
M = SPECIAL
N = TEST COMPARTMENT

NOTE 2

P = INSTANTANEOUS EARTH FAULT
PROTECTION 15% OF F.L.C. OR 30A
Q = INSTANTANEOUS PROTECTION RELAY
TO BS 142
R = IDMT PROTECTION RELAY TO BS 142
S = SENSITIVE EARTH FAULT PROTECTION
(LESS THAN 30 mA)
T = SEE SEPARATE SHEET

NOTE 3

? = MANUFACTURER TO SPECIFY

NOTE 4 - LIST OF CABLE TYPES

MULTICORE CABLES - STRANDED COPPER */SOLID ALUMINIUM * CONDUCTORS

REF TYPE	VOLTAGE GRADE	RELEVANT NATIONAL STD.
1	EPR INSULATED CSP OVERSHEATH	
2	PVC INSULATED LEAD ALLOY SHEATHED EXTRUDED PVC BEDDED STEEL WIRE ARMOUR PVC OVERSHEATH	
3	PVC INSULATED EXTRUDED PVC BEDDED STEEL WIRE ARMOUR PVC OVERSHEATH	

* - DELETE AS APPLICABLE



GS 112-8 LOW VOLTAGE SWITCHGEAR AND CONTROL GEAR

SCHEDULE OF UNITS (PAGE 2 OF 2)

LABEL	CONNECT TO BUSBAR NUMBER	DEVICE (SEE NOTE 1)	PROTECTION (SEE NOTE 2)	CIRCUIT FUSE OR CB RATING (A) (SEE NOTE 3)	CROSS IF AMMETER REQUIRED	FULL LOAD CURRENT (A)	NUMBER OF PHASES	CROSS IF NEUTRAL REQUIRED	CABLE TYPE AND SIZE (mm ²) (SEE NOTE 4)	REMARKS

	REV	DATE	REMARKS	BY	APP	JOB TITLE INDENT/ORDER No. No. REQUIRED PLANT DATE

1. Specification Items to Which Manufacturer Takes Exception
2. Copies of Short Circuit Test Certificates
3. Basis for Interpretation where Conflicting Standards Require Compliance with More Stringent Requirements
4. Where Toxic, Hygroscopic or Flammable Materials are Used
5. Sketch Showing Proposed Busbar Layout
6. Earthing Device Design and Application Information
7. Outline Drawings with Certified Maximum Dimensions, Weight and Layout of Units

REV	DATE	REMARKS	BY	APP	JOB TITLE
					INDENT/ORDER NO.
					NO. REQUIRED
					PLANT
					DATE

INFORMATION TO BE PROVIDED WITH THE TENDER



1. Duty
2. Number of Poles
3. Closing Mechanism
4. Shunt Trip Coil Voltage V d.c.
5. Closing Mechanism Voltage (if Electrically Operated) and Whether a.c. or d.c.

THE FOLLOWING DATA IS PROVIDED WHEN NOT COVERED BY OTHER DATA SHEETS

6. Instrumentation:
7. Protection:
 - Sustained Overcurrent Alarm
 - Type -
 - No. of Elements - C.T. Ratio -
 - Overcurrent
 - Type -
 - No. of Elements - C.T. Ratio -
 - Earth Fault
 - Type -
 - No. of Elements - C.T. Ratio -
 - Other
 - Type -
 - No. of Elements - C.T. Ratio -
 - Trip Circuit Monitoring Relay
 - Type -
8. Key Interlock:
9. Electrical Interlock:

REV	DATE	REMARKS	BY	APP	JOB TITLE
					INDENT/ORDER NO.
					NO. REQUIRED
					PLANT
					DATE

CIRCUIT-BREAKER



DEFINITIONS AND ABBREVIATIONS**Definitions**

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

Definitions listed in IEC or British Standards shall apply. Definitions listed in IEC 439 shall take precedence over other definitions.

Abbreviations

BS	British Standard
CB	Circuit Breaker
CSP	Chlorosulphonated Polyethylene
EN	European Standard
EPR	Ethylene Propylene Rubber
FL	Full Load
HRC	High Rupturing Capacity
IEC	International Electrotechnical Commission
IEE	Institution of Electrical Engineers
PVC	Polyvinyl Chloride
SF ₆	Sulphur Hexafluoride
SI	Système Internationale d'Unités



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

International Standards

IEC 51 (EN 60051)	Direct acting indicating electrical measuring instruments and their accessories.
IEC 73 (pr EN 60073)	Colours of indicator lights and pushbuttons.
IEC 185	Current transformers.
IEC 186	Voltage transformers
IEC 269-1	Low-voltage fuses. General requirements (EN 600269-1)
IEC 269-2	Low-voltage fuses. Supplementary requirements for fuses for industrial applications.
IEC 298 (pr HD 187S5)	AC Metal enclosed switchgear and control gear for rated voltages above 1KV and up to and including 52 KV
IEC 364	Electrical installations of buildings
IEC 417	Graphical symbols for use on equipment
IEC 439-1	Factory-built assemblies of low-voltage switchgear and control gear. Requirements for type-tested and partially type-tested assemblies.
IEC 439-2	Factory built assemblies of low voltage switchgear and control gear. Particular requirements of busbar trunking systems (busways).
IEC 529 (EN 60529)	Degrees of protection provided by enclosures.
IEC 445 (EN 60445)	Identification of equipment terminals.

IEC 947 Low voltage switchgear and control gear.

British Standards

BS 142 Electrical protection relays.

BS 3535 Isolating transformers and safety isolating transformers.
(EN 60742)

BS 4343 Industrial plugs, socket-outlets and couplers for d.c. supplies.

BS 4999 General requirements for rotating electrical machines.

Part 111 Built-in thermal protection for electric motors rated at 660 vac and below.

Part 112 Starting performance of single-speed three phase cage induction motors.

BS 5685 Electricity Meters.

