

# Supplementary Specification to UL 845 Low Voltage Motor Control Centers

#### Revision history

VERSION	DATE	PURPOSE
1.0	December 2020	Issued for Use

---

## Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

### Disclaimer

Whilst every effort has been made to ensure the accuracy of the information contained in this publication, neither IOGP nor any of its Members past present or future warrants its accuracy or will, regardless of its or their negligence, assume liability for any foreseeable or unforeseeable use made thereof, which liability is hereby excluded. Consequently, such use is at the recipient's own risk on the basis that any use by the recipient constitutes agreement to the terms of this disclaimer. The recipient is obliged to inform any subsequent recipient of such terms. This publication is made available for information purposes and solely for the private use of the user. IOGP will not directly or indirectly endorse, approve or accredit the content of any course, event or otherwise where this publication will be reproduced.

### Copyright notice

The contents of these pages are © International Association of Oil & Gas Producers. Permission is given to reproduce this report in whole or in part provided (i) that the copyright of IOGP and (ii) the sources are acknowledged. All other rights are reserved. Any other use requires the prior written permission of IOGP.

These Terms and Conditions shall be governed by and construed in accordance with the laws of England and Wales. Disputes arising here from shall be exclusively subject to the jurisdiction of the courts of England and Wales.

## Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2014).

## Table of Contents

	Foreword .....	1
	Introduction .....	3
1	Scope .....	5
	1.1 Products covered .....	5
3	Definitions .....	5
4	Application information and components .....	5
	4.3 Dependability of materials and parts .....	5
	4.4 Technology readiness and obsolescence .....	5
5	Characteristics .....	6
	5.1 General .....	6
	5.2 Voltage ratings .....	6
	5.3 Current .....	7
	5.4 Short-circuit .....	7
6	Markings and product information .....	7
	6.1 Identification .....	7
	6.2 Product information .....	8
	6.3 Marking .....	8
7	Normal service and transport conditions .....	9
	7.3 Floating marine applications .....	9
8	Construction and performance requirements .....	9
	8.1 General assembly .....	9
	8.2 Construction requirements .....	11
9	Motor control center tests .....	27
	9.21 Factory tests .....	27
	Annex C (Normative) References .....	30
	Annex F (Normative) Factory tests .....	31
	Annex H (Normative) Application information .....	32

### List of Tables

Table 43 Rating for motor space heaters .....	29
---	----

## Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of low voltage motor control centers in accordance with UL 845, Fifth edition, published October 31, 2018, Motor Control Centers for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.



### JIP33 Specification for Procurement Documents Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting data sheet, quality and information requirements as follows.

#### **IOGP S-732: Supplementary Specification to UL 845 Low Voltage Motor Control Centers**

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to UL 845, following the UL 845 clause structure. Clauses from UL 845 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to UL 845 defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

#### **IOGP S-732D: Data Sheet for Low Voltage Motor Control Centers (UL 845)**

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

### **IOGP S-732Q: Quality Requirements for Low Voltage Motor Control Centers (UL 845)**

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

### **IOGP S-732L: Information Requirements for Low Voltage Motor Control Centers (UL 845)**

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

The terminology used within this specification and the supporting data sheet, quality and information requirements follows that of the parent standard and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. This supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) single line diagrams and project drawings;
- d) purchaser defined requirements (data sheet, QRS, IRS);
- e) this specification;
- f) UL 845, Fifth edition.

## 1 Scope

### 1.1 Products covered

Add new clause

#### 1.1.5

This specification defines minimum technical requirements for the purchase (including design features, fabrication quality, inspection, testing, shipment and documentation) of low voltage motor control center equipment. This specification does not apply to motor control centers installed in hazardous (classified) areas.

## 3 Definitions

Add new definition

3.20 **touch-safe** – protected from inadvertent contact by a finger using covers, recessing of terminals or the size of openings.

**NOTE** Touch-safe and similar terms, such as finger safe, are widely used to describe products but are not defined by industry standards. Touch-safe is generally equivalent to IP 2X per ANSI/IEC 60529, but most products are not tested to a particular IP rating.

Add new definition

3.21 **manufacturer** – organization manufacturing and/or supplying the equipment or services, and/or contractor on project; may alternatively be referred to as "vendor", "seller" or "supplier".

## 4 Application information and components

Add new clause

### 4.3 Dependability of materials and parts

#### 4.3.1

The motor control center and sub-components shall be designed for operation for at least 45 000 h (five years) at the continuous-current rating and under normal service conditions.

#### 4.3.2

Under normal service conditions, the bus bars shall not be required to be de-energized for maintenance for the initial five-year operational period.

Add new clause

### 4.4 Technology readiness and obsolescence

#### 4.4.1

The motor control center, excluding electronic components, shall have a design life of and be supported for at least 20 years after delivery.

#### 4.4.2

An obsolescence management plan shall be available from the manufacturer for all motor control center components excluding devices that are specified by the purchaser and not part of the manufacturer's standard offering.

**NOTE** IEC 62402 is an example of an obsolescence management guide.

#### 4.4.3

Proposals shall indicate whether the motor control center or any sub-component (individually denoted) has less than three years of proven operational service.

### 5 Characteristics

#### 5.1 General

Add new clause

##### 5.1.3

Low voltage motor control centers and controllers shall be provided in accordance with the single line diagrams, standard motor control schematics and IOGP S-732D.

Add new clause

##### 5.1.4

The complete assembly and its components shall have a short-circuit rating meeting or exceeding the specified system available fault current and the system X/R ratio.

Add new clause

##### 5.1.5

The motor control center shall be listed or certified by a nationally recognized testing laboratory (NRTL) for the United States or accredited certification organization (ACO) for Canada.

**NOTE** Applications for this equipment in other countries may have additional requirements for certification.

#### 5.2 Voltage ratings

Add new clause

##### 5.2.1

If 24 Vdc control is specified, dual power supplies shall be provided.

Add new clause

##### 5.2.2

If dc power supplies are provided, an alarm contact for each power supply shall be provided to indicate that the output voltage is outside of the acceptable range (i.e. the supply has been turned off or has failed).



## 5.3 Current

### 5.3.2 Horizontal bus rating

Add new clause

#### 5.3.2.1

The bus bar joint and connection plates shall be the same material and plating type as the main power bus.

Add new clause

#### 5.3.2.2

Bus connections from the incoming main section to the horizontal power bus shall have the same minimum ampacity as the horizontal bus.

### 5.3.3 Vertical bus

Add to clause

All vertical bus bars in each section shall be able to carry the current as specified.

## 5.4 Short-circuit

### 5.4.1 Standard short-circuit current ratings of motor control center units

Add new clause

#### 5.4.1.4

The short-circuit rating of each unit shall be equal to or greater than the short-circuit current rating of the motor control center bus structure.

### 5.4.4 Rating of bus structure

Add to clause

The horizontal and vertical bus short-circuit rating in the motor control center shall be equal to or greater than the maximum available fault current specified on the data sheet.

## 6 Markings and product information

### 6.1 Identification

Add to clause

A master nameplate with the following information shall be mounted on the motor control center main incoming unit:

- a) purchase order number;
- b) motor control center designation (tag number);
- c) month and year of manufacture.

## 6.2 Product information

### 6.2.2

Add new list item f)

f) Each individual unit shall have a nameplate with the following information:

- 1) equipment tag number;
- 2) equipment name;
- 3) HP rating, kW rating or full load amperes (FLA).

Add new clause

### 6.2.3

If an arc resistant motor control center is specified, an additional nameplate shall be provided to identify the arc resistant ratings of the motor control center in accordance with IEEE C37.20.7-2017, Clause 6.3.

## 6.3 Marking

### 6.3.36

Add to clause

When the disconnecting means uses a magnetic only trip motor circuit protector or thermal magnetic molded case circuit breaker (MCCB), the position indicator shall include the "TRIP" position.

Add new clause

### 6.3.63 Nameplate details

The motor control center and individual units shall be provided with engraved nameplates and field markings depicting the information within the project nameplate schedule or single line drawing.

#### 6.3.63.1

Nameplates shall be engravable type with black letters on a white background.

#### 6.3.63.2

Nameplates shall be mounted with stainless steel screws on the front of the cubicle.

#### 6.3.63.3

The lettering on the master motor control center nameplate (refer to Clause 6.1) shall be at least 50 mm (2 in) high.

#### 6.3.63.4

Unit nameplates size shall be at least 25.4 mm (1 in) wide by 63.5 mm (2.5 in) long.

**6.3.63.5**

Unit nameplate characters shall be at least 4.8 mm (0.1875 in) high.

Add new clause

**6.3.64**

Separate nameplates shall be provided to identify door mounted items such as meters, switches, indication lights and other devices.

Add new clause

**6.3.65**

Separate device markers shall be provided to identify components within each unit such as terminals, relays, switches and other devices.

**7 Normal service and transport conditions**

Add new clause

**7.3 Floating marine applications**

If specified, motor control center assemblies to be installed on floating offshore installations in United States Coast Guard (USCG) and American Bureau of Shipping (ABS) jurisdictions shall comply with 46 CFR 111 and ABS MODU Publication Number 6 Part 4, respectively.

**NOTE** Additional guidance and information for USCG and ABS requirements for low voltage motor control center installed on floating facilities in US territorial waters can be found in API RP 14 F/FZ.

**8 Construction and performance requirements****8.1 General assembly****8.1.2 Enclosure - General**

Add new clause

**8.1.2.3**

The motor control center structure shall be a dead front, totally enclosed and freestanding assembly.

Add new clause

**8.1.2.4**

If NEMA Type 1 with gasket enclosure is provided, front doors and covers shall close on gaskets installed around the edge of the door, cover or structure.

Add new clause

**8.1.2.5**

Equipment, wiring and field connection terminals shall be accessible from the front.

Add new clause**8.1.2.6**

Each motor control center shipping section shall be provided with removable eyes or removable angle irons for lifting.

Add new clause**8.1.2.7 Motor control center seismic requirements**

If seismic requirements are specified, the low voltage motor control center shall be designed in accordance with the requirements of ASCE/SEI 7-16.

Add new clause**8.1.2.8 Requirements for arc-resistant motor control centers****8.1.2.8.1**

Arc resistant assemblies shall be tested in accordance with the requirements of IEEE C37.20.7-2017, for not less than 0.1 second.

**8.1.2.8.2**

The manufacturer shall identify the methodology defined in IEEE C37.20.7-2017 that is utilized to achieve the arc resistant certification of the motor control center (full withstand capability without protective device, self-extinguishing, current-limiting circuit breaker, current-limiting fuses or duration-limiting device).

**8.1.2.8.3**

Minimum requirements for clear space above or around and other guidelines (e.g. for plenum) related to the performance of the arc resistant motor control center shall be provided.

**8.1.2.8.4**

If a plenum is provided, it shall run the full length of the motor control center assembly.

**8.1.2.8.5**

Motor control center doors shall be secured with latches (tie-down bolts are not allowed).

**8.1.2.8.6**

Special tools shall not be required to latch the front compartment door or engage the arc resistant function.

**8.1.2.8.7**

If accessories (e.g. a solid door) are required to maintain the arc resistant rating when a unit is removed, they shall be provided for each unit (physical size) in the quantity specified.

### **8.1.7 Door interlock**

#### **8.1.7.2**

Replace clause with

A tool operated provision for deactivating the interlock for inspection purposes while the disconnecting device is closed shall be provided.

#### **8.1.9**

Replace sentence before list item a) with

Doors required to be opened during normal operation shall have latches that are operated either by hand, quarter-turn screws using a flat-head screwdriver or similar means, and

Add to NOTE

**Accessing vertical wireways is considered normal operation.**

## **8.2 Construction requirements**

### **8.2.2 Size, location, and covering or screening**

Add new clause

#### **8.2.2.10**

If ventilation filters are provided, all ventilation openings shall be covered with externally accessible washable-type filters.

### **8.2.4 Hinged doors and covers**

Add new clause

#### **8.2.4.6**

Vertical and horizontal wireways shall have separate access covers.

Add new clause

#### **8.2.4.7**

Vertical wireway covers shall be provided with hinges.

Add new clause

#### **8.2.4.8**

If specified, the enclosure and unit doors shall include NRTL or ACO approved thermal scanning inspection windows to allow infrared scanning of the equipment without opening the equipment doors or removing covers.

## **8.2.6 Protection against corrosion**

Delete list item b)

Add new clause

### **8.2.6.1**

Unpainted parts and hardware shall be plated for corrosion resistance or be made of stainless steel.

Add new clause

### **8.2.6.2**

If other service conditions with environmental contamination are specified, the equipment shall be provided as detailed in Clauses 8.2.6.2 a) through c).

- a) The equipment shall be protected against deterioration from corrosive gases by the use of compatible coatings and material selection.
- b) Bare copper, bare silver or their alloys shall not be provided for current carrying parts when the presence of corrosive gases is identified.
- c) The corrosion protection method shall be identified in the equipment specification sheet.

## **8.2.8 Current-carrying parts**

### **8.2.8.2**

Replace first sentence with

Plated steel screws, nuts and studs shall be used to secure pressure wire connectors and bus bars.

## **8.2.9 Bus bars**

### **8.2.9.1**

Replace clause with

Vertical and horizontal current carrying bus bars shall be tin-plated copper or silver-plated copper as specified.

Add new clause

### **8.2.9.5**

Main and ground bus shall be pre-drilled for connection of future sections on each end without the need for additional bus supports or bracing.

Add new clause

## **8.2.9.6 Removable cover plates**

### **8.2.9.6.1**

Removable cover plates shall be provided for the main bus, ground bus and horizontal wireway.

**8.2.9.6.2**

Removable cover plates shall be attached with bolts or screws.

Add new clause

**8.2.9.7**

If insulated main horizontal bus is specified, each bus bar shall be fully insulated for the rated voltage of the motor control center using an insulated covering (e.g. insulated sleeving or epoxy coating).

Add new clause

**8.2.9.8**

Main and ground bus bars shall be free of splices within the shipping split.

Add new clause

**8.2.9.9**

Space shall be provided to allow field installation and servicing of shipping split joint connections with a front accessible bus cover removed (i.e. assembly of joints and access with a torque wrench).

Add new clause

**8.2.9.10**

When a back-to-back motor control center configuration is specified, two separate motor control center assemblies shall be connected through a transition section having separate vertical power buses with the same phasing sequence for the front and back assemblies.

Add new clause

**8.2.9.11**

Vertical bus bars in each motor control center section shall be provided as either:

- a) fully insulated for the rated voltage of the motor control center using an insulated covering around each bus bar (e.g. insulated sleeving or epoxy coating) except for locations where removable units make contact with the bus bars; or
- b) isolated such that bus bars are enclosed individually or as a group by an insulated protective covering (e.g. a clam-shell).

Add new clause

**8.2.9.12**

If an insulated main horizontal bus is specified, all bus bar joints (including shipping splits) shall be fully insulated for the rated voltage of the motor control center using either insulated protective boots or tape in accordance with Clause 8.2.27.8.

## 8.2.10 Protection of service personnel

Add new clause

### 8.2.10.4

Vertical bus bars shall be protected against incidental contact by a touch-safe bus bar enclosure or by automatic insulating shutters when the individual motor control center draw out unit is removed from the structure.

Add new clause

### 8.2.10.5

If specified, the controllers/feeder units shall be provided with an absence of voltage tester device that is NRTL listed to UL 1436 in order to establish an electrically safe work condition and provide a means of verification of isolation without opening the unit door.

Add new clause

### 8.2.10.6

Line side conducting parts that remain energized when the unit disconnect is in the "OFF" position shall be covered with a barrier or otherwise protected from incidental contact.

## 8.2.11 Combination motor control unit

Add new clause

### 8.2.11.10

Motor controllers shall be sized in accordance with NEMA standard maximum horsepower ratings.

Add new clause

### 8.2.11.11

The minimum acceptable motor controller size shall be NEMA size 1.

Add new clause

### 8.2.11.12

Dual and intermediate size motor controllers (such as size 1¾) shall not be acceptable.

Add new clause

### 8.2.11.13

Sizes 1 and 2 motor controllers shall have a minimum vertical space allowance of 305 mm (12 in) nominal.

Add new clause

### 8.2.11.14

Plug-in unit stabs shall be plated copper and equipped with a retractable stab assembly mechanism or other withdrawable unit designs allowing the primary voltage to be disconnected with the unit door closed.



Add new clause

**8.2.11.15**

Breaker frame sizes and trip units shall be sized for starting premium efficiency motors.

Add new clause

**8.2.11.16**

Add new clause

If mechanical overload relays are specified, they shall be provided as detailed in Clauses 8.2.11.16 a) through c).

- a) Mechanical overload relays shall be provided with ambient compensated overload elements.
- b) Mechanical overload relays shall be designed to accept replaceable elements.
- c) Mechanical overload relays shall be equipped with an externally operable manual reset function.

Add new clause

**8.2.11.17**

Add new clause

If adjustable solid-state overload relays are specified, they shall be provided as detailed in Clauses 8.2.11.17 a) through f).

- a) Adjustable solid-state overload relays shall be three-pole.
- b) Adjustable solid-state overload relays shall be current sensing.
- c) Adjustable solid-state overload relays shall have a selectable overload trip of NEMA class 10 to 30.
- d) Adjustable solid-state overload relays shall be provided with an overload trip range that allows a setting of up to 125% of the motor full load current.
- e) Adjustable solid-state overload relays shall be equipped with an externally operable manual reset function.
- f) If fused disconnect type is provided for the unit disconnect means, the adjustable solid-state overload relay shall be designed and configured to open the contactor on loss of a phase to prevent single phase operation of the motor.

Add new clause

**8.2.11.18**

If microprocessor based digital multifunction motor protection relays are specified, they shall be provided with the following functions:

- a) three-phase, adjustable overload protection;
- b) adjustable overload trip of NEMA class 5 to 30;

- c) protective functions to include thermal overload, underload, locked rotor, current imbalance, stall, phase loss and zero sequence ground fault;
- d) programmable trip level, warning level, time delay and inhibit window;
- e) current monitoring functions to include phase current, average current, full load current, current imbalance percent, percent thermal capacity utilized and ground fault current;
- f) on-board communications;
- g) diagnostic information to include device status, warning status, time to reset, trip status, time to overload trip and historical event recording;
- h) four digital inputs and two digital outputs;
- i) undervoltage ride-through and/or auto-restart functionality for the equipment as shown on the single line diagram;
- j) LEDs for status indication.

Add new clause

#### **8.2.11.19**

Surge suppressors shall be installed across all control relay coils, except for electronic relays that include internal surge suppression.

Add new clause

#### **8.2.11.20**

Contactors provided in combination motor controllers shall be air-break magnetic type for sizes 1 through 4 and vacuum-break type for size 5 and larger.

Add new clause

#### **8.2.11.21**

Motor control units with control power transformers shall be provided with primary and secondary overcurrent protection.

Add new clause

#### **8.2.11.22**

If control power transformers are provided, the sizing shall include the control circuit load and motor space heater loads as defined in Table 43.

Add new clause

#### **8.2.11.23**

If extra capacity control power transformers are specified, a minimum of an additional 50 VA shall be provided in addition to the requirement in Clause 8.2.11.22.

Add new clause**8.2.11.24**Add new clause

If a control power source external to the motor control center is specified, the motor control center line-up shall be provided as detailed in Clauses 8.2.11.24 a) through d).

- a) A control power circuit shall be provided in each vertical section with all units wired in parallel.
- b) Separate control power fuses shall be provided for each unit.
- c) The line side of the control power fuse (X1) and the grounded conductor (X2) in each unit shall be wired to pull apart terminal blocks.
- d) An auxiliary contact that operates simultaneously with the unit disconnecting device shall open the control power circuit.

Add new clause**8.2.11.25**

Each motor control unit shall be provided with a minimum of one seal-in contact (for three-wire control) plus one spare normally open and normally closed contact.

Add new clause**8.2.11.26**

Unit interposing relays, auxiliary control devices, control wiring and terminal block connection points shall be provided as shown on the project drawings.

Add new clause**8.2.11.27**

Plug-in type interposing relays supplied within the units shall be provided with retaining clips.

Add new clause**8.2.11.28**

If motor space heaters are specified, the combination motor controller shall be provided with a normally closed "M" contact wired in series with the control power source such that the motor space heater is energized when the contactor is open.

Add new clause**8.2.11.29**

Plug-in units shall be equipped with a mechanical safety interlock that prevents connecting or disconnecting the unit to the vertical bus when the disconnect handle is in the "ON" position.

Add new clause

**8.2.11.30**

If auto trip reset is specified, overload relay shall include functionality to remotely reset a thermal trip or automatically reset after a specified period of time (e.g. automatic reset with a maximum number of resets or reset after thermal capacity is sufficient to allow a restart).

**8.2.12 Unit mounting**

Add to clause

Units of size 4 and larger shall be located in the lower half of the vertical section of the motor control center with smaller units located in the upper half.

**8.2.12.1**

Feeder units providing circuit protection devices shall be thermal MCCB or fused switches, with fuses supplied and installed as indicated on project drawings.

**8.2.12.2**

Feeder units shall include a retractable power stab assembly mechanism or withdrawable unit design allowing the primary voltage to be disconnected with the unit door closed.

**8.2.12.3**

If fused disconnect switches are specified, fuse holders shall be provided as touch-safe.

**8.2.12.4**

Dual feeder-tap units with two MCCB feeders shall not be provided in a single 12 in space factor unit (the use of two separate 6 in space factor units is acceptable).

**8.2.12.5**

Unit control wiring and communications cabling shall be capable of being disconnected without de-energizing adjacent units.

**8.2.12.6**

Plug-in units shall be provided with self-aligning stab construction to ensure positive electrical and mechanical contact to the bus under all load and rated fault conditions.

**8.2.12.7**

A vertical section future space allowance of 305 mm (12 in) or larger shall be provided with the necessary hardware to allow installation of a removable unit (e.g. guides, supports and barriers) and to isolate units from each other.

**8.2.12.8**

Supports and barriers for removable units (draw-out and fixed) shall be designed to be removed or added in the field without special tools.

## **8.2.13 Internal wiring**

### **8.2.13.1**

Delete second sentence

Add new clause

#### **8.2.13.1.1**

The internal motor control center wiring shall be soft or annealed copper wire with 600 V flame retardant insulation rated not less than 90 °C (194 °F).

Add new clause

#### **8.2.13.1.2**

The internal motor control center wiring shall be stranded in accordance with ASTM B8 with Class D stranding for wires that cross hinged joints and Class C stranding or finer for all other wires.

Add new clause

#### **8.2.13.1.3**

The minimum size for control wiring internal to the motor control center shall be 1.3 mm<sup>2</sup> (No.16 AWG).

Add new clause

#### **8.2.13.1.4**

Terminal blocks for termination of field run control conductors shall accept at minimum two conductors sized 2.1 mm<sup>2</sup> (No. 14 AWG) each.

#### **8.2.13.4**

Replace clause with

Internal wiring shall be installed in a single continuous piece from termination point to termination point, free of splices and taps.

Add new clause

#### **8.2.13.17**

Circuit wiring shall be NEMA Class II, Type B.

Add new clause

#### **8.2.13.18**

Terminal strips located in individual units shall be provided with a minimum of 20% spare control terminal blocks (provided it does not increase the size of the unit) and guarded, touch-safe type.

Add new clause

**8.2.13.19 Wire marking**

**8.2.13.19.1**

Internal wiring shall be identified at both ends with machine printed 360° slip-on or heat-shrink wire markers.

**8.2.13.19.2**

Adhesive wrap around or clip-on type wire markers shall not be used for identification.

**8.2.13.19.3**

Wiring permanently marked every 45 cm (18 in) with a unique number is acceptable in lieu of wire markers.

**8.2.13.20 Unit door wiring**

Wiring connected to unit doors shall be provided as detailed in Clauses 8.2.13.20.1 through 8.2.13.20.3.

**8.2.13.20.1**

Door wiring shall operate at 120 Vac (nominal) or less.

**8.2.13.20.3**

Terminals shall be touch-safe or covered by an insulating barrier to provide protection from incidental contact.

**8.2.13.20.2**

Wiring across hinged panels and doors shall be bundled with wraps to protect conductors from damage caused by abrasion or pinching.

Add new clause

**8.2.13.21**

Accessories, such as terminal strips, shall not be installed in wireways unless integral to the draw out design of the motor control center unit.

Add new clause

**8.2.13.22 Current transformers for incoming protection and metering**

**8.2.13.22.1**

Current transformer secondary circuit wiring shall be terminated with insulated, compression ring type lugs.

**8.2.13.22.2**

Current transformer secondary circuit wiring shall be wired directly to short circuiting type terminal blocks.

**8.2.13.22.3**

Current transformer circuit grounding shall have green insulation and be marked "CT Ground" (or ground symbol) at the terminal block and at the ground bus termination point.

**8.2.13.22.4**

One direct ground connection shall be made from the current transformer short-circuiting terminal block to the ground bus without any intermediate terminations or splices.

**8.2.15 Control circuit transformer protection****8.2.15.5**

Delete clause

**8.2.16 Field-wiring terminals****8.2.16.1**

Replace first sentence with

Units shall be provided with pull-apart terminal blocks (one terminal for each conductor) to terminate field control wiring.

Add new clause

**8.2.16.9**

The motor control center assembly shall be provided with insulating barriers between each phase at the incoming supply connection point (i.e. phase barriers if exposed bus, fuses or lugs are present).

Add new clause

**8.2.16.10**

The motor control center assembly shall be provided with insulating barriers to protect the incoming supply (including line side of any overcurrent protective device) against incidental contact.

Add new clause

**8.2.16.11**

The motor control center assembly shall be arranged to allow the incoming supply conductors to be tested for voltage without removal of insulation barriers or guards (e.g. holes for test probes).

**8.2.28 Wiring space****8.2.28.3 Clear wiring space**

Add new clause

**8.2.28.3.8 Vertical wireways****8.2.28.3.8.1**

Vertical wireways shall be full-height, full-depth (space within the motor control center assembly occupied by units) and isolated from all power buses.

**8.2.28.3.8.2**

Vertical wireways shall have a minimum width of 100 mm (4 in), nominal.

**8.2.28.3.8.3**

Vertical wireways shall be isolated from the unit by a metal barrier except for openings necessary for wire passage between the wireway and the unit.

Add new clause

**8.2.28.3.9 Horizontal wireways****8.2.28.3.9.1**

Horizontal wireways shall be isolated from all power buses using one or more barriers.

**8.2.28.3.9.2**

Horizontal wireways shall be continuous across the top and bottom locations for each section.

**8.2.28.3.9.3**

Horizontal wireways shall have a minimum height of 150 mm (6 in) nominal.

**8.2.31 Transformer secondary grounding****8.2.31.1**

Replace clause with

Control power transformers shall have one secondary terminal grounded.

**8.2.33 Ground bus****8.2.33.1 Horizontal ground bus**

Replace clause with

**8.2.33.1.1**

Motor control centers shall include a tin-plated copper horizontal ground bus.

**8.2.33.1.2**

The horizontal ground bus shall be sized in accordance with Table 24 and Table 25 with a minimum rating of 300A.

**8.2.33.1.3**

The horizontal ground bus shall be uniform and continuous across the entire length of the motor control center with the exception of shipping splits.

**8.2.33.1.4**

The horizontal ground bus shall be pre-drilled for outgoing equipment grounding conductors at each end section and equipped with NEMA 2 hole 107 mm<sup>2</sup> (4/0 AWG) lugs.



**8.2.33.1.5**

The horizontal ground bus shall extend to the incoming line section and supplied with a suitable NEMA 2-hole compression-type lugs.

Add new clause

**8.2.33.7**

Each individual motor control center section shall include a tin-plated copper vertical ground bus with a minimum rating of 300 A.

Add new clause

**8.2.33.8**

Each motor control center section vertical ground bus shall be mechanically connected to the horizontal ground bus, forming a complete internal grounding system.

Add new clause

**8.2.34 Incoming Line Section****8.2.34.1**

When a main circuit breaker is specified, the requirements in 8.2.34.1 Clauses a) through c) shall apply.

- a) The main circuit breaker shall be accessible from the front of the unit with removable protective barriers or insulating guards on the line side terminations.
- b) The main circuit breaker shall be operable with the enclosure door closed.
- c) The breaker position status (closed, open, tripped) shall be visible with the enclosure door closed or open.

**8.2.34.2**

If "main lugs only" (MLO) is specified, the incoming section shall be provided with NEMA two-hole, compression type lugs sized for the specified incoming cables.

**8.2.34.3**

If "main lugs only" (MLO) are specified, the incoming section shall be provided with supports for the incoming cables to prevent mechanical stress on the busbars.

**8.2.34.4**

When cable bus or bus duct is specified for the incoming line section, the necessary components for the motor control center to accept the cable bus or bus duct shall be provided.

**8.2.34.5**

If incoming line metering is specified, a microprocessor based metering package that includes phase voltage, phase current, kVA, kW, power factor and communications capability shall be provided.

Add new clause

**8.2.35 Non-motor loads**

**8.2.35.1**

Contactors provided for non-motor loads shall be sized/rated for the specific application (e.g. switching of capacitors, transformers, lighting) as indicated on the project drawings.

**8.2.35.2**

For lighting contactor, process heating and similar applications, units shall be provided with two spare normally open and normally closed auxiliary contacts wired to terminal blocks.

**8.2.35.3**

Lighting contactor units shall have door mounted hand-off-auto (HOA) switch and on/off status light indicators with the capability of being remotely controlled from a photoelectric cell or other devices indicated on the project drawings.

Add new clause

**8.2.36 Integral adjustable speed drives and soft starters**

**8.2.36.1**

Adjustable speed drives and soft starters shall be provided with a programmer or operator interface that is accessible with the door closed.

**8.2.36.2**

The programmer or operator interface shall display speed, current, voltage, alarms and shutdowns.

**8.2.36.3**

Adjustable speed drives and soft starter terminals that interface with field wiring shall be wired to customer terminal blocks.

**8.2.36.4**

For applications that require a reduced voltage starter, solid-state soft starter type unit shall be provided.

**8.2.36.5**

If status indicator lights are specified for motor controller units, adjustable speed drives and soft starter units shall be provided with lights in accordance with Clause 8.2.41.1.

**8.2.36.6**

Adjustable speed drives and soft starter units shall include facilities for isolation and bypass if indicated on the project drawings.

Add new clause**8.2.37 Integral power distribution panels (panelboards)****8.2.37.1**

When low voltage distribution panels are provided, they shall meet the requirements of UL 67.

**8.2.37.2**

Low voltage distribution panels shall be provided with thermal magnetic, bolt-on type branch circuit breakers equipped with a means to be individually locked out in the off position.

**8.2.37.3**

Low voltage distribution panels shall be provided with a circuit directory.

Add new clause**8.2.38 Integral distribution transformers****8.2.38.1**

Transformers shall be dry type with an insulation system temperature of 130 °C (266 °F) and 90 °C (194 °F) hot spot winding temperature rise.

**8.2.38.2**

Transformers shall be provided with a K4 minimum rating.

**8.2.38.3**

Transformers shall be provided with four 2.5% full capacity taps on the high voltage winding with two above and two below rated voltage.

**8.2.38.4**

Transformers primary circuit protection shall be provided by a feeder-tap unit within the motor control center.

**8.2.38.5**

Transformers shall be provided with a thermal-magnetic molded case circuit breaker in the panelboard for secondary protection.

Add new clause**8.2.39 Motor control center vertical section space heaters****8.2.39.1**

If space heaters are specified, they shall provide moisture condensation control within each vertical section of the motor control center as detailed in Clauses 8.2.39.1 a) through d).

- a) Space heaters shall be wired to an accessible terminal block provided for connection to an external power source.

- b) Space heaters shall be guarded by an expanded metal cage around the heaters to prevent burns due to incidental contact.
- c) Space heaters shall be operated at 120 Vac.
- d) Space heaters shall be sized to provide a 5 K temperature rise to prevent condensation.

#### **8.2.39.2**

If thermostat control is specified for space heaters, a control unit shall be provided as detailed in Clauses 8.2.39.2 a) through e).

- a) The control unit supply disconnect shall be a circuit breaker equipped with a means to lockout.
- b) The control unit shall have a control circuit that includes a momentary push button that energizes the heaters (by bypassing the thermostat) to verify the proper operation of the heaters.
- c) The control unit shall be provided with an ammeter.
- d) The control unit ammeter shall have an appropriately sized scaled so that the failure of a single space heater element results in a discernible change in ammeter reading.
- e) The normal operating ampacity of space heater circuit shall be inscribed on the ammeter nameplate.

Add new clause

### **8.2.40 Motor control center data communications**

#### **8.2.40.1**

If motor control center data communications are required, the devices intended to be monitored shall be compatible with the specified communication protocol (or combination of protocols).

#### **8.2.40.2**

Communication network cable connections made in wireways shall have a mechanical means to prevent unintended separation (e.g. screw type connectors, RJ-45 connector, etc.).

#### **8.2.40.3**

Communication cabling shall be rated for 600 Vac.

Add new clause

### **8.2.41 Motor control center indication and control**

#### **8.2.41.1**

If status indicator lights are specified, they shall be in accordance with Clauses 8.2.41.1 a) through c).

- a) Status indicator lights shall be installed on the unit door or visible with the door closed.
- b) Lights colors shall be red (running), green (stopped) and amber (tripped).
- c) Lights shall be LED type with 100 000 h illumination life minimum.

**8.2.41.2**

Push buttons, selector switches and other door mounted devices shall be oil tight and have a heavy-duty rating as defined in NEMA ICS 5.

**8.2.41.3**

Control relay output contacts or other auxiliary (interposing) control-circuit device contacts for field wiring to external equipment shall have a contact ampacity performance rating suitable for the intended switching application in accordance with NEMA ICS 5.

Add new clause

**8.2.42 Motor control center condition based monitoring**

Add new clause

If continuous thermal monitoring is specified, it shall be in accordance with Clauses 8.2.42 a) through c).

- a) Motor control center assemblies shall be equipped with factory integrated continuous thermal monitoring technology.
- b) Thermal monitoring shall provide hotspot detection sensors for main incoming section (main circuit breaker or lug) and other areas of concern, such as individual units or shipping split connections.
- c) Continuous thermal monitoring system shall include a fault relay dry contact output and communications (status and alarming).

**9 Motor control center tests****9.21 Factory tests**

Add new clause

**9.21.1**

After completion of the motor control center assembly and the wiring of each unit, the motor control center shall be functionally tested prior to shipping preparations.

Add new clause

**9.21.2**

Functional testing of the completed motor control center shall include the following:

- a) operation of unit contactor;
- b) unit electrical and mechanical interlocks;
- c) all control devices that are hard wired and/or communicating over a network to a system controller and, if applicable, local human machine interface (HMI);
- d) protective relay and metering;
- e) indicator lights;
- f) unit draw out and mechanical insertions, including operation of any retractable stabs and shutters;

- g) vertical section space heaters and thermostat, if applicable;
- h) continuous thermal monitoring system, if applicable;
- i) auxiliary equipment (e.g. interposing relay panel, mimic panel) provided with the motor control center as part of the system design.

## Tables

Add new Table 43

**Table 43**  
**Rating for motor space heaters**

(Clause 8.2.11.22)

Motor Horsepower	Space Heater Rating (W)
0.5 – 5	45
7.5 – 20	60
25 – 50	120
60 – 100	240
125 – 250	350

## Annex C (Normative)

### References

Add items 31 to 40 to table

Item	United States	Canada	Mexico
31	ABS MODU, Publication Number 6 Part 4 Rules for Building and Classing Mobile Offshore Drilling Units - Part 4 Machinery and Systems	NA	NA
32	IEEE C37.20.7:2017 Guide for Testing Metal-Enclosed Switchgear Rated Up to 52 kV for Internal Arcing Faults	IEEE C37.20.7 - 2017 Guide for Testing Metal-Enclosed Switchgear Rated Up to 52 kV for Internal Arcing Faults	IEEE C37.20.7 - 2017 Guide for Testing Metal-Enclosed Switchgear Rated Up to 52 kV for Internal Arcing Faults
33	IEC 62402 Obsolescence management	IEC 62402 Obsolescence management	IEC 62402 Obsolescence management
34	NEMA ICS 5 Industrial Control and Systems: Control-Circuit and Pilot Devices	NEMA ICS 5 Industrial Control and Systems: Control-Circuit and Pilot Devices	NEMA ICS 5 Industrial Control and Systems: Control-Circuit and Pilot Devices
35	46 CFR 111 Title 46 – Shipping, Chapter I - Department of Coast Guard, Subchapter J - Electrical Engineering, Part 111 - Electrical Systems - General Requirements. (For United States offshore only)	NA	NA
36	ASCE/SEI 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures	ASCE/SEI 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures	ASCE/SEI 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
37	UL 1436 STANDARD FOR SAFETY Outlet Circuit Testers and Similar Indicating Devices	CSA-C22.2 No. 160 Voltage and Polarity Testers	UL 1436 STANDARD FOR SAFETY Outlet Circuit Testers and Similar Indicating Devices
38	API Recommended Practice 14 F Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Division 1 and Division 2 Locations	NA	API Recommended Practice 14 F Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Division 1 and Division 2 Locations
39	API RP 14 FZ Recommend Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations	API Recommended Practice 14 FZ Recommend Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations	API Recommended Practice 14 FZ Recommend Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations
40	UL 67, Panelboards	CSA C22.2 No. 29, Panelboards and Enclosed Panelboards	NMX-J-118-1-ANCE, Panelboards



## **Annex F (Normative)**

### **Factory tests**

In Annex F heading, replace "Informative" with

Normative

#### **F.1**

Delete "As an alternative, a potential 20% higher may be applied for 1 s." from clause

## **Annex H (Normative)**

### **Application information**

In Annex H heading, replace "Informative" with

(Normative)

#### **H.5 Service and storage conditions**

##### **H.5.2 Storage temperature**

Replace last sentence with

If energizing assembly space heaters for temporary storage is specified, the provisions detailed in Clauses H.5.2 a) through c) shall be made for temporary power during storage of the motor control center.

- a) An easily accessible (temporary if required) connection point shall be provided for each shipping split.
- b) Connection point shall be accessible without uncrating or unpacking the motor control center.
- c) Connection point shall be labelled as "temporary space heater connection point" including the voltage and current requirements.

**Registered Office**

City Tower  
Level 14  
40 Basinghall Street  
London EC2V 5DE  
United Kingdom  
T +44 (0)20 3763 9700  
reception@iogp.org

**Brussels Office**

Avenue de Tervuren 188A  
B-1150 Brussels  
Belgium  
T +32 (0)2 790 7762  
reception-europe@iogp.org

**Houston Office**

15377 Memorial Drive  
Suite 250  
Houston, TX 77079  
USA  
T +1 (713) 261 0411  
reception-americas@iogp.org

| [www.iogp.org](http://www.iogp.org)

